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Effect of different organic nutrient management practices on growth, yield and economics of finger millet, *Eleusine coracana* (L) Gaertn

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ABSTRACT

A field experiment was conducted during Kharif season of 2016 to study the effect of different organic nutrient management practices on growth, yield and economics of finger millet, *Eleusine coracana* (L) Gaertn in sandy loam soils of Zonal Agricultural and Horticultural Research Station, Navile, Shivamogga, Karnataka. Among the different nutrient management treatments application of recommended dose of FYM along with 100 per cent N equivalent vermicompost recorded significantly higher grain yield (2745 kg/ha) and straw yield (5166 kg/ha). Similarly higher number of tillers at harvest (4.48), lengthier fingers (9.38 cm) and higher yield per plant (14.12 g) were also recorded with same treatment and it was closely followed by application of recommended dose of FYM along with application 100 per cent N equivalent FYM. Significantly higher gross return (Rs 75503/ha) and net return (Rs 42903/ha) were also recorded with 100 per cent N equivalent vermicompost along with recommended FYM. However significantly higher B-C ratio of 2.50 was recorded with application of 125 per cent of N equivalent vermicompost alone.

Keywords: FYM; finger millet; N equivalent; vermicompost; grain; straw

INTRODUCTION

Production technology for organic finger millet primarily involves three management practices viz efficient crop management, appropriate nutrient management and effective plant protection measures. Among them nutrient management also plays an important role. The high-input agriculture has led to self-sufficiency in food grain production but it has posed several new challenges. The productivity of most of the crops has been declining. Increased prices of manufactured fenrtilizers and concerns about the sustainability of intensive cropping systems have led some countries to promote organic materials as a source of nutrients for crops and as an amendment to improve soil properties. The conversion of modern agriculture into organic agriculture is now widely debated. Hence conversion of modern chemically-intensive agriculture to a more sustainable form of agriculture like organic agriculture appears to be an option for maintaining the desirable agricultural production in future. Organic method is self-sufficient and self-dependent as compared to modern chemical farming with principle of nutrients capturing and relying more on organic inputs that is need of the hour. Organic farming minimizes the use of external inputs and aims at optimization of crop productivity rather than its maximization through renewal and strengthening of ecological processes and functions of farm ecosystem (Shukla et al 2011). Therefore the use of locally available agro-inputs in agriculture by avoiding or minimizing the use of synthetic agrochemicals appears to be one of the probable options to sustain the agricultural productivity. Various organic nutrient sources are available which contain good amount of major plant nutrients to produce comparable yields (Ghosh 2005). The practices of organic cultivation vary with the availability of local resources of manures and their nutrient content and as such it is necessary to identify both the source and its quantity to meet the nutrient requirement of finger millet. At the same time the food habits of the consumers are changing rapidly. Especially in the developed countries people have become more health conscious. Hence the demand for organic food products is on the rise.

Finger millet, *Eleusine coracana* (L) Gaertn is one of the important millet crops grown on the alfisols of southern India. In the year 20014-2015 the area under this crop in India was 12.1 lakh ha and production was 20.6 lakh tonnes. Within India Karnataka stands first in area (7.1 l ha) and production (13.0 lakh tonnes). Finger millet is the important crop of dry lands of Karnataka. The crop is mainly being cultivated in rainfed areas in resource-poor soils with less-management. Being a millet it is highly suitable for less input agriculture like organic agriculture. Hence an attempt was made to develop the organic nutrient management practices for finger millet under rainfed situation.

MATERIAL and METHODS

A field experiment was conducted at Zonal Agricultural and Horticultural Research Station, Navile, Shivamogga, Karnataka during Kharif 2016 to study the effect of organic nutrient management practices on yield and economics of finger millet. The soil of experimental site was slightly acidic in reaction (pH 6.40) with normal electrical conductivity (0.25 dS/m), medium organic carbon (5.2 g/kg), low available nitrogen (238 kg/ha), high available phosphorus (43 kg/ha) and medium available potassium (284 kg/ha). The experiment was laid out in randomized block design with nine treatments and replicated thrice with gross plot size of 5.4 x 4.5 m. Recommended dose of FYM and nitrogen for finger millet under rainfed situation was 7.5 tonnes/ha and 50 kg/ha respectively. Experiment consisted of nine different manurial treatments. Details of total quantity of nutrients applied in each treatment are given in Table 1.

Entire quantity of manures was applied to each plot 15 days before the transplanting of crop and incorporated into the soil. Ragi seedlings were raised in a raised bed and 21 day old seedlings were transplanted in the main field at a spacing of 20 × 10 cm on 1 August 2016. Before transplanting seedlings were dipped in neem oil and biofertilizer solution. Crop received 160 mm rainfall during entire growing period and life saving irrigations were provided at critical stages. Two inter-cultivation operations and one hand weeding were carried out to suppress the weeds. Neem oil was sprayed to control the menace of stem borer.

The relevant growth and yield parameters were recorded at 30, 60 and 90 days and at harvest. Yield attributes and yield observations were recorded at harvest and subjected to statistical analysis. The economics of the system was worked out considering the prevailing cost of inputs and price of output. All the results were then analyzed statistically for drawing conclusion using analysis of variance (ANOVA) procedure (Gomez and Gomez 1984).

RESULTS and DISCUSSION

Growth parameters

All the treatments were statistically at par in plant height except T_6 (Table 2). Nodes and leaves in a plant increase with the plant height. Significantly higher number of leaves (48.1 and 45.9/plant) and leaf area index (LAI) (6.2 and 6.0) at 90 DAT were recorded in treatments T_5 (Recommended FYM, 7.5 tonnes/ha + 100% N equivalent vermicompost) and T_1 (Recommended FYM, 7.5 tonnes/ha + 100% N equivalent FYM) respectively and the two treatments being at par. LAI is the indicator of leaf area produced per unit area. Production of higher leaf area per unit area enhances the harvesting of solar radiation which results in higher photosynthesis and higher dry matter production which in turn results in effective utilization of applied resources.

The same two treatments T_5 and T_1 were also at par wrt dry matter production at harvest (33.4 and 32.9 g/hill respectively) and proved superior to all other treatments (Table 2). Higher dry matter production is the prerequisite for higher yield per plant. This can be attributed to cementing action of polysaccharides and other organic compounds released during the decomposition of organic matter supplied through FYM and/or vermicompost that provided better soil environment thus leading to taller plants, increased number of leaves and tillers and in turn the final yield. The organic manures have slow release of nitrogen due to its slow mineralization which induces the availability of nutrients commensurate with the growth and development of the plants and thus results in higher growth parameters (Channabasanagowda et al 2008). Better availability of plant growth regulators and humic acid in vermicompost results in the increased activity of microbes (Arancon et al 2004). Microbes like fungi,

Table 1. Details of quantity of manures and N applied in each treatment

Treatment	Total quantity of FYM applied (tonnes/ha)	Total vermicompost applied (tonnes/ha)	Total N supplied (kg /ha)
T_1 (Recommended FYM, 7.5 tonnes/ha + 100% N equivalent FYM)	7.5	0	87.5
T_2 (75% N equivalent FYM)	7.5	0	37.5
T_3 (100% N equivalent FYM)	10	0	50.0
T_4 (125% N equivalent FYM)	12.5	0	62.5
T_5 (Recommended FYM, 7.5 tonnes/ha + 100% N equivalent vermicompost)	7.5	4	87.5
T_6 (75% N equivalent vermicompost)	0	3	37.5
T_7 (100% N equivalent vermicompost)	0	4	50
T_8 (125 % N equivalent vermicompost)	0	5	62.5
T_9 (50% N equivalent FYM + 50% N equivalent vermicompost)	5	2	50

N content of FYM= 0.5%, N content of vermicompost= 1.25%

bacteria, yeasts, actinomycetes, algae etc are capable of producing auxins, gibberellins etc in appreciable quantity during vermicomposting (Arancon et al 2004) which affect plant growth appreciably (Arancon et al 2006). Use of higher doses of nitrogen, phosphorus and potassium through organic sources optimizes the availability of nutrients and helps in inducing good vegetative growth (Dhurandher and Tripathi 1999) which results in more number of tillers and higher number of panicles leading to higher yield.

Yield parameters and yield

The grain and straw yields are the manifestation of various growth and yield attributing characters. Among the different organic manure treatments T_5 and T_1 treatments proved statistically at par and recorded significantly higher productive tillers (4.48 and 4.31/hill), higher number of fingers per head (7.06 and 6.96), lengthier fingers (9.38 and 9.11 cm) and finally higher yield per plant (14.12 and 12.73 g/plant) as compared to rest of the treatments (Table 2). Improvement in yield attributes could be due to higher quantity of macro and micronutrients added to soil in the form of FYM and vermicompost (Table 1) resulting in increased availability of nutrients in root zone thus more uptake by crop resulting in higher values of yield attributing characters. These results are in conformity with the result of Poornesh et al (2004).

The two treatments T_5 and T_1 also proved superior to all other treatments wrt grain and straw yields resulting in 2745 and 2580 kg/ha grain and 5166 and 5006 kg/ha straw yield respectively (Table 3). This can be attributed to higher growth and yield attributing characters which occurred due to synergistic effect of organic manures resulting in release of nutrients. This can also be attributed to the slow and steady rate of nutrient release into soil solution to match the required absorption pattern of finger millet. Earlier Devegowd (1997) and Dosani et al (1999) have also reported similar results. Vermicompost contains plant growth regulating materials such as humic acids (Atiyeh et al 2002) and plant growth regulators like auxins, gibberellins and cytokinins (Tomati et al 1988) which are responsible for increased plant growth and yield of many crops (Atiyeh et al 2002). These plant growth regulating materials are produced by action of microbes like fungi, bacteria, actinomycetes and earthworms (Edwards 1998). Vermicompost provides large particulate surface areas that provide many microsites for microbial activities and for strong retention of nutrients (Shi-wei and Fu-zhen 1991). As a result most nutrients are in available form such as nitrates, phosphates, exchangeable calcium and soluble potassium (Edwards 1998). Vermicompost application also suppresses the growth of many fungi like *Pythium*, *Rhizoctonia* and *Verticillium*; as a result many plant diseases are suppressed when vermicompost is applied in ample quantity in the field (Hoitink and Fahy 1986).

Economics

Economics of crop production is dependent on market price of inputs and quantity of output produced and its price in the market. The treatments T_5 and T_1 lead to gross income of Rs 75503 and 71085/ha respectively though at par with each other but higher than all other treatments (Table 3). However the treatment T_5 resulted in highest net return of Rs 42903 which was at par with T_8 (125% N equivalent vermicompost) that fetched a net return of Rs 39741.

Table 2. Effect of different nutrient management practices on growth and yield attributes of finger millet

Treatment	Plant height at harvest (cm)	Number of leaves at 90 DAT	LAI at 90 DAT	Dry matter at harvest (g/hill)	Number of productive tillers at harvest	Number of fingers/head	Finger length (cm)	Yield (g/plant)
T_1	72.250	45.9	6.0	32.9	4.31	6.96	9.11	12.73
T_2	54.287	36.2	4.9	26.2	3.42	5.03	6.98	10.26
T_3	67.377	38.8	5.1	28.1	3.85	5.91	7.43	11.03
T_4	69.190	42.1	5.6	28.9	4.01	6.18	7.92	11.88
T_5	76.840	48.1	6.2	33.4	4.48	7.06	9.38	14.12
T_6	64.997	36.6	5.3	26.8	3.55	5.21	7.02	10.34
T_7	67.377	39.6	5.5	28.6	4.01	5.99	7.56	11.42
T_8	71.457	42.3	5.9	30.1	4.19	6.81	8.87	12.21
T_9	66.357	37.8	5.2	27.3	3.76	5.22	7.22	10.61
SEm±	3.72	1.92	0.09	1.04	0.07	0.12	0.14	0.43
$CD_{0.05}$	11.16	5.72	0.26	3.09	0.20	0.35	0.41	1.39

DAT= Days after transplanting, LAI= Leaf area Index

The treatments T_3, T_5, T_6, T_7, T_8 and T_9 resulted in the B-C ratio of 2.027, 2.316, 2.334, 2.390, 2.500 and 2.166 respectively which were at par with one another and higher than rest of the treatments.

CONCLUSION

Among different organic nutrient management practices application of recommended dose of FYM (7.5 tonnes/ha) along with 100 per cent N equivalent vermicompost (4 tonnes/ha) has been found superior with respect to growth and yield of finger millet. However higher benefit per rupee investment can be obtained with application of 125 per cent N equivalent vermicompost alone (5 tonnes/ha).

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Table 3. Effect of different nutrient management practices on yield and economics of finger millet

Treatment	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index	Gross return (Rs/ha)	Net return (Rs/ha)	B-C ratio
T_1	2580	5006	0.340	71085	34085	1.921
T_2	1990	3638	0.353	54650	27650	2.024
T_3	2170	4221	0.340	59797	30297	2.027
T_4	2290	4145	0.347	62856	30856	1.964
T_5	2745	5166	0.357	75503	42903	2.316
T_6	2010	3810	0.347	55308	31608	2.334
T_7	2181	4101	0.347	59987	34887	2.390
T_8	2410	4476	0.350	66241	39741	2.500
T_9	2146	4155	0.340	59120	31820	2.166
SEm±	94	208	0.01	2598	2598	0.09
$CD_{0.05}$	283	625	NS	7789	7789	0.29

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