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RESEARCH PAPER

Long term effect of different organic nutrient management practices on growth, yield of finger millet (*Eleusine coracana* L.) and soil properties

M. Y. ULLASA, S. PRADEEP, S. SRIDHAR, C. SUNIL, GANAPATHI[1] AND M. DIVYA

Organic Farming Research Center, Shivamogga
University of Agricultural and Horticultural Sciences, Shivamogga - 577 204, Karnataka, India
E-mail: ullas.653@gmail.com

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Abstract: A field experiment was conducted at Organic Farming Research Centre, University of Agricultural and Horticultural Sciences, Shivamogga,Karnataka, India for five consecutive years (2013 to 2017) during *kharif* season to study the 'Long term effect of different organic nutrient management practices on growth, yield of Finger millet (*Eleusine coracana* L.) and soil properties'. Among the different nutrient management practices, application of recommended dose of Farm Yard Manure (7.5 t ha^{-1}) along with 100 per cent N equivalent vermicompost (4 t ha^{-1}) has recorded higher grain yield (25.81 q ha^{-1}) and straw yield (54.69 q ha^{-1}) as compared to other practices. Similarly, higher number of tillers at harvest (4.88/ hill), lengthier fingers (9.5 cm) and higher yield per plant (15 g $plant^{-1}$) were also recorded with the same treatment. However, higher sustainable yield index (81.43 %) coupled with higher built up of organic carbon (OC) status of soil and maximum soil microbial population were noticed in the treatment which received recommended dose of FYM along with 100 percent N equivalent FYM as compared to initial status.

Key words: Finger millet, Nutrient management, Organic carbon, Sustainable yield index

Introduction

Finger millet (*Eleusine coracana* L. Gaertn) is one of the important millet crop grown on the alfisols of Southern India. In the year 2014, the area under this crop in India was 12.1 lakh ha and production was 20.6 lakh tons. Karnataka state stands first in area (7.1 lakh ha) and production (13.0 m t). Finger millet is one of the important crops being grown in dry lands of Karnataka. The crop is mainly being cultivated in rainfed area in resources poor soils with less management. Being a millet, Finger millet is highly suitable for less input agriculture like organic agriculture.

Increased prices of manufactured fertilizers 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 farming 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 nutrient capturing and relying more on organic inputs 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 agro-chemicals 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 yield (Ghosh, 2005). The practices of organic cultivation vary with the availability of local manurial resources and their nutrient content. Hence, it is necessary to identify both the source and its quantity to meet the nutrient requirement of crops to sustain the agricultural productivity. With this background an attempt was made to standardize the organic nutrient management practices for finger millet crop under rainfed situation.

Material and methods

A field experiment was conducted at Organic Farming Research Centre, University of Agricultural and Horticultural Sciences, Navile, Shivamogga, Karnataka (113 degree 58 minute 38 second N, 75 degree, 34 minute, 43 seconds E), during *kharif* season of five consecutive years from 2013 to 2017 to study the Long term effect of different organic nutrient management practices on growth, yield of Finger millet (*Eleusine coracana L.*) and soil properties. The sandy loam soil of experimental site was slightly acidic in reaction (pH 6.58) with a normal electrical conductivity of 0.06 d Sm^{-1} and low in organic carbon (3.50 g kg^{-1}), low in available nitrogen (206 kg ha^{-1}), high in available phosphorus (120 kg ha^{-1}) and medium in available potassium status (175 kg ha^{-1}). The experiment was laid out in randomized block design with nine treatments and replicated thrice with gross plot size of5.4 x 4.5 m. The recommended dose of FYM and Nitrogen for Finger millet under rainfed situation is 7.5 t ha^{-1} and 50 kg ha^{-1}, respectively. Experiment consisted of nine different manurial treatments. Treatment details and the quantity of nutrients applied in each treatment is given in Table 1.

Entire quantity of manures were applied to each plot 15 days before the transplanting of crop and incorporated into the soil. Finger millet seedlings of variety GPU 28 were raised in a raised bed and 21 days old seedlings were uprooted and

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

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 (7.5 t ha^{-1}) + 100 % N equivalent FYM	7.5+10	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 t ha^{-1}) + 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 % Recommended dose of N for rainfed situation, 50 kg ha^{-1}

transplanted in the main field at a spacing of 20×10 cm. Before transplanting, seedlings were dipped in solution containing 3 per cent neem oil and azospirilium. The nursery was raised in the second fortnight of June each year and transplanted in first fortnight of July. Three inter cultivation operations and one hand weeding was carried out to control the weeds. Whenever the stem borer occurred one per cent neem oil solution was sprayed to the crop. Recommended agronomic practices were followed in all the seasons in terms of land preparation, transplanting, plant protection, harvesting and processing.

The average annual rainfall of the station is 850 mm. Major portion of the rainfall (80 %) occurs from South west monsoon (June to September) which coincides with *Kharif* season. Finger millet is a drought tolerant crop, the total water requirement of finger millet is 350 mm. The crop has received optimum rainfall in the year 2013, 2015 2016 and 2017 (Table. 2). However, during the year 2014, excess to an amount of 80 % rainfall was received as compared to long term average. Although the rain fall in 2014 was higher, its impact on crop growth was negligible due to its delayed onset. Heavy rainfall occurred in the month of July (429.2 mm) and August (480.2 mm).

Representative surface soil samples (0-15 cm depth) were collected using core sampler before initiating the experiment and after harvest of the finger millet. The air dried processed soil samples were used for nutrient analysis. The nutrient analysis was done by adopting standard procedures outlined by Piper (1966) and Jackson (1973).

For microbial analysis of soil, treatment wise soil samples were collected from the rhizosphere of the plants at different growth stages. The soil samples collected were placed in a polyethylene bag and brought to laboratory and stored in refrigerator at 5^0C until used for analysis. Samples were analyzed for different soil microorganism *viz.*, total bacteria, total fungi and total actinomycetes using standard dilution plate count technique and plating on specific nutrient media.

The relevant growth and yield parameters were recorded at 30, 60, 90 DAT and at harvest by adopting standard procedures. Yield attributes and yield observations were recorded at harvest. All the data were then analyzed statistically for drawing conclusion using Analysis of Variance (ANOVA) procedure as described by Gomez and Gomez (1984).

Inorder to find out the sustainability of different treatments, Sustainable Yield Index (SYI) was worked out using following formula (Wanjari *et al.,* 2004).

$$SYI=\frac{A-Y}{Y\ max}\times 100$$

A- mean of particular treatment

Y- standard deviation of particular treatment

Ymax- potential yield in different years and treatments

Results and discussion

Growth parameters

The pooled data of growth parameters revealed that**,** among different nutrient management practices, application of 100 per cent N equivalent vermicompost (4 t ha^{-1}) along with recommended FYM (7.5 t ha^{-1}) recorded significantly higher plant height (83.4 cm) as compared to rest of the treatments

Table 2. Month wise actual and normal rain fall of the research station during cropping season

Month/ Year	2013	2014	2015	2016	2017	Normal
June	107.4 (8)	106.4 (9)	294.8 (19)	149.8 (14)	113.6 (9)	114.5
July	333.2 (16)	429.2 (22)	121.0 (11)	158.2 (14)	136.4 (11)	203.3
August	172.2 (11)	480.2 (22)	083.2 (11)	93.8 (15)	156.0 (11)	140.7
September	138.4 (9)	148.6 (8)	214.4 (9)	26.0 (8)	186.6 (14)	105.2
October	30.4 (4)	288.6 (8)	135.0 (6)	18.2 (7)	84.6 (7)	146.1
November	28.3 (5)	037.0 (2)	079.4 (4)	21.2 (3)	6.4 (1)	42.9
Total	808 (53)	1488 (71)	927 (60)	467.2 (61)	681 (53)	752.7

Values in the parenthesis represent number of rainy days except the treatment which received 100 per cent N equivalent FYM (10 t ha^{-1}) along with recommended FYM (7.5 t ha^{-1}) (Table 3). As the height of the plant increase nodes per plant also increases which in turn results in more number of leaves per plant. Significantly more number of leaves per plant (52.8) at 90 days after transplanting (DAT) was recorded in the treatment T_5 which received 100 per cent N equivalent vermicompost (4 t ha^{-1}) along with FYM (7.5 t ha^{-1}) as compared to rest of the treatments (Table 3). The amount of foliage in the plant canopy is one of the basic ecological characteristics commonly quantified by leaf area index (LAI). LAI is one of the main driving forces of net primary production, water and nutrient use, and carbon balance. Production of higher leaf area per unit area enhances the harvesting of solar radiation which results in higher photosynthesis and higher drymatter production which in turn results in effective utilization of applied resources. Among the different treatments application of 100 per cent N equivalent vermicompost (4 t ha^{-1}) along with FYM (7.5 t ha^{-1}) recorded significantly higher LAI (5.16) at 90 DAT as compared to rest of the treatments except with which received 100 per cent N equivalent FYM (10 t ha^{-1}) along with FYM (7.5 t ha^{-1}) (4.96).

Higher drymatter production is the pre requisite for higher yield per plant. Among different treatments application of 100 per cent N equivalent vermicompost (4 t ha^{-1}) along with FYM (7.5 t ha^{-1}) recorded significantly higher dry matter production at harvest (35.8 g hill^{-1}) and closely followed by the treatment which received 100 per cent N equivalent FYM (10 t ha^{-1}) along with recommended FYM (7.5 t ha^{-1}) (Table 3). This was attributed to cementing action of polysaccharides and other organic compounds released during the decomposition of organic matter supplied through FYM and vermicompost, provided better soil environment thus leading to taller plants, increased number of leaves, tillers and in turn the final yield. The organic manures had slow release of nitrogen due to its slow mineralization, which helped in the availability of nutrients commensurate with the growth and development of plants of the plants and development and thus resulted in higher growth parameters (Channabasanagowda *et al.,* 2008).

Treatment which received 7.5 ton FYM and 4 ton vermicompost has provided high quantity of both macro and micro nutrients. Integrated application of FYM and vermicompost resulted in availability of nutrients throughout the crop growth and its higher uptake by the crop apart from favorable effect of FYM and vermicompost on soil physico-chemical and biological properties. Further, the plant growth regulators and humic acid made available through vermicompost also enhanced the growth of plants (Arancon *et al*., 2004). As demonstrated scientifically that microbes like fungi, bacteria, yeasts, actinomycetes, algae are capable of producing auxins, gibberellins in appreciable quantity during vermicomposting (Arancon *et al*., 2004), which affects plant growth appreciably (Arancon *et al*., 2006).

Yield parameters and yield

The grain and straw yields are the manifestation of various growth and yield attributing characters. Among the different organic manurial treatments application of 100 per cent N equivalent vermicompost (4 t ha^{-1}) along with recommended FYM (7.5 t ha^{-1}) recorded significantly higher productive tillers (4.88 hill^{-1}), higher number of fingers per head (7.06), lengthier fingers (9.5 cm) and finally higher yield per plant (15 g plant^{-1}) as compared to rest of the treatments except the treatment which received 100 per cent N equivalent FYM (10 t ha^{-1}) along with recommended FYM (7.5 t ha^{-1}) (4.61 hill^{-1}, 6.96, 9.1 cm, and 13.42 g plant^{-1} of productive tillers, fingers per head, finger length and yield per plant, respectively) (Table 3). Improvement in yield attributes was due to higher concentration of macro and micronutrients added to soil in the form of FYM and vermicompost 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 Ullasa *et al.* (2017).

The grain and straw yield also significantly influenced by different nutrient management treatments (Table 4). Application of 100 per cent N equivalent vermicompost (4 t ha^{-1}) along with FYM (7.5 t ha^{-1}) has recorded significantly higher grain yield (25.81 q ha^{-1}) as compared to rest of the treatments except

Table 3. Effect of different organic nutrient management practices on growth and yield attributes of finger millet (pooled over 5 years)

Treatments	Plant height at harvest (cm)	Number of leaves at 90 DAT/hill	LAI at 90 DAT	Dry matter at harvest (g hill^{-1})	Number of productive tillers at harvest/hill	Number of Fingers per Head	Finger length (cm)	Yield (g plant^{-1})
T_1	78.4	49.2	4.96	34.8	4.61	6.96	9.1	13.42
T_2	63.4	34.3	4.16	27.4	3.49	5.03	7.1	11.11
T_3	70.4	40.0	4.25	30.7	4.04	5.91	7.5	11.38
T_4	76.0	45.8	4.46	30.4	4.13	6.18	8.0	12.01
T_5	83.4	52.8	5.16	35.8	4.88	7.06	9.5	15.00
T_6	62.5	39.3	4.35	27.3	3.61	5.21	7.4	10.92
T_7	68.3	43.1	4.45	29.6	4.22	5.99	7.6	11.49
T_8	73.0	47.1	4.81	30.3	4.23	6.81	8.9	12.86
T_9	71.6	39.3	4.62	28.6	3.89	5.22	7.6	10.99
S.Em.±	3.16	3.80	0.05	0.66	0.04	0.12	0.21	0.30
C. D. at 5 %	9.47	1.26	0.16	2.00	0.14	0.35	0.64	0.91

DAT- Days after transplanting, LAI- Leaf area index

Table 4. Effect of different organic nutrient management practices on straw, grain yield and sustainable yield index of finger millet

Treatments	2013-14		2014-15		2015-16		2016-17		2017-18		Pooled		Sustainable yield index (%)
	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	
T_1	23.82	55.02	25.76	55.02	23.40	56.8	25.80	50.06	26.5	51.5	25.06	53.68	81.43
T_2	21.76	48.09	21.98	48.09	20.14	47.54	19.90	36.38	18.9	35.7	20.54	43.16	66.08
T_3	22.56	50.49	22.75	50.49	20.91	50.12	21.70	42.21	21.5	41.4	21.88	46.94	72.58
T_4	23.52	53.56	22.92	53.56	21.66	53.7	22.90	41.45	23.6	42.5	22.92	48.95	76.10
T_5	23.90	55.94	24.98	55.94	23.63	57.53	27.45	51.66	29.1	52.4	25.81	54.69	80.53
T_6	21.90	48.65	22.65	48.65	20.52	48.25	20.10	38.10	19.9	36.9	21.01	44.11	68.08
T_7	23.12	52.33	24.18	52.33	21.10	52.12	21.81	41.01	23.1	41.0	22.66	47.76	73.71
T_8	23.71	54.03	24.85	54.03	22.59	55.03	24.10	44.76	24.9	45.8	24.03	50.73	79.31
T_9	22.89	51.53	24.16	51.53	20.91	51.01	21.46	41.55	21.1	40.5	22.10	47.22	71.19
S.Em.±	0.13	0.83	0.14	0.87	0.45	0.36	0.94	2.08	1.14	2.42	0.56	1.31	
C.D. at 5 %	0.39	2.49	0.43	2.53	1.35	1.07	2.83	6.25	3.41	7.27	1.68	3.92	

with the treatment which received 100 per cent N equivalent FYM (10 t ha^{-1}) along with recommended FYM (7.5 t ha^{-1}) (25.06 q ha^{-1}). Straw yield also followed the same trend and significantly higher straw yield (54.69 q ha^{-1}) was recorded with application of 100 per cent N equivalent vermicompost (4 t ha^{-1}) along with FYM (7.5 t ha^{-1}) and closely followed by 100 per cent N equivalent FYM (10 t ha^{-1}) along with FYM (7.5 t ha^{-1}). This was attributed to higher growth and yield attributing characters in turn improvement in these characters was due to synergistic effect of organic manures resulting in release of nutrients which was in synchrony with crop demand at different growth stages. This was also attributed to the slow and steady rate of nutrient release into soil solution to match the required absorption pattern of fingermillet. Earlier work by Devegowda (1997) and Dosani *et al*. (1999) have also reported similar results. The treatment which received 50 kg N through vermicompost (T_5) has recorded higher straw and grain yield as compared to 50 kg N supplied through FYM (T_1). This is attributed to 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 forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium (Edwards, 1998). Further, 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).

Sustainability of yield

Achieving the sustainability is the main goal of Organic farming. Hence, any organic nutrient practice which has produced higher yield should also achieve the sustainability in terms of yield. Among the different treatments, highest SYI (81.43 %) was recorded with treatment which received recommended dose of FYM (7.5 t ha^{-1}) along with 100 per cent N equivalent FYM (10 t ha^{-1}). However, it was closely followed by the treatment which received recommended dose of FYM (7.5 t ha^{-1}) along with 100 per cent N equivalent vermicompost (4 t ha^{-1}). Hence, these two treatments were more sustainable in terms of yield as compared to rest of the treatments.

Soil biological properties

The data of soil microbial analysis carried out during each year revealed that the population of microorganisms was increased as compared to initial status, irrespective of treatments. During 2013 the population of bacteria -53 × 10^5, Fungi-8.67 × 10^4, Actinomycetes -5.33 × 10^3, PSMs-11 × 10^3, N-fixers 15.67 × 10^3 CFU / g soil of the experimental site. Application of organic manures enhanced the microbial population over period of five years and the maximum soil microbial population of Bacteria-63.00 × 10^5, 86.00 × 10^5, 57.33 × 10^5, Fungi- 15.67 × 10^4, 20.67 × 10^4, 13.33 × 10^4, Actinomycetes-11.67 × 10^3, 18.00 × 10^3, 11.00 × 10^3, PSMs-19.33 × 10^3, 28.00 × 10^3, 16.67 × 10^3, N-fixers 24.33. × 10^3, 31.67 × 10^3, 20.00 × 10^3 CFU / g soil at 30 DAS, 60 DAS and at harvest respectively, was recorded in the treatment applied with Recommended FYM + 100 % N equivalent to vermicompost followed by the treatment T_1. There was a significant increase in soil microbial population from initial to 60 days there after the microbial population was decreased. The addition of organic inputs enhanced the microbial counts in soil significantly over the years, which might be due to carbon addition and the changes in physico-chemical and biological properties of soil. The Vermicompost contain higher amount of growth promoting substances, vitamins, and enzymes, and increases the root biomass production, which resulted in higher production of root exudates and increasing the beneficial bacteria, fungi and actinomycetes population in rhizosphere region (Upadhyay *et al*., 2011 and Jayanthi *et al*., 2014).

Soil nutrient status

Different nutrient management practices failed to influence the soil pH, EC and K_2O status significantly. Nutrient status of the soil is influenced by soil physico-chemical and biological properties. Soil organic carbon is one of the major components of soil organic matter. It is extremely important in all soil processes *viz.,* nutrient availability, soil structure and soil biological activities. The OC content was improved over the years as compared to initial levels (3.50 g/kg). Significantly higher organic carbon content in the soil was recorded in treatment which received recommended dose of FYM along with 100 per cent N equivalent FYM (5.88 g/kg) as compared to the treatment which received 75 per cent N equivalent Vermicompost.

Soil nitrogen availability depends on N mineralization and which in turn results in increased root biomass this leads to increased uptake of the nutrients by the plants. In the present investigation, after harvest of the crop the soil nitrogen status found significantly higher in the T_1 (253 kg ha^{-1}) which received recommended dose of FYM (7.5 tonnes ha^{-1}) and 100 percent N equivalent FYM over the rest of the treatment. As compared to initial status (206 kg ha^{-1}) gradual buildup of nitrogen content noticed in the treatment which received recommended dose of FYM along with 100 per cent N equivalent FYM (253 kg ha^{-1}). However, the available nitrogen content was low and it was increased slightly with application of organic manures. The available phosphorus was found significantly higher in T_1 (149 kg/ha) gradual increase in available P content was observed as compared to initial values (120 kg ha^{-1}). This is attributed to release of organic acid during microbial decomposition of organic matter which might encompass in the solubility of native phosphates thus increasing available phosphorus pool in the soil. In addition the organic anions compete with phosphate ions for the binding sites on the soil particles (Patra *et al.,* 2011). Different nutrient management treatments failed to influence the potassium status of soil significantly. However, the available potassium was found highest in T_1 (170 kg/ha) over rest of the treatments (Table 5). Organic manure application will improve the soil fertility and availability of nutrients through slow mineralization and slow release of nutrients which in turn results in availability of nutrients throughout the growing period of the crop (Dudhat *et al.*, 1997).

Conclusion

Results of the experiments conducted for five consecutive years revealed that, application of recommended dose of FYM (7.5 t ha^{-1}) along with 100 % N equipment vermicompost (4 t ha^{-1}) found superior with respect to growth and yield of finger millet. However, improvement in soil biological properties,

Table 5. Soil microflora as influenced by different organic nutrient management practices (cfug^{-1} of soil)

	Mircroflora (cfug^{-1} soil)														
Treatments	Bacteria (No. x 10^5)			Fungi (No. × 10^4)			Actinomycetes (No. × 10^3)			PSM (No. × 10^3)			N-fixers (No. × 10^3)		
Initial	53			8.67			5.33			11.00			15.67		
Treatments	30 DAS	60 DAS	At Harvest	30 DAS	60 DAS	At Harvest	30 DAS	60 DAS	At Harvest	30 DAS	60 DAS	At Harvest	30 DAS	60 DAS	At Harvest
T_1	61.33	85.67	56.00	15.00	19.33	13.00	10.00	17.33	10.33	18.00	26.33	15.67	23.33	30.33	19.00
T_2	55.00	77.33	50.00	11.67	14.00	10.33	07.00	12.00	07.00	14.33	20.33	12.00	19.00	25.33	15.00
T_3	56.67	82.67	52.33	13.00	16.00	11.00	08.00	14.00	08.00	16.00	22.33	14.00	20.33	27.67	16.33
T_4	60.67	84.00	55.67	15.00	18.67	12.67	09.67	16.67	09.67	17.67	25.67	15.33	23.00	29.00	18.67
T_5	63.00	86.00	57.33	15.67	20.67	13.33	11.67	18.00	11.00	19.33	28.00	16.67	24.33	31.00	20.00
T_6	55.33	80.33	50.00	12.00	15.00	09.00	07.33	12.67	07.33	15.00	21.00	13.67	19.33	26.33	15.33
T_7	56.00	81.00	51.67	12.67	15.33	10.67	08.00	13.00	07.33	15.33	21.00	14.33	20.00	27.00	16.00
T_8	60.00	83.33	55.00	14.67	18.00	12.00	09.00	15.00	09.00	17.00	24.33	15.00	22.67	28.33	18.00
T_9	57.00	83.00	53.67	14.00	17.33	11.33	08.33	14.33	08.33	16.33	23.67	14.33	21.00	28.00	17.33
S.Em.$\pm$	0.280	0.382	0.325	0.318	0.268	0.320	0.282	0.262	0.320	0.280	0.380	0.320	0.326	0.289	0.30
C.D. at 5%	0.82	1.02	0.90	0.92	0.80	0.90	0.82	0.78	0.90	0.82	1.12	0.92	0.90	0.82	0.88

Table 6. Nutrient status of soil as influenced by different nutrient management practices

	Treatments	pH (1:2.5)	EC(dSm^{-1})	OC (g/kg)	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Initial		6.58	0.06	3.50	206	120	175
T_1	Rec. FYM + 100 %N equivalent to FYM	6.20	0.06	5.88	253	149	170
T_2	75 % N equivalent to FYM	6.15	0.06	4.90	224	111	147
T_3	100 % N equivalent to FYM	6.14	0.04	4.68	219	122	150
T_4	125 % N equivalent to FYM	6.26	0.04	5.17	237	118	170
T_5	Rec.FYM + 100 % N equivalent to vermicompost	6.04	0.05	5.56	243	137	156
T_6	75 % N equivalent to vermicompost	6.19	0.05	4.32	201	106	142
T_7	100 % N equivalent to vermicompost	6.31	0.05	5.09	232	117	161
T_8	125 % N equivalent to vermicompost	5.99	0.05	4.95	226	121	121
T_9	50 % N equivalent to FYM + 50% N equivalent to vermicompost	6.18	0.04	5.20	227	136	147
	S.Em.$\pm$	0.078	0.004	0.486	9.44	5.48	21.86
	C.D. at 5 %	NS	NS	1.46	28.2	16.38	NS

EC- Electrical conductivity, OC-Organic Carbon, N-Nitrogen, P_2O_5-Phosphorus, K_2O-potassium organic carbon status and sustainability of yield was recorded with application of recommended dose of FYM (7.5 t ha^{-1}) along with 100 % N equivalent vermicompost (10 t ha^{-1}).

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