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Effect of nutrient sources and organic liquids on yield and nutrient uptake by finger millet (*Eleusine coracana* L.)

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Abstract
Finger millet known for its nutritional benefits is generally grown on steep slopes in the sub-montane region of Maharashtra having high annual rainfall. Poor soil fertility and nutrient losses along with running rain water is major concern for the finger millet growers of this region. Replenishing depleted major soil nutrient through inorganic fertilizer alone may not prove a wise approach perhaps, conjunct use of inorganic and organic amendments can not only enhanced the crop productivity but also is an expedient strategy to sustain soil health. An investigation was therefore initiated at RCSM College of Agriculture, Kolhapur, with an aim to study the impact of different organic and inorganic nutrient sources on yield contributing attributes, overall yield and nutrient uptake by finger millet crop. The experiment was laid out in a randomised block design comprising thirteen treatments replicated three times. Among the various doses of fertilizer along with various organic nutrient inputs application of 100% RDF+ Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut* recorded highest grain and straw yield 22.8 q ha^{-1} and 30.4 q ha^{-1} respectively while, the mean grain and straw yield obtained was 16.6 q ha^{-1} and 25.05 q ha^{-1} respectively. The application of recommended dose of fertilizer through inorganic sources along with vermicompost @ 2.5 t ha^{-1} and 10% jeevamrut exhibited higher total uptake of nitrogen, phosphorus and potassium to the tune of 57.54, 20.00, 50.20 kg ha^{-} respectively. From the present investigation it is concluded finger millet responds well with application of T_6: 100% RDF+ Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut.*

Keywords: Finger millet. *Jeevamrut*, *Panchagavya*, vermicompost

Introduction

Millet is a collective term referring to several small-seeded annual grasses primarily cultivated as grain crops in arid regions. Millets find cultivation in 130 countries worldwide and have a rich tradition as a staple food in Asia and Africa. Their low Glycemic Index makes them a preferable choice for individuals with diabetes. Millets have deep-rooted historical significance as a traditional staple in dryland regions across the globe. Finger Millet is cultivated in more than 25 countries, particularly in arid and semi-arid regions. In the context of millet production in India, finger millet holds a prominent position among farmers due to its extensive cultivation. Its remarkable resilience and capacity to thrive in adverse climatic and poor soil conditions make it a dependable and profitable crop. In India, finger millet is grown over an area of 1.19 million hectares, resulting in a production of 1.98 million tonnes, with an average productivity of 1661 kg per hectare. Karnataka leads in both area and production, accounting for 56.21% and 59.52%, followed by Tamil Nadu (9.94% and 18.27%), Uttarakhand (9.40% and 7.76%), and Maharashtra (10.56% and 7.16%), respectively (www.indiastat.com). It boasts a composition rich in carbohydrates (65-75%), proteins (8-11%), and fiber (15-20%). Furthermore, it stands out for its substantial calcium content (844 mg/100 g) and mineral (2.5-3.5%) as noted by Chethan and Malleshi in 2007 [12]. As finger millet have high nutritional value, it is a perfect nutri-cereal to make baby foods and its consumption is beneficial for lactating women. Organic solutions such as *Panchagavya, jeevamrut, beejamrut*, and vermiwash leave no residual effects on the soil. Farm yard manure with nutrient content 0.5%N, 0.2%P, 0.5% K and to maximize the output and soil productivity it can be used in conjunction with chemical fertilizers. Vermicompost rich in nitrogen 1.5-2%, phosphorous 1.25% potassium 1-1.5% (Sinha, 2004) [10], consequently soil nutrient status and structure is improved.

Organic formulations such as *jeevamrut* supplies 1.48% Nitrogen, 0.28% Phosphorous, 0.32% Potassium and *Panchagavya* supplies 0.06% nitrogen, 0.03% phosphorous, 0.04% potassium along with plant growth hormones that influences plant growth and yield. The combined use of organic and inorganic nutrient sources supply essentials macro as well as micro nutrients, increases beneficial microbial population and improves soil structure. These organic nutrient sources influences healthy crop stand and maintains soil fertility. Above organic formulations can be made on farm itself so that the expenditure on composts and fertilizer can be minimized. The year 2023 is being celebrated as International Millet Year hence to focus on millets and to create more awareness about organic inputs a field experiment was undertaken to study the Effect of nutrient sources and organic liquids on yield attributes, yield and nutrient uptake by finger millet (*Eleusine coracana* L.)

Materials and Methods

A field experiment was conducted during *kharif* 2022 at research farm, Agronomy section, RCSM College of Agriculture, Kolhapur. It is located on 16° 41' N latitude, 74° 14' longitude. The experimental site was fairly uniform and levelled. The experimental field's soil was characterized as clay loam in texture, with medium available nitrogen (320.5 kg ha^1), high available phosphorus (31 kg ha^1), moderately high available potassium (250 kg ha^1), alkaline pH (8.00), EC (0.28 dSm"), and medium organic carbon (0.58%). Transplanting of finger millet (*Phule kasari*) was done on 18th July 2022 with the spacing of 30 x 10 cm^2, and the harvesting was completed by 1st November 2022. Prior to transplanting FYM and Vermicompost were applied to soil as per treatments. The gross and net plot sizes were 4.50 m x 4.20 m and 3.60 m x 3.10 m, respectively. The experiment followed a randomized block design, comprising thirteen treatments with three replications. These thirteen treatments were as follows: T_1: Absolute Control, T_2: 100% GRDF (60:30:30 kg N: P_2O_5 and K_2O ha^{-1}) + FYM @ 5 t, T_3: 100% RDF (60:30:30 kg NPK ha $^{-1}$), T_4: 100% RDF + Vermicompost @ 2.5 t ha^{-1}, T_5: 100% RDF+ Vermicompost @ 2.5 t ha^{-1} + 5% *Panchagavya*, T_6: 100% RDF+ Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut*, T_7: 100% RDF +5% *Panchagavya*, T_8: 100% RDF + 10% *Jeevamrut*, T_9: 75% RDF + Vermicompost @ 2.5 t ha^{-1}, T_{10}: 75% RDF + Vermicompost @ 2.5 t ha^{-1} + 5% *Panchagavya*, T_{11}: 75% RDF + Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut*, T_{12}: 75% RDF + 5% *Panchagavya*, T_{13}: 75% RDF +10% *Jeevamrut*. Observations were recorded periodically at an interval of fifteen days. For the estimation of phosphorous and potassium Tri-acid digestion method was followed and for nitrogen estimation Kjeldahl method was followed. The data obtained by the investigation then subjected to Statistical analysis as per the standard procedure by using the techniques of analysis of variance and test of significance was carried out as given by Panse and Sukhatme (1985) [11]. In the tabular data C.D values have been given for the comparison only where 'F' test was significant. The statistical analysis was carried out by computer.

Results and Discussion

Grain and straw yield

The data in respect to grain and straw yield is presented in Table 1. The treatment $T_{6:}$100% RDF+ Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut* in field recorded the highest grain yield (22.8 q ha^1) among all treatments, nevertheless it was statistically at par with $T_{5:}$100% RDF + Vermicompost @ 2.5 t ha^{-1} + 5% *Panchagavya* (21.4 q ha^1) and $T_{4:}$ 100% RDF + Vermicompost @ 2.5 t ha^{-1} (20.30 q ha^1). However, the minimum grain yield (9.66 q ha^1) was recorded in absolute control treatment. The treatment $T_{6:}$100% RDF+ Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut* recorded the highest straw yield (30.04 q ha^1), significantly surpassing other treatments although it showed statistically similar results with treatment $T_{5:}$100% RDF+ Vermicompost @ 2.5 t ha^{-1} + 5% *Panchagavya*, $T_{4:}$100% RDF + Vermicompost @ 2.5 t ha^{-1}, $T_{11:}$75% RDF + Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut*, $T_{10:}$75% RDF +Vermicompost @2.5 t ha^{-} + 5% *Panchagavya.* The maximum grain yield in treatment 100% RDF+ Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut*, might be attributed to the optimal availability of macro and micro nutrients from organic liquid i.e. 10% *Jeevamrut* and optimum nutrient supply from vermicompost and 100% RDF. This results in greater nutrient availability in the soil and better nutrient uptake due to improved root penetration, ultimately leading to better nutrient absorption. The yield obtained could be attributed to the combined impact of growth attributes and favorable yield characteristics when provided with sufficient nutrients by organic and inorganic nutrient sources. This encourages the photosynthesis and eventually better partitioning to the sink. These findings are in accordance with Mahapatra (2016) [8], Ullasa (2017) [9].

Table 1: Mean grain and straw yield of finger millet as influenced by the various treatments

Tr. No	Treatments details	Grain yield	Straw yield
		--------- (q ha^{-1})------	
T_1	Absolute Control	9.66	17.40
T_2	100%GRDF (60:30:30 kg NPK ha $^{-1}$)+ FYM @ 5 t	14.80	22.10
T_3	100% RDF (60:30:30 kg NPK ha $^{-1}$)	14.30	23.50
T_4	100% RDF + Vermicompost @ 2.5 t ha^{-1}	20.30	28.60
T_5	100% RDF+ Vermicompost @ 2.5 t ha^{-1} + 5% *Panchagavya*	21.40	29.80
T_6	100% RDF+ Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut*	22.80	30.40
T_7	100% RDF +5% *Panchagavya*	16.30	25.80
T_8	100% RDF + 10% *Jeevamrut*	16.05	24.30
T_9	75% RDF + Vermicompost @ 2.5 t ha^{-1}	17.40	26.40
T_{10}	75% RDF + Vermicompost @ 2.5 t ha^{-1} + 5% *Panchagavya*	18.20	27.03
T_{11}	75% RDF + Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut*	18.80	27.80
T_{12}	75% RDF + 5% *Panchagavya*	13.29	22.01
T_{13}	75% RDF +10% *Jeevamrut*	12.99	20.55
S.Em±		0.95	1.3
CD @ 5%		2.79	3.8
General Mean		16.6	25.05

Nutrient uptake

The data illustrated in Table 2. shows that the nutrient uptake by the plants is significantly affected by the application of various organic and inorganic inputs. Nevertheless, mean total nitrogen, phosphorous and potassium uptake was 38.9, 13.7 and 37.15 kg ha^{-1} respectively. Among all the treatments T_6 recorded the highest total nutrient uptake. Total nitrogen, phosphorous and potassium nutrient uptake recorded in T_6 were 57.54, 20.00, 50.20 kg ha^{-1}respectively. The elevated uptake of N, P and K may be due to enhanced biological efficiency in crop plants with foliar spray of *panchagavya*, and *jeevamrut* creating a more significant source and sink in the plant system, that leads to better nutrient uptake. Above findings are in conformity with Gajbhiye *et al*. (2017) [4].

Table 2: Show the nutrient uptake N uptake, P uptake and K uptake

Tr. No	Treatment details	N Uptake (kg ha^{-1})			P uptake (kg ha^{-1})			K uptake (kg ha^{-1})		
		Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_1	Absolute Control	14.95	7.47	22.43	5.07	2.26	7.33	11.28	11.27	22.55
T_2	100% GRDF (60:30:30 kg NPK ha $^{-1}$)+ FYM @ 5 t	23.68	9.50	33.18	8.19	3.32	11.51	17.57	14.80	32.37
T_3	100% RDF (60:30:30 kg NPK ha $^{-1}$)	22.88	10.09	32.97	7.89	3.52	11.41	16.97	15.82	32.79
T_4	100% RDF + Vermicompost @ 2.5 t ha^{-1}	34.10	13.60	47.71	12.01	5.71	17.72	24.76	20.04	44.80
T_5	100% RDF+ Vermicompost @ 2.5 t ha^{-1} + 5% *Panchagavya*	36.59	14.41	51.01	12.79	5.96	18.75	26.26	21.01	47.27
T_6	100% RDF+ Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut*	42.64	14.90	57.54	13.63	6.37	20.00	28.36	21.84	50.20
T_7	100% RDF +5% *Panchagavya*	26.79	11.53	38.32	9.11	4.39	13.50	19.55	17.29	36.84
T_8	100% RDF + 10% *Jeevamrut*	25.95	10.54	36.48	8.83	3.89	12.72	19.16	16.28	35.44
T_9	75% RDF + Vermicompost @ 2.5 t ha^{-1}	28.54	11.96	40.49	9.74	4.75	14.49	20.99	18.13	39.12
T_{10}	75% RDF + Vermicompost @ 2.5 t ha^{-1} + 5% *Panchagavya*	29.81	12.44	42.25	10.38	5.13	15.51	22.09	18.70	40.79
T_{11}	75% RDF + Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut*	31.58	13.01	44.59	10.99	5.28	16.27	22.70	19.34	42.04
T_{12}	75% RDF + 5% *Panchagavya*	21.26	9.51	30.77	7.13	3.09	10.22	15.73	14.56	30.28
T_{13}	75% RDF +10% *Jeevamrut*	20.00	8.75	28.75	6.82	2.68	9.50	15.25	13.26	28.51
	S.Em±	1.99	0.72	2.29	0.711	0.24	0.80	1.29	0.99	1.86
	CD @ 5%	5.8	2.12	6.69	2.08	0.70	2.34	3.77	2.91	5.46
	General Mean	27.5	11.36	38.9	9.42	4.33	13.7	20.05	17.10	37.15

Conclusion

This experiment concludes that among the treatments of combination of fertilizer level along with various organic inputs, application of 100% RDF+ Vermicompost @ 2.5 t ha^{-1}+ 10% *Jeevamrut* gave the highest grain and straw yield and nutrient uptake. Application of vermicompost found beneficial to improve soil condition and nutrient availability. Combined use of organic and inorganic nutrient sources resulted into a better crop growth and improved soil condition.

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