Original Research Article

Influence of various organic sources on soil nutrient status and nutrient uptake of Ragi under guni method

Abstract

A field experiment was conducted during the *kharif*-2019 at the farmers field of Mylandahalli in Chikkaballapura distict of Karnataka, to study the effect of organic nutrient sources on soil nutrient status of finger millet under Guni method. The trial was framed out in randomized blocked design with twelve treatments replicated thrice. The results showed that supplement of SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + PG spray @ 3% (T_9) had a significant effect on nutrient uptake, fertility status in soil and their values were statistically higher than all the other treatments. The findings of study reported that supplement of SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + PG spray @ 3% (T_9) recorded significantly higher uptake of total nitrogen (124.7 kg ha^{-1}), phosphorus (27.2 kg ha^{-1}) and potassium (84.9 kg ha^{-1}). Likewise, the same treatment had recorded superior in available soil nitrogen, phosphorus and potassium (413.8, 44.6 and 223.1 kg ha^{-1}, respectively) compared to other treatments and recommended FYM (10 t)+100:50:50 kg N: P_2O_5: K_2O ha^{-1} found to be least in soil nutrients and uptake during cropping period of *kharif* 2019.

Keywords: Grain, nitrogen, nutrient balance, phosphorus, potassium and straw uptake

Introduction

India is considered as pivot for the millet crops. Finger millet (*Eleusine coracana* L.) Gaertn.] commonly called as Ragi or African millet in India. Among the millets, finger millet is one of the noticeable millet grown for both food (as a grain) and fodder (as a straw) under varied agro-climatic region. It is grown in Jharkhand, Maharashtra, Tamil Nadu, Uttaranchal Karnataka, Andhra Pradesh and Orissa in an extent of 11.63 lakh tones with a potential of 16.91 lack tones and a productivity of 1454 kg ha^{-1}. Karnataka is one of the principle state of Ragi in India and cultivated in 8.12 lakh tones with an annual yield of 11.48 lakh tons, where as in terms of productivity Tamil Nadu leads with maximum value of 2967 kg ha^{-1} (INDIASTAT, 2023-24). Finger millet, prominent dry land crop with remarkable ability to tolerate extreme weather conditions such as drought and other climatic variations. Among the finger millet seeding techniques, broadcasting and random transplanting are the most widely used. However, adhering to these tenets results in an uneven plant distribution, which intensifies competition for nutrients and moisture (Shashikala *et al*., 2021). A new method called 'Guni' or 'Guli' with wider establishing and spot application of farm yard manure has been established in finger

millet in line with "System of Crop Intensification" (Jagadeesha *et al.*, 2019). In current times have seen farmers in the Karnataka districts of Kolar, Bengaluru rural, and Haveri employed A new method called 'Guni' or 'Guli' with wider establishing and spot application of farm yard manure has been established in finger millet in line with "System of Crop Intensification" (Hebbal *et al.*, 2018). Using a basic ox-drawn plow driven over the field perpendicularly, furrows spaced 20 inches (60 cm) apart are incised on the soil. That will intersect at a designated spot and create a little Guni, or pit, with a depth of 20 cm. Farmers maintained a 60 cm × 60 cm spacing and feed FYM to Guni on-site (0.75 kilogram per Guni) and thoroughly mixed it with soil.

Among several ways of farming, organic farming is an important farming method which improves the soil fertility for sustainable crop production. Use of different organic manures such as farm yard manure (FYM), sericulture waste compost (SWC), bio-digested liquid organic manure (BDLM), enriched bio-digested liquid organic manure (EBDLM), cow urine, panchagavya (PG) and vermiwash (VW) are known to have multiple advantages that improve soil health, yield and quality of product (Sakamma *et al.*, 2018). There is also possibility of replacing fertilizers by organic sources of nutrient (Organic Farming). However low nutrient concentration and slow release of nutrients from organic manures leads the problem of nutrient deficiencies. This problem can be overcome by using liquid organic manures because of faster and continuous release of nutrients during the cropping period. Foliar application is also possible in organic farming which can overcome of scarcity of moisture in top soil. With this in mind, the current test was supported to evaluate the effects of organic nutrient sources on nutrients uptake, soil fertility status and nutrient balance in guni method of finger millet cultivation.

Material and methods

Field trial was carried out in *kharif* 2019 at the farmer field of Mylandahalli in Chikkaballapura distict of Karnataka. The texture of research plot was sandy clay loam, neutral in response (pH 7.41), lower levels of organic carbon (0.38%), medium level of available nitrogen (284.75 kg/ha), higher levels of available phosphorous (32.98 kg/ha) and moderate levels of available potassium (195.70 kg/ha). The twelve treatments in the research were arranged in a randomized block design, and was duplicated thrice. ML-365 variety was used in the trial and transplanted @ spacing of 60 cm x 60 cm. Treatments used in the research were T_1: FYM @ 100% N eq. ha^{-1}, T_2: SWC @ 100% N eq. ha^{-1}, T_3: BDLM @ 100% N eq. ha^{-1}, T_4: EBDLM @ 100% N eq. ha^{-1}, T_5: Cow urine @ 100% N eq. ha^{-1}, T_6: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + VW spray @ 3%, T_7: SWC @ 50% N eq. + BDLM @ 50% N eq.

ha^{-1} + PG spray @ 3%, T_8: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + VW spray @ 3%, T_9: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + PG spray @ 3%, T_{10}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + VW spray @ 3%, T_{11}: SWC @ 50% N eq. + Cow urine @ 50% N eq. + PG spray @ 3% and T_{12}: Recommended FYM (10 t) + 100:50:50 kg NPK ha^{-1}. The raised nursery beds were set up, gaging 3.0 m x 1.5 m and 10 cm high. On the beds, one kilogram of seeds was dispersed per acre. With the Guni method, each plot was levelled evenly, and at 0.6 × 0.6 m intersection, tiny gunis or scoops were manually prepared with a spade. Two seedlings per guni were planted in each of the plots after twenty-one days after transplanting the seedlings. In 100% RDF treatment (T_{12}), urea, single super phosphate and muriate of potash were used to augment the nutrients (100:50:50 kg NPK ha^{-1}). The nutrient composition of various organic manures used in the experiment were included in Table 1.

Uptake of nutrients

Plant sample collected at harvest were dried in hot air oven at 60°C for 24 hours after sun drying. The oven dried samples of plants and air-dried samples of seed were grounded to pass through 40 mesh sieve in macro wiley mill. The sample were analysed for their nutrient content in seed and straw of ragi by using different standard methods and it was converted into nutrient uptake multiplying with yield and divided by 100 following formula. Uptake of nitrogen, phosphorus and potassium was computed using formula

$$\text{Nutrient uptake } \left(\text{kg ha}^{-1}\right) = \frac{\text{Nutrient content in grain or straw (\%)} \times \text{Dry weight of grain or straw } (\text{kg ha}^{-1})}{100}$$

The uptake of nitrogen, phosphorus and potassium by finger millet grain and straw was calculated separately and the sum of uptake of nutrients in grain and straw was considered as the total uptake by the crop and expressed in kg ha^{-1}.

Chemical analysis of soil

Representative soil samples from experimental plot were drawn from the surface (30 cm depth) after harvest of the crop. Soil samples thus collected were air dried in shade, powdered with wooden mallet and passed through 2 mm sieve and chemically analyzed for organic carbon, pH, electrical conductivity, available nitrogen, phosphorus and potassium.

Balance of nitrogen, phosphorous and potassium status in soil (kg ha^{-1})

Balance of N, P_2O_5, K_2O was worked out at the end of crop by considering the initial soil available N, P_2O_5 and K_2O status and N, P_2O_5 and K_2O supplied through fertilizer and manures. Upon subtracting the crop uptake, the expected balance of nutrients was arrived. Net

gain or loss of nutrients was worked out by subtracting the expected balance from initial N, P_2O_5 and K_2O status (Prasad and Kerketta, 1991 and Mongia and Gangwar, 1991).

Conversion of P into P_2O_5 was done by using formula

$$\% P_2O_5 = \% P \text{ (seed or straw)} \times 2.29$$

Similarly, K into K_2O by using formula

$$\% K_2O = \% K \text{ in seed or straw} \times 1.20.$$

The data was statistically analyzed at 5% level of probability (LSD) by subsequent procedure drawn by Gomez and Gomez (1984) n SPSS software (Statistical Package for the Social Sciences).

Results and Discussion

Nutrient uptake (kg ha^{-1})

Data on uptake of NPK by finger millet crop as influenced by various organic nutrient sources is presented in Table 2. Significantly higher uptake of grain, straw, and total nitrogen (46.45, 78.25 and 124.70 kg ha^{-1}, respectively), phosphorus (12.87, 14.30, 27.17 kg ha^{-1}, respectively) and potassium (21.10, 63.87 and 84.97 kg ha^{-1}, respectively) by finger millet crop with the application of SWC @ 50 % N eq. + EBDLM @ 50 % N eq. ha^{-1} + PG spray @ 3 % (T_9). It was on par to T_8 and T_7 followed by T_6. Whereas, significantly lower uptake of total nitrogen (21.01, 44.00 and 65.01 kg ha^{-1}, respectively), phosphorus (4.76, 5.87 and 10.63 kg ha^{-1}, respectively) potassium (8.69, 37.64 and 46.33 kg ha^{-1}, respectively) was noticed with recommended FYM (10 t ha^{-1}) + 100:50:50 kg ha^{-1} N: P: K (T_{12}).

Increased nutrient uptake by finger millet crop is due to increasing in nutrient availability at rhizosphere. Higher nutrient availability in soil caused for spot application of organic manure which reduces nutrient losses (By leaching and volatilization). Due to spot application, all nutrients are accumulated in guni itself. Organic manure not only improve physicochemical and biological properties of soil but also there is higher beneficial microbial load. These microbes involved in mineralization of organic matter and also inhibit the growing of soil born pathogen. Due to slow and steady liberation of fixed nutrients from organic manure, there is a synchronization of nutrients with crop demand. The increase in uptake of nutrient due to application of panchagavya as a foliar spray was ascribed to increase biological efficiency of crop which influence greater source and sink in the plant system. The results are in confirmation with the findings of Kalaraju (2007) in finger millet, Reddy *et al*. (2011) in finger millet, Latha and Shranappa (2014) in groundnut-onion, Prakash (2015) in finger millet and Ananda (2017) in finger millet.

Soil nutrient status

Data on soil properties *viz*. pH, electrical conductivity (EC), organic carbon (OC), nitrogen, phosphorus, and potassium after harvest of finger millet crop was presented in Table 3. Application of various organic manures did not influenced significantly on soil pH, electrical conductivity and organic carbon of the soil. Available nitrogen (413.82 kg ha^{-1}), phosphorus (44.62 kg ha^{-1}) and potassium (223.13 kg ha^{-1}) were significantly higher with SWC @ 50 % N eq. + EBDLM @ 50 % N eq. ha^{-1} + PG @ 3 % (T_9) followed by T_8 (395.48, 43.26 and 221.55 kg ha^{-1} N: P_2O_5: K_2O, respectively), T_7 (388.61, 42.02 and 219.25 kg ha^{-1} N: P_2O_5: K_2O, respectively) and T_6 (368.25, 38.87 and 207.55 kg ha^{-1} N: P_2O_5: K_2O, respectively) and which were on par to each other. However, significantly lower available Nitrogen (258.36 kg ha^{-1}), Phosphorus (27.13 kg ha^{-1}) and potassium (166.69 kg ha^{-1}) was reported with recommended FYM (10 t ha^{-1}) + 100:50:50 kg N: P_2O_5: K_2O ha^{-1} (T_{12}).

Higher available N: P_2O_5: K_2O in soil as influenced by various organic nutrient sources and enrichment of bio-digested liquid manure with pongamia cake might be the reason for increasing the activity of beneficial soil micro-organisms (Table 2) which indirectly enhanced the decomposition process (various solid and liquid organic manures) as a result there was higher N, P_2O_5 and K_2O available in soil. Increase in N availability in soil due to mineralization (unavailable to available form) of organic nutrients which was justified by the increased soil microbial activity and also reduced N loss from the soil because of spot application (in guni). Higher availability of soil P_2O_5 might be due to increased solubility of P from various organic nutrient sources which enhances due to release of organic acid by microbes present in the soil. The increase in available K_2O in soil might be due to release of potassium from EBDLM and solubilization of mineral bound K or native K. The results are confirmation with Saunshi, (2012) and Ananda *et al*. (2017) in finger millet.

Nutrient balance of the soil

Data on N, P_2O_5 and K_2O balance after harvest of finger millet as influenced by various organic nutrient sources are presented in Table 4 to 6.

Available nitrogen balance

The initial soil status of available nitrogen was 312.54, 32.98 and 195.70 kg ha^{-1} and added organic manure and fertilizers supplies 151 kg of nitrogen from each treatment and phosphorus ranges between 95.17-183.07 kg ha^{-1}, while potassium ranges between 68.69-159.17 kg ha^{-1} from different treatment. It makes up total nitrogen about 463.54, kg ha^{-1}, ranges between 128.15-183.07 kg ha^{-1} in case of phosphorus and total potassium ranges between 264.39-359.17 kg ha^{-1}. Application of SWC @ 50 % N eq. + EBDLM @ 50 % N eq. ha^{-1} + PG @ 3 % (T_9) recorded higher actual balance

(413.82, 44.62 and 223.13 kg NPK ha^{-1}, respectively). While, recommended FYM (10 t ha^{-1}) + 100:50:50 kg N: P_2O_5: K_2O ha^{-1} (T_{12}) recorded lower actual balance (258.36, 27.13 and 166.69 kg NPK ha^{-1}, respectively). The higher net gain in nitrogen (74.98 kg ha^{-1}), Phosphorus (-26.21 kg ha^{-1}) and potassium (43.37 kg ha^{-1}) was observed with treatment *i.e*., SWC @ 50 % N eq. + EBDLM @ 50 % N eq. ha^{-1} + PG @ 3 % (T_9). While, Higher net loss of nitrogen (-140.17 kg ha^{-1}) Phosphorus (-93.34 kg ha^{-1}) and potassium (-81.02 kg ha^{-1}) was noticed with recommended FYM (10 t ha^{-1}) + 100:50:50 kg N: P_2O_5: K_2O ha^{-1} (T_{12}).

Nitrogen loss was least in SWC @ 50 % N eq. + EBDLM @ 50 % N eq. ha^{-1} + PG @ 3 % (T_9) may be due to various organic nutrient sources. Due to slow, constant and frequent release of nutrients might have enhanced efficient utilization of nitrogen. Also, guni method of finger millet cultivation conserves the nutrients in guni itself and prevent loss of nitrogen through leaching and volatilization. On the contrary nitrogen source used as urea which was released into soil solution very quickly and leads to loss of more nitrogen. The data obtained in this experiment are similar with the findings of Prakash *et al*. (2015), and Ananda *et al*. (2017) in finger millet. Phosphorus losses might be due to release of fixed form of phosphorous due to decomposition of organic materials.

Conclusion

On findings of the above-summarized results from one-year experimentation, the following conclusions have been drawn that increased N, P and K uptake in grain, straw and total uptake were recorded with SWC @ 50 % N eq. + EBDLM @ 50 % N eq. ha^{-1} + PG spray @ 3 % over rest of the treatments. However, the similar treatment has recorded significantly higher available soil N, P and K after harvest of the crop. Findings indicate that nitrogen, phosphorus and potassium dynamics in the soil were influenced by various organic nutrient sources. Most treatments resulted in a net loss of nitrogen, phosphorus and potassium from the soil, highlighting proper management practices are essential to optimize nutrient retention and ensure sustainable crop production.

Disclaimer (Artificial intelligence)

Authors are hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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Table 1: Nutrient composition of different organic manures used in the experiment

Sl. No.	Particulars	SWC	FYM	BDLM	EBDLM	CU	VW	PG	Method employed
1.	**pH (1:25)**	8.13	8.24	8.30	8.20	7.40	6.70	6.09	Potentiometer (Piper, 1966)
2.	**EC (1:25) (dSm^{-1})**	2.75	0.18	0.11	0.26	4.70	2.90	3.06	Conductivity bridge (Jackson, 1973)
3.	**Organic carbon (%)**	28.76	10.78	0.81	1.13	3.44	0.43	0.78	Walkely and Black Wet oxidation method (Jackson, 1973)
4.	**Total Nitrogen (%)**	7.35	0.51	0.96	1.31	0.49	0.03	0.07	Modified Microkjeldhal method (Jackson,1973)
5.	**Total Phosphorus (%)**	0.94	0.27	0.21	0.42	0.08	0.01	0.04	Vanadomolybdate yellow colour method (Jackson,1973)
6.	**Total Potassium (%)**	0.98	0.48	0.30	0.58	0.48	0.02	0.05	Flame photometer (Jackson,1973)

Table 2. Uptake of primary nutrients (kg ha^{-1}) by ragi crop under guni method as influenced by various organic nutrient sources

Treatments	Nitrogen			Phosphorus			Potassium		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_1	30.11	52.80	82.91	7.35	8.60	15.95	12.15	41.83	53.98
T_2	35.10	56.32	91.42	8.94	8.90	17.84	13.50	45.45	58.95
T_3	36.72	61.82	98.54	9.68	10.10	19.78	14.62	51.34	65.96
T_4	36.92	65.49	102.41	10.22	10.76	20.98	16.13	54.16	70.29
T_5	30.03	51.81	81.84	6.82	7.20	14.02	11.36	41.62	52.98
T_6	42.10	71.34	113.44	11.20	11.33	22.53	17.73	58.34	76.07
T_7	44.46	75.26	119.72	11.44	13.62	25.06	18.14	59.42	77.56
T_8	45.74	76.35	122.09	11.54	14.13	25.67	19.30	61.98	81.28
T_9	46.45	78.25	124.70	12.87	14.30	27.17	21.10	63.87	84.97
T_{10}	31.96	54.78	86.74	8.16	8.70	16.86	13.00	42.86	55.86
T_{11}	35.19	61.60	96.79	9.41	9.00	18.41	14.20	48.92	63.12
T_{12}	21.01	44.00	65.01	4.76	5.87	10.63	8.69	37.64	46.33
S.Em±	**1.52**	**2.48**	**3.85**	**0.61**	**1.04**	**1.59**	**1.16**	**1.90**	**3.12**
C.D (P=0.05)	**4.46**	**7.28**	**11.28**	**1.79**	**3.05**	**4.65**	**3.39**	**5.58**	**9.14**

T_1: FYM @ 100% N eq. ha^{-1}
T_2: SWC @ 100% N eq. ha^{-1}
T_3: BDLM @100% N eq. ha^{-1}
T_4: EBDLM @ 100% N eq. ha^{-1}
T_5: Cow urine @ 100% N eq. ha^{-1}
T_6: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + VW spray @ 3%
T_7: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + PG spray @ 3%
T_8: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + VW spray @ 3%
T_9: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + PG spray @ 3%
T_{10}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + VW spray @ 3%
T_{11}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + PG spray @ 3%
T_{12}: Recommended FYM (10 t) + 100:50:50 kg N: P_2O_5: K_2O ha^{-1}

Note: FYM @ 10 t ha^{-1}was applied for all the treatments except T_{12} and foliar application of VW & PG at 45 and 60 DAT.
FYM: Farm Yard Manure; SWC: Sericulture Waste Compost; BDLM: Bio-Digested Liquid Manure; EBDLM: Enriched Bio-Digested Liquid Manure; VW: Vermiwash; PG: Panchagavya and DAT: Days After Transplanting

Table 3. Effect of various organic nutrient sources on soil nutrient status of finger millet crop under guni method

Treatments	pH	Electrical Conductivity (dSm^{-1})	Organic carbon (%)	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})
T_1	7.01	0.24	0.48	290.30	29.59	176.66
T_2	7.09	0.25	0.53	310.15	33.30	181.80
T_3	7.18	0.26	0.52	331.70	34.01	188.86
T_4	7.21	0.26	0.53	337.74	37.82	193.62
T_5	6.95	0.24	0.54	281.18	29.29	173.20
T_6	7.27	0.27	0.55	368.25	38.87	207.55
T_7	7.31	0.27	0.56	388.61	42.02	219.25
T_8	7.37	0.27	0.58	395.48	43.26	221.55
T_9	7.41	0.28	0.59	413.82	44.62	223.13
T_{10}	7.05	0.25	0.55	296.16	30.69	178.95
T_{11}	7.15	0.26	0.51	325.36	33.83	187.43
T_{12}	6.72	0.21	0.41	258.36	27.13	166.69
S.Em±	**0.38**	**0.02**	**0.04**	**15.66**	**2.01**	**6.29**
C.D (P=0.05)	**NS**	**NS**	**NS**	**45.94**	**5.89**	**18.44**

T_1: FYM @ 100% N eq. ha^{-1}
T_2: SWC @ 100% N eq. ha^{-1}
T_3: BDLM @100% N eq. ha^{-1}
T_4: EBDLM @ 100% N eq. ha^{-1}
T_5: Cow urine @ 100% N eq. ha^{-1}
T_6: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + VW spray @ 3%
T_7: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + PG spray @ 3%
T_8: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + VW spray @ 3%
T_9: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + PG spray @ 3%
T_{10}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + VW spray @ 3%
T_{11}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + PG spray @ 3%
T_{12}: Recommended FYM (10 t) + 100:50:50 kg N: P_2O_5: K_2O ha^{-1}

Note: FYM @ 10 t $ha^{-1}$was applied for all the treatments except T_{12} and foliar application of VW & PG at 45 and 60 DAT.
FYM: Farm Yard Manure; SWC: Sericulture Waste Compost; BDLM: Bio-Digested Liquid Manure; EBDLM: Enriched Bio-Digested Liquid Manure; VW: Vermiwash; PG: Panchagavya and DAT: Days After Transplanting

Table 4. Available nitrogen (N) balance in soil (kg ha^{-1}) after the harvest of finger millet crop under guni method as influenced by various organic nutrient sources

Treatments	Initial soil N	N added through treatments	Total available N	N uptake by finger millet crop	Expected N balance	Actual N balance	Net gain / loss (+/-) of N in soil over expected balance
	1	2	(1+2)=3	4	(3-4)=5	6	(6-5)=7
T_1	312.54	151.00	463.54	82.91	380.63	290.30	-90.33
T_2	312.54	151.00	463.54	91.42	372.12	310.15	-61.97
T_3	312.54	151.00	463.54	98.54	365.00	331.70	-33.30
T_4	312.54	151.00	463.54	102.41	361.13	337.74	-23.39
T_5	312.54	151.00	463.54	81.84	381.70	281.18	-100.52
T_6	312.54	151.00	463.54	113.44	350.10	368.25	18.15
T_7	312.54	151.00	463.54	119.72	343.82	388.61	44.79
T_8	312.54	151.00	463.54	122.09	341.45	395.48	54.03
T_9	312.54	151.00	463.54	124.70	338.84	413.82	74.98
T_{10}	312.54	151.00	463.54	86.74	376.80	296.16	-80.64
T_{11}	312.54	151.00	463.54	96.79	366.75	325.36	-41.39
T_{12}	312.54	151.00	463.54	65.01	398.53	258.36	-140.17

T_1: FYM @ 100% N eq. ha^{-1}
T_2: SWC @ 100% N eq. ha^{-1}
T_3: BDLM @100% N eq. ha^{-1}
T_4: EBDLM @ 100% N eq. ha^{-1}
T_5: Cow urine @ 100% N eq. ha^{-1}
T_6: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + VW spray @ 3%
T_7: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + PG spray @ 3%
T_8: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + VW spray @ 3%
T_9: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + PG spray @ 3%
T_{10}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + VW spray @ 3%
T_{11}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + PG spray @ 3%
T_{12}: Recommended FYM (10 t) + 100:50:50 kg N: P_2O_5: K_2O ha^{-1}

Note: FYM @ 10 t ha^{-1}was applied for all the treatments except T12 and foliar application of VW & PG at 45 and 60 DAT.
FYM: Farm Yard Manure; SWC: Sericulture Waste Compost; BDLM: Bio-Digested Liquid Manure; EBDLM: Enriched Bio-Digested Liquid Manure; VW: Vermiwash, PG: Panchagavya and DAT: Days After Transplanting

Table 5. Available phosphorous (P_2O_5) balance in soil (kg ha^{-1}) after the harvest of finger millet crop under guni method as influenced by various organic nutrient sources

Treatments	Initial soil P_2O_5	P_2O_5 added through treatments	Total available P_2O_5	P_2O_5 uptake by finger millet crop	Expected P_2O_5 balance	Actual P_2O_5 balance	Net gain / loss (+/-) of P_2O_5 in soil over expected balance
	1	2	(1+2)=3	4	(3-4)=5	6	(6-5)=7
T_1	32.98	183.07	216.05	36.53	179.52	29.59	-149.93
T_2	32.98	91.12	124.10	40.85	83.24	33.30	-49.94
T_3	32.98	111.92	144.90	45.30	99.61	34.01	-65.60
T_4	32.98	109.03	142.01	48.04	93.96	37.82	-56.14
T_5	32.98	99.22	132.20	32.11	100.09	29.29	-70.80
T_6	32.98	101.52	134.50	51.59	82.91	38.87	-44.04
T_7	32.98	101.52	134.50	57.39	77.12	42.02	-35.10
T_8	32.98	100.07	133.05	58.78	74.27	43.26	-31.01
T_9	32.98	100.08	133.06	62.22	70.84	44.62	-26.21
T_{10}	32.98	95.17	128.15	38.61	89.54	30.69	-58.85
T_{11}	32.98	95.17	128.15	42.16	85.99	33.83	-52.17
T_{12}	32.98	111.83	144.81	24.34	120.47	27.13	-93.34

T_1: FYM @ 100% N eq. ha^{-1}
T_2: SWC @ 100% N eq. ha^{-1}
T_3: BDLM @100% N eq. ha^{-1}
T_4: EBDLM @ 100% N eq. ha^{-1}
T_5: Cow urine @ 100% N eq. ha^{-1}
T_6: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + VW spray @ 3%
T_7: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + PG spray @ 3%
T_8: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + VW spray @ 3%
T_9: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + PG spray @ 3%
T_{10}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + VW spray @ 3%
T_{11}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + PG spray @ 3%
T_{12}: Recommended FYM (10 t) + 100:50:50 kg N: P_2O_5: K_2O ha^{-1}

Note: FYM @ 10 t $ha^{-1}$was applied for all the treatments except T12 and foliar application of VW & PG at 45 and 60 DAT.
FYM: Farm Yard Manure; SWC: Sericulture Waste Compost; BDLM: Bio-Digested Liquid Manure; EBDLM: Enriched Bio-Digested Liquid Manure; VW: Vermiwash, PG: Panchagavya and DAT: Days After Transplanting

Table 6. Available potassium (K_2O) balance in soil (kg ha^{-1}) after the harvest of finger millet crop under guni method as influenced by various organic nutrient sources

Treatments	Initial K_2O	K_2O added through treatments	Total available K_2O	K_2O uptake by finger millet crop	Expected K_2O balance	Actual K_2O balance	Net gain / loss (+/-) of K_2O in soil over expected balance
	1	2	(1+2)=3	4	(3-4)=5	6	(6-5)=7
T_1	195.70	159.17	354.87	64.78	290.09	176.66	-113.43
T_2	195.70	68.69	264.39	70.74	193.65	181.80	-11.85
T_3	195.70	88.76	284.46	79.15	205.31	188.86	-16.45
T_4	195.70	103.35	299.05	84.35	214.70	193.62	-21.08
T_5	195.70	163.47	359.17	63.57	295.60	173.20	-122.40
T_6	195.70	78.73	274.43	91.28	183.14	207.55	24.40
T_7	195.70	78.73	274.43	93.07	181.36	219.25	37.89
T_8	195.70	86.02	281.72	97.54	184.19	221.55	37.36
T_9	195.70	86.03	281.73	101.96	179.76	223.13	43.37
T_{10}	195.70	116.08	311.78	67.03	244.76	178.95	-65.81
T_{11}	195.70	116.09	311.79	75.74	236.04	187.43	-48.61
T_{12}	195.70	107.60	303.30	55.59	247.71	166.69	-81.02

T_1: FYM @ 100% N eq. ha^{-1}
T_2: SWC @ 100% N eq. ha^{-1}
T_3: BDLM @100% N eq. ha^{-1}
T_4: EBDLM @ 100% N eq. ha^{-1}
T_5: Cow urine @ 100% N eq. ha^{-1}
T_6: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + VW spray @ 3%
T_7: SWC @ 50% N eq. + BDLM @ 50% N eq. ha^{-1} + PG spray @ 3%
T_8: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + VW spray @ 3%
T_9: SWC @ 50% N eq. + EBDLM @ 50% N eq. ha^{-1} + PG spray @ 3%
T_{10}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + VW spray @ 3%
T_{11}: SWC @ 50% N eq. + Cow urine @ 50% N eq. ha^{-1} + PG spray @ 3%
T_{12}: Recommended FYM (10 t) + 100:50:50 kg N: P_2O_5: K_2O ha^{-1}

Note: FYM @ 10 t ha^{-1} was applied for all the treatments except T_{12} and foliar application of VW & PG at 45 and 60 DAT.
FYM: Farm Yard Manure; SWC: Sericulture Waste Compost; BDLM: Bio-Digested Liquid Manure; EBDLM: Enriched Bio-Digested Liquid Manure; VW: Vermiwash, PG: Panchagavya and DAT: Days After Transplanting