Nutrient uptake and quality parameters of finger millet as influenced by tillage and organic nutrient management in finger millet – french bean cropping system

ABSTRACT

A field experiment was conducted at Research Farm of Birsa Agricultural University, Kanke, Ranchi, Jharkhand during 2020-21 and 2021-22. The experimental soil textural class was sandy loam with pH 5.56, EC 0.03 dS/m and OC (5.91 g/kg). The soil was low in available nitrogen (218.63 kg/ha), medium in available phosphorus (15.75 kg/ha) and medium in available potassium (178.32 kg/ha). The experiment was laid out in a split plot design with three replication. The experiment consisted of four main plot treatments viz., conventional tillage–conventional tillage (CT–CT), conventional tillage–zero tillage (CT–ZT), zero tillage–conventional tillage (ZT–CT) and zero tillage–zero tillage (ZT-ZT) and subplot has four treatments with different sources of organic nutrient management *viz*., 100% N through FYM, 100% N through vermicompost, 50% N through FYM + 50% N through vermicompost and 75% N through FYM + 25% N through vermicompost. The results revealed the significantly highest value of total N uptake (36.02 kg/ha), total P uptake (11.03 kg/ha), total K uptake (51.66 kg/ha), protein content (7.93 %), Ca content (321.34 mg/100 g) and Fe content (4.29 mg/100 g) were observed in conventional tillage-conventional tillage. Among organic sources, 100% N through vermicompost gave maximum value of total N uptake (37.05 kg/ha), total P uptake (11.24 kg/ha), total K uptake (52.25 kg/ha) and protein content (8.07 %). Ca content (339.15 mg/100 g) and Fe content (4.50 mg/100 g) were observed maximum in 100% N through FYM.

Keywords: Finger millet, tillage, organic nutrients, NPK uptake, quality parameters

Introduction

"Finger millet is *an important member of small millet group* and is grown extensively in various regions of India. It supplies a major portion of calories and protein for people of low-income group and used as staple food . Finger millet has high content of calcium (0.38%), protein (6-13%), dietary fiber (18%), carbohydrate (65-75%), minerals (2.5-3.5%), phytates (0.48%), tannins (0.61%), phenolic compounds (0.3-3%) and trypsin inhibitory factors and is recognized for its health beneficial effects" (Devi *et al*., 2014). "All over India, it is cultivated in an area of 1.14 Mha with total production of 1.82 MT and an average productivity of 1601 kg/ha. In Jharkhand, it is grown over an area of 14.3 thousand ha with an annual production of 9.2 thousand tonne and an average productivity of 644 kg/ha (Annual Progress Report: 2017-18, ICAR-AICRP on Small Millets; 2015-16). Jharkhand state has good agro-ecological conditions for finger millet production". (Sulochna et. Al., 2022)

In recent years, intensive cropping has been given more importance than individual cropping. Inclusion of pulses crop in sequence is agronomically very significant. French bean is grown extensively because of its short duration and nutritive value. "They are rich source of protein and closely compared with meat. Edible protein is 94% of the pods and per 100 g of edible protein contains: moisture 91.4 g, protein 1.7 g, fat 0.1 g, carbohydrate 4.5 g, fiber 1.8 g, minerals 0.5 g, vitamin A 221 I.U., thiamine 0.08 mg, vitamin C 14 mg, calcium 50 mg, phosphorus 28 mg, iron 1.70 mg, potassium 120 mg, sulphur 37 mg, sodium 4.3 mg copper 0.21 mg" (Prasad, 2005). "In India french bean is grown in an area of 228 thousand ha along with production of 2277 thousand tonne and productivity of 9.98 tonne/ha. In case of Jharkhand, it is cultivated over an area of 12.91 thousand ha with production of 191.18 thousand tonne and productivity of 14.81 tonne/ha" (Horticultural Statistics at a Glance, 2018).

"Finger millet-french bean cropping system may be suitable in the Jharkhand region. So, there is scope to obtain higher yield levels by manipulating different managements in field like adopting appropriate tillage practices. Now a day's conservation agriculture is gaining momentum due to its success in western countries and some cropping systems in India because of the adverse effects of intensive agricultural practices like excessive tilling of land, water and fertilizer applications and consequently resulting into high risk of environmental pollution and deterioration of soil and water resources" (Hatti and Ramachandrappa, 2016). "It has been also observed that disturbing the soil too much through tillage operations is not actually essential to obtain good crop yields (Prasad *et al*. 2006), and also in agriculture, most of the energy (25–30%) is utilized for either preparation of field or establishment of crop where conventional tillage is mainly followed" (Tomar *et al*. 2006). "Along with this fuel cost and availability of effective package and practices for conservation tillage are now re-evaluate tillage in India in recent years. Minimizing the tillage operation influences several aspects of the soil, whereas intensive and unnecessary tillage operations also cause harmful effects on soil. Tillage operation has major influence on physical properties of soil which influences soil aeration, moisture and temperature" (Singh., 2014). "Thereafter a good crop stand depends to a great extent on the emergence of sown seeds, it is a requisite to provide soil physical conditions favourable for germination and the emergence of seedling through tillage practice" (Hatti *et al*., 2018).

"Moreover, the agricultural research is oriented on evolving ecologically sound, biologically sustainable and socio-economically viable technologies. For this, there is need for a new approach to exploit the organic farming practice by utilizing the local available organic sources for growing organic crops". (Naik *et al*., 2017). "Application of organic sources like farm yard manure and vermicompost to the crops is being practiced for long period. Well decomposed farm yard manure and vermicompost not only supply plant nutrients which act as binding material but also improves the soil physical properties. These manures increase the microbial population in the soil and reduces the environmental pollution as well as prolongs the sustainability of soil by conserving high soil organic matter. Broadly, organic agriculture is practiced in over 24 million ha" (Bhattacharya and Chakraborty, 2005). Organic farming is adopted not only due to greater demand for pollution free quality food but also due to natural advantage of organic farming in supporting the sustainability in agriculture. Taking these points in view, organic farming has gained much more attention in recent years all over the world. There was few systemic research carried out in this aspects in finger millet-french bean production, keeping these points in view, the present investigation was undertaken.

Materials and Method

The experiment entitled, "'Nutrient uptake and quality parameters of finger millet as influenced by tillage and organic nutrient management in finger millet – french bean cropping system" was conducted in Agronomical Research Farm of the Birsa Agricultural University, Kanke, Ranchi (23° 17' N latitude, 85^{0} 10' E longitude and 625.22 m above mean sea level), Jharkhand during 2020-21 and 2021-22. "The experiment was laid out in a split-plot design with three replication. The experiment consisted of four main plot treatments *viz.*, conventional tillage–conventional tillage (CT -CT), conventional tillage-zero tillage (CT-ZT), zero tillage - conventional tillage (ZT-CT) and zero tillage-zero tillage (ZT-ZT) and subplot has four treatments with different sources of organic nutrient management *viz.*, 100% N through FYM, 100% N through vermicompost, 50% N through FYM + 50% N through vermicompost and 75% N through FYM + 25% N through vermicompost. Finger millet and French bean (for vegetable purpose) variety taken for cultivation were BBM 10 and Swarna Priya respectively. Seed rate for finger millet and French bean were 10 and 80 kg/ha respectively. Recommended dose of nitrogen (RDN) for finger millet and French bean were 40 and 140 kg/ha respectively. The source of organic nutrients were FYM and vermicompost". (Sulochna et. Al., 2022) "Sowing of finger millet was done on 26th June 2020 and 18th June 2021 with row-to-row spacing of 30 cm and plant to plant 10 cm spacing was maintained after thinning. Fifteen days prior to sowing of green French bean, the organic nutrients were manually incorporated into the soil. Green French bean was sown on 13th Nov 2020 and 06th Nov 2021 with row-to-row spacing of 40 cm and plant-to-plant spacing of 10 cm. Both crops were sown in east-west direction in both the years. The texture of soil (0-15 cm of depth) was sandy loam. Mechanical analysis was done by Hydrometer method, bulk density by core sampler method, permanent wilting point and field capacity by pressure plate method, pH and EC by pH and EC meter, organic carbon by Walkley & Black method, available nitrogen by Alkaline permanganate method, available phosphorus by Bray's P1 method, available potassium by Flame photometer method and microbial count by Pour plate techniques. The soils were acidic, medium in organic carbon, low in available nitrogen, medium in available phosphorous and potassium. The maximum and minimum temperature ranged from 26.8 to 36.8 ^{o}C and from 4.0 to 24.1 ^{o}C respectively during 2020-21. During second season (2021-22) it ranged from 21.0 to 34.2 ^{o}C and from 3.6 to 25.2 ^{o}C respectively. Rainfall varied from 0 to 185.8 mm and from 0 to 229.4 mm in first and second season respectively. Agricultural operations and practices were applied as recommended for the crop. The finger millet crop was harvested on 28th Oct 2020 in first year and on 19th Oct 2021 in second year. While in case of French bean it was harvest on 18th Feb 2021 and on 9th Feb 2022 in first and second year respectively. Data on soil parameters were recorded as per normal procedure" . (Sulochna et. Al., 2022)

Result and Discussion

Uptake (nitrogen, phosphorus and potassium) of finger millet was influenced by tillage and organic nutrient management but their interaction effect were found non-significant. Quality parameters of finger millet was not affected by tillage, organic nutrient management, and their interaction effect.

Nitrogen uptake by finger millet grain (kg/ha)

The perusal of pooled data of nitrogen uptake by finger millet grain (Table 3) showed that CT-CT recorded maximum nitrogen uptake by finger millet grain (30.44 kg/ha) and significantly higher than all the treatments except CT-ZT (28.51 kg/ha). Among organic nutrient management, 100% N through VC reported maximum (31.37 kg/ha) nitrogen uptake by finger millet grain which was at par with 50% N through FYM + 50 % N through VC (28.45 kg/ha) and superior over rest of the treatments.

Nitrogen uptake by finger millet straw (kg/ha)

A critical study of the pooled data related to nitrogen uptake by finger millet straw (Table 3) revealed that treatment CT-CT recorded highest (5.58 kg/ha) value of nitrogen uptake by finger millet straw and significantly higher than ZT-CT (5.15 kg/ha) and ZT-ZT (4.77 kg/ha), but at par with CT-ZT (5.47 kg/ha). Among organic nutrient management treatments, 100% N through VC found with significantly highest value (5.68 kg/ha) of nitrogen uptake by finger millet straw which was remain at par with all the treatments except 100% N through FYM (4.43 kg/ha).

Total nitrogen uptake by finger millet (kg/ha)

It is obvious from the pooled data regarding the total nitrogen uptake by finger millet crop (table 3) that total nitrogen uptake by finger millet crop was significantly influenced by tillage operations. CT-CT recorded maximum value of total nitrogen uptake by finger millet (36.02 kg/ha) and significantly higher than ZT-CT (31.26 kg/ha) and ZT-ZT (29.05 kg/ha) but comparable to CT-ZT (33.98 kg/ha). Application of 100% N through VC recorded statistically maximum (37.05 kg/ha) total nitrogen uptake by finger millet which was superior to all the treatments.

Phosphorus uptake by finger millet grain (kg/ha)

Examination of pooled data (Table 4) revealed that phosphorous uptake by finger millet grain was significantly influenced by tillage practice. Highest value (8.68 kg/ha) of phosphorous uptake by finger millet grain was recorded in CT-CT and significantly superior to all the treatments. Among organic nutrient management, 100% N through VC also reported significantly highest phosphorous uptake (8.83 kg/ha) by finger millet grain which was comparable to all the treatments.

Phosphorus uptake by finger millet straw (kg/ha)

A close observation of pooled data (Table 4) indicated that CT-CT obtained the maximum value of phosphorous uptake by finger millet straw (2.35 kg/ha) and significantly superior to ZT-CT (2.13 kg/ha) and ZT-ZT (1.98 kg/ha) but failed to cause significant variation with CT-ZT (2.26 kg/ha). Among organic nutrient management, 100% N through VC gave higher (2.42 kg/ha) phosphorous uptake by finger millet straw followed by 50% N through FYM + 50% N though VC (2.32 kg/ha) and 75% N through FYM + 25% N though VC (2.19 kg/ha) but superior to 100% N through FYM (1.80 kg/ha).

Total phosphorous uptake by finger millet crop (kg/ha)

It is clear from pooled data (table 4) that the treatment CT-CT recorded highest value of total phosphorous uptake by finger millet (11.03 kg/ha) and significantly higher than ZT-CT (9.31 kg/ha) and ZT-ZT (8.62 kg/ha) but at par with CT-ZT (10.31 kg/ha). Organic source like 100% N through VC statistically observed with a maximum value (11.24 kg/ha) of total phosphorous uptake by finger millet crop which was significantly superior over all the treatments.

Potassium uptake by finger millet grain (kg/ha)

Analysis of the pooled data (Table 5) revealed that tillage practice caused significant variation in potassium uptake by finger millet grain. Treatment CT-CT recorded highest value of potassium uptake by finger millet grain (8.06 kg/ha) and significantly higher than ZT-CT (6.72 kg/ha) and ZT-ZT (6.20 kg/ha) but at par with CT-ZT (7.54 kg/ha). On the other hand, 100% N through VC noticed with maximum value (8.24 kg/ha) of potassium uptake by finger millet grain which was comparable to all the treatments.

Potassium uptake by finger millet straw (kg/ha)

Pooled data regarding potassium uptake by finger millet straw in Table 5 indicated that tillage activity caused significant variation in potassium uptake by finger millet straw. CT-CT recorded highest value of potassium uptake by finger millet straw (43.60 kg/ha) and significantly higher than ZT-CT (40.74 kg/ha) and ZT-ZT (38.72 kg/ha) but failed to cause significant variation with CT-ZT (42.72 kg/ha). Among organic nutrient management, 100% N through VC significantly observed with maximum value of potassium uptake (44.02 kg/ha) by finger millet straw which was significantly higher than 100% N through FYM (36.44 kg/ha) and followed by 50% N through FYM + 50% N through VC (43.32 kg/ha) and 75% N through FYM + 25% N through VC (42.00 kg/ha).

Total potassium uptake by finger millet crop (kg/ha)

A critical study of the pooled data related to total potassium uptake by finger millet crop in Table 5 revealed that CT-CT significantly influenced the total potassium uptake by finger millet crop. CT-CT recorded with maximum value of total potassium uptake by finger millet crop (51.66 kg/ha) and significantly higher than ZT-CT (47.46 kg/ha) and ZT-ZT (44.93 kg/ha) but being at par with CT-ZT (50.26 kg/ha). In case of organic nutrient management, 100% N through VC gave the maximum value of total potassium uptake (52.25 kg/ha) by finger millet crop which was being at par with all treatments except 100% N through FYM (42.12 kg/ha).

Quality parameters

Data on protein content in finger millet grain was not influenced by tillage practices but influenced by organic nutrient management, have been presented in Table 6. However, tillage and organic nutrient management exerted no significant variation on calcium and iron content in finger millet grain. Interaction effect caused by both the factors were observed non-significant on quality parameters of finger millet.

Protein content (%)

It is evident from the pooled data regarding protein content in finger millet grain (Table 6) that tillage was unable to influence the protein content. Protein content in finger millet grain was recorded highest in CT-CT (7.93%) and lower in ZT-ZT (7.62%). Further organic nutrient affected the protein content in finger millet. 100% N through VC significantly produced maximum value (8.07 %) of protein content in finger millet grain which was significantly at par with 50% N through FYM + 50% N through VC (7.79%) and statistically superior to rest of the treatments.

Ca content (mg/100 g)

Tillage and organic nutrient management and also their interaction were unable to produce any significant variation in calcium content in finger millet grain (Table 6). It was recorded maximum in ZT-ZT (337.10 mg/100g grain) and minimum in CT-CT (321.34

mg/100g grain). In case of organic nutrient management 100% N through FYM was produced highest (339.15 mg/100g grain) calcium content in finger millet grain and but lowest calcium content in finger millet grain was obtained in 100% N through VC (319.24 mg/100g grain).

Fe content (mg/100 g)

The trend of iron content (mg/100g grain) in finger millet grain was recorded similar to ca content in finger millet grain (Table 6). Tillage and organic nutrient management were failed to produce any significant effect on iron content in finger millet grain. And also, their interaction had no significant difference on iron content. Maximum iron content was found in ZT-ZT (4.49 mg/100g grain) and minimum in CT-CT (4.29 mg/100g grain). Along with this, the application of 100% N through FYM showed highest (4.50 mg/100 g grain) iron content in finger millet grain. Lowest value was reported in the use of alone source of VC i.e. 100% N through VC (4.27 mg/100g grain) amongst all the organic nutrient managements.

Conventional tillage created the favourable physical condition for seed germination, seedling emergence, stand establishment and subsequent growth which contributed to higher mineralization of nutrients. This was responsible for more availability of nutrients which resulted in higher total uptake of nutrients (nitrogen, phosphorus and potassium) in CT-CT. This was in conformity with the findings of Ikpe *et al.*, (2001). Due to higher content of nitrogen in CT-CT, protein content was also significantly higher in CT-CT and lower in ZT-ZT. Protein content was not influenced by tillage operations. This might be due to combined effect of availability of nutrient and activity of roots, which varied differently under different tillage Practices (Singh *et al*., 2010). Calcium and iron contents were higher under ZT-ZT tillage but not significantly affected by tillage practice.

Among different organic sources, the total uptake of nitrogen, phosphorus, potassium and protein content by finger millet crop was recorded significantly maximum with 100% N through VC in comparison to other treatments. Addition to this, the interaction between tillage with organic nutrient management was observed as non-significant. This might be due to the trend of nutrient uptake was similar as the dry matter accumulation/m^2. The enhanced uptake of nutrients (nitrogen, phosphorus and potassium) could be due to increased and sustained availability of nutrients through organic manure combinations as compared to other application. Application of organic nutrients improve the soil structure, aeration, buffering capacity, water holding capacity, influences solubility of the mineral and provide energy for growth and development of microorganisms. Similar results were found under influence of vermicompost in french bean by Sharma *et al*., (2018).

But organic nutrient management was unable to produce any significant effect no calcium and iron content in finger millet grain with 100% N through FYM gave the higher values of calcium and iron content and lower values in 100% N through VC. Although vermicompost contains more calcium and iron content than farm yard manure (Ravimycin 2016). But farm yard manure was applied in very large quantity in comparison to vermicompost that's why its content was more in 100% N through FYM.

Conclusion

On the basis of two years experiment, the above findings suggest that the higher uptake of nitrogen, phosphorus, potassium and protein content were realized in conventional tillage. Application of balanced fertilization by 100% N through vermicompost played a great role in boosting the uptake of nitrogen, phosphorus, potassium and protein content and quality parameters of finger millet.

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Table 1 NPK content in finger millet grain as influenced by tillage and organic nutrient management in finger millet – french bean cropping system

A. Tillage Practice	N content in Grain (kg/ha)			P content in Grain (kg/ha)			K content in Grain (kg/ha)		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
CT-CT	1.25	1.28	1.27	0.360	0.364	0.362	0.332	0.341	0.337
CT-ZT	1.23	1.25	1.24	0.348	0.352	0.350	0.323	0.332	0.327
ZT-CT	1.22	1.24	1.23	0.336	0.340	0.338	0.313	0.318	0.316
ZT-ZT	1.21	1.23	1.22	0.332	0.336	0.334	0.309	0.312	0.310
SEm±	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
B. Organic Nutrient Management									
100% N through FYM	1.20	1.22	1.21	0.331	0.335	0.333	0.298	0.305	0.301
100% N through Vermicompost	1.28	1.30	1.29	0.361	0.365	0.363	0.336	0.342	0.339
50% N FYM + 50% N Vermicompost	1.24	1.26	1.25	0.344	0.348	0.346	0.325	0.331	0.328
75% N FYM + 25% N Vermicompost	1.21	1.23	1.22	0.339	0.343	0.341	0.319	0.326	0.322
SEm±	0.02	0.02	0.02	0.01	0.01	0.00	0.01	0.01	0.00
CD (P=0.05)	0.07	0.07	0.07	0.02	0.02	0.01	0.02	0.02	0.01
CV %	5.85	6.04	5.60	6.59	6.68	3.65	5.67	5.93	3.55
Interaction (A x B)									
SEm±	0.04	0.04	0.04	0.01	0.01	0.01	0.01	0.01	0.01

CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2 NPK content in finger millet straw as influenced by tillage and organic nutrient management in finger millet – french bean cropping system

A. Tillage Practice	N content in Straw (kg/ha)			P content in Straw (kg/ha)			K content in Straw (kg/ha)		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
CT-CT	0.142	0.145	0.143	0.059	0.062	0.060	1.120	1.124	1.122
CT-ZT	0.141	0.144	0.143	0.058	0.061	0.059	1.114	1.119	1.116
ZT-CT	0.138	0.139	0.139	0.057	0.058	0.057	1.098	1.102	1.100
ZT-ZT	0.136	0.133	0.135	0.055	0.056	0.056	1.093	1.097	1.095
SEm±	0.00	0.003	0.002	0.00	0.00	0.00	0.01	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
B. Organic Nutrient Management									
100% N through FYM	0.131	0.132	0.132	0.053	0.055	0.054	1.083	1.086	1.084
100% N through Vermicompost	0.145	0.146	0.146	0.061	0.063	0.062	1.127	1.131	1.129
50% N FYM + 50% N Vermicompost	0.142	0.143	0.143	0.059	0.061	0.060	1.113	1.118	1.115
75% N FYM + 25% N Vermicompost	0.139	0.140	0.139	0.057	0.059	0.058	1.101	1.106	1.104
SEm±	0.00	0.002	0.002	0.00	0.00	0.00	0.01	0.01	0.01
CD (P=0.05)	0.008	0.007	0.007	0.003	0.003	0.003	0.044	0.045	0.044
CV %	5.87	5.40	4.87	6.23	5.92	5.30	4.05	4.11	4.07
Interaction (A x B)									
SEm±	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.02	0.02
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3 N uptake in grain, straw and total uptake of finger millet as influenced by tillage and organic nutrient management in finger millet – french bean cropping system

A. Tillage Practice	N uptake in Grain (kg/ha)			N uptake in Straw (kg/ha)			Total N uptake (kg/ha)		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
CT-CT	29.35	31.54	30.44	5.41	5.74	5.58	34.77	37.27	36.02
CT-ZT	27.41	29.62	28.51	5.31	5.63	5.47	32.72	35.24	33.98
ZT-CT	25.14	27.09	26.12	5.03	5.26	5.15	30.17	32.35	31.26
ZT-ZT	23.34	25.24	24.29	4.71	4.82	4.77	28.05	30.06	29.05
SEm±	0.48	0.81	0.55	0.07	0.10	0.07	0.49	0.80	0.52
CD (P=0.05)	2.00	3.42	2.29	0.28	0.41	0.28	2.04	3.38	2.20
B. Organic Nutrient Management									
100% N through FYM	21.74	23.43	22.58	4.32	4.55	4.43	26.05	27.98	27.02
100% N through Vermicompost	30.30	32.44	31.37	5.56	5.80	5.68	35.87	38.24	37.05

50% N FYM + 50% N Vermicompost	27.29	29.61	28.45	5.43	5.67	5.55	32.72	35.28	34.00
75% N FYM + 25% N Vermicompost	25.91	28.00	26.96	5.17	5.43	5.30	31.08	33.43	32.25
SEm±	0.79	0.90	0.67	0.17	0.17	0.16	0.77	0.90	0.66
CD (P=0.05)	2.66	3.06	2.28	0.56	0.58	0.55	2.60	3.04	2.23
CV %	10.38	11.04	8.54	11.28	11.04	10.84	8.49	9.25	7.01
Interaction (A x B)									
SEm±	1.45	1.77	1.29	0.30	0.31	0.29	1.42	1.76	1.26
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 4 P uptake in grain, straw and total uptake of finger millet as influenced by tillage and organic nutrient management in finger millet – french bean cropping system

A. Tillage Practice	**P uptake in Grain (kg/ha)**			**P uptake in Straw (kg/ha)**			**Total P uptake (kg/ha)**		
	2020	**2021**	**Pooled**	**2020**	**2021**	**Pooled**	**2020**	**2021**	**Pooled**
CT-CT	8.42	8.93	8.68	2.25	2.45	2.35	10.67	11.39	11.03
CT-ZT	7.76	8.34	8.05	2.16	2.30	2.26	9.92	10.71	10.31
ZT-CT	6.95	7.41	7.18	2.07	2.19	2.13	9.02	9.60	9.31
ZT-ZT	6.39	6.88	6.64	1.93	2.03	1.98	8.32	8.92	8.62
SEm±	0.19	0.23	0.14	0.04	0.05	0.04	0.19	0.26	0.20
CD (P=0.05)	0.82	0.95	0.58	0.18	0.20	0.18	0.78	1.11	0.89
B. Organic Nutrient Management									
100% N through FYM	6.03	6.47	6.25	1.73	1.87	1.80	7.76	8.34	8.05
100% N through Vermicompost	8.59	9.068	8.83	2.33	2.50	2.42	10.92	11.57	11.24
50% N FYM + 50% N Vermicompost	7.61	8.21	7.91	2.24	2.40	2.32	9.84	10.61	10.23
75% N FYM + 25% N Vermicompost	7.29	7.83	7.56	2.11	2.27	2.19	9.40	10.10	9.75
SEm±	0.23	0.25	0.17	0.08	0.07	0.07	0.24	0.27	0.19
CD (P=0.05)	0.77	0.84	0.58	0.26	0.23	0.24	0.81	0.91	0.84
CV %	10.73	10.90	7.84	12.92	10.61	11.41	8.72	9.16	8.88
Interaction (A x B)									
SEm±	0.44	0.49	0.33	0.14	0.13	0.13	0.45	0.54	0.47
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 5 K uptake in grain, straw and total uptake of finger millet as influenced by tillage and organic nutrient management in finger millet – french bean cropping system

A. Tillage Practice	**K uptake in Grain (kg/ha)**			**K uptake in Straw (kg/ha)**			**Total K uptake (kg/ha)**		
	2020	**2021**	**Pooled**	**2020**	**2021**	**Pooled**	**2020**	**2021**	**Pooled**
CT-CT	7.77	8.36	8.06	42.71	44.49	43.60	50.48	52.85	51.66

CT-ZT	7.19	7.88	7.54	41.83	43.61	42.72	49.03	51.49	50.26
ZT-CT	6.51	6.94	6.72	39.87	41.61	40.74	46.37	48.5	47.46
ZT-ZT	5.98	6.42	6.20	37.86	39.59	38.72	43.84	46.02	44.93
SEm±	0.18	0.25	0.19	0.60	0.55	0.57	0.55	0.46	0.49
CD (P=0.05)	0.73	1.06	0.81	2.53	2.32	2.40	2.30	1.93	2.07
B. Organic Nutrient Management									
100% N through FYM	5.47	5.88	5.67	35.60	37.29	36.44	41.07	43.17	42.12
100% N through Vermicompost	7.97	8.50	8.24	43.12	44.91	44.02	51.09	53.41	52.25
50% N FYM + 50% N Vermicompost	7.17	7.80	7.48	42.43	44.21	43.32	49.60	52.01	50.80
75% N FYM + 25% N Vermicompost	6.85	7.42	7.13	41.12	42.89	42.00	47.96	50.31	49.14
SEm±	0.21	0.20	0.16	1.33	1.33	1.33	1.32	1.34	1.32
CD (P=0.05)	0.70	0.66	0.53	4.50	4.51	4.50	4.46	4.54	4.47
CV %	10.49	9.15	7.55	11.36	10.92	11.12	9.64	9.36	9.43
Interaction (A x B)									
SEm±	0.40	0.42	0.33	2.38	2.38	2.37	2.35	237	2.34
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 6 Protein, Ca and Fe content of finger millet as influenced by tillage and organic nutrient management in finger millet – french bean cropping system

A. Tillage Practice	**Protein content (%)**			**Ca content (mg/100 g)**			**Fe content (mg/100 g)**		
	2020	**2021**	**Pooled**	**2020**	**2021**	**Pooled**	**2020**	**2021**	**Pooled**
CT-CT	7.84	8.02	7.93	320.71	321.97	321.34	4.27	4.30	4.29
CT-ZT	7.69	7.81	7.75	325.16	326.27	325.71	4.30	4.34	4.32
ZT-CT	7.63	7.76	7.69	330.72	331.91	331.32	4.42	4.48	4.45
ZT-ZT	7.56	7.68	7.62	336.52	337.68	337.10	4.46	4.51	4.49
SEm±	0.06	0.07	0.06	4.03	3.94	3.99	0.06	0.05	0.04
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
B. Organic Nutrient Management									
100% N through FYM	7.47	7.60	7.53	338.56	339.73	339.15	4.48	4.53	4.50
100% N through Vermicompost	7.98	8.15	8.07	318.65	319.84	319.24	4.25	4.29	4.27
50% N FYM + 50% N Vermicompost	7.72	7.85	7.79	324.49	325.76	325.12	4.31	4.35	4.33
75% N FYM + 25% N Vermicompost	7.55	7.67	7.61	331.40	332.51	331.96	4.42	4.47	4.44
SEm±	0.13	0.14	0.13	5.29	5.32	5.31	0.06	0.07	0.04
CD (P=0.05)	0.44	0.46	0.42	NS	NS	NS	NS	NS	NS
CV %	5.85	6.04	5.60	5.58	5.60	5.59	5.03	5.25	3.51
Interaction (A x B)									
SEm±	0.23	0.25	0.22	10.01	10.03	10.02	0.13	0.13	0.09
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS