International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(2): 1984-1992
© 2020 IJCS
Received: 14-01-2020
Accepted: 18-02-2020

Raviraja
Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, Raichur, Karnataka, India

Balanagoudar SR
Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, Raichur, Karnataka, India

Bhat SN
Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, Raichur, Karnataka, India

Ravi MV
Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, Raichur, Karnataka, India

Yadahalli GS
Department of Agronomy, University of Agricultural Sciences, Raichur, Karnataka, India

Corresponding Author:
Raviraja
Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, Raichur, Karnataka, India

Yield and nutrient uptake as influenced by the integrated nutrient management in foxtail millet

Raviraja, Balanagoudar SR, Bhat SN, Ravi MV and Yadahalli GS

DOI: https://doi.org/10.22271/chemi.2020.v8.i2ad.9045

Abstract
A field experiment was conducted at Main Agricultural Research Station, Raichur, during *kharif* 2018-19 to study the integrated nutrient management on Foxtail millet (*Setaria italic* L.) in black soil. The experiment was laid out with eleven treatments replicated three times in randomized block design. Among all the treatments, application of RDF +2.5 t ha^{-1} Vermicompost + Bio-fertilizer + Foliar spray of 19:19:19 at 15, 30 and 45 DAS significantly recorded grain yield and straw yield were significantly recorded (2414 kg ha^{-1} and 6034 kg ha^{-1}) as compared to absolute control and RDF. The treatment also recorded higher higher nitrogen, phosphorus and potassium uptake (36.9, 9.7 and 18.1 kg ha^{-1} in grain, 56.7, 18.1 and 79.1 kg ha^{-1} in straw, respectively). It is concluded that the application of RDF + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar Spray of 19:19:19 at 15, 30 and 45 DAS is the best treatment in rainfed condition to achieve higher yield, nutrient content and nutrient uptake as compared to RDF and absolute control.

Keywords: Nutrient uptake, foxtail millet

Introduction
Foxtail millet grown since time immemorial is predominantly self-pollinated crop belonging to family graminae. Under condition of low input management, it grows well and produces more than pearl millet. Foxtail millet is one of the world's oldest cultivated crops. It is also called as famine reserve and it is extensively grown under low rainfall area. Foxtail millet is the second most widely grown species of millet and the most important food crop in East Asia. In India, foxtail millet is important crop in arid and semi-arid regions. In South India, it has been a staple diet among people for a long time and it is a warm season crop, typically grown in late spring season and harvested for grain in 75-90 days (800-900 kg ha^{-1}). Foxtail millet is commonly known as Navane in Karnataka (Vinall, 1924) [21].

Metals such as Zinc, iron and manganese have vital roles in plant's life cycle and very important for normal growth plants. Zinc is considered as the most limiting factor in producing crops in different parts of the world. Zn is an essential catalytic component of over 300 enzymes, including alkaline phosphatase, alcohol dehydrogenase, Cu-Zn superoxide dismutase, and carbonic anhydrase. Zinc plays an important role in synthesizing proteins, RNA, DNA and precursor of auxin which is essential for cell elongation.

Iron plays an important role in nitrogen fixation and photosynthesis. Synthesis of chlorophyll, thylakoid, and many ferrous proteins is dependent on this element. Iron deficiency in plants is caused by factors that either inhibit its absorption and translocation or impair its utilization in metabolic processes.

In this context, it is worth to mention that nutrient management through organics plays a major role in maintaining soil health due to buildup of soil organic matter, beneficial microbes and enzymes besides improving soil physical and chemical properties. In a farming system approach, the nutrient needs are met out through recycling process to achieve sustained soil fertility and crop productivity. The options available on the farm include use of various organic manures *viz*., FYM, compost, vermicompost, green manures, bio-fertilizers *etc*. Nutrient management aims at efficient and judicious use of all the major sources of plant nutrients in an integrated manner to get maximum economic yield without any deleterious effects on physico-chemical and biological properties of the soil.

Materials and Methods

The experiment was conducted at MARS, Raichur, Karnataka. A composite surface (0-15 cm) soil sample was drawn from the experimental site before initiation of experiment. The soil was air-dried, powdered and passed through 2 mm sieve and was analyzed for physico-chemical properties. The results and analytical techniques employed for their estimation were given in Table 1. The experiment was conducted with eleven treatments having different sources of organics and recommended dose of fertilizer treatments which were randomly allocated in Randomized Complete Block Design (RCBD) with three replications. The treatment details area T_1: Absolute control, T_2: RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}), T_3: FYM @ 6 t ha^{-1}, T_4: Vermicompost @ 2.5 t ha^{-1}, T_5: RPP (RDF+FYM @ 6 t ha^{-1} + Bio-fertilizer), T_6: RPP (RDF+ Vermicompost @ 2.5 t ha^{-1} + Bio-fertilizer), T_7: RDF+ Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS, T_8: FYM @ 6 t ha^{-1}+ Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS, T_9: Vermicompost @ 2.5 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS T_{10}: RPP (RDF+ FYM @ 6 t ha^{-1} + Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at15, 30 and 45 DAS, T_{11}: RPP (RDF+ Vermicompost @ 2.5 t ha^{-1} + Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS.

Note: Recommended Package Of Practices: RDF (30:15:15 kg N, P_2O_5 and K_2O ha^{-1}), FYM @ 6.0 t ha^{-1}, Biofertilizer (*Azospirillum* @ 200 g ha^{-1}) soil application. The good quality seeds of foxtail millet variety (HN-46) were sown with spacing of 30 × 10 cm. Five plants from the net plot area were randomly selected and they were tagged to record the periodical observations at 30, 60 days after sowing and also at the time of harvest.

Plant sample was collected at harvest stage from each plot and uptake of micro-nutrients was estimated. Nitrogen was determined by Kjeldahl's digestion distillation method. Plant samples (0.5 g) were digested in digestion flasks using sulphuric acid and the digestion mixture (K_2SO_4 + $CuSO_4$ + Se in the ratio of 100:20:1). After complete digestion, the digested materials were distilled in alkaline medium and the liberated ammonia was trapped in four per cent boric acid solution containing mixed indicator. The trapped ammonia was titrated against standard sulphuric acid (Piper, 1966). Phosphorus in the plant sample digest was estimated by vanadomolybdo phosphoric yellow colour method in nitric acid medium and the colour intensity was measured at 430 nm wave length as outlined by Piper (1966). Potassium in the plant sample digest was estimated by atomizing the diluted acid extract to a flame photometer as described by Piper (1966). The content of Zn, Fe were estimated by using Atomic Absorption Spectrophotometer (AAS) as explained by Jackson (1973). The digested material was directly fed to Atomic Absorption Spectrophotometer (AAS) with suitable dilutions wherever necessary and concentration of these elements was recorded in mg kg^{-1}. Uptake (Kg ha^{-1}) was calculated by multiplying its per cent concentration with seed, Stover yield respectively.

Results and Discussion

Grain yield

There was a significant difference in the grain yield, stover yield and Harvest index of foxtail millet due to different treatment combination and the results are shown in the Table 2 and Fig. 1.

Application of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}) recorded significantly higher grain yield (2414 kg ha^{-1}) and it was on par with treatments T_{10} where RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (2252 kg ha^{-1}). However, lower grain yield (853 kg ha^{-1}) was obtained in (T_1) absolute control treatment.

Higher grain yield was noticed with application of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (2414 kg ha^{-1}). It might be due to the adequate amount of nutrients availability both macro and micro nutrient results from treatment effect which enhanced the crop growth. The increased availability of N, P, K, Zn, Cu, Mn and Fe as well as the synergistic effect between organic and inorganic forms of nutrients and formation of stable complexes with humic substances supplied through poultry manure in rice crop (Dosani *et al.*, 1999) [8] in groundnut crop and Balaji and Yakadri 2004) [5]. The combined application of organic and inorganic sources provided greater availability of nutrients for the development of vegetative structures and increased the number of grain, grain weight and resulted in higher grain yield (Uddin *et al*., 2008) [22].

Stover yield

Significantly higher Stover yield was recorded in the treatment which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (6034 kg ha^{-1}). However, it was on par with treatment which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{10}) (5775 kg ha^{-1}). Significantly lower straw yield (2230 kg ha^{-1}) was obtained in absolute control (T_1).

Higher the Stover yield was recorded with application of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (6034 kg ha^{-1}). This was mainly because of increasing in the levels and source of nutrients with organic manures significantly increased the straw yield of hybrid rice which might due to the integrated effect of N, P and K levels and different sources of organic manures on N, P and K availability and their uptake as well as grain and straw yield of hybrid rice. The supply of inorganic and organic manures increased the grain and straw yield of hybrid rice. The addition of organic manure might influence N, P and K availability by maintaining good physical condition of soil for plant growth and yield. The increase in straw yield of hybrid rice with combined application of fertilizer and manure was reported by Rahman *et al.* (2005), Gupta *et al.* (2006) [9] and Bajpai *et al.* (2006) [4].

Nitrogen content in grain and stover

The data on nitrogen content in the grain of foxtail millet at harvest was significantly influenced due to different treatment combination the results were shown in the Table 3 and Fig. 2.

Significantly higher nitrogen concentration in the grain (1.53%) was the recorded in treatment T_{11} with RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. It was on par with treatment T_{10} which received of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45

DAS (1.49%) and by T_9 (1.44%) and T_5 (1.38%). However, lower nitrogen concentration in grain (1.18%) was recorded in T_1 treatment (control).

Significantly higher nitrogen concentration in the Stover (0.94%) recorded with treatment T_{11} with RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio- fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. It was on par with treatment T_{10} which received of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (0.91%), T_6 (0.89%), and T_6 (0.75%). However, lower nitrogen concentration (0.43%) was recorded in T_1 treatment (control).

Significantly higher nitrogen concentration and total nitrogen concentration (grain and Stover) was recorded in the treatment RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. Due to increased nitrogen concentration in the treatments which received higher level of nutrients through inorganic and organics was due to increased N availability in soil as a result of increasing levels of NPK application along with organic manures like FYM and Vermicompost. Application of organic manure as a source of N increased the availability of N in soil as a result of faster mineralization of N from green manure as compared to other organic manures. This might be due to increased N content in grain and stover of foxtail millet at harvest. Similar findings were reported by Singh *et al.* (2006) [18], Shriram Patil (2014) [17], Murali and Setty (2001) [13] and Sunitha *et al*. (2010) [20] in rice crop. Higher availability of nutrients and their supply to the roots might have helped in nutrient absorption and mobilisation.

Phosphorus content in grain and stover

The data pertaining to the application of different organic manures in combination with inorganic fertilizers influenced the phosphorus concentration in grain and stover at harvest of foxtail millet presented in Table 3 and Fig. 2.

Significantly higher phosphorus concentration in grain (0.40%) was recorded in treatment T_{11} with RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio- fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. It was on par with treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio- fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (0.38%), T_6 (0.37%), T_9 (0.37%), T_8 (0.35%), and T_5 (0.32%). However, lower phosphorus concentration in grain (0.27%) was recorded in T_1 treatment (control).

Significantly higher phosphorus concentration in stover (0.30%) was recorded in treatment T_{11} with RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio- fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. It was on par with treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio- fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (0.30%), T_6 (0.29%), T_9 (0.29%), T_8 (0.26%), and T_5 (0.26%). However, lower phosphorus concentration in stover (0.23%) was recorded in T_1 treatment (control).

Significantly higher phosphorus concentration and total phosphorus concentration (grain and stover) recorded with the RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. Due to sufficient supply of phosphorus through both organic and inorganic manure which proliferates root vigorously and resulting in higher phosphorus absorption. Vermicompost also helped in mobilization of phosphorus there by increasing the concentration of phosphorus in grain and straw of foxtail millet. The similar finding was reported by Murthy *et al.* (2015) [14] and Walia *et al.* (2010) [24] in wheat crop.

Table 1: Concentration of N, P and K by grain and stover of foxtail millet in different nutrient management practices at harvest stages.

Treatment	Nutrient concentration (%)					
	N		P		K	
	Grain	Stover	Grain	Stover	Grain	Stover
T_1: Absolute control	1.18	0.43	0.27	0.23	0.55	1.19
T_2: RDF (30:15:15 kg ha^{-1})	1.25	0.54	0.30	0.25	0.64	1.33
T_3: FYM 6 t ha^{-1}	1.20	0.50	0.26	0.24	0.6	1.28
T_4: Vermicompost 2.5 t ha^{-1}	1.22	0.52	0.27	0.24	0.62	1.3
T_5: RPP (RDF+ 6 t ha^{-1} FYM + Bio-fertilizer)	1.38	0.66	0.32	0.26	0.70	1.41
T_6: RPP (RDF + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer)	1.46	0.89	0.37	0.29	0.73	1.45
T_7: RDF+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	1.33	0.62	0.29	0.25	0.67	1.38
T_8: FYM 6 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS 1	1.36	0.64	0.35	0.26	0.69	1.4
T_9: Vermicompost 2.5 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	1.44	0.75	0.37	0.29	0.72	1.46
T_{10}: RPP (RDF+ 6 t ha^{-1} FYM+ Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	1.49	0.91	0.38	0.30	0.74	1.43
T_{11}: RPP (RDF+ 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	1.53	0.94	0.40	0.30	0.75	1.48
S.Em ±	0.05	0.06	0.12	0.01	0.03	0.02
CD at 5%	0.15	0.18	0.34	0.04	0.08	0.05

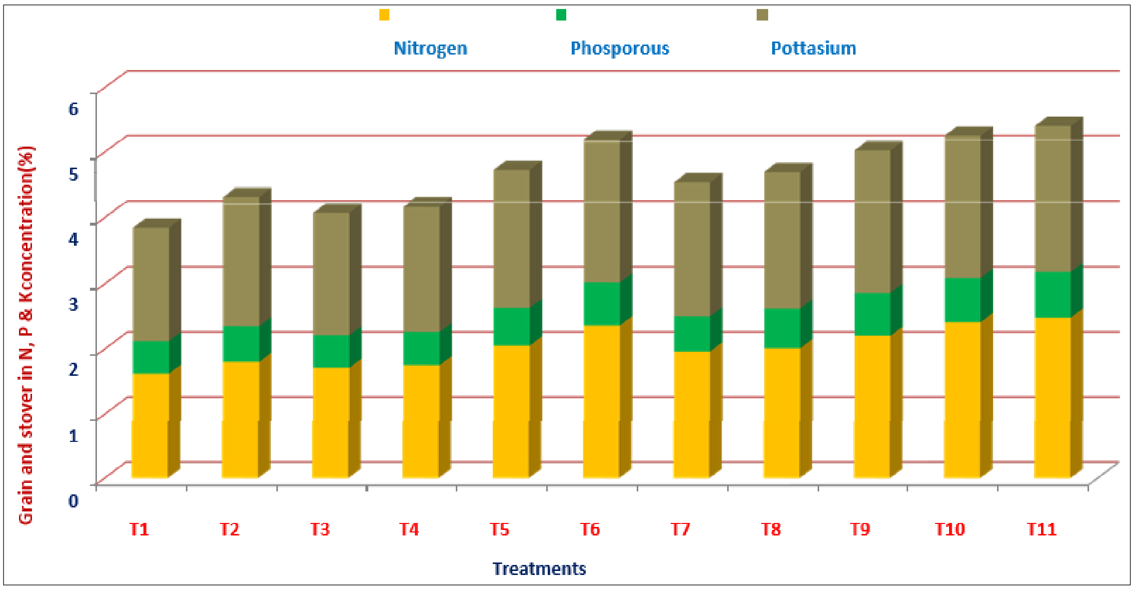

Fig 1: Grain and stover in nitrogen, phosphorous and potassium concentration (%) in foxtail millet by nutrient management practices

Potassium content in grain and stover

The application of different organic manures in combination with inorganic fertilizers influenced the potassium concentration in grain and stover at harvest of foxtail millet and the results are presented in Table 1 and Fig. 2.

Significantly higher potassium concentration in grain (0.75%) was the recorded in treatment T_{11} receiving RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. It was on par with treatment T_{10} which received of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer) + Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (0.74%), T_6 (0.73%), T_9 (0.72%), T_8 (0.69%), and T_5 (0.62%). However, lower potassium concentration in grain (0.55%) was recorded in T_1 control treatment.

Significantly higher potassium concentration in stover (1.48%) was the recorded in treatment T_{11} receiving RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. It was on par with treatment T_{10} which received of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (1.43%), T_6 (1.45%), T_9 (1.46%), T_8 (1.41%), and T_5 (1.40%). However, lower potassium concentration in stover (0.55%) was recorded in T_1 control treatment.

The increase the K concentration in grain and straw might be due to application of nutrients through organic and inorganic fertilizers which increased the availability of K in soil, hence increasing the K content. The application of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS produced the maximum K concentration in grain and straw of foxtail millet. This might be due to increased availability of K in soil as a result of mineralization of vermicompost which resulted in higher K concentration as compared to FYM. These findings were supported by Shriram Patil (2014) [17] and Soni and Sikarawar (1989) [19] in rice crop

Micronutrients content in grain and stover

The data pertaining to concentration of iron, manganese, zinc and copper in the grain and stover of foxtail millet differed significantly due to application of different

Table 2: Concentration Iron and Zinc of by grain and stover of foxtail millet nutrient management practices at harvest stage.

Treatment	Nutrient concentration (mg kg^{-1})			
	Iron		Zinc	
	Grain	Stover	Grain	Stover
T_1: Absolute control	78.20	91.70	21.70	16.50
T_2: RDF(30:15:15 kg ha^{-1})	90.0	102.20	24.80	21.50
T_3: FYM 6 t ha^{-1}	82.20	95.10	21.50	18.700
T_4: Vermicompost 2.5 t ha^{-1}	84.90	98.87	23.00	20.00
T_5: RPP (RDF+ 6 t ha^{-1} FYM + Bio-fertilizer)	99.20	111.30	27.80	22.40
T_6: RPP (RDF+ 2.5 t ha^{-1} Vermicompost + Bio-fertilizer)	104.20	115.10	30.60	24.60
T_7: RDF+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	94.50	106.89	27.10	21.10
T_8: FYM 6 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS [1]	97.70	109.03	27.60	21.90
T_9: Vermicompost 2.5 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	103.1	113.06	28.40	22.90
T_{10}: RPP (RDF+ 6 t ha^{-1} FYM+ Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	108.2	112.80	30.30	24.10
T_{11}: RPP (RDF+ 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	112.69	117.25	31.10	25.40
S.Em ±	2.08	2.26	0.42	0.39
CD at 5%	6.24	6.78	1.26	1.16

Table 3: Uptake of Copper and Manganese by grain and stover of foxtail millet in different nutrient management practices

Treatment	Nutrient concentration ($mg\ kg^{-1}$)			
	Copper		Manganese	
	Grain	Stover	Grain	Stover
T_1: Absolute control	3.16	4.6	12.6	11.8
T_2: RDF(30:15:15 kg ha^{-1})	5.5	4.8	14.8	16.4
T_3: FYM 6 t ha^{-1}	4.7	7.7	14.4	15.3
T_4: Vermicompost 2.5 t ha^{-1}	5.6	8.6	13.2	17.1
T_5: RPP (RDF+ 6 t ha^{-1} FYM + Bio-fertilizer)	5.3	6.7	15.4	14.6
T_6: RPP (RDF+ 2.5 t ha^{-1} Vermicompost + Bio-fertilizer)	6.4	8.6	20.02	15.9
T_7: RDF+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	6.1	9.2	17.5	15.92
T_8: FYM 6 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS [1]	5.5	9.8	18.05	16.12
T_9: Vermicompost 2.5 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	7.4	8.9	19.4	16.8
T_{10}: RPP (RDF+ 6 t ha^{-1} FYM+ Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	5.9	10.3	22.4	17.2
T_{11}: RPP (RDF+ 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	6.2	11.0	21.9	17.8
S.Em ±	0.14	0.28	0.26	0.23
CD at 5%	0.43	0.83	0.78	0.68

organic manures in combination with inorganic fertilizers. The results are presented in Table 2 and 3.

Significantly higher concentration of iron in grain and stover of foxtail millet was recorded in T_{11} with RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (112.69 and 117.25mg kg^{-1} respectively).But it was on par with the treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS in grain (108.2 mg kg^{-1}). But on par with stover in T_6: RPP (RDF + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) (115.1 mg kg^{-1}). However, lower iron concentration in grain and stover (78.2, and 91.7 mg kg^{-1} respectively) was recorded in (T_1) as absolute control.

Significantly higher concentration of zinc in grain and stover of foxtail millet was recorded in T_{11}: RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio- fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (31.1 and 24.6 mg kg^{-1} respectively). It was on par with the treatment T_6: RPP (RDF + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) (30.6 and 24.6 mg kg^{-1}). However, lower zinc concentration in grain and stover (21.7 and 16.5 mg kg^{-1} respectively) was recorded in (T_1) as absolute control.

Significantly higher concentration of manganese in grain and stover of foxtail millet was recorded in T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (22.4 and 17.8 mg kg^{-1}). It was on par with the treatment T_{11}: RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (21.9 and 17.2 mg kg^{-1}) as compared to absolute control (T_1).

Significantly higher concentration of copper in grain and stover of foxtail millet was recorded in T_{11}: RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (7.4 and 11.0 mg kg^{-1}) as compared to absolute control (T_1) (3.16 and 4.6 mg kg^{-1}).

The micronutrient concentration was higher in treatment RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS which may be attributed to more favourable conditions developed either through an increase in solubility of nutrients with in soil solution through added organic manure or possible stimulation of root for absorption (Antil *et al*., 1989) [2] in paddy crop. The increase in concentration might be due to effect of natural chelating agents released from the organic manure that helped in keeping micronutrient in soluble state to be more available for plants. The results are in accordance with the findings of Ramsakal (2001) [16].

Nutrient uptake of foxtail millet

Nitrogen uptake by grain, stover and total nitrogen uptake

The data on nitrogen uptake by grain, stover, and total nitrogen uptake by foxtail millet at harvest as influenced by nutrient management practices are presented in Table 4.

Significantly higher nitrogen uptake by grain was recorded with T_{11} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (36.90 kg ha^{-1}) as compared to all other treatments. However, significantly lower uptake of nitrogen was obtained with (10.10 kg ha^{-1}) in the treatment T_1 absolute control.

Application of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}) was recorded significantly higher nitrogen uptake by stover (56.70 kg ha^{-1}). It was on par with the treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio- fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (52.60 kg ha^{-1}). However, significantly lower nitrogen uptake by stover was noticed in the treatment T_1 as absolute control (9.60 kg ha^{-1}).

Significantly higher total uptake of nitrogen with (93.7 kg ha^{-1}) was recorded due to RPP (RDF + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}). It was on par with the treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (86.10 kg ha^{-1}). However, significantly lower nitrogen uptake by foxtail millet was recorded in the treatment T_1 as absolute control (19.7 kg ha^{-1}).

The uptake of nitrogen by foxtail millet was significantly higher with RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS which might be due to supply of adequate quantity of N through inorganics and mineralization of the nitrogen added through organic manure by soil organisms which facilitated nitrogen transformation and increased release of nitrogen throughout the crop growth and thus contributed to higher concentration and uptake of nitrogen in foxtail millet. Similar results were findings are reported by Laxminarayana (2006) [12] in rice, Singh *et al*.

(2006) [18] in rice, Gupta *et al*. (2006) [9] in wheat, Yadav *et al*. (2011) [23] in rice and Sunitha *et al*. (2010) [20] in finger millet crop. This is mainly because higher uptake of nitrogen was due to favourable influence of nitrogen on higher degree of vegetative growth which in turn absorb higher amount of nutrients from the rhizosphere and supply to the crop resulting in higher dry matter production. This may be due to increase in the availability of nutrients to the crop from added organic manure manures.

Phosphorus uptake by grain, stover and total phosphorus uptake

The data on phosphorus uptake by grain, stover, and total phosphorus uptake by foxtail millet at harvest as influenced by nutrient management practices are presented in Table 4.

Significantly higher phosphorus uptake by grain was recorded in the treatment T_9 which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio- fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (9.7 kg ha^{-1}). It was on par with T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio- fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (8.60 kg ha^{-1}). However, significantly lower uptake by grain was noticed in treatment T_1 as absolute control (2.30 kg ha^{-1}).

Significantly higher phosphorus uptake by stover was recorded in the treatment (18.1 kg ha^{-1}) T_{11} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. It was on par with the treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1})
+ 6 t ha^{-1} FYM + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (17.30 kg ha^{-1}), T_6 which received RPP (RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1}

Table 4: Uptake of N, P and K by grain and stover of foxtail millet in different nutrient management practices at harvest stage.

Treatment	Nutrient uptake (kg ha^{-1})								
	Nitrogen			Phosphorous			Potassium		
	Grain	Stover	Total	Grain	Stover	Total	Grain	Stover	Total
T_1	10.1	9.6	19.7	2.3	5.1	7.4	4.7	27.5	31.2
T_2	18.1	19.1	37.2	4.3	8.8	13.2	9.3	43.2	56.3
T_3	15.4	13.0	28.4	3.3	6.2	9.6	7.7	38.1	40.9
T_4	16.4	18.0	34.5	3.6	8.3	12.0	8.4	40.1	53.5
T_5	25.6	29.9	55.5	5.9	11.8	17.7	13.0	60.1	76.8
T_6	29.6	48.6	78.1	7.5	15.8	23.3	14.8	66.9	93.9
T_7	21.2	22.7	44.0	4.6	9.2	13.8	10.7	47.9	61.3
T_8	22.8	27.3	50.1	5.9	11.1	16.3	11.6	52.2	71.2
T_9	26.5	35.2	61.6	6.6	13.6	18.6	13.2	68.5	82.1
T10	33.6	52.6	86.1	8.6	17.3	25.9	16.7	73.7	98.8
T11	36.9	56.7	93.7	9.7	18.1	27.8	18.1	79.1	107.4
S.Em ±	1.17	1.65	2.94	0.53	0.43	1.86	0.66	2.12	3.63
CD at 5%	3.44	4.80	8.48	1.53	1.25	5.36	1.92	6.17	10.44

T_1: Absolute control, T_2: RDF(30:15:15 kg ha^{-1}) T_3: FYM 6 t ha^{-1}, T_4: Vermicompost 2.5 t ha^{-1} T_5: RPP (RDF+ 6 t ha-1 FYM + Bio-fertilizer) T_6: RPP (RDF+ 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) T_7: RDF+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS T8: FYM 6 t ha^{-1} + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS T_9: Vermicompost 2.5 t ha^{-1} + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS T_{10}: RPP (RDF+ 6 t ha^{-1} FYM+ Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS T_{11}: RPP (RDF+ 2.5 t ha-1 Vermicompost + Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS

Vermicompost + Bio-fertilizer) (4.83kg ha^{-1}). However, significantly lower uptake of phosphorus by stover (5.10 kg ha^{-1}) was observed in absolute control (T_1).

Significantly higher total uptake of phosphorus (27.8 kg ha^{-1}) was recorded with treatment T_{11} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. It was on par with the treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1})
+ 6 t ha^{-1} FYM + Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (25.90 kg ha^{-1}), T_6 which received RPP (RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) 4.83kg ha^{-1}. However, significantly lower total uptake of phosphorus by stover (7.40 kg ha^{-1}) was observed in treatment T_1 (absolute control).

Significantly higher total phosphorus uptake recorded with application of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}) which could be attributed to conversion of fixed and insoluble phosphorus into readily available form by organic acids released during decomposition of green manure and consequent improvement in available P in soil. This might be due to the increased phosphorus uptake by grain and straw was mainly due to increased grain and concentration of the nutrients, which has also been observed by Chetandas (2014) [6]. The application of vermicompost also decreased the adsorption capacity and increased the soluble P and P desorption in soil and this lends support to the higher uptake of P reported by Abebe and morkel (2009).

Potassium uptake by grain, stover and total potassium uptake

The data on uptake of potassium by foxtail millet grain, straw and total uptake as influenced by the application of organic manures in combination with and inorganic fertilizers are presented in Table 4.

Significantly higher potassium uptake by grain was recorded in the treatment T_{11} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio- fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (18.1 kg ha^{-1}) compared to all other treatments. However, significantly lower uptake of (4.70 kg ha^{-1}) was recorded in the treatment T_1 as absolute control.

Application of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}) was recorded significantly higher potassium uptake by stover (79.1 kg ha^{-1}). It was on par with the treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio- fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (73.7 kg ha^{-1}). However, significantly lower potassium uptake by stover was obtained in the treatment T_1 as absolute control (27.50 kg ha^{-1}).

Significantly higher total uptake of potassium (107.4 kg ha^{-1}) was recorded due to RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}). It was on par with the treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (98.80 kg ha^{-1}). However, significantly lower potassium uptake by foxtail millet was recorded in the treatment T_1 as absolute control (31.20 kg ha^{-1}).

Significantly higher potassium uptake by foxtail millet in grain, straw and total uptake was recorded in treatment which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS. It might be attributed to the treatment that sufficiently supplied the nutrient requirement of the crop and increased the efficiency of applied NPK fertilizers thereby, increased the concentration of potassium in foxtail millet grain and straw. Higher uptake of potassium by foxtail millet grain and straw might be due to higher biomass production as influenced by addition of organic manures. The present results are in agreement with the findings by who reported higher N, P and K uptake by foxtail millet with organic manure application over no fertilizer and inorganic fertilizers application (Ashwini *et al*., 2015 and Hossain *et al*., 2010) [3, 10].

Uptake of Iron, Manganese, Zinc and copper in grain and stover

The data pertaining to the uptake of iron, manganese, zinc and copper by foxtail millet grain, stover and total uptake differed significantly due to application different nutrient management practices are presented in the Table 5, 6 and Fig. 2.

Significantly higher uptake of iron in grain, stover and total uptake (272.0, 707.5 and 979.5 g ha^{-1}, respectively) was recorded in the treatment where RDF (30:15:15 kg

Table 5: Uptake of Iron and Zinc by grain and stover of foxtail millet in different nutrient management practices at harvest stage.

Treatment	Nutrient Uptake (g ha^{1})					
	Iron			Zinc		
	Grain	Stover	Total	Grain	Stover	Total
T_1: Absolute control	66.7	204.5	271.2	18.5	36.9	55.4
T_2: RDF(30:15:15 kg ha^{-1})	130.3	361.2	491.5	35.8	75.9	111.8
T_3: FYM 6 t ha^{-1}	105.6	246.3	351.9	27.6	48.3	76.0
T_4: Vermicompost 2.5 t ha^{-1}	114.4	343.0	457.4	31.0	69.2	100.2
T_5: RPP (RDF+ 6 t ha^{-1} FYM + Bio-fertilizer)	183.8	504.2	688.0	51.5	101.5	153.0
T_6: RPP (RDF+ 2.5 t ha^{-1} Vermicompost + Bio-fertilizer)	210.9	628.2	839.1	62.0	134.3	196.3
T_7: RDF+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	150.7	392.1	542.8	43.2	77.4	120.7
T_8: FYM 6 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS [1]	164.0	464.6	628.6	46.3	93.2	139.6
T_9: Vermicompost 2.5 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	189.5	530.4	719.8	52.2	107.4	159.6
T_{10}: RPP (RDF+ 6 t ha^{-1} FYM+ Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	243.7	651.4	895.1	68.2	139.1	207.3
T_{11}: RPP (RDF+ 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	272.0	707.5	979.5	75.1	153.0	228.0
S.Em ±	20.58	25.18	14.73	2.55	4.64	7.32
CD at 5%	59.27	72.54	44.17	7.63	13.92	21.95

Table 6: Concentration Copper and manganese by grain and stover of foxtail millet nutrient management practices at harvest stage.

Treatment	Nutrient uptake (g kg^{-1})					
	Copper			Manganese		
	Grain	Stover	Total	Grain	Stover	Total
T_1: Absolute control	2.7	10.2	12.9	10.7	26.3	37.1
T_2: RDF(30:15:15 kg ha^{-1})	8.0	17.0	24.9	21.4	58.0	79.4
T_3: FYM 6 t ha^{-1}	6.0	20.0	26.1	18.5	39.6	58.1
T_4: Vermicompost 2.5 t ha^{-1}	7.5	29.9	37.5	17.8	59.3	77.1
T_5: RPP (RDF+ 6 t ha^{-1} FYM + Bio-fertilizer)	9.8	30.4	40.2	28.5	66.1	94.7
T_6: RPP (RDF+ 2.5 t ha^{-1} Vermicompost + Bio-fertilizer)	13.0	46.9	59.9	40.5	86.8	127.3
T_7: RDF+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	9.7	33.7	43.5	27.9	58.4	86.3
T_8: FYM 6 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS [1]	9.2	41.8	51.0	30.3	68.7	99.0
T_9: Vermicompost 2.5 t ha^{-1}+ Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	13.6	41.7	55.4	35.7	78.8	114.5
T_{10}: RPP (RDF+ 6 t ha^{-1} FYM+ Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	13.3	59.5	72.8	50.4	99.3	149.8
T_{11}: RPP (RDF+ 2.5 t ha^{-1} Vermicompost + Bio-fertilizer) + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS	15.0	65.5	80.5	52.9	107.4	160.3
S.Em ±	0.54	2.26	2.58	1.16	3.30	6.63
CD at 5%	1.64	6.78	7.73	3.49	9.90	19.09

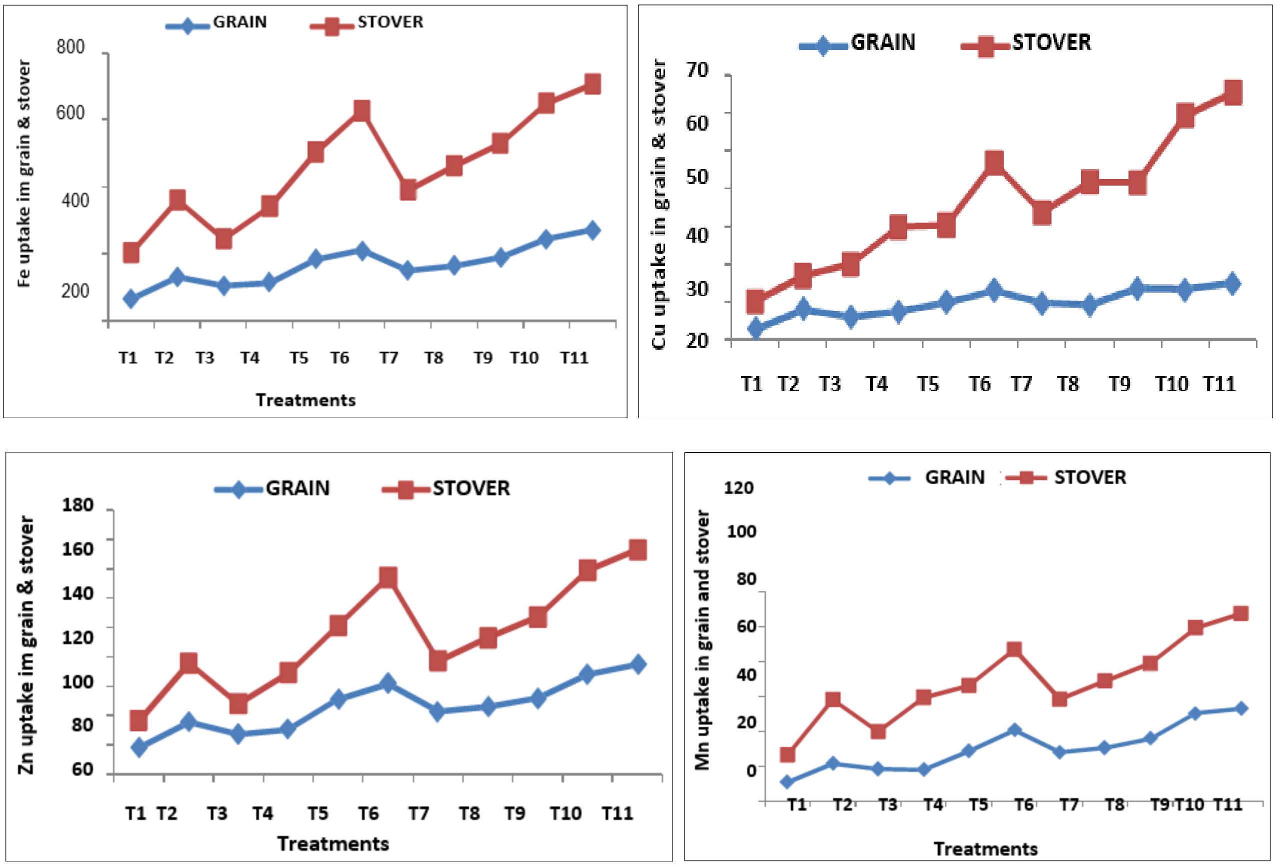

Fig 2: Total uptake (mg kg^{-1}) of micronutrients of foxtail millet by nutrient management practices.

$N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}). It was on par with the treatment T_{10}: RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS grain (243.7, 651.4 and 895.1 g ha^{-1}, respectively) as compared to absolute control (T_1).

Significantly higher uptake of zinc in grain, stover and total uptake (75.1. 153.0 and 228.0 g ha^{-1}, respectively) was recorded in the treatment where RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}). It was on par with the treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS grain (68.2, 139.1 and 207.3 g ha^{-1}, respectively) as compared to absolute control (18.5, 36.9 and 55.4 g ha^{-1}, respectively) (T_1).

Significantly higher uptake of manganese in grain, stover and total uptake (52.9, 107.4 and 160.3 g ha^{-1}, respectively) was recorded in the treatment RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}). It was on par with the treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS grain (50.4, 99.3 and 149.8 g ha^{-1}, respectively) as compared to absolute control (T_1).

Significantly higher uptake of copper in grain, stover and total uptake (15.0, 65.5 and 80.5 g ha^{-1}, respectively) was recorded in the treatment where RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}). It was on par with the treatment T_{10} which received RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 6 t ha^{-1} FYM + Bio-fertilizer + Foliar Spray of 19:19:19 @ 1% at 15, 30 and 45 DAS grain (13.6, 59.5 and 72.8 g ha^{-1}, respectively) as compared to absolute control (T_1).

Increased micronutrient uptake by foxtail millet was with application of RDF (30:15:15 kg $N:P_2O_5:K_2O$ ha^{-1}) + 2.5 t ha^{-1} Vermicompost + Bio-fertilizer + Foliar spray of 19:19:19 @ 1% at 15, 30 and 45 DAS (T_{11}) which could be attributed to production of natural chelating agents from the organic materials which helped in keeping micronutrients in soluble and more available forms for plants. Similar results are also represented by Antil *et al.* (1989) [2]; Ramsakal (2001) [16] and Chitdeshwari and Krishnaswamy (1998) [7].

Conclusion

Low cost technology like organic sources of nutrients and use of Foliar sprays of NPK can help in augmenting yield and quality of produce. The Foliar sprays of 19:19:19 @ 1% at 15, 30 and 45 DAS increased yield to the upto 20.10%.,This study on effect of nutrient management in Foxtail millet is useful for deciding the suitable combination of nutrient sources for sustainable production and profitability.

References

1. Abebe WW, Merkuz AA. Effects of integrated nutrient management on rice (*Oryza sativa* L.) yield and yield attributes nutrient uptake and some physico-chemical properties of soil. J Biol. Agri. Healthcare. 2016; 6(5):20-26.
2. Antil RS, Dahia SS, Bhandari DK. Effect of zinc and manganese application on dry matter yield and uptake of nutrients in paddy (*Oryza sativa* L.) under upland and lowland conditions. Haryana J Agric. Univ. Res. 1989; 3:197-204.
3. Ashwini M, Umesha C, Sridhara CJ. Effect of enriched FYM and fertilizer levels on growth and yield

components of aerobic foxtail millet (*Foxtail millet*). Trends in Biosci. 2015; 8(10):2479-2486.
4. Bajpai RK, Chitale S, Upadhyay SK, Urkurkar JS. The long term studies on soil physico-chemical properties and productivity of rice-wheat system as influenced by integrated nutrient management in *Inceptisol* of Chhattisgarh. J Indian Soc. Soil Sci. 2006; 54:24-29.
5. Balaji NB, Yakadri M. Effect of integrated nutrient management on yield of hybrid rice (*Oryza sativa* L.). J Res. 2004; 32(2):85- 89.
6. Chetandas K. Nitrogen release pattern in *vertisol* as influenced by green manure and farmyard manure application in rice (*Oryza sativa* L.). M.Sc. (Agri.) Thesis, IGKV, Univ. Agric. Sci., Raipur, 2014.
7. Chitdeshwari T, Krishnaswamy R. Effect of zinc and zinc enriched organic manures on the availability of micro nutrient status in rice soils. Adv. Pl. Sci., 1998; 111(2):211-219.
8. Dosani AK, Talashilkar SC, Mehta VB. Effect of poultry manure applied in combination with fertilizers on the yield, quality and nutrient uptake of groundnut. J Indian Soc. Soil Sci. 1999; 47(1):166-169.
9. Gupta V, Sharma RS, Vishvakarma SK. Long-term effect of integrated nutrient management on yield sustainability and soil fertility of rice (*Oryza sativa* L.) and wheat (*Triticum aestivum L.*) cropping system. Indian J Agron. 2006; 51(12):160-164.
10. Hossain MF, Bhuiya MU, Ahmed M, Mian MH. Effect of organic and inorganic fertilizer on the milling and physico-chemical properties of aromatic rice (*Oryza sativa*). Thailand J Agric. Sci. 2010; 42(2):213-218.
11. Jackson ML. Soil Chemical Analysis, Prentice Hall of India (Pvt.) Ltd., New Delhi, 1973, 498.
12. Laxminarayana K. Effect of integrated use of inorganic and organic manures on oil properties, yield and nutrient uptake of rice in *Ultisols* of Mizoram. J Indian Soc. Soil Sci. 2006; 54:120-123.
13. Murali MK, Satty RA. Growth, yield and nutrient uptake of scented rice (*Oryza sativa* L.) as influenced by levels of NPK, vermicompost and triacontanol Karnataka J Agric. Sci. 2001; 35(1):1-4.
14. Murthy KMD, Rao AU, Vijay D, Sridhar TV. Effect of levels of nitrogen, phosphorus and potassium on performance of rice. Indian J Agril. Res. 2015; 49(1):83-87.
15. Rahman MA, Chikushi J, Saifizzaman M, Lauren JG. Rice straw mulching and nitrogen response of no-till wheat following rice in Bangladesh. Field Crops Res. 2007; 91(1):71-81.
16. Ramsakal. Efficient management of micronutrients for sustainable crop production. J Indian Soc. Soil Sci. 2001; 49(4):593- 608.
17. Shriram Patil. Integration of nutrient inputs in rice yield, nutrient uptake and availability in a *vertisol*. M.Sc.(Agri) Thesis, JNKV Agric. Univ., Jabalpur, 2014.
18. Singh Surendra, Singh RN, Singh JP. Effect of integrated nutrient management on yield and uptake of nutrients by rice and soil fertility in rain fed uplands. J Indian Soc. Soil Sci. 2006; 54(3):327-330.
19. Soni PN, Sikarawar HS. Nitrogen application with farm yard manure in rice wheat sequence. Indian J Agro. 1989; 28:393-396.
20. Sunitha BP, Prakasha HC, Gurumurthy KT. Influence of organics, inorganics and their combinations on availability, content and uptake of secondary nutrients by rice crop (*Oryza sativa* L.) in Bhadra Command, Karnataka. Mysore J Agric. Sci. 2010; 44(3):509-516.
21. Vinall HN. Foxtail millet its culture and utilization in the united state. USDA Farmer Bulletin, 1924, 793.
22. Uddin ML, Thembinkosi M, Christopher MP, Gabatshele M. The growth and development of two pearl millet landraces as affected by organic manure application. Int. Curr. Microbiol. App. Sci. 2008; 3(9):505-515.
23. Yadav SK, Panvar NR, Ramana S. Effect of organic nitrogen on yield and nutrient composition of rice (*Oryza sativa* L.). Indian J Plant Physiol. 2011; 15(1):77-79.
24. Walia MK, Walia SS, Dhaliwal SS. Long-term effect of integrated nutrient management of properties of typic ustochrept after twentythree cycles of an irrigated rice (*Oryza sativa* L.)-wheat (*Triticum aestivum* L.) system. J Sustain. Agric. 2010; 34(7):724-774.