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Changes in soil micronutrient status by different nutrient management and seed priming and its effect on yield and micronutrient uptake of finger millet (*Eleusine coracana*)

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Abstract
A field experiment was conducted in the experimental plots of DKS farm, IGKV, Bhatapara Dist- Baloda Bazaar, Chhattisgarh during *kharif* season of the year 2019. The soil of the experimental field was alfisol and climate was sub-humid with a total rainfall of 872.2 mm during the crop growth. The objectives of experiment were to the study changes in soil micronutrient status and its uptake by different nutrient management and seed priming and its effect on yield of finger millet (*Eleusine coracana*). The experiment was laid out in split-plot design. The treatments constituted with five nutrient management N1 (control), N2 (125 kg Neem cake + 1.25 tons/ha vermicompost), N3 (50"kg/ha N : 50 kg/ha P_2O_5 : 50 kg /ha K_2O"and 2% Borax spray at flowering), N4 (125 kg Neem cake + 1.25 tons/ha vermicompost + 50 kg/ha N : 50 kg/ha P_2O_5 : 50 kg /ha K_2O and 2% Borax spray at flowering) and N5 (Recommended "dose of fertilizer i.e. 20 kg/ha N": 20 kg/ha P_2O_5 : 10 kg /ha K_2O) in main plots with four priming treatment P1 (control), P2 (Hydro priming for 6 hrs), P3 (Seed priming with 2% KH_2PO_4 for 6 hrs) and P4 (Seed priming with 20% liquid *Pseudomonas fluorescens*) in sub plots. Results revealed that available cationic micronutrients in soil increased significantly and found higher where either higher doses of chemical fertilizers or the chemical fertilizers in combination with organic manures were applied. The grain, straw and ultimately the biological yields were found higher where either higher doses of chemical fertilizers or the chemical fertilizers in combination with organic manures were applied however, the priming treatments did not influenced the yield significantly. The content of cationic micronutrient namely Fe, Mn, Cu, Zn in plant tissue was not affected by any nutrient management and seed priming treatments however the uptake Fe, Cu, Zn and Mn by grain straw and ultimately total uptake in finger millet increased significantly where either higher doses of chemical fertilizers or the chemical fertilizers in combination with organic manures were applied.

Keywords: finger millet, micronutrient, priming

1. Introduction
Finger millet (*Eleusine coracana* L. Gaertn) is an important small millet crop grown in India and has the pride of place in having highest productivity among millets. It is also known as ragi, African millet and bird's foot millet and an important staple food crop in part of eastern and central Africa and India. Grain is higher in protein, fat and minerals than rice, corn or sorghum." Ragi is commonly known as "Nutritious millet" as "the grain is nutritionally superior to many cereals providing proteins, minerals, calcium and vitamins in abundance to the people. When consumed as food, it provides a sustaining diet, especially for people doing hard work. Straw makes valuable fodder for both working and milking animals. Finger millet is considered an especially wholesome food for diabetics." Grain may also be malted and a flour of the malted grain used as cakes or porridge and a nourishing food for infants and invalids. Malnutrition and under nourishment are the major problems of Indian population due to which millets are becoming alternative sources of human food globally as well as in India.
Finger millet is an important rainfed crop grown in India. It is commonly known as ragi or madua. In India, it is cultivated in an area of 1.02 million ha with a production of 1.39 million tonne. In Chhattisgarh, it covers an area of 6.30 thousand ha with a production of 1.50 thousand tonne at an average productivity of 238 kg ha^{-1} (Anonymous, 2017) [1].
The Government of India has declared the year 2018, as "National Year of Millets" and designated "Millets" as "Nutri-Cereals" to recognize the nutritional and socio-economic importance.
Finger millet (Popularly called as 'Ragi' in A.P.) is a significant staple nourishment in the Eastern and Central Africa just as certain pieces of India (Majumder *et al.* 2006) [6] being one

of the significant hotspots for esteem included items, other than being a staple nourishment particularly in South India.

It is plentiful in protein, iron, calcium, phosphorus, fiber and nutrient substance. The calcium content right now higher than all oats, while, the iodine content is said to be most noteworthy amongst all the nourishment grains. Also, "Though finger millet is valued by traditional farmers as a low fertilizer input crop (NRC, 1996) under these conditions, it suffers from low yields (Rurinda *et al.* 2014) [16]. Most of the soils in semi-arid tropics, where finger millet is grown are deficient in macro and micronutrients mainly due to continuous cropping, poor recycling of crop residues and low rates of organic matter application which can limit yield potential (Rao *et al.* 2012) [13]. "To improve productivity, integrated nutrient management is an important practice. Fertilizer application not only should influence the economic return of the investment through optimized yield and quality but also cause minimum level of environmental hazards. This calls for balanced use of fertilizers and adoption of integrated nutrient management (INM) practices. Integrated nutrient management aims at efficient and judicious use of the major sources of plant nutrients in an integrated approach so as to get maximum economic yield without any deleterious effect on physico-chemical and biological properties of the soil (Arbad *et al*. 2008) [2]. Hence the major advantages of INM are increases in yield, water use efficiency, grain quality, economic return and sustainability (Wu *et al.* 2015) [18].

2. Materials and Methods

2.1 Study Site Description

The field experiment was conducted at DKS farm, IGKV, Bhatapara, Dist- Baloda Bazar, Chhattisgarh during *kharif* season, 2019. Experimental site was situated at 21°45'25" North latitude and 81° 59'22" East longitudes having an altitude of about 930 m above Mean sea level (MSL).

2.2 Experimental details

The field experiment was conducted in split plot design with three replications. The soil was silty clay loam with neutral pH, non-saline condition, medium in organic carbon content, low in available nitrogen and sulphur, medium in available phosphorus and high in available potassium, calcium, magnesium and available DTPA extractable micronutrients content. Treatments constituted with five nutrient management N1 (control), N2 (125 kg Neem cake + 1.25 tons/ha vermicompost), N3 (50"kg/ha N : 50 kg/ha P_2O_5 : 50 kg /ha K_2O"and 2% Borax spray at flowering), N4 (125 kg Neem cake + 1.25 tons/ha vermicompost + 50 kg/ha N : 50 kg/ha P_2O_5 : 50 kg /ha K_2O and 2% Borax spray at flowering) and N5 (Recommended dose of fertilizer i.e. 20 kg/ha N": 20 kg/ha P_2O_5 : 10 kg/ha K_2O) in main plots with four priming treatment P1 (control), P2 (Hydro priming for 6 hrs), P3 (Seed priming with 2% KH_2PO_4 for 6 hrs) and P4 (Seed priming with 20% liquid *Pseudomonas fluorescens*) in sub plots. Magnesium through $MgSO_4$ @50 kg/ha and calcium CaO @ 15 kg/ha was applied uniformly in all the plots before seeding except control treatment plots.

2.3 Cultivation details

"The experimental plot was dry ploughed twice followed by puddling with tractor mounted cage wheels and later leveled uniformly. Fields were drained and allowed mud to settle for 1 day after the final puddling. Field laid out and prepared bunds for 60 individual plots. Nine lines were demarked manually with the help of mattock for transplanting of finger millet. Water was let into the plots and 21 days old seedlings were transplanted @ one seedling per hill with a spacing of 30 cm x 10 cm. No protective irrigation was given for proper establishment of the seedlings due to occurrence of rainfall following the transplanting operation. Just one irrigation was provided to the crop at 45 DAT. The repeated occurrence of rainfall at early and later stages provided sufficient moisture for crop growth reducing the requirement of irrigation. One hand weeding was done at 45 days after transplanting. The weeding was delayed due to continuous rains, which made it difficult to undertake the operation. Fertilizers were applied as per the treatments. Half of nitrogen, full dose of phosphorous and full dose of potassium were applied in the form of urea, SSP and MOP as basal dose at the time of transplanting. Another half dose of nitrogen required was applied at maximum tillering stage as urea. Magnesium through MgSO4 @ 20 kg/ha and calcium CaO @ 15 kg/ha was applied uniformly in all the plots on 16th july 2019 except for control treatment plots. 2% Borax spray application was done at the time of flowering. Organic manures in the form of neem cake and vermicompost were applied as per the treatments. Manure was applied uniformly in plots using broadcasting method. The composition of neem cake was N (Nitrogen 2.61%), P (Phosphorus 0.78%), K (Potassium 1.34%), and composition of vermicompost was N (Nitrogen 0.69%), P (Phosphorus 0.47%) and K (Potassium 0.71%). Bifenthrin @1.5 ml/liter was applied to protect plant against stem borer and Hexaconozole @ 1ml/liter was applied to control the blast diseases in finger millet. The crop was harvested manually at 114 DAS. The five representative sample plants were harvested separately, and then crop was harvested from net plot area and kept for threshing. The plants from each plot were sun dried properly to facilitate easy threshing. Threshing was performed manually using the wooden sticks followed by winnowing.

2.4 Observations recorded

Initially a representative soil sample (0-15 cm depth) was taken by collecting soil from eight different places followed by quartering process, the soil was passed through 2 mm sieve. After harvest of crop surface, soil samples (0-15 cm depth) were collected from each plot separately and shade dried, samples are powdered with wooden rod and sieved in 2 mm sieve and analyzed for available micronutrients. DTPA-extraction method was used for determination of available iron, manganese, zinc and copper in soil. It involves extraction of soil with DTPA-$CaCl_2$-TEA reagent (pH 7.3) and measuring the extracted amounts in AAS. From each plot, grain and straw yields were recorded for five sample plant and whole plot separately. The straw was sun dried properly in field and the yield was recorded. The grain weight was taken after threshing the crop for each plot separately plant. The grain and straw yields were expressed as kg/ha. For plant analysis, plant samples were collected at harvest of finger millet and were oven dried with hot air oven until the constant weight was achieved. Dried samples were prepared by grinding with grinding machine and analyzed for plant nutrients content. For micronutrient estimation of plant one gram of powdered sample was digested with 10 ml di-acid mixture (nitric acid and perchloric acid at 10:4) after overnight pre digestion. The white residue left at the bottom of flask was diluted with water to known volume after filtration. This extract was used in the estimation of micronutrients. The reading of iron, manganese, zinc and copper was taken with the help of atomic absorption spectrophotometer (Zosoki and Burau, 1977).

3. Results and Discussion

3.1 Effect of different nutrient management and seed priming on available micronutrient in soil

3.1.1 Effect of different nutrient management and seed priming on available Fe in soil

Plant available iron in soil varied from 17.67 mg/kg to 21.13 mg/kg (Table 1). The highest available iron was found in N4 treatment (21.13 mg/kg) which was significantly higher than rest of the treatments. The lowest soil available iron was found in N1 treatment (17.67 mg/kg). Plant available iron in soil differed non-significantly between priming treatments. Highest available iron was found in P1 treatment (19.48 mg/kg) followed by P4 (19.34mg/kg) and the lowest was recorded in P3 treatment (18.77 mg/kg). The interaction effect of N×P for plant available iron in soil was found to be differed non-significantly. Maximum available iron was recorded in N4P3 (20.5 mg/kg) and the lowest was recorded in N1P3 (17.4 mg/kg) treatment combination.

3.1.2 Effect of different nutrient management and seed priming on available Mn in soil

Plant available manganese in soil varied from 5.70 mg/kg to 7.20 mg/kg (Table 1). The highest available manganese was found in N4 treatment (7.20 mg/kg) which was significantly higher than rest of the treatments. The lowest soil available manganese was found in N1 treatment (5.70 mg/kg).

Plant available manganese in soil differed non-significantly between priming treatments. The highest available manganese was found in P1 (6.35 mg/kg) followed by P2 (6.32 mg/kg) and the lowest was recorded in P3 and P4 treatment (6.15 mg/kg).

The interaction effect of N×P for plant available manganese in soil was found to be differed non-significantly. Maximum available manganese was recorded in N4P1 (7.7 mg/kg) and the lowest was recorded in N3P4 treatment combination (5.4 mg/kg).

3.1.3 Effect of different nutrient management and seed priming on available Cu in soil

Plant available copper in soil varied from 2.47 mg/kg to 4.05 mg/kg (Table 1). The highest available copper was found in N4 treatment (4.05 mg/kg) which was statistically at par with N3 treatment (3.71 mg/kg) and significantly higher than rest of the treatments. The lowest soil available copper was found in N1 treatment (2.47 mg/kg).

Plant available copper in soil differed non-significantly between priming treatments. The highest available copper was found in P3 (3.50 mg/kg) followed by P1 treatment (3.35 mg/kg) and the lowest was recorded in P4 treatment (3.12 mg/kg).

The interaction effect of N×P for plant available copper in soil was found to be differed non-significantly. Maximum available copper was recorded in N4P3 (4.22 mg/kg) and the lowest was recorded in N1P4 treatment combination (2.17 mg/kg).

3.1.4 Effect of different nutrient management and seed priming on available Zn in soil

Plant available zinc in soil varied from 2.17 mg/kg to 2.61mg/kg (Table 1). The highest available zinc was found in N4 treatment (2.61 mg/kg) which was significantly higher than rest of the treatments. The lowest soil available zinc was found in N1 treatment (2.17 mg/kg).

Plant available zinc in soil differed non-significantly between priming treatments. Highest available zinc was found in P1 (2.35 mg/kg) followed by P3 treatment (2.34 mg/kg) and the lowest was recorded in P4 treatment (2.28 mg/kg).

The interaction effect of N×P for plant available zinc in soil was found to be differed non-significantly. Maximum available zinc was recorded in N4P1 (4.14 mg/kg) and the lowest was recorded in N1P4 treatment combination (2.17 mg/kg).

"The higher availability of available cationic micronutrients in soil particularly with use of integrated nutrient management may be ascribed to mineralization, reduction in fixation of nutrients by organic matter and complexing properties of humic substances released from vermicompost with micronutrients. Similar results were also reported by Vidyavathi *et al.* (2012) [17] and Rani *et al.* (2017) [12].

Table 1: Effect of different nutrient management and seed priming on available micronutrient in soil.

Treatment	Available iron (mg/kg)	Available copper (mg/kg)	Available manganese (mg/kg)	Available zinc (mg/kg)
Nutrient management				
N1: Control	17.67^{c}	2.47^{c}	5.70^{b}	2.17^{c}
N2:125 kg/ha Neem cake + 1.25 tons/ha vermicompost	19.03^{b}	3.21^{b}	6.30^{b}	2.36^{b}
N3: 50 "kg/ha N: 50 kg/ha P_2O_5: 50 kg /ha K_2O and" 2% Borax spray at flowering.	19.31^{ab}	3.71^{a}	6.14^{b}	2.31^{b}
xN4: N2+N3	21.13^{a}	4.05^{a}	7.20^{a}	2.61^{a}
N5: "Recommended dose of fertilizer i.e. 20 kg/ha N : 20 kg/ha P_2O_5 : 10 kg /ha K_2O"	18.91^{bc}	3.12^{b}	5.87^{b}	2.24^{bc}
SEm±	0.21	0.11	0.23	0.05
C.D.(P=0.05)	0.69	0.37	0.75	0.16
Priming				
P1: Control	19.48	3.35	6.35	2.35
P2:Hydro priming for 6hrs	19.24	3.28	6.32	2.34
P3:Seed priming with 2% KH_2PO_4 for 6hrs	18.77	3.50	6.15	2.37
P4:Seed priming with 20% liquid *Pseudomonas fluorescens.*	19.34	3.12	6.15	2.28
SEm±	0.20	2.47	0.17	0.04
C.D.(P=0.05)	NS	NS	NS	NS
Interaction	NS	NS	NS	NS

3.2 Effect of different nutrient management and seed priming on yield of finger millet

3.2.1 Grain yield

Grain "yield of finger millet varied from 17.3 q/ha to 29.2 q/ha (Table 2). The highest grain yield was recorded in N4 treatment (29.2q/ha) which was at par with N3 treatment (26.4 q/ha) and significantly higher than the other treatments. The lowest grain yield was recorded in N1 treatment" (17.2 q/ha).

Grain yield differed non-significantly between priming treatments. The highest grain yield was found in P3 and P4 treatment (24.1 q/ha) and the lowest yield was recorded in P2 treatment (23.9 q/ha).

"The interaction effect of N×P for grain yield was found to be differed non-significantly. Maximum grain yield was recorded in N3P4 (26.6 q/ha) and the minimum grain yield was recorded in N1P1 treatment combinations" (17.2 q/ha).

Higher grain yield with combined application of organic manure and inorganic fertilizers may be due to increased availability of nutrients which improved the soil properties, this in turn, increased absorption and translocation of nutrients by crop leading to increased production of photosynthates by the crop.

Organic manures provided favorable environment for microorganisms like *Azospirillium* which fixes atmospheric nitrogen available to plant and PSB which converts insoluble phosphate into soluble forms by secreting organic acids. These results are in line with the findings of Malinda *et al.* (2015) [7] and Rao *et al.* (2018) [13].

3.2.2 Straw yield

Straw yield of finger millet varied from 24.5 q/ha to 40.9 q/ha (Table 2). The highest straw yield was recorded in N4 treatment (40.9 q/ha) which was significantly higher than the other treatments. The lowest straw yield was found in N1 treatment (24.5 q/ha).

Straw yield differed non-significantly between priming treatments. The highest straw yield was found in P4treatment (33.8q/ha) followed by P3 (32.2 q/ha) and the lowest straw yield was recorded in P1treatment (31.9 q/ha).

The interaction effect of N×P for straw yield was found to be differed non-significantly. Maximum straw yield was recorded in N4P3 (40.8 q/ha) and the lowest straw yield was recorded in N1P1treatment combinations (26.6 q/ha).

Higher straw yield recorded in integrated nutrient management plots may be due to enhancement of the photosynthetic rate resulting in more vegetative growth and dry matter production. These results are in conformity with the findings of Savita *et al.* (2013) and Malinda *et al.* (2015) [7].

3.2.3. Biological yield

Biological yield of finger millet varied from 41.8q/ha to 70.1 q/ha (Table 2). The highest biological yield was found in N4 treatment (70.1 q/ha) which was significantly higher than the other treatments. The lowest biological yield was found in N1treatment (41.8q/ha).

Biological yield differed non-significantly between priming treatments. "The highest Biological yield was found in P4 treatment (58.0 q/ha) followed by P3 (56.3 q/ha) and the lowest biological yield was recorded in P1 treatment (55.8 q/ha)."

"The interaction effect of N×P for biological yield was found to be differed non-significantly. Maximum biological yield was recorded in N4P3 (40.8 q/ha) and the lowest biological yield was recorded in N1P1 treatment combinations (22.6 q/ha)."

Greater total yield of finger millet in integrated nutrient management is due to enhanced growth and yield parameters. The results obtained were in close conformity of Savita *et al.* (2017) and Rani *et al.* (2017) [12]. Seed priming with 20% *Pseudomonas fluorescens* and 2% KH_2PO_4showed higher yield than hydro priming and control however their effects were masked by the rainfall on the week of sowing and next week after showing. Similar results were obtained by Zida *et al*. (2017) [19].

Table 2: Effect of different nutrient management and seed priming on grain, straw and biological yield of finger millet.

Treatment	Grain yield (q/ha)	Straw Yield (q/ha)	Biological yield (q/ha)
Nutrient management			
N1: Control	17.3^e	24.5^e	41.8^e
N2:125 kg Neem cake + 1.25 tons ha^{-1} vermicompost	23.0^d	29.5^d	52.6^d
N3: 50 kg/ha N: 50 kg/ha P_2O_5: 50 kg /ha K_2O and 2% Borax spray at flowering.	26.4^b	35.5^b	61.9^b
N4: N2+N3	29.2^a	40.9^a	70.1^a
N5: Recommended dose of fertilizer i.e. 20 kg/ha N : 20 kg/ha P_2O_5 : 10 kg /ha K_2O	24.3^c	32.2^c	56.5^c
SEm±	0.09	0.80	0.86
C.D.(P=0.05)	0.29	2.60	2.64
Priming			
P1: Control	23.9	31.9	55.8
P2:Hydro priming for 6hrs	24.0	32.1	56.1
P3:Seed priming with 2% KH_2PO_4 for 6hrs	24.1	32.2	56.3
P4: Seed priming with 20% liquid *Pseudomonas fluorescens.*	24.1	33.8	58.0
SEm±	0.11	0.79	0.7
C.D.(P=0.05)	NS	NS	NS
Interaction	NS	NS	NS

3.3 Effect of different nutrient management and seed priming on micronutrient content of finger millet

The data on effect of INM and seed priming on micronutrient content of finger millet are shown in table 3.

As shown as table 3 Micronutrient content of finger millet grains found in the order Fe>Zn>Cu>Mn and the similar order was found for micronutrient content in straw of finger millet. The range of different micronutrient content was very narrow in grain and straw of finger millet. The iron content of finger millet straw was higher than finger millet grain and ranged from 8.21 mg/100g to 8.70 mg/100g (Table 3) in finger millet grain and 34.69 mg/100g to 38.56 mg/100g (Table 3) in finger millet straw. The manganese content was lowest among cationic micronutrients and ranged from 0.74 to

0.77 mg/100g (Table 3) in finger millet grains and 0.77 to 0.82 mg/100g in finger millet straw. Copper content of finger millet grain and straw was nearly same and ranged from 0.93mg/100g to 1.02 mg/100g for finger millet grain and 0.92 mg/ 100g to 0.98 mg/100g in finger millet straw. Zinc content of finger millet grain varied from 3.42 mg/100g to 3.58 mg/100g and from 4.01 mg/100g to 4.10 mg/100g in finger millet straw.

No trend regarding micronutrient content in grain and straw was found for nutrient management and priming treatments. This may be due to the higher plant available Fe (17.15mg/kg), Mn (5.21mg/kg), Cu (2.37mg/kg) and Zn (2.07mg/kg) content of the initial soil and the lower requirements of micronutrients by the plants.

Table 3: Effect of different nutrient management and seed priming on micronutrient content of finger millet.

Treatment	Iron content (mg/100g)		Manganese content (mg/100g)		Copper content (mg/100g)		Zinc content (mg/100g)	
Nutrient management	Grain	straw	Grain	Straw	grain	straw	Grain	Straw
N1: Control	8.21	34.69	0.76	0.77	0.93	0.92	3.42	4.01
N2:125 kg Neem cake + 1.25 tons ha^{-1} vermicompost	8.44	35.70	0.75	0.82	1.02	0.94	3.50	4.05
N3: 50"kg/ha N: 50 kg/ha P_2O_5: 50 kg /ha K_2O and"2% Borax spray at flowering.	8.68	37.14	0.73	0.79	0.97	0.98	3.44	4.10
N4: N2+N3	8.70	38.56	0.77	0.80	1.00	0.96	3.58	4.05
N5: Recommended dose of fertilizer i.e. 20 kg/ha N : 20 kg/ha P_2O_5 : 10 kg /ha K_2O	8.59	38.53	0.74	0.78	1.02	0.94	3.52	4.04
SEm±	0.37	1.25	0.01	0.02	0.02	0.02	0.10	0.17
C.D.(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Priming								
P1: Control	8.34	37.55	0.74	0.78	1.02	0.94	3.59	4.04
P2: Hydro priming for 6 hrs	8.54	38.33	0.75	0.81	0.98	0.95	3.51	4.04
P3: Seed priming with 2% KH_2PO_4 for 6 hrs	9.12	35.36	0.76	0.78	0.96	0.95	3.46	4.10
P4: Seed priming with 20% liquid *Pseudomonas fluorescens.*	8.08	36.45	0.74	0.79	1.00	0.96	3.40	4.02
SEm±	0.28	1.14	0.01	0.01	0.02	0.02	0.10	0.16
C.D.(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

3.4 Effect of different nutrient management and seed priming on micronutrients uptake of finger millet.

The data on effect of INM and seed priming on micronutrient uptake of finger millet are shown in table 4.

As shown in table no 4 Fe uptake in finger millet grain was found highest among all the micronutrients and followed the order Fe>Zn>Cu>Mn. Similar order was followed for finger millet straw's micronutrient uptake and total uptake of different micronutrients.

In finger millet grains, the highest values of Fe (254.37 g/ha), Mn (22.48g/ha), Cu (29.23 g/ha) and Zn (104.71 g/ha) uptake was recorded by N4 treatment. The lowest value of Fe (141.92 g/ha), Mn (13.14g/ha), Cu (16.06 g/ha) and Zn (59.12 g/ha) uptake by finger millet grains was found in N1 treatment which was significantly lower than N4. For priming treatments, no trend was found for different micronutrients uptake and interaction affect for N×P was also found non-significant.

In case of finger millet straw also, the highest values for Fe (1574.94g/ha), Mn (32.67g/ha), Cu (39.23 g/ha) and Zn (165.50 g/ha) uptake was recorded by N4 treatment which was significantly higher than all other treatments. The lowest value of Fe (861.66 g/ha), Mn (18.87 g/ha), Cu (22.56 g/ha) and Zn (98.18 g/ha) uptake by finger millet straw was recorded in N1 treatment.

The highest total uptake of Fe (1829.31 g/ha), Mn (55.15g/ha), Cu(68.86 g/ha) and Zn (270.21 g/ha) of finger millet was seen in N4 treatment, whereas total uptake of all the micronutrients i.e. Fe (1829.31 g/ha), Mn (55.15 g/ha), Cu (68.46 g/ha) and Zn (270.21 g/ha) was seen in N1 treatment. For priming treatments, no trend was found for different micronutrients' uptake and interaction affect for N×P was also found non-significant.

"Higher cationic micronutrient uptake by finger millet grain and straw in case of integrated nutrient management might be due to complexing properties of manures with micronutrients that had prevented precipitation, fixation, leaching and kept them in soluble form by microbial activity and higher uptake of these micronutrients by crop. Similar results were reported by Prasanth *et al.* (2019) and Punia *et al.* (2019).

Table 4: Effect of different nutrient management and seed priming on micronutrient uptake of finger millet.

Treatment	Iron Uptake (g/ha)			Manganese uptake (g/ha)			Copper uptake (g/ha)			Zinc uptake (g/ha)		
Nutrient management	**grain**	**straw**	**total**	**grain**	**straw**	**total**	**grain**	**straw**	**total**	**grain**	**Straw**	**total**
N1: Control	141.92^{c}	861.66^{d}	1003.58^{d}	13.14^{cd}	18.87^{d}	32.02^{d}	16.06^{d}	22.56^{d}	38.61^{d}	59.12^{d}	98.18^{d}	157.30^{d}
N2:125 kg Neem cake + 1.25 tons ha^{-1} vermicompost	194.30^{b}	1053.21^{c}	1247.51^{c}	17.34^{c}	24.11^{c}	41.45^{c}	23.59^{c}	27.87^{c}	51.46^{c}	80.52^{c}	119.45^{c}	199.97^{c}
N3: "50 kg/ha N: 50 kg/ha P_2O_5: 50 kg /ha K_2O and 2% Borax spray at flowering".	228.93^{ab}	1318.30^{b}	1547.23^{b}	19.37^{b}	28.00^{b}	47.37^{b}	25.62^{b}	34.86^{b}	60.49^{b}	90.63^{b}	147.14^{b}	237.77^{b}
N4: N2+N3	254.37^{a}	1574.94^{a}	1829.31^{a}	22.48^{a}	32.67^{a}	55.15^{a}	29.23^{a}	39.23^{a}	68.46^{a}	104.71^{a}	165.50^{a}	270.21^{a}
N5: "Recommended dose of fertilizer i.e. 20 kg/ha N : 20 kg/ha P_2O_5 : 10 kg /ha K_2O"	208.43^{b}	1241.19^{b}	1449.62^{b}	18.04b	25.00^{bc}	43.04^{c}	24.85^{bc}	30.26^{c}	55.11^{c}	85.36^{bc}	130.25^{c}	215.61^{c}
SEm±	9.36	51.69	59.59	0.41	1.04	1.31	0.56	1.01	1.35	2.24	4.98	6.53
C.D.(P=0.05)	30.54	168.56	194.33	1.33	3.40	4.27	1.82	3.30	4.40	7.31	16.24	21.30
Priming												
P1: Control	199.68	1213.54	1413.21	17.79	24.74	42.53	24.67	30.14	54.82	86.17	128.65	214.82
P2: Hydro priming for 6hrs	205.20	1228.21	1433.41	18.11	26.08	44.19	23.44	30.59	54.03	84.97	129.83	214.80
P3:Seed priming (2% KH_2PO_4 for 6hrs)	221.40	1150.41	1371.81	18.37	25.21	43.57	23.35	30.49	53.84	82.68	132.85	215.54

P4:Seed priming (20% *P. fluorescens*)	196.09	1247.29	1443.37	18.02	26.90	44.92	24.02	32.59	56.61	82.45	137.09	219.54
SEm±	3.46	52.04	56.57	0.33	0.83	0.96	0.46	0.90	1.15	2.18	4.32	5.11
C.D.(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

4. Conclusion
The available cationic micronutrients in soil increased significantly and found higher where either higher doses of chemical fertilizers or the chemical fertilizers in combination with organic manures were applied.

The grain, straw and ultimately the biological yields were found higher where either higher doses of chemical fertilizers or the chemical fertilizers in combination with organic manures were applied however, the priming treatments did not influenced the yield significantly.

The content of cationic micronutrient namely Fe, Mn, Cu, Zn in plant tissue was not affected by any nutrient management and seed priming treatments.

The uptake Fe, Cu Zn and by grain straw and ultimately total uptake in finger millet increased significantly where either higher doses of chemical fertilizers or the chemical fertilizers in combination with organic manures were applied.

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