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Yield, Nutrient Availability and Soil Properties of Pearl Millet as Influenced by Enriched Phosphocompost

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Soil Properties, Yield and Nutrient Availability for Pearl Millet as Influenced by Enriched Phosphocompost
Study Design: Randomized Block Design
Place of Study: Bajra Research Scheme, College of Agriculture, Dhule.
Methodology: There were 10 treatments *viz.* T_1- Control, T_2- 100 % Recommended Dose of Fertilizer (RDF), T_3- 100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}, T_4- 100% RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1}, T_5- 100% RDF + 2.5 t FYM ha^{-1}, T_6- 100% RDF + 5 t FYM ha-

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1, T_7- 75% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}, T_8- 75% RDF + 2.5 t Cotton stalks phosphocompost ha^{-1}, T_9- 75 % RDF + 2.5 t FYM ha^{-1}, T_{10}- 75% RDF + 5 t FYM ha^{-1}.
Results: The results indicated that yield, nutrient uptake and soil properties *viz*. organic carbon, cation exchange capacity, soil available N, P, K and micronutrients were found highest in treatments T_4- 100 % RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1} and treatment T_3- 100% RDF+ 2.5 t bajra straw phosphocompost ha^{-1} and lowest in treatment T_1- Control.
Conclusion: Based on the experimental findings application of 100 % RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1} and 100% RDF+ 2.5 t bajra straw phosphocompost ha^{-1} were beneficial in terms of yield parameter, plant nutrient uptake and soil chemical properties on pearl millet.

Keywords: Bajara straw; cotton stalks; phosphocompos; yield; uptake; soil properties.

1. INTRODUCTION

“Pearl millet (*pennisetum glaucum*) is most widely grown type millet, it has been grown in Indian continent since prehistoric times. Pearl millet is well adapted to growing area characterized by drought, low Productivity and high temperature. In India, pearl millet was grown in wide area of arid and semi- arid areas” [1].

“Phosphorus is an essential macronutrient that play vital role in living organism. Adequate P availability results in improved root growth, crop yield, energy storage and higher grain yield in crop” [1]. Therefore, “demand of phosphorus can be met through application of organic manure in the form of phosphocompost and microbial inoculants to the plant. Soil microorganism plays a key role in soil P dynamics and subsequent availability of phosphate to plant” [2].

“Phosphocomposting involves the incorporation of phosphatic fertilizer like rock phosphate (RP) and highly enriched organic manure. Phosphorus inputs are required for sustainable agriculture production in most soils of the tropics been suggested as alternative P sources in these soils. Phosphorus deficiency is a major constraint to crop production in such soils and P fertilizers need to be applied to obtain optimum plant growth and crop yields. Composting manure and biological waste with RP has been shown to the enhance the dissolution of RP and is practiced widely as a low-input technology to improve the fertilizer value of manure” [3]. Composting of rock phosphates with agricultural wastes is known to increase solubility of rock phosphates. Moreover, the application of phosphate rock natural fertilizer combined with amendments of organic manures may improve the phosphorus solubilization and availability. This application is more friendly environmental with respect to the environmental concerns and impacts.

2. MATERIALS AND METHODS

A Field experiment was conducted at the farm of Bajra Research Scheme, College of Agriculture, Dhule. The experiment was laid out with ten treatments with three replications in Randomized Block Design. There were 10 treatments *viz.* T_1- Control, T_2- 100 % RDF, T_3- 100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}, T_4- 100% RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1}, T_5- 100% RDF + 2.5 t FYM ha^{-1}, T_6- 100% RDF + 5 t FYM ha^{-1}, T_7- 75% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}, T_8- 75% RDF + 2.5 t Cotton stalks phosphocompost ha^{-1}, T_9- 75 % RDF + 2.5 t FYM ha^{-1}, T_{10}- 75% RDF + 5 t FYM ha^{-1}. The recommended dose of fertilizer for *kharif* pearl millet was 60:30:25 N: P_2O_5: K_2O kg ha^{-1}, respectively. The fertilizers, urea, single super phosphate and muriate of potash were used as a source of N, P and K, respectively. The half dose of N and full dose of P_2O_5 and K_2O were applied at the time of sowing, whereas remaining half dose of N was applied after the one month.

The experimental soil is medium deep black and clayey texture. The initial soil sample was analyzed by standard method and depicted in Table 1.

The phosphocompost prepared from bajra straw, cotton stalk and FYM were analysed for their chemical composition and data placed in Tables 2 and 3.

In manure analysis, the organic carbon was determined by combustion method [4], the total N was analyzed by microkjeldahl method [5], the total P was analyzed by Vanadomolybdate blue colour colorimetric [6], the citrate and water soluble P was estimated by Colorimetric method [7] and the total K was determined by Flame photometry method [8]. In soil analysis, the soil texture estimated by international pipette method [4], the bulk density was determined by core method [9]. Soil pH (1:2.5) was determined by potentiometric method and electrical conductivity (1:2.5) was determined by conductometric method [7]. Organic carbon in soil was determined by wet oxidation method [10]. The cation exchange capacity was determined by centrifuge method extraction with 0.4 N NaOAc, 0.1 N NaCl (pH 8.2) [11]. "Available N in soil was determined by alkaline permanganate method [12]. Available P in soil was determined by $NaHCO_3$ (0.5 M) method [13]. Available K in soil was determined by Neutral N NH_4OAc method" [7]. "The N, P and K uptake was determined by microkjeldahl method [5], vanadomolybdo phosphoric acid yellow method and flame photometry method" [7].

The data generated were statistically analysed in Randomized Block Design (RBD) as suggested by Panse and Sukhatme [14].

Table 1. Initial soil properties of experimental field

Sr.No	Parameters	Contents
1	Texture	31.92 %
	1) Sand :	21.08 %
	2) Silt :	46.89 %
	3) Clay :	Clayey
	Textural class	
2	Bulk density	1.36 Mg m^{-3}
3	CEC	23.17 Cmol kg^{-1}
4	pH	7.58
5	EC	0.49 dSm^{-1}
6	Total N	0.056 %
7	Organic C	4.7 g kg^{-1}
8	Available N	169.86 kg ha^{-1}
9	Available P	14.44 kg ha^{-1}
10	Available K	358.12 kg ha^{-1}
11	**Available micronutrients**	
A	Fe	6.12 mg kg^{-1}
B	Mn	12.87 mg kg^{-1}
C	Zn	0.97 mg kg^{-1}
D	Cu	1.17 mg kg^{-1}

Table 2. Characterization of phosphocompost

Sr.No	Parameters	Bajra phosphocompost	Cotton phosphocompost
1	pH	7.3	7.4
2	EC (dSm^{-1})	0.63	0.43
3	Organic C (%)	24.88	26.60
4	Total N (%)	1.16	1.31
5	Total P (%)	1.68	1.85
6	Citrate soluble P (%)	0.81	0.88
7	Water Soluble P (%)	0.068	0.076
8	Total K (%)	0.85	0.75
9	C:N Ratio	21.44	20.31

Table 3. Characterization of FYM

Sr no	Parameters	Contents
1	pH	7.1
2	EC (dSm^{-1})	0.11
3	Organic C (%)	12
4	Total N (%)	0.61
5	Total P (%)	0.39
6	Total K(%)	0.79
7	C:N Ratio	19.67

3. RESULTS AND DISCUSSION

3.1 Grain and Straw Yield Influenced by Phosphocompost Application

The data pertaining to the grain and fodder yield has been depicted in Table 4. It was revealed from data that, the highest grain and straw yield (42.18 q ha^{-1} and 75.02 q ha^{-1}) was recorded in the treatment T_4 - 100% RDF + 2.5 t Cotton stalks phosphocompost ha^{-1} followed by treatment T_3- 100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1} (39.69 q ha^{-1} and 70.91 q ha^{-1}) . Further, it is seen that when these cotton stalks (T_8) and bajra straw (T_7) phosphocomposts applied with 75 % RDF. Among the FYM treatments addition of 5 t FYM ha^{-1} (T_6) and 2.5 t FYM ha^{-1} (T_5) along with 100 % RDF recorded the higher pearl millet yield as compared to their application with 100 % RDF. The significantly lower grain and straw yield was reported in the treatment T_1- control.

Role of organics in increasing yield was attributed to supply of all essential nutrient due to continuous mineralization of organics manures. Secondly, INM favorably effects on the proliferation of roots and thereby increasing the uptake of plant nutrients from the soil and ultimately the vegetative growth of the plants. The increase in yield due to application of enriched phoshocompost was previously noticed by Ali et al. [15] and Nagar et al. [16].

Implicit with the foregone discussion, it may be construed that phosphocomposts prepared from locally available crop residues along with low grade rock phosphate is the viable technology foe proper utilization of crop residue. When this phosphocompost is applied with chemical fertilizer, it contributed in maintaining soil fertility and sustainability in yield.

Table. 4 Grain and fodder yield of bajra influenced by phosphocompost application

Treatment	Grain yield (q ha^{-1})	Fodder yield (q ha^{-1})
T_1 - Control	25.28	44.50
T_2 -100% RDF (60:30:25)	32.12	59.51
T_3 -100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}	39.69	70.91
T_4 -100% RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1}	42.18	75.02
T_5 -100% RDF + 2.5 t FYM ha^{-1}	36.06	64.58
T_6 -100% RDF + 5 t FYM ha^{-1}	36.35	68.06
T_7 -75% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}	37.74	67.10
T_8 -75% RDF + 2.5 t Cotton stalks phosphocompost ha^{-1}	39.42	69.43
T_9 -75 % RDF + 2.5 t FYM ha^{-1}	34.06	61.41
T_{10} -75% RDF + 5 t FYM ha^{-1}	34.76	63.31
SE (m)±	1.61	3.12
CD at 5%	4.78	9.2

Table 5. N, P and K uptake by grain and fodder influenced by phosphocompost application

Treatment	Grain uptake (kg ha^{-1})			Fodder uptake (kg ha^{-1})		
	N	**P**	**K**	**N**	**P**	**K**
T_1 - Control	23.37	10.85	15.52	44.92	15.34	115.50
T_2 -100% RDF (60:30:25)	30.17	12.16	18.15	46.37	17.28	121.62
T_3 -100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}	51.77	24.72	31.72	60.33	32.41	217.20
T_4 -100% RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1}	54.65	27.14	32.36	62.64	34.58	230.14
T_5 -100% RDF + 2.5 t FYM ha^{-1}	46.26	17.15	24.31	52.63	22.60	145.21
T_6 -100% RDF + 5 t FYM ha^{-1}	48.19	20.71	25.44	56.38	28.64	168.18
T_7 -75% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}	50.62	18.27	27.52	54.17	24.42	152.48
T_8 -75% RDF + 2.5 t Cotton stalks phosphocompost ha^{-1}	51.45	22.38	29.40	58.28	30.75	179.61
T_9 -75 % RDF + 2.5 t FYM ha^{-1}	39.48	14.47	20.65	48.15	19.23	127.90
T_{10} -75% RDF + 5 t FYM ha^{-1}	42.63	16.92	22.72	50.72	21.27	132.75
SE (m)±	0.69	0.46	0.44	0.48	0.48	0.67
CD at 5%	2.05	1.39	1.32	1.44	1.43	1.97

Table 6. Organic carbon as influenced by phosphocompost application

Treatment	Organic C (g kg^{-1})			Available N (kg ha^{-1})			Available P (kg ha^{-1})			Available K (kg ha^{-1})		
	At sowing	At flowering	At harvest	At sowing	At flowering	At harvest	At sowing	At flowering	At harvest	At sowing	At flowering	At harvest
T_1 -Control	4.72	4.83	4.78	170.64	185.72	178.60	14.67	16.36	15.47	359.24	364.36	356.70
T_2 -100% RDF (60:30:25)	4.76	4.92	4.84	172.32	193.46	183.71	14.82	17.43	15.12	360.17	370.13	365.27
T_3 -100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}	4.93	5.34	5.20	180.43	238.64	212.18	15.96	23.36	18.87	364.72	412.77	397.92
T_4 -100% RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1}	4.96	5.36	5.26	184.51	242.52	220.28	16.23	24.57	19.37	363.48	396.36	381.20
T_5 -100% RDF + 2.5 t FYM ha^{-1}	4.80	5.00	4.90	174.20	216.36	190.75	15.35	18.64	16.58	362.75	387.28	374.26
T_6 -100% RDF + 5 t FYM ha^{-1}	4.83	5.14	4.98	175.81	222.14	196.81	15.62	19.15	16.92	364.25	405.47	390.31
T_7 -75% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}	4.86	5.25	5.12	182.34	228.56	202.13	15.81	20.75	17.43	363.17	392.70	378.18
T_8 -75% RDF + 2.5 t Cotton stalks phosphocompost ha^{-1}	4.90	5.32	5.18	186.65	234.17	207.20	16.05	22.56	18.19	360.47	372.38	366.51
T_9 -75 % RDF + 2.5 t FYM ha^{-1}	4.74	4.96	4.87	175.25	196.27	185.17	14.95	17.72	15.65	361.27	376.59	369.46
T_{10} -75% RDF + 5 t FYM ha^{-1}	4.80	5.12	4.94	177.76	200.18	188.35	15.12	18.24	16.17	362.48	380.17	371.90
SE (m)±	0.08	0.11	0.06	0.59	0.57	0.62	0.49	0.47	0.34	0.53	0.73	0.55
CD at 5%	0.25	0.34	0.20	1.77	1.70	1.86	1.46	1.41	1.01	1.58	2.19	1.64

Table 7. CEC and available micronutrients influenced by phosphocompost application

Treatments	CEC (Cmol kg^{-1})	Fe (mg kg^{-1})	Mn (mg kg^{-1})	Zn (mg kg^{-1})	Cu (mg kg^{-1})
T_1 - Control	23.20	6.82	13.12	1.12	1.25
T_2 -100% RDF (60:30:25)	24.35	7.41	13.78	1.47	1.51
T_3 -100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}	26.40	11.23	22.45	4.67	3.90
T_4 -100% RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1}	26.87	11.97	20.84	5.10	4.12
T_5 -100% RDF + 2.5 t FYM ha^{-1}	25.34	8.47	15.82	2.62	2.36
T_6 -100% RDF + 5 t FYM ha^{-1}	24.68	9.20	16.55	3.27	2.67
T_7 -75% RDF + 2.5 t Bajra straw phosphocompost ha^{-1}	25.92	9.75	17.19	3.81	2.87
T_8 -75% RDF + 2.5 t Cotton stalks phosphocompost ha^{-1}	26.12	10.12	19.22	4.12	3.24
T_9 -75 % RDF + 2.5 t FYM ha^{-1}	25.64	7.83	14.61	1.84	1.97
T_{10} -75% RDF + 5 t FYM ha^{-1}	24.95	8.12	15.17	2.21	2.11
SE (m)±	0.37	0.21	0.18	0.02	0.03
CD at 5%	1.11	0.64	0.54	0.07	0.09

3.2 Nutrient Uptake (N, P and K) by Pearl Millet

Result showing the effect of organics that is phosphocompost and FYM along with inorganic fertilizer was presented in Table 5.

3.2.1 Grain uptake

The significantly maximum N, P and K uptake (54.65, 27.14 and 32.36 kg ha^{-1}, respectively) was recorded in treatment T_4- 100% RDF + 2.5 t Cotton stalks phosphocompost ha^{-1} followed by treatment- T_3 (51.77, 24.72 and 31.72 kg ha^{-1} N, P and K, respectively) *i.e.* with bajra straw phosphocompost. The highest values of uptake are obtained from phosphocompost application as compared to FYM when applied with chemical fertilizers.

Significantly lower N, P and k were founded in treatment T_1- control (23.37, 10.85 and 15.52 kg ha^{-1} N, P and K, respectively).

3.2.2 Straw uptake

The nutrient uptake by pearl millet straw did vary significantly due to phosphocompost application. The maximum N, P and K uptake by straw that *i.e.* 62.64, 34.58 and 230.14 kg ha^{-1}, respectively was noticed under treatment T_4 (100 % RDF + 2.5 t cotton stalks phosphocompost ha^{-1}) followed by 100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1} (T_3) *i.e.* 60.33, 32.41 and 217.20 kg ha^{-1}, respectively.

The increased yield together with N and P content by P application resulted in higher uptake of these nutrients. Positive effect of use of phosphocompost along with chemical fertilizer was earlier reported by Patra and Bandyopadhyay [17] and Biswas and Anusuya [18]. This was due to higher availability of soil phosphorus and greater mineralization of organic phosphorus.

3.3 Organic C, Available N, P and K Content in Soil Influenced by Phosphocompost Application

3.3.1 Soil organic Carbon

Result pertaining to the organic carbon contents in soil influenced by nutrient management through organics and inorganics fertilizer was presented in Table 6.

The significantly maximum organic carbon content was recorded in treatment T_4- 100% RDF + 2.5 t cotton stalks phosphocompost ha^{-1} (4.96,5.36 and 5.26 g kg^{-1}) at sowing, flowering and harvest stage, respectively. The followed result was observed in the treatment T_3- 100% RDF + 2.5 t bajra straw phosphocompost ha^{-1} (4.93, 5.34 and 5.20 g kg^{-1}, respectively). The higher values of organic carbon were also recorded in treatment T_8- 75% RDF + 2.5 t cotton stalk phosphocompost ha^{-1} and treatment T_7- 75% RDF + 2.5 t bajra straw phosphocompost ha^{-1}. It could be evident from the data that organic C content was increased from sowing to flowering of crop and then gradually declined at harvest stage.

Singh et al. [19] recorded the higher organic C contents in the treatment receiving 50 % RDF along with 2 t phosphocompost ha^{-1}. Hussain et al*.* [20] also reported “significantly increased organic C with application of phosphocompost over inorganic fertilizer. The improvement in enhancing SOC in plot receiving 75 % NPK along with enriched compost may be attributed to balanced and integrated use of inorganic and organic sources of nutrients. This may further enhanced crop growth which in turn resulted in increased below ground organic residues (root biomass, rhizodeposition, root exudates etc.), and thus raised SOM status. The increased SOM in enriched compost amended plots also attributed to slower break down rate of enriched compost in soil. The higher value of SOC contents in soil with organic manure might be due to biological immobilization and continuous mineralization of FYM on surface soil layer”.

3.3.2 Available nitrogen

Nitrogen is the one of the important macronutrient which is required for essential growth of the plant. Management practices with phosphocompost, FYM and chemical fertilizer have great influenced on availability of nitrogen in soil. The available nitrogen content in soil influenced by nutrient management through organic and inorganic fertilizer was presented in Table 6.

The significantly maximum available nitrogen content (184.51, 242.52 and 220.28 kg ha^{-1}) was recorded in the treatment T_4- 100% RDF + 2.5 t cotton stalks phosphocompost ha^{-1} followed by the treatment T_3- 100% RDF + 2.5 t bajra straw phosphocompost ha^{-1} (180.43, 238.64 and 212.18 kg ha^{-1}, respectively). The significantly minimum available nitrogen was observed in the treatment T_1- control (170.64, 185.72 and 178.60 kg ha^{-1}).

It was observed that available N contents significantly increased at flowering stage and then gradually declined at harvest but values are quite higher than initial contents. Result are in consonance with Kalhapure et al. [21], they reported that "available N is increased by application of chemical fertilizer and compost by INM". Moharana et al. [22] recorded "the higher available N content in the treatment receiving rock phosphate enriched rice straw compost along with inorganic fertilizer as compared to FYM. Application of manures leads to an enrichment of the soil N pool, and increases the efficiency of organic fertilizer by releasing higher mineral N. Organic manures release mineral N slowly, which help in supplying higher mineral N to crops, particularly latter stages of crops. These results suggest that integrated nutrient management was more persistent in supplying mineral N in soil than only chemical fertilizers".

3.3.3 Available phosphorus

Phosphorus is one of the major and important nutrient which is required for normal growth of the plant. Due to deficiency of P in soil leads restricted growth of plant tops and roots. Hence, application of P containing fertilizer is necessary for growth of plant which is available from phosphocompost , organic manure and chemical fertilizer.

Result pertaining to the P availability in soil influenced by nutrient management through organics *i.e* phospocompost obtained from cotton stalk and bajra stalk, FYM and inorganic fertilizers was presented in Table 6. The significantly maximum available phosphorus content was recorded in the treatment T_4- 100% RDF + 2.5 t cotton stalks phosphocompost ha^{-1} (T_4) followed by the treatment T_3- 100% RDF + 2.5 t bajra straw phosphocompost ha^{-1}. The significantly lower available phosphorous was noted in the control treatment T_1. Quite higher values of available P in soil was noticed with cotton stalk phosphocompost may be due to the higher P content in cotton stalks as compared to bajra straw.

Availability of phosphorus was gradually increased from sowing stage to flowering stage and thereby declined at harvest stage indicating the higher turnover at flowering after sowing. Similar finding were reported by Thakare and Wake [23] with vermicompost and FYM application to pearl millet.

3.3.4 Available potassium

Potassium is an important macro element which require for the growth of plant. Potassium plays certain important role in plant that is enzyme activation, stomatal activities, transport of sugar, protein synthesis and starch synthesis.

Data pertaining to available potassium content in soil influenced by combination of different organic and inorganic sources of nutrients was presented in Table 6.

Among the all treatments, maximum availability of potassium was at flowering stage (412.77 kg ha^{-1}) in the treatment T_3 100% RDF + 2.5 t bajra straw phosphocompost ha^{-1} followed by the treatment T_6 - 100% RDF + 5 t FYM ha^{-1} (405.47 kg ha^{-1}). Higher values of available potassium were also recorded (396.36 and 392.70 kg ha^{-1}, respectively) with 100% RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1} (T_4) and 75% RDF + 2.5 t Bajra straw phosphocompost ha^{-1} (T_7).

At harvest of pearl millet, the highest potassium contents (397.52 kg ha^{-1}) was observed in the treatment T_3 - 100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1} followed by treatment T_6 - 100% RDF + 5 t FYM ha^{-1} (390.31 kg ha^{-1}) and treatment T_4 - 100 % RDF + 2.5 t cotton stalk phosphocompost ha^{-1} (381.20 kg ha^{-1}).

Moharana et al. [22] observed the significant build up of potassium contents in soil due to combined use of organic and inorganic fertilizer. Further, they noticed the increase in K content with advancement of crop growth stages of wheat. Potassium availability increased with the application and levels of organic manures was observed by Thakare and Wake [23].

Available K in soil increased with the application of organic manure which is due to solubilising action of organic acids produced during the decomposition and its higher capacity to hold K in available form.

From the conspectus of earlier discussion, it may be construed that use of enriched phosphocompost prepared from crop residues along with inorganic fertilizers contributes in maintaining NPK status of soil which is required for sustainability in crop production.

3.4 CEC Influenced by Phosphocompost Application

CEC is an inherent soil characteristic and is difficult to alter significantly. It influences the soil's ability to hold essential nutrients.

Result pertaining to the CEC in soil influenced by rock phosphate enriched phosphocompost, FYM and inorganic fertilizer was presented in Table 7. It is quite evident from data that the differences were occurred due to various treatments. CEC at harvest of pearl millet ranges from 23.20 to 26.87 Cmol kg^{-1}. The higher values of CEC were occurred after application of phosphocompost as compared to FYM. The higher values of cation exchange capacity were occurred in treatment T_4 - 100% RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1} (26.87 Cmol kg^{-1}) followed by treatment T_3 - 100% RDF + 2.5 t bajra straw phosphocompost ha^{-1} (26.40 Cmol kg^{-1}. The higher values of CEC were also observed in treatment T_8 (26.12 Cmol kg^{-1}) that is 75% RDF + 2.5 t Cotton stalks phosphocompost ha^{-1} followed by T_7 (25.92 Cmol kg^{-1}) that is 75% RDF + 2.5 t Bajra straw phosphocompost ha^{-1} as compared to FYM .

However, treatments T_3, T_4, T_7 and T_8 was found statistically at par at harvest stage of peal millet. The lower value was found in treatment T_1-control over the all other treatments.

The present findings are in accordance with those of Mahanta et al. [24] who reported that application of organic manure (FYM) increased the cation exchange capacity of soil over NPK application. Similar increase in CEC with INM also noticed by Sharma [25]. The increase in cation exchange capacity is due to the addition of compost/FYM, as formation of humus supplies shelter to exchangeable cations.

3.5 Available Fe, Mn, Zn and Cu Contents at Harvest of Pearl Millet

Soil available micronutrient content after harvest of pearl millet was presented in Table 7. The availability of micronutrient *viz*., Fe, Mn, Zn and Cu with different organic and inorganic treatment were increased from 6.82 to 11.97, 13.12 to 22.45, 1.12 to 5.10 and 1.25 to 4.12 mg kg^{-1}, respectively and the highest contents were recorded in treatment T_4- 100% RDF + 2.5 t Cotton stalks phosphocompost ha^{-1} followed by treatment T_3- 100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1} *i.e.* 11.23, 4.67 and 3.90 mg kg^{-1}, respectively. The highest content of Mn (22.45 mg kg^{-1}) was recorded in 100% RDF + 2.5 t Bajra straw phosphocompost ha^{-1} (T_3) followed by 100% RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1} (20.84 mg kg^{-1}).

Results are in conformity with the finding of Arbad et al. [26]. They observed that application of chemical fertilizer + compost increased availability of DTPA Fe and Zn significantly. They further stated that increase in micronutrient cation might be the result from transformation of sound phase to soluble metal complexes *i.e.* DTPA extractable form.

Significant effect of FYM in increasing micronutrient content was also observed by Rutkowska et al. [27]. Such build-up of cationic micronutrients in soil might be partly owing to release of native soil micronutrients resulting from the dissolution action of organic manure and also partly due to release from applied organic manure. Well decomposed FYM and compost might have involved in formation of chelates with organic ligands which have lowered susceptibility to adsorption, fixation and precipitation in the soil and also it was attributed to mineralization of organic manures and consequent release of micronutrients.

4. CONCLUSION

Based on the experimental findings application of 100 % RDF+ 2.5 t Cotton stalks phosphocompost ha^{-1} and 100% RDF+ 2.5 t bajra straw phosphocompost ha^{-1} were beneficial in terms of yield parameter, plant nutrient uptake and soil chemical properties on pearl millet. The cotton stalks and bajra straw phosphocompost are the better alternative for cow dung compost.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that NO generative AI technologies such as Large Language Models and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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