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EFFECT OF VERMICOMPOST ENRICHED WITH ROCK PHOSPHATE ON THE YIELD AND UPTAKE OF NUTRIENTS IN COWPEA (*VIGNA UNGUICULATA* L. WALP)

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Abstract: A field experiment was conducted in a Rhodic Haplustox during 1997-98 to study the effect of enriched vermicompost on the yield and uptake of nutrients by cowpea. Among the different treatments tried, enriched vermicompost showed its superiority over other treatments for yield and uptake of major nutrients like N, P, K, Ca and Mg. But the micronutrient uptake was not significantly influenced by any of the treatment.

Key words: Cowpea, nutrient uptake, vermicompost, yield

INTRODUCTION

The success of sustainable agriculture is very much dependent upon the availability of cheap and good quality organic manures. Among the sources of available organic manures, vermicompost is a potential source due to the presence of readily available plant nutrients, growth enhancing substances, and a number of beneficial microorganisms like nitrogen fixing, P solubilising and cellulose decomposing organisms. Since a number of microorganisms are in close association with earthworms and vermicompost, enriching vermicompost with rock phosphate may enhance multiplication of beneficial microbes and the P solubilising organisms present and are expected to react with rock phosphate and convert the insoluble phosphate to plant available forms. Such vermicompost will have an added advantage in crop production. Hence an experiment was undertaken to study the efficiency of enriched vermicompost on yield and uptake of nutrients using cowpea as a test crop.

MATERIALS AND METHODS

The investigation was carried out in a Rhodic Haplustox during the period from February to May in the year 1998. The maximum and minimum temperature during the cropping period were 32.26°C and 24.46°C respectively and the annual rainfall received during the period was 1293 mm. The soil of the experimental site was sandy loam having pH 5.0, electrical conductivity 0.01 dSm^{-1}, available N 219.28 kg ha^{-1}, available P_2O_5 30.58 kg ha^{-1} and available K_2O 167.33 kg ha , exchangeable Ca 0.78 cmol kg" and exchangeable Mg 1.12 cmol kg" . The experiment was laid out in RBD with 13 treatments and three replications.The treatment details are given in Table 1.

Table 1. Treatment details

T1	No manures and fertilizers
T2	P_2O_5 30 kg
T3	FYM 20 t
T4	Vermicompost 20 t
T5	Enriched vermicompost 20 t
T6	FYM 20 t + P_2O_5 30 kg
T7	FYM 20 t + P_2O_5 15 kg
T8	Vermicompost 20 t + P_2O_5 30 kg
T9	Vermicompost 20 t + P_2O_5 15 kg
T10	Vermicompost 20 t + P_2O_5 30 kg (primed for 15 days at 60 per cent moisture)
T11	Vermicompost 20 t + P_2O_5 15 kg (primed for 15 days at 60 per cent moisture)
T12	FYM 20 t + P_2O_5 30 kg (primed for 15 days at 60 per cent moisture)
T13	FYM 20 t + P_2O_5 15 kg (primed for 15 days at 60 per cent moisture)

Vermicompost was prepared according to package of practices recommendations of the Kerala Agricultural University using earthworm species *Eudrillus eugeniae* (KAU, 1996). For preparation of enriched vermicompost rock phosphate was added to the biowaste according to the P_2O_5 requirement of cowpea (30 kg ha^{-1}). The nutrient content of vermicompost was 1.83 per cent N, 1.37 per cent P_2O_5 and 2.42 per cent K_2O while that of enriched vermicompost was

1.95 per cent N, 2.15 per cent P_2O_5 and 2.66 per cent K_2O. FYM used in the experiment contained 0.5 per cent N, 0.32 per cent P_2O_5 and 0.5 per cent K_2O. The carrier fertilizers of NPK were urea containing 46 per cent N, Rajphos containing 24 per cent P_2O_5 and muriate of potash containing 60 per cent K_2O.

Nitrogen, potash and lime were applied in all the plots except absolute control. The recommendation for cowpea is 250 kg ha^{-1} lime, 20 kg N ha^{-1}, 30 kg P_2O_5 ha^{-1}, 10 kg K_2O ha^{-1} and 20 t FYM ha^{-1} (KAU, 1996). Cowpea seeds of Kanakamony variety were sown in the field in furrows. FYM, vermicompost @ 20 t ha^{-1} and phosphorus were applied to different plots as basal dose as per the treatments.

Soil samples were collected before and after the experiment for chemical analysis. Plant samples were collected from each plot after harvest of the crop. The samples were oven dried at 65°C for 24 hours and powdered in a Willy mill and used for chemical analysis. The contents of N, P, K in the plant were analyzed (Jackson, 1952) and Ca, Mg and micronutrients were determined using standard procedures (Piper, 1942). The yield was noted and the total uptake of nutrients by plants was calculated from their contents in the plants multiplied by dry matter yield and expressed in kg ha^{-1}.

RESULTS AND DISCUSSION

The data on the yield and yield attributes under different treatments have shown that yield was considerably increased when enriched vermicompost was applied (Table 2). The treatment T_5 produced 28 per cent yield increment over treatment T_6 (FYM + 30 kg P_2O_5) and 21 per cent yield increase over T_8 (vermicompost + 30 kg P_2O_5). The higher availability of nutrients especially N and P and improved soil physical, chemical and biological properties might have contributed to higher yields (More, 1994). Higher yields by the application of enriched organic manures have been reported by Bidanchandra (1992) in green gram, Zachariah (1995) in chilli and Sudhirkumar *et al.* (1997) in chickpea.

The data on the uptake of major nutrients have shown that the uptake of these nutrients was significantly influenced by different treatments (Table 3). The uptake of nutrients by plants was considerably increased when enriched vermicompost was applied. The treatment T_5 enriched vermicompost showed its superiority over other treatments for the uptake of N, P, K, Ca and Mg. Biju (1994) reported higher N uptake in soybean by the application of P solubilisers and organic amendments with rock phosphate. Manjaiah *et al.* (1995) reported similar results in groundnut. The enhanced microbial activity in enriched vermicompost resulted in an increase in the concentration of nutrients in enriched vermicompost. Beneficial microbes like P solublisers and N fixers in the vermicompost induced solubilisation of rock phosphate in enriched vermicompost and helped in N fixation.

Table 2. Yield and uptake of major nutrients, kg ha^{-1}

Treat-ments	Grain yield	Straw yield	N	P	K
T1	585.0	1145.0	40.00	4.53	18.42
T2	690.0	1324.5	42.50	5.42	18.61
T3	817.5	1619.5	50.42	7.39	22.99
T4	877.5	1823.0	63.33	8.57	28.41
T5	1072.5	2093.5	77.88	11.94	33.72
T6	837.5	1650.0	53.42	7.26	23.78
T7	831.5	1575.5	52.45	7.37	22.91
T8	882.5	1839.5	63.13	8.78	28.71
T9	879.0	1830.0	62.62	8.78	28.51
T10	909.0	1850.0	65.08	9.39	29.46
T11	898.5	1810.5	63.58	8.95	29.03
T12	859.0	1678.0	55.86	8.35	24.14
T13	833.5	1623.5	54.85	7.64	24.30
CD	54.05	137.05	6.208	0.723	2.229
SEm+	17.54	44.55	2.012	0.234	0.746

Maximum value for P uptake was recorded by treatment T_5 (enriched vermicompost alone). This treatment was significantly superior to

Table 3. Uptake of secondary and micronutrients at harvest stage

Treat-ments	Ca	Mg	Fe	Mn	Zn	Cu
	kg ha^{-1}		g ha^{-1}			
T1	11.07	4.34	201.5	33.6	48.1	29.00
T2	13.83	5.25	223.5	33.3	59.5	32.00
T3	17.61	6.55	287.0	52.7	74.7	43.75
T4	21.81	7.41	312.5	59.5	82.5	46.00
T5	26.31	8.68	381.5	66.5	93.2	56.00
T6	18.15	6.67	287.00	55.5	74.0	44.10
T7	16.68	6.45	280.0	49.5	71.5	40.85
T8	22.14	7.47	316.5	60.5	81.3	48.10
T9	22.06	7.44	316.5	61.5	81.1	47.85
T10	22.27	7.62	323.5	61.5	85.3	49.85
T11	21.83	7.47	319.0	60.5	83.5	47.00
T12	18.55	6.50	291.5	55.8	76.0	45.90
T13	17.90	6.56	281.0	53.50	73.5	44.10
CD	1.387	0.4094	NS	NS	NS	NS
SEm+	0.4501	0.1328	201.5	33.6	48.1	29.00

treatments T_6 and T_8. P uptake was more in vermicompost treated plots than FYM treated plots. The solubilisation of rock phosphate in enriched vermicompost by P solubilising organisms is attributed to the excretion of organic acids. In addition to P solublisation, these microorganisms can mineralize organic P into soluble forms. These reactions take place in the rhizosphere and because the organisms render more P into solution than that required for their growth and metabolism, the surplus is available for plants, thereby increasing the uptake. Bidanchandra (1992) reported that enriched compost increased N and P uptake in green gram.

Vermicompost treated plots registered high availability of K compared to FYM treated plots. Bhaskar *et al.,* (1992) inferred that earthworm increases the availability of K by shifting the equilibrium among the forms of K from relatively unavailable forms to more available forms. Increased availability of nutrients in enriched vermicompost especially P would have enhanced root proliferation which helped in more uptake of K. Also K linearly increases with N uptake (Biswas, 1987; Salam, 1988). Similar results of K uptake in chickpea were observed by Sudhirkumar *et al.* (1997). Higher amounts of Ca and other bases present in worm casts have been reported by Stephens *et al.* (1994) and Vasanthi and Kumaraswamy (1996). Maximum Ca and Mg uptake was recorded by plants treated with enriched vermicompost (Table 3). The higher content of these cations present in plants treated with enriched vermicompost may be due to increased uptake through enhanced availability from the soil.

There was no significant difference between treatments for the uptake of micronutrients (Table 3). However, compared to FYM treated plots, vermicompost treated plots showed an enhanced micronutrient uptake.

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