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Impact of Different Organic Materials on DTPA-Extractable Zinc and Copper Status in Soils of Karnataka

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Abstract

Three soils of different nature belong to Paleustults, Paleustalfs and Haplusterts taxonomy were collected from Hilly (Mudigere), Soutern Transition (Kathalagere) and Central Dry (Hiriyur) zones of Karnataka. These soils were mixed with FYM, city compost (CC), vermicompost (VC) and pressmud (PM) with quantities that was equal to the rate of 12.5 t/ha and incubated at field capacity for 60 days. After incubation, the soils were analyzed for DTPA extractable zinc and copper. The results indicated that DTPA-Zn and Cu contents of all the three soils were increased significantly over the control due to the addition of organic materials. The magnitude of increase was proportionate to the Zn and Cu content of these organic materials. Accordingly, city compost recorded a maximum value of 1.66, 0.91 and 1.16 mg/kg of DTPA-Zn and 1.91, 3.32 and 1.45 mg/kg of DTPA-Cu in soils collected from Mudigere, Kathalagere and Hiriyur, respectively because of its high Zn and Cu content. However, no significant difference was observed between the organic materials.
Key words : Organic materials, Zinc, Copper, Soil.

Intensive cropping involving adoption of high yielding varieties (HYV) together with continuous use of micro nutrients free inorganic fertilizers and decline in the use of organics may decrease the soil quality which stands for the capacity of soil to sustain biological productivity and maintain environmental quality (1). A decrease in soil quality may be due to deterioration in physical fertility and depletion of secondary and micronutrients availability in soils. The recent emphasis on the improvement of deteriorated soil structure by incorporating agriculture and industrial wastes has received much attention. The beneficial effects of organic matter on soil structure, nutrients retention capacity, aggregate stability and their bio-regulatory roles in soil are well documented (2—4). But, the role of organic as a nutritional source has not been emphasized particularly as source of micronutrients. Recently, Prasad (5) and Prasad et al. (6) emphasized the use of organic manures for amelioration of zinc and Fe deficiency in soils. Organic materials, besides supplying nutrients to growing plants, react with native source of micronutrients and rendering them available to the plants. Therefore, an attempt was made to assess the impact of different organic materials on the availability of zinc and copper in soils of Karnataka.

Methods

Three soils were collected from Mudigere (Hilly zone), Kathalagere (Southern Transitional zone) and Hiriyur (Central Dry zone) of Karnataka. Before incubation, these soils were characterized for their properties. Particle size distribution in soils was determined by International pipette method (7). The pH, EC, organic carbon of both soil and organic materials were determined by potentiometric, conductometric, Walkley and Black's wet oxidation methods, respectively (8) and ammonium ion saturation and acid neutralization methods as described by Jackson (8) for determination of CEC and $CaCO_3$ equivalent in soils. Available nitrogen in soils was estimated by Subbaiah and Asija (9), available P_2O_5 by Bray's and Olsen's methods (8) and the available K_2O by flame photometry using N$\underline{N}$ NH_4OAc as an extractant (8). Total nitrogen content in organic material was determined

Table 1. Physico-chemical properties of soils used in the investigation.

Parameters	Mudigere	Kathalagere	Hiriyur
Soil Properties			
Soil taxonomy	*Paleustult*	*Paleustalf*	*Haplustert*
Sand (%)	80.00	68.50	39.00
Silt (%)	8.00	7.50	12.20
Clay (%)	12.00	24.00	48.80
Soil texture	Sandy loam	Sandy clay loam	Clayey
Chemical Properties			
pH	5.54	6.44	8.53
EC (dS/m at 25 C)	0.43	0.37	0.30
Organic carbon (%)	1.38	0.66	0.51
CEC (cmol (p^+/kg)	10.20	16.80	40.00
$CaCO_3$ Equivalent (%)	–	3.60	6.80
Avail. nitrogen (kg/ha)	347.56	212.52	144.90
Avail. P_2O_5 (kg/ha)	21.35	25.31	17.36
Avail. K_2O (kg/ha)	258.45	365.57	440.83
DTPA-Zn (mg/kg)	1.14	0.62	0.40
DTPA-Cu (mg/kg)	1.68	3.34	1.32
Total Zn (mg/kg)	135.00	200.00	160.00
Total Cu (mg/kg)	26.00	60.00	50.00

Table 2. Chemical characteristics of organic materials used in the investigation.

Parameters	FYM	City compost	Vermi-compost	Press-mud
pH (1 : 10)	7.90	7.64	7.72	6.72
EC (dS/m at 25 C)	1.64	2.02	2.28	2.82
Organic carbon (%)	7.06	8.82	18.00	33.20
Nitrogen (%)	0.90	1.12	1.82	1.34
P_2O_5 (%)	0.40	0.56	0.61	2.10
K_2O (%)	0.60	0.59	0.48	0.53
Total Zn (mg/kg)	100.00	325.00	197.50	180.00
Total Cu (mg/kg)	82.50	177.50	32.50	100.00

by Kjeldahl's method (10). After digesting the organic material with triacid mixture, phosphorus and potassium concentrations in the digest were determined by vanadomolybdate yellow color and flamephotometric methods, respectively. Similarly, zinc and copper concentrations in the digest were also determined by atomic absorption spectrophotometric method (10).

During incubation, in quadruplicate, 500 g of 2mm sieved soil samples were mixed with FYM, city compost (CC), vermicompost (VC) and pressmud (PM) with quantities that was equal to the rate of 12.5 t/ha and incubated at field capacity for 60 days. Then the samples were dried and used for DTPA-Zn and Cu analysis.

DTPA-extractable zinc and copper present in soils were extracted with DTPA-extractant (0.005 M diethylene triamine penta acetic acid +0.1 M triethanolamine + 0.01 M calcium chloride, pH 7.3) at 1:2 soil to extractant ratio, shaken for two hours and filtered (11). Zinc and copper concentrations in the filtrate were determined by using atomic absorption spectrophotometer under suitable measuring conditions as given in the manual of the instrument (10).

Results and Discussion

The data on physico-chemical properties is presented in Table 1. Soil (*Paleustult*) collected from Mudigere, which comes under Hilly zone of Karnataka had a sandy loam texture with 12 percent clay. The soil was acidic (pH 5.54) with high organic carbon status (1.38%), but the cation exchange capacity was low (10.20 cmol (p^+)/kg) and recorded no $CaCO_3$ content because of its acidic nature. Soil (*Paleustalf*) from

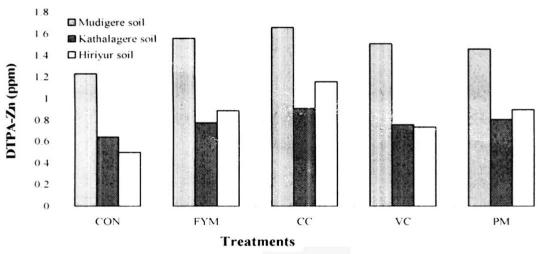

Figure 1. Influence of organic materials on DTPA-extractable zinc status in soils after 60 days of incubation.

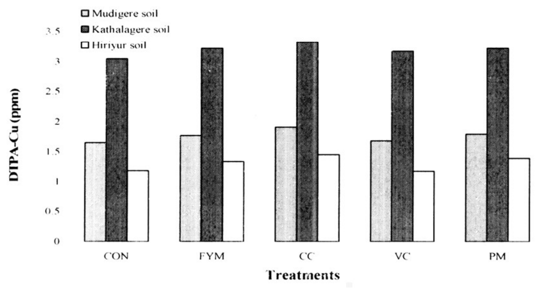

Figure 2. Influence of organic materials on DTPA-extractable copper status in soils after 60 days of incubation.

Table 3. Influence of organic materials on DTPA extractable zinc and copper status (mg/kg) in soils after 60 days of incubation.

Treatments	Mudigere soil		Kathalagere soil		Hiriyur soil	
	Zn	Cu	Zn	Cu	Zn	Cu
Control	1.32	1.65	0.64	3.05	0.50	1.18
FYM 12.5 t/ha	1.56	1.77	0.78	3.22	0.89	1.34
City compost 12.5 t/ha	1.66	1.91	0.91	3.32	1.16	1.45
Vermicompost 12.5 t/ha	1.51	1.68	0.76	3.17	0.74	1.17
Pressmud 12.5 t/ha	1.46	1.79	0.81	3.22	0.90	1.39
SE ±	0.03	0.01	0.02	0.02	0.02	0.01
CD at 5%	0.10	0.04	0.05	0.07	0.07	0.04

Kathalagere (Southern Transitional Zone of Karnataka) exhibited sandy clay loam texture with slightly acidic pH (6.44). Organic carbon content of the soil was medium (0.66%) and the CEC (24 cmol (p^+)/kg) was more than that of soil from Mudigere. Similarly, the third soil (*Haplustert*) used in the study was collected from Hiriyur, which belongs to Central Dry Zone of Karnataka, exhibited clayey texture with 48.80% clay. This soil was alkaline in nature (pH, 8.53) and contained low organic carbon (0.51%). But, the CEC was found to be high (40 cmol (p^+)/kg) compared to other two soils used in the investigation because of its high clay content and was also dominated by montmorillonite clay mineral. The chemical composition of the organic materials used in the investigation is presented in Table 2.

Table 3 indicates that DTPA-Zn in all the three soils significantly increased over the control due to the application of FYM, city compost, vermicompost and pressmud 12.50 t/ha. Among the organic materials, city compost increased the DTPA-Zn to a maximum value of 1.66, 0.91and 1.16 mg/kg in the soils of Mudigere, Kathalagere and Hiriyur, respectively (Fig. 1). Similarly, the applied organic materials significantly increased the DTPA-Cu content in all the three soils compared to the control. However, city compost amended treatment recorded higher values viz., 1.91, 3.32 and 1.45 mg/kg of DTPA-Cu in soils collected from Mudigere, Kathalagere and Hiriyur, respectively (Fig. 2). Further, in all the three soils, it was noticed that magnitude of increase in the DTPA-Zn and Cu was proportionate to the zinc and copper contents of the organic materials (Table 2). An increase in DTPA-Zn and Cu in the soils was due to added organic materials could be explained by the following reasons : Addition of zinc and copper to these soils through the organic materials; an increase in microbial activity in the soils due to addition of organic materials and consequent release of complexing agents which react with native sources zinc and copper in soils and form soluble complexes thereby prevent them from precipitation and fixation by soil constituents. These results confirmed the research findings of Katyal and Sharma (12), Randhawa (13) and Nayak et al. (14).

Therefore, it can be concluded that applying organic materials can increase DTPA-Zn and Cu status in soils and the magnitude of increase could be proportional to the zinc and copper content of the organic materials.

References

1. SSSA. 1996. *Glossary of Soil Sci. Soc.* Am. Madison, Wisconsin, USA.
2. Biswas T. D. and M. H. Ali. 1969. Relation and availability of soil nutrients as influenced by soil organic carbon. *Indian J. Agric. Sci.* 39 : 582—588.
3. Dhoot J. S., N. T. Singh and S. S. Brar. 1974. Note on the influence of organic matter on polyuronides of soil aggregates. *Ind. J. Agric. Sci.* 44 : 243—244.
4. Singh K. D., S. Kar and S. B. Varade. 1975. Structural and moisture retention characteristics of lateritic soil as influenced by organic amendments. *J. Ind. Soc. Soil Sci.* 24 : 129—131.
5. Prasad B. 1981. Use of organic manure for correction of zinc and iron deficiency in maize plant grown in calcareous soils. *J. Ind. Soc. Soil Sci.* 29 : 132—133.
6. Prasad B., A. P. Singh and M. K. Sinha. 1984. Effect of poultry manure as a source of Zn, Fe and as complexing agent on Zn and Fe availability and crop yield in calcareous soil. *J. Ind. Soc. Soil Sci.* 32 : 519—521.
7. Piper C. S. 1966. *Soil and plant analysis.* Hans Publ., Bombay, India.
8. Jackson M. L. 1973. *Soil chemical analysis.* Prentice Hall of India (Pvt.) Ltd., New Delhi, India.
9. Subbaiah B. V. and G. L. Asija. 1956. A rapid procedure for the determination of available nitrogen in soils. *Curr. Sci.* 25 : 259—260.
10. Page A. L., R. H. Miller and D. R. Keeney. 1982. *Methods of soil analysis. Part-2, Chemical and microbiological properties.* Am. Soc. Agron. and Soil Sci. Soc. Am. Inc. publs., Madison, Wisconsin, USA.
11. Lindsay W. L. and W. A. Norvell. 1978. Development of DTPA soil test for Zn, Fe, Mn and Cu. *Soil Sci. Soc. Am. J.* 42 : 421—428.

12. Katyal J. C. and B. D. Sharma. 1991. DTPA extractable and total Zn, Cu, Mn and Fe in Indian soils and their association with some soil properties. *Geoderma.* 49 : 165—179.
13. Randhawa N. S. 1992. Nutrient management for sustained productivity and food security. Int. Symp. on Nutrient Management for Sustained Productivity. PAU, Ludhiana, India.
14. Nayak D. C., S. Mukhopadhyay and D. Sarkar. 2000. Distribution of available micronutrients in alluvial soils of Arunachal Pradesh in relation to soil characteristics. *J. Ind. Soc. Soil Sci.* 40 : 612—614.