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The Effect of Cow Manure and Vermicompost Application on Fractionation and Availability of Zinc and Copper in Wheat Planting

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Introduction: Application of organic fertilizers in agricultural soils with low organic matter content is one of the best ways of nutrientsaddition to these soils. Different organic fertilizers have different effects on nutrient availability in soil. Moreover study of the distribution of nutrients in the soil allows investigating their mobility and bioavailability. The nutrients availability and kinetics of nutrients desorption into the soil solution is often closely related to the distribution of nutrients to different fractions in the soil. It has been assumed that the factors influencing metal fractionation and availability in soil include rate of amendment application, amount of nutrients in amendment, root-induced pH changes, metal binding by root exudates, root-induced changes of microbial activities, and metal depletion because of plant uptake.

Materials and Methods: In this study, availability and fractionation of Zinc (Zn) and Copper (Cu) were compared in one calcareous soil amended with 0, 0.5, and 1% (w/w) of cow manure and vermicompost in a completely randomized design. Also, wheat was planted in treated and untreated soils in greenhouse condition.Available Zn and Cu were determined using different methods (DTPA-TEA, AB-DTPA, and Mehlich 3). For Zn and Cu fractionation, the soil samples were sequentially extracted using an operationally defined sequential fractionation procedure, based on that employed by Tessier et al. (1979) in which increasingly strong extractants were used to release Zn and Cu associated with different soil fractions. Five Zn and Cu -fractions were extracted in the following sequence: Step 1: exchangeable fraction (a 8 ml volume of 1.0 MNaOAc (pH= 8.2) for 120 min. at room temperature)., Step 2: carbonate-associated fraction (a 8 ml volume of 1.0 MNaOAc adjusted to pH 5.0 with acetic acid for 6 h at room temperature, Step 3: iron-manganese oxides-associated fraction (20 ml of 0.04 M $NH_2OH.HCl$ in 25% (v/v) HOAc for 6 h at 96 ^{0}C)., Step 4: organic matter-associated fraction (3 ml of 0.02 N HNO_3 adjusted to pH 2 and 5 ml 30% H_2O_2 (adjusted to pH 2.0 with HNO_3) and at 85 ^{0}C for 2 h in sequence, followed by 3 ml of 30% H_2O_2 (adjusted to pH 2.0 with HNO_3) the sample was heated to 85 ^{0}C for 3 h with intermittent agitation. After cooling, 5 ml of 3.2 M NH_4OAc in 20% (v/v) HNO_3 was added and agitated continuously for 30 min. Finally step 5: residual fraction was determined using 4 M HNO_3 (a 12.5 ml volume of 4 M HNO_3, for 16 h at 80 ^{0}C). Concentrations of Zn and Cu in all extractants were determined by AAS.

Results and Discussion: The results showed that the effect of treatments on amount of extracted Zn by different methods were significant ($P<0.01$), while, the effect of treatments on amount of extracted Cu by different methods wasn't significant ($P>0.05$). The minimum and maximum of extracted Zn by DTPA-TEA were in untreated soil (0.73 mg/kg) and treated soils with 1% manure (1.30 mg/kg) and treated soils with 1% manure (1.17 mg/kg), respectively. The results showed that the effect of treatments on Zn associated with Fe-Mn oxides and Zn associated with organic matter was significant ($P<0.05$), while the effect of treatments on Cu fractions weren't significant ($P>0.05$). The correlation between extracted Zn and Cu by DTPA-TEA and AB-DTPA with Fe-Mn oxides fraction were significant ($P<0.05$).The obtained correlation coefficients showed that correlation between dry matter, concentration, and uptake of Zn with extracted Zn by DTPA-TEA, AB-DTPA, and Mehlich 3, and Zn associated with Fe-Mn oxides were significant ($P<0.05$). Moreover, correlation between extracted Zn by DTPA-TEA, AB-DTPA, and Mehlich with Zn concentration in wheat was significant ($P<0.05$), while correlation between wheat indices and Cu extracted by different methods and fractions weren't significant ($P>0.05$). Minimum and maximum dry matter was found in control soil (4.71 g/pot) and treated soil with 1% cow manure (6.15 g/pot), respectively. The treated soil with 1% vermicompost had maximum dry matter (5.82 g/pot) after soil amended with 1 % cow manure. The results showed that difference between treated soil with 0.5 % cow manure and 0.5 % vermicompost wasnot significant ($P>0.05$).

Conclusion: The results of this study revealed that difference between application of cow manure or

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vermicompost which is produced from cow manure on Zn- and Cu-availability and their fractions weren't significant.

Keywords: Copper fractions, Organic manure, Vermicompost, Wheat, Zinc fractions

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