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Effect of Copper and Organic Matter on Copper Distribution in Two Calcareous Soils.

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Effect of copper and organic matter on copper distribution in two calcareous soils.

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Key Words : copper, calcareous soil, sequential extraction, organic matter

Abstract

Copper is an essential microelement for plants. Soil organic matter content and copper (Cu) are low in most cultivated soils of Iran. Sequential extraction has been used as a suitable method for identification of chemical forms of heavy metals and their potential plant availability. Little information is available about the distribution of Cu in calcareous soils of Iran. A greenhouse experiment was conducted to study the effects of organic matter and Cu on chemical forms of Cu in two calcareous soils Chitgar (S1) and Kamfirooz (S2), of Iran. Treatments consisted of municipal waste compost (K), and cow manure (G) , without organic matter (Con) and two levels of Cu, i.e., 0 , 5 mg Cu kg^{-1} soil in the form of $CuSO_4.H_2O$. The green house study was a factorial experiment arranged as a completely randomized design with three replications which lasted for 8 weeks. Application of organic matter and Cu had significant effects on both soils. Copper mainly occurred in residual fraction in both soils. However, carbonate and organic fractions were also remarkable. Application of organic matter increased organic fraction of both soils. Application of Cu decreased residual and increased carbonate Cu.

Introduction

Copper is one of the trace elements necessary for plant nutrition (Sommer, 1931). Sequential extraction of soils is used for quantification of different chemical forms of metals in soils (Lu et al., 2003). They usually start with the weakest and least aggressive and end with the strongest and most aggressive (Canet et al., 1997). Thus, they fractionate heavy metals into different forms according to their solubilities and mobilities, This, furnishes valuable information for predicting metal availability to plant, metal movement in the soil profile, and transformation between different forms of metals in soils (Lu et al., 2003). Significant amount of Cu was reported to be associated with residual fraction (Canet et al., 1997). Application of organic waste to soil decreased residual fraction and increased carbonate and organic fraction (Canet et al., 1997). In calcareous soils of Iran, studies concerning the capacity of soil components for heavy metals retention and the change in chemical form has received little attention (Mafton et al.,2003). Components for heavy metals retention and the change in chemical form have received little attention. The objective of this research was to study the native Cu in two calcareous soils and effect of application of two organic matter sources and Cu on chemical distribution of Cu in two calcareous soils.

Materials and Methods

The greenhouse experiment was conducted in two calcareous soils, namely, Chitgar (S1) and Kamfirooz (S2). from Fars province in southern Iran. Treatments consisted of two organic wastes Esfahan's municipal compost (K) , and cow manure (G) in two levels (2 % w/w on dry weight basis. and without organic matter (Con) and two levels of Cu (0(Con) , 5 mg Cu kg^{-1} soil in the form of $CuSO_4.H_2O$).A factorial completely randomized design with three replications were used. Chemical forms of Cu, i.e., soluble and exchangeable (Sol+Ex), carbonate-bound (Car), organically bound (Or), and residual forms (Re) were evaluated by sequential extraction method (Sposito et al., 2003). The results were statistically analyzed by MSTATC and Duncan s multiple Range Test.

Table 1. Selected characteristics of the soils used in this study.

Soils (%)	Clay (%)	EC_e dS/m	pH 1:1	Total Cu mg/kg	OM (%)	CCE (%)
(S1)	20	0.4	7.4	1.1	0.5	54.0
(S2)	48	0.6	7.7	4.8	1.0	36.3

Table 2. Selected characteristic of the organic matter used in this study.

Organic Matters	pH	Cu mg/kg	P Total mg/kg	EC (dS/m)
Compost (K)	9.7	310	4810	7.2
Cow Manure (G)	7.7	27	8000	7.9

Results and Discussion

Distribution of Cu among its different chemical forms is shown in figures 1and 2. Soluble and exchangeable forms of Cu of all samples were below the detection limit of flame atomic absorption. Yu et al (2003) reported that Cu concentration in soil solution is generally low (0.01-0.6 µmol L^{-1}), due to high affinity of this element to organic and inorganic soil colloids. Copper was mostly concentrated in residual, carbonate and organic fractions in both soils (Figure 2). The percentage of total Cu in residual fraction was 72% and 59% in Chitgar and Kamfirooz respectively. Gupta and Chen (1975) reported a similar result. Distribution of Cu in untreated Chitgar soil was residual > carbonate > organic > exchangeable whereas in Kamfirooz it was residual > organic > carbonate > exchangeable. It seems that distribution pattern of Cu in the soil depends on the land use, organic matter percentage and calcium carbonate (Table1). In the Chitgar soil, most of the Cu was sorbed by calcium carbonate, these findings are in agreement with the results of Garcia-Delgado et al. (1996) who stated that carbonated forms control the reactivity and mobility of Cu in highly contaminated calcareous soils. Copper in Kamfirooz soil, was mainly associated with organic matter (Figure 2). Han et al. (2001) concluded that the high affinity of Cu for organic matter caused Cu to be preferentially bound by the organic matter. Application of compost increased Om-Cu by

approximately 4 and 6% in Chitgar and Kamfirooz, respectively (Figures 1and -2). Sposito et al. (1982) observed that Om-Cu increased as the rate of sludge application increased in alkaline arid zone soils. Application of organic matter had no significant effect on the carbonate Cu. These results are in agreement with those of Gasemi et al. (2006). Application of organic matter significantly decreased Res Cu ($P<0.05$) in Chitgar soil, whereas the effect was not significant in Kamfirooz soil, Gasemi et al., (2006) observed that application of sludge tended to reduce Res Cu in 20 calcareous soils. Application of Cu to increased Car Cu in both soils (Figure 1). McBride and Bouldin (1984) believed that added Cu is adsorbed as hydroxy carbonate species or as precipitation on CaCO3 as malachite.

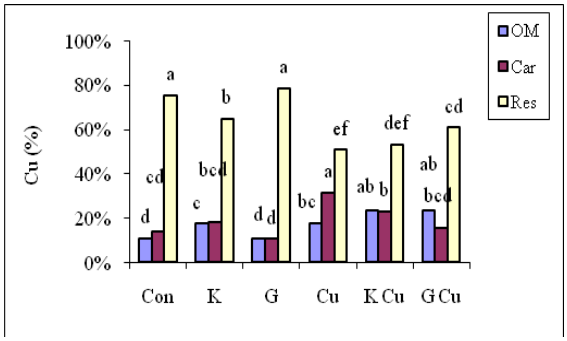

Figure 1: Effect of compost (K) and cow manure (G) with copper (Cu) in copper chemical fraction in Chitgar Soil (S1)

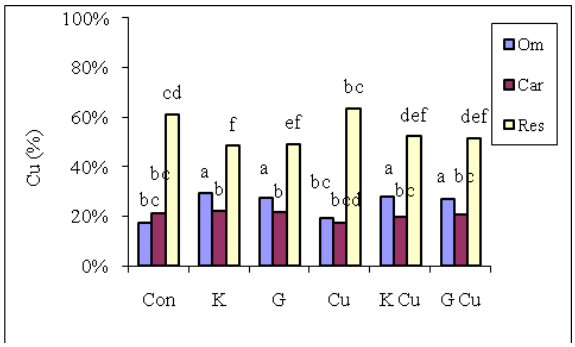

Figure 2: Effect of compost (K) and cow manure (G) with copper (Cu) in Cu chemical fraction in Kamfirooz soil (S2).

Application of Cu tended to significantly decrease Res Cu in both soils,. Canet et al (1997) observed that the Cu treatment in general appeared to decrease the percentage of metals found in Res Cu, because of the increase in the proportion found in the other fraction.

Conclussion

In calcareous soils Cu is appeared to be retained by $CaCO_3$, less Cu is, however retained by $CaCO_3$, when organic matter content is applied. Application of Cu solution decreases the percentage Cu-Res and increases the mobility of Cu. Soil carbonate component has a major role in distribution of Cu in highly contaminated calcareous soils.

Reference

Canet, R., F. Pomares., and F. Tarazona. 1997. Chemical extractability and availability of heavy metals after seven years application of organic wastes to a citrus soil. Soil. Use. Manag, 13: 117-121.

Ghasemi. R., M. Mafton., A. Ronaghi., N. Karimian. J. Yasrebi, and M. T. Assad., 2006. Communi. Soil Sci. Plant Anal. 37:797-809.

Garcia-Delgado,R.A.,Gracia-Herruzo, F., Rodringuez- maroto, J. M., Vereda, C., 1996. Influence of soil carbonate in lead fixation. J Environ Sci and Health. A31 (9): 20999-2109.

Gupta, S.K., and K.Y. Chen. 1975. Partitioning of trace metals in selective chemical fraction of nearshore sediment. Environ. Lett. 10:129-158.

Han, F. X., W. L. Kingery and H. M. Seli. 2001. Accumulation, redistribution, transport, and bioavailability of heavy metals in waste-amended soil. PP. 145-173. In: Iskandar, I.K., M.B. Kirkham, (Eds.), Trace elements in soils, LEWIS Publishers.

Luo, Y., X. .Jiang., L. W. Song., J. Wu., S. Lu., and R. Christie. 2003 Accumulation and chemical fractionation of Cu in a paddy soil irrigated with Cu-rich wastewater. Geoderma. 115: 113-120.

Maftoun, M., N. Karimian, and F. Moshiri. 2002. Sorption characteristics of copper (II) in selected calcareous soils of Iran in relation topsoil properties. Commun. Soil Sci. Plant Anal. 33: 2279-2289.

McBride, M.B, Boulding .P.R. 1984. Longterm reaction of copper in a contaminated calcareous soil. Soil Sci. Soc. Am. J. 1984.48-56-59.

Sommer, A. 1931. Copper as an essential element for plant growth. Plant Physiol. 6: 339-345.

Sposito, G., L. J. Lund, and A. C. Chang. 1982. Trace metal chemistry in arid zone field soils amended with sewage sludge. I. Fractionation of Ni, Cu, Zn, Cd, and Pb in solid phases. Soil Sci. Soc. Am. J. 46: 260-264

Yu. S., L. Z. He, C. Y. Huang, C.G. Chen, and D. V. Calvert. 2003. Copper fractionation and extractability in two contaminated variable- charge soils. Geoderma, 123: 163-175

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	Zhao		Peter Engelund Holm	
14:20-14:40	**Elke Suess** XAS-based characterization of thioarsenates and their transformation to thioarsenites in acidic synthetic solutions	**Nicholas W. Lepp** Woodland development on contaminated soils in N.W. England –benefits and risks	**Irena Twardowska** Potential for sustainable use of biowaste in non-point applications	**Fernando Maya Alejandro** Implementation of in-line pre- and post-column sample treatments in Multi-Syringe Chromatography and their applicability to the determination of trace pollutants in environmental samples
14:40-15:00	**Mauricio Ormachea Muñoz** Arsenic in shallow wells around Poopó Lake in the Bolivian Altiplano	**Theo Thewys** Is the introduction of phytoremediation crops economically viable?	**Peter Engelund Holm** Comparison of EDTA, NTA and soluble humic substances as washing agents for Cd and Cu polluted soil	**Wolfgang Wilcke** Stable isotope ratios of Cu and Zn to distinguish anthropogenic from native Cu and Zn in soil
15:00-15:20	**Summary and Remarks: Steve McGrath Maria Armienta, Martha Litter, Fangjie Zhao**	**Alan Baker** Phytostabilization of saline and arsenic contaminated gold mine tailings using native grass species redgrass (Bothriochloa macra (Steudel) S.T.Blake) Lazarides in the Victorian Goldfields, Australia	**Masafumi Yoshinaga** Biotransformation of methylarsenicals at a Florida golf course: Role of soil bacteria and abiotic factors	**Antonio Serra** MSFIA system for selenium determination using a C18 membrane disk
15:20-15:40		**Nadia Waegeneers** Intake of lead through the consumption of home-produced eggs	**Amir Fotovat** Effect of copper and organic matter on copper distribution in two calcareous soils	**Jean Martins** Heavy metal sorption onto Gram-negative bacteria: a combined approach of solution chemistry, MET-EDX and EXAFS
15:40-16:00		**Engracia Madejón** Restoration strategies in the guadiamar area of South Spain: Evaluation of success after ten years after the aznalcollar accident	**Miguel Vidal** Use of non-hazardous waste materials and clays for the in-situ remediation of a heavy-metal contaminated soil	**Roberto Ramirez Leal** Morphological, size and chemical characterization of inorganic particles atmospheric by scanning electron microscopy with EDS

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