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Effect of compost and manure amendments on zinc bioavailability in an artificially contaminated soil

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Metals are very common contaminants in the soil. Long-term deposition of metals in soil may lead to accumulation, transport and biotoxicity/zootoxicity caused by mobility and bioavailability of significant fractions of metals.

Natural soil organic matter and organic matter supplied to contaminated soils during remediation both decrease Zn availability to plants. The availability of many metal ions, especially trace elements, to higher plants and to soil micro- and macro-faunal organisms is strongly influenced by complexation phenomena with soluble and insoluble fractions of humic substances in soil.

In order to determine the effect of compost addition (highly humified), and manure (poorly humified), on the fate of zinc in soil and plants, a greenhouse pot experiment was carried out in Bari University, Italy. The soil (silt clay loamy) was air dried and sieved through a 2 mm mesh. Solutions of ZnCl2 were added and mixed uniformly with the soil in order to reach an average total concentration of 820 ppm. Then, the soil was transferred in plastic pots of 20 cm diameter and 20 cm depth and it was washed with distillate water to eliminate the excess of free zinc and chloride from the soil. The final total zinc concentration in the soil was 665 mg/kg ss. Each pot (30) was filled with 3 kg of soil plus the organic amendment and thoroughly mixed. Six treatments were carried out in 5 replicates: 1- Control polluted Soil (CTR); 2- Mineral fertilizers (N 97 kg/ha, P 43 kg/ha, K 41 kg/ha); 3- Manure 10 t/ha (M10); 4- Manure 30 t/ha (M30); 5- Compost 20 t/ha (C20); 6- Compost 60 t/ha (C60).

After 60 days, plants were harvested and analyzed for zinc concentration in roots and shoots. Agronomical growth parameters were also determined. Zinc speciation in the soil, redistribution between available and less available chemical form, evaluation of

zinc toxicity under compost, manure and chemical fertilizer application, and quantification of plant uptake were conducted.

Compost promoted an increase in plant growth parameters. Zinc toxicity increased under manure treatments possibly due to the presence of high amount of zinc in soluble (chelated) forms with low molecular weight organic molecules. Toxicity decreased under compost amendments, thus suggesting metal immobilization in the soil possibly through the formation of organo-metallic complexes which reduce its overall availability.