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The Influence of Humic Acids on the Metal Bioavailability and Phytoextraction Efficiency in Long-term Sludge Applied Soil

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Abstract

Heavy metal pollution of soils causes many environmental and human health problems. The bioavailability of metals in soil may be manipulated to improve heavy metal phytoextraction. Although phytoremediation has revealed great potential and synthetic chelators have shown positive effects in enhancing heavy metal extraction, a vast number of negative side-effects was revealed. There exists a need for low cost-effective and environmental friendly materials as an alternative to synthetic chelators. The term humic substances refers to a category of naturally occurring organic materials resulting from the decomposition of plant and animal residues. Humic acids (HA) provide organic macromolecules with an important role in the transport, bioavailability, and solubility of heavy metals. In this research the ability of HA on phytoextraction of heavy metals from sludge polluted soil by the use of tobacco plant under greenhouse conditions was examined. Long-term sludge treated soil enriched with heavy metals (Zn, Cu, Ni, Pb and Cd) was used in the experiment. The influence of exogenous HA on the bioavailability of Zn, Cu, Ni, Pb and Cd from sludge applied soil and heavy metal uptake of tobacco plant was examined in this greenhouse experiment. HA were applied to long-term sewage sludge polluted soil at 1 % and 2 %. Soil samples were collected after harvest and total and DTPA-extractable Zn, Cu, Ni, Pb and Cd contents of soil were determined. Diethylenetriaminepentaaceticacid (DTPA)-extractable Zn, Cu, Ni and Pb concentrations and plant uptake of metals increased significantly by HA applications. While HA treatment at 2 % rate to soil increased the heavy metal concentration in the shoot tissue, plant growth was diminished. The results suggest that soil amendments with HA can be considered as an alternative approach to reduce the availability and mobility of heavy metals and to increase phytoextraction efficiency of heavy metal polluted soils.

Keywords: Humic acids, metal bioavailability, phytoremediation, sludge, tobacco

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