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Overcoming phytoremediation limitations. A case study of Hg contaminated soil

Meri Barbafieri
Institute of Ecosystem Study, Italian National Research Council, Pisa, Italy (meri.barbafieri@ise.cnr.it)

Phytoremediation is a broad term that comprises several technologies to clean up water and soil. Despite the numerous articles appearing in scientific journals, very few field applications of phytoextraction have been successfully realized. The research here reported on Phytoextraction, the use the plant to "extract" metals from contaminated soil, is focused on implementations to overcome two main drawbacks: the survival of plants in unfavorable environmental conditions (contaminant toxicity, low fertility, etc.) and the often lengthy time it takes to reduce contaminants to the requested level. Moreover, to overcome the imbalance between the technology's potential and its drawbacks, there is growing interest in the use of plants to reduce only the fraction that is the most hazardous to the environment and human health, that is to target the bioavailable fractions of metals in soil. Bioavailable Contaminant Stripping (BCS) would be a remediation approach focused to remove the bioavailable metal fractions. BCS have been used in a mercury contaminated soil from Italian industrial site. Bioavailable fractions were determined by sequential extraction with H_2O and NH4Cl.Combined treatments of plant hormone and thioligand to strength Hg uptake by crop plants (Brassica juncea and Helianthus annuus) were tested. Plant biomass, evapotranspiration, Hg uptake and distribution following treatments were compared. Results indicate the plant hormone, cytokinine (CK) foliar treatment, increased evapotranspiration rate in both tested plants. The Hg uptake and translocation in both tested plants increased with simultaneous addition of CK and TS treatments. B. juncea was the most effective in Hg uptake. Application of CK to plants grown in TS-treated soil lead to an increase in Hg concentration of 232% in shoots and 39% in roots with respect to control. While H. annuus gave a better response in plant biomass production, the application of CK to plants grown in TS-treated soil lead to an increase in Hg concentration of 248% in shoots and 185% in roots with respect to control plants.
The BCS efficiency were evaluated analyzing the labile-Hg residue in the soil after the plant growing.
Plants grown with CK and TS in one growing cycle significantly affected labile-Hg pools in soil characterized by sequential extraction, but did not significantly reduce the total metals in the soil. Moreover, if properly optimized, the use of a coupled phytohormone/thioligand system may be a viable strategy to strength Hg uptake by crop plants.