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Chelant-enhanced heavy metals uptake by Eucalyptus trees under controlled deficit irrigation

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Enhancement of phytoremediation of heavy metal polluted soils employs organic ligands, aimed to solubilize, phytoextract and translocate metals into the canopy. The use of more persistent chelants (e.g. EDTA) is phasing out due to concerns over their role in the environment. We tested the hypothesis that controlled deficit irrigation (CDI) of the fast growing, salinity resistant *Eucalyptus camaldulensis* coupled with timely EDTA application enhances sediment phytoremediation while minimizing leaching of metal complexes below the root-zone. This was tested in 220-L lysimeters packed with sand mixed with metals polluted biosolids. One year old trees were brought under CDI with tap or RO water for two growing seasons. EDTA, EDDS and citric acid fertigation at 2 mM started in each May for 2.5-3.5 months, and prescribed soil leaching and sampling of tree leaves started thereafter. While all 3 chelants solubilized biosolids metal in batch extraction (EDDS often being the more efficient), EDTA was the only to increased metal concentrations both in the soil solution and in the *Eucalyptus* leaves. The average concentrations in the soil solution and in the leaves, in the EDTA vs. control (chelant-free) treatments, all respectively, were: Cd - 200 mg L^{-1} vs. 1.0, and 67 vs. 21 mg kg^{-1}; Cu: 90 vs. 1.5 mg L^{-1}, and 17 vs. 3.0 mg kg^{-1}; Cr: 4.0 vs. 1.4 mg L^{-1}, and 3.0 vs. 1.0 mg kg^{-1}; Ni: 60 mg L^{-1} vs. 14, and 20 vs. 6.0 mg kg^{-1}; Pb: $>$44 vs. 0.1 mg L^{-1}, and 9.0 vs. 1.0 mg kg^{-1}; and Zn: 650 vs. 4.0 mg L^{-1} and 200 vs. 70 mg kg^{-1}. While EDDS was undetectable in all the leachates, EDTA concentrated to up to 100 mM. At 10 mM soil solution concentration, EDDS half-life in acclimated lysimeter media was 5-11 days and that of EDTA was $\geq$27-d. The study suggests that sustainable phytostabilization and phytoextraction of heavy metals are achievable under CDI with EDTA augmentation at low dose. This was yet futile with the biodegradable EDDS and citric acid. CDI with RO water further widened the scope of this remediation technique