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Dendroremediation of a Defunct Lead Acid Battery Recycling Site

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Abstract : Use of automobiles has increased and proportionally, the demand for batteries to impulse them. When the device is aged, all the battery materials are reused through lead acid battery recycling (LABR). Importation of used lead acid batteries in Mexico has increased in the last years since many recycling factories have been settled in the country. Inadequate disposal of lead-acid battery recycling (LABR) wastes left soil severely polluted with Pb, Cu, and salts (Na+, SO2− 4, PO3− 4). Soil organic amendments may contribute with essential nutrients and sequester (scavenger compounds) metals to allow plant establishment. The objective of this research was to revegetate a former lead-acid battery recycling site aided with organic amendments. Seven tree species (Acacia farnesiana, Casuarina equisetifolia, Cupressus lusitanica, Eucalyptus obliqua, Fraxinus excelsior, Prosopis laevigata and Pinus greggii) and two organic amendments (vermicompost and vermicompost + sawdust mixture) were tested for phytoremediation of a defunct LABR site. Plants were irrigated during the dry season. Monitoring of the soils was carried out during the experiment: Available metals, salts concentrations and their spatial pattern in soil were analyzed. Plant species and amendments were compared through analysis of covariance and longitudinal analysis. High concentrations of extractable (DTPA-TEA-$CaCl_2$) metals (up to 15,685 mg kg^{-1} and 478 mg kg^{-1} for Pb and Cu) and soluble salts (292 mg kg-1 and 23,578 mg kg-1 for PO3− 4and SO2− 4) were found in the soil after three and six months of setting up the experiment. Lead and Cu concentrations were depleted in the rhizosphere after amendments addition. Spatial pattern of PO3− 4, SO2− 4 and DTPA-extractable Pb and Cu changed slightly through time. In spite of extreme soil conditions the plant species planted: A. farnesiana, E. obliqua, C. equisetifolia and F. excelsior had 100% of survival. Available metals and salts differently affected each species. In addition, negative effect on growth due to Pb accumulated in shoots was observed only in C. lusitanica. Many specimens accumulated high concentrations of Pb (> 1000 mg kg-1) in shoots. C. equisetifolia and C. lusitanica had the best rate of growth. Based on the results, all the evaluated species may be useful for revegetation of Pb-polluted soils. Besides their use in phytoremediation, some ecosystem services can be obtained from the woodland such as encourage wildlife, wood production, and carbon sequestration. Further research should be conducted to analyze these services.

Keywords : heavy metals, inadequate disposal, organic amendments, phytoremediation with trees
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