
**Heavy metal uptake and translocation in *Salix* (willow):
potential as a phyto-remediation agent**

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Salix eriocephala (black diamond willow) and *Salix petiolaris* (slender willow) were grown from strikings for approximately six months, and then subjected to five aqueous treatment levels of thirteen heavy metals (Cu, Pb, Zn, Mo, Ag, Ni, Co, Cr, As, Sb, Cd, Se, Hg; primarily as acetate salts) for three months to assess the level of uptake and distribution of these elements. The -80 mesh (-177 µm) fraction of soils in which the plants were grown were subsequently analyzed in duplicate using aqua regia digestions and ICP-OES and ICP-MS analysis; triplicates of the new growth portions of these plants were dried (at 40°C and 10% humidity), mascerated and subjected to nitric acid/aqua regia digestions and ICP-OES and ICP-MS analysis. In addition, separate plant organs (roots, leaves, old bark, old twigs, new bark, and twigs) were also analyzed by similar biogeochemical methods.

Results reveal that most element concentrations in the soils generally correlate well with respective heavy metal concentrations administered, forming generally linear relationships. In the plants, with the exception of Ni, Sb, Zn, and Ag, element concentrations generally correlate well with the respective heavy metal concentrations administered, but correlate less well with the soil concentrations, probably because of variations in the relative partitioning of these experimental components.

Analyses of the five plant organs reveal that significant translocation of the heavy metals was achieved by the plants. Different elements appear to concentrate in different plant organs, illustrating that the plants have several specific controlling metabolic mechanisms that redistribute these elements within their tissues. For example, Cu, As, Se, Cd, and Hg accumulated strongly in the roots, Mo accumulated strongly in the twigs, and Zn, Ag, Co, Sb, Cd, and Cr accumulated moderately in the bark and to a lesser extent in the leaves.

Results indicate that willow could represent an effective phyto-remediation agent for many soils contaminated by heavy metals. Significant uptake by *Salix* during the growing season could effectively temporarily isolate the contaminants from the environment. Subsequent removal and treatment or recovery of heavy metals from the plant tissues could represent an effective remediation strategy that is far less costly and time consuming than traditional remediation efforts.