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Accumulation of Pb and Zn in Bidens triplinervia and Senecio sp, spontaneous species from mine spoils in Peru, as potential use for phytoremediation in South America

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Heavy metal toxicity has become a global concern due to the ever-increasing contamination of soil, water and crops. Until recent decades little has been known about the remediation of mining sites using spontaneous plants in Latin America. Soil and plant samples were taken in Peru, at a polymetallic mine (mainly silver, lead and copper) in Cajamarca Province, Hualgayoc district. Top soils (0-20 cm) were analyzed for physical and chemical properties by standard methods. Total As, Ba, Cu, Fe, Mn, Pb and Zn concentrations in top soils were determined by ICP-OES. Similar metals in plants were analyzed separately (aerial and root system). Ti content was used as indicator of metal contamination in plants with soil particles. Translocation Factor (TF) defined as the metal concentration ratios between shoot and root and Bioaccumulation Factor (BF) the metal concentration ratios between shoot and soil concentrations were determined.
The soils had near neutral pH (7.4±0.5), a variable content of organic carbon (2.4±1.1) and a loamy texture: sand (42.9±10.8%) and clay (16.7±4.6%). According to the total metal concentrations, the contaminated soils (Hc1 and Hc2) exceeded toxicity thresholds; high Pb (>13500 and 8500 mg•kg-1) and Zn (>28000 and 30500 mg•kg-1) respectively were detected Unusually elevated concentrations of these metals were detected in roots of Bidens triplinervia (e.g. up to 5180 Pb and 9900 Zn) while Senecio sp accumulated more heavy metals in shoots (e.g. up to 4250 and 3870 Zn). Ti content were <1.5%, therefore we descarted the contamination of plant samples with soil. The TF values were <1 in B. triplinervia and >1 in Senecio sp, while the BF were <1 in both species collected in soils contaminated. Bidens triplinervia can be considered interesting for phytostabilization due to its capacity to restrict the accumulation of elevated amounts of Pb and Zn to the roots, while Senecio sp could be interesting for phytoextraction technologies. Moreover, these plants showed an elevated transfer factor and grew in the presence of other toxic metals. The present study, to the best of our knowledge, is the first report on the metal accumulation in roots of Bidens triplinervia and provides a pioner contribution to the very small volume of data available on the potential use of native plant species from contaminated sites in phytostabilization and phytoremediation technologies.