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Phytostabilisation of industrial soils contaminated with Cu, As, Cr and Zn by Salix purpurea

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The ecodynamics of As, Cr, Cu and Zn was studied in phytomanaged soils highly contaminated by Cu from a former wood preservation site (Bordeaux, France). These alluvial sandy soils are managed with natural attenuation, in situ stabilization (compost, dolomitic limestone) combined with phytoextraction (sunflower, tobacco) (so-called aided phytoextraction), and aided phytostabilisation (poplar, willows) and present a wide range of Cu contamination.
This study aims at obtaining data on the soil reaction mechanisms, the concentrations and speciation of potentially toxic trace elements (PTTE) in the water-soil-plant system and notably in the rhizosphere.
First, biotests (cultivation of dwarf beans and bioluminescence of bacteria) were carried out on soils sampled in the field plots presenting an increasing total Cu concentration as well as physico-chemical characterization of the soils, soil solutions and metal speciation (Rhizon, DGT).
Second, two Salix purpurea genotypes were cultivated in mesocosms (rhizoboxes) together with the contaminated soils and an uncontaminated soil from a kitchen garden (belonging to the same soil series). At the end of the growing period, the willow organs were sampled and divided into initial cutting and roots, stems and leaves entirely formed during the treatment for evaluating metal concentrations and mineral masses. Additionally rhizon samplers were deployed into the soils to determine the PTTE concentration in the soil porewater during the development of the root system and the metal(loid) bioavailability was also assessed as before with biotests and DGT probes.
Salix purpurea demonstrated the ability to produce a root system, which was mainly affected at the highest metal concentration, whereas no significant difference in terms of biomass production occurred for the upper plant parts regardless of the different metal concentrations. We also observed a significant absorption of PTTE, while the total dissolved concentration of Cu PTTE in the soil solution was decreased together with the bioavailability after the willow culture. Thus we concluded that willow short rotation coppice may provide a relevant phytomanagement option for these soils.