Assisted phytoremediation: results from a field experiment at a site affected by mining activities (Iberian Pyrite Belt - Portugal)

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Rehabilitation projects for lands impacted by mining activities are being developed, leaving the contaminated soils in place and using amendments, like organic residues and liming materials, to reduce the bioavailability of metals and to restore the ecological function of the site. Organic residues are able to improve soil physical, chemical and biological properties by: (i) raising the pH, (ii) increasing the organic matter content, (iii) adding essential nutrients for plant growth, (iv) increasing the water holding capacity, and (v) modifying heavy metals bioavailability. When amendments are used in conjunction with plants in soil remediation, the strategy can be classified as assisted phytostabilization. This study reports results from a field experiment which aimed to assess the potential use of municipal solid waste compost (MSWC) and lime (CaO), alone or in combination, as soil amendments in aided phytostabilization of a highly acidic metal-contaminated soil affected by mining activities. The study site was located in the vicinity of an active mine in the Portuguese sector of the Iberian Pyrite Belt. The soil at the study site was affected by a spill of mine industrial effluent, and it is highly acidic (pH = 3.6), low in organic matter (0.99%), in essential nutrients (N, P and K) and in cation exchange capacity. Arsenic, Cu, Pb and Zn total concentrations were high (76, 582, 82 and 249 mg kg-1, respectively) and they exceeded the Canadian Soil Quality Guideline values for agricultural soils. The MSWC was applied at 6 Mg ha-1 (dry weight basis), and CaO at 1.3 Mg ha-1, alone or in combination (three replicates per treatment). A control plot, which did not receive any amendment, was also included. Three weeks after soil amendment, each plot was divided in two, and *Helianthus annuus* was seeded in one half of each plot.

The treatments were able to correct soil acidity, especially when simultaneously applied, and, consequently, they were able to immobilize Cu and Zn. On the contrary, As extractability increased as a consequence of the amendments application. Lead extractable content was very low, even in the non-amended plots. The number of germinated plants was significantly higher in plots with simultaneous application of both amendments. However, from the

results, it is possible to conclude that the MSWC application rate should be increased, especially because organic matter content did not increase significantly in the organic amended plots. However, in that case, the increase in As extractability can be a problem that should be further elucidated.

It was impossible to assess the accumulation of metals in plant material, an important aim of this study, because a plague of ants ate the plants that we managed to grew in such a derelict environment. In field experiments, unexpected variables should be expected.

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