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Are plants growing at abandoned mine sites suitable for phytoremediation of contaminated soils?

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Plants growing on abandoned mine sites are of particular interest in the perspective to remediate contaminated soils by phytoremediation, a low cost and environmental friendly technique which uses metal-accumulator plants to clean up moderately contaminated areas. The choice of plants is a crucial aspect for the practical use of this technique, given the ability to accumulate metals in their tissues, being genetically tolerant to high metal concentrations. Up today, more than 400 native plants that hyperaccumulate metals are reported, Brassicaceae being the family with the largest number of hyperaccumulator species. For example, Alyssum bertoloni is well known as Ni accumulator, as well as Thlaspi caerulescens for Zn and Brassica napus for Pb.
However, metal hyperaccumulation is not a common phenomenon in terrestrial higher plants, and many of the European hyperaccumulator plants are of small biomass, and have a slow growth rate. Therefore, there is an urgent need for surveying and screening of plants with ability to accumulate metals in their tissues and a relatively high biomass.

In recent years, a survey of soils and plants growing on contaminated areas at several abandoned sulphide mines in Italy was carried out by working groups of the Universities of Florence, Siena, Cagliari, Bologna, Udine and Venice, in order to evaluate the ability of these plants to colonize mine waste and to accumulate metals, in the perspective of an ecological restoration of contaminated sites.
We investigated the heavy metal concentration of the waste material, and the soils developed from, in order to determine the extent of heavy metal dispersion, and the uptake by plants, and deserved attention to wild plants growing at that sites, to find out new metal-tolerant species to utilize in soil remediation. Current results of these investigations, with particular emphasis on the Tuscan areas, are reported here. All the studied profiles are strongly enriched in metals; their concentration, however, depends on the distance from mine areas, as indicated in the following table:

Sample Metal Mean (ppm) Range (ppm)
Waste soils
ENTISOLS Cu 3527 62-10200
Pb 301 30-830
Zn 798 110-1950
Proximal soils
INCEPTISOLS Cu 1081 16-3400
Pb 623 45-1900
Zn 792 420-1300
Distal soils
ALFISOLS Cu 193 80-340
Pb 267 160-430
Zn 672 410-890

Wild plants (e.g. fescue, plantain, common reed, mint, marigold, dandelion, moon plant, rock-rose, willow) were found to be metal-tolerant and to accumulate high levels of As, Cd, Cr, Cu, Pb, Zn in their tissues (both roots

and aerial parts), although at different extent in response to their metabolic activity, physiology, and to soil and environmental characteristics.

In conclusion, the evaluation of metal uptake by plants, combined with geobotanical observations, is an useful tool to find tolerant plant populations to be used in revegetation programs aimed at reducing the environmental impact of contaminated areas.