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Further investigations on the resilience capacity of Taraxacum officinale Weber growing on mine soils

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Heavy metal accumulation produces significant physiological and biochemical responses in vascular plants. Plants growing on abandoned mine sites are of particular interest, since they are genetically tolerant to high metal concentrations. In this work we examined the effect of heavy metals (HM) on the morphology of T. officinale growing on mine soils, with the following objectives:
- to determine the fate of HM within the soil-plant system;
- to highlight possible damage at anatomical and cytological level;
- to assess the resilience capacity of Taraxacum officinale after three years of pot cultivation.
Wild specimens of Taraxacum officinale Web, with their soil clod, were gathered from four sites with different contamination levels by heavy metals (Cu, Fe, Pb, Zn) in the abandoned Imperina Valley mine (Northeast Italy). Plants were cultivated in pots at the botanical garden of the University of Florence (HBF), and appeared macroscopically not affected by toxic signals (e.g. reduced growth, leaf necrosis) possibly induced by soil HM concentration. Leaves and roots taken at the same growing season were observed by light microscopy (LM) and transmission electron microscopy (TEM).
Light microscopy observations show a clear difference in the cell organization of not-contaminated and contaminated samples. The unpolluted samples present a well organized palisade tissue and spongy photosynthetic parenchyma. Samples from contaminated sites, instead, present a palisade parenchyma less organized, and a reduction of leaf thickness proportional to HM concentration. The poor structural organisations, and the reduced foliar thickness of the contaminated plants, are related to soil contamination. Differences in roots micromorphology concern the cortical parenchyma. Moreover, all the samples examined present mycorrhiza. Ultrastructure observations of the parenchyma cells show mitochondrial structure alteration, with lacking or reduced cristae of the internal membrane at increasing metal content. Instead, chloroplast organization does not present significant differences, particularly in number and compartmentalization of thylakoids.
Although macromorphology does not present evidence of phytotoxicity, the recorded observations of the micromorphological characteristics of leaves and roots, show a suffering state of the plants, strictly related to HM content. Leaching reduced partly the HM content of the soil, therefore decreasing their phytotoxic effect. A gradual restoration of leaf organization suggests that somewhat resilience occurred in plants. Moreover, the presence of stress-tolerant mycorrhizal fungi could contribute to reduce metal toxicity. The resilience capacity suggests that Taraxacum could be a useful species in remediation projects.
Keywords: Heavy metals • Mine soils • Plant morphology • Taraxacum officinale • Ultrastructure