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Use of Plant Bioassays for Assessing Mine Tailings Rehabilitation Strategies

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Extended Abstract

Metalliferous mining is an important economic activity [1] [2] although it produces a large amount of mineral waste (i.e. several thousand million tons per year) that is divided into two distinct physical forms:

- Coarse waste rock: usually with a diameter of 2-20 cm [3] [4]
- Tailings: fine-grained with a diameter <2.0 mm [4]

Disposal and containment of metalliferous mine tailings can result in severe pollution and have aesthetic impacts on the local environment. Creating a vegetation cover on tailings is viewed as an effective strategy for stabilising and reclaiming tailings. Many strategies are available for the remediation of the metalliferous sites, such as physical stabilization, which consists of covering the tailings with an innocuous material, and chemical stabilization, which consists in adding a chemical agent to the tailings able to absorb the pollution [3]. However only with the application of phytoremediation strategies (biological stabilization), it is possible to establish if the remediation is effective and long-term. The phytoremediation of the mine tailings is effective in providing surface stability to prevent the wind-blow of contaminated particulates and in reducing water pollution. Although the phytoremediation is desirable, for several reasons, such as reduced costs compared to conventional remediation techniques, easy monitoring and a high degree of social acceptability, metalliferous wastes are an unfavourable environment for plant growth due to the many growth-limiting factors such as poor water-holding, deficiency of macronutrients and potentially high levels of heavy metals. [5] [6] [7]

Samples of historic (not remediated) Pb/ Zn mine tailing from Ireland and UK were collected in order to assess the metal uptake risk in plants [8]. Tailings were characterized for pH, EC, and the different fractions (soluble, available and total) of metal concentration (using H_2O, 0.1M $CaCl_2$ and aqua regia). The growth of the *Lolium perenne* was evaluated using the Rhizotest™; and the uptake of essential elements (Ca, and Mg) and of heavy metals (Sb, As, Cd, Cr, Fe, Mn, Ni, Pb, Zn) was determined both in the shoots and in the roots.

Finally, the Phytotoxkit™ was used to assess the effects of the remediation treatments on the germination and on the seedling growth of the plant. All the samples were treated with a different amount (percentage) of control soil (i.e. 100% tailings; 80% tailing-20% control-soil; 60% tailings-40% control-soil; until 100% control-soil) using the seeds of *Lepidium sativum*. It was observed that the 100% mine tailings (not treated) severely inhibits the germination and the growth of the plants. The results obtained by the Phytotoxkit show the decrease of percentage inhibition of plant growth (either in roots and shoots) increasing the amount of control soil.

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