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Evaluation of the Metal Removal Capability of Endemic Chilean Species

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Extended Abstract

Copper mining is one of the main economic activities in Chile. Chilean Legislation (Supreme Decree N°248/2007) establishing the concept of tailings as a finely ground solid, which is discarded in mining operations, and it is not considered a hazardous waste. For a long time, due to the lack of regulations, mine tailings were stored without major environmental consideration; therefore, at present, several abandoned impoundments are located near population centres. In 2004 the Supreme Decree N°132 modified the Mining Safety Regulations by incorporating regulations on the closure of mining operations, forcing, for the first time, to the mining companies to execute a closure plan at the end of their production phase including the closure of tailings impoundments.

Phytoremediation is an alternative bioremediation technique that employs plants to recover soil or a water source without adverse effects on the environment [1]. Among the known technologies developed in recent decades, such as physicochemical and thermal processes, phytoremediation has emerged as a cost-effective remediation technology [2,3].

The latest studies in phytoremediation have been performed with flora from Eurasia and South America [2]. In this study, the ability of four endemic species: *Oxalis gigantea*, *Cistanthe grandiflora*, *Haplopappus foliosus* and *Puya berteroniana* to remove Zn, Ni, and Cr from mine tailings was evaluated. These endemic Chilean species belong to families not traditionally considered in the phytoremediation of contaminated substrates, and they were selected based on their adaptation to extreme conditions, low water requirements, ornamental value, availability, and low cost.

The experiments were carried out ex-situ during seven months. After the growth period, the plants were divided in aerial parts (leaves and stems), and roots, and the translocation and bioconcentration factors were calculated together with their removal efficiency for each part. The technique of inductively coupled atomic emission spectroscopy (ICP-OES) was used to determine the elemental composition using a Perkin Elmer ICP Optima 2000DV and the data was treated statistically.

Among the species studied, *Cistanthe grandiflora* and *Puya berteroniana* can accumulate Cr and Zn but not translocate them, showing their potential to phytostabilize these elements, obtaining a bioconcentration factor for Zn close to 1.2 for both species, 1.5 in the case of *Cistanthe grandiflora* for Cr, and 1.7 for *Puya berteroniana* for the same metal. *Oxalis gigantea* and *Haplopappus foliosus* only showed the ability to concentrate Zn in the roots, with a BCF close to 1.2, similar to the value obtained with the other species. In the case of Ni, its bioconcentration factor was under 1 in all species.

Promising results were obtained in the case of Cr and Zn with *Puya berteroniana* and *Cistanthe grandiflora*, but their removal efficiencies were low, not exceeding 10.0% and 6.4%, respectively. Additional work should be conducted to improve the performance of these species in order to make them a real alternative for the phytostabilization of tailings.

References

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