UNIVERSIDAD DE LA FRONTERA

Facultad de Ingeniería y Ciencias

Doctorado en Ciencias de Recursos Naturales

COPPER TOLERANCE AND ACCUMULATION IN IMPERATA CYLINDRICA: A METALLOPHYTE WITH POTENTIAL FOR PHYTOREMEDIATION IN COPPER-CONTAMINATED ENVIRONMENTS

DOCTORAL THESIS IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE DOCTOR OF SCIENCES IN NATURAL RESOURCES

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TEMUCO-CHILE

2021

“"Copper tolerance and accumulation in Imperata cylindrica; a metallophyte with potential for phytoremediation in copper contaminated environments"”

Esta tesis fue realizada bajo la supervisión del director de tesis, Dra. Pablo Cornejo del departamento de Ciencias Químicas y Recursos Naturales de la Universidad de la Frontera y ha sido aprobada por los miembros de la comisión examinadora.

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Thesis summary

"The north-central region of Chile is renowned for its copper mining activity, which has adversely impacted the soil due to excessive copper (Cu) accumulation, resulting in altered physical and chemical properties and reduced plant cover. Notably, certain plant species, including metallophytes adapted to stress, manage to survive in these conditions. Understanding metallophyte responses to potentially toxic elements (PTEs) like Cu holds promise for utilizing these species in bioremediation efforts. In our study, we cultivated Imperata cylindrica plants in substrate supplemented with 300 mg Cu kg-1 under greenhouse conditions for 21 days. The findings reveal I. cylindrica's role as a Cu accumulator, primarily in its roots (200–600 mg Cu kg-1 biomass), displaying tolerance to high Cu levels through increased synthesis of phenolic compounds in shoots. Root gene expression analysis yielded 7386 differentially expressed genes (DEGs), contrasting with a significantly smaller 36 DEGs in shoots. Root DEGs were primarily associated with actin and cytoskeleton structure, along with metal transporters and superoxide dismutase activity. Notably, our results underscore the pivotal role of the cytoskeleton in managing Cu stress through root ultrastructural binding mechanisms."