UNIVERSIDAD DE LA FRONTERA

Facultad de Ingeniería y Ciencias

Doctorado en Ciencias de Recursos Naturales

COPPER NANOPARTICLES IN SOIL-PLANT SYSTEM:

IMPACT ON NITRIFYING BACTERIA

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

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“COPPER NANOPARTICLES IN SOIL-PLANT SYSTEM: IMPACT ON NITRIFYING BACTERIA”

Esta tesis fue realizada bajo la supervisión del director de tesis, Dr. Gonzalo Tortella Fuentes del Departamento de Ingeniería Química de la Universidad de La Frontera y ha sido aprobada por los miembros de la comisión examinadora.

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Thesis summary

"This thesis investigates the impact of commercial copper nanoparticles (CuNPs) on nitrifying communities in a soil-plant system and their influence on plant nitrogen assimilation. The behavior of CuNPs' sorption in soil was evaluated, showing strong sorption with dose-dependent dissolution, enhancing copper's bioavailability. CuNPs led to increased copper translocation in plants over time, attributed to their ability to promote copper dissolution. Initially, nitrification was inhibited by CuNPs, but resistance emerged over time. Reduced nitrate production affected plant nitrogen assimilation, leading to decreased leaf nitrogen content. The study examined the copper impact on soil microbial communities, indicating shifts in bacterial structure and abundance. Ammonia-oxidizing bacteria (AOB) significantly increased in abundance, particularly at higher CuNP concentrations, while archaea (AOA) were minimally affected. The study also explored CuNPs' effect on soils containing the herbicide atrazine, influencing pesticide dissipation and sorption parameters. In conclusion, CuNPs negatively impacted nitrifying communities and soil functioning, resulting in reduced plant nitrogen assimilation. The study highlighted resistance mechanisms in soil microorganisms warranting further investigation."