

**UNIVERSIDAD DE LA FRONTERA**

Facultad de Ingeniería y Ciencias

Doctorado en Ciencias de Recursos Naturales



**EFFECTS OF TILLAGE, FERTILIZATION AND CROP  
ROTATION ON THE BIOLOGICAL ACTIVITIES OF AN  
ECUADORIAN SOIL FROM THE ANDEAN HIGHLANDS:  
TOWARDS THE OPTIMIZATION OF SOIL MANAGEMENT  
FOR A SUSTAINABLE AGRICULTURE**

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

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**TEMUCO-CHILE**

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**“Effects of tillage, fertilization and crop rotation on the biological activities of an Ecuadorian soil from the Andean highlands: towards the optimization of soil management for a sustainable agriculture”**

Esta tesis fue realizada bajo la supervisión del director de tesis, Dr. 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

This study evaluated the impacts of diverse agricultural practices on the physicochemical and biological aspects of an Andean soil in Ecuador. The effects of tillage, nitrogen fertilization, and crop rotation were investigated. Biological indicators, including acid phosphatase,  $\beta$ -glucosidase, fluorescein diacetate hydrolysis, microbial biomass carbon (Cmic), soil basal respiration (BR), arbuscular mycorrhizal fungi (AMF) spore density, and total glomalin content (TGRSP), were analyzed alongside physicochemical properties. Conventional tillage and crop rotation significantly influenced both physicochemical and biological soil attributes. Over successive crop rotations, no-tillage led to enhanced BR, TGRSP, and increased AMF spore density in both rotations. Cmic remained stable in certain rotations, while BR doubled in value. AMF spore density increased significantly, by 308% and 461% at the end of specific rotations, as did TGRSP by 18% and 32%. These positive changes were associated with the accumulation of organic matter from crop residues, facilitated by post-harvest no-tillage, fostering improved soil moisture, biological activity, and AMF interaction. Overall, conservation soil management demonstrated clear advantages over intensive practices, contributing to enhanced soil properties.