

**UNIVERSIDAD DE LA FRONTERA**

Facultad de Ingeniería y Ciencias

Doctorado en Ciencias de Recursos Naturales



**DEVELOPMENT OF A BIO-BASED PROTECTANT FOR  
PLANTS AGAINST FREEZING, USING CASTOR OIL AS  
RAW MATERIAL**

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

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**“Development of a bio-based protectant for plants against freezing, using castor oil as raw material”**

Esta tesis fue realizada bajo la supervisión del director de tesis, Dra. Mara Cea del Departamento de Agroindustria de la Universidad de la Frontera y ha sido aprobada por los miembros de la comisión examinadora.

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## Thesis summary

Low temperature stress is one of the most important abiotic stresses that affect plants, and especially crops. This stress can be divided into chilling ( $> 0^{\circ}\text{C}$ ) and freezing ( $< 0^{\circ}\text{C}$ ) stress, and the damage level will depend on intensity and duration of low temperature. The mechanisms to protect itself against freezing stress can be avoided or tolerated. In this sense, many products have been developed to protect crops. These products could act with one or both mechanisms. Lipid derivatives and polyols have shown effectiveness to protect crops. Castor oil could protect crops against freezing stress through a lipophilic membrane over leaves, due to ricinoleic acid, and increasing the unsaturated fatty acids content in the cellular membrane, improving its stability. Only one application of the castor oil-based emulsion over tomatoes 24 h before the stress did not increase the tomato resistance against freezing. Application of linoleic acid, under the same conditions, avoids freezing slightly, favoring supercooling. Utilization of fatty acid ethyl esters damaged tomato plants, even causing their death. Anyway, some damage level was registered when linoleic acid was applied over leaves. Utilization of fatty acids (or lipids) is considered a passive method, and periodic applications must increase crop protection.

