Title: Adaptive Mechanisms of Freeze Avoidance in Plants: A Brief Update

Author: Michael Wisniewski Lawrence Gusta Gilbert Neuner

PII: S0098-8472(13)00203-7
DOI: http://dx.doi.org/doi:10.1016/j.envexpbot.2013.11.011
Reference: EEB 2712

To appear in: *Environmental and Experimental Botany*

Received date: 6-9-2013
Revised date: 14-11-2013
Accepted date: 15-11-2013

Please cite this article as: Wisniewski, M., Gusta, L., Neuner, G.,Adaptive Mechanisms of Freeze Avoidance in Plants: A Brief Update, *Environmental and Experimental Botany* (2013), http://dx.doi.org/10.1016/j.envexpbot.2013.11.011

Adaptive Mechanisms of Freeze Avoidance in Plants: A Brief Update

Michael Wisniewski[a,*], Lawrence Gusta[b], and Gilbert Neuner[c]

[a] *United States Department of Agriculture, Agricultural Research Service, Kearneysville, WV USA*

[b] *Department of Plant Science, University of Saskatchewan, Saskatoon, Canada*

[c] *Institute of Botany, University of Innsbruck, Innsbruck, Austria*

Abstract

Freeze avoidance has evolved in plants in response to selection pressures brought about by exposure to freezing temperatures. It is a multifaceted adaptive mechanism with many attributes. Despite the prevalence of freeze avoidance as an adaptive mechanism little research has been devoted in recent times to understanding the underlying mechanisms and regulation of freeze avoidance. Therefore, there is no shortage of questions that need to be addressed. Inherent in understanding how plants respond to freezing temperatures is the need to know the properties of water at different temperatures and how the interaction of water with biological substances affects these properties. This review provides an overview of the subject of biological ice nucleation and propagation and how various aspects of plant structure and composition can affect the freezing process. Deep supercooling of plant tissues represents the most extreme example of freeze avoidance. The potential role of anti-nucleating substances in defining the ability to deep supercool is also discussed. The importance of studying intact plants in their natural environments is emphasized. Although, this adds a high degree of complexity to investigations, it is in this context that adaptive mechanisms have evolved and play a role in the biology and survival of plants.

Keywords: biological ice nucleation, ice propagation, deep supercooling, infrared video thermography, frost injury, alpine ecology