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Plant Cold Acclimation

Methods and Protocols

Second Edition

Edited by

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Preface

It has frequently been remarked in the scientific literature that plants as sessile organisms are forced to deal with changes in environmental conditions by rapid acclimation, because they obviously cannot simply move to a more favorable location. Over evolutionary time scales, this has provided plants with complex molecular, physiological, and morphological mechanisms to thrive and survive under stressful conditions. Prevalent stresses that plants are exposed to both in natural and agricultural environments are low temperatures and freezing, i.e., the crystallization of ice in living tissues. Not surprisingly, many plant species are able to survive tissue freezing. In addition, plants from temperate and boreal climate zones are able to adapt to low temperatures prior to an actual freezing event. This phenomenon of plant cold acclimation, i.e., the increase of freezing tolerance under conditions of low, but non-freezing, temperatures, has been the subject of intensive scientific study for many decades. More recently, phenomena such as deacclimation (the loss of freezing tolerance when plants are exposed to warmer temperatures after cold acclimation) and cold memory (when plants react differently to a second cold exposure compared to the first) have gained interest in the research community.

Under natural conditions, cold acclimation helps plants to survive seasonal low winter temperatures. Cold acclimation and freezing tolerance are quantitative traits, and cold acclimation is accompanied by complex changes in gene expression, enzyme activities, and the contents of a large number of proteins, primary and secondary metabolites, and lipids. In addition, even a few days under cold conditions can trigger irreversible morphological changes, particularly in growing plant tissues. Therefore, research on plant cold acclimation, deacclimation, and cold memory can (and quite often has to) be performed at different organizational levels, from populations to single genes and molecules. This requires experimental expertise in scientific disciplines such as ecology, plant breeding, biophysics, computational biology, genetics, physiology, or molecular biology, and strongly favors interdisciplinary approaches. This volume of *Methods in Molecular Biology* combines a wide selection of experimental methods ranging from the whole plant level of ecology and breeding to molecular profiling and the detailed analysis of specific proteins, with many levels of investigated complexity in between. This second edition provides updates on chapters describing methods already included in the first edition but also a number of chapters dealing with new methodology that has found its way into the field in recent years. We hope that this collection of detailed experimental protocols will help researchers, both new and experienced, to enter this exciting field of research or broaden the scope of their investigations.

Potsdam, Germany

Dirk K. Hincha
Ellen Zuther

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