inspection can tell about the history of dried biological specimens, namely whether or not they have been previously exposed to water.

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Evolutionary linkage between water-deficit responses and desiccation tolerance

M.J. Oliver, P.R. Payton
USDA-ARS, Plant Stress Laboratory, 3810 4th St. Lubbock TX 79415, United States

Drought tolerance and desiccation tolerance have often been cited as manifestations of the same mechanism; desiccation tolerance being the extreme form of drought tolerance. However, there is a fundamental difference between drought and desiccation tolerance: drought tolerance mechanisms include ways of maintaining cell water content, such as osmotic regulation and stomatal closure, whereas desiccation tolerance consists of ways to survive the almost complete loss of water. It is clear that an evolutionary understanding of the relationship between drought and desiccation tolerance is necessary to determine which genes are adaptive in nature and which simply respond to secondary events such as cell injury. Our approach is to compare the expression profiles for genes in response to water deficits in drought sensitive species with their orthologues in desiccation-tolerant species during desiccation and within a phylogenetic framework. Our comparisons encompass a dicot to dicot pairing, a monocot to monocot pairing, and the comparison of both to the most primitive form of vegetative desiccation tolerance as manifested in the desiccation tolerant bryophyte *Tortula ruralis*. Initial comparisons between the water stress response of Arabidopsis and the desiccation response of *Tortula*, have generated a solid baseline of similarities and differences that have generated the necessary hypotheses for our pair-wise comparisons. Our comparisons between Arabidopsis and *Craterostigma* and *Sporobolus stapfianus* and *S. pyrimidalis* (aligned with maize) have given us an insight into the evolution of the response to dehydration in vegetative tissues. These data will allow us to focus attention on genes and gene networks that are truly central to cellular dehydration tolerance and may enable a more rational approach for the improvement of drought tolerance in crop species.

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A comparison of the responses of *Eucalyptus grandis* and *E. grandis*×*camaldulensis* to ABA pretreatment and desiccation in preparation for cryostorage

K. Padayachee [a], P. Watt [b], N. Edwards [c], D.J. Mycock [a]
[a] *School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg, South Africa*
[b] *School of Biological and Conservation Sciences, University of KwaZulu-Natal, Durban, South Africa*
[c] *Mondi Business Paper, Trahar Technology Centre, Hilton, South Africa*

Cryopreservation offers an attractive option for the maintenance of potentially useful, clonally propagated genotypes of *Eucalyptus* while field testing is conducted. The most suitable explants for this purpose are *in vitro* axillary buds. However, a major limitation of axillary buds is their susceptibility to freezing injury, as a consequence of being highly hydrated. Reduction of the water content to levels low enough to minimize ice crystal formation may nevertheless, overcome this limitation. The extent to which *Eucalyptus* buds could be dried however, was determined to be a factor of the natural tolerance of the species to water loss. *Eucalyptus grandis*, a drought-sensitive, sub-tropical eucalypt, was found to be less tolerant of water loss when dried over silica gel for varying periods (20, 40 and 60 min), while a more drought-tolerant hybrid, *E. grandis*×*camaldulensis*, was more resistant to water loss, maintaining a significantly higher water content than *E. grandis* at all the drying times tested. This was also evident at the ultrastructural level, where *E. grandis* buds displayed a greater degree of subcellular damage than those of *E. grandis*×*camaldulensis*. The difference between the *E. grandis* and the hybrid was further emphasized by the responses of the buds to exogenously applied abscisic acid (ABA). While ABA-pretreated *E. grandis* buds maintained a significantly higher water content and viability at each drying time tested, and displayed a marked improvement in the maintenance of cellular integrity after 20 min drying, *E. grandis*×*camaldulensis* did not respond to exogenous ABA. The beneficial effects of ABA on *E. grandis* was also demonstrated by the comparison of the responses of encapsulated buds precultured on progressively increasing concentrations of sucrose and glycerol (0.4 M, 0.7 M and 1.0 M) and encapsulated buds precultured on similar media but supplemented with 5 mg l^{-1} ABA. Buds precultured on media containing sucrose, glycerol and ABA were able to resist water loss and maintain viability for a significantly longer period than those precultured on media without ABA. The results therefore demonstrated 1) the impact of genotype on the responses of *Eucalyptus in vitro* buds to desiccation and 2) the significant effect of ABA on the desiccation tolerance of *E. grandis* buds.

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The maturation of recalcitrant seed biology

N.W. Pammenter, P. Berjak
School of Biological and Conservation Sciences, University of KwaZulu-Natal, Durban, South Africa