

Abstract

How has frost tolerance evolved in temperate forest deciduous trees?

I will write a review paper that investigates the evolution of frost tolerance in deciduous tree species found in temperate forests. Temperate tree species are at risk of freezing and drought events in the spring so they must exhibit plastic phenological responses in order to best avoid these risks. Over the winter months, leaf buds in northern regions have evolved to harden and tolerate very low temperatures. This tolerance is possible through various methods including the synthesis of particular proteins and hormones, such as antifreeze proteins and ABA (abscisic acid). However, in the spring, those proteins and hormones will need to diminish in order to allow buds to deharden so that leaf primordia can be exposed and grow. The interplay of dehardening and frost-tolerance has evolved multiple times in many species. I will write a review that assesses the molecular and genetic evolution of temperate tree buds and frost tolerance across native species phylogenies occupying various ecological and climatic niches.

References

- BENEDICT, C., SKINNER, J.S., MENG, R., CHANG, Y., BHALERAO, R., HUNER, N.P.A., FINN, C.E., CHEN, T.H.H. & HURRY, V. (2006) The cbf1-dependent low temperature signalling pathway, regulon and increase in freeze tolerance are conserved in *populus* spp. *Plant, Cell and Environment* **29**, 1259–1272.
- Cavender-Bares, J., González-Rodríguez, A., Eaton, D.A.R., Hipp, A.A.L., Beulke, A. & Manos, P.S. (2015) Phylogeny and biogeography of the american live oaks (*quercus*subsection *virentes*): a genomic and population genetics approach. *Molecular Ecology* **24**, 3668–3687.
- Grime, J. (1977) Evidence for the existence of three primary strategies in plants and its relevance to ecological and evolutionary time. *American Society of Naturalists* **111**, 1169–1194.
- Howe, G.T., Aitken, S.N., Neale, D.B., Jermstad, K.D., Wheeler, N.C. & Chen, T.H. (2003) From genotype to phenotype: unraveling the complexities of cold adaptation in forest trees. *Canadian Journal of Botany* **81**, 1247–1266.
- Koehler, K., Center, A. & Cavender-Bares, J. (2011) Evidence for a freezing tolerance-growth rate trade-off in the live oaks (*quercus* series *virentes*) across the tropical-temperate divide. *New Phytologist* **193**, 730–744.

- Larcher, W. (2005) Climatic constraints drive the evolution of low temperature resistance in woody plants. *Journal of Agricultural Meteorology* **61**, 189–202.
- Lechowicz, M. (1984) Why do temperate deciduous trees leaf out at different times? adaptation and ecology of forest communities. *American Society of Naturalists* **124**, 821–842.
- Niinemets, Ü. (2010) Responses of forest trees to single and multiple environmental stresses from seedlings to mature plants: Past stress history, stress interactions, tolerance and acclimation. *Forest Ecology and Management* **260**, 1623–1639.
- Niinemets, Ü. & Valladares, F. (2006) Tolerance to shade, drought, and waterlogging of temperate northern hemisphere trees and shrubs. *Ecological Monographs* **76**, 521–547.
- Rodrigo, J. (2000) Spring frosts in deciduous fruit trees - morphological damage and flower hardiness. *Scientia Horticulturae* **85**, 155–173.
- Svenning, J.C. (2003) Deterministic plio-pleistocene extinctions in the european cool-temperate tree flora. *Ecology Letters* **6**, 646–653.