Cold acclimation and freezing tolerance in plants – how much light matters?

Břetislav Brzobohatý

Department of Molecular Biology and Radiobiology and CEITEC-Central European Institute of Technology, Mendel University in Brno, Brno, Czech Republic

Distribution of plant species reflects their ability to acclimate to different natural environmental conditions. In the temperate zone, distribution and fitness of a given plant species critically depends on its ability to withstand freezing periods which may be substantially enhanced by cold acclimation, i.e. exposure to low, non-freezing temperatures, over a period of days to weeks. Previous reports indicated that low temperature is not able to induce effective cold acclimation at low light intensity. However, the conclusions were drawn from experiments under long-day photoperiods. In temperate regions, long-day photoperiods only occur in parts of growing season when extreme drops in temperature are unlikely. Therefore, we compared effects of standard and low light intensity on the cold acclimation process of the model plant Arabidopsis thaliana under a short-day photoperiod. The effects were analyzed at a whole plant level first. To address roles of phyllotaxy and ontogenesis, the cold acclimation process was analyzed in leaves 6 and 14 when their cells are completing cell proliferation stage, and in leaf 6 when its cells complete cell expansion and differentiation stage. Common and distinct molecular networks governing leaf responses to the treatments were revealed by an integrative omics-based approach. Relative physiological relevance of selected candidate genes was assessed by analysis of cold acclimation efficiency in corresponding transgenic plants and mutants.