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Identification of molecular determinants of low temperature memory and triggering in Arabidopsis

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Plants from temperate regions can be primed (cold acclimated) by exposure to low, but non-freezing temperatures resulting in improved freezing tolerance. Whereas the molecular and metabolic basis of cold priming has been investigated in detail, hardly anything is known about memory of a previous cold event under warm conditions and a following low temperature triggering event. We were able to show that three days of cold priming at 4°C, a seven-day lag phase at 20°C and a triggering treatment of 4°C improved the freezing tolerance of Arabidopsis Col-0 and other accessions compared to plants that were not primed before. Transcripts, metabolites and lipids as possible molecular determinants of this increase in freezing tolerance were investigated in Arabidopsis accessions Col-0 and N14 after priming, memory phase and triggering by Illumina-based RNA-Seq, GC-MS metabolite profiling and UPLC FT-MS-based lipidomics. In Col-0 and N14 93 and 128 unique differentially expressed genes, one significantly changed metabolite in N14 and three (Col-0) and six (N14) lipids could be identified comparing primed and triggered with only triggered samples with differences between differently tolerant accessions. Possible functions of these candidates will be discussed. This work identified for the first time molecular and metabolic changes accompanying cold stress memory and triggering by a second cold stress.