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Research: Plant Resilience

Abiotic and biotic stresses are major factors that determine the natural geographical distribution of plants and limit agricultural production on an annual basis. Our overarching interest is to understand the mechanisms that plants have evolved that impart resilience to abiotic and biotic stresses and to provide basic information that can be used to improve the yield of food and bioenergy crops.

Most of our work has focused on cold acclimation, the process whereby plants increase in freezing tolerance in response to low non-freezing temperatures. In early work, we discovered the CBF regulatory pathway (Stockinger *et al*., 1997, *PNAS*; Jaglo-Ottosen *et al*. 1998, *Science*), a highly conserved regulatory network in higher plants that imparts freezing tolerance (Figure 1). The pathway comprises two primary components: the *CBF* genes, which encode closely related members of the AP2/ERF family of transcriptional activators, and the CBF target genes, known as the CBF regulon. In Arabidopsis, *CBF1*, *CBF2* and *CBF3* are rapidly induced upon exposing plants to low temperature followed by induction of more than 100 CBF-targeted genes referred to as the CBF regulon. Expression of the CBF regulon leads to increased levels of sugars and proteins with cryoprotective properties that contribute to an increase in plant freezing tolerance. Our recent studies on the CBF pathway have focused on regulation of the *CBF* genes by the CAMTA transcription factors (Doherty *et al*., 2009, *Plant Cell*; Kim *et al*., 2013, *Plant J*), the circadian clock (Dong *et al*., 2010, *PNAS*) and photoperiod (Lee & Thomashow, 2012, *PNAS*).

[Insert Figure 1]

Currently, our efforts focus on the CAMTA transcription factors, a family of regulatory proteins with key roles in two major plant processes: freezing tolerance and defense against pathogens. In particular, the CAMTA transcription factors rapidly induce expression of the *CBF* and other freezing tolerance genes in response to low temperature and repress the expression of genes that impart immunity against biotrophic pathogens in heathy plants grown at moderate temperature (Kim *et al*., 2013, *Plant J*; Kim *et al*., 2018, *Plant Cell*). Our current goals include determining the mechanisms whereby the CAMTA transcription factors rapidly induce the expression of freezing tolerance genes in response to low temperature, how they repress the expression of plant immunity genes in healthy plants grown at moderate temperature, and how the repression activity of the CAMTA transcription factors is suppressed in response to biotrophic pathogens and prolonged exposure of plants to low temperature.