Winter physiology in a warmer world: Cold hardiness and deacclimation sensitivity drive variation in spring phenology

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Abstract

As the climate warms, the focus of concern in viticulture often turns to how higher temperatures may shift growing regions, change the character of AVAs, and alter fruit quality. However, climate warming is increasing most quickly during the winter dormancy cycle, a critical and often underappreciated portion of the grapevine life cycle. In response to decreasing temperatures and decreasing daylength, grapes initiate a series of physiological changes to enter dormancy, acquire freeze resistance, and time spring phenology such that the growing season begins after threat of frost. We have been working to understand the connections between temperature perception and dormancy physiology in grapevine through field and growth chamber experiments. Examining 30 different cultivars over 3 years, we have uncovered a critical link between the depth of freeze resistance, the interaction with chilling accumulation, and the eventual timing of spring budbreak. Results demonstrate that chilling accumulation and perception is conserved across diverse grapevine cultivars and the perceived difference in chill requirement for synchronous budbreak is largely driven by variation in thermal efficiency (deacclimation resistance) during ecodormancy. Phenotypic variation in maximal cold hardiness and deacclimation resistance suggest adaptive potential in different wild grape species that can be tapped for a world of erratic climate.

Keywords: Cold Hardiness, winter survival, deacclimation, dormancy, phenology