UNDERSTANDING THE COMPLEXITY OF GRAPEVINE WINTER PHYSIOLOGY IN THE FACE OF CHANGING CLIMATE

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Abstract:

Context and purpose of the study – The vast majority of our understanding of grapevine physiology is focused on the processes that occur during the growing season. Though not obvious, winter physiological changes are dynamic and complex, and have great influence on the survival and phenology of grapevines. In cool and cold climates, winter temperatures are a constant threat to vine survival. Additionally, as climate changes, grapevine production is moving toward more traditionally cool and cold climates, either latitudinal or altitudinal in location. Our research focuses on understanding how grapevines navigate winter physiological changes and how temperature impacts aspects of cold hardiness and dormancy. Through these studies, we have gained keen insight into the connections between winter temperature, maximum cold haridness, and budbreak phenology, that can be used to develop prediction models for viticulture in a changing climate.

Material and methods – Cold hardiness ability can be assessed for dormant buds of grapevine using a method called differential thermal analysis, or DTA. Using this method, we can measure the precise temperature which results in the death of the primary reproductive bud. We monitor the cold hardiness of *V. vinifera* and North American adapted varieties weekly throughout winter to track changes in cold hardiness. We measure the impact of decreasing fall temperatures on the vines ability to acclimate to cold using growth chamber studies to simulate different winter conditions. Additionally, we collect data on the resistance of these buds to warm temperatures in order to develop risk models associated with early budbreak phenology.

Results – Our studies have revealed many new insights into the processes of winter physiology of the dormant bud. Examining the impact on decreasing winter temperatures have revealed a key requirement for daily temperature oscillation for acclimation, or the gaining of cold hardiness in early winter. Patterns of midwinter cold hardiness across several years demonstrated clear differences between *V. vinifera* and North American adapted cultivars, with adapted cultivars superior in winter hardiness. Deacclimation studies have revealed that these same adapted cultivars are also much more responsive to late winter warming, making them more risky for early spring frosts. When combined, this data has enabled us to build predictive models for cold hardiness and bud phenology that are more accurate than the current methods. These models should allow us to determine which regions, and which cultivars, are risky as climate warms around us.

Keywords: Grapevine, Cold Hardiness, Chilling requirement, Climate change, Winter physiology