Protein Expression in Cold Acclimating and Freezing Tolerant Grape Cane Tissues

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Introduction

The continental climate in Iowa is important when selecting grape cultivars that are tolerant of low-temperature stresses. Many cold-regulated (COR) proteins respond to freezing stress, and are able to protect cellular membranes from cold-induced dehydration damage. It is unknown which proteins are important for cultivars to withstand extreme temperature fluctuations and low temperatures that can injure over-wintering canes. The objective of this investigation is to observe the ability of two grape cultivars to survive extreme temperature fluctuations during cold-acclimation, mid winter, and deacclimation. Experiments will be conducted to determine and compare changes in proteins during cold acclimation and deacclimation in canes for Frontenac and Seyval blanc grape cultivars.

Materials and Methods

The vines used for sampling were established, as a randomized cultivar trial at the Horticulture Research Station in 2002. Five replications of three vines were used. Cane samples were randomly selected, beginning in August 2008 and continuing through April 2009, after daily high and low temperatures dropped by at least 5ºC (9ºF) within three days. One cane was sampled/vine at each sampling time. Canes were divided into segments, pooled by cultivar, and randomly separated for freezing tolerance or protein studies. Percentage of bark development, from selected canes, was determined by measurement from the base of the cane.

Injury analysis. Freezing tolerance for Frontenac and Seyval blanc xylem and bark tissues was determined from laboratory freezing assays using four replications. Percentage of injury was evaluated by visual estimation with increments at 0, 25, 50, 75, and 100% injury. The temperatures that caused 50% tissue injury were used to calculate LT50 values. These values represent the low temperature that injured 50% of the tissue.

Protein analysis. Remaining segments were divided into bark and xylem and will be used to separate and identify proteins associated with freezing tolerance at each sampling time.

Results and Discussion

There was a difference in LT50 values for bark tissues between cultivars on October 16, 2008 ($P < 0.01$), but this was the only date bark tissues were injured at different LT50 values between cultivars. Xylem LT50 values were different between cultivars at all dates ($P \leq .02$). There was a difference in LT50 values between bark and xylem at all sampling dates ($P < .01$). The investigation will continue through April 2009. Protein content is also currently being evaluated.

As grapevines enter into dormancy and are introduced to colder temperatures, they gradually gain freezing tolerance. As seen in Figure 1, xylem, to this point, consistently has more freezing tolerance than bark. The difference in bark development between the two cultivars (Figure 2) does not appear to explain a difference in bark freezing tolerance

between the two cultivars. The loss of freezing tolerance in Frontenac xylem between October 16 and October 28, although significant, cannot be explained at this point.

Acknowledgements

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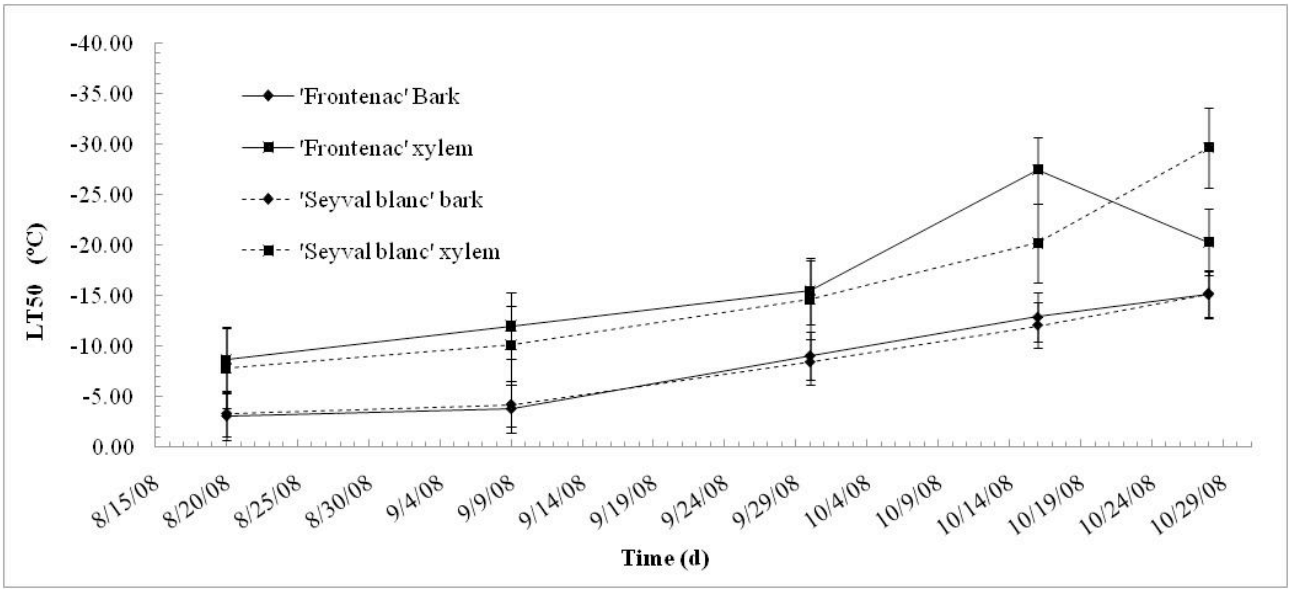

Figure 1. Bark and xylem freezing tolerance of Frontenac and Seyval blanc canes after temperature declines.

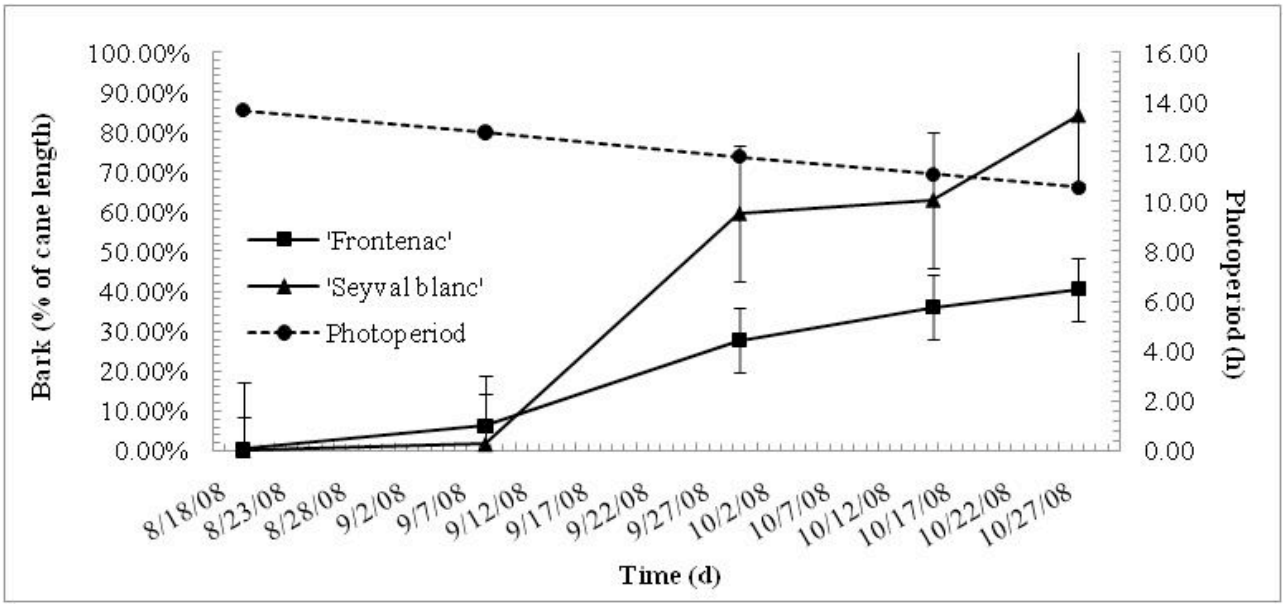

Figure 2. Percentage of bark for Frontenac and Seyval blanc grape cultivars taken at cane-sampling dates.