Final Plain Language Research Summary - AgriScience Grape & Wine Cluster 2018-2023

Activity: *Grapevine evaluation and cold hardiness program to ensure superior plant material for the Canadian Grapevine Certification Network and to improve the sustainability of the Canadian Grape and Wine Industry*

Principal Investigator(s): Jim Willwerth (Brock University) and Harrison Wright (AAFC Kentville)

This activity was a collaborative project between program leads Dr. Jim Willwerth (Brock University/Cool Climate Oenology and Viticulture Institute (CCOVI), St. Catharines, ON) (Vote 10) and Dr. Harrison Wright (AAFC, Kentville Research and Development Centre (KRDC), Kentville, NS) (Vote 1). Activity 7 had five objectives:

1. To study the impact of rootstock on cold tolerance and fruit quality of wine grapes (Vote 10);
2. To study the impact of Abscisic Acid (ABA) analogs on wine grape hardiness and performance (Vote 10);
3. To coordinate wine grape bud hardiness survey work in Ontario, British Columbia and Nova Scotia (Vote 1);
4. To study factors that influence wine grape bud hardiness (Vote 1);
5. To install and study a Chardonnay clone trial in Nova Scotia to act as a satellite site to similar work ongoing in Ontario (Vote 1).

Vote 10. Objective 1 and 2. Objectives within this activity included:
1) Gain in-depth understanding of scion-rootstock combinations to optimize vine performance with respect to production, cold tolerance and fruit/wine quality using certified nursery material; and

2) Elucidate relationships between different grapevine genotypes, cold tolerance, dormancy and associated cold hardiness-related metabolites in their biochemical and physiological responses as well as improving hardiness through Abscisic Acid (ABA) analogs.

The effects of clone x rootstocks on vine performance, cold hardiness and fruit composition have now been evaluated for multiple seasons using cultivars, Chardonnay, Pinot noir, Merlot, Cabernet franc and Sauvignon blanc. We have found some specific impacts of clone x rootstock on cold hardiness with Cabernet franc but the differences are not as evident as previous work with Sauvignon blanc and Riesling. Furthermore, dehydrin proteins were measured for 2

seasons and while these individual proteins varied over dormancy there were no clear indications that dehydrins were associated with greater hardiness. Climate conditions over dormancy did impact clone x rootstock hardiness, winter survival as well as cold hardiness metabolites such as dehydrins. In addition, clone and rootstock can impact vine size, yields, crop loads and some primary fruit chemistry. In some cases with rootstock it appears to be related to advances in maturity that may be related to overall vigour and crop size. Clone and rootstock interactions cannot be ignored through the findings of this research activity. This research is quite novel with respect to being able to demonstrate that clone, rootstock and their interactions can impact vine performance, production and cold tolerance. The research from this activity has successfully demonstrated that selection of plant material is very important with respect to sustainable production in vineyards and quality.

For objective 2:
ABA analogs can improve and maintain dormancy in multiple cultivars including cold tender V. vinifera as well as hybrid cultivars over multiple years of study. However, there can be some seasonal effects to how well ABA analogs maintain dormancy and some analogs may perform more consistently in this regard. Molecular studies involving ABA during key periods of cold acclimation, deacclimation and reacclimation phases revealed unique changes to some cold hardiness related genes and those associated with dehydrins and starch and carbohydrate metabolism. In conclusion, our understanding of genotype and environment on cold hardiness dynamics and respective changes at the biochemical and molecular level are invaluable for understanding how to improve the trait of cold hardiness and identifying more freeze resilient grapevines. In addition, ABA analogs continue to demonstrate promise as a cold hardiness promoter and helping to maintain dormancy. Applications of these molecules may lead to improved hardiness throughout dormancy and reduce the vine's susceptibility to lose hardiness later in dormancy. This may be very beneficial in terms of mitigating the effects of temperature fluctuations that commonly occur during Canadian winters and for greater freeze tolerance for tender V. vinifera cultivars or varieties very susceptible to cold deacclimation such as V. riparia-based varieties such as Marquette.

For objective 3 (bud hardiness survey)
The coordinated bud hardiness survey conducted at locations throughout Canada served a dual purpose. Having researchers and technicians in such a wide array of commercial vineyards provided an excellent opportunity to observe vineyards and to engage growers on the topic of vine hardiness as well as other research questions. Additionally, years of temperature and bud hardiness data are needed from diverse regions and years in order to accurately model vine bud hardiness performance. This analysis is ongoing and will be used to create new metrics assessing the risks associated with growing particular cultivars under different climate change models. This information was particularly informative in the final year of the project when a combination of the warmest winters on record in Nova Scotia followed by one of the coldest low temperature events resulted in widespread winter damage.

For objective 4 (factors associated with hardiness)
Bud viability assessments provided the basal levels needed to assess the impact of severe weather events and other factors. A multitude of studies examined the influence of factors such as crop load, vine balance and harvest timing on vine hardiness. Despite often being listed as a factor, no evidence that crop load impacted hardiness was found in two hybrid cultivars and fruit composition was only moderately influenced. Harvest timing did have some influence on hardiness, but only when the crop load was heavy. Multiyear and multi-cultivar wood sugar and water content data demonstrated that these variables are dynamic while the vine is dormant and provided insights into how the vine balances hardiness and dormancy with the need to resume growth in the spring.

Finally, **for objective 5** (Chardonnay clone trial)
Despite setbacks, a satellite Chardonnay trial that used a subset of clones used in its Ontario counterpart was installed in the final year of the project. If the site responds favourably to the 2023 freeze damage, this will be a source of further collaboration between Ontario and Nova Scotia in future years.