Summerland Research & Development Centre
Wine Grape Research

Bud Hardiness of Wine Grape Cultivars in the Okanagan Valley, British Columbia

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INTRODUCTION

Winter hardiness of grapevines is critical to the success of the wine industry in interior British Columbia. Over-winter survival of fruit buds determines crop yield in the following year, and knowing the bud hardiness of cultivars can help producers select suitable cultivars and planting sites appropriate to site climate, and manage cold protection by installing and operating wind machines. To assist grape growers, we monitored and reported the bud hardiness of several wine grape cultivars in the Okanagan Valley for the last eight years. This multi-year data record allows us to rank cultivars by their hardiness at critical periods during the dormant season, from fall to spring.

HARDINESS MONITORING

Beginning in 2012, this study included 11 widely planted cultivars: Cabernet franc, Cabernet sauvignon, Chardonnay, Gewurztraminer, Merlot, Pinot blanc, Pinot gris, Pinot noir, Riesling, Sauvignon blanc, and Syrah. In 2018, Malbec and Viognier were added to the study. For each cultivar, buds were collected from several vineyards in different regions of the Okanagan Valley, biweekly from October through April. Fifteen buds were collected from six vines per cultivar block and transported to Summerland Research and Development Centre for hardiness analysis. Using specialized freezers, the buds were cooled gradually to -30 °C, and the temperature at which the buds froze, known as the low temperature exotherm (LTE50), was determined. Lower LTE50 values indicate that buds are hardier and can tolerate exposure to lower temperatures.

The multi-year hardiness data for each cultivar were used to predict the average daily hardiness values from October 20 to April 15, as well as the date of maximum hardiness. Despite year to year differences in temperature exposure, relative hardiness among cultivars was fairly consistent within three hardiness periods: acclimation (October to mid-December), maximum hardiness (late-December to mid-February), and deacclimation (late February to April) (Figure 1). The cultivars differed in acclimation and deacclimation rates, and in maximum hardiness, as shown by their hardiness rankings for the three periods (Tables 1-3).

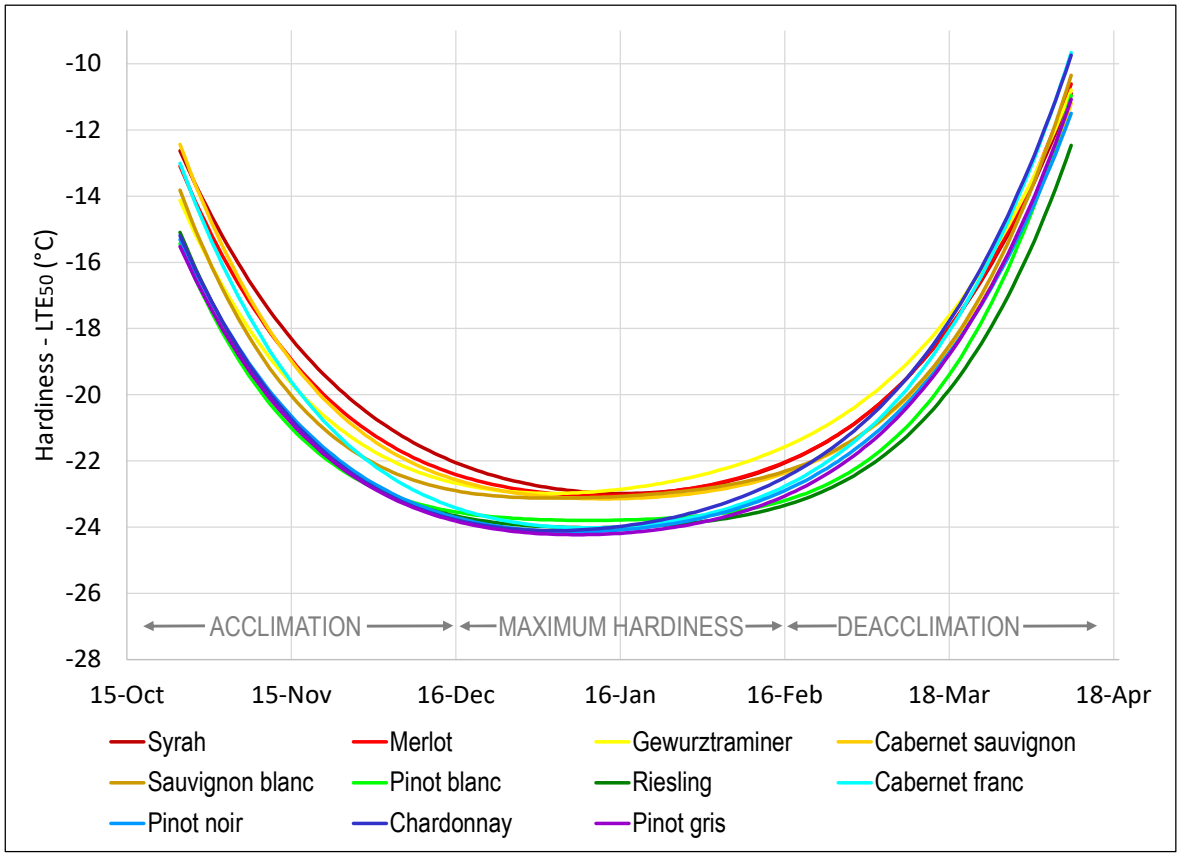

Figure 1. Bud hardiness from late October to early April for 11 wine grape cultivars grown in the Okanagan Valley, British Columbia. The curve for each cultivar was derived from hardiness measurements taken from October to April in eight years, 2012 to 2020, and fit to a fourth-order polynomial model.

ACCLIMATION

During hardiness acclimation in fall, the difference in hardiness between the most and least hardy cultivars was 2.9 °C (Table 1, Figure 1). Pinot blanc, Pinot gris, Pinot noir, Riesling and Chardonnay were relatively early in acclimation and hardiness acquisition, while Syrah, Cabernet sauvignon, Merlot and Cabernet franc acclimated later.

MAXIMUM HARDINESS

Maximum hardiness was reached in early to mid-January (Table 2, Figure 1). There were two distinct cultivar groups that differed in maximum hardiness. The hardier group had a maximum hardiness of about -24 °C, and included Pinot gris, Pinot noir, Chardonnay, Cabernet franc, Riesling, and Pinot blanc. The less hardy group included Gewurztraminer, Syrah, Merlot, Sauvignon blanc, and Cabernet sauvignon, and had a maximum hardiness of

Table 1. Bud hardiness of wine grape cultivars during acclimation, on Nov 1, in the Okanagan Valley. Values are means across sites and years (2012-2020).

Cultivar (listed from least to most hardy)	Hardiness (°C) during acclimation (Nov 1)
Syrah	-14.9
Cabernet sauvignon	-15.2
Merlot	-15.5
Cabernet franc	-15.7
Gewurztraminer	-16.4
Sauvignon blanc	-16.5
Chardonnay	-17.5
Riesling	-17.5
Pinot noir	-17.5
Pinot gris	-17.7
Pinot blanc	-17.8

about -23 °C. These hardiness values are the modelled maxima resulting from the temperature exposures over the eight years of the study.

Table 2. Maximum bud hardiness, and date of maximum bud hardiness, for wine grape cultivars in the Okanagan Valley. Values are fitted to a fourth-order polynomial model based on measurements across sites and years (2012-2020).

Cultivar (listed from least to most hardy)	Maximum hardiness (°C)	Date of maximum hardiness
Gewurztraminer	-23.0	Jan 3
Syrah	-23.0	Jan 17
Merlot	-23.0	Jan 12
Sauvignon blanc	-23.1	Jan 4
Cabernet sauvignon	-23.1	Jan 13
Pinot blanc	-23.8	Jan 10
Riesling	-24.0	Jan 10
Cabernet franc	-24.0	Jan 10
Chardonnay	-24.1	Jan 3
Pinot noir	-24.1	Jan 7
Pinot gris	-24.2	Jan 8

Table 3. Bud hardiness of wine grape cultivars during de-acclimation, on Mar 1, in the Okanagan Valley. Values are means across sites and years (2012-2020).

Cultivar (listed from least to most hardy)	Hardiness (°C) during deacclimation (Mar 1)
Gewurztraminer	-20.1
Merlot	-20.7
Shiraz	-20.8
Chardonnay	-21.0
Cabernet sauvignon	-21.2
Cabernet franc	-21.2
Sauvignon blanc	-21.2
Pinot noir	-21.3
Pinot gris	-21.7
Pinot blanc	-21.9
Riesling	-22.2

DEACCLIMATION

During deacclimation, the cultivars ranged from -22.2 °C to 20.1 °C in hardiness reflecting an earlier loss of hardiness in some cultivars including Gewurztraminer, Merlot, Syrah and Chardonnay (Table 3, Figure 1). Riesling and Pinot blanc had a relatively late loss of hardiness.

CULTIVAR SPECIFIC HARDINESS PROFILES

In all three periods, Pinot gris, Pinot noir, Pinot blanc and Riesling were hardier than most cultivars (Tables 1-3). Chardonnay was relatively hardy early, during acclimation and maximum hardiness, but less hardy later during deacclimation. Chardonnay breaks bud relatively early, and although it is cold tolerant in late fall and winter, it is prone to cold and frost damage in spring.

Malbec and Viognier were first sampled extensively for hardiness testing in fall, 2018. Based on the limited data for these cultivars, Malbec had a maximum hardiness similar to Merlot and would be grouped with less hardy cultivars (Figure 2). Viognier was similar to Chardonnay in maximum hardiness, and would be grouped with the hardier cultivars. During acclimation and deacclimation, hardiness of Malbec and Viognier was inconsistent between years relative to Merlot and Chardonnay. More years of data are needed to describe their relative hardiness during these periods.

In 2019, record cold temperatures in February and early March led to an extended maximum hardiness period and late onset of deacclimation (Figure 2). Acclimation of buds to the unusually cold temperatures

led to greater than average maximum hardiness levels, which were about -25 °C and -24 °C, respectively, for Chardonnay and Merlot.

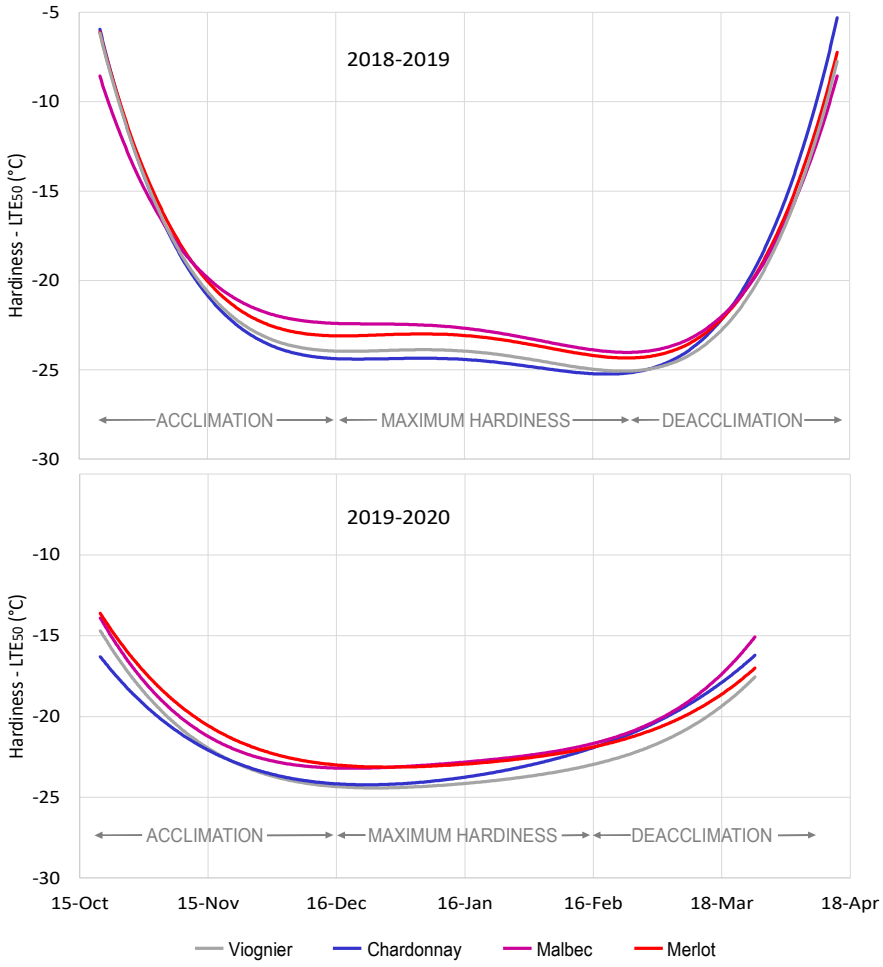

Figure 2. Bud hardiness from late October to early April for Malbec, Viognier, Chardonnay and Merlot grown in the Okanagan valley, British Columbia. The curve for each cultivar was derived from hardiness measurements taken from October to April in 2018-2019 (top) and 2019-2020 (bottom), and fit to a fourth-order polynomial model.

DISCUSSION

This study revealed cultivar differences in hardiness that changed in ranking over three periods, from acclimation in fall, to deacclimation in spring. In the Okanagan Valley and other Pacific Northwest grape growing regions, extreme cold weather events occur more frequently in fall and early winter than in late winter or spring (Bowen, et al. 2016). Early bud acclimation and greater maximum hardiness are therefore critical to viticulture at colder sites within our region. Cultivars acquiring earlier and deeper hardiness, such as Pinot gris, Pinot noir, Riesling and Chardonnay, are most suitable for planting at colder sites. In established vineyards, less hardy cultivars planted at cold sites should be assessed for winter injury and pruned to compensate for the potential loss of viable buds.

CITED

Bowen P, Shellie KC, Mills L, Willwerth J, Bogdanoff C, and Keller M. 2016. Abscisic acid form, concentration, and application timing influence phenology and bud cold hardiness in Merlot grapevines. Can. J. Plant Sci. 96: 347–359 (2016) dx.doi.org/10.1139/cjps-2015-0257

RELATED NEWSLETTERS

Bogdanoff, C. 2019. Grapevine Bud Hardiness Testing. SuRDC Wine Grape Research. Febuary, 2019.

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SERIES EDITOR

Jesse MacDonald, Summerland Research & Development Centre, Agriculture and Agri-Food Canada

FUNDING

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Canadian Grapevine Certification Network
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British Columbia Wine Grape Council