

Bud hardiness monitoring for the winter 2021-2022

Bulletin 1. Reminders of concepts.

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Introduction

As the harvest ends across Quebec, it is time for us at the Centre de recherche agroalimentaire de Mirabel (CRAM) to start tracking grapevine hardiness. Our goal is to help grape growers understand what happens in the vineyard by providing regular updates on grapevine cold hardiness throughout the winter. As in the past two years, we will be collecting dormant buds from the main Quebec wine regions, focusing on cultivars that will not be covered by geotextiles. Grapevines under geotextiles will be sampled before installation and after their removal in order to evaluate the risk of fall and spring cold damage and to better understand the impact of the geotextiles on grapevine cold hardiness.

Reminder about grapevine cold hardiness

Vines survive the winter by tolerating and limiting ice formation in parts like the trunk and cordons, and by avoiding ice formation by supercooling. Vines go into dormancy with the decrease of sunlight hours early in the fall. This leads to many physiological changes directly contributing to cold hardiness, such as lignification and tissue dehydration. The decreasing temperatures lead to the accumulation of cryoprotective metabolites that act as anti-freeze allowing for supercooling, the ability to prevent ice formation even when temperatures drop below the freezing point. The vines are in a period of cold **acclimation** as their hardiness gradually improves. Although ambient temperatures have an impact on cryoprotectant accumulation, acclimatization generally proceeds in a more predictable manner than the other stages of hardiness. When winter arrives, the vines enter a phase of **maximum hardiness** and become very sensitive to ambient temperatures. In order to limit the use of their resources, they only develop enough hardiness for their survival. They gain hardiness on colder days, but quickly lose it on warmer days. It is therefore normal to see variation in hardiness at this time of the year based on daily temperature fluctuations. This means that a milder winter can lead to lower hardiness, creating a risk of cold damage if temperatures drop quickly and drastically. With the arrival of warmer temperatures, the vines lose their hardiness at a temperature-dependent rate. This is the period of **deacclimation**. Although the links between deacclimation and bud break are not yet well understood, it appears that vines must completely lose their cold hardiness before bud break. Cultivars breaking bud early may therefore be at greater risk of cold damage than cultivars breaking bud later.

Hardiness can greatly vary from one bud to the next. As a general rule, acclimation develops from the base of the shoots towards the apex. There can be several degrees of hardiness differences between buds of the same vine or between the vines within a vineyard. We, therefore, provide, for each site and cultivar, the lethal temperatures of 10%, 50% and 90% of the sampled buds under the terms **LT10**, **LT50** and **LT90**.

Maximum hardiness is predetermined by genetics, but several factors can contribute to poor acclimation and reduce overall hardiness. Vines that are too vigorous, overcropped or on poorly drained soils, will often have poorly lignified shoots that are a sign of poor acclimation. Pests and diseases that can, for example, lead to early defoliation, can also lead to incomplete acclimation. Given the importance of ambient temperatures on hardiness, site selection will also significantly impact both hardiness potential and the risk of cold injury. Even under the best conditions, *V. vinifera* cultivars can rarely withstand temperatures below -22 to -25 °C, while hybrid varieties can sometimes withstand temperatures as low as -35 °C.

For more information on vine hardiness, [CCOVI's Vine-Alert](#) site and its "[Resources](#)" section contain a lot of relevant information on the subject as well as on the hardiness analysis system we use at CRAM.

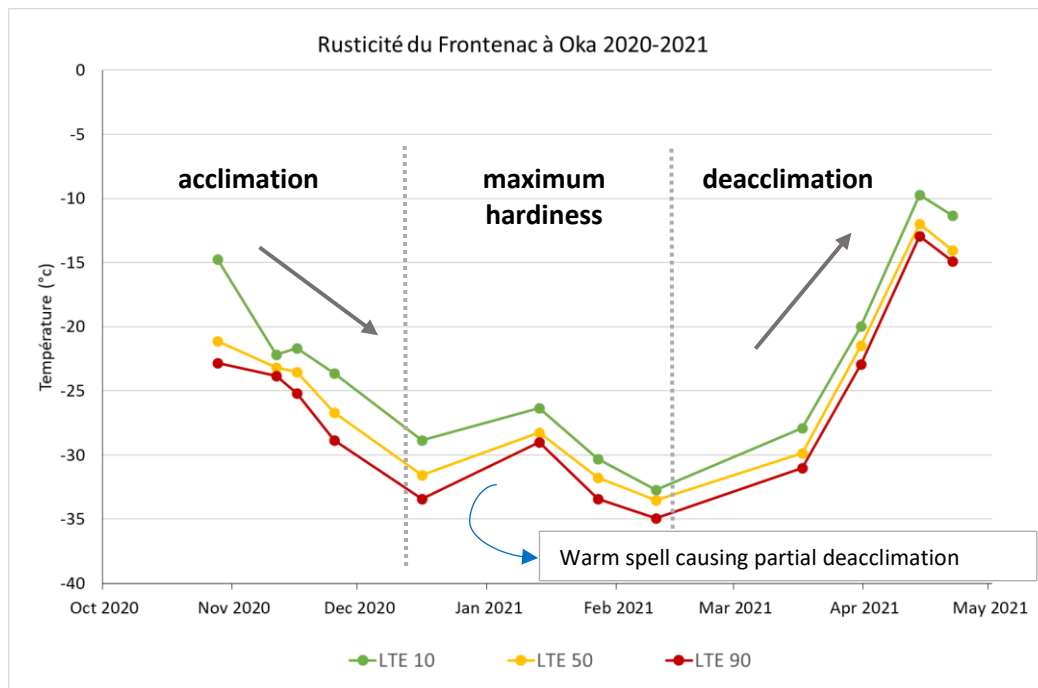


Figure 1. The three phases of cold hardiness. During the phases of maximum hardiness and deacclimation, the vine is particularly sensitive to temperature changes and is likely to lose or gain hardiness with daily fluctuations. LTE10, 50 and 90 represent the lethal temperatures for 10, 50 and 90% of buds, respectively.

Reminder about our data collection system

To determine hardiness, we use a system developed by the Cool Climate Oenology and Viticulture Institute ([CCOVI](#)) at Brock University based on the work of [Mills et al. \(2006\)](#). This system measures supercooling by using differential thermal analysis to accurately measure bud freezing temperature. It allows us to identify the lethal temperature for each bud sampled. We then provide the information in the form of LT10, LT50 and LT90. As hardiness is highly dependant on temperatures and cultivar, we sample many cultivars from a wide range of vineyards.

Over the past two years, we have focused our efforts on sampling hybrid cultivars considered hardy or very hardy and that are often not protected by geotextile, such as Frontenac, Marquette, St-Pépin, Frontenac blanc and Petite Perle. The selected sites are in the main grape growing regions, such as Montérégie, Laurentides, Lanaudière and Estrie. We also sampled hybrids such as Vidal, as well as *V. vinifera* varieties such as Pinot noir and Chardonnay before the installation and after the removal of geotextile. This year we will continue to collect data from the same sites and cultivars as in previous years and will regularly report the results.

Start of the 2021-2022 sampling season

As was noted in most of Quebec's wine regions, October was a warm month. It lead to a higher number of growing degree-days than in any of the last six years in all of the main grape growing regions (see [Karine Bergeron's October 13 2021 newsletter](#) for a breakdown of the monthly growing degree-days accumulation in Québec since 2015). Our experimental vineyard in Oka is no exception, with a total accumulation of 1459 growing degree-days as of October 28, 2021. The precise impact of the warm October is unclear, but it is certain that warmth is preferable to early frost events. The vines are currently less hardy than this time

last year, but they are more acclimated at each new sampling date. The vines are currently in **endodormancy**, which means that they will not be able to break bud until they have been exposed to cold temperatures for the sufficient number of hours (see [Bulletin 1 of the 2020-2021 season](#) for more information). Since cold temperatures are slow to arrive, the vines have not yet entered the **ecodormancy** period, a dormant state where only cold temperatures prevent bud break. The vines are therefore not at risk of extremely early bud break. In addition, the vines are not yet as temperature sensitive as they will be later in the winter. They continue to acclimate gradually despite the warmer temperatures. A gradual decrease in temperatures over the next few weeks would be ideal for an optimal acclimation.

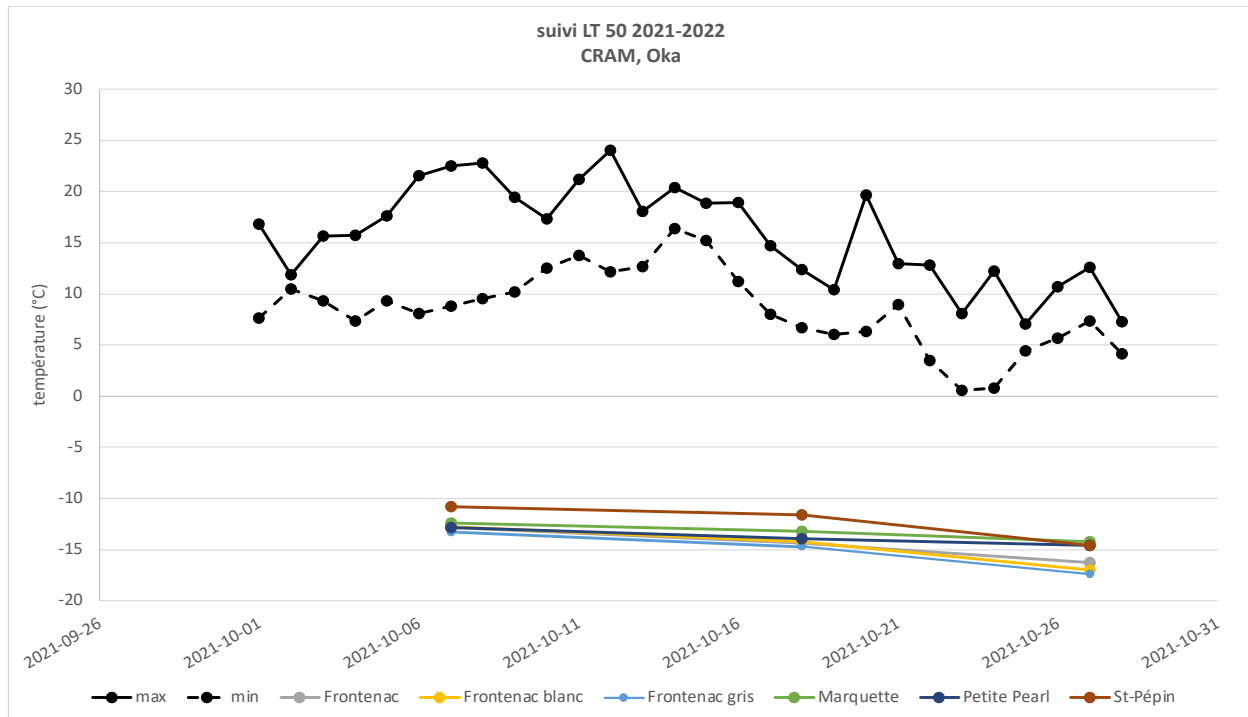


Figure 2: Monitoring of bud cold hardiness (LT 50) for some of the cultivars at the CRAM's experimental vineyard located in Oka, Québec

Table 1: Lethal temperatures of vine buds in October 2021.

MRC	date	cépage	LT 10	LT 50	LT 90
Deux-Montagnes	2021-10-07	Frontenac	-11.83	-12.81	-13.94
Deux-Montagnes	2021-10-07	Frontenac blanc	-11.72	-12.74	-14.57
Deux-Montagnes	2021-10-07	Frontenac gris	-12.21	-13.27	-14.21
Deux-Montagnes	2021-10-07	Marquette	-9.87	-12.40	-13.34
Deux-Montagnes	2021-10-07	Petite Pearl	-11.49	-12.81	-13.86
Deux-Montagnes	2021-10-07	St-Pépin	-8.87	-10.82	-12.09
Deux-Montagnes	2021-10-18	Frontenac	-13.82	-14.38	-15.25
Deux-Montagnes	2021-10-18	Frontenac blanc	-12.98	-14.24	-16.82
Deux-Montagnes	2021-10-18	Frontenac gris	-13.79	-14.71	-15.59
Deux-Montagnes	2021-10-18	Marquette	-11.40	-13.22	-14.21
Deux-Montagnes	2021-10-18	Petite Pearl	-10.98	-13.94	-14.96
Deux-Montagnes	2021-10-18	St-Pépin	-10.55	-11.57	-12.74
Marguerite d'Youville	2021-10-21	Frontenac	-13.98	-14.74	-15.39
Marguerite d'Youville	2021-10-21	Marquette	-12.92	-13.88	-14.75
Marguerite d'Youville	2021-10-21	St-Pépin	-12.37	-13.19	-13.97
Marguerite d'Youville	2021-10-21	Chardonnay	-14.34	-15.57	-16.42
Marguerite d'Youville	2021-10-21	Pinot noir	-13.15	-13.61	-14.27
Les Jardins-de-Napierville	2021-10-25	Chardonnay	-12.23	-14.15	-15.64
Les Jardins-de-Napierville	2021-10-26	Pinot noir	-13.84	-16.13	-16.92
Les Jardins-de-Napierville	2021-10-26	Pinot gris	-10.62	-13.59	-15.19
Les Jardins-de-Napierville	2021-10-26	Vidal	-12.60	-13.55	-15.05
Les Jardins-de-Napierville	2021-10-26	Seyval	-12.98	-14.36	-15.57
Les Jardins-de-Napierville	2021-10-26	Gamay	-13.65	-14.89	-16.17

MRC	date	cépage	LT 10	LT 50	LT 90
Le Haut-St-Laurent	2021-10-26	Seyval	-11.94	-13.16	-13.88
Le Haut-St-Laurent	2021-10-26	Merlot	-10.48	-11.80	-12.97
Le Haut-St-Laurent	2021-10-26	Cabernet franc	-8.51	-11.44	-13.00
Le Haut-Richelieu	2021-10-26	St-Pépin	-12.73	-14.27	-15.54
Le Haut-Richelieu	2021-10-26	Chardonnay	-13.70	-14.67	-16.60
Le Haut-Richelieu	2021-10-26	Pinot noir	-12.66	-13.69	-15.31
Le Haut-Richelieu	2021-10-26	Merlot	-12.74	-13.66	-14.28
Deux-Montagnes	2021-10-27	Frontenac	-14.83	-16.29	-18.03
Deux-Montagnes	2021-10-27	Frontenac blanc	-15.12	-17.00	-18.57
Deux-Montagnes	2021-10-27	Frontenac gris	-15.54	-17.35	-18.98
Deux-Montagnes	2021-10-27	Marquette	-12.60	-14.20	-16.01
Deux-Montagnes	2021-10-27	Petite Pearl	-13.07	-16.20	-19.11
Deux-Montagnes	2021-10-27	St-Pépin	-12.68	-14.58	-15.98
Brome-Missisquoi	2021-10-27	Frontenac	-15.54	-16.95	-19.27
Brome-Missisquoi	2021-10-27	Frontenac blanc	-17.62	-19.41	-22.00
Brome-Missisquoi	2021-10-27	Frontenac gris	-13.63	-15.34	-18.65
Brome-Missisquoi	2021-10-27	Petite Perle	-15.03	-15.92	-20.72
Rouville	2021-10-27	Vidal	-11.95	-12.89	-14.04
Rouville	2021-10-27	Frontenac	-12.94	-14.26	-16.09
Rouville	2021-10-27	Frontenac blanc	-12.84	-14.26	-16.16
Rouville	2021-10-27	Frontenac gris	-12.78	-14.60	-15.62
Rouville	2021-10-27	Marquette	-13.99	-15.30	-16.61
Rouville	2021-10-27	Chardonnay	-12.68	-13.62	-14.74

Links mentioned in this newsletter

- Cool Climate Oenology and Viticulture Institute (CCOVI) at Brock University:
<https://brocku.ca/ccovi/>
- CCOVI's Vine Alert program: <https://www.ccovi.ca/vine-alert/>
- Resources section of Vine Alert: <https://www.ccovi.ca/vine-alert/resources>
- Scientific paper by Mills *et al.* on differential thermal analysis:
<https://www.ajevonline.org/content/57/2/194>
- Agri-Reseau Newsletter of October 13, 2021 by Karine Bergeron on growing degree-days (French only): <https://www.agrireseau.net/vigne-vin/documents/105718/comparatifs-annuels-degrees-jour-2015-2021>
- Winter Season Bulletin 1 2020-2021 (French only): https://www.cram-mirabel.com/wp-content/uploads/2021/09/rapport-suivi-gel-bourgeon-2020_2021_1-1.pdf

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