

# **Bud Hardiness and Winter Injury Assessment 2020-2021**

## **Progress Report**

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### **Research and Extension**

**Introduction.** This is the final year of a project that started in 2009 and has continued for 11 years. It was designed to provide timely information on bud hardiness and potential winter and spring frost injury to growers throughout New York by completing the three objectives outlined:

**Objectives:**

1. Continue using differential thermal analysis (DTA) to determine bud LTEs in standard varieties in three regions of NY (Finger Lakes, Hudson Valley, and Portland, NY (Lake Erie) Laboratory) from late November through April.
2. Provide timely extension information to the industry through the [Bud Hardiness web page](#).
3. With new equipment at CLEREL, monitor and report bud hardiness for regionally important varieties, and determine the relationship of bud hardiness to cropping levels in existing research projects in Lake Erie research and commercial vineyards.

This project operates during the dormant season, so work on the 2020-2021 season is ongoing. Here we report mostly on the results from the 2019-2020 season

Winter minimum temperatures in 2019-2020 occurred on February 14-15, and ranged from +2 to 5° F in the Finger Lakes, Western NY, and the lower Hudson Valley to -2° F in Watertown (Table 1). The Champlain valley region in Northeast NY had much lower temperatures (-13 to -20° F) on those dates. In most of NY it was a mild winter, with LT<sub>50s</sub> (median bud freezing temperatures) well below winter lows.

Bud injury estimates from cutting and examining buds at the end of the cold season was minimal in the Finger Lakes, Lake Erie, and lower Hudson Valley (ranging from 2 to 8% in the Finger Lakes, and 3-8% in the Lake Erie sites). In the Champlain region, the sub-zero temperatures did not cause bud mortality, because the Cold-climate “Minnesota” cultivars resist temperatures down to -18 to -20° F.

This single mid-winter low in the middle of February was a contrast from the previous 2018-2019 season, which saw subzero temperatures in mid-January and late January (-3 to -5 ° F) . Bud injury was also minimal (2-10%), except at cooler sites on the west side of Keuka Lake, where Riesling (24%) and Cabernet Franc (43%) had higher bud injury levels.

There was significant spring frost injury in the Finger Lakes and part of the Hudson Valley, associated with two frost events on May 8-9 and May 12-13, following bud burst. In the Finger Lakes, these had a very significant effect on yields of Native (Concord, Catawba, Niagara) varieties.

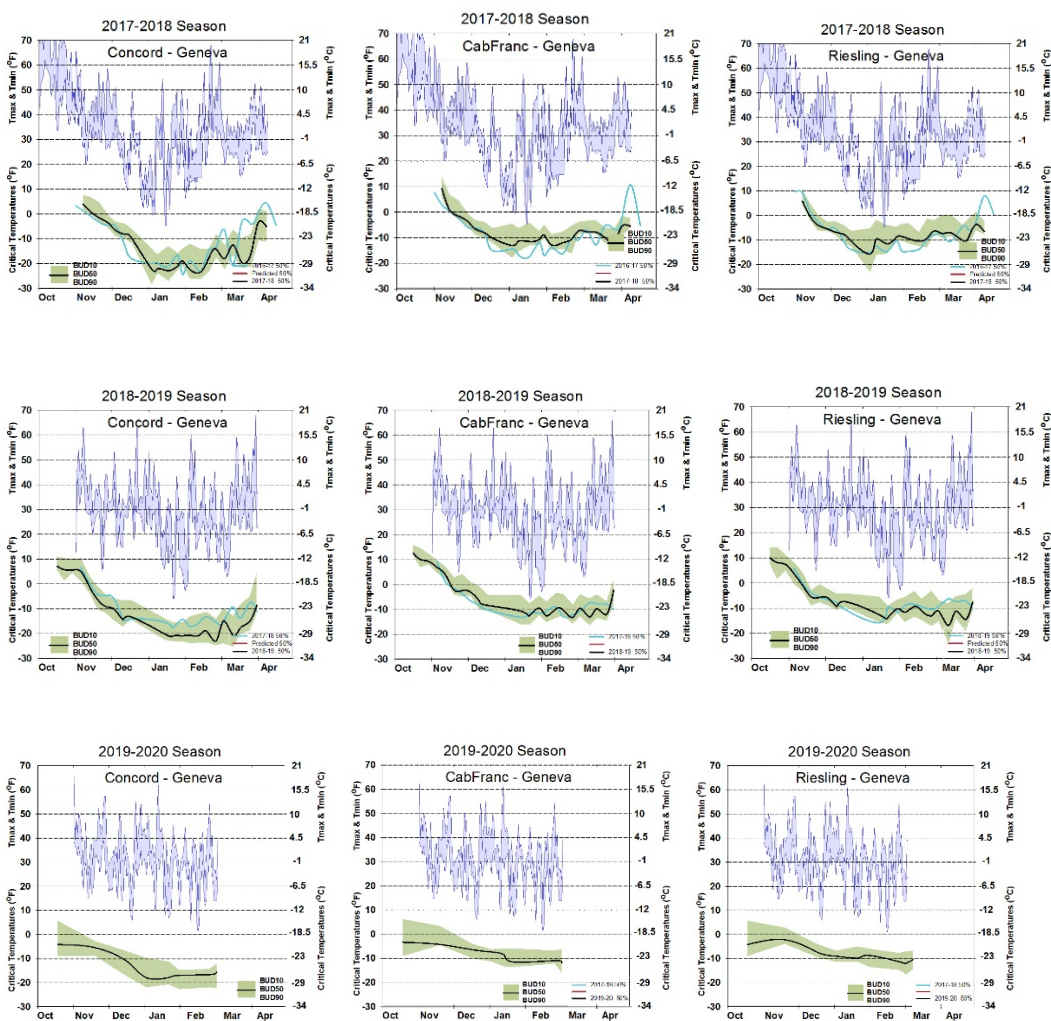
**Table 1. Winter lows during the winter of 2019-2020**

Station	Date	Winter low temperature ° F
Geneva	2/14	2.3
Portland (CLEREL)	2/14	3.5
Highland (Hudson Valley)	2/15	4.6
Albany	2/15	5.0
Willsboro (Champlain)	2/15	-13
Chazy (Champlain)	2/14	-20
Watertown	2/15	-2.0

Monitoring for the [2020-2021 season](#) is still underway. Winter lows have ranged from +10 ° F (Finger Lakes) and +14 (Portland) to -5 ° F in the Champlain Valley.

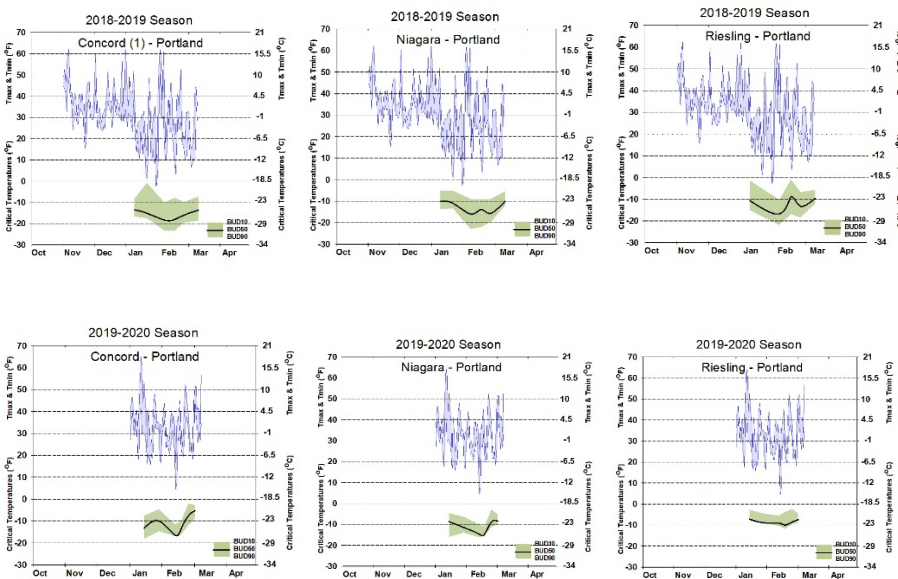
## Activities by objective:

- 1. Differential thermal Analysis (Bud freezing runs).** Buds were collected from Geneva (NYSAES) weekly from Concord, Cabernet franc, Riesling, and Noiret vines from 15 October 2019 through early March April 2020, and subjected to controlled freezing to determine the range of bud-freezing temperatures. In addition, The Finger Lakes, Lake Erie, and Hudson Valley grape extension programs collected buds from the same varieties at 6 locations in the Finger Lakes, 2 locations in Lake Erie, and from the Hudson Valley Laboratory in Highland, NY. Collections were made at two week intervals from early January to March 16, 2020. The COVID-19 pandemic cut short our 2019-2020 collection season. In 2020-2021, we started collections at the Geneva site in mid November, but technical problems with data recovery
- 2. Seasonal LTEs.** Maps and tables showing current LT50s for Concord, Riesling, Cabernet Franc and various hybrids from the Lake Erie, Finger Lakes, and Hudson Valley were posted at the [Bud Hardiness web page](#). Shown below are data from, 2017-2018, and 2018-2019 and 2019-2020. Current collections for 2020-2021 are still in progress.



**Figure 1.** Daily min/max temperatures and bud freezing temperatures (Low Temperature exotherms from laboratory tests on dormant buds; black line is LT<sub>50</sub>) in Cabernet franc, Riesling, and Concord at Geneva

in 2017-2018, 2018-2019 and 2019-2020. Winter minimum temperatures in 2019-2020 didn't get near the LT50 median bud freezing temperatures. To date in 2021 (not shown) low temps have not yet reached bud freezing temperatures.



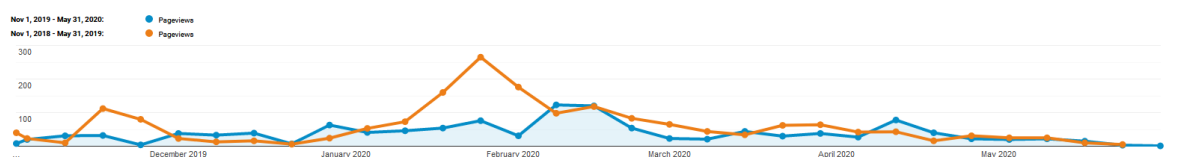
**Figure 2.** In the Lake Erie Region, winter lows in 2019-2020 were around +5° F. Maximum midwinter bud hardiness(LT50) was around -15° F for Concord and Niagara, and around -10° F for Riesling

### 3. With new equipment at CLEREL, determine the relationship of bud hardiness to cropping levels in existing research projects in Lake Erie research and commercial vineyard. .

Results for 2019 and 2020 from Lake Erie are shown in Figure 2. For 2020-2021, Jennifer Russo is the PI for a separate project in association with a field experiment on Riesling and Concord looking at the impact of a range of crop loads on bud hardiness.

**Crop Updates.** Information from bud hardiness monitoring was included several crop updates and newsletter articles by the Lake Erie Regional Grape Program, the Finger Lakes Grape Program, and the Hudson Valley-based Eastern New York Horticulture Extension Program.

**Number of web accesses:** We tracked how many times the bud hardiness pages were accessed for four dormant seasons (November-May, 2016-7, 2017-8, 2018-9, and 2019-2020). Pages were accessed 1150 times in 2017-2018, 1225 times in 2016-2017 and 1,764 times in 2018-2019, and 1204 times in 2019-2020.

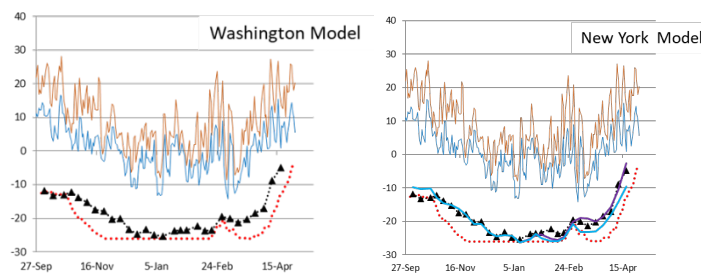


**Figure 3.** Number of page views from November 2019-May 2020 (blue) and comparable data from November 2018-May 2019 (orange). Note that the 2019 page views peaked in late January, following tow cold events, while in 2020 they peaked in mid-February, following the 2/14/2020 cold event.

**Grower Outcomes:** The past two winters (2018-2019 and 2019-2020) were relatively mild, so winter injury has been less of a concern than in earlier seasons (eg. 2014-2015 and 2015-2016). If more severe bud-damaging weather occurs in upcoming winters, we expect there to be more interest.

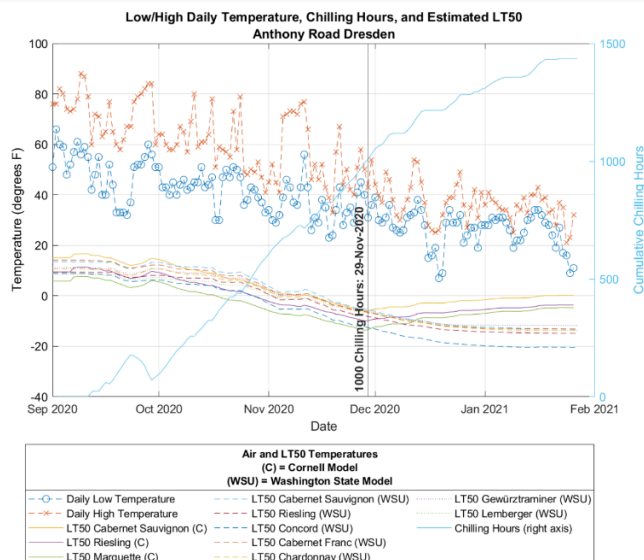
In previous seasons (2014-2015 and 2015-2016), our information had a lot of impact on growers. In part because of our extension outreach, bud hardiness monitoring, and followup bud injury surveys, growers adjusted pruning intensity, in many cases leaving 5x the normal number of buds, and were able to compensate for the winter injury. This is detailed in the Appellation Cornell article [How well did winter bud injury measurements predict the final grape crop?](#)

**Other outcomes:** In a related project, PI Martinson has been working with Dr. Jason Londo, USDA ARS scientist, on developing robust predictive models of bud hardiness. For the past two seasons, his program has done weekly collections from 42 varieties, including Concord and Niagara, but also a wide range of interspecific hybrids and *vinifera* cultivars. The model uses daily min/max temperatures to predict bud hardiness – and to date provides a better fit (Fig. 5, blue line at right) to observed data than a widely-used model from Washington State.



**Figure 4.** The Washington State model(left) predictions (red dotted line) underestimated measured bud hardiness (black line and triangles) before midwinter, and also during the springtime deacclimation phase. The New York model (right, solid blue line) developed by Al Kovaleski and Jason Londo at Geneva used precise measurements of acclimation and deacclimation rates to closely predict LT50s based on daily min/max temperatures.

Cornell Eastern New York Commercial Horticulture program's Extension Educator Jim Meyer has incorporated the Londo model to predict bud hardiness into site-specific weather updates, sent to approximately 100 growers in Eastern NY. This is a prototype for eventually providing predicted bud hardiness information to growers, based solely on local weather station minimum/maximum daily temperature data.



**Figure 5.** Model predictions for bud hardiness and daily min/max temperatures in an extension update.

**Publications:** Information from this project was featured in 3 Finger Lakes Crop Updates ([February 6, 2020](#), [March 12, 2020](#), [December 21, 2020](#)) and one Lake Erie Crop Update ([January 23, 2020](#))

**Summary and Future Directions:** We now have eleven seasons, starting in 2009-2010, of data from numerous sites and varieties throughout New York on seasonal trends in bud hardiness as affected by minimum and maximum temperatures. USDA scientist Jason Londo is doing detailed assessments of winter bud hardiness and the process of vines acquiring endodormancy (resistance to growth in the fall) acquiring maximum winter hardiness (based on environmental conditions, such as low and alternating temperatures), and the transition to ‘ecodormancy’, where vines lose cold-hardiness based on rising temperatures, culminating in bud burst. He is extensively sampling 42 different varieties, and expects to have models that will work on each variety to predict bud hardiness.

My vision is to have a grower-friendly site that uses data from weather stations (eg. NEWA) to predict bud freezing temperatures – and be able to forecast the risk of damaging temperatures 3-5 d in advance. I hope to have such a system in place by the 2021-2022 dormant season.

## B. Appendix

### a. Impact Statement:

Winter injury associated with extreme winter-low temperatures is a major ongoing concern for grape growers in New York. Since 2009, grape extension programs from the Lake Erie, Finger Lakes, and Hudson valley regions have worked with the Statewide Viticulture Extension programs to provide seasonally current estimates of bud freezing temperatures for major varieties by using controlled freezing to determine bud low temperature exotherms. This information posted at the [Bud hardiness data](#) page was accessed 1206 times in 2019-2020, down slightly from 1700 times in 2018-2019 during the dormant season.

### b. Publications:

Martinson, T. and W. Wilsey. 2009-2021. [Bud hardiness data](#), accessed at <https://grapesandwine.cals.cornell.edu/extension/bud-hardiness-data>.