

NYWGF RESEARCH - FINAL REPORT

Funding for fiscal year: 2024-2025

SECTION 1:

Project title: Cold hardiness monitoring and microclimate optimization of grapevines in New York 2024-2025

Principal Investigator with contact info: : Jason P. Londo. Associate professor of Fruit Physiology. Horticulture Section, School of Integrative Plant Science, Cornell AgriTech, Geneva, NY 14456, ph.: 315-787-2463, e-mail: jpl275@cornell.edu

Co-PI Collaborators with contact info:

Hans Walter-Peterson, Area Extension Educator, Finger Lakes Grape Program, hcw5@cornell.edu
315-536-5134

Jennifer Russo, Viticulture Extension Educator, Lake Erie Regional Grape Program,
jjr268@cornell.edu , 716-792-2800

Jeremy Schuster, Viticulture Extension Specialist, Eastern New York, Cornell Cooperative Extension Specialist, jds544@cornell.edu, 845-372-4780

New Research Continued Research

Amount Funded \$ 40,220

SECTION 2:

Project Summary Impact Statement: This project is a continuation of the history of collecting and assessing grapevine cultivars for changing cold hardiness in New York State. Growing grapes in New York is a delicate balance between cultivar, environment, and consumer demand. One of the leading limiting factors is our winter climate and the vine's ability to survive acute cold events. In this proposal we continued monitoring and reporting on cold hardiness for important regional cultivars in the Finger Lakes, Lake Erie, and Hudson Valley AVAs. We also continued our evaluation of microclimate effects on cold hardiness variation and fruit ripening dynamics with the aim of future proofing viticulture in New York as climate variation increases.

Objectives: Objective 1: Monitor the cold hardiness of *vinifera* and hybrid cultivars over the winter season of 2024-2025 using differential thermal analysis of dormant bud tissue from the Finger Lakes, Lake Erie, and Hudson Valley.

Objective 2: Complete the third and final replicate of our winter microclimate study, which tracks local variation in cold hardiness and budbreak phenology in lakeside microclimates in the Finger Lakes and Lake Erie.

Objective 3: Continue examining how microclimates impact vine water use efficiency, fruit growth and ripening patterns to generate the data needed to develop climate suitability models and crop estimates for wine grapes.

Objective 4: Process the data and provide summary cold hardiness and budbreak data to growers and producers through extension presentations, Appellation Cornell, and the newly developed Cornell Bud Hardiness application. Objective 4 was also the central aspect of the project related to technology transfer.

Materials & Methods:

Objective 1: *Monitoring cold hardiness of vinifera and hybrid cultivars.* Dormant canes were collected from grapevine cultivars in the Finger Lakes, Lake Erie, and Hudson Valley regions and assess for cold hardiness using differential thermal analysis (DTA) and detection of the primary bud low temperature exotherm (LTE). LTE values were recorded using the BudFreezer/BudProcessor/BudLTE software package.

Objective 2: *Repeat microclimate cold hardiness study in the Finger Lakes and Lake Erie.* At fifteen Concord sites near Portland, NY, and eighteen Riesling sites around Seneca Lake temperature/humidity sensors were used to measure temperature, humidity, VPD, and barometric pressure every 15 minutes throughout the winter dormancy season. Dormant cane samples were collected from every site every two weeks to directly link variation in vineyard microclimates with cold hardiness level.

Objective 3: *Repeat and expand microclimate study in the Finger Lakes and Lake Erie into the growing season to track variation in temperature, humidity, vine water use efficiency, fruit growth and ripening.* We extended our microclimate monitoring into the growing season to gain a better understanding of how berry ripening changes across New York. Every two weeks starting at pea-berry stage we collected 50 berry subsamples using stratified sampling techniques at each microclimate location for Riesling and Concord, and also for an additional 11 cultivars in each the Finger Lakes and Portland regions. Berrys were weighed and measured and then pressed to juice to measure brix, TA, and pH to track fruit quality development.

Objective 4: *Processing of data and extension engagement.* All cold hardiness and phenology data was summarized and made available through various methods of extension engagement. The primary method was through weekly updates to the interactive Cornell bud hardiness application, which is hosted at [Cornell Bud Hardiness](#). Data was summarized and uploaded to the application weekly. Graphs and downloadable data were updated automatically. Temperatures which result in 10, 50, and 90% of bud death were provided. While we prepared to issue an alert for acute freezing risk, no acute events occurred during the winter 2024-2025 season. Results of the entire season were compiled and shared through extension newsletters and presentations at industry relevant workshops and meetings (e.g., bud cutting workshops, BEVNY, CRAVE).

Results/Outcomes/Next Steps:

Objective 1: Winter conditions in Geneva were relatively stable for the entire winter with prolonged cold in both min and max temperatures in the later half of the winter. Three acute cold events occurred where temperatures decreased below 0 °F, 12/23/2024, 1/22/2025-1/23/2025, and 2/2/2025. In Geneva, 12 varieties were tracked throughout the winter season: Cabernet Franc,

Cabernet Sauvignon, Cayuga White, Chardonnay, Concord, Gewurztraminer, Lemberger, Marquette, Merlot, NY81, Riesling, and Sauvignon blanc. Cold hardiness throughout the season was sufficient to avoid damage at all points in winter. As expected, Gewurztraminer and Merlot were the least cold hardy during midwinter. Delayed acclimation (gain of cold hardiness) was observed in Cabernet Sauvignon, NY81, and Merlot. Rapid deacclimation in late winter was observed for hybrid varieties, relative to vinifera. All cold hardiness data was uploaded to the Cornell bud hardiness application and made available for free. In addition, cold hardiness models were plotted with field collected data. Data shown in Figure 1.

Winter conditions in Portland were broadly similar to that in Geneva, though there were less episodes of acute midwinter cold temperatures. Only at one point did minimum temperatures reach below 0 °F on 1/22/2025. As seen in Geneva, no expected occurrences of vine freeze damage was anticipated during the winter season and overall, winter minimum temperatures were mild and sufficiently warmer than vine cold hardiness. In Portland, 15 varieties were tracked: Aurore, Cabernet Franc, Chardonnay, Concord, Delaware, Elvira, Gewurztraminer, Ives, Marquette, Niagara, Pinot gris, Riesling, Seyval, Vignole, and Vincent. Gewurztraminer, Chardonnay, and Cabernet Franc were the least cold hardy varieties while Concord and Elvira attained the greatest cold hardiness. As seen in the Geneva data, cold hardy and labruscana hybrid varieties in Portland deacclimated more rapidly in late winter than Riesling, or hybrids such as Seyval, and Vignole. As in Geneva, data were uploaded and shared via the free cold hardiness app. Data shown in Figure 2.

Winter conditions in the Hudson Valley were also broadly similar to that in Geneva with two acute cold events during the winter, one on 12/23/2024 and the second on 2/22/2025. In the Hudson Valley, Merlot, Cabernet Franc, Lemberger, Chardonnay, and Pinot noir were monitored. Unlike Geneva and Portland, temperatures dipped to temperatures lower than the field measured LT50 data for Merlot, Cabernet Franc, and Lemberger. Reduced acclimation of Merlot and Cabernet Franc appears to have contributed to overall lower cold hardiness for the winter and rapid deacclimation was observed for Pinot noir in late winter. Field data were uploaded to the cold hardiness app. Data shown in Figure 3.

The next steps for this work were proposed in the 2025-2026 request for proposals. We are looking to the board to help us understand how much cold hardiness monitoring to invest in for the years to come. Our approach for the upcoming year is to split our effort in Geneva and Portland between sampling well documented cultivars to validate current model predictions on the NEWA and cold hardiness applications, and newly developed or under measured cultivars. The new cultivar data can be used to build new models and we have chosen to focus on several Northern hybrid selections from the Cornell breeding program and from the Minnesota program in the Geneva effort. In the Portland effort, we will be evaluating the new German and Italian disease resistant stock now available.

Objective 2: The 2024-2025 winter was our final year of cold hardiness monitoring as part of the microclimate project. In this project, we deployed temperature sensors at 18 Riesling vineyards in the FLX, and 15 Concord vineyards in WNY. Dormant buds were collected every two weeks from November – March and cold hardiness values were determined using DTA methods. Vineyards were chosen to transect across known microclimate gradients in both regions. In FLX there were 6 transect clusters with vineyards positioned near the shores of Seneca Lake, far from the shore, and

at a rough midpoint between. In WNY, there were 3 broad transects of 5 vineyards each, marking the shore of Lake Erie, the Escarpment, and the midpoint between. In past years we have noted wide variation in cold hardiness at each regional site. Microclimate gradients are more apparent in WNY than the FLX sites with lakeshore temperatures being less severe, and the acquired cold hardiness is lower than samples collected on the Escarpment. In the FLX, the sites with mild temperatures and reduced cold hardiness was quite variable, though typically the lakeshore sites along the Eastern shore had the lowest cold hardiness. At no point in the winter of 2024-2025 did minimum temperature drop to levels that would have resulted in any primary bud damage in this part of the project. As in previous years, the maximum difference in cold hardiness among the FLX or WNY vineyards ranged from 3.6-9 degrees depending on collection timepoint. This result demonstrates again that cold hardiness capacity among Riesling or Concorde is quite large, and the microclimate temperature exposure drives high variation in response across both growing regions.

Next steps on this effort are to take the combined results of the three years of this study will be written up as a peer reviewed journal article and an extension facing document.

Objective 3: This objective focused on repeating an assessment of berry ripening behavior for vines in the microclimate locations described above. Essentially expanding our evaluation of microclimate effects beyond cold hardiness into fruit production. We sampled berry subsamples every two weeks from pea-berry to harvest for the 18 Riesling vineyards in the FLX region and the 15 Concord vineyards in the WNY region. Berries were weighed and then crushed to determine brix and TA levels. In addition to these collections, 13 cultivars were evaluated in Geneva (Aravelle, Cabernet Franc, Cabernet Sauvignon, Chardonnay, Gewurztraminer, Lemberger, Marechal Foch, Marquette, Merlot, Pinot Gris, Riesling, Traminette, and Vignoles) and 15 in Portland (Aurore, Cabernet Franc, Cabernet Sauvignon, Chardonnay, Concord, Elvira, Gewurztraminer, Ives, Marquette, Niagara, Pinot gris, Riesling, Seyval, Vignoles, and Vincent). All additional cultivars were collected from a single microclimate in each region and the goal was to evaluate cultivar level differences in the ripening process. Cultivars that were sampled in both locations were used to compare how the FLX and WNY regions differ in fruit ripening and included Cabernet Franc, Cabernet Sauvignon, Chardonnay, Gewurztraminer, Marquette, Pinot gris, Riesling, and Vignoles. When looking within a given region, hybrid grape cultivars tended to have higher brix, but also more rapid decreases in TA, than vinifera cultivars. Examining the ratio between brix and TA revealed a quality response curve with a broadly linear relationship from veraison to just prior to harvest, but the timing and slope of this relationship was different based on hybrid or vinifera heritage (Figure 5). When comparing fruit ripening traits of cultivars sampled both in the FLX and WNY regions relative to sampling date, there was no major difference in fruit ripening. However, when date was converted to heat units (growing degree hours), it was seen that FLX berries achieve higher brix, lower TA, and earlier brix/TA linearization than WNY berries with lower heat exposure (Figure 6). This result contrasts that of similar studies conducted in France on a wide variety of vinifera cultivars where it was shown that fruit ripening is much more conserved. Fruit ripening traits are influenced by other factors besides temperature, for example precipitation or irrigation levels. It appears in our study that we are seeing impacts of the different management styles and microclimates between the FLX and WNY regions. The result of this observation is that we can both develop fruit ripening models and harvest prediction tools for grape production in both regions, but the models themselves will have to be optimized by cultivar and region.

Next steps for this project are that we proposed to repeat the study using the same cultivar lists discussed above, as well as for the Concord microclimate locations. We are concluding our measurement of the Riesling microclimate locations as the variation in vineyard management and vineyard age is so different in the FLX region that it reduces the rigor of the observed fruit quality measurements. This repeated sampling is proposed for the summer of 2025 in a new project proposal, to try and separate the deliverables from the cold hardiness work reported in Objective 1 and 2. Our goal is to collect at least three years of fruit ripening data from both regions to build draft yield prediction and quality prediction models. In addition, we hope to expand these methods into other popular cultivars across New York to capture the impact of different climates on fruit quality traits.

Technology Transfer Plan: The primary method for the transfer of our results to the grower community is through talks at grower workshops, online webinars run by CCE, and through the Cornell cold hardiness online application.

Attachments: relevant charts and graphs, photos etc.

Figure 1: Cold hardiness data from the Geneva (FLX) component of the monitoring project. Maximum (red) and minimum (blue) air temperature for the winter of 2024-2025. The left panel shows the results from field collections for cold hardiness for 12 cultivars. The right panel shows the format for the way these data are shared with growers through the cold hardiness application. The online portal shows field collected results for the LT10, LT50, and LT90 temperatures as well as the available cold hardiness prediction models for each cultivar.

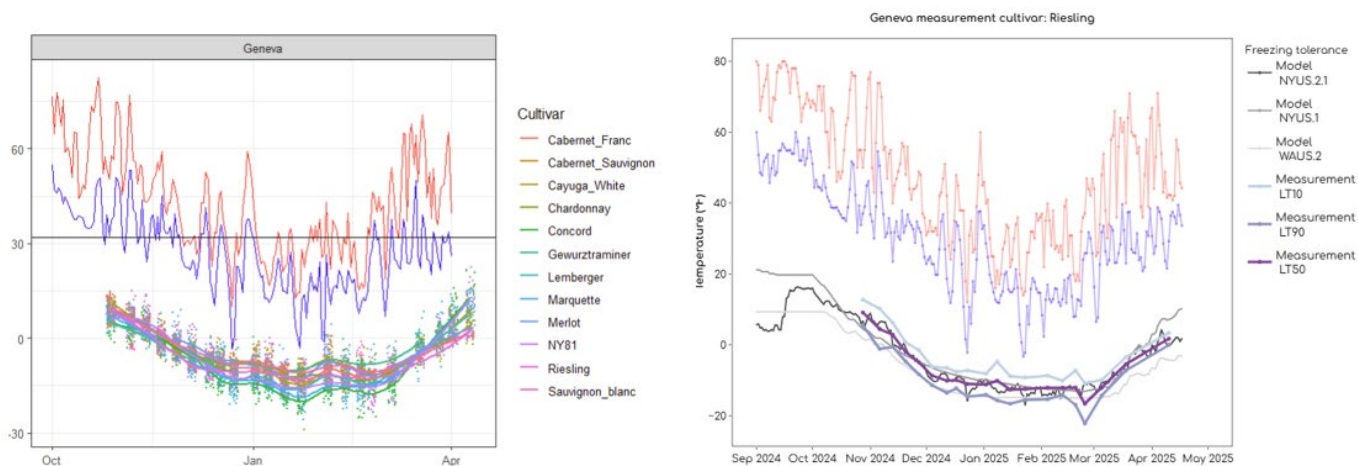


Figure 2: Cold hardiness data from the Portland (WNY) component of the monitoring project. Maximum (red) and minimum (blue) air temperature for the winter of 2024-2025. Left panel shows the results from field collections for cold hardiness for 15 cultivars. Right panel shows the format for the way these data are shared with growers through the cold hardiness application. The online portal shows field collected results for the LT10, LT50, and LT90 temperatures as well as the available cold hardiness prediction models for each cultivar.

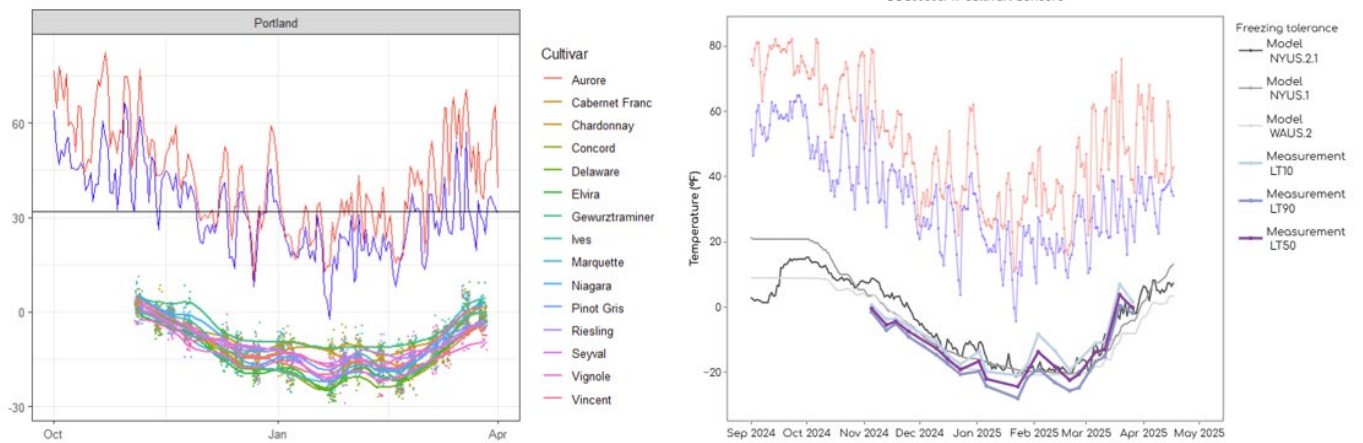


Figure 3: Cold hardiness data from the Hudson Valley component of the monitoring project. Maximum (red) and minimum (blue) air temperature for the winter of 2024-2025. Left panel shows the results from field collections for cold hardiness for 5 cultivars. Right panel shows the format for the way these data are shared with growers through the cold hardiness application. The online portal shows field collected results for the LT10, LT50, and LT90 temperatures as well as the available cold hardiness prediction models for each cultivar.

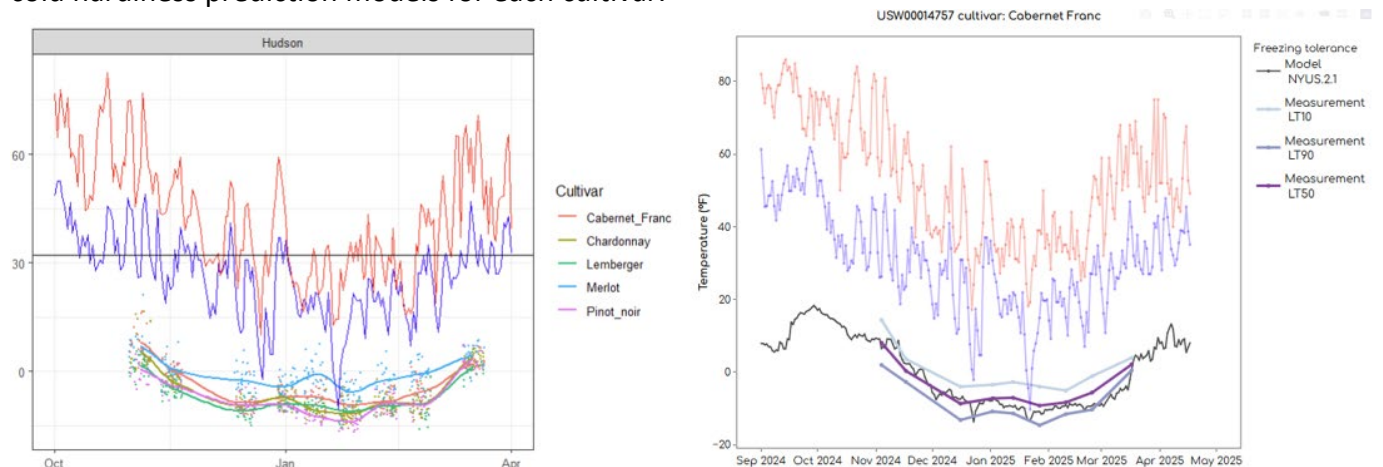


Figure 4: Cold hardiness data from the FLX and WNY microclimate cold hardiness portion of the project. Maximum (red) and minimum (blue) air temperature for the winter of 2024-2025 in each region. Left panel shows the results from field collections for cold hardiness for 18 Riesling vineyards in the FLX region. Right panel shows results from field collections for 15 Concord vineyards sampled in the WNY region. Each black line represents a different microclimate location. Variation in cold hardiness measured at any one date during the season can vary by between 3.6-9 degrees F.

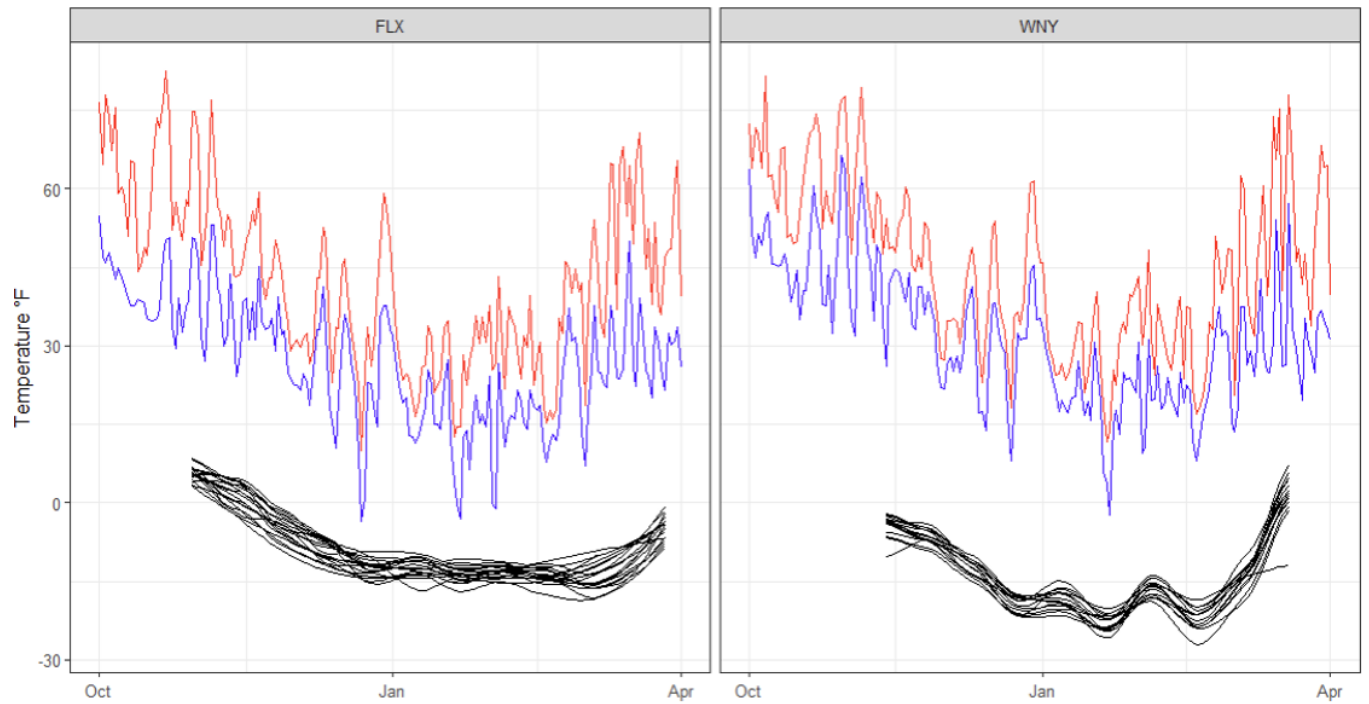


Figure 5: Brix/TA ratio for fruit ripening of different grapevine cultivars. Left panel represents cultivars sampled in the FLX region, right panel represents cultivars sampled in the WNY region. Sampling of berries occurred every two weeks from Pea-berry to harvest and date was adjusted to heat units as growing degree hours.

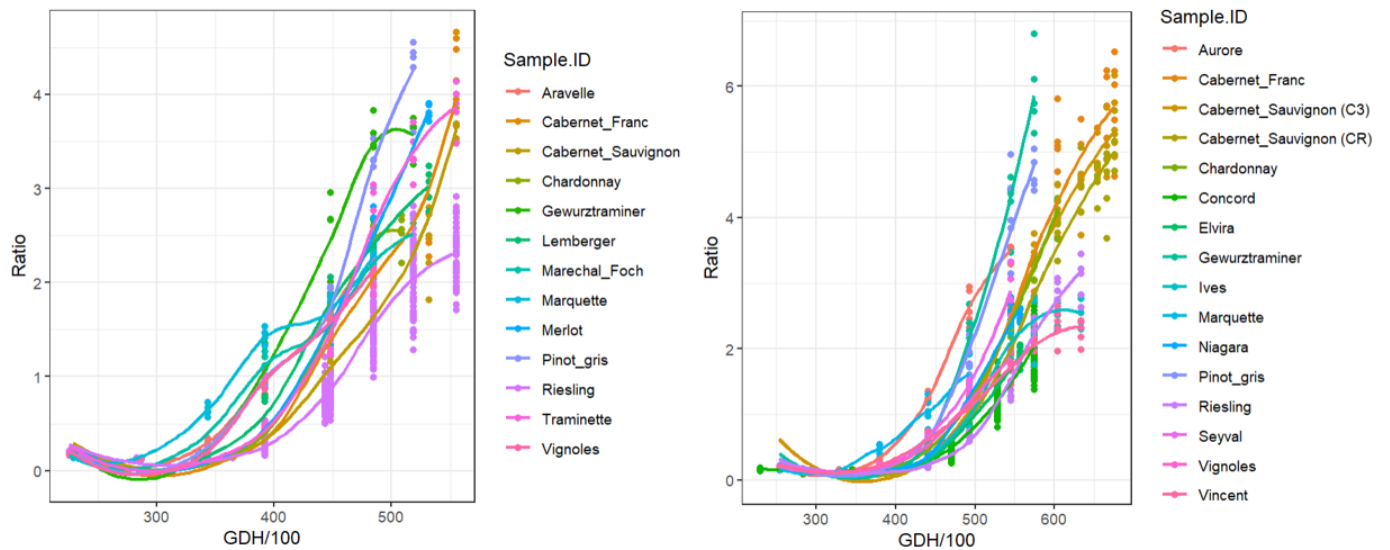
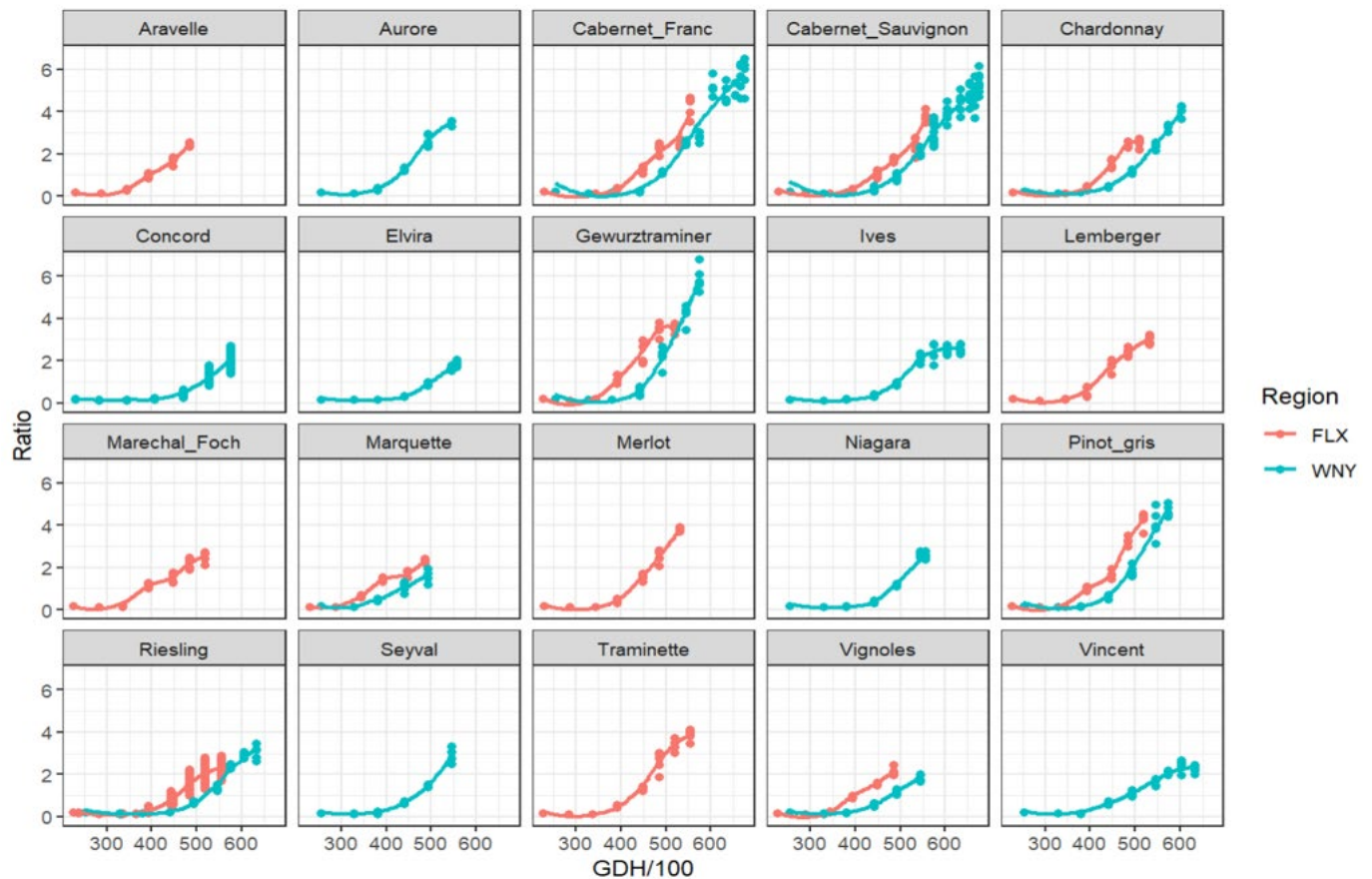


Figure 6: Brix/TA ratio for fruit ripening of different grapevine cultivars demonstrating impact of region on the ripening pattern. Cultivars sampled in the FLX are in red while WNY is in cyan. When adjusted for heat exposure, fruit ripens faster in FLX vineyards for all shared cultivars.



SECTION 3:

Project summary and objectives: This project is a combined effort of a continued project seeking to understand differences in winter hardiness between grapevine cultivars and between grapevine production regions, and a new project concept, which explores how regions and microclimates within regions differ in the patterns of grape berry ripening. We surveyed and reported on the cold hardiness of commercially important grape cultivars throughout the winter, evaluated how variable cold hardiness is based on 18 Riesling vineyards and 15 Concord vineyards, and examined berry ripening patterns in WNY and the FLX regions. Surprisingly large differences in cold hardiness were observed due to microclimate variation, up to 9 degrees difference in cold hardiness due to location. This result demonstrates that vineyard microclimate far exceeds cultivar selection when it comes to maximum cold hardiness. Finally, berry ripening data demonstrate that when adjusted for heat units, fruit ripens faster in the FLX compared to WNY, both with development of Brix and decreases in acid.

Importance of research to the NY wine industry: This research is important to the NY wine industry as it demonstrates that region wide variation and cultivar level variation is high in both cold hardiness and berry ripening physiology. Cold hardiness research is important to the industry both as a monitor for potential damage, and also as the data generator for more cultivar specific modeling efforts. To date we have developed cold hardiness models for 56 different cultivars. The berry ripening data is important to the industry as it also forms the baseline for development cultivar

specific models for berry ripening and fruit quality. Our goal is to develop crop load estimates and targeted harvest date models.

Project Results/next steps: The next step for this project is to break it into two separate efforts, one focused on winter and the other focused on berry ripening modeling. We have proposed to expand the cold hardiness work into the disease resistant hybrid grapes coming out of European breeding programs and the breeding program of Cornell grape breeder Maddy Oravec. For fruit ripening, we are hoping to collect additional years of data to build out our model accuracy with the goal of producing cultivar specific yield and quality estimation.