Virginia Cooperative Extension
Virginia Tech • Virginia State University

VITICULTURE NOTES

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Tony K. Wolf, Viticulture Extension Specialist, AHS Jr. Agricultural Research and Extension Center, Winchester, Virginia

vitis@vt.edu http://www.arec.vaes.vt.edu/alson-h-smith/grapes/viticulture/index.html

I. Current situation: Impact of recent low temperatures on grape cold hardiness

We've had several questions come up recently about the spate of cold weather; specifically, what potential impacts have these low temperature events had on grapevines? Historically, low winter minima were the determining factor in where *vinifera* grapes, in particular, could be grown in Virginia. There was rarely a winter in the eighties or nineties that we didn't lose sleep as temperatures descended to or below 0°F. One of the last truly memorable cold events occurred in February 1996 when many vineyard temperatures in the northern piedmont reported temperature readings in the -10 to -20°F range; temperatures low enough to kill many of our vinifera varieties and cause significant damage on hybrids. We've seen dips in the sub-zero range since then, but the winters have decidedly moderated over the past 15 years to the point that many of us no longer continue to use some of the vine protection measures previously used: delayed dormant pruning, retention of trunk renewal shoots, multiple-trunking, and graft-union protection. The implicit risk in such behavior is that there is always a potential for extreme weather events that have the potential to damage and kill vines. The current January temperatures bring that threat into sharp focus again.

A non-exhaustive survey of temperatures on the 6th and 7th of January (the first wave of very cold air) showed many locations in the western part of Virginia around 0°F. That cold event had a noticeable advective component to it, such that the coldest temperatures were typically at higher elevations, while nearby lower, sheltered areas were several degrees warmer. One of the lowest actual vineyard temperatures that I heard was from the northern Shenandoah Valley, about -5°F. We discussed the prospect of winter injury at the pruning workshop held at Democracy Vineyards on 8 January. Temperatures at that vineyard had not been low enough to cause cold injury; however, bud necrosis occurred at a very high level (>85%) in Viognier. If "bud necrosis" is a new term to you, and/or if you grow Viognier, Riesling, Syrah or other BN-prone varieties, please review some of our prior writing on this disorder (e.g., http://www.sites.ext.vt.edu/newsletter-archive/viticulture/03novemberdecember/03novemberdecember.html)

See also (http://scholar.lib.vt.edu/theses/available/etd-643151739741061/unrestricted/ch3.pdf) for a somewhat more detailed explanation of the disorder. Given the rainy weather of June/July 2013, I anticipate elevated levels of bud necrosis in overwintering buds (and reduced fruitfulness in 2014).

Let's get back to the cold injury question though. The vineyardist that reported vineyard temperatures of -5°F on the morning of 7 January reported low levels of bud kill from that exposure. His most tender varieties, Merlot and Cabernet Sauvignon, both expressed 10 to 15% primary bud damage. If you have not had some experience in judging the viability of dormant buds, see the two-part YouTube videos that Hans Walter-Peterson (Cornell Cooperative Extension) made a number of years ago. The first-part is here: http://www.youtube.com/watch?v=_RHJ5mY3fAs&list=FL54xMsSZurqLUBH0jIKt4Ww&index=8

More detailed presentations on dormant pruning can also be found on our website resources page, here: http://www.arec.vaes.vt.edu/alson-h-smith/grapes/viticulture/extension/index.html Look under item #8. The Adobe Presentations by Fritz Westover go into some detail on strategies to compensate for winter injury if this should be necessary in your vineyard. There are lots of other resources on the Web if you dig a bit.

A second, colder round of arctic air pushed into Virginia this week, and was particularly pronounced on the morning of 22 January, with some of the lowest temperatures again occurring in the northern Shenandoah Valley. A weather station at the same elevation as our research vineyard here at the AREC sustained temperatures of about 0°F. That's low enough to be very concerned about potential bud and cane injury on tender varieties, such as the Cabernet Sauvignon, the principal variety in our long-term floor management project. This particular low temperature event was strongly radiational in nature and while our vineyard (995' asl) was around 0°F, a lower point (~800' asl) within ¼-mile was about -4°F.

A very quick check of buds today (n=50), where canes were allowed to warm indoors overnight, revealed no injury on Cabernet Sauvignon from this event.

We have not conducted winter cold hardiness assessments of grapevines for the past 2 years, as this has not been an active part of our research. I did, however, go back to a presentation that I made at the Eastern Section American Society of Enology and Viticulture meeting in 2011 to look at some cold hardiness data from the 2009-2010 winter, as well as the 2010-2011 winter. The 2009 growing season was relatively cool. The 2010 season was relatively hot, and was followed by a somewhat warmer winter compared to the 09/10 winter.

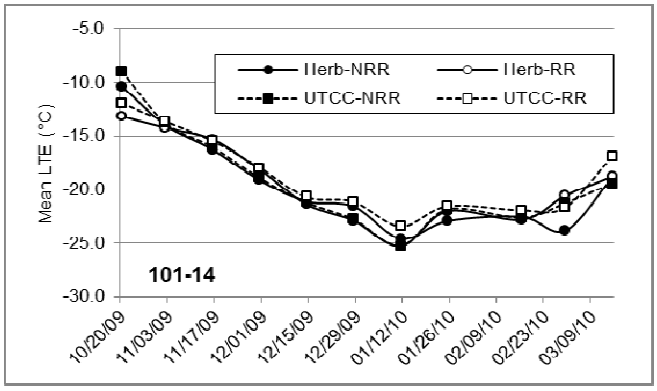

Figure 1. Effects of several vineyard floor management treatments on relative cold tolerance of Cabernet Sauvignon buds during the 2009-2010 winter. See text for explanation.

Figure 1 shows some bud hardiness trends of our Cabernet Sauvignon from the 2009-2010 winter. In the absence of cold hardiness data this winter, the older data of Figure 1 might give an estimation of what the Cabernet could withstand this winter. Some explanation: the vertical axis represents a mean LTE of a sample of buds for 4 different treatments. MLT is Mean Low

Temperature exotherm temperature. Sparing details here, this is an approximation of the temperature that would be required to kill about half of the buds in our laboratory freezing tests conducted throughout the winter. We know from prior research that the lab tests of bud freezing resistance are a very good estimation of field hardiness. The four treatments represent non-root-restricted (NRR) and root-restricted (RR) vines grown either with under-trellis cover crop (UTCC) or with an herbicide strip (Herb). The data in Figure 1 are for vines grown on 101-14 rootstock. The important point to make for the present conversation is that the buds acquire increased resistance to cold injury through the fall, attain maximum resistance in early January, and retain that resistance until air temperature begins to rise in early March. In the 2009-2010 winter, the Cabernet buds attained their maximum cold hardiness in the first two weeks of January; depending on treatment, the MLTE values were around -23 to -25°C (-8 to -13°F). If the buds were comparably hardy this winter (January 2014), we might expect some injury to start being apparent at about -5°F, and increasing with decreasing air temperature. Fortunately we didn't get that low.

Here's where it gets interesting. In my discussion back in 2011 at the ASEV meeting I presented some data based on a then recently developed grapevine bud cold hardiness model developed by researchers at Washington State (Ferguson et al. 2011. Annals of Botany [doi:10.1093/aob/mcq263] "Dynamic thermal time model of cold hardiness for dormant grapevine buds"). Developed by John Ferguson and colleagues, the model essentially used daily mean air temperatures to model the pattern of grape bud hardiness throughout the dormant period. Although it was developed under central Washington State conditions, the model provided an excellent prediction of acclimation and mid-winter hardiness of our Cabernet Sauvignon vines (**Figure 2**).

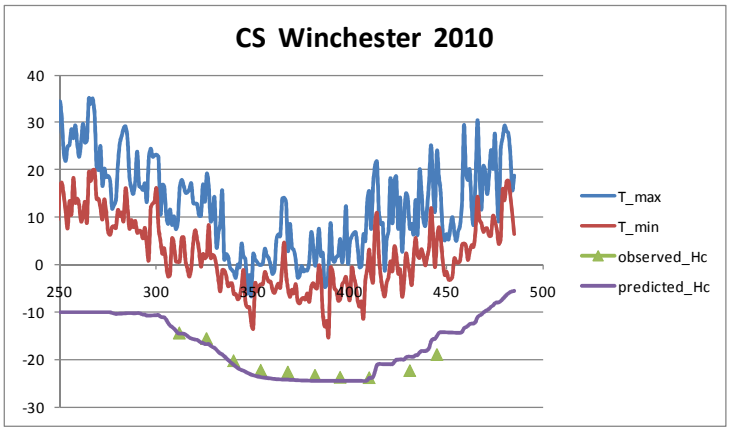

Figure 2. Daily high and low air temperature and predicted and actual grape bud freezing resistance of Cabernet Sauvignon over the 2009-2010 winter, Winchester VA. See text for details.

Let me explain Figure 2. The vertical axis shows temperature in degrees Celsius. As a reference, -18°C is about 0°F. The horizontal axis is time, in days, from a point in late-summer of 2009, extending into spring of 2010. The blue and red lines are daily high and low air temperatures, respectively. The temperature minima of the 2009-2010 winter were only about +5°F. The purple line on the plot and the corresponding green triangles represent the predicted (line) bud hardiness and the actual (triangles) bud cold hardiness that we measured under laboratory conditions. The remarkable feature here was the accuracy with which the model predicted acclimation and mid-winter hardiness. We did see some deviation of the model in the

deacclimation period of March, when the model predicted a more rapid deacclimation than what was actually measured. Still, not a bad fit overall.

What's this got to do with the current situation? Ferguson and colleagues recently published a refined cold hardiness model which also incorporates modeling of other grape varieties. (John C. Ferguson, Michelle M. Moyer, Lynn J. Mills, Gerrit Hoogenboom and Markus Keller. 2013 (on line, 2014 in print). Modeling Dormant Bud Cold Hardiness and Budbreak 2 in 23 *Vitis* Genotypes Reveals Variation by Region of Origin. American Journal of Enology and Viticulture)

My research associate, Tremain Hatch, used the new WSU cold hardiness model with our AREC air temperature data to estimate where our Cabernet *should* be, based on the model. What he obtained is shown in Figure 3.

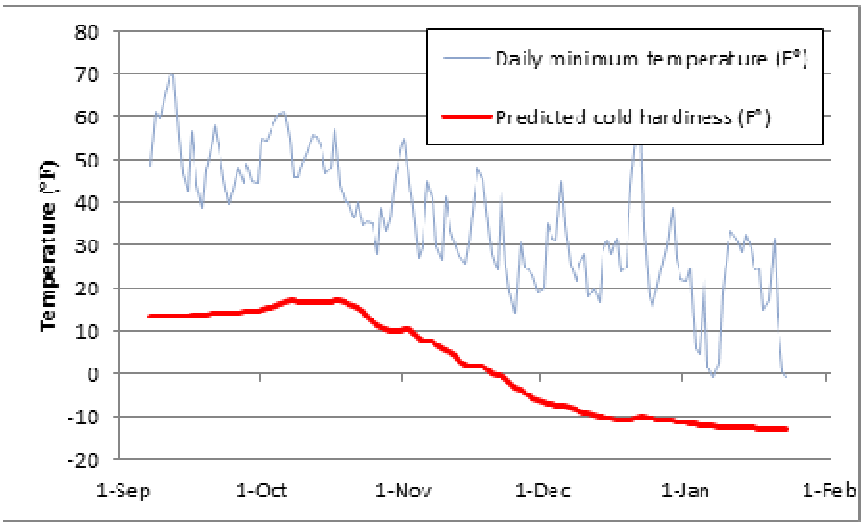

Figure 3. Daily minimum temperature predicted bud cold hardiness of Cabernet Sauvignon at Winchester VA (AHS AREC). See text for details.

Using weather data collected from our Center (just south of Winchester, VA) the model predicts that Cabernet Sauvignon can tolerate temperatures down to about -12°F. The lowest air temperature (blue line) recorded at this weather station has not dropped below the predicted cold hardiness of Cabernet Sauvignon (red line) planted at this site, which is consistent with our observation of no bud injury. This does not mean that *your* vines (Cabernet or otherwise) have not sustained injury. It would be well worth checking buds before any further pruning is done, particularly with varieties such as Merlot, Tannat, Syrah, or others that are considered particularly cold-tender.

There is more cold weather forecast for next week, so we are definitely not out of the woods. The heating bills are killers this month but, thus far, we've been generally fortunate with what I've seen of vineyard temperatures. Areas in the Midwest and some areas further north have not been as fortunate.

II. Upcoming Meetings

Date	Meeting	Location	Time	Details	Region
1/30/2014	Beginners Workshop	VVA Winter Technical, OMNI Charlottesville; http://www.virginiavineyardsassociation.com	After-noon	registration required	State
1/31/2014 -2/1/2014	Winter Technical Meeting	VVA Winter Technical, OMNI Charlottesville; http://www.virginiavineyardsassociation.com	Full Day	registration required	State
2/19/2014	Pruning Workshop	Upper Shirley Vineyards; Check for directions: http://www.arec.vaes.vt.edu/alson-h-smith/grapes/viticulture/extension/index.html	11am to 2pm	no RSVP required	South Eastern Virginia
2/20/2014	IPM workshop	Phillip Carter Winery; http://www.pcwinery.com/contactus.html	10 am till 4 pm	no RSVP required	Northern Virginia
3/4/2014	IPM workshop	The Nelson Center 8445 Thomas Nelson Highway, Lovingston, VA 22949	10 am till 4 pm	no RSVP required	Central Virginia
3/6/2014	IPM workshop	Ingleside Vineyard; http://www.inglesidevineyards.com/index.php?option=com_content&view=article&id=23&Itemid=25	10 am till 4 pm	no RSVP required	Northern Neck
3/7/2014	IPM workshop	Beliveau Winery; http://www.maisonbeliveau.com/directions.html	10 am till 4 pm	no RSVP required	South-western Virginia
TBD	Pruning Workshop	TBD Check for updates: http://www.arec.vaes.vt.edu/alson-h-smith/grapes/viticulture/extension/index.html	1pm to 3 pm	no RSVP required	South-western Virginia
TBD	Pruning Workshop	TBD Check for updates: http://www.arec.vaes.vt.edu/alson-h-smith/grapes/viticulture/extension/index.html	1pm to 3 pm	no RSVP required	Northern Virginia

The 2014 **Maryland** Wine & Grape Industry Annual Meeting will be held Feb 7-8, 2014 at the Sheraton Baltimore North:
See following link: http://www.marylandgrapes.org/events/annualmeeting.shtml.
The agenda includes a full day new grower workshop and also an advanced pesticide workshop for advanced growers. Saturday's schedule includes Vintage Nurseries coming in to speak on rootstocks and clones developed for the East and Tom Payette is our keynote speaker and will be speaking on Emergence of MidAtlantic Wines.