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Viticulture Notes

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I. Recap of April frost events:

Frost/freeze events on the morning of 6 April and 10 April caused geographically widespread injury to Virginia vineyards, but the full extent of crop reduction remains to be seen as vines move through early season growth and flower clusters become easier to count on elongating shoots. Here we'll recount what we know and then speculate some on how the frost might impact crop levels and crop ripening, particularly in light of possible asynchrony in the crop development early in the season.

Central and southern Virginia vineyards, as well as points on the Eastern Shore, had Chardonnay at the full bud swell stage to as much as 3" shoot length on 6 April. Chardonnay had burst bud in some vineyards as early as the last week of March. As mentioned in the April 1 Viticulture Notes, the exceptionally warm March set the stage for the subsequent cold injury, although the temperatures reported on 6 and 10 April were nonetheless unusually low in some vineyards by April standards. Geographically, points south of I-66 and Shenandoah County *generally* suffered more frost injury than did vineyards further north; however, higher elevation vineyards that had somewhat retarded shoot development, and perhaps did not sustain as low a temperature on either of the principal frost mornings, fared better than those at lower elevation. Both frost events were primarily radiational in nature (as opposed to advective), and both events were attended by very low dew points leading to "dry" freeze conditions. Although there was some variance across the state, temperatures on the morning of the 10th were lower than those on the 6th, and the period of sub-freezing temperatures was much longer on the 10th, dipping below freezing as early as midnight in some locations. The duration of sub-freezing temperatures on the 10th posed significant issues with active frost protection, such as use of helicopters. I had many reports of vineyard and orchard temperatures in the mid-twenties and some in the low-twenties; the lowest that I heard for a sheltered thermometer in a vineyard at canopy height was 18F. Aside from Chardonnay, other early developing varieties such as Merlot, Viognier and Cabernet franc probably sustained the greatest injury, while later varieties such as Cabernet Sauvignon experienced little if any injury. Aside from winegrapes, our tree fruit producers also suffered, with stone fruits and early flowering apple varieties sustaining substantial injury. I witnessed one attempt to use burning, round hay bales (~1,000 lbs each) to keep a Chardonnay vineyard above freezing.

There was enough of a gentle breeze that the dozen or so bales aligned along the "windward" side of the vineyard really had no impact on the vineyard temperatures. The slowly burning bales emitted plenty of radiant energy out to about 20 feet, but beyond that, it was a chilly 22F. Fortunately, that vineyard had chosen to double-prune the cordon-trained Chardonnay, and the second, finish pruning had yet to be done. A follow-up conversation with the owner of the vineyard that reported 18F indicated that Cabernet franc was probably most severely affected (the grower does not have Chardonnay), with 2 or 3 apparent primary shoots surviving on 7 – 10-node canes – secondary buds were just now beginning to swell. Merlot in that same vineyard was somewhat less affected while Cabernet Sauvignon and other varieties were essentially unaffected.

While the degree of vine injury varied considerably by variety and vineyard location, and recognizing that it will take some time yet to fully assess the impact, my sense is that Virginia lost as much as 25% of its potential grape crop with the two frost/freeze events, and much of this reduction will be borne by Chardonnay, Cabernet franc and Merlot. Growers who have been through this before will recognize that the frost has little impact on the vine's welfare; secondary shoots, albeit much less fruitful, will emerge and generate a full canopy by mid-summer. Vineyards that might have experienced temperatures in the teens, however, should be monitored for potential cane/trunk injury, as those temperatures could have been injurious to vascular tissues in the canes, cordons (if present) and trunks.

On a positive note, some of the affected vineyards were using double-pruning of spurs and where the second, finish pruning run had not yet been done, growers had some success with avoiding substantial crop loss. This is illustrated by the photograph here (Photo 1) showing 6-node Chardonnay "spurs" of a cordon-trained vine. There is a mix of swollen buds on the spurs – some dead, some alive. However, the more basal buds of the spur are all alive and these less developed buds are those that would be retained with the finish pruning. This is not meant as a general recommendation for cordon-training and spur-pruning, but it is one argument when weighing pros and cons of cordon-training and spur-pruning that might be considered – especially for early bud-bursting varieties that are grown in less than ideal sites.

Photo 1. Chardonnay spurs, 15 April. The smaller buds at nodes 3-5 are likely dead.

Growers whose vines were affected by frost have asked questions about how a mix of primary shoots and secondary shoots on the same vine might affect crop ripening. Surviving primary shoots may have clusters that bloom 3 weeks earlier than clusters borne on secondary shoots that have emerged since the harvest. Does a three-week difference at bloom translate to a three-week difference at veraison? What about harvest dates?

We discussed this potential following the 2007 ("Easter Weekend") frost, and it's worth bringing back that discussion here. The original article can be found in our newsletter archives (http://www.sites.ext.vt.edu/newsletter-archive/viticulture/07julyaugust/07julyaugust.html)

The 2007 article was written by Mardi Longbottom who, at the time, was our Viticulture Extension Associate at the Winchester AREC and who had arrived earlier that year from South Australia. Mardi related her experiences with a 20-acre block of Cabernet Sauvignon that had been hit with a late-spring frost in the Coonawarra district of South Australia.

(ML) At the time of the frost the shoots had 8-10 separated leaves and the inflorescences were clear. The frost burnt most of the shoot tips and many of the inflorescences were either completely or partially affected. Within a couple of weeks of the frost the vines began to recover and pushed new shoots. Many of the original inflorescences on the primary shoots survived and, as expected, new secondary and lateral shoots produced another generation of inflorescences. At this stage it is usual to apply remedial measures to prevent variability in the final crop, most commonly removing all secondary bunches. Alternatively, some growers take the extreme measure of spraying the vines with either a contact herbicide or a concentrated dose of urea to burn off all remaining green tissue to allow uniform regrowth. However, because we had budgeted for a crop from these vines and many of our other blocks were down in yield as a result of the frost, we were reluctant to remove any more fruit.

Figure 1. Cabernet Sauvignon bunches on vines that recovered after frost. The coloured bunches formed before, and survived, the frost. Bunches that emerged after the frost were delayed in development and went through veraison approximately three weeks later.

As I continued to monitor these vines it became apparent that there were two clear bands of fruit and the differences in stage of development were distinct. When the post-frost inflorescences flowered, the two bands of fruit were separated in development by about four weeks. At veraison the contrast between the pre- and post-frost bunches was visually more obvious (Fig. 1), however, the difference in development between the two lots of fruit had begun to close to around 3 weeks. At this stage it was obvious that the differences in maturity between the two lots of fruit may potentially have a big impact on final wine quality. However, there were several important unresolved questions that influenced our decision-making at this stage.

Would removing the late crop improve the quality of the remaining fruit? Would it still be economical to harvest the remaining fruit after fruit thinning? Which fruit should we remove – early or late ripening?

Approximately two weeks prior to the anticipated harvest date I began sampling the block, keeping the two bands of fruit separate. At the first sampling date the difference in sugar concentration between the two samples was around 8° Brix. Because vintage was well underway at this stage and this block was the last of 250 acres to be harvested, the decision about what to do with the fruit was postponed. A week later I sampled the block again and the difference between the pre- and post-frost fruit had decreased to around 4° Brix. Based on these analyses we decided to re-evaluate in another week.

On the final sampling date the difference in sugar concentration between the two lots of fruit from the frosted Cabernet vines was less than 2° Brix and we made the decision to harvest all the fruit together. While this may not have been a great example of timely decision-making, ultimately leaving all the fruit on the vines turned out to be the best decision. We avoided the cost of thinning, we did not lose any crop and all of the fruit ripened satisfactorily.

Last season I observed the same phenomenon in frosted Chardonnay and Shiraz. After several frost events the vines were carrying two distinct generations of fruit, however the differences in fruit development decreased towards the end of the season. At harvest time differences in maturity were negligible and there was no negative effect on final fruit composition.

Fast-forward to April 2016: I think it makes sense to keep what crop you have at this point, rather than selectively removing primary or secondary crop after bloom to try and synchronize ripening and fruit maturity at harvest. Arguments in favor of retaining the crop include saving the manual labor costs that would be required to remove the crop, and salvaging as much of the crop potential as possible. An argument *for* removing a secondary crop now might be in cases where the secondary crop is the minor component of the overall crop, and the owner/operator is intent on maximizing wine quality potential at any cost. In any case, one consideration would be to assess just how much fruit remains on vines where most if not all primary shoots were lost. The contribution of a very small amount of crop on vines could lead to an expensive pest management program where grape berry moth insecticides or botrytis fungicides might otherwise be omitted. Secondary shoots (from secondary buds) are quite variable in their fruitfulness; some hybrids can have very fruitful secondary shoots (essentially a full crop potential); whereas most vinifera and American species cultivars have less fruitful secondary shoots. Aside from the genetic component, the light environment of shoots and renewal nodes in year 1 (2015 in this case) will have a significant bearing on the potential fruitfulness of secondary buds (Sánchez and Dokoozlian, 2005).

Your turn: I'm interested to hear from you and how your vineyard fared during the April frosts, particularly if you tried something novel, and particularly if you think that the approach helped avoid frost injury to your vines. Recall that I mentioned in the April 1 Viticulture Notes that the research community has not found compelling reason for enthusiasm about prophylactic, sprayable "frost avoidance materials". Nevertheless, we occasionally hear field reports/testimony from growers who feel that one or more of these measures or products helped. If you think you have a story (success or failure), please let me know (vitis@vt.edu). It would be most helpful if we knew the specifics of what you did. If you sprayed a particular product, what was the rate and the timing before or after the frost event(s)? What was the grape variety and stage of shoot development? What was the low temperature that you measured in the vineyard where the product was sprayed? How was it measured? What was the outcome with the sprayed vines (estimate or count of % primary bud/shoot survival)? What was the outcome of non-sprayed (control) vines in the same block (again, % bud/shoot survival)? We have an opportunity at an industry meeting on 8 June (see upcoming meeting) to have a discussion about viticultural research needs as well as "citizen science" (CS) opportunities. I believe that the area of "active" frost mitigation would be a worthy topic for CS exploration. Each vineyard and each frost event is somewhat unique, but if the many participants in such a study agreed in advance to the requirements of the study, it could yield very meaningful information. Otherwise, it's all pretty speculative.

Literature cited:

Sánchez, L.A., and N.K. Dokoozlian. 2005. Bud microclimate and fruitfulness in *Vitis vinifera* L. Am. J. Enol. Vitic. 56: 319-329.

II. Upcoming meeting:

Virginia Tech is teaming with the Virginia Vineyards Association to host a "Clean vines/keeping vines clean" seminar on 8 June 2016. Registration is being handled by the Virginia Vineyards Association and details will be forthcoming. Speakers will include James Stamp (Stamp Associates Viticulture), Joshua Puckett (Foundation Plant Services), Mizuho Nita (Virginia Tech grape pathologist), Dustin Hooper (Vintage Nursery), and Rick Dunst (Double-A Nursery). The meeting will be held at Veritas Vineyards and Winery near Charlottesville. The "clean plant" meeting concept is centered on questions related to the phytosanitary status of grape nursery stock, particularly in light of viruses, fungal canker pathogens, and crown gall bacteria, and what is currently being done nationally (e.g., National Clean Plant Network and Foundation Plant Services) and at the commercial nursery level to put "clean", high quality plant material into the marketplace. The clean plant seminar will be followed by a "viticultural research needs assessment" open forum to provide an opportunity to discuss urgent viticultural research needs of the Virginia industry. The research could take the form of research organized and conducted by grape specialists and their students and support personnel, and it could take the form of "Citizen Science" in which industry members are active participants in the investigative process. The research needs forum will be moderated by members of the Virginia Vineyards Association's Board of Directors. Finally, the day will conclude with a wine tasting from one of the most majestic viewpoints in Albemarle County, followed by dinner and socializing at Veritas Winery. If interested, mark your calendars and stay tuned for further details at the VVA website: http://www.virginiavineyardsassociation.com/?