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Viticulture Notes

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I. Spring in February? Pruning, frost avoidance measures, etc.

Not quite, but nothing like a day in the seventies to get one worried about the potentials for spring frost. What about winter injury? I'm not too concerned about a warm day or two this time of year; it would be more worrisome if the warm weather persisted for a week or more though. For what it's worth, and excepting this weekend, forecast temperatures for the balance of February suggest daily highs at or near average – below 50F for the most part. That's probably the best we can hope for. We've conducted one pruning workshop thus far and have another scheduled for 7 March at Breaux Vineyards. The attached notes from Dr. Nita provide some guidance on the use of pruning wound protectants to reduce the likelihood of infection of clean plant material in the field by wood-decaying fungi. Also, for those who want or need a refresher on the "how to" and whys of grapevine pruning, the old presentations by Fritz Westover are still a useful resource. See item #6 under our Extension resources on the viticulture web-site (http://arec.vaes.vt.edu/arec/alson-h-smith/grapes/viticulture/extension.html)

Most larger vineyards are well into or finished with rough-pruning at this point and have made good use of a relatively warm, dry winter to get ahead of this important, annual aspect of vineyard management. But with spring just around the corner, we are reminded of past spring frost episodes and are forced to consider whether frost might again affect vineyards. Recall the unusually warm March of 2016, and the ensuing, in some cases record-breaking freeze events of early April. Whether this is a reflection of changing climatic conditions is debatably, but we can't deny that we choose to grow grapes in a continental climate, and untimely frosts -- whether they occur in spring or fall -- are a feature of such a climate.

There are both active and passive measures that can be used to help lessen the potential impact of frost on a vineyard. I want to briefly comment on some of these measures, and provide some details on practices that might help reduce the chance of frost in established vineyards.

Active frost mitigation efforts are varied and typically involve energy inputs into the vineyard system. These inputs range from the use of helicopters, mobile and solid-set wind machines, heat from various sources, overhead irrigation, micro-sprinkler irrigation of the vineyard floor, and sprayable frost mitigation products. A nice review of how some of these inputs are effectively used is provided in the proceedings of a spring frost workshop that was convened by the University of Missouri following the particularly damaging Easter freeze of 2007 (http://extension.missouri.edu/p/WG1001). No one method is perfect, and the more effective methods tend to be the more expensive with respect to upfront costs. While the capital and operational costs of a solid-set wind machine are steep, if it saves about 15 tons of grapes from loss to

frost, it could "pay" for itself in a single year. Admittedly, this does not add value to the crop and it ultimately represents an additional cost of production.

Site selection remains the single most effective, passive approach to frost management. Most of the damaging spring frosts in Virginia are primarily of a radiational nature wherein the lowest air temperatures are typically found at the lowest points of elevations (aptly named "frost pockets"). While there are exceptions to this pattern, such as the "Easter freeze" of 2007, which had both advective and radiational components of the freeze, situating vineyards at elevations that afford excellent cold air drainage is the single most effective strategy that a grower can use to lessen the risk of late-spring or early-fall frost (Wolf et al., 2008).

Choosing a late-bud bursting variety adds an additional measure of frost mitigation. The spread from earliest (e.g., Chardonnay) to latest (e.g., Mourvedre) bud-bursting variety is over 2 weeks. Even the more commonly grown Cabernet Sauvignon often escapes spring frost injury due to its relatively late spring growth.

Delayed and double-pruning is another approach to reducing the likelihood of spring frost damage. My colleague at Penn State, Dr. Michela Centinari, wrote a detailed, illustrated article about this strategy this past fall in the Penn State Wine & Grapes U. newsletter. Briefly, the strategy here is to take advantage of the apical dominance pattern of bud burst where the more distal buds on a bearing unit will tend to burst earlier than will the more proximal or basal buds of the unit. This might be more easily visualized on cordon-trained and spur-pruned vines where canes are "rough-pruned" to a standard height, for example 6 to 10 buds long. The more distal (further from the cordon) buds *generally* swell and eventually burst before those buds closer to the base of the spur. The delay in bud burst of the more basal buds can be dramatic – 10 or more days. As the name suggests though, double-pruning requires a second pass through the vineyard to adjust the length of these long spurs to the desired length of one or two buds. In addition to the spring frost avoidance, the double-pruning also provides a measure of compensation for climbing cut worm feeding. In practice, double-pruning starts with a rough-pruning anytime in winter, with a follow-up pruning, typically by more experienced workers, at or beyond bud burst. Delaying the follow-up or final pruning of the spurs tends to delay the bursting of the more basal buds in a proportional manner; waiting for an inch or two of shoot growth on the apical buds "buys" more time than does pruning off the excess spur length when the apical buds are still dormant or only at full swell. While perhaps more convenient with cordon-training and spur-pruning, double-pruning can also be used with head-trained, cane-pruned vines by leaving the intended fruiting cane(s) somewhat longer than ultimately needed, and leaving them in an upright position until the more distal buds are swelling or even bursting. The disadvantage of using double-pruning with canes is that ultimately those canes will need to be tied to the trellis fruiting wire, and the process of tying the canes down will invariably cause some damage to swollen or broken buds.

Dormant oil/adjuvant applications: Another technique that has been used occasionally over the years is the application of dormant oil or commercial adjuvants to vines. When he worked with us at Winchester a number of years ago, my colleague Imed Dami, now at The Ohio State University, evaluated the use of dormant oils as a means of delaying spring bud burst (Dami et al., 2000). He subsequently explored this method at his positions in Illinois and in Ohio where some commercial growers continue to use dormant oil applications for this purpose. Research results with dormant oils is generally persuasive in that some delay of bud burst can be achieved, but the results vary with the timing of the oil application, the variety of grape, and the weather conditions leading up to bud burst. I recently asked Imed about the usage of dormant oils and he summarized his experiences in seven bulleted statements, for which I'll try and provide further

explanation. First, some background. Applications of dormant oil are thought to suppress spring bud development by slowing the respiration rate of buds, which can be measured by the evolution of carbon dioxide from the buds (Dami and Beam, 2004) and is reflective of the tissue/organ metabolic activity. To be effective, the oil needs to be applied *before* the bud respiration rate increases, and applied at a concentration that is great enough to be effective but not so great as to cause damage (phytotoxicity) to the bud. In Virginia, this could be anywhere from January through early March, although a very warm March might lessen the effect. Imed's pointers (italics) are followed by some of my own comments:

1) *At same concentration, vegetable-based products (e.g. Amigo) are safer than petroleum-based products with respect to potential phytotoxicity*. Commercially available oils or spray adjuvants have been studied over the years, including soybean oil derivatives such as Amigo, as well as petroleum-based or paraffinic oils such as Prime oil. Thus, soy based oils are generally used at 8 to 10% (v/v) in water, whereas petroleum based oils are generally used at 1-2% rate (v/v). While other soy-based oils might work as well, a number of bud delay studies have shown positive effects of Amigo. Amigo is a spray adjuvant manufactured by Loveland Products, Inc. and is 93% soybean oil and 7% emulsifier; it is labeled for use as a pesticide spray adjuvant to improve coverage.

2) *Excellent coverage of canes is paramount.* To retard bud respiration and delay bud break, the adjuvant (oil) must thoroughly wet the bud. Researchers have achieved this with backpack sprayers and spraying to the point of drip. Scaling up to vineyard blocks, one would need to use 100 or more gallons of spray material per acre, or a vectored spray discharge system to ensure that dormant buds were being covered.

3) *It is very important to know the composition of the adjuvant (emulsifier/surfactant) because phytotoxicity might be caused by the adjuvant and not the oil.* If you want to try dormant oil application, I would suggest that you try Amigo.

4) *Timing: best when buds are dormant (closed, meaning could be eco-dormancy). In VA and IL (both warm to hot climate), it was in Jan and Feb. In OH, March is still ideal (remember in OH there is still a lot of snow on the ground in Jan-Feb). Once buds begin to swell, oil is not as effective.*

5) *Oil is more effective in a cool-spring (slow warming and deacclimation) than warm-spring climate(fast warming).*

6) *Typically, single application is as effective as multiple applications. But this depends on the season.* Frequent rains can erode the oil from the buds and reapplication might be necessary.

7) *Variety-dependent. Some consistently respond e.g. Concord. Others (like vinifera) are less consistent.*

To highlight some of the research on use of dormant oil application, Imed Dami and Brad Beam (Dami and Beam, 2004) conducted trials with three hybrid varieties, Chancellor, Chambourcin, and Chardonel during the 1999-2000 winter in southern Illinois. Amigo and Prime oils were applied at 10% concentration in water and compared with a control. A follow-up study evaluated varied rates of Amigo oil (0% to 10%). Application timing was 29 Nov., 28 Dec., and 3 Feb. Vines were evaluated for phytotoxicity to dormant buds, bud respiration rate, rate of bud burst, yield components and fruit quality. Here's a summary of the findings of this one study:

- Amigo and Prime oils delayed bud burst from 3 to 20 days when used at rates of either 8% or 10% (v/v)
- the delay was more pronounced with Chancellor (9 – 20 days) than with either Chambourcin or Chardonel (3 – 8 days). The bud burst delayed achieved with Amigo in Illinois is comparable to that achieved with an American hybrid, 'Edelweiss' is similar tests conducted in Nebraska (Loseke et al., 2015) where two applications achieved a slightly better response than did a single application.
- CO2 evolution (a measure of bud respiration) was 41% less in Amigo treated Chardonel or Chancellor buds compared to control buds, although the differences were statistically significant only for Chardonel;
- Prime oil caused somewhat greater bud phytotoxicity than did Amigo, possibly due to differences in the nature of the emulsifier used in these products. The phytotoxicity issue is a little confusing in that the authors reported that Prime is a soy-based product while the Prime label describes it as a paraffinic (petroleum-distillate) oil.
- crop yield was slightly reduced – more by Prime than by Amigo – and the reductions varied by variety: Chancellor was relatively unaffected compared to the other two. The reductions in crop yield were noted in only one of the two years of this trial.
- fruit primary chemistry (Brix, pH, TA) at harvest was not adversely affected by the previous winter's oil application.

Should you try the dormant oil? Getting the sprayer out and de-winterizing it for this task is not an appealing thought, but maybe you could try some backpack trials or if you have a *clean*, motorized sprayer on the back of an ATV that you could easily press into action, it might be worth trying. Of course, an important consideration would be whether spring frost has been a recurring problem for you. To play it safe, I would recommend a vegetable-based oil, such as Amigo. The rates mentioned above might serve as a good starting point. You can make the trial as simple (single rate, single application, single variety) as you want, or as complex (multiple applications, 2 or more oil rates, etc.), but I would suggest that you try the dormant oil on a limited number of vines to determine potential sensitivity to the oil. Phytotoxicity can be evaluated sometime prior to bud burst by cutting buds and examining for injury, or looking at the fruitfulness of resulting shoots from the buds. Like bud necrosis, phytotoxicity to the buds will result in decreased fruitfulness.

Let's shift gears. What about other "frost avoidance" materials? Sprayable products to enhance the resistance of buds and shoots to frost is the holy grail in that it could be done relatively easily and inexpensively compared to those inputs that require lots of water, horsepower or BTUs. But do these products perform as advertised? There are two general and plausible ways that sprayable products *might* help improve the tolerance of sensitive tissues to frost/freeze effects: one is through an increase in the tissue solute concentration (osmolarity); the other is through a reduction in the density of ice-nucleators on (extrinsic) or in (intrinsic) the tissue. Some big terms here, but we'll break it down.

Plant cells contain membrane-bound organelles called vacuoles. Think of these as solution reservoirs within the cell. The solute concentration of the cell sap within the vacuoles has a bearing on the freezing point of the solution. Water freezes at or around 0C, if we dismiss the physical effects of potential super-cooling (under controlled conditions, pure water can be cooled to -40C before it freezes). If we add an osmotically-active solute such as table salt to a model solvent (water), the freezing point will be depressed in proportion to the concentration of the solute. For example, 10 grams of table salt (NaCl) added to 100 grams of water will depress the freezing point by -5.9C. Some solutes are better than others: 10 grams of table sugar (sucrose) added to 100 grams of water will only depress the freezing point by -0.56C. The difference between the salt and the sugar is due to the number of molecules in each solute: the salt has about six times as many solute units as does a comparable weight of the sugar. Furthermore, the sodium

chloride disassociates into two ions when dissolved in water, whereas the sucrose molecule remains intact. Where is this discussion going? It's a bit of a stretch going from the model system to cell sap in plant cells, but some of the same physical properties exist within cell vacuoles, suggesting that cells with higher osmotically active solute concentrations should have a slightly depressed freezing point compared to cells with lower solute concentrations. Going a step further, if we can increase the solute concentration of cells with exogenously applied solutes, perhaps we can improve the frost tolerance of the tissue. This is a bit of an over-simplification of the freezing process, but it will do for purposes of this discussion. The trick is finding a solute that (1) is transported into the tissue or cell sap; (2) that is osmotically active; (3) that is not phytotoxic; that is relatively cheap; and (4) that is easily applied in the field.

So that's one mechanism. The other potential mechanism that I mentioned had to do with reducing ice nucleators in and on the sensitive tissue. The freezing of free moisture such as a snowflake or dew on a grapevine leaf requires a physical ice-nucleating agent. Research has shown that certain epiphytic bacteria are very effective ice nucleators and one line of research initiated in the late-seventies sought to use strains of these bacteria, that had been engineered to reduce their ice-nucleating-active (INA) potential. The idea was to then populate the sensitive crop plant with these bacteria, reducing the abundance of the INA bacteria that had been hanging out on the leaves and flowers. The results were promising and, in controlled studies, up to several degrees of freezing avoidance were achieved. But the research was on the forefront of applied genetic engineering and the technology was then, and remains for many, unpalatable. In practice, the use of "antagonistic" bacteria went in another direction; that of selecting naturally occurring strains of bacteria that could suppress the populations of those strains that cause disease. "Pseudomonas 506" is, for example, a strain of bacteria used to help suppress fireblight, a bacterial disease of pome fruits. BlightBan A506 is a commercial preparation of such bacteria and the BlightBan A506 label mentions the potential for "reduction of frost and frost damage.." to certain fruit crops (grapes are not on the label, although grapes are found in the web-based information about BlightBan A506). The "beneficial" bacteria of these products must be capable of out-competing the indigenous INA bacteria or at least knocking the population down such that the probability of ice nucleation is depressed to a lower temperature. Regardless of how "clean" the surface tissue is of "extrinsic" ice nucleating agents (bacteria, dust, etc.) the tissues contain "intrinsic" ice nucleators as well, which precipitate freezing at some point. But as most of us have experienced, frost damage – or not – often occurs within a very narrow temperature range.

Related research has shown some promise in using certain "antibiotics" (such as copper compounds) to depress the population of the ice-nucleating-active (INA) bacteria on the plant surfaces. An example of a copper-containing fungicide that might be used as a tool to depress the population of INA bacteria on plant surfaces is Kocide 101 (77% copper hydroxide). These general biocides can occasionally work but much depends on the degree of plant development, the peculiars of the frost event – especially just how low the temperature drops and for how long – as well as the product itself. I've mentioned these "sprayable" frost mitigation materials in previous news articles, and highlighted the inconsistent results obtained and/or reported in the literature. We do, however, hear of "success" stories from time to time and given that the sprays are relatively inexpensive (compared to flying helicopters or setting out and burning heaters), I won't discourage the intrepid who want to try *something*. Whether you try a potential osmoticum (e.g., Agro-K's KDL) or a potential biocide (e.g., Kocide 101), try to approach it objectively. Ideally, have some recording thermometers (e.g., Spectrum Technologies "watchdog") mounted in shelters at canopy height. Make sure that they are calibrated and that they're recording during potential frost events. Having accurate air temperature data will be important in interpreting your results. Recording wind speed would be helpful too, but this would entail an additional sensor on the datalogger unless you venture out with a hand-held anemometer. Leave some unsprayed control plots, preferably at different locations in the vineyard. Follow

the product label guidelines – most of these materials need to be applied from 24 to 48 hours in advance of the forecast frost/freeze event.

My colleague at Penn State, Dr. Michela Centinari, has done some work with one of these sprayable products (Agro-K's KDL) and I've asked her to speak about this at the upcoming VVA winter technical meeting (see next item).

Literature cited

Wolf, T.K, T.E. Martinson and F.A. Westover. 2008. Vineyard site selection. In: Wine Grape Production for Eastern North America. NRAES., Ithaca, NY.

Dami, I., R. Hamman, C. Stushnoff, and T.K. Wolf. 2000. Use of oils and alginate to delay budbreak of grapevines. In: Proc. ASEV 50th Anniversary meeting, Seattle, WA, pp 73-76.

Dami, I.E. and B.A. Beam. 2004. Response of grapevines to soybean oil application. Am. J. Enol. Vitic. 55:269-275.

Loseke, B.A., P.E. Read, and E.E. Blankenship. 2015. Preventing spring freeze injury on grapevines using multiple applications of Amigo oil and naphthalene acetic acid. Scientia Horticulturae 193:294-300.

II. Registration for VVA winter meeting.

The Virginia Vineyards Association's winter technical meeting is coming up on 24-25 February in Charlottesville. The two-day meeting is preceded by twin track meetings on Thursday afternoon, 23 February, featuring a "new grower" workshop as one track, and a review of the 2016 Governor's Cup wines in the other. I know from a board meeting with the VVA yesterday that registrations for the Thursday events, as well as the two-day technical meeting are brisk. Details on the meeting can be found here: http://www.virginiavineyardsassociation.com/2016/12/winter-technical-meeting-registration-opens/

2017 Upcoming Virginia Vineyard Extension Meetings

Vineyard workshops and VVA Winter Technical Meeting: There are a number of viticulture meetings planned in Virginia in the coming months that we would call to your attention. Virginia Cooperative Extension organizes some of these meetings and grower associations organize some. There is no fee to attend the VCE meetings; however, an on-line registration, via the link in the table, is requested to help with our planning and to alert registrants of any change of plans should snow or other inclement weather cause a serious travel constraint. Details on timing and vineyard address are provided with the response to your registration.

	Program name	Location	Meeting details and registration information
16-Feb	Pruning Workshop	Giles Mountain Vineyards, Southwest Virginia	New River Valley Grape Growers 10 am 290 Moye Road Staffordsville, VA 24167

23-Feb	New Grower Workshop	Charlottesville	http://www.virginiavineyardsassociation.com/2016/12/winter-technical-meeting-registration-opens/
24-Feb	VVA Winter Technical Meeting	Charlottesville	http://www.virginiavineyardsassociation.com/2016/12/winter-technical-meeting-registration-opens/
7-Mar	Bilingual pruning workshop and pruning competition	Breaux Vineyards, Northern Virginia	Virginia Cooperative Extension https://goo.gl/forms/ntzI4JyoXpYUGAli1 Spanish translator will be present
15-Mar	IPM meeting – Pre-season training for vineyard pest management	Early Mountain Vineyards, Central Virginia	Virginia Cooperative Extension https://goo.gl/forms/BiwGpR839b6xzHBi2
9-Mar	New Grower Workshop - Primer for new grape growers	Hunting Creek Vineyards, Southside Virginia	Virginia Cooperative Extension Registration required, **see attachment for registration information**
1-Apr	Weekend Warrior Workshop	AHS Jr. AREC, Northern Virginia	Virginia Cooperative Extension https://goo.gl/forms/a8njcoytWNLvQf8j1

If you are a person with a disability and desire any assistive devices, services or other accommodations to participate in activities related to the programs listed here, please contact Tony Wolf or Tremain Hatch, Virginia Cooperative Extension, AHS Jr. AREC at 540-869-2560 during business hours of 8:00 am and 4:30 pm to discuss accommodations at least 5 days prior to the event.

III. Miscellaneous:

VineSmith's 2017-2018 WineGrape Spray Guides are currently available. This set of unique at-a-glance posters contains all the information you need to quickly and easily select an appropriate fungicide, insecticide or herbicide for your vineyard. The new edition includes 5 new fungicides, 2 new insecticides and 1 new herbicide. All of the major pesticides registered for use on wine grapes east of the Rocky Mountains are included; that's 44 fungicides, 44 insecticides and 23 herbicides. Also, do you worry about rain following your sprays? The new column "rainfast time" tells you when your sprays are safe from washing off. The Guides include separate posters for fungicides, insecticides and herbicides, as well as a "Planning a Vineyard Pest Management Program" booklet. The rows of each poster list the pesticides; the corresponding columns provide info on efficacy, rates of application, resistance risks, cost per acre, REIs, PHIs, and other label information. The matrix format allows an easy comparison of products across all of these product features.

For more information or to purchase, please visit www.vinesmith.com.

Position openings:
Two well established and successful Virginia wineries are seeking to share a full time Winery and Vineyard Assistant who will participate in all phases of vineyard and winery work. This is a job with a chance to learn under the direct supervision of seasoned winemakers. Advancement opportunities.
Some experience in similar work, and a familiarity with farm and/or winery equipment is desired.
Please send resumes to missdixiesharon@gmail.com

Stone Tower Winery, a premium estate vineyard and winery near Leesburg, Virginia, is seeking an experienced Equipment Operator. The ideal candidate will be an independent self-starter and have the willingness and ability to work as part of our team with the ultimate goal of producing grapes of the highest quality. Detailed responsibilities, minimum qualifications and other aspects of the position can be obtained from Daniel Mumbauer at Stone Tower Winery (daniel@stonetowerwinery.com), (703) 999-5596.

Did you know?
Frank, Rimerman & Co, LLP, recently released "The Economic Impact of Wine and Wine Grapes on the State of Virginia – 2015. The January 2017 report is available from the Governor's office at:
http://governor.virginia.gov/media/8546/virginia-2015-ei-update-final.pdf
The total economic impact was assessed at $1.37 billion. The number of wineries increased from 193 in 2010 to 261 in 2015, while the number of full-time equivalent jobs increased from 4,753 to 8,218 over the same period. Virginia was ranked 8th nationally in terms of grape production and acreage in 2015 (both PA and MI produce more grapes than does Virginia, but much of their acreage is in juice grape production).