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I. Current situation

While the beautiful weather of the 7-8 July weekend is much appreciated, the more typical warm, muggy conditions of Virginia will soon return. NOAA's 3-month forecast (https://tinyurl.com/2ew2e) for the Mid-Atlantic is predicting above-average temperatures for the July-September 2018 period, and near-average precipitation for July, but above-average precipitation for the July-September, 3-month period. It might appear that the first half of the season is going to be a fair estimation of how the second half of the season will play out.

Our mid- to late-summer weather often favors the spread of downy mildew (DM). A late-day shower followed by a humid evening creates the perfect scenario of prolonged wetting and warm temperatures that are conducive to repeating stages of downy mildew infection. Fruit becomes resistant to infection as it develops; however, young leaves (such as on laterals) are highly susceptible, and this is often where late-summer infections develop. To avoid a potential defoliation, continue a DM protection program through harvest if the weather remains favorable for infections. Fungicide options are provided in the Virginia Cooperative Extension Pest Management Guide (https://pubs.ext.vt.edu/456/456-017/456-017.html). In our own vineyard, we bank a little heavier on the use of the phosphorus acid materials, and an occasional use of captan in late-summer, trying to lay off applications within 30 days of harvest. Watch the Pre-Harvest Intervals (PHIs): some of the insecticides and even a couple of fungicides (e.g., Ranman and Reason, both of which offer DM protection) have 30-day PHIs, while Ridomil+Copper has a 42-day PHI. Ridomil Gold MZ and the various mancozeb products all carry the 66-day PHI. Don't get caught out on this technical label restriction.

Here are some recent observations from vineyard visits:

Phytotoxicity: Several cases of phytotoxicity were observed over the past 30 days, which is about on par with previous years. "Phytotoxicity" is injury to the foliage and/or fruit due to the application of foliar pesticides, fertilizers or, in some cases, "growth stimulants". Phytotoxicity sometimes occurs when these materials are tank-mixed, and applied under stressful conditions, such as high temperatures (>90°F), or when vines are drought-stressed. As in previous years, some of the commonalities that I've seen this year include higher than recommended concentrations of phosphorus acid products, and the use of "spreader/sticker" adjuvants added to the spray tank. Phosphites, or phosphorous acid fungicides such as ProPhyt or Phostrol are good materials for downy mildew management on grapes, and with a low residue and short REI (4 hours), their use does not significantly impede on-going canopy management activities. But growers need to be aware that phytotoxic responses can occur if the spray solution exceeds about 0.60% phosphite product. The Prophyt label, for example, states "Do not exceed spray solution concentrations greater than 0.6%. Four pints of Prophyt added to 50 gallons of water is a 1% solution – it will cause leaf burning. If you wish to use the full rate of Prophyt (for example), 4 pints/acre, mix with at least 85 gallons of water to keep the concentration below 0.6%. A concise and very helpful summary of do's and don'ts for using phosphorous acid fungicides can be found here: https://tinyurl.com/yc9oa8kw. It might be coincidental, but Merlot seems to stand out as a variety that is perhaps more susceptible to phytotoxicity than other varieties. Adding a spreader-sticker with phosphorous acid fungicides could increase the absorption of the fungicide by grape tissue, and this could possibly lead to a greater likelihood of phytotoxicity.

Poor fruit set: We saw this coming with those extended wet periods and cloudy weather of June, coupled with heavily shaded canopy fruitzones, and possibly greater than usual shoot vigor – a triple-whammy. Chronically affected varieties such as Traminette were particularly affected, but the problems are a local problem reflecting what was blooming during the periods of inclement weather. Crop estimations for 2018 should take the potential for reduced set – and reduced cluster size/weight – into consideration. Don't automatically assume that the average cluster weights of previous years are going to be representative of this year's crop for a given variety. I've spoken about crop estimation and refinements based on using "lag-phase" cluster weights (~50 days after bloom) at our winter technical meeting (22 February), at the summer technical meeting (13 June) and in previous newsletters. Meeting notes on Crop Estimation are appended to this newsletter.

Sunburning vs. bruising: Most of us have seen sunburned fruit from time to time. It's not uncommon to see sunburning when leaves are thinned late, such as "pea berry" size or later, or if the vines are under drought stress. Sunburning tends to diminish the red color of red-fruited cultivars and fruit can have a "cooked" taste. Wine quality potential is invariably reduced. The general recommendation to thin leaves, if leaf-thinning is desired or needed, at or just after fruit-set was established to minimize the likelihood of sunburning of fruit. When it occurs, sunburning often involves many of the berries on a given cluster (Figure 1). The incidence is usually greater on the western side of N/S-oriented rows, owing to the combination of direct sunlight exposure and elevated ambient temperatures of the afternoon, although afternoon clouds can ameliorate the direct heating of fruit by reducing incident radiation.

Figure 1. Example of sunburned fruit.

Figure 2. Bruise or dent (at arrow) caused by light tapping on the berry to simulate a hail strike or other mechanical impact, 25 days post-bloom.

Bruising is another “disorder” that can affect berries, and it sometimes is mistaken as sunburning, or even a pest attack. Pre-veraison berries are especially susceptible to bruising as the berry tissue has not undergone any softening at this early stage. Bruising can be caused by any mechanical impact to the berry. Hail is a common cause. In addition to bruising the berry, hailstones can tear holes through leaves and may cause scars on shoot stems. Lateral shoot and leaf removal can also bruise berries if clusters are roughly handled during the fruitzone thinning. I asked my student, Silvia, to “tap” or lightly flick some berries with her finger tip and to mark the berries for later review just to gain an appreciation of how sensitive the berries are to bruising at this stage. The berries were not quite at “pea-berry” size, about 25 days after full-bloom. As illustrated with the berry (arrow) in the figure included here (Figure 2), a light tap or flick with her fingernail was enough to dent or bruise a berry, with the bruise evident within 24 hours. Direct exposure to sunlight was not necessary for the bruise to develop. A little bruising is probably inconsequential to the quality of fruit harvested, and the berries seem to be ripening normally other than the bruised part of the berry, which remains sunken and discolored.

Insect pests: Japanese beetles got an early start at our research vineyard, but the overall numbers have been relatively low thus far. Our vineyard tends to be a “low pressure” site, however, and may not reflect your own experiences. Adult beetles have many food sources – but grapevine foliage is a favorite. The shiny, metallic green/brown beetles are hard to miss, but here are some key features of the adults:

- Japanese beetles are gregarious – meaning that there will be hot spots or small areas in the vineyard with a high concentration of Japanese beetles feeding. These are often on the edge of the vineyard, and sometimes an insecticide application only to the vineyard perimeter is enough to manage the beetles.
- Japanese beetles will tend to feed on younger leaves near the top of the trellis, but will work down into older leaves as the younger leaves are skeletonized.
- Peak adult activity is in early to mid-July, but may continue into September in some years and at some high pressure locations.
- Pastureland is ideal larval habitat – but adults can fly great distances and enter vineyards from surrounding areas

Consider your Japanese beetle management decisions from a vine balance perspective. Remember that functional leaf area is necessary to produce and ripen crop, but Virginia vineyards often produce more vegetative growth and may require hedging or shoot tipping in the upper portion of the canopy (with VSP training). 15-17 mature unfolded leaves are necessary to ripen approximately 1.5 clusters per shoot. Tolerable Japanese beetle pressure may not require chemical control and it offers free shoot-hedging. Be vigilant, and watch Japanese beetle activity

closely – feeding can quickly defoliate vines and leave vines with inadequate leaf area to ripen fruit. If you use grow tubes, take the time to look in those tubes to see if beetles are congregating there. The damage to vines in shelters can be significant due to the small size of the vine and the hidden nature of the feeding. Chemical control options are available (see following table from the Pest Management Guide).

Pest	Chemical and Formulation	Rate/Acre	Spray Timing and Remarks
Japanese beetle, June beetle, wasps	Sevin 50WP	4.0 lb	Apply when beetles are common. Sevin may not be applied within 7 days of harvest. **See Table 3.4 for Restricted Entry Intervals.**
	or		
	Sevin XLR PLUS	2.0 qt	
	or		
	Surround 95WP	12.5-50.0 lb	
	or		
	Imidan 70WP	2.0 lb	
	or		
	Belay 50 WDG	2.0-4.0 fl oz	
	or		
	Actara 25WDG	1.5-3.5 oz	
	or		
	Assail 70WP	1.1 oz	
	or		
	Avaunt 30DG	3.5-6.0 oz	
	or		
	Neemix 4.5	7.0-16.0 fl oz	
	+	+	
	Trilogy	2% solution	

Leafhoppers, particularly potato leafhoppers, appeared early and have been abundant in some vineyards this year. Leafhoppers are one of the most abundant groups of insects found in vineyards. We have found more than 30 leafhopper species in Virginia vineyards, although the levels of specific leafhoppers can fluctuate over the years. Most leafhoppers will occur at low levels and not injure grapevines. There are, however, two species of leafhopper that are very common on grapevines, and the population of both can build to the point that injury can be become appreciable. Potato leafhoppers (*Empoasca fabae*) are pale green, almost yellow, and about 1/8 inch long (Figure 3). Potato leafhoppers overwinter in the Gulf States and arrive in Virginia in May and June on southerly winds (which we've had a lot of this spring – think about where all that moisture was coming from in May and June). Potato leafhoppers move sideways – crab-like -- when disturbed. Feeding occurs on the lower leaf surface and affected leaves will show marginal or zonal chlorosis and a general cupping of the affected leaves (Figure 4).

Figure 3. Potato leafhopper nymph and adult.

Figure 4. Example of potato leafhopper feeding injury. Photo credit: Michigan State University IPM.

By contrast, grape leafhoppers (Erythroneura spp.) comprise a number of similar species that collectively are called "grape leafhoppers", although *Erythroneura vitis* is often listed as "grape leafhopper". Grape leafhoppers are about the same size as potato leafhoppers (~ 1/8 inch) but are often more colorful, having lines of yellow, red and/or black in interesting patterns on their bodies. Grape leafhoppers have up to 2 generations per year and their numbers tend to build over July and August, somewhat later than potato leafhoppers. These leafhoppers generally move – walk – in a forward motion. Grape leafhopper feeding results in a white "stippling" on the upper leaf surface.

Leafhoppers are relatively easy to manage with commonly used insecticides, a number of which are listed in the Pest Management Guide. Dr. Pfeiffer's recommendations in the PMG indicate that an average of 5 nymphs before 15 July and 10 thereafter are provisional action thresholds for application of an insecticide in July (a comparable action threshold is used for a spray decision around 1 August). In essence, some leafhopper activity is tolerable regardless of the point in the season. As with Japanese beetles, monitor the extent of injury, and the insect numbers carefully though, as the population may rapidly increase.

Figure 5. Example of grape leafhopper feeding.

Figure 6. Mild potassium deficiency symptoms on Cabernet franc.

A note on potato leafhopper feeding injury, or "hopper burn". Look for the adults, nymphs of cast skins on the backs of the leaves to confirm the role of leafhoppers with suspected leafhopper injury. The feeding injury could be confused with other vineyard problems. For example, Figure 6 is a Cabernet franc leaf on 420-A rootstock that is showing mild potassium deficiency. Rootstock 420-A and other *V. berlandieri* crosses have relative low uptake of potassium. A mid-shoot petiole sample collected from the row that this vine was in revealed a potassium (K) concentration of about 1.9% K. That's above the "deficiency" range, and is probably reflective of the entire row, which looked reasonably good and symptom free. However, some vines within the row were showing the marginal chlorosis typical of K deficiency. Although the symptoms were similar, this was not leafhopper injury.

Upcoming meetings

18 July, Sunset Hills Vineyard (Loudoun County)

1 pm – 4 pm
Joint meeting with the Loudoun Wineries Association and Loudoun Winegrowers Association.
Seasonal updates with two special demonstrations; calibration of air blast sprayers and assessing canopy density.
This is a free meeting; please register to help with planning purposes.
To Register, email Aimee Henkle <aimee@lostcreekwinery.com>

26 July, Vineyard Field Trip (Rockbridge to Amherst Counties)

Farmer to farmer learning experience. Visit Virginia vineyards with other wine growers. This meeting will have a point-to-point format. Participants will meet at Rockbridge Vineyard in Rockbridge County, and then drive over the Blue Ridge Mountains to Ankida Ridge Vineyards in Amherst County for lunch and a second vineyard tour. Carpooling to the field trip is encouraged.
Please register early to help us plan. Registration $25
Register online: https://tinyurl.com/VitFieldTrip

If you are a person with a disability and desire any assistive devices, services or other accommodations to participate in this activity, please contact Tremain Hatch, AHS Jr. AREC at (540) 232-6032 during business hours of 9 a.m. and 5 p.m. to discuss accommodations 10 days prior to the event.

Crop estimation basics

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A. Why?

- Avoid overcropping. What constitutes overcropping?
- Determine how much crop to remove to reach a target crop level (if currently above target).
- Know how much crop is available to sell/use in own winery, schedule picking labor and bins, etc.

B. Requirements:

1) Good record of average cluster weights from previous harvests and lag-phase, if using latter
2) Accurate count of sampling unit per acre (or missing units per acre):
   - units might be bearing vines per acre or panels of canopy per acre if vine space is non-uniform. *A "panel" is the row distance between two consecutive line posts.*
3) Accurate count of clusters per sampling unit

C. Sources of variability

Components of yield can be partitioned into two major pools:

1) Components set in previous year/or at dormant pruning which determine <u>clusters per acre</u>:
   Vines per acre, nodes retained per vine, shoots per node, clusters per shoot (fruitfulness)
2) Components determined in current season, which will determine <u>average cluster weight:</u>
   Flowers per cluster, berries per flower (set), and berry weight

Each of the above components is associated with some degree of variability, which collectively reduces the accuracy of our prediction. For example:

<u>Vines per acre:</u> Attrition due to disease, etc. removal of alternate vines to accommodate vigor can increase amount of unfilled trellis. First step would be accurate assessment of bearing units per acre. Calculate the percent missing "units" (eg., vine- or panel-basis) and deduct this percentage from estimate of crop assuming 100% vine stand or trellis-fill.

<u>Nodes per vine:</u> Will vary depending on uniformity of pruning. Will vary from variety-to-variety depending upon crop expectation; e.g., Seyval at Winchester = no count nodes retained/vine; Cabernet = 3 to 4 nodes per foot of cordon.

<u>Shoots per node:</u> Some varietal difference – e.g., Seyval > 1 shoot/node. Bud necrosis or winter injury can lead to < 1 shoot per node. GDC training has led to >1 shoot per node (due to enhanced light environment)

<u>Clusters per shoot:</u> Varietal differences, cane vs. spur-pruning, light and temperature regime of developing buds in previous season, bud necrosis, and previous season's crop level will all affect this variable.

IN PRACTICE, we count <u>clusters per vine</u> to estimate crop, rather than the above three items. Use a grid-pattern in vineyard block, based on 10 to 15 vines per block. For example, we might count the clusters on every 20th vine in every 10th row. The more vines (or other units) counted, the closer our estimate of the mean will be to the true population mean.

Some factors that affect cluster counts:
- winter injury, crown gall, canker rots, spring frost, climbing cutworms…. Etc. etc.
- bud necrosis (e.g., Viognier)
- bud shading during previous season (relate to vine vigor – example of Sauvignon blanc)
- variety and clone (Petit Verdot and Malbec examples)

Variation in average cluster weight (this is major component of variation)

Berries per flower, or berry set: Set runs from around 25 to 80% of flowers

Factors that can affect percent set:
- carbohydrate status of vine
- cloudy, wet weather during bloom/fruit set (2018?)
- viruses, nutrient deficiencies (Zn and B) as well as variety and clone

Berry weight: Affected by fruit set and degree of crop thinning -- i.e., crop thinning tends to increase remaining berry size. Also, strongly affected by moisture conditions after fruit set.

- aim to thin crop in the two-week period before veraison to limit berry size compensation.
- thin earlier if you need to stimulate vine size and vigor

D. Working equation:

$$\frac{Tons}{acre} = \frac{1}{2000lbs} x \frac{Vines}{acre} \text{ x } \frac{Clusters}{Vine} \text{ x Average cluster Wt. (lbs)}$$

Average cluster weight can vary significantly, and will likely be major source of variation or error in accurately predicting yield. Here's an example (happens to be Vidal) of how a 15% difference in average cluster weight can translate to over a ton/acre difference in estimated yield.

Vines/acre	Clusters/vine (2013-2017)	Ave. cluster wt. (lb.)	Tons/acre
691 (9' x 7')	29 – 48 (avg = 38)	0.49	6.43
691 (9' x 7')	29 – 48 (avg = 38)	0.58 (~15% greater)	7.61

E. Improving the working equation:

Crop prediction model can be improved by using an **historical average lag-phase cluster weight**, plus the **current season's lag-phase cluster weight** to adjust the predicted harvest cluster weight:

$$\text{Predicted yield} = \left(\frac{Vines}{acre}\right) \text{X} \left(\frac{Clusters}{Vine}\right) \text{X} \left(\frac{S}{A} \; X \; \text{H}\right)$$

Where: S = lag-phase cluster weight for current season
A = historical, average lag-phase cluster weight (several years' data)
H = historical, average harvest cluster weight (several years' data)

There are (at least) two methods of a sampling clusters to determine the mid-season, or lag-phase cluster weights. One method is a destructive harvest of all clusters from 5 to 15 vines per block. Count the clusters, weigh the total, and calculate the average cluster weight from those data points. The other is to do a more random sampling of 200 – 300 clusters from the block by blindly reaching into the vine canopies and selecting either the basal cluster or the more distal cluster on shoots that bear more than one cluster per shoot on average. Avoid lateral clusters or any small clusters that would not normally constitute a “harvest cluster”. Again, count, weigh, and determine the average cluster weight. The mid-season or lag-phase sampling is done early July, about 45 to 50 days post-bloom. Be consistent each year.

Be aware of extremes of precipitation after lag-phase that may skew results.

Alternatively (less precise): Use a multiplier pre-harvest to predict harvest cluster weight.
Start of lag-phase: use multiplier of “2” (50% of final wt.)
50% veraison: use multiplier of “1.25” (80% of final wt.)

What constitutes an acceptable crop level? Tons per acre is too broadly affected by plant density and subsequent missing vines. Targeting 1.0 to 2.0 pounds of crop per foot of canopy is a generally acceptable, albeit somewhat broad benchmark.

Example: Our Cab Sauvignon vines are planted 9’ x 5’m which translates to 968 vines per acre. If we crop at 1.5 pounds/foot of canopy (VSP-trained), we would have 1.5 pounds X 5’ X 968 vines/acre, or 7,260 pounds (3.63 tons/acre) per acre. We often see a reduction in fruit maturity (e.g., less color density) when we exceed this crop level. White-fruited varieties might be okay with 2.0 pounds per foot; use the lower end for high quality red wine potential.

Complications and considerations:

1) Drought/excess moisture: either extreme, particularly after veraison, can skew the actual yield
2) °Brix is not necessarily a good indicator of crop level, <u>especially with large vines that are not balanced</u> – e.g., 9 tons/acre crop of Cabernet Sauvignon did not differ from 4.5 tons/acre crop with respect to soluble solids accumulation rate or values at harvest.

What is the best time to thin crop????

1) Early (within 30 days of fruit set) results in increased berry size – potential for > rots
2) Less compensation (berry size increase) occurs near veraison
3) Less benefit to remaining crop after veraison
4) “Green thinning” – preferential removal of clusters that exhibit delayed color formation at onset of veraison – tends to reduce variability of maturity at harvest
5) Timing is not so critical with large vines, as it is with small vines.

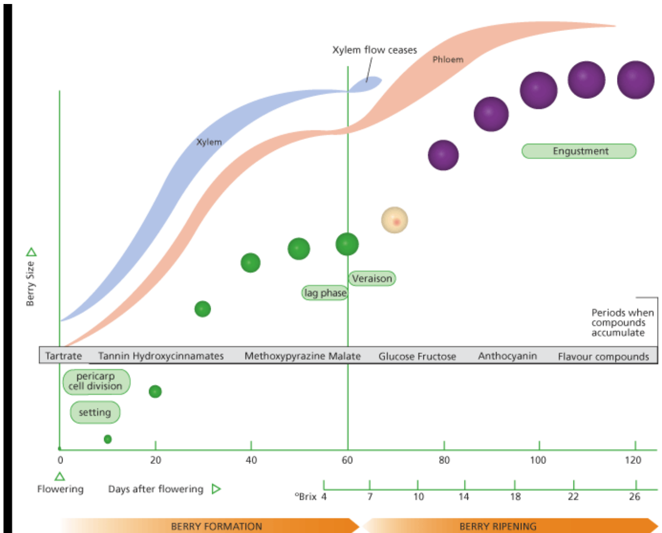

Figure 2: Diagram showing relative size and color of berries at 10-day intervals after flowering, passing through major developmental events (rounded boxes). Also shown are the periods when compounds accumulate, the levels of juice °brix, and an indication of the rate of inflow of xylem and phloem vascular saps into the berry. Illustration by Jordan Koutroumanidis, Winetitles.