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Viticulture Notes

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Current situation (precipitation, perspiration, and respiration…):
Hermine, bless her heart, veered more East while still over North Carolina, but not before drenching the very southeast portion of Virginia as she tracked up the coast. Rainfall totals were dramatically different over a very small area of the Tidewater: Virginia Beach recorded over 4 inches of rain from Thursday through Saturday (3 September), while Cape Charles, on the Delmarva Peninsula, received less than an inch in the same period. Winds were also mercifully light. Meanwhile I irrigated portions of our research vineyard over the Labor Day weekend due to the dry weather conditions that have prevailed here over the past 2 weeks.

Harvest is well underway and it's always a stressful time watching the fruit chemistry, birds and other wildlife, and always keeping a wary eye on the tropic for lurking "disturbances", such as the disturbance noted off the African coast yesterday afternoon (6 September 2016). Late-season downy and powdery mildew are posing moderate (typical) pressure, while birds and other vertebrate wildlife pressure seem about average in those vineyards that I've had the opportunity to visit over the past several weeks. There are always exceptions but fruit quality appears great in those visited vineyards, and running as much as a week ahead of average ripening trends.

In hindsight, the 2016 turned from very wet early in the season to another record-breaking year for heat. We've not yet begun regular monitoring of primary chemistry on our research vineyard varieties, as harvest is not typically before 20 September for the Petit Manseng and mid-October for the Cab Sauvignon; however, we noticed in late-August that the Cabernet was unusually delayed in completing visual color changes associated with véraison. Even today (7 September) some clusters still had many green berries. The photo shown here reflects a minority of the clusters, as most have completely changed

Figure 1. Cabernet Sauvignon clusters at Winchester AREC, 6 September 2016.

to blue-black color, but the change has been slower this year. The crop levels are not greater than in previous years – although there is a lot of fruit illustrated in Figure 1 -- even our lightest cropped vines bore clusters that had delayed color transition in late-August. The canopy condition is excellent, and the vines have had adequate moisture as evidenced by persistent shoot growth, so the delayed ripening has been difficult to explain. We had a slightly delayed bloom in the Cabernet which might explain part of the delay of progress on véraison. I am leaning more towards the probability that the delay in berry coloration in the Cabernet reflects the unusually warm/hot conditions of the 2016 season. The high temperatures might have affected both photosynthesis rates, and possibly more dramatically affected whole plant respiration rates. Briefly, photosynthesis rates peak at around 86°F and then decline, precipitously so at temperatures above the mid-nineties, with variation in optimal rates due to variety, water and nutrient status of the plant, and other factors. It's no surprise that 2016 has been a hot year, and we're seeing a persistence of the heat well into September. With many days hitting max temperatures above 90°F for us this, year, it could well be that daytime highs were reducing photosynthesis and delaying grape development, including véraison. This might be a more prevalent issue in "warmer" regions of the state where growers occasionally comment on "stalled ripening" – often in Merlot, but we see it in a number of varieties; the juice hits about 18 – 20°Brix and then sugar accumulation flat-lines and pH increases.

The "flip" side of photosynthesis is *respiration*, the oxidation of carbon substrates, most commonly sugars, into carbon dioxide and water, generating energy (ATP) and carbon structures that are involved as building blocks for cell structure, proteins, phenolics and other essential compounds. Respiration occurs both during the day and at night, and entails both maintenance (e.g., protein turnover) and growth (e.g., new shoot and fruit development) functions.

Like photosynthesis, respiration is also affected by temperature, although respiration rates can continue to increase with increasing temperature beyond the optima for photosynthesis (Figure 2). Grapevine carbon balance studies (Poni et al., 2006) demonstrate that respiration of the aerial portion of the grapevine consumes about 25% of the carbon gain from photosynthesis. Adding root respiration, as much as 60% or more (Keller, 2010) of the carbon obtained in photosynthesis is used in whole vine respiration. Young leaves have higher rates of respiration than do older leaves, and the rates of respiration (like photosynthesis) decline with leaf senescence (Zufferey, 2016).

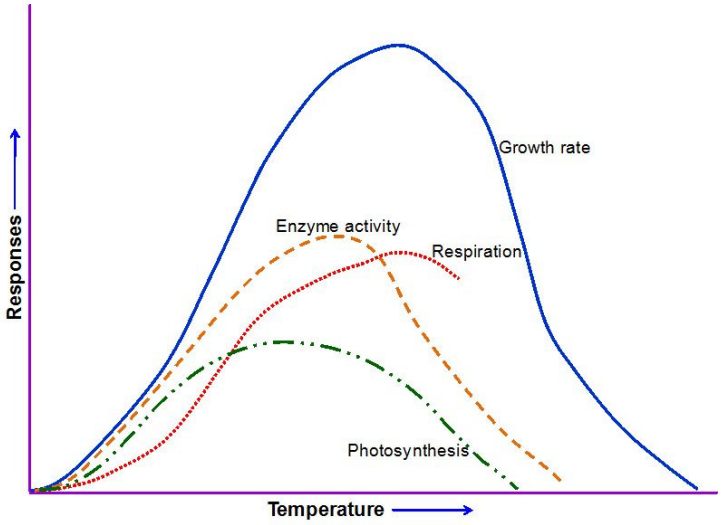

Figure 2 Stylized representation of temperature effects on principal plant physiological processes.

We looked at our vineyard temperature data over the period from 15 June through 25 August over the past three years. The data of Figure 3 are accumulated heat units (growing degree days, or "GDD") calculated as the daily summed figures of average daily temperature minus 10. Thus, an average daily temperature of 30°C would generate 20 GDD for that day. Again, the 3-year trend has been towards increased heat accumulation during the mid-June to late-August period, with the 2016 season attaining about 17% greater heat units than the 2014 season during that period (Figure 3). Is that a meaningful difference in terms of the rate of ripening? I don't know.

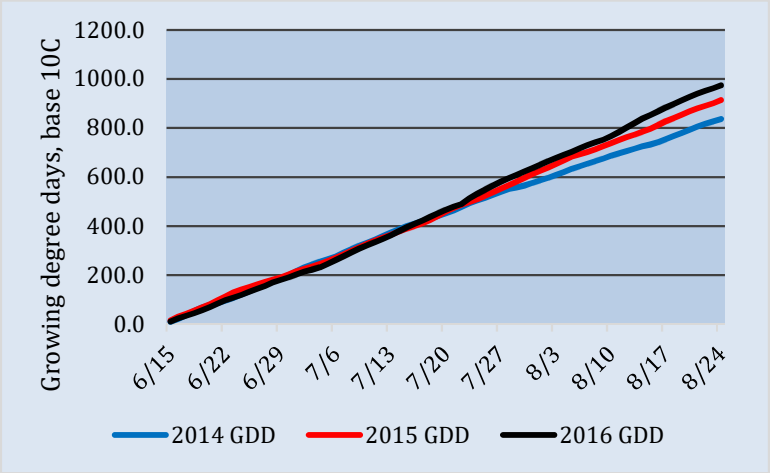

Figure 3. Daily heat unit ("GDD") accumulation from mid-June to late-August over a three-year period, AREC vineyard, Winchester. Heat units are a summation of the daily average temperature minus 10° C.

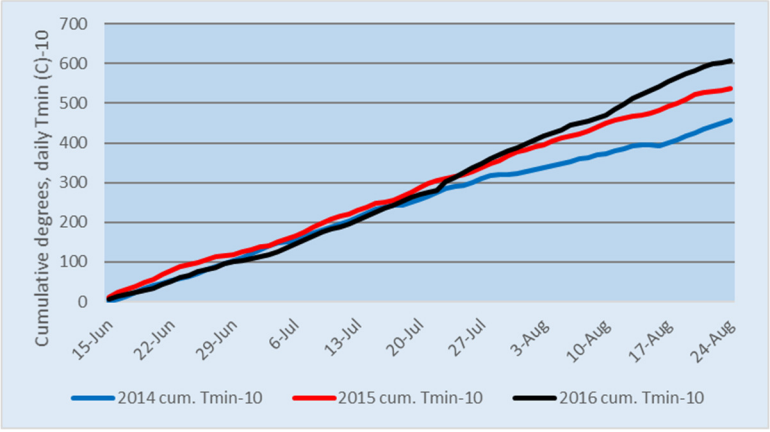

Figure 4. Daily low temperature heat unit accumulation from mid-June to late-August over a three-year period, AREC vineyard, Winchester. Heat units here are a summation of the daily low temperature minus 10° C.

What is more interesting to me is the increase in nightly low temperatures over the same period (Figure 4). Here we simply subtracted 10 degrees (C) from the daily low temperature and then summed the remainder for each day from 15 June to 24 August. Again, the three-year trend was for warmer nights each year, with 2016 being the warmest of the three. Compared to the summed *average* daily heat unit increases (17%), the summed low temperature heat unit increase was 33% over the period of interest. Again, we can't say for certain whether this is impacting the rate of grape ripening, but it's a testable hypothesis. Maybe – hopefully – 2017 will be cooler, but the outlook is not encouraging. A potential topic for more fully evaluating varietal responses to our environment!

References:

Keller, M. 2010. The Science of Grapevines. Elsevier, London.

Poni, S., Palliotti, A., and F. Bernizzoni. 2006. Calibration and evaluation of a STELLA software-based daily CO_2 balance model in *Vitis vinifera* L. J. Am. Soc. Hort. Sci. 131:273-283.

Zufferey, V. 2016. Leaf respiration in grapevine (*Vitis vinifera* 'Chasselas') in relation to environmental and plant factors. Vitis 55:65-72.

This is a short communication to provide some seasonal observations; a more substantive Viticulture Notes will be issued as harvest winds down. Good luck with the rest of harvest!