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Growing Fine Wines in the East: More Questions than Answers

Recently, at the American Society for Enology and Viticulture Eastern Section Conference in Winston-Salem, NC I had a fascinating and wide-ranging viticulture discussion with Dr. Sara Spayd at North Carolina State University and Dr. Stephen Menke, extension enologist at Colorado State University and former extension enologist at Penn State.

Since I arrived in the East from Oregon I have wondered why even in warm-hot areas red wines are often lacking ripeness and balance. Sara commented that 2013 appears to be headed for a "low brix" vintage. What are the underlying reasons for this phenomenon? Low brix fruit is usually okay for whites, but more problematic for red wine production.

In 2012 in Pennsylvania we saw sugars hit the wall in early September. Why does this happen (rhetorical question)? What are the physio-chemical and environmental causes for this phenomenon that prevents us from making consistently fine wines (this is my pie in the sky goal for all wines)?

Ever since I have known him Stephen has asked me how to define "quality in wine." From my experience, quality can be defined and quantified within the broad spectrum of wines. Within a category of wine there is a continuum of quality, although the parameters may be less clear, having been set by general agreement of enologists, wine makers, writers, consumers, etc. A Concord wine has distinctive quality characteristics, and there is such thing as a great (or poor) Concord wine. The same applies for a red Bordeaux blend wine. The quality parameters, as well as the viticulture and wine making that is necessary to achieve either of these wines, are specific for each variety, and in a true sense, for every particular wine. Our role as wine growers is to figure out exactly what the necessary methods are to produce consistently high quality wines according to a widely accepted standard. For example, the site requirements for Concord and Cabernet Sauvignon are different, as would be the viticulture applied to each variety.

In North Carolina, growing degree days will often exceed 4000, which should be plenty of heat to fully ripen Cabernet Sauvignon - so why does it sometimes not ripen, resulting in wines with a soft core and lacking length? 4000 GDD is similar to conditions in the Central Valley of California. We talked about the effects of environmental conditions on fruit ripening, especially our warm, humid and wet conditions in the East, with a focus on vine respiration, photosynthesis and the impact of diurnal temperature shift in fruit ripening.

Alternate systems for determine heat accumulation are being sought, but just like trying to convert from English to metric, or tons per acre to pounds per vine, it's a tough change to make. The Winkler system is antiquated and not well suited for areas with warm nights where vine

respiration continues through the night. For example, Mid-Atlantic temperatures recently have been in the 90s in the day and upper 70s at night, a 20 or so diurnal swing.

Sara worked in Washington State prior to coming home to North Carolina, in the summer both places are warm but Washington is dry and North Carolina is wet. She said a striking difference between the regions is berry size. In a discussion with Jim Harbetson (Washington St. Univ.), they concluded that average berry weight in NC is 2x that in WA. We have big berries and this may contribute to the "hit the wall" phenomenon of berry ripening. This difference is dually caused by berry dehydration in a warm and dry climate in Eastern Washington, and a result of excessive soil moisture in the East pumping up the berries and diluting its contents.

To make better wines it is necessary to reduce berry size on red wines (and some whites) to increase skin to juice ratio and improve color and tannin in wines (see Jim Harbetson Washington State University tannin research). Sites and vineyard design for high quality red wines should have the goal of reducing berry size (see Kees van Leeuwen).

This also relates to cold hardiness. Talks by Kevin Ker (KCMS Consulting/Brock Univ) and Paolo Sabbatini (Michigan State Univ) show that a balanced vine acclimates and tolerates cold better than unbalanced (e.g. overcropped) vines.

If soil moisture is a root cause of the problem of big berries, vine vigor and vines that do not cease vegetative growth at veraison, then the water holding clay soils of North Carolina should be tile drained just as they are on the Niagara Peninsula, which would promote evacuation of soil moisture to a level between permanent wilting point and field capacity. This may be considered the starting point, lacking a well to excessively well-drained soil rating if excess soil moisture is anticipated to be a problem, and I would assign this to all grapes between medium to fine quality. I think the Niagara Peninsula, which has production and fine wine vineyards, represents an outstanding example.

Rain is the key because it becomes soil moisture, so finding any way to avoid it would be advantageous. The conversation veered to artificial exclusion include tent devices and high tunnels (such as those used in cold regions), but these are clearly not mainstream solutions. Site selection that may include features such as slope and rain shadows might offer an advantage.

Why is the fruit not getting ripe? Mark Greenspan taught me to separate out light-derived sugar production (photosynthesis) from flavor and phenolic temperature-drive biosynthesis. According to my understanding of the work of John Gladstones from Australia, the warm day and night temperatures in the East should promote the development of flavors and phenolics, the holy grail of fine wine. Imagine the days this summer when the high temperature is 93 and the low 77 vs. arid areas where diurnal shifts of 30-40 are normal. I secretly hoped that our low DTS would actually translate to more flavorful wines with better tannin profiles, allowing us to make wines of great flavor, complexity and balance of dry regions like California, but also even better than a similar area like Bordeaux. But the weight of rain and humidity and their impact as well as disease and insect pests appear to outweigh any physiological derived benefits to wine quality. I am resigned to the mantra in the popular wine press that "warm days and cool nights" make the best wine. What is lacking is a clear understanding of the effects of vine respiration and

humidity on vine physiology and how these influence the synthesis (or lack of) of key wine quality constituents.

The importance of temperature: how well is it understood and how do environmental conditions affect photosynthesis, respiration, transpiration, and humidity?

I believe that sugar accumulation is not the primary viticulture issues for quality wine production in the East, that flavor and phenolic compounds that contribute to texture, balance and length of a wine are more critical for Eastern wines, along with balancing acidity. If this is the case, then light is less important than temperature conditions. Chapitalization is a wine manipulation that is traditional and accepted and if done properly has little undesirable affect on the wine, other than to raise alcohol and contribute to balance. It is puzzling, too, why with such warm nights and extended respiration, why acid balance is so often a problem in Eastern wines (we often are challenged by high *malic* acid).

We have cloudy conditions in the East. I have been told that grape leaves can photosynthesize at optimal rates at about 30% of full sunlight. In years like 2004 and 2009 there are virtually no sunny days, but I'm not sure how the variably cloudy days translate into fruit ripening conditions for the vine. I know from experience in Oregon that Pinot Noir ripens much faster and completely under warm, dry and sunny conditions, than cool and wet ones, but I know to how the proportions of each contribute to ripening or the lack of it.

Sara mentioned that she thinks that the frequency of some of the pesticide applications, hedging and leafing operations may be affecting the photosynthetic activity of leaves following those operations for some period of time (unknown). Excessive leaf removal also contributes to a reduction in vine leaf area to a level that is out of balance with crop level. However, application of fungicides is critical to combat defoliating disease such as downy mildew. *Vinifera* growers are spraying 12-20 times in wet years like 2009 and 2011 and I have observed that leaves appear to be wrinkled and leathery in mid-season instead of at the end of the season. Phosphoric acid products in particular appear to affect leaves.

Downy mildew is also a threat to leaves, and with grapes for red wines and late harvest whites hanging deeper into the harvest season means managing disease longer than ever. Along with Japanese beetles and other threats to leaf surface area. Stephen said that he did an experiment on another crop punching out holes in leaves up to 90% of the surface area with an interesting physiological response, which he described to us:

The leaf photosynthesis capacity I referred to was immediate respiration flux, upon exposure to midday sunlight, within an isolated leaf that had 90% of its surface removed, not to the accumulation of sugars via the dark phase in a whole plant system that was 90% defoliated. My point was that a leaf rarely uses more than a fraction of each photosynthetic center's ability to accept photons in the photosynthetic machinery, so a leaf could be severely damaged and still contribute well to accumulation of electrons for phosphorylation. This does not mean that these electrons could not become part of cyclic phosphorylation to ATP rather than non-cyclic NADPH for carbohydrate synthesis, nor that the transport of nutrients needed for synthesis is good in a severely damaged leaf

My conclusion is to speculate whether more canopy is necessary to optimal photosynthesis under extended diffuse light conditions. Sara noted that berries will continue to accumulate sugar, even if defoliated through remobilization of sugars from permanent woody tissues, and that

defoliation up to 90% would necessarily impact photosynthetic capacity otherwise vines would not require 15-18 cm^2 of leaves to ripen a gram of fruit.

For the third consecutive year the region is experiencing a hot July, but this year is still wet. It will be interesting to see what happens to *methoxypyrazines* in red wines. In 2011/12, the dry July and part of August may have suppressed MP accumulation, helping to reduce veggie levels in red wines, even as the end season deteriorated. Will it happen again?

Yields affect the grower and wine maker, and they are generally low across the region. Excess vigor begets shade which affects bud initiation and fruitfulness in the following year. Sara said that for Viognier and Nebbiolo fruit set is often poor with flowerless shoots and yields in the 2 t/a regardless of site. In Pennsylvania, between frost and freeze events, physiological disorders such as bunch stem necrosis, poor weather at bloom and other environmental and physiological problems, yields are often disappointingly insufficient. The questions are: is it the plant material (or clone) or the environment (site and phyto-climate, light conditions), or a matter of soil nutrition and available moisture that is causing low fruitfulness. More likely it is a combination of all of these factors.

The few examples of vineyards that I have encountered that can ripen Cabernet Sauvignon on a consistent basis and make high quality wines are usually vineyards sited and designed for that specific purpose, within the right temperature range and on sites that encourage water and air drainage, with vineyard designs (spacing, rootstock, etc.) that promote fruit maturity. But even with these qualities in place the weather must cooperate to get the fruit fully ripe.

This sidebar conversation with Sara and Steve represents a terrific bonus benefit to attending a meeting like the American Society for Enology and Viticulture annual conference. Yes, to some extent this is nerdy viticulture but I believe it is essential to understand the underlying physiology of the grape and vine to be able to consistently produce the best wines possible. Growers are practitioners who are using existing knowledge and instinct to exploit or overcome real conditions in the field. Maybe if we understood the effect of those conditions, we could make consistently better wines together, and create a successful and sustainable wine industry. The neat thing about the society is that it is 100% about the wine - no marketing, no entertainment, it's completely about understanding and making what's in the vineyard and cellar better.

I would like to thank Sara and Stephen for letting me break into their quiet breakfast conversation with all my heavy questions, and for taking the time to review this article. They are fantastic colleagues!

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