PENNSTATE College of Agricultural Sciences

Water and Berry Relations at Harvest

Growing fine wine is a complicated business but it may be argued that nothing is more critical to the process than water. Unfortunately, there is often too much or too little of it. Its presence after veraison affects vine physiology and berry quality in a myriad of different ways.

2007 is developing as a favorable vintage in Pennsylvania and around the Eastern U.S. Rainfall patterns are very unpredictable. Some areas, like Adams County, have experience drought conditions in mid-summer whereas others have had fairly consistent rains, mostly in the form of late afternoon thunder showers. Karamoor Vineyard, located in just northwest of Philadelphia near Fort Washington has 3 year old vines on low vigor rootstocks, 2.3 x 1.2 m vine spacing on VSP with tile drainage, French drains and drip irrigation installed. As is often the case with young vines in dry seasons the sugars outpaced flavor and phenolic development, taking the juice profile out of balance with implications for wine quality. It raised the question how can a grower deal with these kind of conditions and deliver fruit to the winery that are not too high in sugar? If the goal for a wine is 12-14% alcohol to achieve favorable balance and mouth-feel, grapes arriving on the crush pad at 27+ brix create serious wine making challenges. This is problem that is common to vineyards in sun-intense California. I encountered just these issues with berry shrivel and high sugars on a recent visit to Napa Valley in the second week of September.

In both situations there is a very active canopy that is photosynthesizing at peak efficiency leading to rapid accumulation of sugar in the berries. Generally in the East this is a favorable harvest condition. I question how much of the high sugar in the Napa fruit is the result of dehydration in visibly shriveled berries versus normal sugar accumulation. The troubling result is fruit that is out of balance with elevated sugars and undeveloped flavors or jammy, raisiny flavors in the shriveled berries. Another question is whether or not the shriveling is dehydration or the malady known as Berry Shrivel[1] that has a tendency to affect red varieties late in the season but results in low sugar accumulation, a similar effect to leaf roll virus where the phloem is plugged.

The end result of these various phenomenon is a berry/cluster that is dramatically high in sugar with too high alcohol potential. A grower can pick the grapes before they are fully mature to avoid excess sugar and suffer the wine balance consequences. It may be possible to sort out the shriveled berries but in some vineyards I saw it would mean discarding nearly half the crop. Many growers will irrigate in an effort to bring the sugars down and give the flavors time to "catch up." But does this simply dilute the flavors as well?

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1 Berry Shrivel. Dr. Markus Keller. WSU Wine and Grape Research and Extension Newsletter. Volume 15. Issue 4. Fall/Winter 2005. Pg. 2

A situation more familiar to wine growers in temperate or tropical areas is too much water during the harvest season from rain fall. In Pennsylvania the average precipitation in the months from August through October is 1000mm/mo, arguably too much resulting soil moisture to make fine wines. This amount does not include the occasional hurricane that blows up the coast. Drainage of every kind is utilized to remove excess moisture from the root zone but even in the best soils it is still a slow process. Getting shoot tips to terminate prior to veraison is a great challenge. Relative to the berry, where is the water going and how is it being transported?

The question of where does the water go during these harvest irrigation events is an intriguing one that has been addressed in Washington State, an irrigated wine region, by Dr. Markus Keller and his graduate student, Marco Biondi at Washington State University. The project he started, intending to unravel the mystery of water transport in and out of berries, however, had nothing to do with hot, dry climates[2]. In fact, in response to the needs of wine growers in the wet western part of the state, he wanted to find out how water was entering the berry during or after harvest period rainfall. He was also motivated by the Europeans belief that irrigation during the ripening period had negative consequence for fruit quality and, in fact, is forbidden in most A.O.C. regions in France. Using Concord and Merlot grapes, Dr. Keller attempted to test this unproven hypothesis. Concord was perfectly appropriate for this experiment since it is a thin-slip skin variety and also about half of the 60,000 acres of wine grapes in the state. Merlot is a good representative for wine and vinifera. What he found out is rather astonishing.

After a wetting event such as irrigation or rainfall the assumption has always been that roots take up water and transport it directly into the berries, diluting sugars and necessitating a waiting/recovery period for the water to move out of the berry and pre-wetting event sugar levels to return and ripening to move forward. As a grower of Pinot Noir in Oregon through the soggy decade of the 90's, I would swear to this sequence of events.

The xylem connection between rachis and berry remains open after veraison but fluid dynamics are influenced by pressure gradients between xylem and phloem. There is a clear movement of water and solutes into the berry from the phloem that, even under drought conditions, they found will increase berry turgor. Back pressure from the phloem may reduce movement of water through the xylem (surmised, not proven) and can actually lead to a reversal of water out of the berry via the xylem. After veraison water and solutes are entering and exiting the berry primarily through the phloem. If water is added to the root zone, it will move to the leaves and increase leaf function, quite possibly increasing sugar production even further and defeat the intention of irrigating to lower sugars. The phantom dilution effect of irrigation may be explained by a change in concentration in a shrinking berry that is being pumped up by irrigation

Marco used micro sensors to measure berry expansion and found out that Merlot berries do not expand as a result of root zone wetting. They even went so far as to place the roots of a wetted pot-grown vine inside a pressure chamber and squeeze the living daylights out of them. Under ten bar (165 psi) pressure, as water exuded from leaf margins, berry size did not budge, at least

[2] Pre-harvest Irrigation Dilutes Grape Quality! Or Does it? Dr. Markus Keller. WSU Wine and Grape Research and Extension Newsletter. Volume 18. Issue 1. Spring 2008. Pg. 10.

not for the Merlot. However, thin-skinned Concord berries did crack. This exercise may have proven the toughness of Merlot berry skins.

A simple immersion experiment with berries revealed that water moves readily across the berry skin directly into the berry. Deionized water, representing rain water, moved across much faster than tap water, probably due to a high concentration of mineral in the latter. For growers in soggy areas like the Eastern U.S. and Western Washington this result has vast implications. If rain is entering the berry directly, then perhaps the solution to the dilution problem is to somehow protect clusters from moisture. An interesting question for all growers in wet regions is the length of recovery period for the berry to return to its pre-precipitation condition? In Oregon, with Pinot Noir, we considered 3-4 days of dry weather to be long enough to recover the berry. In Bordeaux, they would like to wait a week or more.

Some growers have claimed that covering the vineyard floor with a tarp and thereby preventing rain water from reaching the root zone has led to riper and more concentrated fruit. Dr. Keller has no explanation for this phenomenon.

I noticed on this trip to Napa that south sides of E-W rows had more shriveled berries. The unique dry-farmed Dominus vineyard near Yountville had perfectly formed berries with very little sign of dehydration. I'm not sure how to explain this. It may have to do with roots going deeper for moisture and able to sustain the vine in drier years without supplemental water.

In an effort to mitigate sugar accumulation by reducing photosynthetic efficiency some growers are turning vineyard rows from N-S to NE-SW to deflect the intense afternoon sun. Also, a variety of cross arm configurations are being used to spread the canopy of a VSP from a very thin 1-1.5 leaf layers to canopies with greater depth, from 6-12" to provide more shade over the fruit zone. These canopies are not dense, simply more separated allow for dappled sunlight on the fruit. By reducing the leaf surface area of the outer layer of canopy, the photosynthetic efficiency is lowered and this will hopefully slow sugar accumulation. The problem of sunburn on fruit is also reduced.

On both ends of the weather/climate spectrum, warm and dry, cool and wet, water and berry relations are very important to the production of balanced, fine wines. The more we understand these relationships, the better we can craft our viticulture practices to serve the needs of the berry to make even better wines.

Thank you to Dr. Markus Keller for all of his input in writing this article.

Mark L. Chien
Viticulture Extension Educator
Penn State Cooperative Extension
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