Going with the Flow, Beautiful Vineyards, Wine Cruise

Posted by steven.reynolds | July 7, 2011

Going with the Flow

Yun Zhang

Viticulture researchers at WSU's Irrigated Agriculture Research and Extension Center in Prosser are going with the flow – the inflow via phloem and xylem, and the outflow via transpiration and xylem backflow, that is. The woody xylem is an essential part of a plant's plumbing. It's through the xylem that water moves up through the plant's roots and into leaves and berries as the grapes are developing. The phloem, on the other hand, moves sugar and other nutrients around the plant, mostly from the leaves to the roots and berries.

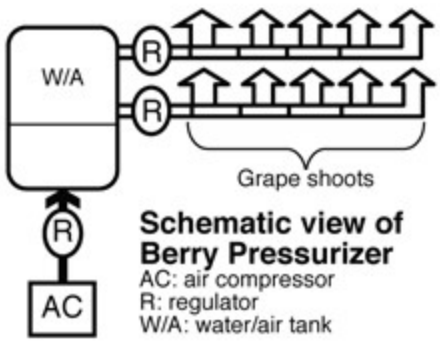
In order to shed light on the importance of backflow and fruit transpiration on berry ripening, doctoral student Yun Zhang, and her mentors Markus Keller, the Chateau Ste. Michelle Distinguished Professor of Viticulture, and Bhaskar Bondada, a grape physiologist based at WSU's Tri-Cities campus, had to come up with some clever ways of running experiments on living grapes.

Scientific experiments need controls to be valid. On living vines, that means

finding two or more clusters of grapes on the same plant that are at similar stages of development. One cluster is treated in some way that affects its ability to move water around while the other is left alone to do its thing *au naturel*.

In addition to evaporating from the berry surface, water backs out of berries through the xylem in a process called backflow. “Backflow is water recycling back into the vine,” said Zhang. Zhang is investigating the effect of xylem backflow on developing berries, including its influence on ripening, cracking and sugar accumulation. The results of her research are some practical implications for vineyard irrigation management.

Science often works by elimination: if you want to know how important a natural process is, you eliminate it and observe what happens. Zhang tested ways to eliminate backflow. One was by applying external pressure via a custom-designed apparatus called the “berry pressurizer.” The berry pressurizer pushes water into clusters through the xylem of the shoot to which the cluster is attached. Zhang observed that sugar accumulation slowed in pressurized clusters, which indicates xylem backflow might facilitate fruit ripening.



Berry pressurizer

Two bunches of grapes, one treated with an anti-transpirant and the other left "au naturel."

“Another thing we wanted to test was how reduced berry transpiration might affect ripening,” Zhang said. Transpiration is essentially sweating, though it does much more than just cool the plant, as transpiration is also involved in the movement of sugar and nutrients. “So I found paired clusters of berries on the same shoot. One got dipped in an anti-transpirant, the other didn’t.” Anti-transpirants apply a waxy sealant on the surface of the grape, thus locking in water — and, crucially for Zhang’s investigation, again slowing down sugar accumulation in the berries.

“What we found was a decline in the amount of sugar accumulation and berry coloration in both experiments. When xylem backflow or fruit transpiration were reduced, berries ripened more slowly,” Zhang said. Apparently, the sugary solution that flows into the berries in the phloem

contains too much water that the berries need to dispose of by backflow and transpiration; if one or both of these water disposal pathways are blocked, ripening slows. For vineyard managers, that's a big deal, as grapes that don't get pumped up with sugar (measured as Brix) are of no interest to wine-grape buyers. Zhang said that rainfall, overhead irrigation, or high humidity in the vineyard may delay ripening.

In other experiments, Zhang's results show that backflow is probably also critical to maintaining proper internal pressure in berries. Without backflow, berries may be more susceptible to cracking or splitting. As with low-Brix grapes, cracked berries are of drastically reduced value and are vulnerable to attack by pests and pathogens. Conversely, if the pressure in other parts of the plant is not optimal, for example due to drought stress, water may flow out of the berries late in the season, leaving them shriveled.

Zhang's research adds weight to the years of work done by Keller, Bondada and their students. How and, crucially, when grapevines utilize and transport water has been a key focus of their work. "What we've found over the years is that irrigation schemes need to be fine-tuned depending on climatic conditions in order to optimize yields while maximizing berry quality without compromising vine longevity," Keller said.

by Brian Clark

Yun Zhang's research is funded in part by USDA Northwest Center for Small Fruits Research and a scholarship from The Rhone Rangers.

Read an article about water use in vineyards by Markus Keller in the Spring 2008 issue of the WSU Wine and Grape Research and Extension Newsletter at http://bit.ly/cwPSMu. In the article, Keller makes some recommendations for growers.

Read an article about ways in which grapevines adapt to changing water supplies at http://bit.ly/l2h6ex.

Read an article about irrigation research conducted by Keller and his former graduate student, Marco Biondi, in the Feb. 2008 issue of Voice of the Vine: http://bit.ly/gOCW0W.

Beautiful Vineyards (with Benefits)

A tourist steps out of a local winery's tasting room, takes a sip of wine, admires the blooming flowers between the long rows of grapevines and smiles. The vineyard owner looks at the same flowers and smiles because

those flowers means the vineyard's insect pest problems are under control.

A beautiful vineyard attracts tourists... and beneficial insects.

That's the goal of one of Washington State University's research programs. The Vineyard Beauty with Benefits project will use native plants to beautify vineyards while also attracting beneficial insects and providing a refuge for threatened beneficial insects like native bees and butterflies.

"We are encouraging beneficial insects to take up residences in or near the vineyard," said Dr. David James, who heads up the research. "This project has the potential to increase tourism while decreasing the need for insecticides." The idea is to plant native shrubs, grasses and flowers in and around vineyards. The project will determine which native plants attract insects that eat mites, leaf hoppers and other vineyard pests.

Getting local vineyard managers to collaborate on the project won't be a problem. The impetus for the project actually came from grape growers. "Some vineyards were already trying to attract beneficial insects with native plants," James said. "They were calling us because they didn't know which plants to put in. This project will allow us to give them some answers."

Native plant species, like this one, attract specific insects.

The first step is to identify which plants attract which insects. Flowering plant species produce nectar that attracts certain insects. It's the plant's way to ensure pollination. In turn, insects take up residence in or near the plant to drink the nectar. Researchers collect leaf samples in the field and use a microscope to count how many insects the plant attracts. Sticky traps, shaking the grapevine canopy and even using a butterfly net also help generate data on insect populations.

In addition to attracting insects, native plants need to stand up to tractors and consume little or no water. "Native plants used as cover crops need to be able to hold down the dust and to grow back after being mowed," James said. Plants native to eastern Washington's shrub steppe landscape are drought hardy, so they'll be able to grow while the

grapevines soak up the water through irrigation systems. “Right now, yarrow and buckwheat both look like good candidates,” James said.

The project’s bottom line benefit is to reduce growers’ spray bills. “We’re working to increase biocontrol — using insects to control pests — so we can reduce, if not remove, the need for insect sprays,” James said

The three-year research project will result in a list of beneficial native plants for vineyards. The plant list could potentially also benefit other crops and backyard gardeners. “What you plant next to a vineyard and what you plant next to an apple orchard might be different depending on what pest you’re trying to control,” James said. “Backyard gardeners can plant drought-hardy native plants that save water while offering pest protection to the rest of the garden.”

by Terri Reddout

The research project is being funded by Western Sustainable Agriculture Research and Education, the Northwest Center for Small Fruits Research, and the Washington Wine Grape industry.

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