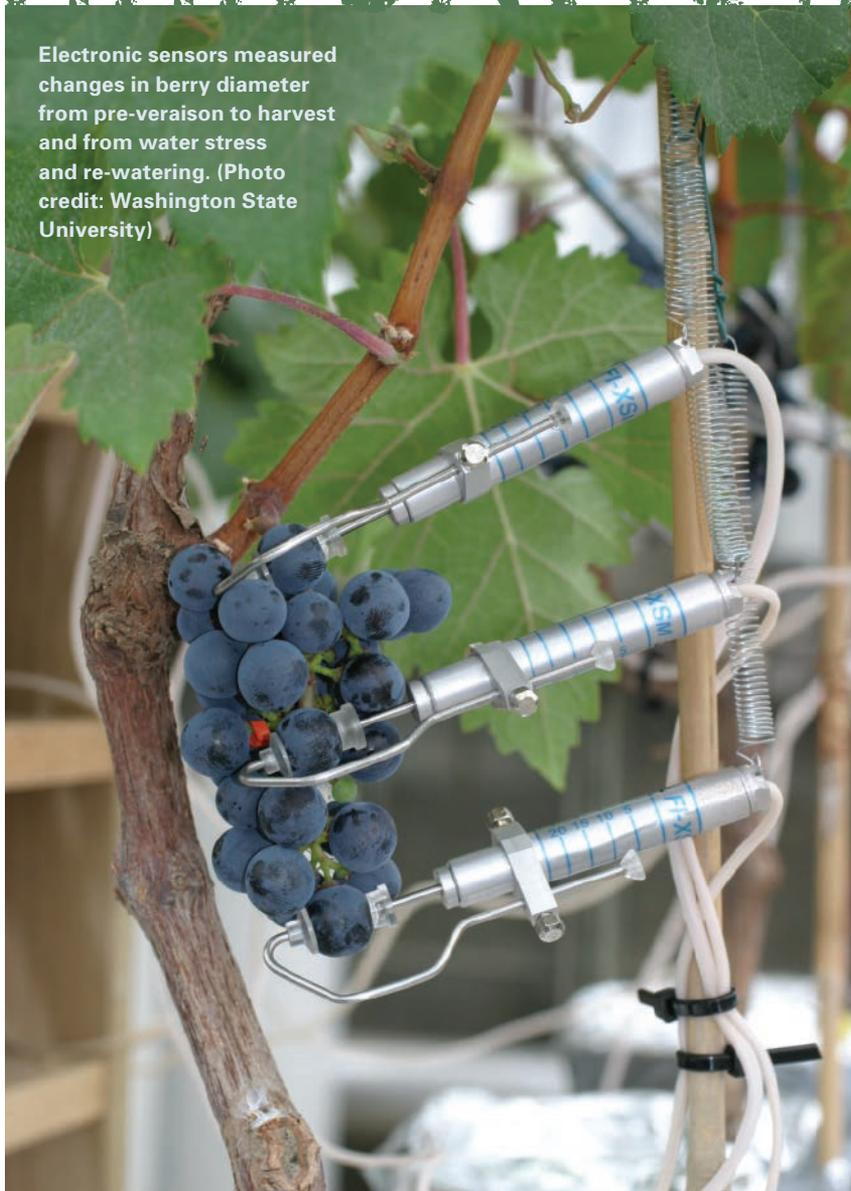


# RETHINKING POST-VERAISON IRRIGATION

Electronic sensors measured changes in berry diameter from pre-veraison to harvest and from water stress and re-watering. (Photo credit: Washington State University)



SCIENCE DISPROVES CENTURIES-OLD TRADITION OF WITHHOLDING PRE-HARVEST IRRIGATION FROM VINES.

The European-held wine dilution theory is so entrenched in the wine industry that many U.S. winemakers also believe it's best not to irrigate wine grapes at all before harvest. It's a theory not supported by science and one that can have detrimental effects on a grower's bottom line.

The combination of no pre-harvest irrigation and a prolonged fruit ripening period can have negative consequences for wine grape growers, especially those in arid climates. In places like Washington State, with scant precipitation in the fall, withholding irrigation after veraison not only has potential for yield loss but, more important, may leave soils dry going into winter, a recipe for root and vine damage if cold winter temperatures hit.

Research supported by the Washington State Wine Commission and the Northwest Center for Small Fruits Research has brought science into the irrigation-dilution concept to help Washington's wine industry keep vines healthy and avoid millions of dollars in yield losses — all while maintaining wine quality. Industry officials have estimated that preventing 5% yield

## AT A GLANCE

- + The tradition of withholding pre-harvest irrigation from vines can be damaging to vineyards.
- + Washington State University research proves that using drip irrigation post-veraison will not increase berry size.
- + The research also shows drip irrigation doesn't dilute sugars and helps avoid berry dehydration.
- + As a result of the research, many Washington winemakers have changed their irrigation mindset.

loss saves around \$10 million annually in grower returns, based on an average crop of four tons per acre valued at \$1,000 per ton grown on 50,000 acres.

More than a decade ago, Washington State University's Dr. Markus Keller initiated research to bring new understanding to berry water movement. He'd heard so often from grape growers complaining about winemakers not wanting grapes to be irrigated before harvest that he decided to look at the science behind the dilution concept. Keller is author of "The Science of Grapevines: Anatomy and Physiology" and recently took on the role of directing the American Society for Enology and Viticulture's peer-reviewed publications.

"The tacit assumption is that irrigation during ripening boosts berry size and dilutes the quality components of the grapes," he stated. Moreover, European laws, like



**Washington State University viticulturist Dr. Markus Keller initiated research to better understand berry water movement.**

those in a technical bulletin published by the International Organization of Biological and Integrated Control, prohibit or highly restrict irrigation after veraison under the guise of guaranteeing good quality of the wine.

"So pervasive is this Old World irrigation tradition that, even in the New World, many wineries encourage growers to withhold irrigation water during fruit ripening because of perceived adverse effects," he said during an interview in his office at WSU's Irrigated Agriculture Research and Extension Center in Prosser. "But the concept has little scientific evidence. Even the textbooks have had the berry water movement theory wrong."

### DRIP YES, SPRINKLER NO

Keller isn't suggesting growers use overhead sprinklers for post-veraison irrigation. His experi-

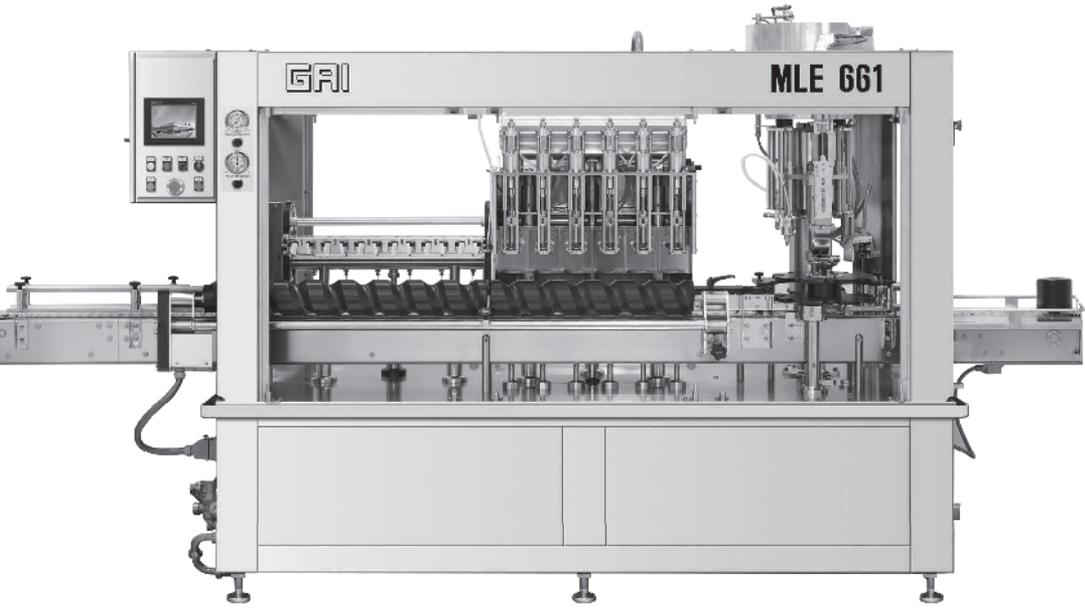
Prospero Equipment proudly presents the new GAI electro-pneumatic filling system. This is a state of the art machine that can fill both carbonated and non carbonated products.



## NEW GAI LINEAR FILLER

Linear fully-automatic bottling machine in stainless steel with 4 or 6 nozzles of rinsing, 4 or 6 nozzles of filling and single head for crowning, corking or corking.





PROSPERO EQUIPMENT OFFERS MANY SOLUTIONS AND CUSTOMIZATION FOR ALL WINE, BEER, SPIRITS AND BEVERAGE NEEDS.

<p><b>Corporate Office</b> 123 Castleon Street Pleasantville, NY 10570 Phone: (914) 769-6252 Fax: (914) 769-6786 info@prosperocorp.biz</p>	<p><b>North</b> 2204 State Route 14 N Geneva, NY 14456-9510 Phone: (315) 719-0480 Fax: (315) 719-0481 geneva@prosperocorp.biz</p>	<p><b>Northwest</b> 1722 SW HWY 18 Suite B McMinnville, OR 97128 Phone: (503) 472-6767 Fax: (503) 472-6768 northwest@prosperocorp.biz</p>	<p><b>West Coast</b> 7787 Bell Road Windsor, CA 95492 Phone: (707) 838-2812 Fax: (707) 838-3164 westcoast@prosperocorp.biz</p>	<p><b>Canada</b> 438 Isabay Suite 270 Montreal, Quebec H4T 1V3 Phone: (514) 336-7117 Fax: (514) 418-2605 canada@prosperocorp.biz</p>	<p><b>British Columbia</b> Authorized Agent Stefan Buhl Phone: Phone: (250) 317-4378 bc@prosperocorp.biz</p>
--	---	---	--	--	--

ments found that overhead sprinklers could be similar to rainfall during berry ripening and induce berry cracking, although cracking is variety-dependent. Once a berry is cracked, its volume can increase and sugar can rapidly be leached from the pulp.

But irrigation applied to the vine after veraison through drip or flood will not increase berry size, will not decrease sugars and isn't detrimental to fruit quality, he says.

### **BALLOONS, RED DYE**

Keller's dilution theory research, which began in earnest in 2004 and has involved a variety of graduate students, has turned into a continuum of research projects, with surprising and startling results.

Students Marco Biondi and Yun Zhang monitored berry diameter with electronic sensors, pressurized vines to study water movement and

observed the berry and vine xylem (part of the vascular system) with dyed water. The research showed that, before ripening, berries were like balloons. The green berries contracted and expanded from drought stress and re-watering. But after veraison, when Biondi tried to make berries explode by forcing massive amounts of water through the roots via a root pressure chamber — so much water that leaves were dripping wet — there was no diameter change for berries with sugar concentrations above 11 °Brix.

When Biondi and Zhang used red-dyed water to observe the vine's xylem, they found that dye moved less into the berry during ripening, which supports common textbook wisdom that the xylem loses functionality at veraison. But when red dye was put into the rear end of the berry to trace outflow, there was surprising water move-



**WSU postdoctoral research associate Yun Zhang works with Markus Keller to continue their research.**



**NAPA BARREL CARE**  
WHERE WE CARE FOR YOUR BARRELS!

**You Store Your Barrels Here Not Just Because Of The  
Cost Savings**

**You Store Your Barrels Here Because Of  
Quality**

**Our Service Allows You To Manage The Details of Your  
Winemaking**

**While Allowing You to Focus The Most Important Goal  
Selling Your Wine**

**Your Trusted Cellar Master**

[www.BarrelCare.com](http://www.BarrelCare.com) | 707-254-1985

1075 Golden Gate Drive | Napa, CA 94558

ment from the berry to the leaves and shoots.

"Previously, the textbook belief was that the xylem became dysfunctional at veraison and only brought water and minerals into the berry up to that time, while the phloem brought the sugars in solution," Keller says. "We saw that the xylem can easily move water out of the berry. But we're still figuring out the how and why."

In explaining the why, Keller says that, after sugars in the berry are unloaded from the phloem's sugar water solution, there's a need to remove the excess water. The berry can't transpire enough to do the job, so the xylem pathway helps the berry in disposing excess water.

## YIELD LOSS

Keller is often asked how much yield loss occurs when winemakers want to hang fruit for extended ripening to maximize flavor profiles and reach high sugars of 26 °Brix and above. At 23 to 25 °Brix, berries reach their sugar maximum. "Any further increase in sugar is a result of sugar concentration from dehydrating and shrinking berries, not from sugar import," he says.

In general, berries lose 5% to 10% in weight for each increase above 23 to 25 °Brix, but the weight loss varies by cultivar. Without quantifiable data regarding wine grape weight loss, it's difficult for wine industry personnel to

estimate yield and economic losses from extended hang time. "Growers know they're losing tonnage from extended ripening because they can see their fruit shrivel," says Keller. "But it's hard to ask for compensation if you don't know how much you're losing."



**An example of Cabernet Sauvignon grapes shriveling from dehydration before harvest.**

Joel Perez, one of Keller's most recent grad students, took weekly berry weight and Brix measurements once fruit reached 20 °Brix on nearly 25 wine grape varieties for two years to quantify berry weight loss due to dehydration or shrinkage. His study found that, while some didn't lose weight, some lost up to 45% during the extended hang time. The preliminary research showed that berry weight loss always began before visual symptoms of shrivel were observed.

## INDUSTRY ADOPTION

As a result of the WSU research, many Washington winemakers have changed their irrigation mindset.

Jim Holmes, owner of Washington's acclaimed Ciel du Cheval Vineyards on Red Mountain near Benton City, shared that when Keller's research was first published, he sent copies to all of his winemaker customers. "At one time, I had several winemakers concerned about late season irrigation, but Markus Keller's research clearly showed there's no problem with drip irrigation and dilution," says Holmes.

His customers are told up-front that he irrigates up to the end of the season. "In my world, there haven't been any winemaker issues with our irrigation practices."

Holmes, who takes rigorous grape chemistry measurements throughout fruit ripening, notes that he hasn't seen any change in their measurements to show dilution or decreased fruit quality effects from irrigation.

"The vine can be shortchanged if irrigations are withheld during fruit ripening, especially during warm vintages," he says. "If you have a long hang time and no irrigation, the plants are ready to call it a day before the fruit is picked."

Yakima Valley appellation grape grower Dick Boushey of Boushey Vineyards agrees that most winemakers have changed their thinking to now allow drip irrigation after veraison. He admits to discussing research results often with his

## ADDITIONAL READING

- + Ripening Grape Berries Remain Hydraulically Connected to the Shoot, *Journal of Experimental Botany* (Vol. 57:2577-2587)
- + Sugar Demand of Ripening Grape Berries Leads to Recycling of Surplus Phloem Water via the Xylem Plant, *Cell & Environment* (Vol. 38:1048-1059)
- + Water Economy in Grape Berries  
<http://wine.wsu.edu/research-extension/files/2013/04/2013-VEEN-Spring-FINALsmaller.pdf>
- + Pre-Harvest Irrigation Dilutes Grape Quality! Or does it?  
<http://winegrapes.wsu.edu/Newsletters/vol18-1-2008.pdf>

**WE'VE BEEN  
SUPPORTING  
CENTRAL  
WASHINGTON  
GROWERS  
FOR OVER  
75 YEARS**



**GIVE US A CALL TO SET UP A  
DEMO IN YOUR  
VINEYARD TODAY**

**[888] 819-5045**  
**BURROWSTRACTOR.COM**

**YAKIMA  
WENATCHEE**



© 2016 CNH INDUSTRIAL CAPITAL AMERICA LLC. ALL RIGHTS RESERVED. CNH INDUSTRIAL CAPITAL AND NEW HOLLAND ARE TRADEMARKS IN THE UNITED STATES AND MANY OTHER COUNTRIES, OWNED BY OR LICENSED TO CNH INDUSTRIAL N.V., ITS SUBSIDIARIES OR AFFILIATES.

35-plus winemaker clients. "Warm vintage years, like 2014 and 2015, really reinforce the importance of watering vines enough to keep them from shutting down before grapes can be harvested."

A winemaker who only recently came around to the WSU research is Juan Muñoz-Oca, head winemaker at Washington's Columbia Crest Winery. Muñoz-Oca grew up in Argentina's wine industry, where the dilution concept is still strongly believed. Keller has had many discussions with Muñoz-Oca.

"My upbringing in Argentina — my initial gut feeling — tells me the dilution theory should be true," he says. "But I can't argue against the research. It makes total sense. Keller's research has proven to me that drip irrigation water doesn't dilute sugars and the irrigation helps avoid berry dehydration. Winemakers sometimes confuse berry dehydration with sweet fruit."

He believes the research is important because it lets everyone make more educated decisions: "Both vineyardists and winemakers have a responsibility to grow healthy vines and prepare them for winter."

Keller's work is proof that centuries of tradition can be changed through science, research and persistence.

**Melissa Hansen** is research program manager for the Washington State Wine Commission (WSW), which represents every licensed winery and wine grape grower in Washington state. Guided by an appointed board, the mission of WSW is to raise positive awareness and demand for Washington state wine through marketing and education while supporting viticulture and enology research to drive industry growth. Funded almost entirely by the industry through assessments based on grape and wine sales, WSW is a state government agency, established by the legislature in 1987. To learn more, visit [www.washingtonwine.org](http://www.washingtonwine.org).

Comments? Please e-mail us at [feedback@vwmmmedia.com](mailto:feedback@vwmmmedia.com).