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WSU Study Finds 30 Winegrape Varieties Reach Drought Stress at the Same Threshold

The results suggest growers should base irrigation on soil water-holding capacity and canopy size, not presumed varietal drought tolerance

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A new Washington State University study is challenging a long-held idea in viticulture by finding that different winegrape varieties may not differ much in how they respond to drought.

The research, conducted at WSU's irrigated agriculture research center in Prosser, Washington, examined 30 winegrape cultivars and found that the vines reached drought stress at a similar threshold, regardless of variety. The finding suggests growers may get better results by tailoring irrigation to soil conditions and canopy size than by assuming one variety is naturally more drought tolerant than another.

The paper was published in BMC Plant Biology and builds on two earlier WSU studies in the same journal. One, published in 2023, examined whether leaf water potential could be used as a stand-in for soil moisture. Another, published in 2025, looked at the relationship between leaf water potential and soil moisture across the same 30 grape varieties.

Markus Keller, the study's corresponding author and a professor in WSU's Department of Viticulture and Enology, said the results run against a common assumption in the field. For years, researchers and growers have discussed grape varieties as either more "optimistic" or more "pessimistic" under water stress. In that framework, some vines are thought to keep photosynthesizing and producing sugar as soils dry, while others conserve water quickly by closing their stomata, the leaf pores that regulate water loss and carbon dioxide intake.

Keller said that idea has shaped thinking about which varieties should be planted in dry regions or managed under deficit irrigation, a strategy widely used in winegrape production to control vine growth and fruit quality while limiting water use. But he also said past research has produced conflicting results, sometimes even for the same variety, depending on the season, the level of water stress, the rootstock used, and the methods of different researchers.

The WSU team set out to test the issue under more controlled conditions. Keller said he was motivated in part by a landmark French study published decades ago, but he noted that the varieties in that work were grown in separate blocks and managed somewhat differently. WSU researchers were able to revisit the question after the Washington

wine industry helped fund a research vineyard in 2010 with 30 winegrape cultivars planted in one location.

Charles Obiero, a former WSU postdoctoral researcher and co-author on the study, tracked how the vines responded as water became less available during the growing season. The vines were fully irrigated, then allowed to dry down gradually. They were irrigated again and then put through a second dry-down period. Over two years, Obiero measured the vines' water status at night, when the plants were at rest, and again during the heat of midday, when water demand was higher. He also recorded physiological responses, including stomatal behavior, while measuring how much water remained in the soil.

That paired approach was central to the study. Keller said many previous experiments focused on plant response without directly measuring how much water in the soil was actually available to the vine. In the WSU work, researchers tracked both the changing soil water supply and the vine's response to it.

According to the researchers, the results showed that the apparent differences between "optimistic" and "pessimistic" behavior can depend on how soil water is measured and on the amount of water available in the soil. Once those factors were accounted for, the varieties shared the same critical threshold for the onset of drought stress.

The study also found large differences in canopy size among the varieties, even when they received the same irrigation. That mattered because larger canopies lose more water through evaporation and transpiration, which causes the soil to dry faster. In practice, that means two varieties may appear to behave differently under drought not because their basic physiology is fundamentally different, but because one has more leaf area and reaches the stress point sooner.

Obiero said that makes soil type and canopy management central to irrigation decisions. A vineyard block with more water-holding capacity can buffer stress longer than a block with coarse soil, while vines with larger canopies will need more water than smaller ones under the same weather conditions. The researchers said growers who know both the soil's water-holding capacity and the vines' stress threshold can

make more accurate irrigation decisions.

That could matter beyond vineyard science. For wine producers and the broader beverage sector, the findings may help support more precise irrigation, lower water use, and lower costs in regions facing tighter water supplies. They also suggest that some assumptions used to match varieties to drought-prone sites may need to be revisited, especially if irrigation strategy has been based more on cultivar identity than on soil and canopy measurements.

The work comes as wine regions in the United States and abroad face more pressure from heat and water scarcity. Deficit irrigation has become a key management tool in premium winegrowing, but it requires balancing water savings with the need to maintain vine health and fruit quality. If the new findings hold up across other sites and conditions, growers may be able to simplify some decisions by focusing less on presumed varietal drought personalities and more on field conditions that can be measured directly.

WSU said the research could also support Sustainable WA, a certification program for Washington winegrapes that emphasizes environmental stewardship, social responsibility, and economic viability. The university said a clearer understanding of how vines respond to declining soil water can help growers apply water more efficiently while maintaining production in a changing climate.