

Precisely-timed irrigation pulses can reduce berry cell death and late-season dehydration

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Authors: Megan K. Bartlett, Alexander Ritter-Jenkins, A. Sergio Serrano, Rolando Corella Caballero, Nikita Kodjak, Dario Cantu, Andrew McElrone, Thorsten Knipfer, Ken Shackel.

Abstract: Hot, dry conditions can exacerbate late-season berry dehydration, reducing yield and altering berry sensory properties. Late-season dehydration occurs when the berries undergo cell death in the mesocarp, and the water released from the ruptured cells evaporates through the skin or is drawn from the fruit to the canopy by a water potential gradient (backflow). Here, we tested whether short pulses of increased irrigation would be a water-use efficient strategy to reduce late-season dehydration by interrupting stress-induced signals for berry cell death. We compared three irrigation treatments: conventional (following standard commercial practices) and an early- and a late-pulse treatment, where irrigation was increased by 40% in the 2 weeks immediately before or after the expected onset of cell death. We measured mature Cabernet Sauvignon vines grafted to 101-14 in an experimental vineyard in UC Davis in summer 2022 and 2023. We monitored vine water stress, berry cell death and shrivel, reactive oxygen species (H_2O_2) concentrations and markers for cell oxidative damage (malonyldialdehyde, MDA). The late-pulse treatment significantly reduced the rate of cell death and the magnitude of berry shrivel at harvest compared to the conventional treatment. However, the early-pulse treatment did not significantly impact the rate or date of onset for cell death or shrivel. Concentrations of the reactive oxygen species H_2O_2 and markers for oxidative damage to cell membranes (MDA) increased at the same time as cell death, consistent with a role in programmed cell death, but were not significantly different among treatments, indicating that other mechanisms regulate irrigation effects on berry cell death. Overall, these findings show that the onset of cell death is not impacted by water status, but a short pulse of irrigation soon after onset can slow the rate of cell death and reduce berry shrivel at harvest.