

# The Physiology and Prevention of Berry Shivel

Craig Macmillan, PhD



**VINEYARD TEAM**  
Promoting Sustainable Winegrowing

Shriveled berries are undesirable. On a cluster with both healthy and shriveled berries, the shriveled berries have higher titratable acidity, less Yeast Assimilable Nitrogen (YAN), and lower total sugar content than healthy clusters. The higher Brix readings found on shriveled fruit are solely the result of dehydration and not sugar accumulation.

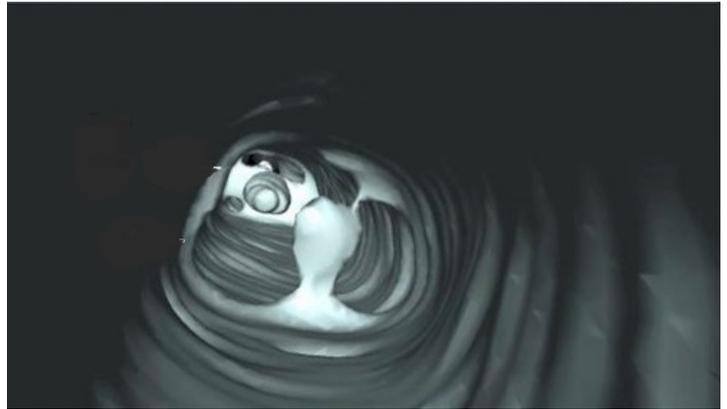
The grape berry transpires much like the rest of the vine. Before veraison, water can move in and out of the berry through the xylem and phloem or be lost through the skin to evaporation. Once the berry starts to ripen most of the water lost is through the skin as the vascular tissues of the pedicel begin to change.

The xylem vessels become occluded reducing the flow of water into the fruit. As the fruit reaches the more advanced stages of maturity, the phloem also becomes non-functional, cutting the berry off from the rest of the vine. However, water continues to evaporate through the berry skin.

The rate and amount of water evaporated by the berry is determined by temperature and relative humidity. Berries dry out faster in hot, dry, and/or windy conditions. The berry cannot control evaporative loss like the rest of the vine because by late summer it does not have functional stomata. Losses can be 6% or more of the berry fresh weight per day.

Early in ripening some of the lost water can be put back into the berry through irrigation. As time goes on, however, the vascular tissues become non-functional and the flow of water into the berry is restricted and eventually halted. This is irrespective of the water status of the vine.

Berries can begin the shriveling process before veraison. Green berries will shrink and expand based on the water



*3-D computer reconstruction of xylem tissue in a grape pedicel after veraison.*

status of the vine, sending water back to the shoot under stress. This means stressed berries will display signs of shivel as early as 10 days after veraison.

Before veraison, berries will hold their size until the vine has used approximately 80% of the transpirable soil water available, then begin to shrink. They will size back up when irrigated.

Water stress after veraison leads to a slow decline in berry size. Relieving water stress prevents the berry from shriveling further, but will not restore the berry's size. This makes sense if vascular conductivity between the berry and the vine is severely restricted. Berry shivel is something that must be prevented, not corrected.

Mark Greenspan has pointed out that shivel is something that is inevitable if the crop is left on the vine long enough. There is simply no water going in while water is evaporating out of the berry. He suggests that long hang times should be supported with late season irrigations to support the crop until the fruit is truly cut off from the vine.

## References

Greenspan, Mark. 2016. "Why Do Grape Berries Shivel?" Wine Business Monthly. January 2016, pp.154-157.

## **References, Cntd.**

Keller, Markus, et al. 2006. "Ripening grape berries remain hydraulically connected to the shoot." *Journal of Experimental Botany* 57(11): 2577–2587.

Knipfer, Thorsten, et al. 2015. "Water Transport Properties of the Grape Pedicel during Fruit Development: Insights into Xylem Anatomy and Function Using Microtomography." *Plant Physiology* 168(4): 1590-1602.

Zhang, Yun and Markus Keller. 2015. "Grape Berry Transpiration Is Determined by Vapor Pressure Deficit, Cuticular Conductance, and Berry Size." *American Journal of Enology & Viticulture* 66(4): 454-462.

Zufferey, Vivian, et al. 2015. "Physiological and histological approaches to study berry shrivel in grapes." *Journal international des sciences de la vigne et du vin* Vol. 49, No 2.