Sometimes the Smaller Drink is Better

A response to an argument in favor of the “big drink”

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**Maybe Some of You** have been following the “controversy” that has evolved over the years. Not sure it is a controversy for the ages, but it’s important enough for me to address it now because an article came out last month by Dr. Thibaut Scholasc in favor of the “big drink” style of irrigation. I, on the other hand, wrote in support of the “small drink” style about five and a half years ago, and I have tended to allude to that practice in other articles on the topic of irrigation, a topic I write about frequently because it is one of my most-studied subjects.

Some may feel that Dr. Scholasc is my nemesis or my enemy as we have publicly debated this topic before. He is neither of those. He is well-studied in this topic also, and we happen to have a professional disagreement about this. In truth, I can find some things in his article with which I agree. I’ll mention those as I go along.

**Does Deep Irrigation Develop a Deeper Root System?**

In general, it is wise to develop a deeper root system in grapevines, especially as water resources are limited in most regions of the West Coast. However, the approach I promote to develop a deeper and more extensive root system may or may not involve irrigation. As I’ve said before, in the North Coast, we receive ample rainfall every winter to “fill the tank.” That is, the soil profile, from the top to the bottom of the root system, is almost always at field capacity or higher at the time of budbreak. The best and most effective way to discourage a shallow root system is to delay the onset of irrigation for as long as possible. Once irrigation begins, whether shallow or deep, the non-wetted portions of the root system will become less active. Rainfall fills the profile, up and down, left and right, to and fro. Let the roots find the water.
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As an example, take a look at soil moisture at several depths in Figure 1. This shows soil moisture being depleted by roots beginning at the shallower depths and progressing down the profile over time as the moisture at shallower depths becomes less available. By delaying heavy, early irrigations we allow the full profile to be explored by roots and have found that initiation of the irrigation sequences can be delayed further into the season after successive years of this practice. We can also see that irrigating too early discourages uptake and activity of the deeper roots (Figure 2).

Indeed, it is the postponing of early irrigation more than deep irrigation that helps to develop a more resilient root system. If one does not measure soil moisture, one has no idea of how much moisture remains in the soil, especially 4 feet down.

Interestingly, we have seen that if irrigations are not deep, root activity and moisture depletion actually do continue at deeper depths. After reviewing hundreds of moisture profiles, I find that deep root activity only slows down if the early irrigations are deep, resuming once again when the irrigations are ceased, or at least reduced, in volume and/or frequency (again, refer to Figure 2).

While offered only as an example, I was surprised to see how early irrigations were applied in Scholasch’s examples from Napa Valley. Beginning in mid-June, we typically look to start irrigations about four weeks after that in Napa and about six to eight weeks after that in much of Sonoma County. Considering my argument about delaying irrigation in the North Coast, I don’t believe this to be nit-picking. Rather, I believe it to be a key element of the approach I prefer to take for irrigation of fine vineyard vineyards: push the irrigation “season” as late as possible to get control over the vines and allow deep root penetration.

What about arid regions? This is where I am more closely aligned with Scholash’s opinion about irrigating deeply to encourage deeper rooting. Only I approach it differently than he is suggesting. I have worked with growers in the Central Coast, eastern Oregon and Washington, and in Chile and Argentina. All of those regions feature winter and spring seasons that receive about 12 inches or less of rainfall. Unlike the North Coast, the soil is rarely naturally at field capacity throughout the profile at budbreak, so the best practice is to provide a long irrigation to fill the profile as much as possible (i.e., “filling the tank”). Keep in mind that it is not always possible to fully wet the profile by using drip irrigation. Water may move vertically more than horizontally in some soils. In other soils, it may hit a stratification boundary and then flow horizontally more than vertically. Very uniform soils will benefit from a thorough wetting, both deep and wide, but such uniform soils are rare in California. But, irrigating for 18 to 24 gallons per vine will
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FIGURE 2: Chart of soil moisture content at a shallow (16 inch) and two deeper (40 and 48 inches) depth of a north coast vineyard receiving early and excessive irrigations. Note that water content spiked at the deepest depth during each irrigation, indicating that the irrigations were percolating past the deepest depth being monitored. Also note that uptake of moisture did not begin to occur until the irrigations were curtailed later in the springtime. Excessive and deep irrigations discouraged moisture uptake while reducing (or eliminating) early-season irrigation allowed the deep moisture to be tapped into by the root system.

usually wet the profile sufficiently to simulate winter rainfall. That is the only time I ever recommend applying that much irrigation at a single time. This is my only foray into the “big drink.”

By doing this, we can then apply the practice of delaying the first irrigation for the purpose of encouraging a more extensive, and less drought-sensitive, root system than if we had babied the vines along with early irrigations.

Do Shorter Irrigation Intervals Induce More Severe Water Deficit?

Scholach contends that shorter irrigation intervals, applied with smaller irrigations, do create more water stress on the vines; and after the short irrigations, vine transpiration decreases quickly and remains low until the succeeding irrigation is applied. With this point, I am in agreement. Indeed, large irrigation applications raise vine water status and maintain it for a longer period of time compared to the same amount of water applied in shorter bursts.

My difference in opinion is that we desire some water stress in our wine-grapes: Not too much and not too little and at the right time. I wrote about this recently; and while it was my own opinion that I was writing about, there is ample evidence to support the general approach I outlined therein: No stress up to and through fruit set, progressively increasing stress up to the “magic window” about two weeks prior to and through veraison, and a relief of some of that stress after veraison and up to harvest. So, controlled stress is the goal, especially for red varieties, for a specific phenological period of time.
This strategy was not developed by accident or by trial and error (well, maybe some of that), but it has been shown in many studies that water stress, via the stress hormone abscisic acid (ABA), stimulates expression of many genes that code for enzymes involved in the berry’s secondary metabolism. Yes, water stress during this period may also reduce berry size, which could have a depressing effect on cluster weight. This can be countered with changes in cluster-thinning practices that can easily counter yield-depressing effects of reduced berry size at harvest.

While we don’t measure ABA in real-time in practice, we can measure stomatal conductance in vines to provide insight into ABA’s effect on induction of stomatal closure. Indeed, stomatal conductance (measured with a portable leaf porometer device) is a highly useful, if not automatable, tool for helping us to control vine stress during the critical phenological stages. For instance, for a variety like Cabernet Sauvignon, we are looking for midday stomatal conductance levels around 125 to 175 mmol m⁻² s⁻¹ during that “magic window.” After that, we can and probably should allow that stress level to be relieved.

I don’t have a lot of experience with the “big drink” approach throughout the growing season, but I do have some growers who use both approaches within the same vineyard. Midday stomatal conductance for two vineyard blocks in 2017 are shown in Figure 3, along with target values of each during the “magic window,” that is also shown. The “big drink” block received three large irrigations in mid-July, late July and late August while the “small drink” block received about 16 small, but frequent, irrigations beginning in late July (veraison was about July 25th that year).

Mind you, this is not a scientific study and is only an example, but you can see that the target stress levels for stomatal conductance were achieved and held during the “magic window” period. Is it always this easy? No. But applying short irrigations allows us to develop the desired stress without excessive and undesirable relief from that stress during the phenological period it is ideally applied. Note that you can also see that the values swung wildly after veraison in both blocks due to some extreme variations in weather.

**Figure 3:** Stomatal conductance over time for two blocks in the same vineyard. One block had a “big drink” irrigation approach and the other a “small drink” irrigation approach. Magic window indicates the target time frame for beneficial effects of water stress on fruit maturation (about 2 weeks prior to veraison and through veraison).
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If vines get too stressed, then relief of that stress can come about very quickly, by either shortening the interval between irrigations or by increasing the volume of irrigation. On the other hand, if vines dive into less-than-desired stress levels, the irrigation interval can be stretched to quickly modulate the stress level as needed. It is an interactive and intensive level of management, but the window of time is brief.

It is not necessary or desirable to maintain the maximum stress level after veraison is complete. Scholach stresses that the large volume irrigation approach allows vines to function at a higher water status and the post-veraison period is where I again agree with him that deeper irrigations are allowable and often desirable. I tend to practice a hybrid approach during ripening, neither adhering to a “small drink” or “large drink” philosophy. While I generally increase the volume of irrigations after veraison, I still would be thought of as a “small drinker.” However, as all farmers must be aware of the weather, a preemptive irrigation prior to a heat event is likely to call for a larger drink than that which is typical before veraison.

The approach I describe, I feel, provides the best of both worlds—controlled stress for quality followed by reduced stress for maintenance of ripening. But I believe Scholach puts too much emphasis on sugar loading and not enough emphasis on secondary metabolism in his discussion. We indeed want to maintain leaf function by keeping vine hydration at a proper level. But we also need to stimulate the “flavor ripening” aspects of berry maturation by applying controlled water stress at the right time. And I feel this is best achieved by delaying the initial irrigation followed by a “small drink” approach to scheduling.
Does “Small Drink” Irrigation Apply More Water Than “Big Drink”?  

The answer to this question is “it depends.” I will concede that deeper irrigations are more efficient in that the direct evaporative losses from the soil surface are smaller compared to the frequent wettings and dryings imposed by “small drinks.” However, “small drinks” induce water stress, as shown above, and bring the vines into a higher water use efficiency range than if the vines are operating at a higher water status and higher transpiration rate.

It is difficult to compare apples to apples here because these practices are rarely tested side-by-side, let alone in a scientific manner, but when I examine the levels of irrigation I apply using a “small drink” approach, guided largely using soil moisture profile measurements, I am usually in the ballpark of 25 percent of full crop ET (i.e., ETo). How do I irrigate so little? Most likely because the vines are kept under a mild water stress where their stomata are not fully open, and thus the vines are operating in a condition of high water use efficiency.

Scholasch tosses out some examples of irrigating with “big drinks” at a seasonal application of about 75mm (3 inches). This is very much in line with how much I usually apply per season (2 to 3 inches in the coastal regions), though often the delayed irrigation allows us to irrigate even less than that. I see very little reason to accept that “big drink” irrigation applies less water than “small drink,” though each approach can be mismanaged. For “small drink” irrigation, very short irrigations can lead to application inefficiencies, especially in hillsides where water is more voluminously applied to the bottoms relative to the tops of hills.

However, I have seen what amounts to almost criminal over-application of water in the “big drink” approach. While I have only an intellectual disagreement about the overall approach, I have seen irrigation applications so long (24 to even 72 hours) that the applied water almost certainly was driven below the root system. To me, this is a terrible waste of a precious resource as well as a possible means to move nitrates and chemicals deep into the profile, beyond where vines can extract them.

If a grower practices this “extreme drink” irrigation in this manner without some means to monitor soil moisture profiles during the irrigation, they are doing so irresponsibly. I will presume that this type of irrigation practice is rare, but I ask those who are doing it to please consider the consequences and at least have the means to monitor what you are doing.

References


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