WASHINGTON STATE UNIVERSITY EXTENSION

GRAPEVINE MANAGEMENT UNDER DROUGHT CONDITIONS

Drought Watch Series

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Grapevine Management Under Drought Conditions

The severity of impacts that drought conditions have on grapevines in a year of low water availability depends on a number of factors that are specific to individual vineyards. Some of the factors that influence a grower's ability to manage severe water stress include:

- Timing of water delivery
- Amount of water available
- Duration, intensity, and timing of hot spells
- Soil texture
- Soil depth
- Method of irrigation

In newly planted vineyards, water management is critical for proper vine establishment. Without sufficient root growth, which is driven by the supply of adequate moisture, vines will struggle with establishment and winter survival. Under drought advisories, if water restrictions are substantial enough to prevent proper irrigation regimes, growers may consider delaying the establishment of new vineyards until irrigation forecasts have improved.

The information presented here, along with other advisories on irrigation management and efficiency, outline the management concerns and possible solutions for growers during periods of inadequate water availability for mature plantings.

Grapevine Water Use

Grapevines can adapt to both low and high water availability in the surrounding soil. *Vitis labrusca* 'Concord' is native to the eastern United States and is thus more suited to higher water availability. Wine grapes *(Vitis vinifera)* have evolved under drier conditions and are more efficient in their water use.

Regardless of plant origin, a basic volume of water is needed for vine survival; in order to reach optimum yield and crop quality, more water than the "absolute minimum" is needed. A general rule of thumb is that 12-16 acre-inches of water is the minimum amount required during the growing season to actually produce a viable crop. However, this rule is highly variable because it is affected by soil type, age of vine, weather, root depth, crop load, and other growing attributes. This effectively means that vines can survive droughts, depending on the severity and duration of the drought, but they may not produce fruit.

Effects of Water Stress

Extreme water stress in vines is most damaging when it occurs between the phenological stages of bloom to pea-size berries (late spring to early summer), concurrent with rapid shoot growth, ovule fertilization, and rapid cell division in young berries (Figure 1). Water stress during this time will result in poor berry set and small berries.

Figure 1. Berries at "fruit set."

In Pacific Northwest wine grapes, regulated deficit irrigation (RDI) is usually practiced between the phenological stages of pea-size berries to véraison (July to mid-August), when cell expansion is occurring in the berry (Figure 2). However, severe water stress during this stage of berry development can dramatically reduce berry size and may delay or, under very severe conditions, prevent fruit maturation (Moyer et al. 2013). In some cases, the vines will also pull water from the developing fruit to maintain shoot health, resulting in premature berry dehydration (i.e., berry shrivel).

Between the stage of véraison and harvest, RDI is still a common practice in red wine grapes, but not white wine grapes or juice grapes.

At this time, vines are less susceptible to drought conditions because they begin using the phloem, rather than the xylem, for water transport. The phloem is less susceptible to changes in soil water levels (Keller 2010); however, they still need sufficient soil moisture so as not to go past the permanent wilting point of the plant. RDI during this time period aids in slowing vegetative vine growth, and helps the processes associated with vine dormancy and cold hardiness acclimation.

Figure 2. Véraison is when the very first berry starts to change color. Pictured here is a cluster around 50% véraison.

Soil moisture should be replenished prior to irrigation shut off in the fall—if possible, either directly before or after harvest.

Replenish the top 24–36" of the soil profile with water, to field capacity. This should be done in both juice and wine grapes.

This water helps protect the roots against cold damage and provides a source of moisture for growth next spring. Soil-applied water at this time will not result in berry cracking or excess water accumulation in the berries.

For more information on the influence of water on vine development and irrigation strategies, see *Irrigation Basics for Eastern Washington Vineyards* (Moyer et al. 2013).

Cultural Practice Solutions

Consider the following cultural practices to provide the most efficient use of water:

1. Fertilize lightly, prune and shoot-thin heavily, and crop-thin early to reduce canopy growth and yields.

2. Reduce weed growth and active cover crop maintenance (such as watering of vineyard row middles) to avoid competition with vines for limited water supplies (Figure 3).

For more information on weed management, see the annually-updated *Pest Management Guide for Grapes in Washington* (Hoheisel and Moyer 2015).

While bare ground under vine rows is advised during low-water years, completely bare ground in vine row middles is not advised, due to potential for wind-driven soil erosion and the exposure of the weed seed bank. An alternative would be to allow the row middle cover crop (either cultivated or native vegetation) to naturally dry out. This will reduce cover crop water use, but also maintain soil structure and reduce erosion due to the presence of cover crop roots.

For more information on viable cover crops, see *Cover Crops as a Floor Management Strategy for Pacific Northwest Vineyards* (Olmstead 2006).

3. Evaluate the efficiency of current water delivery methods and consider upgrading or improving existing systems so water is applied as efficiently as possible.

Figure 3. Example of a low cover crop that would require minimal water use.

Irrigation Delivery Strategies

Drought conditions require efficient use of available water. Growers should constantly monitor soil moisture (see *Online Resources*) and apply water only when needed or at strategic times. Using an irrigation scheduler may increase water savings and avoid overwatering (see *Irrigation Scheduler* on AgWeatherNet after logging in).

Timing. Irrigate early (as soon as water is available) to fill the soil profile if winter precipitation was not adequate. However, do not over-irrigate during this time (filling beyond soil water-holding capacity), as that can result in inadequate iron and zinc uptake by the roots, leaf chlorosis, fertilizer leaching, and anaerobic soil conditions. If possible, at the end of the growing season after vines have begun the dormancy process and periderm has begun to form, (end of September to end of October) be sure the soil moisture level is at or near field capacity before the irrigation cutoff date.

In younger vineyards, the dormancy and cold acclimation processes are not always aligned, so late-season irrigation should be practiced with caution to avoid triggering additional late-season vine development. Also in younger vineyards, replenishing soil moisture should occur in stages starting in the early fall (late September), and should be completed after the first frost if irrigation availability allows.

Having sufficient soil moisture in vineyards through the winter helps prevent cold damage to grapevine roots. In addition, sufficient soil moisture is needed for an even budbreak the following year, and without a guarantee of winter precipitation, a fall irrigation event may be the only source of moisture for the vineyard prior to irrigation recharge the following spring.

Irrigation Strategies. In deep soils with higher water-holding capacity, irrigate less frequently instead of applying less water per irrigation event. Applying the same amount of water per irrigation as before, or even slightly more pushes the water deeper into the soil where it is still available to the vine's roots, but is more protected from evaporation from the soil surface.

If a reduced flow rate is delivered, this may be accomplished by setting fewer rows per irrigation. Of course, do not apply more water than can be held in the vine's root zone as this water will be lost to deep percolation.

Sample your soil to see where the wetting depth penetrates to in the soil. This can be done by digging, using a soil probe, or using soil moisture sensors. In sandy soils, or soils with lower water-holding capacity or excessive drainage, more frequent irrigation events may be required to maintain soil moisture status above the permanent wilting point.

Delivery Method. Drip irrigation systems are most appropriate if water levels are predicted to be low for an extensive part of the growing season, because they provide the most efficient method of water application (Figure 4). However in many juice grape vineyards, rill and sprinkler irrigation systems are still used (Figure 5).

Figure 4. Close-up of drip irrigation practiced in wine and many juice grape vineyards.

Figure 5. Example of rill (furrow) irrigation sometimes practiced with juice grapes.

If, under drought conditions, 100% of the normal supply is available for short periods, rill or sprinkler irrigation systems would allow application of large quantities of water over this short period. To achieve this effect in drip-irrigated systems, the duration of a single application would need to be extended (i.e., on the order of days rather than hours).

Alternative Water Sources

Although there are permitting and restriction issues in Washington and Oregon, consider alternative sources of water, or means to store water such as storage ponds and reservoirs. The use of wells (i.e., ground water) to irrigate vineyards is restricted to a limited quantity of water per day and may not be appropriate for a vineyard depending on the size, soil type, and well water quality. In addition, the ability to drill new wells and use emergency wells is heavily regulated; for many locations, especially those with irrigation district water rights, the use of supplemental well water may still be prohibited in drought years.

Contact your local irrigation district or Department of Ecology office for more information on regulations and permits. The large investment needed to obtain alternate sources of water may be justified, as water reservoirs may be depleted again in future irrigation seasons.

For more information on Washington irrigation water rights, see *The Groundwater Permit Exemption* (Department of Ecology, 2013), and for Oregon, see *Water Rights in Oregon: An Introduction to Oregon's Water Laws* (Oregon Water Resources Department 2009).

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Online Resources

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