



Grape Notes

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Water Use (Drip Irrigation Schedules) for Vineyards in the San Joaquin Valley

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The water requirement (evapotranspiration) of a mature vineyard varies from 19 to 26 inches, depending on the size of the leaf canopy. In addition to evapotranspiration, 6 to 8 inches of water may be needed some years for beneficial purposes such as leaching salts and providing frost protection. Also, the efficiency of the irrigation system must be taken into account when figuring the amount of irrigation required for the season. The efficiency of most irrigation systems is 70% to 80%. Winter rainfall provides 3 to 6 inches towards the water requirement depending on effective rainfall and the ability of the soil to store water. The bottom line is that vineyards in the San Joaquin Valley are irrigated with 24 to 36 inches of water.

The trellis type and vine vigor affect the size of the leaf canopy and, subsequently, seasonal evapotranspiration. A typical raisin vineyard with a vertical two-wire trellis and a 7-foot stake will develop a full canopy by early June that will shade about 50% to 60% of the vineyard floor during midday, and seasonal evapotranspiration is about 19 inches. A table grape vineyard with a 42-inch crossarm and a 7-foot stake will develop a full canopy by mid-June that will shade 75% or more of the vineyard floor during midday, and the seasonal evapotranspiration is about 26 inches.

Water use by grapevines begins with budbreak in early April. It gradually increases as the canopy develops and temperatures climb. The canopy is fully developed by early to mid-June, and peak water use occurs in June, July, and August. The effect of irrigation on vine growth

and fruit development is best discussed by dividing the season into four stages.

Stage I covers the period from budbreak to bloom (April 1 to May 10). The water requirement during this stage is low, with about 2½ inches evapotranspired during the 40-day period. Soil moisture stored from winter rains is usually adequate to meet evapotranspiration requirements during this stage. Even with no spring irrigation, grapevines rarely exhibit symptoms of water stress during stage I. The exceptions are vineyards on very sandy or shallow soils with limited soil water storage or vineyards with covercrops. Irrigations occur during stage I for frost protection. The danger of frost is high until mid-April, after which the probability of frost diminishes rapidly.

Stage II covers the period from bloom to veraison. Veraison is the point when fruit begins to soften or break color, and veraison is in late June or early July for most varieties. Grapevines use 6 to 8 inches of water during this stage (May 10 to July 1). Proper water management is critical during stage II. Rapid cell division is occurring in fruit, and water stress can reduce berry size and yields. Many table grape varieties are girdled at berry set, approximately two weeks after full bloom. Three to four weeks are required for the girdle to heal, and the vines are susceptible to water stress while the girdle is open. The fruit of Thompson Seedless, Calmeria, Red Globe, and Fantasy Seedless and other varieties are susceptible to sunburn during stage II, and water stress should be avoided.

Stage III, the ripening phase, covers the period from veraison to harvest. Veraison occurs from late June to early July, but harvest varies from July to November depending on variety. Thompson Seedless, when harvesting in early September, evapotranspires 8 to 11 inches during the 60 days it is in stage III. Table grape varieties should be irrigated sufficiently to avoid stress and maximize berry size. Mild water stress may be beneficial for table varieties prone to berry cracking and bunch rot. Raisin growers generally quit irrigating two to five weeks prior to harvest, depending on how sandy the soil, to allow time for terrace preparation. Drip irrigated raisin vineyards may be irrigated closer to harvest. Irrigations are cut back to impose moderate stress to wine grape vineyards prone to bunch rot during stage III. Excessive irrigation during stage III can delay fruit maturity, encourage bunch rot and berry cracking, and delay or reduce wood maturity. Excessive water stress during stage III can reduce berry size, color, maturity, and yield.

Stage IV is the postharvest period that concludes with dormancy in early November. The length of stage IV depends on harvest date. Stage IV is about a 60-day period for Thompson Seedless harvested early September, and the water use is 4 to 5 inches. During stage IV irrigations should be applied in amounts to maintain the canopy but not encourage growth. Vines of vigorous varieties will continue to grow or start new growth after

harvest and fail to ripen wood if supplied with readily available water. Mild to moderate water stress irrigation is recommended to replenish some of the soil water reservoir and satisfy the leaching requirement. Vines entering dormancy with a dry root zone tend to have poorer budbreak the following spring.

Table 1 shows the water requirement for a Thompson Seedless table and raisin vineyard during the four stages of vine and fruit development described above. Tables 2 and 3 give seasonal water requirements on a daily basis for a small canopy and large canopy vineyard, respectively.

Symptoms of water stress in vineyards are usually not observed in the San Joaquin Valley until mid-May or early June. The first sign of water stress is a decrease in the angle formed by the axis of the leaf petiole and the plane of the leaf blade. As water stress increases, shoot growth slows and internode growth is inhibited. As water stress becomes more acute, the shoot tips and shoot tendrils die. Finally, in extreme water stress leaf abscission occurs, originating with the most mature leaves and progressing towards the shoot tip. Extreme water stress is usually not seen in the San Joaquin Valley until late June or early July. Severe water stress can result in delayed and poor budbreak the following spring, and flower clusters are smaller and reduced in number.

Table 1. Approximate water use for a raisin vineyard during four seasonal irrigation stages¹

| Irrigation Stage | Phenological events | Approximate dates | Days in irrigation stage | Vineyard water use during irrigation stage (inches/acre) ² | |
|--|----------------------|-------------------|--------------------------|---|--------------|
| | | | | Small Canopy | Large Canopy |
| Stage I ³ | Budbreak to bloom | April 1 to May 10 | 40 | 2.0 | 2.5 |
| Stage II ⁴ | Budbreak to veraison | May 10 to July 1 | 51 | 5.6 | 7.5 |
| Stage III ⁵ | Veraison to harvest | July 1 to Sept 1 | 62 | 8.0 | 10.7 |
| Stage IV ⁶ | Harvest to leaf fall | Sept 1 to Nov 1 | 61 | 3.8 | 5.1 |
| Total vineyard water use for season | | | | 19.4 | 25.8 |

¹Based on Thompson Seedless.

²To convert inches per acre to millimeters, multiply by 25.4.

³Water requirements during irrigation stage one is supplied primarily by soil moisture stored from winter rains (except for vineyards on very sandy or shallow soils). It is difficult to stress vines during this stage. You may be able to help improve berry set by withholding irrigations.

⁴Do not stress vines during irrigation stage two: cell division and berry growth are occurring during this period and the fruit is very susceptible to sunburn.

⁵Deficit irrigation during irrigation stage three (50 to 75% of ET) will be minimal or no effect on yield. Excessive irrigation can increase rot and delay fruit maturation.

⁶Apply enough water to maintain canopy during irrigation stage four. Avoid excessive growth or premature defoliation.

Table 2. Vine water use (drip irrigation schedule) for a small canopy vineyard or one using a single-wire trellis system in the San Joaquin Valley¹

| Date | | Gallons per acre per day ² | Date | | Gallons per acre per day ² |
|-------|-------|---------------------------------------|-----------|-------|---------------------------------------|
| April | 1-7 | 500 | July | 1-7 | 3,550 |
| | 8-14 | 750 | | 8-14 | 3,700 |
| | 15-21 | 1,000 | | 15-21 | 3,800 |
| | 22-30 | 1,200 | | 22-30 | 3,750 |
| May | 1-7 | 1,550 | August | 1-7 | 3,650 |
| | 8-14 | 1,800 | | 8-14 | 3,550 |
| | 15-21 | 2,050 | | 15-21 | 3,400 |
| | 22-31 | 2,300 | | 22-31 | 3,300 |
| June | 1-7 | 2,650 | September | 1-7 | 3,100 |
| | 8-14 | 2,900 | | 8-14 | 2,850 |
| | 15-21 | 3,200 | | 15-21 | 2,650 |
| | 22-30 | 3,350 | | 22-30 | 2,400 |

¹Vineyard canopy covers 50% to 60% of the land surface during summer months. When used to schedule drip irrigation, amounts must be increased according to the efficiency of the drip irrigation.

²Divide values by number of vines per acre to determine gallons per vine per day. Divide values by 27,154 to calculate inches per day. Multiply values by 9.35 to calculate liters per hectare.

Table 3. Vine water use (drip irrigation schedule) for a large canopy vineyard or one using a trellis with a crossarm¹

| Date | | Gallons per acre per day ² | Date | | Gallons per acre per day ² |
|-------|-------|---------------------------------------|-----------|-------|---------------------------------------|
| April | 1-7 | 700 | July | 1-7 | 4,700 |
| | 8-14 | 1,000 | | 8-14 | 4,900 |
| | 15-21 | 1,300 | | 15-21 | 5,050 |
| | 22-30 | 1,650 | | 22-30 | 5,000 |
| May | 1-7 | 2,050 | August | 1-7 | 4,900 |
| | 8-14 | 2,400 | | 8-14 | 4,800 |
| | 15-21 | 2,700 | | 15-21 | 4,550 |
| | 22-31 | 3,100 | | 22-31 | 4,400 |
| June | 1-7 | 3,550 | September | 1-7 | 4,100 |
| | 8-14 | 3,900 | | 8-14 | 3,800 |
| | 15-21 | 4,250 | | 15-21 | 3,500 |
| | 22-30 | 4,500 | | 22-30 | 3,200 |

¹Vineyard canopy covers 75% or more of the land surface during summer months. When used to schedule drip irrigation, amounts must be increased according to the efficiency of the drip irrigation.

²Divide values by number of vines per acre to determine gallons per vine per day. Divide values by 27,154 to calculate inches per day. Multiply values by 9.35 to calculate liters per hectare.