

## Merlot Response to Sprinkler vs Drip Irrigation and Cluster Thinning

It is well known that water stress can be harmful to grapevines and fruit quality, but recent research has shown that mild water stress can improve fruit quality for wine making. As a result, regulated deficit irrigation (RDI) is being widely adopted to cause and control vine water stress. Their adoption is not straight forward, however, because vineyards differ in climate, soil, vine vigor and crop load, all of which can affect vine water status. Recommended methods for implementing deficit irrigation differ in seasonal timing, and in the frequency, volume and spatial distribution of water applied, and little information is available to guide growers on which methods will work best under their vineyard conditions. The goal of our irrigation research is to characterize the interactions among irrigation practices, soil texture, vine vigor and crop load that affect fruit quality for wine making.

Currently most Okanagan vineyards use sprinklers for irrigation because the systems are in place for frost control and experience has taught growers how to manage sprinkler irrigation to produce quality wine grapes. Although drip irrigation conserves substantial water and provides better control for imposing water deficits, conversion from sprinkler to drip irrigation may be risky in an environment with relative humidity levels as low as 15% and mid-summer temperatures that commonly reach 35 C. Root systems that have established under sprinkler irrigation may not respond well initially to the confined spatial distribution of moisture provided by a drip system.

We investigated how vines differ physiologically in response to sprinkler and drip irrigation by studying how leaf function, including stomatal conductance and photosynthesis, is affected by the amount and spatial distribution of moisture in coarse- and fine-textured soils. An experiment was conducted with Merlot vines growing on loamy sand at Sunrock Vinyard near Osoyoos. A factorial combination of irrigation and cluster thinning treatments was applied in a split-plot design with irrigation treatments (sprinkler and drip) each applied to four 10-row x 30-vine main plots, and cluster thinning treatments (with and without) each applied to two two-vine subplots within each main plot. The drip-irrigated plots had been established by conversion from sprinkler irrigation in 2002.

Soil moisture was monitored at 15 cm increments to a depth of 60 cm using segmented time domain reflectometry (TDR) probes (ESI, Victoria, B.C.) inserted 10 cm from emitters and 25 cm from vine trunks. Irrigation was applied when the average moisture level at 15-45 cm depth was depleted to 10%, and to wet the profile to a depth of *ca.* 45-50 cm. Sprinkler irrigation wet the soil profile through the entire vineyard surface while the drip emitters, spaced at 40 cm, wet 50-cm-wide *ca.* spherical volumes which coalesced in the vine rows. Under this regime, drip irrigations were applied more frequently than sprinkler irrigations (31 times vs 23 times in 2003, and 21 vs 18 times in 2004) but the total amount of water applied was 2.7 times more under sprinkler irrigation than under drip irrigation.

All vines were shoot thinned in May to retain 20 shoots. Cluster thinning was applied pre-veraison when berries were pea-sized, and removed the smaller cluster from shoots bearing two clusters.

Growing degree days (GDD, base 10°C) were calculated from temperatures monitored using shielded thermistors at mid-canopy height in main plots. Shoot lengths were measured in mid-July. Canopy gap area (%), viewed from between rows, was estimated pre- and post-veraison. Leaf gas exchange was measured several times during the growing seasons using a portable system (Li-Cor 6400). Berries were sampled periodically for °Brix, pH and titratable acidity (TA) measurements. Fruit was harvested when mature, based primarily on °Brix level.

Leaf function declined sooner after drip than sprinkler irrigation applications, indicating that the root systems of the drip-irrigated vines were less extensive and accessed less moisture than roots of the sprinkler-irrigated vines. Regardless of the level of moisture in the soil, stomatal conductance and photosynthesis rates were more often lower under drip than sprinkler irrigation during mid- to late-summer. This reduction in leaf function was similar to that reported for vines under partial root-zone drying (PRD) which have their root systems divided between drying and moist soil. The drip-irrigated vines also had shorter shoots and canopies with more gap areas indicating lower leaf densities. These findings indicate that much less sugar is produced by canopies of vines under drip than sprinkler irrigation.

Fruit development differed between drip- and sprinkler-irrigated vines. Drip-irrigated vines produced fruit of lower acidity, and despite having less-productive canopies they matured their fruit about 2 weeks earlier in 2003 and 9 days early in 2004 than did sprinkler-irrigated vines. The smaller berries (1.2 g vs 1.5 g in 2003, and 1.5 g vs 1.6 g in 2004), smaller clusters in 2004 (121 g vs 158 g), and lower yields (2.0 kg vs 3.4 kg in 2003, and 3.3 kg vs 4.1 kg in 2004) carried by the drip-irrigated vines may have contributed to the advanced maturation. However, when drip- and sprinkler-irrigated vines carrying similar yields were compared, the fruit of drip-irrigated vines matured earlier and had lower acidity at harvest. The accelerated fruit maturation was likely influenced by the warmer maximum (mid-day) ambient temperatures in drip-irrigated plots during July and August that increased GDD accumulations by 117 GDD in 2003 and 73 GDD in 2004 relative to in sprinkler-irrigated plots. Ambient temperatures in sprinkler-irrigated plots were probably lowered by the higher vine leaf area and transpiration rates and the heavier vegetation coverage on the vineyard floor. Regardless of irrigation method, fruit matured at *ca.* 1,500 GDD in 2003 and *ca.* 1,480 GDD in 2004. The lower acidity resulting from maturation under warmer temperatures necessitated harvesting the fruit earlier than was desirable for hang time.

Cluster thinning reduced cluster numbers by 40% in 2003 and by 45% in 2004, and there was no compensatory increase in berry size in either year. Cluster thinning had no effect on basic fruit composition in 2003, but in 2004 it advanced fruit maturation, reducing juice acidity and increasing juice pH.

We found that drip-irrigated vines differ fundamentally from sprinkler-irrigated vines in their development and physiology. Effects of drip versus sprinkler irrigation on fruit development and maturation involve not only changes in vine water relations and yield components but also alterations in vineyard microclimate. This study is continuing through 2005.