OSU Wine and Grape Research and Extension Newsletter

Octobedr 2008 http://wine.oregonstate.edu

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Welcome to the October 2008 Newsletter!

As the 2008 growing season comes to a close, we prepared this newsletter to provide information on several research projects conducted by OSU faculty and students, address frost concerns from this fall, and showcase the OSU Viticulture & Enology undergraduate program alumni. Dr. Marcus Buchanan has a synopsis of an irrigation trial he has conducted with producers in southern Oregon during the 2008 season. For those of you interested in enology, check out Dr. James Osborne's article about sunlight and temperature on fruit quality. The early frosts put ripening to a halt for some vineyards, and you can learn more about the impacts of frost from Dr. Patty Skinkis' article. Finally, we are showcasing the OSU Enology & Viticulture undergraduate program by featuring a recent graduate of the program. Be sure to check out the insert on new resources available to grape growers and the upcoming events offered by OSU Viticulture & Enology Extension.

Cheers,

~The OSU Winegrape Team

Implications of Fall Frosts in Vineyards

Patty Skinkis, Ph.D., Viticulture Extension Specialist

During harvest, the aim is to allow extra "hang time" when the berries accumulate a larger reservoir of aroma, flavor and texture compounds that define fruit and wine quality. However, this concept of letting fruit ripen to its peak in quality can be obstructed by several factors including rain, cold weather, and frost.

During Oct 10-12, many areas of the state experienced a frost with temperatures reported between 26 and 28°F, including areas of eastern and southern Oregon as well as the Willamette Valley. Active tissues (fleshy and green) such as leaves and fruit are susceptible to freezing temperatures, particularly at temperatures lower than 28°F. The canopy leaves are most susceptible due to the lower sugar content in comparison to the fruit. Cells that comprise the tissues are killed by temperatures at or below 28°F. Once these cells are damaged or killed, they no longer can carry out their biochemical function such as photosynthetic production to provide sugar to the fruit.

The link between vine canopy and fruit is important to the understanding of vine function during ripening. The leaves serve as the workhorse throughout the season, producing carbohydrates through photosynthesis and transporting them to areas of the vine that are in need. Early in the season, the shoot tips require the most carbohydrates and can pull it from reserves and later from photosynthetic leaves. The fruit, which is developing at the same time, must struggle for the carbohydrates. Once the vine shifts from canopy development to fruit development after bloom, the fruit becomes the primary recipient of carbohydrates. However, during this whole time of canopy and fruit development, excess

Figure 1. Frost damage on a Pinot noir leaf (left) and results of frost damage after a few days (right).

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carbohydrates go into storage for the following season. By the time véraison occurs, the vine canopy has stopped growing and demanding carbohydrates; however, they are still actively producing carbohydrates at a reduced rate as compared to the earlier part of the growing season. By the time the vine reaches the ripening phase, the outer epidermis (skin of the stem) begins to lignify (turn brown and harden) which is a sure sign that the vines are beginning to "harden off" or prepare for winter dormancy. It is during this time that there is the threat of the first killing fall frost.

When a fall frost occurs and damages most of the leaf tissues in the canopy, the fruit will not be able to ripen further. Leaves will turn a black-brown color (Figure 1) and may have a water logged appearance due to the cells rupturing. After a few days, the leaves will dry up and eventually fall. During this time, there is no re-harvesting of nutrients or carbohydrates available from photosynthesis for the fruit. The fruit will not mature any further without a canopy as they are not climacteric fruit and thus do not continue ripening on their own, like a banana or pear. It is then time to harvest or the fruit may fall victim to birds and prey.

Figure 2. This year's shoot and grape pedicel (cluster stem) has lignified, indicating the vine has hardened off for winter and most basal buds on the shoot are in dormancy at this time.

When a late season frost occurs, most buds for next season should survive as they are already in dormancy (Figure 2). However, there is a progression of dormancy of the buds along the shoot with the more distal buds on the shoot being less dormant or winter hardy than the basal or proximal buds. Therefore, with these late season frosts, the most distal buds are likely to be damaged. During fall and winter, the vine wood and buds continue to develop a higher level of dormancy and they can withstand colder temperatures, but at this point, temperatures of 26-28°F should not have done catastrophic damage. In some cases, vineyards may not be hardened off by this frost event. These situations usually arise with young vineyards that may have been planted late or those that were fertilized late summer, providing a second flush of growth. This must be avoided to allow for survival of these fall frosts and for winter hardiness.

Protection against frost is important early and late in the season. Spring frosts are far more damaging to the productivity and health of the vineyard. However, one must consider frost protection at both times. This can be achieved with wind machines, overhead irrigation and a weather station. A weather station will provide the current vineyard temperatures and allow implementation of a protection strategy, either wind or water. The type of frost, intensity and duration of the frost event are important to consider as some of these protection methods may not be able to protect the vine in all situations. Cryoprotectants and inhibitors of ice nucleating bacteria in combination with overhead irrigation have been evaluated for many crops to kill bacteria that cause ice formation on plant tissues and decrease the freezing point, thereby offering better frost protection. However, these have proven impractical and ineffective in a trial with Pinot noir in Oregon (Gardea et al. 1993, Gardea 1988) where commercially available *Frostgard* only reduced the freezing temperature about 1°C. If you have a vineyard in an area that consistently experiences either spring or fall frosts that damage new shoot tips or ripening vines, respectively, then a frost protection plan is vital.

Not all varieties respond to frost equally. If you see patterns of damage that are not explained by the topography, it may be due to differences in cultivar susceptibility. Some cultivars are more tolerant due to internal, physiological differences in such compounds as biosynthesized or accumulated osmoticants, such as betaines; however these have been noticed to change with the seasons (Mikelbart et al. 2006). Others may have a shorter duration from bloom to harvest, allowing them to ripen and harden off earlier. In either case, it is important to note both cultivar susceptibility and topography for frost damage in your vineyard to make changes in future years.

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ET-based Guidelines for Vineyard Irrigation Scheduling in Southern Oregon

Marcus Buchanan, Ph.D., Viticulture Advisor
Southern OR Research and Extension Center

It's the climate!

The Southern Oregon region, comprising the Umpqua, Rogue, and, Applegate AVAs, is climatically characterized as distinctly warmer and drier than much of Oregon. Average rainfall ranges from 18 to 60 inches and growing degree days between 2200 to slightly above 3000. Variations in climate, topography, soil type, and vine canopy density require site specific irrigation management approaches. Climate controls both the supply (rainfall) and vine water requirement (evapotranspiration, ET). Soil texture and depth affect the amount of plant available water. Vine canopies, as influenced by phenology, vigor, vine spacing, variety and rootstock, trellis type and canopy management (e.g. thinning, hedging) also influence water demand.

In Southern Oregon most, but not all vineyards are irrigated. Problems with irrigation management and scheduling may contribute to poor vine balance, excessive or poor vigor, decreased berry set, early berry dehydration, nutritional imbalances, and inconsistent yield and quality. Many growers have expressed low or inconsistent confidence in their irrigation management practices and have a desire to gain familiarity and experience with the capabilities, value, advantages and disadvantages of soil moisture monitoring systems. In spring 2008 the Oregon Wine Board awarded funds to support a monitoring and evaluation program for the region. The primary project objectives are to:

- Establish a vineyard network in Jackson, Josephine, and Douglas Counties to represent the range of regional mesoclimates, soil types, and irrigation systems.
- Install and calibrate recording atmometers in vineyards to estimate daily evapotranspiration. Contrast individual site and reference network average full ET estimates obtained at grower sites with that recorded at the Medford AgriMet station.
- Demonstrate to growers the use and interpretation of two soil moisture monitoring technologies (resistance and capacitance). Utilize soil monitoring to determine effective rooting depth, seasonal and depth changes in potential vine available water and, evaluate and improve grower irrigation practice.
- Provide training and regular feedback to grower cooperators and improve their ability to use and interpret ET, canopy cover, and soil water status monitoring.
- Analyze and interpret data to refine a 'user-friendly' ET-based irrigation scheduler that can be adapted to specific vineyard sites with drip or sprinkler systems. Provide individual and group training on the components and use of this tool to improve implementation of grower irrigation strategies.

Southern Oregon growers are well aware of the concept and positive outcomes of controlled water stress on grape quality. Many growers aim to practice some form of deficit irrigation. Regulated deficit irrigation (RDI), has become widely accepted as a method to improve winegrape quality in the last ten years. By imposing a pre-determined, measurable level of water stress at a particular stage of vine growth, it is possible to manipulate berry quality parameters. However, there is less confidence and experience among growers about how to implement and monitor the strategy and practice of RDI. A critical aspect of any successful RDI program is monitoring soil or vine water status to determine when to irrigate.

What is ET-based Irrigation Scheduling?

Daily or seasonal water requirements for vines vary due to fluctuations in weather and canopy size (sic. leaf area). Daily or seasonal ET (inches) is affected by air temperature, humidity, solar intensity, day length, and wind speed. In recent years it has been shown that the percentage of the vineyard floor shaded by the canopy at mid-day (shaded ground x 0.017 = Kc) can substitute for leaf area index measurements to determine a vine crop coefficient.

This crop coefficient is used to adjust full reference ET (ETo or ETr) for determining vine water requirement (ETo x Kc = ETcrop). Irrigation timing and quantity should account for the depth and distribution of root systems, as influenced by the interaction of rootstocks and soil properties, the influence of floor vegetation, and the type of irrigation systems, sprinkler, drip, or hybrid. If a grower knows how much water is delivered by the irrigation system on an acre basis and has a strategy target (e.g. deficit = 65 percent of ETcrop), then a real-time quantitative irrigation schedule can be implemented.

Effective irrigation management integrates strategy, scheduling,

and monitoring. A grower's yield and/or quality goals, as well as, characteristics of the vineyard site and irrigation systems will shape what irrigation strategy can be implemented.

Progress in 2008

Calibration with AgriMet weather station - A commercially produced recording atmometer (product name ET*gage*) was installed adjacent to the AgriMet station located at the Research Center in early April 2008 prior to bud break. The ET*gage* atmometer has been validated to have significant correlation with weather station derived full ET estimates. It is essential to verify correlations to maximize the reliability of the ET*gage* instrument. Thus far, I have confirmed a very strong and predictable relationship between the ETgage and station. The largest deviations have occurred on rainy days (lower than AgriMet) and on summer days with high late evening temperatures and low humidity (higher than AgriMet).

Reference vineyards - Six collaborating vineyards are participating in the first year of the project. Beginning in late July through early September an ET*gage* was installed and linked to a data logger.

Soil moisture monitoring - Two systems employing different sensor technologies, resistance (soil moisture tension) vs. capacitance (volumetric moisture) are being installed for demonstration, data collection, and evaluation. A Watermark system (resistance) with programmable data logger has been installed in each vineyard to continuously record soil moisture fluctuations within the irrigation zone (drip and sprinkler). Later this fall, Aquapro (capacitance) access tubes will be installed in the same station areas, but in different vine- and inter-row locations: in the row mid-way between emitters, one-quarter distance away from vine row and, in the middle inter-row location.

Grower interactions - After confirming that installed devices were functioning properly, I have been able to provide some initial feedback to collaborators regarding scheduling despite having only very limited observations and data. In this preliminary phase, I have used a modified Excel-based irrigation scheduling model that integrates ETo, canopy cover (or ETcrop), rooting depth, soil plant available water capacity and moisture depletion target, row spacing, system flow rate. The model predicts crop water requirement, maximum irrigation interval (as determined by grower determined depletion 'trigger'), and optimal system run time based on flow rate for drip, sprinkler, and hybrid irrigation systems. In some vineyards I have found that vines may have been under-irrigated at the onset of veraison. This was determined by soil moisture monitoring that indicated, despite frequent weekly irrigation sets, that only the upper portion of the root zone was being re-wetted due to insufficient irrigation duration. These observations have provided a basis for some initial 'experimental' changes in irrigation intervals and/or the total runtime for irrigation sets.

What's the Plan for 2009?

The 2009 will be the first full season for the project with the following objectives:

- In Winter 2009, provide a summary of 2008 progress as part of an irrigation program offered to growers and meet with collaborators to develop a work plan and confirm their irrigation strategy for 2009. With regular vineyard meetings during the 2009 season, we will improve our integration of ET-based scheduling and soil moisture monitoring for irrigation scheduling.
- Measure crop canopy development on at least a bi-weekly basis at each vineyard to model early and mid-season water demand. The vine models will be compared to other models developed in Washington and California to estimate the appropriate time to initiate irrigation and improve scheduling decisions after the initiation of irrigation.
- Each grower collaborator will be required to maintain accurate irrigation records. Each irrigation system in the reference blocks will be evaluated for flow rate and distribution uniformity (DU).
- A preliminary irrigation scheduling 'decision matrix' will be developed that will allow each collaborator to use weekly averages of ET for their site to adjust scheduling. During the latter portions of the 2009 season further refine and confirm irrigation scheduling models.
- Provide each cooperator with a post-harvest summary report. Meet to discuss what we have learned and review grower observations of vine development, yield and quality.

If the project receives funding for additional years, I plan to expand the number of collaborating vineyards, both working one-to-one and providing presentations to grower groups in the region. Grower experience and the availability of recording ET instrumentation will provide a sound basis for potential irrigation research projects that assess the relationship of specific deficit irrigation strategies to grape quality. Ultimately it is my hope to incorporate the data and experiences into a published irrigation guide and possibly an online irrigation scheduler tailored for the Southern Oregon region.

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Current Enology Research at OSU – A focus on the Kennedy lab

James Osborne, Ph.D., Enology Extension Specialist
Seth Cohen, PhD candidate

Some recent studies undertaken in the lab of Dr. Jim Kennedy have shed new light on the specific effects of sunlight exposure and temperature on the development of the grape berry, and in particular the accumulation of phenolic compounds. A recently completed study investigated the changes in flavonoid compounds in Pinot noir in shaded and exposed treatments. The study showed that cluster exposure can change the accumulation and composition of important phenolic compounds. Cluster shading resulted in a substantial decrease in the accumulation of flavonols and skin proanthocyanins (believed to provide an improved mouthfeel in wines as compared to seed-derived proanthocyanins) and minimal differences in anthocyanins. Seed proanthocyanin accumulation rapidly increase 1-2 weeks after veraison followed by a decline leading to harvest and was not significantly influenced by cluster exposure. It is thought that changes in the production of flavonoids are in response to exposure to UV. Although results showed no statistically significant difference in the total amount of anthocyanins in shaded and exposed treatments, there were significant differences in the proportions of the various anthocyanins. However, there was some discussion about whether the results were due primarily to differences in cluster exposure or whether instead, changes in temperature caused by the varying levels of cluster exposure were responsible.

Figure 1. Forced air delivery tubes used for heating or cooling individual clusters

In response, a new study was undertaken by Seth Cohen, a PhD student in Dr. Kennedy's lab, to investigate the specific effects of temperature on grape berry development and composition. The study assessed the impact of fruit temperature on the phenological development and phenolic metabolism of grape berries (*Vitis vinifera* L. cv. Merlot) grown under field conditions. The key to the study was isolating the effects of temperature from those of sunlight exposure. An experimental set-up was designed utilizing a device developed by Dr. Julie Tarara, a scientist with USDA-ARS in Prosserr, WA. These devices blow hot or cool air onto individual clusters (see Figure 1) allowing for the manipulation of individual cluster temperatures (+/- 8°C) while controlling for exposure to sunlight.

Clusters were either cooled during the day, warmed during the night, or heated and cooled in combination in order to dampen the diurnal temperature fluctuation. In-situ berry temperatures were collected for detailed analysis of temperature profiles. Samples were collected at véraison and harvest and assessed for physiological and compositional differences. Chemical analysis included quantification of anthocyanins, flavonols, flavan-3-ol monomers and proanthocyanidins (tannins). Metabolites showed variable responses to treatments and timing of treatments. In 2006 and 2007 dampening diurnal temperature range hastened berry ripening as seen by an increase in soluble solids, berry weight and coloration when compared to the other treatments. In particular, anthocyanin accumulation was hastened by dampening. Pre-véraison skin tannin accumulation was positively correlated to heat summation in 2006 and there were consistent shifts in tannin composition due to the various treatments in 2006 and 2007. Post véraison differences manifested as alteration in composition of tannins, anthocyanins and flavonols in the skins of berries. There were minimal differences in seed tannins as a result of treatments imposed in the two years. In summary, this study showed that diurnal dampening hastened berry ripening, and in particular anthocyanin accumulation. Future work will include closely monitoring proanthocyanidins up to veraison and investigating specific gene expression changes within the berry in response to temperature changes.

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Cohen, S.D., Tarara, J.M. and Kennedy, J.A. 2008. Assessing the impact of temperature on grape phenolic metabolism. Analytica Chimica Acta, 621: 57-67.

OSU V&E Student Alumni Spotlight: Bryan Weil

Sunny Lucas, Viticulture Research Assistant

When Bryan Weil began taking classes as an electrical engineering major in 2000, he would not have predicted that eight years later he'd be tasting wine 50 times a day as part of his job. In June, Bryan started a job as a production enologist at Hogue Cellars, the

second largest winery in Washington. As a production enologist, Bryan evaluates the wine inventory weekly, ensures that standard operating procedures (SOPs) are being followed in the cellars, places work orders for moving wine, and coordinates bottle preparation. Bryan will likely hold this position through two vintages, at which time he will be promoted to assistant winemaker. In February, Constellation (Hogue Cellars' parent company) is sending him to work in a winery in New Zealand for 2-3 months as a vintage assistant. Bryan became qualified for this great opportunity through a series of occupational and educational experiences.

Bryan discovered his calling during his two years in the culinary arts program at Linn-Benton Community College. It was there he took his first wine and food pairing class. While at Linn-Benton, he also worked in Dayton at the Joel Palmer House, as a wine steward, and in the tasting room at Domaine Serene. With a passion for food and wine, Bryan decided to pursue a career in winemaking. In order to become a winemaker, he was encouraged by those at Domaine Serene to get a bachelor's degree. So after his experience in the culinary arts, Bryan enrolled in the Food Science & Technology Department at OSU, majoring in enology and viticulture.

Bryan graduated from OSU in June 2008. He has nothing but positive things to say about the Viticulture and Enology (V&E) program. He found himself in a tight knit family, "They take you in… professors, students, office staff, everybody. Each person had something special to give to the program. There was a real passion about the industry."

One of the most worthwhile experiences Bryan had while at OSU was interning at Tyee Wine Cellars in Corvallis. Because Tyee is relatively small, producing 2000 cases annually, Bryan experienced various parts of the industry, from the vineyard to the cellar to the tasting room. Being able to relate what you are learning in school to your job was invaluable, "You can ask your professors practical questions, like 'why was I doing this at my job?'." The enology program was also flexible, and allowed for creativity. Bryan and five other OSU students made eight barrels of Pinot noir as an independent project.

Life in Washington is busy so far. While Bryan misses the friends and football of Corvallis, he's enjoying the opportunity and challenges at Hogue, a winery that produces 600,000 cases of wine annually. Also, working for the largest wine company in the world allows room for a lot of professional growth. When asked about the future, Bryan expressed possible interest in graduate school, or eventually being able to combine his culinary and winemaking passions in a winery/restaurant or catering business. But for now, he is concentrating on excelling at Hogue. And of course, he's drinking wine. His current favorite is Washington Malbec.

Oregon Industry Surveys

Please participate in the following industry surveys presented by OSU:

Cover Cropping in Vineyards - We are asking all vineyards, large and small, throughout the state of Oregon to participate in a survey on cover crops. This short survey will be used to identify further research and extension educational goals based on industry practices. Click here to take the survey online.

Mites & Short Shoot Syndrome in Vineyards - All vineyards throughout Oregon are asked to complete a short survey on the 2008 season regarding mites and "short shoot syndrome." Also, still available is the 2007 survey that investigates vineyard practices that may relate to this problem. Whether you have experienced this in your vineyard or not, we encourage all industry to take this survey. Click here for the 2008 version; click here for the 2007 version.

Upcoming Educational Opportunities and Events

Northwest Center for Small Fruits Research Annual Conference – December 2008 - The NCSFR Annual conference will be held in Corvallis on December 4-5, 2008. Seminars will be presented on research from areas including viticulture and small fruits. We encourage industry members to attend to learn more about important research conducted in the Pacific Northwest. For more information and registration, see http://www.nwsmallfruits.org/conference.html.

Viticulture Lecture Series Distance Education – Winter 2009 - Dr. Patty Skinkis, Viticulture Extension Specialist will be offering a vine physiology course to industry practitioners and the public interested in viticulture across the state of Oregon. Lectures will be held January 6 – March 12, 2009. This series will explain whole vine physiology and how it relates to practical management. For more information and registration, see the following link: http://hort.oregonstate.edu/ViticultureWorkshops.

Oregon Wine Industry Symposium – February 2009 - Mark your calendars now for the upcoming industry symposium on February 23-25, 2009 to be held in Eugene, OR. For more information on the seminars and programs, see http://symposium.oregonwine.org/symposium.php.