November 2012

Oregon Wine Research Institute

Viticulture & Enology Technical Newsletter

Welcome to the November 2012 Newsletter

This issue is packed with new information from various research trials conducted here in Oregon, whether it is from vineyard plots, the wine lab, or the growth chamber, results are likely to have impact on vineyard and winery production here in Oregon. James Osborne, Enology Extension Specialist, opens this month's newsletter with an article about methods for successful malolactic fermentation. Patty Skinkis, Extension Viticulture Specialist, provides an article summarizing various factors relating to fruitfulness and vine balance. Of particular notice this month is the invited article by Melodie Putnam, director of the OSU Plant Clinic. Her article is an update on trunk disease research, a very timely topic for Oregon vineyards given the rising concern. Vaughn Walton, horticultural entomologist, writes about several invasive pests that the OSU Entomology Team has been investigating over the past few years, including the Brown Marmorated Stink Bug and mealybugs. In this issue, we also introduce you to a new faculty member in enology, Elizabeth Tomasino, and provide an update from the OWRI interim director, Bill Boggess. We wrap up the newsletter with a list of new publications authored by researchers at the OWRI. Do not forget to check out the internship and upcoming events section for more ways you can be involved with the programs within the OWRI!

Cheers,

The OWRI Team

Time to start thinking about malolactic fermentation

Dr. James Osborne, Enology Extension Specialist, OSU

As primary fermentations are completing and wine starts to go to barrel, we start looking ahead to the next step in the process--the malolactic fermentation (MLF). While not all of your wines may undergo MLF, it is a vital step in the production of cool climate reds as well as some white wines. The MLF is performed by lactic acid bacteria, primarily *Oenococcus oeni,* and results in the conversion of malic acid to lactic acid. resulting in a decrease in acidity with a drop in pH of about 0.1 to 0.3 units. If malic acid concentrations are higher, this drop in acidity may be even more pronounced. This decrease in acidity is essential to the balance of wines produced from grapes grown in cool climates that contain high levels of malic acid. While MLF is an important part of the winemaking process, it can often be difficult to initiate and control. This may mean large delays as you wait for the MLF to complete, leaving wine prone to spoilage as you are unable to protect your wine with SO_2 until the MLF is finished. However, there are a number of steps you can take to increase the likelihood of a successful MLF.

Managing the MLF begins at the start of the winemaking process. Ensuring you have clean fruit at the beginning will minimize the amount of SO_2 needed and will also minimize nutritional deficiency issues due to rot. When making SO_2 additions to the must prior to fermentation, you should generally add no more than 40 mg/L total for a white and a

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Contact Information

Patty Skinkis, Ph.D.

Viticulture Extension Specialist

Oregon State University

Dept. of Horticulture

541-737-1411

skinkisp@hort.oregonstate.edu

maximum 70 mg/L SO_2 for red if you desire the wine to go through MLF. Excessive SO_2 in the wine may inhibit the malolactic bacteria and may cause a stuck or sluggish MLF. While free SO_2 is the most antimicrobial form of SO_2 to consider, there is evidence that bound SO_2 can also be inhibitory to *O. oeni*. At SO_2 concentrations of less than 10 mg/L free and greater than 40 mg/L bound are suggested as favorable for MLF. However, keep in mind that the toxicity of SO_2 increases at lower pH (higher proportion of molecular SO_2), so low pH wines with excessive SO_2 will be more inhibitory to *O. oeni* than higher pH wines. Juice parameter such as Brix and pH will also impact the MLF further downstream. Optimal alcohol for the MLF is less than 13.5% while a pH between 3.20 and 3.50 is optimal. Below pH 3.0, the bacteria will struggle to grow. The bacteria will grow well at higher pH levels, but the conversion of malic acid to lactic acid is optimal below pH 4.0. However, the higher pHs also favor growth of spoilage lactic acid bacteria such as *Lactobacillus* and *Pediococcus*. Measuring malic acid levels in your juice is important in predicting the final pH range for your wine. If there is high malic acid in your juice, then loss of this acid due to MLF will cause a large increase in pH that may raise pH to unacceptable levels. In this situation, an acid addition may be necessary. Adjustments should be made prior to the alcoholic fermentation if possible. Do not adjust you pH with tartaric acid while the MLF is happening, as the bacteria are sensitive to changes in their environment while they are growing. Finally, yeast strain selection is also an important consideration. When using commercial yeast starter cultures, it is important to note (or ask the supplier) if the yeast strain is compatible with MLF. There are some yeast strains which should not be used if you wish to conduct a MLF as they have shown to inhibit *O. oeni*.

Temperature can be the dominant factor in determining whether the MLF will happen or not. Optimal temperature for the MLF is between 25 and 35˚C. Tolerance to cool temperatures is dependent on *O. oeni* strain, but most strains of *O. oeni* either cease to grow or grow very slowly below 15˚C. Some commercial ML strains have been selected or developed to tolerate lower temperatures, and you should consult with your supplier regarding cold tolerant strains. High temperatures may inhibit bacterial growth particularly in high alcohol wines. A general guideline to follow to avoid this inhibitory effect: if your wine alcohol content is less than 14.5% (v/v), then do not exceed 28˚C, but if your wine contains greater than 14.5% alcohol (v/v), do not exceed 23˚C. In addition, if you are dealing with high alcohol wine, use acclimatization steps for the culture before inoculating. A helpful guide can be found here: http://www.scottlab.com/uploads/documents/downloads/65/Standard%20Build-Up%2011-12-10.pdf. This process allows the bacteria to acclimatize to the wine conditions slowly before being inoculated.

While temperature, SO_2, and ethanol, are the major factors that will impact the success of a MLF, there are a number of other lesser known factors that can play a role in the success of your MLFs. For example, recent research has indicated that certain grape tannins can have a negative influence on *O. oeni*. Certain red cultivars, such as Merlot, can have more difficulty undergoing MLF due to this. Research is ongoing into this phenomenon, as the exact tannins and concentrations are still not well defined. Residual fungicides and pesticides can play a role in years when *Botrytis* incidence is high. Residues of systemic pesticides are particularly problematic. Addition of yeast hulls may help relieve this toxicity.

While the primary motivation for conducting MLF is to de-acidify the wine, the process impacts wine quality in a number of other ways. One of the well-documented impacts of MLF on wine sensory quality is the production of diacetyl. It is a by-product of citric acid metabolism and is best described as having a "movie popcorn" aroma and flavor. It can be objectionable at high concentrations (> 7 mg/L) but it may be desirable at lower concentrations depending on the wine and style. It's sensory threshold in wine ranges from 0.2 mg/L in Chardonnay to 2.8 mg/L in Cabernet Sauvignon. Diacetyl concentration in wines can be controlled to some extent. Some *O. oeni* strains are high producers of diacetyl while others are low producers. In addition, leaving wine on the lees after MLF and prior to SO_2 addition can result in reduced diacetyl as yeast and bacteria can re-metabolize it. Aerobic conditions also favor diactyl production. Aside from diacetyl, there is increasing evidence that *O. oeni* can produce certain esters in sufficient quantities to impact the sensory characteristics of a wine. Recent research is also demonstrating that the MLF may modify wine mouthfeel although the exact mechanism for this change is unknown.

The effect of MLF on wine quality and red wine color has been investigated by my lab. Results from our studies demonstrate that MLF can cause a loss in the color of red wines independent of pH change (Figure 1). The MLF resulted in a reduction in red color and polymeric pigment formation in Pinot noir and Merlot wines and a corresponding higher concentration of monomeric anthocyanins. Color loss was observed when alcoholic and malolactic fermentations were performed simultaneously and also when the MLF was conducted after the alcoholic fermentation. The reduced color in MLF wines was driven in part by the degradation of acetaldehyde by *O. oeni* which reduced formation of polymeric pigments. Delaying the MLF for up to six months resulted in wines containing similar polymeric pigment and monomeric anthocyanin concentrations as the control wine (Figure 2). This was likely due to acetaldehyde being present in the wine for a longer period of time allowing formation of acetaldehyde derived polymeric pigments. The downside of delaying MLF is that the wine is left unprotected for a longer period of time (no as SO_2 additions until MLF is complete) although keeping the wine at a low temperature during this period of time will help. Ongoing research is investigating alternative strategies to accelerate polymeric formation prior to MLF.

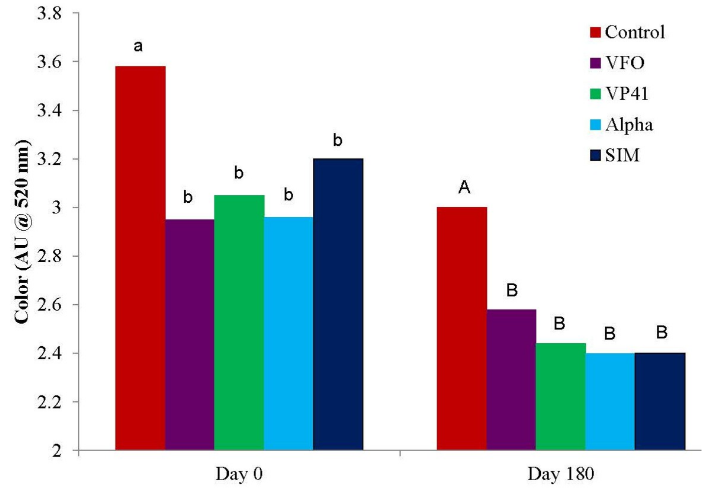
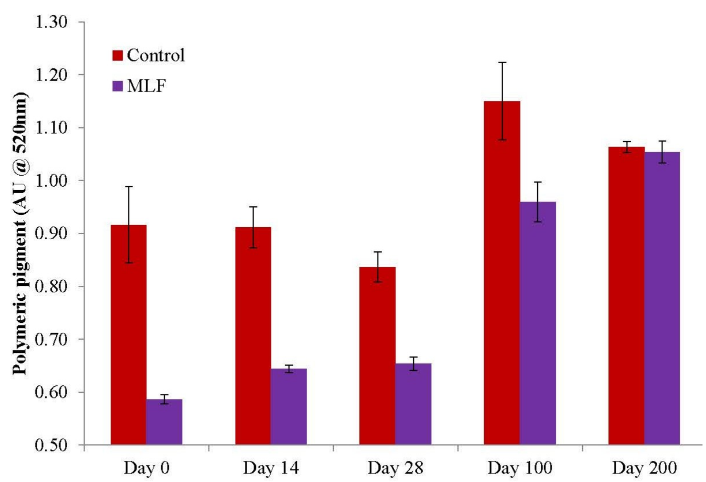


Figure 1. Color of Pinot noir wine that has undergone MLF conducted by various MLF strains (VFO, VP41, Alpha, simultaneous alcoholic and MLF) or wine that did not undergo MLF (control) at bottling (day 0) and after 180 days storage (13°C).

Figure 2. Polymeric pigment content of Pinot noir wines that did not undergo MLF (control) or underwent MLF after being delayed for a set period of time. Error bars represent ± one standard deviation (n=3).



References

Britz, T.J. and R.P. Tracey. 1990. The combination effect of pH, SO_2, ethanol and temperature on the growth of *Leuconostoc oenos*. J. Appl. Bact. 68: 23-31.

Lonvaud-Funel, A. 2010. "Effects of Malolactic Fermentation on Wine Quality" *In*: Understanding and Managing Wine Quality and Safety, Ed: A.G. Reynolds. Woodhead Publishing, UK. 60-92.

Liu, S.-Q. 2002. Malolactic fermentation in wine-beyond deacidification. J. Appl. Micro. 92: 589-601.

Nielsen, J. C. and M. Richelieu. 1999. Control of flavor development in wine during and after malolactic fermentation by *Oenococcus oeni*. App. Env. Micro. 65: 740-745.

Osborne, J.P. 2010. "The Timing of Malolactic Fermentation" *In*: Winemaking Problems Solved. Ed. C. Butzke. Woodhead Publishing, UK. 81-82

Osborne, J.P. and C.G. Edwards. 2005. Bacteria important during winemaking. Adv. Food Nut. Res. 50: 140-177.

Osborne, J.P. and C.G. Edwards. 2006. Inhibition of malolactic fermentation by *Saccharomyces cerevisiae* during the alcoholic fermentation under low- and high nitrogen conditions: a study in synthetic media. Aust. J. Grape Wine Res. 12: 69-78.

Wibowo, D., R. Eschenbruch, C.R. Davis, G.H. Fleet and TH. Lee. 1985. Occurrence and growth of lactic acid bacteria in wine: A review. Am. J. Enol. Vitic. 36: 302-312.

Secondary crop is the vine's rebellion for vine balance

Dr. Patty Skinkis, Viticulture Extension Specialist, OSU
Alison Reeve, Viticulture MS student, OSU

The concept of vine balance has often been discussed in the context of vineyard management and research. It is often assumed that balance is something that can be controlled to achieve quality. However, vines are biological beings with a will of their own. Vine balance often can only be managed, not controlled. This is evident when we consider the variability of fruit set and yield across seasons here in Oregon.

The 2012 growing season had variable fruit set across the state with some producers reporting reduced set at lower elevations due to rain that coincided with bloom. In addition, reduced set was reported at various locations based on instances of inflorescence necrosis and hail damage. Unfortunately, narrowing down one factor for which to blame all fruit set and yield issues on is neither fair nor possible, making management decisions difficult. Factors such as vine health status and environmental conditions are related. Based on the reported yields statewide from 1990 to 2011, there is a reduction in yield on an average of every four years (USDA-NASS 1990-2011). This could be influenced by several factors, but it is likely that these lower yield years coincide with incidences of reduced fruit set. Given that most vineyards across the state are managed to target yield levels at an average range of 2.0 and 3.0 T/A, one could question whether we should care about the amount of fruit that is set, especially if lower fruit set means reduced crop thinning costs. Nevertheless, having an adequate yield comes down to economic stability. For this reason, it is important to look at the various factors influencing yields.

Natural yield reduction can occur at the level of the shoot (number of clusters per shoot), cluster (number of flowers per inflorescence), or flower (poor pollination and fertilization). Based on research gathered over the past few years here in Oregon, we found that weather is only a small part of the story when it comes to baseline yields. Pinot noir has relatively low fruitfulness, defined as number of inflorescences per shoot. Based on data from various cane-pruned Pinot noir vineyards from 2008-2012, the average number of clusters per shoot is 1.6. It is rare to find a mean of 2 clusters per shoot across our Pinot noir trial vines in the Willamette Valley or southern Oregon. When fruitfulness data was analyzed based on crop level, vine nutrition, and overall vine vigor, we found that there was generally a decrease in fruitfulness with decreasing vine vigor and vine nitrogen (N) status. These studies involved vines of moderate to high vigor only. Conversely, other studies show that there can be reduced fruitfulness with very high vigor. Dry and Coombe (1994) associated reduced clusters per shoot in Shiraz to vine vigor. In such vines, they found primary bud necrosis that resulted in growth of the secondary bud. Secondary buds have fewer flower primordia and result in fewer clusters per shoot. From their work, Coombe and Dry found higher primary bud necrosis in nodes with laterals. How much of Oregon's fruitfulness issue is due to high vigor? This is an interesting question to consider in future studies of vine balance.

Tissue N status and vine vigor also play an important role in flowering and fruit set. In a 6-year trial using different vineyard floor management practices, N status influenced vegetative growth, fruitfulness, and fruit set. Vines grown in areas with perennial grass cover have reduced pruning weight, leaf area, and tissue N status. By year four of the study, the clusters in the grass treatment were smaller than other treatments by 6-12 grams, but these vines had higher percent fruit set. The grass treatment did not decrease fruitfulness and number of flowers per inflorescence until years 5 and 6 when the vines were near deficient in tissue N. This suggests that N has an important role in flower development both in the formation of clusters in the buds and flowers that develop in the following season post-bud break.

While changes in the development of primary fruit yields are interesting for long term management of vineyards, the growth of secondary crop (Figure 1) is nearly as important to consider on both physiological and management levels. Changes in the vine vegetative and reproductive growth within various research trials resulted in a shift in the secondary crop production. While many studies have been conducted on vine size and vigor, few report the development or impact of secondary crop. Recent work on auxin-enhanced transgenic vines shows that auxin, a key plant hormone, has a role in increasing both fruitfulness and fruit set in cultivars that typically have low bud fruitfulness (Costantini et al. 2007). However, this work did not report any increase of vine vegetative growth such as increased shoot length, lateral development, or second crop, all of which can be influenced by increased auxin production. To understand true vine balance, both primary and secondary crop was quantified in

Figure 1. Secondary crop is visible as it begins to ripen in the upper canopy above the primary clusters.

vine balance studies here in Oregon.

Both the 2010 and 2012 seasons resulted in lower than average fruit set, and higher levels of secondary crop were quantified. The average fruit set in several research trials within the same vineyard was 45-55% in 2010 and 43-45% in 2012 compared to 65-84% in 2011. The range of fruit set observed within these years was due to the variation in vine vegetative vigor as a result of the trials being conducted. Cultural practices that have an impact on vine balance also resulted in differences in second crop development. Where different vineyard floor management practices were used (grass, alternate tilled, and tilled in alleyways), the greatest impact on vine balance was noticed. During 2012, clean tillage of the vineyard floor resulted in increased primary shoot growth, more lateral shoot development, and longer lateral shoot length. Some lateral shoots produced their own laterals! These vines also produced the most secondary clusters from lateral shoots. These high vigor vines also resulted in the lowest percent fruit set of primary clusters. This suggests that the vine physiologically strives to obtain balance between vegetative and reproductive growth, resulting in increased secondary crop development. In 2010, a similar effect was observed where the largest factor contributing to the formation of secondary crop was the vegetative vigor.

Crop thinning also plays an important role in secondary crop growth. A research trial conducted with different levels and timings of crop thinning revealed that vines thinned earlier in the season have more secondary crop development (Figure 2). This was found to be true for both the 2010 and 2012 growing seasons. The intensity of crop thinning also has an influence on secondary crop development. The more clusters removed from a vine, the greater the development of secondary clusters. Those vines thinned to 30% of full crop had 17-22% more secondary crop weight than those thinned to 60% of full crop or not thinned at all. A much more drastic difference in secondary crop was found when comparing vines with different vigor levels within the vineyard floor management study. Vines grown with grass (moderate vigor) and alternate tilled vines (moderate-high vigor) had 96% less secondary crop than tilled vines (high vigor).

Based on these studies, it is apparent that the vine will try to reach balance between vegetative and reproductive growth on its own. However, we do not know how much this secondary crop development effects primary fruit production. An experiment was conducted in 2012 where the secondary crop was

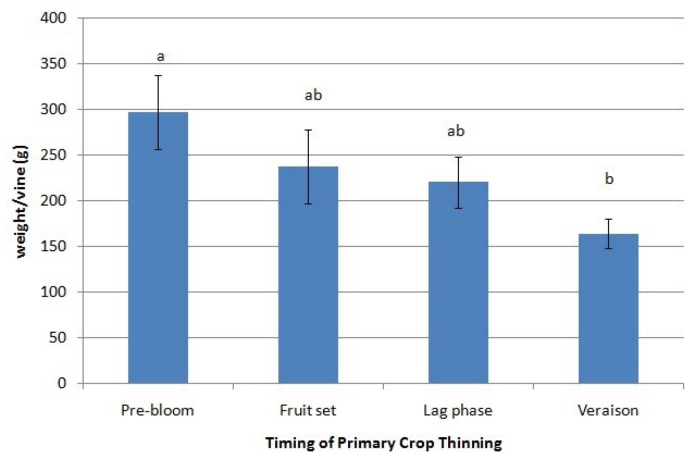


Figure 2. Total weight (mean ± SE) of secondary crop removed at véraison from vines in a crop thinning trial. Primary clusters were thinned at four different time points in the 2012 season. Different letters indicate differences in means at *P=0.0283*, Tukey's HSD mean separation.

removed or retained on vines to determine the impact on ripening of the primary clusters. All secondary clusters were cut from six sets of eight vines in early September when primary crop was approximately 90-100% color change. All secondary crop clusters were weighed at the time of removal. Vines of moderate vigor averaged 22.5 g (SD= 21.2 g) per vine while vines of higher vigor averaged 151.3 g (SD=23.5 g) per vine. At that time, second crop was at stage I or II of berry development as berries were green, hard, and fairly small. Full bloom of secondary clusters began in late July and continuous development of new blooming clusters occurred over the course of the season. This suggests that the vines were in a stage of continuous reproductive development through much of the season with potential competition of the primary clusters with the main canopy, laterals and second crop. With higher vigor, vines had a greater proportion of secondary crop than moderate vigor vines, similar to other data collected in trials from 2010 and 2012.

The primary and secondary clusters from each experimental unit were harvested separately on October 2, 2012. While the primary fruit was ripe, the secondary clusters were at approximately 50% véraison. Despite significant secondary cluster development in this experiment, there were no differences in the primary cluster ripeness (total soluble solids, pH, or TA) from vines with or without secondary clusters (Table 1). This suggests that the secondary clusters had no impact on the ability of the primary clusters to achieve ripeness post-véraison.

Some secondary clusters remained on vines for later sampling post-harvest to observe the extent of ripening. There was not much of an increase in ripening after harvesting primary crop, as total soluble solids reached only 17.2 ˚Brix nearly three weeks after harvest (Figure 3). There may be several reasons that second crop may not be able to reach further ripeness, including reduced sink strength, cooler weather, reduced sunlight, and the leaf senescence that had begun, likely diverting resources to storage organs (trunk and roots) rather than fruit.

The research outlined herein suggests that vegetative vigor management through fertilization, irrigation, and vineyard floor management have an important role in altering the total fruitfulness of shoots and increasing or decreasing yield potential. However, while high vegetative vigor may result in adequate yield and canopy development in western Oregon, the vine expends the ample resources (water or nutrients) on more shoot growth, lateral development, and secondary crop, all of which require canopy management. While secondary crop showed little effect on final ripening of the primary clusters, it is often managed through lateral removal and hedging to reduce canopy density and increase sunlight exposure for better vine health and fruit quality. Oregon vineyards currently require significant costs in canopy management, and this research is helping define what cultural practices can help alter vigor and production costs.

Table 1. Cluster weights and maturity of primary clusters that had secondary crop thinned at véraison (- 2˚ Crop), primary clusters that had secondary clusters left on the vine (+ 2˚ Crop), and secondary clusters on vines with 2˚ crop remaining.

Treatment	Fruit	Cluster wt (g)	% color	TSS (°Brix)	pH	TA (g/L)
(-) 2° Crop	Primary clusters	92.2	100	22.7	3.31	8.6
(+) 2° Crop		98.2	100	23.0	3.36	8.2
(+) 2° Crop	Secondary clusters	13.7	52	11.3	2.69	30

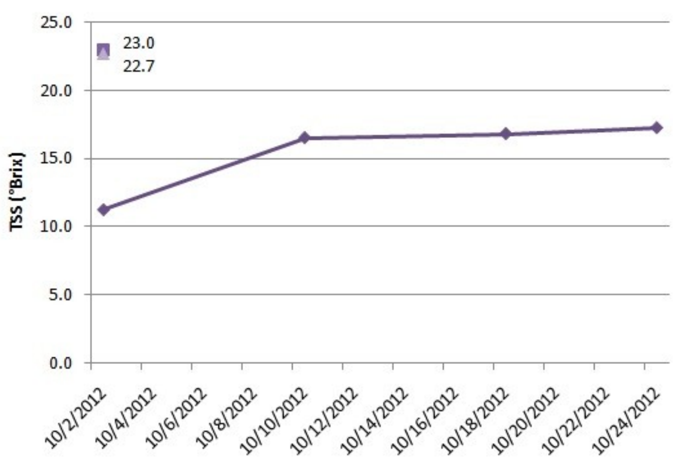


Figure 3. Secondary crop maturity progression during late season 2012. Single markers (top left) indicate the TSS of the primary clusters harvested on that date (23.0 = primary clusters without secondary crop removed; 22.7 = primary clusters with secondary crop removed).

Data summarized herein was extracted from several research studies funded by the following agencies: Oregon Wine Board, Northwest Center for Small Fruit Research, and the Oregon Agriculture Research Foundation.

References

Costantini, E., L. Landi, O. Silvestroni, T. Pandolfini, A. Spena, and B. Mezzetti. 2007. Auxin synthesis-encoding transgene enhances grape fecundity. Plant Phys. 143: 1689-1694.

Dry, P.R. and B.G. Coombe. 1994. Primary bud-axis necrosis of grapevines. I. Natural incidence and correlation with vigor. Vitis. 33: 225-230.

USDA-NASS. 1990-2011. Oregon Vineyard & Winery Report. http://www.nass.usda.gov/Statistics_by_State/Oregon/Publications/Vineyard_and_Winery/index.asp

The 2012 winegrape pest update

Dr. Vaughn Walton, Horticultural Entomologist, Associate Professor, OSU

There are several important insect pests that have been the focus of research efforts by the Oregon State University Entomology Team. These projects include research on vine mealybug spread and its association with Grapevine Leafroll Virus. Other research efforts focus on a new invasive pest, the Brown Marmorated Stink Bug (BMSB). Below are brief summaries of project advances to date.

Mealybug and Grapevine Leafroll Virus

Grape mealybug (*Pseudococcus maritimus*) and vine mealybug (*Planococcus ficus*) are pests of grapevines and known vectors of several strains of Grapevine Leafroll associated Virus (GLRaV). The negative impact of GLRaV on vine health and grape and wine quality has concerned grape production regions in both Washington and California. A team of research and Extension faculty at OSU have been working on this project, including Vaughn Walton, Danny Dalton, Rick Hilton, and Clive Kaiser.

Visual and genomic verification of immature insect stages collected in pheromone traps indicate that GLRaV in Oregon is vectored by Grape Mealybug (*P. maritimus)*, not Vine Mealybug (*P. Ficus*). This is based on seasonal trapping and physical surveys from 2010 to 2012. The surveys show two population peaks of adult male flight and younger developmental stages of Grape Mealybug that exhibit limited movement on vines in southern Oregon and the Columbia Basin. In these regions, first instar mealybugs were observed one month prior to peak male flight and were less abundant during peak flight. Adult females and late instar stages were found on vines at the time of peak male flight. Vineyards in the Willamette Valley displayed one peak male flight period based on the pheromone-baited traps, but no pests in the immature stages were found in visual surveys.

Our data indicates the risk of GLRaV spread is higher in southern and eastern Oregon vineyards due to higher incidence of grape mealybug. A comparison of the distribution of GLRaV symptoms in trial vineyards during 2011 and 2012 show virus spread in most trial vineyards since 2011. In one case, a vineyard displayed no GLRaV symptoms during 2011 and displayed approximately 10% infestation during 2012. In the Willamette Valley, we have found several vineyards where infestation with GLRaV has been due to planting infected plant material from the nursery. During a recent visit to Oregon, Virologist Dr. Gerhard Pietersen of the University of Pretoria, South Africa, stressed that in areas such as the Willamette Valley, efforts should focus on eradicating the virus in order to minimize risk of spread in the future. Risk of virus spread increases as vectors become more established. Dr. Pietersen confirmed that the quality of winegrapes in the Willamette Valley would be affected by GLRaV as the disease delays fruit ripening due to reduced photosynthetic ability of infected vines.

Brown Marmorated Stink Bug

A team of entomologists at OSU (Vaughn Walton, Nik Wiman, Chris Hedstrom, and Peter Shearer) and USDA-ARS Entomologist, Jana Lee, have partnered to study the Brown Marmorated Stink Bug (BMSB) and its impacts on various crops in Oregon, including grape. The Brown Marmorated Stink Bug (*Halyomorpha halys, Hemiptera: Pentatomidae*), is a new invasive species in the United States, and has recently spread into the Pacific Northwest (Figure 1). BMSB has an ability to attack many important crops including winegrapes by feeding on the leaves, rachis, and berries. They feed by penetrating plant tissues with piercing-sucking mouthparts. Feeding results in damaged berries and tissues which may result in infection by other pathogens. Populations of BMSB have increased rapidly since the pest was first detected in Portland in 2004. The range of this pest now includes the entire Willamette Valley, and populations have been established in the Columbia Gorge (Hood River and Wasco Counties) and southern Oregon (Jackson County). BMSB has been detected in two vineyards, but fruit damage has not been found at this time.

Important research objectives that the team is currently addressing include 1) characterization of damage on winegrapes, 2) determining the range and density of current infestations in key grape-growing regions, and 3) determining the potential impact of taint on fruit and wine. The team will use information generated from this project to develop alternative management methods through biological control agents. During our surveys, BMSB have been found in close proximity to major grape growing regions throughout the state. It has been found in vineyards at two north Willamette Valley sites. To find out more about the location of BMSB across the state, click here. Chris Hedstrom, graduate student in the Walton lab, is conducting biological control studies to accelerate the release of an imported parasitoid currently in quarantine at OSU. Dr. Nik Wiman, post-doctoral research entomologist at OSU, has been working on native biological controls, and has found two parasitoids from sentinel egg baits that may be used for control of BMSB (Figure 2). The research team plans to use new research information to help industry develop IPM strategies against BMSB.

Figure 1. Brown marmorated stink bug adult. Photo courtesy of Chris Hedstrom, OSU.

Thanks to funding from the Oregon Wine Board, we are working to determine the level of damage

BMSB can have on winegrapes. The study is taking place in OSU research vineyards under controlled conditions. Care is taken to contain these insects in

Figure 2. *Trissolchus cosmopeplae*, a parasitoid that is being used for BMSB research at OSU. Photo courtesy of Vaughn Walton, OSU.

escape-proof feeding cages. The goal of the study is to characterize BMSB feeding on winegrapes throughout the growing season. Preliminary results show that the skins of berries may be compromised by BMSB feeding. Similar trials conducted in Virginia vineyards found symptoms to be more severe. Research to understand the damage potential in grapes needs to be continued, as Oregon vineyards have less disease pressures than other states. As a result, it is possible that BMSB may be less damaging to Oregon grapes as symptoms of BMSB feeding is thought to be enhanced by secondary infections in eastern states. The OSU Enology Team (Elizabeth Tomasino and James Osborne) has started studies this fall to determine the impact of BMSB taint on wines at two levels of infestation.

Brown Marmorated Stink Bug is a serious pest that is now present in many grape growing regions in Oregon. Continued work is necessary to prevent this pest from becoming an economic problem for Oregon's wine industry. To find out more about BMSB and new research findings, visit the OSU Brown Marmorated Stink Bug Website.

Resources

Skinkis P., J.Pscheidt J., Walton V.M., Dreves A.J., Peachey E., Allen N., and J. Sanchez. 2012 Pest Management Guide for Wine Grapes in Oregon. OSU Extension Service EM8413E.

Skinkis P.A., A.J. Dreves, V.M. Walton, and R.R. Martin. 2009. Field Monitoring for Grapevine Leafroll Virus and Mealybug in Pacific Northwest Vineyards. OSU Extension Bulletin EM 8985.

Walton V., A.J. Dreves , P. Skinkis, C. Kaiser, M. Buchanan, R. Hilton, B.R. Martin, S. Castagnoli, and S. Renquist 2009. Grapevine Leafroll Virus and Mealybug Prevention and Management in Oregon Vineyards. OSU Extension Bulletin EM 8990.

Lots o' Bots: Grapevine trunk disease and the Botryosphaeriaceae

Melodie L. Putnam, Director, OSU Plant Clinic

In simpler times, before people really started paying attention, there were only a few trunk canker diseases known, and most of them were found mainly in Europe. The biggest problem in the US was Eutypa, which was recognized primarily by the dark pie-shaped wedge of diseased tissue found when pruning cankered vines. Boy, those were the good old days. Today trunk diseases of grapevines are found just about anywhere one looks, and there are at least 21 different species in the fungal family Botrysophaeriaceae (known as "Bots" for short) which cause disease in grapevines. This family includes the genus *Botrysophaeria* and many other genera that infect grapes. Some of these fungal genera cause fruit rots, but 17 members of this family have been isolated from wood showing those characteristic wedge-shaped cankers when cutting into the trunk (Figure 1).

Tip 1: Symptoms alone are not sufficient to identify the cause of disease in grapevines.

Why have we observed the proliferation of Bots in

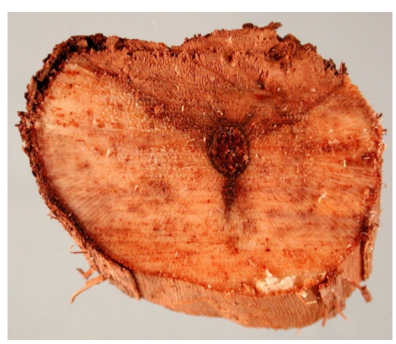


Figure 1. A wedge-shaped area of necrosis in the trunk of a young grapevine. Is it *Eutypa*? No, it is *Botryosphaeria*!

grapes? Part of the reason is that researchers are looking more closely at these diseases and because better tools have been developed for identifying the fungi involved. Research groups in California and

South Africa found that it is not possible to distinguish the fungi associated with grapevine trunk disease unless molecular methods are used. This is because the characteristics used to identify these fungi in the past, such as spore size, shape, and characters of the fruiting body, overlap between species. For example, by using molecular tools, we have found that what were once considered a single genus of a pathogen are actually several distinct genera. These old identification methods led to misidentification of some fungi involved with trunk diseases.

Tip 2: Grapevine pathogens require some time and a lot of work to identify.

Why bother figuring out which fungus is present if they all cause disease? Well, not all Bots are equal. Some cause less disease than others and are less of a threat.

I was fortunate to be able to visit the group in California, Dr. Doug Gubler's lab, which has been studying grapevine diseases for many years. I also spent time with the research group in South Africa which is well-known for its work with Bots from all sorts of woody plants. I realized that the grape Bot question was more complex than I had originally thought. I used my time with both groups to learn how to identify the Bots, including the molecular methods. Identification is not simple. The fungi take weeks to fruit, which is needed to obtain an unmixed culture derived from a single spore. Once a pure culture is obtained, it may take six or eight different molecular assays before one can identify what was in the grapevine to begin with. When working with identifying the Bots, one can't be in a hurry.

What is important to you as growers is that there are a number of Bots that can infect both young and mature grapevines, and the symptoms are similar. Don't discount the possibility that younger vines can have a Bot infection, as Bots have been found causing disease in plants younger than five years old.

Tip 3: Bots aren't just a problem in old vines.

To date, we do not know how serious the Bot problem is in Oregon vineyards. In California, the Bots and Eutypa together cause losses estimated to be over $260 million *annually* due to lost productivity from diseased vines. No one has systematically looked at the vineyards in Oregon to get a good idea of what we may have, but we do know Bot-infected vines have been found. In 2005 a graduate student from Dr. Gubler's lab was in Oregon for a meeting and collected 50 samples from five vineyards in areas of the upper Willamette Valley and Hood River. He said it was not difficult to find declining and infected vines and was able to identify two Bots: *Botryosphaeria obtusa* and *B. stevensii*. These fungi are well known as pathogens of grapevines. This student's results suggest there may be more disease out there than is currently recognized.

Tip 4: Just because you haven't looked doesn't mean it isn't there.

Vines with dead spurs on a cordon or large cankers originating from an old pruning cut should be considered prime candidates for either a Bot infection or Eutypa. The best time to distinguish between the two problems is in the spring after growth has begun. Spur-pruned vines with a Bot infection will often have spurs that simply do not grow (Figure 2), whereas with Eutypa, the leaves produced from an infected vine will be small, cupped and yellowing, and the vines will have short internodes. There is more information on symptoms of both Bots and Eutypa in the PNW Plant Disease Handbook (http://pnwhandbooks.org/plantdisease/grape-vitis-sp-eutypa-dieback). Be alert to the possibility of Bots in the vineyard. If you see trunk disease, be sure to get it diagnosed so that management steps can be taken.

Tip 5: The OSU Plant Clinic can help you identify which Bot is causing the problem.

Since some Bots are more vigorous vine invaders than others, it is best to know which Bot you have. If

Figure 2. A spur-pruned vine in a California vineyard. Three dead spurs are clearly visible on this vine infected with Bot canker.

you have weak vines and want to submit a sample, please call me (Melodie Putnam, 541-737-3472) and I can advise you on the best material to send. Besides selecting the correct material, it is important that samples are shipped or brought in immediately and do not sit around in storage. Bot fungi are quickly overrun by other organisms which have nothing to do with the infection, making diagnosis extremely difficult.

Trunk diseases can be a major problem for the longevity of vineyard plantings throughout Oregon and worldwide. To learn more about preventing and managing canker disease of grapevines, see the March 2011 article "Annual Canker Soapbox" By Jay Pscheidt (http://owri.oregonstate.edu/sites/owri.oregonstate.edu/files/documents/31_vitenotechnwsltr-mar2011.pdf).

OSU welcomes new enologist to the OWRI Team

Dr. Elizabeth Tomasino recently joined the Oregon Wine Research Institute at Oregon State University as Assistant Professor. She resides in the Department of Food Science & Technology where she will conduct enology research and teaching. Elizabeth comes to OSU from New Zealand, where she completed her PhD degree in Oenology from Lincoln University under the direction of Dr. Roland Harrison. Her thesis project involved studying the sensory differences of regional New Zealand Pinot noir wines and their relationships to specific aroma chemicals. Elizabeth obtained her M.S. in Food Science from Cornell University under Dr. Thomas Henick-Kling, and she worked at E&J Gallo, Yalumba and Robert Mondavi prior to beginning her doctoral studies at Lincoln. Her work has been presented at the 61st National Conference of the American Society for Enology and Viticulture, 7th and 8th International Cool Climate Symposium (ICCS) for Viticulture and Oenology and the Romeo Bragato Conference (2011). She also was recently awarded the Sensory and Consumer Sciences Silver Celebration Ph.D. Scholarship from the Institute of Food Technologists.

Dr. Tomasino's main research interests involve investigating the relationship between chemical compounds and wine sensory. Future work will include the influence of chiral aroma compounds on wine aroma and flavor. Chiral compounds are structurally identical compounds except that they are non-super imposable mirror images of each other. While structurally similar, many of these chiral compounds have very different aroma characteristics. Dr. Tomasino will be developing methods to measure these compounds and investigating their sensory affects on wines. In addition, research will be conducted to determine which aromatic compounds

OWRI Director's Corner

It's a distinct pleasure to serve as director of the Oregon Wine Research Institute. Since assuming this role in July, I've focused on developing a deeper understanding of the industry's research needs as well as the Institute's capacity for addressing them. I've been impressed with the quality and breadth of the scientists engaged in viticulture and enology work and even more pleased by their commitment to teamwork and the concept of integrated vine-to-wine research and outreach.

The OWRI is a three-way partnership among the industry, USDA-ARS, and OSU. Our prime directive is to conduct research and disseminate research-based information focused on enhancing the quality of Oregon wines and ensuring continued economic profitability and sustainability of the industry. Between USDA Agricultural Research Service (ARS) and OSU, 20 scientists made contributions to Oregon viticulture and enology research and outreach this past year. Those 20 include our newest scientist, Elizabeth Tomasino, who is profiled elsewhere in this newsletter.

OWRI scientists are committed to working collaboratively with our industry partners to identify critical research needs, to assemble the necessary resources, and to do the research needed to provide answers. Through your partnership and generosity, much of this research has been conducted in collaboration with you or your fellow industry members. This newsletter highlights several important vineyard and winery issues and includes information from current research projects. For more information about our team at the OWRI and resources that we have developed, please visit our website at http://owri.oregonstate.edu/. We greatly appreciate your support and collaboration and invite your continued counsel and engagement as we collectively grow have an impact of wine aroma. While we know that there are many aroma compounds in wine, it is not well understood what specific role these compounds play in aroma, flavor and wine quality.

As Elizabeth develops her program within the OWRI, she hopes to conduct research to differentiate wine aroma, flavor and mouth feel characteristics for different regions, soil types and other important factors that play a part in "place of origin." She has conducted work on this topic while in New Zealand and looks forward to investigating what makes Oregon wines unique from other wines both domestically and internationally. Other sensory interests include the influence of phenolics and other non-volatile compounds on aroma and defining those mouth-feel components important to wine quality from both a chemical and sensory perspective. Her work will compliment many other projects already in place at the OWRI investigating the impacts of viticultural and enological practices which have an impact on wine sensory. One key role she is taking on with Dr. James Osborne is the training and coordination of the OWRI Industry Sensory Panel.

Please welcome Dr. Elizabeth Tomasino, and feel free to contact her by email (elizabeth.tomasino@oregonstate.edu) or by phone (541-737-4866) with any questions, ideas or interests.

OSU Viticulture Internship Program

Are you looking for seasonal assistance in the vineyard, collecting tissue samples, managing data, doing crop estimates, and more? Students in the BS Program in Viticulture & Enology at OSU are anxious to learn from Oregon industry professionals. They are required to complete an internship before they graduate, and many hope to gain practical skills and knowledge on the job to supplement their course-work at the University. Most students are seeking opportunities this winter for placement in June. If you have interest in providing an internship position or taking on an intern, please contact Patty Skinkis, Viticulture Extension Specialist, at skinkisp@hort.oregonstate.edu or 541-737-1411. For more details on serving as an internship provider to students, see *Employer Internship Responsibilities*.

Practical Guides, Resources, and Websites

Many publications are produced by members of the Oregon Wine Research Institute and its partners to meet the needs of the commercial vineyard and winery industry. The publications listed below were developed by Extension faculty, and many are open-access and available online.

Moyer, M., C. Kaiser, J. Davenport, and P. Skinkis. 2012. Considerations and resources for vineyard establishment in the inland Pacific Northwest. Pacific Northwest Extension Publication, PNW634. http://wine.wsu.edu/research-extension/files/2012/07/WA-Resources-for-Establishment-PNW634.pdf

Pacific Northwest Plant Disease Management Handbook. 2012. Edited by J. Pscheidt and C. Ocamb. Oregon State University Extension Service. Revised September 2012. http://pnwhandbooks.org/plantdisease.

Pacific Northwest Weed Management Handbook. 2012. Edited by E. Peachey. Oregon State University Extension Serivce. Revised September 2012. http://pnwhandbooks.org/weed/.

Sullivan, D.M. and N.D. Andrews. 2012. Estimating plant-available nitrogen release from cover crops. Oregon State University Extension Service. http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/34720/pnw636.pdf

Skinkis, P.A. and R.P. Schreiner. 2011. Grapevine Nutrition. Online, interactive educational module and diagnostic tool. Oregon State University Extension Service EM9024. http://extension.oregonstate.edu/catalog/html/em/em9024/.

Tarara, J.M. and J. Lee. 2011. An introduction to environmental influences on ripening in grapes: focus on wine grapes and phenolics. eXtension Grape Community of Practice. http://www.extension.org/pages/33025/an-introduction-to-environmental-influences-on-ripening-in-grapes:-focus-on-wine-grapes-and-phenolics

eViticulture (http://eviticulture.org) is an online resource containing thousands of vineyard production articles produced by viticulture specialists in Extension throughout the US. Articles range from topics that are important for beginning grape growers to advanced topics for current professionals in the industry. Members of the OWRI team have authored more than 10 articles and other media within the eViticulture website.

OSU- Spotted Wing Drosophila Website (http://horticulture.oregonstate.edu/group/spotted-wing-drosophila) website contains research and extension resources on how to monitor and manage in Oregon fruit crops. While this has been of limited impact reported for grape, there is grape-specific information available in the research team's report published in summer 2012. You can read the report online.

OSU - Brown Marmorated Stink Bug Website (http://horticulture.oregonstate.edu/group/brown-marmorated-stink-bug-oregon) website contains survey information, monitoring guides, and methods by which to report sitings of the pest. The Brown Marmorated Stink Bug (BMSB) is a new invasive pest that has potential impacts for Oregon vineyards and wine quality. Click here for a list of current publications on how this pest may affect the winegrape industry.

Research Publications

Results of research projects conducted in the areas of viticulture and enology are published in peer-refereed academic journals, peer-reviewed reports, or books. This peer-reviewed/refereed process validates the scientific work of the authors. Articles listed below include the most recently published results of research conducted by Oregon State University faculty and other members of the Oregon Wine Research Institute at Oregon State University.

Viticulture

Balint, G. and A.G. Reynolds. 2013. Impact of exogenous abscisic acid on vine physiology and grape composition of Cabernet Sauvignon. Am. J. Enol. Vitic. *(published ahead of print 10/5/2012)* http://www.ajevonline.org/content/early/2012/10/04/ajev.2012.12075.abstract

Lee, J. and K.L. Steenwerth. 2011. Rootstock and vineyard floor management influence on 'Cabernet Sauvignon' grape yeast assimilable nitrogen (YAN). Food Chem. 127:926-933. http://www.ars.usda.gov/pandp/docs.htm?docid=15829

Schreiner, R.P., J. Lee, and P.A. Skinkis. 2013. N, P, and K supply to Pinot noir grapevines. Impact on vine nutrient status, growth, physiology, and yield. Am. J. Enol. Vitic. 64:1. (*Published ahead of print 10/11/2012*). http://ajevonline.org/content/early/2012/10/19/ajev.2012.12064.abstract

Tarara, J.M., J.E. Perez Pena, M. Keller, R.P. Schreiner, and R.P. Smithyman. 2011. Net carbon exchange in grapevine canopies responds rapidly to timing and extent of regulated deficit irrigation. Funct. Plant. Bio. 38: 386-400. http://www.publish.csiro.au/paper/FP10221.htm

Insect, Disease, and Pest Management

Biology and management of Spotted Wing Drosophila on small and stone fruits: Year 2 report. 2012. Project directors: V.W. Walton, A.J. Dreves, and P. Shearer. http://horticulture.oregonstate.edu/system/files/SWD_ResearchReviewYear%202_7.16.12.pdf

Bailey, B.N., R. Stoll, E. R. Pardyjak, and W. Mahaffee. 2012. The link between coherent structures and particle transport in canopy flows. Proceedings of 30th Conference on Agricultural and Forest Meteorology; and the First Conference on Atmospheric Biogeosciences. https://ams.confex.com/ams/30AgFBioGeo/webprogram/Paper207703.html

Gadino, A.N and V.M. Walton. 2012. Temperature-related development and population parameters for *Typhlodromus pyri* (Acari: Phytoseiidae) found in Oregon vineyards. Exp. Appl. Acarol. 58: 1-10. http://www.springerlink.com/content/f51u27x6110j8ml8/

Gadino A. N., V.M. Walton, and J. C. Lee. 2012. Evaluation of methyl salicylate lures on populations of *Typhlodromus pyri* (Acari: Phytoseiidae) and other natural enemies in western Oregon vineyards. Biological Control. 63: 48-55. http://www.sciencedirect.com/science/article/pii/S1049964412001181

Lee J. C., H.J. Burrack, L.D. Barrantes, E.H. Beers, A.J. Dreves, K. Hamby, D.R. Haviland, R. Isaacs, T. Richardson, P. Shearer, C.A. Stanley, D.B. Walsh, V.M. Walton, F. G. Zalom, and D.J. Bruck. 2012. Evaluation of monitoring traps for *Drosophila suzukii* (Diptera: Drosophilidae) in North America. J. Econ. Entomol. 105: 1350-1357. http://www.spcru.ars.usda.gov/research/publications/publications.htm?seq_no_115=279940

Miller, N.E., A. Gould, R. Stoll, W. Mahaffee, and E. R. Pardyjak. An experimental study of momentum and heavy particle transport in a row-oriented agricultural canopy Proceedings of 30th Conference on Agricultural and Forest Meteorology; and the First Conference on Atmospheric Biogeosciences. https://ams.confex.com/ams/30AgFBioGeo/webprogram/Paper207704.html

Pfender, W. F., D.H. Gent, D. H., and W.F. Mahaffee. 2012. Sensitivity of disease management decision aids to temperature input errors associated with sampling interval and out-of-canopy sensor placement. Plant Dis. 96:726-736. http://apsjournals.apsnet.org/doi/abs/10.1094/PDIS-03-11-0262

Schreiner, R.P., I.A. Zasada, and J.N. Pinkerton. 2012. Consequences of *Mesocriconema xenoplax* parisitism on Pinot noir grapevines grafted on rootstocks of varying susceptibility. Am. J. Enol. Vitic. 63: 251-261. http://www.ajevonline.org/content/63/2/251.abstract

Schreiner, R.P., J.N. Pinkerton, and I.A. Zasada. 2012. Delayed response to ring nematode (*Mesocriconema xenoplax*) feeding on grape roots linked to vine carbohydrate reserves and nematode feeding pressure. Soil Bio. & Biochem. 45: 89-97. http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=269557

Walton, V.M., K.M. Daane, and P. Addison. 2012. Biological control of arthropods and its application in vineyards. *In* Arthropod Management in Vineyards. N.J. Bostanian, C.Vincent, R. Isaacs (ed.), 91-117, Springer, Netherlands. http://www.springerlink.com/content/g84023872h302316/

Enology

Takush, D.G. and J.P. Osborne. 2012. Impact of yeast on the aroma and flavour of Oregon Pinot noir wine. Aust. J. Grape & Wine Res. 18: 131-137. http://onlinelibrary.wiley.com/doi/10.1111/j.1755-0238.2012.00181.x/abstract

Umiker, N.L., R.A. DeScenzo, J. Lee, and C.G. Edwards. 2012. Removal of *Brettanomyces bruxellensis* from red wine using membrane filtration. J. Food Process. Pres. *In press; accepted 3/3/2012*. http://onlinelibrary.wiley.com/doi/10.1111/j.1745-4549.2012.00702.x/abstract

Wells, A. and J.P. Osborne. 2012. Impact of acetaldehyde and pyruvic acid bound sulfur dioxide on wine lactic acid bacteria. Lett. Appl. Micro. 54: 187-194. http://onlinelibrary.wiley.com/doi/10.1111/j.1472-765X.2011.03193.x/pdf

Berry Chemistry

ACS Symposium Series: Flavor chemistry of wine and other alcoholic beverages. Symposium Series 1104 Edited by Michael C. Qian and Thomas H. Shellhammer. http://pubs.acs.org/isbn/9780841227903

Davis, P.M. and M.C. Qian. 2011. Progress on volatile sulfur compound analysis in wine. Pages 93-115. *In* Volatile Sulfur Compounds in Food, Vol. 1068. American Chemical Society. http://pubs.acs.org/doi/abs/10.1021/bk-2011-1068.ch005.

Fang, Y. and M.C. Qian. 2012. Development of C6 and other volatile compounds in Pinot Noir grapes determined by stir bar sorptive extraction-GC-MS. Pages 81-99. *In* Flavor Chemistry of Wine and Other Alcoholic Beverages, Vol. 1104. American Chemical Society. http://pubs.acs.org/doi/abs/10.1021/bk-2012-1104.ch006

Fang, Y. and M.C Qian. 2012. Accumulation of C_{13}-norisoprenoids and other aroma volatiles in glycoconjugate form during the development of Pinot Noir grapes. Pages 101-115. *In* Flavor Chemistry of Wine and Other Alcoholic Beverages, Vol. 1104. American Chemical Society. http://pubs.acs.org/doi/abs/10.1021/bk-2012-1104.ch007

Lee, J. and C. Rennaker. 2011. Influence of extraction methodology on grape composition values. Food Chem. 126:295-300. http://www.ars.usda.gov/pandp/docs.htm?docid=15829

Song, J., K.C. Shellie, H. Wang, and M.C. Qian. 2012. Influence of deficit irrigation and kaolin particle film on grape composition and volatile compounds in Merlot grape (*Vitis vinifera* L.). Food Chem. 134: 841-850. http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/30164/SongJianqiangFoodScienceInfluenceDeficitIrrigation.pdf?sequence=1

Plant Biology/Metabolomics

Gouthu, S., P.A. Skinkis, J. Morre, C.S. Maier, and L.G. Deluc. 2012. Berry nitrogen status altered by cover cropping: Effects on berry hormone dynamics, growth, and amino acid composition of Pinot Noir. Food Chem. 135: 1-8. http://www.sciencedirect.com/science/article/pii/S0308814612006565

Gouthu, S., J. Morre, C.S. Maier, and L.G. Deluc. 2012. An analytical method to quantify three plant hormone-families in grape berry using Liquid Chromatography and Multiple Reaction Monitoring Mass Spectrometry. *In* Recent Advances in Phytochemistry. 42: 19-36. http://link.springer.com/chapter/10.1007/978-1-4614-4066-6_2?null

Grape and Wine Product Development

Tseng, A. and Y. Zhao. 2012. Effect of different drying methods and storage time on the retention of bioactive compounds and antibacterial activity of wine grape pomace (Pinot Noir and Merlot). J. of Food Sci. 77: H192-H201. http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2012.02840.x/abstract

Upcoming Events

OWRI Research Seminar Series – Winter 2013
This series features monthly research seminars on viticulture, enology and other areas of interest within these subject areas. The seminars are held on-campus and broadcast online, generally from 3:30-4:30 PM. For those of who cannot attend online, many of these webinars are recorded and archived. For more information on upcoming webinars and to view archived recordings, check out the OWRI website: http://owri.oregonstate.edu/owri-seminars.

Oregon Wine Industry Symposium – February 19-20, 2013
The largest Oregon industry educational event and trade show will be held in Portland, OR. This is an excellent opportunity to learn more about new innovations and interact with other industry professionals. For more details, visit http://symposium.oregonwine.org/.

Spray Technology Workshop – February 21, 2013
Dr. Andrew Landers, Spray Technology Specialist at Cornell University, is presenting a full day workshop on spray drift and new spray technology. The event will also feature cost-share information on tunnel sprayers and is co-sponsored by the Yamhill County Soil & Water Conservation District. Mark your calendar! More details will be available soon and will be posted to the OWRI website (http://owri.oregonstate.edu).

2013 OWRI Grape Day - April 2, 2013
The research "Grape Day" is back by popular demand! Join us at the Oregon State University campus on April 2 for a full day of presentations, posters and discussion about new research findings in viticulture and enology. Mark your calendar and plan to attend; registration will open in early 2013!