Viticulture & Enology
Technical Newsletter

March 2011

Welcome to the March 2011 Newsletter

Welcome to the March 2011 Viticulture & Enology Newsletter! We have a number of great articles from members of our team to keep you informed. Marcus Buchanan provides an update on the mealybug trapping efforts that have been in place in southern Oregon's winegrape regions since 2009. Jay Pscheidt writes to remind all grape growers of the threats of canker diseases, and asks all of us to be proactive during dormant pruning. Vaughn Walton also writes about a timely pest topic— rust mites. Please read more if you plan to survey your vineyards for mites. To bridge the gap between viticulture and enology sections of the newsletter, we have a guest article from Jungmin Lee and Kerri Steenwerth regarding fruit quality impacts of cover crop management. James Osborne wraps up the newsletter with tips on managing the malolactic fermentation. Do not forget to check out the new publications, resources and upcoming events listed at the end of the newsletter! We have some great programs coming up in April and May; we hope you can participate!
Cheers,
The Oregon Winegrape Team

Summary of the 2010 Southern Oregon Mealybug Monitoring Program

Marcus Buchanan, Ph.D., Viticulture Extension, OSU - Southern Oregon Research & Extension Center
Rick Hilton, Entomologist, OSU –Southern Oregon Research & Extension Center
Steve Renquist, Extension Horticulturist, OSU Extension, Douglas County

Background

The first detection of a significant grape mealybug (GMB) infestation in a Southern Oregon vineyard was in late August 2008. Almost concurrent with this observation, a statewide monitoring program was initiated in 2009 and focused on detection of GMB and vine mealybug (VMB). Now in the second consecutive year of monitoring, we have confirmed increasing GMB populations and cluster infestations in some parts of the southern Oregon region. Sustained monitoring is critical, especially as VMB has had a significant economic impact in vineyards in California, but it is not yet known to be present in Oregon. Since mealybugs are also known as vectors of grapevine leafroll virus, there is heightened industry concern. Both of these potential economic impacts have contributed to a significant increase in the acreage that has been treated with various insecticides.
In 2010, the Southern Oregon Mealybug Monitoring Program incorporated three objectives: 1) monitor for presence of VMB and GMB at all cooperating sites; 2) develop a better general understanding of GMB phenology; and 3) monitor for presence of obscure (OBS) and longtail (LT) mealybug species at a sub-set of vineyards.

Locations and Methods

There were 45 cooperating sites in a 70 by 120 mile E-W, N-S area including the Applegate, Illinois, Rogue and Umpqua Valleys (Table 1). Monitoring was done with Delta Traps with pheromone lures placed on removable sticky trap liners. Traps were placed by the project team, vineyard owners/managers, and with the gracious assistance of Bill Wendover of Stonefield Vineyard in the Illinois Valley. Additionally, at a few of the sites (not reported

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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

Oregon State University

here), a vine scouting protocol was implemented to visually confirm GMB presence and development. Participating vineyard sites ranged in size from three to approximately 150 acres.

Table 1. Number of monitoring sites and traps for 2010

Sub-Region	Sites	Traps #
Applegate	3	29
Illinois	11	67
Rogue*	26	136
Umpqua	5	61

*Includes Rogue River and Bear Creek basins

VMB and GMB Program – At minimum, two pheromone traps (VMB and GMB) were placed at each of 45 sites (Table 1). Many traps were distributed to growers at a spring OSU Extension meeting with instructions for placement in vineyards, in addition to those traps placed by the project team. At most sites, sticky liners remained in Delta Traps for the entire monitoring period and pheromone lures were changed every 60 days. Traps were installed between 30 April and 1 July and removed as late as 22 November.

GMB Phenology – Six vineyards in the Rogue, Illinois, and Umpqua regions were selected for more intensive monitoring of GMB development. For the pheromone trapping component of the proejct, each site had a greater trap density (on acreage basis) and sticky trap liners were removed and evaluated on a bi-weekly basis. Traps were installed between 30 April and 4 May. Lures were replaced on approximately a 30 day interval with traps removed between 9 and 27 October.

Other Species – Traps baited with OBS and LT pheromones, as well as a lure containing pheromones of all four mealybug species (MIX), were placed in three replicate locations in each of 14 sites. These sites and trap locations within vineyards were identical to the 2009 monitoring program. At most sites, sticky liners remained in Delta Traps for the entire monitoring period with pheromone lures changed every 60 days. Traps were installed between 7 May and 18 June.

Results

General Regional Summary - Of the 45 monitoring locations, adult GMB males were found at 43 sites (96% of all sites). The largest numbers were found in the Rogue Valley, with the most in the Bear Creek basin (Table 2). The predominant species captured were GMB, mainly in GMB and MIX pheromone baited traps. However GMB were found in traps with OBS and LT lures, mostly in vineyards with the highest number of captured males. Additionally, we have reasonable certainty at this time that Grass mealybug (*Phenacoccus sp.*) males flew to traps with OBS, LT, and VMB lures. At one site we believe that a GMB lure may have been mistakenly placed in an OBS trap in mid-summer. We cannot confirm at this time that any individuals found in VMB traps are actually that species as most appear to be grass mealybug males, and additional confirmation is pending.

Table 2. Mealybug male captures in sub-areas and by pheromone lure type

Bear Creek	Rogue	Umpqua	IV	Applegate	Region
72,716	1186	117	497	55	
	Numbers by Pheromone Lure Type				
GMB	VMB	OBS	LT	MIX	TOTAL
64,756	46*	237*	9*	9523	74,571

*Appear to be *Phenacoccus sp.* (Grass Mealybug) or GMB, species ID confirmation in progress Table 2

The Oregon Wine Board funded a late and very short monitoring effort in 2008 that resulted in relatively low captures. During the following season of 2009, there were no grape mealybugs trapped in the Applegate Valley and many of the Illinois and Umpqua Valley sites. In 2010, every site in the Illinois, Applegate, Umpqua, and the Bear Creek area of the Rogue AVA had GMB or MIX traps positive for males. The increased total males captured in 2010 (Table 3) likely reflect, in part, a longer trapping period at the GMB phenology sites and greater trap density at these sites. However, we believe that the data also reflect an increase in population size at many locations.

Table 3. General summary of multi-year mealybug monitoring in Southern Oregon

Year	2008	2009	2010
Positive Locations	7	12	41
Total Males	315	46,956	74,571

A number of sites in the Rogue AVA have had significant populations of grape mealybugs, as determined by male captures, vine scouting, and in some cases, infested clusters. To our knowledge, only five vineyard blocks comprising about 18 acres had a pesticide application due to an economically significant infestation in 2009. However, in 2010 approximately 49 blocks comprising close to 300 acres received chemical control while an organic block utilized selective cluster removal and bark stripping to reduce infestation potential. These sites all had at least 300 males trapped during the first generation flight.

Grape Mealybug Phenology – We found that the bi-weekly trap liner removal protocol provided an excellent indicator of seasonal dynamics in male emergence and density. Based on the data, we are confident that the Rogue region, including the Bear Creek area, can support two generations per season. Figure 1 provides a clear indication of two distinct male flights in a vineyard in the Rogue

Valley. Occasional vine scouting (data not shown) confirmed the presence and activity of adult females, crawlers, and 2nd instar juveniles during each flight period. This may partially explain why we have observed such rapid increases in GMB populations at some Rogue sites. The vineyard from which data were collected for Figure 1 had been selectively treated with Provado in late summer of 2009, Applaud in mid-spring 2010 and followed by Movento in mid-July 2010 due to rapid population increase, cluster infestation and damage in 2009.

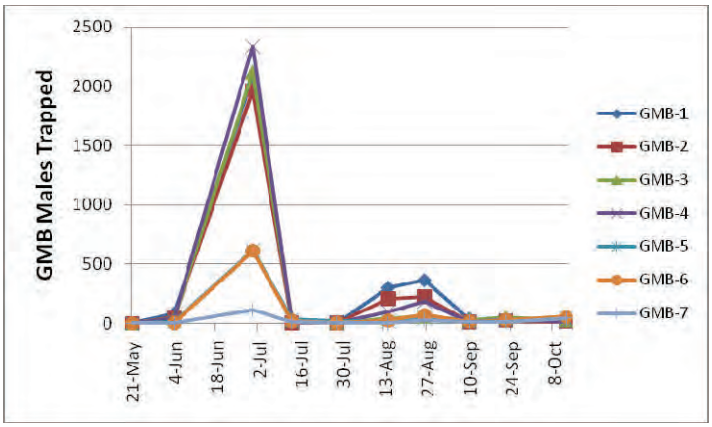


Figure 1. GMB males captured on a bi-weekly sampling basis in a Rogue region vineyard

Conversely, there is no compelling evidence from 2010 to indicate that the Applegate, Illinois, and Umpqua regions had more than one generation as shown in results from an Illinois Valley site (Figure 2). The total number of males captured at this phenology site was very low and we found very few vines with large egg masses or presence of females. In contrast to Rogue phenology sites, the first male flight may have been four to five weeks later at this Illinois Valley site.

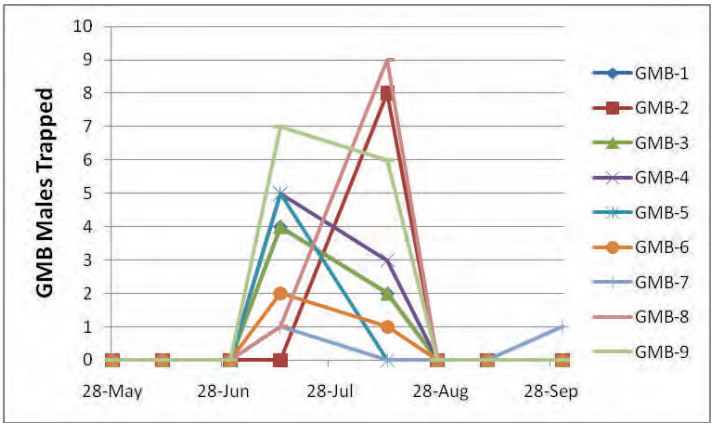


Figure 2. GMB males captured on a bi-weekly sampling basis in an Illinois Valley vineyard

Another Rogue phenology site, where the first significant observation of GMB was found in late 2008, was treated with the systemic insecticide, Movento, in late August of 2009. Figure 3 contrasts the dramatic reduction in total captured males between 2009 and 2010. Vine scouting and cluster inspection at numerous times in spring and summer 2010 confirmed the efficacy of this late season treatment. However while there was no significant male detection during the first Rogue region flight in 2010 (early June), males were found during the second flight period (Figure 4). As this is a small vineyard (3 acres) the question remains if these males hatched within or adjacent to the site.

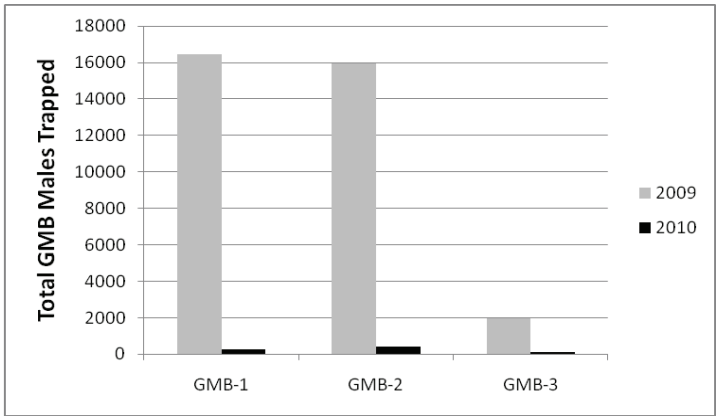


Figure 3. Comparison of GMB trap counts in a Rogue region vineyard (2009-2010)

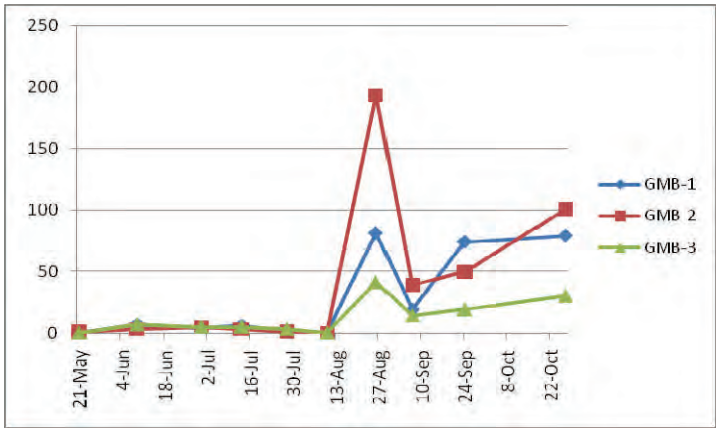


Figure 4. GMB males captured in 2010 following 2009 application of Movento

The dynamics and duration of the male flight during the second Rogue GMB generation as shown in Figure 4 was also likely influenced by weather. We first noted this in another Rogue site that experienced a rapid population increase in the second GMB generation. Here, after first detecting >500 males in a trap following the first flight, four additional GMB traps were installed in additional vineyard blocks on 14 August. Sticky trap liners were removed and

inspected weekly until 9 October. Figure 5 contrasts the weekly male captures with the mean weekly air temperature (at the Medford AgriMet station) and shows a close relationship of average temperature and male numbers. A long early fall period with favorable temperatures, little rain, and without a killing frost or freeze could favor increased mating success and subsequent first generation hatch in the following spring.

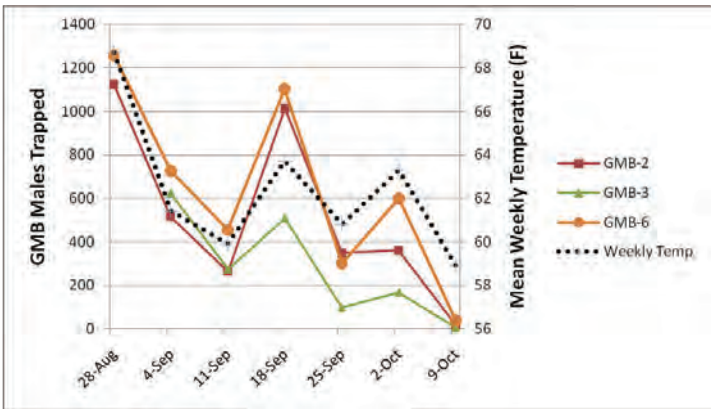


Figure 5. Relationship of second generation male captures to mean weekly temperature

Summary

The mealybug monitoring program has been an increasingly important Extension and industry partnership in the southern Oregon region. Most importantly, the use of pheromone traps has provided early detection of potentially economically damaging populations. This has allowed cooperating growers to make reasonably timely management actions, whether chemical treatment, removal of infected clusters, or vine bark stripping to expose eggs and juveniles. Second, in 2010 we were able to confirm the timing and extent of two GMB male flights (generations) in the Rogue Valley as well as possibly only a single generation in the Applegate, Illinois, and Umpqua Valleys. Pending further confirmation, we are reasonably confident that the region is still free of the vine mealybug.

At the same time, monitoring in 2010 found GMB and grass mealybug presence at 96% of cooperating sites. While total numbers of GMB in Umpqua, Applegate, and Illinois Valley were substantially lower than in the Rogue Valley, this does not suggest that growers and wineries can be less vigilant. We are still uncertain as to the possible factors (i.e. climate, predator status, vine age) that may be leading to increased GMB presence and economic impact. Therefore, we are recommending that vineyard managers continue to utilize pheromone traps and begin to routinely scout their vines. Concurrently in the 2011 season, the Viticulture Program Team will implement more focused in-vineyard monitoring. These efforts should confirm more aspects of developmental biology and ecology as well as the efficacy of chemical and non-chemical management of this emerging winegrape pest in southern Oregon.

The Annual Canker Soapbox

Jay W. Pscheidt, Ph.D., Extension Plant Pathologist, OSU

Eutypa dieback has the potential to be a serious disease problem in Oregon vineyards. So far it does not seem to be a big problem. Why not? This is because we have all been proactive about preventing this disease. Keep up the good work so that we can keep it that way!

Fantastic Fungal Facts for Farmers

Infection occurs when airborne fungal spores contact fresh pruning wounds during or immediately following rain.

Large pruning wounds become resistant to infection about two to four weeks after pruning.

Other hosts which can be a source of these fungal spores include apples, cherries, pears, and walnuts, plants grown as ornamentals, or plants in riparian areas such as big leaf maple and willow.

Symptoms may not appear on diseased vines for more than three years after infection. Symptoms are best seen in spring when healthy grapevine shoots are 10 to 15 inches long, and include shortened, stunted shoots with deformed and tattered leaves.

It is also common to find one side of a vine dead or with disease symptoms and the other side apparently healthy.

Symptoms of other fungal canker diseases are virtually the same as Eutypa. Fortunately, management tactics that work for Eutypa dieback will also work for these other cankers.

Concentrated Control can Contain Cankers

Avoid large pruning cuts when possible, and avoid pruning during and before wet weather.

When making large cuts during wet weather, leave a stub several inches long to be pruned off later during dry weather in spring. This method is sometimes referred to as double pruning.

Remove and destroy all large trunk or cordon pieces from the vineyard.

Treat large pruning wounds with Rally (regular label) or Topsin (SLN OR-100003). Treatment is useful when re-training vines and making large trunk or cordon cuts.

Serenade MAX can be used to prevent infection, but efficacy in the Pacific Northwest is unknown.

More Information

For more information on Eutypa Dieback, visit the following two resources:

- Online Guide to Plant Disease Control
- Grapevine Trunk Diseases in California

This is a vine showing symptoms of Eutypa dieback in spring. Notice the pronounced stunting on the vine with more severe stunting and defoliation on the left cane. (photo courtesy of P. Skinkis)

Act now: Monitor now for mite-associated Short Shoot Syndrome (SSS)

Vaughn M. Walton, Ph.D., Horticultural Entomology, OSU

The late dormant period in vineyards is an important time for growers to determine whether they have overwintering rust or bud mites (eriophyid mites) in cane and bud tissues. Information on the status of eriophyid mite presence can help growers make more informed control decisions regarding management of mite-related Short Shoot Syndrome (em8944-e).

Dormant pruning is currently in progress, and this is an ideal time to collect shoots from areas in your vineyard to see if buds and other vine tissue have eriophyid mite infestations. We encourage growers who have had SSS symptoms and rust mite infestations during previous seasons to take shoot samples now, while the vines are dormant, to determine infestation and plan for action during the wooly bud stage this spring.

How to take vineyard samples:

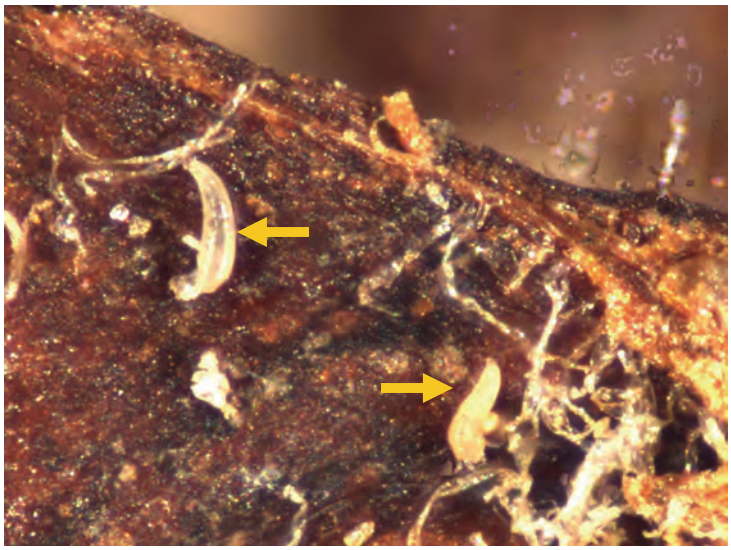
Bud and rust mites are microscopic and very difficult to see when in overwintering sites in the buds and/or canes. Collect samples from previously affected vineyards by sampling areas of between 1 and 4 acres.

1. Collect one basal section of a shoot from each of 40 evenly distributed vines in the affected vineyard area. Discard the distal section.
2. Place shoots inside clearly marked plastic bags. Be sure to include the following details: date, cultivar, year planted, location in field, contact name and address, and other pertinent information that might help researchers understand the problem.
3. Refrigerate samples and keep out of direct sunlight. You can hold samples for as long as two weeks before submitting them for analysis.

You can also see a video on how to take samples, available online at: http://www.youtube.com/watch?v=gQywasrp5TQ

For the late dormant season of 2011, samples should be dropped off or mailed to the following address. If you have questions, please call 541-740-4149.

Vaughn Walton, PhD
Horticultural Entomologist
Oregon State University
Department of Horticulture
4017 ALS Bldg (ALS 4079C)
Corvallis, Oregon 97331



Rust mites are tiny and very difficult to see in dormant bud and cane tissue. This image is highly magnified to show the rust mites present. Yellow arrows indicate the rust mites present.

Rust mite damage can lead to short, stunted shoots with visible scarring. This is a shoot at véraison that had been stunted by rust mites.

To till or not to till? – Impacts on grape YAN

Jungmin Lee, Ph.D., Research Food Chemist, USDA-ARS-Horticultural Crops Research Unit
Kerri Steenwerth, Ph.D., Research Soil Scientist, USDA-ARS-Crops Pathology and Genetics Research Unit

A preliminary study was conducted on how two rootstocks and three vineyard floor management regimes influenced nitrogen (N) containing compounds, sugars, and organic acids in Cabernet Sauvignon grapes in California. Nitrogen-containing compounds have important functions in both grapevine growth and grape composition, and ultimately wine fermentation. Rootstocks have been demonstrated to play a role in the grapevine N profile. In addition, cover cropping has been used as a popular weed control method for sustainable agricultural practices and as a vineyard management tool that might improve soil conditions favorable to grapevines.

Rootstocks evaluated in this study were 110R (110 Richter; high vigor) and 420A (low vigor) grafted to scion Cabernet Sauvignon clone 8. The three vineyard floor management treatments were as follows: 1) resident vegetation composed of forbs and annual grasses that were mowed then tilled (control; current commercial vineyard floor management practice in CA), 2) barley UC603 (*Hordeum vulgare*; short stature barley) mowed in April (CC+mow), and 3) barley UC603 mowed then tilled in April (CC+till). Vines were allowed to growth through the season and grapes were harvested when they reached ~25 ˚Brix. To determine impacts of the field treatments on fruit N, we looked at mainly ammonia and free amino acids, recalculated as YAN.

The two different rootstock and scion combinations altered grape N compounds more than vineyard floor management practices. Grapes from the more vigorous rootstock here, 110R, were significantly higher in some free amino acids (SER, GLN, THR, ARG, VAL, ILE, LEU) and YAN compared to grapes from vines grafted to 420A rootstock. Grapes from both rootstocks would likely require nutrient supplementation prior to alcoholic fermentation since 110R and 420A resulted in 73 mg of YAN/Kg and 64 mg of YAN/Kg in whole berries, respectively. No significant differences in grape YAN among vineyard floor treatments were detected, and fruit ranged from 60 to 78 mg of YAN/Kg in whole berries.

These findings suggest that vineyard managers can utilize barley and mowing (no-tillage) without negatively impacting grape N compounds, sugars, and organic acids, at least in the early period after adoption. One might anticipate longer-term cumulative effects of vineyard floor management. This cover crop research is only in the initial phase at this site, as the vineyard floor treatments existed for two years prior to sampling. It will be interesting to discover if in future years the no-tilling (mowing) vineyard floor managements eventually alter grape N profiles.

Dr. Jungmin Lee is a member of the Oregon Viticulture and Enology Working Group which includes faculty and researchers of Oregon State University and the USDA-ARS. If you would like to read more about the initial part of this work, please refer to the following publication and visit the following research program websites.

Lee, J. and Steenwerth, K.L. 2011. Rootstock and vineyard floor management influence on 'Cabernet Sauvignon' grape yeast assimilable nitrogen (YAN). *Food Chem*. In press.

- http://www.ars.usda.gov/pwa/hcrl/lee
- http://www.ars.usda.gov/pandp/people/people.htm?personid=36998

If you would like to obtain a copy of the publication, feel free to contact the authors at jungmin.lee@ars.usda.gov (208-722-6701 ext 282) and ksteenwerth@ucdavis.edu (530-752-7535).

UC Davis Oakville Experimental Vineyard (Oakville, CA). Vines were planted in 1994. Vine spacing was 1.8 m by 2.4 m, and row orientation was east-west. Vineyard floor management treatments were applied in April.

Managing the Malolactic Fermentation

James Osborne, Ph.D., Extension Enologist, OSU

At the recent Oregon Wine Industry Symposium, a session was dedicated to the malolactic fermentation (MLF). This article will be a follow up to some of the topics covered during the session including how to optimize conditions to conduct a successful MLF. The malolactic fermentation (MLF) is an important secondary fermentation of wines performed by lactic acid bacteria, primarily *Oenococcus oeni*. During this process, malic acid is converted 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. For wines grown in cool climates that contain high levels of malic acid, this decrease in acidity is essential to the balance of the wine, particularly red wines. However, the MLF is much more than just a biochemical deacidification process. The bacteria *O. oeni* can also impact the flavor and aroma of a wine as well as the mouthfeel. For example, *O. oeni* has been shown to change the concentration of flavor and aroma compounds such as diacetyl, acetaldehyde, esters, and terpenes.

Diacetyl is the most well characterized flavor compound produced by *O. oeni*. It is a by-product of citric acid metabolism and is best described as having a "movie popcorn" aroma and flavor. At high concentrations (> 7 mg/L) it can be objectionable in wine but at lower concentrations it may be desirable depending on the wine and style. Its 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 some *O. oeni* strains are capable of releasing bound volatile compounds such as terpenes. The significance of these sensory changes is still being determined.

While an important part of the winemaking process, the MLF can often be difficult to initiate and control. This may mean large delays as you wait for the MLF to complete and also leaves wine prone to spoilage as you are unable to add SO_2 until the MLF is finished. Managing the MLF begins at the start of the winemaking process. Ensuring you have clean fruit 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 maximum 70 mg/L SO_2 for a red if you desire the wine to go through MLF. Excess SO_2 in the wine, and particularly free SO_2, will inhibit the malolactic bacteria and prevent the MLF from occurring. This is also pH-dependent with SO_2 being more effective at lower pH levels. Juice parameters such as°Brix and pH will also impact the MLF further downstream. Optimal alcohol for the MLF is < 13.5% while pH between 3.20 and 3.50 is optimal. Below pH 3.0, the bacteria will struggle to grow. At higher pH levels, the bacteria will grow well, but the conversion of malic acid to lactic acid is optimal below pH 4.0. Also, spoilage bacteria such as *Lactobacillus* and *Pediococcus* are favored at higher pH values. Measuring malic acid levels in your juice can also be 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*.

When it comes to conducting the MLF, temperature can be the dominant factor in determining whether the MLF will happen or not. Optimal temperature for the MLF is around 64-75˚F. High temperatures may kill the bacteria while most strains of *O. oeni* either cease to grow or grow very slowly below 59˚F, although there are some commercial ML strains that have been developed/selected to tolerate lower temperatures. Increasing the temperature of a wine that is slow going through MLF is sometimes enough to get things going again. Often barrel room temperatures may be too cold for the bacteria, so moving the barrels to a warmer room for a while can help the MLF along. An additional concern is alcohol level. Generally, the malolactic bacteria are inhibited to some degree in wines with alcohols above 13.5 %. However, there are some commercial malolactic cultures that have been developed to tolerate high alcohol wines, so be aware of this if you have high ˚Brix musts (say above 26 ˚Brix). In addition, if you are dealing with high alcohol wine, use acclimatization steps for the culture before inoculating: http://www.scottlab.com/uploads/documents/downloads/65/Standard%20Build-Up.pdf This process allows the bacteria to acclimatize to the wine conditions slowly before being inoculated.

Regularly monitor the MLF using paper chromatography or enzymatic analysis. Test strips will show if the MLF is not complete but they are not very accurate, and a more precise analysis is needed to determine when the MLF is complete. It is important to know the progress of the MLF as well as when it is complete so you can make an SO_2 addition. Concentrations of malic acid below 50 mg/L indicate that the MLF is finished. If the MLF is proceeding very slowly or not at all, be vigilant in monitoring for microbial spoilage. Monitor VA as an indicator of spoilage, and be sure to check wine under the microscope to look for the presence of spoilage bacteria. One additional comment about conducting successful MLFs: there needs to be a high population of bacteria present in the wine for the MLF to occur. A population of around 10^6 cells per mL is required to initiate MLF. This means that natural/indigenous MLFs can have a lag phase of weeks to several months before they begin. Be aware of this if you intend to rely on naturally occurring bacteria to conduct the MLF.

As a final note, I would like to emphasize that all of the factors mentioned here act in synergy with each other, so it is important to consider them all together. For example, at lower pH levels, any SO_2 present will be more inhibitory to the malolactic bacteria while at higher temperatures, the bacteria will be more sensitive to high

alcohol content. Any factors which cause stress to the bacteria will make them more susceptible to other environmental pressures. For a successful MLF, try to optimize the factors that influence the growth of the bacteria and remember to monitor the progress of the fermentation so that you are aware of problems when they occur. This may enable you to take remedial action so that you can get your wine through MLF.

Accompanying this article is a flowchart that summarizes parameters, recommendations, and actions for each step of the winemaking process that will help you conduct a successful MLF.

References used

Britz, T.J. and Tracey, R.P. (1990). The combination effect of pH, SO_2, ethanol and temperature on the growth of *Leuconostoc oenos*. Journal of Applied Bacteriology **68**, 23-31.

Henick-Kling, T. (1993). Malolactic Fermentation. *In* "Wine Microbiology and Biotechnology" (G. H. Fleet, Ed.), pp. 286-326. Harwood Academic Publishers, Switzerland.

Liu, S.-Q. (2002). Malolactic fermentation in wine-beyond deacidification. Journal of Applied Microbiology **92**, 589-601.

Nielsen, J. C. and Richelieu, M. (1999). Control of flavor development in wine during and after malolactic fermentation by *Oenococcus oeni*. Applied and Environmental Microbiology **65** (2), 740-745.

Osborne, J.P. and Edwards, C.G. (2005). Bacteria important during winemaking. Advances in Food and Nutrition Research **50**, 140-177.

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

Wibowo, D. Eschenbruch, R. Davis, C.R. Fleet, G.H. and Lee, T.H. (1985). Occurrence and growth of lactic acid bacteria in wine: A review. American Journal of Enology and Viticulture **36**, 302-312.

CONDUCTING A SUCCESSFUL MALOLACTIC FERMENTATION

	PARAMETER	RECOMMENDATION	ACTION
Grapes	pH	Between 3.20 and 3.50	Acid addition after cold soak
	Fruit condition	Visible rot, off odors	Sorting
Crush/Destem Maceration	SO_2	< 40 mg/L total for white < 70 mg/L total for red	Minimize SO_2 by using sound grapes
	Potential alcohol	< 13.5 %	Harvest parameters
Alcoholic Fermentation	Yeast strain	Use yeast strain that is compatible with ML bacteria	Check with yeast supplier
Malolactic Fermentation	Inoculation strategy Timing Strain	Inoculate with starter culture Post-alcoholic fermentation Consider strains recommended for certain difficult wine conditions	Direct, Step 1, or Build up: follow manufacturer recommendation Strains available with low pH tolerance, high SO_2 tolerance and high alcohol tolerance
	Temperature	64-71°F (18-22°C)	Inoculate while wine still warm from primary ferment Temp-controlled cellar/tanks
	SO_2	< 5 mg/L free	NO SO_2 additions until MLF complete
	Alcohol	< 13.5%	Consider higher alcohol tolerant ML strain Use acclimatization steps for culture prior to inoculation
	pH	3.20 to 3.50	Acid adjustment if necessary (not recommended during MLF) Be alert to microbial spoilage issues if you have a high pH
	Nutrients	Consider ML nutrients if vineyard lots have been problematic in the past or you used high nutrient demand yeast strain Conduct MLF on yeast lees	Follow manufacturer recommendation Keep wine on light lees during MLF
	MLF progress	Regular monitoring Microscopic examination for Lactobacillus, Pediococcus Monitor VA as indicator of spoilage bacteria PCR analysis	Paper chromatography, enzymatic analysis, external lab analysis If presence of spoilage bacteria consider lysozyme and re-inoculation after 2-3 weeks
Post Fermentation & Aging	MLF completion	Malic acid < 30-50 mg/L	Confirm with enzymatic assay or external lab analysis before making SO_2 addition

New Viticulture & Enology Resources

2011 Pest Management Guide for Wine Grapes in Oregon

This practical guide is produced annually by Oregon State University Extension faculty and is available free of charge online at http://wine.oregonstate.edu/publications.

eViticulture (http://eViticulture.org)

This is a new online resource for commercial grape growers. It is a result of a national initiative to pull together resources from viticulture specialists across America's land grant universities. The information is made available to the commercial grape industry throughout the US. The website also offers articles in Spanish. Check it out today!

Enology Access (http://enologyaccess.org/Home.htm)

This is an online resource that provides a collection of enology research and knowledge from around the world. It has been created to provide outreach and extension to the wine industry.

Upcoming Events

Sulfides in Winemaking – April 12, 2011

Join us for a half-day workshop to explore the factors influencing sulfide production during winemaking as well as ways to reduce their formation. Dr. Linda Bisson, UC-Davis, will discuss the latest research regarding this complex problem. Gaining a better understanding of sulfide formation may help many minimize problems. Dr. James Osborne, Oregon State University/ OWRI, will also be presenting. For more information and registration, contact Debby Yacas at 541-737-6483 (1-800-823-2357) or email: deborah.yacas@oregonstate.edu.

Vineyard Scouting Workshop – May 17, 2011

This workshop is back by popular demand! A group of OWRI researchers and Extension faculty will be in southern Oregon this year to present this half-day event. Topics to be covered include monitoring for insect pests, diseases (viruses and fungal diseases), nematodes, and vine nutrition. More information can be found at http://wine.oregonstate.edu.

Oregon Wine Research Institute Seminar Series– Spring 2011

Various seminars are being hosted by the OWRI during spring 2011. These are often held on the OSU Campus in Corvallis but are also available live online. To find out more, contact Neil Shay, OWRI Direct, at Neil.Shay@oregonstate.edu, or visit http://wine.oregonstate.edu.

2011 LIVE Lecture Series

The LIVE - Low Input Viticulture & Enology organization has an educational lecture series developed for 2011 with varying topics regarding vineyard sustainability. Information will be presented from a number of OSU/OWRI faculty and researchers during the year. To find out more about these programs, visit http://liveinc.org/lectures.