# OSU Wine and Grape Research and Extension Newsletter

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## In this issue:



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## Welcome to the October 2007 Newsletter!

### Welcome Autumn!

The growing season has come to an end and everyone is feverishly trying to harvest fruit before rain and/or frost, depending on the specific vineyard location throughout the state of Oregon. Here at OSU, we've been busy over the past few months providing programming to growers and winemakers. During August, September and the better part of early October there have been many vineyard and winery visits and workshops presented by OSU faculty. The Southern Oregon Vineyard Tour was held in early August, and OSU faculty members Phil VanBuskirk, Vaughn Walton, Jay Pscheidt, Patty Skinkis and Marcus Buchanan toured several vineyard sites in the Rogue, Illinois and Applegate Valleys with a group of 20+ growers to evaluate and discuss vineyard issues. A similar tour was held in early August in the Columbia Gorge where Patty Skinkis and Steve Castagnoli toured several vineyard sites with a group of growers, lead by Lonnie Wright, of The Pines Vineyard and Winery, to discuss management methods that work well for the area. In mid August, Patty Skinkis, James Osborne and Steve Renquist kicked of the first workshop in a series of statewide programs known as "Vine Ventures" in Roseburg.

As everyone's attention turned to fruit ripening and harvest in September, Skinkis and Osborne presented two hands-on workshops on grape maturity. One of the workshops was in collaboration with Chemeketa's grape and wine programs and the other was presented in Hood River in conjunction with the OSU Hood River County Extension and Columbia Gorge Community College. Participants learned sampling techniques to assess maturity prior to harvest. In addition, Osborne presented a workshop on winery sanitation for Columbia Gorge area wineries. OSU faculty also participated in a LIVE vineyard tour to discuss sustainable management practices including cover crop management, weed control and short shoot problems at Domaine Serene (Joel Myers) and Stoller Vineyards (Allen Holstein and Jaime Cantu) and a look at oak restoration efforts with the Gladharts at Winter's Hill Winery. As we go into the "dormant" or "winemaking" season, depending on your area of expertise, OSU faculty will provide opportunities for workshops on vineyard economics, dormant pruning, winery filtration and more. Please see our "Upcoming Events" section for future OSU workshops as well as state, regional and national conferences.

We look forward to the many opportunities to work with members of the industry throughout the state. As always, we welcome your comments and suggestions!

*~The OSU Winegrape Team*

## Sulfides and Mercaptans in Wine

*Dr. James Osborne, Enology Extension Specialist*

The formation of sulfides and mercaptans in wine has been a problem since winemaking began. Although our knowledge of these compounds and their formation during winemaking has greatly increased over the last decade, problems associated with these compounds persist and in some cases seem to be on the increase. The following article is a general review of the formation of sulfides and mercaptans in wine, factors influencing their formation, and how to deal with these issues when they arise.

**Sulfides.** Sulfides and mercaptans are known to impart distinctive aromas to wines such as skunky, rubbery, garlic, onion, or cabbage like. Hydrogen sulfide (sulfur in its most reduced form) smells like rotten eggs when present in large amounts. Mercaptans and disulfides are often described as having a vegetable character (cabbage, onion, asparagus), or a burnt rubber, kerosene character. In addition, at low levels where objectionable aromas are not detectable these compounds instead can make a wine seem less fruity than expected. The presence of these compounds can also impact the mouthfeel of a wine by decreasing the perception of volume or body and increasing the perception of bitterness and astringency.

These sulfur containing compounds usually originate with yeasts. Sulfur is an essential element for yeast growth. Available as sulfate in grape juice, sulfur is reduced to hydrogen sulfide ($H_2S$) and utilized in the production of proteins and vitamins within the yeast cell. Because $H_2S$ is an integral part of yeast metabolism, it is not possible to completely eliminate its production. There are however, many different factors that can influence the amount of $H_2S$ produced during the alcoholic fermentation and these can be managed to minimize its production. While the mechanisms by which yeast produce sulfides are complex and still not fully understood one thing is clear, that almost any event or condition that stresses yeasts encourages $H_2S$ production. For example, adding yeast to must that is too cold without an acclimation step, over-clarification of the juice, high fermentation rates, low fermentation rates, low nitrogen, low vitamins, high or low fermentation temperature, too much $SO_2$ in the juice, can all cause $H_2S$ formation.

The presence of elemental sulfur in the grape must will also contribute to increased $H_2S$ production. As little as 1 microgram per liter of elemental sulfur in the must is enough to produce objectionable $H_2S$ concentrations in the wine. Therefore sulfur sprays should not occur less than 30 days prior to harvest. If grapes have sulfur dust clinging to them, white juice should be settled and racked to reduce the amount of sulfur dust present. Late-season application of metal-containing fungicides can also increase the production of $H_2S$ and possibly other sulfur-containing compounds. Yeast respond to residual copper by producing $H_2S$ to bind it up. This is also the reason why copper sulfate ($CuSO_4$) should not be added to an active ferment.

**YAN.** The concentration of yeast available nitrogen (YAN) and vitamins in the grape must has been established as having a major impact on $H_2S$ production. When yeast run out of nitrogen, its amino acid metabolism is halted and $H_2S$ is produced instead. In addition, if yeast run out of certain vitamins this will also cause $H_2S$ production. This is because vitamins such as pantothenic acid are involved in utilization of sulfide into amino acids. If this vitamin is deficient the sulfide is unable to be incorporated into an amino acid and instead is released as $H_2S$ by the yeast. Therefore it is important to have sufficient YAN and vitamins in the grape must to ensure both the completion of the fermentation but also to minimize the production of $H_2S$. It is suggested that the grape must contain between 200-300 mg/L of YAN. This includes. YAN can be measured using the NOPA test and ammonia assay which combined give you the nitrogen available from amino acids and ammonia present in the grape must. It is particularly important to measure the amount of nitrogen in your grape must during hot years when nitrogen may naturally be low and you may need to make an amendment. In addition, in years where there may be a lot of rot on the fruit the nitrogen in the must may also be low as moulds and fungi will deplete the nitrogen in the grapes. If your grape must is deficient in nitrogen it may also be low in essential vitamins and therefore it is advised that a complex nutrient containing yeast extract (such as Superfood or Fermaid K) be used in addition to using a nitrogen source such as diammonium phosphate (DAP). It is important to note that these additions should take place before fermentation and during the early period of fermentation, not late in the fermentation. Late in the fermentation the yeast are unable to uptake nitrogen and so nutrient additions are not effective if $H_2S$ appears at the end of fermentation. Yeast strains also differ significantly in their ability to produce $H_2S$. In particular, yeast strains that have a high nutrient requirement are often problematic although due to the complexity of factors influencing $H_2S$ production, no strain can be said to be problem free. After fermentation, $H_2S$ can be formed in barrel-aged wines from interaction with drips from sulfur wicks or rings burnt in the barrel when it was stored empty. These may not have burned completely and so unburned sulfur enters the wine. The use of drip less sulfur sticks and/or sulfur cups will prevent this problem.

**Mercaptans and Disulfides.** These usually emerge post-fermentation during cellaring but some wine may produce disulfides in the fermenter. Mercaptans and disulfides have several sources, including combination of $H_2S$ and alcohol via acetaldehyde. Exposure to light can also produce mercaptans, a problem if wine is bottled in clear bottles. In general, by reducing the formation of $H_2S$ during fermentation you will also reduce the risk of forming mercaptans and disulfides during cellaring. Mercaptans have a very low sensory threshold of approximately 1 part per billion. Mercaptans can be oxidized to disulfides when exposed to air which influences both their sensory attributes and their ability to bind copper. The sensory threshold of disulfides is around 30 parts per million (mg/L). It is important to determine which types of sulfides ($H_2S$, mercaptans, disulphides) are present in your wine so that you can take appropriate action. A useful and simple sulfide detection trial is outlined at the below link:

http://www.thewinelab.com/_fileCabinet/TECH_INFO/sulfidedetectionkit.pdf

**Remedial Steps for Sulfides.** Once you have determined the types of sulfides present in your wine, you can take appropriate measures to avoid this.

While large amounts of $H_2S$ may be produced during fermentation, much of this $H_2S$ is usually volatilized from the wine along with $CO_2$. However, residual $H_2S$ can pose a problem due to its low sensory threshold and its potential reactivity. In particular, the formation of mercaptans and disulfides during cellar aging can be very problematic as these compounds are more difficult to remove. After fermentation, when $H_2S$ alone is present, aeration and splashing may dissipate the odor. However, aeration of wine that contains mercaptans may cause the formation of disulfides. If $H_2S$ aromas persist, it may be necessary to treat the wine with copper. Treatment of wines with copper sulfate is a common practice used to remove $H_2S$ and mercaptans. Copper ions combine with $H_2S$ and mercaptans to form complexes with no offensive smell. Copper sulfate is usually added to the wine and bench top trials MUST be conducted to determine the appropriate dose. Concentrations of between 0.05 and 0.3 mg/L of copper are commonly added. It is important to be careful with the amount of

copper added to your wine as U.S. government regulations allow additions of up to 0.5 mg/L copper while residual levels in the wine cannot exceed 0.2 mg/L (as copper). Additionally, copper should not be added to the wine until the fermentation is complete and the amount of yeast material is reduced by racking. Yeast cells can bind with the copper and reduce its effectiveness.

Although mercaptans react with copper, disulfides do not. Thus, if the wine in question has undergone any oxidation, it may be necessary to reduce the disulfides back to the reactive species, mercaptans. This can be accomplished by addition of ascorbic acid. Generally, addition levels of 50 mg/L or more of ascorbic acid are used, and such additions usually are made several days prior to the addition of copper. Again, bench top trials are recommended to determine whether ascorbic acid is needed and at what rate. Some free $SO_2$ is needed in the wine (preferably at least 0.5 mg/L molecular) or ascorbic acid may promote oxidation. One major concern with disulfides is that if you aerate wine to remove sulfide aromas you may oxidize mercaptans present to disulfides. Initially you will notice a loss of the offensive mercaptan aromas as disulfides have a much higher sensory threshold than mercaptans and may not be detected. However, the disulfides are still there and when conditions in the wine become more reductive (say during barrel aging or, worst case scenario, in the bottle) the disulfides can be reduced back to mercaptans resulting in a "reappearance" of sulfide aromas.

**Lees Management.** This can also play a role in minimizing the formation of sulfides and mercaptans. In particular, wine should be removed from heavy lees as early as possible. Heavy lees are described as those that precipitate within 24 hours after the completion of the alcoholic fermentation. Wines should be separated from these lees as they can promote the production of sulfides and mercaptans. The light lees however, those that don't precipitate after 24 hours, may be useful in improving a wine's mouthfeel and texture. If sulfide aromas develop while on light lees, racking and aeration of the wine, with the temporary removal of the lees, may provide some removal of the reduced sulfur compounds. In fact, the yeast lees can act as a fining agent in the removal of some reduced sulfur compounds as proteins in their cell walls can form bonds with these compounds.

**Conclusion.** Overall, the best way to prevent or minimize the production of sulfides and mercaptans is to treat the wine early. Preventative measures that minimize the production of $H_2S$ during fermentation are likely to be much more successful then trying to remove mercaptans and disulfides from the wine during cellar aging. Early treatment of $H_2S$ problems can also prevent the formation of the more troublesome mercaptans and disulfides. The key points are:

- Prevent elemental sulfur getting into the grape must (no late season sulfur sprays)
- Use fresh, healthy yeast and rehydrate according to manufacturers recommendations (acclimatize yeast to cold temperature must)
- Make sure there is sufficient yeast nutrients in the must. This may mean the addition of DAP and a complex yeast food
- Minimize large fluctuations in temperature during fermentation (stresses yeast)
- Do sulfide detection trials on wine and treat appropriately
- $H_2S$ problems in new wine may be treated with aeration/racking
- $H_2S$ and mercaptans can be treated with copper
- Disulfides must be treated with ascorbic acid before use of copper
- Remove wine from heavy lees

In essence, controlling wine sulfides plays an important role in winemaking and must be monitored correctly.

## Vineyard Management Resources

**NEW! Organic Fertilizer Calculator**
Developed by Nick Andrews of OSU Extension, this calculator helps you determine cost, nutrient value and nitrogen availability of organic fertilizers. This is a free Excel program that can be downloaded at the following website:
http://smallfarms.oregonstate.edu/organic-fertilizer-calculator

## Southern Oregon Welcomes the New Regional Viticulture Instructor

Marcus Buchanan, Ph.D. began his position in viticulture extension in Southern Oregon in mid-July. He brings to the area expertise in soil and irrigation management. Buchanan has experience in soil fertility, plant physiology and nutrition in many irrigated annual and perennial, warm and cool season crops, including winegrapes. During the past 15 years, he worked as a University of California faculty member and as an independent consultant in the areas of nutrient and irrigation management, solid waste and wastewater

Marcus Buchanan (left) and Kurt Lotspeich (right) at the Southern Oregon Vineyard Tour.

OSU Wine and Grape Research and Extension Newsletter

October 2007 http://wine.oregonstate.edu

land application projects in Central California. This work has been performed privately for growers, food processors, wineries, and for public water and irrigation districts. His work in vineyards has been focused on soil and nutrition, the efficacy of drip fertigation, irrigation scheduling, and the use of cover cropping and compost.

Since Marcus began his position at the Oregon State University Southern Oregon Research and Extension Center (SOREC), he has been busy walking vineyards, listening to and learning from growers in Jackson and Josephine Counties. In this time, he has learned that many growers would benefit from more information and education in the areas of soil fertility and vine nutrition, including how to interpret lab soil and tissue analysis reports, fertigation, and irrigation scheduling. He is currently working with growers to increase the health of vineyard blocks that lack sufficient vigor for quality grape production. Some of the other vineyard problems in which Marcus is beginning to focus his efforts in collaboration with growers include crown gall and nutritional concerns (nitrogen, potassium, and zinc).

Marcus is planning to develop a series of winter classes for 2008 to provide growers with basic technical background in soils, plant nutrition and irrigation scheduling. He is also planning to develop some additional on-vineyard projects with growers to address individual and industry-wide production issues.

## Putting the Vineyard to Rest: How to Prepare for Next Season

*Dr. Patty Skinkis, Viticulture Extension Specialist*

The growing season is quickly coming to a close and the last of the vineyards are planning to harvest their fruit relatively soon. Here are a few things to consider before you close up shop and await dormant pruning.

**Think Nutrition!**

As the season winds down and the vines begin dormancy, it is important to consider the health of the vines. Although the shoots have lignified, the leaves begin to drop and the crop has been harvested, the vine has not stopped growing. The roots are actively growing post-harvest and are taking up key soil nutrients for storage and utilization during next season. Nitrogen and other nutrients are taken up from the soil and kept in reserve for next season. Most of the nitrogen used after bud break and prior to bloom is remobilized from storage reserves. If your vineyard has shown low nitrogen levels from your tissue nutrient analysis, now is the time to do some nitrogen fertilization either through the soil or through drip irrigation. Be mindful of the nitrogen levels and formulations that you are using. Also, using too much can lead to volatilization or losses due to nitrate leaching during the wet winter months.

Boron (B) deficiency is one of the main nutritional concerns for many vineyards in Western Oregon. It is most important in fruit set where it influences pollen tube growth for pollination and fertilization (fruit set); therefore, many deficient vines often display poor fruit set and/or shot berries (Figure 1). Deficient vines often have stunted shoot growth in spring as B is vital to cell division in the shoots and leaves (Figure 2). To combat deficiency problems, many vineyards will apply low rates of B (0.5 lb/acre) via foliar sprays at bloom or pre-bloom or spread B sprays throughout the growing season. However, fall B sprays may provide a more efficient delivery to reproductive tissues to be utilized the following season. The vine is less sensitive to B phytotoxicity post-harvest and slightly higher rates can be applied (~1 lb/acre). Recent research indicates a foliar application immediately after harvest leads to a significant increase in fruit set when compared to fall soil B, or pre-bloom/bloom foliar sprays (Christensen et al. 2006). In Christensen's trials, the fall foliar application reduced poor fruit set symptoms by 75% in comparison to the control.

Figure 1. Poor fruit set due to B deficiency. (Zabadal, MSU).

Figure 2. Boron deficient vine with short shoot length and poor fruit set (August 2007). This is distinct from the so-called "Short Shoot Syndrome" (SSS) which is associated with early season rust/bud mite damage. Generally, SSS shoots grow during the season but B deficient vines have shoots that remain stunted. Photo courtesy of Vaughn Walton.

Southern Oregon growers need to be aware that the high calcium (Ca) levels in the serpentine soils can lead to problems with B availability. Foliar B sprays would be better than soil applications due to Ca tying up the B and forming unavailable complexes of the two nutrients. Investigation of the Ca to B ratio in your soil tests will give you an idea of the nutrient availability to the vines. While increased calcium levels cause decreased availability of B, it provides increased

availability of Mg, Zn, K, Na and Mn (Tariq 2006). High soil Ca can further exacerbate already high Mg concentrations in Southern Oregon's serpentine soils.

Figure 2. Boron deficient vine with short shoot length and poor fruit set (August 2007). This is distinct from the so-called "Short Shoot Syndrome" (SSS) which is associated with early season rust/bud mite damage. Generally, SSS shoots grow during the season but B deficient vines have shoots that remain stunted. Photo courtesy of Vaughn Walton.

**Prevent Erosion and Nitrogen Leaching**

If you haven't gotten into your vineyard to plant that over-wintering cover crop, you need to do it soon before your tractor gets stuck in the vineyard indefinitely. This is the case in the Willamette Valley where the "rainy season" appears to have a jump start this year!

If between-row tillage is used in the spring, it is good practice to plant a winter annual that can prevent erosion and provide a green manure when tilled into the soil the following spring. Cereal crops can be used to incorporate biomass without adding too much nitrogen to high vigor sites, such as oats. Certain cereal crops have the ability to scavenge nitrogen from the soil; in fertilized farming systems a cereal crop can sequester over 2000 lb of N per year! This prevents the nitrate N from leaching in the fall and is locked up in the cover crop for later incorporation. Low vigor sites or those with low nitrogen soil and tissue levels may consider planting legume cover crops that will provide a natural source of nitrogen and provide a green manure when tilled in the soil during spring, prior to bloom.

Perennial cover crops such as fescues and perennial grasses can also be established in fall to take advantage of the increased rainfall. These will form perennial sod covers to prevent erosion and provide a surface for worker and tractor traffic. If left un-mowed during the season, perennial sods can provide competition in high vigor sites.

It is important to do basic vineyard management practices this fall. Keep in mind efforts to reduce soil erosion, such as cover cropping. Significant soil losses can occur with slopes and winter rain. If you need to make N or B amendment in your vineyard, be sure to use the correct rates and formulations to have the greatest efficacy. Efforts this fall will help increase vineyard health for next spring!

**Literature Cited**


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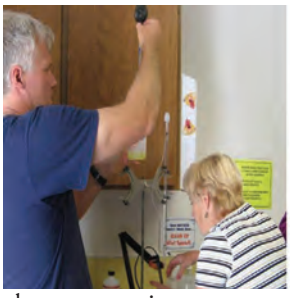
- Tariq, M., C.J.B. Mott. 2006. Influence of applied calcium-boron ratio on the solubility of nutrient-elements in soil. J Ag Bio Sci. 1:1-7.
- Yermiyahu, U., A. Ben-Gal. 2006. Boron toxicity in Grapevine. HortSci. 41:1698-1703.


## Snap-Shots of Viticulture and Enology Extension – October 2007

Participants of the OSU Grape Maturity Workshop sample grapes for analysis from Scott Henry trellis at the OSU Mid-Columbia Agricultural Research and Extension Center, September 2007



Two participants work on measuring grape maturity (soluble solids, pH and TA) at the OSU Grape Maturity Workshop held in Hood River, September 20, 2007.

Patty Skinkis discusses vineyard management practices with growers during the Columbia Gorge Vineyard Tour, August 3, 2007.

Vaughn Walton, Jay Pscheidt and Phil VanBuskirk (left to right) discuss some vineyard pest problems with growers during the Southern Oregon Vineyard Tour, August 2, 2007.

# OSU Wine and Grape Research and Extension Newsletter

October 2007 http://wine.oregonstate.edu

## Upcoming Viticulture and Enology Events

### Upcoming OSU Workshops

**Vine Ventures: Exploring Vineyard Establishment for Central Oregon**
October 20th, 2007, 9:00 AM—4:00 PM
Terrebonne Grange #663
3286 11th Street, Terrebonne, Oregon
Patty Skinkis, Mylen Bohle and Amy Jo Detweiler of OSU will present a workshop on grape vine physiology, understanding vineyard location and climate, and potential grape varieties suitable for central Oregon. Participants will have the opportunity to walk through two new vineyard sites in the area and taste wines produced from such hybrid wine grape varieties as Frontenac, Marchel Foch, Vignoles and more! **Due to limited space, pre-registration/payment is required no later than October 15th.** For more information contact the Crook County Extension office (541) 447-6228, pam.weiderholt@oregonstate.edu

**Vineyard Economics Workshop**
January 18, 2007, 9:00 AM-1:00 PM
North Willamette Research and Extension Center
15210 NE Miley Road, Aurora, OR 97002-9543
Clark Seavert and Patty Skinkis will provide a demonstration on the use of TEAM (Technologies Economics Assessment Model) software to determine costs of establishment and vineyard economic return for existing vineyards. This session will allow you to customize your program for your operations and allow you to use the program to evaluate management decisions down the road.

### Upcoming Conferences

**Napa Valley Winegrape Expo**
COPIA, Napa CA, October 30, 2007
http://napagrowers.org/expo.html

**Northwest Center for Small Fruits Research Annual Meeting**
Holiday Inn, Boise Airport, November 29, 2007
www.nwsmallfruits.org

**Unified Wine and Grape Symposium**
Sacramento Convention Center, Sacramento, CA, January 29-31, 2008
http://unifiedsymposium.org/

**American Society for Enology and Viticulture**
Phenolic Substances in Grapes and Wines, A Symposium honoring Dr. Vernon L. Singleton
Hyatt Regency, Sacramento, CA, February 1, 2008
www.asev.org

**Washington Association of Winegrape Growers Annual Meeting and Trade Show**
Three Rivers Convention Center, Kennewick, February 6-8, 2008
http://www.wawgg.org/index.php?page_id=38

**Oregon Wine Industry Symposium**
Eugene Hilton Hotel, Eugene, OR, February 10-12, 2008
http://explorer.oregonwine.org/symposium.php