OSU Wine and Grape Research and Extension Newsletter

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Welcome to the February 2010 Newsletter

As the dormant season progresses towards the beginning of the 2010 vineyard season, we prepared this newsletter to focus on viticulture topics in disease management and cover cropping.

With pruning taking place across vineyards in Oregon, Dr. Jay Pscheidt reminds vineyard managers to be on alert for canker diseases. Also, as we prepare for this next season, OSU Plant Clinic is preparing for new diagnostic testing services for grape viruses. To round off the vineyard pest management sections of this newsletter, Dr. Amy Dreves provides an updated report on the Spotted Wing Drosophila and the impacts in vineyards.

For those of you who participated in past OSU surveys, you can read a summary of a cover crop survey conducted in 2008-2009. Within that report, Dr. Patty Skinkis provides an update on current cover crop research results.

Finally, take a moment to check out upcoming events for winter 2010 and the newly released OSU Extension Viticulture publications on mealybug and leafroll monitoring.

Cheers,

The OSU Winegrape Team

Avoiding canker problems in the vineyard

Dr. Jay W. Pscheidt, OSU Extension Plant Pathology Specialist

A canker is a dead area of a vine generally found on a trunk or cordon. These dead areas can be due to several different pathogens. We have one called *Eutypa* dieback which, uncontrolled, could become a real problem in Oregon vineyards. This fungus has a 5-year life cycle and many hosts which allow it to sneak into our vineyards slowly. The disease has been quite prevalent on 'Concord' vines in eastern Washington.

Recent surveys in California found that many cankers were caused by several species of *Botryosphaeria*. This fungus may be more extensive and causing more of a problem than *Eutypa*. Similar surveys have not been done in Oregon or Washington to confirm presenence. However, a survey of grape decline problems in British Columbia (Okanagan vineyards) found *B. parva* and *B. dothidea* in declining vineyards.

Symptoms of these various fungal canker diseases can be similar and indistinguishable. You can't diagnose the particular canker disease by visual observation alone. Nevertheless, the management protocols for *Eutypa* dieback and *Botryosphaeria* are the same.

Infection occurs when airborne fungal spores contact large, fresh pruning wounds during or immediately following rain. The small annual pruning wounds we make on one year old wood every year are not a concern. It is larger wounds that are made when removing older wood such as old spurs, cordons or trunks. These larger wounds take a while to heal, becoming resistant to infection about 2 to 4 weeks after pruning.

Pruning during dry weather helps with prevention. However, protecting the newly cut wood has proven to be a more effective tactic. We used to have a product, Benlate - a group 1 fungicide, that was painted onto large pruning wounds for prevention but it is no longer manufactured. Currently, there are no products labeled for canker control on grapes. *Prev-Am*, a product containing borax, is labeled for use on grapes and based on limited preliminary research may have some benefit when used against this disease.

A cultural control method that can be used is "double-pruning." In this method you leave a stub several inches longer than your final cut when making large pruning cuts during wet weather. This extra length of stub is then pruned off later in the year during dry weather when fungal spores lowest. When you are done pruning, be sure to get rid of all those big, gnarly pieces of cordon or trunk you pruned off. They can be sources of these fungi unless they are removed them from the vineyard or burned.

For more information on *Eutypa* dieback or *Botryosphaeria*, visit the OSU Online Guide to Plant Disease Control http://plant-disease.ippc.orst.edu/

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OSU Plant Clinic announces new grape virus testing

The Oregon State University Plant Clinic is gearing up this winter to offer virus testing of grapevines. According to Melody Putnam, chief diagnostician and lab director, the lab is currently testing protocols and hopes to be up and running this spring. They will have the ability to test for Grapevine fan leaf virus, Grapevine fleck virus, and Tomato ring spot virus. By fall of 2010, they will be offering analysis of Grapevine leafroll associated viruses 1, 2, 3, 4, 5, 7, and 9 as well as Grapevine vitivirus A, B, and D, and Rupestris stem pitting-associated virus. The cost of the tests is being determined. If you are interested in this service, please call Melodie Putnam at 541-737-3472.

Currently the OSU Plant Clinic offers diagnostics for Pierce's disease, crown gall, young vine decline, Eutypa, and other fungal and bacterial diseases of grapevines. For more information on location, services, fees, and how to send a sample, visit the OSU Plant Clinic website http://www.science.oregonstate.edu/bpp/Plant_Clinic/index.htm.

Using cover crops as a tool in vineyard management

Dr. Patty Skinkis, OSU Viticulture Extension Specialist

Cover cropping has been a topic of interest in Oregon viticulture for some time. This may be in part because of the requirements to reduce soil erosion, the need to facilitate movement through the vineyard, to provide and enhance biodiversity, or simply because some cover crops look aesthetically pleasing when flowering. To get a better idea of how cover cropping is currently being used in vineyards, a survey of the Oregon winegrape industry was conducted in August 2008-July 2009. This survey was used to better understand what is being planted and how vineyard alleyway vegetation is being managed. Results are being used to develop further research and Extension programming in the area of cover crop management and to understand its use as a management tool in Oregon vineyards. Thanks to participating viticulturists, vineyard managers, consultants, winemakers and wine business owners from across all of Oregon's winegrape production regions, we received a total of 107 responses.

Cover crops are widely used in Oregon as is evidenced by 92 percent of industry respondents who indicated that they grow vegetation in the alleyways of young to mature vineyards. The majority (36%) use perennial grasses as the alleyway cover (Figure 1), and the second most common vegetation being resident vegetation or weeds (23%).

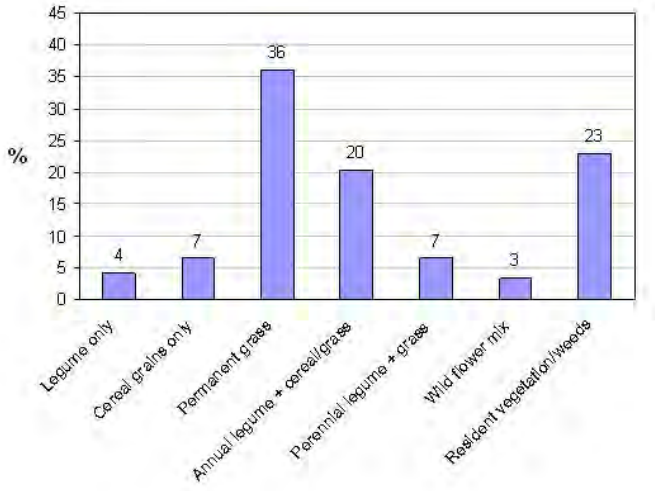

Figure 1. Percent of respondents growing different types of cover crops in alleyways of Oregon vineyards (n=99).

Vegetation management in young vineyards

There are different methods of vineyard floor management used in young (<5 years old) as compared to established or mature sites. This survey was designed to understand vineyard floor management practices of both new and established vineyards. We assumed that vineyards take approximately three years to establish and produce their first crop but considered anything less than five years of age to be "young." Many young vineyards, whether dry-farmed or irrigated, often are not planted with a cover crop in alleyways in order to reduce competition with the vine. According to the survey, many young vineyards (37%) are planted with a winter annual cover crop in winter and tilled in spring. However, 41 percent of vineyards less than five years old are planted with permanent cover in alleyways. This likely reflects a transition of young vineyards to producing vineyards in years four and five where a permanent grass cover is established. Once vines are mature, they are most often managed with a permanent perennial cover that is mowed (Table 3).

Table 1. Vineyard floor management of establishing vineyards

Management method in alleyways	% of Respondents
No tillage or mowing	2
No cover year-round	4
Winter annual cover crop, tilled in during spring	37
Winter annual cover crop, mowed in season	10
Perennial cover crop, mowed in season	41
Resident vegetation in off-season, tilled in-season	5

Vineyards that are tilled, or "clean cultivated," to be free of vegetation during the growing season or year-round were managed in this way for several reasons. The most common reason was to reduce plant competition with vines for water (24%) and nutrients (28%) in establishing vineyards. Other reasons cited for tillage were to increase soil organic matter (24%) and to allow for weed control (14%). Those vineyards in which vegetation or cover crops are maintained in a young vineyard year-round were managed this way to help reduce soil erosion, amongst other benefits (Table 2).

Table 2. Reasons for maintaining vegetative cover in young vineyards year-round

Purpose	% of Respondents
Prevent soil erosion	18
Improve soil structure	16
Weed suppression	11
Provide nutrients to young vines	7
Increase traction for labor/machinery	10
Enhance biodiversity	13
Decrease dust	13
Aesthetics	8
Other	2

Vegetation management in mature vineyards

Established vineyards are generally thought to withstand more alleyway competition as the root system becomes well established when compared to young vines. According to the survey of Oregon vineyard managers, 65 percent indicated that vegetative floor covering was maintained to prevent soil erosion in vineyards (Table 4). The other main reasons for specific management practices were to allow for increased organic matter incorporation into the soil (57%) and to manage soil water (51%). A large percentage used cover crop management to regulate vine growth and vigor by either creating or eliminating competition through cover crop addition or removal from the vineyard system. Only a small percentage of Oregon vineyards currently clean cultivate to be free of any vineyard floor vegetation. These practices may reflect more arid regions of production.

Table 3. Vineyard floor management of established vineyards

Management method in alleyways	% of Respondents
No tillage or mowing	1
No cover year-round; tillage or herbicide used	1
Winter annual cover crop, tilled during season	15
Winter annual cover crop, mowed during season	21
Perennial cover crop, mowed during season	51
Resident vegetation, tilled during season	7
Alternate row tilling annually	4

Table 4. Vineyard floor management in mature vineyards (>5 years old)

Purpose	% of Respondents
Prevent soil erosion	65
Regulate vine growth	46
Increase traction for equipment and workers	53
Provide competition with weeds	36
Add organic matter to soil	58
Management of soil water	51
Clean cultivated to decrease competition with vines	15
Clean cultivated to control weeds/pests	8
Clean cultivated to add nutrients/biomass to soil	9
Enhance biodiversity	3

Vineyard cover crop research

Vineyard floor management has been used as a tool in Oregon vineyards for many reasons, including reducing vine vigor to a state of better vine balance, increasing vineyard nutrition and providing for organism biodiversity. Research is being conducted by the Viticulture Research & Extension Program at OSU to investigate impacts of vineyard floor management on young and mature vines. The goal for younger vines is to decrease water inputs while increasing vine health (nutrition and plant growth). In older vines, permanent grass cover is being evaluated as a tool to decrease vine vigor and increase fruit quality.

Data from the first three years of a vine vigor- cover crop study implemented by the OSU Viticulture Program are currently being analyzed and summarized. The basic foundation of this project was derived from the high vegetative vigor that is common in the cool-climate viticulture region of western Oregon. Management strategies were investigated to reduce vine size and increase fruit quality of Pinot Noir. Three alleyway management regimes, including clean cultivation (no-cover), alternate row tillage, and grass cover (no tilling) of an established perennial grass cover crop, were evaluated in a commercial Pinot Noir vineyard site in the Willamette Valley of Oregon during 2007-2009. Late-season irrigation was also evaluated within these treatments. Vine growth and soil moisture were monitored throughout the three seasons. Vines had 22-24% lower leaf area per shoot allowing for greater sunlight infiltration with the grass cover compared with alternately and completely tilled treatments. Pruning weights and cane weights were between 18-42% lower with grass cover than the clean cultivated treatment over the course of the study, effectively indicating vine size decline and reaching a more balanced Ravaz index (yield/pruning weight) over the course of the three years. Competition of the grass for soil moisture is not likely to be the contributing factor to vine size decrease in this study. In-row vine water status and soil moisture did not differ with treatments for 2007-2009. However, nitrogen (N) competition was observed with treatments. Bloom petiole N differed by treatment in 2009 with clean cultivated vines having the highest N content (1.07%) compared to solid grass cover (0.66%). The same trend was found at the véraison sampling. Vine leaf chlorophyll concentrations were 14-25% lower in the grass cover treatment than in either of the tilled treatments throughout the growing season. The fruit quality was also influenced by these field treatments. Yeast available nitrogen (YAN) concentration of must was lower in grass cover compared to the tilled treatments over the course of the study. Although YANs were lower, berry anthocyanins and total skin phenolics were found highest in the grass cover treatment. Irrigation used within this study had limited impact on vine size or fruit quality parameters measured. This study suggests that differences in vine size, anthocyanin and phenolic concentration may be linked to reduced N concentration. Both anthocyanins and phenolics were negatively correlated with increasing YANC in 2008 and 2009, further indicating the link between nitrogen status and fruit quality. Further research is currently being proposed to better understand the effect of permanent grass cover management on vine vigor, nutrient status and fruit quality within this study.

Another trial that is being conducted involves young vineyard cover crop management. In this trial, cover crop biomass management is being evaluated over a 3-year period to determine impacts on vine nutrition, water conservation, and reduced herbicide and fertilizer inputs in new vineyards. A winter annual cover crop of crimson clover and cereal rye was planted in a newly established commercial vineyard (2008). Cover was mown in spring and biomass distributed in four treatments compared to a non-cover treatment. In-row treatments of 0, 1X and 3X biomass mulch rates

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were compared to biomass incorporations into the alleyway and a non-cover cropped treatment. In season one (2009), leaf area per vine tended to be higher in mulched treatments than non-mulched, with no differences observed in shoot lengths. Leaf chlorophyll content was higher in mulched treatments than non-mulched treatments by mid-season when comparing SPAD readings. Leaf blade and petiole carbon, nitrogen, and C:N ratio at véraison were not different between treatments, though a trend was noted in leaf blade nitrogen. Leaf blade and petiole macro- and micronutrient analyses by ICP will be performed in March 2010. Soil nitrate and ammonia analyses will be performed in February 2010. Leaf and shoot biomass was destructively harvested from grapevines at the end of 2009. There was four-fold greater total biomass in the 3X mulch treatment. In addition, fine root biomass of commercial vines was higher in the 3X mulch treatment. Volumetric soil moisture at 0-23 cm was greater in mulched than non-mulched treatments indicating an advantage in this dry-farmed site. However, no vine water stress was observed during season one. In-row weed suppression was highest in mulched treatments with nearly 100% suppression of broadleaf and grass species. Preliminary data indicate that winter annual cover crops may not compete with young vines and may be managed to enhance growth in non-irrigated vineyards. Further years of research will provide more solid data for understanding treatment effects.

Further results of cover crop work outlined here will be presented in March at the OSU Viticulture & Enology Research Colloquium. See information about the event online at http://hort.oregonstate.edu/3-11-2010Event.

Participate in the Vineyard Floor Management Survey – 2010

As we move forward in our research and Extension efforts, we are asking the Oregon winegrape industry to participate in a second vineyard floor management survey before March 15, 2010. The survey should not take more than five minutes and is available online at https://surveys.bus.oregonstate.edu/BsgSurvey2_0/main.aspx?SurveyID=3239&cmd=survey.

What do we know about the Spotted wing Drosophila in Oregon?

Dr. Amy J. Dreves, Faculty Research Associate,
OSU Crop and Soil Science Department

Infestations of the Spotted Wing Drosophila fly, *Drosophila suzukii* (Diptera: Drosophilidae; SWD), an exotic and invasive pest, were found in Oregon fruit crops in Fall 2009 (Figs. 1 & 2). These flies are native to SE Asia, including China, Japan, Thailand, and Korea. The first discovery in N. America was in California in 2008 and it is now found in Oregon, Washington, Canada, and Florida (Steck et al. 2009). It has been established in Hawaii since the 1980's (Kaneshiro 1983). The SWD causes damage to late season ripening fruit as opposed to overripe and fallen fruit that are infested by most other *Drosophila* species. The significance of SWD is not fully known. There may have been more crop damage than reported as producers were not looking for the fly and may not have recognized the damage as being related to larvae of the fly. The SWD larvae are small, shapeless and pale, easily resembling fruit pulp.

Fig. 1. See dark spots on wings of male Spotted wing Drosophila. M. Hauser, CA FDA.

Interestingly, it was noted in an Japanese article in 1935, that when minimum temperature comes down to ~ 5°C at the end of November, SWD starts to prepare for overwintering and hides under the bark on the south sides of vine trunks. When the temperature becomes much lower, SWD moves to unknown places and reappears the following spring. Investigations on fruit collected in Japan showed varieties such as Black Hamburgh, Gros Coleman, Golden Queen, Muscat of Alexandria, and Muscat Hamburg had many SWD maggots; and Herbert and Foster's Seedling had less numbers of SWD emerging from grapes. It was noted that peak

Fig. 2. Late season raspberries infested with Drosophila larvae. A. Dreves, OSU

SWD adult emergence occurred during cherry and grape seasons.

We (OSU researchers, Extension faculty, USDA-ARS and Oregon Department of Agriculture) confirmed findings of SWD in 15 Oregon counties and over 15 fruits including blueberries, raspberries, blackberries, strawberries, cherries, peaches, plum, Asian pears, persimmons, and table and wine grapes (Fig. 3). At this point, it is unclear which of the fruits listed are most susceptible or preferred by SWD. Laboratory experiments are being conducted at this time to address these questions.

Positive confirmations of SWD flies were found in September emerging from randomly-collected grape samples from vines of Niagara, Concord, one vineyard of Pinot Noir, and Interlaken seedless table grapes. Active SWD flies were also observed on grape pomace piles in October 2009. Grape growers have not reported any noticeable damage to harvested grapes in 2009. However, they

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Fig. 3. A 2009 distribution map of Oregon counties with SWD. H. Rogg, ODA

had observed SWD present in the winery, differentiating these from other fruit flies by the darkened spot on the tip of the males' wings (Fig. 1). While grapes may not appear to be a preference of SWD or a problem because they are processed, there is still cause for concern. The SWD may infest late season crop that has been thinned or those un-composted pomace piles in vineyards. Because the pest is not of concern, it isn't being controlled (by pesticides) and may cause infestation into other nearby berry crops. Further research is needed to verify these concerns.

A 5-year research proposal addressing SWD on the west coast has been submitted to Specialty Crop Research Initiative (SCRI) USDA-NIFA for grant funding in January 2010. Throughout Oregon, California and Washington, there is an urgent need for the coordination of a region-wide project to develop a SWD Integrated Pest Management Program, SWD*IPM. This is based on the lack of information regarding the pest biology and pest control options specific to SWD in multiple fruit production systems. Goals of the proposed research is to develop a sustainable approach to the management of SWD, and provide a network of outreach programs that will deliver new information to improve crop production. The SWD*IPM Research Team includes personnel with expertise in entomology, horticulture, genomics, pest management consulting, agricultural production, economics, sociology, extension, and policy-making from Oregon State University, USDA-Agriculture Research Service, Washington State University, the departments of Agriculture in California, Washington and Oregon, UC-Davis, UC-Berkeley, Ag and Agri-Food Canada, and private consultants (e.g., Peerbolt Inc.).

Symptoms of Damage. Infested fruit exhibits few signs of damage including some scarring and spotting resulting from egg-laying (oviposition). One to two days after oviposition, the eggs hatch and larvae begin feeding on internal fruit tissues thereby creating significant observable damage. An individual fruit may harbor more than 60 maggots. Within as few as two days of larval development, fruit begins to collapse around the feeding site. Fungal and bacterial infections contribute to further breakdown. These damage symptoms result in severe losses in affected crops.

Japanese researchers reported extensive damage (70-80%) to cherries and found SWD in grapes in the 1930's (Kanzawa 1936). SWD is still an ongoing problem for fruit producers in Asia. California cherry growers in the area from Davis to Modesto lost about 33% of their crop in 2009 with a near total crop loss reported by some growers. Additionally, SWD infested fruit resulted in 25-50% crop losses in caneberries (raspberries and blackberries) with limited damage to strawberries in Monterey and Santa Cruz Counties. Agriculture and Agri-Food Canada reported 20% losses due to SWD in conventional blueberry production (S. Fitzpatrick, pers. comm.). Blueberries were rejected from the soft-sorter because of maggots inside fruit. A 50% loss was reported in backyard blueberries in British Columbia in fall of 2009. Oregon's Willamette Valley peach growers were also affected during late summer after SWD was found in August, 2009; losses ranged from 20-80% in some orchards. Crop losses from 20-40% were seen in Oregon's late season blueberries and raspberries. There is concern of significant SWD spread as the sheer variety of fruit crops and fruit-bearing ornamental and native plants ripen at different times throughout the year thereby exacerbating the pest's persistence throughout the west coast (Fig. 4). As the season progresses, SWD densities may increase

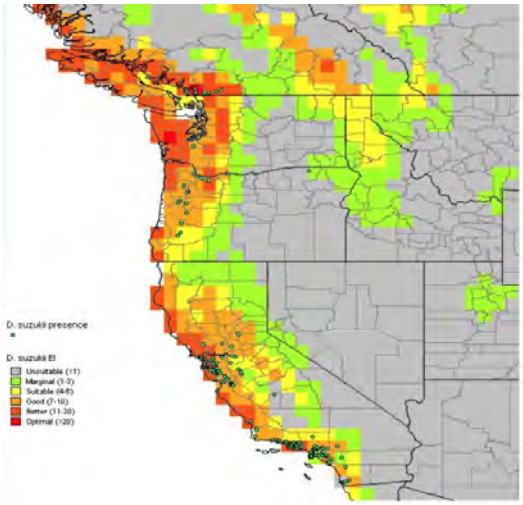

Fig. 4. Expected establishment of SWD on West coast. M. Damus, Canada DFA.

and disperse among numerous cropping systems, urban/rural habitats, and wildland plant communities (e.g., wild blackberries).

Seventy-six percent of all strawberries, blueberries, raspberries, blackberries and cherries grown in the United States are produced in California, Oregon and Washington. The total value of these crops alone is $2.6 billion per year (NASS 2009). If annual losses are conservatively estimated at 20%, then yearly losses in the Pacific States will total $511 million for these crops. These figures do not include costs for control, nor does this include the losses that could happen to grapes, if they are the preferred host.

Insect Life Cycle. A preliminary number of 3 to 5 SWD generations was predicted for western Oregon based on a degree-day

model developed by two Japanese researchers (Sasaki and Sato) in 1995; with an estimated lower developmental threshold of 9.1° C and 268 accumulations of heat units. Kimura (2004) showed that SWD have a tremendous reproductive potential and may exhibit multiple generations per season (up to 13) in Japan.

Management Plan. No management plan has been established for SWD in the west coast. There is a team of Oregon, California, Washington, and Canadian researchers addressing the pest biology to better understand the life cycle and seasonal abundance in order to develop appropriate IPM tools to control SWD. Simple procedures such as a "fruit-dunk flotation" and "salt and carbonated water extraction" will be developed as monitoring tools for SWD maggot detection in fruit before the application of pesticides, processing, and shipping of fruit, thus reducing losses and human-based dispersal of SWD resulting from otherwise undetected maggot-infested products. Cultural and preventative practices such as sanitation techniques, netting, and harvesting methods will be studied in 2010 to help reduce SWD populations. Insecticide products labeled for use and timing of treatments on specific fruits that list 'fruit flies' as pests, are targeted for laboratory and field testing in conventional, IPM, and organic systems.

As we gain knowledge, a management strategy and control recommendations will be developed. In the next newsletter issue, a monitoring trap will be described and IPM practices (chemical, cultural, and preventative tools) will be presented based on historical knowledge and our 'best guesses" at this point in time. However, three principles will be at the heart of reducing SWD regardless of fruiting crop:

1. Control the flies before they lay eggs.
2. Reduce the fly's breeding sites by harvesting fruit in a timely manner.
3. Properly dispose infested fruit left on the plant or in pomace piles.

Oregon State University to feature viticulture and enology research event

This March 11, 2010, Oregon State University Viticulture and Enology Extension join forces to present a one-day event focusing on the research being conducted for the Oregon winegrape industry by OSU and USDA-Agriculture Research Service. The event is designed to provide industry members with information from on-going research and recent trial outcomes. A vast array of research topics will be presented in the areas of viticulture and enology.

Viticulture

- Vineyard floor management techniques to reduce Pinot Noir vine vigor and increase fruit quality
- Alternative methods of cover crop management to enhance vine growth and nutrition while conserving soil moisture and reducing weeds of establishing vineyards
- Contribution of "–omics" technology to understanding grape quality
- Mycorrhizal fungi partners of Pinot Noir winegrape roots
- Using ET-based irrigation scheduling for enhancing vineyard productivity
- Evaluation of new disease control materials for Oregon vineyards
- Evaluation of a spore-trapping method for powdery mildew management
- Grapevine viruses in Oregon vineyards
- Mealybug survey, trapping and management
- Eriophyid mite infestation and management
- Effects of fungicides on beneficial insects in the vineyard

Enology

- Impact of *Saccharomyces* and non-*Saccharomyces* yeast strains on Pinot Noir aroma and flavor
- Deficit irrigation and particle film effect on Merlot wine composition and quality
- Systematic identification of yeast proteins released into model wine during aging on the yeast lees
- Effect of cover crop management on aroma composition of Pinot Noir
- The impact of alternative closures on aroma composition of Pinot Noir

The event will be held on the Oregon State University campus in Corvallis. Registration is required in advance. Details and registration are available online at http://hort.oregonstate.edu/3-11-2010Event.

Assessing vineyard herbicide damage and risk

It is well known that certain herbicides can be damaging to grapevines and pose a risk to vineyard establishment and production. There was some concern and evidence of herbicide damage in Oregon vineyards during 2009 and in the past. An online survey has been developed for the Oregon winegrape industry in efforts to understand the incidence of herbicide damage across the state in resent years and identify potential causes for this damage. The results of this survey will help us to identify areas of education, research and risk management for herbicide damage issues. To take the survey online, please click the following link. https://surveys.bus.oregonstate.edu/BsgSurvey2_0/main.aspx?SurveyID=3384

For background information on herbicide drift, please refer to the OSU Extension publication *Preventing Herbicide Drift and Injury to Grapes* available online at http://extension.oregonstate.edu/catalog/pdf/em/em8860.pdf.

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Upcoming Events

Oregon Wine Industry Symposium
February 21-23, 2010, Eugene, OR
This is the Oregon winegrape industry's largest conference of the year and is filled with educational sessions for viticulture and enology. This year includes a mini-conference taught in Spanish! Learn more at http://symposium.oregonwine.org/. Registration opened December 1, 2009.

OSU Viticulture & Enology Research Colloquium
March 11, 2010, Oregon State University, Corvallis, OR
This one-day event features research presentations of studies that impact Oregon's winegrape industry. This is a portal for members of the Oregon winegrape industry to learn about the most recent outcomes of viticulture and enology-related research conducted by Oregon State University, the USDA-ARS Hort Crops Research Unit and other collaborating units in the program. Registration is required. For more information and registration, visit http://hort.oregonstate.edu/3-11-2010Event.

New Viticulture Extension Publications

- Field Monitoring for Grapevine Leafroll Virus and Mealybug in Pacific Northwest Vineyards by P.A. Skinkis, A.J. Dreves, V.M. Walton, R.R Martin. July 2009. http://wine.oregonstate.edu/files/files/em8985%20proof5.pdf
  Spanish version available! http://wine.oregonstate.edu/files/files/em8985-Srev.pdf

- Grapevine Leafroll Virus and Mealybug Prevention and Management in Oregon Vineyards by V. Walton, A. Dreves, P. Skinkis, C. Kaiser, M. Buchanan, R. Hilton, R.R. Martin, S. Castagnoli, S. Renquist. October 2009. http://wine.oregonstate.edu/files/files/em8990.pdf. Spanish version available! http://wine.oregonstate.edu/files/files/em8990S%20spanish%20version.pdf