OSU Wine and Grape Research and Extension Newsletter

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Welcome to the December 2010 Newsletter

We are happy to present a viticulture-based newsletter this quarter, focusing on some of the challenges that were apparent in vineyard management during 2010. While the *Botrytis* challenges are fresh in the minds of vineyard managers, Walt Mahaffee provides a summary of a replicated field trial using *Botrytis* sprays. Vaughn Walton provides an update on a collaborative mealybug and leafroll virus survey conducted throughout the state in 2009-2010. Finally, Patty Skinkis discusses the factors that lead to poor fruitset, a problem that was experienced at higher incidence and severity this year. It is our hope that this information provides you with more knowledge in preparation for the next growing season!

Cheers, *The Oregon Winegrape Team*

Research Update: Field *Botrytis* Trial

Walt Mahaffee, Ph.D., Reseach Plant Pathologist, USDA-ARS

One question I often hear managers ask is "why am I wasting money treating for *Botrytis*?" To answer to this question, I have always directed them to results of efficacy trials produced by Jay Pscheidt (Oregon State University), Doug Gubler (University California, Davis) or Wayne Wilcox (Cornell University). However, I have often wondered how well small plot results translate to commercial conditions. Due to the wet spring and long range forecast predicting more precipitation to come later in 2010, we thought it would be a good year for testing sustainable (LIVE) and organic-certified products for their efficacy against *Botrytis* bunch rot. Three vineyard managers of commercial vineyards volunteered to apply fungicide products during 2010.

Trials were conducted using a ducted over-the-row air-assisted sprayer with six 50-gal tanks custom built by Rears Manufacturing, Inc. This sprayer is excellent at simulating an airblast sprayer but keeps the spray contained to a row, thereby reducing the acreage needed for a spray efficacy experiment. At each vineyard location, the experiment consisted of six treatments applied to three replicate rows in a randomized complete block design with each replication consisting of 560 to 750 row feet. At one location, the manager agreed to leave untreated controls (nothing applied for *Botrytis*). Two locations had the same treatments applied at 3.79 gallons per 1000 row feet (50 gal/A for vineyards with 7 feet row spacing) banded onto the fruiting zone. The same spreader/sticker was used for all treatments at all locations. Cluster disease incidence was rated visually every two weeks beginning September 23 and conducted by examining fruit without handling clusters on three subsets of five vines from each replication. The same vines were rated until the first week in November, when three groups of 16 clusters were rated for incidence and severity. Then they were incubated in the lab for 48 hours under conditions optimal for bunch rot and rated again. An additional disease assessment was conducted within two to three days of commercial harvest where three groups of 30 clusters were harvested and examined for incidence and severity of bunch rot. We finally finished harvest at the beginning of November and almost beat the birds!

The results of all these experiments are not as informative as we had hoped (see Tables 1-3); this is partially because of the lack of untreated controls at each location, amount of bunch rot that developed post-harvest, and bird-damage that prevented the accurate harvest assessment of one of the trial sites. There was also the typical issue of spatial variability of bunch rot within the vineyard. I was expecting far more differences among products than were seen in these experiments. Only the results from field 1 had statistical differences among the means. This field was also the location with the most uniform terrain and least influence of riparian areas causing shading or air-drainage differences across the plots. There is difference in the ranking of product performance at each location,

potentially indicating that differences in vineyard microclimate impact product performance. However, it is difficult to tell for sure without untreated controls at each location. So the answer to the question regarding the need for Botrytis control is yes. It seems that some products might not be very effective. However, a more important question is how to manage the spatial variability of bunch rot development in the vineyard. It could be that some of these Botrytis "hot spots" were due to microclimate that advanced or slowed vine phenology, thus the optimal fungicide application windows were missed and/or these areas were more conducive for pathogen infection. It would seem that combining efficacy studies with timing of leaf pulling might yield some critical knowledge in improving bunch rot management in the future.

Table 1: Botrytis infection incidence and severity in Field 1 during 2010.

		Assessment Date							
				Harvest		Post-harvest		48 hour Incubation	
		9/24/2010	10/6/2010	10/13/2010		11/2/1010		11/4/2010	
	Rate/50-gal	Incidence	Incidence	Incidence	Severity	Incidence	Severity	Incidence	Severity
Actinovate with Whey	12oz 5lbs	0.5 ± 0.7	2.5 ± 2.1	19.7 ± 9.6	2.3 ± 1.4	71.4 ± 25.0	37.5 ± 30.4	96.0 ± 8.8	57.2 ± 27.2
Endura	8 oz	1.6 ± 1.5	1.8 ± 1.7	16.6 ± 4.7*	2.1 ± 0.7*	52.7 ± 17.7	14.6 ± 12.1	95.6 ± 7.0	69.2 ± 28.0
Flint	2 oz	1.2 ± 1.3	2.0 ± 1.7	14.3 ± 6.6*	2.2 ± 1.8*	61.9 ± 19.1	24.0 ± 13.3	98 ± 4.2	54.8 ± 21.7
Regalia	4 quarts	1.2 ± 1.6	1.1 ± 2.2	21.9 ± 9.4*	3.0 ± 2.9*	47.0 ± 17.6	16.9 ± 10.7	95.6 ± 11.7	47.9 ± 20.6
Serenade Max	3 lbs	0.4 ± 0.8	2.2 ± 1.9	25.6 ± 9.6	4.6 ± 2.7	65.2 ± 9.5	20.8 ± 13.6	100 ± 0	37.0 ± 28.2
Vangard	10 oz	2.0 ± 1.8	1.8 ± 2.5	28.8 ± 10.6	3.5 ± 2.0	65.8 ± 21.0	22.6 ± 11.1	97.8 ± 3.1	54.2 ± 18.3
Untreated Control		1.6 ± 1.8	3.9 ± 3.1	32.8 ± 12.2	5.7 ± 2.5	73.0 ± 25	33.0 ± 33.1	97.0 ± 7.8	51.3 ± 26.8

Mean ± standard deviation

*Significantly different from the untreated control at P=0.05

Table 2. Botrytis infection incidence and severity in Field 2 during 2010.

		Assessment date								
					Harvest		Post harvest		48 hour Incubation	
		9/24/2010	10/6/2010	10/18/2010	10/20/2010		11/3/2010		11/5/2010	
	Rate/50-gal	Incidence	Incidence	Incidence	Incidence	Severity	Incidence	Severity	Incidence	Severity
Actinovate with Whey	12oz 5lbs	2.5 ± 4.6	3.5 ± 2.4	5.2 ± 5.1	24.0 ± 23.7	1.4 ± 1.7	41.9 ± 26.3	2.2 ± 3.2	74.3 ± 15	12.7 ± 15.3
Endura	8 oz	1.2 ± 2.1	2.8 ± 3.4	5.3 ± 3.2	28.8 ± 17.1	1.5 ± 1.1	68.2 ± 15.6	11.6 ± 11.7	91.1 ± 9.4	26.7 ± 16.7
Flint	2 oz	1.3 ± 1.4	3.3 ± 4.0	5.1 ± 6.4	22.2 ± 19.4	1.1 ± 1.3	37.6 ± 19.4	2.2 ± 2.7	81.5 ± 13.3	16.7 ± 13.1
Regalia	4 quarts	1.9 ± 2.1	1.6 ± 1.8	3.0 ± 3.1	21.0 ± 14.9	1.6 ± 2.4	42.4 ± 30.1	9.7 ± 13.5	83.4 ± 18.9	18.0 ± 17.0
Serenade Max	3 lbs	1.3 ± 1.5	1.9 ± 2.3	3.2 ± 1.7	13.8 ± 5.3	0.5 ± 0.5	51.0 ± 15.5	8.6 ± 8.5	89.0 ± 18.6	25.2 ± 21.1
Vangard	10 oz	0.4 ± 0.7	0.6 ± 2.5	1.8 ± 1.6	15.6 ± 6.7	0.7 ± 0.9	44.8 ± 27.7	3.4 ± 3.6	75.2 ± 23.9	12.4 ± 10.0

Mean ± standard deviation

Table 3. Botrytis infection incidence and severity in Field 3 during 2010.

		Assessment date				
					Harvest	
		9/23/2010	10/6/2010	10/18/2010	10/28/2010	
	Rate/50-gal	Incidence	Incidence	Incidence	Incidence	Severity
Actinovate	12 oz	3.1+2.5	6.2+4.9	3.6+3.4	40.0	40.2
Actinovate with Whey	12oz 5lbs	1.6+2.1	4.9+2.1	3.2+3.1	60.0	10.4
Kaligreen	5 lbs	1.8+3.0	4.7+3.9	3.5+1.9	62.5+13.1	13.8+5.9
Regalia	4 quarts	2.7+2.3	5.8+6.3	3.8+3.8	46.7+22.3	16.0+7.7
Serenade Max	3 lbs	1.3+2.8	3.5+3.2	3.1+2.9	46.7	32.7
Grower Standard		2.1+1.9	3.9+4.0	2.9+2.4	73.3+30.4	25.2+8.8

Mean ± standard deviation;

means without standard deviation were a result of plots suffering extensive bird damage

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Determining vine leafroll distribution and the role of virus vectors in virus spread in Oregon vineyards

Vaughn Walton, Ph.D. Horticultural Entomologist

Mealybugs can serve as vectors (carriers) of the grapevine leafroll virus by feeding on infected vines and carrying the virus to other uninfected vines. As vectors, mealybugs serve as one of several mechanisms in which grapevine leafroll virus can spread within a vineyard. Other mechanisms of virus movement include movement of mealybug-infested fruit or equipment which can spread the mealybug vectors into new vineyards, allowing the potential for further infection and spread. In 2009 and 2010, surveys were conducted to identify vineyard-infesting mealybugs using pheromone-baited traps and physical surveys of vineyard plots. These surveys encompassed all major grape-growing areas of Oregon.

Mealybug trapping using pheromone-baited traps: Traps that attract four mealybug species were placed in select vineyards in each region on a monthly basis to determine the species present. Monitoring was conducted for vine mealybug, *Planococcus ficus* (Signoret); obscure mealybug, *Pseudococcus viburni* (Signoret); longtailed mealybug, *Pseudococcus longispinus* (Targioni Tozzetti); and grape mealybug, *Pseudococcus maritmus* (Ehrhorn). Our work indicates that the representative vineyards currently have mainly grape mealybug present. The trap capture was unevenly distributed across the state. The majority of male counts in traps were from trial sites in southern Oregon, Columbia Gorge, and eastern Oregon (Figure 1). Grape mealybug was also found in very low numbers in the Willamette Valley. The first mealybugs were trapped in May in all regions and trapping continued until September, except in the Willamette Valley. The highest trap counts were observed in different months for each growing region: June in the Columbia Gorge (485 males/trap/month), July in the Willamette Valley (154 males/trap/month), August in eastern Oregon (215 males/trap/month), and September in southern Oregon (788 males/trap/month). Two distinct peaks in trap counts were found during the season in each region: eastern Oregon (June and August), Columbia Gorge (June and August) and southern Oregon (July and September). These peaks in trap counts may indicate that two generations are developing in each of these areas during the season.

Physical surveys of mealybugs: In addition to trap counts, physical surveys of trial vineyards were conducted on a monthly basis in each of the regions. This involved physical scouting for mealybugs on vines in order to verify presence. Seasonal phenology and life stages of the mealybugs were recorded and compared to trap counts made in each of the regions (Figure 1). Scouting numbers correlated well with trap counts as mealybug numbers were low in vineyards with low trap counts and high in vineyards with high trap counts. The developmental stages of mealybugs in all regions show presence of second and third instar stages during July through September with the exception of the Willamette Valley. Mealybug infestation showed high to low infestation density gradients in some vineyards, and this may indicate infestation is occurring from a neighboring vineyard (Figure 2). For this reason, it is important to follow sanitation practices within and between vineyards to prevent mealybug spread. For more information on sanitation practices to prevent mealybug spread, please see documents in the "further reading" section.

Mealybug presence and virus distribution: Virus detection and monitoring has been conducted in the same mealy-bug trial vineyards. Some of the virus-infected vineyards were selected, and surveys of the vineyard blocks are helping to determine the distribution and spread of virus with the mealybug vector. The distribution of mealybugs in vineyards was compared to incidence of grapevine leafroll viruses. Initial observations of our data indicate that there is a strong disassociation of mealybug populations with virus-infected vines (data not shown); the mealybugs prefer to feed on healthier vines rather than virus-infected vines. These findings may explain why more rapid virus spread takes place in areas where both mealybug populations and the virus are present.

Mealybugs and leafroll virus are found in all major grape growing areas in Oregon. Grape mealybug was the only species found in Oregon vineyards to date. Data from traps and developmental stages throughout the season indicate that up to two generations are developing per season. Data show that mealybug infestations can spread from neighboring infested vineyard blocks, highlighting the importance of sanitation techniques. A disassociation was found between distribution patterns of mealybugs and virus infected vines, possibly explaining rapid virus spread found in some areas.

Further Reading

- Grapevine Leafroll Virus and Mealybug Prevention and Management in Oregon Vineyards. Oregon State University Extension, EM8990 Online.
- Field Monitoring for Grapevine Leafroll Virus and Mealybug in Pacific Northwest Vineyards, EM8985, Online.
- Trapping and Identifying Mealybugs in Oregon Vineyards, EM 8998, Online.

The research team for this study includes Bob Martin, USDA-ARS, Vaughn Walton, Rick Hilton, Clive Kaiser, Marcus Buchanan, Steve Renquist, Steve Castagnoli and Patty Skinkis, all of Oregon State University. These individuals worked to provide structure and content to generate the data provided within this article.

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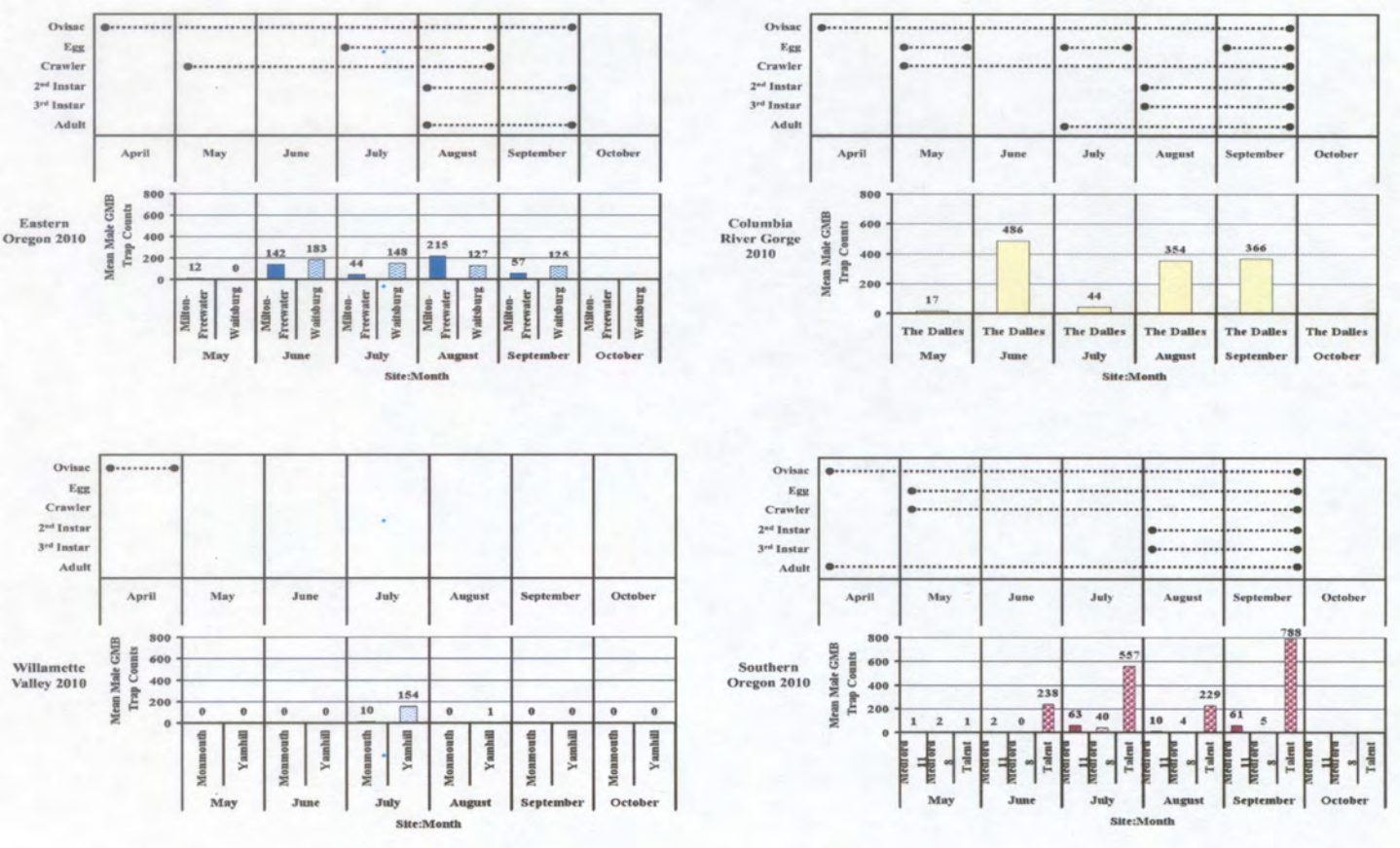

Figure. 1. Seasonal mealybug trap counts and developmental stages in four Oregon grape-growing regions during 2010.

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Figure 2. Mealybug infestation patterns are shown (red rectangles) in a vineyard block and appear to be spreading outward from the neighboring vineyards (located to the right of map shown). This may indicate spread and reinforce the importance of within and between vineyard sanitation.

Poor fruit set remains a challenge in the vineyard

Patty Skinkis, Ph.D., Viticulture Extension Specialist

Poor fruit set and lower-than-normal yields were observed for some winegrape regions of the state this year. The weather conditions during spring were cold and the season progressed very slowly following bud break. These conditions may have created more problems with reduced fruit set and/or inflorescence necrosis that had not been present or quite as drastic in previous years. While it is easy to assume weather was the dominant factor in this year's success or failure at fruit set; it is likely only part of the equation, particularly since the bloom-time weather was dry and warm--conducive to good fruit set.

As scientists we do not fully understand all the gene-regulated mechanisms of inflorescence initiation and floral part formation (Carmona et al. 2008). However, the relative time point at which these events occur are known, and a number of factors have been associated with poor fruit set, including vine vigor status, health status (disease/virus/insects), nutrition, rootstock, microclimate and weather. Many of these factors that affect fruit set are linked to their influence on vine carbon and nitrogen balance which will be described in more detail herein.

Defining poor fruit set

Defining the specific problem with fruit set can be tricky. There are a number of different ways that poor fruit set can be defined. There can be loss of the entire inflorescence (flower cluster), termed *inflorescence necrosis*, and loss of individual flowers within an inflorescence, or *flower necrosis*. Some flowers

may abscise before bloom, and still others may abort prior to bloom. Finally, there can be flowers that set and form small shot berries that never ripen and may abscise before harvest. In some cases, these shot berries are retained (Figure 1). If significant lack of fruit set is observed, it is important to document as much description of what is observed as this may be indicative of a potential causal factor.

Figure 1. A cluster resulting from poor fruitset shown at harvest with shot berries and variable berry size. October 2010.

An individual inflorescence of a grapevine can contain hundreds of flowers. However, not all of those flowers can (or should) set fruit and develop into berries. On average, 50% of flowers within an inflorescence set fruit and become berries (May 2004). Any greater percentage of fruit set can lead to more compact, tight clusters that can be more prone to fungal infections, particularly in those regions that battle *Botrytis* and other rots. Because nearly 50% of the flowers will abort even in a healthy cluster, it is normal to see flower and/or fruit drop during bloom and through fruit set. Based on fruit set data collected within various trials across the Willamette Valley from 2008-2010, fruit set has been within 50-70% with the exception of only one location in 2010 (Skinkis, in progress). The highest fruit set year has been 2009 at 60-70% set. Despite differences in spring-time weather across years, the percent fruit set has been relatively normal, and the only location showing reduced fruit set can be related to under-cropped, high vigor vines in combination with a cool season in 2010. Although these observations are limited to only three trial sites across the Willamette Valley, they mirror the general trend in fruit set observed across the valley for those years. Luckily, fruit set is relatively good in Oregon, particularly after research conducted in the late 1980's at Oregon State University identified low boron as a critical limiting factor in spring growth and flowering. At this time, boron fertilization is a standard practice and is not considered a major factor of poor fruit set experienced in 2010.

Potential pre-bloom causes of poor fruit set

Vine Nutritional Status - Carbon and Nitrogen. When poor fruit set is observed, it can usually be associated with factors that influence the development of critical flower parts during the time period between bud break until bloom. Development begins shortly after bud break and takes approximately 6-8 weeks. If there is some limiting factor such as low carbon (C) or nitrogen (N) reserves, micronutrient deficiencies (B or Zn), or water stress, for example, there can be significant reduction in flower development and fertilization at bloom. Sustained overcast and cool weather can reduce the number of flowers that develop adequately and inhibit bloom or fertilization. Gu et al (1996) found that shading of Pinot Noir vines resulted in 26% higher incidence of inflorescence necrosis than vines that were not shaded in greenhouse studies. This is thought to result from to an imbalance of C and N in the vine. Research on inflorescence necrosis continues to be inconclusive as to the direct causes of this disorder. However, it has been linked to N at both high and low levels in plant tissues prior to- and at bloom (Gu et al 1994, 1996; Keller et al 1998; Bains et al 1981).

Nitrogen is not universally bad for flowering and fruit set; however, it has gained a bad reputation because of such studies that have correlated it with inflorescence necrosis. The N level alone is not the full story; it needs to be considered in context with vine C, both of which are linked to vine vigor and a whole host of signaling events in the vine's physiology, including flowering. Shaded vines or those that are in significantly overcast conditions from bud break to bloom can have reduced carbohydrate levels due to reduced photosynthesis. This allows for a lower C:N ratio, resulting in proportionally higher N levels. It is not clear what level of C and N are needed to avoid problems with fruit set and/or inflorescence necrosis. To help illustrate this, let's consider an example within a vineyard floor management study where vine vigor was altered and both nutrition and fruit set were monitored (Willamette Valley 2007-2010). Vines within solid cover grass treatments had a much lower bloom petiole tissue N concentration which lead to a higher C:N ratio (Table 1) compared to the other two treatments. Despite nearly deficient levels of N, the solid cover treatment did not differ in the percentage of fruit set (Figure 2).

Table 1. Summary of bloom tissue analysis for C and N of Pinot Noir in a vineyard floor management study where variable vine vigor levels was achieved. Means are shown. P-value indicates difference in data (P<0.05 indicates significance), n.s. = not significant.

Treatment	Vigor Status	% C	% N	C:N
Solid Cover	moderate	41.1	0.48	87
Alternate Till	moderate high	41.2	0.68	61
Clean Cultivated	high	41.2	0.88	49
P	–	n.s.	<0.0001	<0.0001

Conversely, high vigor vines have been found to have poor fruitfulness and poor fruit set. This could be due to an imbalance of C:N leading to a lower ratio and high tissue N status. This

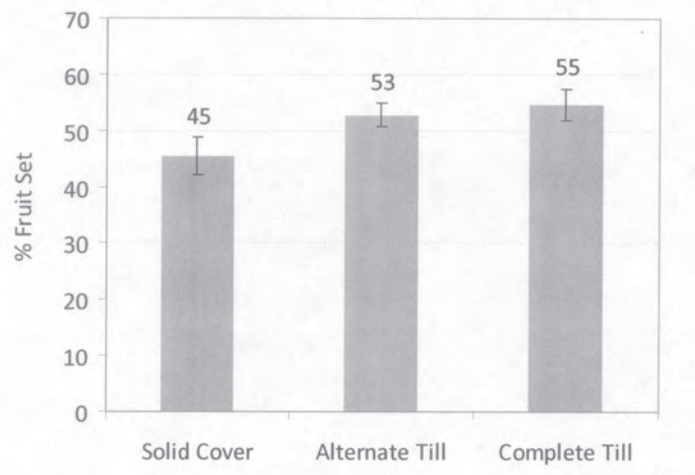

Figure 2. Mean (+ SE) percent fruit set of Pinot Noir clone 115 under different vineyard floor management treatments in 2010. No difference was found by treatment (P=0.0522).

high N status likely further plays a role in the battle between competing sinks: the shoot tip vs. the developing flower. The other factor of reduced yields in over-vigorous vines may be linked to heavy inner canopy shading resulting in poor bud fruitfulness (May 2004, Vasconcelos et al. 2009).

Damaging Events. Anything that is drastically damaging to the vine's canopy from late summer-fall and spring can lead to problems with poor fruit set. Such events include early fall frost, winter damage, hail, or other methods of vine defoliation by herbicides, insect feeding, etc. During fall, the vine is redirecting nutrition from its leaves to store as reserves in the trunk and roots. If a severe fall frost is experienced well before leaf-fall, there can be a significant disruption of this nutrition storage and the vine is left in a weaker state come spring. Similarly, any event that can significantly defoliate a vine during the later part of the season or early spring can lead to poor flower development and lead to reduced fruit set by way of reduced carbon assimilation and storage. One example of this may be the reduced fruit set observed with grape rust mite associated short shoot syndrome. We are uncertain as to whether the grape rust mite populations feeding on infested vines directly or indirectly affect fruit set.

Benefits of Poor Fruit Set?

While poor fruit set may be a good thing in terms of yield control and reducing inputs into crop thinning, the practice of reducing fruit set is highly variable between years and very difficult to control to a point of precision that is required in vineyard production. In many cases, the level of yield variability between seasons has been attributed to seasonable variability in bud fruitfulness and/or fruit set (Carmona et al. 2008). However, there are efforts in place to determine the practicality of management methods to achieve reduced fruit set so as to allow for better disease control and potential for increased fruit quality (Diago et al. 2010; Skinkis, in progress).

Summary

If you observe poor fruit set in your vineyards, it is best to keep records of the situation. If you are not currently doing some estimate of fruit set, it is wise to begin the practice to develop a baseline of information for a given block. To begin observing fruit set, it is best to monitor clusters within 10-12 days post full bloom. Remember, nearly 50% of the flowers may not set fruit, so they can be found falling from the clusters before, during or after fruit set. Consider taking some observational notes at fruit set and photos for rough estimates. Also, fruit set can be estimated through cluster weight data. Records of berries/cluster and berry weight are certainly good to have in your records, but this requires significant sampling across blocks and is very time consuming and not practical on a production scale. If you observe inflorescence necrosis and/or significant flower necrosis, make note of the block and flag the vines for future investigation. Record weather data from bud break to bloom. Consult your vineyard nutritional analysis records and pruning weights to try and determine any changes over time in vine vigor as indicated by yields and pruning weights.

While we cannot control weather conditions, we can do our best to manage vineyards for a healthy, balanced state. When this is achieved, even poor years will cause only a minor problem with flowering and fruit set. Where there are considerable problems with over- or under-vigorous vines and/or poor fruit set, the problems in vegetative and reproductive balance can be difficult to bring back into equilibrium and may take more than one season to achieve.

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New Publications of Interest

Evaluating Soil Nutrients and pH by Depth in Situations of Limited or No Tillage in Western Oregon. This guide is written by Oregon State University Crop and Soil Science faculty and provides practical considerations on how to evaluate soil nutrients by depth considering non-tillage of perennial systems such as orchards and vineyards. This will help you determine whether to use typical soil sampling methodologies or to switch to stratified sampling. To download and read the full publication, visit:
http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/19024/em9014.pdf?sequence=1

Effective Vineyard Spraying – A Practical Guide for Growers
This is a guide authored by Andrew Landers, director of the Applications Technology Program at Cornell University. He is known internationally for his work in spray efficacy, coverage and sprayer technology in fruit and vegetable production systems. This book incorporates ten years of vineyard data and provides practical information for the grape grower. For more information on this guide, visit http://www.effectivespraying.com/.

UPCOMING EVENTS

Online Class: Grapevine Physiology – OSU Viticulture Extension

January – March, 2011
Online and OSU Campus, Corvallis, OR
Register today- space is limited!
This online course will cover various aspects of vine physiology and the importance of understanding vine physiology for making informed management decisions. The class will be offered to industry/public online live (8:00-9:50 AM on Tuesdays and Thursdays) from January through March 2011. Lectures will be recorded and archived for participants. Course content will cover vine growth and development such as physiology as related to vine dormancy, vegetative growth cycles, reproductive growth, flowering and fruit set, berry development, vine water relations, and more! If you are uncertain about online courses, give it a try! It is efficient and easy to use! Registration is required. Click here for more information.

2nd Annual Viticulture & Enology Research Colloquium – 2011

February 24, 2011
LaSells Alumni Center
Oregon State University Campus, Corvallis, OR

Brought to you by the Oregon Wine Research Institute

Join us for this one-day event featuring research that impacts Oregon's winegrape industry! This is an opportunity to learn about the most recent outcomes of viticulture and enology related research projects conducted by researchers at Oregon State University, the USDA-ARS Horticulture Crops Research Unit, and other collaborating units in the program. Seminar sessions will cover vine physiology, vineyard management methods, insect and disease management, wine production, fermentation microbiology, and flavor chemistry. Registration will open in December 2010. For more information, visit
http://wine.oregonstate.edu/researchday.