OSU Viticulture Extension Newsletter, March 2004

By: Anne Connelly[1], Jay Pscheidt[2], and Jessica Howe[3]
[1, 3] OSU Department of Horticulture & [2] Department of Botany & Plant Pathology

Grape powdery mildew caused by the fungus *Uncinula necator* is the disease of greatest concern to Oregon wine grape growers. No other organism occupies the pest management regime in vineyards for quality wine grape production then powdery mildew. All aboveground plant parts can be attacked by powdery mildew. Fungicide application for control must be carried out during the growing season whether the grower is operating under an organic, sustainable, or conventional program. Understanding the biology of the fungus, the climate variables that affect its severity, and the vineyard practices that influence its manifestation will help the wine grape grower control powdery mildew.

The fungus can over-winter in two forms: 1) as thin thread-like hyphae inside the vine's dormant bud and 2) as small black bodies called cleistothesia. The *Uncinula necator* found in dormant buds, although rare in Oregon, can cover emerging shoots with a white mass of mycelium creating what is called 'flag shoots'. The cleistothecia located in the exfoliating bark will release sexual spores during rainy periods and when temperatures are above 50° F until vines reach the bloom stage. Colonies of powdery spots or patches can form on the leaves adjacent to bark. When scouting for powdery, the white-gray patches are best seen when looking at the leaf indirect to sunlight and the direction of the light is coming from over the shoulder. Short stalks with chains of asexual spores called conidia, produced within colonies of powdery spots, can be seen with a 10X lens. Conidia can develop rapidly under optimum conditions of mild temperatures and high humidity. However, temperatures above 85° F will inhibit conidia germination, and water on the leaf surface will burst conidia resulting in abnormal spore germination.

Bloom is the most important period for of control of powdery on fruit. Throughout the growing season new growth can be infected by powdery mildew. Growers must adjust their spray applications to apply fungicide to new unprotected portions of the shoot. The question of when to end the fungicide program depends on fruit cluster development and if infection is present. Fruit is susceptible to powdery mildew up to 8° Brix (measurement of fruit sugar). If infected, fruit can have surface sporulation up to 15° Brix. Infected clusters will have white-gray patches, which turn russet brown and can later crack causing secondary invasion of pathogens. The resulting fruit becomes unacceptable for wine making.

Spray programs for powdery mildew vary depending on the growers approach such as organic verses sustainable verses conventional farming practices. Some growers make sulfur applications every 10 days starting at 6 inches of growth till veraison (color change). Others integrate DMI or reduced risk strobulins fungicides into their program.

Check web citations listed below for more complete descriptions of the fungus and fungicide spray programs for the control of powdery mildew.

Oregon State University Extension Service Center have a web site that describes the cause, symptoms, cultural control, chemical control, forecasting, and biological control of grape powdery mildew. The site address is: http://plant-disease.ippc.orst.edu/search.cfm When you reach the search box, type 'grape powdery mildew' to reach the full online guide.

The 2003 Pest Management for Wine Grapes in Oregon is available on line through the OSU Extension web site:
http://eesc.oregonstate.edu/agcomwebfile/edmat/html/em/em8413/2003em8413.html
In this publication you'll find recommendations for spray schedules for fungicide applications. The 2003 edition includes resources for organic and sustainable standards and materials lists, sustainable/integrated production resources, and other certifying organizations.

Extension Plant Pathology annually publishes Fruit and Ornamental Disease Management Program Reports by Jay Pscheidt. Efficacy results from tests of various fungicides for control of grape powdery mildew and a clinic close-up description of the disease are provided. Reports are disseminated at the OSU Grape day held on campus in Corvallis, Oregon each winter.

The Pacific Northwest Plant Disease Management Handbook is updated annually and can be purchased through the OSU Extension & Station Communications (e-mail: puborders@oregonstate.edu; phone: 541-737-2513). Detailed pest management information of multiple diseases is published in this handbook, and is highly recommended for farm advisors or crop consultants.

University of California Statewide Integrated Pest Management Project has a web site for grape powdery mildew. When viewing this site keep in mind that growing conditions in Oregon can vary from California and recommendations may differ. The site address is: http://www.ipm.ucdavis.edu/PMG/r302100311.html

The American Phytopathological Society APS*net* has a very accessible web site describing the control of powdery mildew using the UC Davis Powdery Mildew Risk Index model. That site is:
http://www.apsnet.org/online/feature/pmildew/Top.html

Grape Powdery Mildew Forecasting Models

Gubler-Thomas UC Davis Cumulative Risk Index is calculated primarily using temperature and leaf wetness for early season forecasting and temperature only for mid and late season forecasting. Data is collected in the vineyard and values are inserted into a simple risk index model. Growers report a reduction in the number of applications of fungicides when adapting the model into their site.

Leaf wetness measurements are particularly helpful during early season control of grape powdery mildew. By understanding early season infection levels growers may change the start date of the first fungicide application and/or reduce the number of early season fungicide sprays. This time period is also critical for predator development in the vineyard used for the control of spider mites. Sulfur sprays are particularly hard on spider mite predators. A grower can facilitate healthier biological control of spider mites in the vineyard through judicious use of early season sulfur applications.

Leaf wetness values are used to determine the Ascospore infection level prior to bloom. Keep in mind, leaf wetness values can be influenced by plant transpiration and soil water. During the secondary cycle of powdery mildew infection, mild temperatures and high humidity can induce germination of single spores. Germinating spores infect plant and produce new colonies. Colonies produce new spores within three days.
By the EL17 stage of shoot and fruit development (see the Pest Management for wine grapes in Oregon web site listed above for details), a powdery mildew program should be underway. When to start the program prior to EL17 is due to a variety of factors such as weather and vine vigor.

The risk level for Ascospore infection can be determined by calculating the number of hours of leaf wetness at an average temperature. ***Growers monitoring Ascospore infection levels can use the risk level model until bloom or until the first colony is found.*** The number of fungicide sprays can be reduced under 'Light risk level' environmental conditions. Growers must individually determine at what point in the 'Medium risk level' they will respond with a fungicide application due to differences between sites, varieties, vine age, fungicide sprayer equipment used, and fungicide selection. The risk model described here was developed with the use of a DMI fungicide because it has the ability to 'reach back' into an infection period for control. More work is needed to understand how this model can be adapted with the use of reduced risk fungicides. The risk model is design to provide initial information to the grower as a means to measure infection levels.

Hours of leaf wetness and average temperatures in ° C to determine Ascospore infection level for grape powdery mildew (adapted from Mills)			
	Light risk level	***Medium risk level***	***High risk level***
Average temp ° C	Hours of wetness	Hours of wetness	Hours of wetness
5 - 5.5	20.0	26.6	40.0
5.6 - 6.1	16.7	22.6	34.0
6.2 - 6.6	14.7	20.0	30.0
6.7 - 7.2	13.3	18.0	27.3
7.3 - 7.8	12.7	16.7	25.3
7.9 - 8.3	11.3	15.3	23.3
8.4 - 8.9	10.0	13.3	20.0
9.0 - 9.4	9.7	13.3	20.0
9.5 - 10	9.3	12.7	19.3
10.1- 10.6	8.7	12.0	18.0
10.7- 11.1	8.0	12.0	17.3
11.2- 11.8	8.0	11.3	16.7
11.8- 12.2	7.7	10.7	16.0
12.3- 12.8	7.3	10.7	16.0

12.9- 13.3	7.3	10.0	14.7
13.4- 13.9	6.7	9.3	14.7
14.0- 14.4	6.7	9.3	14.0
14.5- 15	6.7	8.7	14.0
15.1- 15.6	6.3	8.7	13.3
15.7- 16.1	6.0	8.7	13.3
16.2- 16.7	6.0	8.0	12.7
16.8- 23.9	6.0	8.0	12.0
24.0- 24.4	6.3	8.0	12.7
24.5- 25	7.3	9.3	14.0
25.1- 30	8.7	11.3	17.3
30.1- 40	*No risk*	*No risk*	*No risk*

After bloom or when the first powdery mildew colony is found, growers should switch to the Cumulative Risk Index. Spray intervals can be adjusted to match the potential risk. The cumulative risk index is based on a point system. Average hourly temperature is needed for calculating the risk index.

Add 20 points to your cumulative risk index for each calendar day with greater than 6 continuous hours of temperatures between 70° F (21°C) and 85°F (30°).

Subtract 10 points for each calendar day with less than 6 continuous hours of temperatures between 70°F and 85°F.

Using your calculated index and the table below, determine your spray intervals (number of days) between fungicide spray applications based on your cumulative risk index. Stop spraying when grape sugars reach 12°.

Cumulative Risk Index (adapted from Gubler & Thomas)

Spray Intervals (days between fungicide applications)

	0 – 20 points Low risk	***30 – 50 points Intermediate risk***	***60 – 100 points High risk***
Fungicide			
Dusting sulfur & other fungicides*	14 days	10 days	7 days
Micronized sulfur	18 days	14 days	10 days
DMI fungicides**	21 days	17 days	14 days

* Bicarbonates, Serenade (Bacillus substillis), and AQ-10

** Demethylation-inhibiting fungicides such as Bayleton, Rally, Rubigan, or Procure

Two other forecasting programs have been used in other parts of the world.

One is the German Oi Diag System Kast, W.K.. The Kast model uses a rating of last year’s severity of powdery mildew and the lowest winter temperature to determine when the first fungus colony is expected. Growers are asked to spray 10 days before this day.

After the first spray, growers calculate an average daily index based on temperature, relative humidity, and leaf wetness. Trends in the mean index are examined and spray intervals are adjusted to accommodate changes in mean index values. This model is based on many years of data but only one location in Germany was used for data collection.

The second forecasting program is from Gadoury in New York. This model uses temperature and precipitation to determine spray intervals. DMI fungicides are used from bud break through fruit set then sulfur is used at 14-day intervals until 6 weeks before harvest.

Growers are encouraged to establish an electronic monitoring system in their vineyards that calculates average hourly temperature. If possible leaf wetness should be added to facilitate the early season forecasting. 'Find a sensor' is a web site where growers can research sensor suppliers categorized by area of use. That address is: http://www.findasensor.com/

In summary, growers and field advisors are becoming increasingly aware of the use of site climate information and the computer generated models to help control grape powdery mildew while reducing the number of fungicides. These models must be adapted to each region and each site. Establishing weather stations within vineyards takes financial support. Technical support is needed to accurately monitor the microclimate (canopy-climate) predict powdery mildew infection levels.

OSU Viticulture Extension would appreciate any feedback you may have. Please take the time to complete the following survey. Return to the author's address on the first page. Thank you. Or follow this link to an online version of the form.

Is the content of the manuscript clear from the title (Yes or No)?
Is the manuscript logically sound and factually correct (Yes or No)?
Does the manuscript provide a fair and balanced representation of the issue (Yes or No)?

How would judge the length of the manuscript in relation to its objectives?
Too short_________
About right________
Too long__________

How would judge the readability of the manuscript?
Very readable________
Satisfactory__________
Difficult to read_______

Is sufficient information provided to inform readers of the importance and applicability of the material (Yes or No)?

Are there adequate references to the topic (Yes or No)?

How would rate the importance of the contribution made by this publication?
Not important_____0_1_2_3_4_5_____Important (Circle number)

Are you a grower, academic, student, wine maker, consultant, journalist, wine enthusiast, or other? (Circle all that apply)

Additional comments: