

## Specialty Crops Program – Annual Report, 2003

**Grant Title:** Application of Crop Modeling for Sustainable Grape Production

**Organization:** Rocky Mountain Association of Vintners & Viticulturists (RMAVV)

**Technical Advisors:** Harold Larsen, Horst Caspari, Rod Sharp

### Summary:

Initial incidence of grape powdery mildew in 2003 was detected belatedly and infection levels at one of the cooperating vineyards grew to severe levels before control was obtained. Control costs were higher as a consequence, and no substantial cost difference was found between the grower standard program and the integrated disease management program. Earlier detection might have provided opportunity for earlier control with lower cost control materials. Use of basal shoot leaves adjacent to the cordon arms might well provide an earlier detection of infection and will be incorporated into the detection program for 2004. Both the server and software have been upgraded so that “live” weather data from five vineyard sites are now accessible to growers via a dedicated web site.

### Introduction and Objectives:

Grape powdery mildew is one of the most serious and ubiquitous diseases of grape throughout the world. It is the primary disease of *Vitis vinifera* grapes in Colorado historically, and control has required multiple (two to eight) mildewcide sprays through the season with a seasonal cost of \$40 - 115 per acre for a four spray seasonal program typically used by grape producers.

The typical grape powdery mildew control program in western Colorado vineyards has been preventative in nature, with the use of prophylactic sprays applied beginning with early shoot growth and continuing through veraison at intervals determined by the spray longevity of the materials used. This has historically resulted in four to as many as eight sprays applied each season.

Often, however, such a prophylactic approach may not be needed in the more arid climate of western Colorado. There are many years in which grape powdery mildew infection periods (defined as 12 hour time periods in which temperatures range between 50 and 85 °F with high humidity and leaf wetness periods of 12 hours or more) do not occur until mid-summer. Prophylactic sprays applied prior to such infection periods are likely unneeded for disease control and an unnecessary expense for producers.

The present study investigates the use of electronic weather data to monitor and forecast the risk of powdery mildew infection based on such weather data. Predicted mildew infection risk is verified by on-site monitoring of actual powdery mildew incidence and severity through the season. Finally, comparisons are made of mildew control and costs for adjacent plots that use a “grower’s standard control program” with that of plots that use an “integrated mildew control program” which limits sprays to times associated with actual infection risk.

### Materials and Methods:

Four cooperator vineyards were identified with 2 acres of a single grape variety (three Chardonnay, vineyards A, B, & C, and one Sauvignon blanc, vineyard D). Grower cooperators were to use their choice of control programs (grower’s standard control program) for grape powdery

mildew control on one half of the block (1 acre) and to use the control program designated by the researchers for the other half of the block (1 acre, which included the site of a remote weather station described below). The spray programs varied from one spray per season to eight sprays per season (Tables 1 - 5).

Table 1. Powdery mildew spray programs used at cooperator vineyard A during the 2003 season.

Grower's Standard Mildew Program			Integrated Disease Management Program		
Date	Materials & rates used	Cost <sup>z</sup>	Date	Materials & rates used	Cost <sup>z</sup>
4/29	Sulfur 6F @ 0.5 gal/a	\$2.38	4/29	Sulfur 6F @ 0.5 gal/a	\$2.38
5/12	Sulfur 6F @ 0.5 gal/a	\$2.38			
5/17	Sulfur 6F @ 0.5 gal/a	\$2.38	5/17	Sulfur 6F @ 0.5 gal/a	\$2.38
5/31	Sulfur 6F @ 0.5 gal/a	\$2.38			
6/12	Nova 40W @ 3 oz./a	\$12.90	6/16	Nova 40W @ 3 oz./a	\$12.90
6/27	Sovran 50W @ 4 oz./a + Stylet-Oil @ 1.0% v/v	\$40.15	6/27	Sovran 50W @ 4 oz./a + Stylet-Oil @ 1.0% v/v	\$40.15
7/14	Kaligreen 82W @ 5 lb./a + Stylet-Oil @ 1.5% v/v	\$51.50	7/14	Kaligreen 82W @ 5 lb./a + Stylet-Oil @ 1.5% v/v	\$51.50
7/30	Sovran 50W @ 4 oz./a + Stylet-Oil @ 1.0% v/v	\$40.15	7/30	Sovran 50W @ 4 oz./a + Stylet-Oil @ 1.0% v/v	\$40.15
Total Spray Program Cost		<b>\$ 154.20</b>	Total Spray Program Cost		<b>\$ 149.45</b>

<sup>z</sup> Costs per acre for spray material only.

Table 2. Powdery mildew spray programs used at cooperator vineyard B during the 2003 season.

Grower's Standard Mildew Program			Integrated Disease Management Program		
Date	Materials & rates used	Cost <sup>z</sup>	Date	Materials & rates used	Cost <sup>z</sup>
5/14	Thiolux 80DF @ 5 lbs/a	\$ 4.25	5/14	Thiolux 80DF @ 5 lbs/a	\$ 4.25
5/29	Bayleton 50DF @ 4 oz./a	\$15.74			
6/30	Stylet-Oil @ 1.5% v/v	\$ 14.14			
			7/9	Kaligreen 82W @ 3.5 lb/a + Stylet-Oil @ 1.5% v/v	\$ 34.96
7/25	Nova 40W @ 5 oz./a + Stylet-Oil @ 1.25% v/v	\$ 33.28	7/25	Nova 40W @ 5 oz./a + Stylet-Oil @ 1.25% v/v	\$ 33.28
8/13	Sovran 50W @ 4.5 oz./a + Stylet-Oil @ 1.5% v/v	\$ 42.99	8/13	Sovran 50W @ 4.5 oz./a + Stylet-Oil @ 1.5% v/v	\$ 42.99
Total Spray Program Cost		<b>\$ 110.40</b>	Total Spray Program Cost		<b>\$ 115.49</b>

<sup>z</sup> Costs per acre for spray material only.

Automated AdCon weather stations were installed at two vineyards in 2002 and two in 2003. The stations each were equipped with air temperature, humidity, leaf wetness, rain gauge, wind speed and direction, and solar radiation sensors and ability to send data back to a base station via radio telemetry on 15-minute intervals. The base station database was then accessed using the Thomas-Gubler and the Kast powdery mildew disease models to assess mildew infection risk.

Table 3. Powdery mildew spray programs used at cooperator vineyard C during the 2003 season.

Grower's Standard Mildew Program			Integrated Disease Management Program		
Date	Materials & rates used	Cost <sup>z</sup>	Date	Materials & rates used	Cost <sup>z</sup>
5/24	Sulfur 6F @ 0.5 gal/a	\$ 2.90			
6/7	Nova 40W @ 2.5 oz./a	\$ 10.75			
6/22	Sovran 50W @ 2 oz./a	\$ 12.83			
7/5	Sulfur 6F @ 0.5 gal/a	\$ 2.90			
7/19	Kaligreen 82W @ 5 lb/100 gal + Stylet-Oil @ 1% v/v	\$26.99	7/19	Stylet-Oil @ 1.5% v/v	\$ 13.27
8/2	Kaligreen 82W @ 5 lb/100 gal + Stylet-Oil @ 1% v/v	\$ 26.99	8/2	Kaligreen 82W @ 5 lb/100 gal + Stylet-Oil @ 1% v/v	\$ 26.99
Total Spray Program Cost		<b>\$ 83.36</b>	Total Spray Program Cost		<b>\$ 40.26</b>

<sup>z</sup> Costs per acre for spray material only.

Table 4. Powdery mildew spray programs used at cooperator vineyard D during the 2003 season.

Grower's Standard Mildew Program			Integrated Disease Management Program		
Date	Materials & rates used	Cost <sup>z</sup>	Date	Materials & rates used	Cost <sup>z</sup>
7/30	Thiolux 80DF @ 3 lbs/a	\$ 2.55	7/30	Thiolux 80DF @ 3 lbs/a	\$ 2.55
Total Spray Program Cost		<b>\$ 2.55</b>	Total Spray Program Cost		<b>\$ 2.55</b>

<sup>z</sup> Costs per acre for spray material only.

A field scout assessed powdery mildew infection incidence and severity on variable intervals, typically at least once and often twice a week. Incidence and severity of powdery mildew infections on shoots and leaves were recorded throughout the 2003 season up to and slightly beyond harvest. Funding for the technician/scout has been obtained through an EPA grant that was awarded in July 2002. The EPA grant covers personnel costs for the scout; prior existence of the Specialty Crops Grant greatly expedited approval of that EPA grant.

Data was analyzed via SAS statistical software with means separated at the  $P > 0.05$  level.

### Results:

Weather conditions during 2003 saw some slight easing of the severe drought conditions (experienced in 2001 - 2002) in the early spring months as grapes began bud burst. However, these wet weather periods early in the season were also accompanied by temperatures below the 50 °F threshold for powdery mildew infections. Thus, the first infection period did not occur until June 20th and 21st. The first mildew infections found in the field evaluations occurred on June 26th at only one of the cooperating vineyards. Infections appeared at a second vineyard on the July 3rd evaluation, at a third vineyard location on July 13th, and did not appear at the fourth vineyard until July 17th (Figs. 1 - 2). The first three vineyards in which powdery mildew was detected were older, established vineyards while the final vineyard in which mildew was detected was relatively young (<3 yrs old) with initially sparse canopy development early in the season. In fact, mildew incidence

and severity never exceeded 40% in the young vineyard while incidence and severity in the older vineyards reached 48 - 85% by early August. Veraison occurred on August 11-12 at vineyards A, B, & C (the Chardonnay plots) and August 7 in vineyard D (the Sauvignon blanc plots).

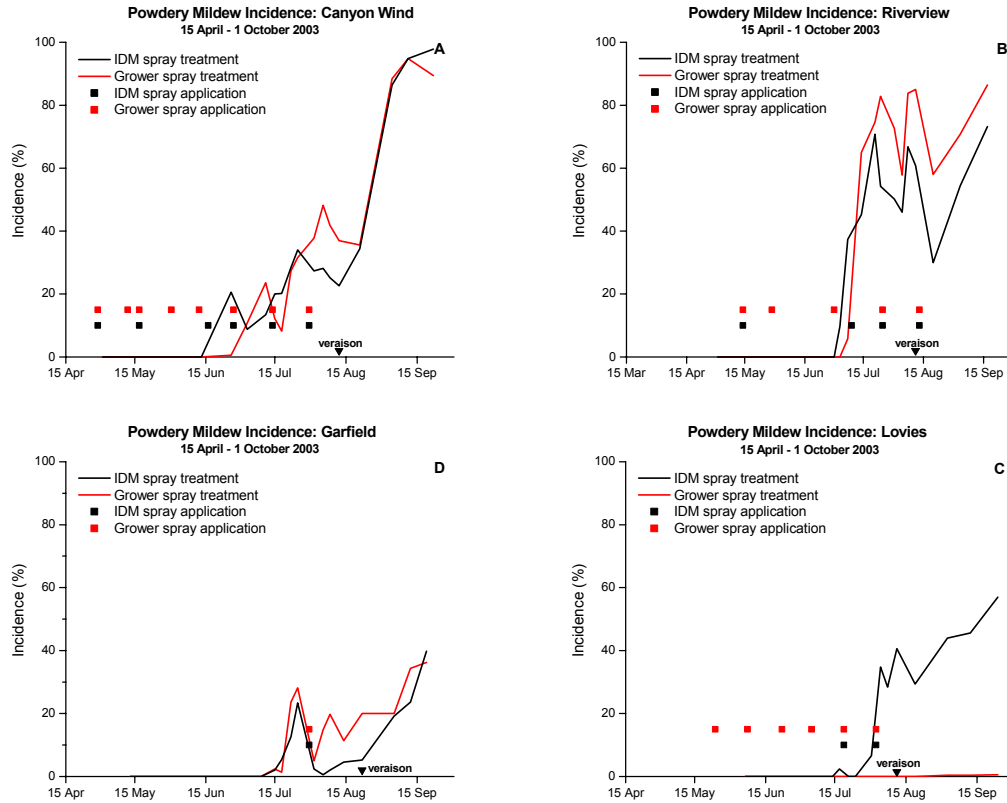


Figure 1. Incidence of grape powdery mildew on Chardonnay (A, B, C) and Sauvignon blanc (D) leaves at four Colorado vineyards in 2003. At each site, the grower’s standard spray program was compared to a reduced (IDM) spray program. Spray applications are indicated by a “■” (grower program) and a “■” (IDM program). Clockwise from top left: Canyon Wind vineyard, Riverview vineyard, Lovie’s vineyard, Garfield Estates vineyard.

It was evident as the season developed that the initial infections (June 20th and 21st) were not found although the scout carefully examined the canopies after the infectin period. This probably was due to the observation protocol that designated observations be made on the upper shoot growth. However, we believe that the intitial infection may have occurred on leaves near the cordons in the lower part of the canopy. Had the lower leaves adjacent to the cordon arms been selected for the observations, the initial infections might have been detected sooner and controls applied on a more efficacious timing. Thus, the initial protocol used at the start of the 2003 season will be modified to utilize the basal leaves for initial infection detection in the future.

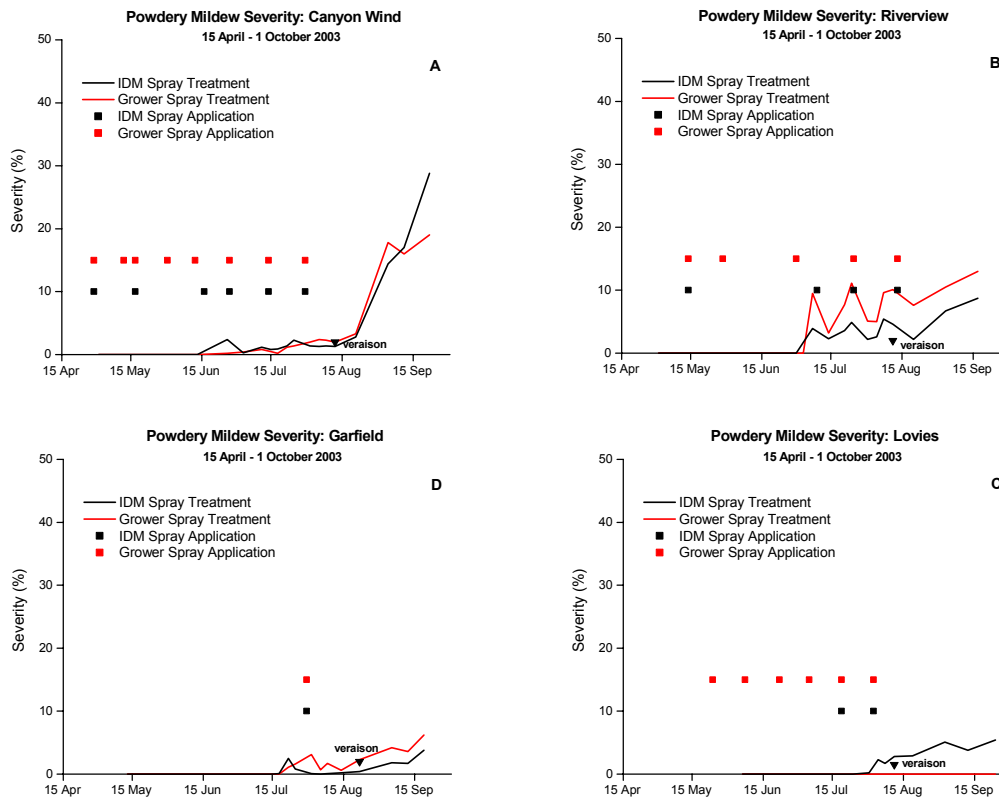


Figure 2. Severity of grape powdery mildew on Chardonnay (A, B, C) and Sauvignon blanc (D) leaves at four Colorado vineyards in 2003. At each site, the grower's standard spray program was compared to a reduced (IDM) spray program. Spray applications are indicated by a "■" (grower program) and a "■" (IDM program). Clockwise from top left: Canyon Wind vineyard, Riverview vineyard, Lovie's vineyard, Garfield Estates vineyard.

The impact of the failure to detect infections as early as needed is reflected in the increased control costs in the integrated disease management plots in vineyards A and B (Table 5). While it is possible that costs for control will be high in both approaches during a season in which powdery mildew infection begins early, there should be a significant reduction in the amounts and costs of fungicides applied under the IDM program (compared to the grower standard program) when disease incidence does not begin until mid-summer. Unfortunately, in 2003, the infections went undetected until the levels were high enough to require a more intensive (and expensive) control program to "catch up" with the disease. On the other hand, control costs with the IDM program on vineyard C were about half that of the standard program. In addition, it should be noted that Table 5 lists costs for materials only, i.e. labour and equipment costs are not included. With the exception of vineyard C, up to four additional sprays were applied in the grower standard program so that the costs savings of the IDM program are higher than what is indicated by Table 5.

Table 5. Comparison of number of sprays applied and costs per acre for four cooperator vineyards in western Colorado that used the grower’s standard program and the integrated (model-driven) program to control grape powdery mildew during the 2003 season.

	Grower’s Standard Program		Model-driven Program	
	No. Sprays	Cost <sup>z</sup>	No. Sprays	Cost <sup>z</sup>
Vineyard A	8	\$ 154.20	6	\$ 149.45
Vineyard B	5	\$ 110.40	4	\$ 115.49
Vineyard C	6	\$ 83.36	2	\$ 40.26
Vineyard D	1	\$ 2.55	1	\$ 2.55

<sup>z</sup> Costs per acre for spray material only.

**Outreach:**

Producers were informed of the project plans at the Spring meeting of the Rocky Mountain Association of Vintners and Viticulturists (RMAVV) held April 20, 2003. A progress report was given at the Summer RMAVV meeting held July 27th, 2003. The season-long results were shared with producers at the fall RMAVV meeting held Nov. 15th, 2003.

For the first two seasons the data acquisition and modeling software ran on an old computer in Dr Caspari’s lab. Due to the limited capabilities of this old computer, access to the data was via dial-up connection and was limited to the participating vineyards. Following several weeks of testing, both a new web server and new software were purchased in the fall of 2003. RMAVV members now have access to “live” weather data from five vineyard sites on a dedicated web page. Access to the data requires a password. The present configuration has three “seats”, i.e. up to three growers can access the data simultaneously. Access may be extended by purchasing additional seats.

The technical advisors also had numerous informal meetings with the grower cooperators throughout the season.

**Acknowledgments:**

Field evaluations were done by Cate Hight and Francois Raimbaud. Sprays were applied by the field staff of the cooperating vineyards: Canyon Wind, Garfield Estates Winery and Vineyard, Lovie’s Vineyard, and Grande River Vineyards (Riverview Vineyard). Cooperation provided by Norm Christianson and Ben Parsons (Canyon Wind), Bob Paxton and Brandon Armitage (Garfield Estates), Ken Loveland (Lovie’s Vineyard), and Jim Mayrose and Stephen Smith (Riverview Vineyard).