Efficacies of Alternative Control Materials for Grape Powdery Mildew in Western Colorado

Harold J. Larsen[1] and Horst W. Caspari[2]

Summary and Recommendations:

Evaluation of "soft" options for control of powdery mildew of grape in western Colorado found no differences provided by the materials included in the study between levels of mildew incidence and severity on Chardonnay grape in 2003. Materials evaluated included oil (paraffinic and jojoba) products, a $KHCO_3$ product, a *Bacillus subtilis* product, and a rotational program that rotated myclobutanil, kresoxim-methyl, and paraffinic oil.

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.

As the wine grape industry expands in Colorado, interest in "softer" approaches to control grape powdery mildew is increasing. This includes materials such as paraffinic oils and plant oils, potassium bicarbonate, and biocontrol materials such as *Bacillus subtilis* and other products. The present study was done to evaluate the efficacy of these materials and compare them against the more standard control options used in western Colorado.

[1] Contact information: Western Colorado Research Center – Orchard Mesa, 3168 B ½ Road, Grand Junction, CO 81503-9621. Phone: 970-434-3264; FAX: 970-434-1035; Email: Harold.Larsen@ColoState.edu

[2] Respectively, Research Fruit Pathologist / Extension Fruit Disease Specialist and Viticulturist, Department of Horticulture and Landscape Architecture, Colorado State University.

Materials and Methods:

The study was established in a block of Chardonnay grapes at the Western Colorado Research Center – Orchard Mesa, located southeast of Grand Junction, CO.

Three powdery mildew sprays were applied during 2003: June 25-26th, July 11th, and July 30th (Table 1). A grape leafhopper spray of imidacloprid was applied at the rate of 52.54 gm a.i./ha on July 30th. The six powdery mildew spray programs were as follows: 1) non-sprayed control; 2) a rotational program that rotated myclobutanil (Nova) with kresoxim-methyl (Sovran) and with paraffinic oil (Stylet-Oil), 3) $KHCO_3$ (Kaligreen), 4) paraffinic oil (Stylet-Oil), 5) jojoba oil (Erase), and 6) *Bacillus subtillis* (Serenade). The rates for these materials are listed in Table 1. Powdery mildew infection was evaluated on six leaves (using the most recent fully expanded leaf on shoots) for incidence and severity on six dates: 6/24, 7/1, 7/9, 7/23, 7/29, and 8/25/2003.

Data was analyzed via SAS statistical analysis program software using a $p>0.05$ threshold for means testing.

Results and Discussion:

The 2003 season was again very hot and dry, at least during the early portion of the growing season. The dry conditions delayed onset of powdery mildew infection as no significant (2.5 mm or more) rainfall occurred in conjunction with temperatures averaging between 10 and 25 ºC (the

Table 1. Mildewcide application dates, materials, and rates used in the experimental vineyard plots at W. Colorado Research Center – Orchard Mesa, Grand Junction, CO during the 2003 growing season.

Trt No.	Treatment Program Type	Spray Dates	Materials & rates used
1	Control	Non-treated control	None
2	Rotation Program	6/25-26/2003 7/11/2003 7/30/2003	a. Nova (myclobutanil) 40W @ 5 oz. / acre (=140 g a.i./ha) b. Sovran (kresoxim-methyl) 50WG @ 4 oz. / acre (= 140 g a.i./ha) c. Stylet-Oil (paraffinic oil @ 1% vol./vol.)
3	Kaligreen	a. 6/26/2003 b. 7/11/2003 c. 7/30/2003	Kaligreen (potassium bicarbonate) 82W @ 5 lb. / acre (= 4.6 kg a.i./ha)
4	Stylet-Oil	a, b, c	Stylet-Oil (paraffinic oil) @ 1% vol./vol.
5	Erase	a, b, c	Erase (jojoba oil) @ 0.5% vol./vol.
6	Serenade	a, b, c	Serenade (*Bacillus subtilis*) 10W @ 6 lbs. / acre (= 673 g a.i./ha)

general conditions necessary for initial infection to occur) until June 20th. Vine shoot growth was better during the early season in 2003 than it was in 2002, but canopy coverage was slow to develop. This likely was a carryover effect from the severe drought conditions experienced in 2002. Initial powdery mildew counts made June 24th found no mildew infections on any leaves within the study plots (Table 2). Mildew infections began showing up in substantial amounts by early July, but dropped at the end of July after 2 weeks of temperatures of 100 °F or above during mid-July. Mildew infections increased in incidence and severity by late July and continued to build throughout August and were extremely high by late August.

An infection period occurred at the site on June 20-21. This was exacerbated by a water line break at the head of the vineyard which allowed water to run down one aisle to such a volume that standing water was present for several days after the line was shut off and repaired. The initial mildew infection and highest incidence and severity was localized in the two rows either side of the break and continued down the row from the top approximately 150 ft of the total 400 ft row length. Infection and severity dropped off greatly as one moved away from the inundated aisle area. The incidence and severity was sufficiently great to cause severe infection and injury on fruit clusters within the severely affected area; much of the fruit was rendered unuseable.

The association of the water break with higher mildew incidence and disease severity points out the role of water in hydrating the overwintering cleistothecia and inducing ascospore release as a cause of primary mildew infection in arid areas such as western Colorado. Typically, no flag shoots are found early in spring in this area. This means initial infections typically are ascospore infections that depend wholly upon hydration events after initiation of shoot growth. If such hydration events do not occur, then ascospore infections do not occur. Thus, control programs can focus on occurrence of hydration events to time initiation of spray applications. And this can reduce the number of applications per year and lower producer costs. (See Larsen & Caspari, 2004)

The decline in Mildew incidence and severity at the end of July likely is a result of the very high daytime temperatures (100+ °F) experienced for two weeks in mid-July.

Mildew spray materials differ substantially in efficacy periods and costs per spray materials (Table 3). In addition, they represent different chemistries and modes of action, and have different risk of resistance development. It is recommended to rotate chemistry groups, not just products, and not use DMI's or strobilurins for repeat (successive) sprays.

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Literature Cited

Larsen, H. J. and H. W. Caspari. 2004. Application of Crop Modeling for Sustainable Grape Production: Year Two Results. p. 29 - 34 *in*: Larsen, H. J. [Ed.]. Western Colorado Research Center Research Report, 2003. Colo. Agric. Exp. Stn. Tech. Rpt. TR03-7. Colo. Agric. Exp. Stn., Colo. St. Univ., Ft. Collins. 60 p. (on the web at: (http://www.colostate.edu/programs/wcrc/annrpt/02/tr03-7.pdf)

Table 2. Incidence (%) and Severity (% surface infected) of foliar mildew infections as affected by treatment program at the W. Colorado Research Center at Orchard Mesa, Grand Junction, CO during the 2003 growing season.

Treatment Program	6/24/2003	7/1/2003	7/9/2003	7/23/2003	7/29/2003	8/25/2003
	Incidence (%)					
Control	0.0	10.00	42.32	6.93	9.24	92.30
Rotation Program	0.0	10.80	41.55	2.31	7.69	96.92
Kaligreen	0.0	2.80	30.03	1.54	4.62	97.69
Stylet-Oil	0.0	0.80	33.88	1.54	9.23	93.07
Erase	0.0	4.00	35.40	1.54	5.39	92.30
Serenade	0.0	6.40	42.33	0.00	7.70	86.92
	Severity (%)					
Control	0.0	0.50	2.84	0.12	0.43	31.80
Rotation Program	0.0	0.94	2.56	0.03	0.24	28.86
Kaligreen	0.0	0.08	1.28	0.06	0.15	31.56
Stylet-Oil	0.0	0.05	1.61	0.03	0.29	22.71
Erase	0.0	0.33	2.16	0.03	0.18	27.21
Serenade	0.0	0.23	2.57	0.00	1.17	30.60

Table 3. Comparative efficacy periods, rates and costs of control materials for grape powdery mildew in 2003.

Material	**Chemistry Group**	**Efficacy Period**	**Rate**	**Cost / acre**
Thiolux 80DF	Sulfur	7 - 10 days	2 - 5 lb/acre	$2 - 4
Sulfur 6F	Sulfur	7 - 10 days	3 - 6 qt/acre	$4 -8
Sulfur 90W	Sulfur	7 - 10 days	5 - 10 lb/acre	$2 - 4
Bayleton 50DF	DMI	14 - 21 days	4 - 6 oz/acre	$16 - 24
Nova 40W	DMI	14 - 21 days	3 - 5 oz/acre	$13 - 22
Procure 50W	DMI	14 - 18 days	4 - 8 oz/acre	$14 - 28
Rubigan 1E	DMI	14 - 21 days	2 - 6 fl. oz./acre	$5 - 14
Stylet-Oil	Oil	14 days	1 - 2 ga.l/100 gal. (1 - 2% vol/vol)	$15 - 30
Erase	Oil	14 days	1 - 2 qts/acre	$24 - 45
Kaligreen 82W	Bicarbonate	10 - 14 days	2.5 - 5 lb/acre	$15 - 30
Abound 2.08F	Strobilurin	14 - 21 days	11 - 15 fl. oz./acre	??
Flint 50WDG	Strobilurin	14 - 21 days	2 oz/acre	$30
Sovran 50W	Strobilurin	14 - 21 days	4 oz/acre	$26
Serenade 10W	*Bacillus subtilis*	10 - 14 days	4 - 8 lb/acre	$33 - 66