

Chemical Control of Grape Powdery Mildew

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I. Sulfur Formulations:

Until 1982 nearly the entire story of chemical control of grape powdery mildew could be summarized by one word: sulfur. Elemental sulfur has been used for 100 years against this disease and is still considered an effective control measure under most circumstances. Sulfur is available in several forms: dust, wettable, micronized, and flowable. These forms differ in their particle size, shape, and uniformity (Table 1).

Laboratory tests have shown that particle size is directly related to fungicidal activity of sulfur against fungal spores. This led to speculation that the various formulations might differ in effectiveness in mildew control in vineyards. The results of 3 experiments are reported here.

Recommended rates of 4 sulfur formulations were evaluated in 1978 and 1979 in a Carignane vineyard located near Lost Hills, CA. The vines were planted in 1968 and had a history of severe mildew infection. The experimental design was a randomized complete block using 10 vines per replicate and 7 replicates. The extent of powdery mildew colonization on the fruit was visually evaluated on at least 100 clusters chosen from the middle 4 vines of each treatment. Evaluations were made when fruit was 7-10% sugar, just prior to color change. One-hundred clusters were harvested and weighed when the fruit was about 22% sugar.

The results (Table 2) show that the wettable, flowable, and micronized sulfurs significantly reduced the severity of mildew attack and they were associated with significantly larger clusters than were found on the untreated vines. However, in 1978, Super Six, a flowable formulation, appeared to give the best results in mildew reduction, while in 1979, Super Micro Sulf, a micronized sulfur, appeared best. It is interesting to note that the two micronized sulfurs, Super Micro Sulf and Thiolux, differed in level of mildew control in both years.

In 1980, to continue the comparison, flowable, micronized, and wettable sulfurs were compared to sulfur dust. Rates were adjusted to give an application of 4 lb/A of elemental sulfur in each treatment. For the experiment, an 8-year-old block of Cabernet Sauvignon vines grown near Oakville, CA, were used. The design was a randomized complete block using ~90 vines per replicate and 5 replicates. Other procedures were similar to those used in the previous experiment.

Note: Mention of trade names does not constitute endorsement of the products or imply criticism of similar products not mentioned.

The results indicate that all treatments reduced the mildew incidence and severity when compared to the untreated vines (Table 3). On an equivalent pound basis the wettable, flowable, and micronized sulfurs were slightly more efficient than sulfur dust in reducing mildew incidence. However, sulfur dust at a higher rate, but on an equivalent application schedule, gave the best control. It is interesting to note that this vineyard did not have severe mildew even in the untreated areas in 1980, a generally severe mildew year. Also, although the results are not statistically significant, the untreated vines produced the largest clusters.

The results of these experiments and several other observations made in blocks of Carignane near Lodi in 1979 and 1980 have convinced us that the wettable, flowable, and micronized sulfurs can reduce mildew when compared to untreated vines or to sulfur dust treatments using the same amounts of sulfur. However, they are not as efficient as greater amounts of sulfur applied as dust but on the same application schedule. We could not make generalizations from our experiments about the efficiency of a type of sulfur. They varied from experiment to experiment. Also, no consistent relationship was found between particle size and control efficiency. Our observations on Carignane vines indicate that good coverage may be much more difficult to achieve with spray formulations than with dusts. We cannot recommend spray applications of sulfur for vines with very dense canopies.

II. New fungicides

Several new fungicides have recently been introduced to European vineyards for powdery mildew control. These materials are now being tested in California. They belong a group of chemicals known as sterol inhibitors. The name is indicative of their mode of action.

In 1981, three tests ~~were~~^{were} conducted to compare these new materials. The tests were located in a Thompson Seedless block near Reedley, in a Carignane vineyard near Hopland, and near Soledad on Cabernet Sauvignon vines.

Two materials, Bayleton and Rubigan, were associated with the greatest reduction in mildew and the least number of applications (Table 4). In the Thompson Seedless test, 3 applications of Bayleton or Rubigan gave better control than 8 sulfur dusting. The materials BASF 9108, CGA 71818, and CGA 64251 have been in testing only a few years, so rates and schedules for these materials may change and give improved efficiency.

The sterol inhibitors appear to be a very promising group of fungicides because we found improved mildew control while using fewer applications than with sulfur. In past tests, we demonstrated that these fungicides can kill existing infections. However, their efficiency is very closely linked to the efficiency of application.

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Table 1. Various formulations of elemental sulfur. Particle size determined by microscopic measurement of at least 300 particles using an eyepiece micrometer

Material*	Mean Particle	Standard
	Size μ	
Super Six	4.67	2.07
Super Micro Sulf	1.45	0.96
Thiolux	2.70	1.01
THAT Flowable	2.05	0.82
FMC Wetttable	6.45	5.14
FMC Sulfur Dust	9.80	4.29

Note: Although care was taken to insure that samples were unbiased, clumping of particles made accurate measurements very difficult. These measurements represent approximate values and may contain considerable sampling error.

*Super Six, Griffin Corp., Valdosta, GA; Super Micro Sulf, Cal-Ag Enterprises, Inc. Dinuba, CA; Thiolux, Sandoz Inc., San Diego, CA; THAT, Stollen Chemical Co., Houston, TX; FMC Wetttable, FMC Corp. Middleport, NY; FMC Sulfur dust, FMC Corp. Middleport, NY.

Table 2. Effect of various sulfur formulations on the incidence and severity of grape powdery mildew and on cluster size for 1978 and 1979. Experiment was conducted in a commercial Carignane vineyard located near Lost Hills, CA.

Material	No. of Applic.	Rate per Applic.	Percent of clusters with mildew	Severity index	Weight/ cluster (kg)
1978					
Super Six	3	6 pt/A	98 ab	13 a	0.26 a
Super Micro Sulf	3	5 lb.	97 a	19 ab	0.24 b
FMC Wetttable	3	2 lb.	99 abc	26 bc	0.24 b
Thiolux	3	5 lb.	99 bc	30 c	0.24 b
Untreated	-	-	100 c	74 d	0.15 c
1979					
Super Six	4	4 pt./A	98 a	65 b	0.26 a
Super Micro Sulf	4	3 lb	100 a	45 a	0.26 a
FMC Wetttable	4	3.75 lb	100 b	69 b	0.26 a
Thiolux	4	3 lb	100 b	73 bc	0.27 a
Untreated	-	-	100 b	79 c	0.16 b

Note: 1978 - All materials were applied on 5/2 (shoots 15-24"), 5/26 (100% bloom) and 6/12. Plots were sprayed with an over the row boom sprayer with adjustable cone jet nozzels (#12430, at 250-300 psi) @ 250 gal/A and 6 oz. Triton B1956 was added/100 gal. water for wetting. Mildew was visually evaluated on 7/25 when fruit at 7 Brix. The fruit was harvested and weighed on 9/12 when fruit at 21 Brix.

1979 - All materials were applied on 5/10 (shoots 16-18"), 5/23 (shatter), 6/6 and 6/20. Plots were sprayed @ 250 gal/A. Mildew was visually evaluated on 7/19 when fruit at 10 Brix. The fruit was harvested and weighed on 8/29 when fruit at 21 Brix. On 5/10 only the following rates were used: Super Micro Sulf, 5 lb/A; Super 6, 6 pts; Wetttable Sulfur, 5 lb.; Thiolux, 5 lb.

Table 3. Effect of various sulfur formulations on the incidence and severity of grape powdery mildew and on cluster size for 1980. Experiment was conducted in a commercial Cabernet sauvignon vineyard located near Oakville, CA.

Material	No. of Applic.	Rate per Applic.*	Percent	Severity	Weight/
			clusters with mildew	Index	cluster (kg)
Sulfur dust	7	15 lb/A	2 a	0 a	0.14
THAT	7	4 lb	22 b	2 a	0.13
Super Micro Sulf	7	4 lb	27 bc	3 a	0.14
FMC Wettable	7	4 lb	35 cd	5 a	0.14
Sulfur dust	7	4 lb	45 d	7 a	0.13
Untreated	-	-	70 e	26 b	0.19
					n.s.

*Rate here given in pounds of elemental sulfur, not as formulation.

Notes: All materials were applied on 5/2 (shoots 12"), 5/15 (full bloom), 5/30, 6/12, 6/27, 7/11, 7/30. Plots were sprayed @ 40 gal/A and the first 3 spray applications contained WEX. Mildew was visually evaluated on 8/20 when fruit 10 Brix. The fruit was harvested and weighed on 10/3 when fruit at 22.9 Brix.

Table 4a

Powdery mildew fungicide test at Kearney Field Station on Thompson Seedless. Each of the 7 treatments consisted of 11 vines replicated 6 times. The mildew was visually evaluated on 7/15/81 when the fruit was ~13 Brix.

Treatment	Rate ¹ per acre		Timing	Percent clusters with		Mildew severity	
	(ai)			mildew		index	
Bayleton	3	oz	4/27, 5/18, 6/8	0	c	0	b
CGA-71818	15	gm	4/13, 5/4, 5/26, 6/15, 7/6 7/27, 8/17	0	c	0	b
Rubigan	12	gm	4/27, 5/18, 6/8	0.7	c	0.1	b
CGA-64251	3.45	lb	4/13, 5/4, 5/26, 6/15, 7/6 7/27, 8/17	9.3	b	0.5	b
BASF-9108	0.22	lb	4/27, 5/18, 6/8	8.9	b	3.2	b
Sulfur dust	10	lb	4/13, 4/22, 5/11, 5/26, 6/8, 6/22, 7/6, 7/27	17.8	b	5.6	b
Untreated	-		-	81.5	a	34.4	a

¹John Bean Sprayer, 150 gal/A

Table 4b

Powdery mildew fungicide test at Milovina Ranch near Hopland on Carignane. Each of the 7 treatments consisted of 14 vines replicated 4 times. The mildew was visually evaluated on 8/24/81 when the fruit was ~12 Brix.

Treatment	Rate ¹		Timing	Percent		Mildew	
	per acre			clusters with		severity	
	(ai)			mildew		index	
Rubigan	12	gm	5/28,6/10,6/24	17.9	d	2.8	d
CGA-71818	15	gm	5/8,5/29,6/16,7/9,7/30	21.4	d	2.6	d
Sulfur dust	10	lb	5/8,5/20,5/27,6/10 6/24,7/8,7/22,8/5	26.8	d	3.0	d
Bayleton	3	oz	5/28,6/10	48.6	c	6.6	cd
BASF-9108	0.22	lb	5/28,6/11,6/24,7/8,7/22,8/5	48.9	c	10.0	c
BASF-9108	0.22	lb	5/28,6/16,7/9,7/30	87.6	b	31.1	b
Untreated	-		-	100.0	a	83.3	a

¹Handgun, sprayed to runoff.

Table 4c

Powdery mildew fungicide test at Junction Vineyard near Soledad on Cabernet Sauvignon. Each of the 7 treatments consisted of 20 vines replicated 4 times. The mildew was visually evaluated on 8/20/81 when the fruit was ~12 Brix. Harvest weights were taken on 10/14/81 (23 Brix); 100 clusters/rep were weighed.

Treatment ¹	Rate per acre		Timing	Percent clusters with mildew		Mildew severity index		Mean weight per cluster gms
	(ai)							
BASF-9108	0.22	1b	6/5,6/26,7/17,8/7	0	a	0	a	102.7
Rubigan	12	gm	6/5,6/15,7/2	0	a	0	a	104.7
BASF-9108	0.22	1b	6/5,6/19,7/2,7/17,8/3,8/14	0.6	a	0	a	102.9
Bayleton	3	oz	6/5,6/15,7/2	0.6	a	0	a	102.1
CGA 71818	15	gm	6/5,6/26,7/17,8/7	0.6	a	0	a	104.7
Untreated	-		-	45.5	c	10.5	b	91.8
Sulfur ²	10	1b	Biweekly	-		-		97.3
								N.S.

¹Materials applied with commercial overvine boom sprayer @ 100 gal/A.

²Sulfur treatment from adjacent field.