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Control of grape powdery mildew with synthetic, biological and organic fungicides: 2010 field trials

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# Control of grape powdery mildew with synthetic, biological and organic fungicides: 2010 field trials

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Department of Plant Pathology,  
University of California, Davis, July 2010

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# Report Summary

Powdery mildew is an economically-important pathogen of grapes worldwide. This report details the findings of our annual powdery mildew fungicide trials on grapevine cultivar Chardonnay (*Vitis vinifera*). The trials were conducted at Herzog Ranch, near Courtland, California in 2010. Treatments were placed in four adjacent trials in the vineyard. Spraying commenced in mid April, amidst significant rainfall events that likely promoted the release of powdery mildew (*Erysiphe necator*) ascospores from overwintering chasmothecia. Powdery mildew pressure began slowly with cool temperatures early on, but quickly built to very high disease pressure levels as temperatures warmed. Spraying was completed on July 23 and treatments were evaluated for disease incidence and severity.

Trial I consisted of soft chemistry products, including biologicals, sulfurs, nutrient applications, oils, and other materials. Spray frequencies varied from weekly applications to 21 day intervals. Many applications were based on the Gubler-Thomas Risk Index, with application intervals based on the index.

Temperatures were mild during much of the 2010 growing season, providing optimal conditions for the asexual reproduction and dispersal of powdery mildew. Overall disease pressure was higher than in similar trials conducted in 2007, 2008, and 2009. By late June, heavy to severe mildew coverage was evident on untreated clusters. Progression of the disease during spring was faster towards the eastern end of the research area. However, by the time of disease evaluation, disease severity in untreated plots in all four trials reached 95-100%.

## Materials and Methods

### A1. Experimental design

Experimental design	Complete randomized design with 5 replicates.		
Experimental unit	2 adjacent vines = 1 plot		
Plot area	154 ft <sup>2</sup> (row spacing = 11 ft, vine spacing = 7 ft)		
Area/treatment	770 ft <sup>2</sup> (5 reps. = 1 treatment)	Area/treatment	0.0177 acre/treatment
Volume water/acre	75 gallons (first spray)= 1.3 gallons/5 replicates 100 gallons (pre-bloom in mid-April), = 1.8 gallons/5 replicates 125 gallons (certain products), = 2.2 gallons/5 replicates 150 gallons (pre-bloom to pea-sized berries, late April - early June), = 2.7 gallons/5 reps 200 gallons (late season), = 3.5 gallons/5 reps		
Application method	Handgun sprayers (attached to Nifty Fifty brand 25 or 50 gallon sprayers).		

## B. Experimental treatments

The treatments described in this report were conducted for **experimental purposes only** and crops treated in a similar manner may not be suitable for commercial or other use.

### Trial I

No.	Flag.	Treatment	Frequency (days)	Application rate (per acre)	FP/5 replicates
1	W	Unsprayed control	none	none	none
2	K	Sporatec	14-21(RI)	.1875% (v/v)	9.4 ml(at 75 gal/A) 12.6 ml (at 100 gal/A) 18.8 ml(at 150 gal/A) 25.1 ml(at 200 gal/A)
3	LG	Sporatec	14-21(RI)	.375% (v/v)	18.8 ml(at 75 gal/A) 25.1 ml(at 100 gal/A) 37.6 ml(at 150 gal/A) 50.3 ml(at 200 gal/A)
4	GKC	Safe-T-Side	14-21(RI)	1% (v/v)	50.3 ml (at 75 gal/A) 67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A)
5	Y	Safe-T-Side	14-21(RI)	2% (v/v)	100.5 ml (at 75 gal/A) 134.0 ml (at 100 gal/A) 201.0 ml (at 150 gal/A) 268.0 ml (at 200 gal/A)
6	YC	Oroboost + Thiosperss	14	.25% + 5 lb	12.6 ml (at 75 gal/A) + 40.1 g 16.8 ml (at 100 gal/A) + 40.1 g 25.1 ml (at 150 gal/A) + 40.1 g 33.5 ml (at 200 gal/A) + 40.1 g
7	BS	Oroboost + Thiosperss	14	.25% + 3 lb	12.6 ml (at 75 gal/A) + 24.1 g 16.8 ml (at 100 gal/A) + 24.1 g 25.1 ml (at 150 gal/A) + 24.1 g 33.5 ml (at 200 gal/A) + 24.1 g
8	KS	Thiosperss	14	3 lb	24.1 g
9	O	BTN + 50% H2O2	14 (3x) then 28	2.0 gal + 0.5 gal (125 gal water)	134 ml + 34 ml (at 125 gal only) (2.2 gal water per treatment)
10	OS	BTN + 50% H2O2 (3x) then Abound alt BTN + 50% H2O2	14 (3x) then 14 alt 14	2.0 gal + 0.5 gal (125 gal water) then Abound label rate	134 ml + 34 ml (at 125 gal only) then 7.2 ml Alt 134 ml + 34 ml (at 125 gal only) (2.2 gal water per treatment)
11	OD	Rally + Yucca Ag Aide	21	5 oz + 0.125 (%v/v)	2.5 g + 6.3 ml (at 75 gal/A) 2.5 g + 8.4 ml (at 100 gal/A) 2.5 g + 12.6 ml (at 150 gal/A) 2.5 g + 16.8 ml (at 200 gal/A)
12	GD	Stylet-oil (1x) then Rally 40 WSP alt Regalia	7	1% (1x) then 3 oz alt 1qt	50.3 ml (at 75 gal/A) (1x) then 1.5 g alt 16.8 ml
13	B	Stylet-oil (1x) then Regalia alt Flint	7 then 7 alt 14	1%(v/v) then 1 qt alt 1.5 oz	50.3 ml (at 75 gal/A) (1x) then 16.8 ml alt .75 g
14	Pu	Regalia + Microthiol Disperss alt Regalia	14 alt 7	1 qt + 5 lb alt 1 qt	16.8 ml + 40.1 g alt 16.8 ml

15	PKD	Stylet-oil alt Vigor Cal + MBI-106020	7	1% alt 1 qt + 1 pt	50.3 ml (at 75 gal/A) alt 16.8 ml + 8.4 ml 67.0 ml (at 100 gal/A) alt 16.8 ml + 8.4 ml 100.5 ml (at 150 gal/A) alt 16.8 ml + 8.4 ml 134.0 ml (at 200 gal/A) alt 16.8 ml + 8.4 ml
16	KD	HiPeak + Hi Wett	10	8.4 lb/100 gal + 2 fl oz	50.6 g (at 75 gal/A) + 1.0 ml 67.4 g (at 100 gal/A) + 1.0 ml 101.2 g (at 150 gal/A) + 1.0 ml 134.9 g (at 200 gal/A) + 1.0 ml
17	P	HiPeak + Hi Wett	10	4.2 lb/100 gal + 2 fl oz	25.3 g (at 75 gal/A) + 1.0 ml 33.7 g (at 100 gal/A) + 1.0 ml 50.6 g (at 150 gal/A) + 1.0 ml 67.4 g (at 200 gal/A) + 1.0 ml
18	GS	HiPeak + Hi Wett	10	13 lb/100 gal + 2 fl oz	78.3 g (at 75 gal/A) + 1.0 ml 104.4 g (at 100 gal/A) + 1.0 ml 156.6 g (at 150 gal/A) + 1.0 ml 208.7 g (at 200 gal/A) + 1.0 ml
19	YD	HiPeak + Hi Wett alt Flint	10 alt 21	8.4 lb/100 gal + 2 fl oz alt 2 oz	50.6 g (at 75 gal/A) + 1.0 ml alt 1.0 g 67.4 g (at 100 gal/A) + 1.0 ml alt 1.0 g 101.2 g (at 150 gal/A) + 1.0 ml alt 1.0 g 134.9 g (at 200 gal/A) + 1.0 ml alt 1.0 g
20	BD	HiPeak + Hi Wett + Kumulus	10	8.4 lb/100 gal + 2 fl oz + 3 lb	50.6 g (at 75 gal/A) + 1.0 ml + 24.1 g 67.4 g (at 100 gal/A) + 1.0 ml + 24.1 g 101.2 g (at 150 gal/A) + 1.0 ml + 24.1 g 134.9 g (at 200 gal/A) + 1.0 ml + 24.1 g
21	KC	MKP + Hi Wett	10	8.4 lb/100 gal + 2 fl oz	50.6 g (at 75 gal/A) + 1.0 ml 67.4 g (at 100 gal/A) + 1.0 ml 101.2 g (at 150 gal/A) + 1.0 ml 134.9 g (at 200 gal/A) + 1.0 ml
22	PKS	HiPeak + Flint	21	8.4 lb/100 gal + 2 oz	50.6 g (at 75 gal/A) + 1.0 g 67.4 g (at 100 gal/A) + 1.0 g 101.2 g (at 150 gal/A) + 1.0 g 134.9 g (at 200 gal/A) + 1.0 g
23	OKD	Actinovate + Biolink	10	9 oz + 4 fl oz	4.5 g + 2.1 ml
24	YS	Actinovate + Biolink + CO2	10	6 oz + 4 fl oz + 6 oz	3.0 g + 2.1 ml + 3.0 g
25	OKS	Flint	21	2 oz	1.0 g

<sup>1</sup> On July 1, Pristine was accidentally applied at approximately 10.5 oz/acre in 200 gallons water/acre on treatment 13 (B). <sup>2</sup> FP = formulated product.

## Trial II

No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/5 replicates
1	W	Unsprayed control	None	none	none
2	K	Torino	10-14 (RI)	3.4 fl oz	1.8 ml
3	LG	Torino	14-17 (RI)	3.4 fl oz	1.8 ml
4	GKC	Torino	18-21 (RI)	3.4 fl oz	1.8 ml
5	Y	Torino (3x) then Pristine then Vintage then Flint	14 (RI) then 18-21 (RI) then 14 (RI) then 14 (RI)	3.4 fl oz then 10.5 oz then 5 fl oz then 2 oz	1.8 ml then 5.3 g then 2.6 ml then 1.0 g
6	YC	Pristine then Vintage then Flint then Torino (3x)	21 (RI) then 14 (RI) then 14 (RI) then 14 (RI) (3x)	10.5 oz then 5 fl oz then 2 oz then 3.4 fl oz	5.3 g then 2.6 ml then 1.0 g then 1.8 ml
7	BS	Torino alt Vintage	14 (RI)	3.4 fl oz then 5.0 fl oz	1.8 ml alt 2.6 ml
8	KS	YT669 + Dyneamic	14	6 fl oz + 6 fl oz	3.1 ml + 3.1 ml
9	O	YT669 + Dyneamic	14	12 fl oz + 6 fl oz	6.3 ml + 3.1 ml
10	OS	Pristine	14	8 oz	4.0 g
11	OD	Vivando + Sylgard 309	14	10.5 fl oz + .03% (v/v)	5.5 ml + 1.5 ml (at 75 gal/A) 5.5 ml + 2.0 ml (at 100 gal/A) 5.5 ml + 3.0 ml (at 150 gal/A) 5.5 ml + 4.0 ml (at 200 gal/A)
12	GD	Vivando + Sylgard 309	21	15.36 fl oz + .03% (v/v)	8.0 ml + 1.5 ml (at 75 gal/A) 8.0 ml + 2.0 ml (at 100 gal/A) 8.0 ml + 3.0 ml (at 150 gal/A) 8.0 ml + 4.0 ml (at 200 gal/A)
13	B	Pristine	21	10.5 oz	5.3 g
14	Pu	Pristine alt Vivando	21	10.5 oz alt 12.8 fl oz	5.3 g + 6.7 ml
15	PKD	Exp. 3	7	0.25% (v/v)	12.6 ml (at 75 gal/A) 16.8 ml (at 100 gal/A) 25.1 ml (at 150 gal/A) 33.5 ml (at 200 gal/A)
16	KD	Exp. 3	10	0.25% (v/v)	12.6 ml (at 75 gal/A) 16.8 ml (at 100 gal/A) 25.1 ml (at 150 gal/A) 33.5 ml (at 200 gal/A)
17	P	Exp. 3 + Spraygard	10	0.25% (v/v) + 0.1 % (v/v)	12.6 ml + 5.0 ml (at 75 gal/A) 16.8 ml + 6.7 ml (at 100 gal/A) 25.1 ml + 10.0 ml (at 150 gal/A) 33.5 ml + 13.4 ml (at 200 gal/A)
18	GS	Exp. 3 + Topguard 1.04 SC	14	0.25% (v/v) + 10 fl oz	12.6 ml (at 75 gal/A) + 5.2 ml 16.8 ml (at 100 gal/A) + 5.2 ml 25.1 ml (at 150 gal/A) + 5.2 ml 33.5 ml (at 200 gal/A) + 5.2 ml

19	YD	Exp. 3 + Topguard 1.04 SC	14	0.25% (v/v) + 5 fl oz	12.6 ml (at 75 gal/A) + 2.6 ml 16.8 ml (at 100 gal/A) + 2.6 ml 25.1 ml (at 150 gal/A) + 2.6 ml 33.5 ml (at 200 gal/A) + 2.6 ml
20	BD	Stylet-oil	10-14	1% (v/v) pre-bloom, 2% (v/v) post-bloom	PRE-BLOOM 50.3 ml (at 75 gal/A) 67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) POST-BLOOM 100.5 ml (at 75 gal/A) 134.0 ml (at 100 gal/A) 201.0 ml (at 150 gal/A) 268.0 ml (at 200 gal/A)
21	KC	Stylet-oil then Quintec (2x) then Stylet-oil + Quintec	10-14 (pre-bloom) then 17 (2x) then 17-21	1% (v/v) pre-bloom then 6 fl oz then 1% (v/v) + 6 fl oz	PRE-BLOOM 50.3 ml (at 75 gal/A) 67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) POST-BLOOM then 3.1 ml (2x) then 50.3 ml + 3.1 ml (at 75 gal/A) 67.0 ml + 3.1 ml (at 100 gal/A) 100.5 ml + 3.1 ml (at 150 gal/A) 134.0 ml + 3.1 ml (at 200 gal/A)
22	PKS	Stylet-oil then Stylet-oil + Flint	10-14 (pre-bloom) then 17	1% (v/v) pre-bloom, then 1% + 2 oz	PRE-BLOOM 50.3 ml (at 75 gal/A) 67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) POST-BLOOM 50.3 ml + 1.0 g (at 75 gal/A) 67.0 ml + 1.0 g (at 100 gal/A) 100.5 ml + 1.0 g (at 150 gal/A) 134.0 ml + 1.0 g (at 200 gal/A)
23	YKS	Stylet-oil then Pristine (2x) then Stylet-oil + Quintec	10-14 (pre-bloom) then 17-21 then 14 (if disease)-17	1% (v/v) pre-bloom, then 10.5 oz (2x) then 1% (v/v) + 6 fl oz	PRE-BLOOM 50.3 ml (at 75 gal/A) 67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) POST-BLOOM then 5.3 g (2x) then 50.3 ml + 3.1 ml (at 75 gal/A) 67.0 ml + 3.1 ml (at 100 gal/A) 100.5 ml + 3.1 ml (at 150 gal/A) 134.0 ml + 3.1 ml (at 200 gal/A)
24	YS	PureSpray alt with Quintec	10-14 (RI) then 14-17 (RI)	1.25% (v/v, 100 gal water) alt 6.6 fl oz	83.8 ml (at 100 gal/A only) alt 3.5 ml
25	OKS	PureSpray alt with Flint	10-14 (RI) then 17-21 (RI)	2.5% (v/v, 100 gal water) alt 2.0 oz	167.5 ml (at 100 gal/A only) alt 1.0 g
26	RKD	PureSpray alt with Inspire Super	10-14 (RI) then 14-21 (RI)	3.75% (v/v, 100 gal water) alt 20 fl oz	251.3 ml (at 100 gal/A only) alt 10.5 ml

### Trial III

No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/5 replicates
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1	W	Untreated			
2	K	Exp. 1	14	2.28 fl oz	1.2 ml
3	LG	Exp. 1	14	3.2 fl oz	1.7 ml
4	GKC	Exp. 1	14	4.1 fl oz	2.2 ml
5	Y	Viticure 480 SC	21	6 fl oz	3.1 ml
6	YC	Viticure 480 SC	21	8 fl oz	4.2 ml
7	BS	Viticure 480 SC + Flint	21	8 fl oz + 2 oz	4.2 ml + 1.0 g
8	KS	Viticure 480 SC + Pristine	21	8 fl oz + 6 oz	4.2 ml + 3.0 g
9	O	Viticure 480 SC + Microthiol	21	8 fl oz + 3 lb	4.2 ml + 24.1 g
10	OS	Regalia (1x) then Stylet-oil alt Flint	7 then 7 alt 14	1 qt then 1%(v/v) alt 1.5 oz	16.8 ml (1x) then 50.3 ml (at 75 gal/A) alt .75 g 67.0 ml (at 100 gal/A) alt .75 g 100.5 ml (at 150 gal/A) alt .75 g 134.0 ml (at 200 gal/A) alt .75 g
11	OD	Inspire Super 2.82 (1x) then Quintec (1x) then Inspire Super (2x) then Quintec (1x) then Inspire Super	14-21 (RI)	14 fl oz (1x) then 4 fl oz (1x) then 14 fl oz (2x) then 4 fl oz (1x) then 14 fl oz	7.3 ml (1x) then 2.1 ml (1x) then 7.3 ml (2x) then 2.1 ml (1x) then 7.3 ml
12	GD	Inspire Super 2.82 + Actigard 50 WG ( 1x) then Quintec (1x) then Inspire Super + Actigard (2x) then Quintec (1x) then Inspire Super	14-21 (RI)	14 fl oz + .25 oz (1x) then 4 fl oz (1x) then 14 fl oz + .25 oz (2x) then 4 fl oz (1x) then 14 fl oz	7.3 ml + .13 g (1x) then 2.1 ml (1x) then 7.3 ml + .13 g (2x) then 2.1 ml (1x) then 7.3 ml
13	B	Inspire Super 2.82 (1x) then Quintec (1x) then Inspire Super (2x) then Quintec (1x) then Inspire Super	14-21 (RI)	20 fl oz (1x) then 4 fl oz (1x) then 20 fl oz (2x) then 4 fl oz (1x) then 20 fl oz	10.5 ml (1x) then 2.1 ml (1x) then 10.5 ml (2x) then 2.1 ml (1x) then 10.5 ml
14	Pu	Quadris Top 2.71 (1x) then Quintec (1x) then Quadris Top (2x) then Quintec (1x) then Quadris	21	10 fl oz (1x) then 4 fl oz (1x) then 10 fl oz (2x) then 4 fl oz (1x) then 10 fl oz	5.2 ml (1x) then 2.1 ml (1x) then 5.2 ml (2x) then 2.1 ml (1x) then 5.2 ml
15	PKD	Quadris Top 2.71 (1x) then Quintec (1x) then Quadris Top (2x) then Quintec (1x) then Quadris	21	14 fl oz (1x) then 4 fl oz (1x) then 14 fl oz (2x) then 4 fl oz (1x) then 14 fl oz	7.3 ml (1x) then 2.1 ml (1x) then 7.3 ml (2x) then 2.1 ml (1x) then 7.3 ml
16	KD	Luna Experience alt Flint	21	6 fl oz then 2 oz	3.1 ml then 1.0 g
17	P	Luna Experience	21	6 fl oz	3.1 ml
18	GS	Adament alt Quintec	21 then 14	4 oz then 6 fl oz	2.0 g then 3.1 ml
19	YD	Adament then Luna Experience then Flint then Luna Experience	21	4 oz then 6 fl oz then 2 oz then 6 fl oz	2.0g then 3.1 ml then 1.0 g then 3.1 ml
20	BD	Topguard	14	8 fl oz	4.2 ml
21	KC	Topguard	14	10 fl oz	5.2 ml
22	PKS	Cueva	7-14 (RI)	1% (v/v)	50.3 ml (at 75 gal/A) 67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A)
23	YKS	Quintec alt Rally alt Flint	17-21 alt 14 alt 21	6 fl oz alt 4 oz alt 2 oz	3.1 ml alt 2.0 g alt 1.0 g
24	YS	Rally alt Quintec	14	4 oz alt 4 fl oz	2.0 g alt 2.1 ml
25	OKS	Rally alt Quintec	21	5 oz alt 6.6 fl oz	2.5 g alt 3.5 ml



26	RKD	Rally + Vintre alt Quintec + Vintre	21	4 oz + .25% (v/v) alt 6.6 fl oz + .25% (v/v) oz	2.0 g + 12.6 ml (at 75 gal/A) 2.0 g + 16.8 ml (at 100 gal/A) 2.0 g + 25.1 ml (at 150 gal/A) 2.0 g + 33.5 ml (at 200 gal/A) ALT 3.5 ml + 12.6 ml (at 75 gal/A) 3.5 ml + 16.8 ml (at 100 gal/A) 3.5 ml + 25.1 ml (at 150 gal/A) 3.5 ml + 33.5 ml (at 200 gal/A)
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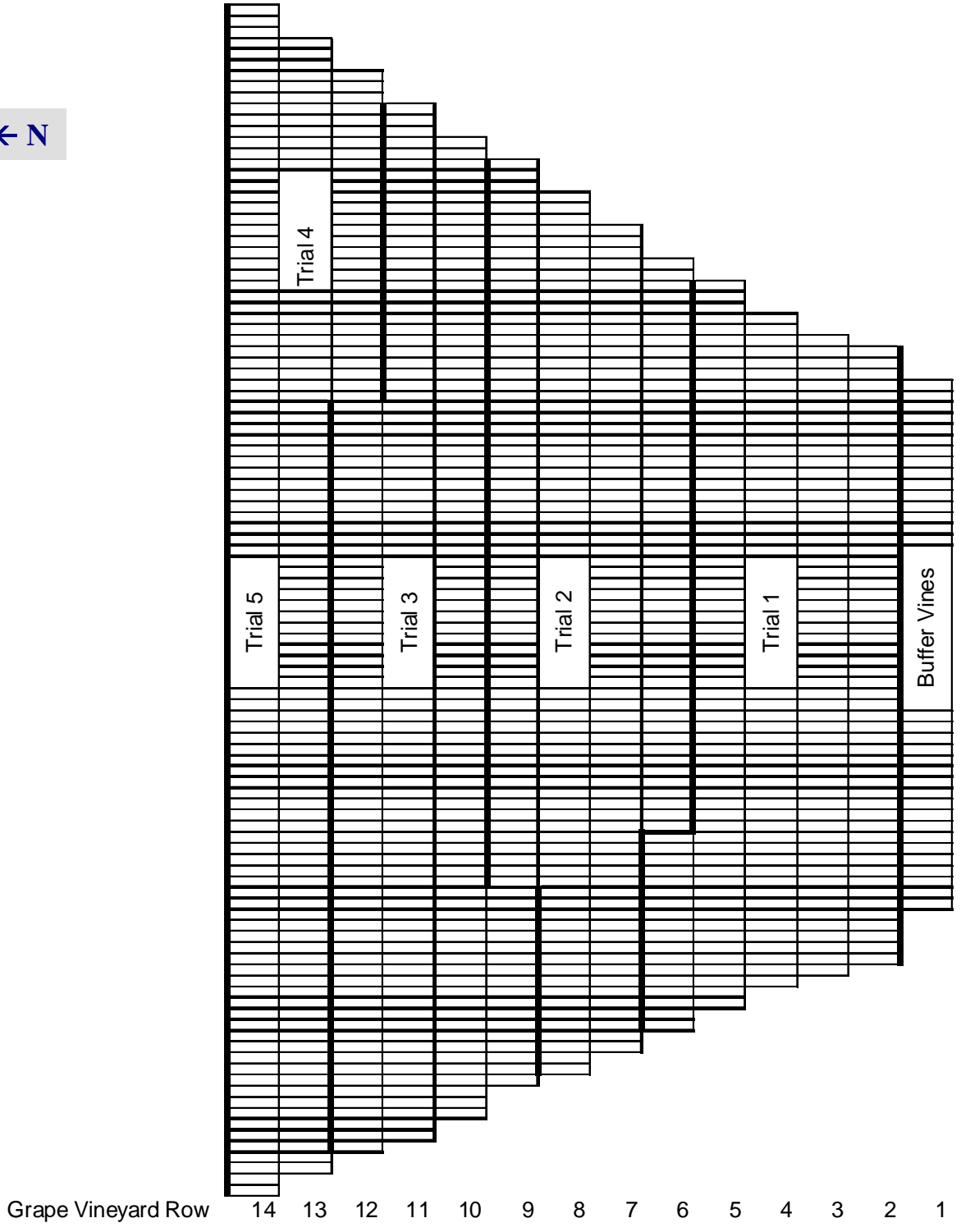
### Trial V

No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/5 replicates
1	W	Untreated			
2	KC	Microthiol Disperss (until bloom) then Tebuzol 45DF	14	5 lb (until bloom) then 4 oz	Pre-bloom 40.1 g Post-Bloom 2.0 g
3	LG	Microthiol Disperss (until bloom) then KFD-64	14	5 lbs (until bloom) then 2.5 lbs	Pre-bloom 40.1 g Post-bloom 20.1 g
4	BS	Exp 4	10	0.5 %(v/v)	25.1 ml(at 75 gal/A) 33.5 ml(at 100 gal/A) 50.3 ml(at 150 gal/A) 67.0 ml(at 200 gal/A)
5	B	Exp 4 + Sprayguard	10	0.5%(v/v) + 0.1%(v/v)	25.1 ml + 5.0 ml(at 75 gal/A) 33.5 ml + 6.7 ml(at 100 gal/A) 50.3 ml + 10.1 ml(at 150 gal/A) 67.0 ml + 13.4 ml(at 200 gal/A)
6	PKD	Quash 50 WDG	14	2.5 oz	1.3 g
7	Pu	Quash 50 WDG	14	4 oz	2.0 g
8	KS	S2200 2.5 SL	14	.1 lb ai (5.1 fl oz)	2.7 ml
9	GKC	S2200 2.5 SL	14	.2 lb ai (10.2 fl oz)	5.4 ml
10	OS	BM 608	10	0.35%	17.6 ml(at 75 gal/A) 23.5 ml(at 100 gal/A) 35.2 ml(at 150 gal/A) 46.9 ml(at 200 gal/A)
11	RD	BM 608	14	0.5%	25.1 ml(at 75 gal/A) 33.5 ml(at 100 gal/A) 50.3 ml(at 150 gal/A) 67.0 ml(at 200 gal/A)
12	GS	BM 608 alt Flint	10 alt 17	.35% alt 2 oz	17.6 ml(at 75 gal/A) 23.5 ml(at 100 gal/A) 35.2 ml(at 150 gal/A) 46.9 ml(at 200 gal/A) ALT 1.0 g
13	KD	Mettle alt Quintec	17-21 (RI)	5 fl oz alt 6 fl oz	2.6 ml alt 3.1 ml
14	YKS	Vigor Cal + Vintre	7-10 (RI)	2 qts + 0.25% (v/v)	34 ml + 12.6 ml (at 75 gal/A) 34 ml + 16.8 ml (at 100 gal/A) 34 ml + 25.1 ml (at 150 gal/A) 34 ml + 33.5 ml (at 200 gal/A)

<sup>1</sup>This experiment was started somewhat late; first applications made on 3 May 2010. <sup>2</sup>FP = formulated product.

## **C. Maps of the trials**

[Overview map](#)



O					
YD					
YKS	GD				
BS	OS	BS			
PKS	OKS	Pu	YC		
KD	YD	O	KC		
BD	KS	P	GD	KS	
GKC	OKD	PKD	B	W	Buffer
W	KC	GKC	O	B	Row
YC	W	PKS	OS	K	
GD	GS	YS	OKS	GKC	
KS	Y	B	P	GS	
OD	YC	YD	GKC	OKD	
YS	BD	W	OKD	KC	
PKD	OD	OKD	KD	OD	
B	KD	GKC	GS	PKD	
Pu	LG	BS	YD	LG	
LG	K	OKS	LG	YS	
K	KD	KD	K	O	
P	PKD	GD	W	KD	
OKS	K	GS	BS	OS	
KC	W	PKS	PKS	BS	
OS	O	OS	Y	YD	
RKD	LG	B	OD	Pu	
Y	GS	P	YS	YC	
GS	YC	Y	BD	BD	
BS	GD	OD	Pu	P	
OD	GKC	LG	PKD	GD	Buffer
KC	P	YS	YC	KS	Row
BD	OKS	KS	BD	OKS	
Y	PKS	K	Pu	Y	
OS	YD	O	KC	PKS	
B	KS	PKD			
YS	OKD				
Pu					

Row 6 5 4 3 2 1

← N

GS					
BS					
GD					
KC	OKS	YD			
KS	K				
BD	B	GD	O		
OKS	YC	PKD	YD		
OD	YS	YS	YKS		
Y		BS	BS		
PKS		Y	PKS		
BD		LG	KD		
GKC	W	KS	BD		
PKD	GKC	OD	GKC		
K	PKD	YKS	W		
OS	Pu	Pu	YC		
	OD	P	GD		
GS	KD	OKS	KS		
B		BD	OD		
YKS	Y	K	YS		
KD	P	W	PKD		
YC	O	PKS	B		
KS	YKS	B	Pu		
YD	YD	OS	LG		
GD	RKD	O	K		
O	PKS	GKC	P		
BS	OS	RKD	OKS		
Pu	LG	KC	KC		
KC	OD	YC	OS		
P	B	KD	RKD		
W	Pu	GS	Y		
YS	YS	KS	GS		
RKD	PKD	PKS	BS		
LG	GKC	GS	OD		
GS	OS	RKD	KC		
PKS	OKS	Y	BD		
YC	O	P	Y		
YKS	KD	LG	OS		
YS	YD	YKS	B		
O	KC	YC	YS		
PKD	GD	W	Pu		
RKD	BS	BD			
	K				

Row 9 8 7 6

TRIAL 2



# D. Application history

TRIAL 1

Trt	Dates product applied						
	April	May	June	July	July	July	July
no. Treatment							
1 Unsprayed control							
2 Sporatec, 1.875%	X	X	X	X	X	X	X
3 Sporatec, 3.75%	X	X	X	X	X	X	X
4 Safe-T-Side, 1%	X	X	X	X	X	X	X
5 Safe-T-Side, 2%	X	X	X	X	X	X	X
6 Oroboost, 25% +	X	X	X	X	X	X	X
7 Thiospers, 5 lb	X	X	X	X	X	X	X
8 Thiospers, 3 lb	X	X	X	X	X	X	X
9 BTN, 2.0 gal +	X	X	X	X	X	X	X
50% H2O2, .5 gal	X	X	X	X	X	X	X
BTN, 2.0 gal +	X	X	X	X	X	X	X
50% H2O2, .5 gal then	X	X	X	X	X	X	X
Abound alt	X	X	X	X	X	X	X
BTN, 2.0 gal +	X	X	X	X	X	X	X
50% H2O2, .5 gal	X	X	X	X	X	X	X
11 Rally, 5 oz +	X	X	X	X	X	X	X
Yucca Ag Aide, 0.125%	X	X	X	X	X	X	X
Stylet-oil, 1% then	X	X	X	X	X	X	X
12 Rally 40 WSP, 3 oz alt	X	X	X	X	X	X	X
Regalia, 1 qt	X	X	X	X	X	X	X
Stylet-oil, 1% then	X	X	X	X	X	X	X
13 Regalia, 1 qt alt	X	X	X	X	X	X	X
Flint, 1.5 oz	X	X	X	X	X	X	X
Regalia, 1 qt +	X	X	X	X	X	X	X
14 Microthiol Dispers, 5 lb alt	X	X	X	X	X	X	X
Regalia, 1 qt	X	X	X	X	X	X	X
Stylet-oil, 1% alt	X	X	X	X	X	X	X
15 Vigor Cal, 1 qt +	X	X	X	X	X	X	X
MBI-106020, 1 pt	X	X	X	X	X	X	X
HPeak, 8.4 lb/100 gal +	X	X	X	X	X	X	X
Hi Wett, 2 fl oz	X	X	X	X	X	X	X
17 HPeak, 4.2 lb/100 gal +	X	X	X	X	X	X	X
Hi Wett, 2 fl oz	X	X	X	X	X	X	X
18 HPeak, 13 lb/100 gal +	X	X	X	X	X	X	X
Hi Wett, 2 fl oz	X	X	X	X	X	X	X
HPeak, 8.4 lb/100 gal +	X	X	X	X	X	X	X
19 Hi Wett, 2 fl oz alt	X	X	X	X	X	X	X
Flint, 2 oz	X	X	X	X	X	X	X
HPeak, 8.4 lb/100 gal +	X	X	X	X	X	X	X
Hi Wett, 2 fl oz +	X	X	X	X	X	X	X
20 Kumulus, 3 lb	X	X	X	X	X	X	X
MKP, 8.4 lb/100 gal +	X	X	X	X	X	X	X
Hi Wett, 2 fl oz	X	X	X	X	X	X	X
21 HPeak, 8.4 lb/100 gal +	X	X	X	X	X	X	X
Flint, 2 oz	X	X	X	X	X	X	X
22 Actinovate, 9 oz +	X	X	X	X	X	X	X
Biolink, 4 fl oz	X	X	X	X	X	X	X
23 Actinovate, 9 oz +	X	X	X	X	X	X	X
Biolink, 4 fl oz +	X	X	X	X	X	X	X
CO2, 6 oz	X	X	X	X	X	X	X
25 Flint, 2 oz	X	X	X	X	X	X	X

DISEASE EVALUATION

Tri	no. Treatment	Dates product applied		
		April	May	June
1	Unsprayed control			
2	Torino, 3.4 fl oz	X	X	X
3	Torino, 3.4 fl oz	X	X	X
4	Torino, 3.4 fl oz	X	X	X
	Torino, 3.4 fl oz then	X	X	X
	Pristine, 10.5 oz then		X	
5	Vintage, 5 fl oz then			X
	Flint, 2 oz			X
	Pristine, 10.5 oz then	X		
	Vintage, 5 fl oz then		X	
	Flint, 2 oz then			X
6	Torino, 3.4 fl oz alt		X	
	Vintage, 5 fl oz alt	X		X
7	Torino, 3.4 fl oz +	X	X	X
	Y1669, 6 fl oz +	X	X	X
	Dynemic, 6 fl oz	X	X	X
8	Y1669, 12 fl oz +	X	X	X
	Dynemic, 6 fl oz	X	X	X
9	Pristine, 8 oz	X	X	X
10	Vivando, 10.5 fl oz +	X	X	X
	Sylgard 309, 0.3%	X	X	X
11	Vivando, 15.36 fl oz +	X	X	X
	Sylgard 309, 0.3%	X	X	X
12	Pristine, 10.5 oz	X	X	X
13	Pristine, 10.5 oz alt	X	X	X
14	Vivando, 12.8 fl oz	X	X	X
15	Exp. 3, 0.25%	X	X	X
16	Exp. 3, 0.25%	X	X	X
17	Exp. 3, 0.25% + Spraygard, 0.1%	X	X	X
18	Exp. 3, 0.25% + Topguard 1.04 SC, 10 fl oz	X	X	X
19	Exp. 3, 0.25% + Topguard 1.04 SC, 5 fl oz	X	X	X
20	Stylet-oil, 1% pre 2% post	X	X	X
	Stylet-oil, 1% then	X	X	X
21	Quincee, 6 fl oz then	X	X	X
	Stylet-oil, 1% + Quincee, 6 fl oz	X	X	X
22	Stylet-oil, 1% then	X	X	X
	Flint, 2 oz	X	X	X
	Stylet-oil, 1% then	X	X	X
23	Pristine, 10.5 oz	X	X	X
	Stylet-oil, 1% + Quincee, 6 fl oz	X	X	X
24	PureSpray, 1.25% alt	X	X	X
	Quincee, 6.6 fl oz	X	X	X
25	PureSpray, 2.5% alt	X	X	X
	Flint, 2 fl oz	X	X	X
26	PureSpray, 3.75% alt	X	X	X
	Inspire Super, 20 fl oz	X	X	X

DISEASE EVALUATION







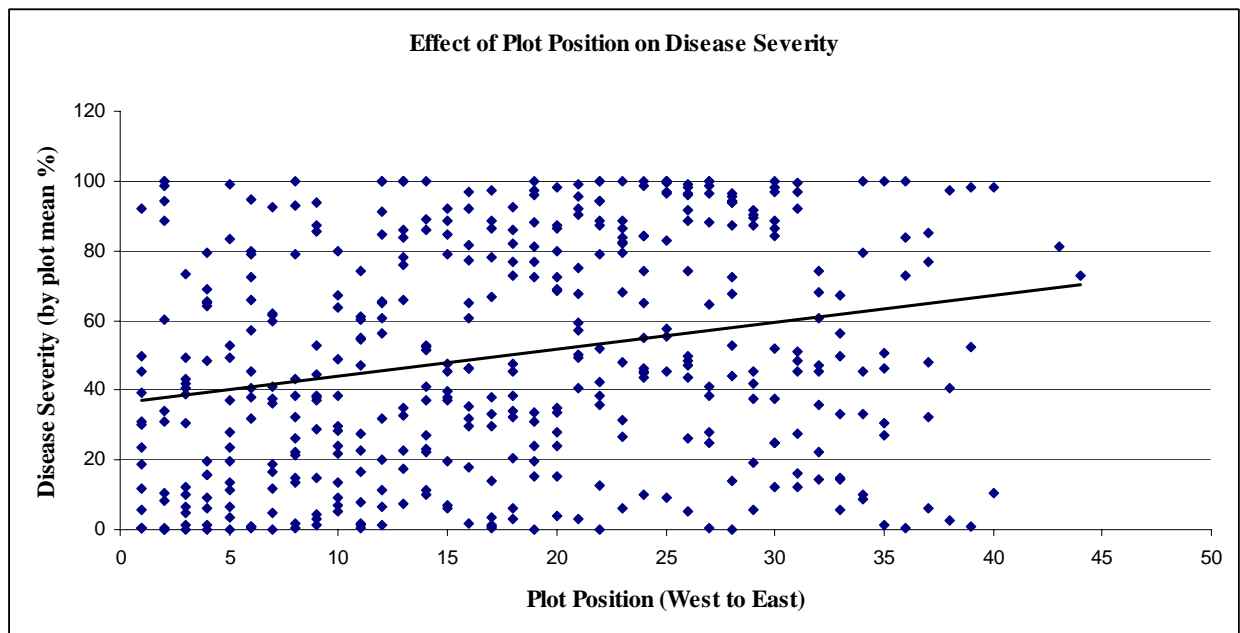
## E. Vine management

During the application period (mid April to mid July), vines were irrigated two times by flooding. Sucker shoots were removed by local field personnel during the third week of May 2010. Leaf removal around the clusters (on only the north facing aspect of the vines) was conducted by our research group on June 4 2010. Sucker and leaf removal were done on all five trials. Overhanging shoots were removed on July 12 2010. Additional small-scale removal of leaves was also conducted at various times.

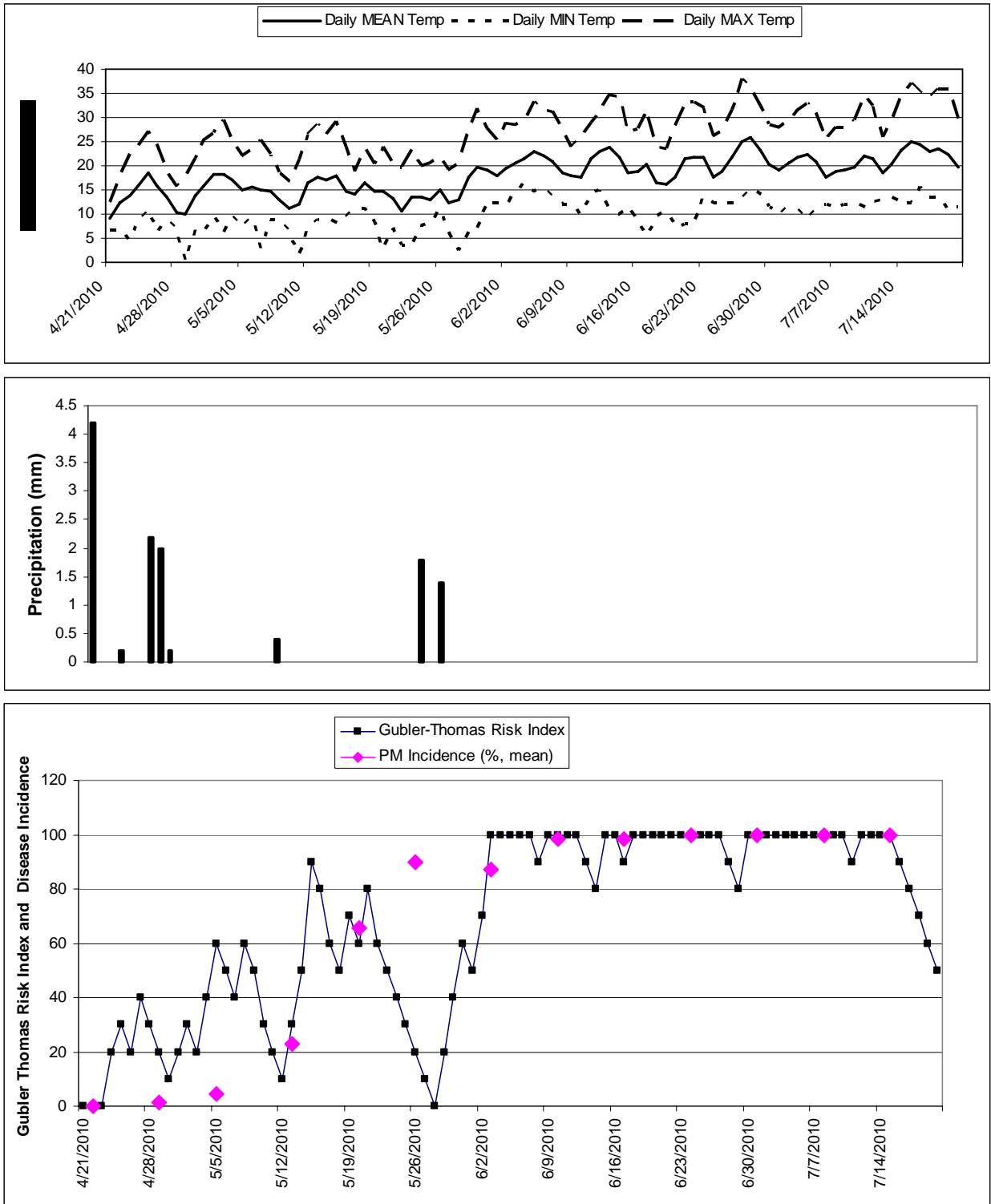
## F. Data collection and statistics

Daily temperature, precipitation data and Gubler-Thomas Risk Index values were computed and obtained from a Metos weather station located at the site. Effect of plot position on plot mean severity was based on data values for all plots from all trials. Disease was assessed on 21 July. 20-25 clusters were evaluated for powdery mildew incidence and severity in each plot. Incidence was defined as the proportion of clusters in a plot hosting at least some living powdery mildew. Severity was determined by estimating the percentage of berries in a cluster that were infected; the severity value of all clusters was then averaged to give a plot wide estimate of disease severity. Visual estimates of severity were made for more heavily infected clusters. Mean incidence and severity values for each treatment along with standard error were computed. Trial models were analyzed using the Wilcoxon/Kruskal Wallis Tests for nonparametric data; P-values for trials 1, 2, 3 and 5 are, respectively,  $P < 0.0001$ ,  $P < 0.0001$ ,  $P < 0.0004$ , and  $P < 0.0128$ . Means comparisons were made using Tukey-Kramer HSD with  $\alpha = 0.10$ .

Figure 2. Effect of plot position on plot mean severity (all trials).



**Figure 1.** Weather data, powdery mildew risk index values, and disease progression in the trials from April to until disease evaluation on 21 July. (A-B) daily records of precipitation and temperatures from the Powdery Mildew index website, <http://www.fieldclimate.com>. (C) Powdery mildew risk index, calculated by an on site Metos weather station, (D) powdery mildew incidence on the upper surface of leaves collected every week from the research site (means  $\pm$  1 S.E.; n=18).



## Results and discussion

**Table 1.** Disease severity and incidence in trial 1 treatments. Product names are followed by rate (per acre) and the frequency of application. Treatment means followed by the same letter are not significantly different according to Tukey-Kramer HSD test at  $\alpha=0.10$ ; alt =alternated with.

Treatment	Disease Severity (%)	Incidence (%)
Safe-T-Side, 2%, 14-21 d	34.0 ± 4.4 g	98.4 ± 1.6
HiPeak, 8.4 lb + Flint, 2 oz, 21 d	37.3 ± 11.4 fg	91.2 ± 5.4
JMS Stylet-oil, 1% alt Vigor Cal, 1 qt + MBI-106020	38.8 ± 4.3 efg	99.2 ± 0.8
Safe-T-Side, 1%, 14-21 d	51.7 ± 5.8 defg	97.6 ± 2.4
JMS Stylet-oil, 1% then Rally 40 WSP, 3 oz alt Regalia, 1 qt, 7d	54.9 ± 7.1 defg	100.0 ± 0.0
Oroboost, 0.25% + Thiosperss, 3 lb, 14d	56.7 ± 4.2 cdefg	100.0 ± 0.0
Flint, 2 oz, 21d	56.9 ± 13.3 cdefg	99.2 ± 0.8
JMS Stylet-oil, 1%, 7d then Regalia, 1 qt, 7d alt Flint, 1.5 oz, 14 d	57.7 ± 9.4 bcdefg	100.0 ± 0.0
HiPeak, 8.4 lb + HiWett, 2 fl oz, 10 d alt Flint, 2 oz, 21 d	60.4 ± 14.6 abcdefg	96.0 ± 4.0
HiPeak, 8.4 lb + HiWett, 2 fl oz + Kumulus, 3 lb, 10 d	62.5 ± 9.2 abcdefg	100.0 ± 0.0
MKP, 8.4 lb + HiWett, 2 fl oz, 10 d	65.3 ± 14.6 abcdefg	100.0 ± 0.0
HiPeak, 4.2 lb + HiWett, 2 fl oz, 10 d	68.6 ± 10.3 abcdefg	100.0 ± 0.0
Sporatec, 0.375%, 14-21 d	72.7 ± 4.4 abcdefg	100.0 ± 0.0
Rally, 5 oz + Yucca Ag Aide, 0.125%, 21 d	73.2 ± 10.2 abcdefg	100.0 ± 0.0
HiPeak, 13 lb + HiWett, 2 fl oz, 10 d	75.3 ± 6.3 abcdef	100.0 ± 0.0
Oroboost, 0.25% + Thiosperss, 5 lb, 14 d	75.5 ± 7.6 abcdef	100.0 ± 0.0
Regalia, 1 qt + Microthiol Disperss, 5 lb, 14 d alt Regalia, 1 qt, 7 d	77.8 ± 9.5 abcde	100.0 ± 0.0
HiPeak, 8.4 lb + HiWett, 2 fl oz, 10 d	80.3 ± 2.2 abcd	100.0 ± 0.0
BTN+ 2 gal, + H2O2, 0.5, 14d (3x) then Abound, 14 fl oz alt BTN+, 2 gal, 14 d	81.4 ± 4.8 abcd	100.0 ± 0.0
Sporatec, 0.1875%, 14-21 d	83.8 ± 2.9 abcd	100.0 ± 0.0
Thiosperss, 3 lb, 14 d	87.9 ± 6.7 abcd	100.0 ± 0.0
Actinovate, 6 oz + Biolink, 4 fl oz + CO2, 6 oz, 10 d	90.9 ± 2.9 abcd	100.0 ± 0.0
Actinovate, 9 oz + Biolink, 4 fl oz, 10 d	94.3 ± 2.1 abc	100.0 ± 0.0
BTN+, 2 gal + H2O2, 0.5 gal, 14 d (3x) then 28 d	96.8 ± 2.2 ab	100.0 ± 0.0
Untreated	99.6 ± 0.4 a	100.0 ± 0.0

**Table 2.** Disease severity and incidence in trial 2 treatments. Product names are followed by rate (per acre) and the frequency of application. Treatment means followed by the same letter are not significantly different according to Tukey-Kramer HSD test at  $\alpha=0.10$ ; alt =alternated with.

Treatment	Disease Severity (%)	Incidence (%)
Torino, 3.4 fl oz, 10-14 d	3.8 ± 1.6 e	39.2 ± 12.5
YT669, 12 fl oz + Dyneamic, 6 fl oz, 14 d	7.4 ± 5.9 de	33.6 ± 18.8
Pristine, 10.5 oz, 17-21 d then Vintage, 5 fl oz, 10-14 d then Flint, 2 oz then Torino, 3.4 fl oz, 10-14 d	9.5 ± 4.7 de	65.0 ± 15.9
Torino, 3.4 fl oz alt Vintage, 5 fl oz, 10-14 d	21.1 ± 10.1 de	64.8 ± 19.1
Exp. 3, 0.25% + Topguard 1.04 SC, 5 fl oz, 14 d	24.9 ± 5.4 cde	89.6 ± 6.8
Torino, 3.4 fl oz, 18-21 d	25.0 ± 12.4 cde	68.8 ± 15.0
Torino, 3.4 fl oz, 10-14 d (3x) then Pristine, 10.5 oz, 18-21 d then Vintage, 5 fl oz, 10-14 d, then Flint, 2 oz, 14 d	25.2 ± 8.4 cde	92.0 ± 5.1
Exp. 3, 0.25% + Topguard, 1.04 SC, 10 fl oz, 14 d	27.4 ± 11.4 cde	81.6 ± 7.5
Pristine, 8 oz, 14 d	27.8 ± 7.3 cde	88.8 ± 10.2
Vivando, 10.5 fl oz + Sylgard 309, 0.03%, 14 d	33.3 ± 14.9 cde	79.2 ± 11.8
JMS Stylet-oil, 1 %, 10-14 d then Quintec, 6 fl oz 17 d (2x) then JMS Stylet-oil, 1% + Quintec, 17-21 d	33.3 ± 7.5 cde	86.4 ± 10.7
Pristine, 10.5 oz, 21 d	35.3 ± 6.8 cde	97.6 ± 2.4
Pristine, 10.5 oz alt Vivando, 12.8 fl oz	36.3 ± 8.0 cde	99.2 ± 0.8
PureSpray, 2.5% 10-14 d alt Flint, 1 oz, 17-21 d	38.2 ± 9.1 cde	85.6 ± 14.4
JMS Stylet-oil, 1 %, 10-14 d then JMS Stylet-oil, 1% + Flint, 2 oz, 17 d	38.3 ± 5.2 cde	97.6 ± 1.6
Torino, 3.4 fl oz, 14-17 d	39.0 ± 17.0 cde	80.8 ± 14.0
Vivando, 15.36 fl oz + Sylgard 309, 0.03%, 21 d	39.3 ± 12.2 cde	92.0 ± 7.0
YT669, 6 fl oz, + Dyneamic, 6 lf oz, 14 d	41.5 ± 23.0 cde	68.0 ± 15.5
JMS Stylet-oil, 1%, 10-14 d then Pristine, 10.5 oz, 17-21 d (2x) then Stylet oil, 1% + Quintec, 6.6 fl oz, 14-17 d	41.6 ± 7.8 cde	92.0 ± 5.5
Purespray, 3.75%, 10-14 d alt Inspire Super, 20 fl oz, 14-21 d	43.1 ± 12.4 bcde	92.0 ± 7.0
JMS Stylet-oil, 1% prebloom, 2% post-bloom, 10-14 d	43.7 ± 1.6 bcde	100.0 ± 0.0
Purespray, 1.25%, 10-14 d alt Quintec, 6.6 fl oz, 14-17 d	52.6 ± 13.5 abcde	97.6 ± 1.6
Exp. 3, 0.25%, 7 d	58.2 ± 14.2 abcd	98.4 ± 1.6
Exp. 3, 0.25% + Spraygard, 0.1% 10 d	76.4 ± 10.8 abc	100.0 ± 0.0
Exp. 3, 0.25%, 10 d	94.2 ± ab	100.0 ± 0.0
Untreated	100.0 ± a	100.0 ± 0.0

**Table 3.** Disease severity and incidence in trial 3 treatments. Product names are followed by amount applied (per acre) and the frequency of application. Treatment means followed by the same letter are not significantly different according to Tukey-Kramer HSD test at  $\alpha=0.10$ ; alt =alternated with

Treatment	Disease Severity (%)	Incidence (%)
Luna Experience, 6 fl oz alt Flint, 2 oz, 21 d	0.72 ± 0.26 d	14.0 ± 5.8
Luna Experience, 6 fl oz, 21 d	0.87 ± 0.37 d	16.0 ± 7.8
Adament, 4 oz then Luna Experience, 6 fl oz, then Flint, 2 oz then Luna Experience, 6 fl oz, 21 d	4.0 ± 2.9 cd	39.0 ± 19.5
Quadris Top 2.71, 14 fl oz (1x) then Quintec, 4 fl oz (1x) then Quadris Top 2.71, 14 fl oz (2x) then Quintec, 4 fl oz, then Quadris Top 2.71, 14 fl oz, 21 d	4.1 ± 2.8 cd	40.0 ± 18.8
Inspire Super 2.82, 20 fl oz (1x) then Quintec 4 fl oz (1x) then Inspire Super 2.82, 20 fl oz (2x), then Quintec, 4 fl oz (1x) then Inspire Super, 20 fl oz, 14-21 d	9.0 ± 3.4 bcd	67.0 ± 20.7
Inspire Super 2.82, 14 fl oz + Actigard 50 WG. 0.25 oz (1x) then Quintec 4 fl oz (1x) then Inspire Super 2.82, 14 fl oz + Actigard 50 WG, 0.25 oz (2x) then Quintec, 4 fl oz (1x) then Inspire Super, 14 fl oz, 14-21 d	10.9 ± 4.0 bcd	62.0 ± 24.0
Topguard, 10 fl oz, 14 d	11.7 ± 5.1 bcd	73.0 ± 18.0
Rally, 4 oz, alt Quintec, 4 fl oz, 14 d	14.2 ± 6.5 bcd	79.0 ± 17.2
Inspire Super 2.82, 14 fl oz (1x) then Quintec, 4 fl oz (1x) then Inspire Super 2.82, 14 fl oz (2x) then Quintec, 4 fl oz (1x) then Inspire Super 12.82, 14 fl oz, 14-21 days	14.5 ± 3.6 bcd	81.0 ± 11.4
Quadris Top 2.71, 10 fl oz (1x) then Quintec, 4 fl oz then Quadris Top 2.71, 10 fl oz (2x) then Quintec, 4 fl oz then Quadris Top 2.71. 10 fl oz, 21d	14.8 ± 5.9 bcd	71.0 ± 19.0
Viticure 480 SC, 8 fl oz + Flint, 2 oz, 21 d	15.1 ± 7.6 bcd	72.0 ± 21.6
Viticure 480 SC, 8 fl oz + Microthiol, 3 lb, 21 d	15.7 ± 11.3 bcd	59.0 ± 16.9
Exp. 1, 4.1 fl oz, 14 d	20.1 ± 4.0 bcd	98.0 ± 2.0
Adament, 4 oz, 21 d alt Quintec, 6 fl oz, 14 d	20.5 ± 10.8 bcd	70.0 ± 19.9
Viticure 480 SC, 8 fl oz + Pristine 6 oz, 21 d	23.1 ± 7.6 bcd	100.0 ± 0.0
Quintec, 6 fl oz, 17-21 d alt Rally, 4 oz, 14 d alt Flint, 2 oz, 21 d	24.0 ± 13.3 bcd	65.0 ± 21.0
Topguard, 8 fl oz, 14 d	25.0 ± 6.0 bcd	94.0 ± 4.8
Rally, 4 oz + Vintre, 0.25% alt Quintec, 6.6 fl oz + Vintre, 0.25%, 21 d	25.6 ± 10.5 bcd	80.0 ± 16.4
Cueva, 1% 7-14 d	30.2 ± 8.6 bcd	85.0 ± 15.0
Rally 5 oz alt Quintec, 6.6 fl oz, 21 d	37.2 ± 14.2 bcd	93.0 ± 7.0
Viticure, 480 SC, 8 fl oz, 21 d	40.4 ± 4.9 bcd	92.0 ± 8.0
Regalia, 1 qt, 7 d then JMS Stylet-oil, 1%, 7 d alt Flint, 1.5 oz, 14 d	41.0 ± 8.5 bcd	100.0 ± 0.0
Exp. 1, 3.2 fl oz, 14 d	41.2 ± 14.2 bcd	99.0 ± 1.0
Exp. 1, 2.28 fl oz, 14 d	48.0 ± 12.4 bc	99.0 ± 1.0
Viticure 480 SC, 6 fl oz, 21 d	50.5 ± 17.2 b	100.0 ± 0.0
Untreated	97.1 ± 1.7 a	100.0 ± 0.0

**Table 4.** Disease severity and incidence in trial 4 treatments. Product names are followed by rate (per acre) and the frequency of application. Treatment means followed by the same letter are not significantly different according to Tukey-Kramer HSD test at  $\alpha=0.10$ ; alt =alternated with

Treatment	Disease Severity (%)	Incidence (%)
S2200 2.5 SL, 0.2 lb, 14 d	26.4 ± 7.8 c	93.8 ± 4.7
Vigor Cal, 2 qt + Vintre, 0.25%, 7-10 d	39.5 ± 5.9 bc	100.0 ± 0.0
Quash 50 WDG, 4 oz, 14 d	43.2 ± 8.7 abc	99.0 ± 1.0
BM 608, 0.35%, 10 d alt Flint, 2 oz, 17 d	45.05 ± 16.0 abc	96.0 ± 4.0
S2200 2.5 SL, 0.1 lb, 14 d	45.6 ± 19.9 abc	89.0 ± 9.7
Quash 50 WDG, 2.5 oz, 14 d	56.0 ± 16.3 abc	97.0 ± 3.0
Microthiol Disperss, 5 lb, (until bloom) then Tebuzol 45DF, 4 oz, 14 d	57.2 ± 13.6 abc	98.0 ± 2.0
Mettle alt Quintec, 6 fl oz, 17-21 d	58.6 ± 14.6 abc	100.0 ± 0.0
Microthiol Disperss, 5 lb, (until bloom) then KFD-64, 2.5 lb, 14 d	59.3 ± 13.8 abc	100.0 ± 0.0
BM 608, 0.5%, 14 d	60.9 ± 16.1 abc	100.0 ± 0.0
BM 608, 0.35%, 10 d	60.9 ± 8.9 abc	100.0 ± 0.0
Exp 4, 0.5% + Sprayguard, 0.1%, 10 d	80.0 ± 6.0 abc	100.0 ± 0.0
Exp. 4, 0.5%, 10 d	91.7 ± 0.3 ab	100.0 ± 0.0
Untreated	97.2 ± 2.1 a	100.0 ± 0.0

## IV. Acknowledgements

We thank Herzog Ranch and for permission to conduct research at their site. Thanks to the various industry donors for provision of testing materials. We thank A. Sutherland for assistance with spraying and J. Urbez-Torres, J. Broome, C. Pisani, L. Schiller, S. Haack, R. Choudhury, F. Trouillas, E. Jeffery, F. Peduto, X. Besoain and A. Sutherland for assisting with disease evaluation in the field.

## VI. Appendix: Materials

Product	Active ingredient(s) and concentration	Manufacturer or distributor	Chemical class (after Adaskaveg et al. 2008)
Actigard 50 WG	acibenzolar-S-methyl (50%)	Syngenta Crop Protection	benzothiadiazole
Actinovate AG	<i>Streptomyces lydicus</i> WYEC 108 (0.0371%)	Natural Industries, Inc.	biological - microbial
Abound	azoxystrobin	Syngenta Crop Protection	QoI
Adament 50WG	trifloxystrobin (25%), tebuconazole (25%)	Bayer	strobilurin (QoI) + DMI
Biolink	Soapbark, alkyl phenol ethoxylate, polysaccharide (10.10%)	Westbridge	biological
BM 608	tea tree oil extract from <i>Melaleuca alterniflora</i> (23.8%)	Biomor Israel, Ltd	biological
BTN+	nitrogen (5%), phosphate (4%), potash (4%), sulfur (3%)	BioTech Nutrients	fertilizer
CO2	calcium (31%), magnesium (0.9%), iron (1.31%)	Reforestation Technologies, Intl.	adjuvant
Cueva	copper octanoate (10%)	Neudorff	copper
Dyneamic	polyalkyleneoxide modified polydimethylsiloxane, nonionic emulsifiers, methyl ester of C16-C18 fatty acids (99%)	Helena Chemical Co.	adjuvant
Expt 1	N/A	proprietary	N/A
Expt 3	N/A	proprietary	N/A
Expt 4	N/A	proprietary	N/A
Flint 50WG	trifloxystrobin (50%)	Bayer	QoI
HiPeak	potassium dihydrogenorthophosphate + dipotassium hydrogenorthophosphate	Rotem Amvert Negal, Ltd.	fertilizer
Hi Wett	polysiloxane polyether copolymer, polyoxyethylene-polyoxypropylene copolymer & alcohol ethoxylate (100%)	First Choice	adjuvant
Hydrogen Peroxide	hydrogen peroxide (50%)	N/A	adjuvant
Inspire Super 2.82	difenoconazole (8.4%), cyprodinil (24%)	Syngenta Crop Protection, Inc.	DMI + anilinopyrimidine
JMS Stylet-Oil	paraffinic oil (97.1%)	JMS Flower Farms, Inc.	oil
KFD-64	tebuconazol tech (4.5%), sulfur (70%)	United Phosphorus, Inc.	N/A
Kumuluf DF	sulfur (80%)	BASF	sulfur
Luna Experience	fluopyram (17.54%), tebuconazole (17.54%)	Bayer	DMI-triazole/ N/A
MBI-106020	unknown	Marrone BioInnovations	unknown
Mettle	tetraconazole (10-12.5%)	Isagro-USA	DMI
MicroThiol Disperss	sulfur (80%)	Ceresagri, Inc.	sulfur
Nutrol (KeeP fertilizer)	phosphate (50%), potash (30%)	Rotem BKG	fertilizer
Oroboost	alcohol ethoxylate (13.58%)	OroAgri, Inc.	adjuvant
Pristine	pyraclostrobin (12.8%) boscalid (25.2%)	BASF	QoI + carboxamide
PureSpray	petroleum oil (98%)	Petro-Canada	oil
Quadris Top 2.71	azoxystrobin (18.2%), difenoconazole (11.9%)	Syngenta Crop Protection, Inc	DMI-triazole/QoI
Quash 50 WDG	metconazole (50%)	Valent USA Corporation	DMI-triazole
Quintec	quinoxifen (22.6%)	Dow AgroSciences LLP	quinoline
Rally 40 WSP	myclobutanil (40%)	Dow AgroSciences LLP	DMI-triazole
Regalia	<i>Reynoutria sachalinensis</i> extract	Marrone BioInnovations	biological
S2200 2.5 SL	N/A	Valent USA Corporation	N/A
Safe-T-Side	petroleum oil (80%)	Lawn and Garden Products, Inc.	oil
Sporatec	rosemary oil (18%), clove oil (10%), thyme oil (10%)	Brandt, Inc.	oil
Sprayguard	N/A	N/A	adjuvant
Sylgard 309	polysiloxane (80%)	Dow Corning Corp	adjuvant
Tebuzol 45 DF	tebuconazole (45%)	United Phosphorus, Inc.	DMI-triazole
Thiosperss	sulfur (80%)	Martin Resources	sulfur
Topguard	flutriafol (12%)	Cheminova	DMI
Torino	N/A	Gowan Co.	N/A
Vigor Cal	calcium (5%)	Agro-K	fertilizer
Vintage SC	fenarimol (11.6%)	Gowan Co.	DMI
Vintre 480 SC	alcohol ethoxylate (8.92%)	OroAgri, Inc.	adjuvant
Viticure	triflumizole (42.14%)	Crompton Manufacturing Company (Chemtura Corp.)	DMI
Vivando	metrafenone (300g/L)	BASF	N/A
YT669	picoxystrobin (250 mg/L)	DuPont	QoI
Yucca Ag Aide	<i>Yucca schidigera</i> extract	Desert King, LLC	adjuvant

Appendix sources: (1) Janousek et al. 2006, 2007, 2008, and 2009 grape powdery mildew reports, (2) Adaskaveg et al. 2008, (3) product-specific MSDS and/or labels.