
Final Report: Control of grape powdery mildew with synthetic, biological and organic fungicides: 2016 field trials

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Report Summary

Powdery mildew is an economically important disease of grapes worldwide. This report details the findings of our annual powdery mildew fungicide trials on grapevine (*Vitis vinifera*, Cultivar Chardonnay). Trials were conducted at Rio Viento Vineyards, near Walnut Grove, California in 2016. Treatments were placed in four adjacent trials in the vineyard in a complete randomized design. Spraying commenced on April 11. Powdery mildew pressure increased rapidly after a major rain event on Apr 22. Spraying was completed at veraison on July 15 and treatments were evaluated for disease incidence and severity on July 20.

The trials consisted of soft chemistry products, experimental and synthetics. Spray frequencies varied from weekly applications to 21 day intervals. Some applications were based on the Gubler-Thomas Risk Index, with application intervals based on the index.

Temperatures were mild and high in humidity during much of the 2016 growing season. Overall disease pressure was high. By early May, mildew was evident on untreated clusters. By the time of disease evaluation, disease incidence in untreated plots in all trials reached 100%.

Materials and Methods

A. Experimental design

Experimental design	Complete randomized design with 5 replicates.		
Experimental unit	2 adjacent vines = 1 plot		
Plot area	154 ft ² (row spacing = 10 ft, vine spacing = 5 ft)		
Area/treatment	500 ft ² (5 reps x 2 vines = 1 treatment)	Area/treatment	0.0115 acre/treatment
Volume water/acre	100 gallons (pre-bloom in mid-April) = 1.2 gallons/5 replicates 150 gallons (pre-bloom to pea-sized berries, late April – early June) = 1.8 gallons/5 reps 200 gallons (late season) = 2.4 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 (Row 143 – West End 137)

No.	Flag.	Treatment	Frequency (days)	Application rate (per acre)	FP/5 replicates
1	W	Untreated Control	None	None	None
2	YD	Vigor SeaCal	14	2 qt	21.8 ml
3	PKS	Sysstem SeaCal	14	2 qt	21.8 ml
4	GS	AKX-801	14	2 qt	21.8 ml
5	YS	Serenade Opti (standard)	14	14 oz	4.6 g
6	GKD	Howler + Capsil	14	5 g/L + 6 fl oz/100 gal	22.5 g + 2.1 ml at 100 gal or 34.0 g + 3.2 ml at 150 gal or 45.5 g + 4.3 ml at 200 gal
7	RKD	Luna Exp alt Quintec + Howler + Capsil	14	4.3 fl oz alt 3.3 fl oz + 5g/L + 6 fl oz/100 gal	(1.5 ml alt 1.1 ml) + 22.5 g + 2.1 ml at 100 gal or 34.0 g + 3.2 ml at 150 gal or 45.5 g + 4.3 ml at 200 gal
8	YKD	Microthiol Disperss (3x) then HML 32 + Exp B	7-10 (RI)	5 lb (3x) then 1.25 L/100 L + 640 g/100 L	26.1 g (3x) Then 56.8 ml at 100 gal or 85.2 ml at 150 gal or 113.6 ml at 200 gal + 28.8 g at 100 gal or 43.5 g at 150 gal or 58.2 g at 200 gal
9	PKD	Microthiol Disperss (3x) then HML 32 + Exp B + Microthiol Disperss	7-10 (RI)	5 lb (3x) then 1.25 L/100 L + 640 g/100 L + 5 lb	26.1 g (3x) Then 56.8 ml at 100 gal or 85.2 ml at 150 gal or 113.6 ml at 200 gal + 28.8 g at 100 gal or 43.5 g at 150 gal or 58.2 g at 200 gal + 26.1 g
10	RD	Microthiol Disperss (3x) then (Pre-bloom – shatter) HML 32 + Exp B then HML 32 + Exp B alt Exp B + Microthiol Disperss	7-10 (RI)	5 lb (3x) then 1.25 L/100 L + 640 g/100 L then 1.25 L/100 L + 640 g/100 L alt 2 qt	26.1 g (3x) then 56.8 ml at 100 gal or 85.2 ml at 150 gal or 113.6 ml at 200 gal + 28.8 g at 100 gal or 43.5 g at 150 gal or 58.2 g at 200 gal alt 28.8 g at 100 gal or 43.5 g at 150 gal or 58.2 g at 200 gal + 26.1 g
11	BKS	Microthiol Disperss (3x) then (Pre-bloom – shatter) HML 32 + Exp B + Microthiol Disperss then HML 32 + Exp B + Microthiol Dperss alt Regalia	7-10 (RI)	5 lb (3x) then 1.25 L/100 L +640 g/100 L + 5 lb then 1.25 L/100 L +640 g/100 L + 5 lb alt 2 qt	26.1 g (3x) Then 56.8 ml at 100 gal or 85.2 ml at 150 gal or 113.6 ml at 200 gal + 28.8 g at 100 gal or 43.5 g at 150 gal or 58.2 g at 200 gal + 26.1 g alt 21.8 ml
12	K	PSG alt Taegro + PSG	7-14 (RI)	1% (v/v) alt 5.4 oz + 0.5% (v/v)	45.6 ml at 100 gal or 68.8 ml at 150 gal or 91.2 ml at 200 gal alt 1.8 g + 22.8 ml at 100 gal or 34.4 ml at 150 gal or 45.6 ml at 200 gal

13	KD	PSG (10d) then (Rhyme alt Quintec alt Sovran) + PSG	10 then 14	1% (v/v) (10d) then (5 fl oz alt 4 fl oz alt 4 oz) + 0.5% (v/v)	45.6 ml at 100 gal or 68.8 ml at 150 gal or 91.2 ml at 200 gal then (1.7 ml alt 1.4 ml then 1.3 g) + 22.8 ml at 100 gal or 34.4 ml at 150 gal or 45.6 ml at 200 gal
14	GD	Regalia	7-10 (RI)	2 qt	21.8 ml
15	BS	Regalia + Stylet Oil	7-10 (RI)	2 qt + 0.25% (v/v)	21.8 ml + 11.4 ml at 100 gal or 17.2 ml at 150 gal or 22.8 ml at 200 gal
16	OS	Regalia then Inspire Super + Stylet Oil then Luna Exp + Syl-Coat then Inspire Super + Stylet Oil then Luna Exp + Syl-Coat then Regalia	7-10 (RI) 14-21 (RI)	2 qt then 10.5 fl oz + 0.25% (v/v) then 6 fl oz + 0.125% (v/v) then 10.5 fl oz + 0.25% (v/v) then 6 fl oz + 0.125% (v/v) then 2 qt	21.8 ml then 3.6 ml + 11.4 ml at 100 gal or 17.2 ml at 150 gal or 22.8 ml at 200 gal then 2.0 ml + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal then 3.6 ml + 11.4 ml at 100 gal or 17.2 ml at 150 gal or 22.8 ml at 200 gal then 2.0 ml + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal then 21.8 ml
17	Pu	W XF-16001	7-10 (RI)	0.17% (v/v)	7.7 ml at 100 gal or 11.6 ml at 150 gal or 15.4 ml at 200 gal
18	GKS	W XF-16001	7-10 (RI)	0.35% (v/v)	15.9 ml at 100 gal or 23.8 ml at 150 gal or 31.8 ml at 200 gal
19	Y	Probiotic	7	0.2% (v/v)	9.1 ml at 100 gal or 13.6 ml at 150 gal or 18.2 ml at 200 gal
20	GKC	LSU (1 gal before blossom)	7-10	2 qt	21.8 ml
21	YC	LSU (1 gal before blossom) alt Clovex (at shatter and veraison)	7-10	2 qt (or 1 gal) alt 2 gal (2x)	21.8 ml (or 43.5 ml) alt 87.0 ml (2x)
22	KC	LSU (1 gal before blossom) alt Clovex + Stylet Oil (at shatter and veraison)	7-10	2 qt (or 1 gal) alt 2 gal + 0.5% (v/v) (2x)	21.8 ml (or 43.5 ml) alt (87.0 ml + 22.8 ml at 100 gal or 34.4 ml at 150 gal or 45.6 ml at 200 gal) (2x)

Trial II (East End 137 – West End 133)

No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/5 replicates
1	W	Untreated Control	None	None	none
2	YS	(Luna Exp alt Inspire Super) + Syl-Coat (standard)	14	(8.6 fl oz alt 20 fl oz) + 0.125% (v/v)	(2.9 ml alt 6.8 ml) + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
3	GKS	ARY-0438-005 + Syl-Coat	14	6.2 oz + 0.125% (v/v)	2.0 g + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
4	BS	UBI-4319-01 + Syl-Coat	14	6 fl oz + 0.125% (v/v)	2.0 ml + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
5	GKC	ARY-0438-005 + UBI-4319-01 + Syl-Coat	14	6.2 oz + 6 fl oz + 0.125% (v/v)	2.0 g + 2.0 ml + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
6	KD	UBI-4319-01 + F1757aa + Syl-Coat	14	6 fl oz + 9 fl oz + 0.125% (v/v)	2.0 ml + 3.1 ml + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
7	KC	DPX-RTB69 + Dyne-Amic	14	1.6 fl oz + 0.125% (v/v)	0.5 ml + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
8	RD	DPX-RTB69 + Rally + Dyne-Amic	14	1.6 fl oz + 4 oz + 0.125% (v/v)	0.5 ml + 1.3 g + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
9	RKD	Rally + Dyne-Amic	14	4 oz + 0.125% (v/v)	1.3 g + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
10	YKD	Torino + Dyne-Amic	14	3.4 fl oz + 0.125% (v/v)	1.2 ml + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
11	RC	GWN-10511 + Dyne-Amic	14	3.4 fl oz + 0.125% (v/v)	1.2 ml + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
12	GD	(Mettle alt Torino) + Dyne-Amic	14	(5 oz alt 3.4 fl oz) + 0.125% (v/v)	(1.6 g alt 1.2 ml) + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
13	BKS	(Aprovia alt Inspire Super) + Syl-Coat	14	(10.5 fl oz alt 20 fl oz) + 0.125% (v/v)	(3.6 ml alt 6.8 ml) + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
14	YC	(A19649 alt Inspire Super) + Syl-Coat	14	(5.13 fl oz alt 20 fl oz) + 0.125% (v/v)	(1.7 ml alt 6.8 ml) + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal

15	GS	(Luna Exp alt Quintec) +Syl-Coat (standard)	21	(8.6 fl oz alt 6.6 fl oz) + 0.125% (v/v)	(2.9 ml alt 2.2 ml) + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
16	PKS	(A19649 (2x) then Inspire Super then A19649) + Syl-Coat	21	(5.13 fl oz (2x) then 20 fl oz then 5.13 fl oz) + 0.125% (v/v)	(1.7 ml (2x) then 6.8 ml then 1.7 ml) + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
17	YD	(A19649 (2x) then Inspire Super then A19649) + Syl-Coat	21	(8.55 fl oz (2x) then 20 fl oz then 8.55 fl oz) + 0.125% (v/v)	(2.9 ml (2x) then 6.8 ml then 2.9 ml) + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
18	OS	Pyraziflumid + Syl-Coat	14	1.7 fl oz + 0.125% (v/v)	0.6 ml + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
19	PKD	Pyraziflumid + Syl-Coat	14	3.38 fl oz + 0.125% (v/v)	1.1 ml + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
20	K	Pyriofenone + NIS	14	4 fl oz + 0.1% (v/v)	1.4 ml + 4.6 ml at 100 gal or 6.9 ml at 150 gal or 9.1 ml at 200 gal
21	GKD	Pyriofenone + NIS	21	5 fl oz + 0.1% (v/v)	1.7 ml + 4.6 ml at 100 gal or 6.9 ml at 150 gal or 9.1 ml at 200 gal
22	YKC	Stylet Oil alt Viathon alt Quintec	10-21	1.5 pt alt 2 pt alt 5 fl oz	8.2 ml alt 10.9 ml alt 1.7 ml
23	RKS	ChampION++ (9x) then Luna Exp + Syl-Coat	3 (9x) then 21	1.75 lb (9x) then 8.6 fl oz + 4 fl oz/100 gal	9.1 g (9x) then 2.9 ml + 1.4 ml at 100 gal or 2.1 ml at 150 gal or 2.8 ml at 200 gal
24	YKS	Kocide 3000 (9x) then Luna Exp + Syl-Coat	3 (9x) then 21	1.75 lb (9x) then 8.6 fl oz + 4 fl oz/100 gal	9.1 g (9x) then 2.9 ml + 1.4 ml at 100 gal or 2.1 ml at 150 gal or 2.8 ml at 200 gal

Trial III (East End 133 – West End 131)

No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/ 5 replicates
1	W	Untreated Control	None	None	None
2	Pu	(Vivando then Pristine then Quintec then Luna Exp then Torino then Switch) + Syl-Coat	14	(15.4 fl oz then 12.5 oz then 6.6 fl oz then 8.6 fl oz then 3.4 fl oz then 14 oz) + 4 fl oz/100 gal	(5.2 ml then 4.1 g then 2.2 ml then 2.9 ml then 1.2 ml then 4.6 g) + 1.4 ml at 100 gal or 2.1 ml at 150 gal or 2.8 ml at 200 gal
3	RD	(Vivando alt Pristine) + Syl-Coat	14	(15.4 fl oz alt 12.5 oz) + 4 fl oz/100 gal	(5.2 ml alt 4.1 g) + 1.4 ml at 100 gal or 2.1 ml at 150 gal or 2.8 ml at 200 gal
4	YD	Microthiol Disperss then (from bloom) (Luna Exp then Flint alt Mettle) + Syl-Coat	7 then 14	5 lb then (from bloom) (8.6 fl oz then 3 oz alt 5 fl oz) + 4 fl oz/100 gal	26.1 g then (from bloom) (2.9 ml then 1.0 g alt 1.7 ml) + 1.4 ml at 100 gal or 2.1 ml at 150 gal or 2.8 ml at 200 gal
5	GKD	Microthiol Disperss then (from bloom) (Luna Exp then Gem alt Mettle) + Syl-Coat	7 then 14	5 lb then (from bloom) (8.6 fl oz then 3.8 fl oz alt 5 fl oz) + 4 fl oz/100 gal	26.1 g then (from bloom) (2.9 ml then 1.3 ml alt 1.7 ml) + 1.4 ml at 100 gal or 2.1 ml at 150 gal or 2.8 ml at 200 gal
6	RKS	Microthiol Disperss then (from bloom) (Luna Exp then Flint then Luna Exp then Flint then Mettle then Flint) + Syl-Coat	7 then 14	5 lb then (from bloom) (8.6 fl oz then 3 oz then 8.6 fl oz then 3 oz then 5 fl oz then 3 oz) + 4 fl oz/100 gal	26.1 g then (from bloom) (2.9 ml then 1.0 g then 2.9 ml then 1.0 g then 1.7 ml then 1.0 g) + 1.4 ml at 100 gal or 2.1 ml at 150 gal or 2.8 ml at 200 gal
7	GD	(Rally alt Quintec) + Syl-Coat	14	(5 oz + 4 fl oz) + 0.125% (v/v)	(1.6 g alt 1.4 ml) + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
8	YKS	(Luna Exp alt Quintec) + Syl-Coat	21	(8 fl oz alt 6.6 fl oz) + 0.125% (v/v)	(2.7 ml alt 2.2 ml) + 5.7 ml at 100 gal or 8.5 ml at 150 gal or 11.4 ml at 200 gal
9	KC	(Quintec then Rhyme then Pristine then Rhyme then Quintec then Fracture) + Dyne-Amic	14	(4 fl oz then 5 fl oz then 12.5 oz then 5 fl oz then 4 fl oz then 20.3 fl oz) + 0.25% (v/v)	(1.4 ml then 1.7 ml then 4.1 g then 1.7 ml then 1.4 ml then 6.9 ml) + 11.4 ml at 100 gal or 17.2 ml at 150 gal or 22.8 ml at 200 gal
10	Y	((Rhyme then Quintec then Fracture) + Dyne-Amic) (2x)	14	((5 fl oz then 4 fl oz then 18.3 fl oz) + 0.25% (v/v)) (2x)	((1.7 fl oz then 1.4 fl oz then 6.2 ml) + 11.4 ml at 100 gal or 17.2 ml at 150 gal or 22.8 ml at 200 gal) (2x)
11	GS	(Quintec then Fracture then Rhyme then Fracture then Quintec then Rhyme) + Dyne-Amic	14	(4 fl oz then 18.3 fl oz then 5 fl oz then 18.3 fl oz then 4 fl oz then 5 fl oz) + 0.25% (v/v)	(1.4 ml then 6.2 ml then 1.7 ml then 6.2 ml then 1.4 ml then 1.7 ml) + 11.4 ml at 100 gal or 17.2 ml at 150 gal or 22.8 ml at 200 gal

Trial IIIa (East End 131)

No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/ 5 replicates
1	RC	ISR-2000	7	16 fl oz	5.4 ml
2	YKC	GC Pro	7	3 lb	15.6 g
3	KC	GC Pro	7	4 lb	20.9 g
4	RKD	SP2700 10 WP	7	500x dilution (1x) then 600x dilution	17.4 g (root) 14.5 g (foliar) then 14.5 g at 200 gal
5	YKS	SP2700 10 WP	7	500x dilution (1x) (root) 300x dilution (foliar) then 300x dilution	17.4 g (root) 29.0 g (foliar) then 29.1 g at 200 gal
6	YC	Polymer	7-10	n/a	128 g

Trial IV (Row 130-123) Heat treatment

No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/ 320 vines (4 rows)
1	O	Heat	7	n/a	n/a
2	W	Luna Experience + Stylet Oil	21	8.6 fl oz + 0.5% (v/v)	23.2 ml + 364.8 ml

C. Maps

Trial I

Row	143	142	141	140	139	138	137
	RD	W	GKD	YKD	BS	GKC	OS
	GS	KC	BS	BKS	Y	YD	PKD
	YS	YC	K	PKS	BS	YS	K
	RD	GKC	YS	OS	RKD	GKS	KGD
	GS	Y	PKD	GD	K	PKS	YKC
		GKS	RD	YC	W	KD	W
		Pu	YD	Y	PKD	YKD	RKS
		OS	YS	RKD	PKS	Y	YKS
		BS	GKD	YD	GKD	K	
		GD	RKD	RC	GS	OS	KC
		KD	YKD	GKC	YC	Pu	RKD
		K	PKD	KD	GKC	RC	PKS
		RD	RD	KC	YKD	GS	KD
			BKS	GKS	KD	GD	Y
			PKS	Pu	YS	RKD	PKD
				W	RC	BKS	W
				YD	GKS	YC	BS
				KC	GD	W	GKC
					Pu	GK	Pu
					OS	KC	GS
					BKS	PKD	YS
						BKS	GKD
						YKD	K
						GKS	OS
							YD
							RC
							GD
							YC

Color:			Pattern:	
B	Blue		C	Checker
G	Green		D	Dot
K	Black		S	Stripe
O	Orange			
P	Pink			
Pu	Purple			
R	Red			
Y	Yellow			
W	White			

Trial II

Row	137	136	135	134	133
	OS	YD	BS	YKS	YD
	PKD	PKS	KD	RC	GKD
	K	GS	GKC	RKD	RKS
	GKD	YC	YS	GKS	GD
	YKC	BKS	RD	W	YKS
	W	GD	Y	KC	KC
	RKS	RC	PKS	BKS	Y
	YKS	YKD	Pu	YD	
		Pu	K	GS	RD
	KC	Y	GKD	GD	KD
	RKD	RKD	RKS	YKD	KC
	PKS	RD	YKC	BKS	YKD
	KD	KC	YC	OS	YKC
	Y	KD	OS	YC	OS
	PKD	GKC	PKD	BS	RKD
	W	BS	YKD	RC	W
	BS	GKS	RD	Y	YD
	GKC	YS	YC	PKS	GS
	Pu	W	GKC	PKD	Y
	GS	K	OS	RKS	RC
	YS	RKD	KD	YKC	K
	GKD	PKD	YD	GD	BKS
	K	YKS	GS	Pu	YC
	OS	YS	PKS	YS	BS
	YD	YKD	RKS	RD	YKS
	RC	YKC	BKS	YKS	YS
	GD	RC	GKD	K	Pu
	YC	GKS	KC	RKD	GD

Color:			Pattern:	
B	Blue		C	Checker
G	Green		D	Dot
K	Black		S	Stripe
O	Orange			
P	Pink			
Pu	Purple			
R	Red			
Y	Yellow			
W	White			

BS	GKS	PKD
Y	KD	RKS
Pu	GS	PKS
GD	KC	GKC
	YD	GKD
	GKC	GKS
		W
		GKD

Trial III

Row	133	132	131
	YD	RD	RC
	GKD	Pu	YKC
	RKS	W	KC
	GD	GS	YKC
	YKS	GKD	RC
	KC	RKS	KC
	Y	GD	YKC
		Y	RC
	RD	KC	RC
	KD	W	YKC
	KC	RD	KC
	YKD	YD	YKC
	YKC	YKS	KC
	OS	Pu	RC
	RKD	GS	
	W	Pu	YC
	YD	KC	YC
	GS	RD	YC
	Y	Y	YC
	RC	YKS	YC
	K	YD	
	BKS	W	GD
	YC	RKS	GD
	BS	Pu	RD
	YKS	GS	YKS
	YS	GKD	GS
	Pu	GKD	KC
	GD	Pu	GKD
	PKD	GD	YD
	RKS	YD	RD
	PKS	Y	Y
	GKC	RKS	W
	GKD	W	
	YKS	RD	
		KC	
		YKS	
		GS	
		RKS	

Color:			Pattern:	
B	Blue		C	Checker
G	Green		D	Dot
K	Black		S	Stripe
O	Orange			
P	Pink			
Pu	Purple			
R	Red			
Y	Yellow			
W	White			

Trial IIIa

Row

131

RC
YKC
KC
YKS
RKD
RC
KC
YKC
RC
YKS
RKD
KC
YKC
RKD
YKS
KC
YKS
KC
RKD
YKC
RKD
YKS
RC
RC
YKC

YC
YC
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YC

GD
GD
RD
YKS
GS
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YD

Y
W

Trial IV (Row 130-123)

Row 141-137)

Ttr	Treatment	Dates product applied																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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1	Unsprayed control																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

(Row 137-133)

Tit No.	Treatment	Dates product applied											
		March	April	May	June	July							
1	Unsprayed control												
2	Lana Exp 8.6 floz												
	Bus pire Super 20 floz												
	Syl-Coat 0.125% v/v												
3	ARY-0438-005 6.2 oz												
	Syl-Coat 0.125% v/v												
4	UB143 B9-016 floz												
	Syl-Coat 0.125% v/v												
5	ARY-0438-005 6.2 oz												
	UB143 B9-016 floz												
	Syl-Coat 0.125% v/v												
6	F157aa 9 floz												
	Syl-Coat 0.125% v/v												
7	DP X-RTB 69 16 floz												
	Dyne-Amic 0.125% (v/v)												
8	DP X-RTB 69 16 floz												
	Rally 4 oz												
	Dyne-Amic 0.125% v/v												
9	Rally 4 oz												
	Dyne-Amic 0.125% v/v												
	Torino 3.4 floz												
	Dyne-Amic 0.125% v/v												
11	GWN-13513.4 floz												
	Dyne-Amic 0.125% v/v												
12	Mettle 5 floz												
	Torino SC 3.4 floz												
	Dyne-Amic 0.125% (v/v)												
13	Aprowia 10.5 floz												
	Bus pire Super 20 floz												
	Syl-Coat 0.125% v/v												
14	A B649 5.13 floz												
	Bus pire Super 20 floz												
	Syl-Coat 0.125% v/v												
15	Lana Exp 8.6 floz												
	Quintec 6.6 floz												
	Syl-Coat 0.125% v/v												
16	Bus pire Super 20 floz												
	Syl-Coat 0.125% v/v												
17	A B649 5.13 floz												
	Bus pire Super 20 floz												
	Syl-Coat 0.125% v/v												
18	R-106506 1.7 floz												
	Syl-Coat 0.125% v/v												
19	R-106506 3.38 floz												
	Syl-Coat 0.125% v/v												
20	P yrio fenone 4 floz												
	NIS 0.1%												
21	P yrio fenone 5 floz												
	NIS 0.1%												
22	Stylet Oil 1.5 pt												
	Vialthon 2 pt												
23	Quintec 5 floz												
	Champion 175 lb												
	Lana Exp 8.6 floz												
	Syl-Coat 0.125% v/v												
24	Kocle 3000 1.75 lb												
	Lana Exp 8.6 floz												
	Syl-Coat 0.125% v/v												

Row 133-131)

Trt No.	Treatment	DISEASE EVALUATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
		March							April							May							June							July																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
1	Unsprayed control																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

E. Vine Management

(Row 130)													
Tin No.	Treatment	March	April	May	June	July							
1	BR-2000 16 fl oz *												
2	GCP no. 3 lb												
3	GCP no. 4 lb												
4	SP 2700 60x dilution **												
5	SP 2700 300x dilution												
6	Ralph Polymer ***												
**Note: treatment # 6 was sprayed with Luna Experience +0.5% Syntel Oil on Apr 15 and May 6 2016													
*Note: treatment # 4 & 5 were sprayed with Luna Experience +0.5% Syntel Oil on Apr 15 and May 6 2016													
*Note: treatment # 1-5 were sprayed with Luna Experience +0.5% Syntel Oil on Apr 15 and May 6 2016													

During the application period, vines were irrigated by drip irrigation. Sucker shoots were removed the first week of May 2016. Leaf removal around the clusters was conducted on the last week of May until second week of Jun.

F. Data Collection and Statistics

Daily temperature, precipitation and Gubler-Thomas Risk Index values were computed and obtained from an Adcon weather station on the trial site. Overall temperature were mild throughout the season (Figure 1), eight precipitation events were recorded on Apr 8, 9, 10, 14, 22, 27 and May 6 (Figure 2). Powdery mildew incidence and severity were assessed in each plot by evaluating twenty five random clusters. Incidence was defined as the proportion of clusters in a plot having some living powdery mildew. Severity was determined by estimating the percentage of area of a cluster that were infected; the severity value of all clusters was then averaged to give a plot-wide estimate of disease severity. Mean incidence and severity values for each treatment were computed. Trial models were analyzed using the ANOVA Tests for data. Means comparisons were made using Fisher's LSD with $\alpha=0.05$.

Heat treatment trial results were based on weekly ratings (Apr 8 – Jun 9 2016) of the number of colonies visible on leaves.

Figure 1. Daily temperature data from Apr 1 to Jul 15 2016 from CIMIS Ryde station Walnut Grove, CA.

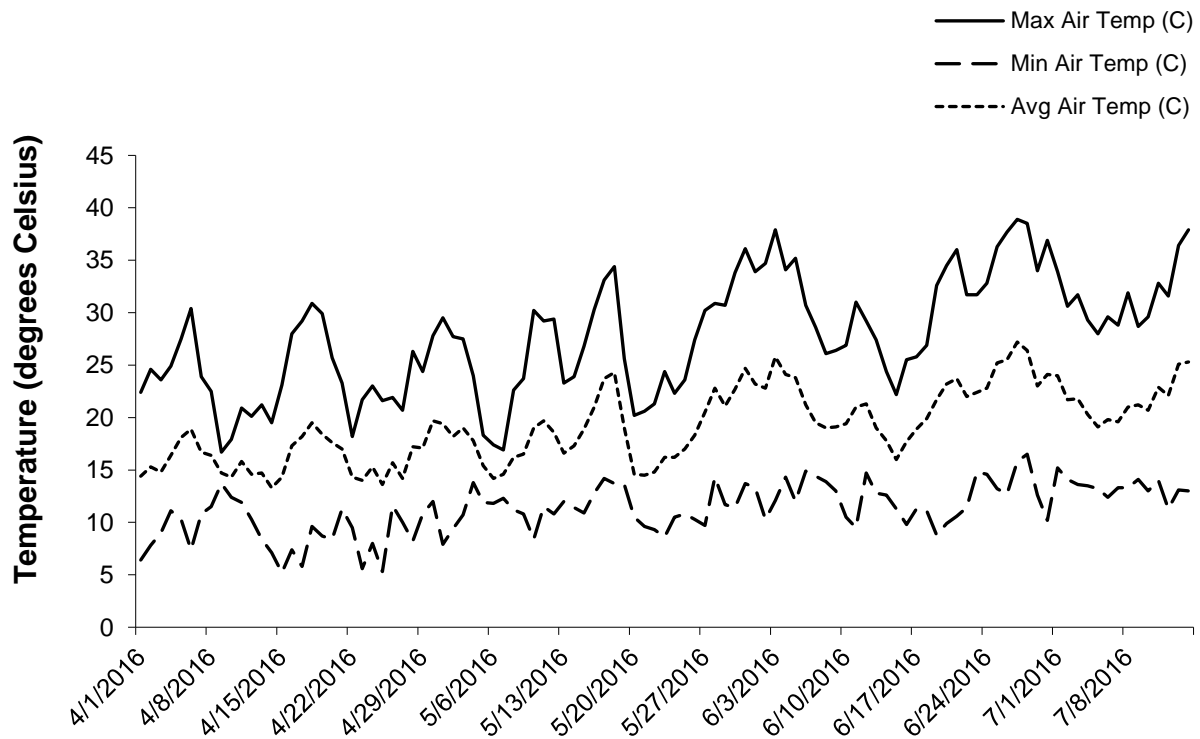


Figure 2. Daily precipitation data from Apr 1 to Jul 15 2016 from CIMIS Ryde station, Walnut Grove, CA.

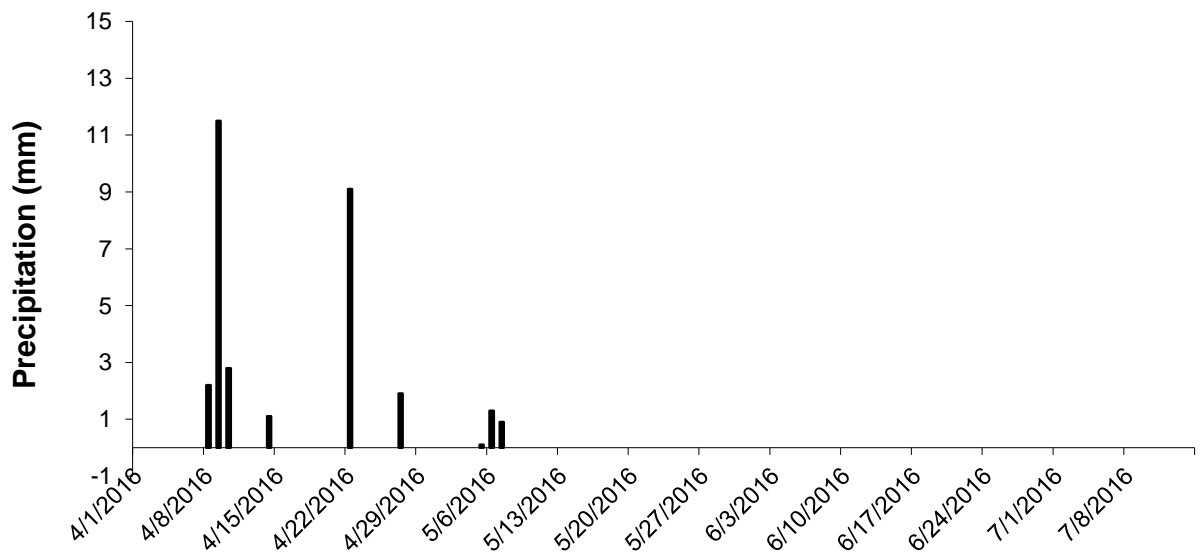
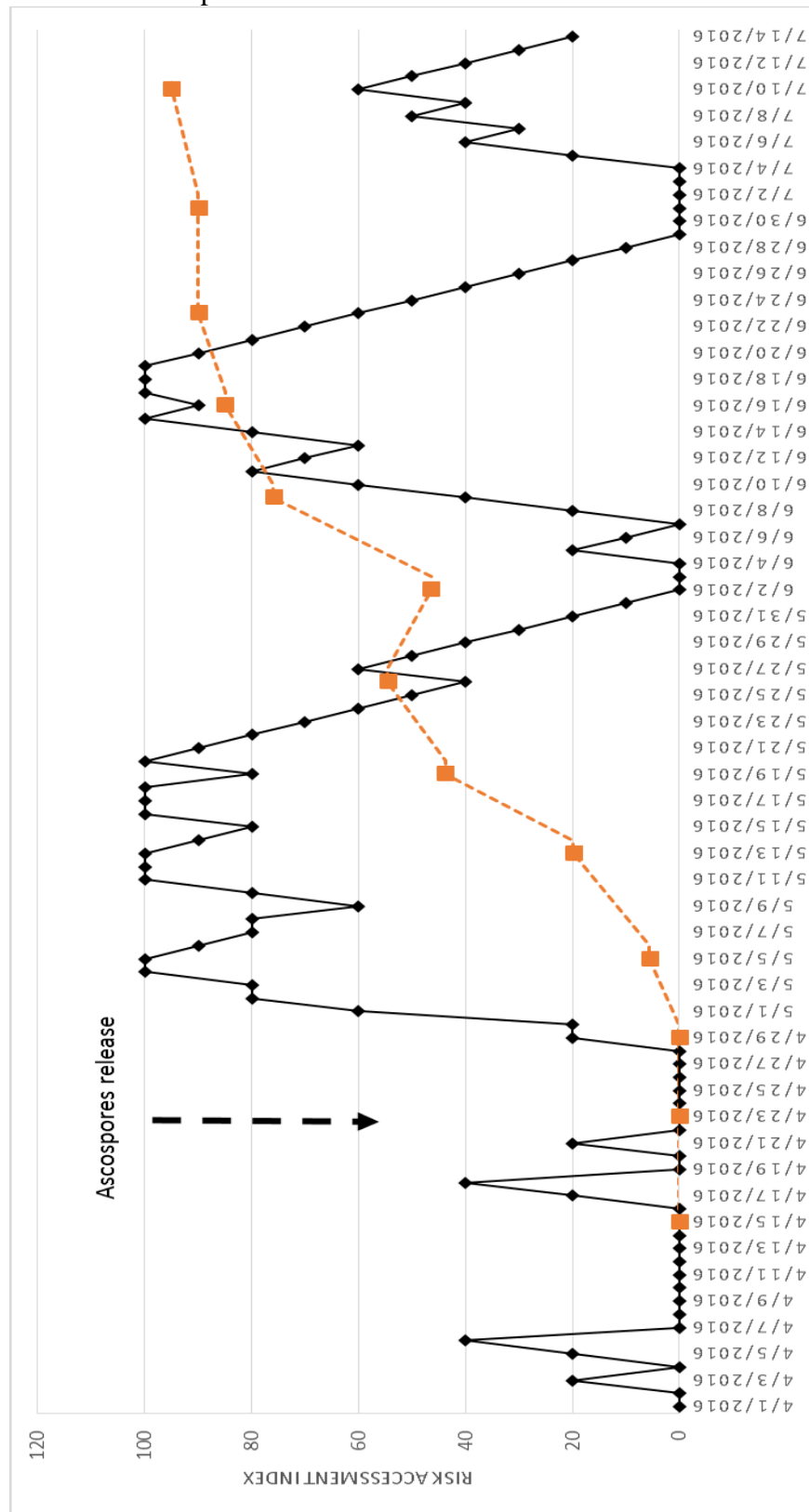


Figure 3. Thomas-Gubler Risk Index data from Apr 1 to Jul 15 2016 from an on-site Adcon station. Dotted line indicates disease progress based on the average weekly ratings of the

untreated controls. Y-axis shows data points indicate risk index > 60 (high risk), between 30 and 60 (moderate risk) and below 30 (no risk). Dashed line shows ascospore release event after a major precipitation event on Apr 22 2016.



Results

Table 1. Disease incidence and severity in trial I. 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 Fisher's LSD at $\alpha=0.05$; alt = alternated with.

Treatment	Mean Severity (%)		Mean Incidence (%)	
Microthiol Disperss (3x) 5 lb then HML 32 1.35 L/100 L + Exp B 640 g/100 L + Microthiol Disperss 5 lb 7-10d	1.12	e	27.20	e
Luna Exp 4.3 fl oz alt Quintec 3.3 fl oz + Howler 5 g/L + Capsil 6 fl oz/100 gal 14d	2.83	de	37.00	de
Regalia 2 qt then Inspire Super 10 fl oz + Stylet Oil 0.25% (v/v) then Luna Exp 6 fl oz + Syl-Coat 0.125% (v/v) then Inspire Super 10.5 fl oz + Stylet Oil 0.25% (v/v) then Luna Exp 6 fl oz + Syl-Coat 0.125% (v/v) then Regalia 2 qt 7-10d	2.06	e	41.60	de
Microthiol Disperss (3x) 5 lb then (Prebloom - shatter) HML 32 1.25 L/100 L + Exp B 640 g/100 L then HML 32 1.25 L/100 L + Exp B 640 g/100 L alt Exp B + Microthiol Disperss 2 qt 7-10d	2.58	e	42.40	de
Microthiol Disperss (3x) 5 lb then HML 32 1.35 L/100 L + Exp B 640 g/100 L 7-10d	1.42	e	43.20	de
Microthiol Disperss (3x) 5 lb then (Prebloom - shatter) HML 32 1.25 L/100 L + Exp B 640 g/100 L + Microthiol Disperss 5 lb then HML 32 1.25 L/ 100 L + Exp B 640 g/100 L + Microthiol Disperss 5 lb alt Regalia 2 qt 7-10d	5.02	de	56.00	cd
PSG (10d) 1 % (v/v) then (Rhyme 5 fl oz alt Quintec 4 fl oz alt Sovran 4 oz) + PSG 0.5% (v/v) 10-14d	4.74	de	69.60	bc
WXF-16001 0.17% (v/v) 7-10d	20.36	cd	82.40	ab
PSG 1 % (v/v) alt Taegro 5.4 oz + PSG 0.5 % (v/v) 7-14d	12.86	de	84.00	ab
LSU (1 gal before blossom) 2 qt (or 1 gal) alt Clovex (at shattered and veraison) 2 gal (2x) 7-10d	9.78	de	84.80	ab
Regalia 2 qt 7-10d	17.42	cde	84.80	ab
Probiotic 0.2% (v/v) 7d	11.14	de	88.00	ab
LSU (1 gal before blossom) 2 qt alt Clovex 2 gal + Stylet Oil (at shattered and veraison) 0.5% (v/v) (2x) 7-10d	13.76	cde	88.00	ab
AKX-801 2qt 14d	94.33	a	88.00	ab
Regalia 2 qt + Stylet Oil 0.25% (v/v) 7-10d	13.72	cde	90.40	ab
Vigor SeaCal 2 qt 14d	30.20	c	92.80	ab
WXF-16001 0.35% (v/v) 7-10d	7.74	de	95.20	a
LSU (1 gal before blossom) 2 qt, 7-10d	16.42	cde	95.20	a
Serenade Opti (standard) 14 oz, 14d	15.42	cde	100.00	a
Howler 5g/L + Capsil 6 fl oz/100 gal 14d	54.80	b	100.00	a
System SealCal 2 qt 14d	56.20	b	100.00	a
Untreated Control	90.40	a	100.00	a

Table 2. Disease incidence and severity in trial II. 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 Fisher's LSD at $\alpha=0.05$; alt = alternated with.

Treatment	Mean Severity (%)	Mean Incidence (%)
Pyraziflumid 3.38 fl oz + Syl-Coat 0.125% (v/v) 14d	0.02 c	2.40 j
Pyraziflumid 1.7 fl oz + Syl-Coat 0.125% (v/v) 14d	0.04 c	4.00 j
A19649 5.13 fl oz alt Inspire Super 20 fl oz) + Syl-Coat 0.125% (v/v) 14d	0.10 c	4.80 j
(Aprovia 10.5 fl oz alt Inspire Super 20 fl oz) + Syl-Coat 0.125% (v/v) 14d	0.08 c	6.40 ij
(A19649 (2x) 5.13 fl oz then Inspire Super 20 fl oz then A19649 5.13 fl oz) + Syl-Coat 0.125% (v/v) 21d	0.42 c	16.80 hij
(Luna Experience 8.6 fl oz alt Inspire Super 20 fl oz) + Syl-Coat 0.125% (v/v) 14d	0.44 c	16.80 hij
(A19649 (2x) 8.55 fl oz then Inspire Super 20 fl oz then A19649 8.55 fl oz) + Syl-Coat 0.125% (v/v) 21d	0.32 c	17.60 hij
(Luna Experience 8.6 fl oz alt Quintec 6.6 fl oz) + Syl-Coat 0.125% (v/v) 21d	0.49 c	17.60 hij
(Mettle 5 oz alt Torino 3.4 fl oz) + Dyne-Amic 0.125% (v/v) 14d	1.69 c	25.60 ghij
Exp A 14.5 fl oz + Dyne-Amic 0.125% (v/v) 14d	0.85 c	26.40 ghij
ChamplION++ (9x) 1.75 lb then Luna Experience 8.6 fl oz + Syl-Coat 4 fl oz/100 gal 3d then 21d	1.40 c	32.00 fghi
Pyriofenone 4 fl oz + NIS 0.1% (v/v) 14d	2.40 c	32.80 fghi
DPX-RTB69 1.6 fl oz + Exp A 14.5 fl oz + Dyne-Amic 0.125% (v/v) 14d	2.36 c	34.40 fgh
ARY-0438-005 6.2 oz + Syl-Coat 0.125% (v/v) 14d	2.67 c	34.40 fgh
Kocide 3000 (9x) 1.75 lb then Luna Experience 8.6 fl oz + Syl-Coat 4 fl oz/100 gal 3d then 21d	2.99 c	40.80 fgh
ARY-0438-005 6.2 oz + UBI 4319-01 6 fl oz + Syl-Coat 0.125% (v/v) 14d	1.78 c	42.40 fgh
Pyriofenone 5 fl oz + NIS 0.1% (v/v) 21d	4.50 c	49.60 efg
GWN-10511 3.4 fl oz + Dyne-Amic 0.125% (v/v) 14d	2.56 c	51.20 defg
Torino 3.4 fl oz + Dyne-Amic 0.125% (v/v) 14d	2.66 c	56.00 cdef
UBI 4319-01 6 fl oz + F1757aa 9 fl oz + Syl-Coat 0.125% (v/v) 14d	4.86 c	72.80 bcde
UBI-4319-01 6 fl oz + Syl-Coat 0.125% (v/v) 14d	4.46 c	75.20 abcde
Rally 4 oz + Dyne-Amic 0.125% (v/v) 14d	16.70 b	76.80 abcd
DPX-RTB69 1.6 fl oz + Dyne-Amic 0.125% (v/v) 14d	19.11 b	78.30 abc
DPX-RTB69 1.6 fl oz + Rally 4 oz + Dyne-Amic 0.125% (v/v) 14d	24.26 b	79.20 abc
Stylet Oil 1.5 pt alt Viathon 2 pt alt Quintec 5 fl oz 10-21d	18.70 b	92.00 ab
Untreated Control	95.20 a	100.00 a

Table 3. Disease incidence and severity in trial III. 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 Fisher's LSD at $\alpha=0.05$; alt = alternated with.

Treatments	Mean Severity (%)		Mean Incidence (%)	
Microthiol Disperss 5 lb then (from bloom) (Luna Experience 8.6 fl oz then Gem 3.8 fl oz alt Mettle 5 fl oz) + Syl-Coat 4 fl oz/100 gal 7 then 14d	0.02	b	0.80	d
Microthiol Disperss 5 lb then (from bloom) (Luna Experience then Flint 3 oz then Luna Experience 8.6 fl oz then Flint 3 oz then Mettle 5 fl oz then Flint 3 oz) + Syl-Coat 4 fl oz/100 gal 7 then 14d	0.02	b	1.60	d
Microthiol Disperss 5 lb then (from bloom) (Luna Experience 8.6 fl oz then Flint 3 oz alt Mettle 5 fl oz) + Syl-Coat 4 fl oz/100 gal 7 then 14d	0.02	b	1.60	d
(Luna Experience 8 fl oz alt Quintec 6.6 fl oz) + Syl-Coat 0.125% (v/v) 21d	0.57	b	17.60	cd
(Vivando 15.4 fl oz alt Pristine 12.5 oz) + Syl-Coat 4 fl oz/100 gal 14d	0.76	b	20.00	cd
(Vivando 15.4 fl oz then Pristine 12.5 oz then Quintec 6.6 fl oz then Luna Experience 8.6 fl oz then Torino 3.4 fl oz then Switch 14 oz) + Syl-Coat 0.25% (v/v) 14d	0.68	b	20.80	cd
(Quintec 4 fl oz then Rhyme 5 fl oz then Pristine 12.5 oz then Rhyme 5 fl oz then Quintec 4 fl oz then Fracture 20.3 fl oz) + Dyne-Amic 0.25% (v/v) 14d	1.11	b	28.80	c
(Quintec 4 fl oz then Fracture 18.3 fl oz then Rhyme 5 fl oz then Fracture 18.3 fl oz then Quintec 4 fl oz then Rhyme 5 fl oz) + Dyne-Amic 0.25% (v/v) 14d	1.34	b	36.80	c
(Rally 5 oz alt Quintec 4 fl oz) + Syl-Coat 0.125% (v/v) 14d	1.22	b	37.60	c
((Rhyme 5 fl oz then Quintec 4 fl oz then Fracture 18.3 fl oz) + Dyne-Amic 0.25% (v/v)) (2x) 14d	3.93	b	64.80	b
Untreated Control	74.72	a	97.60	a

Table 4. Disease incidence and severity in trial IIIa. 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 Fisher's LSD at $\alpha=0.05$; alt = alternated with.

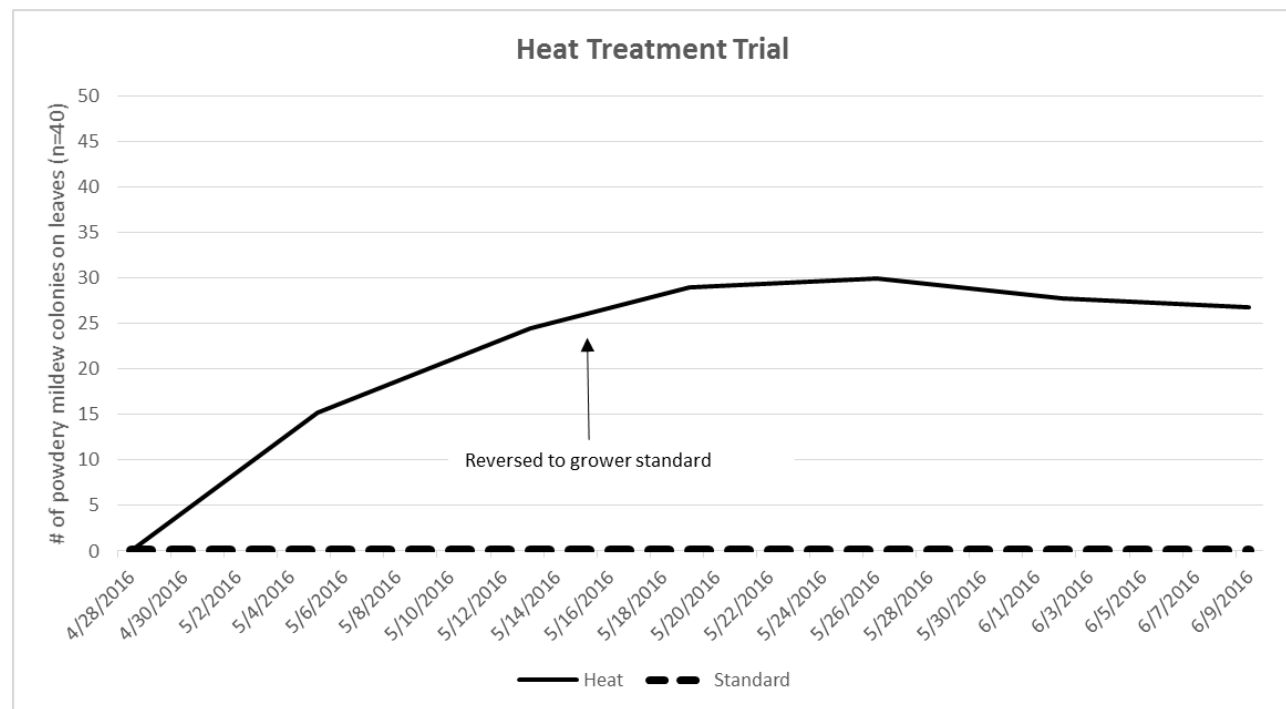
Treatment	Mean Severity (%)	Mean Incidence (%)
Polymer 128g 7-10d ***	0.31 b	16.80 d
SP2700 10 WP 300x dilution 7d **	0.48 b	19.20 cd
SP2700 10 WP 600x dilution 7d **	0.70 b	26.40 cd
ISK-2000 16 fl oz 7d *	1.14 b	40.00 c
GC Pro 4 lb 7d *	2.51 b	64.80 b
GC Pro 3 lb 7d *	2.74 b	75.20 b
Untreated Control	74.72 a	97.60 a

***Note: treatment #6 was sprayed with Luna Experience + 0.5% Stylet Oil on Apr 15 and May 6 2016

**Note: treatment #4 & 5 were sprayed with Luna Experience + 0.5% Stylet Oil on Apr 15 and May 6 2016

*Note: treatment #1-3 were sprayed with Luna Experience + 0.5% Stylet Oil on Apr 15 and May 6 2016

Figure 4: Results for Heat treatment trial based on 7 weeks ratings (Apr 8 – Jun 9 2016).



Acknowledgements

We thank James Reamer for research cooperation and use of the vineyard. Thanks to the various industry donors for providing of testing materials. We thank A. Erickson, Matt Frank, Dr. M. Lima, and C. Waters for assisting with disease evaluation in the field and other aspects of the trials. We thank Petro-Canada (PureSpray Green) for providing lunch for the field day.

Appendix: Materials

Product	Active ingredient(s) and concentration	Manufacturer or distributor	Chemical class (after Adaskaveg et al. 2008)
A19649	proprietary	N/A	proprietary
AKX-801	proprietary	N/A	proprietary
Aprovia	proprietary	N/A	proprietary
ARY-0438-005	proprietary	N/A	proprietary
Capsil	polyether-polymethylsiloxane-copolymer (100%)	Aquatrols	adjuvant
ChampION++	copper hydroxide (46.1%)	Nufarm	minerals
Clovex	proprietary	N/A	proprietary
DPX-RTB69	proprietary	N/A	proprietary
Dyne-Amic	polyalkyleneoxide modified polydimethylsiloxane, nonionic emulsifiers, methyl ester of C16-C18 fatty acids (99%)	Helena Chemical Co.	adjuvant
Exp A	proprietary	N/A	proprietary
Exp B	proprietary	N/A	proprietary
F1757aa	proprietary	N/A	proprietary
Flint	trifloxystrobin (50%)	Bayer CropScience	QoI (11)
Fracture	BLAD (20%)	FMC Corporation	plant extract
Gem 500 SC	trifloxystrobin (25%)	Bayer CropScience	QoI (11)
Greenclean Pro	proprietary	N/A	proprietary
GWN-10511	proprietary	N/A	proprietary
HML32	proprietary	N/A	proprietary
Inspire Super	difenoconazole (8.4%), cyprodinil (24.1%)	Syngenta Crop Protection, Inc.	DMI (3)/anilinopyrimidine (9)
ISK-2000	proprietary	N/A	proprietary
JMS Stylet-Oil	paraffinic oil (97.1%)	JMS Flower Farms, Inc.	oil
Kocide 3000	copper (30%)	Dupont	minerals
LSU (Lime Sulfur Ultra)	calcium polysulfide (28%)	Or-Cal, Inc.	mineral (M2)
Luna Experience	fluopyram (17.54%), tebuconazole (17.54%)	Bayer CropScience	SDHI (7)/DMI-triazole (3)
Mettle 125 ME	tetraconazole (11.6%)	Gowan Co.	DMI-triazole (3)

Microthiol Disperss	sulfur (80%)	United Phosphorus Inc.	mineral (M2)
NIS	proprietary	N/A	proprietary
Pristine	pyraclostrobin (12.8%) boscalid (25.2%)	BASF	SDHI (7)/QoI(11)
Probiotic	proprietary	N/A	proprietary
Purespray Green	low range oil	Petro-Canada	oil
Pyriofenone	proprietary	N/A	proprietary
Quintec	quinoxifen (22.6%)	Dow AgroSciences LLC	quinoline (13)
Rally 40 WSP	myclobutanil (40%)	Dow AgroSciences LLC	DMI-triazole (3)
Pyraziflumid	proprietary	N/A	proprietary
Polymer	proprietary	N/A	proprietary
Regalia	extract of <i>Reynoutria sachalinensis</i> (5%)	Marrone Bio Innovations	plant extract
Rhyme	flutriafol (22.7 %)	Cheminova Inc	DMI-triazole (3)
Serenade Optimum	<i>Bacillus subtilis</i> QST 713 (26%)	Bayer CropScience	biological
Sovran	kresoxim-methyl (50%)	Cheminova	QoI (11)
SP2700 10 WP	proprietary	N/A	proprietary
Switch	cyprodinil (37.5%), fludioxonil (25%)	Syngenta Crop Protection	anilinopyrimidine (9)/phenylpyrrole (12)
Syl-Coat	polyether-polymethylsiloxane-copolymer and Polyether (100%)	Wilbur-Ellis	adjuvant
Sysstem SeaCal	phosphoric acid (14%) calcium (4%)	Agro-K	inorganic salt
Taegro 13 WP	<i>Bacillus subtilis</i> Strain FZB24 (13.0%)	Syngenta	biological
Torino SC	cyflufenamid (10%)	Gowan Co.	phenyl-acetamide (U6)
UBI-4319-01	proprietary	N/A	proprietary
Viathon	potassium phosphite (49%), tebuconazole (3.3%)	Helena Chemical Co.	Phosphonates (33)/DMI-triazole (3)
Vigor SeaCal	soluble potash (0.5%), calcium (5%)	Agro-K	inorganic salt
Vivando	metrafenone (25.2%)	BASF	benzophenone (U6)
WXF-16001	proprietary	N/A	proprietary

Appendix sources: (1) Adaskaveg, et al. 2012. Efficacy and timing of fungicides, bactericides and biologicals for deciduous tree fruit, nut, strawberry, and vine crops 2012, available at <http://ucanr.edu/sites/plp/files/146650.pdf>. (2) Gubler Lab field trials, available at http://plantpathology.ucdavis.edu/Cooperative_Extension/ (3) product-specific MSDS and/or labels.