Grape Powdery Mildew Prevention Trial

Ngatarawa Rd, Hastings, Hawke's Bay

2017-18

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September 2018

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Executive Summary

The objective of the trial was to evaluate and compare various products and combinations of them for the prevention of grape powdery mildew infection under demanding conditions on a highly susceptible variety, Chardonnay.

The registered products included Sulphur, Protector^{hml}, HML32, and the adjuvant HML Silco (potassium silicate).

Many of the outcomes were completely in line with expectations arising from previous trials.

Efficacy improvements were as expected such as HML32 + Sulphur, when compared with HML32, sulphur and HML Silco. Likewise Sulphur compared to HML32 + Sulphur.

The addition of HML Silco to Protector^{hml} and HML32 improved that product's efficacy confirming its function as an adjuvant, particularly given its poor performance when applied alone.

A number of combinations showed excellent efficacy against powdery mildew statistically equivalent to the chemical standard.

No phyto toxicity effects were observed during the trial.

1.0 Introduction

This trial is a continuation of research undertaken over many seasons on the preventative control of grape powdery mildew.

Most of the treatment products are commonly used registered commercial products for grape powdery mildew prevention - Sulphur, HML32 and synthetic chemistries. Protector^{hml} and HML Silco (potassium silicate) were tested alone and used as adjuvants.

HML Silco is currently on the market as an adjuvant because in previous trials, it fell short of the efficacy required for a plant protection product. It was included to confirm its status as an adjuvant and to assess the improved efficacy it imparts to other products.

A number of treatments are not reported here as they are commercially sensitive. However the results have been included in the reported statistics to keep those results meaningful.

2.0 Trial Objectives

The objective of the trial was to evaluate and compare various materials and combinations of them for the prevention of grape powdery mildew infection under demanding conditions on a highly susceptible variety.

3.0 Trial Site and Conditions

3.1. Vineyard description

The trial site was located in a vineyard on Ngatarawa Rd, Hastings, Hawke's Bay, New Zealand, an area with the winegrowing district of 'The Triangle' (see Figure 1 and Figure 2).

The variety was Chardonnay, trellised as 2 cane and 3 cane pruned VSP. The row width was 2.55m with 1.8m between vines. The vines are grafted and approximately 15 years old.

Spraying for disease control up until a couple of weeks before flowering was undertaken by the owner, and thereafter the trial area was the responsibility of Henry Manufacturing Limited.

The owner applied the same viticultural practice during the growing season to the trial area as was applied to rest of the block, including tucking, leaf plucking, mowing and herbicides. The standard of viticultural practice applied was very similar to that which would be applied by an experience contract grower.

Figure 1: Ngatarawa Rd powdery mildew prevention trial site (source Google Earth 2016)

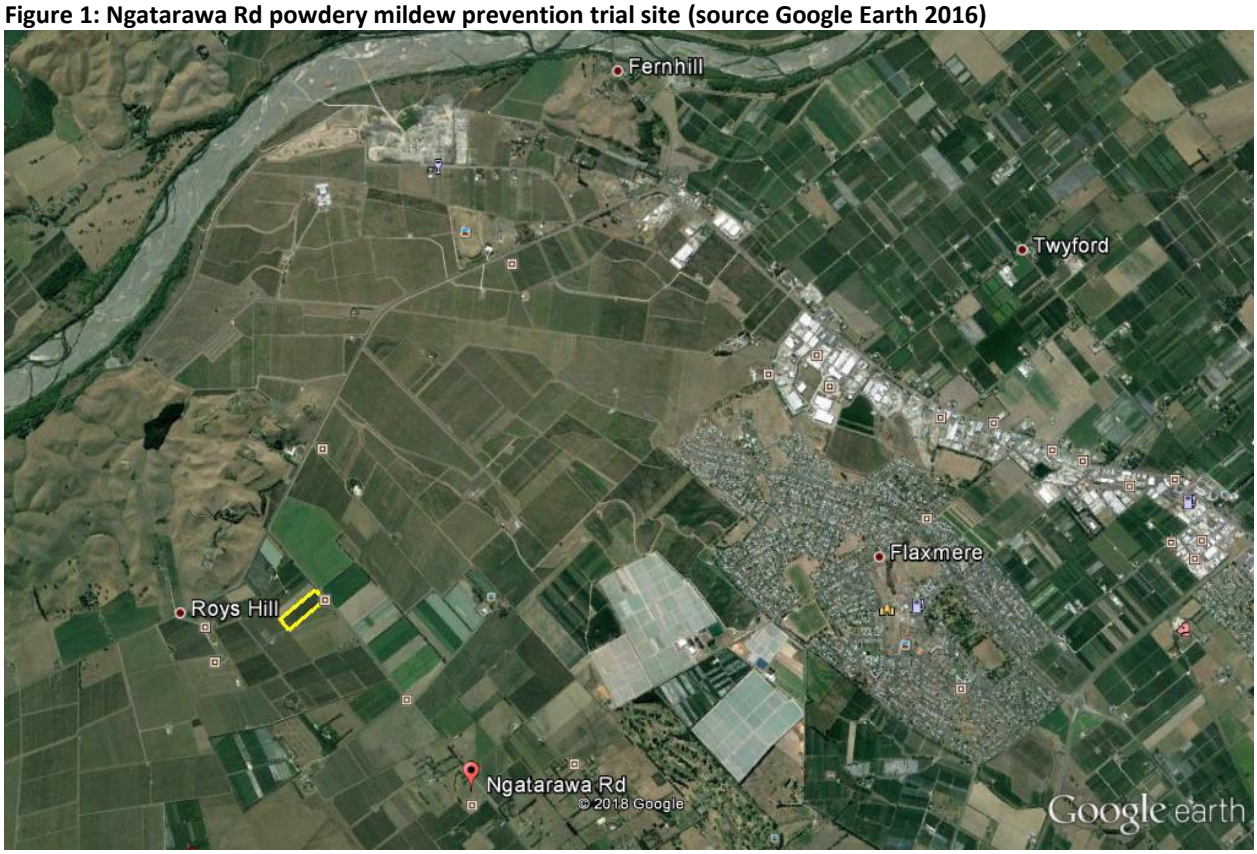


Figure 2: Ngatarawa Rd powdery mildew prevention trial site - Rows 2 and 3 of 6

3.2. Previous history of powdery mildew infection

The vineyard is now under new ownership, renamed 'Oak Estate'. The block has a history of poor control with high incidence of powdery mildew infections most years.

This block (3ha) was the subject of a large machine sprayed trial in the previous season (2016-17) undertaken by the author (Chris Henry, Henry Manufacturing) which achieved a very good level of powdery mildew control throughout the vineyard.

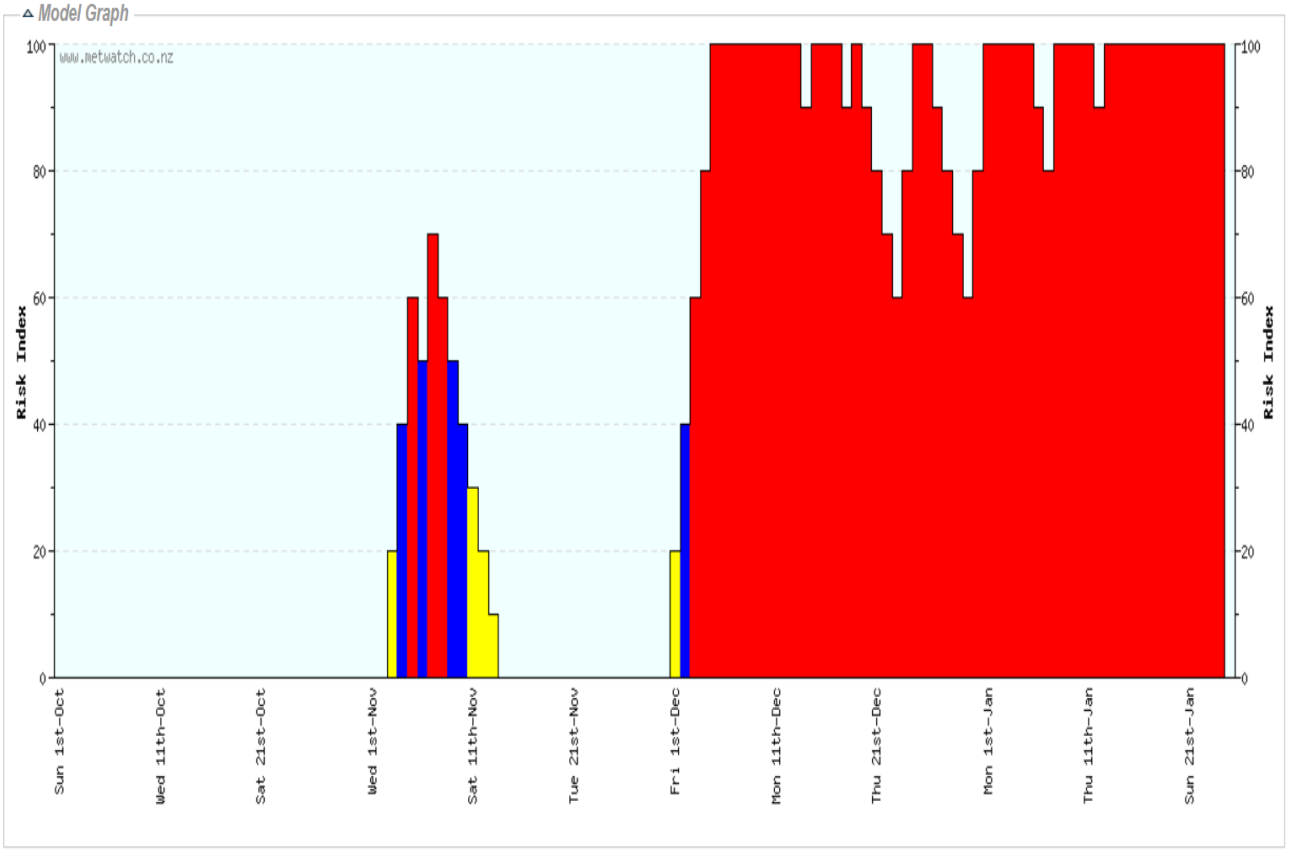
The section of the block used for this trial had not been previously used for hand-sprayed trials.

3.3. Seasonal weather conditions

The 2017-18 season was regarded by most growers in Hawke's Bay as being one of moderate to high pressure for powdery mildew disease. Disease in this trial appeared slightly earlier than 'normal' for Hawke's Bay – the first appearance of powdery mildew was seen in the Untreated plots (single berry only) on the 16 December 2017 and complete collapse of the same plots about 2 weeks prior to veraison.

Figure 3 discloses the seasonal record per the 'Gubler model' for powdery mildew pressure.

Figure 3: Seasonal Record from the 'Gubler Model' for Powdery Mildew Pressure



4.0 Trial Design

4.1. Treatments

The treatments in this trial are described in Table 1 along with the product and water rate information. Details of the programme for the chemical standard treatment is provided in Table 2. More information on the water rate is provided in Section 4.2.

The replication was four and the plots were randomly set out within each replication. The 'untreated' control was allocated 2 sets of plots to address the physical size of the trial. A plot was one bay (panel), most times containing five vines.

The trial covered 6 rows, each row containing 12-13 bays.

Table 1: Trial Treatments and Product Rate information

Trt No.	Treatment	Active Ingredient g/kg or g/L	Product rate/100L	Water Rate (to early flowering / subsequent applications) L/ha
1	Untreated	-	-	
2	Untreated	-	-	
3	Chemical Standard	Refer Table 2	Refer Table 2	380/760
4	Syngenta	800g/kg sulphur	150g	380/760
5	HML Silco	800g/kg potassium silicate	425g	380/760
7	1% Protector	182 g/L fatty acids (potassium salts)	1L	380/760
8	1% Protector + HML Silco	182 g/L fatty acids (potassium salts) 800g/kg potassium silicate	1L 425g	380/760
10	0.5% Protector + Sulphur + HML Silco	182 g/L fatty acids (potassium salts) 800g/kg sulphur 800g/kg potassium silicate	0.5L 150g 425g	380/760
12	HML 32 + Sulphur	157 g/L fatty acids (potassium salts) 254 g/L potassium bicarbonate 800g/kg sulphur	1.25L 150g	380/760
13	HML32 + HML Silco	157 g/L fatty acids (potassium salts) 254 g/L potassium bicarbonate 800g/kg potassium silicate	1.25L	380/760
15	HML 32 + Sulphur + HML Silco	157 g/L fatty acids (potassium salts) 254 g/L potassium bicarbonate 800g/kg sulphur 800g/kg potassium silicate	1.25L 150g 425g	380/760
17	HML Red	183 g/L fatty acids (potassium salts) 22 g/L copper	1L	380/760
18	HML Red + HML Silco	183 g/L fatty acids (potassium salts) 22 g/L copper 800g/kg potassium silicate	1L 425g	380/760

Table 2: Programme for Chemical Standard Treatment and Product Rate Information

Application Round	Treatment	Active Ingredient g/kg or g/L	Product rate/100L
1	Grower application 2 days prior of Sulphur, Mancozeb and Protector	800g/kg sulphur 750g/kg mancozeb 182 g/L fatty acids (potassium salts)	Machine sprayed by grower
2	Sulphur Manzate Evolution	800g/kg sulphur 750g/kg mancozeb	150g 200g
3	Proxima Nando	250g/L quinoxyfen 500g/L fluazinam	10ml 100ml
4	Sulphur	800g/kg sulphur	150g
5	Punch-up Spiral	375g/kg cyprodinil 250g/kg fludioxonil 500 g/L spiroxamine	80g 120ml
6	Proxima	250g/L quinoxyfen	10ml
7	Spiral	500 g/L spiroxamine	120ml
8	0.5% Protector Sulphur	182 g/L fatty acids (potassium salts) 800g/kg sulphur	0.5L 150g
9	Proxima	250g/L quinoxyfen	10ml
10	Sulphur	800g/kg sulphur	150g

4.2. Application Method

Spray applications were made by Chris Henry using a 50 litre Silvan unit mounted on the back of a quad bike. The tank unit was fitted with a 12 volt electric pump delivering an output of approximately 60psi through a hand gun. The handgun was fitted with a '56' swirl plate and D4 cone size which delivered a constant 2.8l/min.

All trial treatments were applied ***to the point of run off in one pass*** by electric pump assisted hand gun from each side of the row.

Water rates have been estimated for full canopy and half canopy, based on the sprayer delivery rate, and the length of time to spray one plot (one bay / both sides). It was then converted to L/ha as follows:

- The row width in the vineyard was 2.55m with 7.2m between posts (a plot) with 4 vines between.
- Lineal metres per ha = 10,000sq.m. / 2.55m = 3636 lineal metres/ha.
- No. of bays/hectare = 3922 lineal metres / 7.2 metres = 545 bays/ha

- Time to spray a bay of vines (full canopy) is approximately 15 seconds per side or 30 seconds/bay (0.5 minutes)
- Therefore **spray volume/ha (full canopy)** is approximately 545 x 0.5 min x 2.8l/min **= approx. 763l/ha.**

- Spray volume/ha used at the beginning of season and as canopy developed was approximately half the volume used at full canopy **= 381l/ha**.

4.3. Application Timings

The trial program was preceded by four applications of Mancozeb and sulphur with Protector[hml] as an adjuvant, applied by machine sprayer over all treatment sites.

There were ten applications of the trial treatments. Table 3 shows the dates of application and the interval between applications, plant growth stages and climate details.

With the exception of cloud cover, the climate details were sourced from MetWatch hourly weather data for Trinity Hill, Hawke's Bay. The data presented is for the mid period of the application round which generally took about 4 hours to complete.

Table 3: Application Dates, Interval, Chemical Standard Treatment, and Climate conditions

App. Round	Application Date	Interval	Plant Growth Stage (modified E-L system)[1]	Air Temp (°C)	Rain (mm)	RH (%)	Wind Speed (km/h)	Wind Dir.	Cloud cover (%)
1	2 Nov 2017	0	E-L15; shoot elongating rapidly; single flowers in compact groups	23	0	37.4	13.5	N	40
2	9 Nov 2017	7	E-L17; Inflorescence well developed, single flowers separated	18.4	0	34.9	8.4	NW	5
3	18 Nov 2017	9	E-L19; beginning of flowering	16.3	0	52.3	14	S	100
4	24 Nov 2017	6	E-L23; 50% Cap fall	17.6	0	79.3	0.5	S	10
5	1 Dec 2017	7	E-L26; Cap fall complete	22.5	0	57.5	10.6	NE	20
6	9 Dec 2017	8	E-L26 / E-L27	26.8	0	35.3	11.2	NW	5
7	16 Dec 2017	8	E-L27; Setting; young berries enlarging, bunch at right angle to stem	23.8	0	42.7	4.1	E	80
8	23 Dec 2017	7	E-L31; Berries pea size	19.1	0	62.1	8.1	NE	100
9	30 Dec 2017	7	E-L32; Beginning bunch closure	13.3	0	93.6	0.6	W	30
10	10 Jan 2018	11	E-L33; Berries still hard and green	29.4	0	44.7	10.3	W	50

[1] Revised version of "Grapevine growth stages - The modified E-L system" viticulture 1 - Resources. 2nd edition 2004. Eds Dry,P. and Coombe, B. (Winetitles)

4.4. Assessment

The assessment was undertaken on 17 January 2018, 7 days after the last powdery mildew spray (10 January 2016). The vines were 7-10 days away from veraison. The sample size per plot was 50, making a total of 200 bunches per treatment.

The trial was field assessed for both powdery mildew incidence and severity by Bridget Wilton, a technical advisor for Horticentre. Her qualifications and CV is provided in Appendix 1. She undertook the assessment blind, and assessing bunches randomly over the length of each plot.

The raw data was provided to Peter Wood, a scientist with Plant and Food Research who undertook the statistical analysis.

5.0 Efficacy Results

The mean percentage of powdery mildew incidence and severity from the examination of 200 bunches per treatment is shown for each treatment in Table 4 and

Figure 4. The incidence and severity analysis for each replicate is provided in Appendix 2 and the raw data for each plot is provided in Appendix 3.

The statistical analysis of the treatment results[2] was undertaken by Peter Wood, Plant and Food Research and are also provided in Table 4. Data were analysed using GenStat Release 17.1.0.14713 (PC/Windows XP) Copyright 2014, Lawes Agricultural Trust (Rothamsted Experimental Station). Before analysis incidence and severity data were subjected to angular transformation. The untransformed means are reported in the tables and figures. Analysis of Variance (ANOVA) and Fisher's Protected Least Significant Differences of Means (LSD, $\alpha = 0.05$) were used to determine statistical differences between treatments. Supporting statistical analysis is provided in Appendix 4.

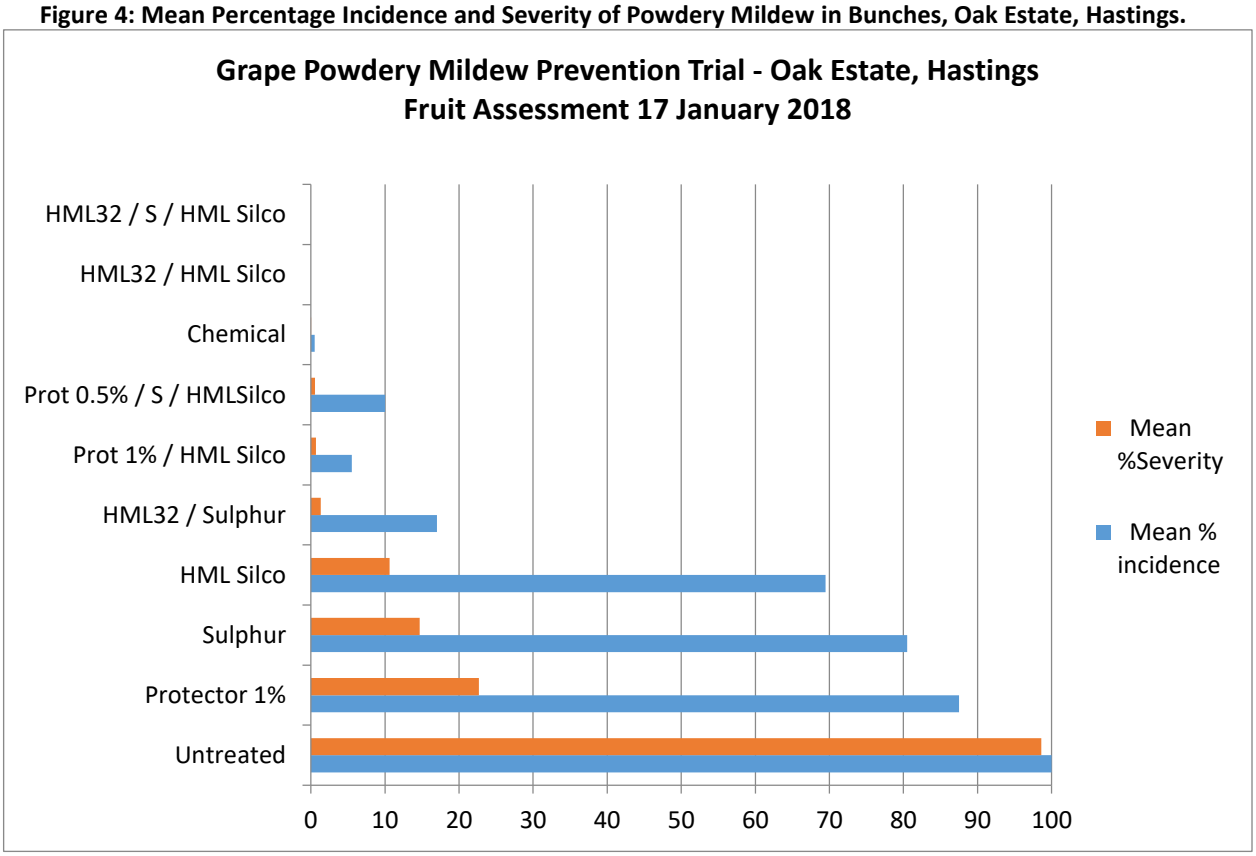
[2] The excluded treatments have been left in for the statistical analysis.

Table 4: Mean Percentage Bunch Powdery Mildew Incidence and Severity and statistical analysis sorted by Percentage Incidence.

Treatment Name	Mean % Incidence	Statistical Analysis of Incident data	Mean % Severity	Statistical Analysis of Severity data
HML32 / S / HML Silco	0	a	0	a
Excluded treatment	0	a	0	a
Excluded treatment	0	a	0	a
HML32 / HML Silco	0	a	0	a
Excluded treatment	0	a	0	a
Chemical	0.5	a	0.03	a
Excluded treatment	1	a	0.05	a
Excluded treatment	2.5	ab	0.15	a
Excluded treatment	3	ab	0.15	a
Prot 1% / HML Silco	5.5	abc	0.7	a
Prot 0.5% / S / HML Silco	10	bcd	0.6	a
Excluded treatment	13.5	cd	0.9	a
HML32 / Sulphur	17	d	1.3	a
HML Silco	69.5	e	10.6	b
Excluded treatment	77	ef	13.4	bc
Sulphur	80.5	fg	14.7	c
Protector 1%	87.5	g	22.7	d
Untreated 1	100	h	98.6	e
Untreated 2	100	h	98.5	e
l.s.d	*8.489*		*3.039*	

Within each column, means followed by the same letter are not significantly different (LSD, $\alpha = 0.05$).
The P value was < 0.001 for both incidence and severity indicating a high level of confidence (99%) that treatment effects were real.

Figure 4: Mean Percentage Incidence and Severity of Powdery Mildew in Bunches, Oak Estate, Hastings.



6.0 Discussion of Results

The objective of the trial was to evaluate and compare various materials and combinations of them for the prevention of grape powdery mildew infection.

This vineyard block had a history of powdery mildew infections. This trial was conducted under severe powdery mildew pressure as demonstrated by the two untreated controls which had 100% mean incidence of powdery mildew and 98.4/98.6% mean severity respectively.

The key findings are:

- With the exception of Sulphur alone, 1% Protector alone, and HML Silco alone, all remaining treatments provided excellent control of powdery mildew.
- The results of the HML Silco treatment confirm that alone, it provides inadequate powdery mildew control.
- The improved control achieved by the addition of HML Silco to 1% Protector and the HML32 and Sulphur mix confirms its usefulness as an adjuvant.
- The mean incidence for 1% Protector went from 87.5% to 5.5% when HML Silco was added. The mean severity for 1% Protector went from 22.7% to 0.7% when HML Silco was added.
- The mean incidence for HML32 and Sulphur went from 17% to 0% when HML Silco was added. The mean severity for HML32 and Sulphur went from 1.3% to 0% HML Silco was added
- The treatments including 1% Protector and HML Silco, and HML32 and HML Silco all provided good to excellent efficacy against powdery mildew, notably without sulphur.

Figure 5 shows a comparison of an untreated plot alongside Protector 0.5%, Sulphur and HML Silco

Figure 5: Untreated plot on left hand side, Protector 0.5%/Sulphur/HML Silco on right hand side

7.0 Conclusions

Many of the outcomes were completely in line with expectations arising from previous trials.

Efficacy improvements were as expected such as HML32 + Sulphur, when compared with HML32, sulphur and HML Silco. Likewise Sulphur compared to HML32 + Sulphur.

The addition of HML Silco to Protector^{hml} and HML32 improved that product's efficacy confirming its function as an adjuvant, particularly given its poor performance when applied alone.

No phyto toxicity effects were observed during the trial.

8.0 Acknowledgements

Chris Henry would like to acknowledge Stefan and Nadine Lötscher, the owners of the vineyard for allowing this trial to be undertaken and for his assistance at times, Bridget Wilton (technical advisor, HortiCentre) for the field evaluation of powdery mildew and Peter Wood, Plant and Food Research's scientist for his analysis and statistical reporting.

Appendix 1: CV for Bridget Wilton

Curriculum Vitae for Bridget Wilton

Relevant Qualifications

1997 Bachelor of Applied Science (Horticulture)

Relevant Employment History

Horticentre - Technical Advisor (Current position)

Farmlands Horticulture - Technical Advisor

Eastern Institute of Technology
Pest, Disease and Disorders in Horticulture Tutor

Constellation New Zealand
Technical Viticulturist and Grower Liaison

Montana Wines – Allied Domeq – Pernod Ricard
Assistant Vineyard Manager
Korokipo Estate, Hawke's Bay
Patutahi Estate, Gisborne

Wainawa River Estate - Vineyard Manager

Appendix 2 : Replicate data (excluding treatments of commercial sensitivity)

Trt Name	Trt#	Rep	% incidence	%Severity
Untreated 1	1	1	100	94.4
Untreated 1	1	2	100	100
Untreated 1	1	3	100	100
Untreated 1	1	4	100	100
Untreated 2	2	1	100	98.8
Untreated 2	2	2	100	100
Untreated 2	2	3	100	100
Untreated 2	2	4	100	95.1
Chemical	3	1	0	0
Chemical	3	2	0	0
Chemical	3	3	0	0
Chemical	3	4	2	0.1
Sulphur	4	1	92	22.3
Sulphur	4	2	76	12.2
Sulphur	4	3	70	9.3
Sulphur	4	4	84	14.9
HML Silco	5	1	74	14.9
HML Silco	5	2	90	12.4
HML Silco	5	3	54	8.1
HML Silco	5	4	60	7.1
Protector 1%	7	1	84	21.3
Protector 1%	7	2	86	21.1
Protector 1%	7	3	84	19.6
Protector 1%	7	4	96	28.7
Prot 1% / HML Silco	8	1	2	0.1
Prot 1% / HML Silco	8	2	16	2.5
Prot 1% / HML Silco	8	3	4	0.2
Prot 1% / HML Silco	8	4	0	0
Prot 0.5% / S / HML Silco	10	1	4	0.2
Prot 0.5% / S / HML Silco	10	2	18	1.1
Prot 0.5% / S / HML Silco	10	3	14	0.7
Prot 0.5% / S / HML Silco	10	4	4	0.2
HML32 / Sulphur	12	1	16	1.5
HML32 / Sulphur	12	2	24	2.3
HML32 / Sulphur	12	3	16	0.9
HML32 / Sulphur	12	4	12	0.6
HML32 / HML Silco	13	1	0	0
HML32 / HML Silco	13	2	0	0
HML32 / HML Silco	13	3	0	0
HML32 / HML Silco	13	4	0	0
HML32 / S / HML Silco	15	1	0	0
HML32 / S / HML Silco	15	2	0	0
HML32 / S / HML Silco	15	3	0	0
HML32 / S / HML Silco	15	4	0	0

Appendix 3: Raw Data (excluding treatments of commercial sensitivity)

Note: Empty cell = 0 (no powdery mildew found)

Trt Name	Untreated 1	Untreated 1	Untreated 1	Untreated 1	Untreated 2	Untreated 2	Untreated 2	Untreated 2	Chemical	Chemical	Chemical	Chemical	Sulphur	Sulphur	Sulphur	Sulphur	HML Silco	HML Silco	HML Silco	HML Silco
Trt#	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5
Rep	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	90	100	100	100	80	100	100	90				5	5	15	5	5	5	10	15	50
2	50	100	100	100	80	100	100	60					15	5	10	5	15	5	5	20
3	70	100	100	100	80	100	100	80					10	10	5	5	5	15	5	5
4	50	100	100	100	100	100	100	80					15	5	5	10	5	30	40	10
5	50	100	100	100	100	100	100	75					30	80	5	5	25	10	5	5
6	60	100	100	100	100	100	100	80					50	30	5	15	50	5	5	15
7	50	100	100	100	100	100	100	70					5	5	30	10	10	20	15	5
8	100	100	100	100	100	100	100	80					20	10	15	5	10	20	10	5
9	100	100	100	100	100	100	100	80					15	15	5	10	5	10	5	5
10	100	100	100	100	100	100	100	80					15	10	10	5	5	20	30	10
11	100	100	100	100	100	100	100	80					40	15	15	15	30	5	5	5
12	100	100	100	100	100	100	100	100					20	30	15	5	15	15	10	5
13	100	100	100	100	100	100	100	100					15	15	15	5	20	10	15	10
14	100	100	100	100	100	100	100	100					15	5	10	30	10	10	5	10
15	100	100	100	100	100	100	100	100					60	5	20	15	30	5	5	10
16	100	100	100	100	100	100	100	100					70	5	5	10	10	15	10	15
17	100	100	100	100	100	100	100	100					50	10	5	40	10	20	15	10
18	100	100	100	100	100	100	100	100					20	10	10	50	5	5	20	5
19	100	100	100	100	100	100	100	100					40	15	30	80	20	10	20	5

20	100	100	100	100	100	100	100	100					10	15	10	15	60	5	50	5
21	100	100	100	100	100	100	100	100					30	5	5	5	50	5	10	5
22	100	100	100	100	100	100	100	100					60	5	10	10	5	10	5	5
23	100	100	100	100	100	100	100	100					40	40	10	5	30	20	30	5
24	100	100	100	100	100	100	100	100					15	15	10	5	20	10	5	15
25	100	100	100	100	100	100	100	100					50	10	40	5	20	5	10	5
26	100	100	100	100	100	100	100	100					60	5	5	20	5	5	5	50
27	100	100	100	100	100	100	100	100					20	30	15	5	10	10	50	15
28	100	100	100	100	100	100	100	100					50	10	5	5	50	15		10
29	100	100	100	100	100	100	100	100					40	5	10	10	50	15		20
30	100	100	100	100	100	100	100	100					15	5	20	20	5	20		15
31	100	100	100	100	100	100	100	100					5	20	80	50	50	15		
32	100	100	100	100	100	100	100	100					5	10	5	15	20	40		
33	100	100	100	100	100	100	100	100					50	5	5	25	50	30		
34	100	100	100	100	100	100	100	100					10	20	5	5	10	25		
35	100	100	100	100	100	100	100	100					5	40	10	5	10	30		
36	100	100	100	100	100	100	100	100					5	30		80	10	5		
37	100	100	100	100	100	100	100	100					5	40		60	5	15		
38	100	100	100	100	100	100	100	100					5	5		5		10		
39	100	100	100	100	100	100	100	100					5			15		10		
40	100	100	100	100	100	100	100	100					10			20		15		
41	100	100	100	100	100	100	100	100					20			20		5		
42	100	100	100	100	100	100	100	100					30			15		10		
43	100	100	100	100	100	100	100	100					15					30		
44	100	100	100	100	100	100	100	100					10					15		
45	100	100	100	100	100	100	100	100					30					5		
46	100	100	100	100	100	100	100	100					5							
47	100	100	100	100	100	100	100	100												
48	100	100	100	100	100	100	100	100												
49	100	100	100	100	100	100	100	100												
50	100	100	100	100	100	100	100	100												

Note: Empty cell = 0 (no powdery mildew found)

Trt Name	Protector 1%	Protector 1%	Protector 1%	Protector 1%	Prot 1% / HML Silco	Prot 1% / HML Silco	Prot 1% / HML Silco	Prot 1% / HML Silco	Prot 0.5% / S / HML Silco 1	Prot 0.5% / S / HML Silco 1	Prot 0.5% / S / HML Silco 1	Prot 0.5% / S / HML Silco 1	HML32 / Sulphur	HML32 / Sulphur	HML32 / Sulphur	HML32 / Sulphur	HML32 / HML Silco	HML32 / HML Silco	HML32 / HML Silco	HML32 / HML Silco
Trt#	7	7	7	7	8	8	8	8	10	10	10	10	12	12	12	12	13	13	13	13
Rep	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	5	40	5	50	5	20	5		5	5	5	5	5	5	5	5				
2	15	5	5	50		5	5		5	5	5	5	10	5	5	5				
3	10	30	5	30		20				5	5		5	5	5	5				
4	40	20	10	5		5				5	5		5	5	5	5				
5	10	50	40	10		15				5	5		10	5	5	5				
6	5	40	25	30		40				5	5		20	5	5	5				
7	15	15	10	40		15				5	5		5	5	5					
8	5	50	5	10		5				10			15	10	10					
9	15	10	15	15						10				5						
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11	50	5	10	30										40						
12	90	20	5	5										5						
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14	10	40	40	10																
15	10	20	15	40																
16	40	10	50	5																
17	30	15	50	20																
18	5	5	15	5																
19	10	30	25	5																
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21	5	50	5	10																

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24	5	90	60	5																
25	15	20	100	30																
26	50	40	5	50																
27	5	50	40	80																
28	20	10	50	80																
29	100	10	20	35																
30	40	5	40	40																
31	30	5	10	10																
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39	5	30	10	40																
40	35	5	10	10																
41	10	30	50	5																
42	5	10	5	80																
43		5		30																
44				40																
45				15																
46				5																
47				5																
48				10																
49																				
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