Grape Powdery Mildew Prevention Trial

Taylors Pass Rd, Blenheim

2020-21

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1.0 Introduction

The broad purpose of the Henry Manufacturing business is to develop and register organically acceptable materials which, while providing its own fungicidal efficacy, enhances other commonly used organic materials. This would allow all winegrowers access to a regime, within their current practices, that would address all canopy fungicidal issues at the critical growth stages or heightened disease pressure. The outcome would 'soften' the control regimes presently used by the industry, provide a healthier environment for people employed within it and a better story for those marketing our wines.

This trial builds on preceding trials with similar materials and combinations.

The purpose of this trial was to evaluate the efficacy of a new potassium soap fungicide called NSA against Grape Powdery Mildew and Botrytis, at different rates and with different additives. NSA has provisional registration (P9721-01) and crop is allowed to be harvested.

2.0 Trial Objectives

The objective of the trial was to evaluate and compare two rates of NSA alone and with various materials and combinations of them for the prevention of Grape Powdery Mildew and Botrytis infection on a highly susceptible variety, Chardonnay. Unfortunately, there was no Botrytis pressure in Marlborough in the 2020-21 season.

3.0 Trial Site and Conditions

3.1. Vineyard description

The trial site was located in a vineyard on Taylors Pass Rd, Blenheim Marlborough, New Zealand. (see Figure 1). It is owned by Meadowbank Station Limited.

The variety was Chardonnay Clone 95, trellised as 2 cane pruned VSP. The row width was 2.00m with 1.44m between vines (5 vines/bay). The vines are grafted and approximately 8 years old. The trial is located at the northern end of a block covering 10 short rows, which included the outside row as a buffer. A short bay (3 vines) on the outside westerly edge was also retained as a buffer.

Spraying for disease control up until the end of October was undertaken by the owner, and thereafter the trial area was the responsibility of Henry Manufacturing Limited. There were three machine applied applications of mineral oil, then two of sulphur with an adjuvant.

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 consistent with corporate managed vineyards. The vines were given a quick manual shoot thin in the heads (7 November 2020) ahead of flowering to address head congestion. The vines were 'collarded' once when berries had all reached the size of a match head (Collarding is the use of high velocity air to remove dead flowering parts (botrytis inoculum) and to shatter surrounding leaves enhancing long term bunch exposure). Bunch exposure of 60-70% was achieved with some leaf growth returning reducing bunch exposure to a minimum of approximate

50-60% (see photos in Appendix 1). The vines were side and head trimmed 3 times through to the end of the season.

3.2. Previous history of Grape Powdery Mildew and Botrytis infection

The vineyard was and is managed well under a conventional, synthetic chemical-based pesticide spray programme with no Grape Powdery Mildew observed in bunches in the preceding seasons. Therefore, overwintering Grape Powdery Mildew inoculum was therefore expected to be low. Botrytis levels are generally linked to rainfall, hence in the 2019/20 season Botrytis levels were low because of end of season dry weather. Chardonnay however is regarded as a particularly vulnerable variety to Grape Powdery Mildew infection and Clone 95 in particular prone to Botrytis because of the compacted bunch this clone produces.

Figure 1: Taylors Pass Rd powdery mildew and botrytis prevention trial site (source Google Earth 2016)

3.3. Seasonal weather conditions

The 2020-21 season was regarded by most growers in Marlborough as being one of moderate – high pressure for powdery mildew disease. The 2020 – 2021 outputs from the 'Gubler Grape Powdery Mildew Prediction model' is shown in Figure 2.

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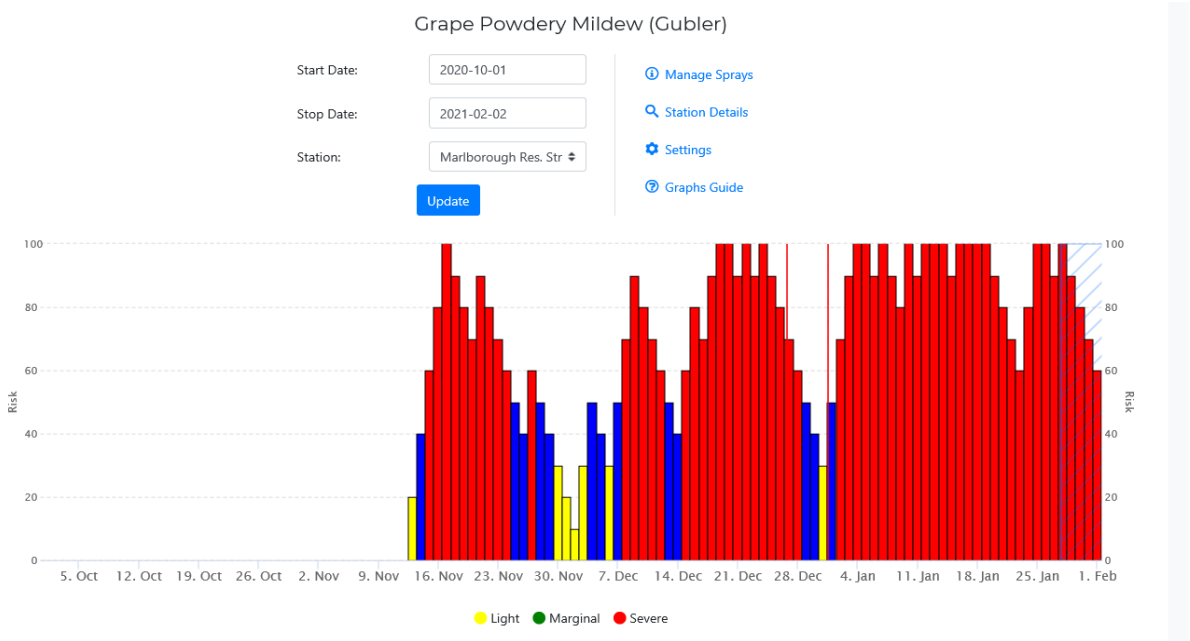
Figure 2: Gubler Grape Powdery Mildew Prediction Model for 20-21 season



Powdery mildew was first observed in the untreated controls (basal leaves on shoots in the head area) around 20 December 2020. An assessment was carried out by the author on the 30 December and 'blind' professional assessments were made on bunches (11 January 2021) and bunches and leaves (22 January 2021).

4.0 Trial Design

The trial design used one bay of vines (5 plants) as a plot. There were 4 replicates in which the treatments (18) were randomised within. There were two untreated controls because of the size of the trial. The trial was laid out over the 10 rows as below.

									13
								3	12
						13	12	15	9
					16	12	***1***	8	14
			10	15	8	3	14	10	15
		17	***1***	10	4	7	16	18	11
B	***2***	12	6	***1***	7	10	13	6	7
U	8	11	7	17	***2***	6	5	8	16
F	4	13	9	9	5	18	9	5	***2***
F	15	18	14	11	18	***2***	11	***1***	17
E	3	16	5	6	14	4	17	3	4
R			B	U	F	F	E	R	
66	65	64	63	62	61	60	59	58	57

4.1. Treatments

The 18 treatments in this trial are described in Table 1 along with the product rate information. Details of the programme for the chemical standard treatment is provided in Table 2.

Table 1: Trial Treatments and Product Rate information

Trt No.	Treatment	Active Ingredient g/kg or g/L	Product rate/100L
1	Untreated		
2	Untreated		
3	Chemical Standard	Refer Table 2	Refer Table 2
4	Sulphur	800g/kg sulphur	150g
5	Copper	750g/kg copper	30g
6	NSA 1%	265g/L fatty acids (potassium salts)	1L
7	NSA 1% Sulphur	265 g/L fatty acids (potassium salts) 800g/kg sulphur	1L 150g
8	NSA 1% Copper	265 g/L fatty acids (potassium salts) 750g/kg copper	1L 30g
9	NSA 1% Potassium Bicarbonate	265 g/L fatty acids (potassium salts) 999g/kg potassium bicarbonate	1L 300g
10	NSA 1% Potassium Bicarbonate	265 g/L fatty acids (potassium salts) 999g/kg potassium bicarbonate	1L 600g
11	NSA 1% Potassium Bicarbonate Sulphur	265g/L fatty acids (potassium salts) 999g/kg potassium bicarbonate 800g/kg sulphur	1L 300g 150g
12	NSA 1% HML Silco 100	265g/L fatty acids (potassium salts) 440g/L potassium silicate	1L 100ml
13	NSA 1% HML Silco 500	265 g/L fatty acids (potassium salts) 440g/L potassium silicate	1L 500mL
14	NSA 0.5%	265 g/L fatty acids (potassium salts)	500mL
15	NSA 0.5% Sulphur	265 g/L fatty acids (potassium salts) 800g/kg sulphur	500mL 150g
16	NSA 0.5% Sulphur HML Silco 100	265 g/L fatty acids (potassium salts) 800g/kg sulphur 440g/L potassium silicate	500mL 150g 100ml
17	NSA 0.5% Sulphur HML Silco 500	265 g/L fatty acids (potassium salts) 800g/kg sulphur 440g/L potassium silicate	500mL 150g 500mL
18	Protector 0.5% Sulphur	182 g/L fatty acids (potassium salts) 800g/kg sulphur	500mL 150g

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

Application Round	Date	Treatment	Active Ingredient g/kg or g/L	Product rate/100L
1	29-30 October 2020	Kumulus, Nordox	800g/kg sulphur 750g copper	150g 90g
2	7 November 2020	Kumulus, Nordox	800g/kg sulphur 750g copper	150g 90g
3	14 November 2020	Impulse Kumulus	500g/l spiroxamine 800g sulphur	120ml 150g
4	21 November 2020	Pinnacle Kumulus	500g/l fluazinam 800g/kg sulphur	100ml 150g
5	1 December 2020	Teldor Luna Sensation Kumulus	500g/l fenhexamid 250g/l fluopyram + 250g/l trifloxystrobin 800g/kg sulphur	75ml 30ml 150g
6	7/8/9 December 2020	Kumulus Nordox Hywet	800g/kg sulphur 750g copper	150g 60kg 50ml
7	16 December 2019	Kumulus Nordox Hywet	800g/kg sulphur 750g copper	150g 60kg 50ml
8	21 December 2019	Switch Flute Kumulus Hywet	375g/kg cyprodinil + 250g/kg fludioxonil 50g/l cyflufenamid 800g/kg sulphur	80g 50ml 150g 50ml
9	29 December 2020	Kumulus, Nordox	800g/kg sulphur 750g copper	150g 60g
10	5 January 2021	Kumulus, Nordox	800g/kg sulphur 750g copper	150g 60g
11	15 January 2021	Kumulus, Nordox	800g/kg sulphur 750g copper	150g 60g
12	25 January 2021	Pinnacle Kumulus	500g/l fluazinam 800g/kg sulphur	100ml 150g
13	3 February 2021	Kumulus, Nordox	800g/kg sulphur 750g copper	150g 60g

An explanation of the different treatments, the function of their components and why they have been included in the trial is provided in Table 3.

Table 3: Explanation and function of treatments

Trt No.	Treatment	Explanation and Function of treatment components
1	Untreated	Two untreated controls were included due to the size of the trial
2	Untreated	
3	Chemical Standard	The chemical standard was the same as the spray programme on the vineyard where the trial was located.
4	Sulphur	Sulphur remains the backbone of the grape industry's powdery mildew control. The rate used was the equivalent of a low field rate. It is usually recommended to be used with adjuvants to

		improve its efficacy but it does have claims against powdery mildew alone. The sulphur product was Kumulus.
5	Copper	The copper product used was Nordox. It has claims for powdery mildew control. The rate used was the equivalent of a low field rate. It was included as a standalone treatment to compare with 1%NSA with and without copper.
6	NSA 1%	The rate of 1L per 100L (1%) was considered to be the base rate for NSA.
7	NSA 1% Sulphur	Sulphur is commonly used with adjuvants. NSA is a soap with high adjuvant properties as well as fungicidal properties.
8	NSA 1% Copper	Previous trials with Protector and copper have shown to be effective against powdery mildew. NSA is a similar potassium soap to Protector^{hml}.
9	NSA 1% Potassium Bicarbonate 300	This combination replicates Henry Manufacturing Limited's existing product HML32, but as a tank mix as opposed to a pre-formulation. The potassium bicarbonate provides eradicant activity.
10	NSA 1% Potassium Bicarbonate 600	This combination contains more potassium bicarbonate than Henry Manufacturing Limited's existing product HML32 but it is similar to the specific eradication mixture where an additional 300G/100L is recommended.
11	NSA 1% Potassium Bicarbonate 300 Sulphur	This combination replicates the recommended use of HML32 with sulphur for improved efficacy.
12	NSA 1% HML Silco 100	The combination was included to assess the benefits of adding a low rate of the adjuvant HML Silco to 1%NSA.
13	NSA 1% HML Silco 500	The combination was included to assess the benefits of adding a higher rate of the adjuvant HML Silco to 1%NSA.
14	NSA 0.5%	This rate is expected to be the adjuvant rate for NSA, similar to the adjuvant rate for Protector^{hml}. It was not expected to provide adequate disease control by itself
15	NSA 0.5% Sulphur	This combination will demonstrate what improvement the adjuvant rate will make to sulphur compared to sulphur alone
16	NSA 0.5% Sulphur HML Silco 100	This combination will demonstrate what improvement the low rate of the adjuvant HML Silco makes to the 0.5% NSA + Sulphur combination.
17	NSA 0.5% Sulphur HML Silco 500	This combination will demonstrate what improvement the high rate of the adjuvant HML Silco makes to the 0.5% NSA + Sulphur combination.
18	Protector 0.5% Sulphur	This combination is a common combination in low disease pressure situations and as part of an integrated programme. It is included to provide a comparison with the 0.5%NSA treatments.

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 2.2l/min.

All trial treatments were applied ***to the point of run off in one pass at full canopy*** by electric pump assisted hand gun from each side of the row (less applied during canopy growth).

Calculation of litres/100m:. 86 vines x1.44= 123.84m which required 23l to spray. Rate l/100m = **18.6l/100m**
The equivalent on 2.4m row spacing within 1ha = 10000m/2.4m = row length of 4166m @ 18.6/100m = **775l/ha on 2.4m rows**

4.3. Application Timings

The trial program was preceded by 3 machine applied applications of fungicides being an EnSpray 99 mineral oil (28 September), a Kumulus (17 October) then a Kumulus and Nordox WG75 (23 October) followed by the trial beginning on the 29 October.

There were 11 applications of the trial treatments leading up to the final powdery mildew assessment on 22 January 2021 and 2 applications thereafter. Table 4 shows the dates of application and the interval between applications, plant growth stages and weather conditions. The intention was to follow the most common spray interval pattern used by grape growers. A 10 day interval until flowering/7 day interval until approximately a month after flowering complete/10 Day interval to finish around veraison. Photographs of canopy and bunch zone taken at various dates through trial are shown in Appendix 1.

Table 4: Application Dates, Interval, Chemical Standard Treatment, and Climate conditions

Application Round	Date	Interval	Plant Growth Stage	Comment on weather conditions
1	29-30 October 2020	0	EL15	About 18 degrees before interrupted by light rain. No wind. Following day fine with some wind towards end of spraying
2	7 November 2020	9	EL17 Inflorescences expanded	Spraying interrupted by light rain. Mild temperatures
3	14 November 2020	7	EL19 Only just 5% cap fall, some flowering beginning around posts	Fine, warm, 25 degrees, no wind
4	21 November 2020	7	EL23 50% Cap fall, nearly all flowers open	Fine, warm , 24 degrees, calm at beginning then strong winds at end,
5	1 December 2020	10	EL25 80% Cap fall	Fine, warm , 25 degrees, calm at beginning then strong winds at end,
6	7/8/9 December 2020	7		Fine with showers, warm , calm early then strong winds at end of each day
7	16 December 2020	9		Fine, warm,26 degrees
8	21 December 2020	5	EL31 Pre-bunch closure	Sprayed early as rain expected. Fine no wind, cool.
9	29 December 2020	8		Fine, 20 degrees, no wind
10	5 January 2021	7	EL33 Bunch closure on 50% bunches	Fine, hot, 27 degrees
11	15 January 2021	10		Fine, hot , 30 degrees, no wind
12	26 January 2021	11		Fine, hot, 30 degrees, no wind
13	3 February 2021	8	EL36 Mid veraison	Fine, 25 degrees, slight wind

4.4. Powdery Mildew Assessment

A preliminary powdery mildew assessment on bunches was undertaken on 30 December 2020 by the author when significant powdery mildew was observed in the untreated controls. A second bunch assessment was undertaken on 11 January 2021 by Mark Allen, Vineyard Services Limited, and a further bunch and leaf assessment on 22 January 2020 (approximately a week before veraison).

The second assessment and the final assessments were undertaken **blind**, assessing bunches or leaves randomly over the length of each plot.

The bunch sample size per plot was 25, making a total of 100 bunches per treatment. Each bunch was turned and assessed for severity of infection if there was any.

The leaf sample size per plot was 25 from the shady side of the plant, making a total of 100 leaves per treatment. The leaves were assessed from a band of the canopy and given a score of 0, 1 ,2 or 3 as shown in the photos in Figure 3.

Figure 3: Leaf assessment - scoring system and the location of assessment within the canopy

Leaf Score	Representative Leaf
0	
1	

2	
3	
Area of canopy where leaf assessment was undertaken	

5.0 Results

5.1. Powdery Mildew Efficacy

Three assessments for powdery mildew were undertaken to show how the disease developed over time. Figure 4 shows the incidence and severity for the first assessment undertaken on 30 December 2020. The disease was first seen on basal leaves in the head on the 20th December.

Figure 4: Mean Percentage Incidence and Severity of Powdery Mildew in Bunches, Chardonnay, Meadowbank Station. Preliminary Assessment date 30 December 2020

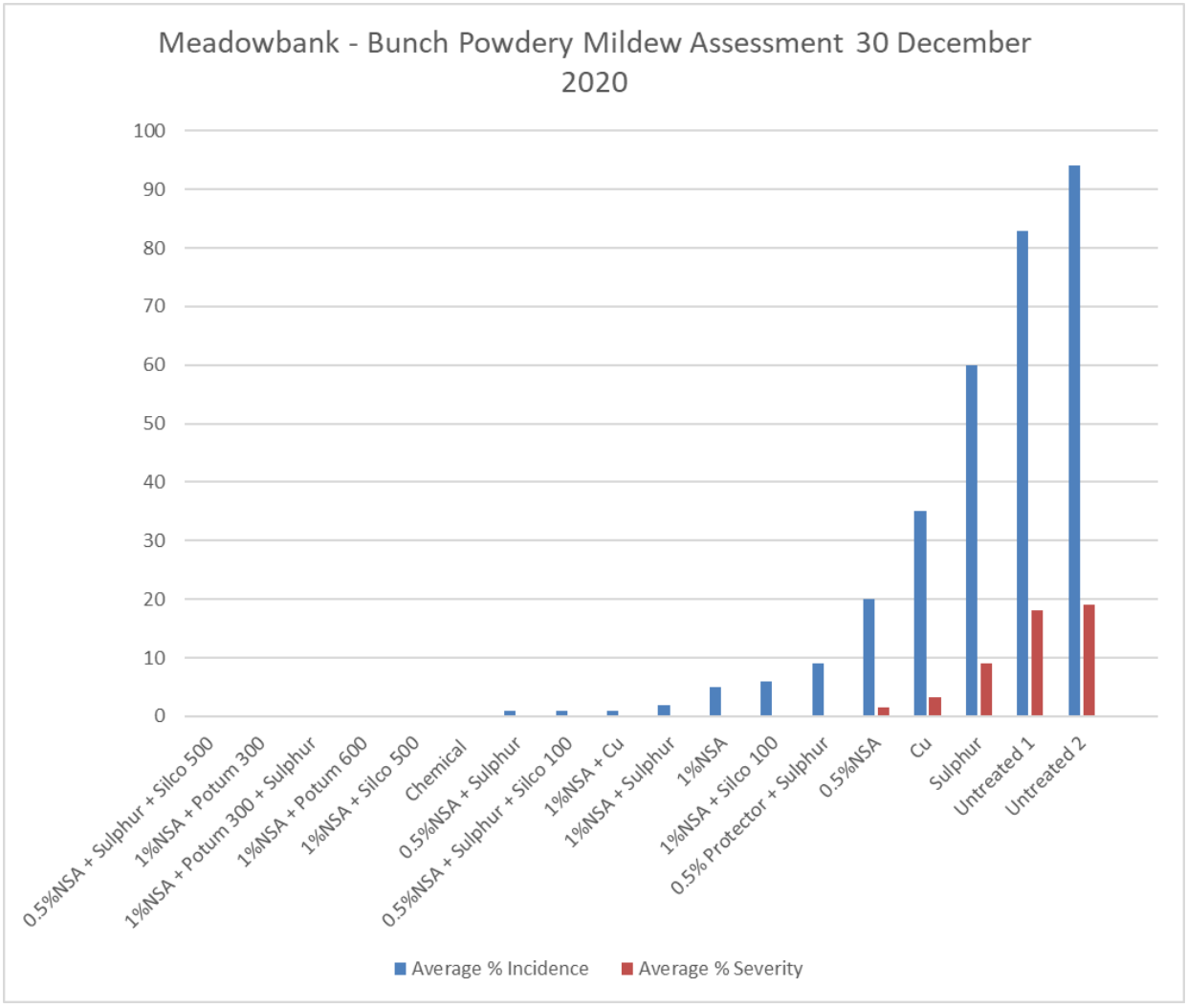


Figure 5 shows the incidence and severity for the second assessment (first independent/blind assessment) undertaken on 11 January 2021 (approximately 2 weeks after completion of flowering). This was two weeks after the first assessment and shows the progression of the disease across some of the weaker treatments.

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Figure 5: Mean Percentage Incidence and Severity of Powdery Mildew in Bunches, Chardonnay, Meadowbank Station. Independent Assessment date 11 January 2021

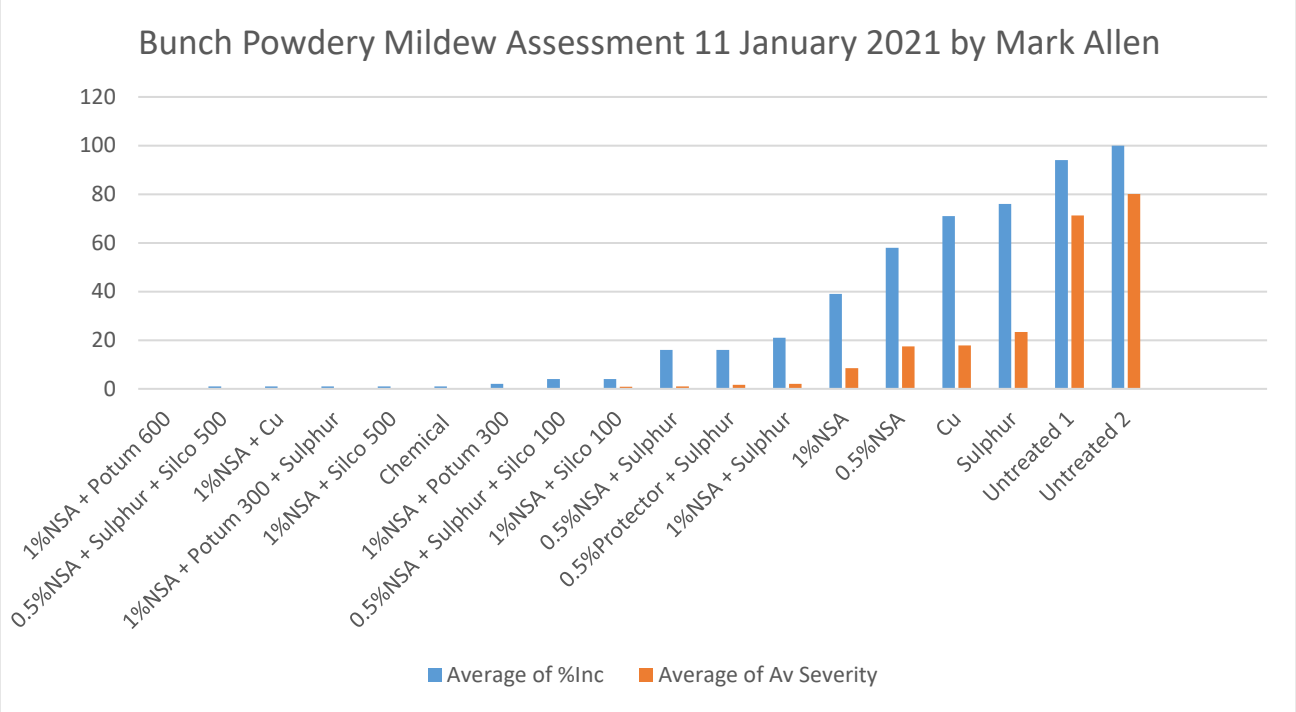


Figure 6 and Figure 7 shows the incidence and severity of bunch and leaf powdery mildew respectively as assessed on 22 January 2021. The statistical results for the 22 January 2021 assessment are tabulated in Table 5 to Table 8. The raw data for this assessment is provided in Appendix 2.

Figure 6: Mean Percentage Incidence and Severity of Powdery Mildew in Bunches, Chardonnay, Meadowbank Station. Independent Assessment date 22 January 2021

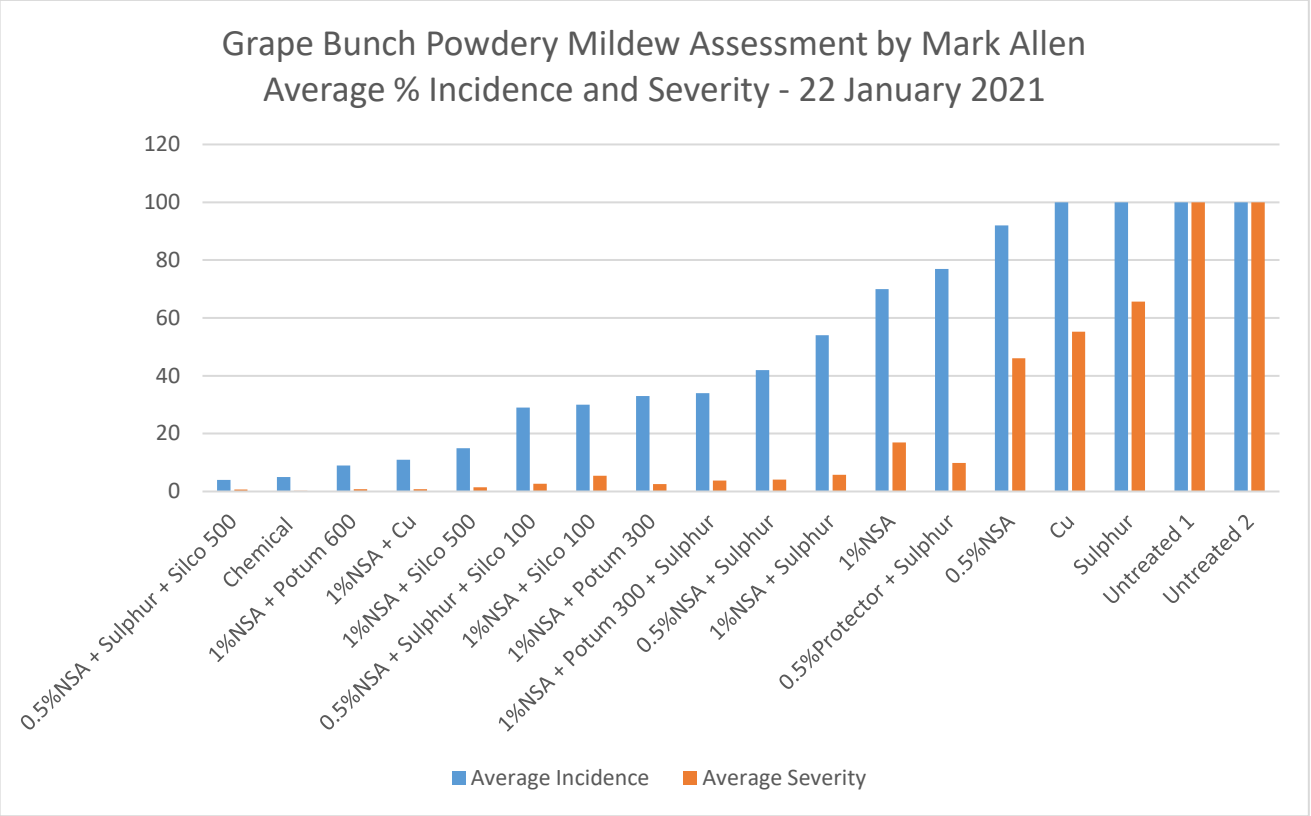


Figure 7: Mean Percentage Incidence and Severity of Powdery Mildew in Leaves, Chardonnay, Meadowbank Station. Independent Assessment date 22 January 2021

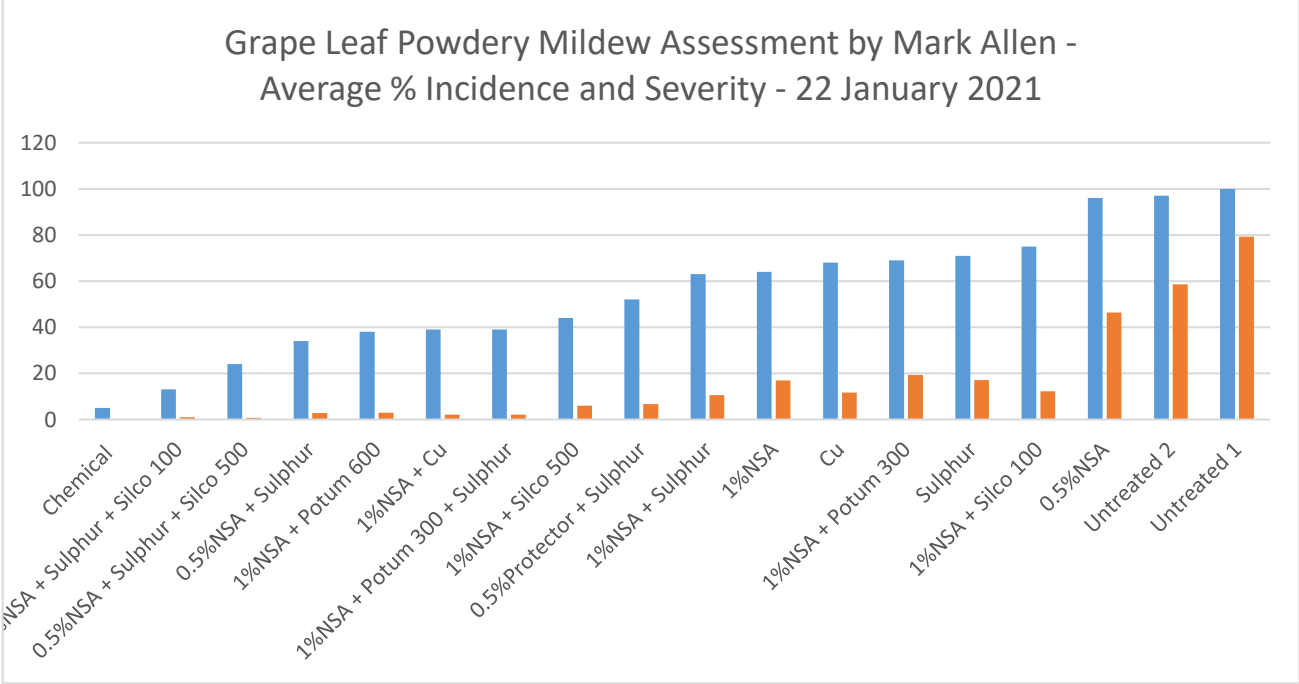


Table 5 : Mean % Incidence of powdery mildew in bunches. Date of assessment 22 January 2021

Bunch incidence percentage			
Treatment	**Product**	**Incidence count**	
17	0.5%NSA + Sulphur + Silco 500	4	a
3	Chemical	5	a
10	1%NSA + Potum 600	9	ab
8	1%NSA + Cu	11	abc
13	1%NSA + Silco 500	15	abcd
16	0.5%NSA + Sulphur + Silco 100	29	bcde
12	1%NSA + Silco 100	30	bcde
9	1%NSA + Potum 300	33	cdef
11	1%NSA + Potum 300 + Sulphur	34	def
15	0.5%NSA + Sulphur	42	ef
7	1%NSA + Sulphur	54	fg
6	1%NSA	70	gh
18	0.5%Protector + Sulphur	77	hi
14	0.5%NSA	92	ij
5	Cu	100	j
4	Sulphur	100	j
1	Untreated 1	100	j
2	Untreated 2	100	j
	F Prob	<0.001	
	CV%	28	

Duncan's Multiple Range Test at the 5% level was used to separate means. Values followed by different letters are statistically different. CV% = Coefficient variation percent.

Table 6: Average severity of powdery mildew in bunches. Date of assessment 22 January 2021

Bunch average severity			
Treatment	**Product**	**Severity**	
3	Chemical	0.25	a
17	0.5%NSA + Sulphur + Silco 500	0.65	ab
10	1%NSA + Potum 600	0.75	ab
8	1%NSA + Cu	0.8	ab
13	1%NSA + Silco 500	1.5	ab
9	1%NSA + Potum 300	2.55	ab
16	0.5%NSA + Sulphur + Silco 100	2.7	ab
11	1%NSA + Potum 300 + Sulphur	3.75	ab
15	0.5%NSA + Sulphur	4.15	ab
12	1%NSA + Silco 100	5.45	ab
7	1%NSA + Sulphur	5.75	ab
18	0.5%Protector + Sulphur	9.85	ab
6	1%NSA	17	b
14	0.5%NSA	46.05	c
5	Cu	55.2	cd
4	Sulphur	65.65	d
1	Untreated 1	100	e
2	Untreated 2	100	e
	F Prob	<0.001	
	CV%	42	

Duncan's Multiple Range Test at the 5% level was used to separate means. Values followed by different letters are statistically different. CV% = Coefficient variation percent.

Table 7: Mean Incidence Percentage of powdery mildew in Leaf. Date of assessment 22 January 2021

Leaf incidence percentage			
Treatment	**Product**	**Incidence count**	
3	Chemical	5	a
16	0.5%NSA + Sulphur + Silco 100	13	ab
17	0.5%NSA + Sulphur + Silco 500	24	bc
15	0.5%NSA + Sulphur	34	cd
10	1%NSA + Potum 600	38	cd
8	1%NSA + Cu	39	cd
11	1%NSA + Potum 300 + Sulphur	39	cd
13	1%NSA + Silco 500	44	d
18	0.5%Protector + Sulphur	52	de
7	1%NSA + Sulphur	63	ef
6	1%NSA	64	ef
5	Cu	68	ef
9	1%NSA + Potum 300	69	ef
5	Sulphur	71	f
12	1%NSA + Silco 100	75	f
14	0.5%NSA	96	g
2	Untreated 2	97	g
1	Untreated 1	100	g
	F Prob	<0.001	
	CV%	21	
Duncan's Multiple Range Test at the 5% level was used to separate means. Values followed by different letters are statistically different. CV% = Coefficient variation percent.			

Table 8: Average Severity of powdery mildew in Leaf. Date of assessment 22 January 2021

Leaf average severity			
Treatment	**Product**	**Severity**	
3	Chemical	0.15	a
17	0.5%NSA + Sulphur + Silco 500	0.72	a
16	0.5%NSA + Sulphur + Silco 100	0.99	a
8	1%NSA + Cu	2.07	ab
11	1%NSA + Potum 300 + Sulphur	2.07	ab
15	0.5%NSA + Sulphur	2.82	ab
10	1%NSA + Potum 600	2.94	ab
13	1%NSA + Silco 500	5.96	abc
18	0.5%Protector + Sulphur	6.66	abc
7	1%NSA + Sulphur	10.5	abc
5	Cu	11.62	abc
12	1%NSA + Silco 100	12.22	abc
6	1%NSA	16.95	bc
5	Sulphur	17.16	bc
9	1%NSA + Potum 300	19.27	c
14	0.5%NSA	46.43	d
2	Untreated 2	58.63	d
1	Untreated 1	79.3	e
	F Prob	<0.001	
	CV%	55	
Duncan's Multiple Range Test at the 5% level was used to separate means. Values followed by different letters are statistically different. CV% = Coefficient variation percent.			

6.0 Discussion

The Grape Powdery Mildew data obtained on the 11th and 22nd January 2021 was uplifted when the trial was under epidemic pressure, of the like not seen normally except in abandoned vineyards – all treatments were infected including a robust chemical regime.

The leaf data (treatment efficacy) follows roughly that produced from bunch data. However there are a number of reasons why the leaf data should not be relied upon when considering efficacy for the fungicidal label claims:

- Firstly, the method of severity assessment was based on a broad scoring system of 0 to 3, being no infection, 3 being epidemic with 2 scores between (refer section 4.4). It is less precise than the bunch data.
- The hand spray method achieves coverage of bunches, but with a hydraulic application it is more difficult to achieve the same coverage in leaves as they do not move or 'flip' (as they do with the use of an air assisted sprayer. Lack of complete coverage is common. The product relies on contact to be efficacious (it is not systemic as in the case for the synthetic chemistries used) so the lack of coverage adversely affects the results.
- There always was a lack of coverage in the upper area (growing tips) of the canopy to restrict overspray into adjacent plots, so coverage of the canopy for disease control was less than optimal.

While the leaf data (treatment efficacy) follows roughly that produced from bunch data, for the reasons provided above, the discussion of the results, particularly with respect to proposed fungicidal label claim, relies on the bunch data.

6.1. Powdery Mildew claim for 1%NSA alone

The treatment of 1%NSA alone performed by a large margin better than the untreated controls. There is an obvious and strong rate effect between untreated controls and NSA when used at 0.5% or 1% in the control of powdery mildew.

NSA at 1% performed statistically better than sulphur alone, Nordox alone and 0.5%NSA alone in terms of bunch incidence and severity and was similar in leaf incidence and severity. Both sulphur (Kumulus) and copper (Nordox) have powdery mildew claims. In this trial however, the sulphur rate was at the lower end of the recommended hand sprayed rate and the copper rate used was less than the recommended use rate.

The data suggests that while NSA alone at 1% is efficacious against powdery mildew, it does not provide sufficiently adequate commercial control.

6.2. Powdery Mildew claim for 1%NSA plus additives

All treatments containing 1% NSA with different combinations of additives (ignoring what additive or combination of additives) performed better than the untreated controls and shared a statistical grouping with the chemical standard in relation to the bunch severity.

6.2.1. Powdery Mildew claim for 1%NSA plus Sulphur

The combination of sulphur with 1%NSA significantly improved the bunch incidence of powdery mildew compared to sulphur and 1%NSA alone, reducing bunch incidence from 100% and 70% to 54% and bunch severity from 65% and 17% to 5.7%.

Photographs are shown in Figure 8.

This shows that the combination of sulphur and 1%NSA does improve the efficacy when compared to the products when used alone.

Figure 8: Photographs of 1%NSA and Sulphur alone and in combination

1%NSA	Sulphur	1%NSA + Sulphur
		

6.2.2. Powdery Mildew claim for 1%NSA plus HML Silco

The combination of HML Silco with 1%NSA at both the 100ml and 500ml rate performed significantly better than 1%NSA alone for bunch incidence, reducing the incidence from 70% to 30 % and 15% respectively. In terms of bunch severity, the two combinations were in group ab compared to b, reducing the severity from 17% to 5.45% for the low rate and 1.5% for the high rate.

Photographs are shown in Figure 9.

This shows that the adjuvant effect of HML Silco contributes to the efficacy of 1%NSA when used in combination.

Figure 9: Photographs of 1%NSA and HML Silco alone and in combination

1%NSA	1%NSA with Silco 100ml	1%NSA with Silco 500ml
		

6.2.3. Powdery Mildew claim for 1%NSA plus HML Potum

The combination of HML Potum at 300g and 600g with 1%NSA performed significantly better than 1%NSA alone for bunch incidence and severity, reducing the incidence from 70% to 33% and 9% respectively and reducing the severity from 17% to 2.5% and 0.75% respectively.

The addition of sulphur to the 1%NSA and Potum 300 combination did not improve the bunch results.

Photographs are shown in Figure 10.

This shows that the combination of HML Potum and 1%NSA significantly improves the efficacy when compared to 1%NSA alone.

Figure 10: Photographs of 1%NSA and HML Potum (potassium bicarbonate) alone and in combination

1%NSA	1%NSA + Potum 300	1%NSA + Potum 600
		

6.2.4. Powdery Mildew claim for 1%NSA plus Copper

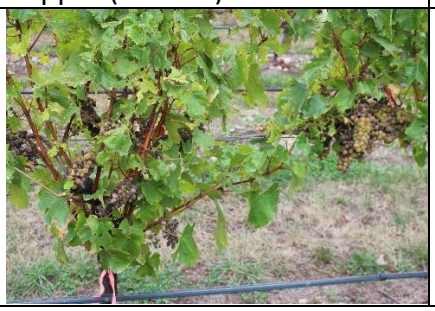
The combination of Nordox with 1%NSA performed significantly better than Nordox alone and 1%NSA alone for bunch incidence and severity, reducing the incidence from 100% and 70% respectively to 11% and the bunch severity from 55% and 17% respectively to 0.8%.

This combination shared statistical groups with the chemical standard.

Photographs are shown in Figure 11.

This shows that the combination of Copper and 1%NSA significantly improves the efficacy when compared to 1%NSA alone and Nordox alone.

Figure 11: Photographs of 1%NSA and Copper alone and in combination

1%NSA	Copper (Nordox)	1%NSA + Copper
		

6.3. Botrytis Claim

No Botrytis (or other end of season rots) occurred in this trial, due to the lack of end of season rain events.

Henry Manufacturing will be relying on the botrytis claim for Protector^{hml} (P7149). The label rate for Protector^{hml} is 2L (364g a.i./100L). Based on the equivalent rate of active ingredient, the proposed rate for a botrytis claim for NSA is 1.4L/100L.

6.4. Adjuvant claim of 0.5-1% NSA

The 0.5% NSA treatment is the proposed rate for the use of NSA as an adjuvant. It did not perform well for disease control at this rate when used alone and was not expected to.

The adjuvant effect is shown by significantly improving the performance of sulphur alone.

The addition of 0.5%NSA to sulphur reduced bunch incidence from 100% to 42%, bunch severity from 66% to 4%, leaf incidence from 71% to 34% and leaf severity from 17% to 2.8%. These reductions were statistically significant.

Photographs of this adjuvant effect are shown in Figure 12.

The 0.5%NSA and Sulphur combination is also is a slight improvement on Protector^{hml} at 0.5% and sulphur (Protector^{hml} being a similarly registered potassium-based soap product).

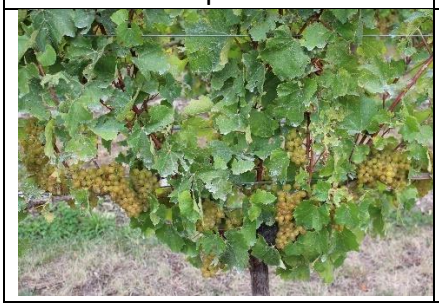
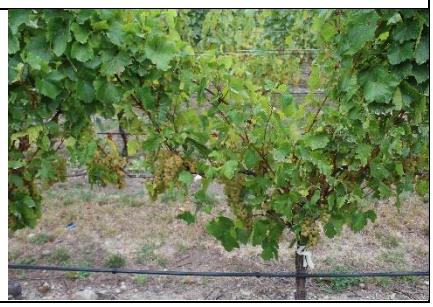
The 0.5%NSA and Sulphur combination was also further enhanced by the addition of a further adjuvant HML Silco at a low rate and a high rate. These two combinations were in the top three treatments for both bunch and leaf incidence and severity. The other treatment in the top three was the chemical standard. These treatments are shown in Figure 13.

As noted in Section 6.2, the use of 1% NSA with a range of different additives further demonstrates the adjuvant effect and an adjuvant rate of 1% is also proposed.

Figure 12: Photographs demonstrating adjuvant effect.

0.5%NSA	Sulphur alone	0.5%NSA and Sulphur
		

Figure 13: Photographs of top three treatments

0.5%NSA + Sulphur + Silco100	0.5%NSA + Sulphur +Silco 500	Chemical
		

6.5. Visible Spray Residues

A moderate visual spray residue was observed on the treatments containing the higher rate of HML Silco, less so on the treatments containing the lower rate of HML Silco. (see Figure 13). Light spray deposit was also seen on any treatment containing sulphur, including the chemical treatment, which while being slightly unusual, can be attributed to the lack of rainfall from mid trial until harvest.

6.6. Crop Tolerance

Thirteen applications of each treatment were applied during this trial. Photographs have been taken throughout the trial and on 12 March 2021 a week before harvest (see Figure 8 to Figure 13).

No adverse effects on the crop were observed on any treatment.

7.0 Plant Safety

Concentrated rates of NSA were applied in the previous season with a Hawkes Bay trial again on Chardonnay. An application of four times (4x) the field rate (4%) had no effect on flowering, nor caused any visual changes. An application of ten times (10x) the field rate (10%) caused russeting of berries and burning on the margins of immature leaves.

In this trial, the crop received thirteen applications of NSA at 1% alone and in combination with additives.

Some phytotoxicity was observed in this trial on the 21st November (mid flowering). Some cupping and slight burning on the margin of third leaf (from the growing tip) was observed on all treatments

which contained sulphur (except sulphur alone), including the chemical treatment (see Figure 14) No effects were seen on growing tips and flowering/fruit set as a result.

No phytotoxicity was observed on any of the other treatments at any time.

Figure 14: Signs of Phytotoxicity on 21st November (mid flowering)

1% NSA + sulphur	Chemical (includes sulphur)
	
1%NSA + Silco100 + sulphur	1%NSA + Silco500 + sulphur
	
1%NSA + Potum300 + sulphur	
	

8.0 Conclusions

Powdery Mildew Efficacy
The efficacy generated by NSA alone at 1.0%, under the disease pressure within the trial, was in the opinion of the author insufficient to provide commercial control for growers.

The efficacy generated by NSA with various additives is in the opinion of the author sufficient to merit a registration for control of the disease on wine grapes. It also demonstrates its adjuvant effect.

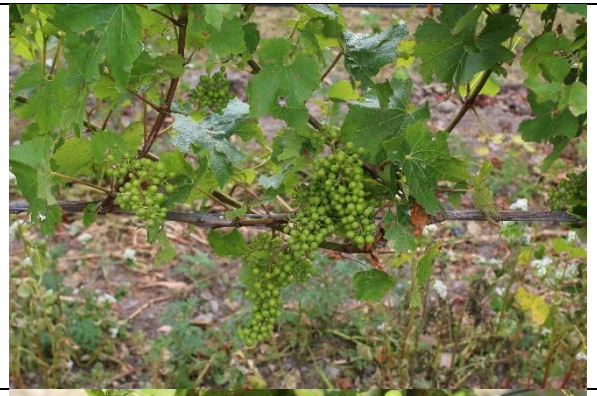
Plant safety
At the likely application rates of 1L or 1.4L per 100L of NSA and with repeated applications, the trial shows that there are no plant safety issues.

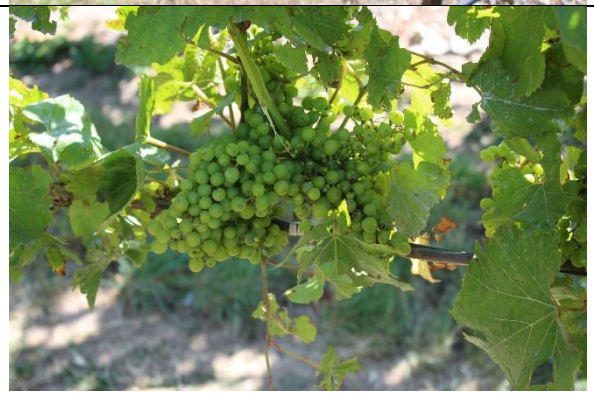
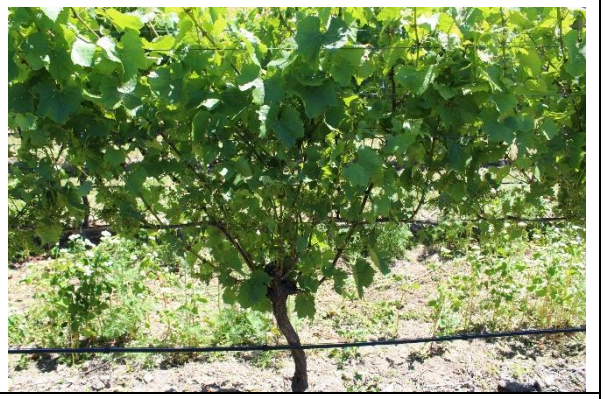
9.0 Acknowledgements

Chris Henry would like to acknowledge Will Grigg, the owner of the vineyard for allowing this trial to be undertaken, Mark Allen for data uplift, Mike Nelson for statistical analysis and Helen Henry for assistance in trial design, photography and reporting.

Appendix 1: Photographs of Bunches and Canopy at different growth stages

Appl. NO.	Date	Plant Growth Stage	Bunch Photographs	Canopy Photographs
1	29-30 October 2020	EL15		
2	7 November 2020	EL17 Inflorescences expanded		
3	14 November 2020	EL19 Only just 5% cap fall, some flowering beginning around posts		
4	21 November 2020	EL23 50% Cap fall, nearly all flowers open		
5	1 December 2020	EL25 80% Cap fall		

6	7/8/9 December 2020			
7	16 December 2020			
8	21 December 2020	EL31 Pre-bunch closure		
9	29 December 2020			

10	5 January 2021	EL33 Bunch closure on 50% bunches		
11	15 January 2021		 Post collard 	 Post collard 
12	26 January 2021			
13	3 February 2021	EL36 Mid veraison		

Appendix 2: Raw Data for assessment undertaken on 22 January 2021

Meadowbank - Powery Mildew Assessment																			**Date**		**####**									
25 bunches were assessed for each replicate/treatment giving a total sample size of 100 per treatment																														
25 leaves on the shady sided were assessed for each replicate/treatment giving a total sample size of 100 per treatment																														
an empy cell means 0 disease present																														
Rep	Treatment	Assessment	Inc	Av Severity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Incidence Count
1	0.5%NSA	Bunch	100	59.8	40	100	90	80	50	40	50	80	100	50	50	80	80	100	50	80	20	80	40	20	50	5	40	20	100	25
1	0.5%NSA	Leaf side 1	100	78.56	100	100	100	100	100	100	33	100	33	33	100	100	33	100	100	100	100	33	33	33	33	100	100	100	100	25
2	0.5%NSA	Bunch	100	73.2	70	100	90	60	30	50	50	90	100	100	100	90	70	50	100	90	80	70	80	40	40	100	50	40	90	25
2	0.5%NSA	Leaf side 1	100	61.84	100	100	100	100	100	33	100	100	33	33	3	3	3	33	33	100	100	100	100	100	3	33	33	3	100	25
3	0.5%NSA	Bunch	68	18	10	10	5	5	10	10	5	70	20	10	5	10	20	50	80	50	80									17
3	0.5%NSA	Leaf side 1	100	35.6	33	100	33	100	3	33	100	100	33	33	3	33	3	33	3	3	33	33	3	3	33	3	100	33	3	25
4	0.5%NSA	Bunch	100	33.2	5	10	20	10	20	40	20	20	10	20	10	5	20	20	50	80	10	80	70	90	80	40	40	20	40	25
4	0.5%NSA	Leaf side 1	84	9.72	3	3	33	33	3	3	3	3	33	3	33	3	3	3	3	3	33	33	3	3	3					21
1	0.5%NSA + Sulphur	Bunch	28	2	5	10	10	10	5	5	5																			7
1	0.5%NSA + Sulphur	Leaf side 1	20	0.6	3	3	3	3	3																					5
2	0.5%NSA + Sulphur	Bunch	44	4.8	5	10	20	10	5	20	5	20	10	5	10															11
2	0.5%NSA + Sulphur	Leaf side 1	48	5.04	3	3	3	3	33	33	3	3	3	3	33	3														12
3	0.5%NSA + Sulphur	Bunch	32	3	10	10	10	10	5	20	5	5																		8
3	0.5%NSA + Sulphur	Leaf side 1	40	4.8	33	3	3	3	3	33	3	3	3	33																10
4	0.5%NSA + Sulphur	Bunch	64	6.8	10	5	5	10	10	5	10	5	10	5	20	20	20	10	5	20										16
4	0.5%NSA + Sulphur	Leaf side 1	28	0.84	3	3	3	3	3	3	3																			7
1	0.5%NSA + Sulphur + Silco 100	Bunch	40	3.8	10	10	10	5	5	20	10	10	10	5																10
1	0.5%NSA + Sulphur + Silco 100	Leaf side 1	0	0																										0
2	0.5%NSA + Sulphur + Silco 100	Bunch	16	1	5	5	10	5																						4
2	0.5%NSA + Sulphur + Silco 100	Leaf side 1	28	3.24	3	33	3	3	3	33	3																			7
3	0.5%NSA + Sulphur + Silco 100	Bunch	32	4	10	40	10	10	5	5	10	10																		8
3	0.5%NSA + Sulphur + Silco 100	Leaf side 1	24	0.72	3	3	3	3	3	3																				6
4	0.5%NSA + Sulphur + Silco 100	Bunch	28	2	5	5	10	5	5	10	10																			7
4	0.5%NSA + Sulphur + Silco 100	Leaf side 1	0	0																										0

1	0.5%NSA + Sulphur + Silco 500	Bunch	12	1	5	10	10																							3
1	0.5%NSA + Sulphur + Silco 500	Leaf side 1	16	0.48	3	3	3	3																						4
2	0.5%NSA + Sulphur + Silco 500	Bunch	0	0																										0
2	0.5%NSA + Sulphur + Silco 500	Leaf side 1	16	0.48	3	3	3	3																						4
3	0.5%NSA + Sulphur + Silco 500	Bunch	4	1.6	40																									1
3	0.5%NSA + Sulphur + Silco 500	Leaf side 1	40	1.2	3	3	3	3	3	3	3	3	3	3																10
4	0.5%NSA + Sulphur + Silco 500	Bunch	0	0																										0
4	0.5%NSA + Sulphur + Silco 500	Leaf side 1	24	0.72	3	3	3	3	3	3																				6
1	0.5%Protector + Sulphur	Bunch	56	7	10	5	10	5	10	10	5	5	5	20	20	40	20	10												14
1	0.5%Protector + Sulphur	Leaf side 1	44	4.92	3	33	3	3	3	3	3	3	33	3	33															11
2	0.5%Protector + Sulphur	Bunch	84	13.8	5	20	20	10	5	30	10	10	5	10	10	50	10	10	10	20	20	20	40	10	20					21
2	0.5%Protector + Sulphur	Leaf side 1	40	4.8	3	33	3	3	3	33	3	3	33	3																10
3	0.5%Protector + Sulphur	Bunch	84	9.6	5	10	20	30	30	5	10	10	10	5	5	5	10	20	10	10	10	10	10	5	10					21
3	0.5%Protector + Sulphur	Leaf side 1	64	7.92	3	3	3	3	3	3	33	3	33	33	33	3	3	3	33	3										16
4	0.5%Protector + Sulphur	Bunch	84	9	5	20	10	20	10	10	20	10	5	20	5	5	5	5	5	5	20	5	20	10	10					21
4	0.5%Protector + Sulphur	Leaf side 1	60	9	33	33	33	3	3	3	3	3	33	33	3	33	3	3	3											15
1	1%NSA	Bunch	48	5.4	5	5	50	5	5	10	5	10	5	5	10	20														12
1	1%NSA	Leaf side 1	40	19.12	3	33	3	3	100	33	100	100	100	3																10
2	1%NSA	Bunch	88	35.4	5	10	20	50	50	100	10	20	10	10	20	10	40	50	50	50	40	50	50	50	90	100				22
2	1%NSA	Leaf side 1	64	16.6	33	3	3	33	33	33	33	33	3	33	33	3	3	100	3	33										16
3	1%NSA	Bunch	80	11.4	20	10	20	10	5	20	5	10	10	10	20	5	30	5	40	10	10	5	20	20						20
3	1%NSA	Leaf side 1	80	13.48	33	3	3	3	3	33	33	3	3	3	3	3	3	3	3	3	33	100	33	33						20
4	1%NSA	Bunch	64	15.8	10	20	10	5	10	5	5	10	50	10	50	20	50	10	50	80										16
4	1%NSA	Leaf side 1	72	18.6	3	33	33	100	3	3	3	3	3	3	33	3	100	100	3	3	3	33								18
1	1%NSA + Cu	Bunch	4	0.8	20																									1
1	1%NSA + Cu	Leaf side 1	24	0.72	3	3	3	3	3	3																				6
2	1%NSA + Cu	Bunch	4	0.2	5																									1
2	1%NSA + Cu	Leaf side 1	44	2.52	3	3	3	3	33	3	3	3	3	3	3															11
3	1%NSA + Cu	Bunch	16	0.8	5	5	5	5																						4
3	1%NSA + Cu	Leaf side 1	32	2.16	3	3	3	3	3	3	33	3																		8
4	1%NSA + Cu	Bunch	20	1.4	5	5	5	10	10																					5
4	1%NSA + Cu	Leaf side 1	56	2.88	3	3	3	3	3	3	3	3	3	3	33	3	3	3												14

1	1%NSA + Potum 300	Bunch	20	1.4	10	5	5	5	10																						5
1	1%NSA + Potum 300	Leaf side 1	80	31.12	33	100	100	3	3	33	33	33	33	3	33	33	100	3	100	3	33	33	33	33							20
2	1%NSA + Potum 300	Bunch	44	4.4	10	20	5	10	5	20	10	10	5	10	5																11
2	1%NSA + Potum 300	Leaf side 1	68	26.24	3	3	3	3	33	33	33	33	3	3	3	3	100	100	100	100	100										17
3	1%NSA + Potum 300	Bunch	48	3.2	20	5	5	5	5	10	5	5	5	5	5	5															12
3	1%NSA + Potum 300	Leaf side 1	64	7.92	33	3	3	3	3	3	33	3	3	3	33	3	3	33	3	33											16
4	1%NSA + Potum 300	Bunch	20	1.2	5	5	10	5	5																						5
4	1%NSA + Potum 300	Leaf side 1	64	11.8	3	3	3	3	33	3	3	33	100	3	3	33	33	3	33	3											16
1	1%NSA + Potum 300 + Sulphur	Bunch	4	0.2	5																										1
1	1%NSA + Potum 300 + Sulphur	Leaf side 1	36	2.28	3	3	33	3	3	3	3	3	3																		9
2	1%NSA + Potum 300 + Sulphur	Bunch	44	5.6	10	10	10	20	20	10	20	5	20	5	10																11
2	1%NSA + Potum 300 + Sulphur	Leaf side 1	44	3.72	3	3	3	3	3	3	3	33	33	3	3																11
3	1%NSA + Potum 300 + Sulphur	Bunch	52	5.6	10	5	5	10	20	40	5	5	10	10	10	5	5														13
3	1%NSA + Potum 300 + Sulphur	Leaf side 1	52	1.56	3	3	3	3	3	3	3	3	3	3	3	3	3														13
4	1%NSA + Potum 300 + Sulphur	Bunch	36	3.6	5	5	10	20	5	10	5	20	10																		9
4	1%NSA + Potum 300 + Sulphur	Leaf side 1	24	0.72	3	3	3	3	3	3																					6
1	1%NSA + Potum 600	Bunch	0	0																											0
1	1%NSA + Potum 600	Leaf side 1	28	2.04	3	3	33	3	3	3	3																				7
2	1%NSA + Potum 600	Bunch	24	2	5	5	10	10	10	10																					6
2	1%NSA + Potum 600	Leaf side 1	48	6.24	33	3	3	3	3	3	3	33	33	3	33	3															12
3	1%NSA + Potum 600	Bunch	4	0.4	10																										1
3	1%NSA + Potum 600	Leaf side 1	32	0.96	3	3	3	3	3	3	3	3																			8
4	1%NSA + Potum 600	Bunch	8	0.6	10	5																									2
4	1%NSA + Potum 600	Leaf side 1	44	2.52	3	3	3	3	3	3	3	3	3	33	3																11
1	1%NSA + Silco 100	Bunch	48	12.4	10	20	30	50	50	30	5	50	10	10	40	5															12
1	1%NSA + Silco 100	Leaf side 1	72	4.56	3	3	33	3	3	3	3	3	3	3	3	33	3	3	3	3	3	3									18
2	1%NSA + Silco 100	Bunch	28	2	5	10	10	5	10	5	5																				7
2	1%NSA + Silco 100	Leaf side 1	80	21.88	33	33	33	33	3	33	33	100	33	3	33	33	3	3	33	3	33	3	33	33							20
3	1%NSA + Silco 100	Bunch	44	7.4	20	10	5	5	5	10	10	20	70	10	20																11
3	1%NSA + Silco 100	Leaf side 1	96	19.68	3	3	3	3	33	33	33	3	33	3	3	33	3	33	33	3	33	3	33	33	33	33	33	33			24
4	1%NSA + Silco 100	Bunch	0	0																											0
4	1%NSA + Silco 100	Leaf side 1	52	2.76	33	3	3	3	3	3	3	3	3	3	3	3	3														13

1	1%NSA + Silco 500	Bunch	48	3.8	10	5	5	5	5	20	5	5	5	10	10	10														12
1	1%NSA + Silco 500	Leaf side 1	52	5.16	33	33	3	3	3	3	3	3	33	3	3	3	3													13
2	1%NSA + Silco 500	Bunch	0	0																										0
2	1%NSA + Silco 500	Leaf side 1	48	5.04	3	3	3	3	33	3	33	3	3	33	3	3														12
3	1%NSA + Silco 500	Bunch	12	2.2	40	10	5																							3
3	1%NSA + Silco 500	Leaf side 1	64	13.28	33	33	100	100	33	3	3	3	3	3	3	3	3	3	3	3										16
4	1%NSA + Silco 500	Bunch	0	0																										0
4	1%NSA + Silco 500	Leaf side 1	12	0.36	3	3	3																							3
1	1%NSA + Sulphur	Bunch	56	4.2	5	10	5	10	5	5	10	5	10	10	5	5	5	15												14
1	1%NSA + Sulphur	Leaf side 1	80	15.88	33	33	3	33	3	3	3	33	3	33	3	3	33	3	33	33	3	3	3	100						20
2	1%NSA + Sulphur	Bunch	80	11.4	5	5	10	20	10	10	20	5	40	20	20	20	5	5	40	5	5	10	10	20						20
2	1%NSA + Sulphur	Leaf side 1	60	17.96	33	100	33	3	3	33	3	3	3	33	33	33	3	100	33											15
3	1%NSA + Sulphur	Bunch	24	1.6	5	5	10	10	5	5																				6
3	1%NSA + Sulphur	Leaf side 1	76	7.08	3	3	33	33	3	3	3	3	3	3	33	3	3	3	3	3	33	3	3							19
4	1%NSA + Sulphur	Bunch	56	5.8	10	5	5	10	5	10	10	10	20	10	20	10	10	10												14
4	1%NSA + Sulphur	Leaf side 1	36	1.08	3	3	3	3	3	3	3	3	3																	9
1	Chemical	Bunch	8	0.4	5	5																								2
1	Chemical	Leaf side 1	4	0.12	3																									1
2	Chemical	Bunch	4	0.2	5																									1
2	Chemical	Leaf side 1	8	0.24	3	3																								2
3	Chemical	Bunch	0	0																										0
3	Chemical	Leaf side 1	8	0.24	3	3																								2
4	Chemical	Bunch	8	0.4	5	5																								2
4	Chemical	Leaf side 1	0	0																										0
1	Cu	Bunch	100	71.2	10	20	50	90	60	10	10	20	100	100	100	80	90	50	100	80	50	100	100	100	80	90	100	100	90	25
1	Cu	Leaf side 1	64	6.72	3	3	3	3	33	3	3	33	33	3	3	3	3	33	3	3										16
2	Cu	Bunch	100	80	100	100	80	80	70	90	100	90	70	20	80	80	80	90	100	70	50	90	100	90	50	90	100	80	50	25
2	Cu	Leaf side 1	60	18.24	3	3	100	33	3	3	3	100	33	100	33	3	3	33	3											15
3	Cu	Bunch	100	35.6	100	100	80	80	50	50	10	5	20	20	5	10	20	20	50	20	80	10	20	10	40	20	50	10	10	25
3	Cu	Leaf side 1	76	10.68	33	33	3	33	3	3	3	3	3	33	3	3	33	33	33	3	3	3	3							19
4	Cu	Bunch	100	34	40	20	20	20	20	50	30	90	10	5	5	10	50	50	20	10	50	20	20	50	50	30	80	50	50	25
4	Cu	Leaf side 1	72	10.84	3	3	3	3	3	3	3	33	33	3	3	33	3	3	33	3	3	100								18

1	Sulphur	Bunch	100	56.4	50	80	80	50	80	70	20	90	90	50	90	50	50	70	70	50	30	20	50	50	70	50	50	30	20	25
1	Sulphur	Leaf side 1	56	5.28	3	33	3	3	3	3	3	33	3	3	3	33	3	3												14
2	Sulphur	Bunch	100	81.6	50	60	80	70	50	40	100	90	100	100	100	90	80	80	80	50	70	90	100	100	90	90	90	90	100	25
2	Sulphur	Leaf side 1	72	26.08	33	3	100	33	3	3	33	100	100	33	3	3	3	33	100	3	33	33								18
3	Sulphur	Bunch	100	85.6	90	100	90	100	90	90	80	50	100	100	80	80	70	100	100	100	100	100	70	80	100	100	70	50	50	25
3	Sulphur	Leaf side 1	96	31.88	3	100	3	100	3	33	100	33	3	3	3	100	33	33	100	3	3	3	3	33	3	33	33	33		24
4	Sulphur	Bunch	100	39	10	10	30	50	50	40	30	50	30	20	80	80	80	80	50	50	20	20	5	10	10	50	80	20	20	25
4	Sulphur	Leaf side 1	60	5.4	33	3	3	3	3	3	3	33	3	3	3	3	33	3	3											15
1	Untreated 1	Bunch	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	25
1	Untreated 1	Leaf side 1	100	74.68	100	33	33	33	3	100	100	33	100	100	100	100	100	33	33	100	33	100	100	33	100	100	100	100	100	25
2	Untreated 1	Bunch	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	25
2	Untreated 1	Leaf side 1	100	94.64	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	33	100	33	25
3	Untreated 1	Bunch	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	25
3	Untreated 1	Leaf side 1	100	73.2	100	100	100	100	100	100	33	33	33	100	33	100	100	100	100	100	33	100	100	100	33	33	33	33	33	25
4	Untreated 1	Bunch	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	25
4	Untreated 1	Leaf side 1	100	74.68	33	100	33	3	33	100	100	100	100	100	100	33	100	33	100	100	100	100	33	100	100	100	33	100	33	25
1	Untreated 2	Bunch	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	25
1	Untreated 2	Leaf side 1	100	74.96	100	100	100	100	100	100	33	100	100	100	100	100	100	100	33	100	33	3	3	3	33	100	100	33	100	25
2	Untreated 2	Bunch	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	25
2	Untreated 2	Leaf side 1	100	61.28	100	33	33	33	100	100	33	100	33	33	33	33	33	100	33	100	33	100	3	100	100	33	33	100	100	25
3	Untreated 2	Bunch	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	25
3	Untreated 2	Leaf side 1	100	53.8	100	100	100	33	33	33	3	100	33	100	33	100	33	33	3	33	100	100	33	3	3	3	100	100	33	25
4	Untreated 2	Bunch	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	25
4	Untreated 2	Leaf side 1	88	44.48	33	3	100	100	33	33	3	3	3	33	100	100	33	100	33	100	33	3	33	33	100	100				22