Protector^{hml} and Potassium Bicarbonate Trial

Sileni's Parkhill Estate
Parkhill Rd
Te Awanga
Hawke's Bay
New Zealand

2010 - 11 season

Written by Chris Henry

All trial assessments and statistical analysis (except powdery mildew) undertaken by independent professional third parties

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Executive Summary

The outcome of this full season study clearly demonstrates that:

- a high level of efficacy on grape diseases (botrytis, powdery mildew and sour rots) can be achieved with moderate rates of potassium bicarbonate combined with a surfactant rate of Protector$^{hml®.}$ The efficacy obtained was in a high disease pressure season, where many grapes in Hawkes Bay were picked early or abandoned because of botrytis, powdery mildew and/or downy mildew disease pressure.
- Protector$^{hml®}$ is compatible with potassium bicarbonate and provides it with a level of enhancement.
- the combination does not interfere with fermentation, nor does it produce off flavours or faults in juices or wine.

In addition there is an as yet unexplained phenomenon in that with an increasing rate of potassium bicarbonate there is:

- an increased level of brix, with a slight decrease in titratable acidity,
- a change in the bunch construction (less chickens, a more open bunch with less compression and more space between berries),
- a counter intuitive, decreasing level of botrytis in the face of increasing level of brix.

ACVM pesticide registration is underway for the high analysis food grade potassium bicarbonate used in the trial, as is BioGro certification. The product's name will be ^{Eco}**Enhancer**®.

Preamble / Background – The reasons for the trial

Protector$^{hml®}$ is a pure liquid potassium soap registered in New Zealand as a fungicide for the control of botrytis in grapes. It is also commonly used as an adjuvant (a quarter of the fungicidal rate) combining with sulphur and/or copper for the control of powdery mildew in grapes, achieving levels of efficacy equivalent to standard chemical programs, while at the same time allowing reduced pesticide and water rates. It is virtually non phytotoxic.

Several potassium bicarbonate products are registered in New Zealand. One is a product called EcoCarb®, which is registered for the control of powdery mildew in grapes. EcoCarb® is Armicarb® relabelled, which is a well known US potassium bicarbonate product. It has an extensive list of crop and disease claims, including botrytis, powdery mildew and downy mildew in grapes. It is a pre-formulated dry mix of potassium bicarbonate with an unknown adjuvant. Potassium bicarbonate products can be highly phytotoxic.

It is commonly accepted that potassium bicarbonate requires an adjuvant to produce reasonable efficacy against plant diseases. Preliminary formulation and compatibility testing confirmed desk top research that no problem would be experienced by tank mixing potassium bicarbonate and Protector$^{hml®}$ together.

Previously there have been many scientific trials using sodium bicarbonate showing variable efficacy predominately against powdery mildew diseases – generally mixed with mineral oil. More recently in Europe there have been trials of potassium bicarbonate combined with coconut soap which showed efficacy against black spot in apple (where it is being considered as a copper replacement).

Potassium bicarbonate is an exempt material world wide in respect of residues. Protector$^{hml®}$ is also exempt world wide in respect of residues (with the exception of Ontario and Canada). Both are acceptable for use within certified organic food production systems.

On the face of it, it would be a useful trial to combine the two products and hope for some synergistic effect between the two of them.

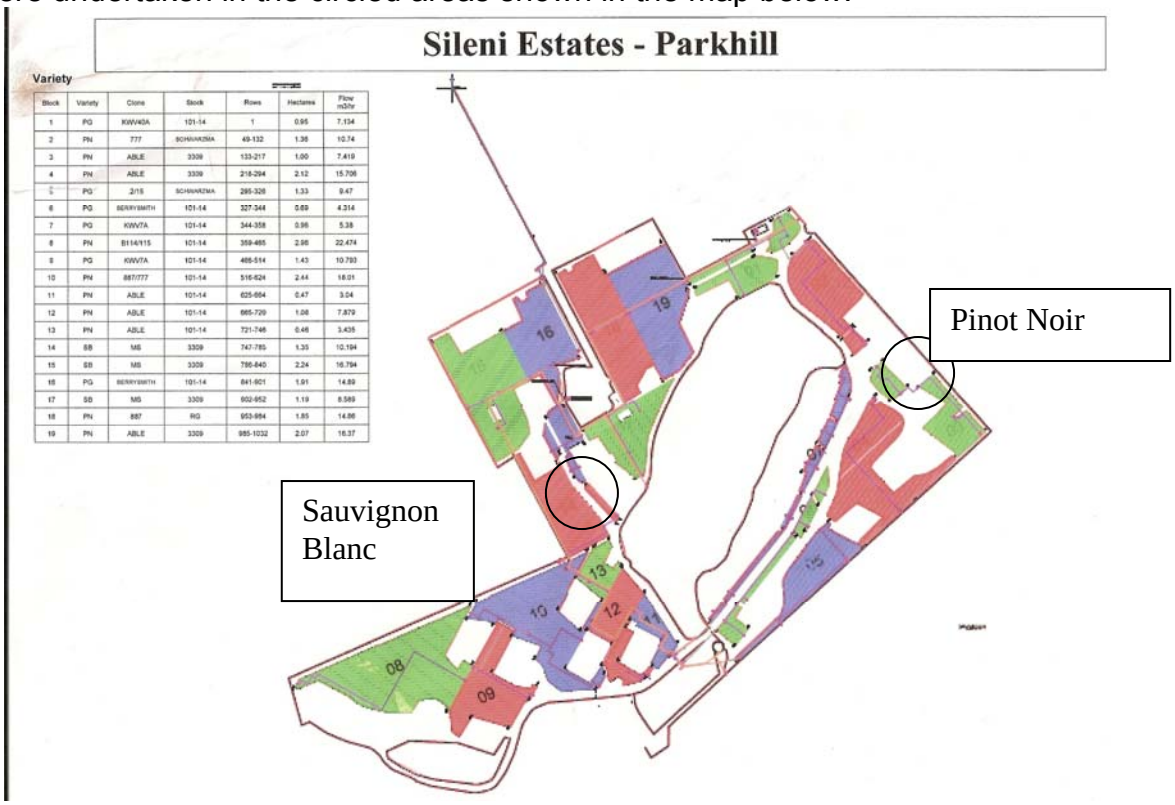
Objective of the trial

To fully evaluate the effects of various rates of potassium bicarbonate using Protector$^{hml®}$ as an adjuvant, against the diseases of botrytis, powdery mildew, downy mildew and sour rots in wine grapes, including any effects on wine making and wine quality.

Trial Site, Varieties and Disease History

The trial site is located at Sileni's Parkhill Estate on Parkhill Road behind the small coastal community of Te Awanga in Hawke's Bay.

Parkhill Estate is on gently sloping north facing land approximately 500m from the sea. The trials were undertaken in the circled areas shown in the map below.



The Sauvignon Blanc vines were 2&3 cane-pruned, VSP trellised and planted in an east west orientation. Adjacent to this vineyard, was an east west oriented block which was sprayed with a conventional chemical spray programme.

The Pinot Noir vineyard was 2 cane-pruned, VSP trellised and planted in a north south orientation. The adjacent rows were treated with the conventional spray programme.

All plants are approximately 5 years old, irrigated and fertigated and well tended.

Both varieties and blocks have a history of significant botrytis infection, including the preceding season.

The vineyard is unusual in that the property contains many small vineyard blocks, of various orientations, surrounding residential housing. Inevitably at times there is tension

between grape growing activities and residents – one of those tensions has been the use of chemicals for the control of grape diseases.

Photograph 1: Sauvignon Blanc trial site

Photograph 2: Pinot Noir trial site

Trial Layout

Pinot Noir

There are four replicates in the Pinot Noir trial site. Each plot contains four plants. The replicates snake from the top inland corner going towards the sea as follows: 1,2,3,4,5,6,7/4,2,6,7,3,1,5/3,7,6,2,4,5,1/5,3,7,1,4,6,2

Sauvignon Blanc

There are six replicates in the Sauvignon Blanc trial site. Each plot is a complete bay of 5 plants. The replicates start from the road corner at the bottom of the site as follows: 1,2,3,4,5,6,7/4,2,6,7,3,1,5/3,7,6,2,4,5,1/5,3,7,1,4,6,2/7,4,1,5,3,2,6/4,7,5,6,2,3,1

Three bays on the seaward side of the trial site were excess to trial design. No data was taken from them and diseases were controlled with unused spray mixes.

Treatments

There are eight treatments in this trial as shown in the table below.
Each treatment below states the total amount of product per 100 L of spray mix.

Table 1: Trial Treatments

Treatment No.	Treatment	Colour code
1	Potassium bicarbonate at 0.125 kg per 100 litres	White
2	Protector 0.5% + Potassium bicarbonate at 0.062 kg per 100 litres then 0.65kg per 100 litres + Protector from 9 December onwards	Single Pink
3	Protector 0.5% + Potassium bicarbonate at 0.125 kg per 100 litres	White/Blue
4	Protector 0.5% + Potassium bicarbonate at 0.250 kg per 100 litres	Double Pink
5	Protector 0.5% + Potassium bicarbonate at 0.400 kg per 100 litres	Red
6	Protector 0.5% + Potassium bicarbonate at 0.125 kg per 100 litres + Sulphur at 0.1kg per 100 litres	White/Blue/Yellow
7	Untreated	Green
8	Growers treatments	

Application Method

All treatments were applied at high volume, to the entire canopy, (including the fruitzone), to the point of run off in one pass by electric pump assisted hand gun. Spray applications were undertaken by Chris Henry or people under his supervision. No attempt is made to convert this to litres/ha.

Photograph 3: Hand-gun spray application of treatments

Dates and Intervals

The aim of the trial was a 14 day calendar spraying program. The dates of application are shown in the table below. The grower applied standard treatments leading up to the commencement of the trial.

Table 2: Spray Application Dates

Application Number	Spray date	Interval (Days)
1	2-November 2010	
2	13-November 2010	11
3	23-November 2010 **5% flowering 30 November 2010** (Grower's diary) **80% flowering 7 December 2010** (Grower's diary)	10
4	9-December 2010	17
5	28-December 2010 **Bunch Closure 29 December 2010** (Growers diary)	19
Assessment	13 December 2010 - Powdery Mildew Assessment - Chris Henry	
6	17-January 2011	21
7	25-January 2011 **Veraison 31 January 2010** (Grower's diary)	8
8	9-February 2011	14
9	19-February 2011	10
10	3-March2011	12
11	15-March 2011	12
Assessment	25 March 2011 - Botrytis Sour Rot Assessment - Peter Wood, Plant and Food Research	

Assessments

The following assessments were undertaken as part of this trial:

- Powdery Mildew
- Botrytis and Sour Rot
- Brix levels
- Berry weights
- Bunch weights
- Yields
- Juice tasting
- Potassium levels in juice
- Micro-vinifications

Photograph 4 Harvesting Green (Untreated) and Single Pink

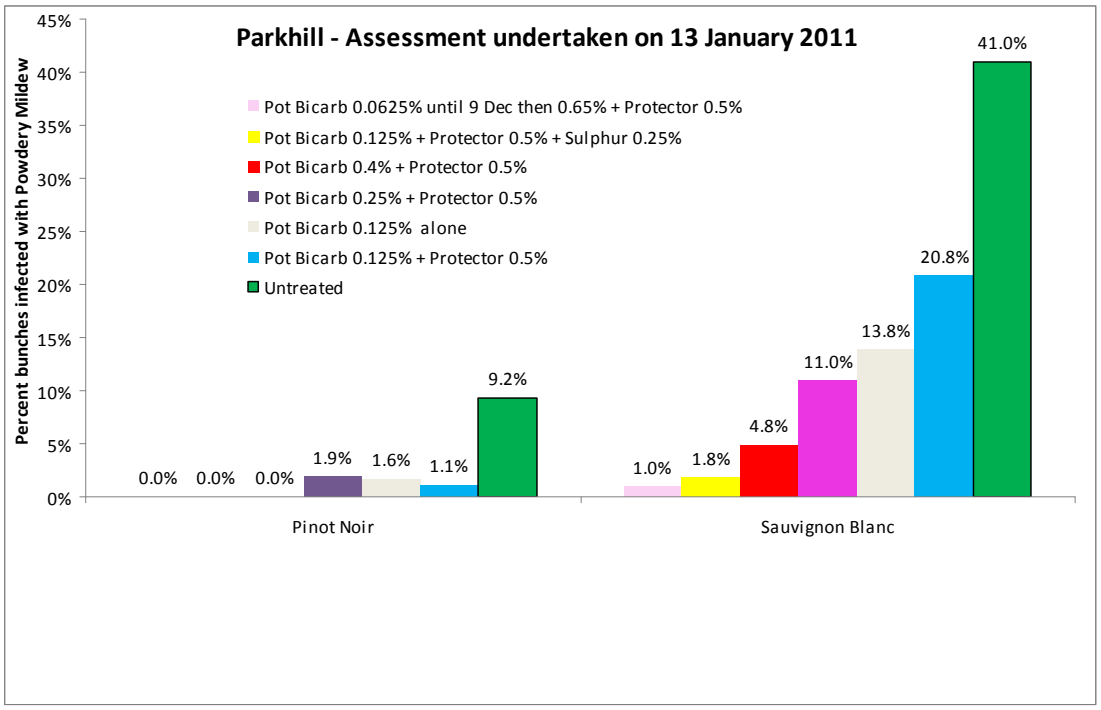
Photograph 5: Harvesting the trial treatments

Results

Table 3: Powdery Mildew Results showing the incidence of infected bunches

Treatment	*Assessment undertaken on 13 January 2011*	Pinot Noir	Sauvignon Blanc
White	**Pot Bicarb 0.125% alone**	**1.6%**	**13.8%**
Pink	**Pot Bicarb 0.0625%, after 9 Dec 0.65% + Protector 0.5% (both)**	**0.0%**	**1.0%**
White/Blue	**Pot Bicarb 0.125% + Protector 0.5%**	**1.1%**	**20.8%**
Pink/pink	**Pot Bicarb 0.25% + Protector 0.5%**	**1.9%**	**11.0%**
Red	**Pot Bicarb 0.4% + Protector 0.5%**	**0.0%**	**4.8%**
White/Blue/Yellow	**Pot Bicarb 0.125% + Protector 0.5% + Sulphur 0.25%**	**0.0%**	**1.8%**
Green	**Untreated**	**9.2%**	**41.0%**

Graph 1: Powdery Mildew Results showing the incidence of infected bunches



Comments on Powdery Mildew Results

The powdery mildew assessment was undertaken on the basis of incidence only, not severity. All Pinot Noir bunches were assessed and in the Sauvignon Blanc, assessment was made on 100 bunches per plot (600 per treatment). See Appendix 1.

Comment should also be made on the random layout within the trials – which for a disease such as powdery mildew, which is wind blown, is important. When there are infected untreated or low efficacy plots in amongst others, a situation can exist where there is heightened disease pressure from those plots – which might not be apparent if that marginal treatment was used over a whole block and not subject to heightened disease pressure.

Of the two varieties, Sauvignon Blanc was more prone to powdery mildew infection, probably not assisted by the blocks orientation which was East West, across the path of the prevailing wind. More can be deduced from the Sauvignon Blanc data than the Pinot Noir, yet both follow a similar pattern. Statistical analysis has not been undertaken.

Broadly speaking only three treatments were effective:-

- Single Pink (0.062kg $KHCO_3$ until 9 December then 0.65kg $KHCO_3$, both with Protector at 0.5%).
- White/Blue/Yellow (0.125kg $KHCO_3$ + Protector 0.5% + Sulphur 0.25%).
- Red (0.4kg $KHCO_3$ + Protector 0.5%).

White/Blue/Yellow was more effective because of the addition of the sulphur, The other treatments containing the same rate of potassium bicarbonate with and without Protector were ineffective – the result was expected.

Between Red and Single Pink there obviously was a rate effect, with Red providing almost total control. This outcome aligns with the rates recommended by other proprietary potassium bicarbonates which recommend a rate of between 0.3kg $KHCO_3$ and 0.6kg $KHCO_3$.

These treatments may provide an alternative to DMI's and other chemicals and/or Protector/Sulphur during times of heightened powdery mildew pressure or where sulphurs cannot be applied because of high ambient temperatures.

Botrytis results

Graph 2: Summary of incidence and severity of botrytis from the various treatments.

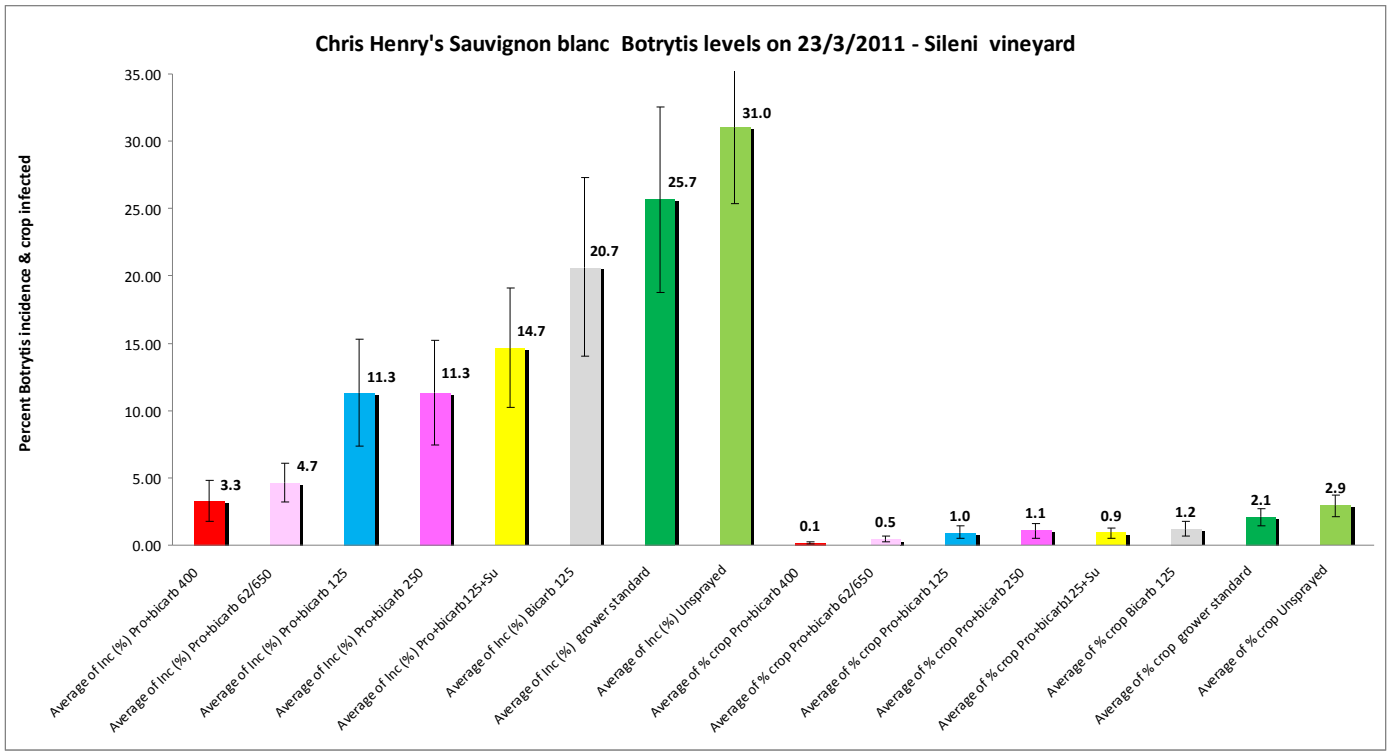
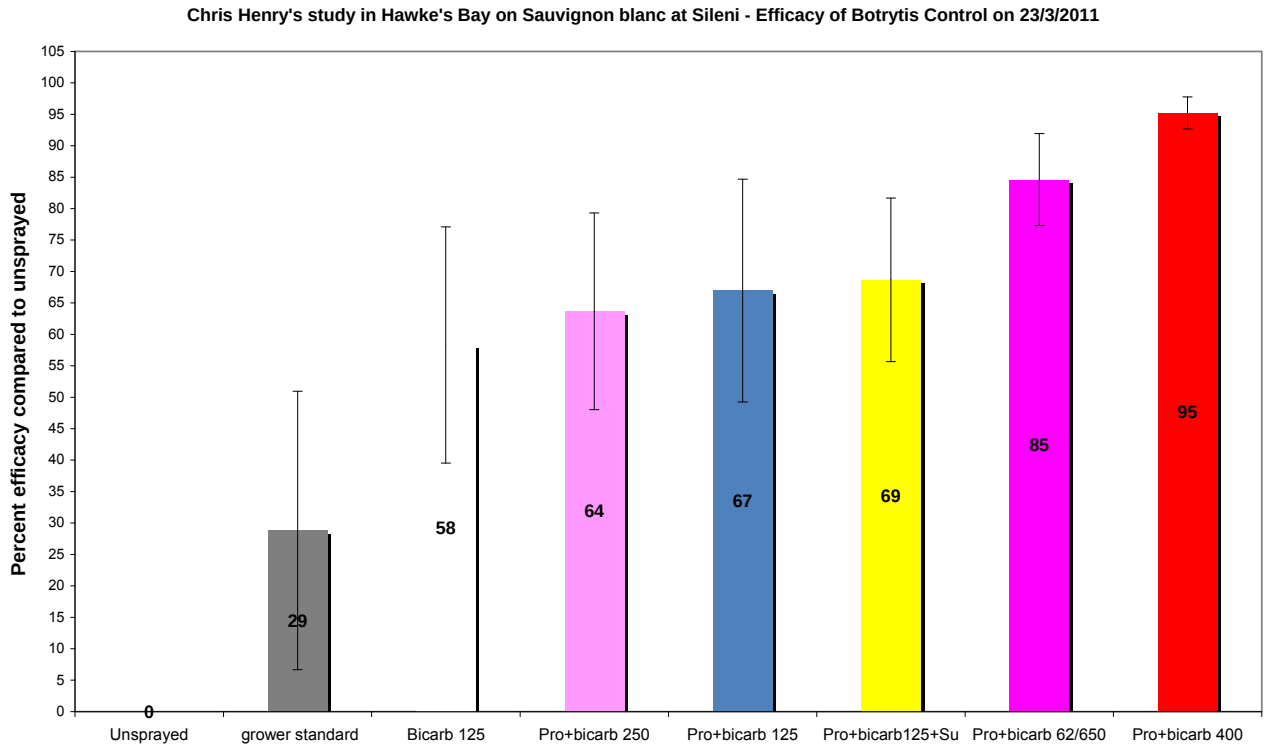


Table 4: Incidence, severity (total crop loss) and significance of botrytis of the various treatments

Data	treatment name	Total	
Average of Inc (%)	Pro+bicarb 400	3.3	**a**
	Pro+bicarb 62/650	4.7	**abc**
	Pro+bicarb 125	11.3	**abc**
	Pro+bicarb 250	11.3	**abc**
	Pro+bicarb125+Su	14.7	**bcd**
	Bicarb 125	20.7	**cde**
	grower standard	25.7	**de**
	Unsprayed	31.0	**e**
Average of % crop	Pro+bicarb 400	0.1	**a**
	Pro+bicarb 62/650	0.5	**ab**
	Pro+bicarb 125	1.0	**abc**
	Pro+bicarb 250	1.1	**abc**
	Pro+bicarb125+Su	0.9	**abc**
	Bicarb 125	1.2	**bcd**
	grower standard	2.1	**cd**
	Unsprayed	2.9	**d**
Total Average of Inc (%)		15.3	
Total Average of % crop		1.2	

Graph 3: Percentage efficiency of the various treatments in reducing the total crop loss compared to the unsprayed treatment.



Comment on Botrytis Results

Statistical analysis cannot be undertaken on the graph above as it is a percentage format. Statistics on botrytis can be seen on previous pages. The graph does lead to a high level of confidence, as the spread (bands) of data associated with the Red and Single pink treatments are narrow, and small in comparison with other treatments.

The result was obtained in what was regarded as a very high pressure year for botrytis with many grapes in Hawkes Bay being picked early or abandoned because of the disease.

What we are left with are two effective treatments (single pink and red), with the 'Red' ahead statistically. Both delivered similar accelerated brix and changes in bunch structure.

The 'Red' was the highest rate of $KHCO_3$ - (0.4kg/100l) during flowering.
The 'Single Pink' was the lowest rate of $KHCO_3$ - (0.062kg/100l) during flowering and then changed to the highest rate of $KHCO_3$ (0.65kg/100l) on the 9th December.
Both were combined with Protector at 0.5%

Initially it was thought the change in bunch structure was effected through flowering applications as in the Pinot Noir the decrease in 'chickens' was noted 4 to 6 weeks in the Red, after flowering, when compared to the Green (untreated), but was not noted in the Single Pink.

However in the Sauvignon Blanc, approximately a month before harvest both treatments had similar loose bunch structures – **which indicate that the changes results from treatments when the berries are growing as opposed to flowering**.

There is no doubt that the lack of botrytis in these treatments, the change in bunch structure and the heightened brix are linked – as the heightened brix and increasing lack of botrytis is counter intuitive. The question of ‘Mode of Action’ is dealt with in a later chapter but cannot be fully answered without further scientific study.

Table 5: Severity (total crop loss) due to sour rot, botrytis and total rot losses of the various treatments

	Data		
Treatment name	crop sour	crop Botrytis	% crop Total ROT
Pro+bicarb 400	0.0	0.14	0.18
Pro+bicarb 62/650	0.2	0.45	0.61
Pro+bicarb125+Su	0.1	0.92	1.05
Pro+bicarb 125	0.1	0.97	1.10
Pro+bicarb 250	0.2	1.06	1.22
Bicarb 125	0.2	1.22	1.41
Unsprayed	0.3	2.93	3.24
grower standard	4.6	2.08	6.67
Grand Total	0.7	1.2	1.93

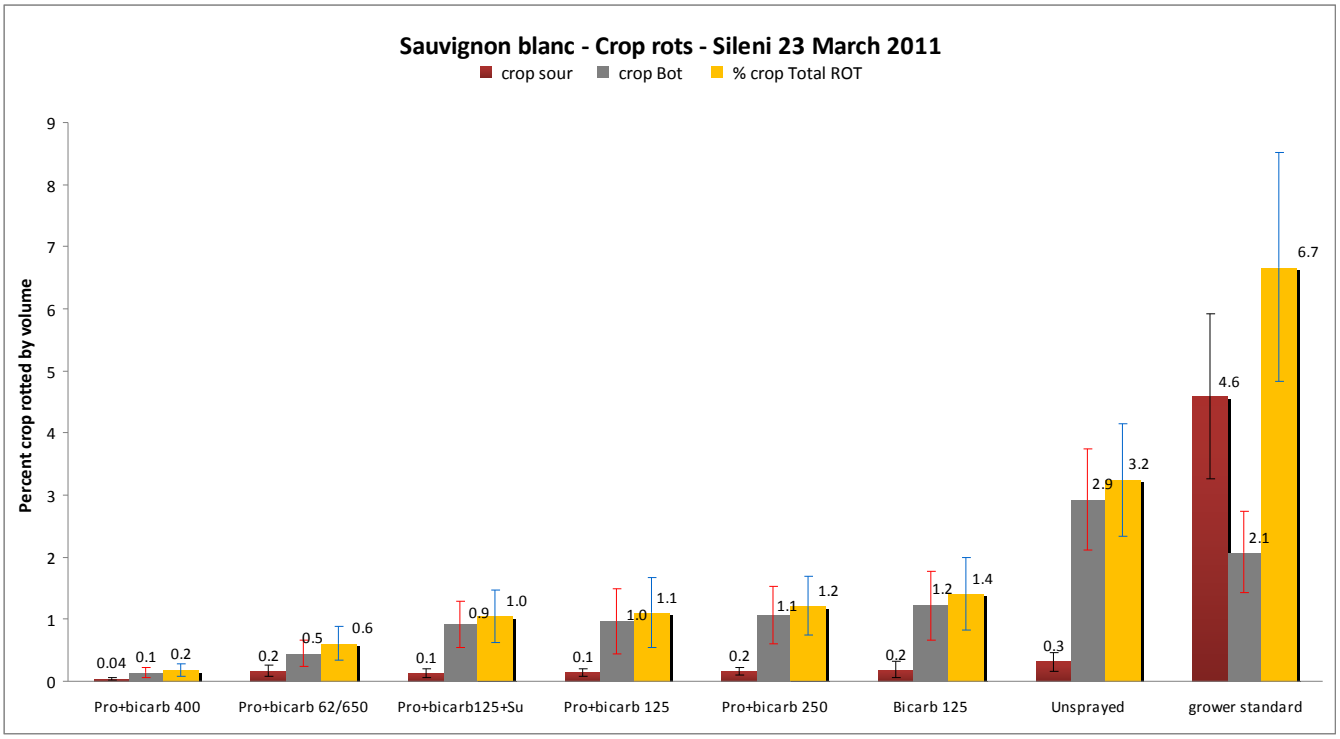
Table 6: Severity (total crop loss) due to sour rot, botrytis and total rot losses of the various treatments and their significance

LSD at 95% confidence

Each treatment with the same letter is not significantly different to each other (α=0.05, *P*<0.05)

	Sour rot (% crop)		Bot (% crop)		Total ROT (% crop)	
Pro+bicarb 400	**0.0**	**a**	**0.1**	**a**	**0.2**	**a**
Pro+bicarb 62/650	**0.2**	**a**	**0.5**	**ab**	**0.6**	**ab**
Pro+bicarb125+Su	**0.1**	**a**	**0.9**	**abc**	**1.0**	**abc**
Pro+bicarb 125	**0.1**	**a**	**1.0**	**abc**	**1.1**	**abc**
Pro+bicarb 250	**0.2**	**a**	**1.1**	**abc**	**1.2**	**abc**
Bicarb 125	**0.2**	**a**	**1.2**	**bcd**	**1.4**	**bcd**
Unsprayed	**0.3**	**a**	**2.9**	**d**	**3.2**	**d**
Grower standard	**4.6**	**b**	**2.1**	**cd**	**6.7**	**cd**

Graph 4: **Percentage efficiency of the various treatments in reducing the total crop loss compared to the unsprayed treatment.**



Graph 5: **Average berry weight and the average brix level at harvest of the various treatments compared to the unsprayed treatment.**

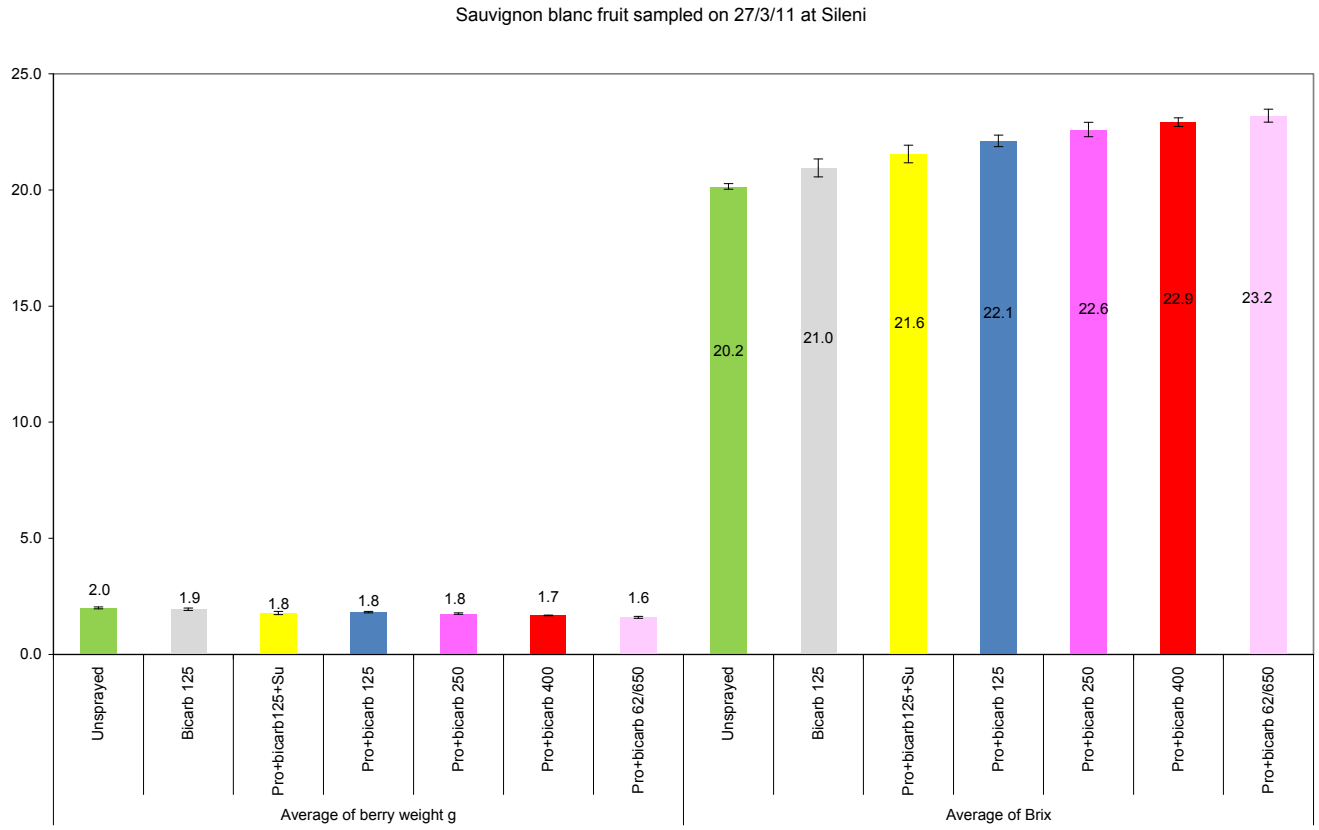


Table 7: **Harvest brix level and the mean berry weight of the various treatments and their significance**

LSD at 95% confidence

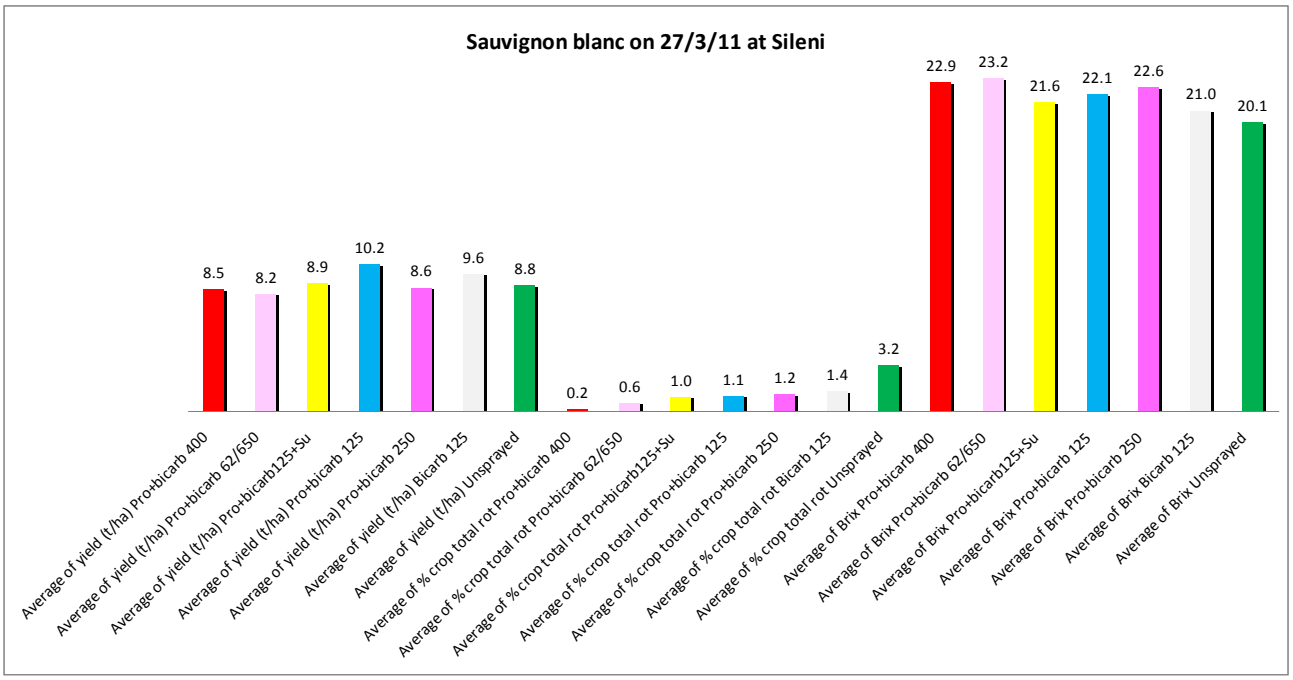
Each treatment with the same letter is not significantly different to each other (α=0.05, *P*<0.05)

treatment	Brix	Mean berry weight (g)
Unsprayed	20.2 a	2.0 a
Bicarb 125	21.0 b	1.9 a
Pro+bicarb125+Su	21.6 bc	1.8 b
Pro+bicarb 125	22.1 cd	1.8 b
Pro+bicarb 250	22.6 de	1.8 bc
Pro+bicarb 400	22.9 e	1.7 cd
Pro+bicarb 62/650	23.2 e	1.6 d

Summary - LSD at 95% confidence

The number of berries per bunch are not significantly different
The bunch weights are not significantly different
The bunches per vine are not significantly different
The yield per ha is not significantly different
The yield per vine was not significantly different

Graph 6: **Showing the average yield, average percentage of total crop loss and the average harvest brix level of each treatment when compared the unsprayed treatment.**



Yield per vine - Percentage Total rots - Brix

Discussion

General Comments on trial

2010-11 was a season of uncommonly high pressure for powdery mildew, botrytis and downy mildew in Hawkes Bay. From a trialist's point of view, it couldn't have been better!

The trial plan was based on calendar applications at 14 day spray intervals – intending to ignore plant growth stages. The spray intervals became greater than 14 days over the December/January period. Treatment 6 (contained sulphur) was deleted from the last spray round.

As it was a hand sprayed study, good coverage was achieved on foliage and fruit with the exception of some of the fruit on the 3rd upper cane (which was not always exposed through leaf plucking). This resulted in more powdery mildew and botrytis infection on the 3rd upper cane.
The same level of coverage could never be expected to be achieved through machine spraying.

After the powdery mildew assessment on the 13th January, 2 x DMI applications were machine sprayed through both varieties approximately 7 days apart - to eradicate the powdery mildew infection so that it did not interfere with the botrytis result – this strategy was effective and powdery mildew was only noted again at very low levels in bunches at the harvest assessment (DMI's have no direct effect on botrytis).

No phytotoxicity was seen at any time in the trial. No plant health issues were seen in the trial.

No assessment was made of downy mildew – a disease not seen on this site before. There was light primary infection toward the end of the season, with no noticeable differences in infection levels when compared to the untreated, the exception was the treatment which contained sulphur, which was completely clear.

In the Pinot Noir trial, no botrytis or sour rot assessment was made due to severe bird damage occurring at and shortly after veraison. The trial was on short rows - the row ends and side were particularly affected, eliminating any useful comparison. It was also harvested ahead of any brix analysis.

The Sauvignon Blanc trial experienced no problems to alter or debase any data taken out of it.

Bunch Structure

Changes in bunch structure were observed in both trial sites.

Approximately 1 month to 6 weeks after flowering, the first signs of change in bunch structure were noted in the Pinot Noir trial site. If the Red treatment (0.4kg/100l $KHCO_3$ + 0.5l/100l Protector) was compared to the Green (Untreated), there was a significant reduction in the number of 'chickens' present. However, this was not quantified. The photographs show the changes in bunch structure that was observed.

P**hotograph 6. - Pinot Noir Red Treatment (Untreated)**

Photograph 7.- Pinot Noir Green

In the Sauvignon Blanc trial site, approximately 1 month before harvest was when the first signs of a change in bunch structure were noted, particularly in the Red treatment (0.4kg/100l $KHCO_3$ + 0.5l/100l Protector) and the single Pink (after 9 Dec - 0.65kg/100l $KHCO_3$ + 0.5l/100l Protector). The bunches were more highly coloured, looser and there was little/no compression between berries. **See data comparing treatments.**

Mode of Action

Protector's mode of action broadly speaking (on botrytis) is directly fungicidal and fungistatic, perhaps elicitoring a mild plant response, when used at a 2% rate.

Its effects are less at an adjuvant rate of 0.5%, (only 60% of the efficacy achieved on botrytis when compared to 2% in an all season 1998 study). On its own, it is virtually non phytotoxic.

Potassium bicarbonate's mode of action broadly speaking revolves around 'changing the pH on leaf surfaces to highly alkaline as well as creating a strong osmotic imbalance between microscopic organisms and the surrounding solution on the plant surface. This has the effect of severely disrupting spores and fungi cell walls.' It exhibits a broad spectrum of fungicidal activity. On its own, potassium bicarbonate is known to be phytotoxic. In this season, marginal leaf burning on young foliage occurred in another trial where the rate was 1kg/100l. The nominal range of proprietary products is normally 0.3kg/100l to 0.6kg/100l.

Singly, neither has exhibited the ability to positively alter plant behaviour – such as the results achieved in this trial.

The combination of the two products appears to deliver a plant response evidenced by the changes in bunch structure and the resilience of berries to external pressure (see juice tasting notes and photos).

It may be that this plant response is what is driving the resistance to disease and accelerated brix.

There is need for further study (see chapter on Future Development). It was thought initially that the plant response was driven from applications made in flowering, but this has been negated to some extent as Treatment 2 (single pink) received an ultra low dose of

potassium bicarbonate through flowering and then the highest dose in the trial after flowering. Treatment 5 (red) received the highest dose through flowering – and both delivered virtually the same result in respect of disease efficacy, heightened brix and changes in bunch construction.

This may lead to a new approach to spray timing, particularly those related to plant growth stages – eg flowering.

'Grower Standard'

Comments on comparison with 'Grower Standard'

Any comparison of data related to the 'grower standard' should be made with caution.

While the blocks were adjacent, there was a difference in viticultural practice. Both sites had been mechanically leaf plucked, but the trial site received a once only additional hand leaf pluck on the 9th January 2011 (80% both side with all bunches exposed).

The other major difference was that the trial site was bird netted, while the grower block was not – resulting in a significant sour rot difference due to bird damage.

Grower Spray Diary

The grower's spray diary for Sauvignon Blanc for the 2010/11 season was as follows:

28/09/2010 – Sulphur 3kg/ha and Copper 0.9kg/ha
07/10/2010 - Sulphur 3kg/ha and Mancozeb® 2kg/ha
26/10/2010 - Sulphur 3kg/ha
Hand Spray Trial begins 2/11/2010
12/11/2010 - Sulphur 3kg/ha and Mancozeb® 2kg/ha
30/11/2010 – Captan® 1.2kg/ha, Pilan® 0.25L/ha and Systhane® 0.125L/ha (5% flowering)
07/12/2010 - Sulphur 3kg/ha and Diva® 1.6L/ha (80% flowering)
24/12/2010 - Sulphur 3kg/ha and Captan® 1.2kg/ha
29/12/2010 - Sulphur 3kg/ha and Switch® 0.8kg/ha (bunch closure)
14/01/2011 - Sulphur 3kg/ha and Copper 0.9kg/ha
31/01/2011 - Sulphur 3kg/ha and Pinnacle® 1L/ha (veraison)
25/02/2011 – Foliactive® 6L/ha

Pilan® is a generic Applaud®
Diva® is a generic Scala®
Pinnacle® is a generic Shirlan®

Nutrient Status of Sauvignon Blanc 2009 (soil and leaf)

The results of soil and leaf tests of samples taken in 2009 in an adjacent block to the trial site are shown below. These results are included for readers interested in trial background potassium levels for comparison to analysed levels of potassium found in juices.

Sample Name: Block 15 **Lab Number:** 710178.4
Sample Type: SOIL Grape, Vineyard (S49)

Analysis		Level Found	Medium Range	Low / Medium / High
pH	pH Units	5.8	5.8 - 6.8	
Olsen Phosphorus	mg/L	50	15 - 40	
Anion Storage Capacity (estimated)	%	20	30 - 60	
Potassium	me/100g	0.57	0.40 - 0.80	
Calcium	me/100g	7.5	6.0 - 12.0	
Magnesium	me/100g	1.16	1.00 - 3.00	
Sodium	me/100g	0.23	0.00 - 0.40	
CEC	me/100g	15	12 - 25	
Total Base Saturation	%	63	60 - 85	
Volume Weight	g/mL	0.82	0.60 - 1.00	
Organic Matter*	%	5.4	7.0 - 17.0	
Total Carbon*	%	3.1		
Base Saturation %		K 3.8	Ca 50	Mg 7.8 Na 1.5
MAF Units		K 10	Ca 8	Mg 22 Na 9

Sample Name: Block 15 Sauv Blanc **Lab Number:** 750168.3
Sample Type: Grape Dissected, Flowering, Sauvignon Blanc (D108)

Analysis		Level Found	Medium Range	Low / Medium / High
Nitrogen*	%	3.7	2.8 - 3.4	
Nitrate-N (Petiole)	mg/kg	3,850	400 - 1600	
Phosphorus	%	0.22	0.22 - 0.35	
Phosphorus (Petiole)	%	0.15	0.18 - 0.45	
Potassium	%	1.0	1.1 - 1.5	
Potassium (Petiole)	%	1.9	2.0 - 3.5	
Sulphur	%	0.28	0.35 - 0.50	
Calcium	%	1.30	1.20 - 2.00	
Magnesium	%	0.24	0.20 - 0.40	
Magnesium (Petiole)	%	0.37	0.30 - 0.60	
Sodium	%	0.03	0.00 - 0.10	
Iron	mg/kg	80	40 - 150	
Manganese	mg/kg	190	40 - 200	
Zinc	mg/kg	25	30 - 80	
Copper	mg/kg	16	6 - 12	
Boron	mg/kg	35	30 - 55	

Wine making

Additional Brix and Acid sample analysis

On 21 March 2010, samples were taken by Caine Thompson, Viticulturist for Mission Estate for brix and acid analysis. The treatments sampled were Single Pink, Red and Green. Fifty bunches were sampled at random. Bunches were individually weighed, and then crushed and tested for Brix, pH and TA. The results are shown below. The Brix results were comparable to the later Brix analysis undertaken by Peter Wood of Plant and Food Research.

Single Pink		Red		Green	
Average Bunch Weight	90.3grams	Average Bunch Weight	84.5 grams	Average Bunch Weight	110.7 grams
Brix	22.8	Brix	23.3	Brix	20.3
pH	2.97	pH	3.05	pH	2.98
TA	15.3	TA	13.3	TA	12.9

Juice tasting assessment

Approximately five kilograms of grapes from each treatment were juiced to check the flavours of the juice. This was undertaken by Jenny Dobson, consultant winemaker on 27 March 2011. The juices were presented in the following order - Blue/White, Double Pink, Single Pink, Blue/White/Yellow, Green, Red, White, and she did not know what treatments the colours represented.

Her notes are provided below.

White (.125kg/100l $KHCO^3$ alone)**:**
Gooseberry
Initially shows depth but acidity quite marked on finish

Single Pink (.062kg/100l $KHCO^3$ till 9 Dec then .65kg/100l $KHCO^3$ both + Protector .5l/100l)**:**
Gooseberry, herbaceous
Rich, full, good depth of flavour – all through palate
Excellent length with good persistence of flavour
Acid fresh but well balanced by flavour

Blue/White (.125kg/100l $KHCO^3$ + Protector .5l/100l):
Gooseberry, herbaceous, fresh lime, fine citrus flavours with gooseberry
Fresh acidity, quite biting

Double Pink (.25kg/100l $KHCO^3$ + Protector .5l/100l):
Gooseberry, nectarine
Fuller richer juice, more luscious
Fine acidity, good length of flavour

Red (.4 kg/100l $KHCO^3$ + Protector .5l/100l):
Lifted gooseberry and herbaceous notes
Good richness on palate

Good flavour persistence
Fresh, lively acidity but balanced by palate richness – good length

Blue/White/Yellow (.125kg/100l $KHCO^3$ + Sulphur 100gm/100l + Protector .5l/100l):
Nectarine, gooseberry
A little flat initially with flavour more apparent late in the palate.
Not quite as full as the single pink with more lifted and marked acidity

Green (No spray – untreated):
Gooseberry, herbaceous, grassy
Fuller on palate than yellow (Blue/White/Yellow) with fresh and lingering acidity

Her comments at the end of the tasting were that the 'yellow' was really the only one out to the extent that she thought she had a dirty glass.

Of the colours she identified 'red' and 'single pink' as the colours that stood out away from the rest, as having good depth of flavour all through the palate and having excellent length with persistence of flavour.

It was noted both the 'red' and the 'single pink' required considerable force over and above the others to crush the juice out, see photograph below.

Potassium levels in Juices and Wine

Potassium levels were tested as there can be concern regarding their effect on acidity. All juice treatments and the finished wines of the Green (untreated), Single Pink and Red (treatments that delivered elevated brix and high botrytis efficacy) were tested.

Testing demonstrated a rate effect between increasing rates of potassium bicarbonate and potassium levels. Finished wine potassium levels fell considerably below that shown in juices, but retained the rate effect.

Potassium levels of finished wine, according to a wine manual are nominally within the range of 500mg/l to 2000mg/l – the finished wines fell either side of the nominal minimum potassium value.

Treatment No.	Treatment	Colour code	Potassium levels in Juice (mg/L)	Potassium levels in Wine (mg/L)
1	Potassium bicarbonate at 0.125 kg per 100 litres	White	1296	-
2	Protector 0.5% + Potassium bicarbonate at 0.062 kg per 100 litres, after 9 Dec ,0.65kg/100l with Protector 0.5%	Single Pink	1849	523
3	Protector 0.5% + Potassium bicarbonate at 0.125 kg per 100 litres	White/Blue	1606	-
4	Protector 0.5% + Potassium bicarbonate at 0.250 kg per 100 litres	Double Pink	1789	-
5	Protector 0.5% + Potassium bicarbonate at 0.400 kg per 100 litres	Red	1812	638
6	Protector 0.5% + Potassium bicarbonate at 0.125 kg per 100 litres + Sulphur at 0.1kg per 100 litres	White/Blue/ Yellow	1581	-
7	Untreated	Green	1363	417
8	Growers treatments			

Finished Wines Comment and Analysis

Microvinifications were undertaken on Single Pink, Red and Green by Eastern Institute of Technology under the guidance of Jenny Dobson, consultant winemaker. She reported on the 18 April 2011 that the fermentations were complete in all samples with no issues being experienced. The Green completed fermentation earlier than the single pink and red treatments because of its lower brix. Post ferment records are shown below.

Taste testing after completion of fermentation revealed no off flavours.

The wines were finished, bottled on the 18th May. To prevent masking of any off or unusual flavours, no other amendments or additions, such as sugar or wine de-acidifiers, were made to the wines.

Post Ferment Sheet – Green				
Date	**Addition**	**Rate**	**Comment**	**Litres**
18.04.11	SO2	30ppm	PMS and bentonite added	
	Bentonite WG	1.5g/L		
25.04.11	SO2	20ppm	Racked off lees FSO2 = 6 Added more	18.7L
			T.A = 7.95 pH = 3.25	
			Back to chiller	
29.04.11	Isinglass	10mg/L	Added isinglass	
11.05.11			Racked off lees FSO2 = 17 Moved to winery	
			T.A = 7.85 pH = 3.25	
25.05.11			Course and sterile filtered to bottle	
	SO2	9ppm	FSO2 = 16 Added more	
			18 bottles	

Final Analysis			
Date	31.05.11		
Litres in Bottling Tank		**pH**	
Free SO_2	21	**RS**	1.00
Total SO_2	89	**Alc**	12.50
TA		**Brix**	-2.30

Post Ferment Sheet - Red				
Date	**Addition**	**Rate**	**Comment**	**Litres**
23.04.11	SO2	30ppm	PMS and bentonite added	
	Bentonite WG	1.5g/L		
29.04.11	SO2	16ppm	Racked off lees FSO2 = 9 Added more	19L
			T.A = 8.55 pH = 3.36	
			Back to chiller	
29.04.11	Isinglass	10mg/L	Added isinglass	
16.05.11	SO2	19ppm	Racked off lees FSO2 = 15 Added more	15 + 2.5L
			T.A = 8.30 pH = 3.44 Moved to winery	
30.05.11			Course and sterile filtered to bottle	
	SO2	13ppm	FSO2 = 21 Added more	
			21 bottles	

Final Analysis			
Date	31.05.11		
Litres in Bottling Tank		**pH**	
Free SO_2	33	**RS**	0.50
Total SO_2	107	**Alc**	13.20
TA		**Brix**	-2.30

Post Ferment Sheet - Pink				
Date	**Addition**	**Rate**	**Comment**	**Litres**
18.04.11	SO2	30ppm	PMS and bentonite added	
	Bentonite WG	1.5g/L		
25.04.11	SO2	20ppm	Racked off lees FSO2 = 6 Added more	18.5L
			T.A = 8.45 pH = 3.28	
			Back to chiller	
29.04.11	Isinglass	10mg/L	Added isinglass	
11.05.11	SO2	19ppm	Racked off lees FSO2 = 15 Added more	15 + 1.9L
			T.A = 8.35 pH = 3.41 Moved to winery	
25.05.11			Course and sterile filtered to bottle	
	SO2	11ppm	FSO2 = 23 Added more	
			19 bottles	

Final Analysis			
Date	31.05.11		
Litres in Bottling Tank		**pH**	
Free SO_2	32	**RS**	1.00
Total SO_2	121	**Alc**	14.30
TA		**Brix**	-2.70

Wine Sensory Evaluation

The wines underwent sensory evaluation by a panel of experienced winemakers on the 10 June 2011. The panel comprised Grant Edmonds (Sileni), Jenny Dobson (Consultant winemaker), Hugh Crichton (Vidal), Dave McKee (Black Barn) and Warren Gibson (Trinity Hill).

The tasting was blind and the three wines were tasted side by side. The wines were served un-chilled.

The objectives in order of importance were:

- to identify any faults or off flavours
- to note characteristics and compare
- to rank on the basis of personal preference.

The order of the wines was how they were taken blind from the carton
Wine 1 – Green – Untreated
Wine 2 – Red – Potassium bicarbonate 0.4kg/100l + Protector 0.5l/100l
Wine 3 – Pink – Potassium bicarbonate 0.062kg/100l then 0.65kg/100l from 9 December, both with Protector 0.5l/100l

The unanimous view of the panel was there were no off-flavours or faults of significance with any of the wines.

Tasting Notes – as written

Grant Edmonds
Wine 1: V.pale green/lemon, sl. Sweet 'jelly bean' aroma, ripe SB, more stonefruit than citrus – high acid but clean, light, fresh, short finish apart from acidity, gives citrus/lemon character

Wine 2: V.pale green/lemon, nose more like pastry/savoury, but also peach/stonefruit, - more weight on palate, still fresh, but fuller bodied, slightly softer, more stonefruit, richer

Wine 3: V.pale green/lemon, more typical NZ SB, gooseberry/grapefruit, fresh, citrus finish, lean, lacks weight of #2

No preference offered.

Jenny Dobson
Wine 1: pale with green highlights – sl honeyed medicinal notes on nose, mineral and leafy aromas – clean, fresh, bright, honeyed flavours with mineral highlights, lean- crisp finish short

Wine 2: Bright gooseberry, grassy aromas, with stonefruit and tropical notes more complexity – vibrant attack, richer texture than 1, good flavour development – Xlent length with weight and flavour well carried

Wine 3: Same gooseberry aromatics as wine 2 with a mineral note and floral aromas. Limey highlight – Vibrant attack, flavoursome palate not quite as rich as 2 but more citrus flavours – fresh finish with good length.

Preference (best first): 3, 2, 1

Hugh Crichton
Wine 1: Relatively closed aromatically marked 2 out of 3. Very slight background reduction. Bot on nose – Fruit – lemons/limes, pure, defined, marked acid. Some phenolics.

Wine 2: Most lifted of the three aromatically, showing low levels of thiols. – Fuller/rounder mouth feel on attack. Still good acidity but balanced out with nice fruit weight. Not as skeletal as Wine 1. Some phenolics.

Wine 3: Most closed of the three aromatically, offering least amount of fruit. More vinous – more closely related to wine 1 although acid profile seems lower and shorter finish on the palate. Some phenolics

Preference (best first): 2, 1, 3

Dave McKee
Wine 1: Vanillan, Tropical with hint sherbet (lemon) bright fresh – bright fresh front of palate, clean acidity – fresh nose and bright fruit – hint of reduction

Wine 2: Hint closed – reduction on first nose, similar fruit characters, mineral – oyster shell note – reduction blows away on 2nd, 3rd – fleshy palate, riper more texture and weight increased Alc feel on finish, disjointed Bot?

Wine 3: Bright fruit, fresh tropical with a hint sherbet – clean – mod(erate) conc(entration) front palate – less ripe with sl. harder acidity – Greener fruit edge and least ripe – most commercial SB nose.

Preference (best first): 3, 1, 2

Warren Gibson

Wine 1: Lifted fresh. A nice level of ripeness. Clean and pure Estery. Commercially very sound. Some slight reduction but no problem. Reduction comes through more as time goes on. – Clean and pure on the palate. Nice acidity and a long clean finish. Some phenolic edges.

Wine 2: Relatively clean. Sherbety. Seems to lack a little purity of wine 1(?). Palate is more phenolic. Dryer on the finish and lacks some zingy freshness. Very astringent palate versus the others and lacks purity.

Wine 3: Complex. Less pure? + Focussed (?) still attractive enough, limey, - fresh on the palate. alive and fresh. Clean with nice acidity. Very pure palate.

Preference (best first): 3, 1, 2

Further Development

What was achieved this season:-

- A hand sprayed all season study on Pinot Noir and Sauvignon Blanc in one Hawkes Bay location, with only Sauvignon Blanc being fully assessed.

What is required in the next season:-

- Completion of report in respect of sensory analysis of finished wine, potassium levels in finished wine, comparative assessment of pruning weights from treatments, comparative yield assessment of treatments in the following year.
- The conversion to machine spraying. In depth assessment on water rates, application rates and machine tuning – split block trials using multi water rates and different concentrations – on different varieties in the major growing areas.
- Further study on the mode of action in relation to plant response and plant growth stages – as a precursor to looking at changes in spray strategy. Also study on whether the combination 'kicks back' on infection following infection periods.
- Further hand sprayed studies with the same and more elevated rates, during flowering and from flowering through to veraison, on varieties which are prone to 'hen and chickens.
- Analysis of potassium levels in finished wine,
- Compatibility studies with other pesticides, foliar fertilisers.
- The effect on mite populations, in particular the effect on erinose mite.
- Further studies with wetable sulphur re Erinose mite control.
- Further studies on downy mildew and outstanding grape diseases such as black spot, phomopsis etc.
- Further studies in other varieties/growing regions
- Follow up studies in the US

What is required in the season following:-

- Study of any outstanding issues
- Full block trials on nominated spray rates etc.
- Support growers to make the transition.

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Caine Thompson, Mission Estate's viticulturist and Brittany Thompson, Elephant Hill's viticulturist

Dave McKee, Black Barn's CEO and winemaker

Warren Gibson, Trinity Hill's winemaker

Hugh Crichton, Vidal's principal winemaker

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Brett Murdoch, the owner of Murdoch Wines

And lastly my partner Helen Codlin for her steady wonderful support that allows me to pursue the dream of assisting the world to one day grow food without the use of toxic materials.