TESTING OF POTENTIAL PSA CONTROL PRODUCTS OVER FLOWERING ON GREEN KIWIFRUIT

BAY OF PLENTY, NEW ZEALAND, 2014/2015

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1. SUMMARY

One small plot replicated field trial was conducted between 20 November 2014 and 23 April 2015 to test the efficacy of three novel products applied over the flowering period to control *Pseudomonas syringae* pv. *actinidiae* (Psa) on Hayward kiwifruit. The trial was conducted near Edgecumbe in the Bay of Plenty, New Zealand.

The following treatments were evaluated:

Treatment	Active ingredient	Product rate (per 100 L)
1. UNTREATED CONTROL	-	-
2. HML32	170 g/L fatty acids + 264 g/L potassium bicarbonate	1.25 L
3. TNL3067	Coded compound	1050 g Comp A + 150 g Comp B
4. PRODUCT C*	Experimental biocontrol agent	500 g
5. NORDOX	750 g/kg Copper as cuprous oxide	37.5 g
6. BOTRY-Zen	> 2.5 x 10^8 CFU/g *Ulocladium oudemansii*	800 g
7. NORDOX + ACTIGARD	750 g/kg Copper as cuprous oxide + 500 g/kg Acibenzolar-S-Methyl	37.5 g + 20 g
8. PRODUCT C + ACTIGARD	Experimental biocontrol agent + 500 g/kg Acibenzolar-S-Methyl	500 g + 20 g

*DuWett applied at 400 mL/ha

The trial was established as a randomised complete block design with eight replicates of each treatment. Each plot was 10.0 m long by 3.6 m wide, a total of 36.0 m^2 per plot.

Treatments were applied as two applications over a five day period from early flowering to late flowering on the Hayward kiwifruit vines. Treatments were applied using a motorised knapsack sprayer incorporating two twin tip TXVK-18 hollow cone nozzles. Treatments were applied at a pressure of 700 kPa in a total water volume of 1000 L/ha.

Detailed assessments were conducted at 4, 27, 147 and 148DAA (days after application), as well as a pre-treatment assessment carried out one day prior to the first application. The primary target of this trial was *Pseudomonas syringae* pv. *actinidiae* (Psa) and control of budrot over the flowering to fruitset period. In addition vines were measured for any positive or negative impacts on fruit development and yield, together with assessments for crop safety.

A moderate level of budrot was observed in the trial prior to the first application of treatments with an average of 14% of buds exhibiting Psa symptoms of sepal browning.

No significant differences in the sepal browning, fruitset, fruit weight and fruit shape were observed between the Untreated Control and any of the applied treatments in this study. While this importantly indicates that none of the treatments had a negative impact on the pollination, or yield components of Hayward kiwifruit, conclusions cannot be made as to the level of control of Psa that each product may have provided. Budrot had already developed in the trial area prior to the start of the trial, and given the window of control in this trial being over the flowering period only, the background level of Psa infection was already considerably well established. To add to this, weather conditions over flowering were ideal with consistent mild temperatures and very little rainfall (<3 mm in total).

All of the products were found to be easy to mix in solution with agitation, and all products were easy to apply. No signs of phytotoxicity were observed as a result of the application of any of the treatments.

2. INTRODUCTION

One small plot replicated field trial was conducted between 20 November 2014 and 23 April 2015 to test the efficacy of three novel products applied over the flowering period to control *Pseudomonas syringae* pv. *actinidiae* (Psa) on Hayward kiwifruit. The trial was conducted near Edgecumbe in the Bay of Plenty, New Zealand.

This report contains the experimental methods used and presents the results obtained.

The trial was conducted under Eurofins Agroscience Services New Zealand project ZESPRI/14/05 and client reference VI1590.

3. EXPERIMENTAL DETAILS

3.1 Site Details

Table 3.1: Site details and trial location	
Location:	Orchard Road, Edgecumbe
Crop:	Kiwifruit (green)
Variety:	Hayward
Trellis	Pergola
Vine age:	<14 years
Male variety	M56 & Chieftan
Water details:	Well water from the orchard was used for spraying and analysed by ARL Ltd. Water pH 6.5 and total hardness of 72 ppm

3.2 Target

The primary target of this trial was *Pseudomonas syringae* pv. *actinidiae* (Psa) and control of budrot over the flowering to fruitset period. In addition vines were measured for any positive or negative impacts on fruit development and yield, together with assessments for crop safety.

3.3 Trial Design

Table 3.3: Trial design	
Design:	Randomised complete block
Replicates:	Eight
Plot size:	5.0 m x 2 bays (10.0 m) by 3.6 m wide, total of 36.0 m^2
Vine details:	Vines were single planted with males planted as strip rows
Buffer details:	No buffers were placed between treatments, however the outside 0.5 m boundary of each plot was not assessed, acting as a buffer to the adjacent plot.

3.4 Test Product Details

Table 3.4: Test product details

Product	**Batch number**	**Manufacture/Expiry date**
HML32	31217A	08/2014
TNL3067	N/R	N/R
PRODUCT C	N/R	N/R
NORDOX	230214	23/02/2014
BOTRYZEN	BZ/G 14896	Oct 2014
ACTIGARD	7GM3F27002	2013/06/27

3.5 Treatment Method

Table3.5: Treatment methods and sprayer output	
Equipment:	Motorised backpack sprayer
Method:	Hand held wand
Nozzles:	Twin tip TXVK-18 hollow cone nozzles
Pressure:	700 kPa
Water volume:	1000 Litres per hectare
Sprayer output:	Average 3.28 Litres per minute
Spray coverage:	Sprayed to incipient runoff

3.6 Treatment List

Table 3.6: Treatment list and product rates

Treatment	Active ingredient	Product rate (per 100 L)
1. UNTREATED CONTROL	-	-
2. HML32	170 g/L fatty acids + 264 g/L potassium bicarbonate	1.25 L
3. TNL3067	Coded compound	1050 g Comp A + 150 g Comp B
4. PRODUCT C*	Experimental biocontrol agent	500 g
5. NORDOX	750 g/kg Copper as cuprous oxide	37.5 g
6. BOTRY-Zen	> 2.5 x 10^8 CFU/g *Ulocladium oudemansii*	800 g
7. NORDOX + ACTIGARD	750 g/kg Copper as cuprous oxide + 500 g/kg Acibenzolar-S-Methyl	37.5 g + 20 g
8. PRODUCT C* + ACTIGARD	Experimental biocontrol agent + 500 g/kg Acibenzolar-S-Methyl	500 g + 20 g

*DuWett applied at 400 mL/ha

3.7 Application Details

Treatments were applied twice over the flowering period with the aim to apply the treatments at approximately 20% open flowers and again at 80% open flowers. The first application had to be applied 1 day prior to 20% flowers open as rain was forecast for the following days. It was estimated that between 2 - 20% flowers were open across all of the treatment plots.

No Psa control products were applied by the orchardist for a period of 3 weeks prior to the first application of the trial treatments.

Table 3.9: Treatment application details

Application number	1	3
Date	21-Nov-14	26-Nov-14
Time	0825 – 1100	0745 – 0945
Spray interval (days)	-	5
Growth stage	2-10% flowering	80-90% flowering
BBCH scale	60 - 61	65 - 67
Water / plot (L)	3.6	3.6
Water / Ha (L)	1000	1000
Wind speed (km/h)	0 - 4.0	0 – 2.7
Wind direction	Nil – NW	Nil – NW
Temperature (°C)	13.5 – 22.7	19.0 – 21.7
Relative humidity (%)	75 – 53	81
Cloud cover (%)	70	90
Soil/Foliage wetness	Dry	Dry
Rainfall (mm)		
Day before	0.0	0.0
Day of	0.0	0.0
Day after	0.0	0.8
Week after	1.8	2.2

3.8 Assessments

Date	Timing	Assessment
20-Nov-14	-1DAA1	Prior to the first application of treatments 50 female flower buds were assessed per plot for the incidence (number of buds infected) and severity (percentage area of sepal browning). A visual whole plot assessment was also conducted on the leaves across each plot to understand if there was any relationship between the infection of female flower buds and leaves.
25-Nov-14	4DAA1	Prior to the second application of treatments four individual canes were tagged in each plot. On each cane the number of flowers was recorded together with the incidence and severity of budrot.
23-Dec-14	27DAA2	The four tagged canes per plot were revisited and the number of fruitlets per cane was counted. Data was converted to percent fruitset per plot.
22-Apr-15	147DAA2	The four tagged canes per plot were revisited and the number of fruit per cane was counted, reported as the percentage fruitset.
23-Apr-15	148DAA2	A 100 fruit sample was harvested at random across each plot. Fruit were weighed and fruit shape was assessed. Fruit were graded into marketable, misshapen and double fruit.

3.9 Statistical Analysis

Statistical analyses were carried out using Gylling's "Agricultural Research Manager" (ARM version 9). Analysis of Variance (ANOVA) and Least Significant Difference (LSD) tests at the 5% level were used to compare treatments.

4. RESULTS AND DISCUSSION

Results are summarised in Tables 4.1.1 – 4.1.5 and are given fully in the appendices.

4.1 Pre-treatment

Prior to the first application of treatments an assessment of the level of budrot across the trial area was conducted. Fifty buds were counted per plot for the incidence and severity of budrot (sepal browning). The severity of infection was determined by the percentage sepal area exhibiting browning.

Table 4.1.1 below shows that the level of budrot observed in this trial was relatively high with 12-20 % buds exhibiting budrot symptoms. The severity of those infected buds averaged around 20%, and the total severity around 2-5%.

Whilst there was some variation between treatments prior to the application of treatments, no significant differences were present, indicating the level of budrot infection was consistent across the trial block.

Table 4.1.1: Mean effect of treatments on sepal browning of buds at pre-treatment and pre-flower - 20-Nov-14 (-1DAA1)

Treatment	Rate per 100 L	Incidence (%)	Severity (%)	Total severity (%)
UNTREATED CONTROL	-	11.75	20.64	2.43
HML32	1.25 L	11.35*	18.07*	2.22*
TNL3067		14.68*	16.93*	2.94*
PRODUCT C	500 g	11.75	18.99	2.39
NORDOX	37.5 g	20.00	23.52	5.51
BOTRYZEN	800 g	16.00	22.07	3.79
NORDOX + ACTIGARD	37.5 g + 20 g	12.50	19.51	2.78
PRODUCT C + ACTIGARD	500 g + 20 g	13.25	19.47	2.86
F Probability		0.202	0.843	0.109
LSD 5 %		n/s	n/s	n/s

**=missing plot*

Numbers in columns followed by a different letter indicate significant differences (P<0.05), n/s indicates no statistical difference.

In order to understand the Psa complex in the Hayward kiwifruit orchard, a measure of leaf spotting was recorded to see if any correlation may exist between budrot in the developing flower buds, and the level of leaf spotting observed (Table 4.1.2). Symptoms of Psa were observed on the leaves in plots across all allocated treatments, as was the case with the buds, but no apparent correlation in the incidence or severity of the infection could be determined between the leaves and flower buds. This being said it is obvious the infection was present in a high number of both leaves and flower buds across the trial area.

Table 4.1.2: Mean effect of treatments on leaf spot infection at pre-treatment and pre-flower - 20-Nov-14 (-1DAA1)

Treatment	Rate per 100 L	Incidence (%)	Severity (%)
UNTREATED CONTROL	-	8.50	14.75
HML32	1.25 L	6.71*	14.19*
TNL3067		6.46*	8.67*
PRODUCT C	500 g	3.88	5.38
NORDOX	37.5 g	3.63	8.00
BOTRYZEN	800 g	5.13	11.50
NORDOX + ACTIGARD	37.5 g + 20 g	4.13	8.88
PRODUCT C + ACTIGARD	500 g + 20 g	5.75	8.38
F Probability		0.836	0.772
LSD 5 %		n/s	n/s

**=missing plot*

Numbers in columns followed by a different letter indicate significant differences (P<0.05), n/s indicates no statistical difference.

An assessment was conducted four days after the first application of treatments to measure the level of budrot on four marked canes, and count the number of flowers per cane so future assessments on fruitset could be made (Table 4.1.3). Data is presented as the percentage of buds with sepal browning on the total of four canes per plot.

Table 4.1.3: Mean effect of treatments on infected buds - 25-Nov-14 (4DAA1)

Treatment	Rate per 100 L	Buds infected (%)
UNTREATED CONTROL	-	22.34
HML32	1.25 L	24.19*
TNL3067		31.74*
PRODUCT C	500 g	3.75
NORDOX	37.5 g	20.63
BOTRYZEN	800 g	29.22
NORDOX + ACTIGARD	37.5 g + 20 g	11.56
PRODUCT C + ACTIGARD	500 g + 20 g	55.47
F Probability		0.389
LSD 5 %		n/s

**=missing plot*

Numbers in columns followed by a different letter indicate significant differences (P<0.05), n/s indicates no statistical difference.

Four days after the first application was made over 60-70% of flowers were open across the trial plots, the ideal time to assess the impact of budrot on flower development. Results indicate that the percentage buds infected not only varied between treatments, but considerable variability was also observed within treatments. This variation had an impact on the trial results with no significance observed between treatments even though there was quite a large range of infected buds across the treatments.

After fruitset another assessment was conducted to measure the percentage of flowers that had set fruit on the four tagged canes in each plot (Table 4.1.4). The fruit on each of the four canes in each plot were also assessed for shape with any misshapen fruit categorised into misshapen fruit and double fruit (flats).

Fruitset across all treatments was high with over 90% of flowers pollinating into fruitlets. This is a surprise given that between 10-20% of buds in the block were measured to have an average 20% area of sepal browning pre-treatment (Table 4.1.1). The sepal browning on the buds therefore did not have a significant impact in the ability of individual buds to pollinate and set fruit. The sepal browning and Psa infection being present in the flower however may impact the fruit shape and ability to develop normally.

In this study there was variation between treatments (and within treatments) in the level of misshapen fruit. While no significant difference was observed between treatments, no products provided any obvious improvement in fruit shape when compared to the Untreated Control.

Table 4.1.4: Mean effect of treatments on fruitset of Hayward kiwifruit - 23-Dec-14 (27DAA2)

Treatment	Rate per 100 L	Fruit set (%)	Misshapen fruit (%)	Double fruit (%)	Total misshapen + double fruit (%)
UNTREATED CONTROL	-	91.38	1.29	0.34	1.62
HML32	1.25 L	93.02*	3.83*	0.24*	4.07*
TNL3067		93.46*	4.78*	0.5*	5.28*
PRODUCT C	500 g	95.65	1.91	0.22	2.13
NORDOX	37.5 g	92.46	4.64*	0.32*	4.96*
BOTRYZEN	800 g	91.31	2.26	1.28	3.54
NORDOX + ACTIGARD	37.5 g + 20 g	90.95	4.01	0.48	4.49
PRODUCT C + ACTIGARD	500 g + 20 g	91.34	3.19	0.00	3.19
F Probability		0.804	0.057	0.095	0.133
LSD 5 %		n/s	n/s	n/s	n/s

**=missing plot*

Numbers in columns followed by a different letter indicate significant differences (P<0.05), n/s indicates no statistical difference.

After the fruitlet assessment on 23 December the orchardist bud thinned the whole trial area. The bud thinning was done across the block and unfortunately fruit were removed from the trial area, thinning for misshapen fruit and to reduce the crop load to improve fruit size.

The final assessment was conducted just prior to commercial harvest. Fruit from each cane were once again counted and fruit weighed (Table 4.1.5). The fruit counts (expressed as percentage fruitset) were much lower than the December assessment, this drop in number a result of fruit removed by the orchardist staff at fruit thinning. Needless to say no differences were observed.

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Table 4.1.5: Mean effect of treatments on Hayward kiwifruit at harvest - 22 and 23-Apr-15 (147DAA2 and 148DAA2)

Treatment	Rate per 100 L	Fruit set (%)	100 Fruit weight (g)	Total misshapen fruit (%)
UNTREATED CONTROL	-	72.31	12402.50	7.88
HML32	1.25 L	70.24*	12388.99*	7.91*
TNL3067		69.43*	12782.26*	7.07*
PRODUCT C	500 g	71.29	12172.38	8.75
NORDOX	37.5 g	68.76	11904.75	7.38
BOTRYZEN	800 g	76.71	12703.50	9.88
NORDOX + ACTIGARD	37.5 g + 20 g	66.05	12763.00	6.13
PRODUCT C + ACTIGARD	500 g + 20 g	74.28	12397.00	8.50
F Probability		0.623	0.255	0.754
LSD 5 %		n/s	n/s	n/s

**=missing plot*

Numbers in columns followed by a different letter indicate significant differences (P<0.05), n/s indicates no statistical difference.

A 100 fruit sample from each plot was harvested and weighed to see if any treatments had a positive or negative effect on fruit size. No difference was observed between treatments, and given the consistency of the bud thinning across the block it can be deduced that the bud thinning would not have had any overall impact on the fruit weight for any specific treatment over another.

The total percentage of misshapen fruit was measured from the 100 fruit sample. While the percentage of misshapen fruit varied between 6 - 9% across all treatments, there was no significant difference between treatments.

5. CONCLUSIONS

A moderate level of budrot was observed in the trial prior to the first application of treatments with an average of 14% of buds exhibiting Psa symptoms of sepal browning.

No significant differences in the sepal browning, fruitset, fruit weight and fruit shape were observed between the Untreated Control and any of the applied treatments in this study. While this importantly indicates that none of the treatments had a negative impact on the pollination, or yield components of Hayward kiwifruit, conclusions cannot be made as to the level of control of Psa that each product may have provided. Budrot had already developed in the trial area prior to the start of the trial, and given the window of control in this trial being over the flowering period only, the background level of Psa infection was already considerably well established. To add to this, weather conditions over flowering were ideal with consistent mild temperatures and very little rainfall (<3 mm in total).

All of the products were found to be easy to mix in solution with agitation, and all products were easy to apply.No signs of phytotoxicity were observed as a result of the application of any of the treatments.

6. APPENDICES

6.1 Raw Data

Table 6.1.1: Mean effect of treatments on sepal browning of buds at pre-treatment and pre-flower - 20-Nov-14 (-1DAA1)

Treatment	Rate per 100 L	Rep.	Incidence (%)	Severity (%)	Total severity (%)
		1	12.00	11.67	1.40
		2	16.00	20.63	3.30
		3	10.00	18.00	1.80
		4	12.00	19.17	2.30
		5	10.00	44.00	4.40
		6	8.00	10.00	0.80
		7	12.00	21.67	2.60
		8	14.00	20.00	2.80
UNTREATED CONTROL	**-**	**Mean**	**11.75**	**20.64**	**2.43**
		1	18.00	22.78	4.10
		2	22.00	21.36	4.70
		3	12.00	15.00	1.80
		4	14.79*	16.69*	2.50*
		5	4.00	7.50	0.30
		6	4.00	12.50	0.50
		7	8.00	25.00	2.00
		8	8.00	23.75	1.90
HML32	**1.25 L**	**Mean**	**11.35**	**18.07**	**2.22**
		1	6.00	5.00	0.30
		2	10.00	6.00	0.60
		3	18.00	30.56	5.50
		4	24.00	20.00	4.80
		5	14.00	20.71	2.90
		6	8.00	8.75	0.70
		7	13.45*	21.05*	3.08*
		8	24.00	23.33	5.60
TNL3067	**0.0**	**Mean**	**14.68**	**16.93**	**2.94**
		1	10.00	23.00	2.30
		2	14.00	8.57	1.20
		3	4.00	12.50	0.50
		4	26.00	20.77	5.40
		5	14.00	31.43	4.40
		6	6.00	6.67	0.40
		7	10.00	30.00	3.00
		8	10.00	19.00	1.90
PRODUCT C	**500 g**	**Mean**	**11.75**	**18.99**	**2.39**
		1	4.00	7.50	0.30
		2	32.00	26.56	8.50
		3	22.00	24.55	5.40
		4	8.00	8.75	0.70
		5	22.00	20.00	4.40
		6	16.00	29.38	4.70
		7	26.00	33.08	8.60
		8	30.00	38.33	11.50

NORDOX	**37.5 g**	**Mean**	**20.00**	**23.52**	**5.51**
		1	16.00	18.75	3.00
		2	4.00	7.50	0.30
		3	30.00	23.00	6.90
		4	24.00	16.25	3.90
		5	18.00	33.33	6.00
		6	16.00	32.50	5.20
		7	6.00	16.67	1.00
		8	14.00	28.57	4.00
BOTRYZEN	**800 g**	**Mean**	**16.00**	**22.07**	**3.79**
		1	6.00	5.00	0.30
		2	22.00	19.55	4.30
		3	14.00	20.00	2.80
		4	10.00	18.00	1.80
		5	10.00	25.00	2.50
		6	4.00	12.50	0.50
		7	12.00	23.33	2.80
		8	22.00	32.73	7.20
NORDOX + ACTIGARD	**37.5 g + 20 g**	**Mean**	**12.50**	**19.51**	**2.78**
		1	18.00	13.33	2.40
		2	12.00	17.50	2.10
		3	10.00	15.00	1.50
		4	20.00	28.50	5.70
		5	16.00	40.00	6.40
		6	10.00	15.00	1.50
		7	14.00	21.43	3.00
		8	6.00	5.00	0.30
PRODUCT C + ACTIGARD	**500 g + 20 g**	**Mean**	**13.25**	**19.47**	**2.86**

**=missing plot*

Table 6.1.2: Mean effect of treatments on leaf spot infection at pre-treatment and pre-flower - 20-Nov-14 (-1DAA1)

Treatment	Rate per 100 L	Rep.	Incidence (%)	Severity (%)
		1	1.00	1.00
		2	2.00	20.00
		3	2.00	1.00
		4	10.00	10.00
		5	1.00	1.00
		6	2.00	25.00
		7	10.00	5.00
		8	40.00	55.00
UNTREATED CONTROL	**-**	**Mean**	**8.50**	**14.75**
		1	20.00	35.00
		2	5.00	45.00
		3	1.00	1.00
		4	7.64*	12.54*
		5	10.00	10.00
		6	5.00	5.00
		7	5.00	5.00

		8	0.00	0.00
HML32	**1.25 L**	**Mean**	**6.71**	**14.19**
		1	0.00	0.00
		2	20.00	35.00
		3	10.00	10.00
		4	5.00	5.00
		5	5.00	2.00
		6	2.00	15.00
		7	4.64*	1.38*
		8	5.00	1.00
TNL3067	**0.0**	**Mean**	**6.46**	**8.67**
		1	2.00	5.00
		2	1.00	1.00
		3	5.00	5.00
		4	5.00	5.00
		5	10.00	20.00
		6	5.00	5.00
		7	1.00	1.00
		8	2.00	1.00
PRODUCT C	**500 g**	**Mean**	**3.88**	**5.38**
		1	0.00	0.00
		2	5.00	5.00
		3	0.00	0.00
		4	2.00	2.00
		5	1.00	5.00
		6	5.00	25.00
		7	1.00	2.00
		8	15.00	25.00
NORDOX	**37.5 g**	**Mean**	**3.63**	**8.00**
		1	5.00	25.00
		2	10.00	15.00
		3	2.00	10.00
		4	5.00	10.00
		5	5.00	5.00
		6	10.00	25.00
		7	2.00	1.00
		8	2.00	1.00
BOTRYZEN	**800 g**	**Mean**	**5.13**	**11.50**
		1	1.00	1.00
		2	15.00	35.00
		3	5.00	15.00
		4	2.00	2.00
		5	2.00	5.00
		6	5.00	10.00
		7	1.00	1.00
NORDOX + ACTIGARD	**37.5 g + 20 g**	8	2.00	2.00
		Mean	**4.13**	**8.88**
		1	2.00	5.00
		2	2.00	1.00
		3	5.00	5.00
		4	15.00	20.00

		5	5.00	10.00
		6	2.00	1.00
		7	5.00	5.00
PRODUCT C +	**500 g +**	8	10.00	20.00
ACTIGARD	**20 g**	**Mean**	**5.75**	**8.38**

**=missing plot*

Table 6.1.3: Mean effect of treatments on infected buds - 25-Nov-14 (4DAA1)

Treatment	Rate per 100 L	Rep.	Buds infected (%)
		1	2.50
		2	5.00
		3	26.25
		4	13.75
		5	0.00
		6	30.00
		7	100.00
		8	1.25
UNTREATED CONTROL	**-**	**Mean**	**22.34**
		1	12.50
		2	0.00
		3	0.00
		4	46.02*
		5	102.50
		6	27.50
		7	5.00
		8	0.00
HML32	**1.25 L**	**Mean**	**24.19**
		1	0.00
		2	12.50
		3	92.50
		4	17.50
		5	90.00
		6	0.00
		7	28.93*
		8	12.50
TNL3067	**0.0**	**Mean**	**31.74**
		1	0.00
		2	0.00
		3	2.50
		4	2.50
		5	0.00
		6	2.50
		7	0.00
		8	22.50
PRODUCT C	**500 g**	**Mean**	**3.75**
		1	7.50
		2	5.00
		3	30.00

		4	5.00
		5	7.50
		6	25.00
		7	5.00
		8	80.00
NORDOX	**37.5 g**	**Mean**	**20.63**
		1	7.50
		2	0.00
		3	42.50
		4	8.75
		5	42.50
		6	45.00
		7	10.00
		8	77.50
BOTRYZEN	**800 g**	**Mean**	**29.22**
		1	5.00
		2	0.00
		3	20.00
		4	20.00
		5	25.00
		6	0.00
		7	7.50
NORDOX + ACTIGARD	**37.5 g + 20 g**	8	15.00
		Mean	**11.56**
		1	2.50
		2	62.50
		3	3.75
		4	260.00
		5	12.50
		6	80.00
		7	20.00
PRODUCT C + ACTIGARD	**500 g + 20 g**	8	2.50
		Mean	**55.47**

**=missing plot*

Table 6.1.4: Mean effect of treatments on fruitset of Hayward kiwifruit - 23-Dec-14 (27DAA2)

Treatment	Rate per 100 L	Rep.	Fruit set (%)	Misshapen fruit (%)	Double fruit (%)	Total Misshapen + double fruit (%)
		1	94.61	2.13	0.00	2.13
		2	96.61	0.00	0.00	0.00
		3	100.00	0.00	0.00	0.00
		4	83.32	2.47	0.00	2.47
		5	95.09	0.00	0.00	0.00
		6	100.00	3.54	0.88	4.42
		7	81.96	0.92	1.83	2.75
		8	79.45	1.22	0.00	1.22
UNTREATED CONTROL	**-**	**Mean**	**91.38**	**1.29**	**0.34**	**1.62**
		1	92.12	6.35	0.00	6.35
		2	89.16	1.28	0.00	1.28

		3	95.95	5.88	0.00	5.88
		4	89.30*	5.31*	0.06*	5.37*
		5	95.80	0.00	0.00	0.00
		6	95.29	1.53	0.76	2.29
		7	88.73	7.95	1.14	9.09
		8	97.79	2.30	0.00	2.30
HML32	**1.25 L**	**Mean**	**93.02**	**3.83**	**0.24**	**4.07**
		1	90.58	1.18	0.00	1.18
		2	95.00	4.04	0.00	4.04
		3	92.41	9.89	3.30	13.19
		4	89.64	4.08	0.00	4.08
		5	97.22	6.32	0.00	6.32
		6	95.59	1.19	0.00	1.19
		7	92.21*	6.62*	0.69*	7.31*
		8	95.00	4.90	0.00	4.90
TNL3067	**0.0**	**Mean**	**93.46**	**4.78**	**0.50**	**5.28**
		1	99.07	1.69	0.85	2.54
		2	96.43	1.06	0.00	1.06
		3	97.56	0.00	0.00	0.00
		4	85.00	0.00	0.00	0.00
		5	94.59	3.00	0.00	3.00
		6	95.61	2.68	0.00	2.68
		7	97.79	3.26	0.00	3.26
		8	99.14	3.60	0.90	4.50
PRODUCT C	**500 g**	**Mean**	**95.65**	**1.91**	**0.22**	**2.13**
		1	96.35	0.00	0.00	0.00
		2	88.13	5.49	1.10	6.59
		3	97.69	4.23*	0.54*	4.77*
		4	90.28	7.41	0.00	7.41
		5	95.96	0.00	0.00	0.00
		6	94.11	0.00	0.00	5.36
		7	96.45	4.11	0.00	4.11
		8	80.72	11.43	0.00	11.43
NORDOX	**37.5 g**	**Mean**	**92.46**	**4.64**	**0.32**	**4.96**
		1	95.17	0.00	0.00	0.00
		2	100.00	0.00	0.00	0.00
		3	81.66	2.63	1.32	3.95
		4	100.00	5.50	1.83	7.34
		5	81.01	1.61	0.00	1.61
		6	84.83	3.03	3.03	6.06
		7	91.34	2.44	1.22	3.66
		8	96.47	2.83	2.83	5.66
BOTRYZEN	**800 g**	**Mean**	**91.31**	**2.26**	**1.28**	**3.53**
		1	96.53	0.00	0.00	0.00
		2	95.85	2.61	1.74	4.35
		3	82.72	0.00	0.00	0.00
		4	91.83	7.14	0.00	7.14
		5	88.44	6.59	0.00	6.59
		6	81.38	2.47	0.00	2.47
		7	93.35	9.09	0.00	9.09
NORDOX +	**37.5 g +**	8	97.52	4.17	2.08	6.25

ACTIGARD	**20 g**	**Mean**	**90.95**	**4.01**	**0.48**	**4.49**
		1	95.59	0.00	0.00	0.00
		2	90.75	4.21	0.00	4.21
		3	97.92	0.00	0.00	0.00
		4	80.43	5.88	0.00	5.88
		5	92.19	3.45	0.00	3.45
		6	97.37	2.04	0.00	2.04
		7	87.78	6.25	0.00	6.25
PRODUCT C +	**500 g +**	8	88.70	3.70	0.00	3.70
ACTIGARD	**20 g**	**Mean**	**91.34**	**3.19**	**0.00**	**3.19**

**=missing plot*

Table 6.1.5: Mean effect of treatments on Hayward kiwifruit at harvest - 22 and 23-Apr-15 (147DAA2 and 148DAA2)

Treatment	Rate per 100 L	Rep.	Fruit set (%) 147DAA2	Fruit weight (g) 148DAA2	Total misshapen fruit (%) 148DAA2
		1	70.93	12700.00	13.00
		2	74.88	11761.00	7.00
		3	65.90	11849.00	8.00
		4	74.03	13097.00	8.00
		5	87.62	11565.00	5.00
		6	80.80	11948.00	8.00
		7	71.66	12670.00	10.00
		8	52.65	13630.00	4.00
UNTREATED CONTROL	**-**	**Mean**	**72.31**	**12402.50**	**7.88**
		1	65.57	13188.00	7.00
		2	84.19	12555.00	6.00
		3	81.37	12000.00	4.00
		4	71.79*	12230.94*	5.25*
		5	74.73	11809.00	15.00
		6	76.87	11320.00	9.00
		7	49.82	12797.00	4.00
		8	57.57	13212.00	13.00
HML32	**1.25 L**	**Mean**	**70.24**	**12388.99**	**7.91**
		1	67.42	12723.00	15.00
		2	84.27	12244.00	8.00
		3	53.38	13831.00	5.00
		4	65.40	12970.00	4.00
		5	62.82	12802.00	8.00
		6	83.34	13067.00	3.00
		7	67.16*	13210.10*	6.59*
		8	71.67	11411.00	7.00
TNL3067	**0.0**	**Mean**	**69.43**	**12782.26**	**7.07**
		1	85.24	12172.00	7.00
		2	68.54	12464.00	13.00
		3	65.62	11329.00	8.00
		4	71.94	11358.00	5.00
		5	75.69	13248.00	11.00

		6	67.86	11976.00	15.00
		7	64.57	12182.00	6.00
		8	70.82	12650.00	5.00
PRODUCT C	**500 g**	**Mean**	**71.29**	**12172.38**	**8.75**
		1	75.13	11444.00	11.00
		2	61.36	12474.00	7.00
		3	71.96	11772.00	7.00
		4	73.33	11268.00	2.00
		5	90.74	10639.00	15.00
		6	65.34	11886.00	15.00
		7	64.22	13385.00	8.00
		8	47.96	12370.00	5.00
NORDOX	**37.5 g**	**Mean**	**68.76**	**11904.75**	**8.75**
		1	89.45	13220.00	25.00
		2	94.63	11586.00	6.00
		3	58.88	13086.00	9.00
		4	79.23	11584.00	5.00
		5	83.58	13707.00	13.00
		6	51.82	12644.00	3.00
		7	80.79	12601.00	13.00
		8	75.32	13200.00	5.00
BOTRYZEN	**800 g**	**Mean**	**76.71**	**12703.50**	**9.88**
		1	77.22	12803.00	2.00
		2	53.73	12360.00	4.00
		3	61.97	12060.00	11.00
		4	68.08	12814.00	8.00
		5	63.25	12181.00	4.00
		6	50.11	12308.00	8.00
		7	73.35	12758.00	6.00
NORDOX +	**37.5 g +**	8	80.72	14820.00	6.00
ACTIGARD	**20 g**	**Mean**	**66.06**	**12763.00**	**6.13**
		1	69.53	11760.00	20.00
		2	66.55	10816.00	5.00
		3	71.35	13045.00	7.00
		4	77.66	12928.00	5.00
		5	80.46	11943.00	12.00
		6	83.00	12380.00	11.00
		7	79.29	13334.00	6.00
PRODUCT C +	**500 g +**	8	66.37	12970.00	2.00
ACTIGARD	**20 g**	**Mean**	**74.28**	**12397.00**	**8.50**

**=missing plot*

6.2 Photographs

Photo 1 – General view of trial at commencement (21-Nov-14)

Photo 2 – BOTRY-Zen on flowers after application (21-Nov-14)

Photo 3 – Growth stage at Appln 2 (26-Nov-14)

Photo 4 – Fruitlet with necrotic stem (23-Dec-14)

Photo 5 – Tagged canes at harvest (22-Apr-14)

Photo 2 – Trial fruit harvested and dropped to the ground (23-Apr-14)

6.3 Weather Data

Name	Station ID	Latitude	Longitude	Altitude	Authority
Whakatane Aero (MetService)	BP2	-37.92	176.92	7 m	HortPlus MetWatch

Event	Date	Max Air Temp. (°C)	Min Air Temp. (°C)	Mean Air Temp. (°C)	Rainfall (mm)
	Wed 19th Nov 2014	21.6	6.0	13.8	0.4
Assessment	**Thu 20th Nov 2014**	**20.8**	**7.2**	**14.0**	**0**
Application 1	**Fri 21st Nov 2014**	**22.5**	**7.5**	**15.0**	**0**
	Sat 22nd Nov 2014	22.7	12.4	17.6	0
	Sun 23rd Nov 2014	21.5	12.3	16.9	0
	Mon 24th Nov 2014	20.2	14.1	17.1	0
Assessment	**Tue 25th Nov 2014**	**22.0**	**12.1**	**17.1**	**0**
Application 2	**Wed 26th Nov 2014**	**26.5**	**15.0**	**20.8**	**0**
	Thu 27th Nov 2014	23.7	7.8	15.8	0.8
	Fri 28th Nov 2014	19.6	14.3	17.0	1
	Sat 29th Nov 2014	21.5	6.4	13.9	0
	Sun 30th Nov 2014	23.3	11.1	17.2	0
	Mon 1st Dec 2014	19.4	8.3	13.8	0.4
	Tue 2nd Dec 2014	20.1	6.2	13.2	0
	Wed 3rd Dec 2014	19.5	4.9	12.2	0
	Thu 4th Dec 2014	22.9	11.1	17.0	0
	Fri 5th Dec 2014	22.7	13.8	18.2	0
	Sat 6th Dec 2014	20.4	13.3	16.9	0
	Sun 7th Dec 2014	28.6	12.0	20.3	0
	Mon 8th Dec 2014	24.4	13.9	19.1	1.4
	Tue 9th Dec 2014	18.9	13.9	16.4	2.4
	Wed 10th Dec 2014	21.6	14.6	18.1	16.8
	Thu 11th Dec 2014	18.9	15.4	17.1	1.4
	Fri 12th Dec 2014	19.2	14.4	16.8	0
	Sat 13th Dec 2014	19.9	9.4	14.6	6.6
	Sun 14th Dec 2014	18.1	13.9	16.0	9.6
	Mon 15th Dec 2014	22.6	13.3	18.0	0
	Tue 16th Dec 2014	21.1	8.2	14.7	7.4
	Wed 17th Dec 2014	18.3	12.3	15.3	114
	Thu 18th Dec 2014	23.0	12.4	17.7	0
	Fri 19th Dec 2014	23.2	13.8	18.5	0
	Sat 20th Dec 2014	22.5	15.2	18.9	9.2
	Sun 21st Dec 2014	24.4	18.8	21.6	0.2
	Mon 22nd Dec 2014	23.5	13.0	18.2	0
Assessment	**Tue 23rd Dec 2014**	**22.6**	**14.0**	**18.3**	**0.8**
	Wed 24th Dec 2014	21.8	16.3	19.1	0
	Thu 25th Dec 2014	21.5	17.1	19.3	0
	Fri 26th Dec 2014	21.3	14.0	17.6	0
	Sat 27th Dec 2014	21.2	15.2	18.2	0
	Sun 28th Dec 2014	22.8	15.4	19.1	0
	Mon 29th Dec 2014	23.3	16.6	20.0	0
	Tue 30th Dec 2014	22.3	15.3	18.8	0
	Wed 31st Dec 2014	22.6	14.1	18.4	6
	Thu 1st Jan 2015	25.1	16.8	21.0	0
	Fri 2nd Jan 2015	23.1	12.2	17.6	0
	Sat 3rd Jan 2015	24.3	16.7	20.5	8.4
	Sun 4th Jan 2015	22.8	16.1	19.5	0
	Mon 5th Jan 2015	24.4	18.7	21.5	0

Tue 6th Jan 2015	23.8	13.8	18.8	0
Wed 7th Jan 2015	25.5	16.1	20.8	0
Thu 8th Jan 2015	26.5	16.7	21.6	0
Fri 9th Jan 2015	22.8	15.5	19.1	0
Sat 10th Jan 2015	24.8	17.1	21.0	1
Sun 11th Jan 2015	23.8	17.6	20.7	0
Mon 12th Jan 2015	25.6	12.9	19.2	0
Tue 13th Jan 2015	25.2	16.4	20.8	0
Wed 14th Jan 2015	25.3	18.1	21.7	0
Thu 15th Jan 2015	24.7	16.5	20.6	0
Fri 16th Jan 2015	25.5	13.9	19.7	0
Sat 17th Jan 2015	25.9	17.3	21.6	0
Sun 18th Jan 2015	27.8	18.0	22.9	0
Mon 19th Jan 2015	26.8	14.1	20.4	0
Tue 20th Jan 2015	26.2	13.3	19.8	0
Wed 21st Jan 2015	26.8	15.2	21.0	0
Thu 22nd Jan 2015	26.0	14.6	20.3	0
Fri 23rd Jan 2015	24.8	15.9	20.4	0
Sat 24th Jan 2015	25.7	15.6	20.6	0
Sun 25th Jan 2015	24.8	16.7	20.8	0
Mon 26th Jan 2015	24.0	12.9	18.4	0
Tue 27th Jan 2015	28.9	13.4	21.1	0
Wed 28th Jan 2015	26.3	14.9	20.6	0
Thu 29th Jan 2015	26.5	15.3	20.9	0
Fri 30th Jan 2015	25.7	18.0	21.9	1
Sat 31st Jan 2015	25.1	18.5	21.8	3.8
Sun 1st Feb 2015	23.8	18.9	21.4	11.6
Mon 2nd Feb 2015	25.5	18.8	22.1	4
Tue 3rd Feb 2015	29.8	18.5	24.1	0
Wed 4th Feb 2015	23.4	14.2	18.8	4
Thu 5th Feb 2015	25.7	17.1	21.4	0
Fri 6th Feb 2015	24.9	15.7	20.3	0
Sat 7th Feb 2015	21.9	7.9	14.9	0
Sun 8th Feb 2015	23.6	9.9	16.8	0
Mon 9th Feb 2015	24.4	12.7	18.5	0
Tue 10th Feb 2015	24.9	14.3	19.6	0
Wed 11th Feb 2015	23.3	7.1	15.2	0
Thu 12th Feb 2015	23.1	14.3	18.7	0
Fri 13th Feb 2015	23.1	8.7	15.9	0
Sat 14th Feb 2015	23.9	11.7	17.8	0
Sun 15th Feb 2015	23.3	7.4	15.4	0
Mon 16th Feb 2015	23.6	10.9	17.2	6.6
Tue 17th Feb 2015	19.3	14.6	16.9	0.4
Wed 18th Feb 2015	23.7	15.3	19.5	0
Thu 19th Feb 2015	24.6	13.5	19.1	0
Fri 20th Feb 2015	23.7	12.8	18.2	0
Sat 21st Feb 2015	24.7	12.0	18.4	-
Sun 22nd Feb 2015	-	-	-	-
Mon 23rd Feb 2015	24.0	-	-	0
Tue 24th Feb 2015	23.8	13.0	18.4	0
Wed 25th Feb 2015	24.6	13.1	18.9	0
Thu 26th Feb 2015	25.4	16.3	20.9	-
Fri 27th Feb 2015	24.0	-	-	0
Sat 28th Feb 2015	25.2	14.0	19.6	0
Sun 1st Mar 2015	24.4	15.0	19.7	0
Mon 2nd Mar 2015	24.3	15.1	19.7	0

	Tue 3rd Mar 2015	23.0	14.3	18.6	0
	Wed 4th Mar 2015	21.2	16.0	18.6	0.2
	Thu 5th Mar 2015	24.0	14.4	19.2	0
	Fri 6th Mar 2015	24.3	18.2	21.2	0
	Sat 7th Mar 2015	24.6	16.5	20.6	5.8
	Sun 8th Mar 2015	26.0	16.8	21.4	0
	Mon 9th Mar 2015	25.1	11.1	18.1	0
	Tue 10th Mar 2015	24.1	13.1	18.6	0
	Wed 11th Mar 2015	24.1	12.9	18.5	6.6
	Thu 12th Mar 2015	22.0	17.1	19.6	1
	Fri 13th Mar 2015	23.9	13.5	18.7	0
	Sat 14th Mar 2015	25.1	12.1	18.6	0
	Sun 15th Mar 2015	24.0	14.2	19.1	12.2
	Mon 16th Mar 2015	23.9	17.4	20.6	0
	Tue 17th Mar 2015	24.2	13.1	18.6	1
	Wed 18th Mar 2015	21.4	7.1	14.2	0
	Thu 19th Mar 2015	21.8	11.3	16.6	0
	Fri 20th Mar 2015	20.5	7.3	13.9	0
	Sat 21st Mar 2015	21.0	5.8	13.4	0
	Sun 22nd Mar 2015	21.9	7.6	14.8	7
	Mon 23rd Mar 2015	21.4	12.0	16.7	0.6
	Tue 24th Mar 2015	21.5	10.2	15.8	0
	Wed 25th Mar 2015	22.3	12.7	17.5	0
	Thu 26th Mar 2015	21.9	12.2	17.0	0.2
	Fri 27th Mar 2015	23.2	15.3	19.2	1.6
	Sat 28th Mar 2015	22.4	16.5	19.4	1.8
	Sun 29th Mar 2015	22.6	17.4	20.0	3
	Mon 30th Mar 2015	23.8	13.6	18.7	0
	Tue 31st Mar 2015	22.6	10.4	16.5	0
	Wed 1st Apr 2015	23.6	9.7	16.6	0
	Thu 2nd Apr 2015	21.1	12.5	16.8	0.2
	Fri 3rd Apr 2015	23.6	7.3	15.5	0
	Sat 4th Apr 2015	24.9	10.4	17.6	0
	Sun 5th Apr 2015	23.5	14.3	18.9	13.6
	Mon 6th Apr 2015	20.9	15.7	18.3	1.2
	Tue 7th Apr 2015	23.1	14.9	19.0	0
	Wed 8th Apr 2015	22.6	13.3	18.0	0.8
	Thu 9th Apr 2015	21.2	17.6	19.4	4.2
	Fri 10th Apr 2015	21.1	16.7	18.9	8.6
	Sat 11th Apr 2015	21.8	15.8	18.8	0
	Sun 12th Apr 2015	21.6	8.5	15.1	0.6
	Mon 13th Apr 2015	20.8	12.4	16.6	5.2
	Tue 14th Apr 2015	16.2	5.1	10.6	0
	Wed 15th Apr 2015	17.5	0.3	8.9	0
	Thu 16th Apr 2015	19.4	2.8	11.1	0
	Fri 17th Apr 2015	20.0	2.6	11.3	1.2
	Sat 18th Apr 2015	15.6	9.5	12.6	4.4
	Sun 19th Apr 2015	21.1	9.7	15.4	0
	Mon 20th Apr 2015	20.6	9.9	15.2	0
	Tue 21st Apr 2015	20.5	11.8	16.1	0
Assessment	**Wed 22nd Apr 2015**	**22.9**	**11.3**	**17.1**	**0.6**
Assessment	**Thu 23rd Apr 2015**	**22.1**	**9.8**	**16.0**	**0**
	Fri 24th Apr 2015	20.6	8.2	14.4	0.2