EVALUATING THE FRUIT SENSITIVE PERIOD TO COPPER IN HAYWARD KIWIFRUIT

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1. EXECUTIVE SUMMARY

During the summer of 2012/13 two trials were established in a Hayward kiwifruit orchard located in Gisborne in the North Island of New Zealand. Trial objectives were:

1. To determine if there is a period post flowering when copper use should be avoided due to damage to fruit, which leads to an increase in fruit rejects.
2. To determine if rates of copper, addition of adjuvants or repeat applications of copper increase the risk of damage to fruit.

Trial 1 investigated the crop safety of applying the copper products Nordox 75WG (37.5g/100L), Champ DP (75g/100L) and Kocide Opti (70g/100L) as single applications targeted at 7, 14, 28, 42 or 56 days after full bloom. Water rates were 1,000L/ha increasing to 1,500L/ha as canopy density increased with later applications.

Trial 2 investigated the effect of copper product, rate, addition of adjuvant and multiple applications on crop safety. Treatments were:

1. Nordox (37.5g/100L)
2. Kocide (70g/100L)
3. Nordox (28g/100L)
4. Kocide (90g/100L)
5. Nordox (37.5g/100L) + Du Wett (400ml ha)
6. Nordox (37.5g/100L) + GroWet (400ml ha)
7. Kocide (70g/100L) + Du Wett (400ml ha)
8. Nordox (37.5g/100L, 3 applications)
9. Kocide (70g /100L, 3 applications)
10. Untreated control

Treatments 1-7 were targeted 28 days after full bloom. Treatments 8 and 9 commenced approximately 14 days after full bloom and were repeated twice at 14 day intervals. Water rate was 1,000L/ha apart from treatments 5-7 which were applied at 2x concentrate in 500L/ha.

Fruit was assessed two weeks after each application, two weeks after the final application, at the start of March and at harvest on 10 April. There was no evidence of fruit russet associated with any treatment in either trial. There was no evidence of any impact on fruit maturity (% dry matter, average hue and green fractile) in trial 2.

Three applications of Nordox at 37.5g/100L in trial 2 resulted in 4.0% water-stain. This was significantly worse that the untreated at 1.2% and three applications of Kocide Opti at 1.7% water-stain. Kiwilustre and Du-Wett Stainless had been applied prior to fruit harvest. Approximately 50% of the water-stain would not have met Zespri class 1 specifications.

Seasonal weather conditions during summer of 2012/13 were hot and dry with Gisborne receiving 66% of long term average rainfall. Weather conditions following application generally favoured rapid drying. There was limited rainfall in the two months prior to harvest. These two factors may have reduced the risk of fruit marking.

The results of this study are generally in line with grower experience over the summer of 2012/13 in Hayward kiwifruit. Regular copper applications made by growers at lower rates of copper were not associated with fruit marking or leaf damage.

2. INTRODUCTION

A 2011/2012 study in Hayward with copper applications commencing on 28 December 2011 found no phytotoxicity in fruit (M Black pers comm). Another study in Hayward (Grochem 2012) showed some phytotoxicity to fruit following multiple applications commencing approximately 25 days post full bloom. However these studies did not include copper applications in the month post-fruit set. This leaves the question as to whether there needs to be a crop safety window with Hayward, and if so, is it a month or shorter?

In a 2011/12 study (Lupton 2012) application of Nordox 75WG to Gold 3 36 days after full bloom at 37.5g/100L (563g/ha) with Latron B1956 at 25ml/100L at 1,500L/ha water rate resulted in 34% fruit with light russet on one side. Conditions at application were fine with good drying. Russet was not consistently observed in any other treatment. This study looked at application timings of 36 to 161 days after fruit set. This leaves the question: is there a window of safety between fruit set and 60 days? If not it would be useful to confirm 60 days as the interval.

In other research (Goodwin & McBrydie 2012), Hayward flowers were sprayed at 1, 2, 3, 4 or 5 day old. When copper sprays were applied to flowers 1, 2 and 3 days old seed numbers and fruit weights were reduced. Negative effects decreased with age of flower at treatment. No effect was observed when flowers were sprayed at 4 and 5 days old. This suggests spraying during flowering, especially early to mid-flowering, is better avoided.

Oil research has shown a risk period in Hayward for oil application between 4 weeks post-fruit set and the 3rd week of January (McKenna et al 2009). In Hort16A oils (McKenna et al 2011) were found to be phytotoxic from 3 weeks post-fruit set onwards, however, there is preliminary evidence of a second safe period around the later part of January. Phytotoxicity on fruit may be related to the growth pattern of the fruit, with most damage from oils observed during the rapid period of growth, when the fruit is rapidly expanding and the skin is thin. Based on fruit physiology, risk periods for oils may be similar for copper risk periods.

At present there is a period of up to 60 days after flowering where growers are nervous about copper use due to phytotoxicity in all kiwifruit varieties. Alternative chemical control options for Psa during this period have shown limited efficacy. It would be beneficial to shorten the period during which copper is not being used post-flowering, to improve protection against Psa.

3. STUDY OBJECTIVES

1. To determine if there is a period post flowering when copper use should be avoided due to damage to fruit, which leads to an increase in fruit rejects.
2. To determine if rates of copper, addition of adjuvants or repeat applications of copper increase the risk of damage to fruit.

4. MATERIALS AND METHOD

Trial Location, Design and Crop

Two trials were established in a Gisborne orchard containing a 0.59 hectare block of Hayward kiwifruit vines planted during the early 1980s. Vines were spaced 3.75m apart in the row with 2.85m between rows. Males were in alternate rows trained as a narrow strip. Vines were irrigated with a trickle system.

The 2012/13 summer in Gisborne was hot and dry with 306mm of rainfall from 1 November 2012 to 30 April 2013, 66% of long term average. 142mm fell in November, prior to the start of the trial. Further weather details are presented in Appendix 2.

Gisborne Rainfall	2012	2013	Long Term Average
1 Nov to 30 Apr	714mm (154%)	306mm (66%)	465mm

These drought conditions followed on from a wetter than normal autumn and winter with some stress related to root damage evident. Moisture stress was visible in some trial vines at the 20 December 2012 application. Hayward yields and fruit size in Gisborne at harvest 2013 were lower than normal and in

contrast with the preceding 2012 harvest which followed on from a summer with above average rainfall. In 2013 the trial orchard produced a crop of 3,568 trays per hectare at 37.5 count and 0.68 TZG compared with 8,860 trays per hectare in 2012.

		Yield Per Ha	Av. Count	TZG
2012	KPIN 7737	8,860	33.4	0.46
	Gisborne Packhouse Average	7,240	33.2	0.56
2013	KPIN 7737	3,570	37.5	0.68
	Gisborne Packhouse Average	5,810	36.6	0.76

The trial block received one application of Nordox 75WG pre flowering. No coppers were applied to the trial block post flowering. Serenade Max was applied in January 2013. A water-stain remover was applied prior to the harvest assessment. The grower spray diary is presented in Appendix 4.

Trial 1 investigated the "crop safe" window for applying copper after fruit set. Treatments included the following copper products and rates.

Product	Active Ingredient	Product Rate / 100L	Copper Rate / 100L	Product (and Copper) Rate / Ha
Nordox 75WG	750g/kg cuprous oxide	37.5g	28g	375-563g/ha (281-422g Cu/ha)
Champ DP	375g/kg copper hydroxide	75g	28g	750-1,125g/ha (281-422g Cu/ha)
Kocide Opti	300g/kg copper hydroxide	70g	21g	700-1,050g/ha (210-315g Cu/ha)

A single application of each product was targeted 7, 14, 28, 42 or 56 days after mid flowering which occurred on 25 November 2012. Plots were 3.75m long by 2.8m wide and contained half a vine. There were 8 replicates of each treatment. Applications were made with Echo SHR 150Si motorised knapsacks operating at 700kPa with 2 TXVK10 nozzles producing an output of 1.8L/min. Target water rate was 1,000L/ha for applications 1 & 2, 1,250L/ha for applications 3 & 4 and 1,500L/ha for application 5.

Trial 1: Application timing and weather data

Application	**1**	**2**	**3**	**4**	**5**
Date	2-Dec-12	11-Dec-12	20-Dec-12	7-Jan-13	20-Jan-13
Days after full bloom (DAFB)	7	16	25	43	56
Time	10.45-11.55	9.45-10.30	7.30-8.30	16.20-17.20	8.40-9.50
Water rate per plot	1.1	1.1	1.3	1.3	1.6
Water Rate per hectare	1,020	980	1,210	1,240	1,510
Wind speed (km/hr)	0-3km/hr	2km/hr	nil	6km/hr	1km/hr
Wind direction	NW	SE	-	SE	MW
Temperature	25°C	22°C	17°C	25°C	22-24°C
Relative Humidity	45%	65%	85%	65%	65%
Drying Time	10 mins	20 mins	60-45mins	20mins	15 mins
Cloud cover	50%	10%	20%	0%	40%
Crop surface	dry	dry	dry	dry	dry
Rainfall: 24 hours pre application	1.2mm	0.0mm	0.0mm	29.0mm	0.0mm
24 hours after	0.0mm	0.0mm	0.0mm	0.0mm	0.0mm
48 hours after	0.4mm	0.0mm	0.0mm	0.0mm	0.0mm

For further details of weather events refer to Appendix 2 which presents daily rainfall and max / min temperatures relating to application timings.

Trial 1: Assessment Timing
Onvine assessments for fruit phytotoxicity were conducted 14 days after an application. All plots were assessed 14 days after the final application and again in early March.

On 10 April 2013 50 fruit were collected from each plot and examined for possible phytotoxicity. Each plot was assessed for plant health on a 0-5 scale, (0= vine highly stressed, no export size fruit, 5= vine with good numbers of large fruit).

Trial 2 investigated the effect of copper rate, addition of adjuvants and multiple applications during a period of perceived risk following fruit set. Treatments included the following copper products, rates and application times.

Treatment	Rate/100L	Rate Per Ha	No. Applications and Target Timing	Target Water Rate Per Hectare
1. Nordox	37.5g	375g	1 at 28 DAFB	1,000
2. Kocide Opti	70g	700g	1 at 28 DAFB	1,000
3. Nordox	28g	280g	1 at 28 DAFB	1,000
4. Kocide Opti	90g	900g	1 at 28 DAFB	1,000
5. Nordox + Du-Wett	75g + 80ml	375g + 400ml	1 at 28 DAFB	500
6. Kocide Opti + Du-Wett	140g + 80ml	700g + 400ml	1 at 28 DAFB	500
7. Nordox + Gro Wet	75g + 80ml	375g + 400ml	1 at 28 DAFB	500
8. Nordox	37.5g	375g	3 at 14, 28 and 42 DAFB	1,000
9. Kocide Opti	70g	700g	3 at 14, 28 and 42 DAFB	1,000
10. Untreated				

Plots were 3.75m long by 5.0m wide and contained one whole vine. There were 10 replicates of each treatment.

Treatments 1-4 and 8-9 were made at a water rate of 1,000L/ha. Treatments 5-7 were made at 500L/ha as a 2x concentrate application with the organo-silicone super wetters Du-Wett and Gro wet.

In a related trial in Gold 3 coverage assessments at both water rates were conducted on 28-Nov-12. Water sensitive papers were pinned to canes adjacent to fruit. The water sensitive papers showed good coverage of the fruit zone at both water rates. The papers are presented in Appendix 3.

Trial 2: Application timing and weather data

Application	**1**	**2**	**3**
Date	11-Dec-12	20-Dec-12	7-Jan-13
Days after full bloom (DAFB)	16	25	43
Time	10.30-11.40	8.50-12.00	15.05-14.00
Water rate per plot	1.9	2.0 (0.96)	1.9
Water Rate per hectare	1,000	1,060 (510)	990
Wind speed (km/hr)	5km/hr	2km/hr	2.5km/hr
Wind direction	SE	SE	SE
Temperature	24°C	19-22°C	23-25°C
Relative Humidity	50%	75-60%	75%
Drying Time	10 mins	30 mins	20 mins
Cloud cover	20%	20-10%	20-0%
Crop surface	dry	dry	Dry
Rainfall: 24 hours pre application	0.0mm	0.0mm	29.0mm
24 hours after	0.0mm	0.0mm	0.0mm
48 hours after	0.0mm	0.0mm	0.0mm

* Figures in brackets refer to treatments 5-7 applied at 2x concentrate

Trial 2: Assessment Timing
On vine assessments for fruit phytotoxicity were conducted 14 days after application. All plots were assessed 14 days after the final application and again in early March.

On 9 April 2013 a composite sample of 100 fruit was collected from each treatment. 10 fruit were collected from each plot (one whole vine) in a regular grid pattern ensuring fruit collected was representative of all positions on the vine. This sample was sent to AgFirst BoP Ltd for maturity analysis.

On 10 April 2013 50 fruit were collected from each plot and examined for possible phytotoxicity. Each plot was assessed for plant health on a 0-5 scale, (0= vine highly stressed, no export size fruit, 5= vine with good numbers of large fruit).

5. RESULTS

Trial 1:
On vine assessments following application: There was no fruit phytotoxicity observed in any on vine inspection conducted 2 weeks after application, 2 weeks after application 5 or in the month prior to harvest.

Harvest assessment for phytotoxicity: 50 fruit per plot were sorted by four assessors. Any possible phytotoxicity was aside with one assessor making the final determination to ensure consistency. Two forms of possible phytotoxicity were observed; light russet and water-stain. These symptoms could be due to copper phytotoxicity, or other factors such as wind rub or leaf breakdown in the canopy. It was not possible to determine the cause of russet or water-stain which occurred at 6.26% to 13.26% of fruit. There was no statistically significant difference in possible phytotoxicity between treatments.

Treatment	DAFB	Plant Health Score (0-5)	% Russet Incidence	% Water-stain Incidence	% Russet + Water-stain Incidence
1. Nordox 37.5g/100L	7	2.44	3.50	3.76	7.26
2. Nordox 37.5g/100L	14	2.56	4.50	3.50	8.00
3. Nordox 37.5g/100L	28	2.38	8.00	3.26	11.26
4. Nordox 37.5g/100L	42	2.63	5.00	3.00	8.00
5. Nordox 37.5g/100L	56	2.81	4.76	2.50	7.26
6. Kocide Opti 70g/100L	7	2.88	4.00	2.76	6.76
7. Kocide Opti 70g/100L	14	2.31	2.50	4.50	7.00
8. Kocide Opti 70g/100L	28	2.44	1.82*	4.88*	6.70*
9. Kocide Opti 70g/100L	42	2.63	4.26	3.76	8.00
10. Kocide Opti 70g/100L	56	2.50	4.00	2.26	6.26
11. Champ DP 75g/100L	7	2.31	3.52*	4.02*	7.54*
12. Champ DP 75g/100L	14	2.56	6.76	3.00	9.76
13. Champ DP 75g/100L	28	2.50	4.50	2.76	7.26
14. Champ DP 75g/100L	42	2.75	7.26	6.00	13.26
15. Champ DP 75g/100L	56	2.63	4.50	4.00	8.50
16. Untreated		2.81	2.76	4.50	7.26
F Probability		0.981	0.110	0.875	0.421
LSD 5%		0.80	3.80	3.60	5.06

*= contains adjustment for missing data due to poor plant health in some plots

Trial 2:

On vine assessments following application: There was no phytotoxicity observed in any on vine inspection conducted 2 weeks after application, 2 weeks after application 3 or in the month prior to harvest.

Harvest assessment for phytotoxicity: fruit samples were collected and assessed as for trial 1 with two forms of possible phytotoxicity observed; light russet and water-stain. Combined russet and water-stain occurred at lower incidence than in trial 1 ranging from 1.56% to 5.94% of fruit affected. The orchard canopy was more open in the trial 2 area. Leaf necrosis and associated water-stain may have been worse in trial 2 than trial 1 due to increased canopy density. There was one statistically significant difference in possible phytotoxicity. Three applications of Nordox 75WG had 4.0% incidence of water-stain. This was significantly worse than the untreated control at 1.22% and three applications of Kocide Opti at 1.70% water-stain.

Treatment	Rate/100L	Plant Health Score (0-5)	% Russet Incidence	% Water-stain Incidence		% Russet + Water-stain Incidence
1. Nordox	37.5g	2.75	1.40	0.40	c	1.80
2. Kocide Opti	70g	3.20	1.46*	0.66*	c	2.14*
3. Nordox	28g	2.40	1.42*	1.46*	bc	2.90*
4. Kocide Opti	90g	2.25	0.76*	0.80*	bc	1.56*
5. Nordox + Du-Wett	75g + 80ml	2.85	0.80	2.40	ab	3.20
6. Kocide Opti + Du-Wett	140g + 80ml	2.65	1.40	1.20	bc	2.60
7. Nordox + Gro Wet	75g + 80ml	2.30	0.78*	0.78*	bc	1.56*
8. Nordox (x3)	37.5g	2.15	1.90*	4.04*	a	5.94*
9. Kocide Opti (x3)	70g	2.10	1.42*	1.70*	bc	3.12*
10. Untreated		2.35	0.64*	1.22*	bc	1.86*
F Probability		0.503	0.843	0.003		0.061
LSD 5%		1.03	1.62	1.70		2.66

*= contains adjustment for missing data due to poor plant health in some plots

Fruit maturity at harvest: the composite 100 fruit sample taken from each treatment the day prior to harvest showed no trends indicating any consistent treatment effect on fruit maturity. While not specifically assessed there was no leaf phytotoxicity observed in either trial. Average fruit weight in treatment 1 appears to be an anomaly.

Treatment	Rate/100L	Average Weight (g)	% DM	TZG
1. Nordox	37.5g	125.5	18.54	0.72
2. Kocide Opti	70g	85.4	18.31	0.67
3. Nordox	28g	82.7	18.52	0.69
4. Kocide Opti	90g	84.4	18.25	0.68
5. Nordox + Du-Wett	75g + 80ml	87.4	17.93	0.63
6. Kocide Opti + Du-Wett	140g + 80ml	86.5	17.26	0.54
7. Nordox + Gro Wet	75g + 80ml	85.8	18.28	0.66
8. Nordox (x3)	37.5g	85.4	18.23	0.67
9. Kocide Opti (x3)	70g	78.9	18.51	0.70
10. Untreated		61.4	18.59	0.69

6. DISCUSSION

Weather conditions were generally hot and dry over summer 2012-13. From 1 November 2012 to 30 April 2013 306mm of rainfall was recorded at Gisborne airport, 66% of long term average. Apart from the 1st application on 7 November 2012 in trial 1 when light rainfall occurred during application, no rainfall was recorded within 48 hours following application. Drying conditions for all other applications were considered to be good (less than 60 minutes). Autumn rainfall following copper applications has been associated with water-stain like fruit markings (S Max per comm).This is thought to occur due to rain washing copper deposits onto the fruit. However rainfall during February, March and early April at 64mm was probably insufficient for this to occur.

Applications were made in manner that emulated grower practise. Water rates in trial 1 increased from 1,000L/ha for applications 1 and 2 (9 and 16 DAFB) to 1,500L/ha for applications 5 (52 DAFB). Good spray coverage of fruit was demonstrated with the use of water sensitive papers.

No russet was observed to fruit (or leaves) in any treatments during this study, even where three applications of Nordox 75WG at 37.5g/100L (375g/ha/application) or Kocide Opti at 70g/100L (700g/ha/application) were made 16, 30 and 43 days after full bloom. No damage resulted from a single application 28 DAFB of Nordox 75WG at 375g/ha or Kocide Opti at 90g/100L (900g/ha).

The only statistically significant result occurred when three applications of Nordox 75WG had 4.0% incidence of water-stain. However three applications of Kocide Opti at the same timing had 1.70% water-stain which was not statistically different to the untreated at 1.2% water-stain. Kiwilustre and Du-Wett Stainless had been applied prior to fruit harvest. Approximately 50% of the water-stain would not have met Zespri class 1 specifications.

The results of this study are generally in line with grower experience over the summer of 2012/13 in Hayward. Regular copper applications made by growers at lower rates of copper (Nordox 75WG at 25 to 37.5g/100L, Kocide Opti at 45 to 70g/100L) were not associated with fruit marking or leaf damage.

However leaf damage was reported in Gold 3 in Gisborne during 2012/13. This poses the question; how far below the margin of safety were the rates and timings in this study?

Risk of damage would seem to increase with the use of:

- Higher copper product rates
- Higher water rates per hectare
- Adverse drying conditions (rain following application)
- Stressed vines

Representatives of one of the chemical companies co-funding the study inspected the trial during summer. They raised the concern that foliar fertilisers may pose an increased risk of copper phytotoxicity as the adjuvants may be selected to assist movement of nutrients into the vine. These adjuvants may also assist the entry of copper into fruit or leaf tissues increasing the risk of damage.

7. FUTURE WORK

The present study has provided guidance on the safe use of coppers on Hayward in the period up to 70 days after full bloom under dry summer conditions. It would be useful to define the difference between safe and unsafe practises. In particular comparing treatments used in the current study with:

- Higher water rates (1,000L/ha vs 2,000L/ha) and corresponding increased copper rates per hectare. The water rates used in this trial provided good coverage of fruit and underside of leaves in a relatively open canopy. Higher water rates may be used by growers with denser canopies and would be expected to result in more copper being deposited on fruit and lower leaves in the canopy with associated increased phytotoxicity risk.
- Foliar fertilisers applied 1-3 days after a copper application
- Different climatic conditions during the month after full bloom.

8. REFERENCES

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9. ACKNOWLEDGEMENTS

Eastern Bay Orchards Ltd provided and maintained the of trial site. Agrivet Services Ltd provided statistical analysis. David Manktelow reviewed the draft report and provided helpful comments.

10. APPENDIX 1 Trial Photos

Green trial 1, 1st application 2 December 2012

Echo motorised knapsack

Trial site and canopy development: 2 December 2012

Fruit size 11 December 2012, 1st application trial 2, 2nd application trial 1

Fruit 40mm long, 20 December 2012, 2nd application trial 2, 3rd application trial 1.

Application 5 trial 1, 20 January 2013

Canopy density, application 5 trial 1, 20 January 2012

Water sensitive papers used to assess fruit coverage in related Gold 3 trial

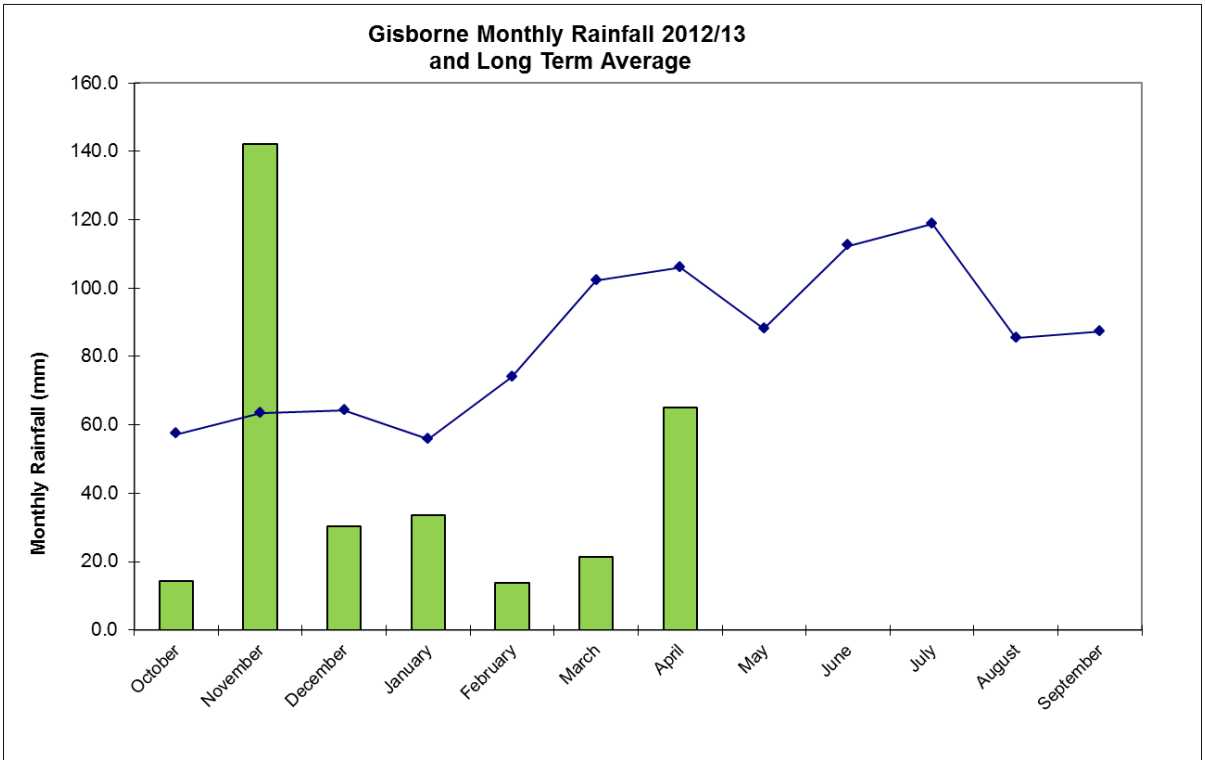
Possible water-stain phytotoxicity symptom at harvest, 10 April 2012

Possible light russet phytotoxicity symptom at harvest, 10 April 2012

Trial harvest team

Harvest assessment

11. APPENDIX 2: Weather data



1 November 2012 to 30 April 2013 306mm of rain was recorded at Gisborne Airport AWS (D87695), 66% of long term average Gisborne airport is 8km from the trial site.

Date	Rain (mm)	T Max	T Min	Event Trial 1	Event Trial 2
1-Nov-12	0	23.3	7.7		
2-Nov-12	0	21.9	13.2		
3-Nov-12	0	24.8	15.2		
4-Nov-12	0.6	20.0	10.6		
5-Nov-12	1.6	14.3	2.9		
6-Nov-12	8	17.7	8.9		
7-Nov-12	0	13.6	5.1		
8-Nov-12	2.8	14.2	5.4		
9-Nov-12	0	14.8	7.0		
10-Nov-12	0	16.0	2.5		
11-Nov-12	0	20.9	8.1		
12-Nov-12	2.4	24.7	12.1		
13-Nov-12	72.4	18.4	11.1		
14-Nov-12	53	12.8	9.3		
15-Nov-12	0	15.1	5.4		
16-Nov-12	0.4	21.3	10.4		
17-Nov-12	0	19.7	10.7		
18-Nov-12	0	20.7	12.7		
19-Nov-12	0	20.2	5.0		
20-Nov-12	0	18.1	7.1		
21-Nov-12	0	18.8	10.2		
22-Nov-12	0	18.9	7.4		
23-Nov-12	0	20.1	9.0		
24-Nov-12	0	25.0	11.2		
25-Nov-12	0	20.6	9.6	Full bloom	
26-Nov-12	0	23.0	11.0		
27-Nov-12	0	23.5	11.7		
28-Nov-12	0	21.5	13.1		
29-Nov-12	0	21.3	10.4		
30-Nov-12	0.8	21.2	9.0		

Date	Rain (mm)	T Max	T Min	Event Trial 1	Event Trial 2
1-Dec-2012	1.2	14.6	5.7		
2-Dec-2012	0	19.8	13.3	Appn 1, 7 DAFB	
3-Dec-2012	0.4	26.0	15.3		
4-Dec-2012	0	22.6	10.9		
5-Dec-2012	4.2	24.8	13.9		
6-Dec-2012	0	24.9	20.0		
7-Dec-2012	0	26.0	16.1		
8-Dec-2012	0	21.7	7.6		
9-Dec-2012	0	18.3	10.0		
10-Dec-2012	0	23.4	9.7		
11-Dec-2012	0	28.5	11.0	Appn 2, 16 DAFB	Appn 1, 16 DAFB
12-Dec-2012	0	20.6	11.2		
13-Dec-2012	0	18.6	13.2		
14-Dec-2012	0	21.2	8.1		
15-Dec-2012	0	26.6	15.5		
16-Dec-2012	0	21.9	11.3		
17-Dec-2012	0	27.5	16.9		
18-Dec-2012	0	22.7	18.6		
19-Dec-2012	0	28.2	19.5		
20-Dec-2012	0	31.7	12.8	Appn 3, 25 DAFB	Appn 2, 25 DAFB
21-Dec-2012	0	22.2	11.7		
22-Dec-2012	0	28.7	16.4		
23-Dec-2012	0.6	28.7	16.4		
24-Dec-2012	16.2	20.7	17.9		
25-Dec-2012	3	21.7	18.6		
26-Dec-2012	0	28.8	16.5		
27-Dec-2012	0	29.0	18.4		
28-Dec-2012	3.4	21.0	16.0		
29-Dec-2012	0.2	22.7	17.3		
30-Dec-2012	0	28.7	17.6		
31-Dec-2012	1.2	27.1	18.3		

Date	Rain (mm)	T Max	T Min	Event Trial 1	Event Trial 2
1-Jan-2013	0	24.7	10.8		
2-Jan-2013	0	27.7	15.3		
3-Jan-2013	0	28.7	18.4		
4-Jan-2013	0.8	23.6	14.6		
5-Jan-2013	0	20.8	13.9		
6-Jan-2013	0.2	20.7	15.5		
7-Jan-2013	29	20.2	16.9	Appn 4, 43 DAFB	Appn 3, 43 DAFB
8-Jan-2013	0	22.8	12.4		
9-Jan-2013	0	26.3	12.2		
10-Jan-2013	0	31.5	18.0		
11-Jan-2013	0	31.8	17.3		
12-Jan-2013	0	30.0	14.0		
13-Jan-2013	0	31.2	19.2		
14-Jan-2013	0	31.5	21.6		
15-Jan-2013	0	27.7	19.4		
16-Jan-2013	0.8	28.3	13.5		
17-Jan-2013	0	23.4	14.2		
18-Jan-2013	0	25.3	7.8		
19-Jan-2013	2	19.6	7.6		
20-Jan-2013	0	23.6	13.3	Appn 5, 56 DAFB	
21-Jan-2013	0	27.4	11.7		
22-Jan-2013	0	25.1	9.7		
23-Jan-2013	0	27.2	14.3		
24-Jan-2013	0	26.8	15.6		
25-Jan-2013	0.6	26.8	16.1		
26-Jan-2013	0	19.9	15.8		
27-Jan-2013	0	21.5	12.1		
28-Jan-2013	0	22.5	12.7		
29-Jan-2013	0	21.4	10.4		
30-Jan-2013	0.2	21.6	10.2		

25-Jan-13 Grower application Serenade Max to trial block

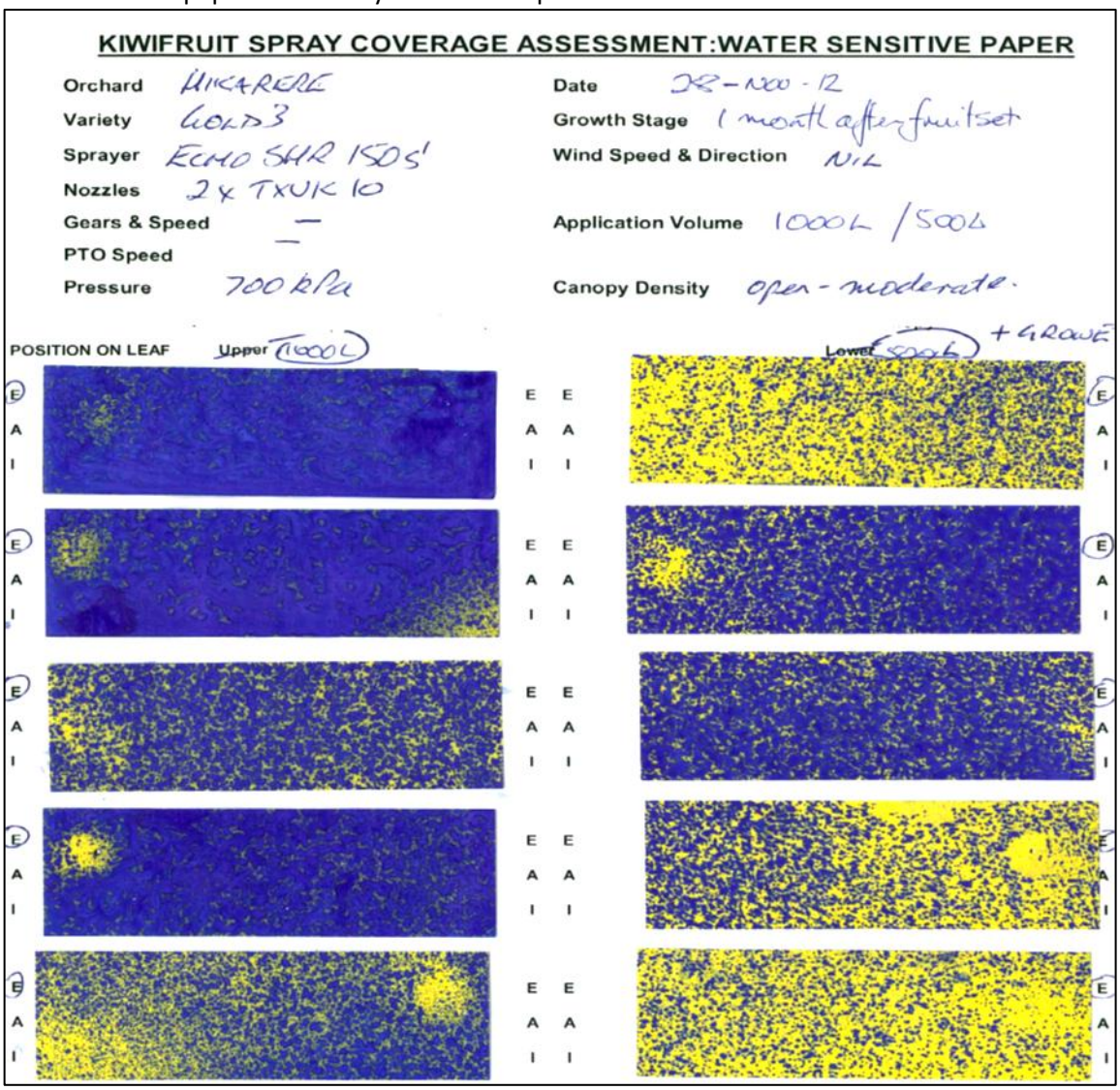
Date	Rain (mm)	T Max	T Min	Event Trial 1	Event Trial 2
1-Feb-2013	0	27.1	10.6		
2-Feb-2013	0	26.1	16.6		
3-Feb-2013	0	28.8	16.5		
4-Feb-2013	0	29.2	15.3		
5-Feb-2013	0.6	29.0	17.6		
6-Feb-2013	10	17.7	11.1		
7-Feb-2013	0	18.5	9.3		
8-Feb-2013	0	19.6	14.0		
9-Feb-2013	0	21.4	8.6		
10-Feb-2013	0	26.5	10.5		
11-Feb-2013	0	24.2	11.8		
12-Feb-2013	0	28.6	13.3		
13-Feb-2013	0	23.6	15.1		
14-Feb-2013	0	27.7	11.6		
15-Feb-2013	0	25.4	9.5		
16-Feb-2013	0	22.0	14.0		
17-Feb-2013	0	26.8	13.2		
18-Feb-2013	1.2	23.8	16.0		
19-Feb-2013	0	21.6	12.9		
20-Feb-2013	0	22.7	8.5		
21-Feb-2013	0	24.1	9.6		
22-Feb-2013	0	25.4	13.4		
23-Feb-2013	0.6	20.9	13.5		
24-Feb-2013	1	20.4	11.9		
25-Feb-2013	0	21.5	11.1		
26-Feb-2013	0	21.3	15.7		
27-Feb-2013	0	21.5	9.7		
28-Feb-2013	0.4	22.8	14.5		

Date	Rain (mm)	T Max	T Min	Event Trial 1	Event Trial 2
1-Mar-2013	1.6	21.0	15.9		
2-Mar-2013	2.8	22.6	17.6		
3-Mar-2013	0	22.0	15.5		
4-Mar-2013	1	21.6	13.3		
5-Mar-2013	10.4	29.9	14.2		
6-Mar-2013	0	19.5	9.5		
7-Mar-2013	0	26.9	12.0		
8-Mar-2013	0	23.0	10.3		
9-Mar-2013	0	22.5	15.0		
10-Mar-2013	0	21.5	16.8		
11-Mar-2013	0.2	21.9	17.3		
12-Mar-2013	0	21.4	17.1		
13-Mar-2013	0	20.6	12.3		
14-Mar-2013	0	21.1	7.5		
15-Mar-2013	0	25.0	9.5		
16-Mar-2013	0	27.3	15.7		
17-Mar-2013	0	27.9	16.6		
18-Mar-2013	0	27.4	17.1		
19-Mar-2013	0	31.2	17.8		
20-Mar-2013	2.4	24.1	14.6		
21-Mar-2013	1	19.8	10.5		
22-Mar-2013	0	20.2	7.7		
23-Mar-2013	0	20.2	7.6		
24-Mar-2013	0.2	19.3	8.6		
25-Mar-2013	1.8	21.6	7.4		
26-Mar-2013	0	22.5	9.6		
27-Mar-2013	0	22.6	10.3		
28-Mar-2013	0	22.7	8.5		
29-Mar-2013	0	23.1	5.6		
30-Mar-2013	0	26.5	12.1		
31-Mar-2013	0	23.6	15.8		

Date	Rain (mm)	T Max	T Min	Event Trial 1	Event Trial 2
1-Apr-2013	0	27.0	13.2		
2-Apr-2013	0	28.2	14.6		
3-Apr-2013	0	25.5	14.9		
4-Apr-2013	0	27.0	17.9		
5-Apr-2013	20	20.7	12.5		
6-Apr-2013	1.6	18.1	9.3		
7-Apr-2013	7.2	16.6	8.5		
8-Apr-2013	0	17.0	7.3		
9-Apr-2013	0	20.1	7.0		Harvest maturity Sample
10-Apr-2013	9	20.0	10.2	Harvest phytotoxicity samples and commercial harvest	
11-Apr-2013	0	15.8	5.8		
12-Apr-2013	0	21.3	10.2		
13-Apr-2013	0	24.0	8.6		
14-Apr-2013	0	21.9	10.0		
15-Apr-2013	0	24.7	8.1		
16-Apr-2013	3.4	21.0	14.1		
17-Apr-2013	1.2	21.8	17.9		
18-Apr-2013	3	23.8	17.2		
19-Apr-2013	0.2	20.6	12.1		
20-Apr-2013	0	17.1	13.0		
21-Apr-2013	6.6	17.8	13.9		
22-Apr-2013	9.4	17.9	14.3		
23-Apr-2013	3.4	19.7	11.3		
24-Apr-2013	0	20.3	12.4		
25-Apr-2013	0	21.8	15.8		
26-Apr-2013	0	22.5	10.7		
27-Apr-2013	0	22.4	11.1		
28-Apr-2013	0	23.3	9.9		
29-Apr-2013	0	23.5	8.2		
30-Apr-2013	0	25.5	10.1		

12. APPENDIX 3: Spray Coverage Assessment (from related trial in Gold 3)

Water sensitive papers attached to cane adjacent to fruit, Gold 3 28 November 2012.
Applied by Echo 150SHR 150Si motorised knapsack operating at 700kPa with 2 TXVK 10 nozzles.
Water rate was 500 (RHS) and 1000 litres per hectare (LHS). Coverage was assessed as excellent on all papers.
The addition of Gro Wet to the 500 litres per hectare water rate would increase spread of the droplets. The water sensitive paper shows only the initial deposit.



13. APPENDIX 4: Grower Spray Programme: Block C

Date	Product & Rate/100L	Water rate /ha	Product and Rate/ha
7-Aug-2012	Hi-cane 7L	650L	Hicane 45.5L
27-Aug-2012	Nordox 75WG 25g	1,200L	Nordox 75WG 300g
24-Oct-2012	Movento 100SC 48ml + Prodigy 25ml	1,500L	Movento 100SC 720ml + Prodigy 375ml
25-Jan-2013	Serenade Max 300g	1,700L	4.25 kg/ha Serenade Max
10-Apr-2013	Kiwilustre 1L + Du-Wett Stainless 50ml	1,000L	Kiwilustre 10L + Du-Wett Stainless 500ml