EVALUATING THE FRUIT SENSITIVE PERIOD TO COPPER IN GOLD 3 KIWIFRUIT

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1. EXECUTIVE SUMMARY

During the summer of 2012/13 two trials were established in a Gold 3 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, 56 or 70 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 marking 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.

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 Gold 3. 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 0.55 hectare block of Gold 3 side grafted from Hayward in 2010. In 2013 the block produced its first commercial crop of 12,700 trays per hectare at 30.1 count and 0.72 TZG. Vines were spaced 2.5m apart in the row with 4.8m between rows. Vines were irrigated under the canopy with micro-jet sprinklers.

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, at 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

The grower applied four applications of copper + Du-Wett and a single application of Actigard pre-flower for Psa management in trial block. No coppers were applied to the trial block post flowering. Serenade Max was applied in December and January. No water-stain remover was applied prior to harvest. 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, 56 or 70 days after mid flowering which occurred on 29 October 2012. Plots were 2.5m long by 2.0m 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 applications 5 & 6.

Trial 1: Application timing and weather data

Application	**1**	**2**	**3**	**4**	**5**	**6**
Date	7 Nov 12	14 Nov 12	28 Nov 12	11 Dec 12	20 Dec 12	7 Jan 13
Days after full bloom (DAFB)	9	16	30	43	52	70
Time	16.30-17.20	13.30-14.10	7.45-8.20	8.40-9.00	12.40-13.30	11.45-12.30
Water rate per plot	0.50L	0.53L	0.63L	0.61L	0.76L	0.78L
Water Rate per hectare	1,000L	1,060L	1,260L	1,230L	1,530L	1,550L
Wind speed (km/hr)	3km/hr	1.5km/hr	nil	nil	2km/hr	10.6km/hr
Wind direction	SW	S	-	-	SE	SE
Temperature	14-11°C	16°C	18°C	20°C	26°C	20°C
Relative Humidity	60-85%	65-75%	50%	65%	50%	60%
Drying Time	Slow, 2+ hours	45 mins	30 mins	30 mins	20 mins	30 mins
Cloud cover	80-100%	100%	100%	0%	5%	80%
Crop surface	damp*	dry	dry	dry	dry	dry
Rainfall: 24 hours pre application	0.0mm	53.0mm	0.0mm	0.0mm	0.0mm	29mm
24 hours after	2.8mm	0.0mm	0.0mm	0.0mm	0.0mm	0.0mm
48 hours after	2.8mm	0.4mm	0.0mm	0.0mm	0.0mm	0.0mm

*****a shower of rain occurred midway through application. Leaves generally shielded fruit from rain. Fruit was dry next morning

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

On-vine 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				

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.

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 4.

Plots were 2.5m long by 4.0m wide and contained one whole vine. There were 10 replicates of each treatment.

Trial 2: Application timing and weather data

Application	**1**	**2**	**3**
Date	14 Nov 12	28 Nov 12	11 Dec 12
Days after full bloom (DAFB)	16	30	43
Time	14.45-15.25	8.45-11.00	7.30-7.45
Water rate per plot	1.0L	1.0L (0.5L)*	1.0L
Water Rate per hectare	1,020L	1,000L (500L)*	1,010L
Wind speed (km/hr)	2km/hr	nil	nil
Wind direction	S	-	-
Temperature	14°C	19-24°C	15°C
Relative Humidity	75%	60-45%	85%
Drying Time	45 mins	20-10 mins	60 mins
Cloud cover	100%	90%	0%
Crop surface	dry	dry	dry
Rainfall: 24 hours pre application	53.0mm	0.0mm	0.0mm
24 hours after	0.0mm	0.0mm	0.0mm
48 hours after	0.4mm	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 6 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 low incidence, 0.75% to 3.75% of fruit.
Data analysis was carried out using Gylling's "Agricultural Research Manager" (ARM version 9). Analysis of Variance (AOV) and Least Significant Difference (LSD) tests at the 5% level were used to compare treatments
There were no statistically significant differences 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	3.25	0.00	1.50	1.50
2. Nordox 37.5g/100L	14	3.75	0.25	1.50	1.75
3. Nordox 37.5g/100L	28	3.69	0.00	0.75	0.75
4. Nordox 37.5g/100L	42	3.69	0.25	1.50	1.75
5. Nordox 37.5g/100L	56	3.69	1.25	0.75	2.00
6. Nordox 37.5g/100L	70	3.88	0.00	0.50	0.50
7. Kocide Opti 70g/100L	7	3.81	0.25	3.50	3.75
8. Kocide Opti 70g/100L	14	4.25	0.25	3.25	3.50
9. Kocide Opti 70g/100L	28	4.00	0.00	1.25	1.25
10. Kocide Opti 70g/100L	42	4.00	0.00	2.25	2.25
11. Kocide Opti 70g/100L	56	3.94	0.50	2.25	2.75
12. Kocide Opti 70g/100L	70	3.75	0.25	1.50	1.75
13. Champ DP 75g/100L	7	4.25	0.00	1.00	1.00
14. Champ DP 75g/100L	14	4.19	0.25	2.75	3.00
15. Champ DP 75g/100L	28	3.81	0.50	1.00	1.50
16. Champ DP 75g/100L	42	4.06	0.00	2.75	2.75
17. Champ DP 75g/100L	56	3.94	0.25	2.50	2.75
18. Champ DP 75g/100L	70	3.69	0.00	1.75	1.75
19. Untreated		3.94	0.50	2.75	3.25
F Probability		0.289	0.429	0.714	0.633
LSD 5%		0.62	0.84	2.82	2.82

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 again occurred at low incidence, 0.6% to 2.4% of fruit affected. There was no statistically significant difference in possible phytotoxicity between treatments.

Treatment	Rate/100L	Plant Health Score (0-5)	% Russet Incidence	% Water-stain Incidence	% Russet + Water-stain Incidence
1. Nordox	37.5g	4.85	1.20	0.60	1.80
2. Kocide Opti	70g	4.95	0.60	1.20	1.80
3. Nordox	28g	4.90	1.60	0.80	2.40
4. Kocide Opti	90g	4.90	0.00	1.40	1.40
5. Nordox + Du-Wett	75g + 80ml	4.75	0.60	0.80	1.40
6. Kocide Opti + Du-Wett	140g + 80ml	4.85	0.60	0.80	1.40
7. Nordox + Gro Wet	75g + 80ml	4.85	0.60	1.20	1.80
8. Nordox (x3)	37.5g	4.85	0.20	0.40	0.60
9. Kocide Opti (x3)	70g	4.90	0.80	0.60	1.40
10. Untreated		4.90	0.80	1.40	2.20
F Probability		0.697	0.548	0.940	0.923
LSD 5%		0.18	1.38	1.62	2.20

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.

Treatment	Rate/100L	Average Weight (g)	% DM	TZG	Av. Hue	Green Fractile
1. Nordox	37.5g	117.3	18.70	0.69	100.9	104.2
2. Kocide Opti	70g	109.7	18.73	0.70	101.1	103.2
3. Nordox	28g	118.1	18.67	0.70	100.5	102.3
4. Kocide Opti	90g	114.8	19.07	0.74	100.6	102.4
5. Nordox + Du-Wett	75g + 80ml	111.6	18.95	0.71	99.8	101.9
6. Kocide Opti + Du-Wett	140g + 80ml	111.6	18.95	0.72	100.3	102.5
7. Nordox + Gro Wet	75g + 80ml	107.8	19.11	0.72	100.0	104.7
8. Nordox (x3)	37.5g	116.7	18.96	0.71	101.0	106.2
9. Kocide Opti (x3)	70g	108.7	18.17	0.59	100.9	102.9
10. Untreated		114.7	18.98	0.73	99.9	101.6

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, which was 66% of long term average. Apart from the first 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 and 6 (52 and 70 DAFB). Good spray coverage of fruit was demonstrated with the use of water sensitive papers.

No damage 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 results of this study are generally in line with grower experience over the summer of 2012/13 in Gold 3. 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 (S Max pers comm).

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:

- Higher copper product rates
- Higher water rates per hectare
- Adverse drying conditions (rain following application)
- Autumn rainfall resulting in water-stain like fruit marking
- 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 in foliar fertilisers 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 Gold 3 in the period up to 70 days after full bloom. 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 and in the month pre harvest.

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

Gold trial 1, 1st application 7 November 2012

Echo motorised knapsack, 1st Application, 7 November 2012

Trial site and canopy development: 14 November 2012

Fruit size 14 November 2012, 1st application trial 2, 2nd application trial 1

Fruit 30-40mm long, 28 November 2012, 2nd application trial 2, 3rd application trial 1. Water sensitive paper pinned to cane adjacent to fruit to assess coverage

Application 3 trial 2, application 5 trial 1, 11 December 2012

Application 5 trial 1, 20 December 2012

Canopy development 20 December 2012

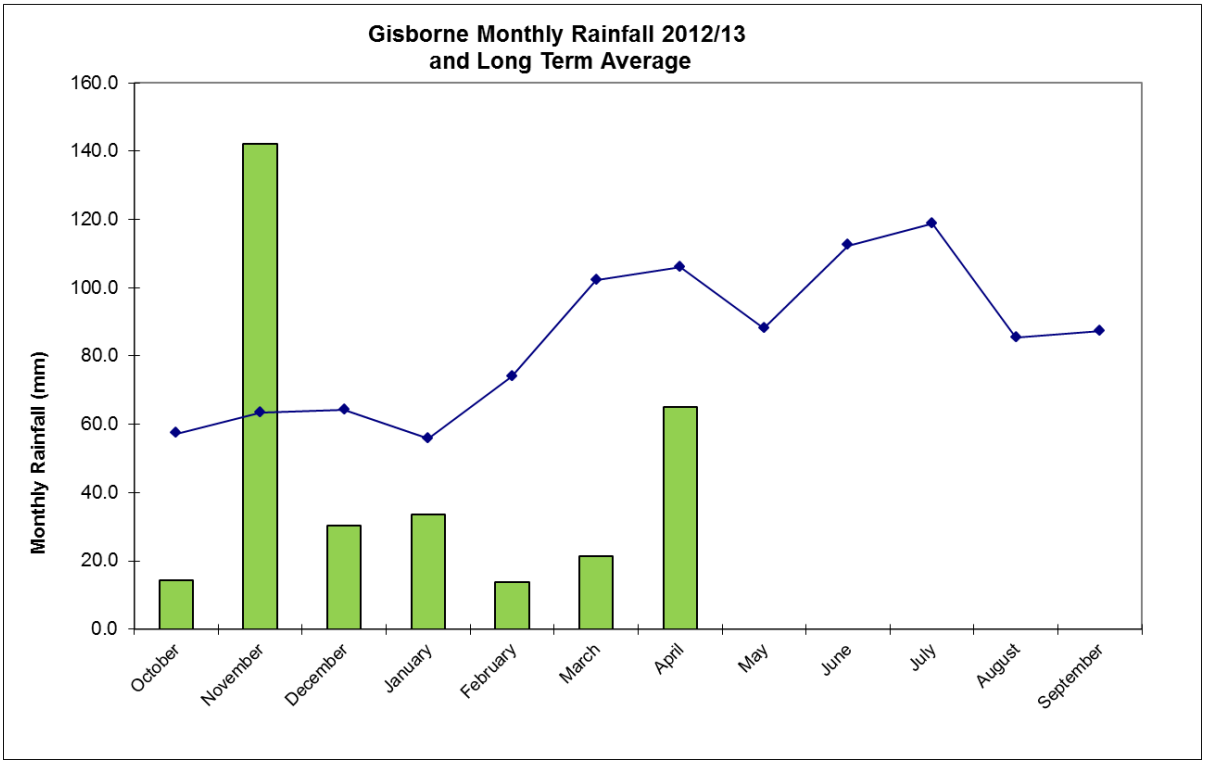
Possible water-stain phytotoxicity symptom at harvest, 10 April 2012

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	1st Appn, 9 DAFB	
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	2nd Appn, 16 DAFB	1st Appn, 16 DAFB
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		
26-Nov-12	0	23.0	11.0		
27-Nov-12	0	23.5	11.7		
28-Nov-12	0	21.5	13.1	3rd Appn, 30 DAFB	2nd Appn, 30 DAFB
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		
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	4th Appn, 43 DAFB	3rd Appn, 43 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	5th Appn, 52 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		

20-Dec-12 Grower application Serenade Max + Bond xtra to trial block

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	6th Appn, 70 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		
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		

24-Jan-13 Grower application Serenade Max + Bond xtra 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		

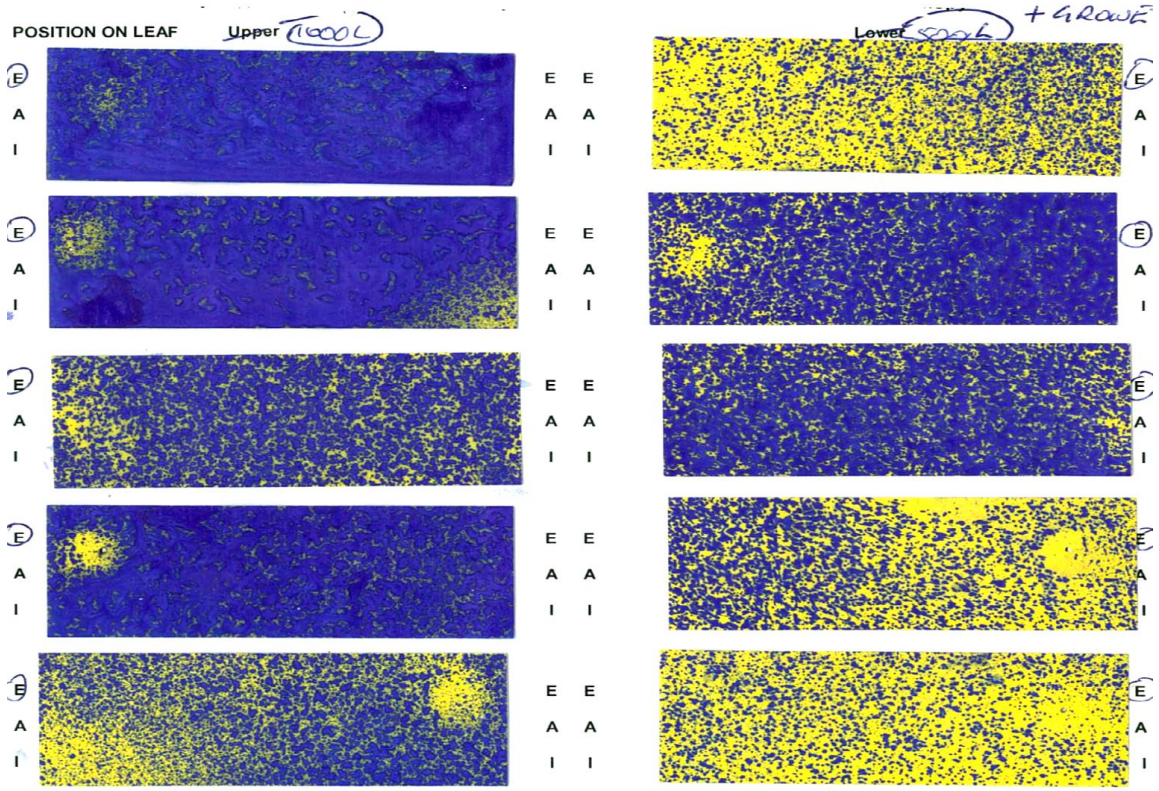
Date	Rain (mm)	T Max	T Min	Event Trial 1	Event Trial 2
1-Apr-2013	0	27.0	13.2		
2-Apr-2013	0	28.2	14.6		
3-Apr-2013	0	25.5	14.9		
4-Apr-2013	0	27.0	17.9		
5-Apr-2013	20	20.7	12.5		
6-Apr-2013	1.6	18.1	9.3		
7-Apr-2013	7.2	16.6	8.5		
8-Apr-2013	0	17.0	7.3		
9-Apr-2013	0	20.1	7.0		Harvest maturity sample
10-Apr-2013	9	20.0	10.2	Harvest phytotoxicity sample 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

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.

KIWIFRUIT SPRAY COVERAGE ASSESSMENT:WATER SENSITIVE PAPER

Orchard	HIKARERE	Date	28-NOV-12
Variety	GOLD 3	Growth Stage	1 month after fruitset
Sprayer	ECHO SHR 150Si	Wind Speed & Direction	NIL
Nozzles	2 x TXVK 10		
Gears & Speed	—	Application Volume	1000L / 500L
PTO Speed	—		
Pressure	700 kPa	Canopy Density	open - moderate.



13.APPENDIX 4: Grower Spray Programme: Block 4

Date	Product & Rate/100L	Water rate /ha	Product and Rate/ha
31-Jul-2012	Hi-cane 4.5L + Driftstop 100ml	600L	Hicane 27.5L + Driftstop 600ml
14-Aug-2012	Kocide Opti 65g + Du-Wett 40ml	1,000L	Kocide Opti 650g + Du-Wett 400ml
28-Aug-2012	Mesurol 150g + Du-Wett 50ml	1,000L	Mesurol 1.5kg + Du-Wett 500ml
29-Aug-2012	Kocide Opti 65g + Du-Wett 80ml	600L	Kocide Opti 390g + Du-Wett 480ml
13-Sept-2012	Kocide Opti 65g + Du-Wett 80ml	600L	Kocide Opti 390g + Du-Wett 480ml
19-Sept-2012	Mantrac 500 100ml	1,000L	Mantrac 1L
25-Sept-2012	Actigard 20g + Movento 100SC 96ml	1,000L	Actigard 200g + Movento 100SC 960ml
26-Sept-2012	Mantrac 500 100ml+ Low biuret urea 500g	1,000L	Mantrac 1L+ Low biuret urea 5kg
3-Oct-2012	Nordox 75WG 25g + Du-Wett 40ml	1,000L	Nordox 250g + Du-Wett 400ml
4-Oct-2012	Mantrac 500 100ml + Low biuret urea 500g	1,000L	Mantrac 1L+ Low biuret urea 5kg
22-Nov-2012	Mantrac 500 100ml + Low biuret urea 500g	1,000L	Mantrac 1L+ Low biuret urea 5kg
23-Nov-2012	Proclaim 2g + Latron B1956 25ml	2,000L	Proclaim 40g + Latron B1956 500ml
12-Dec-2012	Mantrac 500 100ml + Low biuret urea 500g	1,000L	Mantrac 1L+ Low biuret urea 5kg
20-Dec-2012	Serenade Max 250g + Bond xtra 30ml	1,5 00L	Serenade Max 2.5kg + Bond xtra 300ml
24-Jan-2013	Serenade Max 250g + Bond xtra 30ml	1,500L	Serenade Max 2.5kg + Bond xtra 300ml