Report to Zespri Group Ltd

Optimising application of (Psa) protectant sprays on kiwifruit dormant canes

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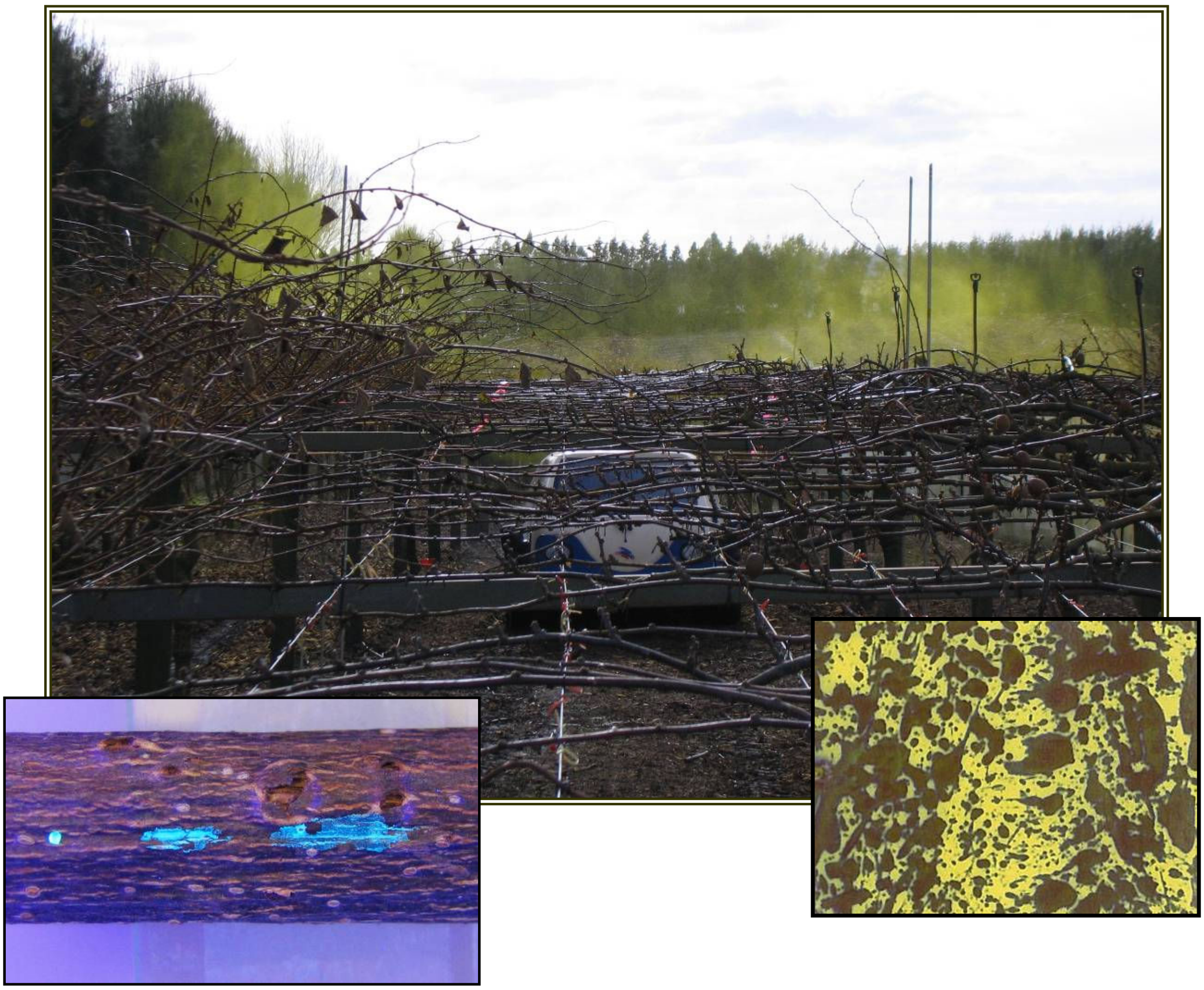
July 2011



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EXECUTIVE SUMMARY

This study was undertaken to provide prescriptions for airblast application of protectant sprays to kiwifruit at the dormant cane stage.

The studies were undertaken in June 2011 in a BOP orchard, on a defoliated Hort 16A pergola canopy on 3.8 m row spacing. A preliminary study was undertaken in which coverage from a range of spray application volumes, droplet sizes, travel speeds and air assistance volumes were compared on the basis of coverage on water sensitive papers. That work culminated in a quantitative deposit study in which five different 600 L/ha spray applications (varying nozzles, travel speed and adjuvant rate) were compared. Deposits were quantified on tied-down canes in the row centre and leader zones, and on untied canes in the leader zone, at 0.2 m and 1 m above the canopy.

In summary:

- Low drift air induction (AI) nozzles (as used for Hi-Cane spraying) and fine hollow cone nozzles both targeted bare canes equally well with 600 L/ha sprays containing Du-Wett Rainmaster adjuvant.

- Deposits on tied-down canes in the centre of rows and in the leader zone were similar. Wider row spacings will likely reduce deposits on the leader zone relative to the centre row but deposits are still adequate for complete coverage on all cane surfaces.

- Deposits on unpruned canes were reduced as their height above the canopy increased.

- Sprayer travel speed (6 km/h versus 7.5 km/h) had little or no effect on deposits on tied down canes, but increased speed reduced deposits on higher canes.

- Use of a proven super-spreader adjuvant is essential when using AI nozzles to apply protectant sprays to bare canes. The adjuvant will maximise spray deposits and surface coverage of canes.

- A higher super-spreader adjuvant rate used with AI nozzles tended to increase overall deposits on canes and reduce deposit variation across the canopy, but this must be weighed against increased cost. Cost-effective super-spreader adjuvant prescriptions have been developed for 600 L/ha & 1000 L/ha sprays.

- AI (coarse) nozzles reduced off-target drift markedly relative to the hollow cone (fine) nozzles and are the preferred option for applying protective sprays to dormant canes.

- Recommendations for applying protectant sprays to dormant canes have been made, covering sprayer setup and adjuvant use.

Optimising application of (Psa) protectant sprays on kiwifruit dormant canes

Introduction

The infection of kiwifruit by *Pseudomonas syringae pv Actinidiae* (Psa) is associated with heavy rain and strong winds. The bacterium is believed to infect the dormant plant in winter through leaf scars, insect damage, pruning wounds on the vine, etc. Application of protectant sprays to dormant canes is considered essential to protect against Psa infection. At this stage the most effective Psa control options appear to be protectant sprays of copper compounds. There is much that is still not known about the optimal use of copper compounds in the management of Psa. However, they are understood to act on the outside of plant tissues by killing bacteria prior to establishment of infection. They may also play a valuable role in reducing the production of viable spores from cankers produced from earlier infections. It is also probable that Cu^{2+} ions are redistributed in rainfall and will accumulate where bacteria also redistribute to. Recent work on the rainfastness of copper compounds (Gaskin *et al*. 2011) has provided encouraging data on the potential longevity of copper compounds on dormant canes. However, the level of copper deposits required to kill Psa bacteria on canes is unknown at this time.

In the absence of any other information, it can be assumed that copper products will have the greatest chance of preventing bacterial infections if dormant canes, leaf and fruit scars, any new pruning wounds, etc. are evenly covered. This includes coverage of bark cracks, cicada egg nest scars, etc. The study reported here was undertaken to develop guidelines for efficient airblast application of protectant sprays to dormant kiwifruit canes in a pergola orchard and to provide spray prescriptions to maximise the spray coverage on both pruned/tied down and unpruned canopies.

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Methods and Materials

The deposit study was undertaken on 15 June 2011, on M. Brick's "Omega" orchard, 220 Maniatutu Road, Pongakawa (Bay of Plenty). Preliminary tests, utilising water sensitive papers (WSPs) to select the most promising sprayer setups, were undertaken on the same orchard two weeks prior (01 June). A summary of the WSPs, spray application volumes, sprayer travel speeds and sprayer air outputs tested in the preliminary screening are given in Appendix 1. These preliminary coverage tests confirmed previous observations from hydrogen cyanamide application studies that canes can be well targeted with spray volumes between 500 and 1000 litres per hectare. The subsequent quantitative deposit study focussed on confirmation of deposits and deposit variability from nozzlings utilised for hydrogen cyanamide applications.
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Treatments
Five treatments were included in the deposit study (Table 1). All were applied in 600 L/ha through either Albuz ATR hollow cone nozzles (fine droplets) or Air Induction (AI) hollow cone nozzles (coarse droplets). The AI nozzle set-up was as used typically to apply Hi-Cane. Travel speed was varied at 6 or 7.5 km/h (and pressure adjusted accordingly).

Du-Wett Rainmaster (DW-RM, Etec Crop Solutions) was included in all treatments as a rainfastening sticker-spreader (Gaskin & Steele 2009) at a rate which would ensure good coverage of canes, either 1.2 or 2.4 L/ha (Appendix 2). Subsequently, commercial copper sprays on kiwifruit canes have been found to be very resistant to rain wash-off (Gaskin *et al*. 2011), and thus, rainfastening of these sprays is unnecessary. DW-RM can be substituted by Du-Wett (Etec) in protectant copper sprays, typically at half the use rate and thus half the cost. Du-Wett has no effect on the longevity of copper deposits on canes and will provide better spreading and coverage of cane surfaces with protectant sprays than the rainfastening adjuvants (Gaskin *et al.* 2011). All sprays contained tartrazine dye (5 g/L) as a tracer to quantify spray deposits. A commercial copper formulation was not included in sprays as they have been shown to have little or no effect on the physical properties of DW-RM adjuvant at the rates used (data not presented).

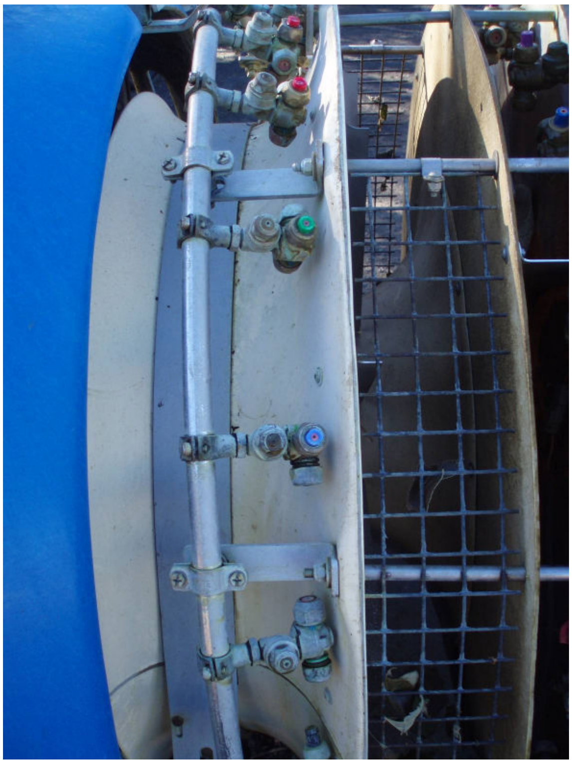
All treatments were applied between 11 am-2.30 pm in warm, moderately calm conditions. While a gusty W-SW breeze blew throughout the day, the block was well sheltered and the highest mean wind speed during spray application was 0.5 m/s. Maximum wind speed recorded was 1.8 m/s.

Table 1: Treatments applied with an Atom 2000 Turbo sprayer.

Tmt #	Nozzles[1]	Spray volume (L/ha)	Pressure (bar)	Fan speed (rpm)	Travel speed (km/h)	Adjuvant rate (L/ha)
1	AI	600	13.5	1600	6.0	1.2
2	AI	600	19	1600	7.5	1.2
3	AI	600	13.5	1600	6.0	2.4
4	ATR	600	10	1600	6.0	1.2
5	ATR	600	14.5	1600	7.5	1.2

[1]AI = Air Induction large droplet low drift nozzles; ATR = Fine droplet ceramic hollow cone nozzles

Sprayer set-up
The sprayer used was a self propelled Atom 2000 Turbo with a front entry axial fan fitted with straightening vanes designed for use in kiwifruit. However, the top baffles in the sprayer had been removed to increase air output into the centre section of the rows (Photograph 1). The sprayer fan output was measured at ca. 27,000 m^3/hr at 1600 engine rpm (Table 1), and was observed to reliably project the spray plume beyond the most distant upwind cane targets under the conditions experienced on the day of application. Nozzling is detailed in Appendix 3.



Photograph 1: LHS =Detail of Atom nozzles and air outlet showing top baffle removed. RHS = Detail of Atom sprayer showing rearward direction of spray plume output as a consequence of the front entry axial fan.

Spray application

Sprays were applied to a Hort 16A pergola canopy on 3.8 m row spacing (Photograph 2). Rows were oriented north-south (Block 4) and vines were pruned and tied down immediately prior to the study. The canopy was completely defoliated. Pruned canes from the block (one year old canes and previously fruited wood) were collected and used in the study. Fresh canes (>2 m in length) were randomly selected and tied into the canopy, in the same positions within the same (single) bay each time, immediately prior to each treatment application (Photograph 2). Ten canes were tied across wires on the pergola (five on each of upwind and downwind sides) parallel to the line of travel of the sprayer. Additionally, individual canes (four in total) were mounted above the canopy, attached to each of two 4 m high poles sited in the leader zone on each side of the row. The canes were >2 m long and had a water sensitive paper (WSP) wrapped around each cane at approx. 1 m above the pergola canopy (Fig. 1).

Sprays were applied to the bay containing tied-in canes and to bays and rows immediately adjacent to it. After spray treatments had dried, each of the 10 canes mounted in the pergola were sub-sampled individually as two (20 cm long) sections from (1) within one wire of the leader, and (2) within one wire of the row centre. The four canes mounted above the pergola in the leader zone were sub-sampled in two sections, (1) 20 cm above the canopy, and (2) 1 m above the canopy (immediately above the WSP). They were processed as described in Gaskin *et al.* 2006. Briefly, they were measured to determine surface area and washed to recover dye and quantify spray deposits.

Photograph 2: LHS = Hort 16A block on 3.8 m row spacing. RHS = Fresh canes were tied into the existing canopy before each spray application.

Deposits were calculated as dose (µg/cm^2) normalised to 1 kg a.i. applied per ha. Results were statistically analysed using ANOVA to determine the significance of treatment on spray deposits retained on cane sections in different zones.

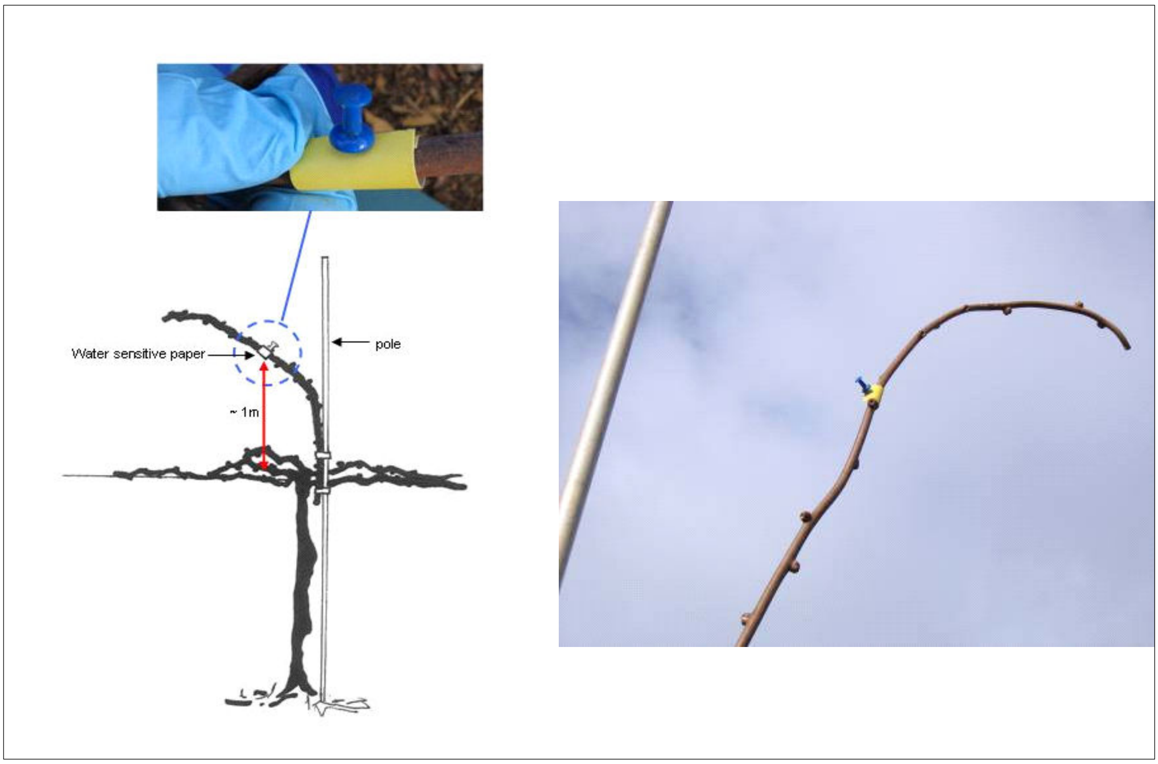


Fig. 1: WSPs were wrapped around canes at approx. 1 m height above the leader canopy and 50 cm inside leader vine

RESULTS AND DISCUSSION

Average cane deposits on tied down canes across all (five) treatments were in the range 5-6 micrograms (millionths of a gram) of chemical per square centimetre of cane surface area, per kilogram of chemical applied per hectare (Fig. 2). These average deposit levels were comparable to, or better than, those seen in earlier deposit studies for hydrogen cyanamide on dormant canes (Gaskin & Manktelow 2007, 2008).

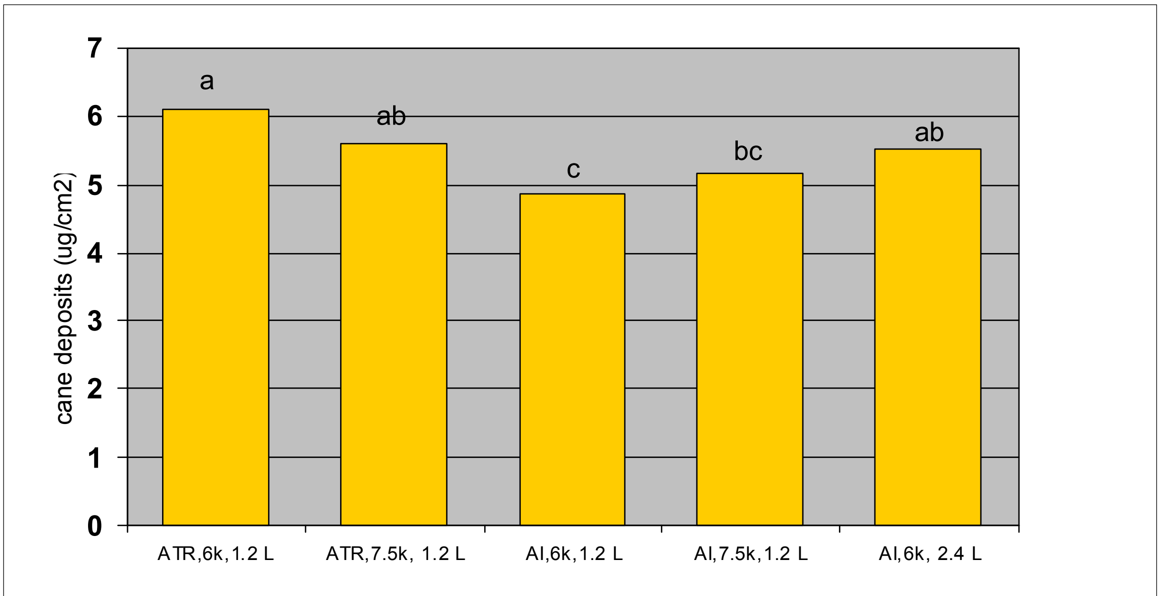


Fig. 2: Average deposits on tied-down canes across the five treatments (see Table 2 for treatment descriptions). Means sharing common letters are not significantly different (P>0.05).

Cane position was the most important variable affecting deposit levels (Table 2). While mean deposits on tied down canes in the centre of the row and in the leader zone were often similar, the trend was for centre canes to receive the highest deposits (Fig. 3). Deposits from ATR (fine) nozzles were generally higher than for AI nozzles, but mean deposits on all treatments were good (>4 $\mu g/cm^2$). There was no obvious effect of higher speed evident on the tied down canes (Fig. 3). Higher adjuvant use rate with AI nozzles had no effect on deposits in the centre row but increased deposits on tied down canes in the leader zone (Table 2, Fig. 3).

Untied canes at 1.0 metre above the pergola structure, in the leader zone, received lower mean deposits overall than canes at 0.2 m above leader vines or canes tied down on the pergola (Table 2). Travel speed had a greater effect on high than on low canes (Fig. 4); higher travel speed tended to reduce deposits on highest canes with both nozzle types (Figs 4 & 5). The overall trend was for higher canes to receive lower deposits and the lowest deposits were associated with the highest sample position (see also analysis of raw data in Appendix 5).

Nozzle type had no effect on deposits on untied high canes (P>0.05); both nozzles targeted high canes equally well (Table 2 & Fig. 4). Higher adjuvant use rate tended to increase deposits from AI nozzles on untied high canes at both heights (Fig. 4) but the effect was not significant (P=0.05).

Table 2: Deposits (µg/cm^2, normalised to a 1 kg/ha application of dye) on canes in four zones, from sprays applied with varying nozzles, speeds and adjuvant rates.

Trt description	Mean/max wind	Tied-down canes within canopy		Untied canes above Leader zone	
Nozzle, speed, adjuvant L/ha	speed (m/s)	Leader	Centre	+0.2 m	+1.0 m
ATR, 6.0, 1.2	0.3/1.5	5.65 ab	6.53 a	4.53 ab	4.30 abc
ATR, 7.5, 1.2	0.5/1.4	5.46 bc	5.73 ab	4.28 abc	3.31 c
AI, 6.0, 1.2	0.4/1.8	4.56 c	5.17 bc	4.70 a	4.45 abc
AI, 7.5, 1.2	0.2/0.7	4.66 c	5.68 ab	5.03 a	3.51 bc
AI, 6.0, 2.4	0.5/1.0	5.76 ab	5.29 bc	5.09 a	4.85 a
Mean[1]		5.22 AB	5.68 A	4.73 B	4.08 C

Means within each coloured table sharing common postscripts (lower case) are not significantly different (LSD, P=0.05).

[1]Mean effects of cane positions sharing common postscripts (upper case) are not significantly different (LSD, P=0.05).

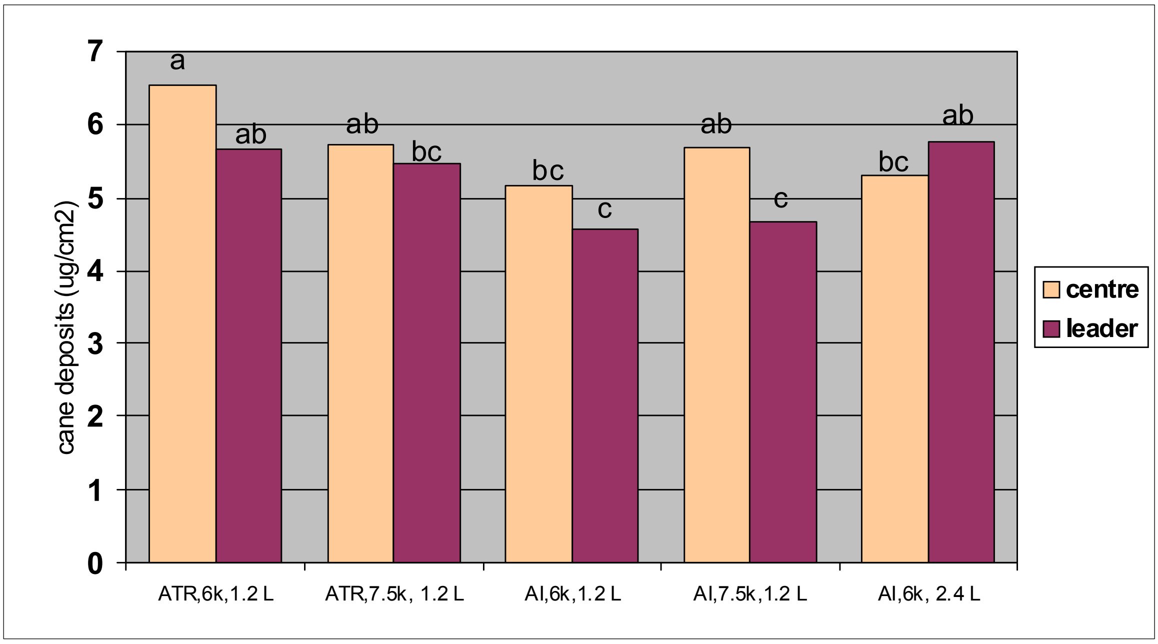


Fig. 3: Average deposits on tied-down canes in centre row and leader zones across the five treatments (see Table 2 for treatment descriptions). Means sharing common letters are not significantly different (P>0.05).

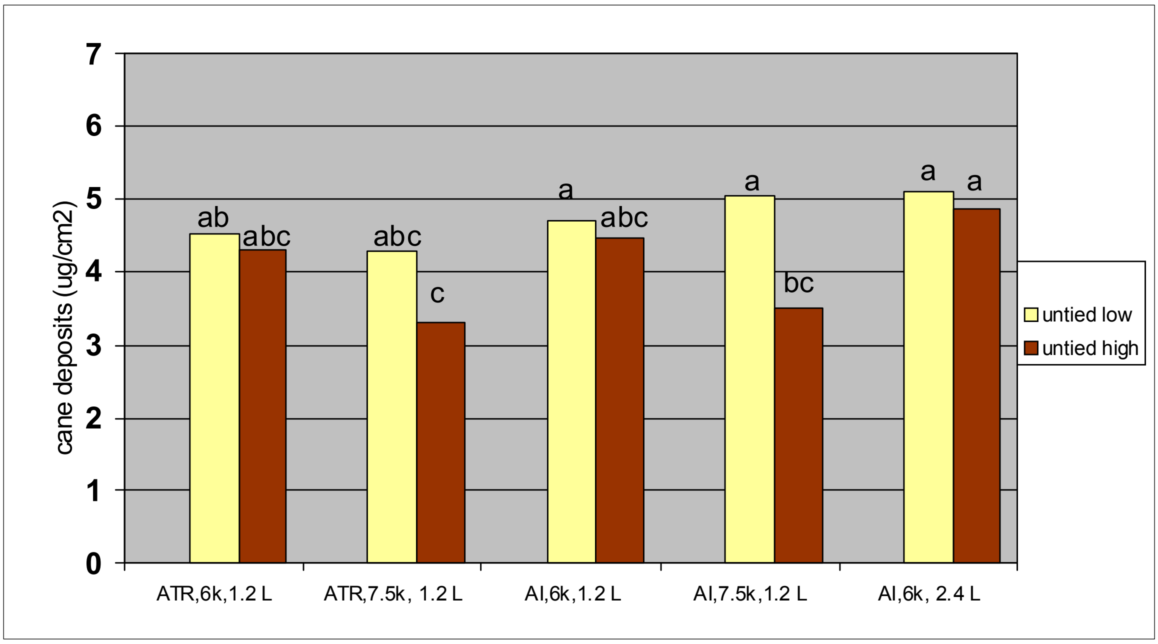


Fig. 4: Average deposits on untied canes: at low (+0.2 m) and high (+1 m) positions in the leader zone (see Table 2 for treatment descriptions). Means sharing common letters are not significantly different (P>0.05).

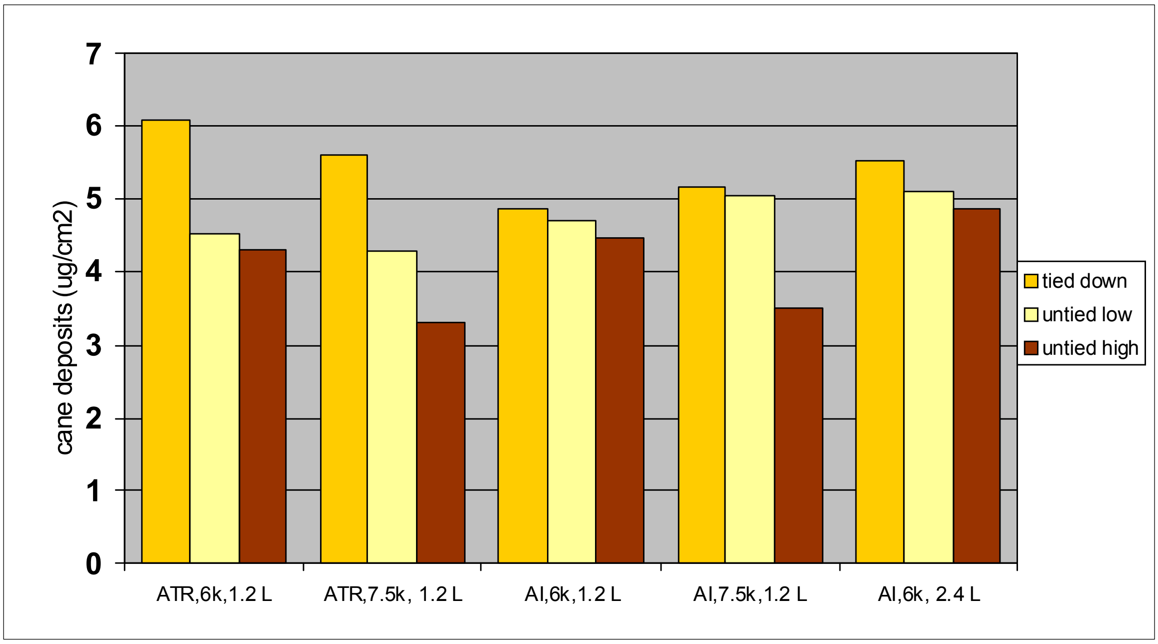


Fig. 5: Average deposits on tied-down versus untied canes in the leader zone (see Table 2 for treatment descriptions).

Nozzle type, travel speed, adjuvant rate and cane position within the row (leader versus centre row) were found to be less important than cane height (tied-down versus untied canes) as sources of potential deposit variability in this study (Table 2, Figs 3-5). It was anticipated that there would be a trend for lower average deposits with increasing cane diameter, with this trend being a function of increasing ‘blind spots’ (with respect to spray coverage) with larger canes. However, there were no significant correlations between deposit levels and the range of cane diameters (5-20 mm) used in this experiment for; nozzle type (large droplet AI versus fine droplet ATR), travel speed (6 versus 7.5 km/h), cane position (leader versus row centre) or adjuvant rate (1.2 L versus 2.4 L/ha). This suggests that shading of large diameter canes is not an issue and the sprayer setup factors influence deposit levels more than cane size.

However, some shading of cane surfaces on the trailing side of the direction of travel, and particularly on the top-side of canes, was evident on WSPs (Appendix 1 & 4). While macro deposits on canes were generally similar for both nozzle types (Table 2), the AI nozzles produce fewer, larger droplets. This can be observed on WSP (Appendix 4). Potentially, this will leave large areas of cane surface not contacted by such droplets.

When the AI nozzles were utilised for applying hydrogen cyanamide sprays (Gaskin & Manktelow 2007, 2008), Driftstop adjuvant (Nufarm) was developed, primarily to reduce drift but also to improve adhesion of large droplets and to improve their spread (coverage) on cane surfaces. Systemic (absorbed) compounds such as hydrogen cyanamide do not require the complete and even coverage of cane surfaces that is critical for protectant sprays to be effective against Psa. The latter can be reliably achieved with correct prescriptions of adjuvants which will super-spread and wet all surfaces requiring protection. This is illustrated with Du-Wett (Fig. 6), an adjuvant which has been extensively researched and developed for use in horticultural sprays. When using AI nozzles (500-700 L/ha) to apply protectant sprays to bare canes, it is essential to use a proven adjuvant such as Du-Wett, Du-Wett Rainmaster or Driftstop to maximise deposits on target and droplet spread/coverage over all surfaces. It is critical to follow the use rate prescriptions given with these adjuvants (Table 3) which have been developed through extensive field and laboratory trials on kiwifruit. Note that the rates recommended here are lower than those evaluated in the reported trial but on the basis of all available information they have been judged to do the job required while minimising any potential spray loss to run-off and cost to growers.

It is important to note that incorrect use of a super-spreader such as Du-Wett, either by using too high a rate or by adding it to fully dilute sprays, will result in spray run-off and potential loss of efficacy. The study reported here has confirmed that 500-700 L/ha sprays will cover kiwifruit canes at least as well as higher volume sprays, and will additionally provide growers with efficiencies of sprayer use. It is expected that the spray and sprayer prescriptions developed can be used through to early shoot development up to ca. one month after bud break.

Use of the super-spreader adjuvant is not essential when using ATR (fine) nozzles (500-700 L/ha), but its use is expected to benefit coverage of the target canes. Similarly with higher volume sprays, the addition of a super-spreader is expected to benefit protectant spray coverage, but the adjuvant use rate must be reduced to prevent excessive spray run-off (Table 3).

It is important to note when using WSP that they do not give any indication of how droplets will spread on a target surface (Fig. 6); their use is to visualise where a sprayer can physically deposit spray, and to provide an indication of spray droplet size ranges. They do not provide a reliable indication of final spray coverage on plant surfaces.

Contrary to what is observed on canes and leaves, the WSP gives no measure of the super-spreading ability of an adjuvant such as Du-Wett on these surfaces.

Table 3: Adjuvant prescriptions for use with protectant copper[1] sprays on kiwifruit dormant canes

Nozzles	Spray volume (L/ha)	Adjuvant	Use rate (ml/ha)
AI or ATR/TX hollow cone	500-700	Du-Wett	500
		Du-Wett Rainmaster	1000
		Driftstop	1000
Masotti 58 or SS disk & core cones	1000	Du-Wett	300
		Du-Wett Rainmaster	600
		Driftstop	600

[1]Sprays other than commercial copper formulations will likely require use of a sticker-spreader (e.g. Du-Wett Rainmaster) to rainfasten sprays if rain is expected within 5 days of spraying.

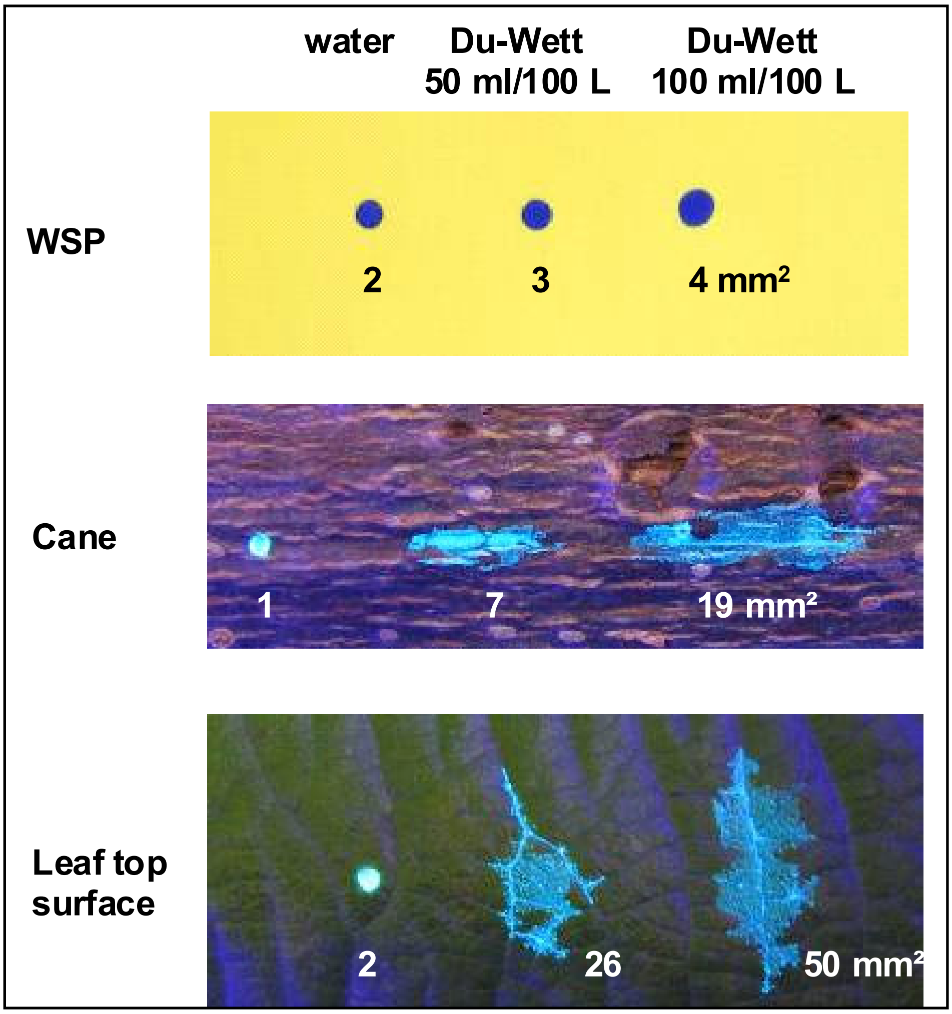


Fig. 6: Spreading (mm^2) of water alone and super-spreader adjuvant spray droplets (0.25 µl) on WSP, Hayward fruiting cane and Hayward leaf surface. Note each droplet contains the same volume of spray.

While there were often no differences in cane deposits between sprays (600 L/ha) applied through AI (coarse) nozzles and hollow cone (fine) ATR nozzles, the AI nozzles have the advantage of minimising drift substantially (Gaskin *et al.* 2008). Drift was not assessed in this study but the reduced drift with AI nozzles was very obvious (Photograph 3). They should be the preferred option for applying protectant sprays to dormant canes, especially as sprayers used to apply hydrogen cyanamide will already be fitted with these nozzles.

Photograph 3: Comparison of visible drift between ATR and AI nozzles at two different speeds.

RECOMMENDATIONS
for applying protectant sprays to dormant canes

- **Nozzles:**
  AI as for hydrogen cyanamide (low drift) plus adjuvant are the preferred option, or Albuz ATR/Spraying Systems TX ceramic hollow cone (high drift risk)

- **Pressures and sprayer air output:**
  Sprayer to be operated at 10-20 bar, and sufficient air must be used to consistently project the spray 1 m beyond leaders and highest canes (look to the upwind side of the sprayer to monitor spray projection)

- **Application volumes:**
  500-700 L/ha plus super-spreading adjuvants recommended.
  Use of up to 1000 L/ha is acceptable. Volumes above 1000 L/ha should not be required for bare cane applications.

- **Travel speeds:**
  6-7 km/h, but increasing speed will reduce deposits on high unpruned canes

- **Sprayer calibration is essential!**

- **Adjuvants:**
  In 500-700 L/ha spray volumes
  Du-Wett at 500 ml/ha
  or
  Du-Wett Rainmaster (if rainfastening of sprays is required) or Driftstop at 1 L/ha

  In 1000 L/ha spray volumes:
  Du-Wett at up to 300 ml/ha
  or
  Du-Wett Rainmaster or Driftstop at up to 600 ml/ha

In practice, it is impossible to ensure full coverage of dormant canes from a single spray application. At least **two applications from opposite directions of travel** should be able to deliver coverage to most cane surfaces. Any new wounds that are created after copper has been applied (pruning cuts, cracked canes, wind rub etc) will require additional protectant cover.

The super-spreader adjuvants used in these tests provide growers with the opportunity to achieve significantly better coverage of hard-to-wet areas with copper or other protectant sprays. In the absence of any data to suggest otherwise, it is strongly recommended that the super-spreader adjuvants are used in order to maximise spray droplet adhesion, spread and target coverage. Adjuvant prescriptions should be followed at all times! Adjuvant addition will improve coverage of cane surfaces from sprays using ATR and TX hollow cone (fine) nozzles also.

The work reported here has confirmed the chemical deposit levels and deposit variability that is achievable with well-setup airblast sprayers. Given the high level of rain-fastness of copper compounds on canes, it should be possible to build a variable rate protectant spray programme that will maximise wood protection without leading to excessive use of copper compounds. Programme recommendations should probably focus on the establishment of a base protectant deposit (from two cover sprays in opposite directions) and the maintenance of this protectant cover with (probably) lower dose applications as required.

ACKNOWLEDGEMENTS

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APPENDIX 1
Water sensitive paper record of spraying parameters assessed in preliminary study

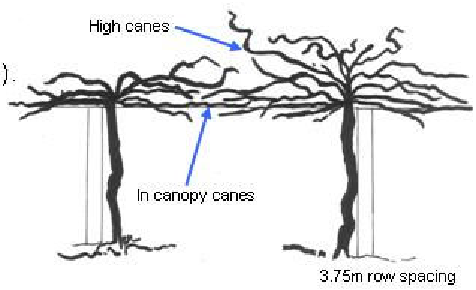
Zespri_PSA_Trial7_Preliminary airblast sprayer trials, on Kiwigold bare cane canopy using water sensitive papers.

Location: 220 Maniatutu Rd, Pongakawa.
Marty Bricks Orchard.

Date: 1st June 2011

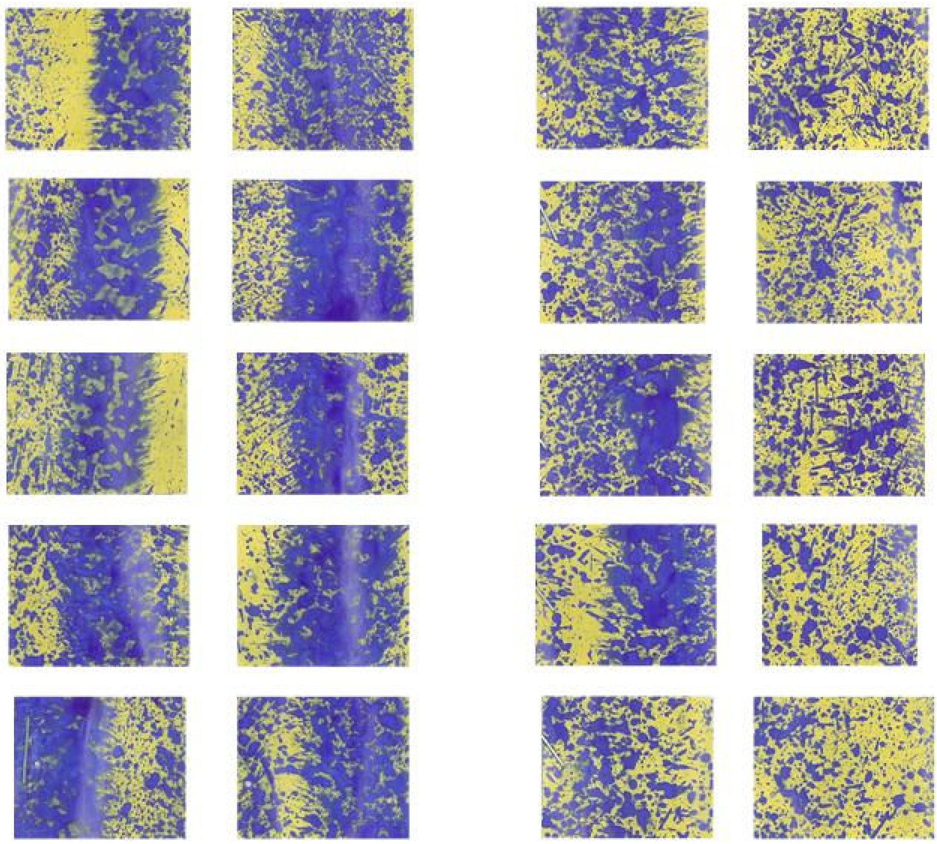
Block: Omega (Block4)

Sprayer: Atom 2000 turbo
Nozzles: 2x TVI AI hollow cone nozzles 80° (top) &
2x Venturi TurboDrop® flat fan nozzles (bottom).
(per side)
1650 rpm fan speed, pressure = 15bar
Water rate (L/ha): 700L
Travel speed (km/h): 6km



Trt: 1_water only

Leader deposits		**Centre deposits**	
High canes	In canopy canes	High canes	In canopy canes
Left side = top of cane		Left side = top of cane	



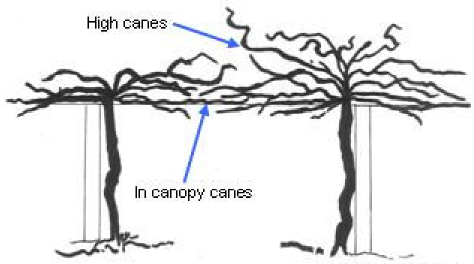
Zespri_PSA_Trial7_Preliminary airblast sprayer trials, on Kiwigold bare cane canopy using water sensitive papers.

Location: 220 Maniatutu Rd, Pongakawa.
Marty Bricks Orchard.

Date: 1st June 2011

Block: Omega (Block4)

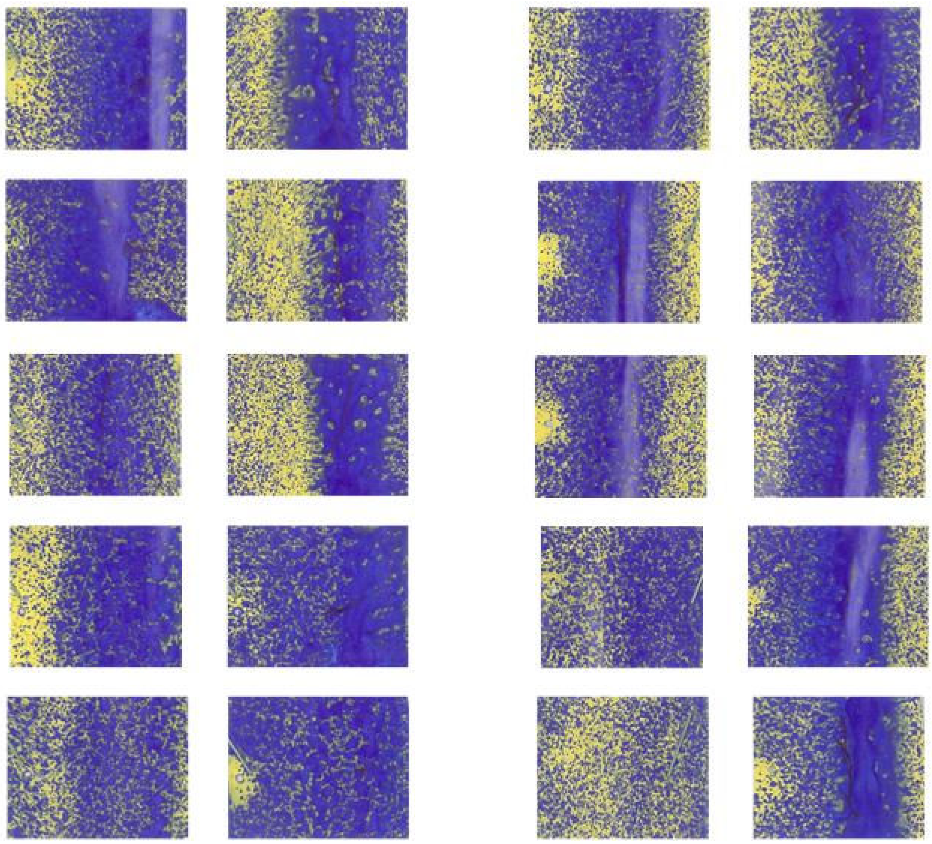
Sprayer: Atom 2000 turbo
Nozzles: 4x Albuz ATR hollow cone (fine) nozzles (per side)
1650 rpm fan speed, pressure = 17bar
Water rate (L/ha): 700L
Travel speed (km/h): 6km



Trt: 2_water only

Leader deposits
High canes In canopy canes
Left side = top of cane

Centre deposits
High canes In canopy canes
Left side = top of cane



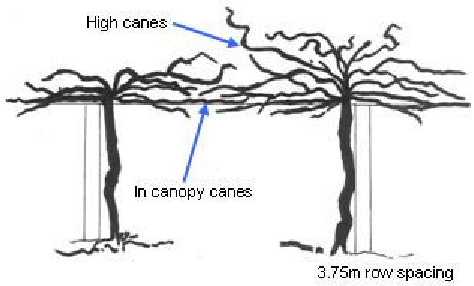
Zespri_PSA_Trial7_Preliminary airblast sprayer trials, on Kiwigold bare cane canopy using water sensitive papers.

Location: 220 Maniatutu Rd, Pongakawa.
Marty Bricks Orchard.

Date: 1st June 2011

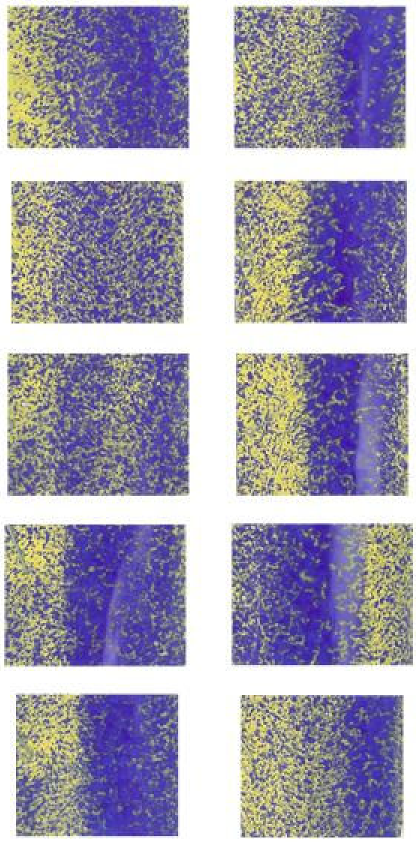
Block: Omega (Block4)

Sprayer: Atom 2000 turbo
Nozzles: 4x Albuz ATR hollow cone (fine) nozzles
(per side)
1650 rpm fan speed
Water rate (L/ha): 500L
Travel speed (km/h): 6km

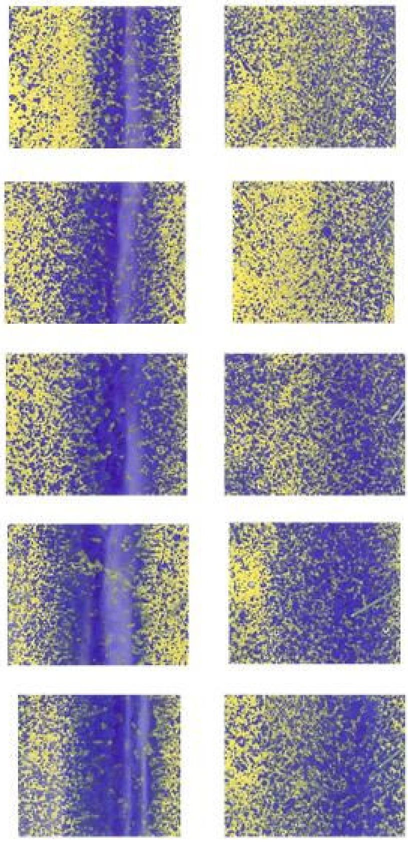


Trt: 3_water only

Leader deposits
High canes In canopy canes
Left side = top of cane



Centre deposits
High canes In canopy canes
Left side = top of cane



Zespri_PSA_Trial7_Preliminary airblast sprayer trials, on Kiwigold bare cane canopy using water sensitive papers.

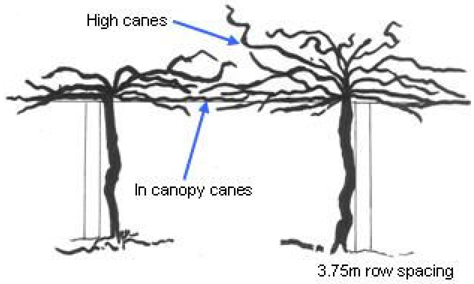
Location: 220 Maniatutu Rd, Pongakawa.
Marty Bricks Orchard.

Date: 1st June 2011

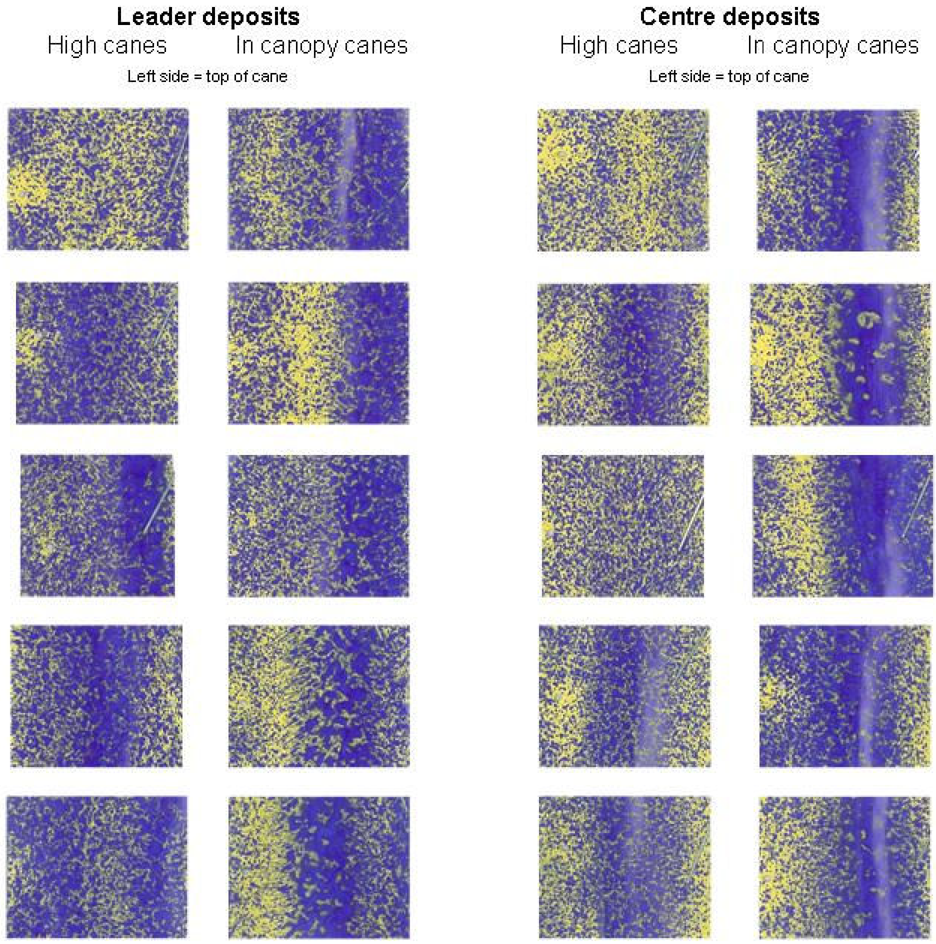
Block: Omega (Block4)

Wind speed (m/s): <1m across rows

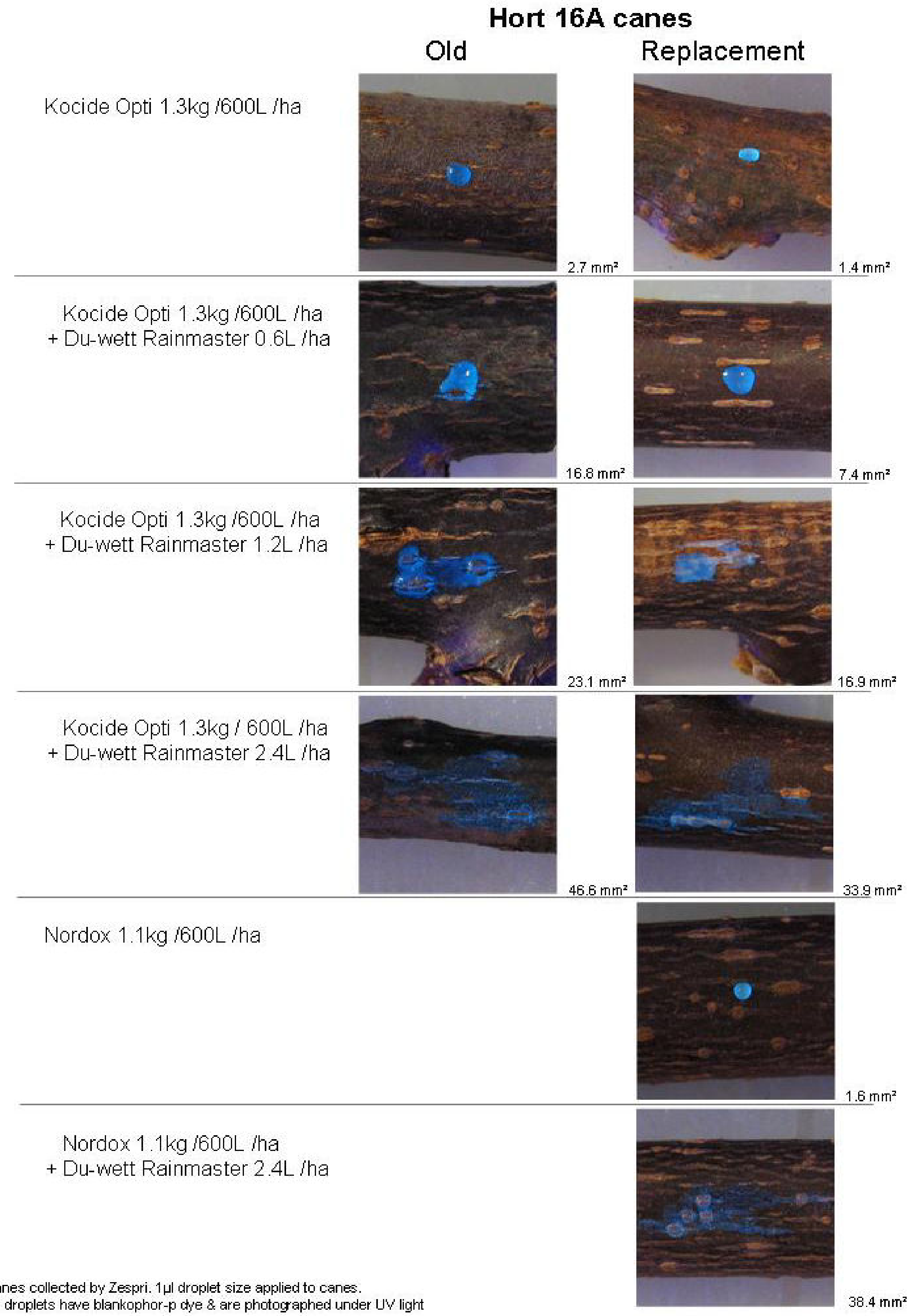
Sprayer: Atom 2000 turbo
Nozzles: 4x Albuz ATR hollow cone (fine) nozzles (per side)
1650 rpm fan speed, pressure = 1400kpa
Water rate (L/ha): 500L
Travel speed (km/h): 7.5km



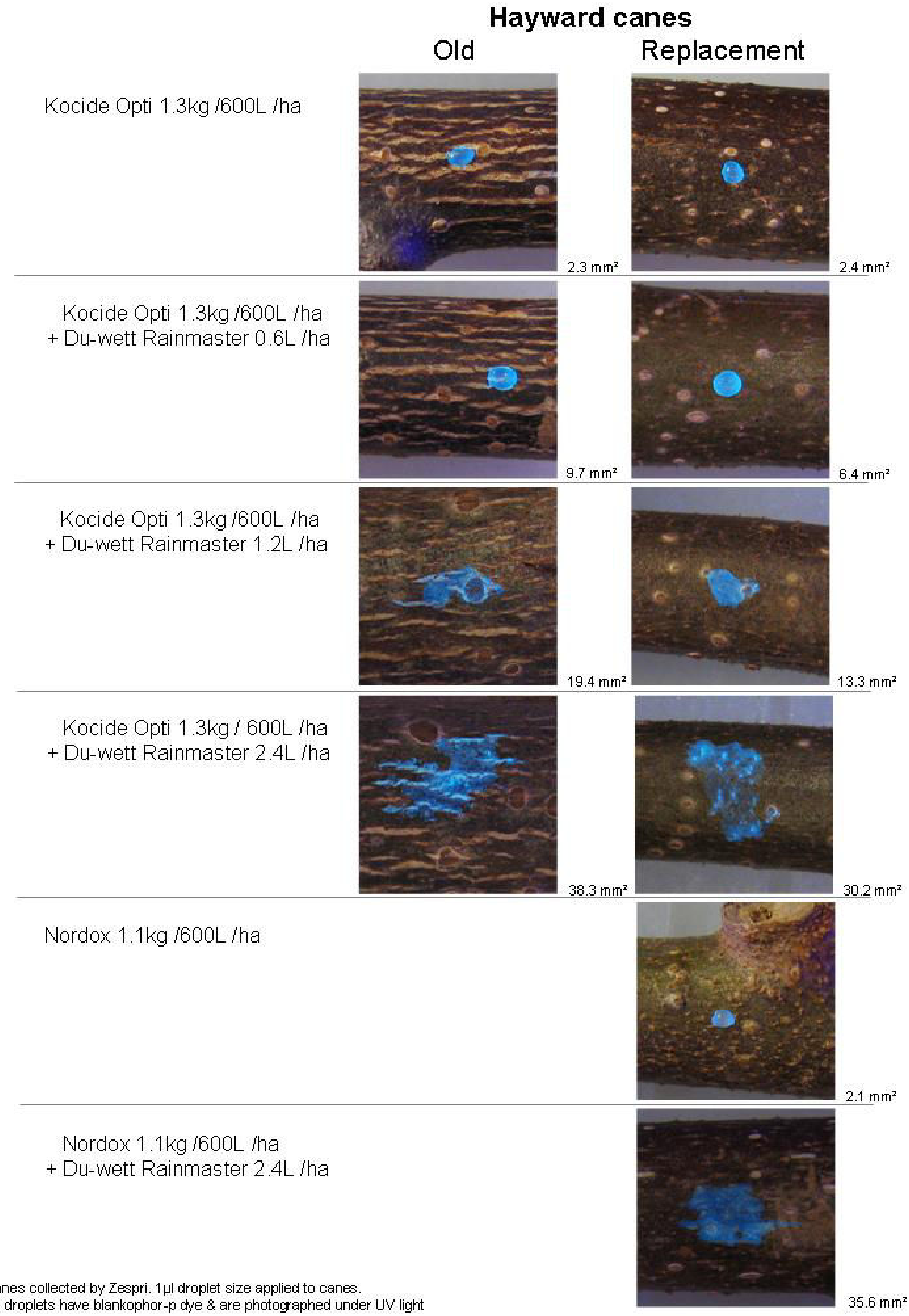
Trt: 4_water only



APPENDIX 2
Coverage of canes with Du-Wett Rainmaster sprays



Canes collected by Zespri. 1µl droplet size applied to canes.
All droplets have blankophor-p dye & are photographed under UV light



Canes collected by Zespri. 1µl droplet size applied to canes.
All droplets have blankophor-p dye & are photographed under UV light

APPENDIX 3
Sprayer nozzle setup

AI = Air Induction large droplet low drift nozzles

Nozzles (from top-bottom on the spray ring):

1 Albuz TVI lilac 80_025
2 Albuz TVI blue 80_03
3 Agrotop TD red 40_04
4 Agrotop TD brown 40_05

Operated at 13.5 bar for 6 km/h travel speed, 19 bar for 7.5 km/h.

ATR = Fine droplet ceramic hollow cone nozzles

Albuz ATR Nozzles (from top-bottom on the spray ring):

1 green
2 green
3 blue
4 blue

Operated at 10 bar for 6 km/h travel speed, 14.5 bar for 7.5 km/h.

APPENDIX 4:
Water sensitive paper records of each treatment at 1 m above canopy in leader zone

Zespri_PSA_Trial8_Airblast sprayer trials, on Kiwigold bare cane canopy using water sensitive papers.

Location: 220 Maniatutu Rd, Pongakawa.
Marty Bricks Orchard.

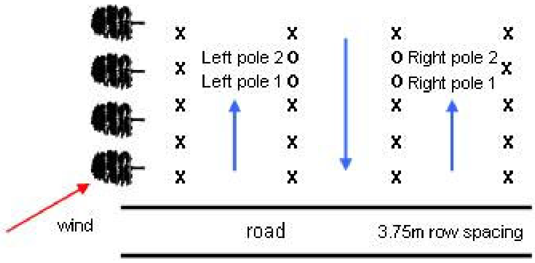
Block: Omega

Sprayer: Atom 2000 turbo
Nozzles: 2x TVI AI hollow cone nozzles (top) &
2x Venturi TurboDrop® flat fan nozzles (bottom). (per side)
1600 rpm fan speed, pressure = ~14bar
Water rate (L/ha): 600L
Travel speed (km/h): 6km

Date: 15th June 2011

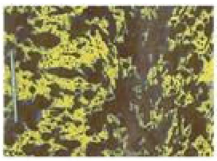
Wind speed (m/s): mean/max: rep1: 0.4/1.1
rep2: 0.41/2.5

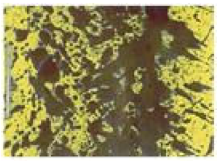
Temperature: -
Sprayer travel direction:

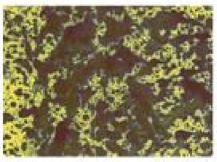


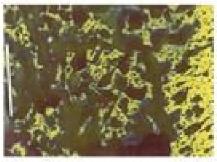
Trt: 1_0.2% Du-wett Rainmaster + tartrazine dye

Cane deposits
Rep1

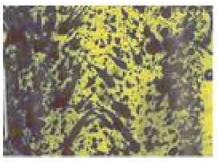

Left pole 1

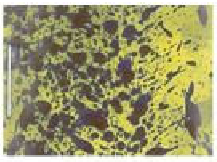

Right pole 1

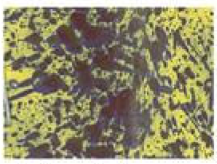

Left pole 2

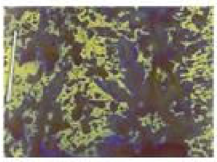

Right pole 2

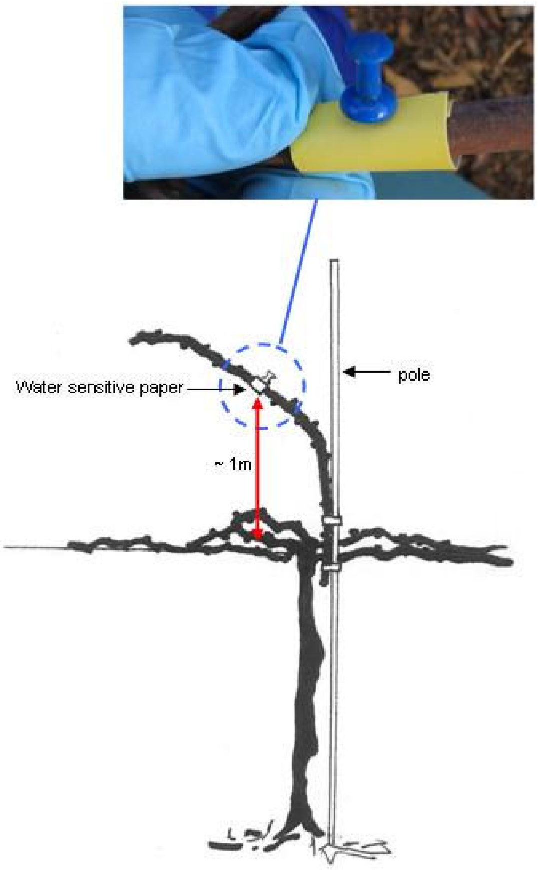
Cane deposits
Rep2


Left pole 1


Right pole 1


Left pole 2


Right pole 2



To simulate high canopy, 4 poles were set-up in a bay (2 on each side). A cane with a water sensitive paper was tied to the pole. 2 samples were taken from the cane (after trt spray), one immediately above the water sensitive paper and the second approx. 20cm above the pergola canopy.

Zespri_PSA_Trial8_Airblast sprayer trials, on Kiwigold bare cane canopy using water sensitive papers.

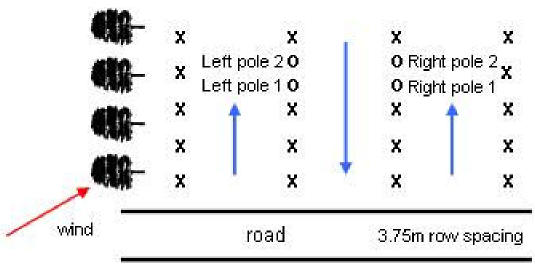
Location: 220 Maniatutu Rd, Pongakawa. Marty Bricks Orchard.

Block: Omega

Sprayer: Atom 2000 turbo
Nozzles: 2x TVI AI hollow cone nozzles (top) & 2x Venturi TurboDrop® flat fan nozzles (bottom). (per side)
1600 rpm fan speed, pressure = ~19bar
Water rate (L/ha): 600L
Travel speed (km/h): 7.5km

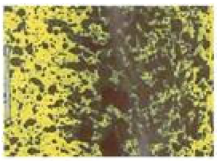
Date: 15th June 2011

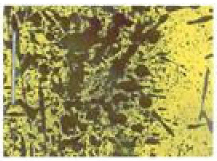
Wind speed (m/s): mean/max: rep1: 0.23/0.83
Temperature: -
Sprayer travel direction:

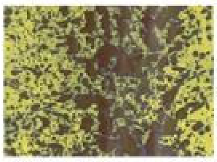


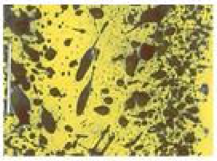
Trt: 2_0.2% Du-wett Rainmaster + tartrazine dye

Cane deposits
Rep1


Left pole 1


Right pole 1


Left pole 2


Right pole 2

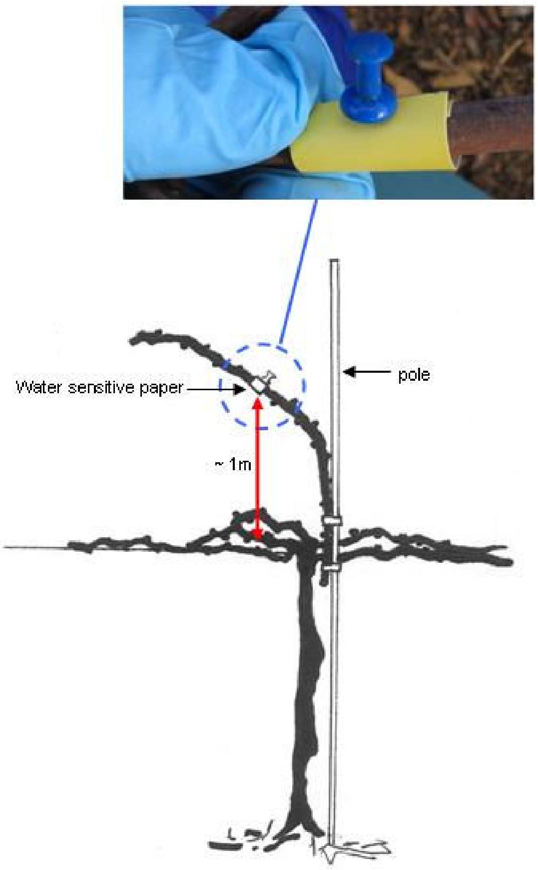
Cane deposits
Rep2

Left pole 1

Right pole 1

Left pole 2

Right pole 2



To simulate high canopy, 4 poles were set-up in a bay (2 on each side). A cane with a water sensitive paper was tied to the pole. 2 samples were taken from the cane (after trt spray), one immediately above the water sensitive paper and the second approx. 20cm above the pergola canopy.

Zespri_PSA_Trial8_Airblast sprayer trials, on Kiwigold bare cane canopy using water sensitive papers.

Location: 220 Maniatutu Rd, Pongakawa.
Marty Bricks Orchard.

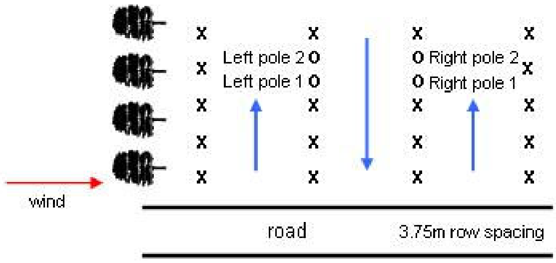
Block: Omega

Sprayer: Atom 2000 turbo
Nozzles: 2x TVI AI hollow cone nozzles (top) & 2x Venturi TurboDrop® flat fan nozzles (bottom). (per side)
1600 rpm fan speed, pressure = ~14bar
Water rate (L/ha): 600L
Travel speed (km/h): 6km

Date: 15th June 2011

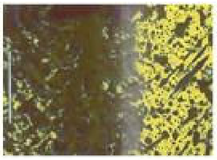
Wind speed (m/s): mean/max: rep1: 0.50/1.21
rep2: 0.28/2.70

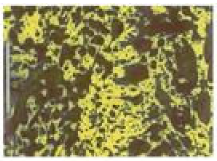
Temperature: -
Sprayer travel direction:

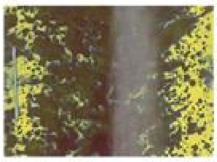


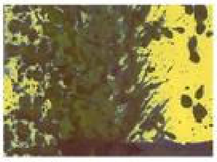
Trt: 3_0.4% Du-wett Rainmaster + tartrazine dye

Cane deposits
Rep1


Left pole 1

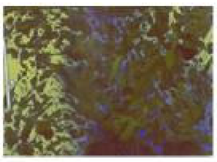

Right pole 1

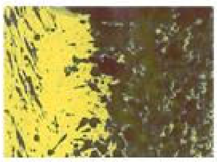

Left pole 2

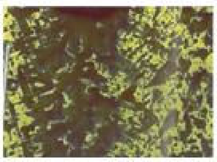

Right pole 2

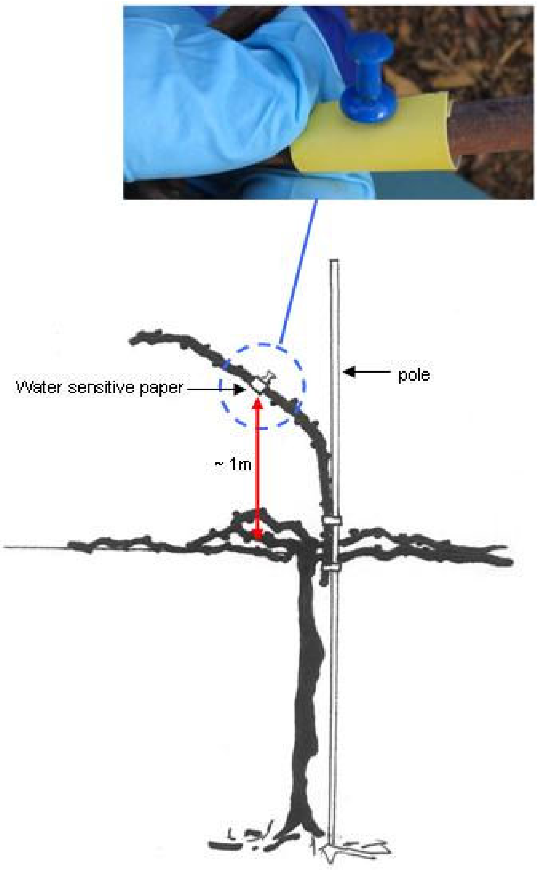
Cane deposits
Rep2


Left pole 1


Right pole 1


Left pole 2


Right pole 2



To simulate high canopy, 4 poles were set-up in a bay (2 on each side). A cane with a water sensitive paper was tied to the pole. 2 samples were taken from the cane (after trt spray), one immediately above the water sensitive paper and the second approx. 20cm above the pergola canopy.

Zespri_PSA_Trial8_Airblast sprayer trials, on Kiwigold bare cane canopy using water sensitive papers.

Location: 220 Maniatutu Rd, Pongakawa.
Marty Bricks Orchard.

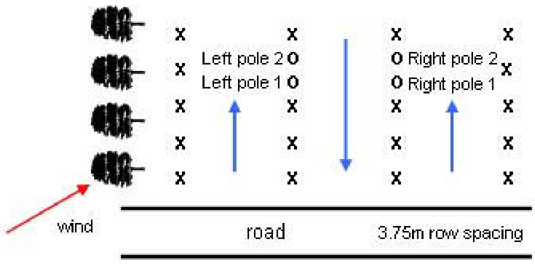
Block: Omega

Sprayer: Atom 2000 turbo
Nozzles: 4x Albuz ATR hollow cone (fine) nozzles (per side)
1600 rpm fan speed, pressure = ~14bar
Water rate (L/ha): 600L
Travel speed (km/h): 6km

Date: 15th June 2011

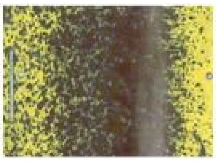
Wind speed (m/s): mean/max: rep1: 0.31/1.50
rep2: 0.01/2.6

Temperature: -
Sprayer travel direction:

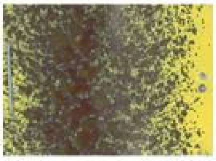


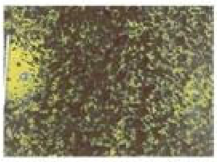
Trt: 4_0.2% Du-wett Rainmaster + tartrazine dye

Cane deposits
Rep1

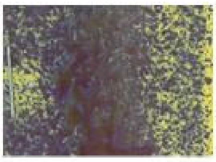

Left pole 1

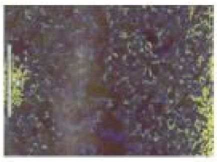

Right pole 1

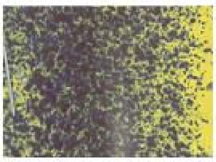

Left pole 2

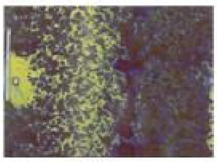

Right pole 2

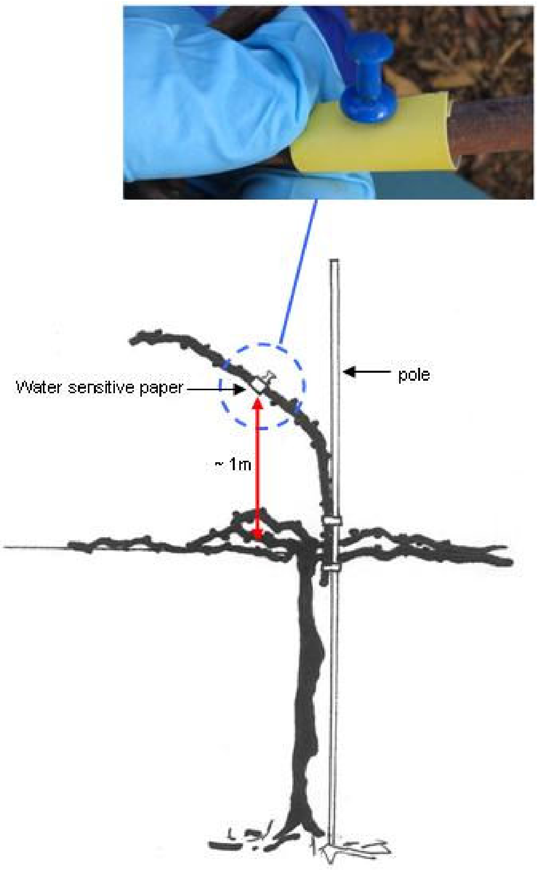
Cane deposits
Rep2 (no wind)


Left pole 1


Right pole 1


Left pole 2


Right pole 2



To simulate high canopy, 4 poles were set-up in a bay (2 on each side). A cane with a water sensitive paper was tied to the pole. 2 samples were taken from the cane (after trt spray), one immediately above the water sensitive paper and the second approx. 20cm above the pergola canopy.

Zespri_PSA_Trial8_Airblast sprayer trials, on Kiwigold bare cane canopy using water sensitive papers.

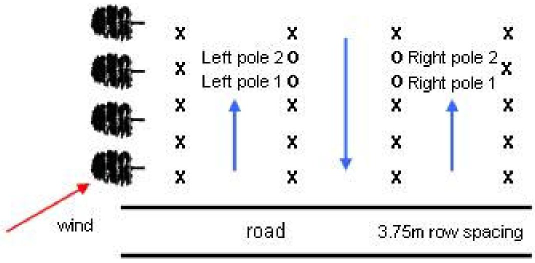
Location: 220 Maniatutu Rd, Pongakawa.
Marty Bricks Orchard.

Date: 15th June 2011

Block: Omega

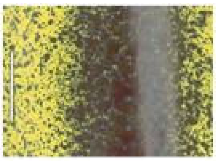
Sprayer: Atom 2000 turbo
Nozzles: 4x Albuz ATR hollow cone (fine) nozzles (per side)
1600 rpm fan speed, pressure = ~19bar
Water rate (L/ha): 600L
Travel speed (km/h): 7.5km

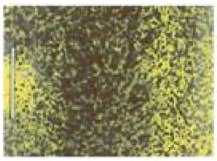
Wind speed (m/s): mean/max: rep1: 0.51/1.48
Temperature: -
Sprayer travel direction:

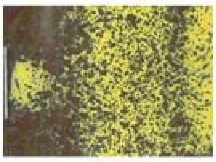


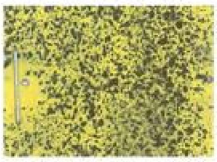
Trt: 5_0.2% Du-wett Rainmaster + tartrazine dye

Cane deposits
Rep1


Left pole 1


Right pole 1


Left pole 2


Right pole 2

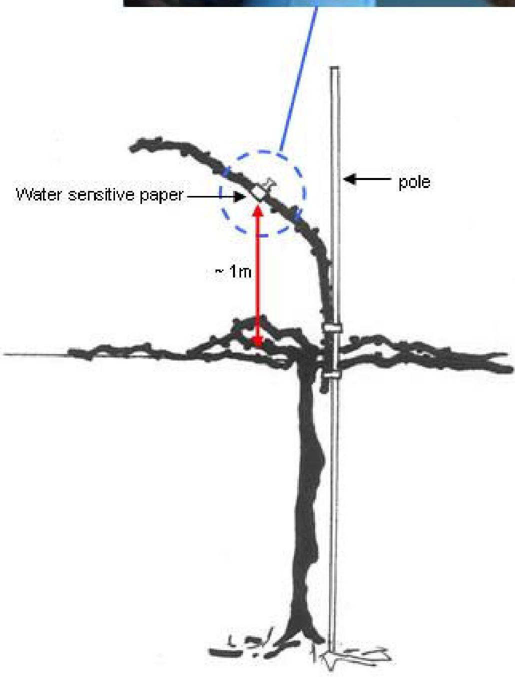
Cane deposits
Rep2

Left pole 1

Right pole 1

Left pole 2

Right pole 2



To simulate high canopy, 4 poles were set-up in a bay (2 on each side). A cane with a water sensitive paper was tied to the pole. 2 samples were taken from the cane (after trt spray), one immediately above the water sensitive paper and the second approx. 20cm above the pergola canopy.

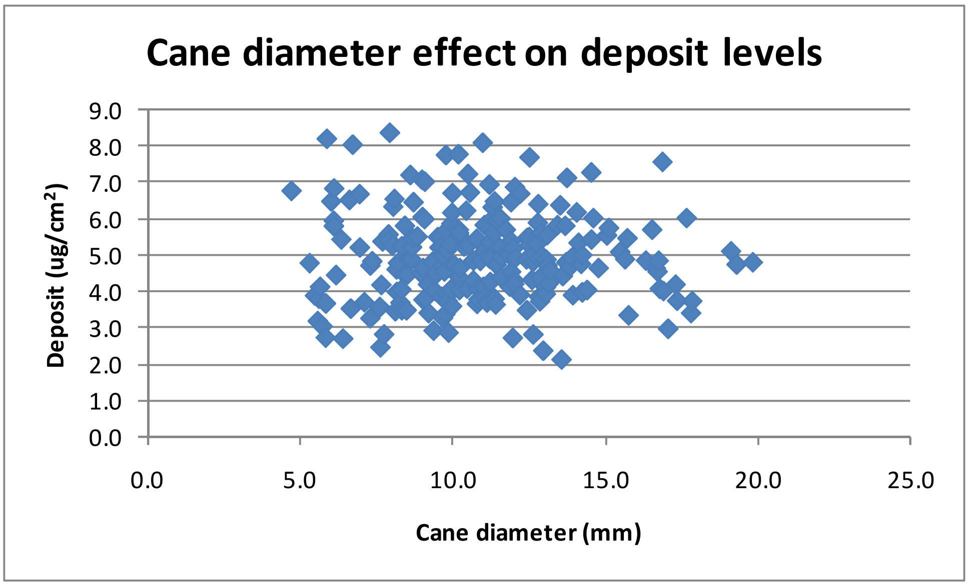
APPENDIX 5
The effect of cane diameter on spray deposit levels

Deposits were measured on a total of 224 individual 20 cm long pieces of cane across the five treatments reported in this study. These cane samples ranged from 5-20 mm in average diameter.

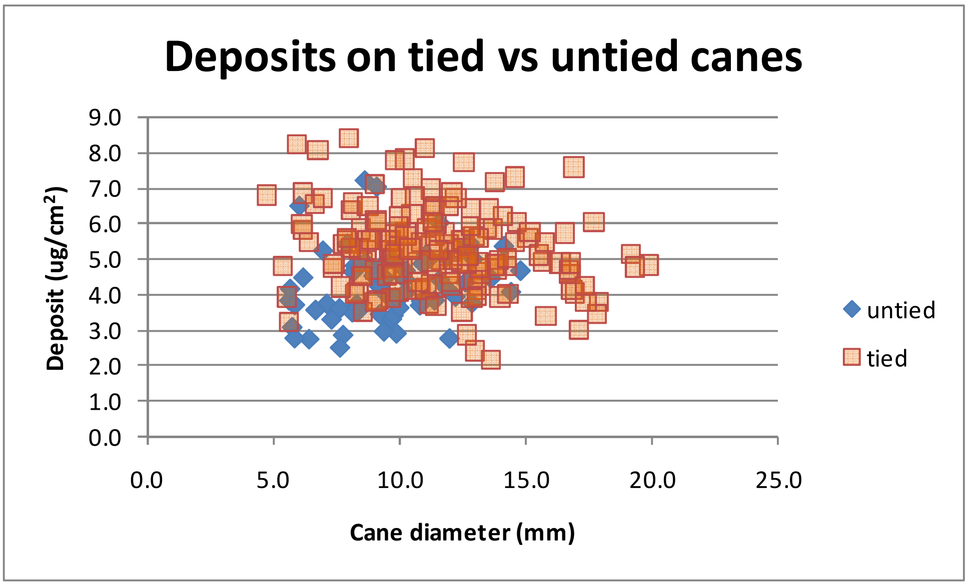
It was anticipated that there would be a trend for lower average deposits with increasing cane diameter, with this trend being a function of increasing 'blind spots' (with respect to coverage) with increasing wood diameters.

There were no significant correlations between deposit levels and the range of cane diameters used in this experiment for; nozzle type (large droplet AI versus fine droplet ATR), travel speed (6 versus 7.5 km/hr), cane position (leader versus row centre) or adjuvant rate (1.2 L versus 2.4 L/ha). These data suggest that the sprayer setup factors identified in the main body of the report (eg. travel speed effects on deposits on canes at different heights) are of more importance to deposit levels than cane size. This is a positive result in that it should be possible to adjust sprayer setup and operational decisions to address deposit variability introduced by variables such as travel speed. It would be far more difficult to adjust sprayers to address deposit variability in relation to cane diameter.

The graph below shows the overall variability in deposits across the 224 canes assessed. The four-fold variation in deposits seen from a single application is important as the lowest deposits define the chemical application rates needed to protect vines from Psa infection. It is expected that the overall variability in deposits will decrease following a second application from the opposite direction of travel, as this second application would tend to fill in deposits on any cane areas that were obscured in the previous application.



The graph below compares the deposits on tied versus untied canes. Note the overall trend for lower deposits on the untied canes. There was a trend (not significant) for lower average deposits on the tied canes with increasing cane diameter. Note that the untied cane data includes both the 0.2 m and 1.0 m sample heights above the pergola structure. The lowest deposits were associated with the highest sample postion.



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