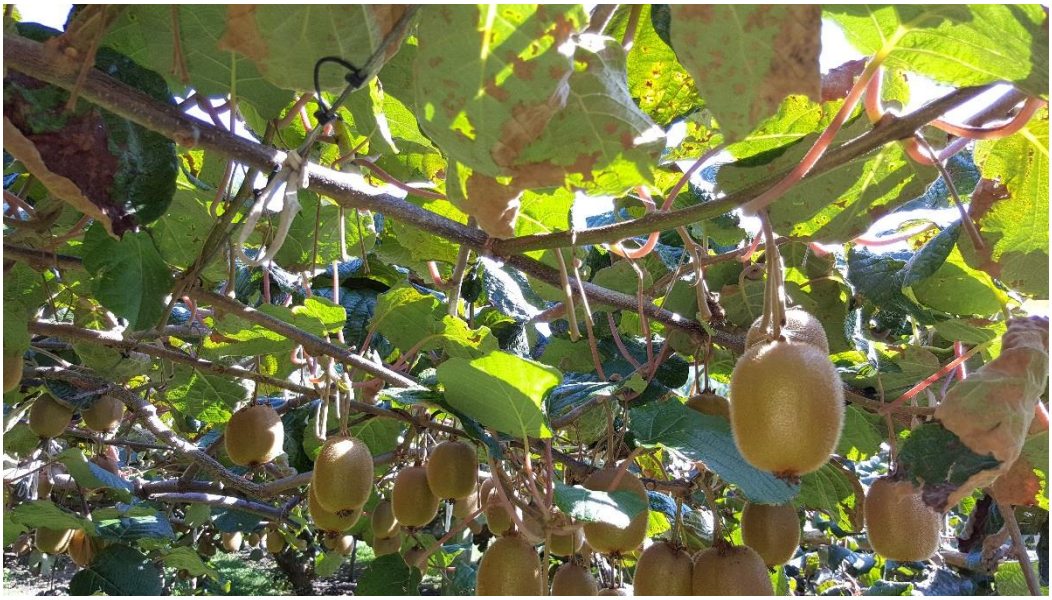
Efficacy of Novel Elicitors on Psa: Final Report
CP 1653 – 670
Confidential Report Prepared for Zespri International Limited



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Executive Summary

Introduction

Zespri engaged HortEvaluation Ltd to undertake a trial to evaluate several novel elicitors for Psa disease control under commercial orchard conditions. The elicitor products had previously shown promise in potted plant testing trials, for control of Psa leaf spot symptoms.

Products to be tested were AB48414, TNL3454, Emix, Estim 20 and Citrox Bioalexin. Other trial work completed after the commencement of this trial showed that Estim 20 did not produce worthwhile effects on Psa leafspot on Gold3 potted plants. Consequently, Estim 20 was discontinued on Gold3 and instead, an alternate product, *Bacillus mycoides* was included in the trial programme, with applications commencing in autumn 2016.

Also included were an industry standard elicitor, Actigard, and an untreated control, where no elicitor type product was applied either as part of the trial or as part of the grower spray programme.

Materials and Methods

The trial was carried out at three Hayward and three Gold3 sites within the Te Puke region of Bay of Plenty. All sites were selected on the basis of likely high natural inoculum pressure, indicated by Psa disease history and Psa disease symptoms present prior to trial commencement.

At each site, each treatment was replicated six times and each trial was laid out as a randomised complete block. Each plot was a whole vine, with sufficient buffer zones between plots, determined by plant spacing and male/female vine arrangement specific to each site.

Products were to be applied twice during the bud phase and twice post-harvest, for two growing seasons 2015/2016 and 2016/2017.

All applications were made with a Solo 433 high pressure motorised knapsack sprayer with working pressure nominally 25 bar (2500 kPa or 363 psi) at 1000 L/ha.

Application conditions were recorded, using on-site Harvest.com weather stations at four of the six sites and the nearest relevant Harvest.com weather stations, for the other two sites.

Treatment 3 AB48414 and treatment 4 TNL3454 were applied and assessed up to the point at which those product proprietors signalled their intent to withdraw their products from evaluation for use on kiwifruit, in 2016/17.

A range of assessment methods of Psa symptoms was made throughout the trial period. At the start of spring 2015, winter 2016, spring 2016 and winter 2017, counts were made of the number of cankers per vine, on both leaders and canes; and the number of dieback sites on both canes and shoots for all Hayward and Gold3 sites.

For Hayward, four fruiting canes per plot were tagged and Psa assessed on leaves and flower buds on each cane prior to flowering. Fruit were counted at fruit set and again just pre-harvest.

For Gold3, the number of fruiting canes per plot, were counted at the start of spring 2015, late November 2015 and late March 2016, and repeated in spring 2016, late November 2016 and late March 2017.

Treatment effects on yield were assessed by undertaking components of yield counts on the four tagged canes per plot, for the Hayward sites and similarly on four tagged canes per plot

for Gold3 sites. Counts were done in spring 2015 to establish a baseline, and again in spring 2016.

Residue test composite samples were collected prior to harvest 2016, per treatment per site, for plots receiving Actigard, AB48414 and TNL3454. AB48414 sample fruit collected were held frozen but not analysed as the proprietor of the product had since indicated that they would not continue commercial development of AB48414 for Psa disease control on kiwifruit. Samples were analysed at Hill Laboratories, Hamilton.

Fruit maturity characteristics were tested at Eurofins, Katikati, for a composite 90 fruit sample per treatment per site, at harvest 2017.

Key Results

- In 2015/2016, for all six sites, Psa diseases assessments showed no significant differences between treatments for any of the variables counted or calculated, for either an individual site or for all three sites of the same variety

- In 2016/2017, for all three Hayward sites, no significant differences were found between the treatments for any of the Psa disease assessment variables at any of the three sites, nor were there any significant site by treatment interactions

- In 2016/2017, for Gold3 sites, the analysis of variance of the log counts found significant treatment differences in the number of shoot diebacks in spring (Treatment 8 *Bacillus mycoides* having higher numbers) and winter (Treatment 1 untreated control having lower numbers)

- Return bloom effects as assessed by components of yield analysis, showed significant differences for treatment two Actigard in 2015/2016 having lower floralness in spring 2016 compared with some or all of the other treatments, depending on the components of yield variable analysed

- Return bloom effects as assessed by components of yield analysis did not show any significant differences between any of the other treatments

- Based on the residue samples collected pre-harvest in 2016, Actigard and TNL 3454 products do not pose a risk of residues at harvest, when used in the bud phase

- For Gold3, dry matter was significantly higher for treatment 2 Actigard (17.87%), than for treatment 7 Citrox Bioalexin (16.67%), treatment 1 untreated control (16.72%) and treatment 8 *Bacillus mycoides* (16.72%), brix equatorial was significantly higher for treatment 2 Actigard (8.869), than for treatment 1 untreated control (7.217) and combining both pressure test readings, fruit was significantly firmer for treatment 1 untreated control (6.9kgf) and treatment 2 Actigard (6.841kgf) than for all other treatments and fresh weight was significantly higher for treatment 2 Actigard (153g), than for treatment 1 untreated control (133.4g)

- These treatment effects of apparently better maturity characteristics for Actigard treatment 2 might reflect lower crop load, indicated by return bloom effects as assessed by components of yield

- For Hayward, no significant differences were detected for the aggregate results in maturity parameters across the three sites

- None of the treatments had adverse effects on fruit maturity by comparison with the untreated controls in both Hayward and Gold3

Conclusions and Recommendations

Prior to the conclusion of the trial, two proprietors had independently indicated that they would no longer pursue work towards supporting registration of their products for Psa disease control. That is; for TNL3454 and AB48414.

This trial was not able to demonstrate efficacy of any of the products tested in providing additional control of Psa disease symptoms, on both Hayward and Gold3 at the six trial sites over two entire growing seasons.

Therefore, efficacy understanding for any of the remaining treatments would need to rely on pre-existing reports of the industry standard Actigard, and new work done by other parties in the interim. For example, Plant and Food Research Ltd has undertaken an extensive trial programme to explore field efficacy of E-Mix.

Orchard based efficacy evaluation of products for Psa disease control could be enhanced by applying Psa in known concentration, but this option is unlikely to be permitted by authorities.

Trialling elicitor product efficacy requires sites which have a reasonable level of Psa inoculum pressure, which in itself, may be a compromise to obtaining meaningful results.

By their very nature, the high inoculum Psa sites chosen for this trial were typically lower lying and therefore exposed to cooler conditions which exacerbate Psa infection and symptoms; and at the same time, limit trial site fitness for purpose in evaluation of elicitor treatments.

Cool sites are likely to be later harvested meaning that it may not be possible to apply two or even one post-harvest elicitor treatment.

Ideal site selection for any future such trial work would have high inoculum pressure Psa, with early to mid-season harvest and canopy which stayed in reasonable condition for post-harvest elicitor application.

2.0 Introduction

Elicitors have been shown to play an important role in the control of plant diseases, including Psa.

There are four main control products in use for the control of Psa; Actigard, copper products, Ambitious and Kasumin. The bactericide streptomycin is able to be used but requires a Zespri Justified Approval for use and is likely to be phased out of the Crop Protection Standard.

Actigard is the current elicitor in the Zespri CPS, but despite the good level of efficacy, there have been some complaints of Actigard having an adverse effect on the canopy, with at least one case of severe loss in canopy vigour. This is because the up-regulation of a metabolic pathway(s) as a result of the elicitor application, may be associated with down-regulation of other metabolic pathways and therefore other potential compromises to plant growth and performance.

In addition, a Gold3 autumn spray trial also indicated that Actigard, possibly along with streptomycin and Engulf, may have significantly impacted floralness. This may not be a surprising result as there are studies showing that use of elicitors for disease control can lead to some adverse effects on plant growth.

This trial targeted high pressure Psa sites, so plants were already under stress, which may have had impacts on the efficacy of elicitors and other elicitor effects.

This trial was proposed to try to determine if four other novel elicitors, recently identified as having efficacy against Psa in potted plants, will have efficacy in an orchard setting. The trial was over two seasons with 2015/2016 as the first season, in order to investigate any impacts on return bloom or other long-term effects.

3.0 Objectives

The trial had four objectives over the two-year trial period.

- To test the efficacy of four novel elicitors; AB48414, TNL3454, Estim-20 and EMix on Psa on orchard
- To assess the effect of the elicitors on return bloom and canopy vigour
- To assess the effect of the elicitors on fruit quality
- To assess residues on fruit

4.0 Materials and Methods

4.1 Sites

The trial was located at six kiwifruit orchard sites, three each of Gold3 and Hayward varieties, comprising mature producing canopies, in the Te Puke area.

Table 1: Sites

Variety	Hayward			Gold3		
Site	**1**	**2**	**3**	**1**	**2**	**3**
Orchard Name	The Challenge Trust	Golf Course	Coachmans Orchards	The Challenge Trust	Golf Course	Kiwi Cross
KPIN	1077	2843	4609	1077	8758	7029
Block	4, western end	H2, north part of block	3	11, South end, last 9 bays	K4 , north part of block	3, rows 73 - 81
Plants	strip male	matrix male	matrix male	strip male	matrix male	strip male
Age from graft (years)	10	25+	20+	4,3,2	4	3

Refer Site Layouts Appendix 1

4.2 Treatments

All blocks for this trial were selected based on the presence of existing high levels of Psa symptoms, as the trial was reliant on natural inoculum to test efficacy of the novel elicitors.

Seven treatment groups were proposed to be applied.

Each treatment was replicated six times and treatments were fully randomized within the block.

Table 2: Treatments

Treatment Number	Programme	Rate/100L; 1000L/ha	Rate/L	Rate/20L	Rate/30L	3 weeks post bud burst	6 weeks post bud burst	immediate post harvest	21 days later*
1	Control					no elicitor or Ambitious			
2	Actigard 200g/ha	20	0.2	4	6	✔	✔	✔	✔
3	AB48414 2L/ha	200	2	40	60	✔	✔	✔	✔
4	TNL3454 2L/ha	200	2	40	60	✔	✔	✔	✔
5	Emix 20ml/L, plus DuWett at 0.05%	2000 + 50	20+0.5	400+10	600+15	not done, no permit	not done, no permit	✔	✔
6	Estim 20 TBA	400	4	80	120	not done, no permit	not done, no permit	Hayward Only	Hayward Only
7	Citrox Bioalexin 40ml/10L	400	4	80	120	✔	✔	✔	✔
8	Bacillus Mycoides (CX 10250)	34	0.34	6.8	10.2			Gold3 Only	Gold3 Only

At the commencement of applications, MPI permission for application of treatment 5 EMix and treatment 6 Estim 20 was not yet available, so these treatments were not applied at any sites in spring 2015.

During the 2015/2016 growing season, Estim 20 was tested for efficacy on Psa leaf spot control in a separate potted plant trial on both Hayward and Gold3. The results of that trial showed that Estim 20 appeared to be effective on Hayward but not on Gold3. Therefore, post-harvest application of Estim 20 application on Gold3 sites was not undertaken in 2015/2016 and in spring and autumn of 2016/2017.

Estim was applied on Hayward, post-harvest in 2016 and again in spring 2016 and post-harvest in 2017.

A new treatment, treatment 8, *Bacillus mycoides* (CX 10250) was introduced, to be applied twice post-harvest on Gold3 in 2016 and again, as per all other treatments, in spring 2016 and autumn 2017. This treatment replaced Estim 20 on Gold3.

During the 2016/2017 season, two product suppliers signalled their intent that they would not continue research work with their products for use on kiwifruit. Treatment 3 AB48414 and treatment 4 TNL3454 were applied and assessed up to the point at which these notifications were received, but not beyond those timepoints.

Treatment one the control programme excluded the use of Actigard or other products which may have elicitor type mode of action such as CPPU products.

4.3 Applications

First applications were made as intended for spring 2015 on all sites. Second spring 2015 applications prior to flowering were not made at all Gold3 sites, due to earlier than predicted flowering.

For the balance of the 2015/16 season, all applications were made as intended on Gold3, except for the alterations to treatments applied, as described in the previous section.

First post-harvest 2016 applications were made on Hayward at sites 1 and 3. Site 2 was not harvested until 28 June 2016, with leaf condition heavily deteriorated by that time and unsuitable for any post-harvest elicitor application.

Both spring applications on Gold3 in 2016/17, were made as intended at all three sites. The two post-harvest applications could only be made at site 2. Sites 1 and 3 had frost damage on the leaves, which meant first post-harvest application was made at both sites but that the leaves were not in suitable condition for the second post-harvest elicitor application.

Both spring applications on Hayward 2016/17, were made as intended at all three sites. Only one post-harvest application was able to be made in autumn 2017, to sites 2 and 3. Site 1 was harvested very late, so leaves were not in a suitable condition for post-harvest elicitor. By the time the required interval had elapsed for second post-harvest application on sites 2 and 3, frost damage on the leaves meant that the leaves were not in suitable condition for elicitor application. **Refer Application Summary Appendix 2**

Application conditions were recorded from Harvest.com weather stations on site, for Gold3 and Hayward sites 1 and 2 and Gold3 site 3. For Hayward site 3, application conditions were recorded from a Harvest.com weather station located on a neighbouring property about 2.6 kilometres directly east of the trial site and at similar altitude above sea level. **Refer Application Conditions Appendix 3**

Application was made with a Solo 433 high pressure motorised knapsack sprayer with working pressure nominally 25 bar (2500 kPa or 363 psi).

Nozzles were two Solo C5 flat fan nozzles on the end of a 1.2 m extension wand permitting swathes from edge to edge of the plot. The nozzles were directed at a 45-degree angle from the vertical in the direction of travel and rotated at edges of the plot with each change of direction, to ensure even coverage.

A small volume of mix was loaded in the sprayer to flush and preload the pump, hoses and wand, the surplus being dumped. The rest of the mix was loaded, and wand flushed again, then the treatment applied. The surplus material was dumped into a catcher.

Calibration of flow rate was made and the volume per plot for the 1000 L/ha was based on time to spray the plot.

There were small variations in the calibrated flow rate each time.

5.0 Assessments

5.1 Psa

At the start of spring 2015, counts were made of the number of cankers per vine, on both leaders and canes and the number of dieback sites on both canes and shoots. These counts were repeated at winter 2016.

The same counts were undertaken in spring 2016 and winter 2017.

Hayward 2015/2016 and 2016/2017

Four fruiting canes per plot were tagged.

Psa on leaves assessed near flowering

- The number of leaves per cane and the number of leaves per cane with Psa leaf spot were counted
- The percentage of leaves with Psa spotting was calculated
- Psa leafspot on each cane was scored on a scale of 0 - 5. 0 = no symptoms, 5 = 100% Psa affected

Psa on Hayward flowers and fruit near flowering

- The number of flower buds per cane was counted and each flower bud assessed for severity of Psa symptoms on a scale of 0 – 4. 0 = no symptoms, 4 = 100% Psa affected
- The average severity of symptoms was calculated
- The number of fruit per cane was counted soon after fruit set, **before thinning**
- The percentage fruit set was calculated
- The number of fruit per cane was counted pre-harvest
- The final percentage of fruit from flowers was calculated

Gold3 2015/2016 and 2016/2017

At the start of spring 2015, counts were made of the number of cankers per vine, on both leaders and canes and the number of dieback sites on both canes and shoots.

These counts were repeated at winter 2016.

Psa assessment on whole vine plots

- The number of fruiting canes per plot, were counted at the start of spring 2015, late November 2015 and late March 2016
- The percentage of canes remaining of the original number counted in spring 2015, was calculated

These counts and calculated percentages were repeated for the 2016/2017 season.

5.2 Growth

Return bloom effects were assessed by undertaking a components of yield count for buds, shoots and flowers on each of the four canes tagged per plot, for the Hayward sites.

Four fruiting canes were also tagged per plot, for the Gold3 sites and similarly counted.

Counts were undertaken in spring 2015 to establish a baseline, and again in spring 2016, to explore any treatment effects on return bloom and yield.

Counts and reporting were carried out by AgFirst/Eurofins Bay of Plenty.

5.3 Residues

At each site, a composite sample comprising approximately 1kg fruit per treatment, drawn from all plots in each treatment, was collected and analysed for residues, prior to first harvest of trial treatments in 2016. Samples were frozen within 2 hours of collection, then delivered frozen to the laboratory.

Samples were collected for both Hayward and Gold3 treatments 1 untreated control, 2 Actigard (acibenzolar-s-methyl parent and acid), 3 AB48414 (isotianil) and 4 TNL3454 (tiadinil).

Residue samples were not collected for the other treatments, as treatment 5 Emix and treatment 6 Estim had not been applied in spring 2015; and treatment 7 Citrox Bioalexin did not have an established laboratory residue test method.

In the event, treatment 3 AB48414 sample fruit collected were held frozen but not analysed. Initially, testing for these residues was not carried out because the laboratory did not have a reference standard of the active ingredient to run the test method prior to sample testing. Subsequently, the proprietor of the product indicated that they would not continue commercial development of AB48414 for Psa disease control on kiwifruit. Sample fruit for treatment 3 was subsequently destroyed.

Sample analyses were carried out by Hill Laboratories, Hamilton.

Fruit from plots receiving treatments 3 and 4 were thinned prior to harvest 2016 and 2017, to ensure that such treated fruit did not enter the Zespri supply chain.

5.4 Fruit Maturity

Fruit maturity samples were collected prior to harvest 2017, after two years of treatment applications, excluding post-harvest treatments in 2017.

At each site, a composite 90 fruit sample was collected across all plots that received each treatment. Samples were collected from each site, close to the time that each block was normally cleared to pick.

For each Hayward site, a composite fruit sample was collected for treatments 1,2,5,6,7.
For each Gold3 site, a composite fruit sample was collected for treatments 1,2,5,7,8.

Collected samples were delivered to the Eurofins Te Puke site, transported to and analysed overnight at the Eurofins Katikati site.

6.0 Data Analysis

Psa data were analysed with VSN International (2017). Genstat *for Windows* 19th Edition. VSN International, Hemel Hempstead, UK. Web page: Genstat.co.uk.

A randomised block analysis of variance was used to analyse the data from the three sites for each variety. In some cases, variables were square-root transformed for analysis due to heterogeneity of the variability.

The combined analysis across the three blocks for each variety provided greater statistical power for the comparisons, than by analysing each block separately.

Fruit maturity data were analysed as the averages of the 90 fruit per treatment across all plots within a treatment, at each site. Treatments were compared using a randomised block analysis of variance. Residual plots from the analyses showed good agreement with the constant variance and normality assumptions, with no need for any data transformation. Tukey's Highest Significant Difference test was used to indicate significant pairwise differences between the treatments.

Components of Yield data were analysed with the same statistical package as for Psa analysis of data.

Treatments were compared using a randomised block analysis of variance (blocking on trial site by variety and replicate within the trial site) on the averages of the four canes of each vine.

The 2015 values were fitted as a covariate to improve the precision of the estimates.

Residual plots from the analyses showed good agreement with the constant variance and normality assumptions for most measurements; all were also analysed with a rank transformation.

Tukey's Highest Significant Difference was used to indicate significant pairwise differences between the treatments. Where the residual plots indicated the need for a transformation, the tests of significance, including the Tukey test, were based on the rank transformed data analyses, but untransformed means (adjusted for pre-treatment differences) are presented.

7.0 Results

7.1 Psa

2015/2016
Data were not analysed for treatments 5 and 6 as these treatments were not able to be applied in spring 2015.

Only assessments with more than 30% non-zero data were analysed.

For all six sites, Psa diseases assessments showed **no** significant differences between treatments for any of the variables counted or calculated, for either an individual site or for all three sites of the same variety.

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Refer Psa Disease Assessments Hayward and Gold3 Sites Appendix 4

Table 3: Psa Disease Assessments Gold3

All Gold 3 Sites	Cane % Dieback Oct 2015	Dieback Cane length (m/plot) Nov 2015	Cane % Dieback Nov 2015	Cane % Dieback of Original Nov 2015	Cane % Dieback of Original Mar 2016
residual df	68	68	68	68	67
Control (Trt 1)	7.55 a	0.67 a	4.25 a	86.0 a	76.6 a
Actigard (Trt 2)	6.81 a	0.72 a	2.10 a	86.0 a	75.1 a
AB48414 (Trt 3)	3.33 a	0.78 a	3.01 a	89.1 a	78.1 a
TNL3454 (Trt 4)	4.68 a	1.39 a	6.27 a	92.1 a	86.3 a
Citrox Bioalexin (Trt 7)	5.03 a	1.00 a	2.99 a	92.0 a	85.5 a
Trt s.e.d	2.365	0.400	2.527	4.61	6.26
LSD 5%	4.719	0.798	5.043	9.20	12.50
Trt P-value	0.398	0.369	0.517	0.494	0.252
Trt Significance	NS	NS	NS	NS	NS
Trt 1 sem	3.667	0.322	1.964	5.41	7.67
Trt 2 sem	3.672	0.310	1.156	4.90	7.88
Trt 3 sem	2.740	0.383	1.700	5.06	8.65
Trt 4 sem	3.109	0.473	3.303	5.06	8.01
Trt 7 sem	3.062	0.360	1.406	4.24	6.77

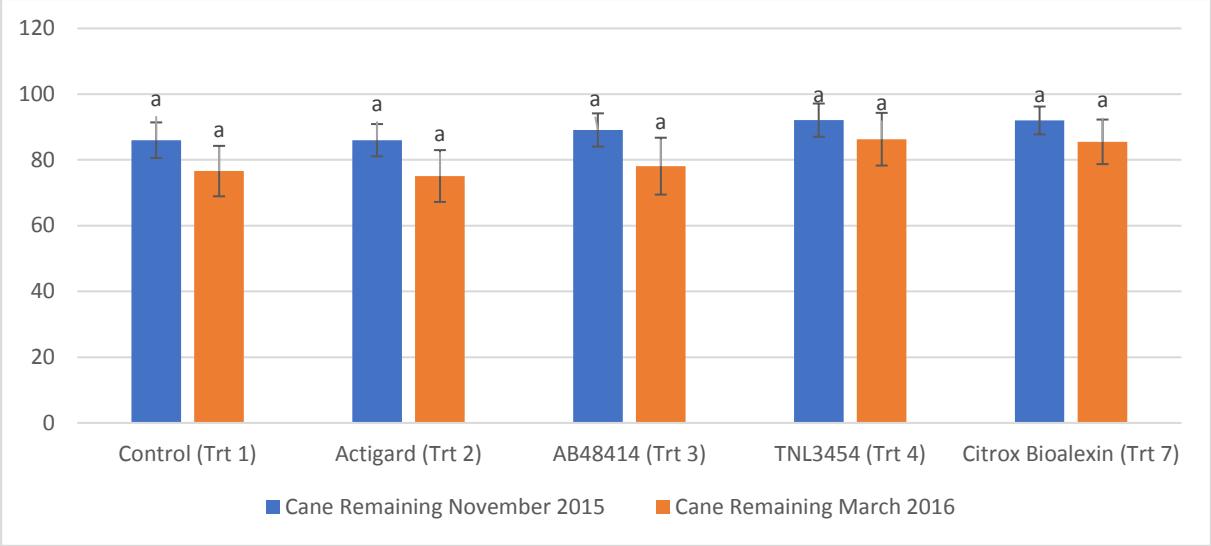

Figure 1: Gold3 Percentage Remaining of October 2015 Initial Cane (letters denote significant difference between the treatments at the final assessment)

For Hayward, the average Psa severity score in flowers for treatment 2 Actigard (0.12) was near to significant, by comparison with the untreated control (0.17).

Table 4: Psa Disease Assessments Hayward and Gold3

All Hayward Sites	Dieback Cane length / Vine Oct 2015	Flower buds	Flower Average PSA Severity Score	% Flowers Affected	Early Fruit as % of Flowers	% Leaves Spotted	Fruit Pre-Harvest as % of Flowers
residual df	68	68	68	68	68	68	68
Control (Trt 1)	2.33 a	30.4 a	0.17 a	9.63 a	85.5 a	17.7 a	58.2 a
Actigard (Trt 2)	2.50 a	37.6 a	0.12 a	7.62 a	84.6 a	17.2 a	59.5 a
AB48414 (Trt 3)	2.89 a	32.1 a	0.16 a	9.53 a	81.0 a	16.3 a	60.7 a
TNL3454 (Trt 4)	2.83 a	34.4 a	0.23 a	12.77 a	79.7 a	22.6 a	52.0 a
Citrox Bioalexin (Trt 7)	2.39 a	33.9 a	0.21 a	11.59 a	83.0 a	20.1 a	54.4 a
Trt s.e.d	0.773	2.93	0.047	2.395	3.88	3.09	4.73
LSD 5%	1.542	5.84	0.094	4.779	7.74	6.17	9.44
Trt P-value	0.926	0.159	0.183	0.247	0.541	0.255	0.326
Trt Significance	NS	NS	NS	NS	NS	NS	NS
Trt 1 sem	1.185	6.13	0.096	5.460	6.52	3.51	3.42
Trt 2 sem	1.136	6.00	0.095	5.510	6.76	4.27	3.47
Trt 3 sem	1.126	6.13	0.096	5.500	6.94	3.78	4.97
Trt 4 sem	1.117	5.99	0.095	5.360	6.73	3.90	3.94
Trt 7 sem	1.230	6.13	0.101	5.620	6.74	4.19	3.65

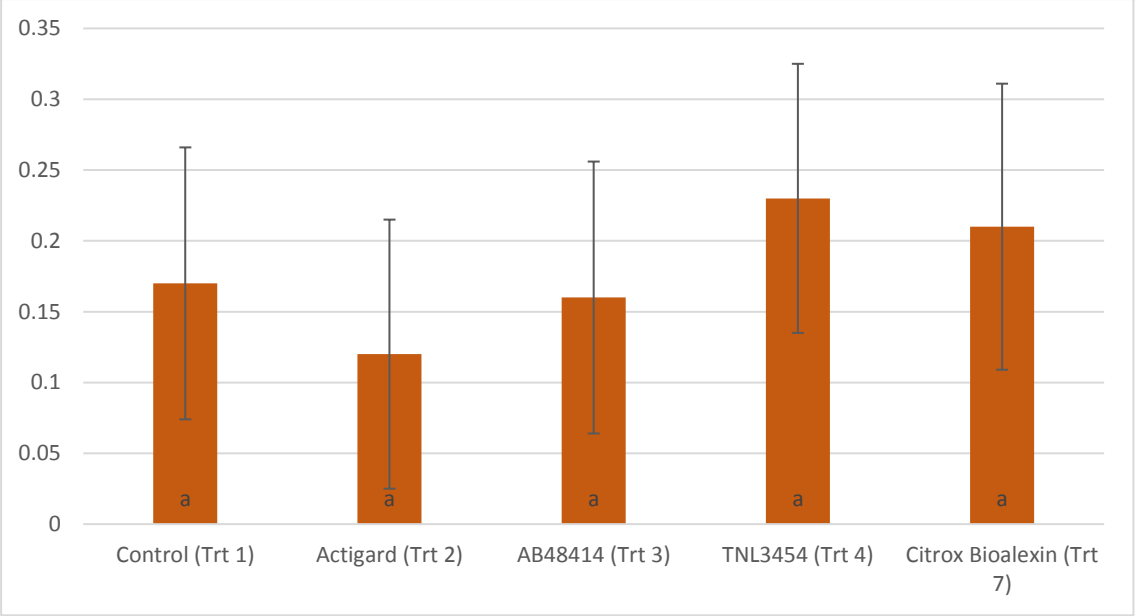

Figure 2: Hayward Psa Flower Bud Rot Severity Score 2016 (letters denote significant difference between the treatments)

2016/2017 Hayward

Separate types of analyses were run on 2016/2017 data, in an attempt to explore different ways of examining data to see if treatment effects were occurring.

Table 5: Psa Disease Assessments Hayward 2016/17 Leaves, Flowers and Fruit

	degrees of freedom	F pr.
Flower Buds Spring	5	0.095
Psa Severity Spring	5	0.711
Flowers Affected Spring	5	0.262
% Flowers Affected Spring	5	0.624
Leaf Area Spot Score	5	0.092
Leaves Spotted Spring	5	0.052
Total Leaves Spring	5	0.489
% Leaves Spotted Spring	5	0.143

No significant differences were found between the treatments for any of the variables at any of the three sites, nor were there any significant site by treatment interactions.

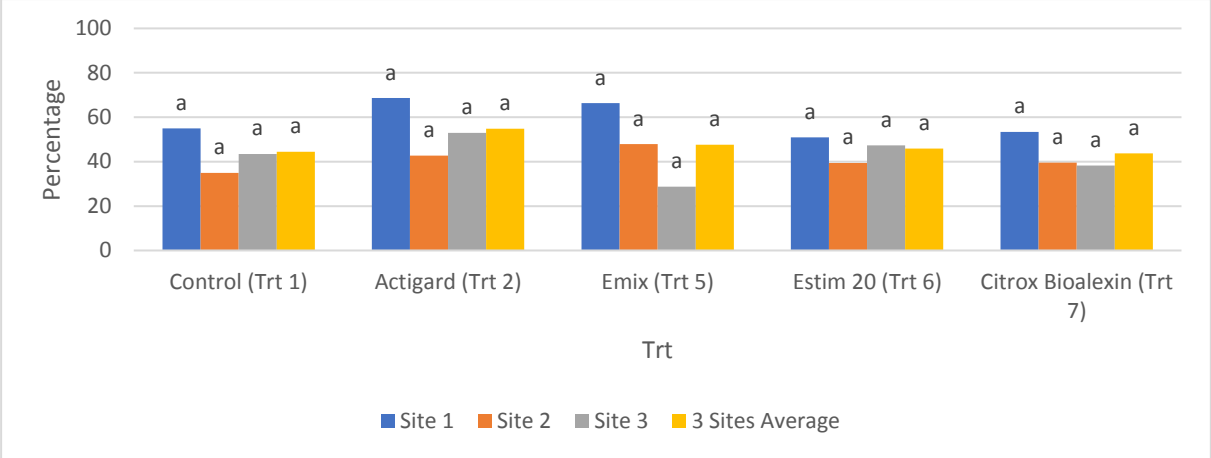

Figure 3: Hayward Fruit as Percentage of Flowers 2017 (letters denote significant difference between the treatments)

There were significant site differences in all variables. The analysis showed that site three had a lesser level of Psa symptoms than either site one or two. However, at all sites the variability within treatments was greater than the variability between treatments, meaning that differences in treatment effects on Psa disease control, were not able to be identified.

Refer Hayward Means and Standard Errors Appendix 4

Psa Effects on Canker and Dieback

These were assessed at the start of the experiment (base levels) and again in winter. The majority of values were zero, making it difficult to detect any treatment differences.

Three analyses were tried:

- Counting the number of plots across the 3 sites where the number of cankers or diebacks had gone up or down between the 2 assessments and comparing the proportion of the changes that had gone up using a chi-squared test.
- Fitting a generalised linear mixed model with Poisson distribution and log link to look for treatment differences in the numbers at each assessment.
- Using an analysis of variance on logs of the numbers (with 1 added) to look for treatment differences in the numbers at each assessment.

The tables and the p-value from the chi-squared test as the first of the above analyses, are shown. The first of the p values tests the proportion of those that change, that increase and the second tests the proportion of all plots that increase.

Table 5: Psa Disease Assessments Hayward 2016/17 Cankers and Dieback

	Leader Cankers		
	Winter		
Trt	Up	Down	Same
1	0	1	17
2	0	0	18
4			0
5	0	1	17
6	1	1	16
7	0	0	18
Chisq test		0.856	0.400

	Cane Cankers		
	Winter		
Trt	Up	Down	Same
1	0	3	15
2	0	3	15
4			0
5	0	2	16
6	1	4	13
7	0	3	15
Chisq test		0.672	0.400

	Cane Dieback		
	Winter		
Trt	Up	Down	Same
1	0	8	10
2	0	4	14
4			0
5	0	6	12
6	0	7	11
7	0	5	13
Chisq test		1.000	1.000

	Shoot Dieback		
	Winter		
Trt	Up	Down	Same
1	0	0	18
2	0	0	18
4			0
5	0	0	18
6	0	0	18
7	0	0	18
Chisq test		#VALUE!	1.000

All three test methods showed **no** significant treatment differences in either base or winter numbers of cankers or dieback.

2016/2017 Gold3

Gold3 cankers and dieback were assessed at the start of the experiment (Base) and again in spring and winter (or summer for canes per vine). The clear majority of values were zero, making it difficult to detect any treatment differences. Three analyses were again tried:

- Counting the number of plots across the 3 sites where the number of cankers or diebacks had gone up or down between the 2 assessments and comparing the proportion of the changes that had gone up using a chi-squared test.
- Fitting a generalised linear mixed model with Poisson distribution and log link to look for treatment differences in the numbers at each assessment.
- Using an analysis of variance on logs of the numbers (with 1 added) to look for treatment differences in the numbers at each assessment.

Table 6: Psa Disease Assessments Gold3 2016/17 Cankers and Dieback

	Leader Cankers					
	Spring			Winter		
Trt	Up	Down	Same	Up	Down	Same
1	1	3	14	1	3	8
2	0	2	16	1	0	11
4	0	3	14			0
5	0	2	15	2	2	7
7	0	0	18	0	0	12
8	1	4	13	1	2	9
Chisq test		0.872	0.555		0.725	0.654

	Cane Cankers					
	Spring			Winter		
Trt	Up	Down	Same	Up	Down	Same
1	1	2	15	1	1	10
2	1	1	16	2	1	9
4	0	4	13			0
5	0	5	12	0	1	10
7	2	3	13	2	3	7
8	2	5	11	1	5	6
Chisq test		0.464	0.543		0.560	0.655

	Cane Dieback					
	Spring			Winter		
Trt	Up	Down	Same	Up	Down	Same
1	1	2	15	8	0	4
2	1	2	15	8	0	4
4	0	4	13			0
5	2	4	11	3	2	6
7	2	3	13	5	1	6
8	2	3	13	6	1	5
Chisq test		0.819	0.749		0.188	0.262

	Shoot Dieback					
	Spring			Winter		
Trt	Up	Down	Same	Up	Down	Same
1	1	1	16	0	0	12
2	0	1	17	6	0	6
4	0	0	17			0
5	0	0	17	3	0	8
7	0	1	17	7	0	5
8	4	0	14	5	0	7
Chisq test		0.319	0.008		1.000	0.027

	Canes per Vine					
	Spring			Summer		
Trt	Up	Down	Same	Up	Down	Same
1	0	11	1	0	11	1
2	1	15	0	0	11	0
4	1	4	7			2
5	1	8	9	0	13	5
7	0	9	3	0	4	2
8	0	16	2	0	17	1
Chisq test		0.361	0.698		1.000	1.000

Tables and the p-value from the chi-squared test (first of the above analyses) are shown. The first of the p values tests the proportion of those that change, that increase and the second tests the proportion of all plots that increase.

There were **no** significant treatment differences in the change from base to spring or base to winter when comparing just those that change.

There are significant treatment differences in the proportion of all plots that show an increase from base to spring and base to winter for shoot dieback.

The analysis of variance of the log counts also found significant treatment differences in the number of shoot diebacks in spring (Trt 8, B.mycoides, having higher numbers) and winter (Trt 1, control, having lower numbers).

7.2 Growth

All significant results arise from treatment two Actigard being different from some or all of the other treatments.

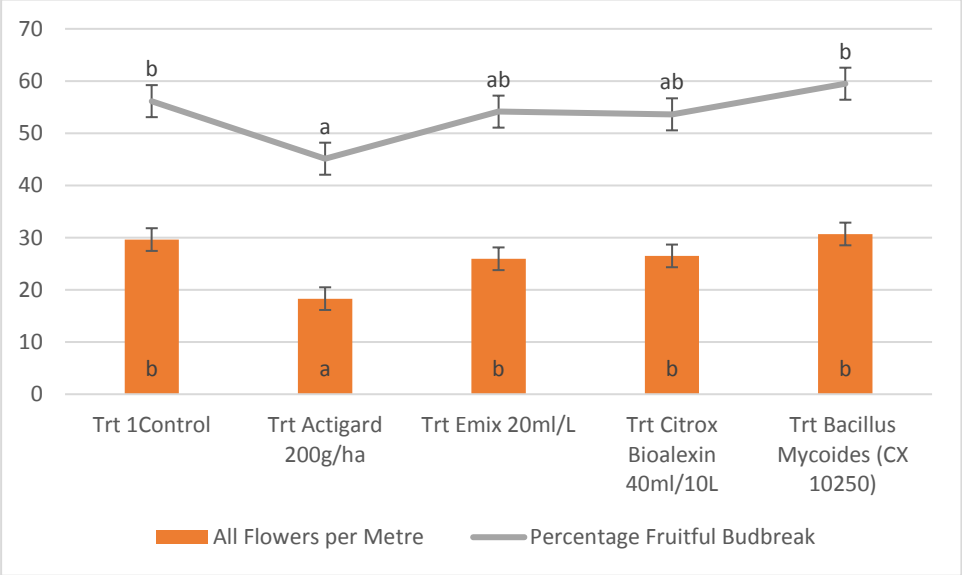

Figure 4: Gold3 Components of Yield: Flowers per Metre of Cane and Percentage Fruitful Budbreak (letters denote significant difference between the treatments)

Tables 8 and 9 below show for each variable and each variety, overall significance of treatment differences, the transformation used for tests of significance, the means (untransformed and ordered from smallest to largest for each variable), standard error of differences (SED), and letters indicating differences between pairs of treatments using the Tukey multiple range test (called Highest Significant Difference).

In Gold3, Actigard treatment 2 in 2015/2016 resulted in lower floralness in spring 2016, as measured by

- lower king flowers per metre, all flowers per metre, side flowers per metre, percentage fruitful budbreak, average king flowers per shoot, average side flowers per shoot, average total flowers per shoot, average king flowers per bud, average all flowers per bud
- higher percentage non-fruitful budbreak, higher blind shoots

In no instance were there differences between the other treatments.

In Hayward, Actigard treatment 2 in 2015/2016 resulted in lower percentage budbreak in spring 2016.

Table 8: Gold3 Comparison of Components of Yield

	Trt Significance										
	Untransf 2016 with covar 2015	Rank 2016 with covar 2015	Transf used	Treatments							SED	
NODESPERMETRE	0.337	0.658	rank	5	4	8	1	7	2	3		
				12.09	12.11	12.24	12.35	12.55	12.59	13.15	0.487	
				a	a	a	a	a	a	a		
KINGFLOWERSPERMETRE	<.001	<.001	none	2	5	4	7	1	8	3		
				16.83	22.83	23.13	23.77	25.21	26.15	26.7	1.926	2 lower than rest
				a	b	b	b	b	b	b		
ALLFLOWERSPERMETRE	<.001	<.001	none	2	5	7	4	1	8	3		
				18.31	25.95	26.5	26.55	29.63	30.7	31.09	2.738	2 lower than rest
				a	b	b	b	b	b	b		
SIDEFLOWERSPERMETRE	0.028	0.003	rank	2	7	4	5	3	1	8		
				1.512	2.812	3.128	3.191	4.313	4.438	5.085	1.082	2 lower than 1, 8
				a	ab	ab	ab	ab	b	b		
PERCENTAGEBUDBREAK	0.967	0.861	none	7	5	2	3	8	4	1		
				66.44	66.66	66.85	67.8	68.07	68.31	68.47	2.512	
				a	a	a	a	a	a	a		
PERCENTAGEFRUITFULBUDBREAK	<.001	0.004	none	2	7	5	4	1	3	8		
				45.12	53.62	54.14	56.01	56.15	56.29	59.49	3.068	2 lower than 1,3,4,8
				a	ab	ab	b	b	b	b		
PERCENTAGENONFRUITFULBUDBREAK	<.001	0.001	rank	8	3	4	1	5	7	2		
				8.59	11.55	12.28	12.4	12.55	12.82	21.6	2.743	2 higher than 3,8
				a	a	ab	ab	ab	ab	b		
AVGKINGFLOWERSPERSHOOT	<.001	<.001	none	2	5	7	1	4	3	8		
				2.183	2.941	2.973	3.022	3.051	3.065	3.318	0.2029	2 lower than rest
				a	b	b	b	b	b	b		
AVGSIDEFLOWERSPERSHOOT	0.020	0.004	rank	2	7	4	5	3	1	8		
				0.1729	0.3316	0.3846	0.4099	0.4325	0.5177	0.643	0.1278	2 lower than 1,5,8
				a	ab	ab	b	ab	b	b		
AVGTOTALFLOWERSPERSHOOT	<.001	0.001	none	2	7	5	4	3	1	8		
				2.353	3.294	3.345	3.489	3.501	3.542	3.893	0.3028	2 lower than rest
				a	b	b	b	b	b	b		
KINGFLOWERSPERBUD	<.001	<.001	none	2	5	7	4	3	1	8		
				1.345	1.912	1.914	1.975	2.022	2.045	2.166	0.1481	2 lower than rest
				a	b	b	b	b	b	b		
FLOWERSPERBUD	<.001	<.001	none	2	7	5	4	3	1	8		
				1.463	2.129	2.172	2.252	2.333	2.393	2.534	0.2091	2 lower than rest
				a	b	b	b	b	b	b		
BLINDSHOOTS	<.001	0.003	rank	8	4	3	1	5	7	2		
				2.9	3.213	3.324	3.403	3.482	3.838	6.972	0.853	2 higher than 3,4,8
				a	a	a	ab	ab	ab	b		
DORMANT	0.841	0.870	none	4	3	1	8	5	7	2		
				7.527	7.632	7.826	8.003	8.297	8.457	8.577	0.859	
				a	a	a	a	a	a	a		
CANELENGTH	0.663	0.829	none	4	3	1	7	8	5	2		
				2.113	2.14	2.156	2.191	2.245	2.256	2.269	0.106	
				a	a	a	a	a	a	a		
NODES	0.606	0.546	none	4	1	3	5	7	2	8		
				25.86	26.34	27.14	27.4	27.41	27.97	28.12	1.341	
				a	a	a	a	a	a	a		
SHOOTS	0.613	0.740	none	4	1	7	5	2	3	8		
				18.27	18.56	19.02	19.22	19.34	19.48	20.04	0.966	
				a	a	a	a	a	a	a		
KING	<.001	<.001	none	2	4	7	1	5	3	8		
				33.66	49.23	50.75	51.99	52.4	55.62	58.33	5.43	2 lower than 1,3,5,7,8
				a	ab	b	b	b	b	b		
LAT	0.088	0.008	rank	2	4	7	5	1	3	8		
				2.958	6.515	6.651	7.419	9.415	10.15	10.349	2.683	2 lower than 1,3,5,8
				a	ab	ab	b	b	b	b		
KINGANDLAT	0.002	<.001	rank	2	4	7	5	1	3	8		
				36.53	55.93	57.09	59.82	61.31	65.98	68.76	7.54	2 lower than rest
				a	b	b	b	b	b	b		

Table 9: Hayward Comparison of Components of Yield

	Trt Significance										
	Untransf 2016 with covar 2015	Rank 2016 with covar 2015	Transf used	Treatments							SED	
NODESPERMETRE	0.185	0.164	none	4	5	6	2	7	1	3		
				10.53	10.6	10.66	10.87	11.1	11.17	11.19	0.3202	
				a	a	a	a	a	a	a		
KINGFLOWERSPERMETRE	0.167	0.152	none	2	5	1	6	4	3	7		
				20.88	22.01	22.2	22.7	24.22	24.35	25.05	1.712	
				a	a	a	a	a	a	a		
ALLFLOWERSPERMETRE	0.059	0.054	none	2	5	6	1	3	4	7		
				22.35	24.81	25.85	25.87	28	28.94	29.3	2.416	
				a	a	a	a	a	a	a		
SIDEFLOWERSPERMETRE	0.145	0.171	rank	2	5	6	3	1	4	7		
				1.732	3.062	3.37	3.421	3.616	4.625	4.651	1.101	
				a	a	a	a	a	a	a		
PERCENTAGEBUDBREAK	0.020	0.074	none	2	3	1	5	7	4	6		
				58.44	62.63	63.33	64.26	64.41	64.82	64.92	1.958	2 lower than 4,6,7
				a	ab	ab	ab	b	b	b		
PERCENTAGEFRUITFULBUDBREAK	0.328	0.342	none	2	1	3	5	6	7	4		
				53.88	54.43	55.29	56.43	57.58	58.33	58.98	2.576	
				a	a	a	a	a	a	a		
PERCENTAGENONFRUITFULBUDBREAK	0.334	0.461	rank	2	4	7	3	6	5	1		
				4.509	5.793	6.284	7.144	7.426	7.741	8.994	1.922	
				a	a	a	a	a	a	a		
AVGKINGFLOWERSPERSHOOT	0.604	0.525	none	5	1	6	2	7	3	4		
				3.43	3.471	3.516	3.558	3.644	3.693	3.774	0.204	
				a	a	a	a	a	a	a		
AVGSIDEFLOWERSPERSHOOT	0.144	0.237	rank	2	3	1	5	6	4	7		
				0.3475	0.5301	0.5932	0.5942	0.6023	0.8195	0.8203	0.1825	
				a	a	a	a	a	a	a		
AVGTOTALFLOWERSPERSHOOT	0.373	0.283	none	2	5	1	6	3	7	4		
				3.847	3.97	4.067	4.082	4.263	4.386	4.599	0.3506	
				a	a	a	a	a	a	a		
KINGFLOWERSPERBUD	0.363	0.371	none	2	1	5	6	3	7	4		
				2.03	2.085	2.13	2.176	2.225	2.291	2.333	0.1469	
				a	a	a	a	a	a	a		
FLOWERSPERBUD	0.109	0.148	none	2	5	1	6	3	7	4		
				2.198	2.407	2.413	2.511	2.562	2.714	2.823	0.2194	
				a	a	a	a	a	a	a		
BLINDSHOOTS	0.413	0.443	rank	2	7	4	5	3	6	1		
				0.883	1.177	1.308	1.441	1.517	1.527	1.927	0.458	
				a	a	a	a	a	a	a		
DORMANT	0.015	0.048	none	6	4	1	7	5	3	2		
				5.04	5.383	5.412	5.425	5.682	6.068	6.569	0.433	2 higher than 6
				a	ab	ab	ab	ab	ab	b		
CANELENGTH	0.227	0.136	rank	1	7	6	2	4	5	3		
				1.419	1.457	1.474	1.507	1.541	1.546	1.552	0.0614	
				a	a	a	a	a	a	a		
NODES	0.286	0.155	rank	6	1	7	2	4	5	3		
				15.61	15.81	15.9	16.39	16.47	16.61	17.31	0.73	
				a	a	a	a	a	a	a		
SHOOTS	0.174	0.171	none	2	1	7	6	5	4	3		
				9.85	10.38	10.48	10.6	10.89	11.1	11.21	0.537	
				a	a	a	a	a	a	a		
KING	0.084	0.018	none	1	2	6	5	7	4	3		
				29.85	31.19	32.9	33.44	35.4	36.74	36.95	2.777	
				a	a	a	a	a	a	a		
LAT	0.075	0.137	rank	2	1	5	6	3	7	4		
				2.25	3.958	4.049	4.246	4.595	6.311	6.46	1.468	
				a	a	a	a	a	a	a		
KINGANDLAT	0.038	0.026	none	2	1	6	5	3	7	4		
				33.42	33.8	37.13	37.42	41.61	41.69	43.26	3.658	
				a	a	a	a	a	a	a		

7.3 Residues

Table 10: Hayward Residue Sample Details and Results

Hayward	Site 1	Site 2	Site 3
	Challenge	Golf Course	Coachman
Last App Date	10/11/2015	10/11/2015	9/11/2015
Residue Sample Collection Date	14/04/2016	7/04/2016	7/04/2016
DAA	156	149	150

Sample Type: Nuts, Fruits and Vegetables and Derived Products						
Sample Name:		Zespri 31 Site 1 KPIN 1077 Trt 1 14-Apr-2016	Zespri 31 Site 1 KPIN 1077 Trt 2 14-Apr-2016	Zespri 31 Site 1 KPIN 1077 Trt 4 14-Apr-2016	Zespri 31 Site 2 KPIN 8758;2843 Trt 1 07-Apr-2016	Zespri 31 Site 2 KPIN 8758;2843 Trt 2 07-Apr-2016
Lab Number:		1571110.1	1571110.2	1571110.4	1571110.5	1571110.6
Acibenzolar acid	mg/kg	< 0.010	< 0.010	-	< 0.010	< 0.010
Acibenzolar-S-methyl	mg/kg	< 0.010	< 0.010	-	< 0.010	< 0.010
Acibenzolar-S-methyl (Total parent + acid)	mg/kg	< 0.013	< 0.013	-	< 0.013	< 0.013
Tiadinil*	mg/kg	< 0.010	-	< 0.010	< 0.010	-

Please refer to the detection limits table for the list of analytes screened and their detection limits.

Sample Name:		Zespri 31 Site 2 KPIN 8758;2843 Trt 4 07-Apr-2016	Zespri 31 Site 2 KPIN 8758;2843 Trt 1 07-Apr-2016	Zespri 31 Site 3 KPIN 4609 Trt 2 07-Apr-2016	Zespri 31 Site 3 KPIN 4609 Trt 4 07-Apr-2016	
Lab Number:		1571110.8	1571110.9	1571110.10	1571110.12	
Acibenzolar acid	mg/kg	-	< 0.010	< 0.010	-	-
Acibenzolar-S-methyl	mg/kg	-	< 0.010	< 0.010	-	-
Acibenzolar-S-methyl (Total parent + acid)	mg/kg	-	< 0.013	< 0.013	-	-
Tiadinil*	mg/kg	< 0.010	< 0.010	-	< 0.010	-

Table 11: Gold3 Residue Sample Details and Results

Gold 3	Site 1	Site 2	Site 3
	Challenge	Golf Course	Kiwi Cross
Last App Date	12/10/2015	12/10/2015	12/10/2015
Residue Sample Collection Date	30/03/2016	23/03/2016	25/03/2016
DAA	170	163	165

Sample Type: Nuts, Fruits and Vegetables and Derived Products						
Sample Name:		Zespri 31 Site 1 Gold3 Sample1 KPIN1077 31-Mar-2016	Zespri 31 Site 1 Gold3 Sample2 KPIN1077 31-Mar-2016	Zespri 31 Site 1 Gold3 Sample4 KPIN1077 31-Mar-2016	Zespri 31 Site 2 Gold3 Sample1 KPIN8758;2843 31-Mar-2016	Zespri 31 Site 2 Gold3 Sample2 KPIN8758;2843 31-Mar-2016
Lab Number:		1559983.1	1559983.2	1559983.4	1559983.6	1559983.7
Acibenzolar acid	mg/kg	< 0.010	< 0.010	-	< 0.010	< 0.010
Acibenzolar-S-methyl	mg/kg	< 0.010	< 0.010	-	< 0.010	< 0.010
Acibenzolar-S-methyl (Total parent + acid)	mg/kg	< 0.013	< 0.013	-	< 0.013	< 0.013
Tiadinil*	mg/kg	< 0.010	-	< 0.010	< 0.010	-

Please refer to the detection limits table for the list of analytes screened and their detection limits.

Sample Name:		Zespri 31 Site 2 Gold3 Sample4 KPIN8758;2843 31-Mar-2016	Zespri 31 Site 3 Gold3 Sample1 KPIN7029 31-Mar-2016	Zespri 31 Site 3 Gold3 Sample2 KPIN7029 31-Mar-2016	Zespri 31 Site 3 Gold3 Sample4 KPIN7029 31-Mar-2016	
Lab Number:		1559983.9	1559983.11	1559983.12	1559983.14	
Acibenzolar acid	mg/kg	-	< 0.010	< 0.010	-	-
Acibenzolar-S-methyl	mg/kg	-	< 0.010	< 0.010	-	-
Acibenzolar-S-methyl (Total parent + acid)	mg/kg	-	< 0.013	< 0.013	-	-
Tiadinil*	mg/kg	< 0.010	< 0.010	-	< 0.010	-

Residues for acibenzolar acid and acibenzolar-s-methyl were below the limits of detection at <0.010mg/kg in all Hayward and Gold3 fruit samples.

Residues for acibenzolar-s-methyl (total parent plus acid) were below the limits of detection at <0.013mg/kg in all Hayward and Gold3 fruit samples.

Residues for tiadinil were below the limits of detection at <0.010mg/kg in all Hayward and Gold3 fruit samples.

These products do not pose a risk of residues at harvest, when used in the bud phase, based on these residue test results.

7.4 Fruit Maturity

Table 12. Gold3 and Hayward Fruit Maturity Results 2017

GA	Trt	Mean	Tukey HSD
Dry Matter	7	16.67	a
	1	16.72	a
	8	16.72	a
	5	17.07	ab
	2	17.87	b
	SED	0.281	
Overall treatment F test P		0.012	
Brix Equatorial	1	7.217	a
	8	7.539	ab
	7	7.574	ab
	5	7.846	ab
	2	8.869	b
	SED	0.423	
Overall treatment F test P		0.034	
Hue 1	2	102.5	a
	5	103.9	a
	1	104.3	a
	7	104.4	a
	8	104.5	a
	SED	0.628	
Overall treatment F test P		0.061	
Pressure 1	2	6.381	a
	5	6.422	a
	7	6.600	ab
	1	6.950	b
	8	6.964	b
	SED	0.1191	
Overall treatment F test P		0.002	
Pressure 2	2	6.284	a
	5	6.353	a
	7	6.627	a
	8	6.717	a
	1	6.851	a
	SED	0.1661	
Overall treatment F test P		0.040	
Fresh Weight	1	133.4	a
	7	138.9	ab
	8	139.4	ab
	5	140.0	ab
	2	153.0	b
	SED	4.17	
Overall treatment F test P		0.016	
Ave Pressure	2	6.332	a
	5	6.388	a
	7	6.614	ab
	8	6.841	b
	1	6.900	b
	SED	0.1231	
Overall treatment F test P		0.005	

HW	Trt	Mean	Tukey HSD
Dry Matter	2	16.33	a
	6	16.43	a
	5	16.44	a
	7	16.53	a
	1	16.55	a
	SED	0.1545	
Overall treatment F test P		0.643	
Brix Equatorial	5	7.139	a
	2	7.156	a
	7	7.179	a
	1	7.252	a
	6	7.316	a
	SED	0.1682	
Overall treatment F test P		0.810	
Pressure 1	1	7.916	a
	6	7.925	a
	7	8.054	a
	5	8.156	a
	2	8.248	a
	SED	0.1662	
Overall treatment F test P		0.350	
Pressure 2	1	7.682	a
	7	7.776	a
	6	7.894	a
	5	8.055	a
	2	8.108	a
	SED	0.1436	
Overall treatment F test P		0.146	
Fresh Weight	6	124.3	a
	1	128.8	a
	5	129.5	a
	2	130.2	a
	7	131.2	a
	SED	5.92	
Overall treatment F test P		0.799	
Ave Pressure	1	7.799	a
	6	7.910	a
	7	7.915	a
	5	8.105	a
	2	8.178	a
	SED	0.1451	
Overall treatment F test P		0.220	

The tables show for each variable and each variety, the means, standard error of differences (SED), overall significance of treatment differences and letters indicating differences between pairs of treatments using the Tukey multiple range test (called Highest Significant Difference).

For Gold3, significant differences were detected for the aggregate results in maturity parameters across the three sites.

Dry matter was significantly higher for treatment 2 Actigard (17.87%), than for treatment 7 Citrox Bioalexin (16.67%), treatment 1 untreated control (16.72%) and treatment 8 Bacillus mycoides (16.72%).

Fresh weight was significantly higher for treatment 2 Actigard (153g), than for treatment 1 untreated control (133.4g).

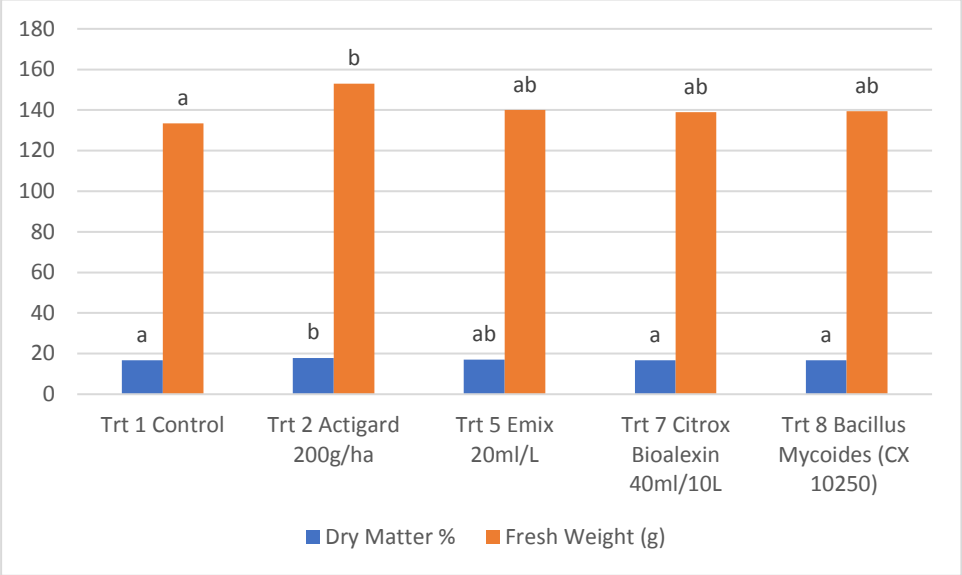

Figure 5: Gold3 Dry Matter (%) and Fresh Weight (g) at harvest 2017 (letters denote significant difference between the treatments)

Brix equatorial was significantly higher for treatment 2 Actigard (8.869), than for treatment 1 untreated control (7.217).

In combining both pressure test readings (pressure 1 and pressure 2), fruit was significantly firmer for treatment 1 untreated control (6.9kgf) and treatment 2 Actigard (6.841kgf) than for all other treatments.

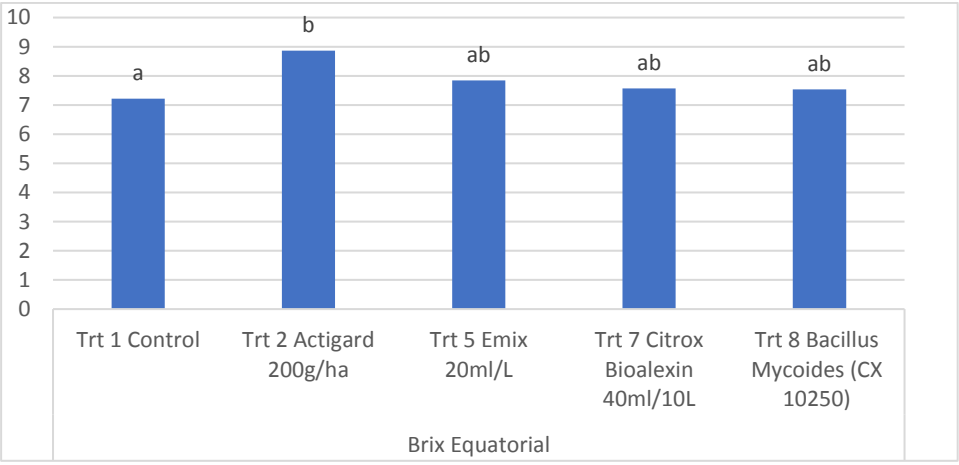

Figure 6: Gold3 Brix Equatorial at harvest 2017 (letters denote significant difference between the treatments)

For Hayward, no significant differences were detected for the aggregate results in maturity parameters across the three sites.

7.0 Discussion

On Hayward in both 2016 and 2017, despite selecting high inoculum pressure Psa sites and in some sites, considerable levels of Psa symptoms present, the trial was unable to identify any significant differences in Psa disease control as a result of the novel elicitor treatments.

Even the industry standard, Actigard treatment 2, did not show any difference in level of effect on Psa, by comparison with the untreated control 1.

On Gold3 in 2016, again despite selecting high inoculum pressure Psa sites, the trial was unable to identify any significant differences in Psa disease control as a result of the novel elicitor treatments.

On Gold3 in 2017, the number of dieback shoots for treatment 8 *B. mycoides* in spring, was significantly higher compared with the baseline and the number of dieback shoots for treatment 1 untreated control in winter, was significantly lower compared with the baseline.

These results may be real or anomalous. It seems unlikely that untreated vines would in reality have fewer dieback shoots as time progressed, compared with any other treatment.

The vagaries of inoculum distribution in commercial orchard environments may have been sufficient to result in variability of Psa symptoms to a greater extent within than between treatments, for no treatment effects other than those above to be discernible.

The effects of Actigard treatment 2 in Gold3 resulted in lower floralness in spring 2016, as measured by

- lower king flowers per metre, all flowers per metre, side flowers per metre, percentage fruitful budbreak, average king flowers per shoot, average side flowers per shoot, average total flowers per shoot, average king flowers per bud, average all flowers per bud
- higher percentage non-fruitful budbreak, higher blind shoots

In Hayward, Actigard treatment 2 resulted in in 2015/2016 resulted in lower percentage budbreak in spring 2016.

Another trial showed that post-harvest Actigard can sometimes have an adverse effect on return bloom (1). However, further work undertaken by Zespri (2) has shown that contrary to these findings, Actigard applied in the post-harvest period did not adversely affect return bloom, as assessed by components of yield analysis.

The cause of this variability of post-harvest Actigard effects on return bloom as assessed by components of yield, is not known. Possible explanations may be that in these sites where Psa was present at challenging levels, Actigard might be considered to have been applied contrary to the label, which specifies that Actigard should not be applied where plants are stressed because of disease.

However, in this trial the suppressive effect on return bloom was not demonstrated for other novel elicitors by comparison with Actigard.

Residues for Actigard and TNL3454 residues were below the limits of detection at commercial harvest in 2016, so do not appear to pose a risk of residues at harvest, when used in the bud phase.

For Gold3, the significant differences detected for the aggregate results in maturity parameters across the three sites for Actigard treatment 2, were higher dry matter, higher Brix equatorial, higher fresh weight and for treatment 2 Actigard and Treatment 1 untreated control, higher firmness.

If it is accepted that there was a reduction in yield across the three Gold3 sites, where Actigard was used, as indicated by components of yield analysis, then these more favourable fruit maturity characteristics associated with treatment 2 Actigard might reflect the lower crop load borne by the Actigard treated Gold3 vines.

8.0 Acknowledgements

The authors would like to thank

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- Catherine Cameron, AgResearch Ltd, for statistical analysis.
- Dr Neil Cox, NeilStat Ltd, for statistical analysis.
- Dr Elaine Gould, Zespri for project leadership and management.

9.0 References

1. Hawes, L. 2014. Autumn spraying for protection from Psa. Final Report, HortEvaluation Ltd, prepared for Zespri Group Ltd. Zespri Project VI1512

Appendix 1: Layouts

HW Site 1 Challenge Trust																														
Layout																														
		Bay	1		2		3		4		5		6		7		8		9		10		11		12		13		14	
		Row																												
	F		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	M															strip male														
	F		-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	-	X	X
	M															strip male														
	F		-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	M		strip male																											
	F		-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	M		strip male																											
	F		X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	M		strip male																											
	F		etc																											

(yellow)	trial area
(light green)	willow shelter
(dark green)	casuarina shelter
X	useable female vine
-	gap
(dashed line)	undervine shelter
(thick line)	undervine and high artificial shelter

HW Site 1 Challenge Trust			Block 4																											
		Bay	1		2		3		4		5		6		7		8		9		10		11		12		13		14	
		Row																												
	F		1,3	X	5,7	X	10,5	X	14,1	X	19,1	X	23,6	X	25,2	X	27,3	X	29,1	X	31,4	X	33,5	X	35,7	X	X	X	X	X
	M															strip male														
	F		-	4,4	X	9,2	X	13,4	X	18,4	X	22,4	X	24,1	X	26,7	X	28,5	-	30,3	X	32,6	X	34,2	X	X	X	-	X	X
	M															strip male														
	F		-	X	6,5	X	11,3	X	15,6	X	20,3	X	37,2	X	40,1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	M															strip male														
	F		-	3,6	X	8,7	X	12,6	X	17,2	X	36,6	X	39,7	X	42,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	M															strip male														
	F		2,2	X	7,1	X	-	X	16,7	X	21,5	X	38,3	X	41,4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	M															strip male														
	F		etc																											

HW Site 2 Golf Course — Block H2

Layout

Row	Bay	1		2		3		4		5		6		7		8		9		10 etc		
13		7,3	X		8,5		X		20,2		27,7		X	X	37,5		X	X	X			
12		X	X		X		19,1		X		X		28,4		X		X		X			
11			6,7		9,1		X		21,3		26,2	X	X		X		38,2		X			
10		X	X		X	X	18,5		X		X		29,2		36,4		X	X	X			
9		5,5		X			X		X		25,6		X		X		39,7		X			
8		X		X	10,7		17,7					X	30,5		35,1		X	X	X			
7		4,4		X													40,1		X			
6		X	X		X	X	16,4		X		X		31,6		34,4			X	X			
5		3,2			11,2		X		X		X		X		X	X						
4		X	X		X		15,6	X		X		X	X		X				X			
3		2,6	X		12,4	X	X		22,3	X	X		X	33,7		41,3						
2		X	X		X		14,3		X		24,3		32,3		X	X	X					
1		1,7			13,6	X			23,1			X	X	X		42,6		X	X			

	trial area
	cryptomeria shelter
	casuarina shelter
X	useable female vine
-	gap
	ditch

HW Site 3 Coachman	Block 3																															
Layout																																
		Row	**Bay**	**1**		**2**		**3**		**4**		**5**		**6**		**7**		**8**		**9**		**10**		**11**		**12**		**13**		**14**		**15**		**16**
		13												36,3		X		37,7		X		38,4		39,6		X		40,2		41,5		X		42,1
		12												UNUSED ROW																			
		11												X		35,6		X		34,2		X		33,7		X		32,3		X		31,5		
		10												UNUSED ROW																			
		9												X		24,7		25,3		26,5		27,4		28,1		29,4		30,1		X				
		8										UNUSED ROW																					
		7		X		23,2		X		22,6		21,1		X		20,2		19,5		X		18,3		X		17,6							
		6		UNUSED ROW																				X									
		5		X		11,2		X		12,6		13,1		14,4		15,7		X		16,4		X											
		4		UNUSED ROW																													
		3		X		10,7		X		9,5		8,3		X		7,4		6,6		5,3		X		Row Spacing		5	m						
		2		UNUSED ROW																				Vine Spacing		5	m						
		1		X		1,2		X		2,5		X		3,1		X		4,7		X		X		Single Planted									
																								Bay Area		25	m2						
	X	unused female vine																						Vine Area		50	m2						
	-	gap																						Plot=single vine		50	m2						
																								Replication		6							
																								Area per Trt		300	m2						

Gold 3 Site 1 Challenge Trust south end, next door property

Layout

Bay	Row	1	2	3	4	5	6	7	8	9	10
		F	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**F**
1		X	M	X	-	X	M	X	M	X	X
2		X	Mp	X	-	-	M	X	M	X	X
3		X	Mp	-	M	X	M	X	M	X?	X
4		X	Mp	X	Mp	X	M	X	Mp	Xp	X
5		X	M	X	M	X	Mp	X	M	Rp	X
6		X	M	X	Mp	X	M	X	M	Xp	X
7		X	M	X	M	X	M	X	M	X	X
8		X	M	X	M	X	M	X	M	X	X
9		X	M	X	M	X	M	X	M	X	X
10		X	M	X	M	X	M	X?	M	X	X
11		X	M	X	M	X	M	X	M	X	X
12		X	M	X	M	X	M	X	M	X	X
etc											

Row Spacing	3	m
Vine Spacing	5	m
Single Planted		
Bay Area	15	m2
Vine Area	30	m2
Plot=single vine	30	m2
Replication	6	
Area per Trt	180	m2

trial area
cauarina shelter
Willow shelter
X useable female vine, single planted
- gap
ditch
p Psa active canker or ooze

Gold 3 Site 1 Challenge Trust Block 11

Plot Layout

Bay	Row	1	2	3	4	5	6	7	8	9	10
		F	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**F**
1		34,8	M	33,3	-	18,2	M	17,7	M	X	1,5
2		35,1	Mp	-	-	19,5	M	16,1	M	X	2,4
3		36,1	Mp	~~32,5~~	M	-	M	15,4	M	X?	3,1
4		37,3	Mp	31,7	Mp	20,8	M	14,3	Mp	Xp	4,8
5		38,7	M	30,4	M	21,3	Mp	13,8	M	Rp	5,3
6		39,5	M	29,2	Mp	22,4	M	12,1	M	Xp	6,2
7		40,2	M	28,8	M	23,2	M	X	M	X	7,7
8		41,4	M	27,3	M	24,5	M	11,5	M	X	~~8,4~~
9		42,8	M	26,7	M	25,1	M	10,7	M	X	9,2
10		X	M	X	M		M	X?	M	X	X
11		X	M	X	M	X	M	X	M	X	X
12		X	M	X	M	X	M	X	M	X	X

Vines Cut Off at 03/05/16

8,4
32,5

Gold 3 Site 2 Golf Course								south end, next door property													
Layout																					
			Bay	**Row**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	
			1		Xp	Op	X	O	Xp	X	X	O	O	O	X	O	O	O	O	O	
					Op	Om	O	O	O	M	Omp		X	O	O	Op	X	O	X	O	
			2		O		Xp	O	X	X	X		X		X	O	X		O	O	
					O	O	O	O	O	Op	O	Om	O	X	O	Om	Op		O	O	
			3		O	O	X		O	O	X			O	X		X	O	X	O	
					O	Om	O	O	X	O	O	O		Om		O	O	Omp	O	O	
			4		O	O		O	X		X		X		X	O	X			O	
					O	Xp	O	Om	O	O	O	Om	O	O	O	Om	O	Omp		O	
			5		O	O	O	X		X	O	X		X	O	X		O	X		
					O	X	Om	O	O	Op	Om	Op	O	O	O	O	O	X	O	O	
			6		O	X	O	X	O	X		Op	O, O	O		O	O	X		X	O
					m	O		O		O	O	X	Om	X	O	X	Om	O	O	O	Om
			etc																		
																	Row Spacing		3.5	m	
		trial area															Vine Spacing		variabl	m	
		cauarina shelter															Single or Double Planted				
		Willow shelter															Bay Area			m2	
	X	useable female vine, single planted															Vine Area			m2	
	-	gap															Plot=single vine			m2	
		ditch															Replication				
	p	Psa active canker or ooze															Area per Trt			m2	

Gold 3 Site 2 Golf Course	Block K3																			
Plot Layout	**Bay**	**Row**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
	1		irrigation works area		1,4	Op	O	O	3,7	X	4,2	O	5,1	O	6,5	O	7,8	O	O
					Op	Om	2,3	O	O	M	Omp		O	O	O	Op	O	O	8,1
	2				O		13,3	O	12,2	X	11,8		10,5	O	9,4	O	O		O
					O	O	O	O	O	Op	O	Om	O	O	O	Om	Op		O
	3				14,7	O	15,3		16,1	O	17,5	-	-	O	18,4		19,8	O	O
					O	Om	O	O	O	O	O	O		Om		O	O	Omp	20,7
	4			27,1	O	26,3		O	25,8		24,4		23,7		22,2	O	21,2		
					O	Xp	O	Om	O	O	O	Om	O	O	O	Om	O	Omp	
	5				28,5	O	29,8	O	30,2	O	31,3	O	O	O	O	O		O	O
					O	O	Om	O	O	Op	Om	Op	32,7	O	O	33,1	O	34,4	O
	6				O	35,5	O	O	O	40,7		Op	O, O	O		O	36,2	O	35,5
					42,3	O		41,8		O	O	39,1	Om	38,4	O	37,5	Om	O	O

Appendix 2: Application Summary

Gold3: Application Summary

		Spring 1			Spring 2			Post Harvest 1			Post Harvest 2		
2015/2016		**Site 1**	**Site 2**	**Site 3**	**Site 1**	**Site 2**	**Site 3**	**Site 1**	**Site 2**	**Site 3**	**Site 1**	**Site 2**	**Site 3**
1	Control	-	-	-	-	-	-	-	-	-	-	-	-
2	Actigard 200g/ha	✔	✔	✔	✘	✘	✘	✔	✔	✔	✔	✔	✔
3	AB48414 2L/ha	✔	✔	✔	✘	✘	✘	✔	✔	✔	✔	✔	✔
4	TNL3454 2L/ha	✔	✔	✔	✘	✘	✘	✔	✔	✔	✔	✔	✔
5	Emix 20ml/L, plus DuWett at 0.05%	✘	✘	✘	✘	✘	✘	✔	✔	✔	✔	✔	✔
6	Estim 20 TBA	✘	✘	✘	✘	✘	✘	N/A	N/A	N/A	N/A	N/A	N/A
7	Citrox Bioalexin 40ml/10L	✔	✔	✔	✘	✘	✘	✔	✔	✔	✔	✔	✔
8	Bacillus Mycoides (CX 10250)	N/A	N/A	N/A	N/A	N/A	N/A	✔	✔	✔	✔	✔	✔
		Spring 1			**Spring 2**			**Post Harvest 1**			**Post Harvest 2**		
2016/2017		**Site 1**	**Site 2**	**Site 3**	**Site 1**	**Site 2**	**Site 3**	**Site 1**	**Site 2**	**Site 3**	**Site 1**	**Site 2**	**Site 3**
1	Control	-	-	-	-	-	-	-	-	-	-	-	-
2	Actigard 200g/ha	✔	✔	✔	✔	✔	✔	✔	✔	✔	✘	✔	✘
3	AB48414 2L/ha	✔	✔	✔	✔	✔	✔	✔	✔	✔	✘	✔	✘
4	TNL3454 2L/ha	✔	✔	✔	✔	✔	✔	✔	✔	✔	✘	✔	✘
5	Emix 20ml/L, plus DuWett at 0.05%	✔	✔	✔	✔	✔	✔	✔	✔	✔	✘	✔	✘
6	Estim 20 TBA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	Citrox Bioalexin 40ml/10L	✔	✔	✔	✔	✔	✔	✔	✔	✔	✘	✔	✘
8	Bacillus Mycoides (CX 10250)	N/A	N/A	N/A	N/A	N/A	N/A	✔	✔	✔	✘	✔	✘

Hayward: Application Summary

2015/2016		Spring 1			Spring 2			Post Harvest 1			Post Harvest 2		
		Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
1	Control	-	-	-	-	-	-	-	-	-	-	-	-
2	Actigard 200g/ha	✔	✔	✔	✔	✔	✔	✔	✘	✔	✘	✘	✔
3	AB48414 2L/ha	✔	✔	✔	✔	✔	✔	✔	✘	✔	✘	✘	✔
4	TNL3454 2L/ha	✔	✔	✔	✔	✔	✔	✔	✘	✔	✘	✘	✔
5	Emix 20ml/L, plus DuWett at 0.05%	✘	✘	✘	✘	✘	✘	✔	✘	✔	✘	✘	✔
6	Estim 20 TBA	✘	✘	✘	✘	✘	✘	✔	✘	✔	✘	✘	✔
7	Citrox Bioalexin 40ml/10L	✔	✔	✔	✔	✔	✔	✔	✘	✔	✘	✘	✔
8	Bacillus Mycoides (CX 10250)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2016/2017		**Spring 1**			**Spring 2**			**Post Harvest 1**			**Post Harvest 2**		
		Site 1	**Site 2**	**Site 3**	**Site 1**	**Site 2**	**Site 3**	**Site 1**	**Site 2**	**Site 3**	**Site 1**	**Site 2**	**Site 3**
1	Control	-	-	-	-	-	-	-	-	-	-	-	-
2	Actigard 200g/ha	✔	✔	✔	✔	✔	✔	✘	✔	✔	✘	✘	✘
3	AB48414 2L/ha	✔	✔	✔	✔	✔	✔	✘	✔	✔	✘	✘	✘
4	TNL3454 2L/ha	✔	✔	✔	✔	✔	✔	✘	✔	✔	✘	✘	✘
5	Emix 20ml/L, plus DuWett at 0.05%	✔	✔	✔	✔	✔	✔	✘	✔	✔	✘	✘	✘
6	Estim 20 TBA	✔	✔	✔	✔	✔	✔	✘	✔	✔	✘	✘	✘
7	Citrox Bioalexin 40ml/10L	✔	✔	✔	✔	✔	✔	✘	✔	✔	✘	✘	✘
8	Bacillus Mycoides (CX 10250)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Appendix 3: Application Conditions

2015/2016

Gold 3												
	Site 1	**Site 2**	**Site 3**	**Sites 1,2,3**	**Site 1**	**Site 2**	**Site 3**	**Site 3**	**Site 1**	**Site 2**	**Site 3**
	Challenge Trust	Golf Course	Kiwi Cross		Challenge Trust	Golf Course	Kiwi Cross	Kiwi Cross	Challenge Trust	Golf Course	Kiwi Cross
Date	12/10/2015	12/10/2015	12/10/2015		3/05/2016	14/05/2016	28/04/2016	14/05/2016	24/05/2016	6/06/2016	19/05/2016
App	spring 1	spring 1	spring 1	spring 2	autumn 1	autumn 1	autumn 1	autumn 1	autumn 2	autumn 2	autumn 2
Start	3.40pm	9.24am	1.00pm		10.12am	9.20am	9.42 am	11.52am	9.00am	10.15am	12.45pm
End	5.15pm	11.15am	2.40pm		12.04pm	11.20am	11.35 am	12.04pm	10.55am	12.21pm	2.35pm
Temp start ^{o}C	18.7	15.3	20		18.8	15.5	16	21.5	9.6	9.6	18.2
Temp end ^{o}C	15	18	21		21.9	18.2	22.1	21.6	16.4	14.8	17.5
Wind direction	W	WSW	W		NNE to N	ESE	SE	W	NNW	SW to SE	W
Wind Speed km/hr	3.1	3.5	3.6		3.6	4.5	1.1	4.4	3.7	1.1	4.2-1.3
Cloud Cover %	85	70	85		30	50	70-85	40	10% start; 80% end	0%	90% start; 15% end

Hayward												
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
	Challenge	Golf Course	Coachman	Challenge	Golf Course	Coachman	Challenge	Golf Course	Coachman	Challenge	Golf Course	Coachman
Date	20/10/2015	20/10/2015	20/10/2015	10/11/2015	10/11/2015	9/11/2015	16/06/2016		22/04/2016			16/05/2016
App	spring 1	spring 1	spring 1	spring 2	spring 2	spring 2	autumn 1	autumn 1	autumn 1	autumn 2	autumn 2	autumn 2
Start	9.15am	12.30pm	3.30pm	2.10pm	11.15am	12.00pm	11.15am		10.15am			9.30am
End	11.15am	2.24pm	5.30pm	3.40pm	1.05pm	2.24pm	1.30pm		2.17pm			12.31pm
Temp start ^{o}C	18.7	15.3	20	25	23	26	15.9		18.1			12.9
Temp end ^{o}C	15	18	21	18	28	28	15.2		20.1			18.2
Wind direction	W	WSW	W	NNW	W	W	ESE, NE		ESE,E,NNW,NW			SW
Wind Speed km/hr	3.1	3.5	3.6	4.8	5	2	0.1 - 4.2		0.3			2.9
Cloud Cover %	15	40	0	0	50	5	40-95		0			45

2016/2017

Gold 3												
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
	Challenge	Golf Course	Kiwi Cross	Challenge	Golf Course	Kiwi Cross	Challenge	Golf Course	Kiwi Cross	Challenge	Golf Course	Kiwi Cross
Date	9/10/2016	5/10/2016	9/10/2016	27/10/2016	26/10/2016	27/10/2016	3/05/2017	28/04/2017	27/04/2017	22/05/2017	22/05/2017	22/05/2017
App	spring 1	spring 1	spring 1	spring 2	spring 2	spring 2	autumn 1	autumn 1	autumn 1	autumn 2	autumn 2	autumn 2
Start	8.36am	10.24am	11.25am	9.05am	3.35pm	12.38pm	9.50am	2.23pm	2.05pm		11.10am	
End	10.10am	12.26pm	1.05pm	10.50am	5.20pm	2.17pm	11.09am	4.04pm	3.25pm		12.48pm	
Temp start ^{o}C	11.9	16.2	16.9	15.1	12.8	18.1	14.9	19.3	20.5		11.3	
Temp end ^{o}C	14.1	18.8	18.9	16.8	12.8	21.8	16.9	21.5	19.8		13.5	
Wind direction	NNE to NW	ESE	W	N	W	W	NE to NNE	W	W		W	
Wind Speed km/hr	4.2	14.9	6.9	2.4	0.7	3.6	0.1	2.9	2.1		0.9	
Cloud Cover %	50	50	20-30%	85	60	90-35%	0	10-5	30-5%		0%	

Hayward												
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
	Edkins	Golf Course	Coachman	Edkins	Golf Course	Coachman	Edkins	Golf Course	Coachman	Edkins	Golf Course	Coachman
Date	13/10/2016	5/10/2016	13/10/2016	9/11/2016	8/11/2016	8/11/2016		27/04/2017	28/04/2017			
App	spring 1	spring 1	spring 1	spring 2	spring 2	spring 2	autumn 1	autumn 1	autumn 1	autumn 2	autumn 2	autumn 2
Start	9.05am	1.25pm	12.37pm	9.04am	9.45am	2.06pm		9.58am	9.55am			
End	10.47am	3.35pm	2.39pm	10.55am	12.10pm	4.12pm		12.08pm	12.16pm			
Temp start ^{o}C	12.9	18.8	20	13.2	15.1	21.2		15.9	16.4			
Temp end ^{o}C	16.2	19.7	20.7	21.2	19.4	22		20.6	17.8			
Wind direction	WNW to W	ESE	WSW	NE to NNE	WSW	Sw to SSW		NNW	SW			
Wind Speed km/hr	2.5	14.5	6.6	2.5	14.1	12.8		1.6	0.4			
Cloud Cover %	0%	50	0%	0%	30%	12%		0-50%	15-20%			

Appendix 4: Psa Disease Assessments 2015/2016 Hayward and Gold3 Sites

Hayward Site 1	Dieback Cane length / Vine Oct 2015	Flower buds	Flower Average PSA Severity Score	% Flowers Affected	Early Fruit as % of Flowers	% Leaves Spotted	Fruit Pre-Harvest as % of Flowers
residual df	20	20	20	20	20	20	20
Control (Trt 1)	0.67 a	35.2 a	0.29 a	16.0 a	77.9 a	21.5 a	59.8 a
Actigard (Trt 2)	0.83 a	47.7 a	0.21 a	12.3 a	76.4 a	21.7 a	57.5 a
AB48414 (Trt 3)	0.67 a	47.0 a	0.37 a	20.4 a	69.4 a	24.0 a	52.4 a
TNL3454 (Trt 4)	1.50 a	48.6 a	0.51 a	26.6 a	61.3 a	30.1 a	45.2 a
Citrox Bioalexin (Trt 7)	0.83 a	37.6 a	0.49 a	26.2 a	63.0 a	34.0 a	48.3 a
Trt s.e.d	0.791	5.54	0.111	5.40	8.50	7.09	7.31
LSD 5%	1.650	11.56	0.230	11.26	17.73	14.79	15.25
Trt P-value	0.819	0.069	0.055	0.061	0.220	0.335	0.271
Trt Significance	NS	NS	NS	NS	NS	NS	NS
Trt 1 sem	0.333	4.99	0.068	3.44	2.51	2.20	4.38
Trt 2 sem	0.307	3.32	0.053	2.65	6.05	6.64	5.05
Trt 3 sem	0.494	4.32	0.092	4.80	6.52	4.99	6.41
Trt 4 sem	0.847	3.57	0.068	2.78	6.01	3.33	4.09
Trt 7 sem	0.654	6.09	0.120	5.56	6.14	6.97	3.32

Hayward Site 2	Dieback Cane length / Vine Oct 2015	Flower buds	Flower Average PSA Severity Score	% Flowers Affected	Early Fruit as % of Flowers	% Leaves Spotted	Fruit Pre-Harvest as % of Flowers	Dieback Cane length / Vine Aug 2016
residual df	20	20	20	20	20	20	20	20
Control (Trt 1)	3.50 a	34.0 a	0.06 a	4.10 a	87.8 a	14.1 a	53.2 a	0.50 a
Actigard (Trt 2)	2.83 a	40.2 a	0.04 a	2.55 a	93.6 a	7.0 a	57.6 a	2.00 a
AB48414 (Trt 3)	2.17 a	28.1 a	0.07 a	4.90 a	87.7 a	12.2 a	64.9 a	1.00 a
TNL3454 (Trt 4)	1.67 a	31.0 a	0.06 a	4.28 a	90.1 a	16.2 a	58.5 a	1.83 a
Citrox Bioalexin (Trt 7)	2.67 a	36.2 a	0.06 a	3.83 a	92.8 a	8.8 a	48.8 a	2.50 a
Trt s.e.d	1.252	5.55	0.037	2.216	6.06	4.27	9.26	0.913
LSD 5%	2.612	11.58	0.077	4.622	12.64	8.91	19.32	1.904
Trt P-value	0.658	0.265	0.914	0.870	0.795	0.229	0.508	0.226
Trt Significance	NS	NS	NS	NS	NS	NS	NS	NS
Trt 1 sem	1.259	3.28	0.020	1.091	4.35	2.22	6.96	0.500
Trt 2 sem	1.060	3.97	0.023	1.427	2.15	3.04	5.53	0.577
Trt 3 sem	0.804	5.07	0.032	1.838	6.69	2.74	11.16	0.447
Trt 4 sem	0.723	2.93	0.025	1.604	1.50	5.54	8.86	0.792
Trt 7 sem	1.397	3.90	0.029	1.767	3.16	2.59	5.85	0.719

Hayward Site 3	Dieback Cane length / Vine Oct 2015	Flower buds	Flower Average PSA Severity Score	% Flowers Affected	Early Fruit as % of Flowers	% Leaves Spotted	Fruit Pre-Harvest as % of Flowers
residual df	20	20	20	20	20	20	20
Control (Trt 1)	2.83 a	22.0 a	0.16 a	8.80 a	90.8 a	17.4 a	61.6 a
Actigard (Trt 2)	3.83 a	25.0 a	0.13 a	8.00 a	83.8 a	22.9 a	63.3 a
AB48414 (Trt 3)	5.83 a	21.2 a	0.05 a	3.30 a	85.9 a	12.7 a	64.8 a
TNL3454 (Trt 4)	5.33 a	23.6 a	0.12 a	7.50 a	87.7 a	21.6 a	52.3 a
Citrox Bioalexin (Trt 7)	3.67 a	27.8 a	0.08 a	4.70 a	93.2 a	17.6 a	66.1 a
Trt s.e.d	1.767	2.71	0.059	3.330	4.52	3.55	7.95
LSD 5%	3.686	5.64	0.123	6.946	9.43	7.41	16.58
Trt P-value	0.435	0.154	0.391	0.444	0.279	0.068	0.458
Trt Significance	NS	NS	NS	NS	NS	NS	NS
Trt 1 sem	1.302	2.54	0.063	3.365	2.68	3.39	6.03
Trt 2 sem	1.302	1.66	0.054	3.500	3.95	2.89	6.01
Trt 3 sem	1.195	2.37	0.029	1.382	4.40	2.63	5.71
Trt 4 sem	0.882	1.74	0.029	1.943	4.00	2.84	5.21
Trt 7 sem	1.801	2.34	0.042	2.098	3.63	1.62	5.66

Gold 3 Site 1	Cane %Dieback Oct 2015	Dieback Cane length / Vine Nov 2015	Cane %Dieback Nov 2015	Cane %Dieback of Original Nov 2015	Cane %Dieback of Original Mar 2016
residual df	20	20	20	20	19
Control (Trt 1)	2.29 a	0.33 a	0.67 a	93.7 a	90.4 a
Actigard (Trt 2)	2.96 a	0.17 a	0.72 a	97.8 a	91.3 a
AB48414 (Trt 3)	0.00 a	0.17 a	0.72 a	87.4 a	86.7 a
TNL3454 (Trt 4)	1.39 a	1.50 b	2.84 a	95.6 a	92.0 a
Citrox Bioalexin (Trt 7)	2.82 a	0.00 a	0.00 a	96.0 a	94.1 a
Trt s.e.d	1.725	0.461	1.500	4.04	4.33
LSD 5%	3.598	0.962	3.129	8.43	9.06
Trt P-value	0.427	0.026	0.414	0.136	0.549
Trt Significance	NS	*	NS	NS	NS
Trt 1 sem	1.046	0.211	0.667	2.55	1.54
Trt 2 sem	1.502	0.167	0.725	1.49	3.20
Trt 3 sem	0.000	0.167	0.725	5.10	5.11
Trt 4 sem	1.389	0.671	2.143	1.95	3.16
Trt 7 sem	1.370	0.000	0.000	1.38	2.17

Gold 3 Site 2	Cane %Dieback Oct 2015	Dieback Cane length / Vine Nov 2015	Cane %Dieback Nov 2015	Cane %Dieback of Original Nov 2015	Cane %Dieback of Original Mar 2016
residual df	20	20	20	20	20
Control (Trt 1)	0.00 a	0.83 a	5.40 a	89.2 a	85.2 a
Actigard (Trt 2)	0.56 a	0.83 a	3.60 a	87.2 a	71.4 a
AB48414 (Trt 3)	1.22 a	1.33 a	4.80 a	95.6 a	79.3 a
TNL3454 (Trt 4)	2.38 a	1.50 a	11.90 a	95.6 a	91.6 a
Citrox Bioalexin (Trt 7)	0.00 a	1.00 a	4.00 a	94.6 a	86.9 a
Trt s.e.d	1.674	0.922	6.860	9.80	13.76
LSD 5%	3.492	1.923	14.310	20.44	28.70
Trt P-value	0.591	0.927	0.743	0.857	0.639
Trt Significance	NS	NS	NS	NS	NS
Trt 1 sem	0.000	0.401	4.751	4.39	5.44
Trt 2 sem	0.556	0.401	1.792	6.56	11.60
Trt 3 sem	0.823	0.882	3.669	7.19	10.96
Trt 4 sem	2.381	0.847	9.540	9.83	12.29
Trt 7 sem	0.000	0.365	2.161	2.94	5.04

Gold 3 Site 3	Cane %Dieback Oct 2015	Dieback Cane length / Vine Nov 2015	Cane %Dieback Nov 2015	Cane %Dieback of Original Nov 2015	Cane %Dieback of Original Mar 2016
residual df	20	20	20	20	20
Control (Trt 1)	20.4 a	0.83 a	6.60 a	75.1 a	54.2 a
Actigard (Trt 2)	16.9 a	1.17 a	2.00 a	73.1 a	62.8 a
AB48414 (Trt 3)	8.8 a	0.83 a	3.50 a	84.4 a	68.4 a
TNL3454 (Trt 4)	10.3 a	1.17 a	4.10 a	85.0 a	74.3 a
Citrox Bioalexin (Trt 7)	12.3 a	2.00 a	4.90 a	85.4 a	75.5 a
Trt s.e.d	6.67	0.634	3.560	9.41	12.65
LSD 5%	13.91	1.323	7.426	19.63	26.39
Trt P-value	0.409	0.370	0.763	0.533	0.450
Trt Significance	NS	NS	NS	NS	NS
Trt 1 sem	7.03	0.608	3.217	11.55	11.15
Trt 2 sem	7.65	0.434	1.280	7.17	7.87
Trt 3 sem	2.88	0.311	1.991	5.54	13.41
Trt 4 sem	4.56	0.704	2.286	4.73	7.07
Trt 7 sem	4.71	0.564	2.342	5.75	5.03