

CP 205 AHDB Horticulture Efficacy Trials 2022

Final Trial Report

Work package:	WP 03
Title:	Bait sprays to control <i>Drosophila suzukii</i> in commercial raspberry
Crop	Raspberry
Target	<i>Drosophila suzukii</i>
Lead researcher:	Michelle Fountain
Organisation:	NIAB, East Malling
Period:	22 August – 1 November 2022
Report date:	20 January 2023
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ORETO Number: (certificate should be attached)	NA

I the undersigned, hereby declare that the work was performed according to the procedures herein described and that this report is an accurate and faithful record of the results obtained

Date

Author's signature

Trial Summary

Introduction

Headline

- Weekly alternating 25% or 50% field rates of AHDB9722 and AHDB9697, with and without bait were as effective in controlling *Drosophila suzukii* in raspberry fruit as full, 100% rates.
- Residues of AHDB9722 and AHDB9697 in fruit were below the MRLs and on most occasions lower in the bait sprayed fruit compared to the fruit from full rate applications.
- The time required to apply the bait sprays was 90% less than that needed to apply the full rate sprays using knapsack equipment.
- No detrimental impacts of the spray treatments were detected on insect pollinators or natural enemies in this 4-week trial.

Background and expected deliverables

Drosophila suzukii phagostimulatory baits could improve the efficacy of insecticides or minimize the dose of insecticide required. The use of baits is expected to improve *D. suzukii* control efficacy of insecticides with the potential to reduce application rates and improve efficacy of a wider range of insecticide types, leading to reduced risk of pesticide residues and resistance. In previous AHDB (SF/TF 145 and 145a) funded research a series of laboratory- and semi-field-based assays tested commercially available and novel baits for attractiveness to *D. suzukii*, toxicity when combined with a low dose of insecticide, and finally, ability to prevent egg laying. Positive results have been obtained over several years in semi-field scale trials but little evidence had been gathered in fully commercial cropping systems or on side-effects on non-target beneficial insects.

Methods

The aims of this work were to compare the efficacy of weekly alternating applications of AHDB9722 and AHDB9697 in a commercial raspberry crop when used:

- at current full field rate applications
- at reduced rates
- at reduced rates with Combi-protec (a commercial adjuvant)

A replicated trial was done where treatments were applied to a raspberry crop at a commercial soft-fruit farm in Kent. Compartments were constructed to prevent treatment drift between plots and to minimize *D. suzukii* movement between treatment plots. Treatments were applied from 1st harvest and efficacy was assessed on numbers of larvae extracted from fruit sampled from each plot for 4 weeks. The Plant Protection Product (PPP) residue levels within fruit were also assessed to gain an understanding of how the combination of adjuvants impact their detection. Finally, impacts on non-targets insect behaviour and abundance and plant phytotoxicity effects were also assessed.

Results

Weekly alternating reduced rates of AHDB9722 (50 or 100 ml in 40 L) and AHDB9697 (225 or 450 ml in 40 L) per ha, with and without Combi-protec bait, were as effective in controlling *D. suzukii* numbers as full field rates of the same insecticides applied at 200 or 900 ml in 500 L per ha without bait (i.e. a reduction in insecticide application of up to 75% with the same *D. suzukii* control effect). All treatments maintained good control of *D. suzukii* during the four assessment weeks of the crop. These results follow on from previous research conducted as part of SFTF145a where bait sprays were shown to improve the efficacy of crop protection products used at 4% field rate in cherry.

Residues of AHDB9722 and AHDB9697 in fruit samples taken from the full field rate, and 50% and 25% field rates with and without Combi-protec were below the respective GB and EU MRL for AHDB9722. On most occasions residues were also lower in the bait sprayed fruit compared to the full field rate applications although it was not possible to test this statistically.

The time required to apply the bait sprays was 90% less than that to the full rate PPP applications.

None of the PPP or PPP + bait treatments caused phytotoxicity symptoms. Sooty mould was observed on leaves and was higher on leaves sprayed with Combi-protec than without (mean % coverage = 6.3 and 0.21 respectively), probably due to the high relative humidity in the tunnel compartments, however the difference was not statistically significant.

Adding bait to the spray did not have a significant impact on numbers of non-target organisms observed during the trial. Beneficials assessed included honeybees, bumblebees, Orius, parasitoids and predatory spiders; pests included aphid and capsids, and others included ants and Diptera spp.. During the assessments, bumblebees were observed visiting flowers and fruits 6 times more than leaves (sum = 39 and 7 respectively) and honeybees 23 times more (sum = 159 and 7 respectively). No bees were observed feeding on PPP droplets on the leaves, in this trial, but further testing would be needed to confirm this in other crops.

Take home message:

- Adjuvants such as Combi-protec can only be used in combination with approved plant protection products and this varies from crop to crop. Consult up-to-date label recommendations.
- Growers should consult with their agronomists and consult current registration and label recommendations before using reduced rates of insecticides.
- Growers should discuss the use of approved adjuvants in combination with plant protection products with a BASIS qualified agronomist and adhere to approvals.
- Rotating PPP actives can help prevent resistance.

SCIENCE SECTION

Objectives

- 1) compare the *D. suzukii* control efficacy of weekly applications of reduced rates of AHDB9722 and AHDB9697 when used with and without Combi-protect in 40 L/ha band sprays, against current field rates in 500L/ha applications in a commercial raspberry crop,
- 2) determine the residue levels detected within the fruit and
- 3) to assess the impact of bait sprays on non-target organisms including natural enemies and pollinators.

Methods

Trial conduct

[UK regulatory guidelines were followed, but EPPO guidelines took precedence. The following EPPO guidelines were followed:]

Relevant EPPO guideline(s)		Variation from EPPO
PP1/135(4)	Phytotoxicity assessment	
PP1/152(4)	Design and analysis of efficacy evaluation trials	
PP1/181 (4)	Conduct and reporting of efficacy evaluation trials including GEP	
PP 1/214(4)	Principles of acceptable efficacy	
PP1/225(2)	Minimum effective dose	
PP1/239(2)	Dose expression for plant protection products	
PP1/281(1)	<i>Drosophila suzukii</i>	Sugar rather than salt used for larval extraction as AHDB research has proved this is the most efficient method

Test site

Item	Details
Location address	confidential
Crop	Raspberry
Cultivar	Majestic
Soil or substrate type	Compost
Agronomic practice	Grower standard
Prior history of site	NA

Trial design

Item	Details
Trial design:	A replicated field trial was set up in a commercial raspberry crop at a soft-fruit farm in Kent. The trial was conducted in two tunnels of commercial Primocane raspberry (cv. Majestic) selected with the collaborating grower. Plots were divided by a barrier of insect exclusion mesh (Gromax industries ltd, Gro-Net AA/6, hole size; 0.8 mm x 0.8 mm) which was clipped to the underside of the tunnel hoop structure. Mesh was used to prevent free movement of <i>D. suzukii</i> between treatment plots and to reduce spray drift between compartments. There were three sections of insect exclusion mesh falling either side and in between the posts and wire systems which supported the raspberry canes
Number of replicates:	There were 4 replicates of 5 treatments distributed along the length of two 119 m polytunnels.
Row spacing:	3 m
Plot size: (w x l)	6.9 m x 8.9 m
Plot size: (m ²)	Average area of 61.2
Number of plants per plot:	15 pots in each row, 3 canes per pot
<i>Leaf Wall Area calculations</i>	37.38 m ²

*

Treatment details

AHDB Code	Active substance	Product name/ manufacturer code	Formulation batch number	Content of active substance in product	Formulation type	Adjuvant
	ND	AHDB9722	ND	ND	suspension	Combi-protect
	ND	AHDB9697	ND	ND	suspoemulsion	Combi-protect

Application schedule

Treatment number	Treatment: product name or AHDB code	Rate of active substance (ml or g a.s./ha)	Rate of product (l or kg/ha)	Application code
1	Positive control 100% rate	96g a.i/h AHDB9722	500L/h	A / C
2	50% rate	48g a.i/h AHDB9722	500L/h	A / C
3	25% rate	24g a.i/h AHDB9722	500L/h	A / C
4	Combi-protec + 50% rate	48g a.i/h AHDB9722	40L/h	A / C
5	Combi-protec + 25% rate	24g a.i/h AHDB9722	40L/h	A / C
1	Positive control 100% rate	90g a.i /h AHDB9697	500L/h	B / D
2	50% rate	45g a.i/h AHDB9697	500L/h	B / D
3	25% rate	22.5g a.i/h AHDB9697	500L/h	B / D
4	Combi-protec + 50% rate	45g a.i/h AHDB9697	40L/h	B / D
5	Combi-protec + 25% rate	22.5g a.i/h AHDB9697	40L/h	B / D

Application details

	Application A	Application B	Application C	Application D
Application date	07/09/2022	14/09/2022	20/09/2022	26/09/2022
Time of day	8.30	17.00	15.45	15.30
Crop growth stage (Max, min average BBCH)	Fruiting	Fruiting	Fruiting	Fruiting
Crop height (cm)	2.10	2.10	2.10	2.10
Crop coverage (%)	Treatment1: 97% Treatment2: 100% Treatment3: 95% Treatment4: 96% Treatment5: 87% Treatment6: 94%	Treatment1: 96% Treatment2: 98% Treatment3: 95% Treatment4: 88% Treatment5: 87% Treatment6: 92%	Treatment1: 102% Treatment2: 102% Treatment3: 97% Treatment4: 92% Treatment5: 92% Treatment6: 94%	Treatment1: 103% Treatment2: 105% Treatment3: 101% Treatment4: 88% Treatment5: 88% Treatment6: 96%
Application Method	Handheld motorized knapsack with blower	Handheld motorized knapsack with blower	Handheld motorized knapsack with blower	Handheld motorized knapsack with blower
Application Placement	Full foliar (treatment 1, 2, 3) 1 meter band (treatment 4, 5)	Full foliar (treatment 1, 2, 3) 1 meter band (treatment 4, 5)	Full foliar (treatment 1, 2, 3) 1 meter band (treatment 4, 5)	Full foliar (treatment 1, 2, 3) 1 meter band (treatment 4, 5)
Application equipment	Birchmeier REC 14 ABC with blower	Birchmeier REC 14 ABC with blower	Birchmeier REC 14 ABC with blower	Birchmeier REC 14 ABC with blower
Nozzle pressure	3 bar	3 bar	3 bar	3 bar

Nozzle type	Albuz ATR 80 orange (treatment 1, 2, 3) Lecher IDK-120-015 green (treatment 4, 5)	Albuz ATR 80 orange (treatment 1, 2, 3) Lecher IDK-120-015 green (treatment 4, 5)	Albuz ATR 80 orange (treatment 1, 2, 3) Lecher IDK-120-015 green (treatment 4, 5)	Albuz ATR 80 orange (treatment 1, 2, 3) Lecher IDK-120-015 green (treatment 4, 5)
Nozzle size	13.68 ml/sec (Albuz ATR 80 orange) 10.72 ml/sec (Lecher IDK-120-015 green)	13.68 ml/sec (Albuz ATR 80 orange) 10.72 ml/sec (Lecher IDK-120-015 green)	13.68 ml/sec (Albuz ATR 80 orange) 10.72 ml/sec (Lecher IDK-120-015 green)	13.68 ml/sec (Albuz ATR 80 orange) 10.72 ml/sec (Lecher IDK-120-015 green)
Application water volume/ha	500 L (treatment 1, 2, 3) 40 L (treatment 4, 5)	500 L (treatment 1, 2, 3) 40 L (treatment 4, 5)	500 L (treatment 1, 2, 3) 40 L (treatment 4, 5)	500 L (treatment 1, 2, 3) 40 L (treatment 4, 5)
Temperature of air - shade (°C)	17.5	21	17	11.5
Relative humidity (%)	NA	NA	NA	NA
Wind speed range (m/s)	2.5	2.5	0	6.4
Dew presence (Y/N)	NA	NA	NA	NA
Temperature of soil - 2-5 cm (°C)	NA	NA	NA	NA
Wetness of soil - 2-5 cm	NA	NA	NA	NA
Cloud cover (%)	NA	NA	NA	NA

Untreated levels of pests/pathogens at application and through the assessment period

Common name	Scientific Name	EPPO Code	Infestation level pre-application	Infestation level at start of assessment period	Infestation level at end of assessment period
NA	NA	NA	NA	NA	NA

Assessment details

Evaluation date	Evaluation Timing (DA)*		Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotoxicity)	Assessment
	After first conventional insecticides	After first bio-pesticides			
26/08/2022	Pre-treatment	NA	fruiting	ecology	Pollinator survey, plant tap sampling for beneficials and pests
06/09/2022	Pre-treatment	NA	fruiting	Pest	Fruit pick 0
08/09/2022	Pre-treatment	NA	fruiting	Pest	Fruit flotation 0 for SWD presence
13/09/2022	6 days	NA	fruiting	Pest	Fruit pick 1
15/09/2022	7 days	NA	fruiting	Pest	Fruit flotation 1 for SWD presence
20/09/2022	13 days	NA	fruiting	Pest, Beneficials	Fruit pick 2, Pollinator survey, plant tap sampling for beneficials and pests
21/09/2022	14 days	NA	fruiting	Phytotoxic	Fruit collection 1 for residue analyses
22/09/2022	15 days	NA	fruiting	Pest	Fruit flotation 2 for SWD presence
25/09/2022	18 days	NA	fruiting	Pest	Fruit pick 3
27/09/2022	20 days	NA	fruiting	Pest	Fruit flotation 3 for SWD presence
29/09/2022	22 days	NA	fruiting	Phytotoxic	Fruit collection 2 for residue analyses
03/10/2022	25 days	NA	fruiting	Pest	Fruit pick 4 Fruit collection 3 for residue analyses
05/10/2022	27 days	NA	fruiting	Beneficials	Pollinator survey, plant tap sampling for beneficials and pests, leaf analysis Fruit flotation 4 for SWD presence Sooty mould on leaves survey
10/10/2022	32 days	NA	fruiting	Pest	Fruit pick 5 for flotation and emergence
12/10/2022	34 days	NA	Fruiting	Pest	Fruit flotation 5 for SWD presence
18/10/2022	41 days	NA	Fruiting	Beneficials	plant tap sampling for beneficials and pests
01/10/2022	53 days	NA	fruiting	Pest	SWD fruit emergence

* DA – days after application

Statistical analysis

Larval flotations and tap samples

The analyses were conducted in two stages; first to estimate the assessment effect and interaction between assessment and treatment, all data including the pre-treatment assessment was included. Then to estimate the treatment main effect, the model was refitted to the data excluding the pre-treatment assessment. A generalized linear mixed model (glmm) with Poisson family was

fitted to the data. The model included a random effect of “plot” to account for the non-independence of repeated measurements, and fixed effects for block, assessment, treatment and the interaction between the latter. To enable a reasonable model fit, a Bayesian prior was used to estimate treatment x assessment combinations which, though measured, had counts of zero.

Pollinator surveys

The main effect of treatment for pollinators was estimated using an analysis of covariance to control for the pre-treatment levels of each pollinator. A simple Poisson GLM model was fitted to the data with fixed effects for pre-treatment, block and treatment. A repeated measures analysis was used to estimate if the effects of treatment on pollinator numbers were the same over assessments (i.e. the interaction between treatment and assessment). A mixed model Poisson glm was fitted to the data, with a random effect of plot used to account for the non-independence of repeated measures, and fixed effects of block, date, treatment and the interaction between the latter.

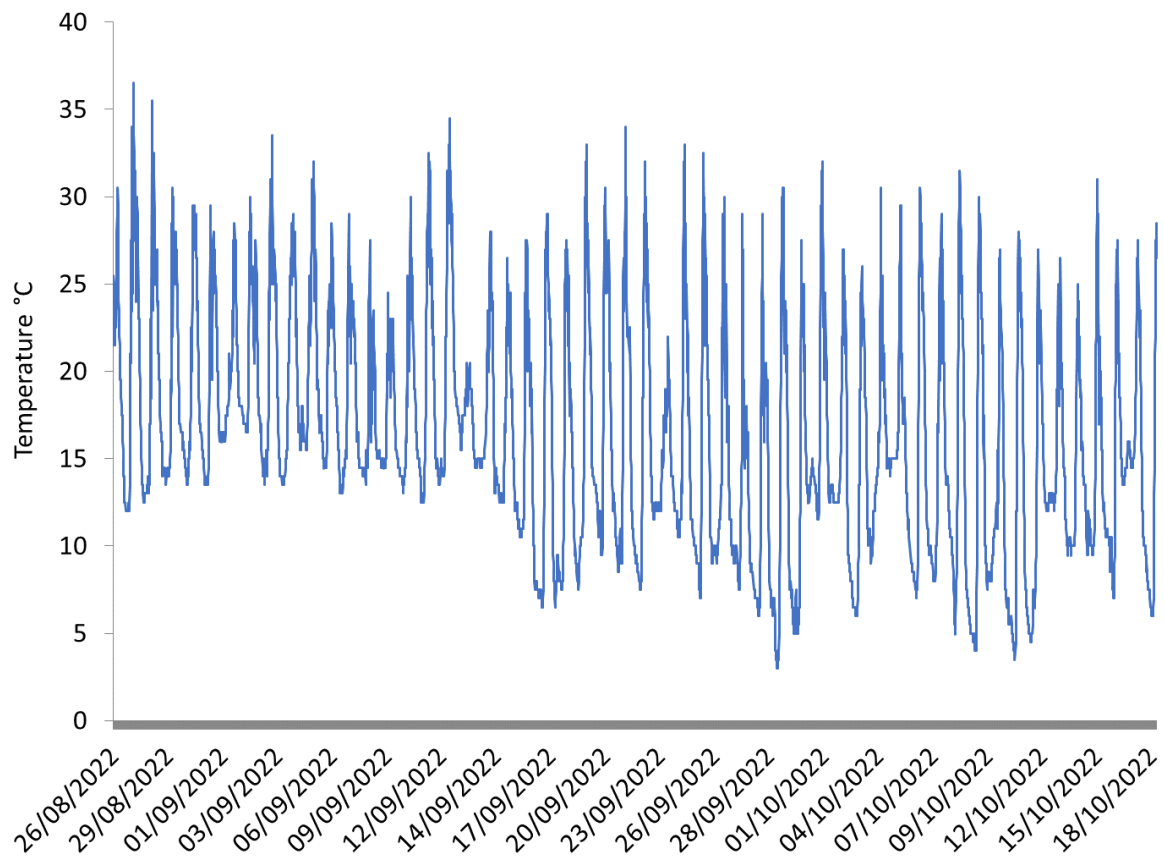
Sooty mould

The main effect of treatment on the proportion of the leaf surface with sooty mould was estimated using ANOVA. A generalized linear model (glm) with Binomial family was fitted to the data with fixed effects of block, canopy position, treatment and the interaction between the latter.

Results

Polytunnel environment

Diurnal fluctuations in air temperature and relative humidity among the polytunnel raspberry plants are shown in Figure 2. During the experiment, the average temperature was 16.3°C; the maximum and minimum temperatures recorded were 36.5 °C and 3.0 °C. The average relative humidity was 80.2%; the maximum and minimum relative humidity was 95% and 35.5%. The enclosed polytunnel compartments resulted in the very high night-time relative humidities which may have caused condensation on the raspberry leaves and promoted sooty mould growth (see next section).



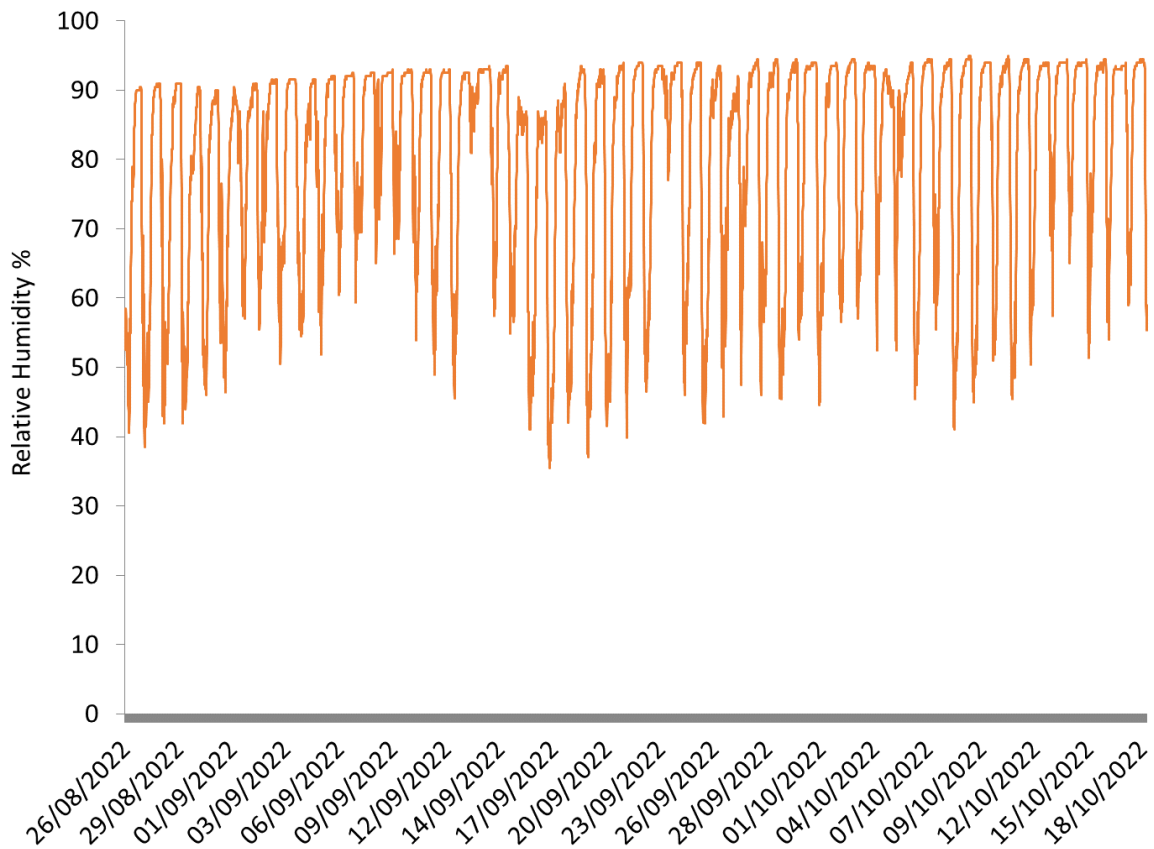


Figure 2. Temperature and relative humidity among polytunnel raspberry plants.

Spray applications

Full field and low rate full foliar applications took 223 seconds per plot (55 pots) compared with 22 seconds for low rate bait sprays. Spray applications measured from the start and end tank volumes were 87% to 105% of the target values (Table 3). Amounts of active ingredients applied per plant are shown in Table 4.

No significant phytotoxicity symptoms were observed in any of the plots, however more sooty mould growth was recorded on leaves where a bait spray had been applied than without (grand mean % = 6.3 and 0.21 respectively), however statistical analysis found the difference was not significant between treatments ($P = 0.851$) owing to most leaves with bait sprays having no sooty mould. There was also no significant interaction between treatment and the canopy level of the crop assessed (bottom third, middle third, top third) on sooty mould coverage (grand mean = 2.09, $P = 1$).

Table 3. Target and actual measured quantities of sprays applied.

Treatment	Spray	Insecticide	Spray vol., ml/plant		Actual/Target
			target	actual	
1. Positive control 100% rate	1	AHDB9722	56.2	54.7	97.36%
	2	AHDB9697	56.2	53.8	95.73%
	3	AHDB9722	56.2	57.5	102.26%
	4	AHDB9697	56.2	58.0	103.28%
2. 50% rate	1	AHDB9722	56.2	56.2	100.02%
	2	AHDB9697	56.2	55.2	98.22%
	3	AHDB9722	56.2	57.1	101.65%
	4	AHDB9697	56.2	58.7	104.51%
3. 25% rate	1	AHDB9722	56.2	53.2	94.71%
	2	AHDB9697	56.2	53.5	95.16%
	3	AHDB9722	56.2	54.5	96.95%
	4	AHDB9697	56.2	56.7	100.83%
4. Combi-protec + 50% rate	1	AHDB9722	4.5	4.3	95.92%
	2	AHDB9697	4.5	3.9	87.76%
	3	AHDB9722	4.5	4.1	91.84%
	4	AHDB9697	4.5	3.9	87.76%
5. Combi-protec + 25% rate	1	AHDB9722	4.5	3.9	86.73%
	2	AHDB9697	4.5	3.9	86.73%
	3	AHDB9722	4.5	4.1	91.84%
	4	AHDB9697	4.5	3.9	87.76%

Table 4. Amounts of active ingredients applied per plant in individual sprays and in total.

Treatment	Spray	Insecticide	Active ingredient mg/plant	
			AHDB972 2	AHDB9697
1. Positive control 100% rate	1	AHDB9722	0.0105	0
	2	AHDB9697	0	0.0097
	3	AHDB9722	0.0110	0
	4	AHDB9697	0	0.0104
	Total		0.0215	0.0201
2. 50% rate	1	AHDB9722	0.0054	0
	2	AHDB9697	0	0.0050
	3	AHDB9722	0.0055	0
	4	AHDB9697	0	0.0053
	Total		0.0109	0.0103
3. 25% rate	1	AHDB9722	0.0026	0
	2	AHDB9697	0	0.0024
	3	AHDB9722	0.0026	0
	4	AHDB9697	0	0.0025
	Total		0.0052	0.0050
4. Combi-protec + 50% rate	1	AHDB9722	0.0052	0
	2	AHDB9697	0	0.0044
	3	AHDB9722	0.0050	0
	4	AHDB9697	0	0.0044
	Total		0.0101	0.0089
5. Combi-protec + 25% rate	1	AHDB9722	0.0023	0
	2	AHDB9697	0	0.0022
	3	AHDB9722	0.0025	0
	4	AHDB9697	0	0.0022
	Total		0.0048	0.0044

Residue analysis

All residue concentrations were within the EU/GB MRLs for AHDB9722 and AHDB9697 in the raspberries (1.5 mg/kg fruit each). PPP residues were generally highest in fruit samples taken from the positive control (full field rate) plots (Tables 5 and 6). Exceptions were 1 day after the 2nd AHDB9722 application when AHDB9697 was marginally higher in the 25% rate treatment compared to 50% (mg/kg fruit = 0.12 and 0.11, respectively) and 3 days after the 2nd AHDB9697 application when AHDB9697 was higher in the Combi-protec + 50% rate treatment compared to the positive control (mg/kg fruit = 0.8 and 0.65, respectively) (Table 6). Residues of AHDB9722 in raspberry samples corresponded with the insecticide application rates (Table 5).

Table 5. Residues of AHDB9722 in fruit samples (mg/kg fruit). GB MRL 1.5 mg/kg fruit.

	1 day after 2nd AHDB9722	3 days after 2nd AHDB9697	7 days after 2nd AHDB9697
1. Positive control 100% rate	0.50	0.65	0.34
2. 50% rate	0.22	0.15	0.09
3. 25% rate	0.14	0.12	0.05
4. Combi-protec + 50% rate	0.23	0.35	0.13
5. Combi-protec + 25% rate	0.19	0.12	0.05

Table 6. Residues of AHDB9697 in fruit samples (mg/kg fruit). GB MRL 1.5 mg/kg fruit.

	1 day after 2nd AHDB9722	3 days after 2nd AHDB9697	7 days after 2nd AHDB9697
1. Positive control 100% rate	0.19	0.65	0.56
2. 50% rate	0.11	0.37	0.12
3. 25% rate	0.12	0.26	0.15
4. Combi-protec + 50% rate	0.15	0.80	0.37
5. Combi-protec + 25% rate	0.14	0.27	0.10

D. suzukii assessments

There was a mean of 10.1 larvae per 20 fruits (one larvae every two fruits) in samples taken for flotation tests the day before spraying commenced, which indicated a moderate background *D. suzukii* infestation of the crop.

Data was first analysed with the pre-assessment included, to measure whether the pattern of change in mean larval counts per 20 fruits over consecutive assessment dates was the same between treatments. No significant interaction was found (grand mean = 2.8, $P = 0.201$). There was a significant effect of assessment on mean larval counts ($P = <0.001$). At assessment 1 (6 days after the 1st AHDB9722 application), there was a significant reduction in the number of larvae in flotation tests compared to the pre-spray assessment (mean = 2.955 and 9.964 respectively, $P = <0.001$). At assessment 2 (6 days after the 1st AHDB9697 application), larval counts were still significantly lower than the pre-assessment (mean = 2.339, $P = <0.001$), but not assessment 1 ($P = 0.824$). At assessment 3 (5 days after the 2nd AHDB9722 application), larval counts were significantly lower than assessments 1 and 2 (mean = 1.062, $P = <0.001$ and 0.023, respectively). At assessments 4 and 5 (7 and 14 days after the 2nd AHDB9697 application), larval counts were significantly lower than assessment 3 (mean = 0.173 and 0.128, $P = 0.014$ and 0.0099 respectively), but not from each other ($P = 0.999$) (Fig. 3).

Data was then analysed excluding the pre-assessment, to look for an overall treatment effect, but there was no significant difference in mean larval counts per 20 fruit between treatments (grand mean = 0.7, $P = 0.067$, Fig. 4).

No adult emergence assessments were done as regular hygiene picks by the farm meant there were few overripe and rotting fruits to support other species of *Drosophila* developing.

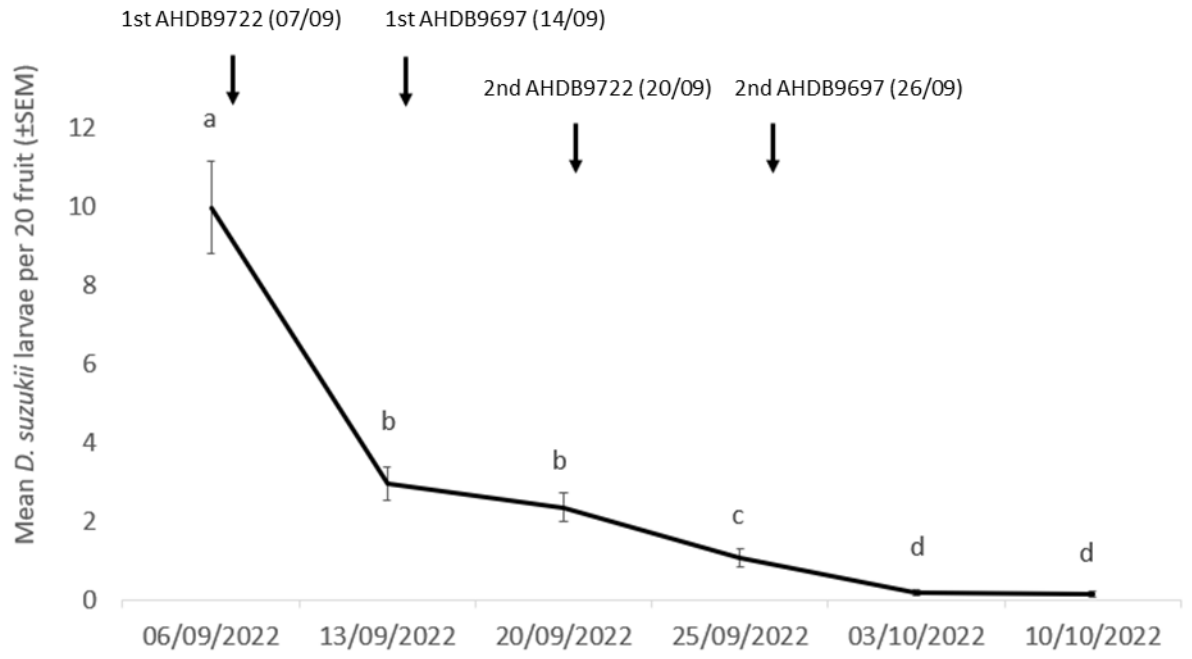


Figure 3. Mean numbers (\pm SE) of *D. suzukii* larvae counted per 20 raspberry fruit at each flotation assessment. Letters denote significant differences at $P = 0.05$. Arrows indicate applications of PPPs.

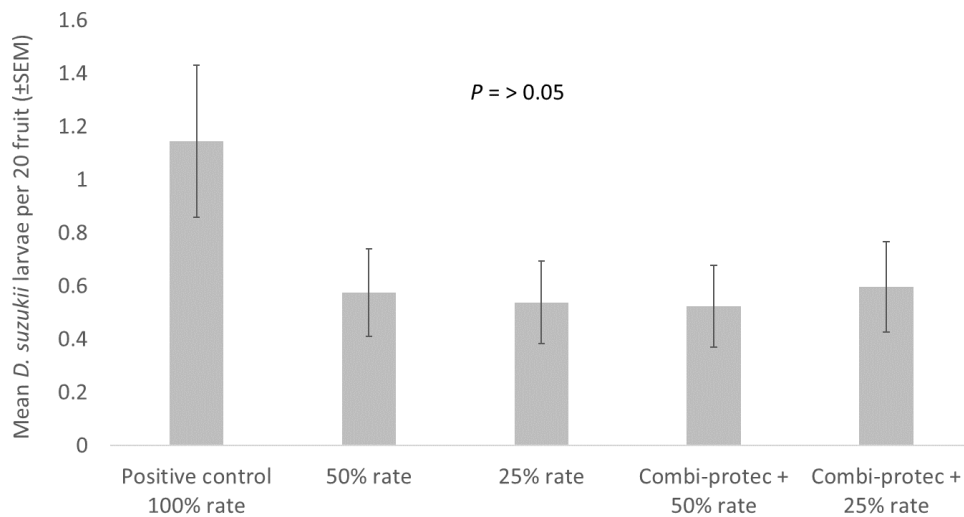


Figure 4. Overall mean numbers (\pm SE) of *D. suzukii* larvae counted per 20 raspberry fruit. There were no significant differences between the treatments.

Beneficial assessments – Pollinator surveys

Crop walk survey dates where significant numbers of pollinators were observed for statistical analysis were the pre-treatment assessment (26 August), and 2 weeks after spray applications began (20 September). During these dates, only bumblebees, and honeybees were observed in high enough numbers for statistical analysis (grand mean 26 August = 0.6 and 0.6 observations/min, respectively) (grand mean 20 September = 0.31 and 0.5 observations/min, respectively). There was no significant difference in the numbers of pollinators visiting raspberry flowers between treatments ($P = 0.34$ and 0.754 respectively, Fig. 5). During all assessments combined, bumblebees and honeybees were observed visiting flowers and fruits 6 and 23 times more than visits to leaves (sum = 39 and 7, respectively; sum = 159 and 7, respectively). No bees were observed feeding on PPP droplets on the leaves in the short surveys.

Other pollinators observed were hoverflies, wasps, and Diptera (grand mean = 0.005, 0.010 and 0.015 observations/ min respectively).

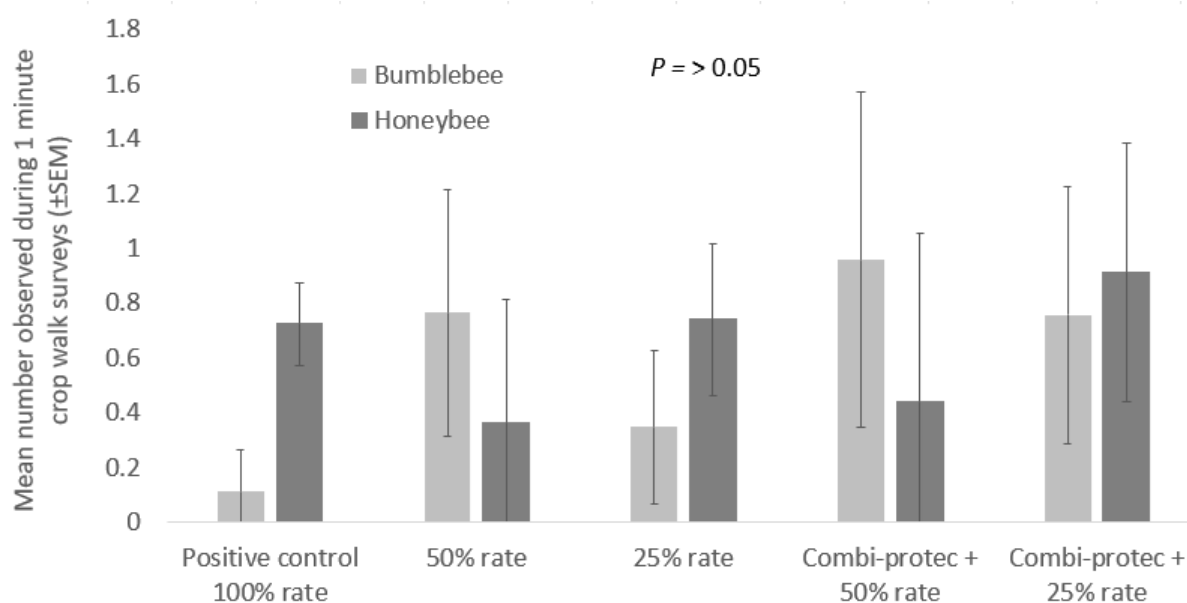


Figure 5. Mean numbers (\pm SE) of bumblebees and honeybees observed visiting plants according to each treatment during 1 minute crop walk surveys of the bait spray trial in raspberry 2022. There were no significant differences between treatments at $P = 0.05$.

Beneficial assessments – Tap samples

Beneficials counted in high enough numbers for statistical analysis were Orius, parasitoids and predatory spiders. Analysis, including the pre-treatment assessment, found no significant interaction between treatment and assessment date (grand mean = 12.8, 15.3 and 8.0, $P = 0.171$, 0.472 and 0.786 , respectively). There was also no significant effect of assessment date on mean counts ($P = 0.086$, 0.248 and 0.054 , respectively). Analysis excluding the pre-treatment assessment found no significant treatment effect (grand mean = 11.2, 14.4 and 6.8, $P = 0.594$, 0.388 and 0.333 , respectively). Numbers of other beneficials observed were too low for statistical analysis, these included wasps, ladybirds, damsel bugs, lacewing (grand mean = 0.009, 0.009, 0.070 and 0.035, respectively), but not hoverflies.

Besides beneficials, pest insects were also observed in tap samples. Those with high enough numbers for statistical analysis were aphids and capsids. Analysis including the pre-treatment assessment found no significant interaction between treatment and assessment date (grand mean = 39.6 and 33.3, $P = 0.39$ and 0.13 , respectively). There was a significant effect of assessment date on mean counts ($P < 0.001$, and $P < 0.001$ respectively). At assessment 1 (6 days after the 1st AHDB9697 application), there was no significant difference in the number of aphids or capsids per plot compared to the pre-spray assessment (mean = 2.61 and 3.31 respectively, $P = 0.988$; mean = 51.26 and 51.76 respectively, $P = 0.999$). At assessment 2 (9 days after the 2nd AHDB9697 application), aphid counts were significantly higher than assessment 1 (mean = 20.34, $P = 0.003$), but capsid counts were significantly lower (mean = 20.64, $P = 0.002$). At assessment 3 (22 days after the 2nd AHDB9697 application), aphid counts were significantly higher than assessments 2 (mean = 123.87, $P = < 0.001$), capsid counts were not significantly different from assessment 2 (mean = 7.74, $P = 0.069$) (Fig. 6).

Analysis excluding the pre-treatment assessment, found no significant treatment effect for either pest (grand mean = 12.8 and 25.8, $P = 0.059$ and 0.705 , respectively).

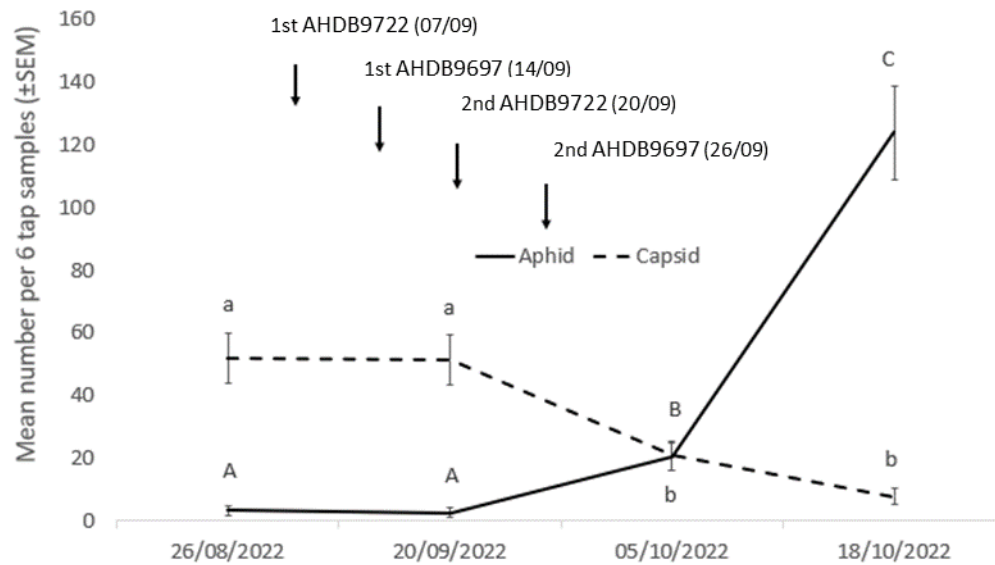


Figure 6. Mean (\pm SE) numbers of aphid and capsids per 6 plants during tap sample assessments in raspberry. Upper case letters denote significant differences between aphid, and lower case letters between capsids, at $P = 0.05$.

Other insects observed in high enough numbers for statistical analysis were ants and Diptera spp. Analysis including the pre-treatment assessment found no significant interaction between treatment and assessment dates (grand mean = 4.1 and 12.5, $P = 0.63$ and 0.98 , respectively). There was a significant effect of assessment date on mean counts ($P = 0.001$, and $P = 0.007$, respectively). At assessment 1 there was no significant difference in the number of ants per plot compared to the pre-spray assessment (mean = 4.28 and 8.58 respectively, $P = 0.351$), but there were significantly more Diptera (mean = 11.82 and 1.76 respectively, $P = 0.025$). At assessment 2 ant counts were significantly lower than the pre-spray assessment (mean = 1.22, $P = 0.020$), but not assessment 1 ($P = 0.307$), Diptera counts were significantly higher than the pre-spray assessment (mean = 16.95, $P = 0.004$), but not assessment 1 ($P = 0.733$). At assessment 3 ant counts were not significantly different to assessment 2 (mean = 1.22, $P = 1.00$), Diptera counts were not significantly different from assessment 2 (mean = 15.24, $P = 0.988$) (Fig. 7).

Analysis excluding the pre-treatment assessment, found no significant treatment effect for ants or Diptera (grand mean = 2.9 and 9.4, $P = 0.902$ and 0.156 , respectively).

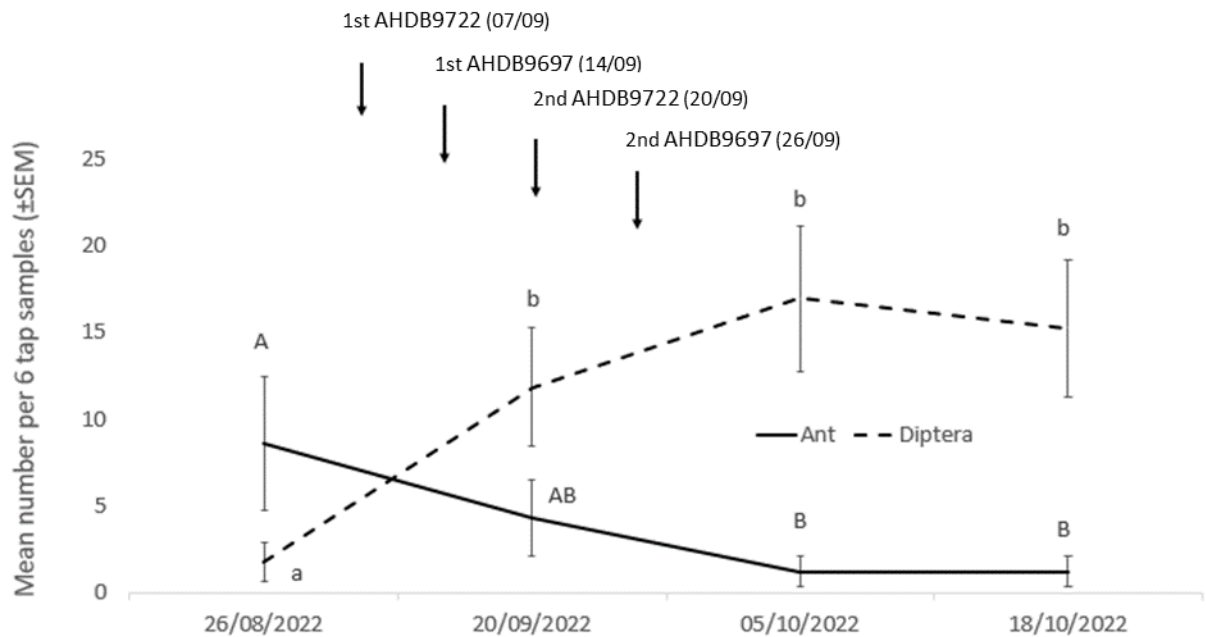


Figure 7. Mean (\pm SE) numbers of ants and Diptera per 6 plants during tap sample assessments in raspberry. Upper case letters denote significant differences for ant assessment and lower case letters for Diptera, at $P = 0.05$.

Conclusions

1. Weekly alternating reduced rates of AHDB9722 (50 or 100 ml) and AHDB9697 (225 or 450 ml) in 40 L per ha, with and without Combi-protect bait, were as effective in controlling *D. suzukii* numbers as full field rates of the same insecticides applied at 200 or 900 ml in 500L per ha without bait (i.e. a reduction in insecticide application of up to 75% with the same *D. suzukii* control effect).
2. As shown in previous research reduced rates of insecticides only cause significant mortality of *Drosophila suzukii* in combination with a bait (see published papers below).
3. All treatments maintained good control of *D. suzukii* during the four assessment weeks of the crop.
4. Residues of AHDB9722 and AHDB9697 in fruit samples taken from the full field rate, 50% and 25% field rates with and without Combi-protect were below the respective GB MRLs and EU MRL for AHDB9722.
5. On most occasions residues were also lower in the bait sprayed fruit compared to the full field rate applications.
6. The time required to apply the bait sprays was 90% less than that needed to spray the full rate applications using knapsack spray equipment.
7. None of the PPP or PPP + bait treatments caused phytotoxicity symptoms.
8. Sooty mould growth was observed on some of the leaves probably due to the enclosed polytunnel compartments and very high relative humidities.

Sooty mould was higher on leaves sprayed with Combi-protect than without (mean % coverage = 6.3 and 0.21 respectively), however the difference was not statistically significant.

9. Adding bait to the spray did not have a significant impact on numbers of non-target organisms observed during this short trial. Beneficials assessed included; honeybees, bumblebees, Orius, parasitoids and predatory spiders, pests included; aphid and capsids and others included; ants and Diptera spp..
10. During the assessments, bumblebees were observed visiting flowers and fruits 6 times more than leaves (sum = 39 and 7 respectively) and honeybees 23 times more (sum = 159 and 7 respectively).
11. During all assessments combined, bumblebees and honeybees were observed visiting flowers and fruits 6 and 23 times more than visits to leaves (sum = 39 and 7, respectively; sum = 159 and 7, respectively).
12. No bees were observed feeding on PPP droplets on the leaves, in this trial, but further testing would be needed to confirm this in other crops.

Acknowledgements

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Appendix

a. Trial diary

Date	Notes
22/08/2022 AW	Visit to host farm for an update on crop growth stage and trial preparation. Spray start predicted week beginning 05 Sep Crop expected to be ready for 1st pick 26 Aug Plot divides to be installed week beginning 29 Aug – expected to take 3 days to install divides Meet on Tue 30 Aug to check divide installation Staff can pick all ripe fruit within tunnels every 2 days NIAB staff need to sample fruit from plots the evening before picking Spraying on the same day and immediately after farm staff have picked to allow a day harvest interval before next pick Will check harvest intervals for AHDB9722 and AHDB9697
26/08/2022 AW BS	Visit to Farm Plots marked using white tape before the netting is installed. 24 plots in total. Crop appears to be in good health. Pre assessments undertaken by AW and DH. 1 minute crop walk in each plot to identify beneficials contacting the crop (landing on fruit, flowers and foliage). 6 tap samples in each plot to record current levels of beneficials and pests. SWD traps collected and replaced. SWD ID undertaken in the lab, male and female SWD present.
30/08/22 BS	Met at farm to discuss the spacing for the compartments. Will be thirteen plots per tunnel (26 in total). This will leave two plots. Mesh will be deployed along the leg row of the tunnels. When the tunnels are vented there will still be access to the compartment for flying insects but this will be minimised in comparison to other times.
06/09/2022 FE	Pre-assessment fruit pick Not enough ripe fruit for 20 per plot, so agreement picked 10 fruit per plot
07/09/2022 AW	1st spray application – AHDB9722 started at 0900 end at 1200
08/09/2022 DH	Pre-assessment fruit floatation
13/09/2022 DH	1st assessment fruit pick 20 per Perspex box An additional 4 boxes of 20 fruit picked from the tunnel adjacent to the tunnel as untreated (by us) control 2 full boxes picked for Corteva for resistance testing

	
14/09/2022 AW	Treatment mixed by AW CS and FE in lab 2nd spray application – AHDB9697 started at 1530 end at 1810
15/09/2022 DH	1st floatation Data input and graphs produced
20/09/2022 CS	2nd assessment fruit pick, picked from 0730 (due to picking at 0900) 20 per Perspex box An additional 4 boxes of 20 fruit picked from the tunnel adjacent to the tunnel as untreated (by us) control 2 full boxes picked for Corteva for resistance testing
20/09/2022 AW	Baits mixed in lab (AHDB9722 added to mixes in the field) 1 min crop walk and 6 taps (per plot) done. Also 4 times in neighbouring untreated tunnels 3rd spray application – AHDB9722 started at 1546 end at 17:47
21/09/2022 AW	1st batch of fruit sampled for residue analysis: Treatments 1, 2, 3, 4 & 5 ~1kg raspberries per treatment Sampled evenly throughout canopy, picking from alleyway
22/09/2022 SD	2nd floatation
25/09/2022 CS	3rd assessment fruit pick afternoon 20 per Perspex box An additional 4 boxes of 20 fruit picked from the tunnel adjacent to the tunnel as untreated (by us) control
26/09/2022 AW	4th spray application – AHDB9697
27/09/2022 SD	3rd floatation
29/09/2022 AW	2nd batch of fruit sampled for residue analysis: Treatments 1, 2, 3, 4 & 5 ~1kg raspberries per treatment Sampled evenly throughout canopy, picking from alleyway
3/10/2022 CS	4th assessment fruit pick in the afternoon. Pollinator observation, leaf analysis and tap samples postponed due to time constraints. 3rd batch of fruit sampled for residue analysis: Treatments 1, 2, 3, 4 & 5

	~1kg raspberries per treatment Sampled evenly throughout canopy, picking from alleyway
5/10/2022 AW	Completion of pollinator observations, leaf analysis and tap samples. 4th floatation.
10/10/2022 CS	Fruit pick
12/10/2022 SD	5th floatation.
18/10/2022 SD	Completion of pollinator observations
01/11/2022 SD	Check for adult emergence. None observed.

b. Trial Photographs



Photos of trial site (above and phytotoxicity testing (below)

c. Raw data

Flotation data

date_picked	date_assessed	plot	treatment	fruit_per_sample	larvae_per_sample	pupae_per_sample
06/09/2022	08/09/2022	101	positive control	10	6	1
06/09/2022	08/09/2022	102	25% rate	10	3	0
06/09/2022	08/09/2022	103	coded adjuvant	10	14	0
06/09/2022	08/09/2022	104	50% rate	10	8	0
06/09/2022	08/09/2022	105	combi-protec 25%	10	2	0
06/09/2022	08/09/2022	106	combi-protec 50%	10	11	1
06/09/2022	08/09/2022	201	combi-protec 50%	10	1	0
06/09/2022	08/09/2022	202	combi-protec 25%	10	4	0
06/09/2022	08/09/2022	203	positive control	10	3	0
06/09/2022	08/09/2022	204	coded adjuvant	10	2	0
06/09/2022	08/09/2022	205	25% rate	10	7	1
06/09/2022	08/09/2022	206	50% rate	10	4	1
06/09/2022	08/09/2022	301	coded adjuvant	10	5	0
06/09/2022	08/09/2022	401	combi-protec 25%	10	9	0
06/09/2022	08/09/2022	402	positive control	10	4	0
06/09/2022	08/09/2022	403	combi-protec 50%	10	3	0
06/09/2022	08/09/2022	404	coded adjuvant	10	1	0
06/09/2022	08/09/2022	405	25% rate	10	10	0
06/09/2022	08/09/2022	406	50% rate	10	6	0
06/09/2022	08/09/2022	501	coded adjuvant	10	3	0
06/09/2022	08/09/2022	502	50% rate	10	2	0
06/09/2022	08/09/2022	503	25% rate	10	8	0
06/09/2022	08/09/2022	504	combi-protec 50%	10	7	0
06/09/2022	08/09/2022	505	combi-protec 25%	10	1	0
06/09/2022	08/09/2022	506	positive control	10	8	0
06/09/2022	08/09/2022	601	coded adjuvant	10	11	0
13/09/2022	15/09/2022	101	positive control	20	9	0
13/09/2022	15/09/2022	102	25% rate	20	6	0
13/09/2022	15/09/2022	103	coded adjuvant	20	4	0
13/09/2022	15/09/2022	104	50% rate	20	3	0
13/09/2022	15/09/2022	105	combi-protec 25%	20	3	0
13/09/2022	15/09/2022	106	combi-protec 50%	20	1	0
13/09/2022	15/09/2022	201	combi-protec 50%	20	3	0
13/09/2022	15/09/2022	202	combi-protec 25%	20	2	0
13/09/2022	15/09/2022	203	positive control	20	5	0
13/09/2022	15/09/2022	204	coded adjuvant	20	2	0
13/09/2022	15/09/2022	205	25% rate	20	0	1
13/09/2022	15/09/2022	206	50% rate	20	4	0
13/09/2022	15/09/2022	301	coded adjuvant	20	8	0
13/09/2022	15/09/2022	401	combi-protec 25%	20	6	0
13/09/2022	15/09/2022	402	positive control	20	2	0

13/09/2022	15/09/2022	403	combi-protec 50%	20	1	0
13/09/2022	15/09/2022	404	coded adjuvant	20	3	0
13/09/2022	15/09/2022	405	25% rate	20	2	0
13/09/2022	15/09/2022	406	50% rate	20	2	0
13/09/2022	15/09/2022	501	coded adjuvant	20	4	0
13/09/2022	15/09/2022	502	50% rate	20	3	0
13/09/2022	15/09/2022	503	25% rate	20	3	0
13/09/2022	15/09/2022	504	combi-protec 50%	20	1	0
13/09/2022	15/09/2022	505	combi-protec 25%	20	2	0
13/09/2022	15/09/2022	506	positive control	20	4	0
13/09/2022	15/09/2022	601	coded adjuvant	20	11	0
13/09/2022	15/09/2022	C1	control	20	6	1
13/09/2022	15/09/2022	C2	control	20	4	0
13/09/2022	15/09/2022	C3	control	20	12	0
13/09/2022	15/09/2022	C4	control	20	3	0
20/09/2022	22/09/2022	101	positive control	20	11	2
20/09/2022	22/09/2022	102	25% rate	20	2	0
20/09/2022	22/09/2022	103	coded adjuvant	20	1	0
20/09/2022	22/09/2022	104	50% rate	20	1	0
20/09/2022	22/09/2022	105	combi-protec 25%	20	0	0
20/09/2022	22/09/2022	106	combi-protec 50%	20	0	0
20/09/2022	22/09/2022	201	combi-protec 50%	20	3	0
20/09/2022	22/09/2022	202	combi-protec 25%	20	2	0
20/09/2022	22/09/2022	203	positive control	20	0	0
20/09/2022	22/09/2022	204	coded adjuvant	20	1	0
20/09/2022	22/09/2022	205	25% rate	20	1	0
20/09/2022	22/09/2022	206	50% rate	20	2	0
20/09/2022	22/09/2022	301	coded adjuvant	20	5	0
20/09/2022	22/09/2022	401	combi-protec 25%	20	2	0
20/09/2022	22/09/2022	402	positive control	20	7	1
20/09/2022	22/09/2022	403	combi-protec 50%	20	1	0
20/09/2022	22/09/2022	404	coded adjuvant	20	2	0
20/09/2022	22/09/2022	405	25% rate	20	1	0
20/09/2022	22/09/2022	406	50% rate	20	3	0
20/09/2022	22/09/2022	501	coded adjuvant	20	2	0
20/09/2022	22/09/2022	502	50% rate	20	1	0
20/09/2022	22/09/2022	503	25% rate	20	3	0
20/09/2022	22/09/2022	504	combi-protec 50%	20	5	0
20/09/2022	22/09/2022	505	combi-protec 25%	20	1	0
20/09/2022	22/09/2022	506	positive control	20	3	0
20/09/2022	22/09/2022	601	coded adjuvant	20	1	0
20/09/2022	22/09/2022	C1	control	20	2	0
20/09/2022	22/09/2022	C2	control	20	1	0
20/09/2022	22/09/2022	C3	control	20	1	0
20/09/2022	22/09/2022	C4	control	20	4	1
25/09/2022	27/09/2022	101	positive control	20	3	0
25/09/2022	27/09/2022	102	25% rate	20	1	0
25/09/2022	27/09/2022	103	coded adjuvant	20	0	0

25/09/2022	27/09/2022	104	50% rate	20	0	0
25/09/2022	27/09/2022	105	combi-protec 25%	20	2	0
25/09/2022	27/09/2022	106	combi-protec 50%	20	2	0
25/09/2022	27/09/2022	201	combi-protec 50%	20	1	0
25/09/2022	27/09/2022	202	combi-protec 25%	20	2	0
25/09/2022	27/09/2022	203	positive control	20	3	0
25/09/2022	27/09/2022	204	coded adjuvant	20	0	0
25/09/2022	27/09/2022	205	25% rate	20	1	0
25/09/2022	27/09/2022	206	50% rate	20	0	0
25/09/2022	27/09/2022	301	coded adjuvant	20	0	0
25/09/2022	27/09/2022	401	combi-protec 25%	20	2	0
25/09/2022	27/09/2022	402	positive control	20	1	0
25/09/2022	27/09/2022	403	combi-protec 50%	20	1	0
25/09/2022	27/09/2022	404	coded adjuvant	20	0	0
25/09/2022	27/09/2022	405	25% rate	20	0	0
25/09/2022	27/09/2022	406	50% rate	20	0	0
25/09/2022	27/09/2022	501	coded adjuvant	20	1	0
25/09/2022	27/09/2022	502	50% rate	20	2	0
25/09/2022	27/09/2022	503	25% rate	20	0	0
25/09/2022	27/09/2022	504	combi-protec 50%	20	1	0
25/09/2022	27/09/2022	505	combi-protec 25%	20	0	0
25/09/2022	27/09/2022	506	positive control	20	0	0
25/09/2022	27/09/2022	601	coded adjuvant	20	3	0
25/09/2022	27/09/2022	C1	control	20	0	0
25/09/2022	27/09/2022	C2	control	20	0	0
25/09/2022	27/09/2022	C3	control	20	0	0
25/09/2022	27/09/2022	C4	control	20	0	0
03/10/2022	05/10/2022	101	positive control	20	0	0
03/10/2022	05/10/2022	102	25% rate	20	0	0
03/10/2022	05/10/2022	103	coded adjuvant	20	0	0
03/10/2022	05/10/2022	104	50% rate	20	1	0
03/10/2022	05/10/2022	105	combi-protec 25%	20	0	0
03/10/2022	05/10/2022	106	combi-protec 50%	20	1	0
03/10/2022	05/10/2022	201	combi-protec 50%	20	0	0
03/10/2022	05/10/2022	202	combi-protec 25%	20	0	0
03/10/2022	05/10/2022	203	positive control	20	0	0
03/10/2022	05/10/2022	204	coded adjuvant	20	0	0
03/10/2022	05/10/2022	205	25% rate	20	0	0
03/10/2022	05/10/2022	206	50% rate	20	0	0
03/10/2022	05/10/2022	301	coded adjuvant	20	0	0
03/10/2022	05/10/2022	401	combi-protec 25%	20	0	0
03/10/2022	05/10/2022	402	positive control	20	0	0
03/10/2022	05/10/2022	403	combi-protec 50%	20	0	0
03/10/2022	05/10/2022	404	coded adjuvant	20	0	0
03/10/2022	05/10/2022	405	25% rate	20	0	0
03/10/2022	05/10/2022	406	50% rate	20	0	0
03/10/2022	05/10/2022	501	coded adjuvant	20	0	0
03/10/2022	05/10/2022	502	50% rate	20	0	0

03/10/2022	05/10/2022	503	25% rate	20	1	0
03/10/2022	05/10/2022	504	combi-protec 50%	20	0	0
03/10/2022	05/10/2022	505	combi-protec 25%	20	0	0
03/10/2022	05/10/2022	506	positive control	20	0	0
03/10/2022	05/10/2022	601	coded adjuvant	20	0	0
03/10/2022	05/10/2022	C1	control	20	0	0
03/10/2022	05/10/2022	C2	control	20	0	0
03/10/2022	05/10/2022	C3	control	20	1	0
03/10/2022	05/10/2022	C4	control	20	0	0
10/10/2022	12/10/2022	101	positive control	20	0	0
10/10/2022	12/10/2022	102	25% rate	20	1	0
10/10/2022	12/10/2022	103	coded adjuvant	20	0	0
10/10/2022	12/10/2022	104	50% rate	20	0	0
10/10/2022	12/10/2022	105	combi-protec 25%	20	0	0
10/10/2022	12/10/2022	106	combi-protec 50%	20	0	0
10/10/2022	12/10/2022	201	combi-protec 50%	20	0	0
10/10/2022	12/10/2022	202	combi-protec 25%	20	0	0
10/10/2022	12/10/2022	203	positive control	20	0	0
10/10/2022	12/10/2022	204	coded adjuvant	20	0	0
10/10/2022	12/10/2022	205	25% rate	20	0	0
10/10/2022	12/10/2022	206	50% rate	20	1	0
10/10/2022	12/10/2022	301	coded adjuvant	20	0	0
10/10/2022	12/10/2022	401	combi-protec 25%	20	0	0
10/10/2022	12/10/2022	402	positive control	20	0	0
10/10/2022	12/10/2022	403	combi-protec 50%	20	0	0
10/10/2022	12/10/2022	404	coded adjuvant	20	0	0
10/10/2022	12/10/2022	405	25% rate	20	0	0
10/10/2022	12/10/2022	406	50% rate	20	0	0
10/10/2022	12/10/2022	501	coded adjuvant	20	0	0
10/10/2022	12/10/2022	502	50% rate	20	0	0
10/10/2022	12/10/2022	503	25% rate	20	0	0
10/10/2022	12/10/2022	504	combi-protec 50%	20	0	0
10/10/2022	12/10/2022	505	combi-protec 25%	20	0	0
10/10/2022	12/10/2022	506	positive control	20	0	0
10/10/2022	12/10/2022	601	coded adjuvant	20	0	0
10/10/2022	12/10/2022	C1	control	20	0	0
10/10/2022	12/10/2022	C2	control	20	1	0
10/10/2022	12/10/2022	C3	control	20	0	0
10/10/2022	12/10/2022	C4	control	20	0	0

Pests

Date (2022)	assessment	number	Colour	Treatment	plot	Aphid	Capsid Nymph	Capsid Adult	capsid total	Weevil	Lygus	SWD	Leafhopper	Thrip
26/08	pre	1	Red	Positive control	101	0	0	0	0	0	0	0	0	0
26/08	pre	2	Yellow	25% rate	102	0	1	0	1	0	0	0	0	0
26/08	pre	3	Green	Coded adjuvant	103	0	0	0	0	0	0	0	0	0
26/08	pre	4	Orange	50% rate	104	0	0	0	0	0	2	0	0	0
26/08	pre	5	Grey	Combi-protect 25%	105	0	2	0	2	0	0	0	0	0
26/08	pre	6	Blue	Combi-protect 50%	106	0	0	0	0	1	0	0	0	0
26/08	pre	7	Blue	Combi-protect 50%	201	0	0	0	0	0	0	0	0	0
26/08	pre	8	Grey	Combi-protect 25%	202	1	7	0	7	0	0	0	0	0
26/08	pre	9	Red	Positive control	203	0	4	0	4	0	0	0	1	0
26/08	pre	10	Green	Coded adjuvant	204	0	3	0	3	1	0	0	0	0
26/08	pre	11	Yellow	25% rate	205	1	2	1	3	1	0	0	0	0
26/08	pre	12	Orange	50% rate	206	0	2	0	2	0	0	0	0	0
26/08	pre	13	Grey	Combi-protect 25%	401	0	1	3	4	0	0	0	0	0
26/08	pre	14	Red	Positive control	402	0	0	0	0	1	0	0	0	0
26/08	pre	15	Blue	Combi-protect 50%	403	0	5	1	6	1	0	0	0	0
26/08	pre	16	Green	Coded adjuvant	404	0	7	0	7	1	0	0	0	0
26/08	pre	17	Yellow	25% rate	405	0	3	0	3	0	0	0	0	0
26/08	pre	18	Orange	50% rate	406	0	5	1	6	0	0	0	0	0
26/08	pre	19	Green	Coded adjuvant	501	0	1	2	3	0	0	0	0	0
26/08	pre	20	Orange	50% rate	502	0	4	0	4	1	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Aphid	Capsid Nymph	Capsid Adult	capisid total	Weevil	Lygus	SWD	Leafhopper	Thrip
26/08	pre	21	Yellow	25% rate	503	0	2	0	2	0	0	0	0	0
26/08	pre	22	Blue	Combi-protect 50%	504	1	5	0	5	0	0	0	0	0
26/08	pre	23	Grey	Combi-protect 25%	505	0	4	2	6	1	0	0	0	0
26/08	pre	24	Red	Positive control	506	0	1	0	1	1	0	0	1	0
20/09	1	1	Red	Positive control	101	0	0	0	0	0	0	0	0	0
20/09	1	2	Yellow	25% rate	102	1	0	3	3	0	0	1	0	0
20/09	1	3	Green	Coded adjuvant	103	0	0	1	1	0	0	0	0	0
20/09	1	4	Orange	50% rate	104	0	0	2	2	0	0	0	0	0
20/09	1	5	Grey	Combi-protect 25%	105	0	0	3	3	0	0	0	0	0
20/09	1	6	Blue	Combi-protect 50%	106	0	0	3	3	1	0	0	0	0
20/09	1	7	Blue	Combi-protect 50%	201	0	0	1	1	0	0	0	0	0
20/09	1	8	Grey	Combi-protect 25%	202	0	0	3	3	0	0	0	0	0
20/09	1	9	Red	Positive control	203	0	0	5	5	0	0	0	0	0
20/09	1	10	Green	Coded adjuvant	204	1	0	2	2	0	0	0	0	0
20/09	1	11	Yellow	25% rate	205	0	0	6	6	0	0	0	1	0
20/09	1	12	Orange	50% rate	206	1	0	4	4	0	0	0	0	0
20/09	1		Green	Coded adjuvant	301	0	0	0	0	0	0	1	0	0
20/09	1	13	Grey	Combi-protect 25%	401	0	0	1	1	0	1	0	0	0
20/09	1	14	Red	Positive control	402	0	0	0	0	0	0	0	0	0
20/09	1	15	Blue	Combi-protect 50%	403	1	0	2	2	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Aphid	Capsid Nymph	Capsid Adult	capisid total	Weevil	Lygus	SWD	Leafhopper	Thrip
20/09	1	16	Green	Coded adjuvant	404	0	0	3	3	0	0	0	0	0
20/09	1	17	Yellow	25% rate	405	0	0	3	3	0	0	0	0	0
20/09	1	18	Orange	50% rate	406	0	0	1	1	0	0	0	0	0
20/09	1	19	Green	Coded adjuvant	501	0	0	3	3	0	0	0	0	0
20/09	1	20	Orange	50% rate	502	0	0	7	7	1	0	0	0	0
20/09	1	21	Yellow	25% rate	503	0	0	4	4	0	0	0	0	0
20/09	1	22	Blue	Combi-protect 50%	504	0	0	2	2	0	0	0	1	0
20/09	1	23	Grey	Combi-protect 25%	505	0	0	3	3	0	0	0	0	0
20/09	1	24	Red	Positive control	506	0	0	2	2	0	0	0	0	0
20/09	1		Green	Coded adjuvant	601	0	0	2	2	0	0	0	1	0
20/09	1		No colour	Control	C1	0	0	5	5	0	0	0	0	0
20/09	1		No colour	Control	C2	0	0	2	2	0	0	0	0	0
20/09	1		No colour	Control	C3	1	0	7	7	0	0	0	0	0
20/09	1		No colour	Control	C4	1	0	1	1	0	0	0	0	0
03/10	2	1	Red	Positive control	101	0	0	5	5	0	0	0	0	0
03/10	2	2	Yellow	25% rate	102	1	0	2	2	0	0	0	0	0
03/10	2	3	Green	Coded adjuvant	103	0	0	3	3	0	0	0	0	0
03/10	2	4	Orange	50% rate	104	2	0	0	0	0	0	0	0	0
03/10	2	5	Grey	Combi-protect 25%	105	0	0	2	2	0	0	0	0	0
03/10	2	6	Blue	Combi-protect 50%	106	2	0	2	2	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Aphid	Capsid Nymph	Capsid Adult	capisid total	Weevil	Lygus	SWD	Leafhopper	Thrip
05/10	2	7	Blue	Combi-protect 50%	201	3	0	2	2	0	0	0	0	0
05/10	2	8	Grey	Combi-protect 25%	202	1	0	2	2	0	0	0	0	0
05/10	2	9	Red	Positive control	203	1	0	0	0	0	0	0	0	0
05/10	2	10	Green	Coded adjuvant	204	0	0	3	3	0	0	0	0	0
05/10	2	11	Yellow	25% rate	205	0	0	0	0	0	0	0	0	0
05/10	2	12	Orange	50% rate	206	1	0	1	1	0	0	0	0	0
05/10	2		Green	Coded adjuvant	301	2	0	0	0	0	0	0	0	0
05/10	2	13	Grey	Combi-protect 25%	401	0	0	0	0	0	0	0	0	0
05/10	2	14	Red	Positive control	402	0	0	0	0	0	0	0	0	0
05/10	2	15	Blue	Combi-protect 50%	403	3	0	0	0	0	0	0	0	0
05/10	2	16	Green	Coded adjuvant	404	2	0	3	3	0	0	0	0	0
05/10	2	17	Yellow	25% rate	405	0	0	1	1	0	0	0	0	0
05/10	2	18	Orange	50% rate	406	0	0	0	0	0	0	0	0	0
05/10	2	19	Green	Coded adjuvant	501	2	0	0	0	0	0	0	0	0
05/10	2	20	Orange	50% rate	502	2	0	4	4	0	0	0	0	0
05/10	2	21	Yellow	25% rate	503	1	0	0	0	0	0	0	0	0
05/10	2	22	Blue	Combi-protect 50%	504	2	0	1	1	0	0	0	0	0
05/10	2	23	Grey	Combi-protect 25%	505	2	0	0	0	0	0	0	0	0
05/10	2	24	Red	Positive control	506	3	0	0	0	0	0	0	0	0
05/10	2		Green	Coded adjuvant	601	0	0	1	1	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Aphid	Capsid Nymph	Capsid Adult	capisid total	Weevil	Lygus	SWD	Leafhopper	Thrip
18/10	3	15	Blue	Combi-protect 50%	403	11	0	0	0	0	0	0	0	0
18/10	3	16	Green	Coded adjuvant	404	14	0	0	0	0	0	0	0	0
18/10	3	17	Yellow	25% rate	405	4	0	0	0	0	0	0	0	0
18/10	3	18	Orange	50% rate	406	9	0	1	1	0	0	0	0	0
18/10	3	19	Green	Coded adjuvant	501	14	0	1	1	0	0	0	0	0
18/10	3	20	Orange	50% rate	502	25	0	1	1	0	0	0	0	0
18/10	3	21	Yellow	25% rate	503	9	0	0	0	0	0	0	0	0
18/10	3	22	Blue	Combi-protect 50%	504	5	0	0	0	0	0	0	0	0
18/10	3	23	Grey	Combi-protect 25%	505	7	0	0	0	0	0	0	0	0
18/10	3	24	Red	Positive control	506	2	0	1	1	0	0	0	0	0
18/10	3		Green	Coded adjuvant	601	3	0	0	0	0	0	0	0	0
18/10	3		No colour	Control	C1	9	0	0	0	0	0	0	0	0
18/10	3		No colour	Control	C2	4	0	0	0	0	0	0	0	0
18/10	3		No colour	Control	C3	11	0	1	1	0	0	0	0	0
18/10	3		No colour	Control	C4	4	0	1	1	0	0	0	0	0

Beneficials (1)

Date (2022)	assessment	number	Colour	Treatment	plot	Anthocorid adult	Anthocorid Nymph	Honeybee	Bumblebee	Wasp	Parasitoid Wasp	Predatory spider
26/08	pre	1	Red	Positive control	101	0	0	0	0	0	0	0
26/08	pre	2	Yellow	25% rate	102	0	0	0	0	1	1	0
26/08	pre	3	Green	Coded adjuvant	103	0	0	0	0	0	1	0
26/08	pre	4	Orange	50% rate	104	0	0	0	0	0	0	0
26/08	pre	5	Grey	Combi-protect 25%	105	2	1	1	0	0	0	0
26/08	pre	6	Blue	Combi-protect 50%	106	3	0	0	1	0	1	0
26/08	pre	7	Blue	Combi-protect 50%	201	0	0	1	0	0	0	0
26/08	pre	8	Grey	Combi-protect 25%	202	2	0	0	0	0	0	0
26/08	pre	9	Red	Positive control	203	2	0	0	0	0	0	0
26/08	pre	10	Green	Coded adjuvant	204	6	0	0	1	0	0	0
26/08	pre	11	Yellow	25% rate	205	5	0	0	0	0	1	0
26/08	pre	12	Orange	50% rate	206	0	0	0	0	0	2	0
26/08	pre	13	Grey	Combi-protect 25%	401	0	0	0	0	0	1	0
26/08	pre	14	Red	Positive control	402	4	0	0	0	0	1	0
26/08	pre	15	Blue	Combi-protect 50%	403	2	0	0	0	0	1	0
26/08	pre	16	Green	Coded adjuvant	404	0	0	0	0	0	0	1
26/08	pre	17	Yellow	25% rate	405	0	0	0	0	0	2	0
26/08	pre	18	Orange	50% rate	406	1	0	0	0	0	3	1
26/08	pre	19	Green	Coded adjuvant	501	1	0	0	0	0	0	3
26/08	pre	20	Orange	50% rate	502	0	0	0	0	0	1	0

Date (2022)	assessment	number	Colour	Treatment	plot	Anthocorid adult	Anthocorid Nymph	Honeybee	Bumblebee	Wasp	Parasitoid Wasp	Predatory spider
26/08	pre	21	Yellow	25% rate	503	0	0	0	0	0	1	0
26/08	pre	22	Blue	Combi-protect 50%	504	0	0	0	0	0	2	0
26/08	pre	23	Grey	Combi-protect 25%	505	3	0	0	0	0	1	0
26/08	pre	24	Red	Positive control	506	1	0	0	0	0	2	1
20/09	1	1	Red	Positive control	101	1	0	0	0	0	0	0
20/09	1	2	Yellow	25% rate	102	1	0	0	0	0	1	0
20/09	1	3	Green	Coded adjuvant	103	0	0	0	0	0	0	1
20/09	1	4	Orange	50% rate	104	0	0	0	0	0	0	0
20/09	1	5	Grey	Combi-protect 25%	105	2	0	0	0	0	0	1
20/09	1	6	Blue	Combi-protect 50%	106	0	0	0	0	0	0	1
20/09	1	7	Blue	Combi-protect 50%	201	1	0	0	0	0	0	1
20/09	1	8	Grey	Combi-protect 25%	202	0	0	0	0	0	0	1
20/09	1	9	Red	Positive control	203	0	0	0	0	0	0	1
20/09	1	10	Green	Coded adjuvant	204	1	0	0	0	0	0	2
20/09	1	11	Yellow	25% rate	205	0	0	0	0	0	0	0
20/09	1	12	Orange	50% rate	206	1	0	0	0	0	0	0
20/09	1		Green	Coded adjuvant	301	0	0	0	0	0	0	0
20/09	1	13	Grey	Combi-protect 25%	401	0	0	0	0	0	0	0
20/09	1	14	Red	Positive control	402	3	0	0	0	0	0	2
20/09	1	15	Blue	Combi-protect 50%	403	0	0	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Anthocorid adult	Anthocorid Nymph	Honeybee	Bumblebee	Wasp	Parasitoid Wasp	Predatory spider
20/09	1	16	Green	Coded adjuvant	404	1	0	0	0	0	0	0
20/09	1	17	Yellow	25% rate	405	1	0	0	0	0	0	1
20/09	1	18	Orange	50% rate	406	3	0	0	0	0	0	0
20/09	1	19	Green	Coded adjuvant	501	1	0	0	0	0	0	0
20/09	1	20	Orange	50% rate	502	1	0	0	0	0	0	1
20/09	1	21	Yellow	25% rate	503	1	0	0	0	0	0	2
20/09	1	22	Blue	Combi-protect 50%	504	0	0	0	0	0	0	1
20/09	1	23	Grey	Combi-protect 25%	505	2	0	0	0	0	0	2
20/09	1	24	Red	Positive control	506	1	0	0	0	0	0	0
20/09	1		Green	Coded adjuvant	601	2	0	0	0	0	0	0
20/09	1		No colour	Control	C1	3	0	0	0	0	0	1
20/09	1		No colour	Control	C2	3	0	0	0	0	0	0
20/09	1		No colour	Control	C3	3	0	0	0	0	0	0
20/09	1		No colour	Control	C4	3	0	0	0	0	0	0
03/10	2	1	Red	Positive control	101	1	0	0	0	0	0	1
03/10	2	2	Yellow	25% rate	102	1	0	0	0	0	1	1
03/10	2	3	Green	Coded adjuvant	103	0	0	0	0	0	0	1
03/10	2	4	Orange	50% rate	104	1	0	0	0	0	1	0
03/10	2	5	Grey	Combi-protect 25%	105	0	0	0	0	0	0	0
03/10	2	6	Blue	Combi-protect 50%	106	0	0	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Anthocorid adult	Anthocorid Nymph	Honeybee	Bumblebee	Wasp	Parasitoid Wasp	Predatory spider
05/10	2	7	Blue	Combi-protect 50%	201	0	0	0	0	0	0	2
05/10	2	8	Grey	Combi-protect 25%	202	0	0	0	0	0	1	2
05/10	2	9	Red	Positive control	203	0	0	0	0	0	0	0
05/10	2	10	Green	Coded adjuvant	204	1	0	0	0	0	0	0
05/10	2	11	Yellow	25% rate	205	0	0	0	0	0	0	1
05/10	2	12	Orange	50% rate	206	0	0	0	0	0	0	0
05/10	2		Green	Coded adjuvant	301	2	0	0	0	0	0	0
05/10	2	13	Grey	Combi-protect 25%	401	0	0	0	0	0	1	0
05/10	2	14	Red	Positive control	402	0	0	0	0	0	0	0
05/10	2	15	Blue	Combi-protect 50%	403	0	0	0	0	0	0	0
05/10	2	16	Green	Coded adjuvant	404	0	0	0	0	0	1	0
05/10	2	17	Yellow	25% rate	405	0	0	0	0	0	2	0
05/10	2	18	Orange	50% rate	406	1	0	0	0	0	0	0
05/10	2	19	Green	Coded adjuvant	501	0	0	0	1	0	0	1
05/10	2	20	Orange	50% rate	502	3	0	0	0	0	0	0
05/10	2	21	Yellow	25% rate	503	0	0	0	0	0	2	0
05/10	2	22	Blue	Combi-protect 50%	504	0	0	0	0	0	0	0
05/10	2	23	Grey	Combi-protect 25%	505	0	0	0	0	0	1	1
05/10	2	24	Red	Positive control	506	0	0	0	0	0	0	0
05/10	2		Green	Coded adjuvant	601	3	0	0	0	0	0	1

Date (2022)	assessment	number	Colour	Treatment	plot	Anthocorid adult	Anthocorid Nymph	Honeybee	Bumblebee	Wasp	Parasitoid Wasp	Predatory spider
05/10	2		No colour	Control	C1	0	0	0	0	0	0	0
05/10	2		No colour	Control	C2	2	0	0	0	0	0	0
05/10	2		No colour	Control	C3	0	0	0	0	0	0	0
05/10	2		No colour	Control	C4	2	0	0	0	0	0	0
18/10	3	1	Red	Positive control	101	0	0	0	0	0	2	4
18/10	3	2	Yellow	25% rate	102	0	0	0	0	0	1	1
18/10	3	3	Green	Coded adjuvant	103	0	0	0	0	0	1	0
18/10	3	4	Orange	50% rate	104	1	0	0	0	0	0	0
18/10	3	5	Grey	Combi-protect 25%	105	4	0	0	0	0	3	0
18/10	3	6	Blue	Combi-protect 50%	106	0	0	0	0	0	0	0
18/10	3	7	Blue	Combi-protect 50%	201	0	0	0	0	0	1	0
18/10	3	8	Grey	Combi-protect 25%	202	0	0	0	0	0	0	0
18/10	3	9	Red	Positive control	203	0	0	0	0	0	1	1
18/10	3	10	Green	Coded adjuvant	204	0	0	0	0	0	1	0
18/10	3	11	Yellow	25% rate	205	0	0	0	0	0	2	2
18/10	3	12	Orange	50% rate	206	0	0	0	0	0	0	0
18/10	3		Green	Coded adjuvant	301	1	0	0	0	0	0	1
18/10	3	13	Grey	Combi-protect 25%	401	0	0	0	0	0	1	0
18/10	3	14	Red	Positive control	402	0	0	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Anthocorid adult	Anthocorid Nymph	Honeybee	Bumblebee	Wasp	Parasitoid Wasp	Predatory spider
18/10	3	15	Blue	Combi-protect 50%	403	0	0	0	0	0	0	0
18/10	3	16	Green	Coded adjuvant	404	1	0	0	0	0	1	0
18/10	3	17	Yellow	25% rate	405	1	0	0	0	0	0	0
18/10	3	18	Orange	50% rate	406	0	0	0	0	0	3	0
18/10	3	19	Green	Coded adjuvant	501	0	0	0	0	0	0	0
18/10	3	20	Orange	50% rate	502	1	0	0	0	0	0	1
18/10	3	21	Yellow	25% rate	503	0	0	0	0	0	2	1
18/10	3	22	Blue	Combi-protect 50%	504	0	0	0	0	0	1	0
18/10	3	23	Grey	Combi-protect 25%	505	1	0	0	0	0	2	1
18/10	3	24	Red	Positive control	506	0	0	0	0	0	1	1
18/10	3		Green	Coded adjuvant	601	0	0	0	0	0	0	0
18/10	3		No colour	Control	C1	1	0	0	0	0	0	0
18/10	3		No colour	Control	C2	0	0	0	0	0	0	1
18/10	3		No colour	Control	C3	0	0	0	0	0	1	0
18/10	3		No colour	Control	C4	0	0	0	0	0	0	0

Beneficials (2)

Date (2022)	assessment	number	Colour	Treatment	plot	Ladybird	Lacewing Adult	Lacewing Nymph	Damsel Bug	Moth	Earwig
26/08	pre	1	Red	Positive control	101	0	0	0	0	0	0
26/08	pre	2	Yellow	25% rate	102	0	0	0	0	0	0
26/08	pre	3	Green	Coded adjuvant	103	0	0	0	0	0	0
26/08	pre	4	Orange	50% rate	104	0	0	0	0	0	0
26/08	pre	5	Grey	Combi-protect 25%	105	0	0	0	0	0	0
26/08	pre	6	Blue	Combi-protect 50%	106	0	0	0	0	0	0
26/08	pre	7	Blue	Combi-protect 50%	201	0	0	0	1	0	0
26/08	pre	8	Grey	Combi-protect 25%	202	0	0	0	0	0	0
26/08	pre	9	Red	Positive control	203	0	0	0	0	0	0
26/08	pre	10	Green	Coded adjuvant	204	0	0	0	1	0	0
26/08	pre	11	Yellow	25% rate	205	0	0	0	0	0	0
26/08	pre	12	Orange	50% rate	206	1	0	0	0	1	0
26/08	pre	13	Grey	Combi-protect 25%	401	0	0	0	1	0	0
26/08	pre	14	Red	Positive control	402	0	0	0	0	0	0
26/08	pre	15	Blue	Combi-protect 50%	403	0	0	0	0	1	0
26/08	pre	16	Green	Coded adjuvant	404	0	1	0	0	0	0
26/08	pre	17	Yellow	25% rate	405	0	1	0	0	0	0
26/08	pre	18	Orange	50% rate	406	0	0	0	0	0	0
26/08	pre	19	Green	Coded adjuvant	501	0	0	0	1	0	0
26/08	pre	20	Orange	50% rate	502	0	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Ladybird	Lacewing Adult	Lacewing Nymph	Damsel Bug	Moth	Earwig
26/08	pre	21	Yellow	25% rate	503	0	0	0	0	0	0
26/08	pre	22	Blue	Combi-protect 50%	504	0	0	0	0	0	0
26/08	pre	23	Grey	Combi-protect 25%	505	0	0	0	1	0	0
26/08	pre	24	Red	Positive control	506	0	0	1	0	0	0
20/09	1	1	Red	Positive control	101	0	0	0	0	0	0
20/09	1	2	Yellow	25% rate	102	0	0	0	0	0	0
20/09	1	3	Green	Coded adjuvant	103	0	1	0	1	0	0
20/09	1	4	Orange	50% rate	104	0	0	0	0	0	0
20/09	1	5	Grey	Combi-protect 25%	105	0	0	0	0	0	0
20/09	1	6	Blue	Combi-protect 50%	106	0	0	0	0	0	0
20/09	1	7	Blue	Combi-protect 50%	201	0	0	0	1	0	0
20/09	1	8	Grey	Combi-protect 25%	202	0	0	0	0	0	0
20/09	1	9	Red	Positive control	203	0	0	0	0	0	0
20/09	1	10	Green	Coded adjuvant	204	0	0	0	0	0	0
20/09	1	11	Yellow	25% rate	205	0	0	0	0	0	0
20/09	1	12	Orange	50% rate	206	0	0	0	0	0	0
20/09	1		Green	Coded adjuvant	301	0	0	0	0	0	0
20/09	1	13	Grey	Combi-protect 25%	401	0	0	0	0	0	0
20/09	1	14	Red	Positive control	402	0	0	0	0	0	0
20/09	1	15	Blue	Combi-protect 50%	403	0	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Ladybird	Lacewing Adult	Lacewing Nymph	Damsel Bug	Moth	Earwig
20/09	1	16	Green	Coded adjuvant	404	0	0	0	0	0	0
20/09	1	17	Yellow	25% rate	405	0	0	0	0	0	0
20/09	1	18	Orange	50% rate	406	0	0	0	0	0	0
20/09	1	19	Green	Coded adjuvant	501	0	0	0	1	0	0
20/09	1	20	Orange	50% rate	502	0	0	0	0	0	0
20/09	1	21	Yellow	25% rate	503	0	0	0	0	0	0
20/09	1	22	Blue	Combi-protect 50%	504	0	0	0	0	0	0
20/09	1	23	Grey	Combi-protect 25%	505	0	0	0	0	0	0
20/09	1	24	Red	Positive control	506	0	0	0	0	0	0
20/09	1		Green	Coded adjuvant	601	0	0	0	0	0	0
20/09	1		No colour	Control	C1	0	0	0	0	0	0
20/09	1		No colour	Control	C2	0	0	0	0	0	0
20/09	1		No colour	Control	C3	0	0	0	0	0	0
20/09	1		No colour	Control	C4	0	0	0	0	0	0
03/10	2	1	Red	Positive control	101	0	0	0	0	0	0
03/10	2	2	Yellow	25% rate	102	0	0	0	0	0	0
03/10	2	3	Green	Coded adjuvant	103	0	0	0	0	0	0
03/10	2	4	Orange	50% rate	104	0	0	0	0	0	0
03/10	2	5	Grey	Combi-protect 25%	105	0	0	0	0	0	0
03/10	2	6	Blue	Combi-protect 50%	106	0	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Ladybird	Lacewing Adult	Lacewing Nymph	Damsel Bug	Moth	Earwig
05/10	2	7	Blue	Combi-protect 50%	201	0	0	0	0	0	0
05/10	2	8	Grey	Combi-protect 25%	202	0	0	0	0	0	0
05/10	2	9	Red	Positive control	203	0	0	0	0	0	1
05/10	2	10	Green	Coded adjuvant	204	0	0	0	0	0	0
05/10	2	11	Yellow	25% rate	205	0	0	0	0	0	0
05/10	2	12	Orange	50% rate	206	0	0	0	0	0	0
05/10	2		Green	Coded adjuvant	301	0	0	0	0	0	0
05/10	2	13	Grey	Combi-protect 25%	401	0	0	0	0	0	0
05/10	2	14	Red	Positive control	402	0	0	0	0	0	0
05/10	2	15	Blue	Combi-protect 50%	403	0	0	0	0	0	0
05/10	2	16	Green	Coded adjuvant	404	0	0	0	0	0	0
05/10	2	17	Yellow	25% rate	405	0	0	0	0	0	0
05/10	2	18	Orange	50% rate	406	0	0	0	0	0	0
05/10	2	19	Green	Coded adjuvant	501	0	0	0	0	0	0
05/10	2	20	Orange	50% rate	502	0	0	0	0	0	0
05/10	2	21	Yellow	25% rate	503	0	0	0	0	0	0
05/10	2	22	Blue	Combi-protect 50%	504	0	0	0	0	0	0
05/10	2	23	Grey	Combi-protect 25%	505	0	0	0	0	0	0
05/10	2	24	Red	Positive control	506	0	0	0	0	0	0
05/10	2		Green	Coded adjuvant	601	0	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Ladybird	Lacewing Adult	Lacewing Nymph	Damsel Bug	Moth	Earwig
05/10	2		No colour	Control	C1	0	0	0	0	0	0
05/10	2		No colour	Control	C2	0	0	0	0	0	0
05/10	2		No colour	Control	C3	0	0	0	0	0	0
05/10	2		No colour	Control	C4	0	0	0	0	0	0
18/10	3	1	Red	Positive control	101	0	0	0	0	0	0
18/10	3	2	Yellow	25% rate	102	0	0	0	0	0	0
18/10	3	3	Green	Coded adjuvant	103	0	0	0	0	0	0
18/10	3	4	Orange	50% rate	104	0	0	0	0	0	0
18/10	3	5	Grey	Combi-protect 25%	105	0	0	0	0	0	0
18/10	3	6	Blue	Combi-protect 50%	106	0	0	0	0	0	0
18/10	3	7	Blue	Combi-protect 50%	201	0	0	0	0	0	0
18/10	3	8	Grey	Combi-protect 25%	202	0	0	0	0	0	0
18/10	3	9	Red	Positive control	203	0	0	0	0	0	0
18/10	3	10	Green	Coded adjuvant	204	0	0	0	0	0	0
18/10	3	11	Yellow	25% rate	205	0	0	0	0	0	0
18/10	3	12	Orange	50% rate	206	0	0	0	0	0	0
18/10	3		Green	Coded adjuvant	301	0	0	0	0	0	0
18/10	3	13	Grey	Combi-protect 25%	401	0	0	0	0	0	0
18/10	3	14	Red	Positive control	402	0	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Ladybird	Lacewing Adult	Lacewing Nymph	Damsel Bug	Moth	Earwig
18/10	3	15	Blue	Combi-protect 50%	403	0	0	0	0	0	0
18/10	3	16	Green	Coded adjuvant	404	0	0	0	0	0	0
18/10	3	17	Yellow	25% rate	405	0	0	0	0	0	0
18/10	3	18	Orange	50% rate	406	0	0	0	0	0	0
18/10	3	19	Green	Coded adjuvant	501	0	0	0	0	0	0
18/10	3	20	Orange	50% rate	502	0	0	0	0	0	0
18/10	3	21	Yellow	25% rate	503	0	0	0	0	0	0
18/10	3	22	Blue	Combi-protect 50%	504	0	0	0	0	0	0
18/10	3	23	Grey	Combi-protect 25%	505	0	0	0	0	0	0
18/10	3	24	Red	Positive control	506	0	0	0	0	0	0
18/10	3		Green	Coded adjuvant	601	0	0	0	0	0	0
18/10	3		No colour	Control	C1	0	0	0	0	0	0
18/10	3		No colour	Control	C2	0	0	0	0	0	0
18/10	3		No colour	Control	C3	0	0	0	0	0	0
18/10	3		No colour	Control	C4	0	0	0	0	0	0

Others

Date (2022)	assessment	number	Colour	Treatment	plot	Ant	Harvestman	Diptera	<i>Trapezonotus sp.</i>	Shieldbug
26/08	pre	1	Red	Positive control	101	0	0	0	8	0
26/08	pre	2	Yellow	25% rate	102	0	0	0	4	0
26/08	pre	3	Green	Coded adjuvant	103	0	0	0	8	0
26/08	pre	4	Orange	50% rate	104	1	0	0	7	0
26/08	pre	5	Grey	Combi-protect 25%	105	1	0	0	7	0
26/08	pre	6	Blue	Combi-protect 50%	106	4	0	0	5	0
26/08	pre	7	Blue	Combi-protect 50%	201	0	0	0	3	0
26/08	pre	8	Grey	Combi-protect 25%	202	1	0	0	4	0
26/08	pre	9	Red	Positive control	203	4	0	0	1	0
26/08	pre	10	Green	Coded adjuvant	204	3	0	0	1	0
26/08	pre	11	Yellow	25% rate	205	2	0	0	0	0
26/08	pre	12	Orange	50% rate	206	0	0	0	1	0
26/08	pre	13	Grey	Combi-protect 25%	401	1	1	0	2	0
26/08	pre	14	Red	Positive control	402	0	0	0	5	0
26/08	pre	15	Blue	Combi-protect 50%	403	0	0	0	7	0
26/08	pre	16	Green	Coded adjuvant	404	0	0	0	5	0
26/08	pre	17	Yellow	25% rate	405	0	0	0	8	0
26/08	pre	18	Orange	50% rate	406	1	0	1	9	0
26/08	pre	19	Green	Coded adjuvant	501	0	0	0	2	0
26/08	pre	20	Orange	50% rate	502	1	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Ant	Harvestman	Diptera	<i>Trapezonotus</i> sp.	Shieldbug
26/08	pre	21	Yellow	25% rate	503	1	0	0	1	0
26/08	pre	22	Blue	Combi-protect 50%	504	0	0	0	0	0
26/08	pre	23	Grey	Combi-protect 25%	505	0	0	0	0	0
26/08	pre	24	Red	Positive control	506	0	0	0	3	0
20/09	1	1	Red	Positive control	101	0	0	0	0	0
20/09	1	2	Yellow	25% rate	102	0	0	1	0	0
20/09	1	3	Green	Coded adjuvant	103	0	0	0	0	0
20/09	1	4	Orange	50% rate	104	0	0	0	0	0
20/09	1	5	Grey	Combi-protect 25%	105	0	0	0	0	0
20/09	1	6	Blue	Combi-protect 50%	106	0	0	0	0	0
20/09	1	7	Blue	Combi-protect 50%	201	0	0	0	0	0
20/09	1	8	Grey	Combi-protect 25%	202	0	0	0	0	0
20/09	1	9	Red	Positive control	203	1	0	0	0	0
20/09	1	10	Green	Coded adjuvant	204	0	0	2	0	0
20/09	1	11	Yellow	25% rate	205	0	0	1	0	0
20/09	1	12	Orange	50% rate	206	0	0	3	0	0
20/09	1		Green	Coded adjuvant	301	2	0	2	0	0
20/09	1	13	Grey	Combi-protect 25%	401	6	0	2	0	0
20/09	1	14	Red	Positive control	402	0	0	1	0	0
20/09	1	15	Blue	Combi-protect 50%	403	0	0	1	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Ant	Harvestman	Diptera	<i>Trapezonotus</i> sp.	Shieldbug
20/09	1	16	Green	Coded adjuvant	404	0	0	0	0	0
20/09	1	17	Yellow	25% rate	405	0	0	1	0	0
20/09	1	18	Orange	50% rate	406	1	0	1	0	0
20/09	1	19	Green	Coded adjuvant	501	0	0	1	0	0
20/09	1	20	Orange	50% rate	502	0	0	0	0	0
20/09	1	21	Yellow	25% rate	503	0	0	0	0	0
20/09	1	22	Blue	Combi-protect 50%	504	0	0	0	0	0
20/09	1	23	Grey	Combi-protect 25%	505	0	0	3	0	0
20/09	1	24	Red	Positive control	506	0	0	0	0	0
20/09	1		Green	Coded adjuvant	601	0	0	1	0	0
20/09	1		No colour	Control	C1	0	0	0	0	0
20/09	1		No colour	Control	C2	0	0	1	0	0
20/09	1		No colour	Control	C3	0	0	0	0	0
20/09	1		No colour	Control	C4	3	0	0	0	0
03/10	2	1	Red	Positive control	101	0	0	1	0	0
03/10	2	2	Yellow	25% rate	102	0	0	2	0	0
03/10	2	3	Green	Coded adjuvant	103	0	0	1	0	0
03/10	2	4	Orange	50% rate	104	0	0	1	0	0
03/10	2	5	Grey	Combi-protect 25%	105	0	0	1	0	0
03/10	2	6	Blue	Combi-protect 50%	106	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Ant	Harvestman	Diptera	<i>Trapezonotus sp.</i>	Shieldbug
05/10	2	7	Blue	Combi-protect 50%	201	0	0	0	0	0
05/10	2	8	Grey	Combi-protect 25%	202	0	0	1	0	0
05/10	2	9	Red	Positive control	203	0	0	0	0	0
05/10	2	10	Green	Coded adjuvant	204	0	0	9	0	0
05/10	2	11	Yellow	25% rate	205	0	0	1	0	0
05/10	2	12	Orange	50% rate	206	0	0	3	0	0
05/10	2		Green	Coded adjuvant	301	0	0	10	0	0
05/10	2	13	Grey	Combi-protect 25%	401	1	0	0	0	0
05/10	2	14	Red	Positive control	402	0	0	0	0	0
05/10	2	15	Blue	Combi-protect 50%	403	0	0	0	0	0
05/10	2	16	Green	Coded adjuvant	404	0	0	2	0	0
05/10	2	17	Yellow	25% rate	405	0	0	1	0	0
05/10	2	18	Orange	50% rate	406	0	0	1	0	0
05/10	2	19	Green	Coded adjuvant	501	0	0	2	0	0
05/10	2	20	Orange	50% rate	502	0	0	0	0	0
05/10	2	21	Yellow	25% rate	503	1	0	2	0	0
05/10	2	22	Blue	Combi-protect 50%	504	0	0	2	0	0
05/10	2	23	Grey	Combi-protect 25%	505	0	0	2	0	0
05/10	2	24	Red	Positive control	506	0	0	2	0	0
05/10	2		Green	Coded adjuvant	601	0	0	9	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Ant	Harvestman	Diptera	<i>Trapezonotus</i> sp.	Shieldbug
05/10	2		No colour	Control	C1	0	0	0	0	0
05/10	2		No colour	Control	C2	0	0	0	0	0
05/10	2		No colour	Control	C3	0	0	0	0	0
05/10	2		No colour	Control	C4	0	0	0	0	0
18/10	3	1	Red	Positive control	101	0	0	0	0	2
18/10	3	2	Yellow	25% rate	102	1	0	0	0	0
18/10	3	3	Green	Coded adjuvant	103	0	0	0	0	0
18/10	3	4	Orange	50% rate	104	0	0	1	0	0
18/10	3	5	Grey	Combi-protect 25%	105	0	0	2	0	0
18/10	3	6	Blue	Combi-protect 50%	106	0	0	1	0	0
18/10	3	7	Blue	Combi-protect 50%	201	0	0	1	0	0
18/10	3	8	Grey	Combi-protect 25%	202	0	0	1	0	0
18/10	3	9	Red	Positive control	203	0	0	1	0	0
18/10	3	10	Green	Coded adjuvant	204	0	0	1	0	0
18/10	3	11	Yellow	25% rate	205	0	0	2	0	0
18/10	3	12	Orange	50% rate	206	1	0	2	0	0
18/10	3		Green	Coded adjuvant	301	0	0	2	0	0
18/10	3	13	Grey	Combi-protect 25%	401	0	0	1	0	0
18/10	3	14	Red	Positive control	402	0	0	0	0	0

Date (2022)	assessment	number	Colour	Treatment	plot	Ant	Harvestman	Diptera	<i>Trapezonotus sp.</i>	Shieldbug
18/10	3	15	Blue	Combi-protect 50%	403	0	0	1	0	0
18/10	3	16	Green	Coded adjuvant	404	1	0	0	0	0
18/10	3	17	Yellow	25% rate	405	0	0	1	0	0
18/10	3	18	Orange	50% rate	406	0	0	0	0	0
18/10	3	19	Green	Coded adjuvant	501	0	0	3	0	0
18/10	3	20	Orange	50% rate	502	0	0	0	0	0
18/10	3	21	Yellow	25% rate	503	0	0	4	0	0
18/10	3	22	Blue	Combi-protect 50%	504	0	0	0	0	0
18/10	3	23	Grey	Combi-protect 25%	505	0	0	0	0	0
18/10	3	24	Red	Positive control	506	0	0	0	0	0
18/10	3		Green	Coded adjuvant	601	0	0	9	0	0
18/10	3		No colour	Control	C1	0	0	0	0	0
18/10	3		No colour	Control	C2	1	0	3	0	0
18/10	3		No colour	Control	C3	0	0	3	0	0
18/10	3		No colour	Control	C4	0	0	2	0	0

- d. Trial design
See methods section
- e. ORETO certificate

