SCEPTREPLUS

Final Trial Report

Trial code:	SP 38
Title:	Control of raspberry cane midge and blackberry leaf midge - efficacy trials
Crop	Raspberry
Target	Blackberry leaf midge (*Dasineura plicatrix*) and Raspberry cane midge (*Resseliella theobaldi*)
Lead researcher:	Dr Bethan Shaw and Dr Charles Whitfield
Organisation:	NIAB EMR
Period:	01 March 2020 – 31 March 2021
Report date:	29 July 2020
Report author:	Dr Bethan Shaw
ORETO Number: (certificate should be attached)	Certificate No. 411

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

…29/07/2020… ………Bethan Shaw………………………………

Date Author's signature

Trial Summary

Introduction

The raspberry cane midge (*Resseliellia theobaldi*) (RCM) and blackberry leaf midge (*Dasineura plicatrix*) (BLM) can be major constraints to UK raspberry production. RCM damages raspberry canes which can lead to secondary pathogen outbreaks (midge blight). BLM damages the tips of raspberry shoots, causing poor growth and branching of the primocane. This makes the canes more difficult to train, more prone to low temperature winter damage and can lower the photosynthetic capacity of the plant and resulting yield the following season. Flower development is damaged causing a direct reduction in fruit production. Previously, growers controlled these pests with chlorpyrifos-based products, but since authorisation for its use was revoked in 2016 and the likely loss of thiacloprid in 2021 they will be increasingly challenging to control. The aim of this trial was to test conventional and novel chemistry and other control strategies (bioprotectants) which could be compatible with an IPM programme, and could be used in the UK to target these pests. Products were chosen after consultation with growers, agronomists, agro-chemical companies, other industry stakeholders and SCEPTREPlus consortium members.

Methods

The trial was deployed within a commercial raspberry crop (cv Kweli, WB Chambers, Boarden Farm). Foliar application of four products (AHDB9971, AHDB9950, AHDB9835 and FLiPPER (fatty acids)), a positive (Decis Protech, (deltamethrin)) and a negative control (water) were applied within a randomized replicated small-plot experimental design. Treatments were applied within 24 hours of pheromone traps reaching threshold captures for BLM (10 individuals). All products, except for AHDB9950, were re-applied 7 days later. Efficacy of products was determined by the amount of foliar damage and larvae on leaf shoots for BLM and the number of eggs and larvae in artificial cane splits for RCM at different periods of time after product application.

Results

Raspberry cane midge

Raspberry cane midge emergence was uncharacteristically early and numbers were high. Trial products did not arrive until after the monitoring trap threshold had been exceeded (due to delivery delays because of Covid-19 and lockdown). This likely resulted in no significant difference between products tested due to high population pressure. However, there were indications that when applied at the correct timing some treatments might be effective.

Blackberry leaf curling midge

Treatments were applied to target blackberry leaf curling midge within 24 hours of trap captures reaching the monitoring trap threshold. AHDB9950 significantly reduced damage to young leaves and larvae in shoots after one application, with the effect lasting up to 20 days post application. For larval counts, numbers were significantly lower on plants treated with AHDB9950 than all other treatments, including the positive control which is the current industry standard, deltamethrin. AHDB9971 significantly reduced damage to young leaves after two sprays. Although there was a reduction in

number of larvae with this product this was not significantly different from the untreated control.
There was no significant difference between the untreated control and FLiPPER in damage to young leaves and larval counts although there was a slight reduction in both. AHDB9835 gave no control of BLM and led to higher counts of larvae than the untreated control and significantly higher counts than all other treatments.

Take home messages:

- AHDB9950 gave good crop protection and resulted in significant reduction in BLM damage (6-fold reduction compared to the untreated control) and larvae (50-fold reduction compared to the untreated control) after one application up to 20 days post treatment.
- AHDB9971 reduced BLM damage to young leaves (3.5-fold reduction compared to the untreated control).
- FLiPPER showed some reduction in BLM damage to young leaves but this was not statistically significant (1.5-fold reduction compared to the untreated control).
- FLiPPER and AHDB9971 could be incorporated into a spray programme, when applied between more effective products.
- AHDB9835 provided no control of BLM with treated plots having significantly higher larval counts than all other treatments, apart from the untreated control.
- For RCM eggs and larvae the products tested showed a similar trend to the results for the BLM. However, the results were not found to be statistically significant. This may have been due to uncharacteristically high population pressure prior to application of products. Further testing should be considered.

Science section

Objectives

The aim of this study was to evaluate the efficacy of promising products identified in SP 38 Control of raspberry cane midge and blackberry leaf midge (review by Charles Whitfield, NIAB EMR).

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**
PP1/152(4)	Design and analysis of efficacy evaluation trials	None
PP1/181(4)	Conduct and reporting of efficacy evaluation trials including good experimental practice	None
PP1/239(2)	Dose expression for plant protection products (PPPs)	None
PP1/135(4)	Phytotoxicity assessment	None
PP1/224(2)	Minimum effective dose	None

Test site

Item	**Details**
Location address	WB Chambers, Boarden Farm, Headcorn, Tonbridge TN12 0EB
Crop	Raspberry, flora cane
Cultivar	Kweli
Soil or substrate type	Coir
Agronomic practice	Conventional
Prior history of site	Raspberry

Trial design

Item	Details
Trial design:	Randomized block
Number of replicates:	5 (42 plots in total)
Row spacing:	7 m between treated rows
Plot size: (w x l)	7.2 x 7 m
Plot size: (m^2)	50.4 m
Number of plants per plot:	42 plants in total per plot. Canes from the central 10 pots assessed.
Leaf Wall Area calculations	Not measured

See appendix for bird's eye view of plot

Treatment details

AHDB Code	Active substance (AI)	Product name/ manufacturers code	Batch number	Content of AI in product	Formulation type	Adjuvant
	fatty acids C7-C20	FLiPPER Bayer MAPP 19154	X163A	479.8 g/L	Emulsion in water	Transact (0.1 L in 100 L)
AHDB9971	N/D	N/D	N/D	N/D	N/D	NA
AHDB9835	N/D	N/D	N/D	N/D	N/D	NA
AHDB9950	N/D	N/D	N/D	N/D	N/D	NA
	Deltamethrin	Decis Protech MAPP 16160	EM4L027188	15 g/L	Emulsion in water	NA
N/A	Untreated	NA	NA	NA	NA	NA

***Products used are not currently approved for the use on raspberry.**

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	FLiPPER	766 g/ha	16 L/ha	A,B
2	AHDB9971	303 g/ha	1.4 L/ha	A,B
3	AHDB9835	75 g/ha	0.75 L/ha	A,B
4	AHDB9950	75 g/ha	0.5 L/ha	A
5	Decis Protech	12.5 g/ha	0.83 L/ha	A,B
6	Untreated	NA	NA	NA

Application details

Treatments were delivered to NIAB EMR on 17 April 2020. Treatments were applied on 21st April 2020, with plots allocated to treatments in a randomized block design (see appendix Figure A2 and Table A1). Four of the five treatments were re-applied on 28 April 2020.

	Application A	**Application B**
Application date	21 April 2020	28 April 2020
Time of day	7:00	8:35
Crop growth stage	Tight flower buds	Buds separating and turning down
Crop height (cm)	1.8	1.8
Crop coverage (%)	Not measured	Not measured
Application Method	Spray	Spray
Application Placement	Foliar	Foliar
Application equipment	Electric Birchmeier +Birchmeier Blower	Electric Birchmeier +Birchmeier Blower
Nozzle pressure	3 bar	3 bar
Nozzle type	Albuz ATR Brown	Albuz ATR Brown
Nozzle size	0,67l/min at 10,0 bar	0,67l/min at 10,0 bar
Application water volume/ha	500	500
Temperature of air - shade (°C)	9.5°C	9°C
Wind speed range (km/h)	1.5	1.7
Dew presence (Y/N)	Y	N
Temperature of soil - 2-5 cm (°C)	Not measured	Not measured
Wetness of soil - 2-5 cm	Not measured	Not measured
Cloud cover (%)	20%	0%

Assessment details

On 9 March 2020, 3 pheromone traps were deployed for blackberry leaf midge (BLM) and 3 for raspberry cane midge (RCM). At this time, raspberry canes were devoid of foliage and cut to three canes per pot. Two monitoring traps for each species were deployed in the centre of the crop and one at the edge. Monitoring traps were checked three times each week (Monday, Wednesday and Friday) for the presence of the targeted species (Figure 1a and 1b). Traps were monitored with the aim of detecting a threshold level of 10 individuals per trap per week. RCM numbers reached the threshold level on 13 April 2020 and BLM on 20 April 2020. Products to be tested were delivered on 17 April 2020 and so could not be applied within 48 hours of reaching RCM threshold. The first spray was applied on 21 April 2020 followed by the second spray on 28 April 2020 (Figure 2). By the time of the first spray application, the majority of canes had new shoot growth. Assessments for BLM were carried out 3, 10 and 20 days after the first spray. The first two assessments consisted of counts of BLM larvae within 50 randomly selected new shoot tips per plot. For the final assessment, full shoots were collected consisting of young (<2 weeks old) and old (>2 weeks old) leaves (see appendix Figure A1). The number of leaves that displayed damage (characteristic twisting and distortion of the veins (appendix Figure A1, a-d) in each shoot tip were counted. The number of larvae within both old and young leaves were assessed and counts pooled.

For RCM, artificial splits were made in raspberry canes on 27 April. Splits were made 24 hours prior to the 2nd spray treatment application. Splits were made by inserting a mounted needle beneath the outer layer of cane and scoring a ~10 cm line at the base of young raspberry spawn. Splits were marked with coloured tape so they could be distinguished from natural splits. Assessments were made 10 days after splits were made (9 days after spray application). The length of each split was measured and the number of eggs/larvae per cm calculated. Figure 2 displays trap catches throughout the field trial, and shows when spray applications and assessments were done.

Figure 1a. RCM in sticky glue in monitoring trap. Species are identified by wing venation and shape of antennal segments.

Figure 1b. BLM in sticky glue in monitoring trap. Species are identified by wing venation and shape of antennal segments.

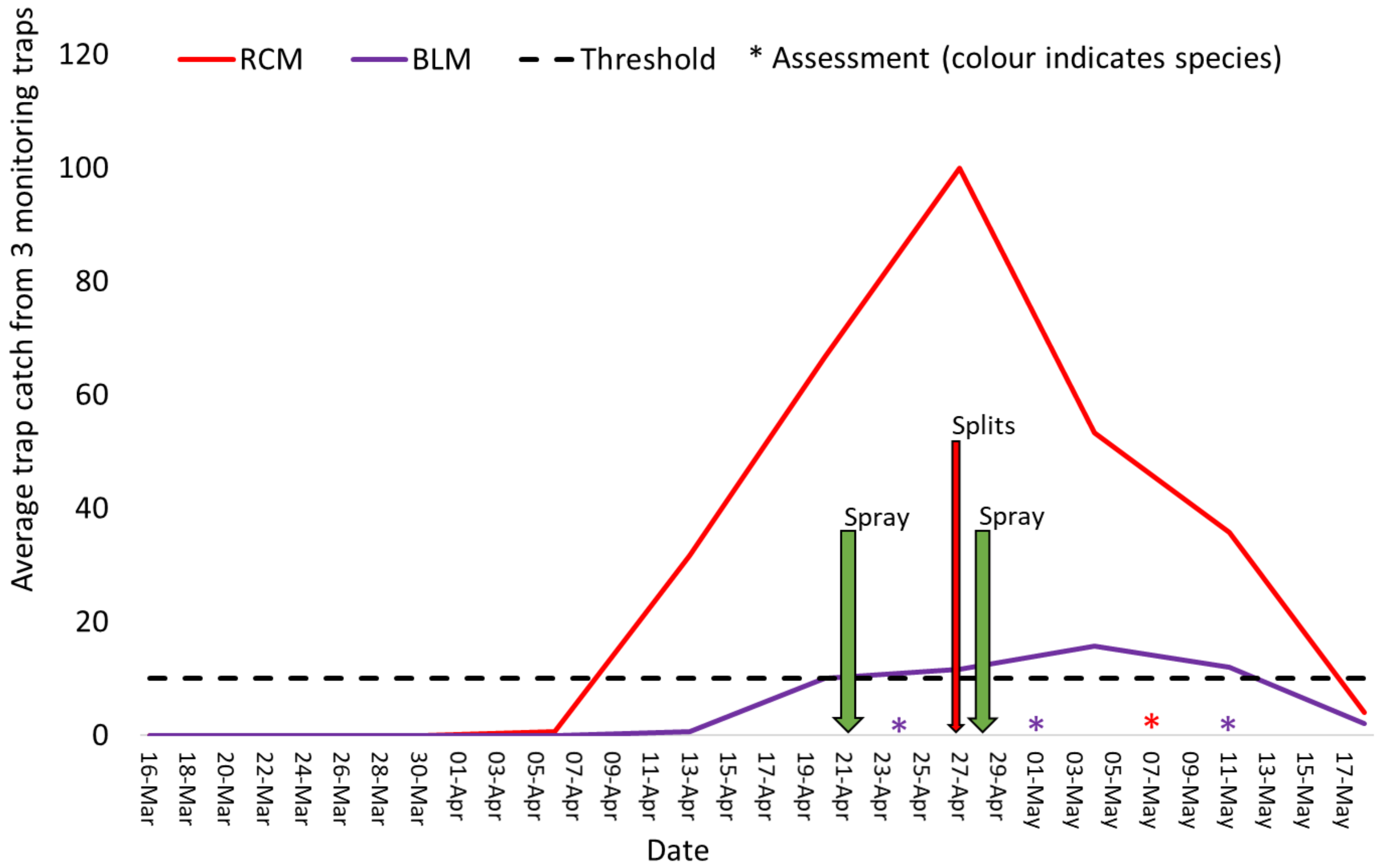

Figure 2. Phenology of adult male blackberry leaf midge (BLM) and raspberry cane midge (RCM) illustrated by captures in species-specific sex pheromone traps, timing of spray applications (green arrows), cane splitting (red arrow) and assessment dates (purple asterisk for BLM and red for RCM). Purple line indicates average number of BLM captured by 3 monitoring traps. Red line indicates average number of RCM captured by 3 monitoring traps. Dashed line is the threshold for treatment application (10 or more midges per trap)

	Evaluation Timing (DA)*			
Evaluation date	**After conventional insecticides**	**After Bio-insecticides**	**Evaluation type (efficacy, phytotox)**	**Assessment number and description**
24 April 20	3	3	Efficacy and phytotox	1: leaf sample collection for counting of larvae to assess blackberry leaf midge
1 May 20	10**	10	Efficacy and phytotox	2: leaf sample collection for counting of larvae to assess blackberry leaf midge
11 May 20	20**	20	Efficacy and phytotox	3: leaf sample collection to assess amount of damage to leaves and counting of larvae of blackberry leaf midge
7 May 20	9***	9	Efficacy	1: cane sample collection, counting of eggs and larvae to assess raspberry cane midge

* DA – days after application

** Note that evaluation timings (DA) are given relative to the first application of treatments on 24 April for BLM. Four of the five treatments were re-applied on 28 April (7 days after the first application) so the 2nd and 3rd assessments (at 10 and 20 DA) were also 3 and 13 DA relative to the second application.

*** Note that for RCM, cane splits were made 24 hours prior to the 2nd spray of treatment application in which AHDB9950 was not applied.

Statistical analysis

Count data were analysed with the R statistics package. There was no effect of 'Block' on the counts of measured variables, so 'block' was not included in the models. For the BLM where count data contained a large number of zeros, a zero-inflated Poisson model was used to test the significance of the treatments, followed by an ANOVA to analyse the deviance. If the analysis showed that the treatment factor significantly affected the counts, post-hoc analyses were done using Tukey pairwise comparisons.

For RCM, there was a block effect. Block was included in the model as a random effect. The data were analysed by Generalised Linear Mixed-Effect Model (GLMM) with a negative binomial distribution and tested for goodness of fit. There was no significant effect of treatment on either the eggs/cm or the larvae/cm, so no post-hoc analysis was done.

Results

Blackberry leaf midge (BLM)

The first two assessments yielded no larvae and so were not included in the statistical analysis. For the third assessment, there were no significant differences between the treatments for damage to old shoots (Figure 3).

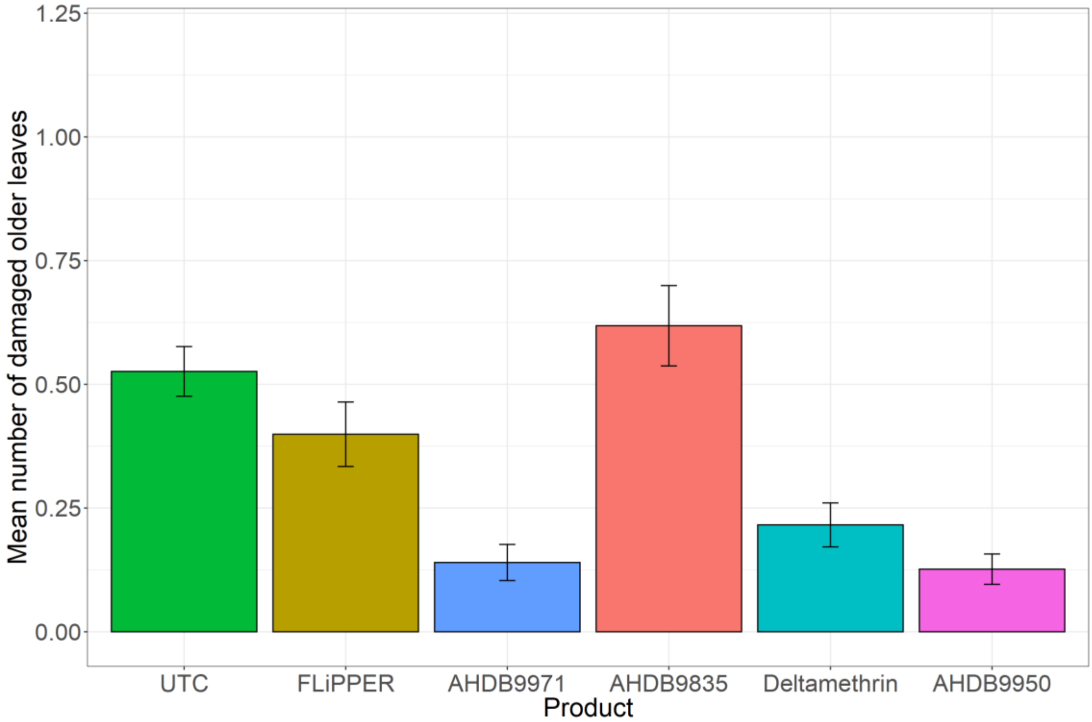

Figure 3. Mean number of old raspberry leaves displaying blackberry leaf midge damage per 50 raspberry shoots. UTC- untreated control. Assessments made 20 and 13 days post 1st and 2nd spray applications respectively.

There were significant differences between treatments in the mean number of young leaves that displayed damage (Table 1 and Figure 4). Plants treated with AHDB9835 had significantly higher levels of damage to young leaves than plants exposed to all other treatments, apart from the untreated control (UTC). Shoots treated with AHDB9971, AHDB9950 and deltamethrin all had significantly lower levels of damage than those in the UTC. There was no difference between the UTC and FLiPPER in the numbers of damaged leaves per young shoot.

Table 1. Mean number of young leaves displaying blackberry leaf midge damage.

Treatment	N	Mean damage count	Standard deviation	Standard error of mean	Confidence interval
UTC	460	0.43	1.12	0.05	0.10
FLiPPER	233	0.28	0.90	0.06	0.12
AHDB9971	250	0.12	0.56	0.04	0.07
AHDB9835	228	0.59	1.32	0.09	0.17
Deltamethrin	250	0.16	0.55	0.03	0.07
AHDB9950	245	0.07	0.37	0.02	0.05

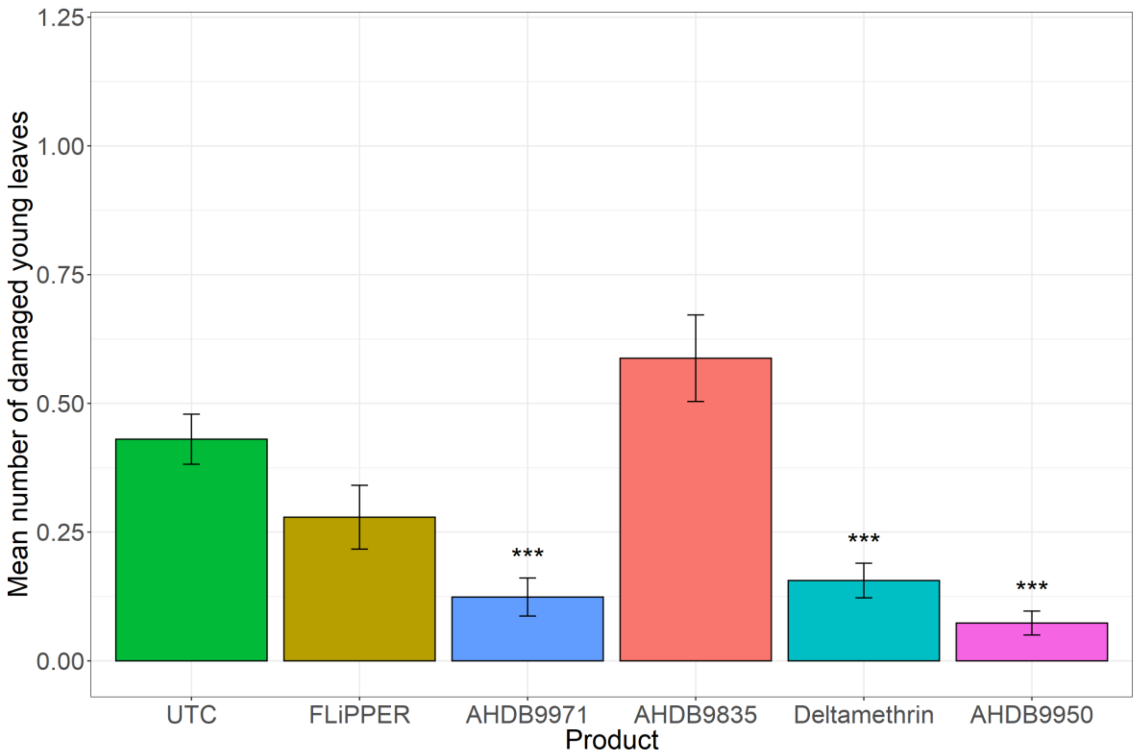

Figure 4. Mean number of young raspberry leaves displaying blackberry leaf midge damage per 50 raspberry shoots. UTC- untreated control. * indicates treatments that are significantly different to the control. Assessment made 20 and 13 days post 1st and 2nd spray application.

Larval counts in shoots reflected the level of damage to young leaves for most treatments (Table 2 and Figure 5). Plants treated with AHDB9835 had significantly higher larval counts than all treatments apart from the UTC. There was no significant difference between UTC and FLiPPER and AHDB9971 in the number of larvae counted within the shoots. Deltamethrin and AHDB9950 had significantly fewer larvae in the shoots than the UTC.

Table 2. Mean numbers of blackberry leaf midge larvae per 50 raspberry shoots.

Treatment	N	Mean damage count	Standard deviation	Standard error of mean	Confidence interval
UTC	460	0.53	1.57	0.07	0.14
FLiPPER	233	0.39	1.69	0.11	0.22
AHDB9971	250	0.30	1.75	0.11	0.22
AHDB9835	228	0.95	3.06	0.20	0.40
Deltamethrin	250	0.20	1.38	0.09	0.17
AHDB9950	245	0.01	0.13	0.01	0.02

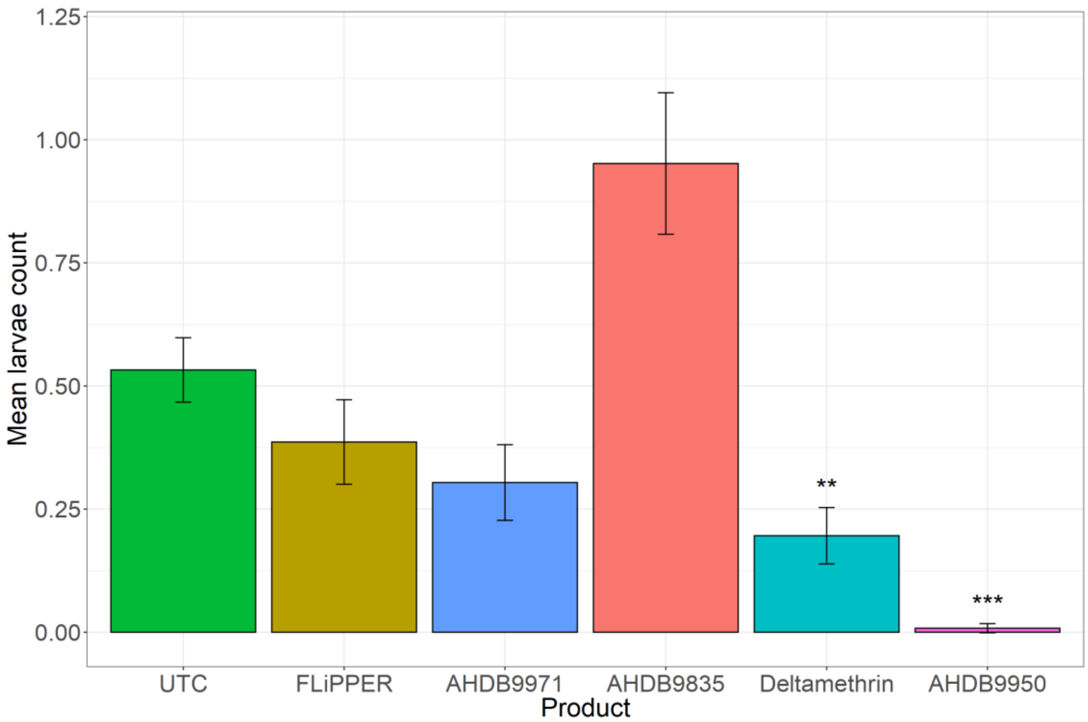

Figure 5. Mean number of blackberry leaf midge larvae per 50 raspberry shoots. UTC- untreated control. * indicates treatments that are significantly different to the control. Assessment made 20 and 13 days post 1st and 2nd spray application.

Raspberry cane midge

There was no significant effect of any of the treatments on either the number of RCM eggs or larvae per cm of cane split (Figure 6a and 6b). However, the UTC had the highest counts of both larvae and eggs.

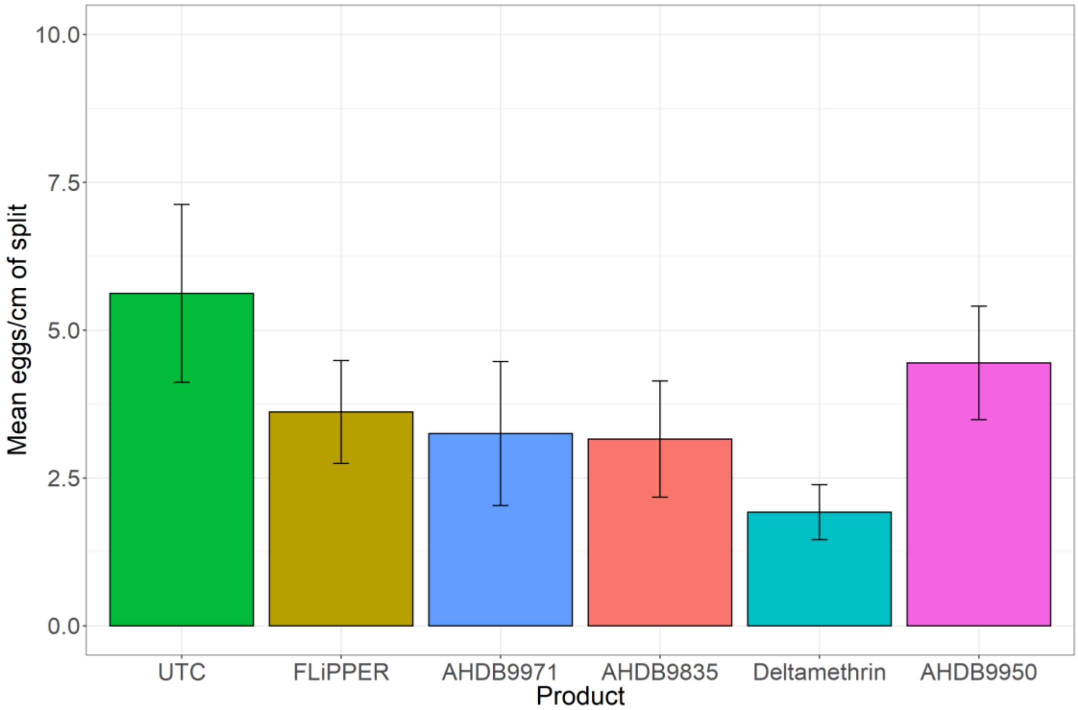

Figure 6a. Mean number of raspberry cane midge eggs per cm of cane split.

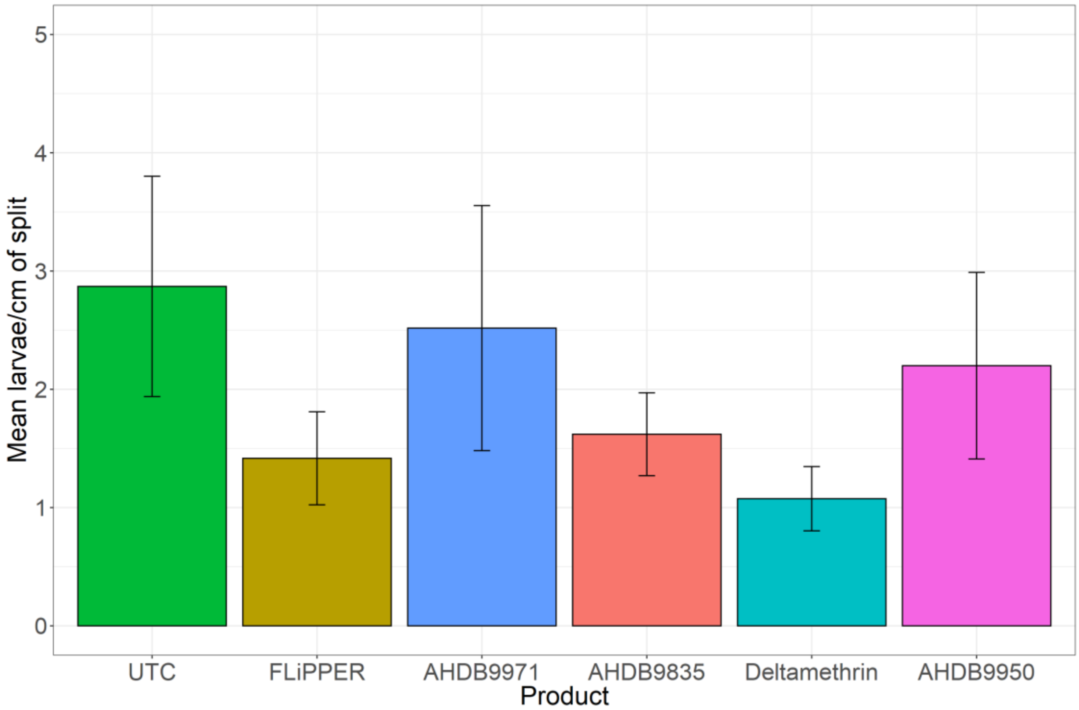

Figure 6b. Mean number of raspberry cane midge larvae per cm of cane split.

Discussion

Treatments were applied within 24 hours of monitoring trap catches reaching the threshold level for BLM (10 midges per trap per week). There was some damage to older leaves although minimal, confirming the effectiveness of using pheromone monitoring traps and a trap threshold to time spray application. If the monitoring traps had been ineffective at detecting the pest presence, we would have expected to find more damage to the older leaves. The traps were checked three times per week to ensure timely application of treatments once the first generation of adult midges emerged. No visual damage or larvae were detected during the first two assessments and damage was only detected during the final assessment, 20 days after the first spray application. This indicates that growers and agronomists cannot rely on visual detection of larvae in leaves to make spray application decisions but that pheromone monitoring traps are a reliable indicator of pest presence. This is further supported by the results from the RCM trap catches and assessments as products were not applied within 24 hours of reaching trap threshold and by the time treatments were applied, pest pressure was so high we were not able to gain control. For RCM no significant differences were identified between treatments and the UTC, either for the egg counts or the larval counts. Unfortunately due to uncharacteristically early emergence and the delay in the products arriving (delays caused by Covid-19), the spray applications for RCM were later than the pheromone trap threshold indicated they should be. The trap threshold was reached on 13 April when trap catches increased from an average of 1 midge per trap per week on 6 April to 32 midges on 13 April. At the point of the first spray application RCM catches were an average of 67 midges per trap per week, and 100 midges per trap per week when splits were made. Although the treatments were applied when the pest population was well above the threshold, several of the treatments did result in large reductions in eggs and larvae (e.g. deltamethrin reduced eggs and larvae by >60%, and cyantraniliprole and FLiPPER reduced larvae by 45% and 52% respectively). However, the variation in the data was high and therefore no statistically significant differences between treatments were identified (Figure 2). It is likely that repeating the trial with treatments being applied at the optimum time will improve the effects of the treatments on the pests. Hence, it would be advisable to repeat this trial, ensuring the products were applied at the threshold of 10 midges per trap.

There was no difference between the treatments in the amount of BLM damage found on older leaves in shoot tips at the final assessment. In younger leaves, BLM damage was significantly lower in plots treated with AHDB9971, AHDB9950 and deltamethrin but larval counts were only significantly reduced in plots treated with deltamethrin and AHDB9950 in comparison to the control (Figure 2). AHDB9950 is not currently registered for use in UK raspberry crops however it has been shown to provide effective control of midges in raspberry outside of the UK. In 2019, an extension of authorization for minor use (EAMU) for AHDB9950 was granted for the control of blackcurrant midge (*Dasineura tetensi*) in blueberry, blackcurrant, whitecurrant, redcurrant and gooseberry indicating the likelihood of registration in raspberry and other soft fruit. The use of AHDB9950 in other berry crops is restricted to 1 application per year which is why within this SCEPTRE trial it was applied only once. In addition, there is a one-year harvest interval (HI) on the EAMU for this product on soft-fruit so

currently it would not be a viable option for growers. The UK label recommendations for AHDB9950 use on approved vegetables stipulate that the HI is between 3-21 days. If approval on raspberry or other soft fruit is granted it is possible that the HI would be reduced in line with vegetables. The reason for the extended HI on fruits relates to concerns over the application of AHDB9950 to flowering crops and risks to pollinators. If the product is targeting the first generation of midges in raspberry it would be applied 4 weeks before flowering, thus reducing the risk to pollinators.
In the EU, approval for deltamethrin expires on 31/10/2019; It was used as the positive control in these trials. It is promising to see that AHDB9950, after only one application, reduced the number of BLM larvae significantly in comparison to deltamethrin of which two applications were made.

AHDB9971 is a neem extract which has been shown to significantly reduce the number of RCM larvae (67-82% reduction compared to control) in raspberry splits in field trials in Bulgaria (Mohamedova, 2017). In this field trial it significantly reduced the amount of BLM damage to young leaves, and although there was a reduction in larval counts in comparison to UTC, it was not significant. The active ingredient looks promising as a control for midge species in raspberry and further investigation should be considered.

There was no significant reduction in damage to young leaves or larval counts in the FLiPPER treated plots. This is a contact-acting product generally applied to target pests upon the crop. It degrades rapidly once applied and has no residual activity (as stated by Bayer).

For young leaf damage and larval counts on plants treated with AHDB9835 there was no significant difference from the untreated control. AHDB9835 is an oil formulation applied to target ‘chewing and sucking pests’ and is one of the most effective products against spotted wing drosophila, SWD. Currently this is not approved for use on raspberry but is approved on strawberry, with a maximum of two applications per crop per season. Even if it had been effective against BLM, growers would be more likely to reserve these applications to target SWD which causes direct crop loss. AHDB9835 has systemic activity and was expected to be effective at controlling BLM and RCM as adults but also as larvae feeding on new leaf shoots. It is effective at controlling other midge species attacking bush fruit. It is not clear why it failed to control BLM or RCM in these trials. We would recommend that this product is re-tested against both pest species to confirm inactivity.

Conclusions

More work is essential to confirm effective products for RCM control. Future work should focus on applying the most effective products as part of a spray programme for both pests against multiple generations. This would devise a strategy that growers could use successfully to control both RCM and BLM in raspberry and provide valuable information for management of other midge species in other crops, e.g. blackcurrant and blueberry.
AHDB9950 gave good control of BLM for up to 20 days after only one application.

AHDB9971 significantly reduced damage to young leaves, and a similar trend was seen in damage to older leaves and larval counts.
Whilst FLiPPER did not significantly reduce BLM counts or damage, the results indicate there may be some reductions in BLM damage and larval counts compared to the UTC. There is potential to incorporate AHDB9971 and FLiPPER as part of a progamme to suppress BLM and to mitigate insecticide resistance.

Acknowledgements
WB Chambers, Salih Hodzov was instrumental in enabling this trial and worked with us to change his normal practice so that the products could be tested. We appreciate the in kind support from the following companies: Bayer Crop Science, Certis, and FMC who provided products to be tested within this project. Thank you to the trials team for the spray applications and the technical staff at NIAB EMR for the support with the assessments.

References
Mohamedova M., 2017 - Field evalutation of three biopesticides for control of the raspberry cane midge, *Resseliella theobaldi* (Barnes) in Bulgaria. – Advances in Horticultural Science, 31(3): 183-189.

Appendix

a. Trial diary – events related to trail in the field

Date	Event
09/03/2020	Began Midge trial. Set-up completed at Boarden Farm: • 6 red delta traps hanging 1 foot off of the ground (attached to irrigation piping) • 6 white and lined sticky traps: ○ 3 with Blackberry leaf curling midge (BLM/BLCM) attractant, ○ 3 with Raspberry cane midge (RCM) attractant. • Yellow hazard tape surrounding trial area Sticky traps are being checked a minimum of three times a week with images taken as record – images are within the Photo folder. Sticky traps are being changed a minimum of once a week to maintain optimum vigilance on possible midge occurrence, and prevent capture over-crowding.
12/03/2020	Sticky bases checked and photos taken. No change required. No BLM or RCM seen.
16/03/2020	Sticky bases checked and photos taken. Changed over sticky bases for new ones, used ones are wrapped in cling film and taken to NIAB for closer inspection. No BLM or RCM seen.
18/03/2020	Sticky bases checked. No change required. No BLM or RCM seen.
20/03/2020	Sticky bases checked and photos taken. No change required. No BLM seen. Possible RCM seen (photo evidence).
23/03/2020	Sticky bases checked and photos taken. Changed over sticky bases for new ones, used ones are wrapped in cling film and taken to NIAB for closer inspection. No BLM or RCM seen.
25/03/2020	Sticky bases checked and photos taken. No change required. No BLM or RCM seen.
27/03/2020	Sticky bases checked and photos taken. No change required. No BLM or RCM seen. Found sticky trap RCM 1 and BLM 1 blown onto the floor due to high winds. Will ensure for the next time the trap is fully secure.
30/03/2020	Sticky bases checked and photos taken. Changed over sticky bases for new ones, used ones are wrapped in cling film and taken to NIAB for closer inspection. No BLM or RCM seen. Seen species of the family.
01/04/2020	Sticky bases checked and photos taken. No change required. New field site signs deployed. Plots marked out with coloured tape for treatments for spray trial.
03/04/2020	Sticky bases checked and photos taken. No change required. No BLM or RCM seen.
06/04/2020	Sticky bases checked and photos taken. Changed over sticky bases for new ones, used ones are wrapped in cling film and taken to NIAB for closer inspection. No BLM seen. Seen 2 positive IDs of RCM species.

	Reported RCM positive ID to the farm - nets will be set-up in the next few days. Plastic tunnel covers are up; ends of tunnels have remained open.
06/04/2020	Discussion with NIAB Trials team around label requirements for FLiPPER. FLiPPER should be applied with water >300 TDS. Options are use deionised water or a water conditioner. Water conditioner is more applicable to commercial farms. Trials team will use Mix Mate or X-Change water conditioners for applying FLiPPER only.
08/04/20	Traps checked and pot marked with treatment colour tape. Only the central 10 pots have been marked. These are the plants that will be sampled during the assessments although all pots in the plot will be treated.
10/04/20	Traps checked. Now over threshold for RCM. 50, 30 and 15 individuals in the traps. So far, still no BLCM. Bases were not changed today as new lures and bases will be put in the traps on Monday 13th.
13/04/20	Sticky bases checked and photos taken. Changed over sticky bases AND lures for new ones, used ones are wrapped in cling film and taken to NIAB for closer inspection. Still over threshold for RCM Seen 2 positive IDs of BLM species.
15/04/20	Sticky bases checked and photos taken. No change required. 0 BLM and 12 RCM seen. *Observation: Likely no BLM due to past few nights of frost and mild winter causing irregular emergence.*
17/04/20	Sticky bases checked and photos taken. No change required for BLM bases, but all RCM bases were changed due to capture coverage. 3 BLM and 204 RCM seen. Nets are up on all ends of tunnels.
20/04/20	Traps for both species are now at threshold.
21/04/20	1st spray applied – assessments for BLCM will be taken of Friday.
24/04/20	1st assessment- No midges found in any of the plots. 50 leaves sampled from all control plots and then 10 leaves from all treatments
27/04/20	10 x Cane splits made in all plots; except Control (green-yellow)for RCM
28/04/20	2nd spay applied
01/05/20	2nd assessment of BLM Leaf samples collected from all plots and analysed in lab. For the controls 50 leaves were checked. Due to very low larvae numbers only 10 leaves were sampled in the treated plots. See data sheets
04/05/20	Traps checked. Sticky bases changed. Both sp still over threshold. RCM still >50 midge per trap. BLCM between 10-20
07/05/20	1st assessment of RCM- canes cut from the crop to be assessed within the lab. Canes cut above and below the 10cm scoring line. Excess foliage removed.
11/05/20	3rd assessment of BLM samples. Whole shoots tips collected (old and young leaves). All 50 leave checked in all samples.
18/05/20	Monitoring traps removed from field site and trial dismantled.

b. Trial photos

Figure A1. Characteristic twisting of leaves on two left hand shoots compared to untwisted leaves on right.

Figure A1a and b. Examples of vein distortion on older leaves


Figure A1c and d. Examples of vein distortion on younger leaves

c. Raw data

Will be attached as a separate Excel document due to size.

d. Trial design

The tests were done on a commercial raspberry crop grown in coir under poly-tunnels. The trial layout is shown below. Each plot consisted of 14 raspberry plants (cv. Kweli) within the central row of the tunnel (Figure A2). Although all 14 plants were sprayed only the central 10 plants were sampled within the assessments. A randomised block design with 5 replicates of 7 treatments was used (Figure A3, Table A1).

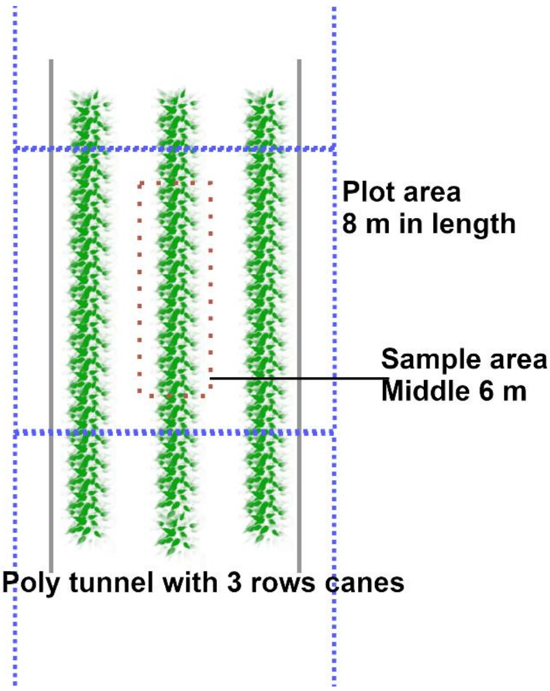

Figure A2. Visualization of tunnel from above.

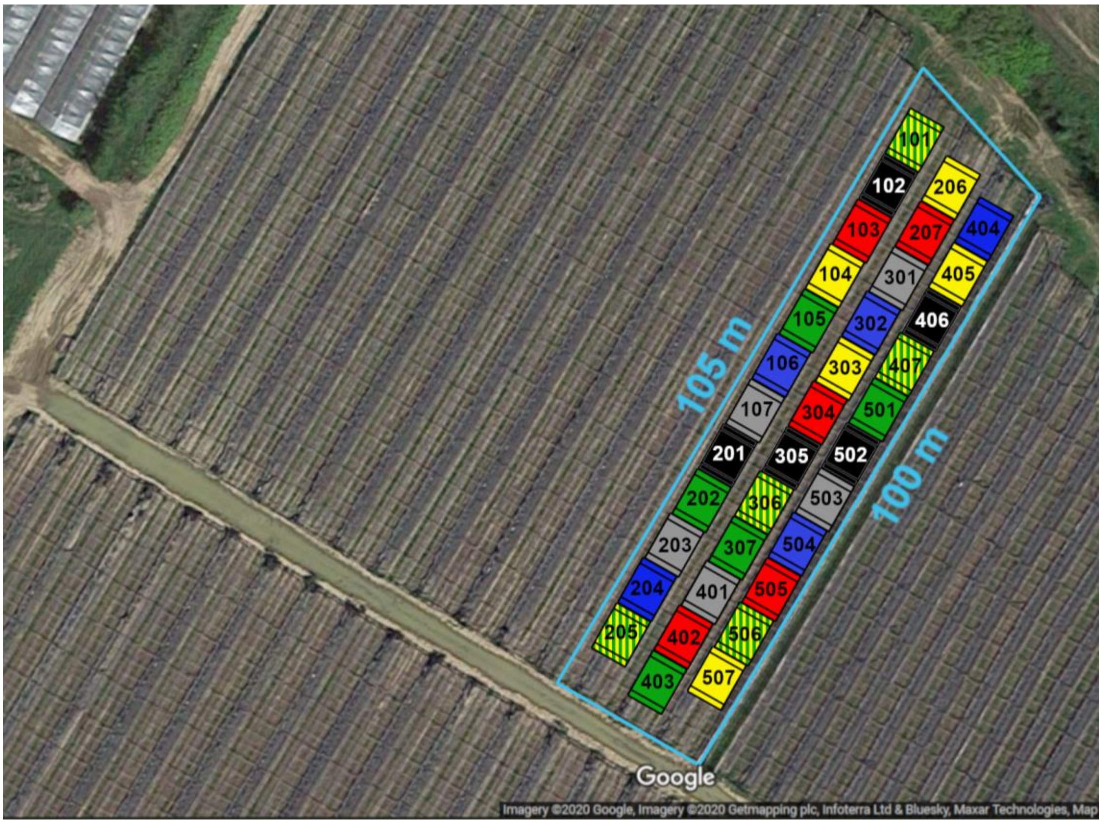

Figure A3. Randomised block design of crop. Colour relates to treatment (see table A1)

Treatments were evaluated in comparison with an untreated control. The randomisation of treatments to plots is given in Table A1 below.

Table A1. Randomisation of treatments with colour codes relating to map of plot design. Note that two untreated control treatments were included in the design which would have been used in a following assessment. GY UTC was not assessed within this trial.

Block 1			Block 2			Block 3			Block 4			Block 5		
Plot	Col	Trt	Plot	Col	Trt	Plot	Col	Trt	Plot	Col	Trt	Plot	Col	Trt
101	GY	UTC2	201	Blk	FLiPPER	301	GR	Decis Protech	401	GR	Decis Protech	501	G	UTC1
102	Blk	FLiPPER	202	G	UTC1	302	B	AHDB9835	402	R	AHDB9971	502	Blk	FLiPPER
103	R	AHDB9971	203	GR	Decis Protech	303	Y	AHDB9950	403	G	UTC1	503	GR	Decis Protech
104	Y	AHDB9950	204	B	AHDB9835	304	R	AHDB9971	404	B	AHDB9835	504	B	AHDB9835
105	G	UTC1	205	GY	UTC2	305	Blk	FLiPPER	405	Y	AHDB9950	505	R	AHDB9971
106	B	AHDB9835	206	Y	AHDB9950	306	GY	UTC2	406	Blk	FLiPPER	506	GY	UTC2
107	GR	Decis Protech	207	R	AHDB9971	307	G	UTC1	407	GY	UTC2	507	Y	AHDB9950

e. ORETO certificate

Certificate of

Official Recognition of Efficacy Testing Facilities or Organisations in the United Kingdom

This certifies that

NIAB EMR

complies with the minimum standards laid down in Regulation (EC) 1107/2009 for efficacy testing.

The above Facility/Organisation has been officially recognised as being competent to carry out efficacy trials/tests in the United Kingdom in the following categories:

Agriculture/Horticulture
Biologicals and Semiochemicals
Stored Crops

Date of issue:	**12 July 2018**
Effective date:	**1 January 2018**
Expiry date:	**31 December 2022**

Signature W. McLeur

Authorised signatory

Certification Number
ORETO 411

HSE
Chemicals Regulation Division

Department of
Agriculture and Rural Development