SCEPTREPLUS

Final Trial Report

Trial code:	SP09.2018 (W2018.557)
Title:	Control of *Tuta absoluta* on tomatoes with novel insecticide sprays
Crop	Group: Protected crops - tomatoes
Target	*Tuta absoluta* - GNORAB
Lead researcher:	Professor Rosemary Collier
Organisation:	University of Warwick, School of Life Sciences, Wellesbourne, Warwick CV35 9EF
Period:	July 2018 – July 2019
Report date:	19/7/19
Report author:	Andrew Jukes and Rosemary Collier
ORETO Number: (certificate should be attached)	381

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.

Rosemary Collier

19 July 2019

…… ……

Date Authors signature

Trial Summary

Introduction

Currently most UK grown tomatoes are protected from damage due to caterpillars of *Tuta absoluta* by the use of a mating disruption pheromone. However, this treatment can be ineffective under certain circumstances, in which case a "knock down" insecticide treatment is required. The timing of this treatment is likely to be after feeding panes are observed (i.e. after the caterpillars have entered the leaf). Standard insecticidal treatments (spinosad and rynaxypyr) are becoming increasingly ineffective due to insect resistance. The aim of these trials/tests was to evaluate some novel insecticide/bio-insecticide treatments for control of *T. absoluta*.

Methods

Greenhouse Trial

Initially tomato seed (cv Dometica F1) was sown into rockwool cells on 22 March 2018. After germination the cubes were placed on rock wool blocks (100 x 15 x 7 cm) to give a between-plant spacing of 30 cm (3 plants per block). Irrigation was supplied through a drip feed attached to each plant. Nutrient feed was supplied 3 times per week. Due to various delays. including a temporary crash in the numbers of laboratory-reared *T. absoluta,* the plants had become too large by the time the trial was ready to start. Further plants were grown from cuttings inserted into rockwool cells on 17 and 25 July 2018.

A culture of *T. absoluta* was maintained in the Insect Rearing Unit at Warwick Crop Centre. Adult moths were allowed to lay eggs on tomato leaves which were removed and stored at 15^{o}C on a daily basis. Eggs hatch in about 7 days so collection was restricted to 5 days. Eggs were removed from leaves with a dampened paint brush and counted on to black filter paper squares (20 eggs/square). Plants were inoculated with 1 filter paper square by attaching it to the underside of a leaf with a paper clip. Initially 3 plants per plot were inoculated on 14 September. The remaining 3 plants were inoculated 2 weeks after treatment on 12 October. The second inoculation focused on 3 treatments – untreated, AHDB9968 and AHDB9949.

Spray treatments were applied in 1000l/ha water using a knapsack sprayer with the boom held vertically. The drip treatment was applied into the hole left when removing the drip irrigation spike using a laboratory pipette in 10 ml. Treatments were applied on 26 September (12 days after inoculation with eggs) when the first mines were observed in the leaves.

Visual assessments of phytotoxicity were made 7 days after treatment. Caterpillar numbers and damage were assessed 7 days after treatment on 3 October and 17 days after post-spray inoculation on 29 October.

Laboratory tests

Test 1 - Detached tomato leaves were dipped in the test solutions (approved/advised per ha rate in 1000l per ha) and inoculated immediately (after allowing the leaves to dry) with 1-day-old *T. absoluta* eggs. The leaf stems were kept immersed in water to keep them alive and the eggs were allowed to hatch and develop. The numbers of surviving larvae and the leaf damage was assessed 13 days after inoculation.

Test 2 - Detached tomato leaves were inoculated with 2-day-old *T. absoluta* eggs. The leaf stems were kept immersed in water to keep them alive and the eggs were allowed to hatch and develop for 7 days (by which time the larvae were embedded within the leaves). The leaves were removed from the water, dipped (as with Test 1) and returned to the water. The numbers of surviving larvae and the leaf damage was assessed 13 days after treatment.

Results

Greenhouse trial

The results from the first assessment were not clear-cut but indicated that the sprays of AHDB9968 and AHDB9949 might be more effective than the other treatments. The second inoculation focused on 3 treatments – untreated, AHDB9968 and AHDB9949. This indicated that AHDB9949 was the most effective treatment and there was some activity from AHDB9968.

		Mean number of feeding panes		Mean number of live insects	
	Treatment	First assessment	Second assessment	First assessment	Second assessment
1	Control	2.78	20.83	4.11	6.75
2	Conserve [1]	4.92		5.08	
3	AHDB9971 [2*]	3.08		4.75	
4	AHDB9971 [1*]	3.08		4.75	
5	AHDB9968 [1*]	3.25	16.00	2.92	2.83
6	AHDB9948 [1]	4.33		3.75	
7	AHDB9951 [1]	4.50		4.17	
8	AHDB9949 [1]	2.25	4.33	2.25	0.50
	F	3.42	10.06	0.91	10.89
	p	0.01	0.01	0.52	<0.001
	df	30	11	30	11
	SED	0.71	3.78	1.44	1.35
	LSD (5%) (two-sided)	1.47	8.56	2.99	3.06
	LSD (5%) (one-sided)	1.22	6.93	2.48	2.48

[1] Spray; [2] Drip; *bio-insecticide

Laboratory tests

Laboratory Test 1

AHDB9971, AHDB9968, AHDB9948 and AHDB9949 reduced the numbers of feeding panes and healthy larvae compared with the untreated control. AHDB9949 was the most effective treatment. Conserve was ineffective.

		Feeding panes	Healthy larvae
	Treatments	**Mean number**	**Mean number**
1	Control	39.0	8.5
2	Conserve	31.8	6.0
4	AHDB9971	23.5	2.0
5	AHDB9968	15.5	2.8
6	AHDB9948	11.8	2.8
7	AHDB9951	21.3	6.0
8	AHDB9949	1.3	0.0
	F	13.08	15.1
	p	<0.001	<0.001
	df	27	26
	SED	4.921	1.218
	LSD (5%) (two-sided)	10.233	2.541
	LSD (5%) (one-sided)	8.467	2.101

Laboratory Test 2

All treatments reduced the number of healthy larvae compared with the untreated control. AHDB9971, AHDB9968, AHDB9948, AHDB9949 and Conserve reduced the numbers of feeding panes and AHDB9971, AHDB9968, AHDB9948 and AHDB9949 reduced the percentage leaflets damaged compared with the untreated control (Table 4). Overall, AHDB9971, AHDB9968 AHDB9948 and AHDB9949 were the most, and similarly, effective treatments.

		Leaves with feeding panes	Healthy larvae	Percent leaflets with feeding panes	
	Treatments	**Mean number**	**Mean number**	**Ang**	**Back-trans**
1	Untreated	36.2	2.4	82.1	98.1
2	Conserve	23.6	1.2	70.2	88.5
4	AHDB9971	9.4	0	36.3	35.0
5	AHDB9968	8.6	0	35.1	33.1
6	AHDB9948	13	0.6	41.4	43.8
7	AHDB9951	25.4	1.6	74.5	92.8
8	AHDB9949	8.2	0	36.8	35.9
	F	5.24	6.08	10.61	
	p	<0.001	<0.001	<0.001	
	d.f.	34	34	34	
	SED	6.67	0.54	9.02	
	LSD (5%) (two-sided)	13.67	1.11	18.49	
	LSD (5%) (one-sided)	11.35	0.92	15.35	

Conclusions

The results of the first assessment from the greenhouse trial were not clear-cut but indicated that AHDB9949 (conventional insecticide) and AHDB9968 (bio-insecticide) applied as sprays had some activity against *T. absoluta* larvae feeding within tomato foliage, although the drip treatment with AHDB9971 did not. The second assessment confirmed that both AHDB9949 and AHDB9968 were relatively persistent (active 2+ weeks after application) and effective against newly-hatched larvae that subsequently burrowed into the foliage.

The laboratory tests where the foliage was dipped in solutions of the different products showed that several of the treatments (conventional and bio-insecticides) provided control against newly-hatched larvae that subsequently burrowed into the foliage (first test). The second test where treatments were applied after the larvae had burrowed into the foliage showed that all of the treatments reduced the number of healthy larvae compared with the untreated control and that AHDB9971, AHDB9968, AHDB9948 and AHDB9949 were the most, and similarly, effective treatments.

In terms of effects on larvae feeding inside the foliage, the results of the greenhouse trial and Laboratory Test 2 are not entirely consistent, in that more of the products appeared to be effective in the dip test than in the greenhouse trial.

As expected, and probably due to insecticide resistance in the population of *T. absoluta* tested, Conserve (spinosad) was ineffective.

Take home message:

Conserve did not provide effective control of *T. absoluta,* probably due to insecticide resistance in the population of *T. absoluta* tested. At present there is no approved insecticide to reliably control infestations of *T. absoluta* when needed as a back-up treatment.

Objectives

1. To evaluate novel insecticides and bioinsecticides as foliar sprays or drip irrigation treatments for the control of *T. absoluta* on tomatoes
2. To monitor the treated crop for phytotoxicity

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**
PP 1/152 (3)	Design and analysis of efficacy evaluation trials	None
PP 1/135 (3)	Phytotoxicity assessment	None
PP 1/181 (3)	Conduct and reporting of efficacy evaluation trials including GEP	None
PP 1/275 (1)	Tuta absoluta	Plot size 6 plants instead of 10, inoculated not natural infestation

Test site

Item	**Details**
Location address	University of Warwick Wellesbourne Campus Wellesbourne Warwick CV35 9EF
Crop	Tomato
Cultivar	Dometica F1
Soil or substrate type	Rockwool
Agronomic practice	See Appendix A
Prior history of site	n/a

Trial design

Item	**Details**
Trial design:	(4 x 4)/2 Trojan square
Number of replicates:	4
Row spacing:	50 cm
Plot size: (w x l)	0.5 x 1m
Plot size: (m^2)	0.5
Number of plants per plot:	6
Leaf Wall Area calculations	

Treatment details

AHDB Code	Active substance	Product name/ manufacturers code	Formulation batch number	Content of active substance in product	Formulation type	Adjuvant
Untreated						
Authorized	Spinosad	Conserve	F055H73037	120 g/l	SC	None
AHDB9971	N/A	N/A	N/A	N/A	N/A	None
AHDB9968	N/A	N/A	N/A	N/A	N/A	None
AHDB9948	N/A	N/A	N/A	N/A	N/A	None
AHDB9951	N/A	N/A	N/A	N/A	N/A	None
AHDB9949	N/A	N/A	N/A	N/A	N/A	None

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	Control			
2	Conserve	96 g	0.8 l	B
3	AHDB9971	36.4 g	1.4 l	A
4	AHDB9971	36.4 g	1.4 l	B
5	AHDB9968	30 g	3 l	B
6	AHDB9948	75 g	0.75 l	B
7	AHDB9951	150 g	0.75 l	B
8	AHDB9949	20 g	2.105 kg	B

Application details

	Application A	Application B
Application date	26/9/18	26/9/18
Time of day	11.00	13.00
Crop growth stage (Max, min average BBCH)	703	703
Crop height (cm)	100	100
Crop coverage (%)	N/A	N/A
Application Method	Irrigation drip	Spray
Application Placement	Rockwool block	Foliar
Application equipment	Pipette	Berthoud Vermorel 2000HP
Nozzle pressure	N/A	2 bar
Nozzle type	N/A	05F110
Nozzle size	N/A	05
Application water volume/ha	10 ml/block	1000
Temperature of air - shade (°C)	19	19
Relative humidity (%)	N/A	N/A
Wind speed range (m/s)	N/A	N/A
Dew presence (Y/N)	N/A	N/A
Temperature of soil - 2-5 cm (°C)	N/A	N/A
Wetness of soil - 2-5 cm	N/A	N/A
Cloud cover (%)	N/A	N/A

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
N/A	*T. absoluta*	GNORAB	20 eggs/plant	3 caterpillars/plant on untreated plants	

Method

Greenhouse Trial

Plant production and inoculation

Initially tomato seed (cv Dometica F1) was sown into rockwool cells on 22 March 2018. After germination the cubes were placed on rock wool blocks (100 x 15 x 7 cm) to give a between-plant spacing of 30 cm (3 plants per block). Irrigation was supplied through a drip feed attached to each plant. Nutrient feed was supplied 3 times per week. Due to various delays including a temporary crash in the numbers of laboratory reared *T. absoluta* the plants had become too large by the time the trial was ready to start. Further plants were grown from cuttings inserted into rockwool cells on 17 and 25 July 2018.

Insect production

A culture of *T. absoluta* provided by Rob Jacobson was maintained in the Insect Rearing Unit at Warwick Crop Centre. Adult moths were allowed to lay eggs on tomato leaves which were removed and stored at 15^{o}C on a daily basis. Eggs hatch in about 7 days so collection was restricted to 5 days. Eggs were removed from leaves with a dampened paint brush and counted on to black filter paper squares (20 eggs/square). Plants were inoculated with 1 filter paper square by attaching to the underside of a leaf with a paper clip. Initially 3 plants per plot were inoculated on 14 September 2018. The remaining 3 plants were inoculated 2 weeks after treatment on 12 October. The second inoculation focused on 3 treatments – untreated, AHDB9968 and AHDB9949.

Treatments

Spray treatments were applied in 1000l/ha water using a knapsack sprayer with the boom held vertically. The drip treatment was applied into the hole left when removing the drip irrigation spike using a laboratory pipette in 10 ml. Treatments were applied on 26 September (12 days after inoculation with eggs) when the first mines were observed in the leaves.

Assessments

Visual assessments of phytotoxicity were made 7 days after treatment. Caterpillar numbers and damage were assessed 7 days after treatment on 3 October and 17 days after post spray inoculation on 29 October.

Laboratory tests

Test 1

Detached tomato leaves were dipped in the test solutions (approved/advised per ha rate in 1000l per ha) and inoculated immediately (after allowing the leaves to dry) with 1-day-old *T. absoluta* eggs. The leaf stems were kept immersed in water to keep them alive and the eggs were allowed to hatch and develop. The numbers of surviving larvae and the leaf damage was assessed 13 days after inoculation.

Test 2

Detached tomato leaves were inoculated with 2-day-old *T. absoluta* eggs. The leaf stems were kept immersed in water to keep them alive and the eggs were allowed to hatch and develop for 7 days (by which time the larvae were embedded within the leaves). The leaves were removed from the water, dipped (as with Test 1) and returned to the water. The numbers of surviving larvae and the leaf damage was assessed 13 days after treatment.

Assessment details

Glasshouse trial

Evaluation date	Evaluation Timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotox)	Assessment
3/10/18	7	703	Phytotoxicity	Leaf damage
3/10/18	7	703	Efficacy	Larvae/pupae numbers and leaf damage
29/10/18	33	704	Efficacy	Larvae/pupae numbers and leaf damage

* DA – days after application

Laboratory tests

Evaluation date	Evaluation Timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotox)	Assessment
10/12/18 (Test 1)	13	na	Efficacy	Larvae/pupae numbers and leaf damage
27/2/19 (Test 2)	13	na	Efficacy	Larvae/pupae numbers and leaf damage

* DA – days after application

Statistical analysis

The data were analysed by ANOVA using the Excel data package.

Results

Phytotoxicity

No phytotoxic effects were observed with any treatment

Survival of *T. absoluta*

Greenhouse trial

The results from the first assessment were not clear-cut but indicated that the sprays of AHDB9968 and AHDB9949 might be more effective than the other treatments (Table 1; Figures 1 and 2).

Table 1. Greenhouse trial – first assessment.

	Greenhouse Trial 1st assessment	Leaves with feeding panes	Total feeding panes	Healthy larvae	Healthy pupae	Total healthy
	Treatments	**Mean number**				
1	Untreated	2.78	14.00	3.11	1.00	4.11
2	Conserve Spray	4.92	18.08	4.00	1.08	5.08
3	AHDB9971 (drip)*	3.08	14.08	3.92	0.83	4.75
4	AHDB9971 (spray)*	3.08	16.92	4.75	0.00	4.75
5	AHDB9968 (spray)*	3.25	17.25	2.92	0.00	2.92
6	AHDB9948 (spray)	4.33	18.75	3.75	0.00	3.75
7	AHDB9951 (spray)	4.50	15.67	3.67	0.50	4.17
8	AHDB9949 (spray)	2.25	12.08	1.83	0.42	2.25
	F	3.42	0.97	1.01	2.58	0.91
	p	0.01	0.47	0.45	0.04	0.52
	df	30	30	30	30	30
	SED	0.71	3.27	1.22	0.39	1.44
	LSD (5%) (two-sided)	1.47	6.76	2.53	0.81	2.99
	LSD (5%) (one-sided)	1.22	5.60	2.10	0.67	2.48

*bio-insecticide

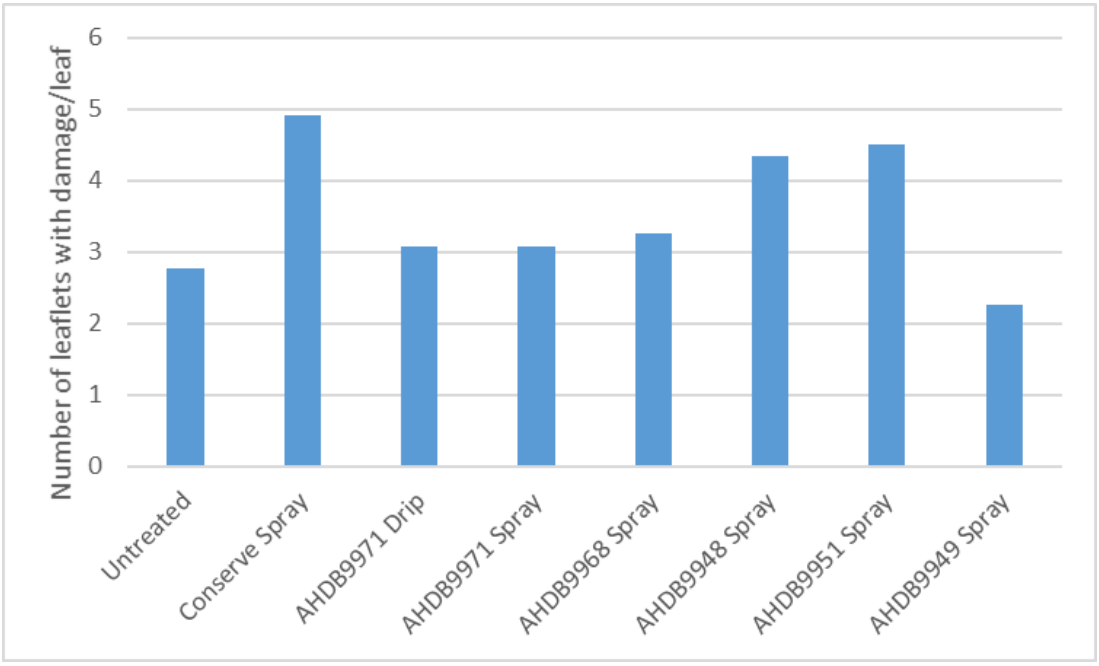

Figure 1. Greenhouse trial – first assessment - mean number of leaflets with feeding panes.

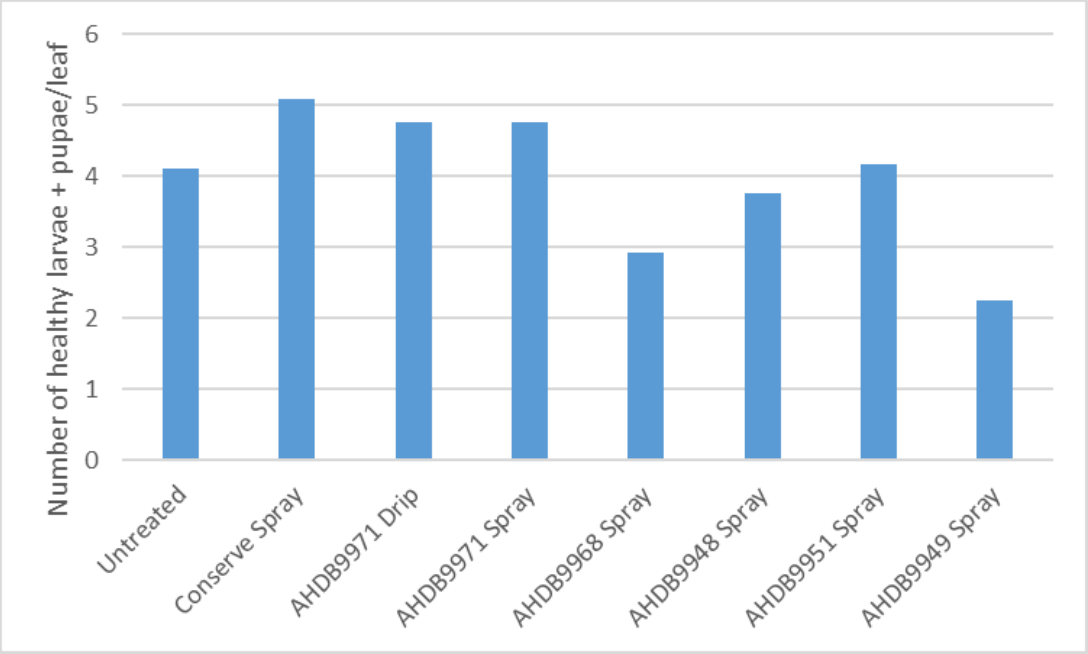

Figure 2. Greenhouse trial – first assessment - mean number of healthy larvae and pupae.

The second inoculation focused on 3 treatments – untreated, AHDB9968 and AHDB9949. This indicated that AHDB9949 was the most effective treatment and there was some activity from AHDB9968 (Table 2, Figures 3 and 4).

Table 2. Greenhouse trial – second assessment following re-infestation.

	Greenhouse Trial - assessment 2	**Leaves with feeding panes**	**Total feeding panes**	**Healthy larvae**
	Treatments	**Mean number**		
1	Untreated	3.42	20.83	6.75
4	AHDB9968*	2.92	16.00	2.83
8	AHDB9949	1.75	4.33	0.50
	F	3.28	10.06	10.89
	p	0.09	0.01	<0.001
	df	11	11	11
	SED	0.67	3.78	1.35
	LSD (5%) (two-sided)	1.51	8.56	3.06
	LSD (5%) (one-sided)	1.22	6.93	2.48

*bio-insecticide

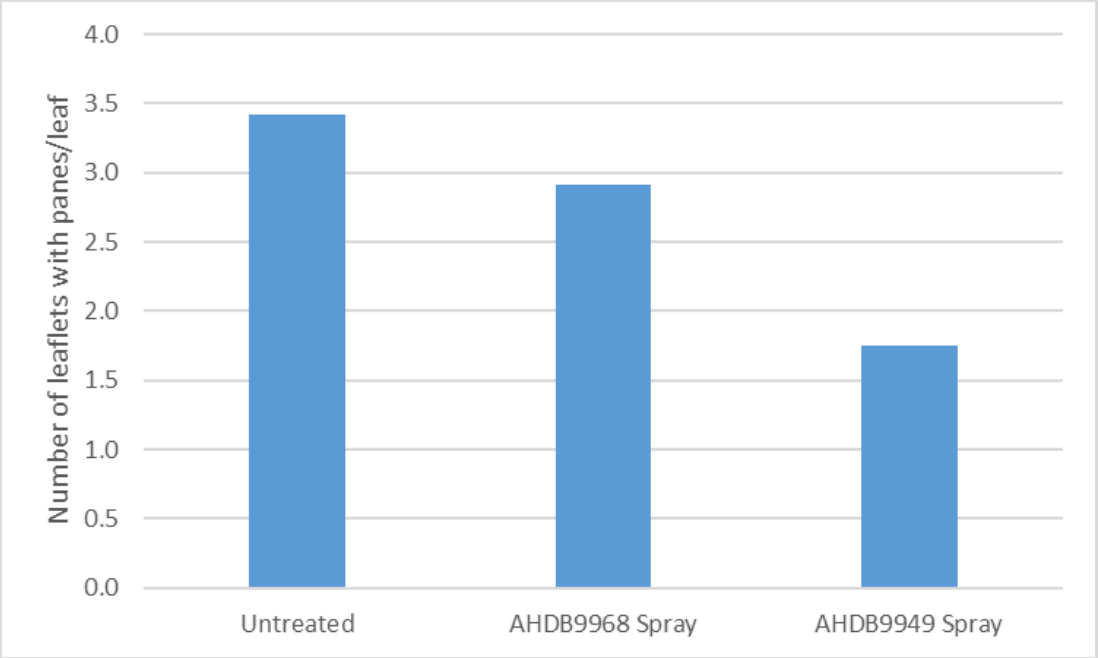

Figure 3. Greenhouse trial – second assessment - mean number of leaflets with feeding panes.

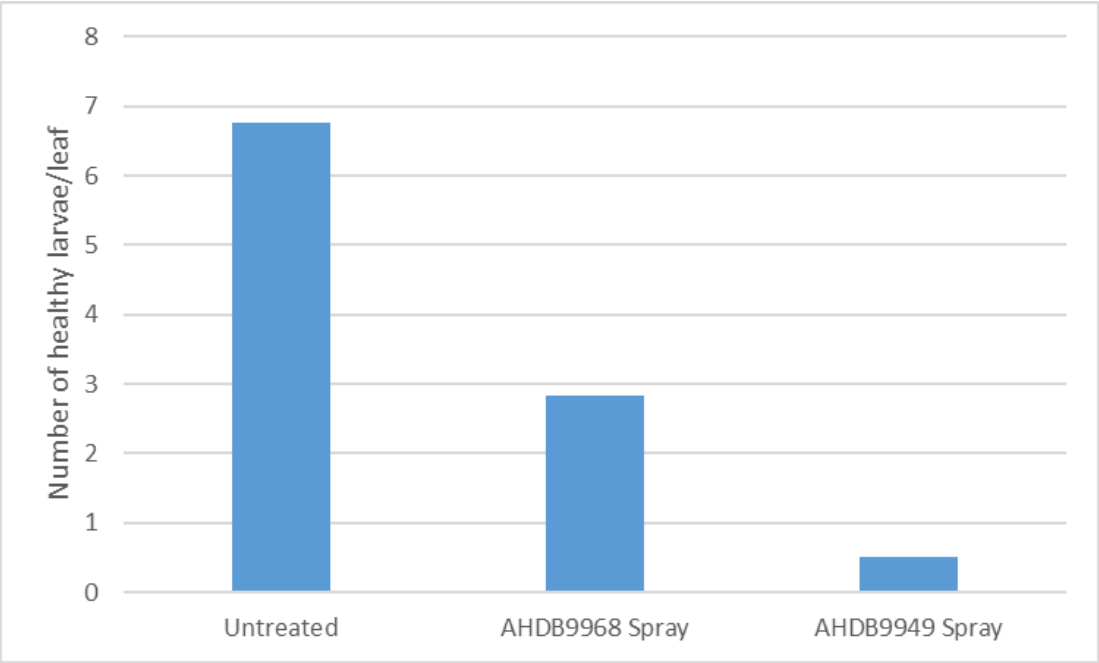

Figure 4. Greenhouse trial – second assessment - mean number of healthy larvae.

Laboratory tests

Test 1

AHDB9971, AHDB9968, AHDB9948 and AHDB9949, reduced the numbers of feeding panes and healthy larvae compared with the untreated control (Table 3, Figures 5 and 6). AHDB9949 was the most effective treatment.

Table 3. Laboratory Test 1 – assessments. Leaves were dipped in insecticide solutions and then inoculated with eggs.

		Feeding panes	Healthy larvae
	Treatments	**Mean number**	**Mean number**
1	Untreated	39.0	8.5
2	Conserve	31.8	6.0
4	AHDB9971*	23.5	2.0
5	AHDB9968*	15.5	2.8
6	AHDB9948	11.8	2.8
7	AHDB9951	21.3	6.0
8	AHDB9949	1.3	0.0
	F	13.08	15.1
	p	<0.001	<0.001
	df	27	26
	SED	4.921	1.218
	LSD (5%) (two-sided)	10.233	2.541
	LSD (5%) (one-sided)	8.467	2.101

*bio-insecticide

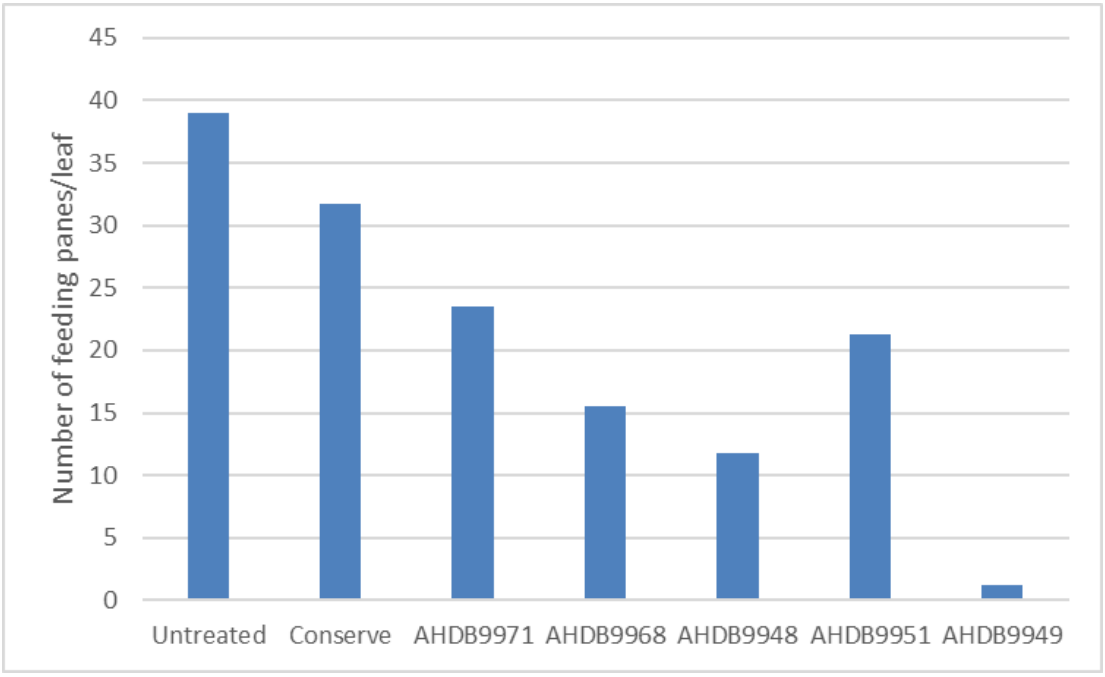

Figure 5. Laboratory Test 1 - mean number of feeding panes per leaf

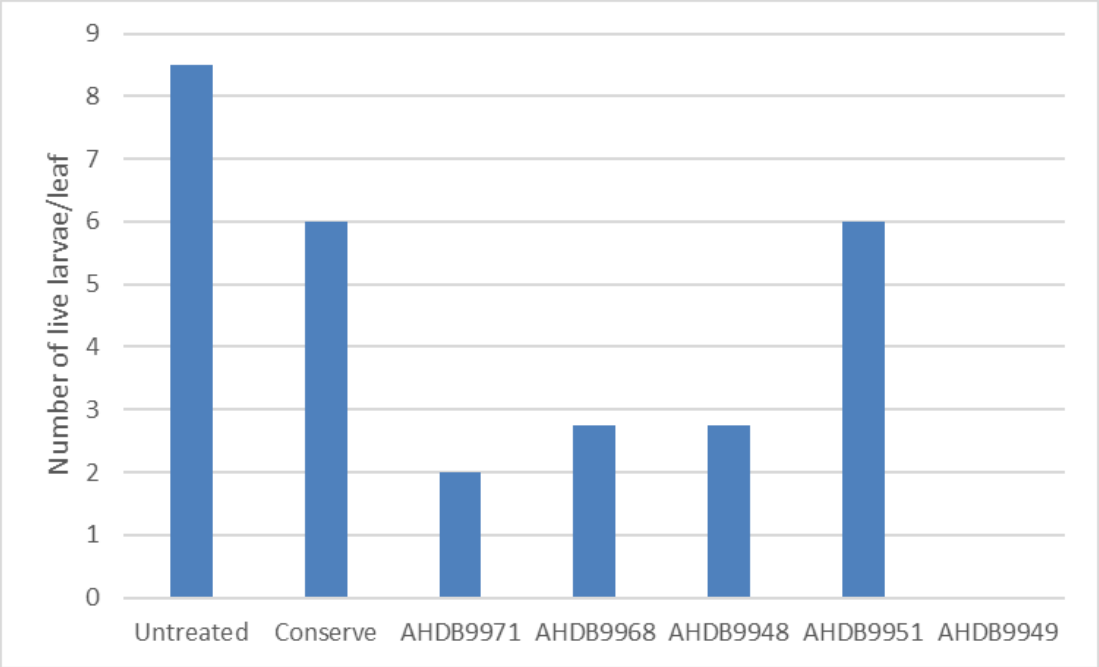

Figure 6. Laboratory Test 1 - mean number of live larvae per leaf

Test 2

All treatments reduced the number of healthy larvae compared with the untreated control. AHDB9971, AHDB9968, AHDB9948, AHDB9949 and Conserve reduced the numbers of feeding panes and AHDB9971, AHDB9968, AHDB9948 and AHDB9949 reduced the percentage leaflets damaged compared with the untreated control (Table 4). Overall, AHDB9971, AHDB9968, AHDB9948 and AHDB9949 were the most, and similarly effective, treatments.

Table 4. Laboratory Test 2 assessments. Leaves were inoculated with eggs and then dipped subsequently, so the larvae were inside the leaves when treated.

		Leaves with feeding panes	Healthy larvae	Percent leaflets with feeding panes	
	Treatments	Mean number	Mean number	Ang trans	Back-trans
1	Untreated	36.2	2.4	82.1	98.1
2	Conserve	23.6	1.2	70.2	88.5
4	AHDB9971*	9.4	0	36.3	35.0
5	AHDB9968*	8.6	0	35.1	33.1
6	AHDB9948	13	0.6	41.4	43.8
7	AHDB9951	25.4	1.6	74.5	92.8
8	AHDB9949	8.2	0	36.8	35.9
	F	5.24	6.08	10.61	
	p	<0.001	<0.001	<0.001	
	d.f.	34	34	34	
	SED	6.67	0.54	9.02	
	LSD (5%) (two-sided)	13.67	1.11	18.49	
	LSD (5%) (one-sided)	11.35	0.92	15.35	

*bio-insecticide

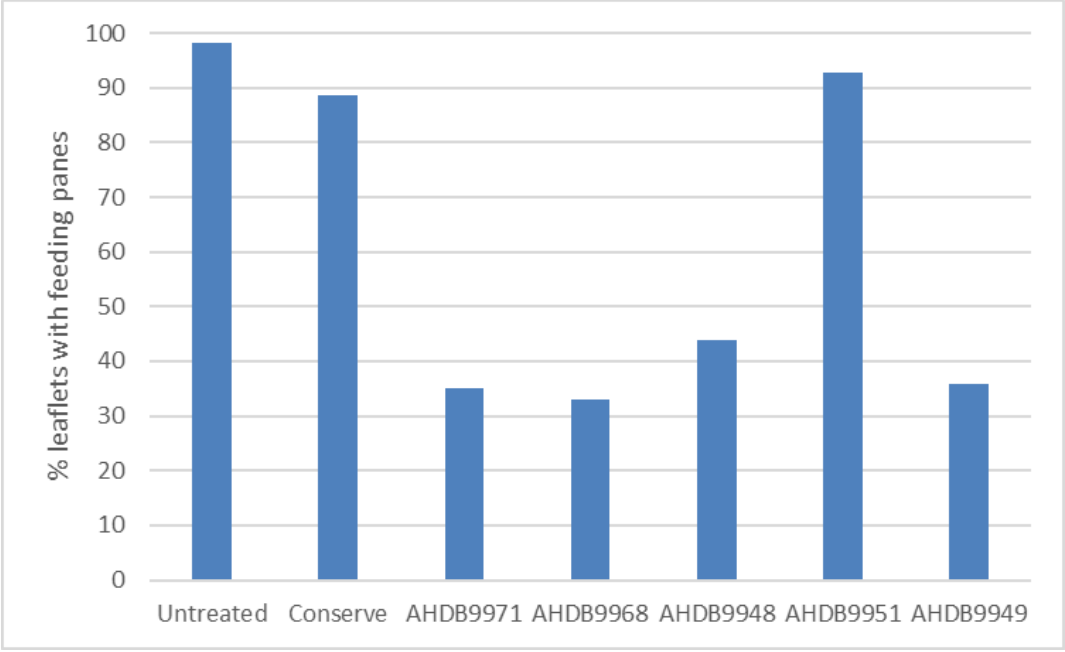

Figure 7. Laboratory Test 2 – mean percentage leaflets with feeding panes (back-transformed data).

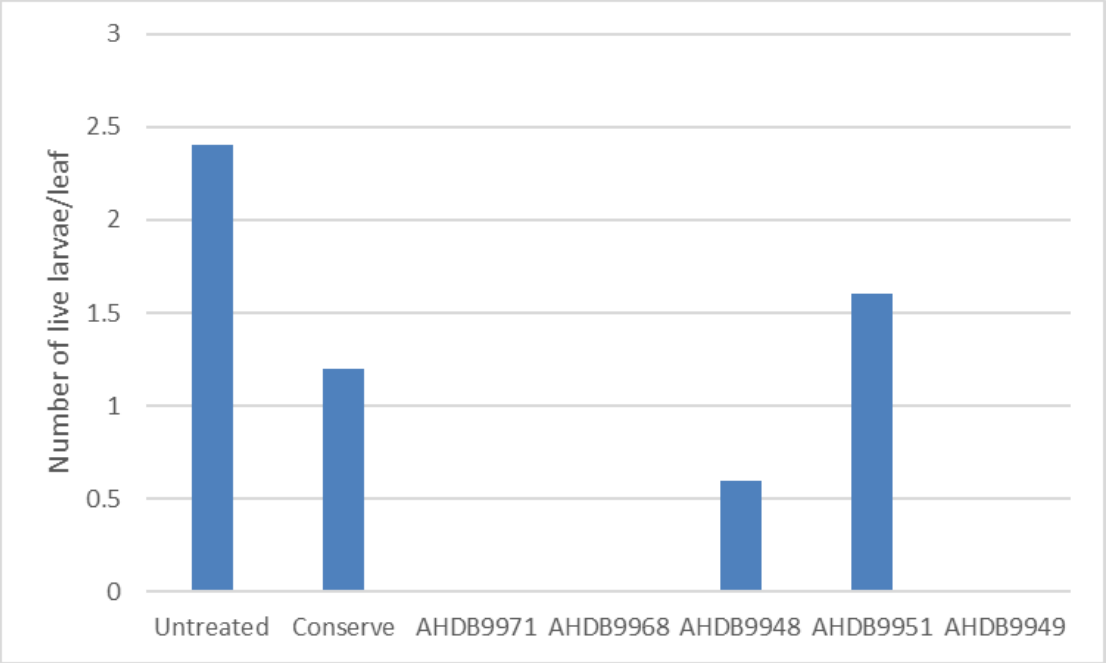

Figure 8. Laboratory Test 2 – mean number live larvae per leaf

Discussion

The structure, size and rate of growth of the tomato crop presents problems for undertaking replicated trials on a range of insecticide/bio-insecticide products. Due to financial and other constraints, experimental approaches have to be at a scale smaller than for commercial production.

Some of the products tested here have been shown to be at least partially effective. For those that may be available to growers in the short-medium term further studies are needed to confirm their activity and impact on introduced natural enemies.

Conclusions

The results of the first assessment from the greenhouse trial were not clear-cut but indicated that AHDB9949 (conventional insecticide) and AHDB9968 (bio-insecticide) applied as sprays had some activity against *T. absoluta* larvae feeding within tomato foliage, although the drip treatment with AHDB9971 did not. The second assessment confirmed that both AHDB9949 and AHDB9968 were relatively persistent (active 2+ weeks after application) and effective against newly-hatched larvae that subsequently burrowed into the foliage.

The laboratory tests where the foliage was dipped in solutions of the different products showed that several of the treatments (conventional and bio-insecticides) provided control against newly-hatched larvae that subsequently burrowed into the foliage (first test).

The second laboratory test, where treatments were applied after the larvae had burrowed into the foliage, showed that all of the treatments reduced the number of

healthy larvae compared with the untreated control and that AHDB9949, AHDB9948, AHDB9971 and AHDB9968 were the most, and similarly, effective treatments.

In terms of effects on larvae feeding inside the foliage, the results of the greenhouse trial and Laboratory Test 2 are not entirely consistent, in that more of the products appeared to be effective in the dip test than in the greenhouse trial.

As expected, and probably due to insecticide resistance in the population of *T. absoluta* tested, Conserve (spinosad) was ineffective.

Acknowledgements

We would like to thank the AHDB for funding and supporting this project and Rob Jacobson for his advice and providing the *T. absoluta* population. We are very grateful for the financial and in kind contributions from the crop protection manufactures and distributors involved with the SCEPTREplus programme as listed below:
Agrii, Alpha Biocontrol Ltd, Andermatt, Arysta Lifescience, BASF, Bayer, Belchim, Bionema Limited, Certis Europe, Dow, DuPont, Eden Research, Fargro Limited, FMC, Gowan, Interfarm, Lallemand Plant Care, Novozymes, Oro Agri, Russell IPM, Sumitomo Chemicals, Syngenta, UPL. We would also like to thank G's for providing the lettuce seed and for their technical advice.

Appendix

a. Crop diary – events related to growing crop

Crop	Cultivar	Planting/sowing date	Row width (m)
Tomato	Dometica	17/7/18	0.3

Active ingredient(s) / fertiliser(s) applied to the trial area

Date	Product	Rate	Unit
All	Solufeed	3.5	E.C.

Details of irrigation regime

Date	Type, rate and duration	Amount applied (mm)
All	As required to maintain Rockwool slabs at 70% water content	

b. Trial diary

Date	Event
17-Jul	Take side-shoots as cuttings from plants in E3 into rockwool cubes and raise in E8
07-Aug	Transfer tomatoes from rockwool cubes into rockwool blocks
15-Aug	Plant new raised tomato cuttings into existing rockwool slabs
14-Sep	3 plants/plot inoculated with 20 tuta eggs
26-Sep	Treatments applied
03-Oct	Assessment
12-Oct	3 plants/plot inoculated with 20 tuta eggs. Treatments 1,5 and 8
29-Oct	Assessment

c. Raw data from assessments

Glasshouse trial – First assessment

		Number		Number healthy		Number	
Plot	Treatment	Leaflets with panes	Total panes	Larvae	Pupae	Dead	Sick
1	5	3	21	5	0	0	0
1	5	3	10	4	0	0	0
1	5	3	12	6	0	0	0
2	3	1	7	2	0	0	0
2	3	5	13	4	0	0	0
2	3	1	8	3	0	0	0
3	2	7	23	3	4	0	0
3	2	5	13	5	1	0	0
3	2	6	22	8	2	0	0
4	8	3	17	0	0	8	0
4	8	3	20	2	0	5	0
4	8	6	19	0	0	6	0
5	1	6	19	0	1	0	0
5	1	1	5	0	0	0	0
5	1	2	17	0	1	0	0
6	7	5	24	1	0	0	0
6	7	5	17	4	1	0	0
6	7	4	10	2	0	0	0
7	6	7	20	2	0	0	0
7	6	5	23	4	0	0	0
7	6	3	13	1	0	0	0
8	4	7	26	7	0	0	0
8	4	3	24	4	0	0	0
8	4	2	15	7	0	0	0
9	1	2	10	4	1	0	0
9	1	5	21	8	1	0	0
9	1	5	11	5	3	0	0
10	8	1	8	0	0	3	0
10	8	3	14	2	0	3	0
10	8	1	7	1	0	1	0
11	5	3	13	4	0	0	0
11	5	2	9	2	0	0	0
11	5	3	11	4	0	0	0
12	4	1	14	2	0	0	0
12	4	2	10	4	0	0	0
12	4	3	14	3	0	0	0
13	6	3	15	5	0	0	0
13	6	5	38	7	0	0	0
13	6	7	22	8	0	0	0

14	3	4	16	5	0	0	0
14	3	0	0	0	0	0	0
14	3	3	13	1	1	0	0
15	7	7	34	8	1	0	0
15	7	4	14	6	0	0	0
15	7	1	3	1	0	0	0
16	2	5	18	3	1	0	0
16	2	5	19	3	1	0	0
16	2	5	15	5	0	0	0
17	2	4	18	2	3	0	0
17	2	8	25	7	0	0	0
17	2	5	25	7	0	0	0
18	6	4	9	3	0	0	0
18	6	6	28	5	0	0	0
18	6	2	4	1	0	0	0
19	7	1	4	0	1	0	0
19	7	7	20	7	2	0	0
19	7	9	24	5	0	0	0
20	3	6	23	7	1	0	0
20	3	3	17	3	5	0	0
20	3	1	5	2	0	0	0
21	4	3	18	7	0	0	0
21	4	3	17	5	0	0	0
21	4	4	25	4	0	0	0
22	8	1	10	3	0	0	0
22	8	3	10	3	1	1	0
22	8	2	11	3	0	1	0
23	5	5	24	4	0	1	0
23	5	1	19	3	0	0	0
23	5	5	29	3	0	0	0
24	1	4	17	1	3	0	0
24	1	3	15	4	0	0	0
24	1	2	22	1	0	0	0
25	7	7	17	7	0	0	0
25	7	3	14	1	1	0	0
25	7	1	7	2	0	0	0
26	4	1	10	3	0	0	0
26	4	6	16	4	0	0	0
26	4	2	14	7	0	0	0
27	1	1	7	2	0	0	0
27	1	2	17	2	1	0	0
27	1	1	6	1	0	0	0
28	6	2	15	1	0	0	0
28	6	2	20	6	0	0	0
28	6	6	18	2	0	0	0

29	5	4	20	0	0	0	4
29	5	6	27	0	0	0	6
29	5	1	12	0	0	0	1
30	2	3	10	1	1	0	0
30	2	1	8	2	0	0	0
30	2	5	21	2	0	0	0
31	8	1	9	3	1	5	0
31	8	1	3	0	0	0	0
31	8	2	17	5	3	0	0
32	3	7	27	12	0	0	0
32	3	3	21	4	1	0	0
32	3	3	19	4	2	0	0

Glasshouse trial – Second assessment

			Number		
Plot	Treatment	Plant	Leaflets with panes	Total panes	Healthy larvae
1	5	1	2	25	5
1	5	2	2	14	4
1	5	3	7	36	4
4	8	1	1	4	1
4	8	2	1	2	0
4	8	3	4	13	2
5	1	1	2	20	8
5	1	2	4	17	6
5	1	3	2	24	5
9	1	1	2	21	3
9	1	2	2	16	2
9	1	3	3	17	3
10	8	1	2	2	0
10	8	2	1	2	0
10	8	3	1	1	0
11	5	1	5	16	4
11	5	2	3	21	3
11	5	3	4	8	1
22	8	1	2	10	1
22	8	2	3	5	1
22	8	3	1	1	0
23	5	1	2	19	4
23	5	2	1	13	3
23	5	3	3	20	2
24	1	1	3	20	6
24	1	2	5	34	11
24	1	3	3	30	12
27	1	1	5	1	4

27	1	2	8	32	10
27	1	3	2	18	11
29	5	1	4	7	0
29	5	2	1	4	2
29	5	3	1	9	2
31	8	1	2	7	1
31	8	2	1	1	0
31	8	3	2	4	0

Laboratory Test 1

		Number		
Treatment	Replicate	Feeding panes	Live larvae	Dead larvae
AHDB9971	1	29	1	0
AHDB9971	2	36	3	2
AHDB9971	3	9	2	0
AHDB9971	4	20	2	0
AHDB9948	1	4	0	0
AHDB9948	2	20	4	1
AHDB9948	3	18	6	0
AHDB9948	4	5	1	0
AHDB9949	1	0	0	0
AHDB9949	2	3	0	1
AHDB9949	3	1	0	1
AHDB9949	4	1	0	0
AHDB9968	1	17	1	0
AHDB9968	2	17	3	0
AHDB9968	3	17	6	0
AHDB9968	4	11	1	0
AHDB9951	1	17	6	0
AHDB9951	2	31		0
AHDB9951	3	14	6	0
AHDB9951	4	23	6	0
Conserve	1	23	6	0
Conserve	2	32	7	0
Conserve	3	36	6	0
Conserve	4	36	5	0
Untreated	1	43	9	0
Untreated	2	34	9	0
Untreated	3	44	8	0
Untreated	4	35	8	0

Laboratory Test 2

			Number	
Treatment	Replicate	Percentage damaged leaflets	Feeding panes	Live larvae
AHDB9971	1	64	10	0
AHDB9971	2	43	17	0
AHDB9971	3	18	7	0
AHDB9971	4	25	6	0
AHDB9971	5	29	7	0
AHDB9948	1	44	4	0
AHDB9948	2	82	22	2
AHDB9948	3	36	24	1
AHDB9948	4	33	10	0
AHDB9948	5	22	5	0
AHDB9949	1	36	11	0
AHDB9949	2	44	10	0
AHDB9949	3	44	10	0
AHDB9949	4	33	5	0
AHDB9949	5	22	5	0
AHDB9968	1	45	13	0
AHDB9968	2	44	8	0
AHDB9968	3	33	8	0
AHDB9968	4	22	7	0
AHDB9968	5	22	7	0
AHDB9951	1	100	22	2
AHDB9951	2	67	29	3
AHDB9951	3	55	30	0
AHDB9951	4	100	26	2
AHDB9951	5	100	20	1
Conserve	1	100	38	2
Conserve	2	91	23	1
Conserve	3	100	45	3
Conserve	4	71	5	0
Conserve	5	43	7	0
Untreated	1	100	45	3
Untreated	2	100	58	2
Untreated	3	91	42	4
Untreated	4	86	16	1
Untreated	5	100	20	2

Trial number	W2018.557
Sponsor	SceptrePlus
Crop	Tomato
Location	GH E3

5	3	2	8	1	7	6	4
1	2	3	4	5	6	7	8
1	8	5	4	6	3	7	2
9	10	11	12	13	14	15	16
2	6	7	3	4	8	5	1
17	18	19	20	21	22	23	24
7	4	1	6	5	2	8	3
25	26	27	28	29	30	31	32

Certificate of

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

This certifies that

Warwick Crop Centre, School of Life Sciences

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

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Authorised signatory

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HSE
Chemicals Regulation Division

Department of
Agriculture and
Rural Development