

SCEPTREPLUS

Final Trial Report

Trial code:	SP55 - W2019.012
Title:	Evaluating efficacy and persistence of "Phytodrip" treatments for the control of aphids on brassicas
Crop	Group: Field vegetables - Brassicas
Target	Cabbage aphid - <i>Brevicoryne brassicae</i> – BRVCBR and Peach potato aphid - <i>Myzus persicae</i> - MYZUPE
Lead researcher:	Rosemary Collier
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Period:	August 2019 – November 2019
Report date:	31 January 2020
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.



28 January 2020

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Date

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Trial Summary

Introduction

Foliar aphids on leafy brassicas have been successfully controlled in the past with neonicotinoid seed treatments (imidacloprid and thiamethoxam) and a sowing-time “Phytodrip” treatment (thiamethoxam), but approval for all of these treatments has been revoked. A number of alternative treatments were identified as possible replacements for neonicotinoids in a trial on lettuce (SP36) and it is these treatments that were taken forward for testing in brassicas.

Methods

Cauliflower seed (cv Skywalker) was sown into 308 Hassy trays. The trial was designed for four replicates of 7 treatments and 5 aphid inoculation dates. Treatments (all conventional insecticides) were applied at sowing (“Phytodrip”), pre-planting (drench) or as a seed treatment. Plants were covered with insect-proof netting at transplanting and inoculated with laboratory-reared *Myzus persicae* and *Brevicoryne brassicae* on 5 occasions (6 – 43 days after transplanting). Aphid numbers were assessed approximately 1 week after inoculation and on one further occasion.

Results

The results for the first assessments are presented in Tables A (*Myzus persicae*) and B (*Brevicoryne brassicae*). Most untreated plants were colonized by both species. All of the analyses were significant at the 5% level using an F-test except the 5th inoculation of *Myzus persicae*.

All treatments reduced numbers of *Myzus persicae* significantly compared with the untreated control after the 1st, 2nd, 3rd and 4th inoculation and with *Brevicoryne brassicae*, all treatments reduced numbers significantly compared with the untreated control after the 1st, 2nd, 3rd, 4th and 5th inoculations with the exceptions of AHDB9943 “Phytodrip” in the 3rd and 5th inoculations and AHDB9966 and AHDB9951 seed treatment in the 5th inoculation.

Table A. Mean numbers of *Myzus persicae* on insecticide-treated cauliflower plants

Treatment	First inoculation		Second inoculation		Third inoculation		Forth inoculation		Fifth inoculation	
	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans
Control	3.45	11.92	2.76	7.61	1.76	3.11	1.34	1.80	0.65	0.43
AHDB9948 ³	0.00	0.00	0.44	0.19	0.43	0.19	0.30	0.09	0.67	0.45
AHDB9948 ¹	0.51	0.26	0.57	0.32	0.00	0.00	0.14	0.02	0.31	0.09
AHDB9943 ¹	0.27	0.08	0.28	0.08	1.00	1.00	0.51	0.26	0.35	0.12
AHDB9966 ¹	0.00	0.00	0.00	0.00	0.39	0.16	0.22	0.05	0.42	0.18
AHDB9951 ¹	0.00	0.00	0.00	0.00	0.10	0.01	0.58	0.34	0.00	0.00
AHDB9951 ²	0.20	0.04	0.11	0.01	0.68	0.47	0.22	0.05	0.38	0.14
F value	23.39		17.64		6.21		2.65		0.783	
P -value	<0.001		<0.001		<0.001		0.045		0.593	
s.e.d.	0.368		0.330		0.343		0.360		0.434	
l.s.d.	0.764		0.686		0.714		0.750		0.902	
d.f.	21		21		21		21		21	

¹ “Phytodrip” at sowing; ² Seed treatment; ³ Pre-planting drench

Table B. Mean numbers of *Brevicoryne brassicae* on insecticide-treated cauliflower plants

Treatment	First inoculation		Second inoculation		Third inoculation		Forth inoculation		Fifth inoculation	
	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans
Control	3.87	14.99	4.25	18.05	1.96	3.83	2.50	6.25	1.18	1.39
AHDB9948 ³	0.00	0.00	0.00	0.00	0.10	0.01	0.83	0.69	0.00	0.00
AHDB9948 ¹	0.31	0.09	0.35	0.13	0.39	0.15	1.03	1.05	0.18	0.03
AHDB9943 ¹	0.50	0.25	1.15	1.32	1.44	2.07	1.58	2.50	0.74	0.54
AHDB9966 ¹	0.00	0.00	0.00	0.00	0.45	0.20	1.11	1.23	1.03	1.05
AHDB9951 ¹	0.00	0.00	0.13	0.02	0.00	0.00	0.34	0.11	0.00	0.00
AHDB9951 ²	0.00	0.00	0.00	0.00	0.77	0.60	0.86	0.74	0.77	0.60
F value	22.83		17.64		5.96		6.71		2.57	
P -value	<0.001		<0.001		<0.001		<0.001		0.050	
s.e.d.	0.422		0.330		0.419		0.378		0.434	
l.s.d.	0.878		0.686		0.870		0.785		0.902	
d.f.	21		21		21		21		21	

¹ "Phytodrip" at sowing; ² Seed treatment; ³ Pre-planting drench

Conclusion

All treatments tested provided excellent control of both aphid species 6, 12 and 19 days after transplanting (with the exception of AHDB9943 "Phytodrip" at 19 days). Control began to diminish thereafter but remained significant for *Brevicoryne brassicae* up to the final assessment (43 days after transplanting) for AHDB9948 ("Phytodrip" or pre-planting drench) and AHDB9951 "Phytodrip", and for *Myzus persicae* for all treatments up to the 4th inoculation (34 days after transplanting).

Take home message:

Five sowing-time treatments have been identified as possible alternatives to neonicotinoid insecticides.

Objectives

1. To evaluate the effectiveness and persistence of conventional insecticides applied as “Phytodrip” treatments against cabbage aphid and peach potato aphid on cauliflower plants as measured by the level of infestation.
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

There were no deviations from EPPO guidance:

Test site

Item	Details
Location address	University of Warwick Wellesbourne Campus Wellesbourne Warwick CV35 9EF
Crop	Cauliflower
Cultivar	Skywalker
Soil or substrate type	Sandy loam
Agronomic practice	See Appendix A
Prior history of site	See Appendix A

Trial design

Item	Details
Trial design:	7 treatments (randomized within plots) x 5 inoculation dates
Number of replicates:	4
Row spacing:	50 cm
Plot size: (w x l)	1.83 x 6.5 m
Plot size: (m ²)	11.9
Number of plants per plot:	42 (6 per treatment)
<i>Leaf Wall Area calculations</i>	n/a

Treatment details

AHDB Code	Active substance	Product name/ manufacturer code	Formulation batch number	Content of active substance in product	Formulation type	Adjuvant
Untreated						
AHDB9948	N/D	N/D	N/D	N/D	N/D	None
AHDB9943	N/D	N/D	N/D	N/D	N/D	None
AHDB9966	N/D	N/D	N/D	N/D	N/D	None
AHDB9951	N/D	N/D	N/D	N/D	N/D	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	AHDB9948	72 g	12ml/1000 plants	B
3	AHDB9948	72 g	12 ml/1000 plants	A
4	AHDB9943	75 g	5.33 g/1000 plants ¹	A
5	AHDB9966	24 g	6.67 ml/1000 plants ²	A
6	AHDB9951	125 g	20.83 ml/1000 plants ³	A
7	AHDB9951	Not known	Not known	C

¹ Calculated from spray rate of 160 g/ha assuming 30,000 plants/ha

² Calculated from spray rate of 200 ml/ha assuming 30,000 plants/ha

³ Calculated from spray rate of 625 ml/ha assuming 30,000 plants/ha

Application details

	Application A	Application B	Application C
Application date	30/7/19	3/9/19	Not known
Time of day	14.00	11.00	Not known
Crop growth stage (Max, min average BBCH)	Seed	14	Seed
Crop height (cm)	N/A	5	N/A
Crop coverage (%)	N/A	N/A	N/A
Application Method	“Phytodrip”	Drench	Seed treatment
Application Placement	Block	Block	Foliar
Application equipment	Pipette	Pipette	Not known
Nozzle pressure	N/A	N/A	N/A
Nozzle type	N/A	N/A	N/A
Nozzle size	N/A	N/A	N/A
Application water volume/ha	0.2 ml/module	1 ml/module	N/A
Temperature of air - shade (°C)	N/A	N/A	N/A
Relative humidity (%)	N/A	N/A	N/A
Wind speed range (m/s)	N/A	N/A	N/A
Dew presence (Y/N)	N/A	N/A	N/A
Temperature of soil - 2-5 cm (°C)	N/A	N/A	N/A
Wetness of soil - 2-5 cm	N/A	N/A	N/A
Cloud cover (%)	N/A	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
Cabbage aphid	<i>Brevicoryne brassicae</i>	BRVCBR	0	10 per plant	1.4 – 18 ¹
Peach potato aphid	<i>Myzus persicae</i>	MYZUPE	0	10 per plant	0.4 – 12 ¹

¹ One week after inoculation

Method

Cauliflower seed (cv Skywalker) was sown into 308 Hassy trays containing Levington M2 compost on 30 July 2019. Treatments were applied at sowing (“Phytodrip”), pre-planting (drench) or as a seed treatment. The “Phytodrip” treatments were applied directly to the seed after sowing in a small volume of water (0.2 ml) and the drench treatment was applied before planting in 1 ml of water. The insecticide-treated seeds were treated and supplied by Elsoms seeds. After poor germination the seed was re-sown and treated on 14 August but the original sowing was used for the field trial. The trial was transplanted with 50 cm plant spacing within and between rows on 4 September. The trial consisted of 7 treatments and each replicate consisted of 6 plants of each treatment covered with insect proof netting (0.8 mm mesh) to exclude

naturally occurring insects. The plots were 6.5 m x 1 bed (1.83 m each) in size and there were a total of 20 plots with the treatments randomized within each plot. All plants in 4 plots were inoculated on 10 September (6 days after transplanting) with 10 each of laboratory reared *Brevicoryne brassicae* and *Myzus persicae*. The aphids were counted into Eppendorf tubes which were then opened and placed at the base of the plant stems. Inoculation of a further 4 plots was repeated on 16 September, 23 September, 8 October and 17 October (12, 19, 34 and 43 days after transplanting respectively). Inoculation timings are shown in Table 1.

Table 1 Aphid inoculation timings.

Inoculation date	Days after treatment		Days after transplanting
	"Phytodrip"/Seed treatment	Drench	
10/9/19	42	7	6
16/9/19	48	13	12
23/9/19	55	20	19
8/10/19	70	35	34
17/10/19	79	44	43

Assessment details

All plants were initially assessed for aphid numbers approximately 1 week after inoculation and on one further occasion (excluding the fifth inoculation).

Germination and phytotoxicity were assessed on sowing-time treatments on 7 August and 20 August (8 and 6 days after first and second sowings respectively).

Evaluation date	Evaluation Timing (DA)*		Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotox)	Assessment
	After sowing	After planting			
7/8/19	8	n/a	12	Phytotoxicity	Germination and leaf damage
2/6/19	10	n/a	12	Phytotoxicity	Germination and leaf damage
18/9/19	50	14		Efficacy	Aphid count (1 st inoculation)
25/9/19	57	21		Efficacy	Aphid count (2 nd inoculation)
1/10/19	63	27		Efficacy	Aphid count (3 rd inoculation)
15/10/19	77	41		Efficacy	Aphid count (4 th inoculation)
28/10/19	90	54		Efficacy	Aphid count (5 th inoculation)
30/10/19	92	56		Efficacy	Aphid count (1 st inoculation)
31/10/19	93	57		Efficacy	Aphid count (2 nd inoculation)
4/11/19	97	61		Efficacy	Aphid count (3 rd inoculation)
12/11/19	105	69		Efficacy	Aphid count (4 th inoculation)

* DA – days after application

Statistical analysis

All treatments were included in all plots. Each plot was caged separately. The treatments were randomized within plots and the inoculation dates were randomized within a 10 x 2 plot grid. The total numbers (winged plus wingless) of *Myzus persicae* and *Brevicoryne brassicae* were analysed after square root transformation by ANOVA using the Excel data package. In all cases plot means were used.

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Results

Phytotoxicity

The number of seedlings which had germinated after sowing on two occasions is shown in Table 2. No analysis was possible but it is clear that germination in the first sowing was poor in a number of the treatments including the untreated control. Germination in the second sowing was much more consistent but there is still evidence that the seed treatment had reduced germination.

Table 2 The number of healthy, unhealthy and missing plants 20 days after sowing and treatment with “Phytodrip” treatments.

Treatment	Number of seedlings (1 st sowing)			Number of seedlings (2 nd sowing)		
	Healthy	Unhealthy	Missing	Healthy	Unhealthy	Missing
Control	264	0	44	303	0	5
AHDB9948 ¹	86	0	54	129	0	11
AHDB9943 ¹	130	0	10	133	0	7
AHDB9966 ¹	113	0	27	137	0	3
AHDB9951 ¹	133	0	7	132	0	8
AHDB9951 ²	208	0	100	245	0	63

¹ “Phytodrip”

² Seed treatment

Aphid numbers – first assessments

There was a general trend with both species for less survival/colonization of aphids on the untreated control plants with each successive inoculation. The majority of aphids observed were wingless but small numbers of winged aphids were also seen. In all cases only total (winged plus wingless) aphids are considered. The numbers of aphids are presented in Table 3 and Figure 1 (*Myzus persicae*) and Table 4 and Figure 2 (*Brevicoryne brassicae*). The data were Square root transformed before analysis. All of the analyses were significant at the 5% level using an F-test except the 5th inoculation of *Myzus persicae*.

All treatments reduced numbers of *Myzus persicae* significantly compared with the untreated control after the 1st, 2nd, 3rd and 4th inoculations. There were small differences between treatments but the only significant differences occurred in the 3rd inoculation where there were more aphids on the AHDB9943 “Phytodrip” treatment than both the AHDB9948 and the AHDB9951 “Phytodrip” treatments.

With *Brevicoryne brassicae*, all treatments reduced numbers significantly compared with the untreated control after the 1st, 2nd, 3rd, 4th and 5th inoculations with the exceptions of AHDB9943 “Phytodrip” in the 3rd and 5th inoculations and AHDB9966 and AHDB9951 seed treatment in the 5th inoculation. Significant differences between treatments occurred in the 3rd inoculation (more aphids on AHDB9943 “Phytodrip” than all other treatments except AHDB9951 Seed Treatment), 4th inoculation (more aphids on AHDB9943 “Phytodrip” than AHDB9951 “Phytodrip”) and 5th inoculation (More aphids on AHDB9966 than AHDB9948 and AHDB9951 “Phytodrip”).

The percentage reduction in numbers of aphids compared with the untreated control was also calculated to aid the comparison of treatments and is presented in Table 5 and Figure 3 (*Myzus persicae*) and Table 6 and Figure 4 (*Brevicoryne brassicae*)

Table 3 Mean numbers of *Myzus persicae* on insecticide-treated cauliflower plants approximately 1 week after inoculation on 5 successive occasions

Treatment	1st inoculation		2 nd inoculation		3 rd inoculation		4 th inoculation		5 th inoculation	
	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans
Control	3.45	11.92	2.76	7.61	1.76	3.11	1.34	1.80	0.65	0.43
AHDB9948 ³	0.00	0.00	0.44	0.19	0.43	0.19	0.30	0.09	0.67	0.45
AHDB9948 ¹	0.51	0.26	0.57	0.32	0.00	0.00	0.14	0.02	0.31	0.09
AHDB9943 ¹	0.27	0.08	0.28	0.08	1.00	1.00	0.51	0.26	0.35	0.12
AHDB9966 ¹	0.00	0.00	0.00	0.00	0.39	0.16	0.22	0.05	0.42	0.18
AHDB9951 ¹	0.00	0.00	0.00	0.00	0.10	0.01	0.58	0.34	0.00	0.00
AHDB9951 ²	0.20	0.04	0.11	0.01	0.68	0.47	0.22	0.05	0.38	0.14
F value	23.39		17.64		6.21		2.65		0.783	
P -value	<0.001		<0.001		<0.001		0.045		0.593	
s.e.d.	0.368		0.330		0.343		0.360		0.434	
l.s.d.	0.764		0.686		0.714		0.750		0.902	
d.f.	21		21		21		21		21	

¹ "Phytodrip" at sowing

² Seed treatment

³ Pre-planting drench

Table 4 Mean numbers of *Brevicoryne brassicae* on insecticide-treated cauliflower plants approximately 1 week after inoculation on 5 successive occasions

Treatment	1st inoculation		2nd inoculation		3rd inoculation		4th inoculation		5th inoculation	
	Sq Rt	Back trans								
Control	3.87	14.99	4.25	18.05	1.96	3.83	2.50	6.25	1.29	1.65
AHDB9948 ³	0.00	0.00	0.00	0.00	0.10	0.01	0.83	0.69	0.00	0.00
AHDB9948 ¹	0.31	0.09	0.35	0.13	0.39	0.15	1.03	1.05	0.18	0.03
AHDB9943 ¹	0.50	0.25	1.15	1.32	1.44	2.07	1.58	2.50	0.74	0.54
AHDB9966 ¹	0.00	0.00	0.00	0.00	0.45	0.20	1.11	1.23	1.03	1.05
AHDB9951 ¹	0.00	0.00	0.13	0.02	0.00	0.00	0.34	0.11	0.00	0.00
AHDB9951 ²	0.00	0.00	0.00	0.00	0.77	0.60	0.86	0.74	0.82	0.67
F value	22.83		17.64		5.96		6.71		2.99	
P -value	<0.001		<0.001		<0.001		<0.001		0.029	
s.e.d.	0.422		0.330		0.419		0.378		0.424	
l.s.d.	0.878		0.686		0.870		0.785		0.883	
d.f.	21		21		21		21		21	

¹ "Phytodrip" at sowing

² Seed treatment

³ Pre-planting drench

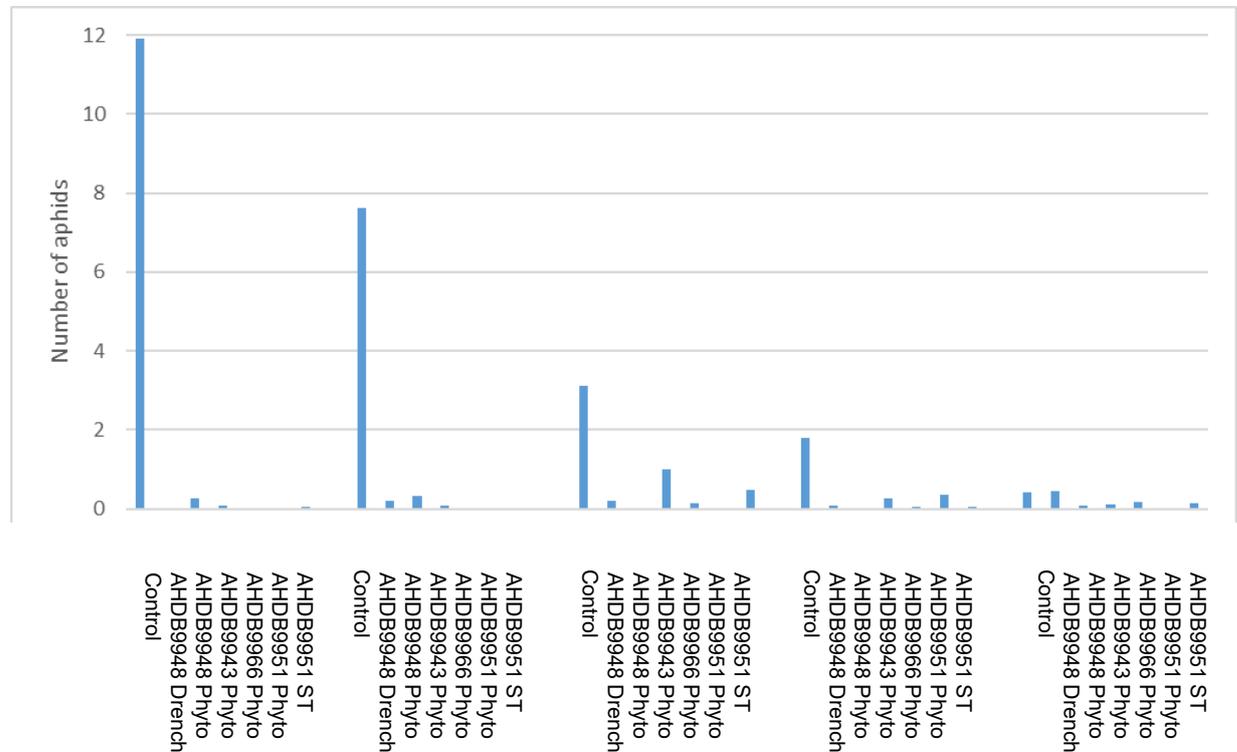


Table 6 Mean percentage reduction in numbers (compared with untreated control) of *Brevicoryne brassicae* on insecticide-treated cauliflower plants approximately 1 week after inoculation on 5 successive occasions

Treatment	1st inoculation	2nd inoculation	3rd inoculation	4th inoculation	5th inoculation
AHDB9948 ³	100.0	100.0	99.7	89.0	100.0
AHDB9948 ¹	99.4	99.3	96.0	83.1	97.8
AHDB9943 ¹	98.3	92.7	46.0	59.9	61.1
AHDB9966 ¹	100.0	100.0	94.7	80.4	24.3
AHDB9951 ¹	100.0	99.9	100.0	98.2	100.0
AHDB9951 ²	100.0	100.0	84.4	88.2	56.9

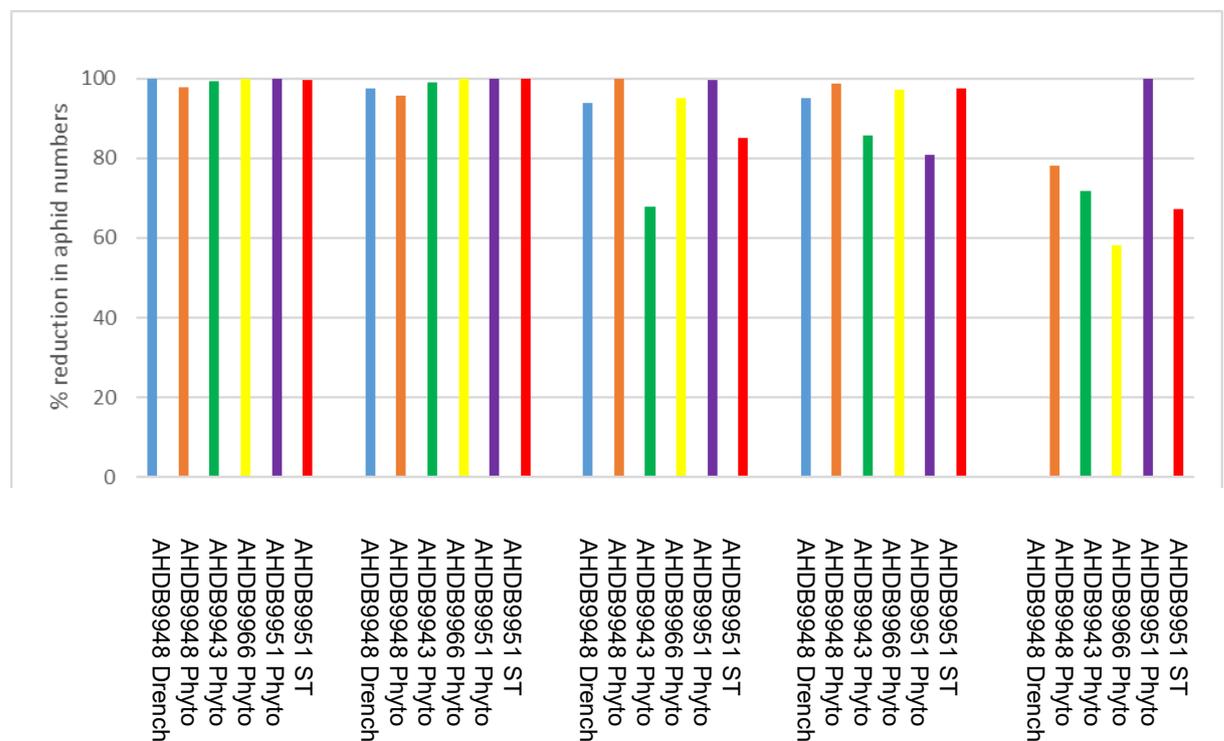


Figure 3 Mean percentage reduction in numbers (compared with untreated control) of *Myzus persicae* on insecticide-treated cauliflower plants approximately 1 week after inoculation on 5 successive occasions

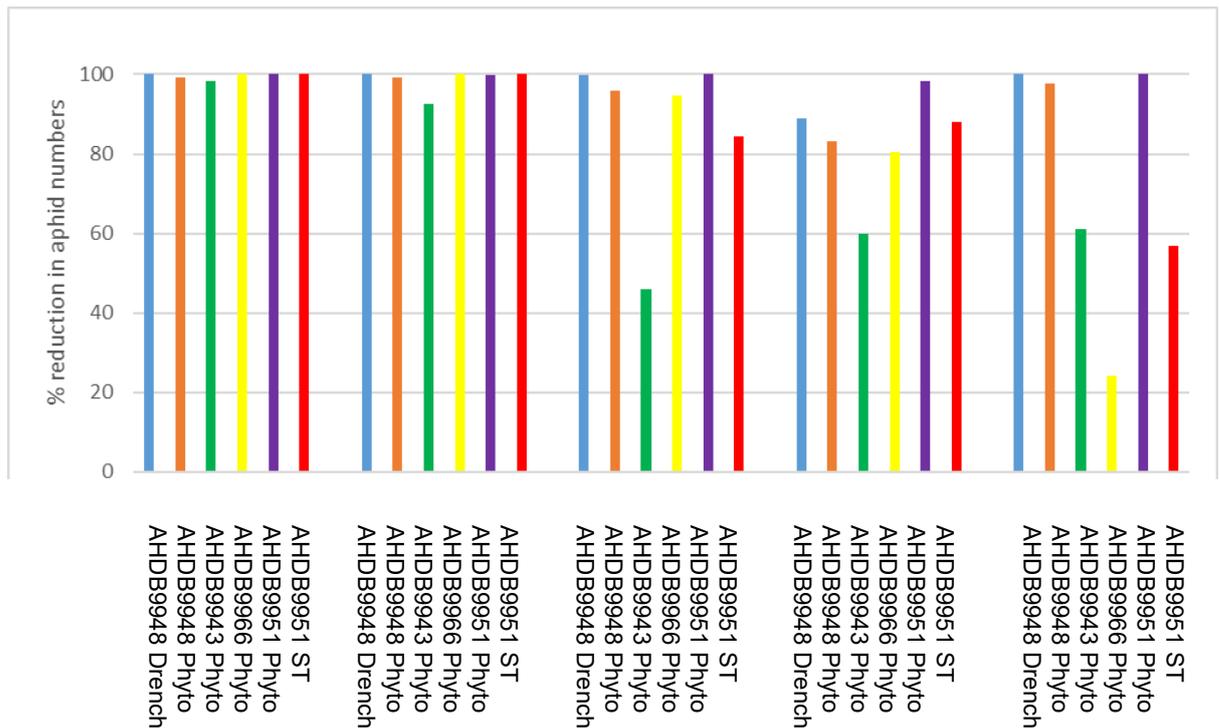


Figure 4 Mean percentage reduction in numbers (compared with untreated control) of *Brevicoryne brassicae* on insecticide-treated cauliflower plants approximately 1 week after inoculation on 5 successive occasions

Aphid numbers – second assessments

In the first 3 inoculations aphid numbers on the untreated control plants had increased compared with the first assessment. The numbers of aphids are presented in Table 7 and Figure 5 (*Myzus persicae*) and Table 8 and Figure 6 (*Brevicoryne brassicae*). The data were Square root transformed before analysis. The analyses for the first three inoculations were significant at the 5% level using an F-test.

Although it is clear that there had been some movement of aphids onto previously aphid-free plants, all treatments reduced numbers of *Myzus persicae* significantly compared with the untreated control after the 1st, 2nd and 3rd inoculations with the exception of AHDB9943 “Phytodrip” in the 3rd inoculation. There were small differences between treatments but the only significant differences occurred in the 3rd inoculation where there were more aphids on the AHDB9943 “Phytodrip” treatment than the AHDB9948 Drench and the AHDB9966 and AHDB9951 “Phytodrip” treatments.

As with *Myzus persicae* there was some movement of *Brevicoryne brassicae* onto previously aphid-free plants. All treatments reduced numbers significantly compared with the untreated control after the 1st, 2nd and 3rd inoculations with the exceptions of AHDB9948 “Phytodrip” in the 1st inoculation and AHDB9943 “Phytodrip” in the 3rd

inoculation. Significant differences between treatments occurred in the 2nd and 3rd inoculations (more aphids on AHDB9943 “Phytodrip” than all other treatments).

The percentage reduction in numbers of aphids compared with the untreated control was not calculated because infestation on some treated plants was due to movement of aphids and not the initial inoculation.

Table 7 Mean numbers of *Myzus persicae* on insecticide-treated cauliflower plants 50, 45, 42 and 35 days respectively after inoculation on 4 successive occasions

	1st inoculation		2 nd inoculation		3 rd inoculation		4 th inoculation	
Days after inoculation	50		45		42		35	
Treatment	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans
Control	7.18	51.60	8.13	66.08	3.60	12.96	0.00	0.00
AHDB9948 ³	1.20	1.43	1.63	2.67	0.33	0.11	0.00	0.00
AHDB9948 ¹	0.56	0.31	2.68	7.17	1.04	1.09	0.00	0.00
AHDB9943 ¹	2.42	5.86	1.78	3.18	2.46	6.03	0.00	0.00
AHDB9966 ¹	2.10	4.43	2.10	4.41	0.38	0.14	0.20	0.04
AHDB9951 ¹	1.18	1.38	1.66	2.75	0.14	0.02	0.00	0.00
AHDB9951 ²	1.46	2.13	2.46	6.05	1.22	1.49	0.00	0.00
F value	10.65		9.26		4.36		1	
P -value	<0.001		<0.001		0.005		0.451	
s.e.d.	0.971		1.084		0.866		0.109	
l.s.d.	2.020		2.253		1.802		0.227	
d.f.	21		21		21		21	

¹ "Phytodrip" at sowing

² Seed treatment

³ Pre-planting drench

Table 8 Mean numbers of *Brevicoryne brassicae* on insecticide-treated cauliflower plants 50, 45, 42 and 35 days respectively after inoculation on 4 successive occasions

	1st inoculation		2 nd inoculation		3 rd inoculation		4 th inoculation	
Treatment	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans	Sq Rt	Back trans
Control	9.23	85.19	8.55	73.02	2.74	7.50	1.80	3.24
AHDB9948 ³	0.20	0.04	0.10	0.01	0.00	0.00	0.00	0.00
AHDB9948 ¹	5.01	25.06	0.36	0.13	0.56	0.31	0.00	0.00
AHDB9943 ¹	2.18	4.76	4.14	17.15	3.12	9.76	0.28	0.08
AHDB9966 ¹	0.46	0.21	0.00	0.00	0.57	0.33	0.00	0.00
AHDB9951 ¹	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00
AHDB9951 ²	0.47	0.22	0.54	0.29	0.56	0.31	0.00	0.00
F value	2.83		27.06		3.40		1.98	
P -value	0.035		<0.001		0.017		0.114	
s.e.d.	2.893		0.887		0.994		0.674	
l.s.d.	6.016		1.844		2.066		1.402	
d.f.	21		21		21		21	

¹ "Phytodrip" at sowing

² Seed treatment

³ Pre-planting drench

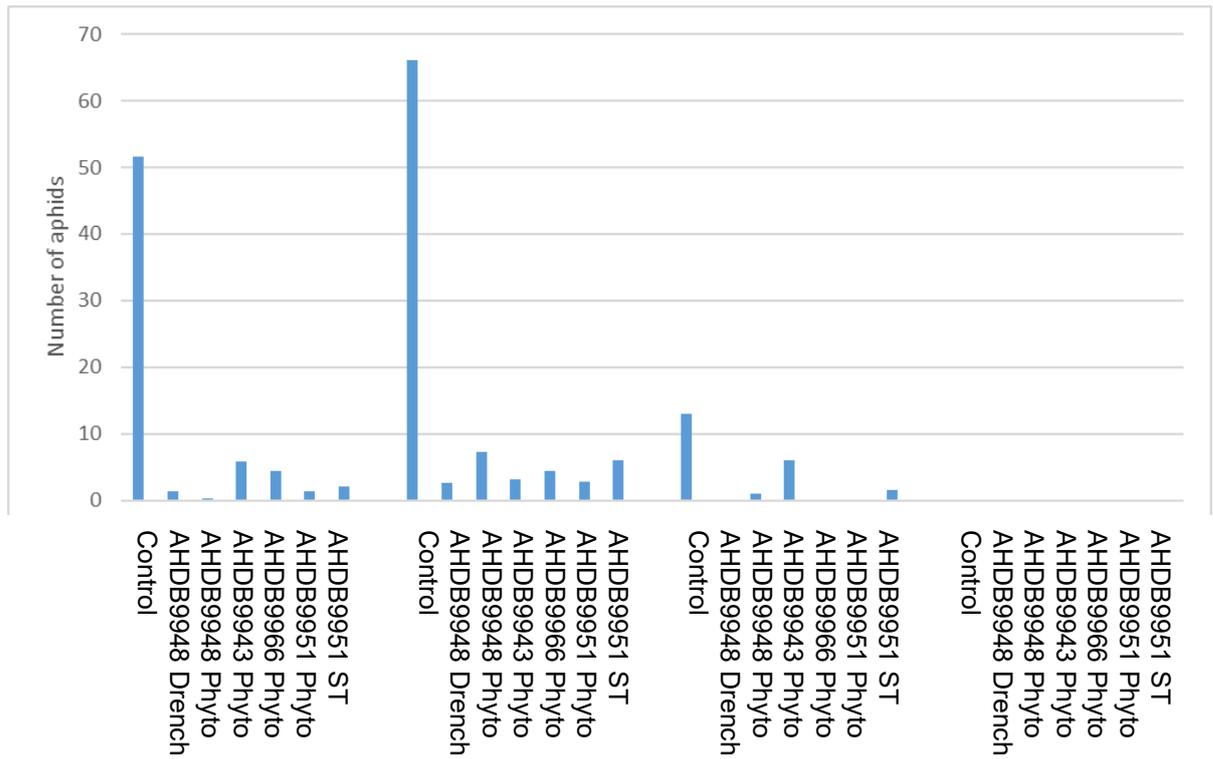


Figure 5 Mean numbers of *Myzus persicae* on insecticide-treated cauliflower plants 50, 45, 42 and 35 days respectively after inoculation on 4 successive occasions

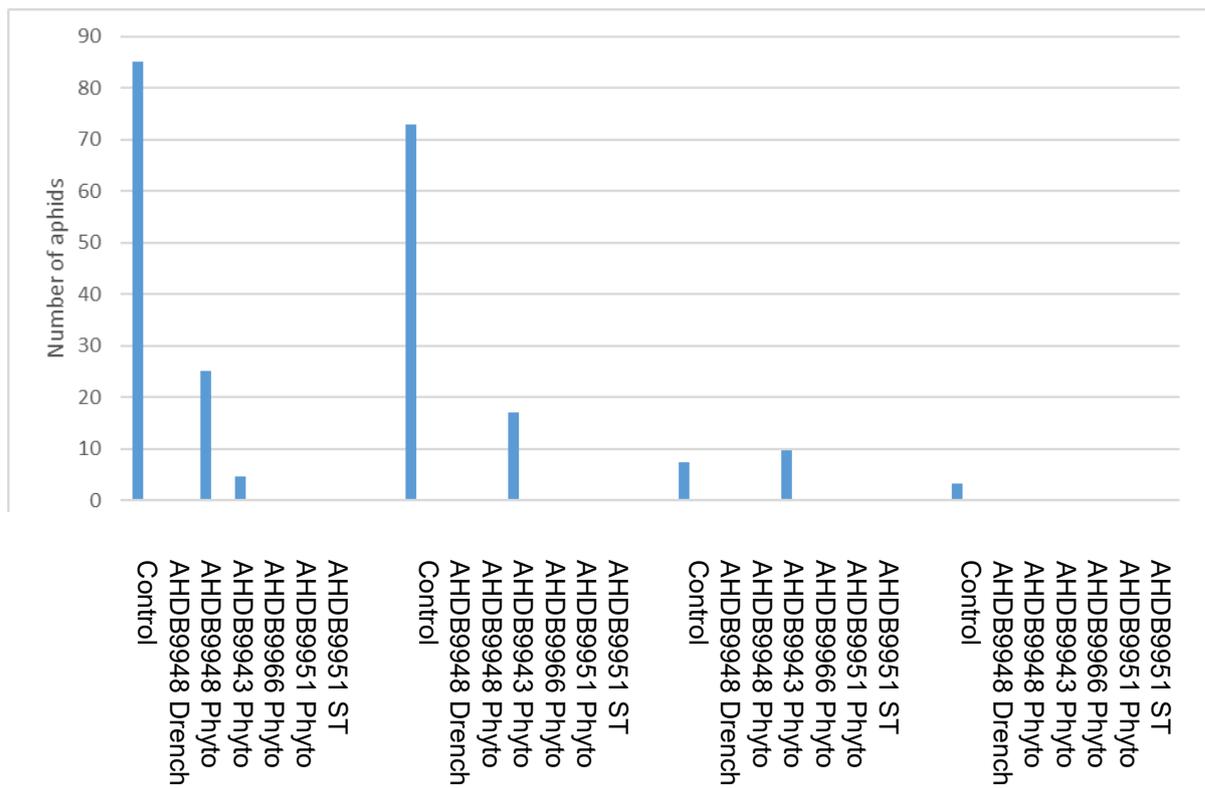


Figure 6 Mean numbers of *Brevicoryne brassicae* on insecticide-treated cauliflower plants 50, 45, 42 and 35 days respectively after inoculation on 4 successive occasions

Discussion

Despite starting the trial in late summer, temperatures remained at typical levels for growth in the UK and plants grew well throughout the trial.

The trial was designed to assess the persistence of sowing time treatments (“Phytodrip” and seed treatment) versus a standard pre-planting drench treatment of AHDB9948. To increase the chances of similar levels of infestation, all plants were inoculated with laboratory-reared aphids and natural populations of aphids (and predators/parasitoids) were excluded by insect proof net. Both species of aphid established well on the untreated plants (and presumably, therefore, also on treated plants before they were controlled) on the first three inoculations. Numbers of aphids (both species) on the untreated plants declined with each successive inoculation so, by the fifth inoculation, numbers were becoming too low to see treatment differences. The decreasing levels of aphid establishment were almost certainly due to the increase in rainfall towards the end of the trial. However, results from the re-assessments suggest that once plants had been colonized, aphid numbers continued to increase despite the deteriorating weather.

All of the treatments significantly reduced numbers of both species of aphid on all 5 inoculations or the first 4 inoculations with *Brevicoryne brassicae* and *Myzus persicae* respectively. With better aphid establishment this may also have been the case with the 5th inoculation of *Myzus persicae* too. Generally there was little difference between the two aphid species in terms of their response to the test chemicals. Very few aphids were observed on treated plants inoculated 6 and 12 days after transplanting and for most treatments (aphid numbers were increasing in the AHDB9943 “Phytodrip” treatment) this continued with the third inoculation, 19 days after transplanting. By the fourth inoculation (34 days after transplanting) both aphid control and aphid establishment were diminishing. Levels of control would have been affected by reducing concentrations of active chemicals within the growing plants due to both metabolism and dilution.

Conclusions

- All of the test treatments were initially very effective against both species of aphid (6 days after transplanting, 42 days after sowing and 12 days after transplanting, 48 days after sowing)
- All treatments significantly reduced numbers of *Myzus persicae* compared with the untreated control in all of the first four inoculations (up to 34 days after transplanting, 70 days after sowing)
- All treatments significantly reduced numbers of *Brevicoryne brassicae* compared with the untreated control in all of the first four inoculations (up to 34 days after transplanting, 70 days after sowing) with the exception of AHDB9943 “Phytodrip” in the 3rd inoculation.
- Control of both species began to decline from the 3rd inoculation onwards but remained high throughout the trial.
- Deteriorating weather conditions affected colonization and made the 5th inoculation difficult to assess.
- AHDB9943 “Phytodrip” was the least effective treatment (at the dose tested).
- AHDB9951 seed treatment may have caused phytotoxic effects.

Acknowledgements

We would like to thank the AHDB for funding and supporting this project and 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 and Elsoms Seeds for supplying treated seed.

Appendix

- a. Crop diary – events related to growing crop

Crop	Cultivar	Planting/sowing date	Row width (m)
Cauliflower	Skywalker		0.5

Previous cropping

Year	Crop
2017	Winter Barley
2018	Winter Wheat

Cultivations

Date	Description	Depth
15/3/19	Ploughing	25cm
6/8/19	Bed forming	15cm

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

Date	Product	Rate	Unit
30/8/18	0:20:20 NPK (Sheep Pens)	666	Kg/ha
3/9/19	Nitram (Sheep Pens)	100	Kg N/ha

Pesticides applied to the trial area

Date	Product	Rate	Unit
21/8/19	Glyphosate	3	l/ha

Details of irrigation regime

Date	Type, rate and duration	Amount applied (mm)
4/9/19	Wright Rain, 1 hour	5
6/9/19	Wright Rain, 1 hour	5
9/9/19	Wright Rain, 1 hour	5
13/9/19	Wright Rain, 1 hour	5

Other actions

Date	Action
N/A	None

b. Trial diary

Date	Event
30-Jul	Seed sown in 308 Hassys
30-Jul	"Phytodrip" treatments applied
07-Aug	Seedling count
14-Aug	Seed re-sown in 308 Hassys
14-Aug	"Phytodrip" treatments applied
20-Aug	Seedling count
03-Sep	Drench treatment applied
04-Sep	Trial transplanted and caged with insect netting
10-Sep	First inoculation with <i>Myzus</i> and <i>Brevicoryne</i> (3 reps)
11-Sep	First inoculation with <i>Myzus</i> and <i>Brevicoryne</i> (1 rep)
16-Sep	Second inoculation with <i>Myzus</i> and <i>Brevicoryne</i> (2 reps)
17-Sep	Second inoculation with <i>Myzus</i> and <i>Brevicoryne</i> (2 reps)
18-Sep	First inoculation assessed
23-Sep	Third inoculation with <i>Myzus</i> and <i>Brevicoryne</i> (2 reps)
24-Sep	Third inoculation with <i>Myzus</i> and <i>Brevicoryne</i> (2 reps)
25-Sep	Second inoculation assessed
01-Oct	Third inoculation assessed
08-Oct	Forth inoculation with <i>Myzus</i> and <i>Brevicoryne</i> (2 reps)
09-Oct	Forth inoculation with <i>Myzus</i> and <i>Brevicoryne</i> (2 reps)
15-Oct	Forth inoculation assessed
17-Oct	Fifth inoculation with <i>Myzus</i> and <i>Brevicoryne</i> (2 reps)
18-Oct	Fifth inoculation with <i>Myzus</i> and <i>Brevicoryne</i> (2 reps)
28-Oct	Fifth inoculation assessed
30-Oct	First inoculation re-assessed
31-Oct	Second inoculation re-assessed
04-Nov	Third inoculation re-assessed
12-Nov	Fourth inoculation re-assessed

c. Climatological data during study period

Date	Temperature		Rainfall (mm)
	Max 09-09	Min 09-09	Total 09-09
01/09/2019	20	9.1	0
02/09/2019	21.1	7.1	0
03/09/2019	22.4	12	1.4
04/09/2019	19.6	14.9	1.6
05/09/2019	18.3	10.2	0
06/09/2019	19	8.4	0.4
07/09/2019	17.3	7.7	0
08/09/2019	18.3	1.7	0
09/09/2019	15.5	10.6	0
10/09/2019	18.8	7.8	0.6
11/09/2019	24.2	13.6	0
12/09/2019	23.6	7.6	0.2
13/09/2019	19.7	6.3	0
14/09/2019	22.4	3.5	0
15/09/2019	23.3	8.5	0
16/09/2019	17	15.2	0
17/09/2019	18.6	5.4	0
18/09/2019	19.6	2.5	0
19/09/2019	22.2	4.8	0
20/09/2019	22.4	4.8	0
21/09/2019	26.2	9	2.8
22/09/2019	20.3	15	2
23/09/2019	20.6	13	19.2
24/09/2019	18.5	14.8	24.6
25/09/2019	18.6	14.3	2.6
26/09/2019	18.6	15.1	2.4
27/09/2019	17.4	12.6	3
28/09/2019	18.5	10.9	19.6
29/09/2019	19.7	12.6	1
30/09/2019	17	8.8	13.6
01/10/2019	19.9	12.7	5.6
02/10/2019	13.5	3.2	0
03/10/2019	13.6	1.8	2.6
04/10/2019	16	6.5	0
05/10/2019	15.3	9.6	9.8
06/10/2019	16.6	12.2	0.8
07/10/2019	14.9	8.8	0
08/10/2019	16.4	10.5	0.8
09/10/2019	14.6	9.7	0
10/10/2019	15.4	7.7	1.8

11/10/2019	16.8	12.6	4.6
12/10/2019	14.8	10.8	9.6
13/10/2019	14.9	10.5	1.4
14/10/2019	13.4	7.5	12.4
15/10/2019	14.2	9.7	0.8
16/10/2019	15.3	9.5	0.2
17/10/2019	14.5	3.1	1.6
18/10/2019	12.5	7.1	5
19/10/2019	13.8	6.3	0
20/10/2019	12.3	6.4	1.6
21/10/2019	12.7	8.7	0.2
22/10/2019	14.6	5.5	0
23/10/2019	13.6	2.3	4.4
24/10/2019	13.4	6.2	2.6
25/10/2019	16.4	9	20
26/10/2019	9.3	9.2	6.2
27/10/2019	12	1.9	0
28/10/2019	8.6	-0.8	0
29/10/2019	10.3	0.6	0.2
30/10/2019	10.9	2.9	0
31/10/2019	12.1	3.8	3
01/11/2019	15.1	6.2	4.6
02/11/2019	11.3	8.6	5.2
03/11/2019	11.9	8.1	2
04/11/2019	11.6	6.3	1.2
05/11/2019	11.5	7.6	0.2
06/11/2019	8.3	0.8	7.4
07/11/2019	10.5	3.8	2
08/11/2019	8.6	2.3	0.4
09/11/2019	5.8	-1.7	18.8
10/11/2019	9	1.3	4
11/11/2019	8.9	3.1	0
12/11/2019	7.5	2.9	0.4
13/11/2019	8.8	1.6	20.8
14/11/2019	6.2	4.2	12
15/11/2019	7.9	3.6	1.6
16/11/2019	9	3.5	1
17/11/2019	8.7	4.4	1.6
18/11/2019	8	1.5	0
19/11/2019	6.6	-2	0
20/11/2019	7.2	1.5	0
21/11/2019	7.2	2.6	4.2
22/11/2019	8.7	3.3	1
23/11/2019	9.7	7.1	4.8

24/11/2019	10.2	7.4	1
25/11/2019	11.7	7.6	5
26/11/2019	14.1	9	3.8
27/11/2019	11.6	8.8	0.6
28/11/2019	9.4	6.7	3.2
29/11/2019	7.8	-1	0
30/11/2019	5	-2.3	0.4

d. Raw data from assessments

Numbers of aphids per plant (plot means) – first assessments

Date	Plot	Treatment	Sub-plot	Myzus persicae			Brevicoryne brassicae		
				Winged	Wingless	total	Winged	Wingless	total
18/09/2019	1	1	3	0.0	13.0	13.0	0.2	19.8	20.0
	1	2	2	0.0	0.0	0.0	0.0	0.0	0.0
	1	3	7	0.0	0.5	0.5	0.0	1.5	1.5
	1	4	5	0.0	0.0	0.0	0.0	0.0	0.0
	1	5	1	0.0	0.0	0.0	0.0	0.0	0.0
	1	6	6	0.0	0.0	0.0	0.0	0.0	0.0
	1	7	4	0.0	0.2	0.2	0.0	0.0	0.0
	9	1	6	0.0	14.0	14.0	0.0	25.2	25.2
	9	2	4	0.0	0.0	0.0	0.0	0.0	0.0
	9	3	3	0.0	0.0	0.0	0.0	0.0	0.0
	9	4	2	0.0	0.0	0.0	0.0	0.0	0.0
	9	5	7	0.0	0.0	0.0	0.0	0.0	0.0
	9	6	5	0.0	0.0	0.0	0.0	0.0	0.0
	9	7	1	0.0	0.0	0.0	0.0	0.0	0.0
	12	1	4	0.0	3.3	3.3	0.0	7.3	7.3
	12	2	3	0.0	0.0	0.0	0.0	0.0	0.0
	12	3	2	0.0	0.2	0.2	0.0	0.0	0.0
	12	4	7	0.0	0.0	0.0	0.0	0.0	0.0
	12	5	5	0.0	0.0	0.0	0.0	0.0	0.0
	12	6	1	0.0	0.0	0.0	0.0	0.0	0.0
	12	7	6	0.0	0.0	0.0	0.0	0.0	0.0
	16	1	7	0.0	21.5	21.5	0.0	10.8	10.8
	16	2	5	0.0	0.0	0.0	0.0	0.0	0.0
	16	3	1	0.0	0.8	0.8	0.0	0.0	0.0
	16	4	6	0.0	1.2	1.2	0.0	4.0	4.0
	16	5	4	0.0	0.0	0.0	0.0	0.0	0.0
	16	6	3	0.0	0.0	0.0	0.0	0.0	0.0
	16	7	2	0.0	0.2	0.2	0.0	0.0	0.0
25/09/2019	3	1	4	0.0	10.8	10.8	0.0	13.5	13.5
	3	2	1	0.0	0.2	0.2	0.0	0.0	0.0
	3	3	7	0.5	1.5	2.0	0.0	0.0	0.0
	3	4	5	0.0	0.0	0.0	0.2	2.7	2.8
	3	5	6	0.0	0.0	0.0	0.0	0.0	0.0
	3	6	2	0.0	0.0	0.0	0.0	0.3	0.3
	3	7	3	0.0	0.0	0.0	0.0	0.0	0.0
	5	1	7	0.0	12.0	12.0	0.0	13.0	13.0
	5	2	5	0.2	0.2	0.3	0.0	0.0	0.0
	5	3	6	0.0	0.8	0.8	0.0	0.0	0.0
	5	4	2	0.0	1.3	1.3	0.0	3.0	3.0

	5	5	3	0.0	0.0	0.0	0.0	0.0	0.0
	5	6	4	0.0	0.0	0.0	0.0	0.0	0.0
	5	7	1	0.0	0.0	0.0	0.0	0.0	0.0
	17	1	2	0.3	5.7	6.0	0.3	21.3	21.7
	17	2	3	0.6	0.0	0.6	0.0	0.0	0.0
	17	3	4	0.0	0.0	0.0	0.0	0.0	0.0
	17	4	1	0.0	0.0	0.0	0.0	0.2	0.2
	17	5	7	0.0	0.0	0.0	0.0	0.0	0.0
	17	6	5	0.0	0.0	0.0	0.0	0.0	0.0
	17	7	6	0.0	0.2	0.2	0.0	0.0	0.0
	20	1	3	0.2	3.2	3.4	0.0	25.6	25.6
	20	2	4	0.0	0.0	0.0	0.0	0.0	0.0
	20	3	1	0.0	0.0	0.0	0.0	2.0	2.0
	20	4	7	0.0	0.0	0.0	0.0	0.6	0.6
	20	5	5	0.0	0.0	0.0	0.0	0.0	0.0
	20	6	6	0.0	0.0	0.0	0.0	0.0	0.0
	20	7	2	0.0	0.0	0.0	0.0	0.0	0.0
01/10/2019	2	1	1	0.3	5.2	5.5	0.2	3.3	3.5
	2	2	4	0.0	0.0	0.0	0.0	0.0	0.0
	2	3	3	0.0	0.0	0.0	0.0	0.0	0.0
	2	4	2	0.0	1.6	1.6	0.2	0.8	1.0
	2	5	7	0.0	0.0	0.0	0.0	0.0	0.0
	2	6	6	0.0	0.0	0.0	0.0	0.0	0.0
	2	7	5	0.0	0.0	0.0	0.3	0.5	0.8
	6	1	6	0.3	3.8	4.0	0.0	0.8	0.8
	6	2	5	0.0	0.0	0.0	0.0	0.0	0.0
	6	3	1	0.0	0.0	0.0	0.0	0.0	0.0
	6	4	4	0.0	1.0	1.0	0.0	1.2	1.2
	6	5	3	0.0	1.0	1.0	0.0	0.0	0.0
	6	6	2	0.0	0.2	0.2	0.0	0.0	0.0
	6	7	7	0.5	0.5	1.0	0.0	0.0	0.0
	14	1	3	0.0	1.4	1.4	0.0	6.0	6.0
	14	2	2	0.2	0.2	0.3	0.2	0.0	0.2
	14	3	7	0.0	0.0	0.0	0.3	0.3	0.5
	14	4	6	0.2	1.2	1.3	0.2	1.3	1.5
	14	5	5	0.3	0.0	0.3	0.0	0.0	0.0
	14	6	1	0.0	0.0	0.0	0.0	0.0	0.0
	14	7	4	0.0	0.0	0.0	0.0	1.5	1.5
	18	1	5	0.3	2.0	2.3	0.3	6.7	7.0
	18	2	1	0.0	1.3	1.3	0.0	0.0	0.0
	18	3	4	0.0	0.0	0.0	0.0	0.8	0.8
	18	4	3	0.0	0.3	0.3	0.3	5.7	6.0
	18	5	2	0.0	0.0	0.0	0.0	3.3	3.3
	18	6	7	0.0	0.0	0.0	0.0	0.0	0.0
	18	7	6	0.0	3.0	3.0	0.0	1.0	1.0

15/10/2019	7	1	1	0.0	0.3	0.3	0.3	3.5	3.8
	7	2	7	0.0	1.4	1.4	0.0	0.6	0.6
	7	3	4	0.0	0.0	0.0	0.3	0.8	1.0
	7	4	2	0.0	0.3	0.3	0.7	1.2	1.8
	7	5	6	0.0	0.0	0.0	0.3	1.7	2.0
	7	6	3	0.2	0.3	0.5	0.0	0.0	0.0
	7	7	5	0.0	0.0	0.0	0.3	3.3	3.7
	10	1	2	0.4	2.8	3.2	0.0	13.6	13.6
	10	2	6	0.0	0.0	0.0	0.3	1.2	1.5
	10	3	3	0.0	0.3	0.3	1.0	0.7	1.7
	10	4	5	0.0	0.0	0.0	0.3	4.0	4.3
	10	5	1	0.0	0.0	0.0	0.0	0.3	0.3
	10	6	7	0.0	0.0	0.0	0.0	0.2	0.2
	10	7	4	0.0	0.8	0.8	0.0	0.5	0.5
	11	1	7	0.0	5.3	5.3	0.3	4.0	4.3
	11	2	4	0.0	0.0	0.0	0.3	0.5	0.8
	11	3	2	0.0	0.0	0.0	0.0	1.0	1.0
	11	4	6	0.0	0.4	0.4	0.2	0.8	1.0
	11	5	3	0.0	0.8	0.8	0.4	0.8	1.2
	11	6	5	0.0	0.4	0.4	0.4	0.4	0.8
	11	7	1	0.0	0.0	0.0	0.0	0.7	0.7
	19	1	5	0.0	0.5	0.5	0.8	4.5	5.3
	19	2	1	0.0	0.0	0.0	0.0	0.2	0.2
	19	3	7	0.0	0.0	0.0	0.7	0.0	0.7
	19	4	4	0.0	0.7	0.7	0.2	3.5	3.7
	19	5	2	0.0	0.0	0.0	1.6	0.2	1.8
	19	6	6	0.0	1.0	1.0	0.0	0.0	0.0
	19	7	3	0.0	0.0	0.0	0.0	0.0	0.0
28/10/2019	4	1	6	0.3	3.0	3.3	0.0	1.3	1.3
	4	2	3	0.0	0.3	0.3	0.0	0.0	0.0
	4	3	1	0.0	0.0	0.0	0.0	0.0	0.0
	4	4	5	0.3	0.0	0.3	0.0	0.3	0.3
	4	5	7	0.0	0.0	0.0	0.4	4.4	4.8
	4	6	4	0.0	0.0	0.0	0.0	0.0	0.0
	4	7	2	0.0	1.0	1.0	0.0	2.0	2.0
	8	1	5	0.0	0.0	0.0	0.0	1.0	1.0
	8	2	7	0.0	1.0	1.0	0.0	0.0	0.0
	8	3	4	0.0	1.5	1.5	0.0	0.0	0.0
	8	4	2	0.0	0.0	0.0	0.0	3.6	3.0
	8	5	6	0.0	0.0	0.0	0.0	0.0	0.0
	8	6	3	0.0	0.0	0.0	0.0	0.0	0.0
	8	7	1	0.0	0.3	0.3	0.0	1.0	1.0
	13	1	3	0.0	0.7	0.7	0.0	1.7	1.7
	13	2	1	0.0	0.5	0.5	0.0	0.0	0.0
	13	3	5	0.0	0.0	0.0	0.0	0.5	0.5

	13	4	7	0.0	0.0	0.0	0.0	0.4	0.4
	13	5	4	0.0	0.3	0.3	0.0	3.7	3.7
	13	6	2	0.0	0.0	0.0	0.0	0.0	0.0
	13	7	6	0.0	0.0	0.0	0.0	0.0	0.0
	15	1	2	0.0	0.0	0.0	0.0	3.0	3.0
	15	2	6	0.0	0.2	0.2	0.0	0.0	0.0
	15	3	3	0.0	0.0	0.0	0.0	0.0	0.0
	15	4	1	0.0	0.7	0.7	0.0	0.0	0.0
	15	5	5	0.0	1.3	1.3	0.0	0.0	0.0
	15	6	7	0.0	0.0	0.0	0.0	0.0	0.0
	15	7	4	0.0	0.0	0.0	0.3	0.5	0.8

Numbers of aphids per plant (plot means) – second assessments

Date	Plot	Treatment	Sub-plot	Myzus persicae			Brevicoryne brassicae		
				Winged	Wingless	total	Winged	Wingless	total
30/10/2019	1	1	3	0.0	52.0	52.0	0.0	96.3	96.3
	1	2	2	0.0	0.6	0.6	0.0	0.0	0.0
	1	3	7	0.0	0.0	0.0	0.0	401.0	401.0
	1	4	5	0.0	18.3	18.3	0.0	0.7	0.7
	1	5	1	0.0	0.5	0.5	0.0	0.0	0.0
	1	6	6	0.0	0.8	0.8	0.0	0.0	0.0
	1	7	4	0.0	7.2	7.2	0.2	3.3	3.5
	9	1	6	0.0	50.0	50.0	0.0	85.0	85.0
	9	2	4	0.0	0.2	0.2	0.0	0.0	0.0
	9	3	3	0.0	0.0	0.0	0.0	0.0	0.0
	9	4	2	0.0	0.0	0.0	0.0	0.0	0.0
	9	5	7	0.0	14.3	14.3	0.0	3.3	3.3
	9	6	5	0.0	6.8	6.8	0.0	0.2	0.2
	9	7	1	0.0	0.0	0.0	0.0	0.0	0.0
	12	1	4	0.2	36.7	36.8	1.3	88.5	89.8
	12	2	3	0.0	3.5	3.5	0.0	0.2	0.2
	12	3	2	0.0	0.0	0.0	0.0	0.0	0.0
	12	4	7	0.0	0.3	0.3	0.0	0.0	0.0
	12	5	5	0.0	5.5	5.5	0.0	0.0	0.0
	12	6	1	0.0	0.0	0.0	0.0	0.0	0.0
	12	7	6	0.0	3.5	3.5	0.0	0.0	0.0
	16	1	7	0.3	70.0	70.3	0.3	70.5	70.8
	16	2	5	0.3	2.7	3.0	0.0	0.2	0.2
	16	3	1	0.0	5.0	5.0	0.0	0.0	0.0
	16	4	6	0.4	23.6	24.0	0.0	62.6	62.6
	16	5	4	0.0	2.5	2.5	0.0	0.0	0.0
	16	6	3	0.0	1.5	1.5	0.0	0.0	0.0
	16	7	2	0.0	1.7	1.7	0.0	0.0	0.0

31/10/2019	3	1	4	0.0	64.3	64.3	0.0	25.0	25.0
	3	2	1	1.2	4.0	5.2	0.0	0.0	0.0
	3	3	7	0.0	28.7	28.7	0.0	0.3	0.3
	3	4	5	0.0	5.8	5.8	0.0	15.4	15.4
	3	5	6	0.0	9.0	9.0	0.0	0.0	0.0
	3	6	2	0.0	3.5	3.5	0.0	0.0	0.0
	3	7	3	0.0	22.3	22.3	0.0	0.0	0.0
	5	1	7	0.0	125.6	125.6	0.0	75.0	75.0
	5	2	5	0.0	3.4	3.4	0.0	0.0	0.0
	5	3	6	0.5	10.3	10.8	0.0	0.0	0.0
	5	4	2	0.0	1.0	1.0	0.0	15.8	15.8
	5	5	3	0.0	0.2	0.2	0.0	0.0	0.0
	5	6	4	0.3	0.3	0.5	0.0	0.0	0.0
	5	7	1	0.0	2.5	2.5	0.0	0.0	0.0
	17	1	2	0.0	23.5	23.5	0.0	80.0	80.0
	17	2	3	0.2	1.8	2.0	0.0	0.0	0.0
	17	3	4	0.0	2.5	2.5	0.0	0.0	0.0
	17	4	1	0.0	2.2	2.2	0.0	6.2	6.2
	17	5	7	0.0	6.8	4.5	0.0	0.0	0.0
	17	6	5	0.0	7.0	7.0	0.0	0.0	0.0
	17	7	6	0.0	1.8	1.8	0.0	0.0	0.0
	20	1	3	0.0	71.3	71.3	0.3	133.8	134.0
	20	2	4	0.0	1.0	1.0	0.2	0.0	0.2
	20	3	1	0.0	0.3	0.3	0.0	0.8	0.8
	20	4	7	0.0	5.0	5.0	0.0	38.2	38.2
	20	5	5	0.0	8.0	8.0	0.0	0.0	0.0
	20	6	6	0.0	2.0	2.0	0.0	0.0	0.0
	20	7	2	0.0	4.8	4.8	0.0	4.6	4.6
04/11/2019	2	1	1	0.0	35.5	35.5	0.0	3.2	3.2
	2	2	4	0.0	1.8	1.8	0.0	0.0	0.0
	2	3	3	0.0	6.5	6.5	0.0	0.3	0.3
	2	4	2	0.0	27.4	27.4	0.0	0.2	0.2
	2	5	7	0.0	0.0	0.0	0.0	0.0	0.0
	2	6	6	0.0	0.3	0.3	0.0	0.0	0.0
	2	7	5	0.0	7.7	7.7	0.0	0.0	0.0
	6	1	6	0.0	5.7	5.7	0.0	4.3	4.3
	6	2	5	0.0	0.0	0.0	0.0	0.0	0.0
	6	3	1	0.0	0.3	0.3	0.0	0.8	0.8
	6	4	4	0.2	0.3	0.5	0.0	3.0	3.0
	6	5	3	0.0	0.3	0.3	0.0	0.0	0.0
	6	6	2	0.0	0.0	0.0	0.0	0.0	0.0
	6	7	7	0.0	0.0	0.0	0.0	0.0	0.0
	14	1	3	0.0	7.0	7.0	0.0	23.6	23.6
	14	2	2	0.0	0.0	0.0	0.0	0.0	0.0
	14	3	7	0.0	1.3	1.3	0.0	0.0	0.0

	14	4	6	0.0	4.8	4.8	0.0	8.7	8.7
	14	5	5	0.0	0.0	0.0	0.0	0.0	0.0
	14	6	1	0.0	0.0	0.0	0.0	0.0	0.0
	14	7	4	0.0	4.5	4.5	0.0	5.0	5.0
	18	1	5	0.0	11.7	11.7	0.0	5.0	5.0
	18	2	1	0.0	0.0	0.0	0.0	0.0	0.0
	18	3	4	0.0	0.0	0.0	0.0	0.8	0.8
	18	4	3	0.0	2.8	2.8	0.0	54.3	54.3
	18	5	2	0.0	1.0	1.0	0.0	5.3	5.3
	18	6	7	0.0	0.0	0.0	0.0	0.0	0.0
	18	7	6	0.0	0.0	0.0	0.0	0.0	0.0
12/11/2019	7	1	1	0.0	0.0	0.0	0.0	0.0	0.0
	7	2	7	0.0	0.0	0.0	0.0	0.0	0.0
	7	3	4	0.0	0.0	0.0	0.0	0.0	0.0
	7	4	2	0.0	0.0	0.0	0.0	0.2	0.2
	7	5	6	0.3	0.3	0.7	0.0	0.0	0.0
	7	6	3	0.0	0.0	0.0	0.0	0.0	0.0
	7	7	5	0.0	0.0	0.0	0.0	0.0	0.0
	10	1	2	0.0	2.8	0.0	0.0	30.2	30.2
	10	2	6	0.0	0.2	0.0	0.0	0.0	0.0
	10	3	3	0.0	0.0	0.0	0.0	0.0	0.0
	10	4	5	0.0	0.0	0.0	0.0	0.5	0.5
	10	5	1	0.0	3.7	0.0	0.0	0.0	0.0
	10	6	7	0.0	0.0	0.0	0.0	0.0	0.0
	10	7	4	0.0	0.3	0.0	0.0	0.0	0.0
	11	1	7	0.0	11.0	0.0	0.0	1.0	1.0
	11	2	4	0.0	0.0	0.0	0.0	0.0	0.0
	11	3	2	0.0	0.0	0.0	0.0	0.0	0.0
	11	4	6	0.0	0.2	0.0	0.0	0.0	0.0
	11	5	3	0.0	0.0	0.0	0.0	0.0	0.0
	11	6	5	0.0	0.0	0.0	0.0	0.0	0.0
	11	7	1	0.0	0.0	0.0	0.0	0.0	0.0
	19	1	5	0.0	1.8	0.0	0.0	0.5	0.5
	19	2	1	0.0	3.0	0.0	0.0	0.0	0.0
	19	3	7	0.0	0.0	0.0	0.0	0.0	0.0
	19	4	4	0.0	2.7	0.0	0.0	0.0	0.0
	19	5	2	0.0	0.0	0.0	0.0	0.0	0.0
	19	6	6	0.0	0.0	0.0	0.0	0.0	0.0
	19	7	3	0.0	0.0	0.0	0.0	0.0	0.0

e. Photographs of the trial



Photograph 1 Some of the plots covered with fine mesh netting.



Photograph 2 Assessing aphid infestations on inoculated plants.



Photograph 3 Established colony of *Brevicoryne brassicae*

f. Field plan

sub-plot										
1	7	6	2	6	4	3	4	2	2	3
2	3	3	6	2	1	7	1	5	5	7
3	5	2	1	1	3	6	2	4	7	1
4	2	1	5	7	7	5	3	3	4	2
5	6	5	3	5	5	2	6	1	1	5
6	4	7	7	4	2	4	7	7	6	6
7	1	4	4	3	6	1	5	6	3	4
plot	11	12	13	14	15	16	17	18	19	20
inoc	4	1	5	3	5	1	2	3	4	2
1	5	1	2	3	7	3	1	7	7	5
2	2	4	6	7	4	6	4	4	4	1
3	1	3	7	2	5	5	6	6	3	3
4	7	2	1	6	6	4	3	3	2	7
5	4	7	4	4	2	2	7	1	6	4
6	6	6	5	1	3	1	5	5	1	2
7	3	5	3	5	1	7	2	2	5	6
plot	1	2	3	4	5	6	7	8	9	10
inoc	1	3	2	5	2	3	4	5	1	4



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Expiry date: **19 March 2022**

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