Project title:	**Brassicas Insecticide screen for aphid control options**
Project number:	FV 462
Project leader:	Angela Huckle, ADAS
Report:	Annual Report 2019
Previous report:	N/A
Key staff:	NIAB, PGRO, ADAS, Duchy College
Location of project:	Elsoms Trial Ground, Spalding. Lincs
Industry Representative:	Andy Richardson, Allium & Brassica Centre Will Illiffe, Southern England Farms
Date project commenced:	01 April 2019
Date project completed (or expected completion date):	31 Mar 2020

DISCLAIMER

While the Agriculture and Horticulture Development Board seeks to ensure that the information contained within this document is accurate at the time of printing, no warranty is given in respect thereof and, to the maximum extent permitted by law the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.

The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

Technology transfer

Updates of trial data were circulated to levy payers by AHDB Horticulture and to agchem companies who supported the trials with samples of products FOC.

Knowledge exchange events were also hosted on these occasions:

1. Elsoms variety field open day in Lincs – 9/10 October 2019
2. Presentation to the Brassica Growers Association – 8 October 2019
3. SW Brassica Trials presentation evening in Cornwall – 15 January 2020
4. Hutchinsons Vegetable Agronomy Update, Lincs – 21 January 2020

These events were well attended by a number of growers, agronomists, research providers, and seed producers etc.

Trials and brassica related updates are regularly featured on social media through twitter @AHDB_Hort @angela_huckle @ADAS_Hortic @ADAS_Group @BritishGrowers with a combined following of over 19,000 users.

BGA newsletters produced by AHDB are also used to circulate key dates and information.

Final Trial Report

Trial code:	FV 462
Title:	Horticulture Strategic Centres for Field Vegetables –Aphid Control
Crop	Group: field vegetables – Brassicas (Savoy cabbage)
Target	Aphid species of brassicas, particularly Cabbage aphid (*Brevicoryne brassicae)* and Peach-potato aphid (*Myzus persica*e)
Lead researcher:	Angela Huckle
Organisation:	RSK ADAS
Period:	1st June 2019 – 31st December 2019
Report date:	20th May 2019
Report author:	Angela Huckle Pete Seymour
ORETO Number: (certificate should be attached)	409

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

…… ……
… …
Date Authors signature

Screen of Insecticides for efficacy against aphids

Trial Summary

Take home message

Movento still offers good control of both the cabbage aphid (*Brevicoryne brassicae*) and the peach–potato aphid (*Myzus periscae*) on savoy cabbage, and if authorised in future FVSC03 also offers an effective alternative product with a different mode of action.

Introduction

The limited range of insecticide modes of action effective at targeting aphids and currently available for use in brassica crops leaves gaps for season long pest control, and growers can experience problems with this pest. With the loss of thiacloprid in 2020 (final use up date 3 Feb 2021), there is also a further gap with a loss of a mode of action, increasing the risk of the development of resistance to those remaining. For this reason it is necessary to test new products which are in the pipeline. Those evaluated are targeted either at application during propagation to protect the crop in its early stages of growth, or for later application for late flushes of aphids after the early applied insecticides have worn off.

The aphid species, *Myzus persica*e (Peach potato aphid) and *Brevicoryne brassicae* (Cabbage aphid) prove to be a consistent problem for growers every year. They can breed asexually and form large colonies very quickly, and are difficult to remove. Though natural predators do exist to attack aphid colonies, once the population increase is too high growers are left with little other option than chemical sprays. Further to this the Cabbage aphid (*Brevicoryne brassicae*) has a chemical defense that lowers the survival of some natural predator larvae making control by predators harder.

The objective of these trials was to identify crop-safe and effective insecticides for aphid control in brassica crops, aiming to expand the options available to growers.

Method

The trials were sited at Elsoms Trial Ground in Lincolnshire. The trial field was planted on 1st August 2019, with savoy cabbage (‘Sabrosa’).

Treatments were applied in propagation and post-planting. All treatments were applied with a 2 m boom, using a precision knapsack sprayer and at 300 L/ha water volume. A randomised block design was used for the trial layout, with two replicates of 12 treatments, including an industry control. There were 24 plots in total, with each plot measuring 2 m x 6 m. Post planting treatments were timed at first arrival of aphid nymphs (17 September – aphids seen on 12 September) and then two to three weeks after the first foliar application (2 October).

The plots were assessed on six occasions (see ‘Assessment details’), focussing on aphid abundance and species presence, and crop phytotoxicity (i.e. treatment safety). Assessments were carried out approximately two, four, six, eight, ten and twelve weeks after transplanting. 10 plants per plot were marked and then assessed at each timing.

Phytoxicity was assessed two, four and eight weeks after transplanting.

Results and discussion

There were no significant differences between the industry control and the treatments for either species of aphid.

All treatments with the exception of 2, 3 and 4 indicated greater levels of control than the old industry control (Dursban applied in propagation). However, only treatments 7, 8, 10, 11 and 12 had significantly lower abundances of both the cabbage aphid (*Brevicoryne brassicae)* and the peach potato aphid *(Myzus persicae)* across the assessment period (**Table 1**). The likely lack of control from treatments 2, 3 and 4 is because the first sightings of aphids arrived on 12 September which is six weeks after planting out and by which time these products applied in propagation would have worn off, and no further foliar insecticides were applied to these plots.

This indicates the necessity for effective foliar aphicides to control later infestations in the crop. Movento and the coded product FVSC03 performed consistently against cabbage aphids reducing the population significantly after two applications. Also, although there were no significant differences between treatments against peach-potato aphid, these two products also showed a trend for the lowest populations of the pest.

No signs of phytotoxicity were seen in the trial at any point, so it appears that the treatments are crop safe if applied in similar circumstances.

Table 1. Summary of two species of aphid abundance from key assessment timing (24th September 2019, twelve weeks post-treatment) and percentage control of the two aphid species compared to the old control (Calculated with Abbots formula). Starred and blue numbers represent a significant difference in control compared to the old control. **Aphid abundance data is shown as back transformed means.**

Trt no	Treatment program	Average Cabbage aphid abundance	Cabbage aphid % control (compared to Old control)	Average Peach-potato aphid abundance	Peach-potato aphid % control (compared to Old control)
1	Dursban (Old control)	5.15		1.467	
2	FVSC01 & Verimark drench	4.947	3.94	0.423	71.17
3	Verimark drench	0.829*	83.90	2.073	-41.31
4	FVSC01 & Tracer drench	15.193	-195.01	0.946	35.51
5	Tracer drench then FVSC01 foliar	0.526*	89.79	0	100.00
6	Tracer drench then FVSC02 foliar	0.45*	91.26	0.256	82.55
7	Tracer drench then FVSC03 foliar	0.295*	94.27	0	100.00
8	Tracer drench then Movento foliar	0.094*	98.17	0.072	95.09
9	Verimark drench then FVSC01 foliar	2.139	58.47	0.621	57.67
10	Verimark drench then FVSC02 foliar	0.547*	89.38	0.072	95.09
11	Verimark drench then FVSC03 foliar	0.056*	98.91	0.035	97.61
12	Verimark drench then Movento foliar	0*	100.00	0.035	97.61

Trt no	Treatment program	Average Cabbage aphid abundance	Cabbage aphid % control (compared to Old control)	Average Peach-potato aphid abundance	Peach-potato aphid % control (compared to Old control)
	F prob. value	<.001		0.13	
	d.f.	11		11	
	L.S.D.	0.4172		0.3663	

* Significantly different to old control

Conclusion

- All the treatments applied as above appear to be crop safe.
- Foliar sprays are still necessary for keeping control of aphid species later in the growing season.
- Treatments seven, eight, ten, eleven and twelve offered significantly more control than Dursban - the old industry control - for both aphid species.

Science Section

Objectives

To compare and demonstrate a number of new and novel insecticides at pre and post planting application timings for selectivity (crop safety) and efficacy in savoy cabbage.

Test site

Item	Details
Location address	Field: Elsoms Trial Ground off A16 PE11 3JG Lincolnshire Grid reference: TF 25745 25975
Crop ('cultivar')	Savoy cabbage ('Sabrosa')
Soil or substrate type	Loamy and clay soil of coastal flats with naturally high groundwater
Agronomic practice	See Appendix
Prior history of site	See Appendix

Trial design

Item	Details
Trial design:	Fully randomised block
Number of replicates:	2
Row spacing:	0.61 m (3 rows per 2 m wide plot)
Plot size: (w x l)	2 m x 6 m
Plot size:	12 m^2
Number of plants per plot:	approx. 33

Application schedule

Trt. No.	Timing A			Timing B			Timing C		
	Trt: product name or AHDB code	**Rate of active substance(s)** (g/ha)	**Rate of product** (L/ha or g/1000 plants)	**Trt: product name or AHDB code**	**Rate of active substance(s)** (g/ha)	**Rate of product** (L/ha or g/1000 plants)	**Trt: product name or AHDB code**	**Rate of active substance(s)** (g/ha)	**Rate of product** (L/ha or g/1000 plants)
1	Dursban (Old control)		6g/1000 plants	-	-	-	-	-	-
2	FVSC01 + Verimark drench		4g/ 1000 plants then 15ml/1000 plants +	-	-	-	-	-	-
3	Verimark drench		15ml/1000 plants	-	-	-	-	-	-
4	FVSC01 + Tracer drench		0.14 kg/ha then 12ml/1000 plants	-	-	-	-	-	-
5	Tracer drench		12ml/1000 plants	FVSC01 foliar		0.14 kg/ha	FVSC01 foliar		0.14 kg/ha
6	Tracer drench		12ml/1000 plants	FVSC02 foliar		0.8 kg/ha	FVSC02 foliar		0.8 kg/ha
7	Tracer drench		12ml/1000 plants	FVSC03 foliar		0.2 L/ha	FVSC03 foliar		0.2 L/ha
8	Tracer drench		12ml/1000 plants	Movento foliar		0.5 L/ha	Movento foliar		0.5 L/ha
9	Verimark drench		15ml/1000 plants	FVSC01 foliar		0.14 kg/ha	FVSC01 foliar		0.14 kg/ha

10	Verimark drench		15ml/1000 plants	FVSC02 foliar		0.8 kg/ha	FVSC02 foliar		0.8 kg/ha
11	Verimark drench		15ml/1000 plants	FVSC03 foliar		0.2 L/ha	FVSC03 foliar		0.2 L/ha
12	Verimark drench		15ml/1000 plants	Movento foliar		0.5 L/ha	Movento foliar		0.5 L/ha

Application details

	Timing A	Timing B	Timing C
Application date	01/08/2019	17/9/2019	02/10/2019
Time of day	06:20 – 07:10	14:30-15:30	13:15-13:45
Crop growth stage (Max, min average BBCH)	N/A (pre-planting)	19	19
Crop height (cm)	N/A	16	22
Crop coverage (%)	N/A	30	70
Application Method	spray	spray	spray
Application Placement	soil	Foliar	Foliar
Application equipment	AZO Plot	OFP	OFP
Nozzle pressure	2.5	2.5	2.5
Nozzle type	Flat fan	Flat fan	Flat fan
Nozzle size	02-F110	02-F110	02-F110
Application water volume (L/ha)	300	300	300
Temperature of air (°C)	18.6	15	13
Relative humidity (%)	91	54	52
Wind speed range (kph)	(NW) 12.0	17	18-23
Dew presence (Y/N)	Y	N	N
Temperature of soil (°C)	15.0	16	10
Wetness of soil	wet	Normal	Wet
Cloud cover (%)	100	30	55

Assessment details

Evaluation date	**Evaluation Timing** (DA)*	**Evaluation type**	**What was assessed and how** (e.g. dead or live pest; disease incidence and severity; yield, marketable quality)
15/08/2019	14	Efficacy Phyto	Aphid counts per plant, 10 plants per plot, note other pest presence. Phyto (scale 0-10, 10 = Dead).
29/08/2019	28	Efficacy Phyto	Aphid counts per plant, 10 plants per plot, note other pest presence. Phyto (scale 0-10, 10 = Dead).
12/09/2019	42	Efficacy	Aphid counts per plant, 10 plants per plot, note other pest presence.

Evaluation date	Evaluation Timing (DA)*	Evaluation type	What was assessed and how (e.g. dead or live pest; disease incidence and severity; yield, marketable quality)
26/09/2019	56	Efficacy Phyto	Aphid counts per plant, 10 plants per plot, note other pest presence. Phyto (scale 0-10, 10 = Dead).
10/10/2019	70	Efficacy	Aphid counts per plant, 10 plants per plot, note other pest presence.
24/10/2019	84	Efficacy Phyto	Aphid counts per plant, 10 plants per plot, note other pest presence.Phyto (scale 0-10, 10 = Dead).

* DA – days after application

Statistical analysis

The trial was a randomised block design, with treatments replicated twice. Each block comprised of 12 treatments, including an industry control.

As the distribution of aphids was uneven across each trial—which is not unexpected in field situations—there was a need to transform this data prior to analysis. To determine treatment efficacy, an angular transformation was performed then the back transformed means presented, from which the % reduction in aphids was calculated using Abbotts formula.

All data was analysed by ANOVA using Genstat 16.0 by Chris Dyer (ADAS).

Results

Phytotoxicity

Throughout this trial no signs of phytoxicity were noted in any of the plots at any of the assessment timings.

Efficacy

Two species of aphid were found on the crop during the trial duration, the cabbage aphid (*Brevicoryne brassicae)* and the peach-potato aphid *(Myzus persicae)*. The Cabbage aphid appeared first, in the sixth week (17 September) with the peach potato aphid arriving in the crop in the tenth week (10 October).

Cabbage Aphid (*Brevicoryne brassicae)* abundance:

Cabbage aphid results are presented in **Table 2** and **Figure 1** for the mean number of aphids per plant. These figures were used to calculate the reduction in aphid abundance compared to the industry control (using Abbotts formula), and these values are listed in **Table 3**.

Table 2. Mean abundances of the cabbage aphid (*Brevicoryne brassicae*) (transformed) at six, eight, ten and twelve weeks post transplantion. Values that are significantly different to untreated are starred and coloured blue.

Trt. No.	Mean cabbage aphid abundance							
	6 weeks		8 weeks		10 weeks		12 weeks	
	Ang	Back-trans	Ang	Back-trans	Ang	Back-trans	Ang	Back-trans
1	0	0	0	0	0.990	8.777	0.789	5.15
2	0	0	0.161	0.448	0.787	5.123	0.774	4.947

Trt. No.	Mean cabbage aphid abundance							
	6 weeks		8 weeks		10 weeks		12 weeks	
	Ang	Back-trans	Ang	Back-trans	Ang	Back-trans	Ang	Back-trans
3	0	0	0	0	0.609	3.067	0.262*	0.829*
4	0	0	0	0	1.168	13.728	1.209	15.193
5	0	0	0.060	0.149	0.387*	1.436*	0.184*	0.526*
6	0	0	0.067	0.167	0.225*	0.68*	0.161*	0.45*
7	0	0	0	0	0.175*	0.497*	0.112*	0.295*
8	0.130	0.35	0.211	0.626	0.045*	0.11*	0.039*	0.094*
9	0.050	0.122	0.209	0.617	0.600	2.981	0.497	2.139
10	0	0	0.118	0.311	0*	0*	0.189*	0.547*
11	0	0	0.039	0.094	0.071*	0.177*	0.024*	0.056*
12	0.141	0.385	0.042	0.102	0*	0*	0*	0*
F prob. value	0.292		0.492		0.003		<.001	
d.f.	11		11		11		11	
L.S.D.	0.1393		0.2481		0.5160		0.4172	

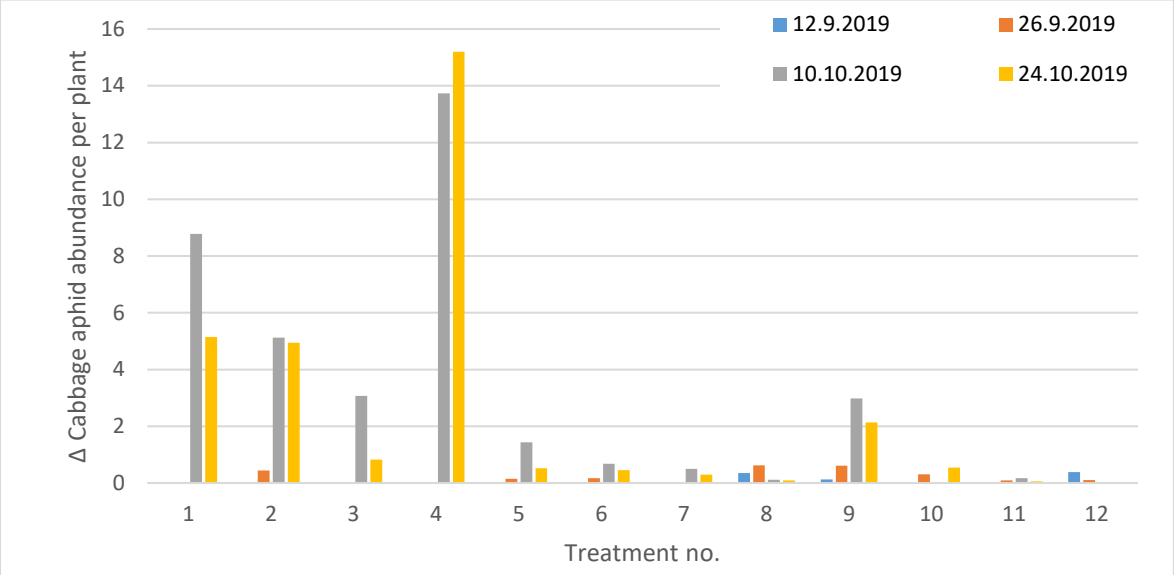

Figure 1. Mean cabbage aphid abundance (back transformed) at six, eight, ten and twelve weeks post-transplant.

Table 3. Percentage reduction in cabbage aphid abundance compared to the industry control at six, eight, ten and twelve weeks post transplantation. Abbots formula could not be applied for the 6 and 8 week periods because of a lack of the pest.

Treatment	Cabbage aphid reduction (%)			
	6 weeks	8 weeks	10 weeks	12 weeks
FVSC01 & Verimark drench	N/a	N/a	41.63	3.94
Verimark drench	N/a	N/a	65.06	83.90
FVSC01 & Tracer drench	N/a	N/a	-56.41	-195.01
Tracer drench then FVSC01 foliar	N/a	N/a	83.64	89.79
Tracer drench then FVSC02 foliar	N/a	N/a	92.25	91.26

Treatment	Cabbage aphid reduction (%)			
	6 weeks	8 weeks	10 weeks	12 weeks
Tracer drench then FVSC03 foliar	N/a	N/a	94.34	94.27
Tracer drench then Movento foliar	N/a	N/a	98.75	98.17
Verimark drench then FVSC01 foliar	N/a	N/a	66.04	58.47
Verimark drench then FVSC02 foliar	N/a	N/a	100.00	89.38
Verimark drench then FVSC03 foliar	N/a	N/a	97.98	98.91
Verimark drench then Movento foliar	N/a	N/a	100.00	100.00

All values except treatment four are positive, indicating lower levels of cabbage aphid than the industry control. Treatment four was negative indicating higher levels of cabbage aphid abundance than the control. Abbots formula could not be applied for the six and eight weeks due to a lack of aphids in the control.

Initial abundances of the cabbage aphid were low and inconsistent between treatments, it wasn't until the tenth week that all treatments had incidence of the pest. All the treatments with a Tracer drench pre-transplant and foliar sprays post-transplant (5-8) and the Verimark drenches with foliar sprays (treatments ten to twelve and treatment three) were significantly different from the industry control. The Verimark drench with FVSC02 foliar sprays and Verimark drench with Movento foliar spray performed particularly well.

Peach-potato aphid (*Myzus persicae)* abundance:
Peach potato aphid results are presented in Tab**le 4** and Fig**ure 2** as the mean number of aphids per plant. These figures were used to calculate the percent reduction in weed cover compared to the industry control (using Abbotts formula), and these values are listed in **Table 5**.

Table 4. Mean abundances of the Peach-potato aphid (*Myzus persicae)* (transformed) at six, eight, ten and twelve weeks after pre-planting treatment application. Values that are significantly different to untreated are starred and coloured blue.

Trt. No.	Mean peach-potato aphid abundance							
	6 weeks		8 weeks		10 weeks		12 weeks	
	Ang	Back-trans	Ang	Back-trans	Ang	Back-trans	Ang	Back-trans
1	N/a	N/a	N/a	N/a	0.711	4.144	0.392	1.467
2	N/a	N/a	N/a	N/a	0.868	6.373	0.153	0.423
3	N/a	N/a	N/a	N/a	0.497	2.141	0.488	2.073
4	N/a	N/a	N/a	N/a	0.51	2.236	0.289	0.946
5	N/a	N/a	N/a	N/a	0.108	0.282	0	0
6	N/a	N/a	N/a	N/a	0.359	1.286	0.099	0.256
7	N/a	N/a	N/a	N/a	0.015*	0.035*	0	0
8	N/a	N/a	N/a	N/a	0*	0*	0.03	0.072
9	N/a	N/a	N/a	N/a	0.015	0.035	0.21	0.621
10	N/a	N/a	N/a	N/a	0.107*	0.28*	0.03	0.072
11	N/a	N/a	N/a	N/a	0*	0*	0.015	0.035
12	N/a	N/a	N/a	N/a	0.03*	0.072*	0.015	0.035
F prob. value	N/a		N/a		0.05		0.13	

d.f.	N/a	N/a	11	11
L.S.D.	N/a	N/a	0.584	0.3663

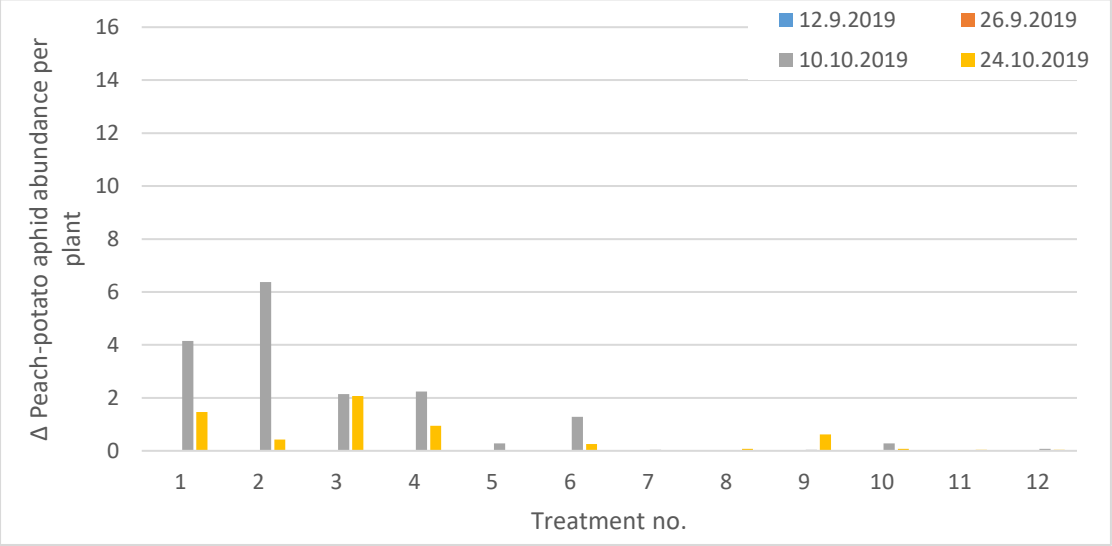

Figure 2. Peach-potato aphid abundance (back transformed) at six, eight, ten and twelve weeks post-transplant.

Table 5. Percentage reduction in peach-potato aphid compared to the industry control at six, eight, ten and twelve weeks after pre-planting treatment application. Abbots formula could not be applied for the 6 and 8 week periods because of a lack of the pest.

Treatment	Peach-potato aphid reduction (%)			
	6 weeks	8 weeks	10 weeks	12 weeks
FVSC01 & Verimark drench	N/a	N/a	-53.79	71.17
Verimark drench	N/a	N/a	48.33	-41.31
FVSC01 & Tracer drench	N/a	N/a	46.04	35.51
Tracer drench then FVSC01 foliar	N/a	N/a	93.19	100.00
Tracer drench then FVSC02 foliar	N/a	N/a	68.97	82.55
Tracer drench then FVSC03 foliar	N/a	N/a	99.16	100.00
Tracer drench then Movento foliar	N/a	N/a	100.00	95.09
Verimark drench then FVSC01 foliar	N/a	N/a	99.16	57.67
Verimark drench then FVSC02 foliar	N/a	N/a	93.24	95.09
Verimark drench then FVSC03 foliar	N/a	N/a	100.00	97.61
Verimark drench then Movento foliar	N/a	N/a	98.26	97.61

All values except treatment two and three are positive, indicating lower levels of peach-potato aphid than the industry control. Treatment two and three both had assessment periods in the

negative indicating higher levels of peach-potato aphid than the control. Abbots formula could not be applied for the six and eight weeks due to a lack of aphids in the control.

It should be noted that incidences of peach-potato aphid were low and therefore these results are an indication of possible trends.

It wasn't until the tenth week that the pest was noted consistently in the crop with most treatments having incidence of the pest. Treatments seven, eight, ten, eleven and twelve were significantly different from the industry control in the 10th week post-transplant but not in the 12th week post-transplant which saw no significant difference from the old industry control.

Discussion

Aphid incidence across the trial area was initially patchy at the start of the trial, but by the end there were aphids of both species in most plots in the trial (Averages of 0-15.1 per plant - *Brevicoryne brassicae* and 0-6.3 per plant- *Myzus persicae*).

No treatments had significantly worse control than the industry control for either species of aphid.

The pre-transplant propagation treatments of FVSC01 with Verimark drench (treatment two) and the Verimark drench (treatment 3) had periods where the control was less than that of the industry control for controlling *Myzus persicae*. FVSC01 and Tracer drench also had less control than the industry control for *Brevicoryne brassicae* at both the ten and twelve week assessments. Indicating that while these treatments are useful for controlling early infestations, foliar sprays are still required for control to remain effective later in the season as these propagation treatments had worn off by the time of the infestation.

All of the other treatments indicated greater levels of control than the old industry control. However, only the treatments with either a Tracer drench and either FVSC03 or Movento foliar sprays (Treatments seven and eight) or the treatments with a Verimark drench and either FVSC02, FVSC03 or Movento foliar sprays (Treatments ten, eleven and twelve) had significantly lower abundances of both the cabbage aphid (*Brevicoryne brassicae)* and the peach potato aphid *(Myzus persicae)* across the assessment period.

No signs of phytotoxicity were seen in the trial, so it appears that the treatments are crop safe if applied in similar circumstances.

Conclusions

- All the treatments applied as above appear to be crop safe.
- Foliar sprays are still necessary for keeping control of aphid species later in the growing season.
- Treatments seven, eight, ten, eleven and twelve offered significantly more control than the old industry control for both aphid species.

Acknowledgements

AHDB for funding the work, and also the crop protection companies for their financial contributions and provision of samples for the trials. Thanks too to Elsoms Seeds, who provided sites and crop for the trials, and to Carl Sharp of the Allium and Brassica Centre, for site management and treatment application.

Appendix

a. Crop diary – events related to growing crop

Crop	**Cultivar**	**Planting date**	**Row width** (m)
Savoy cabbage	Sabrosa	01/08/2019	0.61 m

Previous cropping

Year	**Crop**
2018	PSB/cauliflower (half of the trial area)
2017	Rye (cover crop)
2016	Bare ground

Cultivations

Date	**Description**	**Depth** (cm)
Mar 2019	Power harrowed and rolled prior to planting.	Mar 2019
Dec 2018	Subsoiled and winter ploughed.	Dec 2018

Active ingredients(s)/fertiliser(s) applied to trial area

Date	**Product**	**Rate** (kg/ha)
Mar 2019	Base fertiliser	250 kg/ha 10-15-21 + 20SO3
Mar 2019	Top dressing	80 kg/ha N 26N + 35SO3

Pesticides applied to trial area

Date	**Product**	**Rate** (L/ha)
N/a	N/a	N/a

Details of irrigation regime

Date	**Type, rate and duration**	**Amount applied** (mm)
N/a	**N/a**	**N/a**

b. Table showing sequence of events by date – this relates to treatments and assessments.

	Date	Event
TRIAL 1	01/08/2019	Pre-planting treatments applied. Crop planted.
	15/08/2019	Assessment, two weeks after treatment (phyto/aphid counts).
	29/08/2019	Assessment, four weeks after treatment (phyto/ aphid counts).
	12/9/2019	Assessment, six weeks after treatment (aphid counts).
	26/09/2019	Assessment, eight weeks after treatment (phyto/ aphid counts).
	10/10/2019	Assessment, ten weeks after treatment (aphid counts).
	24/10/2019	Assessment, twelve weeks after treatment (aphid counts).

c. Climatological data during study period from each site.

Date	Min. temp. (°C)	Max. temp. (°C)	Precip. (mm)
01/08/2019	15	22	4
02/08/2019	15	22	1
03/08/2019	12	23	0
04/08/2019	15	26	0
05/08/2019	14	24	2
06/08/2019	13	23	4
07/08/2019	13	24	0
08/08/2019	12	25	0
09/08/2019	16	26	16
10/08/2019	16	23	1
11/08/2019	11	20	1
12/08/2019	9	19	0
13/08/2019	10	19	2
14/08/2019	9	17	22
15/08/2019	10	20	2
16/08/2019	9	18	12
17/08/2019	12	22	5
18/08/2019	12	22	2
19/08/2019	10	22	0
20/08/2019	9	20	0
21/08/2019	12	22	0
22/08/2019	13	24	0

Date	Min. temp. (°C)	Max. temp. (°C)	Precip. (mm)
23/08/2019	13	26	0
24/08/2019	12	27	0
25/08/2019	14	30	0
26/08/2019	15	30	0
27/08/2019	16	30	0
28/08/2019	13	23	2
29/08/2019	11	22	1
30/08/2019	14	24	0
31/08/2019	9	22	0
01/09/2019	9	17	0
02/09/2019	8	19	0
03/09/2019	12	24	0
04/09/2019	13	19	2
05/09/2019	8	19	0
06/09/2019	10	19	0
07/09/2019	7	17	0
08/09/2019	5	18	0
09/09/2019	8	14	2
10/09/2019	10	18	0
11/09/2019	11	22	1
12/09/2019	9	24	0
13/09/2019	8	20	0
14/09/2019	6	22	0
15/09/2019	10	20	3
16/09/2019	10	17	7
17/09/2019	7	17	0
18/09/2019	6	18	0
19/09/2019	6	22	0
20/09/2019	8	20	0
21/09/2019	10	24	0
22/09/2019	12	23	3
23/09/2019	12	20	1
24/09/2019	14	18	16
25/09/2019	13	18	35
26/09/2019	12	20	5
27/09/2019	11	16	9
28/09/2019	11	18	16
29/09/2019	12	19	26
30/09/2019	8	16	14
01/10/2019	7	14	48
02/10/2019	5	13	0
03/10/2019	3	12	7
04/10/2019	10	15	8

Date	Min. temp. (°C)	Max. temp. (°C)	Precip. (mm)
05/10/2019	9	16	0
06/10/2019	9	14	15
07/10/2019	7	13	1
08/10/2019	9	16	0
09/10/2019	8	16	
10/10/2019	5	16	0
11/10/2019	12	16	6
12/10/2019	10	15	0
13/10/2019	8	14	22
14/10/2019	6	13	20
15/10/2019	10	13	11
16/10/2019	5	15	1
17/10/2019	3	13	1
18/10/2019	9	14	1
19/10/2019	7	14	1
20/10/2019	7	12	1
21/10/2019	9	13	1
22/10/2019	3	14	0
23/10/2019	4	14	1
24/10/2019	7	12	10
25/10/2019	6	15	2
26/10/2019	5	9	28
27/10/2019	3	12	0
28/10/2019	2	11	0
29/10/2019	2	12	2
30/10/2019	4	12	1
31/10/2019	3	11	0
01/11/2019	6	14	6
02/11/2019	8	14	10
03/11/2019	6	12	0
04/11/2019	7	12	2
05/11/2019	5	12	12
06/11/2019	3	8	1
07/11/2019	6	9	28
08/11/2019	3	8	6
09/11/2019	1	7	0
10/11/2019	4	10	0
11/11/2019	5	9	12
12/11/2019	4	8	1
13/11/2019	1	9	0
14/11/2019	4	8	39
15/11/2019	3	9	4
16/11/2019	6	9	1

Date	Min. temp. (°C)	Max. temp. (°C)	Precip. (mm)
17/11/2019	5	9	0
18/11/2019	1	8	0
19/11/2019	-3	5	0
20/11/2019	0	7	0
21/11/2019	2	7	0
22/11/2019	6	9	2
23/11/2019	7	10	10
24/11/2019	8	9	0
25/11/2019	7	11	6
26/11/2019	8	12	5
27/11/2019	7	10	26
28/11/2019	3	10	6
29/11/2019	1	7	0
30/11/2019	-3	5	0
01/12/2019	0	6	1
02/12/2019	-1	6	0
03/12/2019	1	8	0
04/12/2019	0	8	0
05/12/2019	0	10	1
06/12/2019	7	13	6
07/12/2019	7	10	0
08/12/2019	5	12	4
09/12/2019	0	7	0

d. Trial design

1	10	2	4	3	6
2	2	2	2	2	2
207	208	209	210	211	212
9	12	11	8	5	7
2	2	2	2	2	2
201	202	203	204	205	206
10	11	3	5	6	2
1	1	1	1	1	1
107	108	109	110	111	112
12	9	7	4	8	1
1	1	1	1	1	1
101	102	103	104	105	106

6	TREATMENT
2	BLOCK
212	PLOT

e. ORETO certificate

Certificate of

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

This certifies that

RSK ADAS Ltd

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
Stored Crops
Biologicals and Semiochemicals

Date of issue: 1 June 2018
Effective date: 18 March 2018
Expiry date: 17 March 2023

Signature Alison Richardson
Authorised signatory

Certification Number
ORETO 409

HSE
Chemicals Regulation Division

Department of Agriculture and Rural Development