SCEPTREPLUS

Final Trial Report

Trial code:	SP59 - W2021.013
Title:	Flea beetle (*Phyllotreta* spp.) infestations on brassicas
Crop	Group: Field vegetables – Pak Choi
Target	Flea beetle - *Phyllotreta* spp. - PHYESP
Lead researcher:	Rosemary Collier
Organisation:	University of Warwick, School of Life Sciences, Wellesbourne, Warwick CV35 9EF
Period:	April 2021 – June 2021
Report date:	31 December 2021
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.

31 December 2021

Rosemary Collier

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Date Authors signature

Trial Summary

Introduction

Eight species of *Phyllotreta* (flea beetles) feed on brassicaceous crops and weeds in the UK and they tend to be considered together. The older literature says that the period of greatest activity is from 10th April – 20th May but more recently, damage appears to have occurred over a more extended period. Consultation with growers and agronomists indicates that pak choi, Chinese cabbage, rocket, tatsoi and mizuna are all important susceptible crops. Many of the crops are drilled, but pak choi can be transplanted. The final target crop was chosen in consultation with key growers and the choice of treatments was informed by the likelihood of them being approved on the target crops and knowledge of the performance of certain products. Insecticides and bioinsecticides were considered (the latter are likely to have a shorter harvest interval).

Methods

Pak choi seed (cv F1 Goku) was sown into 308 Hassy trays containing M2 compost on 24 April 2021 and transplanted on 19 May. Transplanting into field plots was timed to coincide with the expected appearance of damaging numbers of flea beetles. The trial was designed for four replicates of ten treatments. Treatments were applied at sowing ("Phytodrip") or as post-planting sprays on two occasions (28 May and 11 June). Plant damage and flea beetle numbers were assessed on 1 to 2 June, 4 to 5 days after the first spray. Flea beetle numbers were further assessed three hours and 5 days after the second spray.

Results

Levels of flea beetle infestation were high and increased through the trial period. The results were analysed by ANOVA and are presented in Table A. Five days after the first spray only the standard Hallmark treatment significantly reduced the numbers of feeding holes compared with the untreated control and there were no statistically significant differences between numbers of flea beetles. When flea beetle numbers were assessed soon after the second spray (3 hours), Tracer, Spruzit and Hallmark significantly reduced flea beetle numbers compared with the untreated control. However, five days after the second spray there were no statistically significant differences between treatments.

Table A. Mean numbers of holes/leaf (transplanted pak choi) and mean number of flea beetles/plant. Sprays applied on 28 May and 11 June.

	Number of holes/leaf	Number of flea beetle/plant		
Treatment	2 Jun	2 Jun	11 Jun (3 hours post-spraying)	16 Jun
Control	32.96	0.94	1.54	3.35
Hallmark	23.90	0.52	0.04	2.45
AHDB9943 [1]	39.80	0.61	1.74	3.02
AHDB9943	32.89	0.74	0.84	2.67
Tracer	27.45	0.54	0.22	3.97
AHDB9946 [2]	34.91	0.85	1.01	2.80
AHDB9971 [2]	31.86	0.93	1.04	3.03
AHDB9967 [2]	31.98	0.74	1.34	2.92
AHDB9820 [2]	28.43	0.59	1.22	2.66
Spruzit [2]	28.03	0.57	0.06	3.20
F value	2.478	0.744	4.154	0.912
P value	0.043	0.666	0.001	0.528
s.e.d.	4.015	0.265	0.422	0.641
l.s.d.	8.376	0.541	0.862	1.310
d.f.	30	30	30	30

[1] "Phytodrip" at sowing. All other treatments were in-field sprays
[2] Bio-insecticide

Conclusion

Two treatments (Tracer and Spruzit) had similar efficacy to the standard Hallmark treatment but the persistence of all treatments was very short.

Take home message:

Tracer and Spruzit have been shown to have similar activity to the standard Hallmark treatment but do not appear to have any significant residual effects. High levels of flea beetle infestation may require regular treatment. However, none of the effective treatments were assessed on a field scale (rather than a plot scale) where a greater overall reduction in numbers of flea beetles may reduce the rate and level of re-infestation.

Objectives

1. To evaluate the effectiveness of conventional insecticides and bioinsecticides applied to control flea beetles on pak choi as measured by the level of infestation and crop damage.
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	Pak choi
Cultivar	F1 Goku
Soil or substrate type	Sandy loam
Agronomic practice	See Appendix A
Prior history of site	See Appendix A

Trial design

Item	**Details**
Trial design:	(4x5)/2 Trojan Square
Number of replicates:	4
Row spacing:	35 cm
Plot size: (w x l)	1.83 x 5 m
Plot size: (m^2)	9.2
Number of plants per plot:	80
Leaf Wall Area calculations	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						
Authorised for use in protected Pak Choi	Lambda cyhalothrin	Hallmark Zeon	BSN6I1972	100g/l	CS	Phase II
AHDB9943 [1]	Confidential					
AHDB9943	Confidential					
Tracer	Spinosad	Tracer	F056J72126	480 g/l	SC	Phase II
AHDB9946 [2]	Confidential					
AHDB9971 [2]	Confidential					
AHDB9967 [2]	Confidential					
AHDB9820 [2]	Confidential					
Spruzit [2] (No authorisation in Pak Choi)	Pyrethrins	Spruzit	364499	4.59g/l	EC	None

[1] "Phytodrip" at sowing. All other treatments were in-field sprays.
[2] Bioinsecticide.

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	Hallmark	10g	0.1l	B C
3	AHDB9943 [1]	1g/1000 seeds	2g/1000 seeds	A
4	AHDB9943	80g	0.16g	B C
5	Tracer	96g	0.2l	B C
6	AHDB9946 [2]	9.3g	1l	B C
7	AHDB9971 [2]	14.6g	0.56l	B C
8	AHDB9967 [2]	192g	3.2l	B C
9	AHDB9820 [2]	4080g	8l	B C
10	Spruzit [2]	275.4g	6l	B C

[1] "Phytodrip" at sowing. All other treatments were in-field sprays.
[2] Bioinsecticide.

Application details

	Application A	Application B	Application C
Application date	24/4/21	28/5/21	11/6/21
Time of day	16.00	11.00	11.00
Crop growth stage (Max, min average BBCH)	Seed	15-16	16-17
Crop height (cm)	N/A	3	3
Crop coverage (%)	N/A	5	7
Application Method	"Phytodrip"	Spray	Spray
Application Placement	Seed	Foliar	Foliar
Application equipment	Pipette	Berthoud Vermorel 2000HP	
Nozzle pressure	N/A	2 bar	
Nozzle type	N/A	02F110	02F110
Nozzle size	N/A	02	02
Application water volume/ha	0.2 ml/block	300l	300l
Temperature of air - shade (°C)	N/A	17	19
Relative humidity (%)	N/A	55	77
Wind speed range (m/s)	N/A	Light	Moderate
Dew presence (Y/N)	N/A	N	N
Temperature of soil - 2-5 cm (°C)	N/A	Not recorded	Not recorded
Wetness of soil - 2-5 cm	N/A	Dry	Dry
Cloud cover (%)	N/A	Not recorded	Not recorded

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
Flea beetles	*Phyllotreta* spp.	PHYESP	1-5 beetles/plant	1-5 beetles/plant	1-10 beetles/plant

Method

Pak choi seed (cv F1 Goku) was sown on 24 April 2021 into 308 Hassy trays containing M2 compost and plants were raised in a glasshouse. The trial consisted of 10 treatments and each replicate consisted of 80 plants. Plants were transplanted into Pump Ground on 19 May at a spacing of 25 cm within rows and 35 cm between rows to give 4 x 5m rows in each plot. Transplanting into field plots was timed to coincide with the expected appearance of damaging numbers of flea beetles.

Treatments were applied at sowing ("Phytodrip") or as post-planting sprays on two occasions (28 May and 11 June). The "Phytodrip" treatments were applied directly to

the seed after sowing in a small volume of water (0.2 ml) and the first spray treatments were applied as soon as damaging numbers of flea beetles were observed.

The numbers of flea beetles captured in 3 yellow water traps located in a nearby plot of swedes were recorded.

Assessment details

The plots were assessed for feeding damage ("shot" holes) and numbers of flea beetles on 1 to 2 June (4 to 5 days after the first spray). Flea beetle numbers were counted again 3 hours (11 June) and 5 days (16 June) after the second spray. Damage and flea beetle numbers were assessed on 14 plants from each of the middle two rows in each plot after the first spray and flea beetle numbers were assessed on 16 plants from each of the middle two rows in each plot after the second spray.

Germination and phytotoxicity were assessed on the sowing-time treatment on 8 May and phytotoxicity on transplants was assessed 5 days after the first sprays were applied.

	Evaluation Timing (DA)*				
Evaluation date	**After sowing**	**After sprays**	**Crop Growth Stage (BBCH)**	**Evaluation type (efficacy, phytotox)**	**Assessment**
8/5/21	14	n/a	12	Phytotoxicity	Germination and leaf damage
1 to 2/6/21	39	4 to 5 (first spray)	15	Phytotoxicity	Leaf damage
1 to 2/6/21	39	4 to 5 (first spray)	15	Efficacy	Flea beetle numbers and feeding hole numbers
11/6/21	46	0 (second spray)	16	Efficacy	Flea beetle numbers
16/6/21	51	5 (second spray)	17	Efficacy	Flea beetle numbers

* DA – days after application

Statistical analysis

This trial was designed as a Trojan square for 10 treatments in a (4*5)/2 design. The number of holes per leaf and the numbers of flea beetles per plant (3 assessments) were analysed by ANOVA using the Excel data package. In all cases plot means were used.

Results

Phytotoxicity

The number of seedlings which had germinated 14 days after sowing is shown in Table 1. No analysis was possible but it is clear that there is little difference between treated and untreated plants

Table 1 The number of healthy, unhealthy and missing plants 14 days after sowing and treatment with a “Phytodrip” treatment.

	Number of seedlings (1st sowing)		
Treatment	Healthy	Unhealthy	Missing
Control 1	298	3	7
Control 2	299	1	8
AHDB9943	296	4	8

Post-spraying in the field there was no evidence of phytotoxic effects with any treatment.

Flea beetles

The numbers of flea beetles (beetles per trap per day) captured in 3 yellow water traps in a plot of swedes close to the trial are shown in Figure 1. Numbers increased considerably between 25 and 28 May, when the first spray treatments were applied.

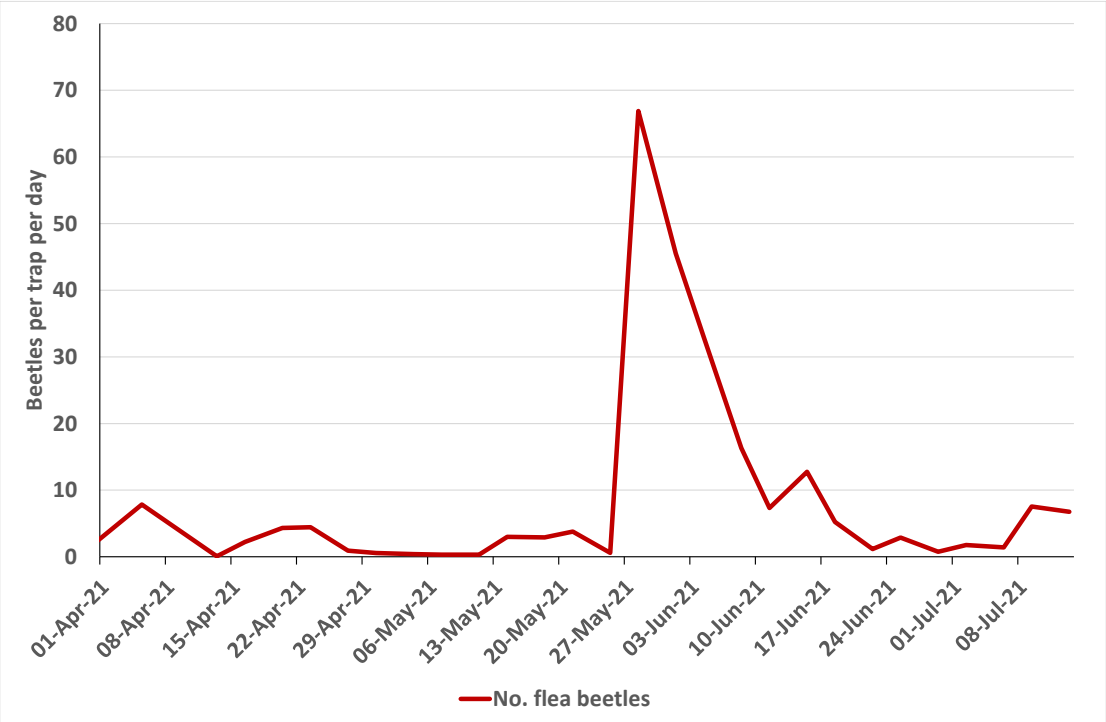

Figure 1. Numbers of flea beetles (beetles per trap per day) captured in 3 yellow water traps in a plot of swedes close to the efficacy trial.

The results for the number of feeding holes per leaf and numbers of flea beetles per plant are presented in Table 2 and Figures 2 - 4. For the assessment four to five days after the first spray (1 to 2 June), analysis of the number of feeding holes per leaf was statistically significant ($p<0.05$) but the only treatment that significantly reduced damage compared with the untreated control was the standard Hallmark treatment. Analysis of flea beetle numbers at this time was not statistically significant. When the plots were assessed on the same day as the second spray application (11 June) Hallmark, Tracer and Spruzit significantly ($p<0.05$) reduced flea

beetle numbers compared with the untreated control. Using the formula: % reduction = (number on untreated – number on treated)/number on untreated x 100 (Table 3) this equates to a percentage reduction in flea beetle numbers of 97.4, 85.7 and 96.1 for Hallmark, Tracer and Spruzit respectively.

Table 2 Mean numbers of holes per leaf and mean number of flea beetles per plant.

	Number of holes/leaf	Number of flea beetle/plant		
Treatment	1 to 2 Jun	1 to 2 Jun	11 Jun	16 Jun
Control	32.96	0.94	1.54	3.35
Hallmark	23.90	0.52	0.04	2.45
AHDB9943 [1]	39.80	0.61	1.74	3.02
AHDB9943	32.89	0.74	0.84	2.67
Tracer	27.45	0.54	0.22	3.97
AHDB9946 [2]	34.91	0.85	1.01	2.80
AHDB9971 [2]	31.86	0.93	1.04	3.03
AHDB9967 [2]	31.98	0.74	1.34	2.92
AHDB9820 [2]	28.43	0.59	1.22	2.66
Spruzit [2]	28.03	0.57	0.06	3.20
F value	2.478	0.744	4.154	0.912
P value	0.043	0.666	0.001	0.528
s.e.d.	4.015	0.265	0.422	0.641
l.s.d.	8.376	0.541	0.862	1.310
d.f.	30	30	30	30

[1] "Phytodrip" at sowing. All other treatments were in-field sprays
[2] Bioinsecticide

Table 3 Percentage reduction in flea beetle numbers compared with the untreated control.

	Percentage reduction in flea beetle numbers		
Treatment	2 Jun	11 Jun	16 Jun
Hallmark	44.7	97.4	26.9
AHDB9943 [1]	35.1	-13.0	9.9
AHDB9943	21.3	45.5	20.3
Tracer	42.6	85.7	-18.5
AHDB9946 [2]	9.6	34.4	16.4
AHDB9971 [2]	1.1	32.5	9.6
AHDB9967 [2]	21.3	13.0	12.8
AHDB9820 [2]	37.2	20.8	20.6
Spruzit [2]	39.4	96.1	4.5

[1] "Phytodrip" at sowing. All other treatments were in-field sprays
[2] Bioinsecticide

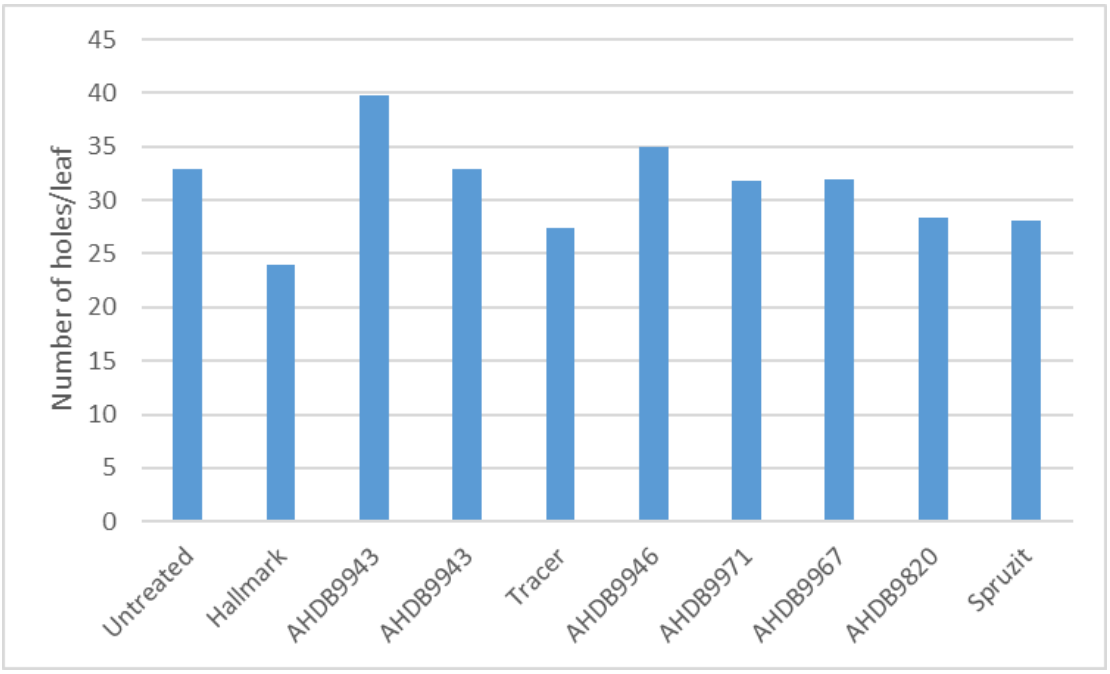

Figure 2 Mean number of flea beetle feeding holes per leaf on 1 to 2 June, 4 to 5 days after first spray.

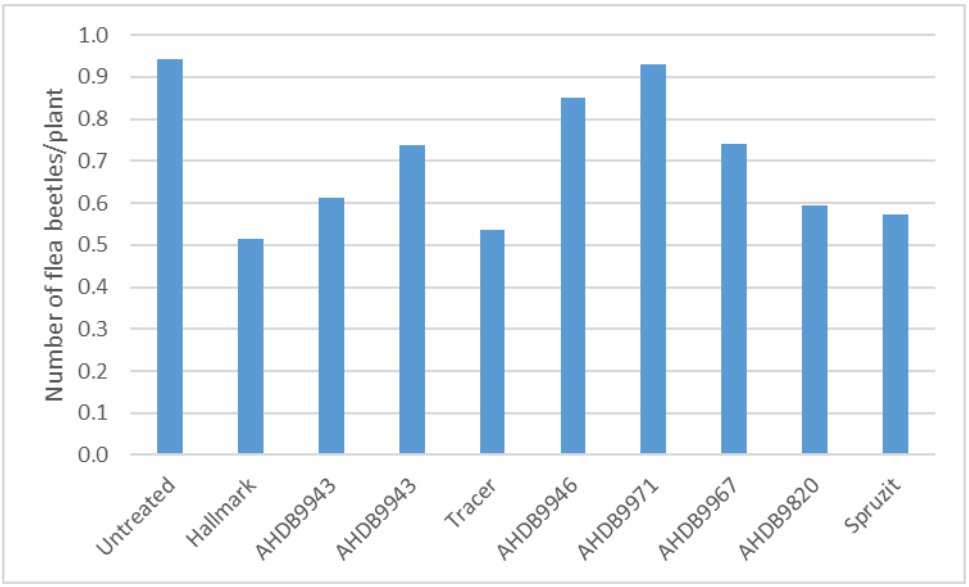

Figure 3 Mean number of flea beetles per plant on 1 to 2 June, 4 to 5 days after first spray.

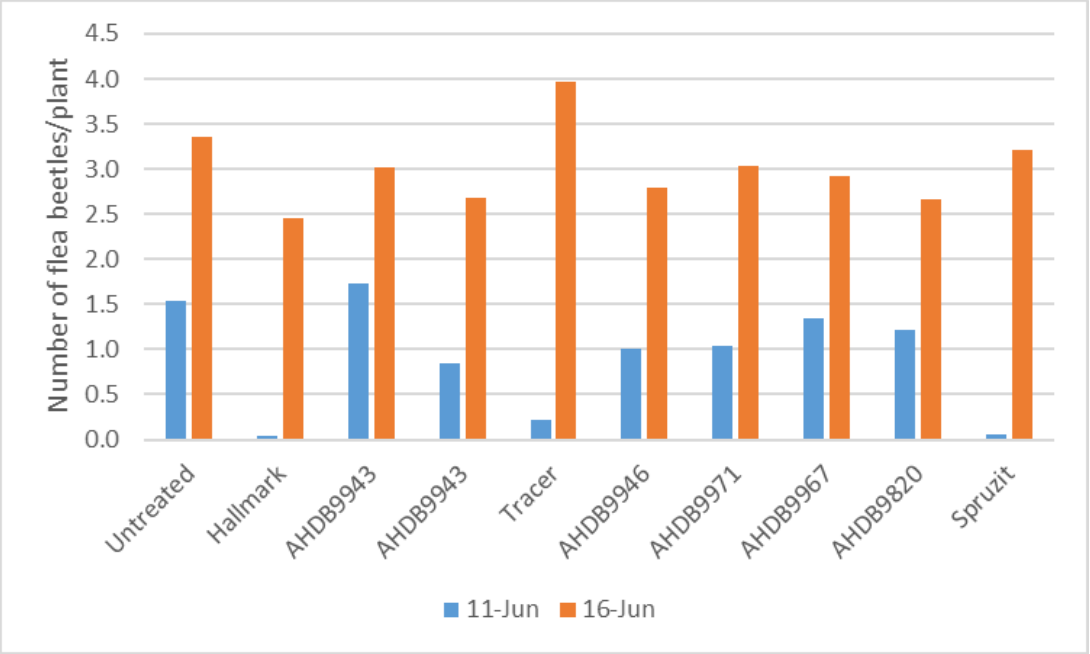

Figure 4 Mean number of flea beetles per plant on 11 June and 16 June, 3 hours and 5 days after second spray.

Discussion

Five days after the first spray application there were no statistically significant differences in the numbers of flea beetles between treatments. However, there was a significant reduction in plant damage with the standard Hallmark treatment compared with the untreated control. The sowing-time Phytodrip treatment was ineffective.

After the second spray application there was too much damage on all plants to differentiate between treatments, so it was only possible to count flea beetles which by this time (2 June vs 11 June) had increased considerably in numbers. First counts were done on the same day as the applications (11 June) and indicated that two treatments (Tracer and Spruzit) had similar efficacy to the standard Hallmark treatment and significantly reduced flea beetle numbers compared with the untreated control. Five days after application, efficacy had diminished considerably and there were no significant differences between treatments, which was probably due to the constant re-invasion by flea beetles, along with a lack of treatment persistence, or a need for direct contact with the spray.

Although Tracer and Spruzit have been shown to have similar activity to the standard Hallmark treatment none of the treatments appear to have any statistically significant residual effects. High levels of flea beetle infestation may require regular treatment. However, none of the effective treatments were assessed on a field scale (rather than a plot scale) where a greater overall reduction in numbers of flea beetles may reduce the rate and level of re-infestation.

All treatments mixed and sprayed well. There were no phytotoxic effects.

Conclusions

- Two treatments (Tracer and Spruzit) applied as foliar sprays significantly reduced flea beetle numbers compared with the untreated control and had similar efficacy to the standard Hallmark treatment.
- However, five days after application, efficacy had diminished considerably and there were no significant differences between treatments, which was probably due to the constant re-invasion by flea beetles, along with a lack of treatment persistence, or a need for direct contact with the spray.
- No treatments 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, Corteva, Eden Research, Fargro Limited, FMC, Gowan, Interfarm, Lallemand Plant Care, Novozymes, Oro Agri, Russell IPM, Sumitomo Chemicals, Syngenta and UPL.

Appendix

a. Crop diary – events related to growing crop

Crop	Cultivar	Planting/sowing date	Row width (m)
Kale	F1 Goku	24/5/21 (sowing)	
		19/5/21 (planting)	0.35

Previous cropping

Year	Crop
2019	Winter Barley
2020	Winter Wheat

Cultivations

Date	Description	Depth
29/9/20	Ploughing	25cm
12/5/21	Bed forming	15cm

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

Date	Product	Rate	Unit
29/9/20	0:20:20 NPK (Sheep Pens)	666	Kg/ha
12/5/21	Nitram (Sheep Pens)	100	Kg N/ha

Pesticides applied to the trial area

Date	Product	Rate	Unit
19/5/21	Sultan Metazachlor	1.5	l/ha

Details of irrigation regime

Date	Type, rate and duration	Amount applied (mm)
3/6/21	Wright Rain, 30 mins	2.5
23/6/21	Wright Rain, 30 mins	2.5

Other actions

Date	Action
19/5/21	Trial area fenced to exclude rabbits

b. Trial diary

	Experimental Diary
Date	Event
24-Apr	Seed sown
24-Apr	Phytodrip treatment applied
24-Apr	Plants raised in E8
14-May	Plants moved to GL5
19-May	Trial transplanted
28-May	Spray treatments applied
01-Jun	Rep 1 assessed
02-Jun	Reps 2-4 assessed
11-Jun	Spray treatments re-applied
11-Jun	Flea beetles counted (all plots)
16-Jun	Flea beetles counted (all plots)

c. Climatological data during study period

	Temperature		Rainfall (mm)
Date	Max 09-09	Min 09-09	Total 09-09
01/05/2021	11.9	1.1	1
02/05/2021	14.3	-0.7	0
03/05/2021	10.6	4.6	9.8
04/05/2021	11.5	6.6	1
05/05/2021	10.6	1.4	1
06/05/2021	11.9	3	0
07/05/2021	14.3	0.8	13.2
08/05/2021	14.9	5.6	6.4

09/05/2021	18.7	10.2	0.6
10/05/2021	15.8	9.5	4
11/05/2021	16.8	6.5	3.6
12/05/2021	16.1	5	1.8
13/05/2021	15.4	9.2	18.8
14/05/2021	13.4	7.4	0.6
15/05/2021	14.3	8.2	2.4
16/05/2021	16.1	6	0
17/05/2021	15.2	8.8	0.4
18/05/2021	15.7	5.5	2
19/05/2021	17.3	7.9	3.8
20/05/2021	13.5	4.3	7.2
21/05/2021	12.1	9.6	6.6
22/05/2021	12.8	7.9	2.4
23/05/2021	13.8	3	7.6
24/05/2021	13.5	5.7	1.8
25/05/2021	15.6	5.7	0
26/05/2021	14.8	4.7	0
27/05/2021	19.1	3.5	0
28/05/2021	17.1	8	0.2
29/05/2021	21.1	12.1	0
30/05/2021	20	5.9	0
31/05/2021	22.6	6.3	0
01/06/2021	24.6	8.6	0
02/06/2021	26.7	9.6	0
03/06/2021	20	16.2	0
04/06/2021	19	9.2	0
05/06/2021	21.8	7.4	1.2
06/06/2021	22	13.6	0
07/06/2021	22.3	14.1	0
08/06/2021	22.6	8.3	0
09/06/2021	23.7	8.8	0
10/06/2021	23.2	14.8	0
11/06/2021	20.7	16.3	0
12/06/2021	23.1	11.5	0
13/06/2021	26.6	9.2	0
14/06/2021	24.9	13.7	0
15/06/2021	24.1	7.6	0
16/06/2021	26.4	11.8	0.8
17/06/2021	22.4	14.8	3.2
18/06/2021	15.5	12.2	16
19/06/2021	17.3	11.7	7
20/06/2021	14.2	11.6	0
21/06/2021	16.6	9	0.8

22/06/2021	17	10	0
23/06/2021	21.9	4.5	0.6
24/06/2021	20.9	13.7	2
25/06/2021	17.7	13.3	0
26/06/2021	19.9	12.4	0
27/06/2021	18.3	13.4	4.6
28/06/2021	15.5	12.5	0
29/06/2021	17.9	13.2	0
30/06/2021	18.4	9.2	0

d. Raw data from assessments

Flea beetle damage and numbers (plot means) – 1 and 2 June 2021

Treatment	Plot number	No. plants	No. leaves	Holes	Holes/leaf	No. beetles	beetles/plant
1	9	27	4.9	153.0	31.8	17	0.63
1	17	28	6.1	212.1	34.0	35	1.25
1	25	28	5.2	171.8	33.0	9	0.32
1	32	28	5.9	278.6	47.6	44	1.57
2	5	26	5.2	126.2	24.4	10	0.38
2	13	28	6.4	155.4	23.9	27	0.96
2	27	28	5.8	136.1	23.3	9	0.32
2	31	28	6.2	156.4	25.0	11	0.39
3	7	27	5.4	221.5	41.4	15	0.56
3	11	27	6.0	242.2	41.2	29	1.07
3	24	27	5.7	206.7	36.8	12	0.44
3	39	27	5.8	220.7	38.6	10	0.37
4	4	27	5.5	168.9	30.8	25	0.93
4	19	28	5.7	156.8	27.5	15	0.54
4	22	28	5.6	224.3	40.5	19	0.68
4	36	27	6.0	189.3	31.3	22	0.81
5	1	27	5.6	167.4	29.8	12	0.44
5	16	28	5.4	167.5	30.2	26	0.93
5	30	26	4.5	100.8	22.4	7	0.27
5	38	28	6.2	171.4	27.1	14	0.50
6	6	29	5.4	250.3	46.3	47	1.62
6	20	28	4.8	124.3	26.7	12	0.43
6	23	28	5.8	182.5	31.7	22	0.79
6	37	28	5.8	156.1	26.3	16	0.57
7	8	26	5.8	176.2	30.7	17	0.65
7	15	28	5.4	147.1	27.3	31	1.11
7	21	28	6.0	224.3	37.6	26	0.93
7	34	27	6.3	189.3	30.4	28	1.04

8	3	28	5.7	208.6	36.7	20	0.71
8	18	26	6.0	175.8	28.8	26	1.00
8	29	28	5.4	159.3	30.4	10	0.36
8	33	28	5.6	195.4	34.9	25	0.89
9	2	28	5.2	153.2	29.4	16	0.57
9	14	28	5.9	163.9	27.6	36	1.29
9	26	28	5.4	148.9	28.3	8	0.29
9	40	26	5.2	115.4	22.4	6	0.23
10	10	27	4.5	103.3	23.1	3	0.11
10	12	28	6.0	185.4	30.3	29	1.04
10	28	28	6.0	185.0	30.7	17	0.61
10	35	28	5.5	143.6	26.3	15	0.54

Flea beetle numbers (plot means) – 11 June 2021

Treatment	Plot number	No. plants	No. beetles	beetles/plant
1	9	29	35	1.21
1	17	31	44	1.42
1	25	30	64	2.13
1	32	31	43	1.39
2	5	29	2	0.07
2	13	32	1	0.03
2	27	29	1	0.03
2	31	32	1	0.03
3	7	32	45	1.41
3	11	32	71	2.22
3	24	31	50	1.61
3	39	28	48	1.71
4	4	30	18	0.60
4	19	32	16	0.50
4	22	31	46	1.48
4	36	30	23	0.77
5	1	31	9	0.29
5	16	32	7	0.22
5	30	27	6	0.22
5	38	32	5	0.16
6	6	32	35	1.09
6	20	25	9	0.36
6	23	32	55	1.72
6	37	30	26	0.87
7	8	30	28	0.93
7	15	29	15	0.52
7	21	32	48	1.50
7	34	31	37	1.19

8	3	32	18	0.56
8	18	30	17	0.57
8	29	30	17	0.57
8	33	32	117	3.66
9	2	30	32	1.07
9	14	32	56	1.75
9	26	31	42	1.35
9	40	21	15	0.71
10	10	28	1	0.04
10	12	32	6	0.19
10	28	31	1	0.03
10	35	25	0	0.00

Flea beetle numbers (plot means) – 16 June 2021

Treatment	Plot number	No. plants	No. beetles	beetles/plant
1	9	29	91	3.14
1	17	31	138	4.45
1	25	30	96	3.20
1	32	31	81	2.61
2	5	29	74	2.55
2	13	32	96	3.00
2	27	29	64	2.21
2	31	32	65	2.03
3	7	32	87	2.72
3	11	32	116	3.63
3	24	31	97	3.13
3	39	28	73	2.61
4	4	30	69	2.30
4	19	32	88	2.75
4	22	31	116	3.74
4	36	30	57	1.90
5	1	31	142	4.58
5	16	32	143	4.47
5	30	27	75	2.78
5	38	32	130	4.06
6	6	32	83	2.59
6	20	25	35	1.40
6	23	32	148	4.63
6	37	30	77	2.57
7	8	30	131	4.37
7	15	29	71	2.45
7	21	32	107	3.34
7	34	31	61	1.97

8	3	32	92	2.88
8	18	30	128	4.27
8	29	30	85	2.83
8	33	32	54	1.69
9	2	30	85	2.83
9	14	32	122	3.81
9	26	31	75	2.42
9	40	21	33	1.57
10	10	28	68	2.43
10	12	32	121	3.78
10	28	31	134	4.32
10	35	25	57	2.28

e. Photographs of the trial

Pak choi with flea beetles before spraying

Pak choi with flea beetle damage after second spray

f. Field plan

5	9	8	4	2	6	3	7	1	10
1	2	3	4	5	6	7	8	9	10
3	10	2	9	7	5	1	8	4	6
11	12	13	14	15	16	17	18	19	20
7	4	6	3	1	9	2	10	8	5
21	22	23	24	25	26	27	28	29	30
2	8	1	7	10	4	6	5	3	9
31	32	33	34	35	36	37	38	39	40

1	Untreated control
2	Hallmark
3	AHDB9943 Phytodrip
4	AHDB9943
5	Tracer
6	AHDB9946
7	AHDB9971
8	AHDB9967
9	AHDB9820
10	Spruzit

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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Signature Alison Richardson
Authorised signatory

Certification Number
ORETO 381

HSE
Chemicals Regulation Division

Department of
Agriculture and
Rural Development