

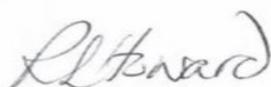
# SCEPTREPLUS

## Final Trial Report

<b>Trial code:</b>	SP22 Yr1
<b>Title:</b>	<b>Research for sustainable plant protection products for use in horticulture:</b> Evaluation of novel active substances for control of bean seed fly ( <i>Delia platura</i> )
<b>Crop</b>	Vining peas (also applicable in green beans, runner beans, broad beans, soya beans, maize):
<b>Target</b>	Bean seed fly
<b>Lead researcher:</b>	Becky Howard
<b>Organisation:</b>	PGRO
<b>Period:</b>	March 2019 to September 2019
<b>Report date:</b>	30 September 2019
<b>Report author:</b>	Becky Howard
<b>ORETO Number: (certificate should be attached)</b>	384

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

25<sup>th</sup> March 2020  
Date



Authors signature

## Trial Summary

### Introduction

Bean seed fly can be a pest of a wide range of crops, but is particularly damaging currently to legumes and alliums. Management of bean seed fly has always been challenging. In recent years the most effective insecticide treatments have been seed treatments. These have relied on a limited number of active ingredients and generally one active ingredient has been available for each crop. If these treatments are lost, for whatever reason, it leaves growers in a very vulnerable position. This has occurred recently in terms of the chlorpyrifos seed treatment on *Phaseolus* beans and thiamethoxam seed treatment on pea; for both crops treated seed was imported to the UK.

Following a review of control and management techniques for bean seed fly larvae (*Delia platura*), carried out by AHDB, PGRO and Warwick Crop Centre in 2018, it was determined that few studies have been undertaken recently. Those that have been undertaken indicated that best control was obtained using insecticidal seed treatments, but that in-furrow insecticide treatments also gave some useful control in some cases.

In 2019, a single replicated trial was conducted near Middleton-on-the-Wolds in the East Riding of Yorkshire in a commercial field of Vining peas (cultivar Boogie) on a clay loam soil to evaluate in-furrow treatments and an insecticidal seed treatment compared to insecticide-free control plots.

### Methods

The trial was drilled on 14 May 2019 using a GroMo plot drill. There were four replicates with a plot size of 1.8m x 5m. There were 9 treatments and a total of 36 plots. Treatments were added into the furrows after drilling, either by hand (for granules and powders) or using a knapsack sprayer (for liquids). The seed was treated using a Hege 11 seed treating machine. Assessments for damage were carried out by digging up plants and scoring damage to seeds and seedlings caused by bean seed fly larvae.

### Results

Date	Mean number of seedlings emerged per metre length of row		Mean number of seedlings not emerged per length of metre row	Mean number of damaged seedlings per metre length of row	Mean % reduction in damage per treatment
	31-May	06-June			
Treatment			06-June	06-June	06-June
1. Untreated	23.42	28.42	9.42	32.58	0
2. AHDB9837	26.92	34.83	6.00	33.08	-1.53
3. AHDB9836	32.67	40.50	0.75	5.50	83.12
4. AHDB9951	22.83	34.67	5.92	32.08	1.53
5. AHDB9968	23.33	30.08	4.50	29.75	8.70
6. AHDB9896	26.42	30.58	4.75	31.42	3.58
7. AHDB9833	25.58	27.25	6.58	29.00	11.00

8. AHDB9834	26.50	30.08	6.42	29.25	10.23
9. AHDB9835	24.67	27.08	7.42	30.42	6.65
	Not significantly different from insecticide-free control ( $p>0.05$ )				
	Significantly different from insecticide-free control ( $p<0.05$ )				

### Conclusions

In this trial none of the in-furrow treatments were effective in reducing damage to peas by bean seed fly larvae compared with the insecticide-free control.

The seed treatment AHDB9836 led to significantly reduced damage to seedlings by bean seed fly larvae compared to the insecticide-free plots.

## Objectives

To investigate whether in-furrow applications of novel active substances can reduce damage to legumes caused by the bean seed fly larva.

## Trial conduct

UK regulatory guidelines were followed but EPPO guidelines took precedence. The following EPPO guidelines were followed:

Relevant EPPO guideline(s)		Variation from EPPO
PP 1/152(3)	Design and analysis of efficacy evaluation trials	None
PP 1/135(3)	Phytotoxicity assessment	None
PP 1/181(3)	Conduct and reporting of efficacy evaluation trials including GEP	None
PP 1/34(2)	<i>Delia platura</i> and <i>Delia florilega</i>	A single trial was conducted at one site

There were no other deviations from EPPO guidance.

The following were also used for reference: PGRO SOP's E1 version 12 (receipt and storage of chemicals), E2 version 7 (measuring samples of chemicals), E3 version 8 (trial site and layout), E6 version 10 (recording data), E12 version 8 (statistical analysis), E24 version 4 (Bean seed fly).

## Test site

Item	Details
Location address	Wold Dyke Farm, Middleton on the Wolds, East Riding of Yorkshire, YO25 9DA (Grid Reference SE92814913)
Crop	Vining peas
Cultivar	Boogie
Soil or substrate type	Clay Loam
Agronomic practice	Conventional
Prior history of site	

## Trial design

Item	Details
Trial design:	Randomised complete block
Number of replicates:	4
Row spacing:	20cm
Plot size: (w x l)	1.8m x 5m
Plot size: (m <sup>2</sup> )	9m <sup>2</sup>
Number of plants per plot:	1125
Leaf Wall Area calculations	

### Treatment details

AHDB Code	Active substance	Product name/ manufacturers code	Formulation batch number	Content of active substance in product	Formulation type	Adjuvant
1. Untreated	-	-	-	-	-	-
2. AHDB9837	N/D	N/D	N/D	N/D	N/D	-
3. AHDB9836	N/D	N/D	N/D	N/D	N/D	-
4. AHDB9951	N/D	N/D	N/D	N/D	N/D	-
5. AHDB9968	N/D	N/D	N/D	N/D	N/D	-
6. AHDB9896	N/D	N/D	N/D	N/D	N/D	-
7. AHDB9833	N/D	N/D	N/D	N/D	N/D	-
8. AHDB9834	N/D	N/D	N/D	N/D	N/D	-
9. AHDB9835	N/D	N/D	N/D	N/D	N/D	-

### 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. Untreated				
2.	AHDB9837	74g /ha	0.185 kg/ha	A
3.	AHDB9836	15 g/ 100,000 seeds (187.5 g/ha based on 125 plants per m <sup>2</sup> )	0.9375 kg/ha	B
4.	AHDB9951	60 g/ha	0.3 l/ha	A
5.	AHDB9968	30 ml/ha	3.0 l/ha	A
6.	AHDB9896	18 kg/ha	40 kg/ha	C
7.	AHDB9833	60 g/ha	15 kg/ha	C
8.	AHDB9834	35 g/ha	0.175 l/ha	A
9.	AHDB9835	75 g/ha	0.75 l/ha	A

## Application details

	Application A	Application B	Application C
Application date	14 <sup>th</sup> May 2019	13 <sup>th</sup> May 2019	14 <sup>th</sup> May 2019
Time of day	Mid-day	Mid-day	Mid-day
Crop growth stage (Max, min average BBCH)	Seed	Seed	Seed
Crop height (cm)	0	0	0
Crop coverage (%)	0	0	0
Application Method	Spray	Seed treatment	Granule
Application Placement	In-furrow	On seed	In-furrow
Application equipment	Berthold knapsack sprayer	Hege 11	By hand
Nozzle pressure	N/D	NA	NA
Nozzle type	HYPRO Green	NA	NA
Nozzle size	0110 015	NA	NA
Application water volume/ha	330 l/ha	NA	NA
Temperature of air - shade (°C)	19°C	NA	19°C
Relative humidity (%)	40%	NA	40%
Wind speed range (m/s)	0-3 m/s	NA	0-3 m/s
Dew presence (Y/N)	N	NA	N
Temperature of soil - 2-5 cm (°C)	N/D	N/D	N/D
Wetness of soil - 2-5 cm	N/D	N/D	N/D
Cloud cover (%)	5%	5%	5%

- Poultry layers mash was applied to all treatments along the rows to ensure a sufficient level of infestation, at a rate of 50g per metre.
- Soil pH was 8.0, P, K and Mg indices were 2 (24.2mg/l), 1 (104mg/l) and 1 (47mg/l) respectively. Organic matter content was 6.3% and soil type is clay loam (27% sand, 47% silt, 26% clay). The soil analysis report is attached in the Appendix.
- Applications made by hand were applied to produce even distribution and correct placement in the soil to provide an equivalent application to commercial practice.
- Seed was treated using Hege 11 seed treating equipment by a qualified operator.

## 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
Bean seed fly	<i>Delia platura</i>	HYLEPL	NA	32.58 <sup>1</sup> (86%)	NA

<sup>1</sup> Mean number of seedlings damaged per metre length of row

## Assessment details

Assessments were carried out to evaluate the effects of treatments on emergence of seedlings and pest damage to seeds and seedlings. The assessments were carried out on 31 May 2019 and 06 June 2019. Three assessments were undertaken on each plot, using 3 x 1m rows per plot. In each row on 31 May, the number of seedlings that had emerged was recorded. On 6 June, the number of seedlings that had emerged was again recorded, seedlings were dug out of the ground and the number of non-emerged seedlings recorded. These were seedlings that had germinated but not emerged. An assessment of damage was carried out on all seedlings, both emerged and non-emerged. Damage caused to seeds and seedlings was recorded as follows: larval damage to seed was seed tunneling and damage to the outer layers, larval damage to seedlings was stem tunneling. The total amount of damage per plot was recorded, and no differentiation was made between seed and stem damage. Phytotoxicity was recorded at both assessments. Plant vigour was recorded at the second assessment using a scale of 0-10, 10 being high and 0 being low. Vigour was compared to the plots treated with Force ST, which showed high vigour.

Evaluation date	Evaluation Timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotox)	Assessment
31/05/19	17	80% emergence (GS BBCH 10)	Efficacy/ phytotoxicity	Number of plants emerged/ number of plants showing phytotoxicity per metre row
06/06/19	23	100% emergence (GS BBCH 13)	Efficacy/ phytotoxicity	Number of plants emerged/ number of plants not emerged/ number of plants damaged by bean seed fly larvae/ number of plants showing phytotoxicity per metre row/ plant vigour

\* DA – days after application

## Pest monitoring

An indication of the population density of adult bean seed flies at the site was obtained using a yellow sticky trap impregnated with a plant volatile lure containing chemical constituents of onion pulp. This was obtained from AgBio, Inc. US. <http://www.agbio-inc.com/seedcorn-and-onion-maggot.html>

Monitoring started on 9 May 2019 and ended on 22 July 2019.

## Statistical analysis

Data were analysed using ANOVA in STAR using an alpha level of 0.05. When evaluating damage caused by bean seed fly all treatments were compared with the insecticide-free control and no comparisons were made between treatments. When evaluating plant vigour, all treatments were compared with the plots that had been seed treated with AHDB9836.

## Results

### Phytotoxicity

No phytotoxic effects were observed on either of the assessment occasions.

### Efficacy

There were no significant differences between treatments in seedling emergence on 31 May 2019. The crop was approximately 80% emerged at the time of assessment.

		<b>Assessment 31 May 2019 <sup>a</sup> (80% emergence)</b>	
	<b>Product</b>	Mean number of seedlings emerged per metre length of row	Phytotoxicity symptoms
1. Untreated		23.42	0
2.	AHDB9837	26.92	0
3.	AHDB9836	32.67	0
4.	AHDB9951	22.83	0
5.	AHDB9968	23.33	0
6.	AHDB9896	26.42	0
7.	AHDB9833	25.58	0
8.	AHDB9834	26.50	0
9.	AHDB9835	24.67	0
		NS	
Alpha = 0.05			
	CV%	15.21	
	F <sub>8,35</sub>	2.31	
	P	0.0542	

<sup>a</sup> 17 days after treatment/ planting

Assessment 06 June 2019 <sup>b</sup> (100% emergence)								
	Product	Mean number of emerged seedlings per metre length of row	Mean number of non-emerged seedlings per metre length of row	Mean number of damaged seedlings per metre length of row	Mean % increase in emerged seedlings per metre length of row <sup>c</sup>	Mean % decrease in damaged seedlings per metre length of row <sup>c</sup>	Phytotoxicity symptoms	Mean vigour score per plot <sup>d</sup>
1	Untreated	28.42 <sup>ab</sup>	9.42	32.58 <sup>a</sup>	0	0	0	7.25 <sup>b</sup>
2	AHDB9837	34.83 <sup>ab</sup>	6.00	33.08 <sup>a</sup>	22.58	-1.53	0	7.75 <sup>ab</sup>
3	AHDB9836	40.50 <sup>a</sup>	0.75	5.50 <sup>b</sup>	42.52	83.12	0	10.00 <sup>a</sup>
4	AHDB9951	31.67 <sup>ab</sup>	5.92	32.08 <sup>a</sup>	11.44	1.53	0	7.75 <sup>ab</sup>
5	AHDB9968	30.08 <sup>ab</sup>	4.50	29.75 <sup>a</sup>	5.87	8.70	0	7.00 <sup>b</sup>
6	AHDB9896	30.58 <sup>ab</sup>	4.75	31.42 <sup>a</sup>	7.63	3.58	0	7.75 <sup>ab</sup>
7	AHDB9833	27.25 <sup>b</sup>	6.58	29.00 <sup>a</sup>	-4.11	11.00	0	7.75 <sup>ab</sup>
8	AHDB9834	30.08 <sup>ab</sup>	6.42	29.25 <sup>a</sup>	5.87	10.23	0	7.25 <sup>b</sup>
9	AHDB9835	27.08 <sup>b</sup>	7.42	30.42 <sup>a</sup>	-4.69	6.65	0	6.75 <sup>b</sup>
		SIG	NS	SIG				SIG
Alpha = 0.05								
	CV%	16.82	65.80	19.26				13.25
	F <sub>8,35</sub>	2.60	1.57	10.10				3.41
	P	0.0333	0.1856	<0.001				0.0092

Means with same letter are not significantly different (using Tukey's HSD test)

<sup>b</sup> 23 days after treatment/ planting

<sup>c</sup> Compared to the insecticide-free control

<sup>d</sup> Compared to treatment 3 (Force ST)

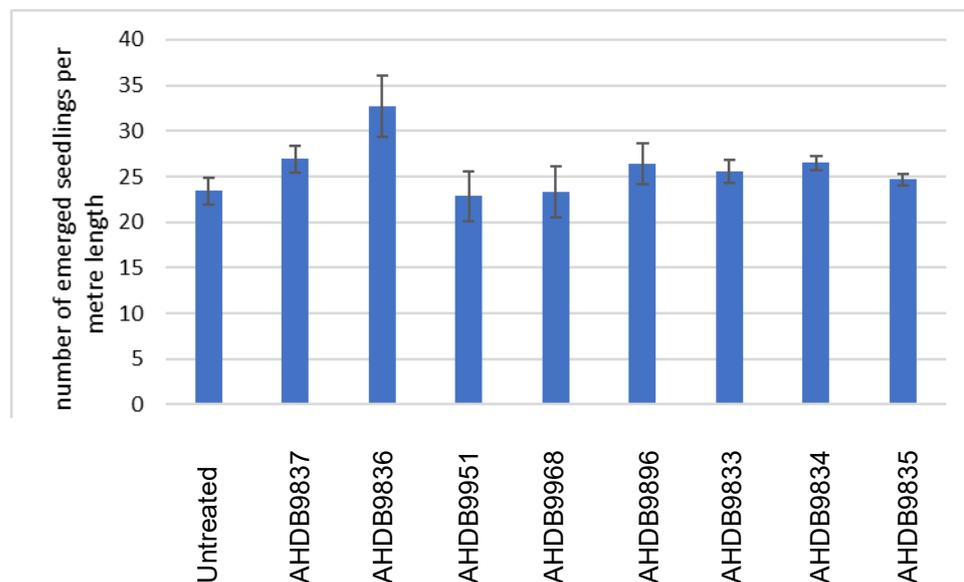


Figure 1: Mean number of pea seedlings emerged per metre length of row on 31 May 2019 at Middleton on the Wolds. Error bars show standard error of the means.

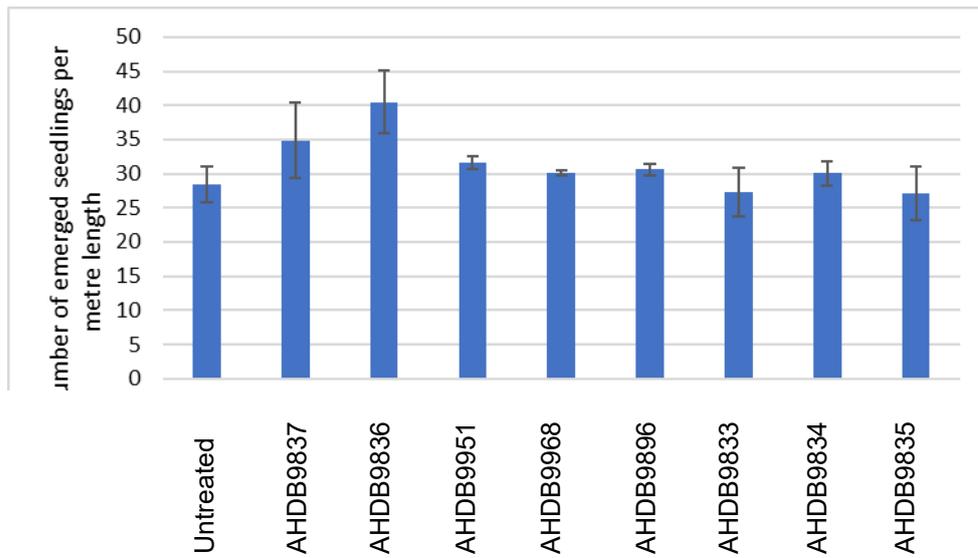


Figure 2: Mean number of pea seedlings emerged per metre length of row per treatment on 06 June 2019 at Middleton on the Wolds. Error bars show standard error of the means.

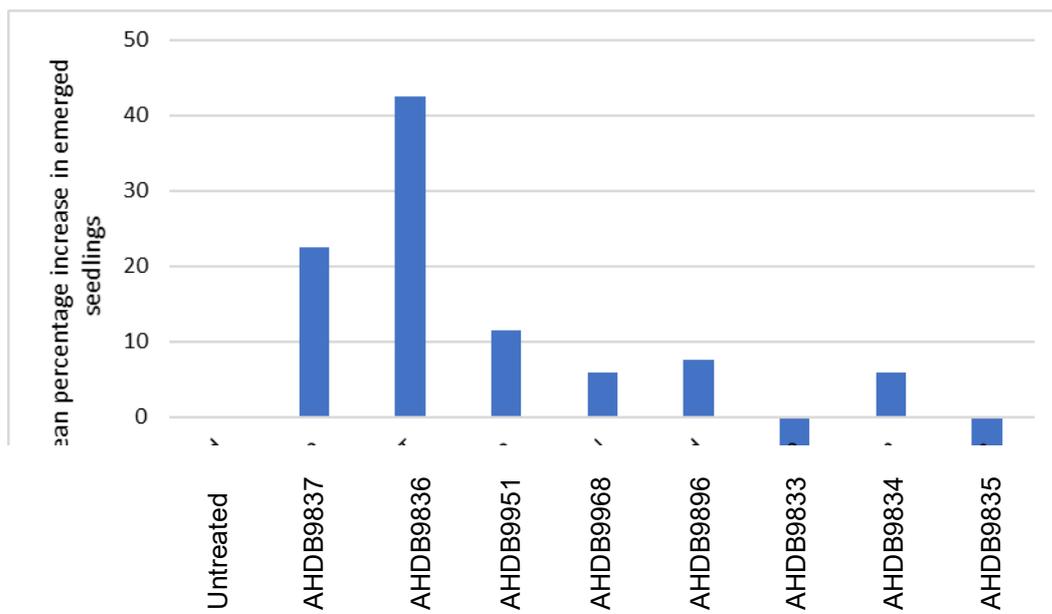


Figure 3: Mean percentage increase in number of pea seedlings emerged per metre length of row compared to the insecticide-free plots on 6 June 2019 at Middleton on the Wolds.

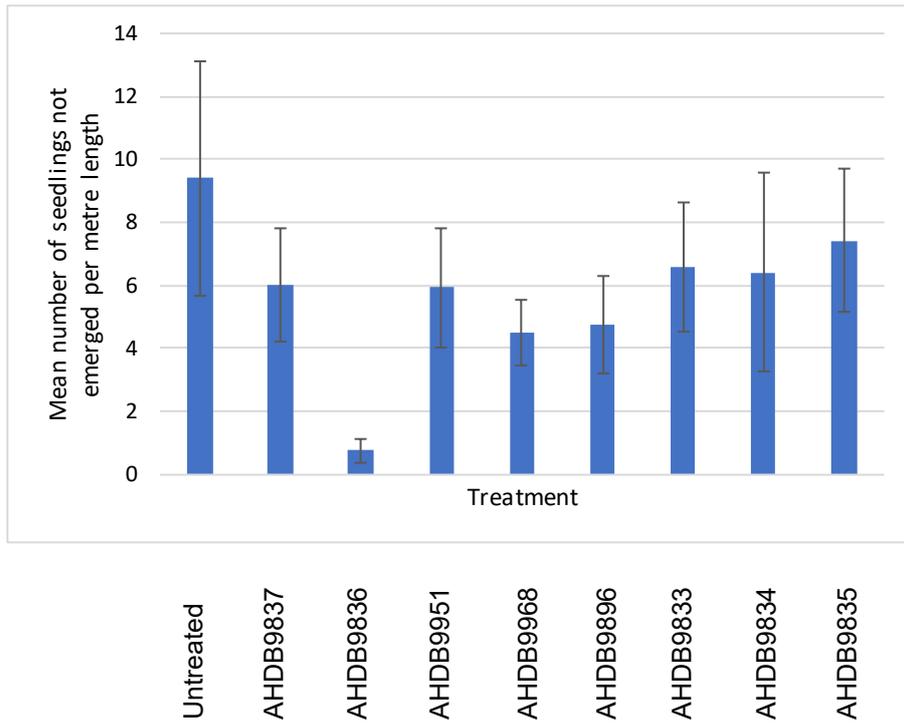


Figure 4: Mean number of pea seedlings that did not emerge per metre length of row on 6 June 2019 at Middleton on the Wolds. Error bars show standard error of the means.

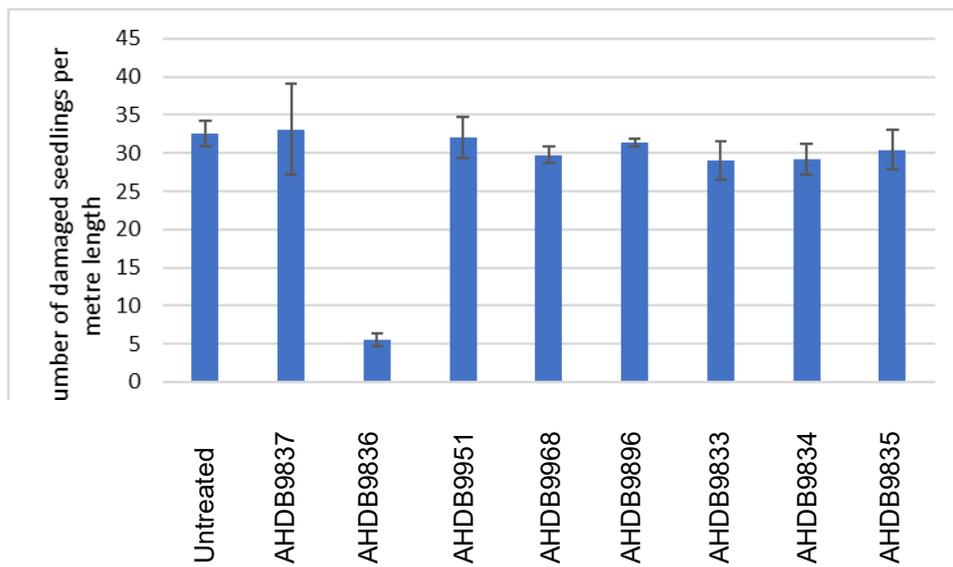


Figure 5: Mean number of pea seedlings damaged by bean seed fly larvae per metre length of row on 6 June 2019 at Middleton on the Wolds. Error bars show standard error of the means.

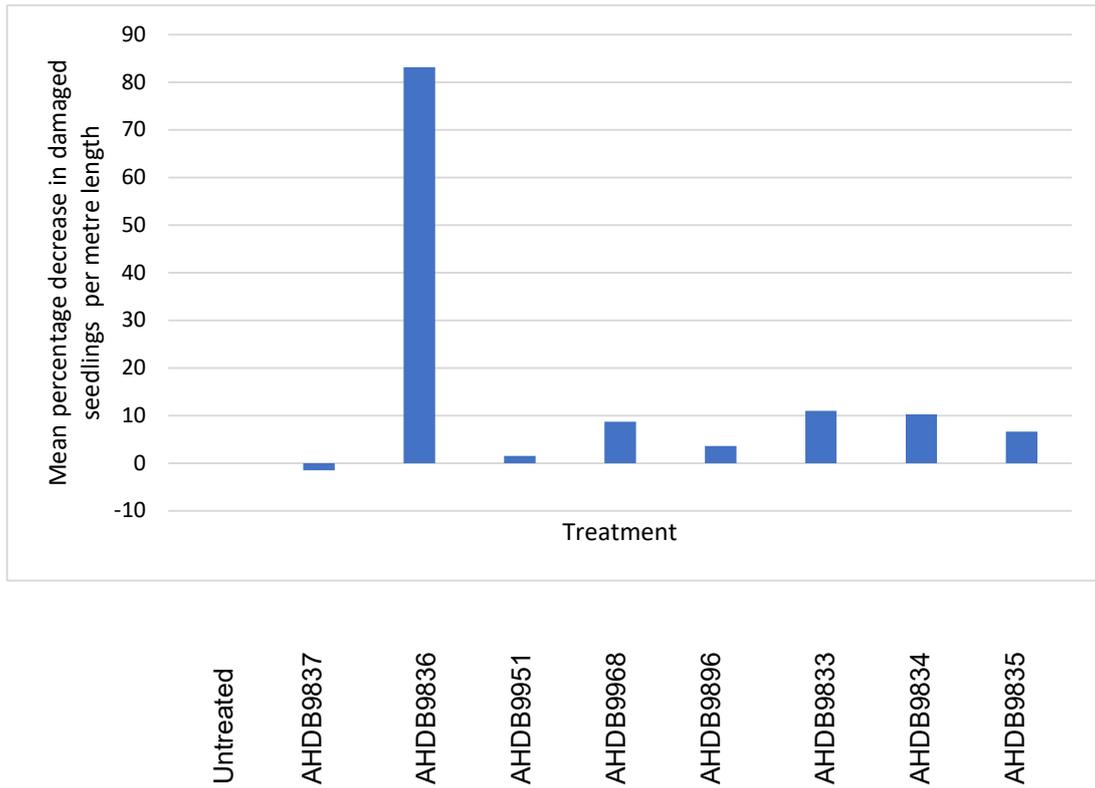


Figure 6: Mean percentage decrease in the number of pea seedlings damaged by bean seed fly larvae per metre length of row compared to the insecticide-free plots on 6 June 2019 at Middleton on the Wolds.

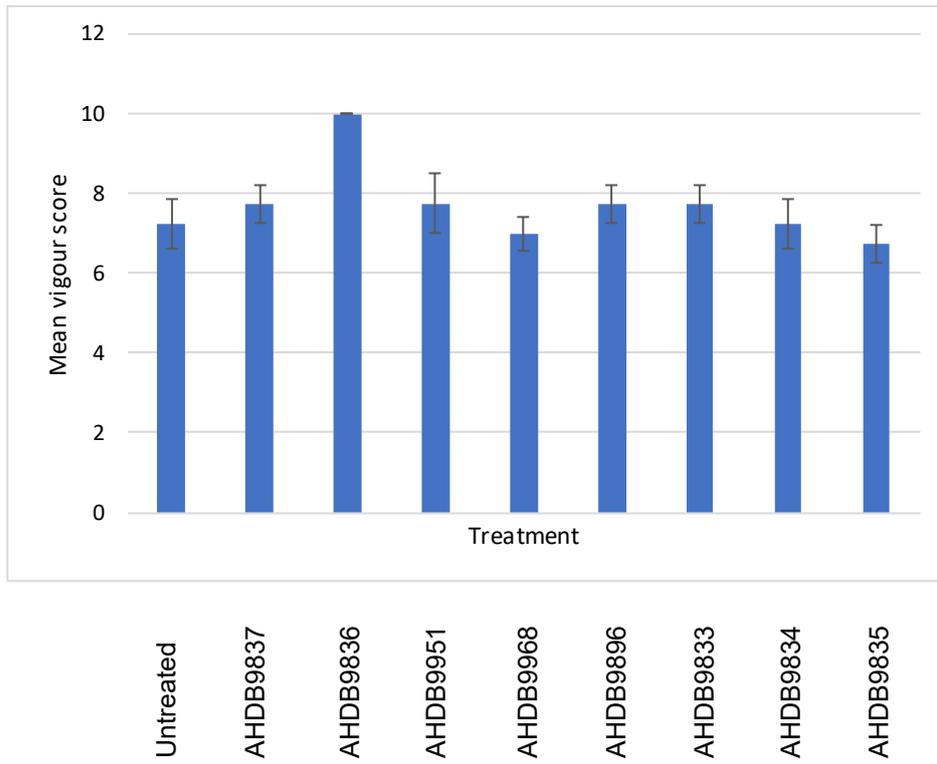


Figure 7: Mean vigour score on 6 June 2019 at Middleton on the Wolds. Error bars show standard error of the means.

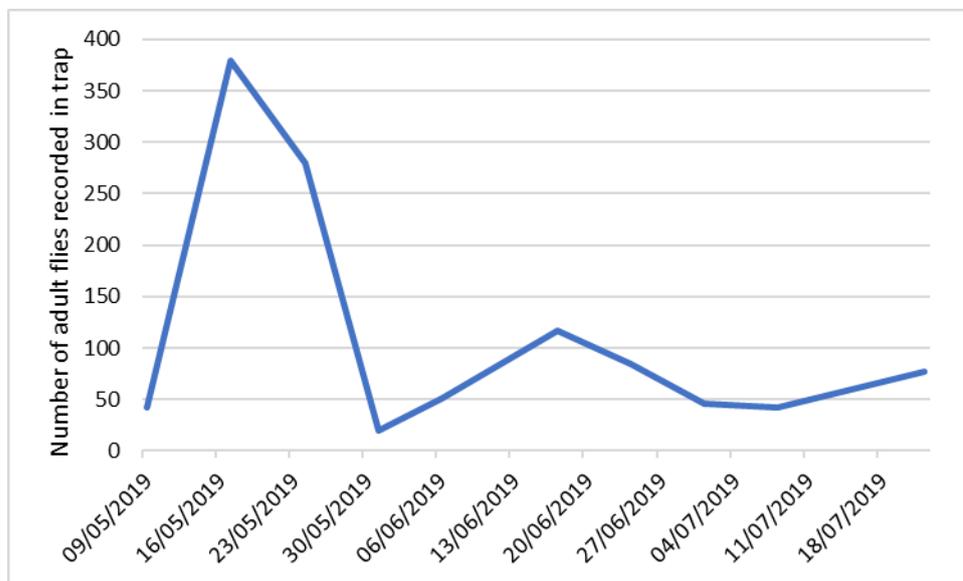


Figure 8: Number of adult bean seed flies captured on the baited sticky trap at Middleton on the Wolds from 9 May to 22 July 2019.

## **Discussion**

The trial was drilled under good soil and weather conditions on 14 May 2019. Discussion had taken place about the availability of drills that could place in-furrow treatments, and none were available in the UK. The decision was made, following consultation with the project managers, to apply treatments manually into the furrows. Liquid treatments were placed into furrows using a single nozzle backpack sprayer using multiple calibrations to deliver 330 litres of water per hectare. Granules were applied into the furrows by hand. At the time of drilling and treatment there were no concerns that treatment was not placed correctly. The seed treatment AHDB9836 was applied to seed on 13 May 2019.

At the assessment conducted on 31 May 2019, there were no significant differences in emergence between the treatments. Emergence was approximately 80% of full emergence and plants were at growth stage BBCH 10.

Crop growth stage at the second assessment on 6 June 2019 was BBCH 13 and there were no significant differences in emergence between any of the treatments and the insecticide-free plots, although there were significant differences between some of the treatments.

There was a significant reduction in damage caused to seedlings in the plots treated with AHDB9836 compared to the insecticide-free plots, but none of the in-furrow treatments showed any reduction in damage compared to the insecticide-free plots. Plants in the plots treated with AHDB9836 had significantly higher vigour than the insecticide-free plots.

Although the trial showed no effective control of bean seed fly larvae using in-furrow treatments, the level of infestation at the site was very high, with the percentage of plants damaged per plot ranging from 60% to 96% for in-furrow treatments, most being greater than 80% of plants damaged. The percentage of plants damaged per plot for those treated with AHDB9836 was between 6 and 17.5%. It is possible that with a lower bean seed fly infestation the in-furrow treatments might have shown more subtle differences compared to the insecticide-free plots. The presence of bean seed fly was indicated by the attractant trap records for the period during and following drilling, and high numbers of adult flies were recorded (Figure 8).

## **Conclusions**

None of the in-furrow treatments gave significant reduction in damage by bean seed fly larvae compared with the insecticide-free plots. The seed treatment AHDB9836 did, however, give a statistically significant reduction in bean seed fly damage to seedlings compared with the insecticide-free plots.

## **Acknowledgements**

Thank you to 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.

Thank you to Swaythorpe Growers Ltd. for providing the site, and general crop maintenance for the duration of the trial, as well as monitoring attractant traps throughout the season.

## Appendix

a. Crop diary – events related to growing crop

b. Trial diary

13 May 2019 – seed prepared and treated with AHDB9836 for treatment 3;

14 May 2019 – trial drilled, and treatments applied;

31 May 2019 – first plant count (plants emerged) and phytotoxicity assessment;

06 June 2019 – plant count (plants emerged, and seedlings not emerged), insect pest damage and phytotoxicity assessment;

Visits were made following the second assessment to evaluate the effects of foot rot diseases in plots, but no foot rot was recorded at any stage.

c. Trial Images



**Figure A: Larval tunneling in seed**



**Figure B: Larval tunneling on stem**



**Figure C: Damaged and undamaged pea plants**



**Figure D: Damaged and undamaged pea plants**



**Figure E: Pupa at base of pea plant**

d. Climatological data during study period

Name: Southburn, Driffield											
Temperature (°C)											
Rain (mm)											
Wind speed (mph)											
Date	Mean temp	High	Time	Low	Time	Rain	Avg wind speed	High	Time	Dom Dir	
01-May-19	11.1	18.4	13.30	3.4	5.15	0.0	2.0	11.0	12.30	ESE	
02-May-19	10.3	15.4	12.45	7.1	3.45	4.2	4.4	15.0	10.30	NE	
03-May-19	6.9	9.9	12.45	3.2	00.00	0.6	3.2	16.0	19.00	NNE	
04-May-19	6.2	10.3	14.45	1.7	3.45	1.4	7.8	31.0	10.45	N	
05-May-19	7.4	10.9	14.30	2.9	00.00	0.0	3.3	16.0	10.45	NW	
06-May-19	5.9	10.0	14.45	0.8	1.45	0.2	3.0	13.0	11.45	NE	
07-May-19	7.6	10.5	16.00	4.3	3.45	1.0	3.4	14.0	16.45	E	
08-May-19	8.6	9.6	10.30	7.6	0.15	13.8	9.5	27.0	12.15	E	
09-May-19	7.8	9.1	10.45	4.3	23.00	0.4	7.4	21.0	13.30	NNE	
10-May-19	7.1	11.3	14.45	0.4	5.30	0.2	2.6	12.0	18.45	ESE	
11-May-19	8.6	13.6	14.15	4.2	6.15	0.8	1.8	11.0	14.30	ENE	
12-May-19	8.9	15.1	13.30	0.1	5.45	0.0	3.2	18.0	17.00	SE	
13-May-19	11.1	19.7	16.45	0.4	4.30	0.0	2.9	13.0	12.45	SW	
14-May-19	12.9	20.9	15.45	3.4	5.30	0.0	2.2	10.0	10.00	SSW	
15-May-19	10.8	18.1	15.15	2.7	5.30	0.0	3.0	14.0	14.00	ESE	
16-May-19	10.8	15.4	14.30	2.9	1.45	0.0	5.3	20.0	14.45	E	
17-May-19	12.1	16.9	14.30	9.3	4.00	0.2	6.6	15.0	8.00	NE	
18-May-19	11.9	15.9	12.15	9.1	23.30	2.2	2.4	10.0	7.45	NE	
19-May-19	12.2	17.8	10.45	8.9	00.00	0.0	2.3	11.0	12.30	E	
20-May-19	12.5	18.4	12.45	7.8	23.15	0.0	1.8	12.0	13.30	E	
21-May-19	11.6	19.6	14.45	3.4	4.30	0.2	3.0	13.0	10.30	WNW	
22-May-19	13	19.7	16.30	3.9	5.00	0.0	5.1	20.0	17.45	W	
23-May-19	12.8	19.2	16.00	4.8	4.45	0.0	4.8	19.0	16.15	W	
24-May-19	12.7	19.4	13.00	6.5	5.00	0.0	3.5	13.0	13.45	W	
25-May-19	13.6	19.5	13.00	6.2	2.30	0.0	3.8	16.0	17.45	W	
26-May-19	15.8	19.8	14.30	11.2	22.30	0.4	9.7	28.0	15.45	W	
27-May-19	11.8	16.3	11.00	8.3	23.45	10.2	5.8	25.0	10.15	W	
28-May-19	10.1	14.1	16.00	8.1	00.00	5.4	2.1	15.0	17.00	ENE	
29-May-19	11.5	16.6	14.00	3.8	4.30	0.8	4.4	19.0	16.45	SW	
30-May-19	17.6	21.4	13.45	13.8	0.30	0.0	8.5	22.0	11.15	W	
31-May-19	17.4	20.7	13.00	14.2	5.15	0.0	6.2	18.0	10.15	WSW	
01-Jun-19	15.2	18.7	14.30	11.0	4.45	0.2	5.1	21.0	1.30	WSW	
02-Jun-19	16.7	21.9	11.45	11.2	00.00	0.2	9.0	30.0	14.45	SSW	
03-Jun-19	13.9	18.8	16.30	9.3	2.45	0.0	8.8	25.0	10.15	SW	
04-Jun-19	12.1	16.0	12.00	9.6	5.15	6.6	5.0	19.0	19.00	SE	
05-Jun-19	12.8	15.9	17.15	9.3	5.00	0.2	6.9	23.0	12.15	SSW	
06-Jun-19	14.2	18.7	16.30	10.4	5.30	0.0	4.8	21.0	14.15	WNW	
07-Jun-19	12.9	16.6	12.45	10.8	1.30	7.6	6.5	23.0	15.00	E	
08-Jun-19	12.2	15.8	11.45	10.6	23.15	0.8	4.8	21.0	13.15	WSW	
09-Jun-19	13.0	17.8	15.00	8.6	4.15	0.2	5.7	19.0	9.45	SW	
10-Jun-19	11.8	13.3	12.00	9.1	4.00	0.6	4.2	17.0	22.15	NNE	

Source: Swaythorpe Growers Ltd.

e. Raw data from assessments

BSF- SCEPTRE+					
Driffield Yorkshire Middleton 31/05/19					
Plant counts per metre length; 4 rows/m width					
Plot	Trt	Rep	No. plants		Phytotoxicity/ m length
			M row emerged/ length m row	emerged/ m length	
1	3	1	1	41	0
	3	1	2	41	0
	3	1	3	29	0
2	2	1	1	21	0
	2	1	2	39	0
	2	1	3	33	0
3	4	1	1	13	0
	4	1	2	44	0
	4	1	3	33	0
4	5	1	1	32	0
	5	1	2	26	0
	5	1	3	33	0
5	1	1	1	20	0
	1	1	2	22	0
	1	1	3	36	0
6	6	1	1	24	0
	6	1	2	28	0
	6	1	3	24	0
7	9	1	1	33	0
	9	1	2	21	0
	9	1	3	23	0
8	8	1	1	21	0
	8	1	2	33	0
	8	1	3	24	0
9	7	1	1	26	0
	7	1	2	32	0
	7	1	3	16	0
10	5	2	1	26	0
	5	2	2	23	0
	5	2	3	15	0
11	6	2	1	29	0
	6	2	2	23	0
	6	2	3	44	0
12	4	2	1	32	0
	4	2	2	20	0
	4	2	3	16	0
13	2	2	1	38	0
	2	2	2	26	0
	2	2	3	13	0
14	9	2	1	38	0
	9	2	2	21	0
	9	2	3	17	0
15	7	2	1	38	0
	7	2	2	25	0
	7	2	3	23	0
16	1	2	1	44	0
	1	2	2	10	0
	1	2	3	13	0
17	8	2	1	42	0
	8	2	2	26	0
	8	2	3	18	0
18	3	2	1	21	0
	3	2	2	19	0
	3	2	3	28	0
19	8	3	1	28	0
	8	3	2	23	0
	8	3	3	24	0
20	3	3	1	64	0
	3	3	2	14	0
	3	3	3	30	0
21	6	3	1	20	0
	6	3	2	28	0
	6	3	3	33	0
22	2	3	1	40	0
	2	3	2	14	0
	2	3	3	18	0
23	5	3	1	24	0
	5	3	2	6	0
	5	3	3	21	0
24	4	3	1	26	0
	4	3	2	24	0
	4	3	3	15	0
25	1	3	1	27	0
	1	3	2	38	0
	1	3	3	12	0
26	9	3	1	25	0
	9	3	2	18	0
	9	3	3	26	0
27	7	3	1	40	0
	7	3	2	24	0
	7	3	3	15	0
28	4	4	1	29	0
	4	4	2	17	0
	4	4	3	5	0
29	6	4	1	28	0
	6	4	2	21	0
	6	4	3	15	0
30	2	4	1	42	0
	2	4	2	17	0
	2	4	3	22	0
31	1	4	1	25	0
	1	4	2	16	0
	1	4	3	18	0
32	5	4	1	18	0
	5	4	2	32	0
	5	4	3	24	0
33	3	4	1	35	0
	3	4	2	38	0
	3	4	3	32	0
34	8	4	1	28	0
	8	4	2	29	0
	8	4	3	22	0
35	7	4	1	25	0
	7	4	2	18	0
	7	4	3	25	0
36	9	4	1	30	0
	9	4	2	19	0
	9	4	3	25	0

BSF- SCEPTR											
Driffield Yorks											
Plant counts per											
Bean seed fly metre length - number of plants damaged											
Plot	Trt	Rep	M row length / m row	Number of plants emerged / m row	Number of plants not emerged / m row	Number of plants damaged by BSF / m row	Phytotoxicity / length	Vigour / plot			
1	3	1	1	44	0	7	0	10			
			2	44	1	8	0				
			3	38	0	7	0				
2	2	1	1	51	2	51	0	9			
			2	45	2	42	0				
			3	52	1	44	0				
3	4	1	1	13	3	11	0	9			
			2	30	1	31	0				
			3	44	0	37	0				
4	5	1	1	25	3	26	0	7			
			2	36	3	39	0				
			3	32	0	26	0				
5	1	1	1	36	2	37	0	7			
			2	36	2	36	0				
			3	36	2	34	0				
6	6	1	1	32	1	33	0	7			
			2	32	2	31	0				
			3	28	5	31	0				
7	9	1	1	22	4	25	0	7			
			2	30	3	31	0				
			3	23	4	21	0				
8	8	1	1	38	2	38	0	9			
			2	23	1	24	0				
			3	24	1	24	0				
9	7	1	1	41	2	38	0	7			
			2	36	5	36	0				
			3	32	4	32	0				
10	5	2	1	24	1	20	0	8			
			2	43	8	44	0				
			3	21	2	20	0				
11	6	2	1	27	7	30	0	7			
			2	23	10	30	0				
			3	45	7	37	0				
12	4	2	1	46	2	37	0	9			
			2	32	6	29	0				
			3	20	5	25	0				
13	2	2	1	36	5	19	0	8			
			2	18	4	22	0				
			3	17	4	10	0				
14	9	2	1	17	12	22	0	6			
			2	31	12	40	0				
			3	13	18	29	0				
15	7	2	1	32	13	37	0	9			
			2	17	13	29	0				
			3	17	11	22	0				
16	1	2	1	32	15	42	0	7			
			2	28	26	34	0				
			3	15	15	29	0				
17	8	2	1	28	6	30	0	6			
			2	45	3	35	0				
			3	14	3	18	0				
18	3	2	1	32	0	2	0	10			
			2	33	0	6	0				
			3	38	0	7	0				
19	8	3	1	31	2	29	0	7			
			2	24	3	15	0				
			3	28	9	33	0				
20	3	3	1	51	0	8	0	10			
			2	17	4	5	0				
			3	37	1	6	0				
21	6	3	1	23	1	22	0	9			
			2	31	2	28	0				
			3	42	2	40	0				
22	2	3	1	41	8	41	0	7			
			2	19	11	30	0				
			3	29	9	35	0				
23	5	3	1	24	8	29	0	6			
			2	33	5	34	0				
			3	31	7	35	0				
24	4	3	1	42	12	50	0	7			
			2	29	12	39	0				
			3	25	5	28	0				
25	1	3	1	29	7	33	0	9			
			2	23	2	25	0				
			3	25	6	28	0				
26	9	3	1	26	8	32	0	8			
			2	15	7	19	0				
			3	33	5	33	0				
27	7	3	1	27	3	25	0	8			
			2	18	7	25	0				
			3	19	10	20	0				
28	4	4	1	38	7	37	0	6			
			2	27	12	31	0				
			3	34	6	30	0				
29	6	4	1	38	3	41	0	8			
			2	28	6	29	0				
			3	18	11	25	0				
30	2	4	1	60	10	52	0	7			
			2	30	6	28	0				
			3	20	10	23	0				
31	1	4	1	29	16	42	0	6			
			2	22	7	22	0				
			3	30	13	29	0				
32	5	4	1	34	4	28	0	7			
			2	21	7	20	0				
			3	37	6	36	0				
33	3	4	1	40	1	1	0	10			
			2	62	2	5	0				
			3	50	0	4	0				
34	8	4	1	27	41	28	0	7			
			2	46	3	42	0				
			3	33	3	35	0				
35	7	4	1	27	5	26	0	7			
			2	25	4	27	0				
			3	36	2	31	0				
36	9	4	1	42	4	38	0	6			
			2	37	8	39	0				
			3	36	4	36	0				

f. Soil analysis



<p>Contact : PGRO GREAT NORTH ROAD THORNHAUGH PETERBOROUGH PE8 6HJ Tel. : 01780 782585</p>	<p>Client : SCEPTRE AND BSF</p>
--	---------------------------------

**X494**

Please quote the above code for all enquiries

Sample Matrix : Agricultural Soil

Laboratory Reference	
Card Number	13110/19

Date Received	09-Jul-19
Date Reported	15-Jul-19

### SOIL ANALYSIS REPORT

Laboratory Sample Reference	Field Details			Index			mg/l (Available)		
	No.	Name or O.S. Reference with Cropping Details	Soil pH	P	K	Mg	P	K	Mg
56147/19	1	SCEPTRE + BSF <i>No cropping details given</i>	8.0	2	1	1	24.2	104	47

*If general fertiliser and lime recommendations have been requested, these are given on the following sheets.  
The analytical methods used are as described in DEFRA Reference Book 427  
The index values are determined from the DEFRA Fertiliser Recommendations RB209 9th Edition.*

Released by Gina Graham On behalf of NRM Ltd Date 15/07/19

NRM Coopers Bridge, Braziers Lane, Bracknell, Berkshire RG42 6NS  
Tel: +44 (0) 1344 886338 Fax: +44 (0) 1344 890972 Email: enquiries@nrm.uk.com www.nrm.uk.com

NRM Laboratories is a division of Cawood Scientific Ltd, Coopers Bridge, Braziers Lane, Bracknell, Berkshire RG42 6NS  
Registered Number: 05655711

**PAAG**  
Professional Agricultural Analysis Group

g. Trial design

<b>TRT</b>	<b>G</b>	<b>9</b>	<b>7</b>	<b>8</b>	<b>3</b>	<b>5</b>	<b>1</b>	<b>2</b>	<b>6</b>	<b>4</b>	<b>G</b>	REP 4
<b>PLOT</b>		36	35	34	33	32	31	30	29	28		
<b>TRT</b>	<b>G</b>	<b>8</b>	<b>3</b>	<b>6</b>	<b>2</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>9</b>	<b>7</b>	<b>G</b>	REP 3
<b>PLOT</b>		19	20	21	22	23	24	25	26	27		
<b>TRT</b>	<b>G</b>	<b>3</b>	<b>8</b>	<b>1</b>	<b>7</b>	<b>9</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>5</b>	<b>G</b>	REP 2
<b>PLOT</b>		18	17	16	15	14	13	12	11	10		
<b>TRT</b>	<b>G</b>	<b>3</b>	<b>2</b>	<b>4</b>	<b>5</b>	<b>1</b>	<b>6</b>	<b>9</b>	<b>8</b>	<b>7</b>	<b>G</b>	REP 1
<b>PLOT</b>		1	2	3	4	5	6	7	8	9		

h. ORETO certificate.

