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IPM
Examples in the Field - Bean Seed Fly

Rosemary Collier, Becca McGowan, Andrew Jukes, Marian Elliott, Becky Howard

Warwick Crop Centre, School of Life Sciences, University of Warwick
PGRO, Thornhaugh, Peterborough

BCPC Annual Pests and Beneficials Review, 26th January 2023

Introduction: What is the Bean Seed Fly?

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- Bean Seed Fly (BSF): Complex of two species (Diptera: Anthomyiidae)
- Root maggot: Feeding on the seed and stem of a wide range of crops
- The problem: Lack of effective insecticides (especially seed treatments)

Delia platura

Delia florilega

Symptoms of BSF damage

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Management of bean seed fly

- Wide range of host plants - greatest problems are with legumes and alliums
- Seed treatments are the most effective way to manage the pest but future not certain
- Research activities
  - Insecticides/bioinsecticides
  - PhD project Becca McGowan – investigating forecasts, monitoring, cultural control
  - Monitoring bean seed fly with SMART traps (EU H2020 SMARTPROTECT project)

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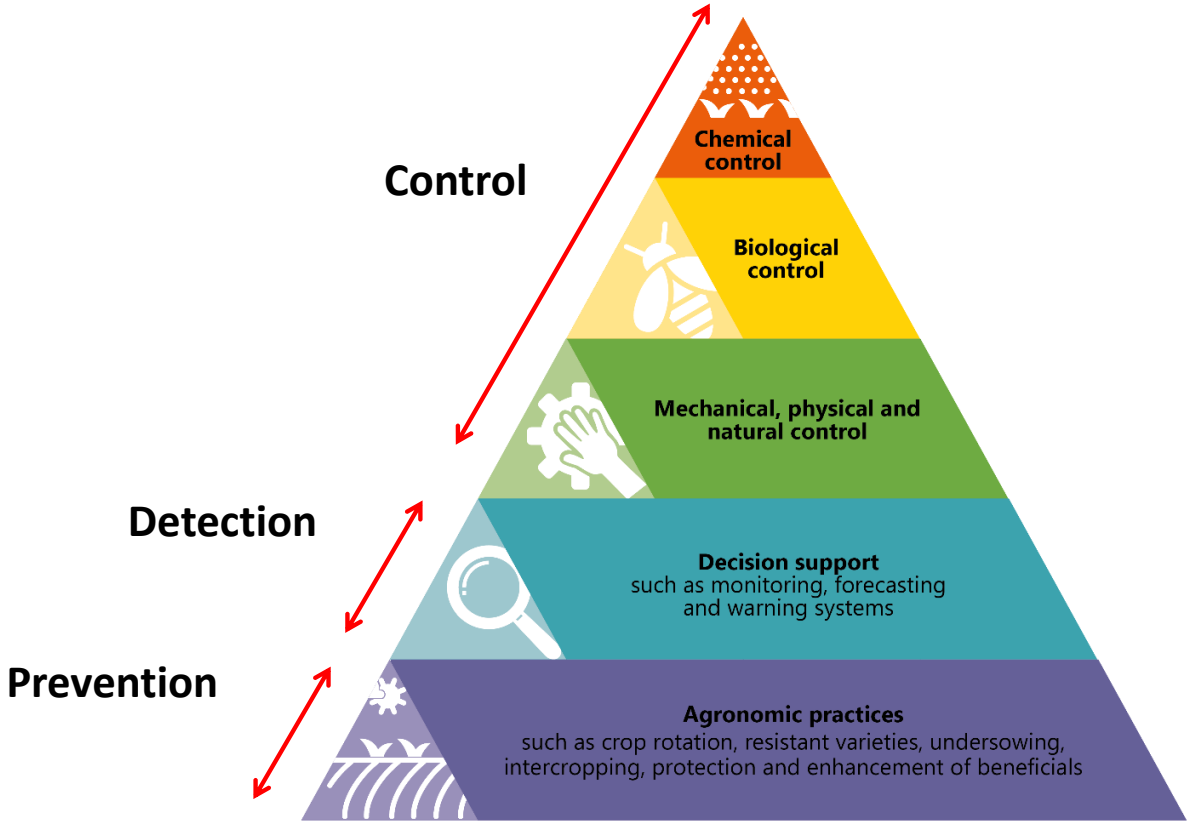
IPM


Control
Detection
Prevention
Chemical control
Biological control
Mechanical, physical and natural control
Decision support
such as monitoring, forecasting and warning systems
Agronomic practices
such as crop rotation, resistant varieties, undersowing, intercropping, protection and enhancement of beneficials

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PhD Project – Becca McGowan

Aim:

Contribute towards an integrated pest management strategy to reduce crop and economic losses caused by bean seed fly (BSF)

Objectives:

- Investigate overwintering biology of BSF
- Create and validate a model to predict spring emergence of BSF
- Identify effective trapping methods for monitoring BSF
- Assess strategies to reduce damage caused by BSF

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Cultivation (Agronomic practice) & Crop covering (Physical control)

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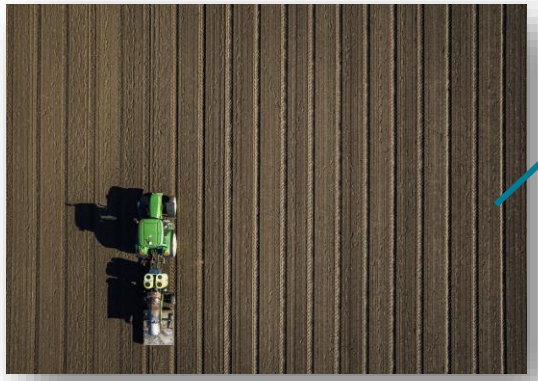
- **Cultivation:** BSF are stimulated to lay eggs in areas of organic matter such as recently cultivated soils



- **Covering the crop:** Row covers may prevent BSF from reaching the soil to lay eggs

1. Can the timing of cultivating a plot in relation to sowing the seed reduce damage caused by BSF?

2. Can the timing of covering a plot with a fine mesh in relation to sowing the seed reduce damage caused by BSF?

Why ask these questions?

Prevents larval feeding on the crop

Row cover, picture source: https://en.wikipedia.org/wiki/Row_cover

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Methods

- 2022 - 4 replicated field trials
- Organic matter added to trial area before initial cultivation
- Vining peas:
  - 46 seeds/m & 3 – 7 cm depth
  - 1 trial
- French beans:
  - 20 seeds/m & 3 – 7 cm depth
  - 3 trials
- Cultivation with power harrow & covering with 0.6 mm insect net

Number of emerged plants

Cultivation (days before sowing)	Crop Covering Timing
21	No covering
14	Day of sowing
7	Day after sowing
3	
1	
0	

Number of ‘baldheaded’ plants

Number of seeds/plants containing larvae

Number of seeds with suspected BSF tunnelling

Vining Peas – 2022

- No significant difference but a trend?
- Large variation
- High level of disease?

Number of seeds with suspected BSF tunnelling

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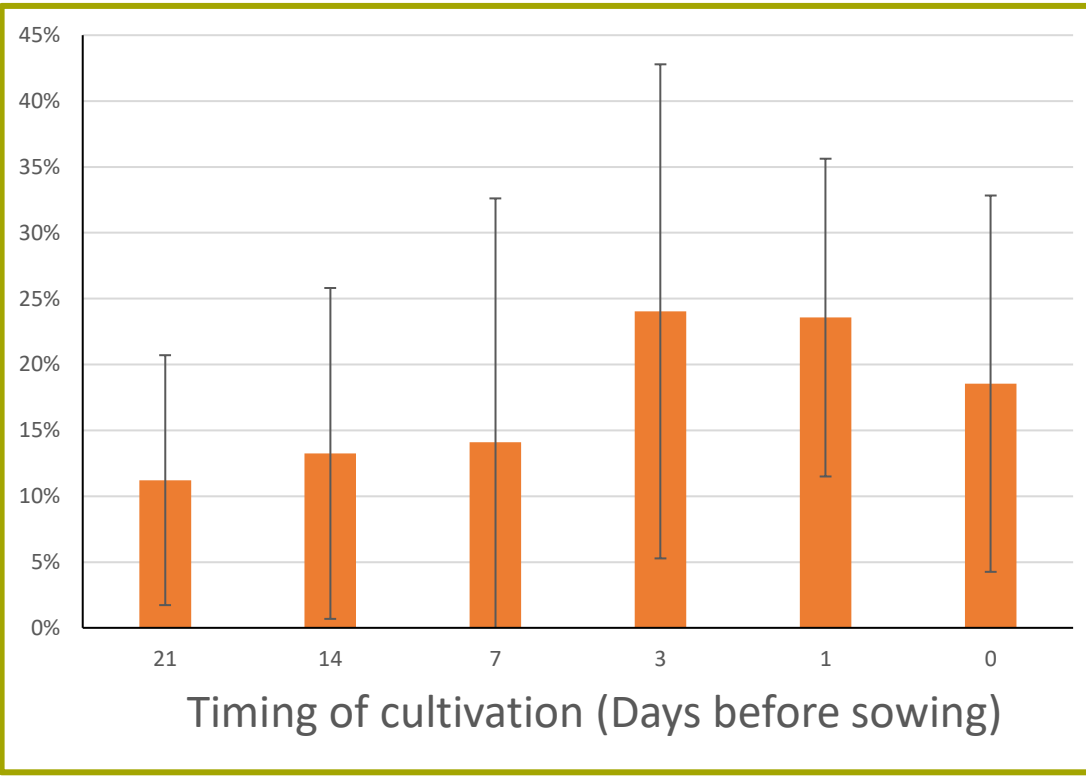
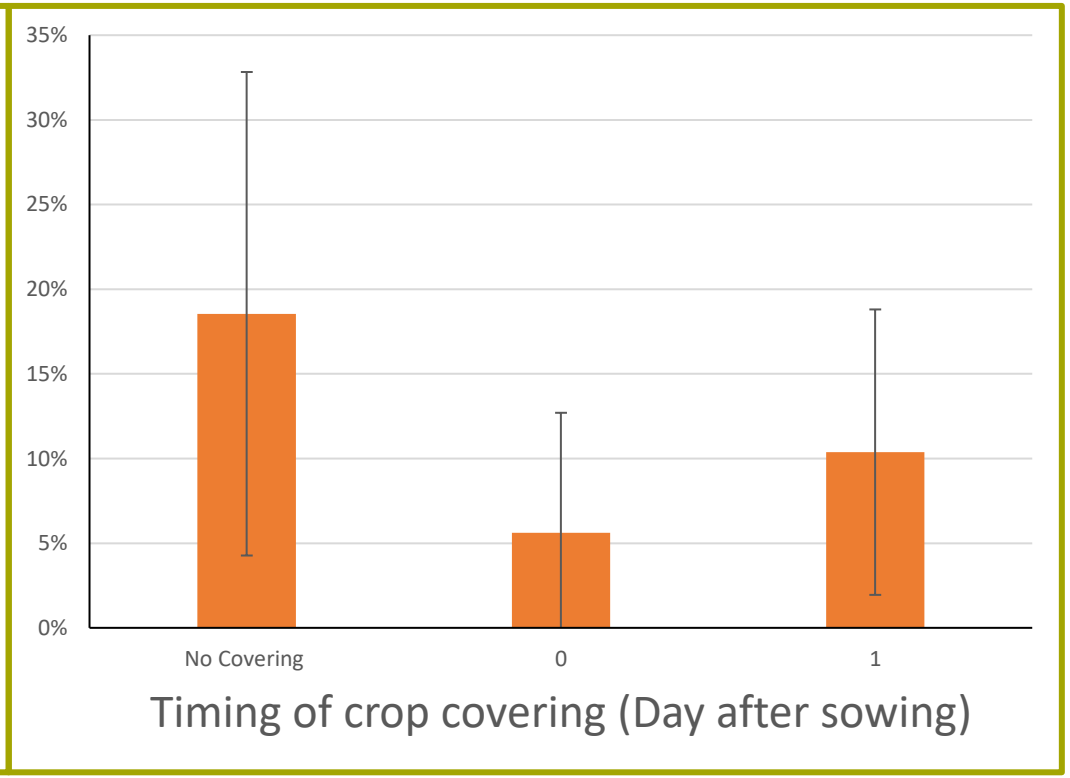
Mean proportion of plants with tunnelling in the seed (2 m row/plot sampled)





French Beans – 2022

- First repeat: Sowing date: 23/06/22
- Significant differences:
  - Cultivation (P = 0.03) & timing of covering (P = 0.003)

Number of ‘baldheaded’ plants

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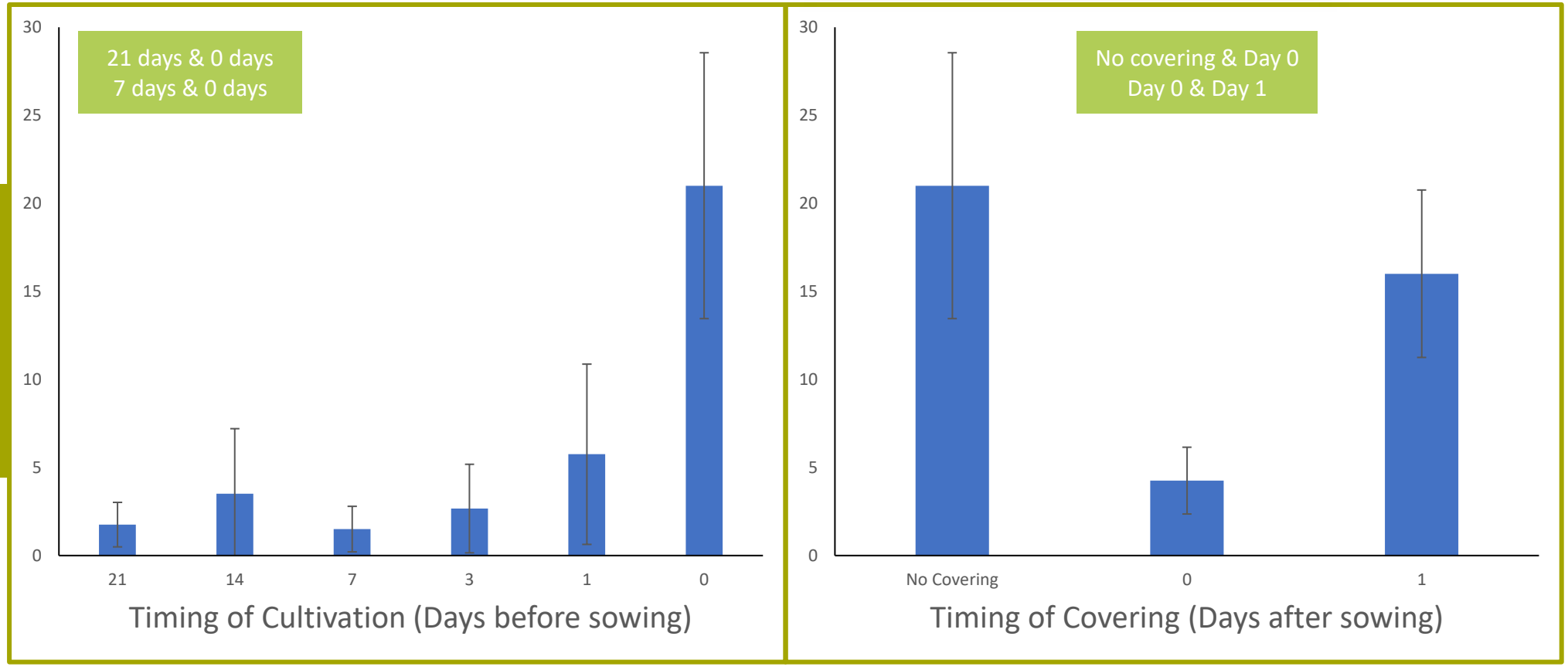
Mean number of ‘baldheaded’ plants (2m row/plot sampled)



French Beans – 2022

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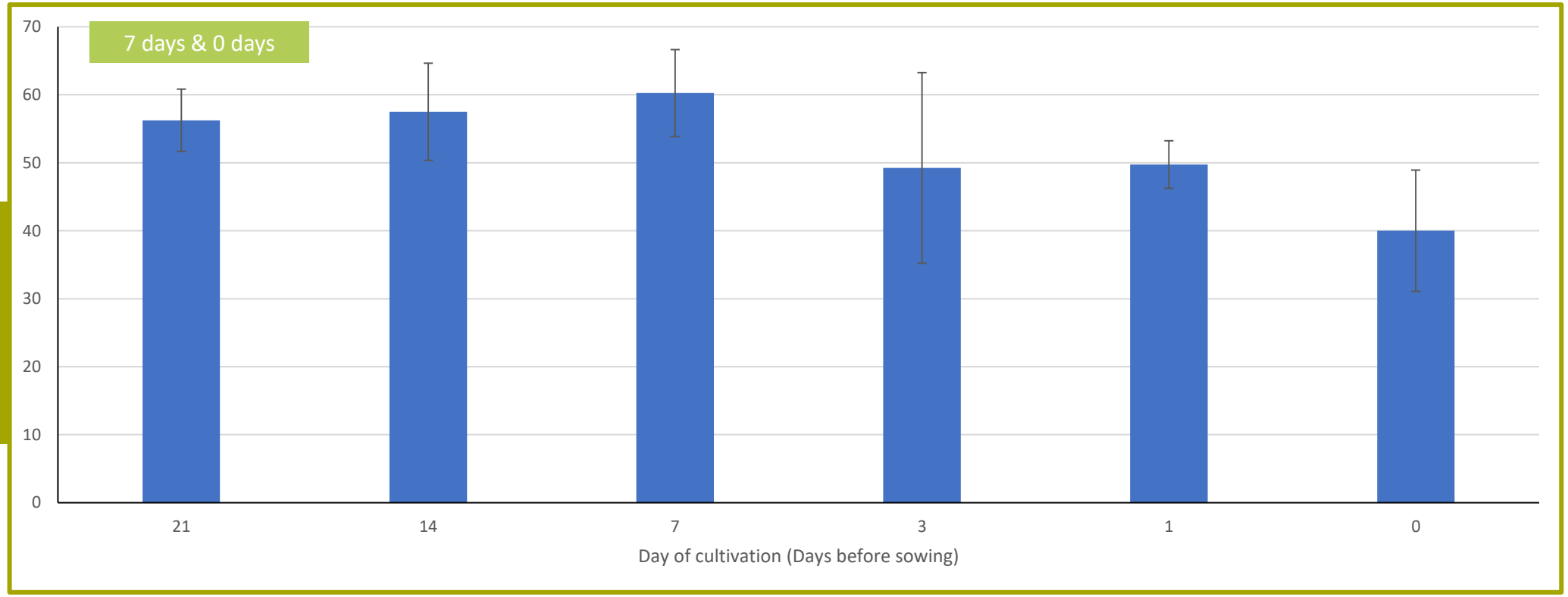
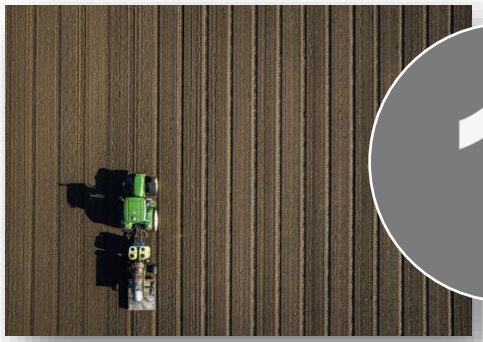
- Second repeat: Sowing date: 11/08/22
- Significant differences: P = 0.023
- Reduced BSF numbers at this time of year

Mean number of emerged plants (2m row/plot sampled)



Conclusions



1

Can the timing of cultivating a plot in relation to sowing the seed reduce damage caused by BSF?

2

Can the timing of covering a plot with a fine mesh in relation to sowing the seed reduce damage caused by BSF?

Yes – in French Beans

Considerations

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- Delaying cultivation: Delay by at least 7 days
- Covering: Cover as soon as possible after sowing the crop
- Vining peas:
  - 2021: Low levels of BSF = low levels of damage?
  - 2022: Increased disease = Difficult to observe potential BSF damage

Prevents larval feeding on the crop

Captures of bean seed fly and cabbage root fly at Wellesbourne 2019 - 2021 – yellow water traps (Monitoring and Forecasting)

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How BSF overwinters determines type of forecast

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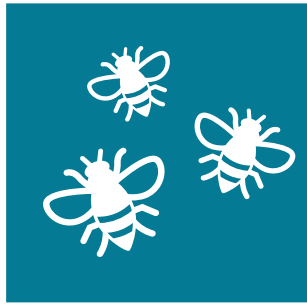
A diapausing & non-diapausing phenotype?

- A small proportion of BSF enter diapause in early autumn under field conditions at Warwick Crop Centre

A short diapause

- Their diapause is relatively short compared to cabbage root fly & onion fly



Aid predictions of spring emergence

A different method to forecast the non-diapausing phenotype?

Change parameters of the forecasting model

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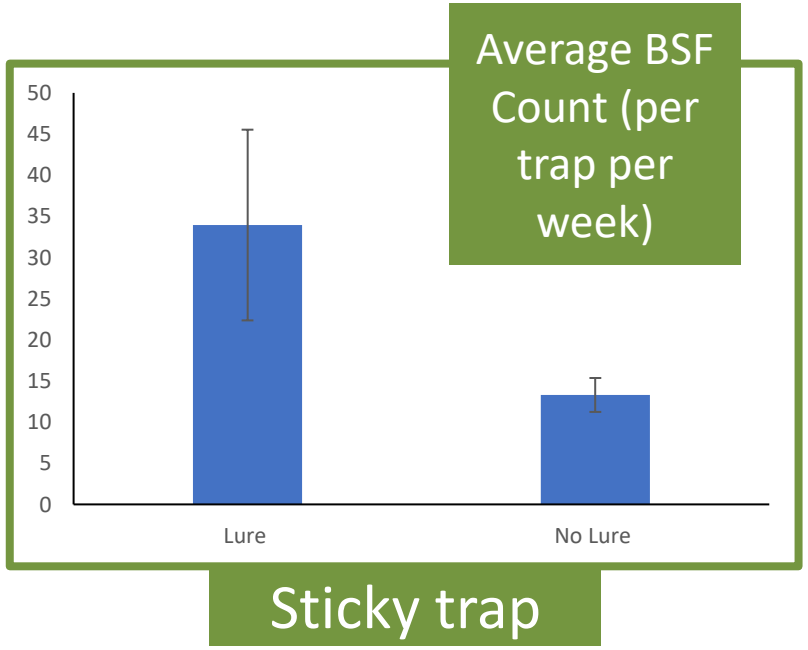
Sticky traps

- BSF can be easily confused with similar species
- Blue sticky traps catch larger ratios of BSF to cabbage root fly
- Significantly more BSF were caught on traps containing a lure than on those not containing a lure



Research Question

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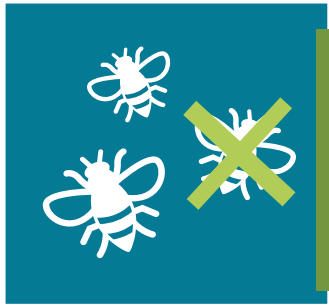
1. Does the height of a blue sticky trap affect the number of BSF to be caught on the trap?
2. Does the orientation of a blue sticky trap (curly vs horizontal) affect the number of BSF to be caught on the trap?
3. Does the proportion of a blue sticky trap that is covered by insects affect the number of BSF to be caught on the trap?

Why ask these questions?



Traps that catch more BSF than similar species

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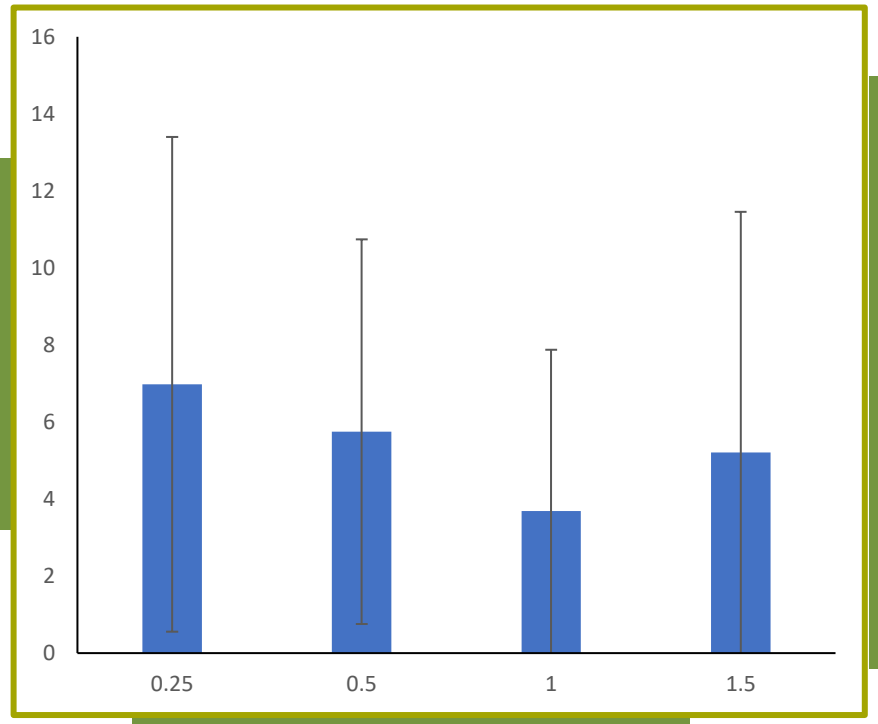
Results: Trap Height

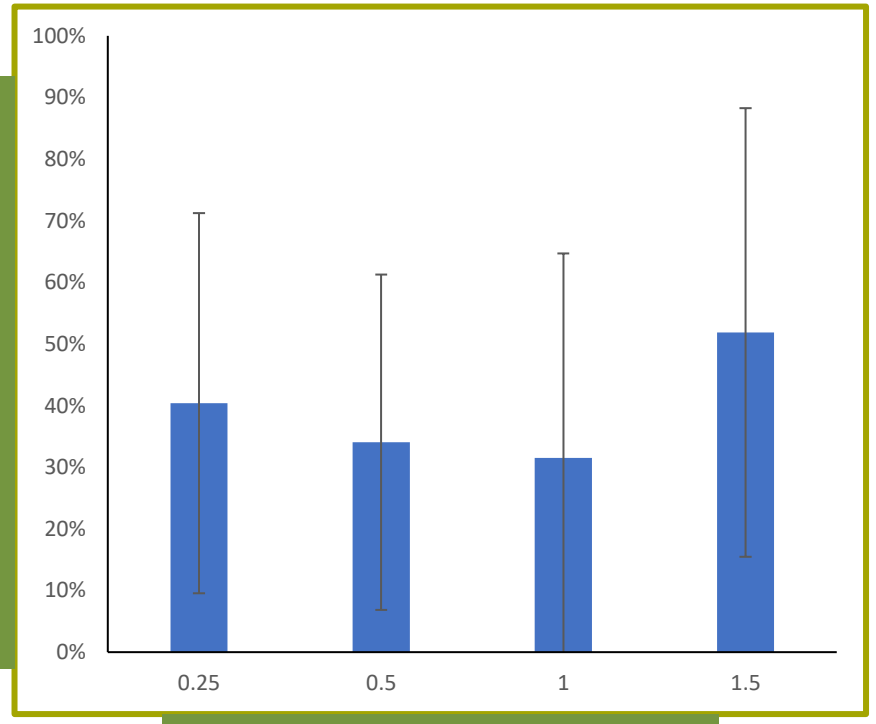
- 4 replicates in space & 4 repeats in time
- No significant difference

Mean BSF Count (per trap)



Trap height (m)

Mean proportion of BSF (per trap) (% of Diptera)



Trap height (m)

Results: Trap Orientation

- 4 replicates in space & 4 repeats in time
- Stats tests: TBC

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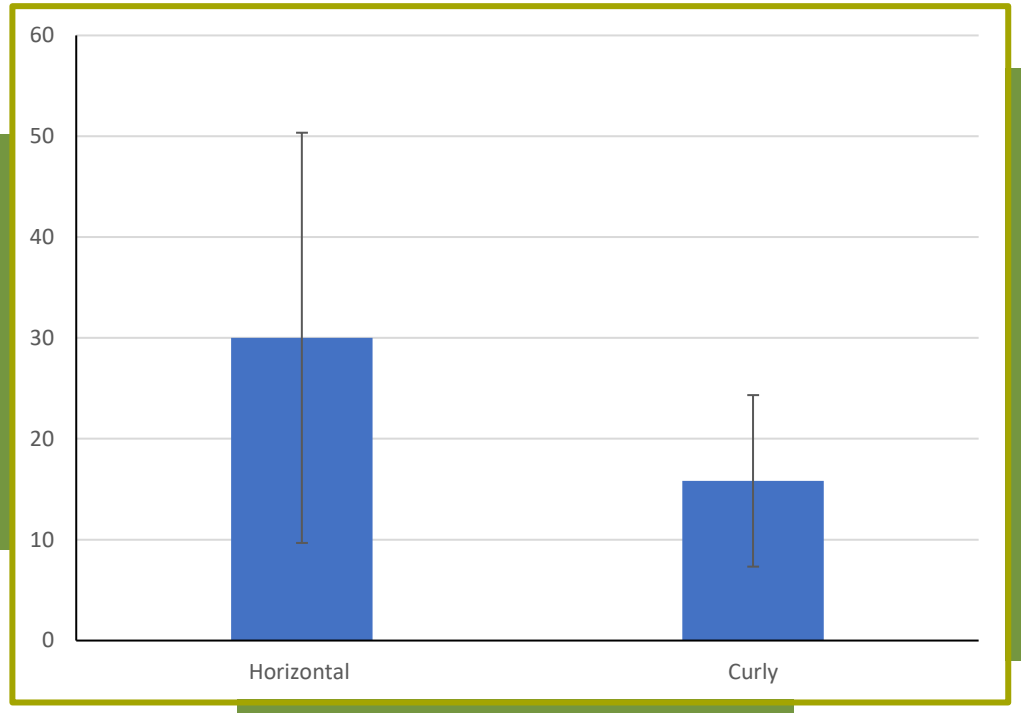
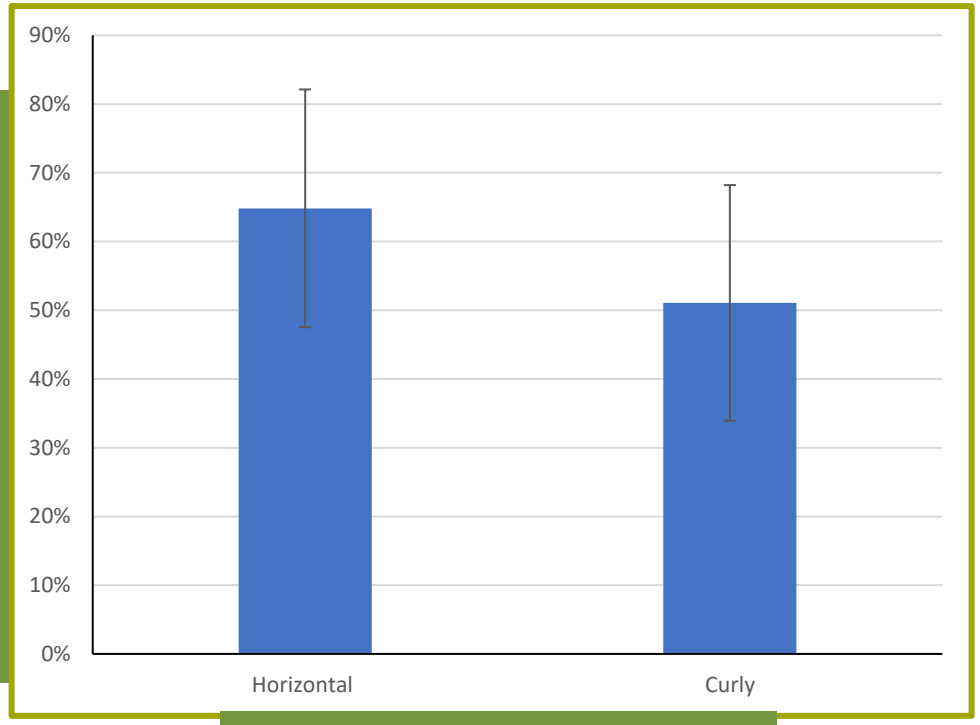
Mean BSF Count (per trap)



Trap orientation

Mean proportion of BSF (per trap) (% of Diptera)



Trap orientation

Results: Proportion covered by insects

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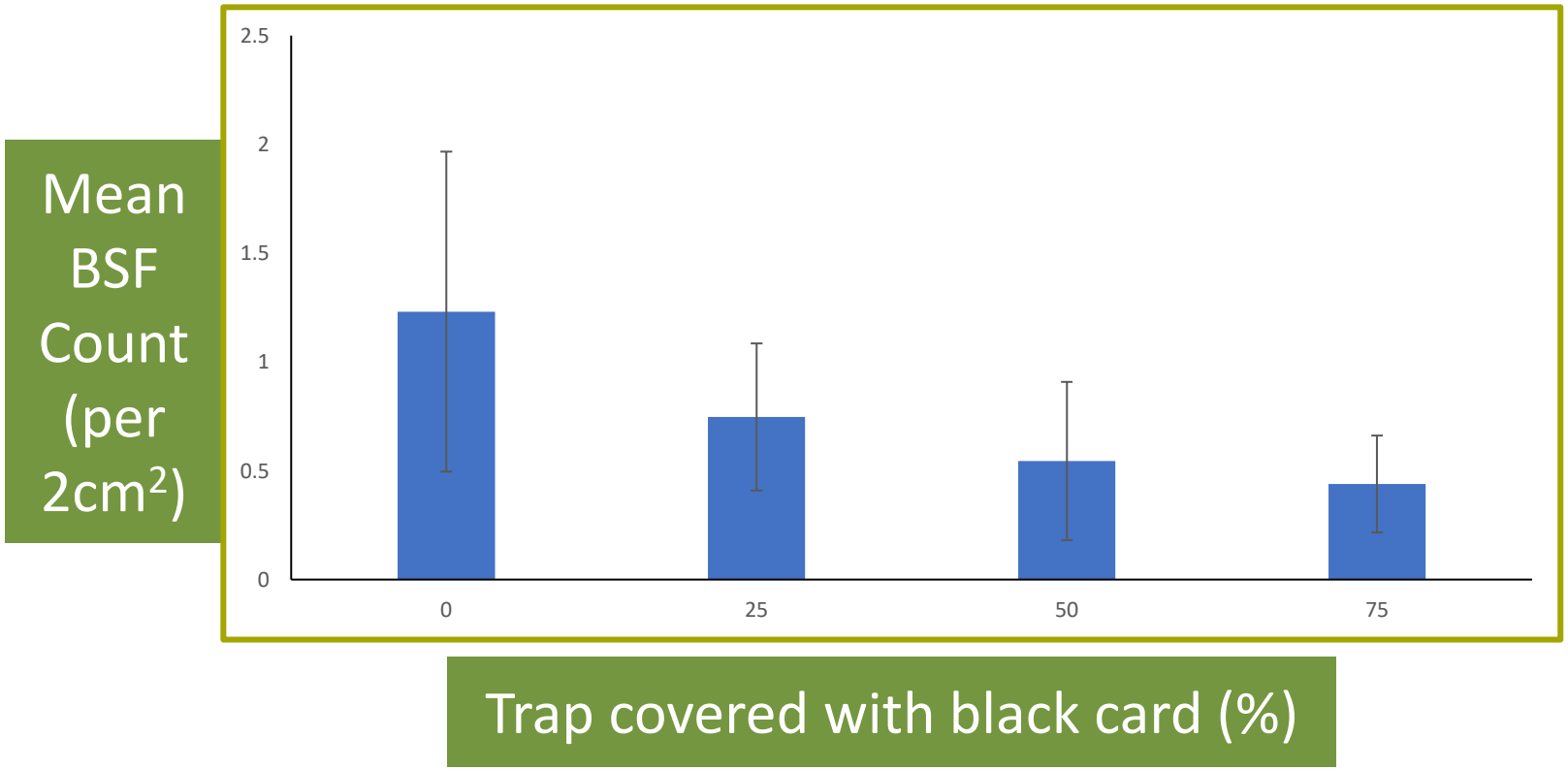
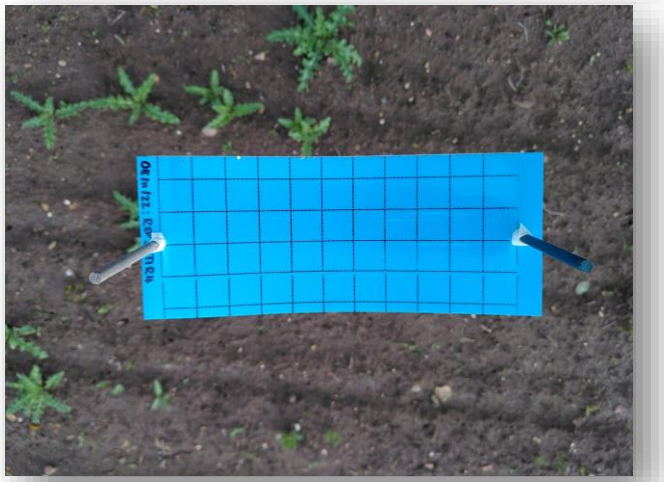
- 4 replicates in space & 3 repeats in time
- Proportion of trap covered by black card
- Stats tests: TBC but a trend?





Summary of findings

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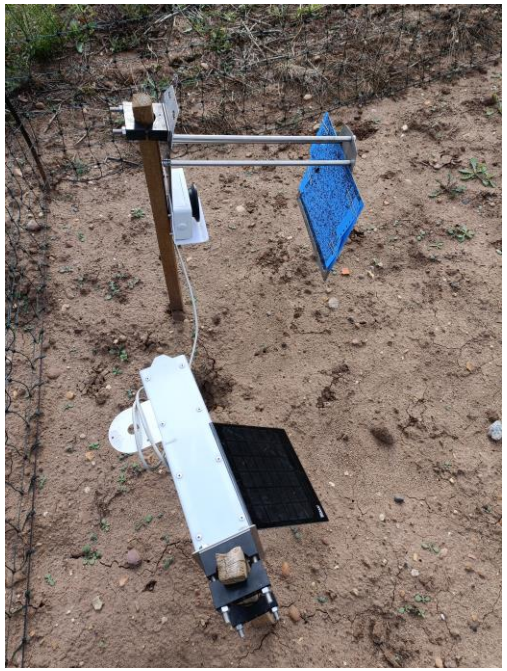
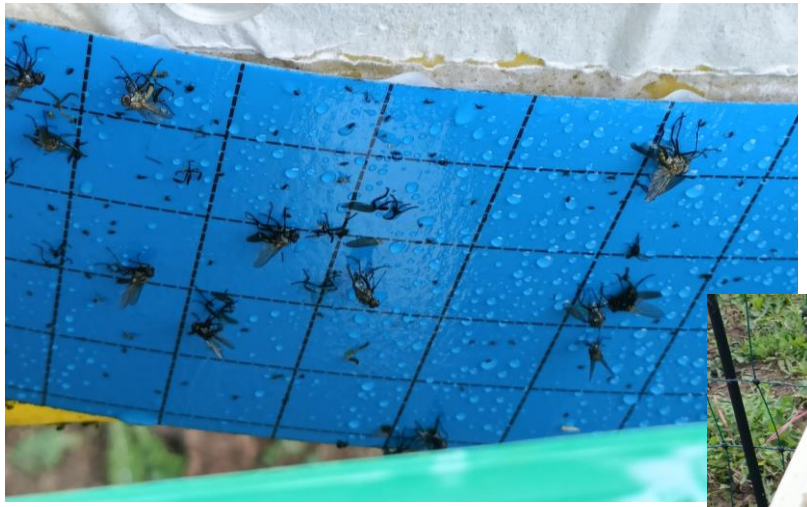
1	Does the height of a blue sticky trap affect the number of BSF to be caught on the trap?	No
2	Does the orientation of a blue sticky trap (curly vs horizontal) affect the number of BSF to be caught on the trap?	Horizontal traps seem to catch more BSF
3	Does the proportion of a blue sticky trap that is covered by insects affect the number of BSF to be caught on the trap?	Traps with less covering with black card seem to catch relatively more BSF

SMART traps





Bean seed fly

Working with growers using SMART traps for monitoring bean seed fly

Challenges:

- Identification from images
- Growers need to replace sticky traps regularly

Chemical and biological control of bean seed fly (*Delia platura*)

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- Have previously tried ‘in furrow’ spray treatments following work in North America – ineffective with insecticides allowed (SCEPTREplus).
- No new seed treatments available but some ‘new’ granule treatments plus ‘ground sprays’ – mainly synthetic insecticides but also biopesticide options.
- AHDB trials in 2022 on leek, salad onion and green beans (Warwick & PGRO).

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Treatments in all 2022 trials

Untreated	
AHDB 9727	Granule
AHDB 9833	Granule
AHDB 9834	Spray
AHDB 9705	Spray
NemGuard	Granule
Tracer	Spray
Hallmark Zeon	Spray

- Organic matter added to French bean and leek trials before cultivation
- Salad onion trial done in commercial crop with no added organic matter and majority of field sown with Force treated seed

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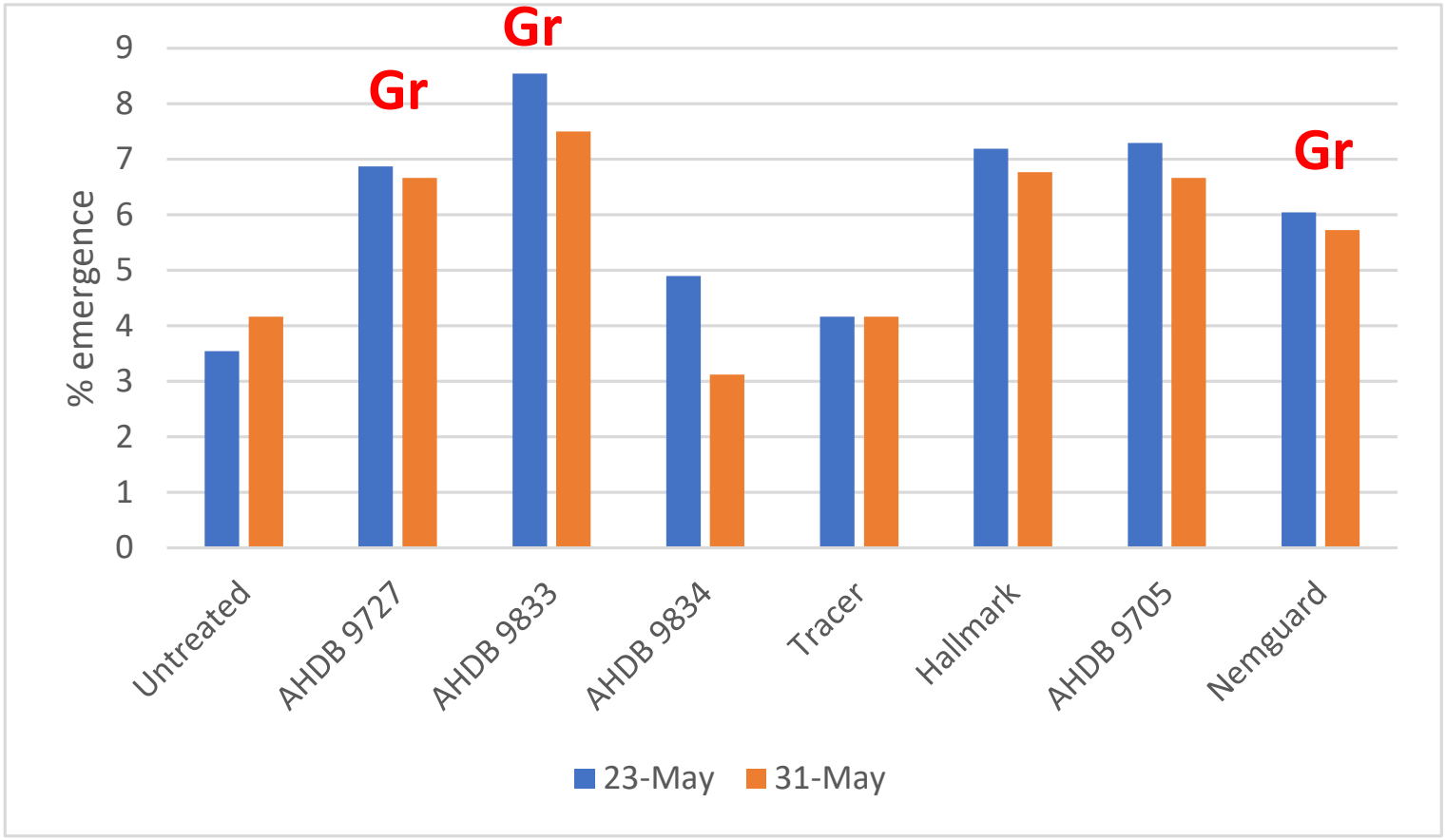
Percentage emergence of leek plants per treatment (5m x 4 rows) (sown 21 April 2022)



- Very low percentage emergence.
- None of the treatments successfully controlled damage and there were no statistically significant differences between treatments when considering emergence.

Gr = granules

Percentage emergence of salad onion plants per treatment (3m x 2 rows) (sown 18 May 2022)

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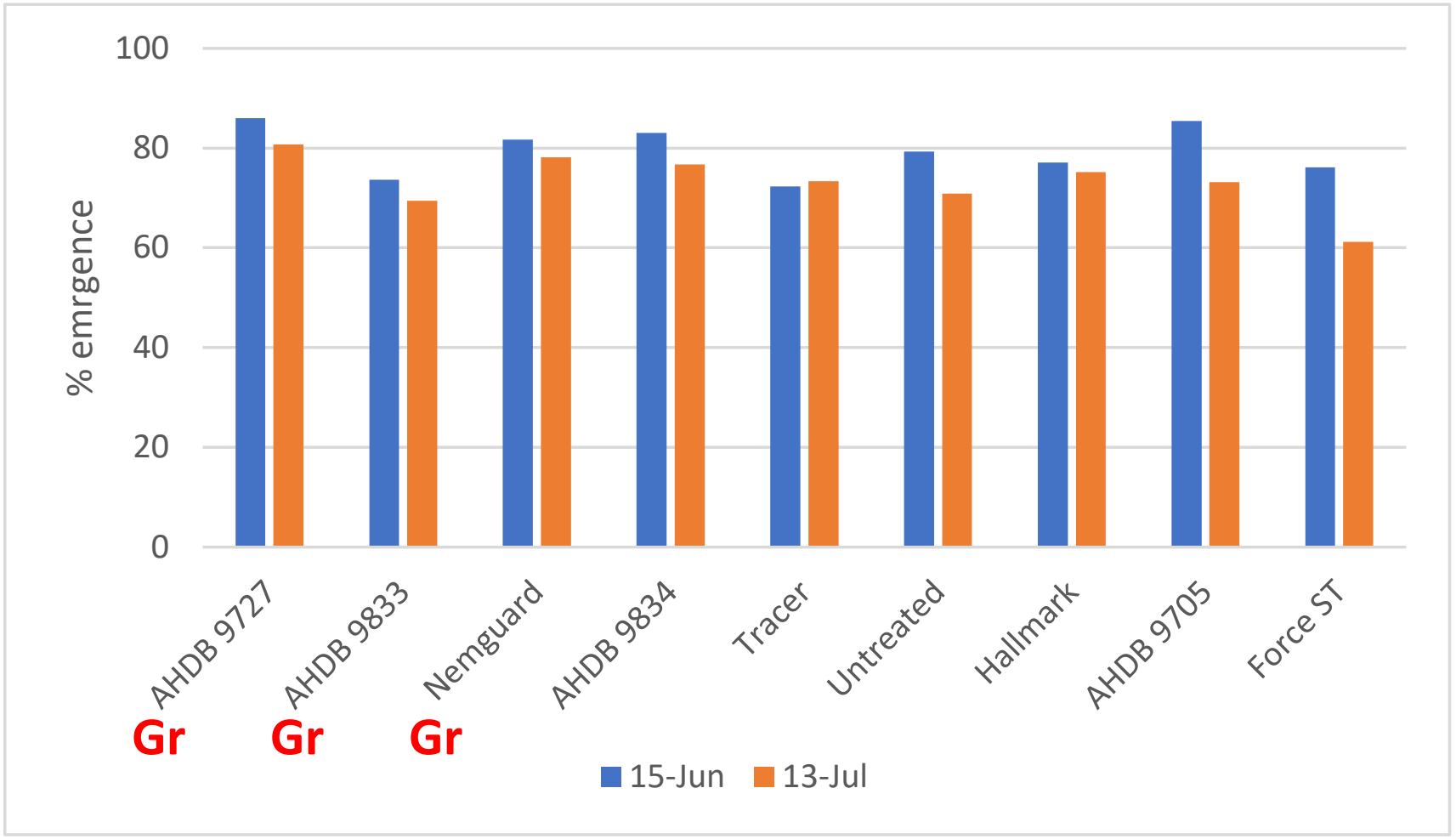

- There were no statistically significant differences between treatments when considering emergence.
- There was little difference between the untreated control and Force seed treatment assessed in adjacent beds.

N.B. Nemguard is not currently authorised for use on salad onion in UK

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Green beans – PGRO – 2 trials

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- Trial sown 5th May 2022 failed due to very high levels of damage from bean seed fly larvae. None of the treatments successfully controlled damage and very few plants established.
- Trial sown 17th June established better.
- However, there were no statistically significant differences in the percentage of plants emerged, damaged plants, non-emerged plants or baldhead symptoms between treatments.

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Stubton, Lincolnshire, 30th June and 1st July 2022. Two 2 metre rows were evaluated in each plot.

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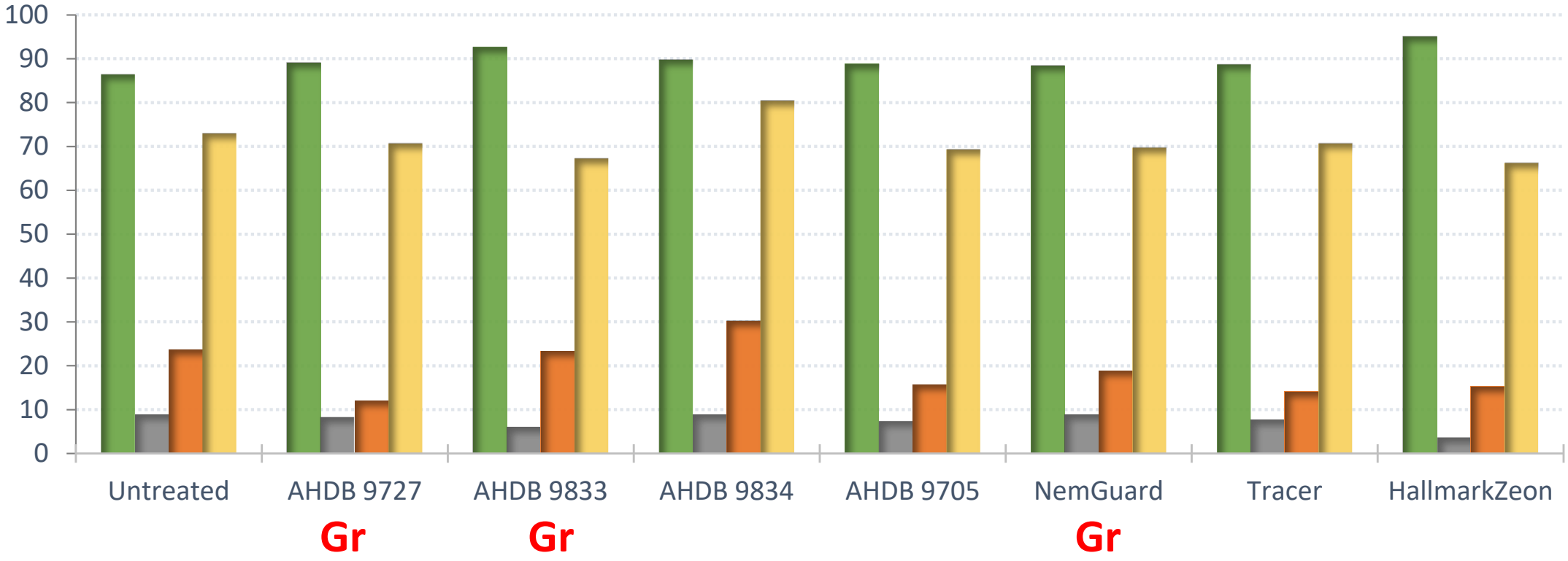

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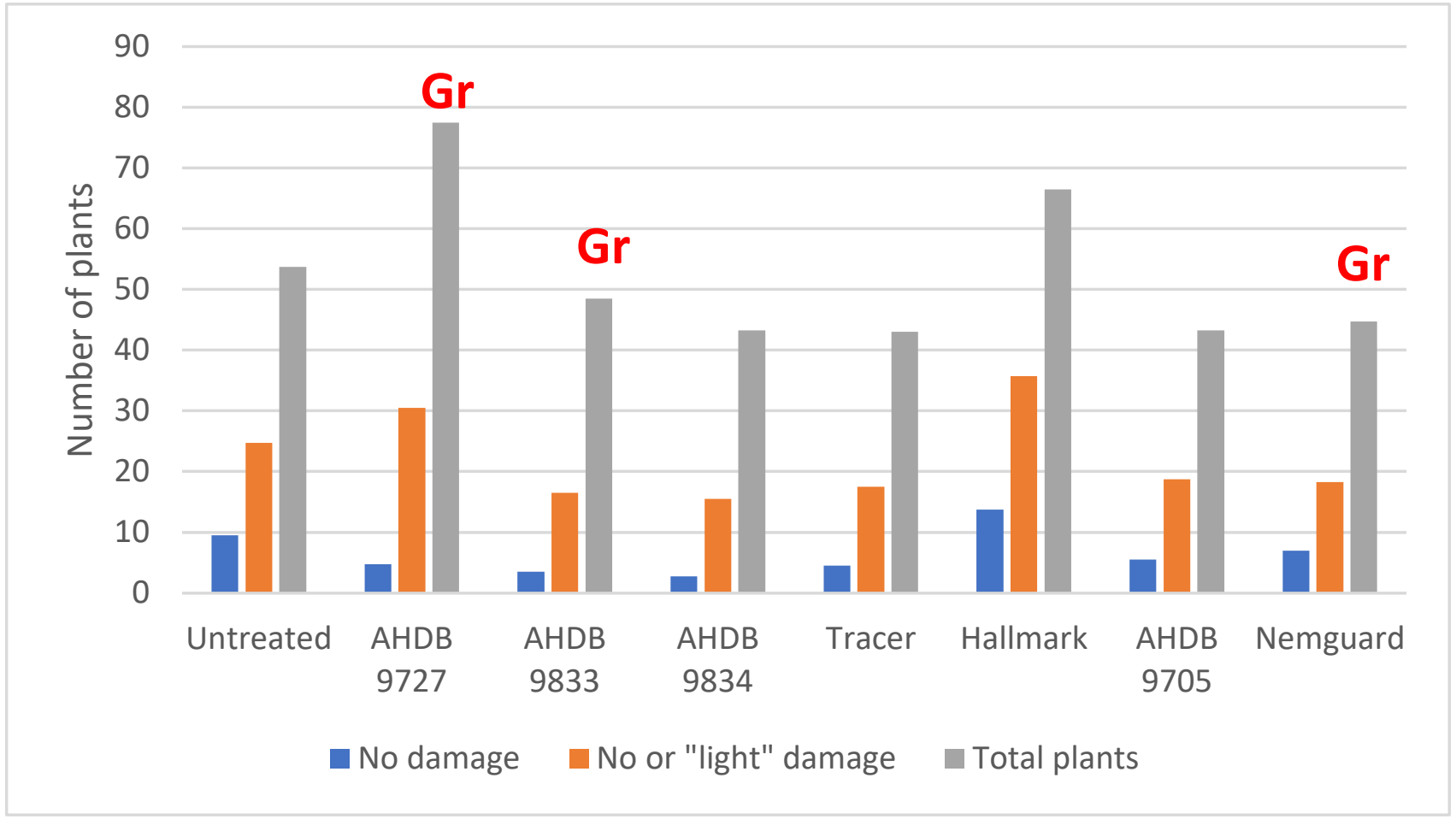
Mean number of green bean plants with no damage, no or light damage and total plants assessed at Warwick Crop Centre in May 2022.



- Sown 27 April 2022.
- The mean number of plants that emerged in control plots was 43 which represented 26% of the total number sown.

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Pot trial to assess granular treatments tested in 2022

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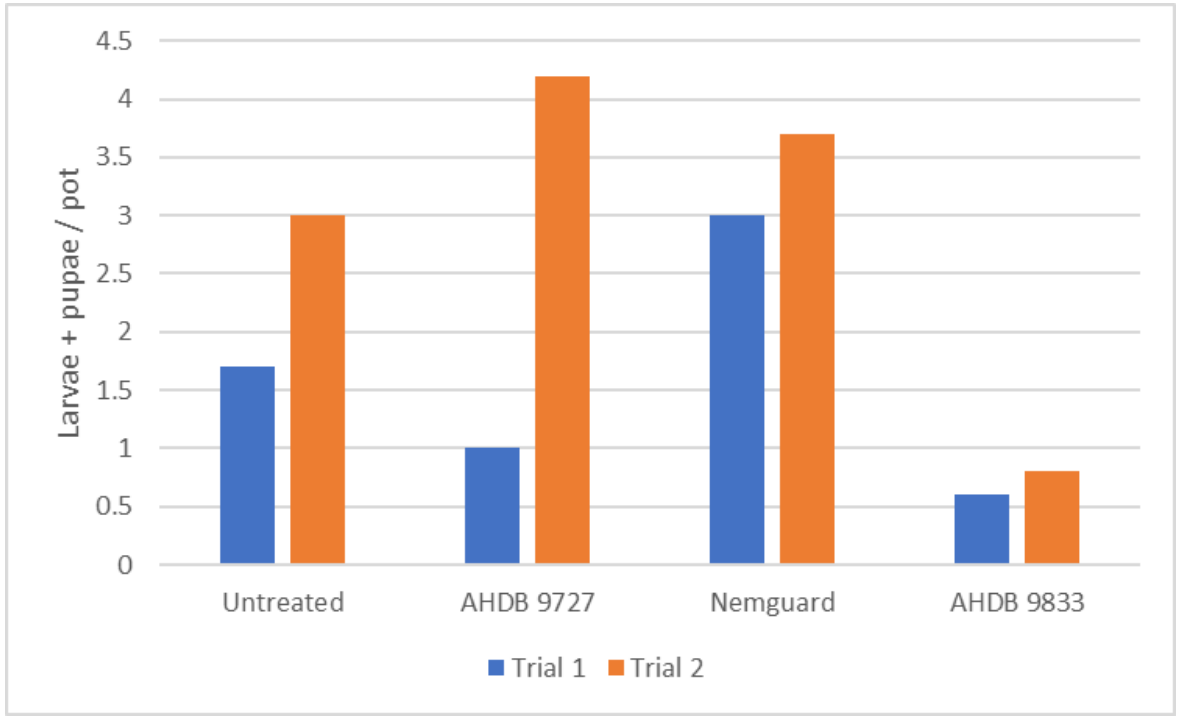

- Granules applied before covering seed
- Pots inoculated with 20 BSF eggs
- Damage and pupae/larvae numbers assessed after 2 weeks
- Significant control with AHDB 9833

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Conclusions

- Cultural control is looking promising for reducing infestation size – but does not always have an ‘effect’.
- Can monitor bean seed flies remotely – SMART traps. But need to manage traps – replace stickies regularly.
- Life cycle very different from related species – may influence final form of day-degree forecast.
- Field trials - none of the treatments managed to deal with a large infestation of bean seed fly.
- Lab trials – one of the granular treatments shows promise under controlled conditions.

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Thank you:

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- Research funders
- British Growers Association and Crop Associations
- Collaborators
- Team at Wellesbourne

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