Studentship Project: Annual Progress Report March 2022 to September 2022

Student Name:	Rebecca McGowan	**AHDB Project Number:**	
Project Title:	The Biology and Integrated Management of the Bean Seed Fly		
Lead Partner:	University of Warwick & Processors and Growers Research Organisation (PGRO)		
Supervisor:	Professor Rosemary Collier (Warwick), Rob Lillywhite (Warwick) & Dr Becky Howard (PGRO)		
Start Date:	Oct 2019	**End Date:**	Sept 2023

1. Project aims and objectives

Aim: To contribute towards an integrated pest management (IPM) strategy to reduce crop damage and economic losses caused by the Bean Seed Fly (BSF) in horticultural crops

Objectives:

1. Establish a BSF culture to provide insects for experimental work
2. Investigate the impact of temperature on BSF development and diapause
3. Identify effective trapping methods for monitoring BSF
4. Create and validate a BSF forecasting model
5. Assess the efficiency of cultural and physical strategies on reducing damage caused by BSF

2. Key messages emerging from the project

Objective Two:

Before March 2022, the findings from various experiments showed that the overwintering strategy of BSF is different from the overwintering strategy of species that share the same genus, *Delia*. It appears that a proportion of BSF do not enter diapause over the winter.

Between March 2022 – September 2022, findings from the overwintering experiments support previous findings. They show that diapause is not initiated under the conditions that initiate the diapause of Cabbage Root Fly (*Delia radicum*) and Onion Fly (*Delia antiqua*). Potentially photoperiod affects diapause initiation and this is currently being investigated.

These findings will have implications for forecasting the Spring emergence of BSF. The methods used to forecast the BSF may need to differ from the methods used to forecast similar species such as the Cabbage Root Fly and Onion Fly.

Objective Three:

It is important that traps are selective to BSF so growers can be confident that they are monitoring BSF as opposed to similar species.

Before March 2022, blue sticky traps containing a lure were shown to catch more BSF than blue sticky traps not containing a lure.

Between March 2022 – September 2022, trap height was shown to not affect the number of BSF caught on blue sticky traps or the ratio of BSF to other dipteran species. Horizontal blue sticky traps were shown to catch more BSF than curly blue sticky traps. The effect of blue sticky traps containing a lure on the ratio of BSF to other dipteran species is currently being investigated.

Objective Four:

Before March 2022, the Spring emergence of BSF was shown to be predicted by accumulating day degrees from 1st January using a threshold temperature of 3.9°C.

Between March 2022 – September 2022, a revised forecast is being developed assuming a proportion of wild BSF do not enter diapause over the winter.

Objective Five:

Before March 2022, three field trials investigated the effect of the timing of cultivation and covering of the crop in relation to the sowing date on damage to vining peas. No significant effects were shown.

Between March 2022 – September 2022, field trials have shown a significant effect of the timing of cultivation and covering of the crop in relation to the sowing date on damage to French beans.

3. Summary of results from the reporting year

Objective Two:

- BSF require between 0 – 8 days at a sub-threshold temperature (< 3.9°C) to complete diapause: There was a significant effect of time spent at 0°C on the proportion of flies to emerge by day 15 at 20°C ($P < 0.001$). The significant differences were found between pupae placed at 0° for 0 days and pupae placed at 0°C for 8 and 20 days

Objective Three:

- The height of blue sticky traps was shown to not affect the number of BSF caught on the trap ($P = 0.897$) and the ratio of BSF to other dipteran species ($P = 0.241$).

Objective Five:

- The timing of cultivation in relation to sowing date had a significant effect on the number of 'baldheaded' French beans per plot ($P = 0.02$). Significantly more plants were 'baldheaded' when the plot was cultivated on the day of sowing compared to plots that were cultivated 1, 3, 7, 14 and >21 days before sowing
- Covering the plot had a significant effect on the number of French beans to emerge per plot ($P < 0.05$) and the number of 'baldheaded' plants per plot ($P < 0.0001$). Significantly more plants emerged in plots that were covered compared with that were not covered. Significantly more plants were 'baldheaded' in plots that were not covered or covered on the day after sowing than in plots covered on the day of sowing. The plots were in the covering trials were cultivated on the day of sowing.

4. Key issues to be addressed in the next year

Objective Two:
Two further experiments will investigate the overwintering biology of BSF. It seems that a proportion of wild BSF overwinter in diapause and a proportion do not overwinter in diapause. A lab experiment will investigate the role of photoperiod in inducing diapause. A pot experiment will monitor the development of BSF from the culture in field conditions over Autumn and Winter.

Objective Three:
Blue sticky traps with a lure attached and positioned horizontally are effective at trapping BSF. Specimens from these experiments are stored in a freezer. We will investigate the selectivity of these different methods for catching BSF compared to similar Dipteran species, using the frozen specimens. A further experiment will investigate how long blue sticky traps should be left outside to monitor BSF populations. These findings should increase the effectiveness of a monitoring strategy for BSF.

Objective Four:
The accumulation of day degrees can be used to predict the emergence of the Spring generation of BSF. The current model that we have used to predict the emergence of the Spring generation of BSF (Weibull type 2 3-parameter model) assumes that wild BSF enter diapause. Another method will be developed to predict the emergence of the Spring generation of BSF using the assumption that BSF do not enter diapause. The model that assumes that BSF do enter diapause will be improved dependent on the findings of the overwintering experiments (e.g. changing the date when day degrees are accumulated).

Objective Five:
One further repeat of the field trial will occur in September 2022. This will be the last field trial of the PhD project.

5. Outputs relating to the project

(events, press articles, conference posters or presentations, scientific papers):

Output	Detail
University of Warwick: School of Life Sciences: PGR Symposium 2022: Presentation	15 minute presentation discussing forecasting the Spring emergence of BSF.
PGRO Pulse Magazine: Article	Two page spread describing my progress through the PhD research and current findings.

6. Partners (if applicable)

Scientific partners	
Industry partners	PGRO (Processors and Growers Research Organisation)
Government sponsor	