

# The Biology & Integrated Management of the Bean Seed Fly Growers' Meeting 2020

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School of Life Sciences & Warwick Crop Centre  
2020

WARWICK

SCHOOL OF LIFE SCIENCES

**AHDB**

HORTICULTURE



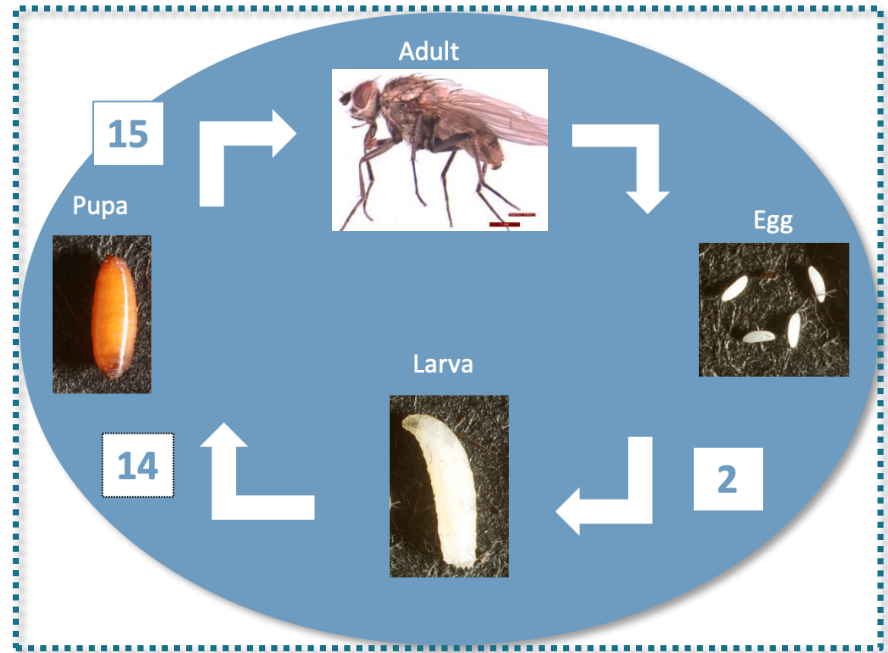
# Contents

- 1 Bean Seed Fly life cycle
- 2 Aims & Objectives
- 3 Progress
- 4 Future Experiments
- 5 Q & A Session

# 1. Introduction to the Bean Seed Fly

## Bean Seed Fly Life Cycle

- Development at 20°C (days)



## 2. Aims & Objectives: Overall Aim

To establish an integrated pest management strategy for control of Bean Seed Fly



## 2. Aims & Objectives: Objectives

1

- Establish a Bean Seed Fly culture to provide insects for experimental work

2

- Investigate the impact of temperature on Bean Seed Fly development and diapause

3

- Identify effective methods for monitoring Bean Seed Fly

4

- Compare the pattern of activity of Bean Seed Fly in different locations

5

- Create and validate a Bean Seed Fly forecasting model

6

- Assess and compare the efficiency of different cultural and physical strategies on reducing Bean Seed Fly crop damage

# 3. Progress

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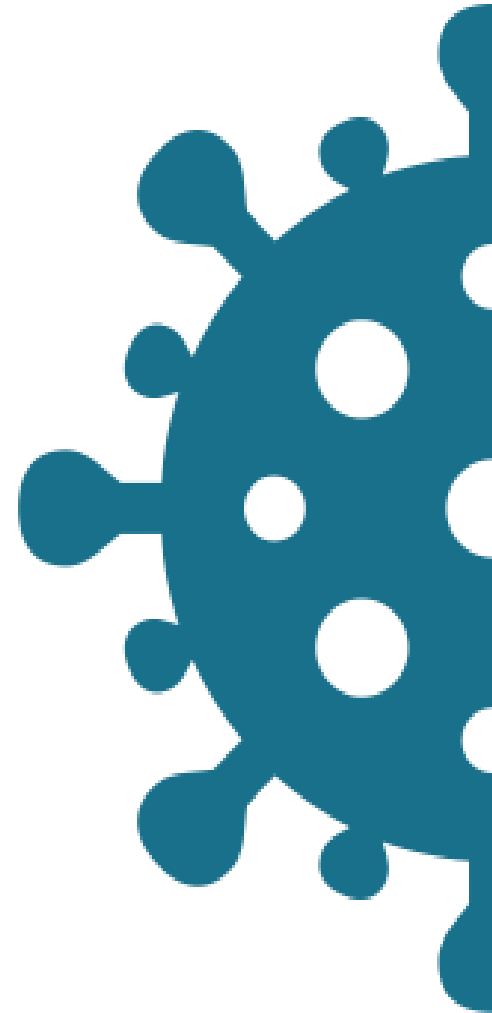
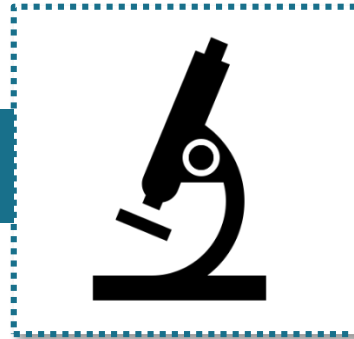
### 3. Progress: Impacts of COVID-19

March – June: No practical work



June - August: Field work began

September: New normal



# Objective One: Establish a Bean Seed Fly culture to provide insects for experimental work

- Before Lockdown: Bean Seed Fly culture established
- Maintained over lockdown
- October 2020: Wild flies to add to culture
- Culture bulking & method improvement





# Objective Two: Investigate the impact of temperature on Bean Seed Fly development and diapause

1

## Experiment One: Do wild Bean Seed Fly enter diapause at WCC?

### Methods

- Batches of pots placed in field every 2 weeks
- Collected from field after 3-4 days
- Pupae collected from pots
- Pupae placed at 20°C and emergence recorded over time
- Emergence within 14 days = not in diapause

2

## Experiment Two: When do wild Bean Seed Fly finish diapause at WCC?

### Methods

- 5 large batches of pots (>270) placed on 5 dates (01/09, 18/09, 29/09, 09/10 & 13/10)
- Collected from field after 3-4 days
- Sub-samples of pupae taken from each batch every 2 weeks after pupation occurs
- Pupae placed at 20°C and emergence recorded over time
- Emergence in 14 days = not in diapause



# Objective Three: Identify effective methods for monitoring Bean Seed Fly

## Experiment One: The effect of a lure attached to a blue sticky trap on Bean Seed Fly count at WCC

### Methods

- Hypothesis: Sticky traps with a lure attached will capture more Bean Seed Flies
- 3 x 4-week periods of sampling:
  - Comparison One: Ag Bio vs No Lure (19/06 – 17/07)
  - Comparison Two: Ag Bio vs Andermatt vs No Lure (06/08 – 03/09)
  - Comparison Three: Andermatt vs No Lure (01/10 – 29/10)



# Objective Three: Identify effective trapping methods for monitoring Bean Seed Fly

## Experiment One: The effect of a lure attached to a blue sticky trap on Bean Seed Fly Count at Warwick Crop Centre

### Methods

- 3 x 4-week periods of sampling
- Different locations at WCC
- Original aim: To identify Bean Seed Fly by species & sex
  - Time consuming!

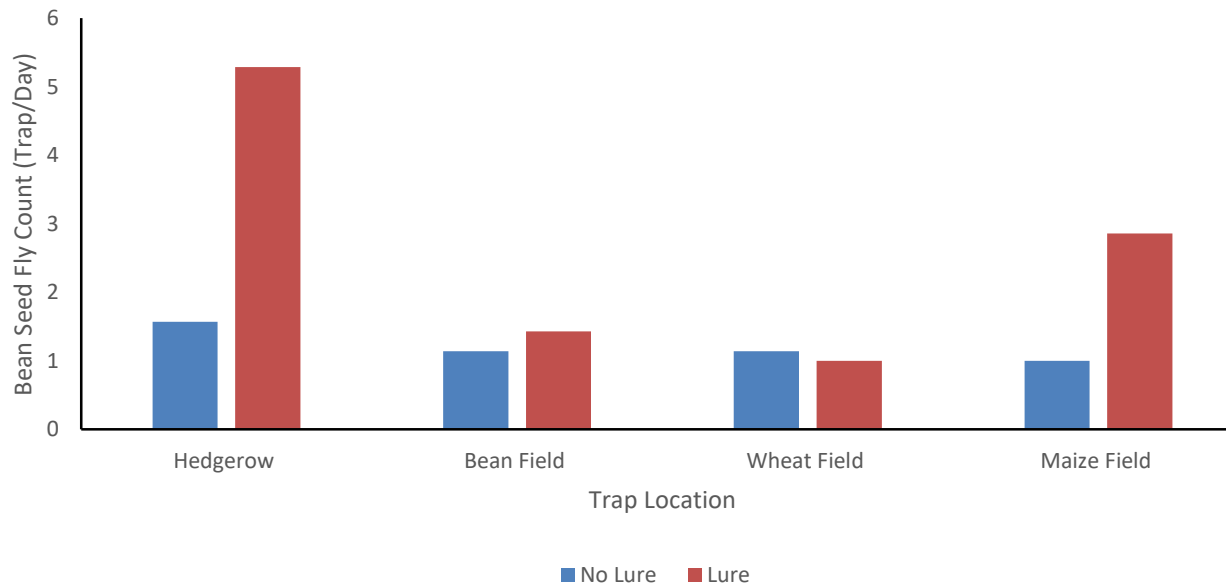


# Objective Three: Identify effective trapping methods for monitoring Bean Seed Fly

## Experiment One: The effect of a lure attached to a blue sticky trap on Bean Seed Fly Count at Warwick Crop Centre

### Results

- Period One: Week One Results: Ag Bio lure



# Objective Three: Identify effective trapping methods for monitoring Bean Seed Fly

## Experiment One: The effect of a lure attached to a blue sticky trap on Bean Seed Fly Count at Warwick Crop Centre

### Identification

- By eye: margin for error?
- By microscope:



1



2



3



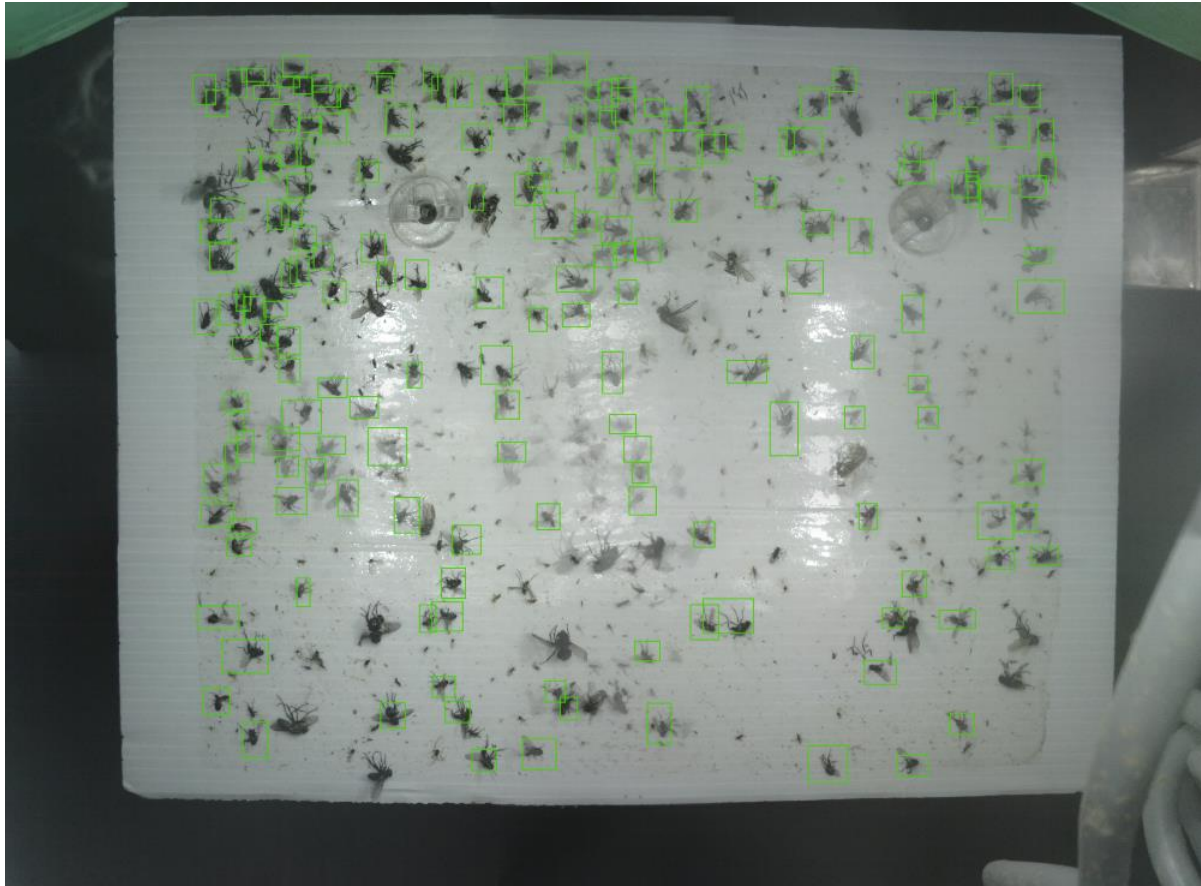
## Trap colour!

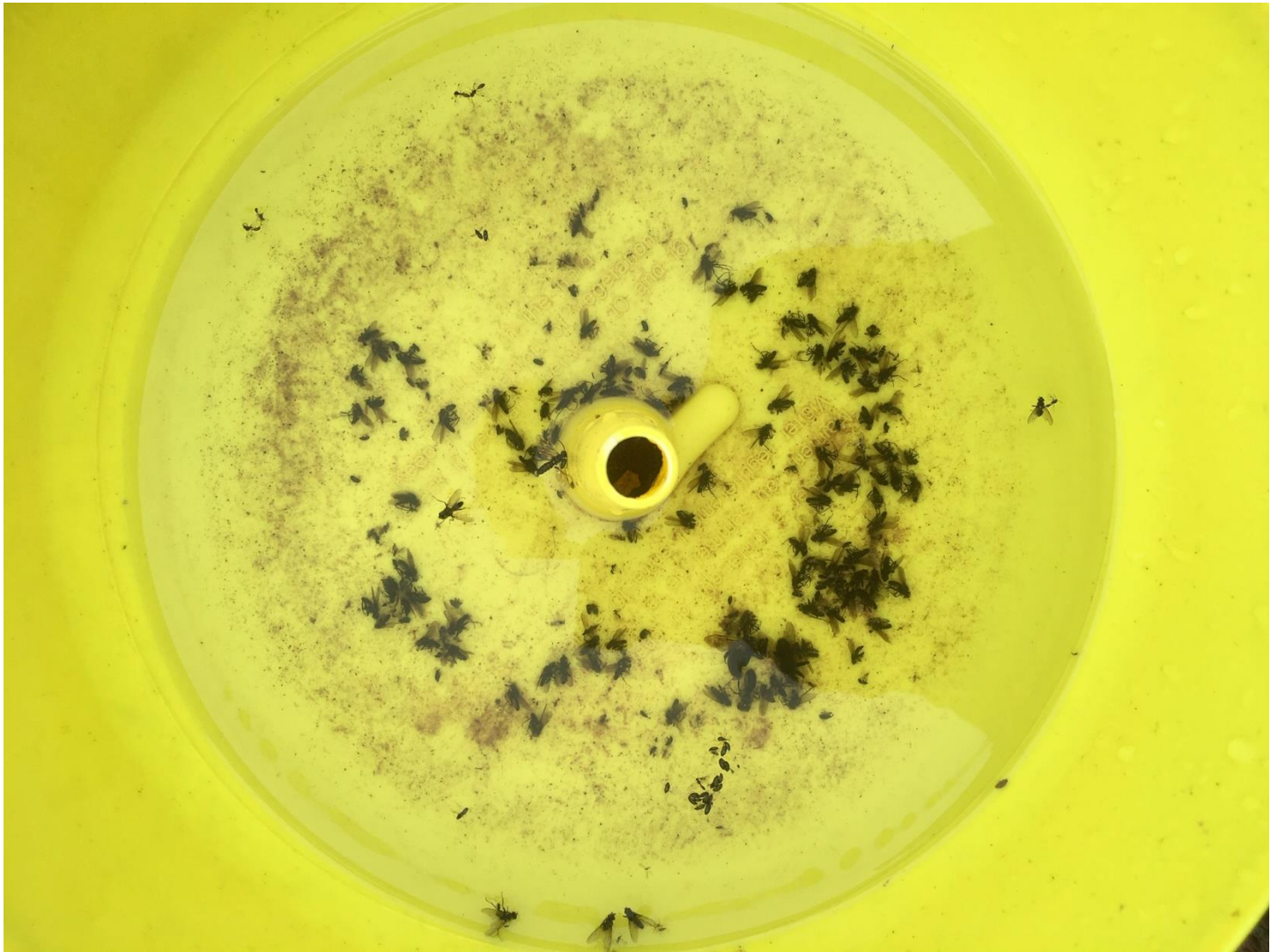
Colour	Cabbage root fly females	Bean seed flies	Hover flies	Bean seed fly per cabbage root fly
Black	2	6	0	3.0
Flame Red	3	14	0	4.7
Poppy	2	15	0	7.5
Coffee Bean Brown	3	16	0	5.3
Orange	8	19	0	2.4
Orange	8	24	0	3.0
Orange	16	38	0	2.4
Green	11	40	0	3.6
Yellow Green	18	45	0	2.5
New Leaf	10	46	0	4.6
Marigold	29	50	2	1.7
Dark Green	10	50	0	5.0
Emerald Green	21	52	0	2.5
Yellow	19	54	2	2.8
Jasmine	20	56	2	2.8
Yellow	25	58	0	2.3
Light Yellow	34	80	9	2.4
Fluorescent Yellow	33	87	17	2.6
Lemon Straw	19	121	2	6.4
Drumhill Grey	19	121	0	6.4
Antique Pink	14	127	3	9.1
Turquoise	21	134	0	6.4
Pink Blush	17	151	1	8.9
Dark Blue	23	162	3	7.0
Aubergine	16	168	1	10.5
Blue	26	188	2	7.2
Bluish Purple	26	218	2	8.4
Azure Blue	29	224	4	7.7
Purple	28	225	4	8.0
Blue	30	232	1	7.7
White	32	240	5	7.5
Blue	32	284	5	8.9

FINCH, S. (1991). Improving the selectivity of water traps for monitoring populations of the cabbage root fly. *Annals of Applied Biology*, 120, 1-7.



# Trapview system – vertical traps this year





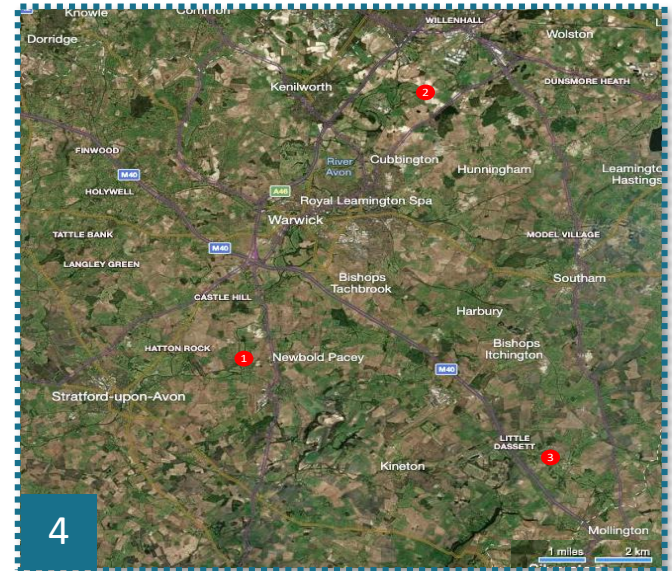


# Objective Four: Determine pattern of Bean Seed Fly activity in different locations

## Experiment One: Monitoring in Warwickshire 2020

### Methods

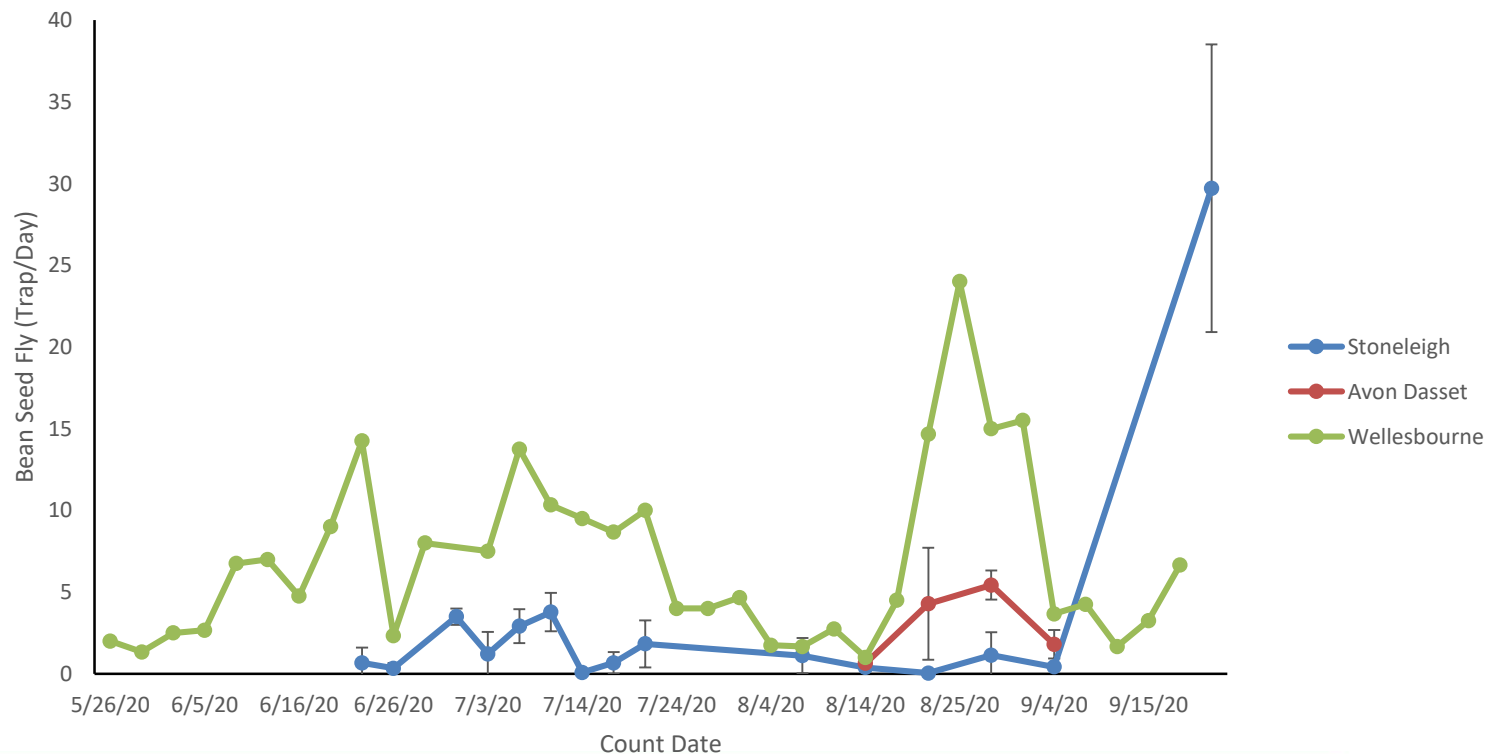
- Water trapping (3 traps)
- Three locations:
  - 1: Warwick Crop Centre
  - 2: Stoneleigh
  - 3: Avon Dasset
- Average number of Bean Seed Fly per trap per day



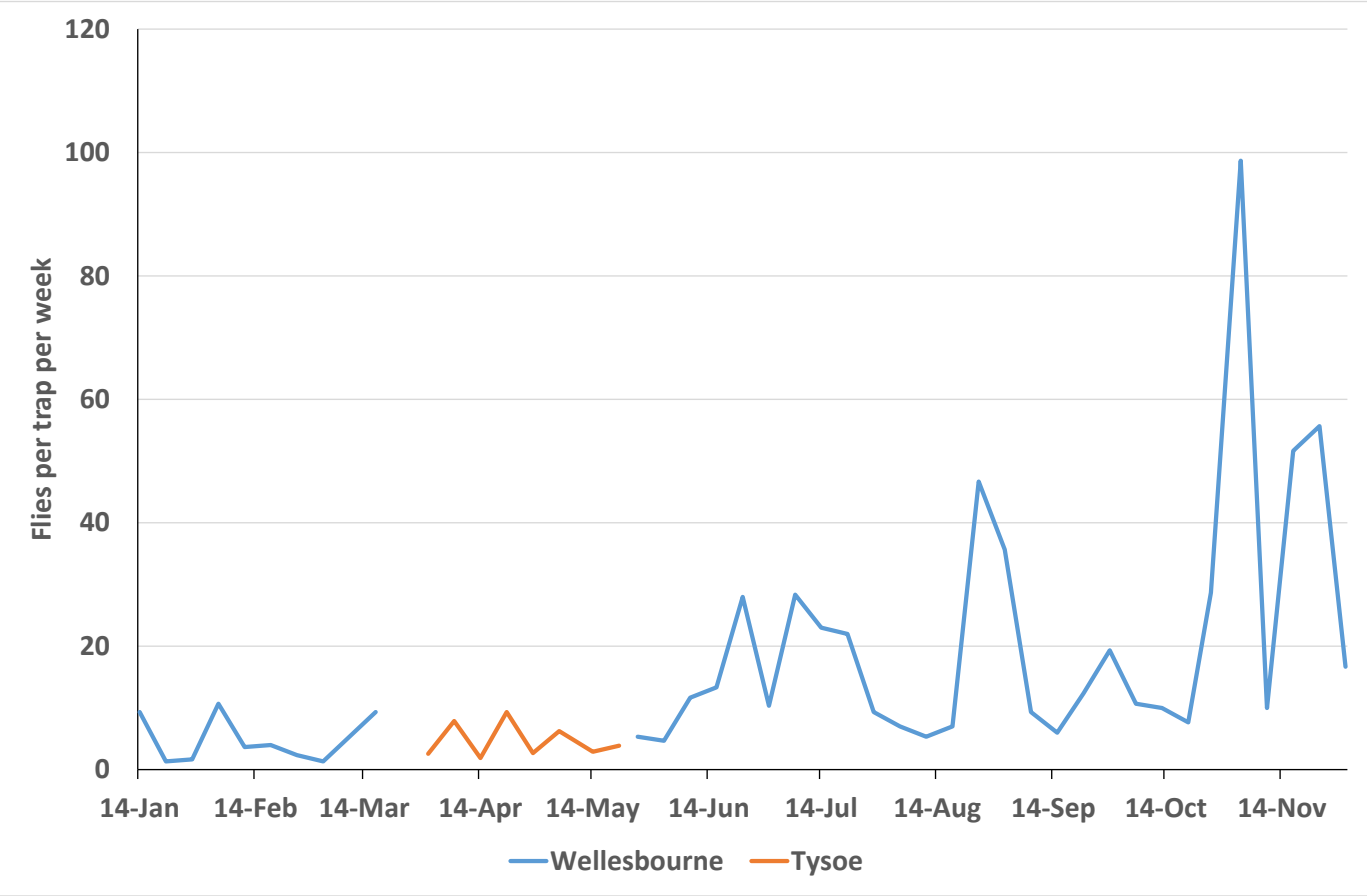
# Objective Four: Determine pattern of Bean Seed Fly activity in different locations

## Experiment One: Monitoring in Warwickshire 2020

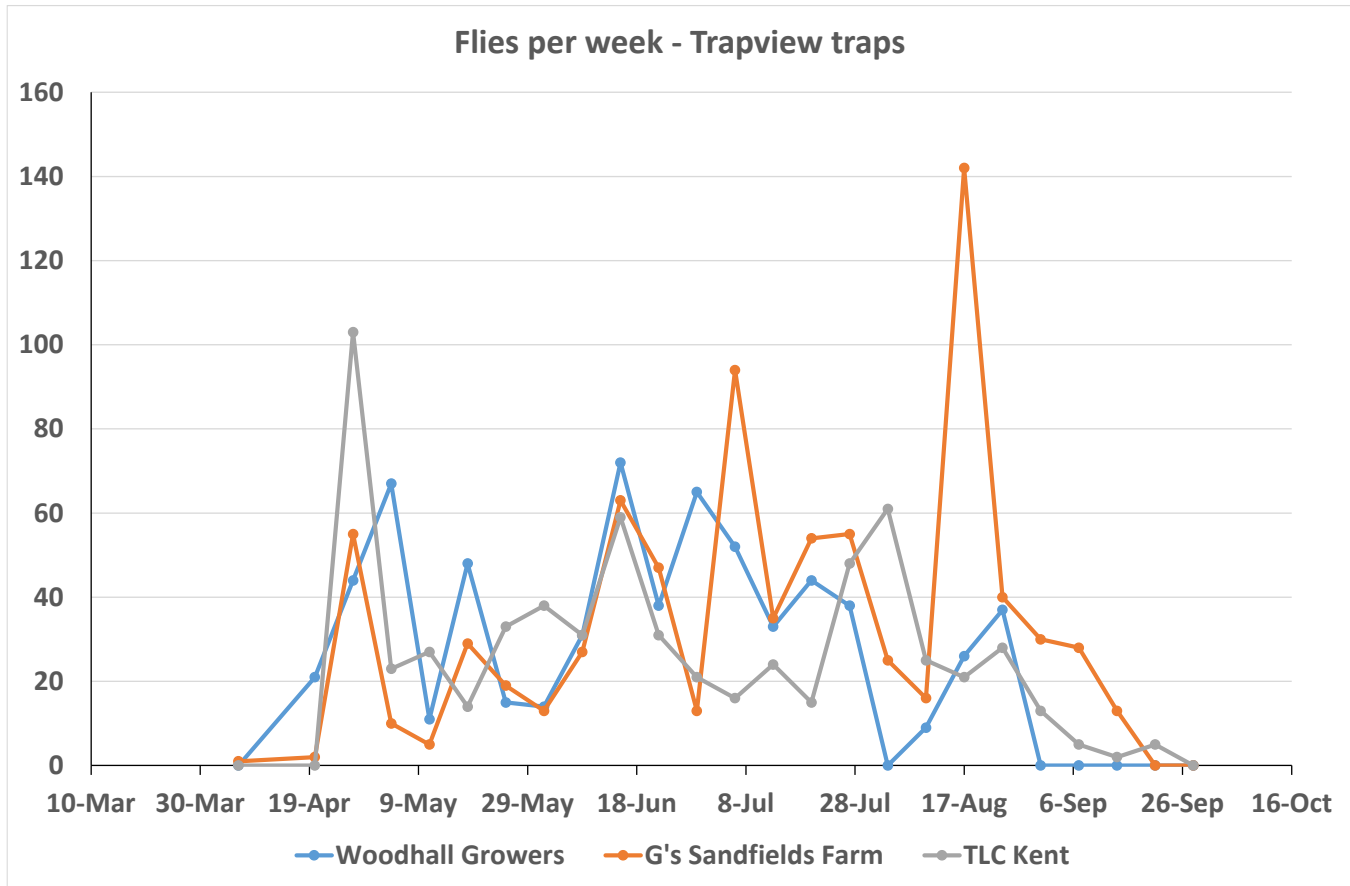
### Results



# Bean seed fly – Wellesbourne and Tysoe 2020



# Bean seed fly - G's Trapview network 2020



Where should the trap be located?



# Objective Five: Create and validate a BSF forecasting model

## Analyses One & Two: Is there a relationship between Bean Seed Fly activity and Day-Degrees?

### Methods

- 20 years of Bean Seed Fly activity data at WCC (1999-2019)
- Water traps (x3)
- Day-Degrees: What are they?
  - Used to estimate development
  - Assumption: Development will only occur when the temperature exceeds a base temperature
  - Calculation example (Rowley et al., 2016):

$$\text{Degree hours} = \sum (\text{Mean hourly soil temperature}) - \text{base temperature}$$

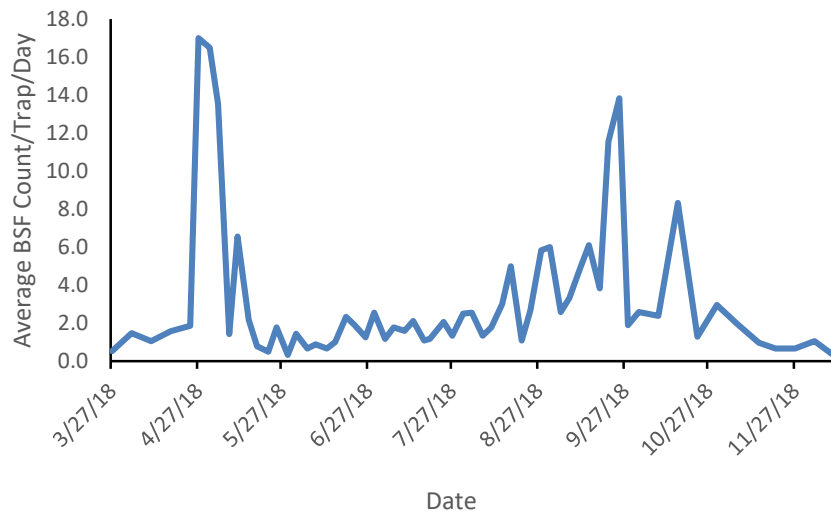
$$\text{Degree days} = \frac{\text{Degree hours}}{24}$$

# Objective Five: Create and validate a BSF forecasting model

## Analyses One & Two: Is there a relationship between Bean Seed Fly activity and Day-Degrees?

### Results: Estimating the Peak

- Day Degrees: 3.9°C base temperature (Broatch et al., 2006) and accumulate from 1st January
- Start & peak dates of spring emergence estimated per year (example year: 2018)
- Estimations using soil & air temperatures



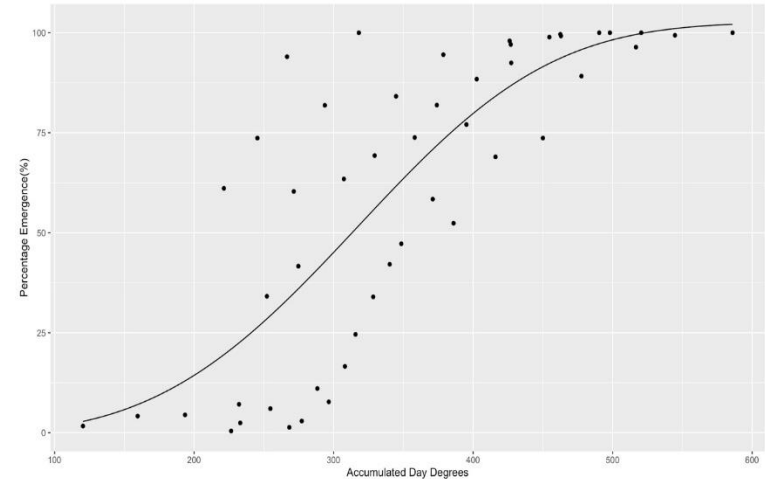
Year	SOIL		AIR	
	START	PEAK	START	PEAK
2014	224	391	319	477
2015			196	295
2016	273	324	332	369
2017	230	271	327	365
2018	118	248	220	352
2019	190	217	296	322
<b>AVERAGE</b>	207	275	299	363
<b>STANDARD DEVIATION</b>	58	72	46	62
<b>COEFFICIENT OF VARIATION</b>	28%	26%	15%	17%

# Objective Five: Create and validate a BSF forecasting model

**Analyses One & Two: Is there a relationship between Bean Seed Fly activity and Accumulated Day-Degrees?**

**Results: A Statistical Relationship?**

- Yes! For soil & air temperatures
- Best model fit using soil temperatures: 3-Parameter Weibull (Type 2) function:
  - All parameters:  $P < 0.001$
- An equation to estimate pattern of activity of Bean Seed Fly in spring
- Requires validity testing
- Please note: Different method for calculation of degree days used in these analyses



Percentage flies caught	Accumulated Day-Degrees
10	178
25	241
50	313
75	384
90	442
100	523

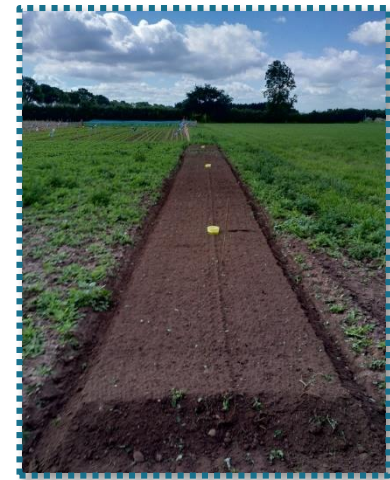
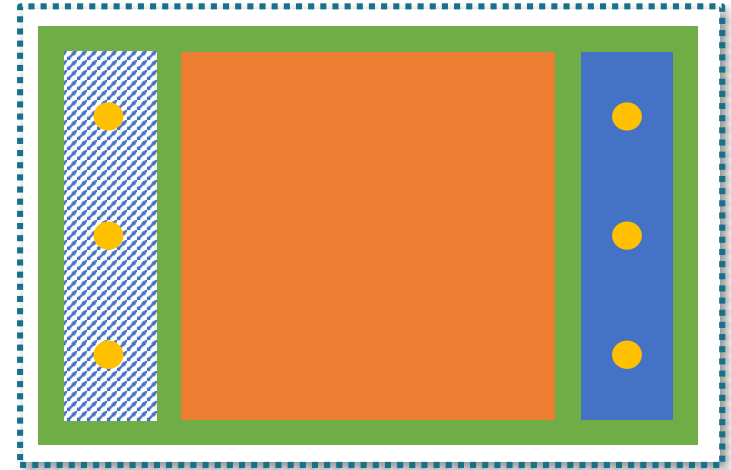


# Objective Six: Assess and compare the efficiency of different cultural and physical control strategies on reducing crop damage

## Experiment One: The effect of cultivation on Bean Seed Fly counts at Warwick Crop Centre

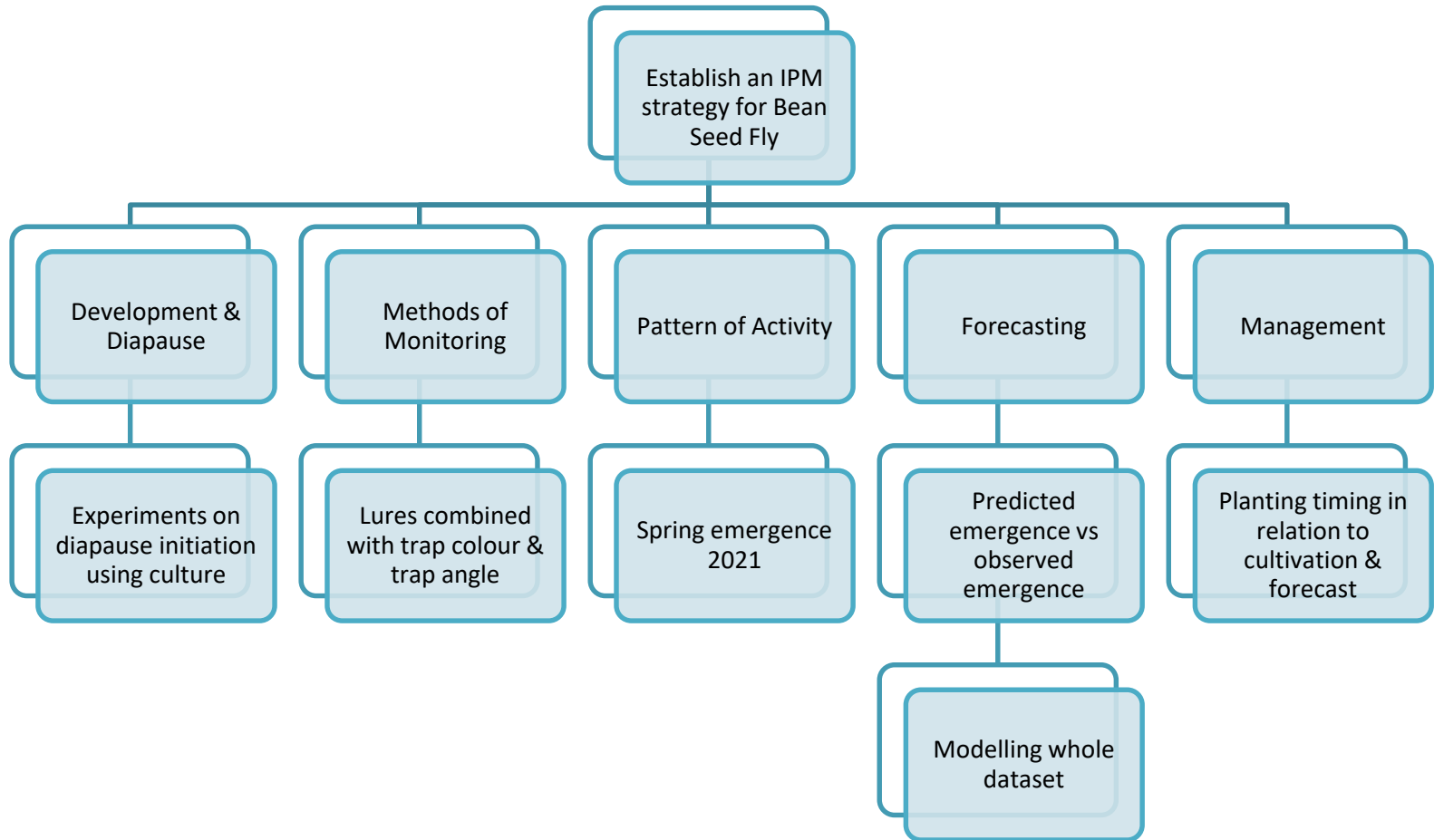
### Methods

- Hypothesis: More Bean Seed Fly will be caught in water traps placed in a bed which has been cultivated than water traps placed in beds which have not been cultivated
- Four sample sites at Warwick Crop Centre
- Two beds per sample site
- Cultivation: 1 bed at random per sample site
- Sampling before & after cultivation
- 2 replications (17/07 & 06/08)





# 4. Future Experiments



# Thank you for listening!

## Any Questions?

Many thanks to:

- Rosemary & Rob (Supervisors at Warwick)
- Andy & Maz (Warwick)
- Becky (PGRO)
- Joe Martin and colleagues (AHDB)
- G's Growers & Jon Bellamy for finding fields for sampling
- To all of you for your involvement & input

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