

Contributing towards an Integrated Pest Management (IPM) strategy for Bean Seed Fly

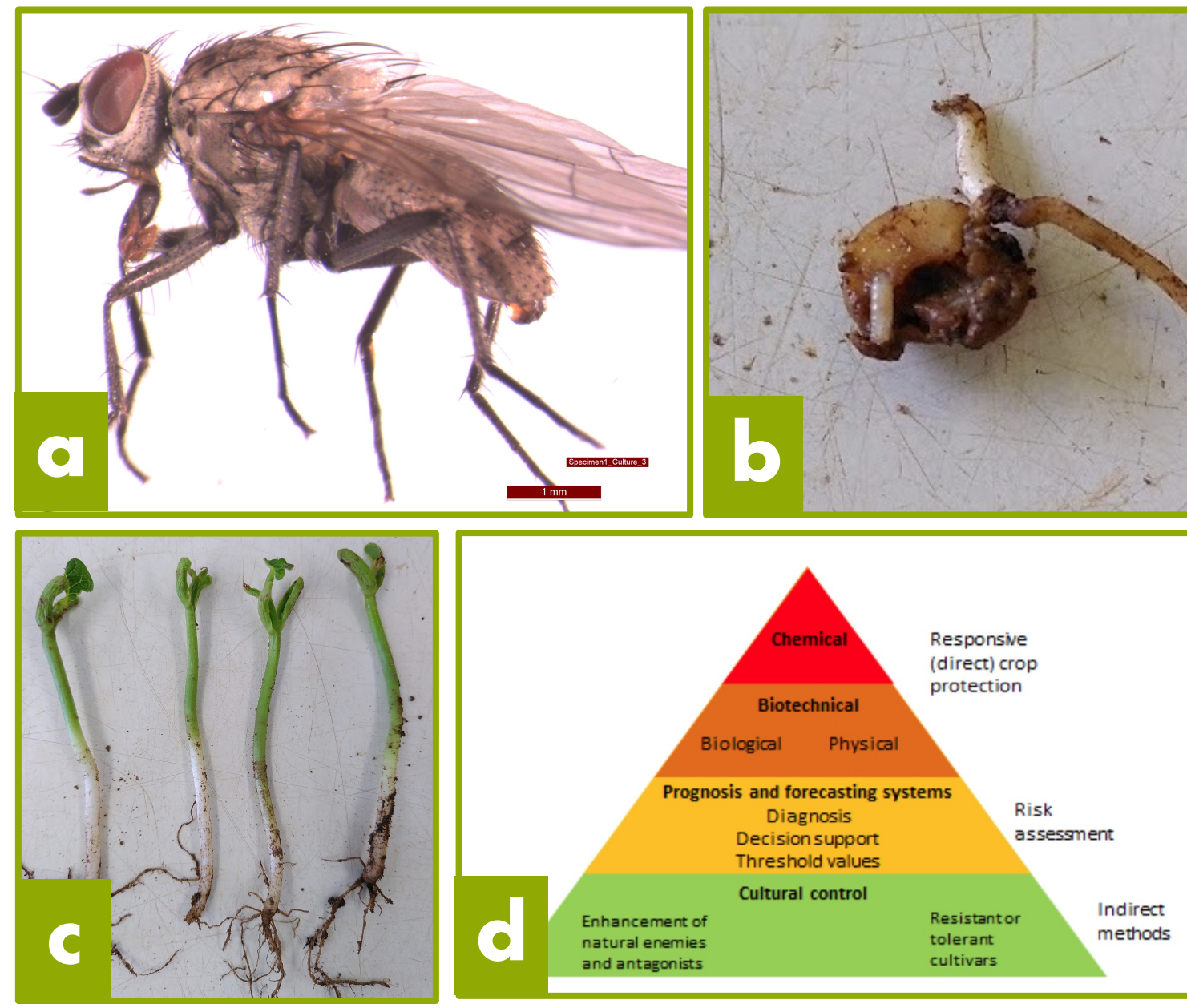


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Introduction

Bean Seed Fly (BSF) is a generalist dipteran pest insect¹. Damage is caused when larvae feed on germinating and emerging seedlings² of legumes³ and alliums⁴ in particular. Pesticidal control options are limited⁵ due to insecticide resistance⁶, and ecological concerns⁷. Alternative strategies using **Integrated Pest Management (IPM)** are required to reduce crop and economic losses.



a) Adult BSF

BSF refers to two species, *Delia platura* and *Delia floraliga*¹

b) BSF larvae feeding on pea

Larvae tunnel into the seed

c) 'Baldheadedness'

A symptom of BSF infestation in beans⁵

d) IPM Pyramid

A bottom up approach to managing pests that prioritises alternative strategies to chemicals⁸

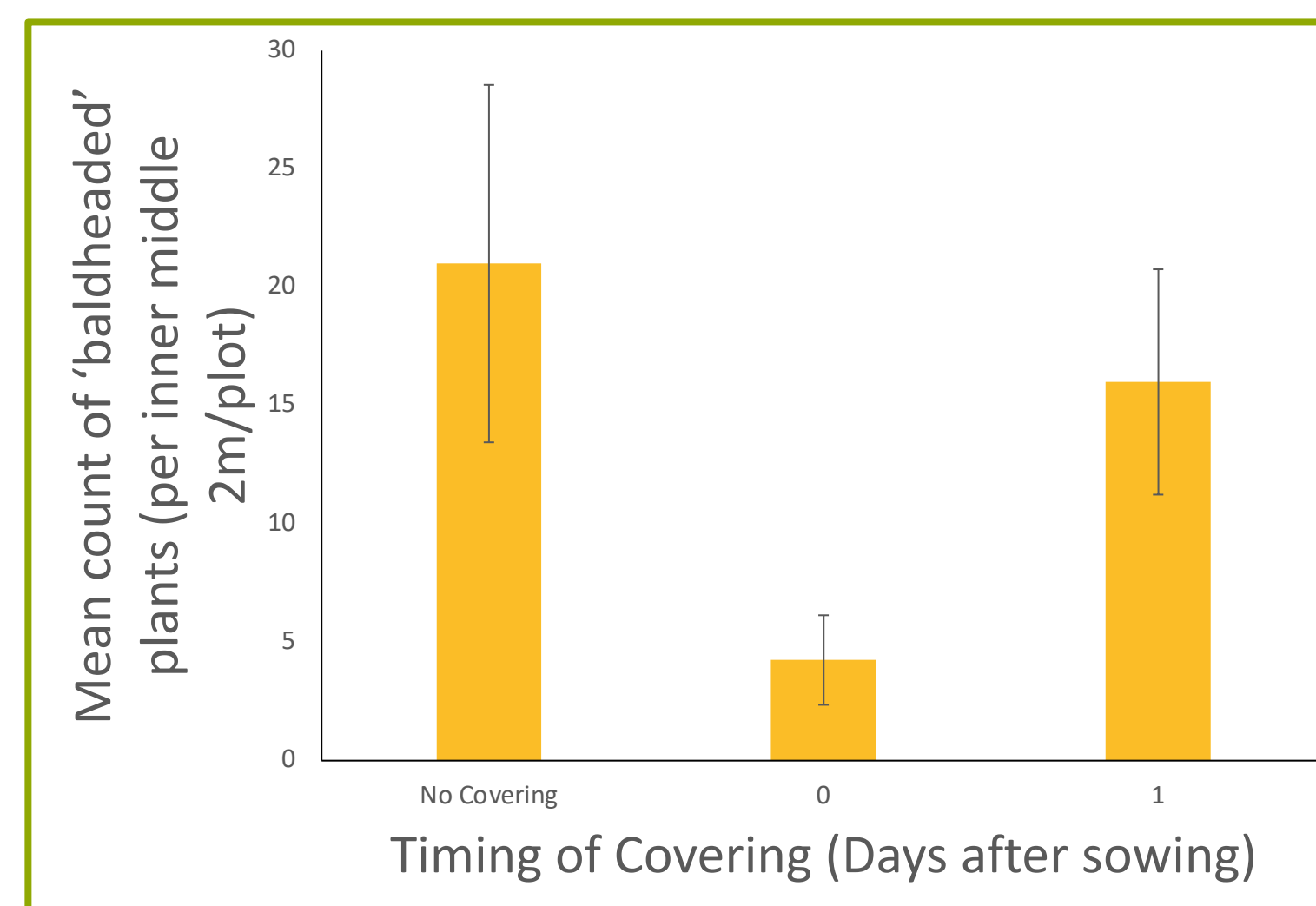
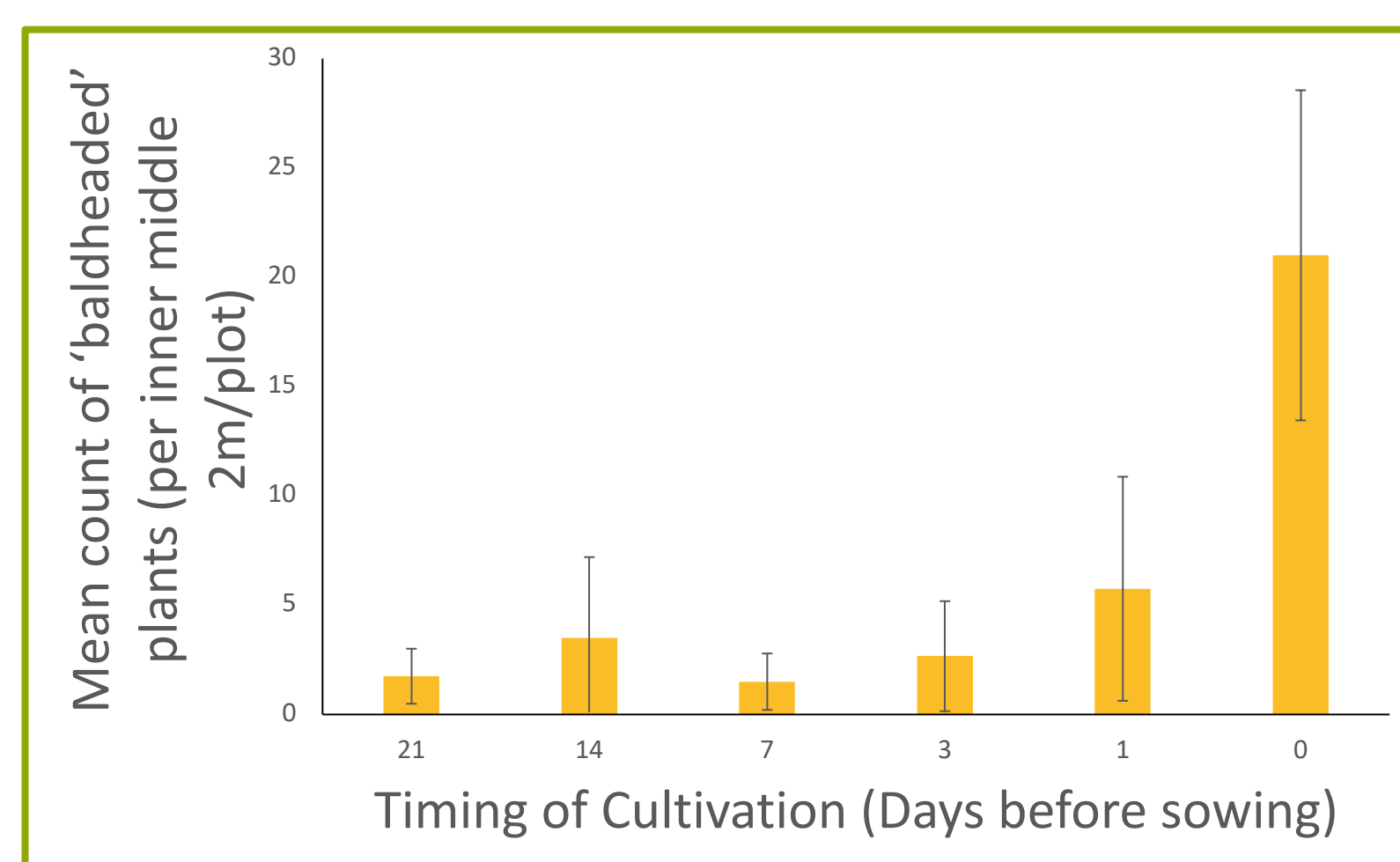
Project Objectives

- 1 Assess cultural & interference strategies for reducing damage by BSF
- 2 Identify effective trapping methods for monitoring BSF
- 3 Investigate the overwintering biology of BSF
- 4 Create & validate a model to predict the spring emergence of BSF

The Effect of Cultivation on the Activity of Bean Seed Fly

BSF are attracted to lay eggs on germinating and emerging seeds². Incorporation of organic matter into a seedbed & disturbed soil enhances the risk of egg laying⁹. Generally, UK growers cultivate on the day the crop is sown. This could increase crop damage. **Does the timing of cultivation in relation to sowing affect the level of damage caused by BSF? If plots are cultivated on the day of sowing, does covering the plot with a fine mesh reduce the damage caused by BSF?**

- 1 In June 2022, French beans were sown in plots at Warwick Crop Centre (Trojan square: 8 treatments x 4 replicates)
- 2 Plots were cultivated with a power harrow on the day of sowing or 1 – 21 days prior to sowing. The mesh had 0.6mm gaps.
- 3 French beans in the middle two rows of each plot were assessed for symptoms of BSF damage



There were significantly more 'baldheaded' plants in plots that were cultivated on the day of sowing than plots cultivated 7 & 21 days prior to sowing ($P = 0.03$).

There were significantly more 'baldheaded' plants in plots not covered and covered a day after sowing than plots covered on the day of sowing ($P = 0.003$).

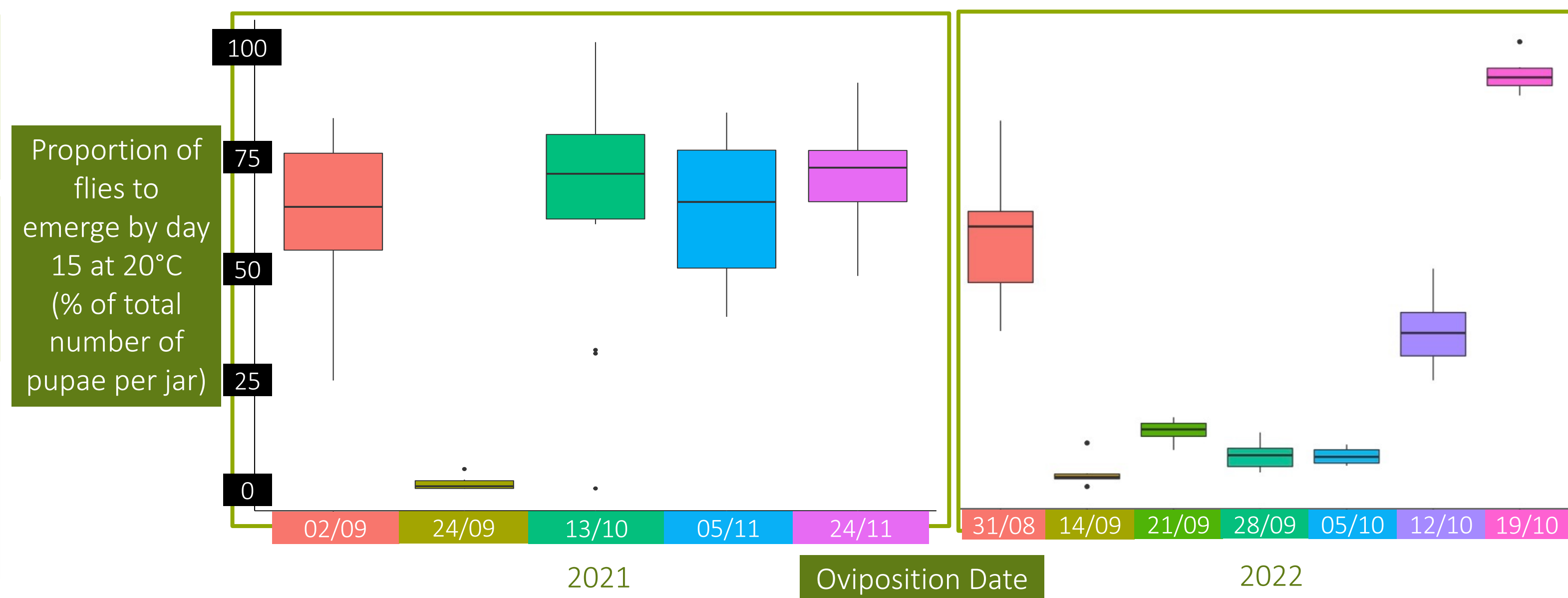
Key Finding

Delaying cultivation and covering the crop with a fine mesh reduces BSF damage

Investigation into the Overwintering Strategy of Bean Seed Fly

Less is known about how BSF overwinter than about closely related species. Understanding their overwintering biology can inform a BSF forecast. **Do BSF enter diapause and if so when do they enter diapause?**

- 1 At intervals during late Summer & Autumn in 2021 & 2022, eggs from the BSF culture were placed under field conditions at Warwick Crop Centre
- 2 When the eggs had developed into pupae (estimated using the the accumulation of day degrees), the pupae were placed at 20°C
- 3 It takes 15 days for pupae to emerge as adult flies at 20°C¹² when they are developing normally. Flies that took > 15 days to emerge were assumed to be in diapause.



In 2021, eggs laid on 24/09 showed < 50% of flies to emerge by day 15 at 20°C. Eggs laid from 13/10 onwards showed >50% of flies to emerge by day 15 at 20°C ($P < 0.0001$).

In 2022, eggs laid between 14/09 – 12/10 showed < 50% of flies to emerge by day 15 at 20°C. Eggs laid on 19/10 showed >50% of flies to emerge by day 15 at 20°C ($P < 0.0001$).

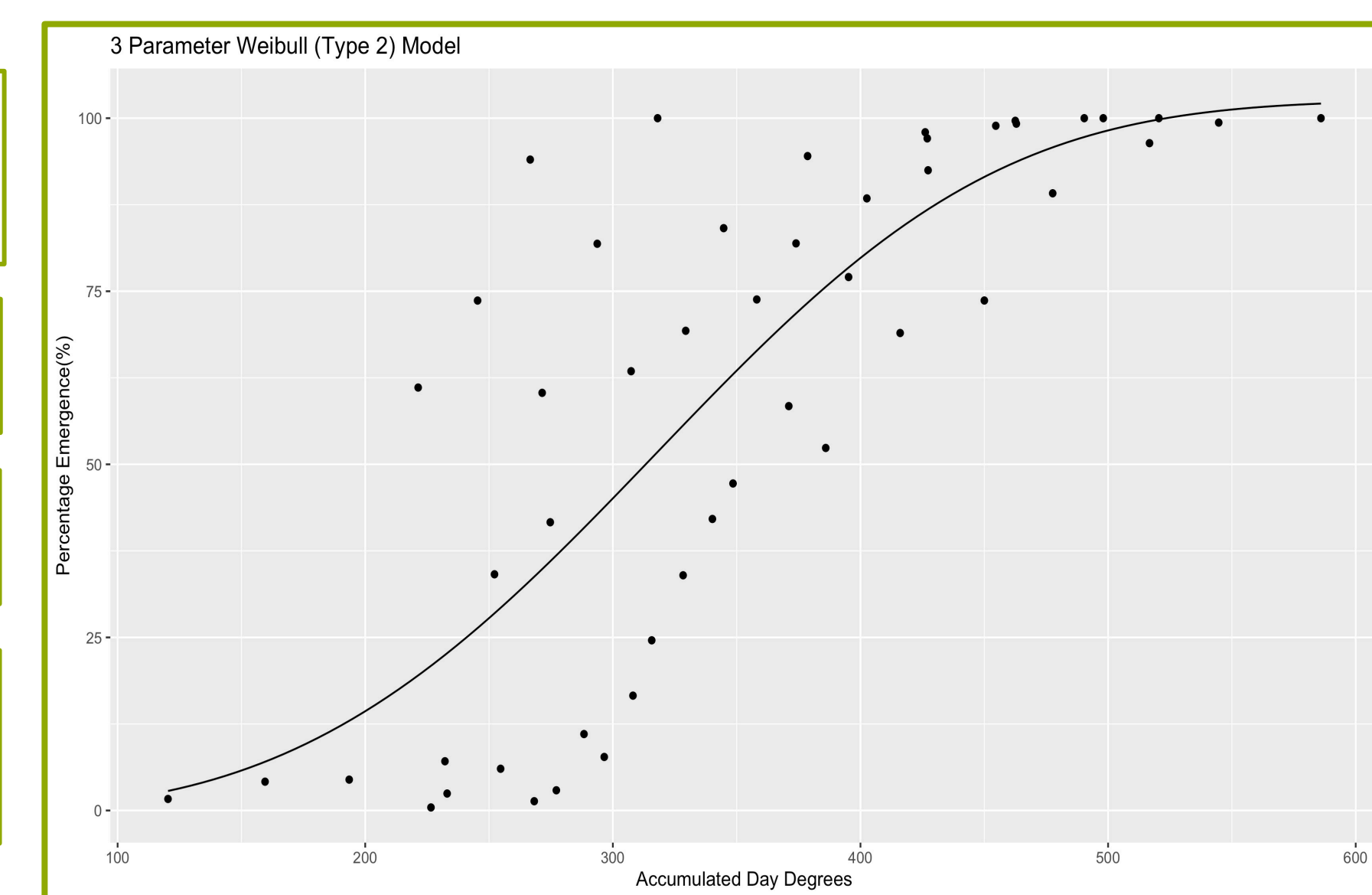
Key Finding

BSF enter diapause under field conditions and this occurs between mid-September and mid-October. Eggs laid after mid-October do not enter diapause.

Forecasting the Spring Emergence of Bean Seed Fly

The emergence of closely related species can be predicted using accumulated day-degrees¹⁰. **Can accumulated day-degrees be used to estimate the spring emergence of BSF?**

- 1 BSF count data was collected from water traps at Warwick Crop Centre over 6 years
- 2 Start & finish of the spring (first) generation in each year was estimated
- 3 Cumulative emergence over time was calculated for each spring generation
- 4 Corresponding day-degrees calculated (threshold temperature = 3.9°C % Biofix date = 1st Jan)



Cumulative emergence (%) of the spring generation ($n = 6$) is plotted against accumulated day-degrees using soil temperature. The Weibull (type 2) 3-parameter model showed the best fit and a significant relationship between cumulative emergence and accumulated day-degrees ($P < 0.0001$).

The model can be used to forecast emergence of the spring generation of BSF. Growers can use this to inform sowing times.

Percentage Emergence (%)	Accumulated Day-Degrees
25	241
50	313
75	384
100	523

Key Finding

Accumulated day-degrees can be used to forecast the spring emergence of BSF

Conclusions & Recommendations to Growers

Objective One

Assess cultural & interference strategies for reducing damage by BSF

Cultivating a seedbed at least 7 days prior to sowing French beans will reduce BSF damage. Covering the bed with a fine mesh on the day of sowing will reduce BSF damage if cultivation cannot be delayed.

Objective Three

Investigate the overwintering biology of BSF

BSF enter a form of diapause in early Autumn. It seems that eggs laid towards mid-Autumn (e.g. end of October) do not enter diapause. This strategy is different from similar species. The forecast may need to consider that a proportion of BSF do not enter diapause.

Objective Four

Create & validate a model to predict the spring emergence of BSF

Accumulated day-degrees can be used to forecast the spring emergence of BSF. The forecast will be adjusted considering the findings of the overwintering experiments. Estimates from the model will be compared with observations in different years and regions.

References

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Picture Sources

Peas in title box: Ellaby, D. 2023. *Pods of peas*. Unsplash. IPM Pyramid: Ecosystems United. 2023. An introduction to Integrated Pest Management (IPM). Taken from: <https://ecosystemsunitd.com/2016/03/15/an-introduction-integrated-pest-management-ipm/> [Accessed: 27/03/2023] Remaining pictures taken by Becca McGowan.