Next Generation Integrated Pest Management for oilseed rape at Rothamsted Research

ROTHAMSTED RESEARCH

Dr Sam Cook

Section Area lead: Next Gen IPM

Protecting Crops & Environment

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@SamCook_IPM samcook-ipm.bsky.social

Aim:

To understand the **behaviour and ecology** of agricultural **pests and their natural enemies**;

To apply knowledge to develop **integrated pest management** tools to help reduce insecticide use and increase the sustainability of farming (**with focus on oilseed rape**)

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We are actively researching each of the 4 IPM ‘steps’ at laboratory, field and farm-scale

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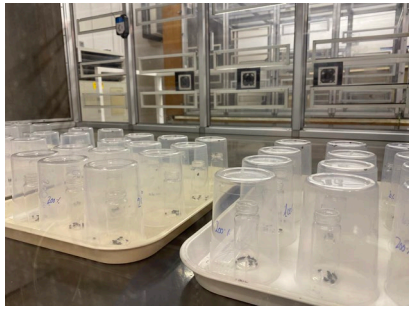
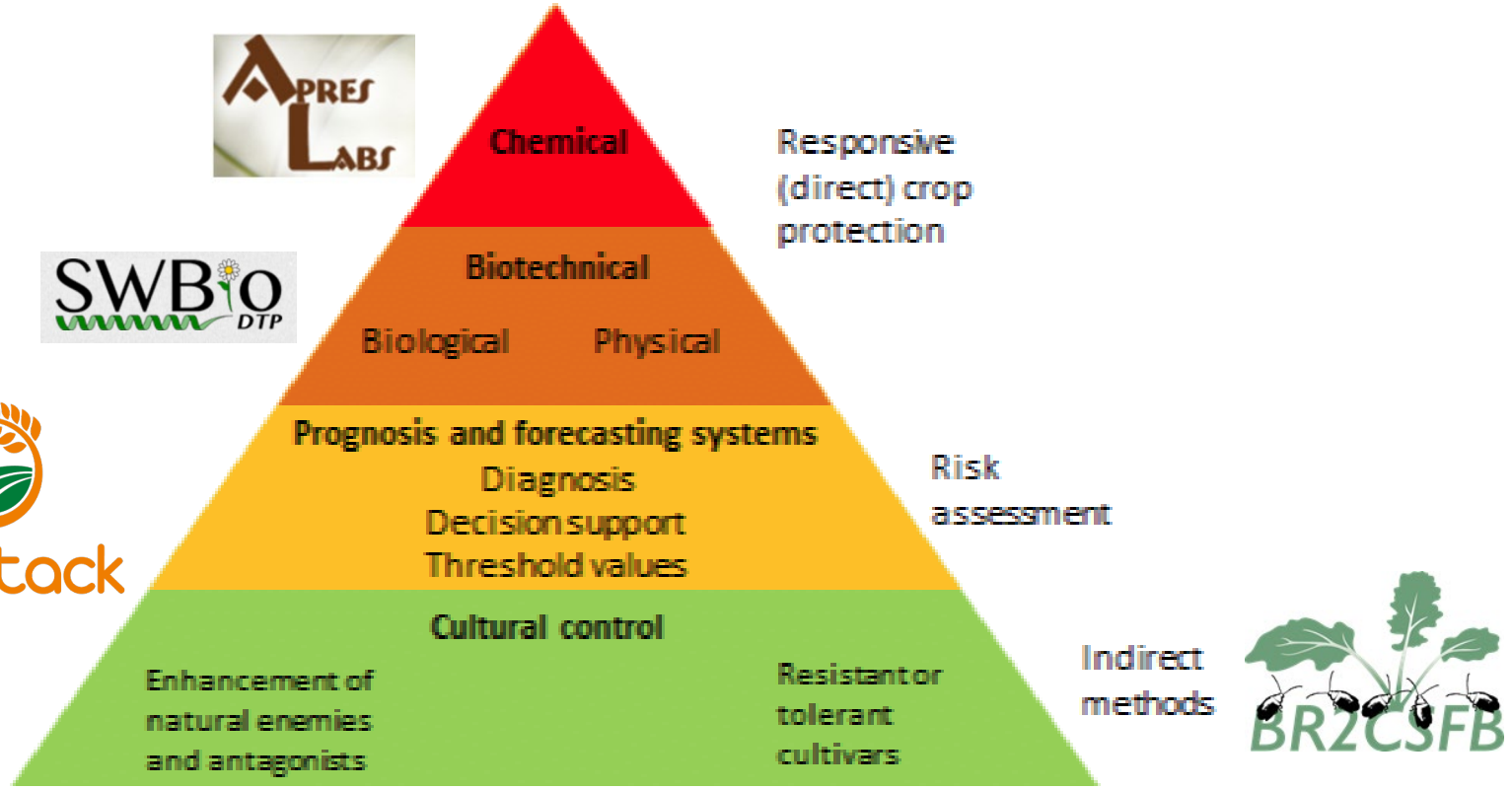


- Current projects:



APRES LABS

SWBio DTP

EcoStack

assist

Growing Health

AgZero+

BR2CSFB

Integrated Pest Management

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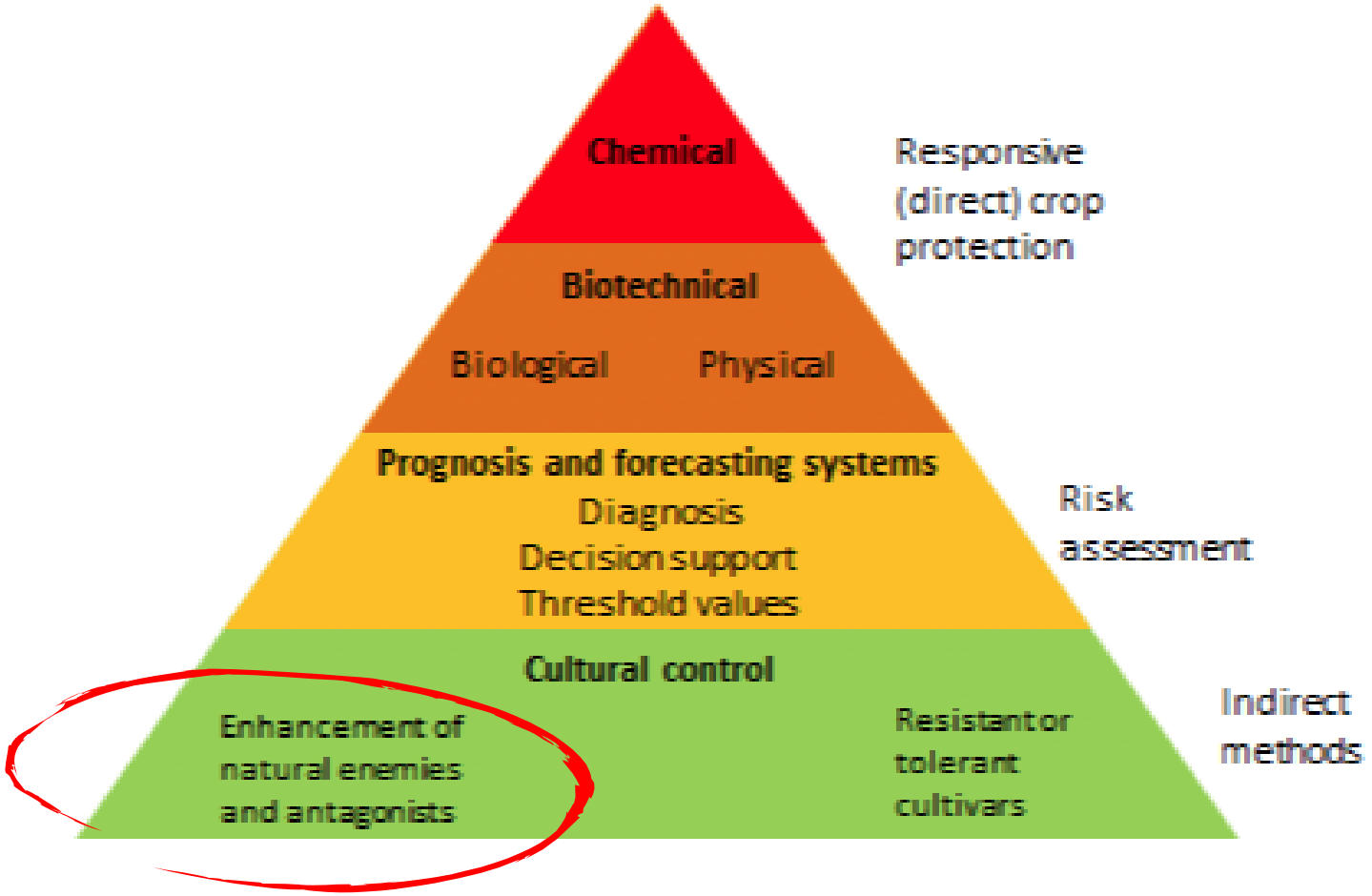

Agroecology/ regen / sustainable ag

Cultural Control – natural enemies and crop management

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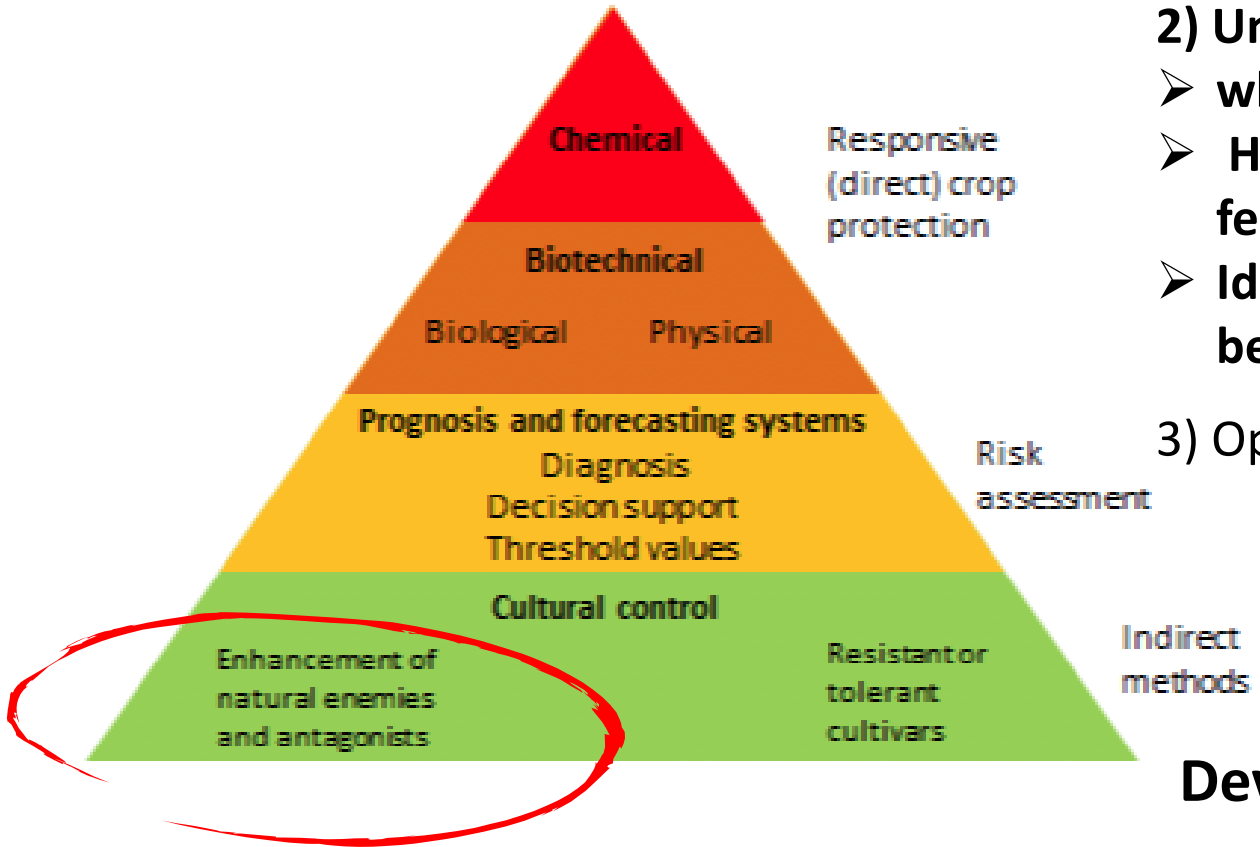
Conservation Biological Control = Use of **agronomy** & **habitat management** methods to conserve the natural enemies of crop pests in the agri-environment to provide pest regulation



1) Identify main natural enemies of target crop pests

2) Understand their needs

- **what resources do they use most in the environment?**
- **How is their abundance and function affected by landscape features and agricultural practises & compare with pests**
- **Identify landscapes/practices which reduce pests and boost beneficials**

3) Optimised resource requirements in time and space

Agroecology

Development of ecologically-based IPM strategies

Using camera traps to identify the main predators of OSR pests (and quantify predation)

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- Hunting cameras; on 1 minute time-lapse
- Prey glued on cards below the camera (24h) (CSFB larvae/eggs OR pollen beetle /pod midge larvae)
- Associated pitfall traps to determine identity of active community

EcoStack

AARHUS UNIVERSITY

Seimandi-Corda, G., …& S.M., Cook, 2024. Identifying insect predators using camera traps reveal unexpected predator communities in oilseed rape fields. *Biological Control*, *198*, p.105636.

Using camera traps to identify the main predators of OSR pests

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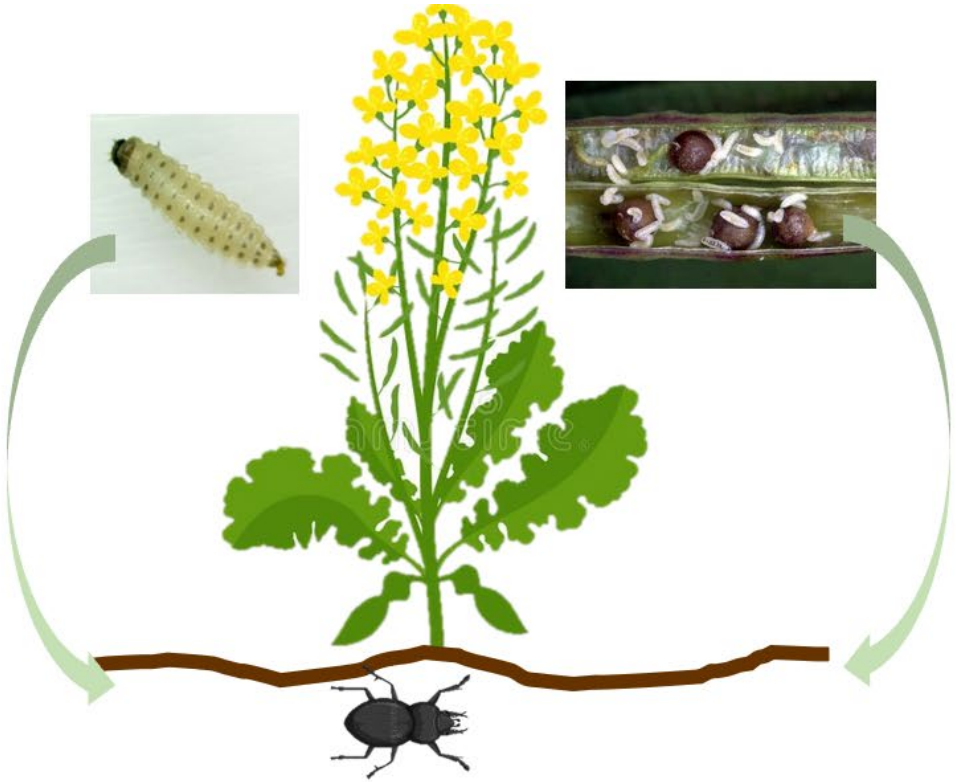
Focus (!) on Pollen beetle (*Brassicogethes aeneus*) & Brassica pod midge (*Dasineura brassicae*)

Pollen beetle



Brassica pod midge

Seimandi-Corda et al. Identifying insect predators using camera traps reveal unexpected predator communities in oilseed rape fields. *Biological Control* 105638

AARHUS UNIVERSITY EcoStack ROTHAMSTED RESEARCH

Grant Agreement no. 773554

Cultural Control – natural enemies and crop management

EcoStack

Acari (mites)

Ants & Carabidae larvae

Carabidae larvae

Carabid beetle adults - *Anchomenus dorsalis*

Seimandi-Corda, G., …& S.M., Cook, *Biological Control* 105638

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Identify the main predators of OSR pests

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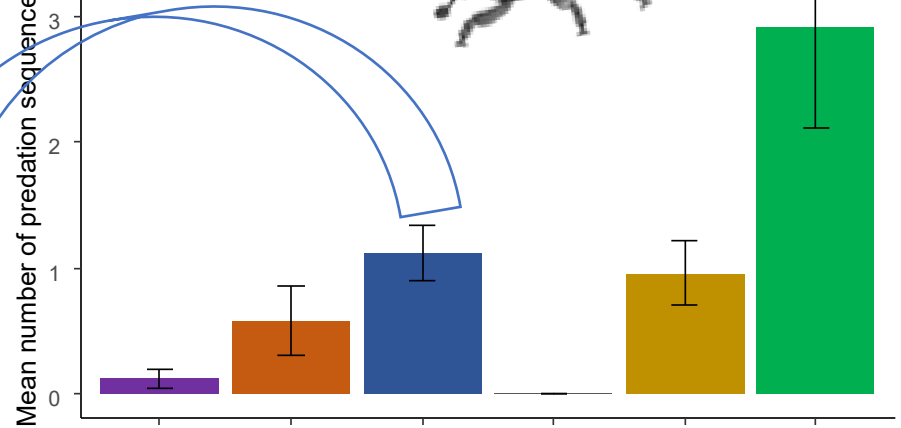
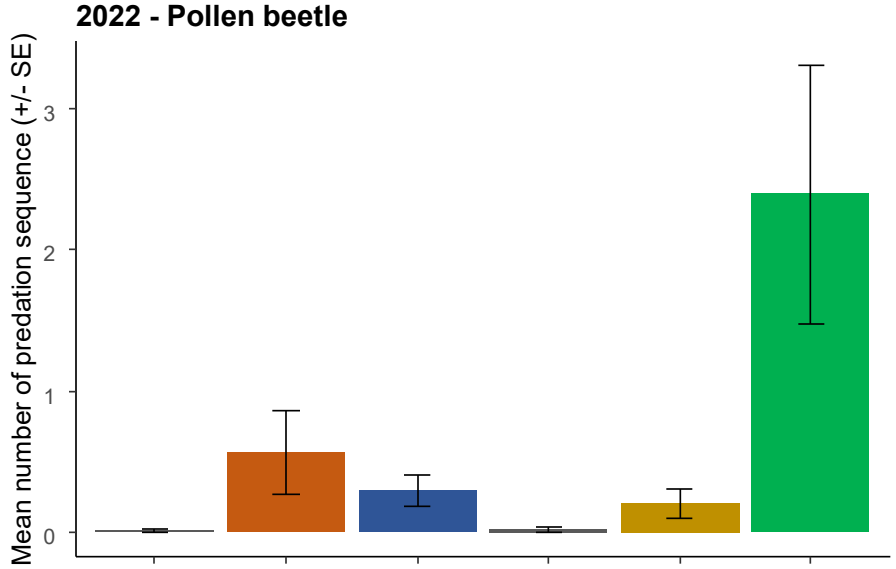
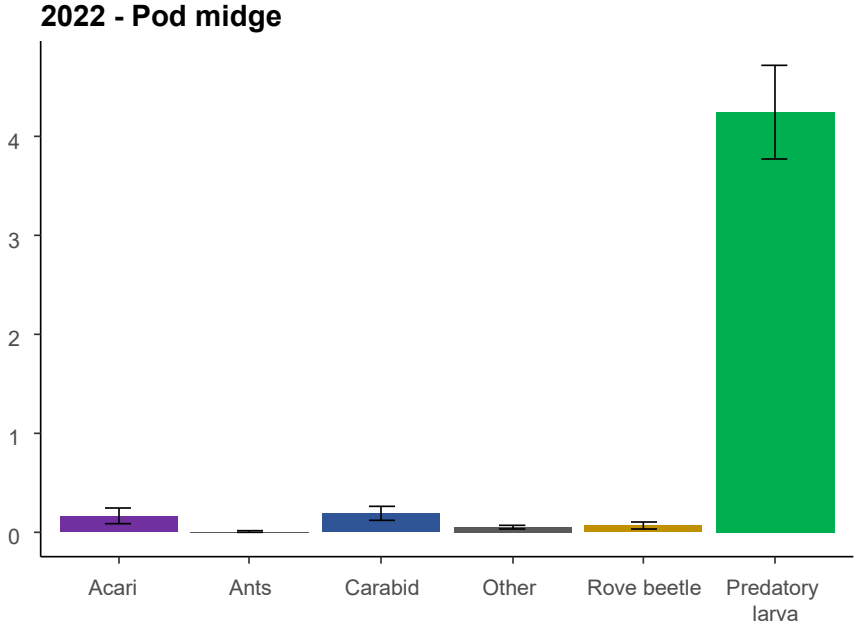
Anchonemus dorsalis



Rove beetle larvae

Trechus sp.





Carabid beetle larvae

Bembidion sp.

Seimandi-Corda, G., …& S.M., Cook, *Biological Control* 105638

EcoStack

Pitfalls of pitfall trapping?

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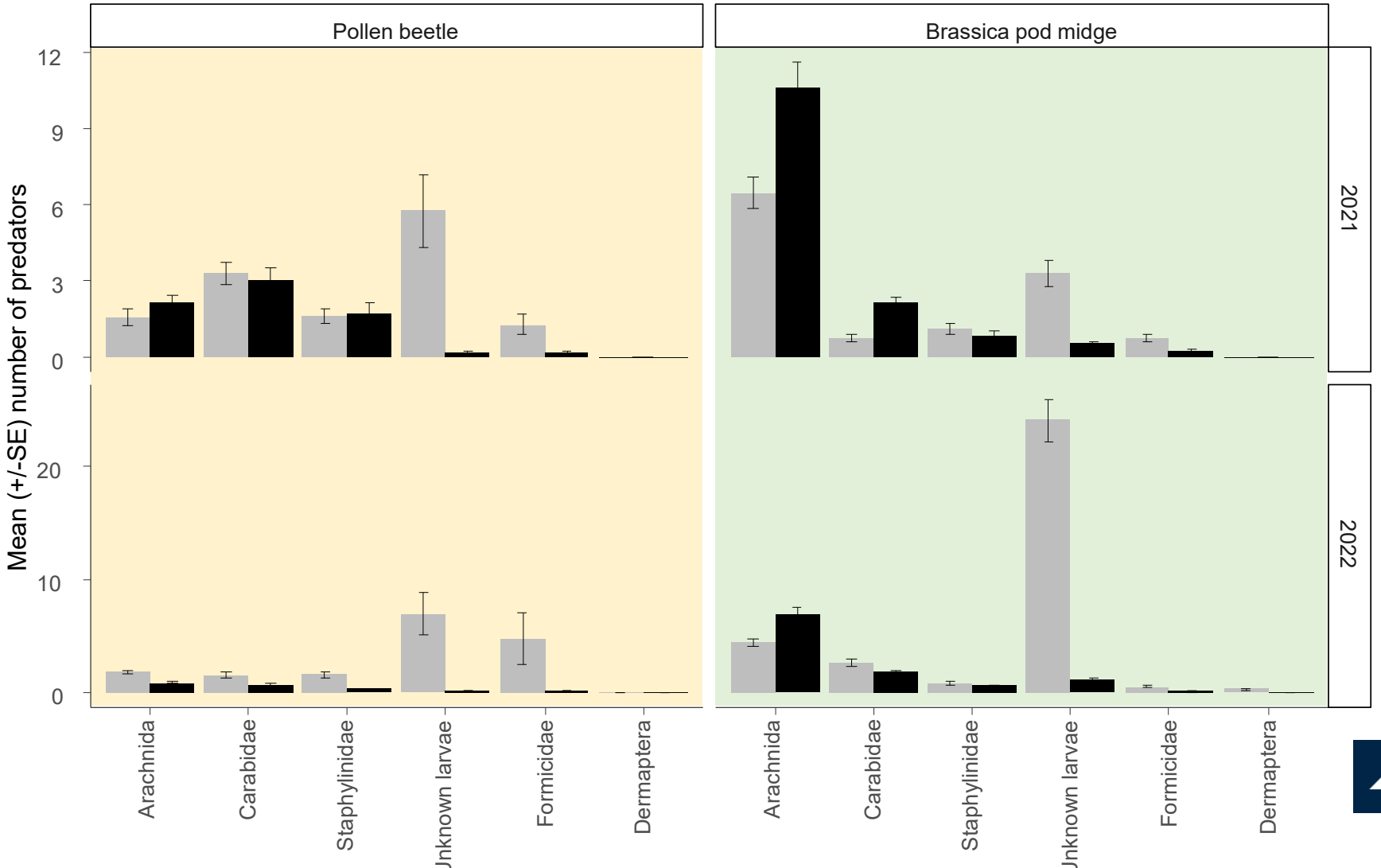
- Predator community different between pitfall and camera traps
  - Most common predators in pitfalls were spiders and carabid beetles (as per literature)



Pitfall traps

Cameras

Seimandi-Corda et al. Identifying insect predators using camera traps reveal unexpected predator communities in oilseed rape fields. *Biological Control* 105638

Grant Agreement no. 773554

Cultural Control – natural enemies and crop management

ROTHAMSTED RESEARCH

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Surveys to understand the role of different farming management techniques on insect biodiversity and abundance

Survey methods:

- Transect walks
- Crop searching
- Pitfall traps
- Water traps
- Sticky traps
- Suction sampling

Cultural Control – natural enemies and crop management

ROTHAMSTED RESEARCH

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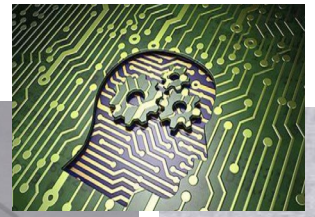
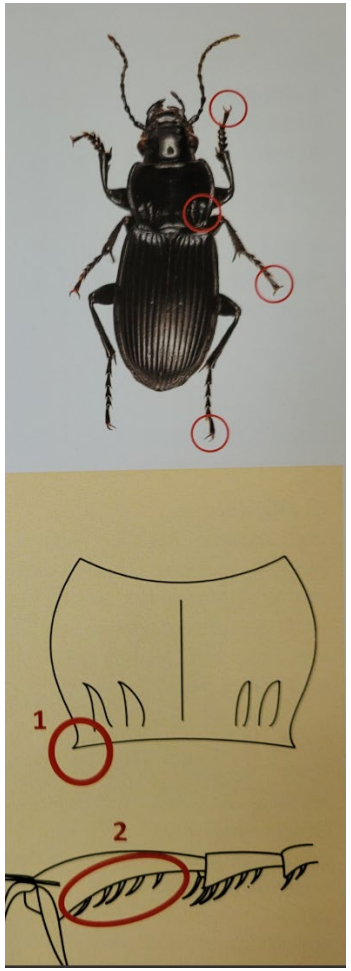
Surveys to understand the role of different farming management techniques on insect biodiversity and abundance …

Taxonomic identification – by highly trained taxonomists!



AI?



Martin Torrance

Cultural Control – crop management

- **Tillage – reduced tillage**
- **In-crop plant diversity**
  - **Companion plants (intercrops, trap crops & <u>undersown nurse plants</u> can reduce pests in OSR**

Gaëtan Seimandi-Corda

Ulrich Ebert

Cultural control – in-crop diversity: companion planting Undersown

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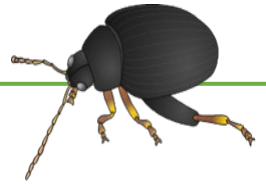
- Many UK farmers undersowing OSR with ‘cover crop’ mixtures for a range of benefits – does this include pest control?
- We tested a range of mixtures for effects on adult CSFB damage and larval infestation

University of Reading ROTHAMSTED RESEARCH

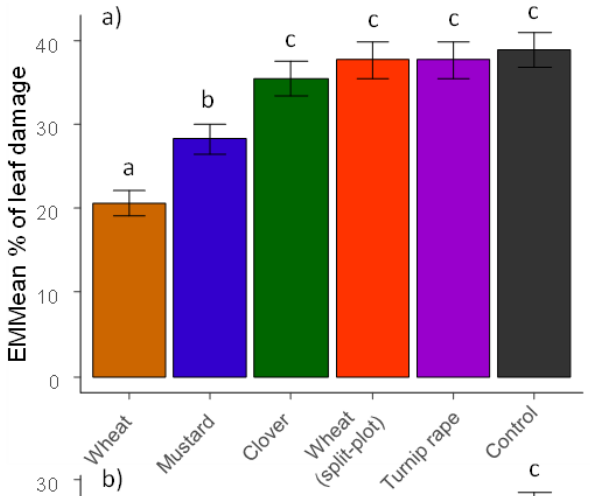
White mustard (*Sinapis alba*) most effective but removal difficult (+ Clearfield system)

Coston, D.J., Breeze, T.D., Clark, S.J., Field, L.M., Potts, S.G., Kightley, S. & Cook, S.M. (2022). Companion planting as a method of reducing pest pressure from Psylliodes chrysocephala on winter oilseed rape (Brassica napus). IOBC-WPRS Bulletin 57:120

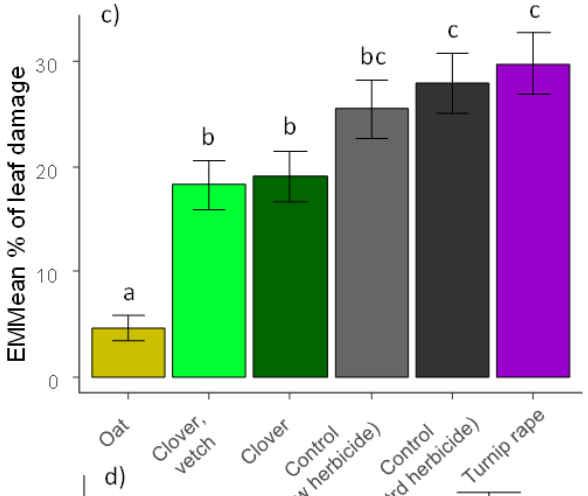
Cultural control – in-crop diversity: companion planting Undersown

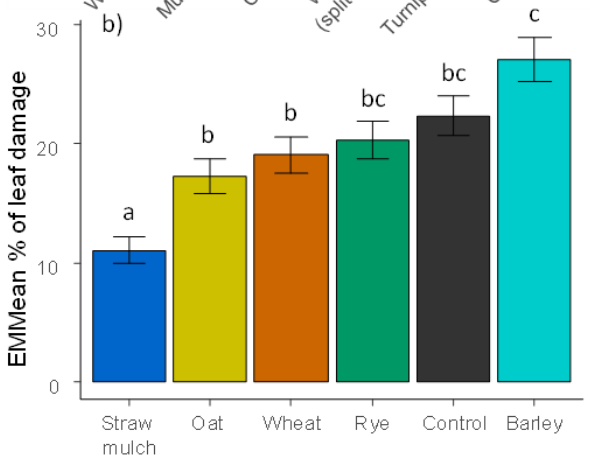


Trial 1

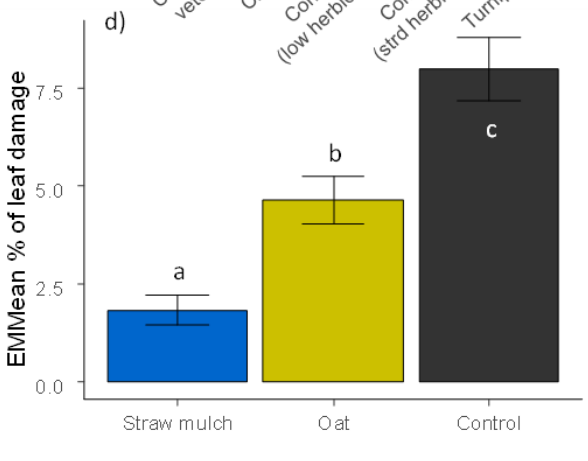


Trial 4



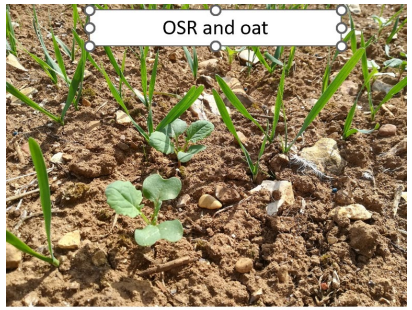


Trial 3



Trial 6

- Reduction of feeding damage with cereals (wheat & oats), white mustard
- Straw mulch also effective to reduce CSFB feeding damage



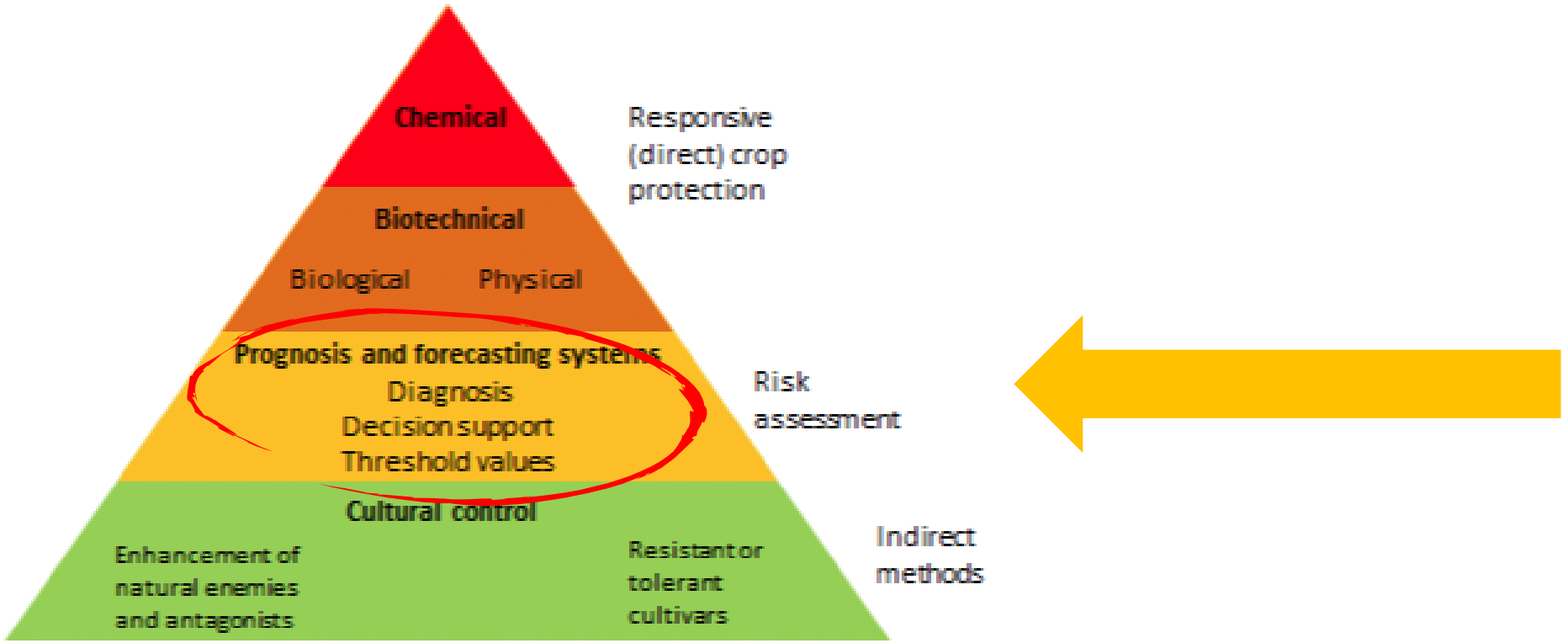
Effect on natural enemies ongoing ☺

Seimandi-Corda, G., Winkler, J., Jenkins, T., Kirchner, S.M., Cook, S.M. Companion crops reduce cabbage stem flea beetle (*Psylliodes chrysocephala*) damage on oilseed rape in autumn *Pest Management Science* 80 (5), 2333-2341.

Risk assessment - monitoring

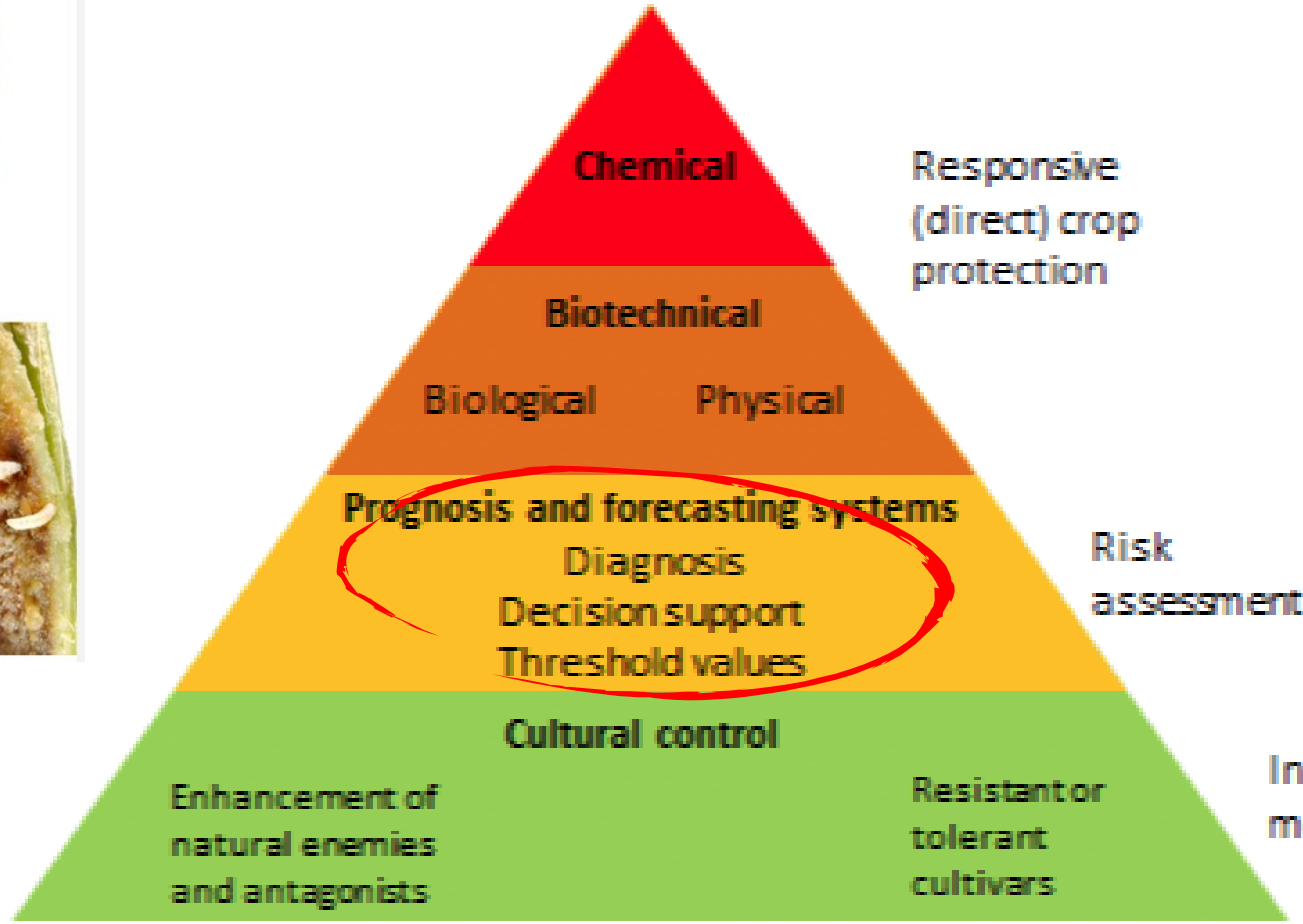
ROTHAMSTED RESEARCH

Aim: Improve pest detection and forecasting for farmers and researchers

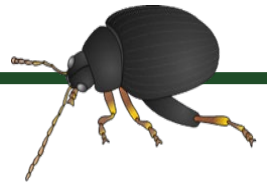


Current pest monitoring methods are onerous!

ROTHAMSTED RESEARCH

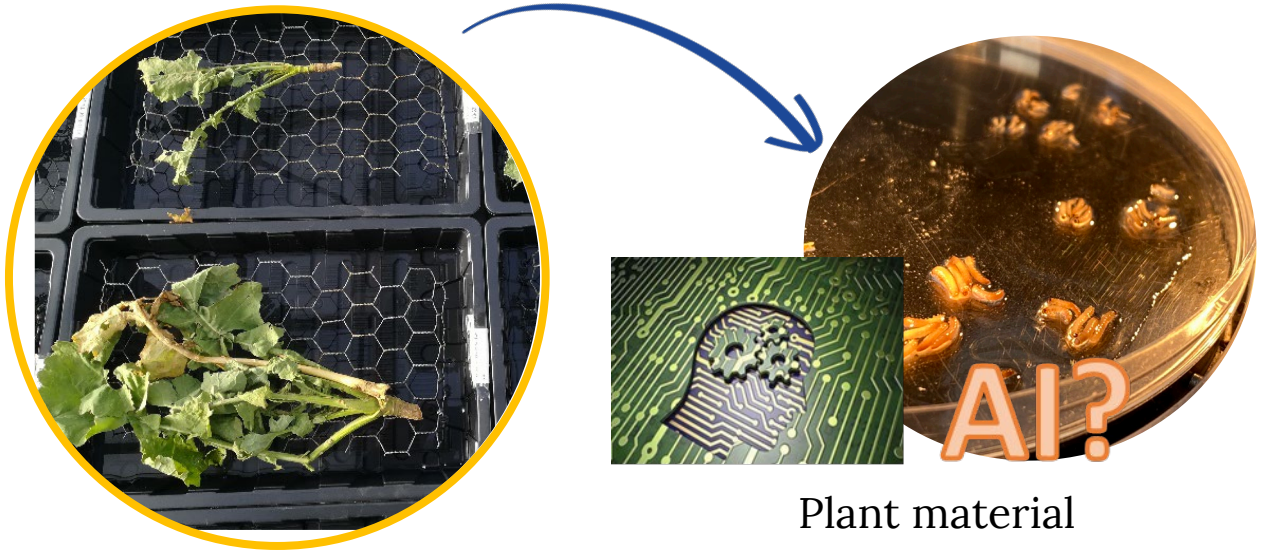


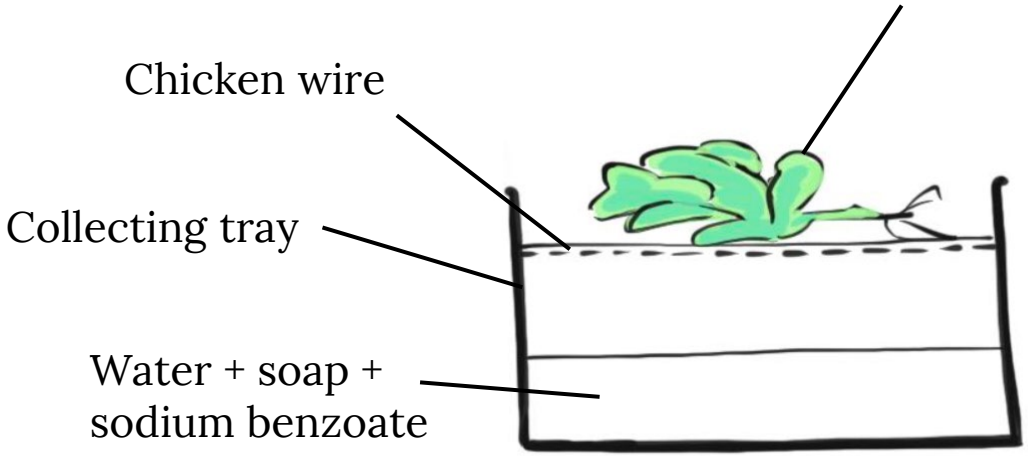
Monitoring CSFB larval abundance

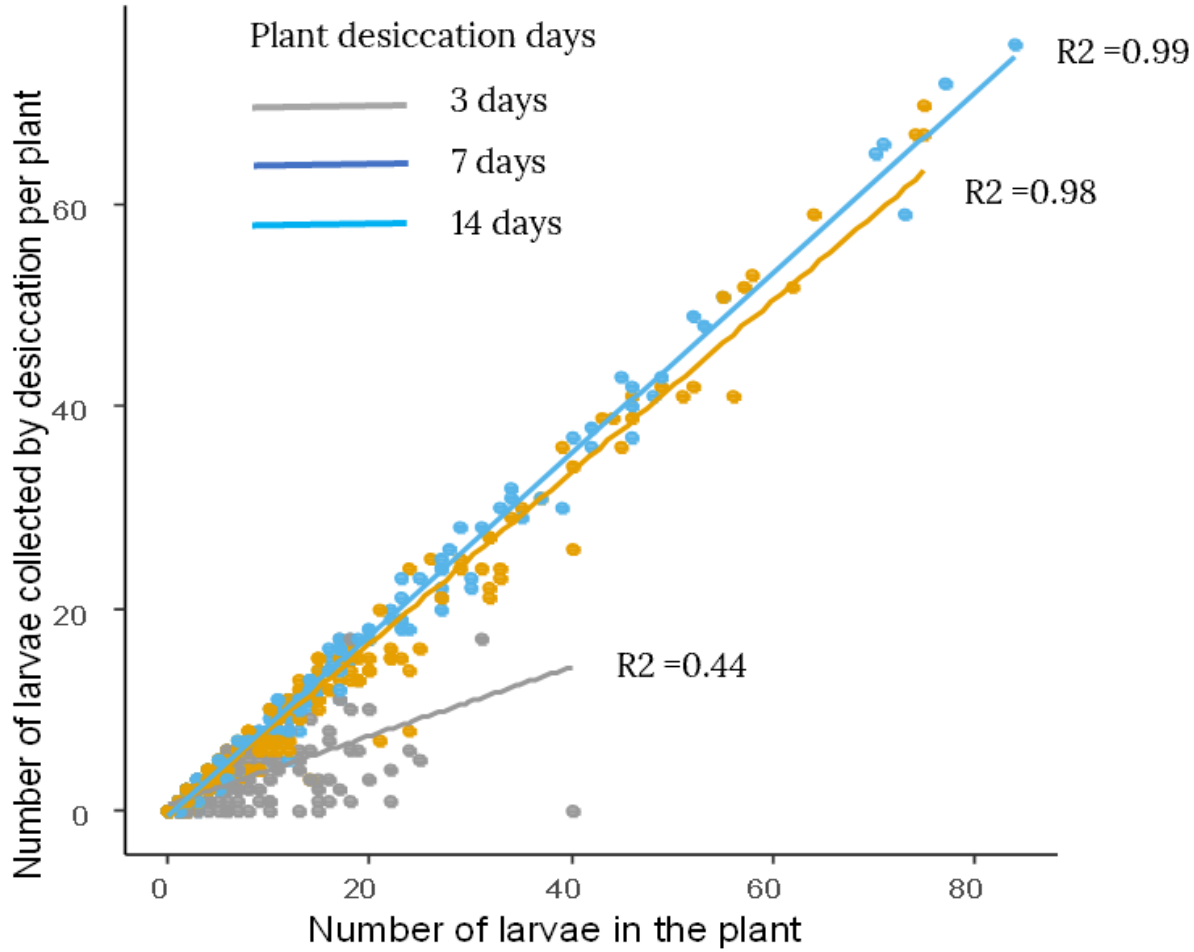


ROTHAMSTED RESEARCH

CSFB Larval evacuation method







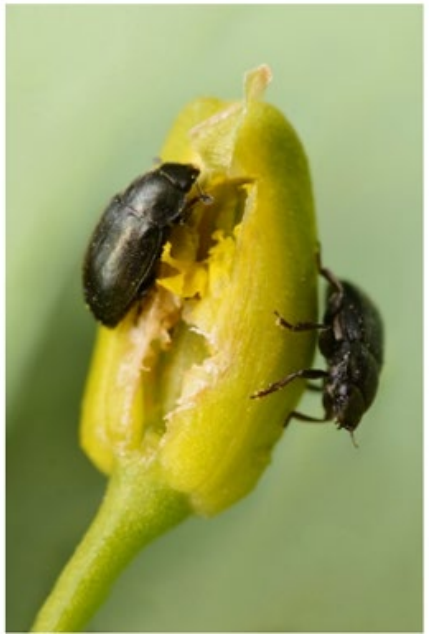
Seimandi-Corda, Hall, Jenkins, & Cook (2022). Relative efficiency of methods to estimate cabbage stem flea beetle (*Psylliodes chrysocephala*) larval infestation in oilseed rape (Brassica napus). *Pest Management Science*. https://doi.org/10.1002/ps.7341

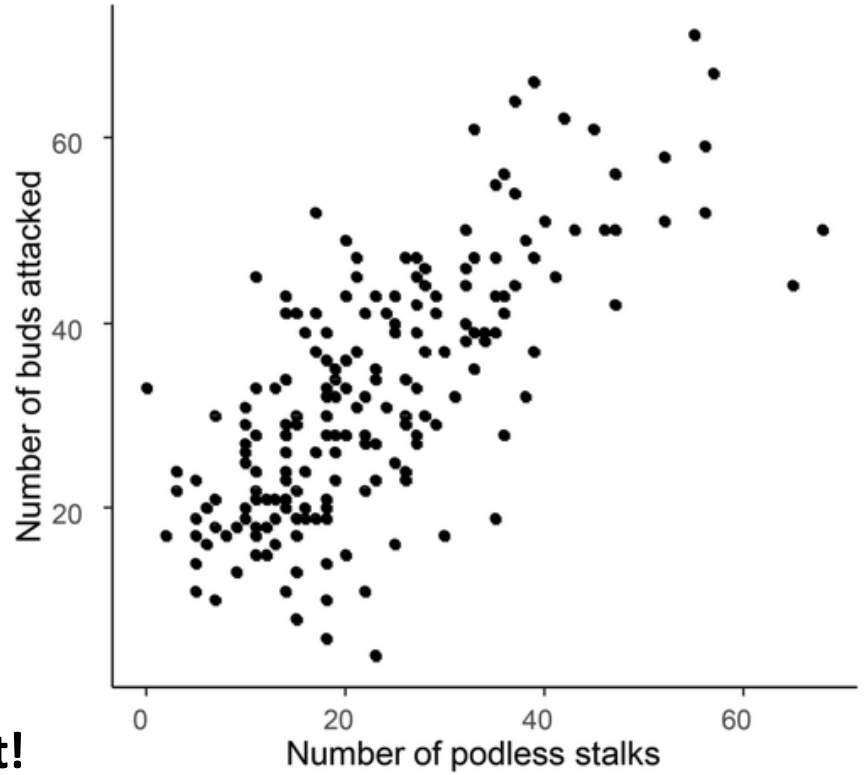
Monitoring pollen beetle abundance

ROTHAMSTED RESEARCH

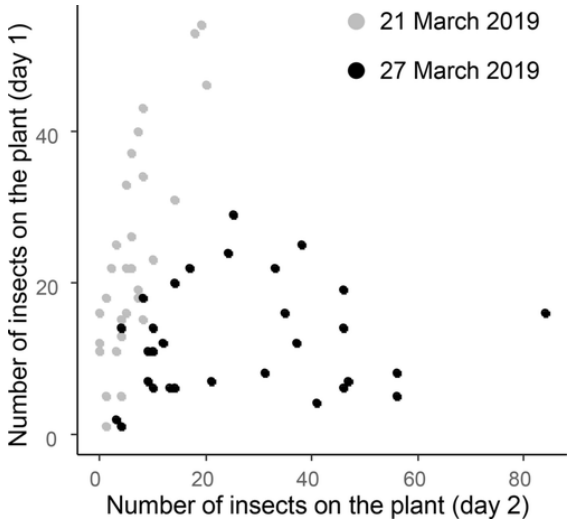
Pollen beetle –

Counting the numbers of adults on the plants, quantifying the number of buds damaged by the insect before flowering or counting the number of podless stalks before harvest.





blind stalk method best!



Seimandi-Corda, Hall, Jenkins, & Cook (2022). Relative efficiency of methods to estimate cabbage stem flea beetle (*Psylliodes chrysocephala*) larval infestation in oilseed rape (Brassica napus). *Pest Management Science*. https://doi.org/10.1002/ps.7341

Monitoring methods for natural enemies

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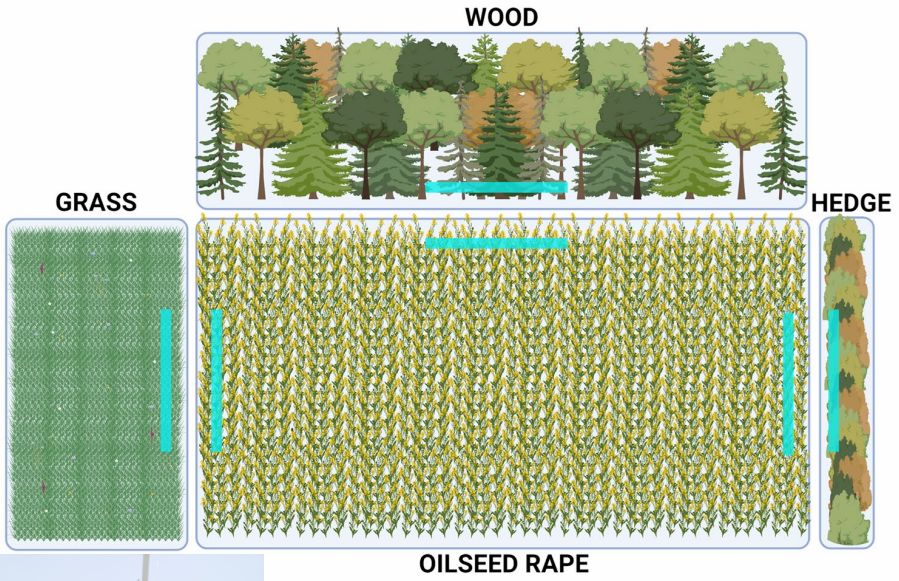
Automated detection and identification of insects on sticky traps via deep learning AI to compare abundance of pests, natural enemies & biodiversity between different habitats



EcoStack

Newcastle University

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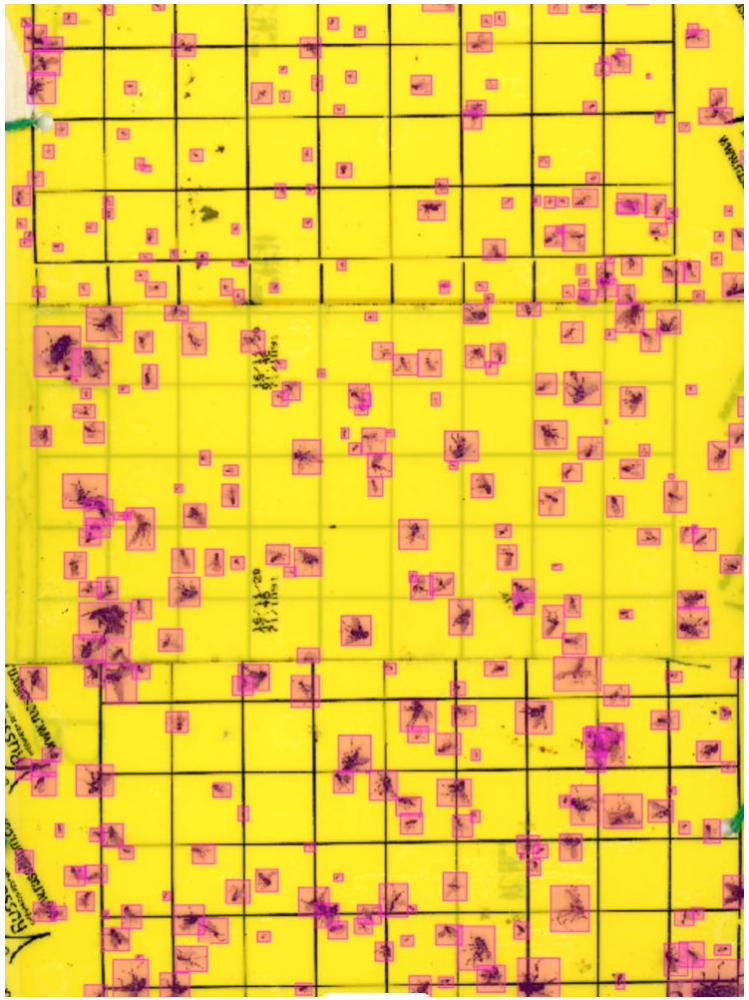

Mukilan Deivarajan Suresh

Potential of optical sensors for real-time monitoring of pest *and beneficial insects*

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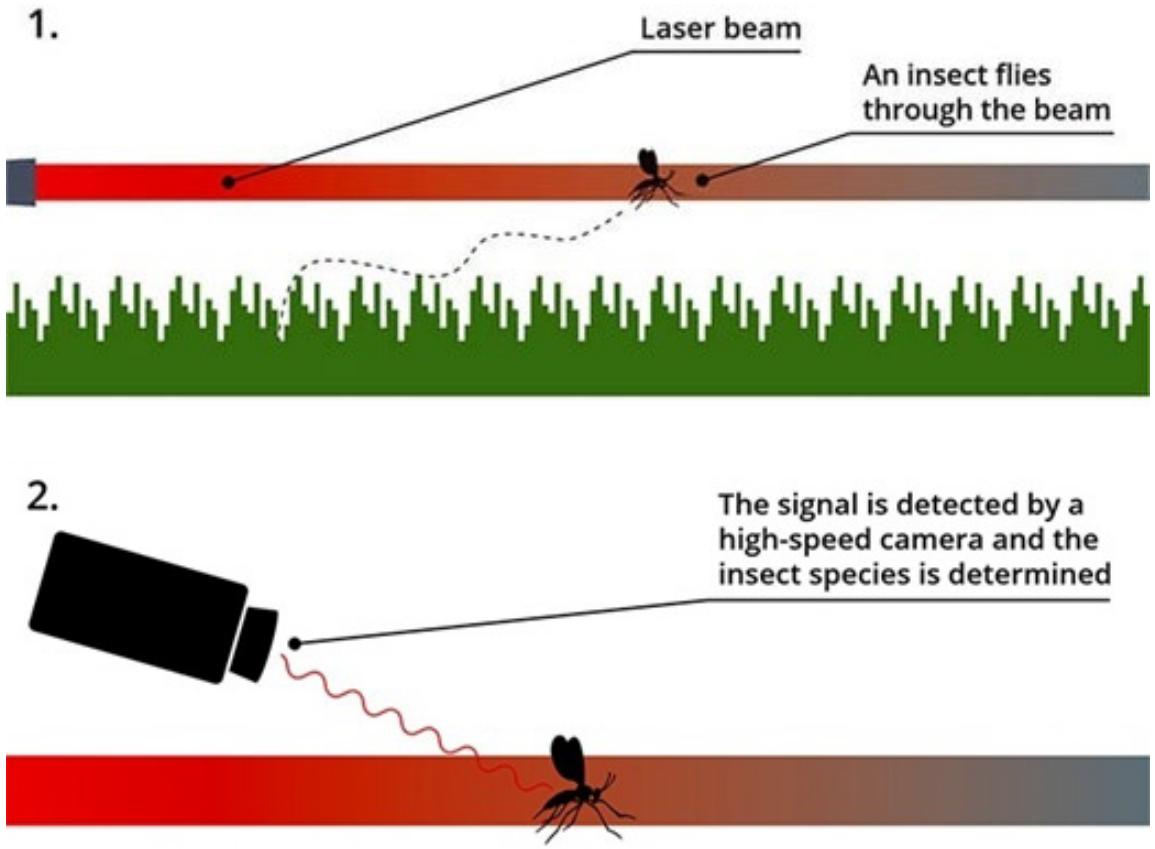

BASF We create chemistry

Digital Farming Solutions

FaunaPhotonics

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Risk assessment - monitoring

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Potential of optical sensors for real-time monitoring of pest and beneficial insects

Create database library of traces for known species & machine learning for identification algorithms

Kirkeby, Rhydmer, Cook et al., (2021) Scientific Reports 11(1): 1555

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Potential of optical sensors for real-time monitoring of pest and beneficial insects

Create database library of traces for known species & machine learning for identification algorithms

Kirkeby, Rhydmer, Cook et al., (2021) Scientific Reports 11(1): 1555

CSFB main target; distinguish from *Phyllotreta*

80-95% accuracy

- Activity and abundance of insects detected by sensor and assigned to CSFB correlates with trap catches in the field

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Risk assessment - monitoring

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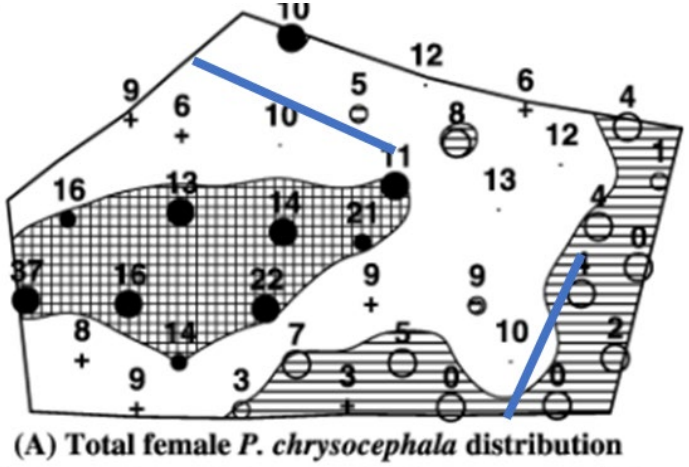
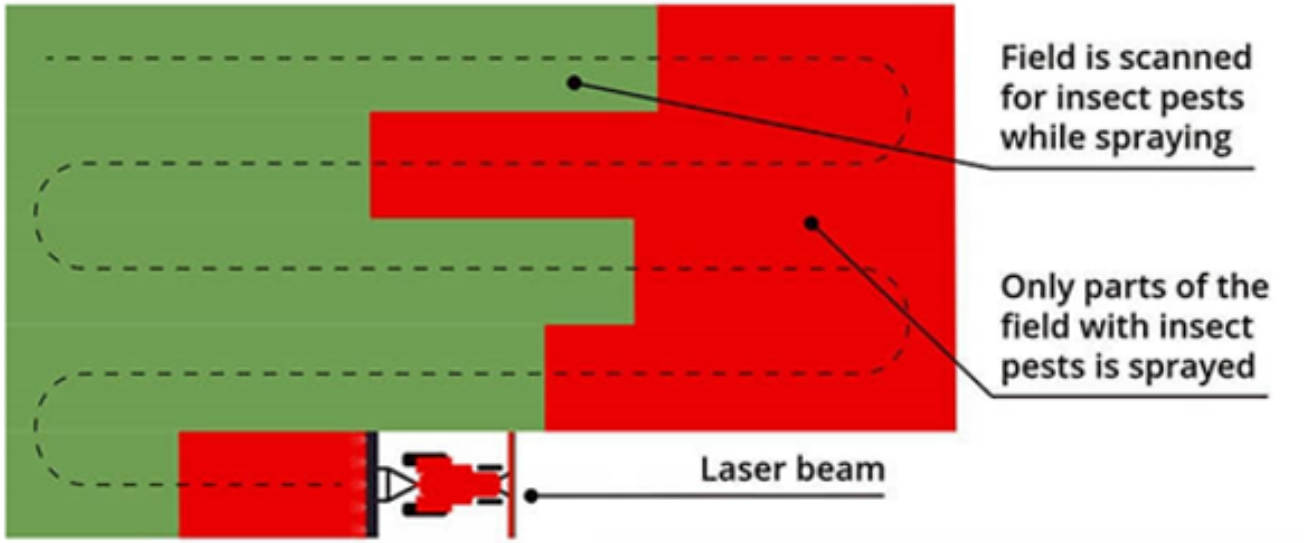
Potential of optical sensors for real-time monitoring of pest and beneficial insects

Vision of the future: tractor mounted apparatus that sprays only areas where pests density exceeds threshold (& beneficial density is low)



(A) Total female *P. chrysocephala* distribution



Cook *et al* in prep

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‘Next-Gen’ sensor - Volito (Latin: ‘flutter’ ‘flit about’)

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Case study – pollen beetle immigration into OSR

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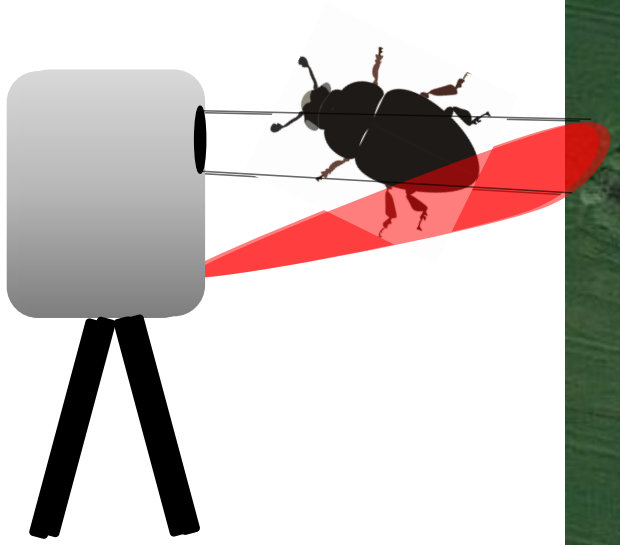

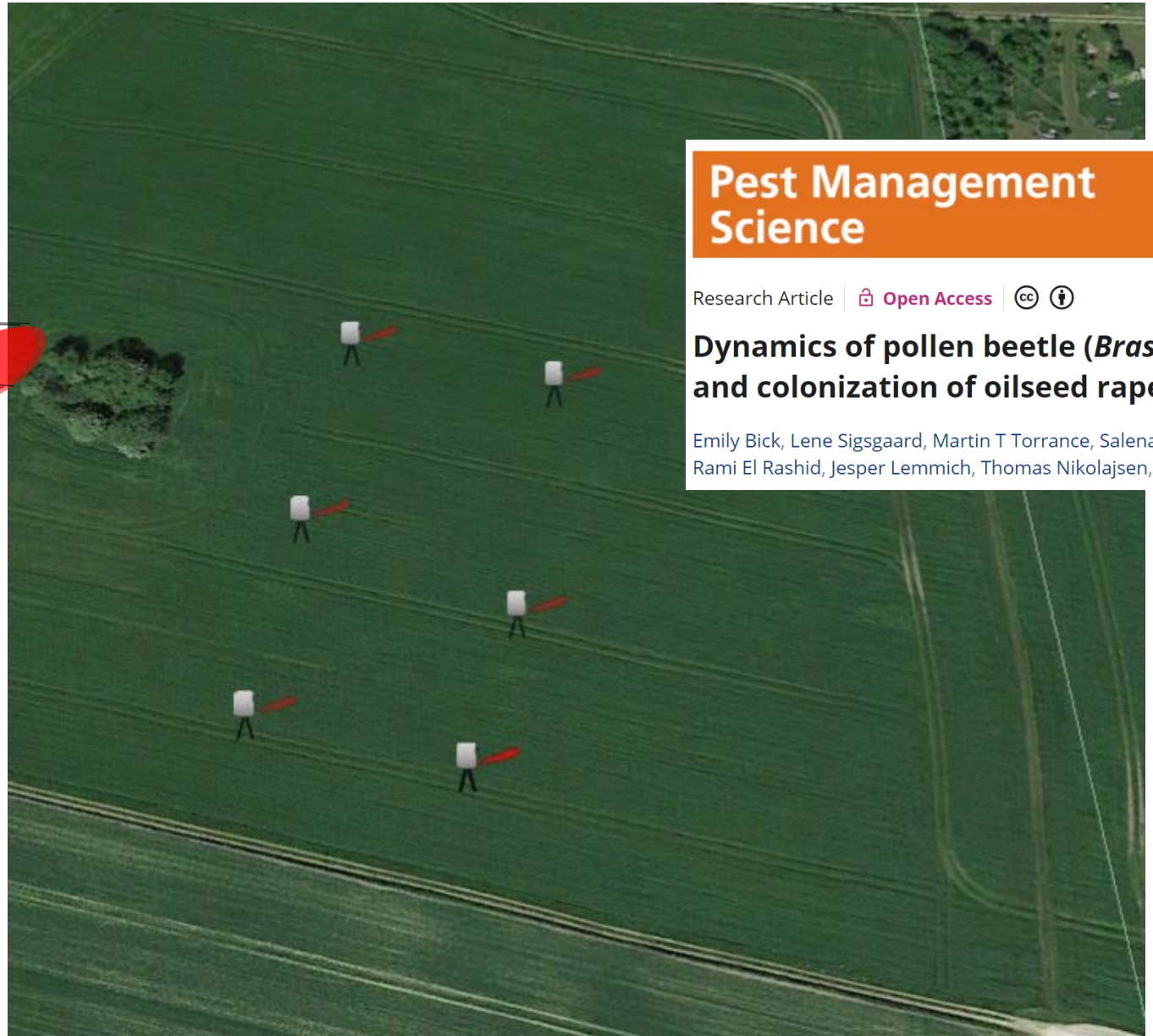

Pest Management Science

SCI where science meets business

Research Article | Open Access

Dynamics of pollen beetle (*Brassicogethes aeneus*) immigration and colonization of oilseed rape (*Brassica napus*) in Europe

Emily Bick, Lene Sigsgaard, Martin T Torrance, Salena Helmreich, Laurence Still, Brittany Beck, Rami El Rashid, Jesper Lemmich, Thomas Nikolajsen, Samantha M Cook

Case study – pollen beetle immigration into OSR

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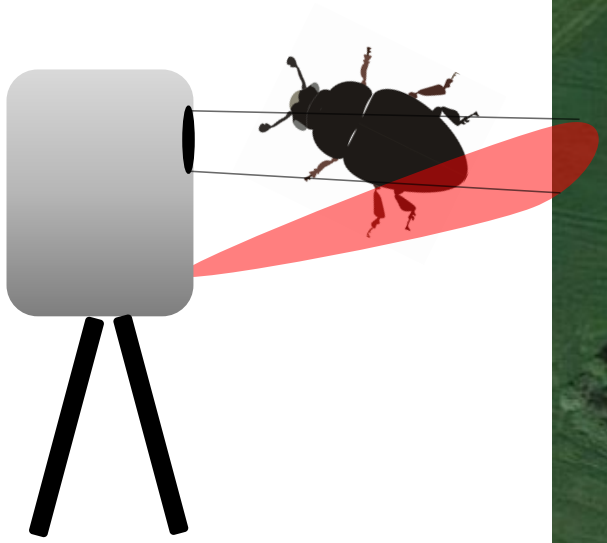

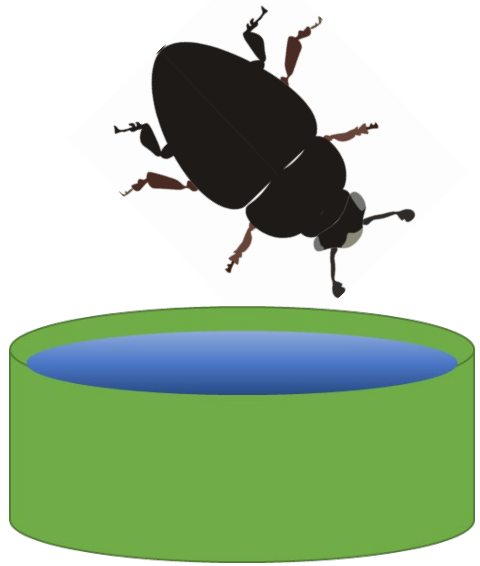

Bick et al., & Cook (2023)
Dynamics of pollen beetle immigration and colonization of oilseed rape
Pest management Science

Case study – pollen beetle immigration into OSR

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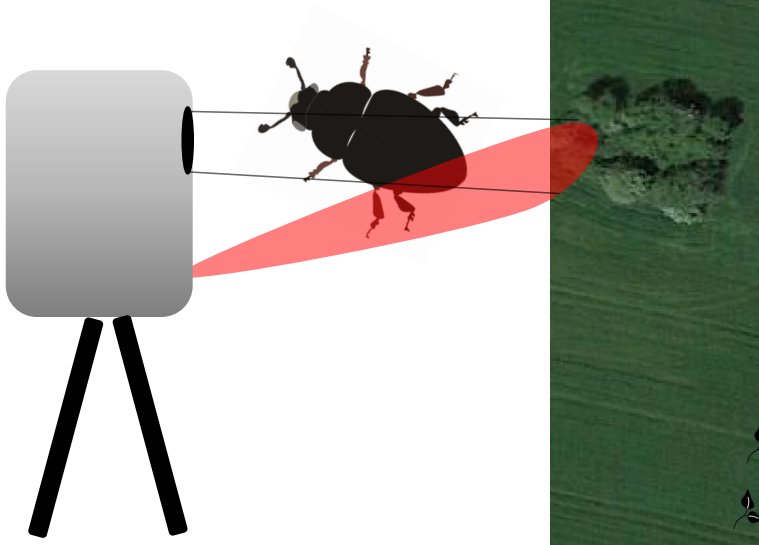
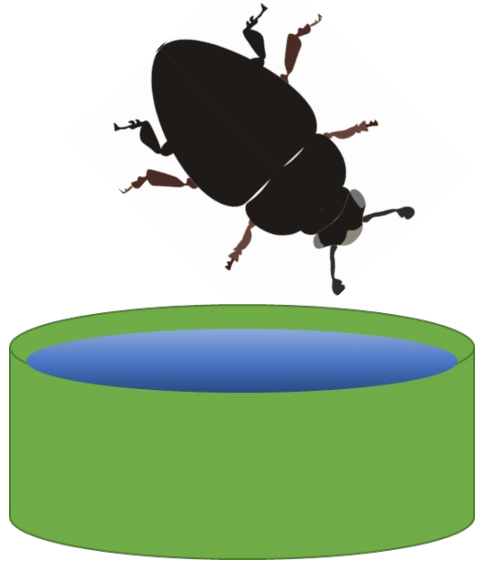
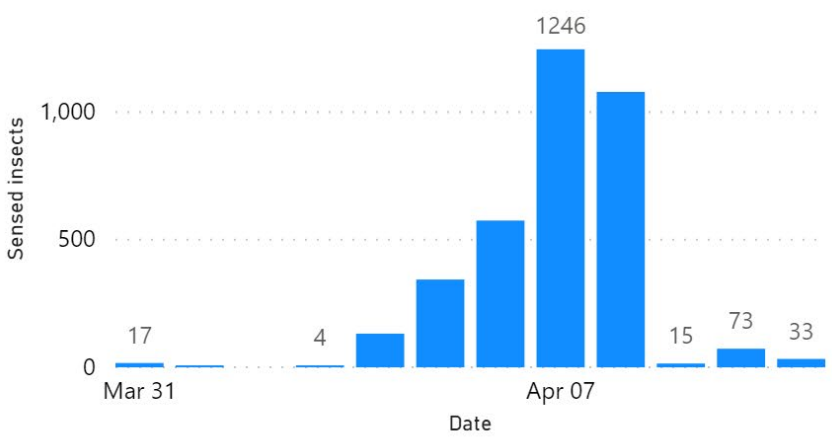




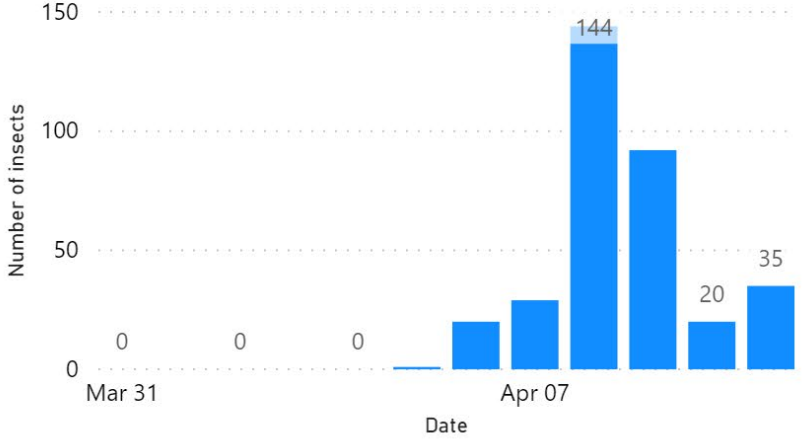
Bick et al., & Cook (2023)
Dynamics of pollen beetle immigration and colonization of oilseed rape
Pest management Science

Optical sensors were the most efficient monitoring method, recording pollen beetles 2 and 4 days ahead of water traps and counts from plant scouting, respectively.

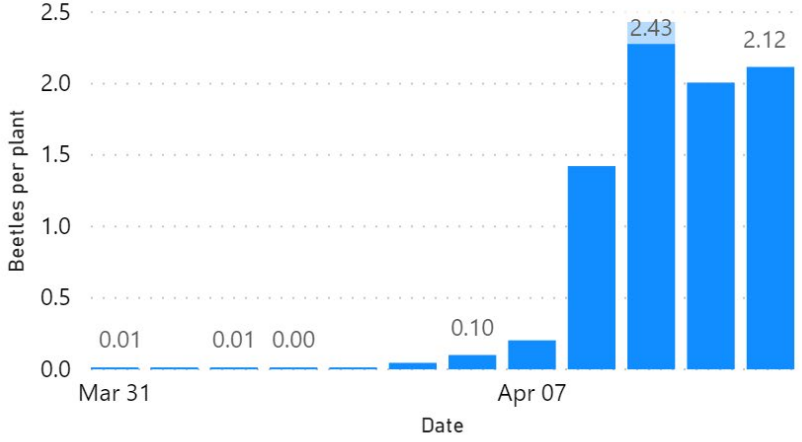
Sensor Counts



Water Traps



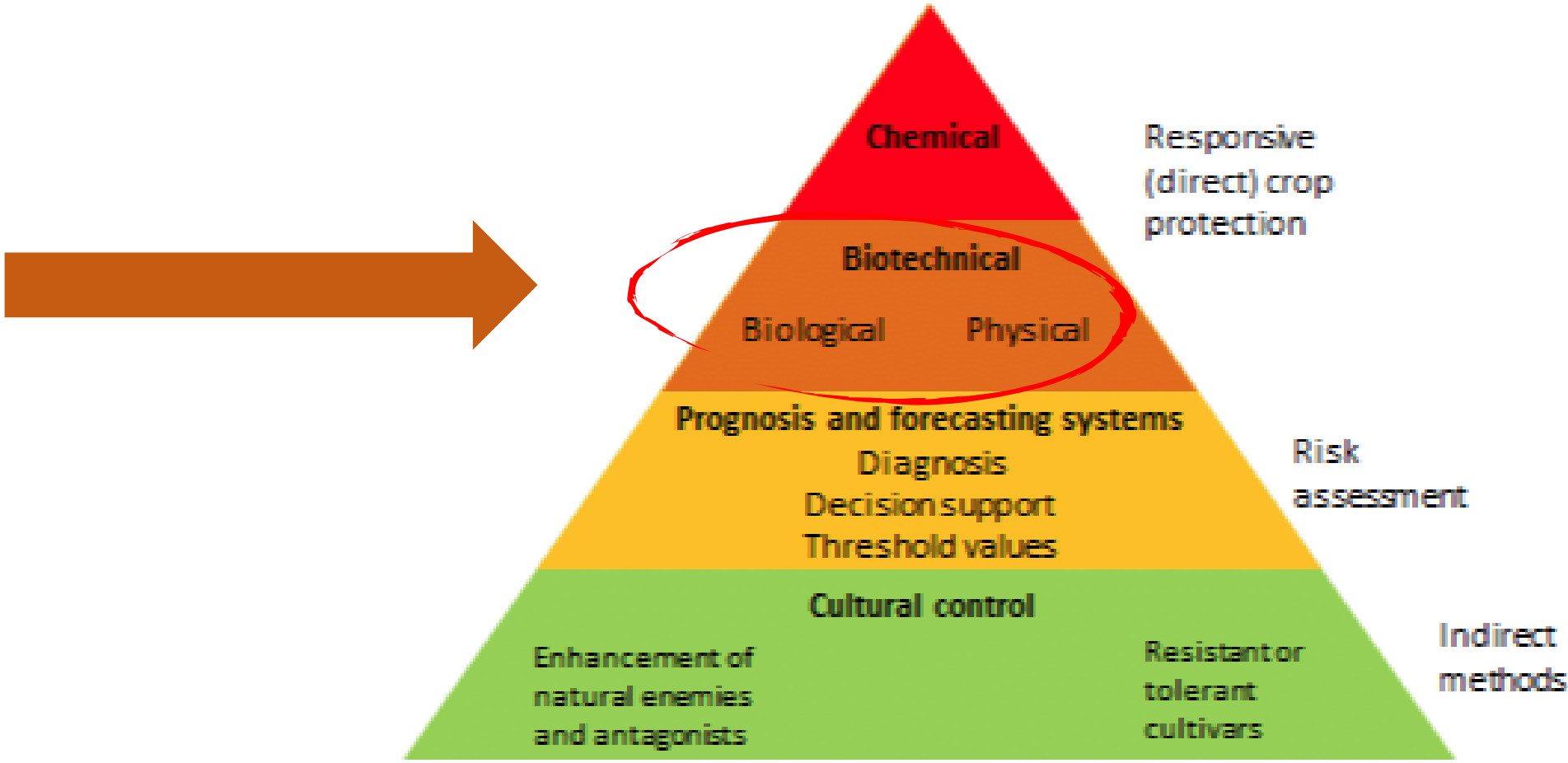
Plant Counts



Biotechnical - biological

@SamCook_IPM

ROTHAMSTED RESEARCH

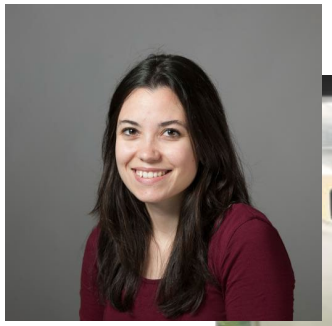


Biopesticides

ROTHAMSTED RESEARCH

Methods: Continuous culture of cabbage stem flea beetle and its parasitoid; enabling standardised, controlled bioassays all year round… using lots of different bioassay methods!

Patry Ortega--Ramos



Biological - biopesticides

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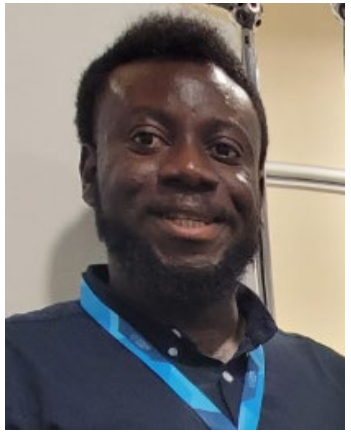
A push-pull bioinsecticidal strategy for autumn pests of OSR

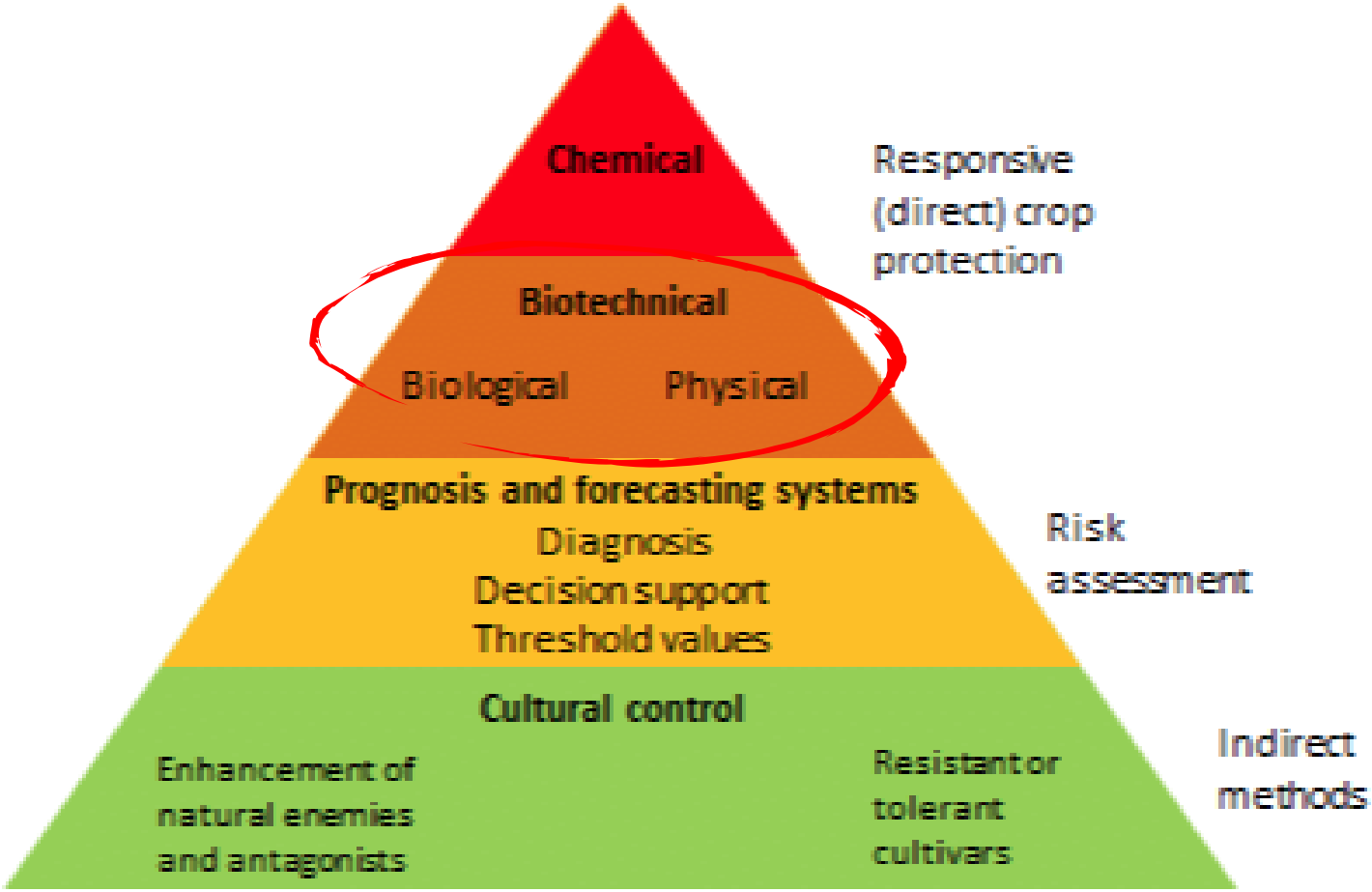


Suleiman Mustapha

SWBio DTP

Swansea University Prifysgol Abertawe

ROTHAMSTED RESEARCH



Synthetic chemical insecticides

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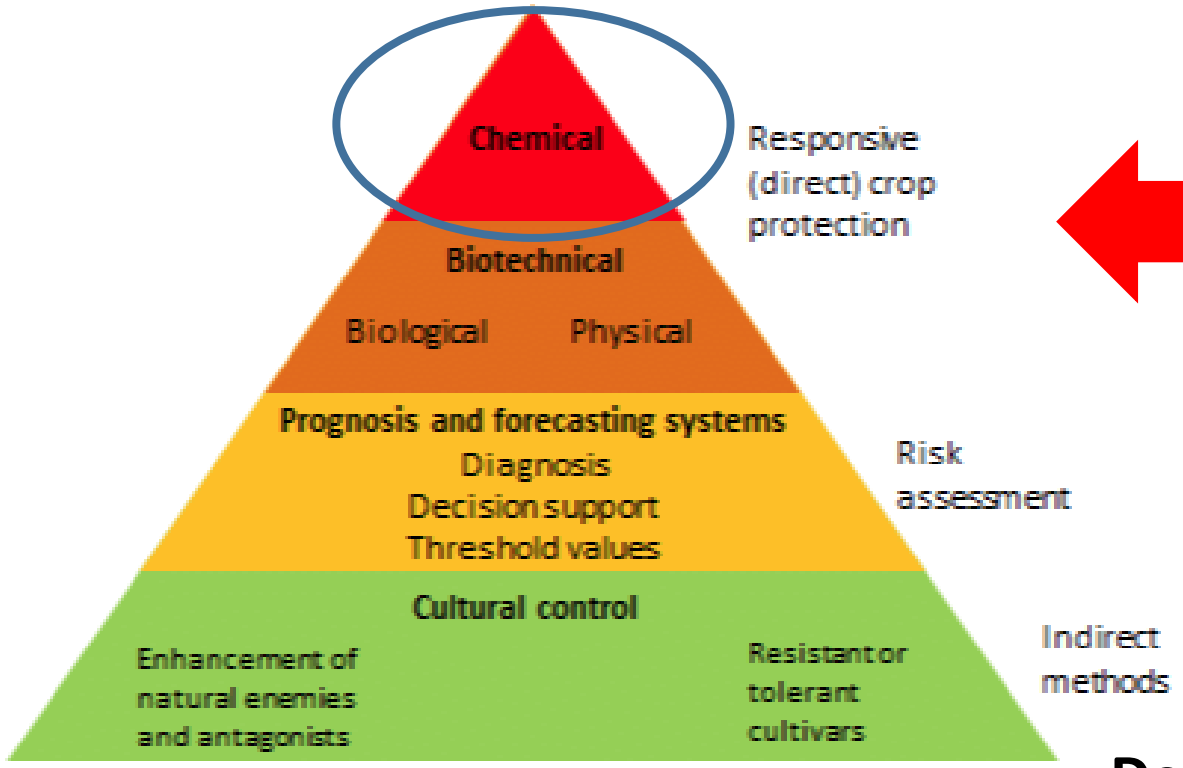
Aim: help industry to develop alternative controls and test effects on natural enemies



Development of ecologically-based IPM strategies

Synthetic chemical insecticides

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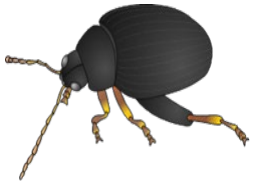
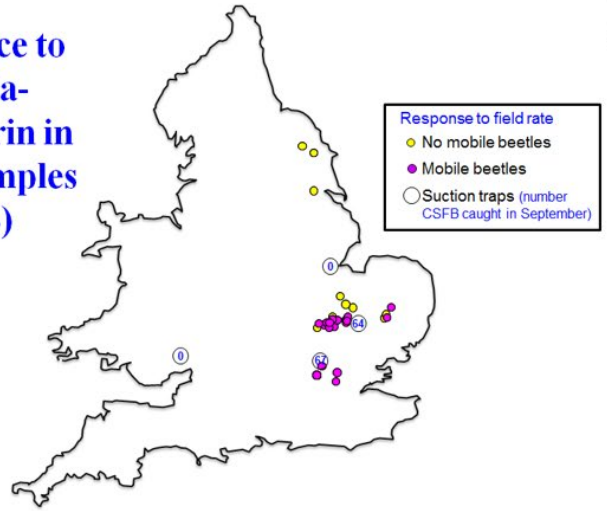
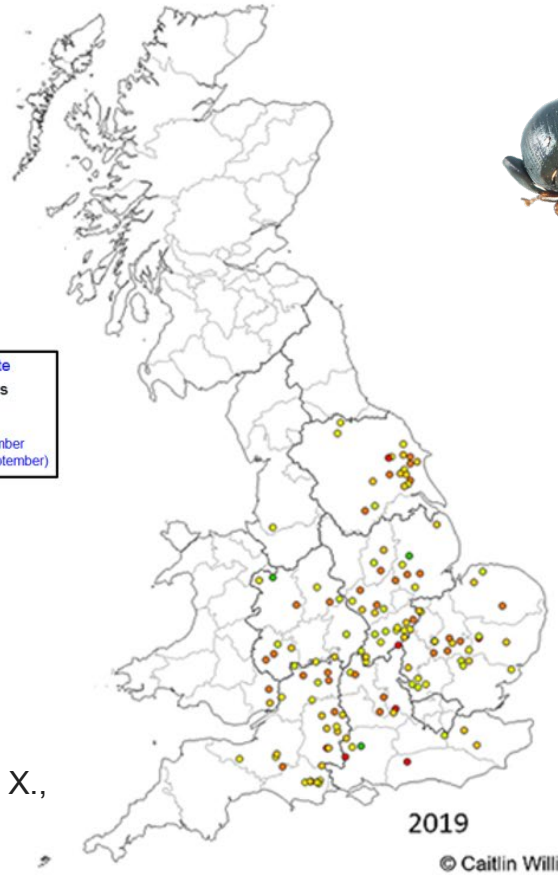
Monitoring resistance of CSFB to pyrethroid insecticides

Caitlin Willis







Willis, C.E., Foster, S.P., Zimmer, C.T., Elias, J., Chang, X., Field, L.M., Williamson, M.S. and Davies, T.E., 2020. Investigating the status of pyrethroid resistance in UK populations of the cabbage stem flea beetle. *Crop Protection*, *138*, p.105316.

Monitoring distribution of CSFB parasitoid *Microctonus brassicae*

Patry Ortega-Ramos

Present in 70% of the fields studied

Parasitization rate around 7%

2024

Synthetic chemical insecticides

ROTHAMSTED RESEARCH

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Susceptibility of cabbage stem flea beetle pests and the parasitoid *Microctonus brassicae* to pyrethroid insecticides; interaction between parasitism and susceptibility

Conclusion

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- Work in the Next-Gen IPM Science Area is helping to develop new understanding of the ecology & behaviour of OSR pests & their natural enemies – and how they interact with their environment.
- We are applying this knowledge to develop Integrated Pest Management Strategies that are environmentally sensitive
  and which place control by natural enemies at the centre (heart)

THANK YOU!