

Next Generation Integrated Pest Management for oilseed rape

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What is IPM?



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- IPM is an environmentally sensitive approach to pest management that relies on a combination practices (*including the judicious use of pesticides*) using information on the life cycles of pests and their interaction with the environment
- 4 usual steps in IPM programmes:
 1. **Set action threshold**
 2. **Monitor pest density & Risk assessment**
 3. **Prevention** – cultural methods e.g. crop rotation, use of pest-resistant cultivars; semiochemicals (e.g. pheromone repellents); habitat diversification (e.g. intercropping, trap cropping)
 4. **Control** – population reduction via: mechanical (e.g. mass trapping), inundative biological control, conservation biocontrol, bio/botanical insecticides, **synthetic chemical pesticides *as a last resort***



What is IPM?



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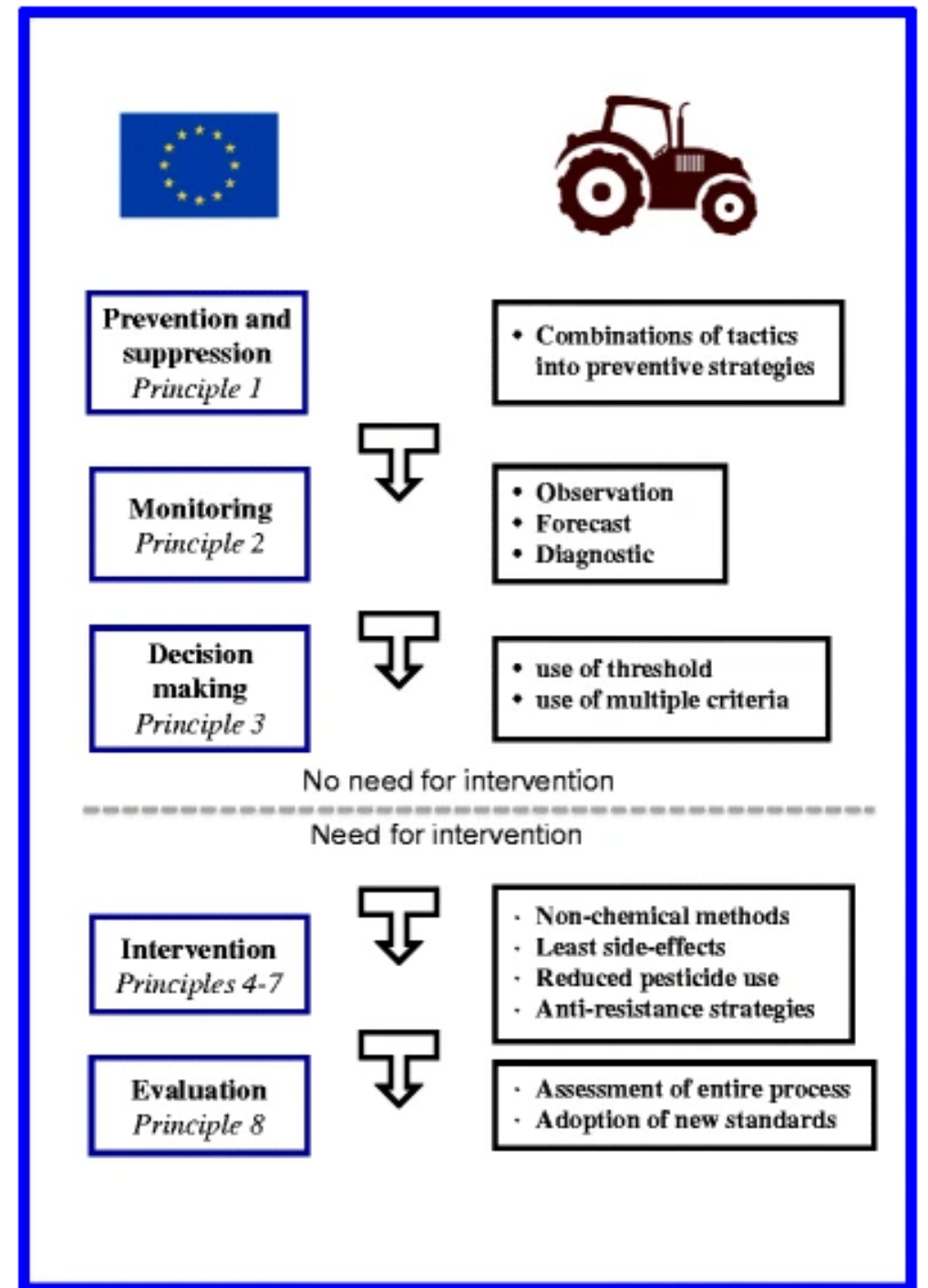
IPM can be insecticide-based (Integrated *Pesticide* management):

- 1. Set action threshold**
- 2. Monitor pest density & assess risk**
- 3. Prevention** – cultural methods e.g. **crop rotation, adequate cultivation** use of pest-resistant cultivars; semiochemical e.g. pheromone repellents, habitat diversification (intercropping, trap cropping etc)
- 4. Control** – mechanical (e.g. trapping), inundative biological control, conservation biocontrol, botanical insecticides, **synthetic chemical pesticides**

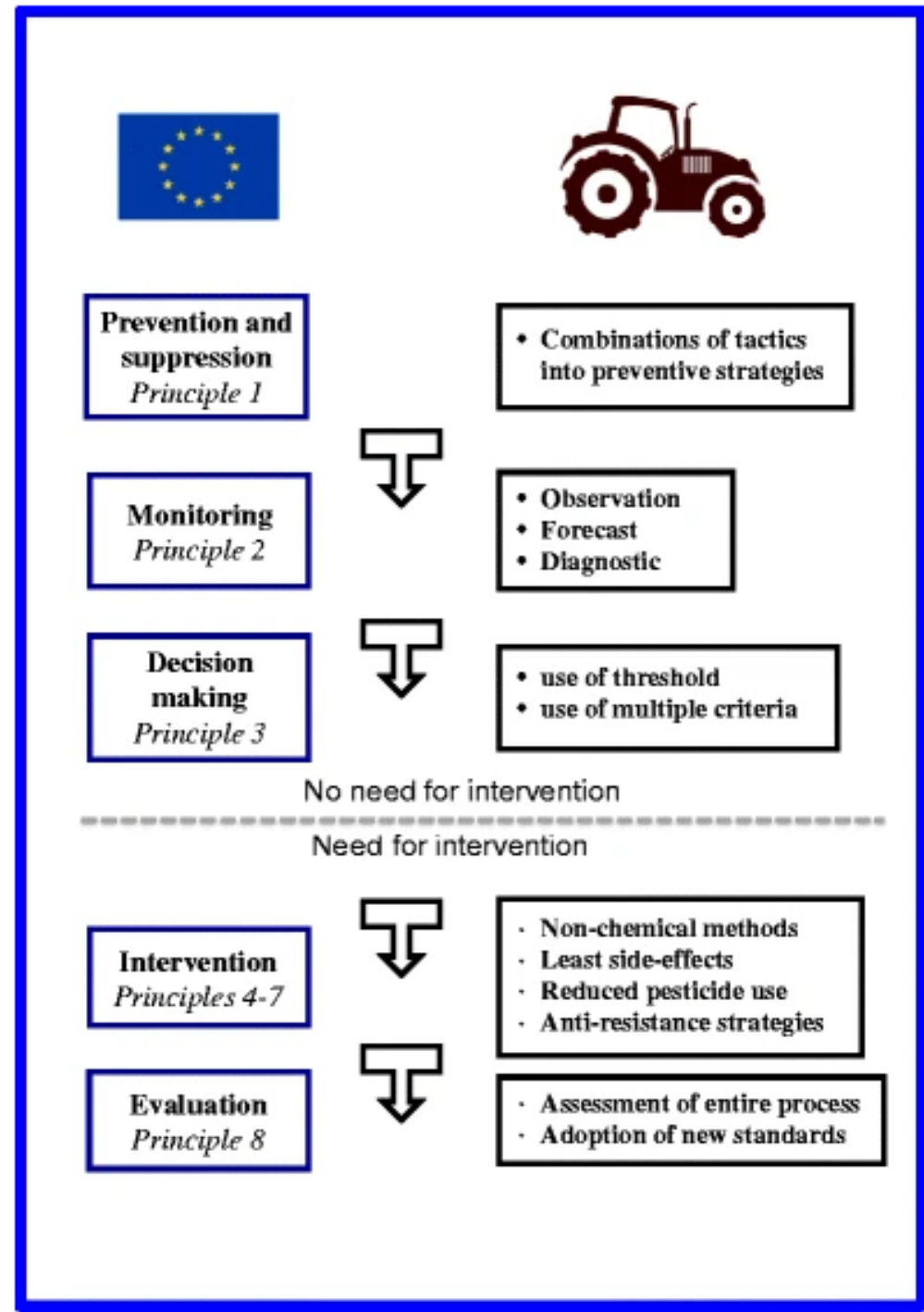
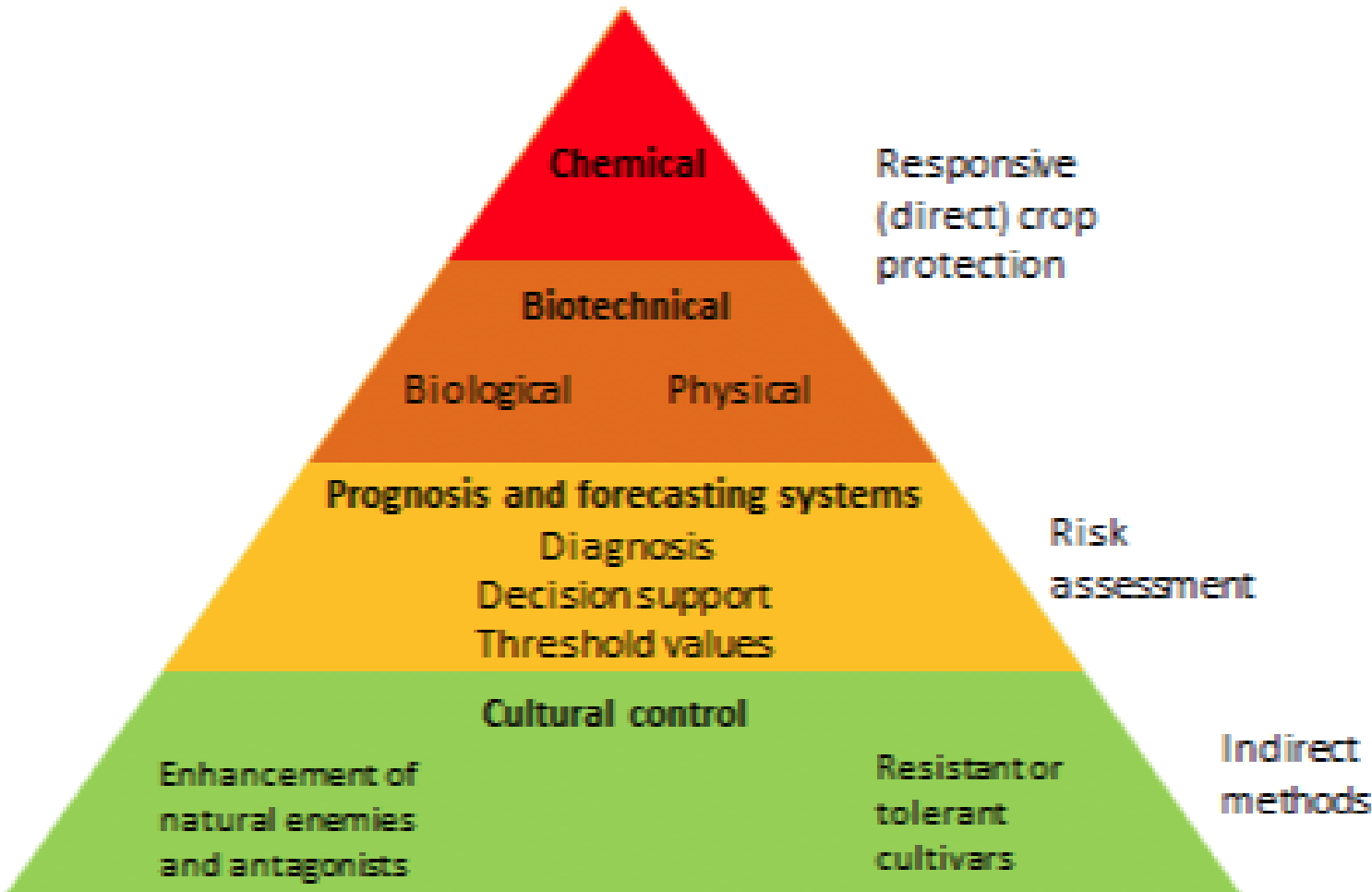
Due to public demand for reduced pesticide use and insect resistance to insecticides, 'real' IPM strategies are a need not an option!

Barzman *et al*'s (2015) 8 principles of IPM

- IPM is an environmentally sensitive approach to pest management, based on a combination of practices (*including the judicious use of pesticides*) that take into account the life cycles of pests and their interaction with the environment.
- 4 usual steps in IPM programmes:
 1. **Set action threshold**
 2. **Monitor pest density & Risk assessment**
 3. **Prevention** – cultural methods e.g. crop rotation, use of natural enemies, semiochemicals (e.g. pheromone repellents); habitat manipulation (e.g. trap cropping)
 4. **Control** – population reduction via: mechanical (e.g. weeding), biological control, conservation biocontrol, bio/bio-pesticides as a last resort



IPM Management triangle



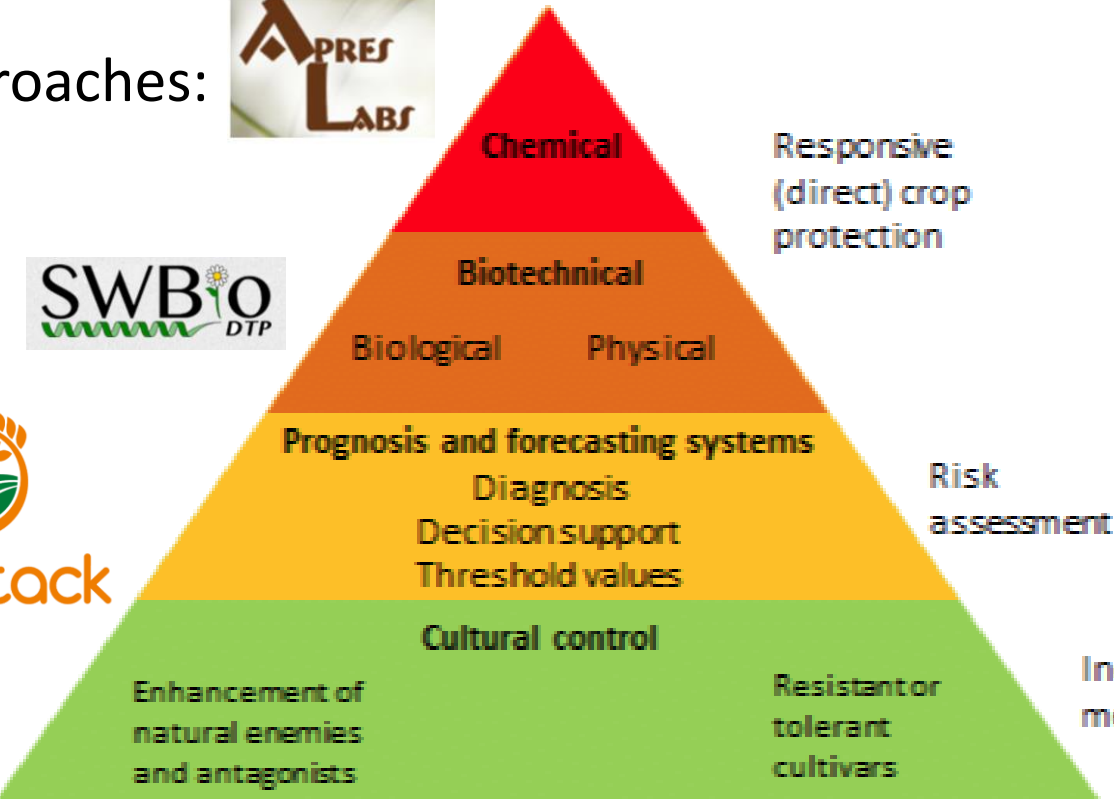
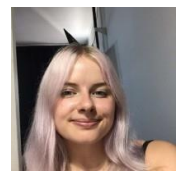
Next-Gen IPM @ Rothamsted - we are actively researching each of the 4 IPM 'steps' for insect pests of oilseed rape - At laboratory, field and farm-scale



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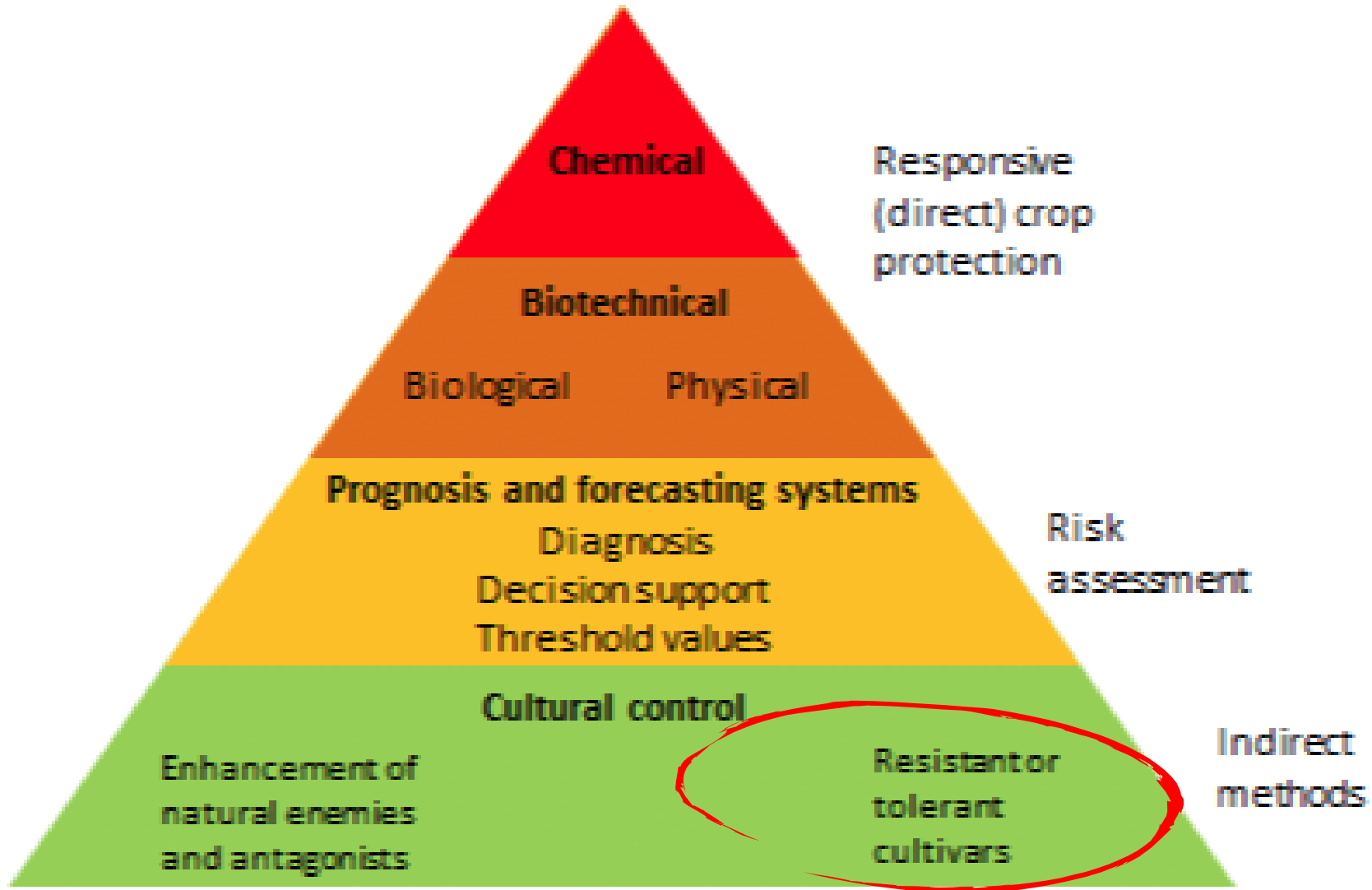
- Using 'Next-Gen' approaches:
 - Agroecology
 - AI & sensors
 - Molecular biology
 - Natural products



- Current projects:



Next-Gen IPM: Cultural control – Resistant or tolerant cultivars

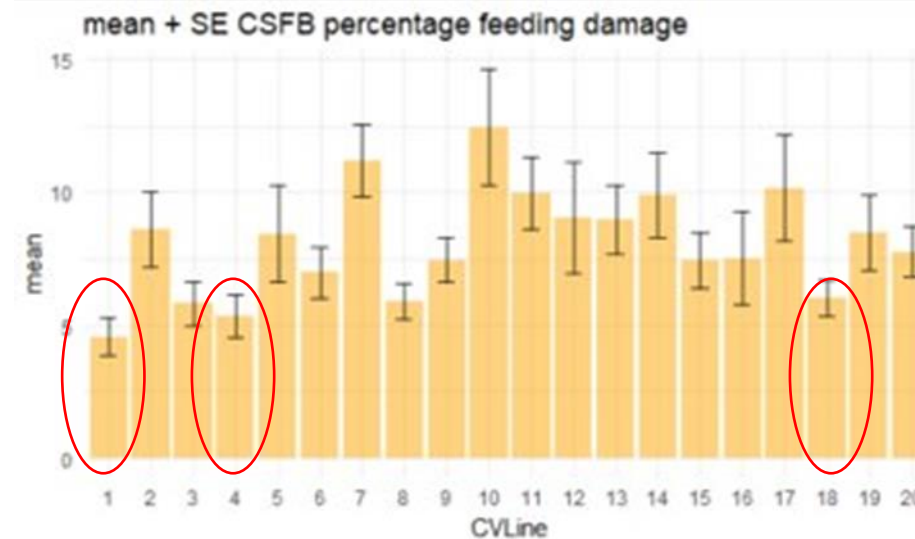


Developing resistant/tolerant cultivars

Breeding for Resistance to cabbage stem flea beetle BR2CSFB



20 OSR lines x 5



Developing resistant/tolerant cultivars



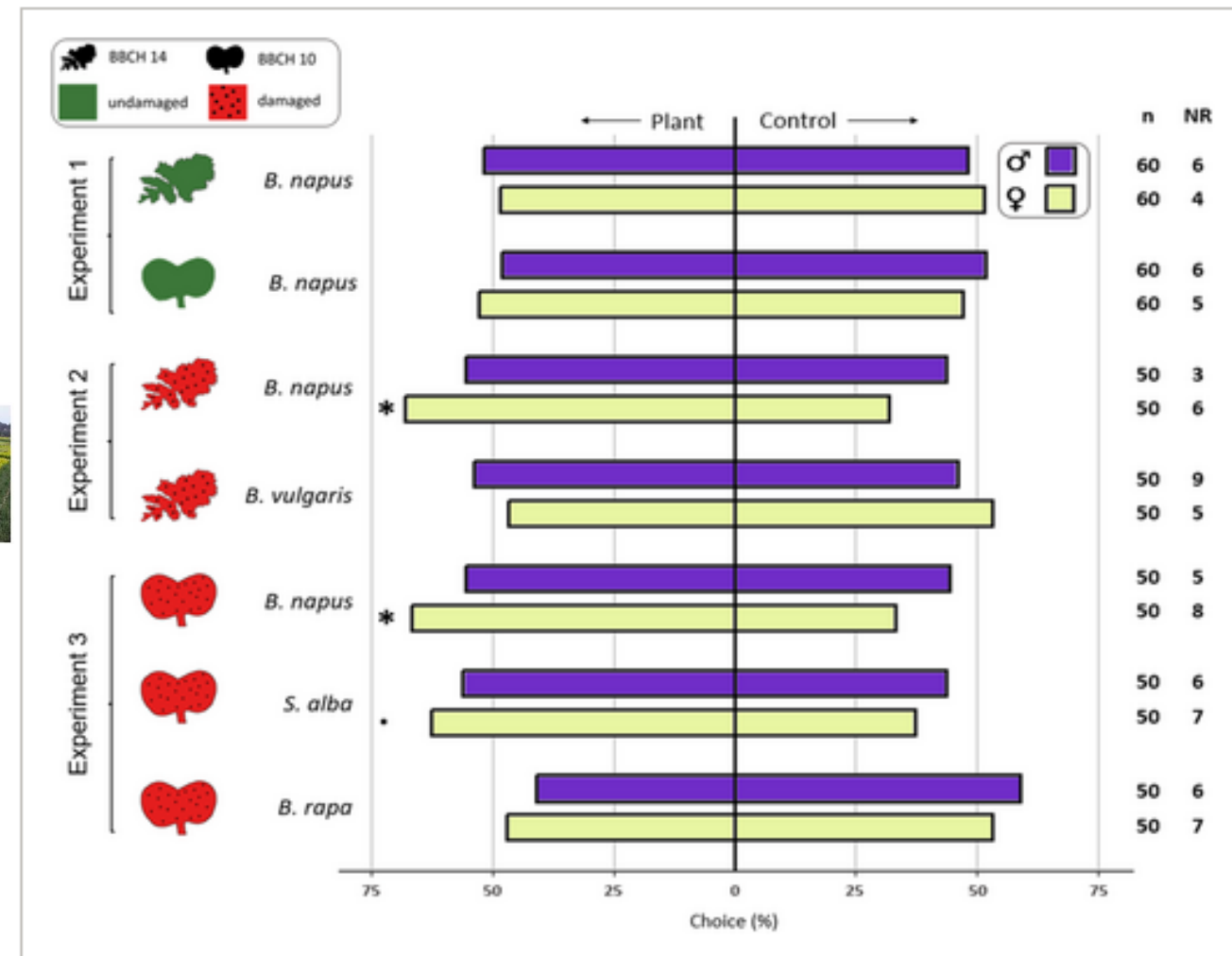
Research Article | [Open Access](#) | [CC](#) [i](#)

Attraction of cabbage stem flea beetle (*Psylliodes chrysocephala*) to host plant odors

Daniel Ruede ✉, Bernd Ulber, Samantha M. Cook, Michael Rostás ✉

First published: 04 February 2025 | <https://doi.org/10.1002/ps.8697>

- *Sinapis alba* less attractive and *B. rapa* more attractive than *B. napus* – why?
- Olfactometer studies showed CSFB were attracted to (damaged) OSR plant volatiles
- Beetles not attracted (nor repelled) by *S alba*
- (but surprisingly were not attracted to *B. rapa* volatiles either!)
- Field attraction to Allyl ITC, sec-Butly ITC, 2-Phenylethyl ITC, indole 3-carbinol



Cultural Control – natural enemies and crop management



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✉ @SamCook_IPM

Conservation Biological Control = Use of agronomy & habitat management

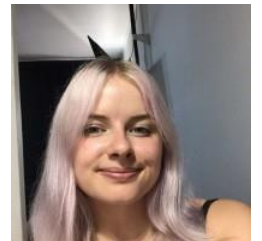
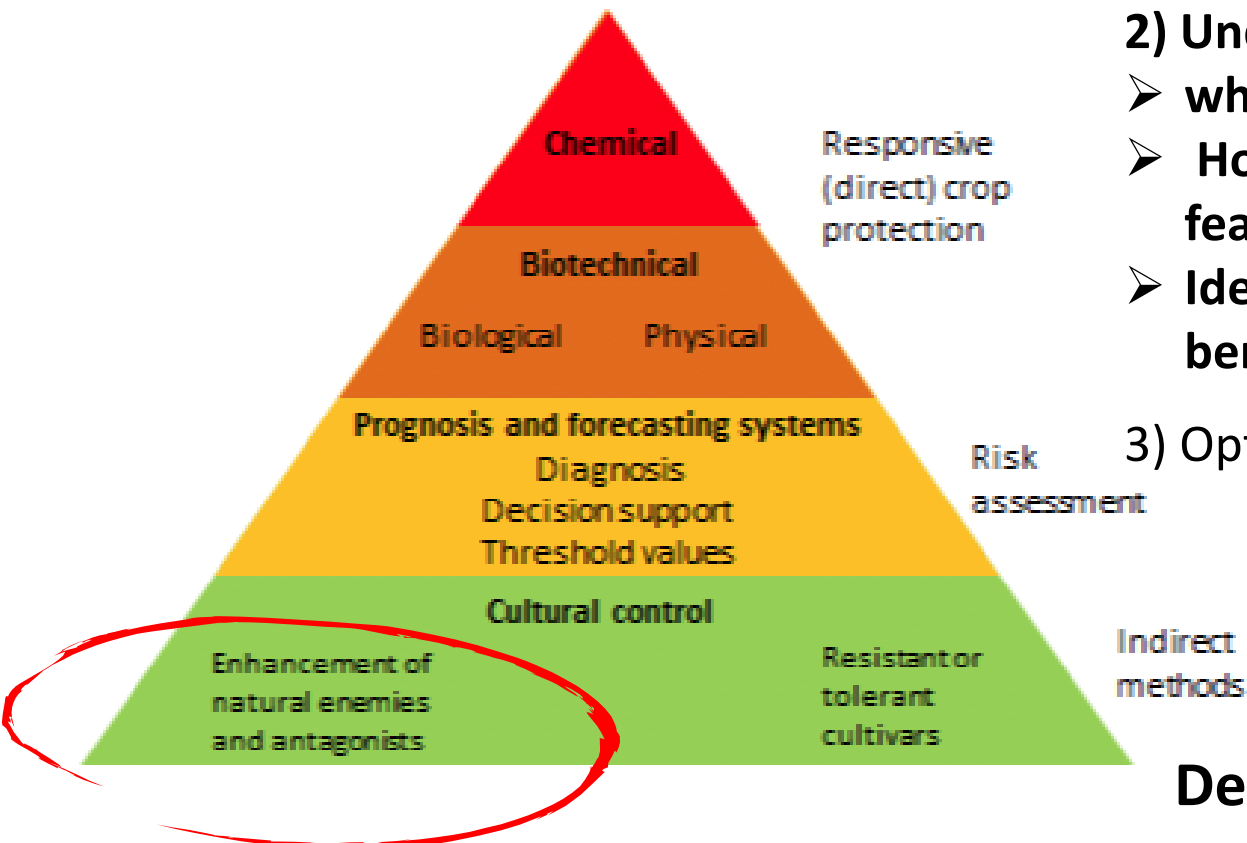
methods to conserve the natural enemies of crop pests in the agri-environment to provide pest regulation

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



Development of ecologically-based IPM strategies



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

- Hunting cameras; on 1 minute time-lapse
- Prey glued on cards below the camera (24h)
- Associated pitfall traps to determine identity of active community



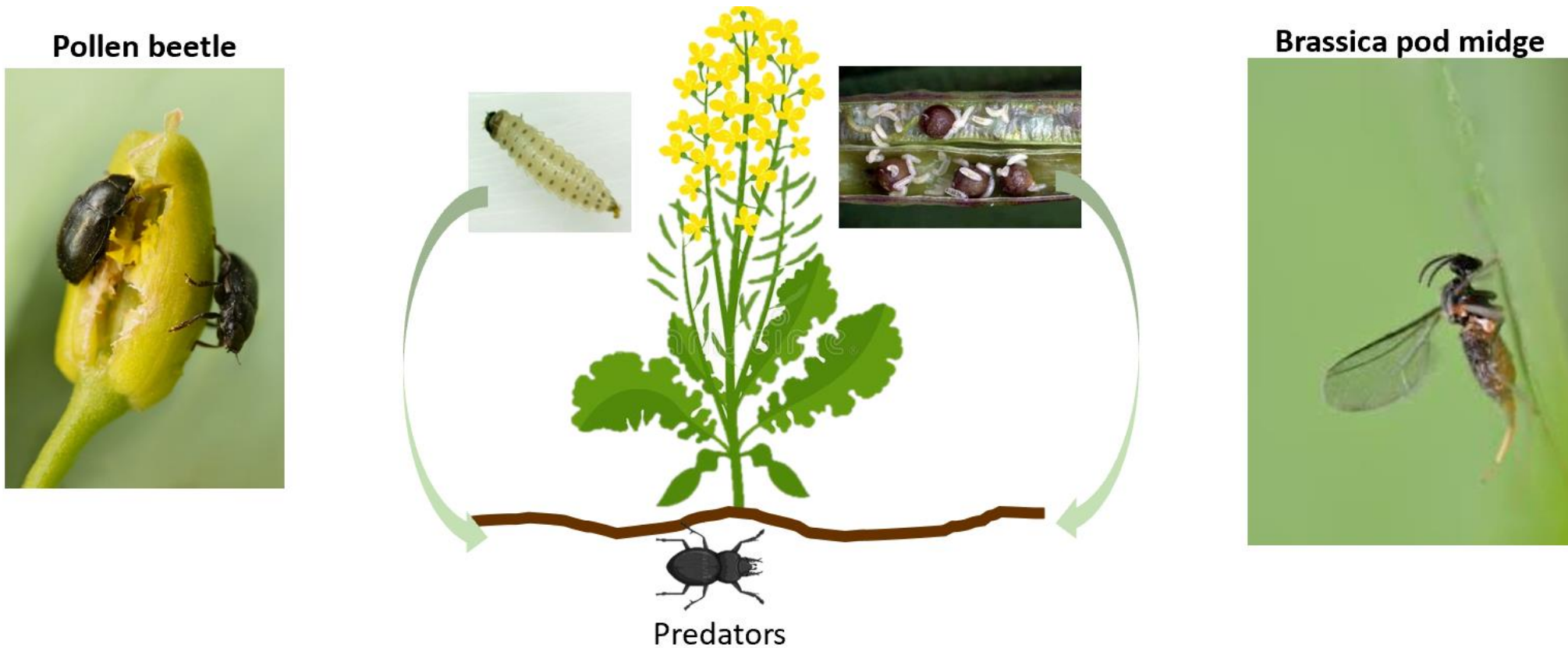
Using camera traps to identify the main predators of OSR pests (and quantify predation)



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



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

The main (unexpected) predators of OSR pests

Ants & Carabid larvae

Anchomenus dorsalis Carabid

Acari (mites)



Carabid larvae

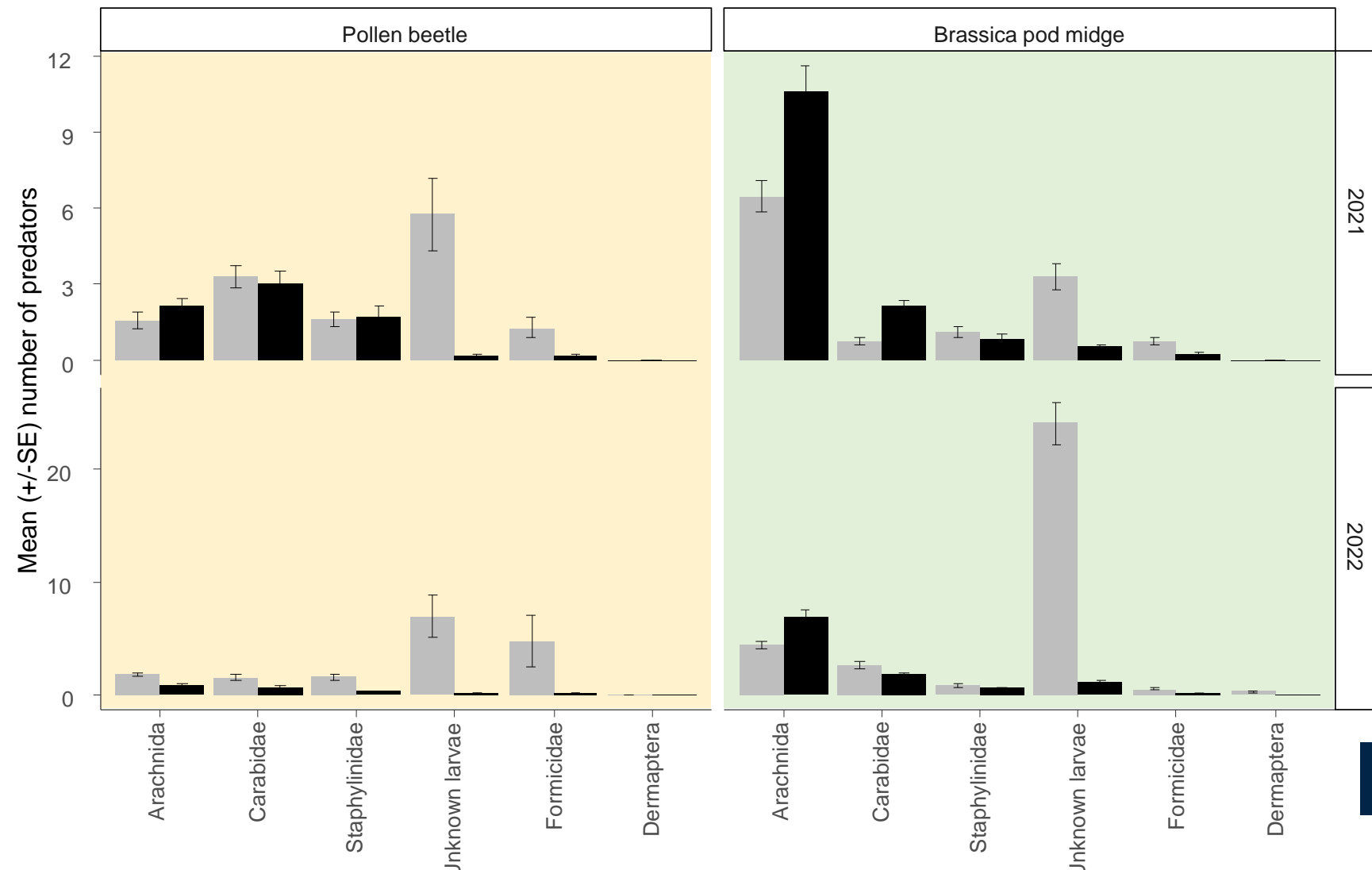


Pitfalls of pitfall trapping?



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



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



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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
- Dung beetles



AgZero+

Cultural Control – natural enemies and crop management

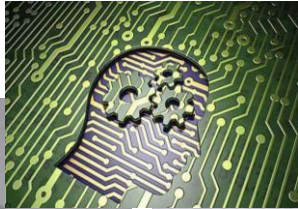


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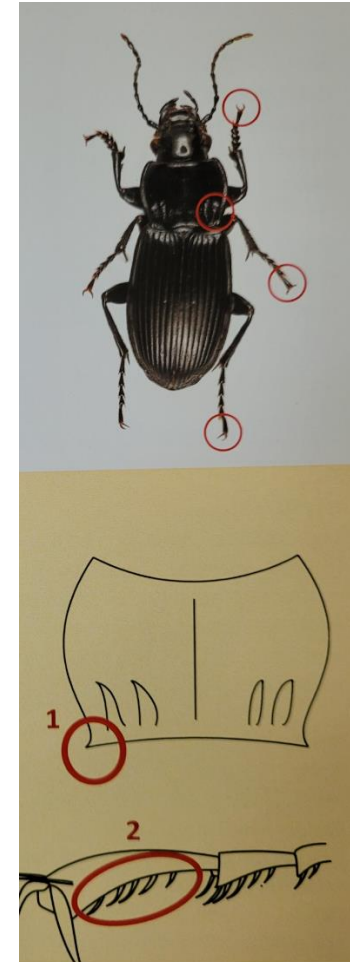
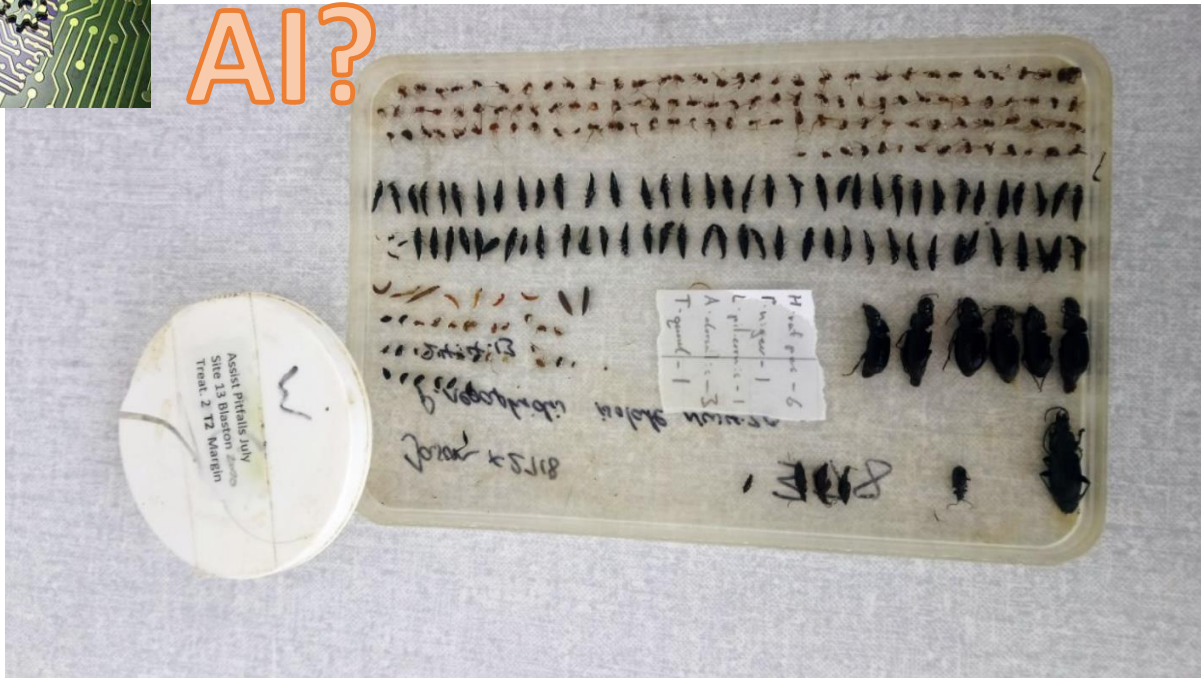
@SamCook_IPM

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 & undersown ‘nurse plants’ can reduce pests in OSR

Gaëtan Seimandi-Corda



Ulrich Ebert



Barari, Cook, Clark & Williams (2005) BioControl 50: 69-86

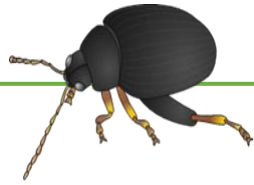


Cultural control – in-crop diversity: companion planting

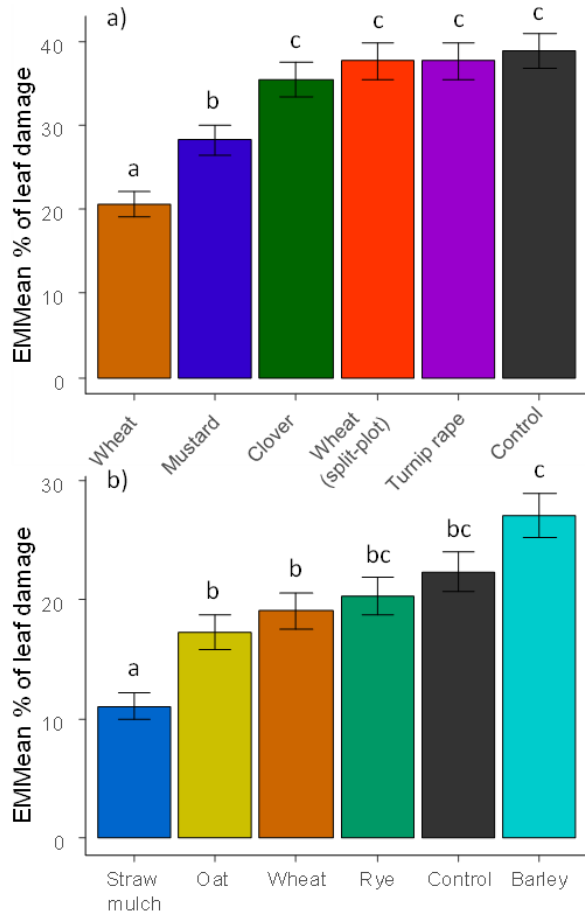
Undersown



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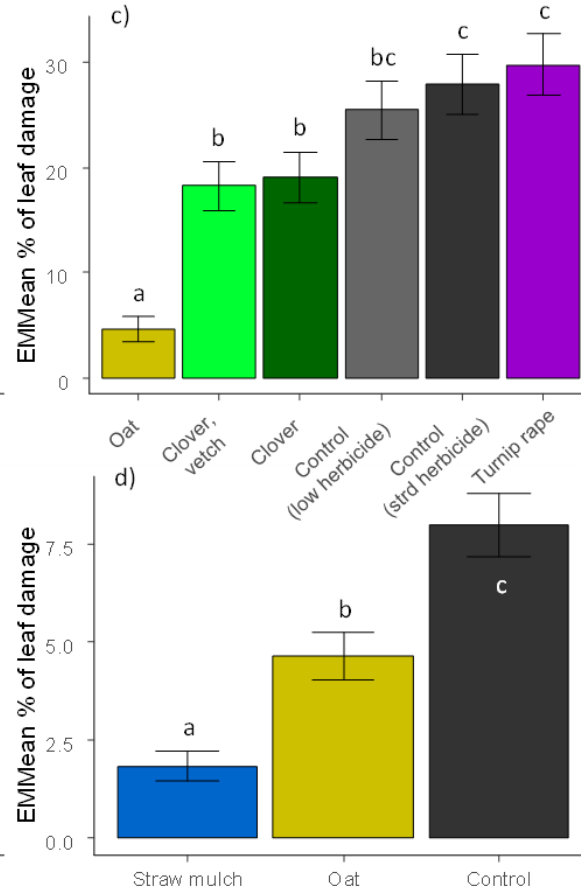


Trial 1



Trial 3

Trial 4



Trial 6

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



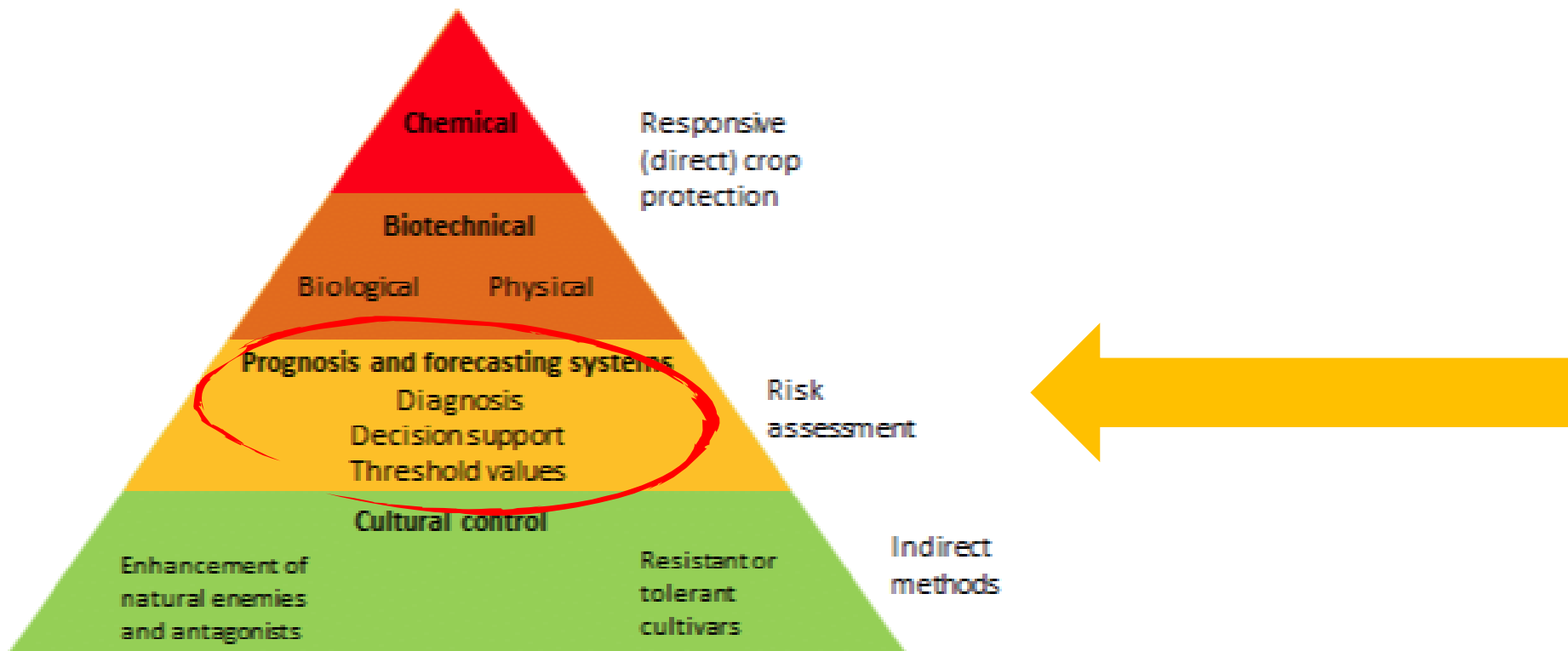
Effect on natural enemies ongoing 😊

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.



IPM - Risk assessment & monitoring

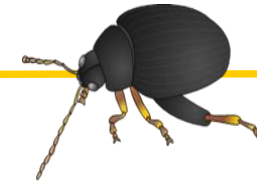
Aim: Improve pest detection and forecasting for farmers and researchers



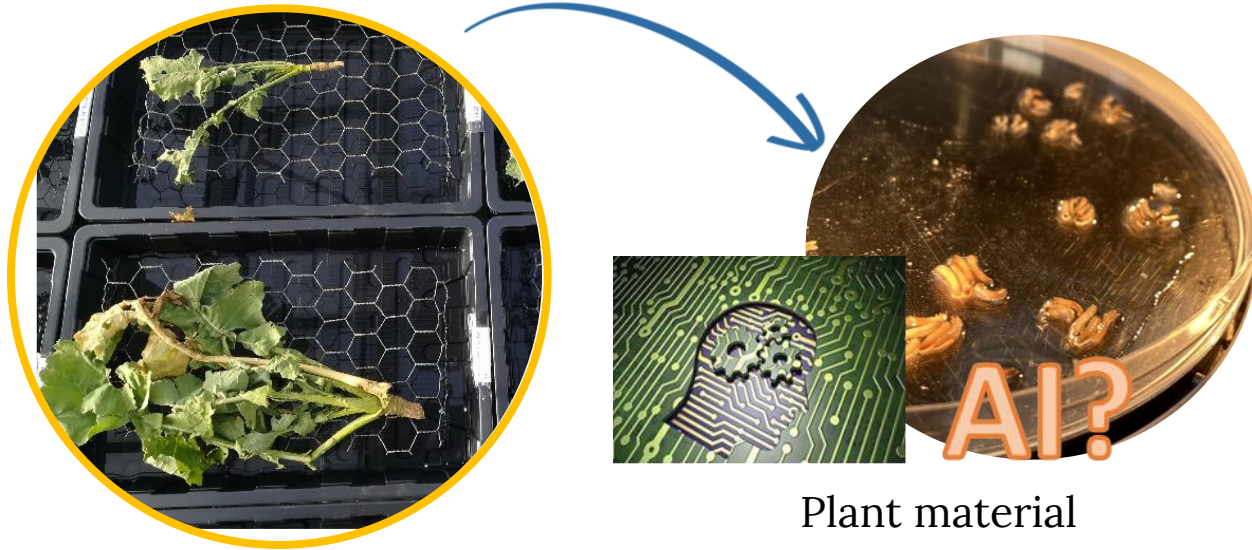
Monitoring CSFB larval abundance



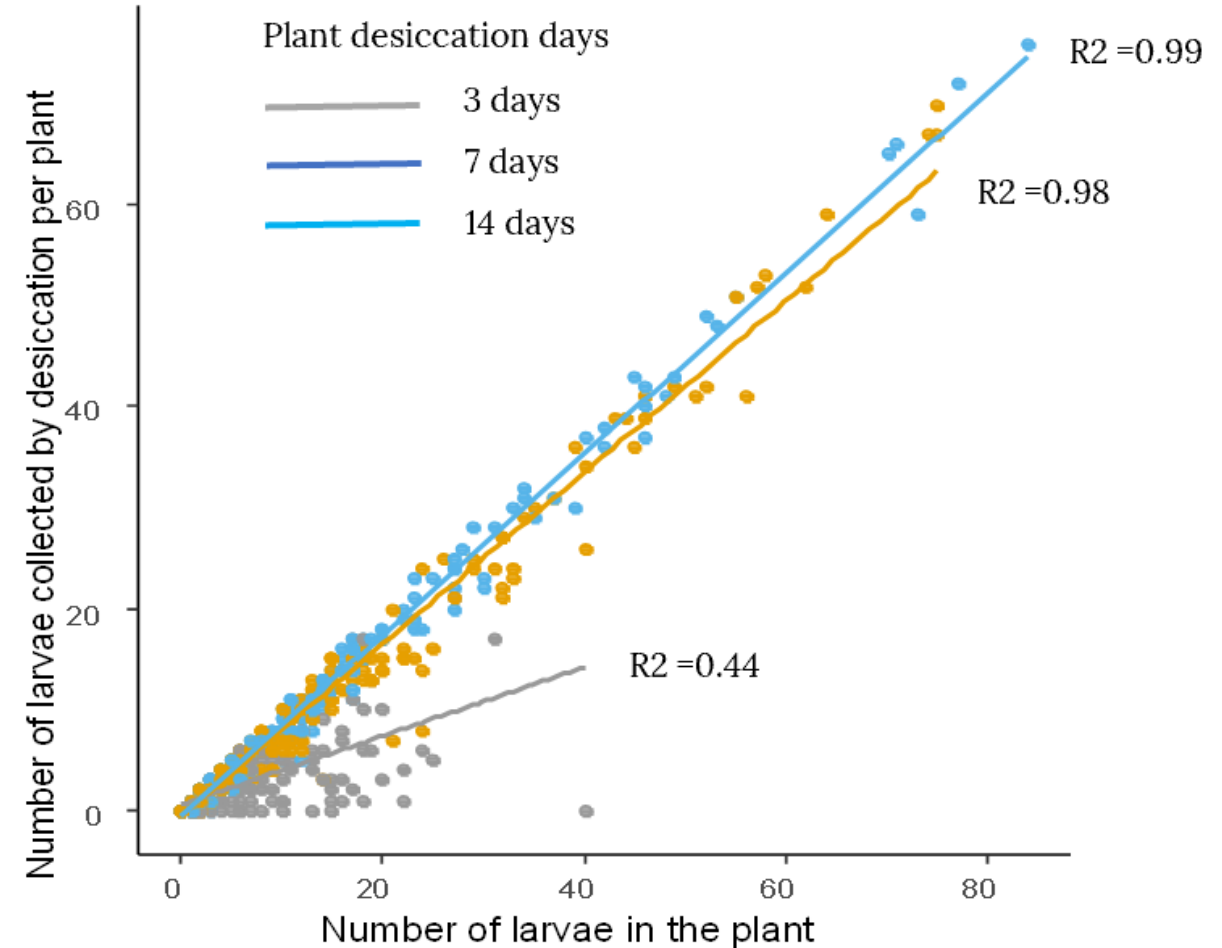
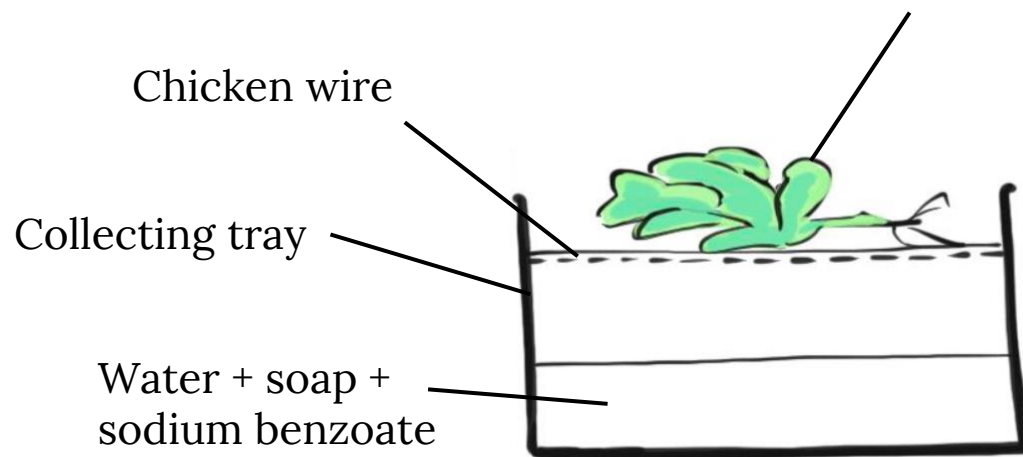
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CSFB Larval evacuation method



Plant material



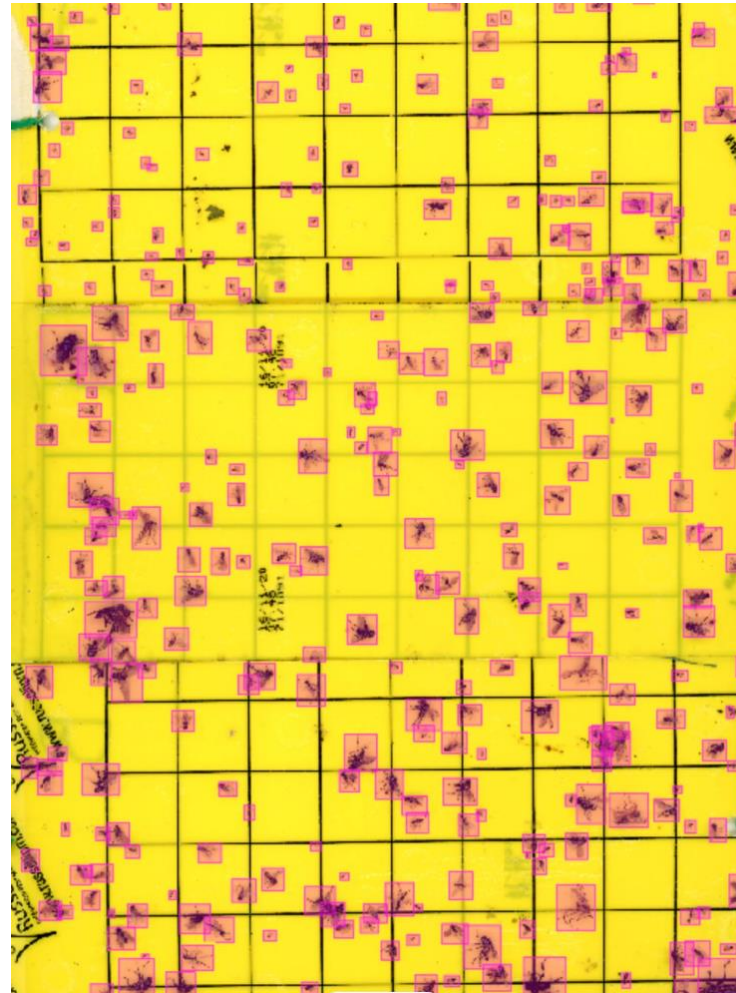
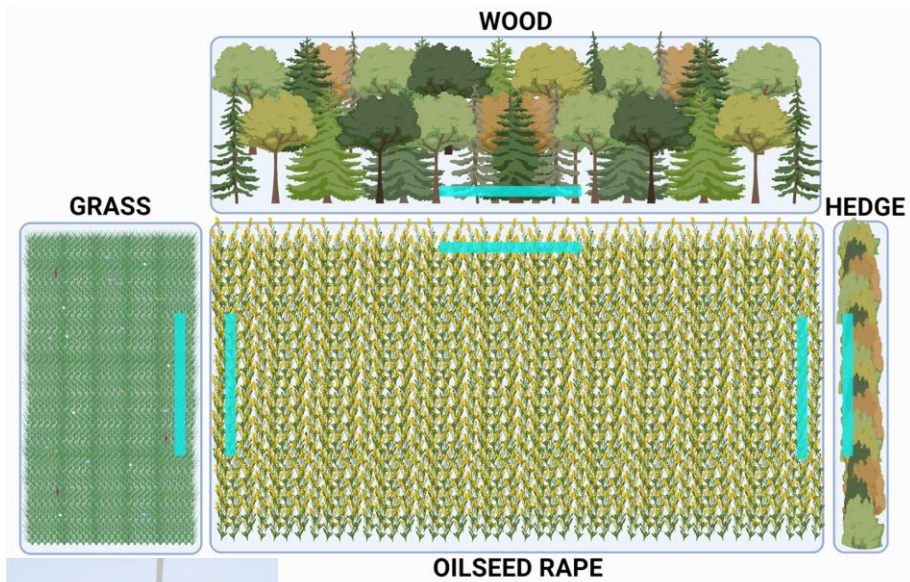
Seimandi-Corda, Hall, Jenkins, & Cook (2022). Relative efficiency of methods to estimate cabbage stem flea beetle (*Psylliodes chrysocephala*) larval infestation in oilseed rape (*Brassica napus*). *Pest Management Science*. <https://doi.org/10.1002/ps.7341>

Monitoring 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



Mukilan Deivarajan Suresh

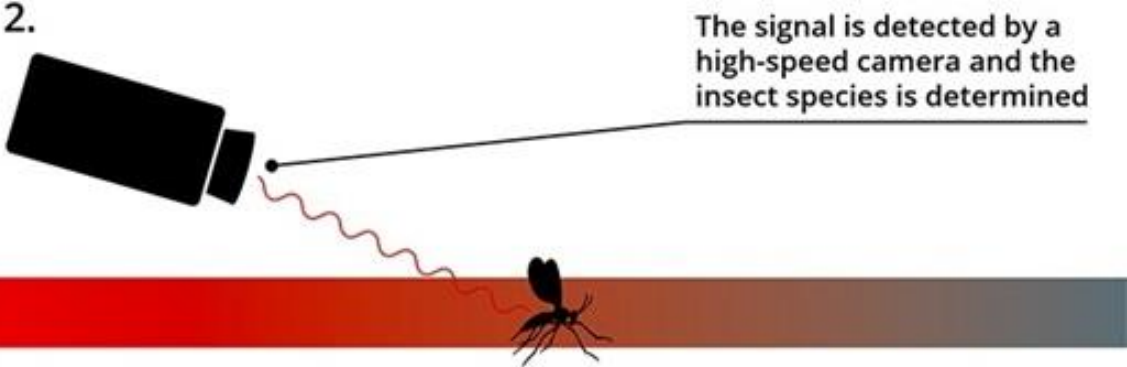
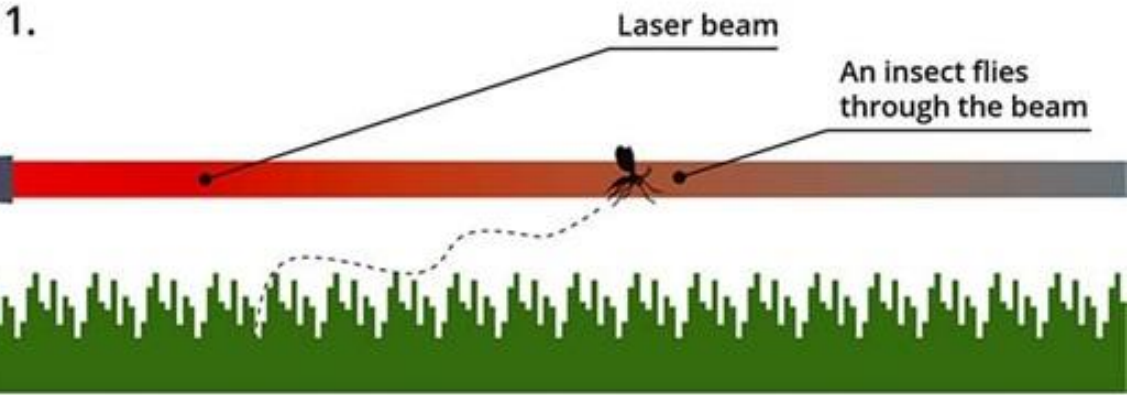


Potential of optical sensors for real-time monitoring of pest and beneficial insects in flight



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

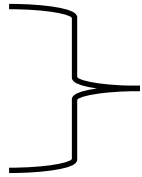


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Create database library of traces for known species & machine learning for identification algorithms

Collect insects from field



Pollen beetle and its parasitoid *Tersilochus heterocerus*



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



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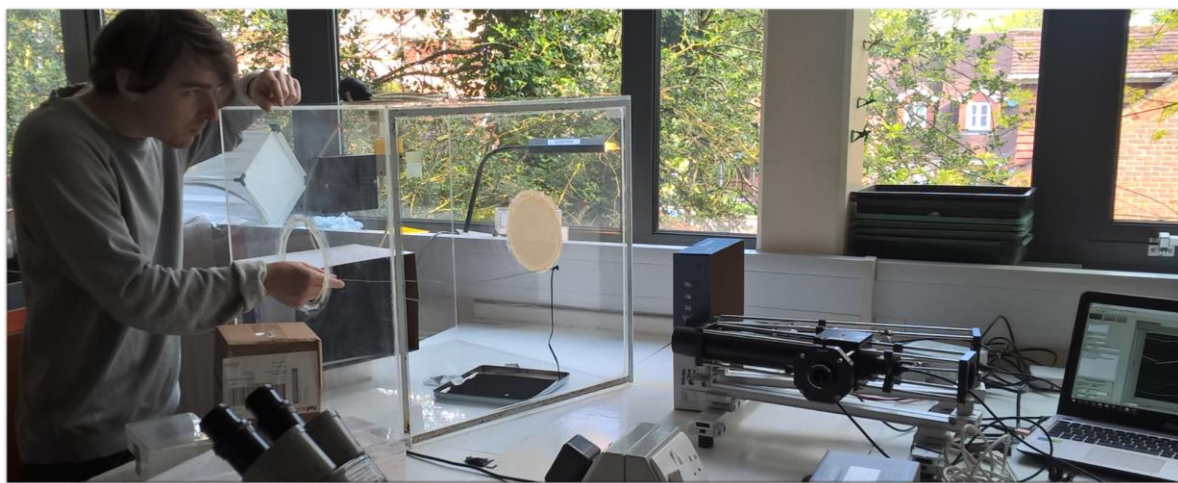
@SamCook_IPM

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

Collect insects from field



Record signatures in LAB1



X 10,000 !



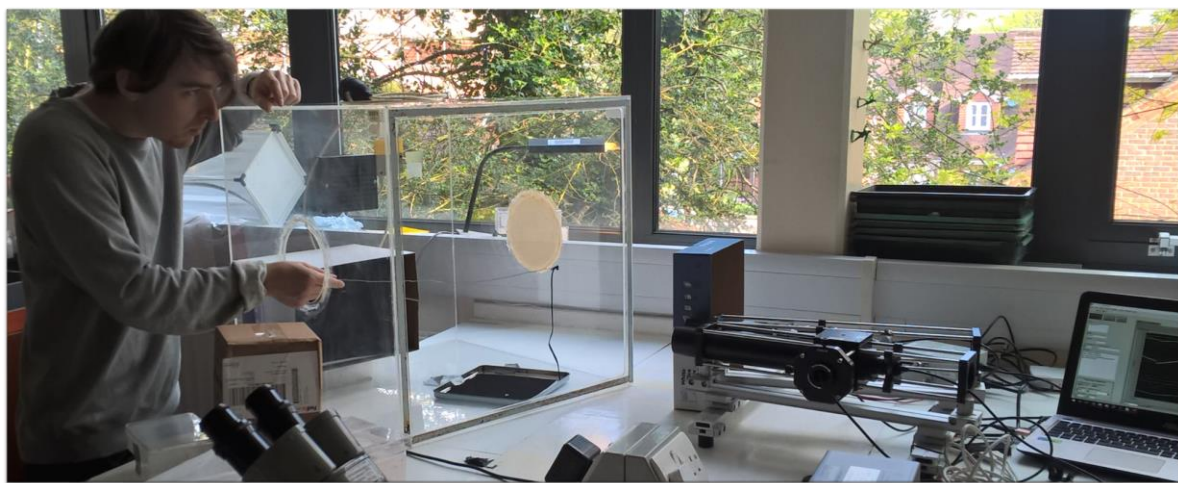
Potential of optical sensors for real-time monitoring of pest and beneficial insects in flight



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@SamCook_IPM

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



X 10,000 !



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



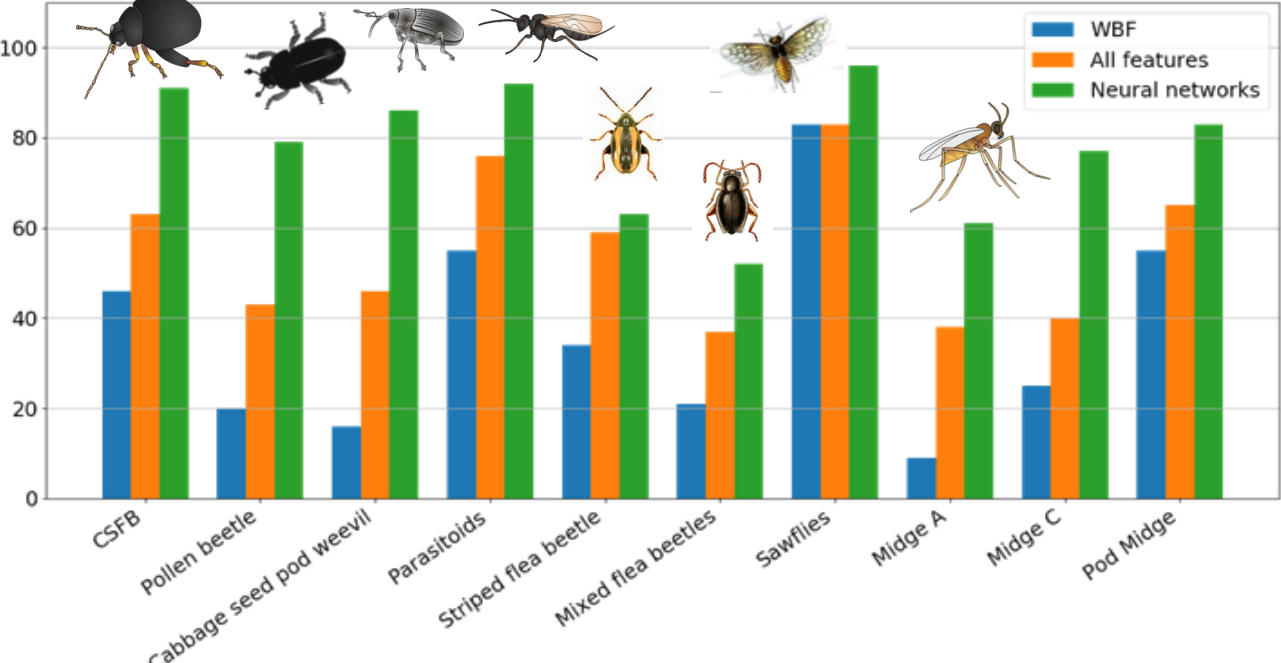
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- Create database library of LIDAR traces for known species & machine learning for identification algorithms



3 different classification methods

- Wingbeat frequency
- Features (random forest)
- Neural Network



- 80-95% accuracy for target species

scientific reports 11 1555 (2021) <https://doi.org/10.1038/s41598-021-81005-0>

Advances in automatic identification of flying insects using optical sensors and machine learning

[Carsten Kirkeby](#), [Klas Rydhmer](#), [Samantha M. Cook](#), [Alfred Strand](#), [Martin T. Torrance](#), [Jennifer L. Swain](#), [Jord Prangma](#), [Andreas Johnen](#), [Mikkel Jensen](#), [Mikkel Brydegaard](#) & [Kaare Græsbeil](#)





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



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.



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Sensor Counts



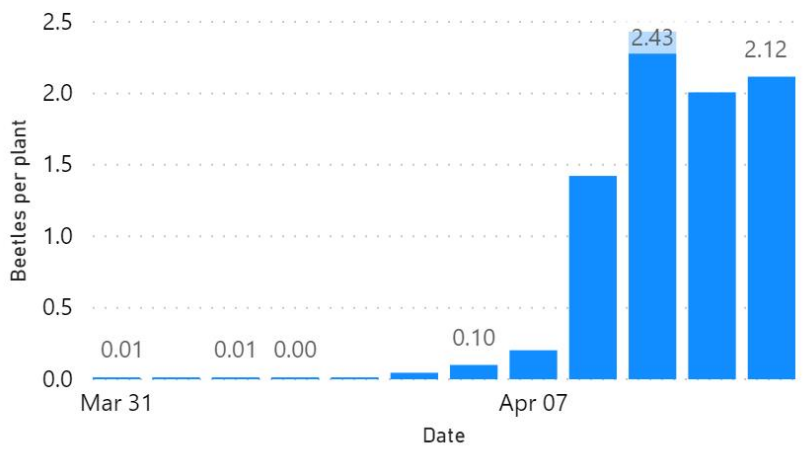
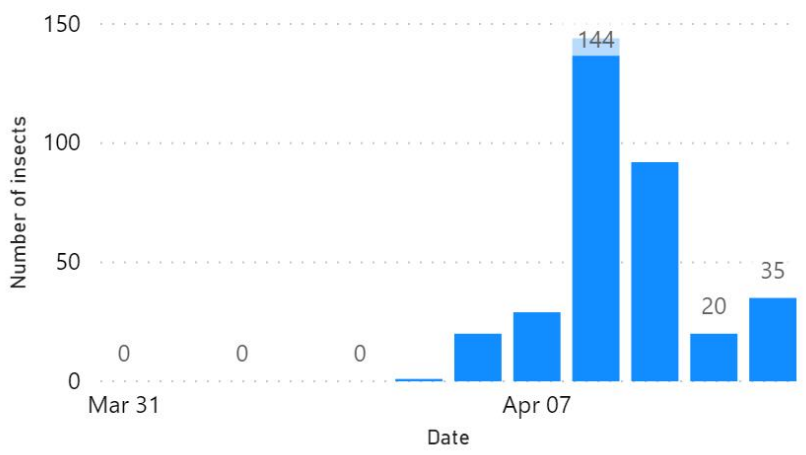
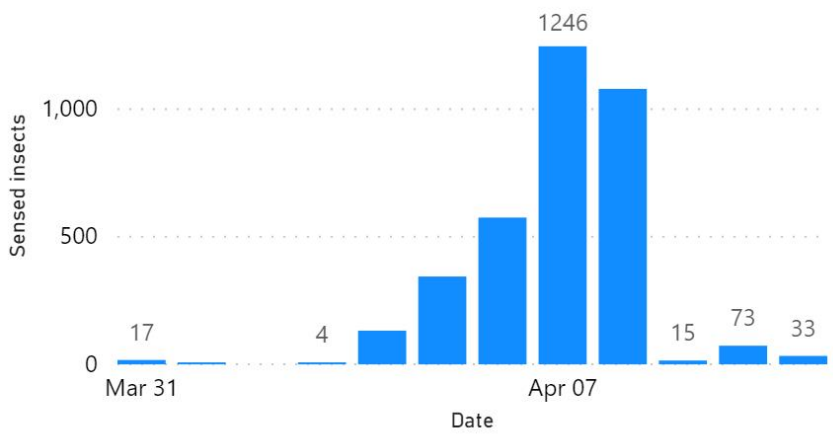
Water Traps



Plant Counts

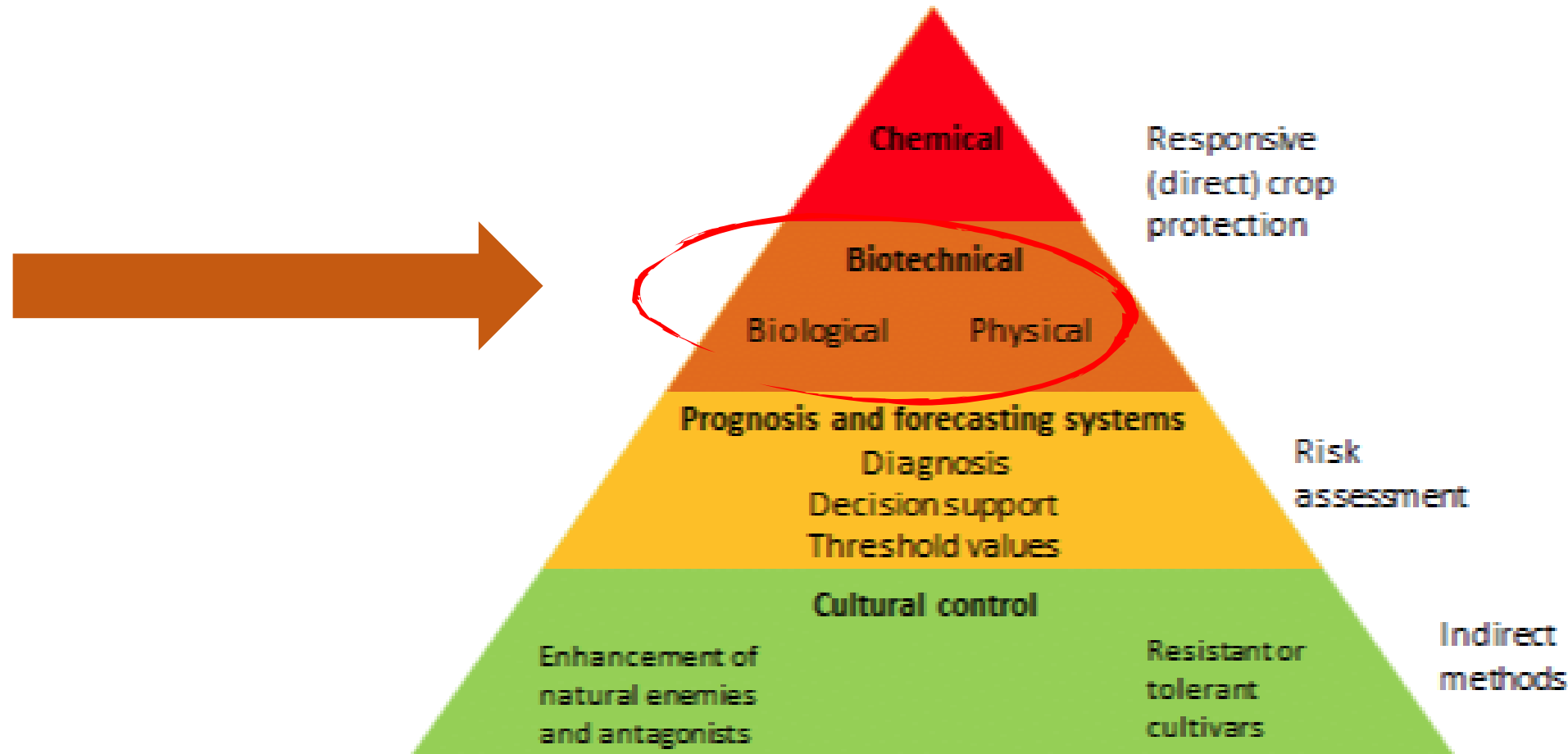


Bick et al., & Cook (2023) *Pest management Science* 80(5):2306-2313



IPM - Biotechnical - biological

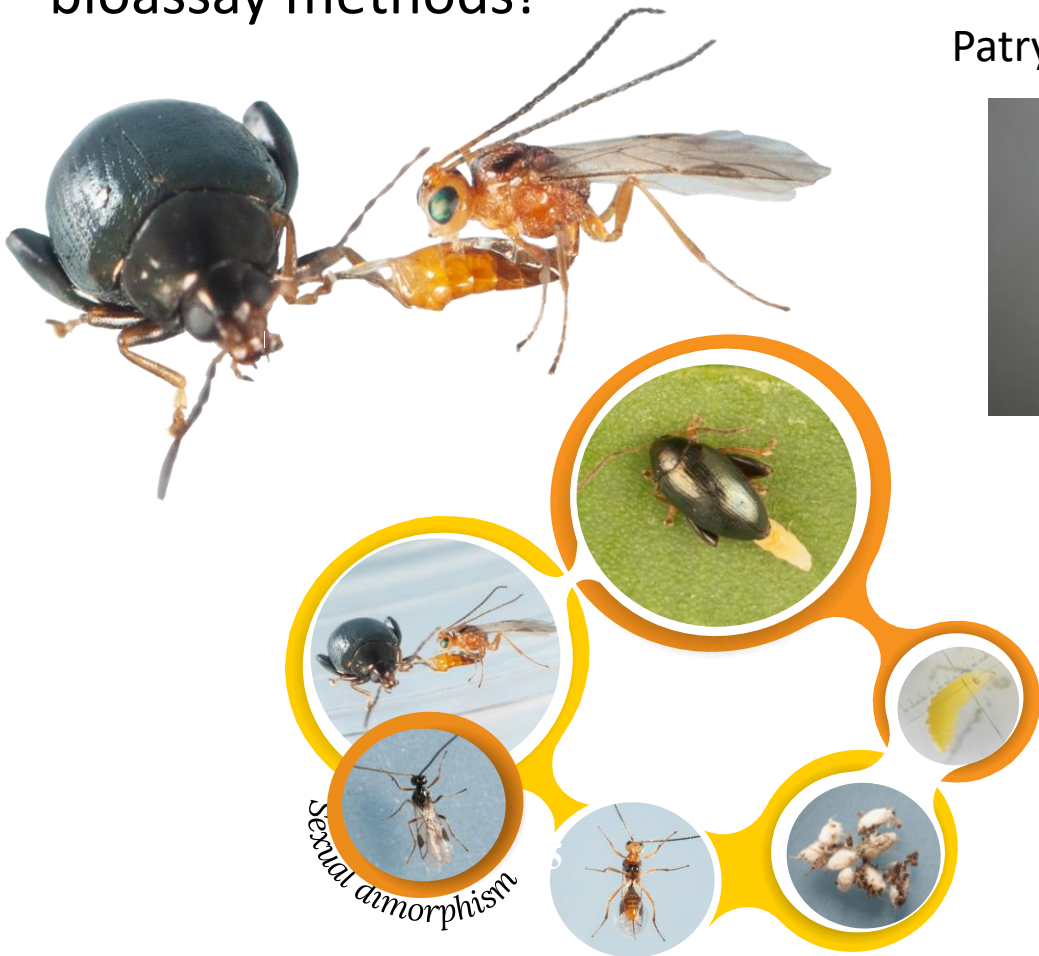
Aim: help industry to develop alternative controls and test effects on natural enemies



Biopesticides

Methods: Continuous culture of cabbage stem flea beetle and its parasitoid (*Microctonus brassicae*); enabling standardised, controlled bioassays all year round... using lots of different bioassay methods!

Patry Ortega-Ramos



Biological - biopesticides

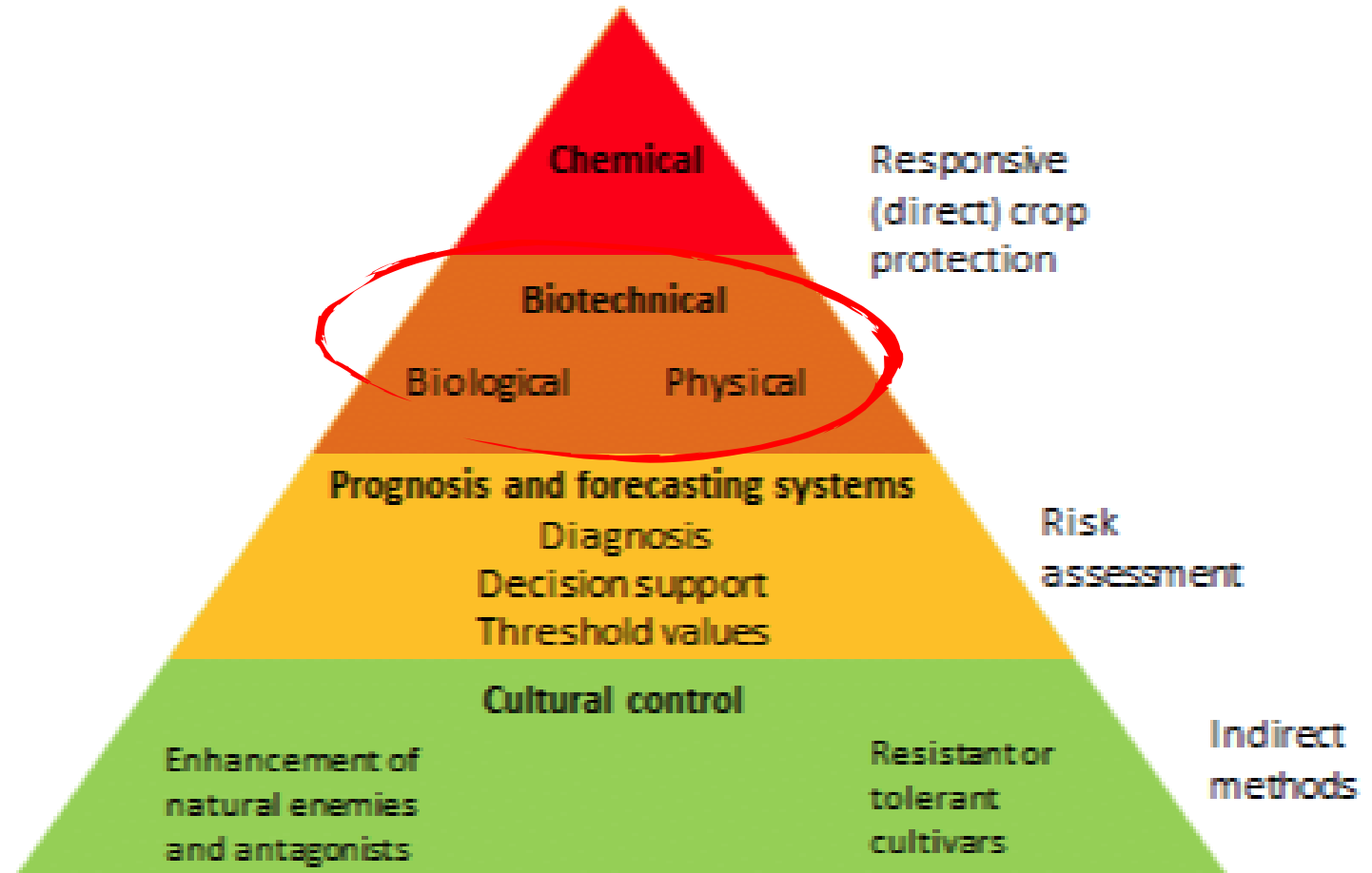


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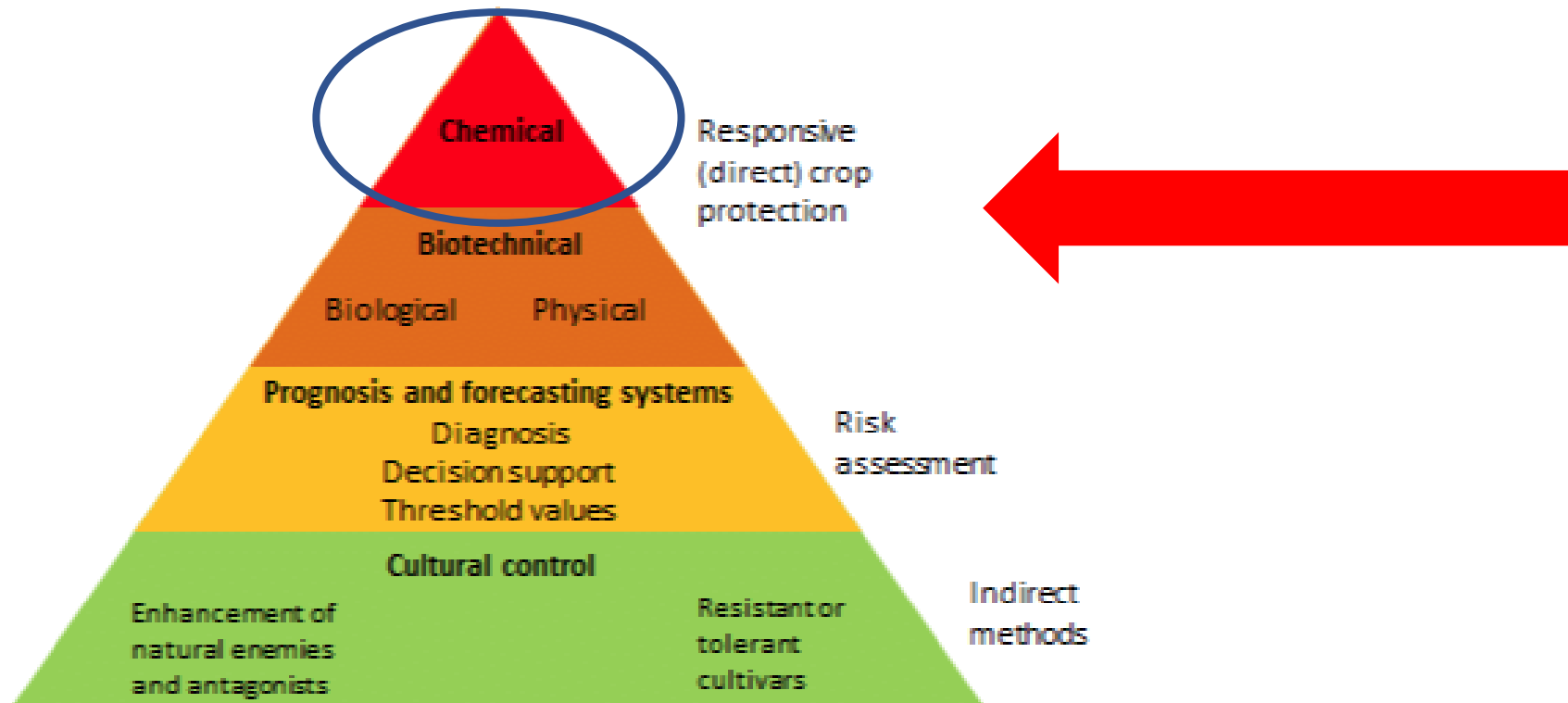
A push-pull bio-insecticidal strategy for autumn pests of OSR



Suleiman Mustapha



IPM - Synthetic chemical insecticides



Synthetic chemical insecticides



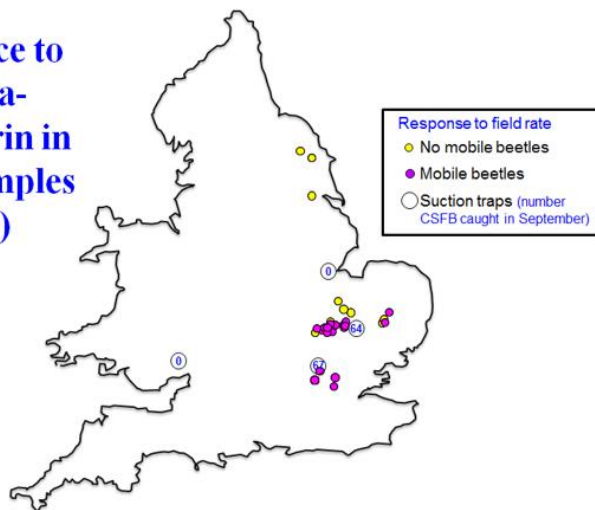
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Monitoring resistance of CSFB to pyrethroid insecticides

Caitlin Willis



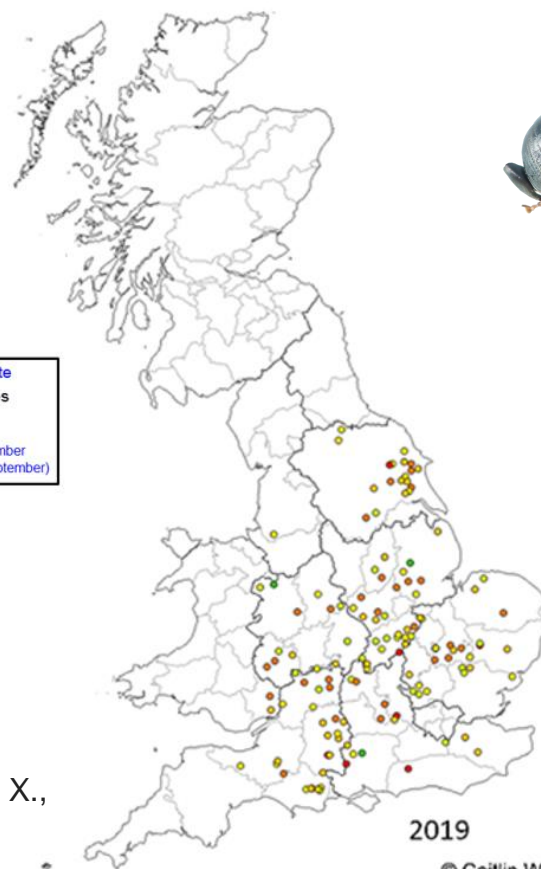
Resistance to
lambda-
cyhalothrin in
CSFB samples
(2014)



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.

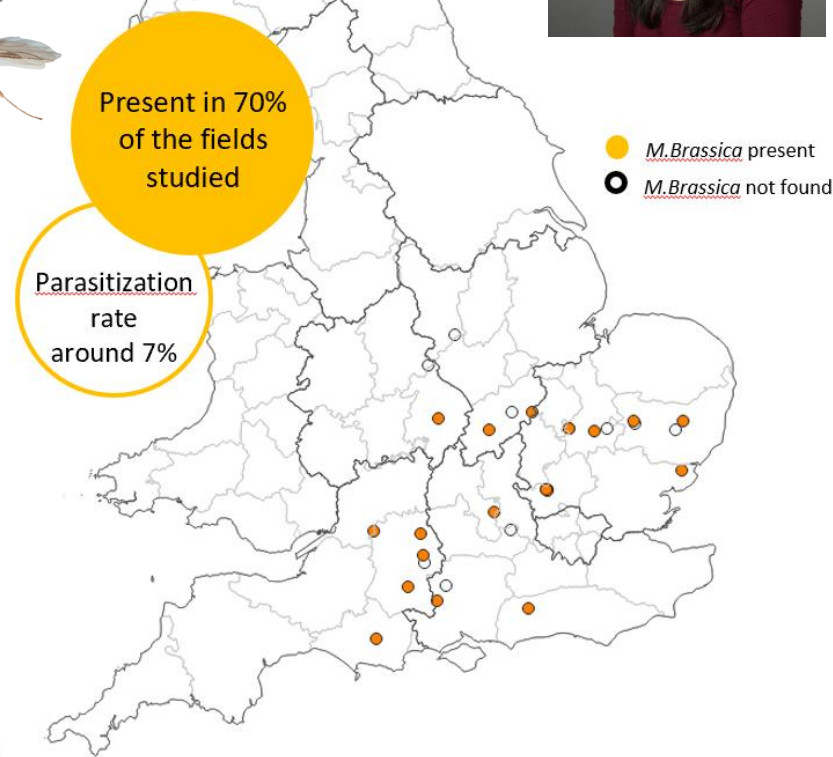
Monitoring distribution of CSFB parasitoid *Microctonus brassicae*, susceptibility to pyrethroids, & interaction between parasitism & susceptibility

Patry Ortega-Ramos



2019

© Caitlin Willis/Rothamsted Research



2024



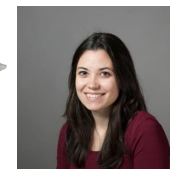
Synthetic chemical insecticides

Effect of organic synergist + pyrethroid insecticides on cabbage stem flea beetle pests and the parasitoid *Microctonus brassicae*

- Insecticide resistance is often caused by increased production of enzymes which break down insecticidal molecules (making them ineffective)



- Synergists block these enzymes, preventing detoxification
- Organic synergist reduces concentration of pyrethroids needed to kill CSFB!
- Potential to make pyrethroids effective on otherwise resistant populations
- & on susceptible populations enable less insecticide to be used



Thank you for your attention 😊

See *Pest Management Science* 80 (5) 2024
Special issue: Integrated Control in Oilseed Crops

New Special Issue open!

Next-Generation Integrated Pest Management for oilseed rape

Guest Editors

Sam M. Cook, Kevin King, Michael Rostas & Małgorzata Jędrzycka

Manuscripts on control of pathogens, insects herbivores & weeds in oilseed rape welcome!

Deadline for submission August 31st 2025

Impact Factor 3.8 (5-Year JIF: 4.3)

