The visual ecology of the cabbage stem flea beetle pest and its natural enemies for improved biomonitoring and sustainable control

Supervisory team:
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Host institution: Rothamsted Research (Harpenden) / Swansea University
CASE partner: Razbio Limited
Submit applications for this project to Swansea University

Project description:
Since the ban on neonicotinoid insecticides and development of resistance to pyrethroid insecticides, the cabbage stem flea beetle (CSFB) Psylliodes chrysocephala has had a devastating impact on economically important oilseed rape crops in the UK (https://doi.org/10.1111/gcbb.12922). Efforts are underway to develop more sustainable and environmentally sensitive control via Integrated Pest Management (IPM) (https://doi.org/10.1111/gcbb.12918). These require accurate monitoring of the abundance of CSFB and its natural enemy, the parasitic wasp Microtonus brassicae (Mb) to ensure that insecticides do not target areas of high parasitoid abundance. Current monitoring via yellow water traps is inefficient for CSFB, and ineffective for Mb, limiting assessments for its biocontrol potential and prospects for spatial targeting of insecticides.

The project will develop innovative traps that specifically target each species. This will offer more accurate monitoring and avoid unnecessary capture of the parasitoids and other beneficials. The student will utilise innovative visual modelling approaches to measures trap appearance from the perspective of target species to identify attractive trap designs from first principles, rather than trial-and-error. The project builds on research in the supervisors' labs pioneering the use of visual modelling approaches for monitoring and control of horticultural and urban pests, applying and extending the design process to arable crop pests, and utilising LEDs to increase trap conspicuousness.

As the visual systems of the two target species have not yet been characterised, genomic approaches, scanning electron microscopy, electroretinography and behavioural tests will establish spectral sensitivity and spatial acuity of CSFB and Mb. The student will then use the insights on the visual biology of the pest and its natural enemy to develop prototype selective traps and test these in lab and field experiments. Experiments will also investigate the mechanisms of action of distractive pest management strategies such as mulching and companion planting, which confuse the pest during host plant location, to better understand the relative roles of visual and olfactory signals to optimise these crop protection strategies.

Work will contribute to the global challenge of secure food production and reducing insecticide use. Students with interests in agroecology, entomology, animal vision or behaviour, who are pursuing careers in industry or academia requiring strong quantitative skills and an interdisciplinary perspective, are encouraged to apply. The student will gain firsthand experience in the IPM industry with Razbio Ltd as industrial CASE partner.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.