The Inside Story: Exploring and exploiting the cabbage stem flea beetle endosymbiont microbiome as a novel potential means of crop protection.

Project ID: 276

Supervisory team

Rothamsted supervisor: Dr David Withall (Rothamsted Research)
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Project description: Cabbage stem flea beetle (CSFB), Psylliodes chrysocephala, has rapidly emerged as the most important pest affecting oil seed rape, brassicas and vegetable crops, following the removal of neonicotinoid pesticides in 2013 and emerging widespread resistance to pyrethroids. Crop damage results in over 20% yield loss, valued at over £120 million annually, and with low profit margins the area planted by UK farmers declined by more than 60% in 2020. This PhD project aims to explore a promising new approach to managing this economically important pest through exploring the insect microbiome, with a specific focus on endosymbionts.There is growing evidence in the scientific literature and results from our own research on other agricultural insect pests that the host microbiome, including endosymbionts, play an important role in modulating physiological functions at all stages of their life cycle. This includes allowing their host to thrive on nutritionally unbalanced diets, protecting the host from predators/diseases, increasing resistance to insecticides, affecting host plant preferences, improving adaption to ecological niches and abiotic/biotic stresses and regulating mating cycles. By developing a better understanding of the composition and role of the microbiome, we will be able to develop new control strategies through manipulation of the host microbiome.In this interdisciplinary PhD project, we propose to use an innovative combination of molecular biology, genomics, chemical ecology and bioinformatics alongside state-of-the-art equipment and methodologies (e.g. next-gen sequencing, analytical chemistry, computational models, X-Ray CT) to determine the composition and role of the CSFB microbiome. This will underpin the development of novel, targeted crop protection strategies based on manipulating the insect microbiome. To achieve this objective, this project will:1. Use 16S/18S rRNA and ITS nanopore amplicon sequencing approaches to characterise the composition and abundance of the microbiome, including endosymbionts, of wild collected populations of CSFB across all life cycle stages. We will use a range of microbiological approaches to isolate culturable members of the microbiome for further characterisation.2. Determine the role of the CSFB microbiome and endosymbionts, as a whole and individually, to adapt to ecological and environmental niches. We will use a combination of in vivo and in vitro behavioural/developmental bioassays (e.g. host plant preferences, fecundity, attraction/repellence, parasitoid resistance), insecticide resistance and phenotypic characterisation.3. Evaluate the feasibility of manipulating the CSFB microbiome through feeding of commercially available antimicrobial compounds and previously isolated natural products with known ecologically relevant antimicrobial activity.

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.