

Protecting Ant Biodiversity and Ecosystem Services by Understanding Determinants of Insecticide Sensitivity

Project ID: 143

Supervisory team

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CASE partner: Bayer

Project description: BackgroundAnts perform vital ecosystem services in their role as ecosystem engineers, nutrient recyclers, seed dispersers, pest control agents and biological indicators. However, while performing these ecologically and economically important functions, ants may come into contact with potentially harmful toxins in the environment such as pesticides. Thus, understanding the key factors that influence the toxicological outcomes of their exposure to these chemicals, in isolation or combination, is essential to safeguard their health and the ecosystem services they provide. Insects have evolved sophisticated metabolic systems that mediate the conversion of harmful xenobiotics to less toxic forms, and these detoxification pathways can be critically important in defining their sensitivity to toxins including pesticides (<https://doi.org/10.1016/j.scitotenv.2024.170174>). However, the evolution and function of the enzymes involved in key beneficial insects such as ants remains exceptionally poorly understood. Project aims and approaches



The aim of this interdisciplinary project is to understand what determines the sensitivity of ants to insecticides at the molecular level, and translate this knowledge into tools and strategies to protect them from pesticides. This project will address three key questions. Q1. To what extent are insecticide-metabolising enzymes shared across ant diversity, and what evolutionary processes underlie the patterns observed? The project will exploit the recent dramatic increase in genomic and transcriptomic data available for ants, in combination with phylogenetic and functional analyses (recombinant expression of ant enzymes) to understand the evolution of detoxification enzymes in this important group of insects. Q2. How much genetic variation exists in detoxification genes within ant populations and how important is this for insecticide metabolism? Publicly available ant population genomic datasets will be leveraged, in combination with additional sequencing and functional assays to characterise genetic variation in detoxification enzyme genes in populations of a model ant species. Q3. What are the critical structural and functional determinants of insecticide metabolism? In silico modelling (using AI-based approaches) and functional assays will be used to identify which amino acid residues in ant detoxification enzymes are critical in determining insecticide metabolism and which structural groups of insecticide chemistry they interact with. Outcomes The data generated in the project will fundamentally advance our understanding of the evolution and function of detoxification enzymes in ants and help safeguard ants from potentially harmful pesticide exposure. Training The student will receive training in state-of-the-art approaches that are highly sought-after by employers and benefit from direct interaction with industry as part of the CASE scheme.

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.