How do insect microbial communities affect insecticide resistance?

Supervisory team:
Main supervisor: Dr Bram Kuijper (University of Exeter)
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Host institution: University of Exeter (Penryn)

Project description:
Are you interested in solving major problems in sustainability by performing experiments in insects, while at the same time enriching your CV with key bioinformatics expertise and other computational skills? This exciting project focuses on microbes in the gut of the green peach aphid Myzus persicae (a major crop pest) and the role these microbes play in insecticide resistance. Microbes in insect guts are known to break down noxious substances, but whether they also play a role in insecticide resistance is poorly understood. While their short generation times allows bacteria to evolve faster than their hosts, the ability to break down insecticides comes at various costs that make for a competitive disadvantage at times when pesticide levels are lower. This raises the question whether varying pesticide levels could potentially hamper the evolution of bacterial pesticide resistance. This project aims to provide a systematic experimental analysis of this prediction. Below we suggest three components of this project, but you are of course welcome to suggest other components that are closer to your interests!

1. Bioinformatics to unravel how gut microbial communities respond to insecticides. You will learn how to apply state-of-the-art bioinformatics techniques to compare bacterial community compositions before and after pesticide exposure. This helps to pinpoint those bacterial species that are (indirectly) conducive to heightened pesticide resistance levels. Moreover, to explore the role of the host background, we can compare changes in bacterial communities between specific clonal lines that are selected from a massive range of 110 different clonal lines of the green peach aphid Myzus persicae from across the world, available in Prof Bass' lab.
2. Experimentally vary different pesticide fluctuation regimes and their consequences on microbiomes. By working with aphids in the lab, we can experimentally test the prediction that fluctuations in pesticide levels negatively affect frequencies of those bacteria capable of breaking down pesticides. We expose selected lines of M. persicae to levels of pesticides that either fluctuate at 24h or 72h rates. We then compare community compositions between the two experimental lines and see how many resistant species are shared with that of experiment 1.
3. Computational models of pesticide resistance evolution in bacterial communities We can develop computational models to simulate how evolutionary change across gut bacterial communities influences pesticide resistance. This allows us to predict the optimal level of pesticide fluctuations or how other tools (e.g., antibiotics) affect insecticide resistance evolution.

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.