How do microplastics affect pesticide risk in honeybees?

Supervisory team:
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Project description:
Microplastics are persistent pollutants that are present in soils, water and vegetation. Moreover, microplastics have been reported in various animals, including in economically important insects species such as honey bees. A critical feature of microplastics is that they are carriers of pollutants, which has led some to suggest that microplastics could enhance exposure of bees to pesticides, providing a (partial) explanation of the recent loss events of honeybee colonies across the globe.

This project sets out to investigate the interplay between microplastics and pesticide exposure and has the following aims: (i) investigate the impact of different combinations of microplastics and pesticides on bee survival and gut microbiome; and (ii) investigate the long-term consequences of microplastics on bee adaptation to novel pesticides. The project contains a unique mix of experiments using bees, mathematical modelling of the impacts of pesticides and working with NGS sequencing data to understand the interplay of microplastics and pesticide exposure.
All projects in our labs are student-led, so we encourage the student to design their own projects according to their interests. Potential suggestions for research projects are:

(1) lab experiments in which bees receive (through nectar) different combinations/types of microplastics and pesticide concentrations. Such experiments give critical insight into how different microplastic × pesticide treatments affect key traits central to hive persistence, such as bee (social) behaviour, foraging success and ultimately survival.
(2) Moreover, we could exploit these experimental lines to investigate the biomechanics of microplastics: do microplastics accumulate in bee guts (similar to larger microplastics in vertebrates), or are they again rapidly excreted? In turn, we could use techniques like HPLC to get more insight on how gut microplastics release pesticides over time.
(3) Another promising line of reseach is to use NGS sequencing to investigate how microplastics affect insect gut microbial communities; while there are some suggestions microplastics can degenerate the bee gut microbiome, properly controlled experiments that compare microbiota before and after microplastic exposure are so far lacking.
(4) Dependent on the interests of the student, they could use athematical modeling to explore how microplastics influence the evolution of pesticide resistance. Microplastics cause prolonged low-level pesticide exposure, leading to hormesis—where early exposure enhances resistance later. Since evidence on hormesis is mixed, models can help determine the exposure levels that may boost organisms' responses to new pesticides, making them valuable tools for understanding this evolutionary process.

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.