FoodBioSystems DTP - PhD Project Advertisement Text

Project Title: FOODBIOSYSTEMS - Understanding the ecology and coevolution of aphids and parasitoids to improve natural biocontrol measures in field crops

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Research Group: FOODBIOSYSTEMS BBSRC DTP
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Application Deadline: 6 March 2020

Project Description:
Background - Parasitoids are insects that play a fundamental ecological role in both natural and agricultural ecosystems by regulating the population of herbivore pests, such as aphids. Despite much work on the ecology and evolution of parasitoids, research has so far ignored that there are remarkable differences in the reproductive strategies across both parasitoid species and host species, which in part should reflect the coevolutionary arm race between them. As a result, we still ignore to what extent the demography of the enemy (the parasitoid) is adapted to that of the host (the crop pest) and viceversa. Parasitoid species also differ in their degree of specialization to the host (i.e. whether they can parasitize one or multiple host species). However, we still have a poor understanding of how degree of specialisation facilitates or undermines population persistence of parasitoids in the environment. Moreover, it is currently unknown whether more patchy and diverse environments offer refugia points for parasitoids as opposed to more homogeneous environments. Finally, our understanding of how populations of crop pest hosts and their parasitoids will respond to predicted climate change is currently very limited, undermining our ability to adapt to climate change and improve food security from field crops.

Project design -
The student will address these fundamental questions using a powerful combination of approaches. Specifically, the student will:

1. Derive general principles using phylogenetic comparative methods by investigating questions at the global scale across hundreds of parasitoid species and their hosts, on (i) how different reproductive strategies evolved in hosts and in parasitoids, and coevolved between them; (ii) how the degree of host specialisation affects the population dynamics in both hosts and parasitoids.
2. Run experiments with plants, pests and parasitoids in controlled environmental conditions to test the hypotheses to investigate their response to predicted future climate and extreme climatic events.
3. Run field trials to investigate whether habitat patchiness supports parasitoid populations better than uniform habitats, using the agri-environments and a cereal-aphid-parasitoid complex as models in both natural and agri-environments.

Importantly, the project is designed to offer the student the opportunity to expand or reduce the experimental and field components as best suited to their interests or as needed. This project is therefore truly suitable to everyone interested in the ecology and coevolution of hosts and their natural enemies.

Project outputs - The results of this project will not only unravel fundamental ecological and evolutionary principles suitable for publications in top journals, but, by using agri-environments and a ceral-aphid-parasitoid complex as models, they will provide important insights to policy guidelines for a more sustainable agriculture. In fact, while insecticide resistance is an emerging problem in crop pests leading to yield loss, food insecurity and financial loss, nature based approaches to exploit parasitoid populations are increasingly promoted worldwide as a sustainable pest control measure that can replace or reduce the use of chemical pesticides. However, while parasitoids are very effective in glasshouse crops, their effectiveness in field crops is variable and unpredictable. This project will investigate possible ecological principles that may explain how, why and when parasitoids may succeed or fail in controlling crop pests, and will provide clear guidelines on how to overcome the challenges so far encountered in exploiting effectively parasitoids as biocontrol agents in the field.

Funding Notes: This project is part of the FoodBioSystems BBSRC Doctoral Training Partnership (DTP), it will be funded subject to a competition to identify the strongest applicants. Due to restrictions on the funding, this studentship is only open to UK students and EU students who have lived in the UK for the past three years.

This project is a CASE studentship with Agri-Food Biosciences Institute (AFBI). The CASE partner Agri-Food Biosciences Institute (AFBI) may offer a 3 months placement and £1400pa towards research expenses through the Strategic Partnership between QUB and AFBI, pending final business case approval.

The FoodBioSystems DTP is a collaboration between the University of Reading, Cranfield University, Queen's University Belfast, Aberystwyth University, Surrey University and Brunel University London. Our vision is to develop the next generation of highly skilled UK Agri-Food bioscientists with expertise spanning the entire food value chain. We have over 60 Associate and Affiliate partners. To find out more about us and the training programme we offer all our postgraduate researchers please visit https://research.reading.ac.uk/foodbiosystems/.

Training opportunities: The student will have the rare opportunity to be trained in many different methods and develop a unique skillset that will increase their employability, while gaining knowledge of fundamental biological and evolutionary principles underpinning important basic science and applied questions.

Specifically, the project offers the opportunity to learn:

- state of the art statistical modelling including phylogenetic comparative methods;
- data collection and management of large datasets;
- numeracy;
- experimental design and implementation in both controlled environments and in the field;
- evaluating risks and uncertainty.

These skills have been flagged as highly needed in the sector within and outside academia.

There is also the opportunity to collaborate with colleagues in the wider collaborative network of the supervisors. Specifically, the student may gain further expertise in mathematical demographic modelling to

predict demographic responses for both parasitoids and crop pests under future climate scenarios; and/or taxonomy and sampling of host species and parasitoids across farms in NI.

Placement: The project is further supported by collaboration with a CASE partner AFBI through the Strategic Partnership between QUB and AFBI, pending final business case approval. This will offer the student the opportunity to spend 3 months at AFBI for a placement and help translate the results of the project into guidelines for biocontrol programmes of crop pests. Altogether, the unique combination of skills gained throughout the PhD will allow the student to be ideally placed for a career in both the applied sector as well as academia.

Student profile: The ideal candidate has a first-class degree and a Masters in ecology, biology, agriculture or related discipline; good experience in statistical or mathematical modelling and/or phylogenetic approaches; experience with experimental approaches in the field or lab.