Polarization vision in beneficial insect enemies of crop pests

Supervisory team:
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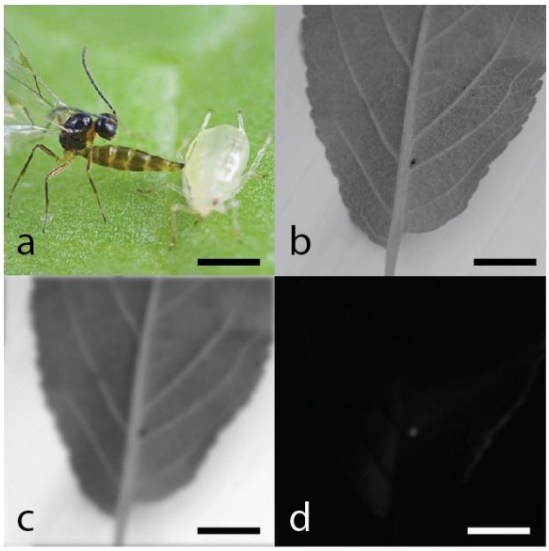
Project description:
Insect pests, such aphids, cause millions of pounds worth of damage to crops every year. Integrated pest management is crucial for future food production, and beneficial insects that prey on crop pests play a key role in a sustainable strategy.

Parasitoid wasps are an exceptionally diverse group of insects and are one of the most important groups of beneficial crop pest predators. These wasps lay their eggs inside host species, and their larvae then eat the host from within. Currently, we understand that parasitoid wasps use a number of sensory signals to locate their crop pests. They use chemical signals from plants that are under attack, and then visual information to identify specific prey to attack. However, sensitivity to the polarization of light is an extra visual adaptation common to many insects but has never been studied before in this context. The aim of this project is to discover how the polarization of light plays a role in parasitoid wasps attacking crop pests, and how we can use that information to enhance their value as biocontrol agents. This project will study two common UK wasp species, Aphidius ervi and A. colemani which are parasitoids of aphids, including the cereal or wheat aphid, Sitobion avenae. Both of these species are commercially available bio-controls.

Three different experimental approaches will be used. The retinal morphology of the parasitoid species will be investigated using light and electron microscopy to understand how the structure of the eyes are able to detect the polarization of light. A second part of the project will be imaging pest aphids in the natural environment and quantifying how polarization can help better locate hosts. Using this information, the final part of the project will use behavioural experiments to investigate the use and response of the wasps to different and ecologically relevant polarization stimuli.

The Ph.D. will be supervised jointly by Prof Nicholas Roberts at the University of Bristol and Prof Martin Stevens at the University of Exeter. The student will learn an interdisciplinary range of skills, from advanced microscopy and imaging techniques to behavioral design, and will make a significant contribution to a high-profile area in the field of sensory ecology.

This will be the first investigation of polarization sensitivity in this important group of insects. The study is important because it provides a new understanding of how these important bio-control parasitoid insects locate hosts.



a) Aphidius colmani parasatizing an aphid. b) Achormatic contrast on an aphid on a leaf (to human vision). c) How the aphid appears to a parasitoid wasp from 5cm. d) The polarization signal of the aphid seen by the wasp from 5cm. Scale bars a) 1mm. b-d) 12mm. Image credit a) www.agrimag.it