Impact of fungal antioxidants on crop disease

Supervisory team:
Main supervisor: Dr Michael Deeks (University of Exeter)
Second supervisor: Prof Nicholas Smirnoff (University of Exeter)
Prof Kim Hammond-Kosack (Rothamsted Research), Prof Julian Moger (University of Exeter), Prof Jacqueline Christmas (University of Exeter)

Collaborators: Dr Martin Urban (Rothamsted Research)

Host institution: University of Exeter (Streatham)

Project description:
Antioxidants including ascorbate (vitamin C) play essential metabolic functions and control the levels of harmful reactive oxygen species (ROS) to protect DNA and other biomolecules from damage. Fungi produce their own distinct varieties of antioxidants including erythroascorbate (a chemical analogue of ascorbate) and ergothioneine (a histidine derivative). These antioxidant synthesis pathways could be valuable targets for controlling fungal diseases of crops as they represent physiology that is unique to the pathogenic microbe rather than the host. Increasing resistance in the field to common commercial fungicides means that new interventions for fungal phytopathogens such as Zymoseptoria tritici, the most important fungal pathogen of wheat in northern Europe, are urgently needed. We have found through mutant analysis that Z. tritici places particular emphasis on individual antioxidants and their depletion causes a range of phenotypes including sensitivity to ROS, altered morphology and reduced pathogenicity. We have assembled an interdisciplinary supervisory team that spans cell biology and phytopathology (Deeks and Hammond-Kosack), biochemistry and metabolite profiling (Smirnoff) and advanced label-free chemical imaging and image analysis (Moger and Christmas) to build-upon these preliminary data and understand the infection biology of antioxidants in phytopathogens.

The student undertaking this project will have the opportunity to learn core skills in phytopathology both at Exeter and through a first-year rotation project at Rothamsted Research under the co-supervision of Prof Kim Hammond-Kosack with the aim of conducting comparative studies in Fusarium graminearum (another globally important pathogen of wheat). A second rotation project will give the student the experience of exploring phenotypes using cutting-edge label free Raman imaging techniques and computer vision approaches to quantify disease progression. This will be co-supervised by discipline experts Profs. Julian Moger and Jacqueline Christmas. Integration of these interdisciplinary techniques into the main project will be strongly encouraged but research strategies can be adapted around the emerging ambitions and skills of the student. The main project will be undertaken at Exeter using established workflows (previously exploited at Exeter by industrial partners) to generate and analyse recombinant mutant phytopathogens. Phenotypes will be analysed as part of an ongoing collaboration between the primary and secondary supervisor Prof. Nick Smirnoff, on the use of hydrogen peroxide biosensors to investigate the role of ROS in plant pathogen-interactions.

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.