The temporal dynamics of higher-order gene regulation in plant immunity

Supervisory team:
Main supervisor: Dr Hans-Wilhelm Nützmann (University of Exeter)
Second supervisor: Dr Kim Hammond-Kosack (Rothamsted Research)
Prof Vinod Kumar (University of Exeter), Dr Volkan Cevik (University of Bath)

Host institution: University of Exeter (Streatham)

Project description:
Every year, more than 20 % of agricultural productivity is lost due to plant diseases caused by pathogens. An essential element for the plant to effectively counteract pathogen attack is the ability to precisely control the expression of its defence-related genes. Regulation of gene expression, switching genes on and off, is a process that is generally modulated on different molecular levels. A higher level of gene regulation, the epigenetic and topological organisation of chromosomes, has only recently been recognised as playing an important role in gene expression. Dynamic changes to the epigenetic modification of chromatin and the three-dimensional folding of chromosomes were linked to the differential regulation of individual genes, defined genomic regions and large chromosomal territories.

How the temporal dynamics of plant immunity gene expression is regulated on this level is largely unexplored. Yet, understanding its mechanism will expand our fundamental knowledge about plant defence and reveal novel paths to enhance the resilience of plants against pathogens.

The core objectives of this project will be: (i) to define the shared epigenomic signatures of plant defence genes, (ii) to characterize how higher-order gene regulatory mechanisms determine the temporal gene expression profile during the plant defence response, and (iii) to establish how plant defence can be manipulated by interfering with higher-order gene regulation.

To tackle our objectives, you will employ state-of-the-art molecular techniques including chromosome conformation capture (Hi-C), Cut&Tag and CRISPR/Cas9 technology and you will use relevant mutant lines. To identify shared patterns of higher-order gene regulation across species and systems, you will work in the model system A. thaliana and the staple crop wheat, and you will use different pathogens and elicitors to induce plant defence programs.
The overarching long-term goal of this program is to uncover novel principles in plant gene regulation and to identify novel targets for plant breeding against pests and for improved plant health.

Embedded within a collaboration between scientists in Exeter, Rothamsted and Bath this studentship brings together expertise in plant and genome biology as well as plant-pathogen interactions. It will train an early career researcher in high-demand plant molecular and computational skills.

We are looking for an applicant who is curious about molecular genetics and plant immunity and excited to apply cutting-edge technology. From the onset of the studentship, the prospective student will actively participate in the design of the project and will be encouraged to bring in their own research ideas.

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.