Investigating the interplay of 3D chromosome structure and non-coding RNAs in plant defence

Supervisory team:
Main supervisor: Dr Hans-Wilhelm Nuetzmann (University of Bath)
Second supervisor: Prof Laurence Hurst (University of Bath)
Dr Keith Vance (University of Bath), Dr Nicholas Kent (Cardiff University), Dr Davide Michieletto (University of Bath)

Collaborators: Dr Selene Lizbeth Fernández Valverde (LANGEBIO, National Laboratory of Genomics for Biodiversity, Irapuato, Mexico)

Host institution: University of Bath

Project description:
Every year, more than 20 % of agricultural productivity is destroyed by plant pathogens. An essential element for the plant to effectively defend itself is the ability to control the expression of its defence-related genes. But how is the co-ordinate regulation of defence genes accomplished in the three-dimensional space of plant nuclei? This is the question at the heart of a PhD project that combines epigenetics, bioinformatics, biophysics and plant science to improve our fundamental understanding of plant defence gene regulation and eukaryotic genome organisation. In this interdisciplinary project, you will analyse the role of non-coding RNAs and chromosome structure in transcriptional co-ordination of plant disease resistance and defence metabolite genes in the model plant Arabidopsis thaliana. Non-coding RNAs have emerged as important modulators of transcriptional activity across the eukaryotes and have been shown to induce changes to chromatin modifications and three-dimensional chromosome structure.

The student will be trained in the bioinformatic analysis of large-scale datasets to generate a comprehensive overview of defence gene expression and their associated chromosome structure and ncRNAs. These analyses will be combined with functional molecular experiments involving techniques such as chromatin immunoprecipitation, RNA-DNA binding assays and chromosome conformation capture. The project will further investigate the evolutionary conservation of ncRNAs and implement polymer simulations to devise a general model for co-ordinate gene regulation in plant defence.

Our goal is to uncover new principles in plant gene regulation to identify novel targets for plant breeding against pests and for improved plant health. The doctoral researcher will be based at the newly established Milner Centre for Evolution at the University of Bath and integrated into an ongoing collaboration between the Milner Centre and the National Laboratory of Genomics for Biodiversity (LANGEBIO), Irapuato, Mexico.

We are welcoming applicants with backgrounds in disciplines such as molecular biology, plant science, bioinformatics or biophysics and we can adjust the project depending on the students interests and strengths. Practical skills in plant molecular biology/epigenetics and coding/modelling are advantageous but not required as specialised training will be provided.