

Understanding plant chromosome architecture and evolution

Supervisory team:

Main supervisor: Dr Hans-Wilhelm Nuetzmann (University of Exeter) Second supervisor: Dr Simon Scofield (Cardiff University) Prof Vinod Kumar (University of Exeter)

Collaborators: Dr Tamara Lechon Gomez (Cardiff University), Dr Alexandros Bousios (University of Sussex)

Host institution: University of Exeter (Streatham)

Project description:

Plants constantly need to adapt to changing environments. Climate change and the spread of pathogens are currently accelerating the speed in which plants must adapt to survive. Indeed, some regions of plant genomes are evolving faster than others. These regions are crucial for plants to respond rapidly to new environmental conditions on a genetic level. It is therefore paramount for us to understand how these regions are organised, function and evolve. At the heart of this PhD project is the question of how such recently evolved regions of plant genomes are integrated into the three-dimensional (3D) space of the nucleus. In all eukaryotes, genes are incorporated into a complex and dynamic 3D configuration of chromosomes. This spatial organisation of chromosomes modulates the activity and efficiency of all DNA related processes. Crucially, the unique 3D organisation of specific genomic regions may shape their evolutionary trajectory and separate recently evolved sites from highly conserved areas of the genome. In this project, you will characterise chromosome structure at recently evolved regions in the genomes of A. thaliana and wheat by chromosome conformation capture (HiC) and fluorescence in situ hybridisation (FISH) technology. In addition, you will devise a computational pipeline to identify recently evolved regions in plant genomes and determine the associated chromosome structure. By comparing chromosome structure across unrelated plant species, you will be able to determine general rules associated with groups of recently and co-ordinately evolved groups of genes. To analyse and evaluate the generated large-scale datasets you will be trained in the application of advanced bioinformatic analysis pipelines of high-throughput data and essential coding skills.

Overall, you will combine plant science, genomics, 3D genomics and bioinformatics to improve our fundamental understanding of plant genome evolution and eukaryotic genome organisation. This will provide you with a cutting-edge training experience for the next generation plant scientists.

You will be based at the Department of Biosciences at Exeter University, Streatham Campus, and you will be incorporated into the host's group at the Milner Centre for Evolution, Bath, and the collaborator's groups at the Universities of Bristol and Cardiff. We are looking for an applicant who is curious to understand the fundamental biology behind the evolution of plant genomes and we are welcoming ideas and input to design and implementation of the project.

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.