SWBio DTP

BBSRC Doctoral Training Partnerships

# Investigating the effect of whole genome duplication on cell size and cell division

**Supervisory team:**
**Main supervisor:** Prof Jim Murray (Cardiff University)
**Second supervisor:** Dr Paula Kover (University of Bath)
Dr Angharad Jones (Cardiff University), Dr Veronica Grieneisen (Cardiff University), Prof Stan Maree (Cardiff University)

**Collaborators:** Dr Leah Band (University of Nottingham), Dr Richard Smith (John Innes Centre, Norwich)

**Host institution:** Cardiff University

**Project description:**

Whole genome duplication events have been common in the domestication of crop species. One of the consequences of increased genome size is a global increase in cell size that leads to larger harvestable organs and increased yields. Although the relationship between DNA content and cell size is very strong, we know little about why increasing genome size should increase cell volume. This project explores whether the effect of whole genome duplication on cell size can be explained purely by total DNA content or whether the copy number or expression level of a subset of genes might play a more significant role in the process. This will allow us to better understand the mechanisms that led to increased crop yields during domestication, but will also address important fundamental questions about cell size control (a major unanswered question in cell biology across all kingdoms) and suggest potential mechanisms for increasing crop yields in the future.

One of the simplest explanations for why whole genome duplication leads to larger cell sizes is that a larger genome is hypothesized to be able to support the higher protein synthesis rates needed to produce a larger cytoplasmic volume. Whole genome duplication events do not, however, always result in the increase in cell size that would be predicted by genome size alone. This suggests that certain components of the genome have a greater effect than others. We believe that cell cycle genes could play a role in this process. We will use two approaches to investigate how the expression of cell cycle genes scales during whole genome duplication and what effect this has on cell cycle progression and the size at which cell division is triggered. First we will use a collection of polyploids created from different diploid Arabidopsis ecotypes to screen for examples where cell size does and does not match total DNA content. We will use advanced microscopy techniques to identify whether there are differences in cell cycle progression in these lines and determine whether these changes correlate with transcriptomic changes in expression of cell cycle genes. Second we will actively manipulate the copy number of cell cycle genes in polyploid plants and measure the effect that this has on cell size.

The project will run alongside an interdisciplinary project that is investigating cell size in diploid plant cells and will help build a model of cell size control in plants. Full training and support will be provided in all aspects of the project.