Identifying mechanisms for cell division plane orientation in plants

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Project description:

Summary: Plant shape is a primary determinant of productivity and yield because it affects light interception and photosynthesis. As plant cells are bound by a cell wall and cannot move, shape arises as an outcome of the plane of new cell divisions, and subsequent cell growth. Flowering plant models such as Arabidopsis have complex tissue organizations that can mask cell division plane defects. There are also many genes per gene family, which can make it hard to identify mutants. For these reasons, few genetic regulators of cell division plane orientation have been discovered. In contrast to flowering plants, mosses have simple tissue organizations and there are few genes per gene family. I established a moss model to study plant cell division plane orientation [1], and recently determined that the CLAVATA receptor-like kinase sets the plane of cell divisions [2, 3]. Although mosses are distantly related to flowering plants, our findings were transferable to Arabidopsis, and we are now manipulating CLAVATA function in wheat to improve productivity [4]. Harnessing the benefits of the moss model, this project aims to discover how CLAVATA determines the plane of cell divisions in plants to affect their overall shape and productivity.

To determine how CLAVATA orients division planes in moss the project will:
1. Identify downstream targets of CLAVATA by RNAseq and bioinformatic analysis
2. Generate mutants of a candidate target and analyse mutant phenotypes
3. Analyse gene regulatory network architecture using computational approaches
4. Identify novel cell division plane regulators using a suppressor screen.

Training: By combining computational and wet lab approaches, the project will provide training at the cutting edge of the plant development field. It will benefit from further formal teaching and internships included in the SWBioDTP programme. The skills and techniques the student will learn will be broadly applicable in the academic biology and biotech sectors and widely transferable amongst areas such as science policy, publishing and computing.

Reading: [1] Harrison et al. 2009. Local cues and asymmetric cell divisions underpin body plan transitions in the moss Physcomitrella patens. Current Biology 19: 1-11. [2] Whitewoods et al. 2018. CLAVATA was a genetic novelty for the morphological innovation of 3D growth in land plants. Current Biology 28: 2365-2376. [3] Bergmann 2018. Taking development to three dimensions. Developmental Cell 17: 678-679. [4] Fletcher 2018. The CLV-WUS stem cell signaling pathway: a roadmap to crop yield optimization. Plants 7: 87.