The control of light-induced stomatal opening

Supervisory team:
Main supervisor: Prof Alistair Hetherington (University of Bristol)
Second supervisor: Prof John Harwood (Cardiff University)
Prof Keith Edwards (University of Bristol), Dr Tom Batstone (University of Bristol), Dr Simon Scofield (Cardiff University)

Collaborators: Prof Ian Graham FRS (University of York)

Host institution: University of Bristol

Project description:
The control of light-induced stomatal opening. Background. Stomata are valve-like structures on the leaf surface that control transpirational water loss and the uptake of carbon dioxide for photosynthesis. They open and close in response to signals from the environment and their function impacts directly on key agronomic parameters such as water use efficiency (WUE), and nutrient accumulation.

We recently discovered that guard cells contain triacylglycerol (TAG)-containing lipid droplets (LDs). During light-induced stomatal opening the TAGs are broken down to yield fatty acids, which are subsequently metabolised to generate the ATP required to support stomatal opening (McLachlan et al 2016 Current Biology 26, 707-712). Our discovery represents a completely new and unsuspected source of ATP required to support stomatal movement and provides a new opportunity for improving crop WUE.

Research Objectives:
1. Understand how environmental signals regulate TAG biosynthesis and accumulation.
2. Manipulate TAG metabolism genes in Arabidopsis and wheat to investigate whether WUE is improved.

Training and Experimental Programme. The student will test whether genetic manipulation of TAG biosynthesis genes impacts positively on Arabidopsis and wheat WUE. RNAseq data from TAG metabolism mutants will be used to identify putative regulators of TAG metabolism. This will be complemented by analytical flux control analysis pioneered by Harwood to investigate lipid biosynthesis. Putative regulatory genes will be tested in Arabidopsis. To move the discoveries into wheat the Edward’s lab development of CRISPR-cas9 technology will be employed with the focus on genes controlling TAG breakdown. WUE and stomatal behaviour will be characterised in the transgenic wheat lines. The student will receive training in plant physiology, lipid analysis and metabolism, CRISPR Cas-9 technology and bioinformatic analysis.

Supervisory team. The training will be provided by a multi-disciplinary supervisory team. Hetherington (Bristol) is an expert in guard cell signalling, Harwood (Cardiff) has an international reputation in lipid metabolism, Edwards (Bristol) is an expert in wheat genomics, Scofield (Cardiff) is an expert in molecular regulation of plant development and Batstone (Bristol) is an expert in bioinformatics. Accordingly, the studentship is highly multidisciplinary. Environment. The student will have the
opportunity of working in well-supported and vibrant labs at the University of Bristol and Cardiff University.