Global climate change is resulting in changing weather patterns – it is predicted that we will get warmer wetter winters and hotter drier summers. At the same time, there will be an increase in the frequency of extreme weather, including periods of droughts and heat waves, but also more storms and floods. This, combined with growing demand for food across the world, means that agriculture is facing unprecedented challenges. The crops used by farmers will have to change. We will need plants that produce greater yields whilst being able to survive extreme weather conditions.

A common feature of most forms of abiotic stress is the production of reactive oxygen species (ROS) – highly reactive molecules that can damage proteins, lipids and DNA. The main source of ROS in stressed plants is photosynthesis, where electrons from photosystems may be diverted to interact with molecular oxygen. To prevent such damages there are a number of enzymatic processes in chloroplast to scavenge ROS. Unfortunately they are highly energetically demanding, requiring the synthesis of high concentrations of the low-molecular weight antioxidants and antioxidant enzymes. An alternative strategy, placing less of a metabolic burden on plants, would be to avoid the production of ROS. This could be potentially achieved by regulation of the photosynthetic electron transport.

We provided evidence in model plant *Eutrema salsugineum*, a close stress-tolerant relative of *Arabidopsis thaliana*, that a protein termed the Plastid Terminal Oxidase (PTOX), acts as an alternative sink for the photosynthetic electron transport under stress conditions, protecting plants from an enhanced generation of the reactive oxygen species and photooxidative damage. This pathway, however, is not widely observed in other plant species. Recently, we successfully produced transgenic plants overexpressing PTOX from Eutrema. We were the first group to show evidence that activation of the protein required its translocation from stroma lamellae to the grana stacks. These findings made it clear that overexpression of PTOX activity, rather than just the protein, is a promising approach with the potential to confer increased stress tolerance on crop species.

The aim of this project is to investigate in detail the role and functioning of the plastid terminal oxidase and in particular the factors that allow it to translocate within chloroplast and to act as a safety valve for the photosynthetic electron transport. Additionally, we will investigate whether the complete PTOX activity can be successfully genetically transferred into another species and whether this has the potential to increase stress tolerance.

The need to ensure on-going food security in the face of changing climates is widely recognised as a major concern and is prominent amongst the recently defined European and global priorities. A better understanding of how photosynthesis is regulated in response to stress will therefore be essential in meeting future demands for stress tolerant crops. With this project we are ideally placed to make a direct and significant contribution towards meeting those priorities, producing plants with enhanced PTOX activity as a means to increase stress tolerance.