# FoodBioSystems DTP - PhD Project Advertisement

**Project title:**

FBS2021-32-Bishop: Addressing the challenge of combined heat and drought stress for cereal production

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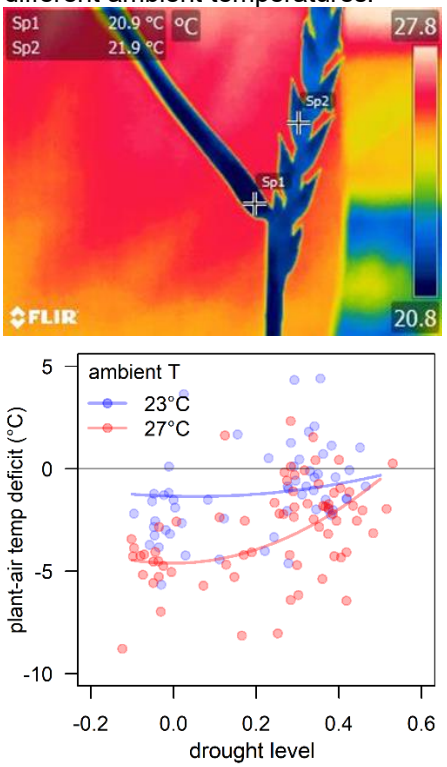
## Project description:

We are looking to recruit a new PhD student to help us discover novel chemical compounds that could reduce the impacts of drought stress and improve crop water use efficiency. Drought currently restricts global cereal production by approximately 10% and this situation is projected to worsen with climate change[1]. Researchers have recently identified chemical compounds that can reduce the impacts of drought by modifying plant physiology[2]. These compounds, typically anti-transpirants, encourage stomatal closure which reduces water loss from plant leaves and increases the efficiency of water use – enabling "more crop per drop". Our industry partner, Syngenta, a leading science-based agricultural technology company with more than 28,000 employees in over 90 countries, wants to advance this research by screening c. 200 candidate compounds.

**Fig 1:** Results and an infra-red image from our pilot work in wheat. The plot shows the difference between leaf and air temperature in response to soil moisture loss at different ambient temperatures.




A downside of existing 'drought avoidance by stomatal closure' approaches is that drought often co-occurs with heat waves[3]. Plants with enough water can normally keep themselves cool; they release water when air temperature is above optimal, the water evaporates, and plant internal temperature is reduced below ambient (Fig. 1, left side of curves). Plants without adequate water, or plants with disrupted stomatal functioning, cannot cool themselves, with negative consequences for yield (Fig. 1, right side, also see [4]). In our rapidly warming world, crop producers cannot rely on stomatal closure or other drought tolerance mechanisms that sacrifice cooling ability. We need to find new solutions.

Our proposed project therefore has two main objectives: in broad terms we want to increase understanding, and eventually predict, the effects of combined drought and high temperature on crop yield. Second, we want to use this biological understanding to identify novel compounds with novel modes of action that confer drought tolerance while avoiding increased susceptibility to heat stress.

**How will you address the challenge of combined heat and drought stress?**

You will apply a method that we have developed for quantifying effects of heat and drought separately and in combination (Fig. 1). The experimental work will focus on maize and wheat. First, you will

withhold water from your experimental plants for different durations, allowing the soil to dry to specific moisture levels. Then you will expose the plants to a range of temperature regimes in controlled environment chambers and apply different chemical compounds to the plants. You will take measurements to understand the effect of different compounds on plant stress tolerance. You will measure how the plants respond using three key variables: plant growth rate via multispectral 3D scans to provide detailed insights into effects of stress and the different compounds on development; transpiration rate to understand effects of compounds on stomatal closure; and leaf temperature (particularly the temperature difference between plants and the surrounding air) to quantify stress.

You will conduct most of your work on plants at seedling stage. The short timescales involved will allow multiple trials and rapid screening across Syngenta's large number of candidate compounds. Once we have identified promising compounds, you will conduct trials on plants during reproductive development, which represents a realistic use case of the compounds in the field and brings us closer to real-world use on the farm. With the combined expertise across the supervisory team you can then gain an understanding of compound mode of action, for instance by quantifying changes in root and shoot growth ratio and gene expression, water use efficiency through isotope discrimination, the impacts on hormone concentrations and more.

### Training opportunities:

This project offers you the opportunity to equip yourself for an onward career in scientific research in a university or industry setting. The experimental work will develop your skills in a wide range of highly desirable areas where funders have identified UK and international skill deficits. You will work closely with the industry partner, conducting research with real-world impact. You will take advantage of advanced plant phenotyping infrastructure and controlled environment facilities at Aberystwyth, Reading and Syngenta, and receive guidance from a team of supervisors with diverse expertise.

### Student profile:

This project would be suitable for students with a first-class degree and/or masters in biology or a closely related subject. Previous experience in plant physiology and practical experimentation on plants is desirable.

### Funding particulars:

This project is supported with CASE funding from Syngenta which increases the research budget and the student stipend (by £1600 per year). In addition, Syngenta will host you for a placement at a Syngenta Research site (there are sites a short journey within Berkshire and further afield in Switzerland) for up to 3 months to enable industry-exposure (accommodation and travel covered).

### References:

1 doi.org/10.1038/nature16467
2 doi.org/10.1126/science.aaw8848
3 doi.org/10.1038/srep00066
4 doi.org/10.1111/jac.12038

**Funding Note**

This project is part of the FoodBioSystems BBSRC Doctoral Training Partnership (DTP), it will be funded subject to a competition to identify the strongest applicants.
The studentship is open to UK and international students (including EU countries) however due to funding rules, no more than 30% of the projects can be allocated to international students.
The funding will include a tax free stipend (minimum £15, 285 per year), support for tuition fees at the standard UK rate (currently £4,407 per year) and a contribution towards research costs. **Please note** that the host universities have not yet confirmed the level of fees charged to international students funded by the DTP. Fee levels may vary across the institutions. This information will be shared on the FoodBioSystems DTP website as soon as it becomes available.

**To apply**

Please go to FoodBioSystems DTP website for information on how to apply for this studentship. The closing date for applications will be 8 February 2021.