FoodBioSystems DTP - PhD Project Advertisement Text

Project Title: FOODBIOSYSTEMS - 100 years of plant breeding – what have we done to the seed microbiome?

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Research Group: FOODBIOSYSTEMS BBSRC DTP
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Project Description: Humans have domesticated plants for millennia, with cereals first domesticated in the Fertile Crescent of the Middle East around 9000 BCE. The plant has traditionally been considered as a single entity, with selection based on phenotype resulting in modification of the plant genome, and more latterly, understanding of the genome being used to accelerate selection of key phenotypes. However, with the advent of next generation sequencing technology, there has been greater appreciation of the role of the plant microbiome and its metagenome in plant performance. Seed biobanks are critically important for preserving plant diversity which may be lost in the wild due to habitat loss and the changing environment, but we know nothing about the effect of long-term storage on the microbiome. **We will test the hypothesis that domestication, breeding and storage alter the composition of the plant microbiome, with impacts on plant performance in terms of yield, resilience and quality.** The seed microbiome is the ideal target for this study as this represents the community recruited by the plant and potentially adapted to endophytic existence.

We will analyse the bacterial microbiomes of 3 crops with contrasting histories and agricultural uses:

- *Avena sativa* (**oats**)**:** domesticated as a grain crop for human food during the first millennium BC.
- ***Lolium** perenne*: a forage grass for livestock (meat and milk) production that has been bred for ~100 years.
- **Miscanthus**: a tall grass recently selected from the wild as a feedstock for bioenergy and industrial products, as well as nutraceuticals (e.g. prebiotics and sweeteners) and represents a novel domestication in progress.

The seed biobank at AU holds collections, including wild relatives and breeding lines, of all three species, going back approximately 40 years, 100 years, and 15 years respectively.

We are increasingly placing value on seed biobanks to preserve diversity, including for genetic material from which to breed for future climate scenarios. To date there have been no studies on the effect of long-term storage on the microbiome of the stored seeds, despite an increasing body of evidence for the microbiome providing a range of benefits to the plant in terms of performance and resilience to various stresses. Furthermore, very little is known about the impact of domestication and breeding on the plant microbiome and its functionality within the plant. In this project we will use the resources available in the 100 year old

collections at Aberystwyth to provide novel evidence on:

1. The impact of storage on the germination and viability of oat, Lolium and Miscanthus seed.
2. The impact of domestication, breeding and storage on the composition of the plant microbiome: have we selected for the best, or lost functionality due to modern agronomic practices?
3. The impact of diversity loss within the microbiome, and re-application of specific strains, on plant performance in terms of yield, resilience and quality.

The information generated by this project will enable targeted selection of seed for collection/application based on the microbiome (metagenome) as well as the genetic and phenotypic diversity of the plant. It will address the fundamental question of how humans have modified the plant microbiome through selection, and hence how we might optimise it in future, either via application such as biofertilisers or though novel breeding targets. And finally it will provide information on the effect of storage, and hence how we might optimise the preservation of the plant microbiome as well as the plant genome within long-term storage for use by breeders and future generations.

Funding Notes: 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. Due to restrictions on the funding, this studentship is only open to UK students and EU students who have lived in the UK for the past three years.

The FoodBioSystems DTP is a collaboration between the University of Reading, Cranfield University, Queen's University Belfast, Aberystwyth University, Surrey University and Brunel University London. Our vision is to develop the next generation of highly skilled UK Agri-Food bioscientists with expertise spanning the entire food value chain. We have over 60 Associate and Affiliate partners. To find out more about us and the training programme we offer all our postgraduate researchers please visit https://research.reading.ac.uk/foodbiosystems/.

Training opportunities: The student will join an interdisciplinary team, with excellent facilities and strong links to industry. They will attend AU and DTP accredited modules in Y1&2 and benefit from regular placements at UoR.

Practical training and support e.g. on experimental design and execution, good laboratory practice, seed selection, bacterial culturing, DNA extraction and library preparation, statistics and modelling will be provided primarily by the supervisory team. Sequencing and informatics support will be provided by Dr Matthew Hegarty and Dr Martin Swain (AU) and plant experiments will be supported by the National Plant Phenomics Centre. The student will be encouraged to explore different directions to take the project according to their data and interests.

Additional training opportunities will include participating in the SysMic online training in maths and computing for the bioscience community, and a Professional Internship for PhD students provided by AberInnovations.

Student profile: Applicants should hold, or expect to obtain, a first or upper-second class honours degree, or a Masters degree (or equivalent) in Plant Science, Microbiology or related subjects. Applicants with practical experience in microbiology, plant biology, bacterial bioinformatics and statistics are particularly welcome. An interest in plant-microbe interactions and an understanding of the challenges facing the Agri-Food sector are desirable, as are experience of presenting and publishing.

AU is a Bilingual Institution which complies with the Welsh Language Standards and is committed to Equal Opportunities. Students are welcome to apply in Welsh or English and any application submitted will be treated equally.

References:

Cope-Selby N, Cookson A, Squance M, Donnison I, Flavell R and **Farrar K.** Endophytic bacteria in Miscanthus seed: implications for germination, vertical inheritance of endophytes, plant evolution and breeding. *GCB Bioenergy* 9.1 (2017): 57-77.
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