PhD Project Advertisement

Project No/title: FBS2026 18 Doonan ar / *Bean_AI for breeding better beans*
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Co-supervisors:
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Project Details

Faba beans are nutritional powerhouses: high in protein, climate-resilient and well suited to UK agriculture. As nitrogen-fixing legumes, they reduce fertiliser use and support more sustainable cropping systems. With growing demand for plant-based foods, faba beans offer a promising alternative to meat and dairy in Western diets.

To realise this potential, we need a deeper understanding of the seeds themselves. Key traits — including physical structure and nutritional composition — determine their value for food, feed and processing, yet many remain poorly characterised. For example, the outer seedcoat, which protects against environmental stress and predation, can hinder processing and consumer acceptability; optimising both roles requires understanding the genetic basis of this variation.

We have already developed a diverse, genome-sequenced bean panel at Reading (Jayakodi et al., 2023). In this project, you will use advanced imaging and AI to explore seed structure and composition, helping reveal the biological and genetic foundations of seed quality.

Research aims: How does variation in seed architecture affect processing and nutritional properties? Can we identify genetic markers associated with this variation that would be useful in breeding a better bean?

What you will do: You will use:

- microCT scanning to visualise internal structures in 3D
- Hyperspectral and multispectral imaging to capture biochemical signatures
- Machine learning and AI to detect patterns and predict traits
- Genomics and bioinformatics to link seed structure to genetic variation

References:

1. Hughes, A., Askew, K., Scotson, C.P. et al. Non-destructive, high-content analysis of wheat grain traits using X-ray micro computed tomography. Plant Methods 13, 76 (2017). https://doi.org/10.1186/s13007-017-0229-8
2. Ying Zhou, Xiaoliang Wang, Yaping Shi, Haiyang Ding, Yanbo Hui, Ju Gao, Luyao Bai, Qiao Wang, 3D reconstruction and morphological characterisation of single wheat grains by X-ray μCT, International Journal of Food Science and Technology, Volume 59, Issue 12, December 2024, Pages 9131–9146, https://doi.org/10.1111/ijfs.17500.
3. https://www.reading.ac.uk/news/2023/Research-News/Bean-genome-sequenced-for-improved-nutrition?
4. Google Scholar link for Doonan Lab: https://scholar.google.com/citations?user=6KcPHw8AAAAJ&hl=en
5. Google Scholar link for O'Sullivan Lab: https://scholar.google.com/citations?hl=en&user=ow2rxK8AAAAJ&view_op=list_works&sortby=pubdate
6. Google Scholar link for Howarth Lab: https://scholar.google.com/citations?hl=en&user=j52cU1UAAAAJ&view_op=list_works&sortby=pubdate
7. Google Scholar link for Lu Lab: https://scholar.google.com/citations?hl=en&user=tvY6seQAAAAJ&view_op=list_works&sortby=pubdate National Plant
8. Phenomics Centre Website: https://www.plant-phenomics.ac.uk/

Student profile
Essential for project: 1. 2.1 Honours degree in a relevant subject area related to biological sciences, maths, computer science or agriculture, with an interest in working across disciplines. Other applications may be considered if they have significant relevant outputs/experience
Desirable for project: Prior experience in the seed or food industries; interest or experience in photography/imaging/imaging technologies; experience in practical experimental work
Minimum requirements for all FoodBioSystems applicants: An upper 2nd class degree (or equivalent) in a subject relevant to the project. Candidates with a lower class of Bachelors degree, but merit or above at Masters level will also be considered. Demonstrable skills in problem-solving, team-working, communication and time management.

Training
Project specific training opportunities: Training in state of the art imaging, Advanced coding including building and evaluating your own versions of emerging AI approaches to CT scanning; biodiversity and genomics; seed developmental biology.

FoodBioSystems training opportunities: Throughout their studentship, all FoodBioSystems doctoral researchers participate in cohort training that covers four key themes: food systems, big data (data analytics and modelling), business, and research fundamentals. All doctoral researchers complete a placement: either project-related with a non-academic (CASE) partner, or unrelated to the project and outside the academic environment (PIPS). Details of training are available on the DTP website: https://research.reading.ac.uk/foodbiosystems/training/.

Project supervision style
The student will be supported by a structured supervision plan involving regular contact with the full supervisory team. The lead supervisor (Prof. Doonan) will meet the student weekly for 1:1 meetings to review progress, troubleshoot issues, and plan upcoming work. Monthly meetings will be held with the full supervisory team (including Prof O'Sullivan, Dr Lu and Dr Howarth), alternating between in-person and virtual formats to ensure cross-institutional engagement. The student will also participate in lab group meetings and data-focused hackathons, providing additional peer support and opportunities for feedback. Written work (e.g. reports, thesis chapters) will receive feedback within two weeks of submission. The student will maintain a shared project log and timeline to support transparent planning and progress tracking. The supervisory team will review progress formally at 6-month intervals, aligned with DTP milestones.

Stipend (Salary)
FoodBioSystems DTP students receive an annual tax-free stipend (salary) that is paid in instalments throughout the year. For 2025/26 this is £20,780 and it will increase slightly each year at rate set by UKRI.

Equity Diversity and Inclusion
The FoodBioSystems DTP is committed to equity, diversity and inclusion (EDI), to building a doctoral researcher (DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the FoodBioSystems DTP website and include:

- Offering reasonable adjustments at interview for shortlisted candidates who have disclosed a disability or specific learning difference.
- Guaranteed interview and applicant mentoring schemes for applicants, with UK home fees status, from eligible under-represented ethnic groups who also meet academic eligibility criteria and the student profile essential for the project.

These are opt-in processes.

Our studentships can be offered to home students on a part-time basis, and studentship end date and stipend payments will be amended to reflect the part-time registration. The minimum registration for DTP funded part-time students is 0.5 FTE (studying an average of 20 hours per week over 8 years). We regret that part time registration is not available to international students due to complexities of visa restrictions.