PhD Project Advertisement

Project title: ***A receptor-ligand module with practical applications to improve food production***
Project No: FBS25-45-Stephens-ra

Lead supervisor: Professor Gary Stephens, SCFP (Pharmacy), University of Reading

Email: g.j.stephens@reading.ac.uk

Co-supervisors:
Dr Maurice Bosch, IBERS, Aberystwyth University
Dr Andrew Quigley, Membrane Protein Laboratory (MPL), Diamond Light Source and Research Complex at Harwell

Project description: This fully funded 4-year project will take a multi-disciplinary approach to unlock the secrets of plant reproduction in order to produce better crops. The ability of plants to reproduce and produce seeds is vital for food production and global food security. Many flowering plants have evolved a natural mechanism called self-incompatibility (SI), which prevents self-fertilization. SI encourages cross-pollination, helping plants maintain genetic diversity, adapt to changing environments, and grow stronger.

The common poppy (*Papaver rhoeas*) has one of the best-studied SI systems. This system relies on two key proteins: PrpS, which acts as a receptor in the pollen, and PrsS, a protein released by the pistil (the female part of the flower). PrpS-PrsS interaction triggers a process that stops pollen growth by causing 'self-destruction'. This process its vital to ensure that the plant is only fertilized by pollen from other plants, leading to healthier seeds.

Researchers have already transferred this poppy SI system into other plants to improve agriculture. If SI could be introduced into crops like wheat or rice, it could make hybrid crops easier to produce. Hybrids are important because they are more productive, more resilient to stress, and better able to cope with pests and diseases. However, researchers still don't fully understand how PrpS works, especially how it interacts with PrsS and what role it plays in the SI process.

Your role:

As part of this PhD project, you will uncover the secrets of PrpS and its role in self-incompatibility. You will gain experience in an exciting range of cutting-edge techniques as part of a team using structural biology, electrophysiology and molecular biology at a number of collaborating research institutes:

1. Explore PrpS's Structure (Diamond Light Source, Oxford with Dr Andrew Quigley):
   You will use advanced tools including X-ray crystallography and cryo-electron microscopy to map the detailed structure of PrpS.

2. Test PrpS's Role as a Calcium Channel (University of Reading with Professor Gary Stephens):
   You will use protein biochemistry and electrophysiology to investigate whether PrpS allows calcium ions to flow into cell - a key step in the SI signalling pathway.

3. Study Interaction Dynamics (Aberystwyth University with Dr Maurice Bosch):
   By creating modified versions of PrpS, you'll examine how different parts of the protein affect its ability to interact with PrsS and initiate SI.

Your work will deepen our understanding of plant reproduction and will contribute to developing more sustainable and efficient crop-breeding.

Training opportunities: This fully-funded PhD studentship offers a rich and varied training program in cutting-edge techniques and interdisciplinary approaches:

- Structural biology: You will work with Andrew Quigley at the international renowned Diamond Light Source facility, learning techniques like X-ray crystallography, cryo-electron microscopy, and size exclusion chromatography-small angle X-ray scattering (SEC-SAXS) to study PrpS.

- Electrophysiology: Under supervision of Gary Stephens at Reading, you will gain expertise in patch-clamp techniques to explore PrpS's potential role as a calcium channel. You will also attend selected undergraduate neuroscience lab sessions to build a deeper understanding of ion channel function.

- Mutagenesis and cell biology: At Aberystwyth, you will work with Maurice Bosch, creating and testing modified PrpS proteins to study their role in SI signalling. This will include a 3–6 month placement focusing on reproductive biology techniques.

This interdisciplinary project provides an excellent foundation for careers in bioscience and agricultural innovation.

Project supervision style: Regular and structured meetings will ensure comprehensive support for the student throughout their research project, primarily based at Reading. The lead supervisor, Gary Stephens, will meet with the student weekly for 1:1 sessions to discuss progress, address challenges, and provide feedback on ongoing research activities. During periods when the student spends most of their time at Diamond, Andrew Quigley will assume weekly supervision to ensure continuity and focused guidance on structural analysis work. Bi-weekly lab group meetings will involve the entire supervisory team, including Maurice Bosch, fostering collaborative discussions on project developments and interdisciplinary insights. Feedback on submitted work will be provided within a maximum of one week, ensuring timely guidance for the student. Additionally, quarterly reviews will assess progress against project milestones and objectives, facilitating adjustments to the research plan as necessary. This structured approach aims to create a supportive environment conducive to the student's academic and professional development.

Student profile: This is a plant science focused project, however, the cell biology techniques to be applied to determine the structure and function of the PrpS protein are equally applicable to applicants with undergraduate and/or Masters level skills in biomedical, pharmacology and related subjects.

Stipend (Salary):
FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2024/25 this is £19,237) 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.

These are opt-in processes**.**

Our studentships are offered on a part time basis in addition to full time registration. The minimum registration is 50% FT and the studentship end date will be extended to reflect the part-time registration.

The closing date is 3 February 2025 (10.00 GMT). Please visit the FoodBioSystems website to access the 2025 cohort applicant guidance document; and for up to-date information on how to apply, eligibility, studentship rates, and part time registration.