PhD Project Advertisement

Project No/title: FBS2026 72 Stephens ra / *How Plants Prevent Self-Fertilisation: Unlocking Pathways to Better Crops*

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

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

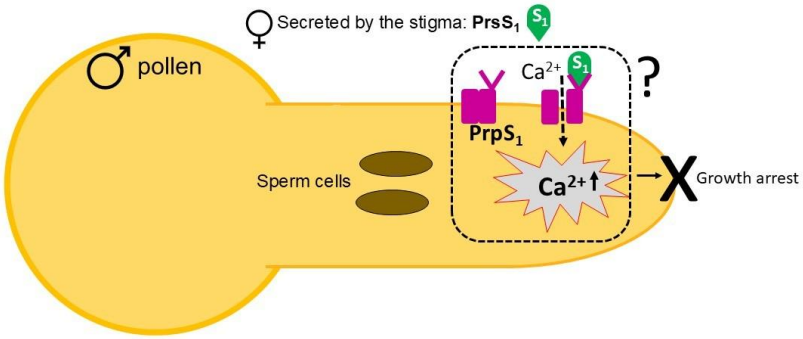
Co-supervisors:

Dr Maurice Bosch, Aberystwyth University

Dr Andrew Quigley, Diamond Light Source and Research Complex at Harwell

Project Details

Plants rely on successful reproduction to produce the seeds that underpin much of the global food supplies. Many plants use a natural system called self-incompatibility, which prevents self-fertilization and helps maintain genetic diversity. One of the best-understood self-incompatibility systems is found in poppy (*Papaver rhoeas*). It depends on two proteins: a receptor called PrpS present in the pollen, and a ligand called PrsS secreted by the stigma. When the ligand binds to the receptor, a signal is generated that leads to pollen tube growth arrest, thus preventing fertilisation. Remarkably, this poppy self-incompatibility system can also function in other plant species, offering promising opportunities for developing hybrid crops that are higher yielding and more resilient. However, we still do not understand how the PrpS receptor works at the molecular level or how environmental factors, such as temperature, influence self-incompatibility. This project will address these knowledge gaps.



Research aims: Using a combination of structural biology, electrophysiology, biochemistry and plant cell biology, this multidisciplinary project aims to uncover how the PrpS receptor works, how it interacts with its ligand PrsS, and how temperature affects the SI response.

What you will do: The student will be based at the University of Reading, working closely with partners at Diamond Light Source and Aberystwyth University.

- At Reading, under the supervision of Gary Stephens, the student will investigate how the PrpS receptor protein functions, using protein biochemistry and electrophysiology to test whether PrpS acts as an ion channel that allows calcium entry and triggers the self-incompatibility response.
- At Diamond Light Source, supervised by Andrew Quigley, the student will spend time in the Membrane Protein Laboratory to explore the structural basis for PrpS function using advanced tools including X-ray crystallography and single-partial cryo-electron microscopy.
- At Aberystwyth, supervised by Maurice Bosch, the student will investigate how temperature affects self-incompatibility. This work will include live-cell imaging, and measuring cellular signals, including calcium, pH, and reactive oxygen species.

Together, these activities will build a detailed picture of how the self-incompatibility system operates and how environmental conditions influence it.

References:

1. Goring DR, Bosch M, Franklin-Tong VE. Contrasting self-recognition rejection systems for self-incompatibility in Brassica and Papaver. Current Biology. 2023; 33(11):R530-42, (https://doi.org/10.1016/j.cub.2023.03.037).

2. Lin Z, Eaves DJ, Sanchez-Moran E, Franklin FC, Franklin-Tong VE. The Papaver rhoeas S determinants confer self-incompatibility to Arabidopsis thaliana in planta. Science. 2015; 350(6261):684-7, (https://doi.org/10.1126/science.aad2983).
3. Wang L, Lin Z, Carli J, Gladala-Kostarz A, Davies JM, Franklin-Tong VE, Bosch M. ATP depletion plays a pivotal role in self-incompatibility, revealing a link between cellular energy status, cytosolic acidification and actin remodelling in pollen tubes. New Phytologist. 2022; 236(5):1691-707, (https://doi.org/10.1111/nph.18350).

Student profile

Essential for project: A background in one or more of the following: plant science, molecular or cell biology, biochemistry, physiology, pharmacology, structural biology, or a related field that offers experience with biological systems.

Desirable for project: Experience with laboratory techniques such as cloning, protein expression, electrophysiology, or plant handling is desirable but not required. Comprehensive training is available to support candidates new to these methods.

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: This PhD offers broad, unique hands-on training across structural biology, electrophysiology, biochemistry and plant cell biology. At Reading, the student will gain skills in electrophysiology, including patch-clamp methods widely used as a gold standard methodology to study ion channels. Regular visits to Diamond will support structural work and the student will have the opportunity for a 3-6 month placement at Aberystwyth to study the impact of heat stress on self-incompatibility. At Aberystwyth University, the student will be trained in plant biology techniques. Training and support are available for candidates new to any of the techniques involved. This interdisciplinary experience will equip the student with versatile skills suited to careers across academia, industry, and the wider life sciences sector.

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

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.

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.

Funding note

We welcome applications from candidates with Home/ROI fees and international fees status. This studentship is funded by UKRI and covers stipend, fees at Home/ROI rate, and research costs.

Costs that must be found from other sources or met by the individual student include:

The difference between international and Home/ROI fees at University of Reading, visa fees, healthcare surcharge, relocation costs and guarantor services.

Information about fees is available at https://www.reading.ac.uk/doctoral-researcher-college/funding/fees/fees-new-students.

For up to date information on funding eligibility, studentship rates and part-time registration, please visit the FoodBioSystems website.