Project 2_2 Optimising Seed Dormancy Traits for Protected Cropping Systems

PC Hub Theme (see list here)
Theme 2: Plant Breeding – Rapid Candidate Gene Identification, Validation and Engineering
Principal supervisors
Prof. Mathew Lewsey
Co-supervisor
Dr Bhavna Hurgobin

Seeds allow plants to suspend their offspring in time so that the offspring can wait to grow until environmental conditions are favourable. To achieve this, seeds can remain inactive whilst simultaneously monitoring their surrounding environment. They then rapidly initiate a germination program to commence growth when appropriate environmental conditions are perceived. Initiating germination requires a seed's genome to be reactivated, so that genes essential for growth and cellular function can be expressed. The molecular mechanisms underlying genome reactivation are unknown.

Seeds contain an inactive embryo, which is the offspring of the parent plant. Germination will commence, and the embryo will begin to grow into a seedling, when environmental conditions are favourable. However, seeds of many species exhibit dormancy, an adaptive trait whereby the seeds do not germinate despite favourable conditions. This is a strategy that enables seeds to wait to germinate until conditions may be most optimal (e.g. post bushfire), to bet-hedge against climate variability by accumulating seeds in the soil for subsequent seasons, or to disperse long-distance before germinating.

Protected cropping systems most frequently start with large amounts of seed of the desired crop species (eg, herbs, tomatoes, leafy greens). Inappropriate dormancy properties in these seeds can have significant impacts on the performance of protected cropping systems, such as variable establishment and flowering time. It is consequently desirable to have seeds with tightly defined and controllable dormancy properties.

This project aims to define and manipulate dormancy mechanisms in tomato, a valued protected cropping species. The project will use single-cell and spatial transcriptomic technologies to **pinpoint the cell-types responsible for dormancy initiation and release**. These experiments will be informed by parallel studies of Arabidopsis. Synthetic biology approaches will be used to modify the properties of cell-types that regulate dormancy, to optimise the species for protected cropping, and findings will be applied to breeding approaches aimed at improving dormancy properties.

The PhD candidate will:

- Conduct experiments to define cell-types influencing dormancy properties in tomato and Arabidopsis, using single-cell and spatial transcriptomic methodologies.
- Analyse and integrate single-cell data derived from multiple sources.
- Validate the findings of computational analyses using methods such as RNA in situ hybridization, virus-induced gene silencing and imaging mass spectrometry.
- Perform molecular construct design and assembly following synthetic biology principles, then generate stable transformant plants expressing these constructs.

Further reading

Lewsey, M.G., Bassel, G., & Whelan, J. Dynamic and spatial control of cellular activity during seed germination. *Current Opinion in Plant Biology* (2025). https://doi.org/10.1016/j.pbi.2025.102754

Liew, L.C., You, Y., Auroux, L. *et al.* Establishment of single-cell transcriptional states during seed germination. *Nature Plants* (2024). https://doi.org/10.1038/s41477-024-01771-3

Peirats-Llobet, M., Yi, C., Liew, L.C., Berkowitz, O., Narsai, R., Lewsey, M.G., Whelan, J. Spatially resolved transcriptomic analysis of the germinating barley grain, *Nucleic Acids Research* (2023). https://doi.org/10.1093/nar/gkad521

How to apply

The PC Hub offers a limited number of competitive scholarships.
To apply, please email the following documents to pchub@latrobe.edu.au by **15 February 2026:**

- Application form completed.
- Up-to-date CV
- University transcripts

Only shortlisted applicants will be contacted.