

Roles of proteins in root exudates in root-soil interactions in monocots (wheat) and dicots (Arabidopsis)

Supervisory team:

Rothamsted supervisor: Dr Richard Whalley (Rothamsted Research)

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Collaborators: Prof Sacha Mooney (University of Nottingham)

Host institution: Rothamsted Research

CASE Partner: LettUs Grow

Project description:

Global food security depends on reducing human impacts on water and arable soil availability. Understanding how plants interact with their environments and what traits enhance these interactions could aid development of crop varieties with increased yields and resource efficiency. Plants that require less water and reduce soil erosion in drier or wetter conditions are promising candidates for future crops that can resist several of the challenges of climate change.

Understanding how secreted compounds called exudates affect plant growth could improve crop choice and cultivation practices. Investigating molecular and cellular mechanisms that regulate exudate synthesis and deposition can describe how they contribute to plant root health, plant communities, and plant-environment interactions. This project applies information about exudates from Arabidopsis to wheat to discover how well conserved exudate composition and function are between dicots and monocots. Knowing how exudates affect plant growth and soil stability could enhance crop development and food security.

The Project: You will use proteomics datasets to confirm existing candidates and identify new wheat orthologs of Arabidopsis exudates. Using the genetic tools in Arabidopsis, you will verify root-adhesion phenotypes in the mutants of these candidates and compare the phenotypes of transgenic Arabidopsis and wheat lines. You will develop screens for exudate variance in wheat germplasm and test how wheat exudate composition or deposition affect root-soil interactions. You will learn to use bioinformatics, genetics, molecular/cell biology, microscopy, and soil science to evaluate the mechanisms of gene expression and protein function between dicot and monocot plant root exudates that affect root-soil cohesion and plant growth.

At Rothamsted, you will have access to cutting-edge agricultural research facilities to dovetail Arabidopsis-based lab techniques used in the Grierson lab with crop science. Rothamsted houses a diverse science community that will provide training in a dynamic research environment. The CASE partnership with LettUs Grow provides access to new tools for evaluating root biology and exudate collection in Arabidopsis and wheat seedlings. You will also participate in a placement at LettUs Grow to learn about vertical farming and growth system development with an up-and-coming industrial leader. The collaboration with the Mooney lab at Nottingham will evaluate root-soil interactions in Arabidopsis and wheat mutants using X-ray Computed Tomography.

The outcome of this project will have potential implications in the translation of basic plant biology to agricultural advancement, as well as broad applications in sustainable farming and land management.