

Functional Analysis of Pollen Expressed Ligand-like Peptides during Plant Reproduction

Supervisory team:

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Host institution: Cardiff University

Project description:

Seed set in flowering plants results from successful species-specific communication events between pollen and pistil. Only pollen from the same species will be accepted and develop a growing pollen tube to deliver sperm cells to the ovary, where ovules are waiting to be fertilised. All 'foreign' pollen however will be rejected, either immediately upon pollination or during pollen tube growth. Signals to reject or promote fertilisation can be brought in by the landing pollen and/or those provided by the female pistil tissues. How pollen, pollen tubes and pistils perceive these signals and translate them into species-specific growth promoting responses or arrests is currently largely unknown. Small signalling peptides are involved in different aspects of plant reproductive development, pollen-stigma compatibility and in self-incompatibility (SI). We are specifically interested in the function of a group of Papaver rhoeas S-protein homologs (SPHs) found in Arabidopsis thaliana, that are being expressed in mature pollen and during pollen tube growth. Given the SPH amino acid sequence variability across the many different flowering plant species, we hypothesize that pollen-expressed SPH proteins are important compatibility factors that contribute to pollen-pistil recognition between different flowering plant species.

This exciting PhD project involves the study of SPH protein function during pollen-pistil interactions, i.e. their communication after pollen landing as well as during pollen tube growth. The student will focus on a selection of reproduction SPH genes, i.e., those showing an exclusive expression in mature pollen. The student will analyse pollen SPH function in Arabidopsis SPH mutant knockout lines, including pollen hydration and tube germination, using in vitro and in (semi) vivo pollen tube growth assays. In addition, pollen RNA silencing and overexpression lines with these SPHs will be generated to study the effects on pollen viability and tube growth, again both, in vitro and in vivo. (III) Due to a putative functional redundancy of the many pollen SPHs, we will also generate combinations of multiple SPH knockouts, making use of a CRISPR gene editing toolbox, developed at Cardiff School of Biosciences. The dynamics and localisation of these pollen SPH proteins will be investigated using fluorescent protein fusions in Arabidopsis. In case pollen tube growth is affected, as a complementation assay, the student will generate transgenic Arabidopsis lines expressing these 'pollen expressed' SPHs in Arabidopsis pistils, to study the effects of their pistil presence on wild type and mutant pollen and pollen tubes.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.