John Innes Centre

Year in Industry Proposal for 2027/28

Title of Project	The role of timekeeping in beneficial plant-bacteria interactions
Name of Supervisor	Professor Antony Dodd, with Dr Holly Kay
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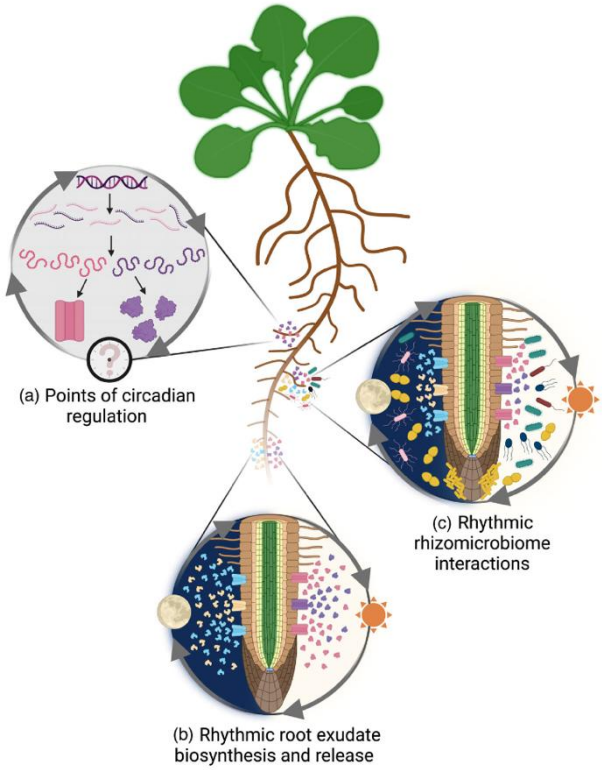
Project on Offer

Successful farming calls for an intimate relationship between crops and the soil. The astonishing thing about the soil is that it contains an incredibly high density of microorganisms that form very close associations with crops. This relationship is important for protection of crops from pathogens, the supply of nutrients to crops, and their protection from stress (see diagram; Bending et al. 2024). In turn, the plants shape the composition of the microorganisms around the roots and supply them with the nutrients that they need to thrive. At a global scale, this interaction is crucial for biogeochemical cycling and carbon capture into the ground.

Plants and their associated microorganisms are exposed to seasonal and daily cycles in the environmental conditions. This has resulted in the evolution of the "circadian clock": a biological timekeeper that allows organisms to anticipate changes in the time of day. However, we know virtually nothing about biological clocks in the bacteria that inhabit the soil and form associations with plants. In a major breakthrough, we discovered the first biological clock in a soil bacterium that associates with plant roots (Eelderink-Chen et al. 2021). We know very little about this clock, but we know that it is important for both its cell differentiation and the and the operation of its metabolic pathways.



In this project you will work to understand the biological processes that guide the intimate relationship that forms between plants and bacteria. The experiments will use a bacterium called *Bacillus subtilis* which we have developed as a new model to study biological clocks, as well as the model plant *Arabidopsis thaliana*. The types of experiments you will do will depend on the status of this rapidly changing field, and could include confocal microscopy, PCR-based techniques, bioluminescence imaging, and root colonisation assays.

Suggested reading:

Bending et al. (2024) Plant, Cell and Environment 48, 2040-2052.

Eelderink-Chen et al. (2021) Science Advances 7, article eabe2086.

Diagram source: de Barros Dantas et al. (2023) Plant Journal 116, 650-668.

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PERSON PROFILE *2 bullets max per box*	**Essential**	**Desirable**
Education *e.g. degree subject*	- A-level(s) or equivalent qualification in a science subject. - Pursuing a degree in the biosciences, preferably with a focus on biochemistry or molecular biology.	
Specialist knowledge and skills *e.g. course module*	A good knowledge of underpinning principles in biological sciences.	An understanding of plant physiology and development A general understanding of signal transduction
Relevant experience *e.g. lab/research work*	Some experience of molecular biology techniques; for example, from practical classes or summer projects.	Working as part of a team.
Interpersonal and communication skills *e.g. teamwork and record-keeping*	Excellent communication skills, and willingness to present research within research group and at wider level within the research institute.	
Additional requirements *e.g. outdoor working*	Good organizational skills and time-keeping.	

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