Characterising the effect of root secretions in vertical farming systems

Supervisory team:
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Host institution: University of Bristol
CASE partner: LettUs Grow

Project description:
Humanity must increase food production by 70% to feed 10 billion people and, according to the UN, more than 5 billion people could suffer water shortages by 2050 due to climate change. Much of the population will be concentrated in cities and food supply chains have colossal environmental impacts. For example, 900,000 tonnes of food are wasted in transit to the UK. Aeroponic companies like LettUs Grow address this systemic problem by establishing localised indoor farms around cities to improve local food supplies and reduce food waste. Aeroponics uses 95% less water than traditional field farming and grows plants in a pesticide-free environment. Also, LettUs Grow's patent-pending system increases the growth rate of crops by up to 70%. The potential may be even greater because current biological knowledge of aeroponic farming is patchy. One of the biggest unknowns is how plants change their environment. Plants secrete between 20-40% of assimilated carbon as compounds (exudates) to help optimize their growing conditions (Badri & Vivanco, 2009). Knowing how these exudates affect plant growth could be used to improve crop choice and cultivation practices. Also, studies at a molecular and cellular level can help us learn more about how these compounds contribute to plant root health, plant communities, and plant-environment interactions.

1. Project summary. You will use the model plant Arabidopsis thaliana to explore how plants defective in exudate composition grow, respond to change in growth conditions, and what compounds these plants can and cannot produce. You will use live cell imaging, quantitative assays to measure plant-substrate adhesion, immunochemistry, statistical analyses, and bioinformatic approaches, along with molecular biology techniques. The results will enable you to evaluate exudate composition and investigate how individual genes and compounds contribute.

2. CASE partnership. To understand how all of this affects aeroponic cultivation, you will collaborate with LettUs Grow in Bristol, who are pioneers in aeroponic technology development. This is a unique opportunity to examine how plant exudates affect nutrient media conditions and plant root health/growth in a commercial aeroponics setting. Using what you learn in the lab, you can test what exudates collect in aeroponic media and what effects this might have on plant growth and production. The findings from this project will have high impact in both the scientific and commercial fields that will help develop new agricultural strategies whilst expanding our foundational knowledge of plant-environment interactions.