Plant root zone characterisation and modelling

Key words: phyllosphere, root architecture, root phenotyping, rhizosphere, root microbiome

Abstract: In Bioregenerative Life Support Systems (BLSSs), as the MELiSSA loop, the achievement of plant cultivation efficiency cannot disregard the “hidden half” of the plant, namely the root system. The root system efficiency is critical for efficient use of water and nutrients. The parameters of substrate, including the ability of retaining water and nutrients, as well as the nutrient solution composition, can have a deep impact on the root zone health and plant growth efficiency. Characterizing the root-substrate is crucial for designing plant cultivation units, and more specifically of the root zone compartment. Such a characterization involves multiple traits including root morphology and architecture and their interactions with water, nutrients and the surrounding microbiota. Indeed, microbial communities associated with roots can influence not only growth efficiency (in the case of plant beneficial microorganisms), but can have an impact on the quality of harvested products. The student activities shall be targeted to study 1) root phenotyping systems that can assess root development and growth, 2) how the nutrient solution composition may affect the functional development of root systems for the most efficient resource use, 3) substrate compositions for better root growth and resource use efficiency, 4) the interactions between rhizosphere-microbiome that improve the efficiency of root systems and crop yield. Models for the root zone management should be developed based on the acquired knowledge. This work would be done at laboratory scale in a closed growth chamber equipped using a closed loop hydroponic system. Development of prediction models to define the best root-zone environment and its impact on growth and yield will strengthen crop cultivation strategies for efficient use of resources and secure food supply in BLSSs.

Impact on MELiSSA:
This study is the first step to achieve a deep knowledge on the root system-root zone interactions to define the requirements of the root compartment of the plant modules in BLSSs.

MELiSSA Partners: University of Ghent; ETHZ (CH), Universidad Autonoma de Barcelona, University of Guelph,

Expected Deliverables:
Requirements, Bibliography, Mid-term report, Test plan & Test Report, Peer review publications, Dissertation report.

References:

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- Paradiso, R., Arena, C., De Micco, V., Giordano, M., Aronne, G. and De Pascale, S. (2017), Changes in leaf anatomical traits enhanced photosynthetic activity of soybean grown in hydroponics with plant growth-promoting microorganisms. Frontiers in Plant Science, 8, 674 90:575–587

Desired knowledge:

Candidates preferably possess a degree in agronomy/agricultural science, biotechnology or biology, possibly with experience in horticulture. They have to be familiar with hydroponics, microbiology and modelling.