

Master Project: Investigating how microorganisms alter the physical properties of soils

Statement of dissertation (can be changed at any time until the deadline for the thesis).

The world's population keeps increasing, and with that a rising demand for food. This carries a range of challenges for agricultural productivity and sustainability. One such challenge is the climate change impact at the worldwide freshwater storage, which is a highly important resource for plant production. Especially considering agriculture already accounts for 70% of all freshwater withdrawals globally. Deprivation of the freshwater supply is already limiting crop yield today and will likely be a problematic bottleneck for plant production in the future.

An answer might be found by examining the underlying biology of how plant roots interact with soil bacteria through the rhizosphere soil interface. The rhizosphere is an environment that provides the right condition for large and diverse soil microbial communities, some of which promote plant growth through different means and interactions. One interesting hypothesis is that rhizosphere microorganism release biofilms, which is a biosynthesized polymeric substance. Biofilms alter the soil pore space, and thus soil properties, which can result in larger water holding capacity. Therefore, biofilms may have the potential to improve plant drought stress tolerance.

This is an area with limited knowledge. Therefore, this project will explore some of the unanswered questions about the mechanisms that govern the interaction between soil microbiological communities, and the physiochemical and hydrological properties of the rhizosphere soil, that may affect plant drought stress tolerance. By attaining such knowledge, we may get one step closer to a more sustainable, efficient, and greener plant production.

Eventually, the goal is to implement a predictive model of plant-soil-microbe systems, through the mechanistic simulation program Daisy. This can be applied for estimations at the field scale, - to lower agricultural drought risks, and improve crop yields. To accomplish this laboratory work will be performed. The soil hydraulic properties will be measured for a soil treated with a community of biofilms producing microbes, at different concentrations. Furthermore, based on the laboratory work, quantifications of root water uptake will be approximated with a numerical model.

Supervision

The following section serves as a tool for considering the different expectations related to the supervision regarding Kasper Tolborg's master project: *"Investigating how microorganisms alter the physical properties of soils"*

Kasper is aware that the supervisors Efstathios Diamantopoulos and Mette Haubjerg Nicolaisen will participate in supervision process that is manageable and has a limited timeframe according to a 45 ECTS project. It is expected that Kasper will adhere to the agreed upon deadlines and provide sufficient material in order to receive feedback from the supervisors. They will be informed on which part of the research process where help is especially needed, if needed. Consequently, it is also expected that Mette and Efstathios provide sufficient guidance for the thesis and research process.

Kasper has the right to discuss matters related to the thesis and to receive constructive feedback. However, he is responsible for setting his own goal and managing his own work. Furthermore, Kasper will prepare for arranged meetings, as well as utilize feedback provided from the supervisors. Finally, in agreement with the Efstathios, a supervising meeting will be held once a week. Meetings with Mette will be planned accordingly and held as needed.

Expected from the student:

- The student should consider his master thesis project as his first project management course, where the supervisors guides the student with the project when it is needed.
- When the student calls for a meeting with the supervisors, the student must clarify the agenda for the meeting.
- It is asked from the student that he gives an overview (at least every 2nd week) where he is at in the process of the project.
- The student must get in contact with the supervisors when he gets stuck during the process of the project.
- When there is needed supervision by the supervisors on the literature or similar, the student must send the respective material 1-2 days before a meeting.
- The student must in advance let the supervisors know about the topic/section which will be worked on in the upcoming week. This is important as it is crucial to make the supervisors aware of what they will need to help with in the coming weeks.
- The student is always welcome to ask for more help with a sudden topic/section if needed.
- When the thesis is finished, the student should return all material, devices, copy of notes-files to the supervisor together with table of contents.

For example:

Formalia:

50-70 pages + USB stick containing DAISY scripts or additional data.

- The student is welcome to participate in the events/meetings set up by the research group