

sDiv working group meeting report

“sPSF: Soil microbial controls over plant coexistence - synthesizing data and theory to unravel context dependence of plant-soil feedbacks under global change”

The goal of our working group is to synthesize empirical and theoretical insights on how global change affects the ubiquitous interactions between plants and soil microbes, and how changes to these interactions in turn affect plant species coexistence in novel environments. We are addressing this goal with three primary objectives. First, we are bringing together information from global trait databases and experimental studies of plant-soil microbe interactions to evaluate how plant traits affect microbially mediated coexistence dynamics. The second objective is to integrate insights from theory and data to enable predictions of how global change alters soil microbial effects on plant coexistence. The third objective is to foster new collaborations among group members, most of whom had never worked together prior to this working group, but all of whom bring unique skills to address this challenge. We are especially hoping that the new collaborations will allow us to apply novel theoretical frameworks for evaluating how soil microbes shape plant communities, and that our group can stimulate more research on plant-soil microbe interactions in tropical and subtropical ecosystems, which remain far less represented in the literature.

Project 1: How plant functional traits shape plant-microbe interactions

Most days of the group's first working group meeting were devoted to the first objective (trait-coexistence meta-analysis). After an overview of the working group and a warm welcome to sDiv by Stan Harpole, our week began in earnest with a presentation by Xinyi Yan, a graduate student member of the group, about her recent meta-analysis showing that soil microbes often generate stronger fitness differences than stabilizing niche differences, as a result of which soil microbes are often predicted to drive exclusion rather than coexistence among species pairs. Co-PI Gaurav Kandlikar then shared a brief presentation of preliminary analysis that combined the plant performance data from Xinyi's meta-analysis with trait data from other sources like GROOT. These preliminary analyses provide some evidence that root traits mediate soil microbial effects on plant performance, but the analyses also underscored the need to develop more concrete predictions and analytical frameworks for this project. The first 2.5 days of the meeting focused on brainstorming these predictions and discussing the appropriate response metrics to use for this project. Co-PI Meghna Krishnadas will take the lead on developing the meta-analysis using a Bayesian statistical framework, with help on data management, analysis, and interpretation from all group members.

Project 2: How global change might alter microbially mediated plant coexistence dynamics

We spent one working day focused on the group's second objective, which is to integrate theory and data for enabling theoretically justified predictions of how global change effects on plant-microbe interactions scale up to affect plant community dynamics. Towards this goal, we wrote down a tentative mathematical model of interacting plants, mutualists, and pathogens, whose dynamics and interactions are shaped by abiotic environmental conditions. Our preliminary analysis of this model using simple assumptions of fast microbial dynamics showed that the equations can be represented as generalized Lotka-Volterra dynamics, with outcomes that depend on the environmental parameters. We also began to generate specific predictions of how individual parameters (e.g. mutualists' per-capita effect on plant performance) respond to individual global change factors (e.g. drought), based on published literature. Co-PI Gaurav Kandlikar will take the lead on a manuscript developing and analysing this framework, and will organize regular meetings with subgroup members to define the questions and global change factors that can be analysed within this context.

Other projects

While the bulk of our effort is focused on the two primary projects listed above, the new collaborations enabled by this working group are bound to generate other exciting outcomes. For example, the Co-PIs of this group will be working with group member Adriana Corrales to develop a proposal for a Special Issue for the American Journal of Botany on plant-microbe interactions in tropical and subtropical ecosystems ([link to announcement](#)). Po-Ju Ke proposed ideas for new modeling studies for linking plant-soil microbe interactions to community patterns like species abundances; we will delve more into this topic in the following working group meeting.

Organization and Logistics

This was our group's first in-person meeting, which meant it was the first time most group members met each other in person! Adriana Corrales and Po-Ju Ke had to join the group remotely, and we eagerly look forward to their joining the group in Leipzig for the next meeting. The infrastructure and staff at sDiv provided fantastic support to enable our work. The on-site logistics were smooth thanks to the incredible staff of sDiv, and the technological setup of the room (complete with multiple cameras and microphones) greatly facilitated our hybrid model. Our meeting also coincided with iDiv's 10th Anniversary celebrations, which meant extra cake to fuel our work!