m-CAFEs: EcoFABs: Investigating Soil Microbe-Plant Interactions in Regulated Ecosystems

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http://eco-fab.org

Project goals: **To derive mechanistic understandings of plant-microbe-soil interactions using reproducible, simplified ecosystems.** The m-CAFEs program is a collaborative, coordinated and integrated, mission-driven program to interrogate the function of soil microbiomes with critical implications for nutrient availability and plant productivity in natural and managed ecosystems.

Ecological Fabrications (EcoFABs) are microfluidic devices of molded polydimethylsiloxane (PDMS) bonded or clamped to glass slides to create highly controlled plant-growth platform that address the research needs for microbial-plant studies. These systems are adaptable to variable levels of soil complexity, including hydroponic conditions or filled with soil or other solid substrates such as synthetic soil, perlite, or sand. EcoFABs can be designed to contain separations or pillars, creating niches for slower growing microbes; barriers for hyphae-mediated nutrient transport; or flat roots for improved microscopy. Imagining of plant roots is easily achieved through 0-4 weeks of plant growth in EcoFABs bonded to glass cover slips for magnification between 5-40x. We have found that EcoFABs support the growth of DOE-relevant grasses, including switchgrass (*Panicum virgatum*), *Panicum hallii*, sorghum, maize, and *Brachypodium distachyon.* Importantly, a recent intra-lab ring-trial has shown a high degree of reproducibility between labs for diverse plant traits. Root imaging in an ecoFAB device was recently improved through the incorporation of novel flow paths. The device regulates the root development path, allowing the root to stay in focus for microscopy. This modified device has been used to localize the distributions of rhizopsphere bacteria. The results of experiments using these devices will transform our understanding of soil metabolism and microbiome science, contributing to DOE missions in energy and environment.

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