Title: Functional Diversity of Soil Microbiomes and Their Consequences

Hui-Ling (Sunny) Liao

Abstract

Rhizosphere are diverse in soil microbial organisms. The mechanisms governing the assembly and function of these microorganisms play key roles in the regulation of physiological processes of their host plants and ecosystem process. Many of these microbial organisms are host-generalists, uniquely present without apparent host specificity. Other microbiota are adapted to specialize with specific host plants. Both generalists and specialists are key players on the fitness of land plants. The dynamic interactions between plant and their microorganisms underlying nature and agriculture systems remain to be elucidated. To study the mechanistic mechanisms involved in whole soil/root microbiomes (generalists and specialists)-their plant hosts interactions *in situ*, we analyzed belowground samples using metaomics. The questions we asked include: (a) What environmental factors (with emphasis on plant species, spatial and temporal variables, climate gradient, biotic and abiotic strass) are responsible for shaping the composition and function of the soil microbiomes? (b) What strategies of the fungal generalists and specialists used to interact with their plant hosts? (c) How do these dynamic changes in turn affect plant development and ecosystem process? Given the unique ability of rhizosphere microbiomes to provide the majority of plant available nutrients (nitrogen) and to use over 30% of plant and/or soil carbon, our mechanistic understanding will advance model development for microbial-plant-soil interactions to maximize those functions in forest and agriculture ecosystem process and sustainability.

Urban Ecosystem Ecology from a Watershed Perspective

Alexander J. Reisinger

Abstract

Florida's population is projected to expand dramatically over the coming decades. This expected population expansion, coupled with the fact that more than 90% of the state's population resides in urban areas, emphasizes the need to understand the environmental and ecological impacts of urbanization throughout the state. In the Reisinger Urban Ecosystem Ecology Laboratory, we address questions related to the impact of urbanization on soil and water quality through an ecosystem ecology framework at the watershed scale. We are interested in how human activities throughout the landscape affect nutrient and energy fluxes within and across ecosystems. Typical residential development practices lead to compacted, low quality soils. Our research addresses the soil development process in urban landscapes, and alternative management practices to stimulate this development. These urban landscapes then commonly drain into stormwater ponds, which provide flood control and water quality functions, but little is known about nutrient removal efficiencies in these engineered ecosystems that represent a junction between the built and natural environments. Our research addresses how nutrient dynamics change along a pond age gradient to identify potential management interventions to improve nutrient removal efficiencies. Finally, urbanization drastically alters the hydrology and water quality of urban stream networks. We are developing a long-term monitoring program to estimate trends and drivers of urban water quality, and to quantify biogeochemical processes affecting urban stream water quality. Overall, our research attempts to identify drivers of soil and water quality impairments, and to address potential management interventions that can mitigate these impairments.

The Potential Benefits of Agroecological Practices on Soil Fertility and Soil Health in Florida Agroecosystems

Gabriel Maltais-Landry

Abstract

Food production has successfully increased in recent decades, but this has resulted in important environmental impacts, such as soil erosion and downstream eutrophication. Better understanding nutrient cycling in agroecosystems can improve nutrient management and help increase agricultural productivity, maintain soil fertility, improve soil health, and limit impacts on surrounding ecosystems. Our research team seeks to determine how agroecological practices can complement current soil fertility practices to improve the management of soil nitrogen and phosphorus in diverse Florida agroecosystems that are subject to challenging soil and climatic conditions. First, our team studies how livestock integration in row crop agriculture of North Florida affects nutrient cycling and efficiency in systems that are known to increase yields/profitability and improve soil properties such as soil organic matter. We also work on how organic amendments (mostly composts and manures) may improve nutrient recycling and benefit soil health in Florida agroecosystems, combining different experimental approaches. Finally, we are investigating the impacts of cover crop diversity and management on soil nutrient cycling and potential trade-offs with other agricultural constraints (e.g., weeds, nematodes), focusing on winter cover crops in row crops and summer cover crops in vegetables. Ultimately, our goal is to improve nutrient management to provide benefits for farmers, soils, and surrounding ecosystems.