The Control of Plant Biomass Development Mediated by Soil Microbe Nutrient Cycling

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Healthy interactions between plants and the soil microbe community are key to the success of tree reforestation, forest biomass production, breeding programs and the general health of ecosystems. In mycorrhizal symbiosis, plant roots form mutually - beneficial interactions with soil fungi that subsequently assist in the uptake and transport of soil nutrients. Rhizosphere bacteria also play important roles in the development of plants in unfavorable soil conditions because they can provide access to nutrients that would otherwise remain locked within the soil structure. Moreover, before these types of interactions can occur, plant roots must have sensor mechanisms capable of detecting beneficial fungi and bacteria, allowing them to distinguish potential symbionts from pathogens. Unfortunately, the molecular mechanisms at the heart of plant-fungal-bacterial symbiotic establishment and nutrient sharing remain poorly understood. Consequently, current projects in our laboratory aim to build a better understanding of the sensory mechanisms and species-specific nutrient cycling pathways through the elucidation of molecular mechanisms that link extracellular conditions to patterns of gene expression. A key component of this work makes use of chemical imaging of the rhizosphere through infrared spectroscopic and x-ray fluorescence microprobe (XFM) imaging to identify and quantify the chemical components surrounding tree roots as they respond to different organisms. The resulting data will be combined with previously collected data to generate computational models of the molecular mechanisms associated with each type of interaction, thus yielding specific, testable biological hypotheses for signaling compounds, sensor complexes, and the mechanisms of soil nutrient cycling between organisms.