Plant-Microbe Interfaces: Investigating microbial recruitment and colonization dynamics in the poplar microbiome

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Project Goals: The goal of the PMI SFA is to characterize and interpret the physical, molecular, and chemical interfaces between plants and microbes and determine their functional roles in biological and environmental systems. *Populus* and its associated microbial community serve as the experimental system for understanding the dynamic exchange of energy, information, and materials across this interface and its expression as functional properties at diverse spatial and temporal scales. To achieve this goal, we focus on 1) defining the bidirectional progression of molecular and cellular events involved in selecting and maintaining specific, mutualistic *Populus*-microbe interfaces, 2) defining the chemical environment and molecular signals that influence community structure and function, and 3) understanding the dynamic relationship and extrinsic stressors that shape microbiome composition and affect host performance.

The organization and behavior of plant-microbe communities are dictated by a complex network of physical and chemical interactions between organisms within the rhizosphere. These interactions produce spatially and temporally localized micro-environments that change as organisms grow, consume and produce materials and alter their surroundings. The goal of this research is to understand how the chemical environment of the poplar rhizosphere influences microbial recruitment and community organization. Previous results have shown that bacteria colonize the plant host to differing extents, ranging in abundance by orders of magnitude (10^8-10^3 cfu/gram root). To better understand these patterns, we are utilizing methods to image and measure the dynamics of microbial colonization along plant roots with increasing spatial and temporal resolution. The results show that some bacterial species reproducibly colonize specific regions of the plant root, suggesting that the bacteria are sensing and responding to physical and chemical cues from the host plant. We are currently performing screening experiments using capillary assays and microfluidic habitats to determine how specific chemicals influence growth and chemotactic behaviors based on the hypothesis that some bacteria are recruited to the host plant via the secretion of compounds that act as chemoattactants. By correlating these data with visualization of microbial colonization dynamics using imaging chambers and with data from ongoing efforts to sample the chemical environment of the rhizosphere, we hope to gain important insights into how the microbiome is recruited and organized.

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