Poplar Esterified Cell Wall Transformations and Metabolic Integration (PECTIN) Study

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Project Goals: The main goal of **PECTIN phase 1** is to quantify O-acetyl and methyl ester cell wall metabolism in poplar trees and its interactions with central metabolism and volatile metabolite exchange with the atmosphere. Critical to this goal is the development of novel methodology for xylem injections of ^{13}C-metabolite solutions involved in cell wall ester metabolism with injection flow rates scaled to sap flow. Using detached leaves to simulate drought and initiate senescence, a secondary goal is to determine quantitative relationships between the emissions of leaf methanol and acetic acid and changes in the degree of cell wall acetylation and methylation.

Abstract: Polysaccharides are major components of plant cell walls that can be converted into fuels by microbial fermentation, making plant biomass an important bioenergy resource. However, a substantial fraction of plant cell wall polysaccharides are chemically modified with methyl and acetyl groups that reduce yield of microbial fermentation. Although little is known about the biochemical and physiological functions of those cell wall modifications, it has been shown that their volatile intermediates (methanol and acetic acid) are tightly associated with plant growth, stress, and senescence processes but are not captured by traditional metabolomics analysis, representing an important gap in our knowledge of cell wall metabolism. This project studies the metabolism of those cell wall modifications and volatile intermediates as well as their role in central physiological processes in the emerging biofuel tree species California poplar (*Populus trichocarpa*) using field settings and controlled environmental conditions. The main goal of this research is to modify the expression of key genes involved in cell wall metabolism in order to reduce the amount of methyl and acetyl groups present on cell walls. These genetic modifications will be evaluated for potential impacts on important plant hydraulic and physiological processes including proper functioning of vascular tissues to support transpiration, leaf water potential and stomatal regulation, net photosynthesis, and high temperature/drought stress responses. Understanding and manipulating the metabolism of cell wall modifications will not only provide important knowledge on the physiology and ecology of plants but will also allow the generation of engineered bioenergy crops such as poplar for sustainable production of biofuels and bioproducts, addressing BER's goal of developing renewable bioenergy resources.

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