Engineering Mannan Biosynthesis in Plants

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The goal of this project is to increase the accessible hexose content of the plant cell wall. This will increase the fermentation efficiency of lignocellulosic biomass into renewable transportation fuels.

Plant biomass serves as an abundant renewable source for biofuel and bioenergy production. As energy demand steadily increases the competing priorities between energy production needs and food supply will grow significantly. Therefore, it is critical that biomass is sourced from sustainable, non-food sources - namely lignocellulosic biomass. However, fermentation of lignocellulosic material is currently costly, both economically and environmentally. One approach to improve fermentation of lignocellulosic feedstocks is to increase the hexose sugar content in plant cell walls, since the majority of microorganisms favor hexoses over pentoses for fermentation. Plant cell walls are composed of cellulose, hemicellulose, and lignin, of which only cellulose and a small fraction of the hemicelluloses contain C6 sugars. In cellulose these sugars are packed in crystalline arrays and are least accessible to microbial fermentation. The C6 sugars in hemicelluloses like mannans are more accessible to enzymatic hydrolysis. Our goal is to increase the content of mannans in the plant cell wall to produce plants with enhanced bio refinery feedstock characteristics, meaning increased biofuel production through improved fermentation.

The Cellulose Synthase-like A (CslA) proteins have been identified as mannan synthesizing enzymes in plants. However, overexpression of theses enzymes *in planta* resulted in only a minor increase in cell wall mannan. Therefore, we hypothesize that we may need to alter other aspects of mannan biosynthesis, such as substrate pools, mannan solubility and enzyme efficiency in order to achieve a meaningful boost in cell wall hexose content.

We are using a systems approach to understand the factors which control mannan biosynthesis. Here we will present our approach to targeting different aspects of mannan biosynthesis, some preliminary data, and our future plans to integrate these into a single plant.

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