

## 131. Tackling biomass recalcitrance with novel biological approaches

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<http://www.jbei.org/research/divisions/feedstock/cell-wall-engineering/>

**Project Goals:** The main goals of this research are to develop and validate technologies that reduce biomass recalcitrance

The development of alternative transportation fuels that can meet future demands while reducing global warming is critical to the national, environmental, and economic security of the United States. Currently, sugars used for biofuels production are largely derived from sucrose extracted from sugarcane and starch from corn, but there is a large, untapped resource (more than a billion tons per year) stored in plant biomass that could be utilized for liquid fuels production. However, cell wall recalcitrance hampers the development of cost-effective and energy-efficient processes to convert this biomass into fermentable sugars. Plant cell walls are mainly composed of cellulose, hemicellulose and lignin and their recalcitrance to enzymatic hydrolysis is primarily caused by lignin followed by cellulose crystallinity. Both are essential for plant development as they provide structural support to plants and protect plants against multiple stresses, which render their manipulations more challenging.

We developed non-conventional approaches and used synthetic biology to tackle both bottlenecks. We first developed and applied biological switches to express a defective cellulose synthase protein in fiber cells to reduce cellulose crystallinity without affecting plant growth. In parallel we elaborated a novel strategy to biologically inhibit lignin biosynthesis and primarily targeted hydroxycinnamoyl transferase (HCT) activity. We screened and identified HCT competitive inhibitors and reconstituted in situ metabolic pathways to inhibit lignin biosynthesis in secondary cell wall. In planta characterization revealed that both approaches were successful in reducing biomass recalcitrance and increasing sugar yield.

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