Engineered switchgrass and poplar, downregulated in Galacturonosyltransferase (GAUT)4, have both increased biomass yield and sugar release

Background

- The recalcitrance of lignocellulosic feedstocks is a major barrier during bioconversion to biofuels and biomaterials. To overcome this, a detailed understanding of the structure of plant cell walls and the function of the genes associated with the synthesis of wall structures is essential. In this study, we targeted a specific cell wall pectin biosynthetic gene, *galacturonosyltransferase (GAUT)4,* to understand the biological functions of this gene in relation to biomass yield and recalcitrance in both grass and woody feedstocks.

Approach

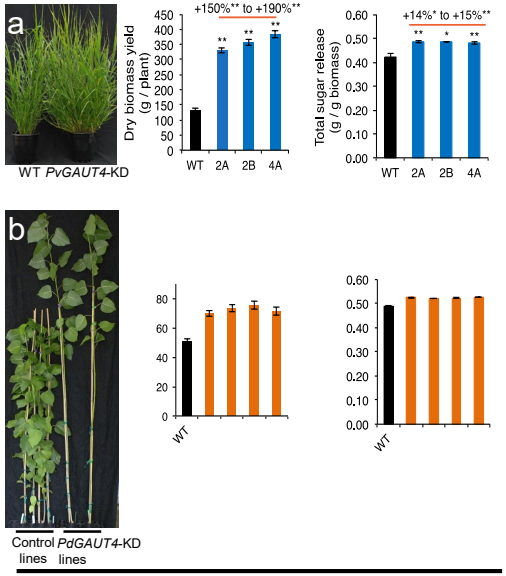
- We used RNAi to downregulate the expression of *GAUT4* in switchgrass, rice and poplar. Greenhouse-grown transgenics were assessed for plant growth, biomass saccharification, and cell wall structure. A 3-year field trial of transgenic *GAUT4*-KD switchgrass was carried out to evaluate performance in the field.

Outcomes

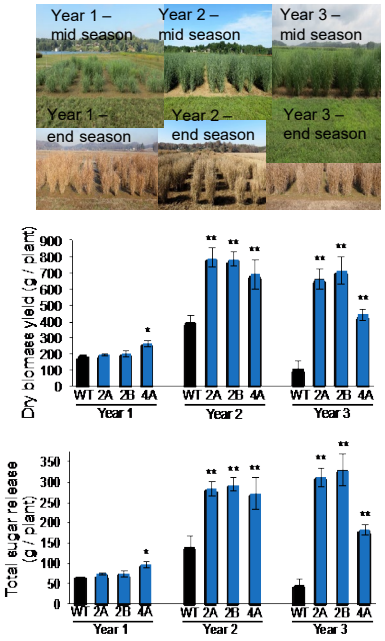
- All *GAUT4*-KD grasses and trees showed enhanced growth in the greenhouse.
- *GAUT4*-KD switchgrass lines grown 3 years in the field provide up to 7-fold increased saccharification and ethanol production, and 6-fold more biomass yield vs. field-grown controls.
- GAUT4 was shown to be an α-1,4-galacturonosyltransferase that synthesizes homogalacturonan (HG). Mechanistic studies showed that downregulation of *GAUT4* reduces cell wall HG and rhamnogalacturonan II content and their associated polymer crosslinking. These changes lead to loosened cell walls with increased cell expansion, plant growth and polymer accessibility during saccharification.

Significance

- This is the first example of a specific plant cell wall structural modification that results in increased biomass yield and reduced recalcitrance in both woody and grass biofuel feedstocks. These results also illustrate the impact of polymer crosslinkages and specifically pectin on biomass recalcitrance.



Greenhouse grown switchgrass (a) and poplar (b) with biomass and sugar release



Field-grown switchgrass: 2A, 2B and 4A are the transgenics

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