Knock-down of *Galacturonosyltransferase-4* gene leads to reduction in lignin-carbohydrate crosslinking in switchgrass

Background

- A fundamental understanding of the molecular structures of polymers in the cell wall is crucial to tackle the recalcitrance of biomass for biofuels and biomaterials development. In this study, we investigated the influences of downregulation of a pectin biosynthetic gene, galacturonosyltransferase (GAUT4), on the structures of lignin and lignin-carbohydrate crosslinking and their importance to the recalcitrance of switchgrass.

Approach

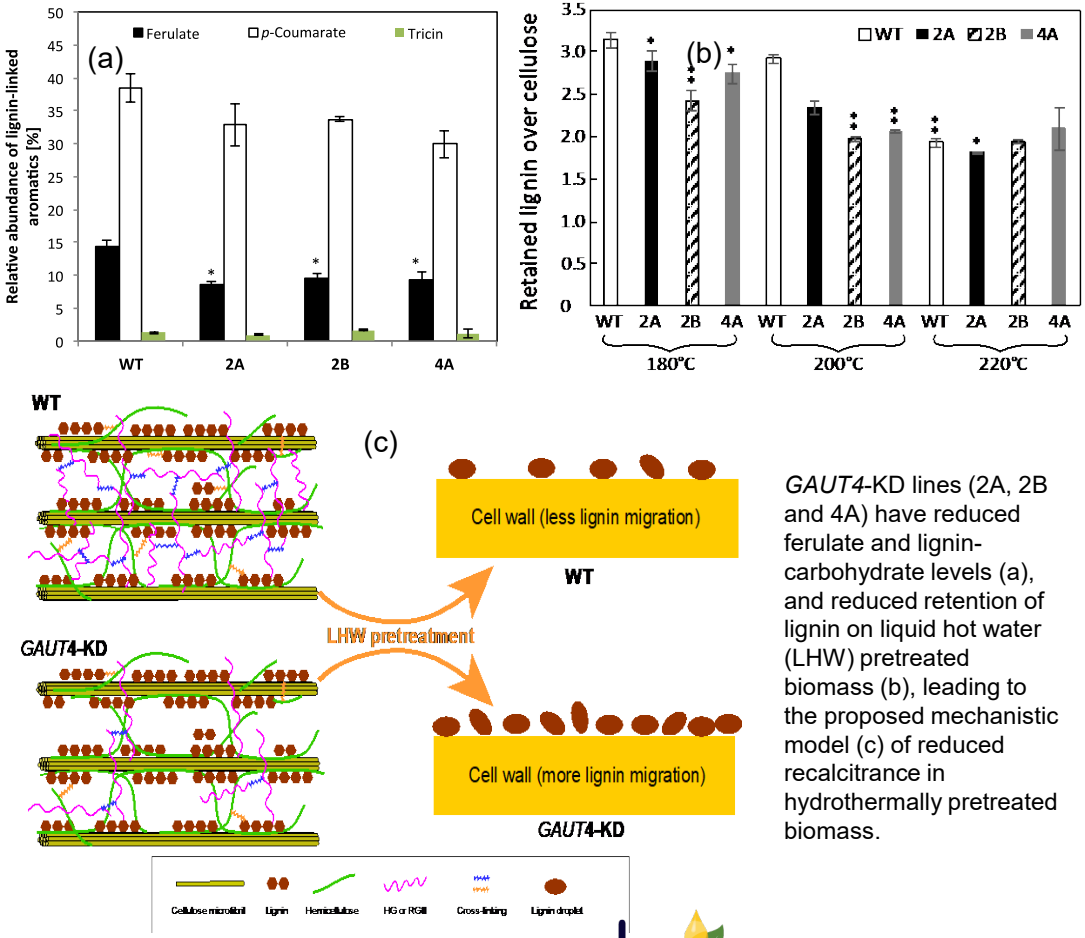
- We used chromatographic and NMR analyses to identify the molecular structure of lignin and hemicellulose as well as the level of lignin-carbohydrate crosslinking in *GAUT4*-downregulated switchgrass. The morphological features of pretreated biomass were studied using scanning electron microscopy.

Outcomes

- *GAUT4*-KD lines have a lower abundance of ferulate and lignin-carbohydrate complex cross-linkages, reduced hemicellulose molecular weights, and reduced amounts of residual arabinan and xylan in lignin-enriched fractions, in comparison to the wildtype (WT).
- These molecular structure changes in lignin and hemicellulose lead to a greater coalescence and migration of lignin after hydrothermal pretreatment. The results reveal the roles of both decreased lignin-polymer and pectin cross-links in the reduction of recalcitrance in *GAUT4*-KD switchgrass.

Significance

- These results increase our fundamental understanding of the roles of lignin and lignin-carbohydrates crosslinking in reduced recalcitrance in grass biofuel feedstocks. The results also illustrate the impact of polymer crosslinkages and specifically pectin on biomass recalcitrance.



GAUT4-KD lines (2A, 2B and 4A) have reduced ferulate and lignin-carbohydrate levels (a), and reduced retention of lignin on liquid hot water (LHW) pretreated biomass (b), leading to the proposed mechanistic model (c) of reduced recalcitrance in hydrothermally pretreated biomass.

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