Overexpression of lignin transcription factor in switchgrass significantly increases biofuel yields

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Background:

- Early approaches to improving saccharification efficiency have focused on down-regulation of single lignin biosynthetic genes (e.g. COMT). While successful, increases in fermentation inhibitors are often seen.

Approach:

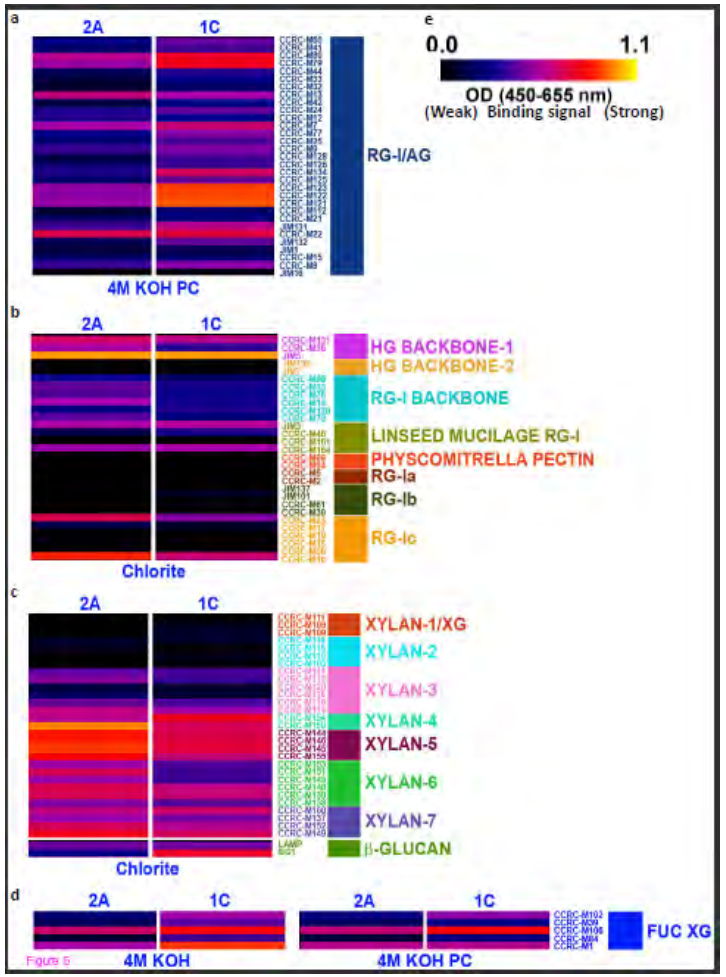
- Previous work had demonstrated 300% improvement with overexpressed *PvMYB4,* this work reports further evaluation of the bioconversion of ethanol using yeast-based simultaneous saccharification and fermentation (SSF) methods either with hot-water pretreatment or no pretreatment.

Outcomes:

- Overexpression of the transcription factor PvMYB4 in switchgrass dramatically improved the yield of cellulosic ethanol yield from switchgrass when compared to non-treated controls or COMT transgenic plants.
- The strategy reduced carbon deposition into lignin and phenolic fermentation inhibitors while maintaining the availability of potentially fermentable soluble sugars and pectic polysaccharides.
- Detailed biomass characterization analyses revealed that the levels and nature of phenolic acids embedded in the cell-wall, the lignin content and polymer size, lignin internal linkage levels, linkages between lignin and xylans/ pectins, and levels of wall-bound fucose are all altered in PvMYB4-OX lines.

Significance:

- Results have demonstrated that overexpression of PvMYB4, a general transcriptional repressor of the phenylpropanoid/lignin biosynthesis pathway, can lead to a very high yield ethanol production through dramatic reduction of recalcitrance. MYB4-OX switchgrass is an excellent model system for understanding recalcitrance, and provides new germplasm for developing switchgrass cultivars as biomass feedstocks for biofuel production.



Glycome profiling heatmaps of specific cell wall extracts showing reduced association of xylan and pectins with lignin in PvMYB4-OX switchgrass.

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