Over-expression of poplar Galacturonosyltransferase (GAUT)12 confirms key role in xylan synthesis and recalcitrance

Background
- A better understanding of plant cell wall structure and function is needed to elucidate the molecular mechanisms of biomass recalcitrance. Reduced expression galacturonosyltransferase (GAUT)12 – a putative glycosyltransferase involved in secondary cell wall glucuronoxylan and pectin production – increased saccharification and growth in *Populus*.

Approach
- The *Populus GAUT12.1* gene was overexpressed. Greenhouse-grown transgenic and control lines were assessed for plant growth, biomass saccharification, and cell wall structure. Importantly, selected transgenic lines were also grown in a 2.8-year field trial to evaluate performance in the field.

Outcomes
- *Populus GAUT12.1*-overexpression (PtGAUT12.1-OE) lines had 12-13% decreased sugar release, as well as decreased plant height (6-54%), stem diameter (8-40%), and total aerial biomass yield (48-61%) compared to controls. The biomass saccharification, growth, and cell wall phenotypes of PtGAUT12.1-OE lines were completely opposite to those previously observed in PdGAUT12.1-knockdown lines. The data support the hypothesis that poplar GAUT12.1 is involved in the synthesis of a wall structure containing both pectic homogalacturonan and xylan, and that these glycans may be connected to each other by a base-sensitive covalent linkage.

Significance
- The results establish GAUT12.1 as a recalcitrance- and growth-associated gene in poplar and support the hypothesis that GAUT12.1 synthesizes either an HG-containing primer for xylan synthesis or an HG glycan required for xylan deposition, anchoring, and/or architecture in the wall.

Biswal AK et al. Working towards recalcitrance mechanisms: increased xylan and homogalacturonan production by overexpression of GALactUronosylTransferase12 (GAUT12) causes increased recalcitrance and decreased growth in *Populus*. Biotechnology for Biofuel, 2018; 11: 9