Use of *Populus* natural variants as a research tool to further determine molecular basis of recalcitrance

U.S. DEPARTMENT OF ENERGY | Office of Science

Background

- Increased depth in phenotypic and genotypic characterization of the BESC population of *Populus* natural variants, which possess differing recalcitrance properties suggests that this resource can serve as a valuable research toolset to help deepen our understanding of the basis of recalcitrance.

Approach

- Six 4-year-old natural poplar variants harvested from Clatskanie, OR, differing in their sugar release phenotype were selected as the experimental set.
- A comprehensive compositional and structural characterization including cellulose degree of polymerization (DP), crystallinity (CrI), cellulose accessibility, and lignin structural features were performed and the correlations between these physicochemical properties and enzymatic hydrolysis yield were investigated.

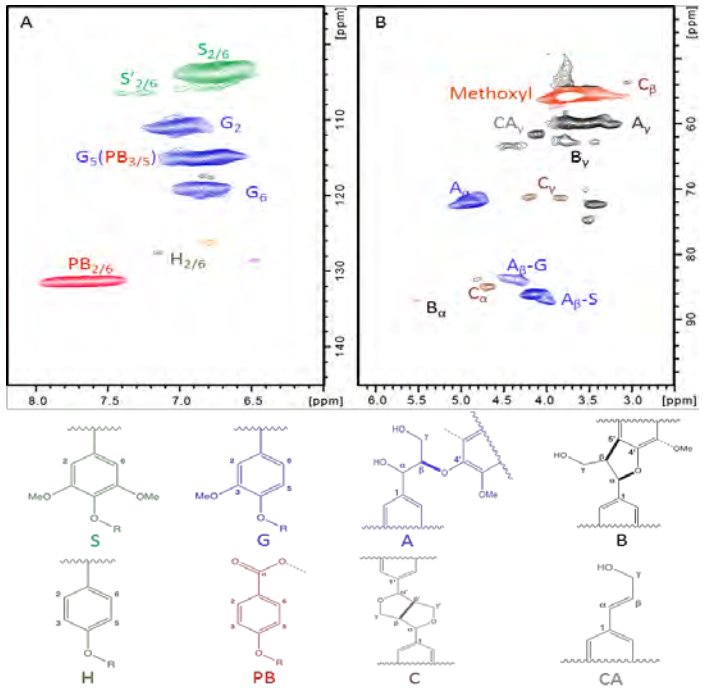
Outcome

- Cellulose relevant factors such as cellulose DP and accessibility appeared to have a stronger correlation with glucose release than lignin structural features.
- Lignin structural features, such as phenolic hydroxyl group content and the S/G ratio, were found to have a strong impact on xylose release.
- Low lignin content, low cellulose DP, and high cellulose accessibility generally favor enzymatic hydrolysis; however, recalcitrance cannot be merely judged on any single substrate factor.
- The relative contribution of each factor in biomass recalcitrance varies from sample to sample, and once one factor is no longer limiting, other factors normally become determinant.

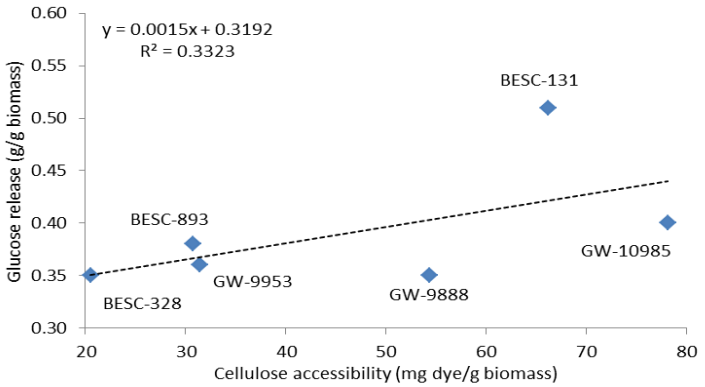
Significance

- This project investigates the relative contributions of various factors to recalcitrance by a first-order multi-variants linear correlation analysis, which significantly helps improve the understanding of the fundamental mechanisms of biomass recalcitrance.

A representative HSQC NMR spectra of natural poplar variant lignin



Relationship between cellulose accessibility and glucose release



BESC BioEnergy Science Center

Meng et al., "An In-depth Understanding of Biomass Recalcitrance Using Natural Poplar Variants as the Feedstock," *ChemSusChem* 9, 1-13, 2016; DOI: 10.1002/cssc.201601303.