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Reactivity of glucan and xylan in sorghum feedstocks: Comparing wild versus reduced lignin content lines and dilute acid versus deacetylation followed by dilute acid pretreatment

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Introduction

• For biofuel production processes **to be economically efficient, it is essential to maximize the production of monomeric carbohydrates** from glucan (cellulose) and xylan (hemicelluloses) of feedstock.
This can be achieved by identifying **less recalcitrant feedstocks** by screening or by genetic modifications such as the **brown midrib (*bmr*) genes** to get feedstocks with reduced lignin content.
This can also be accomplished by using a pretreatment **enhancing the reactivity such as deacetylation**. It is a dilute NaOH pretreatment enabling to remove the acetyl groups of xylan.

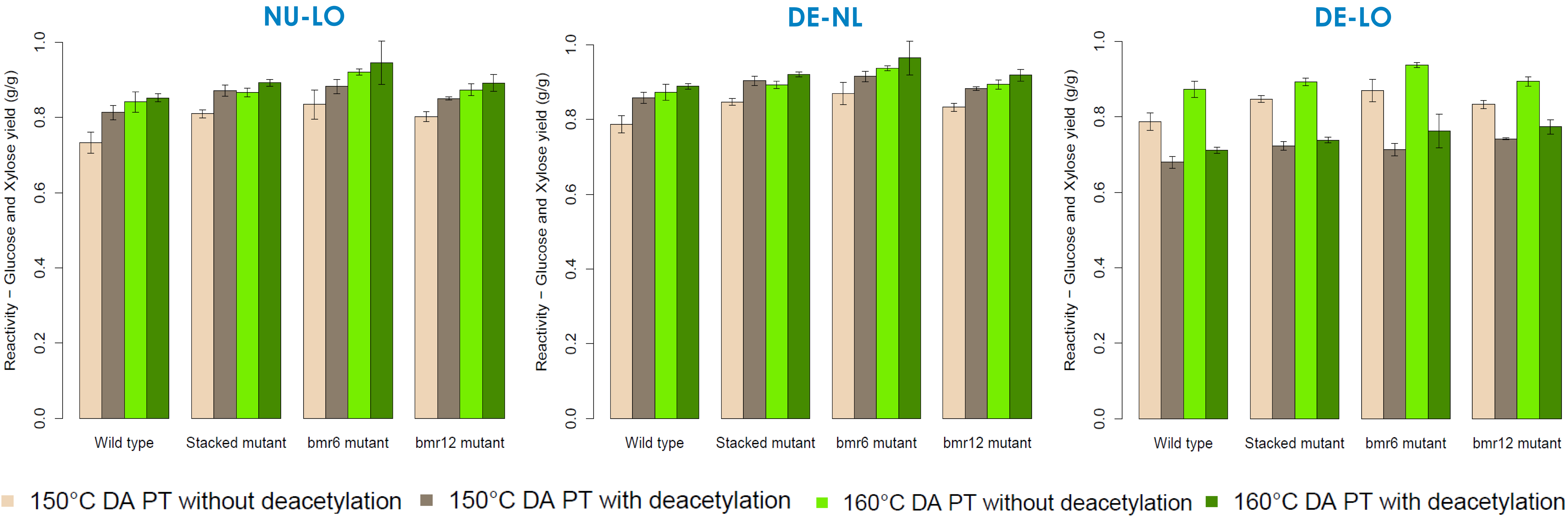
Method

• A **laboratory-scale screening tool (ASE350) working at relevant biofuel process conditions** has been used to compare the combined reactivity of glucan and xylan of near-isogenic *bmr* sorghum mutants to their wild type.
• It has also been used to evaluate the effect on the combined reactivity of glucan and xylan of these feedstocks made by deacetylation before 1.0% sulfuric acid (DA) pretreatment (PT) at 150°C or 160°C.

Results

• **The three *bmr* sorghums compared to the wild type had a significant (p-value<0.05) reduced total Klason lignin** and acid detergent lignin, and an increased enzymatically digestible organic matter for all three mutants.

Sorghum reactivity: 3 different ways of calculating the reactivity



• ***NU-LO***: **Reactivity** calculated by **subtracting the non-structural sugars from the numerator** but assuming non-structural and structural sugars **are lost during deacetylation**
• ***DE-NL***: **Reactivity** calculated by **adding the non-structural sugars to the denominator** and assuming non-structural and structural sugars **are not lost after the deacetylation step**
• ***DE-LO***: **Reactivity** calculated by **adding the structural sugars to the denominator** but assuming non-structural and structural sugars **are lost during deacetylation**

Conclusions

• ***bmr* mutants** compared to wild type, deacetylation before dilute acid pretreatment and higher temperature of dilute acid pretreatment **significantly increased significantly the reactivity.**
These differences decreased with an increasing temperature of dilute acid pretreatment or with deacetylation. **High dilute acid pretreatment severity rubs out the differences between similar feedstocks.**

• How **non-structural carbohydrates are accounted for the calculation of reactivity** in feedstocks with high non-structural carbohydrates content **has an impact on the final result.** They increase the reactivity value if they are added to the denominator of the yield compared to when they are subtracted of the numerator of the yield.
In addition, a **feedstock with high non-structural carbohydrates content is not recommended to be used for deacetylation** if the carbohydrates solubilized during this process are not recovered.