

## Bioconversion of Pelletized Big Bluestem, Switchgrass, and Low-Diversity Grass Mixtures into Sugars and Bioethanol

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### Project Goals:

To investigate preprocessing, pretreatment, and bioconversion of three bioenergy crops adapted for production on northern marginal farmland.

Three crops of warm-season grasses are being developed for biomass production on northern rain-fed marginal farmland: big bluestem (BBS), switchgrass (SG), and a low diversity mixture of grasses (LDM). In this study, biomass harvested from established fields were compared for pelletization and subsequent conversion to sugars and ethanol. Each biomass was successfully pelletized to similar bulk densities without adding a binder at a commercial feed operation. Pelletizing increased the bulk density by 407% on average and was equally effective on all three biomass samples (528–554 kg/m<sup>3</sup>). Chemical analysis of the samples indicated that glucan and xylan contents were slightly reduced during pelletizing (by 23 and 16 g/kg, respectively), as well as theoretical ethanol yields, which are based upon total carbohydrate contents. Pellets and milled straws were pre-treated with either liquid hot-water or low-moisture ammonium hydroxide (LMA) and subsequently hydrolyzed with cellulases. Glucose and total sugar yields were similar for non-pellets and pellets using either pre-treatment; carbohydrates present in pellets were more efficiently recovered compared to non-pellets. LMA pretreated samples were separately hydrolyzed and fermented to ethanol using *Scheffersomyces stipitis* yeast. Hydrolysis recovered 69.7–76.8% of the glucose and 66.5–73.3% of the xylose across all samples. Glucose yields were 251–279 g/kg, db and were significantly lower for SG as compared to the other biomass samples. Recovered sugars were fermented to ethanol at 77.7–86.7% of theoretical yield. As a result, final ethanol yields (245.9–275.5 L/Mg, db) were similar for all of the grasses and estimated to equate to production levels for BBS, LDM, and SG of 1,952, 2,586, and 2,636 l of ethanol per ha, respectively.

### References

Dien BS, Mitchell RB, Bowman MJ, Jin VL, Quarterman J, Schmer MR, Singh V, Slininger PJ. Bioconversion of pelletized big bluestem, switchgrass, and low-diversity grass mixtures into sugars and bioethanol. *Frontiers in Energy Research*. 2018.

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