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U.S. Department of Transportation

SunGrant INITIATIVE South Central Region

Project Title: ***Develop Comprehensive Understanding and Utilization of Sorghum Stover and Brown Midrib Forage Sorghum for Ethanol Production***

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Project Goal

The goal of this research was to develop comprehensive understanding and utilization of regular sorghum stover and bmr sorghum (sorghum biomass) for ethanol production.

The specific objectives were:

1) To characterize the physical properties and chemical composition of selected sorghum biomass
2) To develop chemical/physical pretreatment technologies to increase the fermentable sugars yields from sorghum biomass
3) To increase the ethanol yields by identifying and reducing the effects of potential inhibitors formed during pretreatment of sorghum biomass
4) To investigate energy inputs and outputs associated with bioprocessing sorghum biomass.

Project Outcomes:

- Five varieties of forage sorghum (stems and leaves) including regular sorghum hybrids, forage sorghum, mid-rid (bmr) sorghum, photosensitive and sweet sorghum were characterized and evaluated as feedstock for fermentable sugar production.
- Chemical composition of the sorghum biomasses ranged from 28-44% cellulose, 18-24% hemicellulose, 14-20% lignin, 1.5-6.5% starch (as free sugars), and 4-10% ash. The total carbohydrate composition ranged from 51-69%. There is strong relationship among chemical structure, function, composition, and fermentable sugars yield.
- Forage sorghums with a high percentage of guaiacyl rings in their lignin structure were easy to hydrolyze after pretreatment. Pretreatment was more effective for forage sorghums with a low crystallinity index and easily transformed crystalline cellulose to amorphous cellulose, despite initial cellulose content.
- Results showed that SSF using *S. Cerevisiae* is an effective method to hydrolyze and ferment cellulose remaining in treated solids with high ethanol yields up to 88%. Input/output flows and estimated processing cost indicated that forage sorghum is an ideal feedstock for biofuel production with low energy input.

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