

**Grain Quality and Structure Research Unit,**  
**Grain Marketing and Production Research Center, Manhattan, KS**

Primary Contact: Scott Bean

Current Research Projects and Objectives related to bioenergy: Identify sorghum grain components (physical and chemical) related to bio-industrial uses such as ethanol production

Key accomplishments: The goal of this research is to understand the key factors impacting ethanol production from grain sorghum. We have studied the effect of genetic x environmental interactions and found that both factors contribute to fermentation yields. Sorghum hybrids with improved fermentation quality have been identified. Seventy genotypes and elite hybrids, with a range of chemical compositions and physical properties selected from approximately 1200 sorghum lines, were evaluated for ethanol production, and were used to study the relationships among composition, grain structure, and physical features that affect ethanol yield and fermentation efficiency. Variations of 22% in ethanol yield and 9% in fermentation efficiency were observed among the 70 sorghum samples. Genotypes with high and low conversion efficiencies were associated with attributes that may be manipulated to improve fermentation efficiency. Major characteristics of the elite sorghum genotypes for ethanol production by the dry-grind method include high starch content, rapid liquefaction, low viscosity during liquefaction, high fermentation speed, and high fermentation efficiency. Major factors adversely affecting the bioconversion process were, low protein digestibility, high mash viscosity, and an elevated concentration of amylose-lipid complex in the mash. We have also found methods for improving the ethanol yield from sorghum by pre-treating the sorghum through the use of extrusion processing and decortication. The latest developments show that decortication improves ethanol yield up to 20% by allowing higher starch loading during fermentation.

In addition to work on sorghum, the RU has also begun investigating the quality components in wheat that are related to ethanol yields.

Lead SY (Sorghum-ethanol research): Scott Bean [scott@ars.usda.gov](mailto:scott@ars.usda.gov); 785-776-2725

Lead SY (Wheat-ethanol research): Brad Seabourn [brad.seabourn@ars.usda.gov](mailto:brad.seabourn@ars.usda.gov); 785-776-2751

Other scientific expertise or capabilities already available in the RU applicable to bioenergy:

Dr. Michael Tilley ([Michael.tilley@ars.usda.gov](mailto:Michael.tilley@ars.usda.gov)) : Fermentation of teff to ethanol

Dr. Jeff Wilson ([jeff.D.wilson@ars.usda.gov](mailto:jeff.D.wilson@ars.usda.gov)) : Starch composition and chemistry of wheat and sorghum

Dr. Brad Seabourn ([Brad.seabourn@ars.usda.gov](mailto:Brad.seabourn@ars.usda.gov)) : Quality factors related to the fermentation of wheat to ethanol, spectroscopy of wheat, functionality of wheat proteins