Biomass Sorghum Supply Systems for Advanced Biofuel Production

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Project Goals: Enhancing bioenergy sorghum productivity over a wide range of field environments while minimizing nutrient inputs, identifying the most cost-competitive and scalable biomass sorghum-to-fuel and bioproducts conversion technologies that will reduce GHG and water footprints, reduce the generation of pollutants and toxins, minimize demands and impacts on natural resources, and create more jobs.

Availability, cost, and quality (total carbohydrates) of biomass feedstock are some of the key drivers for the commercial success of the advanced biofuels production (such as aviation fuels) in the future. Biomass sorghum could be an ideal feedstock to address these concerns due to a high biomass production rate of 28 metric ton (dry)/ha, natural drought-tolerance (can grow across the United States), and a high total carbohydrates of ~70 wt% (photoperiod-sensitive or brown midrib (BMR) sorghum varieties). However, biomass sorghum feedstock supply system for cellulosic biorefinery have not been well studied and could be very challenging due to a high moisture content at harvest of 60-70 wt%. This study identifies six potential supply systems and quantifies corresponding supply costs considering two different production methods (rainfed and irrigated) and four different feedstock forms, including chopped (ensiled)-biomass, module, bale, and pellet. The results indicate that the chopped (ensiled)-biomass supply system with or without preprocessing depot between the field and the biorefinery is the most cost effective option when compared to the bale- or module-based biomass supply system. We find that if the biorefinery is located within the supply radius of 94.8 km (58.9 miles) the direct transportation of the chopped (ensiled)-biomass from the field to the biorefinery is more cost effective than a two-stage transportation system (a combination of the chopped-biomass and pellet system where pellets are produced at the preprocessing depot). This economic cut-off supply distances for the module and bale systems are 119.6 km (74.3 miles) and 107.9 km (67.1 miles), respectively. These promising feedstock supply routes require system-wide improvements including a biomass yield, sustainable farming with a low nutrient and water uses, and best management practices to reduce harvesting and handling hours, material losses, and supply distances. These future improvements enhance the availability of biomass sorghum feedstock for cellulosic biorefineries at a reasonable price.

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