

Public Abstract

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Title:NUTRIENT, WATER, AND SOIL TYPE MANAGEMENT OF BIOFUEL FEEDSTOCK PRODUCTION BY CORN, SORGHUM, AND SWITCHGRASS

Efficient use of biomass to produce biofuel and the development of more drought tolerant crops can contribute to helping address current and future problems faced by mankind, and are the focus of this dissertation. Objectives of experiments done in Portageville, Missouri, from 2007 to 2009 were to: (1) determine the effect of nitrogen (N) fertilization rate on the grain yield, the content and yield of oil, protein, starch, and the nutrient removal by corn; (2) determine the effect of N fertilization rate and the soil type on the biomass, juice, bagasse, sugars yield, and the nutrient removal by sweet sorghum; and to (3) determine the best date to harvest switchgrass in order to maximize biomass production with minimum nutrient removal. We found that in contrast to sweet sorghum, corn required 179 to 224 kg N ha⁻¹ for maximum corn grain yield. Sweet sorghum mostly responded to N fertilization only on clay soil; loam and sand soils had enough N when planted in a cotton/soybean rotation. However, the soil type and N rate highly impacted a variety of sweet sorghum yields, with the optimum yield recorded with 67 kg N ha⁻¹ if sweet sorghum is grown after soybean or cotton. N fertilization changed the oil, protein, mineral, and carbohydrate composition of the corn kernel. In general, the increase of N fertilization rate increased the grain yield and also the uptake of most nutrients, suggesting that nutrient removal will be critical for biofuel production from corn. The nutrient removal by sweet sorghum significantly depended on the year, soil type and N rate. The return of the leaves and the bagasse to the soil significantly reduced the nutrient removal by sweet sorghum. In general, the loam is the best soil type to produce corn and sweet sorghum in order to maximize biomass, and carbohydrates yield, and consequently biofuel production.

Switchgrass cv. Alamo produced twice the amount of biomass as the Blackwell cultivars. From July to November the nutrient uptake in the aboveground biomass decreased and their sink was successfully determined. Harvesting switchgrass biomass in late November is appropriate to minimize the nutrient removal, maximize biomass yield and reduce the biomass drying cost.

Experiments performed in Columbia, MO, focused upon beginning to measure the root and the leaf responses of sorghum varieties Tx7000, Tx642, RTx2817, Px898012, and M81E compared to a well-studied corn variety, FR697 to limiting water. Using two systems modeled after the work of Dr. R. Sharp and colleagues, we found significant differences across the varieties. Drought stress significantly reduced the biomass yield and changed the morphology of the roots, suggesting that it can significantly impact the biofuel production from these crops. A combination of the change in the root protein content and the leaf and root lengths correlated with the drought tolerance of the varieties studied.