Biomass Sorghum Production Potential in Texas: A Preliminary Simulation-Based Assessment

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Introduction

- Bioenergy crops are an attractive alternative to traditional cropping systems with potential economic and environmental benefits.
- Sorghum, a multi-purpose crop, is a crop of major interest because it can produce high grain, biomass, and sugar yields.
- Currently about 12-20% of the US grain sorghum crop goes into ethanol production and its co-products.
- Biomass sorghum has an untapped potential for biofuel production and can be a key rotational crop.

Objectives

- Assess biomass sorghum yield and production potential under rainfed and irrigated conditions across the state agricultural soils using the simulation model EPIC.
- Obtain preliminary estimates of nutrient extraction with the harvested biomass and erosion.

Methods

EPIC Model Simulations – Simulations were made for several dryland and irrigated sorghum cropping systems, over a 100- year time series for combinations of soils and climates for several counties across Texas.

EPIC Database Runs – Data from the National Nutrient Loss & Soil Carbon Database (NNLSC) were compiled and processed for the cropland area of the United States to obtain spatially distributed estimates of production potential.

Spatially Distributed Yield

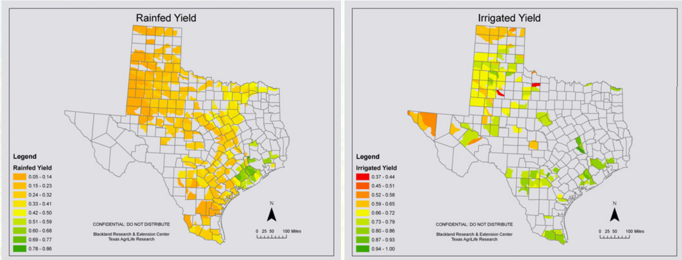

Figure 1. Normalized yield for rainfed and irrigated summer crops in Texas. Each polygon is the intersection of an 8-digit watershed, county, and Major Land Resource Area. Within a region (several mapping units), the maximum values are indicative of overall growth potential (green color).

- Texas has in production approximately 0.94 and 1.5 million ha of irrigated and dryland "equivalent maximum yield area".
- These numbers allow to easily calculate biomass and liquid fuel production based on maximum yields (Table 1). Experimental yields ~40% higher than those in Table 1 have been reported.

Table 1. Simulated average yield, nitrogen and phosphorus extraction, irrigation and water as well as temperature stress of biomass sorghum in Texas.

		Harvested Biomass	Nitrogen Extraction	Phosphorus Extraction	Irrigation	Water Stress Days	Low Temp. Stress Days
		$Mg\ ha^{-1}$	$Kg\ ha^{-1}$	$Kg\ ha^{-1}$	mm	d	d
Dryland	West TX	10.4	120	17	-	77	42
	South TX	14.2	160	24	-	58	12
	Valley	12.6	163	26	-	65	13
	Central TX	11.8	149	22	-	53	16
	East TX	14.4	168	26	-	48	23
Irrigated	West TX	18.6	188	23	430	16	31
	South TX	19.6	167	25	520	12	12
	Valley	18.7	198	24	620	8	12
	Central TX	16.6	173	24	415	10	24
	East TX	19.3	182	24	390	10	23

Yield Variability

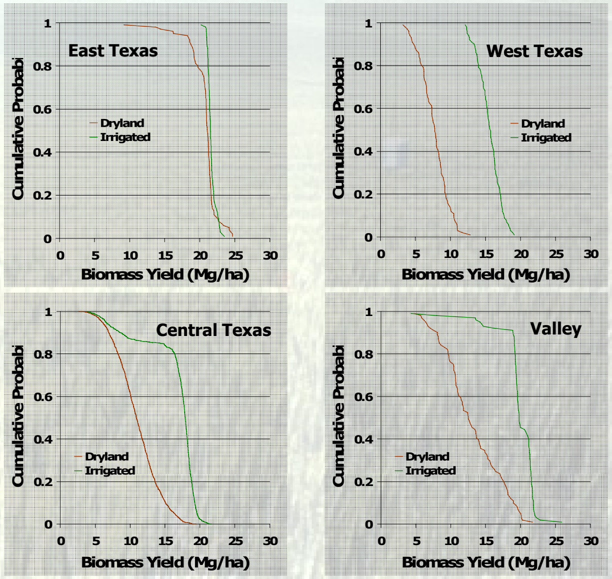

Figure 2. Cumulative probability of biomass yield in east and west Texas under dryland and irrigated conditions. Notice the difference in yield stability under dryland and the leveling effect of irrigation.

Concluding Remarks

- Both state-wide and local assessments of biomass sorghum production potential and inter-year yield variability can be obtained by appropriately using simulation models.
- Under dryland conditions, nitrogen extraction can be similar to that of high yielding corn crops.

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