



AgriLIFE RESEARCH

Texas A&M System

# Energy Sorghum in Subtropical/Temperate Climates

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# Outline

- Bioenergy Sorghum Development
  - Sweet Sorghum
    - Development
    - Challenges
  - Energy Sorghums
    - Development
    - Challenges

Emphasis on Subtropical/Temperate Environments means....the fall/winter season precludes year round production.

Implication: *Year round production (just-in-time harvest) is not possible.*

# Sorghum Types and Use

- **Grain Sorghum**
  - Grain
  - Stover
- **Forage Sorghum**
  - Hay, Grazing
  - Silage
- **Sweet Sorghum**
  - Accumulate sugar in the stalk
- **Energy Sorghum**
  - Delayed flowering in temperate environments



# Why Sweet Sorghum in U.S.?

- High Yield Potential
  - Sugars, Starch, and Lignocellulose
- Harvest Flexibility
  - Ratoon
  - Staggered Planting
- More Water-Use Efficient than other sugar production crops
- Sugar to Ethanol is proven technology....

# Sweet Sorghum

- Component Yields
  - Sugars in Juice from Stalk
  - Starch in Grain
  - Structural Carbohydrates in bagasse
- Production System use combined infrastructure
  - Sorghum-based planting
  - Modified Sorghum Production model
  - Modified Cane-Based harvest system
  - Modified Cane-Based Processing System



# Sweet Sorghum: Challenge No. 1

- Sweet Sorghum Cultivars
  - Low seed yield
  - Difficult to produce
  - Don't capture heterosis
- Sweet Sorghum Hybrids
  - Subtropical/Temperate Adaptation
  - High Sugar Yield
    - High Sugar Content in Juice
    - High Juice Yields

# Sweet Sorghum Hybrid Development in Texas AgriLife Research

- Seed Parent Development
  - High Brix
  - Short Height
  - Med to High Juice Volume
  - Good Seed Production
  - Daylength Insensitive
- Seed Parent Distribution
  - Available through Texas AgriLife/TAMU OTC
- Hybrid limitations will be solved quickly.

# Sweet Sorghum: Challenge No. 2

- Short harvest season in temperate zones
  - Reduces Length of Mill Season
- Seasonal limitations in subtropical zones
  - Sugar yields / biomass yields vary across seasons
  - Cropping systems for sweet sorghum are important

# Sweet Sorghum: Challenges

- Challenge No. 3
  - Hybrid sweet sorghum produces starch (primarily in grain);
    - Harvest/Processing Systems
    - Plant physiological processes must be modified through genetics and breeding
- Challenge No. 4
  - Need Agronomic and Pest Management Practices for Sweet Sorghum

# Energy Sorghum



# Why Energy Sorghum in U.S.?



- Photoperiod Sensitive - Reproductive growth is initiated in response to increasing night length/diminishing daylengths
  - genotype defines trigger
  - ranges from 13'30" to as low as 11'30" (daylength)
- Why is this Beneficial?
  - Long Canopy Duration
  - Enhanced Drought Tolerance
    - Vegetative Growth
    - Quiescent Periods
  - Higher Biomass Yields and less sensitive to timing of moisture

# Energy Sorghum

- Component Yields
  - Ligno-cellulosic biomass
  - minimal, if any, sugar or starch
- Hybrids
  - Dual Purpose (multicut)
  - Bioenergy (single cut)
- Production is roughly modeled on Forage Production Systems.



# Development of Energy Sorghum



- Germplasm Development
  - High Yield
  - No Lodging
  - Dry Matter
  - Composition
- Breeding
  - Hybrid Development and Testing
- Existing Hybrids are good....
- Future Hybrids will be better....

# Ceres-Texas AgriLife Sorghum Commercialization



**BLADE**™  
ENERGY CROPS

- **Products from collaboration will be sold under Ceres' Blade brand**
  - High biomass and sweet types
- **Late-stage trials & seed scale-up**
- **Royalties support future research**

# Energy Sorghum: Challenges

- Challenge No. 1
  - Efficient and economic biofuel conversion system for lignin, cellulose and hemicellulose
- Challenge No. 2
  - Modification of NSC composition to match conversion system
  - Genetic manipulation of PS systems to match production regions

# Energy Sorghum: Challenges

- Challenge No. 3
  - Efficient agronomic production practices
- Challenge No. 4
  - Efficient harvest, storage and pre-processing practices



**“Sorghum is drought tolerant and performs well on marginal soils.”**

- **Crop specialists interpretation:**  
*Compared to other crops, sorghum will yield under stress.*
- **Non crop specialist's interpretation:**  
*Sorghum is a crop that will produce high yields with very little water and little, if any, fertilizer.*
- **Reality:**  
*Sorghum will produce proportionally to inputs*

# Summary

- Sorghum is the logical choice for use as an annual dedicated bioenergy crop
- Sweet sorghum have potential in specific production regions
- Energy sorghums have wider adaptation and greater potential in temperate regions.
- There are challenges to be solved; it will require research.

# Questions?

