



# Bioenergy Program

---

**Robert V. Avant, Jr., P.E.**  
**Bioenergy Program Director**

Improving Life through Science and  
Technology.



# Outline

---

- Texas AgriLife Research
- Bioenergy Feedstocks, Logistics, and Development Issues

**The Texas A&M University System**

**Texas A&M AgriLife**

**10 Universities  
7 State Agencies**

**Texas A&M Engineering**

**College of Agriculture and Life Sciences  
Texas A&M University**

**Texas AgriLife Research**

**Texas AgriLife Extension**

**Texas Forest Service**

**Texas Veterinary Medical  
Diagnostic Laboratory**

**Dwight Look College of Engineering  
Texas A&M University**

**Texas Engineering Experiment Station**

**Texas Engineering Extension Service**

**Texas Transportation Institute**





# Texas A&M AgriLife

## College of Agriculture and Life Sciences

- **14** academic departments
- **350 faculty**
- **6,689** College Enrollment
  - **5,613** undergraduate students
  - **1,076** graduate students
- **Ranked among top 3 U.S. Ag schools**
- Biological and Agricultural Engineering Department ranked #2 in nation
- 1 Nobel Laureate & 3 Wolf Prize Recipients
- 4 faculty in National Academy of Sciences

*FY 2009 data*

## Texas AgriLife Research

- 13 Research & Extension Centers
- 859 Contract & Grant Awards
- \$68 million in Contracts & Grants
- \$171 million in Total Expenditures
- 380 faculty located statewide
- 7 Institutes

## Texas AgriLife Extension

- **950** professional educators across Texas
- **14.1 million** direct teaching exposures in Texas in 2007



# Agricultural Critical Mass!

---

## Departments (14)

- Agricultural Economics
- Agricultural Leadership, Education & Communication
- Animal Science
- Biochemistry/Biophysics
- Biological & Agricultural Engineering
- Ecosystem Science & Management
- Entomology
- Horticultural Sciences
- Nutrition & Food Sciences
- Plant Pathology & Microbiology
- Poultry Science
- Recreation, Parks & Tourism
- Soil & Crop Science
- Wildlife & Fisheries Sciences



# Agricultural Critical Mass!

---

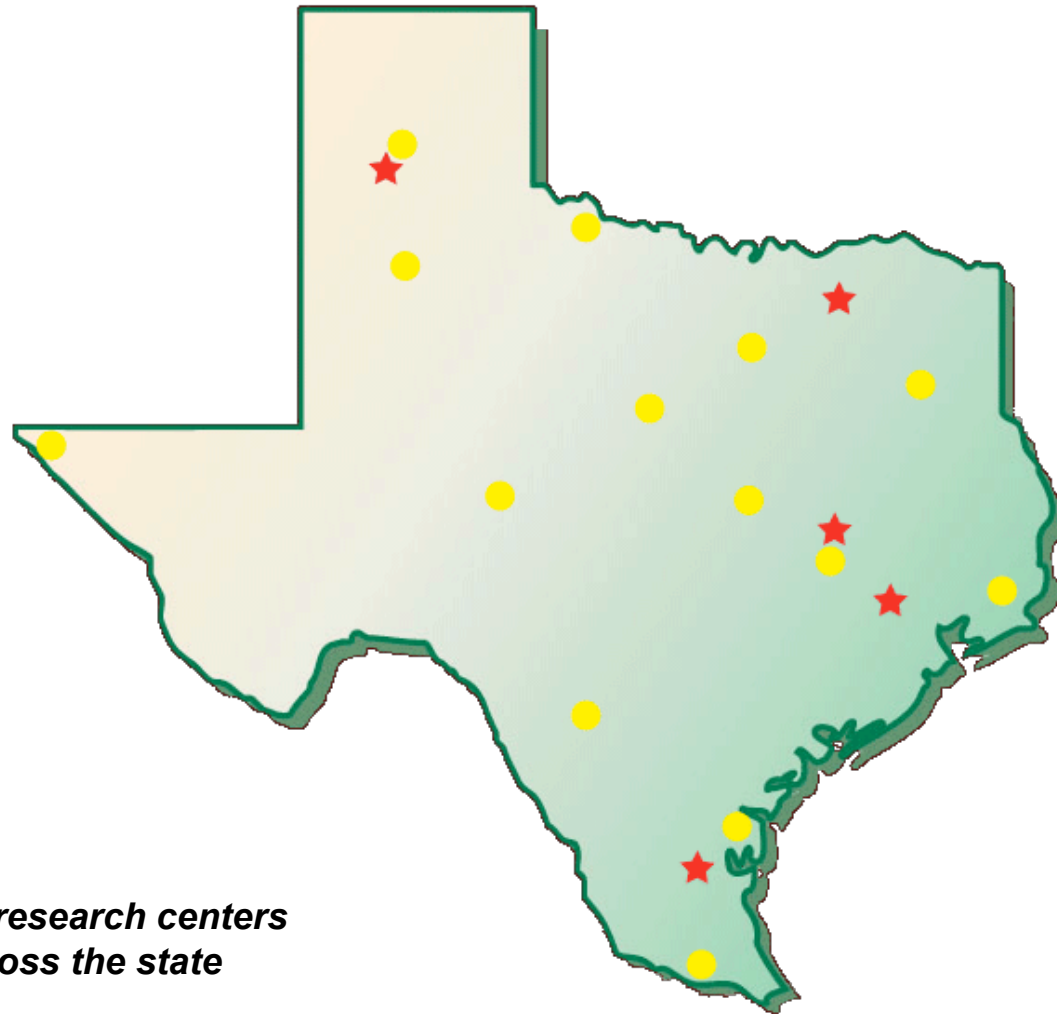
## Research and Extension Centers (13)

- Amarillo
- Lubbock
- Vernon
- El Paso
- San Angelo
- Uvalde
- Stephenville
- Dallas
- Overton
- Beaumont
- Temple
- Corpus Christi
- Weslaco

## Stations, Farms, & Facilities

- Fort Stockton
- Port Aransas
- Alice
- Etter
- Chillicothe
- Beeville
- Barnhart
- Sonora
- Eagle Lake
- McGregor
- Pecos
- A&M Research Farm
- Stiles Farm
- AG-CARES
- Halfway (Helms)
- Proctor

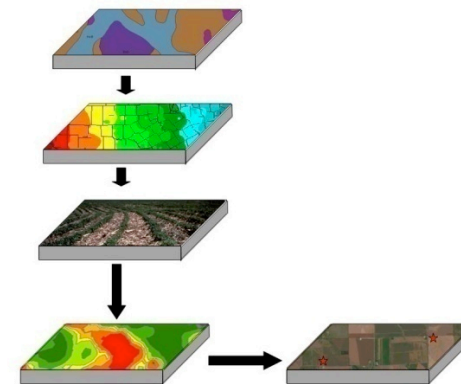
# Texas AgriLife Research Centers



*13 research centers  
across the state*

# Texas AgriLife Research Bioenergy Strategic Approach

- Develop dedicated lignocellulosic and oilseed **feedstock crops** that do not compete with food or feed.
- Screen and characterize land for biomass production using **modeling** to determine economic and sustainable production areas.



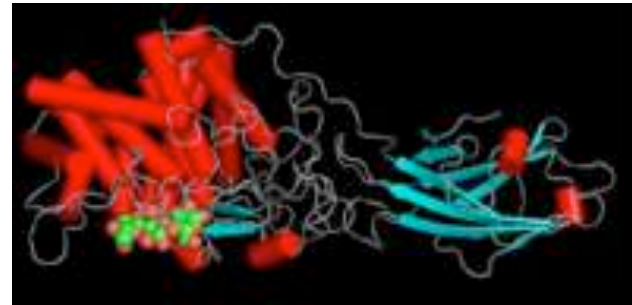
# Texas AgriLife Research Bioenergy Priorities

- Develop **agronomic practices** for sustainable production systems on diverse soil types.
- Develop **production logistics** to efficiently produce, harvest, transport, and store biomass 24/7/365.



# Texas AgriLife Research Bioenergy Priorities

- Optimize **microbial/enzymatic systems** to facilitate more cost effective conversion.
- Optimize cellulosic and thermal **conversion technologies** to improve biofuels economics.
- Evaluate sustainable **economic, policy, and environmental approaches.**





# Bioenergy Research Program

---

- Over 40 projects with a portfolio value of about \$30 million
- Major programs with:
  - Ceres (Sorghum)
  - Chevron (Oil seeds and energy cane)
  - General Atomics (Algae)
  - State of Texas (ETF and appropriations)
  - U.S. Govt.
  - Sungrant



# Outline

---

- Texas AgriLife Research
- Bioenergy Feedstocks,  
Logistics, and Development  
Issues



# Bioenergy Issues

---

- How much potential is there?
- What are the leading feedstocks?
- What conversion technologies might win out?
- How will biomass production affect the food vs fuel issue?
- What are the impacts on water usage?
- What are the carbon impacts?
- What are the impacts on animal agriculture?
- How can bioenergy crops be produced in a sustainable manner?
- Do we have available land?

# Assumptions to Meet Biomass Requirements

---

- Land/feedstocks available
- Equipment technology / logistics available
- Producer/Land Owner buy-in (\$)
- Conversion technologies progress as expected



# Lignocellulosic Crops

## High-tonnage sorghum (Annual)

- Long Canopy Duration
- Drought Tolerant
- High Biomass Accumulation (expect >15-20Tons/acre)

## Sweet Sorghum (Annual)

- High sugar content
- Drought Tolerant
- Med. Biomass Accumulation (5-10Tons/acre)

## Energy Canes (Perennial)

- Sub-tropical production
- High water demand
- High Biomass Accumulation (20+ Tons/acre)

## Grasses (Perennial)

- Drought Tolerant
- Marginal lands
- Med. Biomass Accumulation (5-10Tons/acre)



# Energy Sorghum





# Bottom Line for Dedicated Bioenergy/Biofeedstock Crops

- High tonnage production(15+ DT/ac) on good soils in rotation  
(Marginal lands (perennials) can help but high production on good soil is critical.)
- Moderate to high nutrient input  
(To produce biomass, nitrogen and other nutrients are needed.)
- Adequate moisture  
(Consistent rainfall of 30+ in/year, surplus irrigation capabilities, or drought tolerant crops will be required.)



# Key Elements of Production/ Delivery System

---

- High tonnage feedstocks
- Proven agronomics
- No-till/ridge till
- Minimized equipment requirements
- Composition suited to conversion technology
- Feedstock available through extended periods
- Low moisture content
- Flowable material from field
- Just in time delivery, year round
- Stockpiles

# Biomass Cost?

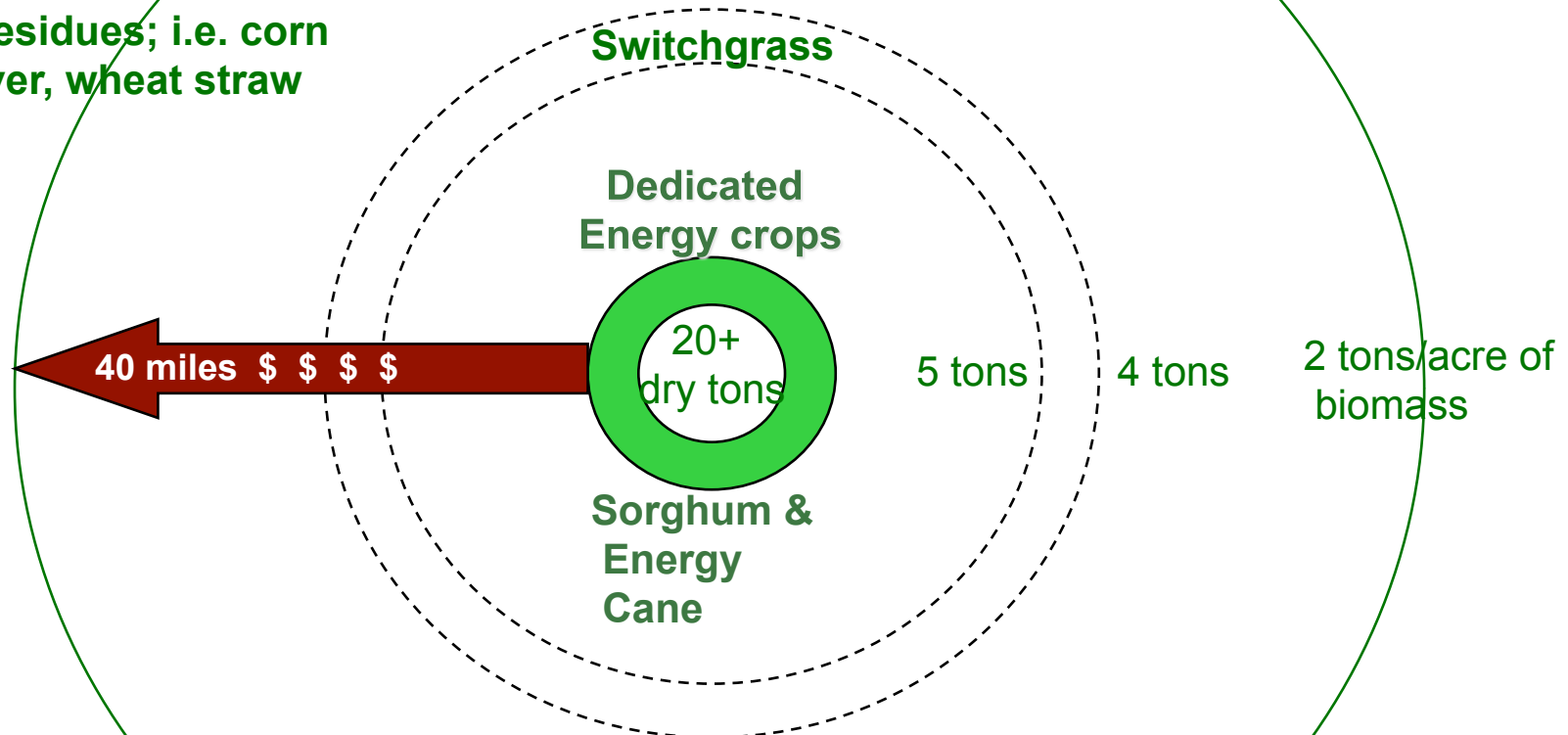
Biomass that can be produced per acre (dry tons)

	Residue	Woody Biomass	Switch Grass	Forage Sorghum	Bioenergy Sorghum
<b>Biomass per acre per year that can be converted (DT)</b>	<b>2</b>	<b>5-10</b>	<b>8</b>	<b>10</b>	<b>15-20</b>
<b>Estimated cost delivered to converter</b>	<b>\$60+</b>	<b>\$50-75</b>	<b>\$60-90</b>	<b>\$65</b>	<b>\$50-60</b>

High tonnage crops = More compact production footprint  
Shorter haul distances  
Lower delivered costs

# A New Paradigm for Biomass Production

Ag residues; i.e. corn stover, wheat straw



**Economics of Bioenergy Production = Biomass Yield Density, Harvest and Transportation**

<http://www.ceres.net/Products/Products-Ovw-Econ.asp>

# System Logistics

The logistics of producing hundreds of millions tons per year of lignocellulosic feedstocks is the Achilles' Heel!

- Production
- Harvesting
- Transporting
- Storage
- Processing



**To meet USDOE projections, 110,000 truck loads per day required!**



# Requirements for a Sustainable Bioenergy/Bioproducts Economy

---

- Consistent energy/biofuels policy
- Oil prices > \$60/barrel?
- Loan guarantees for early projects
- Technology advances
- Markets for biofuels
- Positive economics
- Environmentally sound production practices
- Positive Life Cycle Analysis



# Questions