2009 ESS/SAES/ARD Meeting and Workshop

Schedule

September 14 - 17, 2009

Oklahoma City, OK

MONDAY, September 14, 2009	
3:00 - 6:00	Regional Meetings
6:00	**Opening Reception**
TUESDAY, September 15, 2009	
7:00 - 8:00	**Breakfast**
8:00 - 10:00	**Welcome** - Bob Whitson, Vice President, Dean and Director, Division of Agricultural Sciences and Natural Resources, Oklahoma State University **Overview of Oklahoma** - Clarence Watson, Oklahoma State University **Oklahoma Agricultural Experiment Station Research Highlights** Speakers - **Jacque Fletcher** , Director, The National Institute for Microbial Forensics & Food and Agricultural Biosecurity, "Protecting America's Food, Fiber and Fuel" **Sam Fuhlendorf** , Professor, Natural Resource Ecology and Management, "Fire: its Role in Sustainable Production and Conservation of Natural Resources" **Ray Huhnke**, Professor, Biosystems and Agricultural Engineering, "Bioenergy Research at OSU - From Field to Fuel" **Brett Carver**, Regents Professor, Plant and Soil Sciences, "OSU's Wheat Improvement Team: Sky's the Limit"
10:00 - 10:30	**Break**
10:30 - 12:00	**ESS Business Meeting** - Steve Pueppke, Michigan State University
12:00 - 1:30	**Lunch**
1:30 - 3:00	**ESS Business Meeting** - Steve Pueppke, Michigan State University
3:00 - 3:30	**Break**
3:30 - 5:00	**Best Practices Session - Managing High Cost Agricultural Research Facilities** Moderator - Eric Young, SAAESD Panelists- **Steve Slack**, The Ohio State University **Lee Sommers**, Colorado State University
	Dinner on your own
WEDNESDAY, September 16, 2009	

7:00 - 8:00	**Breakfast**
8:00 - 9:30	**Renewable Energy: Big Questions, Big Opportunities for Agriculture and the Land Grants** Moderator - Steven Pueppke, Michigan State University Panelists - **Bruce Babcock**, Professor of Agricultural Economics, Iowa State University **Bruce Dale**, Professor of Chemical Engineering and Materials Science, Michigan State University **Maria Gallo**, Professor of Agronomy, University of Florida **Larry Walker**, Professor of Biological and Environmental Engineering, Cornell University
9:30 - 10:00	**Break**
10:00 - 11:30	Science Roadmap **Delphi Survey Results** - Greg Bohach, Utah State University **Breakout Sessions** - Dan Rossi, NERA
11:30 - 1:00	**Lunch**
1:00 - 3:00	**2012 Federal Budget Priorities** **Survey Results and BAC Themes** - David Boethel, LSU AgCenter **Breakout Sessions** - Mike Harrington, WAAESD
3:00 - 3:30	**Break**
3:30 - 5:00	**Research Constraints Related to Intellectual Property and Genetic Modification** Moderator - Arlen Leholm, NCRA Panelist - **Ralph Cavalieri**, Washington State University **Elson Shields,** Professor of Entomology, Cornell University **Keith Jones,** Intellectual Property Director, Washington State Univ.
5:30	Load buses for National Cowboy & Western Heritage Museum
6:00 - 10:00	**Museum Visit and Banquet**
THURSDAY, September 17, 2009	
7:00 - 8:00	**Breakfast**
8:00 - 10:00	Meeting room available if needed

WELCOME

TO

OKLAHOMA

Oklahoma

69,898 sq. mi.

Oklahoma: Native America

- Choctaw for "red people"
- 39 Native American Tribes
- 2nd largest tribal population in USA

Oklahoma: State Flag

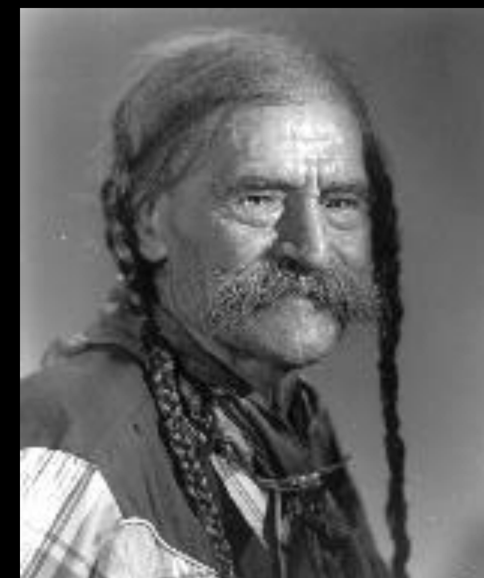
- Red flag 1911-1925, after Russian revolution 1917 it was disfavored. Red flag w/ white star reflected communism.
- New- Osage warrior shield, 7 eagle feathers, peace pipe, olive branch, 6 white crosses (stars), blue background from a flag the Choctaw soldiers carried during the Civil War. “Oklahoma” added in 1941.

Oklahoma: History

Land run of 1889

- High noon April 22, 1889
- 50,000 people settled 2 million acres in central Oklahoma with 160-acre claims
- Early claim stakers hid out and arrived at the choice homesteads – “Sooners”

Frank Eaton (Pistol Pete)
U.S. Marshal – Indian Territory



OKLAHOMA STATE UNIVERSITY

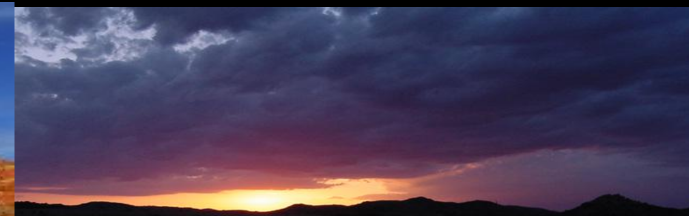
Statehood

Nov. 16, 1907

Oklahoma: The Land

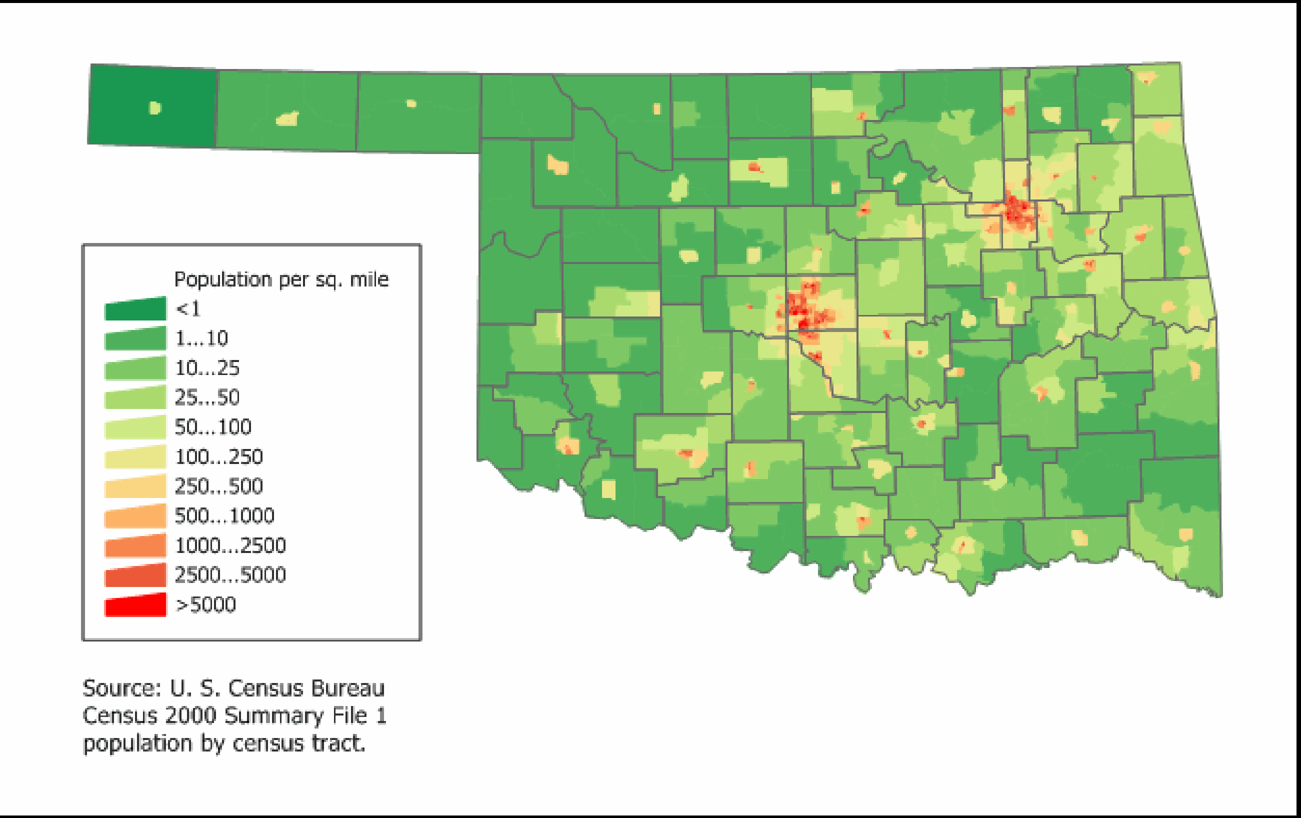
- More shoreline than Atlantic and Gulf coasts combined
- Port facilities to the Gulf of Mexico
- Nation's crossroads

Natural Diversity

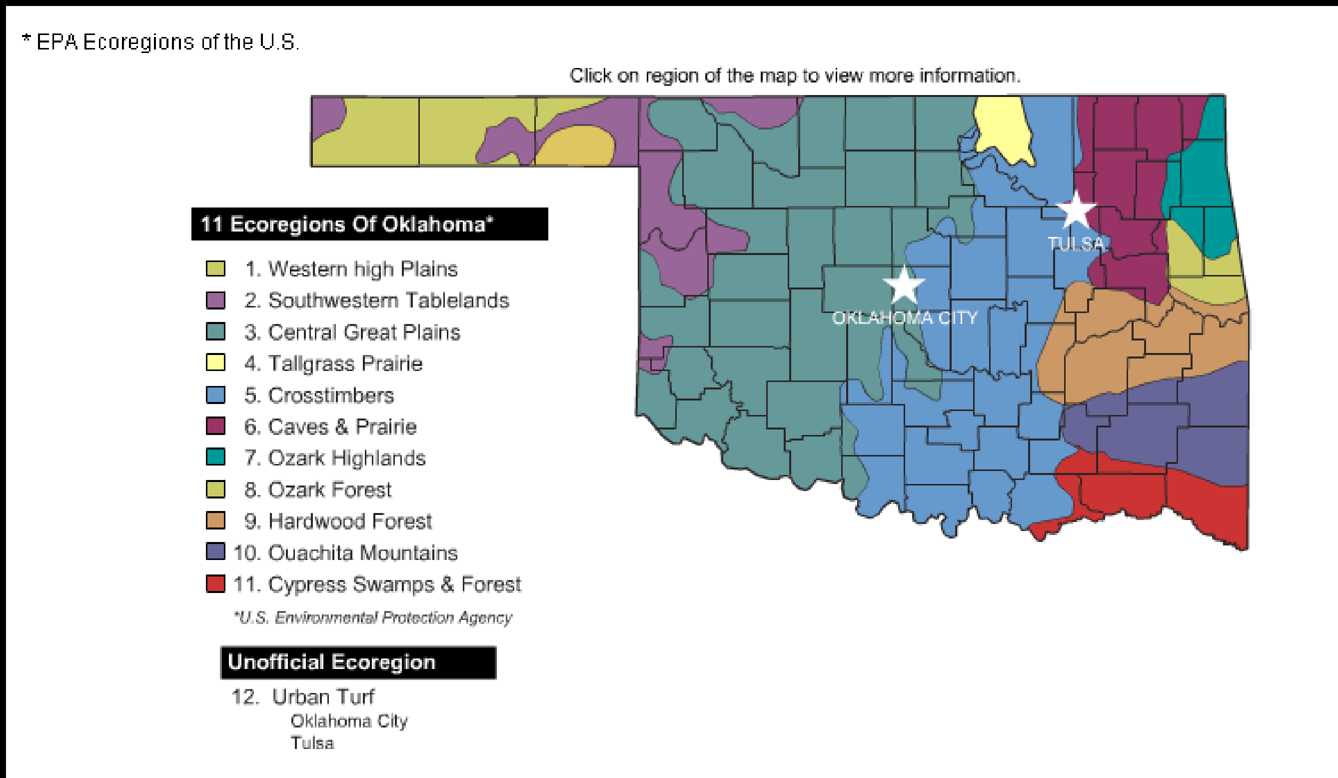


5 distinct climatic zones
11 different ecosystems
2,500 soil types

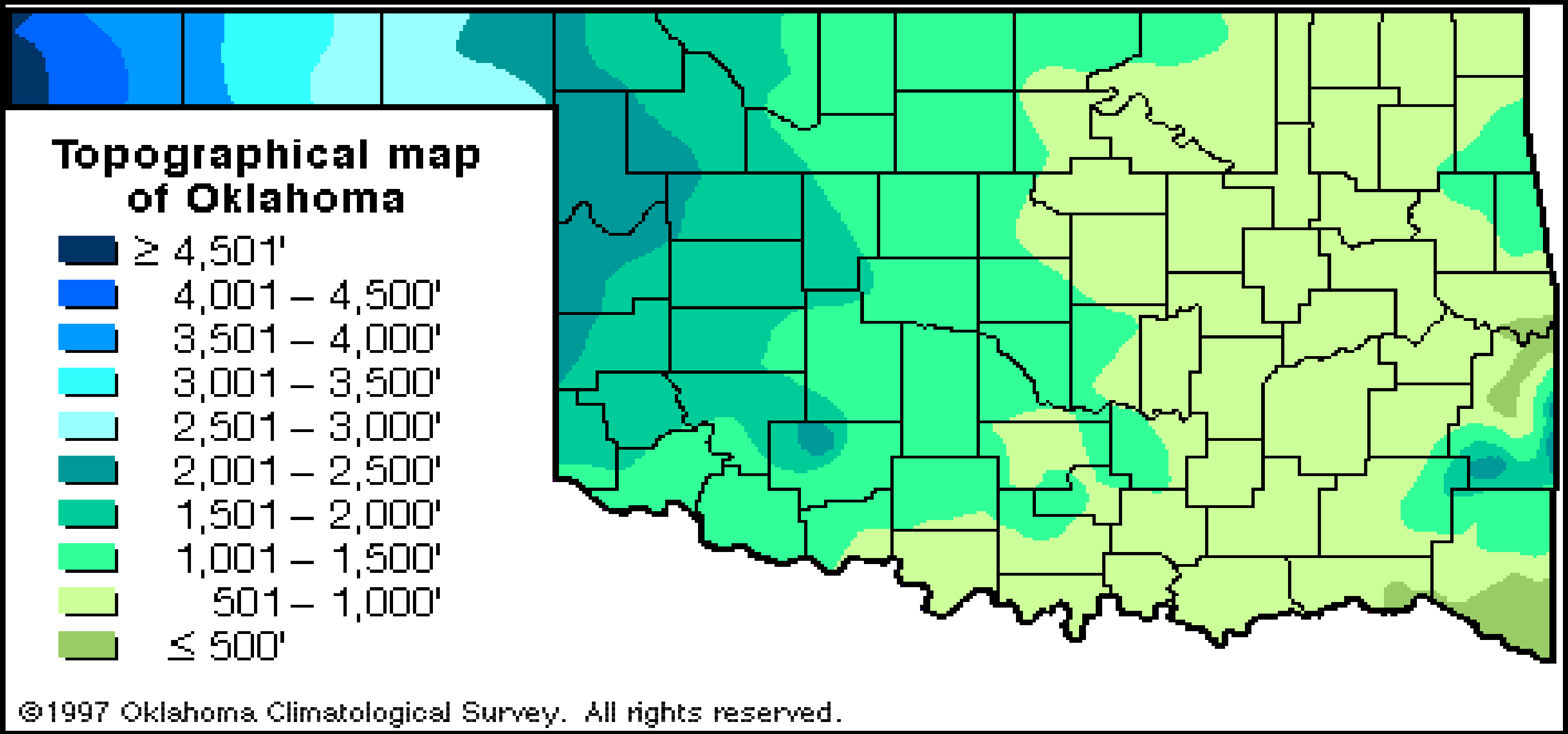
Population – 3.6 M



EPA – Ecoregions



Topography

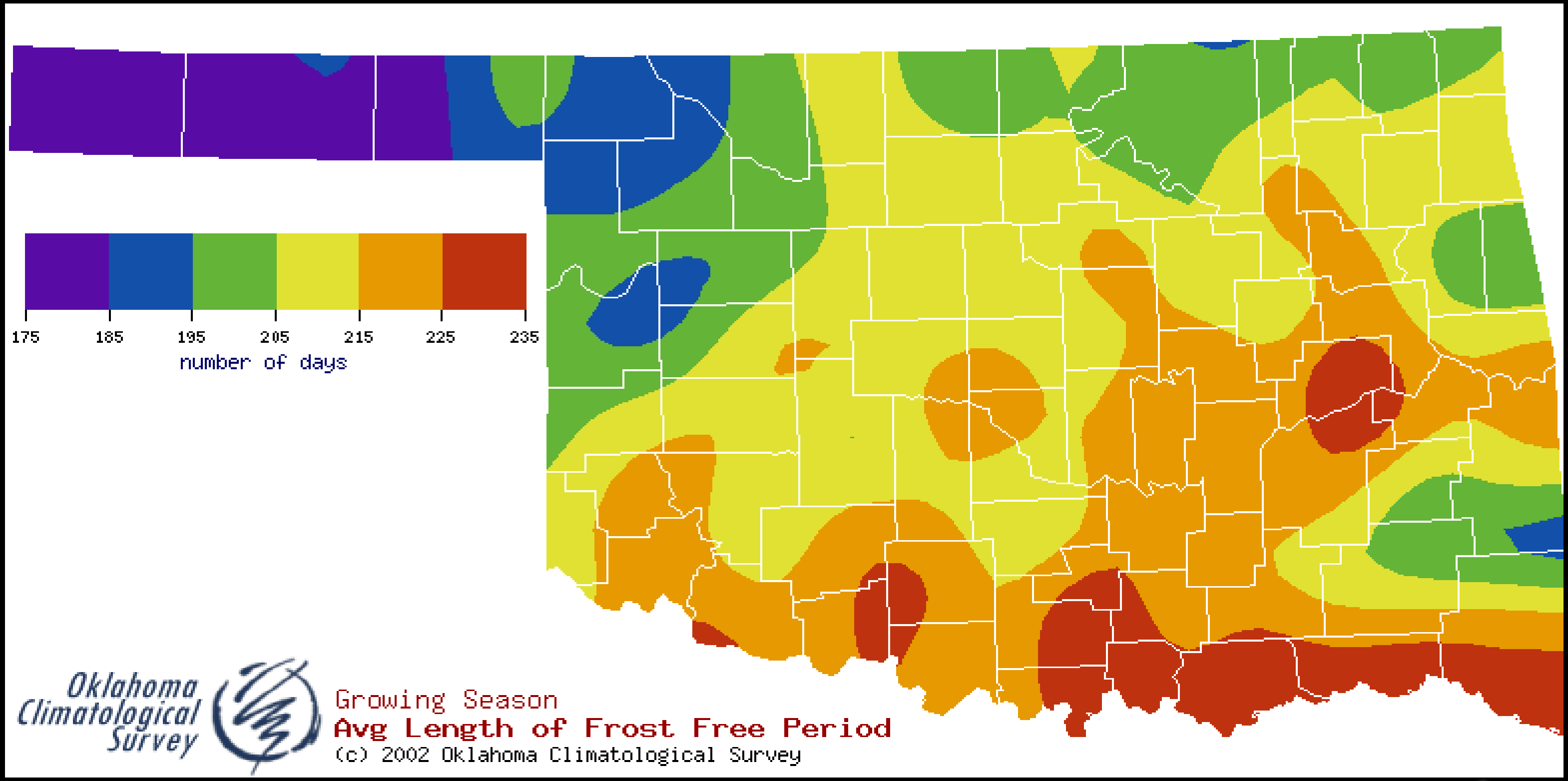


- 289 – 4973 ft

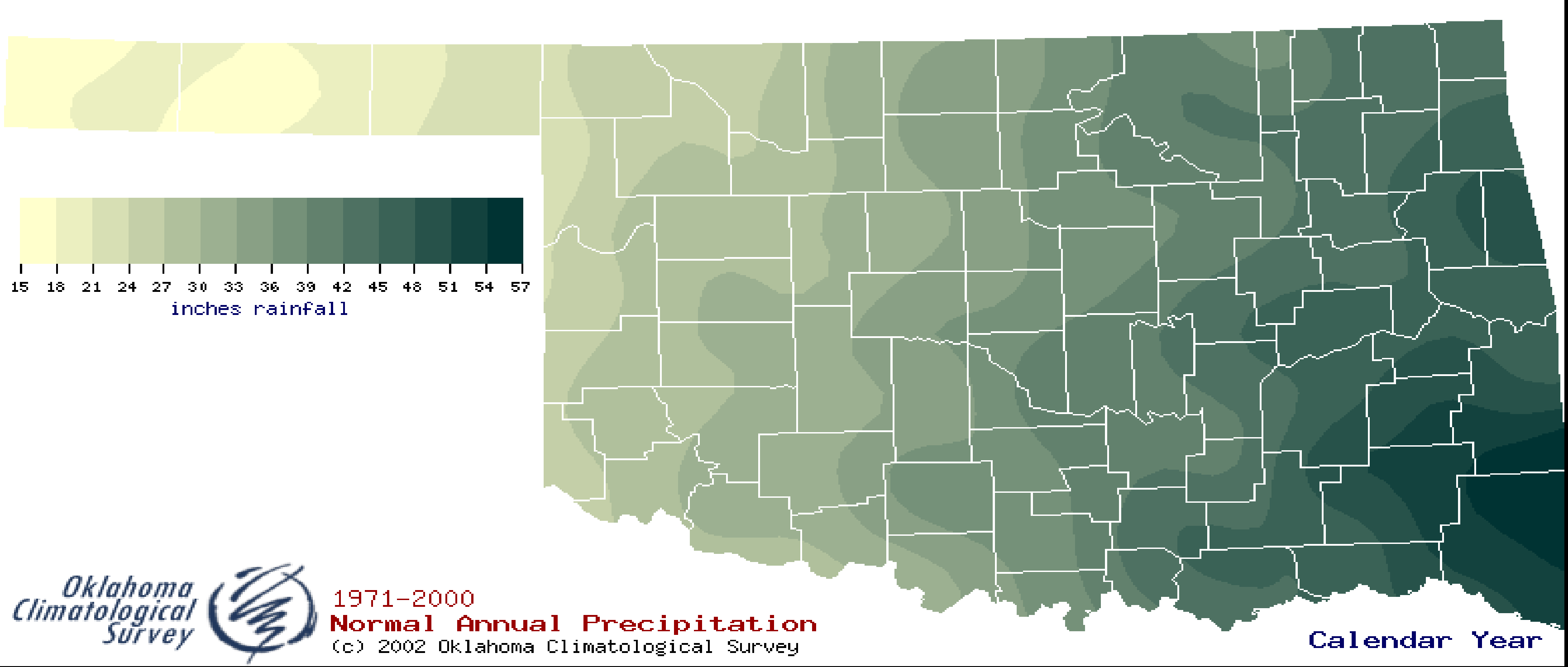
Oklahoma: The Weather

- Four Seasons
  - Hail
  - Tornado
  - Drought
  - Flood

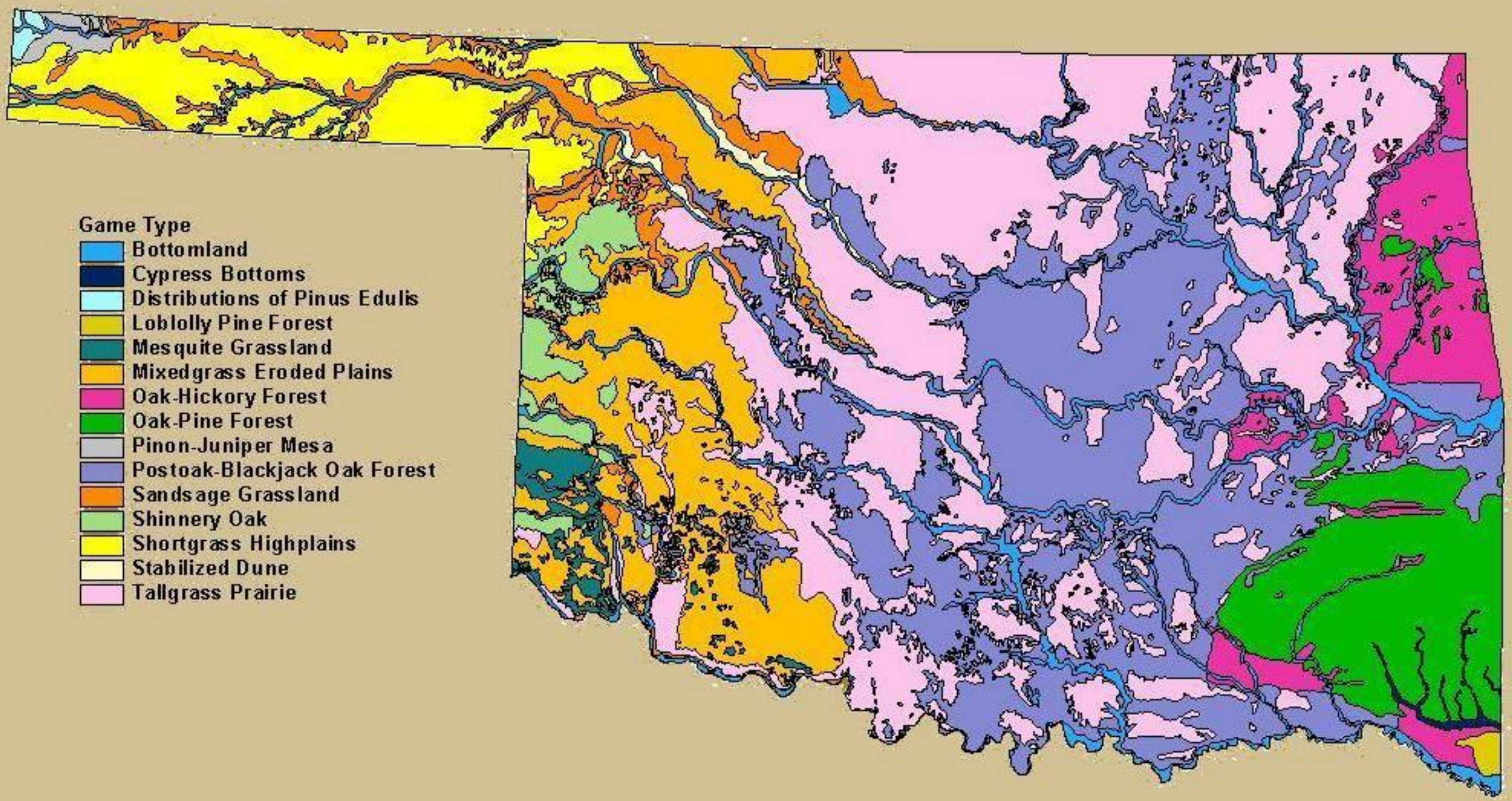
Frost–Free Days



Average Precipitation

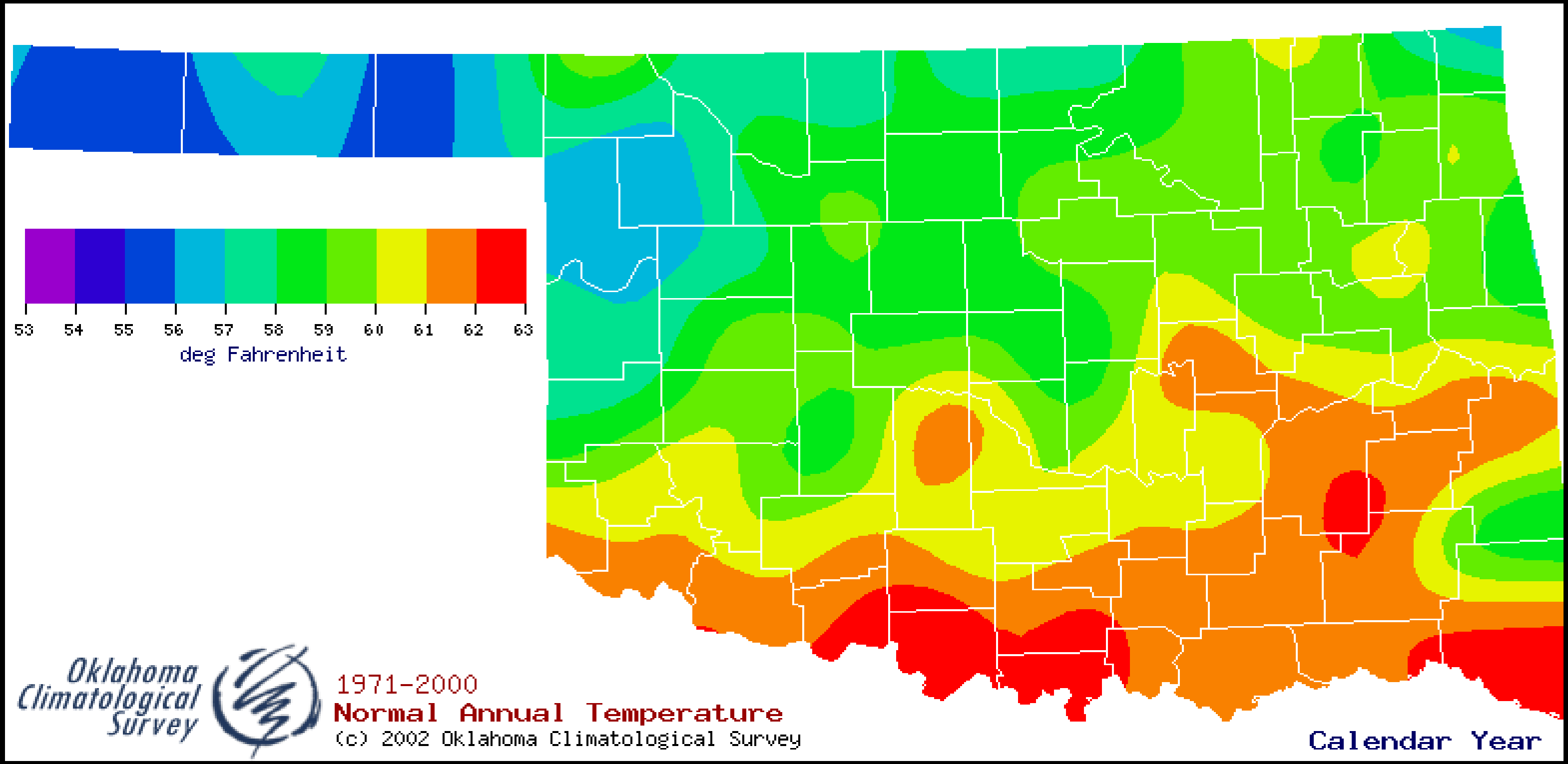


- 14 – 55 in.

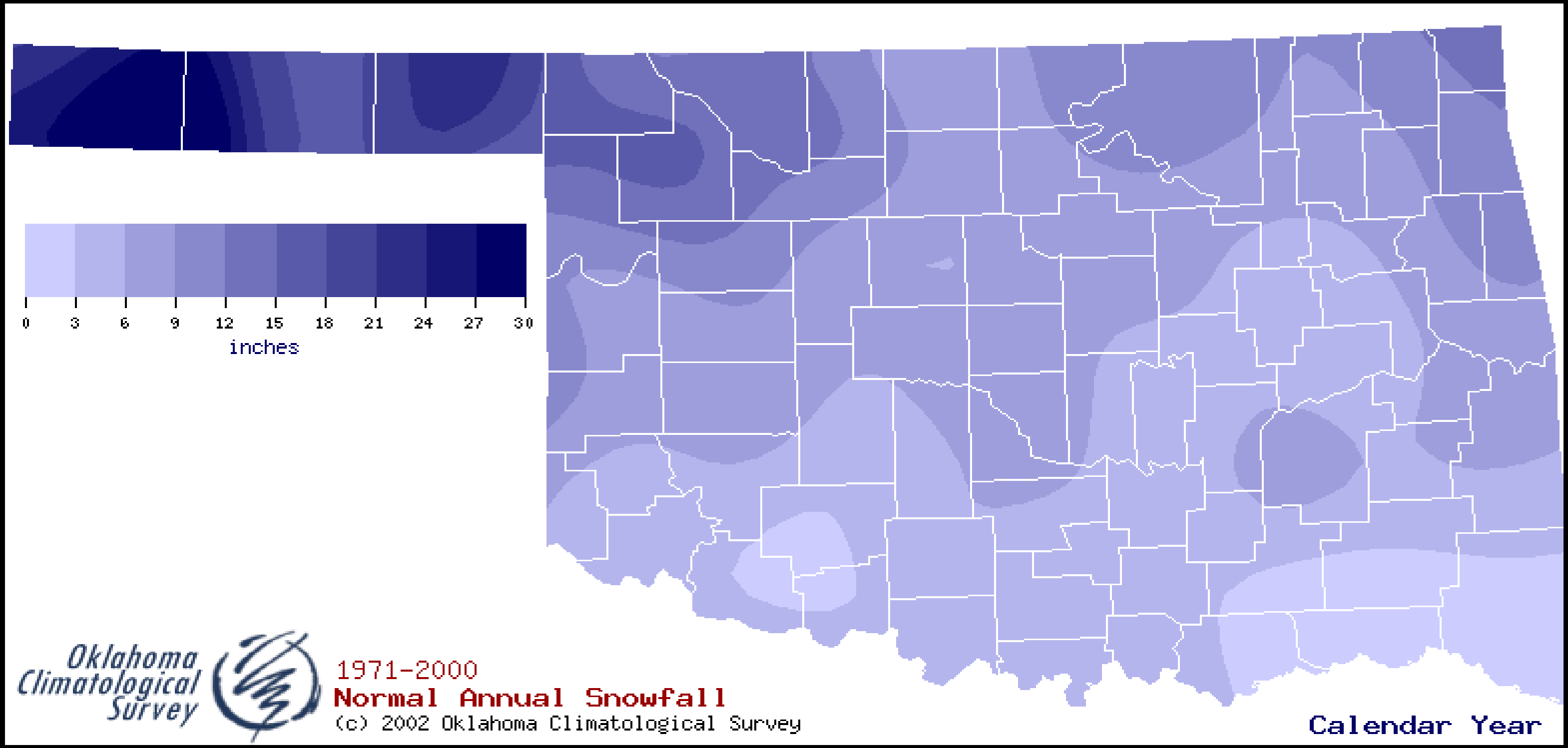


Map courtesy of Oklahoma Biological Survey

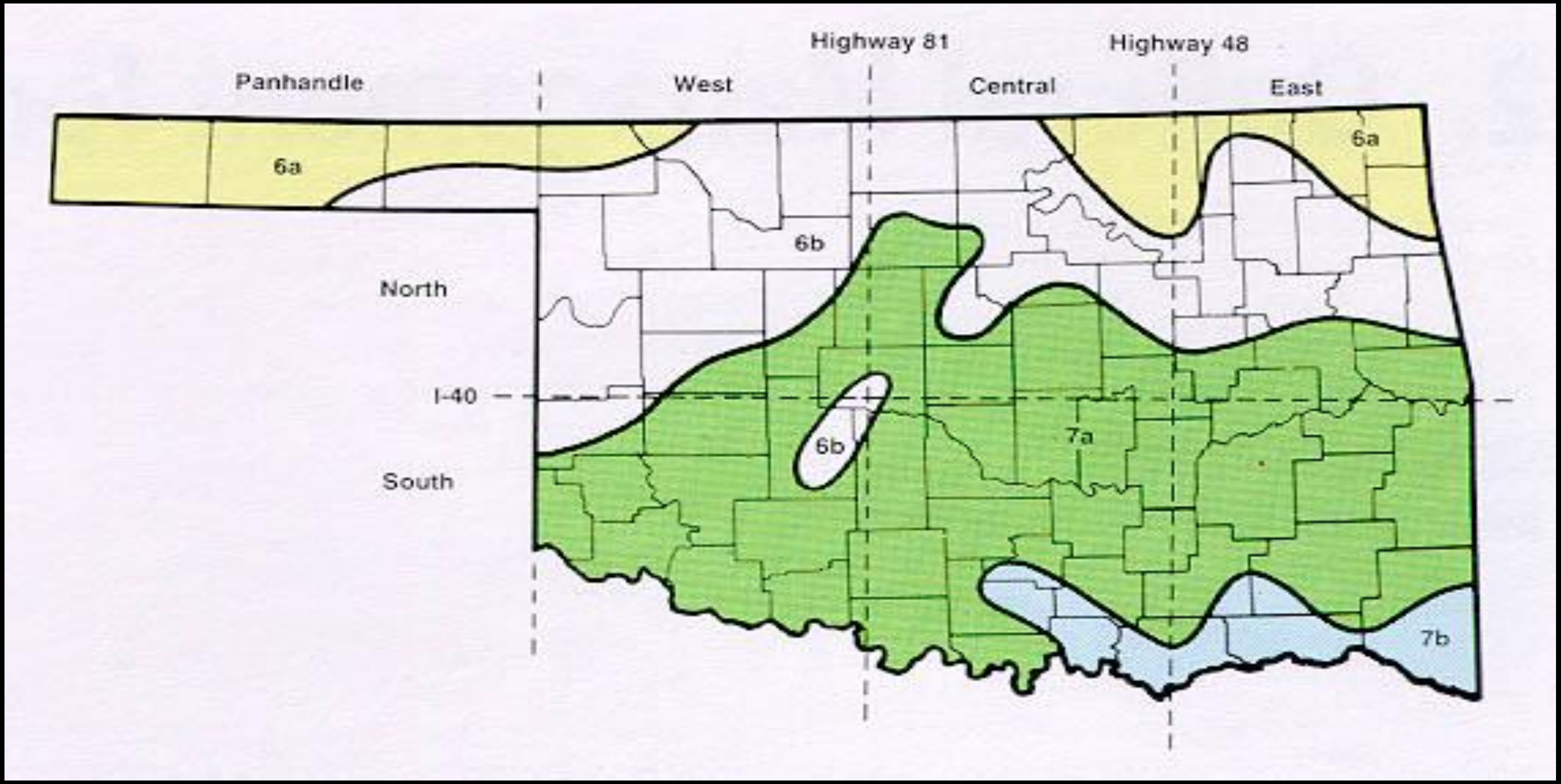
Average Temperature



Average Snowfall



Plant Hardiness Zones



- Zones 6a – 7b

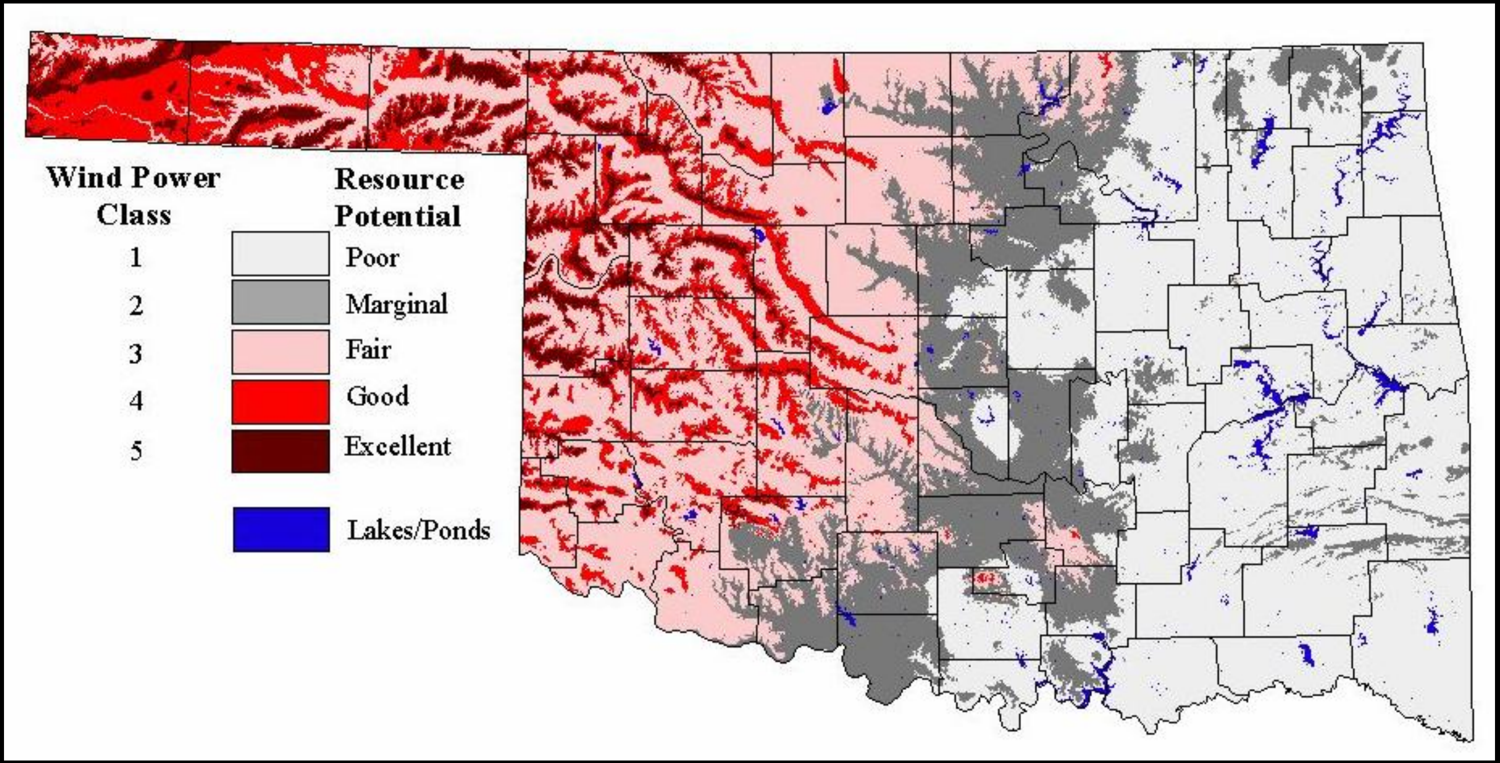
Oklahoma Weather

- It's mostly about the WIND

Oklahoma Wind Resource Map

Estimated Wind Speeds at 50 meters

Map Version Date: 06/01/06

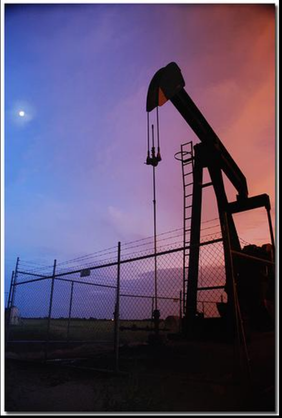


Oklahoma Wind Power Initiative

owpi

Oklahoma: Leading Industries

- Energy
- Agriculture
- Aerospace
- Defense



Oklahoma: Agriculture

Agriculture trails only oil and natural gas in state economic impact

- 34 million acres farmed in state
- 84,000 farms
- 5.4 million cattle (2008)
- 166.5 million bushels of wheat (2008)

Agriculture –2008

- Cattle = $ 2.436 billion
- Wheat = $ 1.104 billion
- Hogs = $ 558 million
- Broilers = $ 554 million
- Hay = $ 479 million
- Dairy = $213 million

- Horse Country, USA

Oklahoma State University

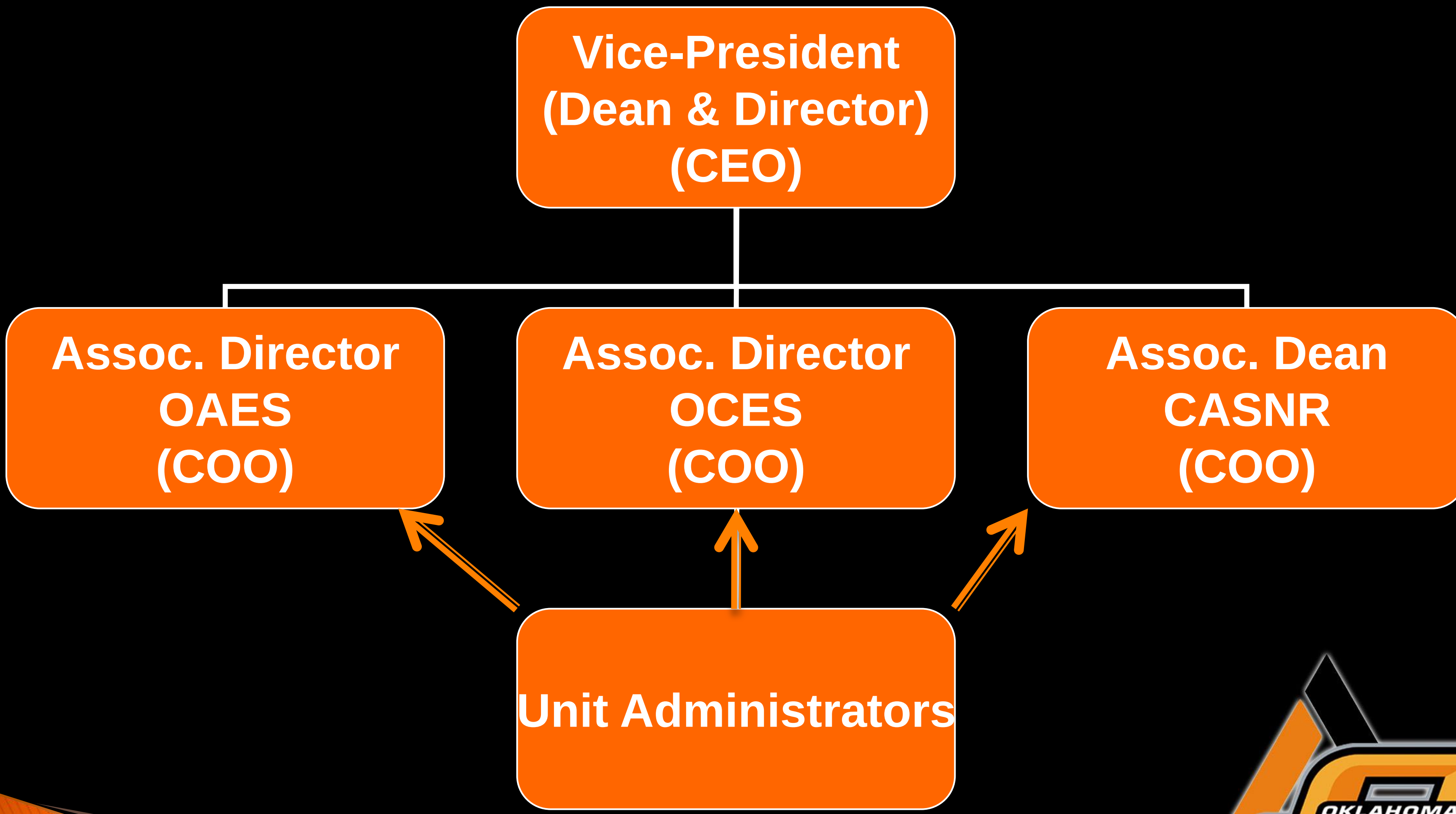
- *An 1862 "land-grant" institution*
- *5-campus system*
- *9 different colleges*
- *$138 million in Total Research Expenditures for 2008*

Oklahoma A& M

Oklahoma AES

1890

DASNR



Vice-President
(Dean & Director)
(CEO)
Assoc. Director
OAES
(COO)
Assoc. Director
OCES
(COO)
Assoc. Dean
CASNR
(COO)
Unit Administrators

Nine Academic Departments

1. Agricultural Economics
2. Agricultural Education, Communications, and Leadership
3. Animal Science
4. Biochemistry and Molecular Biology
5. Biosystems and Agricultural Engineering
6. Entomology and Plant Pathology
7. Horticulture and Landscape Architecture
8. Natural Resource Ecology and Management
9. Plant and Soil Sciences

Other DASNR Programs

- Family and Consumer Sciences
- 4-H Youth Development
- Ag Leadership Program
- Foundation Seed Stocks
- Food and Agricultural Products Center
- Field and Research Services Units

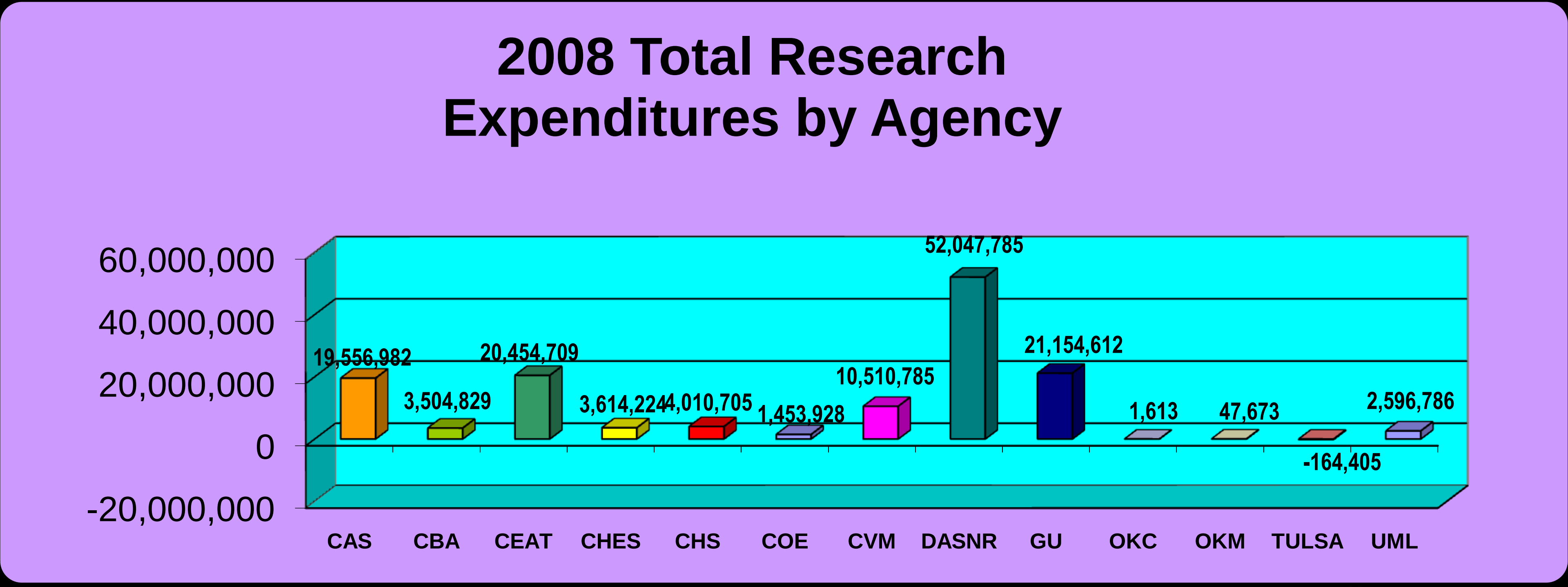
Oklahoma Agricultural Experiment Station

Oklahoma Agricultural Experiment Stations

1. A. Agronomy Research Station - Stillwater
   B. OSU Research Range - West of Stillwater
2. Oklahoma Panhandle Research and Extension Center (OPREC) - Goodwell
3. Southern Plains Research Station (USDA) - Woodward
4. Marvin Klemme Range Research Station - Bessie
5. North Central Research Station - Lahoma
6. Eastern Research Station - Haskell
7. Cimarron Valley Research Station - Perkins
8. Central Oklahoma Research Station Complex
   A. South Central Research Station - Chickasha
   B. Caddo Research Station - Ft. Cobb
9. Southwest Research and Extension Center (SWREC)
   A. Headquarters - Altus
   B. Sandyland Research Station - Mangum
   C. Southwest Agronomy Research Station - Tipton
10. Wes Watkins Agricultural Research and Extension Center - Lane
11. Oklahoma Vegetable Research Station - Bixby
12. Kiamichi Forestry Research Station - Idabel
13. Ardmore
14. Mac Lindley Research & Demonstration Farm -Valliant

Research Expenditures

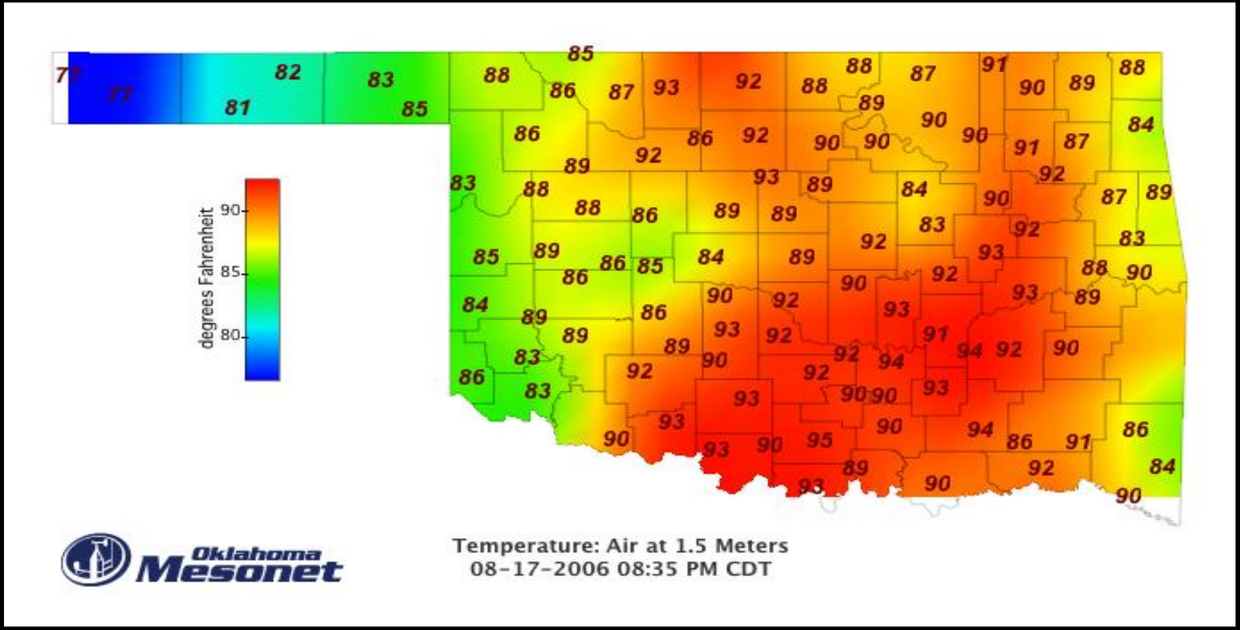
> $ 52,000,000



OAES

- RESEARCH PROGRAMS

Oklahoma Mesonet



Oklahoma Mesonet

- 1982 Oklahoma scientists realized the need for a statewide monitoring system.
- 1987 OSU & OU developed a partnership.
- 1991 first Mesonet towers installed & by 1993, 108 were completely operational.
- No other state in the nation has the capability to measure environmental conditions at so many sites.

National Weather Center

Oklahoma Mesonet

Oklahoma Climatological Survey

Oklahoma State University

Oklahoma State University

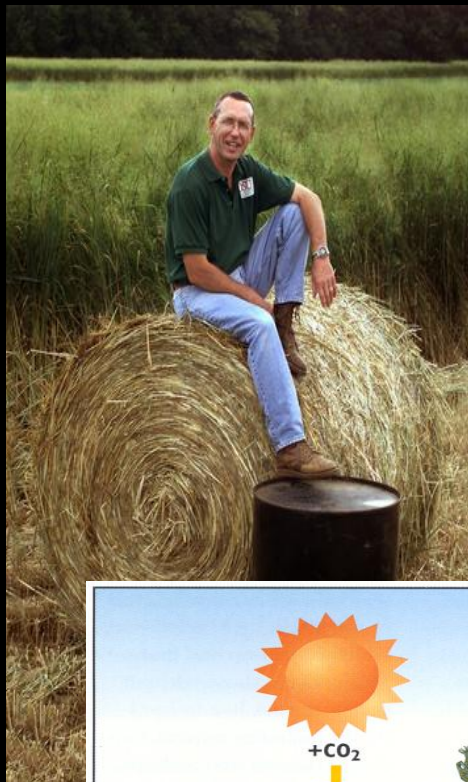
Energy

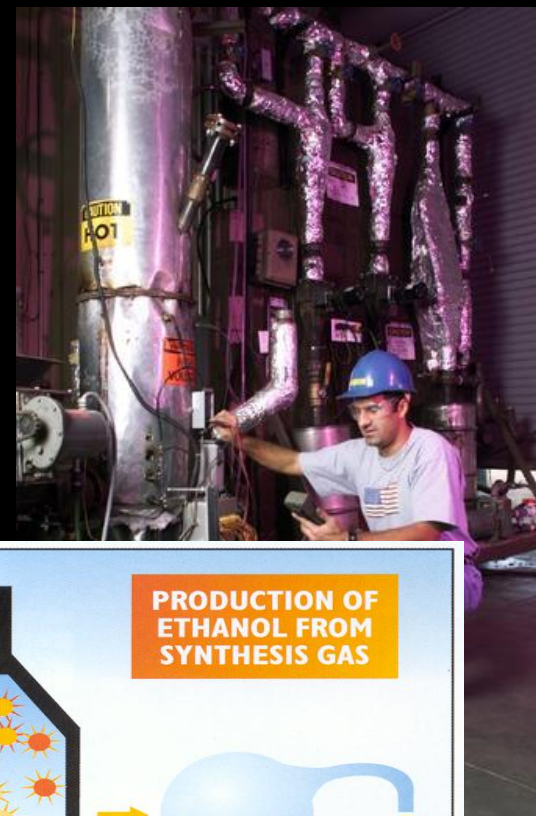
Oklahoma: Energy

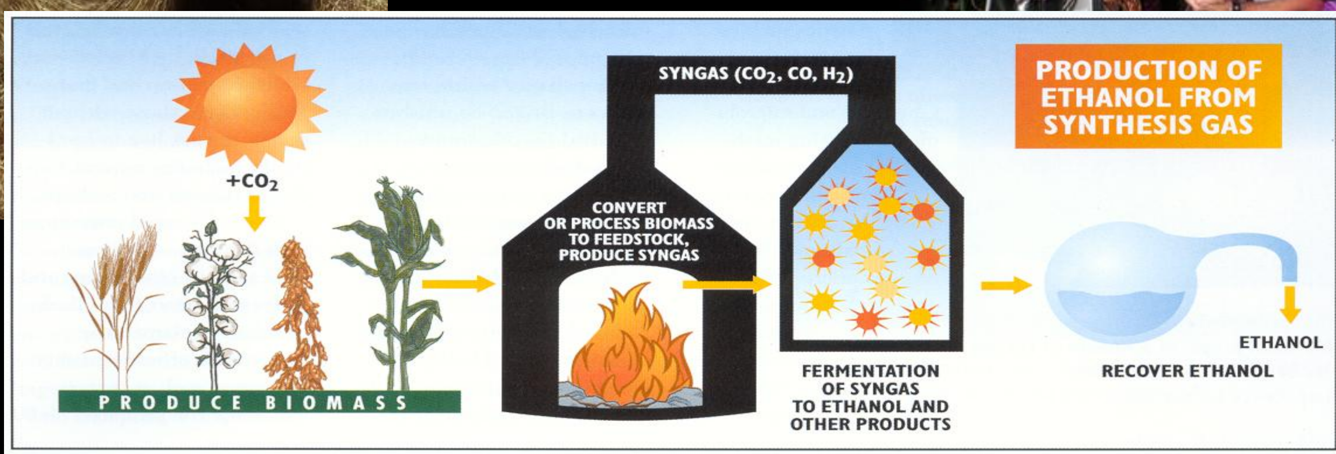
- **Crude Oil** 178,000 barrels/day –2003– 6th nation, 3% of US production
- **Natural Gas** 1.662 trillion cubic ft –2003– 2nd nation, 9% of US production
- 24th in total energy consumption
- 1.5 quadrillion btu’s

Switchgrass

Gasification







Sweet Sorghum

SunGrant

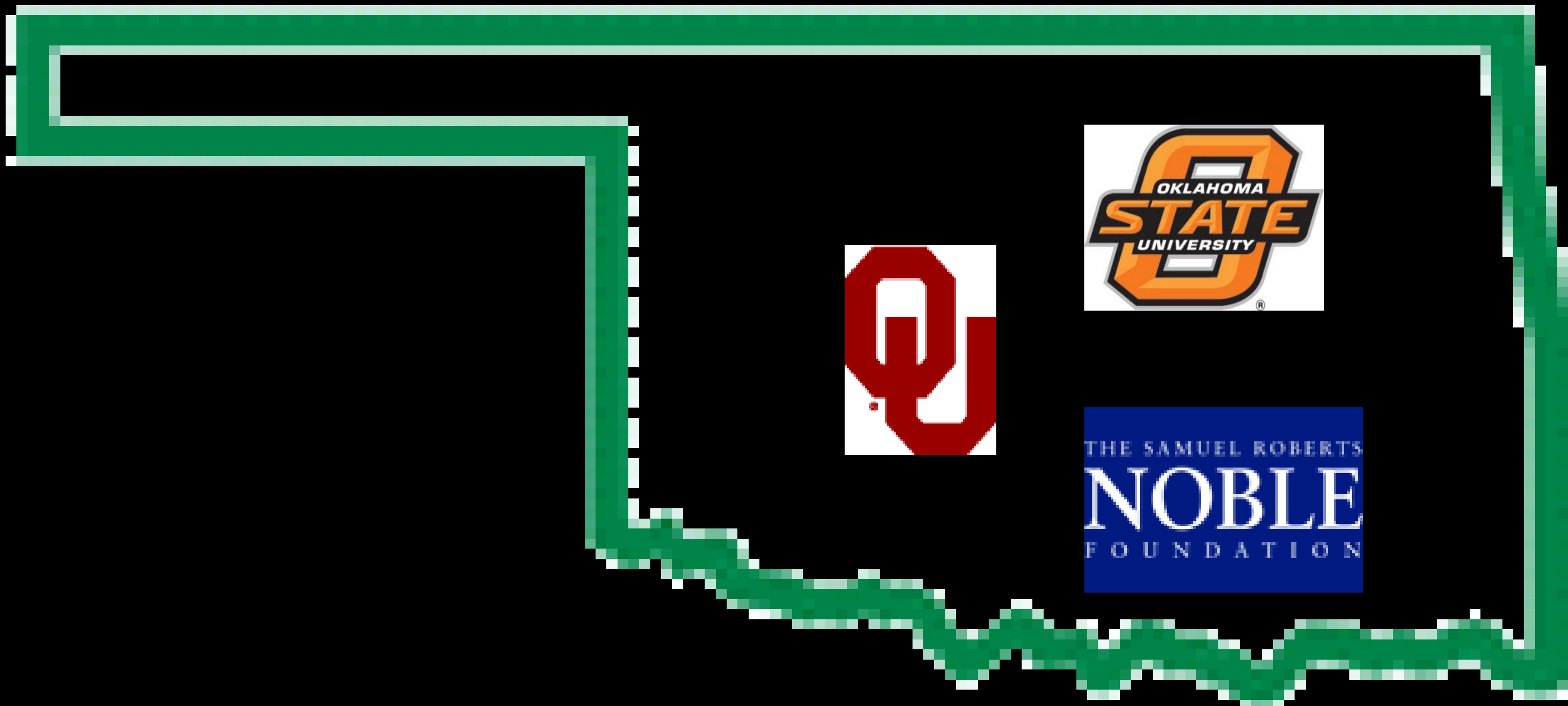
U.S. Department of Transportation

U.S. DEPARTMENT OF ENERGY

USDA

OKLAHOMA STATE UNIVERSITY

Oklahoma BioEnergy Center



- *$10 million, year one*

Bio-Security

NIMFFAB

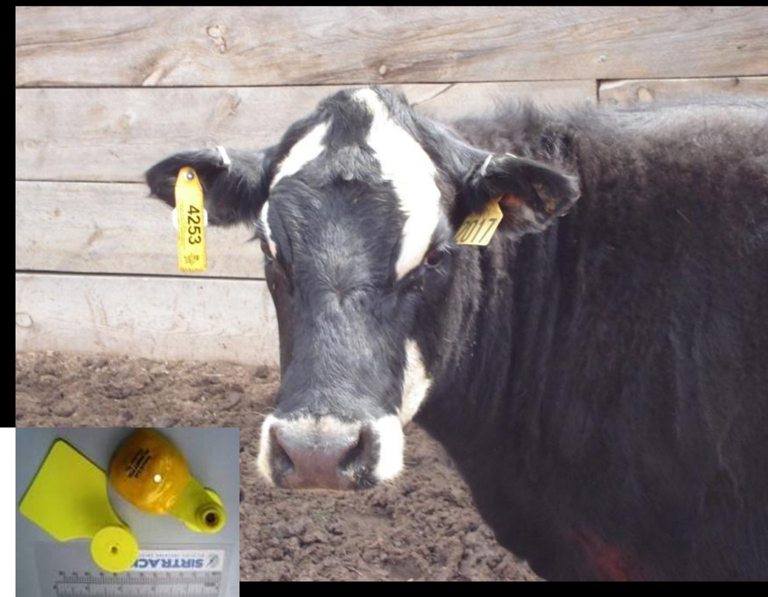
- DASNR
- OSU-Tulsa Health Sciences

Precision Agriculture

Precision Agriculture

GreenSeeker technology - CIMMYT

Precision Agriculture

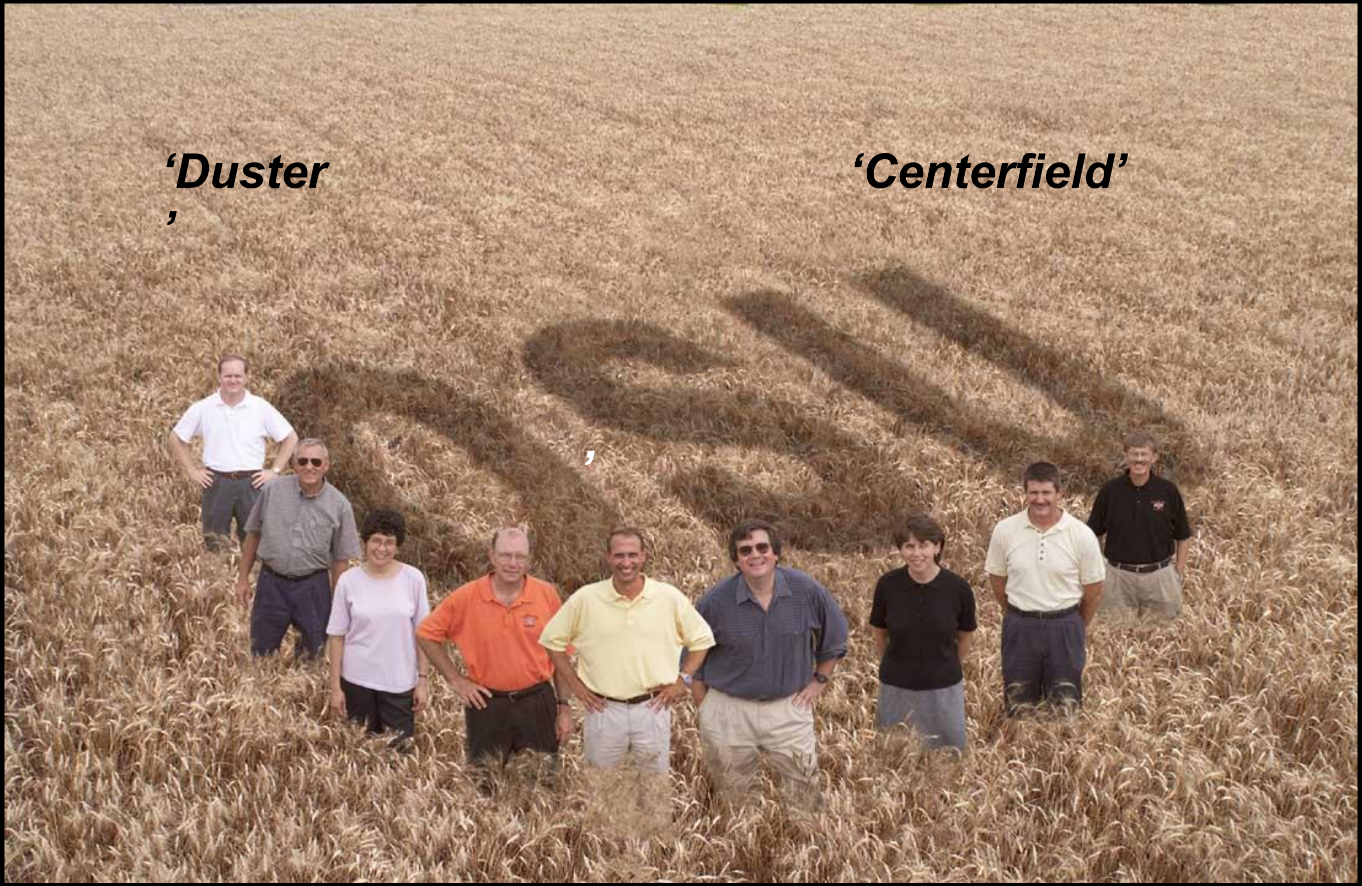


Precision Ranching

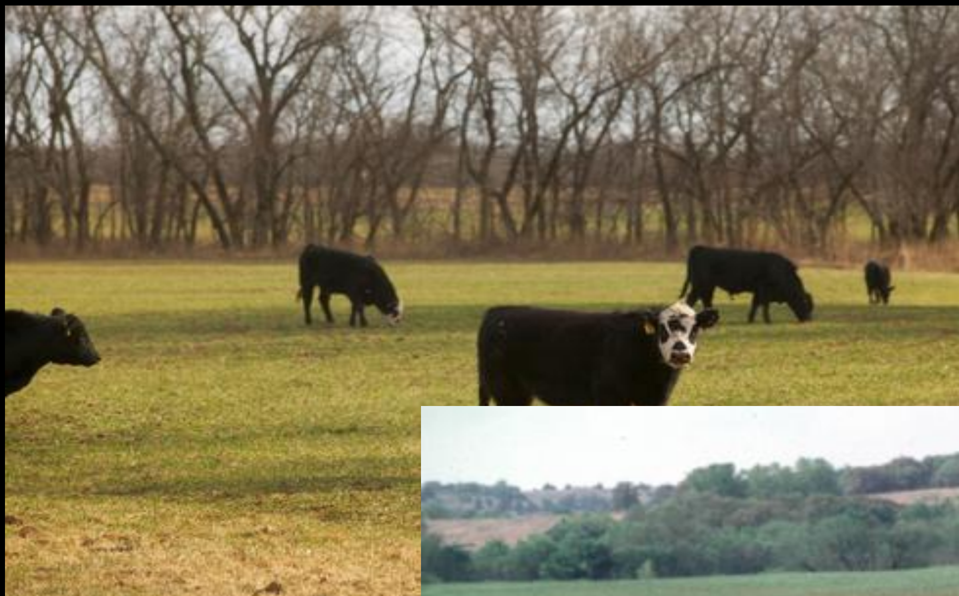
WHEAT


YUKON'S BEST
FLOUR
NO FINER OR MORE MODERN
MILLS IN AMERICA
YUKON MILL & GRAIN CO.
YUKON, OKLA.
Yukon Czech Capital of Oklahoma

Wheat Improvement Team



Wheat Pasture Research Station



Stored Products Research and Education Center

Livestock

OKLAHOMA STATE UNIVERSITY

Beef Cattle Nutrition and Management

Range Management

Robert M. Kerr
Food & Agricultural Products Center

1997

Food Safety

- Robert M. Kerr Food and Agricultural Products Center

Value Added Products

Post Harvest Processing

Wine Industry

OKLAHOMA STATE UNIVERSITY

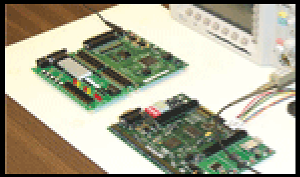
Pecans

Oklahoma State University

DASNR
CEAT
CIED

NPDC

New Product Development Center



OKLAHOMA STATE UNIVERSITY

Partnerships

OKLAHOMA

Welcomes You!

NIMFFAB

September 15, 2009

National Institute for Microbial Forensics & Food and Agricultural Biosecurity

Jacqueline Fletcher, Director

Department of Entomology & Plant Pathology

Oklahoma State University

Plant pathogens as bioweapons

- Plant pathogens are easily available to those with nefarious intent

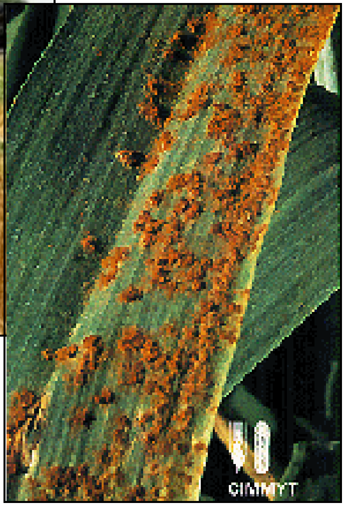
- Plant pathogens part of the biowarfare programs of several countries, including former USSR and the U.S.

- Notes on use of plant pathogens found in Afghani caves
    - Wheat rust
    - Rice blast

- Motives: Terrorism, economic gain, revenge, political/social statement (ELF, PETA, etc)

Wheat rust

Issues for forensic plant pathology



- Over 50,000 plant diseases in U.S.
- Generally, effort has *not* been made to eradicate pathogens of crops
- For any given crop, several pathogens do not *yet* occur in the U.S., but cause major losses elsewhere
- 2/3 of all U.S. cropland is planted to just 3 crops: wheat, corn and soybeans

Issues for forensic plant pathology

- 100s of plant species
- A number of pathogens uncultivable
- Culture collections scattered, inadequate & often lost with retirements
- Some diagnostics still based on time-consuming tests (e.g., reactions on host plant “differentials”, mating types)
- Plant pathogen entries in key databases (NCBI, GeneBank, BIOLOG, FAME, etc) very limited
- Lack of information on pathogen biology
- Lack of effective molecular detection tags: primers, probes and antibodies

Issues for forensic plant pathology

- Seeds and vegetative plant propagules are tiny samples
- Diagnostic and detection tools rarely standardized, validated
- Relative effectiveness of different technologies unknown in most cases
- “Best” test generally depends on the tools and databases available for that taxon and closely related taxa
- The “species” concept is becoming cloudy
- Funding for plant disease research is comparatively small

Corn stunt

Plants as food

AP Photo

Getty Images

Sep 17, 2006 LOS ANGELES (AP)
Spinach Pulled From Stores Across US

Sep 10, 2008 (CIDRAP News)
Unusual E. coli strain 0111 sickens 231 in OK

Plants as food

May 17, 2008

Tomatoes suspect in salmonella cases

January 16, 2009

Peanut Butter Probe Expand; *Salmonella* at Georgia Plant

NIMFFAB

A strong national security plan should include:

- Early **detection and diagnostic** systems
- Epidemiological models for **predicting** pathogen spread
- Reasonable but effective **strategies and policies** for crop biosecurity
- Distributed physical and administrative **infrastructure**
- National response **coordination** plan and infrastructure
- ***Microbial forensic capability: Validated technology and investigative capability***

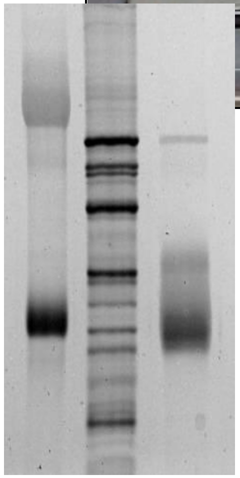
OKLAHOMA STATE UNIVERSITY AGRICULTURE

Is this something new?

- Usual goals of an applied plant pathologist:
  - to identify the pathogen as needed for management strategies
  - to quickly and effectively manage a disease outbreak with optimal strategies
- **NEW :**
  - Discerning natural vs. intentional outbreaks
  - Attributing the crime
- The U.S. security community has identified **a need for enhanced capability in microbial forensics** (humans, animals and plants)

Is this something new?

- **The goals of a microbial forensics specialist:**
  - Collect very **specific** forensic (microbial and associated physical) evidence via tests that
    - Are standardized and **validated**
    - Have very high **confidence** levels
    - Are sufficiently **robust** to withstand rigorous adversarial review in a court of law
  - Attribution
    - Determination of biothreat agent **source**
    - Identification of the **perpetrators**
    - Criminal **prosecution**
  - Deterrence of future attempts



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U.S. capability in microbial forensics

- **2002 – Study commissioned by US defense community found a need for greater capability in microbial forensics**
- **Included specific language with respect to plant pathogen forensics**

MICROBIOLOGY AND MOLECULAR BIOLOGY REVIEWS, June 2006, p. 450–471 Vol. 70, No. 2
1092-2172/06/$08.00+0 doi:10.1128/MMBR.00022-05

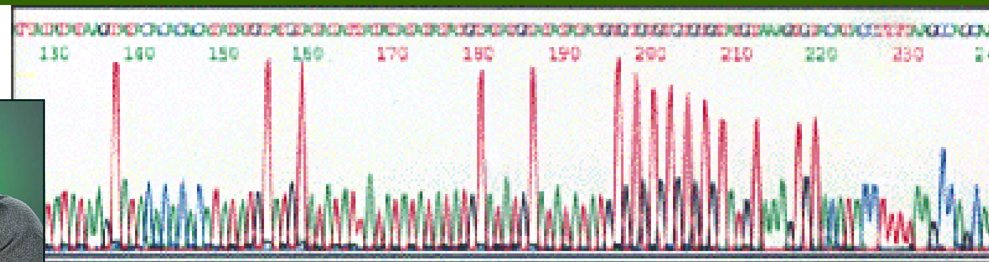
Plant Pathogen Forensics: Capabilities, Needs, and Recommendations

J. Fletcher,[1]* C. Bender,[1] B. Budowle,[2] W. T. Cobb,[3] S. E. Gold,[4] C. A. Ishimaru,[5]† D. Luster,[6] U. Melcher,[1] R. Murch,[7]‡ H. Scherm,[4] R. C. Seem,[8] J. L. Sherwood,[4] B. W. Sobral,[9] and S. A. Tolin[10]

Oklahoma State University, Stillwater, Oklahoma[1]; Federal Bureau of Investigation, Quantico, Virginia[2]; Cobb Consulting Services, Kennewick, Washington[3]; University of Georgia, Athens, Georgia[4]; Colorado State University, Ft. Collins, Colorado[5]; USDA-ARS, Ft. Detrick, Maryland[6]; Institute for Defense Analysis, Alexandria, Virginia[7]; Cornell University, Geneva, New York[8]; Virginia Bioinformatics Institute, Blacksburg, Virginia[9]; and Virginia Polytechnic Institute and State University, Blacksburg, Virginia[10]

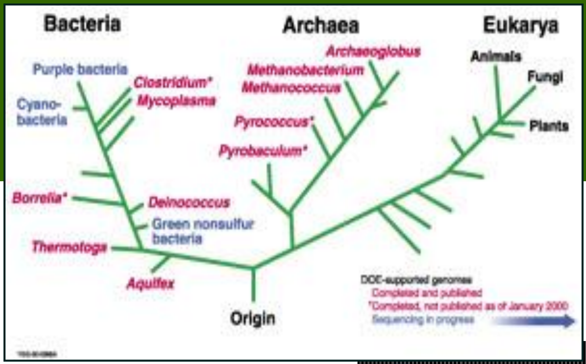
OKLAHOMA STATE UNIVERSITY AGRICULTURE

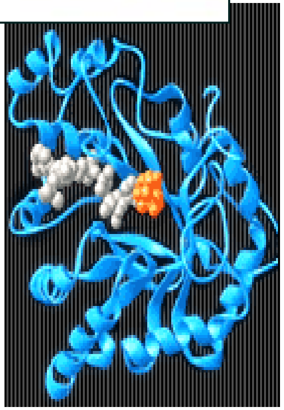
Needs



- Advances in genomics of microbial threat agents
  - **Complete** genome sequences known for only a few plant pathogens
  - Sequences of **multiple strains** very rare
  - Fungal genomes are **large and expensive**; nematodes even worse!
- Supporting info for molecular analyses
  - More specific tools (primers, probes, antibodies)
  - More multi-plex tests

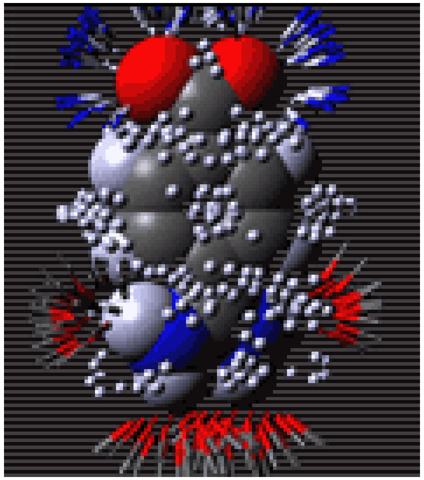
Needs:





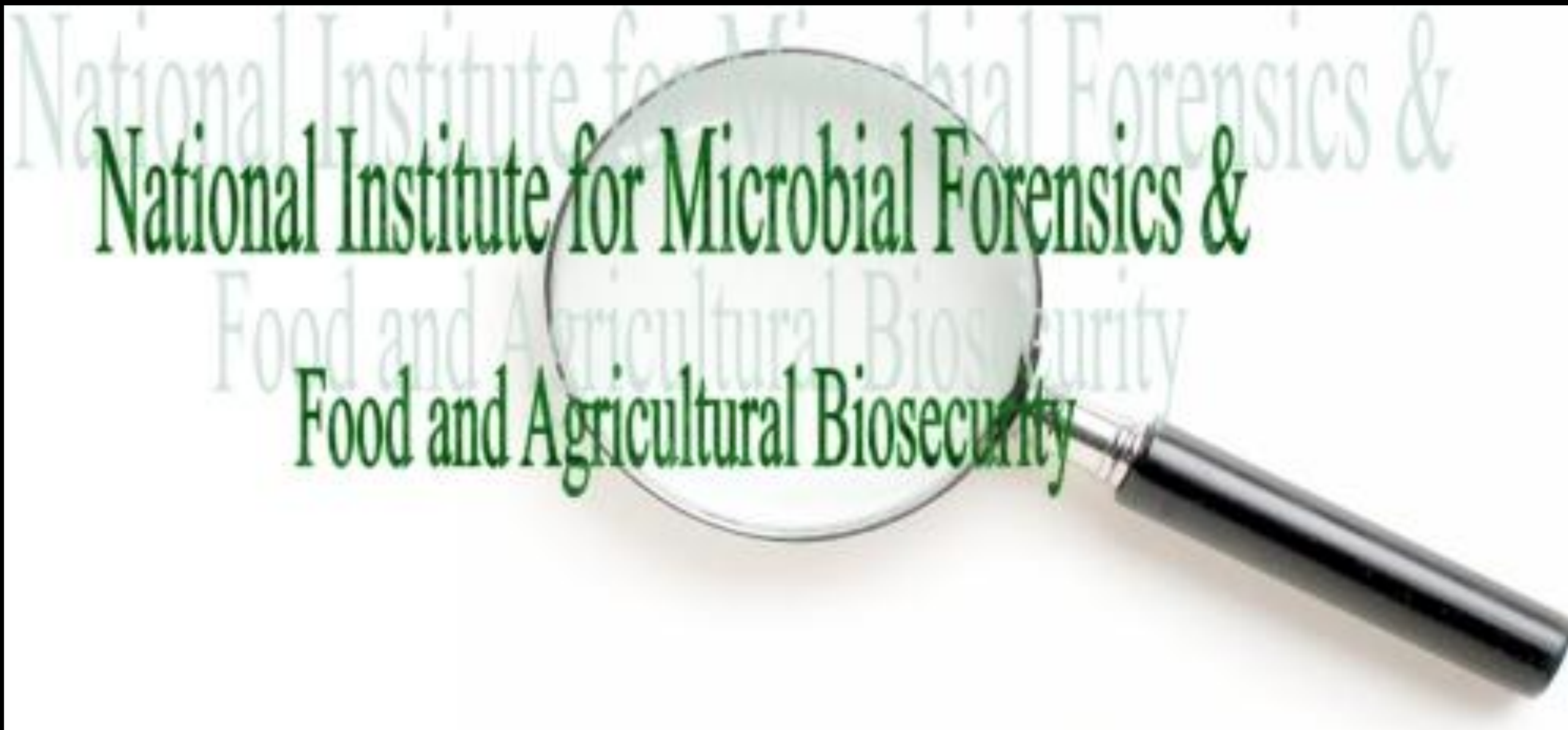
- Non-nucleic acid components
  - More **specific antibodies**
  - Virulence factors in **secreted** fraction
  - Pathogen **gene expression** in plant and vectors
  - **Regulation** including signaling, quorum sensing, biofilms, secretion systems, virulence factors:
  - **Host plant defense** molecules
- Pathogen-pest population biology
  - Pathogen diversity and geographic location(s) of virulent biotypes
  - Knowledge of evolutionary biology and epidemiology

Needs: Other technologies



- Isotope analysis
- Presence of other signatures related to source location or perpetrators
- Generally not yet applied to plant pathogens
- *Need for targeted, goal-oriented research and development*
- *Need for more trained scientists (<u>many positions restricted to U.S. citizens!</u>)*

Design, Rick Grantham



NIMFFAB Mission

To **identify, prioritize, facilitate and conduct** research, education and outreach related to national needs in microbial forensic science with respect to pathogens of crops, forests, rangelands and food products.

*The **NIMFFAB** builds on, connects and enhances existing programs that support and address issues of crop and food security.*

NIMFFAB Objectives

- **Assess national capabilities** in microbial forensics related to plant pathogens and food safety.
- Provide **strategic planning**, a long-range **vision** and **prioritization** of needs and resources in forensic plant pathology.
- Conduct focused and outcome-oriented **research** in priority areas of microbial forensics.
- Establish a **coalition** of investigators conducting research on crop and food biosecurity and forensics issues.

NIMFFAB objectives, *continued*

- Serve as a link for **communication, cooperation** and **outreach** between the plant pathology and law enforcement/homeland security communities
- **Deliver outputs to end users** including the FBI, Department of Homeland Security, and USDA
- Develop and provide **educational and training** opportunities for students and stakeholders
- **Communicate** and **work in parallel**, locally and nationally, with programs related to animal and human pathogens

NIMFFAB

Oklahoma ‘partners’

a) Oklahoma State University

- Experienced faculty
- Core facilities
- Graduate and undergraduate programs
- Cooperative extension

b) OSU Center for Health Sciences - Forensic Sciences

- Department of Forensic Sciences

c) OK Plant Disease & Insect Diagnostic Laboratory

- OSU Department of Entomology and Plant Pathology
- Part of the **National Plant Diagnostic Network (NPDN)**
- Part of the **Great Plains Diagnostic Network (GPDN)**

Oklahoma resources

d) OSU Food and Agricultural Products Center

- Assists value-added food industry enterprises
- Expertise & research on microbiology of food safety

e) OSU Multispectral Laboratory, Ponca City

- Sensor technology development & applications

f) Advanced Center for Genome Technology, Norman

- University of Oklahoma
- Internationally recognized genome sequencing center

NIMFFAB people

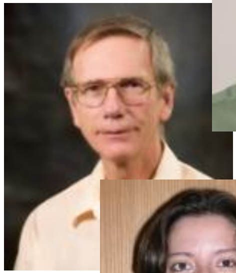



***Director** – Forensic plant pathology

***Asst. Director** – Insect transmission of threatening pathogens

***Plant Pathology** – Diagnostics & detection

***Food Safety** – Food contamination, human pathogens


Associated Faculty

Forensic Sciences – Human DNA analysis

Forensic Sciences – Chemical signatures

Molecular Biology – Discriminatory assays

Water Quality – Microbial detection

Education

New Courses & Programs

- Undergraduate course
  - Global Issues in Agricultural Biosecurity and Forensics
- Graduate course
  - Microbial Forensics (Online D2L)
- Degree minor/specialization
  - Undergraduate: Entomology – Bioforensics, Pre-Med, Pre-Vet
  - Graduate: Specialization within majors
- Potential for distance education
- Potential for international courses

NIMFFAB

Education

USDA National Needs Graduate Fellowship Program

First graduate program to blend the fields of plant pathology & forensic sciences

3 M.S. (Forensic Sciences)

- Adaptation of human DNA detection technologies to plant pathogen detection (**Jesse Carver, Charlene Beauman, Andrew Taylor**)

Education

NNF Fellow Research Projects

3 Ph.D. (Plant Path; Biochem & Molec Biol)

- **Multi-locus variable number tandem repeats** for strain identification of *Pseudomonas syringae* pv, tomato (**Christy Baker**)
- **Microarrays for plant virus detection** and assessment of intentional introduction (**TeeCie West**)
- Development of "**decision trees"** for use by law enforcement personnel at a potential field crime scene (**Stephanie Rogers**)

– **Internships at the FBI Laboratory**

Research

Department of Homeland Security

National Bioforensics Analysis Center

“NBFAC Spoke Laboratory”

for

Forensic Plant Pathology

Technology development & validation

NIMFFAB

Research

Microbial Rosetta Stone

Goals:

- **Map the landscape of infectious agents**
- **Curate literature for high threat agents**

Application:

- **Assist forensic investigation & define attribution in case of a bioterror event**

Sponsors:

- **DARPA**
- **FBI**
- **DHS – NBFAC**

cBio Inc.

NIMFFAB: Plant pathogen database

Outreach - Workshop

January 11-13, 2007

Plant Pathogen Forensics: Filling the Gaps

Oklahoma City, Oklahoma

Attendees included:

- USDA: APHIS, ARS, CSREES
- FBI Laboratory
- Department of Homeland Security
- National Laboratories: Los Alamos, Lawrence Livermore
- Academic community – OSU & nationwide
- Oklahoma agricultural security community

Outreach – Field Exercise

May 2008

Partnering for Success During a Plant Health Response

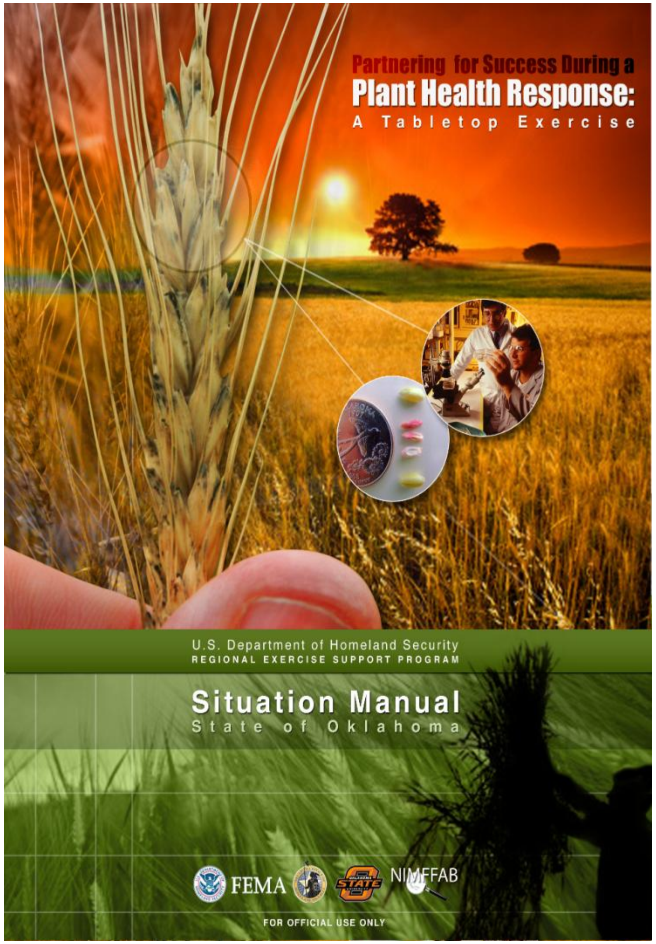
Stillwater, OK

Collaboration: NIMFFAB, OSU DASNR, FBI, DHS, CIA, USDA, NPDN

- Intentional plant pathogen introduction in a field setting
- Law enforcement interactions (FBI, APHIS, local police, etc)
- **Issues**

• Agency roles & interactions
• Determining what is evidence
• How to collect, store and transfer evidence
• What tests to use
• How to interpret them

Outreach – Tabletop Exercise



June 2009

Partnering for Success During a Plant Health Response II

Oklahoma City, OK

Collaboration: NIMFFAB, OSU DASNR, FBI, DHS, CIA, USDA APHIS, USDA Off. of H.S., NPDN

- Scenario practice
- Law enforcement interactions (FBI, APHIS, local police, etc)
- Issues

2010 – Full Scale Exercise

NIMFFAB

Financial Support and Thanks

Oklahoma State University

Division of Agricultural Sciences & Natural Resources

Vice President for Research & Technology Transfer

OSU Provost

US Department of Agriculture

CSREES Competitive Grants

ARS Collaborations

Department of Homeland Security

Federal Bureau of Investigation

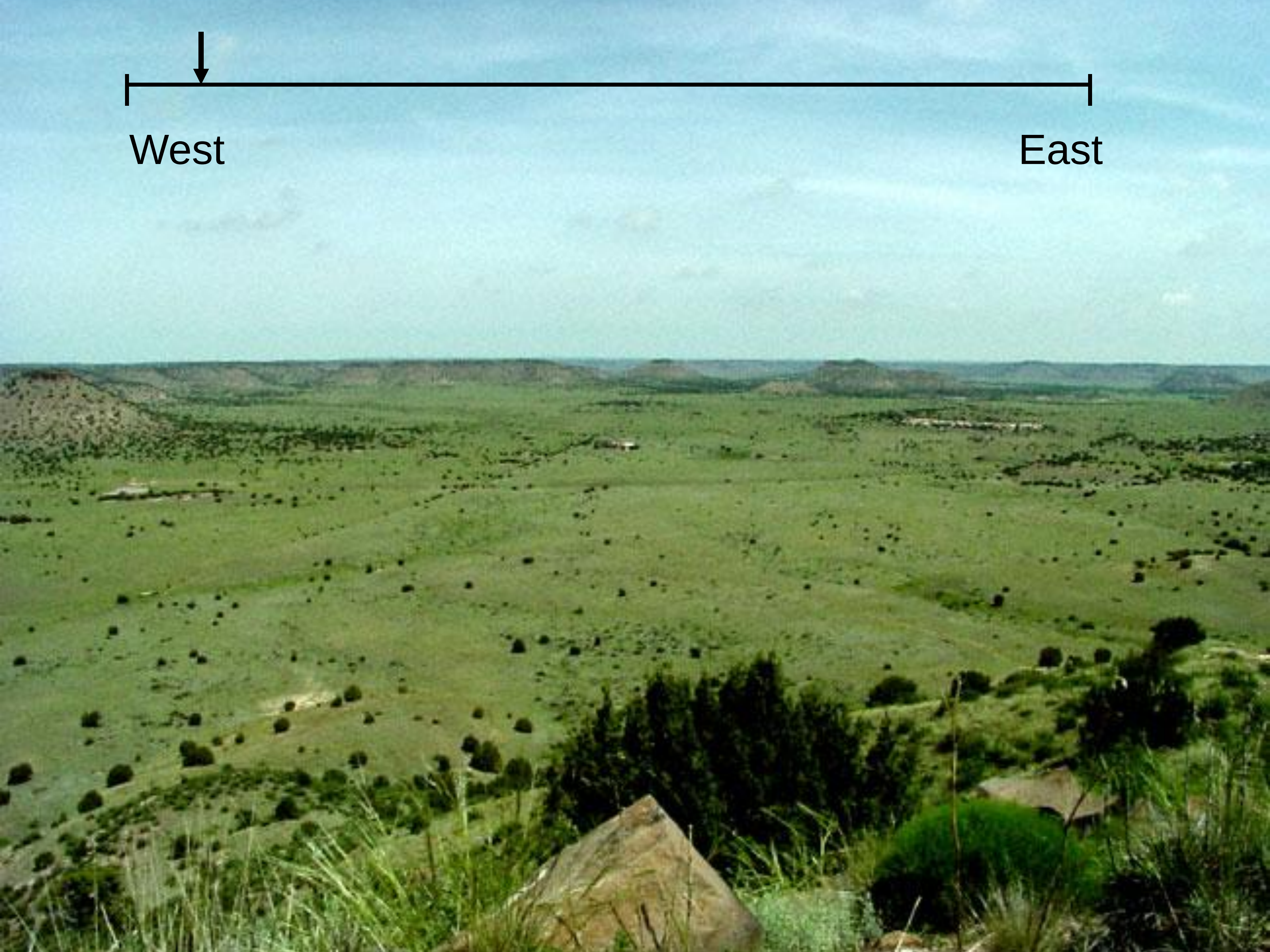
OK Office of Homeland Security

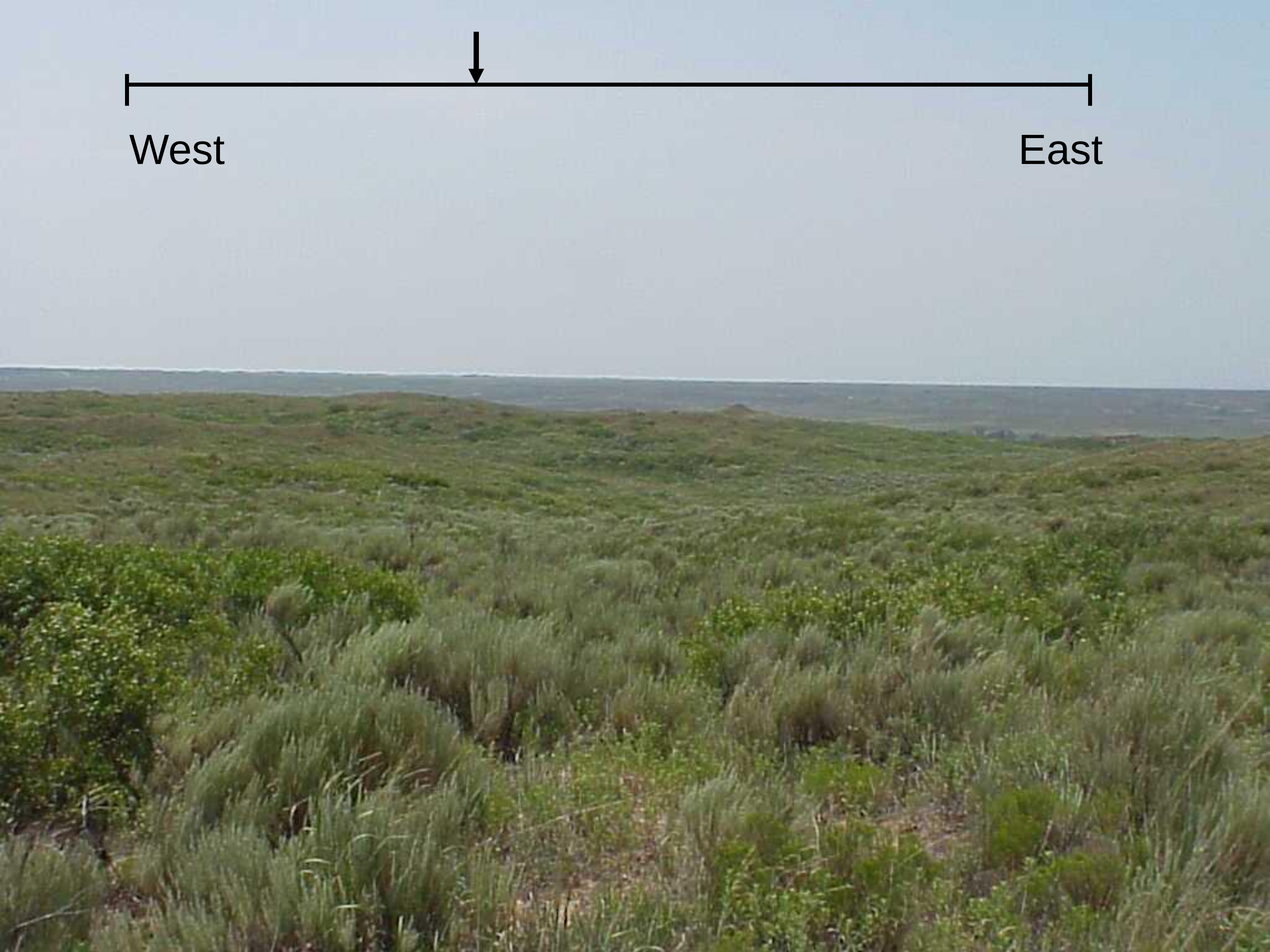
OK Center for the Advancement of Science & Technology

Fresh Produce Industry

"The grass is at times green and short and at other times tall and white… .. nothing but bare prairie, which becomes confused in the distance with the smoke of burning grass."

Washington Irving Expedition, 1832 Near Stillwater OK


West
East


West
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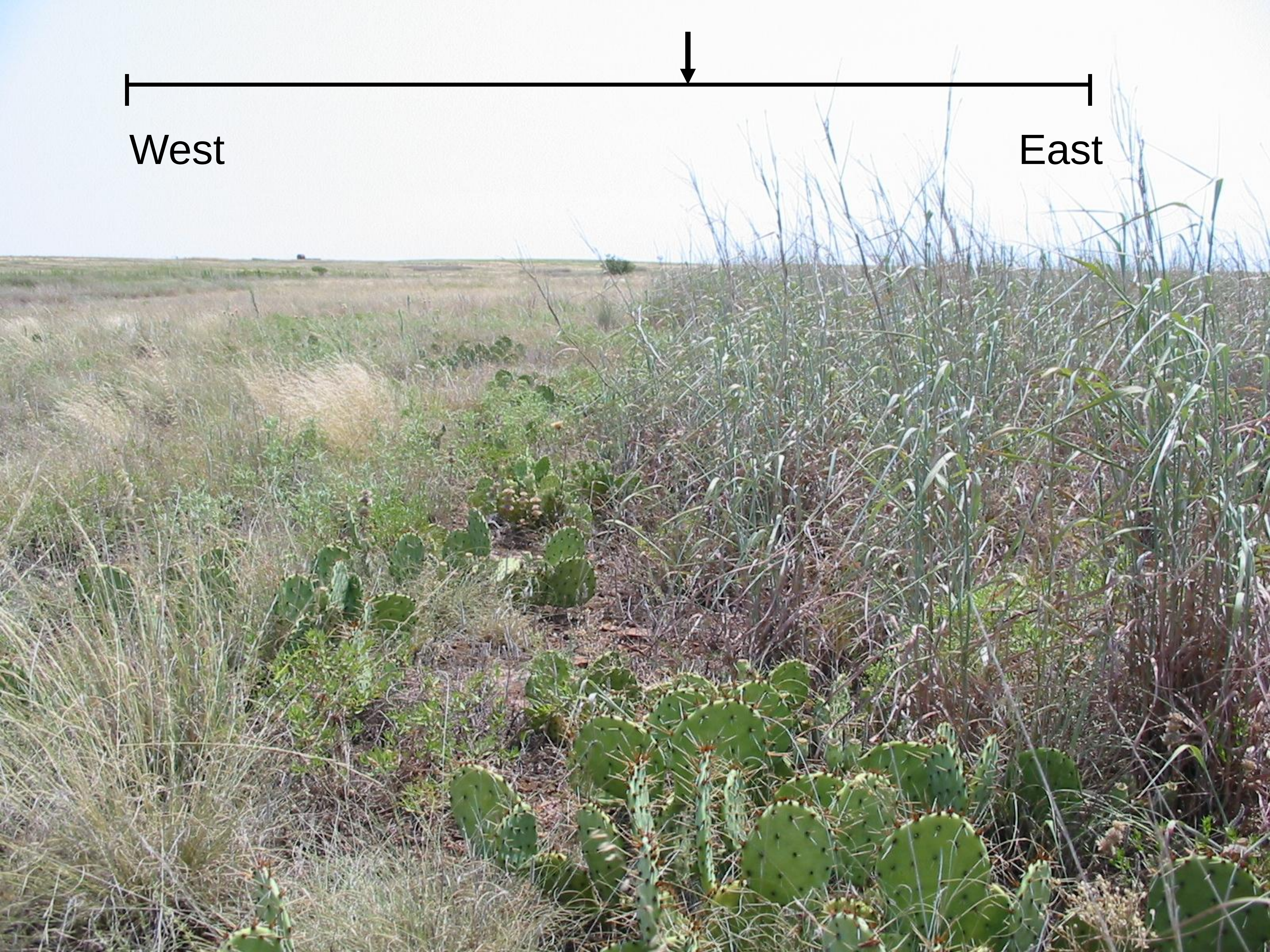
West
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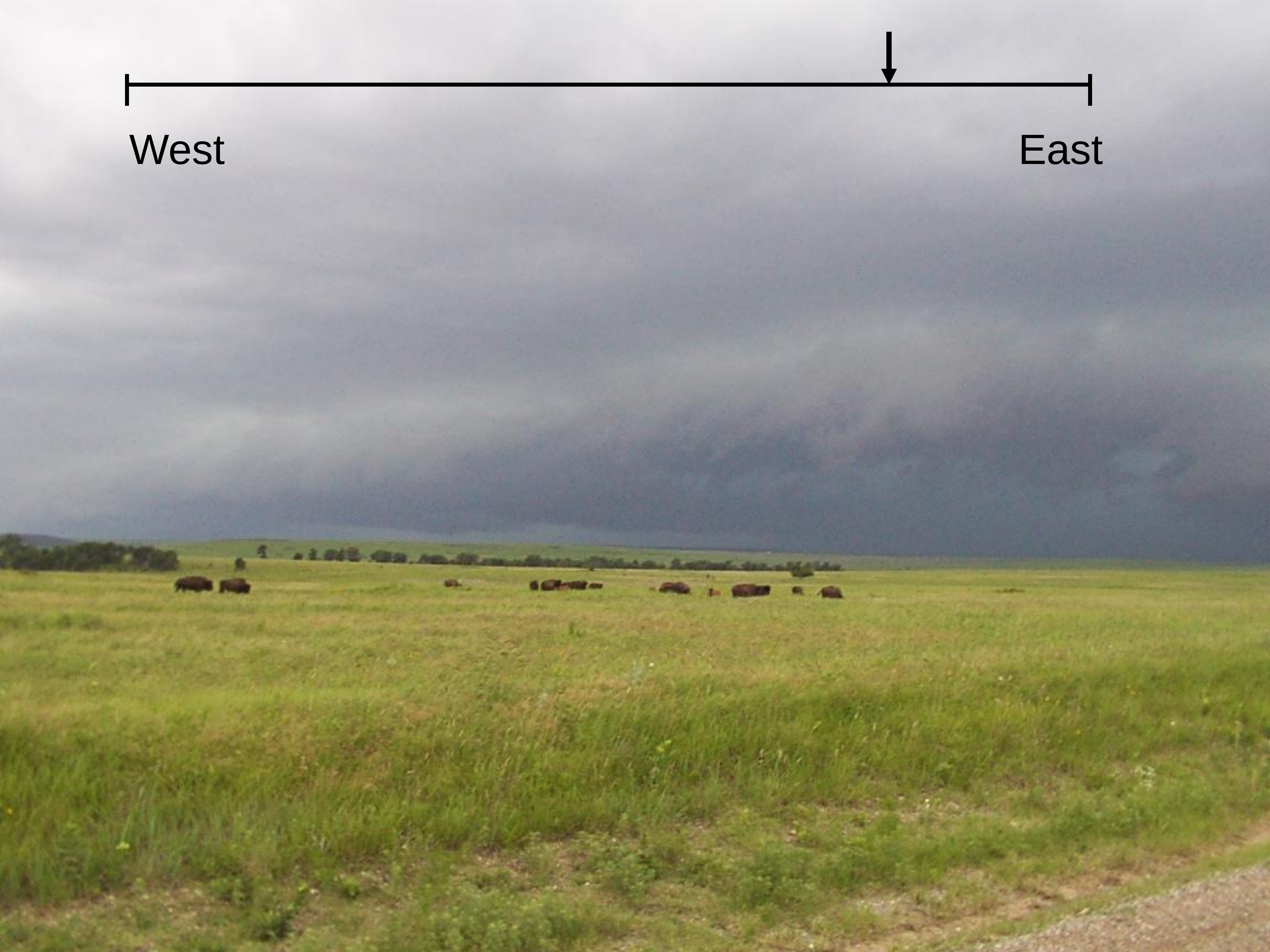
West
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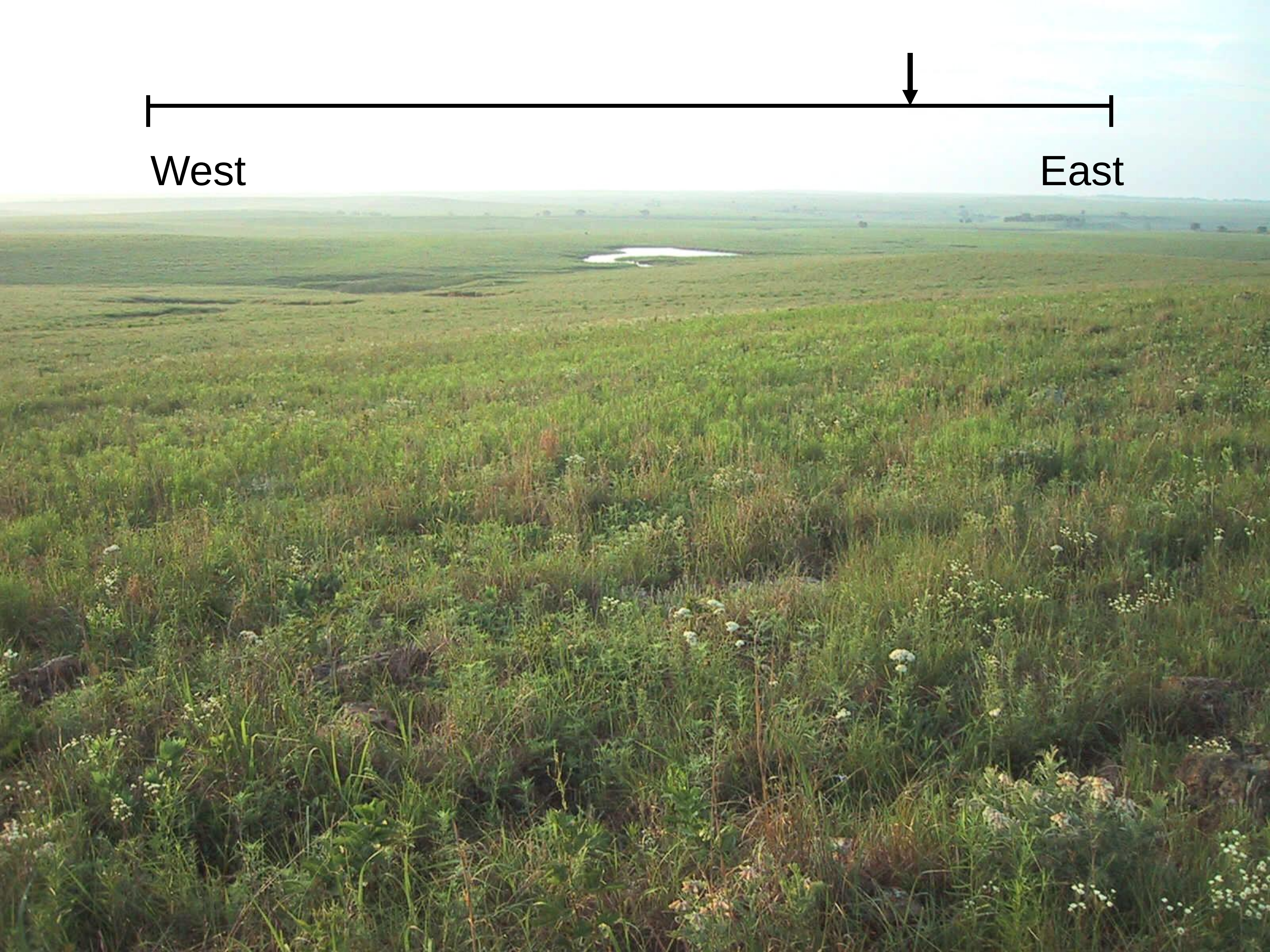
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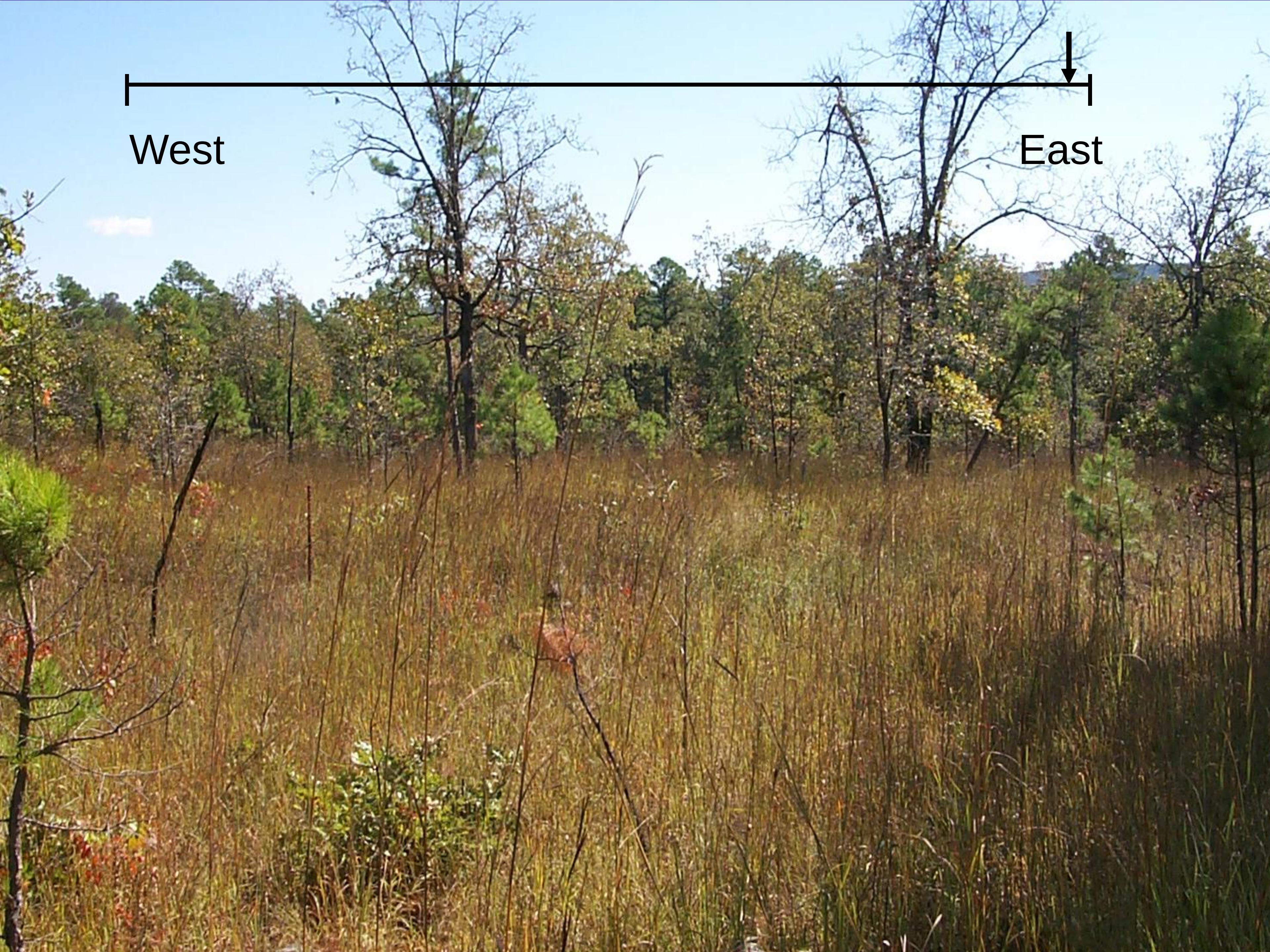
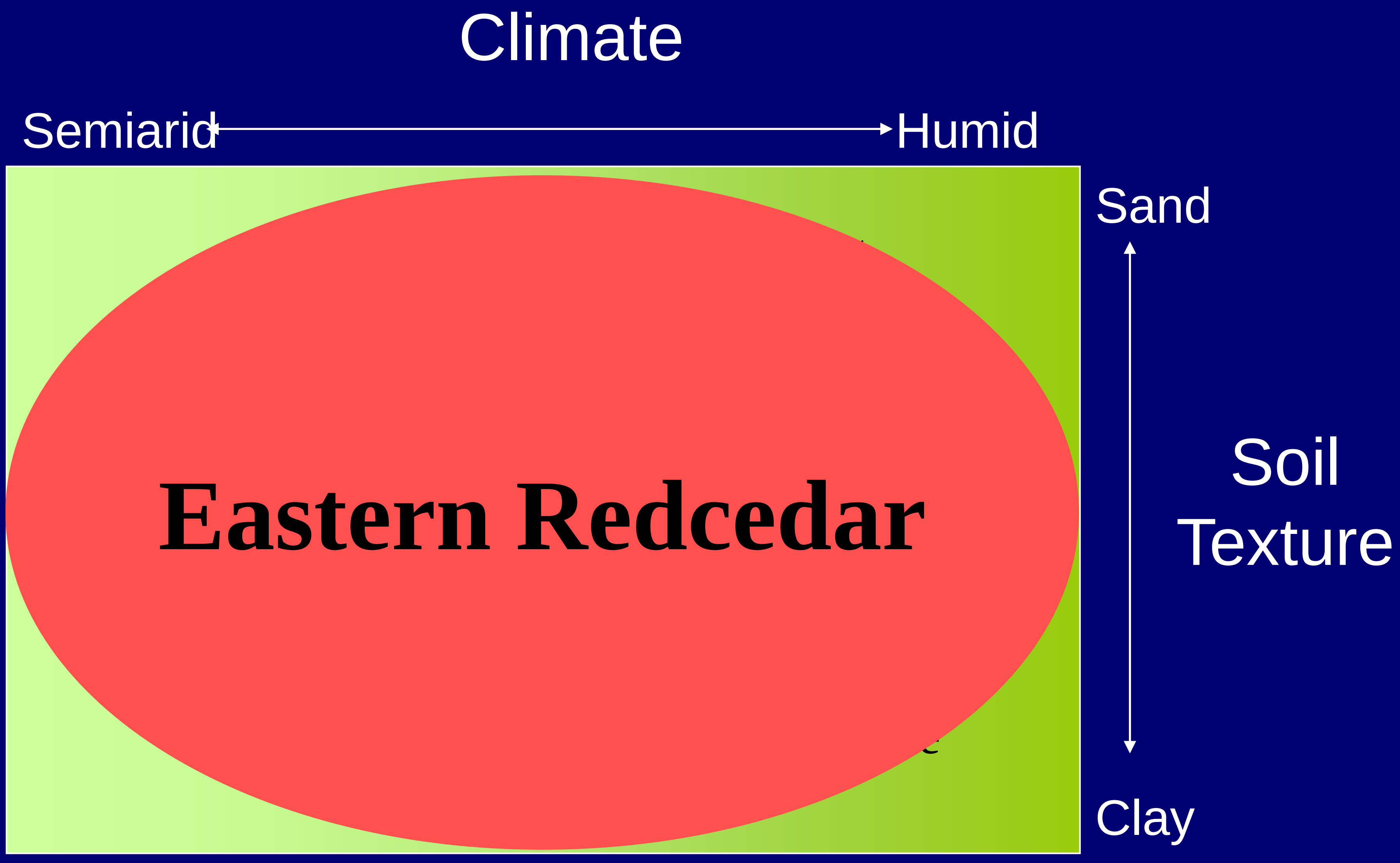
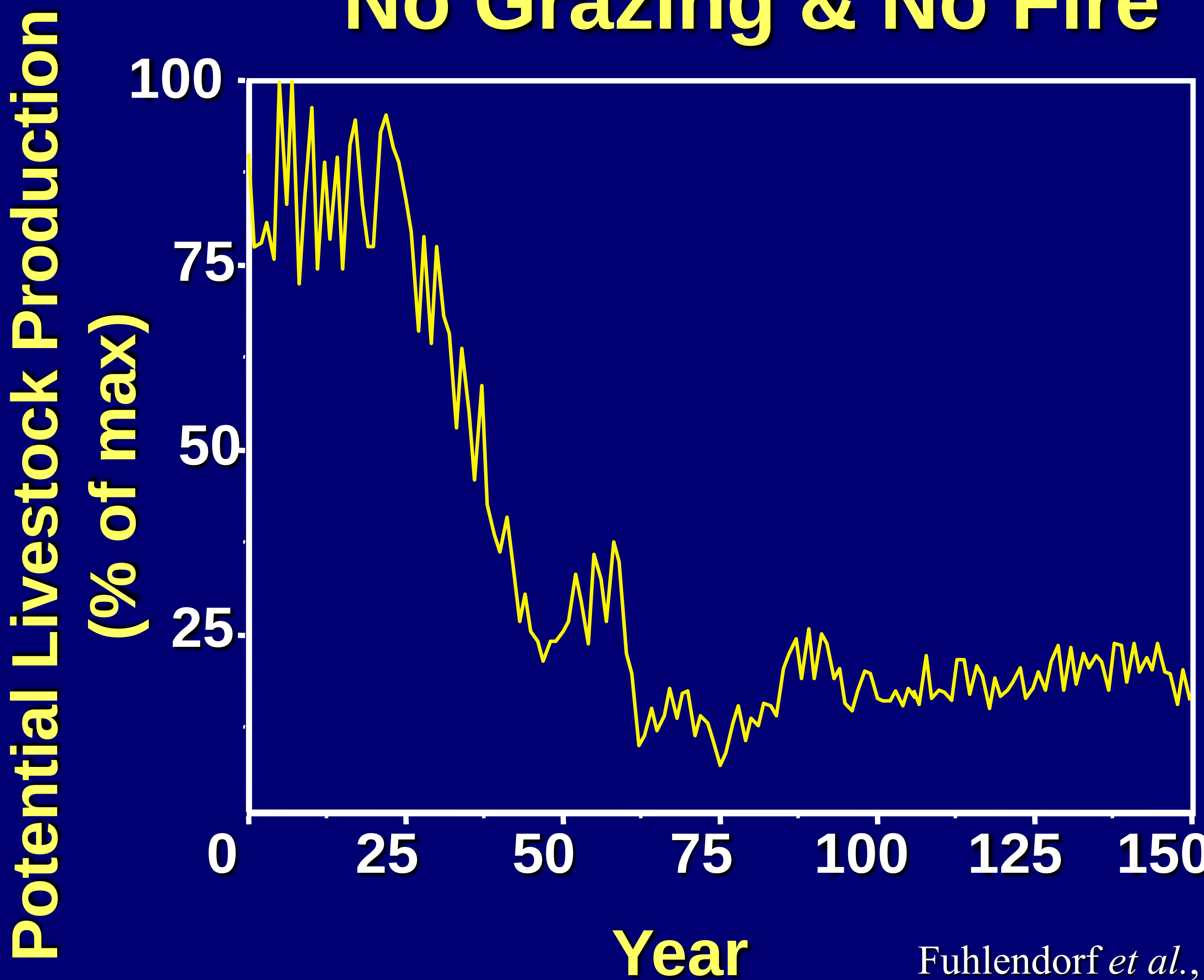
East


West
East

Oklahoma Vegetation

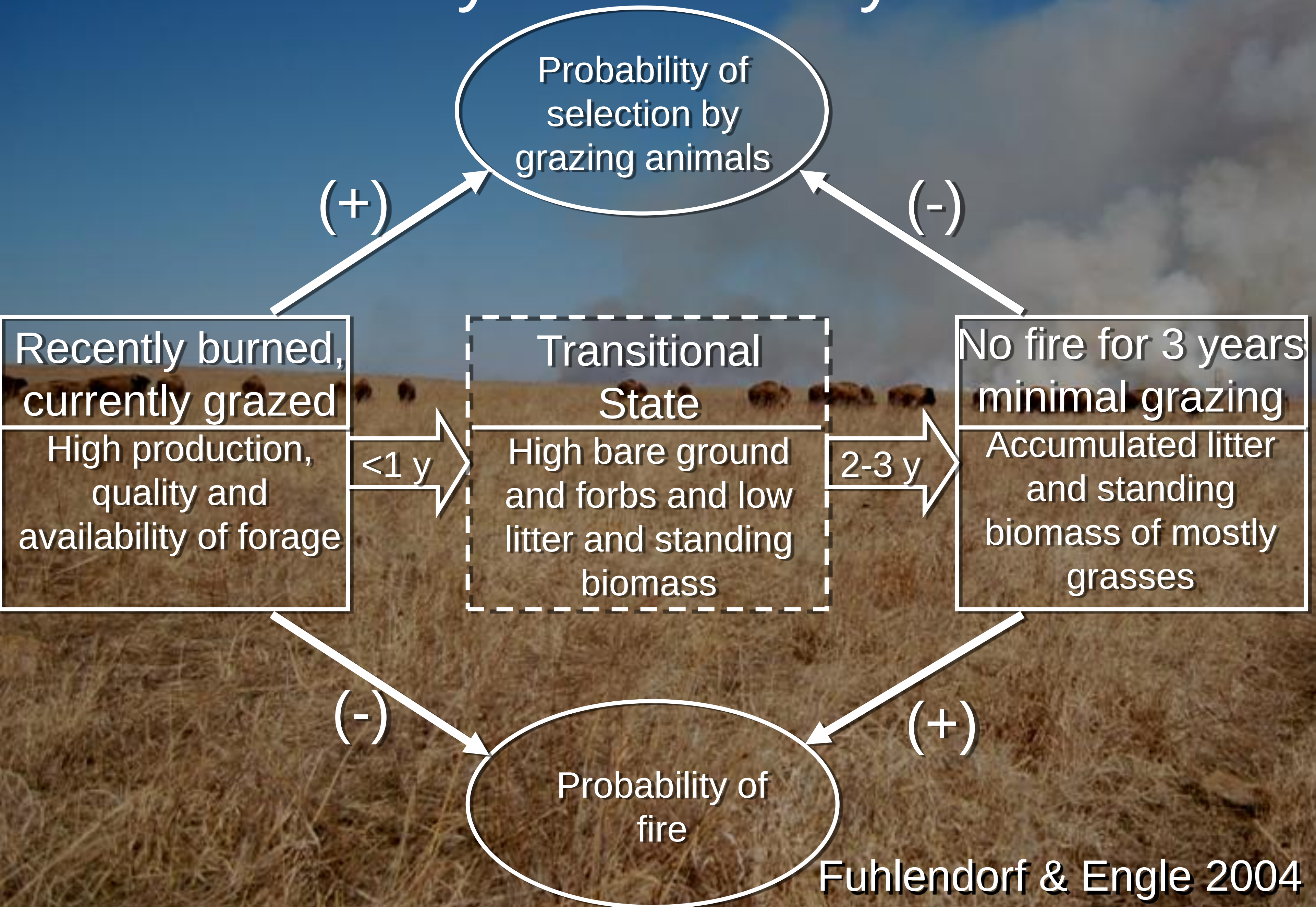


No Grazing & No Fire

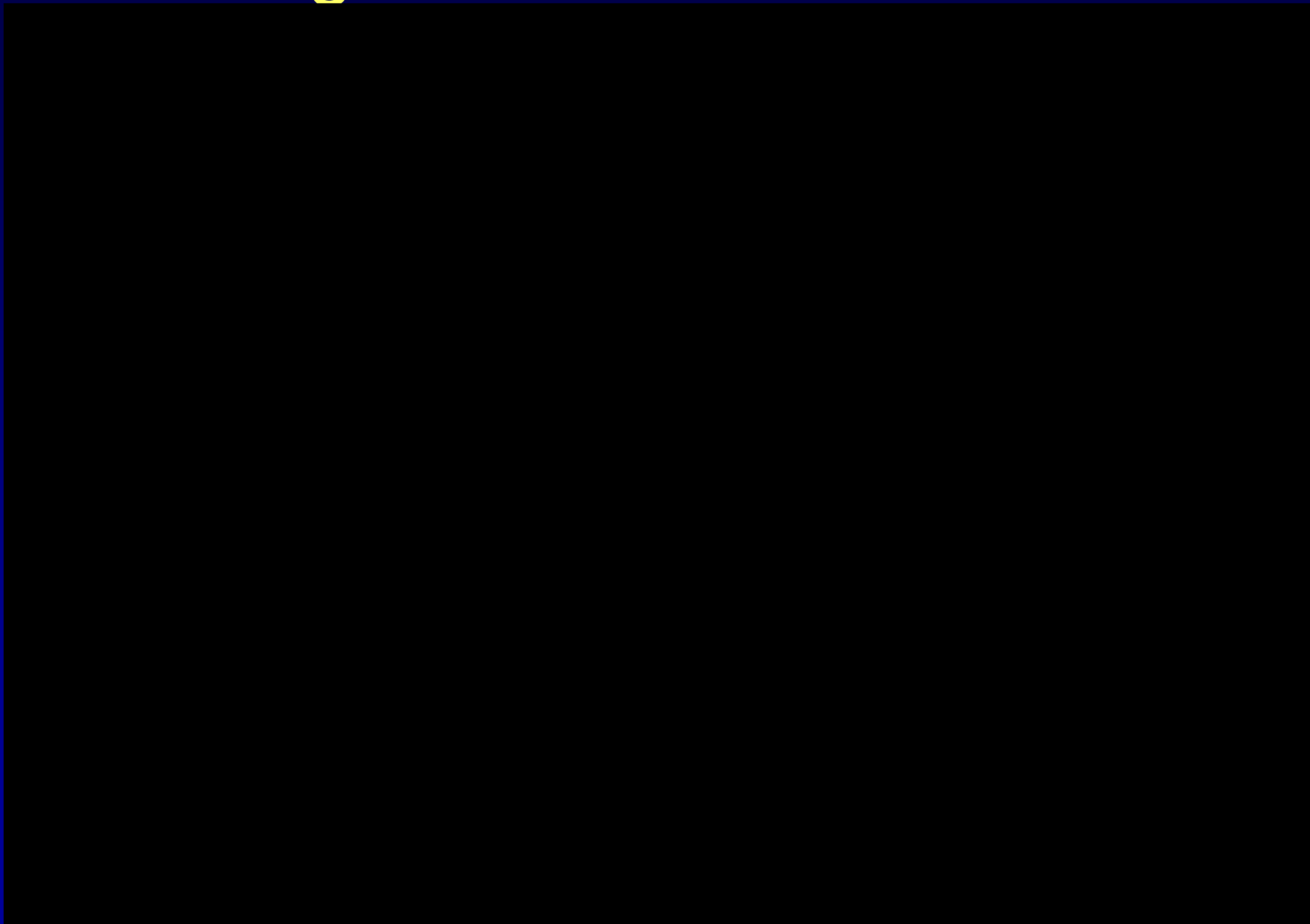


Fuhlendorf *et al.*, 2008

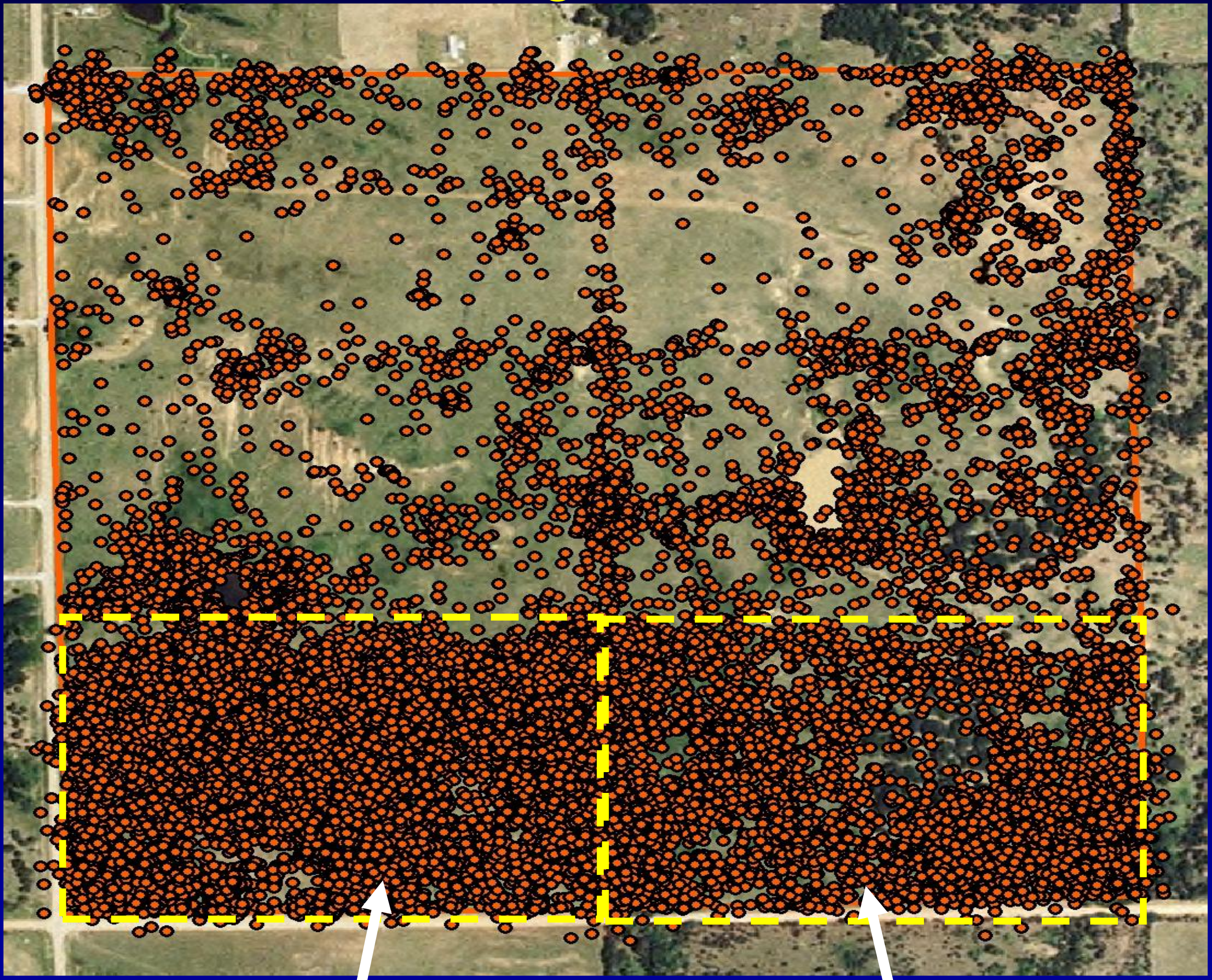
Pyric-herbivory



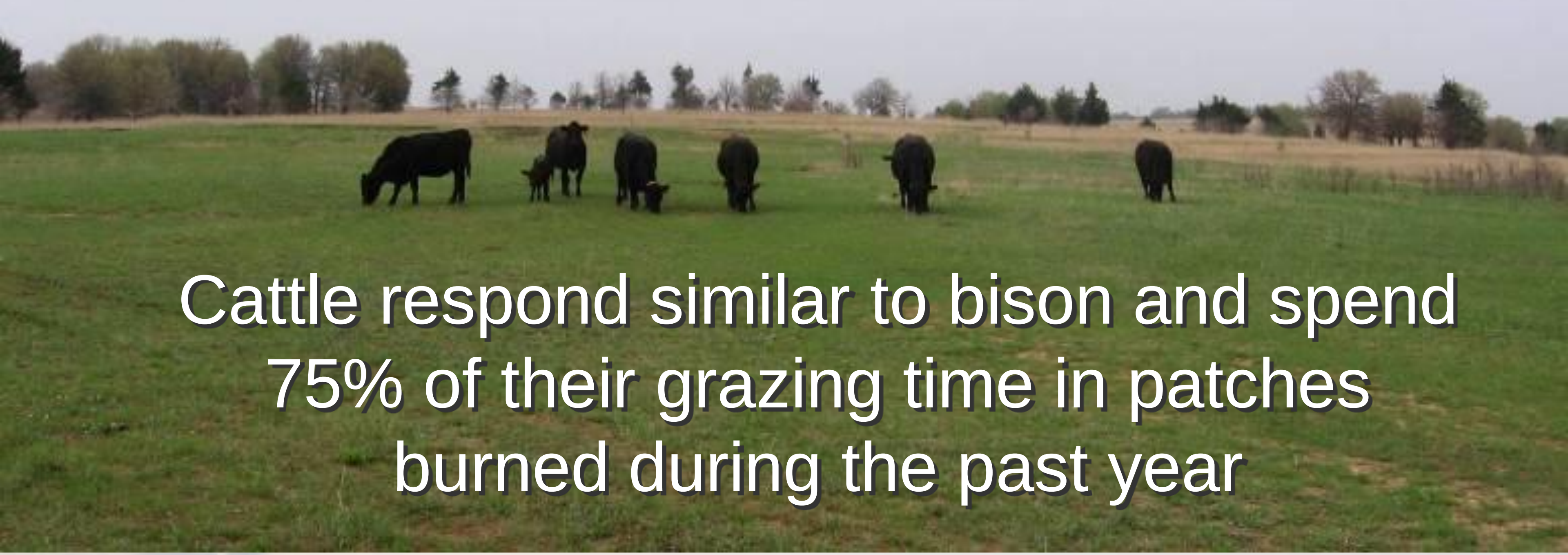
Tallgrass Prairie Preserve



Grazing Site Selection in Heterogeneous Treatment Growing Season 2008

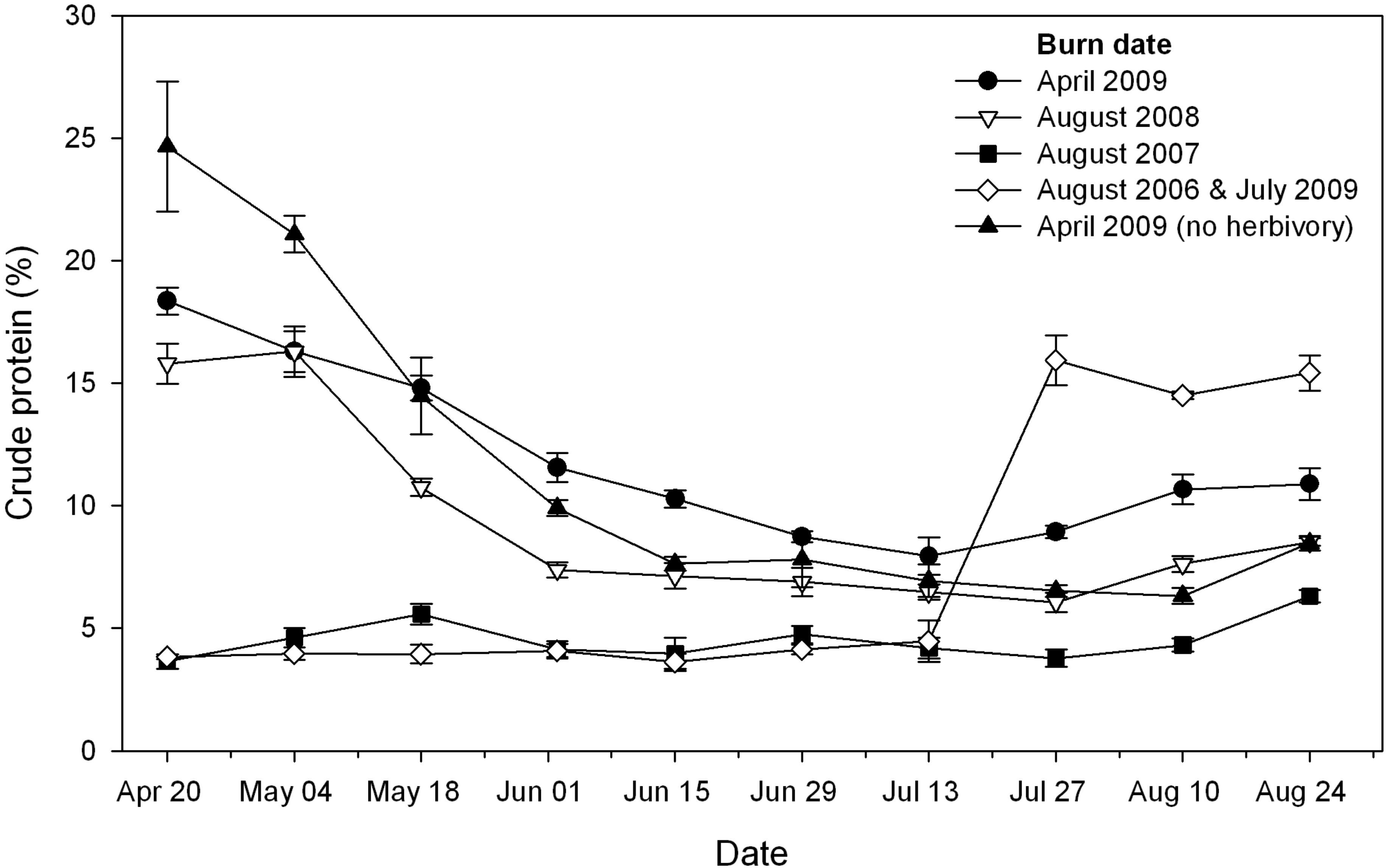


Burned Spring 2008 Burned Summer 2007

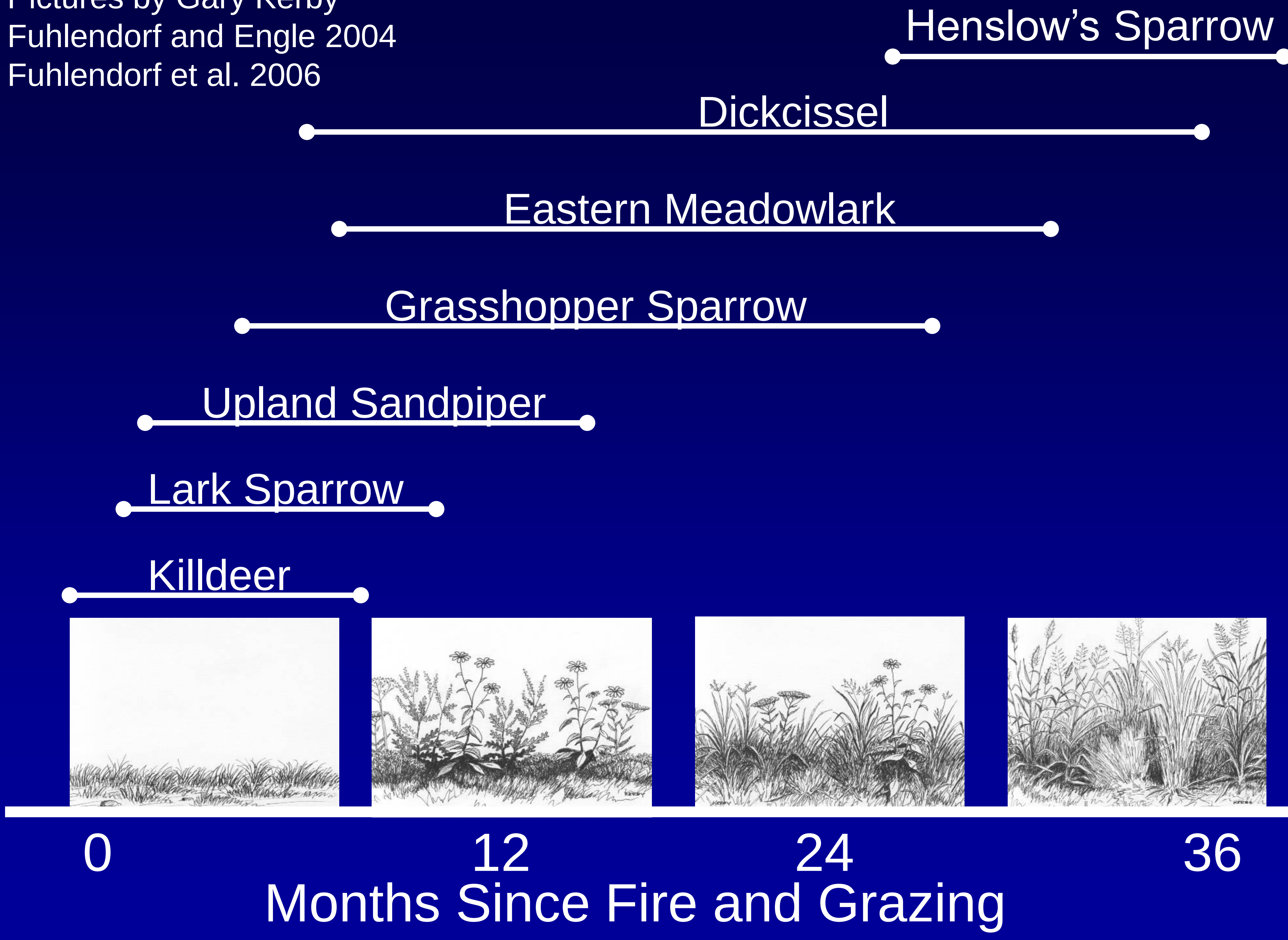

Cattle respond similar to bison and spend
75% of their grazing time in patches
burned during the past year


Fuhlendorf & Engle 2004

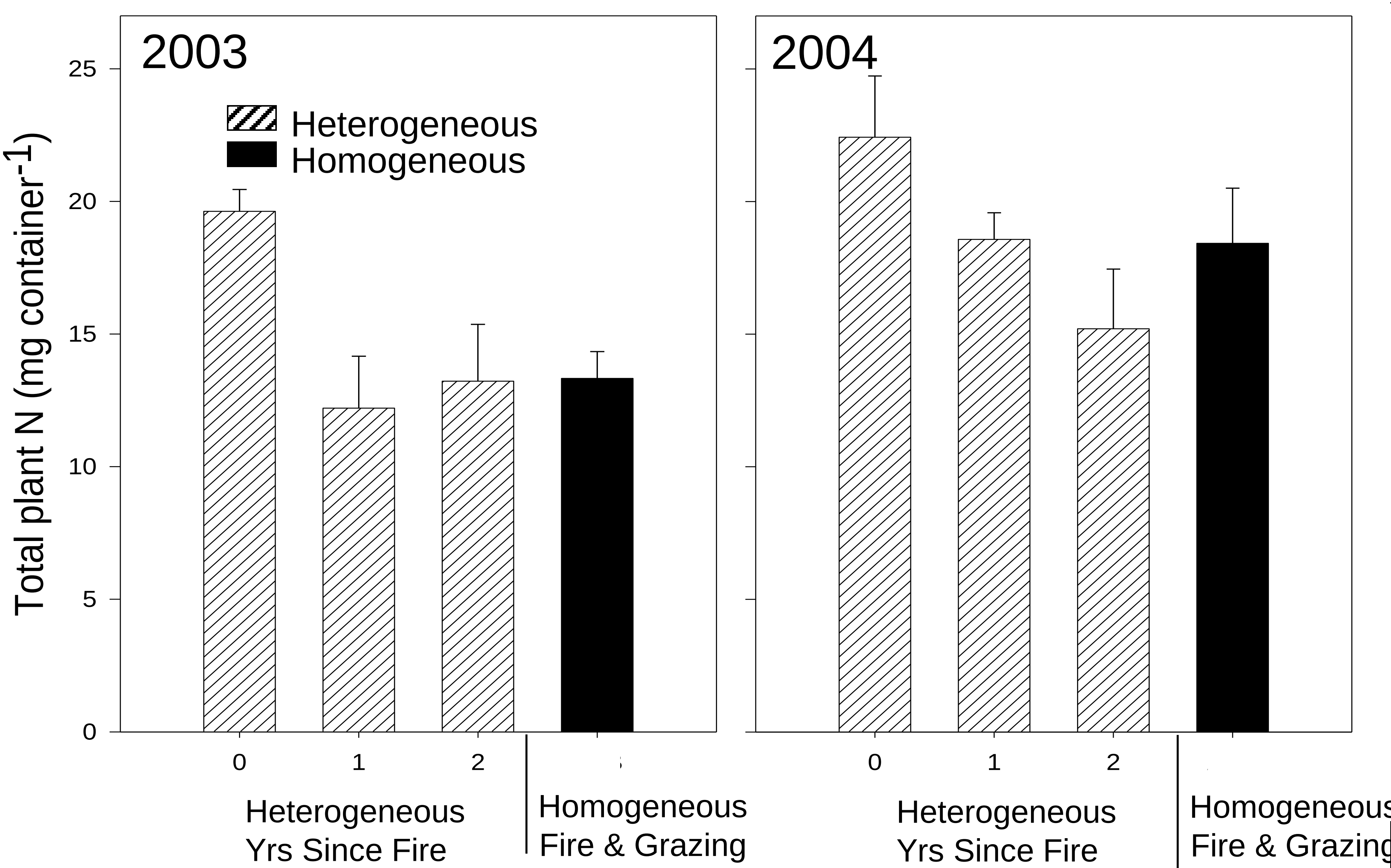
Forage quality with time since fire



Pictures by Gary Kerby
Fuhlendorf and Engle 2004
Fuhlendorf et al. 2006



Greater nitrogen available on recently burned patches that attract greater densities of grazers



Anderson, Fuhlendorf & Engle 2006

Animal Production

Bison and other grazers

- Bison have the highest breeding populations when allowed to interact with fire
- High tendency to select burned areas by many species
- Intensive spot grazing an evolutionary response to low nitrogen

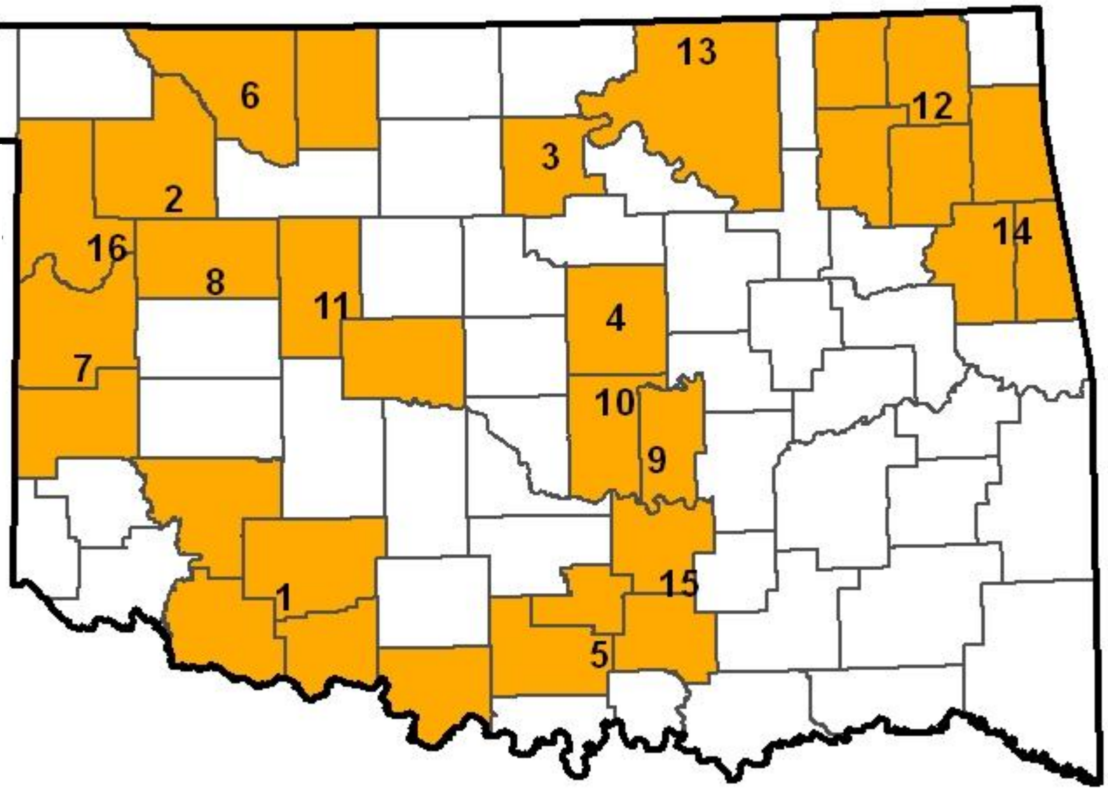
Stockers and Cow/calf- 10 years of data

- No Differences from traditional management
    - Average Daily Gain
    - Gain per acre
    - Body condition scores
    - Weaning weights
- Reduced supplementation

Conclusions:

1. Fire and grazing have been decoupled
2. Fire and grazing are linked through heterogeneity
3. Most land management reduces heterogeneity
4. Management that re-couples fire and grazing by promoting heterogeneity can use fire to:
    - Reduce woody plant encroachment without destocking
    - Move livestock
    - Increase biodiversity
    - Sustain ecological processes-nutrient and water cycling
    - Maintain production with reduced inputs

Oklahoma's Prescribed Burning Associations



- **16 Associations**
- **30 counties**
- **350+ members**
- **In 2008 and 2009 six associations safely conducted 125 burns on 56,000+ acres**
- **Received over $150,000 in grants and donations**

John Weir, Natural Resource Ecology and Management

Funding

Competitive Grants

USDA-CSREES-AFRI-Managed Ecosystems-2010. $500,000 over 4 years
USDA-CSREES-NRI-Managed Ecosystems. 2009. $376,000 over 3 years
USDA-CSREES-NRI-Biolology of Weedy and Invasive species. 2005. $500,000 over 4 years
USDA-CSREES-NRI-Managed Ecosystems. 2001. $340,000 over 4 years
Joint Fire Sciences. 2003. $378,446 over 3 years.
Oklahoma Division of Wildife Conservation. 2006. $150,000 for 3 years
Oklahoma Agricultural Experiment Station. 2006. TIP $35,000 for 2 years
Oklahoma Agricultural Experiment Station. 1999. TRIP $40,000 for 2 years

Research Contracts

Nebraska Fish and Game. 2009. $107,031 for 3 years.
The Nature Conservancy. 2008. $50,000 for 3 years
The Nature Conservancy, 2002-2006. $30,000 over 4 years.
The Nature Conservancy, 2001 $20,000 over 3 years
US Fish and Wildlife Service-Wichita Mountains National Wildlife Refuge. 2009. $93,000 over 3 years
US Fish and Wildlife Service- Charles M. Russell National Wildlife Refuge. 2008. $55,000 over 2 years.


Questions?

Bioenergy Research at OSU from FIELD to FUEL

Ray Huhnke, Director

Biobased Products and Energy Center
Div. of Agricultural Sciences and Natural Resources
Oklahoma State University

Research at OSU

- Feedstock Development
- Biomass Production
- Harvest, Handling & Storage Logistics
- Bioconversion Technologies
- Modeling and Economic Analyses

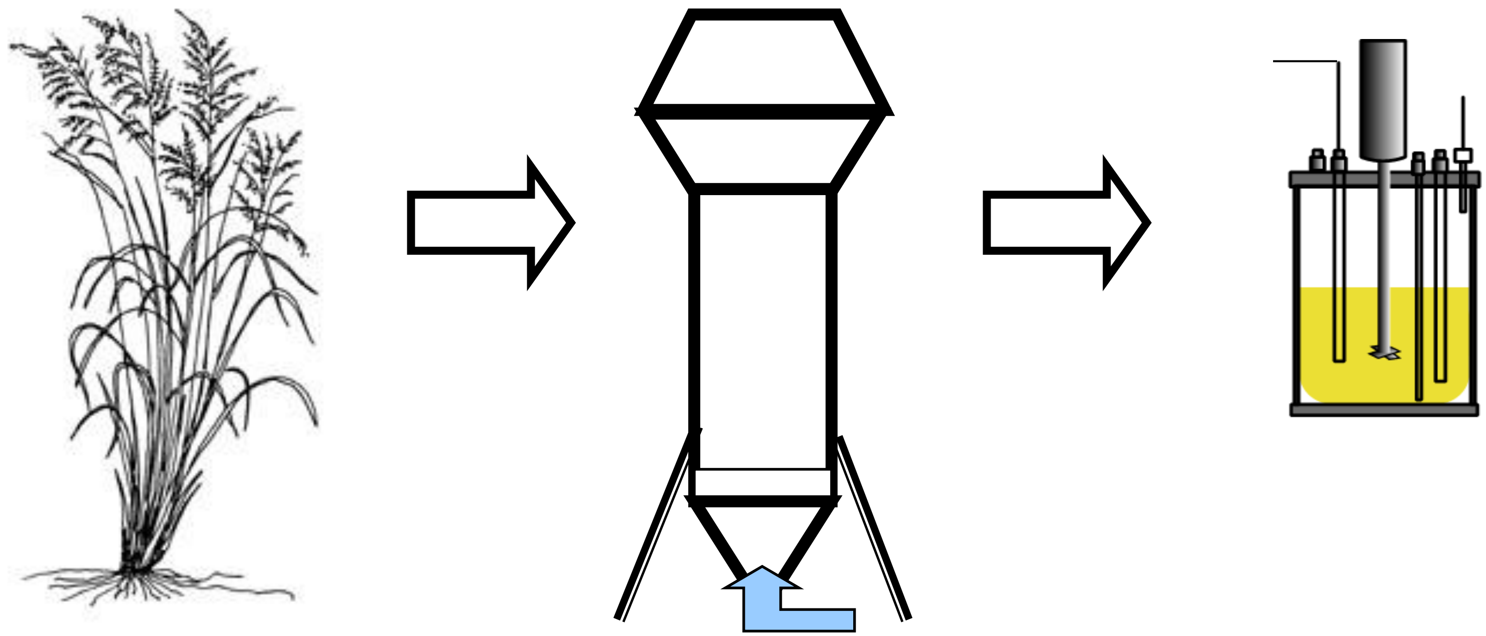
Selected Projects & Activities

- GRASSohol Project
- Sweet Sorghum Ethanol
- Oklahoma Bioenergy Center
- NSF EPSCoR Project
- Biomass Research & Development Initiative
- Sun Grant Initiative

GRASSohol

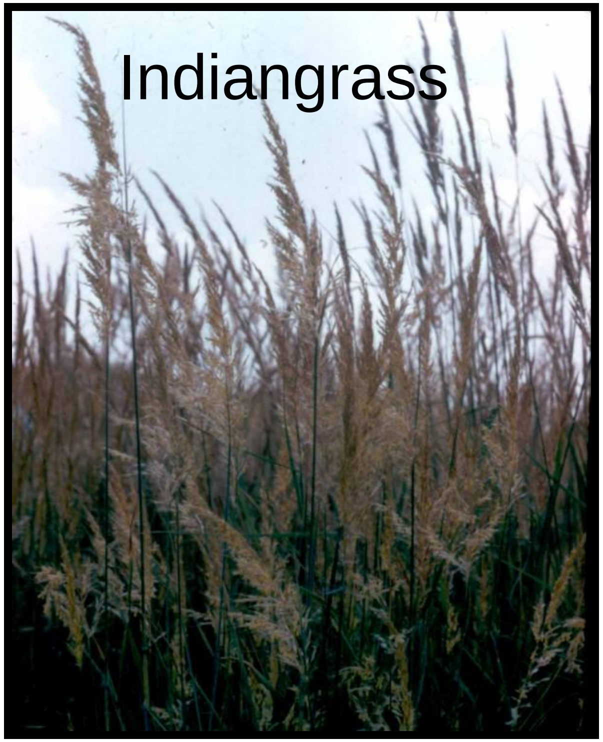
Using gasification-fermentation
to convert biomass to fuel-grade ethanol

GRASSohol Process



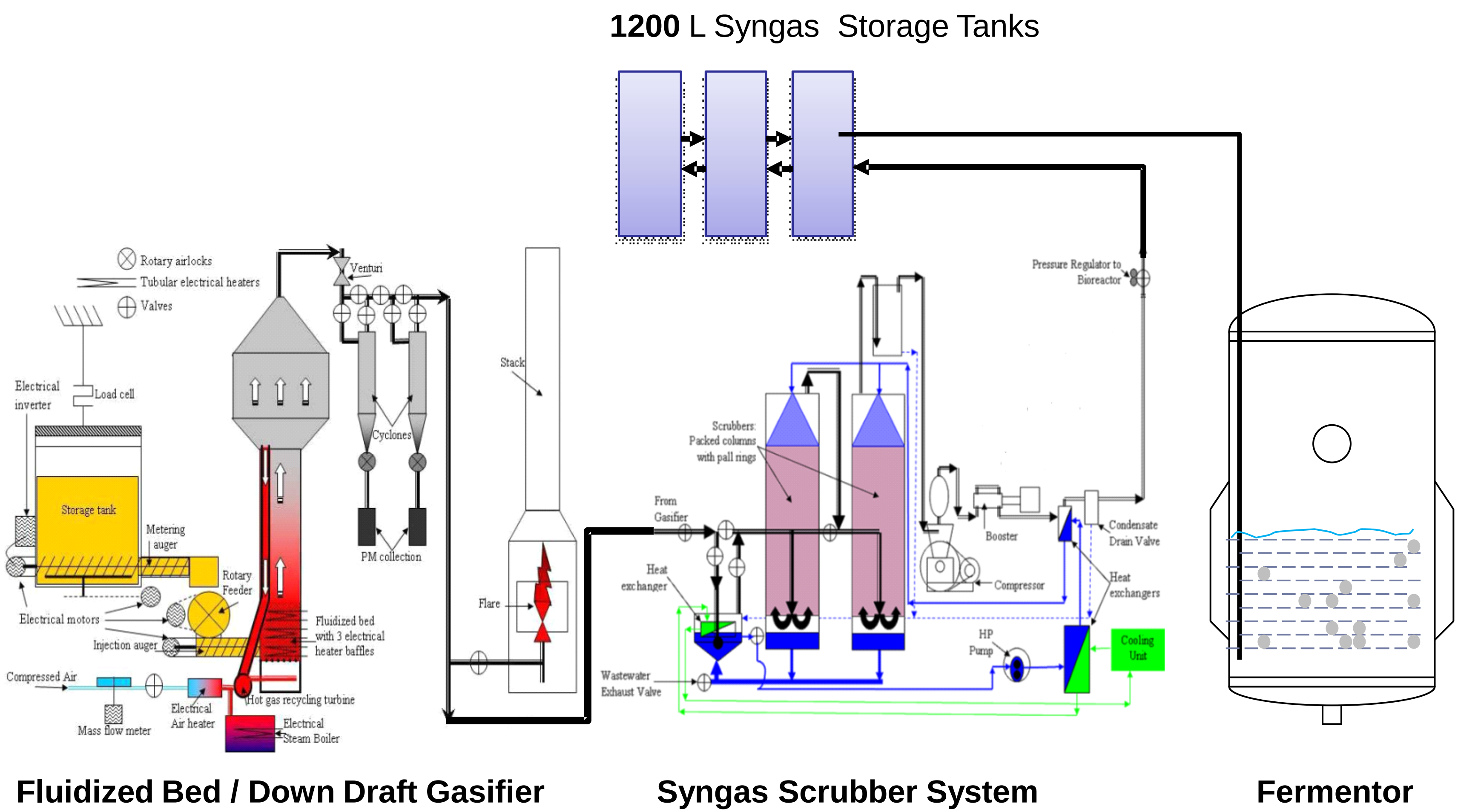
Biomass Gasifier Fermentation

Traditional grasses with high production potential



“Exotic” grasses with
high production potential

GRASSohol Process



Gasification and Cleaning System

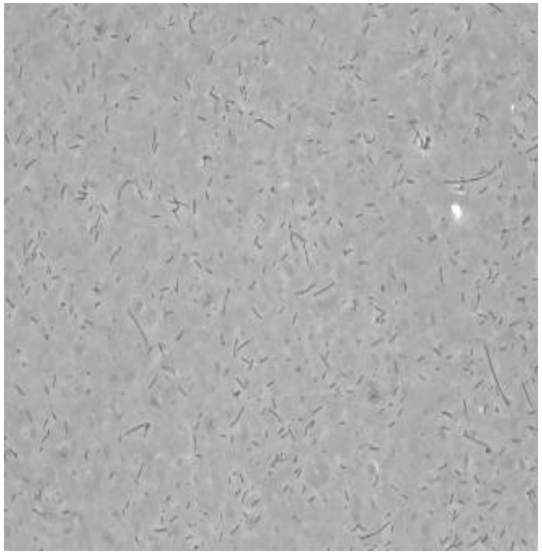
Gasification Research

- Reactors
  - Fluidized-Bed
    - Air Blown
    - Internal Supplemental Heat
    - Steam
  - Downdraft
- Maximize syngas quality (CO, H_2, CO_2)
- Tar Identification/Quantification

Bioreactor

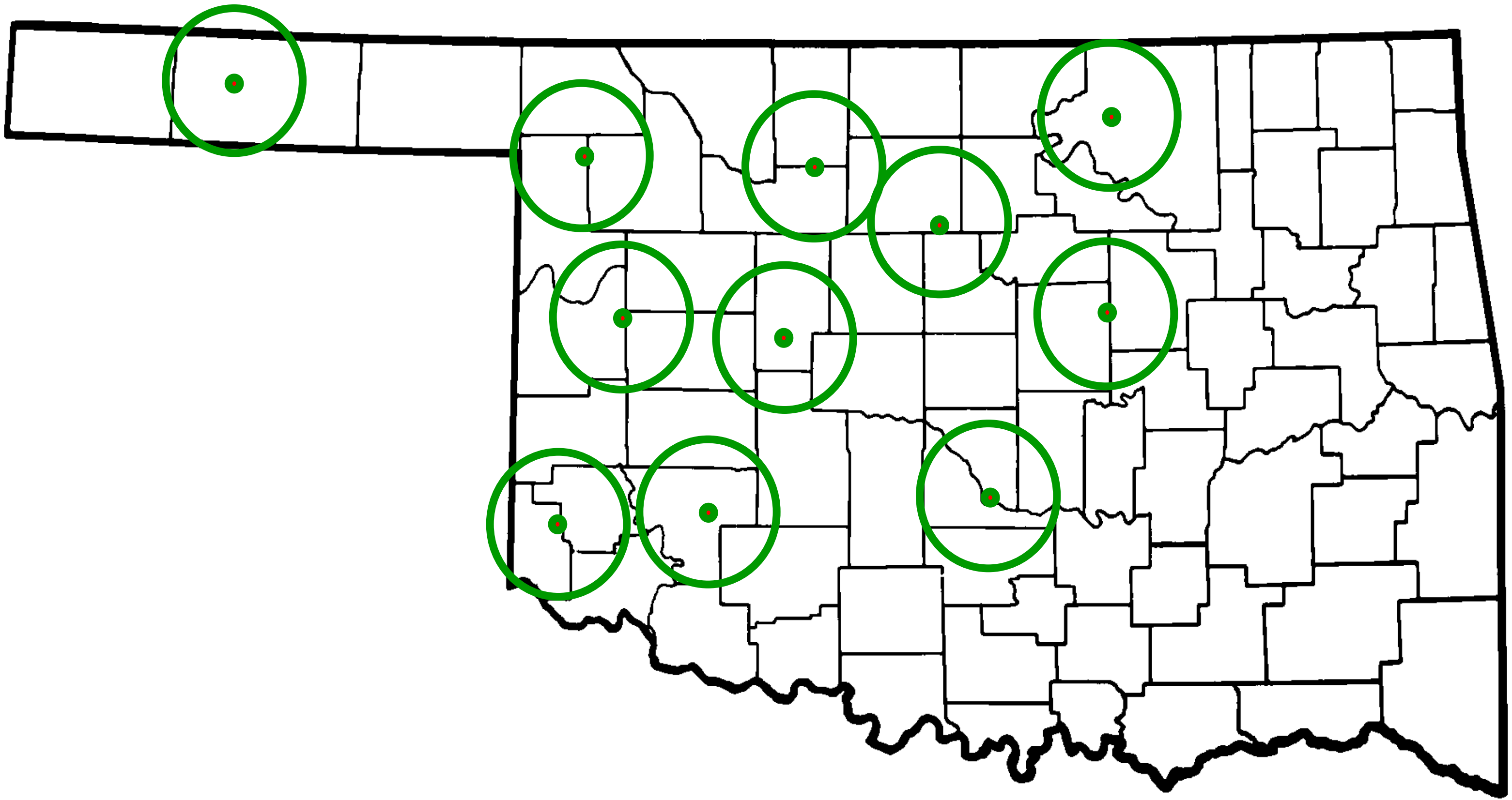
Microbial Catalysts

- Identified five unique, candidate microorganisms
- Novel clostridium species, gram positive
- Patent pending
- Successful transformation of acetogen strain P11 by plasmid pIKM1 by electroporation.

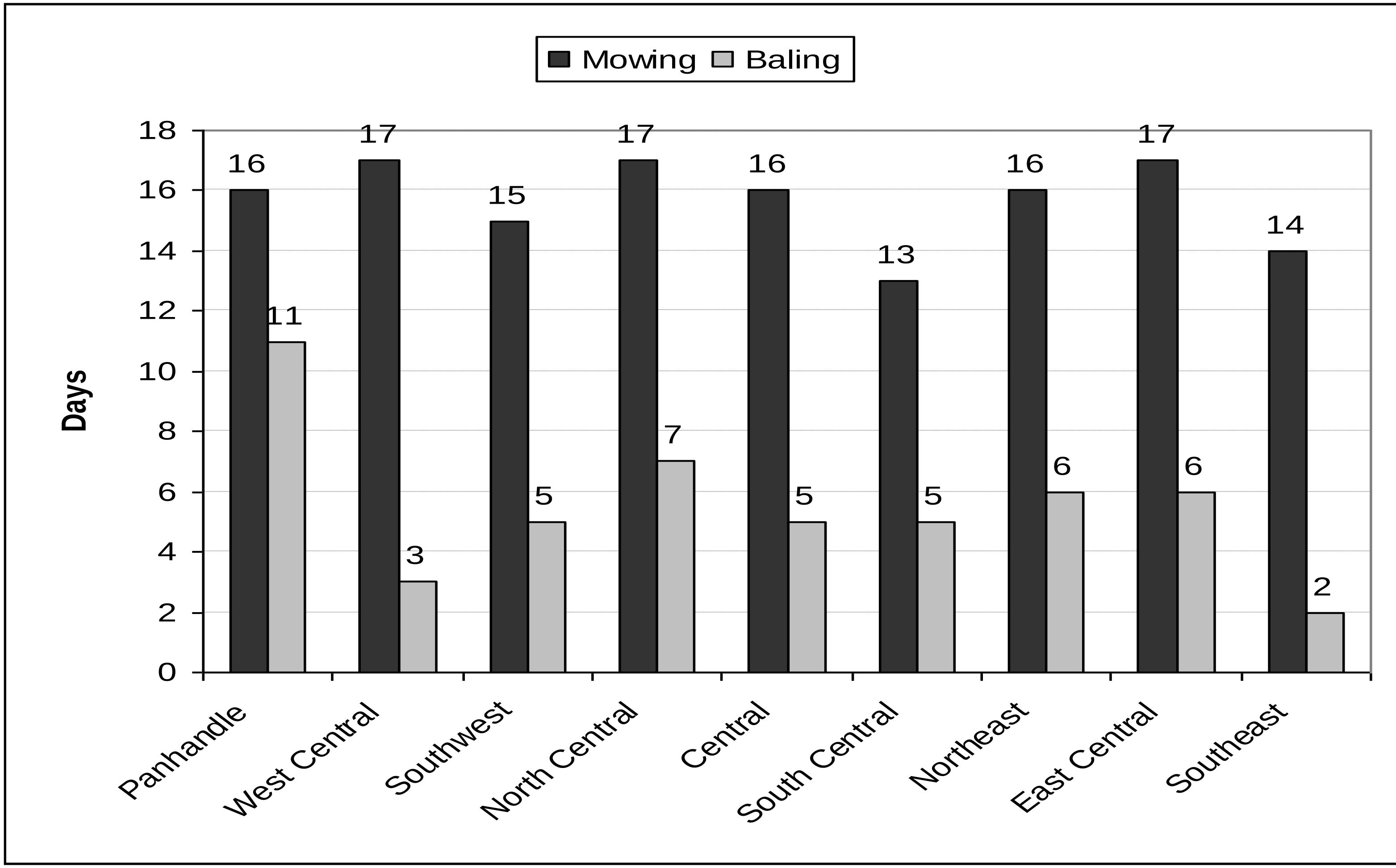


P7 – Clostridium carboxidovorans

Potential Biorefinery Plant Locations



Estimated Days of Mowing and Baling for October at the 95% Probability Level



Participants

- OSU
- University of Oklahoma
- Brigham Young University
- Mississippi State University

Funding

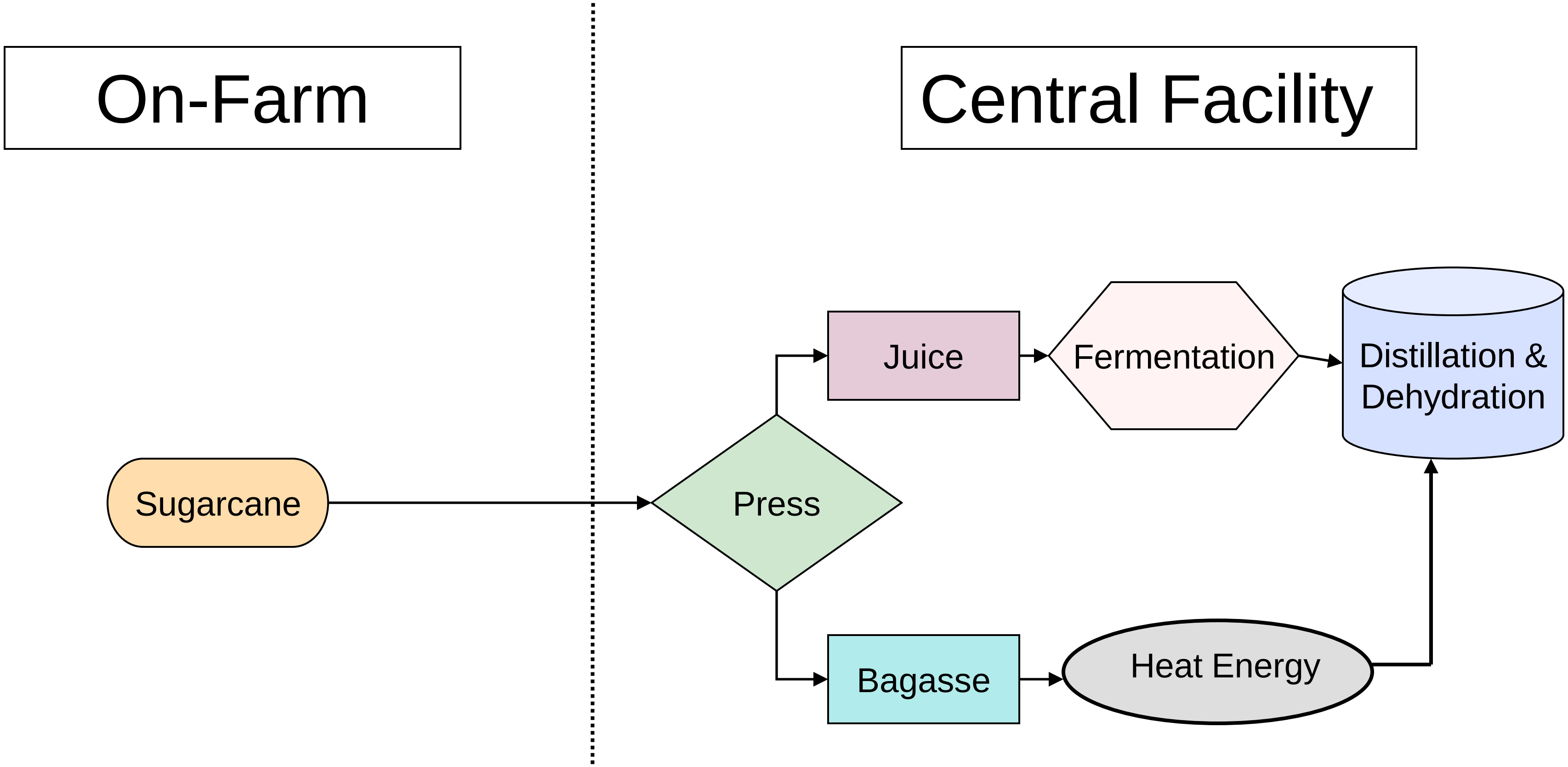
- Oklahoma Agricultural Experiment Station
- USDA-CSREES: Competitive and Special Grants
- Coskata, Inc.

Direct Fermentation of Sugars from Sweet Sorghum Juice

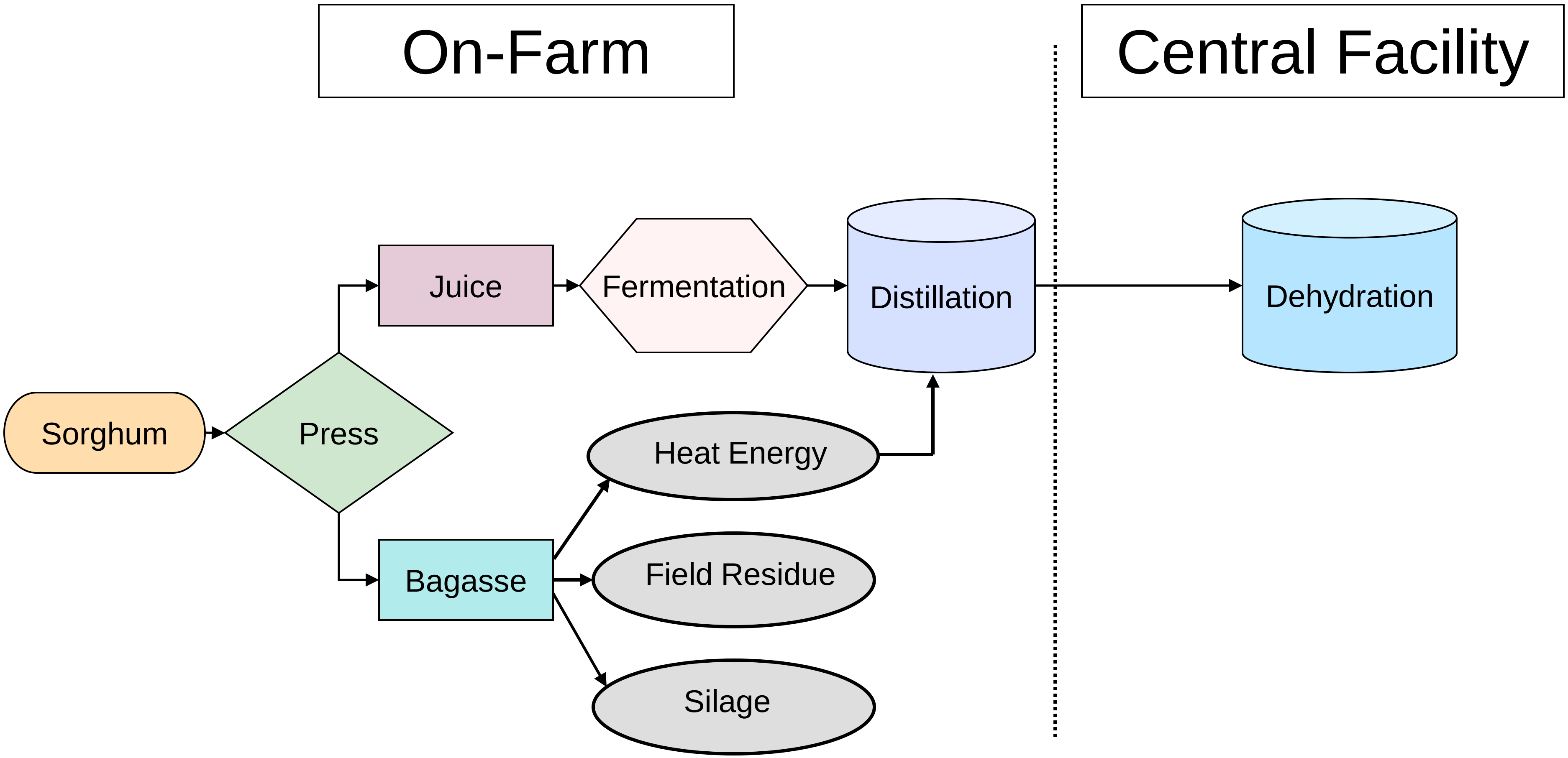
Sweet Sorghum

- High energy crop for ethanol production (15-20% directly fermentable sugar)
- Can be grown in temperate climates
- Low fertility requirements
- Low water requirement: 1/2 corn and 1/3 sugarcane

Traditional Sugar Processing



Potential In-Field Processing of Sweet Sorghum



Sweet Sorghum Research

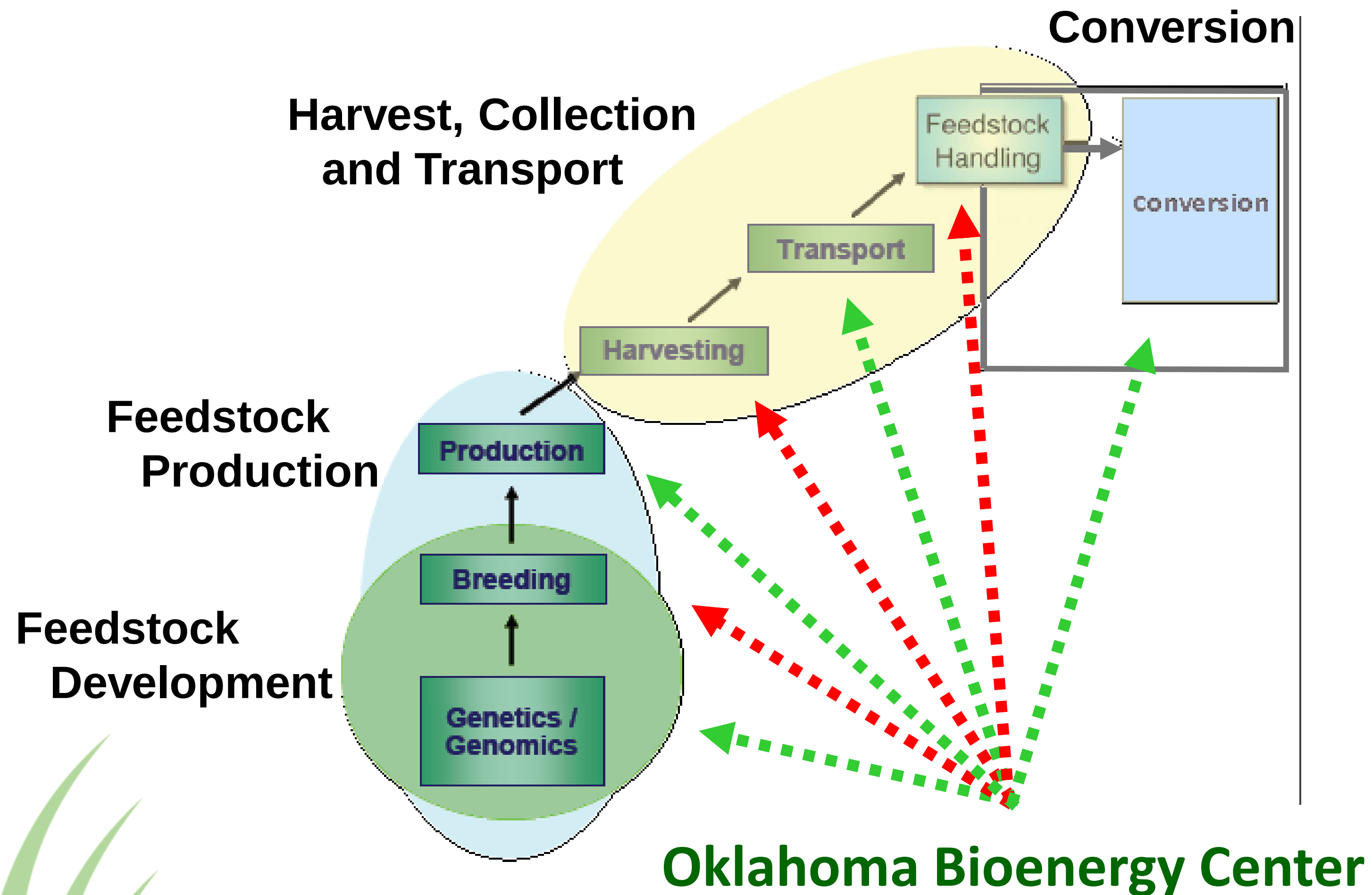
- Production
  - Fertility
  - Row spacing
- Sugar content
- Juice expression efficiency
- Fermentation efficiency

Oklahoma Bioenergy Center Act - 2007

- Created the Oklahoma Bioenergy Center.
- $40 million over 4 years.
- Founding member institutions:
  - Oklahoma State University
  - University of Oklahoma
  - The Samuel Roberts Noble Foundation

Research Programs

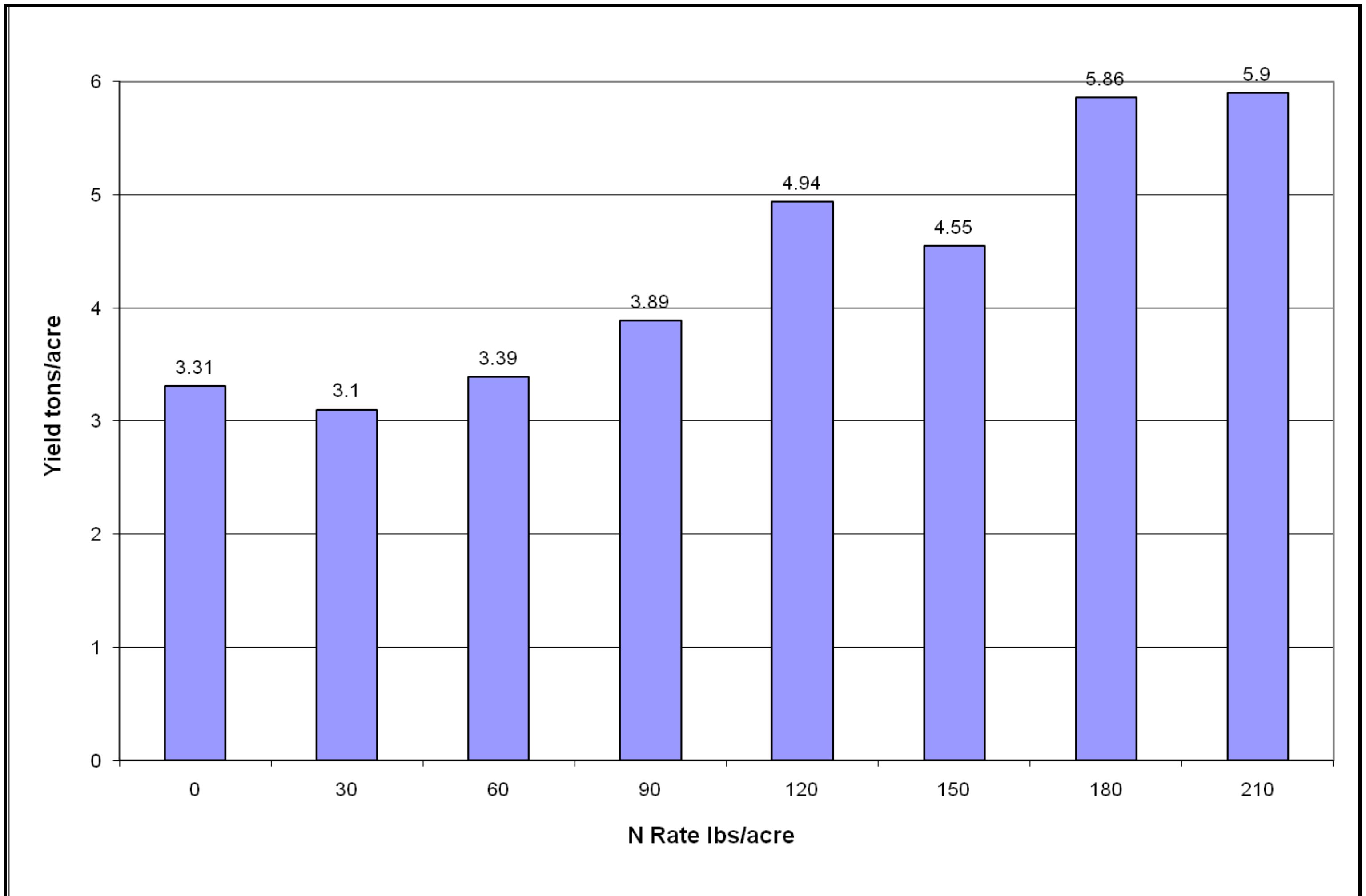
- Primary
  - Outcomes: Sustainable, economic production of **cellulosic ethanol** (or other high-value outputs).
  - Approach: Comprehensive, whole-system research that integrates solutions from each stage of the biofuels production/value chain.
- Secondary
  - Outcomes: Critical elements in production of **biodiesel and ethanol from non-cellulosic sources**.


Conversion
Harvest, Collection
and Transport
Feedstock
Handling
Conversion
Transport
Harvesting
Feedstock
Production
Production
Breeding
Feedstock
Development
Genetics /
Genomics
Oklahoma Bioenergy Center

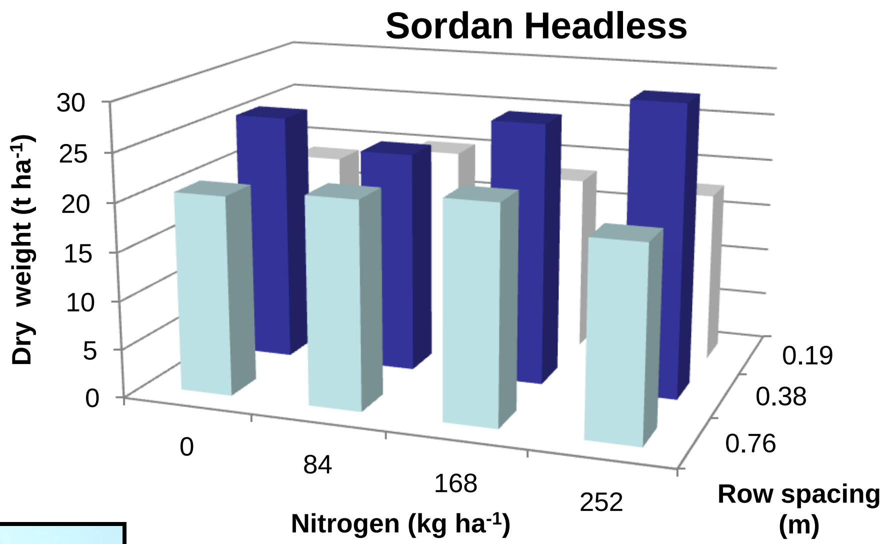
Feedstock Production

Switchgrass Yield and Quality based on Nitrogen Application

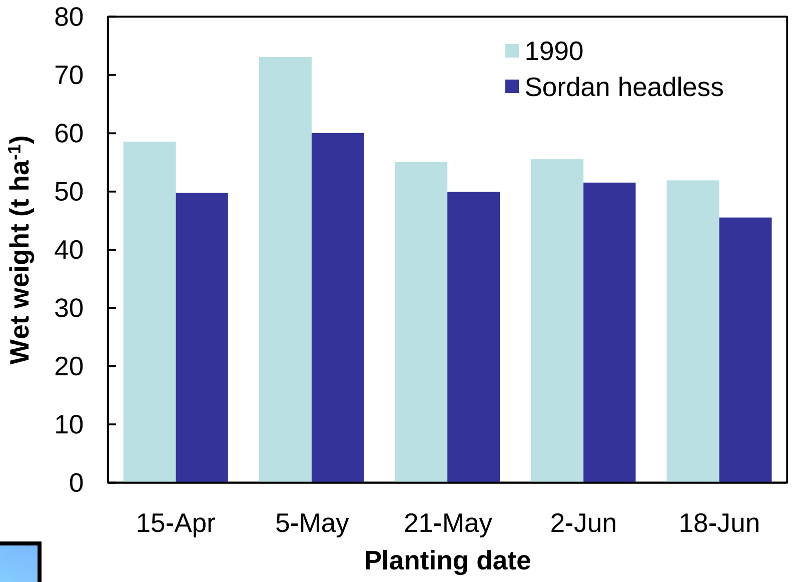
Switchgrass Yield based on Nitrogen Application



High Biomass Sorghum – Spacing x Nitrogen



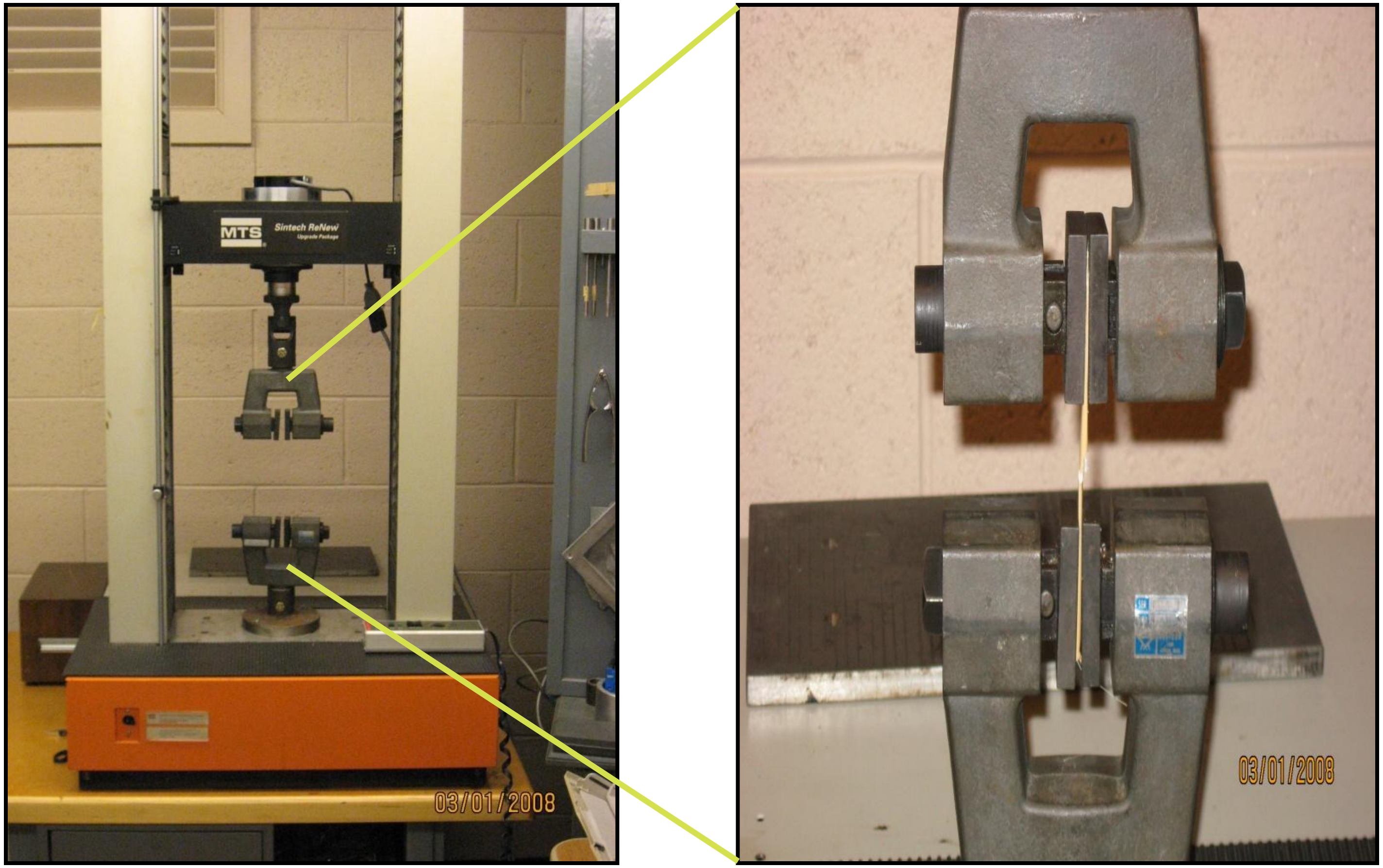
High Biomass Sorghum – Optimum Planting Date



Agronomic Considerations for Oilseed Crops

Harvest and Handling Logistics

Physical Properties of Switchgrass



Bale Storage

Building Leadership in Cellulosic Bioenergy

NSF EPSCoR RII Project

Future of Cellulosic Bioenergy?

Based on published proposed changes to the renewable fuel standard program, USEPA predicts **85%** of the production of dedicated energy crops in the U.S. in 2022 is expected to occur in Oklahoma.

"The majority of switchgrass is projected to likely be grown in Oklahoma….."

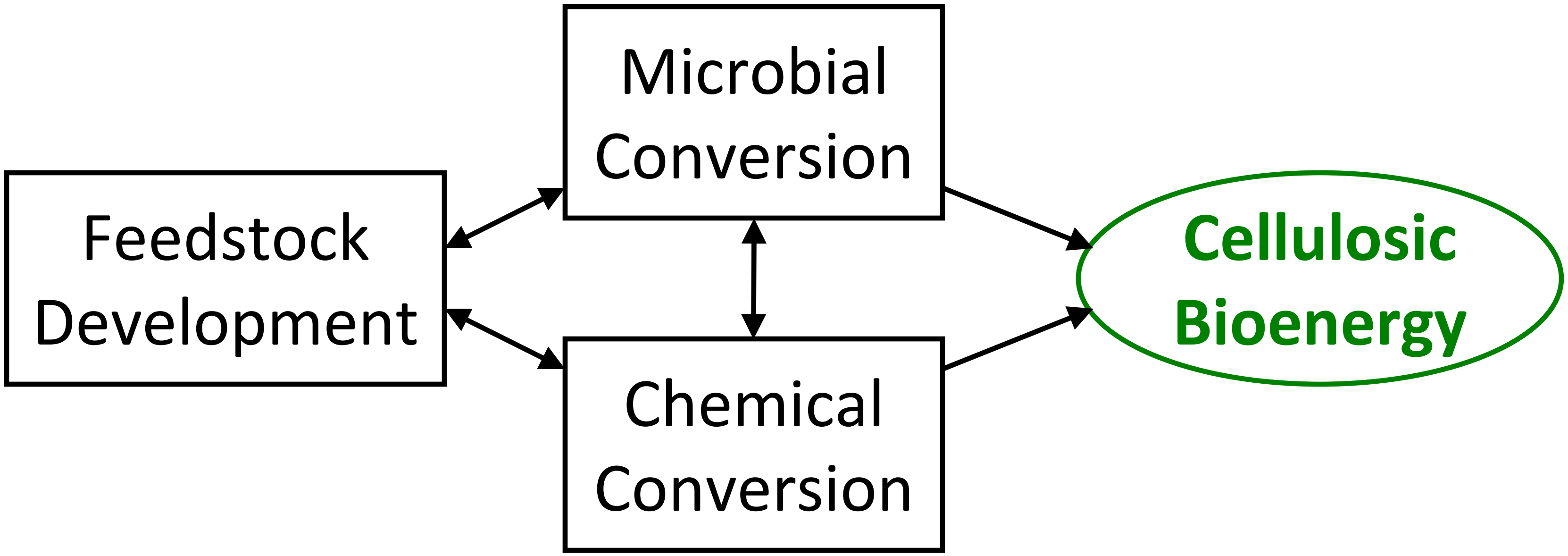
(U.S. Environmental Protection Agency, 2009)

OKLAHOMA STATE UNIVERSITY

Objectives

1. To discover molecular mechanisms and tools for **biomass development** by genomics, functional genomics and genetic transformation
2. To understand the molecular basis and mechanisms underlying efficient **microbial conversion** of biomass to liquid fuels through direct and indirect fermentation
3. To improve existing and develop new catalytic/thermo**chemical conversion** processes of cellulosic biomass

Relationship of Objectives



- *Total Dry Matter (Carbon)*
- *Pest Resistance*
- *Drought Tolerance*

- *Efficiency*
- *New Processes/Fuels*
- *Cost Effectiveness*

- *Carbon Footprint*
- *Sustainability*

Sustainable Feedstock Production Supply Systems to Support Cellulosic Biorefinery Industries

Biomass Research and Development Initiative, USDA-CSREES

Participants

- OSU
- Samuel Roberts Noble Foundation
- Idaho National Laboratory
- AGCO Industries
- Stinger, Inc.

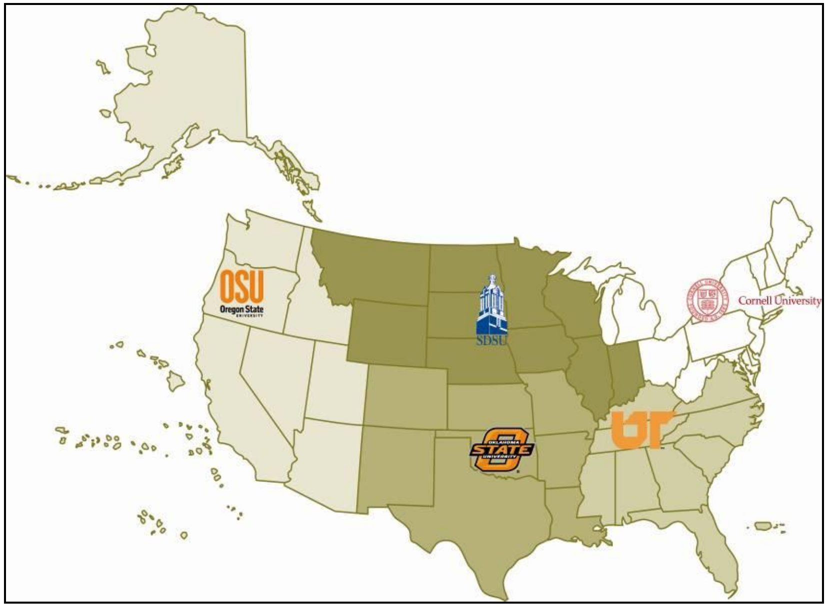
Collaborators

- Abengoa Bioenergy
- Ceres, Inc.

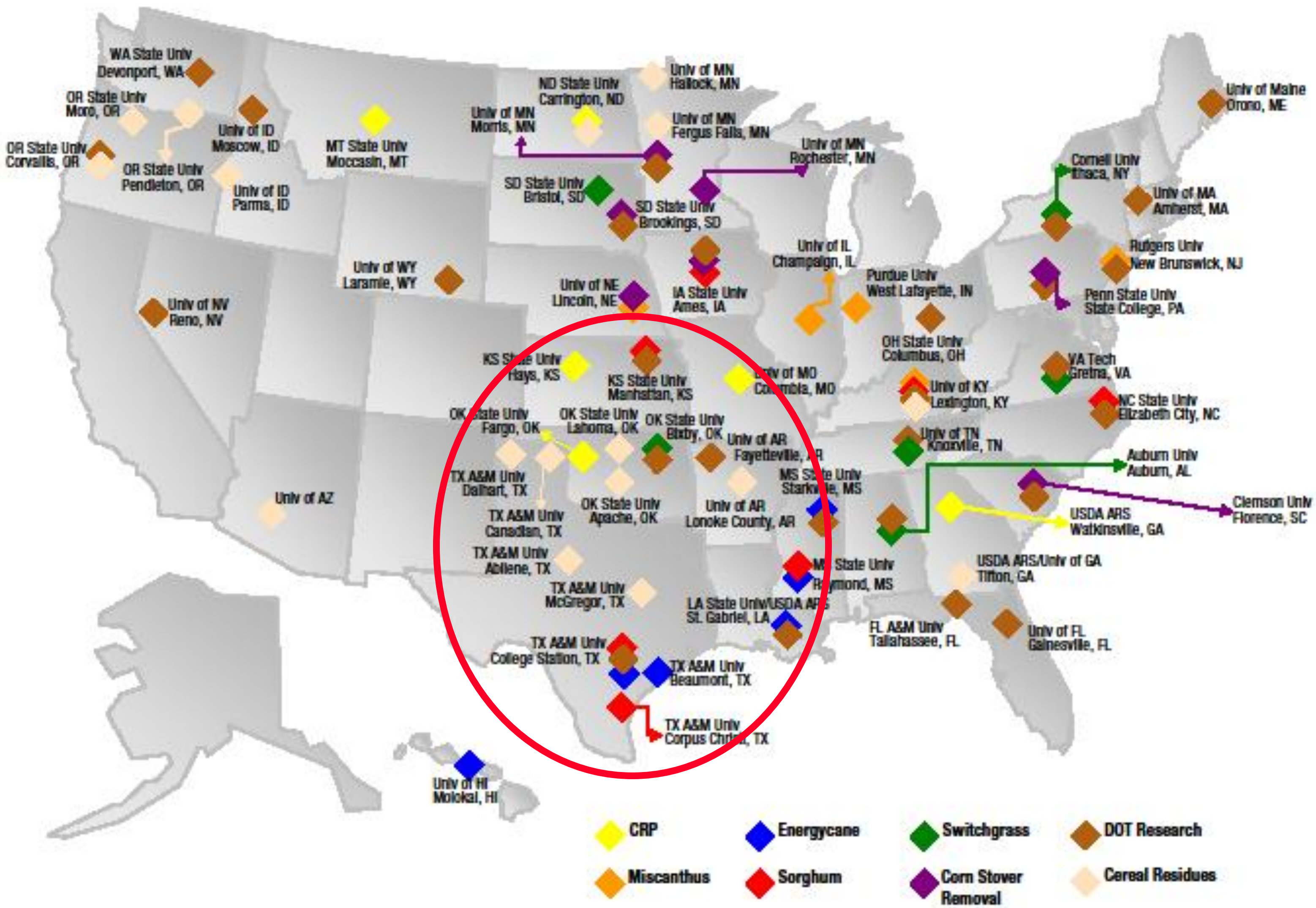
Objectives

1. Develop BMPs for sustainable **large-scale establishment and production**.
2. Development of **mixed-species** bioenergy production systems.
3. Evaluate and develop **dual-use production systems**.
4. Estimate **carbon sequestration** and climate change mitigation.
5. Determine potential to conserve **surface and groundwater resources**.
6. Model **spatial variability** of biomass yields and soil properties.
7. Identify **quality characteristics** of feedstock, using Abengoa Bioenergy as a customer of reference.
8. Determine **market bid price** for short- and long-term crop and pastureland leases.

- Develop biobased products
- Stimulate economic activity



Feedstocks Partnership



DOT Competitive Grants Program

Priorities

- Feedstock development
- Biofuels conversion processes
- Biofuels system analysis
- Economics, marketing and policy
- Environmental impacts

2007 RFA

- Seed Grants: 50 proposals, 10 awards = $693,435
- Integrated Projects: 38 proposals, 7 awards = $1,843,538

2009 RFA

- Seed Grants: 45 proposals, 6 awards = $388,152
- Integrated Projects: 35 proposals, 3 awards = $807,987

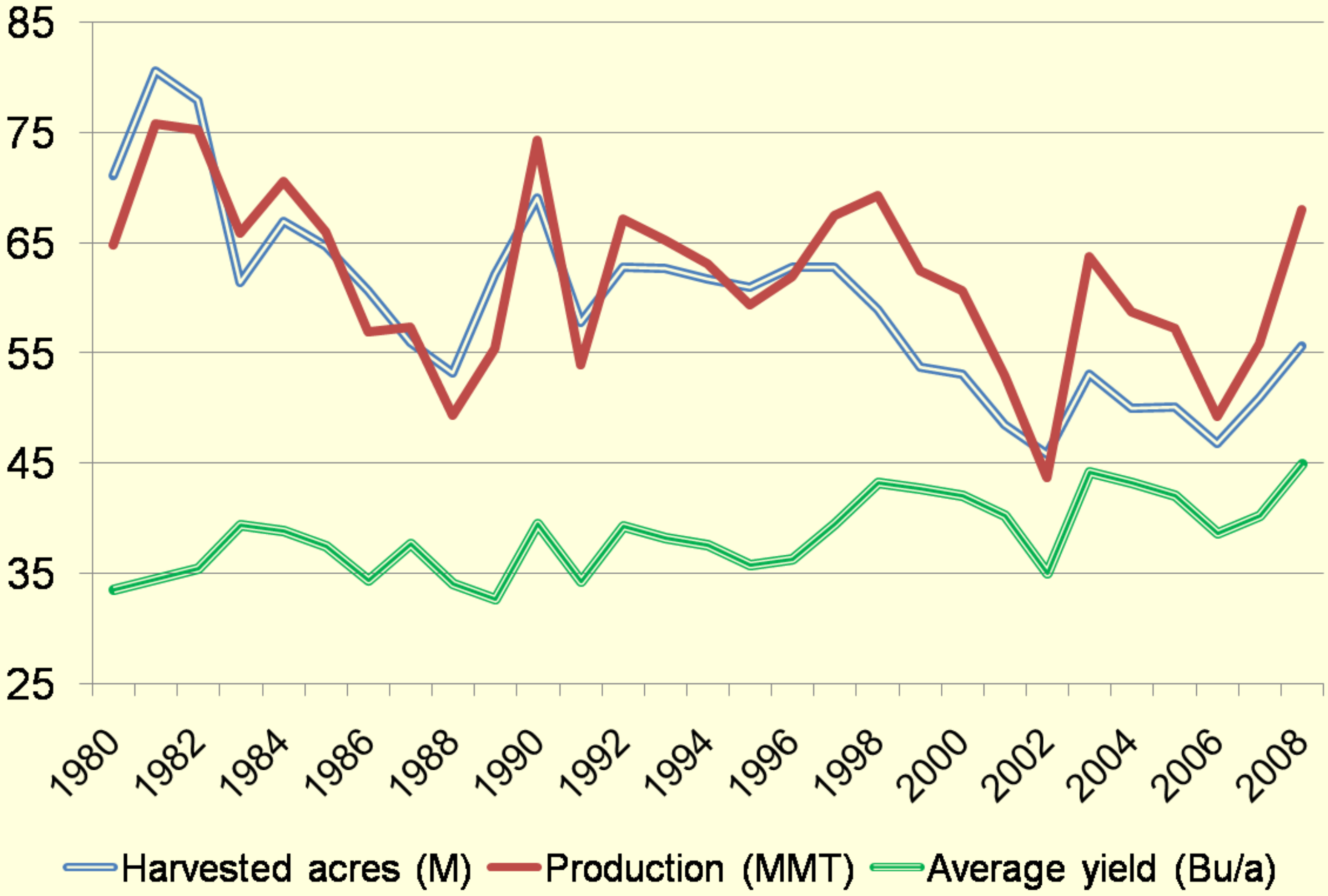
Bioenergy Research at OSU from FIELD to FUEL

Ray Huhnke, Director

Biobased Products and Energy Center
Div. of Agricultural Sciences and Natural Resources
Oklahoma State University


OSU Wheat Improvement:
Sky's the Limit
Annual Meeting
ESS/SAES/ARD Directors
15 September 2009

US Wheat Production, 1980>



Wheat Rusts: Leaf, Stem, & Stripe

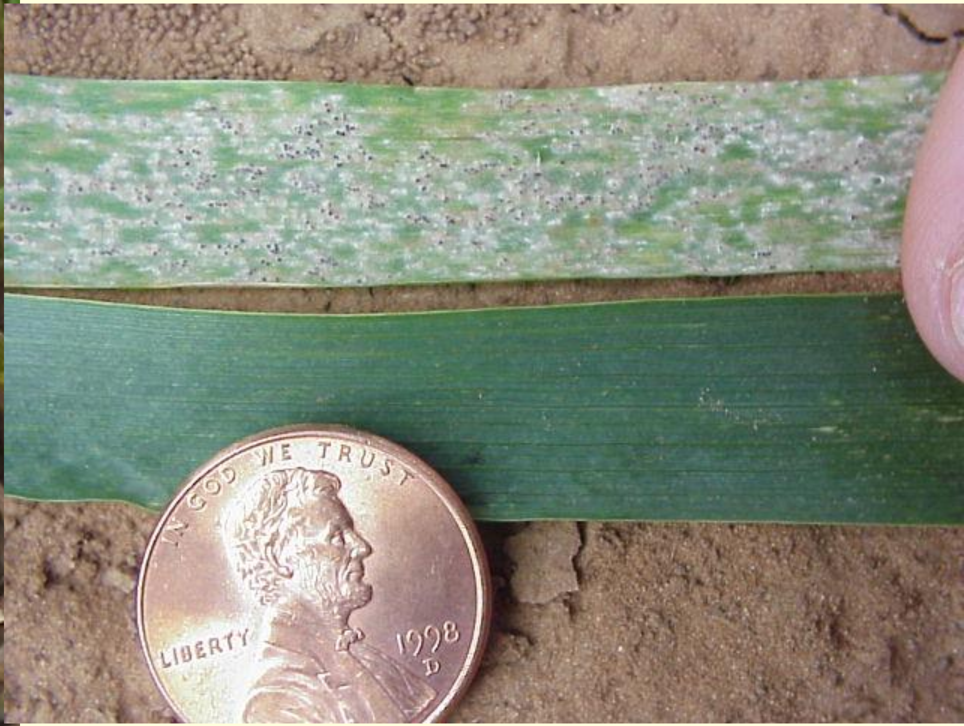
Leaf rust

Stem rust

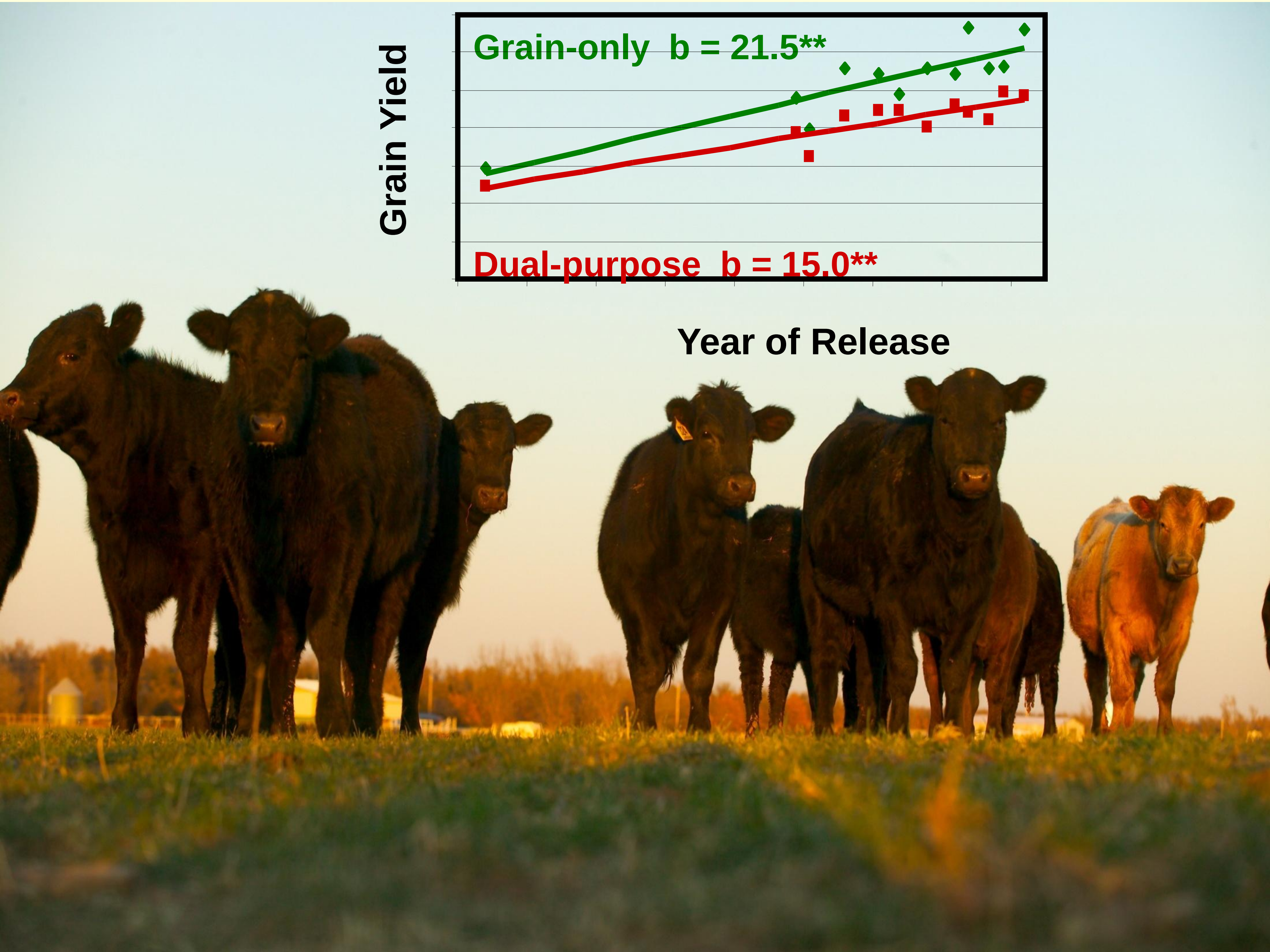
Cereal Disease Lab, St. Paul, MN

Stripe rust


HAW
SIERR
GA #10
GA #9


IN GOD WE TRUST
LIBERTY
1998
D




Grain-only b = 21.5**
Dual-purpose b = 15.0**
Grain Yield
Year of Release


FOUNDATION SEED
PEDIGREED SEED
OKLAHOMA FOUNDATION SEED
Productive
Oklahoma Pedigreed Seed Service
OK
Foundation Seed
GROWN IN OKLAHOMA
KNOWN PEDIGREES
FIELD INSPECTED
ENDURANCE
WN902
OKLAHOMA FOUNDATION SEED STOCKS

Wheat Improvement Research

Team Driven (OSU-DASNR)

Product Oriented

Stakeholder Influenced

Market Guided

WIT at Work for OK Wheat

***Create*: *GRAZE*n*GRAIN* breeding system**

***Deliver*: comprehensive/multimedia extension package for optimum management & pest control**

***Protect*: a wheat industry sensitive to perilous attacks from insects and pathogens**

***Enable*: an expanded wheat industry**

Publish:* world-class journals from *Crop Science* to *Science

Financial Support

About 2.5 faculty FTE, plus associated technical support, devoted to WIT research PLUS....

Oklahoma Wheat Res. Foundation	$220,000
OSU Foundation (Endowed Chair)	$60,000
OAES M&O	$10,000
USDA-CSREES (Special Grants)	$30,000
Royalties (subject to change)	$28,000

Financial Impact

Tens of millions . . .

2008 displacement:

$18.5 M

Total displacement in future:

$105 M minimum

Disease Resistance

- Characterize disease reactions of current and prospective wheat varieties
- Save OK wheat producers money by developing genetic resistance to wheat diseases
- Deliver information to producers through extension

Bob Hunger
26 years

Information Exchange

- Collect agronomic data from wheat research studies across the state
- Develop educational tools such as fact sheets, pamphlets, and web-based materials, and distribute to stakeholders

Jeff Edwards
5 years

Insect Resistance

- Develop IPM tools to save producers money and protect the environment
- Discover new sources of Hessian fly resistance

Tom Royer
3 years

Kris Giles
3 years

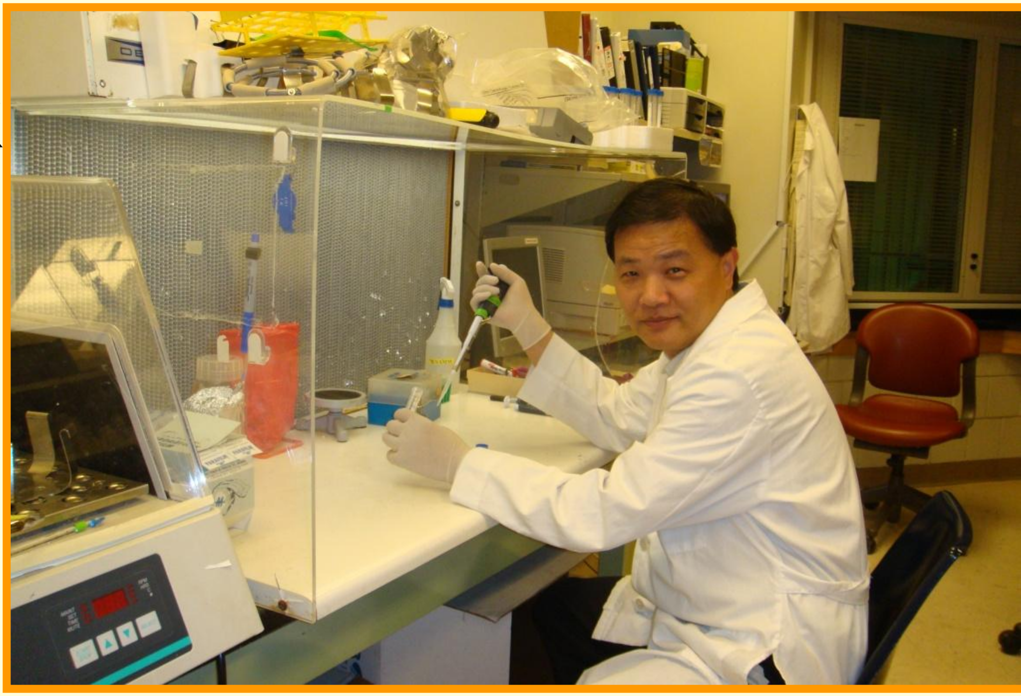
Gene Pool Enrichment

- Find new sources for genetic resistance to wheat diseases
- Use synthetic wheat to deliver genes mother nature may have left out 8,000 years ago

Art Klatt
10 years

QTL Discovery & Genomic Applications

- Find genetic markers for critical wheat traits that ensure productivity in OK
- Use MAS to speed and improve the breeding process
- Draw attention to OSU and the WIT through high-profile publications.



Liuling Yan
3 years

Drought Resistance

Develop seedling assays for coleoptile elongation under water stress

Bjorn Martin
10 years

Protein Functionality

- Develop new tools for assessing functionality of wheat that are consistent with end-user demands
- Help market the Oklahoma wheat crop by characterizing end-use quality

Patricia Rayas-Duarte
10 years

Wheat Breeding & Variety Development

- Combine the expertise of the WIT into a focused, cohesive research unit
- Produce wheat varieties tailor-made for Oklahoma
- Deliver the kind of wheat quality that customers will buy

Brett Carver
24 years

A WIT "contract"

Deliverables (Yan, FY2010)

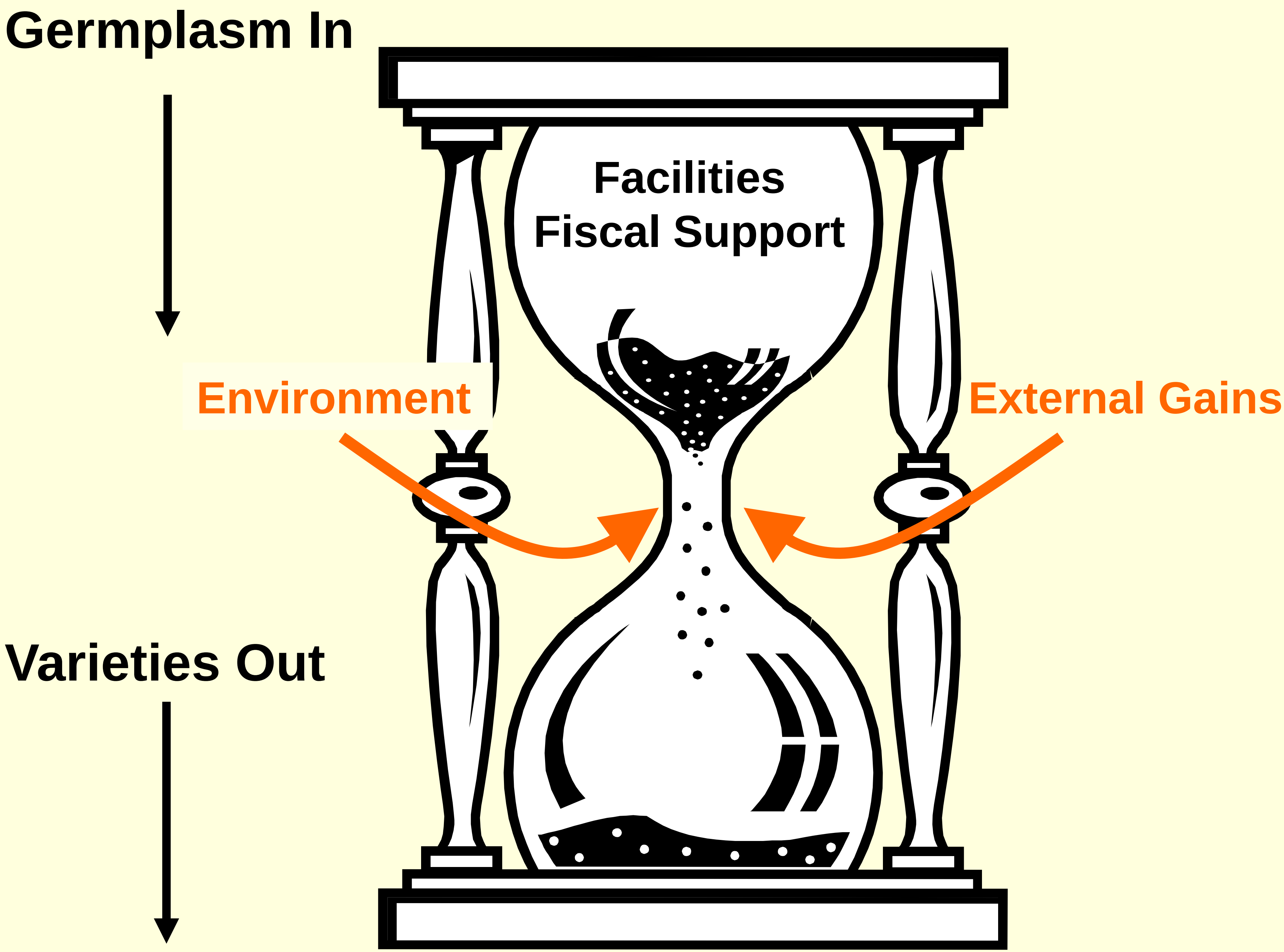
(1) A genetic model and molecular mechanism to explain the effects of three genes (*VRN-A1*, *PPD-D1*, and *VRN-D3*) on the timing of first-hollow-stem stage, heading, and physiological maturity in winter wheat, and a protocol for extending perfect markers for these loci to breeding populations.

(2) A precise molecular explanation for allelic variation in powdery mildew resistance between Jagger and 2174, and a protocol for extending a perfect marker for the powdery mildew resistance gene to breeding populations.

(3) Development and application of a PCR-based marker for resistance to leaf rust and stripe rust in OSU breeding materials and relevant cultivars.

Procedures

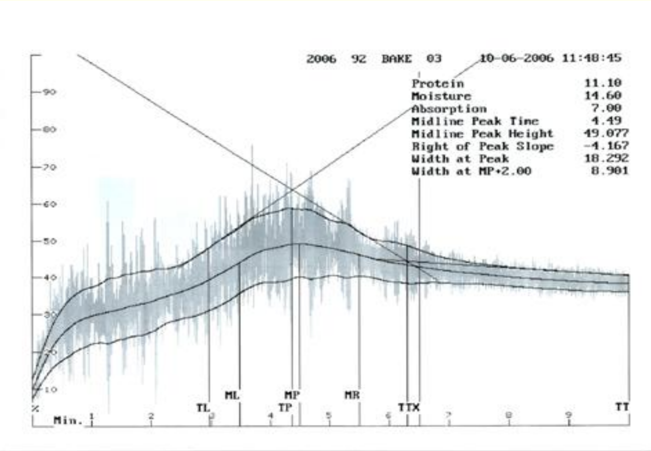
Deliverable 1: We have genetically mapped the variation in developmental phases associated with three major QTLs, each tightly linked with a known flowering gene, *VRN-A1* (=*AP1*) on chromosome 5A, *PPD-D1* on chromosome 2D, and *VRN-D3* (=*FT*) on chromosome 7D, in the Jagger x 2174 population . The effect of *VRN-A1* slightly. . .

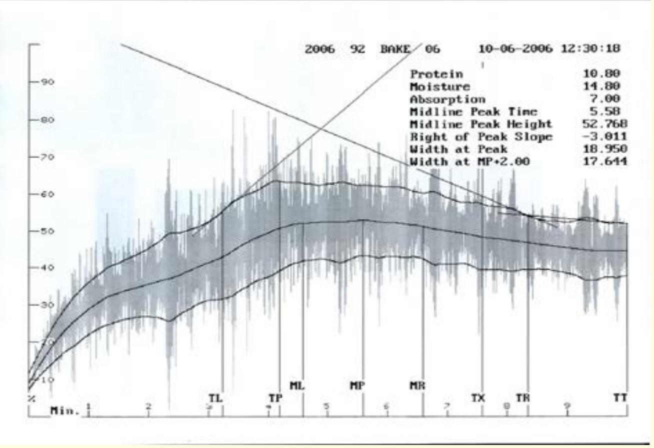

Germplasm In
Facilities
Fiscal Support
Environment
External Gains
Varieties Out

End-product orientation

Quality is a devastating, competitive weapon.

-off the wall of a textile mill in North Carolina





Our Wheat Buyers

Molinos Modernos

60 AÑOS gruma

BIMBO BAKERIES USA

ConAgra Foods

GRUPO ALTEX

The Big Picture

Wheat today:

224 million hectares harvested

680 million tonnes produced

124 million tonnes traded globally

Produce what we can sell, not sell what we can produce


We're Oklahoma Risin', brighter than a star
Stand up and sing about her, let the world know who we are
We're the sons and the daughters, children of the West
We're Oklahoma Risin', risin' up to be the best

Perspectives

- 60% productivity increase in 30 years?
- Need to put the offense in the field
- Transgenic applications: opportunity, but not salvation
- Molecular markers: tremendous voids, thus huge potential
- Phytochemical recovery – wide open
- Hard white wheat: buyers want choices

Managing Facilities and Facility Costs On & Off Campus

Steven A. Slack

Best Management Practices
SAES/ARD Workshop
Oklahoma City, OK
September 14-17, 2009


THE OHIO AGRICULTURAL RESEARCH & DEVELOPMENT CENTER
AGRICULTURAL RESEARCH STATIONS
ASHTABULA
KINGSVILLE
NORTH CENTRAL
FREMONT
NORTHWEST
CUSTAR
MUCK CROPS
WILLARD
WOOSTER CAMPUS
WOOSTER
NAEWS & POMERENE LAB
COSHOCTON
COLUMBUS CAMPUS
COLUMBUS
WESTERN
SOUTH CHARLESTON
EASTERN
CALDWELL
OSU SOUTH CENTERS
PIKETON
JACKSON
JACKSON
SOUTHERN
RIPLEY
LAKE ERIE
(I)
(II)

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

EASTERN Agricultural Research Station

Maximizing Livestock Productivity in Appalachian Ohio

Located on 2,093 acres in the rolling hills and valleys of Ohio's Appalachian plateau, the Eastern Agricultural Research Station focuses on beef cattle and sheep production research and on the evaluation of forage production systems. These activities are a central part of the economic backbone of eastern Ohio.

Station personnel work with Ohio Agricultural Research and Development Center (OARDC) scientists, Ohio State University Extension specialists, producers, and industry groups to conduct innovative studies on cattle reproduction and nutrition; sheep management and health; improved forages; and lower-cost feeding alternatives. The knowledge generated at the Station is then communicated to farmers and transferred throughout the beef cattle and sheep industries.

Eastern Ohio counties represent the bulk of the state's beef cattle and sheep production — industries that have an estimated $770 million economic impact in Ohio.

History

The Eastern Agricultural Research Station was established in 1965 through the purchase of a 728-acre block of hilly land near Belle Valley in Noble County. This land, along with 40 acres acquired later on, is known as Unit I. The Station's size was significantly increased in 1966, when the Union Carbide Corporation and the Baker-Noon Coal Company donated an additional 1,325 acres that had been extensively strip-mined for coal. This area is known as Unit II and was the subject of land-reclamation experiments through the 1990s.

Wayne Shriver, Manager
Eastern Agricultural Research Station
16870 Township Road 126
Caldwell, Ohio 43724
740-732-2682, shriver.13@osu.edu

THE OHIO STATE UNIVERSITY OARDC

Bringing Knowledge to Life

http://oardc.osu.edu/branches/branchinfo.asp?id=8

THE OHIO STATE UNIVERSITY OARDC

CASE I
OFF CAMPUS-CLOSING

- **Communications**
  - State legislators
  - County Commissioners
  - Advisory Council
  - OSU hierarchy

- **Information Flow**
  - Met in county/public forum
  - Talked with local reporters

- **Personnel Impacts**
  - Notified our personnel first
  - Met our personnel face-to-face
  - Program/personnel relocations (Human Resources)
  - Notified other OARS
  - Separation over 18 mo.

CASE II
OFF CAMPUS-GIFT

- **Communications and Management**
  - Work with OSU Development
  - Is there a need? Rationale?
  - Management/Business Plan
  - Cost Recovery opportunities (Plant/Animal)
  - Must do diligence/must visit site
  - State/local officials if appropriate

Wooster Campus


Bioenergy/Bioproducts/
Biomass Complex
Wooster Bike Trail
Secrest Rd Improvement
Secrest Arboretum
Secrest Entrance
Secrest Center
BioHio Phase II
Pond
MCIC
PAAR
Shisler -Fisher Conference
Center & Auditorium
BioHio Phase I
THE OHIO STATE UNIVERSITY
OARDC

THE OHIO STATE UNIVERSITY
OARDC

CASE III
ON CAMPUS-NEW FACILITY

- **Communications**
  - OSU hierarchy
  - Faculty User Groups
    - ✓ Planning
    - ✓ Funding/Business Plan
    - ✓ Building Consensus
    - ✓ Governance
      - Management
      - Fees
  - Stakeholders as appropriate

- **Information Flow**
  - Keep campus informed
  - Keep community informed

- **Personnel Impacts**
  - MOUs as needed
  - Involve Human Resources

CASE IV
ON CAMPUS-CLOSING/USE CHANGE

- **Communications**
  - OSU facility department
  - Engage groups impacted directly
    - ✓ Departments
    - ✓ Campus facility units
    - ✓ Faculty/staff/students
  - Stakeholders if appropriate
  - MOUs if appropriate

- **Information Flow**
  - Notify campus
  - Notify community as appropriate
    - ✓ Press, local groups, meetings

- **Personnel Impacts**
  - Notify our personnel first
  - Meet our personnel face-to-face

Program Change Comments

Lee Sommers
Colorado State University

Greenhouse Management

- Situation
  - Units: Ag Sci(5), Nat Res(2), Nat Sci(1)
  - Space assigned to departments
  - Inappropriate use, i.e., storage
  - Disjointed requests for new space
- External Consultant retained
  - Recommended centralized management

CSU Plant Growth Facilities

- Solution
  - State funding obtained for renovation
    - Greenhouses and growth chambers
    - Central storage
  - AES management
    - Funding from colleges, AES, Ext
    - Reps serve as Oversight Committee
  - Users assessed fee based on sq ft used
  - System additions
    - Phase 2 of renovation
    - New services for pots, media, storage

Near Campus Field Research Center (ARDEC)

- Situation
  - Plant Sciences – AES admin since 1992
  - Animal Sciences – Department admin since 1907
- Preliminary
  - Interviewed faculty and staff
  - External review committee
- Recommendation
  - Consolidate management under CAS/AES

Near Campus-2

- Implementation
  - Created faculty advisory committee
  - Developed job description for Manager
  - Regional search
  - AES funding
    - Manager and 2 support staff
    - Reimbursed An Sci for equipment purchased
    - Cattle inventory transferred

Big Questions, Big Opportunities

Estimating Unintended Impacts on Land Use from Energy and Climate Change Policy

Bruce A. Babcock
Center for Agricultural and Rural Development
Iowa State University

ESS/SAES/ARD Meeting and Workshop
September 14-16, 2009
Oklahoma City, Oklahoma

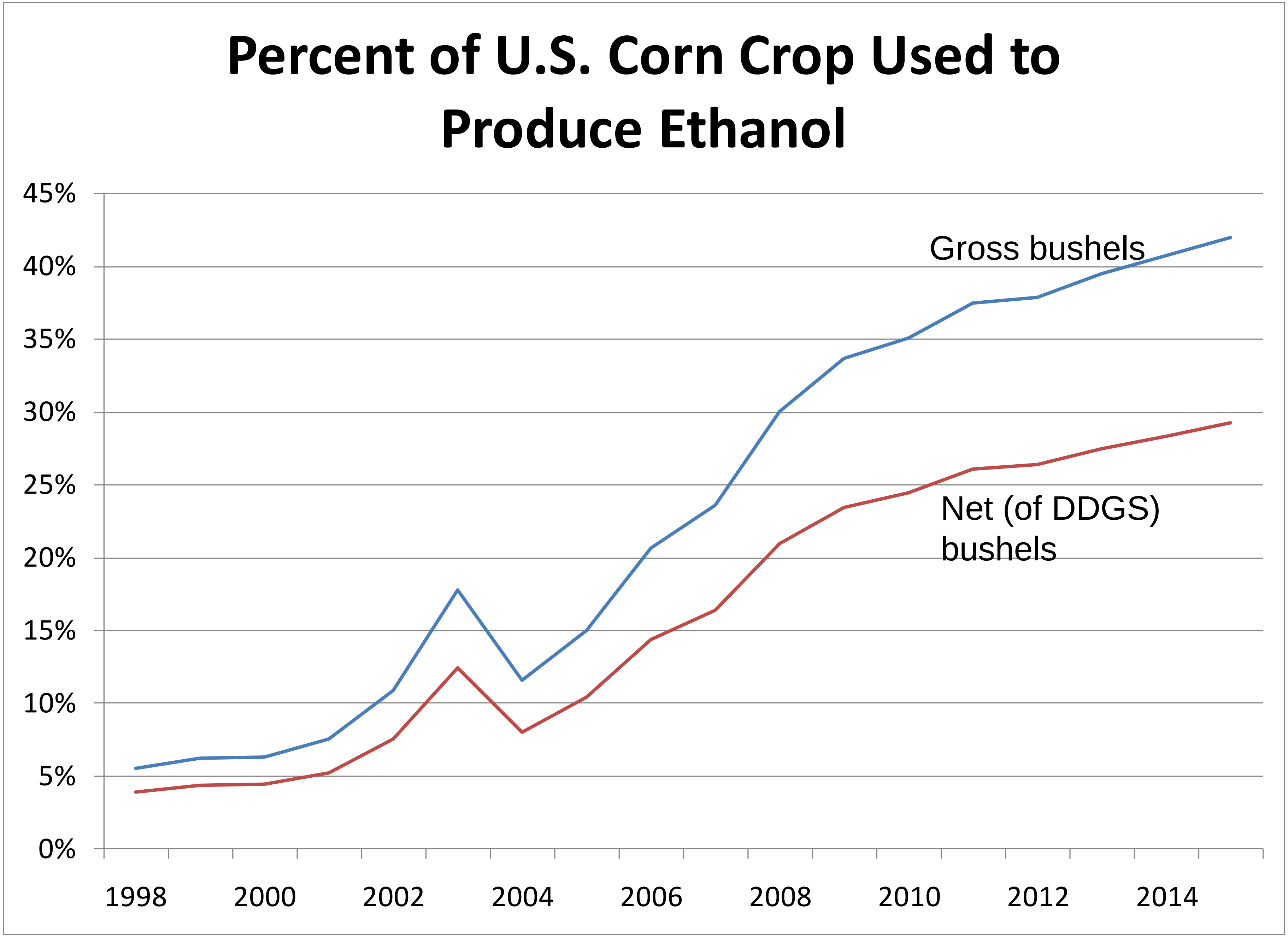
Competing Demands for Land

- Traditional uses
  - Feed for livestock (grass and feed grains)
  - Food for humans
  - Environmental services (eg, open space, habitat, flood control)
- New Demands
  - Feedstock for liquid fuels
  - Feedstock for renewable electricity
  - Carbon sink in soils
  - Carbon sink in forests

Two Examples of Unintended Consequences

- Energy Independence and Security Act
  - Mandates 20% of U.S. liquid fuels comes from biofuels

- House climate change bill (Markey Waxman)
  - Allows agricultural sinks to serve as GHG offsets



Percent of U.S. Corn Crop Used to Produce Ethanol
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
1998
2000
2002
2004
2006
2008
2010
2012
2014
Gross bushels
Net (of DDGS) bushels

Impacts from Increased Corn Ethanol

- World prices of corn and crops that compete with corn for land will be higher
- U.S. and international production will increase
- Expanded crop production comes about in part by expanding cropland
- Expansion of cropland increases CO2 emissions relative to what they would be without ethanol
- Indirect emissions offset at least a portion of the direct emission reduction from using renewable fuel

Markey Waxman

- Collin Peterson’s amendment allows agriculture to sell emission offsets
- Growing trees likely the largest provider of offsets
- Restrictions on international offsets means that trees will be grown in the U.S.
- EPA estimates that many millions of acres of U.S. cropland will be converted to trees
- Where will the crops get grown?

Science of Land Use not Well Developed

- Regulators' demand for science has outstripped supply
- Agriculture's participation (positive or negative) in a world where CO_2 (or equivalent) is valued requires more knowledge than for other sectors because agriculture is a non-point source of CO_2.
  - Who is going to do the science? Researchers that know nothing about agriculture and food production?
  - Will the public support the cost of increased knowledge?

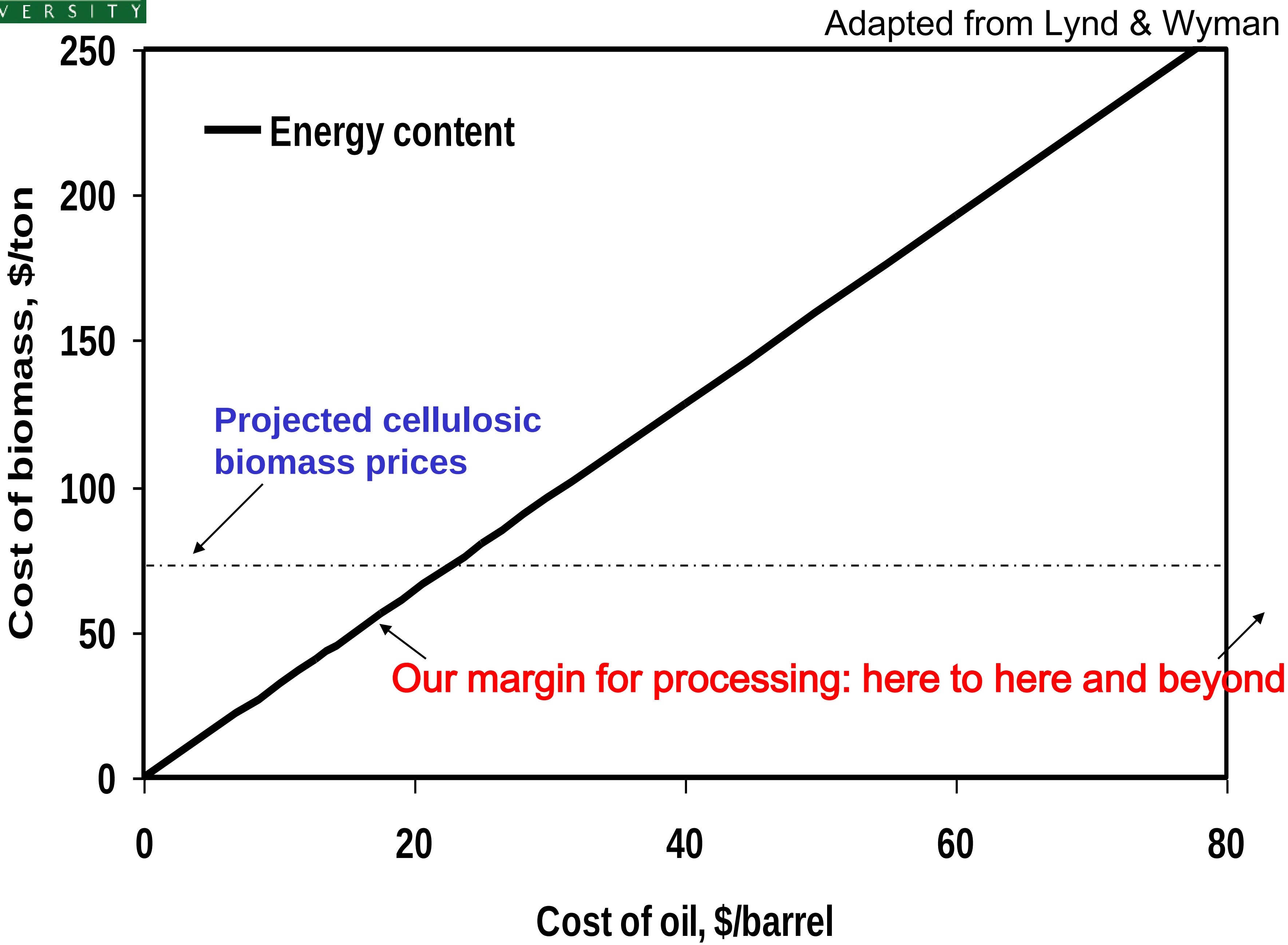
MICHIGAN STATE UNIVERSITY

Renewable Energy: Big Questions, Big Opportunities for Agriculture & the Land Grants

Bruce E. Dale, Professor
Dept. of Chemical Engineering & Materials Science
Associate Director: Office of Biobased Technologies
Michigan State University
www.everythingbiomass.org

ESS/SAES/ARD Meeting and Workshop
September 14-16, 2009
Oklahoma City, Oklahoma

MICHIGAN STATE UNIVERSITY



Biomass is the cheapest carbon, especially in a carbon-constrained world

MICHIGAN STATE UNIVERSITY

Questions for a Biofuels Future

- Premise: *the biofuels industry will continue to grow rapidly in coming years.*
- Some resulting questions:
  - How will supply chains develop?—**big** issue
  - How will society/interest groups, etc. react?
  - How will related environmental issues (carbon sequestration, water, soil quality, landscape values, biodiversity, etc.) be addressed?
  - Given a large biofuel demand, what will the implications be for food/feed/fiber markets?
  - Can we coproduce fuels (& foods/feeds)?
  - How can farmers & local communities benefit?
  - Will the agricultural research system rise to its huge opportunity?

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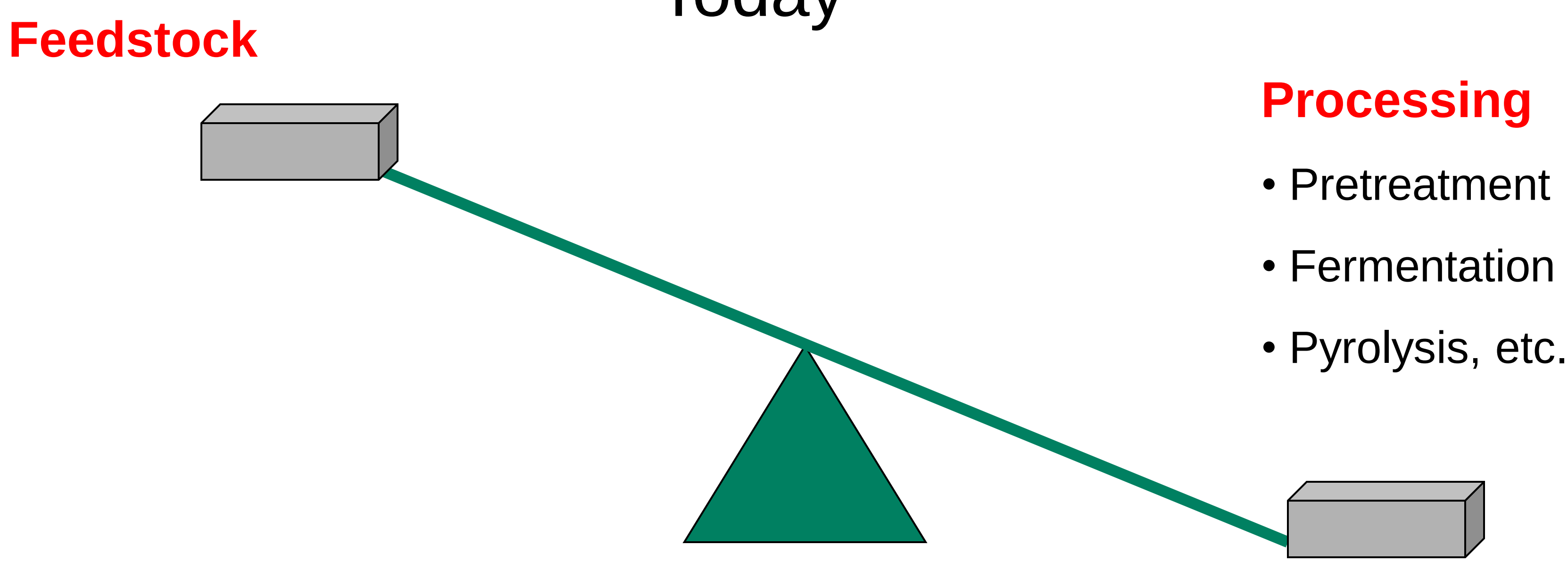
Biofuels: Changing Balance between Processing and Feedstock

Today



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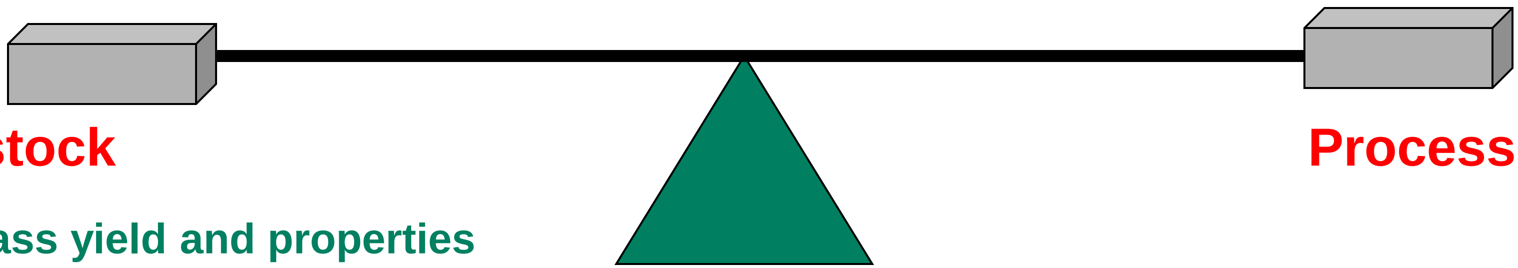
Changing Balance between Processing & Feedstock: *Opportunities for Research*

Near Future

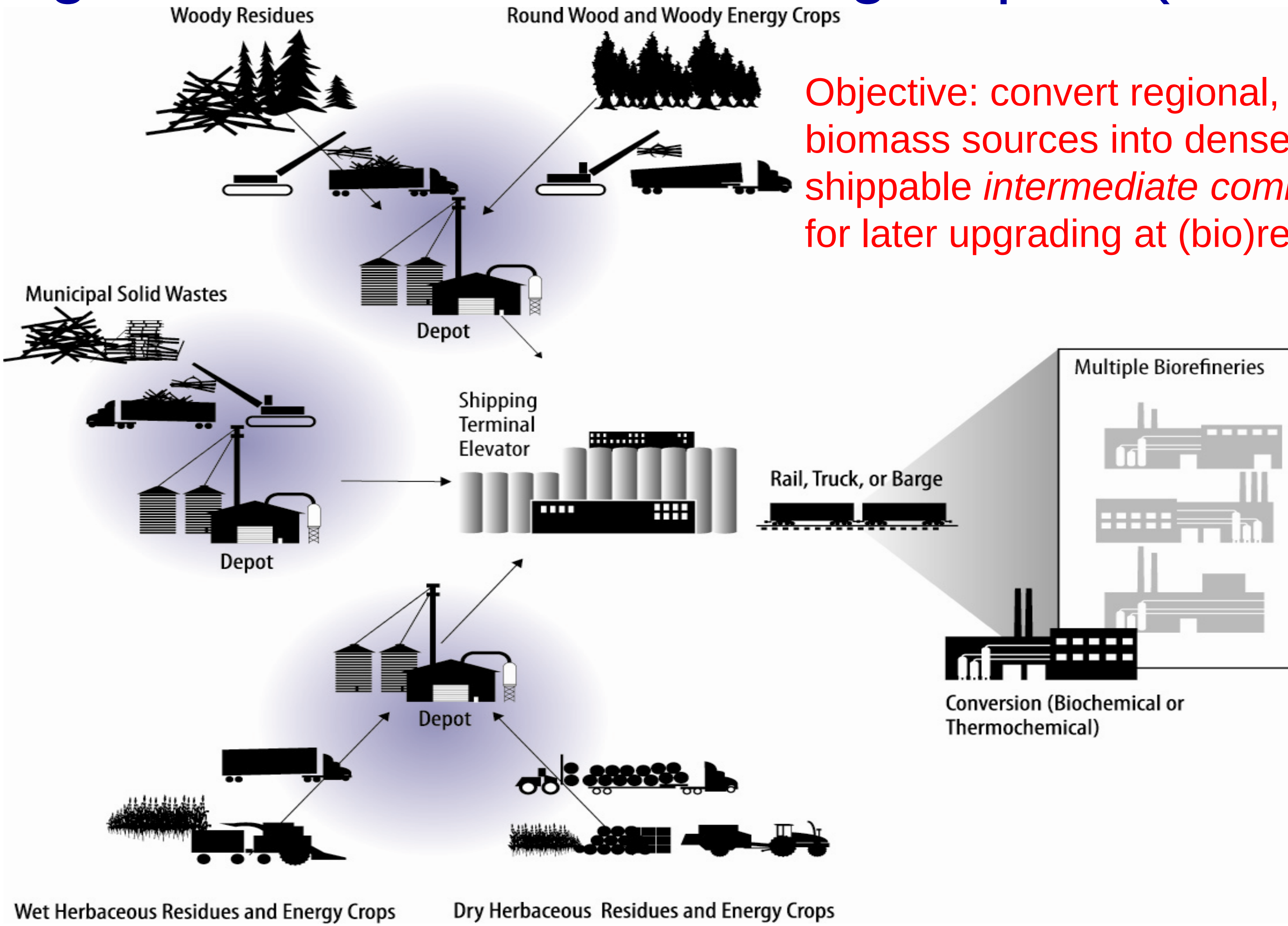


Feedstock

Processing

- **Biomass yield and properties**
- **Harvest/transport logistics**
- **Sustainability**
- **Rural economic development**
- **Co-products**
- **Others**

Attacking Biomass Supply Challenges: Regional Biomass Processing Depots (RPBDs)



Objective: convert regional, distinct biomass sources into dense, stable, shippable *intermediate commodities* for later upgrading at (bio)refineries

Advantages and R&D Needs for Regional Biomass Processing Depots

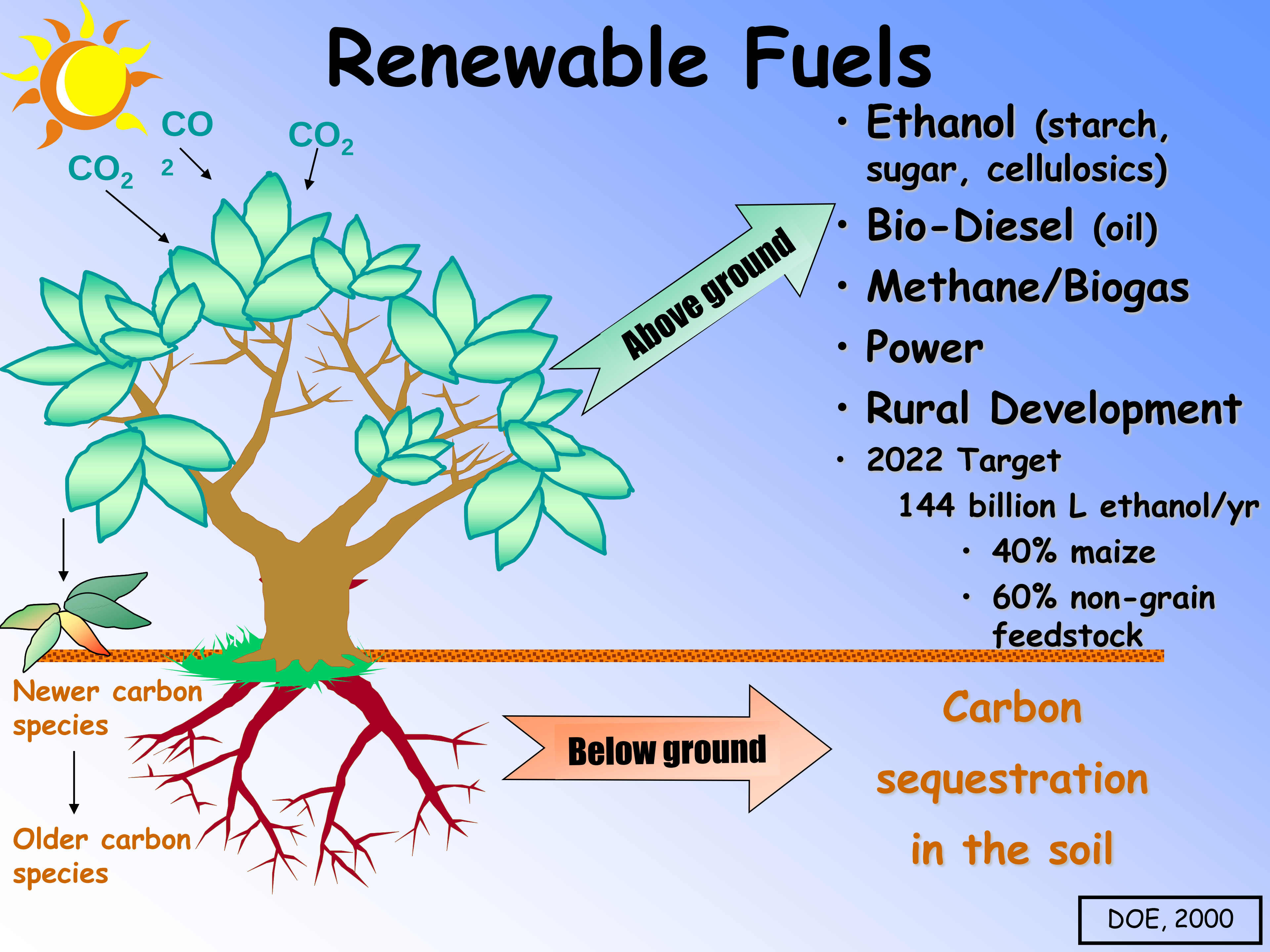
- Advantages of RBPDs
  - Address biomass variability near point of production
  - Produce dense, stable, shippable *intermediate commodities* for biofuel producers ("biorefineries")
  - Reduce transaction costs & capital risks for biorefineries
  - Benefit rural communities through job creation & ownership
  - Address "food vs. fuel" and sustainability issues directly
- Research needs to implement RBPDs
  - Optimize in field harvest/storage/logistical systems
  - Optimize supply chain for "best" intermediate products
  - Conduct techno-economic and life cycle studies
  - Develop processing technology/property data for biofuel *intermediates* & coproducts (eg, biochar, animal feeds)

Renewable Energy
Big Questions, Big Opportunities for Agriculture and the Land Grants

Maria Gallo, Professor
Agronomy Department
Florida Institute for Sustainable Energy
University of Florida
www.energy.ufl.edu

UF UNIVERSITY of FLORIDA
The Foundation for The Gator Nation

ESS/SAES/ARD Workshop, 2009



Renewable Fuels
CO2
CO
2
CO2
• Ethanol (starch, sugar, cellulosics)
• Bio-Diesel (oil)
• Methane/Biogas
• Power
• Rural Development
• 2022 Target
144 billion L ethanol/yr
• 40% maize
• 60% non-grain feedstock
Above ground
Below ground
Newer carbon species
Older carbon species
Carbon sequestration in the soil
DOE, 2000

Biofuel Limits

- Light
  - C3 species: 1.9 g sugar or 1.4 g plant mass/MJ of solar E
  - C4 species: 2.4 g sugar or 1.8 g plant mass/MJ of solar E (Annual mass yield = 43.2 metric tonnes per hectare)
  - Oil crops: 0.42 g oil/g of sugar or 0.8 g plant mass/MJ of solar E
- Yield Goals for US in 2022
  - 37 million acres of maize (half of the land currently used for maize)
  - 118 million acres of cellulose-based feedstock

Sinclair TR, 2009, Amer. Sci. 97:400-407

Big Questions

- How do we increase yield and/or efficiency with low inputs in a sustainable fashion?
- How do we maintain adequate N?
- How do we decrease N leaching and release of greenhouse gases?
- How do we minimize soil erosion and degradation?
- How do we efficiently use water?
- What lands are suitable?
- How do we prevent a net negative energy return?

Not one silver bullet!!!

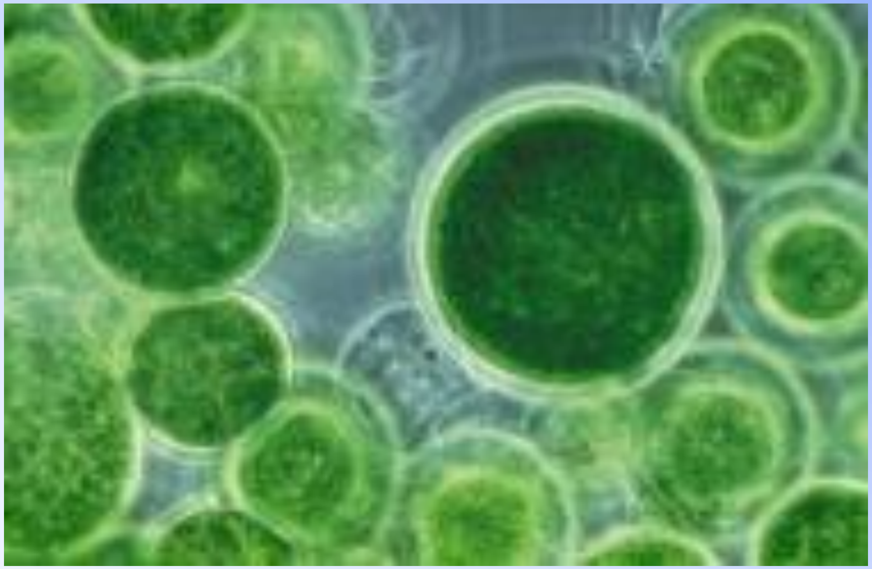
Genetic Resources

- Existing Mutants
- Reverse Genetics
- Forward Genetics
- Transgenic Approaches (genotype non-specific)
- Breeding and Selection

Big Opportunities
Dedicated Energy Crops on Marginal Lands

- Generate perennial plants that have more biomass, and are faster growing (hormones) with reduced requirements for water and N (photosynthesis, respiration, circadian clocks, etc.) with abiotic (temperature) and biotic stress tolerance (insects and pathogens).
- Explore N redistribution in C4 plants.
- Develop plants with an over-wintering storage capability in below ground tissue.
- Understand and manipulate lignin composition, biosynthesis and regulation (and maintain structural integrity).
- Produce plants that express cellulases and hemicellulases (in subcellular compartments).
- Up-regulate cellulose and hemicellulose biosynthesis enzymes in plants (chloroplast genome) and increase their activity.
- BMPs: cover crops, fertilizer application, irrigation, tillage…

Algae!!!???



Some Late Nights Thoughts While Listening to Thelonious Monk

Dr. Larry P. Walker
Professor
Department of Biological and Environmental Engineering
Director of the North East Sun Grant Institute of Excellence
Director of Cornell Biofuels Research Laboratory
Cornell University

Major Premise

Agriculture will increasingly provide the raw materials and energy needed to drive our transition to a sustainable world.

Good Science and Engineering

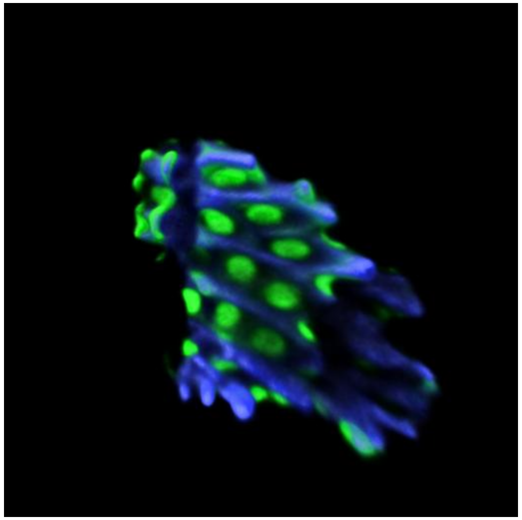
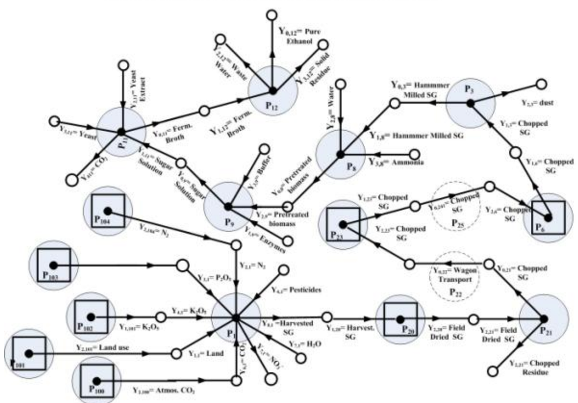
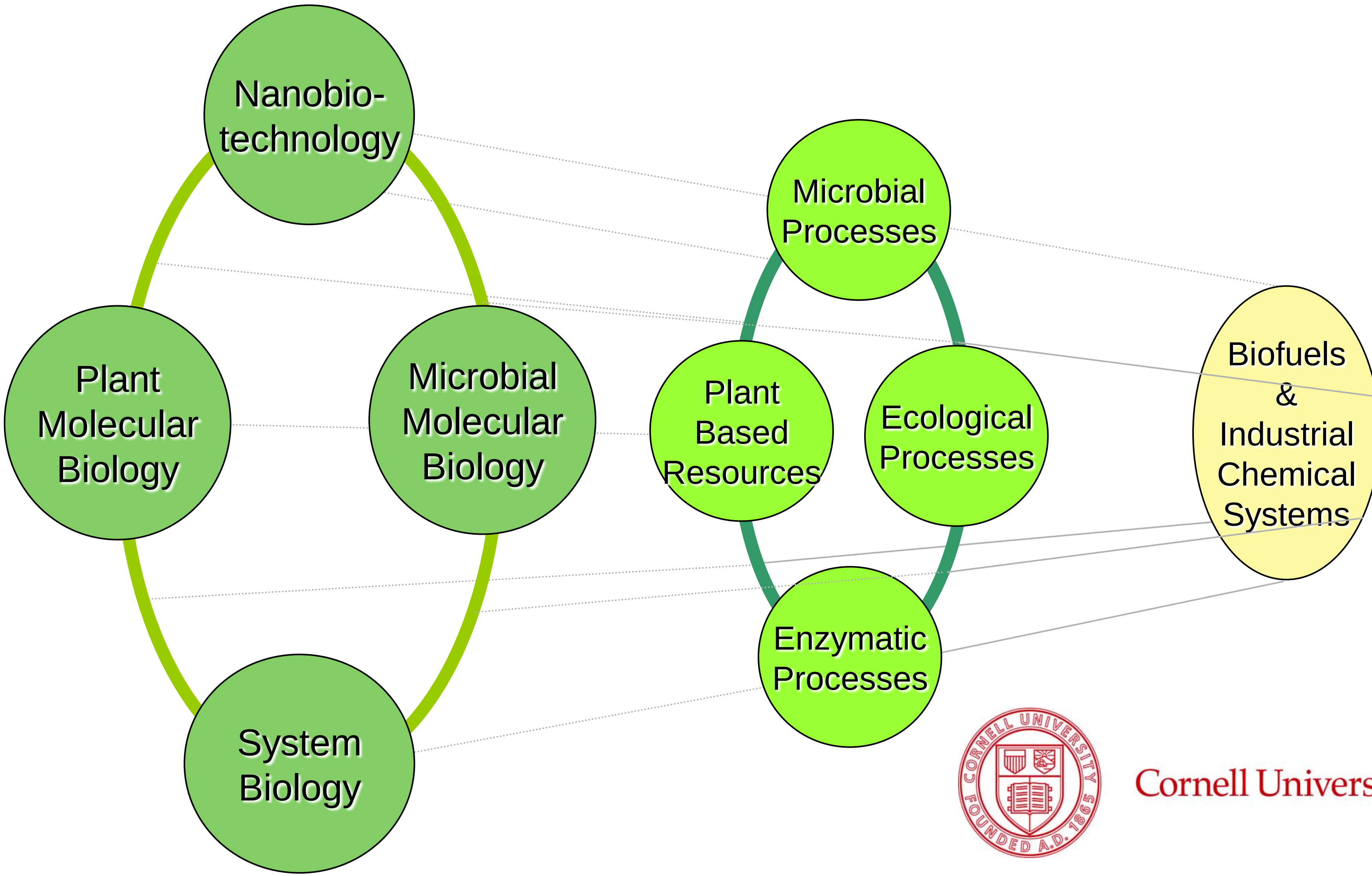


Figure 1. Switch grass bio-ethanol system with feedstock logistic subsystem



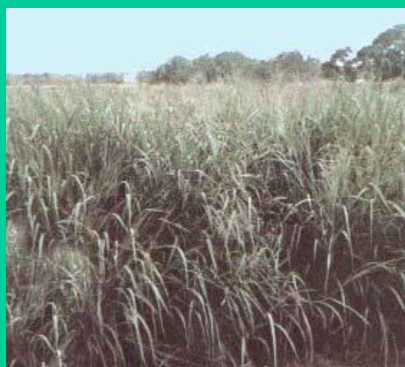
- genomics
- proteomics
- protein engineering
- system biology
- molecular modeling
- nanobiotechnology
- advanced materials
- advanced bioreactors
- more sophisticated control systems
- advance systems engineering tools

Integrating Knowledge and Methods from Basic and Applied Sciences for a Mission



Cornell University

Major Subsystems of Sustainable Agricultural Based Energy System



BIOMASS PRODUCTION

FEEDSTOCK LOGISTICS

CONVERSION TECHNOLOGY

Innovative in How We Network Transformation Processes

How do we integrate structural and dynamic aspects of natural ecology in our design of industrial ecology?

Some Principles of Ecosystem Design

An ecosystem model implies an evolutionary process as a major organizing principle:

- Components come into existence at different times and are therefore in different stages of their evolutionary history.
- New components coexists with mature products and with other on their way to extinction.

Number of tractors on farms exceeds the number horses and mules for the first time in 1954

Some Principles of Ecosystem Design

An ecosystem model assumes that the system is not the results of centralized planning or any systematic design process:

- "Natural selection acts more rapidly and most forcefully at the small scales, where feedback loops are tight...".
- Evolutionary processes do not necessarily produce optimum outcomes –they produce satisfactory outcomes.

Dealing with Complexity!

"For every complex problem there is a simple, and often wrong, solution!"

2009 Science Roadmap Preliminary Report

Science Roadmap
History

- FIRST SCIENCE ROADMAP COMPLETED IN 1998-99 AND UPDATED IN 2006 AND 2008
- S & T COMMITTEE RECEIVED APPROVAL FROM ESCOP IN MARCH TO PROCEED WITH PROPOSAL TO UTILIZE DELPHI PROCESS
- DR. TRAVIS PARK (CORNELL) PREPARED FORMAL PROPOSAL
- ESCOP EXEC COMMITTEE APPROVED EXPENDITURE OF UP TO $5,000 TO SUPPORT CORNELL'S EFFORTS

Science Roadmap
History

- STEVE PUEPPKE SENT LETTER TO DEANS & DIRECTORS OF RESEARCH, EXTENSION & ACADEMIC PROGRAMS REQUESTING NOMINATIONS
- 457 INDIVIDUALS WERE NOMINATED FROM BROAD ARRAY OF DISCIPLINES
- FIRST ROUND WAS INITIATED ON JUNE 10 & 264 (57.8%) INDIVIDUALS PARTICIPATED
- 260 (56.9%), 249 (54.5%) AND 246 (53.8%) PARTICIPANTS IN 2^{ND}, 3^{RD}, & 4^{TH} ROUNDS

Science Roadmap
Methodology

- PARTICIPANTS ASKED TO COMPLETE 4 ROUNDS
- QUESTIONS IN ROUND 1 FROM PREVIOUS VERSIONS
- IN FIRST 3 ROUNDS, PARTICIPANTS RESPONDED TO PROPOSED RESEARCH PRIORITIES IN RATING SCALE FORMAT OF (5) STRONGLY AGREE TO (1) STRONGLY DISAGREE

Science Roadmap
Methodology

- QUESTIONS WITH MEAN RESPONSE > 3.0 & STD. DEV. < 1.0 ACCEPTED & HELD FOR 4TH ROUND
- QUESTIONS WITH MEAN RESPONSE < 3.0 DROPPED
- PARTICIPANTS HAD OPPORTUNITY TO REWORD OR ADD PRIORITIES

Science Roadmap
Methodology

- IN 4TH ROUND, PARTICIPANTS ASKED (YES/NO) WHETHER TO INCLUDE PRIORITIES IN NEW ROADMAP

- RESEARCH PRIORITIES WITH > 60% CONSENSUS WERE RETAINED

Science Roadmap
Respondent Demographics
Discipline (*n = 246*)

	N	%
ANIMAL SCIENCE	31	12.6
PLANT SCIENCE	27	10.9
AGRIC. ECONOMICS	24	9.8
AGRONOMY & SOIL SCI.	24	9.8
NATURAL RES. & ENVIR. SCI.	18	7.3
FOOD SCI. & NUTRITION	15	6.1
AGRIC. EXTENSION	14	5.7
FAMILY & CONSUMER SCI.	11	4.5
MICROBIOLOGY & BIOCHEM.	11	4.5
ENTOMOLOGY	10	4.1
OTHER/NO RESPONSE	61	24.7

Science Roadmap
Respondent Demographics
Primary Responsibility (*n = 246*)

	N	*%*
ADMINISTRATION	137	55.7
RESEARCH	47	19.1
TEACHING	21	8.6
EXTENSION	5	2.0
OTHER	19	7.7
NO RESPONSE	17	6.9

Science Roadmap
Respondent Demographics
Academic Title (*n* = 246)

	N	%
PROVOST	1	0.4
DEAN	17	6.9
DIRECTOR	46	18.7
CHAIR	26	10.6
FACULTY	60	24.4
OTHER	79	32.1
NO RESPONSE	17	6.9

Science Roadmap
Respondent Demographics
Land Grant Institution ($n = 246$)

	N	%
1862	196	79.7
1890	28	11.4
1994	5	2.0
NO RESPONSE	17	6.9

Science Roadmap
Respondent Demographics
Geographic Region (n = 246)

	N	%
SOUTH	79	32.1
WEST	74	30.1
NORTHEAST	45	18.3
CENTRAL	31	12.6
NO RESPONSE	17	6.9

Science Roadmap
Results
General

- Over 100 "research priorities" were suggested from respondents during 1st 3 rounds
- 58 new or revised research priorities garnered 60% consensus
- Of 28 research objectives proposed in 2006, 15 were retained

Science Roadmap
Results
Themes

79.1% Develop renewable energy & biofuel systems

78.2% Manage agricultural water usage

75.0% Develop agricultural systems for a changing global climate

74.4% Develop new plant products, uses, & crop production systems

73.0% Enhance production of safe & abundant food

Science Roadmap
Results
Themes

72.1% Develop new animal production practices, products & uses

71.8% Improve the economic return to agric. Producers

71.8% Maintain a sustainable environment

71.4% Enhance the uses of biotechnology

70.6% Increase public awareness of food, fiber & fuel production

Science Roadmap
Results
Themes

70.1% Improve the productivity of organic & sustainable agriculture

65.4% Develop human capital & capacity in agriculture

64.8% Sustain individual, family, & community resilience

Science Roadmap

Results

"Develop Renewable Energy & Biofuel Systems"

- Develop & implement use of alternative energy sources for agric. purposes incl., but not limited to, wind energy, biofuel, methane production, & small-scale hydroelectric, geothermal, solar, & tidal energy
- Develop agricultural systems that utilize inputs efficiently & create fewer waste products, esp. by converting "traditional" waste products into biomass fuels & by developing secondary uses & markets for current agricultural waste products
- Assess environmental, sociological, & economic impacts from production of biofuels & co-products at local & regional levels to ensure sustainability

Science Roadmap

Results

“Develop Renewable Energy & Biofuel Systems”

- Develop technologies to improve production-processing efficiency of regionally appropriate biomass into by-products (including biofuels)
- Expand biofuel research with respect to non-arable land, algae, pest issues that limit biofuel crop yields, & emissions of alternative fuels
- Investigate opportunity costs of biofuel production from food crops, agricultural waste, & other sources

Science Roadmap

Results

“Manage Agricultural Water Usage”

- Create new &/or modify existing profitable agricultural & natural resource systems that conserve use of & recycle water
- Develop technologies to improve production efficiencies of use distribution & quality of water
- Research effects of global climate change w/ regard to water usage for agricultural production & processing methods
- Evaluate & enhance water recharge value of agricultural & forestry production areas
- Examine the policy & legal issues relating to water use, distribution, & quality

Science Roadmap

Results

"Develop Agricultural Systems for a Changing Global Climate"

- Explore relationships between global climate change, climate variability, invasive species, native species, & crop & livestock responses

- Develop biotechnologies that enable enhanced production of food, adaption of animal & plant food systems to face global climate change, utilization of integrated pest management, & negotiation of socioeconomic challenges to the food system

- Explore production systems that enhance economic viability, improve efficiency, and/or reduce emissions of methane or other greenhouse gasses

Science Roadmap

Results

"Develop Agricultural Systems for a Changing Global Climate"

- Research breeding programs, local practices, & pest & disease management systems that help animal & plant agriculturalists adapt to global climate change

- Analyze impacts of carbon policy on agriculture & the food system & develop strategies to help producers & processors in agriculture, natural resources, & food industries benefit from carbon trading & ecosystem service markets

Science Roadmap

Results

"Develop New Plant Products, Uses, & Crop Production Systems"

- Improve crop productivity w/ limited inputs of water & nutrients through enhanced efficiencies, plant biology, innovative management systems
- Develop strategies to enhance energy efficiency in agricultural production systems
- Develop technologies to improve processing efficiency of crop bioproducts
- Investigate interdependency of multiple land use decisions, incl. food, fiber, biofuels, & ecosystem services

Science Roadmap

Results

"Develop New Plant Products, Uses, & Crop Production Systems"

- Assess benefits & cost of decreasing the dependency on synthetic, petroleum-based chemicals in the agricultural industry
- Conceive new markets for new plant products & new uses for those crops

Science Roadmap

Results

"Enhance Production of Safe & Abundant Food"

- Develop methods to prevent, detect, monitor, control, & respond to potential food safety hazards in production & processing of food crops & livestock grown under all production systems

- Develop food systems & technologies that improve nutritional values, diversity, & health benefits of food

- Develop strategies to detect & eliminate food-borne illnesses, bioterrorism agents, invasive species, & pathogens affecting plants, humans, & animals

- Decrease dependence on chemicals with harmful effects to people & the environment by optimizing effective crop, weed, pest, & pathogen management strategies

Science Roadmap
Results
"Enhance Production of Safe & Abundant Food"

- Identify plant compounds that prevent human diseases (ex. cancer), & develop & encourage methods to enhance or introduce these plants & compounds into the food system

- Establish plant & animal breeding programs that balance & optimize nutritional value to complement production characteristics

- Examine impact of food supply changes & food transportation relative to preservation practices, safety, & energy efficiency at local & regional scales

Science Roadmap

Results

"Develop New Animal Production Practices, Products, & Uses"

- Promote animal health & well-being in all production systems through enhanced nutrition, efficiency, utilization of non-traditional feeds, genetics, & disease reduction

- Develop new & enhanced technologies for the improved efficiency & welfare of animals that are processed for food

Science Roadmap
Results
“Improve the Economic Return to Agric. Producers”

- Develop sustainable production systems that are profitable, productive, & include integration of crop & livestock production systems
- Provide evidence-based recommendations for alternatives to the current price support system that encourage agricultural production
- Explore use of alternative economic models for stimulating farming through use of farmer supports besides price supports
- Support development of marketing infrastructure for crop bioproducts

Science Roadmap
Results
"Maintain a Sustainable Environment"

- Develop efficient & sustainable farming & food processing systems that rely on renewable energy systems & decrease the carbon footprint, particularly those systems that convert agricultural wastes into biomass fuels that further improve the efficiency of production

- Develop environmentally friendly crop & livestock production systems that utilize sustainable feeding & pest management strategies

- Develop methods to protect the environment both on & beyond the farm from any negative impacts of agriculture through optimum use of cropping systems including agroforestry, phytoremediation, site-specific management, multicrop polyfarms, & perennial crops

Science Roadmap
Results
"Maintain a Sustainable Environment"

- Develop innovative technologies for reducing impact of animal agriculture on the environment

- Develop strategies, ecological & socioeconomic system models, & policy analyses to address conservation, biodiversity, ecological services, recycling, & land use policies

- Develop agricultural systems that create fewer waste products

- Create clear understanding of the principles & facets underlying the concept of sustainability as it relates to urban & rural agriculture

Science Roadmap

Results

"Enhance the Uses of Biotechnology"

- Develop & assess impact of nanotechnology for pathogen & pest identification, detection, & eradication, w/ the overall goal of improving human health
- Assess safety & effectiveness of genetically-engineered organisms on human & environmental health
- Assess safety of nanotechnologies & nanomaterials on human & environmental health
- Integrate nanotechnologies into agricultural & food production practices

Science Roadmap
Results
"Increase Public Awareness of Food, Fiber & Fuel Production"

- **I**ncrease public awareness of agricultural production & processing – incl. traditional & organic methods, & the societal & environmental benefits & consequences of agriculture

- Discover effective educational methods to help individuals make informed & healthy food choices

- Understand behavioral & educational dimensions (personal, consumption, & policy) that influence personal & family dietary & health decision-making to reduce public health issues; e.g., obesity

- Conduct research on the relationship between food consumption, portion size, exercise, & obesity, & build extension programs that lead to behavior change regarding eating habits

Science Roadmap

Results

"Improve the Productivity of Organic & Sustainable Agriculture"

- Research feasibility & sustainability of organic & non-organic systems, esp. as related to population growth & future food needs
- Develop improved pest, weed, & disease control and management strategies for organic production
- Examine optimal conservation, environmental, and production outcomes—incl. sustainability, nutrition content, profitability, & energy efficiency—for organically produced agricultural products

Science Roadmap

Results

“Develop Human Capital & Capacity in Agriculture”

- Develop farming systems that increase economic viability, social acceptability, & environmental quality of all participants in the agricultural system

- Identify & assess avenues by which beginning farmers can access necessary education, land, &/or capital to overcome barriers

- Conduct research on retention of existing & development of new human capital in agriculture

- Develop educational programs that build food production capacity & are focused on assistance to ethnic, immigrant, underserved, urban, &/or economically disadvantaged populations interested in entering food production

Science Roadmap

Results

"Sustain Individual, Family, & Community Resilience"

- Determine strategies to enhance well-being of families & individuals, incl. those strategies that ensure access to high-quality food, health care, education, social services, & a clean, healthy environment
- Explore ways to introduce & measure impact of rural & urban agricultural education, natural resources education, & food literacy education in all high schools across the nation
- Increase assistance to 4-H programs, FFA, & private sector youth programs that integrate environmental & agricultural topics into their curriculum

Science Roadmap
Results
"Sustain Individual, Family, & Community Resilience"

- Examine economic impact of entrepreneurship & business development on rural communities, & develop new forms of economic activity built around regional trade associations, rural cooperatives, & local production networks

- Assess strategies for building coalitions among agricultural, environmental, academic, governmental, labor, & community development groups to facilitate scientifically sound social change in rural communities

- Investigate means of enhancing problem-solving capacities of rural communities through developing leadership, implementing action plans which strengthen family & community resilience, & negotiating urban-rural interface issues

Science Roadmap

Results

"Sustain Individual, Family, & Community Resilience"

- Develop strategies for integration of local, regional, national, & global food systems to maximize benefits to both U.S. & global agriculture, particularly in underserved & immigrant populations

Science Roadmap
Next Steps
Review of Survey Results

- Are there too many themes?
- Which can be combined or integrated?
- Can the themes be rolled up into true Grand Challenges?
- Have any critical research priorities been overlooked?

Science Roadmap

Next Steps

Development of the Roadmap

Once we have a consensus on the grand challenges and priorities, what are the next steps to develop a roadmap and then how to operationalize the roadmap?

Science Roadmap
Next Steps
Development of the Roadmap

What is the purpose?

- Increase resources
- Increase visibility
- Provide direction to institutions
- Provide input to funding agencies

Science Roadmap
Next Steps
Development of the Roadmap

Who are the audiences?

- Legislators
- Funding agencies
- Research administrators

What should the final product look like?

Science Roadmap

Next Steps

Development of the Roadmap

What are the key elements?

- Grand challenges
- Research priorities
- Potential impacts
- Current gaps in knowledge & resources
- Targets of opportunity
- Future strategies
- Metrics to measure progress

Science Roadmap

Next Steps
Development of the Roadmap

- **What is the process for moving forward?**

- **Who should be the participants in the process?**
  - Science & Technology Committee
  - PBD Emerging Issues Task Force
  - Key experts
  - Research ED's
  - Stakeholders

Science Roadmap

Next Steps

Development of the Roadmap

What is a realistic timeframe?

What approval process should be used?

ESS Preliminary Priorities Survey Results

David Boethel
ESCOP Budget and Legislative Committee Chair

$200 MILLION PROGRAMS IN BIOENERGY, FEEDSTOCKS AND CONVERSION

- Sustainable production/development of feedstocks including forests, algal systems, and also municipal solid waste
- Develop 2nd and 3rd generation biofuels;
- Develop improved bioconversion processes
- Develop regional experimental biorefineries
- Engineer plants to produce coproducts and be productive under water limiting conditions and on marginal lands.
- Develop cost effective systems for small communities

Note: Environmental impacts, sustainability and water must be included in any discussion of bioenergy

$200 MILLION PROGRAMS IN HEALTH AND NUTRITION, CULTURAL CONSUMPTION PRACTICES, FOOD AND HEALTH

- Fundamental and applied research that provides solutions to food-related health challenges (obesity, diabetes, heart disease, cancer, etc);
- Characterize and utilize ethnic foods in biomedical/preventative disease applications;
- Develop functional foods with improved nutritional and/or medicinal properties;
- Research on the "culture of consumption" and develop interventions

Note: Most projects should have strong outreach components involving Extension. Many should also involve industry, schools and agencies that deliver nutrition education

$200 MILLION PROGRAMS IN CLIMATE CHANGE, MITIGATION AND ADAPTATION

- Carbon sequestration and life-cycle carbon balance;
- Mitigation and contribution so agriculture to climate change
- Competitively fund research and extension projects that focus on:
  - Life cycle analyses
  - Sustainable food, fuel, and fiber systems;
  - Conversion of lands to forests and to other plants species
  - Plants adapted to new climate paradigms
  - Regionally adapted climate models
  - Endemic and invasive pests and diseases;
  - Social and/or ecological resiliency
  - Water and climate change (affects on water quality, quantity, seasonality, and predictability)

Note: While not specifically stated, this effort must include “the environment”

$200 MILLION PROGRAMS IN FOOD SAFETY

- Study the ecology of pathogens from field to fork (pathogen types, prevalence, concentration, serotypes, fingerprinting, food types, geography, climate, season, etc.);
- Develop pathogen controls based on the multiple hurdle concept, microbial physiology, and modes and mechanisms of action of hurdles;
- Develop and implement methods rapidly detect, respond to, and recover from food borne illness, including trace-back and trace-forward labeling to identify contaminate food products;
- Broadly implement food irradiation
- Develop coordinated, regionalized food safety system

$200 MILLION PROGRAMS IN FOOD SECURITY AND WORLD HUNGER

- Develop smaller scale production systems that are economically viable regionally using local production as a core, i.e. match production with local consumption;
- Increase in scientific knowledge pool and training for international graduate students and professionals;
- Use biotechnology to enhance traits and production of local food crops;
- Reduce food crop use for bioenergy production
- Establish collaborative international research programs between US land-grant institutions and partner institutions in foreign countries;

Notes:

Must increase number of persons entering farming in the U.S

All efforts must include water availability

HIGH PRIORITY THEMES NOT IDENTIFIED

- Bioproducts
- Water resources management - quality and quantity
- Infrastructure and buildings programs
- Human capacity development

NIFA INSTITUTES

- YES 66% support the concept
- Plant and Animal Systems - Yes 80%
- Bioenergy and Climate Change - Yes 60%
- Health Nutrition and Food Safety - Yes 80%

Concerns:

Creation of institutes may result in an inflexible structure; suggest using the NSF Divisions model

One institute might dominate

Need to minimize the number to assure resources

OTHER INSTITUTES:

Institute for formula programs – No 75%

- Plant and Animal Diseases
- Families and Communities
- Natural Resources and Environmental Management

INCREASES TO FORMULA FUNDS

- General support for inflationary to 5% annual increases, which ever is greater

Washington State University

World Class. Face to Face.

Best Management Practices in Intellectual Property Administration or Lessons Learned Dealing with IP at WSU

Ralph Cavalieri, Director
Agricultural Research Center
Washington State University

Background

- Bayh-Dole Act – 1980
  - Gave control and priority for ownership of IP to universities for IP resulting from federally funded research.
  - Hatch and other formula funds throughout our system means USDA has a position relative to virtually all our IP.
  - Government retains certain rights.

University Policies

- Role of Intellectual Property Office / Research Foundation
  - Charge is to facilitate the transfer of WSU research results (IP) to the private sector
- Patent Funding Options
  - Boundary between university and the research foundation affects ability to fund patents
- Royalty Distribution Policies: utility, seed-propagated, vegetatively propagated

Royalty Distribution at WSU

Cumulative Net Income	Inventor	University
$1-$10,000	**100%**	
$10,001 - $200,000	50%	50%
Above $200,000	25%	75%

Notes: Royalty distribution schedule for utility patents and trademarks. None of the royalty stream comes to experiment station. Department gets a portion of university share

Plant Breeding Royalty Distribution

Seed Propagated

- 70% of net to ARC for program support
- 10% to breeder team
- 10% to ARC for admin
- 10% to WSURF

Vegetatively Propagated

- 50% of net to ARC for program support
- 30% to breeder team
- 10% to ARC for admin
- 10% to WSURF

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Working with Faculty and Staff

Education of faculty and staff regarding IP policies

- Cooperation is essential – some will disagree with Bayh-Dole and perception it violates LGU mission
- Understanding and acceptance of following are critical:
  - IP process is opportunity for program support, personal gain, and seeing research have societal impact
  - Necessity to protect research notes and materials (e.g., collaborative breeding; lab data security)
  - Responsibility to disclose potential IP in a timely manner & work with IP office to file IP protection

Working with Faculty and Staff (con't.)

Education of faculty and staff regarding IP policies

- Responsibility to obtain incoming and outgoing Material Transfer Agreements and to understand the implications for the research program
  - Examples
    - loss of IP from research product if material coming in has restrictive clauses (marker library case)
    - loss of IP & trauma with commodity commission relationship due to unprotected germplasm distribution (cherries, wheat)

What I have learned about educating faculty and staff

- Have clearly worded policies at the university and experiment station level & have forms on web
- Train, remind, and give feedback to unit leaders
- Give introduction to topic at new faculty orientation
- Be responsive to questions as they arise, involving unit leaders in discussion with faculty
- Offer to discuss at department faculty meetings and at all-faculty meetings

Working with Commodity Organizations

- Allow for a long time to arrive at first agreement. Typically little understanding of intellectual property issues and practices
- Can be conflict between commission's perception that IP should be available (to all their producers) vs. making exclusive or otherwise good business sense licensing arrangements.
- May also be conflict between commission's desire to have the IP available to their producers (within your state) and requirements of federal funding and/or good business.

Working with Commodity Organizations Examples

- PNW Potato Variety Marketing Institute – several years to establish
- WA-2 – first apple variety released by WSU. Effort to arrive at written plan for commercialization with Tree Fruit Research Commission
- Red Raspberry – International licensing
- Clearfield wheat – PNW seed distribution partnership

Working with Businesses

- Smaller companies may be similar to commodity commissions in lack of knowledge and unrealistic expectations
- Most issues should be addressed at time of writing research contract (no contract – no IP expectation)
- Faculty member may urge signing of unacceptable contract stating “no IP will be developed”. Obtain a signed document that states the expectation of no IP and apprises the faculty member of the implications in the event IP were to be developed.

Working with Businesses Example

- WSU Microwave Sterilization Consortium
  - Formed in 2001. Six industrial partners, plus the US Army Natick Soldier Systems Center, with technical support from National Food Processors Association, Dublin Technical Service Center . Two new industrial members joined the consortium in 2003. Fee is $30,000 per year.
- Five years free license to the patents generated from the consortium’s work. Companies can also apply for joint patents.
- Took university VP-level decision to get approval

Working with Businesses
Another Example

- Animal genetics company
- Wanted to “donate” to faculty member’s research, avoiding F&A on research contract – encouraged by faculty member
- Wanted access to markers being developed by faculty member
- After negotiation, company came to understand value of research contract, which gave it the “first option to negotiate a license” to the IP coming out of the funded research

Summary Suggested Practices

- Celebrate and publicize IP successes
- Work closely with university intellectual property office
- Consider funding a position that is the day to day liaison with intellectual property office and faculty and who will manage many of the IP activities of the experiment station
- Understand laws and university policies. Consider translating them into experiment station policies written in terms that faculty and administrators will understand.
- Post policies and document templates in one place on the web so faculty and department chairs don’t have to work hard to find them.

- Educate department leadership, faculty, and staff about protection of IP and advantages of paying attention to details and disclosing IP
- Anticipate IP issues with commodity groups and engage them in discussion early, understanding that arriving at an agreement may take several years.
- Engage potential industrial partners early to arrive at a win-win contractual relationship

Elson Shields

Acting Spokesperson for the 24 public sector corn insect scientists who voted to upload the public statement onto the EPA SAP website.

Recent Past Chair of NCCC-046 " Development, Optimization, and Delivery of Management Strategies for Corn Rootworm and other Below-ground Insect Pests of Maize.

The Issue:

Technology/stewardship agreements required for the purchase of genetically modified seed explicitly prohibit research.

Strictly focused on commercial seed products for sale to farmers.

Monsanto Technology/Stewardship Agreement:

Covers all seeds containing Monsanto Technology which include corn, soybeans, cotton, sugarbeets, canola, alfalfa.

"Growers may not plant and may not transfer to others for planting any seed for crop breeding, research or generation of herbicide registration data."

Dow AgroSciences: Grower Agreement

“Grower may not:

use seed or other plant material containing HERCULEX® Technologies, or provide such seed plant material to any other person or entity, for research, breeding or seed production.”

Pioneer Hi-Bred Seed and Technology Agreement

"You agree:

To not use this Seed or its progeny or provide it to anyone for crop breeding, seed production, **research**, or marker profiling (other than to make agronomic comparisons and conduct yield testing)."

Syngenta Agrisure™: Grower Agreement

"Not to use or allow others to use Seed, grain produced from Seed, the Syngenta Technologies or any plant material containing Syngenta Technologies for crop breeding, **research (including, without limitation, generating cooperative data against corn seed containing non-Syngenta technologies),** generation of registration data or Seed production (unless Grower has entered into a valid, written production agreement with a licensed seed company);"

This statement prevents any public scientist from purchasing a bag of seed which is commercially available and conducting pest management research independent of the company’s approval.

Industry Imposed Restrictions on Public Scientists

Refusing to allow proposed research

Outright denial

Endless legal wrangling until the window of opportunity closes or the legal costs to the public institution become excessive.

Industry Imposed Restrictions on Public Scientists

Blocking publication of scientific articles with negative information about products.

Refusing to give permission to publish experimental results

Threatening lawsuits if the experimental results is published after permission is refused.

Types of Research Restricted

Levels of Plant Incorporated Toxins in the plant across the life of the plant.

Critical information needed for insect resistance development studies.

Off target risks of plant incorporated toxins to decomposers.

Types of Research Restricted

All types of comparative research between different products (Monsanto vs Dow etc)

Critical information for the Farmers who depend on the technology to produce the nation’s/world’s food supply.

Types of Research Restricted

Modes of action of the different toxins patented by different companies.

Are they truly different?

This has serious implications in resistance management strategies.

Types of Research Restricted

Off-Target impacts.

Impact on insects feeding on plants surrounding the GM field.

BT corn- Monarchs – J. Losey

Impact on beneficial insects (Biological control insects, pollinators etc)

Off target gene flow into surrounding ecosystems.

Breadth of the issue

All GM crops

(corn, soybeans, cotton, sugar beets, canola, alfalfa)

All Field oriented science

(Insects, weeds, diseases, potential off target effects)

Strategies by Scientists to Cope with the Restrictions

Not conducting the research viewed as critical to the long-term deployment of the technology.

Altering research protocol to win industry approval (less desirable experimental design).

Purchasing the seed and conducting the research in violation of the Technology agreement (knowingly or unknowingly).

We have difficulty understanding why these studies threaten patents and require the heavy handed approach by Industry.

Instead, we view this approach as a strategy to marginalize the public sector scientist, who in industry's views are an unpredictable risk to their profit margin.

We believe that the general public is the ultimate loser in Industry's quest to control the public sector scientist.

Mandate of public scientist to evaluate agricultural products available to the American Farmer on the Open Market.

No interference with formulating scientific questions

No interference with experimental design

No interference with conducting comparative studies.

No interference with reporting results

Public Scientists conducting independent research play the role of

1) Scientific information untainted by corporate priorities/interests

2) Quality control of science

3) Consumer-protection

We respect the right of Companies to protect their Patents.

But

We fail to understand how this argument applies to the wide array of research commonly conducted by public scientists particularly in the areas of pest management.

“In frustration with Industry’s unwillingness to address the issues, the following statement was uploaded onto two EPA Scientific Panel websites focused on Plant Incorporated Protectants”

Statement:

The following statement has been submitted by 24 leading corn insect scientists working at public research institutions located in 17 corn producing states. . . .

Represents more than 60% of the public corn insect scientists and more than 90% of the major corn producing states (more than 1 million acres).

86 million acres of corn in the US in 2008. Corn is the largest acreage crop grown in the US

(soybeans = 75 M acres, cotton = 8 M acres).

Statement:

The names of the scientists have been withheld from the public docket because virtually all of us require cooperation from industry at some level to conduct our research.

Blacklisting is a reality.

Many of us need access to industry controlled seed supply to conduct ongoing research and do our job.

'Statement:

Technology/stewardship agreements required for the purchase of genetically modified seed explicitly prohibit research.

These agreements inhibit public scientists from pursuing their mandated role on behalf of the public good unless the research is approved by industry.

'Statement:

As a result of restricted access, no truly independent research can be legally conducted on many critical questions regarding the technology, its performance, its management implications, IRM, and its interactions with insect biology.

'Statement:

Consequently, data flowing to an EPA Scientific Advisory Panel from the public sector is unduly limited.

All data flowing to EPA flows from either industry approved studies where results are “approved” by the company or from the company own “in house” studies.

'Statement:

Given the importance of the FIFRA SAP (Scientific Advisory Panel) process to an effective and credible assessment of new PIPs (Plant Incorporated Protectants) on behalf of the American public,

we urge EPA to require registrants to remove the prohibition on research on their products and specifically allow research by public-sector scientists.'

How did we get to this point as public scientists where industry dominates/controls our science?

Excellence in science requires an environment unfettered from artificially imposed restraints which restrict freedom of thought and the pursuit of information.

Impact of the Public Statement

NY Times article

National Academy of Science Briefing

Worldwide coverage of the issue (many articles at all levels)

Scientific American (most recent)

Nature Biotechnology (expected soon)

Impact of the Public Statement

Industry Response:

Research with Commercially Available Seed Products

The American Seed Trade Association is committed to public sector research, teaching and extension programs and recommends that member companies provide public sector researchers and public sector institutions the opportunity to conduct studies on commercially available, patent-protected seed products. Although every company must determine independently the terms under which it would provide such research opportunities, this statement describes the principles and objectives behind this commitment.

Limitations to ASTA Statement

Each company independently negotiates with each scientist, university and USDA-ARS.

One uncooperative company derails the whole process in a critical area of comparative research.

Two of the four companies have already indicated to scientists that they will not comply with the ASTA guidelines.

Problem easily solved?

Companies remove the “generalized research restriction” from the technology agreement.

Companies are not willing because they still want to control access to the technology by researchers and therefore control the research and message.

Problem easily solved?

EPA require access for the public scientist to the technology for research that does not infringe on their patents as a condition of licensing for sale.

May require a political process.

Problem easily solved?

Legal Challenge to the Technology Agreement as it pertains to public scientists.

NAS committee members (the attorneys) felt that the technology agreement would not hold up in court. (a precedent with software licensing)

Volunteers for a test case?

Industry realizes the public relations nightmare even if they won the case.

Future Direction

Invited article: Inaugural issue of "GM Crops"

Symposium at National and/or Regional professional meetings **(expand topics to cover all affected commodities/disciplines)**

Presentation Topic for the Farmer Groups at all levels **(Local to National)**

WASHINGTON STATE UNIVERSITY

16th September 2009,
ESS– Oklahoma City, OK

Agricultural Technology Transfer and licensing – Implementation

Keith J. Jones PhD

Executive Director, Office of Intellectual Property Administration / WSU Research Foundation

Agricultural research – historically a public good
Genetic Improvement – specialty crops

Grapes

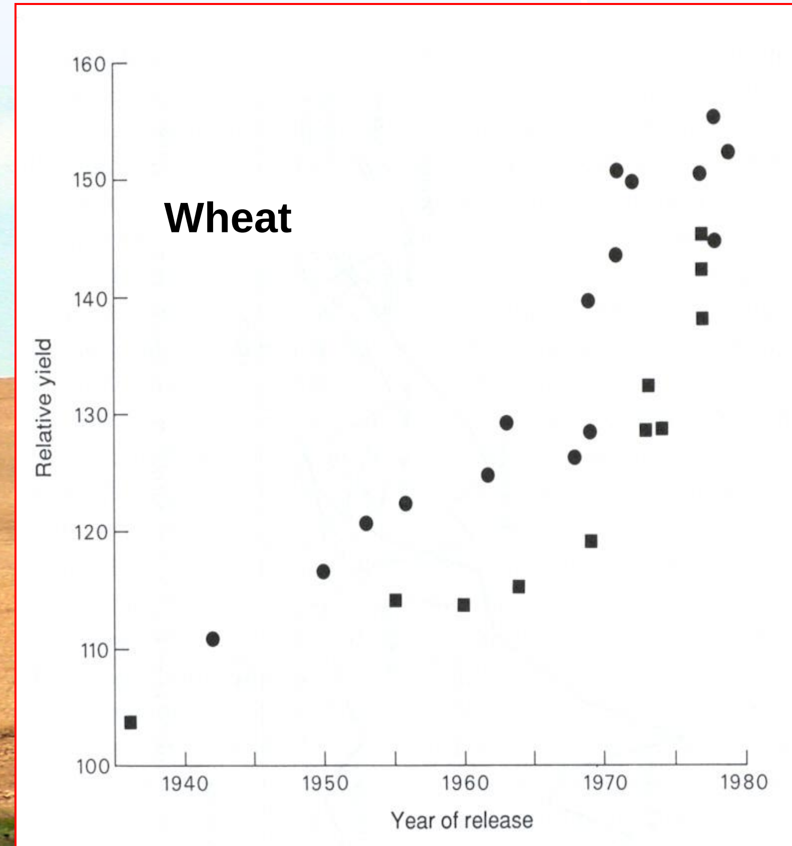
Onions

Lentils

Apples

Raspberries

Strawberries

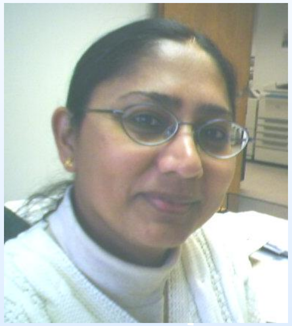


WSURF

- WSURF – a 501(c)(3) corporation with separate board
- Board consisting of Community, Alumni and Ex-Officio WSU representatives.
- Manages the technology
  - Traditional License
  - License to Start-up
  - Gap Funding
- Manages the Research and Technology Park

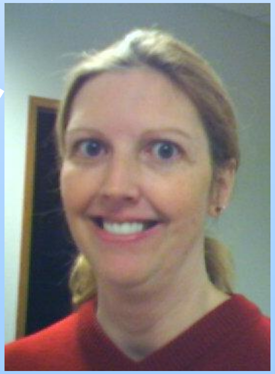
Staff

Executive Director – Keith Jones PhD
Assistant Director - Sita Pappu PhD
Commercialization Managers –

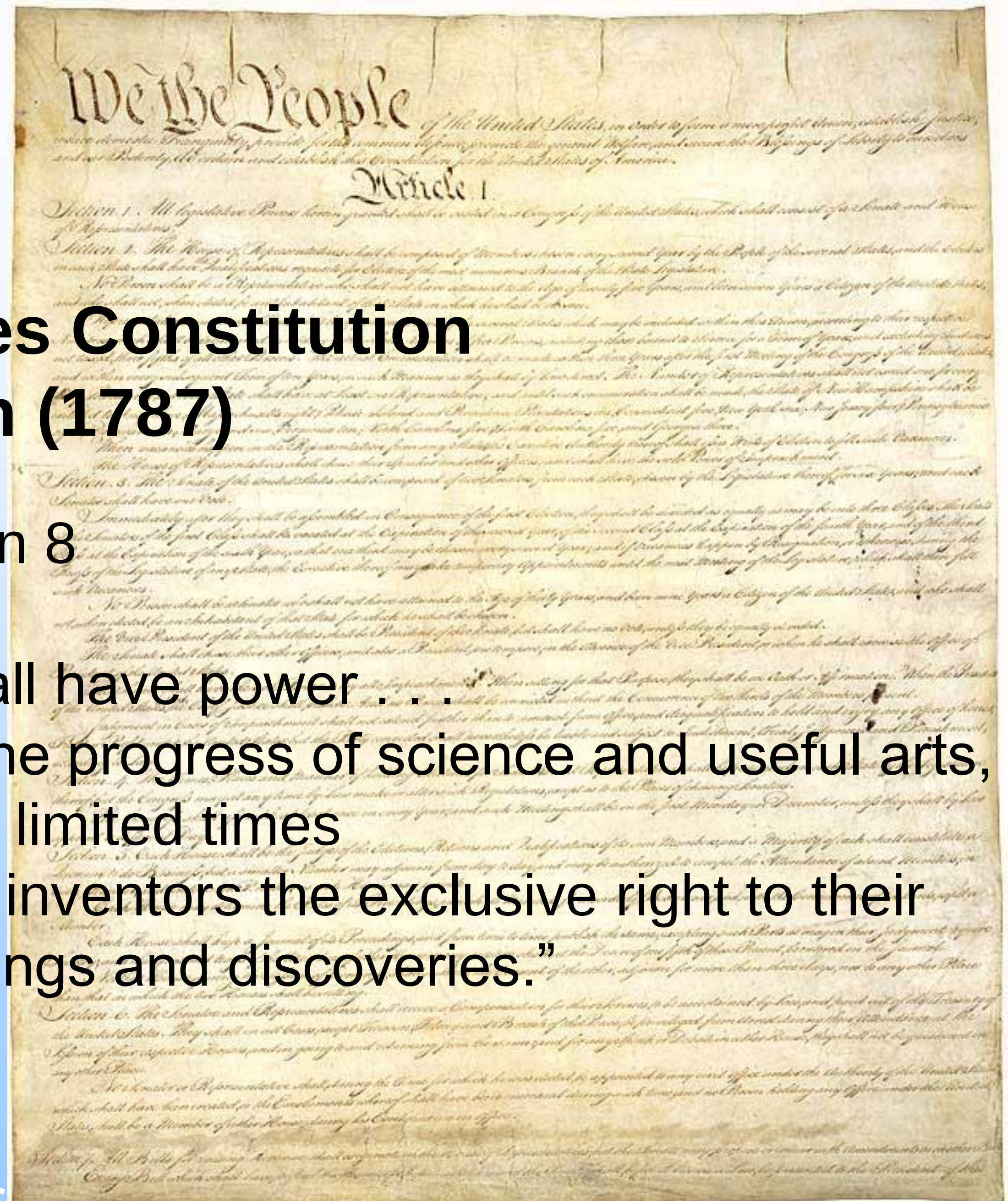


Brian Kra

Tom Kelly MBA
Travis Woodland JD
Graduate Student – Jane Payumo



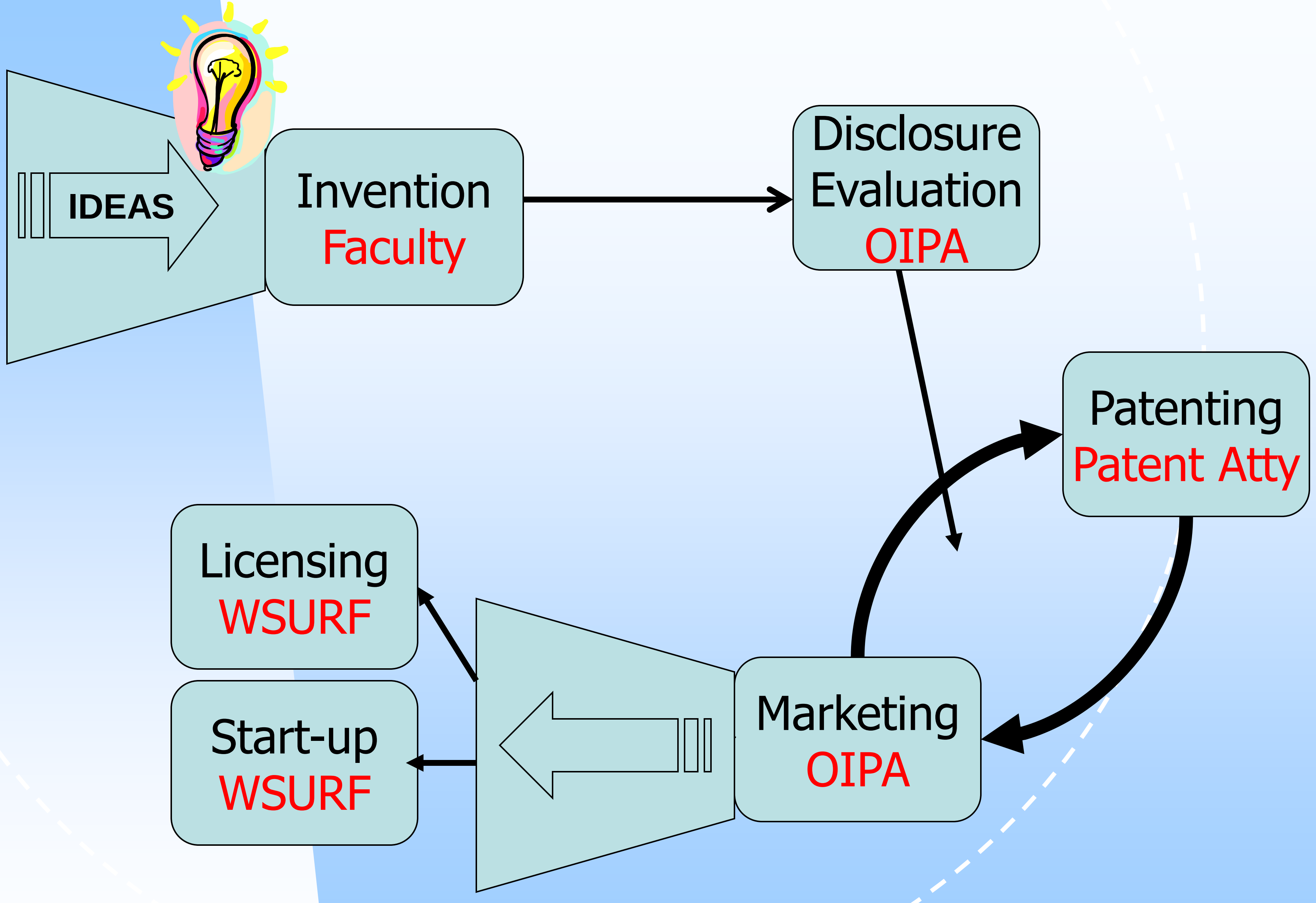
- **Program Administrative Manager – Mary Frei MBA**
- **Accountant - Heather Yockey**



United States Constitution
Constitution (1787)

Article I, section 8

"Congress shall have power . . .
…to promote the progress of science and useful arts,
by securing for limited times
to authors and inventors the exclusive right to their
respective writings and discoveries."


IDEAS
Invention
Faculty
Disclosure
Evaluation
OIPA
Patenting
Patent Atty
Licensing
WSURF
Start-up
WSURF
Marketing
OIPA

• Potatoes

PVMI
Potato Variety Management Institute

Office (541) 318-1485
Fax (541) 318-7561

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- News
- Varieties
- Seed Growers
- Events
- Tri-State Links
- Contracts & Agreements
- Getting Started
- Board Members

PVMI

Potato Variety Management Institute

In 2005 the state potato commissions of Washington, Oregon, and Idaho launched a new nonprofit 501(c)(3) corporation called the Potato Variety Management Institute (PVMI) to handle the licensing and royalty collection on Tri-State potato varieties. It was developed as a grower-controlled alternative to the universities' efforts to manage varieties and interact with industry in royalty collection. PVMI hopes to provide the following main benefits to the industry:

- Exert grower control over varieties developed through grower supported research
- Work with end-users to increase adoption of new varieties in processing, grocery, and restaurant trades
- Use market research to focus variety development goals
- Manage distribution and use of varieties around the world
- Return royalties directly to Tri-State potato research programs

PVMI is governed by a nine-member Board of Directors and an Executive Committee.

Mission

Raspberry

Cascade Delight

Mid Season, Very Large, Firm Berries

Parentage
Cascade Delight was produced from a cross of Chilliwack and WSU 994 made in 1989 at the Washington State University (WSU) Puyallup Research and Extension Center. The original seedling was selected in 1992 by Dr Pat Moore and evaluated as WSU 1090.

Season
In trials in the Pacific Northwest (PNW) of the USA the midpoint of harvest for Cascade Delight is similar to Meeker and Tulameen, but the length of the harvest season is slightly shorter.

Plant Characteristics
Cascade Delight is very vigorous with long fruiting laterals and produces an adequate number of canes, similar to Meeker. Although the basal portions of young canes (less than 30 cm tall) have 20-40 spines per cm of cane, the upper portions of taller canes (over 1 m in height) have much smaller and fewer spines (<5 spines per cm).

Raspberry - UK

MEIOSIS

Welcome | Fruits | Licence Holders | Breeding Programmes | Full Members | Associate Members | Contact Us | Sitemap

INTRODUCTION

MEIOSIS, established in 1989 in the name of NSA Plants, was the brainchild of major soft fruit and tree fruit propagators together with leading soft fruit marketing groups in the UK. Designed to work closely with fruit breeding programmes throughout the world, MEIOSIS task was then, and is now to introduce new cultivars to the Soft Fruit Industry. Through the strength of our portfolio, we are able to protect new material against unlicensed propagation, and provide growers with new and potentially improved varieties for early trials.

As a Company focussed on the commercial exploitation of new soft fruit cultivars, MEIOSIS undivided attention is given to ensuring the best efforts of the Breeders/Owners are made available to commerce, with the ensuing rewards success brings.

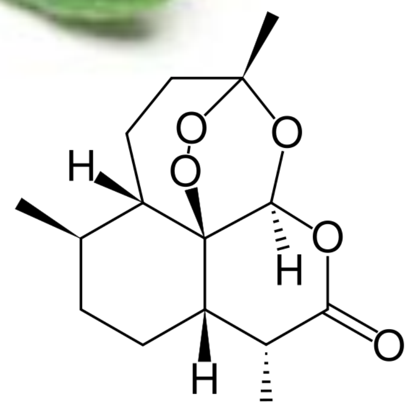
MEIOSIS have Variety Development Agreements in place with many overseas Soft fruit Breeding Programs, and provide a free service for the commercial introduction of new cultivars from those programs.

Registered Address: Meiosis Ltd, Bradbourne House, Stable Block, East Malling, Kent, ME19 6DZ
Company Registration number 2330975 VAT number 514 0055 01
Registered in England and Wales

Raspberry – North-West US

Solutions For Fine Chemicals

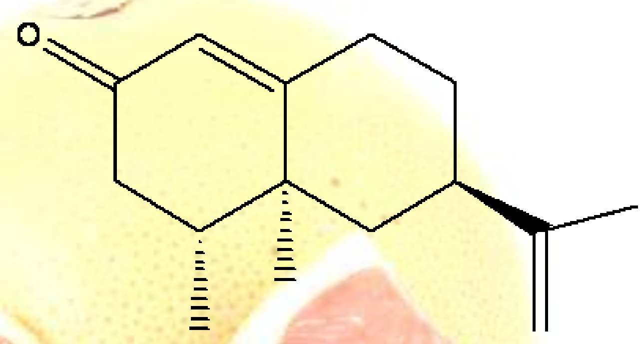
Flavor and Fragrance



AJUGA
BioSciences

The Problem –
Shortage of Affordable Aroma Chemicals

Example: Nootkatone
(grapefruit flavor)



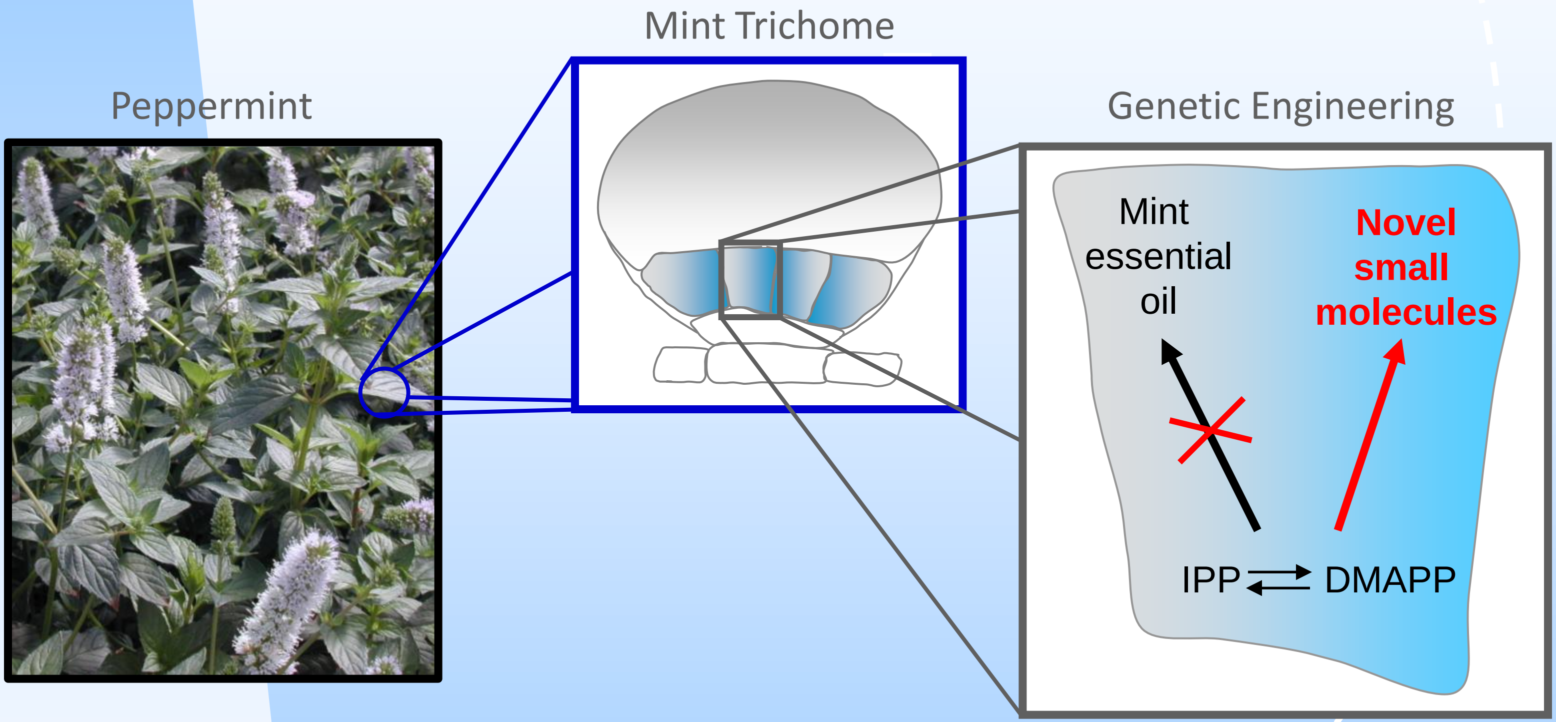
Extracted from natural source

Shortage of raw material

Low volume / high cost

$ 4,000 – 10,000 per kg

The Technology – Mint Trichome Engineering



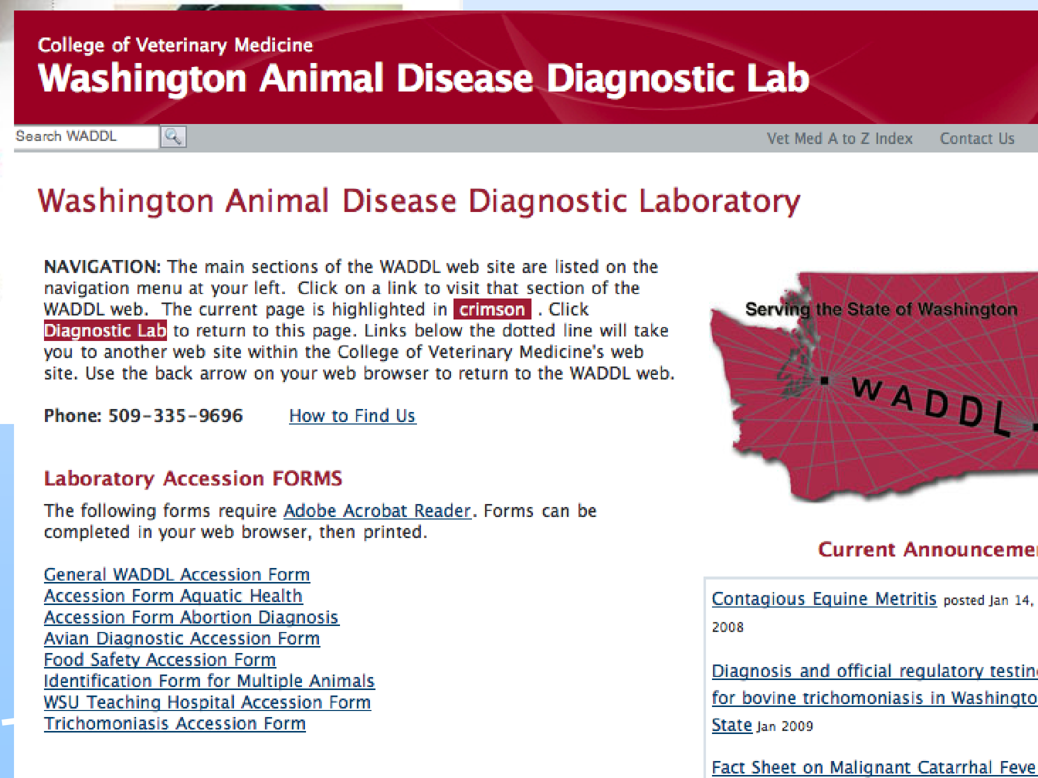
- Synthesis in specialized cells.
- Strong IP position.

  Patents (composition of matter, genes, enzymes, methods).

  Know-how (transformation, genetic engineering)

AJUGA BioSciences

Animal Disease Diagnostics



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VMRD, Inc.

Toll Free: 1-800-222-8673

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Veterinary Medical Research & Development

Adventitious Virus Testing

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What's New...

- The ***Babesia caballi*** cELISA and the ***Babesia equi*** cELISA are both licensed and in stock.
- ***ELISAWare™*** plate reading software now available for all VMRD ELISA kits
- ***Reference Samples*** available for VMRD ***EIA AGID and EIA ELISA*** kits.
- VMRD's ***Spring Newsletter*** is now available here!
- ***PPV Conjugate*** is now available!
- Vesicular Stomatitis Virus (VSV) FITC Conjugates now available

Farm Animal Commercialization – SNP markers for meat quality prediction

- Technology opportunity
  - WSU has a herd of Wagu cross cattle
  - Extreme variability in meat quality measures
  - "Chip" technology allows very economical packaging of many SNP markers
- Market opportunity
  - Selling chips to farmer service organizations to improve beef
- License
  - Exclusive , field of use
  - WSURF retained medical use - obesity

Contact IGENITY

igenity

Select Country: USA

Home | Beef | IGENITY Profile

Beef
- IGENITY Profile
  - Feed Efficiency
  - Carcass Traits
  - Tenderness
  - Maternal Traits
  - Docility
  - Coat Color
  - Parentage
  - Genetic Evaluation
  - Horned/Polled
  - BVD-PI
- IGENITY Software
- Application
- Testimonial
- Get Started
- FAQs

Dairy

IGENITY News

Additional Resources

Events Calendar

Order a Kit

Results

IGENITY® for beef

The 2005 National Beef Quality Audit (NBQA) provided a new benchmark for the U.S. beef industry. NBQA identified the following 10 goals to help American beef remain the best in the world:

1. Clarify market signals to encourage production of cattle, carcasses and cuts to meet industry targets.
2. Foster communication among industry groups and segments of the beef supply chain.
3. Move expeditiously toward source and age verification to build supply lines of cattle (domestic and export).
4. Minimize production of excess fat.
5. Strive for uniformity/consistency in cattle production.
6. Consider tenderness in genetic and management decisions.
7. Consider tenderness in genetic and management decisions.
8. Recognize the importance of marbling as a value-determining trait.
9. Use instrument assessment of cattle, carcasses and cuts for genetic and management decisions.
10. Select management practices that increase value.

Material Transfer Agreements

- All Material needs to have an MTA attached to it.
- What is Material? Clones, cultures, oligos, proteins, varieties, cultivars inbreds. anything you developed!
- Two Kinds:
  - Out-going (via our office)
    - Only for research purposes and no commercial use allowed
    - Usually no further transfer allowed
    - Careful how "Modifications" are defined so you protect your invention
    - UBMTA or SMTA (international germplasm)
  - In-coming (via Office of Grants and Research DevelopmentOGRD)

Research Agreements – Process:

A Company interested in sponsoring research and wants to discuss first---

What to do next?

- Set up a non-disclosure agreement
- Discuss research; Submit Proposal; Grant
- SRA negotiated
- Incoming MTA negotiated
- Conduct research and an Invention results
- Submit Invention Disclosure
- Evaluation then negotiation with Company with outgoing MTA
- Usually relatively quick as there is a Win/Win solution

Work with us! We will guide you through the process

Testing Agreement

- Existing product already on (or close to) market
- Handled by marketing / business development
- Market development
- Very concerned over endangering a significant investment
- Only allow a very defined plan of work
- University researcher often demand that the university agree that 1) no IP will be created, 2) long delay or denial of publication
- Usually very little interest in negotiation

Lessons learned:

- Technology commercialization:
  - is a service to researchers
  - is a way to get research results into the hands of those that need them
  - is, very rarely, a way to make money
  - enhances and enables research collaborations
  - is demanded by many scientists (recruitment and retention)

How the Ag biotech industry looks at the World.

- **Major crops: soy, maize (corn), cotton, canola in the developed world**
- **Minor crops: everything else, everywhere else**

Comparison of Ag to other technologies

Pharmaceutical example:

Cure for Cancer

Start-up

Big Pharma

Market

Comparison of Ag to other technologies

High tech example:

IP Creators
Mostly big companies (10's)

Start-up

Large / medium High Tech Companies
Cross licensing / standards / pooling / IV

Market

An example Ag Case:

Stem Rust Resistance in wheat

Universities (100's)
National Ag Services (100's)
International organizations
Grower groups (100's)
Participatory breeders (potentially 1000's)

Multi-national Ag
Regional seed companies
Local seed companies
Seed dealers
Farmers

Lots of other IP with diverse owners:
Germplasm (local varieties)
Drought resistance
Heat tolerance
Biotech traits

"Market"

National Partner Initiative

- International "Community of Practice" in IP management for Agricultural Development
- www.cas-ip.org /projects/npi/
- Case studies
- Compendium
- Facilitation skills

Agricultural Technology “Trust”

- An actively managed licensing / networking hub
- Not primarily a match maker
- For profit or not-for profit or hybrid
- Legal entity to take license and sub license
- In biotech – potential formal patent pool

Thank You

Questions?

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