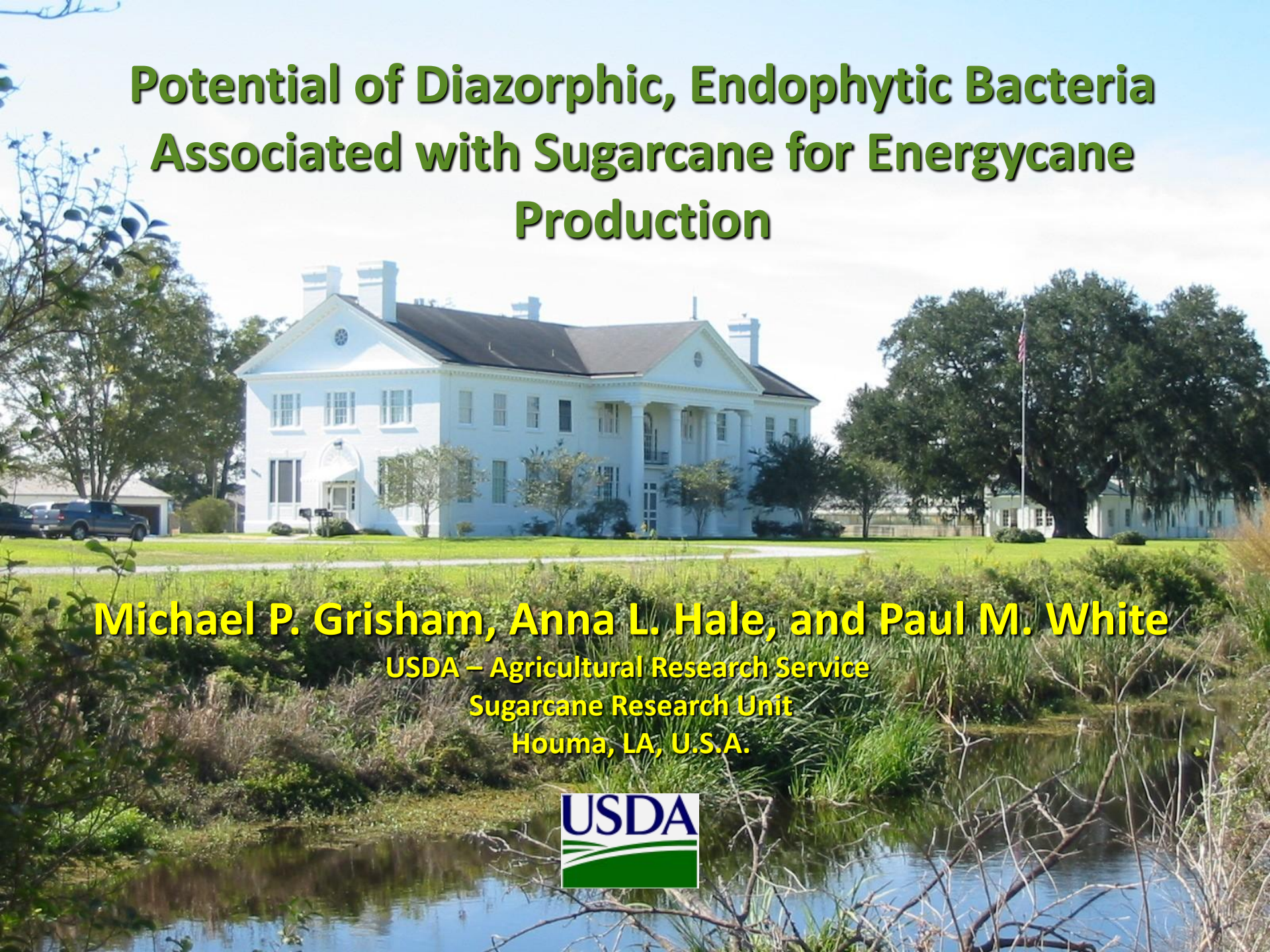
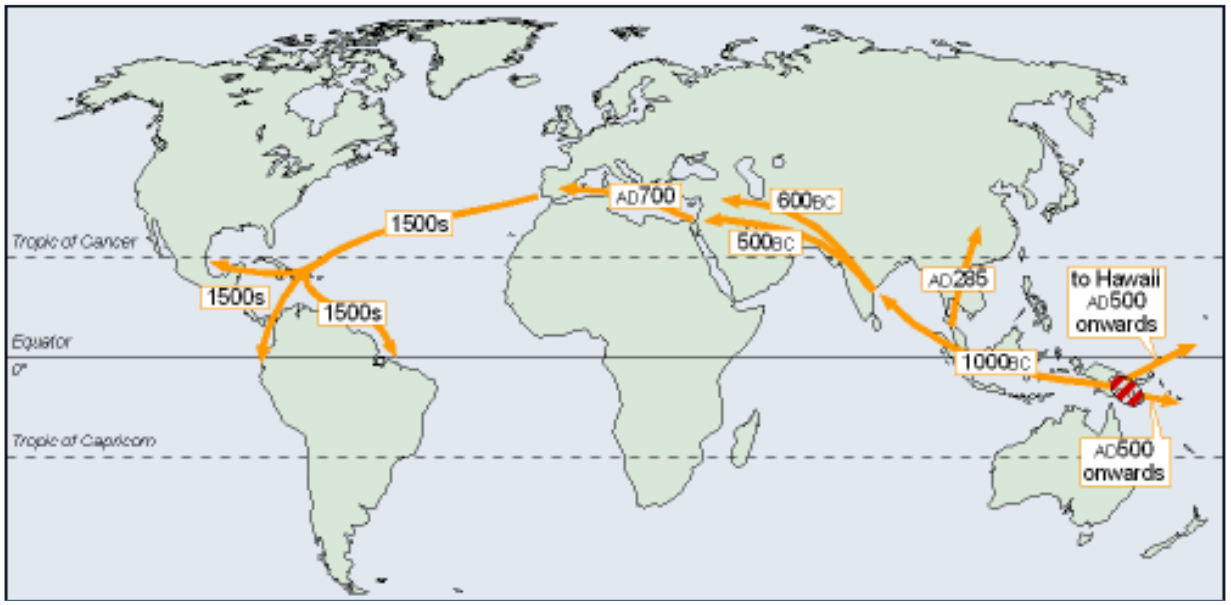
Potential of Diazorphic, Endophytic Bacteria Associated with Sugarcane for Energycane Production



Michael P. Grisham, Anna L. Hale, and Paul M. White

USDA – Agricultural Research Service
Sugarcane Research Unit
Houma, LA, U.S.A.

Origin and Spread of Sugarcane



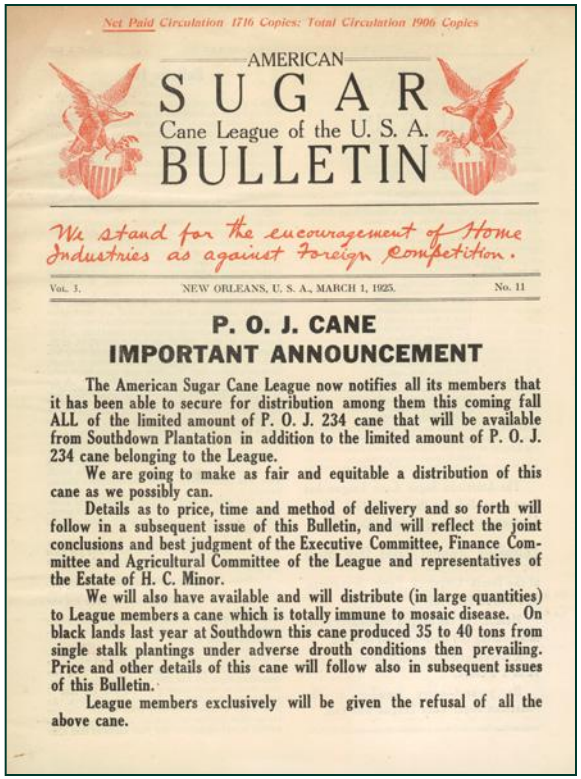
6000 BC Domestication of sugarcane in New Guinea
1000 BC Traders began spreading sugarcane westward

1493 Brought by Columbus to Hispaniola from Canary Islands
1500s Spanish and Portuguese explores bring sugarcane to Americas

"Creole," a noble sugarcane, grown for 250 years in the Americas

1750s Jesuits brought sugarcane to Louisiana "Otaheite"
1794 First commercial sugarcane in Louisiana

- **1800s Noble varieties such as “Louisiana Purple”, “Louisiana Stripe,” and “D74” grown in Louisiana**
- **Early 1900s Devastating crop failures in Louisiana sugarcane industry**
- **1919 Dr. Elmer W. Brandes, USDA, identified mosaic as major cause of poor yields**
- **1922 Interspecific hybrid P.O.J. varieties imported from Java, key to saving industry**
- **1924 Supply of P.O.J. 234 available for distribution through the American Sugarcane League**
- **1928 85% of the state’s acreage was P.O.J. varieties**



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AMERICAN
SUGAR
Cane League of the U. S. A.
BULLETIN

We stand for the encouragement of Home Industries as against foreign competition.

Vol. 3. NEW ORLEANS, U. S. A., MARCH 1, 1925. No. 11

P. O. J. CANE
IMPORTANT ANNOUNCEMENT

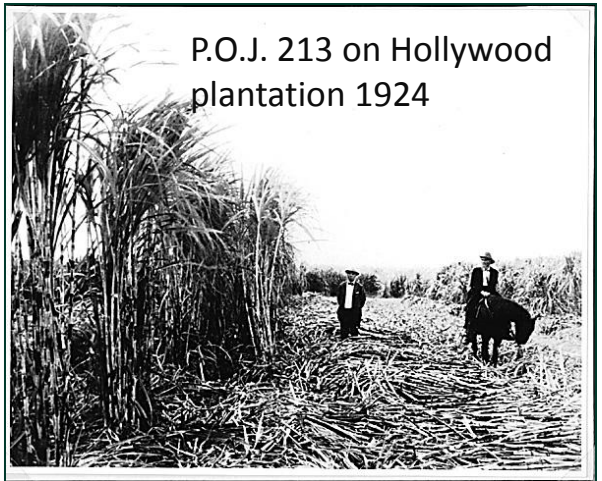
The American Sugar Cane League now notifies all its members that it has been able to secure for distribution among them this coming fall ALL of the limited amount of P. O. J. 234 cane that will be available from Southdown Plantation in addition to the limited amount of P. O. J. 234 cane belonging to the League.

We are going to make as fair and equitable a distribution of this cane as we possibly can.

Details as to price, time and method of delivery and so forth will follow in a subsequent issue of this Bulletin, and will reflect the joint conclusions and best judgment of the Executive Committee, Finance Committee and Agricultural Committee of the League and representatives of the Estate of H. C. Minor.

We will also have available and will distribute (in large quantities) to League members a cane which is totally immune to mosaic disease. On black lands last year at Southdown this cane produced 35 to 40 tons from single stalk plantings under adverse drouth conditions then prevailing. Price and other details of this cane will follow also in subsequent issues of this Bulletin.

League members exclusively will be given the refusal of all the above cane.



P.O.J. 213 on Hollywood plantation 1924

Flagging plots for harvest operator

Breeding

- Participating with the LSU Ag Center and the American Sugar Cane League in developing new commercial varieties
- Using wild relatives of sugarcane to broaden the genetic base of our parental material
- Developing “energy cane” varieties
- Developing and utilizing DNA-based molecular markers to fingerprint varieties and to improve selection efficiencies.

Energycanes

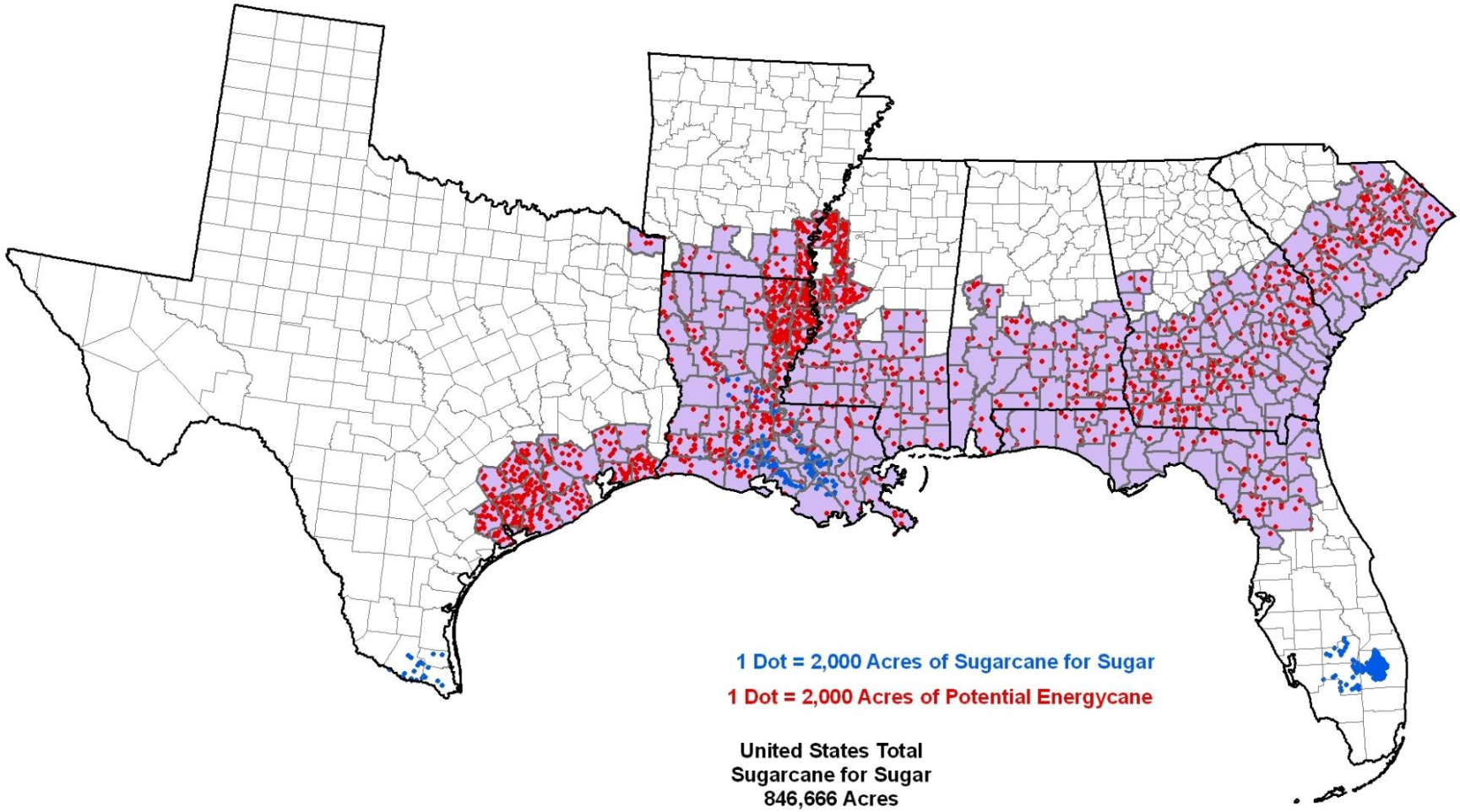
- Hybrids (F_1 and BC_1) between cultivated sugarcane and wild relatives (*Saccharum, Miscanthus, Erianthus*)
- Vegetatively propagated perennial with better cold tolerance than sugarcane
- Higher fiber and better ratooning ability
- Developed specifically as a bioenergy crop
  - Type I – Dual-purpose sugar and lignocellulosic crop
  - Type II – Primarily lignocellulosic

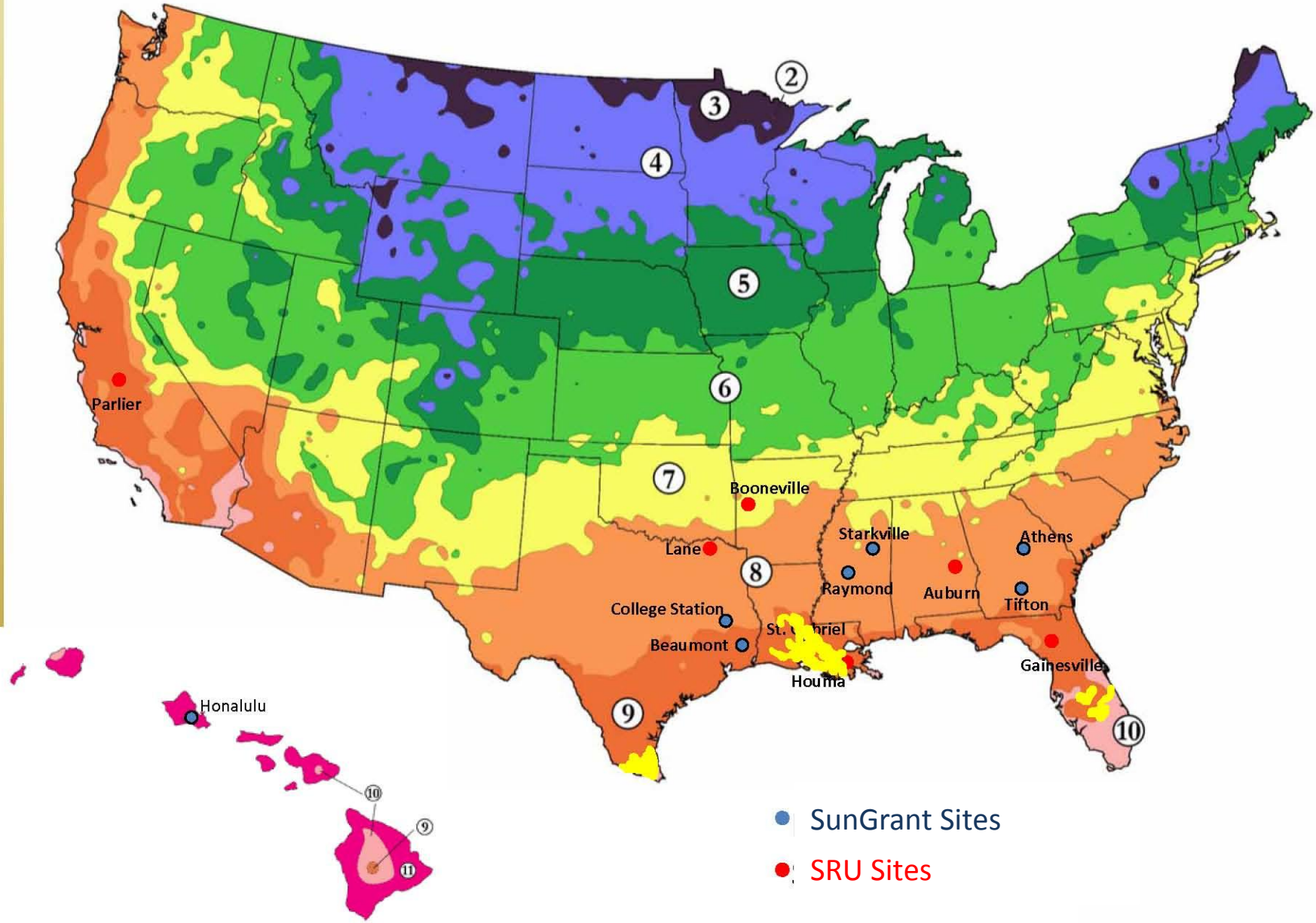
Breeding with wild relatives:

- ✓*Saccharum spontaneum*
- ✓*Miscanthus*
- ✓*Erianthus*


3/12/2001


10/01/2001


1 Dot = 2,000 Acres of Sugarcane for Sugar
1 Dot = 2,000 Acres of Potential Energycane
United States Total
Sugarcane for Sugar
846,666 Acres
Energycane
3,800,000 Estimated Acres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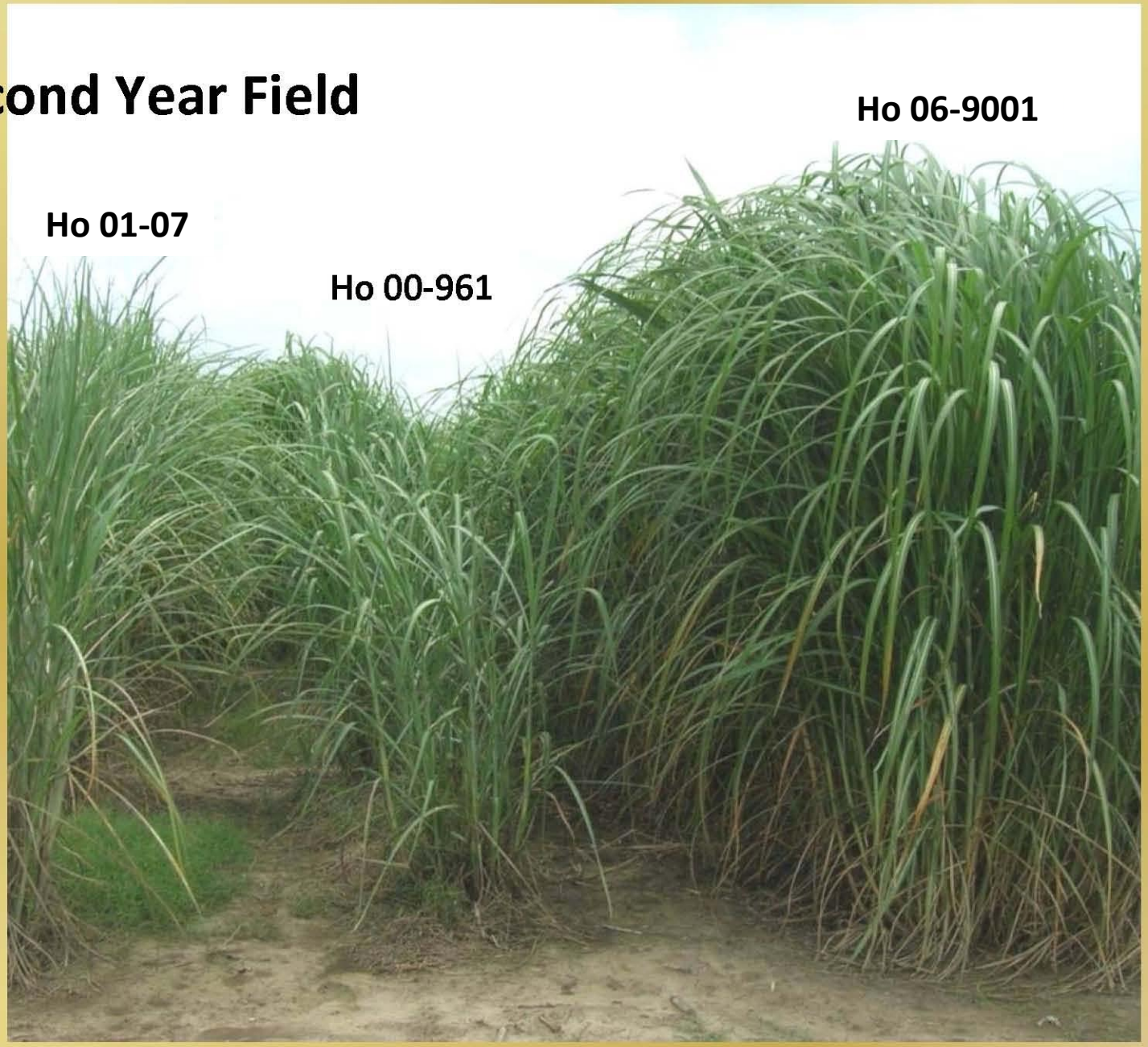
Parlier
Booneville
Lane
Starkville
Athens
Raymond
Auburn
Tifton
College Station
Beaumont
Houma
Gainesville
Honalulu
10
9
11
SunGrant Sites
SRU Sites

Common Energycane Germplasm

Germplasm Line*	Pedigree
Ho 02-147	F_1 (Wild Cane x Sugarcane)
Ho 02-144	F_1 (Wild Cane x Sugarcane)
US 72-114	BC_1 with Sugarcane
Ho 06-9001	BC_1 with Wild Cane
Ho 06-9002	BC_1 with Wild Cane
Ho 00-961	R-MS, Be-TX & HI
Ho 95-988	HI
Ho 00-07	HI

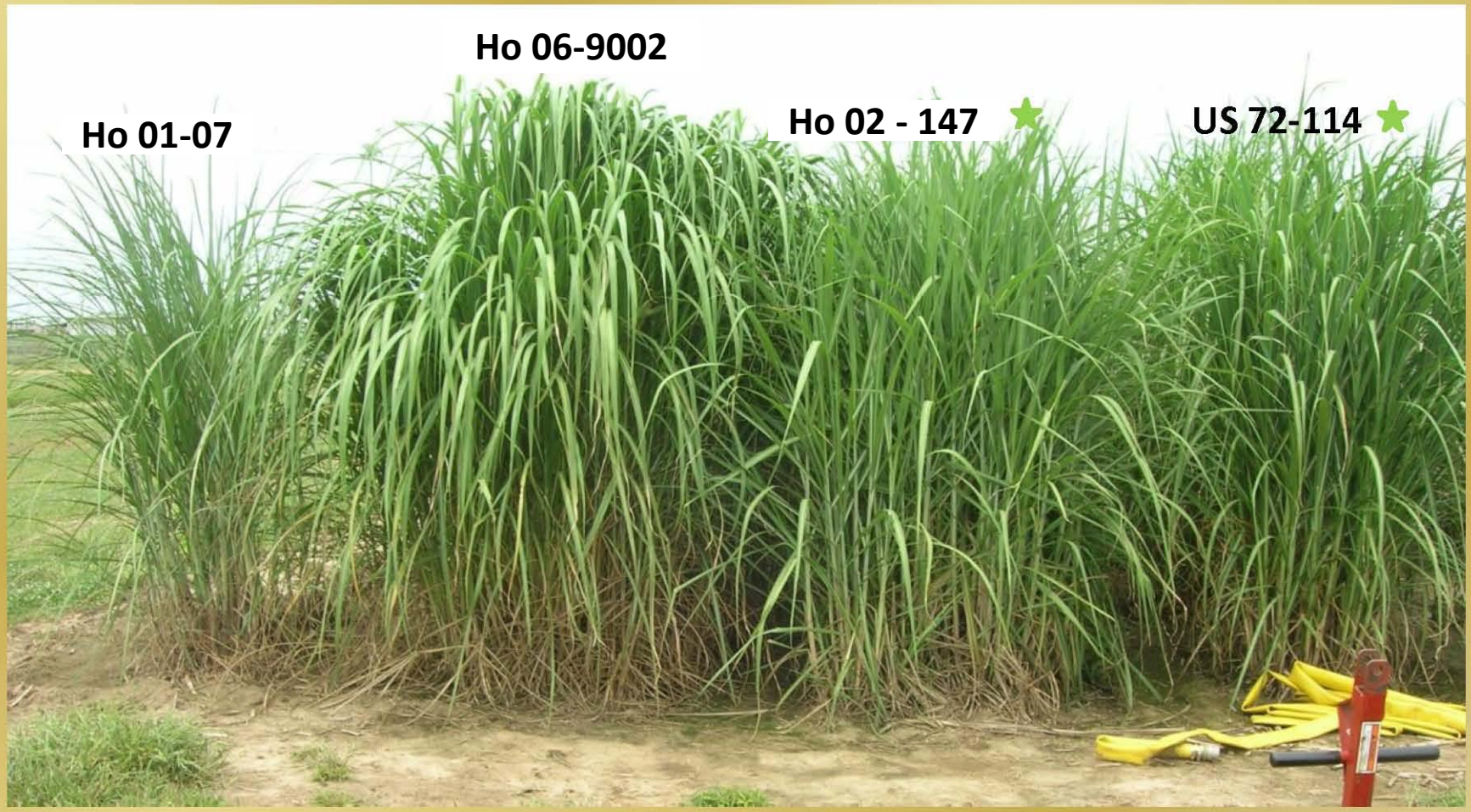
*from USDA-ARS-SRU, Houma, LA

Second Year Field



Starkville, MS; Aug 2008

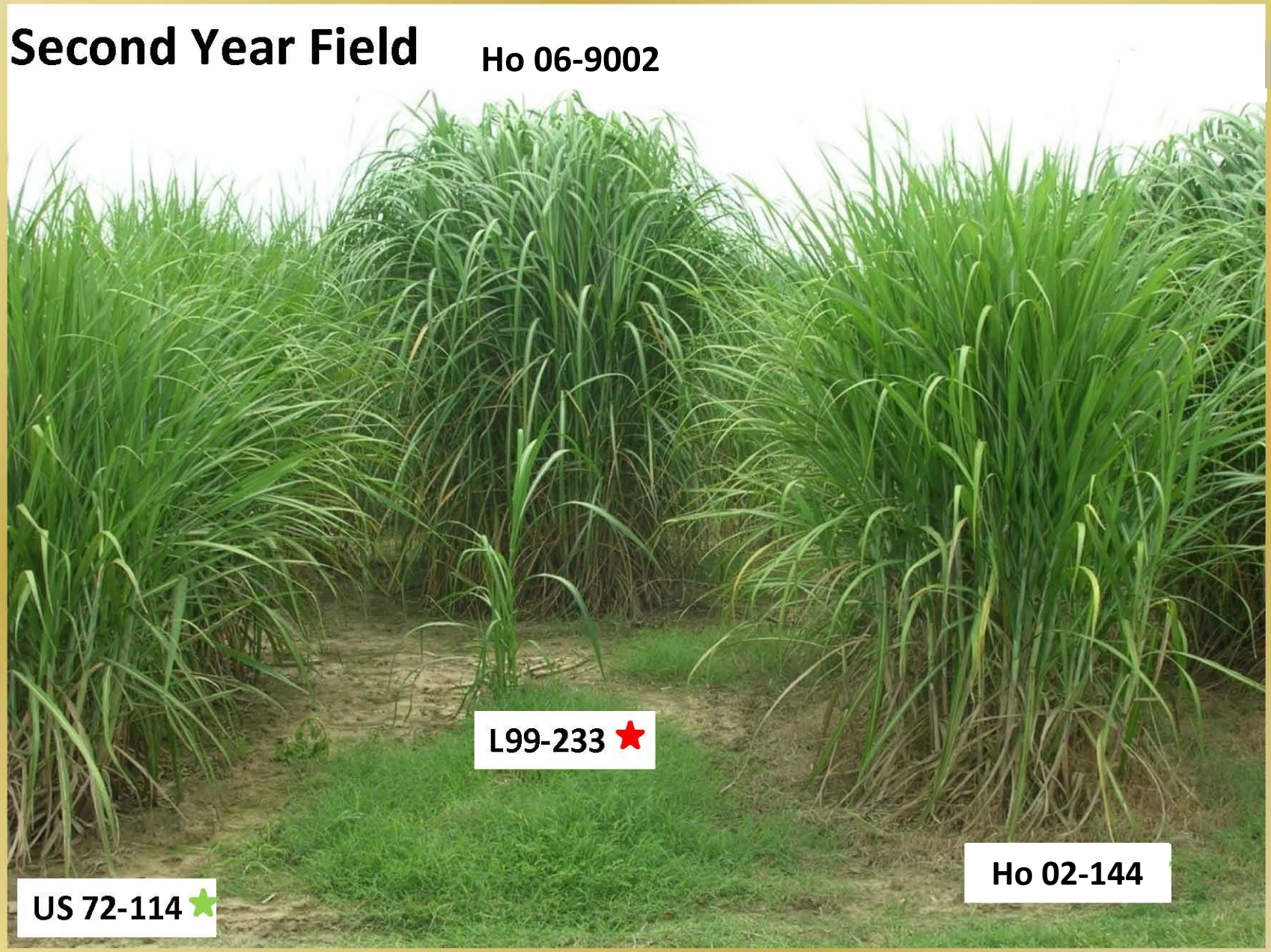
Second Year Field



Courtesy of Brian Baldwin, MSU

Starkville, MS; Aug 2008

Second Year Field



Courtesy of Brian Baldwin, MSU

Starkville, MS; Aug 2008

Courtesy of Brian Baldwin, MSU

Starkville - February 2008

Introduction

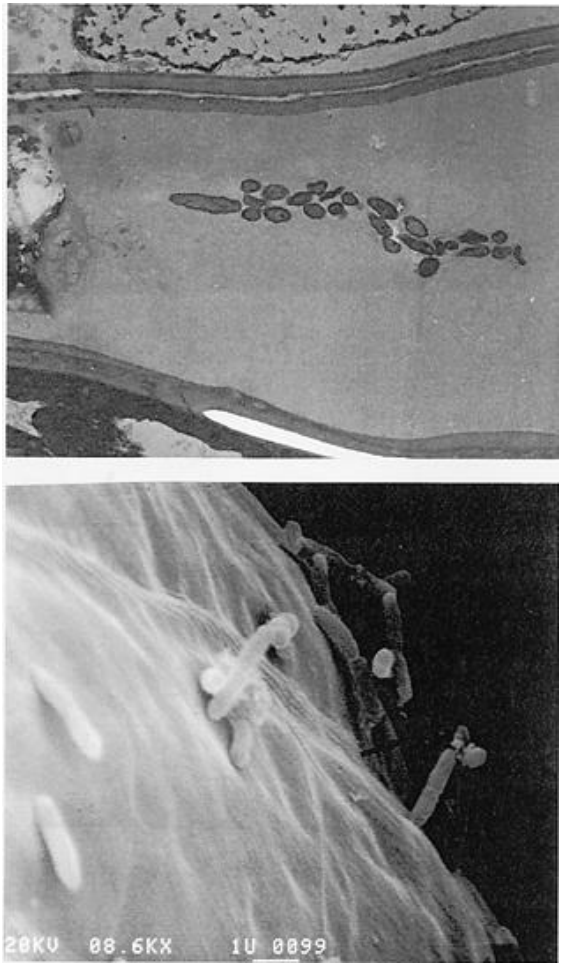
- Louisiana sugarcane receives 90-180 kg N/ha
- Biological N fixation (BNF) may reduce requirement
- In one nitrogen balance study in sugarcane, 70% of biomass from BNF

USDA ARS

Research Objectives

- **Attempt to isolate diazotrophic, endophytic bacteria from Louisiana-grown sugarcane**
- **Measure how much N can the isolates “fix”**
- **Determine if we can inoculate commercial varieties with N-fixing bacteria**

BNF Process



- Endophytic bacteria (live among cells of plant tissue)
- Convert atmospheric N to plant-available N
- Some may be antagonistic to pathogens

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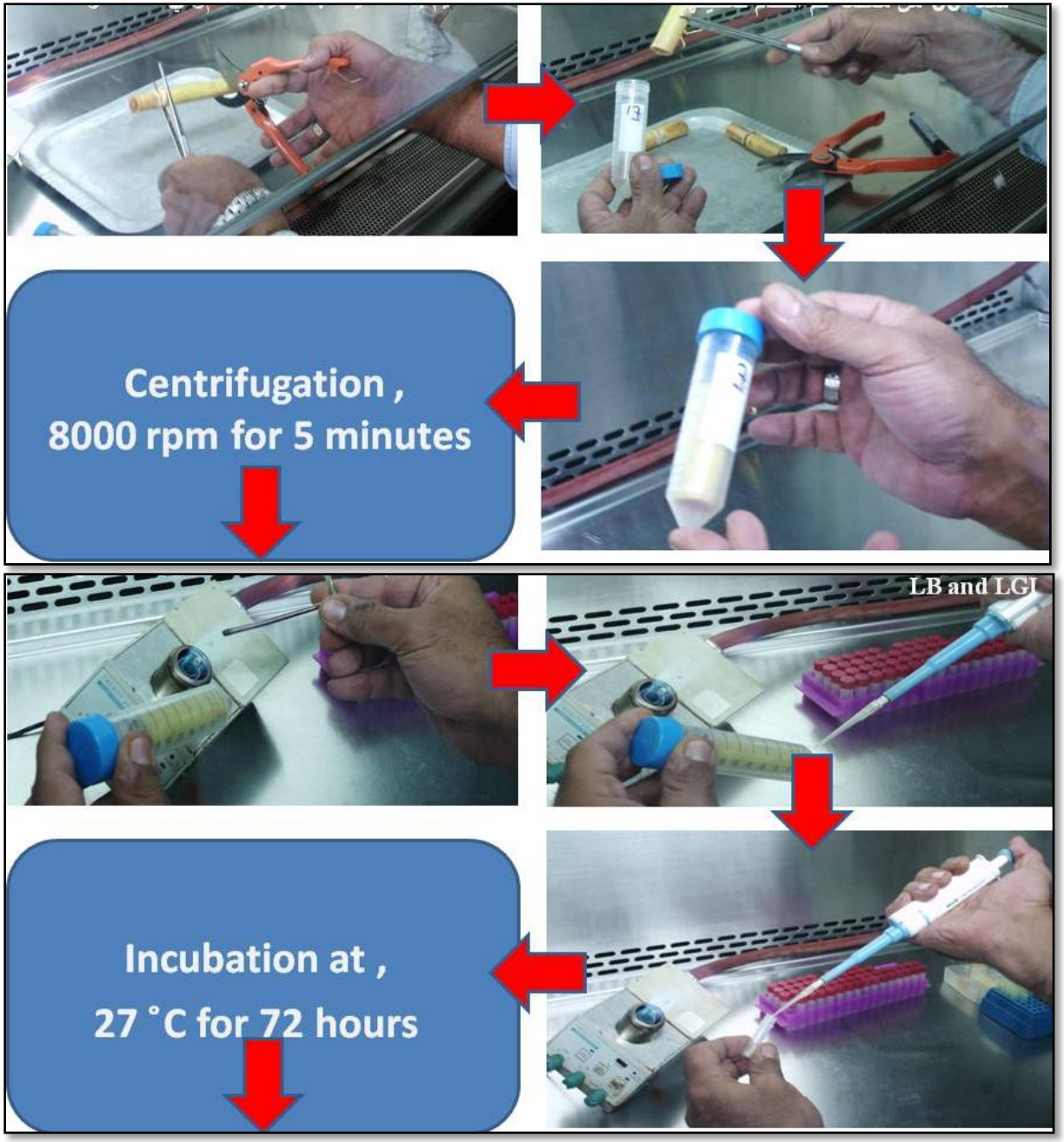
- **Isolate bacteria on nitrogen-free medium (LGI-P) from stalks**

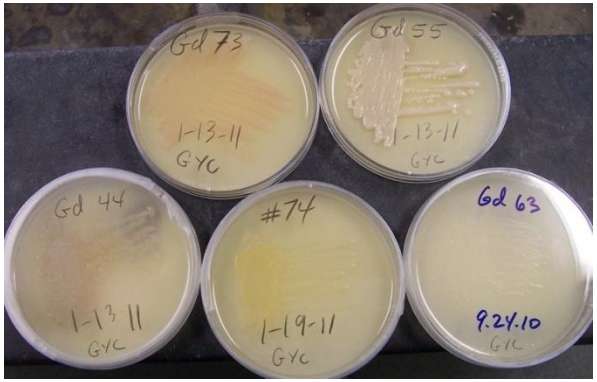


Procedures

- Isolate bacteria on nitrogen-free medium (LGI-P) from stalks
- Identify isolates through rDNA sequences analysis and blasted in NCBI
- Nitrogen-fixation capability testing
- Inoculation studies
- Test effect of N-fixing bacteria on pathogens

Current Progress

- **Isolated approx. 100 bacterial isolates from commercial Louisiana varieties**
- **Isolates grew on N-deleted media**



- **The identity of some is the same as those from Brazilian sugarcane**

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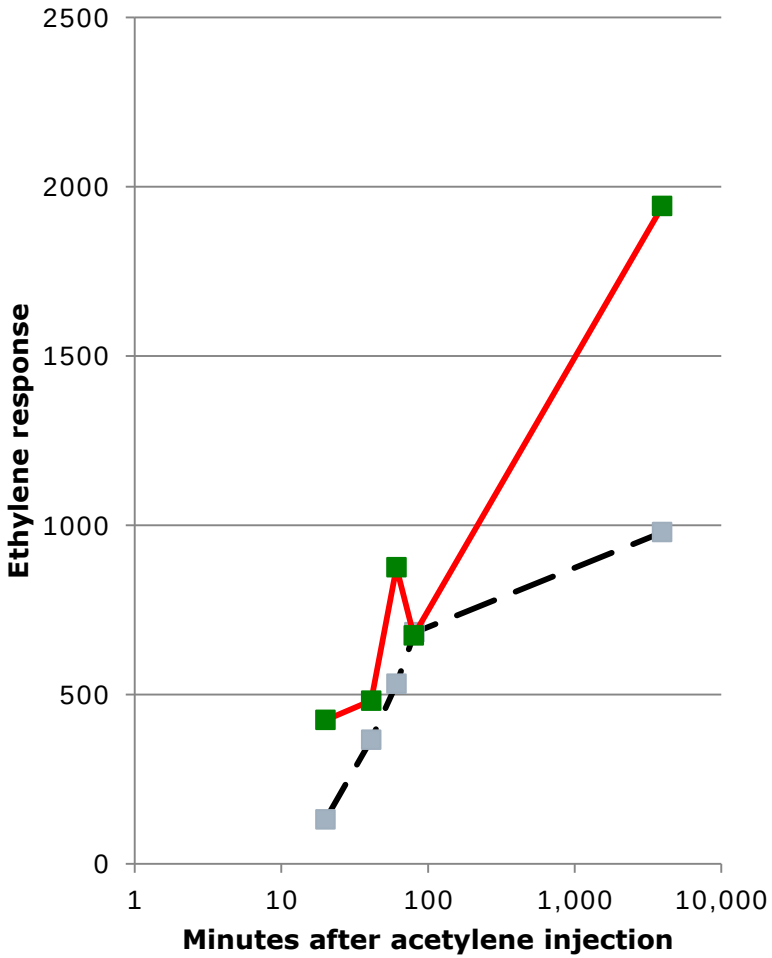
Bacterial Isolation

Egyptian Isolates (20)	Louisiana Isolates (85)
Gluconacetobacter*	Gluconacetobacter*
Burkholderia	Burkholderia
	Herbaspirillium
Panocea	Panocea
Enterobacter	Enterobacter
Pseudomonas	Pseudomonas
Frateauria or Dyella	
Aneurinibaciilus	
Pectobacterium	
	Xanthomonas oryzae oryzae
* Including G. diazotrophicus	

- **Two *Gluconacetobacter diazotrophicus* isolates demonstrated nitrogen-fixation capability**



Isolates of *G. diatrophicus* exhibited moderate levels of nitrogenase activity (2 nmol C_2H_4 per hour).

Industry Benefits

- **Lower nitrogen fertility rates**
- **Inoculating tissue-culture propagated plants with endophytic, N-fixing bacteria could:**
  - **improve seed cane germination**
  - **reduce effects of systemic diseases**

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Thank You