DOE Bioenergy Technologies Office (BETO)
2021 Project Peer Review

Sustainable Herbaceous Energy Crop Production in the Southeast United States

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Feedstock Technologies Program

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Project Overview

***Over-riding goal** is to assess economic viability and environmental sustainability of biomass sorghum and energycane production in the southeast U.S.*

- ***What is the potential for cellulosic bioenergy crop production?***
  - *Cellulosic bioenergy crop production is a nascent industry in the U.S. and has the potential to supply up to 5% of U.S. energy demand while achieving increased carbon reduction (Langholtz et al. 2016) (8.7% of electricity generation in Brazil via cellulosic feedstock, Vasconcellos et al. 2018)*
  - *The Southeast U.S. is ideally suited for a cellulosic industry due to plentiful land, ample rainfall, and a pressing need for agricultural diversification*
- ***What does the project expect to achieve?***
  - *To characterize the seasonal dynamics of biomass production of two cellulosic energy crops*
  - *To assess the economic viability and environmental sustainability of energy crop production and potential impact of competition with conventional crop production*
  - *To develop site-specific Best Management Practices and Operational Plans to optimize biomass production, harvest and storage*

Overview - Progress, Anticipated Outcomes and Impacts

2019-2020 Progress

- *Develop comprehensive data on multi-location productivity of biomass sorghum and local conventional crops in terms of agronomics (water use, seasonal biomass, production costs) and sustainability (water quality, water percolation, soil erosion, nutrient leaching, biodiversity)*

2021-2023 Anticipated Project Deliverables

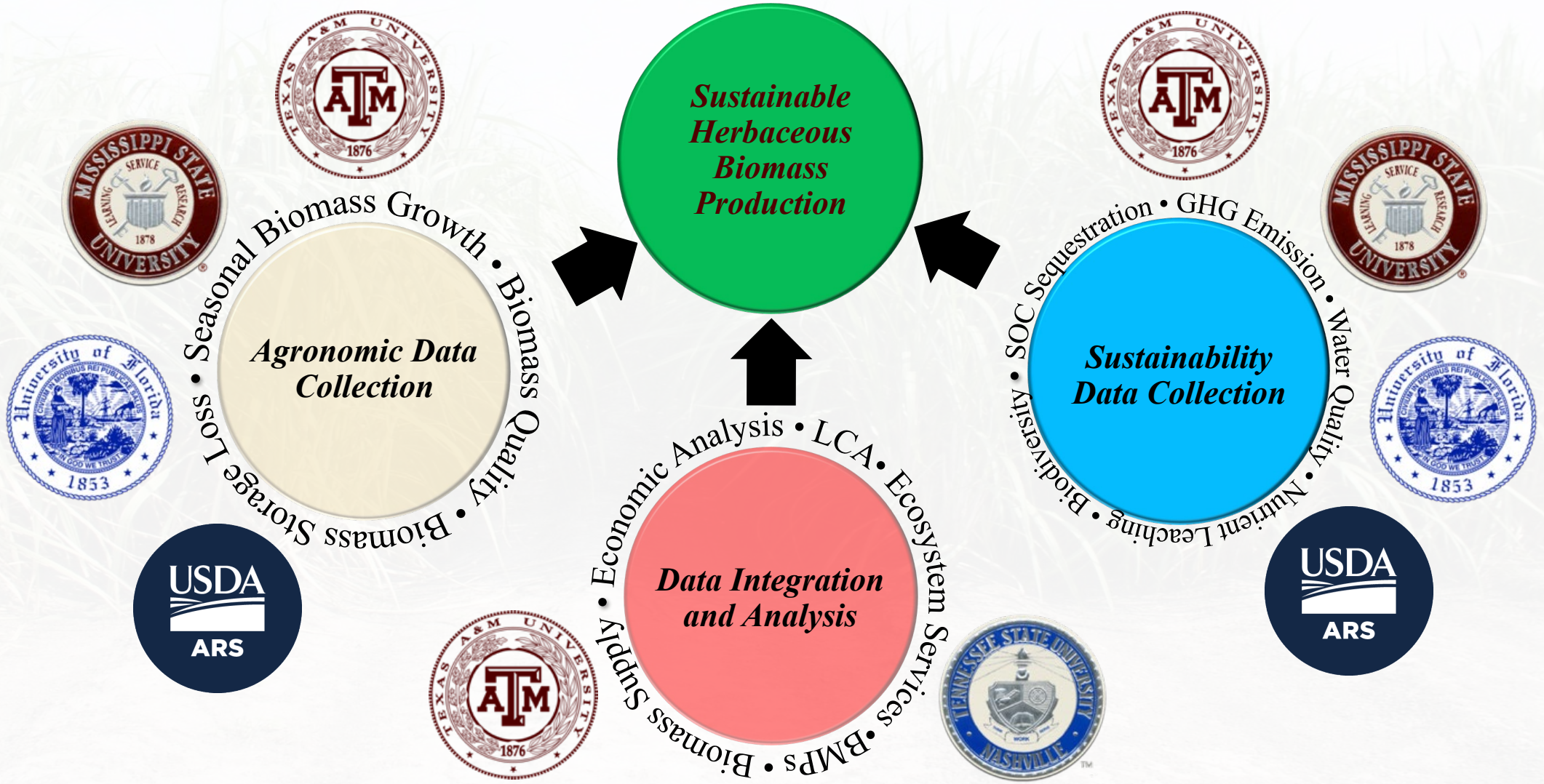
- *Expand the multi-year, multi-location database to include energycane*
- *A comprehensive assessment of the economic viability, environment sustainability, and ecosystem services for each crop and each genotype*
- *Develop edaphic and climate specific BMPs and OPs for the entire U.S. Gulf Coast*

Anticipated Outcomes and Impacts

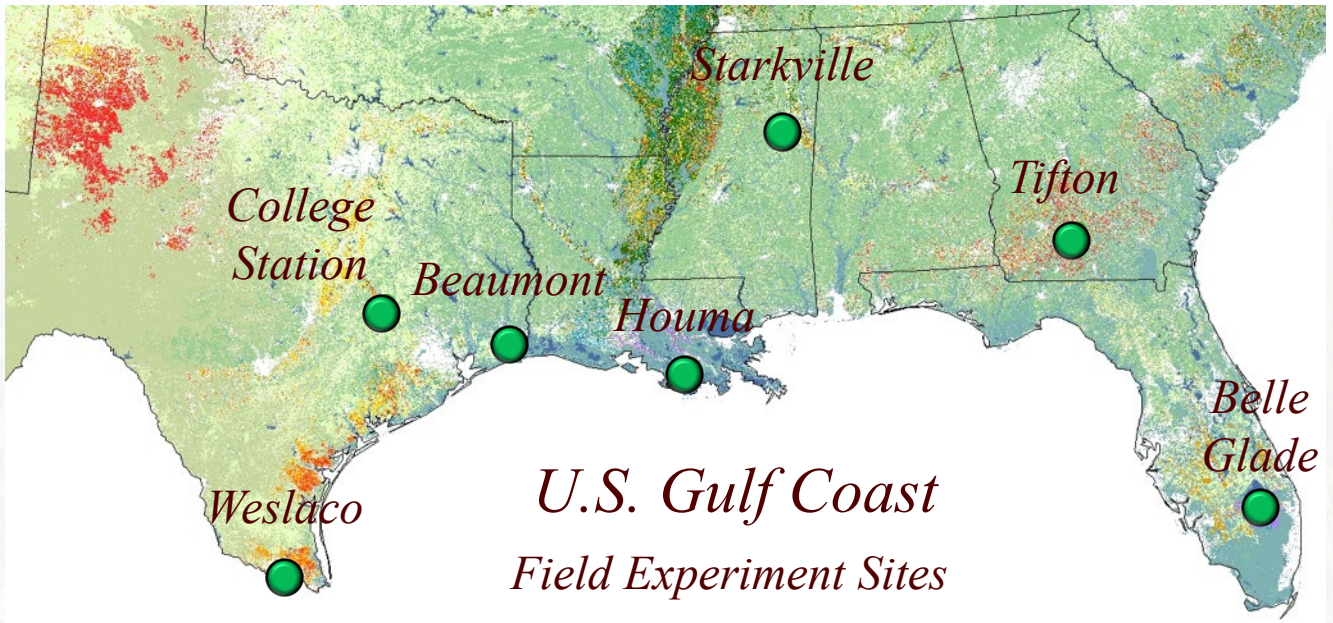
- *Accelerate adoption of cellulosic bioenergy development in support of DOE BETO's strategic goal to reduce the price of biofuels to < $3/gasoline gallon equivalent and reduce the cost of feedstock delivered to the conversion reactor throat to less than $84/dry ton*
- *The proposed research is expected to increase the availability and affordability of biomass-derived transportation fuels and bioproducts*

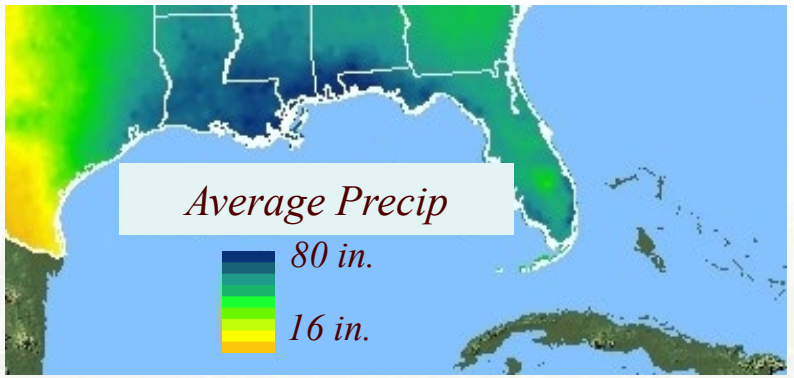
Management – Project Structure and Expertise

Our 14-member DOE project team has expertise with major aspects of bioenergy and conventional crop research in the Southeastern U.S.



Management - Field Locations and Characteristics





Annual average precipitation (Modified from USGS).

Location	Energycane Cultivars	Biomass Sorghum	Conventional Crop
Weslaco, TX	Cultivars (3)	Cultivars (3)	Cotton
College Station, TX	same	same	Grain Sorghum
Beaumont, TX	same	same	Rice
Houma, LA	same	-	Sugarcane
Starkville, MS	same	same	Corn
Tifton, Ga	same	same	Corn
Belle Glade, FL	same*	same	Sugarcane

*Florida phytosanitation laws required planting energycane from existing genotypes from within the state

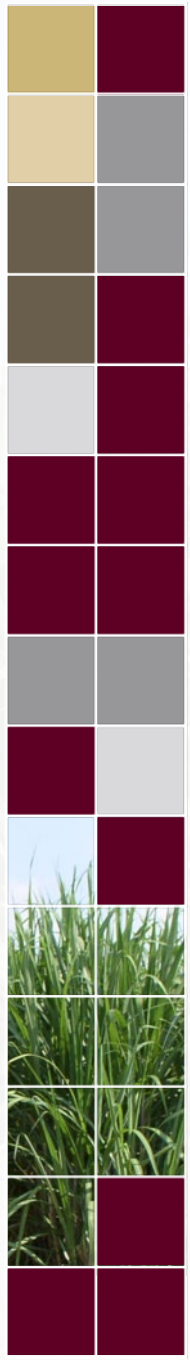
Management - Team Communications

Team Communications

- *Regular emails, phone calls and video conferences on emerging issues*
- *Monthly progress updates and activities tracking with project site leaders and with DOE Project Officer and Technology Manager*
- *Quarterly project reports to DOE*
- *Annual project review and planning meetings to discuss progress, review milestones, planned research tasks, and timelines*

Team Communications and Collaborations with related Projects

- *Linkage with the University of Illinois Center for Advanced Bioenergy and Bioproducts Innovation (CABBI)*
- *Memberships on previously funded DOE SunGrant Herbaceous Feedstock Project and three USDA NIFA projects to develop economic thresholds and sampling methods for pests of sugarcane and cellulosic bioenergy crops*
- *Provide biomass samples to the Idaho National Laboratory feedstock collection*
- *Partner with Verd Company to test feedstock using ethanol-ensiled technology*



Risk Identification and Mitigation to Ensure Success

Key Risks that have been identified and mitigations taken to ensure project success

Structural

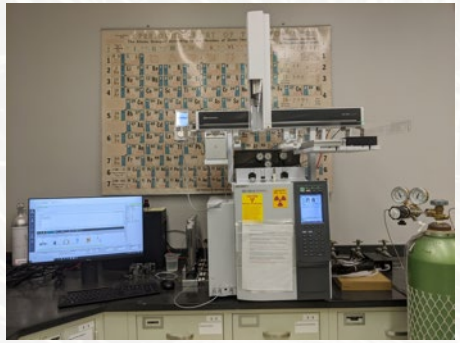
- *Tightly manage each component of our research schedule to stay on top of all land operations as a buffer to unpredictable weather*
- *Cross-train project personnel to mitigate any effects of possible changes in personnel*

Operational

- *Production of excess biomass sorghum hybrid seed/energycane stalks to ensure sufficient material to plant the research plots*
- *Increased seedbed height at research sites with heavier soils and greater rainfall to ensure an aerobic environment for root health*

2019 Progress and Outcomes - Equipment Fabrication/Installation

- *GHG static chamber fabrication*



- *Ground-active invertebrates sampled with pitfall traps*

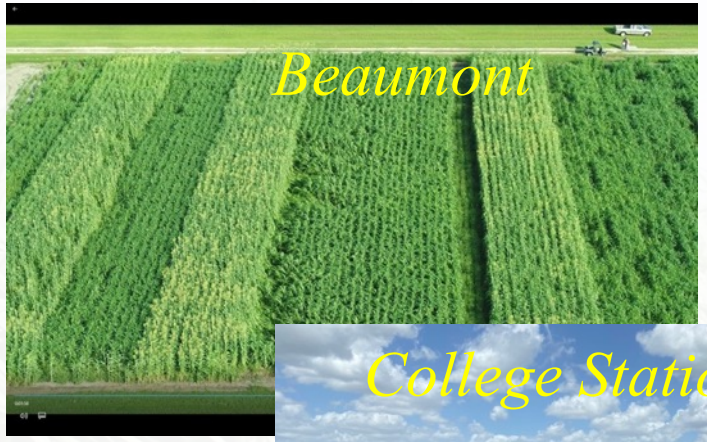
- *Soil microbial diversity (RNA sequences)*

- *Water percolation*

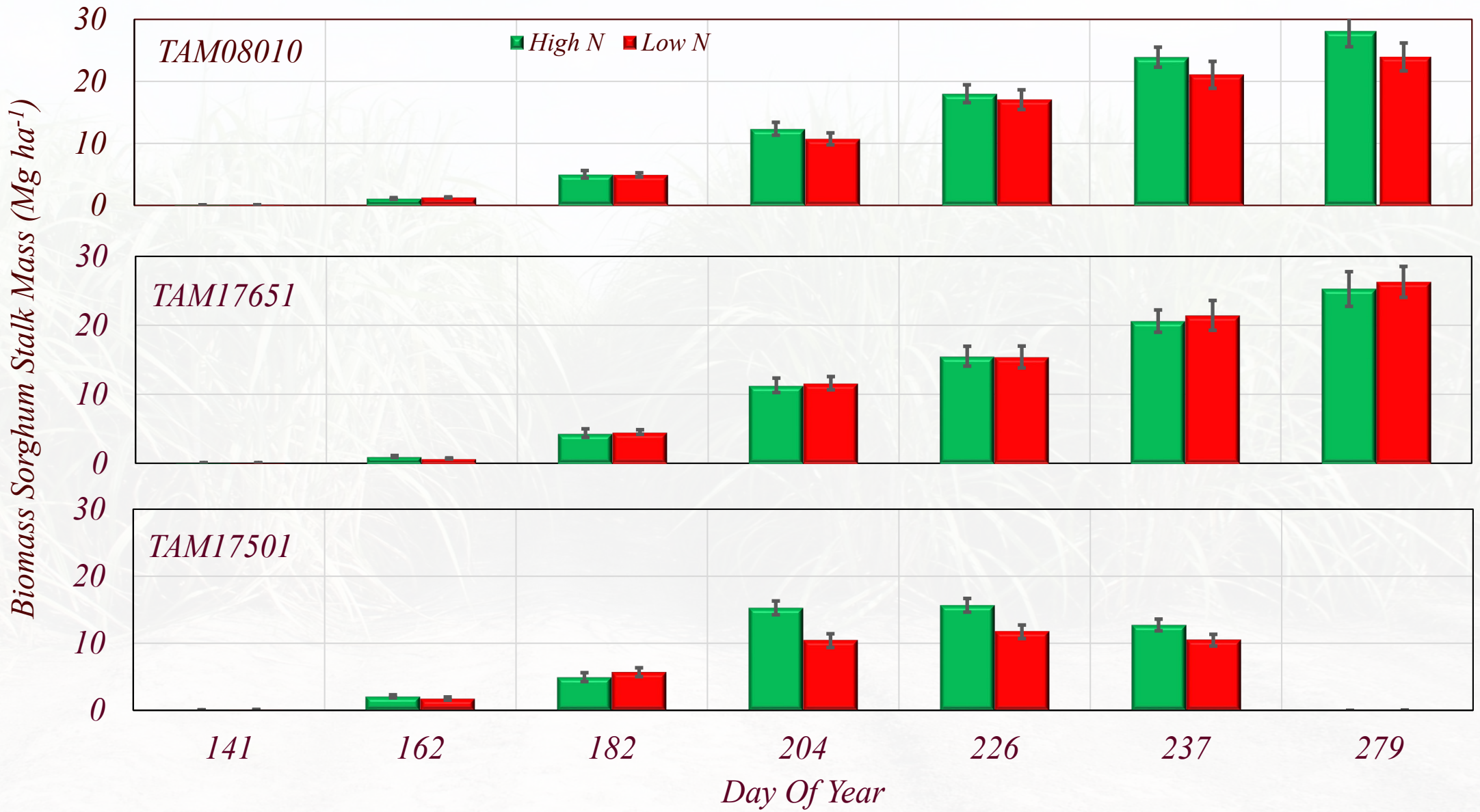
- *Surface runoff harvesting device (5-gallon bucket with open slots on the side)*

Biomass Sorghum Field Experiments - Summer 2020

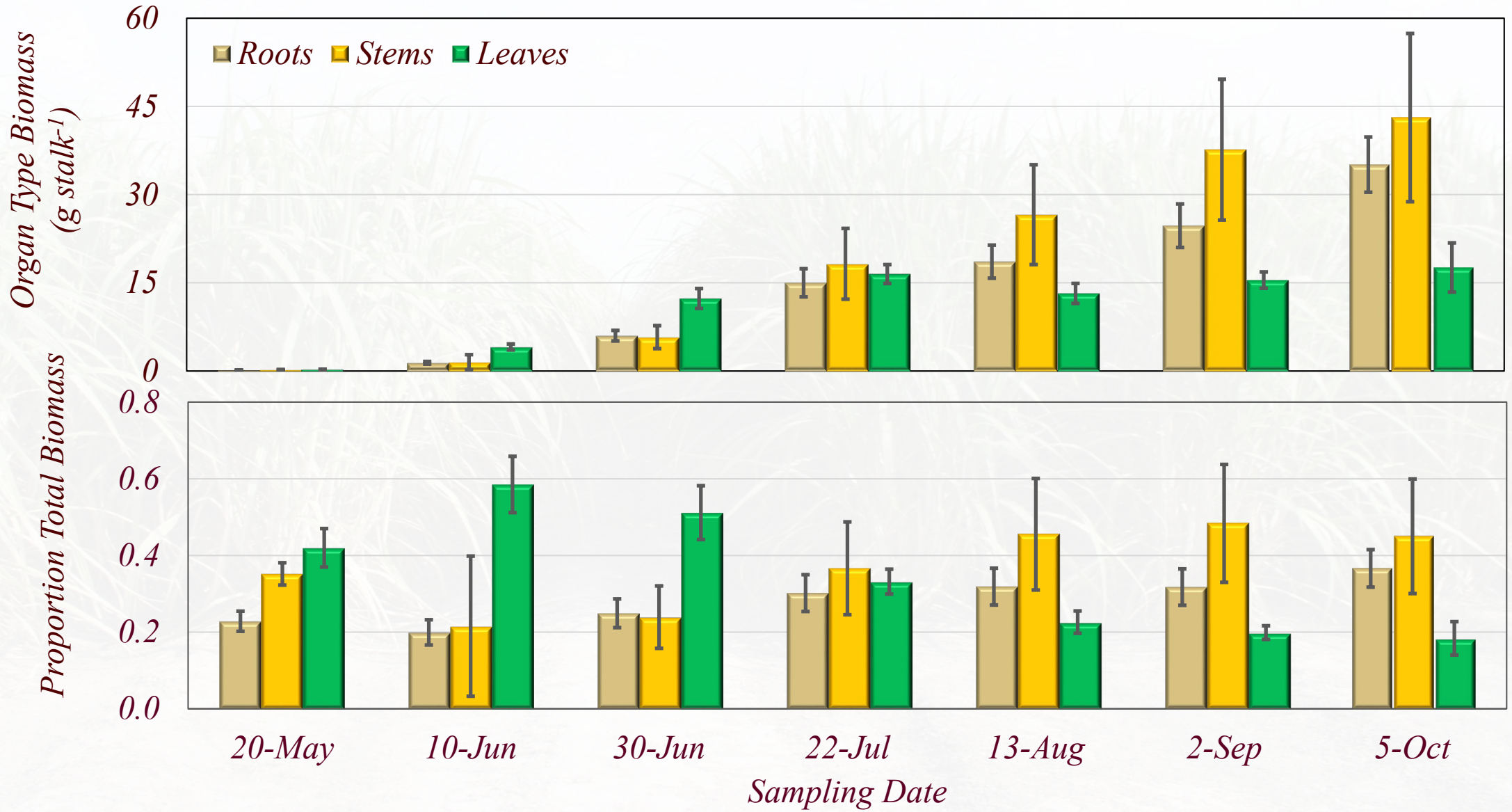
- Each of the six biomass sorghum experiments



2020 Biomass Sorghum Seasonal Mass (Mg ha^{-1}) - Beaumont Site

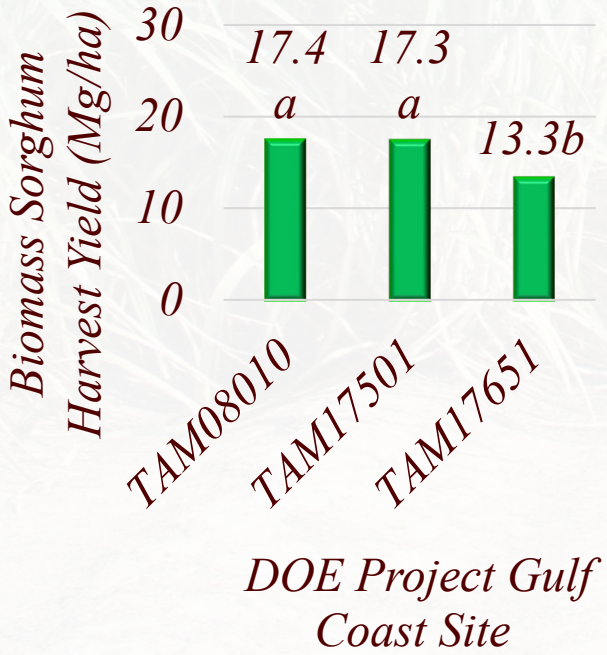


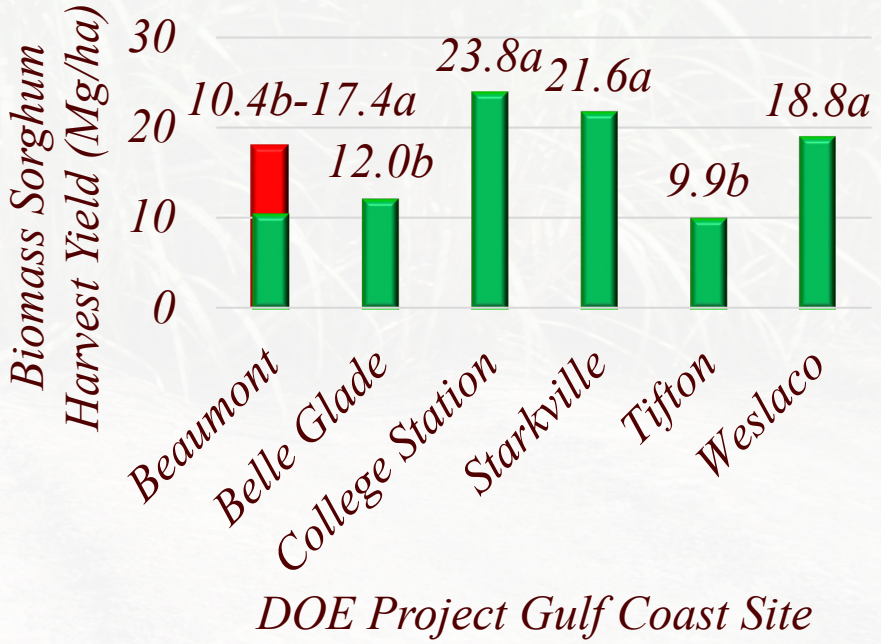
2020 Biomass Sorghum Organ Mass (g stalk^{-1}) - Beaumont Site



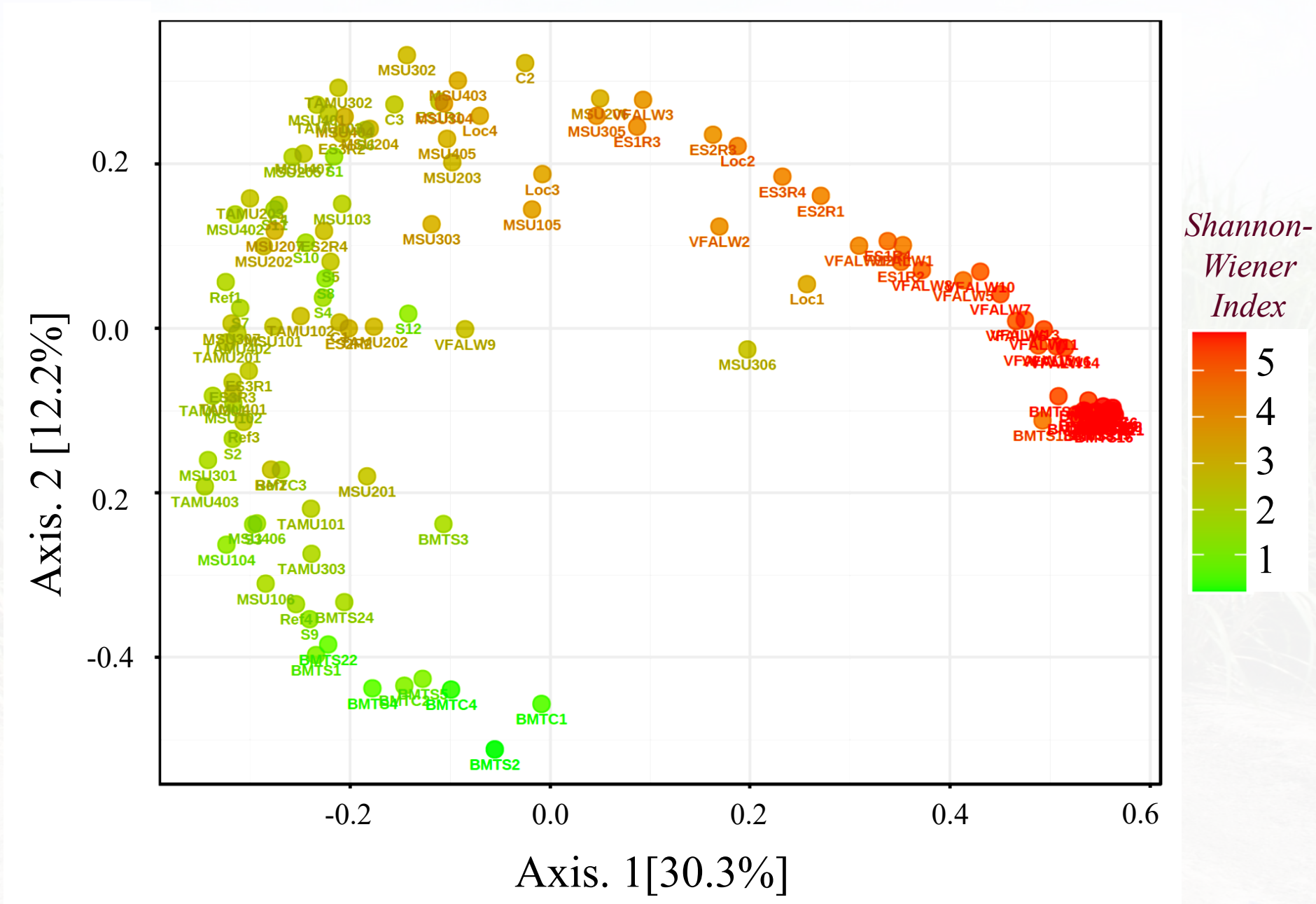
2020 Biomass Sorghum Harvested Yield (Mg/ha) for Six Gulf Coast DOE Project Locations

Source	DF	Sum of Squares	F Ratio	Prob
Model	17	3786.05	10.95	<.0001*
Genotype	2	237.51	5.84	0.0043*
Site	5	2976.01	29.28	<.0001*
G x E (Site)	10	455.75	2.24	0.0234*
Error	78	1585.48		
C. Total	95	5371.53		





2020 Biomass Sorghum Preplant Soil Microbial Diversity



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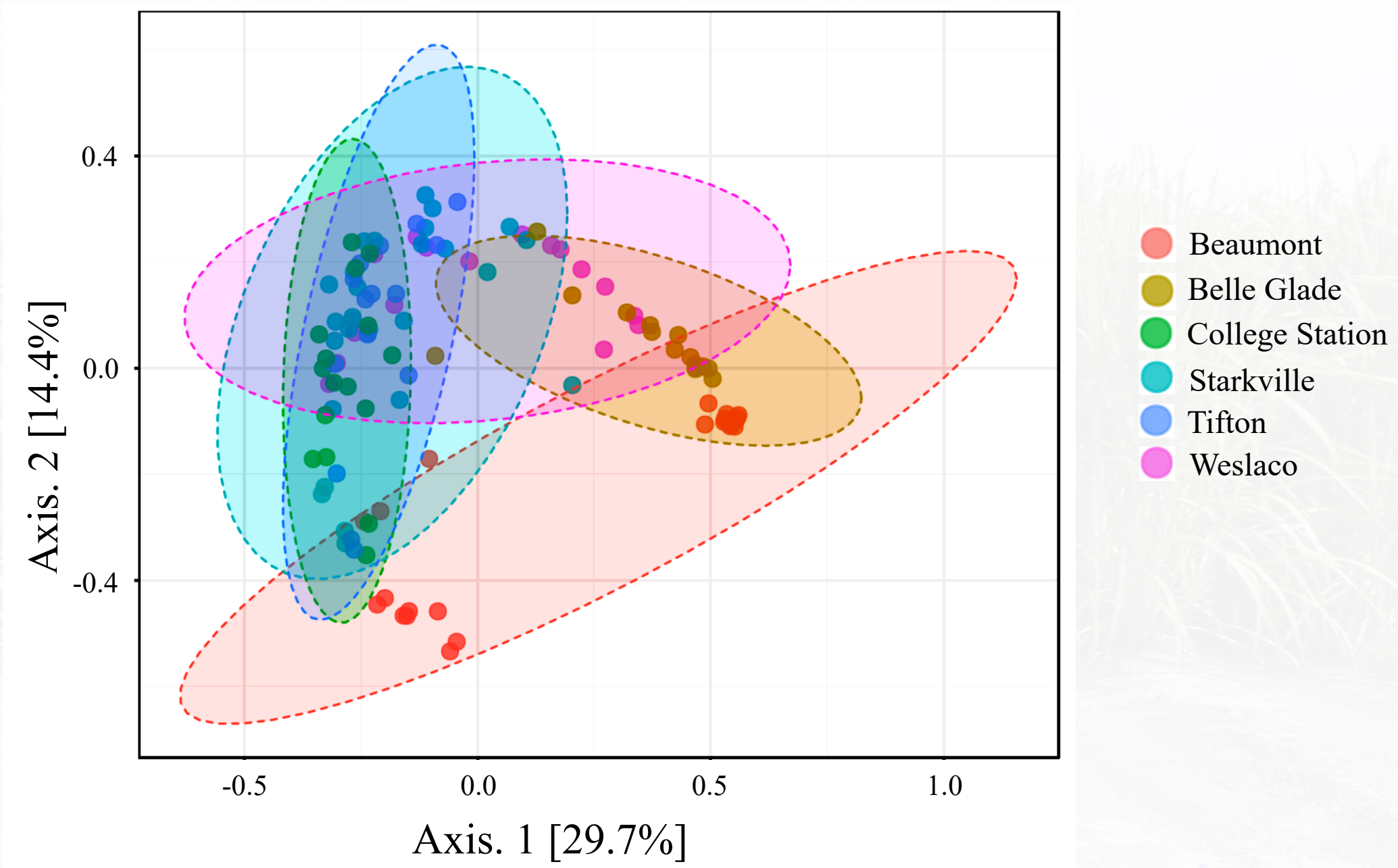
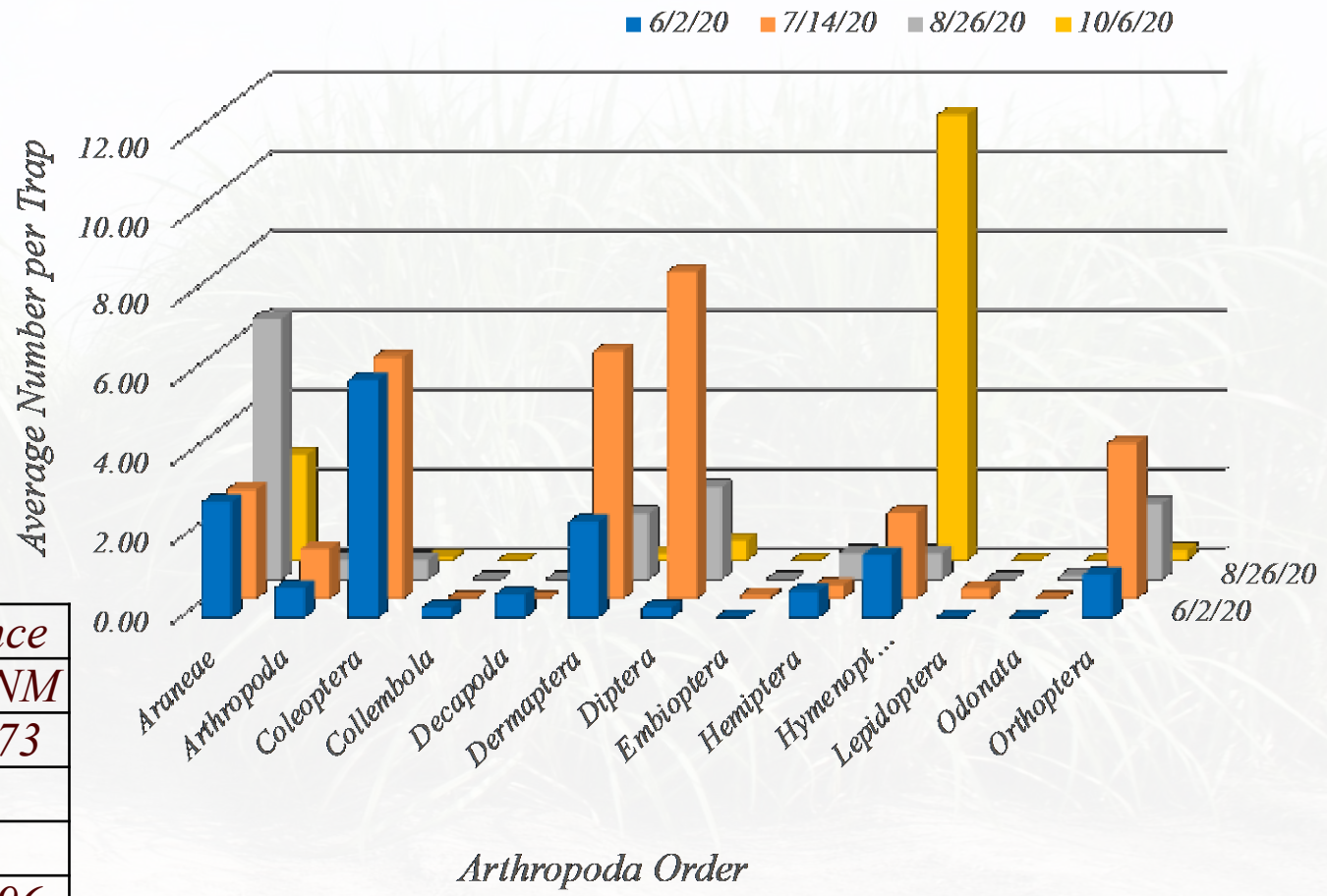


2020 Biomass Sorghum Ground-Active Invertebrates – Taxonomic Abundance Analyses Across Six Sites

	ANOVA Significance		
Source	S x CT	S x G	S x NM
Site	0.004	0.001	0.073
Crop Type	0.236		
Genotype		0.466	
Nitrogen Management			0.496
Site x Crop Type	0.323		
Site x Genotype		0.101	
Site x N Management			0.499



Summary

Accomplished in 2019 and 2020

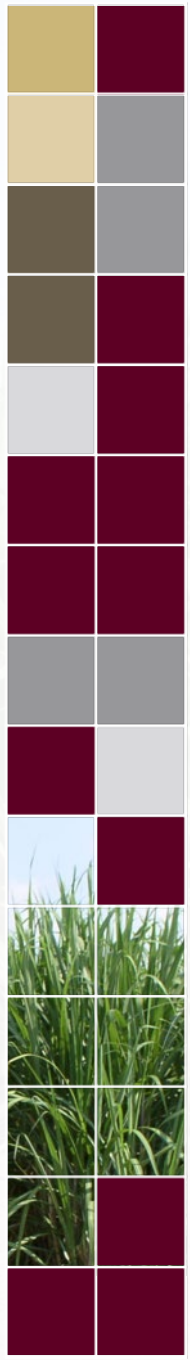
- *Equipment fabrication and testing for greenhouse gas, water, and invertebrate biodiversity*
- *Successful establishment of energycane experiment plots across 7 sites*
- *Biomass and environment sustainability data collection for biomass sorghum across 6 sites*
- *Identified the critical importance of high seedbed forming and drainage for biomass production*

Research focus from 2021 through the end of the project

- *Data collection for agronomics, economics, and environmental sustainability (Years 3-5)*
- *Economic viable and environmental sustainability analyses for biomass production, harvest and storage (Years 4-5)*
- *Develop site-specific best management practices and operational plans for year-round biomass supply (Years 4-5)*

Deliverables that will be achieved in 2021 through to the end of the project

- *Development of site-specific BMPs and OPs that ensure field to fuel economic viability and environment sustainability that will contribute to accelerating cellulosic bioenergy development*
- *Support DOE BETO's strategic goal of reducing the feedstock cost and biofuel price*



Thank You!

Quad Chart Overview

Timeline

- Project start date: 10/01/2018
- Project end date: 09/30/2023

	FY20 Costed	Total Award
DOE Funding	*$691,884*	**$4,999,539**
Project Cost Share	$247,436	$1,252,066

Project Partners

Mississippi State University, University of Florida, Tennessee State University, USDA-ARS Sugarcane Research, Houma, LA, USDA-ARS Crop Genetics & Breeding, Tifton, GA, Verde Company, Houston, TA

Project Goal

Develop a comprehensive assessment of the economic viability and environment sustainability of producing advanced energycane and biomass sorghum for optimizing biomass production in the southeast United States

End of Project Milestone

Economic Viability Costs and benefits of energy crop production, harvest and storage

Environment Sustainability Carbon footprint from biomass production, harvest, storage and delivery

Ecosystem Services Effects on water quality, soil erosion, nutrient retention, soil quality and biodiversity

Site-specific Best Management Practices and Operational Plans on biomass production, harvesting, storage, and land allocation, derived from economic and environment impact analysis

Funding Mechanism

Affordable and Sustainable Energy Crops (ASEC) DE-FOA-0001917