SUGARCANE BREEDING STRATEGIES, AND DEVELOPMENT OF COLD TOLERANT VARIETIES

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ULTIMATE GOAL – GOOD VARIETIES

- High TRS
- Early Maturity
- High SPA
- Low Fiber
- Solid

- High TCA
- Disease Resistant
- Cold Tolerant
- Good Ratooning Ability

ASSESSING CANE QUALITY

- Brix
- Sugar
- Fiber
- Color
- Cold
- Disease Resistance

THE CORE LAB AT THE ARDOYNE RESEARCH FARM















Oreol Pre-O Roller	uer er Holler Mill	New a Existing C New Batch C Existing	Datch 12508 La	6412
N ex	alue So	ngic ID	Nix	Pol
4	ALH S415	2201	16.4	58.2
7	ALH S415	1001	16.8	59
1	ALH 3415	1201	17.3	63.2
5	ALH S416	1803	17.5	63
2	ALH S415	1301	17.7	62.8
6	ALH S415	1702	17.9	64.1
9	ALH S415	801	18.1	64.8
8	ALH S415	901	18.8	68.4
10	ALH S415	1703	19.6	0
3	ALH S415	1802	19.9	73.8

WHAT DOES THIS HAVE TO DO WITH BREEDING PROGRAM?

- Faster results
- Less labor required
 - No clarification
 - "One-stop shop" for Brix and Sucrose



CORE LAB BRIX VS. NIR BRIX



CORE LAB SUCROSEVS. NIR SUCROSE















2010 Maturity Curve for Major Louisiana Varieties



- Biotic and Abiotic stress conditions
 - Increase reactive oxygen species in plants
 - Induce oxidative stress

Plant Response

- Accumulate antioxidants which function as free radical scavengers, reducing agents, and metal chelators
 - phenolic acids, vitamin C, vitamin E, etc. (low MW)
 - High MW secondary metabolities (e.g. tannins)

MEASURING OVERALL STRESS RESPONSE

Total Antioxidant Activity

- Measured using DPPH
 - A hydroxide radical
- What variability exists in our populations?
 - Commercial
 - Basic
- Is it related to yield stability?

CAN WE INCREASE YIELD STABILITY BY INCREASING ANTIOXIDANT ACTIVITY?

... OR DO WE WANT TO INCREASE IT?

KEEPING THE BIG PICTURE IN MIND

Are basic varieties increasing color?

Do high antioxidants = High color?

• Will high antioxidant activity be hurtful or helpful?



SHOTGUN APPROACH

- Un replicated line trials
 - Commercial
 - Basic
- Replicated Tests Commercial
 - 4 locations
 - 8 tests
 - 3 replications/test

REPLICATED COMMERCIAL TESTS

Effect	F-Value	P Value
Variety	3.49	0.0003
Test	81.30	<0.0001
Variety *Test	I.62	0.0428

No Sign GXE at P=.01 Test has biggest F-Value Based on 8 tests at 4 loc

Antioxidant Activity By Generation



ANTIOXIDANT ACTIVITY AND COLOR

ANTIOXIDANT ACTIVITY VS. COLOR PH9



IS ANTIOXIDANT ACTIVITY FROM PHENOLICS?

WHAT ABOUT COLOR?



MEASURING PHENOLICS



PHENOLICS VS.AA



Ug Trolox eq/mL juice

CORRELATIONS

	AA	Color pH4	Color pH7	Color pH9	Phenolics
AA	I	0.17	0.42	0.70	0.92
Phenolics	0.92	0.08	0.53	0.79	I

WHAT WE NOW KNOW...

- Basics are not likely creating our color issues
- Antioxidant activity, phenolics, and color are related.
- We developed a rapid assay to assess color in our variety program
 - Validated in a mill lab

COLD TOLERANCE







DIFFERENT ANGLES

Different types

- Stubble
- Late-season (juice)
- Leaf tolerance
- Different Methods for Evaluation
 - Traditional
 - Molecular
 - Field
 - Lab/growth chamber

Early Spring Vigor






Ho 95-988

Ho 02-144

SELECTION FROM EARLY STAGE IN THE NORTH

WHEN WE WANT FREEZES TO HAPPEN, THEY DON'T.....



2006 arborday.org Hardiness Zones Map





Testing Intergeneric Seedlings for Cold Tolerance

I6cm freeze





Collaboration with Dr. Brian Baldwin

Starkville, MS; Aug 2008

2ND RATOON - STARKVILLE



Photo by: Dr. Brian Baldwin

BIOENERGY GRANTS AND COLD TOLERANCE TESTING

- Selection of varieties adapated to North Louisiana
- I 000 varieties planted in Winnsboro, LA (Macon Ridge)
 - 50 families
 - 20 individuals per family
 - Planted as unselected stalks
- Selected for 3 years



HOUMAVS. MACON RIDGE



SELECTED VARIETIES

- Derived from 18 different cross combinations
- I7 of the 26 selections were derived from the same S. spontaneum.
 - Most selections made at both locations were from this S. spontaneum
 - Most of the clones with leaf tolerance were also from this S. spontaneum
- These 26 clones are being tested in Starkville, MS now and have overwintered. They overwintered and look good.
- We seem to have selected for parents with wide adaptability and cold tolerance.

LATE-SEASON FREEZING

- Leads to post-freeze degradation
 - Reduced profits
 - Slow processing
 - Can lead to factory shut down
- Shortened growing season

Collaborators: Ryan Viator and Gillian Eggleston







Mannitol is used as an indicator of dextran deterioration

TEST IN NORTH LOUISIANA

10 Louisiana 8 Florida 5 E-canes 3 Commercial 5 replications

34 ° N

Year | Minimum Air Temperature



2 YEARS – LAST SAMPLE DATE (PPM MANNITOL)



Ppm Mannitol/Brix



ARTIFICAL ASSAY

- Stubble Freezer Evaluation
 - Plant Materials Lab Galliano
 - I5 degrees for 6 days
- Stubble survival
 - 9 cold tolerant clones
 - HoCP 96-540



Stubble Survival of Basic Cane in Freezer Assay



STALK BUD FREEZE TOLERANCE

- 3 years, 3 replications
- Treatments:
 - Stalks frozen for 6 days at 15°F
 - Control: maintained in the dark at 6 °C
- I2 eyes planted (per treatment per rep)
- Germination and height determined after 3 weeks.









CLONES ANALYZED INCLUDED:

- 3 Erianthus arundinaceious
- 5 S. barberi
- 3 S. officinarum
- 3 S. robustum
- **5** S. sinense
- 43 S. spontaneum
- 4 LA cultivars

PERCENT REDUCTION

	Shoot number		Height	
Effect	F-ratio	P-value	F-ratio	P-Value
Clone	1.68	0.0032	1.78	0.0012
Year	4.60	0.0985	2.85	0.1167
Clone x Year	1.06	0.3802	1.06	0.4049

IDENTIFIED CLONES

Germination

- Best Wild Relatives
- MPTH 97-213
 - SES 234A

Height

- Best Wild Relatives
 - SES114
 - Guangxi87-22
 - SES234A















CONCLUDING REMARKS

- Variety development is a slow process
- The pipeline is already established
- Wild relatives are continuously being utilized in the Louisiana program
- The breeders are always exploring new ways to hasten variety development that lead to the best varieties for the industry.
