Nitrogen Management in Sugarcane and Cotton in Louisiana

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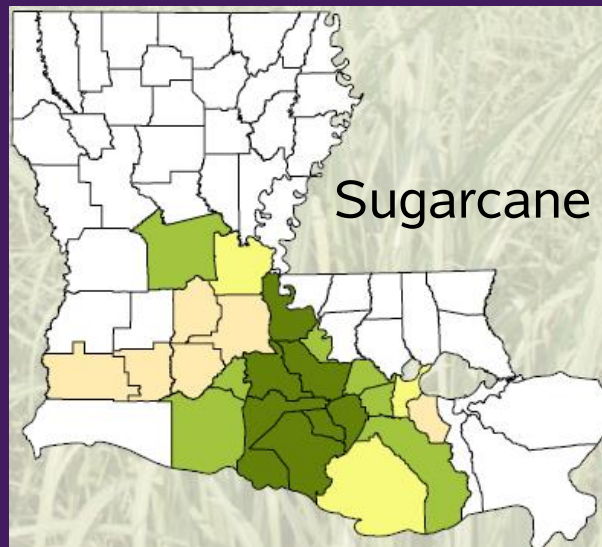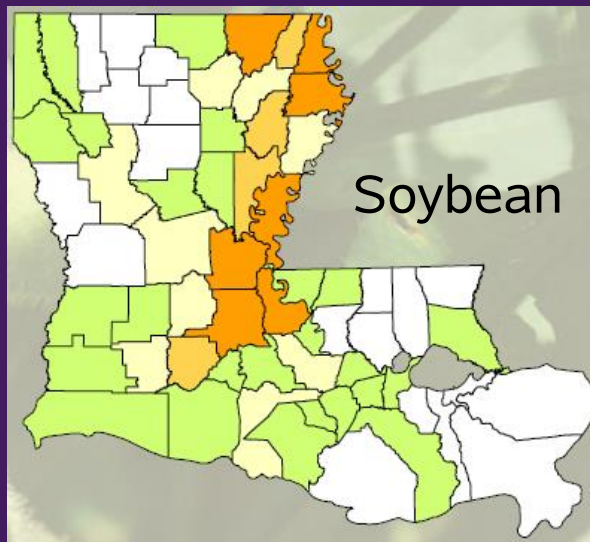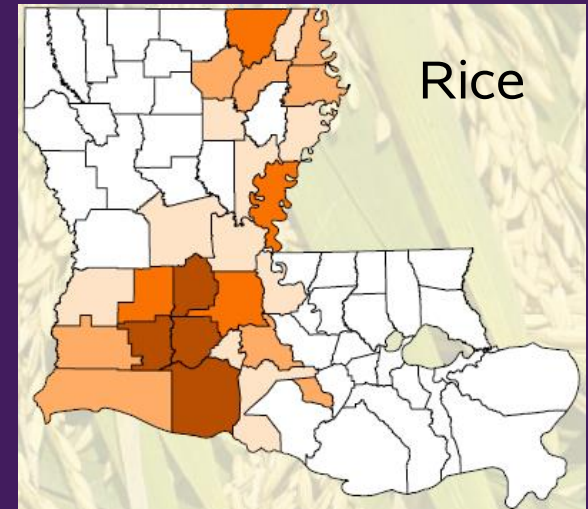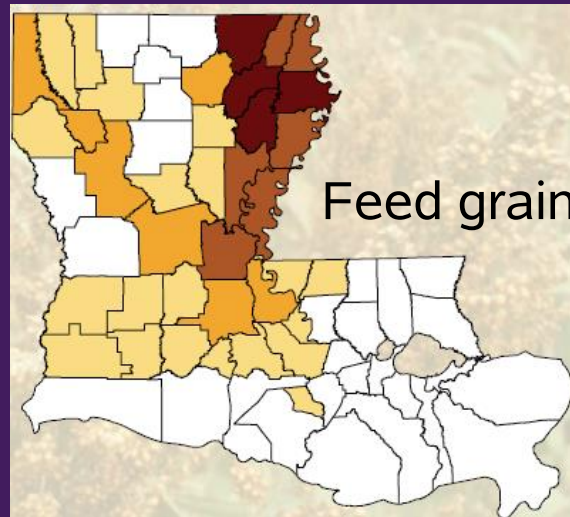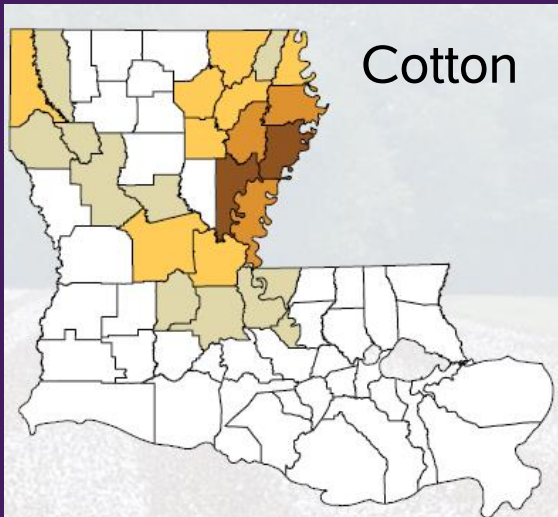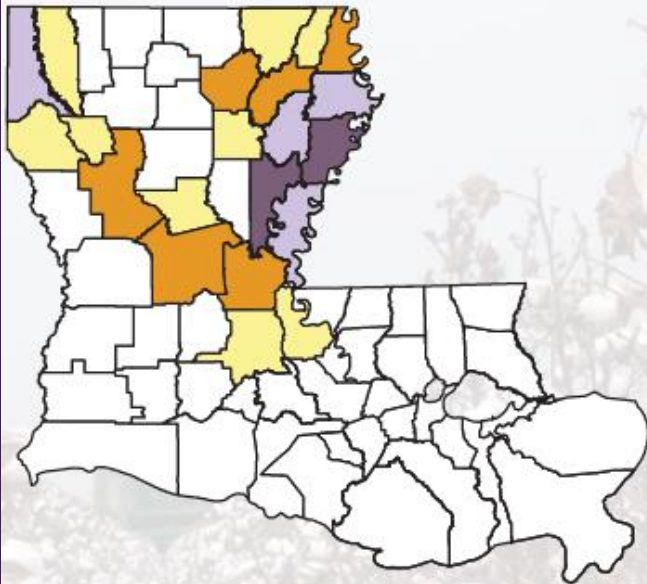Louisiana State University AgCenter

Content

- Nitrogen Fertilizer Management

- Sensor-Based N Recommendation (History)

- Results On-Farm Trials

Acreage of Major Crops Grown in Louisiana

Cotton

Feed grain

Rice

Soybean

Sugarcane

Sugarcane and Cotton

Total value of Louisiana cotton production during 2014: $198 million

Cotton Gross Farm Value ($)
- None
- Under 3,000,000
- 3,000,001 - 10,000,000
- 10,000,001 - 20,000,000
- 20,000,001 - 40,870,562
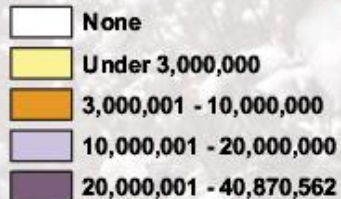
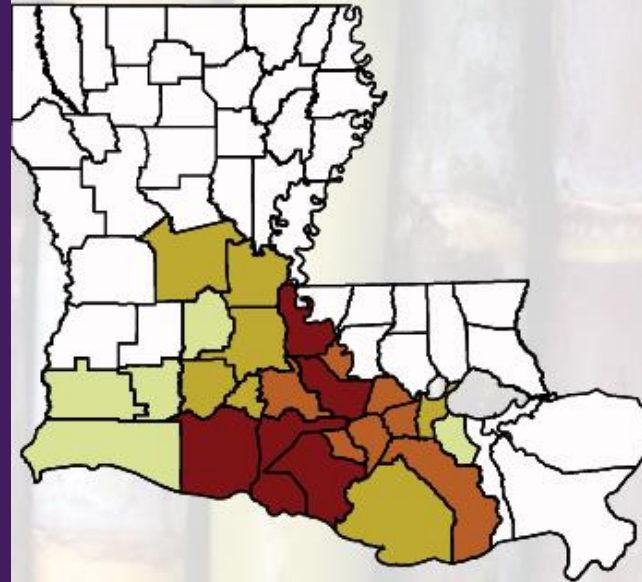164,000 acres in production

Total value of Louisiana sugarcane production in 2014: $747 million

Sugarcane Gross Farm Value ($)
- None
- Under 2,500,000
- 2,500,001 - 15,000,000
- 15,000,001 - 35,000,000
- 35,000,001 - 60,974,910

412,000 acres in production

Soil We Cultivate
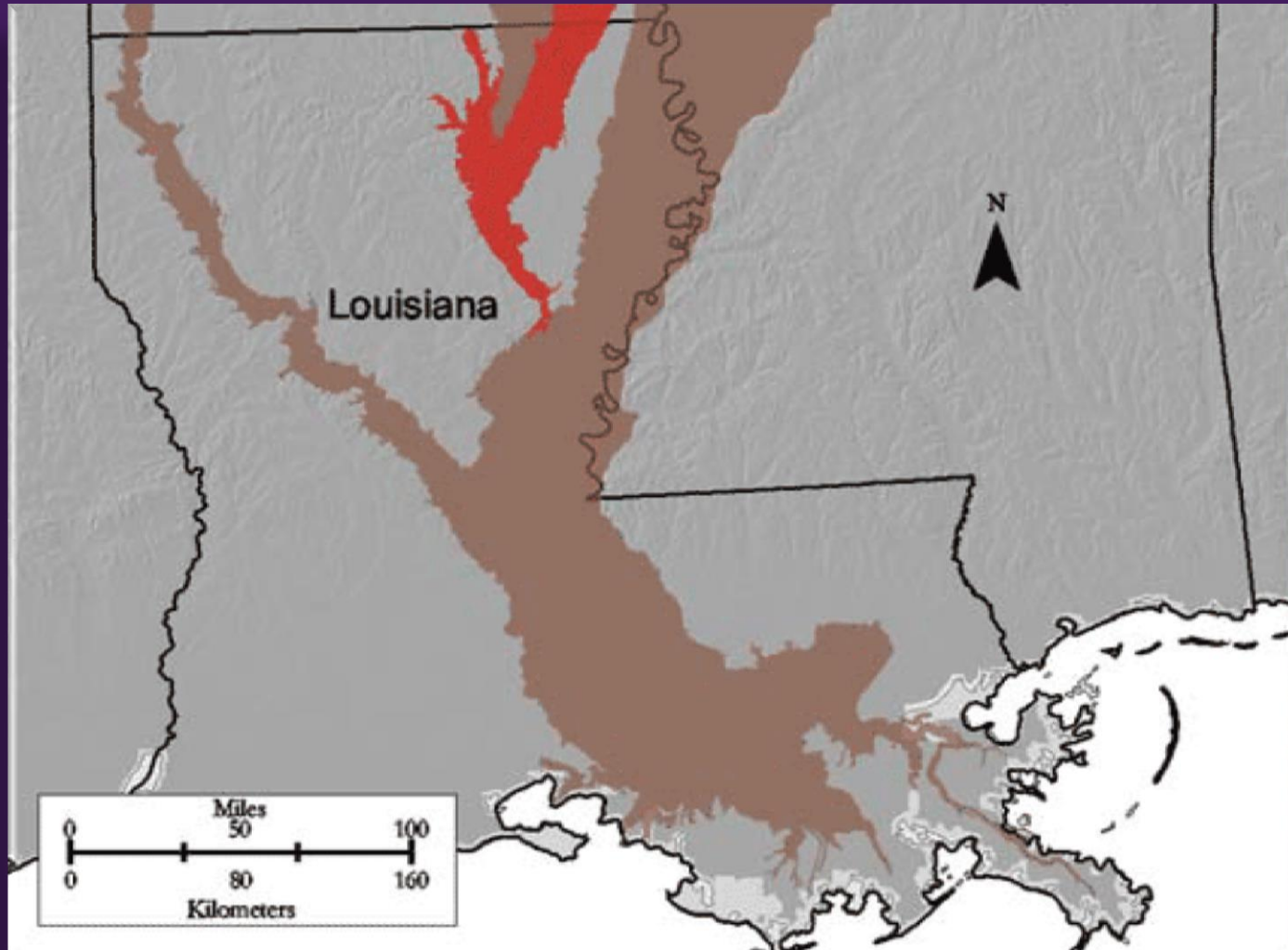
Sandy soil

Clay

LSU AgCenter
Sugar Research Station

Mississippi River

Unpredictable N demand
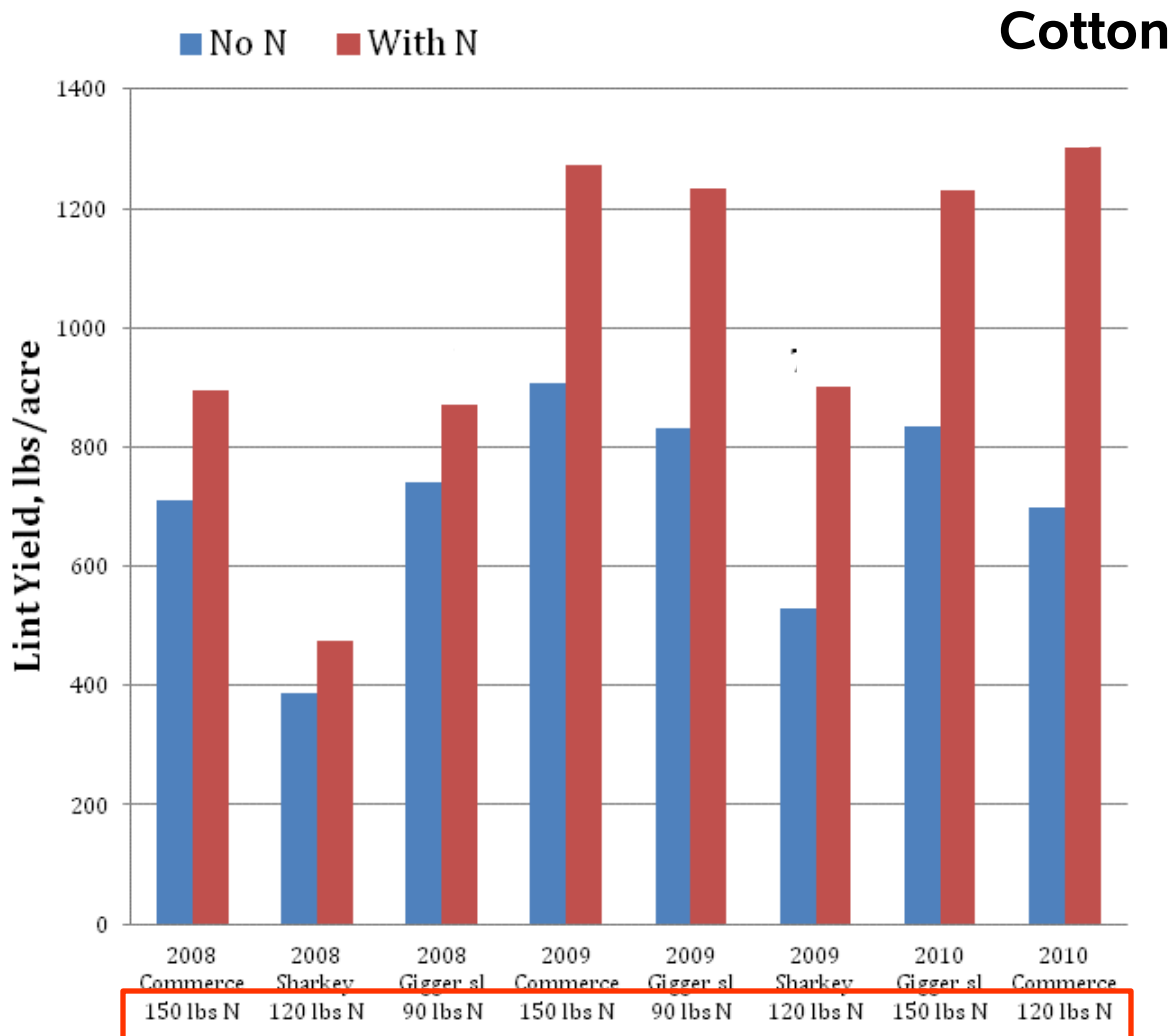
Cotton

Varying Magnitude of Response

Sugarcane chart showing Cane tonnage, ton/ac for 0 N and 80 lbs N/ac treatments across St. Gabriel (Plant Cane 2007, 1st Stubble 2008, 2nd Stubble 2009; Plant Cane 2010, 1st Stubble 2011, 2nd Stubble 2012) and Iberia (Plant Cane 2010, 1st Stubble 2011, 2nd Stubble 2012). Response values labeled: 0, 7, 14, 4, 8, 13, 3, 0, 14.
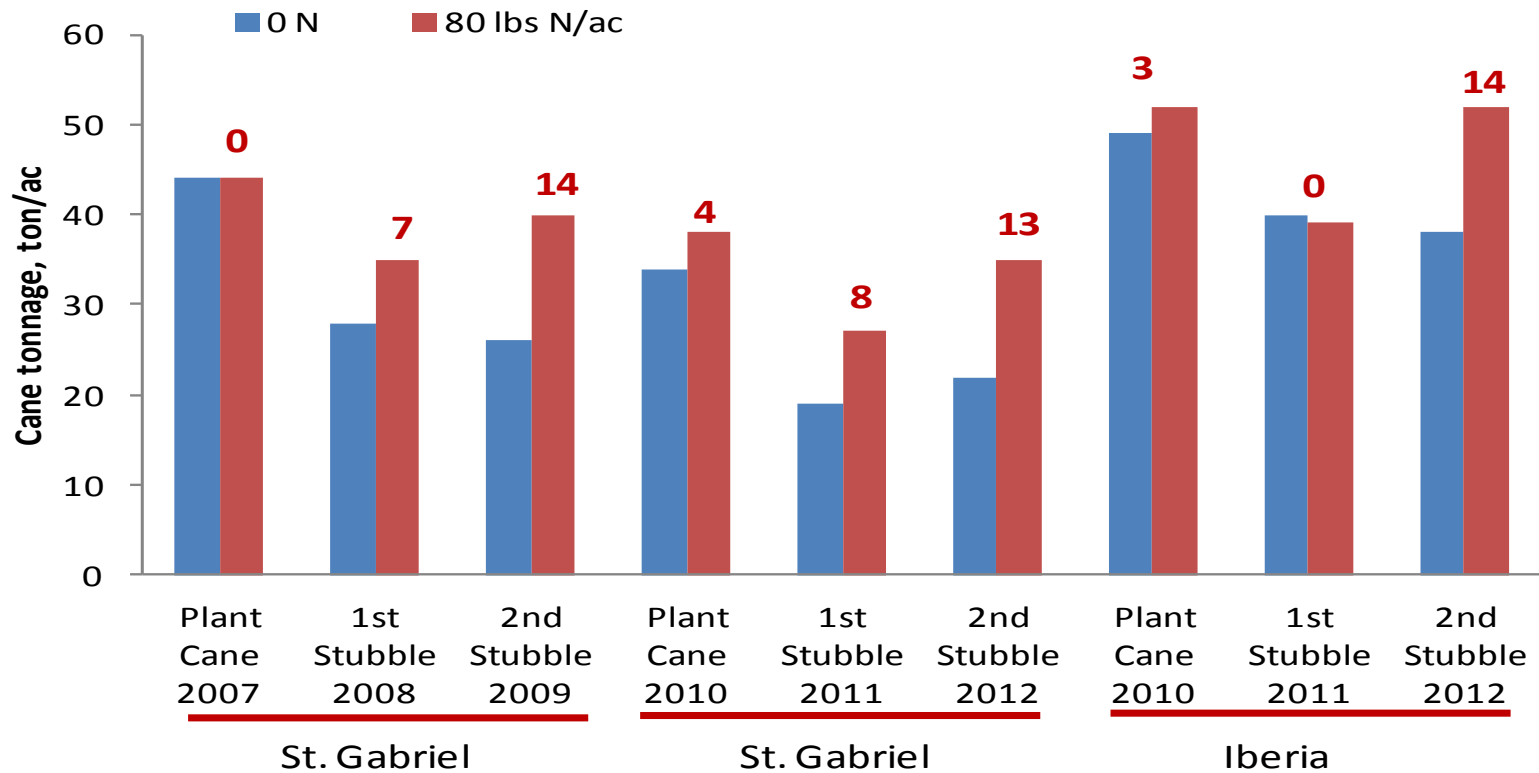
Nitrogen Fertilizer Management

- Cotton

  75 to 150 lbs N/ac, one time application

Nitrogen Fertilizer Management

- Utilize N recommendation based on N response trials

Crop Age	Texture	N Rate, lbs/ac
Plant Cane	Light soils	60-80
	Heavy soils	80-100
Stubble cane	Light soils	80-100
	Heavy soils	100-120

- These recommendations assume a proper soil pH and an application date of April 1-30.

Sugarcane

Survey Results

Survey Results

- Nitrogen is a major concern in sugarcane production (71%)
- 29% own variable rate applicator
- 50% own GPS unit
- 21% showed interest on remote sensing technology
- 67% are interested to use VRT

Survey Results

- Profitability and cost of investment – strong driving force

- Results in 5 tons/acre increase in cane yield or 1000 lbs/acre increase in sugar yield - potentially assure adoption of new production technology

N Fertilization – April (Year 2, 3, and 4)

Harvesting - Dec (Year 2 – plant cane)
- Nov (Year 3 – 1st ratoon)
- Oct (Year 4 – 2nd ratoon)

Components of Algorithm

Sensor-Based N Recommendation
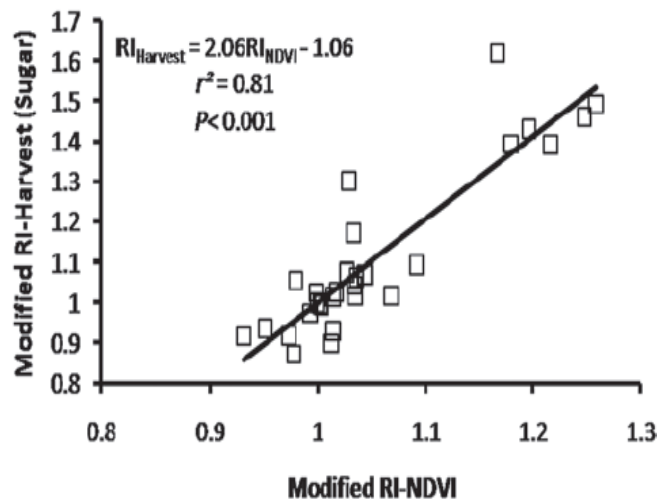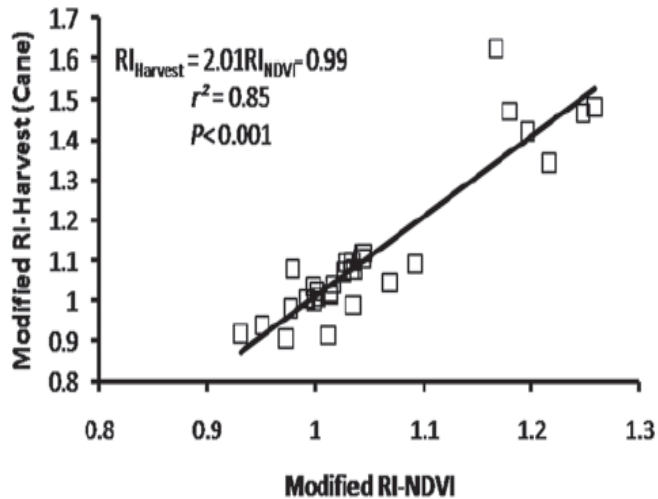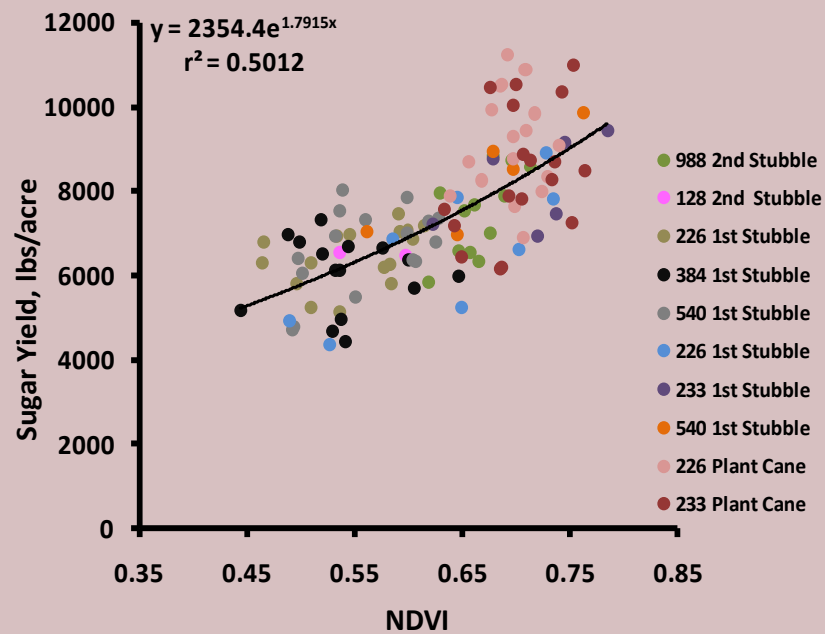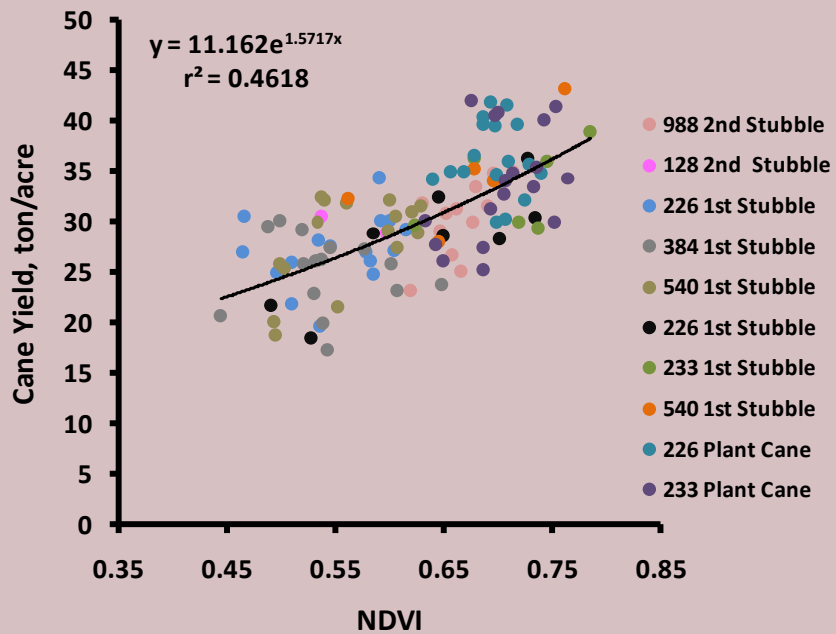
On-Farm Trials

- Established at 3 locations
- Replications: 3
- Plot size:
  - Sugar Research Station - 9000 ft^2
  - Gravois Farm – 33,000 ft^2
  - Dugas Farm – 12,000 ft^2

On-Farm Demonstration – N Management Practices

	T1R1 101	T2R1 102	T3R1 103	T1R2 201	T2R2 202	T3R2 203	T1R3 301	T2R3 302	T3R3 303	
N-RICH STRIP										N-RICH STRIP

Trt No	Rate
1	Farmer's Standard Practice
2	Based Cane N Removal Rate
3	Sensor Based N Rec

Sugar Research Station (3 rows x 500 ft)

Gravois Farm (5 rows x 1100 ft)

Dugas Farm (5 rows x 400 ft)
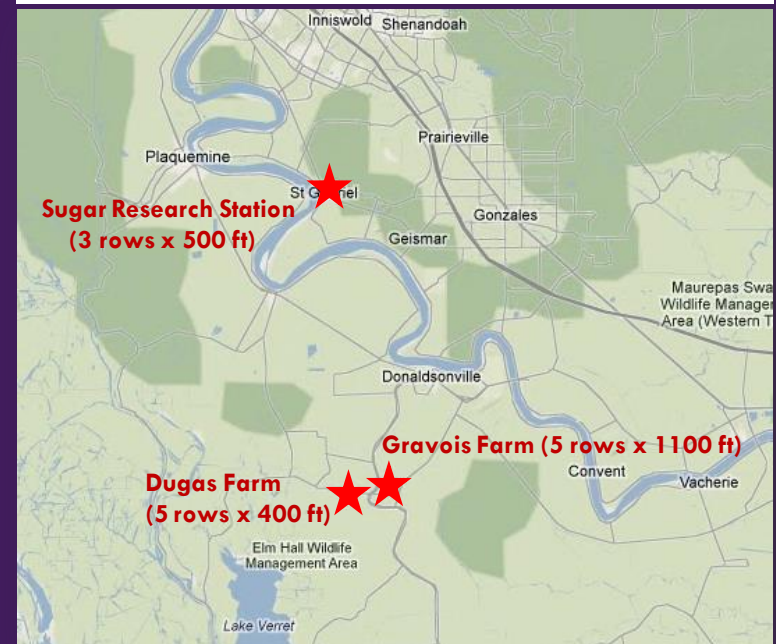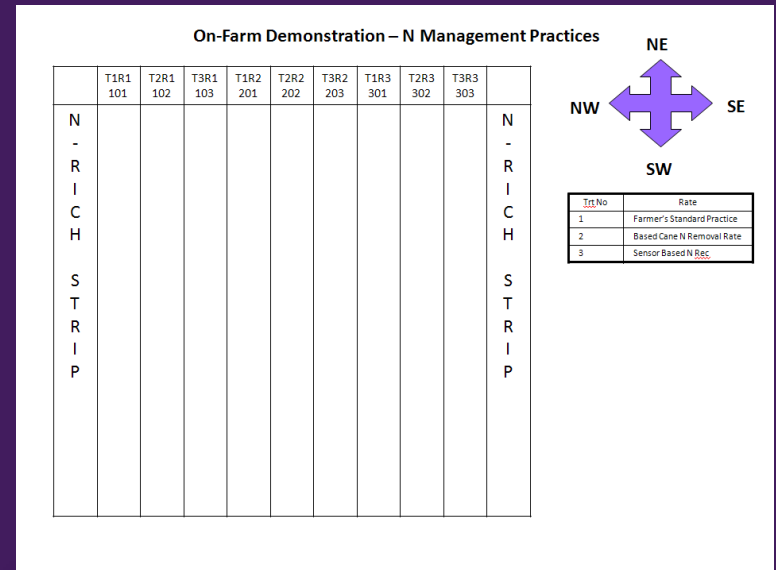
Farmer's Standard Practice

Crop Age	Texture	N Rate, lbs/ac
Plant Cane	Light soils	60-80
	Heavy soils	80-100
Ratoon cane	Light soils	80-100
	Heavy soils	100-120

Optical sensor/VRT

Estimated yield potential using SENSOR READINGS

N Rate = Yield   x N response index

N-Rich strip
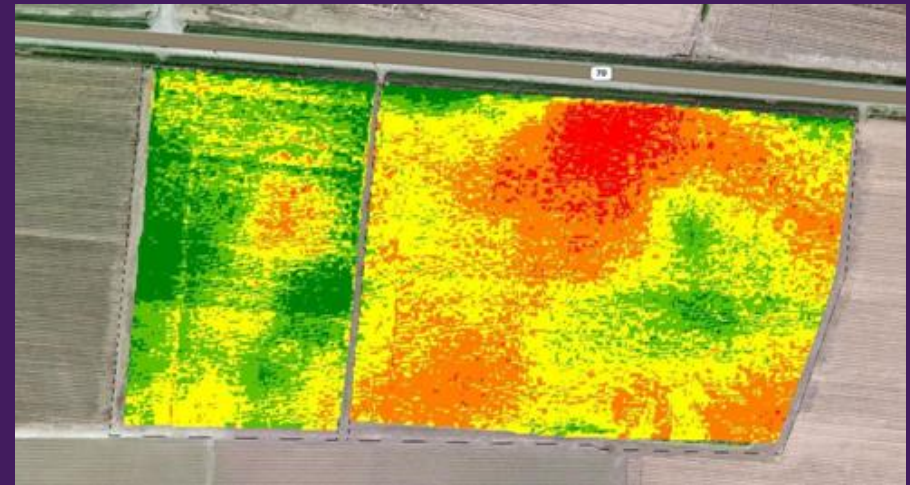
N-Rich Strip

2015 Optical Sensing/VRT
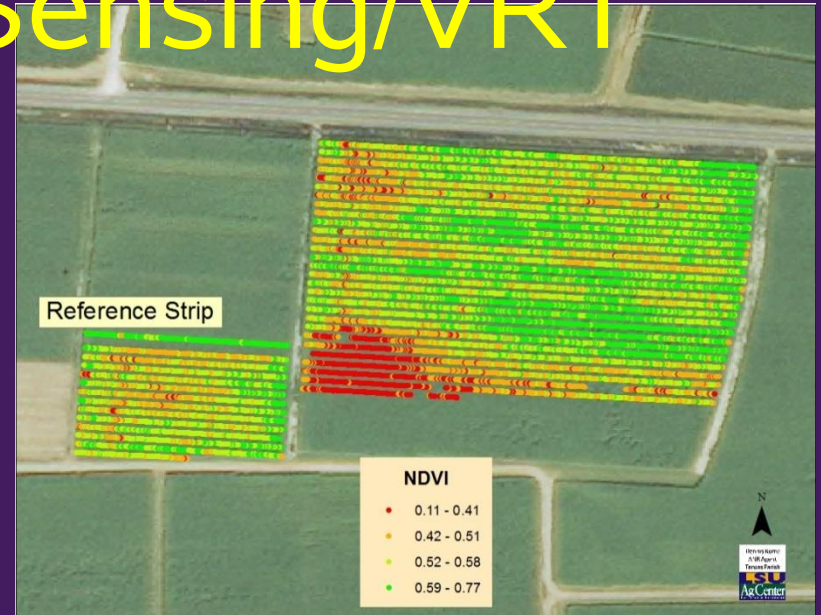
Average N applied : 73 lbs/ac
438/22,008 recommended >120 lbs/ac
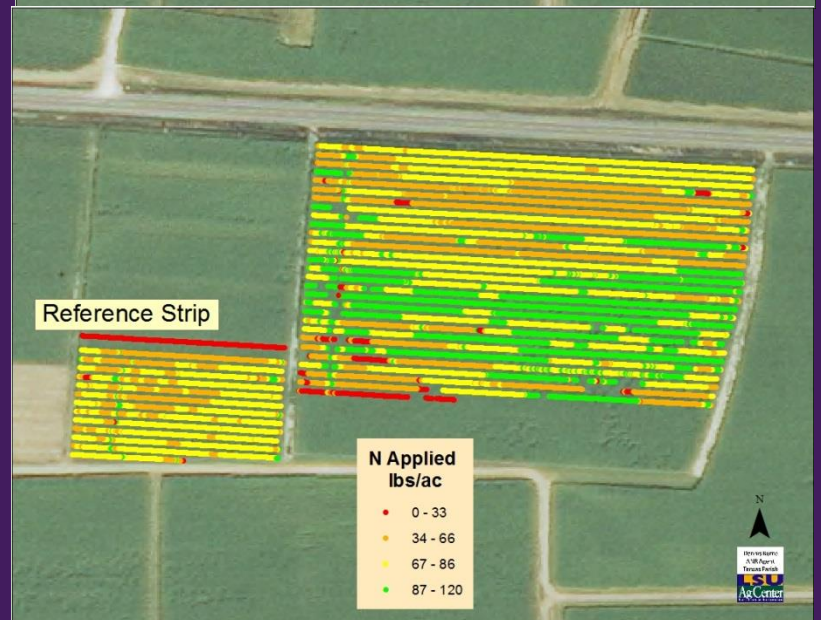
Nitrogen rate, sugar yield and net return of sugarcane under different N recommendation approach

- 2013 -

Site	N Approach	N Applied lbs/ac	Sugar Yield lbs/ac	Income: Sugar yield		Saving: N fertilizer		Net
				lbs/ac	$/ac	lbs/ac	$/ac	$/ac
Dugas	Current/Farmer's	100	8420					
	Sensor-Based	110	8749	329	66	10	-6	60
Gravois	Current/Farmer's	110	7899					
	Sensor-Based	90	8170	272	54	-20	12	66
SRS	Current/Farmer's	100	9632					
	Sensor-Based	70	9793	161	32	-30	18	50

- 2014 -

Site	N Approach	N Applied lbs/ac	Sugar Yield lbs/ac	Income: Sugar yield		Saving: N fertilizer		Net
				lbs/ac	$/ac	lbs/ac	$/ac	$/ac
Dugas	Current/Farmer's	120	6151					
	Sensor-Based	93	5851	-300	-63	-27	16	-47
Gravois	Current/Farmer's	120	8668					
	Sensor-Based	40	9502	834	175	-80	48	223
SRS	Current/Farmer's	120	8847					
	Sensor-Based	40	8165	-682	-143	-80	48	-95

SRS – LSU AgCenter Sugar Research Station; Raw sugar price - $0.21/lb; Price of N fertilizer - $0.60/lb; Current/Farmer's Standard Practice – reference to compute for economic return.

Farm Operational Setting

NDVI - UAV
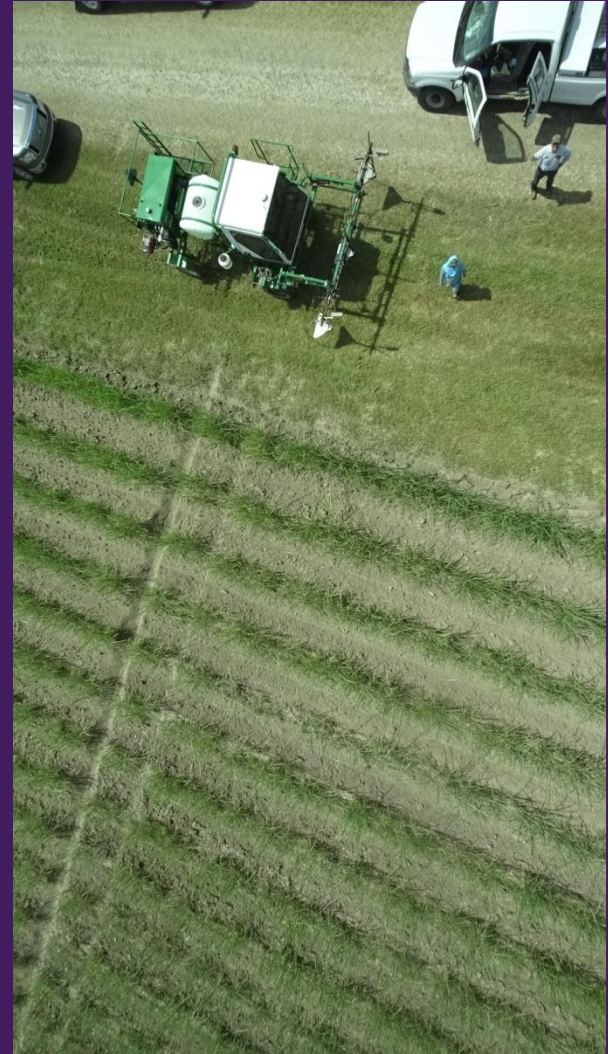
NDVI-UAV

Cotton

Tensas Parish

Soil Types
Silt Loams
Silty Clay
Loams
Sharkey Clays
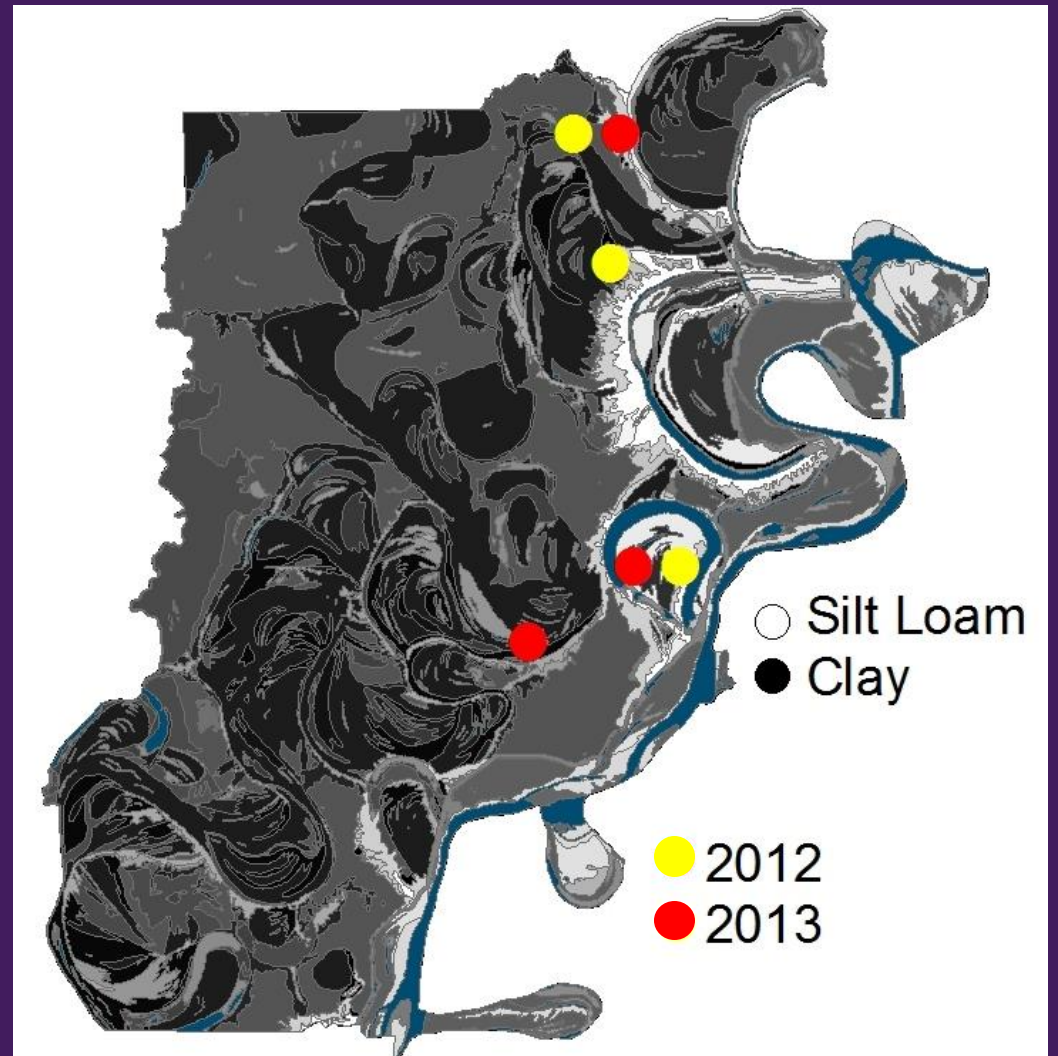
Model for Lint Yield Potential Prediction

Response Index

Two Weeks After Early Bloom

○ 2008 St. Joseph - sl
▲ 2008 St. Joseph - clay
○ 2008 Winnsboro - sl

$RI_{(lint\ yield)} = 5.129*(RI\ NDVI) - 4.0811$

$r^2 = 0.4116$

Response Index (lint yield)

Response Index (NDVI)

2008

Two Weeks After Early Bloom

○ 2008 St. Joseph - sl
▲ 2008 St. Joseph - clay
○ 2008 Winnsboro - sl
▩ 2009 St. Joseph - sl
◇ 2009 Winnsboro - sl

$RI_{(lint\ yield)} = 4.0336*(RI - NDVI) - 2.9376$

$r^2 = 0.3778$

Response Index (lint yield)

Response Index (NDVI)

2009

Sensor-Based N Recommendation

Sensor Based N Rate Calculator, Cotton

DATA ENTRY	
Max yield, lbs/ac	4000
Planting Date	12-Apr-10
Sensing Date	14-Jun-10
NDVI, N Rich Strip	0.8845
NDVI, Farmer practice	0.858
NUE expected	0.6

RESULTS	
Response Index	1.28
Days, planting to sensing	62
Potential yield (0-N), lbs/ac	4000
Potential yield (+ N), lbs/ac	5131
Fertilizer N, lb N/ac	**0**

Note:

NRS (Nitrogen Rich Strip) - plots receiving non limiting amount of N fertilizer applied at preplant

FP (Farmer Practice)- plots receiving modest amount of N applied at preplant

NDVI (normalized difference vegetative index)

Max yield - average yield x 2

PROCEDURE:

1. Farmer is asked to Establish the Maximum Yield Achievable, For that Year (YPMAX)
2. Sense the N Rich Strip (NRS)
3. Sense a strip parallel to the NRS (Farmer Practice or FP)
4. Determine how many days from planting to sensing
5. Compute INSEY (NDVI/days from planting to sensing)
6. Predict yield
7. Predict seed cotton N uptake in FP
8. Predict seed cotton N uptake in FP based on RI
9. N rate = (seed cotton N uptake in FP based on RI - seed cotton N uptake in FP)/expected NUE

Contributors: Brenda Tubana, Donald Boquet, and Ernie Clawson

Variable N Rate Applicator
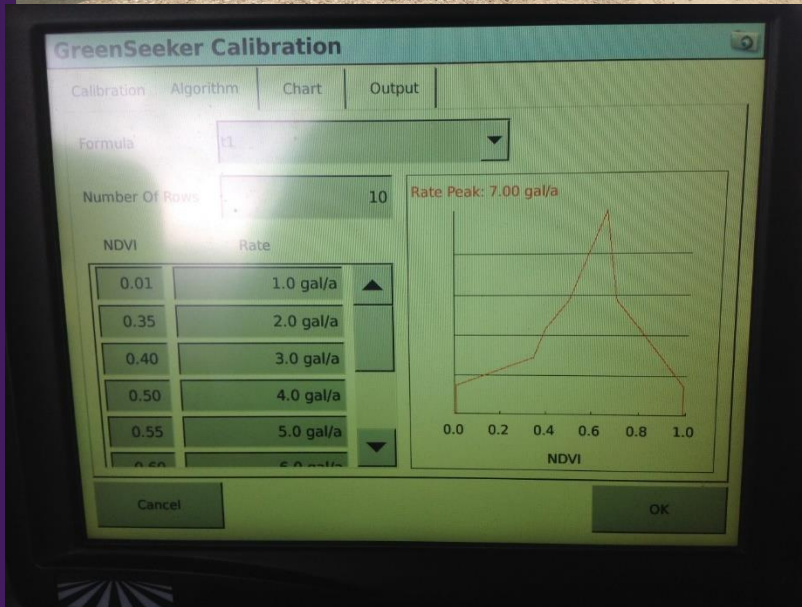
Demonstration Plots (Cotton)
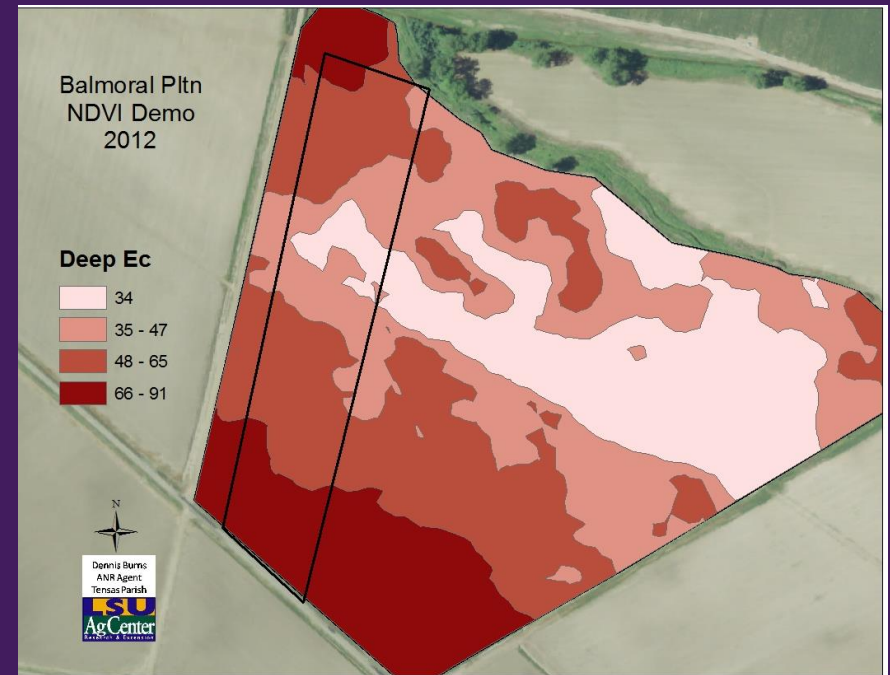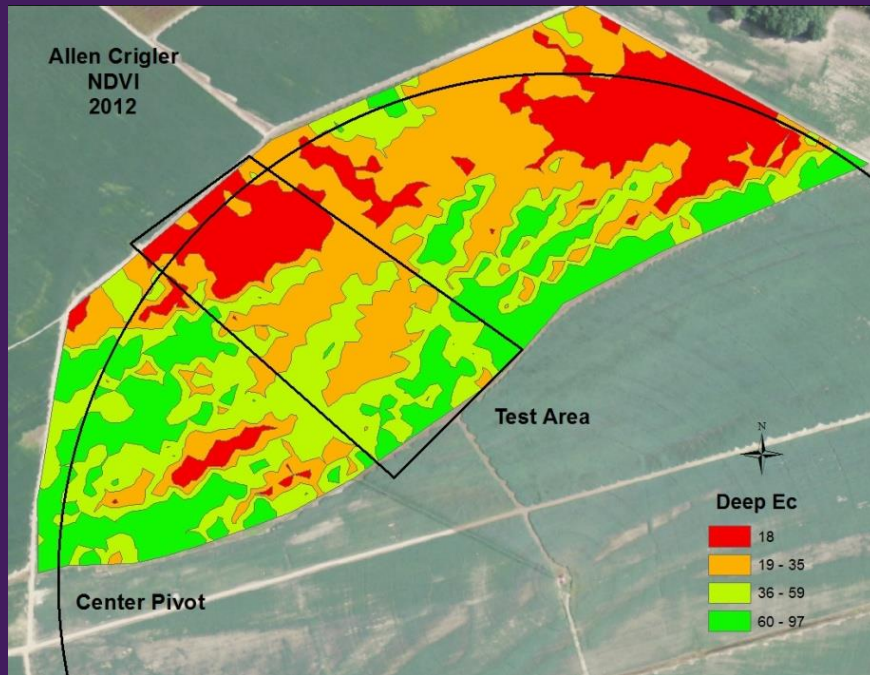
- Established at 3 locations
- Replications: 3
- Plot size: 12 rows (40 inches row) x 1000 ft

Crigler's Field

2012		Lint Yield lbs/ac	from FS	Nitrogen Application, lbs/ac				from FS	Net $/ac
				Pre	Mid	Adj.	Total		
	FS	1078	----	98	0	0	98	----	----
	GS	1072	-6	52	20	0	72	-26	13.22

2013		Lint Yield lbs/ac	from FS	Nitrogen Application, lbs/ac				from FS	Net $/ac
				Pre	Mid	Adj.	Total		
	FS	1772	----	100	0	0	100	----	----
	GS	1802	30	50	38	0	88	--12	29.04

2014		Lint Yield lbs/ac	from FS	Nitrogen Application, lbs/ac				from FS	Net $/ac
				Pre	Mid	Adj.	Total		
	FS	1579	----	100	0	0	100	----	----
	GS	1582	3	50	51	0	101	-1	2.82

Balmoral

2012		Lint Yield lbs/ac	from FS	Nitrogen Application, lbs/ac				from FS	Net $/ac
				Pre	Mid	Adj.	Total		
	FS	1576	----	130	0	0	130	----	----
	GS	1543	-24	65	23	0	88	-42	11.34

2013		Lint Yield lbs/ac	from FS	Nitrogen Application, lbs/ac				from FS	Net $/ac
				Pre	Mid	Adj.	Total		
	FS	1653	-----	130	0	0	130	-----	
	GS	1636	-17	65	60	0	125	-5	-8.46

2014		Lint Yield lbs/ac	from FS	Nitrogen Application, lbs/ac				from FS	Net $/ac
				Pre	Mid	Adj.	Total		
	FS	1336	----	130	0	0	130	----	----
	GS	1344	8	65	26	0	91	-39	31.73

Hardwick

	Lint Yield lbs/ac	from FS	Nitrogen Application, lbs/ac				from FS	Net $/ac
			Pre	Mid	Adj.	Total		
2013 FS	1117	----	75	0	0	75	----	----
GS	1242	125	75	72	0	147	72	39.26

Deep Core Soil Sampling

Preplant
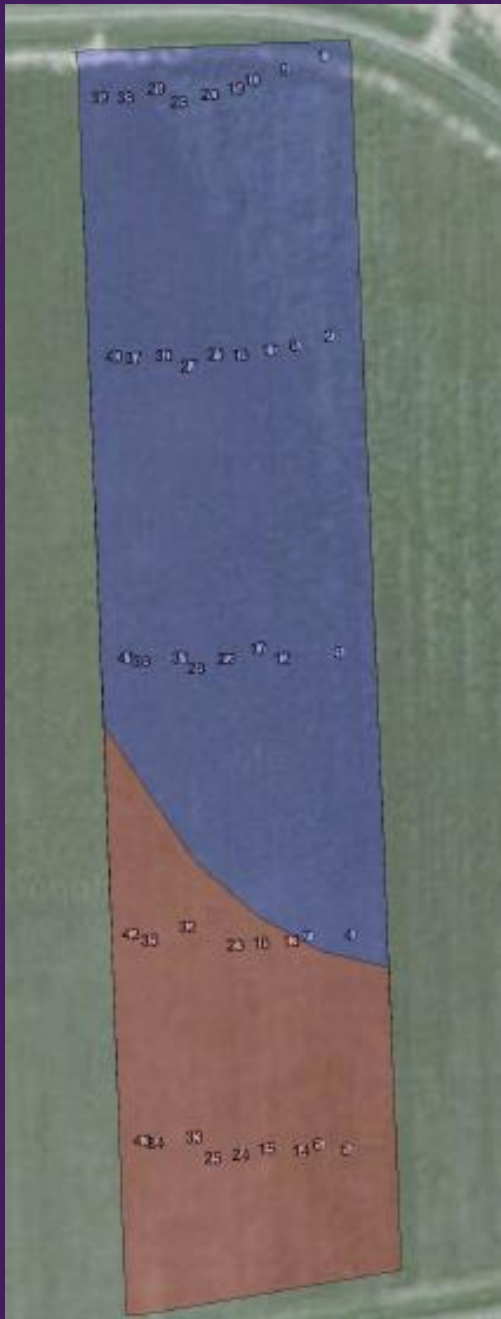
Lbs N (inorganic N)/ac 0-6 in

	33	50	21	66	18	62	22	24
30	21	60	51	46	18	23	35	30
20	37	62	24	22	19	59	22	12
25	45	66	51	64	21	42	28	12
35	29	8	23	38	43	32	60	30

Lbs N (inorganic N)/ac 6-12 in

38	30	28	21	32	23	21	16	20
50	27	19	25	30	20	28	18	18
51	26	26	25	40	32	25	21	19
27	25	25	17	39	18	35	22	9
40	24	14	26	33	22	52	26	16

Lbs N (inorganic N)/ac 12-18 in

47	34	26	16	26	18	20	14	25
27	27	17	14	27	19	28	17	24
26	18	32	24	20		19	19	25
28	23	18	19	23	15	19	18	12
23	24	22	20	17	22	22	27	20

Lbs N (inorganic N)/ac 18-24 in

21	31	16	20	30	16	30	17	21
28	16	27	19	17	24	25	17	16
25	17	19	19	18	27	35	14	11
30	17	28	18	19	13	16	15	19
16	16	9	18	14	23	26	15	16

Lbs N (inorganic N)/ac 0-6 in

43	28	32	53	27	29	55	32	23
49	13	31	42	57	55	38	23	46
35	37	39	56	32	24	33	39	34
43	37	28	47	43	17	38	55	39
30	32	23	35	44	19	20	32	40

Lbs N (inorganic N)/ac 6-12 in

18	19	14	19	11	9	18	16	18
18	12	11	26	17	2	19	16	24
18	18	12	22	12	9	13	16	23
17	20	9	14	13	14	13	12	24
17	15	18	15	13	13	26	24	24

Lbs N (inorganic N)/ac 12-18 in

14	10	10	17	7	10	10	11	14
11	11	8	16	11	14	13	11	20
12	15	8	18	9	7	11	12	13
12	20	6	10	8	11	11	16	21
12	12	9	13	12	9	24	14	17

Lbs N (inorganic N)/ac 18-24 in

11	7	7	16	8	6	8	10	14
10	11	6	14	6	5	12	11	12
9	12	8	16	8	7	13	13	11
9	15	6	6	8	5	10	15	33
11	14	7	10	9	7	16	17	16

Summary

- VRT/GreenSeeker - Increase in net return (savings on N fertilizer)
- NDVI maps (acquired by high precision images – UAV) – optional farm operational setting
- Extension and research work continues

Acknowledgements

- American Sugar Cane League
- USDA-AFRI
- USDA-NRCS-CIG
- Graduate Students
- Producers
- Research Station Staff
- Dennis Burns
- Ralph Frazier

Questions