Hay Quality as Related to Storage and Precision Nitrogen

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CLEMSON PRECISION AGRICULTURE CLEMSON COOPERATIVE EXTENSION

1. STORAGE COSTS/SAVINGS
2. NITROGEN MGT. IN GRASS HAY
3. AERIAL IMAGERY FOR N MGT?
4. CONCLUSIONS

CLEMSON PRECISION AGRICULTURE CLEMSON COOPERATIVE EXTENSION

Assume this is a 5x4 hay bale (WxD)

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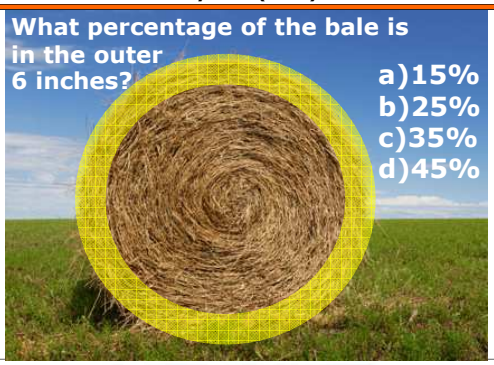

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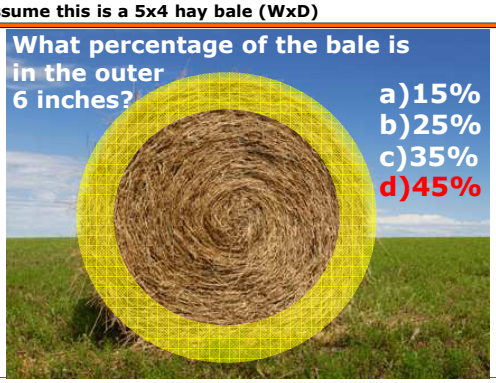

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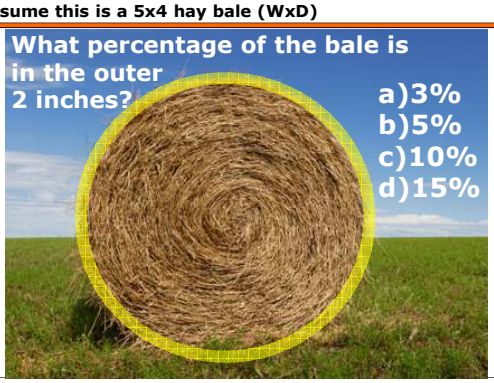


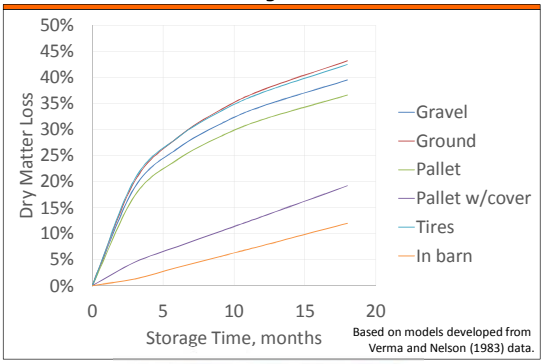
CLEMSON PRECISION AGRICULTURE CLEMSON COOPERATIVE EXTENSION

Assume this is a 5x4 hay bale (WxD)

Bale DW loss from weathering

Bale Diameter	Weathered Layer Depth, inches 2	4	6	8
	------% of Bale in Outer Layer------			
4 ft	16.0%	30.6%	43.8%	55.6%
5 ft	12.9%	24.9%	36.0%	46.2%
6 ft	10.8%	21.0%	30.6%	39.5%

Losses as a function of storage conditions



Based on models developed from Verma and Nelson (1983) data.

From Collins et al. (1997)

Investment Cost for Different Storage Options

Storage System	System cost per sq ft	System Cost per 100 bales	System Life Yrs	Storage $/bale
Conventional Shed	3.50	3948.5	20	$5.14
Pole shed with plastic roof on pad	1.20	1866.5	20	$3.21
	0.12	186.5	4	
Reusable tarp on pad	0.73	880	4	$2.91
Bale sleeve on ground	0.15	300	1	$3.18
Plastic wrap on ground	0.29	550	1	$5.78
Elevated stack on pad	0.40	933.5	20	$0.95
Net wrap on ground	0.08	150	1	$1.58
Twine on ground	0.04	75	1	$0.79

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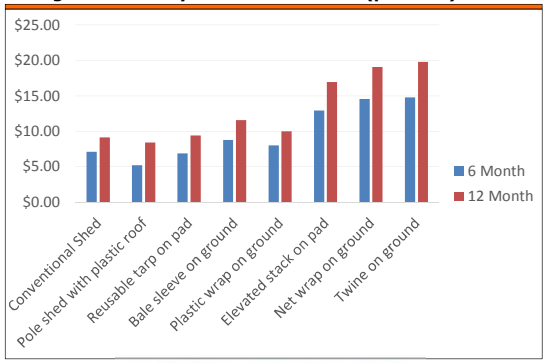
From Collins et al. (1997); Verma and Nelson (1983)

Investment Cost for Different Storage Options

Storage System	6 Month DM Loss	6 Month Value Loss per Bale	6 Month Value Loss + Storage Cost	12 Month DM Loss	12 Month Value Loss per Bale	12 Month Value Loss + Storage Cost
Conventional Shed	4%	$2.00	$7.14	8%	$4.00	$9.14
Pole shed with plastic roof on pad	4%	$2.00	$5.21	8%	$4.00	$8.42
Reusable tarp on pad	8%	$4.00	$6.91	13%	$6.50	$9.41
Bale sleeve on ground	11%	$5.60	$8.78	17%	$8.40	$11.58
Plastic wrap on ground	4%	$2.23	$8.01	8%	$4.22	$9.99
Elevated stack on pad	24%	$12.00	$12.95	32%	$16.00	$16.95
Net wrap on ground	26%	$13.00	$14.58	35%	$17.50	$19.08
Twine on ground	28%	$14.00	$14.79	38%	$19.00	$19.79

From Collins et al. (1997); Verma and Nelson (1983)

Storage Costs + Dry Matter Loss Costs (per bale)



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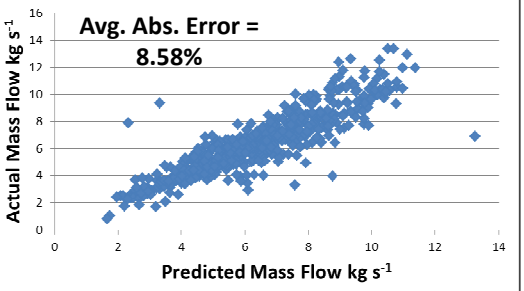
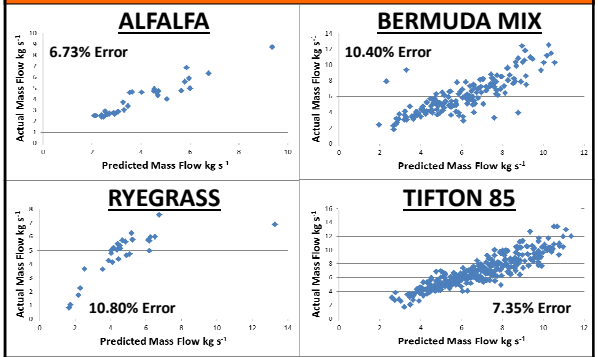
Clemson hay yield monitor operation (Patent Pending)

- Tongue/throat mounted sensors measure windrow height on-the-go
- Windrow height multiplied by distance traveled to calculate windrow volume
- Windrow volume correlated to mass flow feeding into the baler

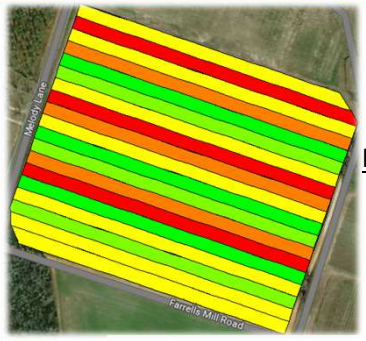
Hay YM Accuracy: 2016 All Bales



Accuracy by Grass/Forage Type



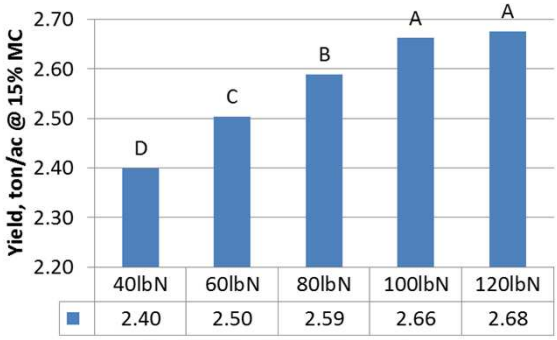
Nitrogen Strip Test Design – Tifton 85 Bermudagrass



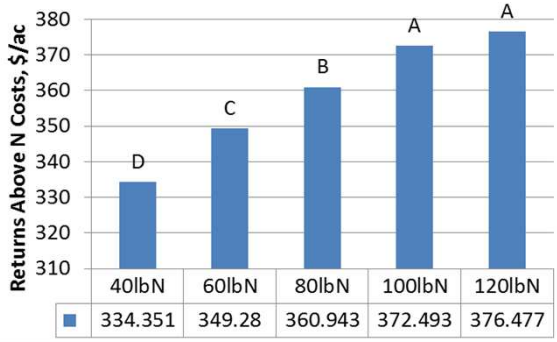
Harvest dates in test

- 2016
  - Cut 3: August 17th
  - Cut 4: October 3rd
- 2017
  - Cut 1: May 28th
  - Cut 2: July 14th
  - Cut 3: September 5th

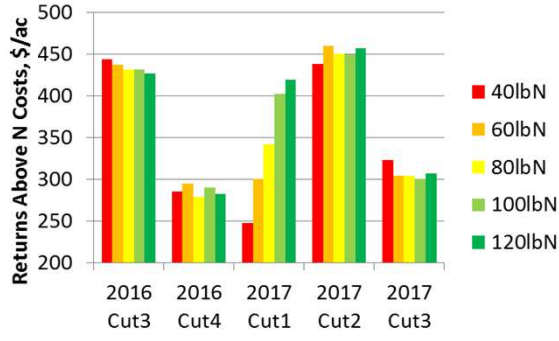
Yield Response to Nitrogen Across all Cuttings



Profit Response to Nitrogen Across all Cuttings



Profit Response to Nitrogen By Cutting



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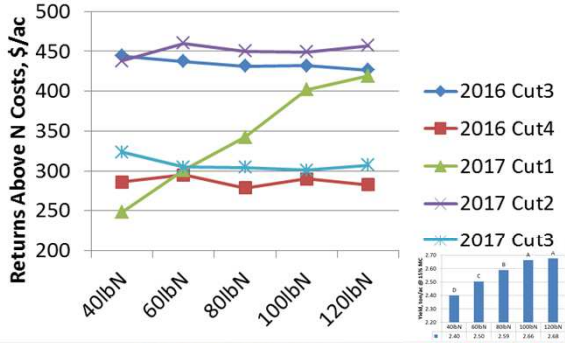
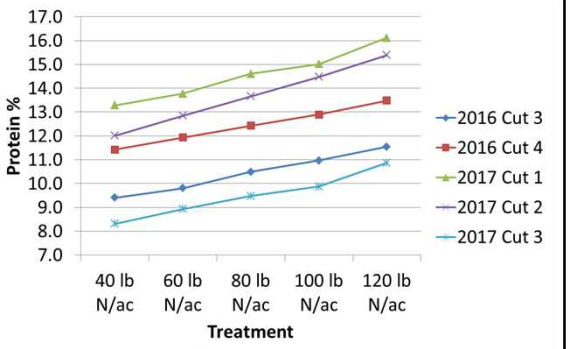


Mean Crude Protein Content for each Cutting by N-Rate



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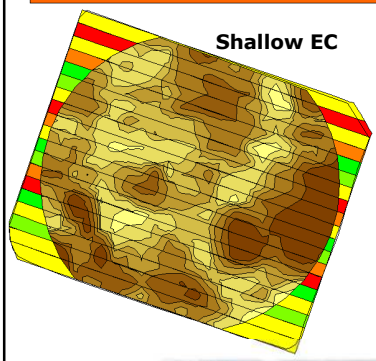
Clemson's Directed Prescriptions (D-Rx) System



Uniform Rate Nitrogen Strips

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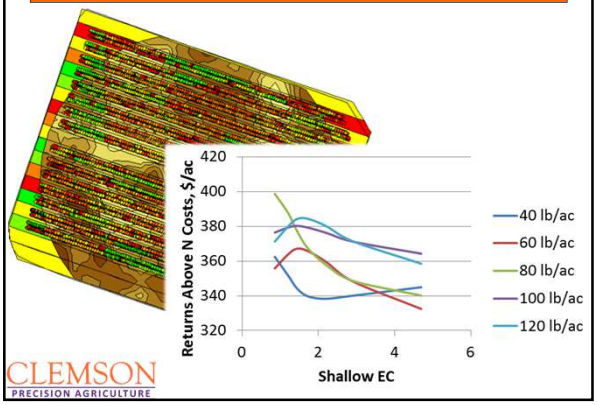

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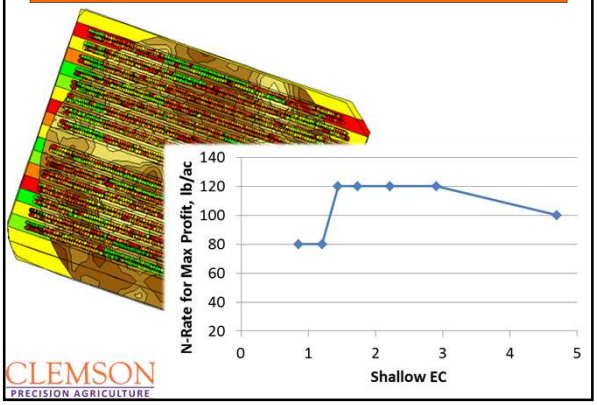

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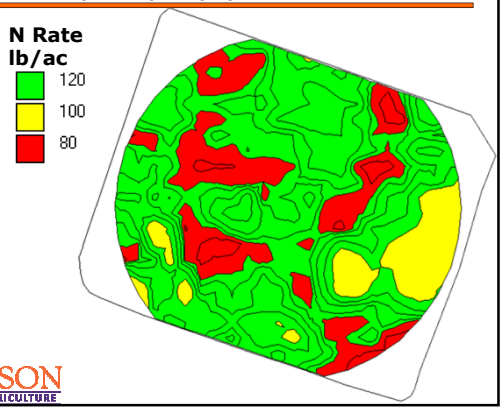

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N Rate for Max Profit as vs. Shallow EC by Cutting

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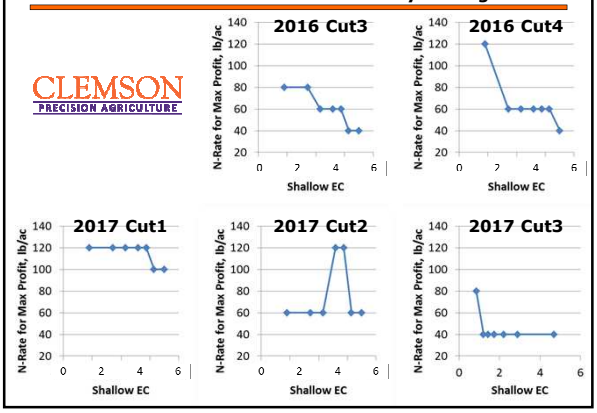
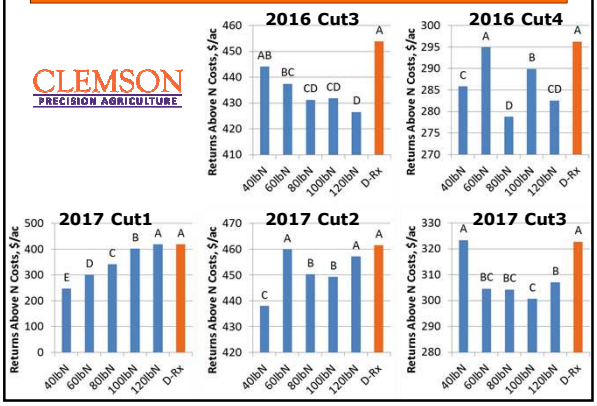
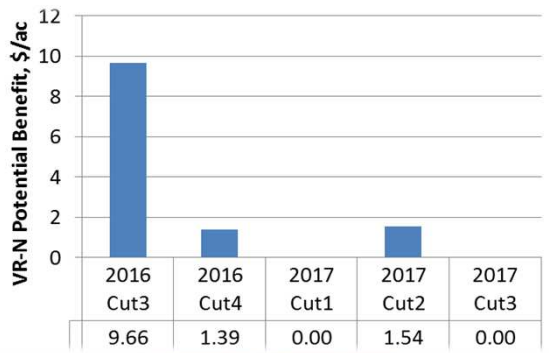


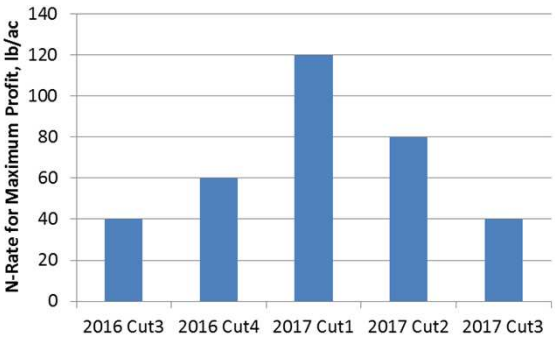
Profit Comparisons: Uniform N Rates and D-Rx by Cutting



Variable Rate N Potential Benefit, $/ac (By Cutting)



Uniform N Rate for Maximum Profit, lb/ac (By Cutting)



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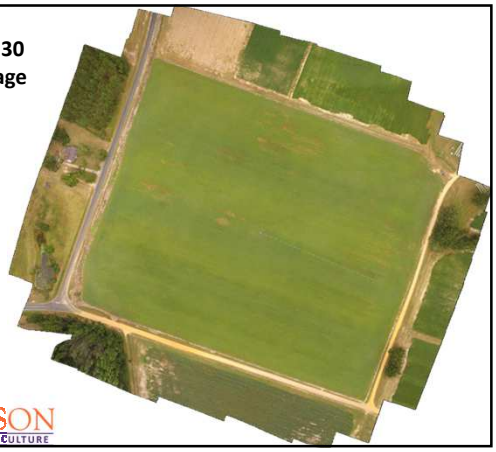
3. **AERIAL IMAGERY FOR N MGT?**
4. CONCLUSIONS

Potential for use of UAVs in Hay and Forage

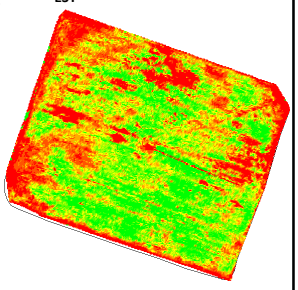
- Harvest timing
- Protein/yield assessment
- Weed location/identification
- Input prescription
- Problem identification

Tifton 85
2017 Aug 30
Aerial Image



Tifton 85
2017 Aug 30
Aerial Image

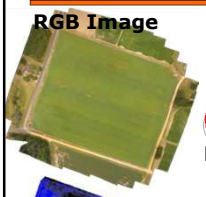
Tifton 85
2017 Aug 30
$NDVI_{EST}$ from Aerial



CLEMSON PRECISION AGRICULTURE CLEMSON COOPERATIVE EXTENSION

All image data layers exported by SID©

RGB Image



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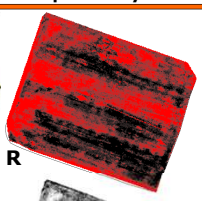

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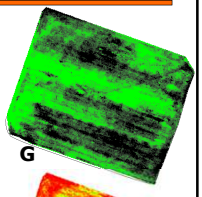

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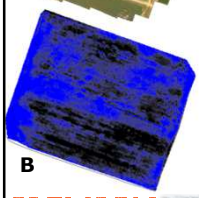

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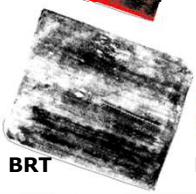
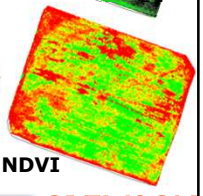


NDVI



CLEMSON PRECISION AGRICULTURE CLEMSON COOPERATIVE EXTENSION

USE OF AERIAL IMAGE FOR PREDICTING YIELD

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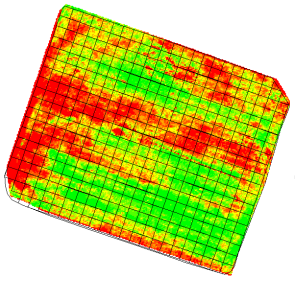
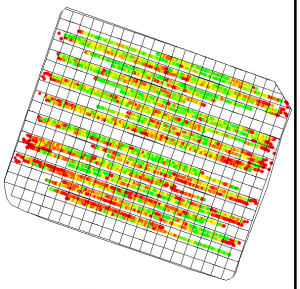
Tifton 85
2017 Aug 30
$NDVI_{EST}$ from Aerial



Tifton 85
2017 Sept 5
Dry Yield



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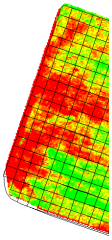

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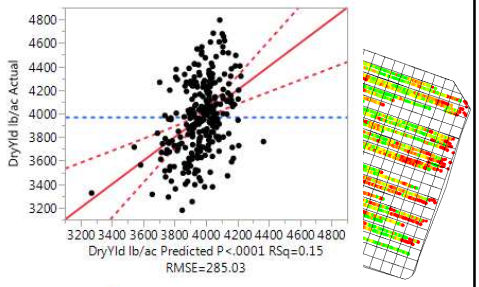
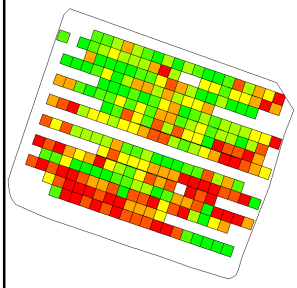
2017 Sept 5
Dry Yield

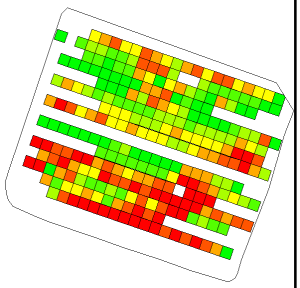


CLEMSON PRECISION AGRICULTURE CLEMSON COOPERATIVE EXTENSION

Tifton 85
2017 Sept 5
Actual Dry Yield



Tifton 85
2017 Aug 30
Predicted Dry Yield



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USE OF AERIAL IMAGE FOR PREDICTING PROTEIN

CLEMSON PRECISION AGRICULTURE

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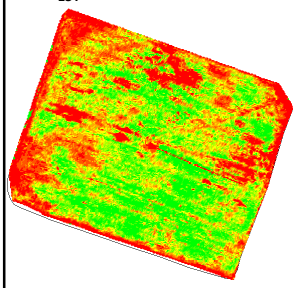
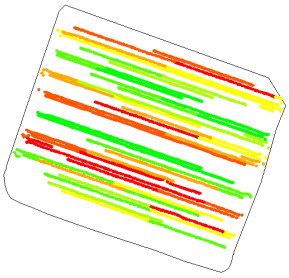


Tifton 85
2017 Sept 5
Protein Content



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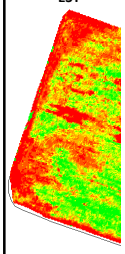
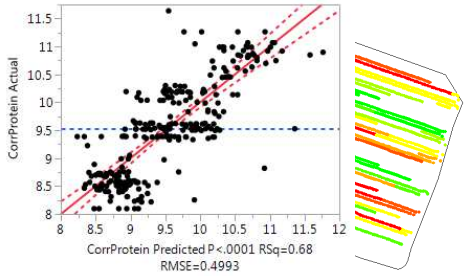
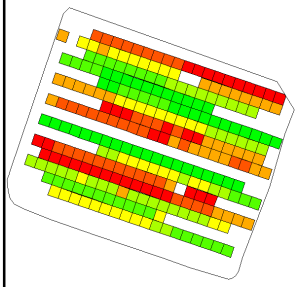


Tifton 85
2017 Sept 5
Protein Content

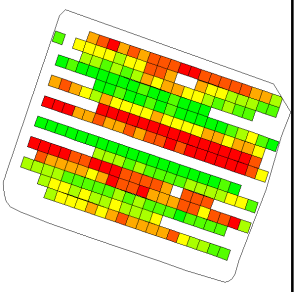


CLEMSON PRECISION AGRICULTURE CLEMSON COOPERATIVE EXTENSION

Tifton 85
2017 Sept 5
Actual Protein



Tifton 85
2017 Aug 30
Predicted Protein



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Conclusions – Hay Storage

- Investments in storage cost less than the dry matter value loss from lack of storage
  - Over its lifetime, storage can cost more than $5 per bale
  - 6-12 month value savings can amount to $12-15 per bale

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Conclusions – Yield Monitoring

- Hay yield monitors not available yet
- What questions would you like answered?
  - Yield monitors are powerful tools for conducting tests on your fields
  - Seeding rates? Nutrient rates? Hybrids? Product A vs. Product B?

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Conclusions – N Management in Tifton 85

- Response to N varies depending on time of year
  - Largest N response for first cutting
  - Optimum N rate for profit/yield may decrease during growing season
  - Optimum N rate for profit may decrease with GDD
- Variable rate N prescription requires more research
  - Hay yield monitor availability is a hindrance
  - VRN may be profitable mid-season only
  - Optimum N rate by zone difficult to predict
  - Yield response to N was inconsistent

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Conclusions – Aerial Imagery

- Primary current application as scouting tool
  - Not currently anywhere near capable of replacing boots in the field
- Pre-harvest yield estimation
  - May be useful for planning harvest logistics and timing
  - May be useful for insurance documentation
- Protein mapping
  - May be inexpensive alternative to constituent sensing options

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