



# Precision Ag Technology and Data Applications to Improve Cotton Production and Profitability in the Southeastern US

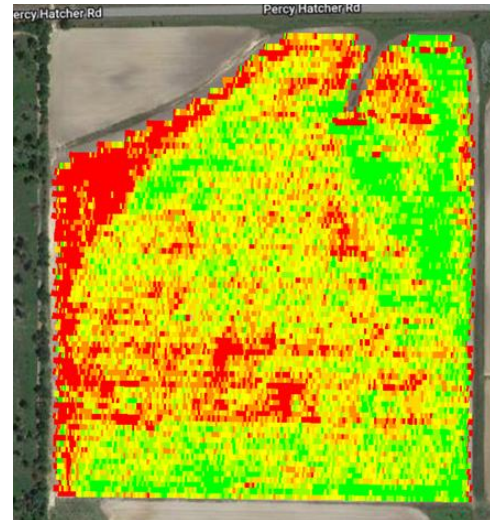
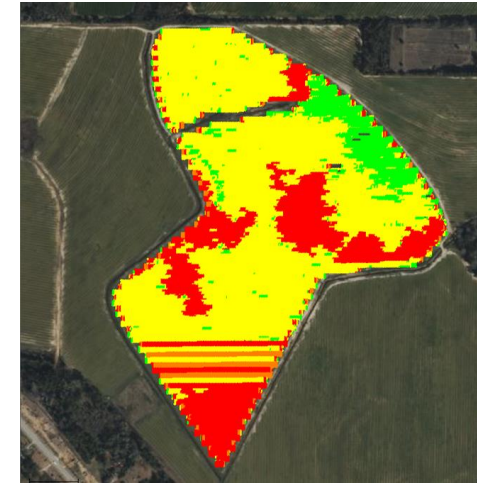
**Simer Virk<sup>1</sup> & Brenda Ortiz<sup>2</sup>**

Extension Precision Ag Specialist

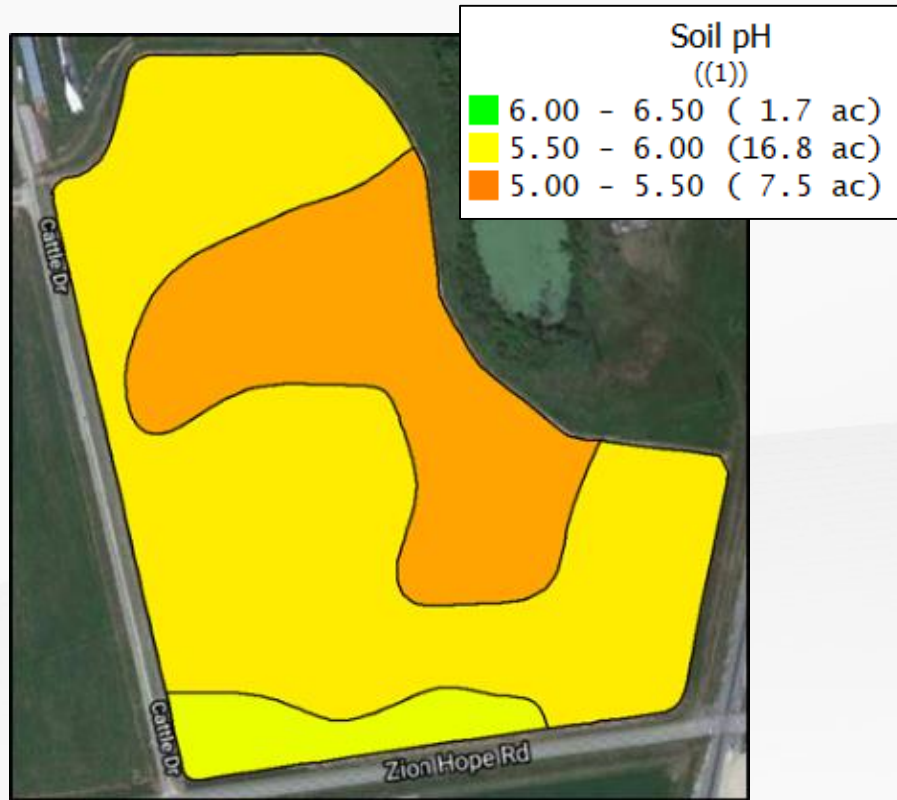
<sup>1</sup>University of Georgia, <sup>2</sup>Auburn University

# Precision Ag Technologies – Cotton Production

- **Fertilization:** Precision soil sampling and variable-rate applications
- **Planting:** Precision seed metering and placement
- **Pest Management:** Section control, rate controller and nozzle type/droplet size
- **Plant Growth Management:** in-season aerial imagery and variable-rate PGR applications
- **Defoliation:** ground and aerial application technologies
- **Harvest:** Yield monitoring and mapping



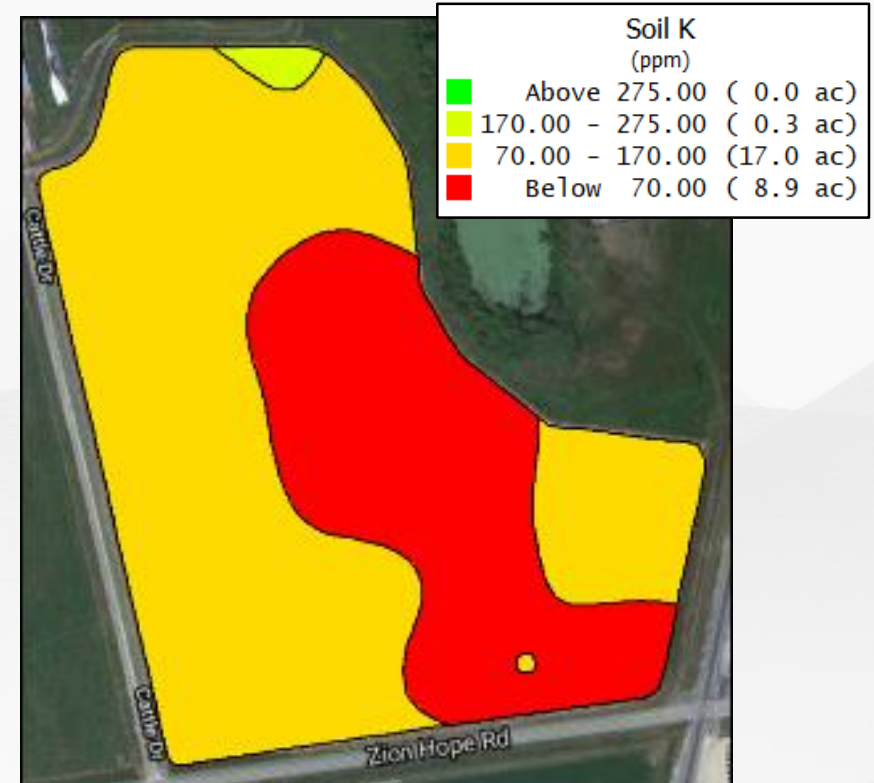
# Uniform vs Variable-Rate Lime and Fertilizer Application



## Lime

Uniform Application - 26 ton - \$1,300  
 Variable-Rate Application - 14 ton - \$700

**\$23/acre**



## N-P-K (30-0-110 lbs)

Uniform Application - 2,860 lbs - \$3,224  
 Variable-Rate Application - 2,180 lbs - \$2,566

**\$25/acre**

# Precision Soil Sampling Strategies

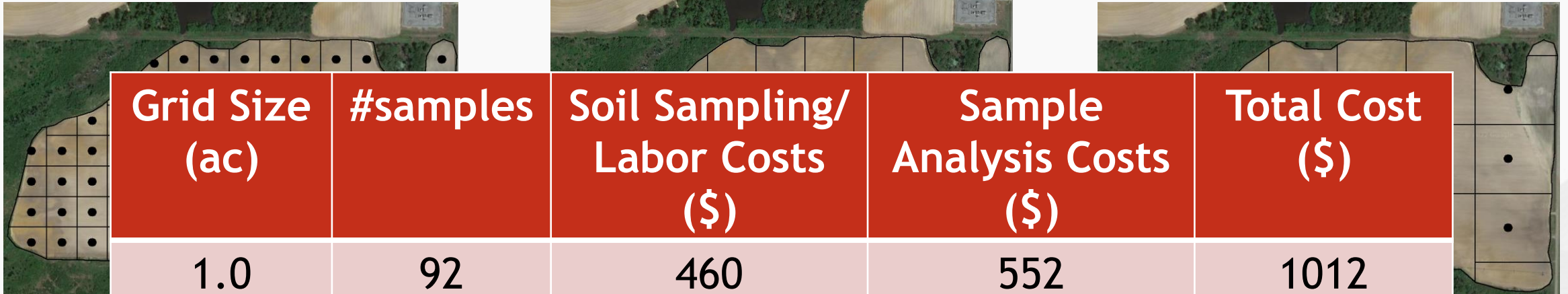


Traditional Soil Sampling  
(1-2 composite sample)

Grid Soil Sampling  
(uniform sized grids)

Zone Soil Sampling  
(zones based on certain  
soil/crop properties)

# Precision Soil Sampling – Optimal Grid Size



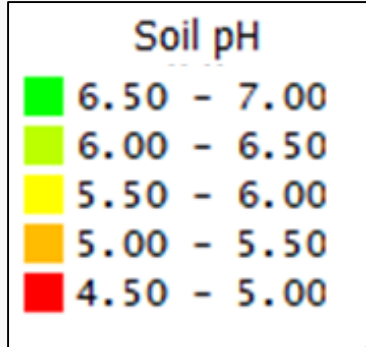
Grid Size (ac)	#samples	Soil Sampling/ Labor Costs (\$)	Sample Analysis Costs (\$)	Total Cost (\$)
1.0	92	460	552	1012
2.5	35	414	210	624
5.0	17	368	102	470
7.5	13	368	78	446
10.0	8	368	48	416



7.5 ac



10.0 ac

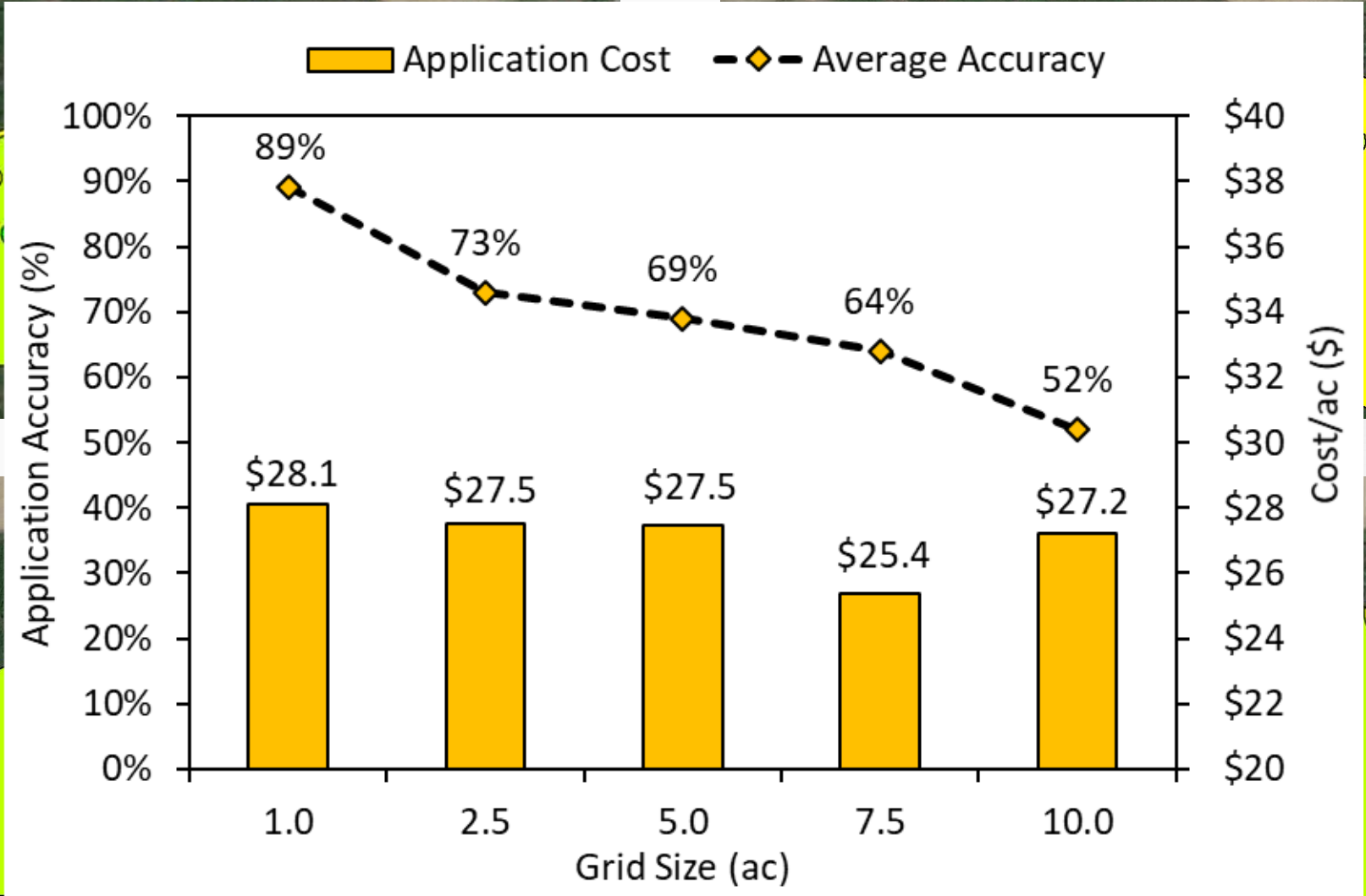


Actual Soil pH  
Variability  
(163 Samples)

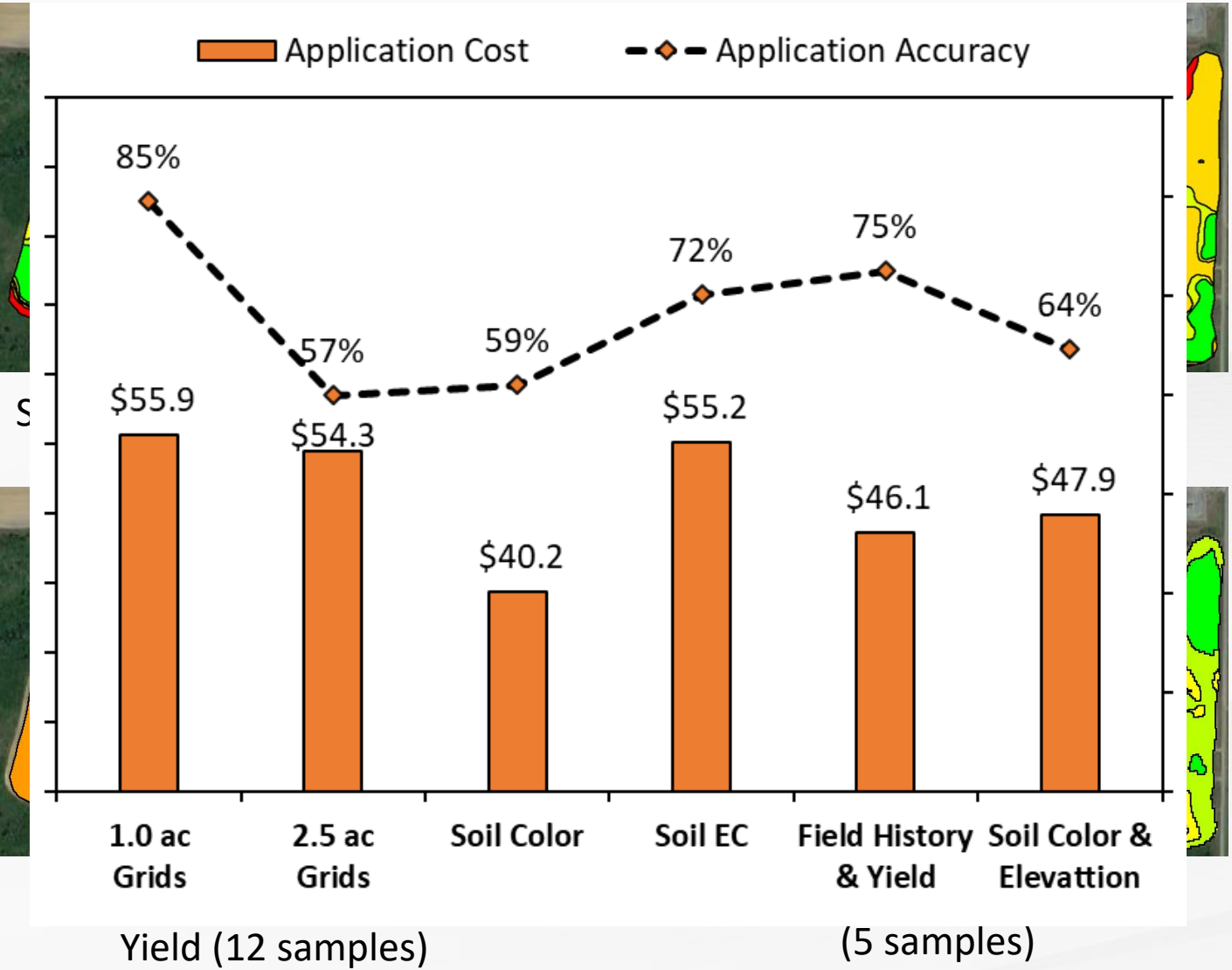
2.5 ac  
(35 samples)

1 ac  
(92 samples)

5 ac  
(17 samples)



# Zone Sampling Strategies



Each zone = 3 - 10 soil cores mixed together to make a composite sample

Overall less number of soil samples

Soil Sampling/labor costs - \$8-10/ac (*expertise to create zones*)

# Planting Technologies

Timely and uniform stand establishment is critical to maximize yield potential!

- ✓ Seeding Rate (2 -3 seed/ft)
- ✓ Seeding Depth (0.5 to 1.0")
- ✓ Seed Spacing (uniform)

## Seed Monitor: (by-row feedback)

- Population (over or under)
- Seed Singulation (98 - 100%)





JOHN DEERE

Planter

09:58

RTK

SCV

25400  
(seeds/lac)

10.8  
(in H2O)

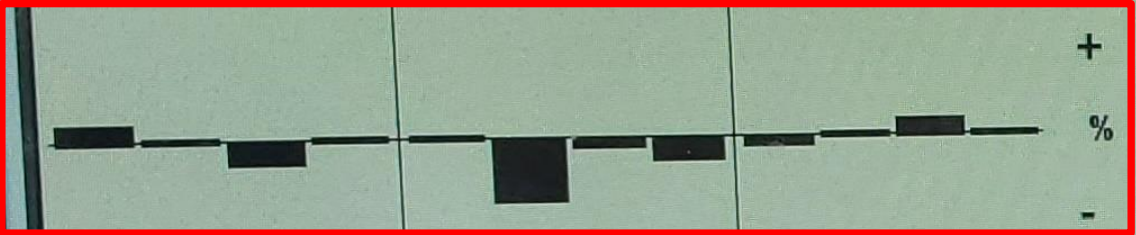
I

+

2.40

-

Location



0in

AutoTrac

A

Active

ON

Steering

AUTO

# Seed Singulation



$$\text{Singulation (\%)} = 100 - \text{skips (\%)} - \text{multiples (\%)}$$

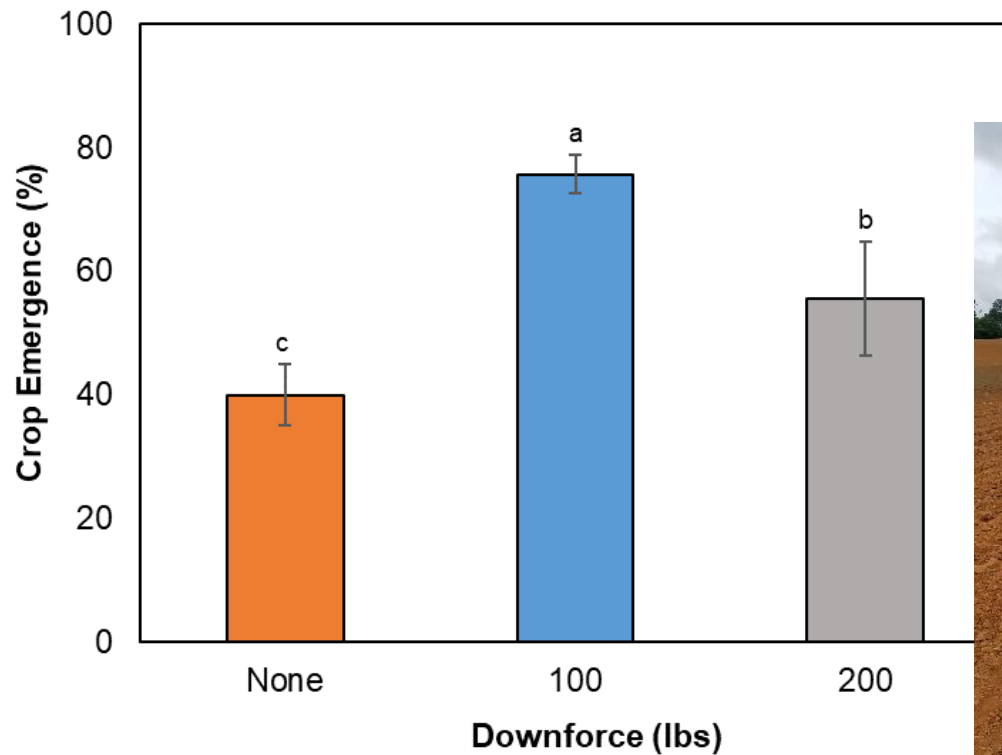
## What affects singulation?

- Seed meter setup
- Planter settings (e.g. vacuum)
- Ground speed
- Row-unit vibration
- Field conditions.....

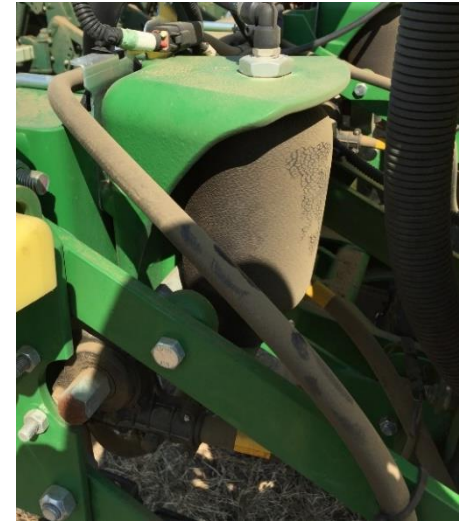
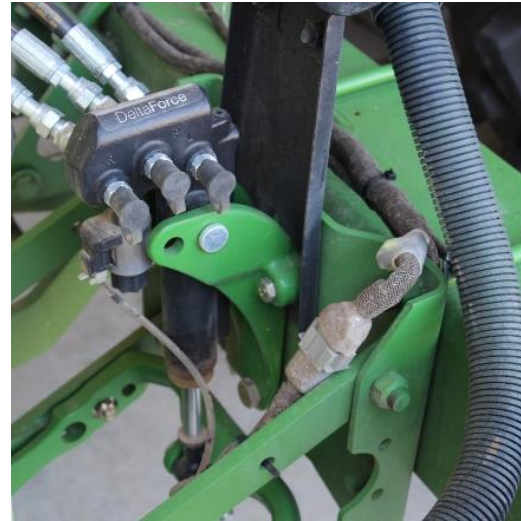
# Seeding Depth and Downforce

## For Cotton:

- Both **too little** and **too much downforce** can affect stand establishment



# Downforce Technology



Active Downforce Systems

## Benefits:

- Enable automatic downforce adjustments as field conditions change
- Improves seed placement in varying field conditions

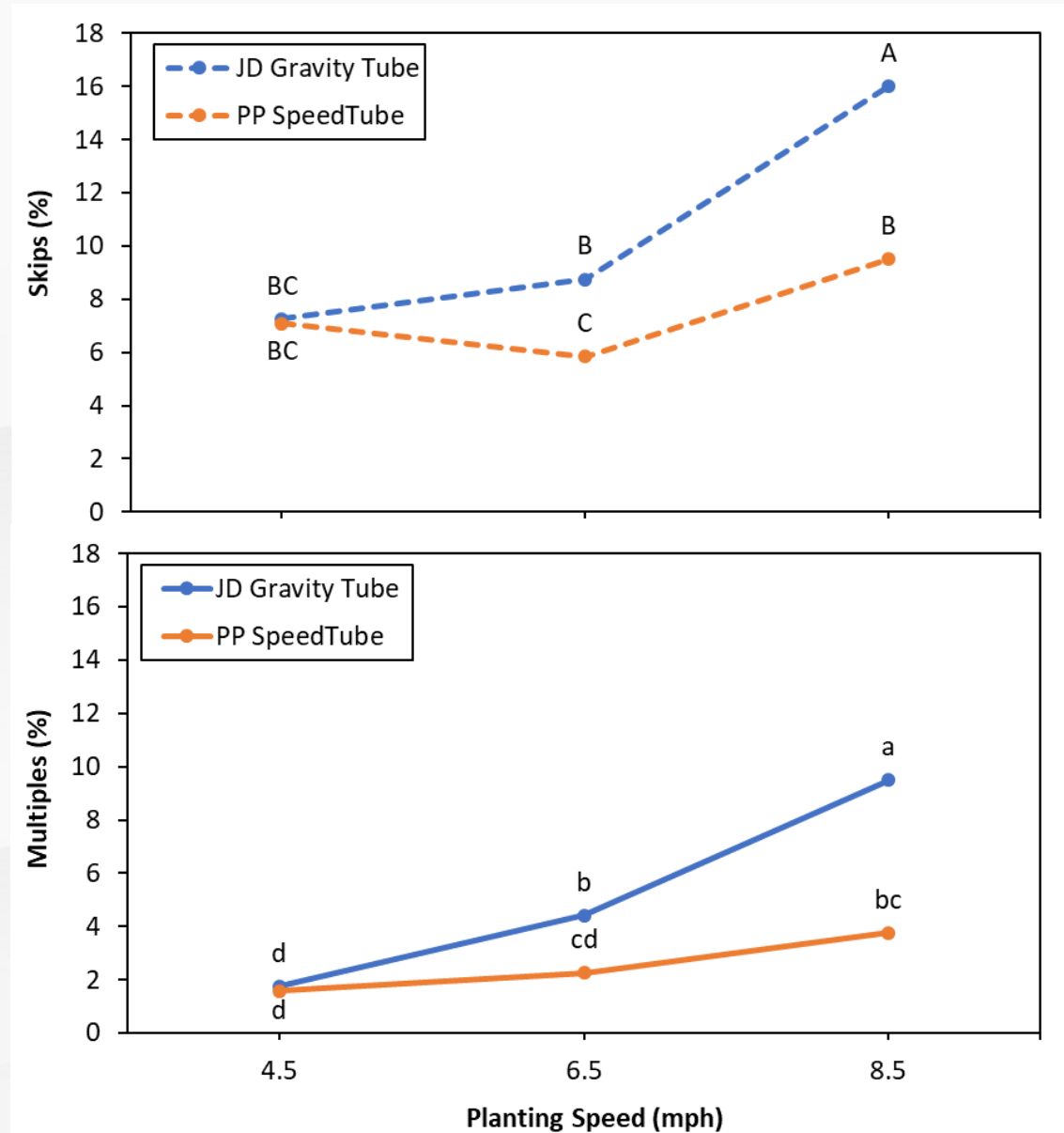
# Advanced Planting Technologies

## Electric Seed Meter:

- Eliminates chains, sprockets and other mechanical components
- Enables individual row control, turn compensation, and VR seeding

## Speed Tube:

- Improved seed delivery to the furrow
- Enables high-speed planting (8-10 mph)



# Precision Pest Management

**Effective pesticide applications are critical!**

- ✓ Effective (rate and coverage)
- ✓ On-Target (mitigate spray drift)

## Basic Spray Technologies:

- Rate controller
- Automatic section control



# Nozzle Technology – Coverage vs Drift Management

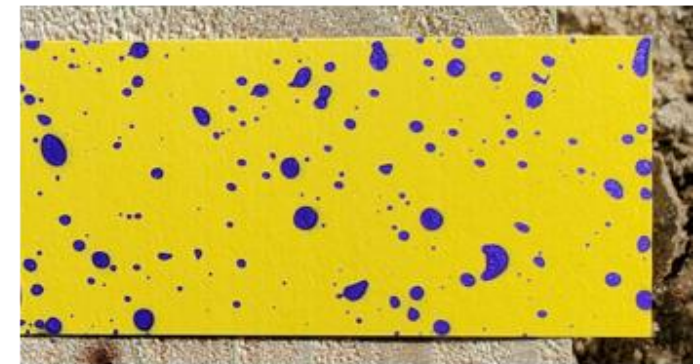
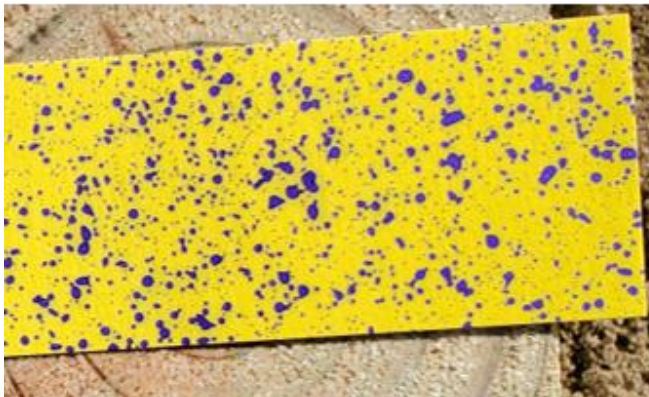
Standard Flat-Fan (XR)



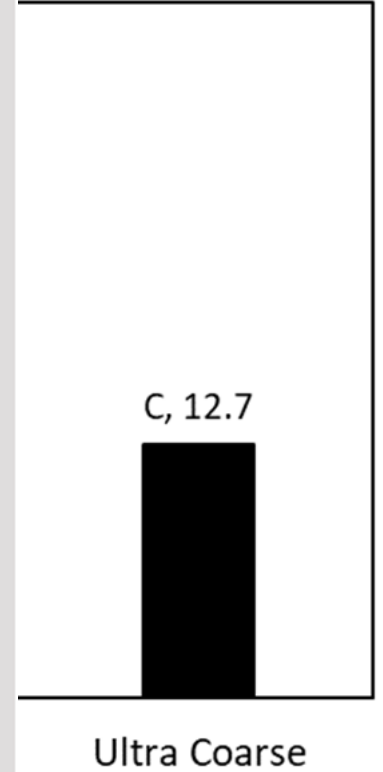
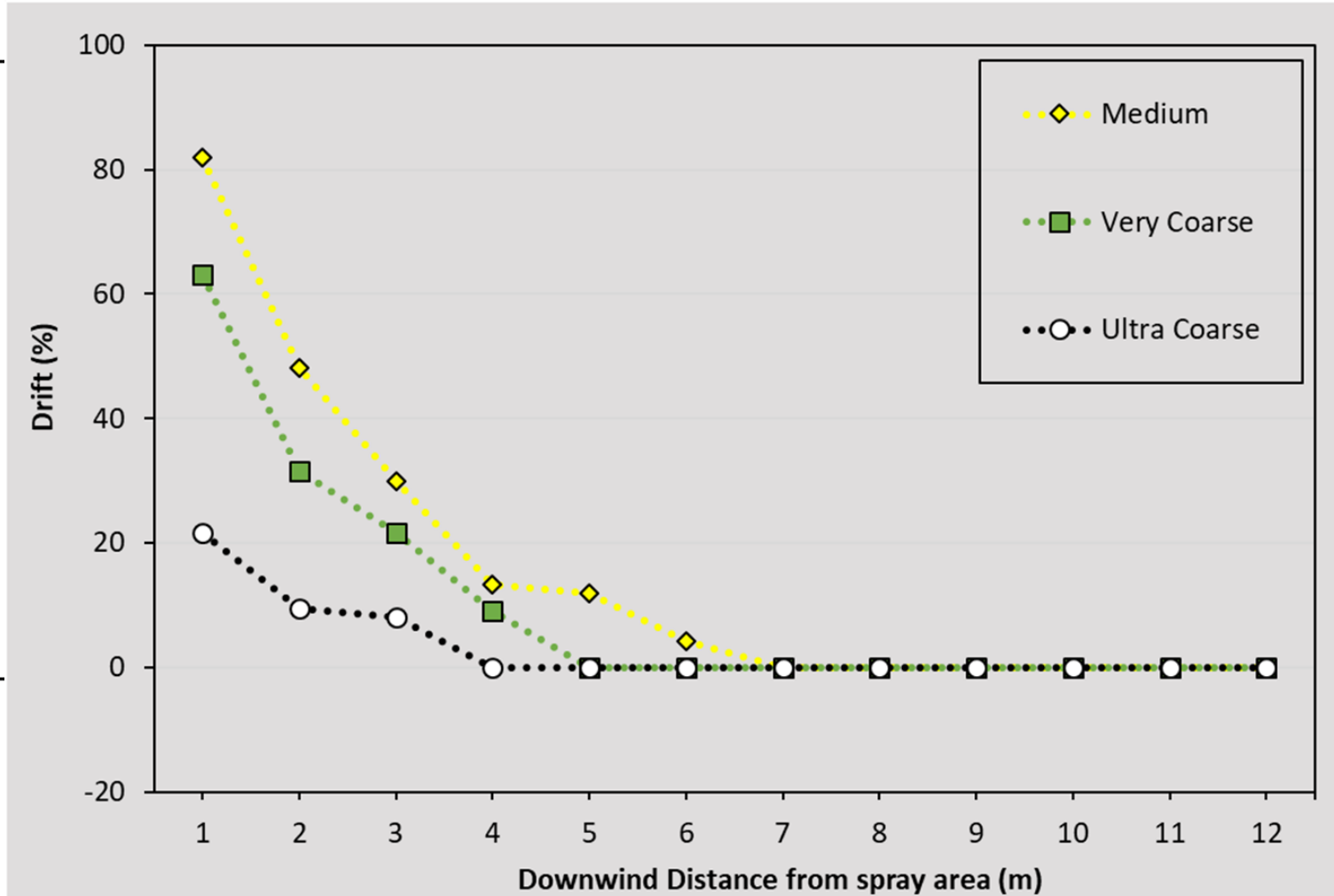
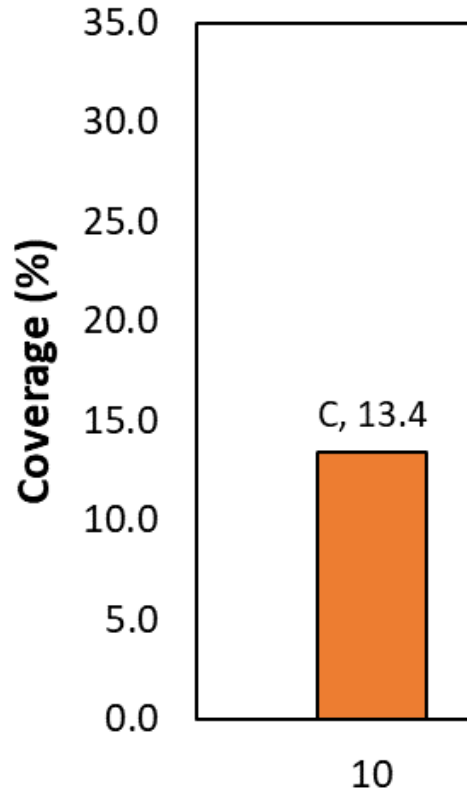
Air-Induction (AIXR)



Dicamba Tip (TTI)



# Coverage vs Drift Management

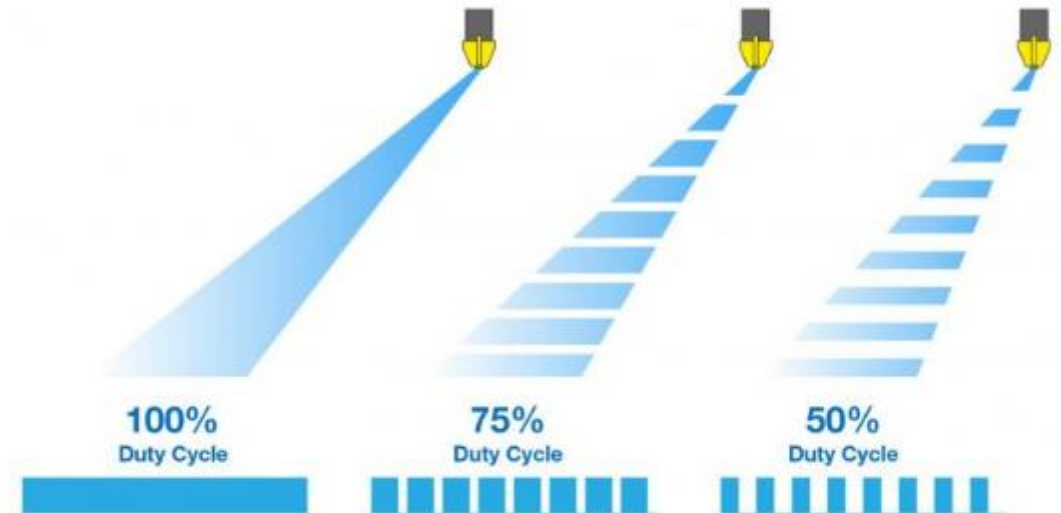




# Pulse-Width Modulation (PWM) Technology



- Constant spray pressure across the boom (droplet size control)
- Flow (rate) changes are accomplished by varying duty cycle

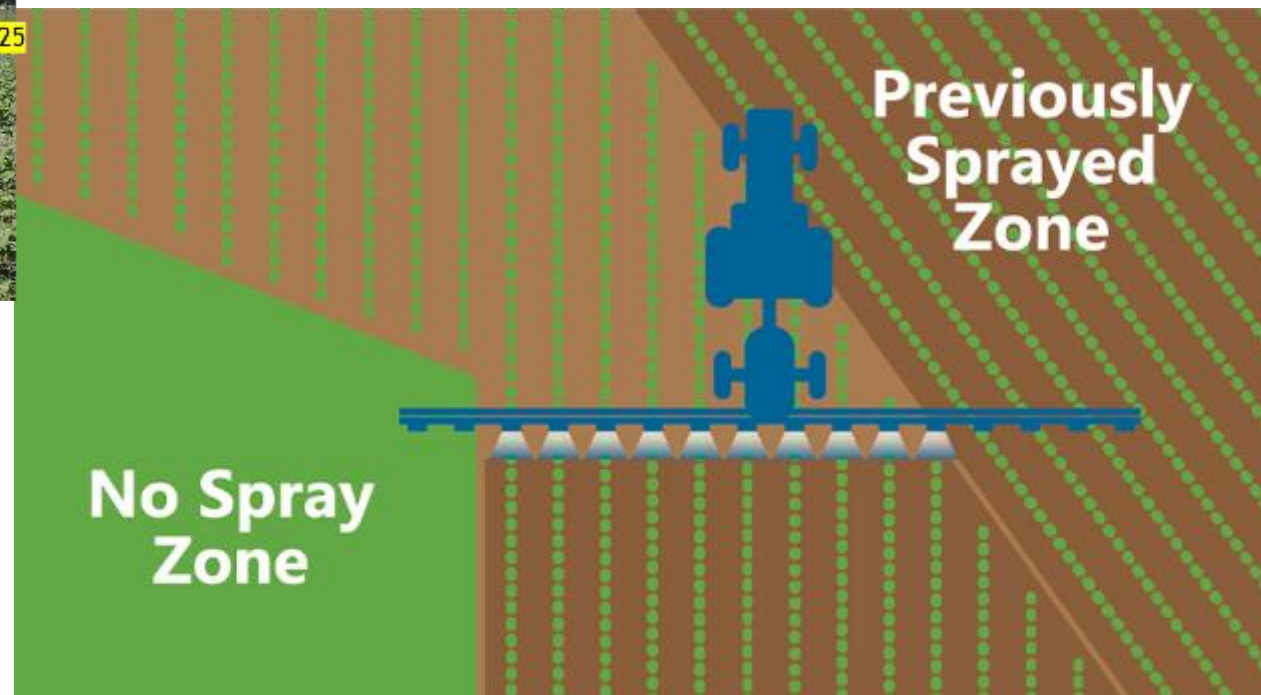


# Individual Nozzle Control



- Individual nozzles can turn ON/OFF as they come out of spray and non-spray/already sprayed areas.

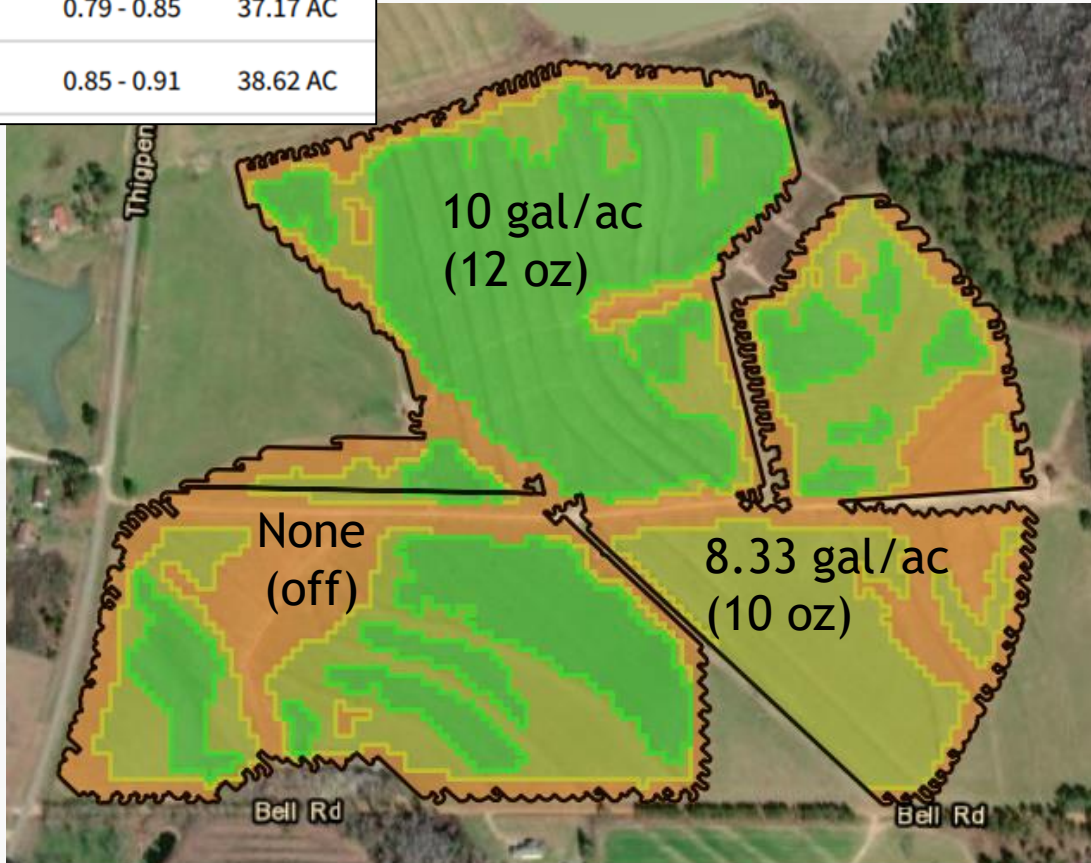
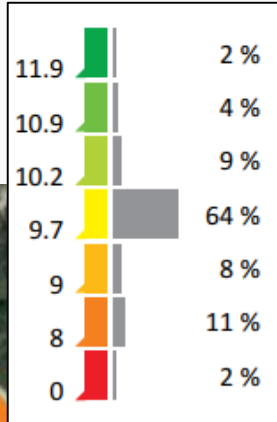
- Reduction in over-application and application in environmentally sensitive areas.



# Plant Growth Management

*(Variable-Rate PGR Applications)*

ZONE	SPAN	AREA
1	0.3 - 0.79	31.57 AC
2	0.79 - 0.85	37.17 AC
3	0.85 - 0.91	38.62 AC

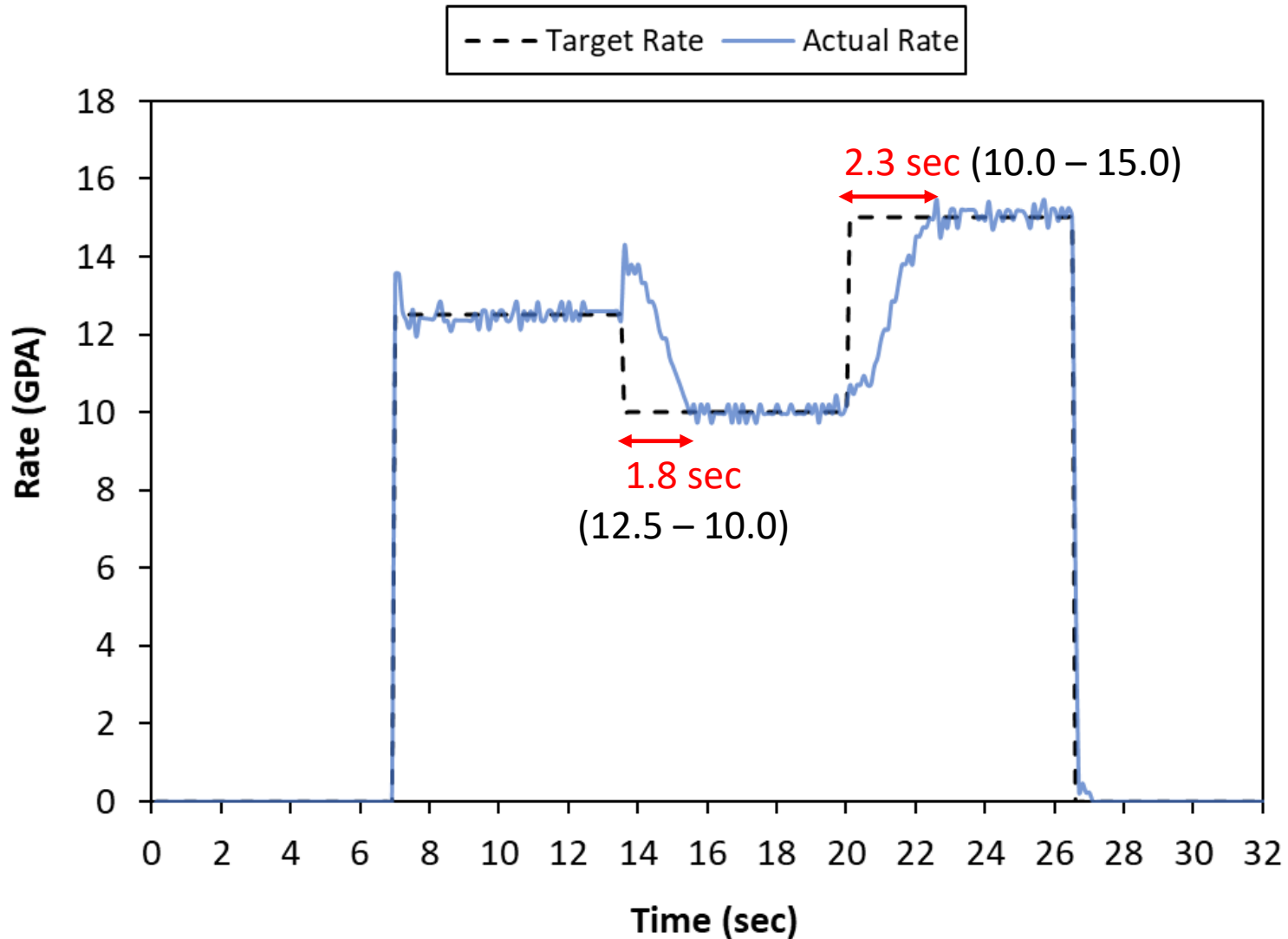


In-season aerial imagery



As-applied PGR Map

# Sprayer Accuracy – VR Application



Ground Speed (mph)	Length required for rate stabilization (ft)
8	28
10	35
12	42
14	49
16	56

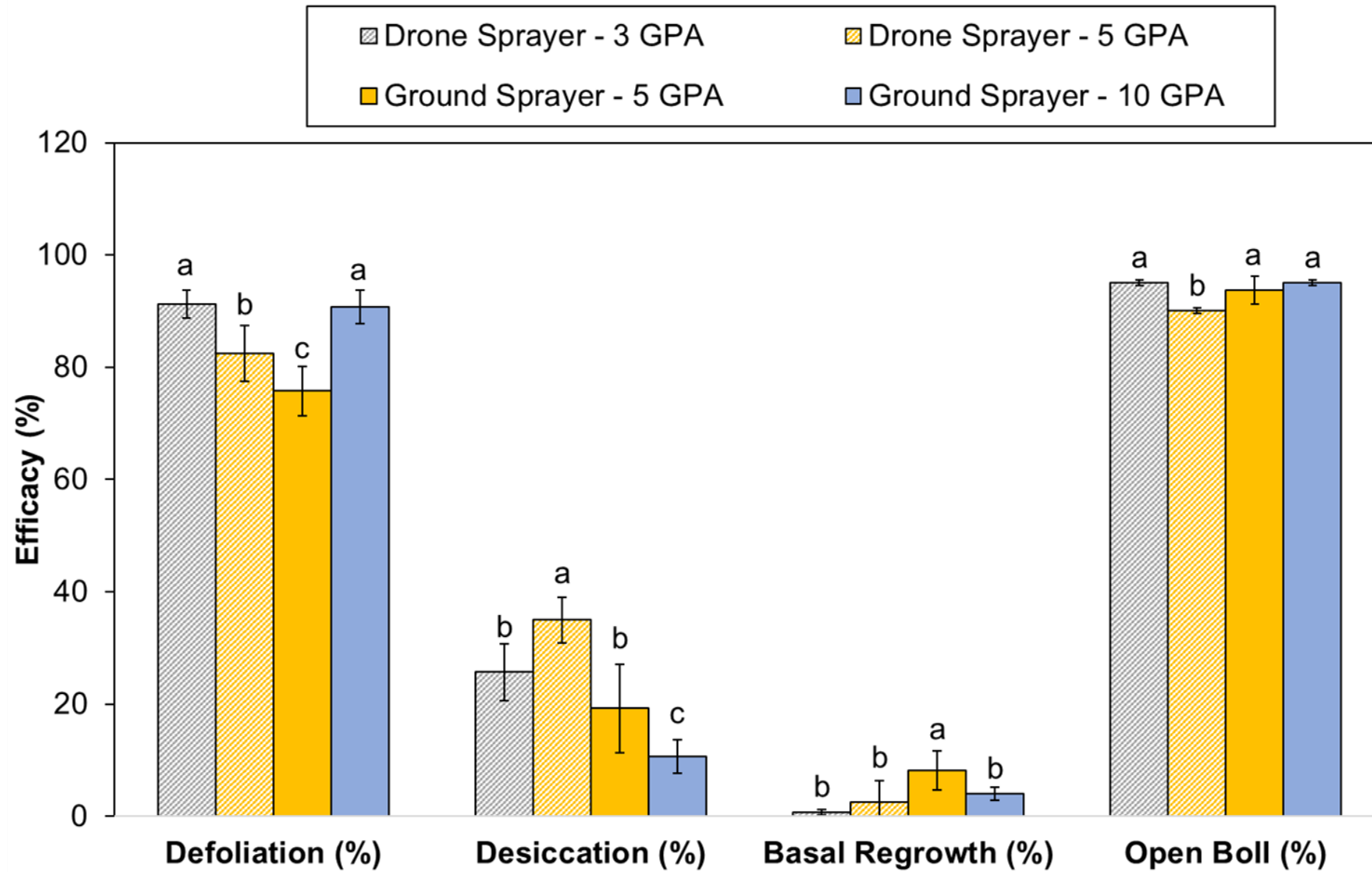
# Defoliation



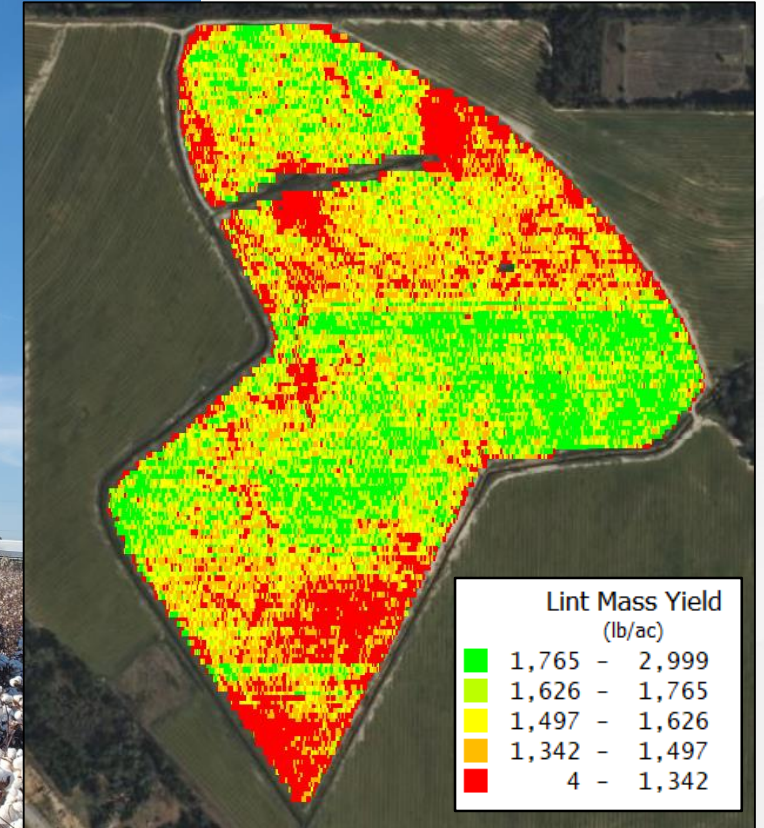
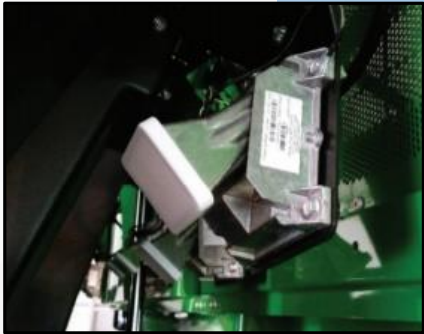
- Effective application
- On-Target application



# Defoliation Efficacy



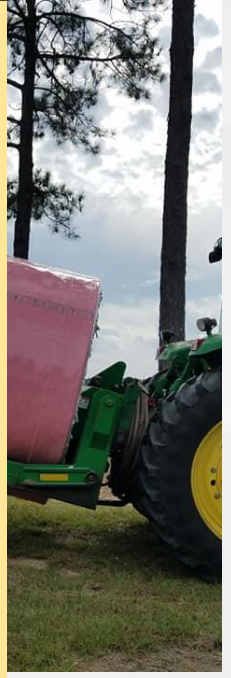
# Harvest Technologies





# Harvest Technologies

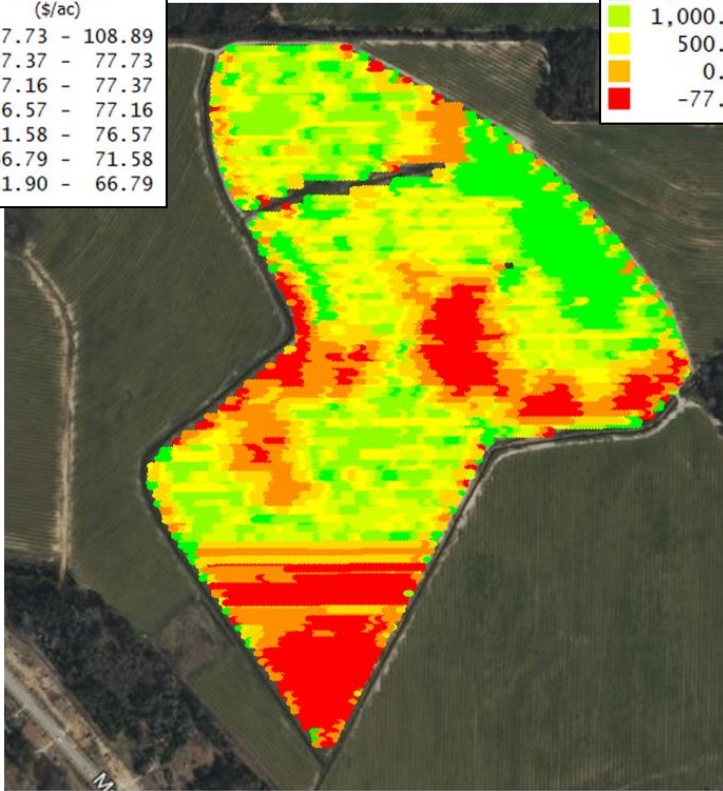
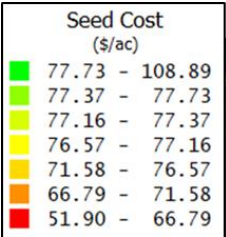
Yield	Pass#	Area (ac)	Lint (%)	Cal. Scale (lb/ac)	Picker OWS (lb/ac)	Error (%)	Yield Map (lb/ac)	Error (%)	Platform
	Pass1	1.12	0.40	1240	1138	1.9	1159	9.0	
	Pass2	1.11	0.40	1335	1241	0.7	1250	7.6	
	Pass3	1.11	0.40	1314	1204	-0.3	1200	9.2	
	Pass4	1.10	0.40	1217	1129	2.5	1157	7.8	
	Pass5	1.12	0.40	1153	1186	-0.3	1182	-2.7	
	Pass6	1.11	0.40	1338	1250	2.2	1277	7.0	
	Pass7	1.11	0.40	1212	1123	2.8	1154	8.0	
	Pass8	1.10	0.40	1213	1236	-1.1	1223	-1.9	
	Pass9	1.12	0.40	1380	1234	1.3	1250	11.8	



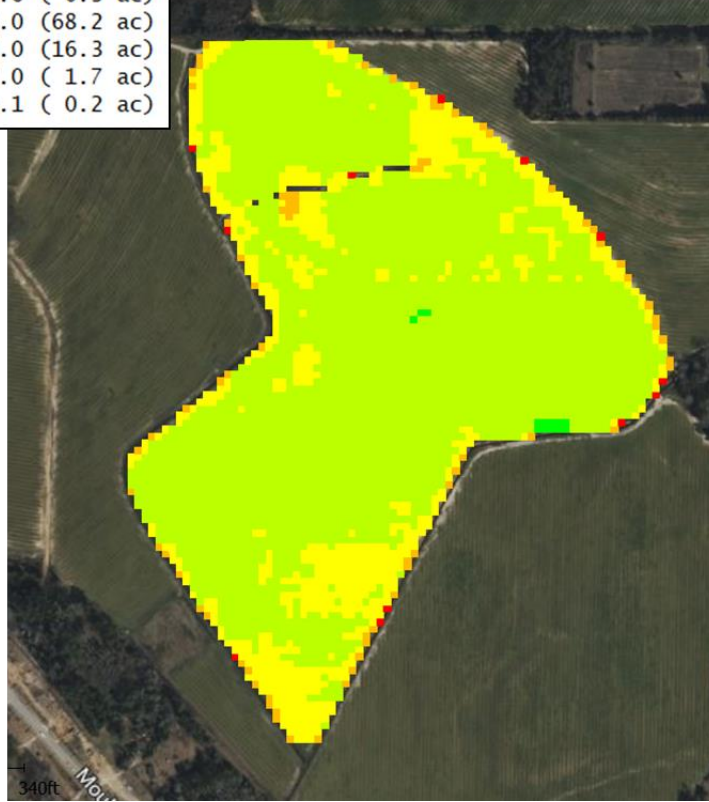
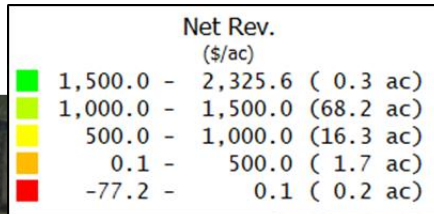
1.4%

7.2%

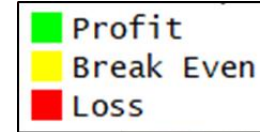
# Data and Tools - Profitability Analysis



Seed Cost per Acre



Net Revenue per Acre



Profit/loss per acre



UNIVERSITY OF GEORGIA  
EXTENSION



GEORGIA  
COTTON  
COMMISSION



Cotton  
Incorporated

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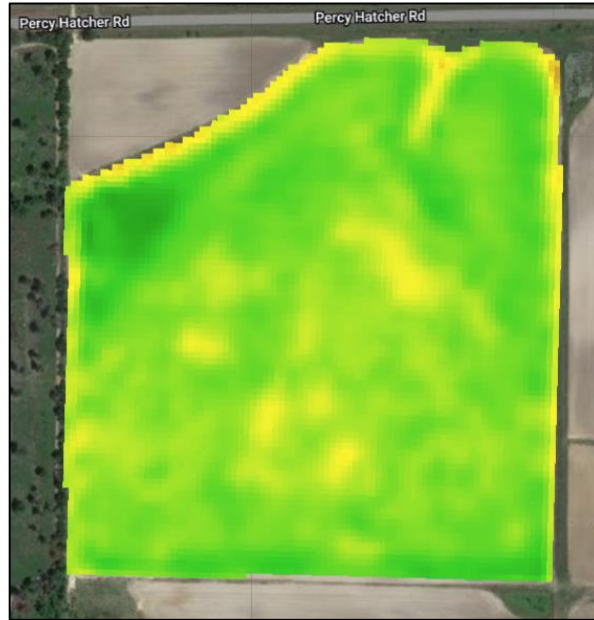
# On-Farm Seeding Rate Research



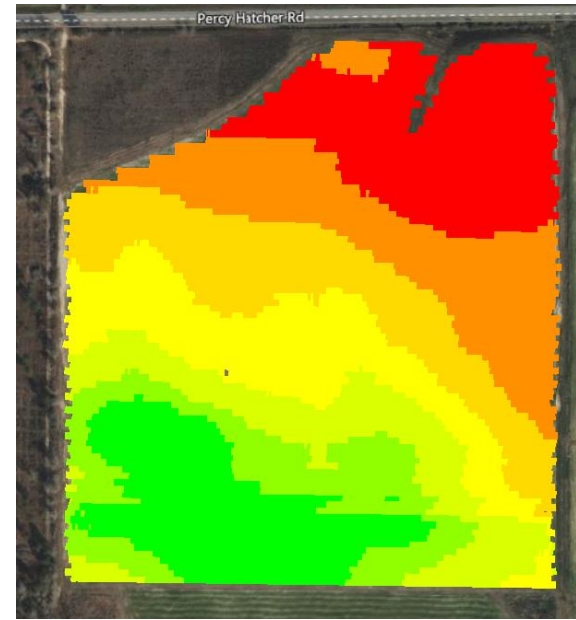
# Management Zones



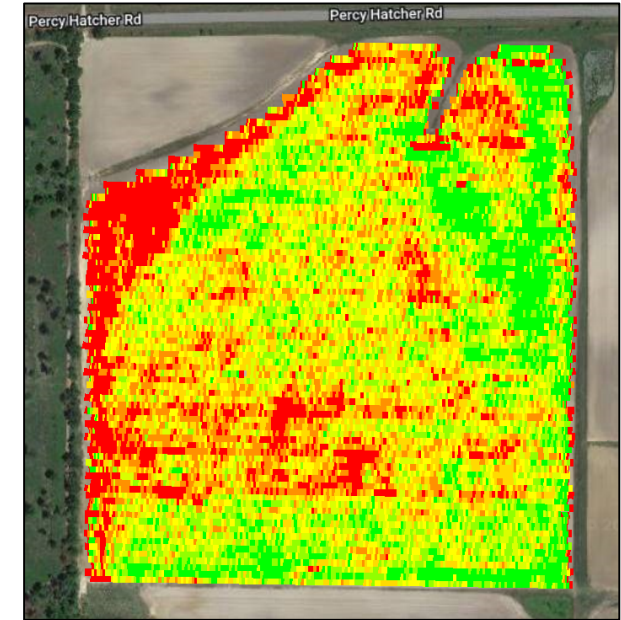
Soil Type or Texture



In-season crop imagery



Elevation

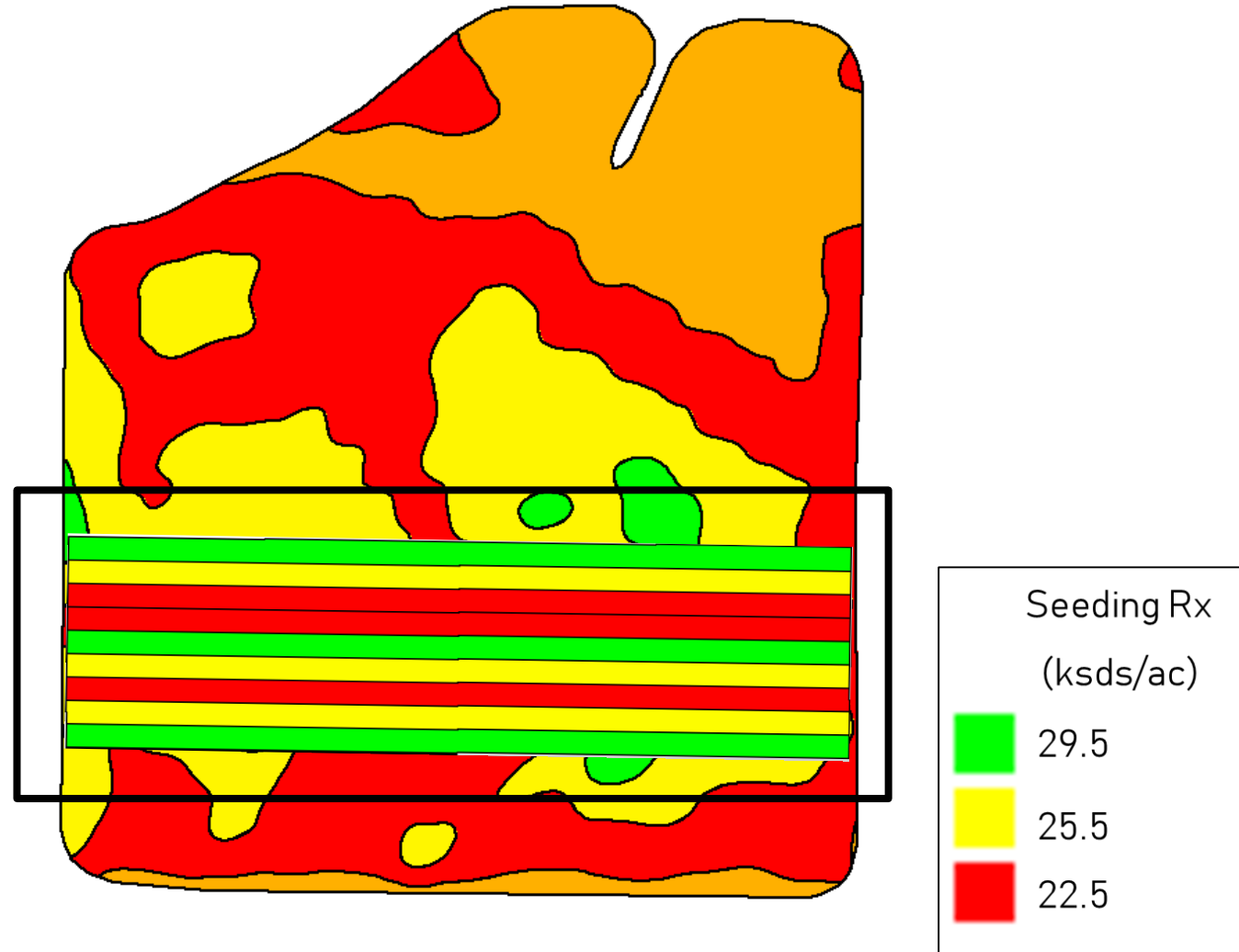


Yield Map

- Management zones were created within each field using different soil and/or crop spatial attributes

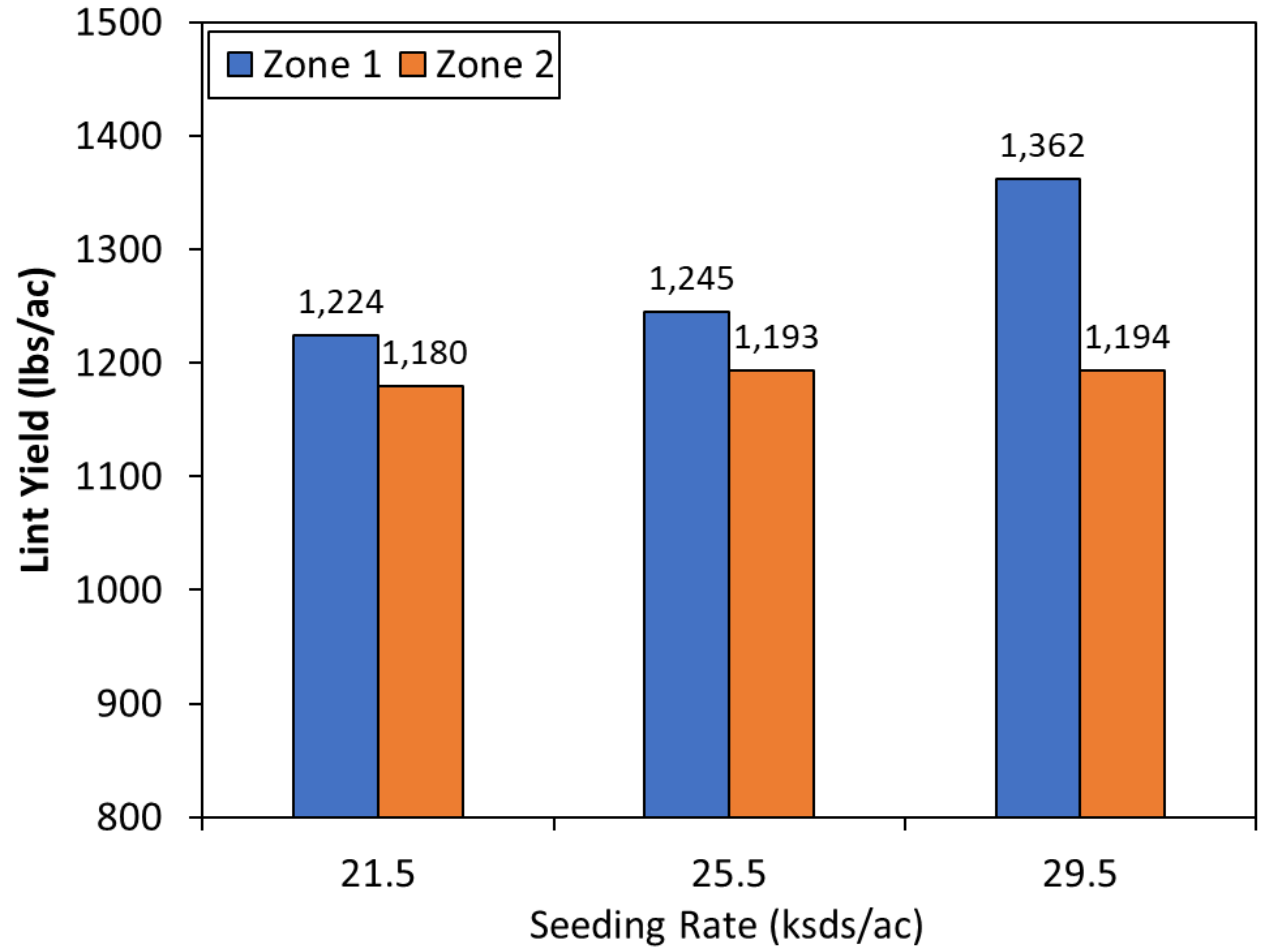
# Seeding Rate Strips

- Two to three zones in each field
- Three Seeding Rates
  - 22.5 (ksds/ac)
  - 25.5 (ksds/ac)
  - 29.5 (ksds/ac) (*Grower Nominal*)
- Three replications and seeding rates randomized within each replication
- Each pass represented a seeding rate (800 - 1350 ft length)



# Crop Emergence and Yield

Zone	Target Rate (ksds/ac)	Population (plants/ac)	Emergence* (%)
1	21.5	16,590 a	77%
1	25.5	19,494 b	76%
1	29.5	22,506 c	76%
<hr style="border-top: 1px dashed black;"/>			
2	21.5	17,935 a	83%
2	25.5	21,780 b	85%
2	29.5	24,119 c	82%



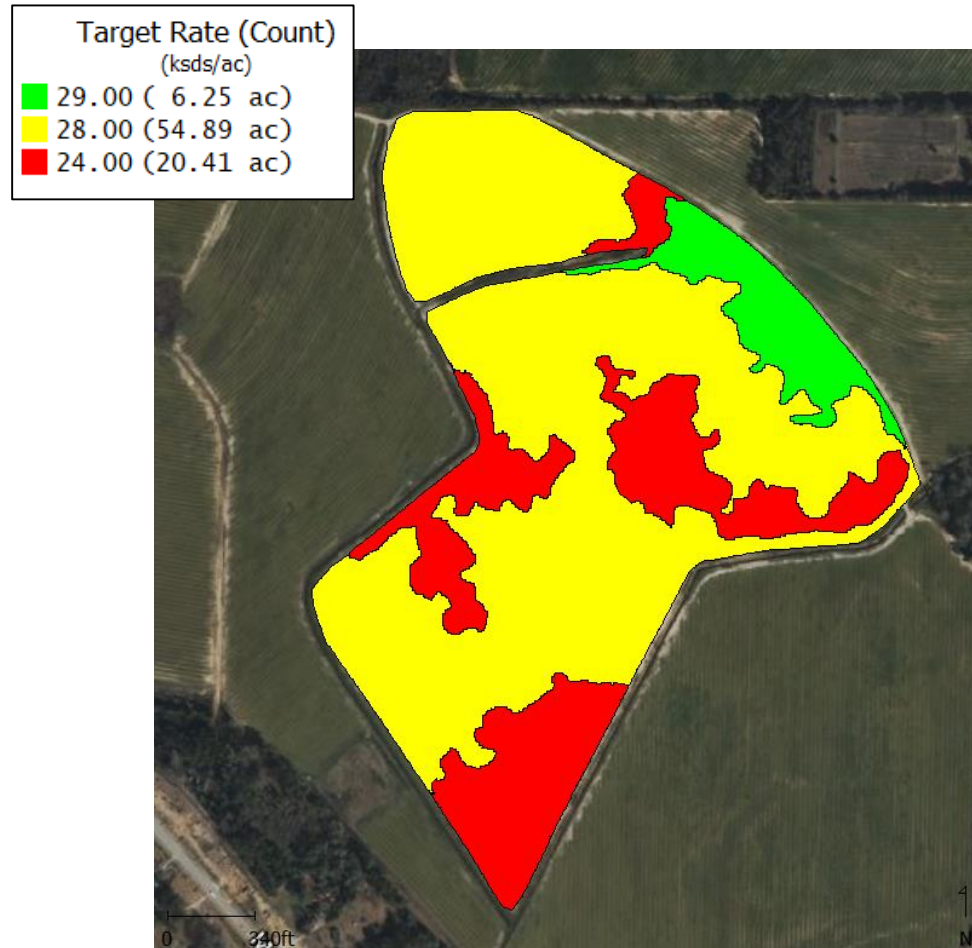
# Cotton Seeding Rate Vs Yield Economics

Zone	Seeding Rate (seeds/ac)	Lint Yield (lbs/ac)	Gross Rev. per acre	Seed Cost (\$/ac)	Net Rev. per acre
1	22.5	1,224	\$1,004	\$62	\$942
1	25.5	1,245	\$1,021	\$70	\$951
1	29.5	1,362	\$1,117	\$81	\$1,035
2	22.5	1,180	\$968	\$62	\$906
2	25.5	1,193	\$978	\$70	\$908
2	29.5	1,194	\$979	\$81	\$898

\*UGA Cotton Enterprise Budget: \$2.76/1000 seeds  
Cotton price: \$0.82/lb



# VR Seeding Rate Studies - 2023



VR Seeding Prescription (Rx) Map



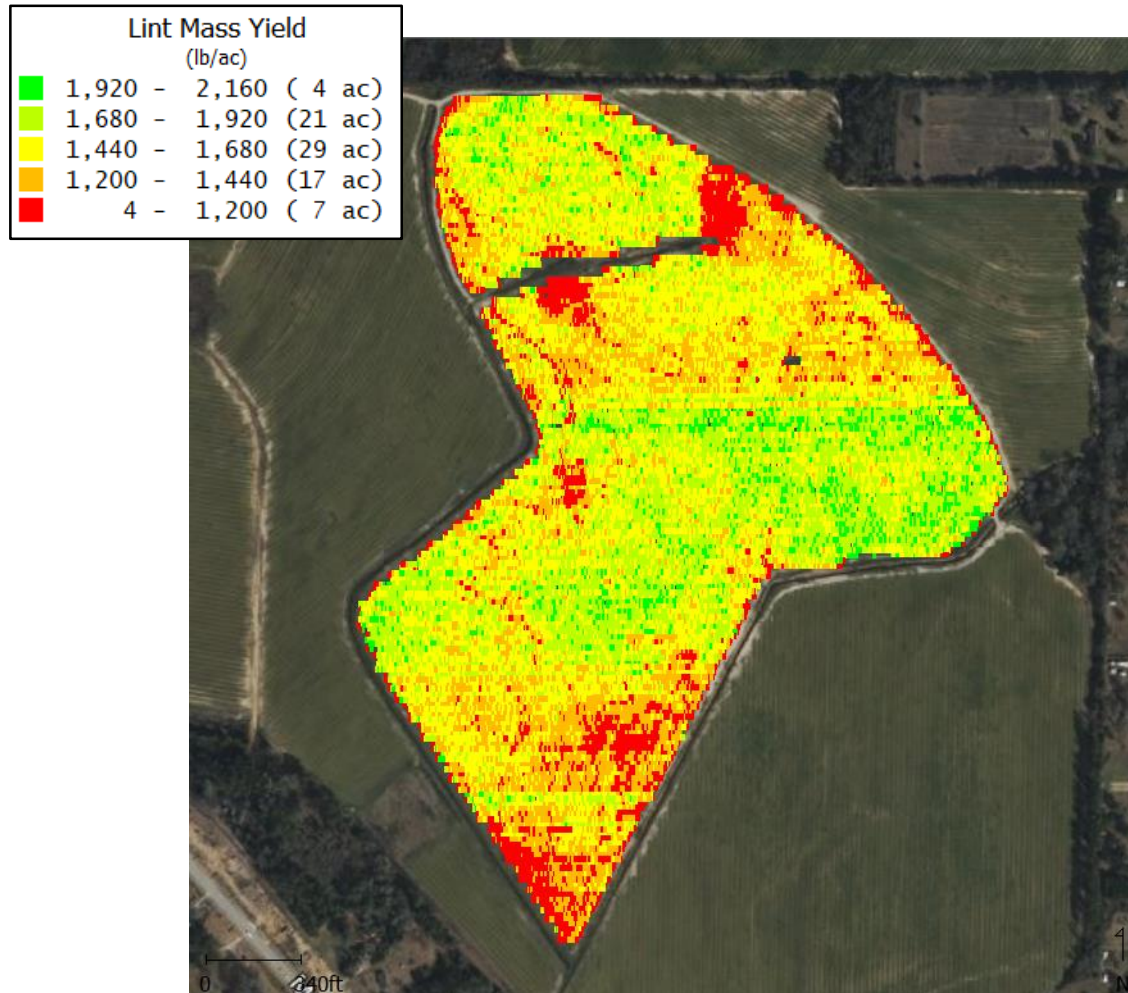
As-Applied (Planted) Map

# Population by Management Zone

Zone	Seeding Rate (ksds/ac)	Population (plants/ac) x 1000	Emergence (%)
1	24.0	19.9	82.9
2	24.0	21.2	88.3
3	24.0	21.0	87.5
4	24.0	20.8	86.6
5	28.0	24.2	86.4
6	28.0	24.4	87.1
7	29.0	25.6	88.2

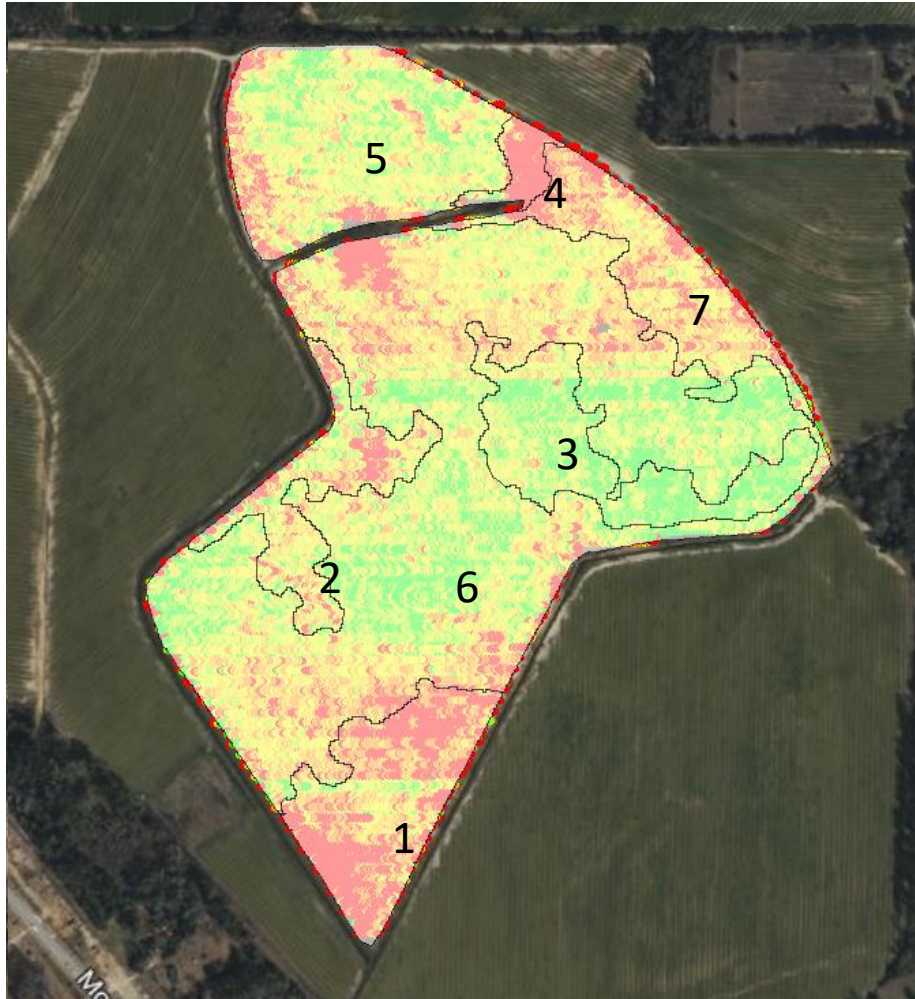


# Cotton Yield



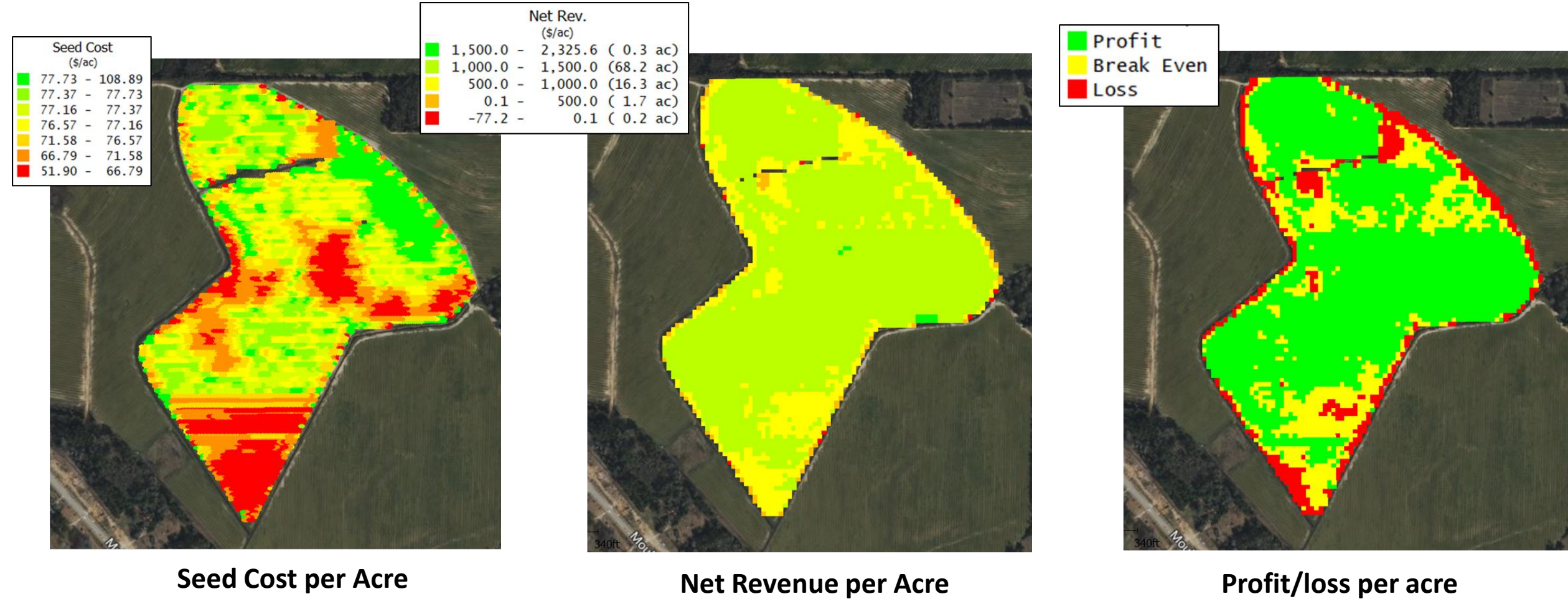
Lint Yield (lb/ac)	Area (ac)
0 - 280	0.4
241 - 480	0.2
481 - 720	0.4
721 - 960	1.3
961 - 1200	4.8
1201 - 1440	17.5
1441 - 1680	29.4
1681 - 1920	20.9
1921 - 2160	4.3

# Yield by Management Zone



Polygon	Lint Yield (lb/ac)	Area (ac)
1	1276 ± 274	7.5
2	1460 ± 289	5.0
3	1752 ± 195	6.8
4	1063 ± 321	1.1
5	1570 ± 255	12.0
6	1587 ± 252	42.9
7	1399 ± 255	6.2
24.0	1475 ± 340	20.4
28.0	1583 ± 253	54.9
29.0	1399 ± 255	6.2

# Profit-Loss Analysis



UGA Cotton Enterprise Budget: \$2.76/1000 seeds; 1 seed bag = \$635 (2,30,000 seeds); production costs = \$972.55/ac