Efficacy and Economics of Precision Soil Sampling Strategies for Site-Specific Soil pH Management in Peanut

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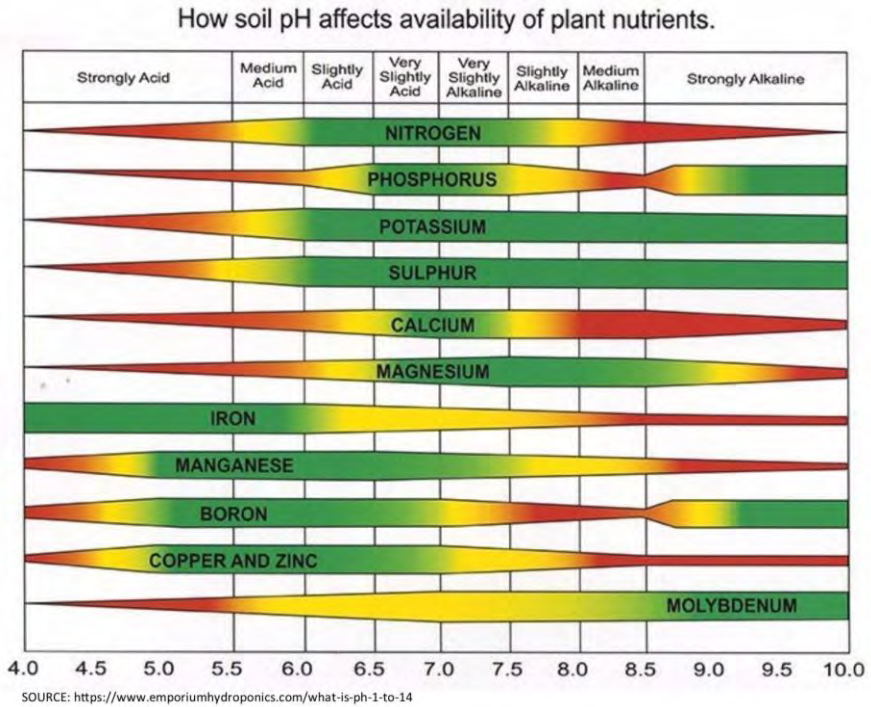
Background

❑ Importance of proper soil pH

- Peanuts perform best in soil pH range of 6.0-6.5
- Low pH can result in low nutrient availability or zinc toxicity

❑ Lime Applications

- Used to increase soil pH and reduce soil acidity
- Variable-rate applications are common among the peanut growers in the southeastern US



Soil pH: 6.0

Soil pH: 5.5

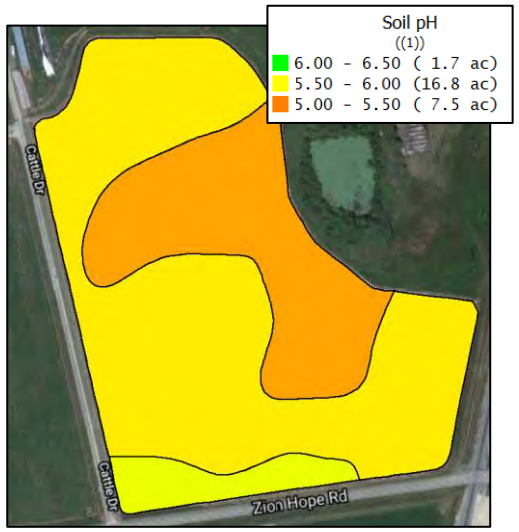
Introduction

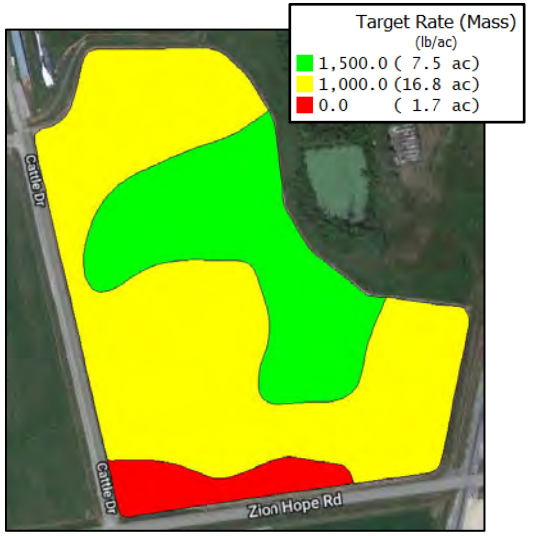
❑ Common soil sampling methods

- Composite
- Grid Sampling
- Zone Sampling

❑ Variable Rate Applications

- Used to help combat soil nutrient variability
- Aid in site-specific nutrient management
- Only as good as the prescription (Rx) map





Research Motivation

Growers are interested in making data-driven decisions **(grid vs zone)**…but they want to be sure it's quality data and cost effective **(sampling size vs cost)**.

Objectives

- To evaluate the efficacy of commonly used precision soil sampling strategies and their influence on the depiction of soil pH variability
- To analyze and compare the economics of commonly used precision soil sampling strategies

Study Locations

❑ Field 1

- Worth Co, GA
- 31.5 ac
- pH: 4.9 - 6.2

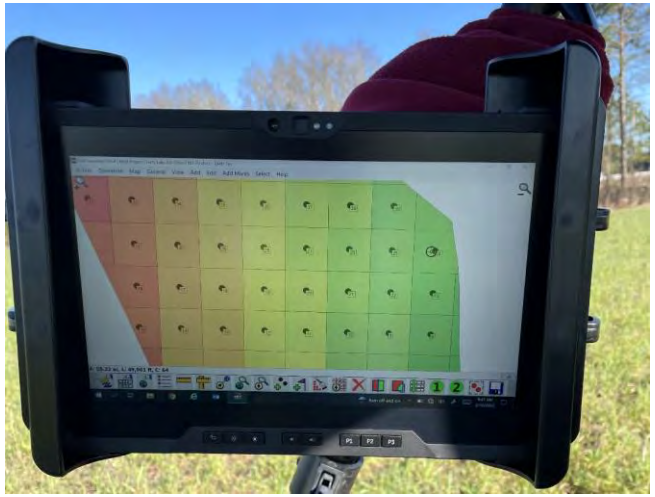
❑ Field 2

- Colquitt Co, GA
- 92.93 ac
- pH: 4.6 - 6.6

Sampling Methods

❑ Grid-based Soil Sampling

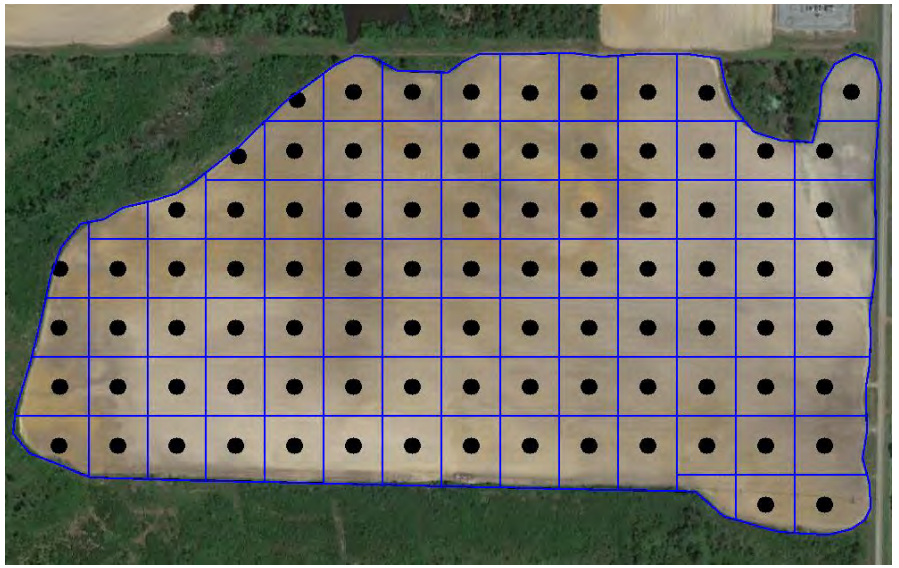
- Grids were created in sizes of 1.0, 2.5, 5.0, 7.5, and 10.0 ac
- Point sampling method (center of the grid)
- Depth of soil sampling = 6 inch
- Number of samples per grid = 12-15 cores



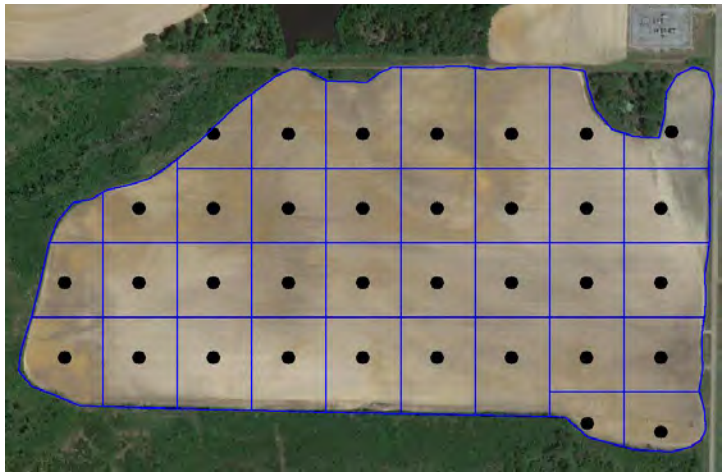
5.0 ac

7.5 ac

1.0 ac



2.5 ac

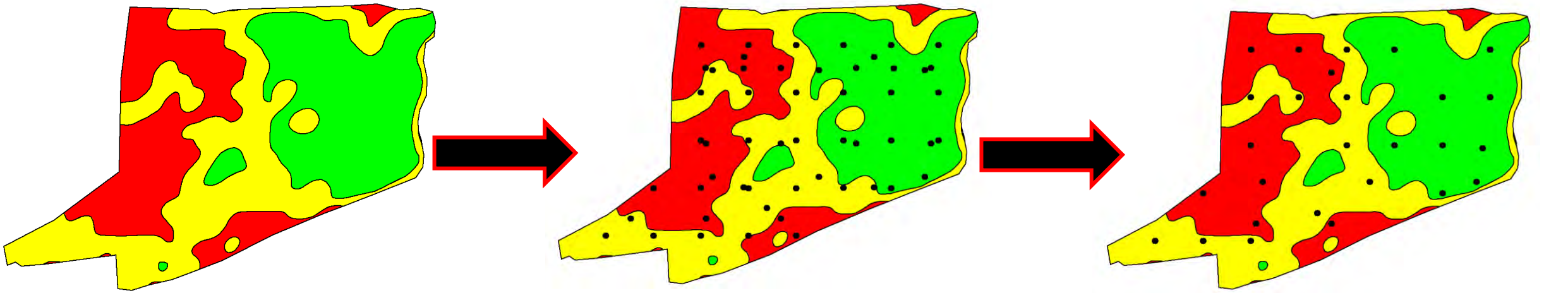


10.0 ac

Sampling Methods

❑ Zone-based Sampling

- Areas of similar properties (soil texture, crop health, etc.)
  - Electrical Conductivity (EC)
  - Soil Brightness Index (SBI)

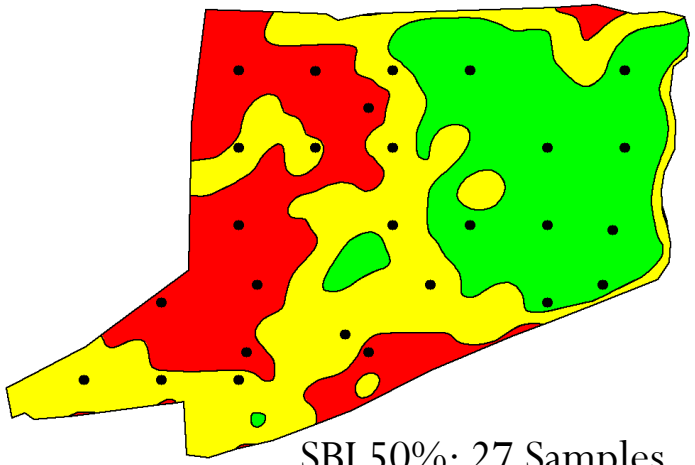


SBI Map

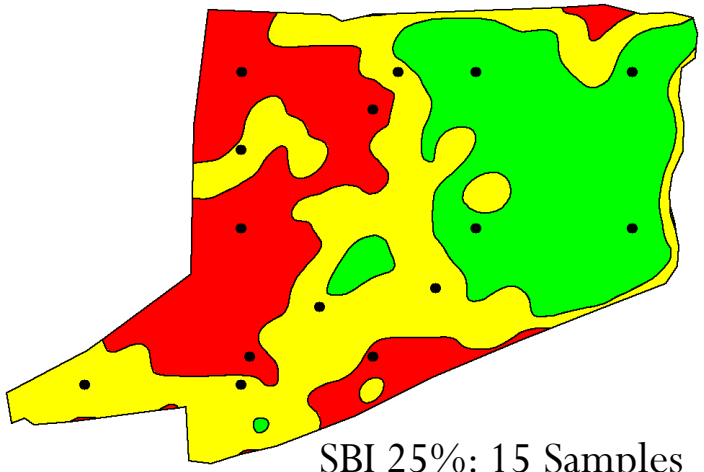
SBI Map with All Soil Points

SBI Map with 50% of All Soil Points

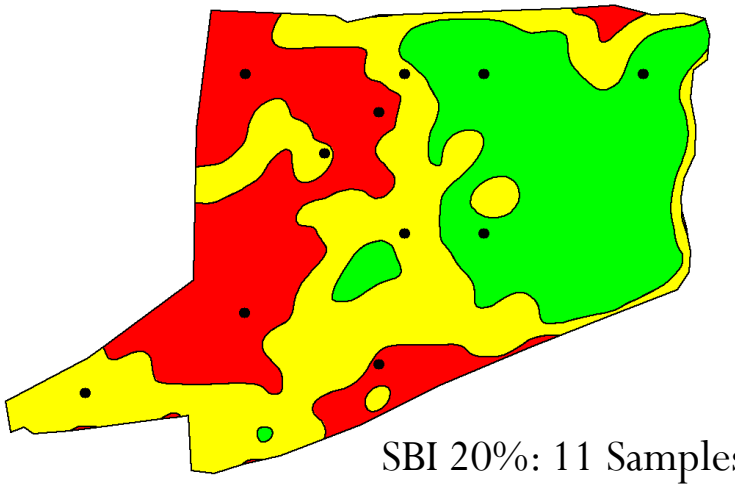
Zone Sampling



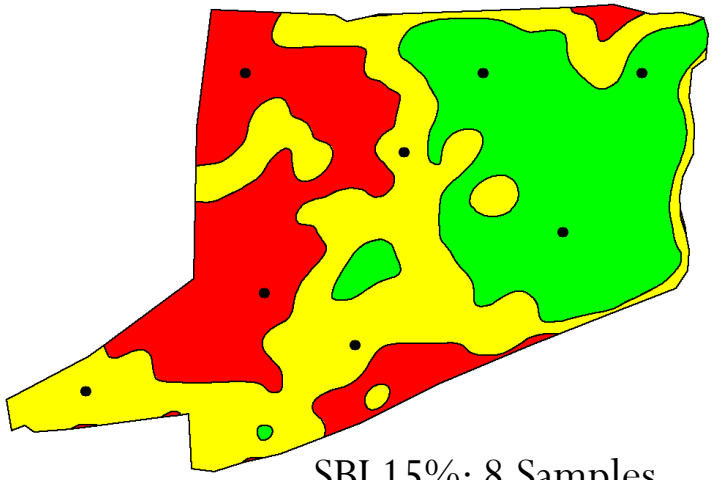
SBI 50%: 27 Samples



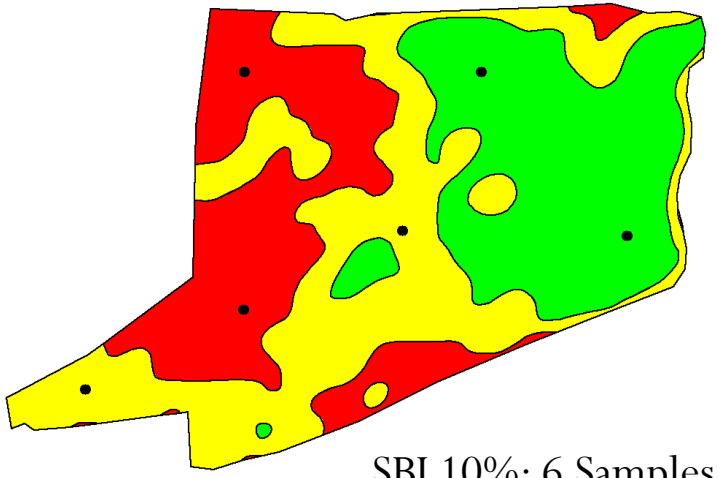
SBI 25%: 15 Samples



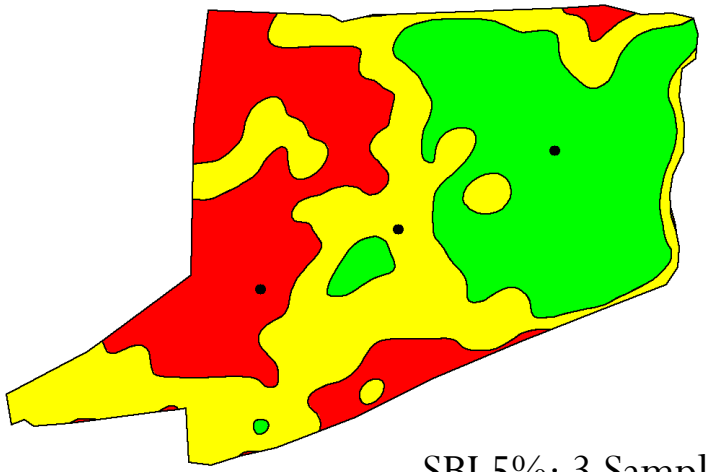
SBI 20%: 11 Samples



SBI 15%: 8 Samples



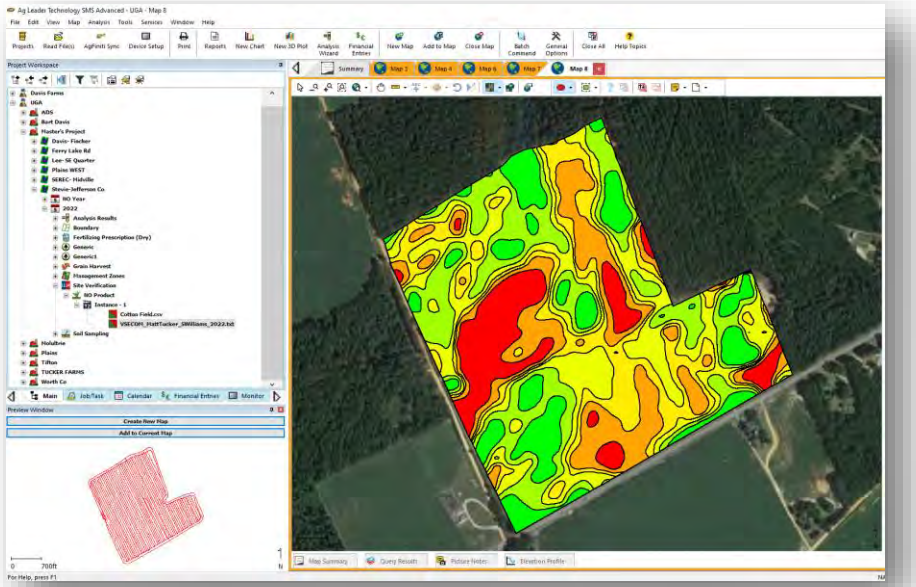
SBI 10%: 6 Samples

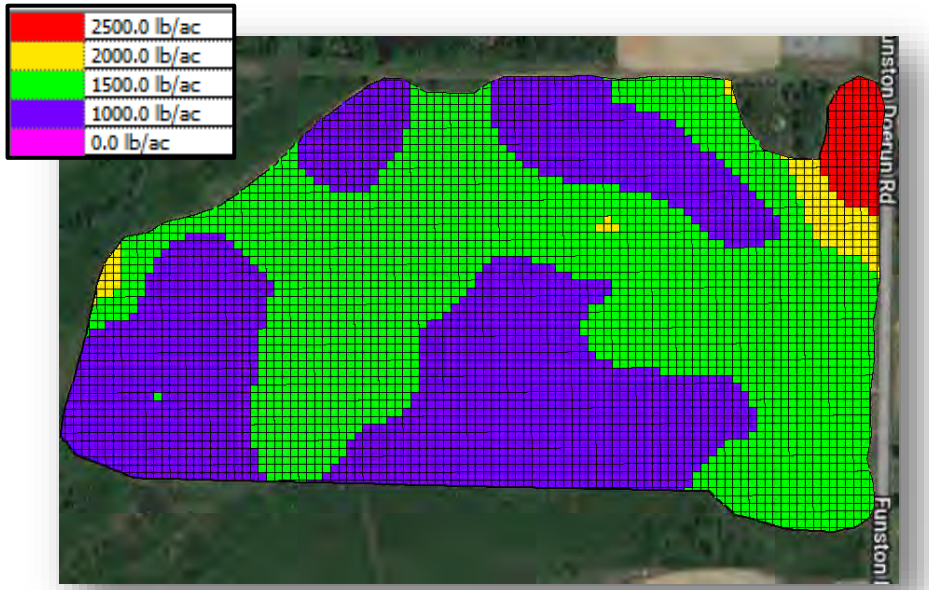


SBI 5%: 3 Samples

Data Analysis and GIS

- Spatial analysis and interpolation using the Inverse Distance Weighting (IDW) method in SMS Advanced (Ag Leader Technology, Ames, IA).
- Correlation analysis was conducted among the sampling strategies in JMP Pro 15 (SAS Institute, Cary, NC) using alpha = 0.10.
- Prescription (Rx) maps were created for Lime in SMS Advanced software.





Results - Effectiveness

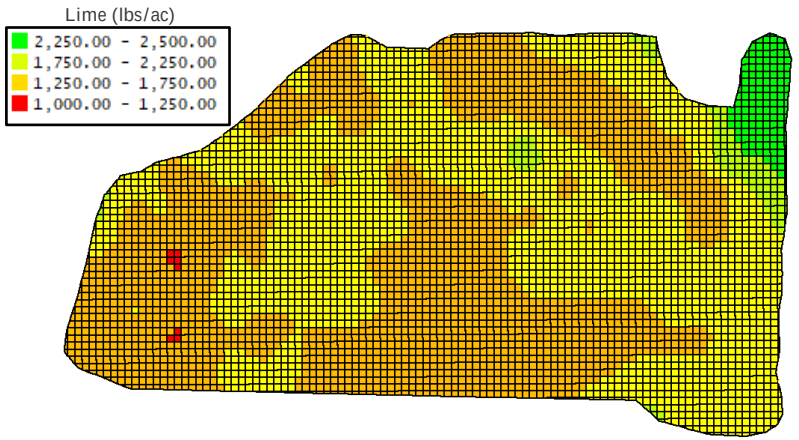
Correlation Analysis – Grid Size

Field 1	
Grid Size	**pH**
1.0	0.94
2.5	0.47
5.0	0.49
7.5	0.56
10.0	-0.21

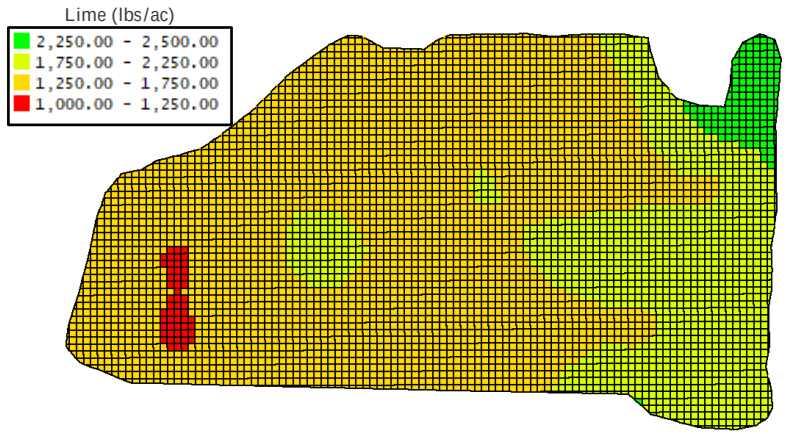
Field 2	
Grid Size	**pH**
1.0	0.95
2.5	0.81
5.0	0.40
7.5	-0.32
10.0	-0.12

Application Accuracy associated with different grid sizes

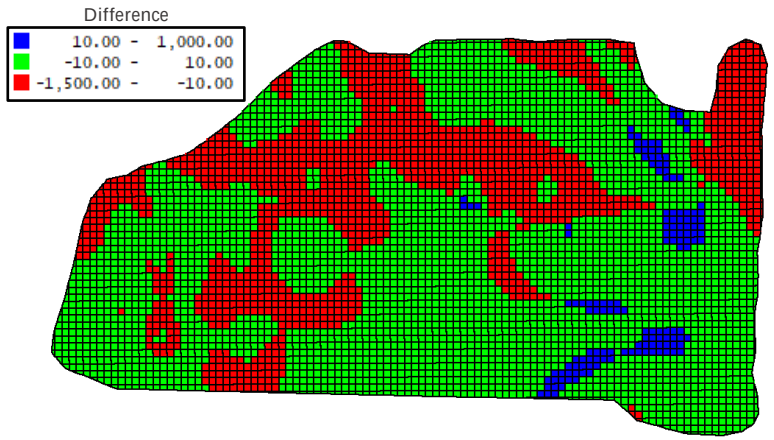
	Grid Size	1.0	2.5	5.0	7.5	10.0
Field 1	**Over**	5	76	22	8	24
	Target	91	13	77	81	76
	Under	4	9	1	10	0
Field 2	**Over**	10	3	1	12	47
	Target	87	66	51	46	45
	Under	3	31	48	42	9



Lime Rx Map (All Soil Points)



Lime Rx Map (2.5 acre)



Lime Difference Map

Correlation Analysis – Zones

MZ	Field 1	Field 2
EC 50	0.94	0.92
EC 25	0.82	0.84
EC 20	0.82	0.79
EC 15	0.71	0.77
EC 10	0.66	0.69
EC 5	0.64	0.68

MZ	Field 1	Field 2
SBI 50	0.94	0.93
SBI 25	0.80	0.77
SBI 20	0.72	0.51
SBI 15	0.69	0.75
SBI 10	0.77	0.75
SBI 5	0.57	0.42

	MZ	EC 50	EC 25	EC 20	EC 15	EC 10	EC 5	SBI 50	SBI 25	SBI 20	SBI 15	SBI 10	SBI 5	Composite
Field 1	Over	8	10	6	10	10	7	9	4	10	13	23	24	26
	Target	88	82	82	80	73	77	88	85	75	76	64	76	74
	Under	4	9	11	10	16	16	3	11	14	11	12	0	0
Field 2	Over	9	11	17	18	8	27	9	12	18	21	27	31	0
	Target	83	74	70	71	58	55	86	73	69	66	62	55	50
	Under	8	15	13	11	35	17	5	14	13	13	11	13	50

Results - Economics

Field	Method	# of Samples	$ of samples	Total Sampling $	Lime (tons)	$ of Lime	Total $	$/ac	% on Target
Field 1	All	53	$ 318.00	$ 444.00	29.4	$ 1,471.29	$ 1,915.29	$ 60.80	100
	1ac	29	$ 174.00	$ 300.00	29.5	$ 1,475.10	$ 1,775.10	$ 56.35	91
	2.5ac	11	$ 66.00	$ 192.00	36.2	$ 1,812.18	$ 2,004.18	$ 63.62	13
	5ac	6	$ 36.00	$ 162.00	31.2	$ 1,558.64	$ 1,720.64	$ 54.62	77
	7.5ac	4	$ 24.00	$ 150.00	29.3	$ 1,465.02	$ 1,615.02	$ 51.27	81
	10ac	3	$ 18.00	$ 144.00	31.4	$ 1,571.56	$ 1,715.56	$ 54.46	76
Field 2	All	163	$ 978.00	$ 1,349.72	60.15575	$ 3,007.79	$ 4,357.51	$ 138.33	100
	1ac	90	$ 540.00	$ 911.72	61.68535	$ 3,084.27	$ 3,995.99	$ 126.86	87
	2.5ac	35	$ 210.00	$ 581.72	53.3223	$ 2,666.12	$ 3,247.84	$ 103.11	66
	5ac	17	$ 102.00	$ 473.72	47.7417	$ 2,387.09	$ 2,860.81	$ 90.82	51
	7.5ac	13	$ 78.00	$ 449.72	51.4405	$ 2,572.03	$ 3,021.75	$ 95.93	46
	10ac	8	$ 48.00	$ 419.72	68.3771	$ 3,418.86	$ 3,838.58	$ 121.86	45

Results - Economics

Field	Method	# of Samples	$ of samples	Total Sampling $	Lime (tons)	$ of Lime	Total $	$/ac	% on Target
Field 1	All	53	$ 318.00	$ 444.00	29.4	$ 1,471.29	$ 1,915.29	$ 60.80	100
	EC 50%	26	$ 156.00	$ 282.00	29.7	$ 1,483.49	$ 1,765.49	$ 56.05	88
	EC 25%	15	$ 90.00	$ 216.00	29.5	$ 1,474.89	$ 1,690.89	$ 53.68	82
	EC 20%	11	$ 66.00	$ 192.00	29.1	$ 1,452.98	$ 1,644.98	$ 52.22	82
	EC 15%	8	$ 48.00	$ 174.00	29.3	$ 1,465.53	$ 1,639.53	$ 52.05	80
	EC 10%	6	$ 36.00	$ 162.00	29.0	$ 1,448.48	$ 1,610.48	$ 51.13	73
	EC 5%	3	$ 18.00	$ 144.00	30.1	$ 1,505.44	$ 1,649.44	$ 52.36	77
	SBI 50%	27	$ 162.00	$ 288.00	29.9	$ 1,494.50	$ 1,782.50	$ 56.59	88
	SBI 25%	15	$ 90.00	$ 216.00	28.9	$ 1,443.07	$ 1,659.07	$ 52.67	85
	SBI 20%	11	$ 66.00	$ 192.00	29.1	$ 1,456.25	$ 1,648.25	$ 52.33	75
	SBI 15%	8	$ 48.00	$ 174.00	29.6	$ 1,478.62	$ 1,652.62	$ 52.46	76
	SBI 10%	6	$ 36.00	$ 162.00	30.3	$ 1,513.54	$ 1,675.54	$ 53.19	64
	SBI 5%	3	$ 18.00	$ 144.00	31.4	$ 1,571.56	$ 1,715.56	$ 54.46	76
	Composite	1	$ 6.00	$ 132.00	31.5	$ 1,575.00	$ 1,707.00	$ 54.19	74
Field 2	All	163	$ 978.00	$ 1,349.72	60.15575	$ 3,007.79	$ 4,357.51	$ 138.33	100
	EC 50%	80	$ 480.00	$ 851.72	60.3	$ 3,015.28	$ 3,867.00	$ 122.76	83
	EC 25%	43	$ 258.00	$ 629.72	59.2	$ 2,962.06	$ 3,591.78	$ 114.02	74
	EC 20%	35	$ 210.00	$ 581.72	60.9	$ 3,046.40	$ 3,628.12	$ 115.18	70
	EC 15%	23	$ 138.00	$ 509.72	61.7	$ 3,085.27	$ 3,594.99	$ 114.13	71
	EC 10%	16	$ 96.00	$ 467.72	52.1	$ 2,606.53	$ 3,074.25	$ 97.60	58
	EC 5%	8	$ 48.00	$ 419.72	62.1	$ 3,103.52	$ 3,523.24	$ 111.85	55
	SBI 50%	81	$ 486.00	$ 857.72	61.1	$ 3,054.29	$ 3,912.01	$ 124.19	86
	SBI 25%	45	$ 270.00	$ 641.72	59.7	$ 2,985.83	$ 3,627.55	$ 115.16	73
	SBI 20%	33	$ 198.00	$ 569.72	60.6	$ 3,031.74	$ 3,601.46	$ 114.33	69
	SBI 15%	25	$ 150.00	$ 521.72	62.2	$ 3,111.26	$ 3,632.98	$ 115.33	66
	SBI 10%	16	$ 96.00	$ 467.72	64.1	$ 3,204.44	$ 3,672.16	$ 116.58	62
	SBI 5%	9	$ 54.00	$ 425.72	65.9	$ 3,296.70	$ 3,722.42	$ 118.17	55
	Composite	1	$ 6.00	$ 377.72	46.5	$ 2,323.25	$ 2,700.97	$ 85.75	50

Conclusions

- **Efficacy of Rx map**
  - **Study suggests as grid size increases the correlation to the "true nutrient variability" decreases as well as "on target" application.**
  - **Correlation values and application accuracy increase as the amount of sampling points increase.**
- **Economics**
  - **Depending on the "amount of error" a grower is willing to take in soil amendment accuracy, the study shows opportunity to decrease the number of samples (reducing overall cost) while maintaining 80% accuracy.**

Future work: Data collection will be focused more on zone delineation and use of multiple spatial data layers to create management zones.

Thank You!

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Georgia Peanut Commission

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