Effectiveness of Different Precision Soil Sampling Strategies for Site-Specific Nutrient Management in Row-Crops

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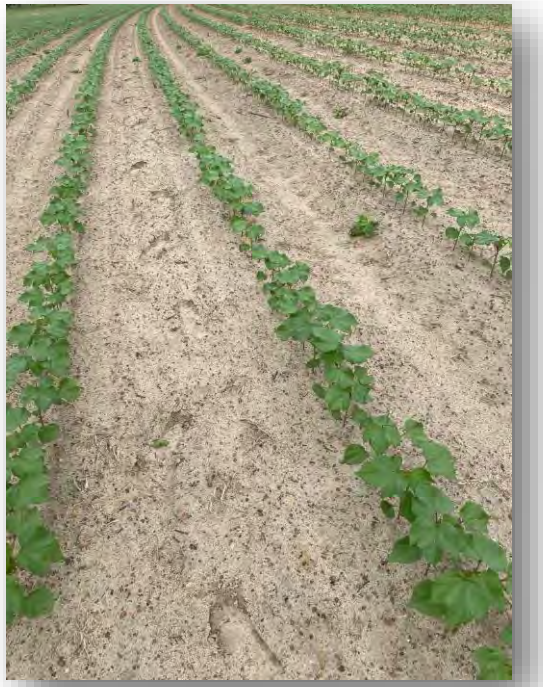
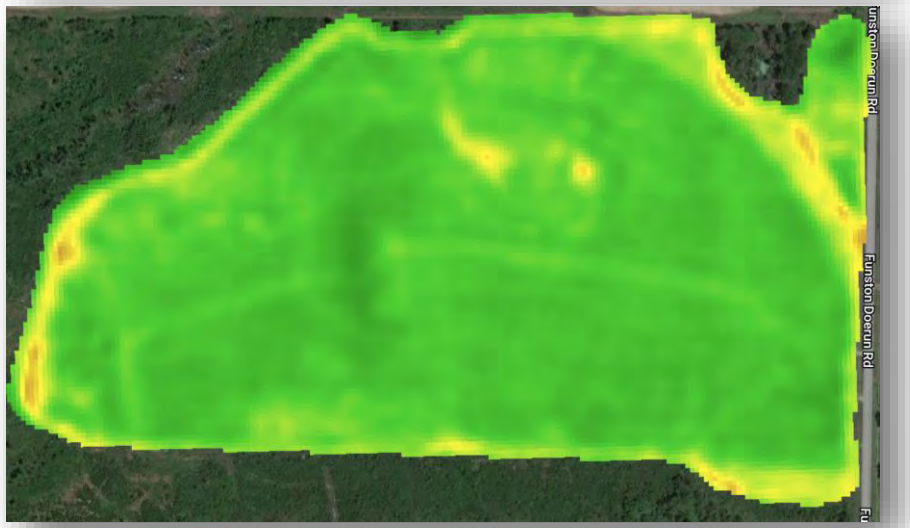
Background

- **Soil spatial variability creates many challenges for row crop production, especially in the Southeastern US.**
  - Soil texture and color
  - Nutrients
  - Stand development
  - Crop health





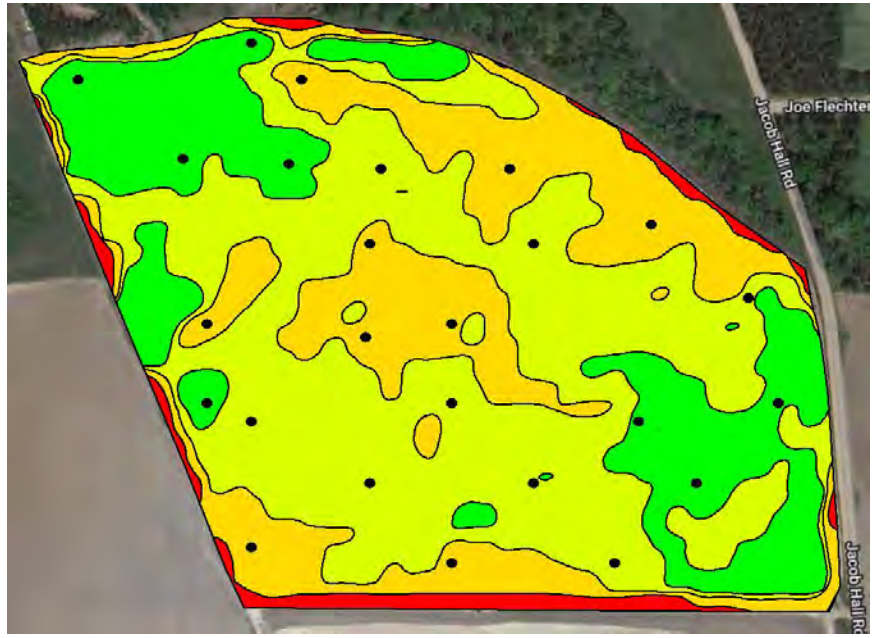
Introduction

❑ Precision Soil Sampling

- Capture spatial variability
- Grid soil sampling
- Zone Sampling

❑ Variable Rate Applications

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



Research Motivation

Growers are interested in making data driven decisions… but they want to be sure they have quality data.

Objective

To evaluate the effectiveness of commonly used precision soil sampling strategies and their influence on the depiction of soil nutrient variability and site-specific nutrient application requirements

Study Locations

- ❑ **7 Locations: 154.77 total hectares**
  - Tift County (22.46 ha)
  - Terrell County (25.50 ha)
  - Jefferson County (36.83 ha)
  - Colquitt County (37.64 ha)
  - Burke County (9.10 ha)
  - Sumter County (10.52 ha)
  - Worth County (12.72 ha)

Methods and Materials

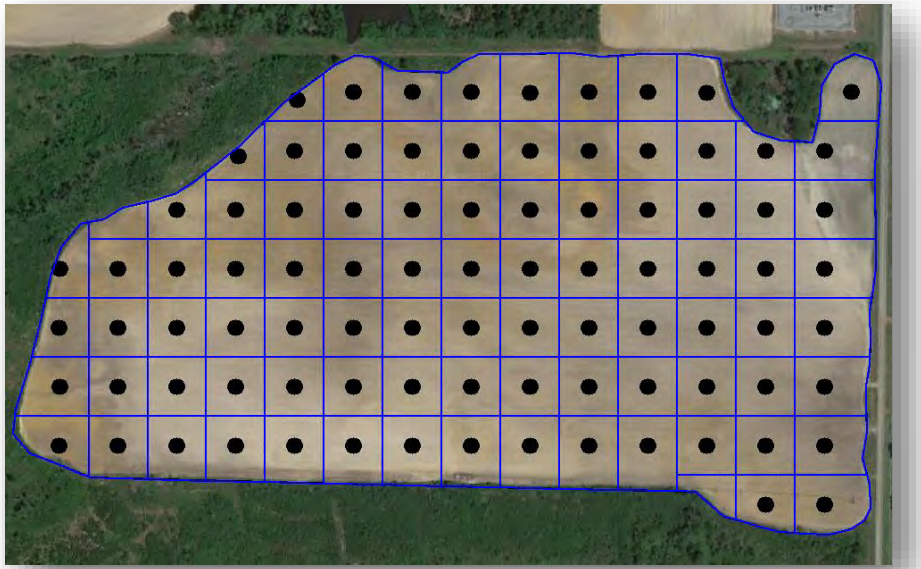
❑ Grid Sampling

- Grids were created in sizes of 0.4, 1.0, 2.0, 3.0, 4.0 ha
- Point sampling method
- 15.25cm depth
- 12-15 cores

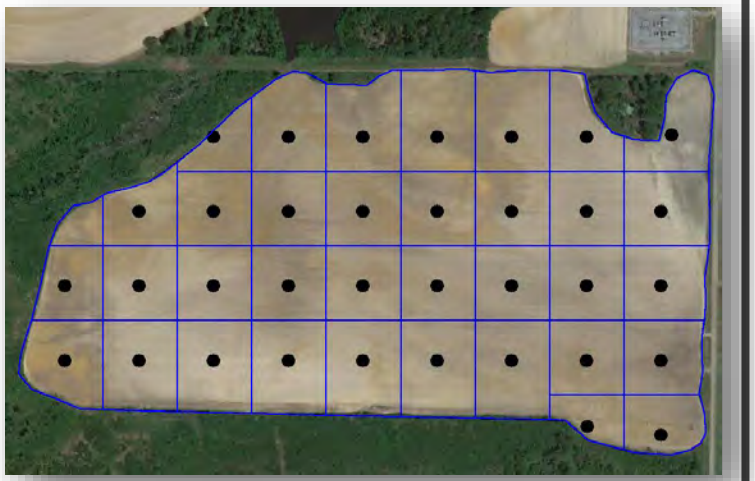
2.0 ha

3.0 ha

0.4 ha



1.0 ha

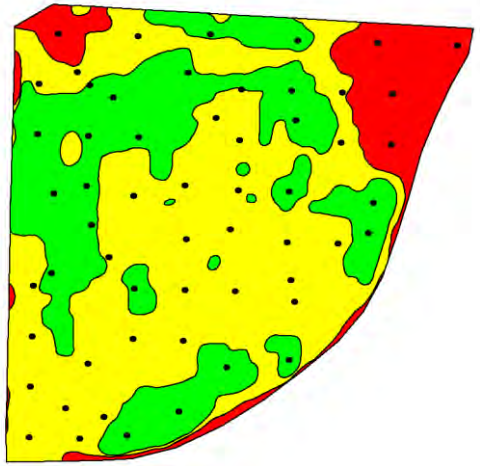


4.0 ha

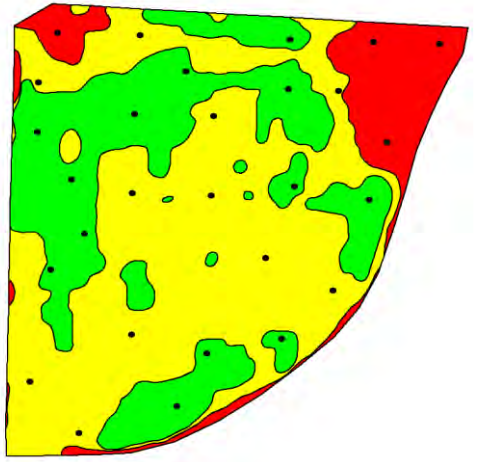
Methods and Materials

❑ Zone Sampling

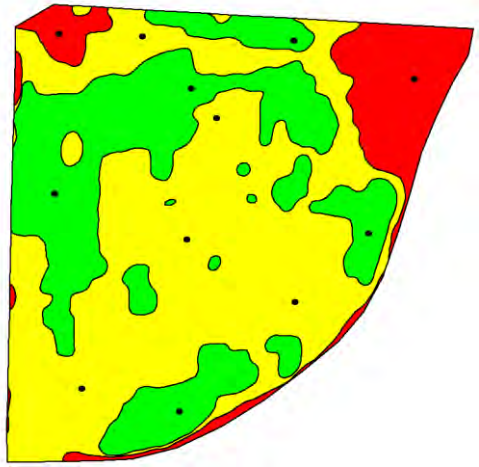
- MZ's were created using two spatial data layers
  - Electrical Conductivity (EC)
  - Soil Brightness (SBI)
- Soil sampling locations were selected from the locations previously sampled for the grid-based method
- Three % of all soil points were used for each zone method
  - 50% ≈ 0.4 ha per sample
  - 25% ≈ 1 ha per sample
  - 10% ≈ 2 ha per sample



50% EC (60 samples)



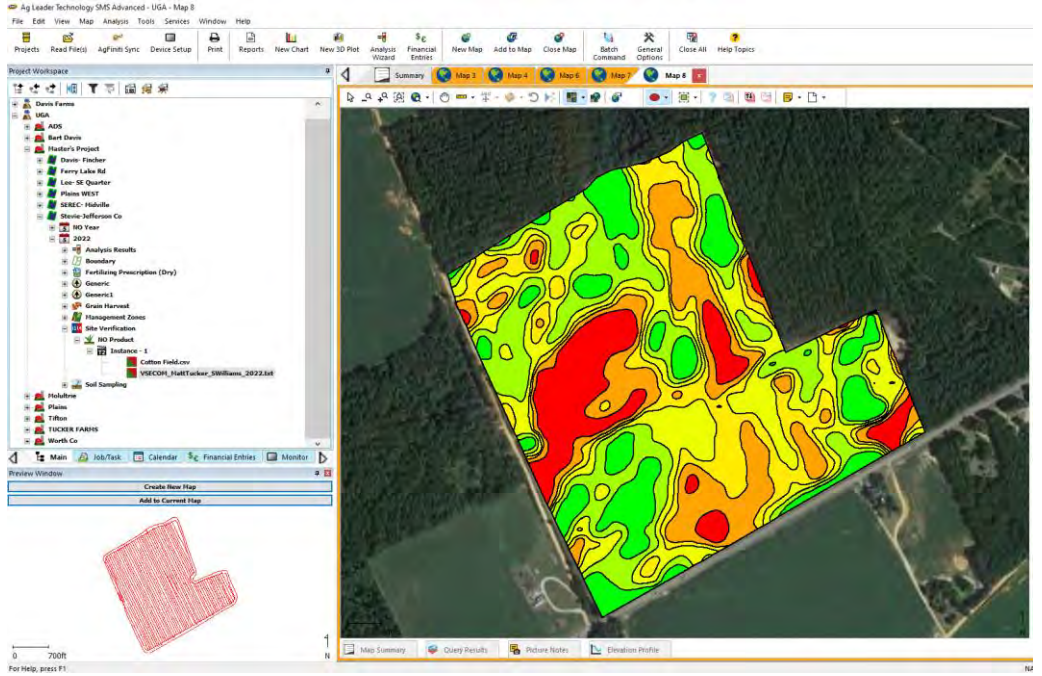
25% EC (30 samples)

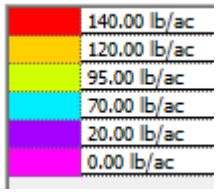


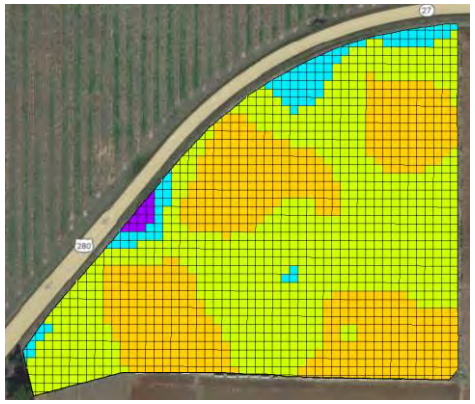
10% EC (12 samples)

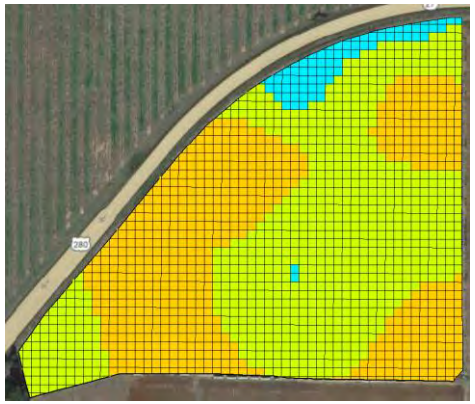
Data Analysis and GIS

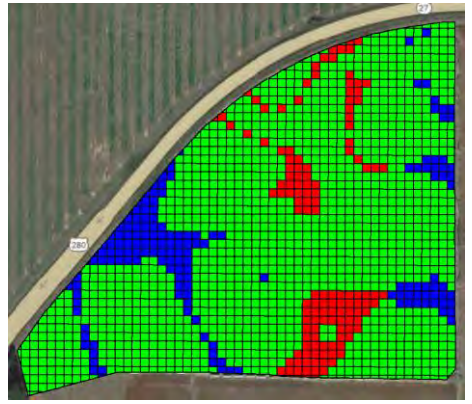
- Interpolation using the Inverse Distance Weighting (IDW) method in SMS Advanced
- Correlation analysis was conducted among the sampling strategies in JMP Pro 15
- Rx maps were created for Lime, Phosphorous, and Potassium in SMS Advanced











Results - Grids

Grid Size	Tifton		
ha	pH	P	K
0.4	0.96	0.98	0.96
1.0	0.92	0.96	0.75
2.0	0.77	0.69	0.61
3.0	0.78	0.90	0.35
4.0	-0.17	0.89	0.47

Grid Size	Midville		
ha	pH	P	K
0.4	0.82	0.92	0.98
1.0	0.46	0.45	0.74
2.0	0.30	-0.22	-0.12
3.0	-0.14	0.09	0.65
4.0	-0.22	0.20	0.61

Grid Size	Plains		
ha	pH	P	K
0.4	0.60	0.66	0.98
1.0	0.72	0.47	0.90
2.0	0.21	0.08	0.67
3.0	0.14	-0.17	0.48
4.0	-0.25	0.08	0.43

Grid Size	Average (7 Locations)		
ha	pH	P	K
0.4	0.87	0.91	0.96
1.0	0.57	0.73	0.74
2.0	0.43	0.46	0.48
3.0	0.22	0.41	0.52
4.0	-0.09	0.50	0.46

Application Accuracy

Barts

		0.4	1	2	3	4
pH	Over	10	3	1	12	47
	Target	87	66	51	46	45
	Under	3	31	48	42	9
P	Over	10	12	26	21	22
	Target	84	58	49	42	42
	Under	6	30	26	36	35
K	Over	9	20	16	7	32
	Target	85	57	52	49	44
	Under	6	22	32	45	24

Tifton

		0.4	1	2	3	4
pH	Over	6	3	9	29	41
	Target	89	85	75	66	34
	Under	5	13	16	5	24
P	Over	2	12	20	17	7
	Target	92	82	70	74	77
	Under	6	6	10	9	15
K	Over	5	13	10	30	28
	Target	88	72	66	49	54
	Under	6	14	23	21	18

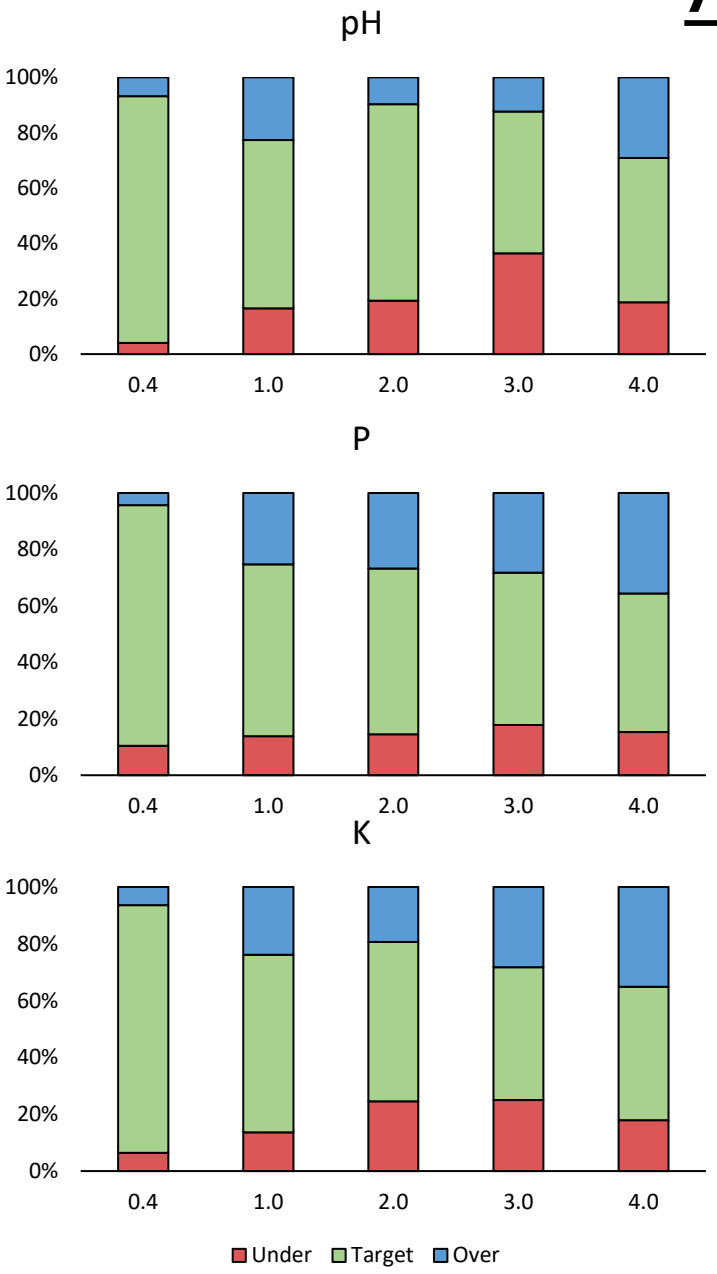
Lee

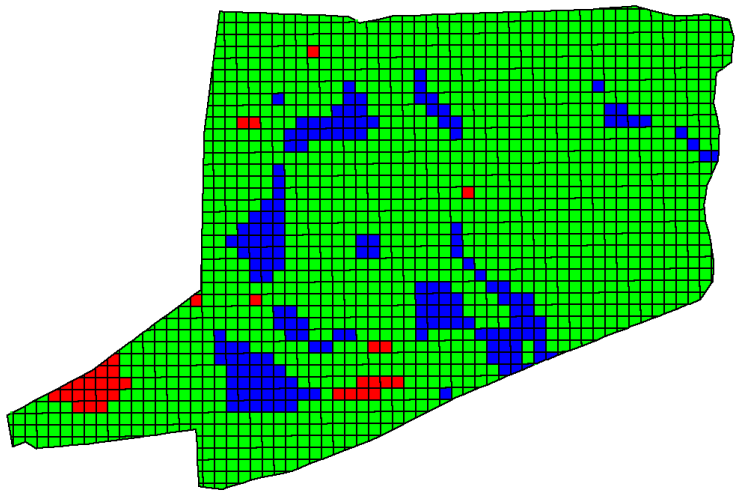
		0.4	1	2	3	4
pH	Over	6	9	7	0	4
	Target	90	78	81	11	54
	Under	4	13	13	89	42
P	Over	1	58	35	54	77
	Target	75	36	53	32	20
	Under	23	5	12	14	3
K	Over	1	35	19	51	66
	Target	89	59	68	38	32
	Under	10	6	13	11	2

Worth

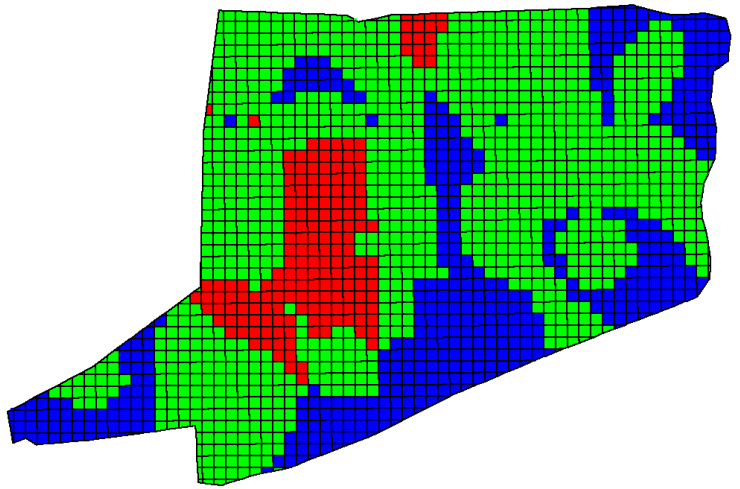
		0.4	1	2	3	4
pH	Over	5	76	22	8	24
	Target	91	13	77	81	76
	Under	4	9	1	10	0
P	Over	3	19	27	21	36
	Target	91	68	63	67	57
	Under	6	14	10	12	8
K	Over	11	27	32	25	15
	Target	87	61	39	51	58
	Under	2	12	29	24	27

Application Accuracy

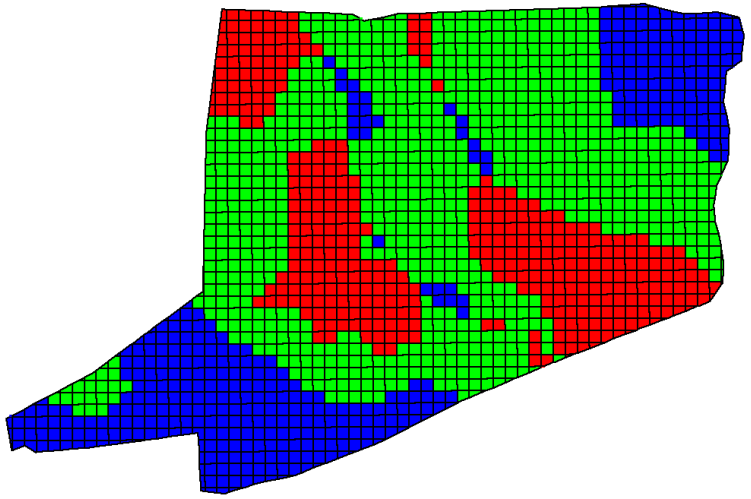




1ac K: 13% off-target



2.5ac K: 39% off-target



7.5ac K: 49% off-target

Results – Zones

	Barts		
Zone Method	pH	P	K
EC 10	0.69	0.35	0.43
EC 25	0.84	0.83	0.73
EC 50	0.92	0.93	0.88
SBI 10	0.75	0.54	0.36
SBI 25	0.77	0.68	0.70
SBI 50	0.93	0.89	0.90

	Lee		
Zone Method	pH	P	K
EC 10	0.31	0.64	0.35
EC 25	0.44	0.68	0.68
EC 50	0.54	0.85	0.88
SBI 10	0.05	0.53	0.61
SBI 25	0.46	0.70	0.71
SBI 50	0.71	0.84	0.86

	Tifton		
Zone Method	pH	P	K
EC 10	0.89	0.92	0.52
EC 25	0.87	0.96	0.82
EC 50	0.94	0.98	0.92
SBI 10	0.66	0.93	0.68
SBI 25	0.88	0.94	0.68
SBI 50	0.95	0.98	0.90

	Worth		
Zone Method	pH	P	K
EC 10	0.66	0.83	0.84
EC 25	0.82	0.84	0.80
EC 50	0.94	0.72	0.85
SBI 10	0.77	-0.36	0.87
SBI 25	0.80	0.83	0.37
SBI 50	0.94	0.70	0.43

Application Accuracy

Barts

		EC 10	EC 25	EC 50	SBI 10	SBI 25	SBI 50
pH	Over	8	11	9	27	12	9
	Target	58	74	83	62	73	86
	Under	35	15	8	11	14	5
P	Over	23	21	13	22	30	15
	Target	52	64	75	53	59	76
	Under	25	14	12	25	11	9
K	Over	29	19	16	30	22	9
	Target	48	64	76	45	62	79
	Under	24	17	8	24	16	12

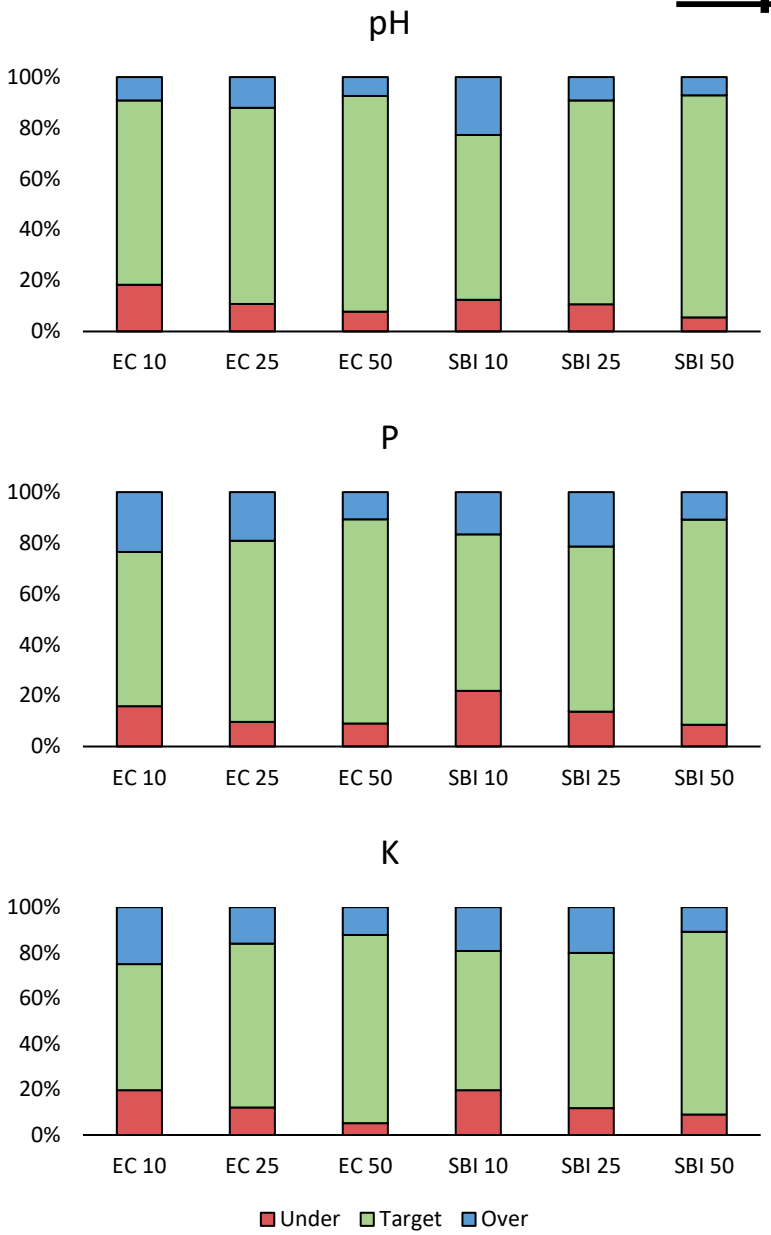
Tifton

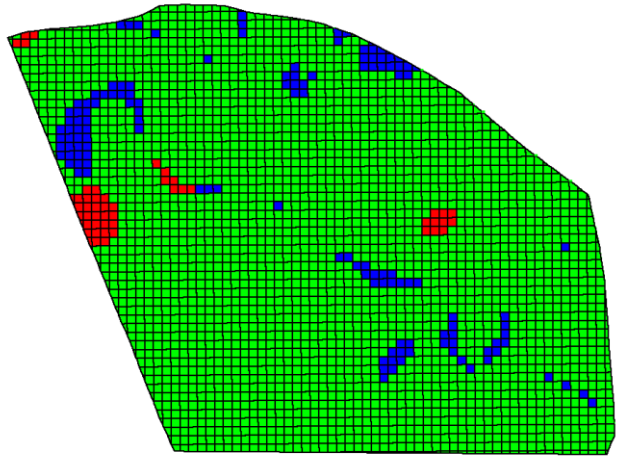
		EC 10	EC 25	EC 50	SBI 10	SBI 25	SBI 50
pH	Over	10	15	8	32	4	5
	Target	83	76	85	55	82	88
	Under	8	9	7	13	15	7
P	Over	6	9	2	10	3	5
	Target	80	88	91	77	87	93
	Under	14	4	7	13	10	2
K	Over	17	14	11	20	19	9
	Target	59	76	85	68	70	83
	Under	24	10	4	12	10	8

Lee

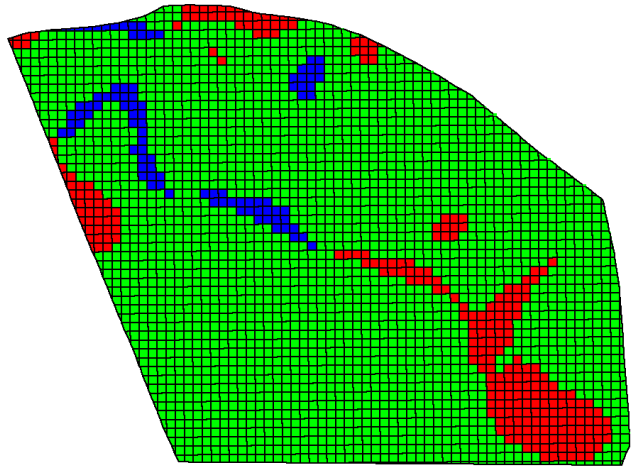
		EC 10	EC 25	EC 50	SBI 10	SBI 25	SBI 50
pH	Over	10	10	6	10	12	8
	Target	77	81	86	81	86	87
	Under	12	9	8	14	3	5
P	Over	41	27	18	18	31	13
	Target	50	62	74	55	49	72
	Under	9	11	8	27	20	15
K	Over	29	15	10	7	18	14
	Target	59	76	87	70	73	79
	Under	11	9	3	23	9	7

Application Accuracy

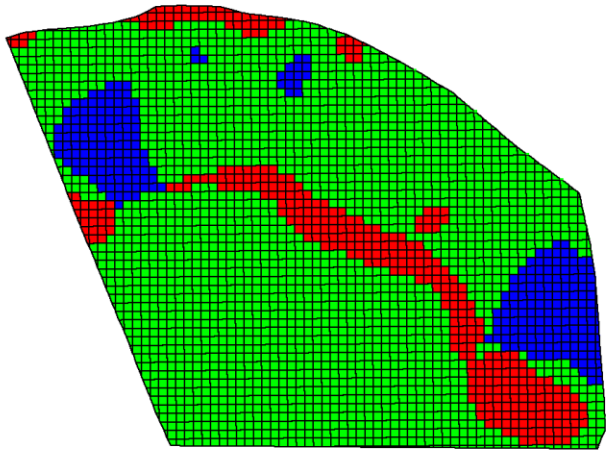




SBI 50: 7% off-target



SBI 25: 13% off-target



SBI 10: 23% off-target

Summary

❑ Grid Soil Sampling

- **Study suggests as grid size increases the correlation to the "true nutrient variability" and application accuracy decreases.**
- **On average the 0.4-ha grid size method was found to explain the largest amount of nutrient variability and create the most accurate Rx maps across all locations.**

❑ Zone Soil Sampling

- **Correlation values for zone sampling methods, in most cases, increase as the amount of sampling points increases.**
- **Application accuracy increases as the sampling points increase, while it is subjective to the grower to determine the amount of error they are willing to accept. SBI and EC both show potential to be valuable layers in management zone creation.**

Future work: Year two of data collection will be focused more on zone delineation and economical analysis to determine what soil sampling method is most cost effective.

Thank you!

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