Potential of Zone-Based Soil Sampling Strategies for Site-Specific Nutrient Management in Cotton

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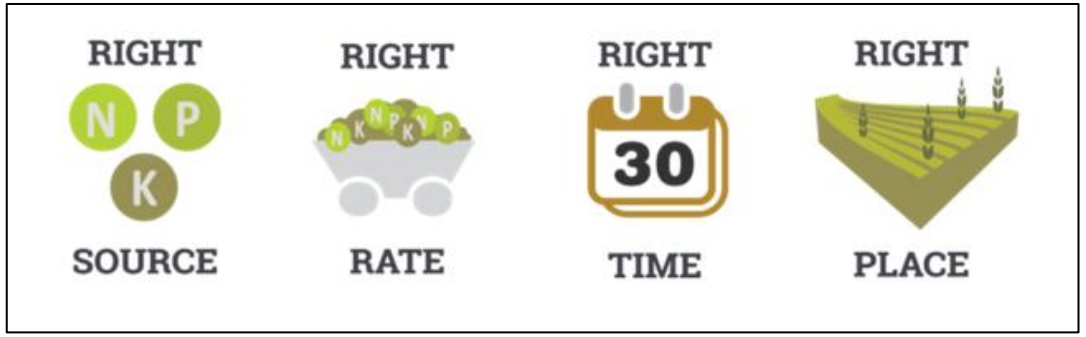
Introduction

- **Proper nutrient management –** important for high cotton yields
- **4R's of nutrient management –** ensures right source, rate, time, and placement
- **Site-specific nutrient management –** variable-rate fertilizer applications (P & K - right rate at the right place)



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)

Research on Optimal Soil Sampling Grid Size

1.0 ac

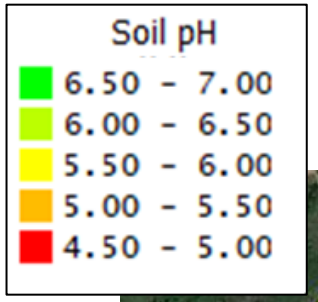
2.5 ac

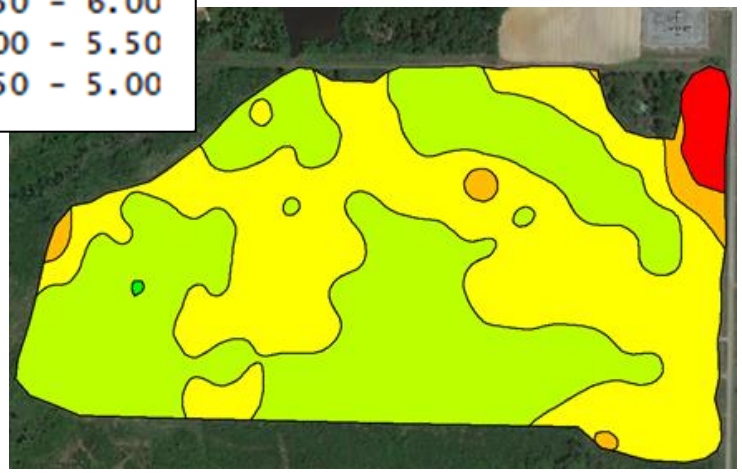
5.0 ac

7.5 ac

10.0 ac

Research on Optimal Soil Sampling Grid Size





Assumed actual spatial variability

1.0 ac

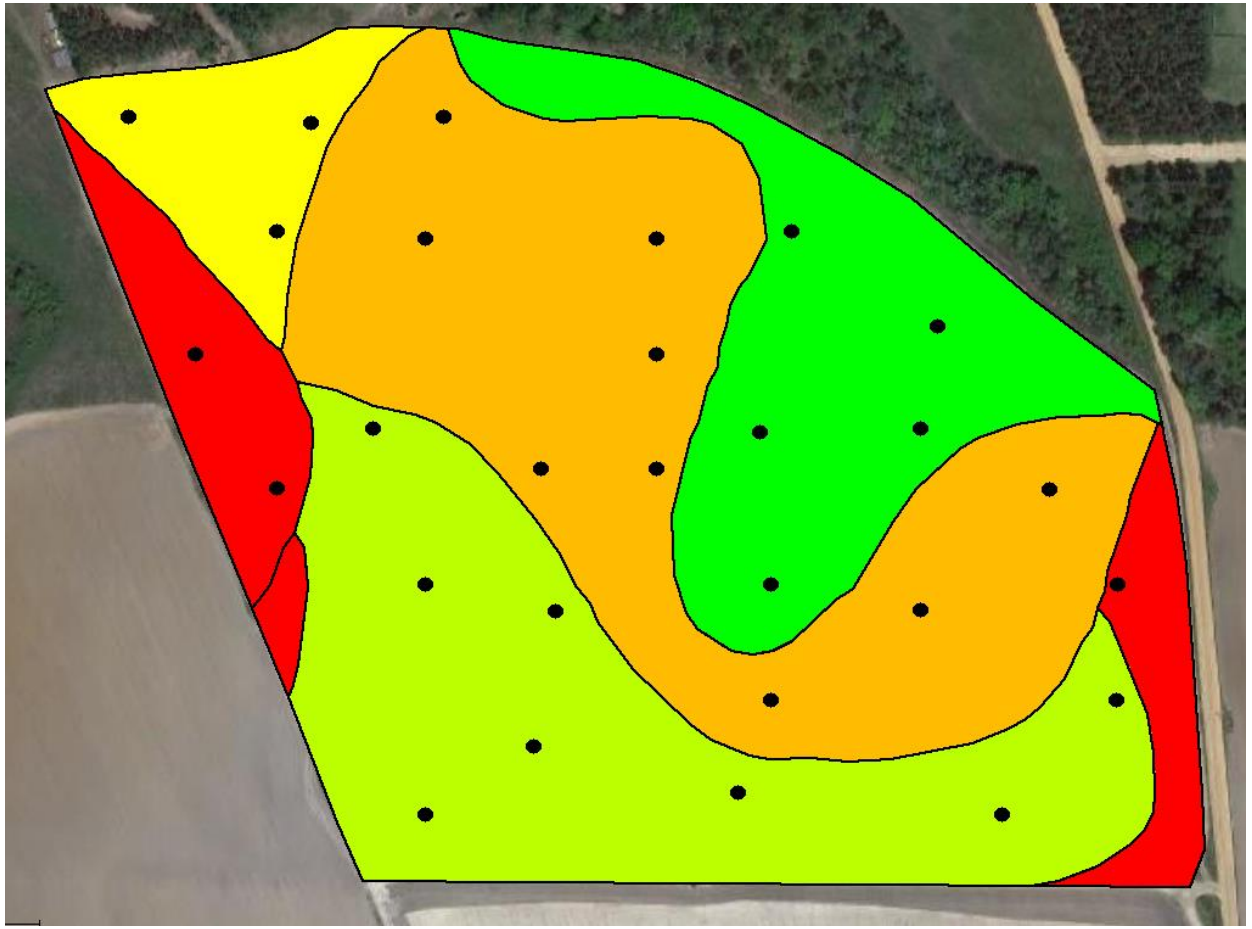
2.5 ac

5.0 ac

7.5 ac

10.0 ac

Zone-Based Soil Sampling



1-ac grid : 53 samples

- 5 Zones = 5 Soil Samples *(composite for each zone)*
- Each zone = 3 – 10 soil cores mixed together to make a composite sample
- Potential to reduce the number of soil samples while providing similar spatial representation of soil nutrient levels

Hypothesis

Zone-based soil sampling can depict similar nutrient spatial variability as grid sampling while lowering the overall application costs

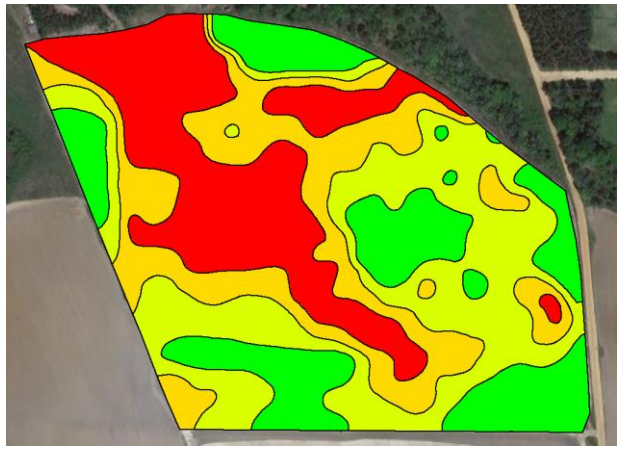
Objective

To investigate the potential of different zone-based soil sampling strategies for site-specific nutrient management in cotton

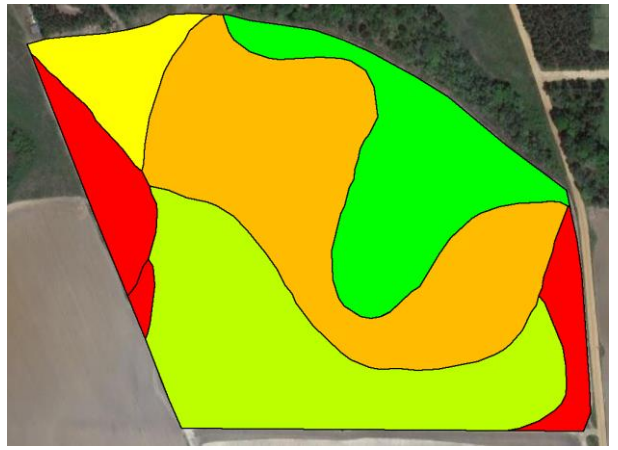
Zone Sampling – Strategy 1

Zones based on single soil/crop spatial layers:

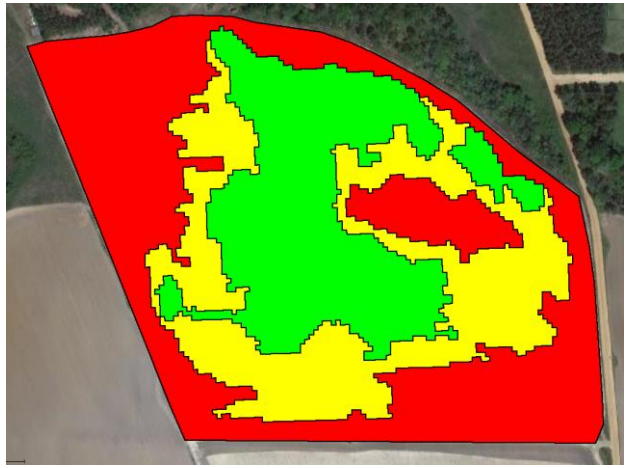
- Soil EC – collected using Veris equipment
- Soil type – SSURGO maps
- Crop imagery – aerial satellite images (AgStudio)
- Soil Color/Brightness – bare soil imagery (Planet Labs)



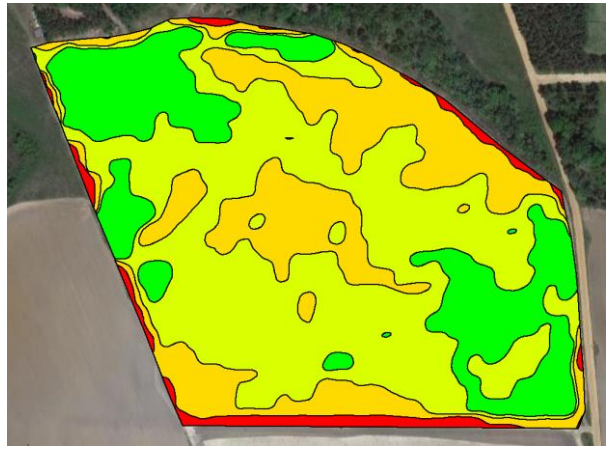
Soil EC (4 zones)



Soil Type (5 zones)



In-Season Crop Imagery (3 zones)

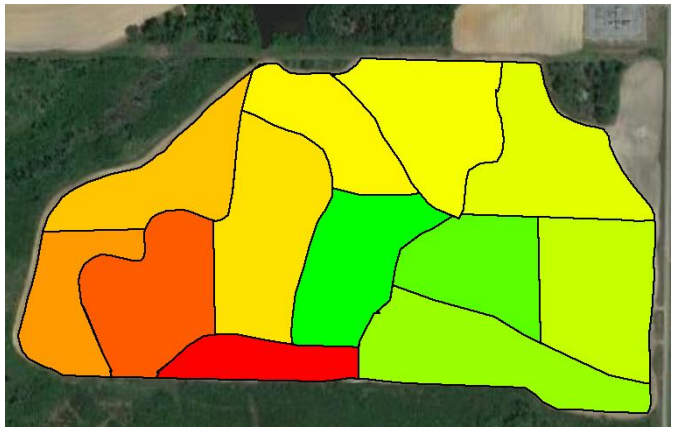


Soil Color/Brightness (3 zones)

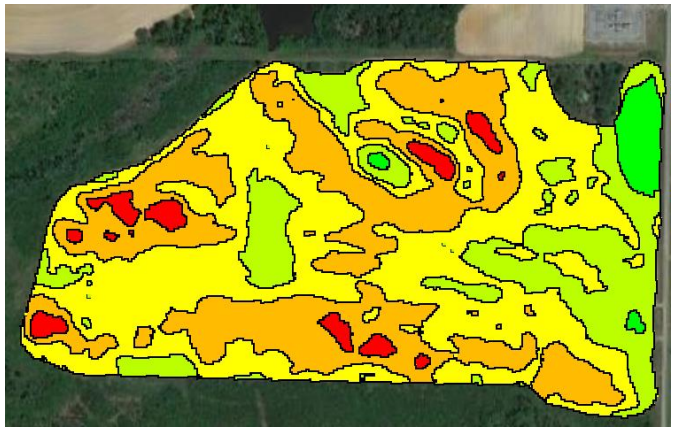
Zone Sampling – Strategy 2

Zones based on combining two or more spatial layers:

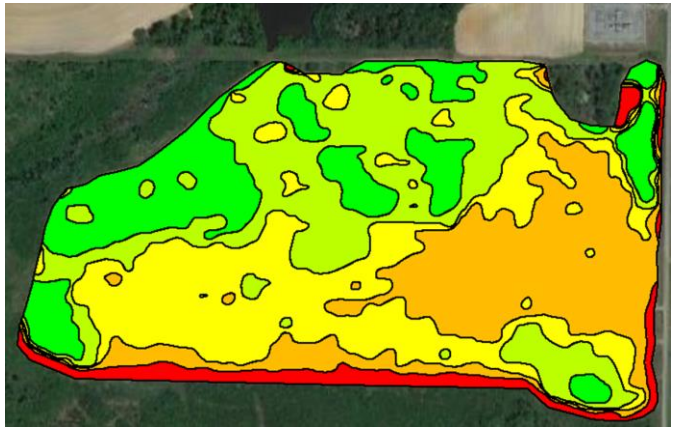
- Field knowledge and yield – Grower knowledge of the field plus yield data
- Soil color and elevation – bare soil imagery plus elevation from equipment



Field Knowledge and Yield (12 samples)



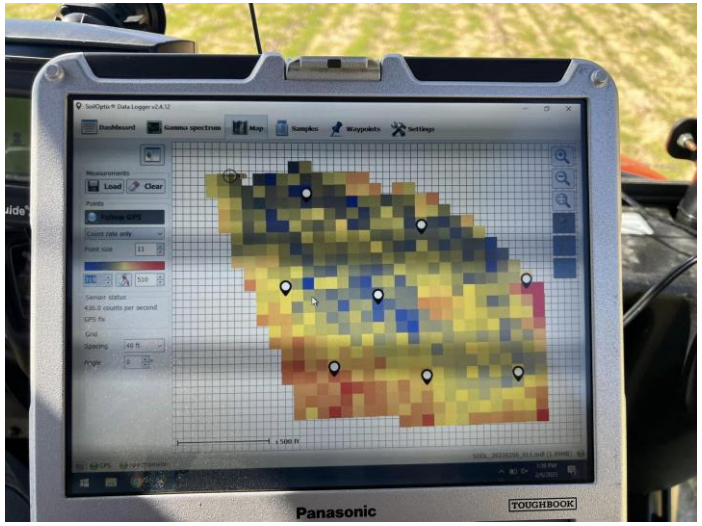
Soil Color and Elevation (5 samples)

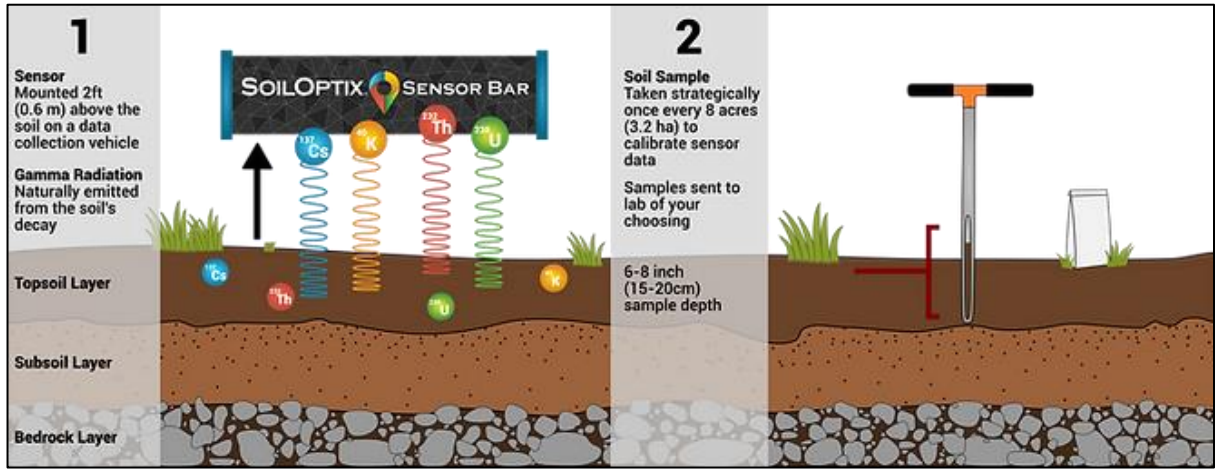


Soil Color/Brightness (5 samples)

Soil EC (4 samples)

Zone Sampling – Strategy 3



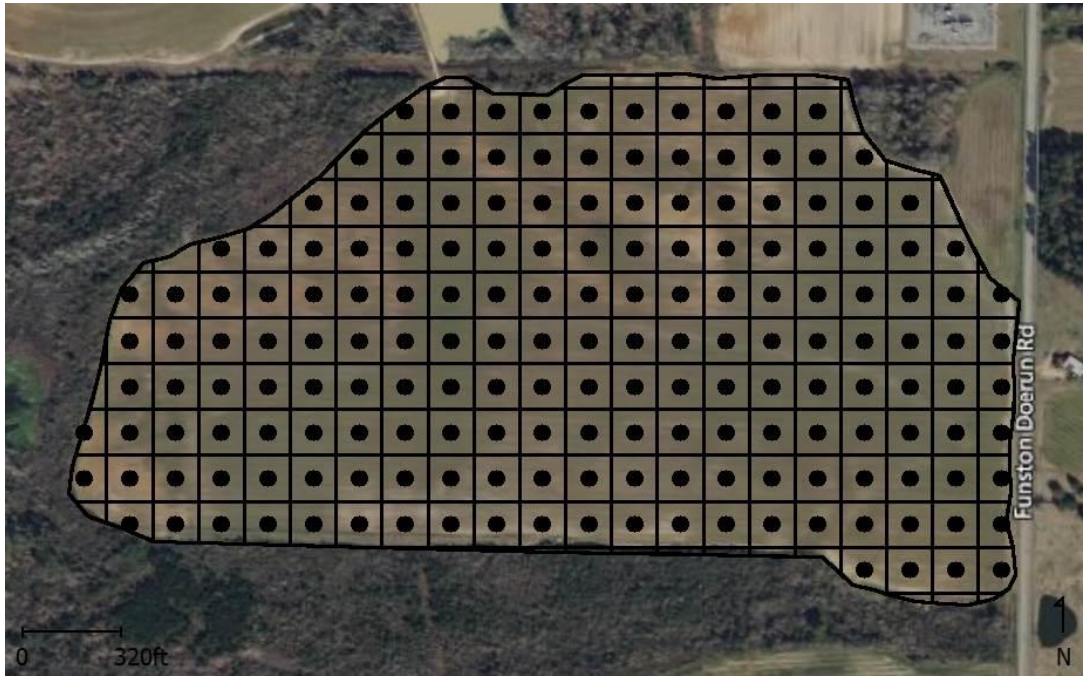


Commercial Provider/Software:

- Soil Optix (Gamma Radiation sensor)
- 2 ft off the ground and 40 ft swaths
- Measures natural geological properties emitted from the soil's decay
- Soil samples are taken in strategically placed locations (min. 4 samples per field)

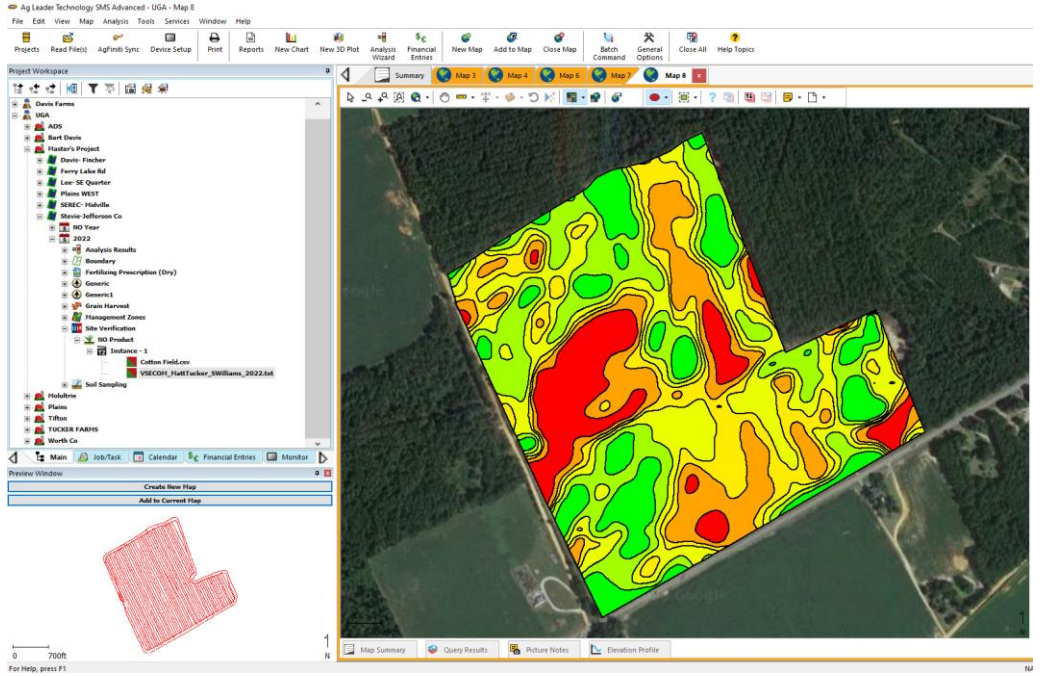
Nutrient Maps and Spatial Data Analysis

- Soil sampling on 0.5 ac grids to obtain a reference of spatial nutrient variability within each field



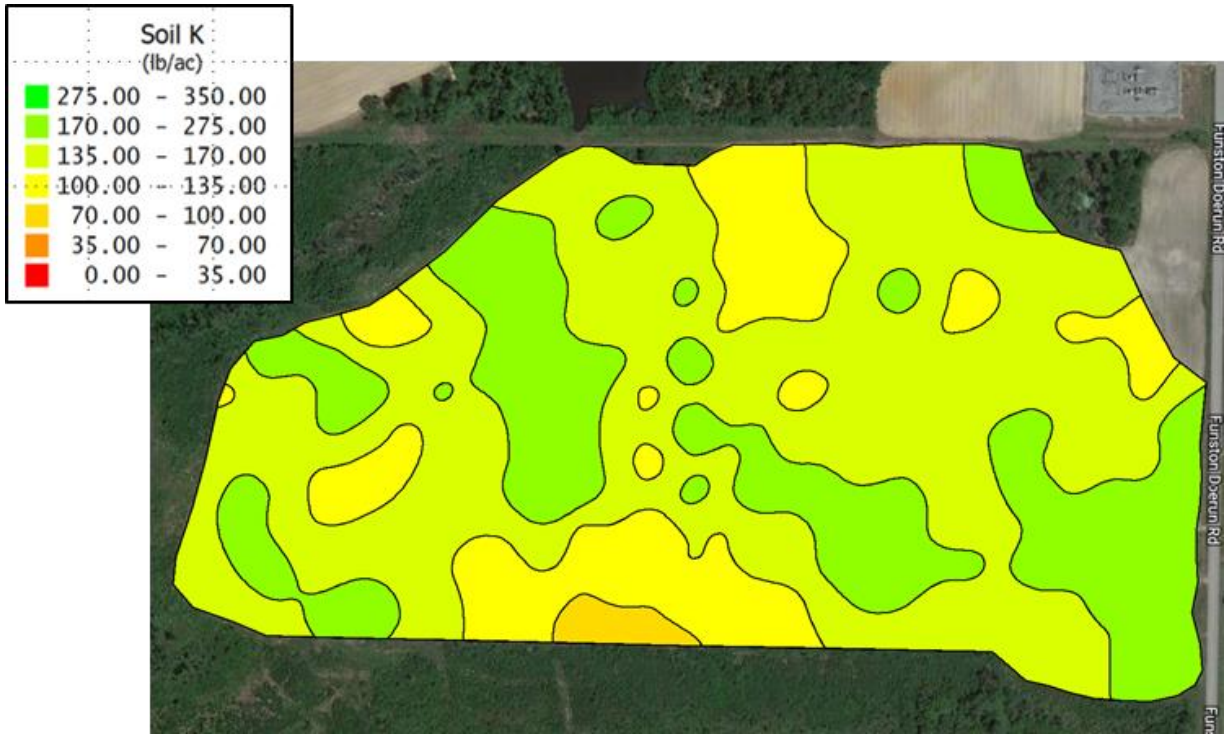
- All spatial data and analysis was performed using SMS Advanced Software (AgLeader Technology)

- Spatial nutrient maps were generated using IDW interpolation method.



Spatial and Economic Analysis

- Prescription (Rx) maps were created for Lime, Phosphorus, and Potassium using **cotton yield goal of 1200 lbs/ac and UGA Cotton Fertility recommendations.**



- Soil Sampling = $4/ac, Sample analysis = $6/ac
- Lime = $50/ton, P = $0.67/lb, K = $0.68/lb

Total Cost ($/ac)

=

Soil Sampling Cost ($/ac)

+

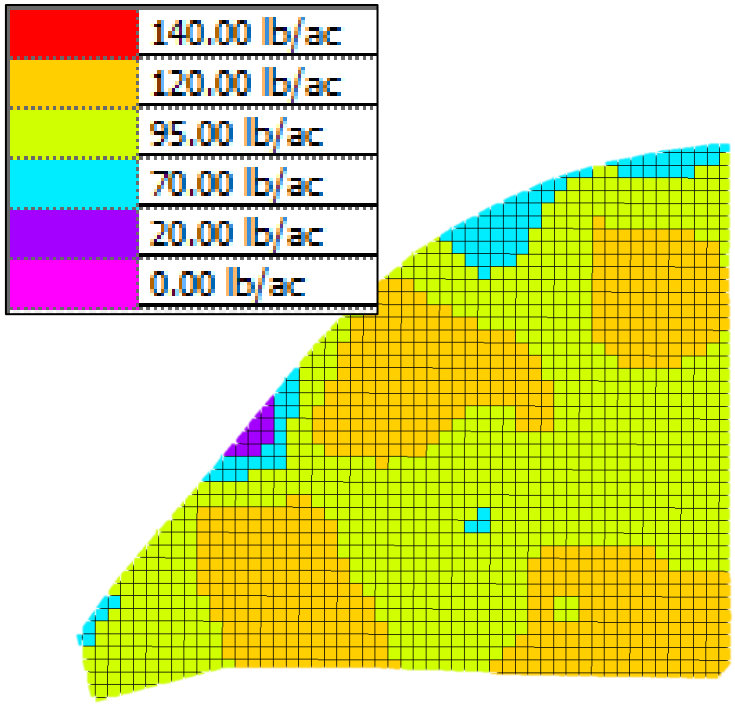
Soil Analysis Cost ($/ac)

+

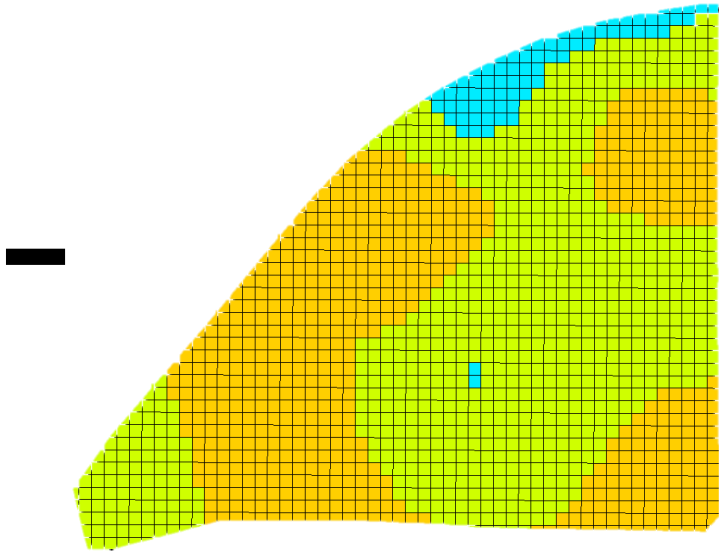
Fertilizer Cost ($/ac)

https://agecon.uga.edu/content/dam/caes-subsite/ag-econ/documents/extension/budgets/2023-budgets/2023-Irr-Cotton.xlsx

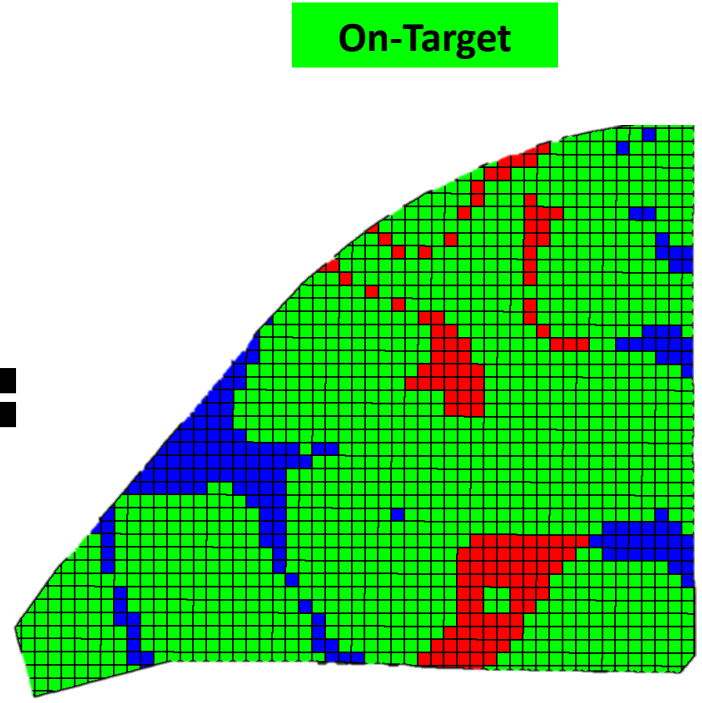
Application Accuracy Assessment



K Prescription Map
(Assumed actual spatial nutrient variability)



K Prescription Map
(EC data sampling)



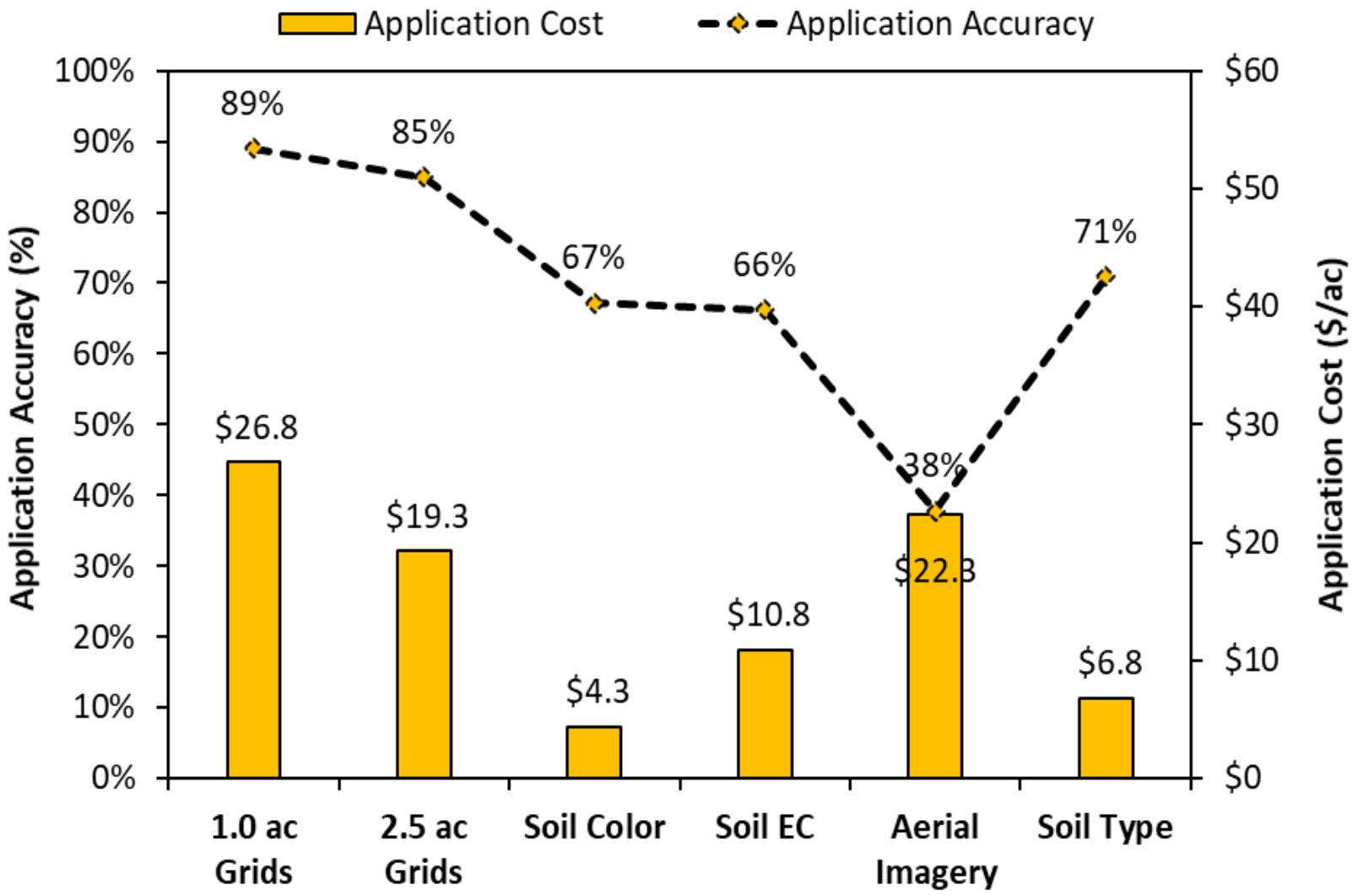
Map showing on-target, under- and over-application areas

Under Applied

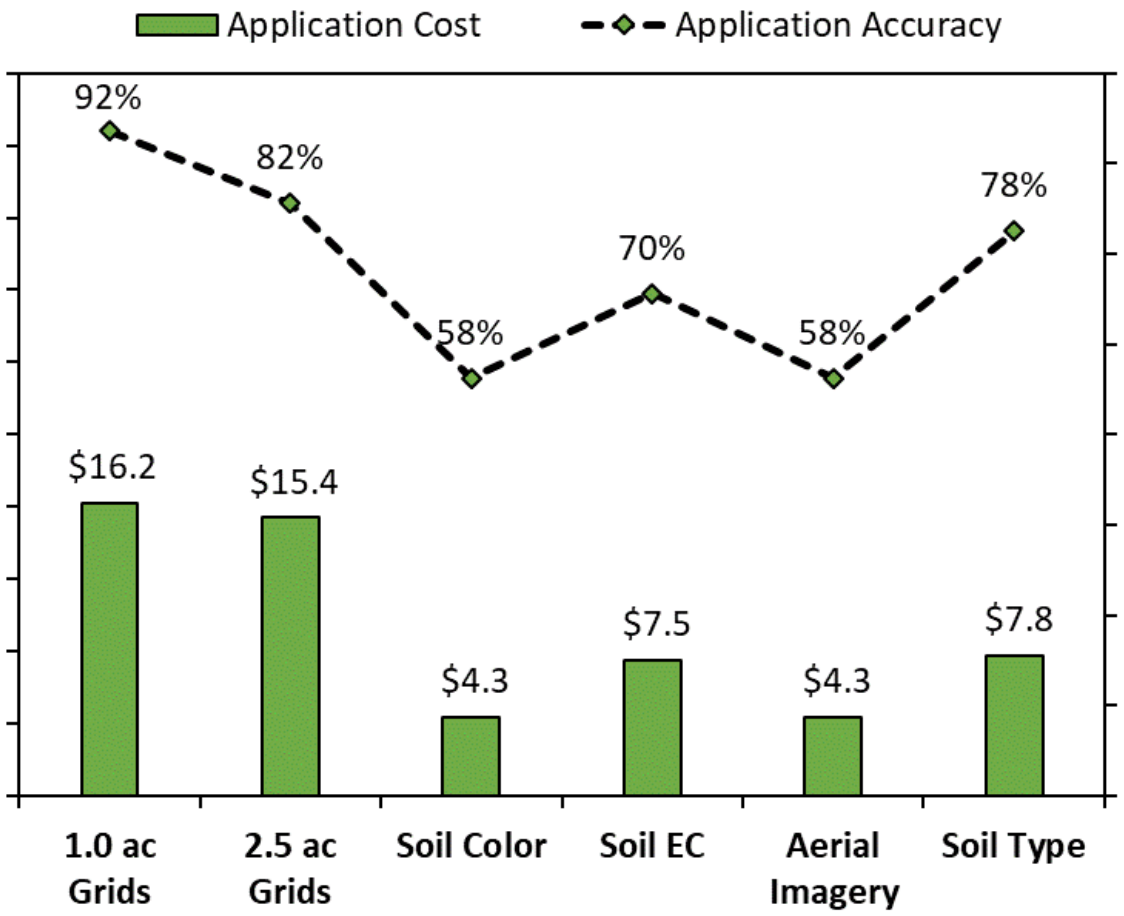
Over Applied

Results – Zone Sampling Strategy 1

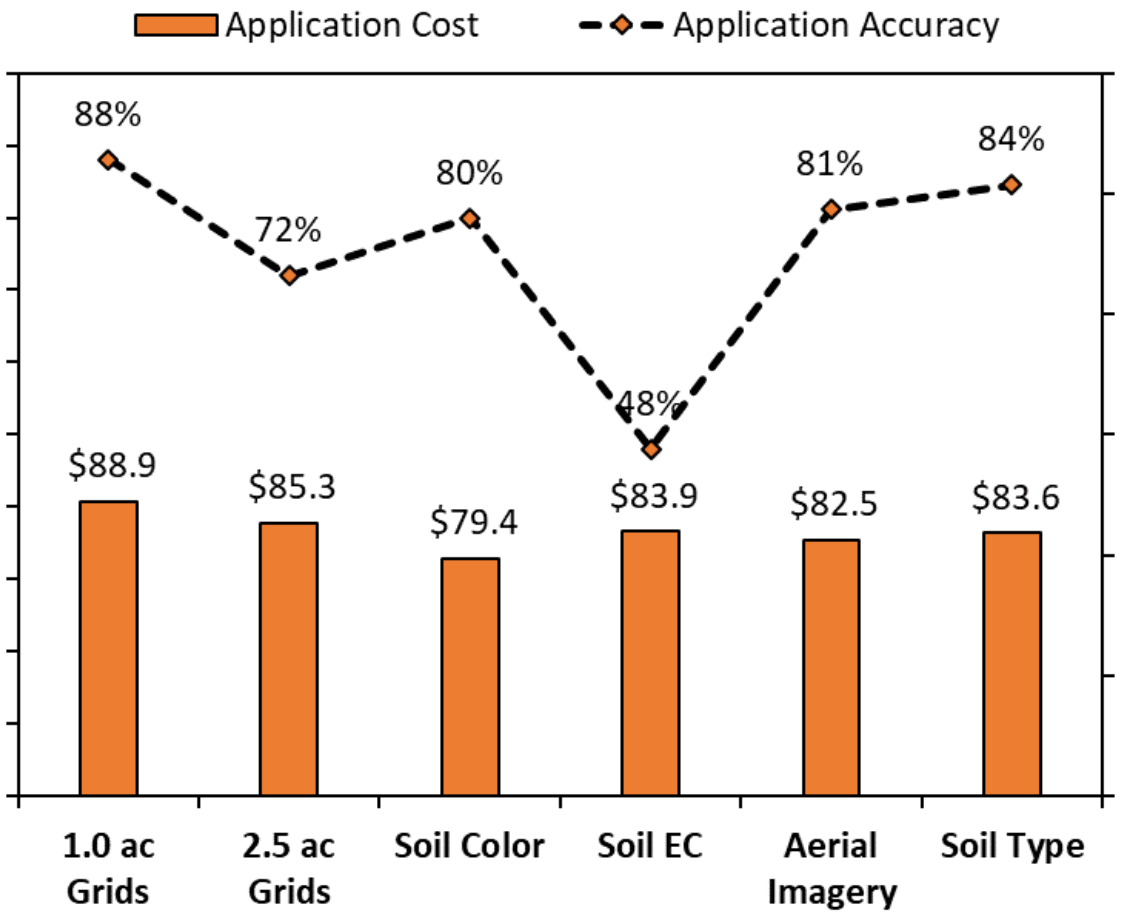
(Lime)



Phosphorus (P)

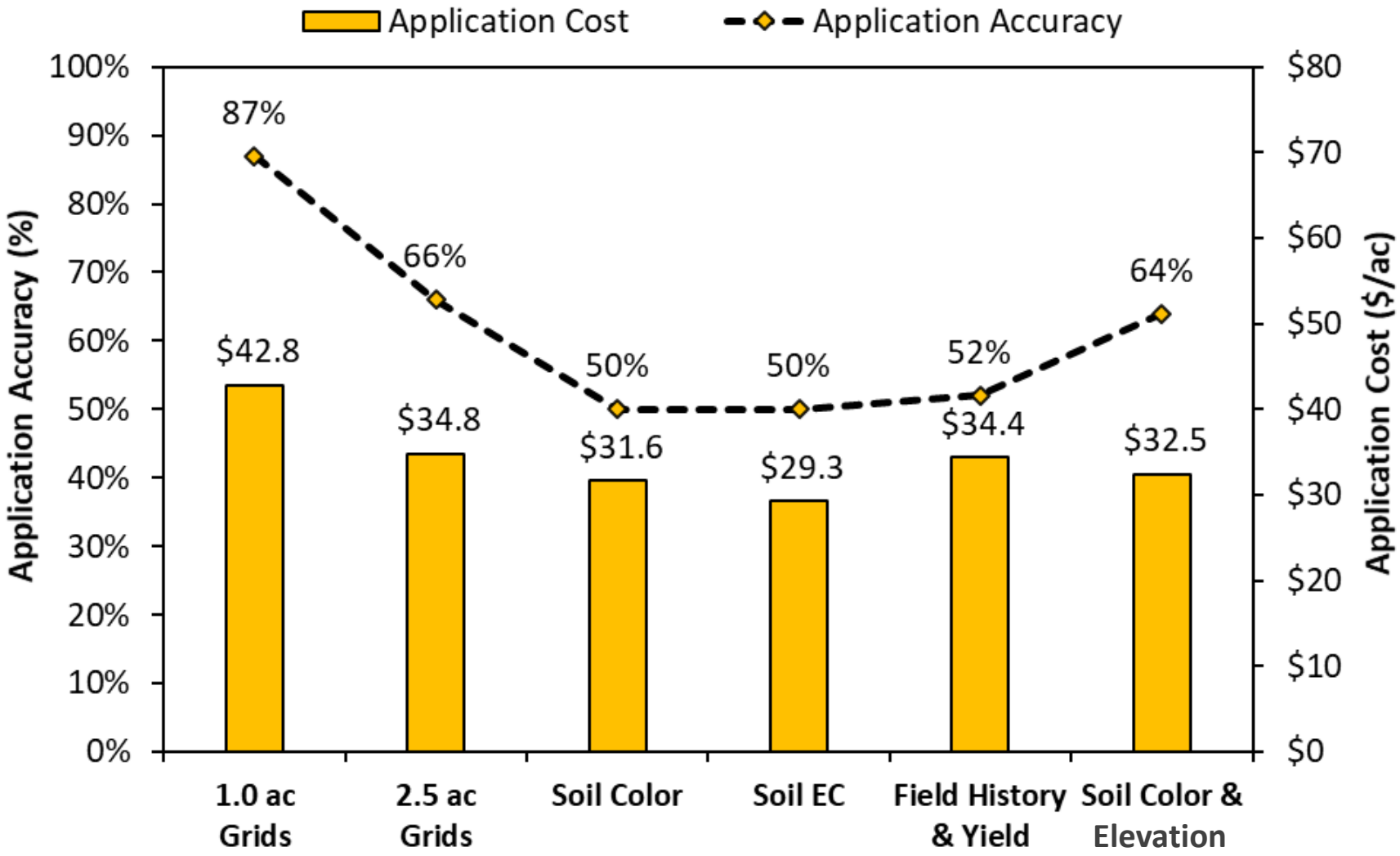


Potassium (K)

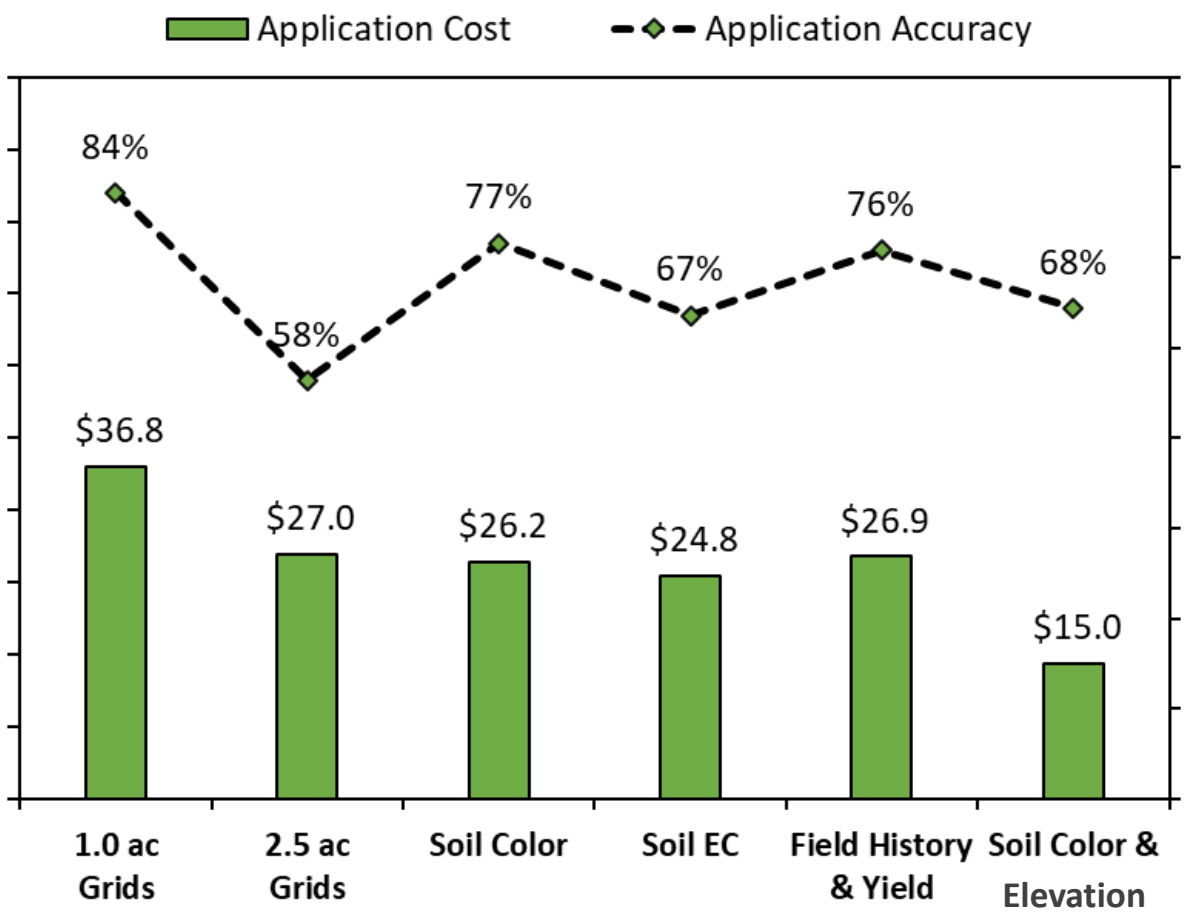


Zone Sampling Strategy 2

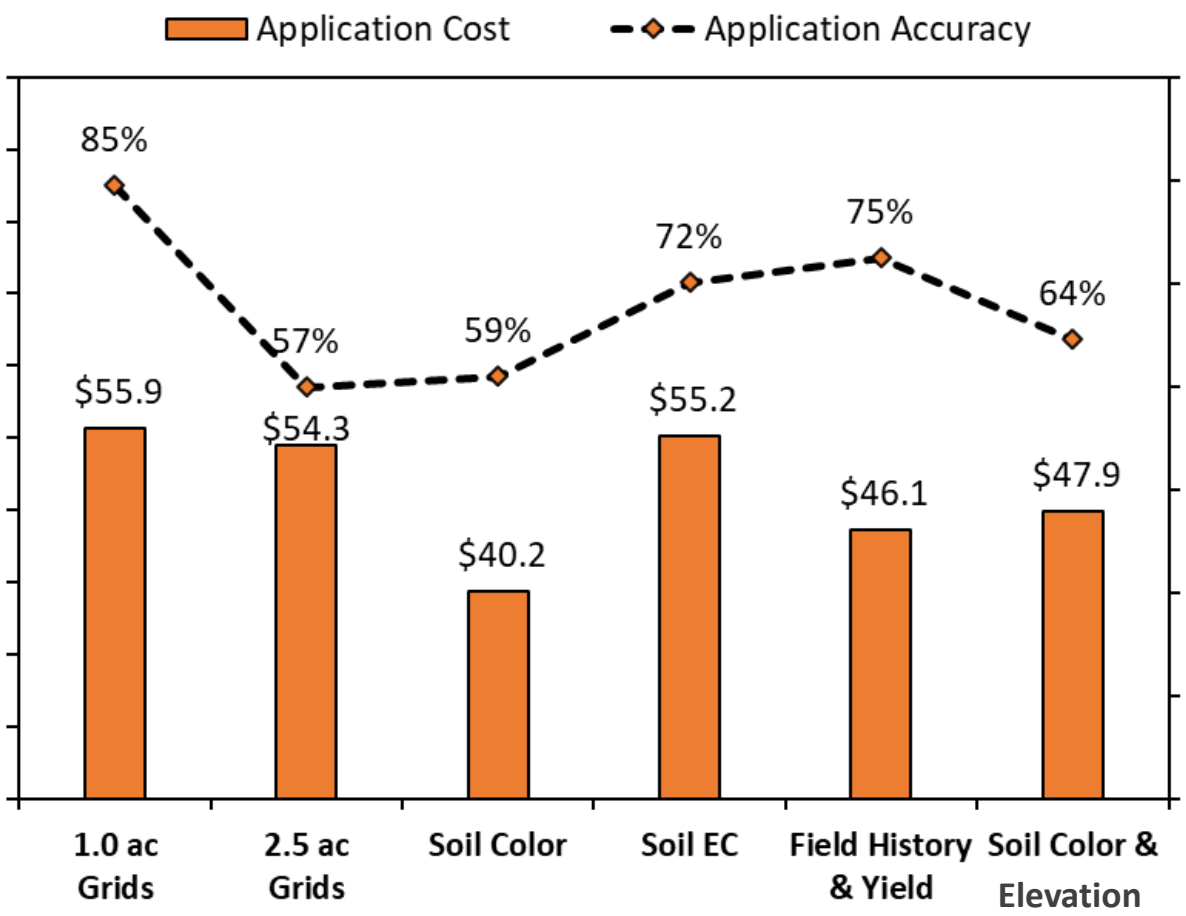
(Lime)



Phosphorus (P)



Potassium (K)



Zone Sampling Strategy 3

Field 1

Method	pH	P	K
1 ac Grid	93%	89%	83%
EC Zones	86%	73%	52%
SoilOptix	80%	78%	73%

Field 2

Method	pH	P	K
1 ac Grid	84%	82%	84%
EC Zones	65%	56%	70%
SoilOptix	57%	53%	69%

Summary and Conclusions

- **Zone sampling based on single spatial layers**: few spatial layers indicated high application accuracy but only for one or two nutrients (lime, P and K).
- **Zone sampling based on two or more spatial layers:** field history and yield were more effective when applying Potash (K) and Phosphorus (P)
- **Zone sampling based on commercial software**: results varied between fields. It may be useful in some fields but needs more data for economic evaluation
- Zone sampling strategy will change from field to field. Different spatial layers may be needed depending on field variability
- In some fields, grid based soil sampling may still be the most accurate and cost-effective approach.

Future Research: *Multi-year investigation in fields with varying nutrient variability using both grid and zone soil sampling methods*

Thanks!

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