Brandon Farms

Farming From Above

ARAUS Engineering Technology

VIDEO

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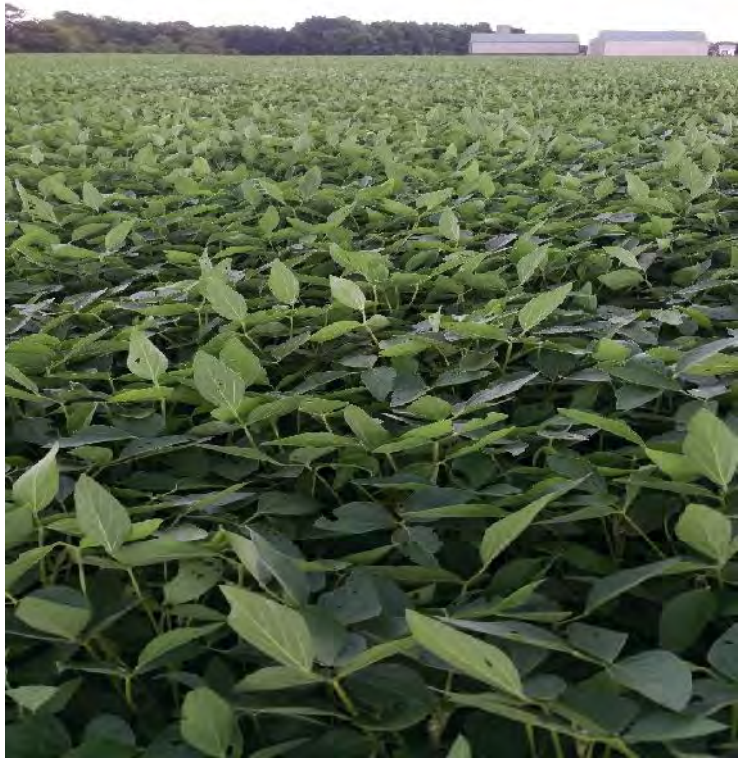
How can I apply Unmanned Aerial Vehicles (UAVs) to aid in my precision agriculture application?



Why should a farmer be interested in the aerial perspective of their farm?

Presentation Outline

1) What are UAVs?

2) What are their capabilities & how are they outfitted?

3) Use cases & scenarios.

4) Future research directions and applications.

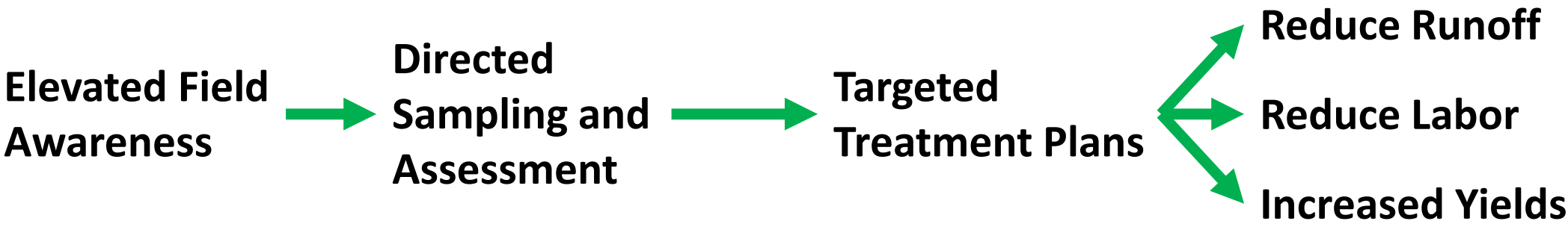
5) Questions

What are UAVs? Why would a farmer be interested?

UAVs are Unmanned Aerial Vehicles often referred to as drones. They are what their creator makes them to be.

UAVs for the purposes of precision agriculture can aid a farmer in assessing crop health, precisely locate epicenters of pest infestation, aid in fertilizer application etc. Applications are numerous and continuously are being discovered.

However, this is not the Holy Grail.



How can UAVs help in Precision Agriculture?

- **Survey flights for consultants (larger aircraft)**
- **Intense scouting flights for farmers (easier aircraft)**
- **Sensor technology to assist in decision making**

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Fixed Wing Aircraft

Advantages:

- **Field Coverage / Endurance**
- **Payload Capacity**
- **Weatherability**
- **Recoverability**

Disadvantages:

- **Landing and Takeoff**
- **Operator Capabilities**
- **Reparability**
- **Large Area of Operations**

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Rotary Wing Aircraft

Advantages:

- **Ease of Use**
- **Sit & Perch**
- **Inherently Stable**
- **Tight maneuverability**

Disadvantages:

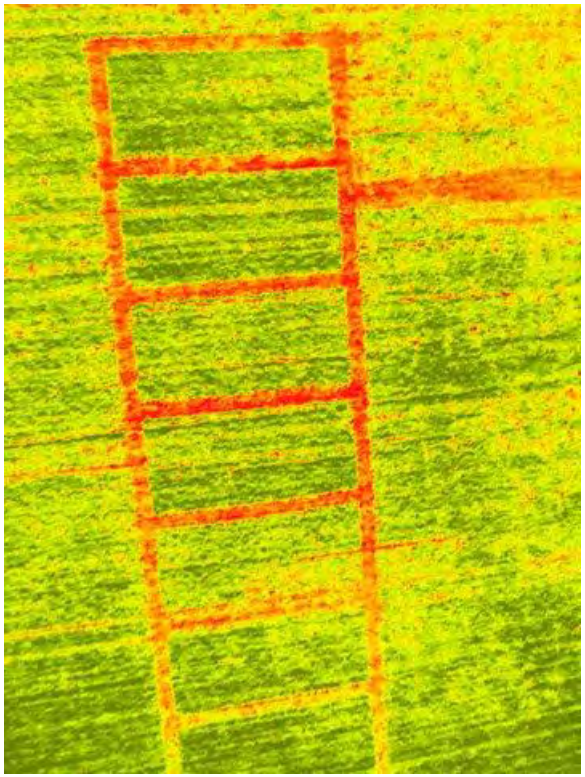
- **Limited Flight Endurance**
- **High Vibration Levels**
- **Specific Configuration**
- **Limited Recovery Capability**

What can a UAV do for me?

When used to aid in field analysis, UAS in precision agriculture can promote a higher field health awareness.

When used in conjunction with good field work, record keeping, and test/trial analysis it can be highly useful.

Enhanced Imagery for Biomass Estimation

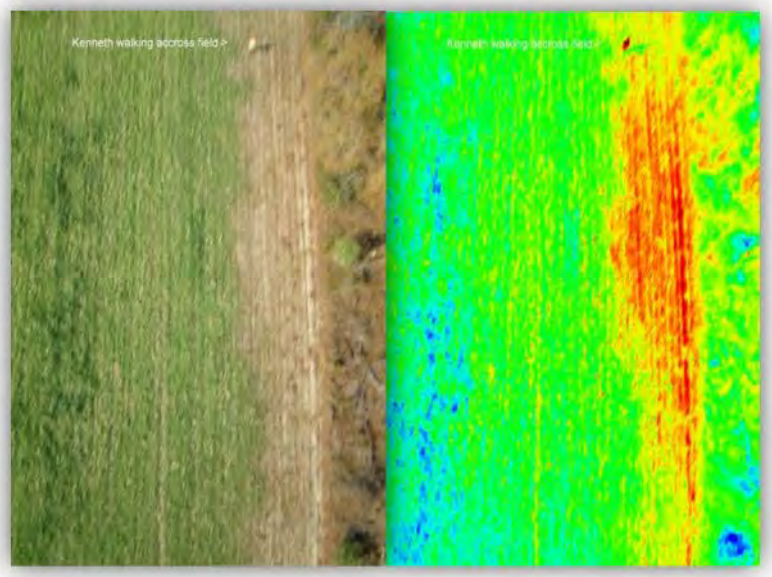


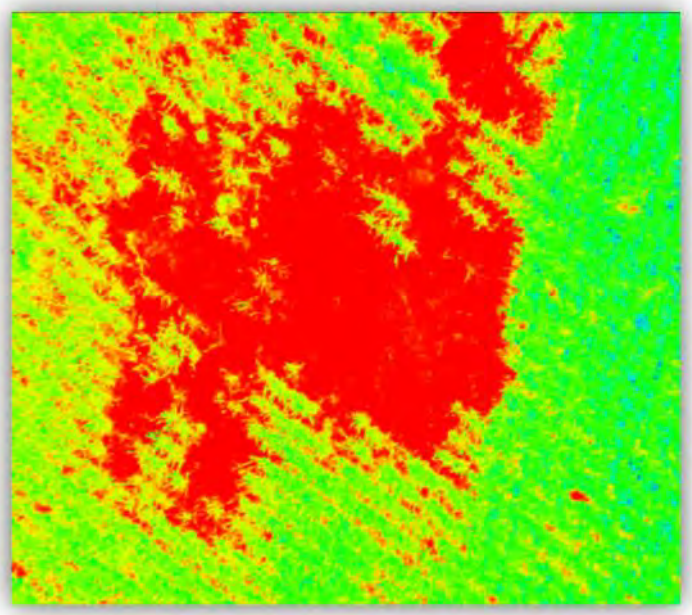
Biomass and residue estimation for cost shared practices

- Can we generate estimates of both density and mass of cover crop biomass?
- Flights before cover crop is planted and throughout growth cycle is important.

Monitoring a live feed from a UAS.

- Requires the UAS to carry an onboard computer and a specialized camera for interaction and data rate.
- Quick detection of
  - Missed rows
  - Inadequate canopy development
  - Bare spots
  - Variations in field





Gives the farmer an enhanced capability to scout the fields for further surveying and targeted analysis.

Early season aerial views shows variation in crop.

Helicopter conducted aerial survey and captured field in single frame.

Variation across field.

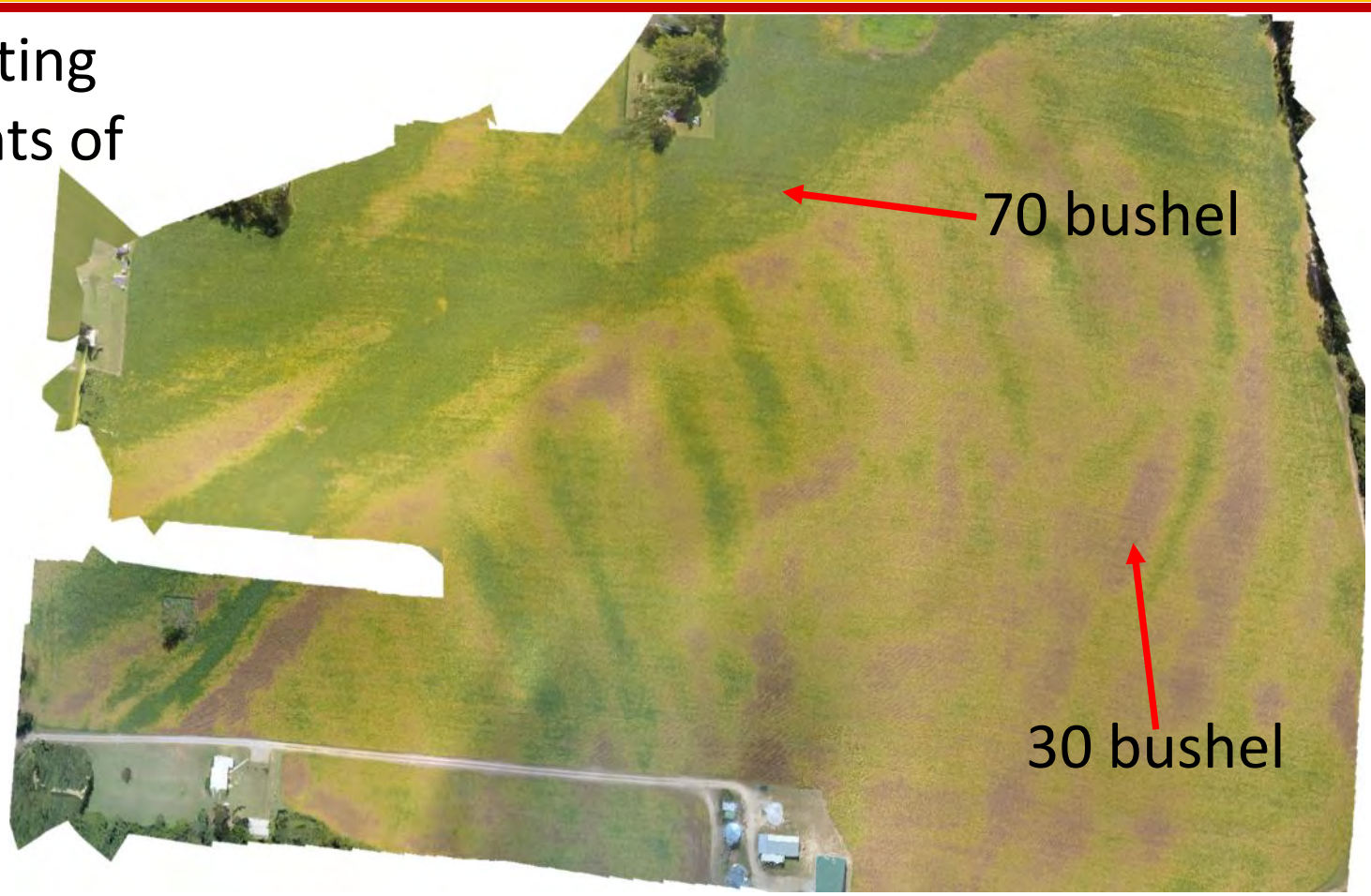
Allowed us to identify the stressed areas and perform in field analysis lending to a number of problems reducing yield.

End of the season drought and nematodes.

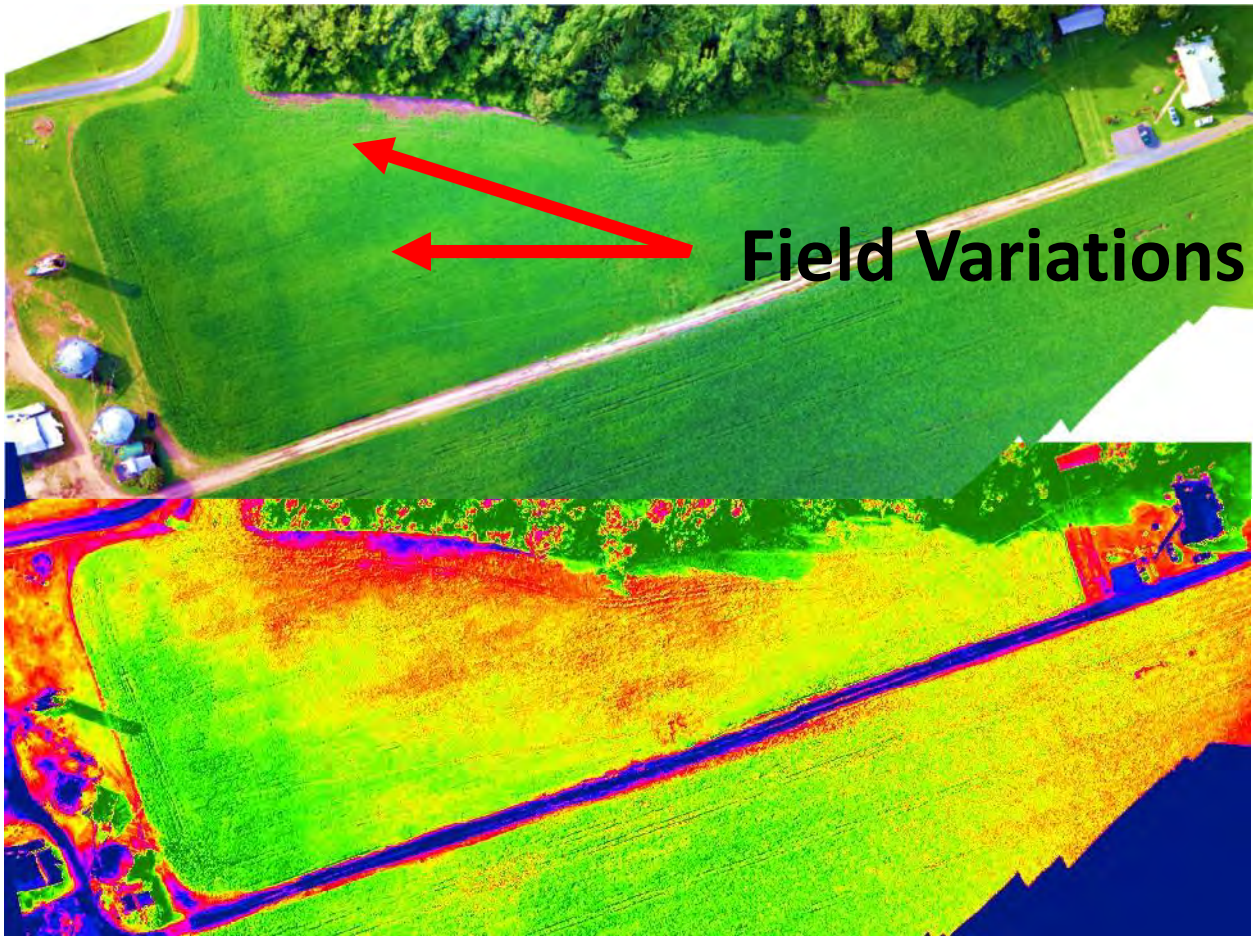
Targeted soil testing yielded high counts of nematodes.

Field Average: 60 bushel

Mandated a change for next season.



Another field study in soybeans.



Same field of soybeans later in season shows the stressed areas were hard hit.

What have we learned?

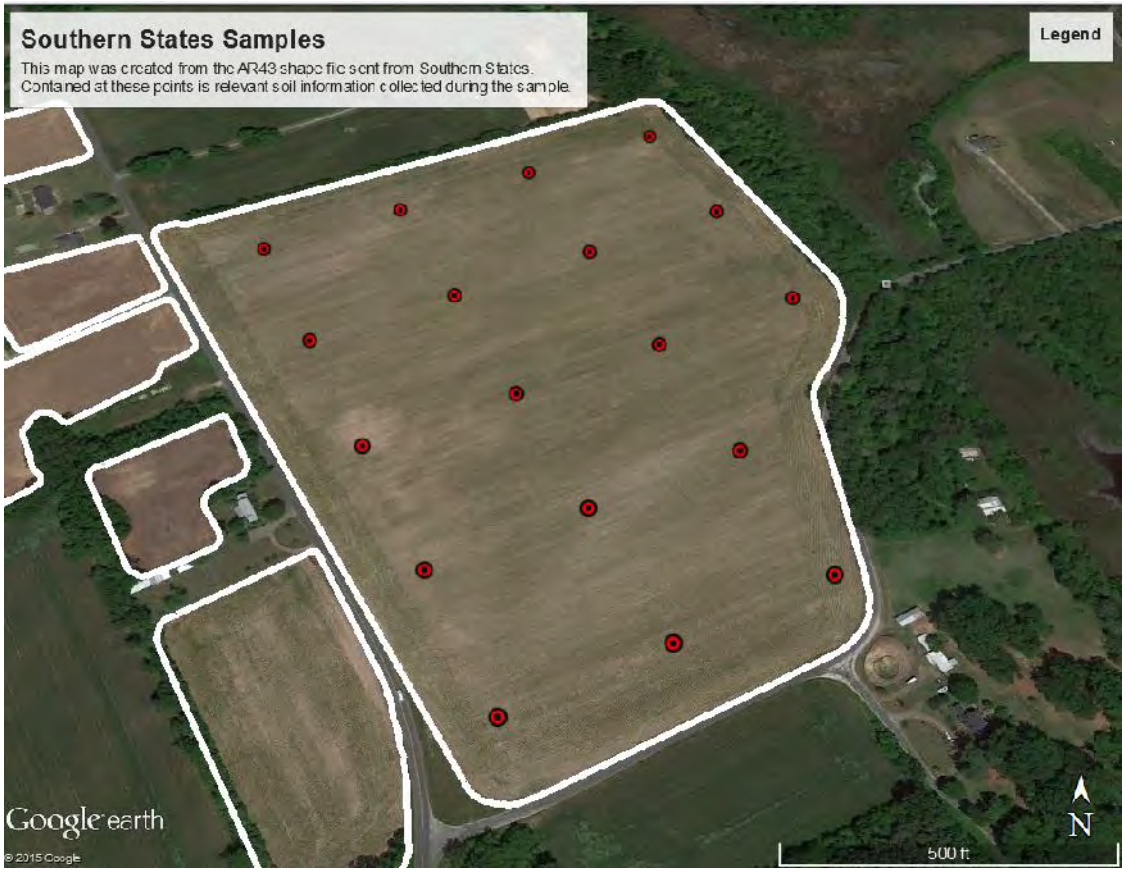
Variable rate Lime, Phosphorus, and Potassium can provide targeted fertilizer needs based on soil sampling and image analysis.

Imagery required throughout season to monitor progress.

Can we target predictive yield estimates for improved commodity marketing?

Can PSNT or tissue samples be related to nitrogen and phosphorus applications for corn and small grains?

Comparing Zone and Grid Sampling

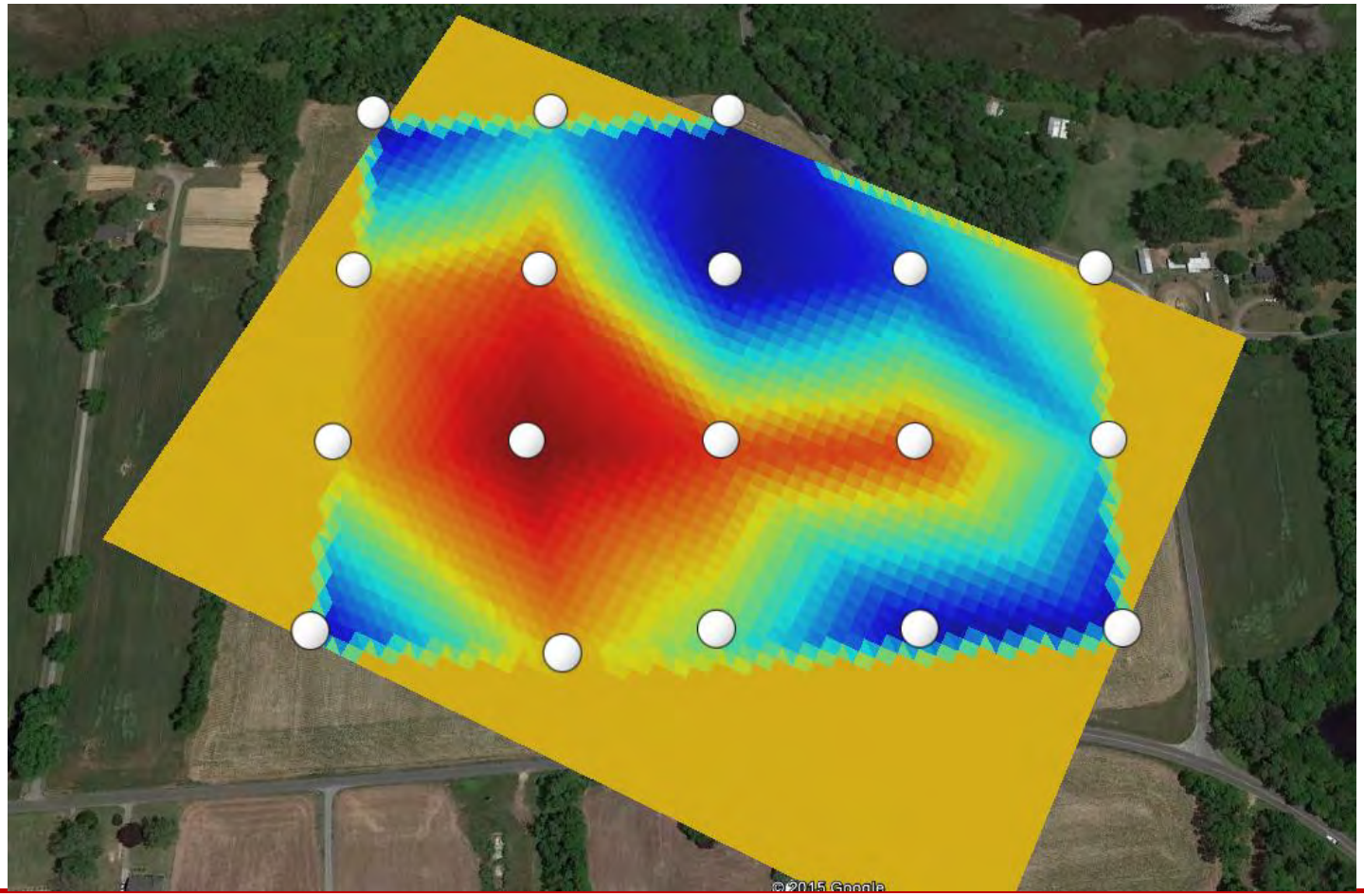


Grid sampling can promote accurate results at a granular level, however, are costly in time and expense.

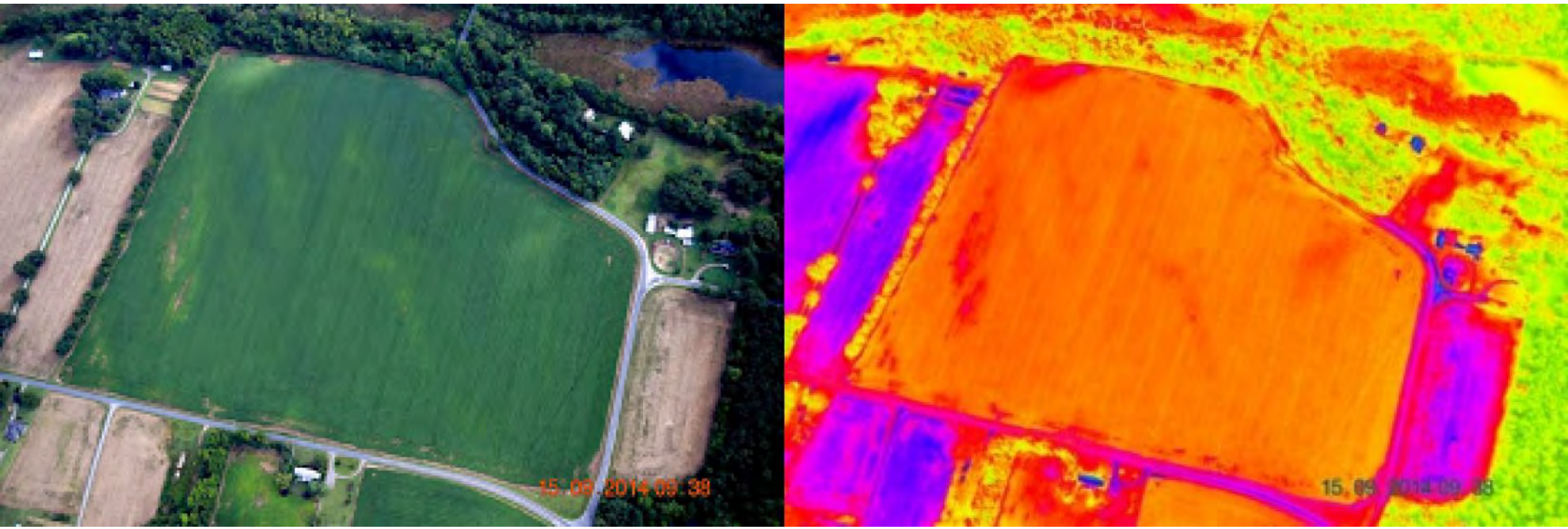
Zone sampling takes advantage of application history maps or soil maps for dispersed sampling.

UAV generated maps can take advantage of this and merge the two sampling techniques.

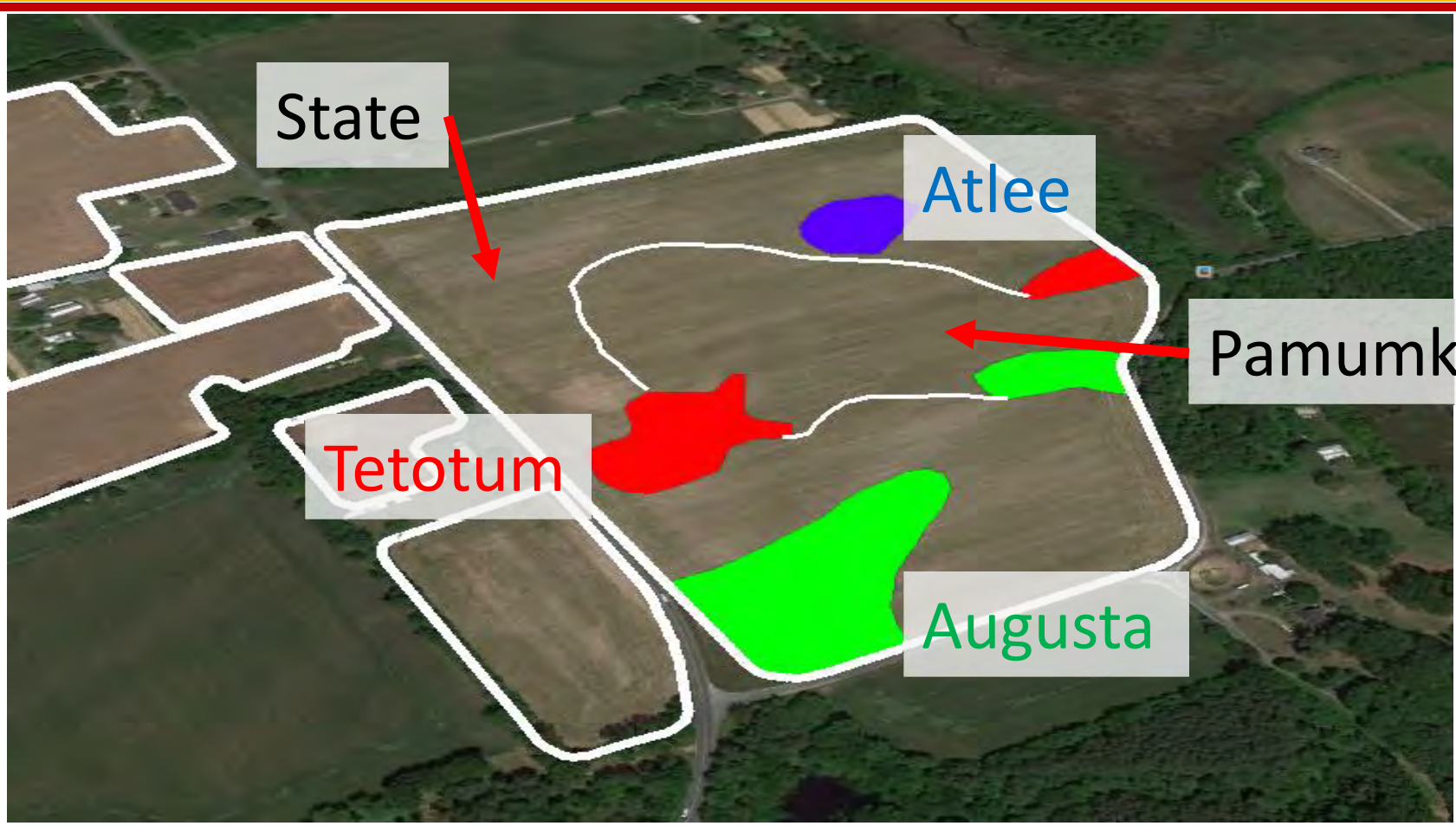
Grid based sample pH map AR43



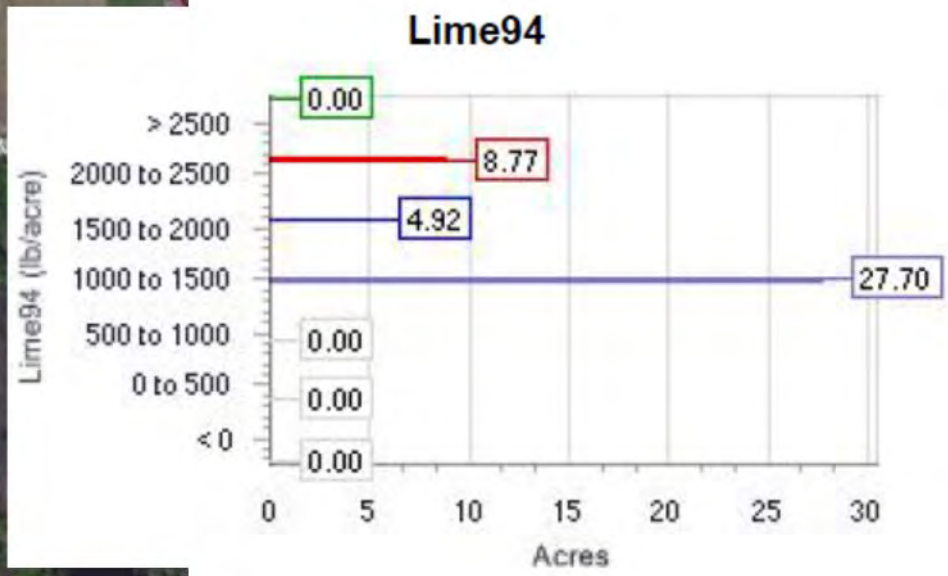
Prior season thermal heatmaps showed similar trends.



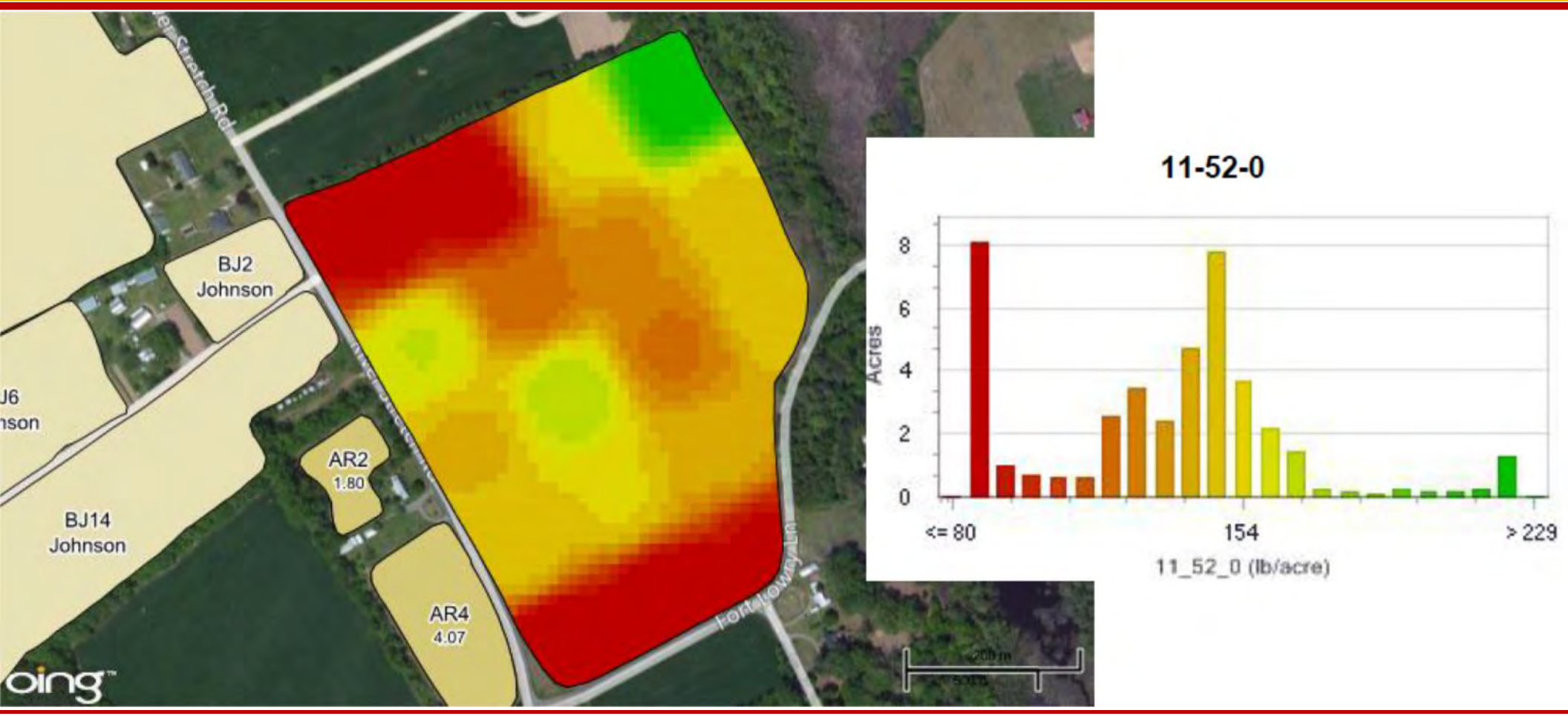
Soils type map throughout AR43



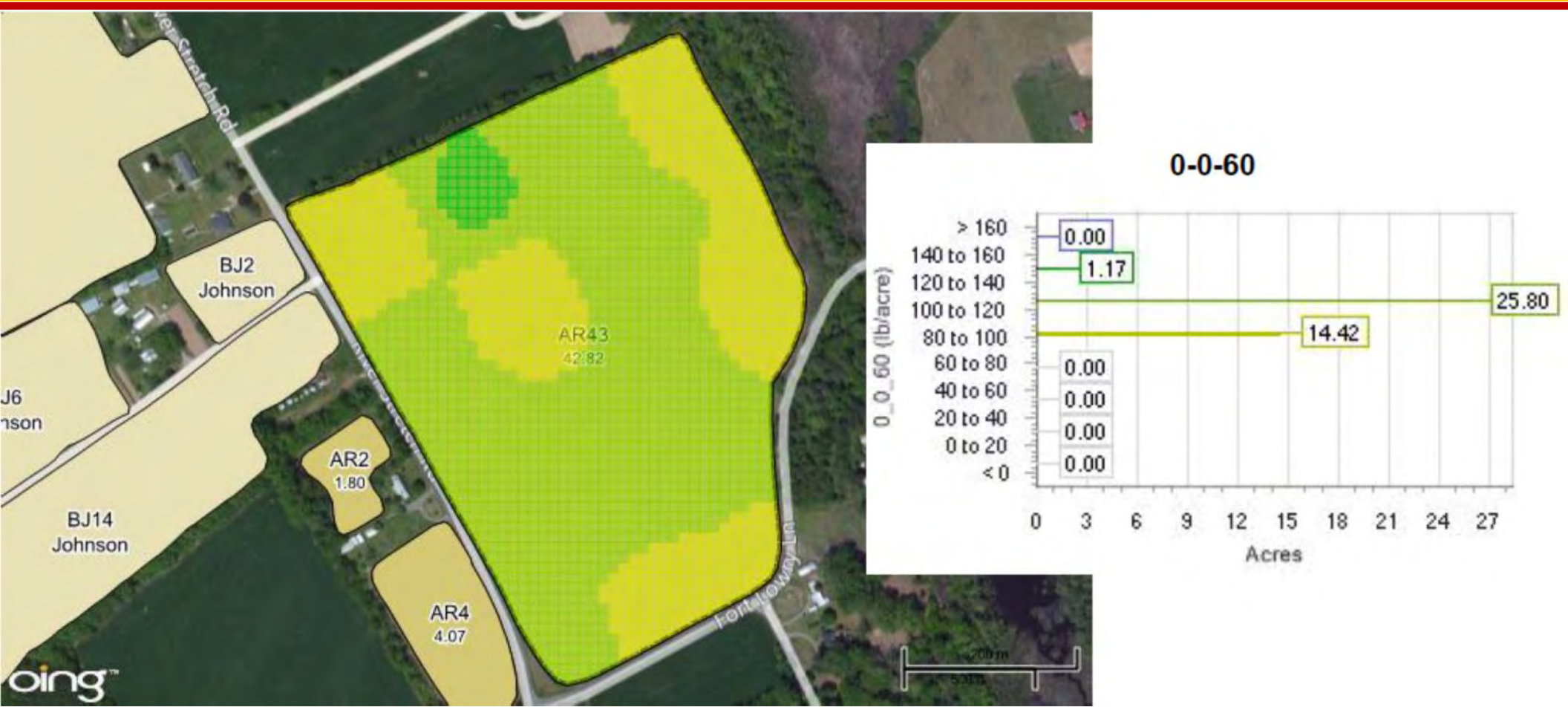
Lime application map for AR43



Phosphorous application map for AR43



Potash application map for AR43



Generating a discrete compaction map on 43 acre field.

Walked a compaction meter through a field to find local pans.

Stored data points in cell phone app.

Red (Shallow <3”)
Orange (>3” but <6”
Yellow (>6” but <9”)
Purple (>9”)

Targeting variable rate compaction while limiting deep tillage.

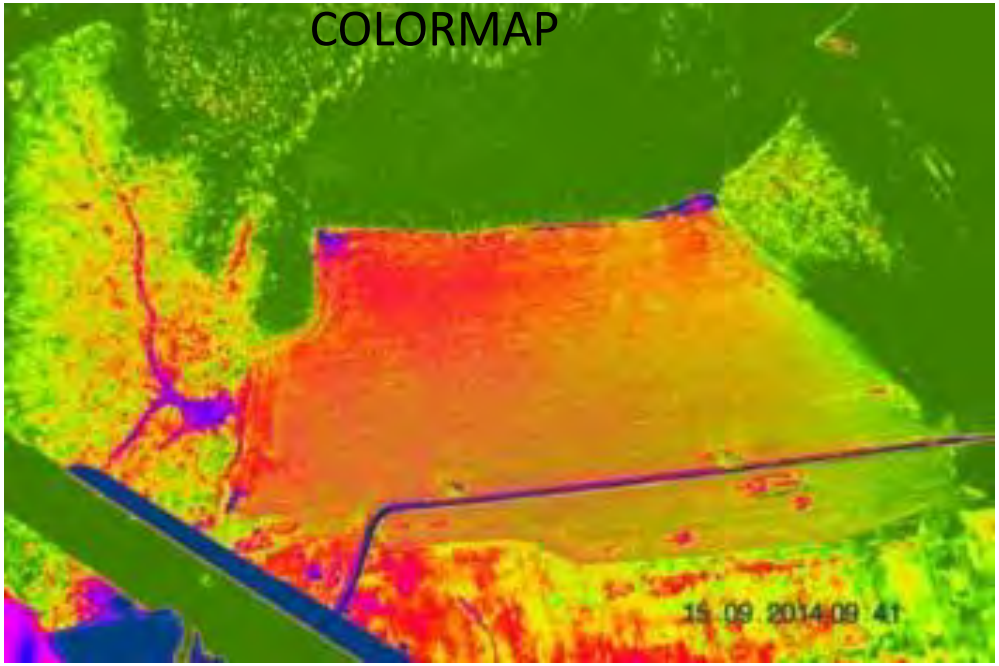
- Custom software to work with collected data samples.
- Works by farmer defining influential radius about sample and defining field boundaries.
- Working on recommending depth of tillage.

Examining the drydown of crops can provide the farmer an idea of harvest timeline.

Green (High Moisture) → **Red (Low Moisture)**

RAW

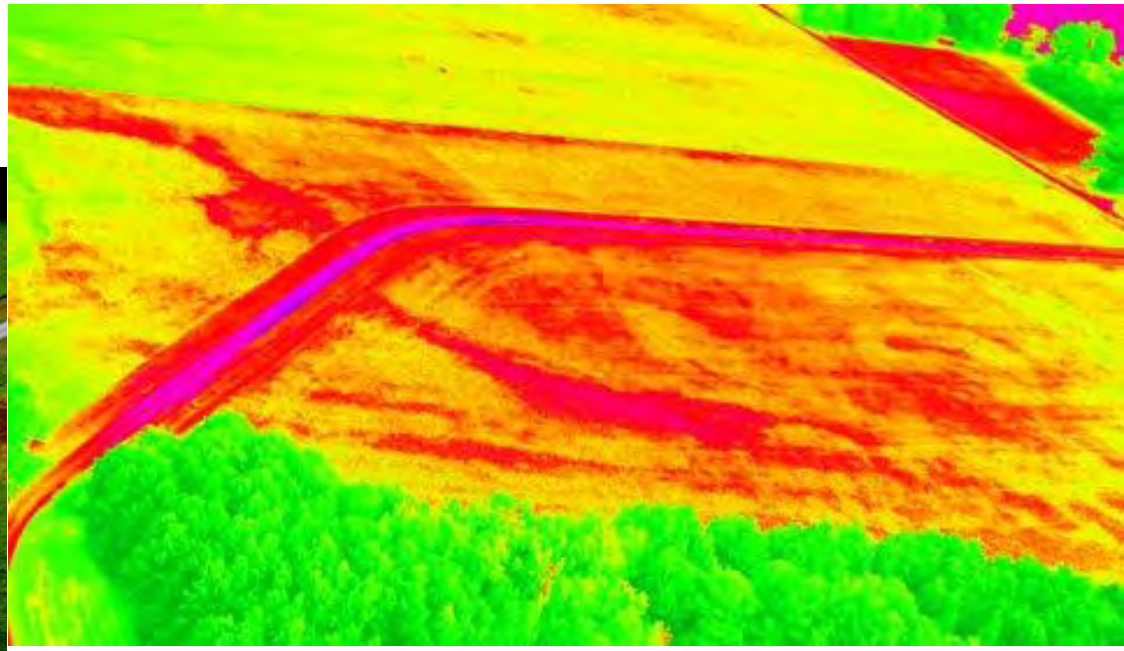
FALSE COLORMAP



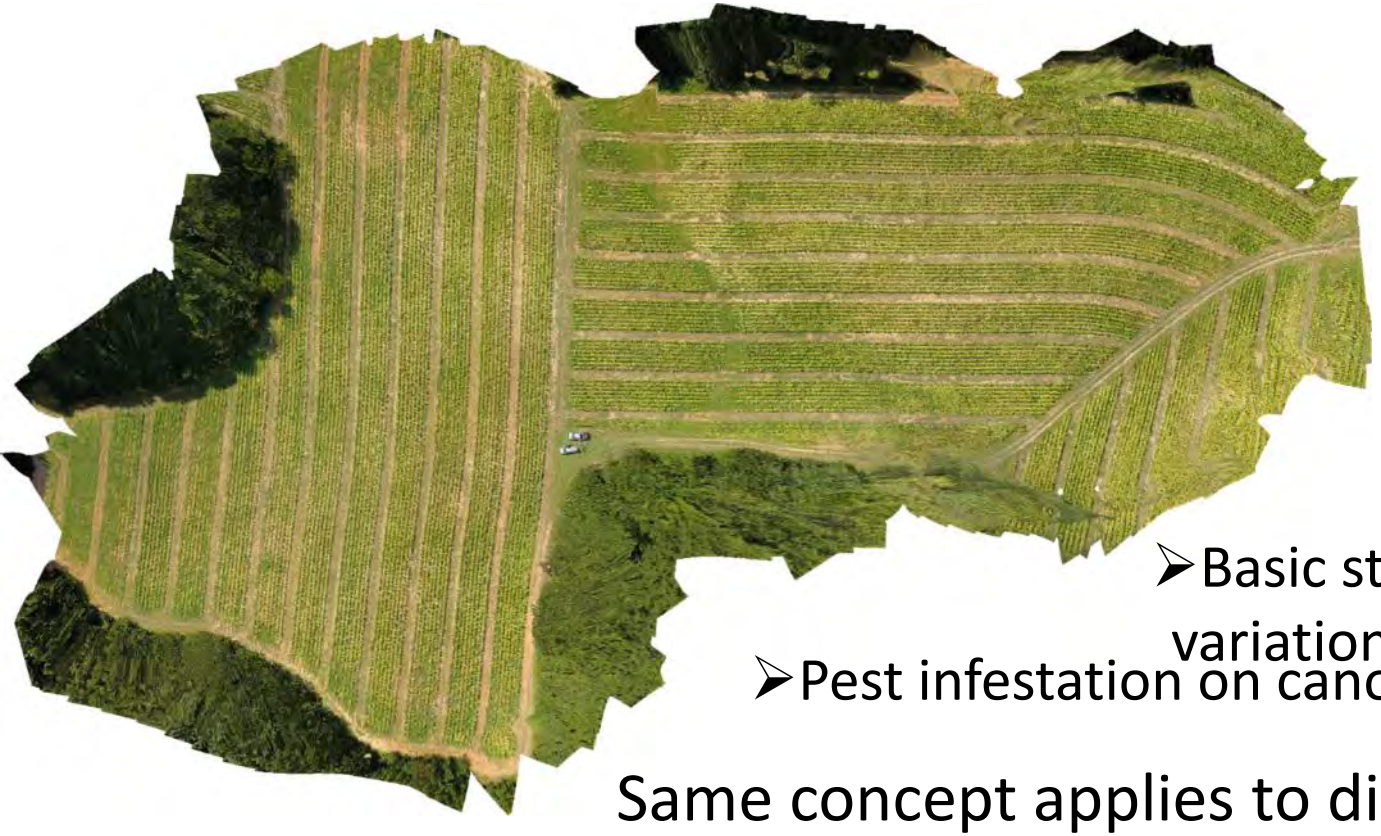
Assessing Morning Glory vine growth in corn can be achieved by assessing amount of infestation.

Aerial maps can give a perspective of drainage issues.

Assessing drainage through thermal heatmaps.



Similar technologies can be applied to assess tobacco.



High quality imagery can yield a lot of basic information without additional algorithms.

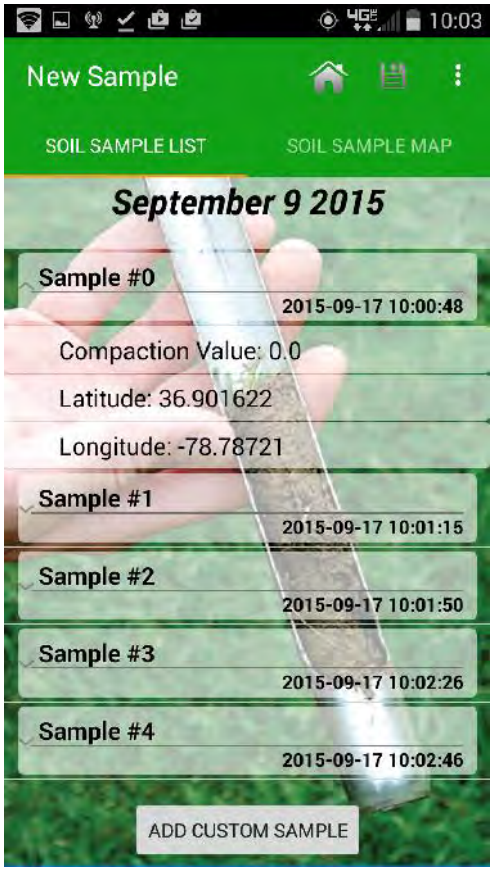
- Tobacco stand count.
- Basic stress detection and variation.
- Pest infestation on canopies.

Same concept applies to different crops, follow up with field work, targeted treatments, reduce costs.

How often, how fast, and how can I get access to data?

- Frequent flights throughout the season
- Field coverage 30~100 acres
- Data processed 2~24hrs depending on quality required
- Georeferenced orthomosiacs
- Perform ground truth assessments
- Integrate results into farm management plan

Synchronizing Data and Field Scouting



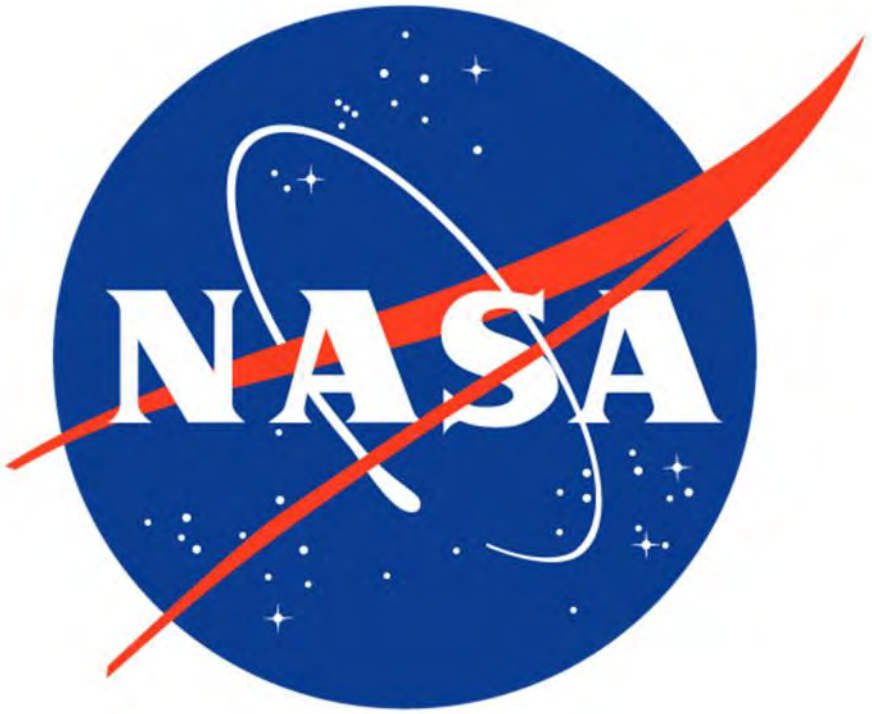
Teaming efforts with NASA as UAS proving ground

Custom solutions for multiple UAS deployment:

- Increase operational efficiency
- Further detailed information

Safe operations in the NAS:

- Simulated cluttered environment
- Relatively safe integration ground
- Technologies that anyone can use



Exploring UAS Applications This Season

- *pH application map generation*
- *Biomass estimation for cost shared practices*
- *Relating PSNT or tissues samples to nitrogen and phosphorous applications for corn and small grains*
- *Predicting yield and drydown of crops*
- *Crop scouting for weeds or pests and spot spraying*
- *Supplementing field compaction mapping*
- *Effective field irrigation by soil type*

Futuristic Applications & Ideas

- *Mobile application for record keeping and tracking*
- *Irrigation component inspection*
- *Remote monitoring of sensor networks*
- *Spot spraying fields based on early detection procedures*
- *Automated detection and categorizing diseases (VT)*
- *Farm equipment inspections and monitoring*

ANY FUTURE APPLICATIONS YOU MAY WANT TO EXPLORE?

September 2016 National Small Farms Conference

Precision Agriculture Event:

- ✓ Field demonstrations of effective soil sampling techniques.
- ✓ Integrated mobile based applications to aid in crop scouting and record management.
- ✓ Aerial imagery and the applications in field awareness.

Tying it all together.

Early detection promotes:

- ✓ Increased crop health awareness
- ✓ Increased yield productivity
- ✓ Reduce operational costs and inputs
- ✓ Reduce field variability
- ✓ Relevant soil sample collection
- ✓ Year to year field predictability
- ✓ Reduction of NPS pollutants

QUESTIONS or SUGGUESTIONS?

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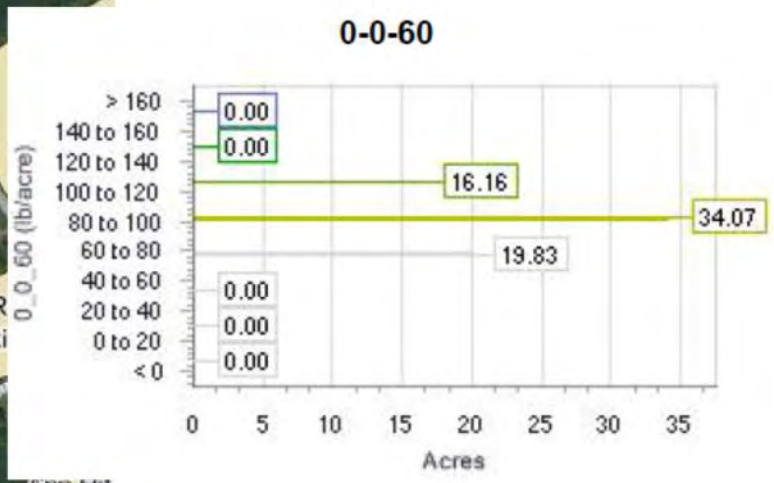

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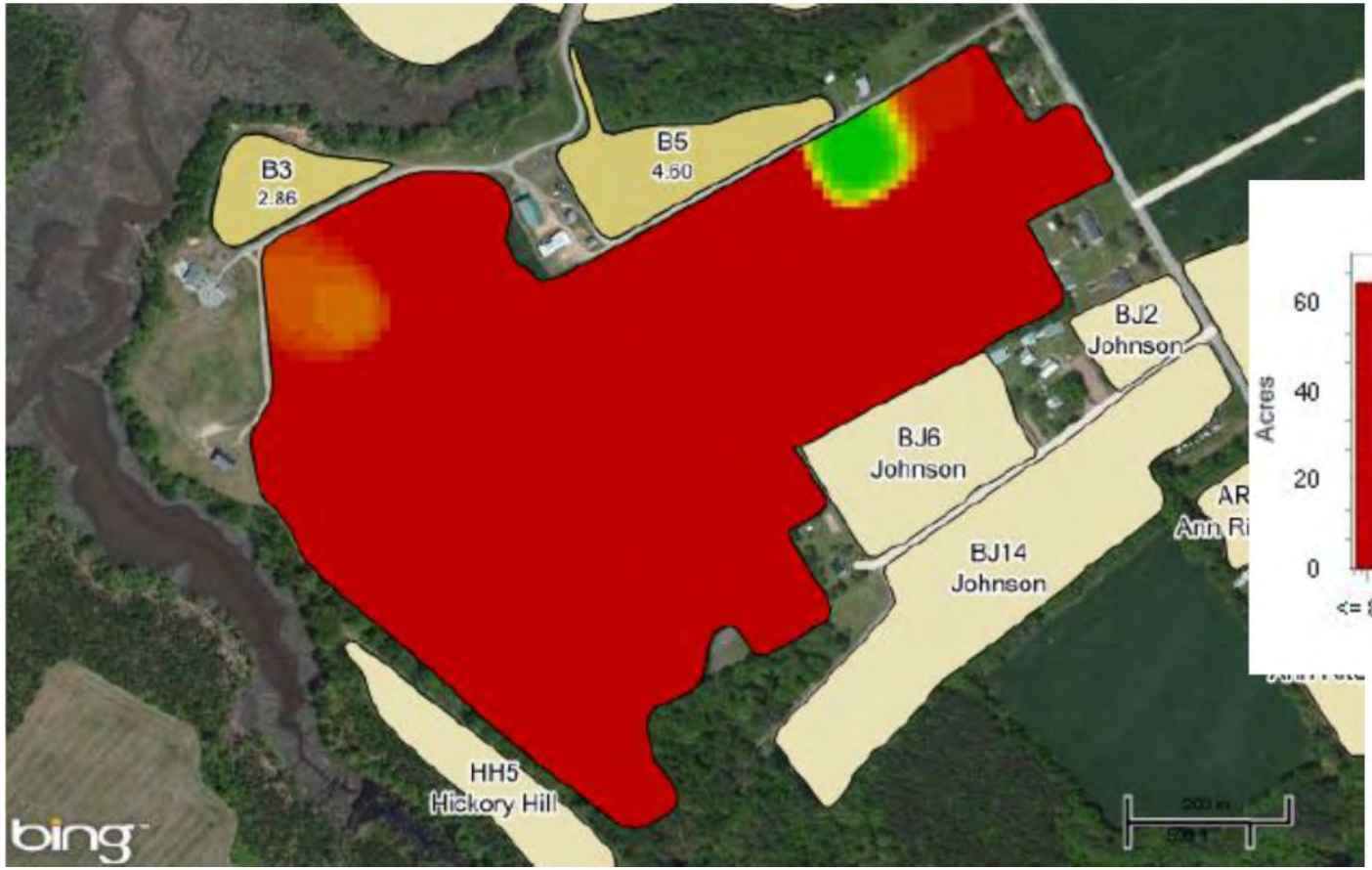

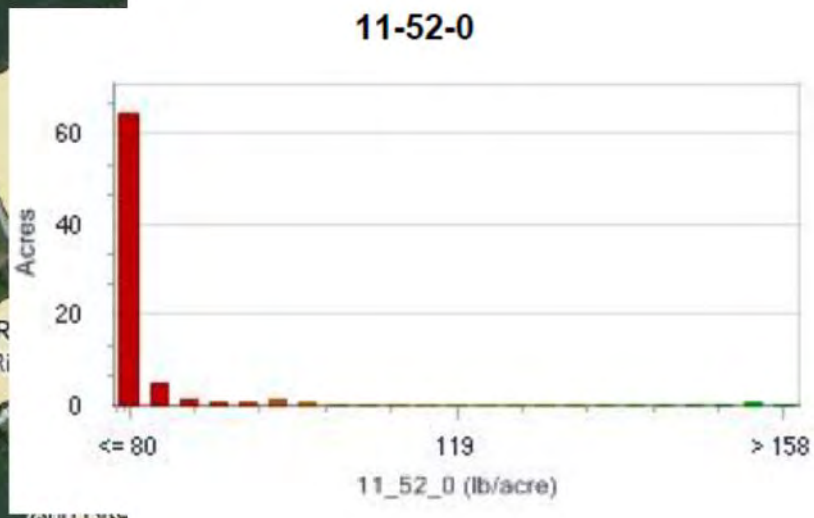

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