Crop Production Clinics

Precision N Management Through Sensor and Model Based Approaches

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Session Goals

- At the end of this session participants will be able to:
  - Identify the main benefits and required inputs for sensor and model-based N tools
  - Identify the sensor and modeling based tools available for N management
  - Evaluate if in-season N management based on sensors or models is feasible for your operation

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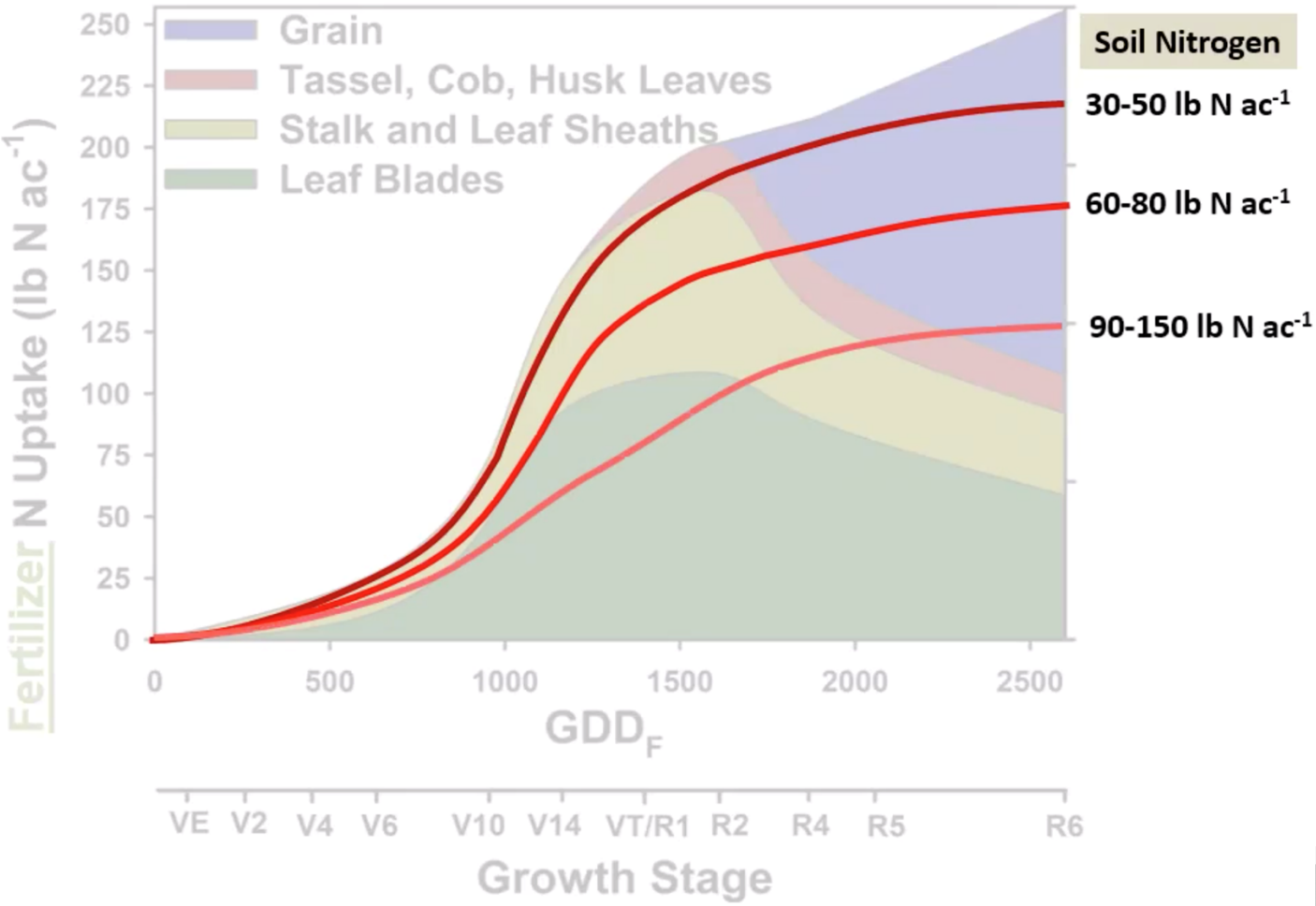
Why In-Season N Management?



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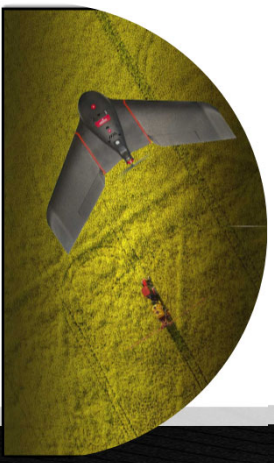
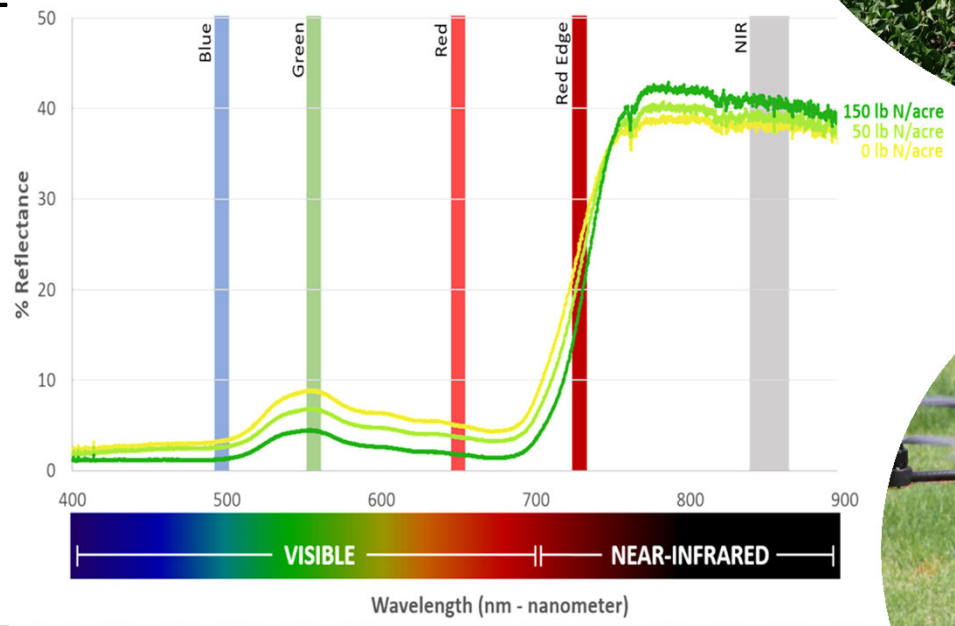
Crop canopy sensing

- Within spatial variability +
- Temporal variability +
- N losses +/-
- Reactive





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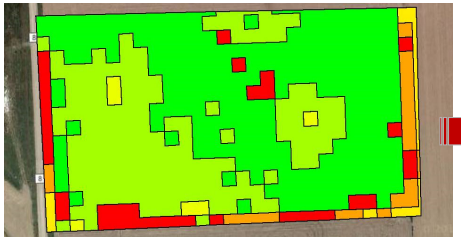
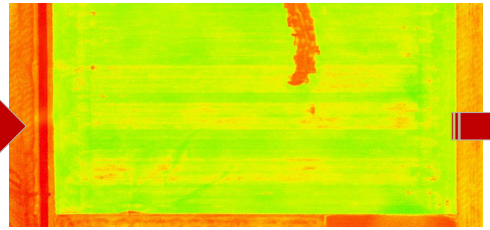
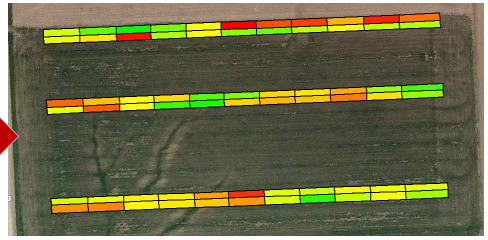
Management Zone Integration



Cluster analysis to create zones



NDRE image from drone flight

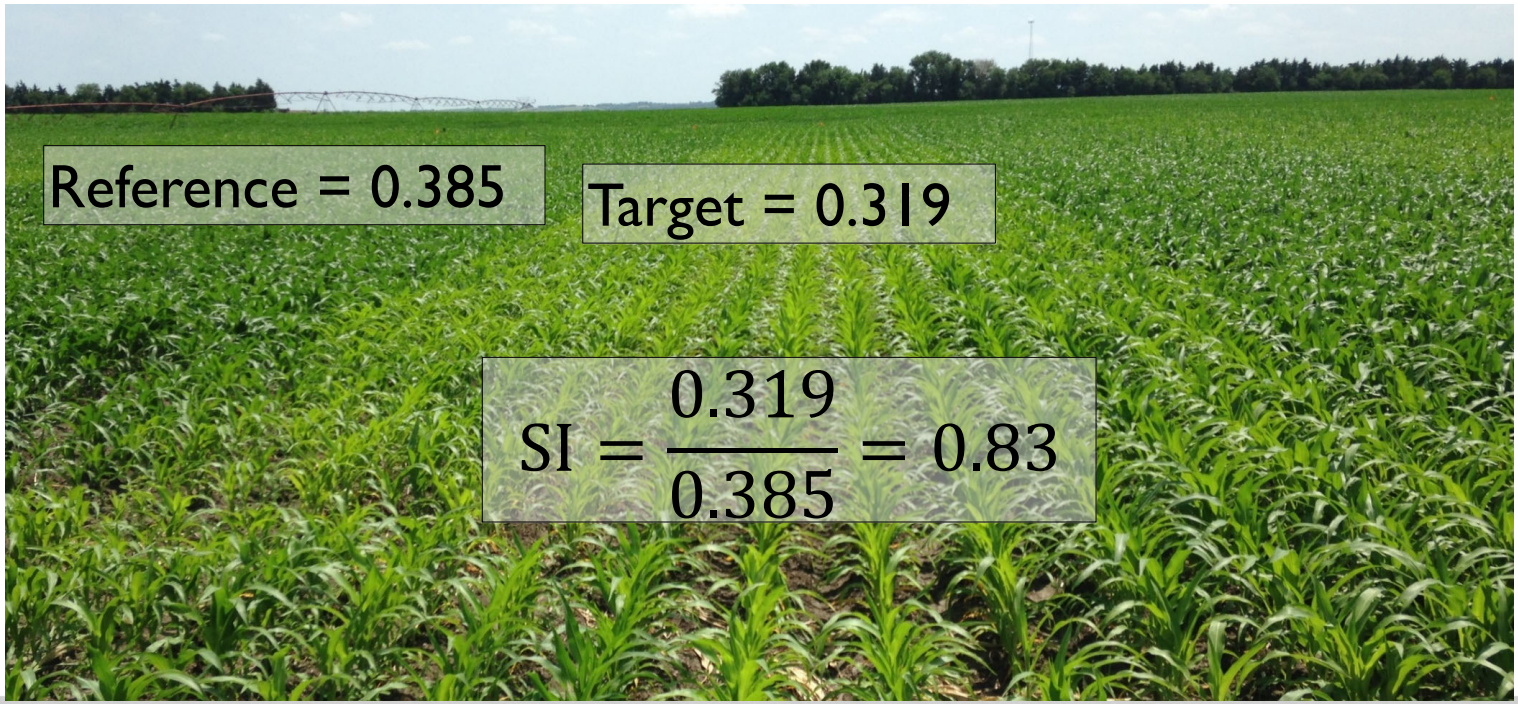


Prescription map for trial strips

- Created management zones using soil-based characteristics of elevation, organic matter, soil texture, and hydrology data paired with yield goals for each area from historical yield.

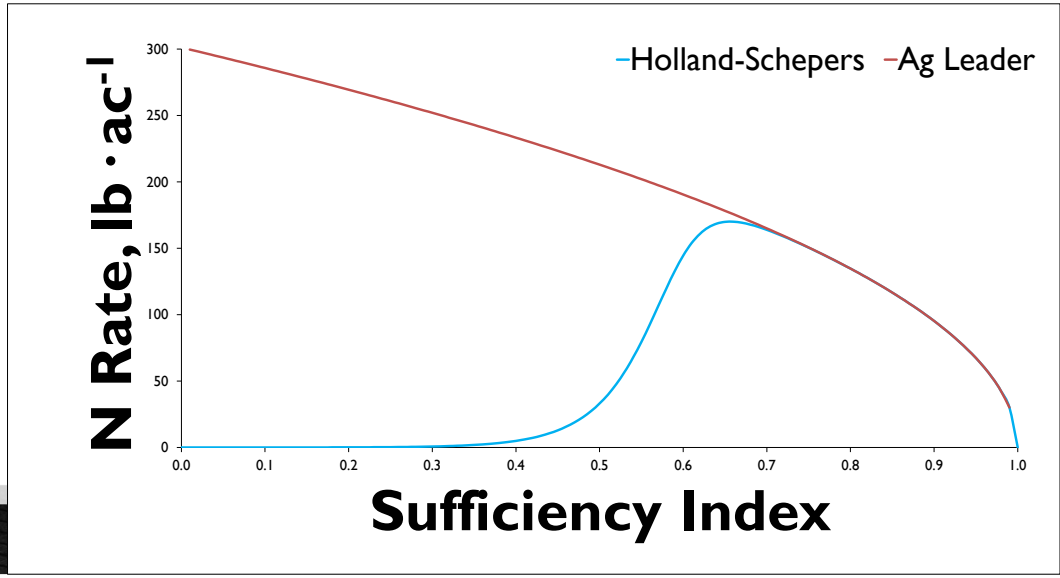
SUFFICIENCY INDEX (SI)

- Relates the crop to be fertilized to a non-limiting reference



From SI to a N rec

$$(N_{OPT} - N_{PreFert} - N_{CRD}) \cdot \sqrt{\frac{(1 - SI)}{\Delta SI}}$$

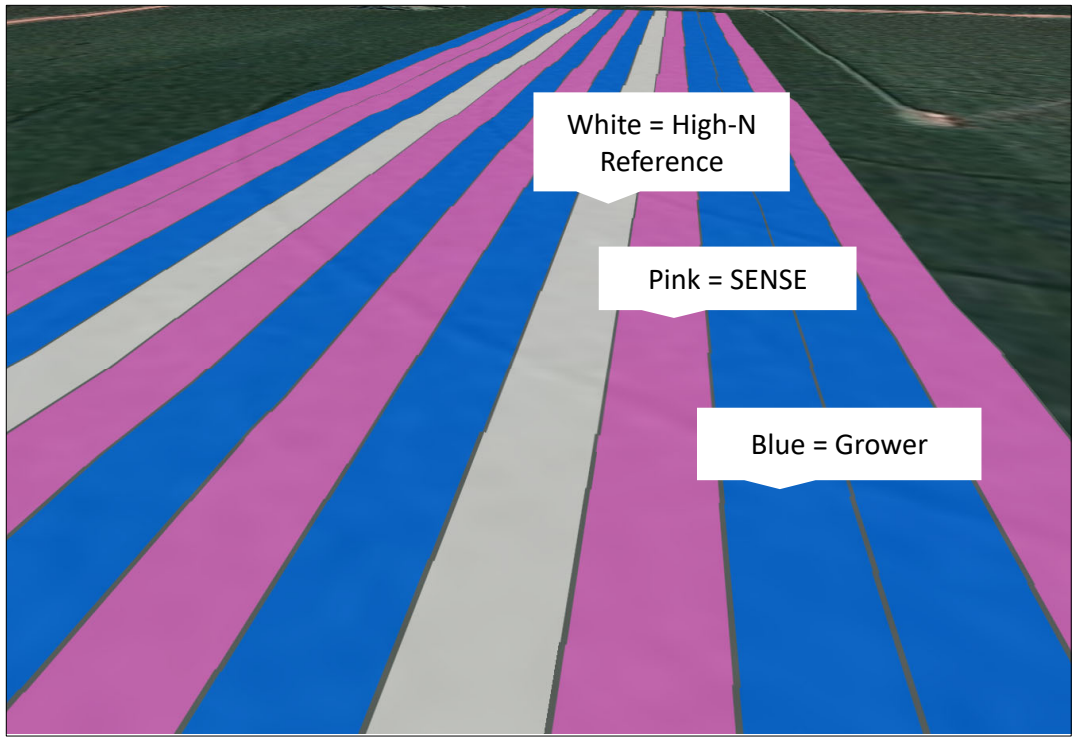


Pre-plant fertilizer N application

- Avoid excessive low N stress prior to the in-season N application.
- 30-50% of the expected total fertilizer N need ~ 75 lb/ac if in-season N application is targeted for V12-V14.
- If in-season N < V12, pre-plant fertilizer N rate ~ 25% of the total to be applied.
- Great opportunity for remote sensing guided in-season N application with manured fields.

Plot Layout

- Randomized, replicated field length strips placed across field to match grower equipment widths



Typical base rate (75 to 100 lb-N/ac) at or before planting

Follow-up application at V8 to V12 with crop canopy sensors

Collect & analyze harvest data

EXTENSION

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Table 1. Summary of 51 sites in 2015, 2016, 2017, and 2018 comparing sensor-based N management to the grower's traditional method.

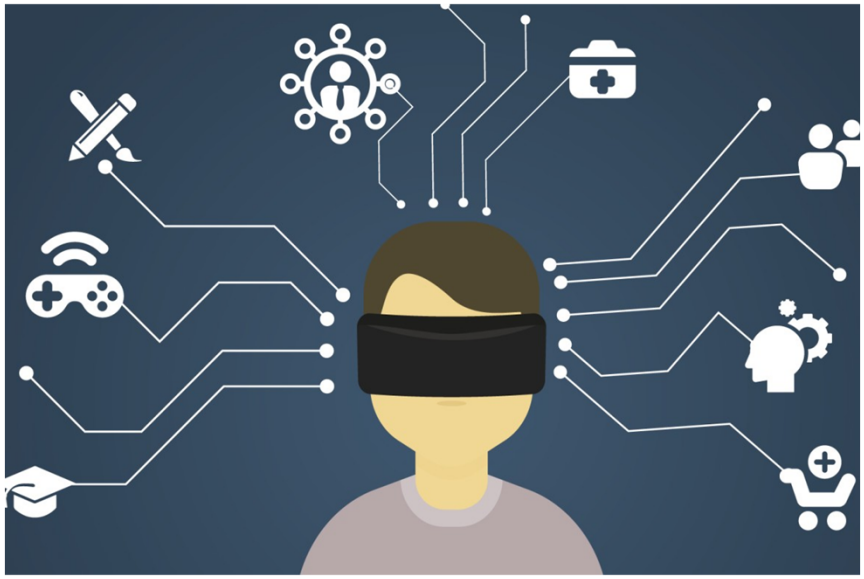
	SENSE	Grower
Total N rate (lb-N/ac)	159.4 B*	188.1 A
Yield (bu/ac)	217.6 B	218.7 A
Partial Factor Productivity of Nitrogen (lb grain/lb-N)	83 A	68 B
Nitrogen Use Efficiency (lb-N/bu grain)	0.75 B	0.91 A
Partial Profitability ($/ac) [@3.65/bu and $0.65/lb-N]	$690.59 A	$675.83 B
Partial Profitability ($/ac) [@3.15/bu and $0.41/lb-N]	$620.06 A	$611.65 B

*Values with the same letter are not significantly different at a 95% confidence interval.

- An average of 28 lbs less N applied with SENSE (2019)
- Yield was only statistically different at one site
- No statistical difference in profitability
- Management zone integration with the HS model using drone imagery had similar results to the sensors

Crop model based tools. What is a crop model?

What if you had a virtual reality that was a replicate of your farm?



Inputs

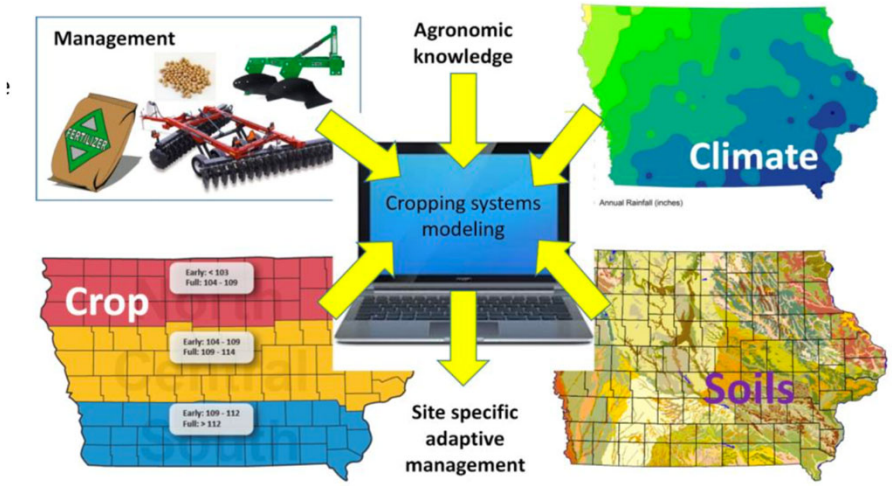


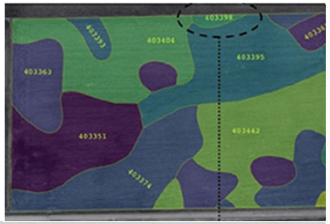
***Figure 1**. A cropping systems model uses agronomic principles to analyze information on soils, crop, climate, and management practices for every field and year separately.*

Crop model-based tools

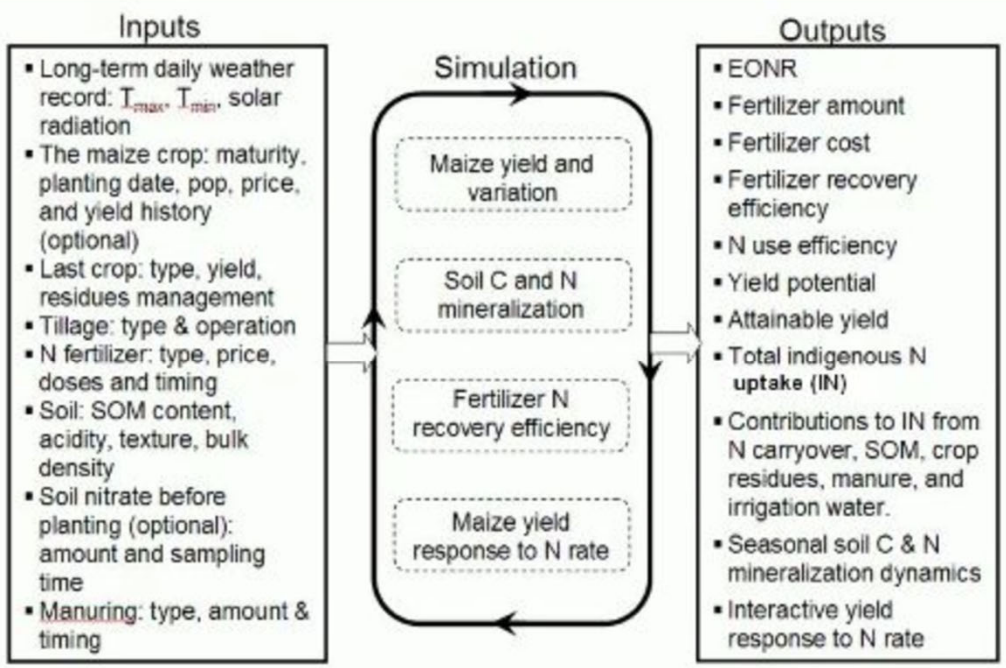
Point based

Grid based

Zone based

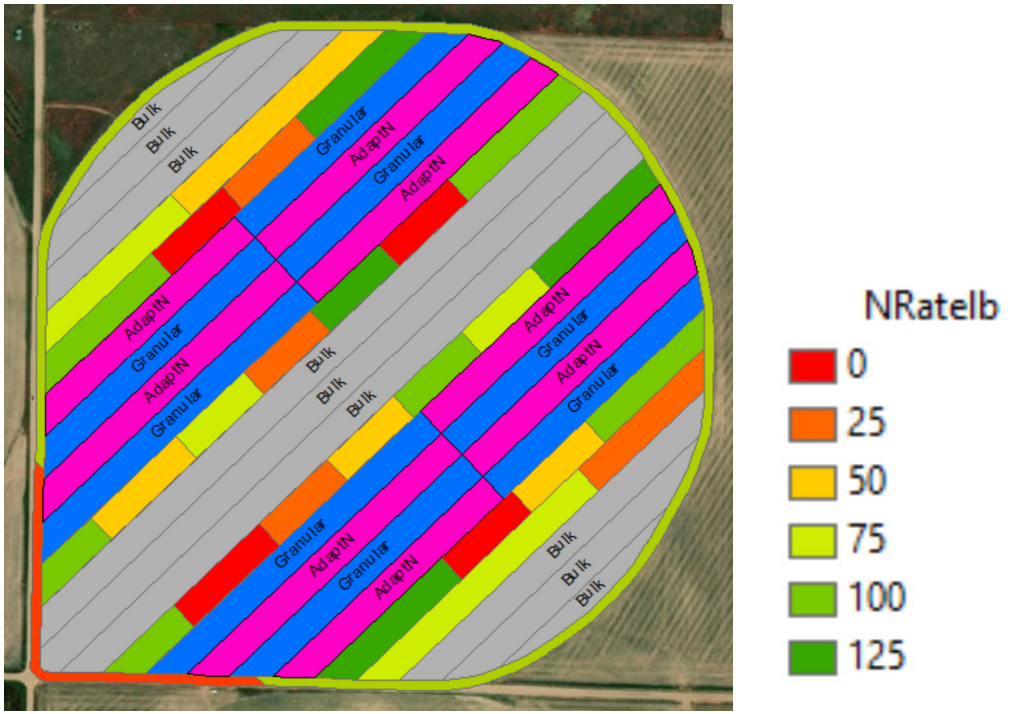


Maize-N, UNL



Crop model-based tools. Testing

- Flurosat
- Adapt-N (Yara)
- Granular
- Others



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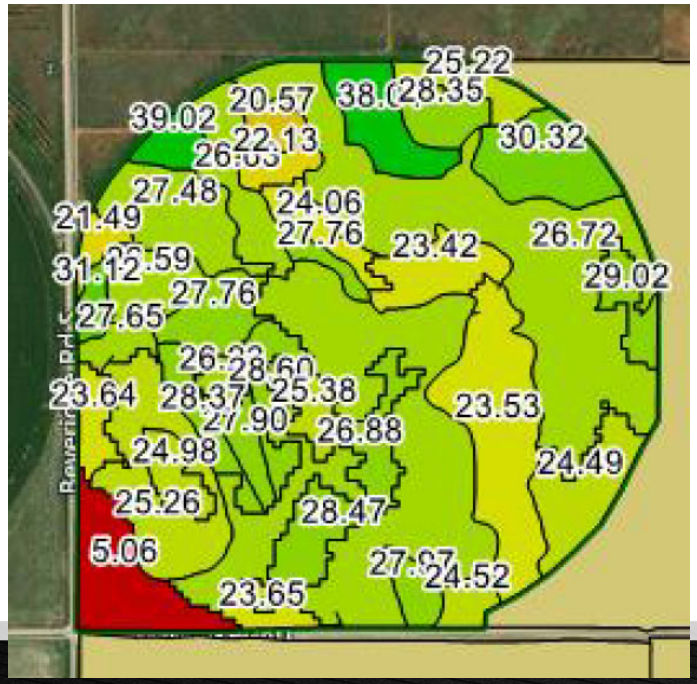
Granular

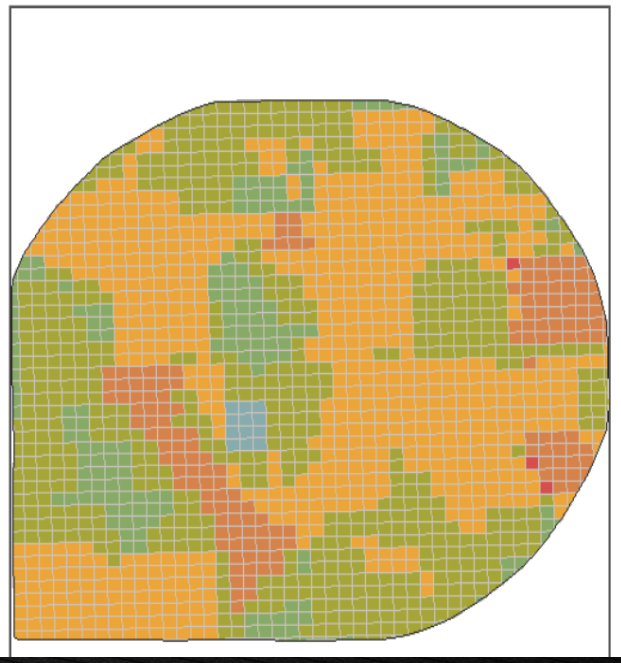
average of 26 gal/ac (92 lb N/ac)



Adapt-N

average of 23 gal/ac (82 lb N/ac)

	UAN	acres
	11	1
	12 - 16	13
	18 - 22	50
	23 - 29	59
	30 - 35	12
	36	< 1



Take Home Points

- N management through sensor and models take advantage of growing season variability with high potential for reducing N needs.
- Reasonable EONR and YG estimates are critical…still requires input.
- Consider NUE metrics that you are currently operating at…how much more efficient can you operate economically?
- Quality of inputs = Quality of outputs
- On-farm research and precision ag technology offers a great opportunity to test sensor and model-based N tools.

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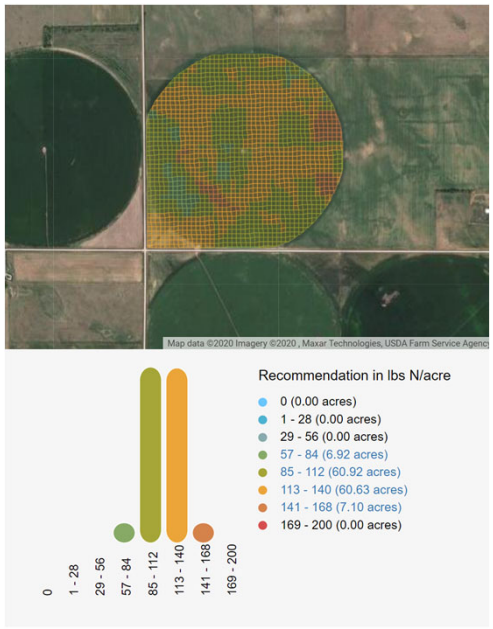
Interested in how agriculture technologies can improve nitrogen management on your farm?



https://cropwatch.unl.edu/precision-nitrogen-management-farm-research-project

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Thanks!

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