A VIEW FROM THE SKY:
MAPPING CORN NITROGEN STATUS IN
THE CEDAR RIVER WATERSHED

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Bradford Wirt
Objectives

• Utilize aerial imagery to map N status at a watershed level

• Identify how soon or late we can detect N stress with aerial imagery
4R Concept

**RIGHT SOURCE**
Matches fertilizer type to crop needs.

**RIGHT RATE**
Matches amount of fertilizer type crop needs.

**RIGHT TIME**
Makes nutrients available when crops needs them.

**RIGHT PLACE**
Keep nutrients where crops can use them.
Annual Corn N Survey: 2006-2017

>4,000 fields
Annual Corn N Survey: 2006-2017

#4: Target Deficient Area

Between 6 and 14 inches
Relative Yield and Corn N Status

![Graph showing relative yield vs. nitrate-N concentration in stalk (ppm).](image)

Iowa State Univ. PM 1584
Stalk Nitrate Test and Yield Response

Error Rate for Deficient Category 25%

break-even response
Middle Cedar Watershed Survey

2016: 100,000 Acres, 180 Fields

2017: 134,000 Acres, 85 Fields
Imagery Specification

Aerial Services Inc.
Leica ASD80 Pushbroom Sensor
Red, Green, Blue, NIR
Flown all at once, Late August
Imagery Calibration Tarps

% reflectance
3
6
12
33
56
66
Green Reflectance to Assess N Status
Green Reflectance vs Log Stalk Nitrate

- Excessive
- Optimal
- Deficient
Green Reflectance and N Status in 2017

- Excessive N Rate (lb/acre): 160
- Optimal
- Deficient N Rate (lb/acre): 185
- 230

Log Stalk Nitrate

Green Reflectance
## Predicted N Status vs Observed

<table>
<thead>
<tr>
<th></th>
<th>Predicted</th>
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<th>Correct Prediction (%)</th>
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<td></td>
<td>Observed</td>
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<td>2016</td>
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<td>Actual Class</td>
<td>A</td>
<td>B</td>
<td>C</td>
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<td>Observed 2016</td>
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<td>93</td>
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<td>69</td>
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<tr>
<td>Excessive</td>
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<td>Observed 2017</td>
<td>Deficient</td>
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<tr>
<td>Optimal</td>
<td>6</td>
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<td>19</td>
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<tr>
<td>Excessive</td>
<td>3</td>
<td>44</td>
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Imagery Analysis: Grids
Imagery Analysis: Buffers
Imagery Analysis: Zonal Calculation
Mapping N Status Within Fields

Field 1

Field 2

Field 3

Field 4

Field 5

Field 6

Soil Layers:
- Excessive
- Optimal
- Deficient
- Sampling Location
Predicted Within-Field Areas

2016
- Deficient: 27%
- Optimal: 49%
- Excessive: 24%

2017
- Deficient: 27%
- Optimal: 67%
- Excessive: 6%
Cedar River Watershed (2016-2017 Rainfall)
Corn after Soybean – Perfect Deficient vs. May/June Rainfall

2016 - 2017

Percent Deficient vs. May through June Rainfall (Inches)

- Sidedress
- Spring Urea
- Fall Anhydrous
- Spring Anhydrous Ammonia
- Fall Hog Manure
Corn after Soybean – Percent Deficient vs. Summer Rainfall

- Nitrogen Deficient Area (%)
- Summer Rainfall (Inches)

2016 - 2017

- SPRING UREA
- SIDEDRESS
- FALL ANHYDROUS
- FALL HOG MANURE
- SPRING ANHYDROUS AMMONIA
Corn after Soybean – Predicted N Excessive Area (%)
Corn after Soybean – Predicted N Excessive Area (%)
Corn after Soybean – Predicted N Excessive Area (%)
Northeast Iowa: N Rates for Optimal Status

2005 - 2017

Corn after Corn

FALL
ANHYDROUS
FALL
HOG
MANURE
SIDEDRESS
SPRING
ANHYDROUS
AMMONIA
SPRING
UREA

Corn after Soybean

FALL
ANHYDROUS
FALL
HOG
MANURE
SIDEDRESS
SPRING
ANHYDROUS
AMMONIA
SPRING
UREA
Cedar River Watershed: N Rates for Optimal Status

2005 - 2017
A Typical Field Over Time
Relative Yield to the Yield at max Nrate=200  ST2017IA0031

![Relative Yield Graph](image-url)
The Future of Aerial Imagery

Calibration Tarps
The Future of Aerial Imagery

Drones
The Future of Aerial Imagery

In-Field Sensors
Acknowledgments

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Iowa Farm Livestock Integrated Management Project

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Questions ????

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