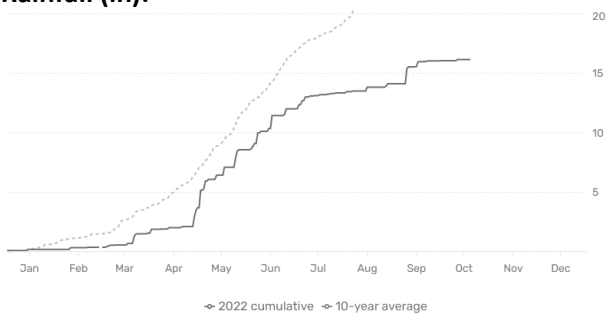
Sensor-based Nitrogen Management on Winter Wheat

Study ID: 1245023202201
County: Butler
Soil Type: Pohocco silty clay loam 6-11% slopes; Pohocco silty clay loam 11-17% slopes; Yutan silty clay loam 2-6% slopes
Planting Date: 10/18/21
Harvest Date: 7/15/22
Seeding Rate:
Row Spacing (in): 7.5
Hybrid: WestBred® WB4401
Reps: 3
Previous Crop: Soybean
Tillage: No-till
Herbicides: None

Seed Treatment: CruiserMaxx® and Vibrance®
Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: None
Rainfall (in):



Soil Tests. Soil test conducted at three locations within the field on April 13, 2022 (Figure 1, left).

						---------- Melich III ----------										% Base Saturation			
ID	Depth (inches)	pH 1:1	BpH	OM LOI%	Nitrate -N N ppm	Melich-III P ppm	K ppm	Ca ppm	Mg ppm	Na ppm	S ppm	CEC me/100g	Sand %	Silt %	Clay %	K	Mg	Ca	Na	H
0	6	6.0	6.59	2.3	2.7	21	197	2624	669	11	9	22.6	28	53	18	2.2	24.7	58.1	0.2	15
1	6	7.2	6.93	3.3	8.9	21	270	2427	443	6	6	16.5	24	61	14	4.2	22.4	73.5	0.2	0
2	6	5.2	6.33	3.4	12.2	17	156	1621	352	7	10	17.5	30	51	18	2.3	16.8	46.3	0.2	34.3

Introduction: This study evaluated a sensor-based N management strategy for winter wheat compared to the grower's traditional N management. The experiment was arranged in a randomized complete block design with three replications of two treatments; sensor-based N management and grower's N management (Figure 1, left). The entire field received a pre-plant application of 180 lb/ac of 11-52-0, contributing 19 lb N/ac.

Treatments: The sensor-based N management strategy was compared to the grower's N management.

- *Grower's N management:* 120 lb N/ac as 32% UAN was applied with TeeJet's StreamJet nozzles at green-up on April 17, 2022, for a total of 139 lb N/ac.
- *Sensor-based N management:* A flat rate of 27 lb N/ac was applied on April 17. Satellite imagery was captured using Planet® SkySat on May 12, 2022 and May 22, 2022. The normalized difference vegetation index (NDVI) was calculated from the imagery (Figure 2). On May 21, 2022, in-field measurements were taken with a handheld Trimble® GreenSeeker® in selected locations in the bulk of the field to calibrate the imagery. The imagery and GreenSeeker® measurements were processed in the Ninja Ag platform using the University of Nebraska-Lincoln algorithm. On average, 60 lb N/ac was recommended. The variable-rate application averaging 60 lb N/ac was applied on June 6, 2022. The total N application averaged 106 lb N/ac.
- *N rate ramps:* At the April 17 application date, a set of four N rates ranging from 0 to 106 lb N/ac was applied, for total rates ranging from 19 to 125 lb N/ac (Figure 1, left). This N rate ramp was used to determine the observed economic optimum nitrogen rate (EONR).

As-applied fertilizer maps were used to evaluate the accuracy of fertilizer application, and only areas with high accuracy were included in the analysis. Hand samples were collected at harvest to determine grain protein.

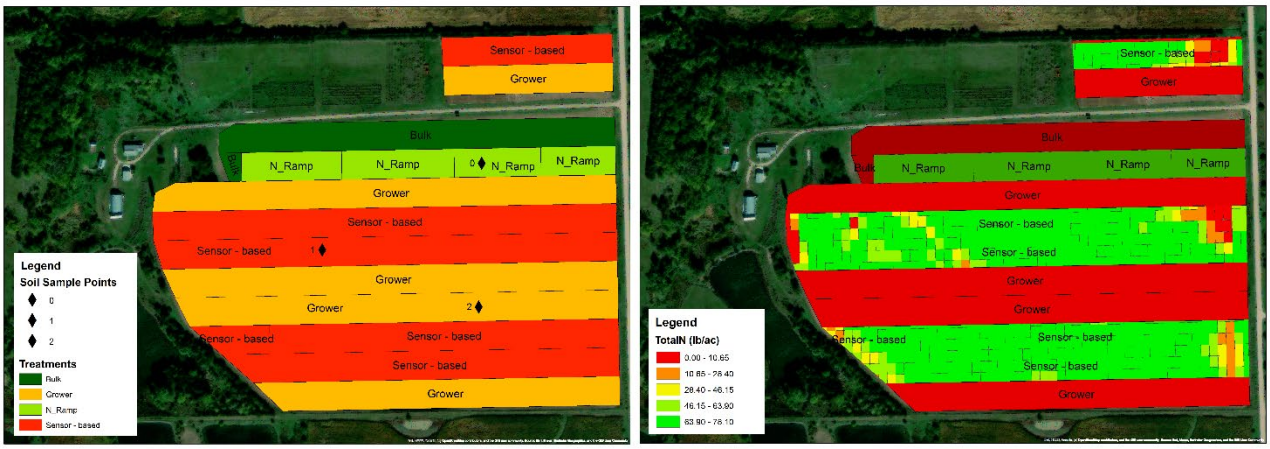


Figure 1. Treatment layout with grower, sensor-based, and nitrogen rate blocks (N_Ramp) with increasing N rates. Soil sampling points from April 13, 2022, are indicated (left). Sensor-based, variable-rate nitrogen recommended by Ninja Ag prescription and applied on June 6, 2022.

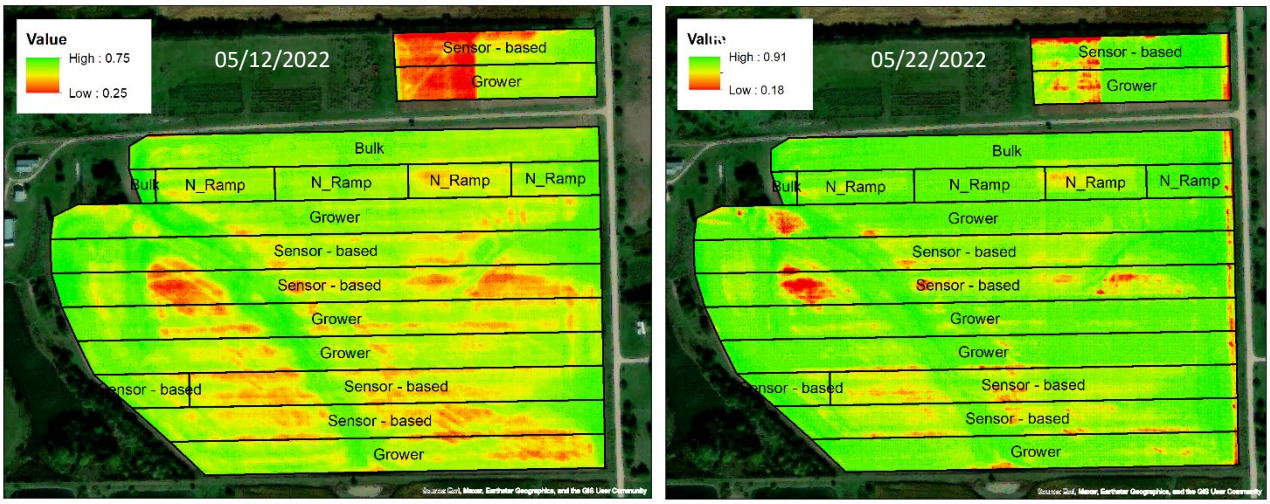


Figure 2. Normalized difference vegetation index (NDVI) values captured on May 12 (left), and May 22 (right) using Planet® SkySat satellite imagery (50 cm resolution).

Results:

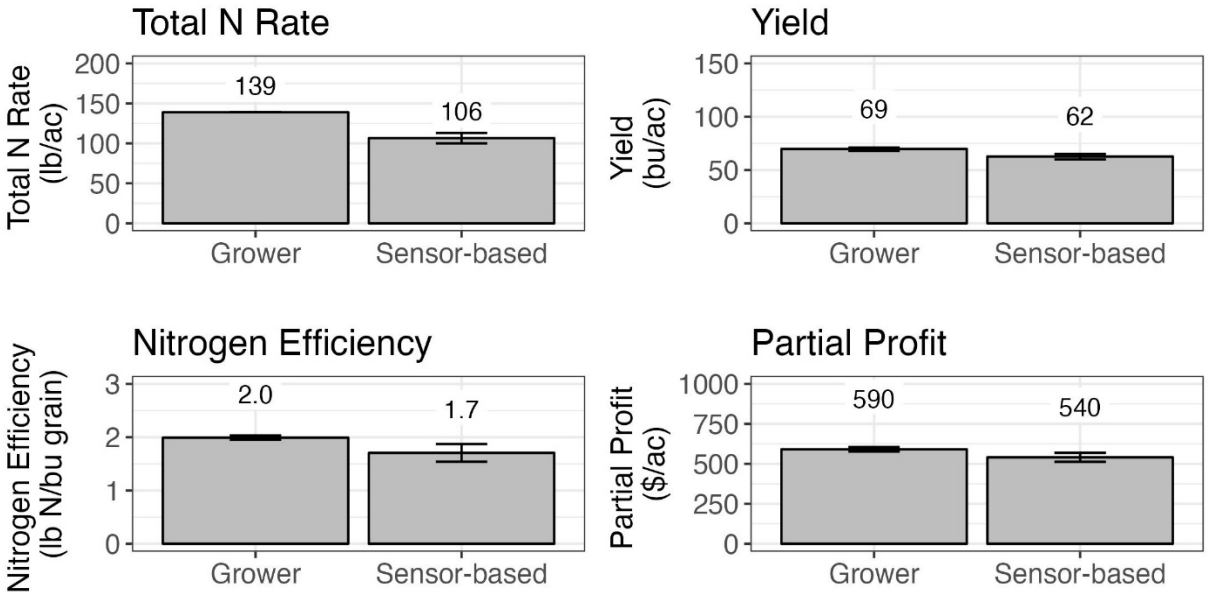


Figure 3. Total N rate, yield, nitrogen efficiency, and partial profit for the grower's N management and sensor-based N management. Vertical bars represent the standard deviation of the mean. Averages reported are means of all observations, and will not be identical to results in table below, which are summarized first by replication.

	Total N rate (lb/ac)	Yield (bu/ac)†	Nitrogen Efficiency (lb N/bu grain)	Protein (%)	Partial Profit‡ ($/ac)
Grower N Management	139 A*	70 A	1.99 A	11.1 A	591 A
Sensor-based N Management	106 B	63 B	1.7 B	10.7 B	541 B
P-Value	0.013	0.008	0.060	<0.01	0.026

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from weight wagon. Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $9.58/bu wheat and $0.56/lb N.

Summary:

- The average stand count in the field was 880,000 plants/ac on April 25, 2022.
- The sensor-based approach averaged 33 lb N/ac lower than the grower's traditional management.
- Yield was 7 bu/ac lower for the sensor-based treatment. The yield reduction may be due to the late timing of the application.
- The lower N rates resulted in greater N efficiency for the sensor-based treatment.
- Profit was $50/ac lower for the sensor-based treatment compared to the grower's management as the yield reduction was not offset by the fertilizer savings.
- This field and area were abnormally dry, according to the U.S. Drought Monitor (https://droughtmonitor.unl.edu/) during grain fill in June, which may have limited yield potential and N uptake. Additionally, there was minimal snow cover during the vernalization period.

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