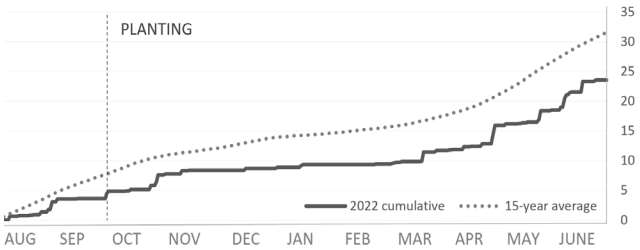
Sensor-Based Nitrogen Management on Winter Wheat

Study ID: 0656127202201
County: Nemaha
Soil Type: Judson silt loam 2-6% slopes; Pohocco silty clay loam 6-11% slopes; Pohocco silty clay loam 2-6% slopes
Planting Date: 9/30/21 and 10/13/21
Harvest Date: 7/5/22
Seeding Rate: 1.25 million
Row Spacing (in): 7.5
Hybrid: AG Icon, from AGSECO
Reps: 5
Previous Crop: Soybean
Tillage: No-till
Herbicides: ***Post:*** Dicamba applied in November

Seed Treatment: Sativa™ IM RTU
Foliar Insecticides: None
Foliar Fungicides: AzoxyProp Xtra
Irrigation: None
Rainfall (in):



Soil Tests. Soil test conducted at four locations within the field on April 27, 2022 (Figure 1, left).

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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 %	% Base Saturation K	Mg	Ca	Na	H
0	6	6.2	6.66	3.7	3.9	10	175	3308	369	12	9	22.8	18	61	20	2	13.5	72.5	0.2	11.8
1	6	6.1	6.7	3.5	2.9	10	108	2302	288	10	10	16.5	26	55	18	1.7	14.5	69.8	0.3	13.9
2	6	5.8	6.67	3.6	4.2	8	120	1683	283	10	10	13.7	22	59	18	2.2	17.2	61.4	0.3	19
3	6	5.8	6.63	3.5	4.4	11	81	2039	259	11	9	15.6	24	55	20	1.3	13.8	65.4	0.3	19.2

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 five replications of two treatments (Figure 1, left). The entire field received 30 lb N/ac in the fall as urea and 30 lb N/ac as UAN 32% with fungicide in April.

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

- *Grower's N management:* 20 lb N/ac was applied on May 31, 2022, for a total of 80 lb N/ac.
- *Sensor-based N management:* A senseFly eBee ag drone with a 4-band multispectral camera (Parrot Sequoia+) was used to capture imagery of the field on May 3, 2022. The normalized difference vegetation index (NDVI) was calculated from the imagery (Figure 2). On the same date, 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 winter wheat algorithm. On average, 19 lb N/ac was recommended. A variable-rate application averaging 19 lb N/ac was made on May 31, 2022, for a total of 79 lb N/ac.
- *N rate ramps:* At the May 31 application date, two sets of high and low N rates were established using a variable-rate prescription (Figure 1, right). The low N rate had no additional N applied for a total N rate of 60 lb N/, whereas the high N rate had 67 lb N/ac applied for a total N rate of 127 lb N/ac. N rate ramps were used to determine the yield response at low and high N rates.

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.

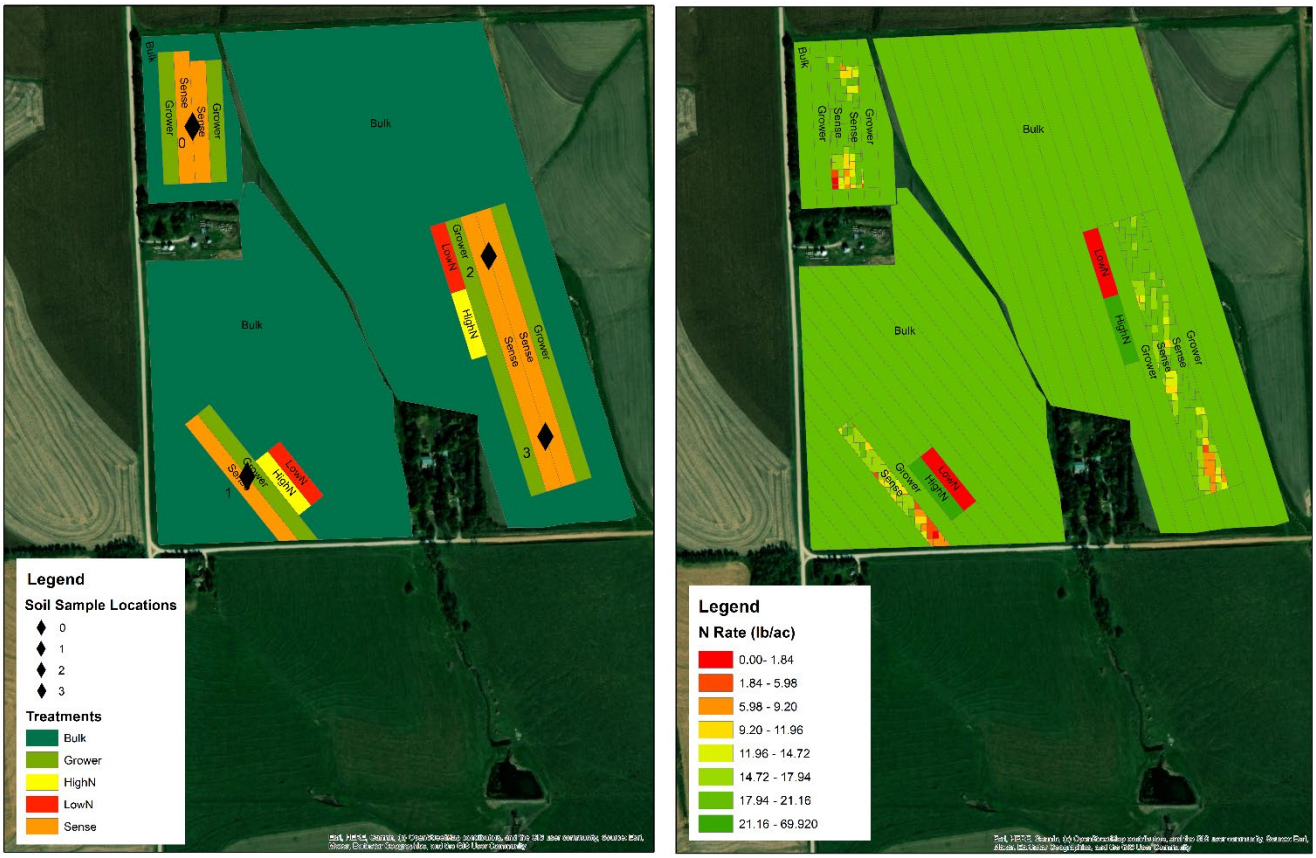

Figure 1. Treatment layout and soil sampling points with grower, sensor-based, low, and high nitrogen blocks (60 and 127 lb N/ac) (left). Nitrogen application prescription for sensor-based management, grower's management, high N blocks, and low N blocks applied on May 31, 2022 (right).

Results:

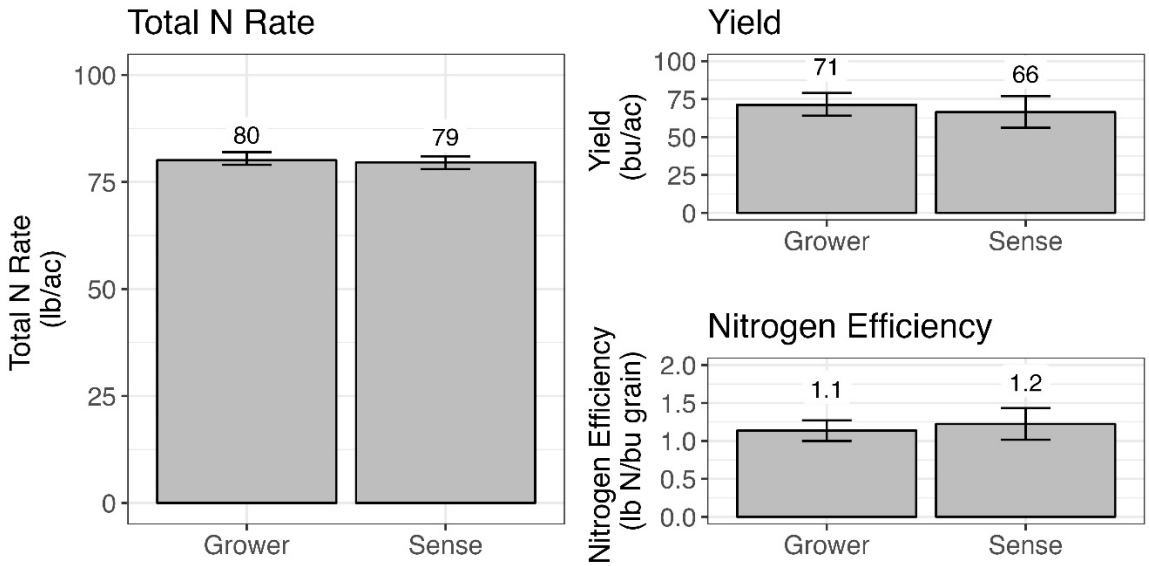

Figure 2. Total N rate, yield, nitrogen efficiency, and partial profit for the grower's N management and sensor-based N management. Vertical bars represent the standard deviation of the mean. Averages reported are means of all observations and will not be identical to results in table below, which are summarized first by replication.

High and low N blocks were only replicated two times; therefore, they are not included in the statistics, but means are provided in the table below for reference.

	Total N rate (lb/ac)	Yield (bu/ac)†	Nitrogen Efficiency (lb N/bu grain)	Protein (%)	Partial Profit‡ ($/ac)
Grower N Management	80 A*	71 A	1.14 B	13.6	637 A
Sensor-based N Management	79 A	65 B	1.22 A	13.6	581 B
High N	127	72	1.75	-	619
Low N	60	71	0.85	-	646
P-Value	0.465	0.055	0.058	-	0.055

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13.5% moisture.
‡Marginal net return based on $9.58/bu wheat and $0.56/lb N.

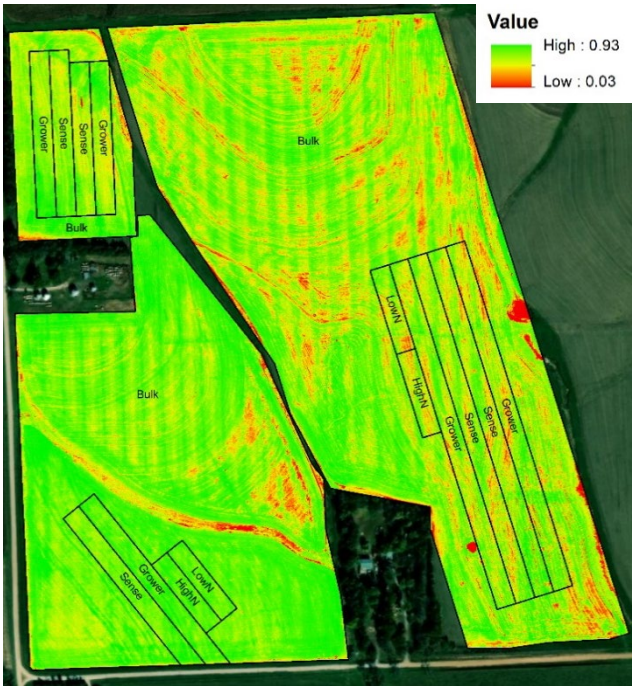

Figure 2. Normalized difference vegetation index (NDVI) values captured with a senseFly eBee ag drone and 4-band multispectral camera (Parrot Sequoia+) on May 3, 2022.

Summary:

- The variable-rate-sensor-based management applied on average the same amount of fertilizer as the grower's traditional management. A delay from the time of obtaining sensor and imagery data (May 3) and applying the prescription (May 31) may have reduced the reliability of the prescription.
- The grower's traditional management yielded 6 bu/ac more than the sensor-based approach, was $56/ac more profitable, and had greater nitrogen use efficiency.
- There was no difference in grain protein between the treatments.
- This field and area were moderately 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.
- This field was damaged by hail two times in June 2022, and had a yield loss of 8% across the entire field according to the insurance.

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