

Sensor-Based Nitrogen Management on Winter Wheat

Study ID: 1268067202201

County: Gage

Soil Type: Malmo complex; Nodaway silt loam channeled, occasionally flooded; Pawnee complex 6-11% slopes; Wymore silty clay loam 0-2% slope; Wymore silty clay loam 2-6% slopes

Planting Date: 10/14/21

Harvest Date: 7/15/22

Row Spacing (in): 7.5

Hybrid: WestBred® WB4699

Reps: 8

Previous Crop: Soybean

Tillage: No-till

Herbicides: Post: 0.8 oz/ac Affinity®

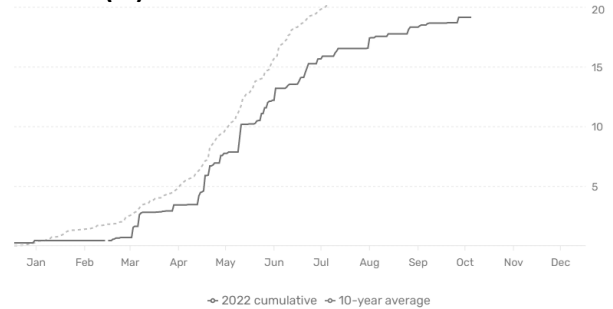
Seed Treatment: Vibrance® Extreme

Foliar Insecticides: None

Foliar Fungicides: Miravis® Ace

Irrigation: Pivot

Rainfall (in):



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

----- Melich III -----																					
ID	Depth (inches)	pH 1:1	BpH	OM LOI%	Nitrate -N N ppm	Melich-											% Base Saturation				
						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	6.8	6.85	2.7	3.9	11	216	3674	856	195	10	27.7	30	43	26	2	25.8	66.3	3.1	2.9	
1	6	6.5	6.74	2.8	1.4	8	118	3463	608	110	8	25.1	34	35	30	1.2	20.2	69	1.9	7.6	
2	12	6.1	-	3.5	2	8	143	2853	549	28	9	22.5	38	46	16	1.6	20.3	63.4	0.5	14.2	

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 eight replications of two treatments (Figure 1, left). The entire field received a broadcast application of MAP, AMS, and potash in the fall resulting in 22.8 lb of N/acre.

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

- *Grower's N management:* 80 lb N/ac was applied as 32% UAN at green-up on April 15, 2022, for a total N rate of 103 lb N/ac.
- *Sensor-based N management:* A satellite image was captured using Planet® SkySat on May 11, 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, 63 lb N/ac was recommended. The variable-rate application averaging 63 lb N/ac was applied on May 21, 2022, at jointing (Figure 1, right) for a total of 86 lb N/ac. The field received approximately 1" of rain on May 24.
- *N rate ramps:* At the April 15 application date, two sets of four N rates were applied with total N ranging from 0 to 120 lb N/ac, for total rates ranging from 23 to 143 lb N/ac (Figure 1, left). These N rate ramps were used to determine the observed economic optimum nitrogen rate (EONR data not shown).

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.

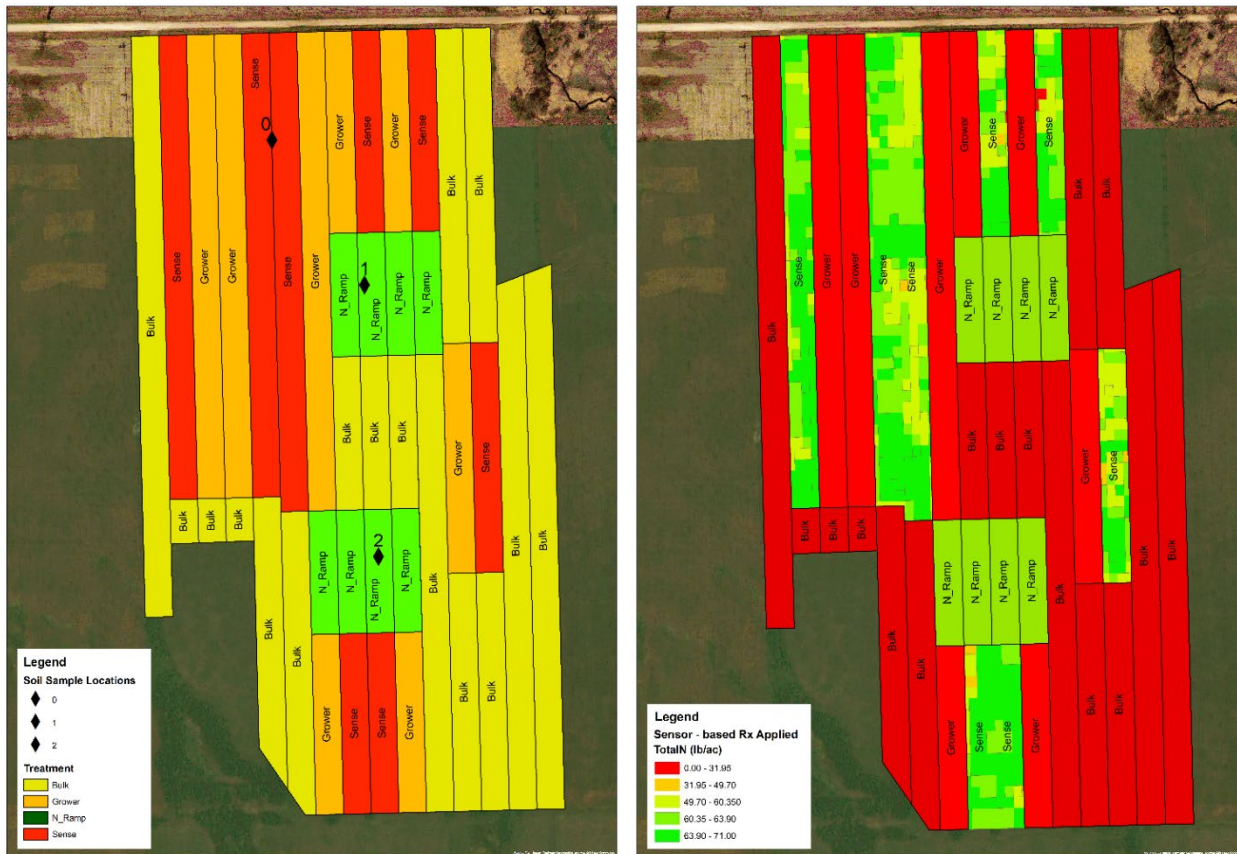


Figure 1. Treatment layout with grower, sensor-based, and nitrogen rate blocks (N_Ramp) with increasing N rates. Soil sampling points are indicated (left). Nitrogen application prescription for sensor-based management applied on May 21, 2022 (left).

Results:

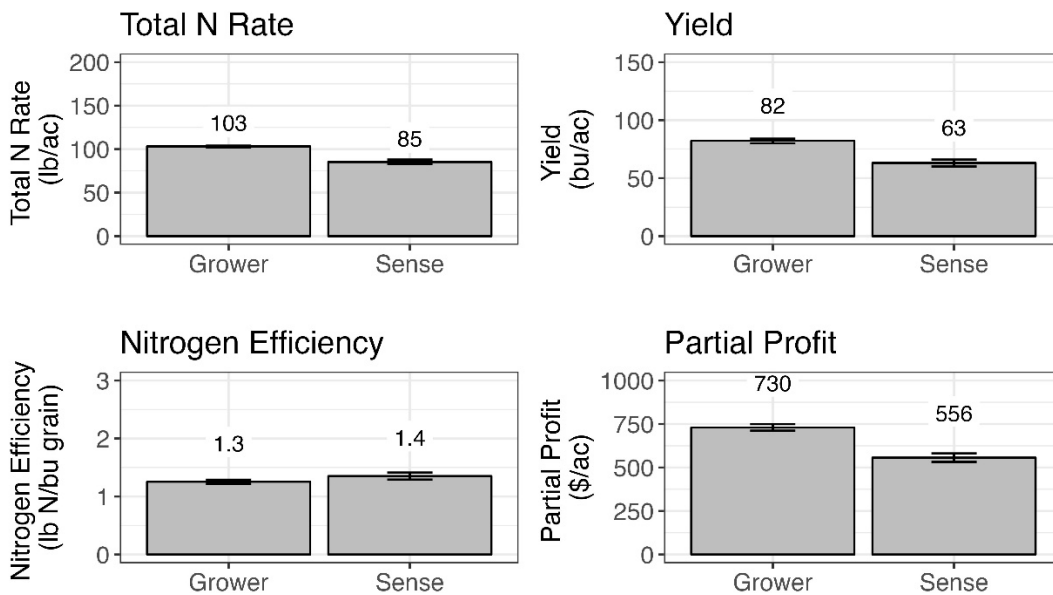


Figure 2. Total N rate, yield, nitrogen efficiency, and partial profit for the grower's N management and sensor-based N management. Vertical bars represent the standard deviation of the mean. Averages reported are means of all observations and will not be identical to results in table below, which are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

	Total N rate (lb/ac)	Yield (bu/ac)†	Protein (%)	Nitrogen Efficiency (lb N/bu grain)	Partial Profit‡ (\$/ac)
Grower N Management	103 A*	82 A	11.4	1.25 B	731 A
Sensor-based N Management	85 B	63 B	11.1	1.35 A	557 B
P-Value	<0.0001	<0.0001	-	0.002	<0.0001

*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.

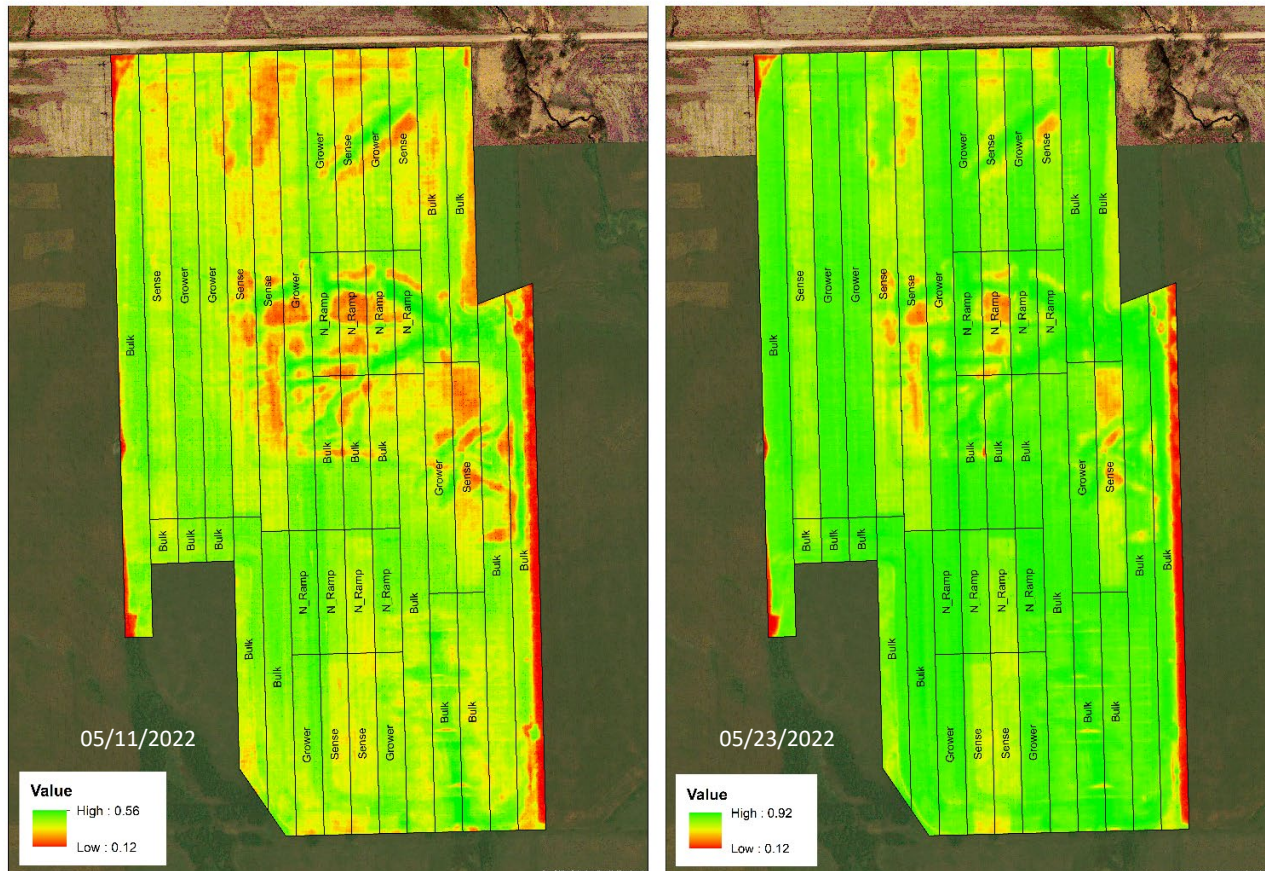


Figure 2. Normalized difference vegetation index (NDVI) values captured on May 11 (left), and May 23 (right) using Planet® SkySat satellite imagery (50 cm resolution).

Summary:

- The sensor-based approach applied 19 lb N/ac less than the grower’s N management and delayed N application by over a month compared to the grower.
- Yield was 19 bu/ac lower for the sensor-based treatment, and resulted in \$174/ac lower profit. Delayed N application for the sensor-based treatment may have resulted in unrecoverable N stress.
- Nitrogen efficiency was greater for the sensor-based treatment.



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