Sensor-Based Nitrogen Fertigation Management

Study ID: 0207121202001
County: Merrick
Soil Type: Janude sandy loam rarely flooded; Alda loam occasionally flooded; Fonner loam rarely flooded
Planting Date: 4/26/20
Harvest Date: 10/2/20
Seeding Rate: 31,700
Row Spacing (in): 30
Hybrid: Pioneer® 1366Q
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
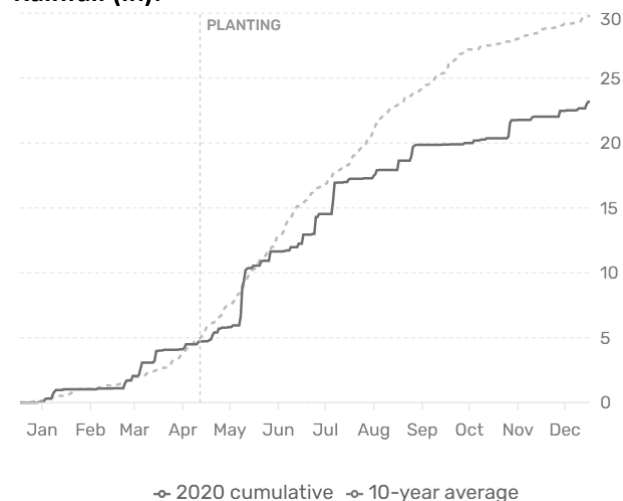**Herbicides:** *Pre:* 2.5 qt/ac Acuron®, 1 pt/ac atrazine, and 28 oz/ac glyphosate
Foliar Insecticides: 6 oz/ac Brigade® 2EC
Foliar Fungicides: 10.5 oz/ac Gold Rush® Duo

Irrigation: Pivot, Total: 6.95"
Rainfall (in):

Soil Test (April 2020, soil tests are averages of four replications of each of two treatments):

	pH	BpH	OM LOI %	Nitrate – N ppm N	Mehlich P-III ppm P	Sulfate-S ppm S	Ammonium Acetate (ppm)				CEC me/100g	% Base Saturation				
							K	Ca	Mg	Na		H	K	Ca	Mg	Na
Grower	7.0	7.2	2.1	4.1	14	10	162	1585	180	11	10	0	5	78	17	0.5
Full-Season	7.2	7.2	2.2	4.5	15	11	148	1873	183	12	11	0	4	80	16	0.5

Introduction: Corn nitrogen management may be improved by using sensors or imagery to detect and respond to corn nitrogen need during the growing season. This study used weekly aerial imagery obtained with a multispectral sensor on a fixed-wing drone to monitor indicator plots that had lower N rates. If indicator plots demonstrated nitrogen deficiency, a fertigation application of 30 lb/ac was triggered. Originally, this study was intended to compare the grower's standard N management with two reactive, sensor-based fertigation approaches. Due to miscommunication regarding the rate of starter fertilizer applied (10 lb/ac N more than actual), this site only evaluated the full-season sensor-based management versus the grower management as follows:

Grower Management: The grower's standard N management plan involved applying 18 lb/ac N as 13 gal/ac of 10-34-0 and 4 gal/ac 6-24-6 on April 26 with planting, 52 lb/ac N as 28-0-0-5S on June 3 with a high-clearance applicator, 20 lb/ac N as 28-0-0-5S through fertigation on June 25, July 10, and July 16, and 10 lb/ac N as 28-0-0-5S through fertigation on July 28. Total N application was 140 lb/ac.

Full-Season Sensor-Based Management: The sensor-based method is used to recommend N applications from V6 to R3 growth stages. Fertigation application decisions were made based on a decision logic applied to aerial imagery. The base rate of N was 70 lb/ac N (from planting and high-clearance applications). All sensor-based fertigation applications were made at a rate of 30 lb/ac N. Sensor-based fertigation with 28-0-0-5S was triggered on three dates: one of four replications received N on June 25, all four replications received N on July 20, and two replications received N on July 24. The total N application was 122 lb/ac N.
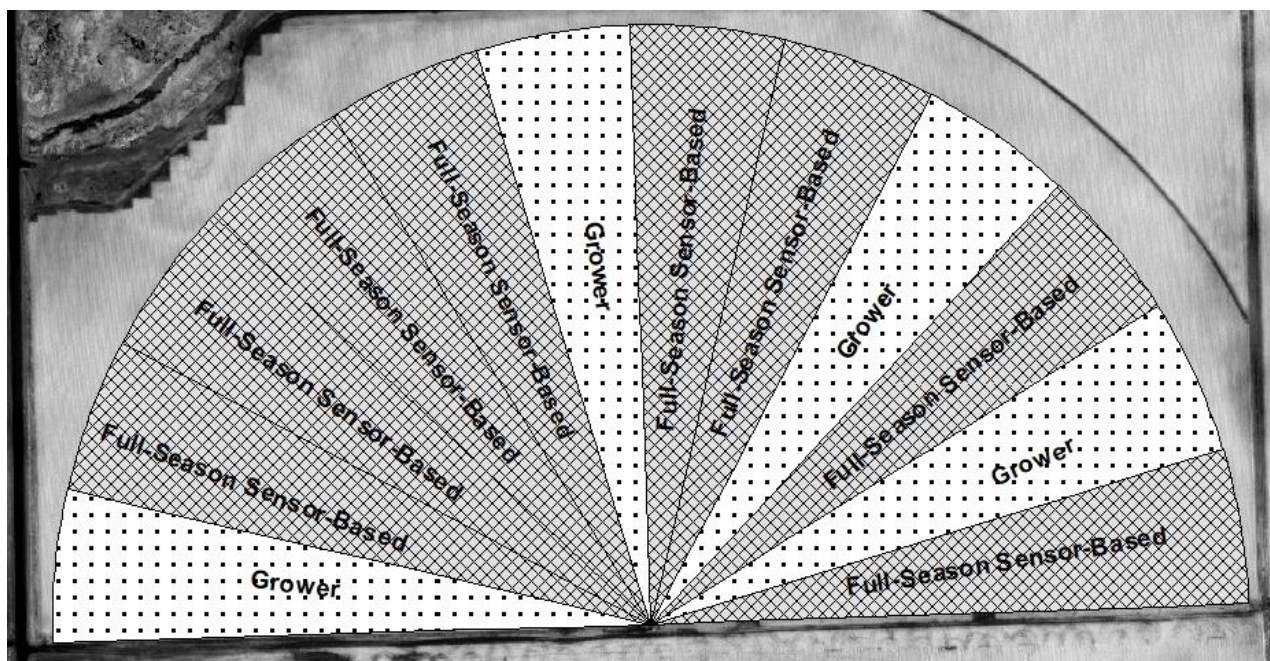
Figure 1. Experiment layout showing four replications of two treatments arranged in sectors.

Results:

	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/bu grain	Marginal Net Return‡ ($/ac)	NO$_3$-N ppm N$^\Psi$ 0-8"	NO$_3$-N ppm N 8-24"
Grower	140 A*	15.8 A	233 A	93 B	0.60 A	760.02 A	5.5 A	2.0 A
Full-Season	122 B	16.1 A	236 A	109 A	0.51 B	779.77 A	5.0 A	1.7 A
P-Value	0.041	0.372	0.676	0.032	0.019	0.496	0.541	0.409

*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 15.5% moisture.
‡Marginal net return based on $3.51/bu corn and $0.41/lb N.
ΨSoil samples collected after harvest in November 2020.

Summary:

- At this site, the full-season sensor-based management approach applied 18 lb/ac less N than the grower's management.
- Yield was not statistically different between the sensor-based management and the grower's N management.
- The sensor-based approach resulted in greater nitrogen use efficiency as measured by lb of N per bu of grain; the sensor-based approach used 0.09 fewer lb of N to produce a bushel of grain.
- There was no statistical difference in marginal net return between the sensor-based approach and the grower's N management.
- Results at this site suggest that full-season sensor-based nitrogen management can significantly increase N use efficiency without significantly impacting yields, even compared with intensive grower management.
- There were no statistically significant differences in residual soil nitrate between treatments or relative change in soil nitrate from spring to fall.