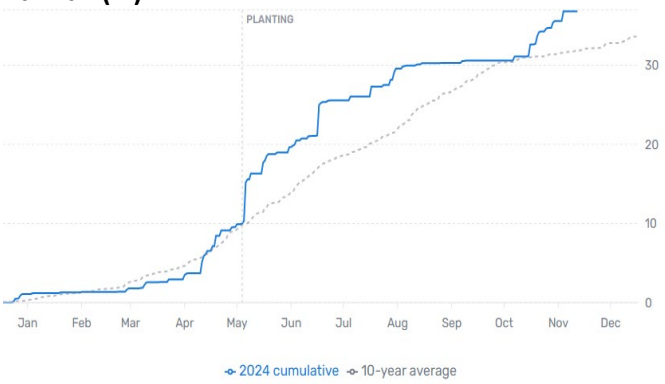
Sensor-Based Nitrogen Management on Irrigated Corn

Study ID: 1524155202401
County: Saunders
Soil Type: Tomek silt loam
Planting Date: 5/18/24
Harvest Date: 10/25/24
Population: 34,500
Row Spacing (in): 30”
Hybrid: Pioneer® P1278Q
Reps: 5
Previous Crop: Corn
Tillage: Reduced Tillage
Herbicides: ***Pre:*** 1.6 qt/ac Harness Xtra® + 3 oz/ac Balance Flex® ***Post:*** 32 oz/ac Symbol Release® + 32 oz/ac atrazine + 3 oz/ac Laudis® + 22 oz/ac glyphosate + 9.5 oz/ac Superb® + 8 oz/ac Bountiful® + 20 oz/ac Interlock® + 24 oz/ac Class Act Ridion®
Seed Treatment: Base Pioneer® Seed Treatment

Foliar Insecticides: 5 oz/ac Battalion 2EC® + 2 oz/ac Wetcit® applied on 7/20/24
Foliar Fungicides: 7 oz/ac Veltyma® applied on 7/20/24
Irrigation: Pivot, Total: 5”
Rainfall (in):



Introduction: Corn nitrogen management may be improved by using sensors or imagery to account for within-field variability and respond to corn nitrogen needs during the growing season. This study used weekly aerial imagery obtained with a multispectral sensor on a quadcopter drone to determine the in-season nitrogen rate. This study compared the grower’s standard nitrogen treatment and a sensor-based nitrogen approach while also including a nitrogen rate ramp to determine the economic optimum nitrogen rate (EONR) for the field (after harvest).

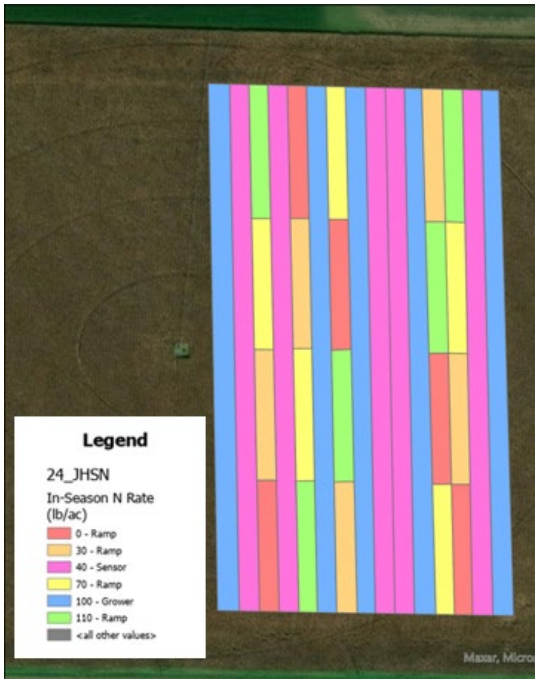


Figure 1: Project Design and Layout

Grower Nitrogen Treatment*:* The field received a target base rate of 120 lb N/ac as anhydrous ammonia on November 30, 2023, and a target flat rate of 100 lb N/ac as 32% UAN on July 7, 2024. The as-applied data showed that the average anhydrous ammonia rate was 121 lb N/ac and the average UAN rate was 99 lb N/ac for the grower treatment.

Sensor Nitrogen Treatment: The field had a target base rate of 120 lb N/ac as anhydrous ammonia applied on November 30, 2023. As-applied data showed that the average anhydrous ammonia rate was 120 lb N/ac. Aerial imagery was obtained with a multispectral sensor on a quadcopter drone to monitor the crop weekly from V6 to R5 growth stages. The imagery from July 6, 2024, was used to direct the in-season N application using the Holland-Schepers and UNL N algorithms. The sufficiency index was calculated from aerial imagery, and the UNL N algorithm (https://agritools.unl.edu/tools/nitrogen) was employed to generate an estimated optimum nitrogen rate input, which was required in the Holland-Schepers algorithm. Credits for the anhydrous ammonia were also taken into consideration in this algorithm. Based on the Holland-Schepers algorithm, the sensor application called for 32 lb N/ac on all sensor plots. However, to manage risk, the grower determined he wanted a minimum rate of 40 lb N/ac in-season on the sensor-based treatments, more than the sensor recommended rate. Therefore, the in-

season application of 40 lb N/ac was applied as 32% UAN on July 9, 2024, using a Hagie STS 12 with a coulter bar. As-applied data showed the average sensor-based in-season application was 41 lb N/ac.

Nitrogen Rate Ramps: During the in-season application, nitrogen rate ramps were also applied, with in-season N rates of 0, 30, 70, and 110 lb N/ac and were used to determine the economic optimum N rate (EONR) for the field to compare with the grower and sensor-based N rates. The treatment layout is shown in figure 1.

Results:

Treatment	Total N Rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	NUE (lb N/bu grain)	Marginal Net Return‡ ($/ac)
Grower	220 A*	14.7 A	248 A	63 B	0.88 A	984 B
Sensor	161 B	14.7 A	247 A	86 A	0.65 B	1,010 A
P-Value:	<0.001	0.88	0.78	<0.001	<0.001	0.08

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $4.35/bu corn, $0.38 NH3, and $0.50 32% UAN.

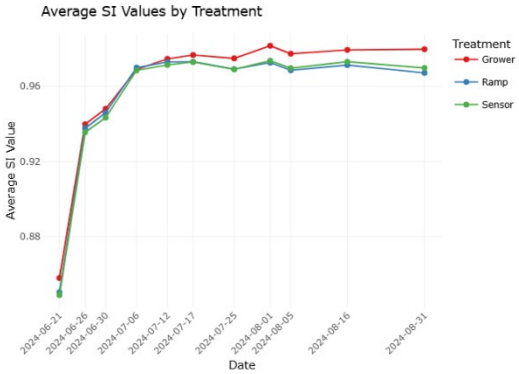


Figure 3: Average SI Values by Treatment

Summary:

- The sensor-based management N rate was 59 lb N/ac lower than the grower's traditional N management
- There were no differences in yield between the grower's traditional N management and the sensor-based management.
- Each unit of N applied by the sensor-based management produced 36% more grain (partial factor productivity of the fertilizer) compared to the grower management.
- Optimal N rates could not be fit using the N ramp treatments, suggesting using the lowest amount of N (120 lb N/ac).
- Marginal net return was $26/ac greater for the sensor-based N management.
- The economically optimal N rate (EONR) calculated after harvest (using the N ramp strips) for the field was 120 lb N/ac, with an estimated yield of 248 bu/ac. The EONR was 41 lb/ac lower than the sensor-based N rate and 100 lb/ac lower than the grower's traditional N management.
- Using a sensing technology capable of accounting for within-field and in-season variability, growers can produce corn more efficiently in terms of nitrogen and increase their profits, potentially reducing the environmental impact of N applications.