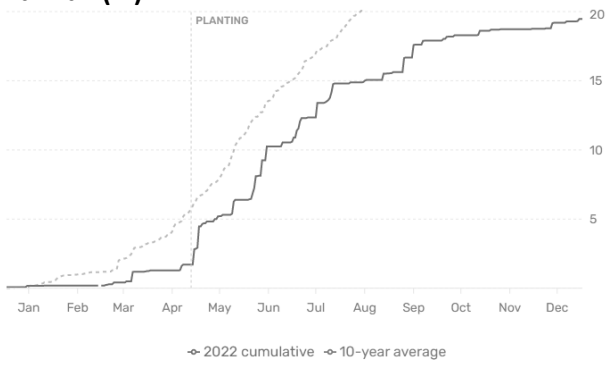
Sensor-Based Nitrogen Fertigation Management

Study ID: 1260079202201
County: Hall
Soil Type: Holder loam 0-3% slope; Holder loam 0-3% slopes, overblown
Planting Date: 4/27/22
Harvest Date: 10/16/22
Seeding Rate: 32,000
Row Spacing (in): 36
Hybrid: Pioneer® P1185AM
Reps: 4
Previous Crop: Corn
Tillage: Conventional + strip-till
Herbicides: ***Post:*** 1.5 qt/ac Resicore®, 1 qt/ac atrazine, 1 qt/ac Roundup®, and 8 oz/ac DiFlexx® on 5/18/22. 1 qt/ac Warrant® Ultra and 22 oz/ac Roundup® on 6/27/22
Seed Treatment: None

Foliar Insecticides: 8 oz/ac Index® during planting on 4/27/22. 6 oz/ac bifenthrin on 7/20/22
Foliar Fungicides: 12 oz/ac Quilt Xcel® on 7/20/22
Note: Hail damage on 6/7 at the V6 growth stage
Irrigation: Pivot, Total: 9.0"
Rainfall (in):



Introduction: Corn nitrogen management may be improved by using sensors or imagery to detect and respond to corn nitrogen needs 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 or 60 lb/ac was triggered. This study compared the grower's standard management with two reactive, sensor-based fertigation approaches as follows:

Grower Management: Cooperating grower made the fertigation management decisions for this treatment throughout the growing season.

Risk-Averse Post-Establishment (RAP): Fertigation application decisions were made based on decision logic and analytics applied to aerial imagery from the V6 growth stage to the R3 growth stage.

Risk-Averse Post-Establishment Increased-Rate (RAP-IR): Fertigation application decisions were made based on decision logic and analytics applied to aerial imagery from the V6 growth stage to the R3 growth stage with application rate increased from 30 lb N/ac to 60 lb N/ac for any fertigation applications recommended between V9 and V14.

Application Table: Unless otherwise noted, N was applied using 32% UAN. Gray shaded area to the right of the striped line indicates where sensor-based management dictated N rates. The applied values are averages across all four reps; therefore, if only one out of four replications triggered an application of 30 lb N/ac, a value of 7.5 lb N/ac is reported as the average treatment N application across reps.

	4/5	4/9	4/9	4/27	6/24	7/8	7/13	Total N Applied
Treatment	----------*lb N/ac applied*----------							
Grower	125 [a]	11.7[b]	35.5[c]	3[d]	35.5	35.5	-	**246**
RAP	90 [a]	11.7[b]	35.5[c]	3[d]	7.5	-		**148**
RAP-IR	90[a]	11.7[b]	35.5[c]	3[d]	-	-	7.5	**148**

[a] Product used was 32-0-0 via coulter rig

[b] Product used was 10-34-0 via dual applicator coulter rig

[c] Product used was 32-0-0 via dual applicator coulter rig

[d] Product used was 9-24-3 via planter

Results:

	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lb N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	246 A*	17.4 A	212 A	48 B	1.16 A	1,245 B
RAP	148 B	17.3 A	214 A	82 A	0.69 B	1,338 A
RAP-IR	148 B	17.3 A	212 A	81 A	0.70 B	1,325 A
P-Value	<0.0001	0.321	0.623	0.001	0.0001	0.011

*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 $6.80/bu corn and $0.80/lb N.

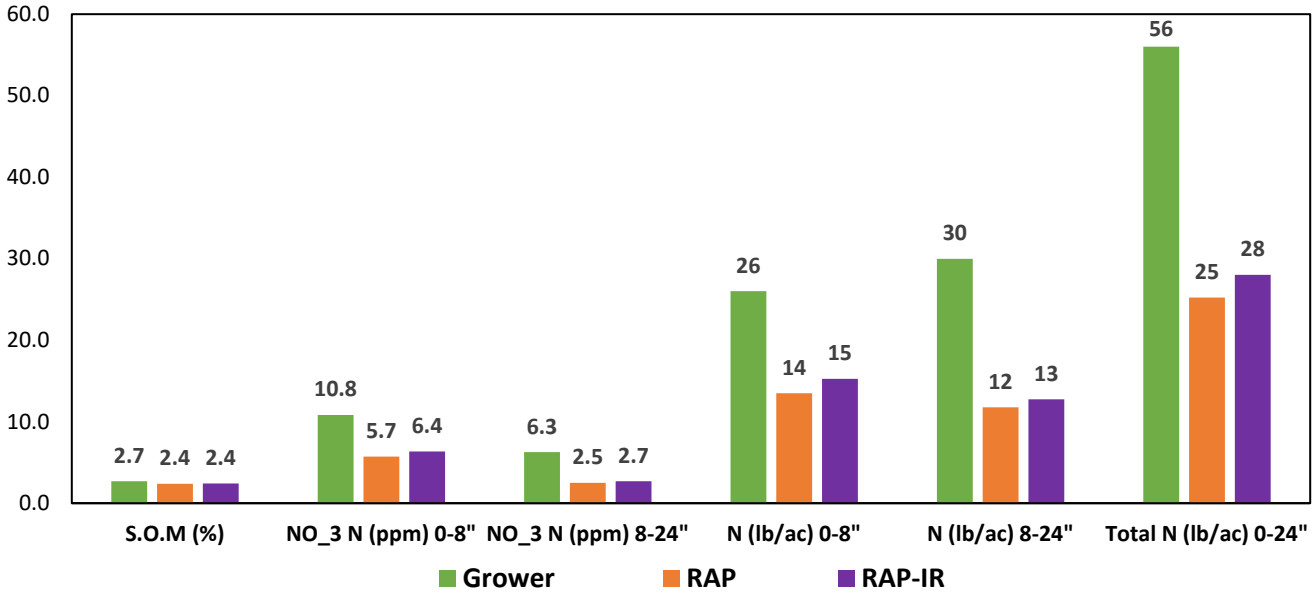


Figure 1. Post-harvest soil samples were taken in 12 treatment sectors (one sample per sector) for grower, risk-averse post-establishment (RAP), and risk-averse post-establishment increased-rate (RAP-IR) treatments. Soil organic matter (S.O.M.) in percent, nitrate nitrogen in ppm (NO_3 N), and nitrogen (N) in lb/ac are reported for two depths, 0-8" and 8-24".

Summary:

- Both sensor based approaches resulted in a significant N fertilizer saving (98 lb N/ac) compared to the grower's management.
- Yield was not statistically different among treatments.
- A substantial reduction in N fertilizer while maintaining yields resulted in an $80/ac increase in profit for the RAP-IR approach and $93/ac increase in profit for the RAP approach compared to the grower's management.
- Nitrogen efficiency was greater for the sensor-based management approaches compared to the grower's traditional management.
- RAP-IR treatment did not trigger an application during the increased rate period between V9 and V14; therefore, the treatment followed the same protocol as the RAP treatment.
- Both sensor-based fertigation approaches resulted in significantly lower residual soil nitrate values compared to the grower's management (Figure 1).

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