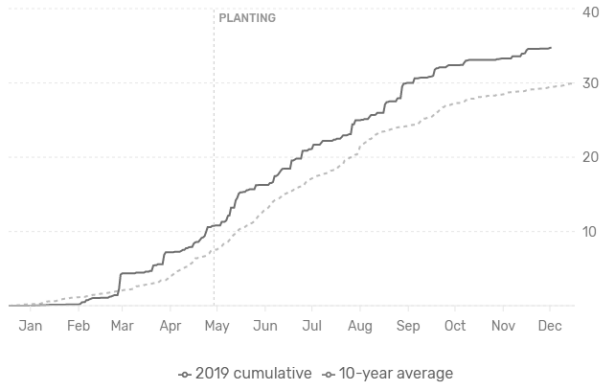
Sensor-based Nitrogen Fertigation

Study ID: 0929139201901
County: Pierce
Soil Type: Alcester silty clay loam 2-6% slopes; Loretto sandy loam 0-3% slope; Blendon fine sandy loam 2-6% slopes; Boelus fine sand 2-6% slopes; Nora silt loam 2-6% slopes; Loretto loam 2-6% slopes; Loretto sandy loam 3-6% slopes; Doger fine sand 2-6% slopes; Thurman loamy fine sand 2-6% slope; Ortello fine sandy loam 2-6% slope
Planting Date: 5/13/19
Harvest Date: 11/22/19
Seeding Rate: 30,000
Row Spacing (in): 30
Variety: NK®1094-3220 E-Z Refuge
Reps: 4
Previous Crop: Soybean
Tillage: No-Till

Herbicides: ***Pre:*** 0.5 pt/ac 2,4-D, 32 oz/ac Roundup PowerMAX®, 2.5 oz/ac Balance® Flexx, 1.5 qt/ac Harness® Xtra, and 2 oz/ac Diligence-EA® with 9 oz/ac BRONC®MAX on 5/19/19 (Balance® Flexx was mistakenly applied pre-emergent; no adverse impacts were seen)
Seed Treatment: None
Foliar Insecticides: 4 oz/ac Perm-UP® on 5/19/19
Foliar Fungicides: None
Irrigation: Pivot
Rainfall (in):



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 to monitor indicator plots with lower N rates. Sensor-based fertigation management began once the cumulative N applied was 60 lb/ac less than the grower's total target N for the season. If indicator plots demonstrated nitrogen deficiency, a fertigation application of 30 lb/ac was triggered. This study compared the grower's standard N management with two reactive, sensor-based fertigation approaches as follows:

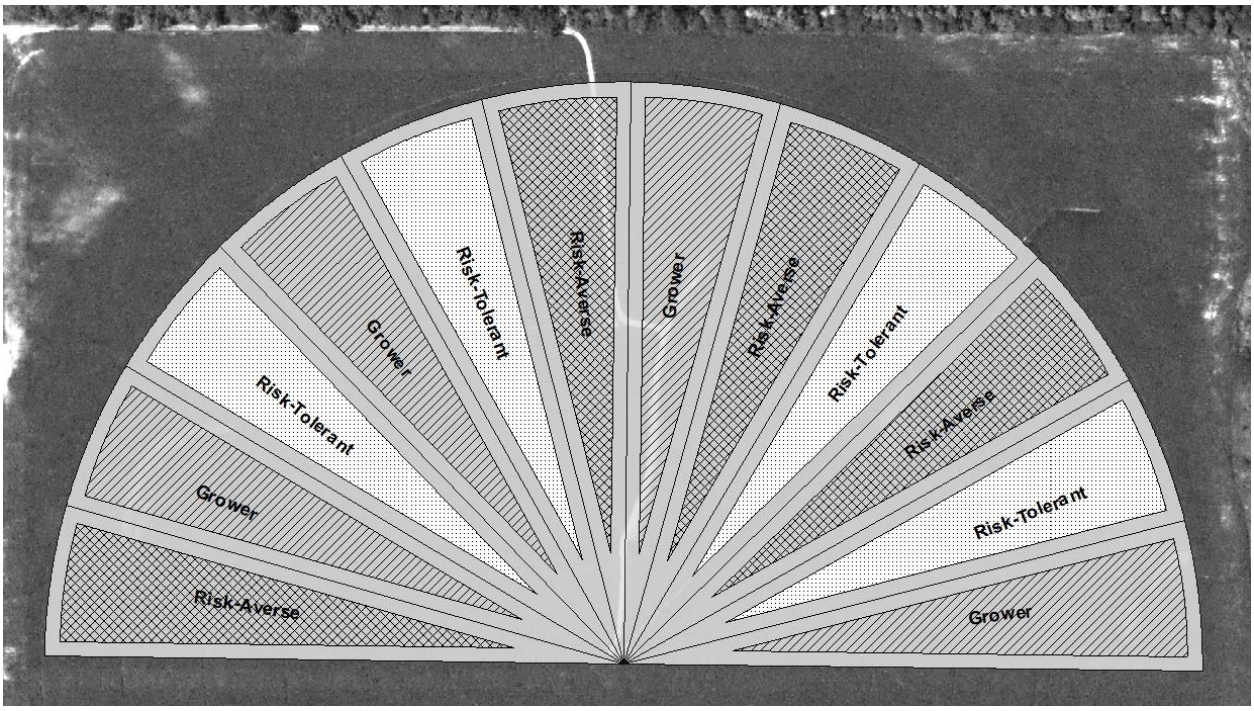


Figure 1. Experiment layout showing four replications of three treatments arranged in sectors.

Grower Management: 20.2 lb N/ac was applied as 8-20-3-6-0.4 on May 13 at planting. Thirty lb N/ac was applied as 5 gal/ac 32% UAN, 5 gal/ac 10-34-0, and 5 gal/ac 12-0-0-26 applied on June 16. Forty lb N/ac was applied as 32% UAN on June 18. The June 18 application was also used to establish the indicator blocks. UAN was applied through fertigation at several dates: 28.3 lb N/ac on July 11, 30 lb N/ac on July 19, and 30 lb N/ac on July 31. The total N applied was 179 lb N/ac.

Risk-Averse Fertigation Treatment: This approach triggered N fertigation when one indicator block showed N deficiency and therefore may better protect yield by applying N more frequently. The base rate of N was 90.2 lb N/ac, which was established with 20.2 lb N/ac (applied as 8-20-3-6-0.4) on May 13 at planting, 30 lb N/ac (applied as 5 gal/ac 32% UAN, 5 gal/ac 10-34-0, and 5 gal/ac 12-0-0-26) on June 16, and 40 lb N/ac (applied as 32% UAN) on June 18. An additional fertigation application of 28.3 lb N/ac with 32% UAN was made on July 11 under the grower's standard N management. Sensor-based fertigation management began after the July 11 fertigation, which brought the cumulative N applied to 119 lb/ac, 60 lb/ac less than the grower's target total N rate. Sensor-based fertigation with 32% UAN was triggered on two dates: 30 lb N/ac was applied July 19 to all four replications and 30 lb N/ac was applied on July 31 to three of the four replications. Total sensor-based fertigation was 53 lb N/ac and the total applied during the growing season was 171 lb N/ac.

Risk-Tolerant Fertigation Treatment: This approach triggered N fertigation when three indicator blocks showed N deficiency and may better guard against excess N applications by only applying N when several indicator blocks agree that N is needed. The base rate of N was 90.2 lb N/ac, which was established with 20.2 lb N/ac (applied as 8-20-3-6-0.4) on May 13 at planting, 30 lb N/ac (applied as 5 gal/ac 32% UAN, 5 gal/ac 10-34-0, and 5 gal/ac 12-0-0-26) on June 16, and 40 lb N/ac (applied as 32% UAN) on June 18. An additional fertigation application of 28.3 lb N/ac with 32% UAN was made on July 11 under the grower's standard N management. Sensor-based fertigation management began after the July 11 fertigation, which brought the cumulative N applied to 119 lb/ac, 60 lb/ac less than the grower's target total N rate. Sensor-based fertigation with 32% UAN was triggered on July 31 and 30 lb N/ac was applied to only one of four

replications. The total applied through sensor-based fertigation was 8 lb N/ac, and the total applied over the growing season was 126 lb N/ac.

Results:

N Management Strategy	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)
Grower	179 A*	15.9 A	235 A	74 B	0.76 A	828.99 B
Risk-Averse Fertigation	171 A	15.6 A	240 A	79 B	0.71 A	852.43 AB
Risk-Tolerant Fertigation	126 B	15.8 A	243 A	109 A	0.52 B	879.66 A
P-Value	0.001	0.454	0.404	0.0003	0.003	0.093

*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 adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.40/lb N.

Summary:

- At this site, the risk adverse fertigation approach applied 8 lb/ac less N than the grower's N management, while the risk tolerant fertigation approach applied 53 lb/ac less N than the grower's N management.
- There was no yield difference between the sensor-based fertigation approaches and the grower's N management.
- The risk tolerant sensor-based fertigation approach had greater N efficiency compared to the grower's N management and compared to the risk averse fertigation approach.
- The risk tolerant sensor-based fertigation approach had higher profitability than the grower's N management. The risk averse sensor-based fertigation approach was not different than the grower's N management.

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