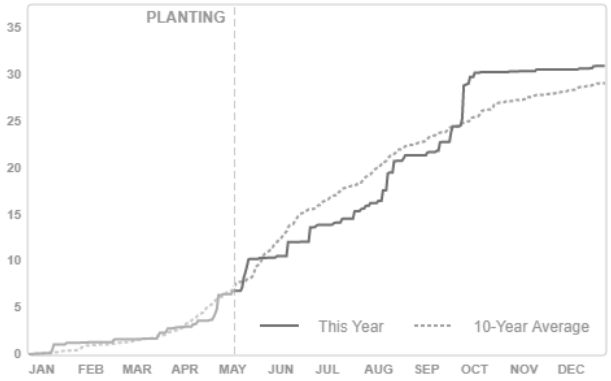
Project SENSE (Sensor-based In-season N Management)

Study ID: 207121201701
County: Merrick
Soil Type: Blendon fine sandy loam 2-6% slopes; O'Neill sandy loam 0-2% slope; Wann loam occasionally flooded; Lamo-Saltine complex occasionally flooded
Planting Date: 5/11/17
Harvest Date: 11/3/17
Population: 31,000
Hybrid: CRM (days) 114
Reps: 5
Previous Crop: Soybean
Tillage: Reduced Tillage

Note: 40 lb N/ac from irrigation
Irrigation: Pivot
Rainfall (in):



Soil Sample Results: Soil samples were taken in three locations within the research study area and do not correspond to specific treatments or replications.

ID	Soil pH 1:1	WDRF Buffer pH	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI %	Nitrate – N ppm N	Nitrate lb N/A	Mehlich P-III ppm P	Sulfate-S ppm S	Zn (ppm)	Ammonium Acetate (ppm)				CEC me/100g	% Base Saturation				
											K	Ca	Mg	Na		H	K	Ca	Mg	Na
3	6.8	7.2	0.12	NONE	1.2	7.5	18	99	8	4.94	204	1019	162	14	7	0	7	73	19	1
14	8	7.2	0.3	LOW	2.7	29.6	71	119	17	4.38	321	3559	334	89	21.8	0	4	81	13	2
22	7.8	7.2	0.36	NONE	3	25.4	61	192	10	5	370	2950	321	48	18.6	0	5	79	14	1

Introduction: This study compares sensor based in-season N application with the grower's standard N management. For the Project SENSE nitrogen treatments, a high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. At this site, a third treatment was added – the drone based sensor N management. For the drone based treatment, a SenseFly eBee drone was equipped with a Parrot® Sequoia™ multispectral sensor. The drone and sensor was flown over the field to create NDRE (normalized difference red edge) index maps. These data were then used to develop an in-season N fertilizing prescription which was applied using the same high clearance applicator and drop nozzles.

Grower Nitrogen Treatment: The initial grower N rate was 35 lb N/acre applied at planting with a burndown herbicide application. Additionally, 4 lb N/acre was applied in-furrow with planting. An in-season application of 75 lb N/acre was applied on June 19, 2017. The total N rate was 114 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 4 lb N/acre was applied on May 11, 2017, with the planter, and an additional 35 lb N/acre was applied on June 19, 2017. Crop canopy sensing and application occurred on July 1, 2017, at the V11 growth stage. The normalized difference red edge (NDRE) index values captured using the crop canopy sensors are shown in *Figure 1*. Across all Project SENSE treatments, the average N rate applied in-season was 36 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 3*. The total N rate was 75 lb N/acre.

Drone Based Sensor N Treatment: For the drone based sensor treatment, 4 lb N/acre was applied on May 11, 2017, with the planter, and an additional 35 lb N/acre was applied on June 19, 2017. The drone was flown over the field on June 26, 2017 and the NDRE imagery was used to develop a N prescription map. The normalized difference red edge (NDRE) index values captured using the drone are shown in *Figure 2*. The average N rate applied in-season was 74 lb N/acre. These N rates were applied on July 1, 2017, at the V11 growth stage. Nitrogen application for the drone based treatment strips are shown in *Figure 3*. The total N rate was 113 lb N/acre.

Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation was performed with Fisher's LSD.

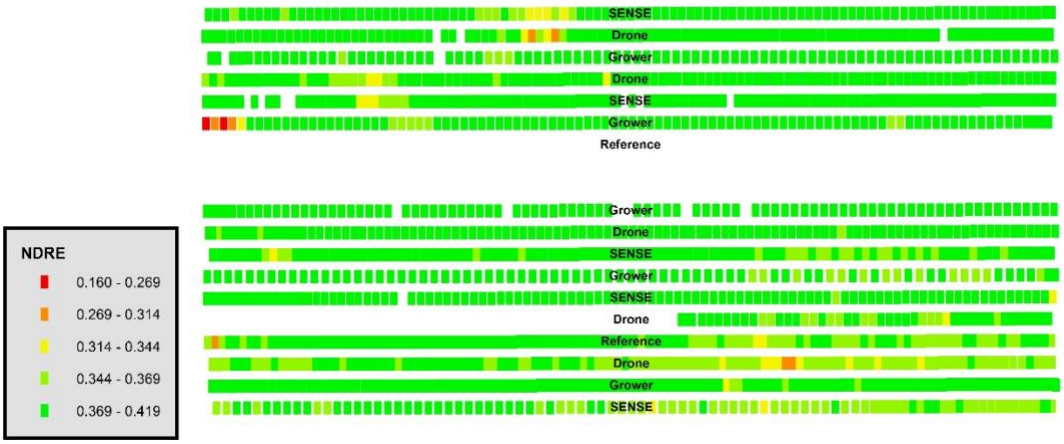


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on July 1, 2017.

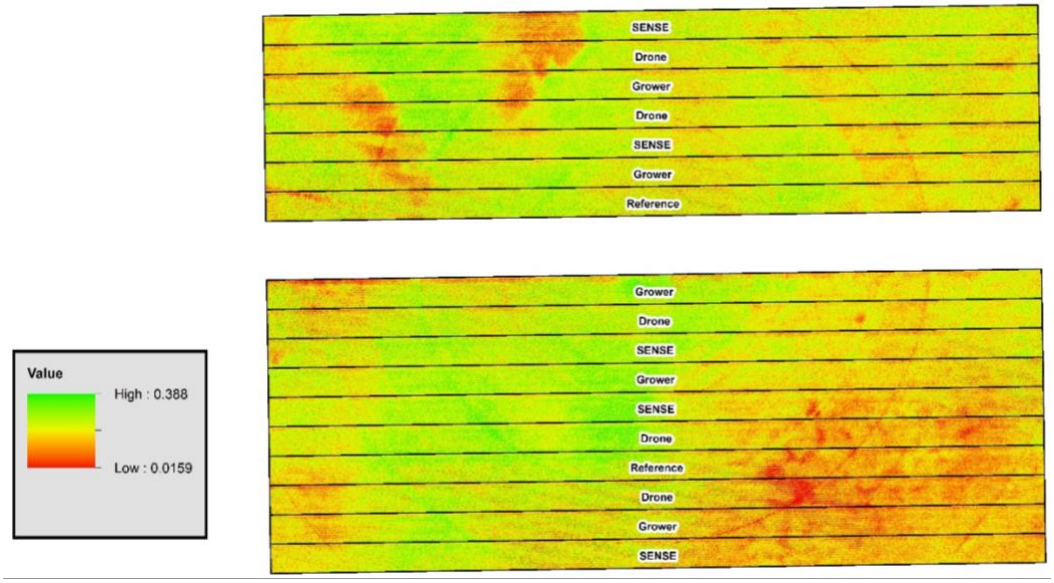


Figure 2. NDRE (normalized difference red edge) index obtained using a drone based sensor on June 26, 2017.

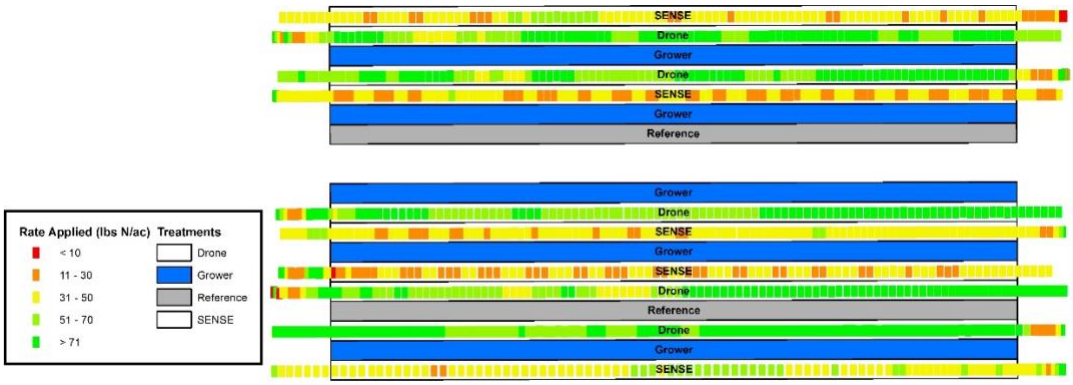


Figure 3. Nitrogen rate applied to Project SENSE N Management and Drone Based Sensor Management treatments based on NDRE values in *Figure 1* and *Figure 2*.

Results:

	Total N rate (lb/ac)	Yield (bu/acre)†	Partial Factor Productivity of N (lb grain/lb N)	lb N/ bu grain	Marginal Net Return‡ ($/ac)
Drone Based Sensor N Management	113	236 A*	118 B	0.48 A	698.28 B
Grower N Management	114	238 A	117 B	0.48 A	703.25 AB
Project SENSE N Management	75	237 A	177 A	0.32 B	714.90 A
P-Value	N/A	0.663	<0.0001	<0.0001	0.059

*Values with the same letter are not significantly different at a 95% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $3.15/bu corn and $0.41/lb nitrogen fertilizer.

Summary:

- The Project SENSE N management resulted in a much lower N recommendation than the drone management and the grower management. The drone management and grower management resulted in very similar N recommendations.
- Despite the different N rates, there were no yield differences. This resulted in much higher N use efficiency for the Project SENSE N management.
- The drone based sensor management had much higher N recommendations than the Project SENSE N management. The drone based sensing was completed on June 26; however, due to rain, the N was not applied until July 1, nearly a week later. During this time the corn may have taken up more N and appeared greener. Had the drone sensing been completed closer to the Project SENSE crop canopy sensing, differences may not have been as large.

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