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

Study ID: 208121201701

County: Merrick

Soil Type: Leshara silt loam occasionally flooded; Gibbon loam occasionally flooded; Silver Creek complex saline-alkali, rarely flooded

Planting Date: 5/9/17

Harvest Date: 11/2/17

Population: 31,300

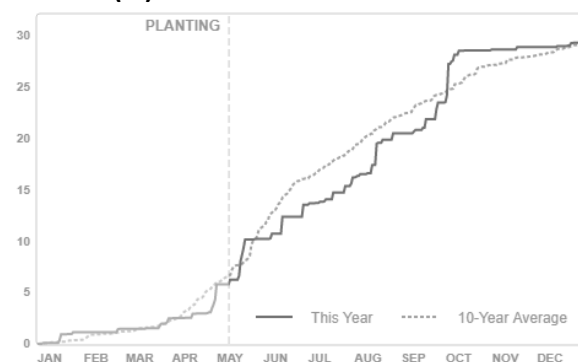**Hybrid:** CRM (days) 111

Reps: 5

Previous Crop: Corn

Tillage: No-Till

Note: 15 lb N/ac from irrigation

Irrigation: SDI

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	7.2	7.2	0.22	NONE	2.1	21.6	52	41	7	1.35	468	1749	217	42	11.9	0	10	73	15	2
14	6.8	7.2	0.25	NONE	2	22.2	53	40	8	1.5	585	1604	248	27	11.7	0	13	68	18	1
22	6.8	7.2	0.17	NONE	2.2	16.9	41	32	8	1.78	464	1681	240	34	11.7	0	10	72	17	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 11 lb N/acre applied as 11-52-0 prior to planting. An additional 35 lb N/acre was applied as starter on May 9, 2017, 55 lb N/acre was applied on June 10, 2017, and 149 lb N/acre on June 18, 2017. The total N rate was 250 lb N/acre.
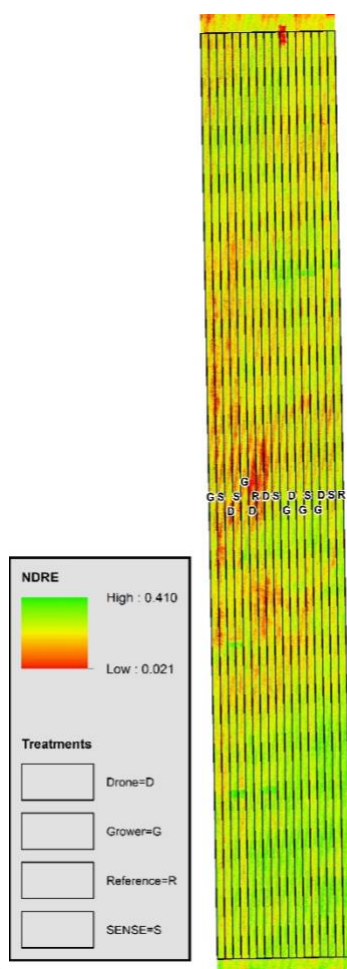
Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 11 lb N/acre was applied on May 9, 2017, with the planter. An additional 35 lb N/acre was applied on May 11, 2017, and 55 lb N/acre was applied on June 10, 2017. Crop canopy sensing and application occurred on June 27, 2017, at the V11 growth stage with liquid UAN surface applied. 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 145 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 3*. The total N rate was 246 lb N/acre.

Drone Based Sensor N Treatment: For the drone based sensor treatment, 11 lb N/acre was applied on May 9, 2017, with the planter. An additional 35 lb N/acre was applied on May 11, 2017, and 55 lb N/acre was applied on June 10, 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 169 lb N/acre. These N

rates were applied on June 27, 2017, at the V11 growth stage as liquid UAN surface applied. Nitrogen application for the drone based treatment strips is shown in *Figure 3*. The total N rate was 270 lb N/acre.

Cover crops were planted about a week prior to the Project SENSE and drone based management N application. Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation was performed with Fisher's LSD.
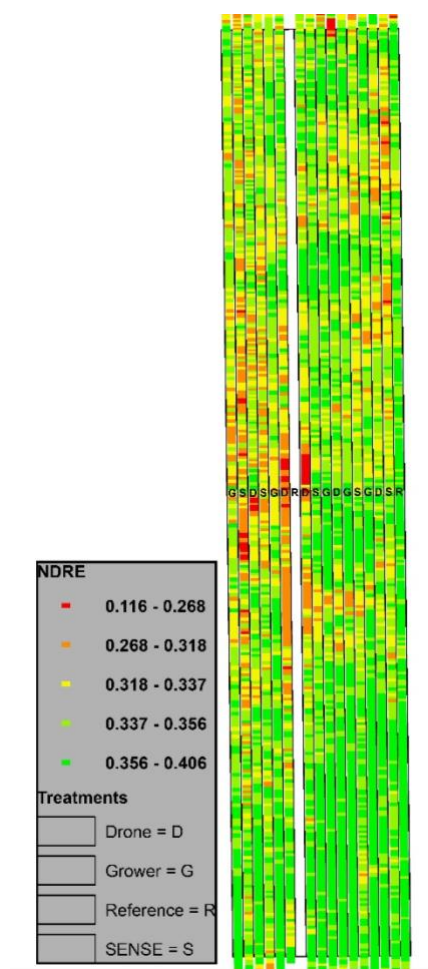
Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on June 27, 2017.

Figure 2. NDRE (normalized difference red edge) index obtained using a drone based sensor on June 26, 2017.
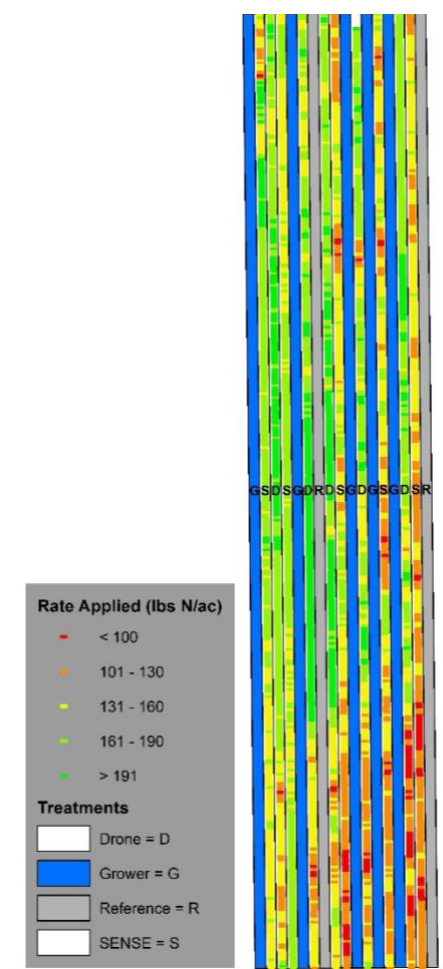
Figure 3. Nitrogen rate applied to Project SENSE N Management and Drone Based Sensor Management treatments based on NDRE values in *Figure 1* and *Figure 2*.

Results:

	Total N rate	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	270	231 A*	48 B	1.17 A	615.50 B
Grower N Management	250	235 A	53 A	1.06 B	638.53 A
Project SENSE N Management	246	224 B	51 A	1.10 AB	604.41 B
P-Value	N/A	0.008	0.023	0.024	0.017

*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 drone based N management had a higher total N rate than the grower N management and Project SENSE N management. The grower N management and Project SENSE N management were very similar.

- While the Project SENSE management had N rates similar to the grower N management, it had significantly reduced yields. This is likely due to the timing and method of N application. The grower applied in-season N on June 18 using a coulter toolbar, while the Project SENSE application was not made until June 27 and was applied to the surface. This field is irrigated through a sub-surface drip system, and, therefore, N fertilizer applied to the surface may not have been properly incorporated.

- Although the drone management used more N, it did not have increased yield compared with the grower N management. This may be due to the later application time and the difference in application method compared with the grower N management (drone N management was also applied as a surface application of liquid N). This resulted in lower N use efficiency compared with the grower and Project SENSE management.

- The grower N management had the highest marginal net return.