EC3030

EXTENSION

On-Farm Research

2017 GROWING SEASON RESULTS

Post-Conference Publication March 2018

University of Nebraska-Lincoln

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NEBRASKA ON-FARM RESEARCH NETWORK

2018 Results Update Meetings

- **Feb. 19 | Eastern Nebraska Research and Extension Center, near Mead**
- **Feb. 20 | Lifelong Learning Center, Northeast Community College, Norfolk**
- **Feb. 21 | Hall County Extension Office, College Park Campus, Grand Island**
- **Feb. 27 | Henry J. Stumpf International Wheat Center, Grant**
- **Feb. 28 | Knight Museum & Sandhills Center, Alliance**

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Thank you also to the companies and businesses
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NEBRASKA ON-FARM RESEARCH NETWORK

In production ag it's what you think you know, that you really don't know, that can hurt you.

Nebraska Extension On-Farm Research Network Introduction

Laura Thompson, Keith Glewen
Nebraska Extension Educators and
On-Farm Research Network Coordinators

On-farm research can provide a great avenue to accelerate learning about topics that impact farm productivity and profitability. It is research that you do on your field, using your equipment, and with your production practices. This means the research is directly applicable to your operation. The Nebraska On-Farm Research Network approaches topics that are critical to farmer productivity, profitability, and sustainability. These topics include nutrient management, pest control, irrigation strategies, conservation programs, new technologies, soil amendments, cultural practices, and hybrid and variety selection. Research comparisons are identified and designed to answer producers' production questions. Projects' protocols are developed first and foremost to meet individual cooperator needs. Multiple year comparisons are encouraged.

We would like to thank all the cooperators who were involved in the valuable research studies contained in this report. Your efforts lead to new discovery and validate current production practices. We would also like to thank the Nebraska Corn Board, Nebraska Corn Growers Association, Nebraska Soybean Board, and Nebraska Dry Bean Commission for the financial support that makes this research, publication, and update meetings possible.

We invite you to become an on-farm research participant. To learn more or to discuss this report, please contact Nebraska Extension On-Farm Research Coordinators, Laura Thompson or Keith Glewen (contact information is on page 6), visit us online at http://cropwatch.unl.edu/on-farm-research, or find us on Facebook and Twitter.

Unless otherwise noted, data in this report were analyzed using Statistixs 10.0 Analytical Software and means were separated using Tukey's HSD (honest significant difference) test.

Statistics 101

Replication: In statistics, replication is the repetition of an experiment or observation in the same or similar conditions. Replication is important because it adds information about the reliability of the conclusions or estimates to be drawn from the data. The statistical methods that assess that reliability rely on replication.

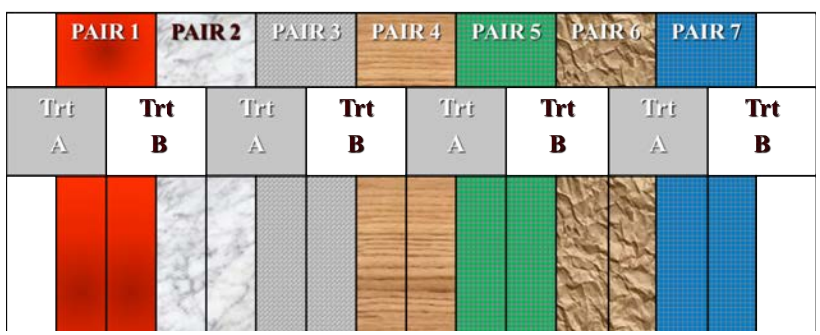
Randomization: Using random sampling as a method of selecting a sample from a population in which all the items in the population have an equal chance of being chosen in the sample. Randomization reduces the introduction of bias into the analysis. Two common designs that meet these criteria are shown below.

What is the P-value? In field research studies we impose a *treatment* – this treatment may be a new product or practice that is being compared to a standard management. Both the **treatments** that we are testing and **random error** (such as field variability) influence research results (such as yield). You intuitively know that this error exists – for example, the average yield for each combine pass will not come out exactly the same, even if no treatments were applied. The P-Value reported for each study assists us in determining if the differences we detect are due to error or due to the treatment we have imposed.

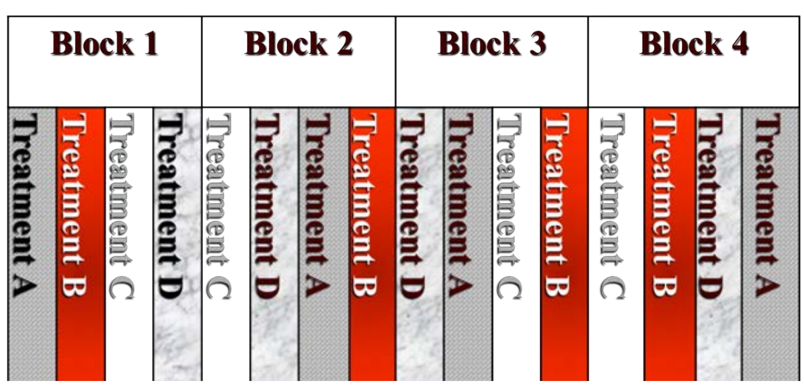
- As the P-Value decreases, the probability that differences are due to random chance decreases.
- As the P-Value increases, we are less able to distinguish if the difference is due to error or the treatment (hence we have less confidence in the results being due to the treatment).

For these studies, we have chosen a cutoff P-Value of 0.1; therefore, if the P-Value is greater than 0.1 we declare that there are not statistically significant differences due to the treatments. If the value is less than 0.1, we declare that differences between treatments are statistically significant. When this is the case, we follow the yield values with different letters to show they are statistically different. The value of 0.1 is arbitrary – another cutoff could be chosen. However, as you increase your cutoff value, you increase the chance that you will declare that treatments are different when they really are not. Conversely, if you lower the P-Value, you are more likely to miss real treatment differences.

Paired comparison design



Randomized complete block design



Profit Calculation

Many of our studies include a net return calculation. It is difficult to make this figure applicable to every producer. In order to calculate revenue for our research plots we use input costs provided by the producer, application costs from Nebraska Extension's 2016 Nebraska Farm Custom Rates – Part 1 and 2 (EC823 and EC826 - both revised May 2016), and an average commodity market price for 2016.

Average market commodity prices for the 2017 report are:

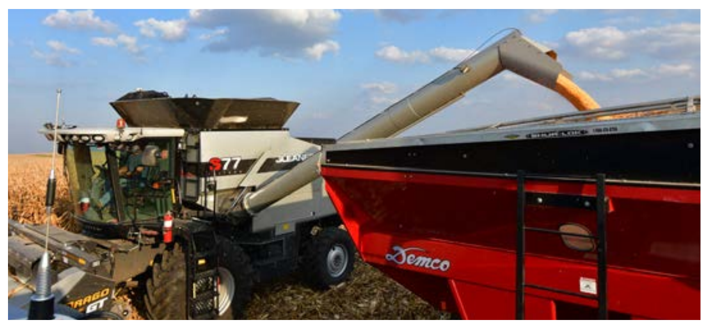
Corn	$3.15/bu
Soybeans	$8.90/bu
Wheat	$3.40/bu
Sorghum	$5.40/bu
Dry Edible Beans	$14.40/bu
Field Peas	$6.40/bu
Organic Corn	$9.00/bu

In order to make this information relevant to your operation, you may need to refigure return per acre with costs that you expect.

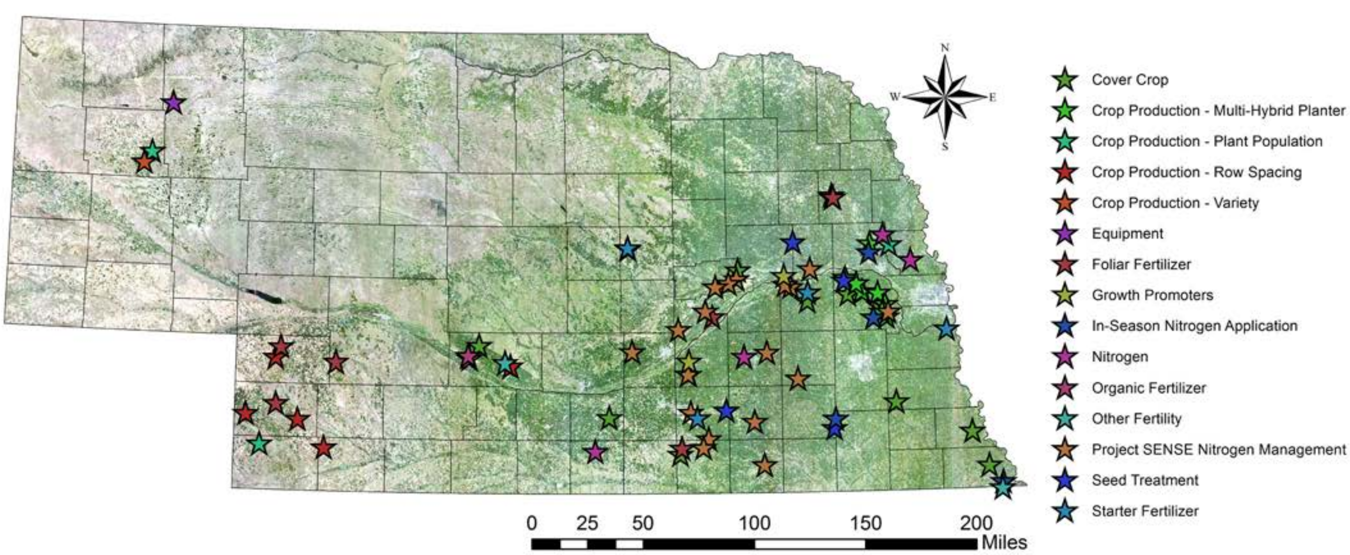
Rainfall Data

Rainfall data is provided for each study based on the field location. The rainfall graphs are developed using data from National Weather Service radar and ground stations that report rainfall for 1.2 x 1.2 mile grids.

FarmLogs https://farmlogs.com

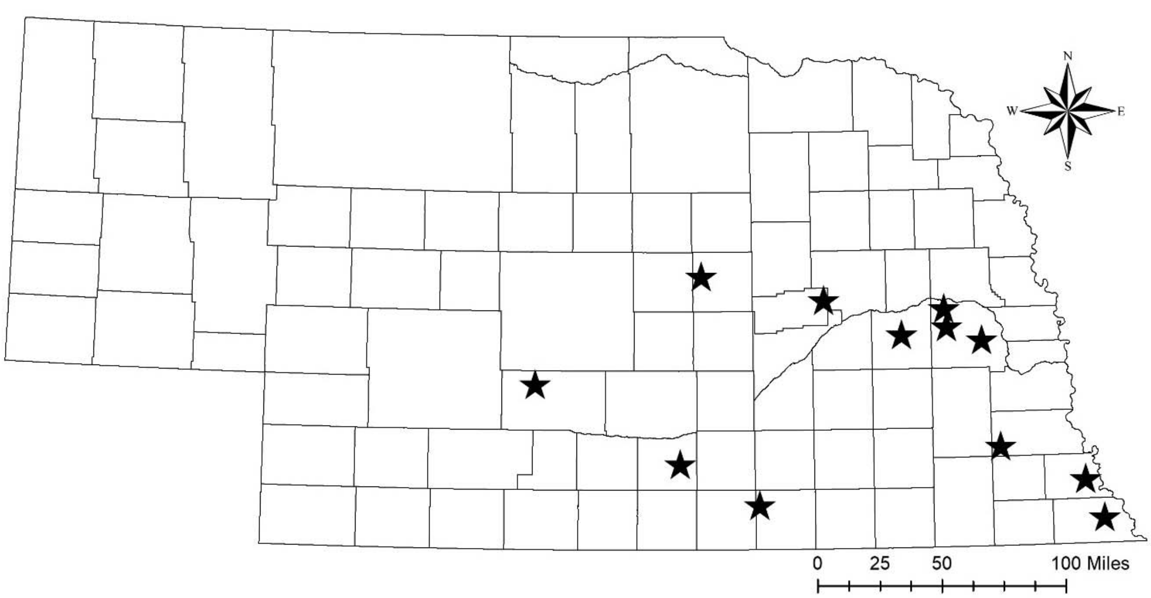


2017 Study Locations



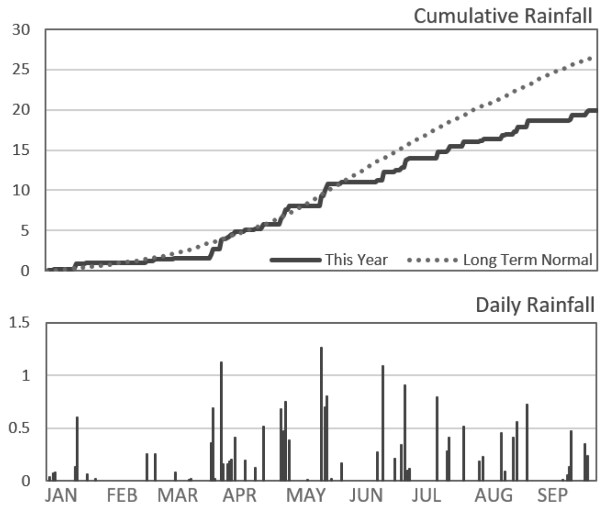
COVER CROPS

- Corn Following Winter Terminated and Winter Hardy Cover Crops (NRCS Demo Farm site)
- Soybeans Following Winter Terminated and Winter Hardy Cover Crops (NRCS Demo Farm site)
- Impact of a Cover Crop Mix with One Cereal Grain versus Cover Crop Mix with Multiple Cereal Grains on Soil Quality, Moisture, and the Subsequent Corn Yield (NRCS Demo Farm site)
- Soybeans Planted into Rye Cover Crop (2 sites)
- Effect of Interseeding Cover Crops at Planting on Organic Corn
- Integrating Cover Crops on Sandy Soils to Improve Water Quality and Soil Health
- Integrating Cover Crops on Sloping Soils to Improve Water Quality and Soil Health
- Corn Planted After Spring-grazed or Non-grazed Rye Cover Crop (2 sites)
- Effects of Grazing Cover Crops in a Three-year Non-Irrigated Rotation
- Evaluating Corn Relative Maturity for Improving Cover Crop Establishment (2 sites)



Corn Following Winter Terminated and Winter Hardy Cover Crops

Study ID: 656127201701
County: Nemaha
Soil Type: Judson silt loam 0-2% slope; Judson silt loam 2-6% slopes
Corn Planting Date: 4/11/17
Harvest Date: 9/19/17
Population: 33,000
Row Spacing (in): 30
Hybrid: Pioneer P0636AM
Reps: 7
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 64 oz/ac FulTime®, 16 oz/ac Range Star®, and 3.2 oz/ac ABSORB 100 ***Post:*** 32 oz/ac Buccaneer® 5 Extra, 2 oz/ac Bellum™, and 3.2 oz/ac N-Tense™
Seed Treatment: PPST 250
Foliar Fungicides: 8 oz/ac Quilt Xcel®
Fertilizer: 12-40-60-10-1-1 dry and 175 lb N/ac as UAN 32% spring pre-plant, and 1 gal/ac NResponse™ foliarly applied
Irrigation: None
Rainfall (in) as measured at field:



Introduction: This study is being conducted on a soil health demonstration farm as part of the Nebraska USDA/Natural Resources Conservation Service's (NRCS) Soil Health Initiative, and involves the farmer, the Nebraska On-Farm Research Network and the USDA/NRCS. The two treatments, the use of winter terminated cover crops and the use of winter hardy cover crops, will be used in this 5-yr study (2016-2021). The cover crops were drilled on 9/29/16. The winter terminated treatment was a mix of oats, turnips, and common rape seed, whereas the winter hardy treatment consisted of cereal rye, turnips, and common rape seed. This study did not have a non-cover crop control. For uniformity, both cover crop mixes were sprayed with glyphosate on 4/12/17. This terminated the winter hardy treatment and controlled weeds and brassicas, which had overwintered in the winter terminated cover crop treatment. Baseline soil health measures (one per treatment) were collected on 10/19/16. Soil health measurements will be collected every other year while conducting this study.

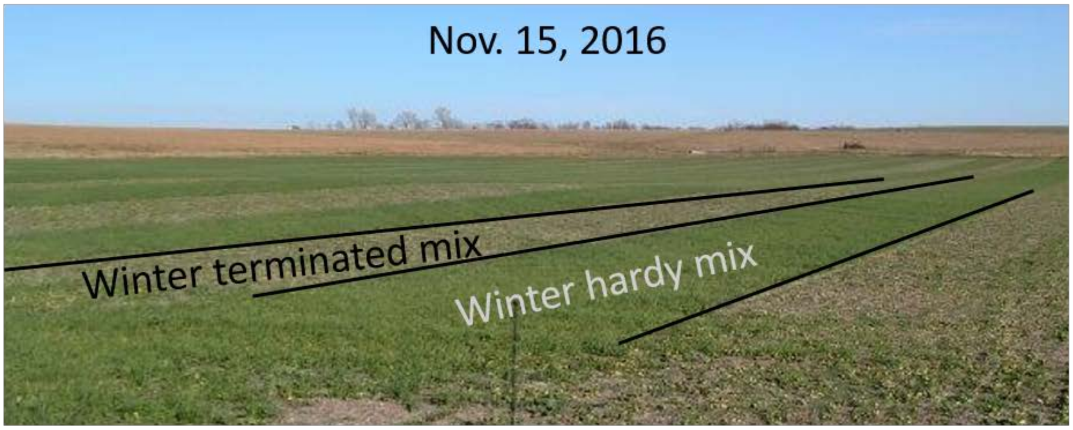
Baseline Soil Quality Measurements:

	Bulk Density (g/cm^3)	Total Pore Space (%)	Water Holding Capacity if all pores filled (inch H_2O/ft)	Solvita at 24 hr	Estimated Solvita Microbial Activity Rating	Average Soil Health Indicator Score
Sample Site 2 (Winter Terminated)	1.25	52.8	6.3	2.0	Low	2.44
Sample Site 1 (Winter Hardy)	1.22	53.9	6.5	2.0	Low	2.59

Results:

	Corn Stand Count at Harvest (plants/acre)	Corn Test Weight (lb/bu)	Corn Moisture (%)	Corn Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Winter Terminated Cover Crop	30,355 A*	54 A	18.0 B	183 A	546.97 A
Winter Hardy Cover Crop	30,023 A	52 B	19.1 A	168 B	498.00 B
P-Value	0.802	0.0209	0.0034	0.0003	0.0003

*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 $3.15/bu corn and $30.07 cost for cover crop seed and drilling in both treatments.

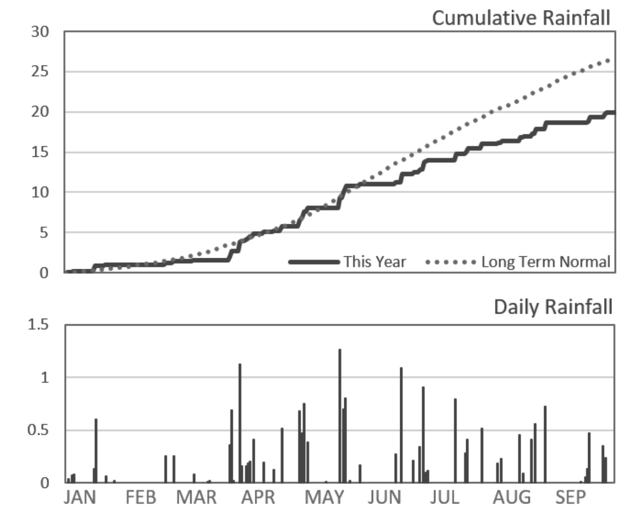


Summary: Corn planted after winter terminated cover crops had a higher yield, higher test weight, and was drier than the winter hardy cover crops. There were no differences in harvest stand counts for the corn following the winter killed and winter hardy cover crops. The corn following the winter hardy mix was three days slower to tassel than the corn following the winter kill mix as shown in the July 7 picture above.

Soybeans Following Winter Terminated and Winter Hardy Cover Crops

Study ID: 656127201702
County: Nemaha
Soil Type: Judson silt loam 0-2% slope; Judson silt loam 2-6% slopes
Soybean Planting Date: 4/30/17
Harvest Date: 9/20/17
Population: 175,000
Row Spacing (in): 15
Variety: Pioneer 24T19R
Reps: 7
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 5 oz/ac Sonic®, 2 oz/ac Blanket® 4F, 14 oz/ac 2,4-D LV, and 3.2 oz/ac ABSORB 100
Post: 32 oz/ac Buccaneer® 5 Extra, 16 oz/ac Flexstar®, 6.4 oz/ac Clethodim®, 3.2 oz/ac ABSORB 100, and 10.5 oz/ac AzoxyProp Xtra

Irrigation: None
Rainfall (in) as measured at field:



Introduction: This study is being conducted on a soil health demonstration farm as part of the Nebraska USDA/Natural Resources Conservation Service's (NRCS) Soil Health Initiative, and involves the farmer, the Nebraska On-Farm Research Network and the USDA/NRCS. The two treatments, the use of winter terminated cover crops and the use of winter hardy cover crops, will be used in this five-year study (2016-2021). The cover crops were drilled on 9/29/16. The winter terminated treatment was a mix of oats, turnips, and common rape seed, whereas the winter hardy treatment consisted of cereal rye, turnips, and common rape seed. This study did not have a non-cover crop control. For uniformity, both cover crop mixes were sprayed with glyphosate on 4/12/17. This terminated the winter hardy treatment and controlled weeds and brassicas, which had over wintered in the winter terminated cover crop treatment. Baseline soil health measures (one per treatment) were collected on 10/19/16. Soil health measurements will be collected every other year while conducting this study.

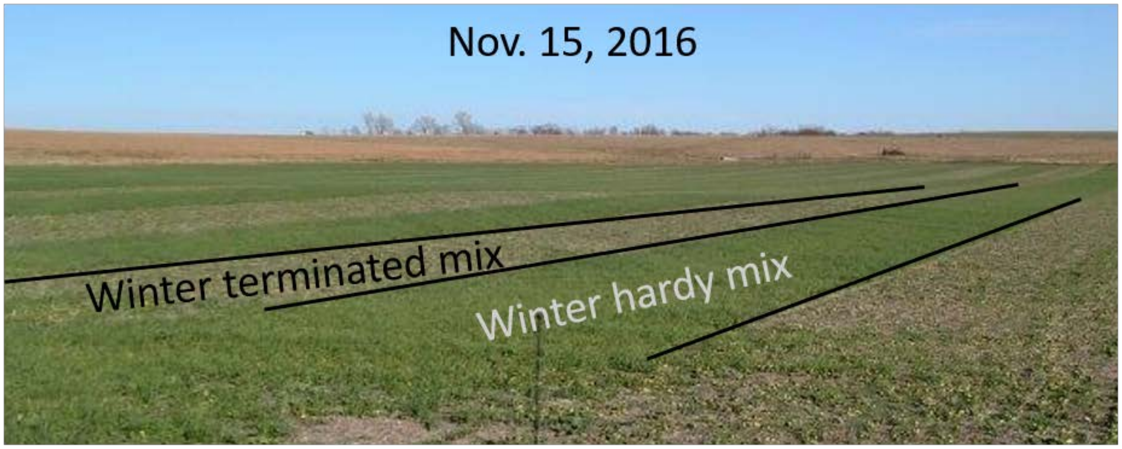
Baseline Soil Quality Measurements:

	Average Steady State Infiltration (in/hr)	Bulk Density (g/cm^3)	Total Pore Space (%)	Water Holding Capacity if all pores filled (inch H_2O/ft)	Solvita at 24 hr	Estimated Solvita Microbial Activity Rating	Average Soil Health Indicator Score
Sample Site 3 (Winter Terminated)	1.30	1.22	53.8	6.5	2.0	Low	2.44
Sample Site 4 (Winter Hardy)	1.12	1.32	50.2	6.0	2.0	Low	2.59

Results:

	Soybean Stand Count at Harvest (plants/ac)	Soybean Test Weight (lb/bu)	Soybean Moisture (%)	Soybean Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Winter Terminated Cover Crop	102,178 A*	56 A	10.6 A	62 A	518.84 A
Winter Hardy Cover Crop	102,178 A	56 A	10.6 A	61 A	516.42 A
P-Value	1	0.4886	1	0.7345	0.735

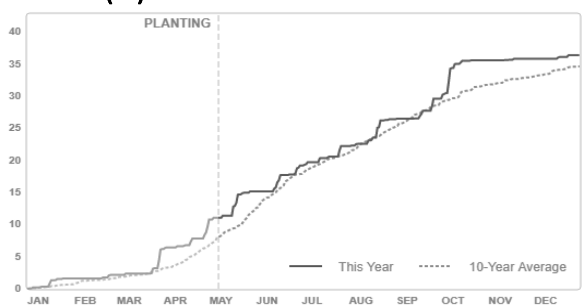
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $30.07 cost for cover crop seed and drilling in both treatments.



Summary: There were no differences in soybean yield, moisture, test weight, or harvest stand counts when cover crops were winter terminated or winter hardy. The harvest stand counts were notably lower than the planting population.

Impact of a Cover Crop Mix with One Cereal Grain versus Cover Crop Mix with Multiple Cereal Grains on Soil Quality, Moisture, and the Subsequent Corn Yield

Study ID: 388131201701
County: Otoe
Soil Type: Wymore silty clay loam 2-6% slopes; Pawnee clay loam 4-8% slopes, eroded; Judson silt loam 2-6% slopes
Planting Date: 5/7/17
Harvest Date: 11/16-18/17
Population: 26,500
Row Spacing (in): 30
Hybrid: Rob-See-Co RC6435-GTA
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 12 oz Verdict®, 16 oz Atrazine, 16 oz MSO™, 2.5 lbs AMS, 44 oz Glyphosate, and 5.4 oz/ac 2,4-D 6# on 4/16/17
Post: 4.5 oz/ac Outlook®, 8 oz/ac Atrazine 4L, 9.6 oz/ac MSO™, 1.5 lb/ac AMS, 26 oz/ac Glyphosate, 0.85 oz/ac Armezon, and 0.5# Thrust on 6/14/17
Seed Treatment: Insecticide
Foliar Insecticides: 1 pint Lorsban® on 7/29/17
Foliar Fungicides: 10.5 oz Quilt Excel® with .25 gal Brandt Smart Trio™ and 2 oz surfactant on 7/29/17
Fertilizer: 120 lb N/ac as 32-0-0, one week pre-plant. 5 gal/acre 8-21-5-5(S)-0.5(Zn) at planting. Note: There was green snap in mid-June that appeared to affect approximately 3-5% of field. A windstorm on Oct. 20 appeared to cause damage to 2-3% of stalks.
Irrigation: None
Rainfall (in):



Introduction: This study is being conducted on a soil health demonstration farm as part of the Nebraska USDA/Natural Resources Conservation Service's (NRCS) Soil Health Initiative, and involves the farmer, the Nebraska On-Farm Research Network and the USDA/NRCS. The purpose of this study is to compare the impact of a cover crop mixture with one cereal grain and a cover crop mix with multiple cereal grains on soil quality, soil moisture, and subsequent crop yield. Cover crops were drilled in the fall of 2016. Both mixtures included annual rye, canola, balansa clover, camelina, vetch, crimson clover, winter lentils, alfalfa, and northern annual field peas. The cover crop mix with one cereal grain included cereal rye as a base while the cover crop mix with multiple cereal grains included winter oats, spring barley, winter barley, triticale, wheat, and cereal rye. The cover crops were terminated with glyphosate herbicide on 4/16/17. This is an early termination date relative to the corn planting date of May 7 for the area (NRCS Zone 3). A baseline Haney soil test is available from fall 2016. A representative sample was taken from each treatment for Haney soil tests in fall 2017. The study did not have a no cover crop control.

Soil Tests:

Treatment	Solvita CO2 Burst (ppm)	Total Nitrogen (ppm)	Organic Nitrogen (ppm)	Total Organic Carbon (ppm)	Nitrate (ppm)	Ammonium (ppm)	Inorganic Nitrogen (ppm)	Organic C : N	Organic Nitrogen Release (ppm)	Organic Nitrogen Reserve (ppm)	Soil Health Calculation
2016 Baseline	118.0	27.3	17.9	184	9.3	1.0	10.2	10.3	17.9	0.0	15.05
2017 Cover Crop Mix with One Cereal Grain	71.8	16.3	12.5	180	2.7	0.1	2.8	14.4	12.5	0.0	12.02
2017 Cover Crop Mix with Multiple Cereal Grains	119.2	20.1	13.5	194	4.7	1.5	6.2	14.4	13.5	0.0	15.17

Soil Moisture:

Watermark Sensors were installed at two locations in the field. Daily readings (kPa) were recorded at each depth from June 7 to October 15, 2017. The higher the reading the more depleted the soil moisture, while a reading of zero represents full soil water capacity.

Northeast Sample Location	Cover Crop Mix with One Cereal Grain				Cover Crop Mix with Multiple Cereal Grains			
Depth	1'	2'	3'	4'	1'	2'	3'	4'
Avg. Reading (kPa)	25.76	20.28	22.68	11.63	51.63	55.38	86.1	47.73
Mid-South Sample Location	Cover Crop Mix with One Cereal Grain				Cover Crop Mix with Multiple Cereal Grains			
Depth	1'	2'	3'	4'	1'	2'	3'	4'
Avg. Reading (kPa)	47.08	30.18	90.88	39.47	35.44	45.51	55.46	15.95

Results:

	Corn Moisture (%)	**Corn Yield (bu/acre)†**	**Marginal Net Return‡ ($/ac)**
Cover Crop Mix with One Cereal Grain	14.6 A*	157 A	421.56 A
Cover Crop Mix with Multiple Cereal Grains	14.8 A	159 A	432.92 A
P-Value	0.209	0.708	0.588

*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.

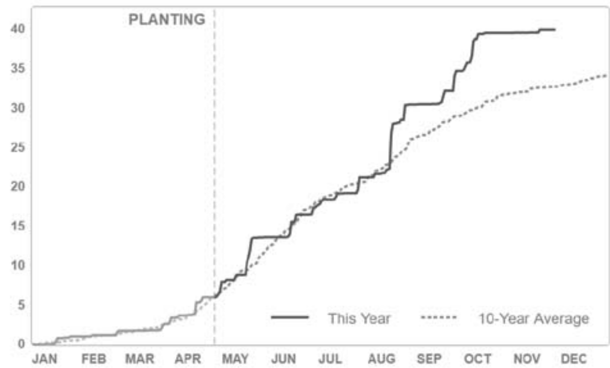
‡Marginal net return based on $3.15/bu corn, $53.84/acre for cover crop mix with one cereal grain, $50.21/acre for cover crop mix with multiple cereal grains.

Summary: There was no significant difference in yield, moisture, or marginal net return for the two treatments. This is a five-year study and will continue to be evaluated through 2021.

Soybeans Planted into Cereal Rye Cover Crop

Study ID: 007155201701
County: Saunders
Soil Type: Judson silt loam 2-6% slopes; Nodaway silt loam occasionally flooded; Yutan, eroded-Judson complex 6-11% slopes; Yutan, eroded-Aksarben silty clay loam 2-6% slopes
Planting Date: 4/26/17
Harvest Date: 10/23/17
Population: 140,000
Row Spacing (in): 15
Variety: Stine 28LF32
Reps: 7
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** Killing Rye and Pre: 3 oz/ac Valor® XLT, 0.5 pt/ac 2,4-D 6# Ester, 32 oz/ac Roundup®, and 1.5 gal/100 gal Liquid AMS on 4/17/17 ***Post:*** 32 oz/ac Liberty, 3 lb/ac dry AMS, 2 pt/ac Warrant, and 5.33 oz/ac Select on 6/29/17

Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 11-52-0 variable rate with average of 100-150 lb of 11-52-0 in spring
Irrigation: Pivot, Total: 0" applied this year
Rainfall (in):



Introduction: The objective of the study was to assess the impact of rye cover crop on subsequent crop yield. This is the second year this study has been conducted. The cereal rye cover crop was drilled following corn harvest on November 5, 2016 in alternating strips with a no cover crop check. Cereal rye strips were terminated with 32 oz/ac Roundup, 3 oz/ac Valor XLT, 0.5 pt/ac of 2,4-D 6# Ester, and 1.5 gal/100gal of Liq AMS on April 17, 2017. Rye was approximately 6" in height. Soybean was planted into rye and check strips on April 26, 2017.

Results:

	Soybean Stand Count at Harvest	Soybean Moisture (%)	Soybean Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	108,647 A*	8.3 A	63 A	561.50 A
Cover Crop - Rye	100,353 A	8.2 A	61 A	509.42 B
P-Value	0.166	0.415	0.511	0.084

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean, $20/ac rye seed and drilling cost, and $15/ac for rye termination.

To assess differences in soil loss and soil conditioning index (SCI) for the rye cover crop, the USDA-NRCS Revised Universal Soil Loss Equation 2 (RUSLE2) was used. The output on the following page is an estimated two year scenario evaluating the impact of rye cover crop.

USDA NRCS Natural Resources Conservation Service

RUSLE2 Profile Erosion Calculation Record – Without Rye Cover Crop

Outputs:

Date	*Operation*	*Vegetation*	*Surf. residue cover after operation, %*
4/25/0	Planter, double disk opnr, 15" row spacing	Corn, grain, high yield	57
10/20/0	Harvest, killing crop 50pct standing stubble		87
5/10/1	Planter, double disk opnr, 15" inch row spacing	Soybean, 15 - 20 in rows	75
10/10/1	Harvest, killing crop 20pct standing stubble		91

Soil loss for cons. plan: **2.0 t/ac/yr** Sediment delivery: 2.0 t/ac/yr T value: 5.0 t/ac/yr
Soil conditioning index (SCI): **0.742**
Avg. annual slope STIR: 5.03

RUSLE2 Profile Erosion Calculation Record – With Rye Cover Crop

Outputs:

Date	*Operation*	*Vegetation*	*Surf. residue cover after operation, %*
4/18/0	**Sprayer, kill crop**		**63**
4/25/0	Planter, double disk opnr, 15" row spacing	Corn, grain, high yield	51
10/23/0	Harvest, killing crop 50pct standing stubble		88
5/10/1	Planter, double disk opnr, 15" row spacing	Soybean, 15 - 20 in rows	76
10/10/1	Harvest, killing crop 20pct standing stubble		91
10/15/1	**Drill or air seeder single disk openers 7-10 in spac.**	**Rye, winter cover**	**80**

Soil loss for cons. plan: **2.0 t/ac/yr** Sediment delivery: 2.0 t/ac/yr T value: 5.0 t/ac/yr
Soil conditioning index (SCI): **0.781**
Avg. annual slope STIR: 6.32

NRCS RUSLE2 Inputs:
Location: Saunders County
Soil: Yutan, eroded-Judson complex, 6 to 11 percent slopes/Yutan Silty clay loam eroded 64%
Slope length (along slope): 150 ft
Avg. slope steepness: 9.0 %
Yield values used: 215 bu/acre corn, 60 bu/acre soybean, and 3,360 lb/acre rye
Contouring: default
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)
Adjust res. burial level: bury 30% more than normal

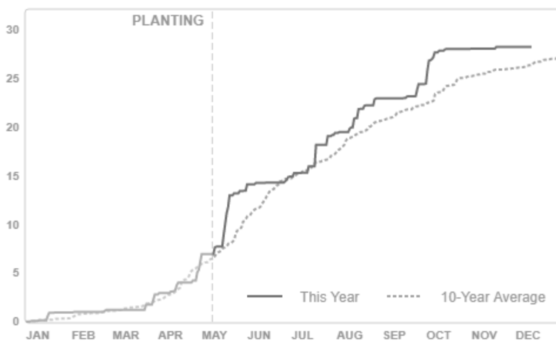
Summary: Grain yield, moisture, and stand count did not differ between the no cover crop and cereal rye cover crop treatments. The RUSLE2, NRCS erosion calculation model indicates that no differences in soil loss occurred between the two treatments under these specific soil conditions. However, the soil conditioning index (SCI) was improved on the rye cover crop strips when compared with the no cover crop. Due to the cost of rye seed and drilling, the no cover crop check had a higher marginal net return.

Soybeans Planted into Rye Cover Crop

Study ID: 064099201701
County: Kearney
Soil Type: Coly-Kenesaw loam 0-3% slope; Hersh fine sandy loam 0-6% slopes; Kenesaw silt loam 0-1% slope; Libory loamy fine sand 0-3% slope; Coly silt loam 3-6% slopes
Planting Date: 5/8/17
Harvest Date: 10/13/17 and 10/16/17
Population: 170,000
Row Spacing (in): 10
Variety: Pioneer 24T84X
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Seed Treatment: ILeVO®
Soil Samples (Nov. 2016):

N (lb)	P (ppm)	K (ppm)	S (ppm)	Zn (ppm)
53	66	396	15	6.52

Fertilizer: 20 ton/ac feedlot manure spread on field in March 2016
Herbicides: ***Pre:*** 2,4-D LV6 on 4/8/17; 53 oz/ac glyphosate and 2.9 oz/ac Elite, and 10 oz/ac Sharpen® on 5/5/17 ***Post:*** 49 oz/ac glyphosate, 22 oz/ac ExtendiMax®, 6 oz/ac Outlook®, 1.5 oz/ac Zidua®
Irrigation: Pivot, Total: 7"
Rainfall (in):



Introduction: This study compared the effects of a cereal rye cover crop on the soybean crop yield. The rye treatment was compared with a no cover crop check. Rye was drilled following corn harvest in 10" rows on Nov. 1, 2016. The rye was terminated with glyphosate on May 5, 2017. Soybeans were drilled in 10" rows on May 8, 2017. The satellite imagery from April 19, 2017, shows the rye and no rye strips prior to termination (*Figure 1*). A close-up is shown in *Figure 2*.

Figure 1. Aerial imagery of the study area from April 19, 2017.

Figure 2. Soybeans growing in corn stubble only (no cover crop) (left) and in rye cover crop (right) on June 27, 2017.

Results:

	Harvest Stand Count	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	153,267	12.0 B*	80 A	714.25 A
Cover Crop - Rye	138,027	12.1 A	81 A	692.20 B
P-Value	-	0.058	0.682	0.008

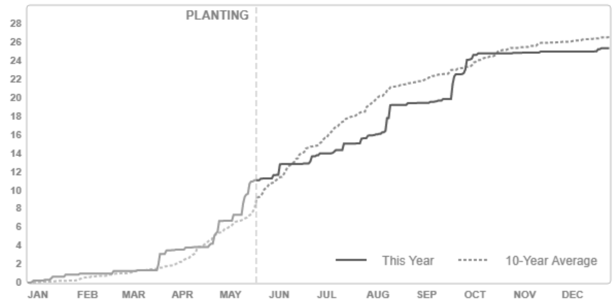
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $24.30 cover crop cost.

Summary:

- Statistics were not completed on the harvest stand counts as counts were not made for each replication.
- There was no yield difference for the soybeans following the rye cover crop treatment compared with the soybeans following no cover crop.
- The marginal net return was lower for the soybeans following the rye cover crop due to the increased input costs for establishing cover crops.

Effect of Interseeding Cover Crops at Planting on Organic Corn

Study ID: 641047201701
County: Dawson
Soil Type: Cozad fine sandy loam; Cozad silt loam; Hord silt loam wet sub-stratum
Planting Date: 5/24/17
Harvest Date: 11/11/17
Population: 34,500
Row Spacing (in): 36
Hybrid: Great Harvest 59R5
Reps: 3
Previous Crop: Alfalfa
Tillage: Full Tillage, Chisel 3/15/17
Herbicides: ***Pre:*** None ***Post:*** None
Seed Treatment: SoilBiotics humic acid
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 19.17 tons/ac beef manure on 12/2/16
Irrigation: Pivot, Total: 19.5"
Rainfall (in):



Introduction: This study evaluated the effects of planting cover crops at the same time corn is planted. The corn is under organic production. Three cover crop treatments were evaluated, along with a no cover crop control, and a twin row corn planting established by planting corn twice with a standard planter. The three cover crop treatments being evaluated were:

12 lb/ac soybeans

2 lb/ac clover

5 lb/ac mixture consisting of phacelia, lentils, and turnips.

The clover and mix treatments were planted 5/15/17. A rain event delayed further field work until 5/24/17. The soybeans, twin row, and control plots were field cultivated on 5/24/17 and then soybean cover crop treatment and corn cash crop were planted. The clover and mix treatments did not receive a cultivation.

Yield was analyzed for each treatment across the whole field. In addition, sub-field analysis was conducted to measure yield for each treatment within each soil series and across the elevation gradient of the field with a goal of determining if the treatments had a different impact on yield in different portions of the field with different field characteristics.

Results:

Table 1. Yield, moisture, and net return for each treatment on a whole field basis.

	Corn Moisture (%)	Corn Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	16.3 B*	232 A	2,082.99 A
Cover Crop - Clover	16.5 AB	235 A	2,105.22 A
Cover Crop - Beans	16.5 AB	234 A	2,090.23 A
Cover Crop - Mix	16.7 A	235 A	2,094.46 A
Twin Row Planting	16.3 B	238 A	2,130.13 A
P-Value	0.020	0.584	0.654

*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 $9/bu organic corn, $17.15/ac for the cover crop mix, $14/ac for the soybean cover, $12/ac for the clover cover crop, and $8/acre for twin row corn planting. Costs of all products include $8/ac for an extra trip across the field.

Further analysis by soil type *(Figure 1* and *Table 2)* shows that the highest yields for all treatments occurred in the Hord silt loam, 0-1% slopes. There were no clear trends indicating one cover crop type resulted in lower performing corn yields in a specific soil region of the field.

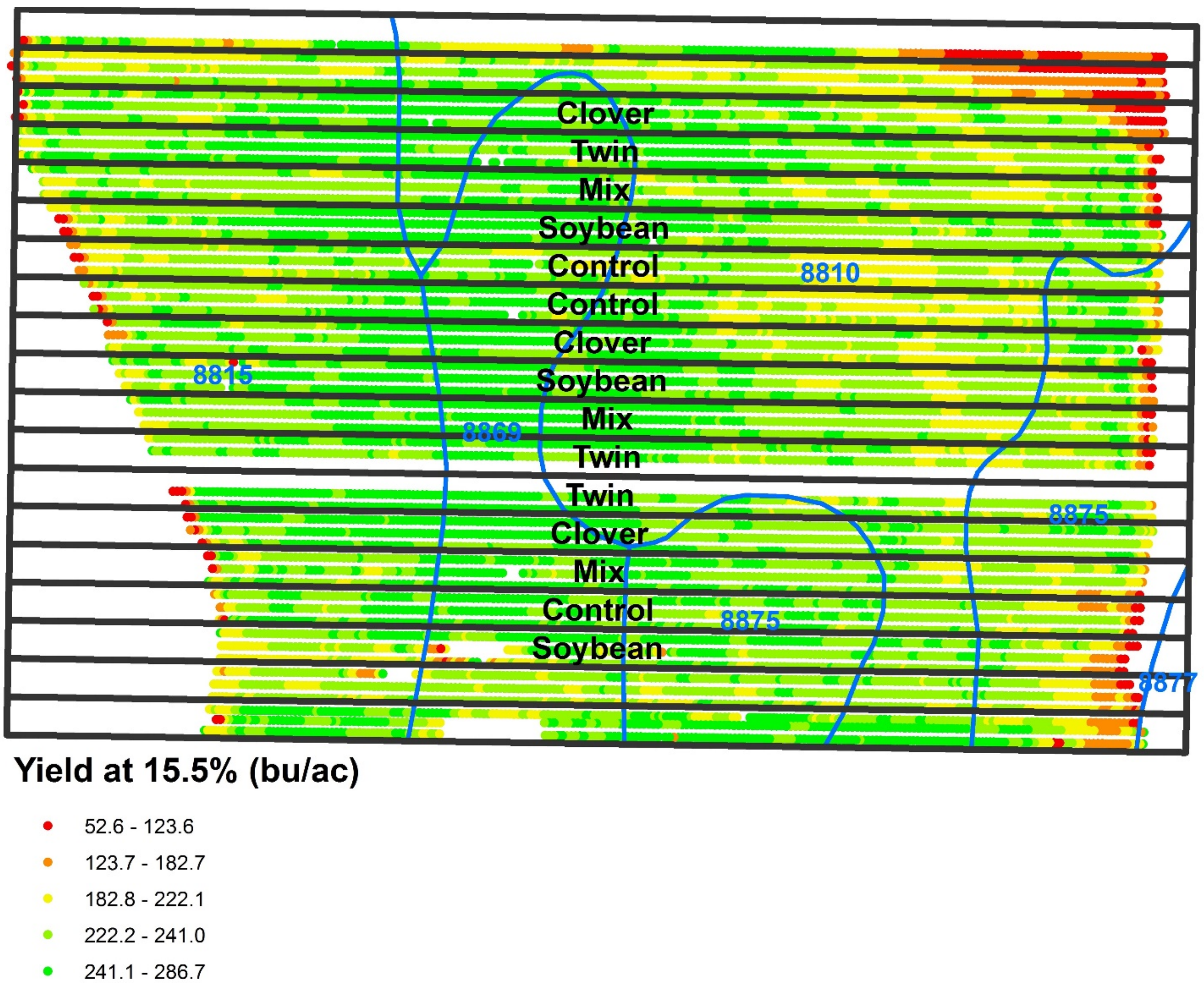


Figure 1. Yield data with soil map unit.

Table 2. Yield by treatment and soil map unit.

Map Symbol	Map Unit	Clover	Control	Mix	Soybean	Twin	Clover	Control	Mix	Soybean	Twin
		Yield (bu/ac)					Percent of Trial				
8810	Cozad fine sandy loam, 0 to 1 percent slopes	232.3	228.8	232.4	236.1	236.1	8.3%	6.6%	7.4%	7.6%	9.0%
8815	Cozad silt loam, 0 to 1 percent slopes	237.8	231.9	233.8	232.5	242.0	6.2%	5.9%	5.9%	5.7%	6.1%
8869	Hord silt loam, 0 to 1 percent slopes	248.7	243.1	247.4	242.9	248.2	2.6%	3.5%	2.9%	3.1%	2.3%
8875	Hord silt loam, wet substratum, 0 to 1 percent slopes	232.0	227.9	225.7	165.9	226.0	3.2%	4.0%	3.6%	3.4%	2.7%

Yield by treatment by elevation analysis did not result in any clear differentiation of cover crop performance by field elevation *(Figure 2)*.

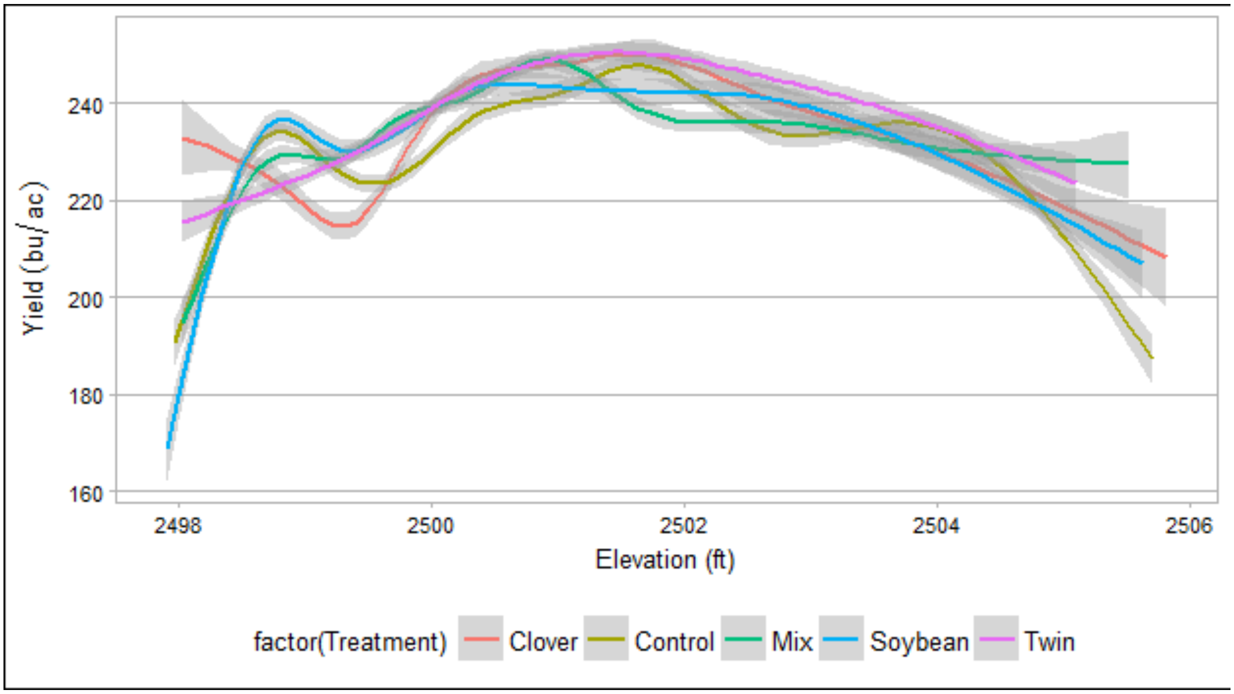


Figure 2. Yield by elevation for each of the treatments.

Summary:

Yield was very consistent across all treatments when considered on a whole field or subfield basis.

Integrating Cover Crops on Sandy Soils to Improve Water Quality and Soil Health

Study ID: 737119201701
County: Madison
Crop: Soybean
Soil Type: Boel sandy loam 0-1% slope
Planting Date: 4/24/17
Harvest Date: 11/14/17
Population: 150,000

Variety: Asgrow 2733
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Irrigation: Pivot, Total: 5.23"
Rainfall: 28.14"

Introduction: The objective of this study was to evaluate the potential for cover crops to reduce water erosion of nutrients, improve water quality by reducing nitrate leaching, and enhance soil health in Nebraska corn/soybean production systems on sandy soils. This report includes data from year one of the three-year project. The treatments will remain in the same locations each year so we can monitor changes in water erosion, water quality, and soil health over time. This study consists of three treatments with six replications: check (no cover crop), pre-corn harvest planted cereal rye cover crop, and post-corn harvest planted cereal rye cover crop. The pre-harvest rye was broadcast on September 19, 2016 into standing corn using a high-clearance seeder *(Figure 1)*. The post-harvest planted rye was drilled on November 3, 2016. Rye cover crop was planted at a rate of 56 lb/ac. Plots are 40 feet wide for the check and the post-harvest planted cover crop; 60 feet wide strips were used for the pre-harvest planted cover crop. In the spring of 2017, cover crop biomass was measured and soil samples were collected to determine nitrate concentration change with depth and to test soil biological activity through the Solvita® 24-hour CO_2 Burst test. In the fall of 2017, we hand harvested a 17.5-foot long soybean row in the center of each plot to determine grain yield. The plants plus the beans were harvested, dried in a forced-air oven, and then threshed. Grain was corrected for moisture content. Additional data on water erosion and quality will be collected in 2018.

Figure 1. High clearance applicator planting cover crops into standing corn on September 19, 2016.

Results:

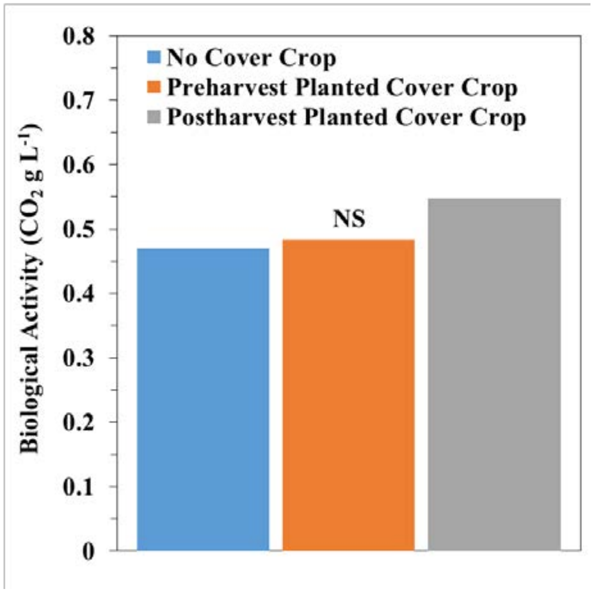


Figure 2. Rye cover crop planting date effect on soil biological activity in a sandy loam soil in Nebraska. NS denotes no significant differences among the three treatments.

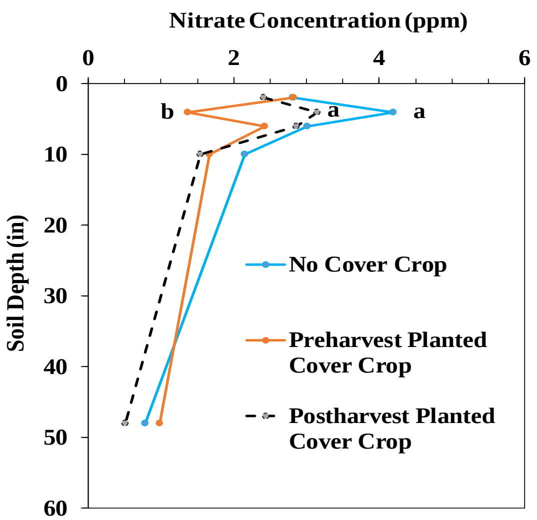


Figure 3. Cover crop planting date effect on nitrate concentration on a sandy site.

	Soybean Yield† (bu/ac)	Spring Cover Crop Biomass (lb/ac)	Marginal Net Return‡ ($/ac)
Check	82 A*	N/A	733.49 A
Cover Crop - Pre-harvest Planting	65 B	254.14 A	556.71 B
Cover Crop - Post-harvest Planting	66 AB	121.21 B	560.55 B
P-Value	0.0575	0.014	0.031

*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 13% moisture.
‡Marginal net return based on $8.90/bu soybeans, $0.16/lb cereal rye seed cost, $8.13/ac high clearance applicator cost, and $17.16/ac drill cost.

Summary:

- Spring cover crop biomass was significantly greater in the pre-harvest broadcast compared with post-harvest drilled treatment.
- Soybean yields were significantly less in the pre-harvest cover crop treatment when compared with the check whereas no differences occurred between the post-harvest treatment and the check.
- The yield reduction and increased costs for establishing cover crops resulted in significantly lower marginal net return for both cover crop treatments compared with the check.
- There were no significant differences in biological activity across treatments *(Figure 2)*.
- Significant differences in nitrate concentration were only observed at the 4-8" depth *(Figure 3)*. At this depth, pre-harvest planted cover crop had significantly less nitrate concentration when compared with the post-harvest planted cover crop and the check. This suggests that at this site, the greater cover crop biomass produced by the pre-harvest planted cover crop reduced nitrate concentration in the 4-8" depth.

Integrating Cover Crops on Sloping Soils to Improve Water Quality and Soil Health

Study ID: 742023201701
County: Butler
Crop: Corn
Soil Type: Aksarben silty clay loam; Yutan silty clay loam; Pohocco silty clay loam
Planting Date: 5/8/17
Harvest Date: 10/28-29/17

Population: 29,500
Hybrid: Dekalb DKC60-88RIB
Reps: 6
Previous Crop: Soybean
Tillage: No-Till
Irrigation: None
Rainfall: 38.04"

Figure 1. Pre-harvest planted cover crop.

Figure 2. Cover crop just before termination.

Introduction: The objective of this study was to evaluate the potential for cover crops to reduce water erosion of nutrients, improve water quality by reducing nitrate leaching, and enhance soil health in Nebraska corn/soybean production systems on sloping soils. Impact of cover crops on the subsequent corn yield was also evaluated. This report includes data from year one of the three-year project. Treatments are held on the same plot during each year of the study to monitor changes in soil erosion, water quality, and soil health over time. This study includes three treatments with six replications: check (no cover crop), pre-harvest planted cereal rye cover crop *(Figure 1)*, and post-harvest planted cereal rye cover crop *(Figure 2)*. The pre-harvest rye planting occurred on October 3, 2016, into standing soybean using a high-clearance broadcast seeder. The post-harvest planted rye was drilled on October 24, 2016. Rye cover crop was planted at 50 lb/ac. Plots are 40-foot wide for check and the post-harvest planted cover crop; 60-foot wide strips were used for the pre-harvest planted cover crop. In the spring of 2017, cover crop biomass was measured and soil samples were collected to determine nitrate concentration change with depth and to test soil biological activity through the Solvita® 24-hour CO_2 Burst test. In the fall of 2017, we hand harvested ears from a 17.5-foot-long corn row in the center of each plot to determine grain yield. Ears were dried, shelled, and dried again. Grain weight was then determined and corrected to 15.5 percent moisture content. Additional data on water erosion and quality will be collected in 2018.

Results:

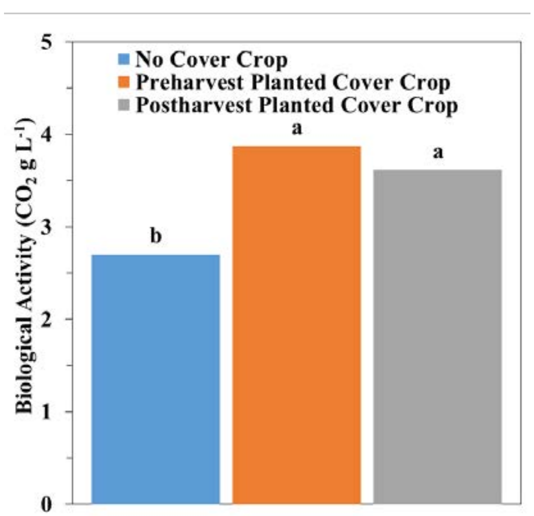


Figure 3. Rye cover crop planting date effect on soil biological activity in a sloping silty clay loam soil in Nebraska. Different lowercase letters above bars denote statistical differences among treatments.

	Corn Yield† (bu/acre)	Cover Crop Biomass (lb/ac)	Marginal Net Return‡ ($/ac)
Check	251 A*	N/A	789.24 A
Cover Crop - Pre-harvest Planting	241 A	2,727 A	741.54 A
Cover Crop - Post-harvest Planting	257 A	2,318 A	781.81 A
P-Value	0.8745	0.3159	0.867

*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 $3.15/bu corn, $0.19/lb cover crop seed cost, $8.13/ac high clearance applicator cost, and $17.16/ac drill cost.

Summary:

- No differences in cover crop biomass occurred between pre- and post-harvest planted cover crops.
- There was no significant difference in yield across the three treatments.
- Marginal net return was not impacted by the cover crop treatments.
- Biological activity was significantly greater in the cover crop treatments, indicating increased soil activity from cover crop treatments *(Figure 3)*.

Corn Planted After Spring-grazed or Non-grazed Rye Cover Crop

Study ID: 078155201705
County: Saunders
Soil Type: Yutan silty clay loam 2-6% slopes, eroded; Pohocco-Pahuk complex 6-11% slopes, eroded; Filbert silt loam 0-1% slope; Tomek silt loam 0-2% slopes
Planting Date: 5/13/17
Harvest Date: 10/23/17
Population: 33,048
Row Spacing (in): 30
Hybrid: Pioneer 0801AMXT
Reps: 3
Previous Crop: Wheat
Tillage: No-Till
Herbicides: 37 oz/ac Roundup PowerMax®, 33.1 oz/ac AMS, 2.6 oz/ac Laudis®, 11.2 oz/ac Atrazine 4L, and 18.5 oz/ac MSO
Foliar Insecticides: 2.5 oz/ac Baythroid® XL and 9.2 oz/ac Capture® LFR®
Foliar Fungicides: 2.7 oz/ac Trivapro®

Fertilizer: 40 lb/ac 11-52-0, 15.6 gal/ac 32% UAN, 3.8 gal/ac 10-18-4, 0.3 gal/ac Zinc chelate, 1 gal/ac CoRoN®-Ag, 0.2 gal/ac Nutrisphere-N®, 0.2 gal/ac Boron, 0.4 gal/ac Magnesium, 0.3 gal/ac Pro-Manganese® 5
Irrigation: Pivot, Total: 2.4-3.4"
Rainfall (in):

Introduction: This study tested the effects of grazed and un-grazed rye cover crop on corn yield, as well as the addition of an ionophore supplement (monensin at 1,600 g/ton) on the weight gain of calves. The study consisted of four treatments: grazed rye cover crop with ionophore supplement, grazed rye cover crop without ionophore supplement, un-grazed rye cover crop, and a check with no cover crop. The field had wheat, then a sorghum-sudan hay prior to planting rye. Elbon cereal rye cover crop was planted on 10/28/16 at a rate of 70 lb/acre. Dry soil conditions in late fall and early spring reduced rye growth. Rye was not irrigated at any point. 700 lb steers were stocked at a rate of 0.95 hd/acre on 4/3/17 and were pulled on 4/29/17. Paddock 1 was pulled earlier due to overgrazing and was not included in the analysis. Rye cover crop was terminated at planting with glyphosate herbicide.

Results:

	--------------------Corn--------------------			-------Cover Crop-----------		---------Cattle-------	
	Yield† (bu/ac)	Early Season Stand Count (plants/ac)	Harvest Stand Count (plants/ac)	Ground Cover at Corn Planting (%)	Biomass at Planting (ton/ac DM)	Average Daily Gain (lb/d)	Cattle Weight Gain (lb/ac)
Check	211 A*	33,926 A	37,778 A	87.2 AB	0.31 B	N/A	N/A
Cover Crop - Rye	204 A	33,852 A	35,222 A	91.6 A	0.40 C	N/A	N/A
Cover Crop - Grazed	190 A	31,852 B	31,111 A	81.6 B	0.23 A	2.9 A	60 A
Cover Crop - Grazed w/ Ionophore Supplement	203 A	33,519 A	34,222 A	81.7 B	0.25 A	3.6 A	68 A
P-Value	0.636	0.034	0.274	0.04	<0.01	0.152	0.23

*Values with the same letter are not significantly different at a 90% confidence level.
† Bushels per acre corrected to 15% moisture.

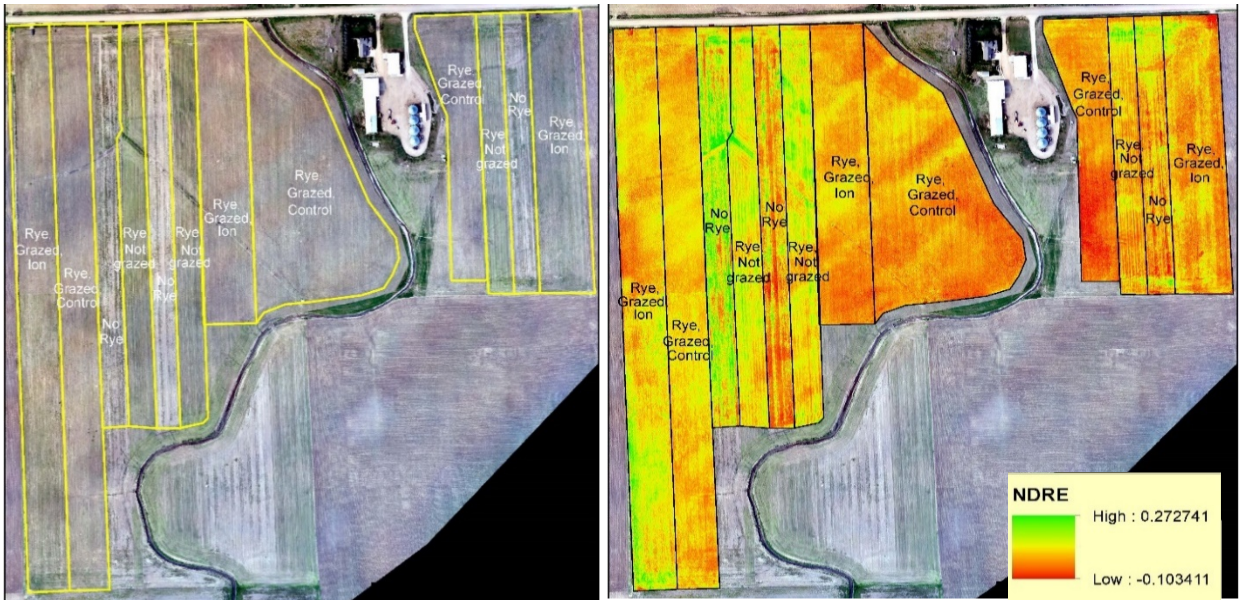


Figure 1. True color (RGB) imagery (left) and normalized difference red edge index (NDRE) imagery (right) of the field area on April 27, 2017.

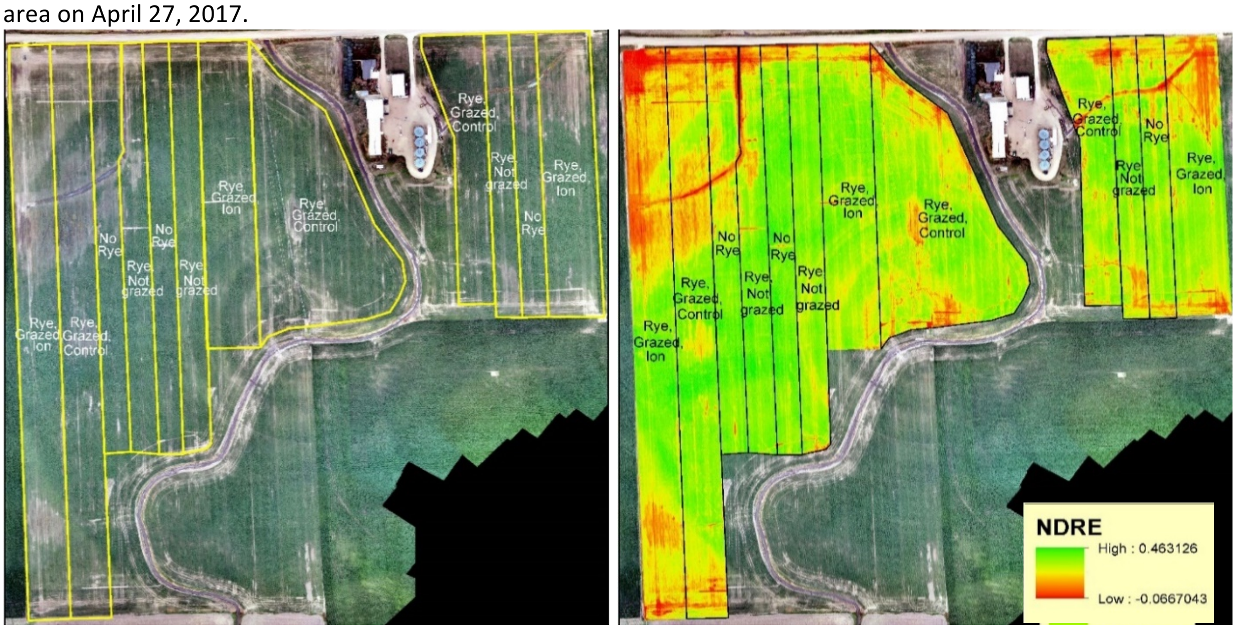


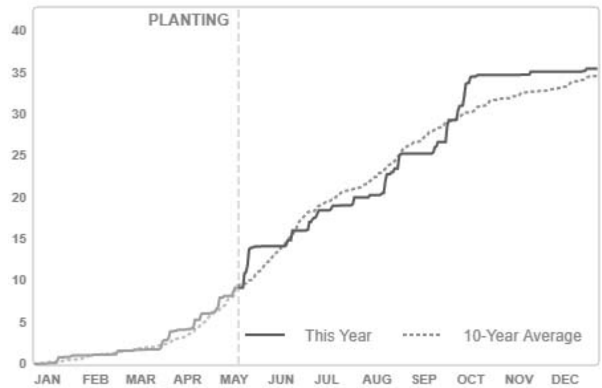
Figure 2. True color (RGB) imagery (left) and normalized difference red edge index (NDRE) imagery (right) of the field area on June 30, 2017.

Summary: No significant difference was observed between grazing treatments for average daily gain or total gain. Significant differences were observed in the amount of ground cover at planting with the grazed treatments having less cover than the rye cover crop or the control. No significant difference was observed in corn yield among treatments. Differences among treatments are evident in aerial imagery from April 27, 2017 *(Figure 1)* but less apparent on June 30, 2017 *(Figure 2).* Planting and grazing the rye with 700 lb steers resulted in returns above cost of establishment ($34.60 seed and seeding plus $19.80/ac fertilizer and application) and cattle care costs ($0.07/hd/d mineral, $0.10/hd/d yardage, $2.64/hd transportation and fencing at $4.40/ac) of $28.75/ac or $27.31/hd when calves were valued at $140/cwt.

Corn Planted After Spring-grazed or Non-grazed Rye Cover Crop

Study ID: 078155201706
County: Saunders
Soil Type: Filbert silt loam 0-1% slope; Yutan silty clay loam 2-6% slopes; Tomek silt loam 0-2% slope
Harvest Date: 10/23/17
Population: 33,048
Row Spacing (in): 30
Hybrid: P0589AM/RR2/LL and Curry 725-59AM planted on 5/7-5/8; A6499 replanted on 5/12
Reps: 3
Previous Crop: Soybean
Tillage: No-Till
Herbicides: 37 oz/ac Roundup PowerMax®, 33.1 oz/ac AMS, 2.6 oz/ac Laudis®, 11.2 oz/ac Atrazine 4L, and 18.5 oz/ac MSO
Foliar Insecticides: 2.5 oz/ac Baythroid® XL and 9.2 oz/ac Capture® LFR®
Foliar Fungicides: 2.7 oz/ac Trivapro®

Fertilizer: 40 lb/ac 11-52-0, 15.6 gal/ac 32% UAN, 3.8 gal/ac 10-18-4, 0.3 gal/ac Zinc chelate, 1 gal/ac CoRoN®-Ag, 0.2 gal/ac Nutrisphere-N®, 0.2 gal/ac Boron, 0.4 gal/ac Magnesium, 0.3 gal/ac Pro-Manganese® 5
Irrigation: Pivot, Total: 2.4-3.4"
Rainfall (in):



Introduction: This study tested the effects of grazed and un-grazed rye cover crop on corn yield, as well as the addition of an ionophore supplement (monensin at 1,600 g/ton) on the weight gain of calves. The study consisted of four treatments: grazed rye cover crop with ionophore supplement, grazed rye cover crop without ionophore supplement, un-grazed rye cover crop, and a check with no cover crop. The field was divided into three blocks and treatments were randomly assigned with each block. Elbon cereal rye cover crop was planted on 10/28/16 at a rate of 70 lb/acre. Calves were stocked at a rate of 2 hd/acre on 4/3/17 and were pulled on 4/29/17. Rye cover crop was terminated at corn planting with glyphosate herbicide.

Results:

	--------------Corn---------------		----------Cover Crop---------		---------Cattle--------	
	Early Season Stand Count (plants/ac)	**Harvest Stand Count (plants/ac)**	**Ground Cover at Corn Planting (%)**	**Biomass at Planting (ton/ac DM)**	**Average Daily Gain (lb/d)**	**Cattle Weight Gain (lb/ac)**
Check	31,074 A	31,667 A	92.33 A	N/A	N/A	N/A
Cover Crop - Rye	33,074 A	32,778 A	94.57 A	1.64 B	N/A	N/A
Cover Crop - Grazed	30,889 A	31,222 A	66.67 B	0.25 A	3.41 A	152 A
Cover Crop - Grazed with Ionophore Supplement	32,000 A	33,889 A	73.13 B	0.26 A	2.88 A	128 A
P-Value	0.2135	0.512	0.0077	<0.01	0.258	0.35

*Values with the same letter are not significantly different at a 90% confidence level.
† Bushels per acre corrected to 15% moisture.

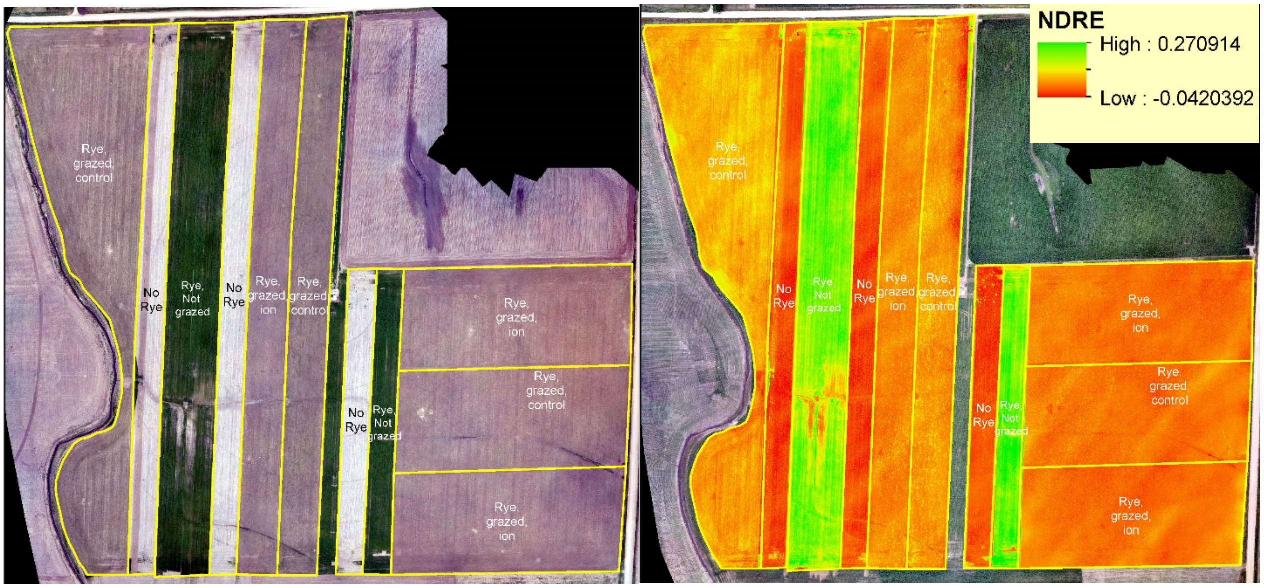


Figure 1. True color (RGB) imagery (left) and normalized difference red edge (NDRE) index imagery (right) of the field area on April 27, 2017.

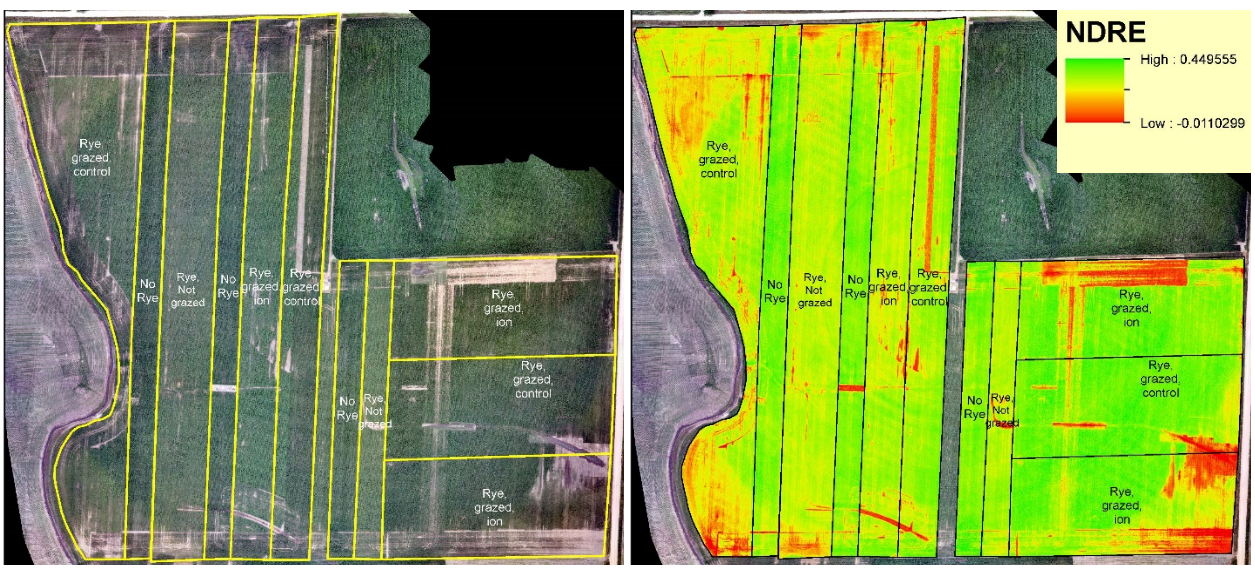


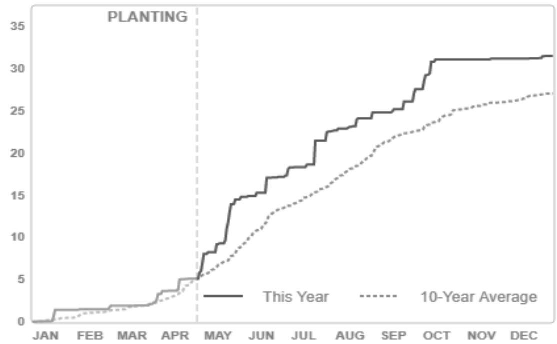
Figure 2. True color (RGB) imagery (left) and normalized difference red edge (NDRE) index imagery (right) of the field area on June 30, 2017.

Summary: No significant difference was observed between grazing treatments for average daily gain or total gain. Significant differences were observed in the amount of ground cover at planting with the grazed treatments having less cover than the rye cover crop or the control. Corn yield was measured by hand harvesting samples from each treatment. Because multiple hybrids were planted in the field, and yield samples for the treatments may have contained different hybrids, yield data is not reported. Planting and grazing the rye with 700 lb steers resulted in returns above cost of establishment ($34.60 seed and seeding plus $19.80/ac fertilizer and application) and cattle care costs ($0.07/hd/d mineral, $0.10/hd/d yardage, $2.64/hd transportation and fencing at $4.40/ac) of $125.56/ac or $62.78/hd when calves were valued at $140/cwt.

Effects of Grazing Cover Crops in a Three-year Non-Irrigated Rotation

Study ID: 720129201701
County: Nuckolls
Soil Type: Hastings silt loam 0-1% slope
Planting Date: 5/15/17
Harvest Date: 10/25/17
Population: 25,000
Row Spacing (in): 30
Hybrid: Pioneer 1151
Reps: 4
Previous Crop: Wheat
Tillage: No-Till
Herbicides: ***Pre:*** 24 oz/ac Glyphosate and 8 oz/ac 2,4-D and 5 oz/ac Balance® Flex and 1.3 lb/ac Atrazine ***Post:*** 32 oz/ac Glyphosate and 2.5 oz/ac Status®

Fertilizer: 15 ton/ac manure after wheat harvest, 160 lb/ac actual N Anhydrous Ammonia and 6 gal/ac 10-34-0 starter
Irrigation: None
Rainfall (in):



Introduction: In rainfed systems with limited precipitation, adding cover crops into the rotation can decrease yields, but the use of these cover crops for forage may offset the costs while retaining soil benefits. This study evaluated four treatments: grazed cover crop, ungrazed cover crop, ungrazed wheat stubble, and grazed wheat stubble. The cover crop treatments were planted on August 14 following wheat harvest and consisted of a mix of winter peas, spring triticale, oats, collards, and purple top turnip. Grazed treatments were grazed in the fall of 2016. Corn was planted in 2017 across all treatments.

Cover crop biomass was measured in the fall. Baseline soil samples were taken in April, prior to planting corn. Soil moisture was recorded from August 2016 through corn harvest in 2017 with Watermark soil moisture sensors. Soil moisture status from from March through July 2017 (pre-corn planting and first few months of corn growth) is presented in Figures 1 and 2. Corn stand counts, stalk lodging, yield, grain moisture and marginal net return were collected.

Results:

Table 1. Cover crop composition (% of biomass on DM basis).

Grass	53.5%
Winter Pea	1.5%
Collards	8.7%
Turnip Tops	20.9%
Turnip Bottoms	14.5%
Other	0.9%

Table 2. Soil analysis taken prior to corn planting in April.

			0 to 8 inches		
	Soil pH	OM %	Nitrate-N ppm	Nitrogen lb N/A	
Cover Crop – Non Grazed	5.52 A	3.1 A	5.4 B	9.3 B	
Cover Crop – Grazed	5.68 A	3.1 A	7.3 B	12.6 B	
Wheat Stubble – Non Grazed	5.40 A	3.1 A	12.9 A	24.5 A	
P-value	0.38	0.90	0.01	<0.01	
			0 to 4 inches		
	Solvita CO2-C (ppm)	Total Biomass (ng/g)	Total Bacteria Biomass (ng/g)	Total Fungi Biomass (ng/g)	Diversity Index
Cover Crop – Non Grazed	133	4,225 A	2,187	351	1.44
Cover Crop – Grazed	161	3,927 AB	2,142	333	1.44
Wheat Stubble – Non Grazed	128	3,046 B	1,605	306	1.5
P-value	0.19	0.09	0.12	0.90	0.90

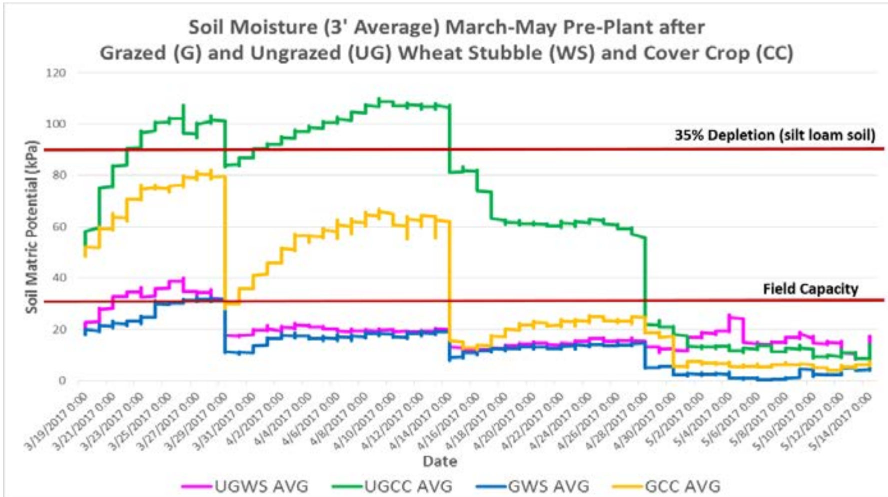


Figure 1. Soil moisture data for three feet depth from March through May 2017 for the four treatments. UGWS = ungrazed wheat stubble, UGCC = ungrazed cover crop, GWS = grazed wheat stubble, and GCC = grazed cover crop.

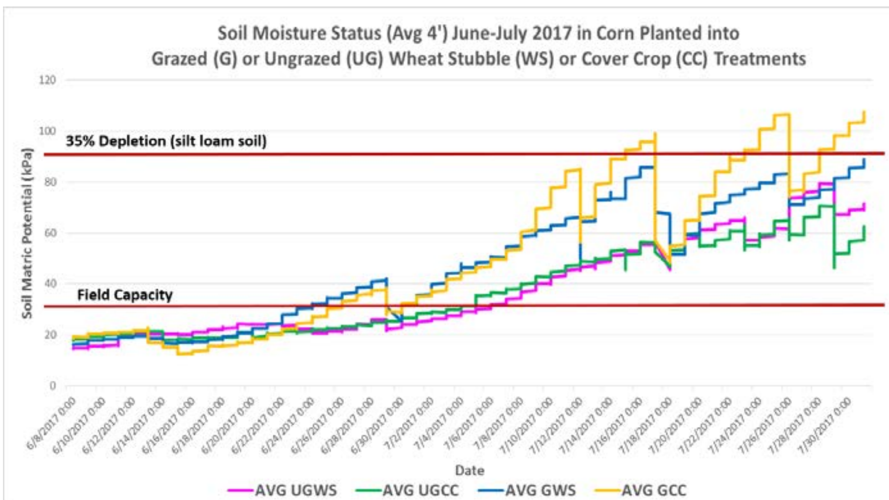


Figure 2. Soil moisture data for four feet depth from June through July 2017 for the four treatments. UGWS = ungrazed wheat stubble, UGCC = ungrazed cover crop, GWS = grazed wheat stubble, and GCC = grazed cover crop.

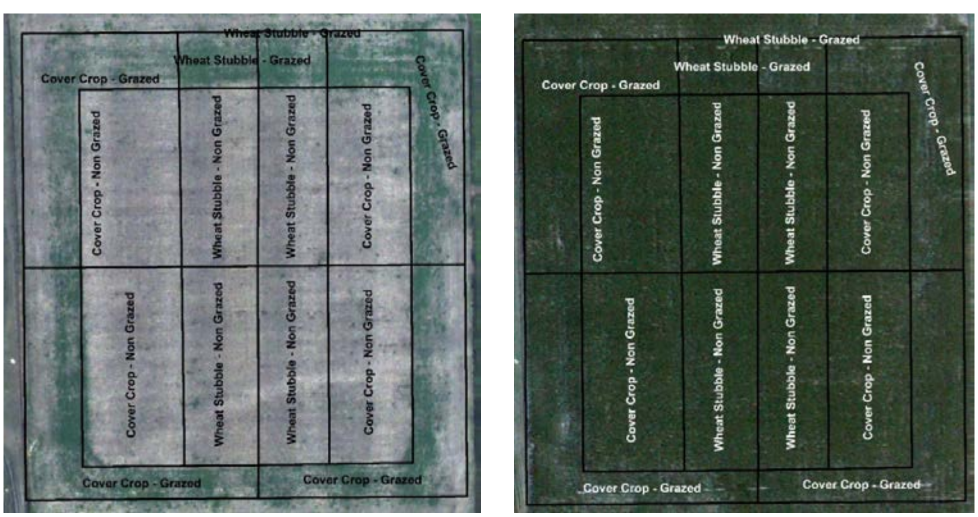


Figure 3. True color imagery from June 20 (left) and July 16 (right).

Table 3. Lodging, moisture, test weight, harvest stand count, yield, and marginal net return.

	Corn Stalk Lodging (%)	Corn Moisture (%)	Corn Test Weight	Corn Stand Count at Harvest	Corn Yield (bu/acre)†
Cover Crop - Non Grazed	5 A*	15.0 A	61 A	22,500 A	213 A
Cover Crop - Grazed	8 A	14.9 A	61 A	22,167 A	211 A
Wheat Stubble - Non Grazed	5 A	15.2 A	61 A	22,500 A	218 A
Wheat Stubble - Grazed‡	18	14.6	62	23,750	212
P-Value	0.626	0.129	0.267	0.952	0.141

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Wheat Stubble – Grazed treatment is not included in statistical analysis due to only having 2 replications and cows congregating in this area.

Summary:

Cover crop biomass measured on October 19 was 3,401 lb/ac and consisted mainly of grass and turnip. Starting in early November, 28 (1,100 lb) first-calf heifers grazed 9.6 acres for 22 days resulting in the cover crop carrying 2.4 animal unit month (AUM)/ac. Post-grazing 2177 lb/ac of biomass was still present.

During March through May, prior to planting corn, the cover crop treatments were around 35% depletion (the typical trigger point for irrigation on these soil types) while the wheat stubble treatments remained near field capacity (full soil moisture profile) *(Figure 1)*. In May, 8 inches of rain recharged the soil profile, and all treatments had a full 4 feet soil moisture profile at the beginning of June *(Figure 2)*; therefore, the cover crop treatments did not result in lower beginning moisture which could limit yield potential. The grazed treatments began to show greater soil moisture depletion than the ungrazed treatments as time progressed. The soil moisture status at harvest is not available at this time.

Aerial imagery was obtained throughout the growing season *(Figure 3).* On the June 20 imagery, green vegetation is observed in the grazed treatments and along the border of the non-grazed treatments. Ground observation showed that the green vegetation was palmer amaranth which was concentrated where the cattle created trails walking the electric fence and where they lay in the grazed wheat stubble.

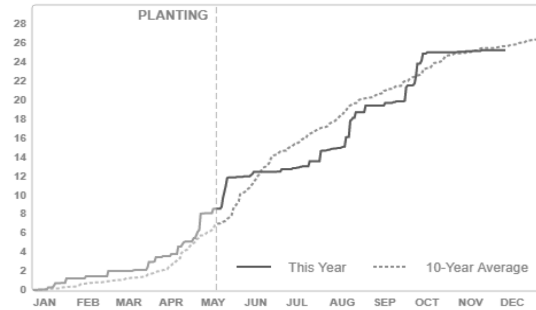
No significant yield differences occurred among treatments. Corn yield where the cover crop was planted and not grazed (213 bu/ac) did not differ from where it was grazed (211 bu/ac). There were only two replications of the grazed wheat stubble treatment and cows tended to congregate in these areas; therefore, this data was not included in the statistical analysis. Means for this treatment are presented in *Table 3*.

Costs for the non-grazed cover crop treatments were $46.64/ac ($28.64/ac for seed and $18/ac for drilling). Costs for the grazed cover crop treatments were $61.94/ac ($46.64/ac for the cover crop seed and planting, $5/ac for fencing, and $10.30/ac for water). Water cost was calculated assuming hauling water (1,000 gal) 15 miles every two days at $2 per loaded mile and $6 per 1,000 gal. Costs for the grazed cover crop treatments equaled $30.97/AUM. Value of the forage is estimated to be $84.80/ac (based on rental rates of $53/pair/month (1.25 AUM) or $42.40/AUM).

Evaluating Corn Relative Maturity for Improving Cover Crop Establishment

Study ID: 708077201702
County: Greeley
Soil Type: Gates silt loam
Planting Date: 5/12/17
Harvest Date: 11/15/17
Population: 20,000
Row Spacing (in): 30
Reps: 4
Tillage: No-Till
Herbicides: ***Pre:*** 16 oz/ac 2,4-D LV4, 24 oz/ac Durango® DMA® on 4/18/17 ***Post:*** 3 qt/ac Lexar® EZ and 24 oz/ac Durango® DMA® on 6/15/17
Foliar Insecticides/Fungicides: None

Fertilizer: 5 gal/ac 10-34-0 and 1 qt/ac Zinc as starter; 75 lb/ac N as 46% Urea and 10 lb/ac S (AMS) at planting; 75 lb/ac N as 32% UAN at V6
Irrigation: None
Rainfall (in):



Introduction: Cover crops have the potential to provide several ecosystem services, which is why more corn producers are finding ways to integrate them into their cropping systems. One of the primary limitations to fall planted cover crops in Nebraska is the limited growing window following corn. Recent small plot research at the University of Nebraska found that shorter season comparative relative maturity (CRM) (95 CRM) corn hybrids have similar yields to longer season CRM hybrids (111 CRM). This research also showed the potential for greater cereal rye biomass accumulation following the 95 CRM hybrid compared with the 111 CRM hybrid. Based on these results our objective is to evaluate corn growth, development, and yield for different CRM hybrids using on-farm research. In this study four different CRM corn hybrids were evaluated.

95 day CRM = DKC 45-65 RIB (GENSS RIB)
105 day CRM = DKC 55-20 RIB (GENSS RIB)
111 day CRM = DKC 61-54 RIB (GENSS RIB)
115 day CRM = 215-83STXRIB (GENSS RIB)

Results:

	Corn Test Weight	Corn Moisture (%)	Corn Yield (bu/acre)†	Corn Marginal Net Return‡ ($/ac)
95 Day CRM	60 AB*	14.1 C	88 B	253.77 B
105 Day CRM	59 BC	14.4 C	100 AB	293.94 AB
111 Day CRM	61 A	15.7 B	104 AB	302.94 AB
115 Day CRM	59 C	16.3 A	109 A	331.56 A
P-Value	0.002	<0.0001	0.058	0.019

*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 $3.15/bu corn and assumes hybrids have same cost.

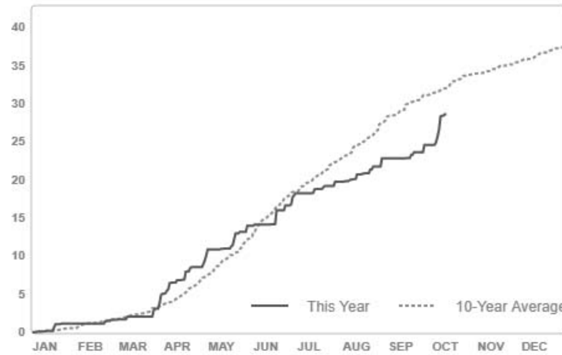
Summary:

- There were significant differences in test weight, with the 111 day and 95 day having the highest test weight.
- There were significant moisture differences. Despite the late harvest date of November 15, the 115 day corn was still at 16.3% moisture.
- Yield trend showed an increasing yield as the relative maturity increased. The 95 day corn was significantly lower yielding than the 115 day corn but was not significantly lower yielding than the 105 or 110 day corn.
- The 95 day corn had a significantly lower marginal net return than the 115 day corn, but was not significantly lower yielding than the 105 or 110 day corn. Marginal net return does not take into account varying seed corn prices.

Evaluating Corn Relative Maturity for Improving Cover Crop Establishment

Study ID: 701147201701
County: Richardson
Soil Type: Pohocco silty clay loam 6-11% slopes, eroded; Marshall silty clay loam 6-11% slopes, eroded; Zook silty clay loam occasionally flooded; Judson silt loam 2-6% slopes; Marshall silty clay loam 2-6% slopes
Planting Date: 5/8/17
Harvest Date: 10/3/17
Population: 27,500
Row Spacing (in): 30
Reps: 6
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** Banvel® and 2,4-D ***Post:*** Roundup®, Atrazine, and Callisto®

Fertilizer: 130 lb N/acre
Irrigation: None
Rainfall (in):



Introduction: Cover crops have the potential to provide several ecosystem services, which is why more corn producers are finding ways to integrate them into their cropping systems. One of the primary limitations to fall planted cover crops in Nebraska is the limited growing window following corn. Recent small plot research at the University of Nebraska found that shorter season comparative relative maturity (CRM) (95 CRM) corn hybrids have similar yields to longer season CRM hybrids (111 CRM). This research also showed the potential for greater cereal rye biomass accumulation following the 95 CRM hybrid compared with the 111 CRM hybrid. Based on these results our objective is to evaluate corn growth, development, and yield for different CRM hybrids using on-farm research. In this study four different CRM corn hybrids were evaluated.

95 day CRM = DKC 45-65 RIB (GENSS RIB)
105 day CRM = DKC 55-20 RIB (GENSS RIB)
111 day CRM = DKC 61-54 RIB (GENSS RIB)
115 day CRM = 215-83STXRIB (GENSS RIB)

Results:

	Corn Stand Count at Harvest (plants/ac)	Corn Test Weight (lb/bu)	Corn Moisture (%)	Corn Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
95 Day CRM	22,426 B*	57 B	13.4 D	178 B	561.58 B
105 Day CRM	25,479 A	58 A	14.7 C	204 A	642.80 A
111 Day CRM	26,172 A	59 A	16.6 B	216 A	680.06 A
115 Day CRM	24,168 AB	56 B	18.1 A	202 A	635.35 A
P-Value	0.005	0.0001	<0.0001	0.005	0.005

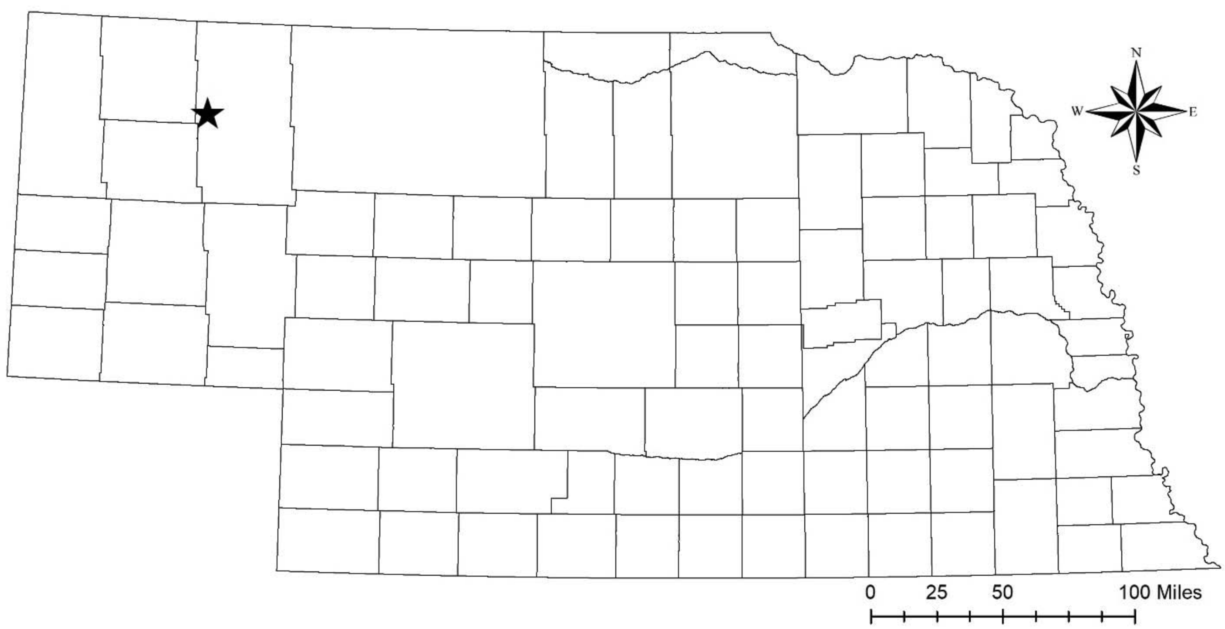
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $3.15/bu corn and assumes hybrids have same cost.

Summary:

- Some portions of the field had ground squirrel damage and planter skips for part or all of the length of the study area. Plots where these instances occurred were removed from the analysis.
- There were significant moisture differences with the longest CRM (115) having the wettest corn at the time of harvest and the shortest CRM (95) having the driest corn at harvest.
- There were significant differences in test weight, but they did not follow a pattern with relation to the CRM.
- Yields were adjusted to a standard moisture of 15.5 percent. Significant yield differences were observed between the CRMs tested. The 95 day corn was significantly lower yielding than the other three CRMs. There was no significant yield difference between the 105, 111, and 115 day corn.
- Stand counts at harvest were significantly different between the CRMs. To determine if this impacted yield, a covariate analysis was conducted. Including actual treatment populations as a covariate did not affect the yield analysis.
- The 95 day CRM hybrid had a significantly lower marginal net return than the other three treatments.

EQUIPMENT

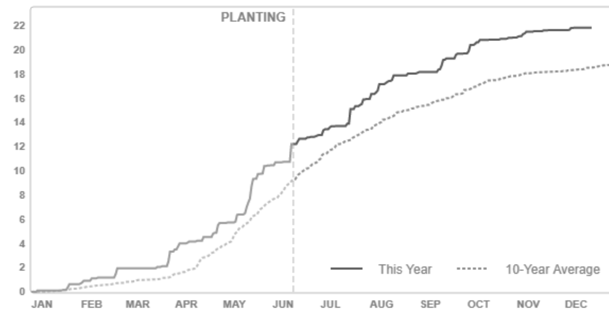
- Dry Bean Direct Harvest Combine Speed Evaluation



Dry Bean Direct Harvest Combine Speed

Study ID: 601161201702
County: Sheridan
Soil Type: Johnstown loam 0-2% slope; Keith loam 1-3% slope
Planting Date: 6/14/2017
Harvest Date: 10/24/17
Population: 120,000
Row Spacing (in): 15
Variety: Sinaloa pinto beans
Reps: 4
Previous Crop: Oats
Tillage: Field cultivator and vertical tillage 3 times
Herbicides: ***Pre:*** 32 oz Prowl® and 14 oz Outlook® on 6/17/17 ***Post:*** 21 oz Varisto® (Raptor® + Basagran®) and 8 oz Basagran® on 7/17/17

Seed Treatment: None
Foliar Fungicides: 32 oz Sanidate® on 9/1/17
Fertilizer: 25 lb/ac N, 25 lb/ac P, 10 lb/ac S, 1 lb/ac Zn, and 2 lb/ac Mn dry spread on 6/13/17
Irrigation: Pivot, Total: 10"
Rainfall (in):



Introduction: Combine harvest is the final and one of the most critical aspects of raising dry beans. You can grow a good crop but combine operation is critical to successfully harvesting that crop. The purpose of this study is to examine combine speed and the affect it has on harvest loss and bean quality. In this case we looked at a John Deere S690 combine with a 40' MacDon flex draper head. The plots were 300 feet long by the width of the combine and the speeds were 1.0, 2.0, and 4.0 mph. The beans were harvested on October 24. No desiccant was applied to the crop. The temperature was 58°F and relative humidity was 22 percent at harvest time. The harvested bean moisture was 13 percent. The overall yield for the field was 55 bu/ac. Nine square-foot samples were taken randomly in the harvested area in the left, center, and right zones behind the combine and header to estimate harvest loss. The bean variety was Sinaloa and the pod height was measured at 90.6 percent being 2" or more above the soil surface. In the table, damage means any seed visibly split, cracked, or broken (and therefore rejected at the elevator), and seed coat damage means visibly intact beans that show wrinkling during a five minute water soak test. One hundred grams of seed was examined for damage and damage percent by weight was recorded. One hundred seeds were soaked in water for five minutes to determine seed coat damage and the percent by number of seeds was recorded.

Because combine speed impacts harvest loss and damaged seed, combine speed directly influences profit. Profit lost due to harvest loss was calculated by multiplying the harvest loss by the price beans would have been sold for ($14.40/bu). Total damaged beans for each treatment strip (bu/acre) were determined using the average yield for the field (55 bu/acre) adjusted for harvest loss (adding in bu/acre lost for each treatment strip to determine a relative total yield) and multiplied by the percent damaged beans. No payment is made for damaged beans; therefore, the bu/acre of damaged beans for each treatment strip was multiplied by the price the beans would have been sold for. The profit loss due to harvest loss and due to damaged beans was summed to determine the total profit loss. Seed coat damage does not impact profit.

Results:

	Harvest Loss (bu/ac)	Damaged (%)	Seed Coat Damage (%)	(Profit Loss) ($/ac)
1 MPH	5.5 A*	3.2 A	15.0 A	106.03 A
2 MPH	4.9 A	2.0 B	5.5 B	87.65 A
4 MPH	7.0 A	1.3 B	7.8 B	112.92 A
P-Value	0.350	0.009	0.001	0.541

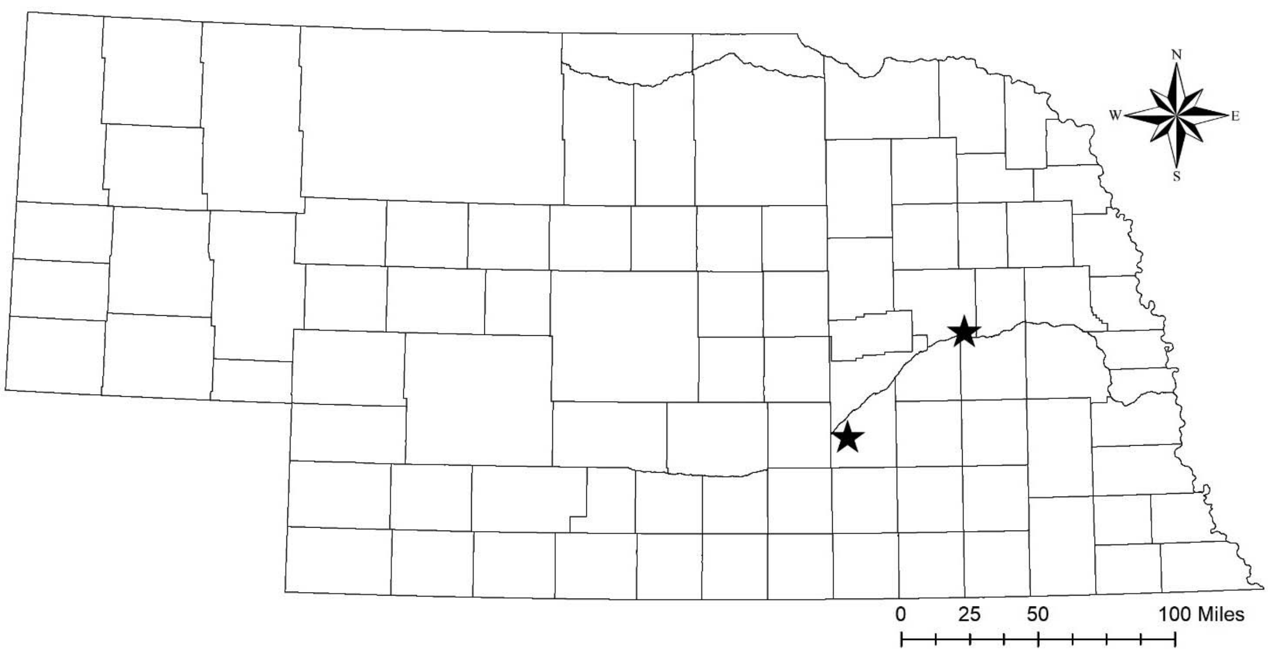
*Values with the same letter are not significantly different at a 90% confidence level.

Summary:

- There was no significant difference in harvest loss between the three combining speeds tested.
- Visibly broken seed was higher at the slowest combining speed of 1 mph. The medium and high speed treatments were not significantly different from one another. This is probably due to a lower volume of plant material moving through the machine at the slower speeds, resulting in bean seeds having greater contact with the metal surfaces within the combine. This is consistent with results of this study in 2016.
- Wrinkling of seed coats from the five minute soak test showed greatest damage under the slowest speed tested, reinforcing increased seed contact with metal surfaces inside the combine during the harvesting process. This is consistent with results of this study in 2016.
- There was no significant difference in profit loss between the three combine speeds tested. In the profit loss figures shown, increased harvest time for slower combine speeds is not accounted for, but is certainly an economic and practical consideration. Growers need to evaluate the expected profit loss associated with different combine speeds and determine the level of loss and length of harvest time that works with their operation. This grower's standard operation is close to 2 mph; therefore, increasing the combine speed to 4 mph resulted in an additional profit loss of $25.27/ac.
- This study evaluated harvest loss and seed damage at varying harvest speeds. Ideal harvest speeds may vary depending on the harvest equipment and the operator's comfort level. However, we would expect similar trends between harvest speed and loss or damage. This study demonstrates the need for operators to understand the importance of harvest speed and take observations on loss or damage in order to determine an optimal harvest speed.

GROWTH PROMOTERS

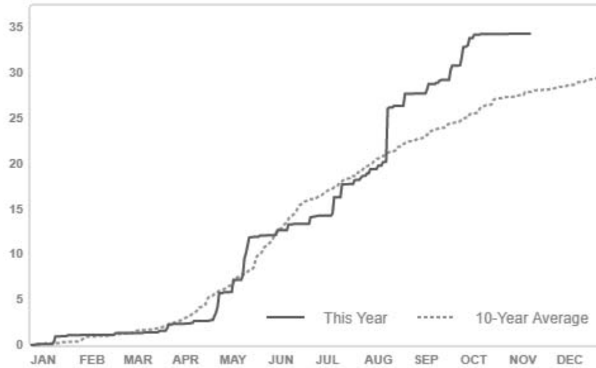
- Vigeo™ Growth Promoter on Soybeans
- Ag Concepts® EnVigor on Irrigated Soybeans



Vigeo™ Growth Promoter on Soybeans

Study ID: 073081201702
County: Hamilton
Soil Type: Hastings silt loam 0-1% slope; Fillmore silt loam 0-1% slope; Detroit silt loam 0-1% slope; Hastings silt loam 1-3% slope
Planting Date: 5/26/17
Harvest Date: 10/25/17
Population: 125,000
Row Spacing (in): 30
Variety: A2814NLL
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 3.2 oz/ac Authority® First, 2.5 fl oz/ac Blanket™, and 24 fl oz/ac Durango® on 5/27/17 ***Post:*** 24 oz/ac Liberty® and 5.12 oz/ac Targa™ on 6/20/17; 32 oz/ac Liberty® on 7/21/17

Seed Treatment: Cruiser Maxx®
Note: Light hail on the field
Irrigation: Pivot, Total: 2"
Rainfall (in):



Introduction: The objective of this study is to evaluate a plant growth regulator product, Vigeo™, applied at a rate of 6.67 oz/ac in-furrow. Product information is at right. Soybean yield was recorded using a yield monitor; yield data was cleaned prior to analysis (*Table 1, Figure 1*). Aerial imagery was collected in August to observe differences in plant vegetation. Aerial imagery was used to calculate the normalized difference vegetative index (NDVI). This index is indicative of overall plant biomass and greenness. True color imagery and NDVI are presented in *Figure 2*.

Active Ingredients:

Cytokinin (as kinetin)	0.01%
Indole Butyric Acid	0.005%
Gibberellic Acid (A_3)	0.004%
Other Ingredients:	99.981%
Total:	100.000%

http://www.vividlifesci.com/wp-content/uploads/2017/05/Vigeo-250-gal-label-per-SAL-011317.pdf

Results:

Table 1.

	Harvest Stand Count (plants/ac)	NDVI 8/28/17	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	98,750 A*	0.462 A	9.7 A	64 A	570.31 A
Vigeo	97,500 A	0.464 A	10.2 A	64 A	558.91 A
P-Value	0.239	0.362	0.260	0.653	0.233

*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 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $6.25/ac for Vigeo (application rate of 6.67 oz/ac and product cost of $120/gal.

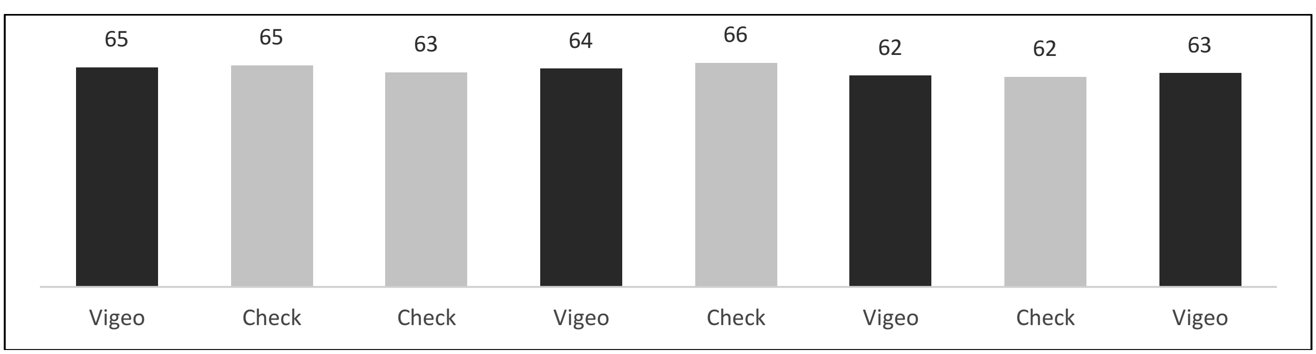


Figure 1. Yield average by treatment (bu/ac) across the field.

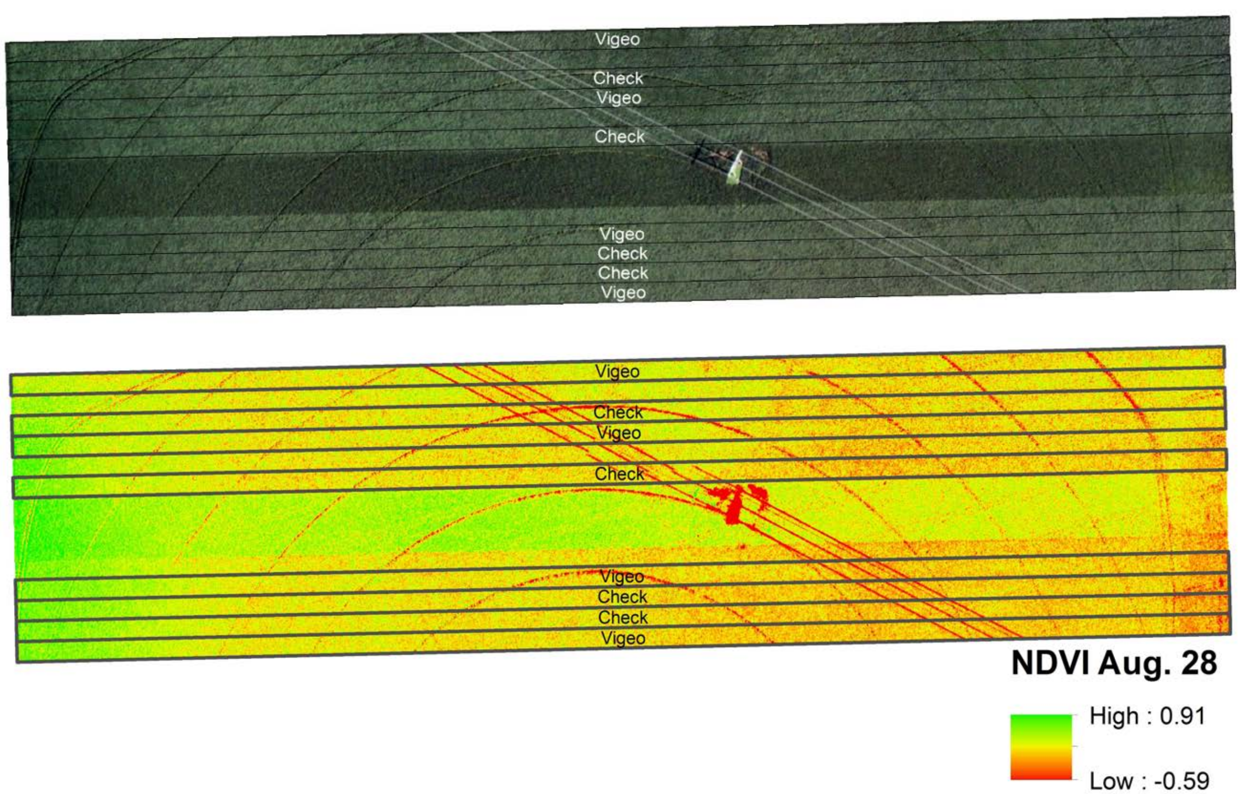


Figure 2. True color (red-green-blue) imagery (top) and NDVI (bottom) from August 28, 2017. For NDVI analysis, portions of the image, including the high power lines crossing the field, were excluded.

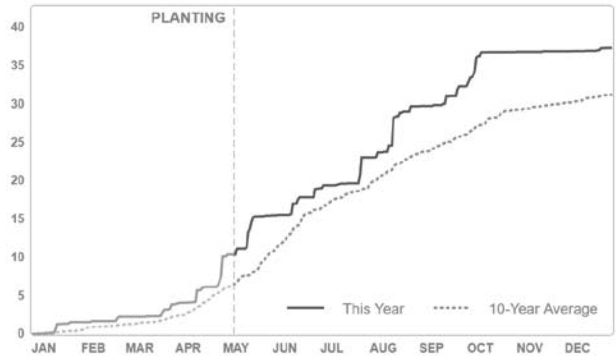
Summary: There were no differences in yield, moisture, stand count, or NDVI.

This study was sponsored in part by Vivid Life Sciences.

Ag Concepts® EnVigor on Irrigated Soybeans

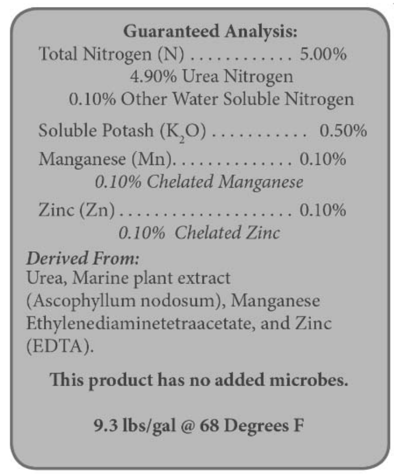
Study ID: 085141201701
County: Platte
Soil Type: Inavale fine sandy loam; Boel fine sandy loam; Inavale loamy fine sand
Planting Date: 5/8/17
Harvest Date: 10/16/17
Population: 150,000
Row Spacing (in): 30
Variety: NK 34-P7
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** Afforia®, Enlite®, Roundup®, and 2,4-D on 4/11/17. ***Post:*** 1 qt/ac Roundup®, 3 pt/ac Warrant®, and 5 oz/ac Select® on 6/10/17; 1 qt/ac Roundup®, 24 oz/ac Avalanche®, and 1 pt/100 gal Preference® on 7/8/17.

Seed Treatment: Clariva™
Fertilizer: 100 lb/ac of 8-20-5-S5-Zn.5 product; foliar application of 1 pt/ac Kugler MicroMax on 6/10/17; 3 gal/ac Kugler 353 on 9/13/17.
Note: Severe hailstorm on 9/24/2017 resulted in 40-50 bushels shattered on ground
Irrigation: Pivot, Total: 10"
Rainfall (in):



Introduction: Ag Concepts® EnVigor is a foliar product for soybeans. The goal of EnVigor is to increase pod set and therefore yield. EnVigor contains nitrogen, potash, manganese, and zinc (product information is at right). EnVigor was applied on July 18, 2017, at the R2 growth stage. Two application rates were evaluated: a low rate of 1.5 qt/acre and a high rate of 2.0 qt/acre. Both rates were applied with 10 gal water/qt product. These two rates were compared with an untreated check.

Yield, moisture, and net return were measured. A severe hailstorm on September 24, 2017, resulted in 40-50 bu/ac yield loss as determined by beans shattered on the ground.


Guaranteed Analysis:
Total Nitrogen (N) 5.00%
4.90% Urea Nitrogen
0.10% Other Water Soluble Nitrogen
Soluble Potash (K_2O) 0.50%
Manganese (Mn)............. 0.10%
0.10% Chelated Manganese
Zinc (Zn) 0.10%
0.10% Chelated Zinc
Derived From:
Urea, Marine plant extract (Ascophyllum nodosum), Manganese Ethylenediaminetetraacetate, and Zinc (EDTA).
This product has no added microbes.
9.3 lbs/gal @ 68 Degrees F

Product information from: Ag Concepts®

Results:

	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	11.6 A*	23 A	204.03 A
Ag Concepts® EnVigor Low Rate	11.8 A	21 A	161.71 A
Ag Concepts® EnVigor High Rate	11.6 A	23 A	173.90 A
P-Value	0.181	0.502	0.122

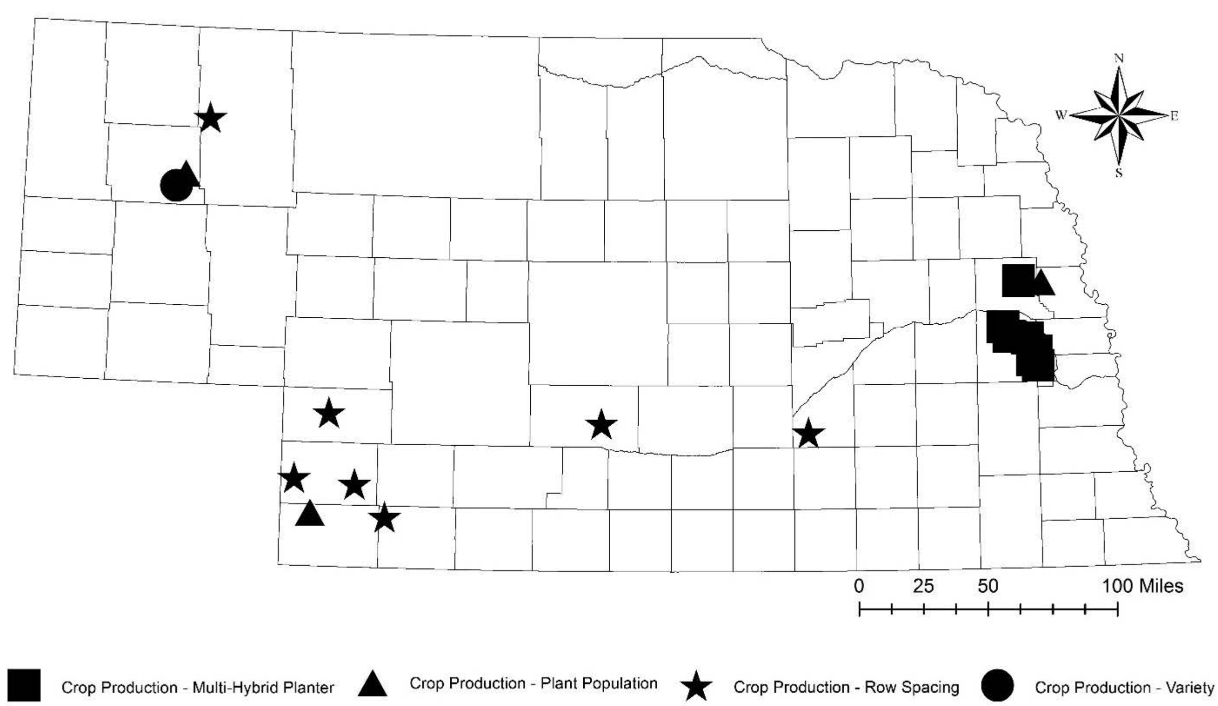
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean, $9/qt EnVigor, and $8.13 product application cost.

Summary: There were no differences in moisture, yield, or net return between the low rate, high rate, and untreated check. The severe hail event made yield differences for the various treatments unlikely; therefore, this study needs to be repeated in future years.

This study was sponsored in part by Ag Concepts® Corp.

CROP PRODUCTION

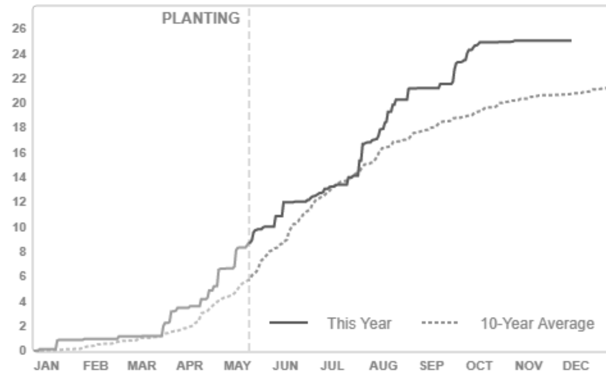
- 15" vs 30" Row Spacing for Soybeans (3 studies)
- 7.5" vs 30" Row Spacing for Soybeans
- Non-Irrigated Soybean Population Study
- 15" vs 30" Row Spacing for Dry Beans (2 studies)
- Dry Bean Row Spacing and Population for Direct Harvest
- Dry Bean Direct Harvest Variety Study
- Planting Populations for Direct Harvested Dry Beans
- Irrigated Field Pea Seeding Rate
- Multi-Hybrid Planting Considerations in Nebraska
    - Multi-Hybrid Planting for Corn Hybrid Placement (6 sites)
    - Multi-Hybrid Planting for Spatial Soybean Seed Treatments (3 sites)



15" vs 30" Row Spacing for Soybeans

Study ID: 179029201701
County: Chase
Soil Type: Valent loamy sand 3-9% slopes
Planting Date: 5/17/17
Harvest Date: 10/14/17
Population: 145,000
Variety: Asgrow 2733
Reps: 7
Previous Crop: Corn
Tillage: Disk
Herbicides: ***Pre:*** 32 oz/ac Roundup® and 4 oz/ac Fusilade®
Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: 3 gal/ac 13-0-0 and 8 lb/ac 0-21-0 micronized soft rock phosphate on 6/4/17
Note: Hail on 10/1/17
Irrigation: Pivot, Total: 13.10"
Rainfall (in):



Introduction: Research from UNL's Soybean Management Field Days showed a yield benefit for 15" row spacing compared with 30" rows. This is the second year this grower evaluated 15" versus 30" row spacing; he also conducted this experiment in 2015.

Results:

	Moisture (%)	Test Weight	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
15"	10.4 A*	58 A	62 A	548.86 A
30"	10.3 B	58 A	58 B	519.91 B
P-Value	0.082	0.510	0.009	0.009

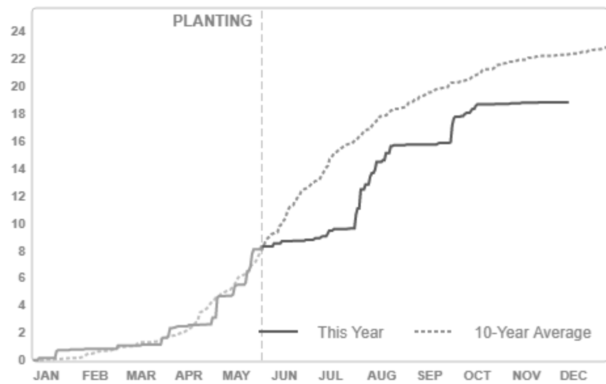
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean.

Summary:

- There was no difference in test weight between the 15" and 30" row spacings.
- Moisture was significantly higher for the 15" row spacing, but was only a difference of 0.1 percent.
- Yield was 4 bu/ac greater for the 15" row spacing treatment. This is consistent with the grower's results from 2015, when a 4 bu/ac yield increase was seen for the 15" row spacing.
- Net return was significantly greater for the 15" row spacing treatment.

15" vs 30" Row Spacing for Soybeans

Study ID: 238135201701
County: Perkins
Soil Type: Valent loamy sand 3-9% slopes; Valent loamy sand 0-3% slope; Woodly fine sandy loam 0-3% slope
Planting Date: 5/26/17
Harvest Date: 10/28/17
Population: 120,000
Variety: Curry 1264
Reps: 5
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** Authority MTZ, 32 oz/ac Durango®, and 8 oz/ac generic 2,4-D on 4/15/17
Post: 40 oz/ac Durango®, 0.9 oz/ac Cadet®, 6.5 oz/ac Superb®, 8.5 oz/ac Clethodim® on 6/21/17; 48 oz/ac Durango®, 0.6 oz/ac Cadet®, 8 oz/ac Class Act®, and 8 oz/ac Superb® on 7/11/17; 48 oz Durango® on 7/25/17
Seed Treatment: fungicide and inoculant
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: Starter: 2 gal/ac of 10-34-0, 2 gal/ac 12-0-0-26, 0.5 gal/ac Aurora bean starter, 0.5 gal/ac Sure-K, 0.11 gal/ac Attain, 0.5 gal/ac fulvic acid, and 0.11 gal/ac sugar on 5/27/17; Chemigation: 2.5 gal/ac 32-0-0, 2.5 gal 12-0-0-26, 3.9 gal/ac 0-0-12 on 8/18
Irrigation: Pivot, Total: 13"
Rainfall (in):



Introduction: Research from UNL's Soybean Management Field Days showed a yield benefit for 15" row spacing compared with 30" rows. In this study, the grower wanted to look at yield effects due to 15" and 30" row spacing in his own soybean field.

Results:

	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
15"	12.6 B*	62 A	553.06 A
30"	13.5 A	48 B	425.02 B
P-Value	0.011	0.001	0.001

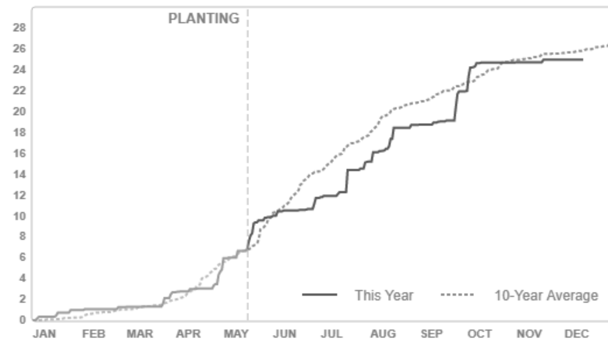
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean and

Summary:

- Soybeans planted in 15" rows were about 0.9 percent drier than the beans planted in 30" rows.
- Yield was 14 bu/ac greater for soybeans planted in 15" rows compared with soybeans planted in 30" rows.
- The soybeans planted in 15" rows had a significantly greater marginal net return.

15" vs 30" Row Spacing for Soybeans

Study ID: 709047201701
County: Dawson
Soil Type: Cozad silt loam 0-1% slope; Cozad silty clay loam 0-1% slope
Planting Date: 5/16/17
Harvest Date: 10/12/17
Population: 130,000
Variety: Pioneer 27T59R
Reps: 5
Previous Crop: Corn followed by winter wheat cover crop
Herbicides: ***Pre:*** 22 oz/ac Roundup PowerMAX® and 3 oz/ac Enlite® on 5/24/17 ***Post:*** 22 oz/ac Roundup PowerMAX®, 1.5 qt/ac Warrant®, 6 oz/ac Section® 2EC, and 0.6 oz/ac Cadet® on 6/23/17
Seed Treatment: Inoculant, fungicide, Gaucho® insecticide
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 47 lb/ac average 11-52-0 (variable rate application) and 47 lb/ac average 0-0-60 (variable rate application)
Irrigation: Pivot, Total: 4"
Rainfall (in):



Soil Test (March 2017):

Sample	pH	Soluble Salts	OM	KCl Nitrate NO$_3$-N	KCl Nitrate NO$_3$-N	Mehlich 3 P	CaPO$_4$ SO$_4$-S	Ammonium Acetate K	Ammonium Acetate Ca	Ammonium Acetate Mg	Ammonium Acetate Na	Sum of Cations	DPTA Zn
		mS/cm	%	ppm	lb/ac	ppm	ppm	ppm	ppm	ppm	ppm	meq/100g	ppm
1	7.4	0.6	2.7	17	41	108	32	662	1788	462	87	15	3.9
2	7.4	0.5	3.0	12	29	124	29	645	2410	600	100	19	3.5
3	7.4	0.6	2.7	22	53	108	31	610	1732	460	75	14	4.0
4	7.3	0.5	2.4	14	34	93	25	552	2200	474	81	17	3.2

Introduction: Soybeans were planted following a winter wheat cover crop that was terminated on 5/24/17. The two treatments being studied were planted with a no-till planter in 30" rows and drilled with a no-till drill in 15" spacing.

Results:

	Harvest Stand Count	Lodging (%)	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
15"	105,000	1	11.5 A*	67 A	593.71 A
30"	112,000	2	12.0 A	64 B	570.38 B
P-Value	-	-	0.243	0.033	0.033

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean.

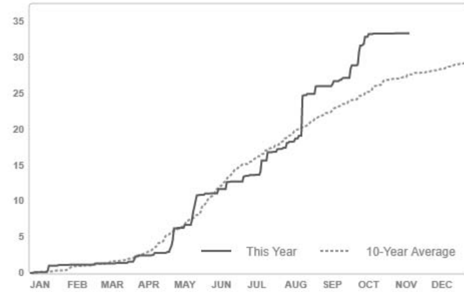
Summary:

- Harvest stand counts and lodging were recorded at select locations in the field. Because they were not recorded for each replication, statistics were not conducted for these variables.
- There was no moisture difference between the two treatments.
- Yield was 3 bu/ac higher for the 15" drilled treatment compared with the 30" planted treatment.
- Marginal net return was significantly greater for the 15" drilled treatment.

7.5" vs. 30" Row Spacing for Soybeans

Study ID: 073081201701
County: Hamilton
Soil Type: Hastings silt loam
Planting Date: 5/26/17
Harvest Date: 10/19/17
Population: 130,000
Variety: A2814NLL
Reps: 4
Previous Crop: Corn
Tillage: Disk
Herbicides: ***Pre:*** 3.2 oz/ac Authority® First, 2.5 fl oz/ac Blanket™, and 24 fl oz/ac Durango® on 5/27/17 ***Post:*** 24 oz/ac Liberty® and 5.12 oz/ac Targa™ on 6/20/17; 32 oz/ac Liberty® on 7/21/17

Seed Treatment: Cruiser Maxx®
Note: Light hail on the field
Irrigation: Pivot, Total: 2"
Rainfall (in):



Introduction: The objective of this study was to evaluate soybeans planted in 30" row spacing versus drilled in 7.5" row spacing. Yield was recorded using a yield monitor; yield data was cleaned prior to analysis (*Table 1, Figure 1*). The grower was interested in evaluating the row spacing options not only for yield, but also for weed control. Because 7.5" rows canopy earlier, they have more potential for weed suppression. Aerial imagery was collected throughout the summer to observe differences in total vegetation and canopy closure for each of the row spacings. Aerial imagery was used to calculate the normalized difference vegetative index (NDVI). This index is indicative of overall plant biomass and greenness. Imagery and NDVI from July 1 (*Figure 2*) and August 17 (*Figure 3*) are presented here. A 15" row spacing treatment is also shown in the imagery. However, because the 15" treatment was established by double planting with a 30" row spacing planter, soil was thrown over the previous planted row and there were some issues with establishment. For this reason, results of the 15" treatment are not presented in this report.

Results:

Table 1.

	Harvest Stand Count (plants/ac)	NDVI 7/1	NDVI 8/17	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
7.5" drilled	118,800	0.849 A*	0.947 A	10.70 A	69 A	565.41 A
30" planted	108,600	0.788 B	0.946 A	10.60 B	66 B	533.84 B
P-Value	N/A	<0.0001	0.197	0.128	0.025	0.025

*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 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $45/ac seed costs for all treatments.

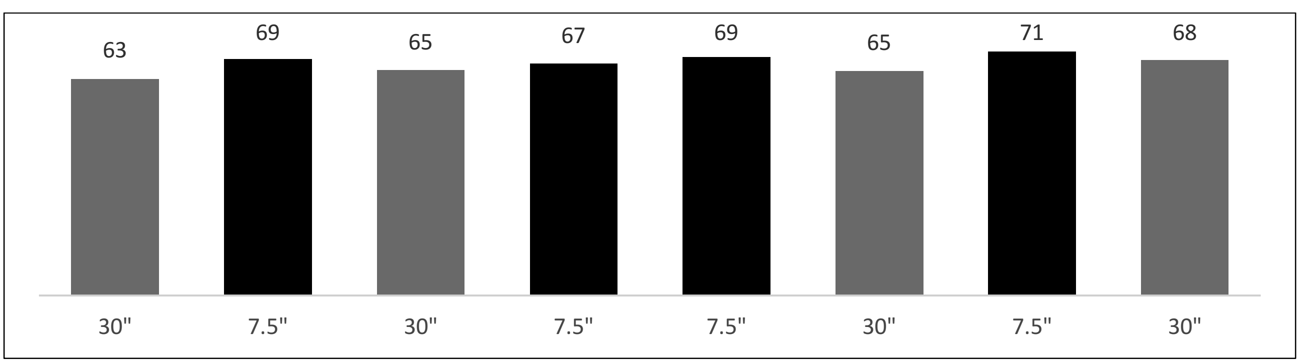


Figure 1. Yield average by treatment (bu/ac) across the field.

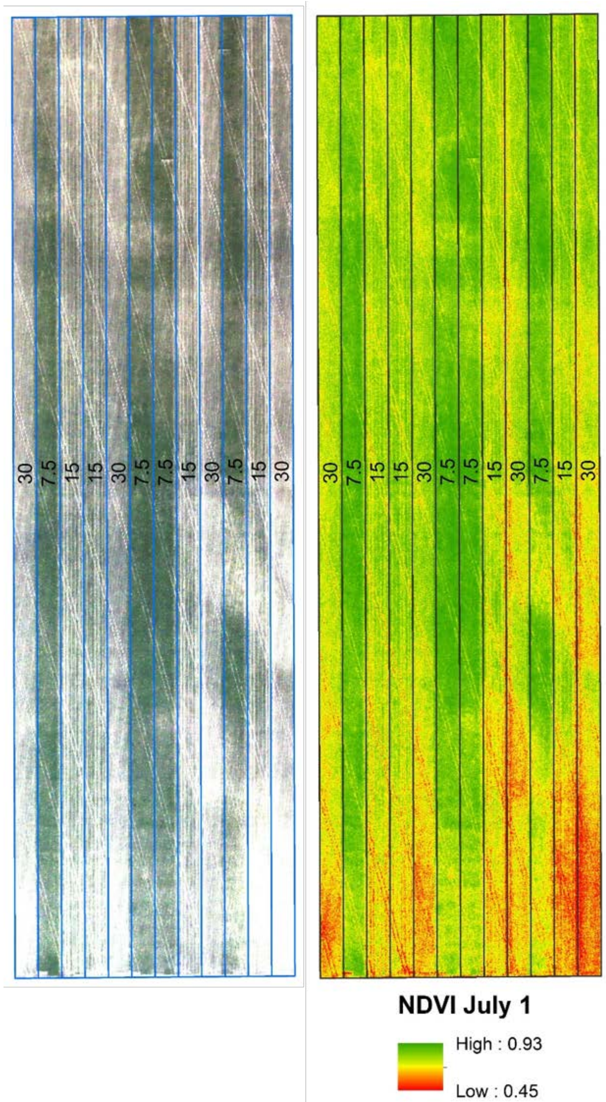


Figure 2. True color (red-green-blue) imagery (left) and NDVI (right) from July 1, 2017.

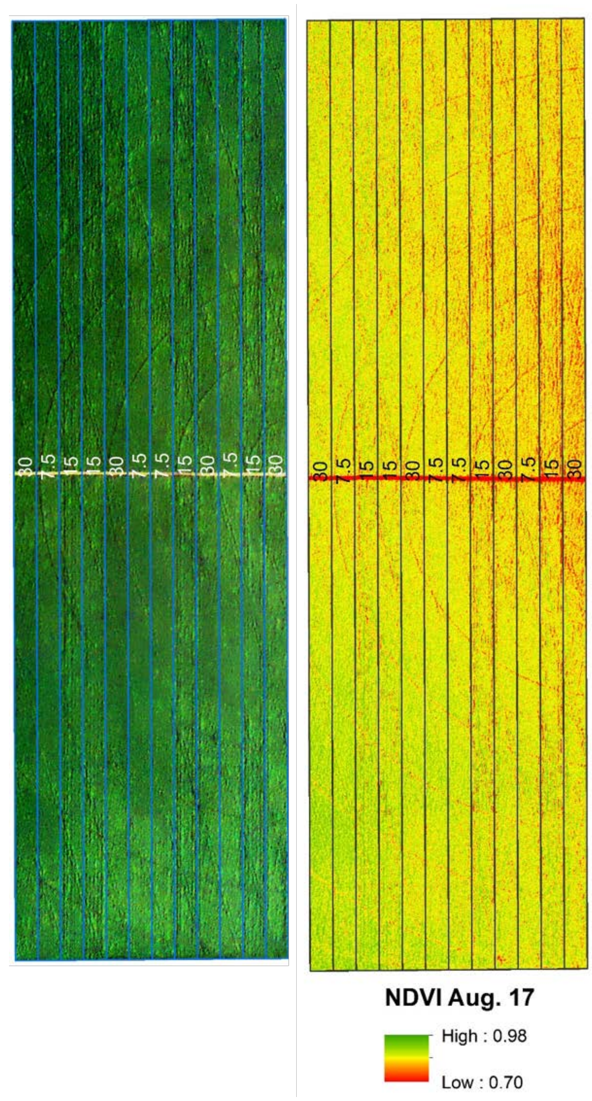


Figure 3. True color (red-green-blue) imagery (left) and NDVI (right) from August 17, 2017.

Figure 4. A close-up of the aerial imagery and corresponding picture taken from the ground show differences in sprayer tracks between the 30" treatment and 7.5" treatment.

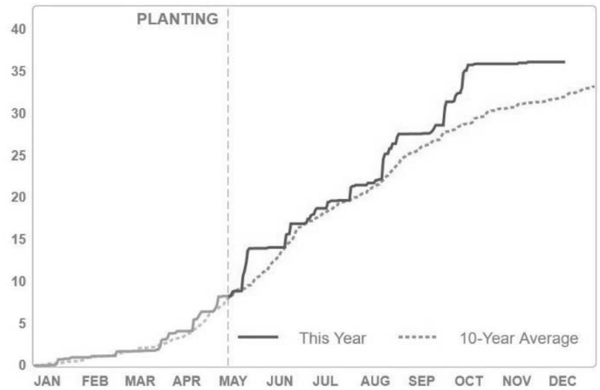
Summary:

- NDVI values from the July 1 imagery show significant differences between the treatments, with the 7.5" treatment having the higher NDVI. This imagery clearly shows the potential for earlier canopy closure with the 7.5" row spacing. By the August 17 imagery there were no longer differences in NDVI between the treatments. *Figure 4* shows a close-up of the aerial imagery and a corresponding picture taken from the ground. This demonstrates the differences in sprayer tracks between the 30" treatment in the foreground and the 7.5" treatment in the distance.
- Stand counts were collected on June 20 at representative locations across each row spacing studied and averaged. Because each treatment and replication was not counted, statistics cannot be run.
- The 7.5" drilled treatment had a statistically higher yield than the 30" row spacing treatments.
- Due to identical treatment costs, the 7.5" drilled treatment had the highest net return, resulting in an increase of $31.57/ac compared with the 30" treatment.

Non-Irrigated Soybean Population Study

Study ID: 610177201701
County: Washington
Soil Type: Belfore silty clay loam 0-2% slope
Planting Date: 5/7/17
Harvest Date: 10/17/17
Row Spacing (in): 15
Variety: Asgrow 2733
Reps: 4
Previous Crop: Corn
Tillage: No-Till, stalks baled
Herbicides: ***Pre:*** 6 oz/ac Zidua® Pro, 32 oz/ac Roundup PowerMAX®, and 6 oz/ac Metro™ 2,4-D on 4/23/17 ***Post:*** Flexstar® GT
Seed Treatment: Acceleron®
Foliar Insecticides: None
Foliar Fungicides: 4 oz/ac Stratego® YLD on 7/31/17

Fertilizer: Dairy manure applied (rate of nutrient applied unknown)
Irrigation: None
Rainfall (in):



Introduction: Previous on-farm research has demonstrated that planting rates of 80,000 to 120,000 seeds/acre resulted in the highest profitability. Most of this research was conducted in irrigated conditions with 30" row spacing. The purpose of this study was to determine the optimal planting rate in non-irrigated conditions with 15" row spacing. Actual seeding rates were 90,449 seeds/ac (90,000 seeds/ac treatment), 119,263 seeds/ac (120,000 seeds/ac treatment), 149,955 seeds/ac (150,000 seeds/ac treatment), and 180,338 seeds/ac (180,000 seeds/ac treatment). Aerial imagery was collected throughout the summer to observe differences in total vegetation and canopy closure for each of the row spacings. Imagery from September 20 is presented in *Figure 1*.

Results:

	Early Season Stand Count	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
90,000 seeds/acre	84,750 D*	11.7 A	94 A	795.76 A
120,000 seeds/acre	110,583 C	11.7 A	95 A	789.93 A
150,000 seeds/acre	137,833 B	11.6 A	96 A	787.77 A
180,000 seeds/acre	167,833 A	11.6 A	96 A	775.21 A
P-Value	<0.0001	0.171	0.365	0.376

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $60.01/unit of soybean seed.

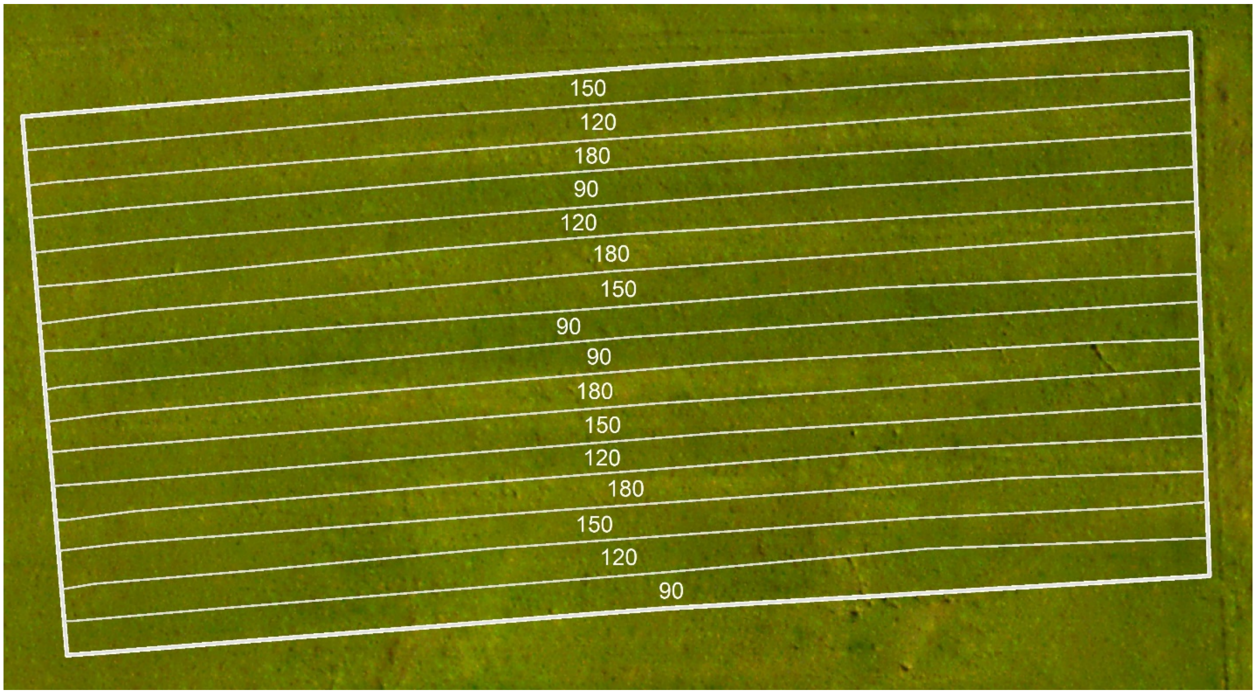


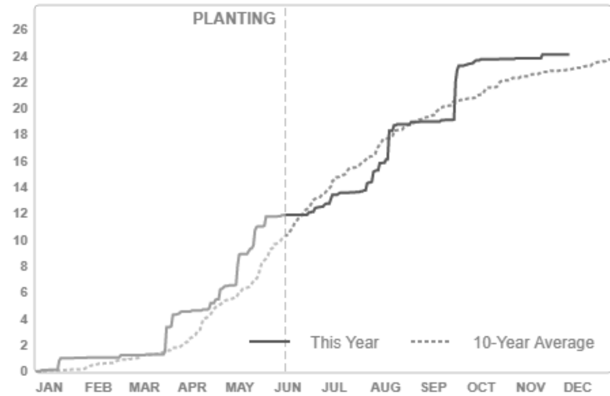
Figure 1. True color (red-green-blue) imagery from September 20, 2017.

Summary: It was observed that higher seeding rates senesced earlier than the lower seeding rates. This is evident in *Figure 1*. This is the second year this producer conducted this study. There was no yield difference between the four seeding rates tested in 2016. Results in 2017 were consistent with previous findings. There were no yield differences between the seeding rates tested, indicating the lowest seeding rate of 90,000 seeds/ac was enough to maximize yields.

15" vs 30" Row Spacing for Dry Beans

Study ID: 190087201701
County: Hitchcock
Soil Type: Blackwood loam 0-1% slope
Planting Date: 6/8/17
Harvest Date: 9/10/17
Variety: Torreon
Reps: 4
Previous Crop: Popcorn
Tillage: Chisel in March, disked twice in June
Herbicides: ***Pre:*** Prowl® and Outlook® on 6/11/17
Post: Raptor® and Basagran® on 7/10, 3.5 pt/ac Eptam® on 8/1
Seed Treatment: Cruiser® 250
Foliar Fungicides: 5 oz/ac Sanidate on 8/10 and 8/25
Fertilizer: 10 gal/ac of 10-34-0 sprinkled on top of seed furrow at planting; 30 lb/ac N using 32% urea in mid-July

Irrigation: Pivot, Total: 5" at rates of 0.4" to 0.6" per application
Rainfall (in):



Introduction: The purpose of this study was to evaluate dry beans planted in 15" versus 30" row spacing. The 15" row spacing was planted at 120,000 seeds/ac, and the 30" row spacing was planted at 100,000 seeds/ac. The 30" row spacing was cultivated on July 27. The study was harvested using the traditional method of cutting and windrowing followed by combining.

Results:

	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
15"	40 B*	513.16 B
30"	47 A	602.24 A
P-Value	0.031	0.033

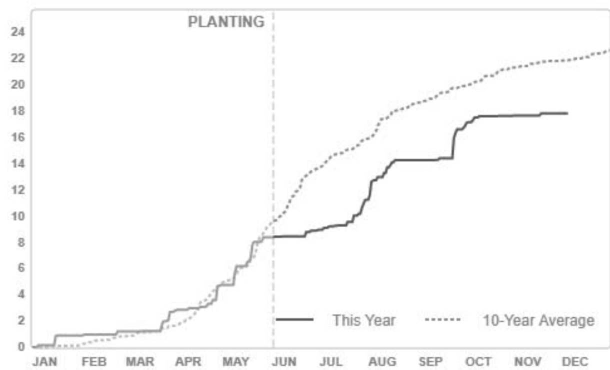
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 14% moisture.
‡Marginal net return based on $24/cwt ($14.40/bu at 60 lb/bu), $65/ac seed cost for the 15" row spacing treatment with 120,000 seeds/ac, $52/ac seed cost for the 30" row spacing treatment with 100,000 seeds/ac, and $15/ac for cultivation on the 30" treatment only.

Summary: The 30" row spacing treatment with 100,000 seeds/ac resulted in higher yields and higher net return compared with the 15" row spacing treatment. White mold was present in both treatments. Mold pressure was observed to be lower in the 30" row spacing treatment – around 50 percent in the 15" treatment compared with 5 percent in the 30" treatment. Hail on August 5 caused around 50 percent harvest loss in both treatments.

15" vs 30" Row Spacing for Dry Beans

Study ID: 706029201701
County: Chase
Soil Type: Goshen silt loam rarely flooded
Planting Date: 6/2/17
Harvest Date: swathed on 9/19/17, harvested on 10/12/17
Variety: Torreon
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** Roundup®, Dual®, and Permit® at labeled rates on 6/4/17 ***Post:*** Varisto™ and Outlook® at labeled rates on 7/1/17
Seed Treatment: fungicide and inoculant
Foliar Insecticides: None
Foliar Fungicides: Nu-Cop® fungicide on 7/20/17; Regalia® Rx on 8/8/17

Fertilizer: 15 gal/ac 8-20-5-5-0.5 (N-P-K-S-Zn) 2x2 (2" on side of seed) on 6/2/17; 10 gal/ac 32-0-0 with herbicide on 6/4/17; and 1 gal/ac Black Label Zn with herbicide on 7/1/17
Irrigation: Pivot
Rainfall (in):



Introduction: The purpose of this study was to evaluate dry beans planted in 15" versus 30" row spacing. The 15" row spacing was planted at 120,000 seeds/ac and the 30" row spacing was planted at 100,000 seeds/ac. The study was harvested using the traditional method of cutting and windrowing followed by combining.

Results:

	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
15"	20 A	228.88 A
30"	20 A	230.95 A
P-Value	0.68	0.94

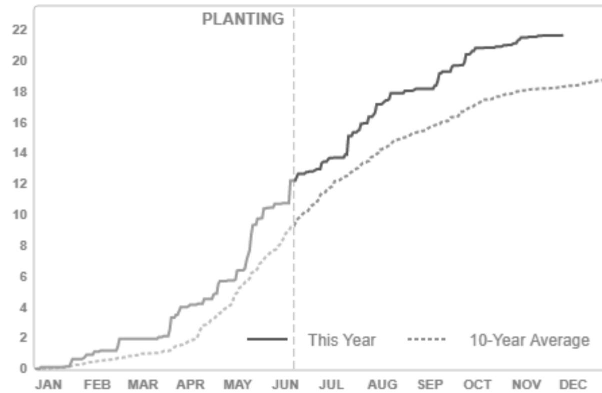
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 14% moisture.
‡Marginal net return based on $24/cwt ($14.40/bu at 60 lb/bu), $65/ac seed cost for the 15" row spacing treatment with 120,000 seeds/ac and $51/ac seed cost for the 30" row spacing treatment with 100,000 seeds/ac.

Summary: There was no difference in yield or net return between the 15" and 30" row spacing treatments. Hail on the field resulted in a 40 percent hail insurance adjustment.

Dry Bean Row Spacing and Population for Direct Harvest

Study ID: 601161201701
County: Sheridan
Soil Type: Johnstown loam 0-2% slope; Keith loam gravelly substratum, 1-3% slope
Planting Date: 6/15/17
Harvest Date: 10/24/17
Variety: Sinaloa pinto beans
Reps: 5
Previous Crop: Oats
Tillage: Field cultivator and vertical tillage 3 times
Herbicides: ***Pre:*** 32 oz/ac Prowl® and 14 oz/ac Outlook® on 6/17/17
Post: 21 oz/ac Varisto® (Raptor® and Basagran®) and 8 oz/ac Basagran® on 7/17/17
Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: 32 oz/ac Sanidate on 9/1/17

Fertilizer: 25 lb/ac N, 25 lb/ac P, 10 lb/ac S, 1 lb/ac Zn, and 2 lb/ac Mn spread on 6/13/17
Irrigation: Pivot, Total: 10"
Rainfall (in):



Introduction: The purpose of this study was to compare dry edible beans (Sinaloa variety) planted in 30" rows with a target population of 90,000 plants per acre with beans drilled in 7.5" rows with a target population of 120,000 plants per acre. These are two common planting scenarios for growers in western Nebraska. The two planting treatments were evaluated in a direct harvest bean production system looking at yield, harvest loss, pod height, and other agronomic characteristics.

The treatments were replicated five times in plots 700 feet by 40 feet (0.64 acres). The plots were planted in a randomized complete block design on June 15. The drilled treatments went in with a Landoll 5531 drill. The 30" row treatment went in with a White model 8824 with Precision Plant seed meters.

The plots were harvested on October 24 using a John Deere S690 with a MacDon 40 foot flex draper. To evaluate harvest weight, beans were weighed at the scales at Kelley Bean, Mirage Flats. Samples from each plot were analyzed for bean quality parameters. Pod height measurements were taken on Oct. 11 to determine the percent of pods 2" or greater above the soil surface. Harvest loss estimates were determined by taking counts in 12 one-square-foot frames randomly chosen in the harvested area but equally representing left side of header, center of header, and right side of the header area behind the combine.

Results:

	Early Season Stand Count	Pods >2" above ground (%)	Harvest Loss (bu/ac)	Split (%)	Small (%)	Moisture (%)	Density (lb/bu)	Seeds per lb	Yield (bu/ac) †	Marginal Net Return‡ ($/ac)
7.5" row spacing, 120,000 plants/ac	106,564 A*	88 A	3.9 B	1.8 A	11.5 A	12.1 A	61.1 A	1,506 A	40 A	483.93 A
30" row spacing, 90,000 plants/ac	68,093 B	76 B	5.8 A	2.4 A	8.3 A	12.1 A	60.7 A	1,476 A	40 A	515.38 A
P-Value	0.0001	0.001	0.012	0.218	0.237	0.950	0.375	0.308	0.942	0.201

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 14% moisture and is adjusted for clean yield (% splits, % small, and % foreign material removed).
‡Marginal net return based on $24/cwt ($14.40/bu at 60lb/bu).

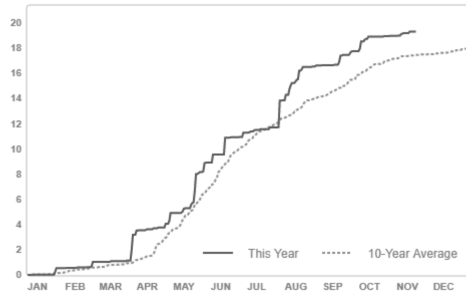
Summary:

1) Stand counts were lower than target populations for both the 90,000 and 120,000 target.
2) 88 percent of the pods in the 7.5" row spacing and 120,000 plants/acre treatment were 2" or more above the soil as compared with 76 percent in the 30" row spacing and 90,000 plant/acre treatment. This is consistent with the results of this study in 2016 where 95 percent of the pods in the 7.5" row spacing and 120,000 plants/acre treatment were 2" or more above the soil as compared with 91.6 percent in the 30" row spacing and 90,000 plants/acre treatment. A late harvest with dried bean plants remaining in the field contributed to lower than usual pod heights.
3) Harvest loss was significantly higher in the 30" row spacing and 90,000 plants/acre treatment, probably due to pod height. This is also consistent with results in 2016.
4) There was no difference in percent splits, percent small beans, moisture, seed density, seeds per lb, or yield between the two treatments.

Dry Bean Direct Harvest Variety Study

Study ID: 152013201701
County: Box Butte
Soil Type: Keith loam
Planting Date: 6/7/17
Harvest Date: 10/16/17
Population: 120,000 target
Row Spacing (in): 15
Reps: 4
Previous Crop: Corn
Tillage: Double disked and rolled before planting
Herbicides: ***Pre:*** 30 oz/ac Roundup®, 30 oz/ac Prowl®, and 15 oz/ac Outlook® on 6/8/17
Post: 4 oz/ac Raptor®, 30 oz/ac Basagran®, and 10 oz/ac Select® on 7/5/17; Desiccant/harvest aid: 32 oz/ac Gramoxone®, 2 oz/ac Sharpen®, and 1% crop oil on 9/17/17.

Seed Treatment: Apron XL®, Maxim®, Rancona®, Dynasty®
Foliar Insecticides: None
Foliar Fungicides: 4 oz/ac Priaxor®, 0.75 lb/ac Nu-Cop® HB on 8/6/17
Fertilizer: 50 lb/ac N
Irrigation: Pivot, Total: 10"
Rainfall (in):



Introduction: The purpose of this study was to compare four different Pinto bean varieties in a direct harvest bean production system looking at both yield and harvest loss. Currently, most dry beans in western Nebraska are harvested in a two-step process starting with a cutting windrowing operation, and then combining. Direct harvest is simply one pass through the field with the combine. A good upright bean variety, proper level field conditions and a combine header suitable for direct harvest are essential to minimize harvest loss and economically justify direct harvest.

This study evaluated four Pinto bean varieties all suitable for direct harvest. The varieties Monterrey, Radiant, Vibrant, and ND Palamino were replicated four times in plots 555 feet by 30 feet. The plots were planted in a randomized complete block design with a Case IH 5400 Soybean Drill. Stand counts were taken early in the season. The plots were fertilized, sprinkler irrigated, and treated identically. Low hanging pods are a major cause of harvest loss in the direct harvest process; therefore, pod height measurements were taken to determine the percent of pods greater than 2" above the ground just before harvest. The varieties Radiant, Vibrant, and ND Palamino are all new slow darkening Pinto varieties that are currently desired by industry.

The plots were harvested on October 16 using a Case IH 7088 combine equipped with a MacDon FD70, 30 foot flex draper head. The center 30 feet of the 40 foot plot was harvested. The beans from each plot were weighed using a Par-Kan weigh wagon with a Weigh-Tronix scale. Nine square-foot counts along the plot area were taken the day of harvest to estimate harvest loss during combining. A sample of beans was taken from each plot and analyzed for quality by Kelley Bean Company in Scottsbluff. All bean samples graded USDA #1, and the moistures were between 12.5 and 14.6 percent.

Results:

	Early Season Stand Count (plants/ac)	Pods >2" above ground (%)	Harvest Loss (bu/ac)	Small (%)	Moisture (%)	Density (lb/bu)	Seeds per lb	Yield (bu/ acre)†	Marginal Net Return‡ ($/ac)
Monterrey	84,705 AB*	79 A	5.6 B	0.6 A	13.3 A	59 A	1,275 A	52 AB	668.61 AB
Radiant	72,023 C	73 B	4.5 BC	0.3 A	13.3 A	59 A	1,230 AB	52 AB	687.17 AB
Vibrant	90,804 A	78 AB	3.8 C	0.4 A	13.2 A	58 A	1,208 B	57 A	740.90 A
ND Palamino	74,928 BC	59 C	7.9 A	0.6 A	13.3 A	56 B	1,238 AB	49 B	639.90 B
P-Value	0.002	<0.0001	0.0002	0.380	0.987	0.085	0.085	0.037	0.063

*Values with the same letter are not significantly different at a 90% confidence level.

†Bushels per acre corrected to 14% moisture and adjusted for clean yield (% splits, % small, and foreign material removed).

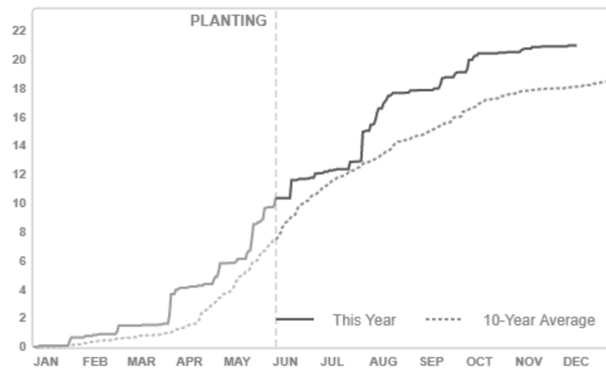
‡Marginal net return based on $24/cwt ($14.40/bu at 60lb/bu). Seed cost was the same for all varieties planted; however, seed size varies, such that the same drill setting results in different seeding rates. To account for this, seed costs are adjusted for actual stands. Radiant cost $61.78/ac, Vibrant cost $78.00/ac, Monterrey cost $72.93/ac, and ND Palomino cost $64.35/ac

Summary:

- Moisture and percent of small seeds were the same between varieties tested.
- Stand counts are significantly different between varieties due to seed size and seed movement through the drill. Adjustments to the drill were not made between varieties. More studies are needed to evaluate the relationship between seeding rate and yield. Dry beans have the capacity to compensate under reduced plant stands.
- There was a significant difference in pod height between the varieties. Monterrey and Vibrant had a greater percent of pods above 2". ND Palomino had the least amount of pods above 2". Overall, the pod heights were lower than desired for direct harvest due to delayed harvest.
- Harvest loss was also significantly different between the varieties, ranging from 3.8 to 8 bu/ac. Vibrant and Radiant had lower harvest loss. ND Palomino had the greatest amount of harvest loss primarily due to low pod height.
- ND Palomino had significantly less dense seed than the other varieties tested.
- Yield and marginal net return were significantly different between varieties. Vibrant had a significantly higher yield and net return than ND Palomino. There was no statistical yield or net return difference between Vibrant, Radiant, and Monterrey.

Planting Populations for Direct Harvested Dry Beans

Study ID: 608013201701
County: Box Butte
Soil Type: Creighton very fine sandy loam 3-6% slopes; Creighton very fine sandy loam 6-11% slopes; Duroc loam 1-3% slope; Keith loam 1-3% slope
Planting Date: 6/3/17
Harvest Date: 9/14/17
Row Spacing (in): 7.5
Variety: Sinaloa
Reps: 4
Previous Crop: Corn
Tillage: Vertical till, chisel, and 2 packings
Herbicides: ***Pre:*** Post-plant, pre-emerge: 35 oz/ac Roundup® ***Post:*** 21 oz/ac Varisto™, 8 oz/ac Basagran®, 8 oz/ac Section®, 4.8 oz/ac Preference®; Desiccant of Roundup® and Valor® on 8/29/17.
Foliar Fungicides: Priaxor® fungicide, Nu-Cop® HB copper fungicide, and Ascend® growth promotor on 7/25/17
Fertilizer: 50 lb/ac N, 40 lb/ac P, 10 lb/ac S, and 12 lb/ac Zn
Irrigation: Pivot, Total: 3.5"
Rainfall (in):



Introduction: The purpose of this study was to compare several planting rates of dry edible beans (Sinaloa variety pinto) drilled in 7.5" rows. The Sinaloa variety is indeterminate. Target populations were 90,000, 110,000, and 130,000 seeds/ac. The plots were drilled with a JD1990 single disk drill. Serious hail on July 27 resulted in 50 percent loss. The plots were harvested on September 14 using a John Deere 9760 STS combine and a 35 foot John Deere flex auger head with Crary Wind and flex fingers. A yield monitor was used to evaluate treatment yields. Samples from each plot were analyzed for bean quality parameters. Pod height measurements were taken to determine the percent of pods 2" or greater above the soil surface. Harvest loss estimates were determined by taking counts in 12 one-square-foot frames randomly chosen in the harvested area but equally representing left side of header, center of header, and right side of header area behind the combine.

Results:

Treatment (seeds/ac)	Early Season Stand Count	Pods >2" above ground (%)	Harvest Loss (bu/ac)	Split (%)	Small (%)	Moisture (%)	Test Weight (lb/bu)	Seeds per lb	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
90,000	87,851 C*	82 B	2.3 B	0.7 A	13.4 A	10.7 A	62 A	1,603 A	24 A	279.60 A
110,000	121,104 B	86 AB	2.6 AB	0.6 A	16.4 A	10.4 A	63 A	1,565 A	26 A	281.44 A
130,000	138,529 A	88 A	2.8 A	0.5 A	18.2 A	10.4 A	62 A	1,660 A	26 A	262.92 A
P-Value	<0.0001	0.061	0.074	0.343	0.176	0.107	0.837	0.339	0.501	0.699

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 14% moisture and is adjusted for clean yield (% splits, % small, and % foreign material removed).
‡Marginal net return based on $24/cwt ($14.40/bu at 60lb/bu).

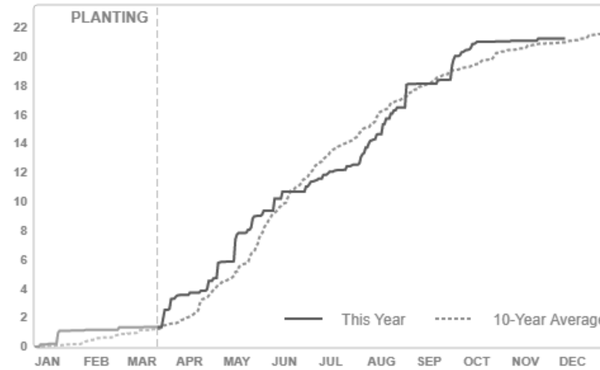
Summary:

- Actual stand counts were higher for the 110,000 and 130,000 seeds/ac treatment and lower for the 90,000 seeds/ac treatment.
- 88 percent of the pods in the 130,000 seeds/ac treatment were 2" or more above the soil as compared with only 82 percent in the 90,000 seeds/ac treatment.
- Harvest loss was significantly greater for the 130,000 seeds/acre treatment, compared with the 90,000 seeds/ac treatment. Considering that pod height in all the treatments was less than 90 percent above 2", the harvest loss range of 2.3 to 2.8 bu/ac is very low.
- There was no difference in the percent splits, percent small beans, moisture, seed density, or seed per lb between the three seeding rates.
- Yield and net return was not significantly different between the three seeding rates.

Irrigated Field Pea Seeding Rate

Study ID: 707057201701
County: Dundy
Soil Type: Valent sand 3-9% slopes; Overlake sand 0-3% slope
Planting Date: 3/20/17
Harvest Date: 7/10/17
Row Spacing (in): 7.5
Variety: SW Midas - bin run
Reps: 3
Previous Crop: Double Cropped Field Peas and Cane
Tillage: No-Till
Seed Treatment: None

Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The purpose of this study was to evaluate two seeding rates for field pea production. Because the grower was using bin run seed rather than certified seed, he was interested in seeding at a higher rate. The 2.8 bu/ac seeding rate was established by drilling once with a 7.5" drill. The 5.6 bu/ac seeding rate was established by drilling twice in a diamond pattern.

Results:

	Germination Rate (%)	Early Season Stand Count (plants/ac)	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
2.8 bu/ac	82% A*	285,754 B	11.7 A	47 B	243.12 B
5.6 bu/ac	76% A	534,336 A	11.7 A	55 A	295.25 A
P-Value	0.176	0.009	0.852	0.094	0.066

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 12% moisture.
‡Marginal net return based on $6.40/bu field pea selling price, $7/bu bin run seed cost, $17.17/acre for one planting pass, and $34.34 for two planting passes.

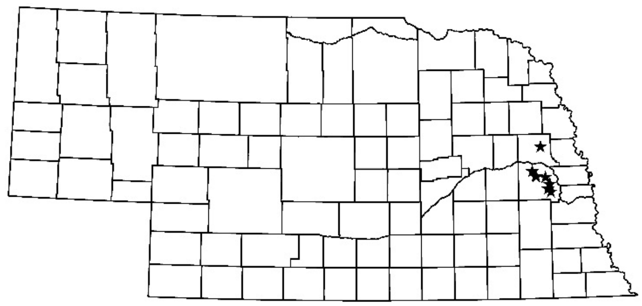
Summary:

- There was no difference in germination rate for the 2.8 and 5.6 bu/ac seeding rate as determined by early season stand counts.
- There was no moisture difference between the two treatments.
- Yield was 8 bu/ac higher for the 5.6 bu/ac double planted treatment.
- Net return was higher for the 5.6 bu/ac double planted treatment.
- If a grower is using certified seed, doubling the seeding rate to 5.8 bu/ac may not be economically justified as certified seed costs are around $15/bu.
- The grower noted better weed control in the 5.8 bu/ac treatment.

Multi-Hybrid Planting

Investigating Use of Multi-Hybrid Planting for Corn Hybrid Placement and Spatial Soybean Seed Treatments

The 2016 growing season marked the beginning of a collaboration by the University of Nebraska with several industry partners and producers to assess multi-hybrid planting. While the operation of multi-hybrid systems has been validated, many questions still need to be answered in order to prepare for mainstream adoption of the technology. Those considering adoption of the technology have questions pertaining to zone creation, assessment, and hybrid selection. Producers, consultants and researchers have seen the need to plant multiple hybrids or treatments across variable fields since hybrid selection is often considered one of the most important features to optimizing production. The advent of the multi-hybrid planter takes that selection to a new level by allowing hybrid selection by sub-field zone. Since the first prototypes were developed at the University of South Dakota, the technology has advanced with several systems now commercially available. For this study, a Kinze 4900MH planter was used.



Multi-Hybrid Technology

The main objective of multi-hybrid planting is to switch hybrids or treatments as the planter moves across predetermined zones. These zones are mapped and assigned hybrids ahead of time based on both the characteristics of the zone and the hybrid. The planter features two seed meters in each row unit. These meters are run by electric drives, which allows for a nearly instantaneous transition between each hybrid. As the planter moves across zones, the seed meters switch off and on according to the prescription map. Two bulk tanks are mounted on the planter, each holding a different hybrid. These bulk tanks feed seed to every row unit. Multi-hybrid planters are often equipped with other features such as variable rate seeding and fertilizer capabilities, as well as variable downforce. These capabilities make multi-hybrid planters among the most complex and innovative planters on the market.

Uses for Multi-Hybrid Planting

Multi-Hybrid planting has many applications. The most common use is for planting two contrasting hybrids in adequate moisture versus limited moisture field conditions. Alternative uses include incorporation of a hybrid or treatment for insect and herbicide resistance, site specific applications of seed treatment, or planting two hybrids with different maturities for quicker or slower dry down. Multi-hybrid planting really could be considered multi-management planting, as many alternate uses are possible with the platform.

Field Sites

Corn and soybean fields were selected in eastern Nebraska in Seward, Saunders, and Dodge counties. Corn fields selected were determined to be highly variable in both yield and productivity. This often related back to varying soil types present. A total of 15 different soil types were present in this study in 2016, and 13 different types in 2017. Two contrasting hybrids were selected for the fields, one with a drought tolerant trait for portions of the field typically under water limiting conditions, and a potentially more productive hybrid for portions of the field maintaining adequate moisture. These hybrids were selected in a joint effort by the producer, seed consultant, and the researchers. Soybean sites were selected for the presence of Sudden Death Syndrome (SDS). This disease is caused by a soil borne fungus, Fusarium solani f. sp. glycines. SDS can result in yield restrictions in infected plants. Soils additionally containing soybean cyst nematode can result in more severe manifestation of SDS. ILeVO® is a seed treatment marketed by Bayer Crop Science for SDS and nematode activity. This study focused on the site specific placement of the ILeVO® product in portions of the field historically subjected to SDS.

Creation of Management Zones

Zones were created using Management Zone Analyst (MZA), a software developed by the University of Missouri. This program uses fuzzy clustering to group spatial data into like regions of the field. Fuzzy clustering allows partial membership to multiple zones, giving a more accurate representation of soil and agronomic distribution of data. Output from MZA provides the user with the optimum number of zones for the field through two performance indices. The goal when developing these zones is to reduce overall variation across the field. Each zone should have less variation than the field as a whole. Various data layers were utilized in each field, depending on the correlation between available layers for clustering. Available data layers included multiple years of historical yield, deep and shallow electrical conductivity, aerial imagery, and topographic attributes.

Growing Season Challenges

The 2016 and 2017 growing seasons were challenging for multi-hybrid planting research. All of the corn sites received well above average moisture compared with the 10-year average. Given the rainfall conditions, hybrids with drought tolerant traits were unnecessary for the growing season. Generally, this resulted in no significant difference between the hybrids selected for the field. In some instances, the high productivity hybrid should have been planted across the whole field. These factors make it challenging to appropriately assess zone creation. Further years of study, encompassing a wide range of growing season weather conditions, will be needed to verify zone delineation for the study sites. Each of the study fields planted to soybeans had a late onset of Sudden Death Syndrome, potentially reducing the overall impact the disease had on final yield. Additionally, flooding at one field site resulted in a late planting date, a strategy typically employed to reduce overall impact of SDS. Varying levels of disease were present in all the fields.

Summary

Instability of environmental, zone, and hybrid factors made it difficult to assess zone delineation. Multiple field sites in 2017 showed no yield advantage for either hybrid in the zones. Above average rainfall in both growing seasons contributed to highly productive growing seasons across all sites. There was little need for a defensive hybrid in most cases. Three field sites should have been planted to an offensive hybrid uniformly from a yield perspective. One field should have been planted to a defensive hybrid uniformly. A third field should have been planted to an offensive hybrid in the offensive zone only. The rest of the field sites showed no difference in hybrids for each zone.

Economics for each field showed that profitability was not always correlated with yield results. For fields with highest yield in the offensive hybrid, the offensive hybrid provided the highest economic return. For fields with no difference in yield, results were mixed as to which hybrid provided the highest profitability. This is largely due to the price per bag of the offensive versus defensive hybrid. It is important to consider economics when utilizing multi-hybrid planting. Even in situations where the offensive hybrid yielded higher, the defensive hybrid still may provide the best profitability option. All of the fields showed that a single hybrid should have been planted across the whole field for optimum economic return.

Correct hybrid and zone pairings were difficult to achieve and not stable between years. Even at field sites with 10 years of historical yield data, zone structure could not be verified. Additional years of testing of the management zones used in this study are needed to verify zone performance in average or dry years. Based on two years of analysis, multi-hybrid planting would not be economically feasible at these field sites. Analysis would indicate the potential for yield and economic success based on simulated zones. Better or revised zone delineation is necessary to accommodate the implementation of a multi-hybrid planter. Use of this technology in a more consistently dry environment may show more benefit. Based on this study, many more years of yield analysis are needed to truly determine performance and validity of a zone layout for multi-hybrid planting of corn.

In the soybean sites, the ILeVO® treatment did a fairly consistent job of resulting in a higher marginal net return within the SDS zones. Within the standard zones, results were mixed with some field sites seeing an advantage for using ILeVO® and some locations resulting in an economic loss due to cost of treatment. Breakeven analysis was varied, resulting in time to breakeven ranging from 5 to 45 years. Economics will be an important consideration when considering whether to use the ILeVO® treatment. With a cost of $15.17 per acre, the price may be a deterrent to application. Additionally, cost for prescription map creation and implementation should be included in costs for adoption. However, several of the field sites resulted in higher economic returns, even with the price of the application included. Yield and economic results for report 54615520701 on subsequent pages provide an ideal scenario for using multi-treatment planting to optimize yield and profitability. While this site was an excellent example, careful consideration will be necessary when determining zone structure and application sites. To prepare for multi-hybrid planting, producers should take care to document areas of the field with SDS through yield mapping, aerial imagery, and field scouting. Thorough documentation will be key in preparing for the use of seed treatments with multi-hybrid planting.

Further analysis and results can be found in upcoming publications from Nebraska Extension and University of Nebraska – Lincoln Department of Biological Systems Engineering.

Thank you to our collaborating partners:

THE DIFFERENCE IS KINZE

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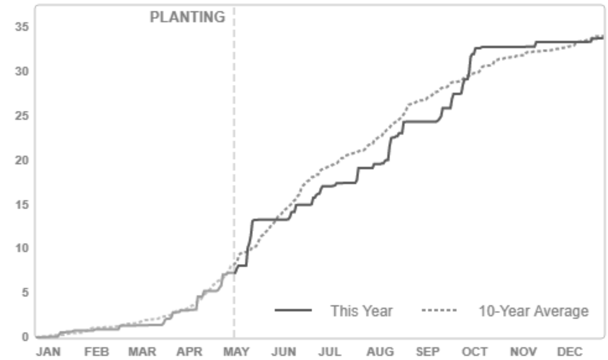
DUPONT PIONEER

EXTENSION

Multi-Hybrid Planting for Corn Hybrid Placement

Study ID: 078155201701
County: Saunders
Soil Type: Judson silt loam; Nodaway silt loam; Pohocco-Pahuk complex; Tomek silt loam; Yutan, eroded-Aksarben silty clay loam; Yutan, eroded-Judson complex
Planting Date: 5/8/17
Harvest Date: 11/3/17
Population: 28,000
Row Spacing (in): 30
Reps: 11
Previous Crop: Soybean
Tillage: No-Till

Irrigation: None
Rainfall (in):



Introduction: Using a multi-hybrid planter, hybrids can theoretically be placed to optimize production in stable management zones. This study compares two contrasting hybrids, one with a drought tolerant trait and one geared towards high production, placed in defined management zones *(Figure 1)*.

- The drought tolerant/**defensive hybrid**, A6499, was placed in portions of the field that typically had lower water retention (dark grey).
- The **offensive hybrid**, P1197AM, was placed in portions of the field that normally maintained adequate moisture across the growing season (light grey).
- Check strips of the opposing hybrid were placed in each zone as shown in *Figure 1*.

Management Zone Creation: Six years of yield data, wetness potential, deep EC, and organic matter were used for clustering in Management Zone Analyst Version 1.0 (USDA-ARS, University of Missouri, Columbia, MO).

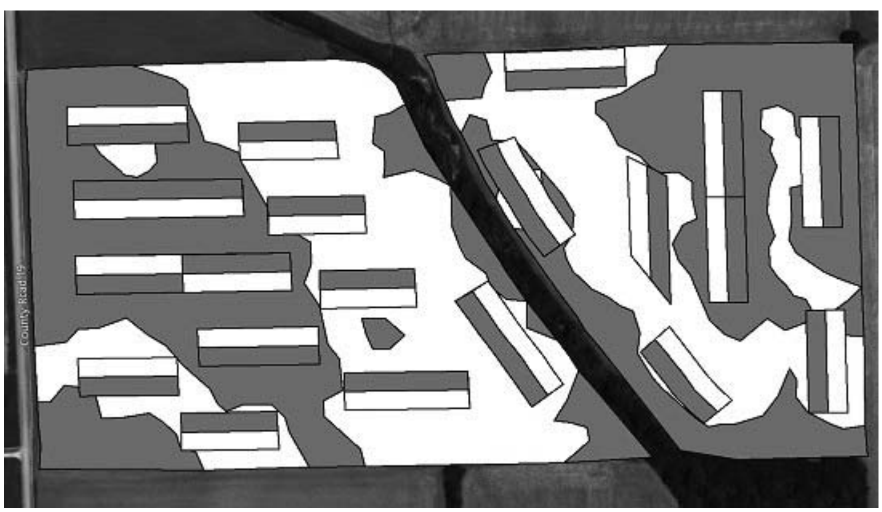


Figure 1. Management zones for defensive hybrid (dark grey), and offensive hybrid (light grey) with check strips of the opposing hybrid.

Results: Within each zone, success of the offensive and defensive hybrid was evaluated by comparing the yield of the check strips to the yield in an adjacent strip of the hybrid assigned to that zone. Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation for hybrids within a zone was performed with Fisher's LSD. Letters below apply for differences within a zone.

Treatment	Agrigold A6499 (defensive hybrid)	Pioneer 1197AM (offensive hybrid)	P-Value
	***Yield** (bu/ac) †*		
Defensive Zone	179 A*	181 A	0.641
Offensive Zone	184 A	181 A	0.424
	***Marginal Net Return** ($/ac)‡*		
Defensive Zone	495.07	493.83	
Offensive Zone	510.08	493.07	

*Values with the same letter are not significantly different at a 95% confidence interval. Letters apply within zone.
†Bushels per acre corrected to 15.5% moisture.
‡Net return calculated using $3.20/bu corn and seed costs of $221/bag for Agrigold A6499 and $242/bag for Pioneer 1197AM.

Summary: The offensive hybrid, P1197AM, and defensive hybrid, A6499, yielded the same in both the offensive and defensive zones. Yield in both zones was relatively similar across the whole field. Several hot days around July 6 resulted in the defensive hybrid, A6499, having rolled leaves during the hottest part of the day, while the offensive hybrid, P1197, did not. This response can help conserve water and maintain cellular function. Despite these different responses, there were no yield differences.

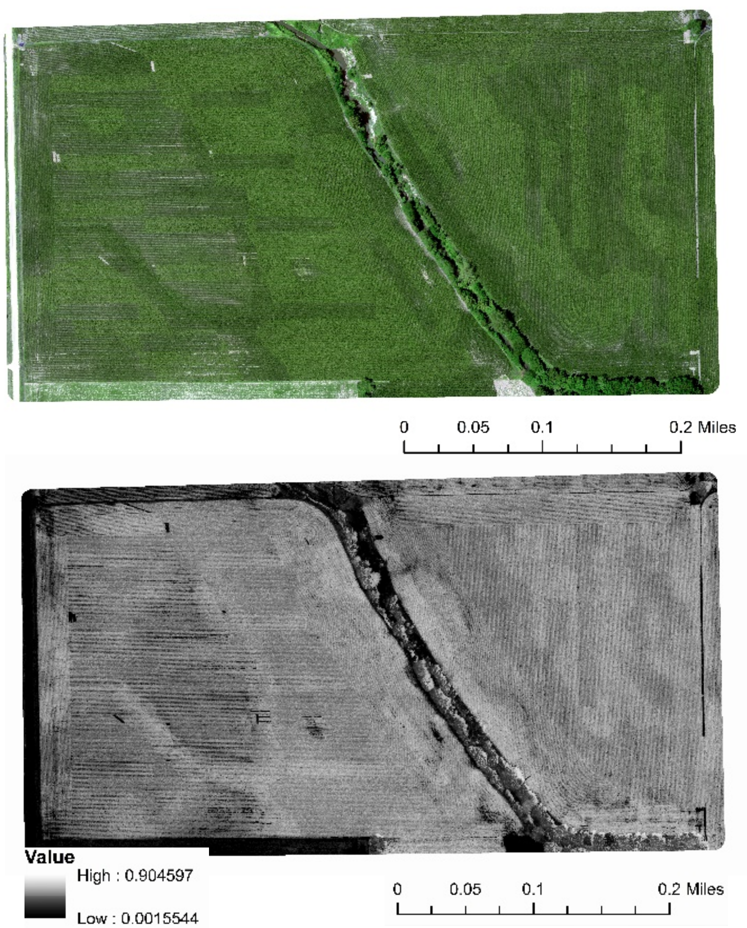


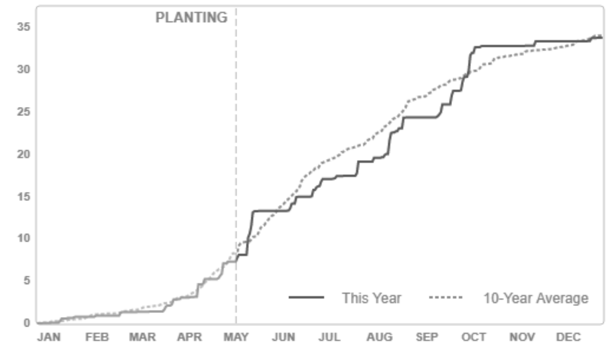
Figure 2. True-color imagery (top) and NDRE imagery (bottom) for the field from July 6.

Aerial imagery was collected with a drone on July 6, 2017 *(Figure 2)*. Hybrid differences are apparent in both the true color (RGB) and NDRE (normalized difference red edge index). More ground is visible in the defensive hybrid zone (A6499) as leaves were rolled in this hybrid.

Multi-Hybrid Planting for Corn Hybrid Placement

Study ID: 078155201702
County: Saunders
Soil Type: Judson silt loam; Nodaway silt loam; Yutan, eroded-Aksarben silty clay loam; Yutan, eroded-Judson complex
Planting Date: 5/9/17
Harvest Date: 11/2/17
Population: 28,000
Row Spacing (in): 30
Previous Crop: Soybean
Tillage: No-Till

Irrigation: None
Rainfall (in):



Introduction: Using a multi-hybrid planter, hybrids can theoretically be placed to optimize production in stable management zones. This study compares two contrasting hybrids, one with a drought tolerant trait and one geared towards high production, placed in defined management zones *(Figure 1)*.

- The drought tolerant/**defensive hybrid**, 830-39AMX, was placed in portions of the field that typically had lower water retention (dark grey).
- The **offensive hybrid**, 5F-709AM, was placed in portions of the field that normally maintained adequate moisture across the growing season (light grey).
- Check strips of the opposing hybrid were placed in each zone as shown in *Figure 1*.

Management Zone Creation: Five years of yield data, elevation, slope, wetness potential, deep and shallow EC were used for clustering in Management Zone Analyst Version 1.0 (USDA-ARS, University of Missouri, Columbia, MO).

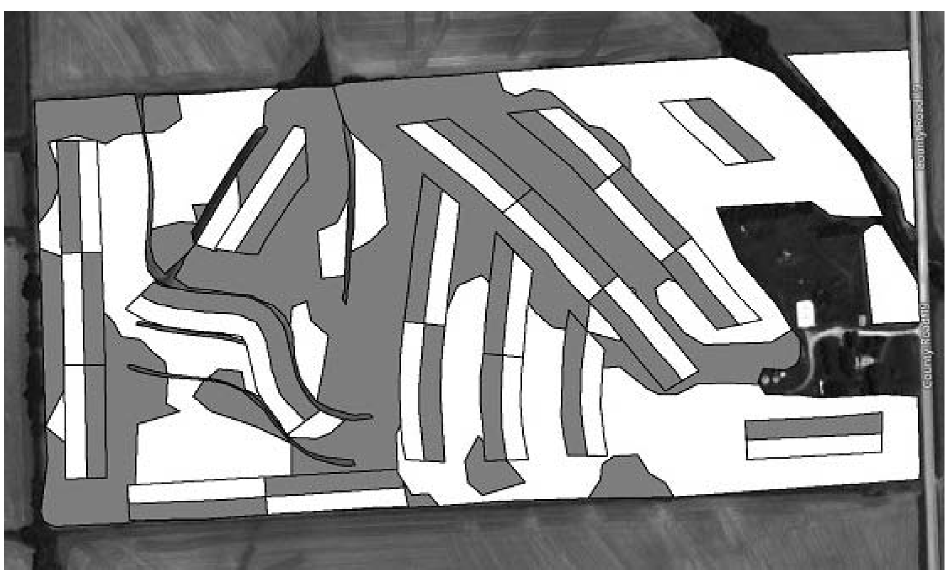


Figure 1. Management zones for defensive hybrid (dark grey), and offensive hybrid (light grey) with check strips of the opposing hybrid.

Results: Within each zone, success of the offensive and defensive hybrid was evaluated by comparing the yield of the check strips to the yield in an adjacent strip of the hybrid assigned to that zone. Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation for hybrids within a zone was performed with Fisher's LSD. Letters below apply for differences within a zone.

Treatment	Curry 830-39AMX (defensive hybrid)	NuTech 5F-709AM (offensive hybrid)	P-Value
	***Yield** (bu/ac) †*		
Defensive Zone	163 A*	162 A	0.860
Offensive Zone	167 A	171 A	0.356
	***Marginal Net Return** ($/ac)‡*		
Defensive Zone	455.14	457.12	
Offensive Zone	466.50	486.62	

*Values with the same letter are not significantly different at a 95% confidence interval. Letters apply within zone.
†Bushels per acre corrected to 15.5% moisture.
‡Net return calculated using $3.20/bu corn and seed costs of $190/bag for Curry 830-39AMX and $175/bag for NuTech 5F-709AM.

Summary: The offensive hybrid, 5F-709AM, performed similarly to the defensive hybrid, 830-39AMX, in the offensive and defensive zone. Although not statistically analyzed, a yield gap between the offensive and defensive zone may be present, indicating that perhaps zone structure was correct. A large amount of variability was present at this field site in both zones. Growing season rainfall was 2.4" above the 30-year average, providing adequate water during the growing season.

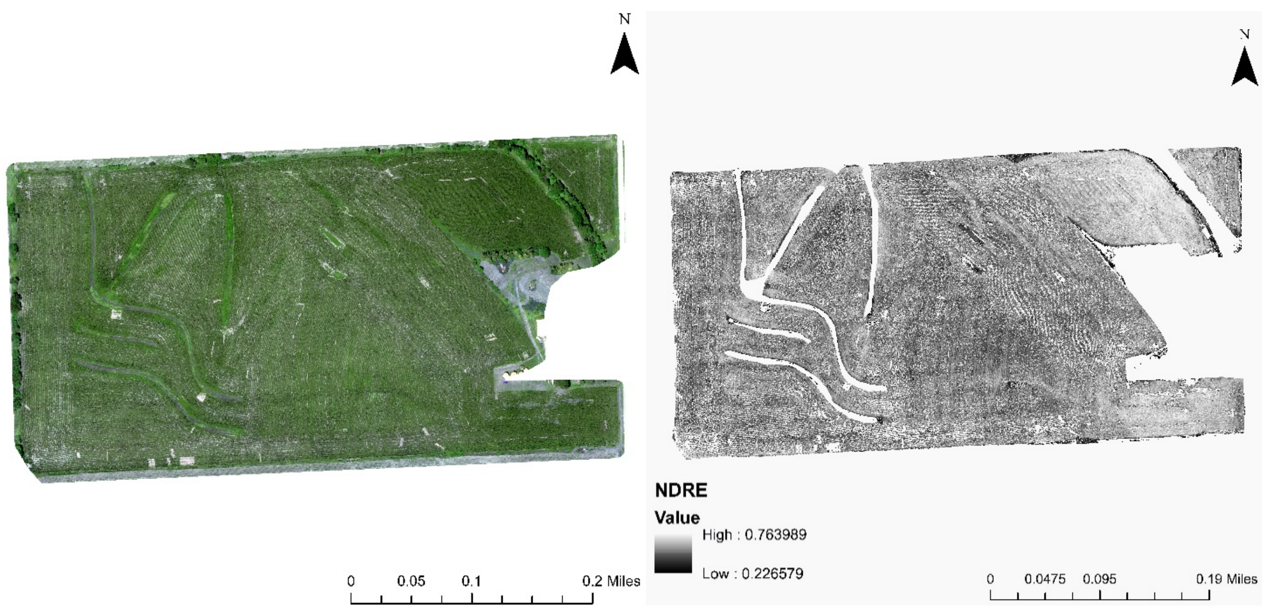


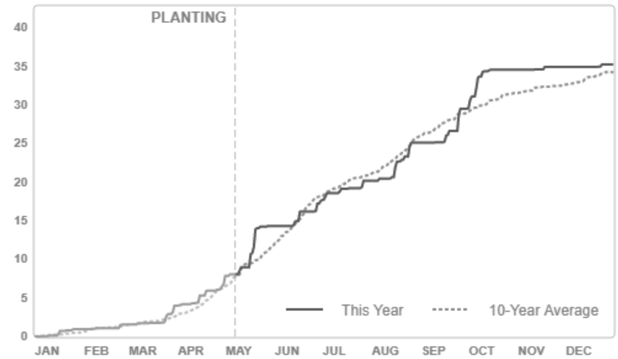
Figure 2. True color (left) and NDRE (right) imagery from the field area from July 6.

Aerial imagery was collected on July 6 with a drone *(Figure 2)*. No hybrid differences were apparent in either the true color or NDRE (normalized difference red edge index) images. Some planter skips are evident.

Multi-Hybrid Planting for Corn Hybrid Placement

Study ID: 078155201703
County: Saunders
Soil Type: Filbert silt loam; Tomek silt loam; Yutan silty clay loam
Planting Date: 5/7/17
Harvest Date: 10/29/17
Population: 31,000
Row Spacing (in): 30
Previous Crop: Soybean
Tillage: No-Till

Irrigation: Pivot
Rainfall (in):



Introduction: Using a multi-hybrid planter, hybrids can theoretically be placed to optimize production in stable management zones. This study compares two contrasting hybrids, one with a drought tolerant trait and one geared towards high production, placed in defined management zones *(Figure 1)*.

- The drought tolerant/**defensive hybrid**, 732-99AM, was placed in portions of the field that typically had lower water retention (dark grey).
- The **offensive hybrid**, P1197AM, was placed in portions of the field that normally maintained adequate moisture across the growing season (light grey).
- Check strips of the opposing hybrid were placed in each zone as shown in *Figure 1*.

Management Zone Creation: Five years of yield data were used for clustering in Management Zone Analyst Version 1.0 (USDA-ARS, University of Missouri, Columbia, MO). Pivot corners were assigned as the defensive hybrid.

Results: Within each zone, success of the offensive and defensive hybrid was evaluated by comparing the yield of the check strips to the yield in an adjacent strip of the hybrid assigned to that zone. Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation for hybrids within a zone was performed with Fisher's LSD. Letters below apply for differences within a zone.

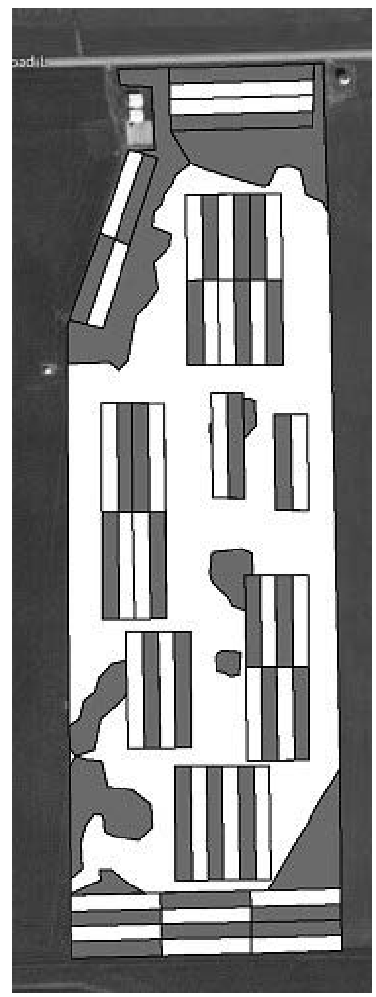


Figure 1. Management zones for defensive hybrid (dark grey), and offensive hybrid (light grey) with check strips of the opposing hybrid.

Treatment	Curry 732-99AMX (defensive hybrid)	Pioneer 1197AM (offensive hybrid)	P-Value
	***Yield** (bu/ac) †*		
Defensive Zone	195 B*	214 A	0.030
Offensive Zone	217 B	227 A	0.004
	***Marginal Net Return** ($/ac)‡*		
Defensive Zone	549.67	589.69	
Offensive Zone	620.39	633.95	

*Values with the same letter are not significantly different at a 95% confidence interval. Letters apply within zone.
†Bushels per acre corrected to 15.5% moisture.
‡Net return calculated using $3.20/bu corn and seed costs of $190/bag for Curry 732-99AMX and $242/bag for Pioneer 1197AM.

Summary: The offensive hybrid, P1197AM, yielded higher than the defensive hybrid, 732-99AM, in both the offensive and defensive zones. Moisture was adequate throughout the growing season for this location. Rainfall was supplemented by center pivot irrigation (for the irrigated portion of the field). Although not statistically analyzed, yield was numerically lower in the defensive zone for both the offensive and defensive hybrids, but P1197 still out yielded 732-99 even in non-irrigated pivot corners.

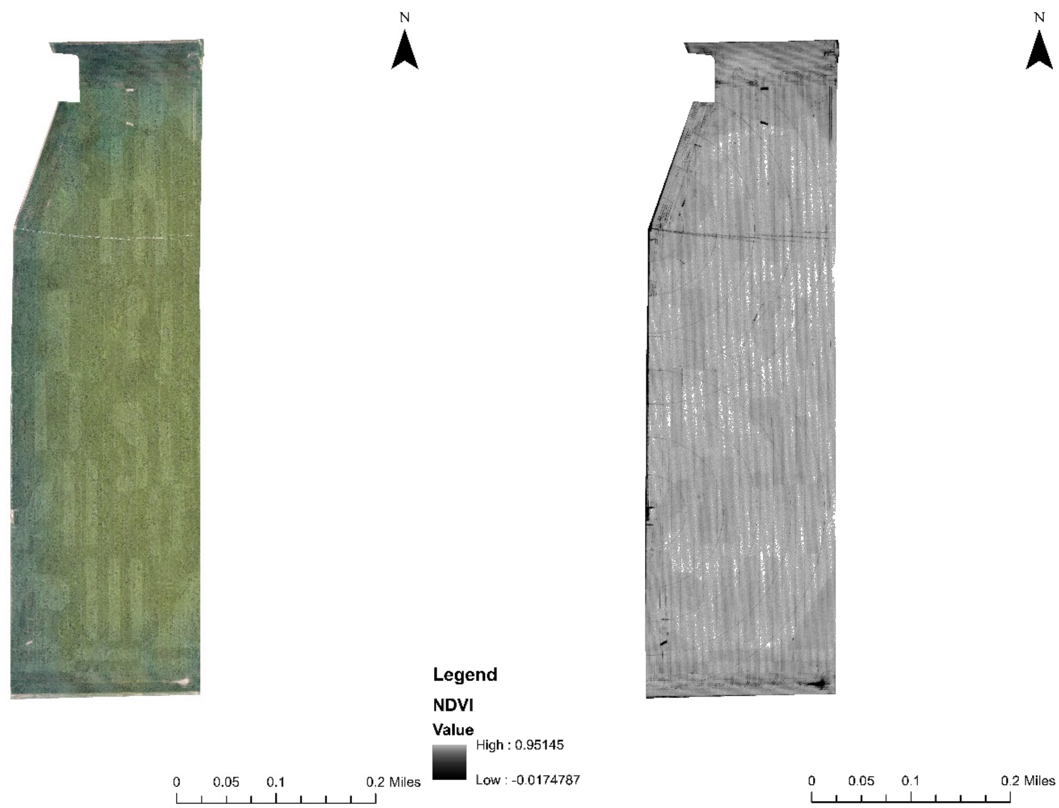


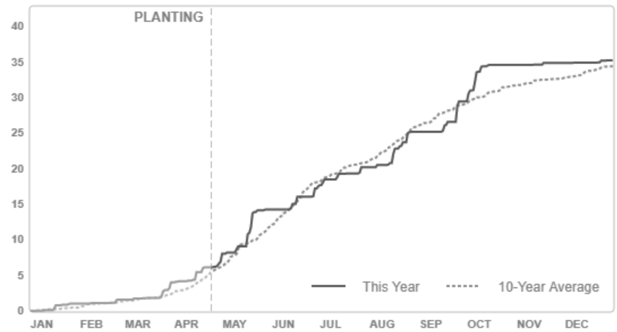
Figure 2. True color (left) and NDVI (right) imagery for the field from mid-July.

Aerial imagery was collected with a drone in mid-July *(Figure 2)*. Hybrid zones and check strips are apparent in both the true color (RGB) and NDVI (normalized difference vegetative index).

Multi-Hybrid Planting for Corn Hybrid Placement

Study ID: 108155201702
County: Saunders
Soil Type: Filbert silt loam; Scott silt loam; Tomek silt loam; Yutan silty clay loam
Planting Date: 4/24/17
Harvest Date: 11/2/17
Population: 28,000
Row Spacing (in): 30
Previous Crop: Soybean
Tillage: No-Till

Irrigation: None
Rainfall (in):



Introduction: Using a multi-hybrid planter, hybrids can theoretically be placed to optimize production in stable management zones. This study compares two contrasting hybrids, one with a drought tolerant trait and one geared towards high production, placed in defined management zones *(Figure 1)*.

- The drought tolerant/**defensive hybrid**, P1151AM, was placed in portions of the field that typically had lower water retention (light grey).
- The **offensive hybrid**, DKC62-98RIB, was placed in portions of the field that normally maintained adequate moisture across the growing season (dark grey).
- Check strips of the opposing hybrid were placed in each zone as shown in *Figure 1*.

Management Zone Creation: Three years of yield data, elevation, slope, wetness potential, deep and shallow EC, were used for clustering in Management Zone Analyst Version 1.0 (USDA-ARS, University of Missouri, Columbia, MO).

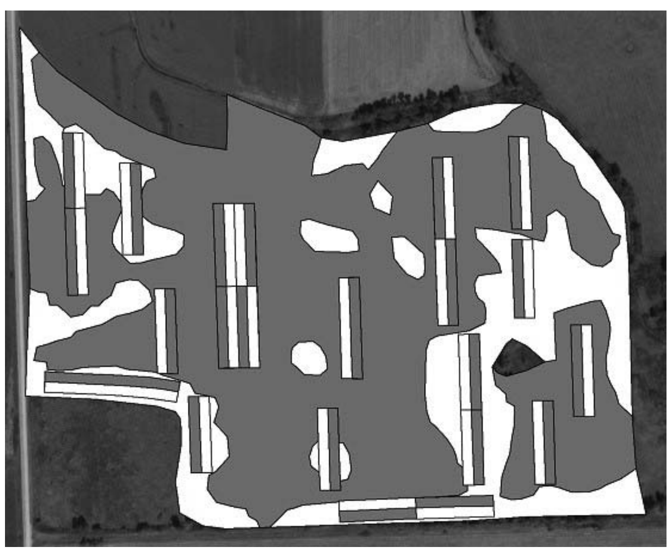


Figure 1. Management zones for defensive hybrid (light grey), and offensive hybrid (dark grey) with check strips of the opposing hybrid.

Results: Within each zone, success of the offensive and defensive hybrid was evaluated by comparing the yield of the check strips to the yield in an adjacent strip of the hybrid assigned to that zone. Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation for hybrids within a zone was performed with Fisher's LSD. Letters below apply for differences within a zone.

Treatment	Pioneer 1151AM (defensive hybrid)	DKC 62-98RIB (offensive hybrid)	P-Value
	***Yield** (bu/ac) †*		
Defensive Zone	160 A*	165 A	0.374
Offensive Zone	193 B	200 A	0.014
	***Marginal Net Return** ($/ac)‡*		
Defensive Zone	428.06	443.74	
Offensive Zone	534.49	556.09	

*Values with the same letter are not significantly different at a 95% confidence interval. Letters apply within zone.
†Bushels per acre corrected to 15.5% moisture.
‡Net return calculated using $3.20/bu corn and seed costs of $236/bag for Pioneer 1151AM and $238/bag for DKC 62-98RIB.

Summary: In the offensive zone, the offensive hybrid, DKC62-98RIB, yielded higher than the defensive hybrid, P1151AM. In the defensive zone, there was no difference between the two hybrids. This indicates that the offensive hybrid was placed correctly in the offensive zone. This year the growing season rainfall was 4.3" above the 30-year average; therefore, water limiting conditions were not an issue and the traits provided by the defensive hybrid were not needed. However, it is notable that using the defensive hybrid, even in a year where dry conditions were not experienced, did not result in reduced yield.

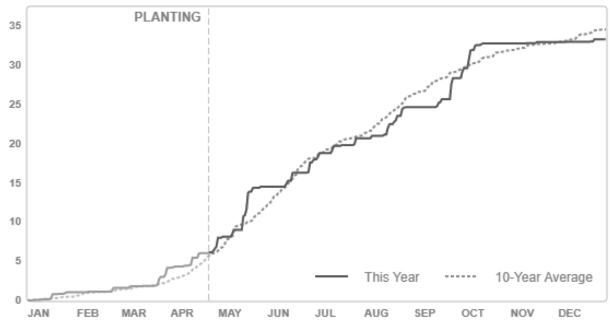
Figure 2. True color (left), and NDVI (right) imagery of the research field from mid-July.

Aerial imagery was collected with a drone in mid-July *(Figure 2)*. Some check strips and zone differences are apparent in both the true color and NDVI (normalized difference vegetative index) imagery.

Multi-Hybrid Planting for Corn Hybrid Placement

Study ID: 108155201703
County: Saunders
Soil Type: Filbert silt loam; Fillmore silt loam; Scott silt loam; Tomek silt loam; Yutan silty clay loam
Planting Date: 4/25/17
Harvest Date: 10/31/17
Population: 28,000
Row Spacing (in): 30
Previous Crop: Soybean
Tillage: No-Till
Irrigation: None

Rainfall (in):



Introduction: Using a multi-hybrid planter, hybrids can theoretically be placed to optimize production in stable management zones. This study compares two contrasting hybrids, one with a drought tolerant trait and one geared towards high production, placed in defined management zones *(Figure 1)*.

- The drought tolerant/**defensive hybrid**, P1498AM, was placed in portions of the field that typically had lower water retention (dark grey).
- The **offensive hybrid**, P1257AM, was placed in portions of the field that normally maintained adequate moisture across the growing season (light grey).
- Check strips of the opposing hybrid were placed in each zone as shown in *Figure 1*.

Management Zone Creation: Five years of yield data were used for clustering in Management Zone Analyst Version 1.0 (USDA-ARS, University of Missouri, Columbia, MO).

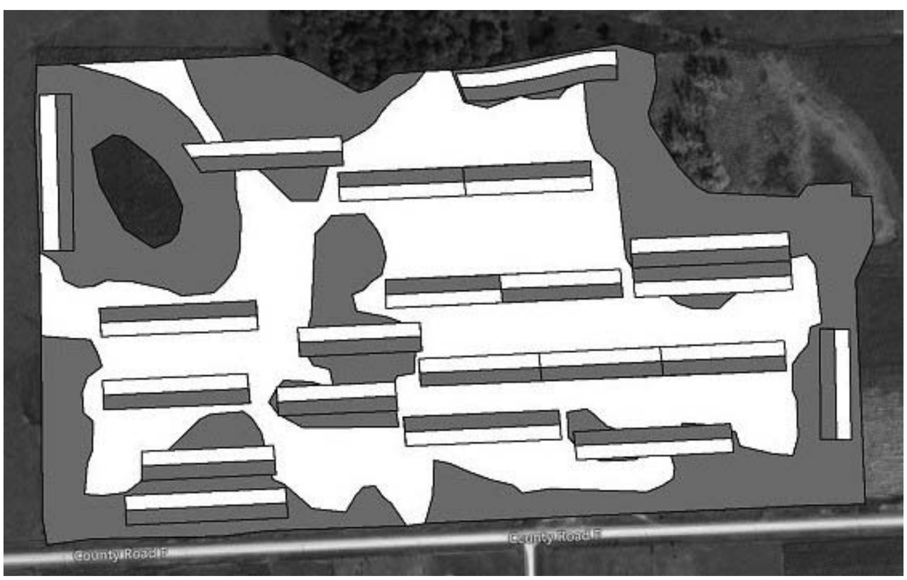


Figure 1. Management zones for defensive hybrid (dark grey), and offensive hybrid (light grey) with check strips of the opposing hybrid.

Results: Within each zone, success of the offensive and defensive hybrid was evaluated by comparing the yield of the check strips to the yield in an adjacent strip of the hybrid assigned to that zone. Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation for hybrids within a zone was performed with Fisher's LSD. Letters below apply for differences within a zone.

Treatment	Pioneer 1498AM (defensive hybrid)	Pioneer 1257AM (offensive hybrid)	P-Value
	***Yield** (bu/ac) †*		
Defensive Zone	175 A*	139 B	0.0003
Offensive Zone	203 A	165 B	0.0001
	***Marginal Net Return** ($/ac)‡*		
Defensive Zone	478.10	356.31	
Offensive Zone	566.61	440.25	

*Values with the same letter are not significantly different at a 95% confidence interval. Letters apply within zone.
†Bushels per acre corrected to 15.5% moisture.
‡Net return calculated using $3.20/bu corn and seed costs of $233/bag for Pioneer 1498AM and $252/bag for Pioneer 1257AM.

Summary: In both the offensive and defensive zones, the offensive hybrid, P1257AM, yielded significantly lower than the defensive hybrid, P1498AM. In previous multi-hybrid research, P1257AM has outperformed P1498AM in a variety of field settings; therefore, the results of this year's study were unexpected.

While it is not known why P1257AM was lower yielding, temperatures at pollination may have contributed. Based on GDD accumulated at the field site, P1257AM was silking on July 16. During this time frame, temperatures were above 90°F, potentially inhibiting silking and pollination. Based on GDD accumulation, P1498AM was silking on July 14. For a three-day window between July 13 and 15, temperatures did not reach 90° F, potentially providing more favorable conditions for silking and pollination. The drastic yield difference between the two hybrids appears to be uniform across the field. This could also point to a uniform weather event that had a greater impact on P1257AM. Wind was also an issue at this field resulting in dropped ears and may be a contributing factor in yield results.

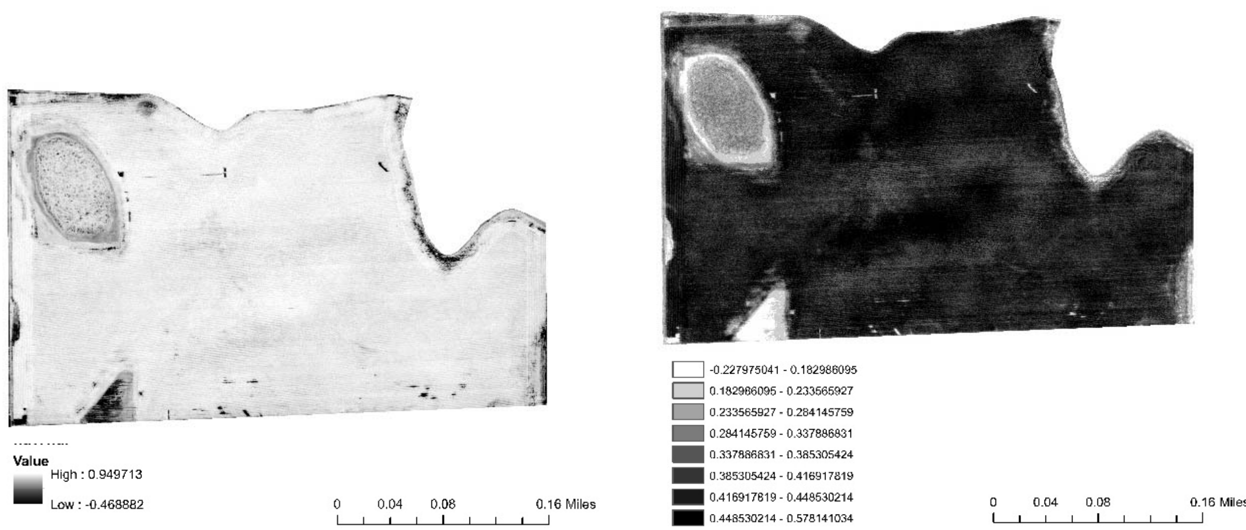


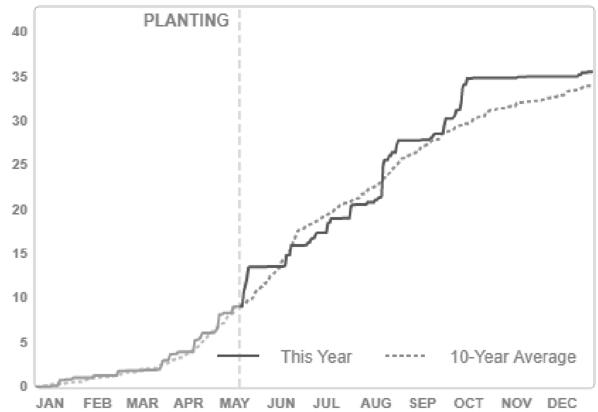
Figure 2. NDVI (left) and NDRE (right) imagery of the field area.

Aerial imagery was obtained in mid-July *(Figure 2).* Despite large yield differences between the two hybrids tested, very few differences were observed in NDVI (normalized difference vegetative index) or NDRE (normalized difference red edge) imagery.

Multi-Hybrid Planting for Corn Hybrid Placement

Study ID: 150053201701
County: Dodge
Soil Type: Fillmore silt loam; Moody silty clay loam; Crofton silt loam; Nora silt loam
Planting Date: 5/14/17
Harvest Date: 11/10/17
Population: 32,500
Row Spacing (in): 30
Reps: 8
Previous Crop: Corn
Tillage: No-Till
Herbicides: 3 qt/ac Resicore™ on 5/25/17; 22 oz/ac Roundup PowerMAX® on 6/25/17
Seed Treatment: Acceleron® Extra
Foliar Insecticides: None
Foliar Fungicides: 10.5 oz/ac Quilt Xcel® on 8/1/17

Fertilizer: 102 lb N/ac as pre-plant dry spread ammonium nitrate on 5/5/17; 82 lb N/ac as UAN coulter applied on 6/27/17
Irrigation: None
Rainfall (in): Actual measured growing season rainfall was 22.65"



Soil Test (May 2017):

OM	pH	BpH	CEC	N (0-6")	P1	P2	K	Mg	S	Zn	Mn	Fe	Cu	B	Ca	CO_2C Burst
%				ppm												
3.1	5.9	6.6	19.7	42	29	41	317	311	18	1.3	8	55	0.8	0.4	2573	148

Introduction: Using a multi-hybrid planter, hybrids can ideally be placed to optimize production in stable management zones. This study compares two contrasting hybrids, one with a drought tolerant trait and one geared towards high production, placed in defined management zones *(Figure 1)*.

- The drought tolerant/**defensive hybrid**, Channel 211-35STXRIB, was placed in portions of the field that typically had lower water retention (dark grey).
- The **offensive hybrid**, Channel 209-53STXRIB, was placed in portions of the field that normally maintained adequate moisture across the growing season (light grey).
- Check strips of the opposing hybrid were placed in each zone as shown in *Figure 1*.

Management Zone Creation: Four years of yield data were used for clustering in Management Zone Analyst Version 1.0 (USDA-ARS, University of Missouri, Columbia, MO).

Results: Within each zone, success of the offensive and defensive hybrid was evaluated by comparing the yield of the check strips to the yield in an adjacent strip of the hybrid assigned to that zone. Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation for hybrids within a zone was performed with Fisher's LSD. Letters below apply for differences within a zone.

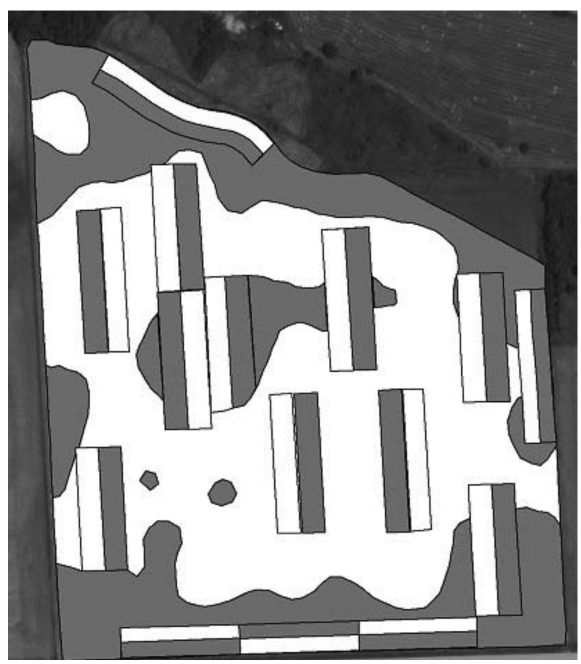


Figure 1. Management zones for defensive hybrid (dark grey), and offensive hybrid (light grey) with check strips of the opposing hybrid.

Treatment	Channel 211 (defensive hybrid)	Channel 209 (offensive hybrid)	P-Value
	***Yield** (bu/ac) †*		
Defensive Zone	223 A*	213 A	0.223
Offensive Zone	242 A	237 A	0.116
	***Marginal Net Return** ($/ac)‡*		
Defensive Zone	577.99	542.29	
Offensive Zone	640.17	626.44	

*Values with the same letter are not significantly different at a 95% confidence interval. Letters apply within zone.
†Bushels per acre corrected to 15.5% moisture.
‡Net return calculated using $3.20/bu corn and seed costs of $322/bag for Channel 209 and $322/bag for Channel 211.

Summary: There was no difference between hybrid yields in the defensive or offensive zone. This is consistent with the research results of this same study conducted on this field in 2016. The 2017 growing season was the second year of corn in a row, which provided an opportunity for greater effectiveness of a defensive hybrid. In a corn following corn system, a defensive hybrid may help with issues such as disease and insect resistance and lodging or standability which may result from a lack of crop rotation. Emergence can also be compromised with increased residue leading to cool, wet soils and slower emergence. The defensive hybrid may have provided some of these features, but ultimately, there was no difference in hybrids. Rainfall recorded at this site was 4" above the 30-year average for the growing season; subsequently, a defensive hybrid was not likely needed.

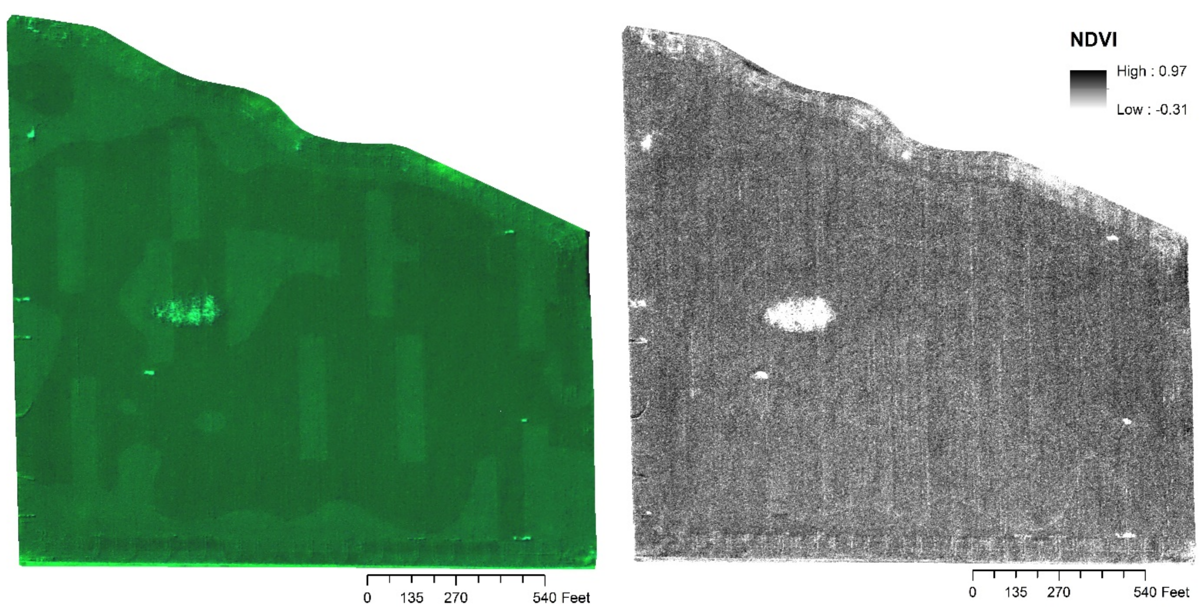


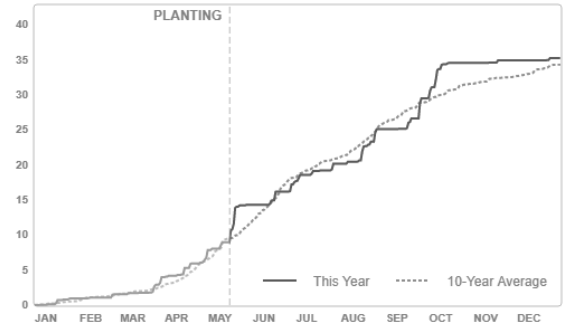
Figure 2. True color (left) and NDVI (right) imagery of the plot area from August 31, 2017.

Aerial imagery was collected with an airplane throughout the growing season. The hybrid zones and check strips were apparent in the true color imagery from July 15 through the end of the growing season. Imagery from August 31 *(Figure 2)* shows these differences in the true color imagery. Differences were not apparent in the NDVI imagery.

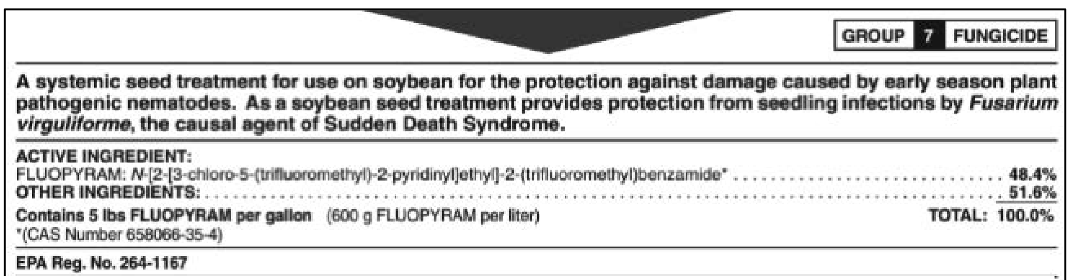
Multi-Hybrid Planting for Spatial Soybean Seed Treatments

Study ID: 078155201704
County: Saunders
Soil Type: Filbert silt loam, Fillmore silt loam, Nodaway silt loam, Pohocco silty clay loam, Tomek silt loam, Yutan silty clay loam
Planting Date: 5/16/17
Harvest Date: 10/17/17
Population: 140,000
Row Spacing (in): 30
Variety: P31T11
Reps: 17
Previous Crop: Corn
Tillage: Conventional Till

Seed Treatment: None, other than those being studied
Irrigation: Pivot
Rainfall (in):



Introduction: Sudden Death Syndrome (SDS) is caused by the soil borne fungus *Fusarium solani f. sp. glycines*. While this is a relatively new disease for Nebraska soybean farmers, there are several locations in the state where significant percentages of fields are being affected. In fields where SDS is present and soybean cyst nematode is also present, the disease can be more severe. There are not clear guidelines to determine at what point a field will have enough increase in yield to justify treatment and, therefore, on-farm research projects like this one are needed.



GROUP 7 FUNGICIDE

A systemic seed treatment for use on soybean for the protection against damage caused by early season plant pathogenic nematodes. As a soybean seed treatment provides protection from seedling infections by *Fusarium virguliforme*, the causal agent of Sudden Death Syndrome.

ACTIVE INGREDIENT:
FLUOPYRAM: *N*-[2-[3-chloro-5-(trifluoromethyl)-2-pyridinyl]ethyl]-2-(trifluoromethyl)benzamide* 48.4%
OTHER INGREDIENTS: 51.6%
Contains 5 lbs FLUOPYRAM per gallon (600 g FLUOPYRAM per liter) **TOTAL: 100.0%**
*(CAS Number 658066-35-4)

EPA Reg. No. 264-1167

Product information from: *http://www.agrian.com/pdfs/ILeVO_Label1.pdf*

ILeVO® is a seed treatment marketed by Bayer CropScience for SDS and also has nematode activity (label at right). This field was selected due to the presence of SDS in the 2014 soybean crop. Two treatments were selected to test the efficacy of the ILeVO® seed treatment.

A: Standard soybean treatment (for this study PPST2030)
B: Standard soybean treatment plus ILeVO at a rate of 1.18 fl oz/140,000 seed unit

The additional capabilities of the multi-hybrid planter allow for site specific application of ILeVO in the portions of the field that historically show the effects of SDS. This site specific application of ILeVO can reduce input costs while still effectively managing SDS pressure.

Management Zone Creation: Historical yield data was used to cluster data into management zones representing distribution of SDS in the field. (*Figure 1)*. These zones were assessed for SDS disease levels and final yield results.

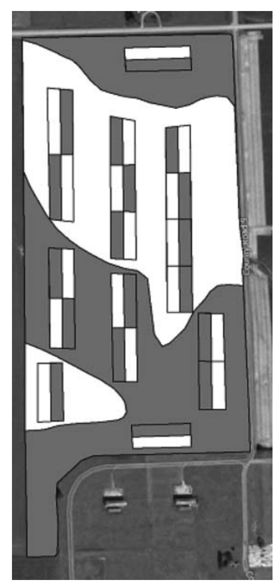


Figure 1. Zone prescription for soybean treated with standard treatment (dark grey) and ILeVO (light grey).

Results: Within each zone, check strips of the opposite seed treatment were established for evaluation. Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation for treatment within a zone was performed with Fisher's LSD. Letters below apply for differences within a zone.

Disease levels were low through harvest at this field site; therefore, no disease ratings were collected during the growing season.

Treatment	Standard Treatment + ILeVO®	Standard Treatment	P-Value
	***Yield** (bu/ac) †*		
SDS Zone	66 A*	65 A	0.963
Standard Zone	65 A	65 A	0.949
	***Marginal Net Return** ($/ac)‡*		
SDS Zone	529.06	607.79	
Standard Zone	584.44	599.98	

*Values with the same letter are not significantly different at a 95% confidence interval.
†Bushels per acre corrected to 13% moisture.
‡ Marginal Net Return based on $9.25/bu soybeans, $15.17/acre ILeVO seed treatment cost ($10.19/oz).

Summary: There was no difference between the standard + ILeVO and standard treated seed in the SDS or standard zone. Yield results were very similar across the whole field. No visible SDS was detectible during the growing season. Some of the paired strips did yield higher individually with the ILeVO treatment; however, these areas did not display symptoms of SDS. It is possible that the ILeVO treatment was yielding higher in portions of the field with higher levels of SCN, but denser sampling of populations and analysis against treatment check strips would be needed to verify this theory.

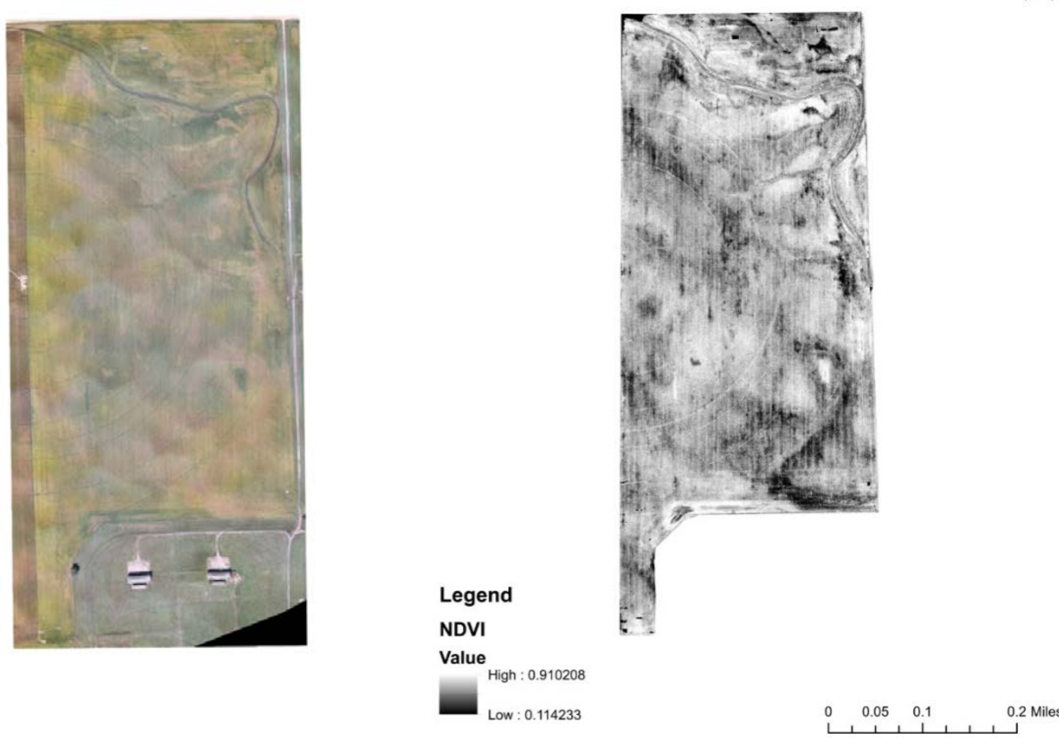


Figure 2. RGB (left) and NDVI (right) imagery of the field area.

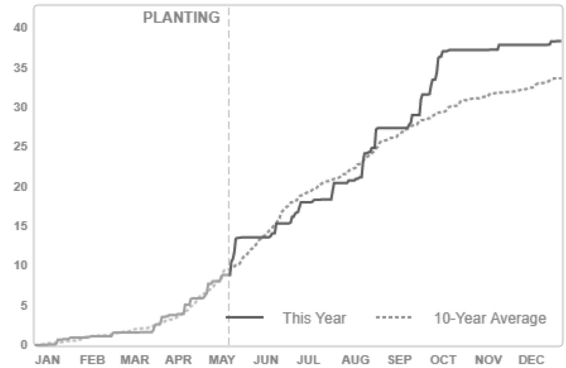
Aerial imagery was obtained in late August *(Figure 2).* Neither RGB nor NDVI (normalized difference vegetative index) show distribution of SDS through the field. No levels of disease were detected during field scouting; consequently, no difference in treatments was visible in the aerial imagery.

This study sponsored in part by: Bayer CropScience LP

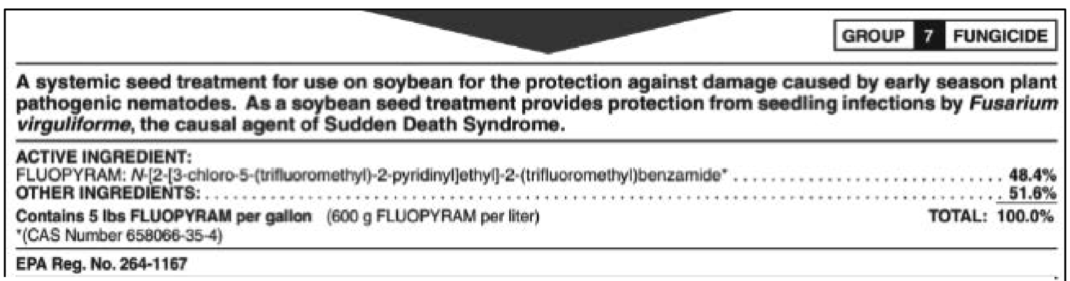
Multi-Hybrid Planting for Spatial Soybean Seed Treatments

Study ID: 546155201701
County: Saunders
Soil Type: Filbert silt loam, Fillmore silt loam, Judson silt loam, Pohocco-Pahuk complex, Tomek silt loam, Yutan silty clay loam
Planting Date: 5/15/17
Harvest Date: 10/18/17
Population: 140,000
Row Spacing (in): 30
Variety: NK34-P7
Reps: 24
Previous Crop: Corn
Tillage: No-Till

Seed Treatment: None, other than those being studied
Irrigation: Pivot
Rainfall (in):



Introduction: Sudden Death Syndrome (SDS) is caused by the soil borne fungus *Fusarium solani f. sp. glycines*. While this is a relatively new disease for Nebraska soybean farmers, there are several locations in the state where significant percentages of fields are being affected. In fields where SDS is present and soybean cyst nematode is also present, the disease can be more severe. There are not clear guidelines to determine at what point a field will have enough increase in yield to justify treatment and, therefore, on-farm research projects like this one are needed.



GROUP 7 FUNGICIDE

A systemic seed treatment for use on soybean for the protection against damage caused by early season plant pathogenic nematodes. As a soybean seed treatment provides protection from seedling infections by *Fusarium virguliforme*, the causal agent of Sudden Death Syndrome.

ACTIVE INGREDIENT:
FLUOPYRAM: *N*-[2-[3-chloro-5-(trifluoromethyl)-2-pyridinyl]ethyl]-2-(trifluoromethyl)benzamide* 48.4%
OTHER INGREDIENTS: 51.6%
Contains 5 lbs FLUOPYRAM per gallon (600 g FLUOPYRAM per liter) **TOTAL: 100.0%**
*(CAS Number 658066-35-4)

EPA Reg. No. 264-1167

Product information from: *http://www.agrian.com/pdfs/ILeVO_Label1.pdf*

ILeVO® is a seed treatment marketed by Bayer CropScience for SDS and also has nematode activity (label at right). This field was selected due to the presence of SDS in the 2014 soybean crop. Two treatments were selected to test the efficacy of the ILeVO® seed treatment.

A: Standard soybean treatment (for this study Cruiser Maxx®)

B: Standard soybean treatment plus ILeVO at a rate of 1.18 fl oz/140,000 seed unit

The additional capabilities of the multi-hybrid planter allow for site specific application of ILeVO in the portions of the field that historically show the effects of SDS. This site specific application of ILeVO can reduce input costs while still effectively managing SDS pressure.

Management Zone Creation: Historical yield data was used to cluster data into management zones representing distribution of SDS in the field. (*Figure 1*). These zones were assessed for SDS disease levels and final yield results.

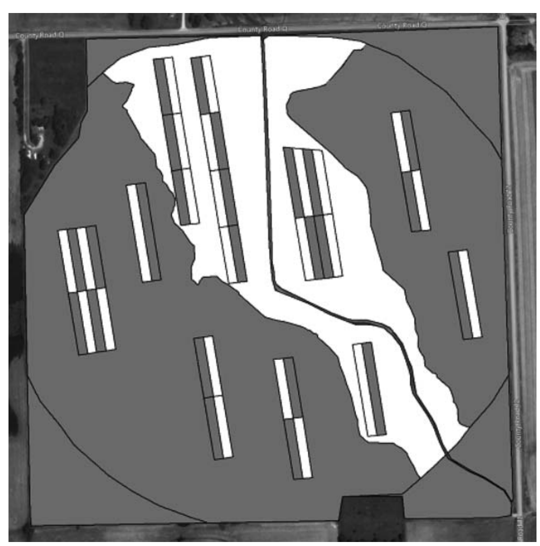


Figure 1. Zone prescription for soybean treated with standard treatment (dark grey) and ILeVO (light grey).

Results: Within each zone, check strips of the opposite seed treatment were established for evaluation. Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation for treatment within a zone was performed with Fisher's LSD. Letters below apply for differences within a zone.

Treatment	Standard Treatment + ILeVO®	Standard Treatment	P-Value
	***Yield** (bu/ac) †*		
SDS Zone	67 A*	57 B	0.0003
Standard Zone	70 A	70 A	0.849
P-Value	0.9631	0.9494	
	***Marginal Net Return** ($/ac)‡*		
SDS Zone	608.19	529.75	
Standard Zone	637.60	651.57	

*Values with the same letter are not significantly different at a 95% confidence interval.
†Bushels per acre corrected to 13% moisture.
‡ Marginal Net Return based on $9.25/bu soybeans, $15.17/acre ILeVO seed treatment cost ($10.19/oz).

Summary: The standard + ILeVO treatment yielded higher than the standard treated seed in the SDS zone. There was no difference in treatments in the standard zone. The drastic yield difference between the ILeVO and standard treatment in the SDS zone resulted in a $79 advantage for using the ILeVO treatment. Considering the size of the SDS zone (around 50 acres), the additional return by using the ILeVO treatment would equal around $4,000 for the field. If the additional cost of a multi-hybrid planter is around $20,000, the technology could be paid off in around five soybean growing seasons in this field.

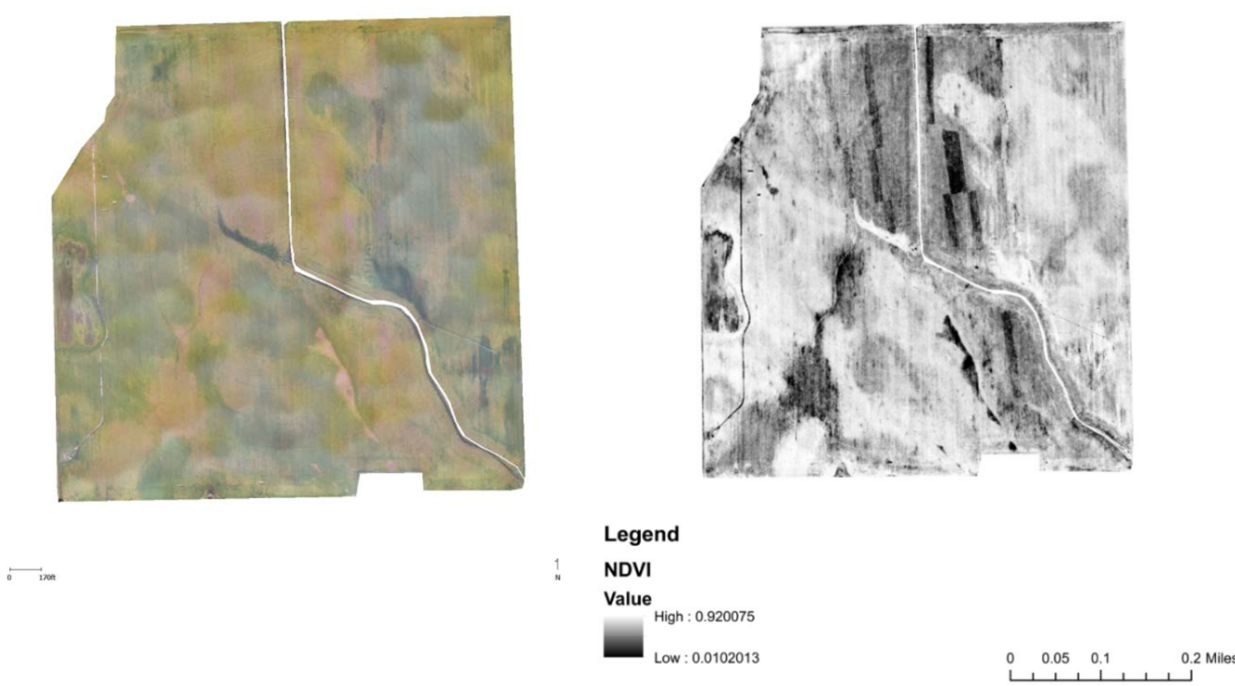


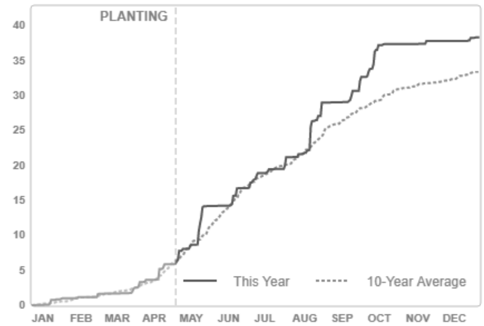
Figure 2. RGB (left) and NDVI (right) imagery of the field area.

Aerial imagery was obtained in late August *(Figure 2).* True color (RGB) imagery shows some of the standard zone check strips in the SDS zone at the north end of the field. NDVI (normalized difference vegetative index) imagery distinctly shows the standard treatment strips within the SDS zone that had higher levels of SDS.

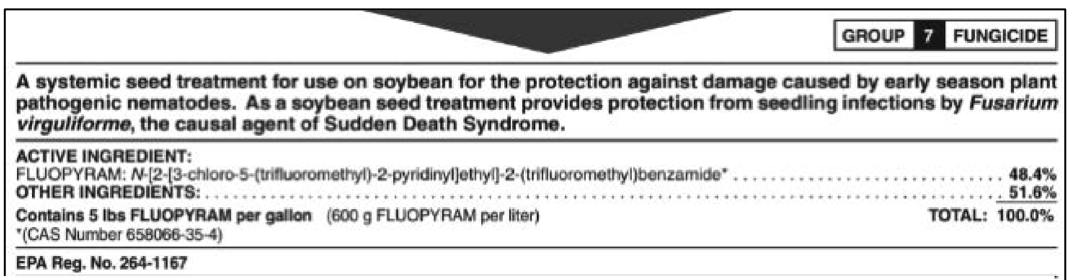
This study sponsored in part by: Bayer CropScience LP

Multi-Hybrid Planting for Spatial Soybean Seed Treatments

Study ID: 180155201701
County: Saunders
Soil Type: Nodaway silt loam, Tomek silt loam, Yutan silty clay loam, Yutan, eroded-Aksarben silty clay loams, Yutan, eroded-Judson complex
Planting Date: 4/28/17
Harvest Date: 9/29/17, 10/06/17, 10/12/17
Population: 160,000
Row Spacing (in): 15
Variety: Pioneer 31T11
Reps: 18
Previous Crop: Corn
Tillage: Conventional Till
Seed Treatment: None, other than those being studied
Irrigation: Pivot
Rainfall (in):



Introduction: Sudden Death Syndrome (SDS) is caused by the soil borne fungus *Fusarium solani f. sp. glycines*. While this is a relatively new disease for Nebraska soybean farmers, there are several locations in the state where significant percentages of fields are being affected. In fields where SDS is present and soybean cyst nematode is also present, the disease can be more severe. There are not clear guidelines to determine at what point a field will have enough increase in yield to justify treatment and, therefore, on-farm research projects like this one are needed.


GROUP 7 FUNGICIDE

A systemic seed treatment for use on soybean for the protection against damage caused by early season plant pathogenic nematodes. As a soybean seed treatment provides protection from seedling infections by *Fusarium virguliforme*, the causal agent of Sudden Death Syndrome.

ACTIVE INGREDIENT:
FLUOPYRAM: *N*-[2-[3-chloro-5-(trifluoromethyl)-2-pyridinyl]ethyl]-2-(trifluoromethyl)benzamide* 48.4%
OTHER INGREDIENTS: 51.6%
Contains 5 lbs FLUOPYRAM per gallon (600 g FLUOPYRAM per liter) **TOTAL: 100.0%**
*(CAS Number 658066-35-4)

EPA Reg. No. 264-1167

Product information from: *http://www.agrian.com/pdfs/ILeVO_Label1.pdf*

ILeVO® is a seed treatment marketed by Bayer CropScience for SDS and also has nematode activity (label at right). This field was selected due to the presence of SDS in the 2014 soybean crop. Two treatments were selected to test the efficacy of the ILeVO® seed treatment.

A: Standard soybean treatment (for this study Evergol Energy (0.5 fl. Oz/unit), Gaucho (0.80 fl. Oz/unit), PPST2030 (1 fl. Oz/unit), Allegiance (0.28 fl. Oz/unit), PPST120+ (1 fl. Oz/unit))

B: Standard soybean treatment plus ILeVO at a rate of 1.18 fl oz/140,000 seed unit

The additional capabilities of the multi-hybrid planter allow for site specific application of ILeVO in the portions of the field that historically show the effects of SDS. This site specific application of ILeVO can reduce input costs while still effectively managing SDS pressure.

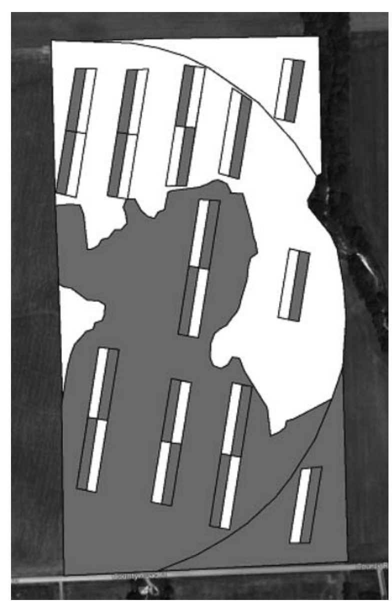


Figure 1. Zone prescription for soybean treated with standard treatment (dark grey) and ILeVO (light grey).

Management Zone Creation: Historical yield data was used to cluster data into management zones representing distribution of SDS in the field. (*Figure 1)*. These zones were assessed for SDS disease levels and final yield results.

Results: Within each zone, check strips of the opposite seed treatment were established for evaluation. Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation for treatment within a zone was performed with Fisher's LSD. Letters below apply for differences within a zone.

Foliar disease symptoms were assessed using Southern Illinois University at Carbondale's Method of SDS scoring. The disease symptoms were assessed using a 1 to 9 scoring system, with a score of 1 indicating the least symptoms and 9 indicating premature death. In addition, the overall incidence of affected plants was determined. These two scores were combined to create the disease index. The disease index = disease incidence x disease severity/9. Disease assessments were conducted on September 7, 2017.

	Disease Index on a Zone Basis		**Disease Index on a Whole Field Basis**
Treatment	**SDS Zone**	**Standard Zone**	**Disease Index**
Standard Treatment + ILeVO®	1.87 A*	0.07 A	0.97 A
Standard Treatment	6.47 A	2.43 A	4.45 B
P-Value	0.1145	0.0553	0.0212

Treatment	**Standard Treatment + ILeVO®**	**Standard Treatment**	**P-Value**
	Yield *(bu/ac)†*		
SDS Zone	70 A	67 A	0.108
Standard Zone	79 A	78 A	0.453
P-Value	0.9631	0.9494	
	Marginal Net Return *($/ac)‡*		
SDS Zone	633.33	621.71	
Standard Zone	711.51	718.60	

*Values with the same letter are not significantly different at a 95% confidence interval.
†Bushels per acre corrected to 13% moisture.
‡ Marginal Net Return based on $9.25/bu soybeans, $15.17/acre ILeVO seed treatment cost ($10.19/oz).

Summary: There was no difference between the standard + ILeVO versus standard treated seed in the SDS or standard zone. Disease ratings indicate no difference in disease on a zone basis. When considering the disease levels across the whole field, the ILeVO treatment had significantly lower disease levels than the standard treatment. All disease observations recorded are considered low disease levels.

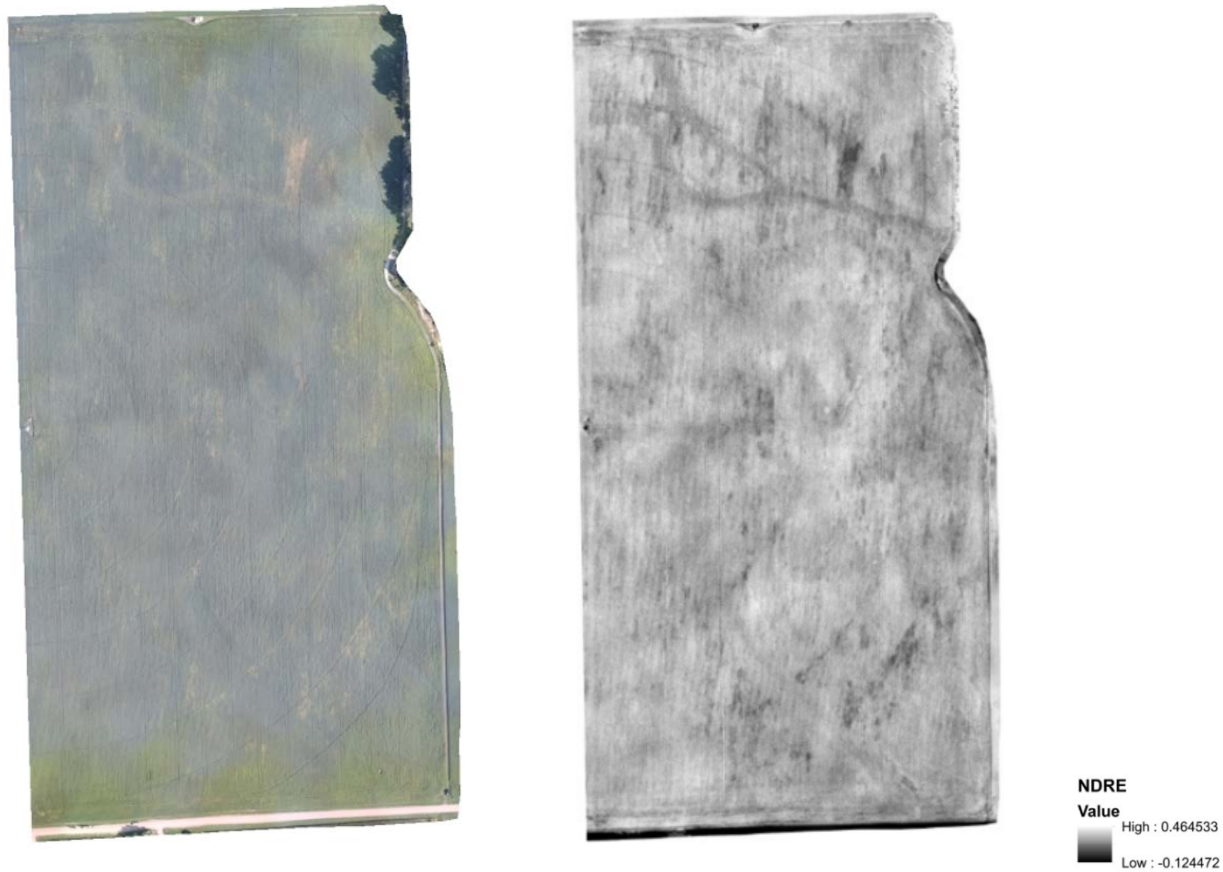


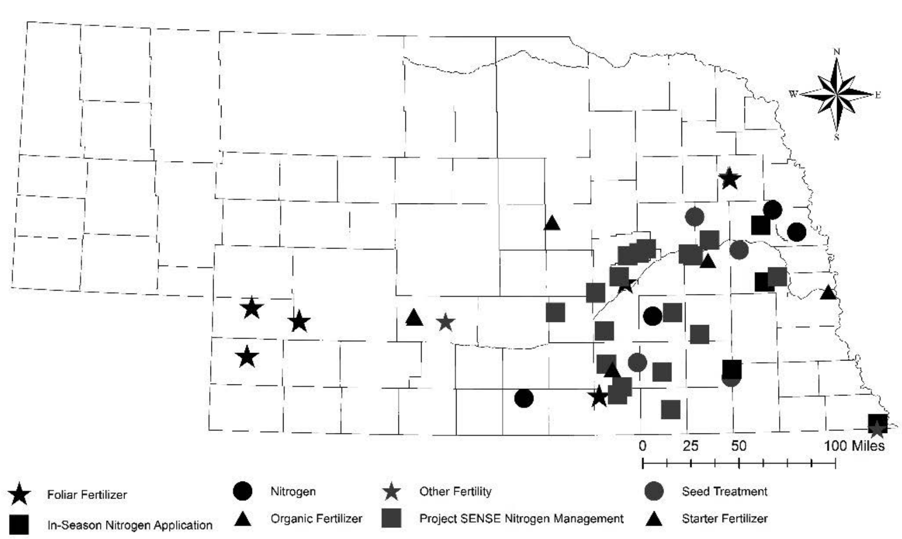
Figure 2. RGB (left) and NDRE (right) imagery of the field area.

Aerial imagery was obtained in late August *(Figure 2).* Both true color (RGB) imagery and NDRE (normalized difference red edge index) imagery show some of the standard zone check strips in the SDS zone at the north end of the field.

This study sponsored in part by: Bayer CropScience LP

FERTILITY AND SOIL MANAGEMENT

- Organic Fertilizer
  - Organic Corn Yield Response to Organic Fertilizer (2 sites)
- Foliar Fertilizers
  - Fertigated Nitrogen Application on Soybeans (3 sites)
  - Conklin® Kip Cullers' Nutrient Compass Foliar Fertilizer on Soybeans
  - CoRoN® Foliar Feed on Sorghum
  - Foliar and In-Furrow Fertilizers Applied to Soybeans with Iron Chlorosis
- Starter Fertilizers
  - Starter Fertilizer on Soybeans
  - Determining the Effects of Starter Fertilizers on Corn Yield
  - Starter Fertilizer on Irrigated Corn
  - Impact of Kickoff® Fertilizer and Optify®/Stretch on Quality and Yield of Soybeans
- Seed Treatment
  - Impact of Commence® Seed Treatment at Planting on Soybean Yield
  - Impact of Commence® Seed Treatment at Planting on Corn Yield (2 sites)
  - Evaluation of Commence®, Generate® and Bio-Sure Grow in Corn
- Nitrogen Rate, Placement, and Additives on Corn
  - Nitrogen Application to Corn Following Cover Crops (NRCS Demo Farm Site)
  - Nitrification Inhibitor
  - N-Serve® on Spring Applied Anhydrous Ammonia
  - Anhydrous Ammonia Nitrogen Rates Following Manure Application on Corn
- In-Season Nitrogen Application
  - Nitrogen Rate and Timing on Corn (3 sites)
  - In-season Nitrogen Application on Corn Following Rye Cover Crop
  - Using Drone Based Sensors to Direct Variable-Rate In-Season Aerial Nitrogen Application on Corn
  - Project SENSE Nitrogen Management (18 sites)
- Other Fertility
  - Evaluation of Kugler KQ Calcium Chloride Fertilization in Soybeans
  - Conklin® Wex Wetting Agent on Soybeans
  - Phosphorus Application Rates for Soybeans on Soil with Low P Test
  - No-Till vs Strip-Till vs Strip-Till + Fertilizer on Soybeans



Organic Corn Yield Response to Organic Fertilizer Summary (2 sites)

Several fertilizer products were tested for organic corn production. Fertilizers were applied in 6" bands using a modified Krause drill. The crop was then planted into the band after application. Treatments tested include:

Nature Safe 13-0-0 (150 lb/ac)

Nature Safe 13-0-0 (300 lb/ac)

Beju pelleted manure containing micronutrients (100 lb/ac) – (http://bejuplantfood.com)

Humic DG (10 lb/ac)

Nature Safe 13-0-0

GUARANTEED ANALYSIS:

Total nitrogen (N) 13%
Ammoniacal nitrogen 0.19%
Water-insoluble nitrogen 12.04%
Water-soluble organic nitrogen 0.77%
Sulfur (S) 1.25%

SOURCE OF NUTRIENTS:
Hydrolyzed feather meal, meat meal and blood meal.

The nitrogen source is derived from premium quality hydrolyzed feather meal, meat meal and blood meal. 13-0-0 is allowed under NOP guidelines validating its use in the production of organic certified crops.

Product information from: *http://www.midwesternbioag.com/wp-content/uploads/2012/12/13-0-0bulk.pdf*

Humic DG

CONTAINS NON-PLANT FOOD INGREDIENT

Soil amending ingredient
Humic Acid (derived from leonardite) 70%
Total Other Ingredients (inactive components of leonardite, proprietary binding agent, water) 30%

Product information from: *https://andersonshumates.com/wp-content/uploads/2015/05/HumicDG_ASPHUDG40C15.pdf*

Two studies were conducted in 2017, each with five replications. Data from both studies were analyzed together using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation was done with Fisher's LSD.

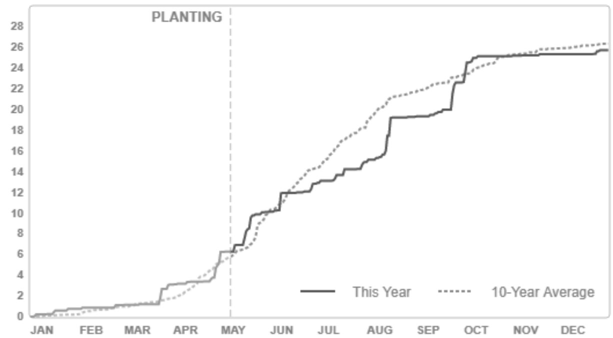
Table 1. Yield of organic corn receiving various organic fertilizers at two site locations.

	Yield (bu/acre)†
Check	193.8 A
Nature Safe - 150 lb/ac	195.3 A
Nature Safe - 300 lb/ac	191.5 A
Beju	188.7 A
Humic DG	190.9 A
Site (P>F)	*0.035*
Treatment (P>F)	*0.472*
*Site*Treatment*	*0.206*

Summary: There was no significant yield increase for any of the fertilizers tested when looking across both sites. The sites did have significantly different yields.

Organic Corn Yield Response to Organic Fertilizer

Study ID: 641047201702
County: Dawson
Soil Type: Cozad fine sandy loam; Cozad silt loam saline-alkali; Gosper loam saline-alkali
Planting Date: 5/7/17
Population: 32,500
Row Spacing (in): 36
Hybrid: Great Harvest 58E4
Reps: 5
Previous Crop: Corn
Tillage: Disk
Herbicides: ***Pre:*** None ***Post:*** None
Seed Treatment: SoilBiotics humic acid
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 12.37 ton/ac beef manure on 11/9/15
Irrigation: Gravity, Total: 21"
Rainfall (in):



Introduction: Several fertilizer products were tested for organic corn production. Fertilizers were applied in 6" bands using a modified Krause drill. The crop was then planted into the band after application.

Treatments tested include:

Nature Safe 13-0-0 (150 lb/ac)

Nature Safe 13-0-0 (300 lb/ac)

Beju pelleted manure containing micronutrients (100 lb/ac)

Humic DG (10 lb/ac)

Nature Safe was a 1/8" pellet, Beju was a 1/4" pellet, and Humic DG was a prill. 12.37 ton/ac of beef manure was applied in Nov. 2015. No herbicides were used. Weeds were controlled through flame cultivation on 6/16/17. The site received hail on July 3, 2017.

Nature Safe 13-0-0

GUARANTEED ANALYSIS:

Total nitrogen (N)	13%
Ammoniacal nitrogen	0.19%
Water-insoluble nitrogen	12.04%
Water-soluble organic nitrogen	0.77%
Sulfur (S)	1.25%

SOURCE OF NUTRIENTS:
Hydrolyzed feather meal, meat meal and blood meal.

The nitrogen source is derived from premium quality hydrolyzed feather meal, meat meal and blood meal. 13-0-0 is allowed under NOP guidelines validating its use in the production of organic certified crops.

Product information from: *http://www.midwesternbioag.com/wp-content/uploads/2012/12/13-0-0bulk.pdf*

Humic DG

CONTAINS NON-PLANT FOOD INGREDIENT

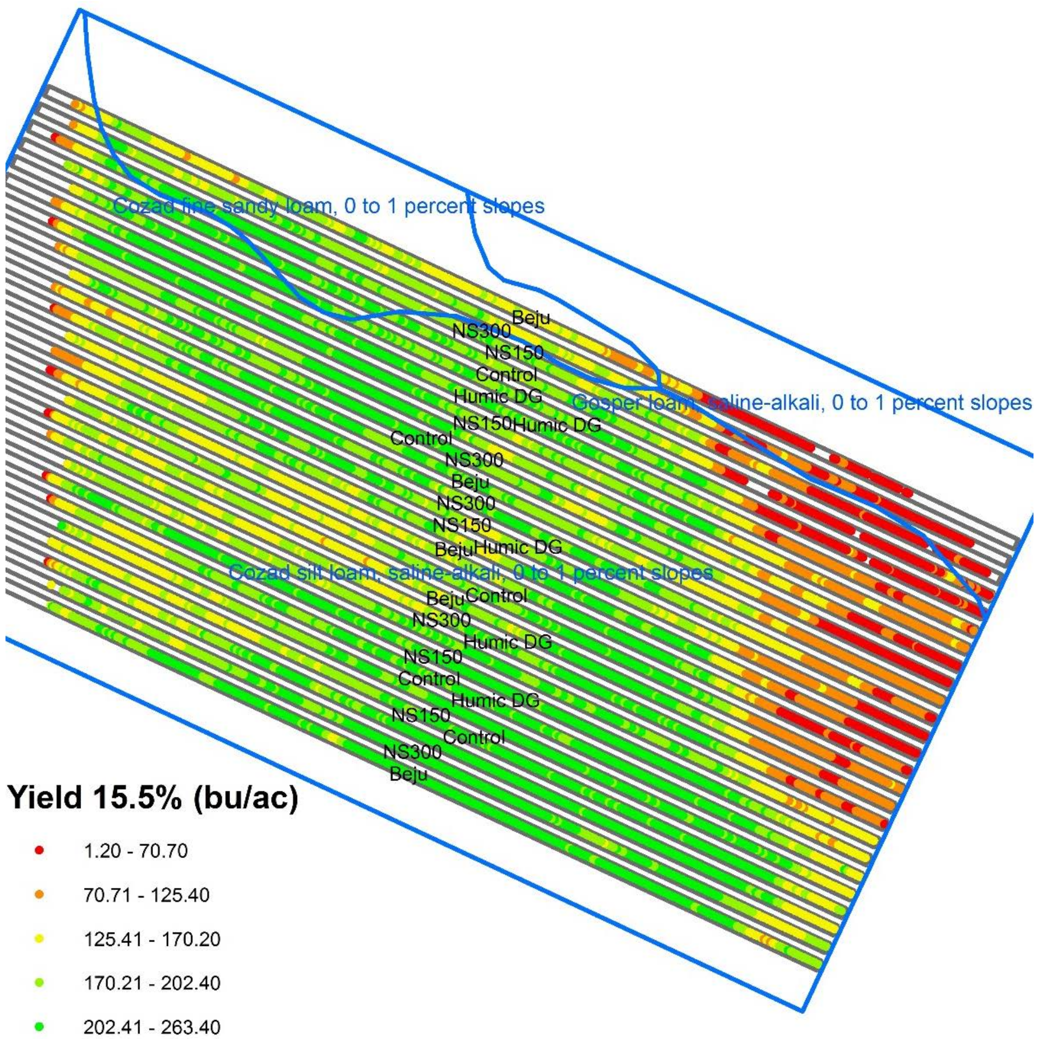
Soil amending ingredient	
Humic Acid (derived from leonardite)	70%
Total Other Ingredients (inactive components of leonardite, proprietary binding agent, water)	30%

Product information from: *https://andersonshumates.com/wp-content/uploads/2015/05/HumicDG_ASPHUDG40C15.pdf*

Results:

	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	15.6 A*	176 A	1,584.32 A
Nature Safe - 150 lb/ac	15.4 A	178 A	1,523.85 AB
Nature Safe - 300 lb/ac	15.6 A	171 A	1,391.63 B
Beju	15.5 A	163 A	1,388.51 B
Humic DG	15.5 A	172 A	1,534.72 AB
P-Value	0.733	0.277	0.017

*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 $9/bu organic corn, $75.50/ac Nature Safe at 150 lb/ac rate, $143/ac Nature Safe at 300 lb/ac rate, $78/ac Beju, and $16.75/ac Humic DG. Costs of all products include $8/ac for an extra trip across the field.

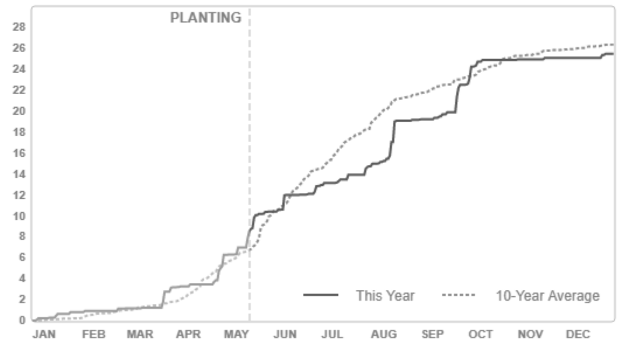


Summary:

- None of the products tested increased yield compared with the untreated check.
- Nature Safe at 300 lb/ac and Beju significantly decreased marginal net return due to the increased production cost.

Organic Corn Yield Response to Organic Fertilizer

Study ID: 641047201703
County: Dawson
Soil Type: Cozad silt loam; Cozad silt loam saline-alkali; Cozad fine sandy loam
Planting Date: 5/17/17
Harvest Date: 11/2/17
Population: 32,500
Row Spacing (in): 36
Hybrid: Great Harvest 58E4
Reps: 5
Previous Crop: Corn
Tillage: Disk
Herbicides: ***Pre:*** None ***Post:*** None
Seed Treatment: SoilBiotics humic acid
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 14.72 tons/ac beef manure on 2/17/16
Irrigation: Gravity, Total: 15"
Rainfall (in):



Introduction: Several fertilizer products were tested for organic corn production. Fertilizers were applied in 6" bands using a modified Krause drill. The crop was then planted into the band after application.

Treatments tested include:

Nature Safe 13-0-0 (150 lb/ac)

Nature Safe 13-0-0 (300 lb/ac)

Beju pelleted manure containing micronutrients (100 lb/ac)

Humic DG (10 lb/ac)

Nature Safe was a 1/8" pellet, Beju was a 1/4" pellet, and Humic DG was a prill. 14.72 ton/ac of beef manure was applied in Feb. 2016.

Nature Safe 13-0-0

GUARANTEED ANALYSIS:

Total nitrogen (N)	13%
Ammoniacal nitrogen	0.19%
Water-insoluble nitrogen	12.04%
Water-soluble organic nitrogen	0.77%
Sulfur (S)	1.25%

SOURCE OF NUTRIENTS:
Hydrolyzed feather meal, meat meal and blood meal.

The nitrogen source is derived from premium quality hydrolyzed feather meal, meat meal and blood meal. 13-0-0 is allowed under NOP guidelines validating its use in the production of organic certified crops.

Product information from: *http://www.midwesternbioag.com/wp-content/uploads/2012/12/13-0-0bulk.pdf*

Humic DG

CONTAINS NON-PLANT FOOD INGREDIENT

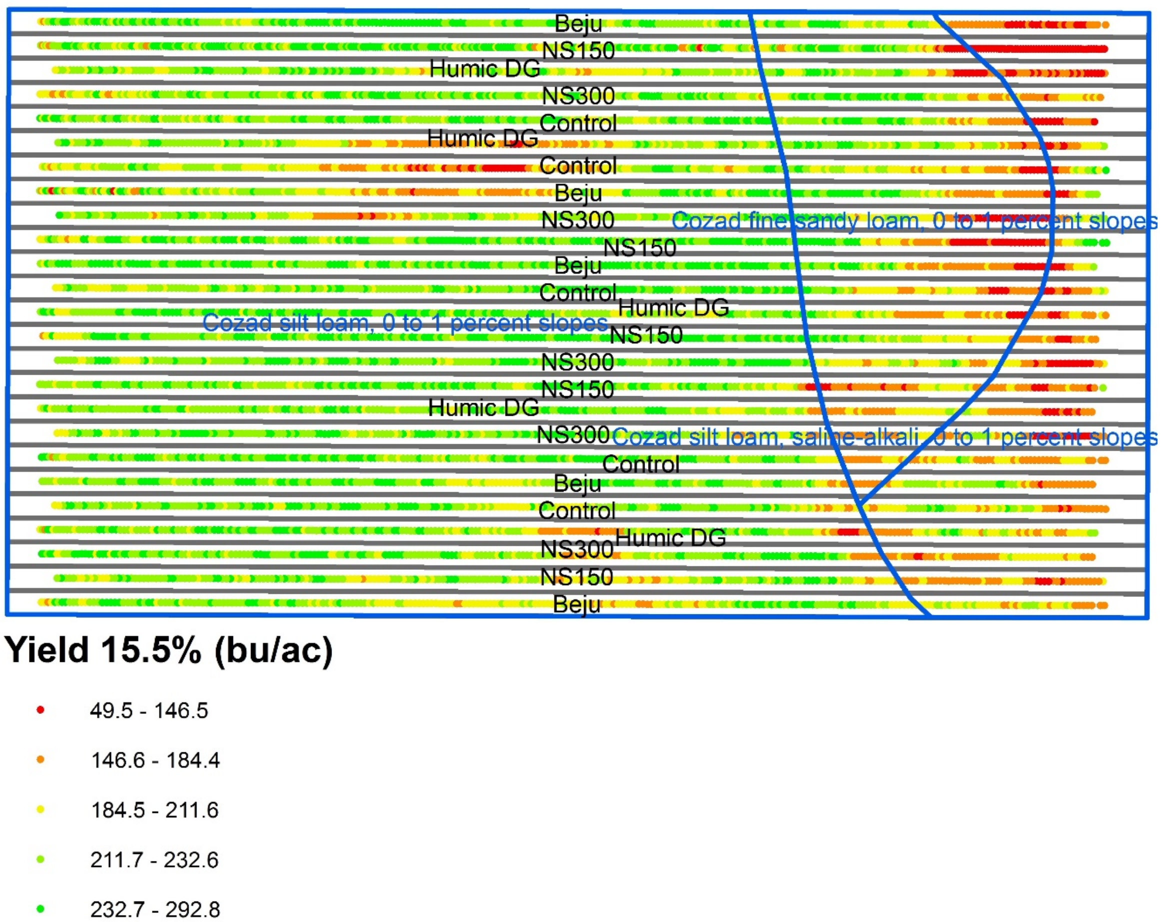
Soil amending ingredient	
Humic Acid (derived from leonardite)	70%
Total Other Ingredients (inactive components of leonardite, proprietary binding agent, water)	30%

Product information from: *https://andersonshumates.com/wp-content/uploads/2015/05/HumicDG_ASPHUDG40C15.pdf*

Results:

	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	16.1 A*	212 A	1,904.24 A
Nature Safe - 150 lb/ac	15.9 A	213 A	1,841.31 AB
Nature Safe - 300 lb/ac	16.0 A	213 A	1,770.14 B
Beju	15.9 A	214 A	1,851.71 AB
Humic DG	16.0 A	209 A	1,867.99 A
P-Value	0.554	0.685	0.008

*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 $9/bu organic corn, $75.50/ac Nature Safe at 150 lb/ac rate, $143/ac Nature Safe at 300 lb/ac rate, $78/ac Beju, and $16.75/ac Humic DG. Costs of all products include $8/ac for an extra trip across the field.



Summary:

- None of the products tested increased yield compared with the untreated check.
- Nature Safe at 300 lb/ac significantly decreased marginal net return compared with the check.

Nitrogen on Soybeans at R2 Summary (3 sites)

Three studies in southwest Nebraska looked at N fertilizer applications to soybeans through a center pivot irrigation system at R2 growth stage in 2017. These sites used different foliar N rates. There were a total of 11 replications between the three studies. Data from these studies were analyzed together using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation was done with Fisher's LSD.

Table 1. Yield of soybean with and without foliar N application from the three site locations.

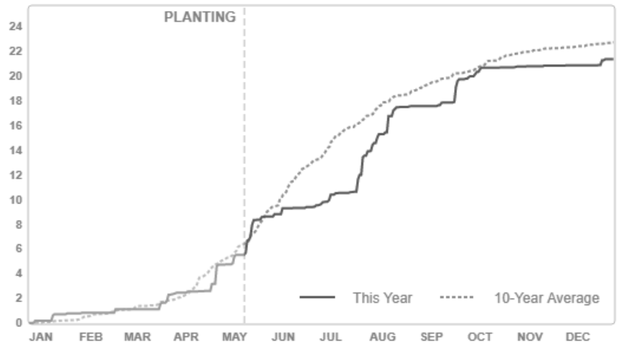
	Yield (bu/acre)†
Check	69.9 B
N fertilizer at R2	71.7 A
Site (P>F)	*0.0005*
Treatment (P>F)	*0.0231*
*Site*Treatment*	*0.0719*

Summary: When all sites were considered together, there was a 1.8 bu/ac yield increase for applying N fertilizer to soybeans at R2. The sites did have significantly different yields, and there was an interaction of site and treatment indicating the sites responded differently to the treatment. Individual reports from each of the three sites follows.

Fertigated Nitrogen Application on Soybeans

Study ID: 735135201701
County: Perkins
Soil Type: Keith silt loam 1-3% slope; Satanta very fine sandy loam 3-6% slopes; Satanta very fine sandy loam 1-3% slope; Jayem fine sandy loam 3-6% slopes
Planting Date: 5/15/17
Harvest Date: 10/20/17
Population: 175,000
Row Spacing (in): 30
Variety: Pioneer 22T41
Reps: 3
Previous Crop: Corn
Tillage: Vertical-Till
Herbicides: ***Pre:*** 32 oz Glyphosate + 16 oz WeedMaster® on 3/21/17 ***Post:*** 32 oz Glyphosate + 1.5 oz Zidua(R) + 2.5 pt Sequence(R) on 5/24/17

Seed Treatment: Innoculant only
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 2 gal of 9-24-3 on 5/15/17
Irrigation: Pivot, Total: 10.5"
Rainfall (in):



Introduction: This study investigated the effects of applying nitrogen fertilizer to soybeans. A foliar application of 70 lb N/acre of nitrogen was made through pivot irrigation water at the R2 growth stage. The plot layout consisted of alternating pie-shaped sections, some of which received N through the pivot and some which were left as untreated checks. Surface and sub-surface soil samples for each treatment and replication were taken prior to planting as well as at the R2 growth stage and at harvest to investigate the change in both NO_3-N and NH_4-N soil concentrations throughout the growing season *(Figure 1, Figure 2)*. Plant tissue samples were taken at the R2 and R5-R6 growth stages to monitor nutrient content within the plants. Plant residue was analyzed for residual nitrogen content. Harvested grain was sampled for protein and oil content for two of three replications so statistical analysis was not performed for these data.

Results:

Foliar Tissue Samples at R2 Growth Stage (6/29/2017):

	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Sulfur (%)	Calcium (%)	Magnesium (%)	Iron (ppm)	Manganese (ppm)	Copper (ppm)	Boron (ppm)	Zinc (ppm)
Check	6.38 A	0.47 A	2.38 A	0.33 A	1.03 A	0.30 A	82 A	69 A	6.97 A	45 A	31 A
Foliar N at R2	6.27 A*	0.52 A	2.64 A	0.35 A	1.13 A	0.32 A	86 A	86 A	7.33 A	48 A	32 A
P-Value	0.628	0.339	0.532	0.300	0.423	0.368	0.383	0.285	0.811	0.525	0.642

Foliar Tissue Samples at R5-R6 Growth Stage (8/25/2017):

	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Sulfur (%)	Calcium (%)	Magnesium (%)	Iron (ppm)	Manganese (ppm)	Copper (ppm)	Boron (ppm)	Zinc (ppm)
Check	5.06 A	0.37 A	2.01 A	0.34 A	1.67 B	0.21 A	86 A	112 A	6.80 A	47 A	32 A
Foliar N at R2	5.05 A	0.42 A	2.05 A	0.34 A	1.92 A	0.23 A	88 A	148 A	6.30 A	45 A	31 A
P-Value	0.673	0.494	0.444	0.184	0.047	0.184	0.499	0.248	0.650	0.621	0.711

	Yield (bu/acre)†	Moisture (%)	Residue Residual N (lb N/ac)	Oil (%)	Protein (%)	Marginal Net Return‡ ($/ac)
Check	73 B	11.9 A	39 A	19.87	34.4	646.03 A
Foliar N at R2	77 A	11.7 A	47 A	20.35	34.5	656.89 A
P-Value	0.0497	0.8102	0.383	---	---	0.3635

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $0.41/lb Nitrogen cost.

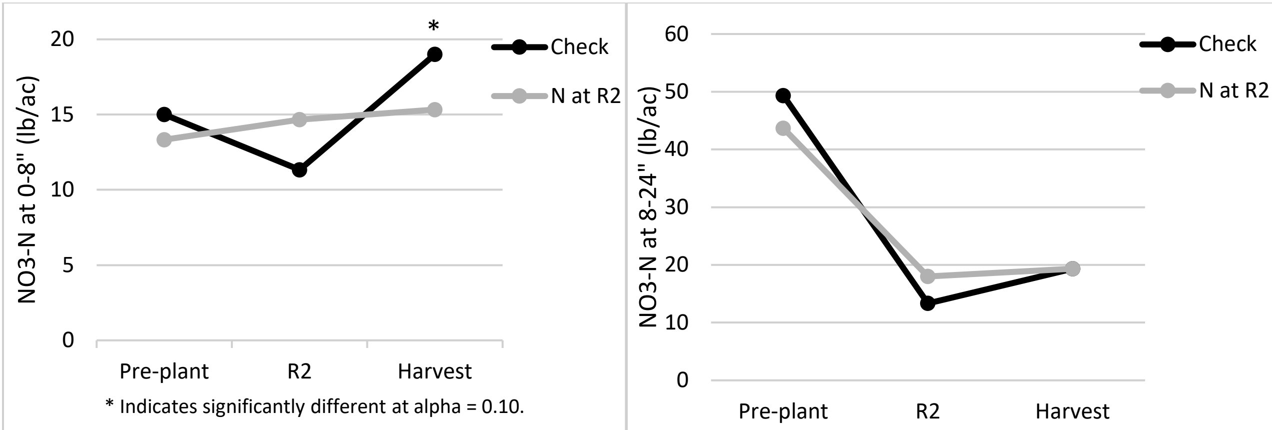


Figure 1. Pre-plant, R2, and Harvest soil NO_3-N concentrations at 0-8" and 8-24" depths.

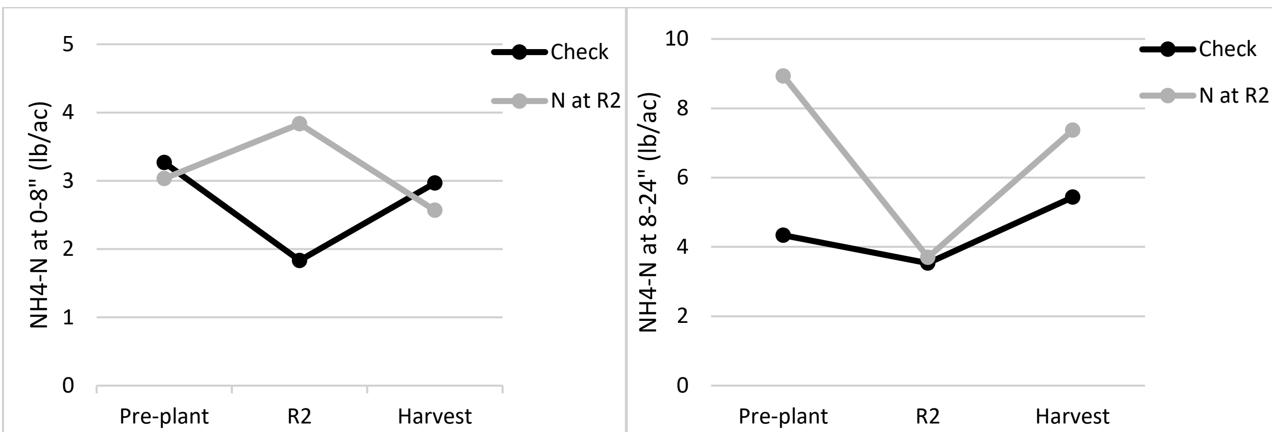


Figure 2. Pre-plant, R2, and Harvest soil NH_4-N concentrations at 0-8" and 8-24" depths.

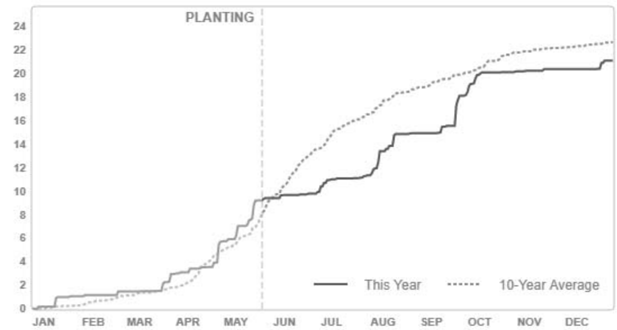
Summary:

- No significant differences were noted in the foliar tissue samples at either the R2 or R5-R6 growth stages with the exception of the calcium foliar test at R5-R6.
- There was no significant difference in moisture content of the harvested grain or the residual nitrogen content of the plant residue between the two treatments.
- The treatment of 70 lb N/ac at the R2 growth stage resulted in a significantly higher yield. There was no significant difference in marginal net return.

Fertigated Nitrogen Application on Soybean

Study ID: 736111201701
County: Lincoln
Soil Type: Holdrege fine sandy loam 0-3% slope; Anselmo fine sandy loam 1-3% slope; Hord silt loam 0-1% slope
Planting Date: 5/25/17
Harvest Date: 10/15/17
Population: 140,000
Row Spacing (in): 15
Variety: Channel 2402
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 22 oz Glyphosate, .75 oz Aim® EC, 13 oz 2,4-D, 8 oz Authority® Assist, 1 gal/100 MSO on 5/11/17 ***Post:*** 40 oz Glyphosate, 10 oz Outlook®, 8 oz Clethodim, 1 gal/100 MSO on 6/29/17

Seed Treatment: Innoculant only
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 3 gal 10-34-0 at planting
Note: Light hail damage on the far east side, whole field average was 68
Irrigation: Pivot, Total: 13.5"
Rainfall (in):



Introduction: This study investigated the effects of applying nitrogen fertilizer to soybeans. A foliar application of 85 lb/ac of nitrogen was made through pivot irrigation water at the R2 growth stage. The plot layout consisted of alternating pie-shaped sections, some of which received N through the pivot and some which were left as untreated checks. Surface and sub-surface soil samples for each treatment and replication were taken prior to planting as well as at the R2 growth stage and at harvest to investigate the change in both NO_3-N and NH_4-N soil concentrations throughout the growing season *(Figure 1, Figure 2)*. Plant tissue samples were taken at the R2 and R5-R6 growth stages to monitor nutrient content within the plants. Plant residue was analyzed for residual nitrogen content. Harvested grain was sampled for protein and oil content for two of four replications so statistical analysis was not performed on these data.

Results:

Foliar Tissue Samples at R2 Growth Stage (6/29/2017):

	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Sulfur (%)	Calcium (%)	Magnesium (%)	Iron (ppm)	Manganese (ppm)	Copper (ppm)	Boron (ppm)	Zinc (ppm)
Check	5.89 A*	0.47 A	2.70 A	0.35 A	1.12 A	0.39 A	110 A	108 A	7 A	43 A	49 A
Foliar N at R2	6.20 A	0.47 A	2.67 A	0.35 A	1.11 A	0.38 A	110 A	119 A	8 A	44 A	49 A
P-Value	0.225	1.0	0.772	0.861	0.771	0.565	0.981	0.278	0.283	0.787	0.970

Foliar Tissue Samples at R5-R6 Growth Stage (8/25/2017):

	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Sulfur (%)	Calcium (%)	Magnesium (%)	Iron (ppm)	Manganese (ppm)	Copper (ppm)	Boron (ppm)	Zinc (ppm)
Check	5.79 A	0.35 A	1.80 A	0.36 A	1.55 A	0.26 A	98 A	225 A	7 A	45 A	51 B
Foliar N at R2	5.60 A	0.34 A	1.73 A	0.36 A	1.70 A	0.31 A	98 A	245 A	7 A	47 A	60 A
P-Value	0.226	0.520	0.160	0.824	0.340	0.126	0.916	0.454	0.910	0.270	0.055

	Yield (bu/acre)†	Moisture (%)	Residue Residual N (lb N/ac)	Oil (%)	Protein (%)	Marginal Net Return‡ ($/ac)
Check	73 A	11.9 A	38 A	19.7	36.1	646.35 A
Foliar N at R2	73 A	11.9 A	52 A	20.2	35.9	614.87 B
P-Value	0.815	0.964	0.352	---	---	0.082

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $0.41/lb Nitrogen cost.

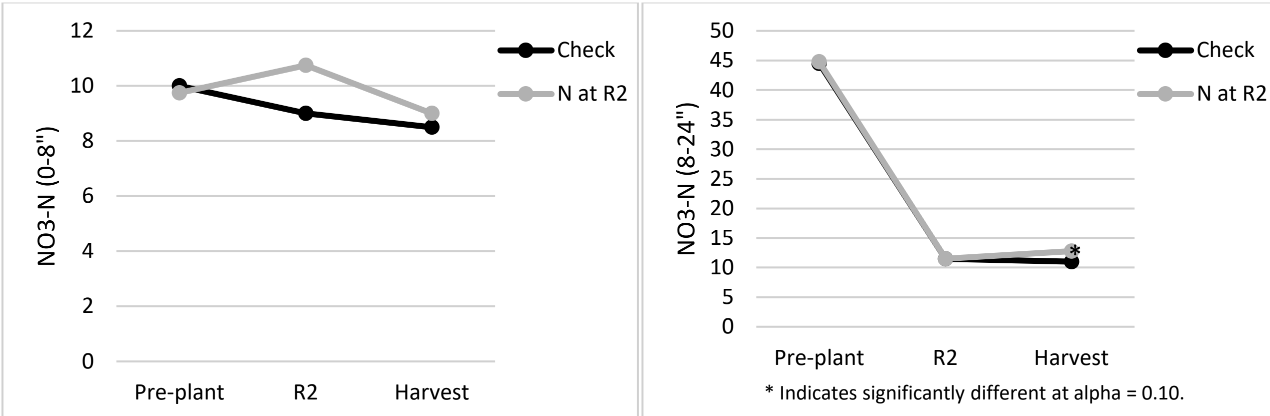


Figure 1. Pre-plant, R2, and Harvest soil NO_3-N concentrations at 0-8" and 8-24" depths.

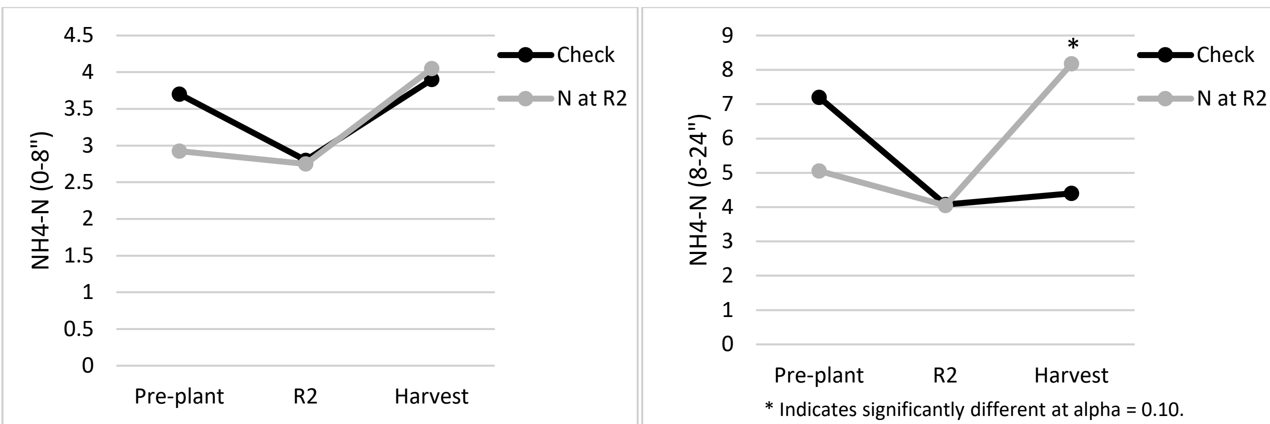


Figure 2. Pre-plant, R2, and Harvest soil NH_4-N concentrations at 0-8" and 8-24" depths.

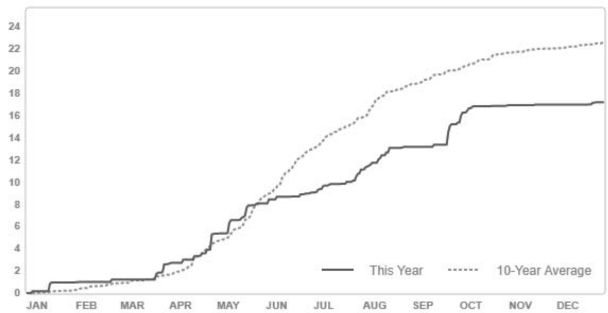
Summary:

- No significant differences were noted in the foliar tissue samples at either the R2 or R5-R6 growth stages with the exception of the zinc test at R5-R6.
- There was no significant difference in moisture content or yield of the harvested grain nor were there significant differences in the residual nitrogen content of the plant residue between the two treatments.
- The treatment of 85 lb N/ac at the R2 growth stage resulted in a significantly lower marginal net return due to increased cost of the N fertilizer and no yield increase.

Fertigated Nitrogen Application on Soybean

Study ID: 741029201701
County: Chase
Soil Type: Jayem loamy fine sand 0-3% slope; Tassel-Duda loamy sand 0-3% slope; Haxtun loamy fine sand 0-3% slope; Ascalon fine sandy loam 1-3% slope
Harvest Date: 10/20/2017
Reps: 4
Previous Crop: Corn
Irrigation: Pivot

Rainfall (in):



Introduction: This study investigated the effects of applying nitrogen fertilizer to soybeans. A foliar application of 65 lb N/acre of nitrogen was made through pivot irrigation water at the R2 growth stage. The plot layout consisted of alternating pie-shaped sections, some of which received N through the pivot and some which were left as untreated checks. Surface and sub-surface soil samples for each treatment and replication were taken prior to planting as well as at the R2 growth stage and at harvest to investigate the change in both NO3-N and NH4-N soil concentrations throughout the growing season *(Figure 1, Figure 2)*. Plant tissue samples were taken at the R2 and R5-R6 growth stages to monitor nutrient content within the plants. Plant residue was analyzed for residual nitrogen content. Harvested grain was sampled for protein and oil content for two of four replications so statistical analysis was not performed for these data.

Results:

Foliar Tissue Samples at R2 Growth Stage (6/26/2017):

	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Sulfur (%)	Calcium (%)	Magnesium (%)	Iron (ppm)	Manganese (ppm)	Copper (ppm)	Boron (ppm)	Zinc (ppm)
Check	6.03 A*	0.53 A	2.43 A	0.37 A	1.31 A	0.34 A	144 A	112 A	9 A	64 A	80 A
Foliar N at R2	5.62 A	0.50 A	2.47 A	0.36 B	1.40 A	0.34 A	115 B	115 A	9 A	62 B	79 A
P-Value	0.218	0.330	0.800	0.014	0.442	1.0	0.051	0.828	0.885	0.076	0.452

Foliar Tissue Samples at R5-R6 Growth Stage (8/25/2017):

	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Sulfur (%)	Calcium (%)	Magnesium (%)	Iron (ppm)	Manganese (ppm)	Copper (ppm)	Boron (ppm)	Zinc (ppm)
Check	4.93 A	0.38 A	1.88 B	0.32 B	1.84 A	0.24 A	102 A	183 B	9 A	81 A	116 A
Foliar N at R2	5.30 A	0.40 A	2.01 A	0.35 A	1.76 B	0.24 A	117 A	231 A	9 A	82 A	130 A
P-Value	0.162	0.363	0.054	0.031	0.089	0.893	0.275	0.053	0.919	0.778	0.409

	Yield (bu/acre)†	Moisture (%)	Residue Residual N (lb N/ac)	Oil (%)	Protein (%)	Marginal Net Return‡ ($/ac)
Check	64 A	9.5 A	29 A	21.7	34.4	573.32 A
Foliar N at R2	65 A	9.4 A	34 A	18.6	34.5	552.62 B
P-Value	0.467	0.837	0.249	N/A	N/A	0.060

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $0.41/lb Nitrogen cost.

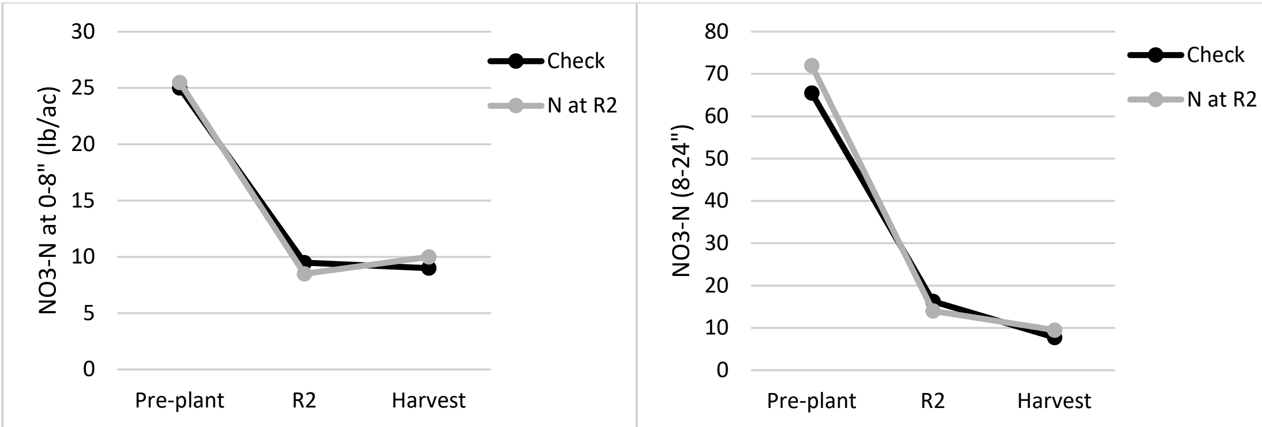


Figure 1. Pre-plant, R2, and Harvest soil NO_3-N concentrations at 0-8" and 8-24" depths.

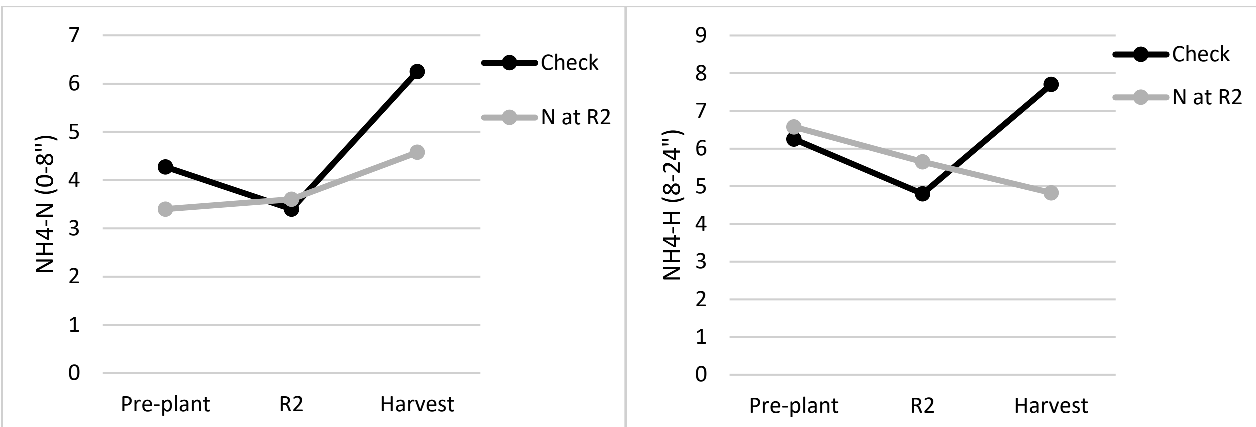


Figure 2. Pre-plant, R2, and Harvest soil NH_4-N concentrations at 0-8" and 8-24" depths.

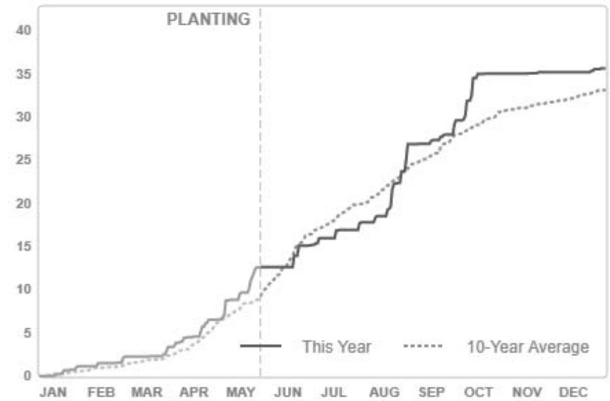
Summary:

- No significant differences were noted in the foliar tissue samples at either the R2 or R5-R6 growth stages with the exception of the iron and boron foliar tests at R2 and the potassium, sulfur, calcium, and manganese foliar tests at R5-R6.
- There was no significant difference in moisture content and yield of the harvested grain or the residual nitrogen content of the plant residue between the two treatments.
- The treatment of 65 lb N/ac at the R2 growth stage resulted in a significantly lower marginal net return.

Conklin® Kip Cullers' Nutrient Compass Foliar Fertilizer on Soybeans

Study ID: 319039201702
County: Cuming
Soil Type: Silty clay loam
Planting Date: 5/23/17
Harvest Date: 10/25/17
Row Spacing (in): 36
Variety: Curry 1267
Reps: 5
Tillage: No-Till
Herbicides: ***Pre:*** 3 oz/ac Surveil®, 6 oz/ac Tricor® DF, and 10 oz/ac 2-4D LV6 ***Post:*** 2.5 oz/ac Anthem® Maxx, 28 oz/ac Roundup® PowerMAX, 6 oz Clethodim®, and 1 lb/ac dextrose
Seed Treatment: Commence® from Agnition and Nutriplant® SD from Amway

Fertilizer: 12.5 ton/ac beef manure (17.5 lb N, 181 lb P, 116 lb K, 41.3 lb S & 1.6 lb Zn/ac)
Irrigation: None
Rainfall (in):



Introduction: This study was evaluating Conklin Kip Cullers' Nutrient Compass Foliar Fertilizer® (product information at right). The product was applied to soybeans at R 3.5 growth stage at a rate of 1 qt/ac on August 2, 2107. The weather was cloudy. The product was designed to be able to spray with the post herbicide at V3-V5; this study was looking at the product applied at a different growth stage than what was recommended. The product was compared with an untreated check and moisture, yield, and net return were evaluated.

Guaranteed Analysis: 3-3-9
Total Nitrogen (N) 3.0%
0.4% Ammoniacal Nitrogen; 1.9% Urea Nitrogen; 0.7% Other Water Soluble Nitrogen
Available Phosphate (P_2O_5) 3.0%
Soluble Potash (K_2O) 9.0%
Sulfur (S) 1.4%
1.4 % combined Sulfur (S)
Boron (B) 0.04%
Manganese (Mn) 1.7%
1.7% Chelated Manganese (Mn)
Molybdenum (Mo) 0.0009%
Zinc (Zn) 0.8%
0.8% Chelated Zinc (Zn)
Plant nutrients derived from: ammonia, urea, potassium hydroxide, phosphoric acid, potassium thiosulfate, boric acid, manganese oxide (EDTA), sodium molybdate, zinc oxide (EDTA).

Product information from:
http://www.kellysolutions.com/erenewals/documentsubmit/KellyData/ND%5CFertilizer%5CProduct%20Label%5C200108520_6_9_2016_4_12_00_PM.pdf

Results:

	Moisture (%)	**Yield (bu/acre)†**	**Marginal Net Return‡ ($/ac)**
Check	9.4 A*	71 A	628.53 A
Kip Cullers Nutrient Compass Foliar Fertilizer	9.3 A	70 A	604.88 B
P-Value	0.542	0.138	0.007

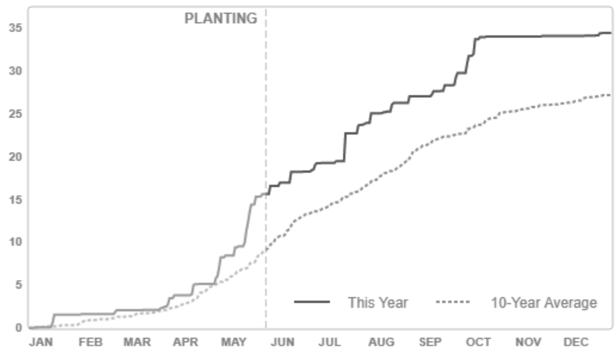
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean, $7.12/ac product cost, and $8.13/ac application.

Summary:
- There was no difference in moisture or yield for the Conklin Kip Cullers' Nutrient Compass Foliar Fertilizer® compared with the untreated check.
- The check had a higher marginal net return due to lower input costs. The cost of using the product would be lower if it were applied with the herbicide as it would not require a separate pass across the field.

CoRoN® Foliar Feed on Sorghum

Study ID: 009129201701
County: Nuckolls
Soil Type: Hastings silt loam
Planting Date: 5/29/17
Harvest Date: 10/30/17
Population: 62,500
Row Spacing (in): 30
Hybrid: Pioneer 85Y40
Reps: 5
Previous Crop: Wheat
Tillage: No-Till
Herbicides: ***Pre:*** 1.5 qt/ac Lexar® EZ, 12 oz/ac 6 lb 2,4-D, and 40 oz/ac Roundup PowerMAX® on 4/19/17; 1.5 qt/ac Lexar® EZ and 32 oz/ac Roundup PowerMAX® on 5/30/17. ***Post:*** 13 oz/ac Huskie® on 7/1/17
Seed Treatment: Cruiser®

Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 130 lb/ac N as 46-0-0, 45 lb/ac P from 11-52-0, and 3 lb/ac Zn on 5/1/17
Note: Hail at 3 leaf stage
Irrigation: None
Rainfall (in):



Soil Test (2/7/17):

pH	BpH	Sol. Salts	Excess Lime	OM	Nitrate-Nitrogen		P	K	S	Ca	Mg	Na	Zn	Fe	Mn	Cu	CEC	H	K	Ca	Mg	Na
		mmho/cm		*%*	*ppm*	*lb N/ac*	ppm											%				
5.9	6.8	0.12	no	2.4	5	15	20	278	8	1780	216	12	0.6	117	47	1.1	14	17	5	64	13	0

Introduction: CoRoN® 25-0-0-0.5B (25 percent of N as controlled release N) was applied to sorghum at early boot stage on July 25, 2017. The CoRoN® application was compared with a non-treated check. Yield, test weight, and moisture were measured.

Foliar samples were taken at V5, prior to the CoRoN® application.

N	P	K	S	Ca	Mg	B	Cu	Fe	Mn	Zn	Na
%						*ppm*					*%*
3.83	0.29	2.4	0.17	0.36	0.17	10	12	174	62	20	0.01

Results:

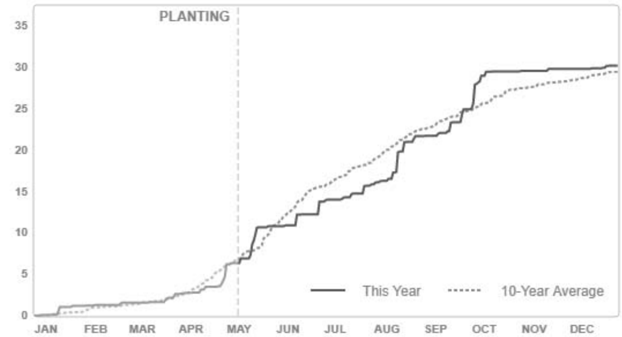
	Test Weight	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
CoRoN	60 A	12.9 A	110 A	575.08 A
Check	61 A*	13.0 A	110 A	591.46 A
P-Value	0.384	0.926	0.784	0.333

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 14% moisture.
‡Marginal net return based on $5.40/bu sorghum, $12.50 CoRoN® cost, and $8.13/ac application cost.

Summary: There was no difference in yield, moisture, test weight, or net return between the sorghum that was treated with CoRoN® and the non-treated check.

Foliar and In-Furrow Fertilizers Applied to Soybeans with Iron Chlorosis

Study ID: 722121201701
County: Merrick
Soil Type: Lex loam; Platte loam; Alda loam
Planting Date: 5/8/17
Harvest Date: 10/16/17
Population: 175,000
Row Spacing (in): 36
Variety: Syngenta S30-C1
Reps: 3
Previous Crop: Corn
Tillage: Ridge-Till and Cultivate
Herbicides: ***Post:*** 44 oz/ac glyposate and 12 oz/ac Flexstar® on 6/20/17
Seed Treatment: Dyna-Start® PBC and CruiserMaxx®
Foliar Insecticides: 5 oz/ac Bifenture® on 6/20/17
Fertilizer: 15 gal/ac 10-34-0
Irrigation: Pivot
Rainfall (in):



Introduction: Highly calcareous soils with pH levels above 7.8 can result in crops with symptoms of iron chlorosis. The soil at this site has a pH of 8.1 and iron chlorosis has been an issue on the field. This study tested several in-furrow and foliar applied fertilizer treatments.

All treatments including the check had 15 gal/ac of 10-34-0 in 2-by-2 orientation.

The products tested were:

- Toggle™ applied at a rate of 40 oz/ac at V2
- Max-IN® Iron applied at a rate of 32 oz/ac at V2
- Toggle™ at 40 oz/ac + Max-IN® Iron at 32 oz/ac at V2
- Aurora Bean Starter™ applied at a rate of 1 gal/ac at planting in-furrow
- Toggle™ at 8 oz/ac + IronForce-H at 80 oz/ac applied at planting in-furrow.

Yield, protein, oil, seed weight, and moisture were recorded.

Toggle™

0.1 - 0.4 - 1.6

GUARANTEED MINIMUM ANALYSIS	
Total Nitrogen (N)	0.1%
0.1% Water Soluble Nitrogen	
Available Phosphate (P_2O_5)	0.4%
Soluble Potash (K_2O)	1.6%
Derived from 100% *Ascophyllum nodosum*	

Product info from: http://www.kellysolutions.com/erenewals/documentsubmit/KellyData/ND%5CFertilizer%5CProduct%20Label%5CToggle_3_27_2015_3_08_21_PM.pdf

MAX-IN® Iron

The Next Generation of Foliar Nutrition
With
CornSorb® Technology

12-0-0

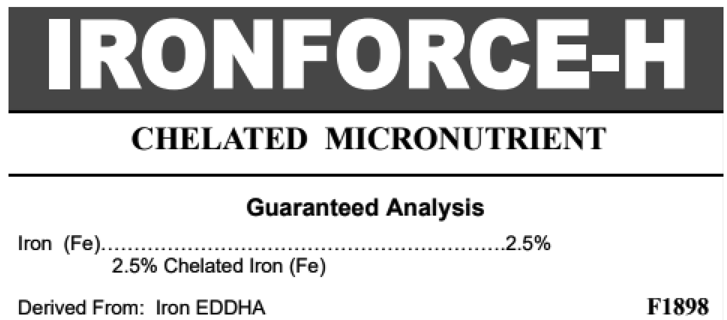
GUARANTEED ANALYSIS

Total Nitrogen (N)............ 12.0%
12.0% Urea Nitrogen
Iron (Fe)............ 5.0%
5.0% Water Soluble Iron (Fe)
Manganese (Mn)............ 1.0%
1.0% Water Soluble Manganese (Mn)

Derived From: Urea, Ferrous Sulfate and Manganese sulfate

Product info from:
http://www.kellysolutions.com/erenewals/documentsubmit/KellyData/ND%5CFertilizer%5CProduct%20Label%5C200115216_5_16_2016_2_56_24_PM.pdf

Product info from:
https://auroracoop.com/img/pdf/Emerge%20TogetherWin%20Together.pdf



Product info from:
http://www.kellysolutions.com/erenewals/documentsubmit/KellyData/ND%5CFertilizer%5CProduct%20Label%5CIRONFORCE_H_10_23_2014_1_41_29_PM.pdf

Results:

	Moisture (%)	Protein (%)	Oil (%)	Weight (grams/ 100 seeds)	Yield (bu/acre)†
Check	10.8 A*	38.7 A	19.9 A	21 A	76 A
Toggle at V2	11.0 A	38.6 A	20.4 A	21 A	78 A
Max-IN Iron at V2	11.3 A	38.9 A	20.4 A	21 A	78 A
Toggle + Max-IN Iron at V2	10.8 A	38.6 A	19.9 A	21 A	79 A
Aurora Bean Starter at Planting	11.1 A	39.1 A	20.2 A	21 A	79 A
Toggle + IronForce-H at Planting	10.9 A	38.7 A	19.9 A	21 A	80 A
P-Value	0.837	0.789	0.319	0.509	0.535

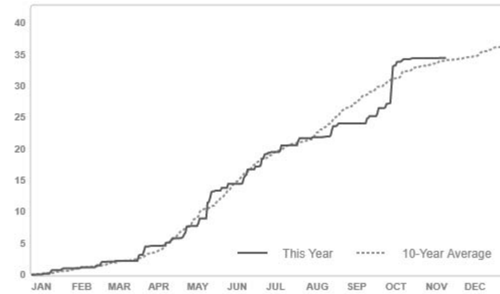
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.

Summary:

- None of the products tested increased yield compared with the check.
- Moisture, oil, protein, and seed weight were also not affected by any of the products.
- Costs for all products were not available; therefore, net return calculations are not provided.

Starter Fertilizer on Soybeans

Study ID: 027025201701
County: Cass
Soil Type: Kennebec silt loam occasionally flooded; Judson silt loam 2-6% slopes
Planting Date: 4/8/17
Harvest Date: 10/26/17
Population: 165,000
Row Spacing (in): 15
Variety: AG4034
Reps: 3
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 2.25 oz/ac Canopy®, 4 oz/ac Sencor® DF, 1 oz/ac Sharpen®, 2 pt/ac Stealth™, and 3 pt/ac Tomahawk® 5
Post: 0.45 oz/ac First-Rate®, 1 pt/ac Battle Star®, 10 oz/ac Clethodim, and 4 oz/ac Resource®
Seed Treatment: Acceleron® Complete
Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: None
Rainfall (in):



Soil Info:

O.M. (%)	C.E.C.	pH	P (ppm)	K (ppm)
3.1	16.3	7.1	21	244

Introduction:

Recommendations from industry, public institutions and growers in other states who are experiencing high yields often include the use of starter fertilizer as one of the factors for this accomplishment. This grower decided to validate this production input option on his own farm. Opti-Start Gold (product information below) was applied at a rate of 5 gal/ac as a starter fertilizer in a 2x2 placement (2 inches to the side of the furrow and 2 inches down into the soil.

GUARANTEED ANALYSIS	
Total Nitrogen (N) 5.4% Ammoniacal Nitrogen; 0.6% Urea Nitrogen	6.0%
Available Phosphate (P_2O_5)	20.0%
Soluble Potash (K_2O)	5.0%
Sulfur (S) 2.0% Combined Sulfur	2.0%
Manganese (Mn) 0.05% Chelated Manganese	0.05%
Zinc (Zn) 0.10% Chelated Zinc	0.10%

Derived from: Phosphoric Acid, Anhydrous Ammonia, Potassium Hydroxide, Urea, Ammonium Thiosulfate, Zinc Di-ammonium EDTA, Manganese Di-potassium EDTA .
Net weight 11 lb/gal at 68°F; pH 6.3

Product information from: https://s3-us-west-1.amazonaws.com/www.agrian.com/pdfs/OptiStart_Gold_Label.pdf

Aerial imagery was collected on September 3 to observe differences in plant vegetation. Aerial imagery was used to calculate the normalized difference vegetative index (NDVI). This index is indicative of overall plant biomass and greenness. True color imagery and NDVI are presented in *Figure 1*.

Results:

	Harvest Stand Count (plants/ac)	NDVI 09/03	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	152,833 B*	0.635 A	11.5 A	46 A	407.70 A
Starter	160,167 A	0.624 A	11.5 A	47 A	397.04 A
P-Value	0.002	0.187	0.423	0.260	N/A

†Bushels per acre corrected to 13% moisture.
*Values with the same letter are not significantly different at a 90% confidence level.
‡Marginal net return based on $8.90/bu soybean and $4.55/gal for Opti-Start Gold.

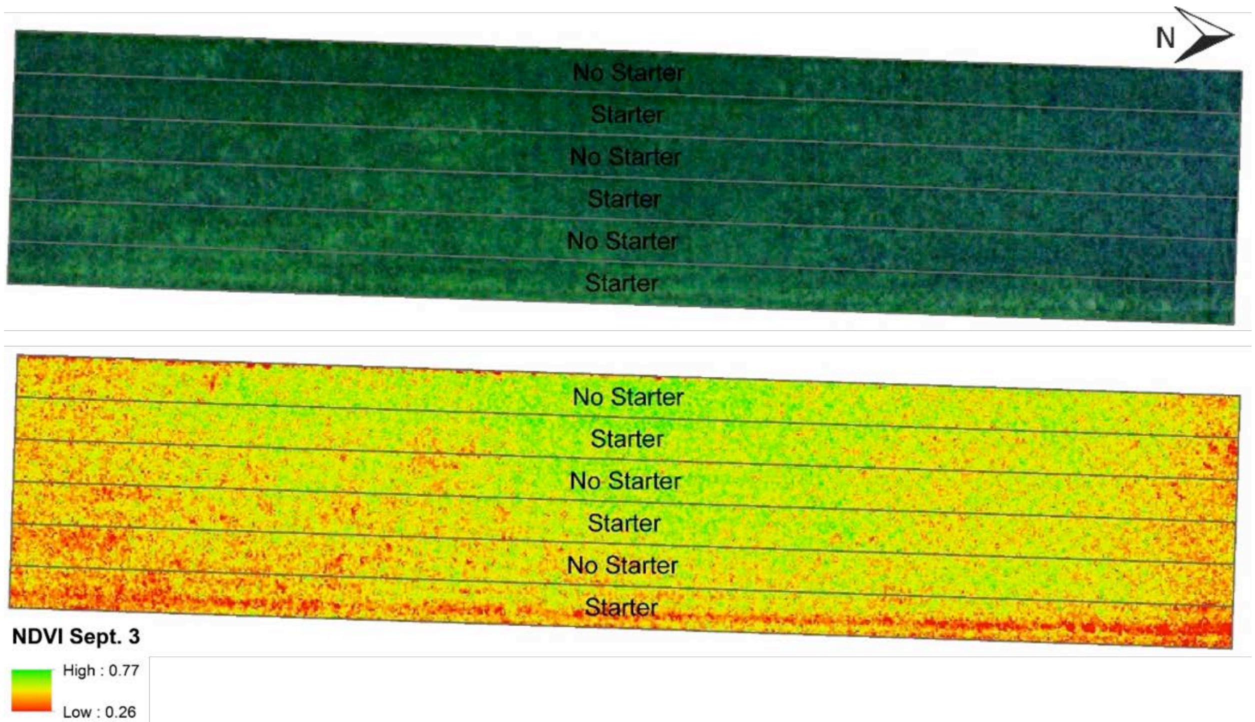


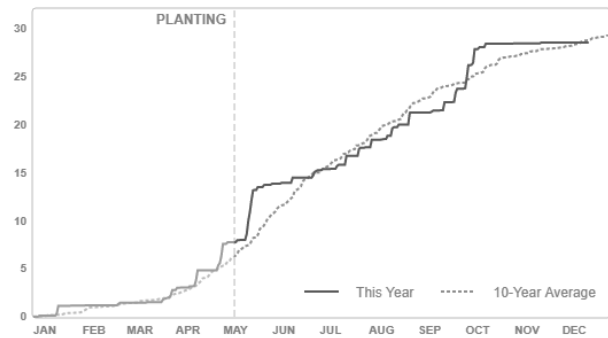
Figure 1. True color (red-green-blue) imagery (top) and NDVI (bottom) from September 3, 2017.

Summary:

- There was no yield increase for using starter fertilizer.
- Moisture and NDVI were the same for both the starter fertilizer treatment and the check.
- Because there were significant differences between starter and check harvest stand counts, we conducted a covariate analysis to test if the actual population affected yield. Including actual harvest populations as a covariate did not affect the analysis, so the analysis presented is the original yield presented.
- There was no statistical difference in net return.

Determining the Effects of Starter Fertilizers on Corn Yield

Study ID: 686035201701
County: Clay
Soil Type: Hastings silt loam; Crete silt loam
Planting Date: 5/8/17
Harvest Date: 10/19/17
Population: 34000
Row Spacing (in): 30
Hybrid: Pioneer 1257
Reps: 4
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Burndown:*** 12 oz/ac 2-4-D LV6, 30 oz/ac Durango®, and 3.84 oz/ac Weatherguard Complete on 4/7/17 ***Pre:*** 40 oz/ac Acuron®, 16 oz/ac Atrazine, 32 oz/ac Durango®, and 3.84 oz/ac Weatherguard Complete on 5/9/17 ***Post:*** 40 oz/ac Acuron®, 16 oz/ac Atrazine, 32 oz/ac Durango®, and 3.84 oz/ac Weatherguard Complete on 6/3/17
Foliar Insecticides: 1 pt/ac Lorsban and 6.4 oz/ac War Hawk® (Bifenthrin) pivot applied on 07/28/17
Foliar Fungicides: Quilt XL® aerial applied on 8/2/17
Fertilizer: 164 lb N/ac as anhydrous on 3/6/17 strip tilled; 15 gal/ac 32-0-0 on 6/7/17 coulter injected; 10 gal/ac 32-0-0 on7/7/17 pivot applied; 5 gal 32-0-0 on 7/31/17 pivot applied
Note: Minor hail on 6/13/17
Irrigation: Pivot, Total: 7.73
Rainfall (in):



Soil Tests (May 2017):

Soil pH 1:1	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	Ca-P Sulfate ppm S
6.9	1.19	NONE	2.2	38.0	91	10	153

DTPA (ppm)				Ammonium Acetate (ppm)				CEC me/100g	% Base Saturation				
Zn	Fe	Mn	Cu	K	Ca	Mg	Na		H	K	Ca	Mg	Na
1.01	35.6	13.1	0.58	236	2824	661	255	21.3	0	3	66	26	5

Introduction: The producer was interested in evaluating numerous starter fertilizer products in-furrow (under the seed tube) because new formulations and products were being promoted as improving emergence and increasing yield. The producer evaluated several of these products and compared them with an untreated check that received no starter fertilizer. The soil phosphorus level was 10 ppm (Mehlich-P3 test). In order to evaluate the impact of the starter products on emergence, stand counts were taken repeatedly as the crop emerged. From day to day, counts were taken within the same premeasured area. Yield was measured by weighing strips with a calibrated grain cart scale.

Results:

	Stalk Rot (%)	Test Weight	Harvest Stand Count	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	6.88 A*	58 A	35,125	17.7 A	285 A	897.11 A
3.5 gal 9-24-3	10.00 A	58 A	35,250	17.8 A	282 A	872.31 B
3.5 gal 9-24-3 + 46 oz Pro-Lock	20.63 A	58 A	35,000	17.5 A	284 A	865.97 BC
3.5 gal R8-24-3	13.75 A	58 A	34,875	17.7 A	283 A	873.40 B
3 gal Levitate + 1.1 gal 10-34-0	28.13 A	58 A	35,250	17.8 A	279 A	844.61 C
2.5 gal 10-34-0	15.63 A	58 A	34,875	17.3 A	280 A	873.49 B
2.5 gal 10-34-0 + 1qt Accomplish + 1pt Prozinc	10.63 A	58 A	35,500	17.3 A	281 A	866.86 B
P-Value	0.647	0.799	N/A	0.407	0.223	0.0002

*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 $3.15/bu corn and starter fertilizer costs of $17.15/ac for 3.5 gal 9-24-0, $28.26 for 3.5 gal 9-24-3 + 46 oz Pro-Lock, $18.76 for 3.5 gal R8-24-3, $33.69 for 3 gal Levitate + 1.1 gal 10-34-0, $9.83 for 2.5 gal 10-34-0, and $19.61 for 2.5 gal 10-34-0 + 1 qt Accomplish + 1 pt Prozinc

	Early Season Stand Count				
	5/16 AM	**5/16 PM**	**5/17 PM**	**5/18 AM**	**5/22 AM**
Check	30,875 A	35,125 A	35,250 A	35,250 A	35,375 A
3.5 gal 9-24-3	27,625 A	33,875 A	35,250 A	35,250 A	35,250 A
3.5 gal 9-24-3 + 46 oz Pro-Lock	26,500 A	34,125 A	35,750 A	35,875 A	35,875 A
3.5 gal R8-24-3	29,500 A	34,375 A	34,750 A	34,875 A	35,000 A
3 gal Levitate + 1.1 gal 10-34-0	29,625 A	35,125 A	35,250 A	35,250 A	35,500 A
2.5 gal 10-34-0	28,625 A	34,125 A	35,500 A	35,625 A	35,625 A
2.5 gal 10-34-0 + 1qt Accomplish + 1pt Prozinc	28,125 A	33,625 A	35,125 A	34,875 A	35,250 A
P-Value	0.229	0.644	0.801	0.508	0.778

	% of Final Stand (Harvest Stand Count)				
	5/16 AM	**5/16 PM**	**5/17 PM**	**5/18 AM**	**5/22 AM**
Check	88 A	100 A	100 A	100 A	101 A
3.5 gal 9-24-3	78 A	96 A	100 A	100 A	100 A
3.5 gal 9-24-3 + 46 oz Pro-Lock	76 A	98 A	102 A	103 A	103 A
3.5 gal R8-24-3	85 A	99 A	100 A	100 A	100 A
3 gal Levitate + 1.1 gal 10-34-0	84 A	100 A	100 A	100 A	101 A
2.5 gal 10-34-0	82 A	98 A	102 A	102 A	102 A
2.5 gal 10-34-0 + 1qt Accomplish + 1pt Prozinc	79 A	95 A	99 A	98 A	99 A
P-Value	0.345	0.855	0.882	0.687	0.874

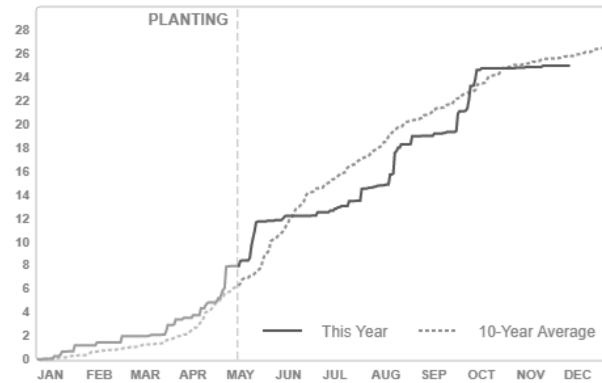
Summary:

- There was no difference in emergence between any of the starter fertilizer products tested or between the starter products and the untreated check.
- There was no difference in stalk rot, test weight, grain moisture, or grain yield between any of the starter fertilizer products and the untreated check.
- Marginal net return was significantly greater for the untreated check due to not having the starter fertilizer product input cost.

Starter Fertilizer on Irrigated Corn

Study ID: 708077201701
County: Greeley
Soil Type: Gates silt loam; Hersh fine sandy loam
Planting Date: 5/8/17
Harvest Date: 11/15/17
Population: 31,000
Row Spacing (in): 30
Hybrid: DKC 61-55
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 16 oz/ac 2,4-D LV4 and 24 oz/ac Durango® DMA® on 4/18/17 ***Post:*** 3 qt/ac Lexar® EZ and 24 oz/ac Durango® DMA® on 6/15/17
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: 52 lb/ac N as 32% UAN on 4/22/17; 150 lb/ac P and 80 lb/ac K on 4/29/17; 120 lb/ac N and S (28-0-0-6) applied through fertigation
Irrigation: Pivot
Rainfall (in):



Soil Tests (spring 2014):

OM	pH	BpH	CEC	Bray P1	Bray P2	K	Mg	Ca	NO_3	S	Zn	K	Mg	Ca	H
%				-------	-------	-------	ppm	-------	-------	-------		-------	%	-------	
0.7	5.4	6.7	8.4	49	64	175	159	843	8	15	1.5	5.3	15.8	50.2	28.7
0.6	5.8	6.8	6.9	41	54	151	157	783	4	13	1.6	5.6	19	56.7	18.7
0.7	5.6	6.7	8.5	51	61	147	186	920	6	7	1.3	4.4	18.2	54.1	23.3
0.5	5.5	6.7	6.7	56	63	143	136	691	4	7	1.2	5.5	16.9	51.6	26
1.2	7.6	7.1	17.2	26	137	257	364	2699	9	9	1.4	3.8	17.6	78.6	0
1.0	6.1	6.8	10.6	44	66	201	222	1349	7	7	1.6	4.9	17.5	63.6	14

Introduction: The purpose of this study was to evaluate starter fertilizer on corn production. The starter fertilizer included 5 gal/ac 10-34-0 and 1 qt/ac Zn. The starter treatment was compared with a no starter check.

Previous on-farm research on starter fertilizer on corn found that for soils with phosphorus levels <10 ppm, an increase of 12 bu/ac was realized due to starter, for soils with phosphorus levels of 10-20 ppm, an increase of 3 bu/ac was realized, and for soils with phosphorus levels of 20-30 ppm, only 1 bu/ac yield increase was realized due to starter fertilizer (https://go.unl.edu/starter). Studies have shown there can be an early growth and yield response from N in an N-P starter fertilizer (https://go.unl.edu/starterfert).

Results:

	Test Weight	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	60 A*	16.8 A	201 B	633.89 A
Starter (5 gal 10-34-0 + 1 qt Zinc)	60 A	16.7 A	214 A	658.87 A
P-Value	0.607	0.718	0.041	0.141

*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 $3.15/bu corn and $16.41/ac cost for starter products.

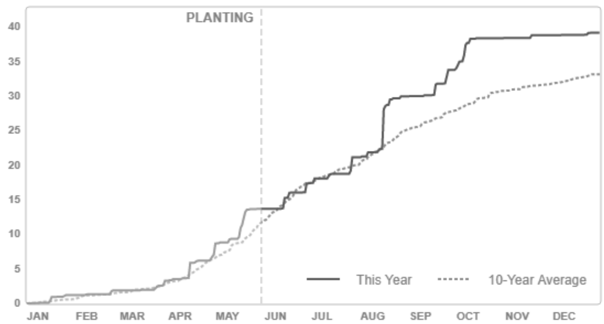
Summary:

- There was no difference in moisture or test weight between the starter fertilizer and the check.
- The starter fertilizer resulted in a yield increase of 13 bu/ac.

Impact of Kickoff® Fertilizer and Optify®/Stretch on Quality and Yield of Soybeans

Study ID: 218023201701
County: Butler
Soil Type: Hastings silty clay loam 3-7% slopes; Crofton silt loam
Planting Date: 5/30/17
Harvest Date: 10/19/17
Population: 140,000
Row Spacing (in): 30
Variety: Asgrow 3432 Gen RR2Y
Reps: 4
Previous Crop: Corn
Seed Treatment: Batch #5 Acceleron®

Irrigation: None
Rainfall (in):



Introduction: The purpose of this study is to evaluate Kickoff® fertilizer and Optify®/Stretch applied in-furrow at planting. Kickoff was applied at a rate of 6 gal/ac and is comprised of 9-15-4, 3S, 0.5Zn, and 0.05 Mn. Actual nutrients supplied by this application are 5.8 lb N/ac, 9.7 lb P/ac, 2.6 lb K/ac, 1.9 lb S/ac, 0.32 lb Zn/ac, and 0.03 lb Mn/ac. Optify®/Stretch was applied at a rate of 8 oz/ac. Product ingredients for Optify®/Stretch are below.

Optify®/Stretch

INGREDIENTS

0.11% Complex Polymeric Polyhydroxy Acids (CPPA)
0.01% Cytokinin (as kinetin)

Product information from:
https://www.winfieldunited.com/Product/Optify%C2%AE-Stretch/278

Results:

	Yield (bu/acre)†	Protein (%)	Oil (%)	Weight (grams/100 seeds)
Check	64 A*	40.5 A	17.5 B	18 A
Kickoff Fertilizer	64 A	39.8 B	17.9 A	18 A
Kickoff Fertilizer + Optify/Stretch	68 A	40.3 AB	17.6 AB	18 A
P-Value	0.317	0.098	0.098	0.848

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.

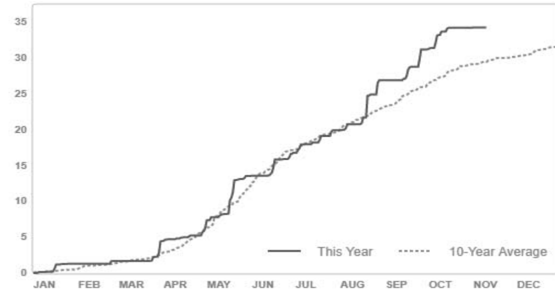
Summary:

- There was no yield or weight increase for using Kickoff® and Optify®/Stretch.
- The Kickoff® treatment had significantly lower protein and significantly higher oil than the check.
- Product prices were not available; therefore, no net return calculations could be completed.

Impact of Commence® Seed Treatment at Planting on Soybean Yield

Study ID: 704151201701
County: Saline
Soil Type: Muir silt loam rarely flooded; Zook silt loam occasionally flooded
Planting Date: 5/6/17
Harvest Date: 10/20/17
Population: 140,000
Row Spacing (in) 30
Variety: Asgrow 3231
Reps: 7
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 0.5 lb/acre Sencor®, 1 qt/acre Dual®, 5 oz/acre Valor® XLT, 0.5 pt/acre 2,4D ***Post:*** 1 qt/acre Roundup®, 1 qt/acre Dual®

Seed Treatment: Fungicide, Cruiser®, and 1/2 rate of ILeVO®
Foliar Insecticides/Fungicides: None
Fertilizer: 100 lb/ac 11-52-0, 2 lb/ac Zn, 4 lb/ac S applied broadcast in the spring
Irrigation: Pivot, Total: 6"
Rainfall (in.):



Soil Tests (2015):

OM (%)	**pH**	**Buffer pH**	**Bray P1** (ppm)	**K** (ppm)	**Zinc** (ppm)	**Sulfate S** (ppm)	**NO3-N**
2.4	6.1	6.8	28	261	0.7	8	6.9
2.9	6.0	6.7	16	273	0.8	8	6.4

Introduction: This study was looking at Commence® seed treatment applied to soybeans. The product was applied at 4 oz/100 lb of seed. This product was applied following other seed treatments applied to the soybeans. Product information is at right. Yield was recorded using a weigh wagon *(Table 1, Figure 1)*.

GUARANTEED ANALYSIS	
Cobalt (Co)	1.90%
Copper (Cu)	0.45%
Iron (Fe)	0.94%
Manganese (Mn)	0.61%
Zinc (Zn)	0.38%

PLANT NUTRIENT DERIVED FROM: Cobalt Carbonate, Cobalt Sulfate, Copper (II) Carbonate, Iron (III) Oxide, Manganese (II) Oxide, Manganese (II) Sulfate, Zinc Carbonate, Zinc Sulfate

Product information from:
http://www.kellysolutions.com/erenewals/documentsubmit/KellyData/ND%5CFertilizer%5CProduct%20Label%5CCommence_for_Soybeans_9_1_2015_10_52_24_AM.pdf

Results:

	Harvest Stand Count (plants/ac)	**Test Weight (lb/bu)**	**Moisture (%)**	**Yield (bu/acre)†**	**Marginal Net Return‡ ($/ac)**
Check	110,571 A*	56 A	12.3 A	68.4 A	608.93 A
Commence	107,000 A	56 A	12.3 A	69.5 A	612.70 A
P-Value	0.317	0.362	0.778	0.162	0.561

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $6/ac Commence product and application cost.

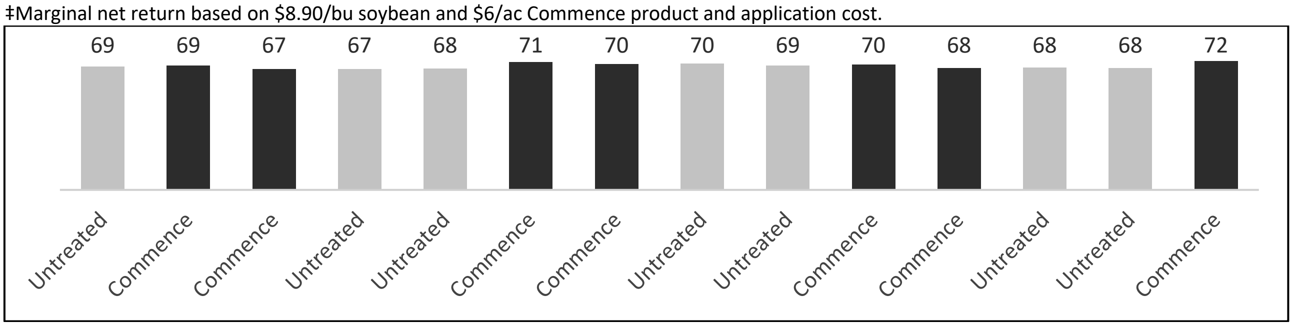


Figure 1. Yield average by treatment (bu/ac) across the field.

Summary: There were no differences in test weight, moisture, harvest stand counts, yield, or net return between the Commence® treated seed and the untreated seed. Some lodging and stem breakage noted at harvest.

This study sponsored in part by: Agnition

Impact of Commence® Seed Treatment on Corn Summary (3 sites)

The purpose of this study was to evaluate Commence® seed treatment. Commence® was applied at a rate of 6 oz/100 lb of seed. Product information is below.

GUARANTEED ANALYSIS
Cobalt (Co)................ 1.58%
Copper (Cu) 0.33%
Iron (Fe).................... 0.85%
Manganese (Mn)....... 0.49%
Zinc (Zn) 0.27%

Product information from: *Agnition*

Three studies were conducted in 2017, for a total of 19 replications. Data from these studies were analyzed together using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation was done with Fisher's LSD.

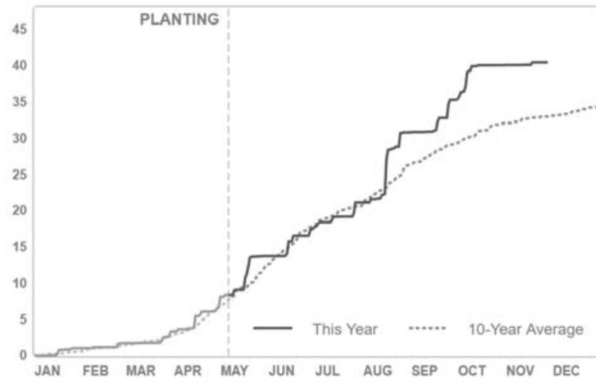
Table 1. Yield of corn with and without Commence seed treatment from three site locations.

	Yield (bu/acre)†
Check	180.6 A
Commence Seed Treatment	182.4 A
Site (P>F)	*<0.0001*
Treatment (P>F)	*0.1255*
*Site*Treatment*	*0.0892*

Summary: There was no significant yield increase for using Commence seed treatment when all three sites are considered together. The sites did have significantly different yields, and there was an interaction of site and treatment indicating the sites responded differently to the Commence seed treatment.

Impact of Commence® Seed Treatment at Planting on Corn Yield

Study ID: 007155201702
County: Saunders
Soil Type: Yutan, eroded-Aksarben silty clay loam 2-6% slopes; Judson silt loam 2-6% slopes; Yutan, eroded-Judson complex 6-11% slopes
Planting Date: 5/6/17
Harvest Date: 11/6/17
Population: 32,000
Row Spacing (in): 15
Hybrid: Channel 207-27VT2
Reps: 7
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 32 oz/ac Buccaneer® Plus, 4.5 oz/ac Corvus®, 1 lb/ac Atrazine, and 1.5 gal/100 gal Liquid AMS on 4/11/17 ***Post:*** 24 oz/ac Buccaneer® 5, 3 oz/ac Laudis™, and 8.5 lb/100 gal dry AMS on 6/16/17
Seed Treatment: Acceleron® Basic
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 140 lb/ac N as 32% UAN on 5/7/17; Variable rate application of 11-52-0 in spring; 8 gal/ac 6-24-6 and 1 pt/ac chelated zinc with planting
Irrigation: None
Rainfall (in):



Introduction:

The purpose of this study was to evaluate Commence® seed treatment. Commence® was applied at a rate of 6 oz/100 lb of seed. Product information is at right. Corn was planted into standing rye that was sprayed just prior to planting.

GUARANTEED ANALYSIS

Cobalt (Co)	1.58%
Copper (Cu)	0.33%
Iron (Fe)	0.85%
Manganese (Mn)	0.49%
Zinc (Zn)	0.27%

Product information from: *Agnition*

Results:

	Stand Count	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	29,600	15.3 A*	182 B	571.70 A
Commence Seed Treatment	31,600	15.4 A	187 A	581.96 A
P-Value	-	0.172	0.040	0.150

*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 $3.15/bu corn and $6/ac for Commence seed treatment and application cost.

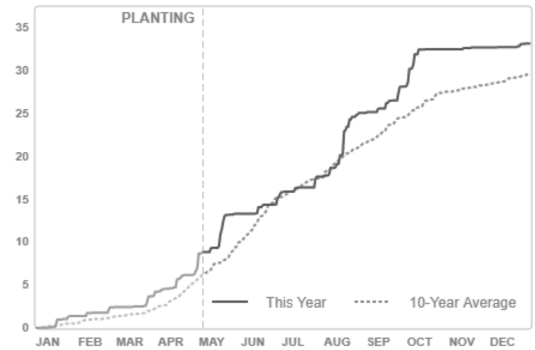
Summary:

- Stand counts were taken mid-season. They were not taken for each replication, so no statistics were conducted.
- There was no difference in grain moisture for Commence® treated seed versus the check.
- The corn treated with Commence® seed treatment yielded 5 bu/ac higher than the untreated check.

Impact of Commence® Seed Treatment at Planting on Corn Yield

Study ID: 726037201701
County: Colfax
Soil Type: Shell silt loam; Alcester silty clay loam; Moody silty clay loam
Planting Date: 5/4/17
Row Spacing (in): 30 (planted in twin rows)
Hybrid: Seitec 6433
Reps: 7
Previous Crop: Soybean
Tillage: No-Till
Herbicides: Trizar®, Roundup®, Instinct®, and Laudis®
Fertilizer: 150 lb N/ac from 32-0-0. 5 gal/ac 10-54-0 starter on 5/4/17.

Rainfall (in):



Introduction: The purpose of this study was to evaluate Commence® seed treatment. Commence® was applied at a rate of 6 oz/100 lb of seed. See product information at right.

GUARANTEED ANALYSIS
Cobalt (Co)................ 1.58%
Copper (Cu) 0.33%
Iron (Fe).................... 0.85%
Manganese (Mn)....... 0.49%
Zinc (Zn) 0.27%

Product information from: *Agniton*

Results:

	Early Season Stand Count	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	28,191 A*	19.2 A	212 A	667.94 A
Commence Seed Treatment	25,119 B	19.1 A	211 A	659.83 A
P-Value	0.018	0.31	0.736	0.224

*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 $3.15/bu corn and $6/ac Commence Seed Treatment product and application cost.

Summary:

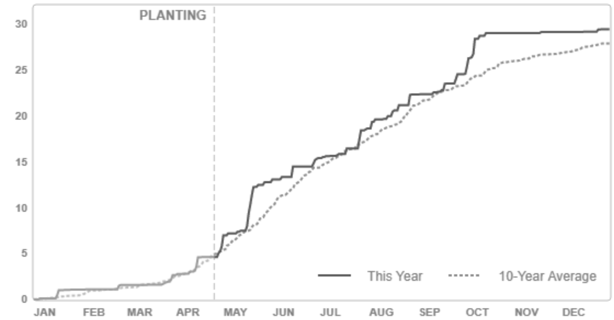
- Stand counts were taken early in the season. The grower treated the seed with Commence® the morning of the day he planted and had issues with seed not metering properly for the Commence® seed despite adding talc. This likely resulted in the lower early season stand counts and may have contributed to lack of yield response for the Commence® seed treatment.
- There was no difference in grain moisture or net return for Commence® treated seed versus the check.

This study sponsored in part by: Agnition

Evaluation of Commence®, Generate® and Bio-Sure Grow in Corn

Study ID: 011035201701
County: Clay
Soil Type: Butler silt loam; Crete silt loam; Fillmore silt loam
Harvest Date: 9/21/17
Population: 24,000
Row Spacing (in): 30
Hybrid: DKC 63-55
Reps: 5
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** Acuron® Herbicide, AATrex®, and Touchdown Total®
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: 125 lb/ac N, 1 pt/ac Agrotain® Ultra; 3 gal/ac of 6-24-6 starter with 1 qt/ac zinc at planting
Irrigation: None
Rainfall (in):



Introduction: This study evaluated the impact of several microbial and nutrient products on corn yield and soil health tests. All treatments, including the check, received 3 gal/ac 6-24-6 non-salt starter and 1 qt/ac zinc. Three microbial and nutrient treatments were evaluated. Commence was applied to the seed prior to planting. Bio-Sure Grow was applied at a rate of 1 gal/ac in-furrow at planting. Generate was applied at a rate of 1 pt/ac in-furrow at planting. Product information is below.

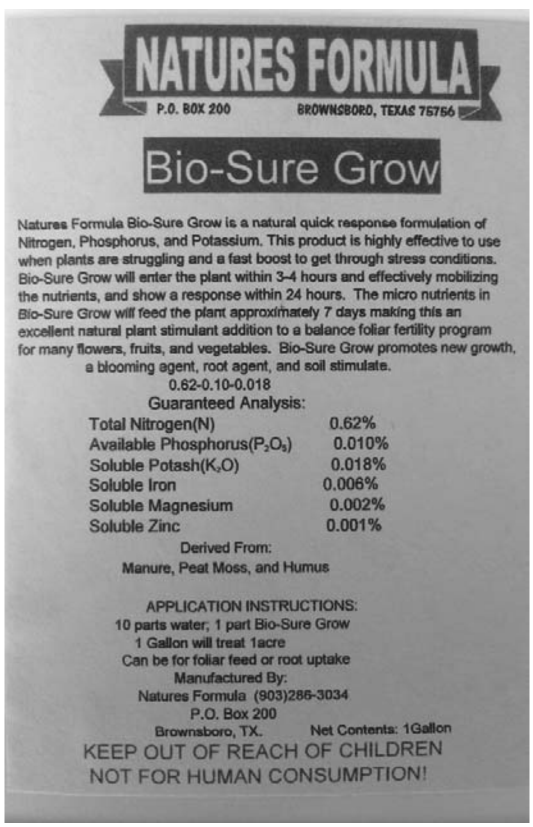
There were extreme drought conditions at this location, which impacted yield. Biological tests were collected for each treatment during the growing season.

Commence®

GUARANTEED ANALYSIS

Cobalt (Co)	1.58%
Copper (Cu)	0.33%
Iron (Fe)	0.85%
Manganese (Mn)	0.49%
Zinc (Zn)	0.27%

Product information from: *Agnition*


NATURES FORMULA
P.O. BOX 200 BROWNSBORO, TEXAS 75756
Bio-Sure Grow

Natures Formula Bio-Sure Grow is a natural quick response formulation of Nitrogen, Phosphorus, and Potassium. This product is highly effective to use when plants are struggling and a fast boost to get through stress conditions. Bio-Sure Grow will enter the plant within 3-4 hours and effectively mobilizing the nutrients, and show a response within 24 hours. The micro nutrients in Bio-Sure Grow will feed the plant approximately 7 days making this an excellent natural plant stimulant addition to a balance foliar fertility program for many flowers, fruits, and vegetables. Bio-Sure Grow promotes new growth, a blooming agent, root agent, and soil stimulate.

0.62-0.10-0.018
Guaranteed Analysis:

Total Nitrogen(N)	0.62%
Available Phosphorus(P_2O_5)	0.010%
Soluble Potash(K_2O)	0.018%
Soluble Iron	0.006%
Soluble Magnesium	0.002%
Soluble Zinc	0.001%

Derived From:
Manure, Peat Moss, and Humus

APPLICATION INSTRUCTIONS:
10 parts water; 1 part Bio-Sure Grow
1 Gallon will treat 1acre
Can be for foliar feed or root uptake
Manufactured By:
Natures Formula (903)286-3034
P.O. Box 200
Brownsboro, TX. Net Contents: 1Gallon
KEEP OUT OF REACH OF CHILDREN
NOT FOR HUMAN CONSUMPTION!

Generate®

GUARANTEED ANALYSIS

Cobalt (Co)	0.52%
Copper (Cu)	0.14%
Iron (Fe)	0.28%
Manganese (Mn)	0.11%
Molybdenum (Mo)	0.001%
Sodium (Na)	0.11%
Zinc (Zn)	0.11%

PLANT NUTRIENT DERIVED FROM: Cobalt Carbonate, Iron Oxide, Manganese Oxide, Copper Sulfate, Zinc Sulfate, Molybdic Acid, Sodium EDTA

Product information from: *http://www.kellysolutions.com/erenewals/documentsubmit/KellyData/ND/Fertilizer/Product%20Label/GENERATE_STARTER_2_25_2013_1_34_39_PM.pdf*

Results:

	Harvest Stand Count	Stalk Rot (%)	Moisture (%)	Test Weight	Yield† (bu/ac)	Marginal Net Return‡ ($/ac)
Check	20,500 A*	18.50 A	14.9 A	59 A	148 A	466.96 A
Commence	20,500 A	14.50 A	14.4 B	58 A	149 A	463.60 A
Commence + Bio-Sure Grow	21,800 A	21.50 A	14.7 AB	58 A	150 A	449.80 B
Commence + Bio-Sure Grow + Generate	22,000 A	26.50 A	14.6 B	59 A	149 A	440.04 B
P-Value	0.054	0.403	0.009	0.488	0.906	0.001

*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 $3.15/bu corn, $6/ac for Commence Seed Treatment, $8/ac for Generate, and $15/ac for Bio-Sure Grow,

	PLFA Total	PLFA Func Group Index	PLFA Total Bacteria	PLFA Gram +	PLFA Gram -	PLFA Total Fungi	PLFA Total Arbus Myc
Check	1,593 A	2 A	733 A	511 A	223 A	146 A	21 A
Commence	1,171 A	2 A	569 A	376 A	193 A	115 AB	16 AB
Commence + Bio-Sure Grow	801 A	1 A	401 A	337 A	63 A	27 B	2 B
Commence + Bio-Sure Grow + Generate	1,669 A	2 A	676 A	464 A	212 A	125 A	15 AB
P-Value	0.232	0.006	0.109	0.188	0.110	0.04	0.086

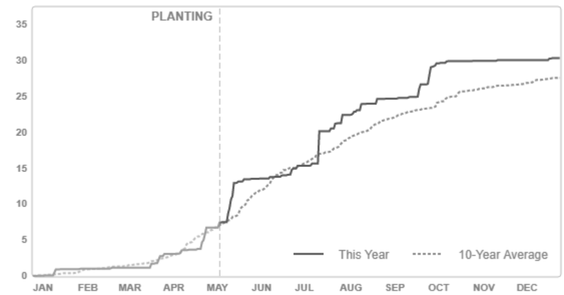
	PLFA Saprophytes	PLFA Protozoa	PLFA Undifferentiated	Haney pH	Haney OM	Haney Solvita	Haney Soil Health
Check	125 A	1 A	714 A	5 A	3 A	48 A	8 A
Commence	99 AB	0 A	487 A	7 A	3 A	33 A	6 A
Commence + Bio-Sure Grow	25 B	0 A	374 A	5 A	3 A	39 A	6 A
Commence + Bio-Sure Grow + Generate	110 A	0 A	869 A	5 A	3 A	39 A	7 A
P-Value	0.038	0.455	0.370	0.087	0.514	0.527	0.394

Summary:

- Of the soil quality measures, PFLA functional group index, PFLA total fungi, PFLA saprophytes, and Haney pH were significantly different between some of the treatments.
- None of the products tested resulted in increased yield compared with the starter alone check.
- The Commence® seed treatment and Commence® + Bio-Sure Grow + Generate® treatment had drier grain moisture at harvest compared with the check.
- None of the products had reduced stalk rot compared with the starter alone check.
- The addition of Bio-Sure Grow and Generate® resulted in decreased net return compared with the untreated check and the Commence® treatment.

Nitrogen Application to Corn Following Cover Crops

Study ID: 731061201701
County: Franklin
Soil Type: Kenesaw silt loam 0-1% slope; Kenesaw silt loam 1-3% slope
Planting Date: 5/10/17
Harvest Date: 10/19/17
Population: 30,000
Row Spacing (in): 30
Hybrid: Cropland
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** Roundup® and a pre-plant residual
Foliar Insecticides: None
Foliar Fungicides: None
Note: Hail and wind in October 2017; 25-30 bushels on the ground; marked off 17.5 ft of row and counted ears.
Irrigation: Pivot, Total: 4"
Rainfall (in):



Introduction: The purpose of this study was to better understand N management of corn following cover crops. The cover crop mix included cereal rye, winter wheat, and winter pea. They were established by drilling in the fall following harvest and were grazed in the spring. They were terminated at the end of April, prior to planting. Nitrogen was applied as dry N spread on May 15, 2017 at four rates: 0, 75, 150, and 225 lb N/acre. The plot layout is shown in *Figure 1*. Plot sizes ranged from 0.11 acres to 0.76 acres. Soil tests were taken for each plot in April 2017 prior to application of N *(Table 1)*.

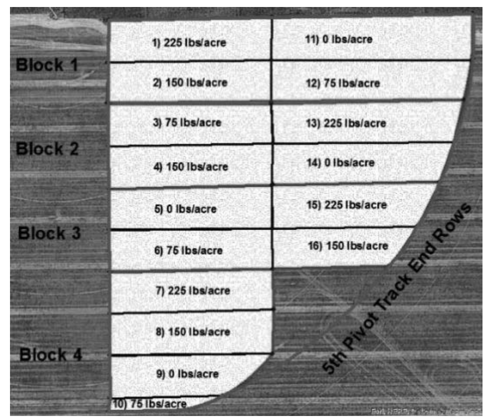


Figure 1. Plot layout.

Table 1. Soil samples for each plot. ID number corresponds to the plot number in *Figure 1*.

ID	Soil pH 1:1	BpH	Soluble Salts 1:1 mmho/cm	OM LOI %	Nitrate – N ppm N	Nitrate lb N/A	Mehlich P-III ppm P	Sulfate-S ppm	DPTA (ppm) Zn	Fe	Mn	Cu	Ammonium Acetate (ppm) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
1	5.8	6.6	0.18	3.5	2.5	6	109	18	2.7	85.6	26.8	1.15	429	1606	254	32	15.5	26	7	52	14	1
2	6.1	6.8	0.14	2.4	4.3	10	19	17	1.9	45.5	23.1	0.68	271	1372	197	36	11.5	18	6	60	14	1
3	6.6		0.15	2.6	4.9	12	21	17	2.5	36.6	13.0	1.51	259	1320	180	32	8.9	0	7	74	17	2
4	6.7		0.19	3.2	3.2	8	30	17	2.9	49.7	14.1	1.52	386	1669	248	41	11.6	0	9	71	18	2
5	6.6		0.13	2.0	2.7	6	19	15	3.5	30.0	15.9	0.65	301	1362	193	31	9.3	0	8	73	17	1
6	6.4	6.9	0.12	2.4	1.9	5	17	16	2.1	38.6	17.0	0.75	271	1463	212	62	11.1	10	6	66	16	2
7	6.2	6.9	0.12	2.3	1.8	4	26	15	2.2	36.2	17.5	0.70	246	1343	209	29	10.2	10	6	66	17	1
8	6.5	6.9	0.11	1.8	4.4	11	14	14	2.4	33.0	16.0	0.59	253	1232	181	35	9.2	8	7	67	16	2
9	5.8	6.7	0.11	2.2	2.8	7	48	18	1.9	77.1	20.9	0.94	361	1734	284	40	15.2	20	6	57	16	1
10	6.3	6.9	0.12	2.3	2.2	5	18	20	2.5	40.9	17.4	0.81	314	1664	247	39	12.7	10	6	66	16	1
11	6.3	6.8	0.15	3.0	4.6	11	168	18	3.4	134.3	10.7	1.47	428	1916	324	47	15.8	14	7	61	17	1
12	6.3	6.8	0.14	2.9	3.1	7	115	19	2.9	101.0	12.3	1.14	425	1764	265	38	14.5	15	8	61	15	1
13	5.9	6.8	0.10	2.4	2.5	6	36	17	2.2	66.1	21.4	0.81	281	1407	209	39	12.1	20	6	58	14	1
14	6.3	6.9	0.13	2.4	2.5	6	31	17	2.1	52.8	19.4	0.90	369	1727	270	43	13.3	10	7	65	17	1
15	6.7		0.15	3.0	4.3	10	24	18	2.7	36.5	13.9	0.70	409	1591	240	36	11.2	0	9	71	18	1
16	6.4	6.9	0.19	3.2	3.0	7	30	16	4.0	48.0	16.9	0.83	438	1758	254	37	13.3	8	8	66	16	1

Table 2. Soil health tests from each treatment area taken in April, prior to N application and planting.

Treatment lb N/acre	Solvita CO2 Burst, ppm C	Total Nitrogen, ppm N	Organic Nitrogen, ppm N	Total Organic Carbon, ppm C	Nitrate, ppm NO3-N	Ammonium, ppm NH4-N	Inorganic Nitrogen, ppm N	Organic C : Organic N	Nitrogen Mineralization, ppm N	Organic Nitrogen Release, ppm N	Organic Nitrogen Reserve, ppm N	Soil Health Calculation
0	113.0	20.7	16.8	203	3.3	1.5	4.8	12.0	16.3	16.8	0.0	13.09
75	128.0	20.5	17.8	225	2.0	1.6	3.7	12.7	16.7	17.8	0.0	14.14
150	102.0	18.7	15.5	186	2.7	1.3	4.0	12.0	14.8	15.5	0.0	11.89
225	123.0	19.5	16.7	228	2.3	1.5	3.9	13.6	13.5	16.7	0.0	12.98

NDRE (normalized difference vegetation index) data was collected weekly with a RapidSCAN CS-45 Handheld Crop Sensor (Holland Scientific, Lincoln, NE). NDRE imagery was also obtained using a drone and multispectral sensor. Yield was collected for each plot by hand harvesting.

Results: Significant differences in NDRE collected with a RapidSCAN were apparent between treatments throughout the growing season *(Table 3)*. At the first two data collection dates (6/29 and 7/6) there were no differences between the 75, 150, and 225 lb N/ac treatments. At the third and fourth data collection dates, the 75 lb N/ac treatment had a significantly lower NDRE than the 150 and 225 lb N/ac treatments. Throughout the season, no differences in NDRE were apparent between the 150 and 225 lb N/ac treatments. Quadratic regressions of these measurements are shown in *Figure 2*.

Table 3. NDRE collected with a RapidSCAN from each N treatment during the growing season from V8 (6/29) to VT/R1 (8/1).

	NDRE (6/29)	NDRE (7/6)	NDRE (7/13)	NDRE (7/19)	NDRE (7/25)	NDRE (8/1)
0 lb N/ac	0.254 B*	0.338 B	0.372 C	0.393 C	0.357 B	0.385 C
75 lb N/ac	0.291 A	0.391 A	0.413 B	0.440 B	0.408 A	0.435 B
150 lb N/ac	0.313 A	0.405 A	0.429 A	0.463 A	0.422 A	0.462 AB
225 lb N/ac	0.314 A	0.399 A	0.433 A	0.465 A	0.434 A	0.472 A
P-Value	0.004	0.0002	<0.0001	0.0001	0.001	0.0003

*Values with the same letter are not significantly different at a 90% confidence level.

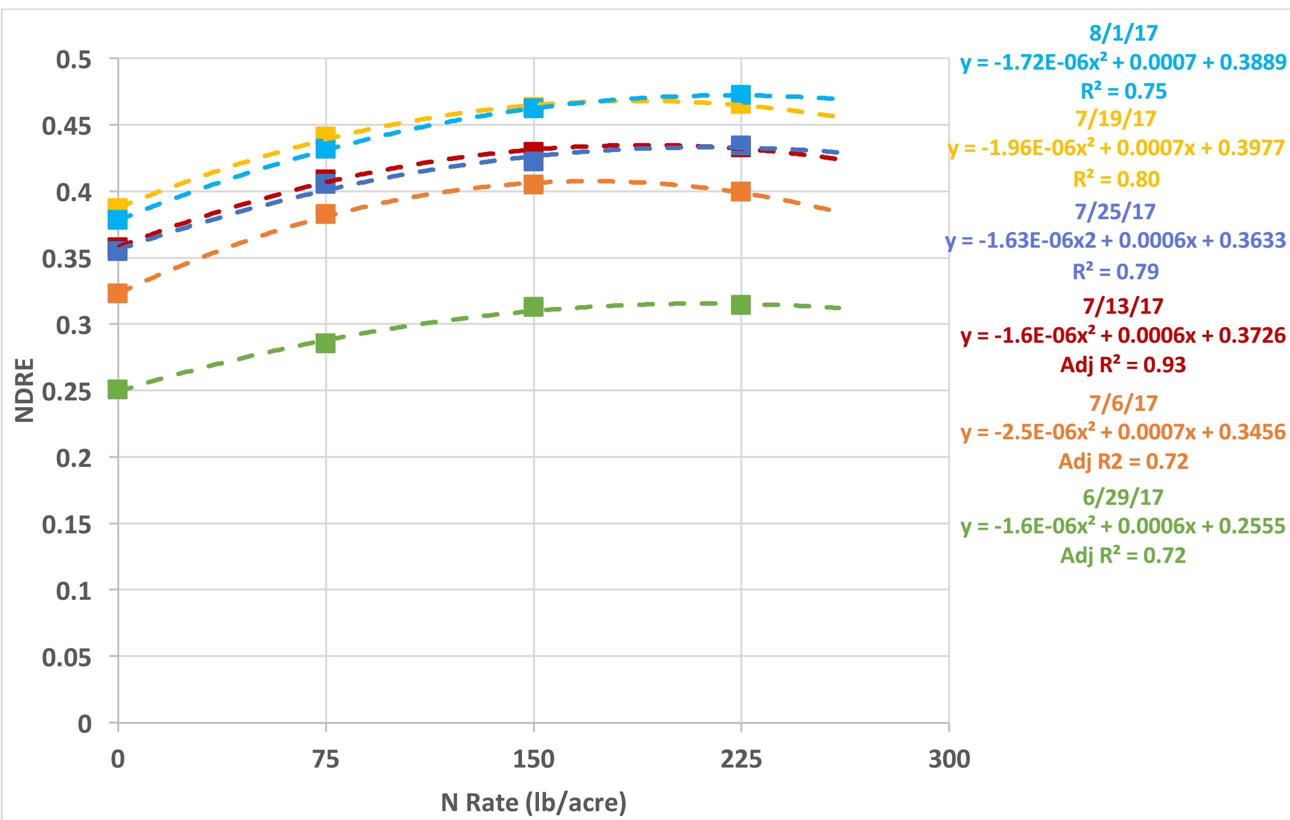


Figure 2. Quadratic regression and equations for NDRE data collected with the RapidSCAN.

NDRE of the plot area was also obtained using a drone and sensor *(Figure 3)* in August. While imagery was not quantitatively analyzed, differences are apparent between the treatments.

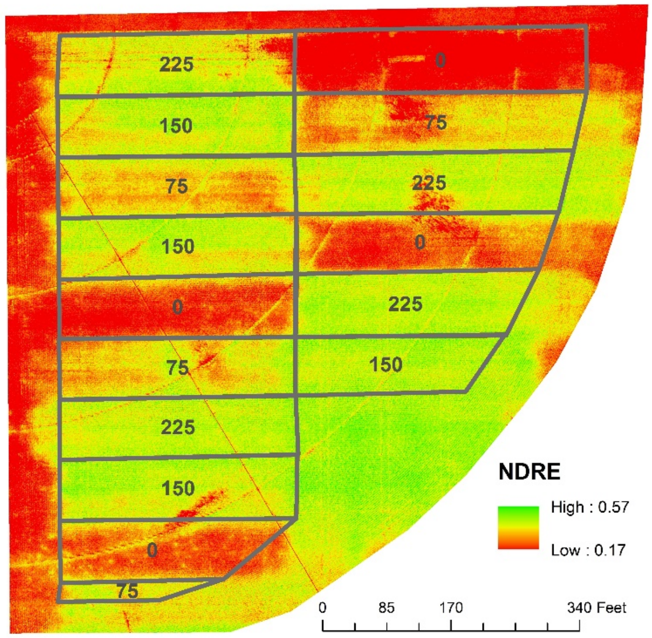


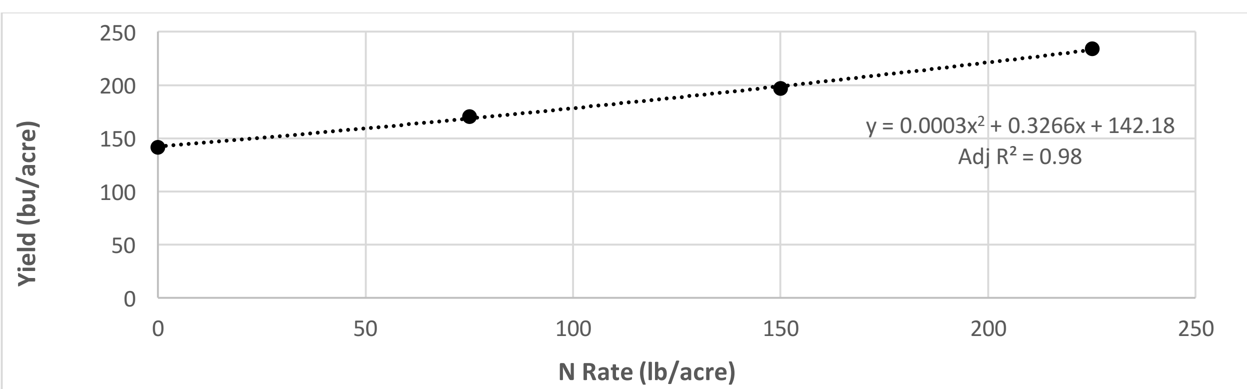
Figure 3. NDRE (normalized difference red edge) index imagery of the plot area on August 1, 2017. Difference in NDRE values for the various N treatments are apparent.

Yield was collected via hand harvesting. Significant differences in yield and marginal net return are apparent. The highest yield and net return was obtained in the 225 lb N/ac treatment.

Table 4. Yield and net return for the four nitrogen rates measured.

	Yield (bu/acre) †	Marginal Net Return‡ ($/ac)
0 lb N/ac	142 D	445.86 D
75 lb N/ac	171 C	500.29 C
150 lb N/ac	197 B	552.88 B
225 lb N/ac	234 A	637.89 A
P-Value	<0.0001	<0.0001

†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 15% moisture.
‡Marginal net return based on $3.15/bu corn, $0.41/lb N fertilizer, and $6.17/ac application cost.



Summary: A maximum N rate of 225 lb N/ac was selected with a goal of providing an excess of N so that the plateau of yield response to N could be identified. However, results indicated that the highest N rate resulted in the highest yield; it is unknown if higher N applications would have resulted in greater yields.

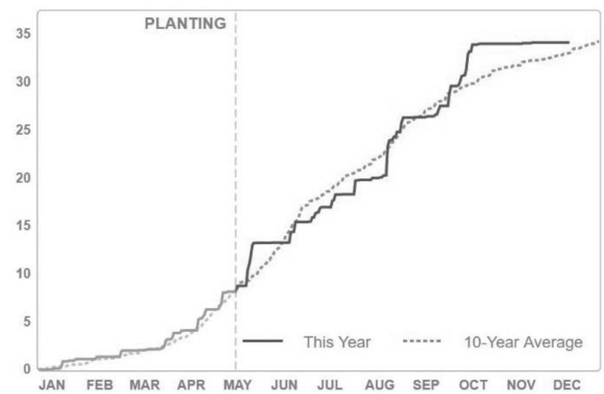
The producer was interested in evaluating how other N recommendation methods would have compared. Fertilizer recommendations based on a standard soil test with a yield goal of 220 bu/ac ranged from 165 to 175 lb N/ac. A Haney soil health analysis resulted in recommendations of 177 to 181 lb N/ac with a yield goal of 220 bu/ac. Based on the findings of this study, N recommendations from a standard soil test and Haney soil test were not high enough to maximize yield.

The producer plans to continue this study, adding in a no cover crop treatment. Additional analysis is planned to determine N recommendations from the RapidSCAN sensor during the growing season.

Nitrification Inhibitor

Study ID: 711053201701
County: Dodge
Soil Type: Calco silty clay loam 0-2% slope; Alcester silty clay loam 2-6% slopes
Planting Date: 5/9/17
Harvest Date: 10/27/17
Population: 30,000
Row Spacing (in): 30
Hybrid: Golden Harvest G12J11-3111A
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 13 oz/ac Verdict®, 24 oz/ac Atrazine, and 32 oz/ac Durango® at 15 gal water/acre on 5/9/17 ***Post:*** 1.5 qt/ac Resicore®, 8 oz/ac Atrazine, and 23 oz/ac Durango® at 15 gal water/acre on 6/6/17
Seed Treatment: Avicta® 500
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 10-34-0 applied in furrow at planting on 5/9/17; other N applied is detailed in treatments

Irrigation: None
Rainfall (in):

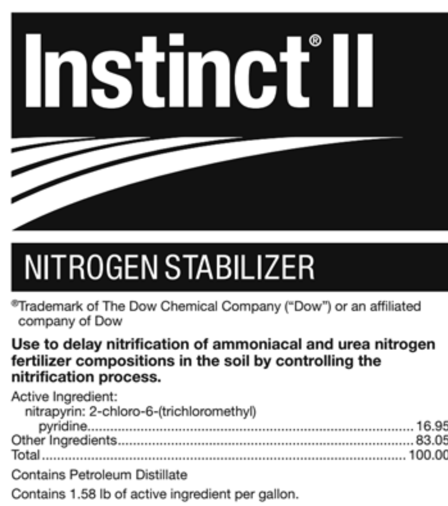


Soil Test (April 2017):

OM	N (0-6")	N (0-24")	P1	P2	K	Mg	S	Zn	Mn	Fe	Cu	B	Ca	CO_2C Burst
%	ppm													
3.1	7	8	39	69	309	367	17	1.2	7	51	1.1	0.5	2772	134

Introduction: This study is evaluating Instinct® nitrification inhibitor (product information at right). Nitrification inhibitors reduce the rate at which ammonium is converted to nitrate. This can help reduce N losses through denitrification and leaching. Nitrogen was applied on 4/11/17 at a rate of 38 gal/ac of 32% UAN (135 lb N/ac). The nitrification inhibitor was applied at a rate of 40 oz/ac for the Instinct® treatments.

Ear leaf N concentrations were taken at R2. Aerial imagery was collected in September to observe differences in plant vegetation. Aerial imagery was used to calculate the normalized difference vegetative index (NDVI). This index is indicative of overall plant biomass and greenness. True color imagery and NDVI are presented in *Figure 1*.



Product information from:
http://msdssearch.dow.com/PublishedLiteratureDAS/dh_0968/0901b803809685 48.pdf?filepath=pdfs/noreg/010-02288.pdf&fromPage=GetDoc

Results:

	Ear Leaf N (%)	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
135 lb N/ac	3.07 A*	17.2 B	239 B	754.21 A
135 lb N/ac with 40 oz/ac Instinct	3.08 A	17.4 A	243 A	752.83 A
P-Value	0.964	0.023	0.077	0.752

*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 $3.15/bu corn and $11.90 for 40 oz Instinct.

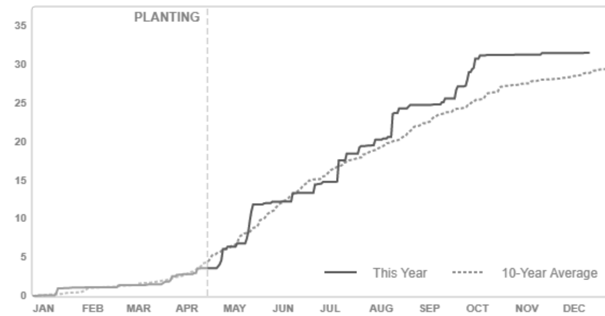
Figure 1. True color (red-green-blue) imagery (left) and NDVI (right) from September 11, 2017.

Summary:

- There was no difference in ear leaf N percent between the treatments with and without Instinct®.
- Grain moisture was higher for the Instinct® treatment.
- Yield was 4 bu/ac higher where Instinct® was used.
- There was no difference in marginal net return between the with and without Instinct® treatments.

N-Serve® on Spring Applied Anhydrous Ammonia

Study ID: 718185201701
County: York
Soil Type: Hastings silt loam
Planting Date: 4/21/17
Harvest Date: 10/30/17
Population: 33,000
Row Spacing (in): 30
Hybrid: Pioneer 1311AM
Reps: 7
Previous Crop: Soybean
Tillage: Ridge-Till
Herbicides: ***Pre:*** 1 pt/ac Brash® on 2/17/17; 2 qt/ac Lexar® on 4/21/17 ***Post:*** 32 oz/ac glyphosate and 2 oz/ac Status® on 6/6/17
Seed Treatment: None
Foliar Insecticides: 1 oz/ac PermUp® on 4/21/17; 6 oz/ac Discipline® 2EC on 8/3/17
Foliar Fungicides: 5 ox/ac Absolute® Maxx on 8/3/17
Fertilizer: 170 lb/ac N as Anhydrous Ammonia on 3/9/17
Note: Wind caused lodging and ear loss
Irrigation: Pivot, Total: 3"
Rainfall (in):



Soil Sample (October 2016):

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 (0-10 in)	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
6.8		0.16	NONE	3.3	5.0	15	18	13	1.77	429	2409	474	85	17.5	0	6	69	23	2

Introduction: This study is evaluating N-Serve® nitrification inhibitor (product information at right). Nitrification inhibitors reduce the rate at which ammonium is converted to nitrate. This can help reduce N losses through denitrification and leaching. Nitrogen was applied at a rate of 170 lb/N ac as anhydrous ammonia on March 9, 2017.

Use to delay nitrification of ammoniacal and urea nitrogen fertilizer compositions in the soil by controlling the nitrification process.
Active Ingredients:
nitrapyrin: 2-chloro-6-(trichloromethyl) pyridine.......22.2%
Other Ingredients.......77.8%
Total.......100.0%
Contains petroleum distillates
Contains 2 lb of active ingredients per gallon.

Product information from: https://assets.greenbook.net/16-11-54-12-10-2017-D02-011-020_N-Serve_24_Specimen_Label.pdf

Results:

	Harvest Stand Count	Stalk Rot (%)	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Anhydrous Ammonia without N-Serve	31,286 A*	31.29 A	15.39 B	210 A	662.49 A
Anhydrous Ammonia with N-Serve	32,214 A	28.29 A	15.44 A	212 A	655.41 A
P-Value	0.289	0.671	0.03	0.808	0.663

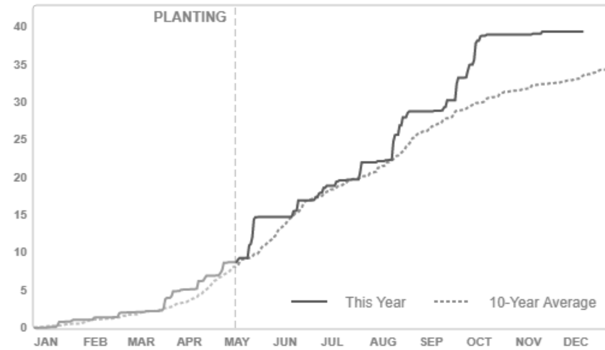
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $3.15/bu corn and $11/ac N-Serve cost.

Summary:

- Moisture was significantly higher where N-Serve was used.
- There was no difference in stand count, stalk rot, yield, or marginal net return between the treatments with N-Serve and without N-Serve.

Anhydrous Ammonia Nitrogen Rates Following Manure Application on Corn

Study ID: 572177201701
County: Washington
Soil Type: Marshall silty clay loam 0-6% slopes
Planting Date: 5/8/17
Harvest Date: 11/25/17
Population: 30,316
Row Spacing (in): 30
Hybrid: P1309WYHR
Reps: 5
Previous Crop: Soybean
Tillage: No-Till
Herbicides: 0.5 pt/ac 2,4-D, 1 gal/100 COC, 4 oz/ac Corvus®, 1.5 pt/ac Atrazine, 32 oz/ac glyphosate, and 17 lb/100 AMS
Seed Treatment: PPST 250
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 20 ton/ac of cattle manure
Irrigation: None
Rainfall (in):



Introduction: The goal of this study was to determine how much N fertilizer was needed following a manure application on the field. Cattle manure was applied evenly with a West Point vertical beater manure spreader at 20 ton/ac in December of 2016. No manure sample was taken. Three rates of anhydrous ammonia were tested. The N rate recommended by using the UNL N rate equation was 90 lb N/ac. Rates of 30 lb N/ac higher and lower were also evaluated. Anhydrous ammonia was applied on April 3, 2017.

Results:

	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
60 lb N/ac Anhydrous Ammonia	16.3 B*	227 B	696.57 A
90 lb N/ac Anhydrous Ammonia (UNL Rate)	16.4 AB	231 A	699.47 A
120 lb N/ac Anhydrous Ammonia	16.5 A	234 A	697.96 A
P-Value	0.015	0.002	0.732

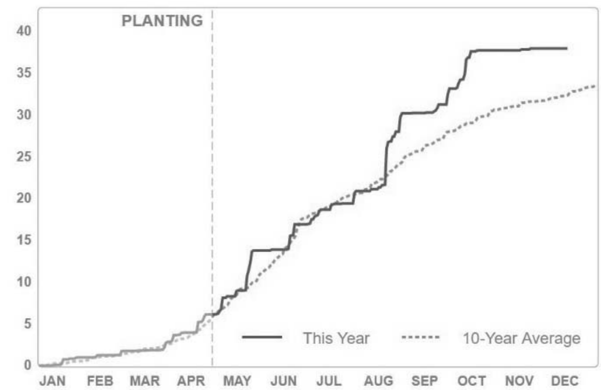
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $3.15/bu corn and $0.32/lb N.

Summary:

- The grain moisture for the 60 lb N/ac treatment was drier than the 120 lb N/ac treatment.
- The 60 lb N/ac rate yielded 4 bu/ac lower than the UNL rate (90 lb N/ac). There was no statistical yield increase for the 120 lb N/ac rate, indicating that the UNL N rate was likely adequate.
- There was no difference in marginal net return between the three treatments tested.

Nitrogen Rate and Timing on Corn

Study ID: 004053201701
County: Dodge
Soil Type: Moody silty clay loam 0-2% slope; Fillmore silt loam occasionally ponded
Planting Date: 4/24/17
Harvest Date: 10/25/17
Population: 34,000
Row Spacing (in): 30
Hybrid: Hoegemeyer 8471
Reps: 4
Previous Crop: Corn
Tillage: Mulch finish
Herbicides: ***Pre:*** 2.4 qt/ac Keystone® LA on 4/24/17 ***Post:*** 0.75 oz/ac Armazon™, 0.5 lb/ac Atrazine, and 22 oz/ac Roundup® on 5/24/17
Seed Treatment:
Foliar Insecticides: 6 oz/ac Capture® LFR® on 4/24/17
Foliar Fungicides: 10 oz/ac Headline AMP® on 7/12/17
Fertilizer: 11-52-0 in fall 2016 and 58 lb/ac 10-24-0 on 4/24/17 in addition to N rates tested and listed in treatments
Irrigation: Pivot, Total: 4"
Rainfall (in):



Soil Tests (May 2017):

OM	P1	P2	K	Mg	S	Zn	Mn	Fe	Cu	B	Ca	CO_2C Burst
%	--					*ppm*	--					
3.1	59	85	356	430	20	2.4	7	85	1.1	0.4	2889	176

Introduction: The objective of this study was to evaluate sidedress N rates. The producer's normal N management is to apply 70 lb N/ac pre-plant and 140 lb N/ac sidedress. To test the rate and timing, the producer compared his normal N sidedress rate with sidedress rates of 110 lb N/ac and 170 lb N/ac (normal sidedress rate minus 30 lb N/ac and normal sidedress rate plus 30 lb N/ac). All sidedress application treatments were made on June 5, 2017, with 32 percent UAN. The producer's normal N management was compared with a pre-plant only treatment. In this treatment the same total N was applied (210 lb N/ac); however, all the N was applied as pre-plant. Ear leaf N concentrations were taken at R2. Aerial imagery was collected in July and August to observe differences in plant vegetation. Aerial imagery was used to calculate the normalized difference vegetative index (NDVI). This index is indicative of overall plant biomass and greenness. True color imagery and NDVI are presented in *Figure 1*.

Results:

	Harvest Stand Count	Foliar Nitrogen (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
210 lb N/ac Pre-plant	32,250 A*	3.04 B	15.5 B	216 B	610.98 B
70 lb N/ac Pre-plant + 110 lb N/ac Sidedress	32,833 A	3.27 AB	15.9 A	239 A	684.90 A
70 lb N/ac Pre-plant + 140 lb N/ac Sidedress	31,667 A	3.44 A	16.2 A	243 A	689.43 A
70 lb N/ac Pre-plant + 170 lb N/ac Sidedress	31,833 A	3.29 AB	16.2 A	251 A	704.07 A
P-Value	0.113	0.054	0.001	0.0007	0.0009

*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 $3.15/bu corn, $0.33/lb N, and $6.82/ac application cost for in-season application with Hagie.

	NDVI 7/1/17	NDVI 8/31/17
210 lb N/ac Pre-plant	0.891 A	0.899 B
70 lb N/ac Pre-plant + 110 lb N/ac Sidedress	0.889 A	0.905 AB
70 lb N/ac Pre-plant + 140 lb N/ac Sidedress	0.889 A	0.906 A
70 lb N/ac Pre-plant + 170 lb N/ac Sidedress	0.889 A	0.907 A
P-Value	0.215	0.050

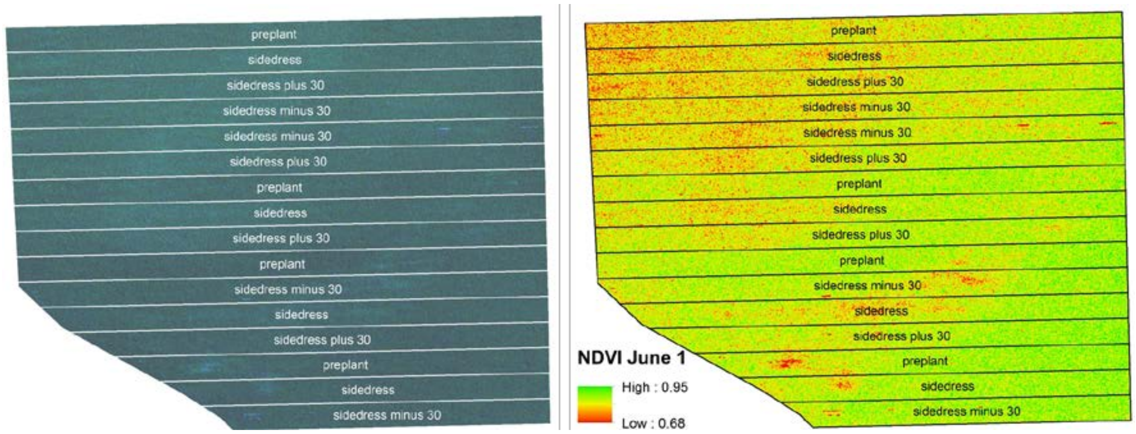


Figure 1. True color (red-green-blue) imagery (left) and NDVI (right) from June 1, 2017.

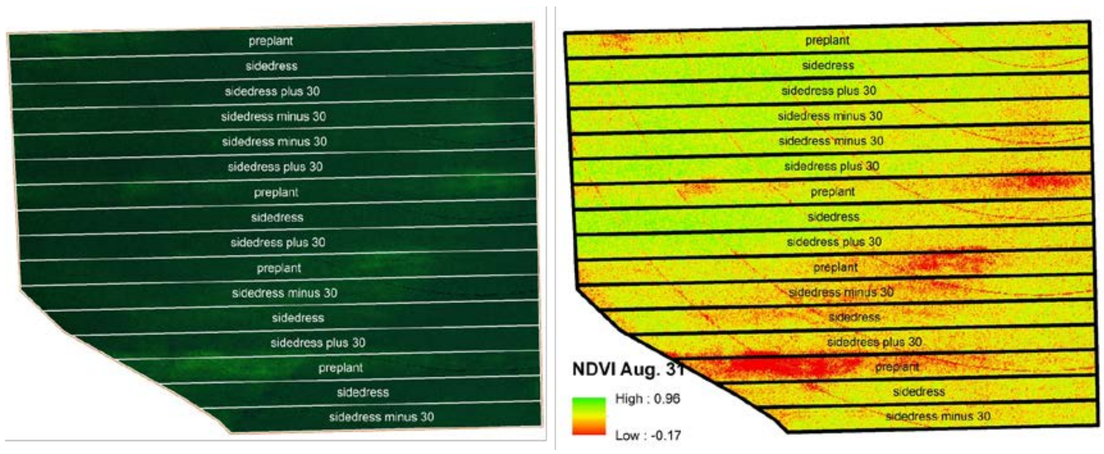


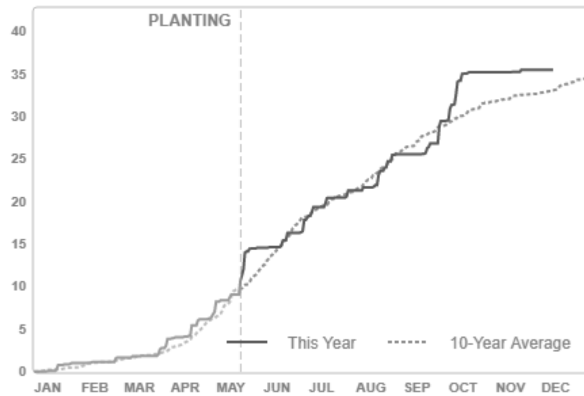
Figure 2. True color (red-green-blue) imagery (left) and NDVI (right) from August 31, 2017.

Summary:

- Moisture was significantly drier for the pre-plant only treatment.
- Harvest stand counts were not different between the N timing and rates.
- The leaf pre-plant rates were significantly different – the pre-plant rate had a significantly lower leaf N concentration than the producer's normal sidedress rate of 140 lb N/ac.
- There were no NDVI differences on July 1. There were differences in NDVI on August 31. The pre-plant N treatment had lower NDVI than the 140 lb N/ac and 170 lb N/ac sidedress treatments.
- Yield was significantly lower for the pre-plant treatment compared with the treatments with sidedress applications. There were no yield differences between the three sidedress N rates.
- Marginal net return was significantly lower for the pre-plant treatment compared with the treatments with sidedress applications. There were no marginal net return differences between the three sidedress N rates.

Nitrogen Rate and Timing on Corn

Study ID: 401155201701
County: Saunders
Soil Type: Aksarben silty clay loam 0-2% slope; Judson silt loam 2-6% slopes
Planting Date: 5/8/17
Harvest Date: 11/3/17
Population: 26,500
Row Spacing (in): 30
Hybrid: NK 59B-GTA
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 2.5 qt/ac Acuron™ and 1 qt/ac Roundup PowerMAX® on 5/10/17 ***Post:*** 1 qt/ac Roundup PowerMAX®, and 1 pt/ac Dual II Magnum® on 6/10/17
Seed Treatment: Avicta®, CruiserMaxx®
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 150 lb/ac of Phos Plus 36D (11-30-0-9S-2Zn) in Dec. 2016; 2 Ton/Ac Ag Lime (90% CCE) in Jan. 2017; 4 gal/ac 12-0-0-26S, 1.5 gal/ac 9% Zn, 1.5 gal/ac 10% Boron, 0.5 gal/ac 6% Mn on 5/9/17, in addition to N applied as treatments in this study
Note: Severe wind events in late October
Irrigation: None
Rainfall (in):



Soil Sample (Oct. 2016):

OM	P1	P2	K	Mg	Ca	Na	pH	Buffer pH	C.E.C.	K	Mg	Ca	H	Na	S	Zn	Mn	Fe	Cu	B
%	------------------*ppm*-------------------									--*% base saturation*---					--------------*ppm*--------------					
3.1	11	17	213	356	2248	20	5.8	6.6	18.3	3	16.2	61.4	18.9	0.5	15	1	10	53	0.9	0.4

Introduction: The purpose of this study was to evaluate different N management strategies on corn. Applying a portion of the N fertilizer during the growing season allows fertilizer availability to better match the time the corn is uptaking N. The N in this study was applied as 32 percent UAN. There were four treatments: 1) 140 lb/ac N as pre-plant, 2) 100 lb/ac N pre-plant plus 40 lb/ac N sidedress, 3) 100 lb/ac N pre-plant plus 40 lb/ac N sidedress and Hydras-Hume humic acid at a rate of 3 gal/ac per 100 gal of 32 percent UAN, and 4) 100 lb/ac N pre-plant plus 75 lb/ac N sidedress. The pre-plant application was on 5/9/17. The sidedress applications were made on 6/20/17 with a homemade Y-Drop type applicator. There was a 1.25" rain on June 28. Stalk nitrate samples were taken from one replication in late September (because samples were not taken in each replication, statistics cannot be conducted).

Results:

	Test Weight	Moisture (%)	Stalk Nitrate (ppm)	Yield (bu/ac) †	Marginal Net Return‡ ($/ac)
140 lb/ac Pre-plant N	57 A*	13.5 A	665	185 A	517.73 A
100 lb/ac Pre-plant N + 40 lb/ac Sidedress N	57 A	13.6 A	427	183 A	503.29 A
100 lb/ac Pre-plant N + 40 lb/ac Sidedress N + Humic Acid	57 A	13.6 A	164	183 A	498.42 A
100 lb/ac Pre-plant N + 75 lb/ac Sidedress N	57 A	13.6 A	2,410	185 A	495.96 A
P-Value	0.874	0.983	-	0.820	0.205

*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 $3.15/bu corn, $1.46/gal 32% liquid fertilizer ($0.36/lb N), and $7/ac per application.

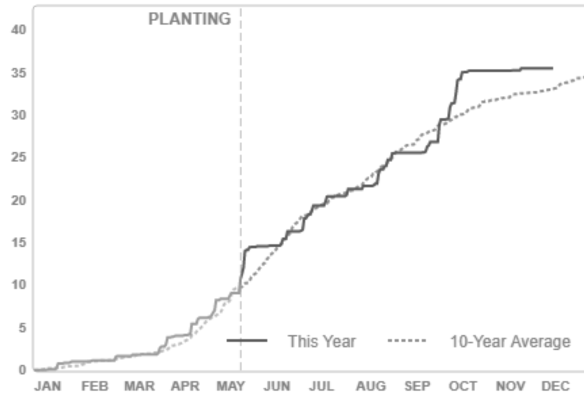
Summary:

- There was no difference in test weight, moisture, yield, or net return between the treatments studied.
- Statistics could not be conducted on the stalk nitrate samples; however, there are numeric differences between the samples.

Nitrogen Rate and Timing on Corn

Study ID: 401155201702
County: Saunders
Soil Type: Aksarben silty clay loam 0-2% slope; Judson silt loam 2-6% slopes
Planting Date: 5/9/17
Harvest Date: 11/3/17
Population: 26,500
Row Spacing (in): 30
Hybrid: NK 73Y-3111
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 2.5 qt/ac Acuron™ and 1 qt/ac Roundup PowerMAX® on 5/10/17 ***Post:*** 1 qt/ac Roundup PowerMAX®, and 1 pt/ac Dual II Magnum® on 6/10/17
Seed Treatment: Avicta®, CruiserMaxx®
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: 150 lb/ac of Phos Plus 36D (11-30-0-9S-2Zn) in Dec. 2016; 2 Ton/Ac Ag Lime (90% CCE) in Jan. 2017; 4 gal/ac 12-0-0-26S, 1.5 gal/ac 9% Zn, 1.5 gal/ac 10% Boron, 0.5 gal/ac 6% Mn on 5/9/17, in addition to N applied as treatments in this study
Note: Severe wind events in late October
Irrigation: None
Rainfall (in):



Soil Sample (Oct. 2016):

OM	P1	P2	K	Mg	Ca	Na	pH	Buffer pH	C.E.C.	K	Mg	Ca	H	Na	S	Zn	Mn	Fe	Cu	B
%	------------------*ppm*-------------------									--*% base saturation*---					--------------*ppm*--------------					
3.1	11	17	213	356	2248	20	5.8	6.6	18.3	3	16.2	61.4	18.9	0.5	15	1	10	53	0.9	0.4

Introduction: The purpose of this study was to evaluate different N management strategies on corn. Applying a portion of the N fertilizer during the growing season allows fertilizer availability to better match the time the corn is uptaking N. The N in this study was applied as 32 percent UAN. There were four treatments: 1) 140 lb/ac N as pre-plant, 2) 100 lb/ac N pre-plant plus 40 lb/ac N sidedress, 3) 100 lb/ac N pre-plant plus 40 lb/ac N sidedress and Hydras-Hume humic acid at a rate of 3 gal/ac per 100 gal of 32 percent UAN, and 4) 100 lb/ac N pre-plant plus 75 lb/ac N sidedress. The pre-plant application was on 5/9/17. The sidedress applications were made on 6/20/17 with a homemade Y-Drop type applicator. There was a 1.25" rain on June 28.

Results:

	Test Weight	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
140 lb/ac Pre-plant N	56 A*	13.5 A	193 A	542.59 A
100 lb/ac Pre-plant N + 40 lb/ac Sidedress N	56 A	13.6 A	195 A	540.66 A
100 lb/ac Pre-plant N + 40 lb/ac Sidedress N + Humic Acid	56 A	13.6 A	199 A	549.40 A
100 lb/ac Pre-plant N + 75 lb/ac Sidedress N	56 A	13.6 A	200 A	542.61 A
P-Value	0.420	0.785	0.463	0.946

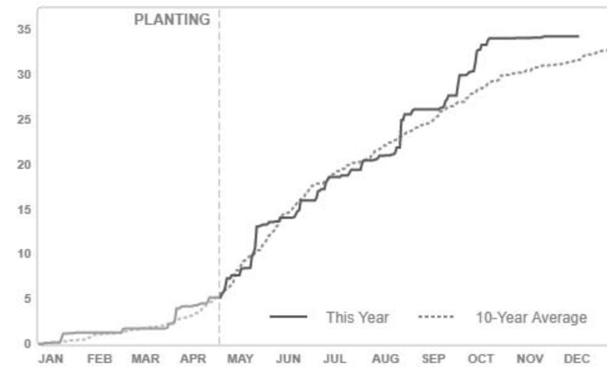
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $3.15/bu corn, $1.46/gal 32% liquid fertilizer ($0.36/lb N), and $7/ac per application.

Summary: There was no difference in test weight, moisture, yield, or net return between the treatments studied.

In-season Nitrogen Application on Corn Following Rye Cover Crop

Study ID: 710067201701
County: Gage
Soil Type: Wymore silty clay loam 2-6% slopes
Planting Date: 4/26/17
Harvest Date: 10/12/17
Population: Variable Rate 20-28,000
Row Spacing (in): 30
Hybrid: Channel 214-00D6T2 RIB
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Early post to kill rye (planted into green rye):*** 17 lb AMS/100 gal, 1.3 oz/ac Sharpen®, 1.2 lb Citric acid/100 gal, 1 gal MSO™/100 gal, 1 pt/ac generic Dual, 40 oz/ac Roundup Ultra® MAX at 8.5 gal/ac on 5/6/17 ***Post:*** 17 lb/ac AMS, 0.5 lb/ac Aatrex® Nine-O® Atrazine, 3 oz/ac Callisto®, 1 pt/ac 90-10 spreader sticker, and 32 oz/ac Roundup ULTRA® MAX

Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: Fungicide applied aerially
Fertilizer: 42 gal/ac 32% (149 lb N/ac) injected on 4/18/17; 5 gal/ac 10-34-0 (5.8 lb N/ac) with planter on 4/26/17
Irrigation: None
Rainfall (in):



Soil Test (2017):

ID	Soil pH 1:1	WDRF Buffer pH	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI %	FIA Nitrate 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
1	6.3	6.6	0.35	NONE	4.0	39.1	94	24	10	0.88	262	2432	326	17	19.2	19	3	63	14	0

Introduction: The corn in this study followed a rye cover crop. Rye was noticeably taller where directly over the nitrogen injected knife marks. The whole field was grazed from January through April 1. Corn was planted on 4/26/17 into a standing rye cover crop. The rye was terminated on 5/6/17 with herbicide. As the rye cover crop breaks down, nitrogen may be temporarily unavailable to the growing corn crop. Because of this, many growers are trying to better understand nitrogen management for corn following a rye cover crop. A total of 155 lb/ac N was applied prior to planting or at planting.

This study tested three rates of nitrogen sidedress applied as 46-0-0 broadcast urea on May 24 at the V5-V6 growth stage.

For analysis, two rows of 15 foot length were hand harvested, shelled, and weighed. Plant counts and ear counts represent the same two rows and 15 foot length; values were converted to plants/ac and ears/ac for reporting.

Results:

	Harvest Stand Count	Ears Count (ears/ac)	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
0 lb/ac Sidedress	23,513 A*	22,932 A	15.2 A	190 A	598.89 A
50 lb/ac Sidedress	23,803 A	24,819 A	15.6 A	194 A	586.13 A
100 lb/ac Sidedress	24,093 A	24,819 A	15.5 A	198 A	580.15 A
P-Value	0.692	0.110	0.781	0.815	0.875

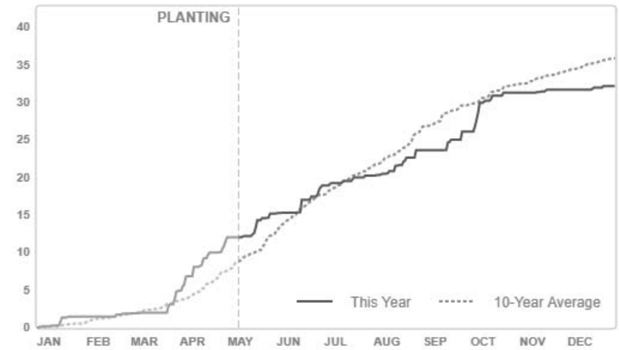
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $3.15/bu corn, $0.36/lb N, and $6.17/ac broadcast application cost.

Summary: There was no difference in number of plants, number of ears, moisture, yield, or net return between the in-season nitrogen rates tested.

Using Drone Based Sensors to Direct Variable-Rate In-Season Aerial Nitrogen Application on Corn

Study ID: 416147201701
County: Richardson
Soil Type: Nodaway silt loam occasionally flooded; Zook silty clay loam occasionally flooded; Wabash silty clay loam occasionally flooded
Planting Date: 5/8/17
Harvest Date: 10/20/17 and 10/26/17
Population: 32,800
Row Spacing (in): 30
Hybrid: P1197
Reps: 4
Previous Crop: Soybean
Tillage: No-Till

Irrigation: None
Rainfall (in):



Soil Tests (2015 – averaged over study area):

OM %	CEC	pH	P	K	S	Zn	B	Fe	Mg	Mn	Na
			----------------	----------------	----------------	----------------	(ppm)	----------------	----------------	----------------	----------------
2.5	14.8	6.6	45	134	9.0	3.3	0.45	149.3	231.5	103.7	11.5

Introduction: Applying a portion of the N fertilizer during the growing season, alongside the growing corn crop is one way to improve N management. In-season N applications allow N fertilizer availability and crop N uptake to more closely match and allows for N management, which is responsive to current growing season conditions. Active crop canopy sensors have been used during the growing season to direct in-season N application and have been found to reduce N application and increase profit. This sensor technology is most commonly used on high clearance applicators, where sensing and application take place simultaneously. In southeast Nebraska and other regions of the corn belt, in-season N application by ground-based applicators is not common due to rolling topography, and contour and terrace farming practices. Some farmers in these landscapes rely on airplanes for in-season N applications. Additionally, small, passive, multi-spectral sensors can be carried on drones, enabling crop sensing to occur from the air. This study uses drone based sensing and aerial N application to demonstrate in-season N management, which is conducted without vehicles on the ground in the field.

The goal of this research project is to evaluate the use of a passive crop canopy sensor to direct variable-rate, in-season N fertilizer recommendation rates on corn and apply this recommendation using variable-rate aerial technology. Determining the correct amount of N to apply as a base rate to provide the crop with enough N to reach the in-season N application is also critical. This study evaluated two different N base rates to attempt to identify the optimum base rate for in-season sensing and application.

There were three treatments (*Figure 1*):

1. Farmer management: 160 lb N/ac + flat rate in-season N application if needed

2. 75 lb/ac N base rate + in-season N management directed by drone

3. 100 lb/ac N base rate + in-season N management directed by drone.

A high N reference received 225 lb N/ac in two smaller blocks.

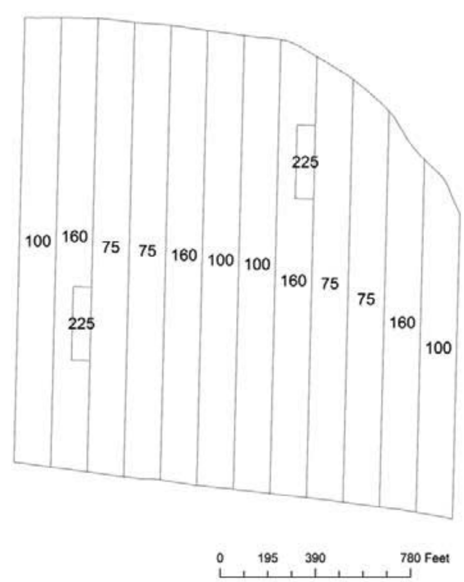


Figure 1. Treatment layout for study with base N rates labeled (lb/ac).

Pre-plant N was applied on February 15 as anhydrous ammonia. During the growing season, the field was flown with a DJI Inspire drone equipped with a MicaSense Red Edge 5 band sensor. Imagery was obtained on June 5, June 15, June 24, July 14, and September 4. The normalized difference red edge (NDRE) index was calculated for each flight. The NDRE index uses the near-infrared portion of the spectrum and allows differences in crop vegetation to be apparent, even when not visible in regular, true-color imagery *(Figure 2)*. NDRE data was processed with unsupervised classification to remove pixels, which are shadows and soil so that only plant pixels remain. A sufficiency index (SI) was calculated by dividing the NDRE of each pixel by the NDRE value of the top 5 percent of the field (virtual reference method). This allows each portion of the field to be compared with non-N limiting corn. NDRE data from the June 24 flight *(Figure 2)* was used to create an in-season, variable-rate prescription.

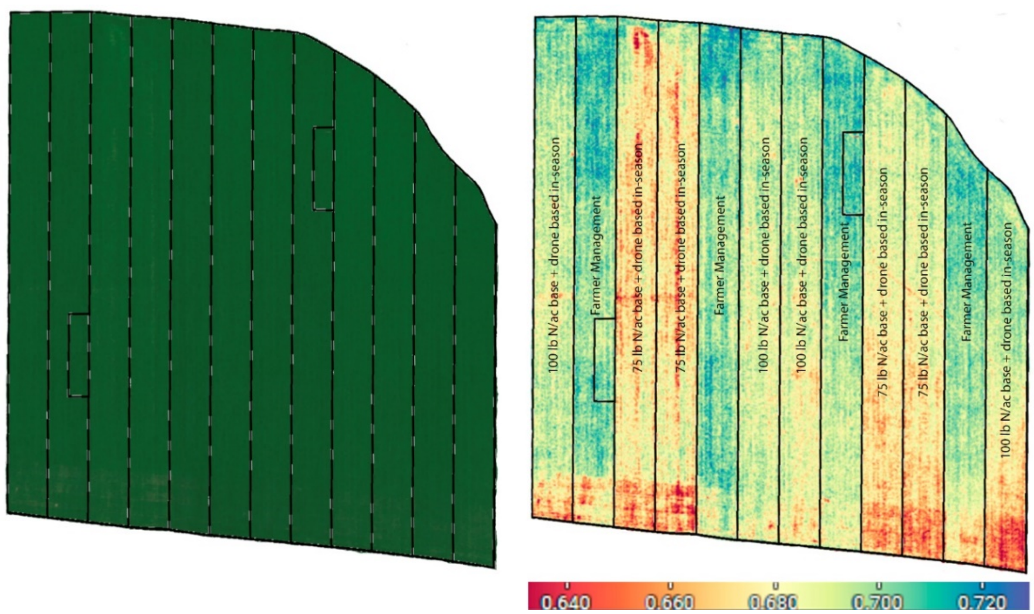


Figure 2. True color image (left) and NDRE (normalized difference red edge index) (right) of the study area on June 24, 2017 at V12.

In-season N application was applied as stablized urea (46% N) on June 29. Variable rate capabilities of the airplane dictated the length of a given rate be at least 200 ft and no more than 10 rates could be used. The in-season, variable-rate prescription is shown in *Figure 3*. The farmer elected to apply 40 lb N/ac to the farmer managed strips at this time.

NDRE values from imagery prior to and after in-season N application were collected as well as final crop yield and net return.

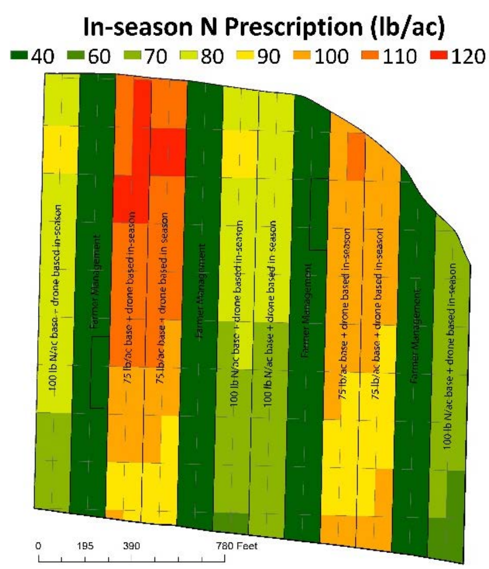


Figure 3. In-season N prescription applied on June 29 at V13 to V14.

Results:

The imagery collected before and after the in-season N application revealed that differences which existed prior to application were no longer present after N application. This suggests that following the in-season N application, the crop was able to recover from any N deficiency *(Figure 4).*

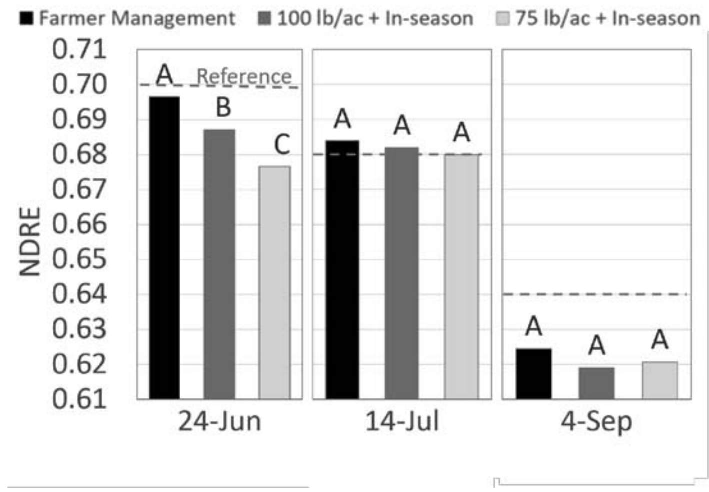


Figure 4. NDRE from the three treatments prior to and after N application. Reference is values from the high N rate blocks.

	Total N rate (lb/ac)	Moisture (%)	Test Weight	Yield (bu/ac)†	NUE (lb N/bu grain)	Marginal Net Return‡ ($/ac)
Grower N Management	200	15.2 A*	60 A	246 A	0.81 A	689.86 A
Drone Management with 75 lb Base	177	15.3 A	60 A	247 A	0.72 B	692.51 A
Drone Management with 100 lb Base	175	15.4 A	60 A	246 A	0.71 B	692.64 A
P-Value	N/A	0.473	0.345	0.971	0.002	0.962

*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 $3.15/bu corn, $465/ton anhydrous, $326.67/ton coated urea, $14/ac anhydrous application, $12/ac flat rate airplane application of urea, and $13.75/ac variable rate airplane application of urea.

Summary:

- There was no yield difference between the farmer managed strips and drone managed strips.
- Both the 75 and 100 lb/ac pre-plant rates resulted in less total N application than the farmer rate. This resulted in higher N use efficiency for the drone managed strips.
- Costs for N fertilizer and application were comparable between the three treatments.
- In order to optimize sensor-based in-season N application, it is necessary to time the N application to when the crop is expressing N deficiency, but prior to non-recoverable yield loss. A drone is one platform that allows the field to be sensed multiple times throughout the growing season with the goal of identifying the ideal timing for in-season N application. Further work is needed to develop guidelines for the ideal threshold for triggering in-season N application based on sensor readings.
- This study will be continued on two farms in 2018.

This study was funded in part with a grant from North Central Region-SARE.

Project SENSE

Sensors for Efficient N use and Stewardship of the Environment

The Nebraska On-Farm Research Network launched a project in 2015 focused on improving the efficiency of nitrogen fertilizer use. Project SENSE (Sensors for Efficient Nitrogen Use and Stewardship of the Environment) was a three-year project that looked at using crop canopy sensors to direct variable-rate, in-season nitrogen application in corn. Seventeen on-farm research sites were selected in 2015, 19 sites were selected in 2016, and 18 sites were selected in 2017 (*Figure 1*). These sites were located in five Natural Resource Districts: Central Platte, Little Blue, Lower Loup, Lower Platte North, and Upper Big Blue. Since 1988, the nitrate concentration in groundwater in Nebraska's Central Platte River Valley has been steadily declining, largely due to the conversion from furrow to center-pivot irrigation. However, over the last 25 years, fertilizer nitrogen use efficiency has remained static. This trend points to the need for adoption of available technologies such as crop canopy sensors for further improvement in nitrogen use efficiency. Strategies that direct crop nitrogen status at early growth stages are promising as a way to improve nitrogen fertilizer efficiency.

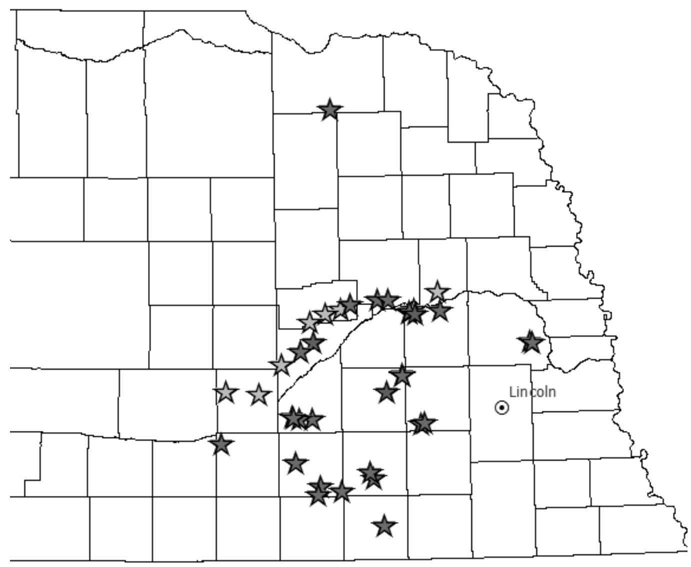


Figure 1. Locations of Project SENSE on-farm research sites in 2015 (17 sites), 2016 (19 sites), and 2017 (18 sites).

Managing Variability with Sensors

It is difficult to determine the optimum amount of nitrogen to apply in a field; nitrogen needs in a field vary spatially and from year to year. Because crop canopy sensors are designed to be responsive to nitrogen needs, they can help account for this variability. Another challenge with nitrogen management is that all the nitrogen for the crop is often applied prior to the growing season, before the crop begins to rapidly uptake nitrogen. This results in unnecessary losses of nitrogen from the cropping system and has negative economic and environmental implications. Applying a portion of the total nitrogen during the growing season helps better match nitrogen availability to the timing of nitrogen uptake.

Active sensors work by emitting light onto the crop canopy and then measuring reflectance from the canopy with photodetectors (*Figure 2*). The light source simultaneously emits visible and near infrared light, which is detected synchronously by sensor electronics. When used to detect plant health, light in both the visible (VIS; 400-700 nm) and near-infrared (NIR; 700-1000 nm) portions of the electromagnetic

Figure 2. Active crop canopy sensor positioned over corn canopy.

spectrum are generally measured. These wavelengths are combined to create various vegetation indices (VI), such as the commonly used normalized difference vegetation index (NDVI), that are correlated with specific crop conditions of interest. Algorithms are then used to translate the NDVI values into an in-season nitrogen recommendation rate. In this study, the normalized difference red edge (NDRE) index was used.

Equipment and Experimental Design

Figure 3. High clearance applicator equipped with OptRx® crop canopy sensors, GPS, and drop nozzles.

A high clearance applicator was equipped with an Ag Leader® Integra in-cab monitor and four OptRx® sensors. A master module enables connection between the OptRx® sensors and Ag Leader® in-cab monitor. An application rate module communicates the target rate from the Ag Leader® monitor to the rate controller. A GPS receiver is not required for sensing but may be used for applicator ground speed and as-applied mapping. The applicator was equipped with straight stream drop nozzles in order to apply UAN fertilizer to the crop as it was sensed (*Figure 3*).

Project SENSE plots were arranged in a randomized complete block design with six replications. The grower's normal N management was compared with the Project SENSE N Management. For the Project SENSE strips, a base rate (75 lb N/ac for most sites) was applied at planting or very early in the growing season. Between V8 and VT, corn was sensed with the crop canopy sensors and variable-rate N was applied on-the-go. Grower N rates were noted and in-season Project SENSE N rates were logged and averaged. At harvest, yield monitor data was recorded, logged, and averaged. For each site, the average difference in N applied (lb/acre) and the average difference in yield (bu/acre) were calculated. Nitrogen use efficiency (NUE) was also calculated as partial factor productivity of N (PFPn) (lb grain/lb N fertilizer) and as lb N applied per bushel of grain produced.

In 2017 an additional treatment was added to four of the research sites. This treatment investigated the use of a drone and sensor for determining in-season nitrogen rates. A SenseFly eBee drone equipped with a Parrot® Sequoia™ multispectral sensor was used to generate NDRE values. A prescription map was then developed and applied with the high clearance applicator on the same date as the OptRx sensing and application.

2015, 2016, and 2017 All Site Results

Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation was performed with Fisher's LSD. Over all sites combined, the Project SENSE N management resulted in a reduction of 40 lb, 34 lb, and 15 lb of N/acre when compared with the grower N management for 2015, 2016, and 2017, respectively. This resulted in a loss of 5 bu/ac in 2015, 3 bu/ac in 2016, and 3 bu/ac in 2017. NUE was greater for the Project SENSE N management in all years. Marginal net return was greater for the Project SENSE N management in 2015 and 2016, but was less in 2017. Summaries for each site in 2017 are presented in the following pages of this report, and previous year summaries can be found at https://cropwatch.unl.edu/on-farm-research.

2015 Summary (17 sites)

	N Rate (lb/ac)	Yield (bu/ac)†	PFPn§	Lb N/bu	Marginal Net Return ($/ac)‡
Grower N Management	195	227 A*	66 B	0.88 A	701.80
Project SENSE N Management	155	222 B	86 A	0.71 B	709.55
P-Value	*N/A*	*<.0001*	*<.0001*	*<.0001*	*N/A*

*Values with the same letter are not significantly different at a 95% confidence level.
†Bushels per acre are corrected to 15.5% moisture.
‡Marginal net return based on $3.65/bu corn and $0.65/lb N fertilizer. Cost of applicator and equipment is not included in this calculation.
§Partial factor productivity of N (lb grain/lb N fertilizer).

2016 Summary (19 sites)

	N Rate (lb/ac)	Yield (bu/ac)†	PFPn§	Lb N/bu	Marginal Net Return ($/ac)‡
Grower N Management	188	202 A*	63 B	0.95 A	530.44 B
Project SENSE N Management	154	199 B	75 A	0.79 B	537.48 A
P-Value	*N/A*	*<.0001*	*<.0001*	*<.0001*	*<.0001*

*Values with the same letter are not significantly different at a 95% confidence level.
†Bushels per acre are corrected to 15.5% moisture.
‡Marginal net return based on $3.05/bu corn and $0.45/lb N fertilizer. Cost of applicator and equipment is not included in this calculation.
§Partial factor productivity of N (lb grain/lb N fertilizer).

2017 Summary (18 sites)

	N Rate (lb/ac)	Yield (bu/ac)†	PFPn§	Lb N/bu	Marginal Net Return ($/ac)‡
Grower N Management	188	234 A*	75 B	0.81 A	664.70 A
Project SENSE N Management	173	231 B	85 A	0.75 B	658.64 B
P-Value	*N/A*	*<.0001*	*<.0001*	*<.0001*	*0.0003*

*Values with the same letter are not significantly different at a 95% confidence level.
†Bushels per acre are corrected to 15.5% moisture.
‡Marginal net return based on $3.15/bu corn and $0.41/lb N fertilizer. Cost of applicator and equipment is not included in this calculation.
§Partial factor productivity of N (lb grain/lb N fertilizer).

Profitability and efficiency of Project SENSE N management was compared with the grower's standard management *(Figure 2).* Sites falling above the horizontal line represent higher profitability for Project SENSE. Sites falling to the right of the vertical line represent greater efficiency for Project SENSE management. At the majority of the sites Project SENSE had higher profit and greater efficiency (top right quadrant).

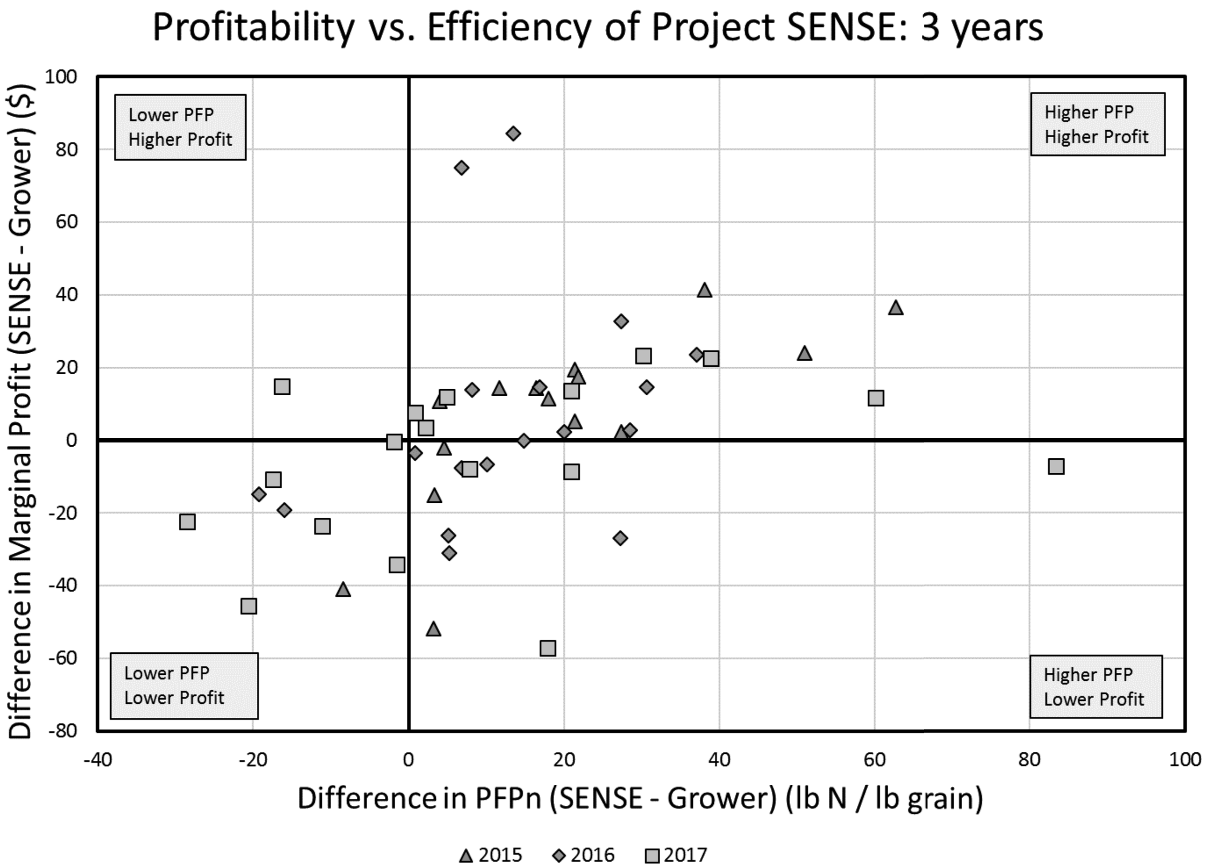


Figure 4. Profitability and efficiency of Project SENSE N management compared with the grower's management.

Continuing On

Project SENSE will continue with increased emphasis on sensor-based fertigation and drone based sensors. Additionally, field demonstration days will continue to be held in each NRD to showcase the equipment, teach how it is used, and present study results.

Project SENSE is made possible through support from:

Nebraska's Natural Resources Districts

Central Platte
Little Blue
Lower Loup
Lower Platte North
Upper Big Blue

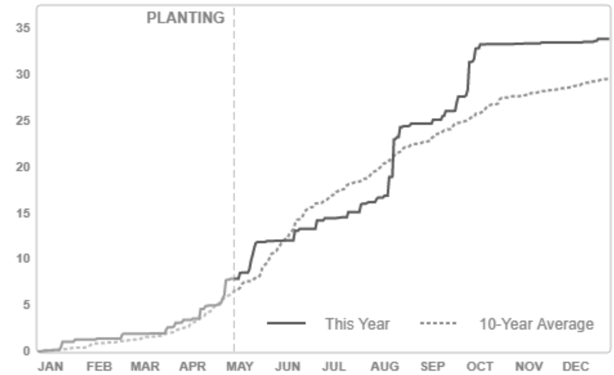
Nebraska CornBoard

USDA

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

Study ID: 021125201701
County: Nance
Soil Type: Loretto-Thurman complex 1-3% slope; Thurman loamy fine sand 2-6% slopes; Thurman loamy fine sand 2-6% slopes, eroded
Planting Date: 5/6/17
Harvest Date: 11/5/17
Population: 27,600
Hybrid: CRM (days) 112
Reps: 6
Previous Crop: Soybean
Tillage: No-Till

Irrigation: Pivot; 27 N lb/ac from irrigation
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	6.4	6.8	0.07	NONE	1.2	11.5	28	30	9	2.66	218	884	82	6	7.2	21	8	61	10	0
14	5.6	6.7	0.1	NONE	1	10.2	25	65	8	2	183	515	69	5	6.8	47	7	38	8	0
22	6.6	7.2	0.09	NONE	1.5	8.8	21	31	7	2.62	225	1051	105	7	6.7	0	9	78	13	0

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial grower N rate was 70 lb N/acre on May 9, 2017. An additional application of 75 lb N/acre was made on June 10, 2017. Total N applied was 145 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 70 lb N/acre was applied on May 9, 2017. Crop canopy sensing and application occurred on June 28, 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 119 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 189 lb N/acre.

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

	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)
Grower N Management	145	216 B*	84 A	0.67 B	622.29 B
Project SENSE N Management	189	227 A	67 B	0.84 A	637.02 A
P-Value	N/A	0.0003	0.0001	0.0004	0.012

*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.

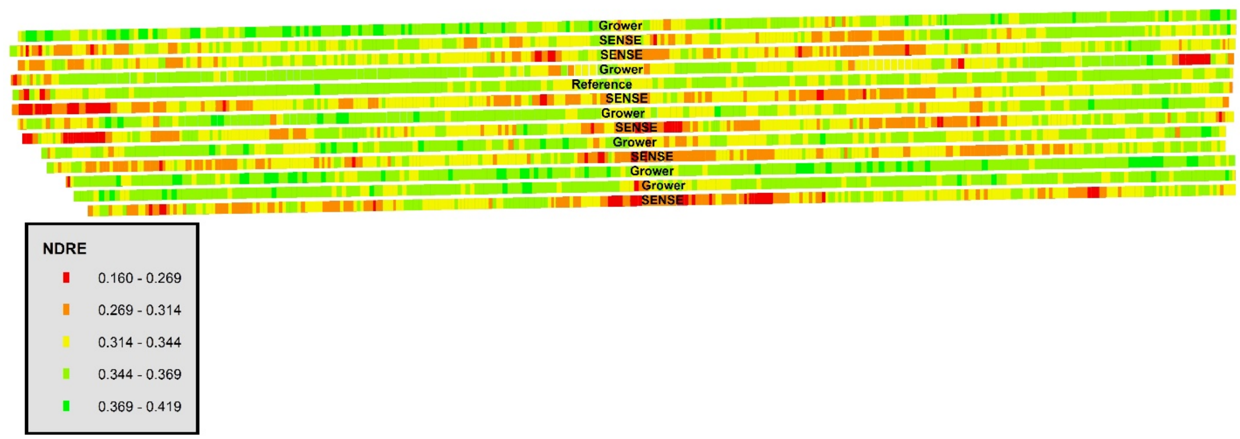


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on June 28, 2017.

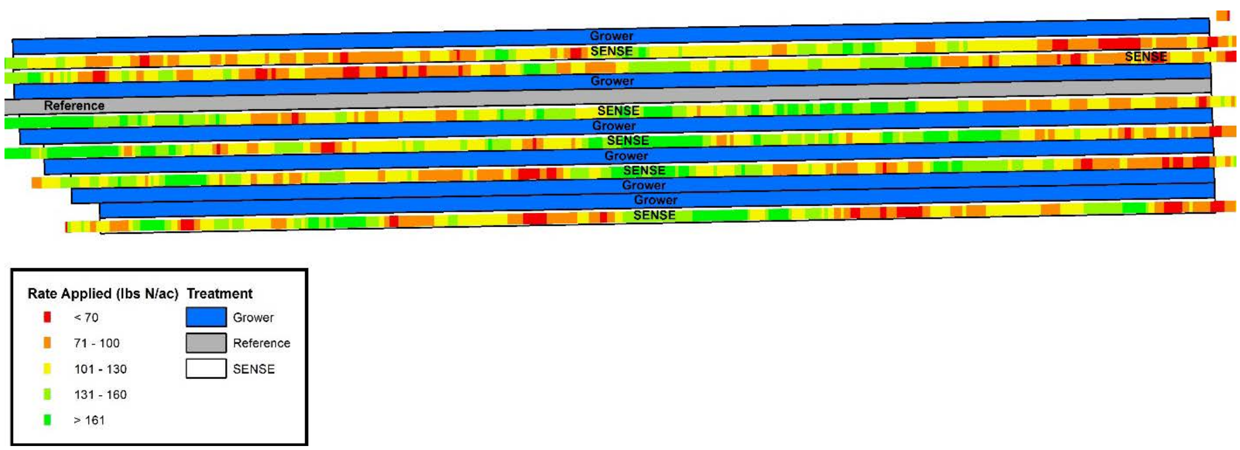


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

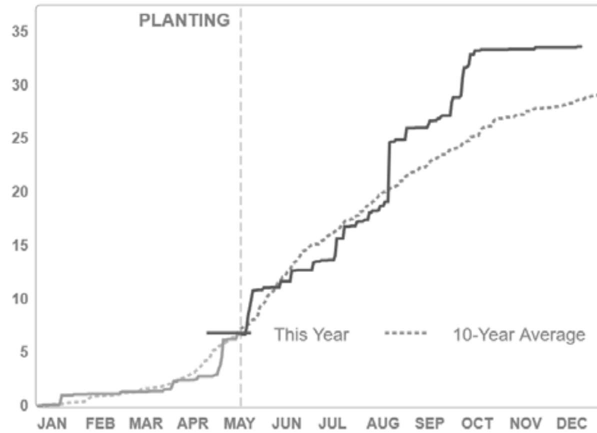
Summary:

- Project SENSE N application was 44 lb N/acre higher than the grower's N application.
- The Project SENSE N management resulted in a 10.5 bu/acre yield increase compared with the grower's N management.
- The grower's N management resulted in higher N use efficiency than the Project SENSE N management.
- The Project SENSE N management resulted in a $15/acre higher marginal net return than the grower's N management.

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

Study ID: 073081201703
County: Hamilton
Soil Type: Hastings silt loam 0-1% slope; Hastings silt loam 1-3% slope; Hastings silty clay loam 3-7% slopes, eroded
Planting Date: 5/12/17
Harvest Date: 10/30/17
Population: 33,600
Hybrid: CRM (days) 113
Reps: 5
Previous Crop: Corn
Tillage: Reduced Tillage

Irrigation: Pivot; 20 lb N/ac from irrigation
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) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
1	5.7	6.5	0.11	NONE	3.3	7.2	17	31	15	1.61	286	1751	222	18	16.8	32	4	52	11	0
2	6	6.7	0.13	NONE	3.3	5.5	13	14	19	1.96	391	2069	354	19	17.4	17	6	60	17	0
3	5.7	6.6	0.18	NONE	3.2	7.4	18	28	16	1.84	325	1764	256	16	16.2	27	5	55	13	0

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial grower N rate was 162 lb N/acre applied on June 7, 2017. An additional application of 48 lb N/acre was made on July 5, 2017. Total N applied was 210 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 81 lb N/acre was applied June 7, 2017. Crop canopy sensing and application occurred on July 5, 2017, at V13 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 52 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 133 lb N/acre.

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

	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)
Grower N Management	210	256 A*	68 B	0.82 A	719.93 B
Project SENSE N Management	133	253 B	107 A	0.53 B	742.43 A
P-Value	N/A	0.011	0.0001	<0.0001	0.001

*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.

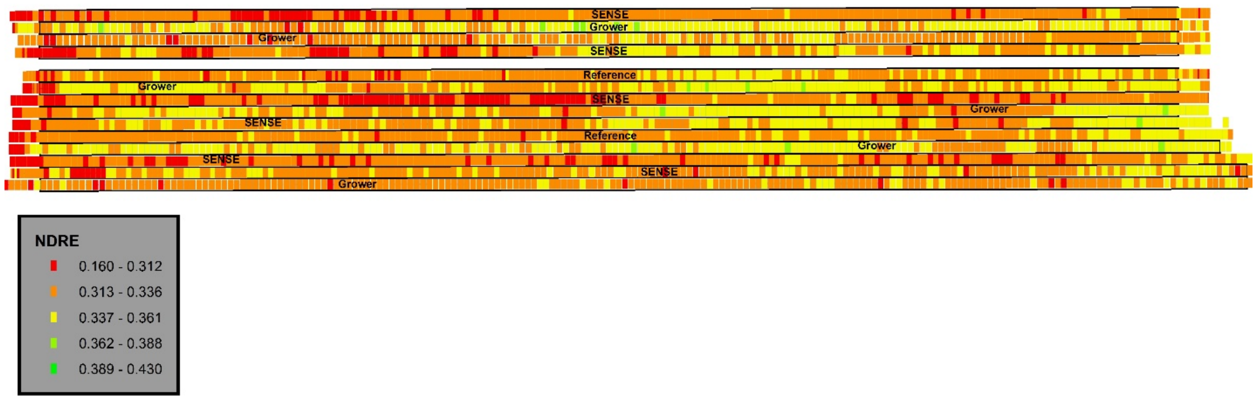


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on July 5, 2017.

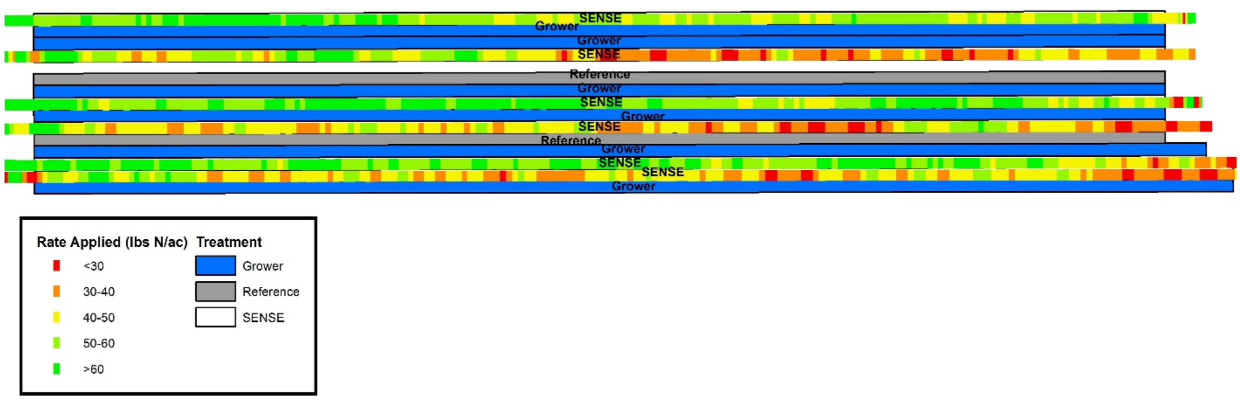


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

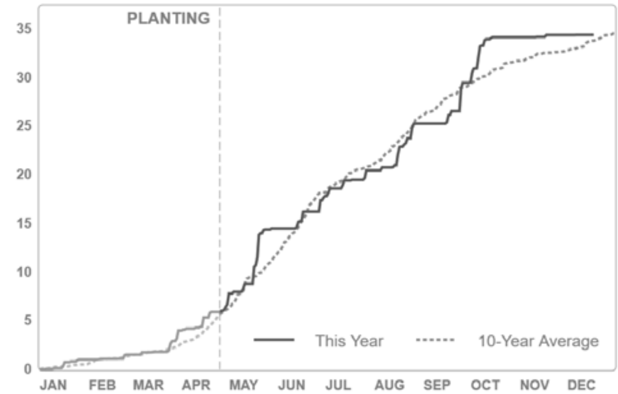
Summary:

- Project SENSE N application was 77 lb N/acre lower than the grower's N application.
- The grower's N management resulted in a 3 bu/acre yield increase compared with the Project SENSE N management.
- Project SENSE N management resulted in higher N use efficiency than the grower's N application.
- The Project SENSE N management resulted in $22.50/acre higher marginal net return than the grower's N management.

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

Study ID: 108155201701
County: Saunders
Soil Type: Yutan silty clay loam 2-6% slopes, eroded; Filbert silt loam 0-1% slope; Tomek silt loam 0-2% slope
Planting Date: 4/25/17
Harvest Date: 10/11/17
Population: 32,300
Hybrid: DKC 62-98
Reps: 6
Previous Crop: Soybean
Tillage: No-Till

Irrigation: Pivot; 15 lb N/ac from irrigation
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) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
3	6	6.3	0.12	NONE	3.7	14.7	35	9	8	1.14	425	2120	282	32	21.1	33	5	50	11	1
14	6.9	7.2	0.17	NONE	2.4	7.1	17	4	7	0.37	334	2945	653	49	21.2	0	4	69	26	1
22	6.1	6.4	0.09	NONE	3.5	5.1	12	12	5	0.95	480	2223	309	7	21.2	30	6	52	12	0

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

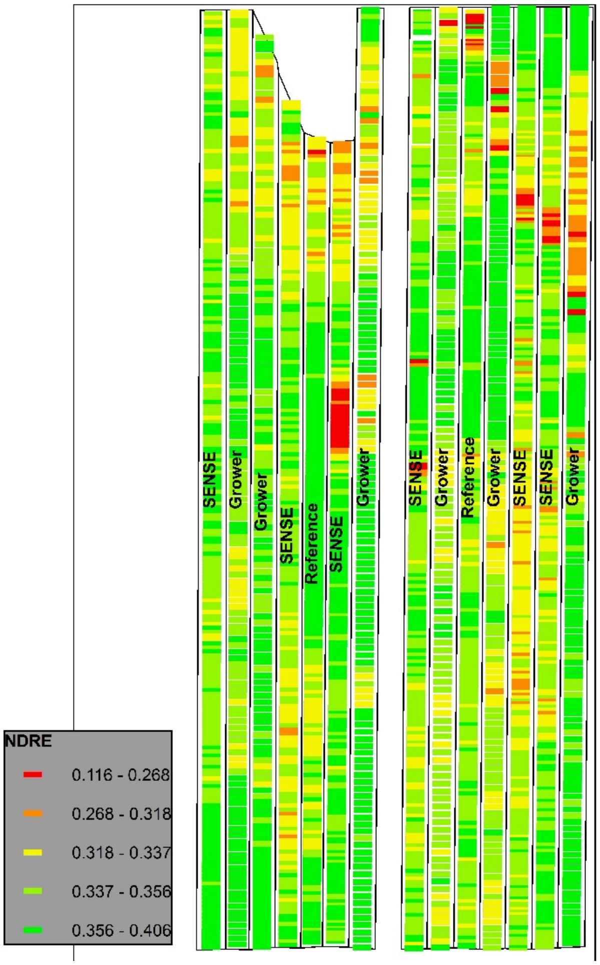
Grower Nitrogen Treatment: The initial grower N rate was 180 lb N/acre applied prior to planting on March 24, 2017. No additional applications were made during the growing season.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 75 lb N/acre was applied at or prior to planting. Crop canopy sensing and application occurred on June 23, 2017, at the V10 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 157 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 232 lb N/acre.

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

	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)
Grower N Management	180	261 B*	81 A	0.69 B	748.92 A
Project SENSE N Management	232	265 A	64 B	0.88 A	738.08 B
P-Value	N/A	0.011	<0.0001	<0.0001	0.015

*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.



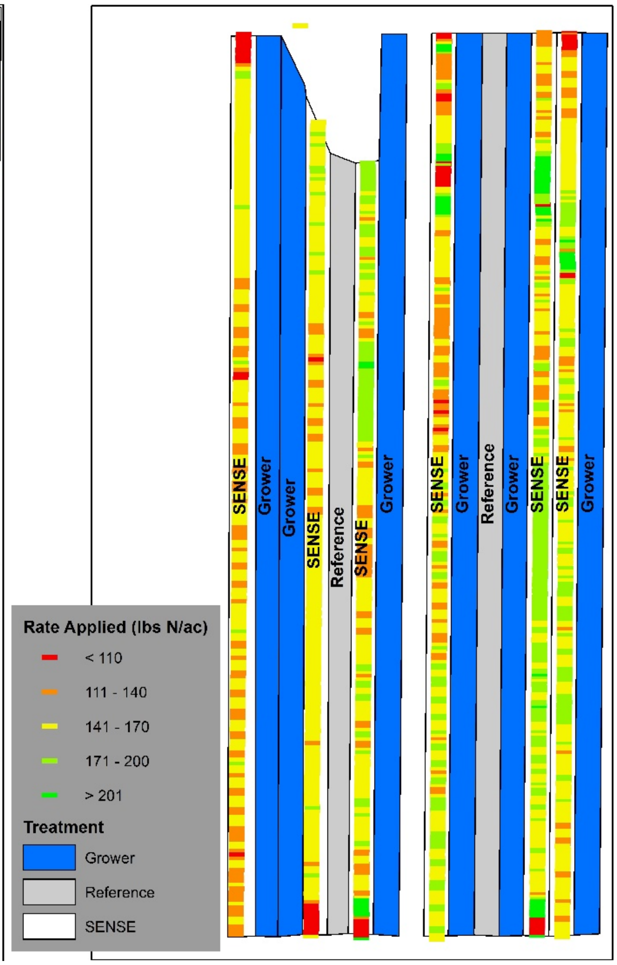


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on June 23, 2017.

Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

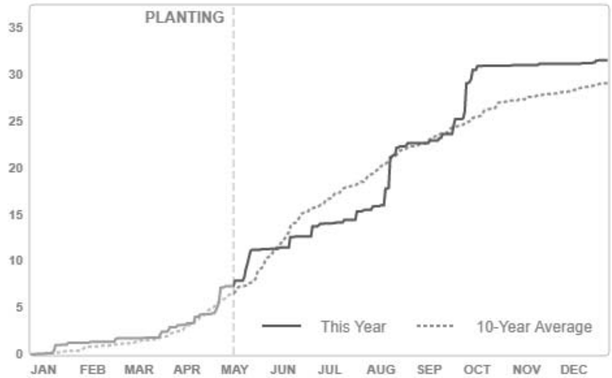
Summary:

- Project SENSE N application was 52 lb N/acre higher than the grower's N application.
- The Project SENSE N management resulted in a 3 bu/acre yield increase compared with the grower's N management.
- The grower's N management resulted in higher N use efficiency than the Project SENSE N management.
- The grower's N management resulted in an $11/acre higher marginal net return.

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

Study ID: 200125201701
County: Nance
Soil Type: Ortello fine sandy loam 1-3% slope; Hord fine sandy loam 0-1% slope
Planting Date: 5/9/17
Harvest Date: 11/8/17
Population: 27,600
Hybrid: Pioneer 1498
Reps: 6
Previous Crop: Corn
Tillage: Reduced Tillage

Irrigation: Pivot; 24.6 lb N/ac from irrigation
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
1	6.9	7.2	0.31	NONE	2.2	19.8	48	62	13	7.49	473	1652	190	10	11.1	0	11	74	14	0
2	6.3	6.8	0.12	NONE	1.7	12	29	71	12	5.02	344	954	97	9	8.4	23	10	57	10	0
3	5.8	6.7	0.1	NONE	1.8	12	29	15	12	1.12	125	1045	128	13	10	33	3	52	11	1

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial grower N rate was 45 lb N/acre applied on May 9, 2017. An additional application of 110 lb N/acre was made on June 7, 2017. Total N applied was 155 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 75 lb N/acre was applied as a base rate. 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 33 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 108 lb N/acre.

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

	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)
Grower N Management	155	185 A*	67 B	0.84 A	520.01 A
Project SENSE N Management	108	187 A	97 A	0.58 B	543.24 A
P-Value	N/A	0.795	<0.0001	<0.0001	0.148

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

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.

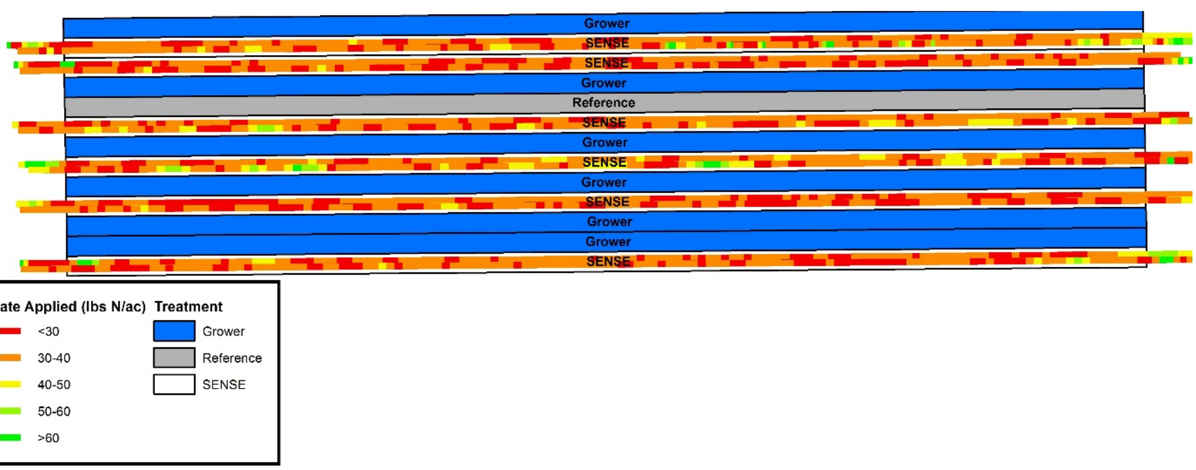


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

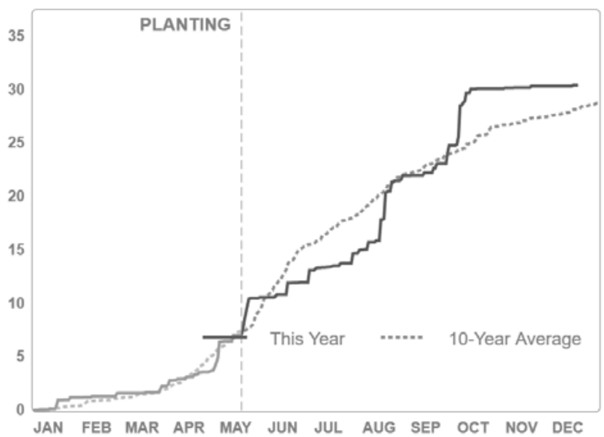
Summary:

- Project SENSE N application was 47 lb N/acre lower than the grower's N application.
- There was no difference in yield between the Project SENSE N management and grower's N management.
- The Project SENSE N management resulted in higher N use efficiency than the grower's N management.
- There was no difference in marginal net return between the Project SENSE N management and grower's N management.

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

Study ID: 202125201701
County: Nance
Soil Type: Hord very fine sandy loam 1-3% slope; Detroit silt loam 0-1% slope; Loretto-Thurman complex 3-6% slopes; Gibbon silt loam occasionally flooded
Planting Date: 5/15/17
Harvest Date: 11/8/17
Population: 29,300
Hybrid: CRM (days) 114
Reps: 6
Previous Crop: Soybean
Tillage: Reduced Tillage

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
1	6.8	7.2	0.09	NONE	2.8	6.6	16	17	11	2.79	408	1472	163	12	9.8	0	11	74	14	1
2	6	6.7	0.08	NONE	2.3	6.5	16	17	13	1.79	421	1279	130	9	12.1	29	9	53	9	0
3	5.5	6.6	0.07	NONE	1.8	7.2	17	30	11	1.81	242	877	108	11	10.5	43	6	42	9	0

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial grower N rate was 50 lb N/acre on May 15, 2017. An additional application of 135 lb N/acre was made in mid-June. Total N applied was 185 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 50 lb N/acre was applied on May 15, 2017. Crop canopy sensing and application occurred on July 6, 2017, at the V13 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 125 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 175 lb N/acre.

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

	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)
Grower N Management	185	224 A*	68 B	0.83 A	629.00 A
Project SENSE N Management	175	226 A	73 A	0.78 B	640.91 A
P-Value	N/A	0.392	0.026	0.017	0.208

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

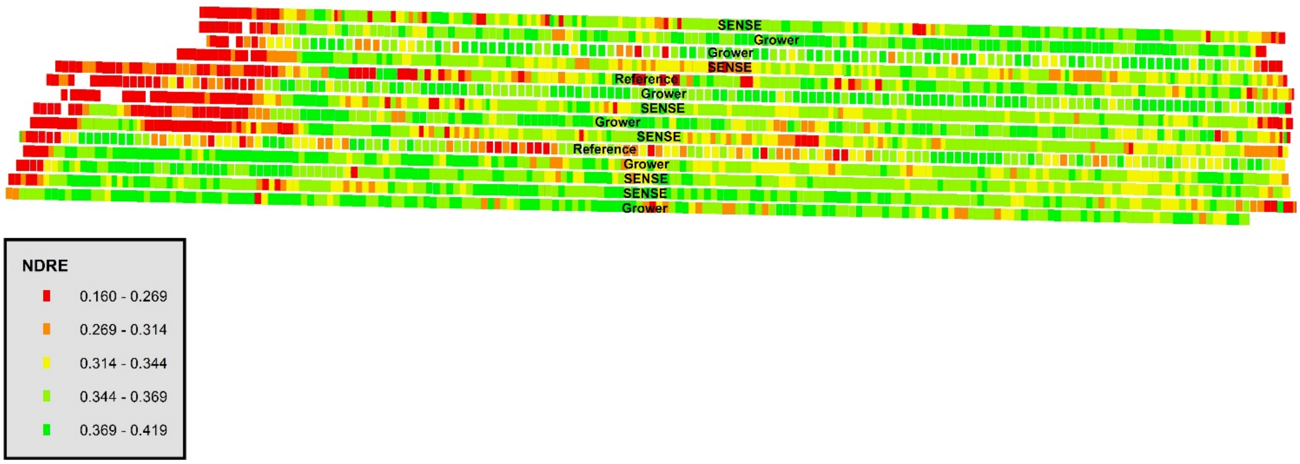


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on July 6, 2017.

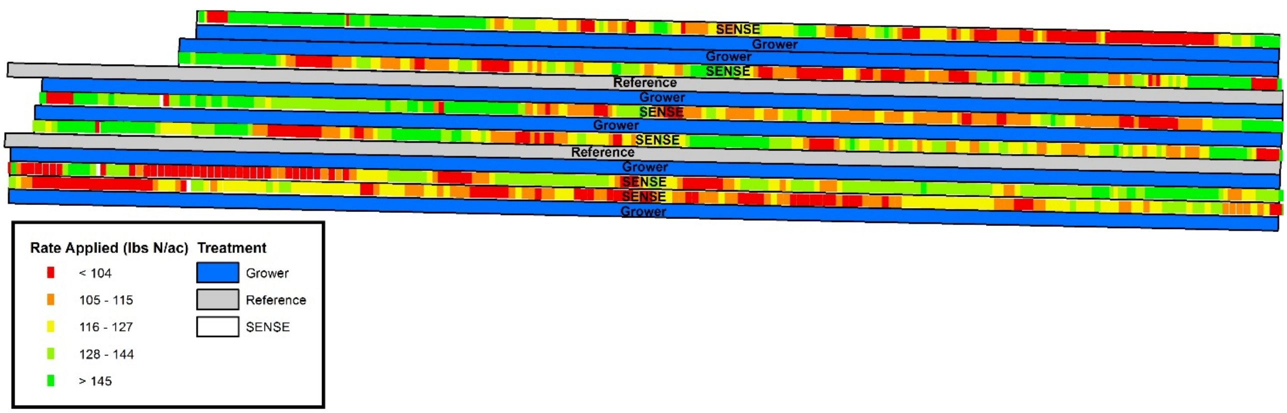


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

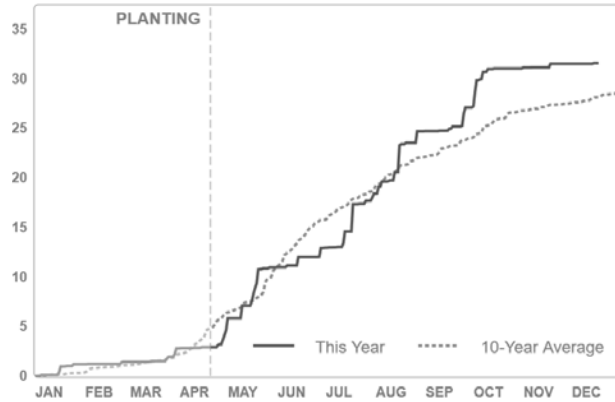
Summary:

- Project SENSE N application was 10 lb N/acre lower than the grower's N application.
- There was no difference in yield between the grower's N management and the Project SENSE N management.
- Project SENSE N management resulted in higher N use efficiency than the grower's N application.
- There were no significant differences in marginal net return.

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

Study ID: 205079201701
County: Hall
Soil Type: Hord silt loam 0-1% slope; Hord silt loam 1-3% slope
Planting Date: 4/20/17
Harvest Date: 10/25/17
Population: 31,600
Hybrid: CRM (days) 120
Reps: 6
Previous Crop: Corn
Tillage: No-Till

Irrigation: Pivot; 20 lb N/ac from irrigation
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) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
1	7.1	7.2	0.12	NONE	2.2	9.5	23	46	11	3.38	301	2047	223	19	13	0	6	79	14	1
2	7.2	7.2	0.15	NONE	2.4	13.2	32	33	10	3.39	323	2520	275	27	15.8	0	5	80	14	1
3	7.3	7.2	0.14	NONE	1.9	8.6	21	23	9	3.57	221	2252	235	31	13.9	0	4	81	14	1

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial grower N rate was 16 lb N/acre applied on March 28, 2017. An additional application of 46 lb N/acre was made on April 18, 2017. During the growing season, 160 lb N/acre was applied on June 14, 2017. Total N applied was 222 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 16 lb N/acre was applied on March 28, 2017, and 46 lb N/acre was made on April 18, 2017. Crop canopy sensing and application occurred on June 27, 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 100 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 162 lb N/acre.

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

	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)
Grower N Management	222	225 A*	57 B	0.99 A	616.72 A
Project SENSE N Management	162	221 A	78 A	0.73 B	630.30 A
P-Value	N/A	0.120	0.004	0.001	0.058

*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.

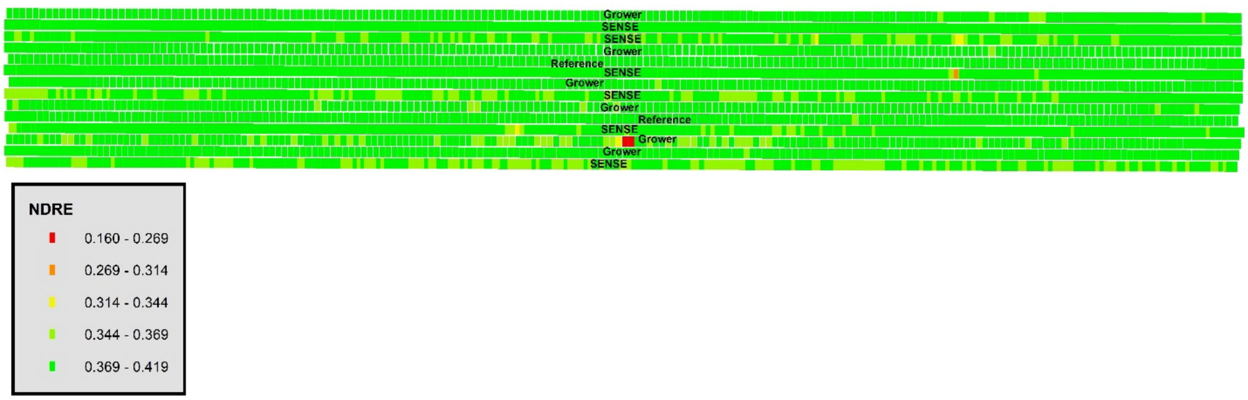


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on June 27, 2017.

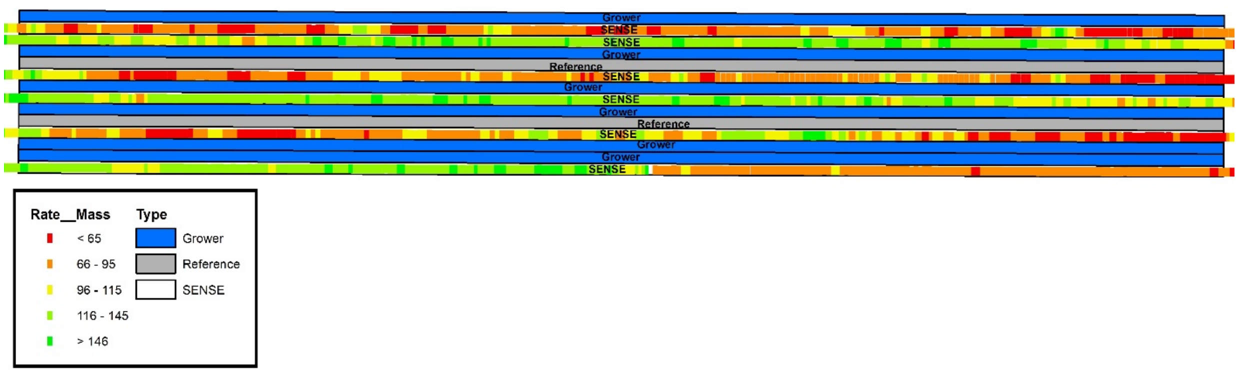


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

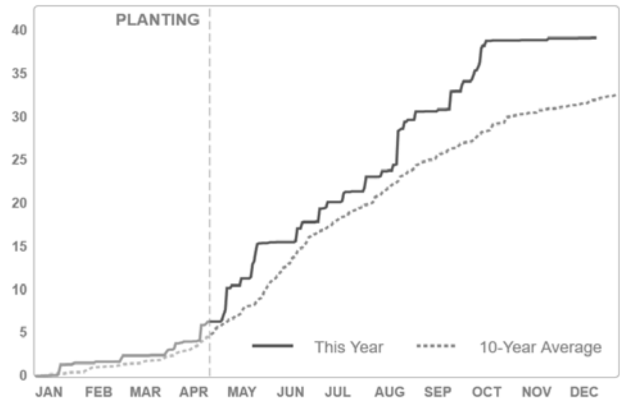
Summary:

- Project SENSE N application was 60 lb N/acre lower than the grower's N application.
- There was no difference in yield between the Project SENSE N management and grower's N management.
- The Project SENSE N management resulted in higher N use efficiency than the grower's N management.
- There was no difference in marginal net return between the Project SENSE N management and grower's N management.

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

Study ID: 211023201701
County: Butler
Soil Type: Ovina-Thurman complex 0-6% slopes; Muir silt loam rarely flooded
Planting Date: 4/20/17
Harvest Date: 10/26/17
Population: 32,000
Hybrid: CRM (days) 110
Reps: 6
Previous Crop: Corn
Tillage: Reduced Tillage

Irrigation: Pivot; 10 lb N/ac from irrigation
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
1	6.5	6.9	0.16	NONE	2.8	7.7	18	27	11	2.42	214	2120	257	20	14.5	8	4	72	15	1
2	5.9	6.7	0.09	NONE	1.7	5.8	14	18	12	1.57	216	1211	150	11	10.8	27	5	56	12	0
3	6	6.8	0.1	NONE	1.8	8.2	20	10	14	1.76	142	1432	178	14	11.3	20	3	63	13	1

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial grower N rate was 70 lb N/acre applied on April 20, 2017. An additional application of 115 lb N/acre was made on June 1, 2017. Total N applied was 185 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 70 lb N/acre was applied on April 20, 2017. Crop canopy sensing and application occurred on June 21, 2017, at V10 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 115 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 185 lb N/acre.

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

	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)
Grower N Management	185	202 B*	61 A	0.92 A	561.67 B
Project SENSE N Management	185	205 A	62 A	0.91 A	569.22 A
P-Value	N/A	0.011	0.584	0.701	0.035

*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.

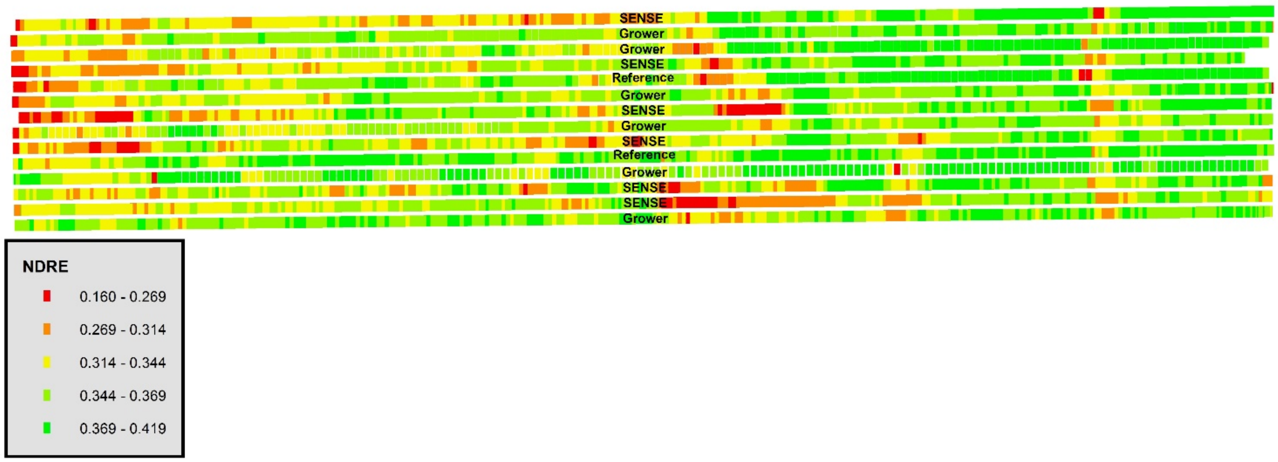


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on June 21, 2017.

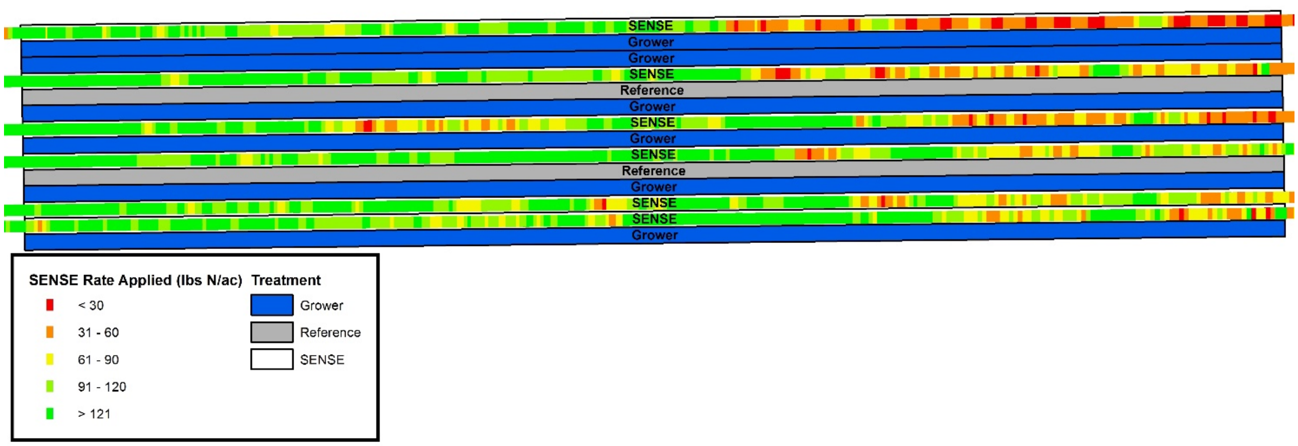


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

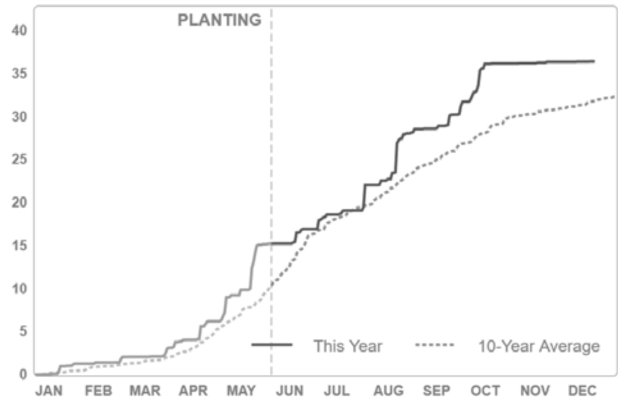
Summary:

- The total N application was the same for both the grower's N management and the Project SENSE N management.
- The Project SENSE N management had a 2.4 bu/acre yield increase compared with the grower's N management despite identical N rates. Different in-season application timing for the Project SENSE N management and grower N management is likely the cause of the yield difference. At the time of in-season application for the Project SENSE strips, some N deficiency was visually observed.
- There were no differences in N use efficiency between the grower's N management and the Project SENSE N management.
- The Project SENSE N management resulted in an $8/acre increase in marginal net return compared with the grower's N management.

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

Study ID: 574037201701
County: Colfax
Soil Type: Lawet silt loam rarely flooded
Planting Date: 5/29/17
Harvest Date: 11/7/17
Population: 31,000
Hybrid: CRM (days) 107
Reps: 6
Previous Crop: Corn
Tillage: Reduced Tillage

Irrigation: Pivot; 24 lb N/ac from irrigation
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	8.1	7.2	0.31	HIGH	5	6.3	15	45	7	2.21	341	5135	789	9	33.2	0	3	77	20	0
14	8.1	7.2	0.3	HIGH	4.5	6.4	15	42	6	2.16	279	5128	773	9	32.8	0	2	78	20	0
22	8.2	7.2	0.33	HIGH	5.3	8.1	19	50	7	2.14	326	5250	913	15	34.8	0	2	76	22	0

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial grower N rate was 54 lb N/acre applied on May 29, 2017. An additional application of 173 lb N/acre was made during the growing season. Total N applied was 227 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 54 lb N/acre was applied on May 29, 2017. Crop canopy sensing and application occurred on July 10, 2017, at the V13 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 31 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 85 lb N/acre.

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

	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)
Grower N Management	227	233 A*	58 B	0.97 A	641.95 A
Project SENSE N Management	85	213 B	141 A	0.40 B	634.76 B
P-Value	N/A	<0.0001	<0.0001	<0.0001	0.038

*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.

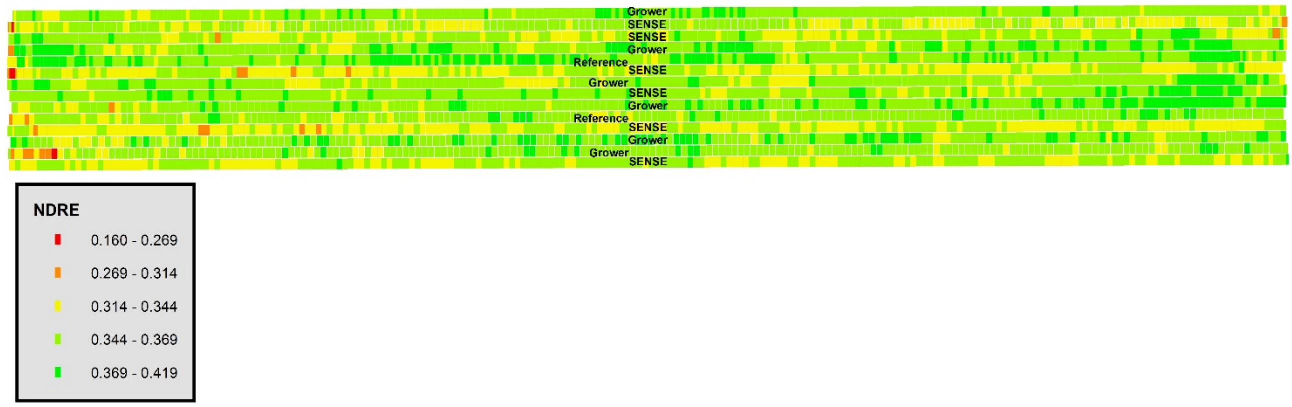


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on July 10, 2017.

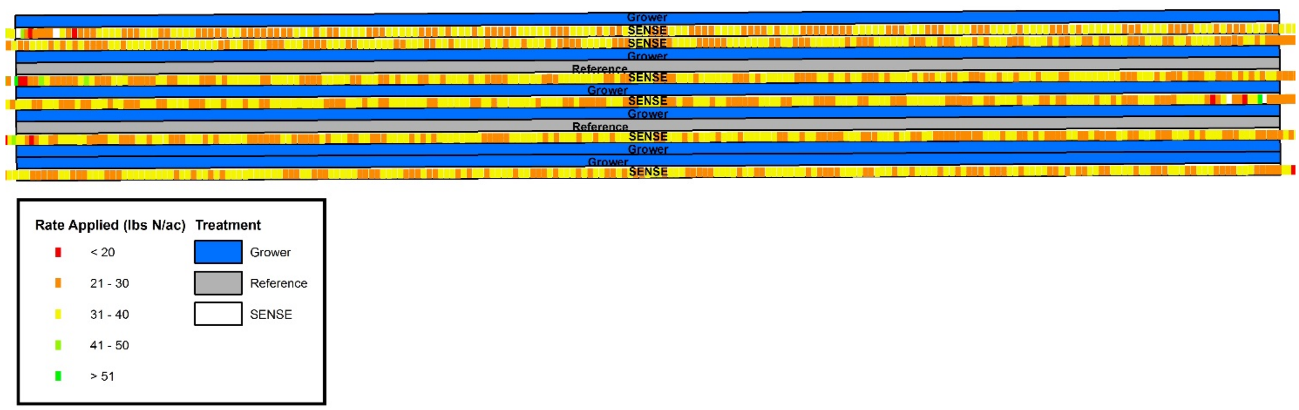


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

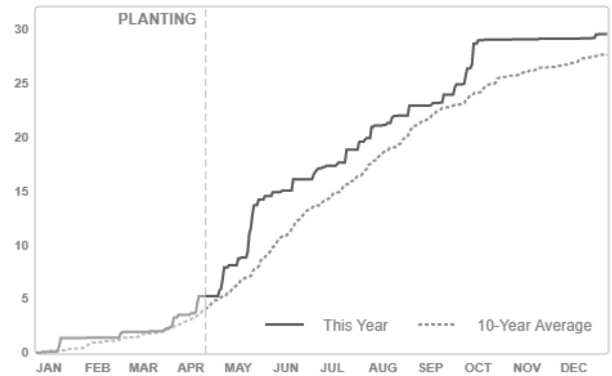
Summary:

- Project SENSE N application was 143 lb N/acre lower than the grower's N application.
- The grower's N management had a 21 bu/acre yield increase compared with the Project SENSE N management.
- The Project SENSE N management resulted in higher N use efficiency than the grower's N management.
- The grower's N management had a $7/acre higher marginal net return.

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

Study ID: 617035201701
County: Clay
Soil Type: Hastings silt loam 0-1% slope; Butler silt loam 0-1% slope
Planting Date: 4/24/17
Harvest Date: 10/28/17
Population: 34,000
Hybrid: Channel 209-51VT2P
Reps: 6
Previous Crop: Soybean
Tillage: Strip-till

Irrigation: Pivot; 0 lb N/ac from irrigation
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
1	6	6.6	0.31	NONE	2.9	27.4	66	18	13	2.44	371	2111	275	26	17.6	21	5	60	13	1
2	6.4	6.8	0.22	NONE	3.3	6.9	16	6	10	3.43	427	2354	294	34	17.5	11	6	67	14	1
3	6.8	7.2	0.19	NONE	3.3	6	14	14	10	4.57	483	1956	219	32	13	0	10	75	14	1

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The grower applied all of his N fertilizer on March 17, 2017 in a variable rate application averaging 163 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 90 lb N/acre was applied on March 17, 2017. Crop canopy sensing and application occurred on July 5, 2017, at the V16 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 119 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 209 lb N/acre.

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

	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)
Grower N Management	163	245 A*	84 A	0.67 B	705.17 A
Project SENSE N Management	209	237 B	64 B	0.88 A	659.63 B
P-Value	N/A	<0.0001	<0.0001	<0.0001	<0.0001

*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.

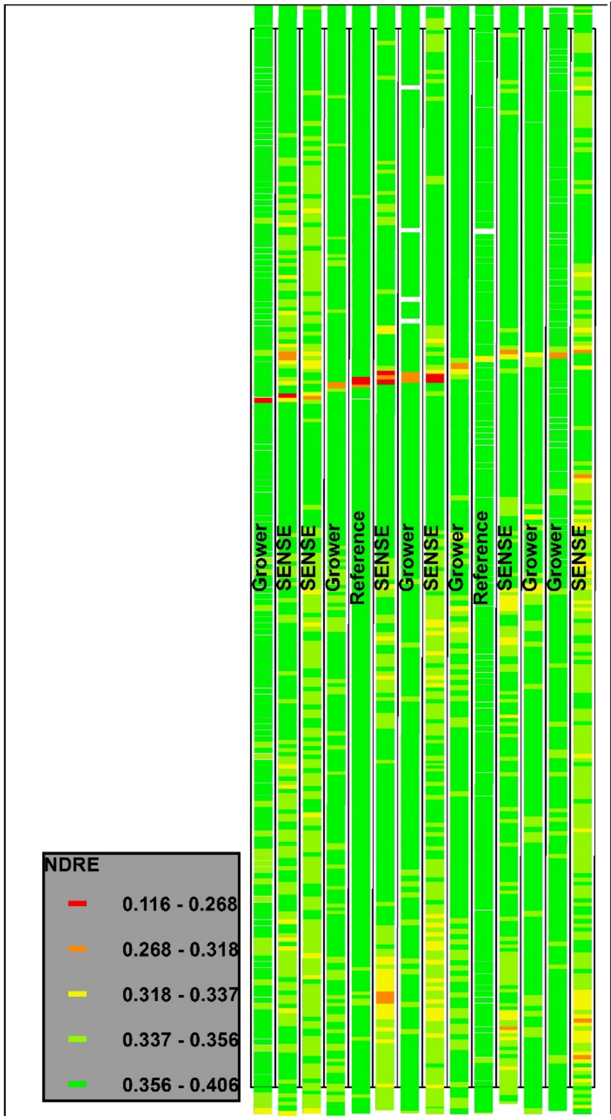


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on July 5, 2017.

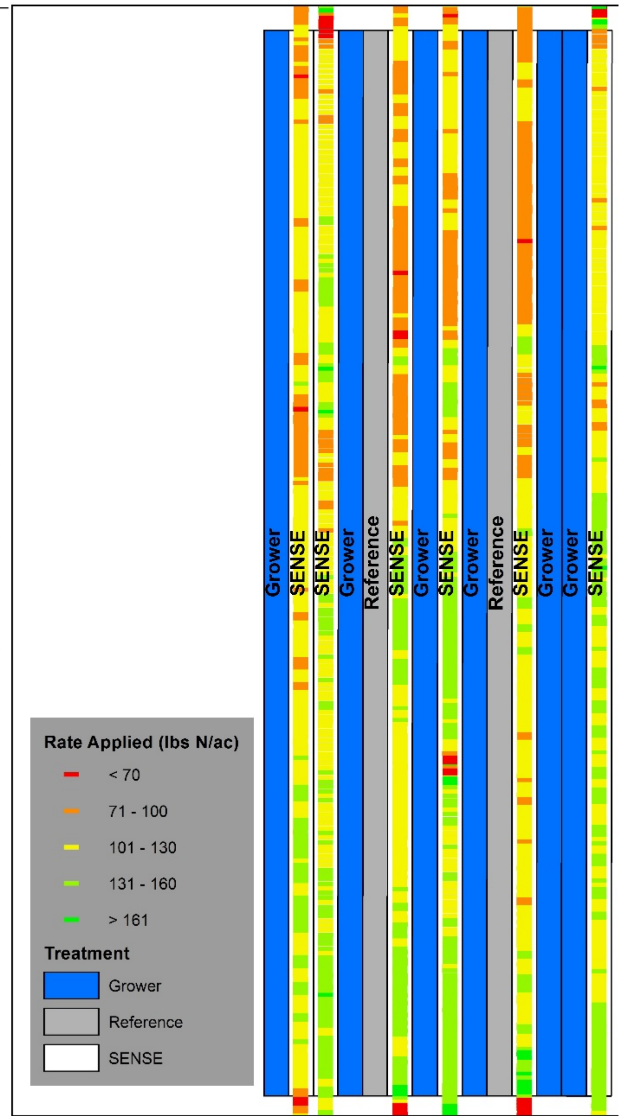


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

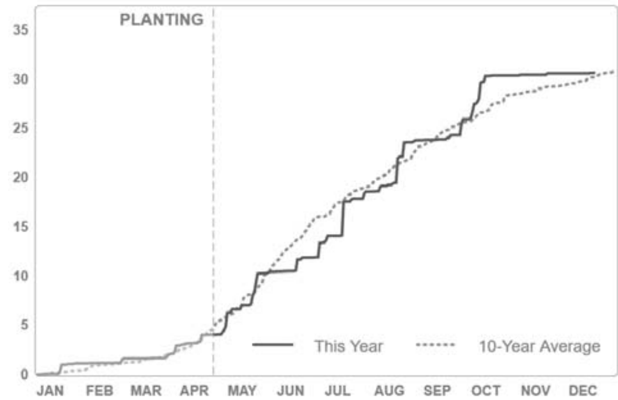
Summary:

- Project SENSE N application was 46 lb N/acre higher than the grower's N application.
- The grower's N management resulted in a 9 bu/acre yield increase compared with the Project SENSE N management.
- At the time of in-season application, deficiencies were not visually evident. Lack of incorporation of the in-season N application is a possible explanation for the lower yields despite higher N rates.
- The grower's N management resulted in higher N use efficiency than the Project SENSE N management.
- The grower's N management resulted in a $46/acre higher marginal net return.

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

Study ID: 618185201701
County: York
Soil Type: Hastings silt loam 0-1% slope; Fillmore silt loam frequently ponded
Planting Date: 4/22/17
Harvest Date: 10/21/17
Population: 32,600
Hybrid: CRM (days) 112
Reps: 5
Previous Crop: Corn
Tillage: No-Till

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) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
1	5.8	6.5	0.21	NONE	3.3	25.7	62	28	14	2.01	310	2079	369	16	19.6	27	4	53	16	0
2	6	6.6	0.21	NONE	3.4	31.9	77	25	14	1.68	336	1911	276	18	16.7	23	5	57	14	0
3	5.8	6.4	0.15	NONE	3.6	21	50	28	14	4.55	310	1416	179	14	15.7	40	5	45	9	0

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial grower N rate was 70 lb N/acre applied near the time of planting. A variable rate application averaging 140 lb N/acre was applied in late June. The toal N rate was 210 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 70 lb N/acre was applied near the time of planting. Crop canopy sensing and application occurred on July 5, 2017, at the V16 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 146 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 216 lb N/acre.

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

	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)
Grower N Management	210	247 A*	66 A	0.85 A	691.53 A
Project SENSE N Management	216	248 A	64 A	0.88 A	691.15 A
P-Value	N/A	0.817	0.115	0.125	0.972

*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.

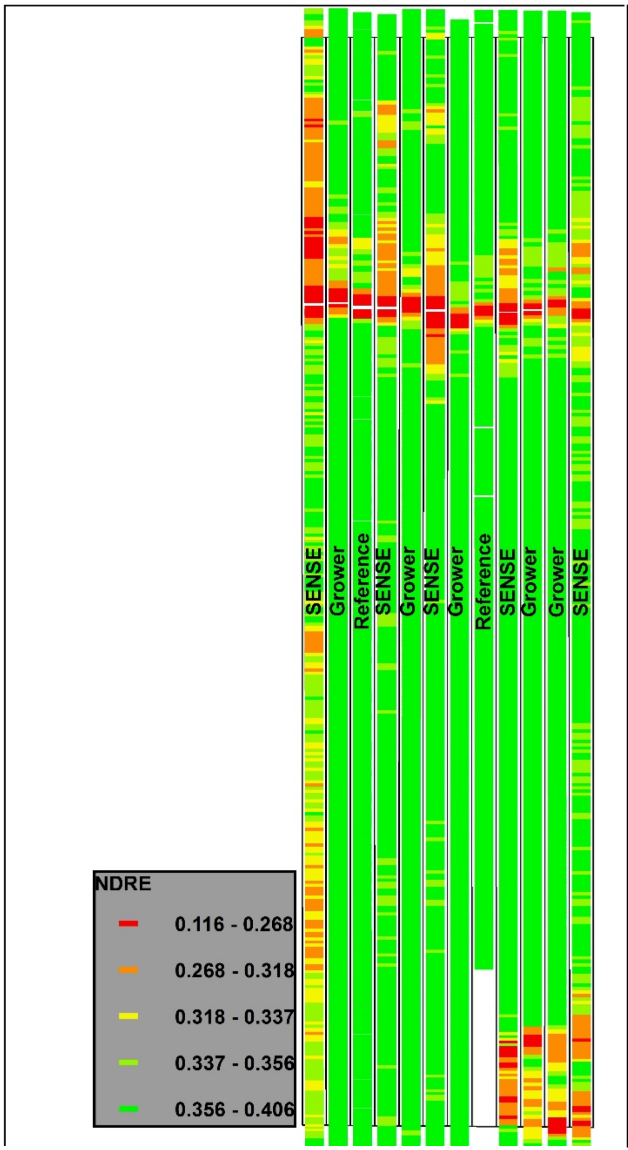


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on July 5, 2017.

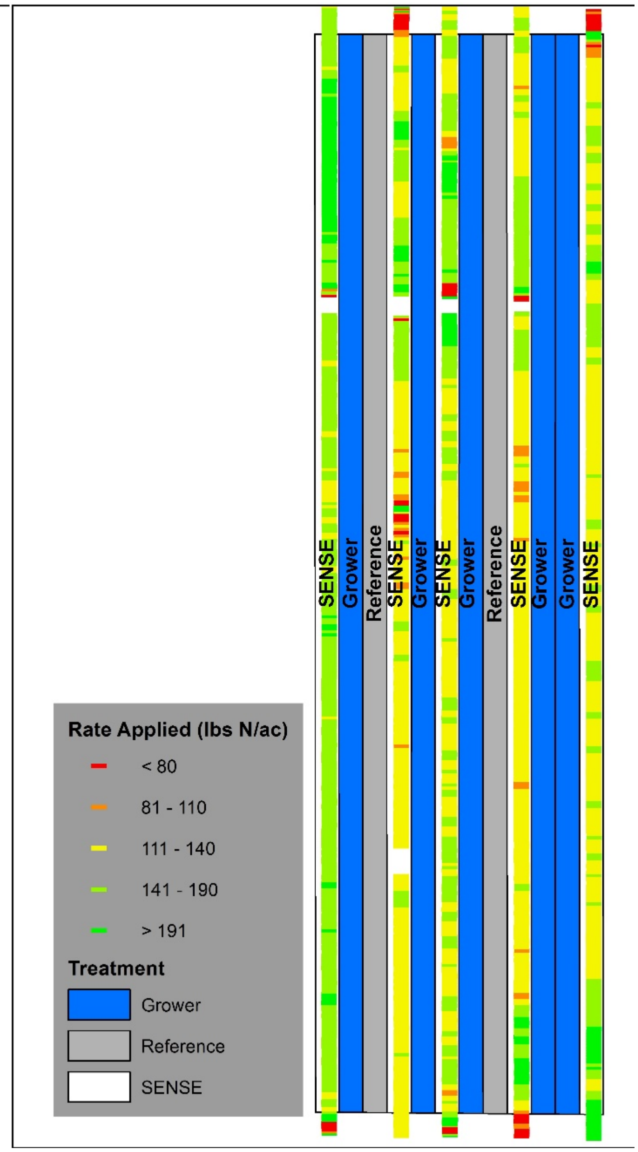


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

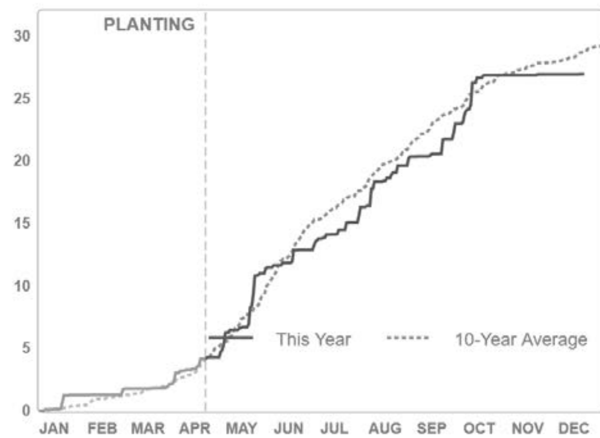
Summary:

- Project SENSE N application was 7 lb N/acre higher than the grower's N application.
- There was no yield difference between the Project SENSE N management and the grower's N management.
- There was no difference in N use efficiency between the Project SENSE N management and the grower's N management.
- There was no difference in marginal net return between the Project SENSE N management and the grower's N management.

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

Study ID: 620059201701
County: Fillmore
Soil Type: Crete silt loam 1-3% slope; Butler silt loam 0-1% slope; Fillmore silt loam drained, 0-1% slopes; Crete silt loam 0-1% slope; Crete silty clay loam 3-7% slopes, eroded; Fillmore silt loam frequently ponded
Planting Date: 4/18/17
Harvest Date: 10/17/17
Population: 35,300
Hybrid: CRM (days) 112
Reps: 6
Previous Crop: Soybean
Tillage: Reduced Tillage

Irrigation: Pivot; 5 N lb/ac from irrigation
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
1	5.8	6.7	0.51	NONE	2.8	50.5	121	21	14	1.31	264	3070	602	45	23.9	11	3	64	21	1
2	5.8	6.5	0.43	NONE	3.6	54.9	132	40	15	2.68	312	2335	295	37	20.4	26	4	57	12	1
3	6.2	6.8	0.21	NONE	3.3	6.4	15	13	16	2.08	261	2532	404	46	18.9	11	4	66	18	1

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial grower N rate was 82 lb N/acre applied on March 10, 2017. An additional 3 lb N/acre was applied at planting. On June 8, 2017, 70 lb N/acre was applied as an in-season application. Total N applied was 155 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 82 lb N/acre was applied on March 10, 2017 and an additional 3 lb N/acre was applied at planting. Crop canopy sensing and application occurred on June 6, 2017, at 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 56 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 141 lb N/acre.

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

	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)
Grower N Management	155	256 A*	92 B	0.61 A	741.33 A
Project SENSE N Management	141	251 B	100 A	0.56 B	733.36 A
P-Value	N/A	0.039	0.008	0.008	0.181

*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.

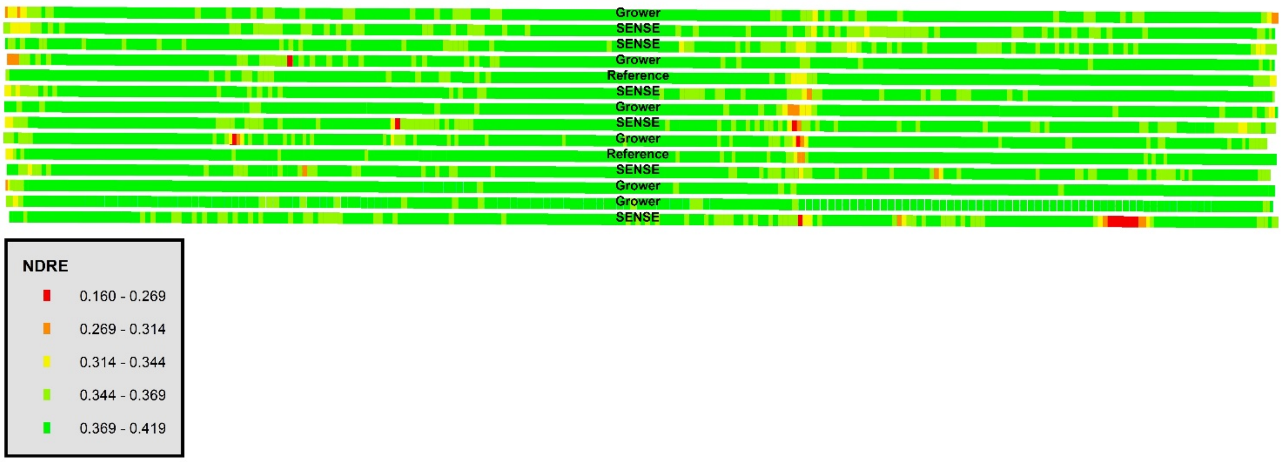


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on June 6, 2017.

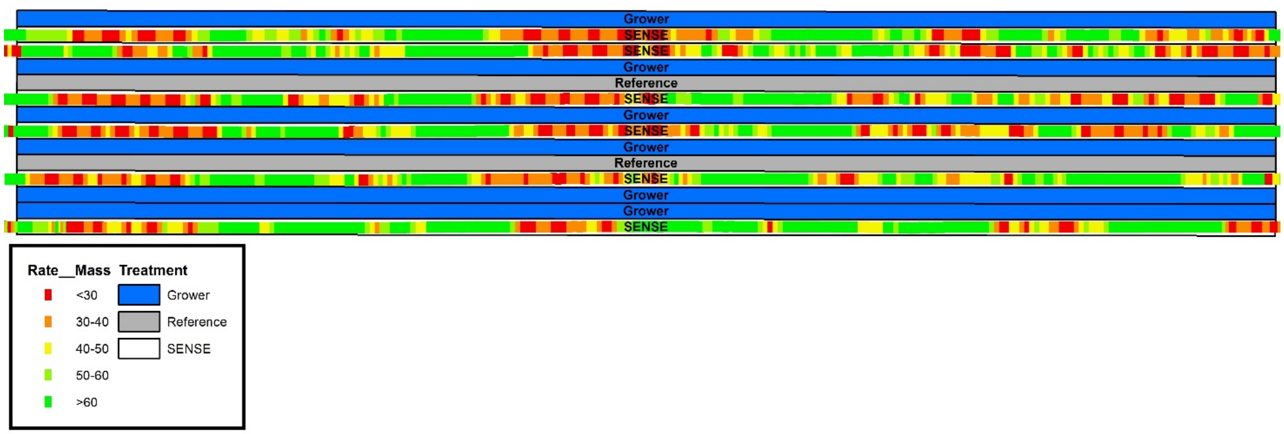


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

Summary:

- Project SENSE N application was 14 lb N/acre lower than the grower's N application.
- The grower's N management resulted in a 4 bu/acre yield increase compared with the Project SENSE N management.
- Project SENSE N management resulted in higher N use efficiency than the grower's N application.
- There was no difference in marginal net return between the Project SENSE N management and the grower's N management.

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

Study ID: 621023201701
County: Butler
Soil Type: Thurman loamy fine sand 2-6% slopes; Brocksburg loam 0-2% slope; Simeon loamy sand 0-3% slope
Planting Date: 4/23/17
Harvest Date: 10/18/17
Population: 30,300
Hybrid: Pioneer 1498
Reps: 6
Previous Crop: Soybean
Tillage: No-Till

Irrigation: Pivot; 22.8 lb N/ac from irrigation
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) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
3	6.8	7.2	0.07	NONE	1.8	4.5	11	29	7	4.93	181	1464	142	9	9	0	5	81	13	0
14	6.3	6.8	0.03	NONE	0.7	2	5	26	4	2.5	64	734	72	6	6.5	31	3	57	9	0
22	6.9	7.2	0.03	NONE	0.7	2.1	5	12	4	2.63	48	618	66	6	3.8	0	3	81	15	1

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial grower N rate was 13 lb N/acre applied on April 23, 2017. An additional 74 lb N/acre was applied on April 29, 2017, 21 lb N/acre was applied on June 2, 2017, and 110 lb N/acre was applied on June 11, 2017. Total N applied was 218 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 13 lb N/acre was applied on April 23, 2017, 74 lb N/acre was applied on April 29, 2017, and 21 lb N/acre was applied on June 2, 2017. Crop canopy sensing and application occurred on June 29, 2017, at 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 42 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 150 lb N/acre.

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

	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)
Grower N Management	218	220 A*	57 B	0.99 A	663.09 A
Project SENSE N Management	150	199 B	75 A	0.76 B	605.88 B
P-Value	N/A	0.002	0.0003	<0.0001	0.004

*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 nitrogen fertilizer.

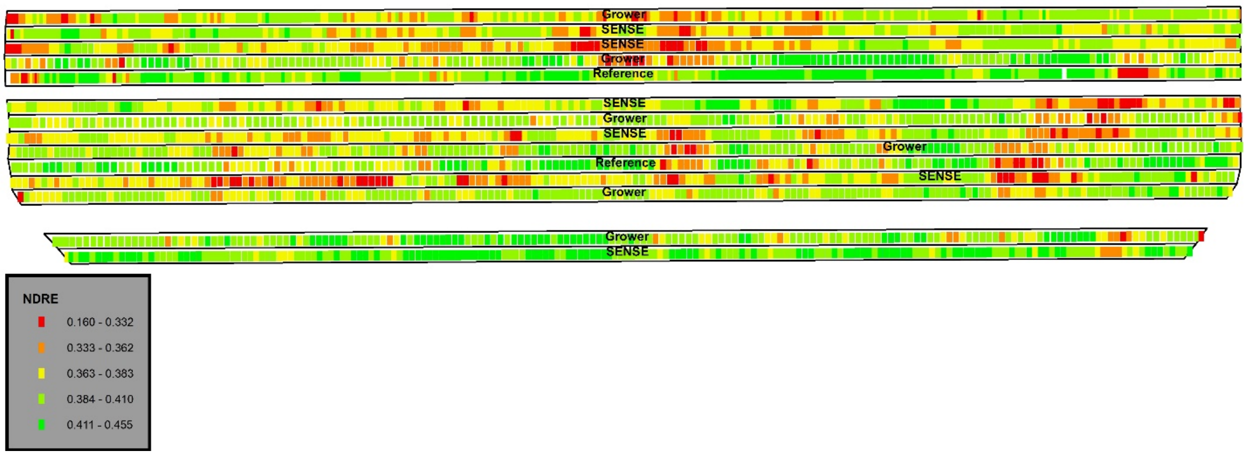


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on June 29, 2017.

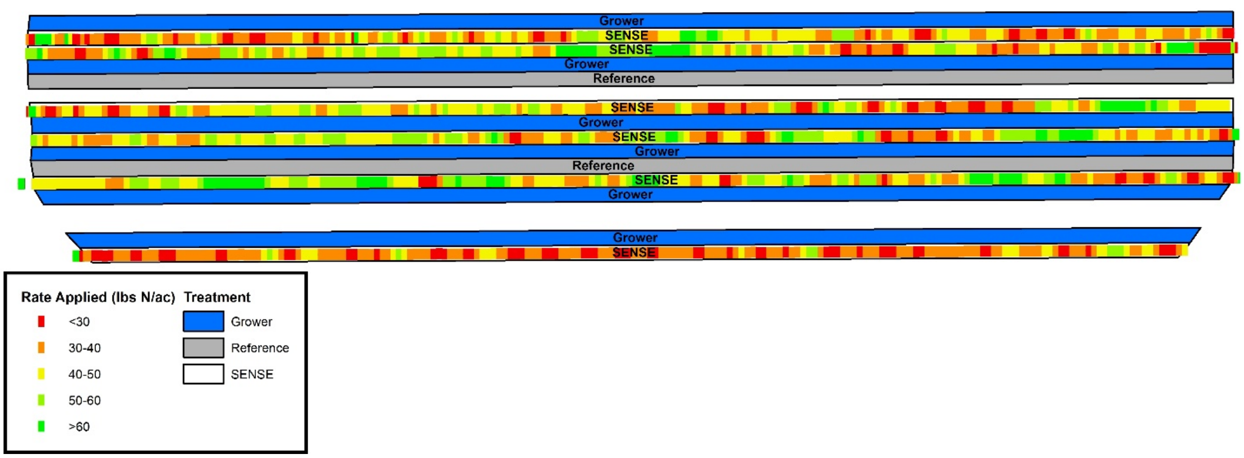


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

Summary:

- Project SENSE N application was 68 lb N/acre lower than the grower's N application.
- The grower's N management resulted in a 21 bu/acre yield increase compared with the Project SENSE N management.
- The Project SENSE N management resulted in higher N use efficiency than the grower's N management.
- The grower's N management resulted in a $57/acre higher marginal net return.

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

Study ID: 715035201701
County: Clay
Soil Type: Crete silt loam 0-1% slope; Hastings silt loam 1-3% slope; Butler silt loam 0-1% slope
Planting Date: 4/22/17
Harvest Date: 10/27/17
Population: 31,000
Hybrid: CRM (days) 114
Reps: 6
Previous Crop: Corn
Tillage: Strip-Till

Irrigation: Pivot; 0 lb N/ac from irrigation
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
1	6.7	7.2	0.23	NONE	3.5	7.9	19	55	15	1.52	237	2029	284	45	13.3	0	5	76	18	1
2	6.5	6.8	0.17	NONE	3.6	8.5	20	79	15	1.85	246	2018	261	40	15.5	16	4	65	14	1
3	6.6	7.2	0.21	NONE	3.9	7.3	18	100	16	1.83	259	2250	392	60	15.4	0	4	73	21	2

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: 71 lb N/acre was applied as 32 percent UAN pre-plant with a strip-till applicator; 6 lb N/acre was applied as 10-34-0 at planting on April 22, 2017. On June 15, 2017, 106 lb N/acre was applied as an in-season application. Total N applied was 183 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 6 lb N/ac was applied as 10-34-0 at planting on April 22, 2017, and an additional 71 lb N/acre was applied as 32 percent UAN shortly after planting. Crop canopy sensing and application occurred on June 27, 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 162 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 239 lb N/acre.

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

	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)
Grower N Management	183	241 A*	122 A	0.76 B	683.60 A
Project SENSE N Management	239	241 A	94 B	0.99 A	661.17 B
P-Value	N/A	0.924	<0.0001	<0.0001	0.018

*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.

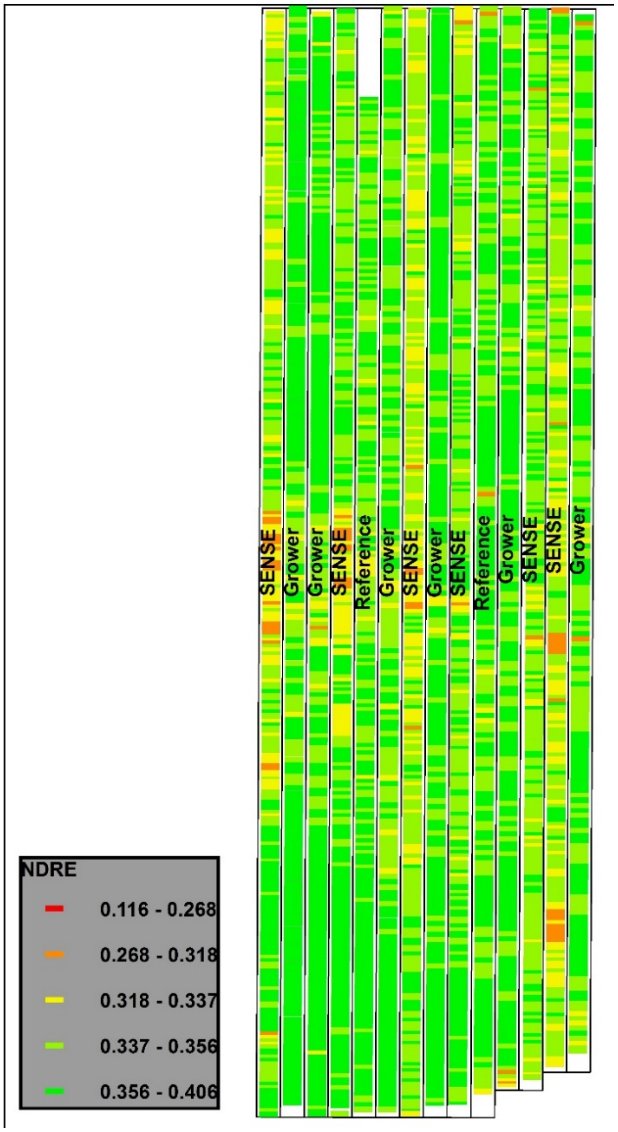


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on June 27, 2017.

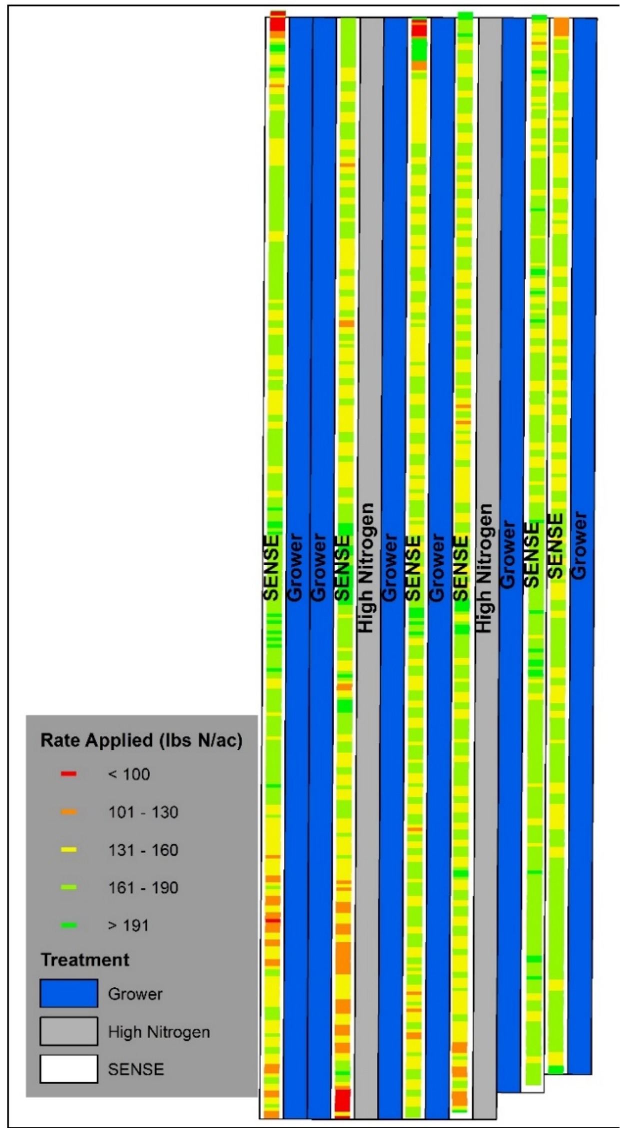


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

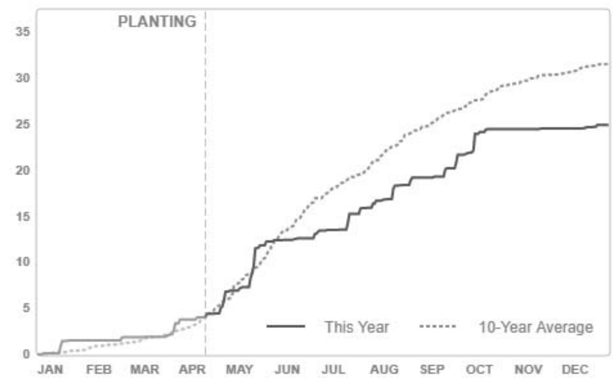
Summary:

- Project SENSE N application was 56 lb N/acre higher than the grower's N application.
- There was no difference in yield between the Project SENSE N management and grower's N management.
- The grower's N management resulted in higher N use efficiency than the Project SENSE N management.
- The Project SENSE N management had a lower marginal net return than the grower's N management.
- Two additional N credits are not included in the figure above. Manure was applied in fall 2014 to the whole field, and N was applied to a cover crop in fall 2016. The soil test values should reflect these contributions.

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

Study ID: 716169201701
County: Thayer
Soil Type: Crete silt loam 0-1% slope; Hastings silty clay loam 3-7% slopes; Geary silty clay loam 11-30% slopes
Planting Date: 4/18/17
Harvest Date: 10/20/17
Population: 33,300
Hybrid: DKC 60-69
Reps: 6
Previous Crop: Soybean
Tillage: No-Till

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) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
1	6.5	6.8	0.44	NONE	3.5	22.7	54	34	18	7.53	473	3390	428	34	23.7	8	5	71	15	1
2	6.5	6.8	0.26	NONE	4.7	12.9	31	46	15	9.1	480	2198	237	21	16.2	12	8	67	12	1
3	6.5	6.7	0.28	NONE	4	11.4	27	43	15	11.64	434	3074	407	36	22.8	12	5	67	15	1

Introduction: A high clearance applicator was equipped with Ag Leader® OptRx sensors. UAN fertilizer was applied with drop nozzles as the crop canopy was sensed. This study compares crop canopy sensor based in-season N application with the grower's standard N management.

Grower Nitrogen Treatment: The initial N application was 85 lb N/ac applied on March 24, 2017. An additional 6 lb N/ace was applied at planting on April 18, 2017. On June 6, 2017, 120 lb N/acre was applied. Total N applied was 211 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 85 lb N/acre was applied on March 24, 2017, and 6 lb N/acre was applied at planting. Crop canopy sensing and application occurred on June 26, 2017, at the V10 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 161 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 2*. The total N rate was 252 lb N/acre.

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

	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)
Grower N Management	211	253 A*	67 A	0.84 B	709.95 A
Project SENSE N Management	252	251 A	56 B	1.01 A	686.38 B
P-Value	N/A	0.060	0.0006	0.001	0.001

*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.

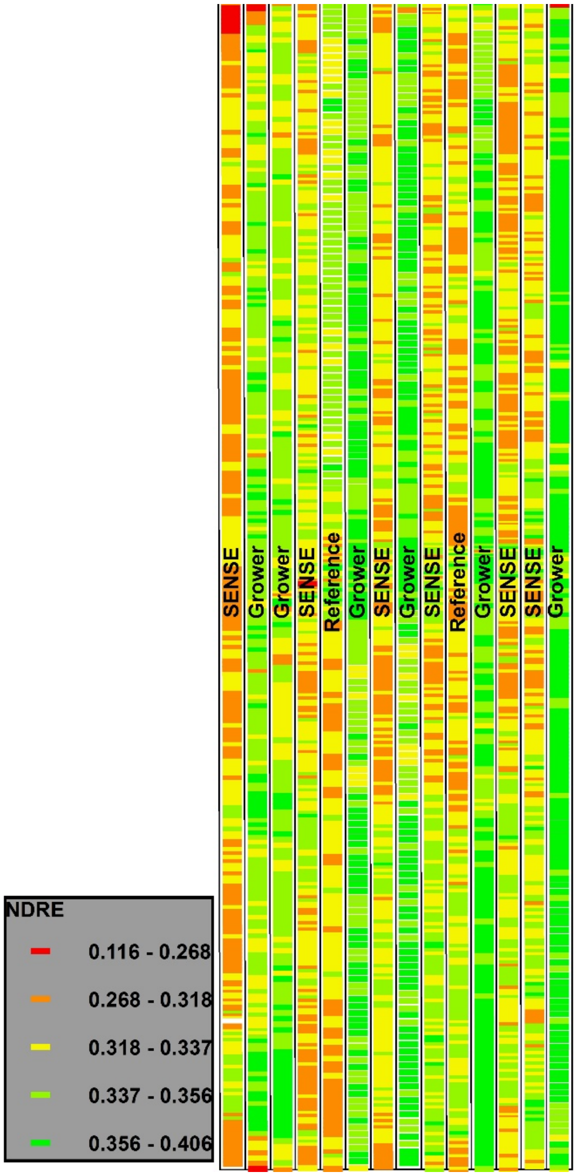


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on June 26, 2017.

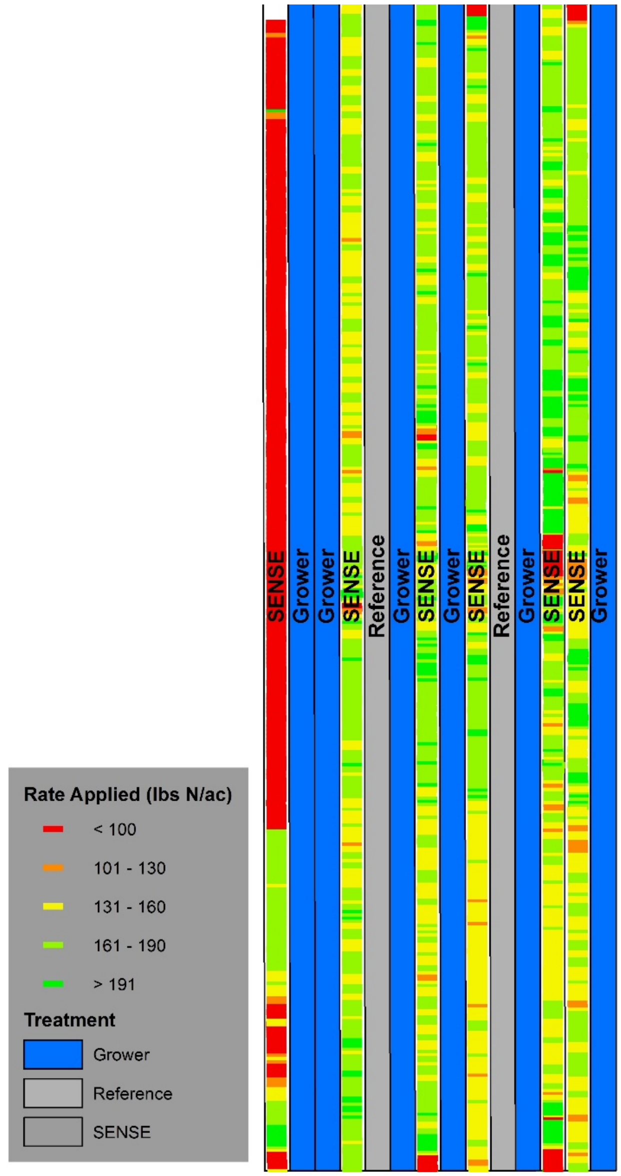


Figure 2. Nitrogen rate applied to Project SENSE N Management treatments based on NDRE captured with the crop canopy sensors and displayed in *Figure 1*.

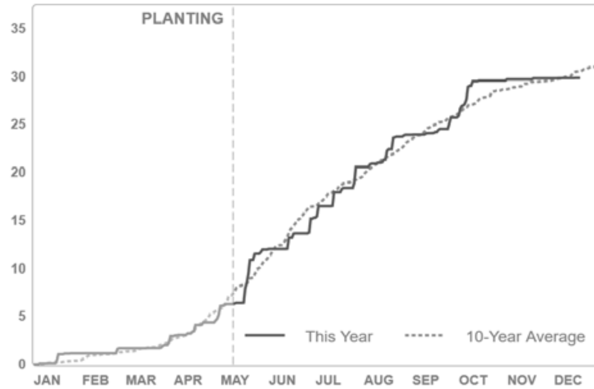
Summary:

- Project SENSE N application was 41 lb N/acre higher than the grower's N application.
- There was no difference in yield between the Project SENSE N management and grower's N management.
- The grower's N management resulted in higher N use efficiency than the Project SENSE N management.
- The grower's N management resulted in a $24/acre higher marginal net return.

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

Study ID: 619159201701
County: Seward
Soil Type: Butler silt loam 0-1% slope; Hobbs silt loam frequently flooded; Crete silt loam 1-3% slope
Planting Date: 05/09/17
Harvest Date: 10/24/17
Population: 35,000
Hybrid: CRM (days) 113
Reps: 5
Previous Crop: Soybean
Tillage: No-Till

Note: 5 lb N/ac from irrigation
Irrigation: Pivot
Rainfall (in):



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 100 lb N/acre applied on March 18, 2017. An additional 30 lb N/acre was applied on May 10, 2017, and an additional 60 lb N/acre was applied on July 6, 2017. The total N rate was 190 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 100 lb N/acre was applied on March 18, 2017, and an additional 30 lb N/acre was applied on May 10, 2017. Crop canopy sensing and application occurred on July 6, 2017, at the V13 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 54 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 3*. The total N rate was 184 lb N/acre.

Drone Based Sensor N Treatment: For the drone based sensor treatment, 100 lb N/acre applied on March 18, 2017, and an additional 30 lb N/acre was applied on May 10, 2017. The drone was flown over the field on July 5, 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 48 lb N/acre. These N rates were applied on July 6, 2017, at the V13 growth stage. Nitrogen application for the drone based treatment strips is shown in *Figure 3*. The total N rate was 178 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.

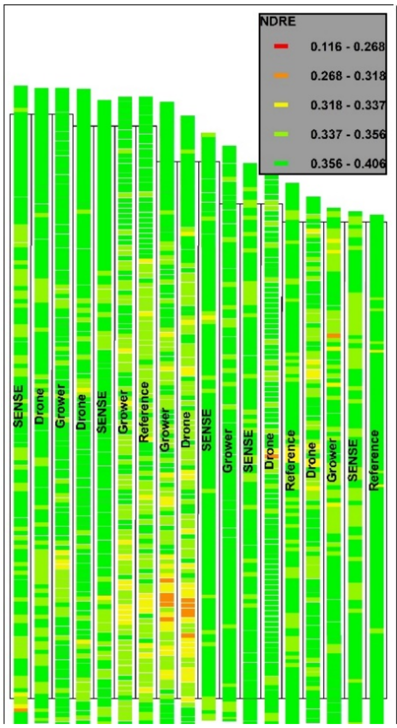


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on July 6, 2017.

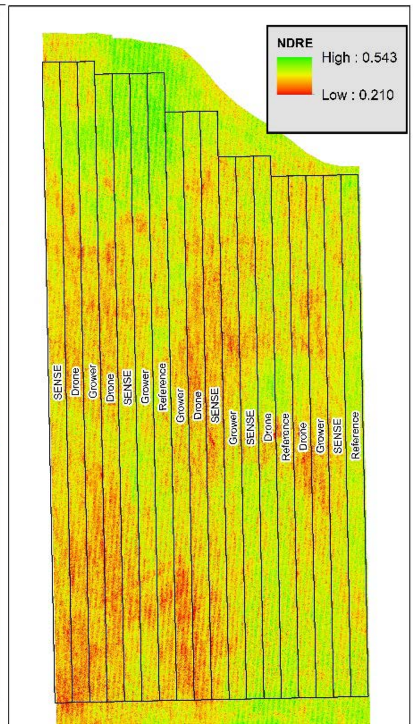


Figure 2. NDRE (normalized difference red edge) index obtained using a drone based sensor on July 5, 2017.

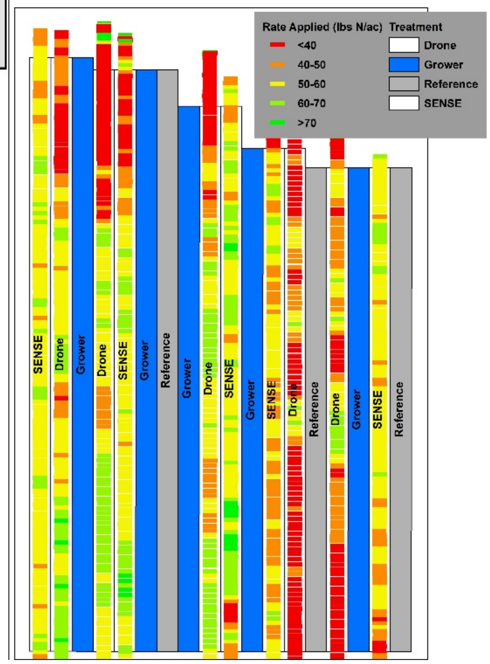


Figure 3. Nitrogen rate applied to Project SENSE N Management and Drone Based Sensor Management treatments based on NDRE values in *Figure 1* and *Figure 2*.

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	178	244 A*	77 A	0.73 C	694.02 A
Grower N Management	190	245 A	72 C	0.78 A	692.60 A
Project SENSE N Management	184	245 A	74 B	0.75 B	696.12 A
P-Value	N/A	0.764	0.002	0.001	0.833

*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

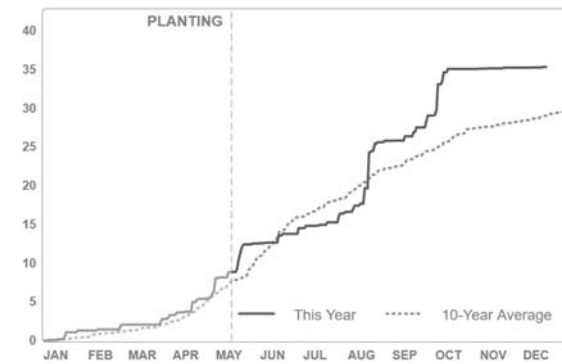
Summary:

- Both the Project SENSE N management and drone based sensor management had a lower total N rate than the grower, and did not have a reduced yield compared with the grower. This indicates that both approaches appropriately reduced the N rate, leading to higher nitrogen use efficiency.
- The drone based treatment had lower N recommendations than the Project SENSE treatment, resulting in greater N efficiencies.
- There was no difference in marginal net return between the three treatments.

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

Study ID: 714125201701
County: Nance
Soil Type: Ortello fine sandy loam 1-3% slope
Planting Date: 5/12/17
Harvest Date: 10/29/17
Population: 29,600
Hybrid: CRM (days) 115
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Note: 34 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) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
3	6.9	7.2	0.07	NONE	1.3	2.2	5	15	9	3.82	218	1138	113	6	7.2	0	8	79	13	0
10	6.3	6.8	0.2	NONE	2.2	3.4	8	20	10	6.24	290	1345	144	12	10.2	15	7	65	12	1
20	6.2	6.8	0.07	NONE	1.2	1.9	4	48	9	3.52	281	804	82	4	6.9	22	10	58	10	0

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 25 lb N/acre applied on May 12, 2017. An additional 50 lb N/acre was applied on June 20, 2017, and an additional 103 lb N/acre was applied on July 10, 2017. The total N rate was 178 lb N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 25 lb N/acre was applied on May 12, 2017, and an additional 50 lb N/acre was applied on June 20, 2017. Crop canopy sensing and application occurred on July 10, 2017, at the V13 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 60 lb N/acre. Nitrogen application for the Project SENSE treatment strips is shown in *Figure 3*. The total N rate was 135 lb N/acre.

Drone Based Sensor N Treatment: For the drone based sensor treatment, 25 lb N/acre was applied on May 12, 2017, and an additional 50 lb N/acre was applied on June 20, 2017. The drone was flown over the field on July 7, 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 100 lb N/acre. These N rates were applied on July 10, 2017, at the V13 growth stage. Nitrogen application for the drone based treatment strips are shown in *Figure 3*. The total N rate was 175 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.

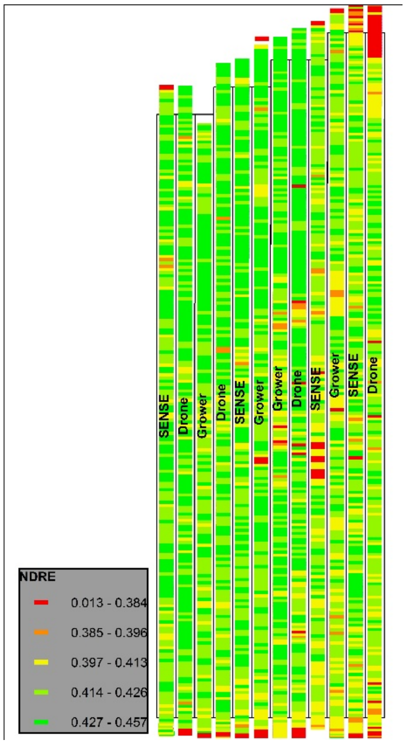


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on July 10, 2017.

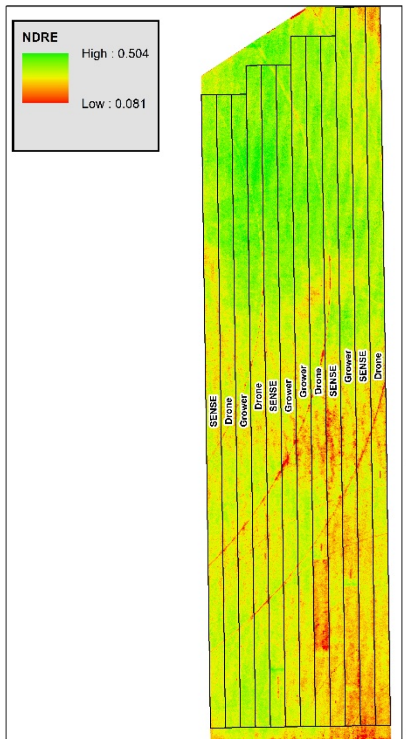


Figure 2. NDRE (normalized difference red edge) index obtained using a drone based sensor on July 7, 2017.

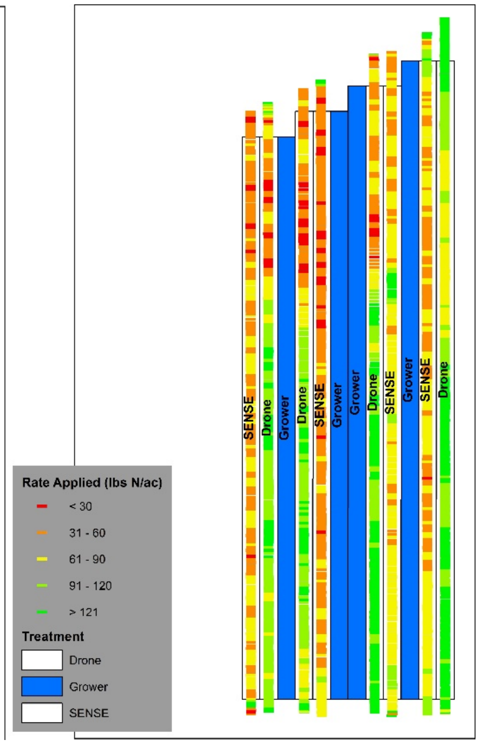


Figure 3. Nitrogen rate applied to Project SENSE N Management and Drone Based Sensor Management treatments based on NDRE values in *Figure 1* and *Figure 2*.

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	175	232 A*	75 B	0.75 A	660.11 A
Grower N Management	178	238 A	75 B	0.75 A	675.11 A
Project SENSE N Management	135	229 B	96 A	0.59 B	666.46 A
P-Value	N/A	0.012	0.002	0.001	0.165

*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:

- At this site, the Project SENSE N management used 43 less lb N/acre than the grower and had a lower yield.
- The drone based management and grower management resulted in similar total N rates and no difference in yield.
- It is not clear why the drone based sensor and high clearance applicator sensor resulted in such different N recommendations.

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) K	Ca	Mg	Na	CEC me/100g	% Base Saturation 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.

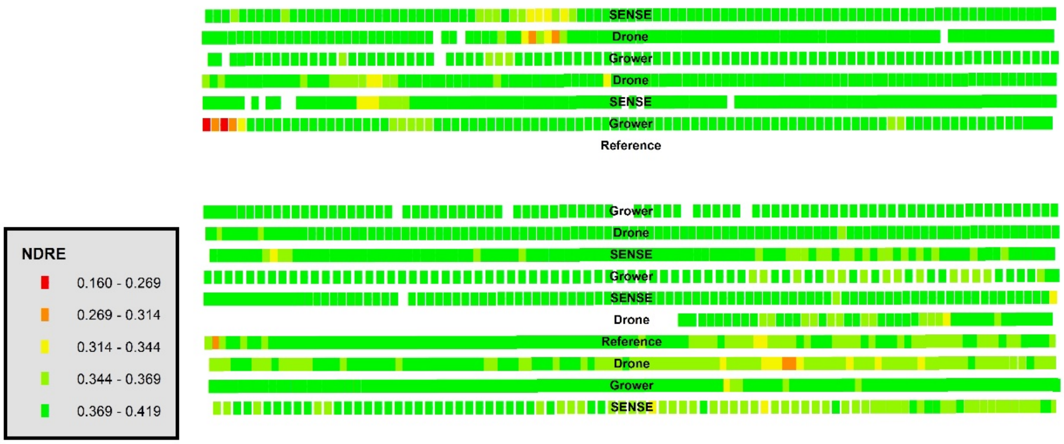


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on July 1, 2017.

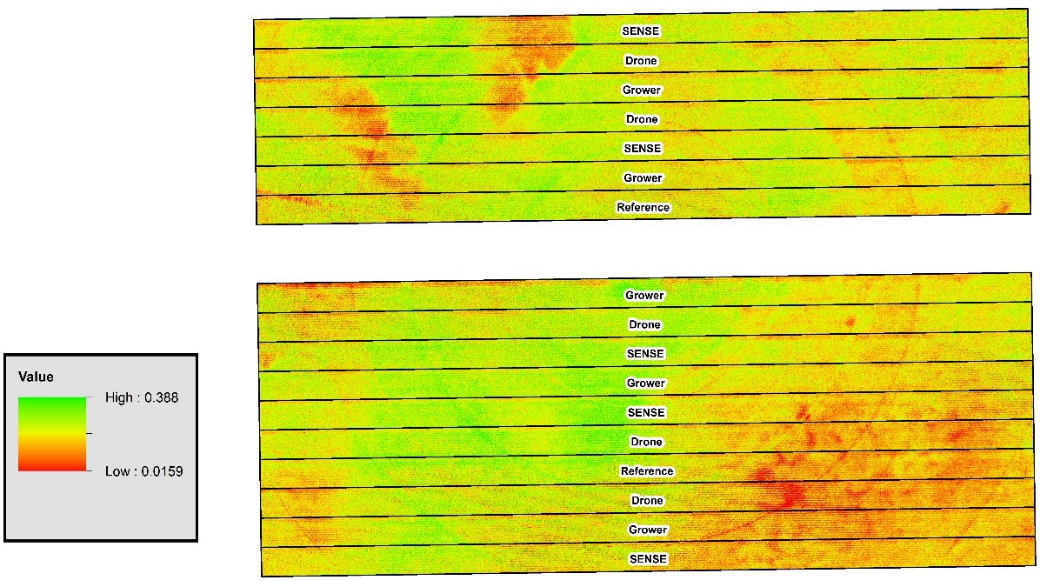


Figure 2. NDRE (normalized difference red edge) index obtained using a drone based sensor on June 26, 2017.

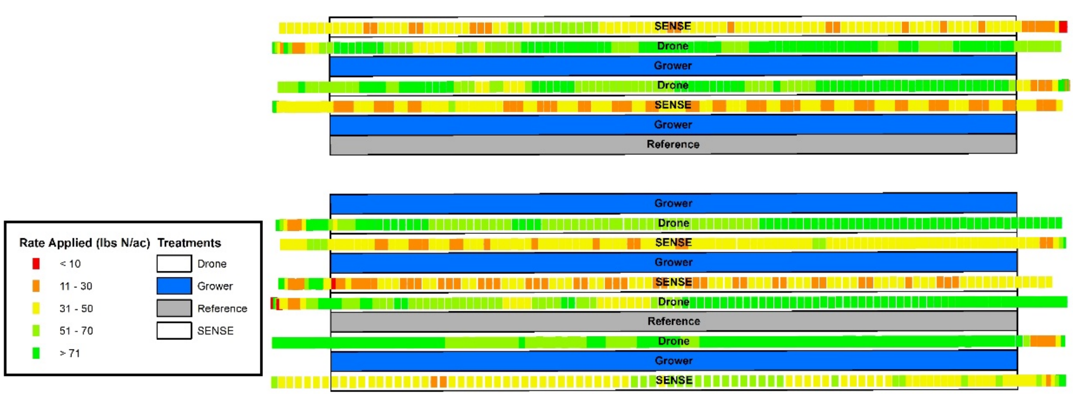


Figure 3. Nitrogen rate applied to Project SENSE N Management and Drone Based Sensor Management treatments based on NDRE values in *Figure 1* and *Figure 2*.

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.

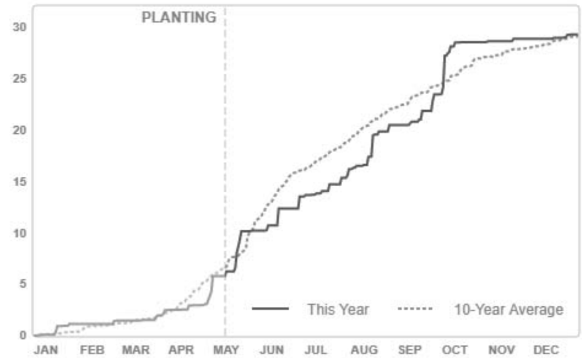
Summary:

- 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.

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) K	Ca	Mg	Na	CEC me/100g	% Base Saturation 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.

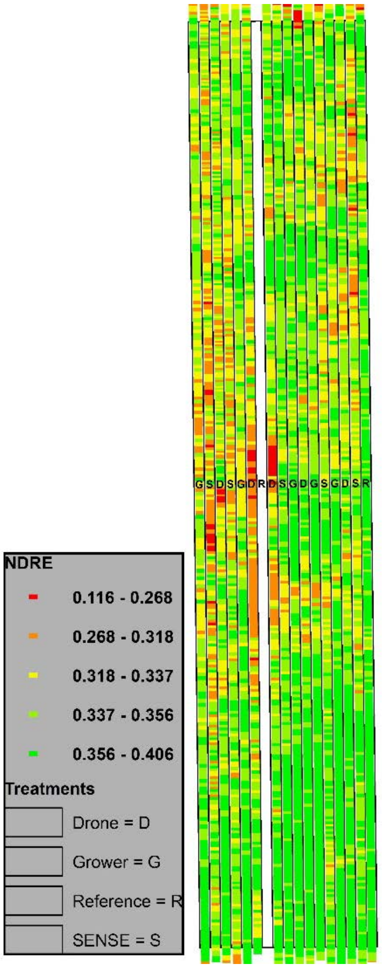


Figure 1. NDRE (normalized difference red edge) index obtained using crop canopy sensors mounted on a high clearance applicator for the plot area on June 27, 2017.

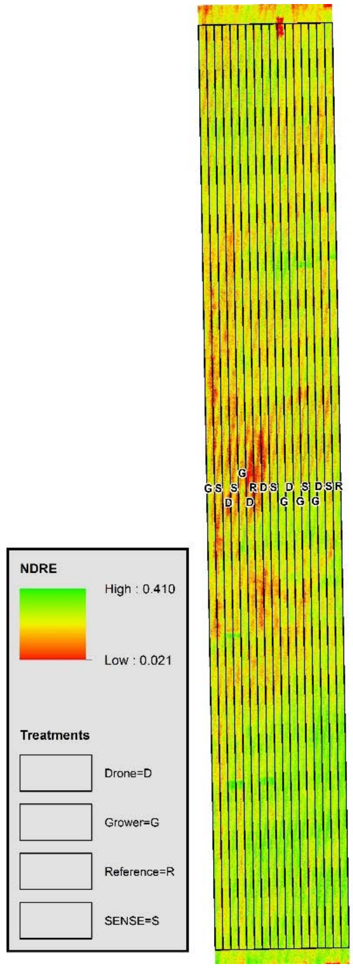


Figure 2. NDRE (normalized difference red edge) index obtained using a drone based sensor on June 26, 2017.

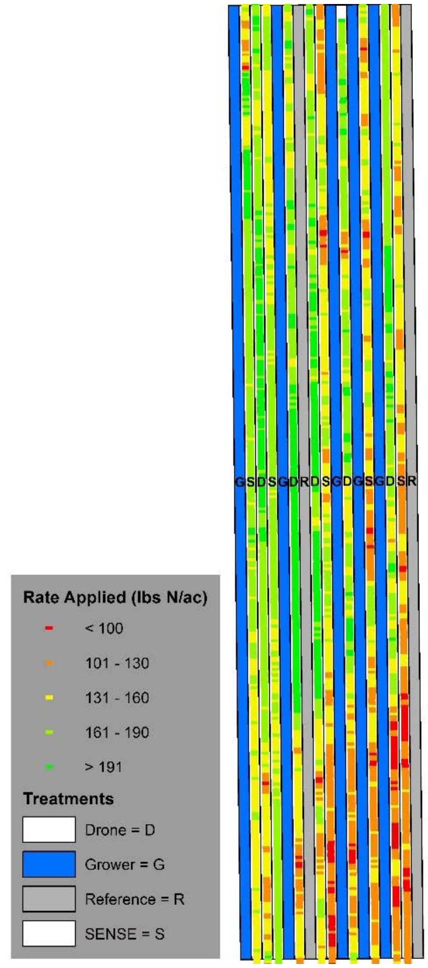


Figure 3. Nitrogen rate applied to Project SENSE N Management and Drone Based Sensor Management treatments based on NDRE values in *Figure 1* and *Figure 2*.

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.

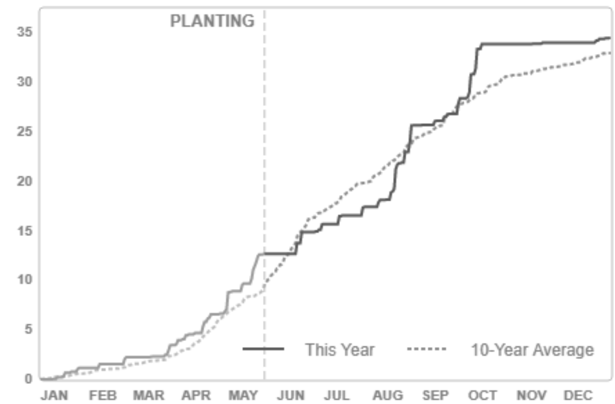
Summary:

- 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.

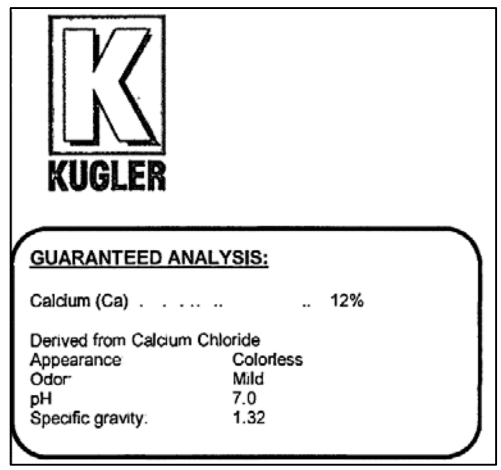
Evaluation of Kugler KQ Calcium Chloride Fertilization in Soybeans

Study ID: 319039201701
County: Cuming
Soil Type: Moody silty clay loam 2-6% slopes
Planting Date: 5/24/17
Harvest Date: 10/16/17
Row Spacing (in): 36
Variety: Curry 1252
Reps: 4
Tillage: No-Till
Herbicides: ***Pre:*** 3 oz/ac Surveil®, 6 oz/ac Tricor® DF, and 10 oz/ac 2,4-D LV6 ***Post:*** 2.5 oz/ac Anthem® Maxx, 28 oz/ac Roundup® PowerMAX, 6 oz Clethodim®, and 1 lb/ac dextrose
Seed Treatment: Commence® from Agnition and Nutriplant® SD from Amway

Fertilizer: 2.5 ton/ac beef manure (17.5 lb N, 181 lb P, 116 lb K, 41.3 lb S, and 1.6 lb Zn)
Irrigation: None
Rainfall (in):



Introduction: Kugler KQ calcium chloride (product information at right) was applied at a rate of 1 gal/ac to the soil on April 7, 2017. The calcium chloride application was compared with an untreated check. Yield, moisture, and net return were measured. Soil tests for the field indicated pH was 5.6. Base saturations were as follows: K% = 2.8, Mg% = 16.2, Ca% = 56.9, H% = 23.7, and Na% = 0.4.



Results:

	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	12.7 A*	70 A	624.96 A
Calcium Chloride	12.8 A	70 A	606.84 B
P-Value	0.245	0.405	0.039

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean, $5/ac for product, and $8.13 for product application.

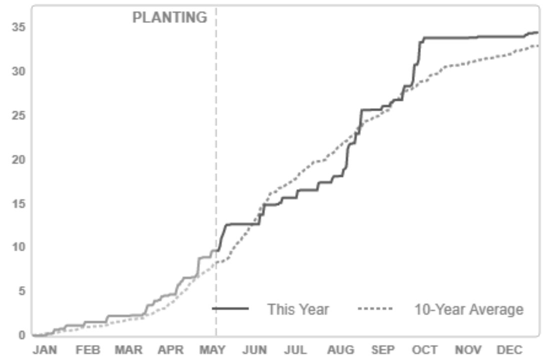
Summary:

- There were no differences in yield or moisture for the calcium chloride treatment compared with the untreated check.
- The check had a significantly higher marginal net return due to reduced input costs compared with the calcium chloride treatment.

Conklin® Wex Wetting Agent on Soybeans

Study ID: 319039201703
County: Cuming
Soil Type: Silty clay loam
Planting Date: 5/13/17
Harvest Date: 10/26/17
Row Spacing (in): 36
Variety: Curry 1299
Reps: 5
Tillage: No-Till
Herbicides: ***Pre:*** 3 oz/ac Surveil®, 6 oz/ac Tricor® DF, 10 oz/ac 2,4-D LV6 ***Post:*** 2.5 oz/ac Anthem® Maxx, 28 oz/ac Roundup® PowerMAX, 6 oz Clethodim®, 1 lb/ac dextrose
Seed Treatment: Commence® from Agnition and Nutriplant® SD from Amway

Fertilizer: None
Irrigation: None
Rainfall (in):



Introduction: This study was evaluating Conklin Wex® Multipurpose Nonionic Wetting Agent (product information at right). The product was applied to the soil in a broadcast application at a rate of 1.5 pt/acre. The product was designed to be able to spray with the burndown or pre-plant herbicide; the product serves as a surfactant and is supposed to help prevent the herbicide from breaking down too quickly and increase the residual. However, in this study, the product was applied as a separate application rather than with herbicide products. The product was compared with an untreated check and moisture, yield, and net return were evaluated.

Principal Functioning Agents:	
Alcohol Ethoxylates	23.02%
Propylene Glycol	10.01%
Dimethylpolysiloxane	2.70%
Total	35.73%
Constituents Ineffective as Spray Adjuvants:	
Water	61.80%
Others	2.47%
Total	64.27%
Grand Total	**100.00%**

Product information from:
http://www.kellysolutions.com/erenewals/documentsubmit/KellyData/ND%5CFertilizer%5CProduct%20Label%5C200108520_6_9_2016_4_12_00_PM.pdf

Results:

	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Check	8.9 A*	69 A	611.36 A
Wex Wetting Agent	9.0 A	68 A	596.71 B
P-Value	0.621	0.352	0.004

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean, $3.91/ac product cost, and $8.13 application cost.

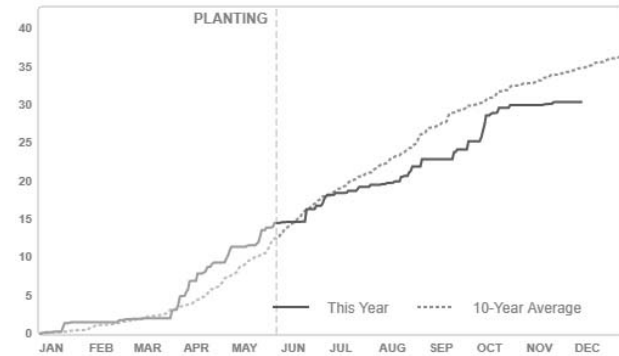
Summary:

- There was no difference in moisture or yield for the Conklin Wex® compared with the untreated check.
- The check had a higher marginal net return due to lower input costs. The cost of using the product would be lower if it were applied with the herbicide as it would not require a separate pass across the field.

Phosphorus Application Rates on Soil with Low P Test

Study ID: 510147201701
County: Richardson
Soil Type: Marshall silty clay loam 5-9% slopes; Marshall silt loam 2-5% slopes
Planting Date: 5/29/17
Harvest Date: 11/3/17
Population: 135,000
Row Spacing (in): 15
Variety: Pioneer 35T75X
Reps: 4
Previous Crop: Corn
Tillage: Disk
Herbicides: ***Pre:*** Burndown on 12/5/16 ***Post:*** 1 qt/ac Roundup® and 2 qt/ac Warrant® on 6/20/17

Seed Treatment: Allegiance® fungicide, EverGol™ Energy fungicide, Gaucho®, PPST2030, and PPST120+ rhizobial inoculant
Foliar Insecticides/Fungicides: None
Irrigation: None
Rainfall (in):



Soil Samples: *(Lime was applied and incorporated prior to the 2017 crop.)*

2016	O.M.	C.E.C.	pH	BpH	P1	P2	K	S	Zn	Ca	Mg
	--%--				ppm						
	3.8	17.1	5.4	6.5	4	8	198	20	0.9	1856	287
	4.0	13.7	5.6	6.6	5	7	181	21	1.3	1615	236
2017	**O.M.**	**C.E.C.**	**pH**	**BpH**	**P1**	**P2**	**K**	**S**	**Zn**	**Ca**	**Mg**
	--%--				ppm						
	4.0	14.5	6.0	6.7	14	18	164	-	-	1915	271
	3.8	12.1	6.0	6.7	12	15	153	-	-	1635	204

Introduction: This is the first year the farmer rented this ground. Grid soil tests in fall of 2016 (2.5 acre grid) revealed very low P levels, ranging from 4-8 ppm (Bray 1) for the whole field. The study tested two rates of P application: 75 lb/ac actual P_2O_5 and 125 lb/ac actual P_2O_5, applied on 2/2/17. Soil samples were also taken in approximately the same locations in fall of 2017 following application of P and harvest of the soybean crop.

There are various approaches for recommending P application rates. This field is located on the Kansas/Nebraska state line; therefore, for reference, recommendation rates from both land-grant universities are presented.

- UNL Extension: With soil P levels of 5-8 ppm, the recommendation would be for 40 lb/ac P application (https://go.unl.edu/soyfertilizer).
- K-State Agronomy Department Sufficiency Approach: At soil P levels of 5-10 ppm and yield goal of 70 bu/ac, the recommendation for a sufficiency approach would be 55 lb/ac P_2O_5.
- K-State Agronomy Department Build and Maintenance Approach (four year time frame): At soil P levels of 5-10 ppm and a yield goal of 70 bu/ac, the build and maintenance approach recommendation would be 112 lb/ac P_2O_5.

Results:

	NDVI 7/3	NDVI 7/15	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
75 lb/ac P P_2O_5	0.818 A*	0.916 A	13.8 A	71 A	602.66 A
125 lb/ac P_2O_5	0.824 A	0.917 A	13.8 A	71 A	581.10 B
P-Value	0.338	0.210	0.610	0.913	0.108

*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 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $425/ton of 11-52-0 (75 lb/ac P rate cost $30.75/ac and 125 lb/ac P rate cost $51.25/ac).

Drone imagery was used to calculate the normalized difference vegetative index (NDVI). This index is indicative of overall plant biomass and greenness. Imagery and NDVI from July 3 (*Figure 1*) and July 15 (*Figure 2*) are presented here.

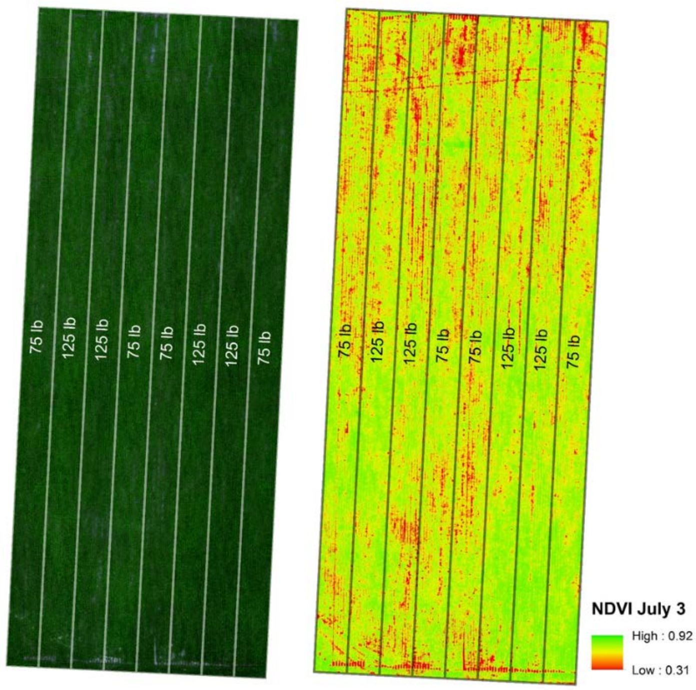


Figure 1. True color (red-green-blue) imagery (left) and NDVI (right) from July 3, 2017.

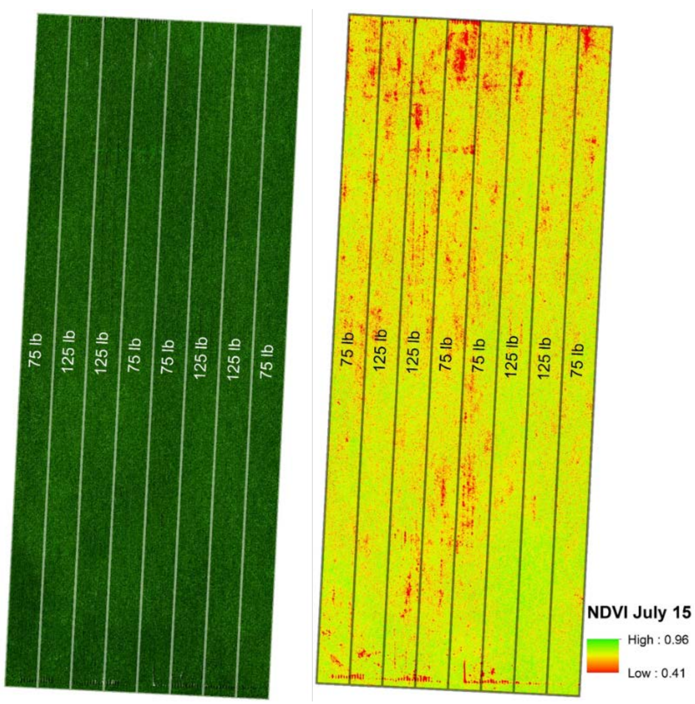
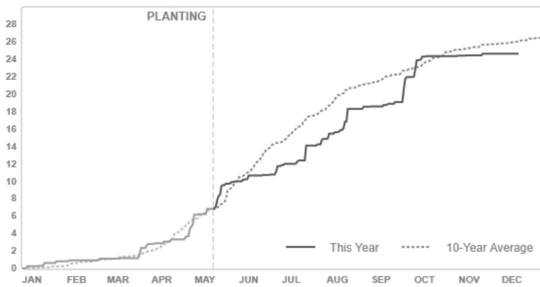


Figure 2. True color (red-green-blue) imagery (left) and NDVI (right) from July 15, 2017.

Summary: There was no difference in moisture, yield, or NDVI between the 75 lb/ac P_2O_5 rate and the 125 lb/ac P_2O_5 rate. The 75 lb/ac P_2O_5 rate had a higher net return due to reduced input costs. The locations of these strips were marked with GPS so yield can continue to be monitored in future years.

No-Till vs Strip-Till vs Strip-Till + Fertilizer on Soybeans

Study ID: 709047201702
County: Dawson
Soil Type: Cozad silt loam 0-1% slope; Rusco silt loam 0-1% slope
Planting Date: 5/14/17
Harvest Date: 10/13/17
Population: 130,000
Row Spacing (in): 30
Variety: Pioneer 27T59R
Reps: 4
Previous Crop: Corn followed by winter wheat cover crop
Herbicides: ***Pre:*** 22 oz/ac Roundup PowerMAX® and 3 oz/ac Enlite® on 5/24/17 ***Post:*** 22 oz/ac Roundup PowerMAX®, 1.5 qt/ac Warrant®, and 6 oz/ac Section® 2EC on 6/17/17
Seed Treatment: Inoculant, fungicide, Gaucho® insecticide
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 116 lb/ac average 11-52-0 (variable rate application), 116 lb/ac average 0-0-60 (variable rate application), and 6 lb/ac average 36% dry Zn (variable rate application)
Irrigation: Pivot, Total: 4.1"
Rainfall (in):



Soil Test (January 2017):

Sample	pH	Soluble Salts	OM	KCl Nitrate NO_3-N	NO_3-N	Mehlich 3 P	$CaPO_4$ SO_4-S	Ammonium Acetate K	Ca	Mg	Na	Sum of Cations	DPTA Zn
		mS/cm	%	ppm	lb/ac	-----------ppm					-----------	meq/100g	ppm
1	6.6	1.1	2.8	13	31	21	71	399	2135	460	145	16	1.1
2	6.7	0.7	2.7	16	38	33	36	461	2491	463	115	18	1.6
3	6.9	0.7	2.8	10	23	31	27	458	2668	479	70	19	2.0
4	6.9	0.6	2.6	11	26	19	23	356	2474	472	67	18	1.5
5	6.5	0.5	2.7	12	29	17	28	389	2470	430	60	17	1.7
6	5.9		2.8	14	34	18	28	327	1816	425	109	16	1.3

Introduction: Soybeans were planted following a winter wheat cover crop, which was terminated on 5/24/17. In this study, all soybeans were planted in 30" rows. The check treatment was soybeans planted no-till. This was compared with soybeans planted into strip-till and soybeans planted into strip-till with 100 lb/ac 11-52-0 applied 8" deep in the strip. Strip-till was completed on 5/8/17. The cost for planting was taken from Nebraska Extension 2016 Nebraska Farm Custom Rates – Part 1 (EC823). Strip-till and fertilizer costs were actual costs charged for the custom strip-till operation and fertilizer product.

Results:

	Moisture (%)	Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
No-Till	11.3 B	75 B	653.87 A
Strip-Till	12.3 A*	78 AB	646.71 A
Strip-Till with Fertilizer	11.5 AB	81 A	652.42 A
P-Value	0.056	0.029	0.860

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean, $18/ac for planting no-till, $48/ac for strip-till and planting, and $69.50/ac for strip-till, additional fertilizer, and planting.

Summary:

- Moisture of the strip-till treatment was significantly higher than the no-till treatment. The strip-till with fertilizer was not significantly different than the strip-till or no-till treatments.
- Yield for the strip-till with fertilizer was significantly higher than the no-till treatment. The strip-till alone was not significantly different than the no-till or the strip-till with fertilizer.
- There were no differences in marginal net return. Actual costs for strip-till application vary; therefore, determining your actual costs is important.

NEBRASKA ON-FARM RESEARCH NETWORK

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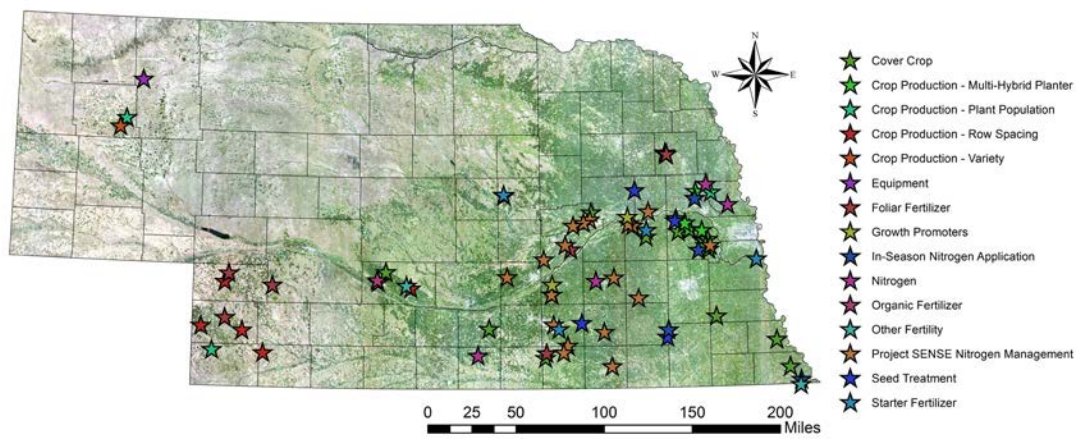
critical production, profitability, and natural resources questions.

2017 Study Locations



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Nebraska Dry Bean Commission

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