EXTENSION

On-Farm Research

2019 ON-FARM RESEARCH RESULTS

Post-Conference Publication March 2020 **EC3047**

University of Nebraska Lincoln

NEBRASKA ON-FARM RESEARCH NETWORK

2020 Results Update Meetings

Feb. 18 | BEATRICE, Holiday Inn Express

Feb. 19 | NEAR MEAD, Eastern Nebraska Research and Extension Center

Feb. 20 | NORFOLK, Madison County Extension Office

Feb. 26 | KEARNEY, Buffalo County Extension Office

Feb. 27 | ALLIANCE, Knight Museum & Sandhills Center

Feb. 28 | YORK, Holtus Convention Center - **Special Focus* On-Farm Research Meeting* -
Cover Crops and Soil Health - Jointly sponsored by USDA-NRCS and the Nebraska On-Farm Research Network

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NEBRASKA SOYBEAN CHECKOFF

Nebraska Dry Bean Commission

University of Nebraska–Lincoln Institute of Agriculture and Natural Resources

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NEBRASKA ON-FARM RESEARCH NETWORK

Special thanks to the cooperators involved with the
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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 and 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 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 also 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.

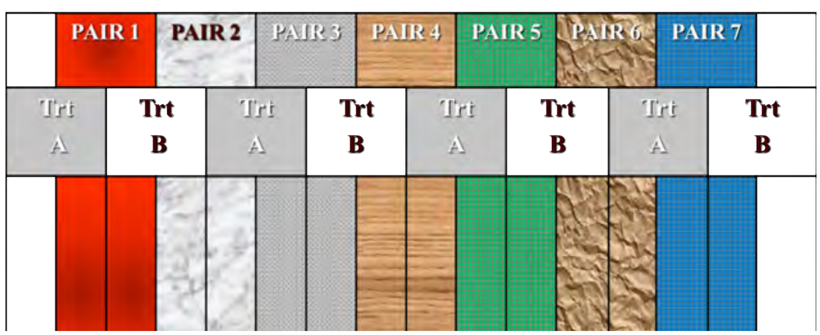
Randomization: Using random sampling as a method of selecting a sample from a population in which all the items in the population have an equal chance of being chosen in the sample. Randomization reduces the introduction of bias into the analysis. Two common designs that meet these criteria are shown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

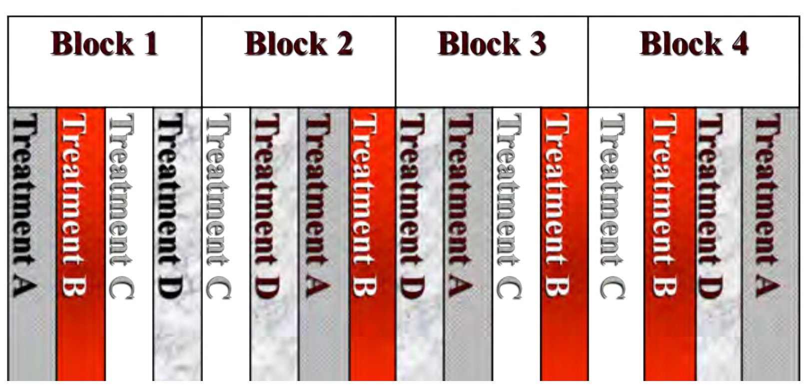
- As the P-Value decreases, the probability that differences are due to random chance decreases.
- As the P-Value increases, we are less able to distinguish if the difference is due to error or the treatment (hence, we have less confidence in the results being due to the treatment).

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. As you increase your cutoff value, however, 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 2018 Nebraska Farm Custom Rates (EC823 - revised June 2018) and an average commodity market price for 2019.

Average market commodity prices for the 2019 report are:

Corn	\$3.83/bu
Soybeans	\$8.10/bu
Wheat	\$3.65/bu
Sorghum	\$5.40/bu
Pinto Beans	\$25/cwt (\$15/bu at 60 lb/bu)
Great Northern Beans	\$30/cwt (\$18/bu at 60 lb/bu)

For each study, net return is calculated as follows:
Net Return = gross income (yield × commodity price) - treatment cost.

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

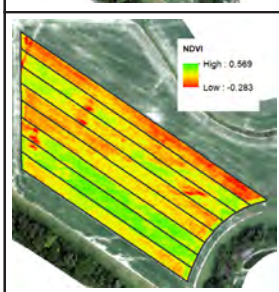
RAINFALL DATA

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 × 1.2 mile grids.

FarmLogs https://farmlogs.com

AERIAL IMAGERY

For many studies, aerial imagery was captured using a drone or airplane. Drone imagery may be captured through a number of different platforms. Airplane imagery was acquired from TerrAvion (https://www.terravion.com/). Throughout this report, imagery may be displayed in several ways:

	**True Color Imagery/RGB:** True Color imagery displays the Earth in colors similar to what we might see with our own eyes. This product is a combination of the red, green, and blue wavebands of visible light and, as such, is sometimes referred to as RGB imagery.
	**Normalized Difference Vegetation Index (NDVI):** NDVI is calculated using the red and near-infrared (NIR) wavebands as follows: NDVI = (NIR-Red)/(NIR+Red). This index is often correlated with plant biomass and chlorophyll content. Higher NDVI values are indicative of greater plant biomass and/or a higher chlorophyll concentration. In the example at left, NDVI was displayed with a green to red color ramp: areas with higher NDVI values appear bright green, areas with lower NDVI values appear red and intermediary values are yellow. **Normalized Difference Red Edge (NDRE) Index:** This index is similar to NDVI, and is displayed similarly to NDVI, but is calculated with the red edge waveband in place of the red waveband as follows: NDRE = (NIR-Red Edge)/(NIR+Red Edge). NDRE is also correlated with plant biomass and chlorophyll content. This index is often preferred over NDVI when looking at high biomass crops (such as corn in the mid and late growth stages). Higher NDRE values are indicative of greater plant biomass and/or higher chlorophyll concentration.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COVER CROPS

Non-irrigated Soybean Planted Following a Cover Crop Mix and No Cover Crop

Study ID: 0913037201901
County: Colfax
Soil Type: Moody silty clay loam, 0-2% slope; Moody silty clay loam 2-6% slopes
Planting Date: 5/14/19
Harvest Date: 10/14/19
Seeding Rate: 140,000
Row Spacing (in): 15
Variety: Legend®25X924N
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 6 oz/ac Zidua® PRO, 40 oz/ac Roundup®, and 8 oz/ac Dicamba on 5/10/19 ***Post:*** 7.25 oz/ac Marvel™, 32 oz/ac Roundup®, and 6 oz/ac Select Max® on 6/28/19

Seed Treatment: fungicide, insecticide, inoculant
Foliar Insecticides: 2.8 oz/ac Leverage® on 7/30/19
Foliar Fungicides: 4 oz/ac Priaxor® on 7/30/19
Fertilizer: None
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 study compared the effects of a cover crop mix on soybean yield and soil health properties. The cover crop mix was 8 lb/ac winter wheat, 8 lb/ac winter rye, 8 lb/ac triticale, 1 lb/ac Dwarf Essex rapeseed, 5 lb/ac winter oats, 8 lb/ac winter barley, 1 lb/ac camelina, 1 lb/ac hairy vetch, 2.5 lb/ac winter Morton lentil and 1 lb/ac Dixie crimson clover. The cover crop was seeded after corn harvest on November 19, 2018. The cover crop was terminated with herbicides on May 10, 2019 at a height of 10-18". Soybeans were planted on May 14 in 15" row spacing. This is the second year of the study and second planting of cover crops on the same cover crop treatment strips; however, it is the first year reporting crop yields and soil health measurements.

Results:

Table 1. Soil physical, chemical, and biological properties for cover crop and no cover crop treatments. Samples were collected on 11/5/19 (1 sample per treatment replication, 6 samples per treatment).

Treatment	Infiltration (in/hr)	Soil moisture (%)	Bulk density (g/cm^3)	Soil temp. (F)	Soil respiration[1]
Check	2.09 A*	23.61 A	1.14 A	40.85 A	3.33 A
Cover Crop - Mix	6.47 A	24.60 A	1.13 A	40.93 A	2.67 A
P-Value	0.343	0.336	0.478	0.794	0.102

[1]Soil respiration (Modified Solvita burst).
*Values with the same letter are not significantly different at a 90% confidence level.

Table 2. NRCS field assessments of soil health. Samples were collected on 11/5/19 (1 sample per treatment replication, 6 samples per treatment).

	NRCS Field Assessment of Soil Health								
Treatment	Structure	Structure type	Surface condition	Mgmt	Soil pores	Earth worm	Biological activity	Soil smell	Overall indicator[2]
Check	1.83 A	1.92 A	2.08 A	1.67 B	2.5 A	2.50 A	2.25 A	2.67 A	2.18 A
Cover Crop - Mix	2.00 A	1.92 A	2.08 A	2.33 A	2.58 A	2.41 A	2.412 A	2.83 A	2.32 A
P-Value	0.465	1.00	1.00	0.0429	0.771	0.862	0.175	0.175	0.295

[2]Score based on field assessment. The overall indicator score is based on the sum of 8 indicators (averaged from 1-3; 1=degraded, 2=in transition, 3=healthy): soil structure, structure type, surface condition, soil management, soil pores, earthworms, biological activity, and smell.

Table 3. Soybean yield, moisture, and marginal net return for cover crop mix and no cover crop treatments.

	Moisture (%)	Soybean Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
No Cover Crop	11.8 A*	68 A	549.30 A
Cover Crop - Mix	11.9 A	68 A	514.83 B
P-Value	0.607	0.994	0.002

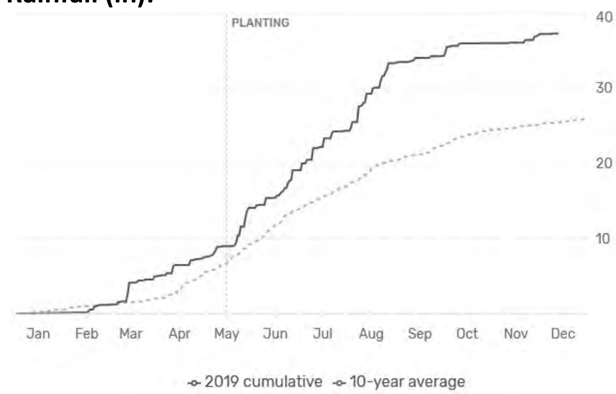
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $20.11/ac cover crop seed, and $14.40 for cover crop drilling.

Summary:

- Soil physical, chemical, and biological properties measured did not show differences between the cover crop mix and no cover crop treatments in the second year of the study.
- There were no differences in soybean moisture or yield.
- Marginal net return was lower for the cover crop treatment due to the additional cost of seed and drilling.

Irrigated Soybeans Planted Following a Cover Crop Mix and No Cover Crop

Study ID: 0708077201901
County: Greeley
Soil Type: Hersh fine sandy loam 3-6% slopes; Gates silt loam 6-11% slopes; Gates silt loam 11-17% slopes
Planting Date: 5/15/19
Harvest Date: 10/16/19
Seeding Rate: 140,000
Row Spacing (in): 30
Variety: Asgrow® AG21X7
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 5.0 oz/ac Zidua® PRO, and 32 oz/ac Roundup® on 5/5/19 ***Post:*** 22 oz/ac FeXapan®, and 32 oz/ac Roundup® on 6/28/19
Seed Treatment: Vault® SP inoculant
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 40 lb P/ac, 40 lb K/ac on 6/8/19
Irrigation: Pivot
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. This is the second year of this study; however, it is the first time crop yield is being reported. The two treatments are a no cover crop check and a cover crop mix, which included rye, forage collards, turnips, rapeseed, and kale. The cover crop was drilled following corn harvest in 2018. Soybeans were planted into the cover crop on May 15, 2019. The cover crop was terminated on June 1, 2019, with a herbicide application. Cover crops were 10" tall at the time of termination. The year was very wet with 21" of rain from planting to August 26, 2019.

Results:

Table 1. Soil physical, chemical, and biological properties for cover crop and no cover crop treatments. Samples were collected on 10/22/19 (1 sample per treatment replication, 6 samples per treatment).

Treatment	Infiltration (in/hr)	Soil moisture (%)	Bulk density (g/cm^3)	Soil temp. (F)	Soil respiration[1]
Check	2.03 A*	13.25 A	1.41 A	44.16 B	2.44 A
Cover Crop Mix	6.45 A	14.56 A	1.27 A	46.06 A	2.86 A
P-Value	0.267	0.488	0.179	0.098	0.296

[1]Soil respiration (Modified Solvita burst).
*Values with the same letter are not significantly different at a 90% confidence level.

Table 2. NRCS field assessments of soil health. Samples were collected on 10/22/19 (1 sample per treatment replication, 6 samples per treatment).

	NRCS Field Assessment of Soil Health								
Treatment	Structure	Structure type	Surface condition	Mgmt	Soil pores	Earth worm	Biological activity	Soil smell	Overall indicator[2]
Check	1.81 A	1.50 A	1.63 A	1.50 B	2.00 A	1.43 A	1.81 A	1.50 A	1.65 A
Cover Crop Mix	1.75 A	1.63 A	1.50 A	2.00 A	2.00 A	1.25 A	1.88 A	1.56 A	1.70 A
P-Value	0.364	0.171	0.679	<0.0001	1.0	0.308	0.612	0.352	0.370

[2]Score based on field assessment. The overall indicator score is based on the sum of 8 indicators (averaged from 1-3; 1=degraded, 2=in transition, 3=healthy): soil structure, structure type, surface condition, soil management, soil pores, earthworms, biological activity, and smell.

Table 3. Soybean yield, moisture, and marginal net return for cover crop mix and no cover crop treatments.

	Test Weight (lb/bu)	Moisture (%)	Soybean Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
No Cover Crop	57 A	10.0 A	55 A	444.82 A
Cover Crop Mix	57 A	9.9 A	54 A	397.26 B
P-Value	0.180	0.530	0.514	0.010

†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $25/ac cover crop seed cost, and $14.40/ac for drilling.

Summary:

- There were no differences in soybean yield, moisture, or test weight between the cover crop treatment and no cover crop check. Marginal net return was lower for the cover crop treatment due to the additional cost of cover crop seed and drilling.
- Results of the soil physical, chemical, and biological properties evaluation showed no differences between the two treatments with the exception of soil temperature. The no cover crop treatment had cooler soil temperature than the cover crop treatment in October.

Irrigated Soybeans Planted Following a Cover Crop Mix and No Cover Crop

Study ID: 0914093201901
County: Howard
Soil Type: Holdrege silty clay loam
Planting Date: 5/16/19
Harvest Date: 9/30/19
Seeding Rate: 180,000
Row Spacing (in): 30
Variety: AgriGold® G2405RX
Reps: 5
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 25 oz/ac BroadAxe®XC and 48 oz/ac Gramoxone® SL ***Post:*** 12.8 oz/ac Engenia® and 32 oz/ac Buccaneer® 5 Extra
Seed Treatment: fungicide, insecticide, inoculant
Foliar Insecticides: 2 oz/ac Warrior II with Zeon Technology®
Fertilizer: 108 lb/ac 11-52-0, 87 lb/ac 0-0-22-22 S-11 Mg, and 23 lb/ac 98% lime
Irrigation: Pivot
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 study compared the effects of a cover crop mix on soybean yield and soil health properties. The cover crop mix was Barkant turnips, African cabbage, Impact Forage Collards, Dwarf Essex rapeseed, Eco-Till radish, Peredovick sunflowers, safflowers, VNS hairy vetch, Viceroy lentils, and cereal rye. The cover crop was seeded after corn harvest on September 21, 2018. Cover crops that did not winter terminate were terminated with herbicides on May 14, 2019 at a height of 3". Soybeans were planted on May 16 in 30" row spacing. Soybeans experienced damage from heavy thistle caterpillar infestations. This is the second year of the study and second planting of cover crops on the same cover crop treatment strips; however, it is the first year reporting crop yields and soil health measurements. Due to visual differences observed in imagery and crop senescence, additional grain quality samples were collected.

Results:

Table 1. Soil physical, chemical, and biological properties for cover crop and no cover crop treatments. Samples were collected on 10/29/19 (1 sample per treatment replication, 7 samples per treatment).

Treatment	Infiltration (in/hr)	Soil moisture (%)	Bulk density (g/cm^3)	Soil temp. (F)	Soil respiration[1]
Check	0.59 A*	21.51 A	1.16 A	47.71 A	3.64 A
Cover Crop Mix	0.62 A	23.33 A	1.15 A	46.69 A	4.43 A
P-Value	0.781	0.616	0.817	0.521	0.297

[1]Soil respiration (Modified Solvita burst).
*Values with the same letter are not significantly different at a 90% confidence level.

Table 2. NRCS field assessments of soil health. Samples were collected on 10/29/19 (1 sample per treatment replication, 7 samples per treatment).

	NRCS Field Assessment of Soil Health								
Treatment	Structure	Structure type	Surface condition	Mgmt	Soil pores	Earth worm	Biological activity	Soil smell	Overall indicator[2]
Check	1.79 A	1.86 A	2.21 A	1.43 B	2.00 B	1.57 A	1.71 A	1.57 A	1.77 B
Cover Crop Mix	2.00 A	2.00 A	2.00 A	2.50 A	2.21 A	1.64 A	2.00 A	1.64 A	2.00 A
P-Value	0.199	0.172	0.199	<.0001	0.078	0.766	0.103	0.604	0.001

[2]Score based on field assessment. The overall indicator score is based on the sum of 8 indicators (averaged from 1-3; 1=degraded, 2=in transition, 3=healthy): soil structure, structure type, surface condition, soil management, soil pores, earthworms, biological activity, and smell.

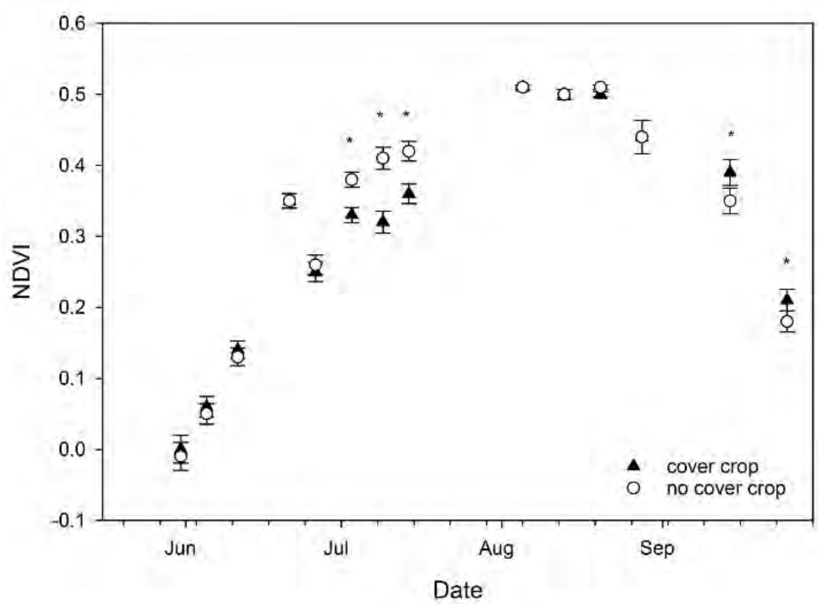


Figure 1: Average normalized difference vegetation index (NDVI) values for soybean planted on previous cover crop and no cover crop strips. Error bars represent standard error of the mean at the 95% confidence interval. Asterisk (*) within each date indicates significant difference (p < 0.10) between cover crop and no cover crop.

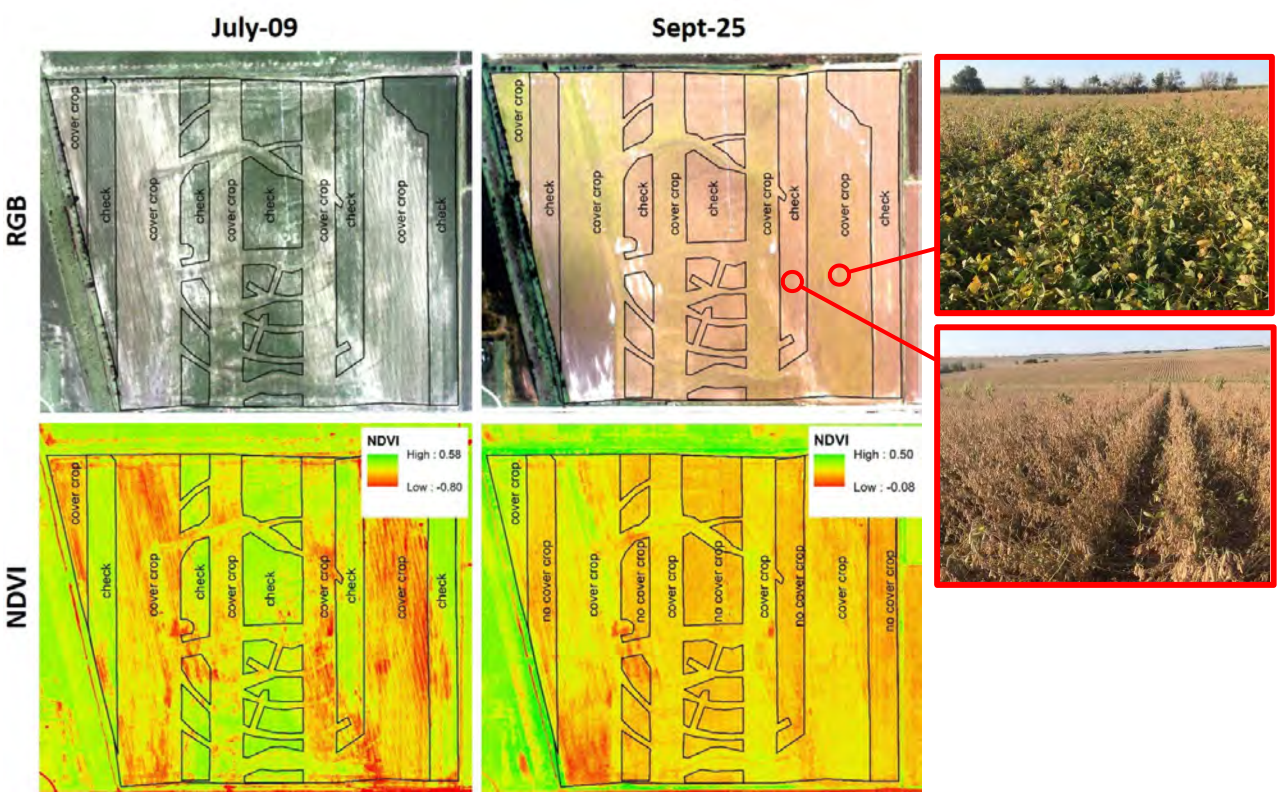


Figure 2. Aerial imagery from July 9 (left) and September 25 (right) displayed as true color (top) and normalized difference vegetation index (NDVI) (bottom). In some areas, such as pivot tracks and vulnerable areas, cover crops were seeded in areas originally designated as check; all areas where cover crops were seeded were included in the cover crop treatment image analysis. These boundaries between cover crop and no cover crop are indicated with black outlines. Far right inset images are pictures taken on September 26 in cover crop and no cover crop treatments.

Table 3. Soybean yield, yield components, oil, moisture, and marginal net return for cover crop mix and no cover crop treatments.

	Pods/ plant	Seeds/ plant	Linoleic (%)	Saturated fat (%)	Protein (%)	Oil (%)	Fiber (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	48.5 A	103 A	6.7 A	10.6 A	34.0 A	19.6 A	4.9 A	15.0 A	67.9 A	549.67 A
Cover Crop Mix	49.9 A	107 A	6.6 A	11.1 A	35.1 A	19.2 A	4.8 A	16.8 A	69.5 A	524.69 A
P-Value	0.897	0.771	0.880	0.397	0.385	0.175	0.178	0.210	0.779	0.605

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $24/ac cover crop seed, and $14.40 drilling.

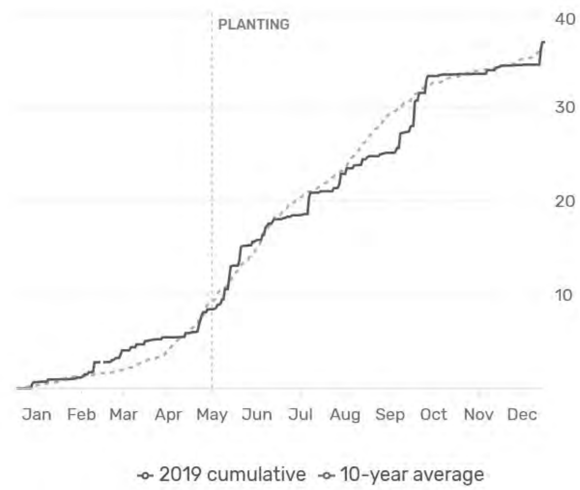
Summary:

- Aerial imagery normalized difference vegetation index (NDVI) analysis showed lower values for soybeans following cover crops in July (Figure 2).
- Soybeans following cover crops had lower biomass and were not as canopied as soybeans following no cover crop.
- In September, the soybeans following cover crops had higher NDVI representing soybeans that were not as mature. Soybeans following the no cover crop treatments had greater leaf senescence and were more mature.
- Soil management, soil pore indicator scores, and the overall indicator score were significantly lower for the check than the cover crop treatment.
- The treatments did not result in differences in soybean moisture, yield, or net return.

Non-irrigated Soybeans Planted into Cereal Rye Cover Crop

Study ID: 0136109201901
County: Lancaster
Soil Type: Yutan silty clay loam; Aksarben silty clay loam; Judson silt loam
Planting Date: 5/15/19
Harvest Date: 10/22/19
Seeding Rate: 140,000
Row Spacing (in): 15
Variety: Asgrow® AG39X7
Reps: 8
Previous Crop: Corn
Tillage: No-Till
Fertilizer: None

Irrigation: None
Rainfall (in):



Introduction: The purpose of this study was to evaluate the impact of a rye cover crop on subsequent soybean crop production. There are two treatments, rye cover crop and a no cover crop control. This is the second year of the study, and cover crop strips were located in the same place as the previous year. Elbon cereal rye was seeded at a rate of 40 lb/ac on November 1, 2018. Soybeans were planted on May 15, 2019. The cover crop was terminated May 20, 2019 with Roundup®. At termination the cover crop was 14-18" high and was 20-40% headed out.

Results:

	Moisture (%)	Soybean Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	11.9 A*	60 A	486.68 A
Cover Crop - Rye	11.9 A	58 A	453.71 A
P-Value	0.857	0.391	0.119

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $16/ac rye cover crop seed and drilling cost.

Summary: There were no differences in soybean moisture, yield, or net return between the cover crop treatment and the no cover crop control.

Summary of Previous Year (Year 1)

2018

In year one (2018), the rye cover crop was drilled at a rate of 40 lb/ac on November 1, 2017 following soybean harvest. The rye was terminated with glyphosate in mid-May at a height of approximately 12”. Corn was planted into the strips on April 23, 2018 with 5 gal/ac of 10-34-0 starter fertilizer.

Results:

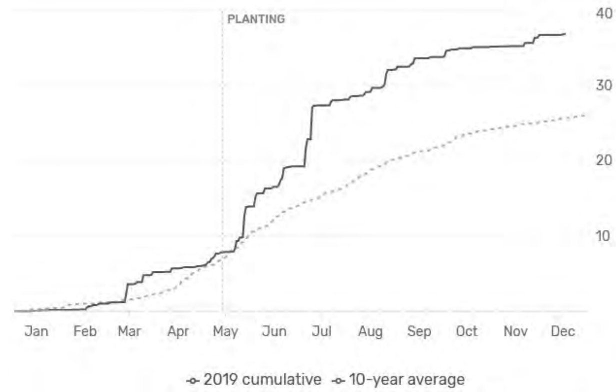
	Moisture (%)	Corn Yield† (bu/ac)	Marginal Net Return‡ ($/ac)
Check	15.5 B*	213 A	686.95 A
Cover Crop - Rye	15.9 A	208 B	656.99 B
P-Value	<0.0001	0.0099	0.0004

*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 $3.23/bu corn, $7.67/ac rye cover crop seed, and $6/ac for drilling cover crop.

Irrigated Soybeans Planted into Cereal Rye Cover Crop

Study ID: 0064099201901
County: Kearney
Soil Type: Coly-Kenesaw silt loam, 0-3% slope; Hersh fine sandy loam, 0-3% slope
Planting Date: 5/13/19
Harvest Date: 10/10/19
Seeding Rate: 145,000
Row Spacing (in): 30
Variety: Stine® 27EA23
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 1 qt/ac Enlist One®, and 48 oz/ac Roundup® on 5/15/2019 ***Post:*** 48 oz/ac Roundup®, 1.87 pt/ac Enlist One®, 1.33 pt/ac Brawl II™, and 6 oz/ac clethodim on 6/15/2019; 32 oz/ac Liberty®, and 3 pt/ac Warrant® on 7/12/2019

Seed Treatment: ILeVO® and fungicide
Fertilizer: 100 lb/ac 11-52-0 broadcast in March
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: This study compared the effects of a cereal rye cover crop on the following soybean crop yield. This is the third year this study has been conducted, with cereal rye cover crop strips and check strips maintained in the same location from year to year. Rye was drilled in 10" rows at 50 lb/ac following corn harvest on November 1, 2018. The rye was terminated with Roundup® on May 5, 2019. Rye was approximately 12" tall at the time of termination.

Results:

	Stand Count (plants/ac)	Moisture (%)	Soybean Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	127,904 A*	11.9 A	86 B	694.94 A
Cover Crop - Rye	123,658 A	11.9 A	87 A	674.64 B
P-Value	0.233	1	0.017	0.002

*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 $8.10/bu soybean and $30/ac cover crop seed and drilling cost.

Summary:

- There was no grain moisture difference between the soybeans following the rye cover crop treatment and the soybeans following the no cover crop check.
- Yield was 1.2 bu/ac higher for the soybeans following the rye cover crop; however, marginal net return was lower for the soybeans following the rye cover crop due to increased input costs for establishing cover crops.

Summary of Previous Years (Year 1 and 2)

2017

In year one (2017), cover crops were drilled on November 1, 2016. Rye was terminated with glyphosate on May 5, 2017. Soybeans were drilled in 10” rows on May 8, 2017.

Results:

	Moisture (%)	Soybean Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	12.0 B*	80 A	714.25 A
Cover Crop - Rye	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.

2018

In year two (2018), cover crops were drilled on October 21, 2017 following soybean harvest. Cattle pastured the rye in March and early April. The rye was terminated with glyphosate on May 6, 2018 at a height of approximately 15”. Corn was planted into the strips on April 28, 2018. Due to poor stand resulting from fertilizer salt injury the field was replanted on May 17, 2018.

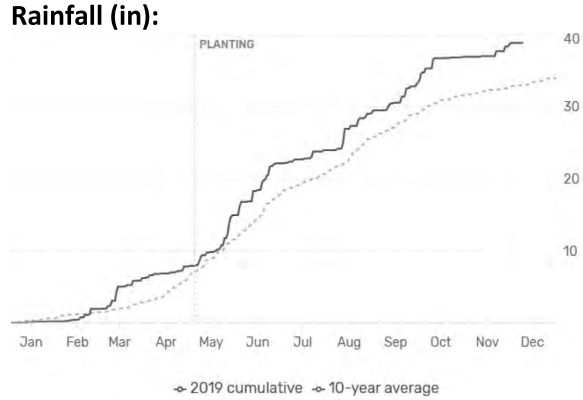
Results:

	Moisture (%)	Corn Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	15.5 A*	227 A	733.70 A
Cover Crop - Rye	15.6 A	228 A	713.43 B
P-Value	0.219	0.454	0.014

*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 $3.23/bu corn and $24.30 cover crop cost.

Rye Cover Crop Seeding Rate Effects on Irrigated Corn

Study ID: 0129155201901
County: Saunders
Soil Type: Alda fine sandy loam, occasionally flooded
Planting Date: 5/4/19
Harvest Date: 10/29/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: Pioneer® P1563
Reps: 6
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 40 oz/ac Roundup® on 4/24/19
Post: 2 qt/ac Volley® ATZ Lite NXT, 2.5 pt/ac Resicore® on 6/15/19
Seed Treatment: Poncho® 250
Foliar Insecticides: 5 oz/ac Brigade® 2 EC on 7/9/19
Foliar Fungicides: 10 oz/ac Headline AMP® sprayed at full tassel on 07/29/2019
Fertilizer: 3 gal/ac 10-34-0 and 1 pt/ac zinc in-furrow on 5/4/19; 5 gal/ac 32% UAN and 20 gal/ac 10-34-0 applied 2" to the side of each row; 180 lb N/ac as 32% UAN and 36 lb/ac Thio-sul® as sidedress application on 6/19/19
Irrigation: Pivot, Total: 3.75"
Rainfall (in):



Introduction: The objective of this study was to evaluate rye cover crop seeding rate effects on corn production and soil properties. The rye cover crop was planted at three different seeding rates: 30 lb/ac, 60 lb/ac, 90 lb/ac and a 0 lb/ac control. The rye variety used was Rymin and was planted by drilling on November 16, 2018 in 7.5" rows. Cover crops were terminated with 40 oz/ac Roundup® on April 24, 2019. Cover crops were around 6" at the time of termination. Corn was planted on May 4, 2019 at 32,000 seeds/ac and a depth of 2". Biomass samples were collected on May 1, 2019 and soil samples were collected on May 15, 2019. The corn was harvested on October 29, 2019.

Results:

	---Cover Crop---		--------------Soil (0-8") ---------------				-------------------------Corn-------------------------				
	Dry Biomass (lb/ac)	Biomass N (lb/ac)	Nitrate (ppm)	P (ppm)	K (ppm)	Total Microbial Biomass (ng/g)	Harvest Stand Count (plants/ac)	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac) †	Marginal Net Return‡ ($/ac)
Check	0 C*	0.0 C	22.7 A	11.0 A	123.6 A	1,272.7 A	30,778 B	59 A	18.1 A	155 A	594.75 A
30 lb/ac	71 B	4.0 B	19.6 A	12.6 A	158.9 A	1,804.0 A	32,333 A	59 A	18.3 A	156 A	576.18 A
60 lb/ac	103 A	5.3 A	11.8 A	10.7 A	115.8 A	1,709.9 A	31,667 AB	59 A	18.3 A	157 A	573.11 A
90 lb/ac	127 A	6.3 A	18.4 A	16.1 A	122.2 A	1,460.8 A	31,611 AB	58 A	18.5 A	157 A	568.51 A
P-Value	<0.0001	<0.0001	0.277	0.406	0.141	0.22	0.088	0.363	0.312	0.895	0.144

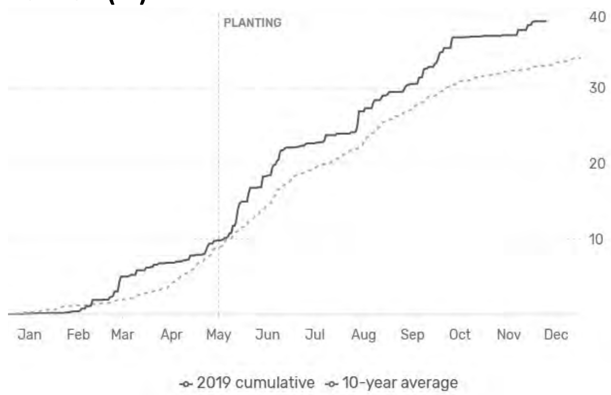
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $21/ac for 30 lb/ac rye seed and drilling, $27.60/ac for 60 lb/ac rye seed and drilling, and $34.20/ac for 90 lb/ac rye seed and drilling.

Summary:

- Cover crop total dry biomass increased with increasing rye seeding rate; however, biomass accumulation was low for all seeding rates. Total biomass N followed a similar trend to the dry biomass accumulation.
- Soil nitrate, P, K, and microbial biomass in 0-8" were not significantly impacted by the rye cover crop treatments.
- There were no differences in corn grain moisture, test weight, yield, or marginal net return between any of the treatments.
- Corn stand counts varied, with the untreated check having a lower stand count than the 30 lb/ac rye treatment.

Rye Cover Crop Seeding Rate Effects on Irrigated Soybean

Study ID: 0129155201902
County: Saunders
Soil Type: Alda fine sandy loam, occasionally flooded
Planting Date: 5/15/19
Harvest Date: 10/8/19
Seeding Rate: 145,000
Row Spacing (in): 18
Variety: Pioneer® P27A17X
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 40 oz/ac Roundup®, 10 oz/ac 2,4-D on 4/24/19 ***Post:*** 5 oz/ac Marvel™, 32 oz/ac Roundup® on 6/1/19
Seed Treatment: CruiserMaxx®
Foliar Insecticides: 2.8 oz/ac Leverage® on 08/09/19
Foliar Fungicides: 4 oz/ac Priaxor® on 8/9/19
Fertilizer: 100 lb/ac 0-0-60, 100 lb/ac 11-52-0, 25 lb/ac elemental sulfur, broadcast application on 4/10/19
Irrigation: Pivot, Total: 3"
Rainfall (in):



Introduction: The objective of this study was to evaluate rye cover crop seeding rate effects on soybean production and soil properties. The rye cover crop was planted at three different seeding rates: 30 lb/ac, 60 lb/ac, 90 lb/ac and a 0 lb/ac control. The rye variety used was Rymin and was planted by drilling on November 16, 2018 in 7.5" rows. Cover crops were terminated with 40 oz/ac Roundup® on April 24, 2019. Cover crops were around 6" at the time of termination. Soybean was planted on May 15, 2019 at 145,000 seeds/ac and a depth of 1.25". Biomass samples were collected on May 1, 2019 and soil samples were collected on May 15, 2019. The soybeans were harvested on October 8, 2019.

Results:

	-------Cover Crop-------		--------------------Soil (0-8") -----------------				----------------Soybean------------------		
	Dry Biomass (lb/ac)	Biomass N (lb/ac)	Nitrate (ppm)	P (ppm)	K (ppm)	Total Microbial Biomass (ng/g)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	0 C*	0.0 B	8.8 A	18.6 A	116.2 A	1,208.4 A	11.6 A	69 A	555.92 A
30 lb/ac	46 B	2.8 A	8.6 A	17.4 A	105.1 A	1,321.5 A	11.6 A	70 A	549.43 A
60 lb/ac	78 AB	4.2 A	8.1 A	16.7 A	105.8 A	1,567.2 A	11.6 A	72 A	557.85 A
90 lb/ac	89 A	4.2 A	7.0 A	19.3 A	109.8 A	1,485.3 A	11.5 A	71 A	541.99 A
P-Value	0.0003	0.0003	0.282	0.569	0.734	0.580	0.793	0.395	0.785

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $21/ac for 30 lb/ac rye seed and drilling, $27.60/ac for 60 lb/ac rye seed and drilling, and $34.20/ac for 90 lb/ac rye seed and drilling.

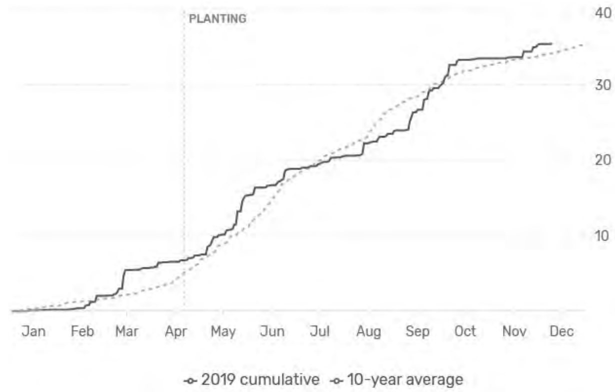
Summary:

- Cover crop total dry biomass increased with increasing rye seeding rate, but had low overall accumulation before termination. Total biomass N was not different among the three rye seeding rates.
- Soil nitrate, P, K, and microbial biomass in 0-8" were not significantly impacted by the rye cover crop treatments.
- There were no differences in soybean grain moisture, test weight, yield, or marginal net return between any of the treatments.

Rye Cover Crop Seeding Rate Effects on Non-irrigated Soybean

Study ID: 0919053201901
County: Dodge
Soil Type: Alcester silty clay loam 2-6% slopes; Moody silty clay loam, 2-6% slope; Moody silty clay loam, 6-11% slope; Monona silt loam terrace, 0-2% slope
Planting Date: 4/20/19
Harvest Date: 10/17/19
Seeding Rate: 130,000
Row Spacing (in): 15
Variety: Pioneer® P25A54X
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 15 gal/ac, of carrier AMS, 32 oz/ac Roundup PowerMAX®, and 0.32 lb/ac Sonic® on 4/19/19 ***Post:*** 20 gal/ac, 2 lb carrier AMS, 7 oz/ac crop oil, 32 oz/ac Roundup PowerMAX®, 5 oz/ac Section® Three, 11 oz/ac Sinister™ on 6/26/19

Foliar Insecticides: None
Foliar Fungicides: 2 oz/ac Stratego® YLD 7/22/19
Fertilizer: None
Irrigation: None
Rainfall (in):



Introduction: The objectives of this study were to evaluate the effect of rye cover crops on soil characteristics and the following soybean crop yield. The rye cover crops were planted at three different seeding rates: 30 lb/ac, 60 lb/ac, and 90 lb/ac and included a 0 lb/ac control. The experimental design was randomized complete blocks with 4 replications. The cover crop was planted by drilling on October 19, 2018 in 15" rows. The cover crop was terminated on April 19, 2019 with 32 fl oz/ac Roundup PowerMAX®. Cover crop height at the time of termination was 6-12". Soybeans were planted on April 20, 2019 in 15" row spacing at a planting depth of 1.25". The final soybean stand was around 100,000. The soybean crop was harvested on October 17, 2019. Cover crop biomass, soil samples, soybean yield, and net return were evaluated.

Results:

	-----Cover Crop-----		----------------------Soil (0-8")----------------				----------------Soybeans----------------		
	Dry Biomass (lb/ac)	Biomass N (lb/ac)	Nitrate (ppm)	P (ppm)	K (ppm)	Total Microbial Biomass (ng/g)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	0 D*	0.0 C	7.5 A	57.3 A	154.6 A	2,696.3 A	11.4 A	63 A	510.16 A
30 lb/ac	90 C	4.8 B	7.3 A	56.6 A	153.6 A	2,203.3 A	11.5 A	63 A	489.44 A
60 lb/ac	129 B	6.4 AB	5.5 B	77.6 A	168.7 A	2,399.1 A	11.4 A	62 A	474.09 A
90 lb/ac	172 A	8.0 A	5.3 B	61.4 A	152.4 A	2,540.3 A	11.4 A	64 A	485.22 A
P-Value	<0.0001	<0.0001	0.002	0.510	0.665	0.244	0.181	0.942	0.644

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $23.88/ac for 30 lb/ac rye seed and drilling, $29.76/ac for 60 lb/ac rye seed and drilling, and $35.64/ac for 90 lb/ac rye seed and drilling.

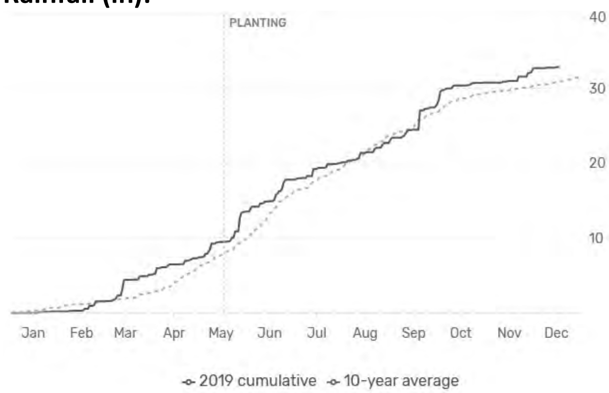
Summary:

- Cover crop total dry biomass increased with increasing rye seeding rate. Total biomass N followed a similar trend.
- Soil nitrate concentration in 0-8" was significantly reduced for the 60 lb/ac and 90 lb/ac rye treatment, compared to the no cover crop check and 30 lb/ac treatment.
- There were no differences in total microbial biomass, moisture, yield, or marginal net return between any of the treatments.

Evaluating the Impact of Monoculture Rye Cover Crop versus Multispecies Cover Crop on Subsequent Crop Yield and Soil Quality Indicators

Study ID: 0732167201901
County: Stanton
Soil Type: Alcester silty clay loam, 2-6% slopes; Moody silty clay loam, 2-6% slopes; Nora silty clay loam, 6-11% slopes; Nora silty clay loam, 11-17% slopes; Nora-Crofton complex, 6-11% slopes
Planting Date: 5/17/19
Harvest Date: 11/4-5/19
Seeding Rate: 30,919
Row Spacing (in): 20
Variety: Golden Harvest® 09Y24-3220A E-Z Refuge
Reps: 4
Previous Crop: Wheat
Tillage: No-Till
Herbicides: 8 oz/ac 2,4-D, 40 oz/ac glyphosate
Seed Treatment: Avicta® 500 FS

Fertilizer: 5 gal/ac 8-20-8-4-2 on 5/17/19; 150 lb/ac urea and 20 lb/ac AMS on 5/22/19
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. This study compares two treatments, a monoculture rye cover crop versus a cover crop mix. Soil health indicators, soil tests, and yield data are evaluated each year. This is the third year of the study. Cover crops were drilled on July 27, 2018 following wheat harvest in July 2018. The monoculture cover crop was 50 lb/ac cereal rye. The cover crop mix was 30 lb/ac cereal rye, 3 lb/ac red clover, 2 lb/ac rapeseed/canola, and 6 lb/ac hairy vetch. Cover crops were terminated on May 16, 2019 and corn was planted on May 17, 2019.

Results:

Table 1. Baseline soil health test.

	Total Bacteria	Bacteria Gram (+)	Bacteria Gram (-)	Total Fungi	Arbuscular Mycorrhizal	Saprophytes	Protozoa	Undifferentiated
	-----Biomass, PLFA ng/g-----							
2017 (1 *composite sample collected for all replications of a treatment; samples collected on Mar. 2017)*								
Rye	1596.8	993.3	603.5	221.2	85.4	135.8	10.6	902.3
Mix	1651.6	904.8	746.7	379.8	78.5	301.3	24.0	1808.8
2019 (1 *composite sample collected for all replications of a treatment; samples collected on May. 2019)*								
Rye	2294.8	1419.3	875.5	648.6	177.4	471.2	16.7	1888.8
Mix	1723.6	1020.8	702.9	421.4	117.9	303.6	27.1	1753.2

	Soil pH	Buffer pH	OM %	CO_2-C	Total Nitrogen	Organic Nitrogen	Total Organic Carbon	Nitrate	Ammonium	Organic C:N	Soil Health Score
				-----ppm-----							
Rye	6.1	6.7	4.3	118.0	29.7	19.5	186	7.3	1.4	9.5	16.22
Mix	7.2		4.2	128.0	22.0	15.1	159	5.2	1.3	10.5	15.27

Table 2. Soil physical, chemical, and biological properties for cover crop and no cover crop treatments. Samples were collected on 11/5/19 (1 sample per treatment replication, 8 samples per treatment).

Treatment	Infiltration (in/hr)	Soil moisture (%)	Bulk density (g/cm^3)	Soil temp. (F)	Soil respiration[1]
Cover Crop – Rye	18.61 A*	25.63 A	1.13 A	36.24 A	3.13 A
Cover Crop – Mix	31.24 A	25.11 A	1.10 A	36.61 A	3.22 A
P-Value	0.378	0.766	0.5083	0.454	0.879

[1]Soil respiration (Modified Solvita burst).
*Values with the same letter are not significantly different at a 90% confidence level.

Table 3. NRCS field assessments of soil health. Samples were collected on 11/5/19 (1 sample per treatment replication, 8 samples per treatment).

	NRCS Field Assessment of Soil Health							
Treatment	Structure	Structure type	Surface condition	Soil pores	Earthworm	Biological activity	Soil smell	Overall indicator[2]
Cover Crop - Rye	2.06 A	2.00 A	2.56 A	2.75 A	2.56 A	2.25 A	2.38 A	2.45 A
Cover Crop - Mix	2.10 A	2.22 A	2.29 B	2.94 A	2.45 A	2.19 A	2.42 A	2.48 A
P-Value	0.840	0.278	0.078	0.217	0.746	0.414	0.699	0.482

[2]Score based on field assessment. The overall indicator score is based on the sum of 8 indicators (averaged from 1-3; 1=degraded, 2=in transition, 3=healthy): soil structure, structure type, surface condition, soil management, soil pores, earthworms, biological activity, and smell.

Table 4. Corn yield, moisture, and marginal net return for cover crop mix and monoculture rye treatments.

	Moisture (%)	Corn Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Cover Crop - Rye	20.3 A	192 A	708.03 A
Cover Crop - Mix	19.9 A	179 A	655.90 B
P-Value	0.317	0.101	0.085

†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $27.33/ac for the rye seed and drilling, and $31.34/ac for the mix seed and drilling.

Summary:

- There was no difference in corn moisture between the mix and monoculture rye cover crop.
- Yield was very close to statistically significant at the 90% confidence level, with the monoculture rye cover crop having a higher yield than the multispecies cover crop.
- The monoculture rye cover crop had a higher net return.

Summary of Previous Year (2018)

2018

In year one, cover crops were drilled in October 2016. The monoculture cover crop was 50 lb/ac rye. The cover crop mix consisted of 35 lb/ac Elbon rye, 0.5 lb/ac Bayou kale, 0.5 lb/ac Impact forage collards, 0.5 lb/ac Trophy rape, 0.5 lb/ac purple top turnip, 0.5 lb/ac African cabbage, 3.5 lb/ac hairy vetch, 30 lb/ac Austrian winter pea, and 2 lb/ac winter lentil. Cover crops were terminated on May 14, 2017 and soybeans were planted on May 25, 2017 and harvested on September 29, 2017. Wheat was planted in October 2017. Wheat yield was obtained for each treatment using yield monitor data with a 15' buffer applied to the treatments.

Results:

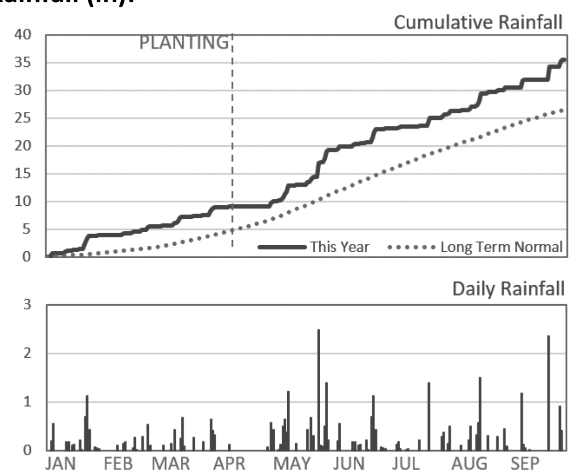
	Moisture (%)	Wheat Yield† (bu/ac)
Cover Crop - Rye	14.2 A*	35 A
Cover Crop - Mix	14.6 A	33 A
P-Value	0.591	0.366

†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13.5% moisture.
*Values with the same letter are not significantly different at a 90% confidence level.

There was no difference in wheat yield or moisture for the monoculture versus cover crop mix. The field was hailed on June 23, 2018.

Non-irrigated Corn Following Winter Terminated and Winter Hardy Cover Crop

Study ID: 0656127201901
County: Nemaha
Soil Type: Judson silt loam 0-2% slope; Judson silt loam 2-6% slopes
Planting Date: 4/10/19
Harvest Date: 9/19/19
Seeding Rate: 33,000
Row Spacing (in): 30
Variety: Pioneer® P0688AM™
Reps: 7
Previous Crop: Wheat
Tillage: No-Till
Herbicides: ***Pre:*** 40 oz/ac Resicore®, 32 oz/ac Buccaneer® 5 EXTRA, 16 oz/ac Detonate® on 4/2/19 ***Post:*** 3.2 oz/ac Meso Star and 32 oz/ac Buccaneer® 5 EXTRA on 6/5/19
Foliar Insecticides: 3.84 oz/ac Lambda-Cyhalothrin 1 EC on 7/28/19 aerial applied
Foliar Fungicides: 6.4 oz/ac AzoxyProp Xtra on 6/5/19 with herbicide; 10.5 oz/ac AzoxyProp Xtra on 7/28/19 aerial applied
Fertilizer: 150 lb/ac NPSZ (18 lb/ac N, 67.5 lb/ac P, 7.5 lb/ac S, and 1.5 lb/ac Zn), 75 lb/ac potash, and 7 lb/ac boron 15% on 2/5/19; 150 lb N/ac as 32% UAN on 4/2/19; 6.4 oz/ac N-TENSE™ on 6/5/19; 46 lb N/ac as 46% urea on 6/27/19
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. This is the third year of this study. The two treatments, the use of winter terminated cover crops and the use of winter hardy cover crops, will be used in this multi-year study (2016-2021). The cover crops were drilled August 1, 2018. The winter terminated treatment was a mix of 30 lb/ac oats and 1 lb/ac turnip. The winter hardy treatment consisted of 30 lb/ac cereal rye and 1 lb/ac turnip. This study had no cover crop control. Cattle were put out on the cover crop on November 1 and taken off on November 26. For uniformity, both cover crop mixes were sprayed with herbicide to terminate the cover crops on April 2, 2019. Baseline soil health measures (one per treatment) were collected on October 19, 2016 (Table 1). This is the third year of this study for yield data collection. On these treatment strips wheat was planted in 2018 and soybeans were planted in 2017.

Table 1. Soil physical, chemical, and biological properties for winter hardy and winter kill cover crops.

	Bulk density (g/cm^3)	Total pore space (%)	Water Holding Capacity - pores filled (inch H_2O/ft)	Soil moisture (%)	Soil resp[1]	Soil temp (F)	Infiltration (inch/hr)
2016 *(1 composite sample collected for all replications of a treatment; samples collected on Oct. 19, 2016)*							
Winter hardy	1.22	53.84	3.56	-	2.0	59	1.30
Winter terminated	1.32	50.22	3.94	-	2.0	59	1.12
2018 *(1 composite sample collected for all replications of a treatment; samples collected on Oct. 31, 2018)*							
Winter hardy	1.25	52.84	3.27	-	3.5	49.67	0.69
Winter terminated	1.24	52.27	3.18	-	3.4	50.33	0.89
2019 *(1 sample per treatment replication, n=4 per treatment; samples collected on Oct. 24, 2019)*							
Winter hardy	1.19 A			22.6 A	2.88 A	48.83 A	0.72 A
Winter terminated	1.26 A			26.4 A	2.38 A	48.98 A	0.62 A
P-value	0.284			0.195	0.308	0.638	0.599

[1]Soil respiration (Modified Solvita burst).

Table 2. NRCS field assessments of soil health.

	Structure	Structure Type	Soil Surface	Soil Mgmt	Soil Pores	Earth-worm	Soil smell	Biological activity	Overall indicator[2]
2016 *(1 composite sample collected for all replications of a treatment; samples collected on Oct. 24, 2019)*									
Winter Terminated	2.0 A	1.5 A	2.5 A	2.5 A	3.0 A	3.0 A	2.5 A	2.5 A	2.44 A
Winter Hardy	2.0 A	1.5 A	2.5 A	2.5 A	3.0 A	3.0 A	2.5 A	2.5 A	2.44 A
P-Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

[2]Score based on field assessment. The overall indicator score is based on the sum of 8 indicators (averaged from 1-3; 1=degraded, 2=in transition, 3=healthy): soil structure, structure type, surface condition, soil management, soil pores, earthworms, biological activity, and smell.

Table 3. Normalized difference vegetation index (NDVI) values from aerial imagery for the corn crop following winter hardy and winter terminated cover crops.

	June 27	July 10	July 14	July 27	Aug 9	Aug 17	Aug 27	Sept 13
Winter Terminated Cover Crop	0.462 A*	0.496 A	0.481 A	0.428 A	0.451 A	0.445 A	0.416 A	0.296 A
Winter Hardy Cover Crop	0.449 A	0.478 A	0.472 A	0.411 A	0.443 A	0.430 A	0.414 A	0.304 A
P-Value	0.345	0.363	0.368	0.351	0.385	0.324	0.485	0.188

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

Table 4. 2019 corn stand counts, test weight, moisture, yield, and net return for winter hardy and winter terminated cover crop treatments.

	Stand Count (plans/ac)	Test Weight (lb/bu)	Moisture (%)	Corn Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Winter Terminated Cover Crop	29,952 A*	57 A	17.7 A	217 A	805.04 A
Winter Hardy Cover Crop	29,429 A	57 A	17.8 A	214 A	792.55 A
P-Value	0.207	0.552	0.891	0.277	0.216

*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 $3.83/bu corn, $12/ac winter terminated cover crop seed mix, $13.80/ac winter hardy cover crop seed mix, and $14.40/ac drilling cost.

Summary: In 2019, there were no differences in corn population, moisture, test weight, yield, or net return. These observations are in agreement with the crop vigor calculated throughout the corn growing season that showed no differences between the two cover crop treatments.

Summary of Previous Years (Year 1 and 2)

In year one, cover crops were drilled on September 29, 2016. The winter terminated treatment was a mix of oats, turnips, and common rapeseed, whereas the winter hardy treatment consisted of cereal rye, turnips, and common rapeseed. For uniformity, both cover crop mixes were sprayed with glyphosate on April 12, 2017. This terminated the winter hardy treatment and controlled weeds and brassicas, which had overwintered in the winter terminated cover crop treatment. In 2017, soybeans had no difference in yield, test weight, moisture, or net return following the winter terminated and winter hardy cover crops.

Table 3. 2017 soybean stand counts, test weight, yield, and net return for winter hardy and winter terminated cover crop treatments.

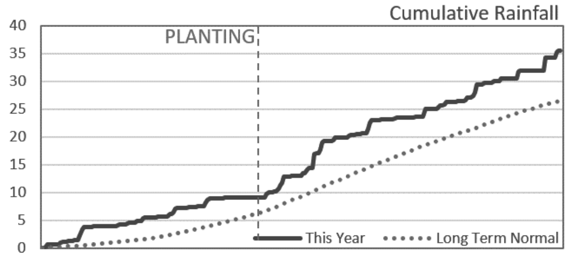
	Soybean Stand Count at Harvest (plants/ac)	Soybean Test Weight (lb/bu)	Soybean Moisture (%)	Soybean Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Winter Terminated Cover Crop	102,178 A*	56 A	10.6 A	62 A	518.84 A
Winter Hardy Cover Crop	102,178 A	56 A	10.6 A	61 A	516.42 A
P-Value	1	0.4886	1	0.7345	0.735

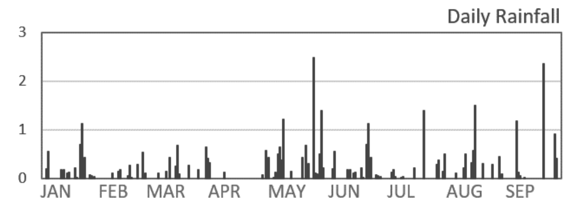
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.90/bu soybean and $30.07 cost for cover crop seed and drilling in both treatments.

In year two, following soybean harvest in 2017, the two cover crop treatments were drilled in the same locations. In 2018, wheat was planted in this area. No yield measurements were made for the winter terminated and winter hardy cover crop strips.

Non-irrigated Soybeans Following Winter Terminated and Winter Hardy Cover Crop

Study ID: 0656127201902
County: Nemaha
Soil Type: Judson silt loam 0-2% slope; Judson silt loam 2-6% slopes
Planting Date: 4/26/19
Harvest Date: 9/26/19
Seeding Rate: 140,000
Row Spacing (in): 30
Variety: Pioneer® P23A32X
Reps: 7
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 6 oz/ac Sonic®, 24 oz/ac Metalica, 16 oz/ac 2,4-D LV6, and 32 oz/ac Buccaneer® 5 Extra with 6.4 oz/ac Absorb 100 on 4/9/19 ***Post:*** 16 oz/ac Metalica, 16 oz/ac Shafen Star, 8 oz/ac Se-CURE EC, and 32 oz/ac Buccaneer® 5 Extra with 9.6 oz/ac Absorb 100 on 6/19/19
Foliar Insecticides: 3.84 oz/ac Lambda-Cyhalothrin 1 EC aerial applied on 8/15/19
Foliar Fungicides: 10.5 oz/ac AzoxyProp Xtra aerial applied 8/15/19
Fertilizer: 100 lb/ac NPSZ (12 lb/ac N, 45 lb/ac P, 5 lb/ac S, and 1 lb/ac Zn) and 100 lb/ac potash on 2/5/19
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 two treatments, the use of winter terminated cover crops and the use of winter hardy cover crops, will be used in this multi-year study (2016-2021). This is the third year of this study. The cover crops were drilled September 15, 2018. The winter terminated treatment was a mix of 30 lb/ac oats and 1 lb/ac turnip. The winter hardy treatment consisted of 30 lb/ac cereal rye and 1 lb/ac turnip. This study did not have a no cover crop control. Cattle were put out on the cover crop on November 1 and removed November 26. For uniformity, both cover crop mixes were sprayed with herbicide to terminate the cover crops on April 9, 2019. Baseline soil health measures (one per treatment) were collected on 10/19/16 (Table 1).

Table 1. Soil physical, chemical, and biological properties for winter hardy and winter kill cover crops.

Treatment	Bulk density (g/cm^3)	Total pore space (%)	Water Holding Capacity - pores filled (inch H_2O/ft)	Soil moisture (%)	Soil resp[1]	Soil temp (F)	Infiltration (inch/hr)
2016 *(1 composite sample collected for all replications of a treatment; samples collected on Oct. 19, 2016)*							
Winter hardy	1.43	46.2	3.82	-	-	-	-
Winter terminated	1.15	56.6	3.14	-	-	-	-
2018 *(1 composite sample collected for all replications of a treatment; samples collected on Oct. 31, 2018)*							
Winter hardy	1.204	56.3	2.53	-	3.0	49.0	0.86
Winter terminated	1.375	48.7	3.15	-	3.0	49.5	1.71
2019 *(1 sample per treatment replication, n=4 per treatment; samples collected on Oct. 24, 2019)*							
Winter hardy	1.30 A	-	-	25.7 A	2.9 A	49.5 A	2.00 A
Winter terminated	1.34 A	-	-	22.95 A	2.5 A	48.8 A	9.94 A
P-Value	0.299			0.302	0.520	0.007	0.258

[1]Soil respiration (Modified Solvita burst).

Table 2. NRCS field assessments of soil health.

Treatment	Soil resp[1]	Structure	Mgmt	Soil pores	Earth worm	Soil smell	Biological activity	Overall indicator[2]
2018 *(1 composite sample collected for all replications of a treatment; samples collected on Oct. 31, 2017)*								
Winter hardy	3.0	1.5	2	3	3	3	3	2.31
Winter terminated	3.3	1.5	2	3	2	3	3	2.19
2019 *(1 sample per treatment replication, n=4 per treatment; samples collected on Oct. 24, 2019)*								
Winter hardy	2.88 A	2.13 A	2.50 A	3.00 A	2.88 A	2.63 A	2.63 A	2.48 A
Winter terminated	2.50 A	2.13 A	2.50 A	2.88 A	2.88 A	2.50 A	2.50 A	2.44 A
P-Value	0.520	1.0	1.0	0.391	1.0	0.391	0.391	0.2152

[2]Score based on field assessment. The overall indicator score is based on the sum of 8 indicators (averaged from 1-3; 1=degraded, 2=in transition, 3=healthy): soil structure, structure type, surface condition, soil management, soil pores, earthworms, biological activity, and smell.

Table 3. Normalized difference vegetation index (NDVI) values from aerial imagery for the soybean crop following winter hardy and winter terminated cover crops.

	June 27	July 10	July 14	July 27	Aug 9	Aug 17	Aug 27	Sept 13
Winter Terminated Cover Crop	0.283 A*	0.424 B	0.459 B	0.455 B	0.495 B	0.508 B	0.493 A	0.408 A
Winter Hardy Cover Crop	0.286 A	0.433 A	0.468 A	0.460 A	0.497 A	0.510 A	0.494 A	0.416 A
P-Value	0.513	0.048	0.015	0.016	0.011	0.059	0.283	0.102

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

Table 4. 2019 soybean stand counts, test weight, moisture, yield, and net return for winter hardy and winter terminated cover crop treatments.

	Stand Count (plants/ac)	Test Weight (lb/bu)	Moisture (%)	Soybean Yield (bu/acre)†	Marginal Net Return‡ ($/ac)
Winter Terminated Cover Crop	100,519 A*	56 A	12.6 A	84 A	652.21 A
Winter Hardy Cover Crop	93,884 B	56 A	12.9 A	86 A	670.35 A
P-Value	0.099	0.629	0.447	0.693	0.719

*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 $8.10/bu soybean, $12/ac winter terminated cover crop seed mix, $13.80/ac winter hardy cover crop seed mix, and $14.40/ac drilling cost.

Summary: In 2019, there were no differences in soybean yield, moisture, test weight, or net return between the winter terminated and winter hardy cover crop. Soybean stand counts taken at harvest were lower for the soybean following winter hardy cover crop.

Summary of Previous Years (Year 1 and 2)

In year one, cover crops were drilled on September 29, 2016. The winter terminated treatment was a mix of oats, turnips, and common rapeseed, whereas the winter hardy treatment consisted of cereal rye, turnips, and common rapeseed. For uniformity, both cover crop mixes were sprayed with glyphosate on April 12, 2017. This terminated the winter hardy treatment and controlled weeds and brassicas, which had overwintered in the winter terminated cover crop treatment. In 2017, wheat was planted and no measurements were made on the winter terminated and winter hardy cover crop strips. No yield measurements were made to compare wheat yield on the two treatments.

In year two, following wheat harvest, winter terminated and winter hardy cover crops were drilled in the same strips on August 1, 2017. The winter terminated treatment was a mix of 30 lb/ac oats, 1.5 lb/ac canola/rapeseed, and 1 lb/ac turnip. The winter hardy treatment consisted of 30 lb/ac cereal rye, 1.5 lb/ac canola/rapeseed, and 1 lb/ac turnip. Both cover crop mixes were sprayed with herbicide to terminate the cover crops on April 4, 2018. Corn was planted in April 2018 and measurements on the corn following the winter hardy and winter terminated cover crop are in Table 3.

Table 3. 2018 corn stand counts, test weight, yield, and net return for winter hardy and winter terminated cover crop treatments.

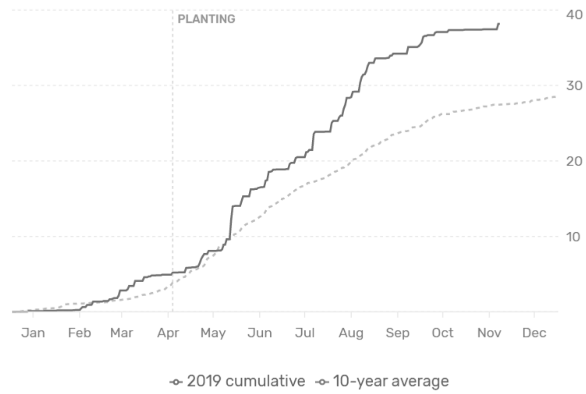
	Stand Count (plants/ac)	Test Weight (lb/bu)	Moisture (%)	Corn Yield† (bu/ac)	Marginal Net Return‡ ($/ac)
Winter Terminated	29,710 A*	56 A	20.7 A	243 A	759.43 A
Winter Hardy	29,515 A	56 A	20.9 A	240 A	748.71 A
P-Value	0.677	0.226	0.516	0.281	0.283

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture for corn.
‡Marginal net return based on $3.23/bu corn, $12.48/ac winter terminated cover crop seed mix, $12.45/ac winter hardy cover crop seed mix, and $14.40/ac drilling cost.

In 2018, corn planted after winter terminated cover crops had no difference in yield, test weight, moisture, or net return.

Impact of Early Interseeded Cover Crop on Irrigated Corn

Study ID: 0916185201901
County: York
Soil Type: Hastings silt loam 0-1% slope
Planting Date: 4/18/2019
Harvest Date: 10/11/19
Seeding Rate: 30,000
Row Spacing (in): 36
Variety: Pioneer® P1366AMXT™
Reps: 4
Previous Crop: Corn
Tillage: Ridge-Till
Herbicides: ***Pre:*** 2.5 oz/ac Corvus® banded with planter ***Post:*** 22 oz/ac glufosinate one day prior to interseeding cover crop
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 195 lb N/ac as NH_3; 4 gal/ac 10-34-0 in-furrow at planting
Irrigation: Pivot, Total: 1.5"
Rainfall (in):



Introduction: This study evaluated the impact of interseeded cover crops on corn yield. There were three treatments: a check with no cover crops interseeded, an interseeded nitrogen cover crop mix, and an interseeded diverse cover crop mix. The nitrogen mix consisted of 4 lb/ac crimson clover, 3 lb/ac red clover, 2 lb/ac yellow sweet clover, 4 lb/ac Winterhawk annual ryegrass, 1.5 lb/ac impact forage collards, and 1.5 lb/ac Trophy rapeseed. The diverse mix consisted of 2 lb/ac red clover, 2.5 lb/ac Hubam white seed clover, 4 lb/ac Winterhawk annual ryegrass, 1 lb/ac purple top turnip, 3 lb/ac golden flax, 0.5 lb/ac phacelia Angelia, and 0.5 lb/ac chicory. Glufosinate was used to burndown any emerged weeds one day prior to interseeding. The cover crop mixes were interseeded by drilling on June 7 when corn was V5-V6. Corn yield, stand counts, and stalk rot were measured. Cover crop species and biomass were also measured by sampling 9 sq ft per treatment.

Figure 1. Interseeding cover crop mixes on June 7, 2019 (left) and cover crop establishment in standing corn on September 6, 2019 (right).

Results:

	Brassica	Rye	Clover	Weeds	Standing Dead Material	Total (not including weeds & dead)
	--------------------	--------------------	------lb dry matter/ac	--------------------	--------------------	--------------------
Crop Crop - Diverse Mix	71 A*	24 A	2 A	95 A	9 A	97 A
Cover Crop - Nitrogen Mix	192 A	17 A	11 A	75 A	11 A	220 A
P-Value	0.586	0.757	0.111	0.549	0.745	0.619

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

	Stalk Rot (%)	Stand Count (plants/ac)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	13.75 A	25,500 A	19.4 A	241 A	923.21 A
Crop Crop - Diverse Mix	8.13 A	25,750 A	19.4 A	241 A	883.04 B
Cover Crop - Nitrogen Mix	10.00 A	25,708 A	19.4 A	243 A	890.46 B
P-Value	0.700	0.983	0.192	0.750	0.041

†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $25.58/ac nitrogen mix seed cost, $23.61/ac diverse mix seed cost, and $14.40/ac drilling cost.

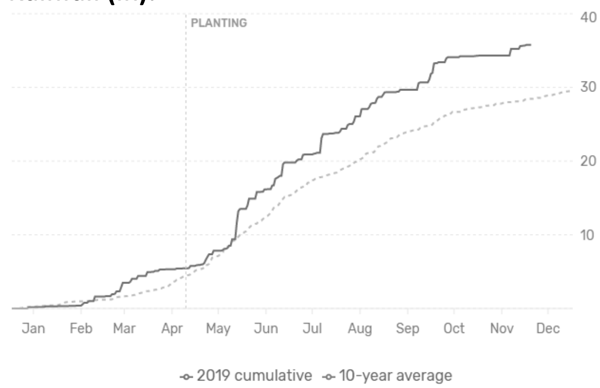
Summary:

- Measured cover crop biomass was variable and had no statistically significant differences between the two cover crop mixes.
- Corn stand count, stalk rot, and yield were not different between the three treatments. Net return was lower for the cover crop treatments due to additional seed costs and drilling costs.

Impact of Early Interseeded Cover Crops on Irrigated Corn

Study ID: 0918185201902
County: York
Soil Type: Hastings silt loam, 0-1% slope; Hastings silt loam, 1-3% slope
Planting Date: 4/24/19
Harvest Date: 10/16/19
Seeding Rate: 34,000
Row Spacing (in): 30
Variety: DEKALB® DKC60-88 VT2
Reps: 6
Previous Crop: Soybean
Tillage: Ridge-Till
Herbicides: ***Pre:*** Staunch® II on 4/25/2019 ***Post:*** 3 oz/ac Callisto® and 32 oz/ac Roundup® on 6/10/19
Seed Treatment: Acceleron®

Fertilizer: 28 gal/ac 32% UAN on 4/25/19 and 18 gal/ac 32% UAN on 6/17/19
Irrigation: Pivot
Rainfall (in):



Introduction: This study evaluated the impact of interseeded cover crops on corn yield. The interseeded cover crop treatment was compared to a no cover crop check. The field received 0.40" of rain the night before interseeding. On June 14 the field was cultivated then broadcast interseeded with a high-clearance applicator. The cover crop mixture was 10 lb/ac red clover and 5 lb/ac buckwheat. Corn was at V6 growth stage. A time-lapse camera was installed to monitor cover crop progress. By June 24, seeds had germinated and small seedlings were present; however, seedlings did not survive and by a few days later, no cover crops remained in the field (Figure 1). A possible explanation is that the Callisto® reactivated with rain and impacted the cover crop seedlings.

Figure 1. Broadcast interseeding cover crops with high-clearance applicator on June 14 (left), germinated cover crops on June 24 (middle), and no cover crops remaining in rows on July 3 (right).

Results:

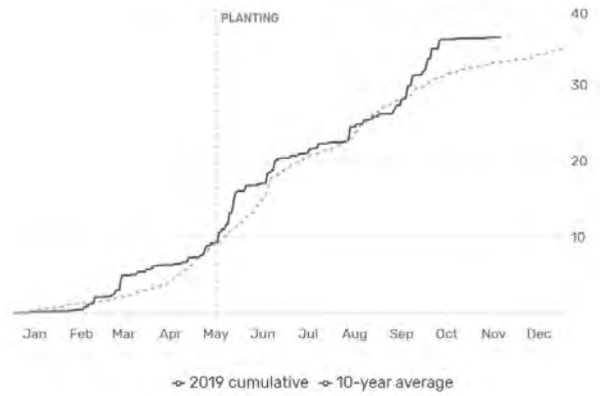
	Harvest Stand Count (plants/ac)	Stalk Rot (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	32,500 A*	2.08 A	12.5 A	258 A	986.23 A
Cover Crop - Interseeding	30,667 A	1.67 A	12.6 A	256 A	970.75 A
P-Value	0.208	0.849	0.172	0.613	0.211

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $6.67/ac for cover crop seed, and $3/ac for interseeding.

Summary: There was no impact of interseeding cover crop on corn stand count, stalk rot, grain moisture, yield, or net return.

Evaluating 30" vs 60" Irrigated Corn Row Spacing for Interseeding Cover Crops

Study ID: 0359053201901
County: Dodge
Soil Type: Alcester silty clay loam, 2-6% slopes; Zook silt loam, 0-2% slope
Planting Date: 5/15/19
Harvest Date: 10/25/19
Seeding Rate: 34,000
Row Spacing (in): 30
Variety: Stine® 9808E-0
Reps: 8
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 8 oz/ac Verdict®, 0.5 lb/ac atrazine, 32 oz/ac glyphosate, 7.5 oz/ac 2-4D LV6 on 5/15/19 ***Post:*** None
Seed Treatment: Cruiser 250
Foliar Insecticides: None
Foliar Fungicides: 4 oz/ac Priaxor®, 4 oz/ac Tilt®, and 1 gal/ac QLF Agronomy L-CBF Boost™ aerial applied on 8/3/19
Fertilizer: 110 lb/ac 11-52-0 on 04/23/29; 2 gal/ac humic acid, 3 gal/ac 6-24-6, 0.5 gal/ac 0-0-25-17S, 0.5 lb/ac Zn, 0.5 lb/ac Mn, 0.25 gal/ac Conklin® Syntose FA® as starter; 75 lb N/ac with pre-emerge on 5/15/19; 140 lb N/ac as ammonium nitrate and Sulfate on 7/2/19
Irrigation: Pivot, Total: 4"
Rainfall (in):



Introduction: Wider corn row spacing may provide a better opportunity for establishment of interseeded cover crops. This study compared row and plant spacing for establishment of interseeded cover crops. The two treatments were:

1) corn planted at 30" row spacing and a population of 34,000 plants/ac (6.15" between plants in the row)

2) corn planted at 60" row spacing and a population of 34,000 plants/ac (3.07" between plants in the row)

The interseeded cover crops were planted on June 12, 2019. The cover crop was a 12 species mix that included 3 lb/ac annual ryegrass, 16 lb/ac winter wheat, 10 lb/ac Jerry oats, 0.125 lb/ac turnips, 0.125 lb/ac rapeseed, 0.5 lb/ac daikon radish, 3 lb/ac buckwheat, 2 lb/ac lentils, 0.5 lb/ac flax, 0.25 lb/ac FIXatioN balansa clover, 1.5 lb/ac crimson clover, and 3 lb/ac common vetch. Some of the cover crops will winter kill; others died off due to shading. Soybeans will be planted into the living cover crops that overwintered.

Results:

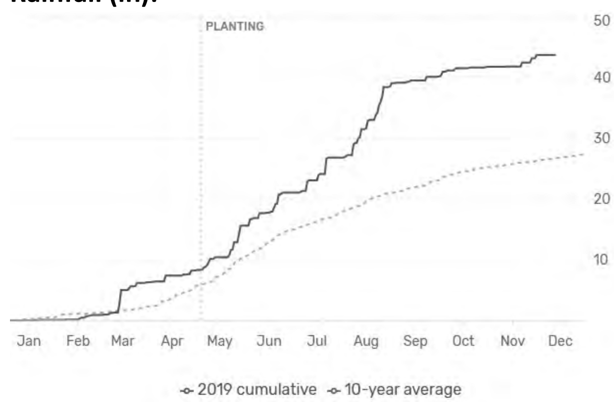
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
30"	19.3 A*	248 A	949.51 A
60"	18.7 B	199 B	763.36 B
P-Value	0.004	<0.0001	<0.0001

*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 $3.83/bu corn.

Summary: The 60" row spacing with higher within row plant density resulted in drier grain at harvest, reduced yield, and reduced net return.

Irrigated Soybeans Planted Following Dormant and Interseeded Cover Crop, Dormant Seeded Cover Crop, and No Cover Crop Check

Study ID: 0815079201901
County: Hall
Soil Type: Kenesaw silt loam, 1-6% slopes; Valentine-Thurman, 0-17% slopes; Thurman loamy fine sand, 0-2% slope; Thurman loamy fine sand, 2-6% slopes; Kenesaw silt loam, 0-1% slope
Planting Date: 5/3/19
Harvest Date: 10/8/19
Seeding Rate: 174,000
Row Spacing (in): 30
Variety: Pioneer® P24A99X
Reps: 6
Previous Crop: Corn
Tillage: Strip-Till
Herbicides: ***Pre:*** 32 oz/ac Buccaneer® 5 Extra, and 8 oz/ac Outlook® on 5/5/19 ***Post:*** 6 oz/ac clethodim, 18 oz/ac Buccaneer® 5 Extra, and 4 oz/ac Outlook® on 6/4/19; 48 oz/ac Buccaneer® 5 Extra, and 10 oz/ac Outlook® on 6/24/19
Seed Treatment: Lumisena™ and EverGol® Energy SB
Foliar Insecticides: 2 oz/ac Serpent™ and 2 oz/ac Fanfare™ through pivot on 7/19/19; 2 oz/ac Serpent™ and 2 oz/ac Fanfare™ through pivot on 8/2/19
Fertilizer: 5 gal/ac 10-34-0 and 1 pt/ac Zn on 5/3/19
Irrigation: Pivot, Total: 3.92"
Rainfall (in):



Baseline Soil Health Soil Test (Jan. 2017 – 18 samples, averaged over study area):

CO_2-C	Total Nitrogen	Organic Nitrogen	Total Organic Carbon	Nitrate	Ammonium	Organic C:N	Soil Health Score
ppm							
19.51	11.83	9.47	129.50	1.71	0.56	13.84	5.49

Baseline Standard Soil Test (Jan. 2017 - 31 samples, averaged over study area):

OM%	pH	CEC (meq/100 g)	Nitrate	Phosphorus	Potassium	Magnesium	Sulfur	Sodium	Sol Salts (S/m)
			ppm						
1.094	5.57	9.41	7.07	34.55	207.1	121.03	17.1	21.77	0.11

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. This study is examining three treatments: 1) dormant (post-harvest) seeded cover crops and interseeded cover crops, 2) dormant (post-harvest) seeded cover crops, and 3) a no cover crop check. This is the second year of the study.

During the 2018 growing season, when the field was planted to corn, cover crops were interseeded using a Hiniker interseeder. The interseeding mix consisted of 6 lb/ac cowpea, 6 lb/ac soybean, 0.5 lb/ac crimson clover, 5 lb/ac sunn hemp, 2 lb/ac hairy vetch, 3 lb/ac buckwheat, 0.5 lb/ac chicory, 0.5 lb/ac flax, 0.5 lb/ac rapeseed/canola, 6 lb/ac Elbon cereal rye, and 6 lb/ac spring oats. The farm was in soybeans this year, so there was not any interseeding of cover crops during the 2019 growing season.

In the fall of 2018, the dormant seeded cover crop strips were seeded with a cover crop mix of Elbon cereal rye, winter wheat, triticale, annual ryegrass, winter oats, hairy vetch, camelina, and winter lentil. Soybeans were planted on May 3, 2019 in 30" row spacing. The cover crop mix was terminated May 5, 2019 by herbicide. Cover crops were 8 to 10" tall at the time of termination. Thistle caterpillars caused a large amount of defoliation in the field in June 2019.

Results:

Table 1. Soil physical, chemical, and biological properties for dormant and interseeded cover crop and no cover crop treatments. Samples were collected on 10/29/19 (1 sample per treatment replication, 6 samples per treatment).

Treatment	Infiltration (in/hr)	Soil moisture (%)	Bulk density (g/cm^3)	Soil temp. (F)	Soil respiration[1]
Check	6.15 A*	16.50 A	1.24 A	37.33 A	2.42 A
Dormant	3.12 A	15.21 A	1.28 A	37.00 A	2.33 B
Dormant + Interseeded	8.81 A	13.33 A	1.24 A	37.17 A	3.42 A
P-Value	0.532	0.262	0.904	0.690	0.064

[1]Soil respiration (Modified Solvita burst).
*Values with the same letter are not significantly different at a 90% confidence level.

Table 2. NRCS field assessments of soil health. Samples were collected on 10/29/19 (1 sample per treatment replication, 6 samples per treatment).

	NRCS Field Assessment of Soil Health								
Treatment	Structure	Structure type	Surface condition	Mgmt	Soil pores	Earth worm	Biological activity	Soil smell	Overall indicator[2]
Check	2.08 A	2.08 A	1.92 A	1.50 B	2.17 A	1.58 A	1.91 A	2.00 A	1.91 A
Dormant	1.92 A	1.91 A	1.83 A	2.42 A	2.17 A	1.58 A	1.91 A	1.75 A	1.94 A
Dormant + Interseeded	1.92 A	1.91 A	1.75 A	2.50 A	1.87 B	1.67 A	2.00 A	1.89 A	1.86 A
P-Value	0.708	0.681	0.402	<.0001	0.018	0.900	0.808	0.195	0.715

[2]Score based on field assessment. The overall indicator score is based on the sum of 8 indicators (averaged from 1-3; 1=degraded, 2=in transition, 3=healthy): soil structure, structure type, surface condition, soil management, soil pores, earthworms, biological activity, and smell.

Table 3. Soybean yield, moisture, and marginal net return for dormant and interseeded cover crop and no cover crop treatments.

Treatment	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	13.5 A	84 A	681.00 AB
Dormant Seeded	13.8 A	87 A	661.85 B
Dormant + Interseeded	13.5 A	89 A	724.21 A
P-Value	0.738	0.119	N/A

†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $31.19/ac for seed mix for dormant seeded treatment, and $14.40/ac for drilling for dormant seeded treatment. Interseeded cover crop costs were accounted for in the previous year's report; therefore, they are not included in this analysis.

Summary:

- Of the soil physical, chemical, and biological properties measured, only soil respiration, management, and soil pores were different in the second year of the study. The dormant cover crop treatment had a reduced soil respiration score, the check had a lower management score, and the dormant and interseeded treatment had a lower soil pore score.
- There was no yield or grain moisture difference between the treatments.
- Net return was higher this year for the interseeded treatment than the dormant seeded treatment. This is because the cover crops interseeded in the summer of 2018 already had the cover crop seed and planting costs accounted for in the previous year's analysis; therefore, there were no additional costs of cover crop seed or planting in this analysis. A comprehensive profitability analysis will be completed at the conclusion of the project.

Summary of Previous Year (Year 1)

2018

In the fall of 2017, both the dormant seeded treatment strips and the dormant and interseeded treatment strips had a cover crop mix. The mix consisted of 40 lb/ac Elbon cereal rye, 1 lb/ac rapeseed/canola, 3 lb/ac winter oats, and 6 lb/ac hairy vetch. The cover crop was terminated on May 10 with glyphosate.

During the 2018 growing season, the interseeded cover crop treatment strips were planted with a cover crop mix on June 26 using a Hiniker interseeder (Figure 1). The interseeding mix consisted of 6 lb/ac cowpea, 6 lb/ac soybean, 0.5 lb/ac crimson clover, 5 lb/ac sunn hemp, 2 lb/ac hairy vetch, 3 lb/ac buckwheat, 0.5 lb/ac chicory, 0.5 lb/ac flax, 0.5 lb/ac rapeseed/canola, 6 lb/ac Elbon cereal rye, and 6 lb/ac spring oats.

The 2018 corn crop was harvested on October 6 and evaluated for yield and moisture.

Results:

	Moisture (%)	Yield† (bu/ac)	Marginal Net Return‡ ($/ac)
Check	19.1 A*	203 A	654.96 A
Cover Crop – Dormant Seeded	18.8 A	205 A	624.81 AB
Cover Crop – Dormant + Interseeded	18.8 A	209 A	586.09 B
P-Value	0.280	0.674	0.048

*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 $3.23/bu corn. Interseeded cover crop seed cost $37.50/ac. The dormant seeded cover crop seed in 2017 prior to this growing season cost $24/ac. A typical custom rate for the Hiniker interseeder is not available; therefore, both seeding methods (dormant drilled and interseeded) are estimated to be $14.40/ac. The interseeded cover crop treatment this year also was preceded by a dormant seeded cover crop; therefore, both the dormant and interseeded seed and seeding costs were incurred by this treatment this year.

Effects of Grazing Cover Crops in a Three-year Non-irrigated Rotation
3 year summary report

Study ID: 0720129201901
County: Nuckolls
Soil Type: Hastings silt loam 0-1% slope
Reps: 4

Introduction

In rainfed systems, adding cover crops into the rotation can decrease crop yields if precipitation is limited; however, the use of cover crops for forage may offset costs while retaining soil benefits. This study evaluated three treatments: grazed cover crop (or stubble, depending on the year of crop rotation), non-grazed cover crop, and non-grazed wheat stubble. This is a three-year, no-till crop rotation of wheat, corn, and soybean, with cover crops planted in the cover crop treatments following the wheat crop only. WATERMARK™ soil moisture sensors were installed to determine treatment impacts for each growing season.

Year 1 (2017 crop)

In year one of the study, cover crop treatments were planted on August 14, 2016, following wheat harvest and consisted of a mix of winter peas, spring triticale, oats, collards, and purple top turnip. Cover crop biomass measured on October 19, 2016, was 3,401 lb/ac and consisted mainly of grass and turnip (Table 1).

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%

The grazed treatment was grazed in the fall of 2016. Starting in November 2016, 28 (1,100 lb) first-calf heifers grazed 9.6 acres for 22 days, resulting in the cover crop carrying 2.4 animal unit months (AUM)/ac. Post-grazing 2,177 lb/ac of biomass were still present. Baseline soil samples were collected in April 2017, prior to planting corn (Table 2).

Table 2. Soil analysis taken prior to corn planting in April 2017.

	----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/Stubble – Grazed	5.68 A	3.1 A	7.3 B	12.6 B
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 CO_2-C (ppm)	Total Biomass (ng/g)	Total Bacteria Biomass (ng/g)	Total Fungi Biomass (ng/g)	Diversity Index
Cover Crop – Non-grazed	133 A	4,225 A	2,187 A	351 A	1.44 A
Cover Crop/Stubble – Grazed	161 A	3,927 AB	2,142 A	333 A	1.44 A
Stubble – Non-grazed	128 A	3,046 B	1,605 A	306 A	1.5 A
P-Value	0.19	0.09	0.12	0.90	0.90

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

During March through May 2017, prior to planting corn, the cover crop treatments were around 35% depletion (the typical trigger point for irrigation on these soil types), whereas the wheat stubble treatments remained near field capacity (full soil moisture profile). Corn was planted in 2017 across all treatments. In May 2017, 8” of rain recharged the soil profile and all treatments had a full 4’ soil moisture profile at the beginning of June. 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. In June 2017, it was observed that the grazed treatments had concentrations of Palmer amaranth where the cattle created trails walking along the electric fence; palmer amaranth was controlled with dicamba herbicide. For the 2017 corn crop, no significant yield differences occurred (Table 3). 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).

Table 3. 2017 corn yield results.

	Stand Count (plants/ac)	Moisture (%)	Test Weight	Corn Yield (bu/ac)†
Cover Crop—Non-grazed	22,500 A	15.0 A	61 A	213 A
Cover Crop/Stubble—Grazed	22,167 A	14.9 A	61 A	211 A
Stubble—Non-grazed	22,500 A	15.2 A	61 A	218 A
P-Value	0.952	0.129	0.267	0.141

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture for corn.

Year 2 (2018 crop)

In year two of the study, following corn harvest in the fall of 2017, no cover crops were planted. In the previously established grazed cover crop treatment, 11 bulls grazed on the corn stalks (9.6 acres) for 18 days. The two previously non-grazed treatments remained non-grazed. Soybeans were planted in 2018 across all treatments. In August, the grazed treatment showed greater moisture stress than the non-grazed treatments (Figure 1).

Figure 1. August 3, 2018 image with grazed treatment (cover crop in 2016 and stubble in 2017) showing greater moisture stress.

Table 4. 2018 soybean yield results.

	Stand Count (plants/ac)	Test Weight	Moisture (%)	Soybean Yield† (bu/ac)
Cover Crop—Non-grazed	120,750 A*	55 A	10.7 B	50 A
Cover Crop/Stubble—Grazed	120,500 A	55 A	11.0 A	40 B
Stubble—Non-grazed	117,750 A	55 A	10.6 C	52 A
P-Value	0.629	0.397	0.0002	0.0004

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

For the 2018 soybean crop, there were no differences in test weight or stand counts between the three treatments (Table 4). Grain moisture was significantly higher for the grazed cover crop treatment, followed by the non-grazed cover crop treatment, then the non-grazed wheat stubble. Yield of the non-grazed treatments was 10-12 bu/ac higher than for the grazed cover crop treatment.

Year 3 (2019 crop)

Following soybean harvest in October of 2018, Overland wheat was planted on October 22, 2018 at a seeding rate of 120 lb/ac and row spacing of 7.5". The field received 10 gal/ac 10-34-0 at planting and 80 lb N/ac as a spring topdress application. Wheat was harvested on July 26, 2019 and yield and grain moisture was recorded. For the 2019 wheat crop, there was no difference in test weight or yield (Table 5). Grain moisture was slightly different with the grazed cover crop treatment being wetter than the ungrazed wheat stubble treatment. The wet 2019 season delayed wheat harvest to July 26, 2019. This study will continue another full three years with the cover crop planted on September 4, 2019 due to the rain and wet field. Three-year follow-up soil analysis for nutrient and soil health (Table 6) were taken August 5, 2019 (following wheat harvest and prior to planting cover crops).

Table 5. 2019 wheat yield results.

	Test Weight (lb/bu)	Moisture (%)	Wheat Yield (bu/ac)†
Cover Crop – Non-grazed	59 A*	10.3 AB	84 A
Cover Crop/Stubble – Grazed	59 A	10.4 A	84 A
Stubble – Non-grazed	59 A	10.2 B	83 A
P-Value	0.483	0.067	0.613

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

Table 6. Three-year follow up soil analysis taken prior to cover crop planting August 5, 2019.

	----------0 to 8 inches----------			
	Soil pH	OM %	Nitrate-N ppm	Nitrogen lb N/A
Cover Crop – Non-grazed	5.7 A*	3.3 A	6.6 A	16.0 A
Cover Crop/Stubble – Grazed	5.5 AB	3.2 A	6.3 A	15.0 A
Stubble – Non-grazed	5.5 B	3.1 A	6.0 A	14.5 A
P-Value	0.090	0.105	0.395	0.390

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

	Solvita CO2-C (ppm)	Total Biomass (ng/g)	Total Bacteria Biomass (ng/g)	Total Fungi Biomass (ng/g)	Diversity Index	Soil Health Calculation
	----------0 to 4 inches----------					
Cover Crop – Non-grazed	59	2860	1073	183	1.06	10.00
Cover Crop/Stubble – Grazed	44	3498	1524	298	1.44	7.87
Stubble – Non-grazed	63	2760	1287	198	1.30	9.69
	----------4 to 8 inches----------					
Cover Crop – Non-grazed	31	906	353	4	0.94	5.89
Cover Crop/Stubble – Grazed	29	1526	569	53	1.22	5.53
Stubble – Non-grazed	21	977	354	12	1.06	4.65

3 Year Soil Physical Properties Changes

Sampling for soil physical properties including bulk density was completed on August 5, 2019. Neither cover crops nor grazing had a significant effect on soil bulk density in the top 2 inches. The average bulk density for the grazed cover crops was 1.08 g/cm^3, for ungrazed cover crops was 1.09 g/cm^3, and the ungrazed wheat stubble was 1.06 g/cm^3. There was no effect of grazing or cover crop in the 2-4" depth of soil. The average bulk density for the soil in the 2-4" depth was 1.31 g/cm^3 for the grazed cover crop treatment, 1.28 g/cm^3 for the ungrazed cover crop treatment, and 1.28 g/cm^3 for the ungrazed wheat stubble treatment.

Soil cone index value is a measurement of how easy it is to penetrate the soil. Figure 2 shows no significant effect on soil cone index value at any of the soil depths. The ungrazed cover crop tended to have a lower soil cone index value, but it was not significantly different from the other two treatments.

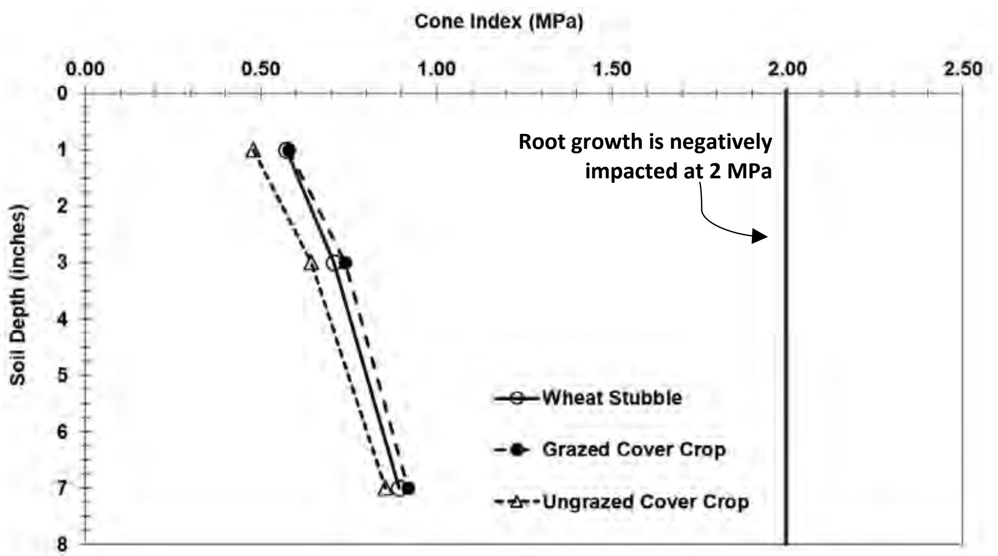


Figure 2. Three-year follow up soil cone index values by treatment taken August 5, 2019. The line on the far right represents where root growth is negatively impacted because roots are no longer able to easily penetrate through the soil.

Multi-Year Economic Analysis (2016 cover crop to 2019 wheat crop)

2016: Cost for spraying wheat stubble was $18/ac. Costs for the non-grazed cover crop treatments were $46.64/ac ($28.64/ac for seed and $18/ac for drilling). Costs for 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 (animal unit months). Value of the forage is estimated to be $84.80/ac (based on rental rates of $53/pair/month [1.25 AUMs] or $42.40 AUM).

2017: The economic analysis had no input differences for any of the treatments for corn production. UNL Corn Budget 21 (EC872, 2017 Nebraska Crop Budgets, revised Nov. 2016) was the closest that fit this operation, so a total cost/ac of $459.60/ac and a market year average price of $3.15/bu was used. In the previously established grazed cover crop treatment, cattle grazed on the corn stalks. A $5/ac cornstalk rental rate value was assessed to this 9.6 acre area. This rate assumes water, fencing, and the care of the animals.

2018: The inputs were the same for the soybeans planted into all the previous treatments. UNL Budget 56 (EC872, 2018 Nebraska Crop Budgets, revised Nov. 2017) was used, which stated a $315.82/ac total cost. A market year average price of $7.40/bu was used.

2019: The inputs were the same for the wheat planted into all the previous treatments. UNL Budget 70 (EC872, 2019 Nebraska Crop Budgets, revised Nov. 2018) was used which stated a $247.04/ac total cost. A market year average price of $3.65/bu was used. The summary of all years is presented in Table 7.

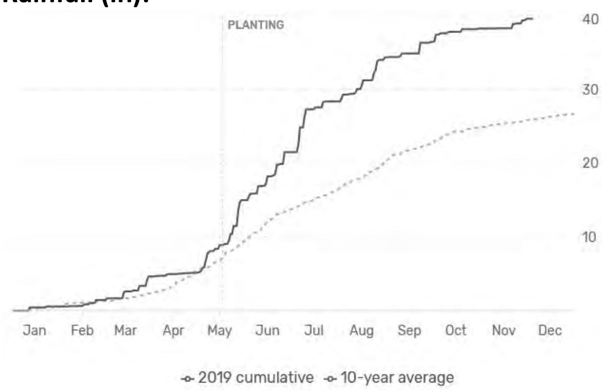
Table 7. Three crop year economic analysis summary of this study.

	2016 Cover	2017 Corn	2018 Soy	2019 Wheat	3-Year Total
Cover Crop—Non-grazed	-$46.64	$211.35	$54.18	$59.56	**$278.45**
Cover Crop/Stubble—Grazed	$22.86	$210.05	-$19.82	$59.56	**$272.65**
Stubble—Non-grazed	-$18.00	$227.10	$68.98	$55.91	**$333.99**

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

Study ID: 0721181201901
County: Webster
Soil Type: Holdrege silt loam 0-1% slope
Planting Date: 5/17/19
Harvest Date: 11/1/19
Seeding Rate: 25,000
Row Spacing (in): 30
Variety: Pioneer® P1498
Reps: 4
Previous Crop: Wheat
Tillage: No-Till
Herbicides: ***Pre:*** atrazine, Balance® Flexx, Roundup® ***Post:*** DiFlexx® Duo (safened dicamba), Roundup®

Fertilizer: 200 lb N/ac preplant; 6 gal/ac 10-34-0 starter
Irrigation: None
Rainfall (in):



Introduction

This is the first year of a study evaluating crop rotation and cover crop impacts. In rainfed systems, adding cover crops into the rotation has the potential to decrease yields when precipitation is limited; however, the use of cover crops for forage may offset the costs while retaining soil benefits. This study evaluated three treatments: grazed cover crop (or stubble only depending on year of crop rotation), non-grazed cover crop, and non-grazed stubble.

Year 1 (2019 crop)

Following wheat harvest in 2018, beginning soil nutrient and health samples were taken (July 10, 2018 Table 1). Initial infiltration rates were also conducted. This is the amount of time for 70 mL of water to enter the soil. Four replications were taken with values (minutes:seconds) of: 4:00, 4:05, 1:25, and 1:30.

Table 1. Beginning soil analysis prior to cover crop planting July 10, 2018. The lab didn't specify treatments for the nutrient levels in its report, so 12 reps each are represented in the 0-4" and 4-8" beginning nutrient depths.

	---0 to 8 inches---			
	Soil pH	**OM %**	**Nitrate-N ppm**	**Nitrogen lb N/A**
0-4"	5.2	2.7	9.9	12
4-8"	5.7	2.5	6.3	7.5

	---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	58 A*	2054 A	594 AB	93 B	1.34 B
Cover Crop/Stubble – Grazed	67 A	2095 A	808 A	187 A	1.58 A
Stubble – Non-grazed	57 A	1556 A	491 B	62 B	1.27 B
P-Value	0.304	0.184	0.049	0.004	0.002

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

Cover crops were planted in the cover crop treatments on July 15, 2018. The cover crop mix included 6 lb/ac cowpea, 7 lb/ac BMR sorghum sudan, 4 lb/ac pearl millet, 2 lb/ac radish, and 1.5 lb/ac turnip. Cover crops were terminated by freeze and sorghum sudan was 4-5' tall when terminated. Cover crop biomass was measured on November 6, 2018 following frost termination. These samples were taken from the ungrazed cover crop treatments as cattle were currently grazing the grazed treatment. Total average pounds of grass and brassica biomass was 8,405 lb/ac. The cover crop contained 12.3% turnip/radishes and

87.7% grass species. The grazed area contained 52.3 acres. October 21, 2018, 35 head of first-calf heifers weighing 1,100 lbs grazed for 91 days. A great deal of forage remained in the grazed area when cattle were removed according to the cooperating producer. Post-grazing biomass samples were not able to be collected.

WATERMARK™ soil moisture sensors were installed in the treatments after cover crop emergence. The wet fall of 2018 and wet spring of 2019 resulted in no differences in soil moisture amongst treatments prior to corn planting (Figure 1). Heavy rains washed the wheat residue into piles toward the field endrows. This left bare ground in that portion of the field compared to the ungrazed and grazed treatment areas (Figure 2). The lack of cover in the ungrazed wheat stubble was visible via aerial imagery in this field (Figure 3).

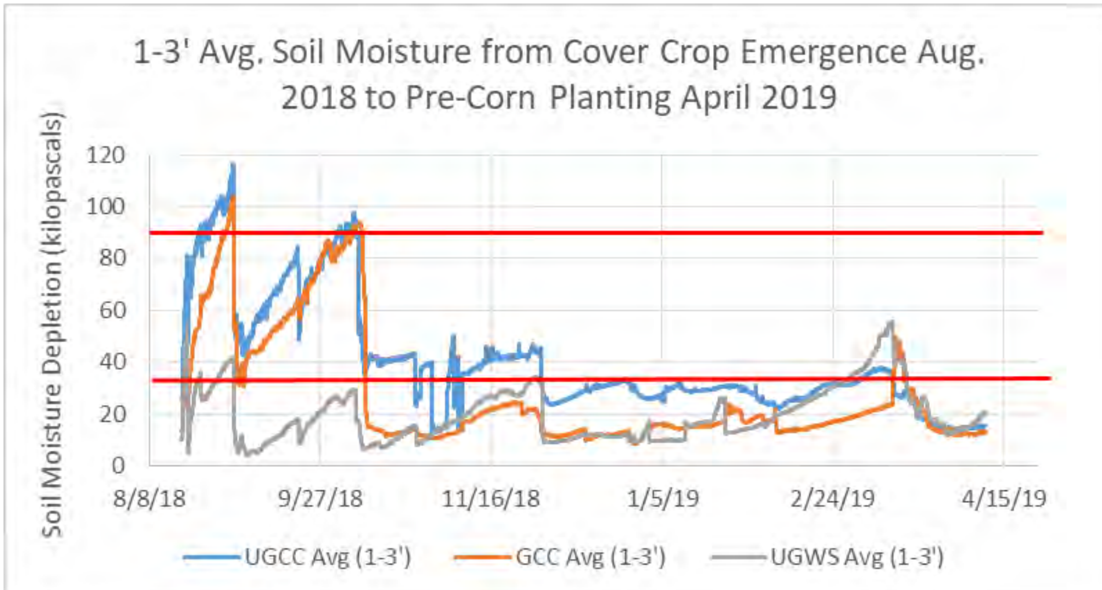


Figure 1. Soil moisture data for three feet depth from September 2018 to April 2019 for the three treatments. UGWS = Ungrazed Wheat Stubble, UGCC = Ungrazed Cover Crop, GCC = Grazed Cover Crop. Lines for field capacity (30 kPa) and 35% depletion (90 kPa) for silt loam soils are shown for reference. While this is a non-irrigated field, 35% depletion is the suggested irrigation trigger for silt loam soils in Nebraska. The data shows that all treatments had a full soil moisture profile going into the corn growing season of 2019.

Figures 2 and 3. Heavy spring rains dislodged and washed the ungrazed wheat stubble in the field leaving residue piles in the endrows (left). The lack of residue cover in the ungrazed wheat stubble treatments could be seen throughout the growing season via aerial imagery (shown via June 20, 2019 true color image photo as dark colored strips in center of field in the photo on the right).

Corn was planted on May 17, 2019. Stand counts, stalk rot, grain moisture, test weight, and yield were evaluated for the corn crop (Table 2). Soil moisture via WATERMARK™ sensors was also evaluated for all treatments for the duration of the growing season (not shown in this report).

Table 2. Corn yield data for 2019.

	Stand Count (plants/ac)	**Stalk Rot (%)**	**Test Weight (lb/bu)**	**Moisture (%)**	**Corn Yield (bu/ac)†**
Cover Crop – Non-grazed	24,333 A*	3.33 A	61 AB	15.0 A	189 A
Cover Crop – Grazed	24,833 A	1.00 A	61 B	14.6 B	191 A
Wheat Stubble – Non-grazed	23,167 A	0.83 A	62 A	14.2 B	187 A
P-Value	0.409	0.474	0.067	0.009	0.233

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.

The addition of cover crops and grazing did not impact beginning soil moisture for the 2019 corn crop due to a wet fall in 2018 and wet spring in 2019. Corn stand count, stalk rot, and yield were not impacted by the cover crop and grazing treatments. Corn test weight for the ungrazed wheat stubble treatment was higher than for the grazed cover crop treatment. Grain moisture was higher for the ungrazed cover crop treatment than the grazed cover crop treatment and ungrazed wheat stubble treatment.

Economic Summary (preliminary)

Costs to spray the wheat stubble for weed control were $18/ac. Costs for the non-grazed cover crop treatments were $41.82/ac for cover crop seed and drilling. Costs for the grazed cover crop treatments were $47.74 ($41.82/ac for cover crop seed and drilling, $5/ac for fencing, and $0.92/ac water). Grazing benefit is $6370 (using a value of $2.00/head/day) for the 52.3 acres grazed. The resulting net benefit is $74.06/acre. Costs in Table 3 will be updated each year to determine the final 3-year total.

Table 3. Marginal net return ($/ac) economic analysis of this study for three crop years.

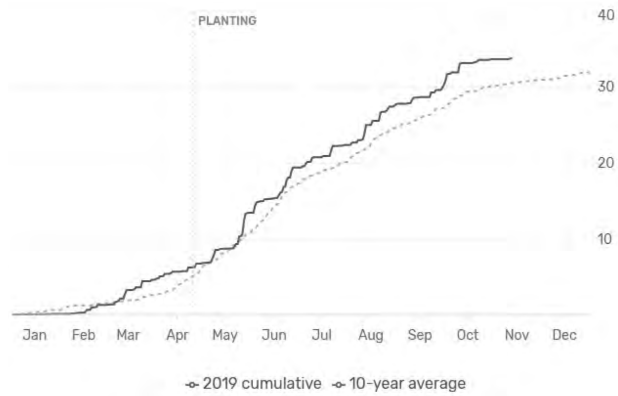
	2018 Cover	**2019 Corn**	**2020 Soy**	**2021 Wheat**	**3-Year Total**
Cover Crop—Non-grazed	(-$41.82)	$285.79	TBD	TBD	*$243.97*
Cover Crop/Stubble—Grazed	$74.06	$298.45	TBD	TBD	*$372.51*
Stubble—Non-grazed	(-$18.00)	$278.13	TBD	TBD	*$260.13*

The study will continue in 2020, with the cash crop rotating to soybeans.

EQUIPMENT

Impact of Planting Speed on Corn Yield

Study ID: 0085141201901
County: Platte
Soil Type: Gibbon silt loam occasionally flooded; Grigston silt loam wet sub-stratum
Planting Date: 4/25/19
Harvest Date: 10/22/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC63-57
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 2 qt/ac Degree Xtra®, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® HC and 3 oz/ac Class Act® ***Post:*** 50 oz/ac Halex® GT, 16 oz/ac atrazine, and 22 oz/ac Roundup PowerMAX® with Class Act® at late post V6
Seed Treatment: Acceleron® Basic 500
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in March; 10 gal/ac of mixture of 90% UAN (32%) and 10% thiosulfate with planting, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 43 gal/ac of mixture of 90% UAN (32%) and 10% thiosulfate sidedress on 6/15/19
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: This study evaluated the impact of planting speed on corn yield when using Precision Planting® SpeedTubes. Corn was planted on April 25, into green cover crop. The cover crop consisted of 30 lb/ac rye, 2 lb/ac radishes, and 5 lb/ac canola and was planted on 10/25/18 and terminated with herbicide on May 1 at a height of 12". Corn planting was conducted at three speeds: 5.5 mph, 6.5 mph, and 7.5 mph. Stand counts (taken on June 7, 2019), ear counts (taken at harvest), and yield were evaluated.

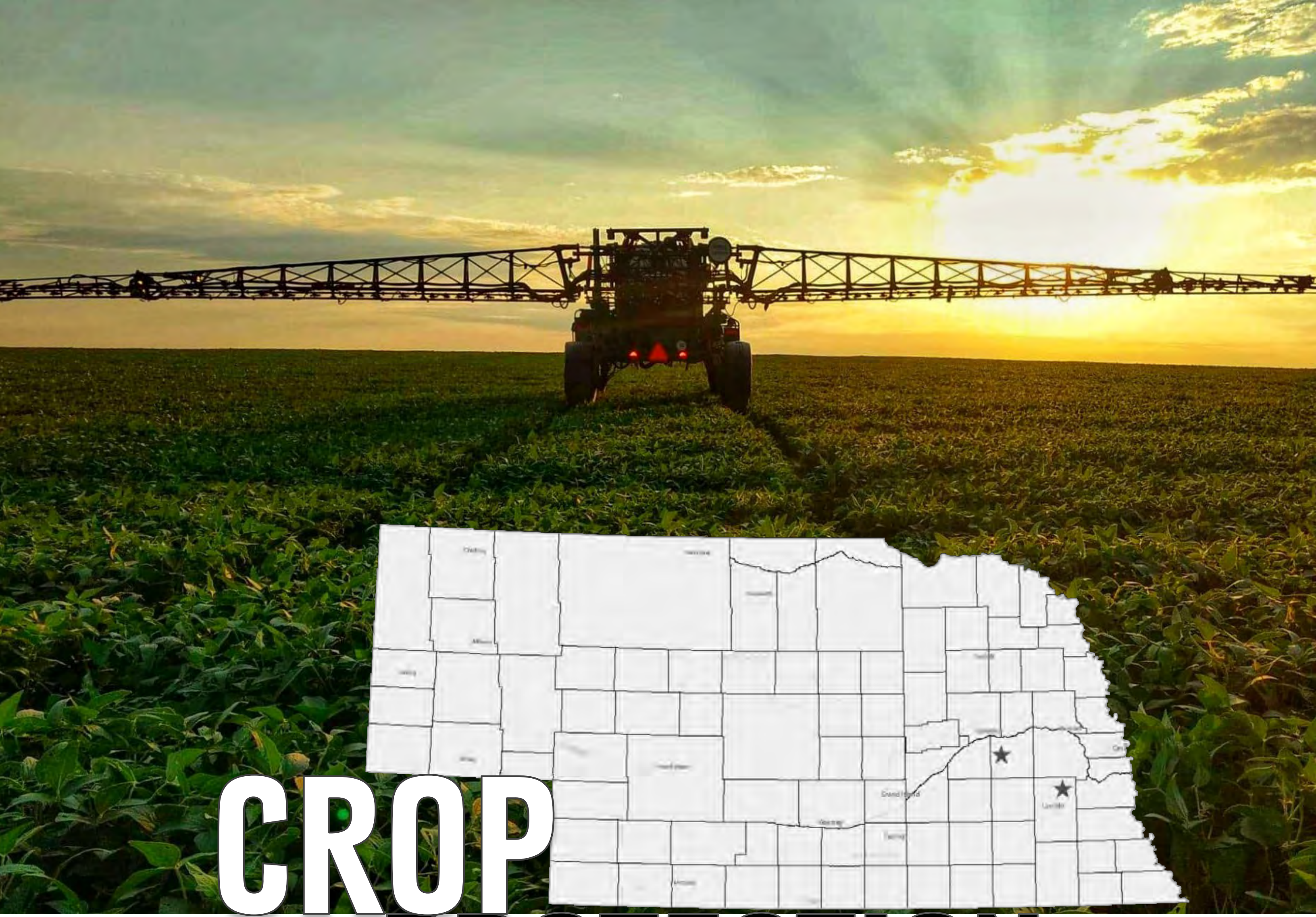
Results:

	Moisture (%)	Stand Count (plants/ac)	Ear Count (ears/ac)	Yield (bu/ac)†
5.5 MPH	16.1 A*	30,922 A	31,417 A	258 A
6.5 MPH	16.1 A	31,234 A	31,250 A	258 A
7.5 MPH	16.2 A	30,281 A	31,125 A	257 A
P-Value	0.105	0.116	0.410	0.750

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.

Summary:

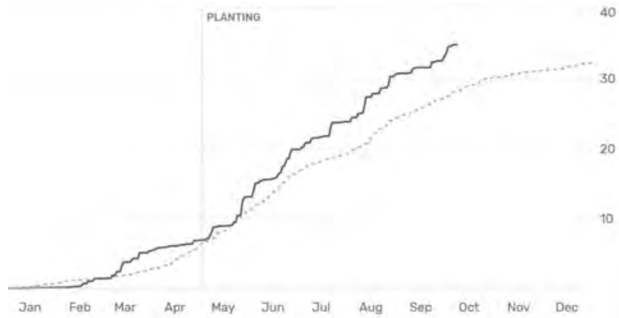
- There was no difference in ear counts, grain moisture, or yield at the three planting speeds evaluated.
- Net return was not calculated for the study as it depends on potential time and labor savings for increased planting speed.



CROP PROTECTION

Impact of Ethos® XB In-furrow Fungicide and Insecticide on Corn Yield

Study ID: 0102023201901
County: Butler
Soil Type: Butler silt loam 0-1% slope; Hastings silt loam 1-3% slope; Hastings silt loam 0-1% slope
Planting Date: 5/2/19
Harvest Date: 11/2/19
Seeding Rate: 32,800
Row Spacing (in): 30
Variety: Pioneer® P1366AM™ and P1563AM™
Reps: 27
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 20 oz/ac PowerMAX®, 20 oz/ac TripleFLEX®, 7oz/ac Balance® Flexx on 4/19/19
Post: 2 oz/ac Laudis®, 1.5 pt/ac atrazine, and 32 oz/ac PowerMAX® with 0.5 g/ac crop oil and 24 oz/ac Class Act® on 6/16/19
Seed Treatment: LumiGEN™
Foliar Insecticides and Fungicides: 4 oz/ac Brigade® and 8 oz/ac Delaro® at VT on 7/21/19 as an aerial application
Fertilizer: 162 lb N/ac as anhydrous ammonia on 4/13/19; 35 lb N/ac as 32% UAN with burndown on 4/19/19; 5 gal/ac Kickoff 9-15-4-3-1 in-furrow with planting on 5/2/19; 103.8 lb/ac AMS on 6/12/19
Irrigation: Pivot, Total: 2.08”
Rainfall (in):



Soil Tests (Nov. 2018) – 4 samples were taken in the study area:

pH	Excess Lime	OM%	Nitrate ppm	Nitrogen lb. N/A	M-III P ppm P	K ppm P	S ppm	S lb. S/A	Ca ppm	Mg ppm	Na ppm	Zn ppm	Fe ppm	Mn ppm	Cu ppm	B ppm
6.9	NO	3.3	10.3	31	50	362	11	33	2680	264	27	3.3	89.9	66.3	2.4	.07
7.0	NO	3.3	10.3	31	45	387	10	30	2690	255	28	3.2	77.5	74.7	2.2	.07
7.0	NO	3.2	9.6	29	17	504	9	27	2570	242	26	2.4	94	72.6	1.4	.08
7.0	NO	3.6	12.9	39	25	404	10	30	2570	251	28	2.6	79.3	69.9	1.8	.07

Introduction: This study evaluated Ethos® XB in-furrow fungicide and insecticide added to starter fertilizer at 4 oz/ac. The study was evaluated for two corn hybrids, Pioneer® P1563AM™ (11 total replications, with 4 replications for stand counts) and Pioneer® P1366AM™ (16 total replications, with 4 replications for stand counts). Product information is at right.

EPA Reg. No. 279-3473 **EPA Est. 279-NY-1**

ACTIVE INGREDIENTS:	**By Wt.**
Bifenthrin *	15.67%
Bacillus amyloliquefaciens strain D747 **	5.00%
Other Ingredients	79.33%
Total:	100.00%

*Cis isomers 97% minimum, trans isomers 3% maximum
** Contains a minimum of 1x 10[11] colony-forming units (cfu) per milliliter of product.
This product contains 1.5 lbs bifenthrin per gallon.

Product information from:
http://www.cdms.net/ldat/ldCGE005.pdf

Results:

	Stand Count (plants/ac)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
	Pioneer® P1366AM™ (16 replications)			
Check	29,750 A*	16.1 A	257 A	985.63 A
Ethos® XB	30,625 A	16.2 A	259 A	982.22 A
P-Value	0.109	0.508	0.398	0.549
	Pioneer® P1563AM™ (11 replications)			
Check	29,000 A*	17.1 A	264 A	1,009.68 A
Ethos® XB	29,417 A	17.0 B	263 A	998.12 B
P-Value	0.320	0.057	0.563	0.063

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $8.25/ac for Ethos XB.

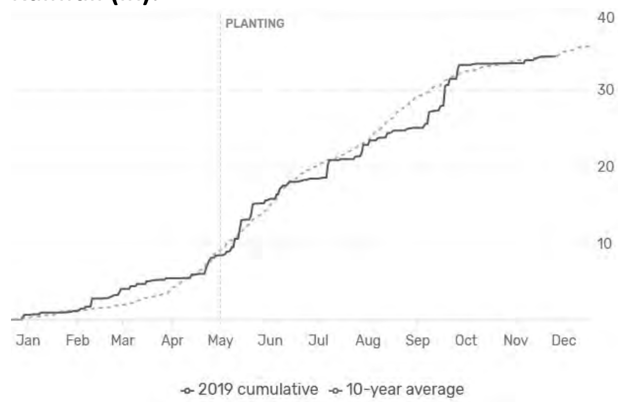
Summary:

- For Pioneer® P1563AM™, the use of Ethos® XB did not result in different stand counts or grain yield. The net return was lower where Ethos® XB was used due to the additional treatment cost.
- For Pioneer® P1366AM™, the use of Ethos® XB did not result in different stand counts, grain moisture, grain yield, or net return.

Impact of Foliar Applied Fungicide and Insecticide on Soybean

Study ID: 0136109201902
County: Lancaster
Soil Type: Mayberry silty clay loam, 3-6% slopes, eroded; Judson silt loam, 2-6% slopes; Crete silt loam, 0-1% slopes; Yutan silty clay loam, 6-11% slopes, eroded; Kennebec silt loam, occasionally flooded
Planting Date: 5/15/19
Harvest Date: 10/23/19
Seeding Rate: 140,000
Row Spacing (in): 15
Variety: Asgrow® AG39X7
Reps: 8
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 6.4 oz/ac Authority® XL, 12 oz/ac Engenia®, and 32 oz/ac Roundup PowerMAX® on 5/5/19 ***Post:*** 40 oz/ac Roundup PowerMAX®

Seed Treatment: fungicide
Fertilizer: None
Irrigation: None
Rainfall (in):



Introduction: The purpose of this study was to evaluate the impact of foliar applied fungicide and insecticide on soybeans at R3. The insecticides were 3 oz/ac lambda and 1.5 oz/ac imidacloprid, and the fungicide was azoxystrobin and propiconazole. No insect or disease pressure was noted.

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	12.2 A*	61 B	490.21 B
Fungicide & Insecticide	12.2 A	65 A	506.93 A
P-Value	0.763	0.001	0.016

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $6.15/ac fungicide, $2.13/ac insecticide, $0.22/ac surfactant, and $6.94/ac application.

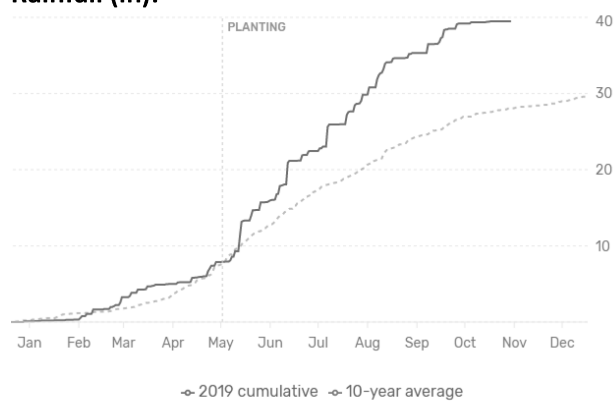
Summary: The use of the foliar fungicides and insecticides at R3 resulted in a 4 bu/ac yield increase and $16.72/ac profit increase.

CROP PRODUCTION

Group 2.7 versus Group 3.4 Soybean Maturity with Early Planting

Study ID: 0118185201902
County: York
Soil Type: Hastings silt loam, 0-1% slope; Hastings silt loam, 1-3% slope
Planting Date: 5/16/2019
Harvest Date: 10/20/2019
Seeding Rate: 130,000
Row Spacing (in): 30
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** Shredder® 2,4-D LV6, Authority® First, Brawl™, and Dimetric®DF with Destiny® HC
Post: Roundup PowerMAX® and Cobra® with Class Act® NG®

Seed Treatment: CruiserMaxx®, Vibrance®, and ILeVO®
Fertilizer: None
Irrigation: Pivot, Total: 1.5"
Rainfall (in):



Introduction: With early planting of soybean (in April or as close to May 1 as possible), a longer-season variety may help take advantage of the longer growing season. However, some growers are also obtaining high yields with mid-group 2 varieties. The goal of this study was to determine if growers need to plant a longer-season maturity soybean to achieve optimum yields when planting early. A group 2 (Golden Harvest® GH2788X) and group 3 (Golden Harvest® GH3475X) soybean were evaluated. The soybeans were planted on May 16 and harvested on October 20.

Figure 1. Aerial imagery from September 10 displayed as true color (RGB). The shorter season variety appears lighter and is showing signs of earlier senescence.

Results:

	Harvest Stand Count (plants/ac)	Pods/ plant	Nodes/ plant	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Group 2.7 (GH2788X)	111,300 A*	56 A	21 A	57 A	11.3 A	71 A	577.42 A
Group 3.4 (GH3475X)	103,800 A	48 B	22 A	57 A	11.2 A	72 A	579.61 A
P-Value	0.588	0.064	0.252	0.272	0.611	0.870	0.870

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean. Because both varieties cost $72/unit, seed and treatment costs are not included in marginal net return analysis.

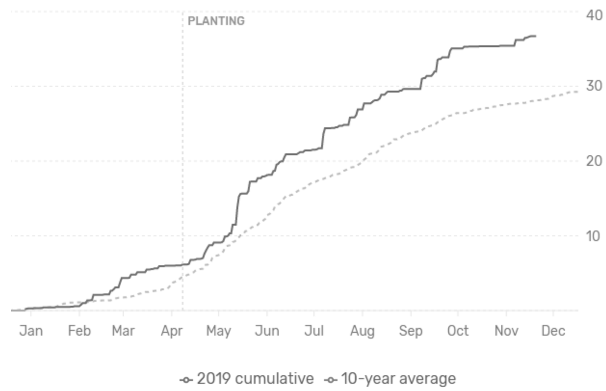
Summary:

- Test weight, moisture, stand counts, nodes per plant, yield, and net return were the same between the group 2 and group 3 soybean varieties evaluated.
- The group 2 soybeans had a greater number of pods per plant than the group 3 soybeans.
- Aerial imagery from September 10 (Figure 1) shows lighter green appearance of the shorter season variety, which is indicative of the earlier maturity and senescence.

Group 2.1 versus Group 3.1 Soybean Maturity

Study ID: 0802159201901
County: Seward
Soil Type: Hastings silt loam 0-1% slope; Hastings silt loam 1-3% slope; Hastings silt loam 11-17% slopes
Planting Date: 4/22/19
Harvest Date: 9/18/19 and 9/27/19
Seeding Rate: 146,087
Row Spacing (in): 30
Reps: 3
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 8 oz/ac 2-4D LV6, 24 oz/ac Roundup PowerMAX®, 17 lb/100 gal AMS, 6oz/ac Zidua® PRO on 4/16/2019 ***Post:*** 40 oz/ac Roundup PowerMAX®, 6 oz/ac Select Max®, and 17 lb/100 gal AMS

Seed Treatment: Lumisena™, EverGol® Energy, Gaucho®, Pioneer Premium Seed Treatment (PPST) 2030, PPST 120+, LumiGEN™
Fertilizer: None
Irrigation: None
Rainfall (in):



Introduction: With early planting of soybean (in April or as close to May 1 as possible), a longer-season variety may help take advantage of the longer growing season. However, some growers are also obtaining high yields with mid-group 2 varieties. The goal of this study was to determine if growers need to plant a longer-season maturity soybean to achieve optimum yields when planting early. A group 2 (Pioneer® P21A28X) and group 3 (Pioneer® P31A22X) soybean were evaluated. The soybeans were planted on April 22. Pioneer® P21A28X was harvested on September 18 and Pioneer® P31A22X was harvested on September 27.

Figure 1. Aerial imagery from September 13 displayed as true color (RGB). The shorter season variety appears browner showing earlier senescence.

Results:

	Stand Count (plants/ac)	Pods/ plant	Nodes/ plant	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Group 2.1 (Pioneer P21A28X)	108,333 B*	43 B	18 A	9.3 B	57 A	70 A	509.05 A
Group 3.1 (Pioneer P31A22X)	119,333 A	58 A	19 A	13.5 A	56 A	67 B	468.20 B
P-Value	0.028	0.020	0.244	0.001	0.109	0.004	0.002

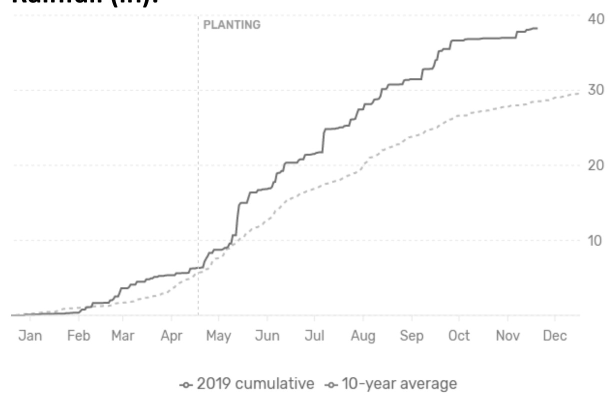
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $61.28/ac for Pioneer® P21A28X, and $76.07/ac for Pioneer® P31A22X.

Summary:
- Nodes per plant and test weight were the same between the group 2 and group 3 soybean varieties tested.
- The group 3 soybeans had a higher stand count, higher grain moisture at harvest, and more pods per plant than the group 2 soybeans.
- The group 2 soybeans yielded 3.2 bu/ac greater than the group 3 soybeans and resulted in a $40.85 increase in profit compared to the group 3 soybeans.

Group 2.4 versus Group 2.7 versus Group 3.1 versus Group 3.3 Soybean Maturity

Study ID: 0802159201902
County: Seward
Soil Type: Hastings silt loam 0-1% slope
Planting Date: 5/2/2019
Harvest Date: 9/20/19 and 10/14/19
Seeding Rate: 139,830
Row Spacing (in): 30
Reps: 4
Previous Crop: Corn
Tillage: Ridge-Till
Herbicides: ***Pre:*** 24 oz/ac Roundup PowerMAX® and 6 oz/ac Zidua® PRO with 17 lb/100 gal AMS on 4/26/19 ***Post:*** 24 oz/ac Roundup PowerMAX®, 8 oz/ac Flexstar®, and 6 oz/ac Select Max®, with 17 lb/100 gal AMS

Seed Treatment: LumiGEN®, Lumisena™, EverGol® Energy, Gaucho®, Pioneer Premium Seed Treatment (PPST) 2030, PPST 120+
Irrigation: Gravity, Total: 4.20"
Rainfall (in):



Introduction: With early planting of soybean (in April or as close to May 1 as possible), a longer-season variety may help take advantage of the longer growing season. However, some growers are also obtaining high yields with mid-group 2 varieties. The goal of this study was to determine if growers need to plant a longer-season maturity soybean to achieve optimum yields when planting early. Four soybean varieties with different maturities were evaluated: group 2.4 (Pioneer® P24A99X), group 2.7 (Pioneer® P27A17X), group 3.1 (Pioneer® P31A22X), and group 3.3 (Pioneer® P33A53X). The soybeans were planted on May 2. The group 2 varieties had stand counts, pod counts, and node counts taken on September 13, and were harvested on September 20. The group 3 varieties had stand counts, pod counts, and node counts taken on September 26 and were harvested on October 14.

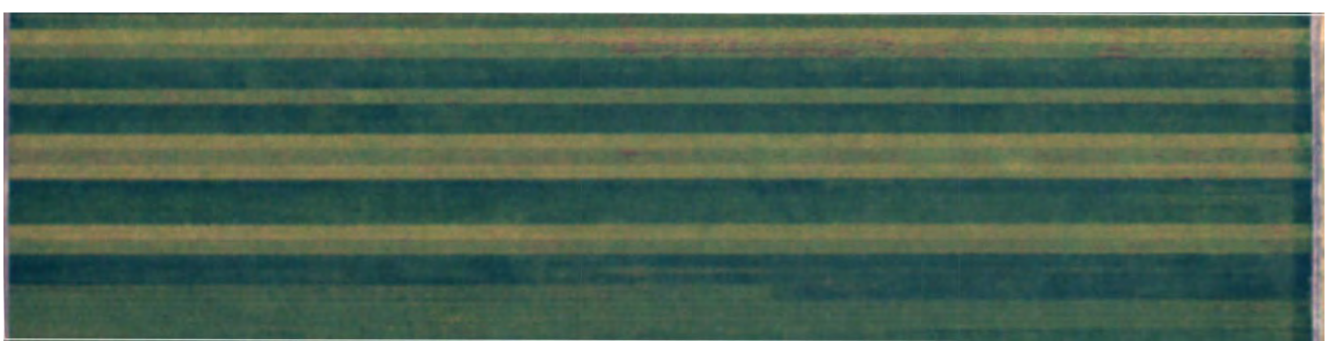


Figure 1. Aerial imagery from September 10 displayed as true color (RGB). The varying senescence of the different maturity soybeans evaluated is apparent.

Results:

	Stand Count (plants/ac)	Pods/ plant	Nodes/ plant	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Group 2.4 (Pioneer® P24A99X)	105,375 B*	41 A	17 B	54 B	14.3 A	71 AB	533.47 AB
Group 2.7 (Pioneer® P27A17X)	109,875 AB	55 A	21 A	54 B	13.1 AB	73 A	541.85 A
Group 3.1 (Pioneer® P31A22X)	116,875 A	52 A	20 A	56 A	12.4 B	70 BC	513.05 BC
Group 3.3 (Pioneer® P33A53X)	114,125 AB	47 A	19 A	56 A	12.1 B	67 C	493.21 C
P-Value	0.039	0.188	0.005	0.0001	0.01	0.002	0.002

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $45.18/ac for Pioneer® P24A99X, $48.54/ac of Pioneer® P27A17X, $50.57/ac for Pioneer® P31A22X, and $49.22/ac for Pioneer® P33A53X.

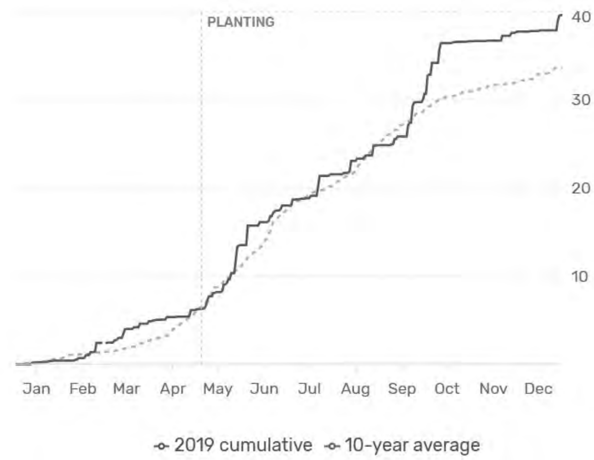
Summary:

- There was some variation in stand counts between the four varieties tested; however, all stands were in the range that previous on-farm research has shown to not result in yield differences.
- Pods per plant were not different between the four varieties tested.
- The group 2.7, 3.1, and 3.3 soybeans had more nodes per plant than the group 2.4 soybeans.
- The group 3 soybeans had higher test weights than the group 2 soybeans.
- The group 2 soybeans resulted in the highest yield, with yields significantly greater than the group 3.3 soybean.

15" vs 30" Row Spacing for Soybeans

Study ID: 0849155201902
County: Saunders
Soil Type: Yutan silty clay loam terrace, 2-6% slopes, eroded; Filbert silt loam 0-1% slope; Tomek silt loam 0-2% slope; Fillmore silt loam terrace, occasionally ponded
Planting Date: 5/4/19
Harvest Date: 10/18/19
Seeding Rate: 150,000
Variety: Pioneer® P36A18X
Reps: 18
Previous Crop: Soybeans

Irrigation: None
Rainfall (in):



Introduction: The objective of this study was to evaluate soybeans planted in 15" and 30" row spacings. The treatments were established by using two different planters – a John Deere® 1775NT with 30" row spacing and a John Deere® 1795NT with 15" row spacing. Both planters were 40' implements with MaxEmerge™ 5 technology. Yield was recorded using a GreenStar™ 3 2630 yield monitor in a John Deere® S650 combine.

Results:

	Moisture (%)	Yield (bu/ac)†
15"	10.7 B*	63 A
30"	10.8 A	60 B
P-Value	0.040	0.0001

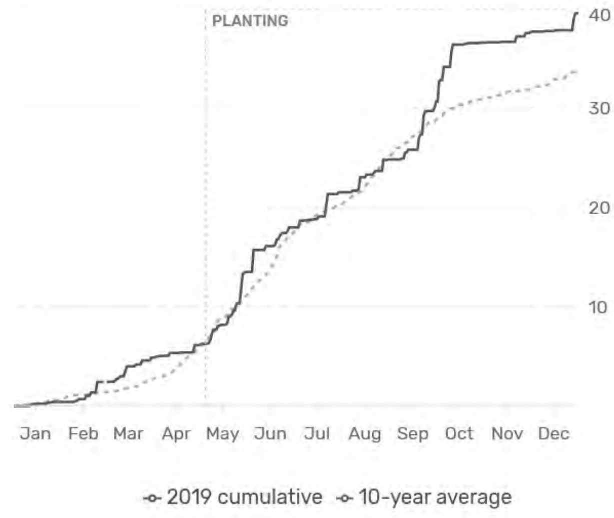
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean.

Summary: The 15" row spacing resulted in a 3 bu/ac yield increase compared to the 30" row spacing.

15" vs 30" Row Spacing for Soybeans

Study ID: 0849155201903
County: Saunders
Soil Type: Tomek silt loam 0-2% slope; Yutan silty clay loam terrace, 2-6% slopes, eroded; Filbert silt loam 0-1% slope; Fillmore silt loam terrace, occasionally ponded
Planting Date: 5/4/19
Harvest Date: 10/22/19
Seeding Rate: 157,000
Variety: Pioneer® P36A18X
Reps: 10
Previous Crop: Corn

Irrigation: Pivot
Rainfall (in):



Introduction: The objective of this study was to evaluate soybeans planted in 15" and 30" row spacings. The treatments were established by using two different planters – a John Deere® 1775NT with 30" row spacing and a John Deere® 1795NT with 15" row spacing. Both planters were 40’ implements with MaxEmerge™ 5 technology. Yield was recorded using a GreenStar™ 3 2630 yield monitor in a John Deere S650 combine.

Results:

	Moisture (%)	Yield (bu/ac)†
15"	12.33 A*	72 A
30"	12.28 B	68 B
P-Value	0.012	0.0001

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean.

Summary: The 15" row spacing resulted in a 4 bu/ac yield increase compared to the 30" row spacing.

Data-Intensive Farm Management: Soybean Seeding Rate
Summary of 6 Sites in 2019

Introduction

In 2019, the Nebraska On-Farm Research Network continued work on the Data-Intensive Farm Management Project, a multi-university collaboration led by the University of Illinois at Urbana-Champaign. The goal of these research studies is to utilize precision agriculture technology for conducting on-farm research. In 2019, six research sites evaluated soybean seeding rates (Figure 1).

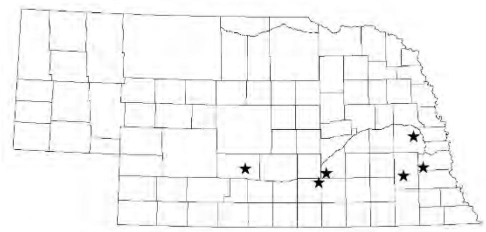


Figure 1. Data-Intensive Farm Management soybean seeding rate study locations for 2019.

Previous on-farm research studies from 2006 to 2017, with 15" and 30" row spacings on non-irrigated and irrigated sites looked at seeding rates ranging from 90,000 to 180,000 seeds/ac (Figure 2). These studies found that yield increase from 90,000 seeds/ac to 180,000 seeds/ac was minimal, about 1.3 bu/ac, which was not enough to offset the increased seed cost.

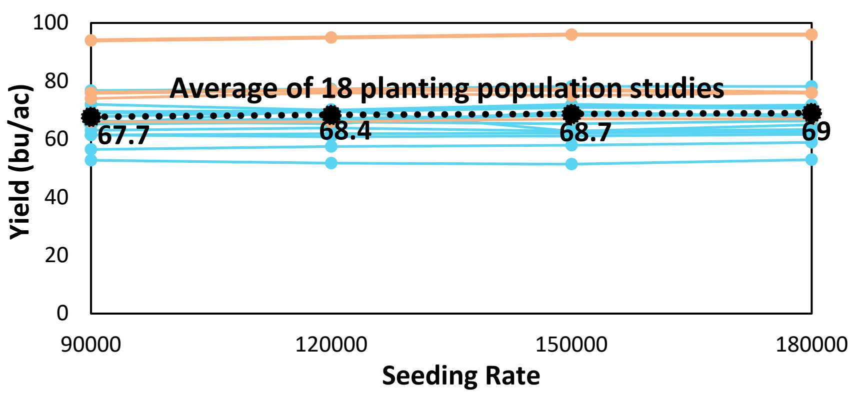


Figure 2. Soybean yield response to seeding rate for 14 irrigated sites (blue) and 4 non-irrigated sites (orange) from 2006 to 2017.

Study Design

For the six studies in 2019, four seeding rates were evaluated: 80,000, 110,000, 140,000, and 170,000 seeds/ac. The experiments were arranged in a randomized complete block design with numerous replications of the four seeding rates. Rather than using field length strips, these studies rely on using precision ag technologies such as variable rate seeding capabilities and in-cab monitors to implement numerous treatment blocks across the entire field such as the example layout in Figure 3. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. The as-planted data were evaluated and only areas that achieved planting rates within 10% of the target seeding rate were included for yield analysis.

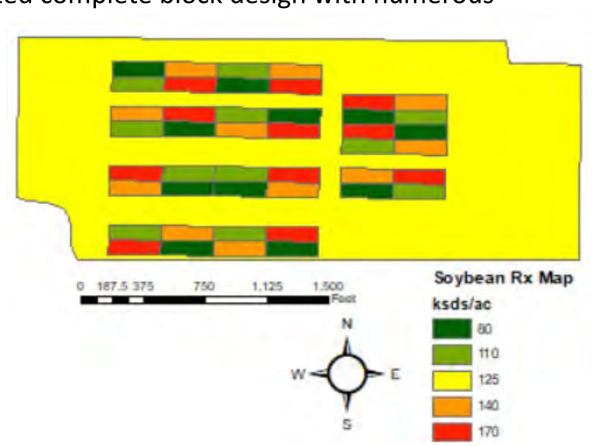


Figure 3. Soybean seeding rate prescription map.

There was also interest in evaluating how seeding rate influenced stem diameter and, in turn, if stem diameter influenced Dectes stem borer infestation. Dectes stem borer has most commonly been found in south-central Nebraska but has been expanding its range in Nebraska to the east, west, and north. Dectes larvae burrow in the stem and by the end of the growing season are found at the base of the plant where they overwinter. They hollow out a cavity at the base of the plant, which weakens the stem and can lead to lodging and stem breakage. Therefore, to evaluate the impact of seeding rate on stem diameter and Dectes stem borer, in-field measurements were taken to determine stand counts, stem diameter, and percent of plants infested with Dectes stem borer.

Summarized 2019 Results

Across all six sites with 179 observations, yield was significantly related to plant population determined by stand counts (Figure 4-a). The economic optimum plant population was 123,000 seeds/ac resulting in a yield of 69 bu/ac. Stem diameter was also significantly related to plant populations (Figure 4-b) with lower plant populations having greater stem diameters. Dectes stem borer infestation was examined for the three sites where Dectes infestation averaged greater than 5% (the remaining three sites that were excluded had Dectes infestation levels ranging from 0.25% to 2.8% on average). Dectes stem borer infestation was significantly related to the stem diameter with smaller stem diameters having lower infestation numbers (Figure 4-c). Individual site reports follow on the subsequent pages.

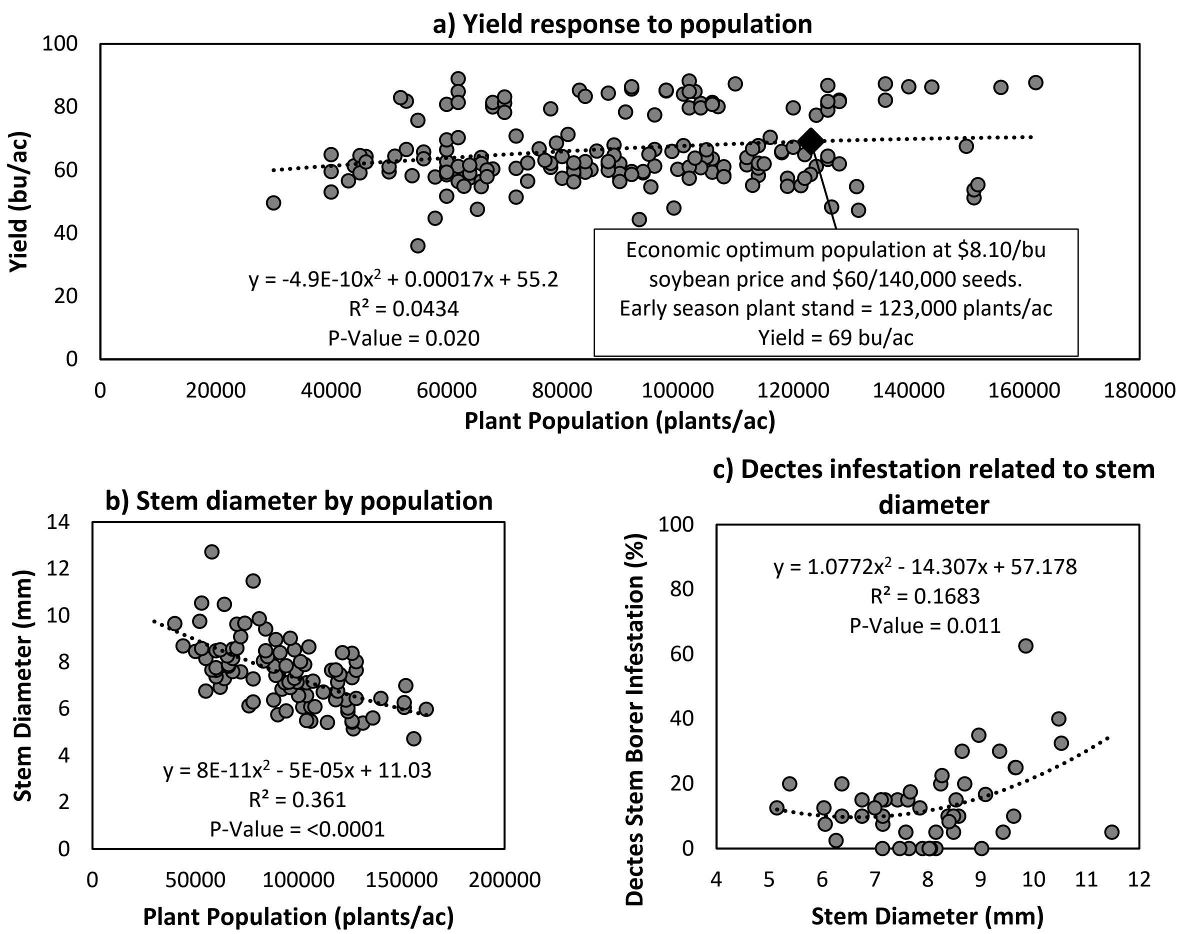
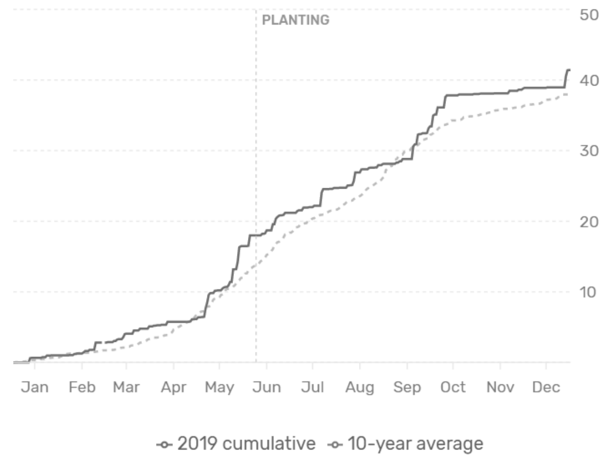


Figure 4. For six soybean seeding rate on-farm research sites in 2019: **a)** yield response to plant population determined by stand counts, **b)** stem diameter compared to plant population determined by stand counts, and **c)** Dectes stem borer infestation percent as related to stem diameter.

This research was supported in part by an award from the USDA NIFA Agriculture and Food Research Initiative's Food Security Challenge Area program, award number 2016 − 68004 − 24769.

Data-Intensive Farm Management: Soybean Seeding Rate

Study ID: 0816025201902
County: Cass
Soil Type: Judson silt loam 2-6% slopes; Wymore silty clay loam 3-6% slopes, eroded; Wymore silty clay loam 0-2% slope; Wymore silty clay loam 2-6% slopes
Planting Date: 6/8/19
Harvest Date: 10/15/19
Row Spacing (in): 30
Variety: LG Seeds® C3550RX
Reps: 10
Previous Crop: Corn (averaged >200 bu/ac)
Tillage: No-Till
Herbicides: ***Pre:*** 25 oz/ac BroadAxe®, 3 oz/ac Dimetric® EXT, 32 oz/ac Durango® DMA®, and 16 oz/ac 2,4-D ***Post:*** 6 oz/ac Cleanse® 2 EC, 3.5 pt/ac Flexstar® GT, and 2.5 pt/ac Sequence® with 4 oz/ac InterLock®
Seed Treatment: ApronMaXX® with Vibrance®
Irrigation: None
Rainfall (in):



Introduction: This study is part of the Data-Intensive Farm Management Project, a multi-university collaboration led by the University of Illinois at Urbana-Champaign. The goal of these research studies is to utilize precision agriculture technology for conducting on-farm research. This study tested four soybean planting rates: 80,000 seeds/ac, 110,000 seeds/ac, 140,000 seeds/ac, and 170,000 seeds/ac. Treatments were randomized and replicated in 90' wide by 300' long blocks across the field (Figure 1). At this site, there were 10 replications. Variable-rate prescription maps for the study were developed and uploaded to the in-cab monitor. Air downforce was used on the planter; row cleaners were not engaged. Soybean rows were planted between the previous year's corn rows. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. The as-planted data were evaluated, and only areas that achieved planting rates within 10% of the target seeding rate were included for yield analysis.

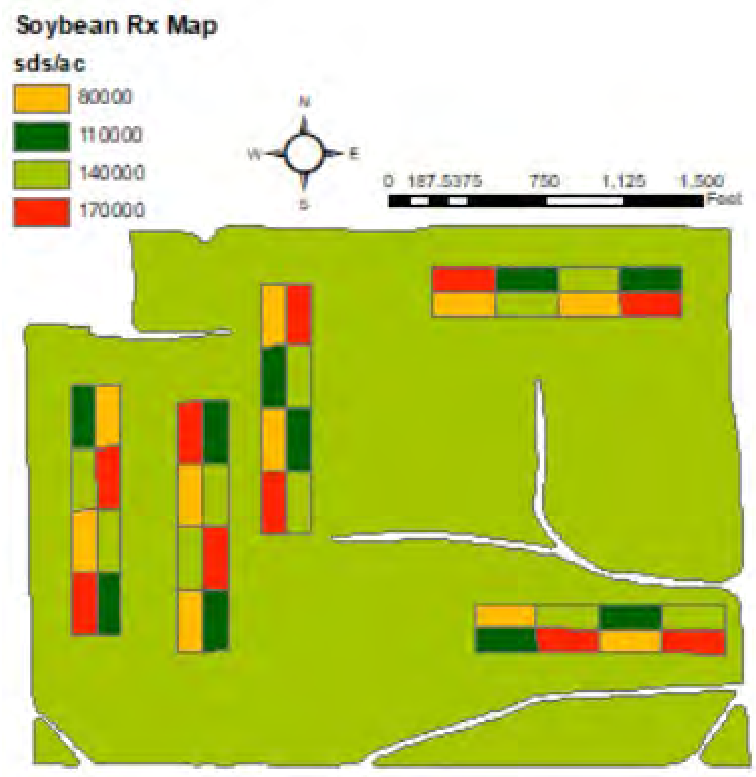


Figure 1. Soybean seeding rate prescription map for 2019 field site.

Stand counts were taken on June 25 for all 10 replications; these stand counts were used to determine percent emergence. There was interest in determining if soybean stem diameter was related to planting rate and if stem diameter was related to infestations of Dectes stem borer. In field measurements were made to determine stem diameter and Dectes stem borer infestation on October 15 for four of the replications.

Results:

Planting rate (seeds/ac)	Stand Count (plants/ac)	Emergence (%)	Stem Diameter (mm)	Dectes Stem Borer Infestation %	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
80,000	60,600 D*	76 A	8 A	0 A	11.4 A	59 A	444.58 A
110,000	78,600 C	72 AB	7 B	1 A	11.2 AB	60 A	434.69 AB
140,000	98,800 B	71 AB	6 B	0 A	11.0 B	60 A	426.43 AB
170,000	110,600 A	65 B	6 C	1 A	11.0 B	60 A	413.75 B
P-Value	<0.0001	0.037	<0.0001	0.618	0.001	0.795	0.016

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $60/unit of 140,000 seeds.

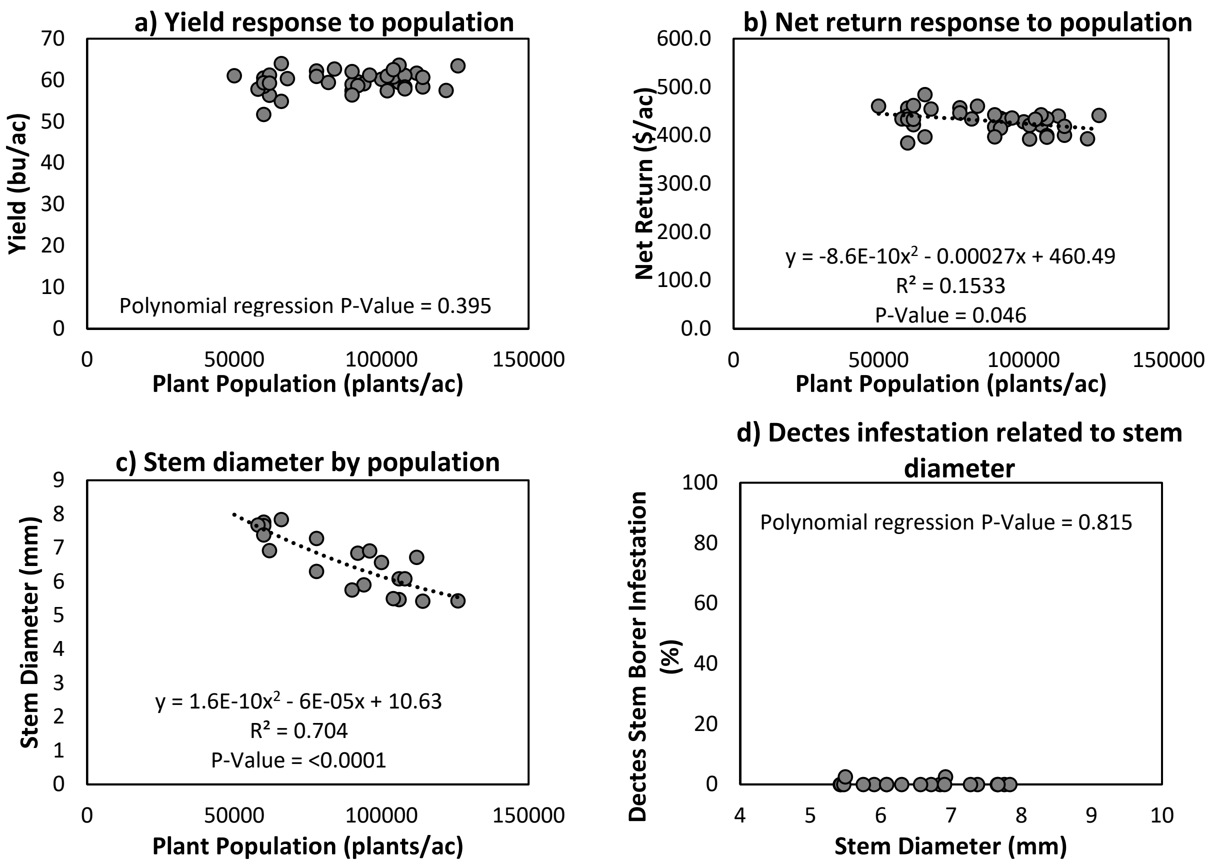


Figure 2. a) Yield response to plant population (determined by stand count), **b)** net return response to population (determined by stand counts), **c)** stem diameter by plant population (determined by stand counts), and **d)** Dectes stem borer infestation as related to stem diameter. Regression lines were fit and displayed if the relationship was statistically significant.

Summary:

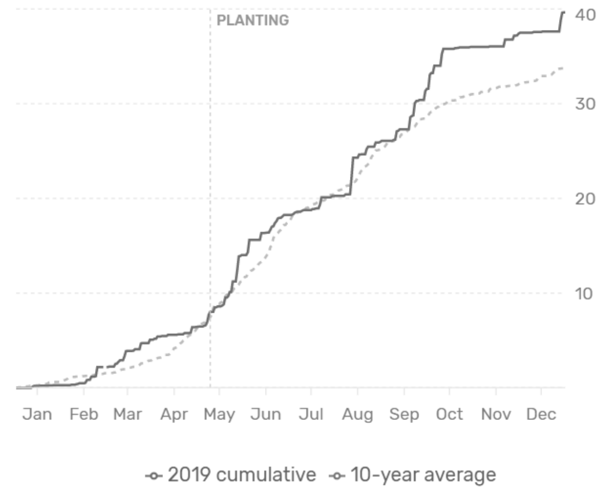
- Plant stands ranged from 65% to 76% of the seeding rate.
- Stem diameter was larger for lower planting rates. Stem diameter was not related to Dectes stem borer infestation, which was very low at this site regardless of seeding rate.
- There were no yield differences among the four seeding rates evaluated. There was no significant linear or polynomial relationship between plant population and yield (Figure 2).
- Marginal net return was significantly related to the plant population (Figure 3). The highest marginal net return was obtained at the lowest seeding rate evaluated (80,000 seeds/ac).

This research was supported in part by an award from the USDA NIFA Agriculture and Food Research Initiative's Food Security Challenge Area program, award number 2016 − 68004 − 24769.

Data-Intensive Farm Management: Soybean Seeding Rate

Study ID: 0546155201902
County: Saunders
Soil Type: Yutan silty clay loam 2-6% slopes, eroded; Filbert silt loam 0-1% slope
Planting Date: 5/9/18
Harvest Date: 9/27/18
Row Spacing (in): 30
Variety: Golden Harvest® GH2788X
Reps: 9
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 7 oz/ac Authority® Supreme and 8 oz/ac 2-4,D ***Post:*** 36 oz/ac Flexstar® GT, 1 qt/ac Warrant®, 6 oz/ac Select Max®, and 12 oz/ac Roundup®
Seed Treatment: CruiserMaxx®
Foliar Insecticides: 5 oz/ac Brigade® at R3
Foliar Fungicides: 4 oz/ac Priaxor® at R3

Fertilizer: None
Irrigation: Pivot, Total: 2"
Rainfall (in):



Introduction: This study is part of the Data-Intensive Farm Management Project, a multi-university collaboration led by the University of Illinois at Urbana-Champaign. The goal of these research studies is to utilize precision agriculture technology for conducting on-farm research. This study tested four soybean planting rates: 80,000 seeds/ac, 110,000 seeds/ac, 140,000 seeds/ac, and 170,000 seeds/ac. Treatments were randomized and replicated in 90' wide by 240' long blocks across the field (Figure 1). Variable-rate prescription maps for the study were developed and uploaded to the in-cab monitor. Row cleaners were on the planter, but were not run aggresively during planting. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. The as-planted data were evaluated, and only areas that achieved planting rates within 10% of the target seeding rate were included for yield analysis; 9 of the 11 originally planned blocks shown in Figure 1 were used in the yield analysis.

Stand counts were taken on June 11 for eight replications; these stand counts were used to determine percent emergence. There was interest in determining if soybean stem diameter was related to planting rate and if stem diameter was related to infestations of Dectes stem borer. In field measurements were made to determine stem diameter and Dectes stem borer infestation on September 26 for four of the replications.

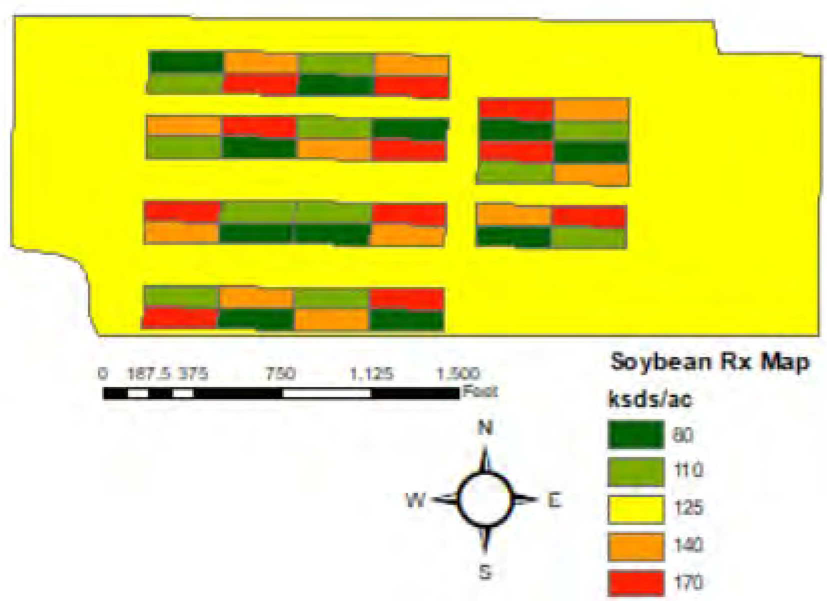


Figure 1. Soybean seeding rate prescription map.

Results:

Planting rate (seeds/ac)	Stand Count (plants/ac)	Emergence (%)	Stem Diameter (mm)	Dectes Stem Borer Infestation %	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
80,000	64,000 C*	80 A	9 A	3 A	11.8 A	83 A	635.49 A
110,000	91,750 B	83 A	7 AB	3 A	11.8 A	83 A	628.32 A
140,000	117,250 A	84 A	6 B	2 A	12.1 A	83 A	610.82 A
170,000	133,500 A	79 A	6 B	3 A	12.3 A	86 A	624.13 A
P-Value	<0.0001	0.726	0.005	0.888	0.137	0.164	0.319

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $60/unit of 140,000 seeds.

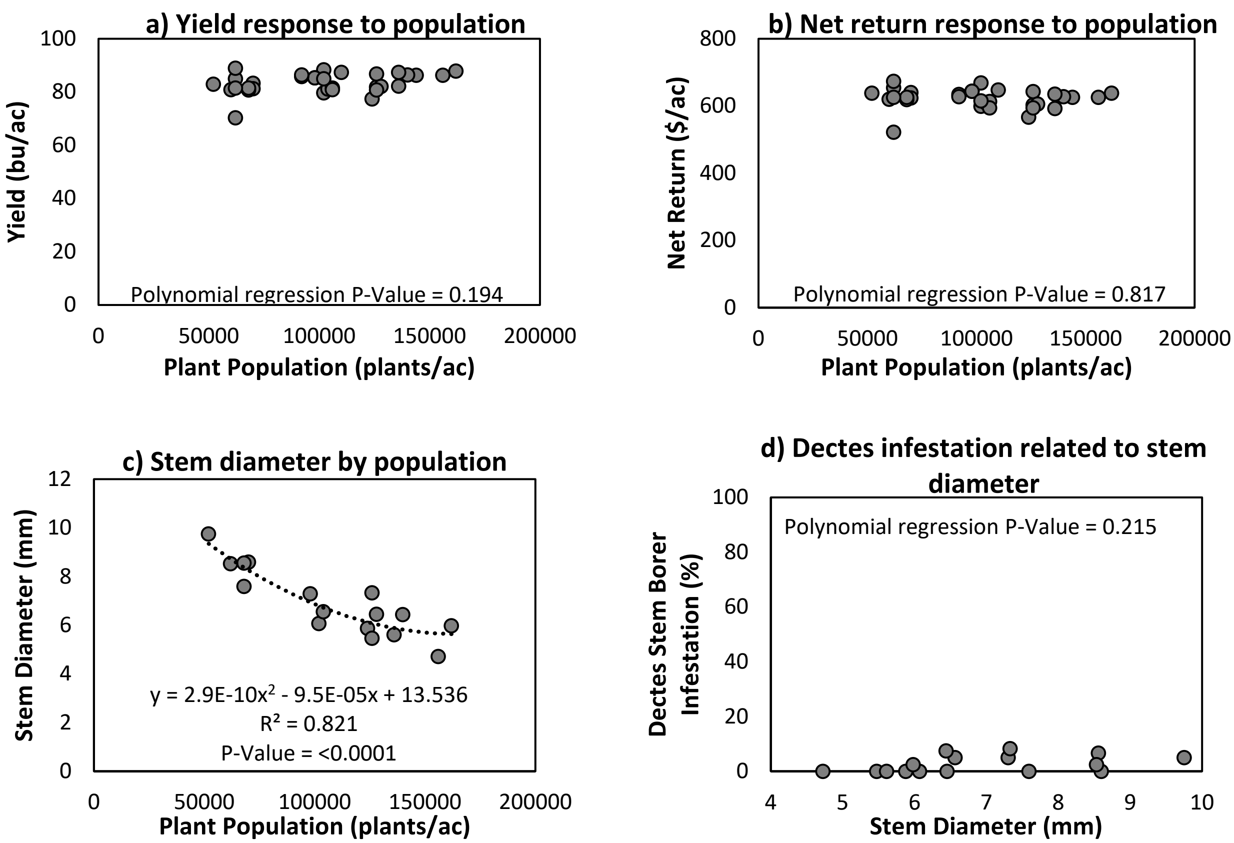


Figure 2. a) Yield response to plant population (determined by stand count), **b)** net return response to population (determined by stand counts), **c)** stem diameter by plant population (determined by stand counts), and **d)** Dectes stem borer infestation as related to stem diameter. Regression lines were fit and displayed if the relationship was statistically significant.

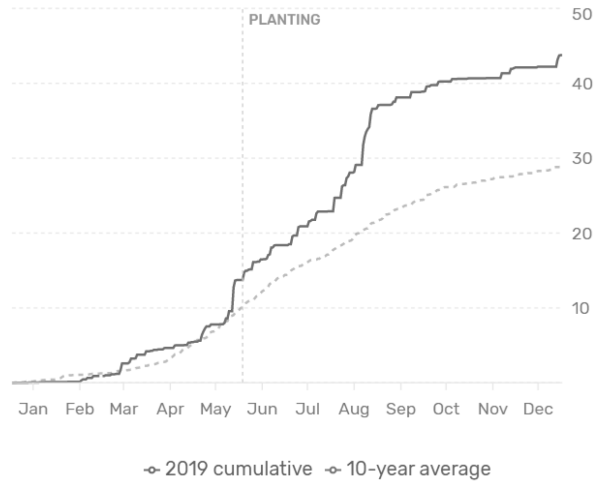
Summary:

- Plant populations at this site ranged from 79% to 84% of the target seeding rate.
- Stem diameter was related to seeding rate and plant population, with lower seeding rates having larger stem diameters.
- Dectes stem borer counts at this site were fairly low, with only 2% to 3.1% of plants infested. Dectes stem borer infestation was not related to stem diameter and seeding rate.
- Yield and net return was not different among the four seeding rates evaluated.

This research was supported in part by an award from the USDA NIFA Agriculture and Food Research Initiative's Food Security Challenge Area program, award number 2016 − 68004 − 24769.

Data-Intensive Farm Management: Soybean Seeding Rate

Study ID: 0073081201901
County: Hamilton
Soil Type: Hastings silt loam 0-1% slope; Crete silt loam 0-1% slope; Hastings silty clay loam 7-11% slopes, eroded; Uly silt loam 11-30% slopes, eroded; Butler silt loam 0-1% slope
Planting Date: 6/2/19
Harvest Date: 10/23/19
Row Spacing (in): 30
Variety: Pioneer® P28A74PR
Reps: 6
Previous Crop: Corn
Tillage: Strip-Till
Herbicides: ***Pre:*** 24 oz/ac glyphosate 53.8%, 7 oz/ac Verdict®, and 1 pt/ac Metalica with 0.5 pt/ac MSO XTRA on 6/2/19 ***Post:*** 28 oz/ac glyphosate 53.8% with 2.67 oz/ac FBN™ AMS Pro on 6/20/19; 24 oz/ac Buccaneer Plus® with 1 qt/ac FBN™ AMS pro on 7/28/19
Fertilizer: 95 lb/ac 11-52-0 on 5/17/19
Note: 1 pt/ac Conklin® Syntose FA® added with 6/20/19 herbicide application
Irrigation: Pivot, Total: 0"
Rainfall (in):



Introduction: This study is part of the Data-Intensive Farm Management Project, a multi-university collaboration led by the University of Illinois at Urbana-Champaign. The goal of these research studies is to utilize precision agriculture technology for conducting on-farm research. This study tested four soybean planting rates: 80,000 seeds/ac, 110,000 seeds/ac, 140,000 seeds/ac, and 170,000 seeds/ac. Treatments were randomized and replicated in 80' wide by 300' long blocks across the field (Figure 1). Variable-rate prescription maps for the study were developed and uploaded to the in-cab monitor. The planter utilized air bag downforce on the row units; row cleaners were not engaged during planting. There was an oat cover crop located from the south border of the field to approximately 250-feet north of the pivot point; the cover crop did not appear to consistently affect yield or emergence. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. The as-planted data were evaluated and only areas that achieved planting rates within 10% of the target seeding rate were included for yield analysis; 6 of the 15 originally planned blocks shown in Figure 1 were used in the yield analysis.

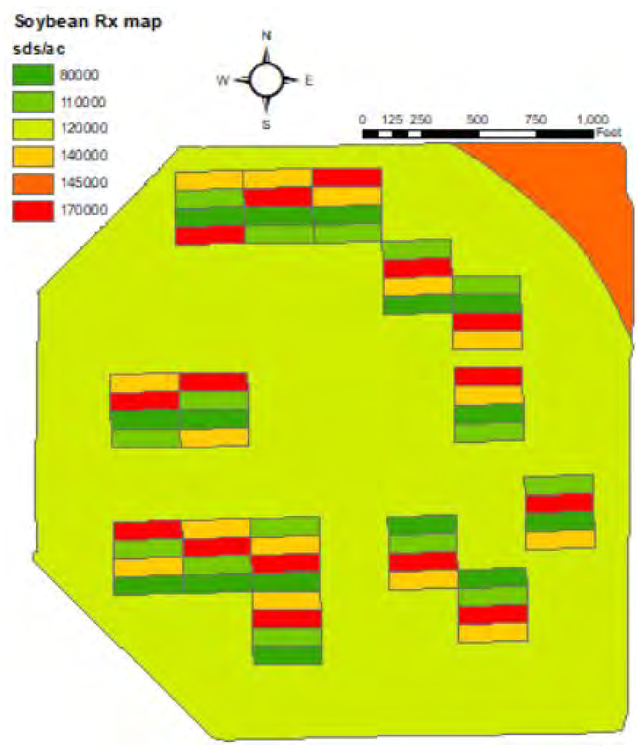


Figure 1. Soybean seeding rate prescription map for 2019 field site.

Stand counts were taken on June 19 for all six replications; these stand counts were used to determine percent emergence. There was interest in determining if soybean stem diameter was related to planting rate and if stem diameter was related to infestations of Dectes stem borer. In field measurements were made to determine stem diameter and Dectes stem borer infestation on October 7 for two replications. Since Dectes stem borer infestation and stem diameter were only measured on two of the six replications, no statistical analyses are provided; averages are reported.

Results:

Planting rate (seeds/ac)	Stand Count (plants/ac)	Emergence (%)	Stem Diameter (mm)	Dectes Stem Borer Infestation %	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
80,000	49,000 C*	61 A	10	0	11.4 A	57 B	430 A
110,000	73,000 BC	66 A	7	3	11.4 A	63 A	460 A
140,000	83,333 B	60 A	7	6	11.4 A	64 A	456 A
170,000	115,667 A	68 A	8	3	11.5 A	64 A	445 A
P-Value	0.0002	0.747	-	-	0.881	0.006	0.202

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $60/unit of 140,000 seeds.

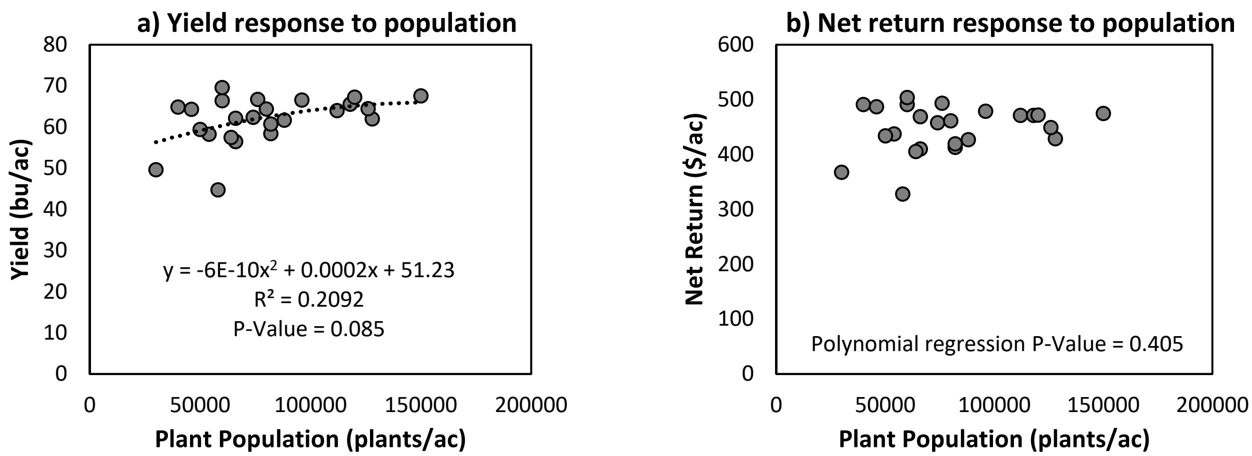


Figure 2. a) Yield response to plant population and **b)** net return response to population. Plant populations were determined by stand counts. Regression lines were fit and displayed if the relationship was statistically significant.

Summary:

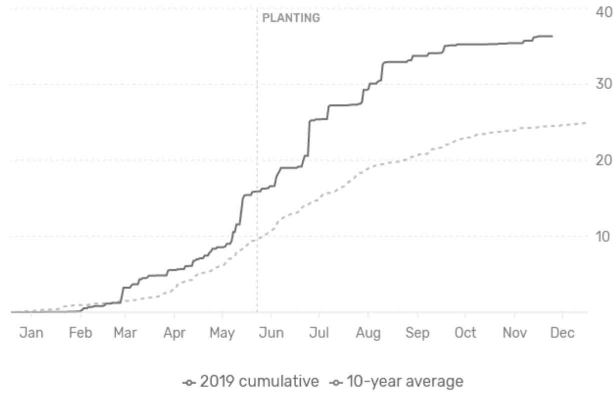
- Plant populations at this site were notably lower than target seeding rates ranging from 60% to 68% of the seeding rate.
- Dectes stem borer counts were low at this site with treatment averages ranging from 0% to 6% of plants infested.
- Yield was lower for the 80,000 seeds/ac treatment, which had stands of 49,000 plants/ac. There was no yield difference for the 110,000 through 170,000 seeds/ac treatments, which had stands ranging from 73,000 to 116,000 plants/ac. Economically optimum yield at a price of $8.10/bu soybeans and $60/140,000 seeds was obtained at 113,000 plants/ac.

This research was supported in part by an award from the USDA NIFA Agriculture and Food Research Initiative's Food Security Challenge Area program, award number 2016 − 68004 − 24769.

Data-Intensive Farm Management: Soybean Seeding Rate

Study ID: 0709047201901
County: Dawson
Soil Type: Cozad silt loam, 0-1% slope; Cozad silt loam, 1-3% slope; Hall silt loam, 0-1% slope; Hord silt loam, 0-1% slope
Planting Date: 6/6/19
Harvest Date: 10/15/19
Row Spacing (in): 30
Variety: Channel® 2519R2X
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 24 oz/ac Mad Dog® 5.4#, 2.8 oz/ac Valor®, and 12.8 oz/ac Engenia® on 6/6/19
Post: 24 oz/ac Mad Dog® 5.4#, 5 oz/ac Assure® II, and 48 oz/ac Warrant®
Seed Treatment: NemaStrike™, Optimize®, Acceleron® Elite

Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 100 lb/ac 21-0-0-24S, and 100 lb/ac 0-0-60 both dry spread on 5/20/19
Irrigation: Pivot, Total: 0.25" (post-planting)
Rainfall (in):



Soil Tests (December 2018):

Soil pH 1:1	Soluble Salts 1:1 mmho/cm	Organic Matter LOI %	Nitrate surface lb N/A	Nitrate deep lb N/ac	Mehlich P-III ppm P	$CaPO_4$ SO_4-S ppm	Ammonium Acetate (ppm) K	Ca	Mg	Na	Sum of Cations me/100g	Zn (ppm)
6.5	0.3	2.8	12	34	54	3	331	2689	448	51	18	1.6
6.8	0.3	3.1	12	42	49	9	548	2666	660	112	21	2.1
6.5	0.4	3.0	26	50	57	5	391	3118	481	49	21	2.0
6.2	0.4	3.4	31	-	40	7	389	3136	455	41	21	1.9
7.2	0.6	2.7	31	-	43	11	428	2738	468	54	19	2.3
6.8	0.3	2.8	22	-	44	4	326	2643	386	41	17	3.0

Introduction: This study is part of the Data-Intensive Farm Management Project, a multi-university collaboration led by the University of Illinois at Urbana-Champaign. The goal of these research studies is to utilize precision agriculture technology for conducting on-farm research. This study tested four soybean planting rates: 80,000 seeds/ac, 110,000 seeds/ac, 140,000 seeds/ac, and 170,000 seeds/ac. Treatments were randomized and replicated in 90' wide by 300' long blocks across the field (Figure 1). At this site, 12 replications were planned; however, only 6 replications were planted due to monitor errors and wet areas that remained unplanted (Figure 1). Variable-rate prescription maps for the study were developed and uploaded to the in-cab monitor. The planter utilized airbag downforce pressure on row units and row cleaners. Soybean rows were planted between the previous year's corn rows. Flooding and heavy rain in early July resulted in large variations in plant conditions with no obvious pattern. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. The as-planted data were evaluated, and only areas that achieved planting rates within 10% of the target seeding rate were included for yield analysis. Stand counts were taken on June 27 in 12 replications; these stand counts were used to determine percent emergence. There was interest in determining if soybean stem diameter was related to planting rate and if stem diameter was related to infestations of Dectes stem borer. In field measurements were made to determine stem diameter and Dectes stem borer infestation on August 1 in 12 replications.

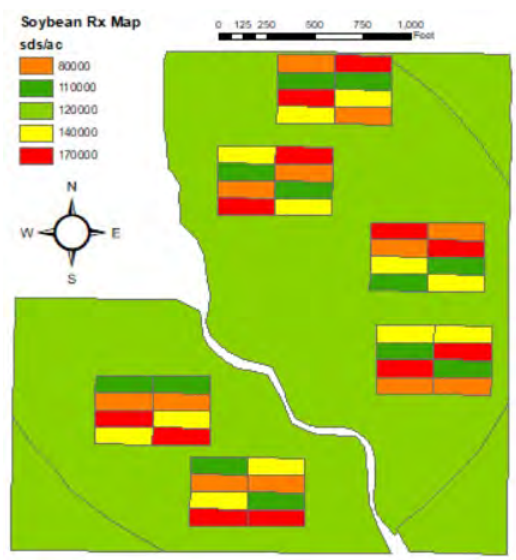


Figure 1. Soybean seeding rate prescription map for 2019 field site.

Results:

Planting rate (seeds/ac)	Stand Count (plants/ac)	Emergence (%)	Stem Diameter (mm)	Dectes Stem Borer Infestation %	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
80,000	65,833 C*	82 A	9 A	7 A	10.5 A	73 A	552.69 A
110,000	83,833 B	76 A	8 A	8 A	10.5 A	76 A	567.99 A
140,000	104,000 A	74 A	8 A	5 A	10.6 A	78 A	570.08 A
170,000	118,833 A	70 A	8 A	7 A	10.6 A	75 A	532.34 A
P-Value	<0.0001	0.276	0.135	0.930	0.242	0.344	0.374

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $60/unit of 140,000 seeds.

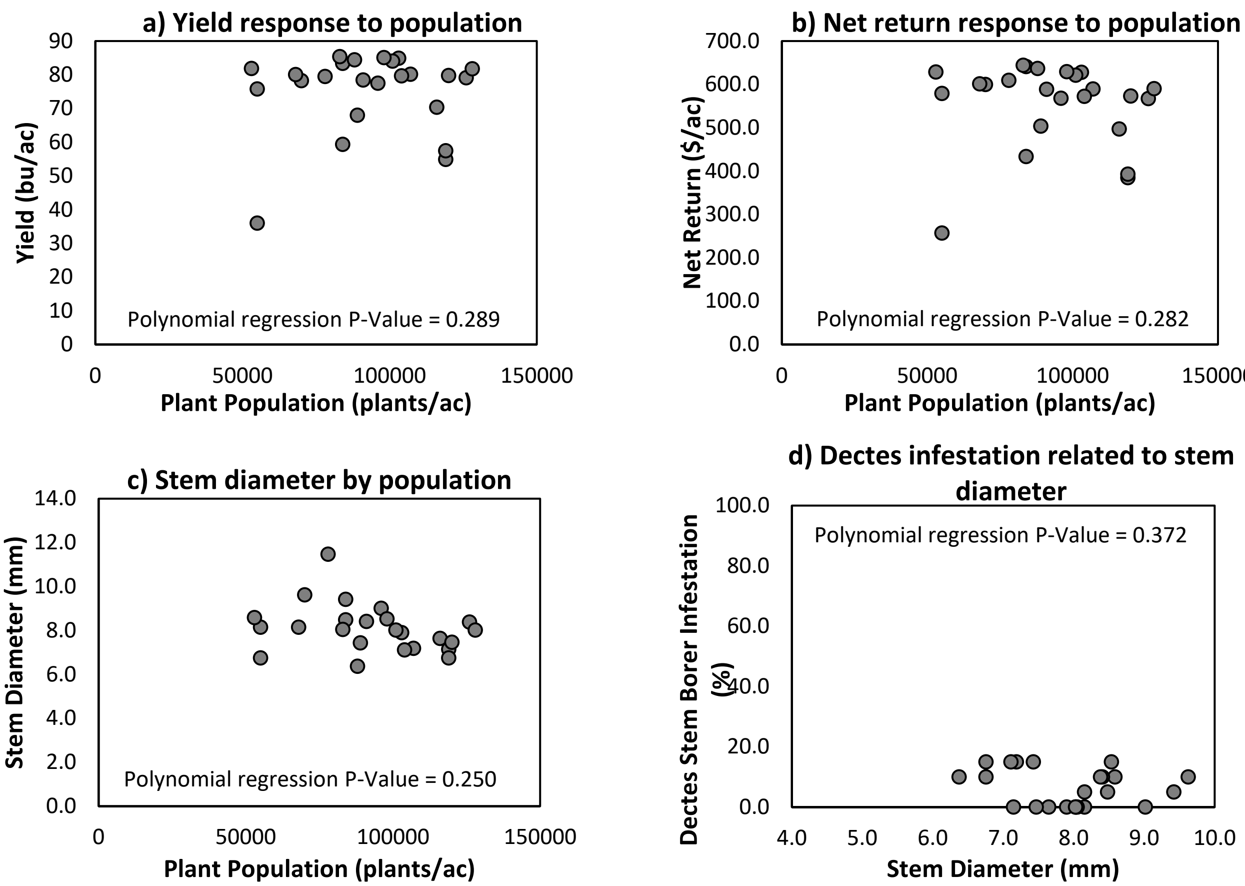


Figure 2. a) Yield response to plant population (determined by stand count), **b)** net return response to population (determined by stand counts), **c)** stem diameter by plant population (determined by stand counts), and **d)** Dectes stem borer infestation as related to stem diameter. Regression lines were fit and displayed if the relationship was statistically significant.

Summary:

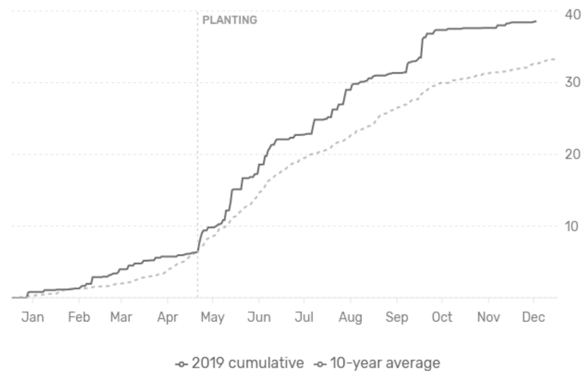
- Plant stands ranged from 70% to 82% of the seeding rate.
- Stem diameter and Dectes stem borer infestation were not impacted by seeding rate or plant population at this site. Dectes stem borer infestation was relatively low, ranging from 5% to 7%.
- Yield and net return were not significantly different for the planting rates evaluated. The lowest seeding rate of 80,000 seeds/ac with plant stands averaging 66,000 plants/ac achieved yields as high as the 170,000 seeds/ac treatment with plant stands averaging 119,000 plants/ac.

This research was supported in part by an award from the USDA NIFA Agriculture and Food Research Initiative's Food Security Challenge Area program, award number 2016 − 68004 − 24769.

Data-Intensive Farm Management: Soybean Seeding Rate

Study ID: 0409109201901
County: Lancaster
Soil Type: Wymore silty clay loam, 3-6% slopes, eroded; Aksarben silty clay loam 2-6% slopes
Planting Date: 5/5/19 and 5/10/19
Harvest Date: 10/17-18/19
Row Spacing (in): 15
Variety: Pioneer® P37A69X
Reps: 12
Previous Crop: Corn (average >200 bu/ac)
Tillage: No-Till
Herbicides: ***Pre:*** 6.4 oz/ac Engenia®, 4 oz/ac Sonic®, and 4 oz/ac TriCor® ***Post:*** 1.5 qt/ac Buccaneer Plus®, 1 pt/ac Metalica, and 4 oz/ac clethodim

Seed Treatment: EverGol® Energy, Lumisena™, Gaucho®, PPST 2030, PPST 120+
Foliar Insecticides: 1.5 oz/ac Midash Forte and 3.2 oz/ac Lambda-Cyhalothrin 1 EC
Irrigation: None
Rainfall (in):



Introduction: This study is part of the Data-Intensive Farm Management Project, a multi-university collaboration led by the University of Illinois at Urbana-Champaign. The goal of these research studies is to utilize precision agriculture technology for conducting on-farm research. This study tested four soybean planting rates: 80,000 seeds/ac, 110,000 seeds/ac, 140,000 seeds/ac, and 170,000 seeds/ac. Treatments were randomized and replicated in 80' wide by 350' long blocks across the field (Figure 1). Variable-rate prescription maps for the study were developed and uploaded to the in-cab monitor. The planter utilized hydraulic downforce on row units; row cleaners were not used. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. The as-planted data were evaluated and only areas that achieved planting rates within 10% of the target seeding rates were included for yield analysis; 12 of the 15 originally planned blocks shown in Figure 1 were used in the yield analysis. Stand counts were taken on June 6 and 7 for four of the replications; these stand counts were used to determine percent emergence. There was interest in determining if larger soybean stem diameters would lead to lower Dectes stem borer infestations. In field measurements were made to determine stem diameter and Dectes stem borer infestation on October 3 for four of the replications.

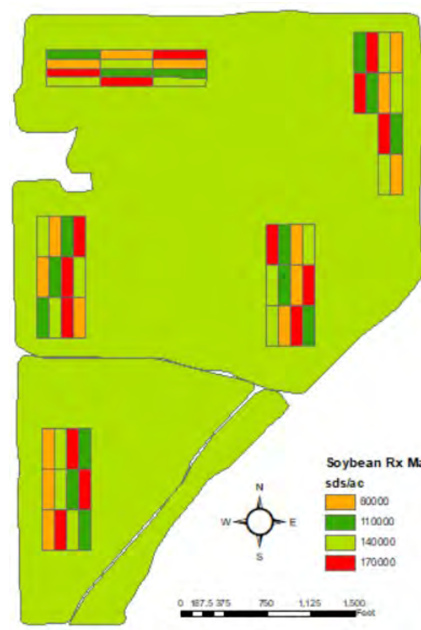


Figure 1. Soybean seeding rate prescription map for 2019 field site.

Results:

Planting rate (seeds/ac)	Stand Count (plants/ac)	Emergence (%)	Stem Diameter (mm)	Dectes Stem Borer Infestation %	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
80,000	51,583 D*	65 A	10 A	27 A	9.1 AB	60.5 B	455.92 A
110,000	70,917 C	65 A	9 AB	27 A	9.0 B	63.1 A	463.89 A
140,000	97,457 B	63 A	9 AB	23 A	9.1 AB	62.7 AB	447.76 AB
170,000	110,417 A	63 A	7 B	20 A	9.2 A	62.8 AB	435.52 B
P-Value	<0.0001	0.9851	0.007	0.874	0.118	0.046	0.007

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $60/unit of 140,000 seeds.

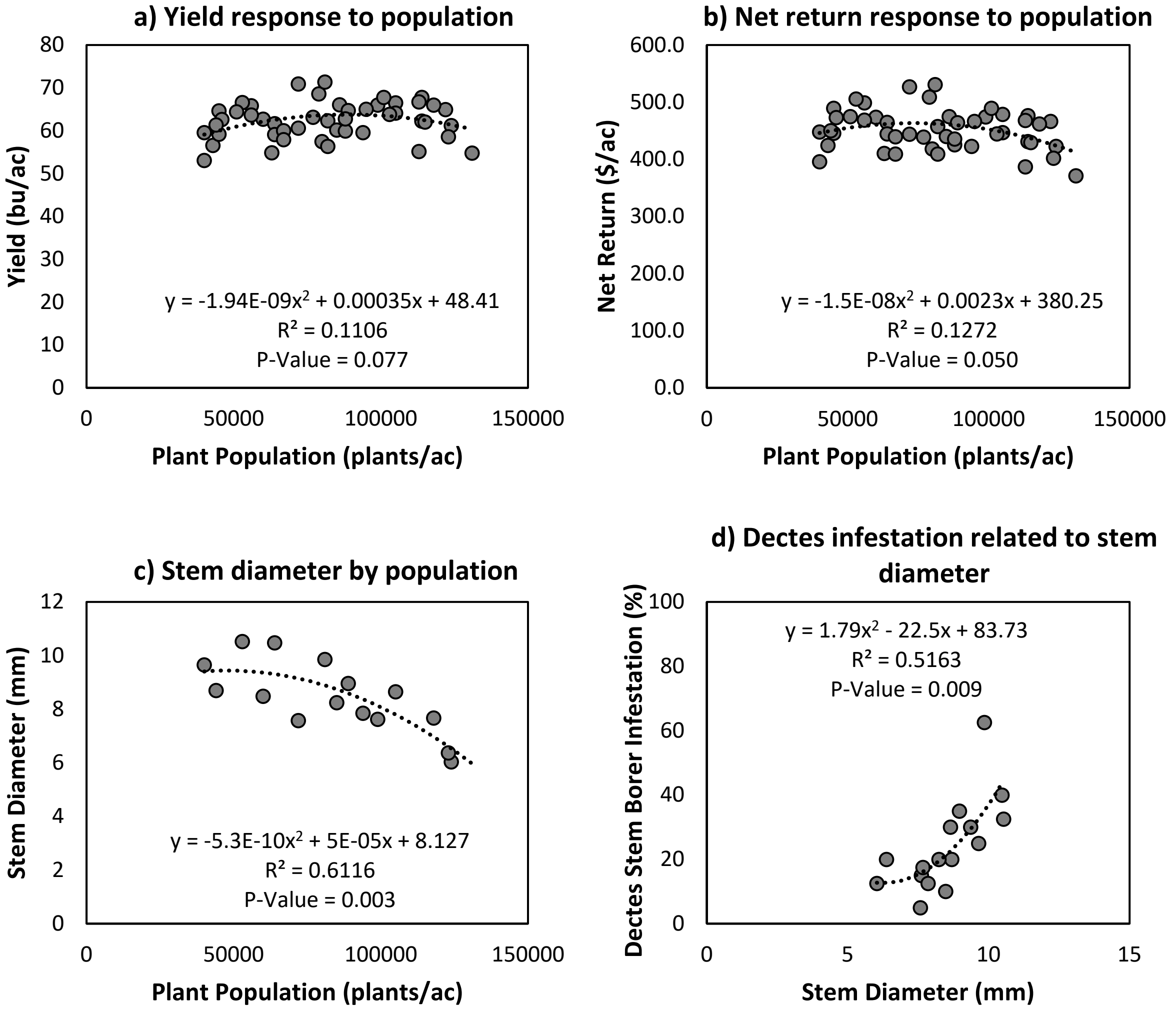


Figure 2. a) Yield response to plant population (determined by stand count), **b)** net return response to population (determined by stand counts), **c)** stem diameter by plant population (determined by stand counts), and **d)** Dectes stem borer infestation as related to stem diameter. Regression lines were fit and displayed if the relationship was statistically significant.

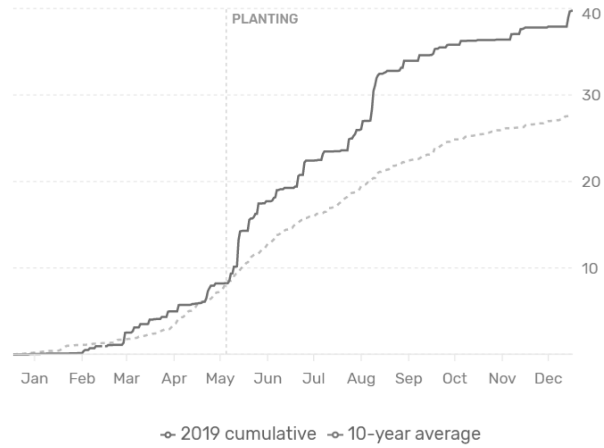
Summary:

- Plant populations at this site were notably lower than target seeding rates ranging from 63% to 64% of the seeding rates.
- Stem diameter was related to seeding rate and plant population, with lower seeding rates having larger stem diameters.
- Dectes stem borer counts ranged from 20% to 27% of plants infested. Dectes stem borer infestation was related to stem diameter, with larger stem diameters having a higher infestation (Figure 2d).
- Yield was lower for the 80,000 seeds/ac treatment, which had stands of 52,000 plants/ac. There was no yield difference for the 110,000 through 170,000 seeds/ac treatments, which had stands ranging from 71,000 to 110,000 plants/ac.
- Net return was related to plant population and was optimized at approximately 72,000 plants/ac.

This research was supported in part by an award from the USDA NIFA Agriculture and Food Research Initiative's Food Security Challenge Area program, award number 2016 – 68004 – 24769.

Data-Intensive Farm Management: Soybean Seeding Rate

Study ID: 0831001201901
County: Adams
Soil Type: Hastings silt loam 0-1% slope; Crete silt loam 0-1% slope
Planting Date: 5/19/19
Harvest Date: 9/25/19
Variety: Pioneer® P24A99X
Row Spacing (in): 30
Reps: 3
Previous Crop: Seed Corn
Tillage: Row stalker before planting; cultivated and hilled
Herbicides: ***Pre:*** 6 oz/ac Zidua® PRO, 16 oz/ac 2,4-D LV, and 32 oz/ac glyphosate on 4/24/19 ***Post:*** 12.8 oz/ac Engenia®, 12 oz/ac clethodim, 32 oz/ac glyphosate, and 2 qt/ac Warrant® on 6/24/19
Seed Treatment: EverGol® Energy, Allegiance®, Gaucho®, Pioneer Premium Seed Treatment (PPST) 120+
Foliar Insecticides and Fungicides: None
Fertilizer: None
Irrigation: subsurface drip irrigation
Rainfall (in):



Introduction: This study is part of the Data-Intensive Farm Management Project, a multi-university collaboration led by the University of Illinois at Urbana-Champaign. The goal of these research studies is to utilize precision agriculture technology for conducting on-farm research. This study tested four soybean planting rates: 80,000 seeds/ac, 110,000 seeds/ac, 140,000 seeds/ac, and 170,000 seeds/ac. Treatments were randomized and replicated in field length strips; at this site, there were 3 replications. Variable-rate prescription maps for the study were developed and uploaded to the in-cab monitor. The planter utilized Precision Planting® row sweeps and Martin-Till® row cleaners with air downforce on row units. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. The as-planted data were evaluated, and only areas that achieved planting rates within 10% of the target seeding rates were included for yield analysis.

Stand counts were taken on June 26; these stand counts were used to determine percent emergence. There was interest in determining if larger soybean stem diameters would lead to lower Dectes stem borer infestations. In field measurements were made to determine stem diameter and Dectes stem borer infestation on September 25 for all three replications in three locations within the length of each treatment strip. Hail and wind damage occurred during early pod fill and over 30" of rain was received during the growing season.

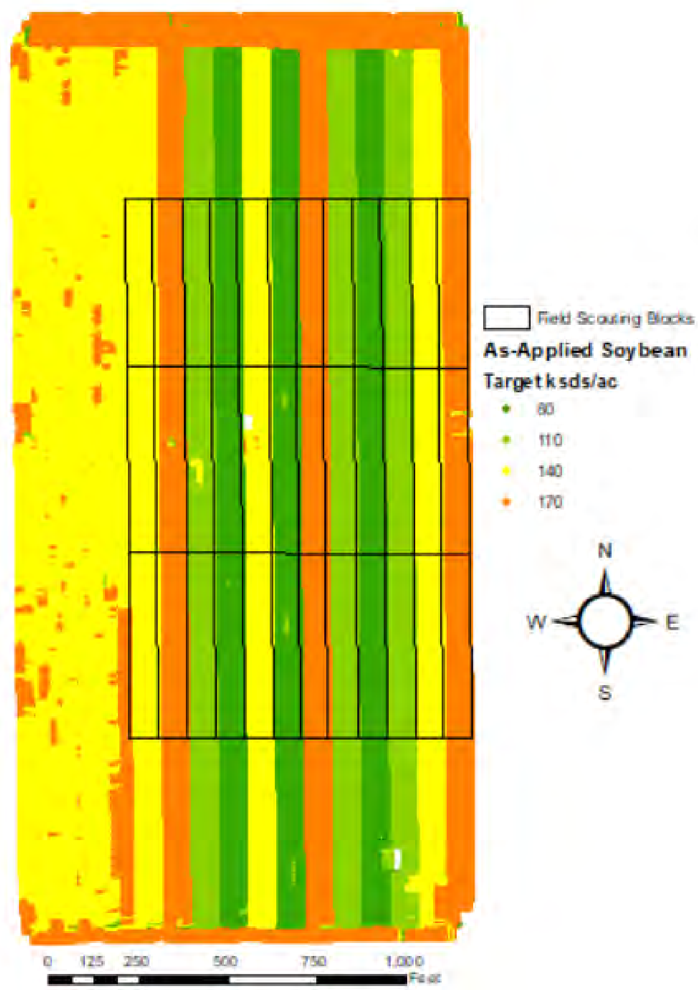


Figure 1. Field length strip target rates (manually entered by operators) with corresponding blocks used for field scouting (emergence and pest observations).

Results:

Planting rate (seeds/ac)	Stand Count (plants/ac)	Emergence (%)	Stem Diameter (mm)	Dectes Stem Borer Infestation %	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
80,000	70,445 D*	88 A	9 A	21 A	12.8 A	52 A	385.60 A
110,000	96,000 C	87 A	7 AB	11 BC	11.8 A	49 A	349.80 A
140,000	126,445 B	90 A	6 B	14 B	11.9 A	50 A	346.94 A
170,000	151,556 A	89 A	6 B	8 C	12.8 A	54 A	360.41 A
P-Value	<0.0001	0.775	0.049	0.0001	0.792	0.697	0.619

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $60/unit of 140,000 seeds.

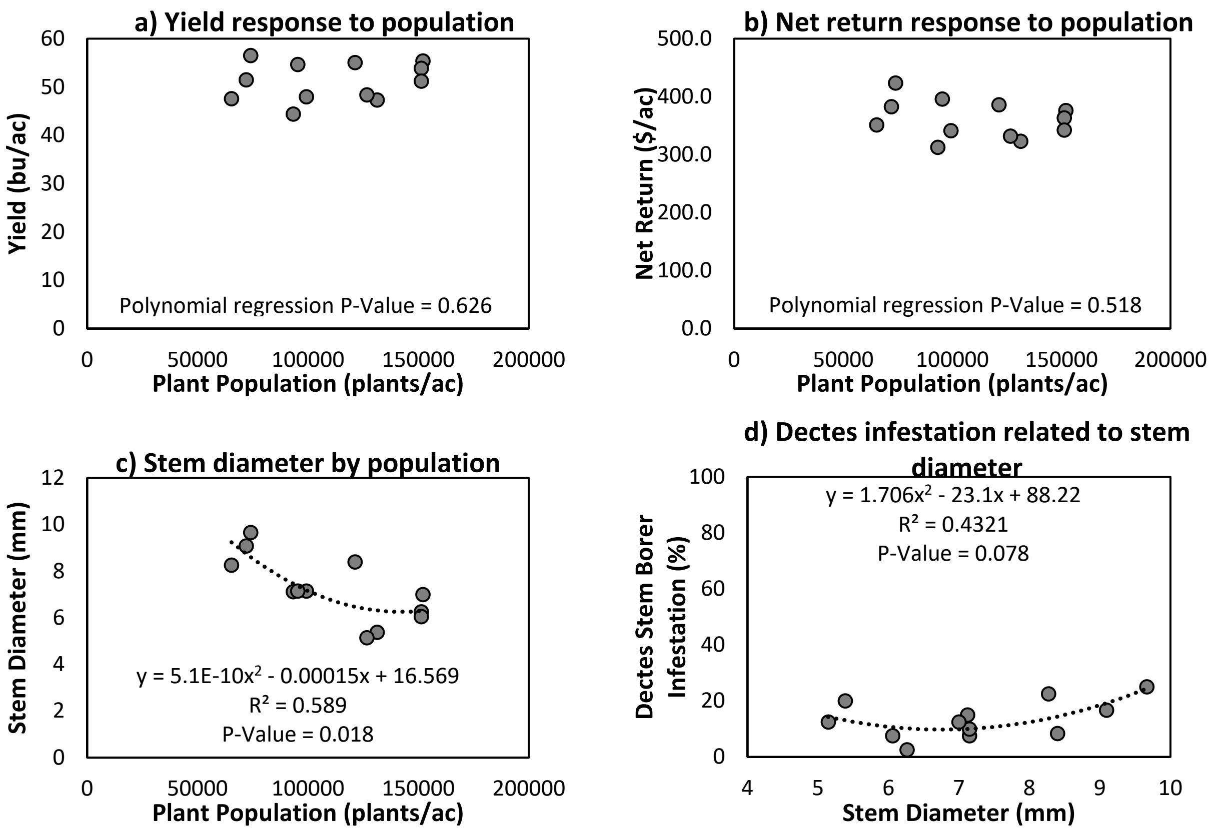


Figure 2. a) Yield response to plant population (determined by stand count), **b)** net return response to population (determined by stand counts), **c)** stem diameter by plant population (determined by stand counts), and **d)** Dectes stem borer infestation as related to stem diameter. Regression lines were fit and displayed if the relationship was statistically significant.

Summary:

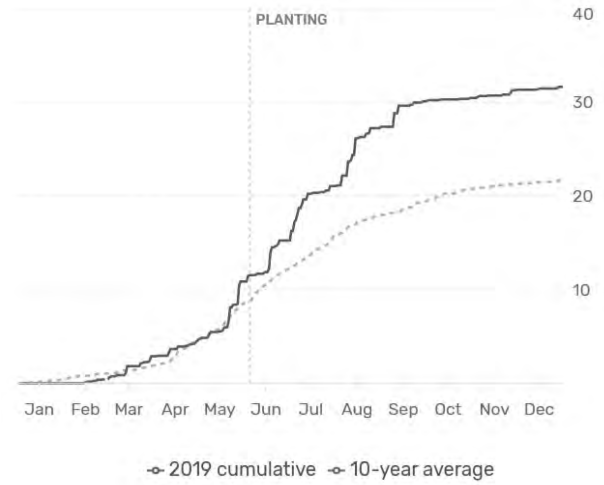
- Plant populations at this site ranged from 87% to 90% of the target seeding rate.
- Stem diameter was related to seeding rate and plant population, with lower seeding rates having larger stem diameters.
- Dectes stem borer counts at this site ranged from 8% to 22% of plants infested. Dectes stem borer infestation was related to stem diameter and seeding rate, with larger stem diameters and lower seeding rates having a higher infestation.
- Yield and net return was not different among the four seeding rates evaluated.

This research was supported in part by an award from the USDA NIFA Agriculture and Food Research Initiative's Food Security Challenge Area program, award number 2016 − 68004 − 24769.

Irrigated Soybean Population Study

Study ID: 0153101201903
County: Keith
Soil Type: Satanta loam 3-6% slopes; Satanta-Dix complex 3-9% slopes
Planting Date: 6/4/19
Harvest Date: 10/15/19
Row Spacing (in): 30
Variety: Pioneer® P23A32X
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 32 oz/ac Roundup®, 8 oz/ac 2,4-D
Post: 32 oz/ac Roundup® and 15 oz/ac Authority®; 32 oz/ac Roundup® and 10 oz/ac Select Max®
Seed Treatment: Gaucho® insecticide and Lumisena™ fungicide
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: None
Irrigation: Pivot, Total: 6.2"
Rainfall (in):



Introduction: Previous on-farm research has demonstrated that soybean planting rates of 80,000 to 120,000 seeds/ac resulted in the highest profitability. The purpose of this study was to evaluate five seeding rates to determine the seeding rate that maximized yield and profit. The target seeding rates were 80,000, 100,000, 120,000 150,000, and 180,000 seeds/ac.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
80,000 seeds/acre	26 C*	176.20 A
100,000 seeds/acre	27 C	171.61 A
120,000 seeds/acre	27 BC	169.30 A
150,000 seeds/acre	29 AB	170.05 A
180,000 seeds/acre	31 A	174.84 A
P-Value	0.0004	0.828

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $60/140,000 seeds.

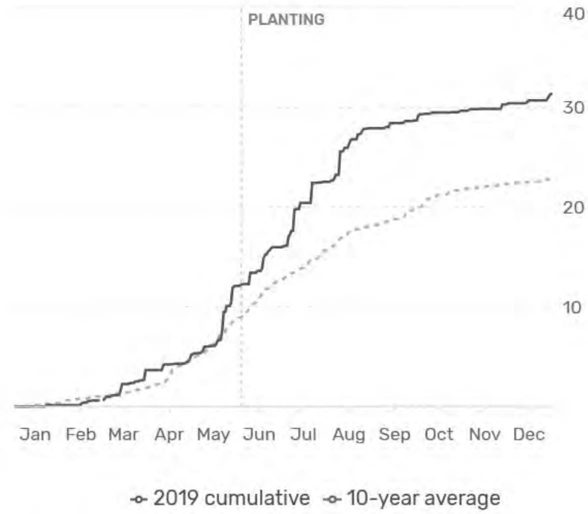
Summary:

- In this study, the 150,000 and 180,000 seeds/ac treatments had the highest yield. Actual stand counts are not available to confirm if target seeding rates were achieved.
- Yields at this site were limited due to hail.
- There was no difference in marginal net return between the seeding rates evaluated.

Irrigated Soybean Population Study

Study ID: 0153111201902
County: Lincoln
Soil Type: Cozad silt loam 0-1% slope
Planting Date: 6/3/19
Harvest Date: 10/8/19
Row Spacing (in): 30
Variety: Pioneer® P29A25X
Reps: 4
Previous Crop: Sorghum
Tillage: No-Till
Herbicides: ***Pre:*** 32 oz/ac Roundup® and 12 oz/ac Authority® MTZ ***Post:*** 1.33 pt/ac Brawl® II , 8 oz/ac clethodim, and 32 oz/ac Roundup®
Seed Treatment: LumiGEN™
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: None

Irrigation: Linear-move, Total: 2.6"
Rainfall (in):



Introduction: Previous on-farm research has demonstrated that soybean planting rates of 80,000 to 120,000 seeds/ac resulted in the highest profitability. The purpose of this study was to evaluate four seeding rates to determine the seeding rate that maximized yield and profit. The target seeding rates were 100,000, 120,000, 150,000, and 180,000 seeds/ac.

Results:

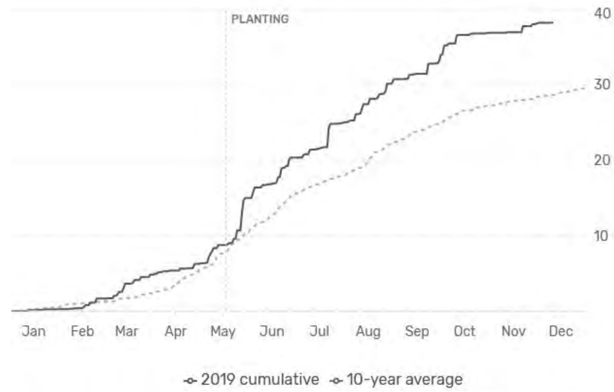
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
100,000 seeds/acre	11.8 A*	40 A	277.89 A
120,000 seeds/acre	11.7 A	40 A	275.15 A
150,000 seeds/acre	11.7 A	41 A	265.10 A
180,000 seeds/acre	11.9 A	42 A	260.83 A
P-Value	0.677	0.631	0.542

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $60/140,000 seeds/ac.

Summary: There was no difference in yield, grain moisture, or net return between the seeding rates evaluated.

Irrigated Soybean Population Study

Study ID: 0811023201901
County: Butler
Soil Type: Hastings silt loam 0-1% slope
Planting Date: 5/17/19
Harvest Date: 10/19/19
Row Spacing (in): 30
Variety: Pioneer® P28T71X
Reps: 4
Previous Crop: Corn
Tillage: Disk, Harrow
Herbicides: ***Pre:*** 1 pt/ac 2-4D LV EST, 4 oz/ac Authority® First, 2 pt/ac Boundary®, 24 oz/ac Durango® ***Post:*** 32 oz/ac Durango®, 1 pt/ac Ultra Blazer®, 8 oz/ac clethodim, 2 oz/ac Anthem®MAXX
Seed Treatment: Gaucho® and Lumivia™
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: None
Irrigation: Pivot, Total: 2"
Rainfall (in):



Introduction: Previous on-farm research has demonstrated that soybean planting rates of 80,000 to 120,000 seeds/ac resulted in the highest profitability. The purpose of this study was to evaluate three seeding rates to determine the seeding rate that maximized yield and profit. The target seeding rates were 90,000, 120,000, and 150,000 seeds/ac. Stand counts and Dectes stem borer counts were taken on September 23. High wind laid beans over.

Results:

Treatment (seeds/ac)	Stand Count (plants/ac)	% of Planted Seeds Present at Harvest	Dectes Stem Borer Infestation %	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
90,000	76,000 C*	85 B	6 A	11.3 A	56 A	69 A	528.04 A
120,000	111,500 B	93 A	8 A	11.2 A	56 A	69 A	519.62 AB
150,000	132,125 A	88 AB	9 A	11.5 A	56 A	69 A	501.73 B
P-Value	<0.0001	0.029	0.867	0.135	0.664	0.608	0.028

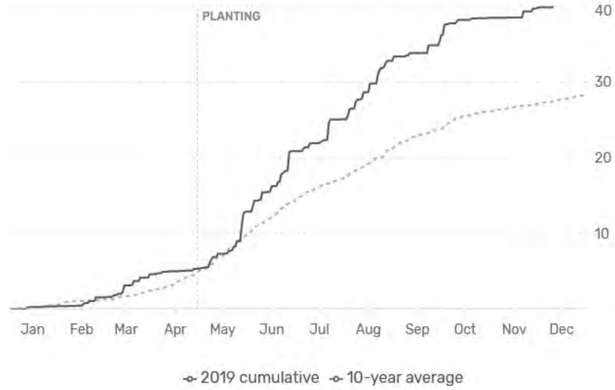
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $49.45/unit seed ($31.79/ac for 90,000 seeds/ac; $42.39/ac for 120,000 seeds/ac; $52.98/ac for 150,000 seeds/ac)

Summary:

- Final plant stands at harvest ranged from 85% to 93% of the planting rate.
- There was no difference in test weight, grain moisture, Dectes stem borer counts, or yield between the seeding rates evaluated.
- The lowest seeding rate had the highest net return.

Irrigated Soybean Population Study

Study ID: 0811185201902
County: York
Soil Type: Hastings silt loam, 1-3% slope; Hord silt loam, 1-3% slope; Hastings silt loam, 0-1% slope
Planting Date: 4/29/19
Harvest Date: 10/18/19
Row Spacing (in): 30
Variety: Pioneer® P33A53X
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 1 pt/ac 2-4D LV EST, 4 oz/ac Authority® First, 2 pts/ac Boundary®, 24 oz/ac Durango® ***Post:*** 32 oz/ac Durango®,1 pt/ac Ultra Blazer®, 8 oz/ac clethodim, 2 oz/ac Anthem® MAXX
Seed Treatment: Gaucho® and Lumivia™
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: None
Irrigation: Pivot, Total: 2"
Rainfall (in):



Introduction: Previous on-farm research has demonstrated that soybean planting rates of 80,000 to 120,000 seeds/ac resulted in the highest profitability. The purpose of this study was to evaluate three seeding rates to determine the seeding rate that maximized yield and profit. The target seeding rates were 90,000, 120,000, and 150,000 seeds/ac. Stand counts and Dectes stem borer counts were taken on October 8.

Results:

Treatment (seeds/ac)	Stand Count (plants/ac)	% of Planted Seeds Present at Harvest	Dectes Stem Borer Infestation %	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
90,000	82,750 C*	92 A	5 A	10.5 A	57 A	72 A	553.62 A
120,000	109,750 B	92 A	6 A	10.5 A	57 AB	74 A	555.24 A
150,000	130,500 A	87 A	9 A	10.7 A	57 B	74 A	556.43 A
P-Value	<0.0001	0.206	0.168	0.207	0.062	0.269	0.970

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $49.45/unit ($31.79/ac for 90,000 seeds/ac; $42.39/ac for 120,000 seeds/ac; $52.98/ac for 150,000 seeds/ac)

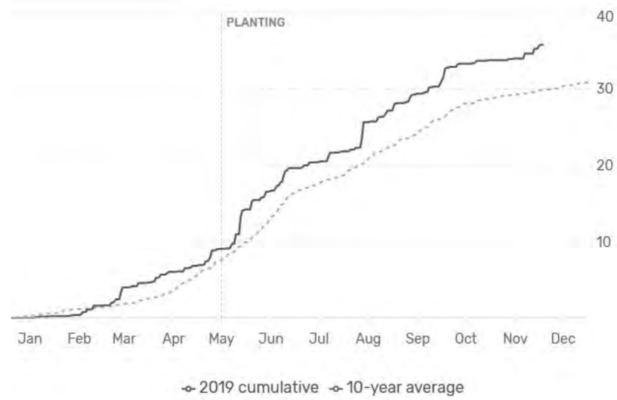
Summary:

- Final plant stands at harvest ranged from 87% to 92% of the seeding rate.
- There was no difference in grain moisture, Dectes stem borer counts, yield, or net return between the seeding rates evaluated.

Non-irrigated Soybean Planting Population

Study ID: 0820037201901
County: Colfax
Soil Type: Belfore silty clay loam 0-2% slope; Moody silty clay loam 2-6% slopes
Planting Date: 5/15/19
Harvest Date: 10/18/19
Row Spacing (in): 15
Variety: Pioneer® P27A17X
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Post:*** 22 oz/ac XtendiMax®, 54 oz/ac Roundup®, and 21 oz/ac Charger Max® on 6/7/19
Seed Treatment: LumiGEN™
Foliar Insecticides: 10 oz/ac Tundra® Supreme on 8/1/19
Foliar Fungicides: 6.0 oz/ac Aproach® Prima on 8/1/19

Fertilizer: 1.8 tons/ac ag lime on 12/12/18; field had 25 ton/ac of cattle feedlot manure spread in the spring of 2017
Irrigation: None
Rainfall (in):



Soil Tests (January 2018 – average of study area):

OM %	CEC	pH	BpH	Nitrate	Phosphorus P1	Phosphorus P2	K	Mg	Ca	S	Zn	Mn	Fe	Cu	B	Na
				--------	--------	--------	--------	ppm	--------	--------	--------	--------	--------	--------	--------	--------
2.9	23.4	6.0	6.6	9	55	73	354	608	2752	24	3.0	8	52	1.4	0.5	44

Introduction: Previous on-farm research has demonstrated that soybean planting rates of 80,000 to 120,000 seeds/ac resulted in the highest profitability. The purpose of this study was to evaluate three seeding rates to determine the seeding rate that maximized yield and profit. The target seeding rates were 120,000, 140,000, and 160,000 seeds/ac; treatment seeding rates listed were the closest planter population settings available. Stand counts were taken on June 25, 2019 and October 16, 2019. The soybeans were planted into a cereal rye cover crop that was drilled November 20, 2018 at 45 lb/acre. The rye was in boot stage at termination. There was some thistle caterpillar feeding, so an insecticide with a residual was applied to prevent additional damage.

Results:

Treatment (seeds/ac)	Early Season Stand Count (plants/ac)	Harvest Stand Count (plants/ac)	% of Planted Seeds Present at Harvest	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
120,000	108,250 C*	107,750 C	90 A	10.2 A	74 A	517.03 A
140,500	128,063 B	129,125 B	92 A	10.1 A	73 A	501.06 A
158,500	143,625 A	145,125 A	92 A	10.1 A	75 A	508.40 A
P-Value	<0.0001	0.001	0.758	0.559	0.152	0.192

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $72/unit of soybean seed ($61.71/ac for 120,000 seeds/ac; $72.26/ac for 140,500 seeds/ac; $81.51/ac for 158,500 seeds/ac).

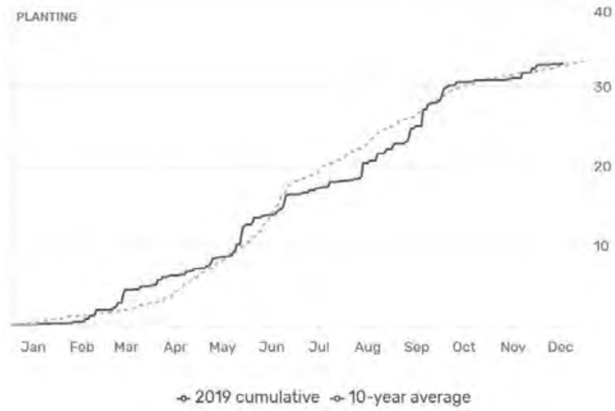
Summary:

- Final plant stands at harvest ranged from 90 to 92% of the planting rate.
- There was no difference in grain moisture or yield between the seeding rates tested.
- There was no significant difference in marginal net return between the three seeding rates evaluated.

Soybean Benchmarking-Baseline vs Improved Soybean Practices

Study ID: 0926039201901
County: Cuming
Soil Type: Kennebec silt loam, overwash, occasionally flooded
Harvest Date: 10/16/19
Seeding Rate: 150,000
Row Spacing (in): 30
Variety: Midland Genetics® 2819E3
Reps: 5
Previous Crop: Corn, baled residue
Tillage: Conventional-Till
Herbicides: ***Pre:*** 2 pt/ac Treflan® ***Post:*** Enlist Duo®
Seed Treatment: CruiserMaxx®
Fertilizer: Manure on 10/15/18

Irrigation: None
Rainfall (in):



Soil Tests (June 2019 - average of study area):

Soil pH 1:1	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI %	Nitrate – N ppm N	Nitrate lb N/A (0-8”)	Mehlich P-III ppm P	Ammonium Acetate (ppm)				M-2 Sulfate ppm S	DTPA (ppm)				Boron ppm	CaNO3 Chloride ppm Cl	CEC me/100g	% Base Saturation				
							K	Ca	Mg	Na		Zn	Fe	Mn	Cu				H	K	Ca	Mg	Na
6.7	0.19	None	1.3	12.4	30	74	388	1856	249	14	9.9	1.51	39.4	8.0	0.69	0.50	3.0	12.4	0	8	75	17	0

Introduction: Analysis of producer survey data revealed: (1) an average yield gap of 20-30% between current farmer yield and potential yield as determined by climate, soil, and genetics, and (2) a number of agronomic practices that, for a given soil-climate context, can be fine-tuned to close the gap and improve soybean producer profit. In Nebraska, three practices were identified as being important for improving yield and producer profit. These practices relate to planting date, seeding rate, and the use of foliar fungicides and insecticides. This study collectively tested the "baseline" practices versus the "improved" practices.

In this study, both the baseline and improved treatment were planted at a rate of 150,000 seeds/ac. The baseline treatment was planted on May 16 with no foliar fungicide or insecticide. The improved treatment was planted on May 6 with a fungicide (Priaxor®) and insecticide (Sniper®) on July 24.

Soybean cyst nematode tests for this field came back negative.

Results:

	Stand Count (plants/ac)	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Baseline: Late Planted, No Fungicide & Insecticide	131,689 A*	56 A	11.6 A	66 B	531.52 A
Improved: Early Planted, Fungicide and Insecticide	114,757 B	56 A	11.5 A	73 A	552.11 A
P-Value	0.083	0.621	0.74	0.006	0.137

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $40/ac for fungicide, insecticide, and application for the improved treatment.

Summary:

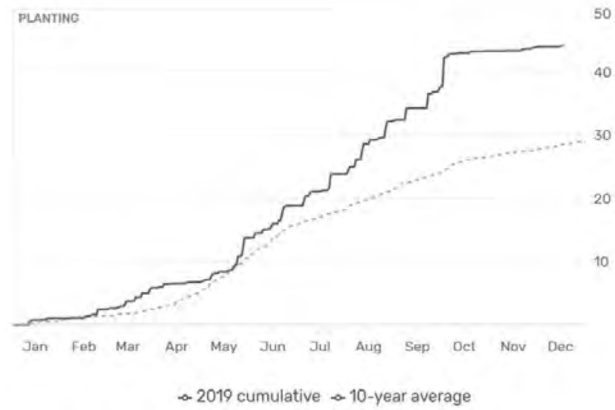
- Despite using the same seeding rate, stand counts were different between the two treatments.
- The improved treatment (early planting and fungicide and insecticide application) resulted in a 7.5 bu/ac yield increase. Marginal net return was not significantly different between the treatments.
- Treatment differences were not visible in aerial imagery at this site.

This study was conducted in cooperation with a regional study funded by the North Central Region Soybean Research Program.

Soybean Benchmarking-Baseline vs Improved Soybean Practices

Study ID: 0917059201901
County: Fillmore
Soil Type: Crete silt loam 1-3% slope
Harvest Date: 10/23/19
Row Spacing (in): 30
Variety: Channel® 3519R2X
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 4 oz/ac Fierce® XLT, 22 oz/ac XtendiMax®, 32 oz/ac glyphosate, and 12.9 oz/ac MOUNTAINEER® MAX on 5/14/19 ***Post:*** 22 oz/ac Roundup PowerMAX® and 6 oz/ac chlethodim with 17 lb dry AMS/100 gallon solution
Seed Treatment: Marauder® (inoculant) and Inovate® (fungicide and insecticide)

Fertilizer: None
Irrigation: None
Rainfall (in):



Soil Tests (Oct 2019 - average of each treatment):

	Soil pH 1:1	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI %	Nitrate – N ppm N	Nitrate lb N/A (0-8")	Mehlich P-III ppm P	Ammonium Acetate (ppm) K	Ca	Mg	Na	M-2 Sulfate ppm S	DTPA (ppm) Zn	Fe	Mn	Cu	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
Baseline	6.4	0.16	None	3.0	6.2	15	28	403	2457	351	31	15.6	1.32	62.5	17.1	1.09	21.5	24	5	56	14	1
Improved	6.3	0.15	None	3.3	6.2	15	21	397	2504	361	10	9.8	1.07	65.6	18.1	1.11	22.7	27	4	55	13	0

Introduction: Analysis of producer survey data revealed: (1) an average yield gap of 20-30% between current farmer yield and potential yield as determined by climate, soil, and genetics, and (2) a number of agronomic practices that, for a given soil-climate context, can be fine-tuned to close the gap and improve soybean producer profit.

In Nebraska, three practices were identified as being important for improving yield and producer profit. These practices relate to planting date, seeding rate, and the use of foliar fungicides and insecticides. This study collectively tested the "baseline" practices versus the "improved" practices.

In this study, the baseline treatment was soybeans planted on June 2 at a rate of 160,000 seeds/ac with no foliar fungicide or insecticide. The improved treatment was soybeans planted on May 3 at a rate of 130,000 seeds/ac with a foliar fungicide and insecticide application on July 31 with 10 oz/ac Affiance® and 4 oz/ac FanFare®.

Soybean cyst nematode tests for this field came back negative.

Results:

	Harvest Stand Count (plants/ac)	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Baseline: Late Planted, Higher Seeding Rate, No Fungicide & Insecticide	107,500 A*	57 A	10.7 B	75 B	551.19 B
Improved: Early Planted, Lower Seeding Rate, Fungicide and Insecticide	104,500 A	57 A	10.8 A	79 A	568.60 A
P-Value	0.734	0.591	0.058	0.016	0.057

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $49.45/unit seed ($56.51/ac for baseline and $45.92/ac for improved), $15/ac for fungicide and insecticide for improved treatment, and $6.94/ac for application of fungicide and insecticide on improved treatment.

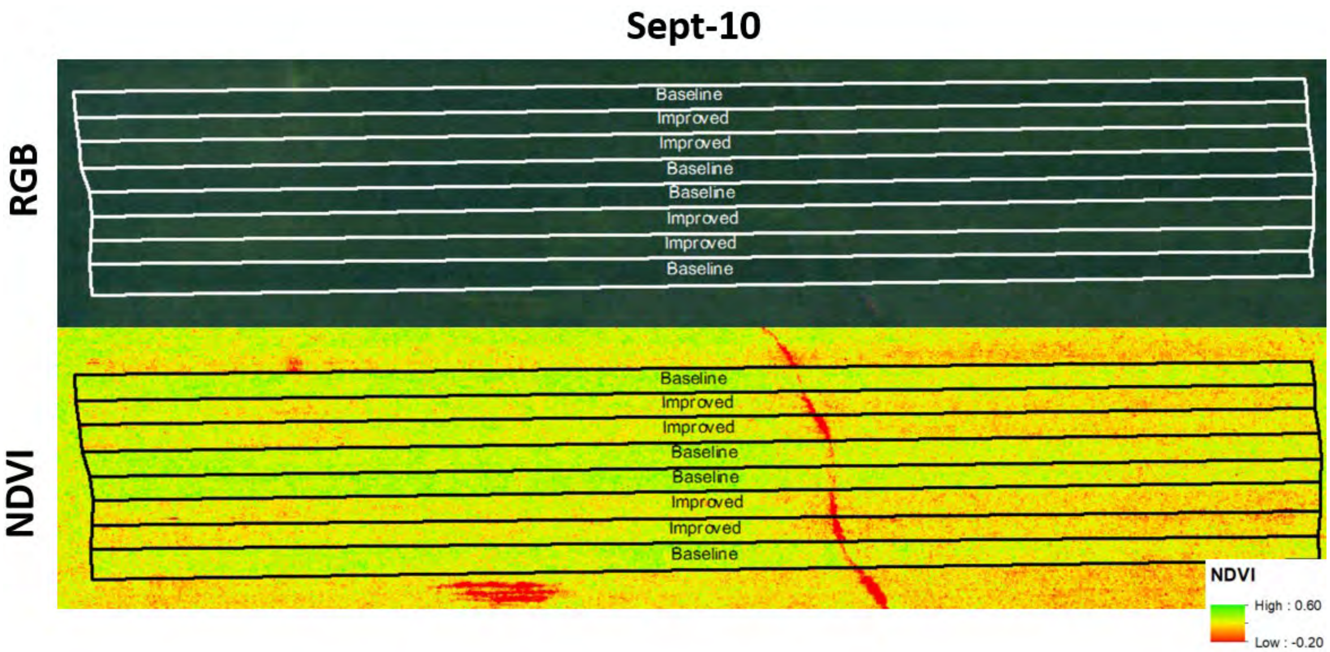


Figure 1. Aerial imagery from September 10 displayed as true color (top) and normalized difference vegetation index (NDVI) (bottom).

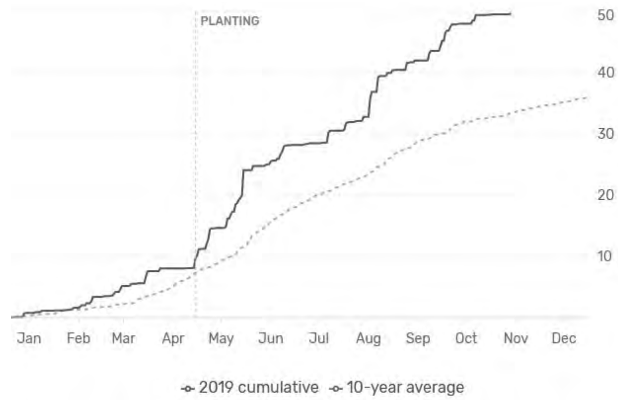
Summary:

- Despite different seeding rates for the two treatments, stand counts at harvest were not significantly different.
- The improved treatment (lower seeding rate with early planting and fungicide and insecticide application) resulted in a 3.6 bu/ac yield increase and $17.41/ac increase in profit.
- Aerial imagery from September 10 showed the improved treatment was less green and had lower NDVI values indicating these plots were senescing earlier.

This study was conducted in cooperation with a regional study funded by the North Central Region Soybean Research Program.

Soybean Benchmarking-Baseline vs Improved Soybean Practices

Study ID: 0821147201901
County: Richardson
Soil Type: Wabash silty clay loam, occasionally flooded
Harvest Date: 10/25/19
Row Spacing (in): 15
Variety: Pioneer® P40A47X
Reps: 4
Previous Crop: Corn
Tillage: No-Till, Strip-Till
Herbicides: ***Pre:*** 32 oz/ac Buccaneer® 5, 8 oz/ac dicamba, and 6 oz/ac Zidua® PRO on 4/16/19 ***Post:*** 32 oz/ac Buccaneer® 5, 10 oz/ac Outlook®, and 6 oz/ac Volunteer® on 6/12/19
Seed Treatment: None
Fertilizer: None
Irrigation: None
Rainfall (in):



Soil Tests (July 2019 - average of study area)

pH	BpH	CEC	1:1 S Salts	OM	Nitrate-N	K	S	Zn	Fe	Mn	Cu	Ca	Mg	Na	H	K	Ca	Mg	Na	Mehlich P-III
		meq/100g	mmho/cm	%	ppm	ppm									%					ppm
6	6.8	14.9	0.09	3	4.4	136	3.8	1.12	68.8	17.3	0.93	2156	258	7	11	2	72	14	0	40

Introduction: Analysis of producer survey data revealed: (1) an average yield gap of 20-30% between current farmer yield and potential yield as determined by climate, soil, and genetics, and (2) a number of agronomic practices that, for a given soil-climate context, can be fine-tuned to close the gap and improve soybean producer profit.

In Nebraska, three practices were identified as being important for improving yield and producer profit. These practices relate to planting date, seeding rate, and the use of foliar fungicides and insecticides. This study collectively tested the "baseline" practices versus the "improved" practices.

In this study, the baseline treatment was soybeans planted on June 5 at a rate of 160,000 seeds/ac with no foliar fungicide or insecticide. The improved treatment was soybeans planted on April 26 at a rate of 130,000 seeds/ac with a fungicide (4 oz/ac Priaxor®) and insecticide (4 oz/ac Hero®) application in mid-July.

Soybean cyst nematode tests for this field came back negative.

Results:

	Early Season Stand Count (plants/ac)	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Baseline: Late Planted, Higher Seeding Rate, No Fungicide & Insecticide	133,817 A*	55 A	12.3 B	65 B	473.02 B
Improved: Early Planted, Lower Seeding Rate, Fungicide & Insecticide	98,984 B	56 A	12.7 A	74 A	531.35 A
P-Value	0.038	0.245	0.002	0.001	0.002

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from yield monitor data. Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $49.45/unit seed ($56.51/ac for baseline and $45.92/ac for improved), $452/gal Priaxor®, and $138/gal Hero® ($18.44/ac for fungicide and insecticide for improved treatment), and $6.94/ac for application of fungicide and insecticide on improved treatment.

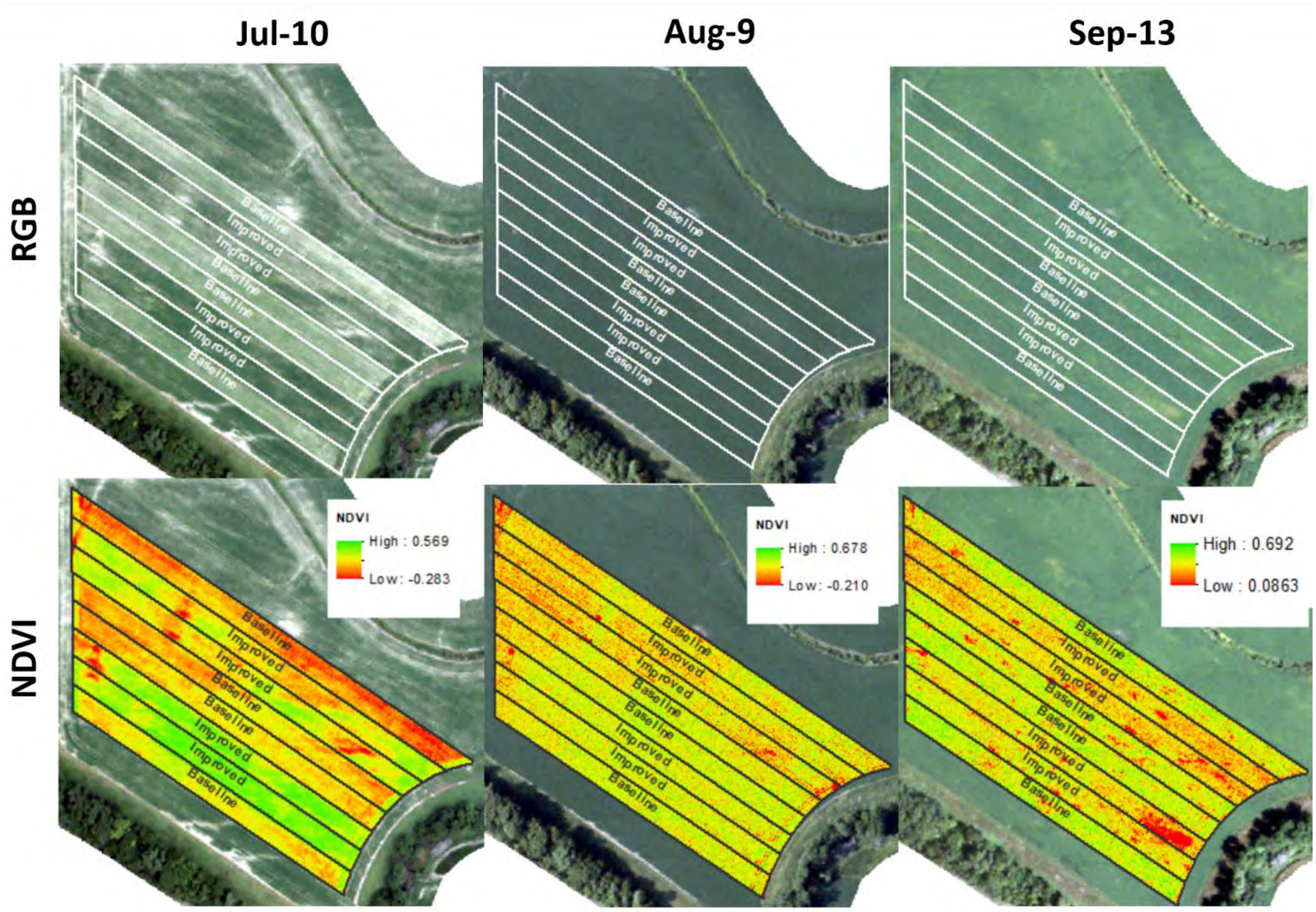


Figure 1. Aerial imagery from July 10, August 9, and September 13 displayed as true color (top) and normalized difference vegetation index (NDVI) (bottom).

Summary:

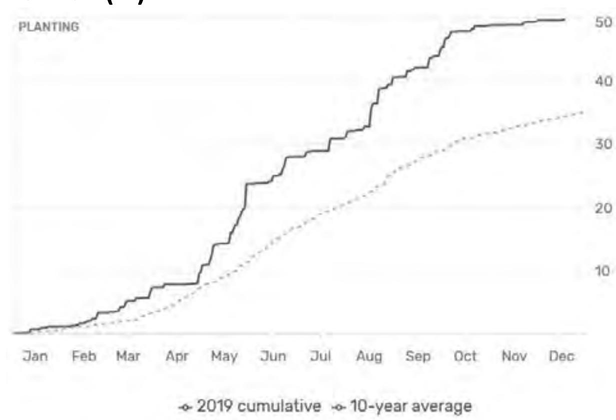
- The improved treatment (lower seeding rate with early planting and fungicide and insecticide application) resulted in a 9 bu/ac yield increase and a $58.32/ac increase in profit.
- Aerial imagery from July 10 showed the improved treatment was greener and had higher NDVI values compared to the baseline treatment. September 13 imagery showed the improved treatment was less green and had lower NDVI values compared to the baseline treatment, corresponding to earlier senescence for the early planted treatment.

This study was conducted in cooperation with a regional study funded by the North Central Region Soybean Research Program.

Soybean Benchmarking-Baseline vs Improved Soybean Practices

Study ID: 0416147201901
County: Richardson
Soil Type: Monona silt loam 1-6% slopes
Harvest Date: 10/19/19
Row Spacing (in): 15
Variety: Pioneer® P33A53X
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 9 oz/ac Authority® Supreme, 24 oz/ac WeedMaster®, and 24 oz/ac glyphosate on 4/13/19 ***Post:*** 2.5 pt/ac Warrant®, 12.8 oz/ac Engenia®, 30 oz/ac glyphosate, and 8 oz/ac Volunteer® on 6/13/19
Seed Treatment: biological, Gaucho®, Lumisena™, rhizobia, EverGol® Energy

Foliar Insecticides: Entire field received 5 oz/ac Hero® on 6/20/19 for thistle caterpillars
Fertilizer: 51 lb K/ac as 0-0-60 on 4/15/19; 6.9 lb N/ac and 33 lb P/ac as 11-52-0 on 4/15/19
Irrigation: None
Rainfall (in):



Soil Tests (July 2019 - average of study area)

pH	BpH	CEC	1:1 S Salts	OM	Nitrate-N	K	S	Zn	Fe	Mn	Cu	Ca	Mg	Na	H	K	Ca	Mg	Na	Mehlich P-III
		meq/100g	mmho/cm	%	ppm	----------------------------ppm------------------------									-----------%----------					---ppm--
6.1	6.8	16.6	0.09	3.9	9	186	8.7	1.5	36.8	12.1	0.62	2421	297	8	9	3	73	15	0	28

Introduction: Analysis of producer survey data revealed: (1) an average yield gap of 20-30% between current farmer yield and potential yield as determined by climate, soil, and genetics, and (2) a number of agronomic practices that, for a given soil-climate context, can be fine-tuned to close the gap and improve soybean producer profit.

In Nebraska, three practices were identified as being important for improving yield and producer profit. These practices relate to planting date, seeding rate, and the use of foliar fungicides and insecticides. This study collectively tested the "baseline" practices versus the "improved" practices.

In this study, the baseline treatment was soybeans planted on June 1 at a rate of 160,000 seeds/ac. The improved treatment was soybeans planted on April 20 at a rate of 130,000 seeds/ac. Both treatments were sprayed with 5 oz/ac Hero® on June 20 due to thistle caterpillar presence and damage. On July 30, the improved treatment received a foliar fungicide and insecticide application of 4 oz/ac Priaxor® and 5 oz/ac Hero®.

Soybean cyst nematode tests for this field came back negative. Sudden death syndrome (SDS) was identified in this field and was found to be located primarily in the improved (early planted) treatment. The locations in the field with sudden death syndrome are apparent in aerial imagery (Figure 1).

Results:

	Early Season Stand Count (plants/ac)	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Baseline: Late Planted, Higher Seeding Rate, No Fungicide & Insecticide	146,667 A*	56 A	10.2 A	71 B	504.55 B
Improved: Early Planted, Lower Seeding Rate, Fungicide and Insecticide	110,167 B	57 A	10.3 A	83 A	591.98 A
P-Value	0.001	0.083	0.703	0.007	0.011

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean, $59.24/unit seed ($67.70/ac for baseline and $55.01/ac for improved), $452/gal Priaxor®, and $138/gal Hero® ($19.52/ac for fungicide and insecticide for improved treatment), and $6.94/ac for application of fungicide and insecticide on improved treatment.

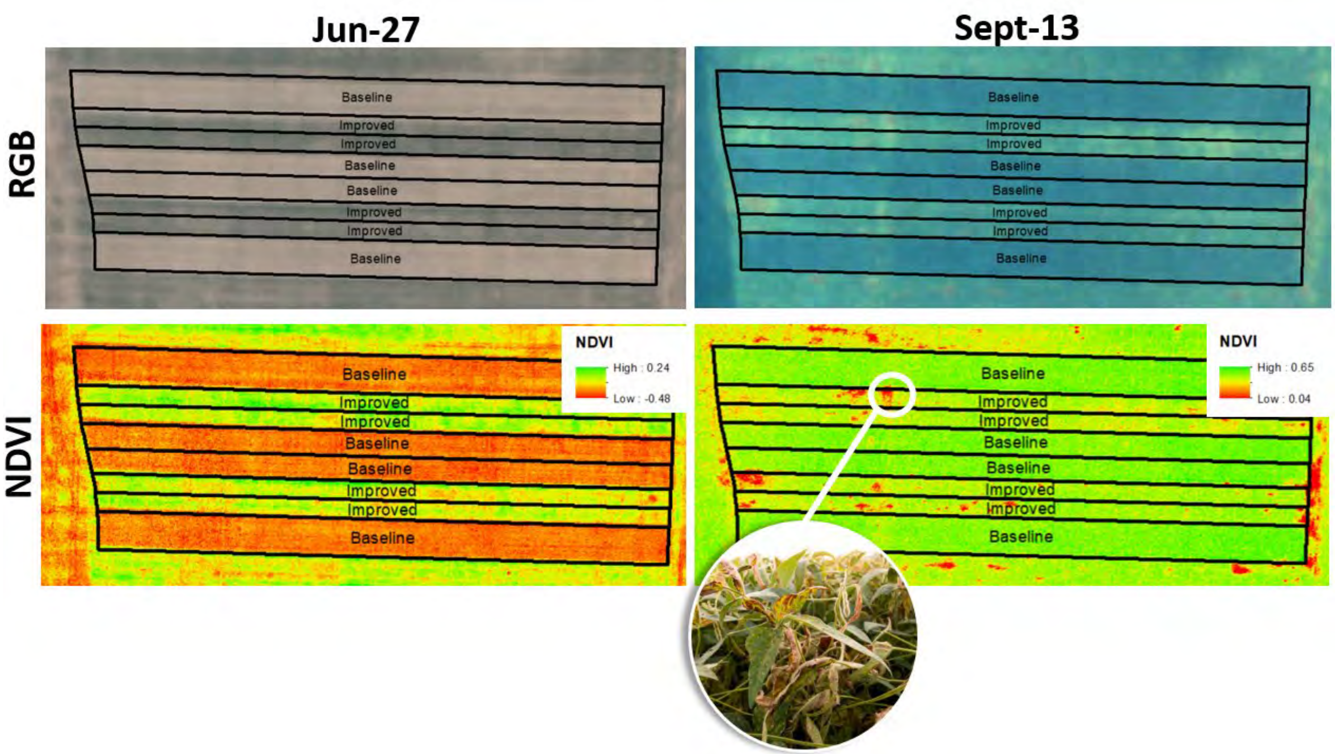


Figure 1. Aerial imagery from June 27 and September 13 displayed as true color (top) and normalized difference vegetation index (NDVI) (bottom).

Summary:

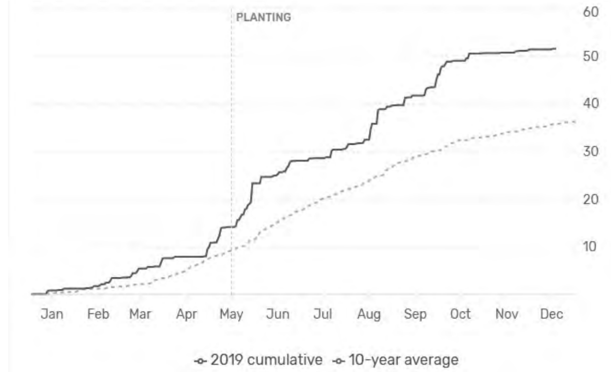
- The improved treatment (lower seeding rate with early planting and fungicide and insecticide application) resulted in a 12.5 bu/ac yield increase and a $87.43/ac increase in profit.
- Aerial imagery from June 27 showed the improved treatment was greener and had higher NDVI values compared to the baseline treatment. September 13 imagery showed the improved treatment was less green, had lower NDVI values, and had incidence of SDS (red spots in NDVI imagery).

This study was conducted in cooperation with a regional study funded by the North Central Region Soybean Research Program.

Impact of Variable Rate Seeding on Non-irrigated Corn

Study ID: 0416147201905
County: Richardson
Soil Type: Monona silt loam 6-11% slopes; Kennebec silt loam rarely flooded; Judson silt loam 2-6% slopes
Planting Date: 5/15/19
Harvest Date: 11/9/19
Row Spacing (in): 30
Variety: Pioneer® P1870
Reps: 6
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** None ***Post:*** 2.25 qt Keystone® NXT, 5.3 oz/ac Callisto®, 32 oz/ac glyphosate on 6/1/19
Seed Treatment: Poncho® 1250 + VOTiVO® and Raxil®
Foliar Insecticides: None
Foliar Fungicides: 10 oz/ac Headline AMP® on 7/29/19

Fertilizer: 170 lb N/ac as anhydrous ammonia on 4/10/19; 133 lb/ac 0-0-60, 179 lb/ac 11-52-0, 84 lb/ac gypsum on 4/15/19; 1.0 gal/ac CoRoN® on 7/29/19
Irrigation: None
Rainfall (in):



Introduction: Many farmers now have planters that can vary seeding rate on the go. The goal of the technology is to optimize seeding rate by within-field management zones and therefore optimize return on seed investment. Practically, there are still questions related to 1) what factors to use to delineate management zones for seeding, and 2) how to determine the optimal rate in each management zone.

Many companies offer variable rate seeding prescriptions based on proprietary algorithms or models. In this study, three seeding rate management zones were delineated with Helena® AGRIntelligence® SeedStrong® (Figure 1). The SeedStrong® tool utilized yield data files from 2003, 2005, 2007, 2009, 2011, 2015, and 2017 and grid soil samples from 2018. The rates for each management zone were assigned by the farmer. To evaluate the seeding prescription, rate blocks with all three seeding rates were placed in multiple locations in the field in both the low seeding rate zone and the medium seeding rate zone (Figure 1). Evaluation blocks were not able to be placed in the high seeding rate zones because the size and shape of these zones did not allow for blocks to fit. Stand count, grain moisture, and yield were evaluated for each of the evaluation blocks, both overall and by zone. As-planted data were examined to ensure that all areas used for yield data analysis were planted at rates within 15% of the target seeding rate.

Results:

Across all zones, there was no impact of seeding rate on yield, moisture, or marginal net return.

	Harvest Stand Count (plants/ac)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
30,000 seeds/ac	28,447 C*	18.3 A	249 A	865.94 A
33,000 seeds/ac	31,205 B	18.4 A	249 A	855.35 A
36,000 seeds/ac	33,672 A	18.4 A	254 A	866.56 A
P-Value	0.0002	0.430	0.133	0.478

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $236.28/80,000 seeds ($88.60/ac for 30,000 seeds/ac; $97.47/ac for 33,000 seeds/ac; $106.33/ac for 36,000 seeds/ac)

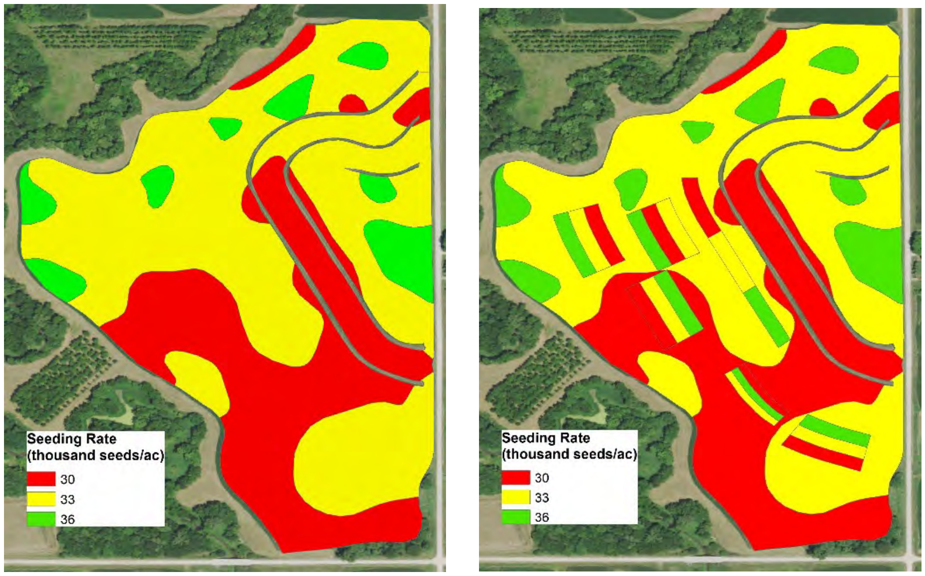


Figure 1. Three seeding rate management zones delineated with Helena® AGRIntelligence® SeedStrong® with rates assigned by the farmer (left) and seeding rate management zones with rate check blocks added to evaluate seeding rates in the low and medium zone (right).

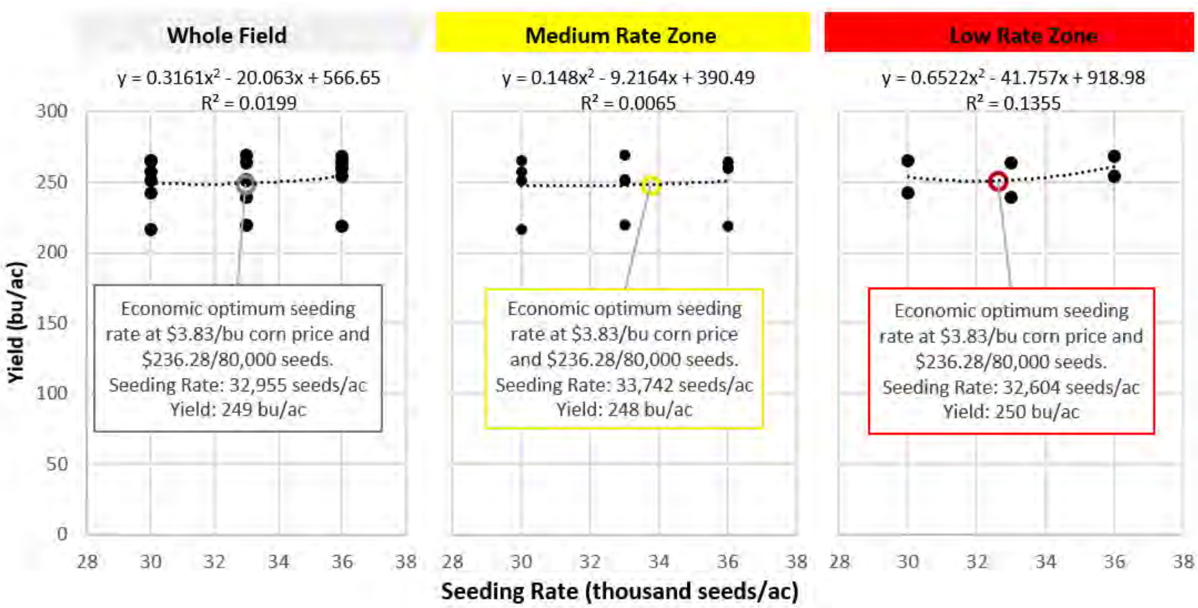


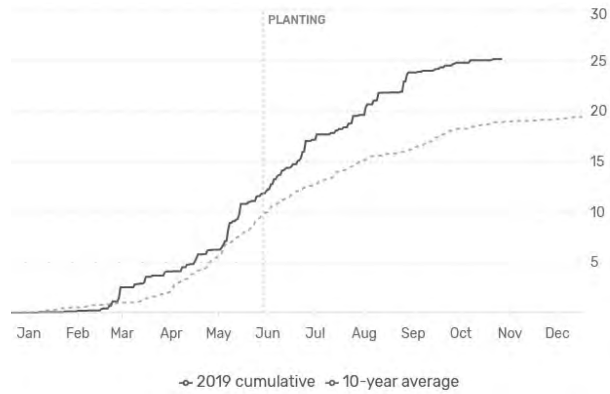
Figure 2. Economic optimum seeding rate when considering rate blocks over the whole field (left), rate blocks within the medium rate zone (middle), and rate blocks within the low rate zone (right).

Summary:

- Harvest stand counts were significantly different, and ranged from approximately 1,600 to 2,300 plants/ac lower than the seeding rate.
- Overall, the economic optimum seeding rate was 33,000 seeds/ac (Figure 2). Economic optimum seeding rate in the medium zone was slightly higher at 33,700 seeds/ac compared to 32,600 seeds/ac in the low zone. There were not large variations in economic optimum seeding rate.
- Collecting additional data, such as electrical conductivity measurements and elevation may help refine management zones and further examine the utility of variable rate seeding in this field.

Pinto Bean Planting Population for Direct Harvested Dry Beans

Study ID: 0807031201901
County: Cherry
Soil Type: Valentine loamy fine sand 3-9% slopes
Planting Date: 6/10/19
Harvest Date: 9/17/19
Row Spacing (in): 20
Variety: La Paz pinto beans
Reps: 4
Previous Crop: Corn
Tillage: Disk chopping vertical till twice and then rolled before planting
Herbicides: ***Pre:*** 1.3 pts/ac Medal® II ***Post:*** 21 oz/ac Varisto® and 7 oz/ac Targa® with 1 pt/ac crop oil
Desiccant: 2 oz/ac Sharpen®, 32 oz/ac Durango®, and 5 oz/ac Flame® with 3 oz/ac Downdraft® and 1 pt/ac MSO on 9/10/19
Seed Treatment: Maxim®, Apron®, Rancona®, and Vibrance®
Foliar Insecticides: 5 oz/ac L-C Insecticide™ pivot-applied
Foliar Fungicides: SaniDate® 12.0 pivot-applied with 2 applications in July and August
Fertilizer: 12 lb N/ac, 45 lb P/ac, 90 lb K/ac, 5 lb S/ac, 1 lb Zn/ac, and 1 lb B/ac dry broadcast; 20 lb N/ac, 40 lb P/ac, 15 lb S/ac, and 1 lb Zn/ac as starter; 70 lb N/ac and 10 lb S/ac through pivot in July; 2.83 lb/ac 32% UAN with post herbicide
Irrigation: Pivot, Total: 7”
Rainfall (in):



Introduction: The purpose of this study was to compare several planting rates of dry edible beans (La Paz pinto variety) planted in 20" row spacing. Target populations were 100,000 and 130,000 plants/ac; however, the planting equipment used resulted in seeding rates that differed from the intended rate. Actual populations were determined by early season stand counts and were 96,703 and 125,344 plants/ac, respectively. To estimate the treatment seeding rate and subsequent seed costs, 10% was added to the stand count values; this resulted in treatment seeding rates of approximately 106,370 and 137,830 seeds/ac, and assumes all treatments had similar emergence and germination. The plots were direct harvested on September 17 with a John Deere® S780 combine and John Deere® 635F flex draper header and Crary® Wind System. Temperature at harvest was 77°F at 54% relative humidity

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 one-square-foot frames randomly chosen in the harvested area, but equally representing the left side of header, center of header, and right side of header area behind the combine.

Results:

Treatment (seeds/ac)	Stand Count (plants/ac)	Pods > 2" above-ground (%)	Harvest Loss (bu/ac)	Small (%)	Split (%)	Foreign Material (%)	Damaged (%)	Moisture (%)	Density (lb/bu)	Seeds per lb	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
100,000	96,703 B*	87 B	1.5 A	3 A	1 A	0 A	5.9 A	15.3 A	60.6 A	1,408 A	33 A	364.27 A
130,000	125,344 A	94 A	1.5 A	4 A	0 A	0 A	8.0 A	15.5 A	60.0 B	1,378 A	34 A	311.43 B
P-Value	0.0001	0.003	0.878	0.387	0.154	0.462	0.130	0.566	0.068	0.409	0.677	0.094

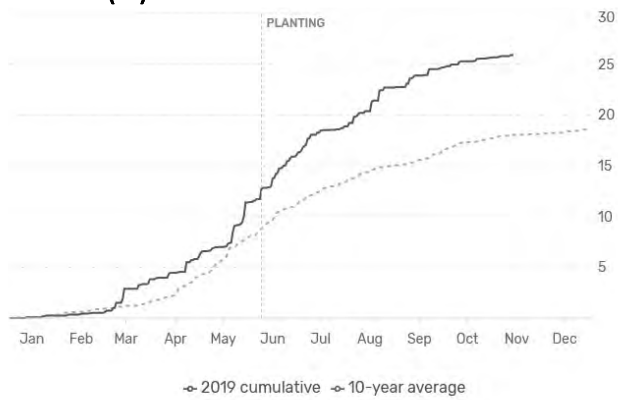
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 14% moisture and adjusted for clean yield (%splits, %small, and % foreign material removed).
‡Marginal net return based on $25/cwt ($15/bu at 60lb/bu). Seed cost for the bean seed was $69.50/100,000 seeds. Seed costs for each treatment were adjusted to represent the estimated actual seeding rate: $73.93/ac for 100,000 seeds/ac, and $95.79/ac for 130,000 seeds/ac treatment.

Summary:

- The percent of pods greater than 2" above the soil was greater for the 130,000 seeds/ac treatment than the 100,000 seeds/ac treatment. Pod heights were fairly good for these treatments with the 130,000 population holding pods significantly higher than the 100,000 population.
- Harvest loss was not different between the two populations tested.
- There were no differences in percent small, percent split, percent foreign material, percent damage, moisture, and seeds per lb.
- There was no yield difference among the two populations tested.
- The surrounding field was planted to La Paz variety pinto beans and the overall average yield for the surrounding field was 33.4 bu/ac.
- Market value for net return was adjusted for beans having more than 3% damage in pinto beans.
- Increasing the seeding rate from 100,000 seeds/ac to 130,000 seeds/ac resulted in lower net returns due to increased seed cost and no yield advantage.

Pinto Bean Planting Population for Direct Harvested Dry Beans

Study ID: 0809013201901
County: Box Butte
Soil Type: Valentine loamy fine sand 0-3% slope
Planting Date: 6/8/19
Harvest Date: 9/24/19
Row Spacing (in): 20
Variety: Radiant
Reps: 4
Previous Crop: Corn
Tillage: Vertical-Till; rolled field after planting, rotary hoe after planting
Herbicides: ***Pre:*** 2 pt/ac Prowl®, 14 oz/ac Outlook®, 22 oz/ac Roundup PowerMAX® ***Post:*** 21 oz/ac Varisto®, 8 oz/ac Basagran®, and 7 oz/ac Outlook®
Desiccant: 2 oz/ac Sharpen® and 2 pt/ac Gramoxone® on 9/15/19
Seed Treatment: Maxim®, Apron®, Dynasty®, Cruiser®, and Vibrance®
Foliar Insecticides: None
Foliar Fungicides: 12 oz/ac Aproach® and 1 application Champ® (copper hydroxide)
Fertilizer: 10 gal/ac 10-34-0 (banded), 5 gal/ac Thio-Sul®, 1 gal/ac Awaken® with coulter machine; 2 gal/ac 10-34-0, 4 gal/ac Riser® (7-17-3), and 4 oz/ac Radiate® (indolebutyric acid and cytokinin) in-furrow at planting
Note: Field was hailed
Irrigation: Pivot, Total: 9-10"
Rainfall (in):



Soil Test (Dec. 2018) – 1 sample taken in the study area:

Soil pH 1:1	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI %	Nitrate-N 0-8" ppm	Nitrate-N 8-36" ppm	Bray P1 ppm	Bray P2 ppm	M-3 Sulfate ppm S	Zn ppm	Mn ppm	Fe ppm	Cu ppm	B ppm	Ammonium Acetate ppm K	Ammonium Acetate ppm Ca	Ammonium Acetate ppm Mg	Ammonium Acetate ppm Na	CEC me/100g	% Base Saturation K	% Base Saturation Ca	% Base Saturation Mg	% Base Saturation Na
6.9	0.2	L	1.3	12	7	40	65	7	2.7	9	32	1	0.6	196	1214	150	34	8	6.3	76.3	15.6	1.8

Introduction: The purpose of this study was to compare several planting rates of dry edible beans (Radiant pinto variety) planted in 20" row spacing. Target populations were 60,000, 100,000, and 130,000 plants/ac; however, the planting equipment used resulted in seeding rates that differed from the intended rate. Actual populations were determined by early season stand counts and were 52,369, 87,699, and 108,603 plants/ac, respectively. To estimate the treatment seeding rate and subsequent seed costs, 10% was added to the stand count values; this resulted in treatment seeding rates of approximately 57,600, 96,470, and 119,460 seeds/ac, and assumes all treatments had similar emergence and germination. The plots were direct harvested on September 24 with a John Deere® S680 combine and MacDon® FD75 FlexDraper® 35-foot head.

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 one-square-foot frames randomly chosen in the harvested area, but equally representing the left side of header, center of header, and right side of header area behind the combine. The field experienced some damaging hail with an estimated 15 bu/ac loss. Plants remained small on this study location probably due to a historical nematode infestation on this field.

Results:

Treatment (seeds/ac)	Stand Count (plants/ac)	Pods > 2" above-ground (%)	Harvest Loss (bu/ac)	Small (%)	Split (%)	Foreign Material (%)	Damaged (%)	Moisture (%)	Density (lb/bu)	Seeds per lb	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
60,000	52,369 C*	66 B	11 A	4 A	3 A	1 A	4.3 A	9.6 A	60.7 A	1,329 A	16 B	200.41 A
100,000	87,699 B	76 A	8.4 B	4 A	2 A	1 A	4.4 A	9.6 A	59.8 A	1,328 A	21 A	242.66 A
130,000	108,603 A	75 AB	7.5 B	4 A	2 A	1 A	3.4 A	9.5 A	60.3 A	1,362 A	20 AB	208.04 A
P-Value	<0.0001	0.033	0.011	0.926	0.243	0.997	0.378	0.670	0.156	0.414	0.084	0.321

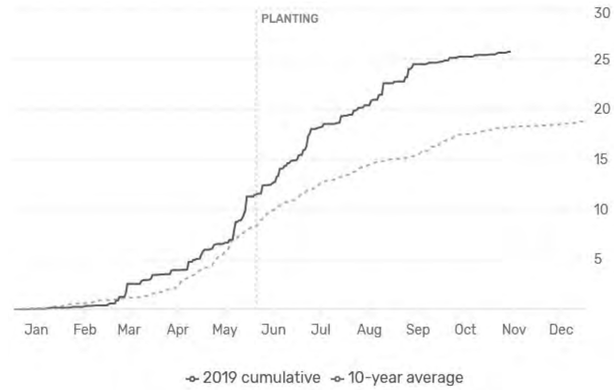
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 14% moisture and adjusted for clean yield (% splits, % small, and % foreign material removed).
‡Marginal net return based on $25/cwt ($15/bu at 60lb/bu). Seed cost for the bean seed was $73/100,000 seeds. Seed costs for each treatment were adjusted to represent the estimated actual seeding rate based on field stand counts: $42.08/ac for 60,000 seeds/ac, $70.42/ac for 100,000 seeds/ac, and $87.21/ac for 130,000 seeds/ac.

Summary:

- Plants didn't grow very tall, so many pods were near the ground. The percent of pods greater than 2" above the soil was greater for the 100,000 and 130,000 seeds/ac treatment. For the 60,000 seeds/ac treatment, only 66% of pods were greater than 2" above the ground.
- Harvest loss was highest for the 60,000 seeds/ac treatment. This is expected as the 60,000 seeds/ac treatment had a greater percentage of pods lower than 2" above the ground. Harvest loss for all treatments was higher than desired, with the lowest harvest loss at 7.5 bu/ac.
- There were no differences in percent small, percent split, percent foreign material, percent damage, moisture, density, and seeds per lb.
- Yields for all treatments were lower than desired due to a nematode infestation and 15-20% hail loss. The 100,000 seeds/ac treatment resulted in a higher yield than the 60,000 seeds/ac treatment. Increasing the seeding rate to 130,000 seeds/ac did not result in additional yield gains.
- There was no difference in net return among the three populations tested.
- Market value for net return was adjusted for beans having more than 3% damage in pinto beans.
- The surrounding field was planted to Radiant variety pintos and the overall average yield was 19.6 bu/ac.

Pinto Bean Planting Population for Direct Harvested Dry Beans

Study ID: 0809123201902
County: Morrill
Soil Type: Valentine sandy loam 3-9% slopes
Planting Date: 6/4/19
Harvest Date: 9/13/19
Row Spacing (in): 20
Variety: Vibrant
Reps: 4
Previous Crop: Corn
Tillage: Ripper/disk; rolled after planting
Herbicides: ***Pre:*** 2 pt/ac Prowl®, 14 oz/ac Outlook®, 22 oz/ac Roundup PowerMAX® ***Post:*** 21 oz/ac Varisto®, 8 oz/ac Basagran®, and 7 oz/ac Outlook® ***Desiccant:*** 2 oz/ac Sharpen® and 2 pt/ac Gramoxone® on 9/5/19
Seed Treatment: Maxim®, Apron®, Dynasty®, Cruiser®, and Vibrance®
Foliar Fungicides: 12 oz/ac Aproach®, 2 applications of Champ® (copper hydroxide)
Fertilizer: 20 ton/ac manure, 2 gal/ac 10-34-0, 4 gal/ac Riser® (7-17-3), 4 oz/ac Radiate® (indolebutric acid and cytokinin) in-furrow at planting; 4 qt/ac Awaken® at first bloom
Irrigation: Pivot, Total: 8"
Rainfall (in):



Soil Test (Nov. 2018) – 1 sample taken in the study area:

Soil pH 1:1	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI %	Nitrate-N 0-8" ppm	Nitrate-N 8-36" ppm	Bray P1 ppm	Bray P2 ppm	Olsen P ppm	M-3 Sulfate ppm S	Zn ppm	Mn ppm	Fe ppm	Cu ppm	B ppm	Ammonium Acetate ppm K	Ammonium Acetate ppm Ca	Ammonium Acetate ppm Mg	Ammonium Acetate ppm Na	CEC me/100g	% Base Saturation K	% Base Saturation Ca	% Base Saturation Mg	% Base Saturation Na
7.5	0.2	L	0.9	16	9	59	86	36	10	3.3	2	8	0.4	0.5	9.5	71.5	17.1	1.9	6.5	241	928	133	29

Introduction: The purpose of this study was to compare several planting rates of dry edible beans (Vibrant pinto variety) planted in 20" row spacing. Target populations were 60,000, 100,000, and 130,000 plants/ac; however, the planting equipment used resulted in seeding rates that differed from the intended rate. Actual populations were determined by early season stand counts and were 50,300, 81,820, and 102,942 plants/ac, respectively. To estimate the treatment seeding rate and subsequent seed costs, 10% was added to the stand count values; this resulted in treatment seeding rates of approximately 55,000, 90,000, and 113,000 seeds/ac, and assumes all treatments had similar emergence and germination. The plots were direct harvested on September 13 with a John Deere® S680 combine and MacDon® FD75S FlexDraper® 35-foot head. The temperature at harvest was 76°F with 31% relative humidity. There was no hail, very little disease, and very good weed control.

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 one-square-foot frames randomly chosen in the harvested area, but equally representing the left side of header, center of header, and right side of header area behind the combine.

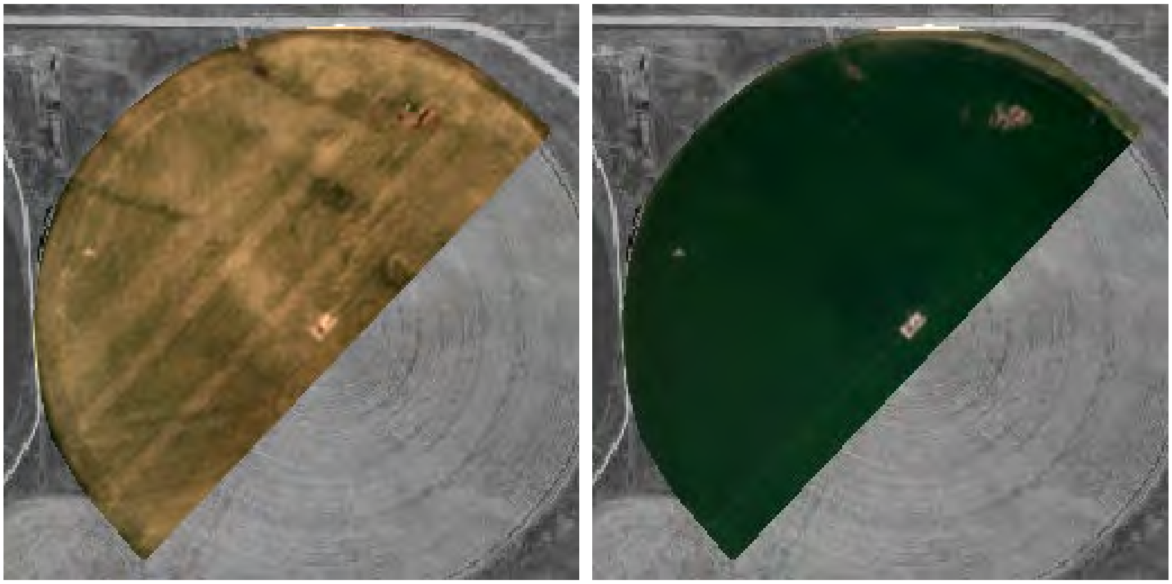


Figure 1. Reduced biomass for the lower population treatment is visible in aerial imagery from July 9 (left). By late July and early August treatment differences were no longer visible as evidenced in aerial imagery from August 5 (right).

Results:

Treatment (seeds/ac)	Stand Count (plants/ac)	Pods > 2" above-ground (%)	Harvest Loss (bu/ac)	Small (%)	Split (%)	Foreign Material (%)	Damaged (%)	Moisture (%)	Density (lbs/bu)	Seeds per lb	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
60,000	50,300 C*	81 B	2.5 A	2 B	1 A	0 A	0.7 A	13.4 A	59.7 A	1,233 A	62 A	893.89 A
100,000	81,820 B	89 A	2.0 A	5 A	1 A	1 A	0.8 A	13.4 A	61.8 A	1,215 A	60 A	836.80 A
130,000	102,941 A	90 A	2.2 A	4 A	1 A	1 A	1.0 A	13.4 A	62.1 A	1,213 A	62 A	843.22 A
P-Value	<0.0001	0.002	0.184	0.015	0.542	0.983	0.571	0.974	0.386	0.826	0.650	0.266

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

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

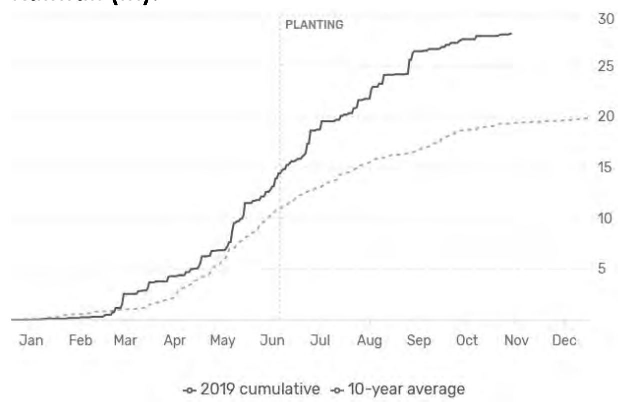
‡Marginal net return based on $25/cwt ($15/bu at 60lb/bu). Seed cost for the bean seed was $73/100,000 seeds. Seed costs for each treatment were adjusted to represent the estimated actual seeding rate based on stand counts: $40.15/ac for 60,000 seeds/ac, $65.85/ac for 100,000 seeds/ac, and $82.71/ac for 130,000 seeds/ac.

Summary:

- Reduced biomass for the lower population treatment was visible in early season imagery, but by late July and early August treatment differences were no longer visually apparent (Figure 1).
- The percent of pods greater than 2" above the soil was greater for the 100,000 and 130,000 seeds/ac treatment; however, the 60,000 seeds/ac treatment still had 81% of pods greater than 2" above the ground.
- The 60,000 seeds/ac treatment had a lower percentage of small seeds than the 100,000 and 130,000 seeds/ac treatments.
- There were no differences in harvest loss, percent split, percent foreign material, percent damage, moisture, density, and seeds per lb.
- There was no difference in yield or marginal net return among the three populations tested. It is interesting to note that the higher populations did not result in significantly higher yields.
- Damage was less than 3% so no price dockage occurred as it did in many other fields in the area.
- The surrounding field was planted to Vibrant variety pintos and the overall average yield was 57 bu/ac.

Pinto Varieties for Direct Harvest

Study ID: 0608013201901
County: Box Butte
Soil Type: Keith loam, 0-1% slope; Busher-Jayem loamy very fine sands, 0-3% slope
Planting Date: 6/20/19
Harvest Date: 10/17/19
Seeding Rate: 110,000
Row Spacing (in): 7.5
Reps: 4
Previous Crop: Corn
Tillage: Vertical-Till, chisel, and two packings
Herbicides: ***Pre:*** 14 oz/ac Outlook® on 6/13/19; 32 oz/ac glyphosate with 13 oz/ac crop oil on 6/19/19
Post: 26.5 oz/ac Basagran®, 4 oz/ac Raptor®, and 8 oz/ac Targa® with 26.5 oz/ac Prime crop oil on 7/19/19
Seed Treatment: Maxim®, Apron XL®, Rancona®, Dynasty®, Cruiser®
Foliar Fungicides: 4.9 oz/ac Priaxor®, 16 oz/ac Badge® SC, and 2 oz/ac PREV-AM® Ultra (aerially applied with 3 gal/ac carrier)
Fertilizer: 45 lb N/ac, 40 lb P/ac, 7 lb S/ac, 2 lb Zn/ac dry spread; 32 oz/ac 32% UAN with pre-herbicide on 6/19/19; 20 lb N/ac and 2 lb S/ac by chemigation in July; 32 oz/ac 32% UAN with post-herbicide on 7/19/19
Irrigation: Pivot, Total: 7"
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.

The study evaluated Gleam, Radiant, Lumen, and Palomino. The study was planted with a 40-foot John Deere® 1990 air drill in 7.5" spacing. The target population for the study was 110,000 plants per acre. Because of the inaccuracy of drills, normally as a result of seed size and seed flow through the machine, actual plant populations determined by early season stand counts were 85,601 plants/ac for Gleam, 70,136 plants/ac for Radiant, 67,740 plants/ac for Lumen, and 68,829 plants/ac for Palomino. Planting populations were assumed to be 10% greater at approximately 94,161 seeds/ac for Gleam, 77,150 seeds/ac for Radiant, 74,514 seeds/ac for Lumen, and 75,712 seeds/ac for Palomino. Emergence of beans in June was poor due to the very wet planting conditions; poor stands are visible in aerial imagery (Figure 1). The study was planted 9 days after the surrounding field due to wet conditions.

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 plots were direct harvested on October 17 with a John Deere® S670 combine with a John Deere® 635F HydraFlex™ 35-foot head and Crary® Wind System. The temperature at harvest was 78°F and 16% relative humidity. Hot and dry weather conditions at harvest generally result in greater harvest loss through pod shattering. The poor emergence and stands resulted in low yields, which are not representative of these varieties in normal growing conditions.

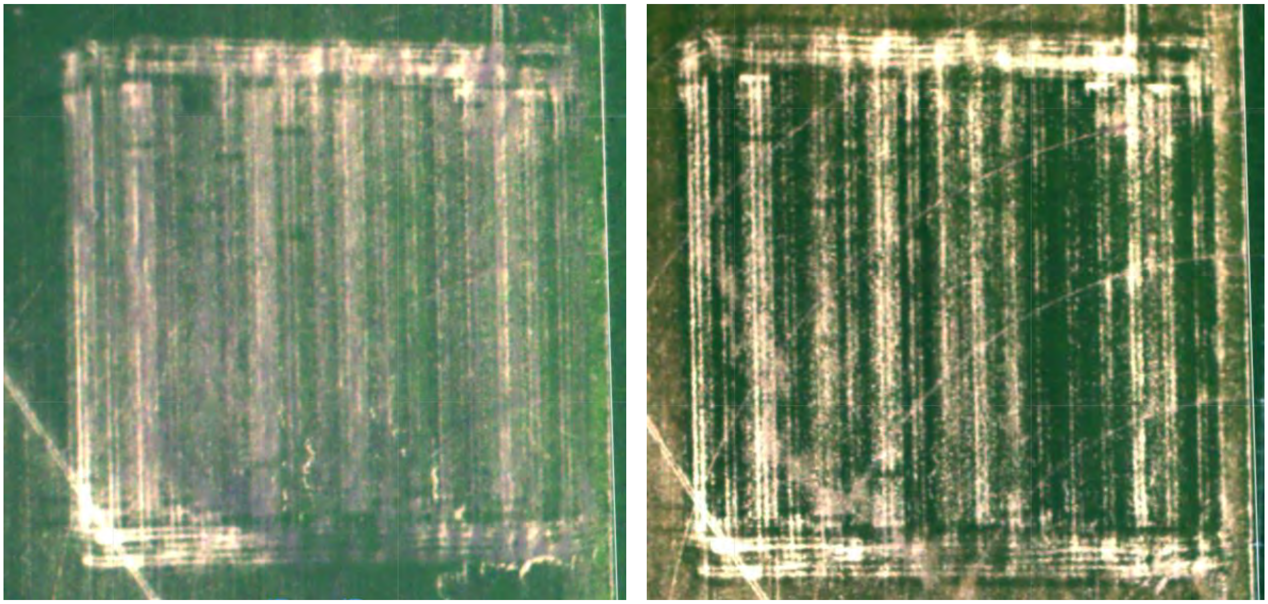


Figure 1. Wet conditions resulted in poor emergence as evidenced in aerial imagery from August 5 (left). The impact of poor emergence continued through the season, with poor stands visible in aerial imagery from September 3 (right) and resulting in low yields.

Results:

	Stand Count (plants/ac)	% Pods >2" above-ground	Harvest Loss (bu/ac)	Small (%)	Split (%)	Foreign Material (%)	Damaged (%)	Moisture (%)	Density (lb/bu)	Seeds per lb	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Gleam	85,600 A*	70 A	13 A	4.4 B	1.0 B	0 A	3.1 A	12.6 B	61.3 A	1,488 A	23 A	269.49 A
Radiant	70,136 AB	61 B	10 AB	4.3 B	2.3 A	1 A	2.2 A	11.3 D	59.1 B	1,435 A	17 B	198.64 B
Lumen	67,740 B	63 AB	7 B	5.8 A	1.0 B	1 A	3.1 A	13.2 A	61.4 A	1,473 A	11 C	102.79 C
Palomino	68,829 B	56 B	9 AB	2.3 C	2.0 AB	1 A	3.3 A	11.8 C	58.5 B	1,448 A	22 A	266.07 A
P-Value	0.055	0.013	0.027	0.0001	0.045	0.160	0.379	<0.0001	<0.0001	0.104	<0.0001	0.0001

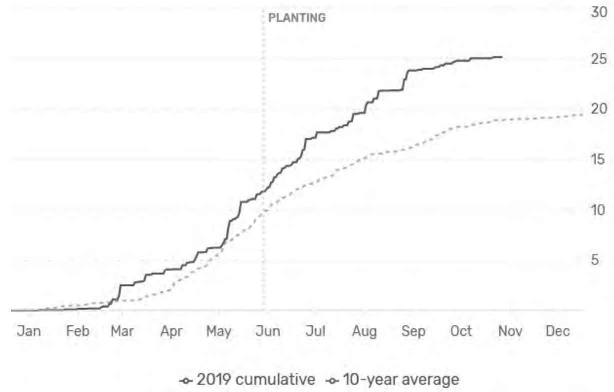
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 14% moisture and adjusted for clean yield (% splits, % small, and % foreign material removed).
‡Marginal net return based on $25/cwt ($15/bu at 60lb/bu). Seed cost for the bean seed was $73/100,000 seeds. Seed costs for each treatment were adjusted to represent the estimated actual seeding rate based on stand counts: $68.74/ac for Gleam, $56.32/ac for Radiant, $54.40/ac for Lumen, and $55.27/ac for Palomino.

Summary:

- There were significant differences in stand counts among the treatments.
- Gleam had the highest percentage of pods greater than 2" above the soil. Palomino had only 56% of pods greater than 2" above the soil.
- Despite having the greater percentage of pods 2" above the soil, Gleam had the greatest harvest loss.
- Percent splits, percent smalls, moisture, and density varied among treatments.
- There was no difference among varieties in seeds per lb, percent foreign material, or percent damage.
- Gleam and Palomino had the highest yield, followed by Radiant. Lumen had the lowest yield.
- Net return followed the same pattern as yield; Gleam and Palomino had the highest net return followed by Radiant. Lumen had the lowest net return.
- Market value for net return was adjusted for beans having more than 3% damage.
- The surrounding field was planted to Radiant variety pintos and the overall field average yield was 26 bu/ac.

Dry Bean Direct Harvest Great Northern Variety

Study ID: 0152013201901
County: Box Butte
Soil Type: Keith loam, 0-1% slope; Goshen loam, 0-1% slope
Planting Date: 6/12/19
Harvest Date: 10/7/19
Seeding Rate: 110,000
Row Spacing (in): 15
Reps: 4
Previous Crop: Corn
Tillage: Disked once, then rolled before planting
Herbicides: ***Pre:*** 30 oz/ac Prowl®, 15 oz/ac Outlook®, and 1 qt/ac Roundup® on 6/10/19 ***Post:*** 30 oz/ac Basagran®, 4 oz/ac Raptor®, and 15 oz/ac Select® on 7/15/19 ***Desiccant:*** 2 pt/ac Gramoxone® with 1 qt/ac crop oil on 9/16/19
Seed Treatment: Apron XL®, Maxim®, Rancona®, Dynasty®, and Cruiser®
Foliar Insecticides: None
Foliar Fungicides: Copper Plus on 8/1/19
Fertilizer: 50 lb N/ac and 50 lb P/ac, dry spread; 900 gal/ac 32-0-0 through pivot
Irrigation: Pivot, Total: 7"
Rainfall (in):



Introduction: The purpose of this study was to compare four different great northern 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.

The study evaluated Draco, Andromeda, Virgo, and 14172. The study was planted with a 20-foot soybean drill in 15" rows. The target population for the study was 110,000 plants per acre. Because of the inaccuracy of drills, normally as a result of seed size and seed flow through the machine, actual plant populations determined by early season stand counts were 82,115 plants/ac for Draco, 74,928 plants/ac for Andromeda, 85,819 plants/ac for Virgo, and 83,967 seeds/ac for 14172. Planting populations were assumed to be approximately 10% greater at 90,300 seeds/ac for Draco, 82,420 seeds/ac for Andromeda, 94,400 seeds/ac for Virgo, and 92,400 seeds/ac for 14172. 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 plots were direct harvested on October 7 with a CaseIH® 7088 combine with a MacDon® 30-foot flex draper head. The temperature at harvest was 69°F and 15% relative humidity. Hot and dry weather conditions at harvest generally result in greater harvest loss through pod shattering.

Results:

	Early Season Stand Count (plants/ac)	Pods > 2" above-ground (%)	Harvest Loss (bu/ac)	Small (%)	Split (%)	Foreign Material (%)	Damaged (%)	Moisture (%)	Density (lb/bu)	Seeds per lb	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
GN Draco	82,115 AB*	38 B	13 A	2 AB	1 B	1 A	4.2 A	14.2 A	57.8 A	1,240 B	36 B	546.55 B
GN Andromeda	74,928 B	46 B	16 A	1 B	1 A	1 A	3.7 A	14.4 A	57.1 A	1,023 C	35 B	529.51 B
GN Virgo	85,818 A	67 A	8 B	2 AB	1 B	0 A	3.2 A	13.6 B	59.1 A	1,258 B	44 A	698.48 A
GN 14172	83,967 AB	50 B	13 A	2 A	1 AB	1 A	3.3 A	13.4 B	59.0 A	1,340 A	32 C	468.74 C
P-Value	0.076	0.003	0.004	0.117	0.048	0.232	0.317	0.001	0.388	<0.0001	<0.0001	<0.0001

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 14% moisture and adjusted for clean yield (% splits, % small, and % foreign material removed).
‡Marginal net return based on $30/cwt ($18/bu at 60 lb/bu). Seed cost for the bean seed was $73/100,000 seeds. Seed costs for each treatment were adjusted to represent the estimated actual seeding rate based on stand counts: Draco $75/100,000 seeds; Andromeda $79/100,000 seeds; Virgo: $77/100,000 seeds; 14172: $77/100,000 seeds.

Summary:

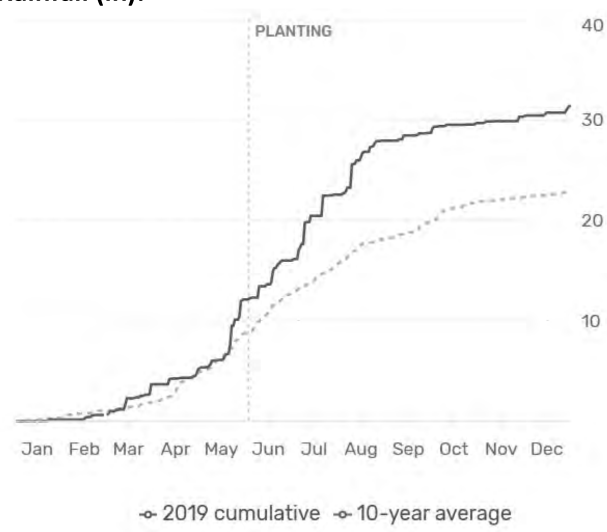
- There were significant differences in stand counts among the treatments.
- Virgo had a higher percentage of pods greater than 2" above the soil than the other varieties; however, the percent of pods greater than 2" above the soil was lower than desired for all varieties tested.
- A greater percentage of pods 2" above the soil resulted in Virgo having less harvest loss than the other varieties tested.
- Percent splits and percent smalls varied among treatments; however, values for all varieties were fairly low and in an acceptable range.
- There was no difference among varieties in percent foreign material, density, or percent damage. Market value for net return was adjusted for beans having more than 2% damage in great northerns.
- Seeds per lb varied among treatments with 14172 having the greatest number of seeds per lb.
- Virgo had the highest yield, followed by Draco and Andromeda. 14172 had the lowest yield.
- Net return followed the same pattern as yield; Virgo had the highest net return followed by Draco and Andromeda. 14172 had the lowest net return.
- The surrounding field was planted to Draco variety great northerns and the overall average yield for the surrounding field was 35 bu/ac.

Fertility & Soil Management

Impact of Soygreen® on Soybeans

Study ID: 0153111201901
County: Lincoln
Soil Type: Cozad silt loam 0-1% slope
Planting Date: 6/2/19
Harvest Date: 10/14/19
Seeding Rate: 140,000
Row Spacing (in): 30
Variety: Pioneer® P24A99X
Reps: 9
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** None ***Post:*** 1.33 pt/ac Brawl™ II, 8 oz/ac clethodim, and 32 oz/ac Roundup®
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: None

Irrigation: Linear-move, Total: 2.1"
Rainfall (in):



Introduction: Iron deficiency chlorosis (IDC) of soybeans is a common problem in fields with high pH levels (alkaline soils). Soygreen® is an iron chelate of ortho-ortho EDDHA form that can help make iron more available to plants. The field in this study has areas with high pH and is susceptible to IDC. In this study, Soygreen® was applied in a liquid formulation (1.8%) at a rate of 1 gal/ac and was compared to an untreated check.

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	10.7 A*	31 A	252.12 A
Soygreen®	10.8 A	30 A	214.18 B
P-Value	0.878	0.333	0.007

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $28/ac Soygreen®.

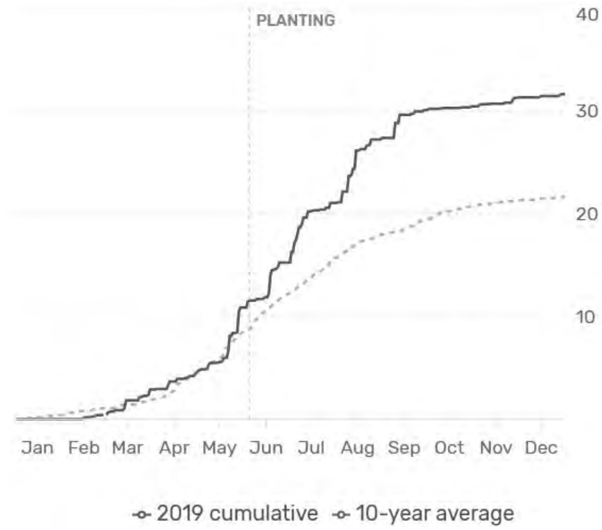
Summary:

- The use of Soygreen® did not increase soybean yield at this location.
- Yields at this site were limited due to herbicide resistant weeds.
- Marginal net return was lower where Soygreen® was used due to the additional product cost, which was not offset by increased yield.

Impact of Soygreen® on Soybeans

Study ID: 0153101201904
County: Keith
Soil Type: Altvan-Dix complex 6-30% slopes; Satanta-Dix complex 3-9% slopes
Planting Date: 6/4/19
Harvest Date: 10/16/19
Seeding Rate: 140,000
Row Spacing (in): 30
Variety: Pioneer® P23A32X
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 32 oz/ac Roundup® and 8 oz/ac 2,4-D ***Post:*** 32 oz/ac Roundup®, 15 oz/ac Authority®, and 32 oz/ac Select Max®
Seed Treatment: Gaucho® insecticide and Lumisena™ fungicide
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: None
Irrigation: Pivot, Total: 6.2"
Rainfall (in):



Introduction: Iron deficiency chlorosis (IDC) of soybeans is a common problem in fields with high pH levels (alkaline soils). Soygreen® is an iron chelate of ortho-ortho EDDHA form that can help make iron more available to plants. The field in this study has areas with high pH and is susceptible to IDC. In this study, Soygreen® was applied in a liquid formulation (1.8%) at a rate of 1 gal/ac and was compared to an untreated check.

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	8.3 A*	23 A	189.32 A
Soygreen®	8.4 A	24 A	165.83 B
P-Value	0.844	0.550	0.040

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $28/ac for Soygreen®.

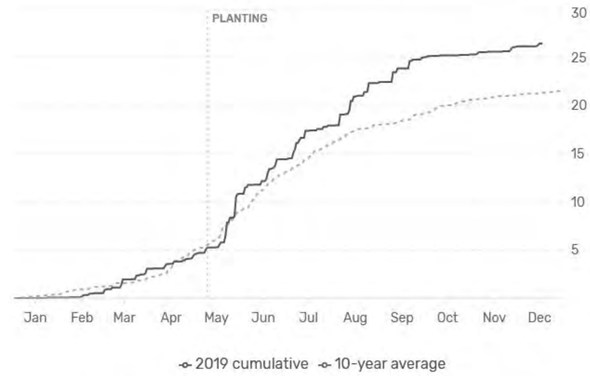
Summary:

- The use of Soygreen® did not increase soybean yield at this location.
- Yields at this site were limited due to hail.
- Marginal net return was lower where Soygreen® was used due to the additional product cost, which was not offset by increased yield.

Impact of Soygreen® on Soybeans

Study ID: 0911101201901
County: Keith
Soil Type: Bayard very fine sandy loam, 1-3% slope
Planting Date: 5/9/19
Note: Hailed off on 5/30/19; hailed off again on 6/7/19; replanted at 60,000 6/12/19
Harvest Date: 10/17/19
Seeding Rate: 160,000
Row Spacing (in): 15
Variety: Stine® 28LF32
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 10 oz/ac Verdict® on 4/28/19
Post: 32 oz/ac Liberty®, 8 oz/ac Select®, and 3 oz/ac Zidua® PRO on 6/12/19; 32 oz/ac Liberty® on 7/10/19
Seed Treatment: Conklin® Magnify® LST, insecticide, and fungicide

Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 3 gal/ac 8-16-11-2S foliar with in-season herbicide; 75 lb/ac AMS sidedress on 7/5/19
Irrigation: Pivot
Rainfall (in):



Introduction: Iron deficiency chlorosis (IDC) of soybeans is a common problem in fields with high pH levels (alkaline soils). Soygreen® is an iron chelate of ortho-ortho EDDHA form that can help make iron more available to plants. The field in this study has areas with high pH and is susceptible to IDC. In this study, Soygreen® was applied in a dry formulation (2%) at a rate of 9 lb/ac and was compared to an untreated check.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	80 B*	650.03 A
Soygreen®	85 A	658.07 A
P-Value	0.040	0.495

†Bushels per acre adjusted to 13% moisture.
*Values with the same letter are not significantly different at a 90% confidence level.
‡Marginal net return based on $8.10/bu soybean and $28/ac Soygreen®.

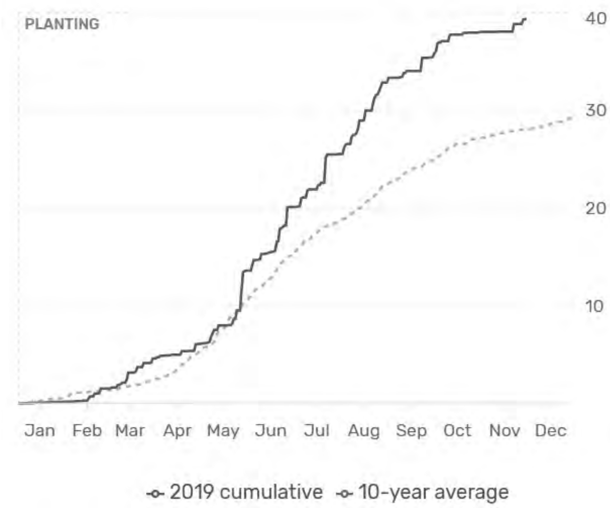
Summary:

- The Soygreen® treatment had a 4.4 bu/ac yield increase.
- There was no difference in marginal net return. Applying Soygreen® only in areas of the field that are susceptible to ICD through site-specific management technologies, such as a multi-hybrid planter, may help maximize the profitability of using this product.

Starter Fertilizer on Irrigated Corn

Study ID: 0718185201902
County: York
Soil Type: Hastings silt loam, 0-1% slopes; Uly-Hobbs silt loams, 11-30% slopes
Planting Date: 4/24/19
Harvest Date: 10/19/2019
Seeding Rate: 34,000
Row Spacing (in): 30
Variety: Pioneer® P1563AM™
Reps: 6
Previous Crop: Soybean
Tillage: Minimum-Till
Herbicides: ***Pre:*** 2 qt/ac Medal® II ATZ and 5 oz/ac Explorer™ on 4/23/19
Seed Treatment: None
Foliar Insecticides: 6.4 oz/ac Tundra® EC on 8/4/19
Foliar Fungicides: 8 oz/ac Delaro® on 8/4/19

Fertilizer: 180 lb/ac N as spring applied anhydrous ammonia on 4/10/19
Irrigation: Pivot, Total: 0.75"
Rainfall (in):



Soil Test (Nov. 2018 – 2 samples were taken in the study area at 0-10" depth):

Soil pH 1:1	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI %	Nitrate – N ppm N	Nitrate lb N/A 0-10"	Mehlich P-III ppm P	M-3 Sulfate ppm S	Zn (ppm)	Ammonium Acetate (ppm) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
6.3	0.19	NONE	3.3	8.3	25	26	8.9	2.26	444	2367	346	39	19.4	18	6	60	15	1
6.9	0.28	NONE	3.3	11.0	33	40	8.4	2.74	506	2765	427	52	18.9	0	7	73	19	1

Introduction: The purpose of this study was to evaluate starter fertilizer in irrigated corn production. Previous on-farm research starter fertilizer studies showed minimal yield and economic gains if soil test phosphorus levels were 10 ppm or greater in a corn and soybean rotation (https://go.unl.edu/starter). Yet a number of growers still utilize starter fertilizer for various reasons. Studies have shown that there can be an early growth and yield response from N in an N-P starter fertilizer (https://go.unl.edu/starterfert). In this study, the starter fertilizer was 5 gal/ac 10-34-0 and was compared with a no starter check.

Results:

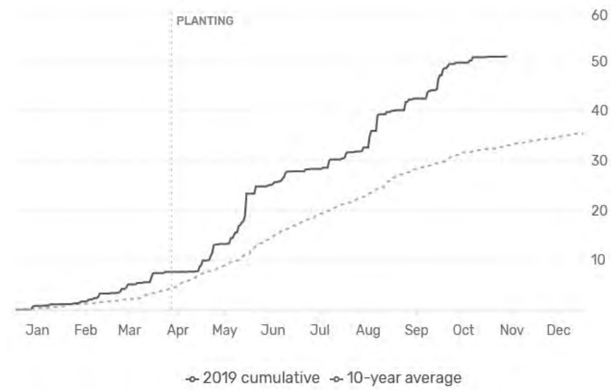
	Stand Count (plants/ac)	Stalk Rot (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	32,417 A*	10.42 B	18.6 A	255 A	975.83 A
Starter (5 gal 10-34-0)	31,750 B	14.17 A	18.3 B	253 A	957.03 B
P-Value	0.062	0.045	0.023	0.335	0.016

*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 $3.83/bu corn and $13.16/ac starter fertilizer cost.

Summary:
- Plant stand counts were 667 plants/ac higher for the check than the starter fertilizer treatment.
- Using a starter fertilizer did not result in a yield increase.
- Grain moisture was higher for the check and there was more stalk rot in the starter fertilizer treatment.
- The use of starter fertilizer resulted in a lower net return as there was no yield increase, yet there was an additional cost of starter fertilizer.

Starter Fertilizer on Non-irrigated Corn

Study ID: 0701147201901
County: Richardson
Soil Type: Marshall silty clay loam, 6-11% slopes, eroded; Pohocco silty clay loam, 6-11% slopes, eroded; Zook silty clay loam, occasionally flooded; Marshall silty clay loam, 2-6% slopes; Judson silt loam, 2-6% slopes
Planting Date: 6/11/19
Harvest Date: 11/15/19
Seeding Rate: 27,512
Row Spacing (in): 30
Variety: Pioneer® P1244
Reps: 7
Previous Crop: Soybean
Tillage: No-Till
Fertilizer: 170 lb N/ac as anhydrous ammonia applied prior to planting
Irrigation: None
Rainfall (in):



Soil Tests (July 2019 – 3 samples were collected in the study area at 0-8" depth):

Soil pH 1:1	BpH	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI %	Nitrate – N ppm N	Nitrate lb N/A (0-8")	Mehlich P-III ppm P	Ammonium Acetate (ppm) K	Ca	Mg	Na	M-2 Sulfate ppm S	DTPA (ppm) Zn	Fe	Mn	Cu	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
5.9	6.9	0.36	None	2.2	34.8	84	16	120	2804	376	8	5.5	2.02	39.1	21.6	1.16	18.5	5	2	76	17	0
5.3	6.9	0.26	None	1.8	38.7	93	7	86	1137	158	6	7.3	1.14	28.0	22.9	0.47	8.0	10	3	71	16	0
5.4	6.7	0.20	None	2.9	19.2	46	7	77	1750	287	7	8.3	1.02	42.8	16.9	0.69	14.7	23	1	60	16	0

Introduction: The objective of this study was to evaluate starter fertilizer in non-irrigated corn production. Previous on-farm research starter fertilizer studies showed minimal yield and economic gains if soil test phosphorus levels were 10 ppm or greater in corn and soybean rotation (https://go.unl.edu/starter).

The starter fertilizer used in the study was 5 gal/ac 10-34-0 and 1 qt/ac Zn. The starter fertilizer treatment was compared to a no starter fertilizer check. For this field location, soil P values ranged from 7 to 16 ppm Mehlich 3 P and zinc soil test values ranged from 1.02 to 2.02 ppm. Due to the low P values in portions of the field, a yield response to 10-34-0 might be expected.

Results:

	Early Season Stand Count (plants/ac)	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	28,053 A*	54 A	17.0 A	151 B	579.69 A
Starter (5 gal 10-34-0 + 1 qt Zinc)	27,867 A	54 A	16.9 A	158 A	590.77 A
P-Value	0.796	0.280	0.366	0.024	0.234

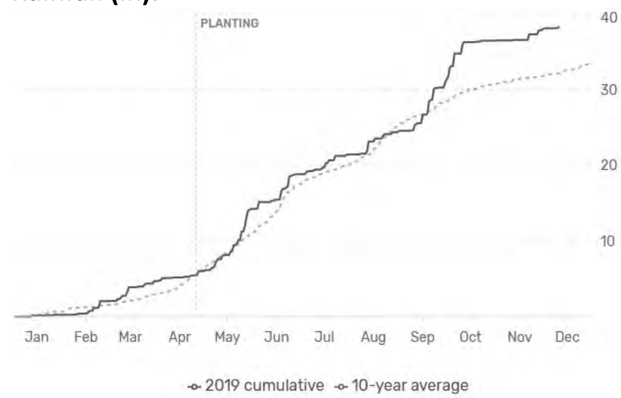
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $11.17/ac ($385/ton) for 5 gal/ac of 10-34-0, and $2.88/ac ($11.50/gal) for 1 qt/ac zinc.

Summary:

- Using starter fertilizer resulted in a 6.6 bu/ac yield increase. Grain moisture, test weight, and stand counts did not differ between the starter fertilizer treatment and the untreated check.
- Marginal net return was not significantly different between the treatments.

Comparison of Starter Fertilizers on Non-irrigated Corn

Study ID: 0029053201901
County: Dodge
Soil Type: Moody silty clay loam, terrace, 0-2% slopes; Moody silty clay loam, 2-6% slopes
Planting Date: 4/25/19
Harvest Date: 10/30/19
Seeding Rate: 28,500
Row Spacing (in): 30
Variety: Hoegemeyer® 8326 AM™
Reps: 6
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 1.8 qt/ac Keystone® and 0.5 pt/ac 2,4-D ***Post:*** 22 oz/ac Roundup® and 3 oz/ac Resource®
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 145 lb N/ac as UAN
Irrigation: None
Rainfall (in):



Soil Test (Nov. 2019 – 1 soil sample in study area):

Soil pH 1:1	Buffer pH	Organic Matter LOI %	Bray P1	Bray P2	Ammonium Acetate (ppm) K	Ca	Mg	CEC me/100g	% Base Saturation H	K	Ca	Mg
5.8	6.6	3.3	8	11	236	2668	426	21.6	19	2.8	61.8	16.4

Introduction: The objective of this study was to evaluate starter fertilizer rates and placement. Five gal/ac 10-34-0 fertilizer applied in-furrow was compared to 13 gal/ac 10-34-0 fertilizer applied in a 2x2 band placement (2" to the side and 2" deep). Aerial multispectral imagery was collected on the field during the growing season. The normalized difference vegetation index (NDVI) values are presented for August 28, 2019.

Results:

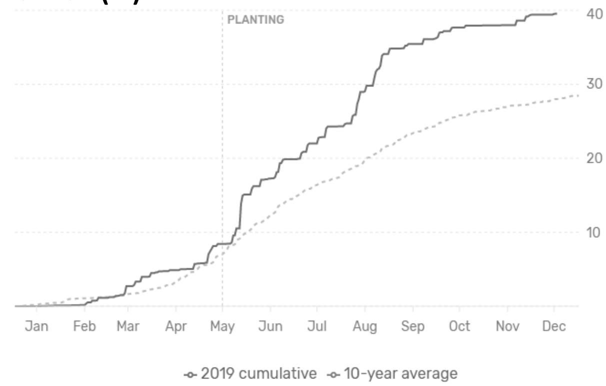
	NDVI Aug. 28	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
5 gal/ac 10-34-0 in-furrow	0.435 A*	19.1 A	155 A	575.91 A
13 gal/ac 10-34-0 banded	0.426 A	18.8 A	158 A	557.97 A
P-Value	0.326	0.108	0.692	0.487

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $17.47/ac for the 5 gal/ac 10-34-0 in-furrow, and $45.43/ac for the 13 gal/ac 10-34-0 banded.

Summary: There was no difference in yield, grain moisture, NDVI, or net return between the two starter fertilizer treatments.

Data-Intensive Farm Management: Nitrogen Application Rates on Corn

Study ID: 0817081201901
County: Hamilton
Soil Type: Hastings silt loam 0-1% slope; Hastings silty clay loam 3-7% slopes, eroded
Planting Date: 4/20/19
Harvest Date: 10/20-26/19
Seeding Rate: 34,200
Row Spacing (in): 30
Variety: Pioneer® P1306WHR
Reps: 10
Previous Crop: Soybean
Tillage: Ridge-Till
Herbicides: ***Pre:*** 12 oz/ac Verdict®, 32 oz/ac glyphosate, and 1 qt/ac atrazine on 4/26/19 ***Post:*** 16 oz/ac Armezon® PRO, 32 oz/ac glyphosate, and 1 qt/ac atrazine on 6/11/19
Seed Treatment: insecticide and fungicide
Foliar Insecticides: 5 oz/ac Hero® aerially applied at tassel on 7/18/19
Foliar Fungicides: 10 oz/ac Headline AMP® aerially applied at tassel on 7/18/19
Irrigation: Pivot, Total: 3"
Rainfall (in):



Introduction: This project is part of the Data-Intensive Farm Management Project, a multi-university collaboration led by the University of Illinois at Urbana-Champaign. The goal of these research studies is to utilize precision agriculture technology for conducting on-farm research. This study tested four nitrogen rates applied with anhydrous ammonia on April 13, 2019. Treatments were randomized and replicated in 40' wide by 280' long blocks across the entire field (Figure 1). Variable-rate prescription maps for the nitrogen study were developed and uploaded to the in-cab monitor. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. The as-applied fertilizer data were evaluated, and only areas that achieved application rates within 10% of the target application rate were included for yield analysis. The entire field received 5.8 lb N/ac as 5 gal/ac of 10-34-0 starter fertilizer at planting; therefore, values in the results table reflect the total N applications of 106 lb N/ac, 146 lb N/ac, 186 lb N/ac, and 226 lb N/ac.

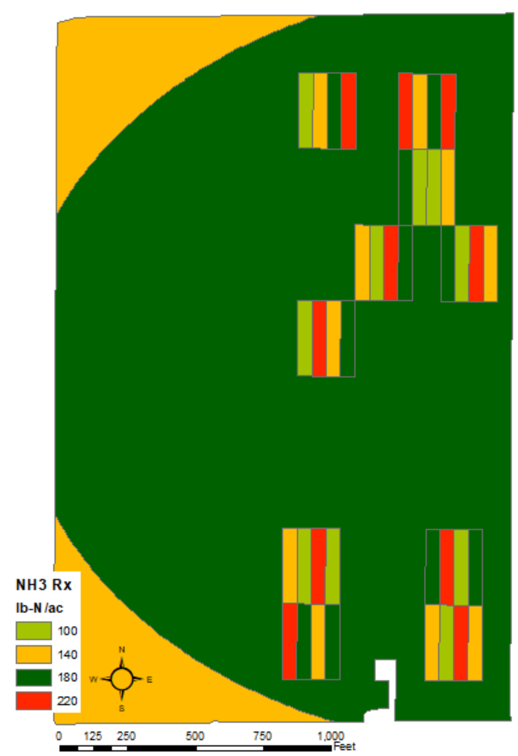


Figure 1. Nitrogen prescription map for anhydrous ammonia application.

Results:

	Moisture (%)	Yield (bu/ac)†	lbs N/bu grain	Marginal Net Return‡ ($/ac)
106 lb N/ac	16.5 B*	238 C	0.42 D	877.31 B
146 lb N/ac	16.6 AB	246 B	0.57 C	896.71 A
186 lb N/ac	16.8 A	249 AB	0.72 B	894.23 A
226 lb N/ac	16.6 AB	251 A	0.88 A	888.73 AB
P-Value	0.023	<0.0001	<0.0001	0.042

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.32/lb N.

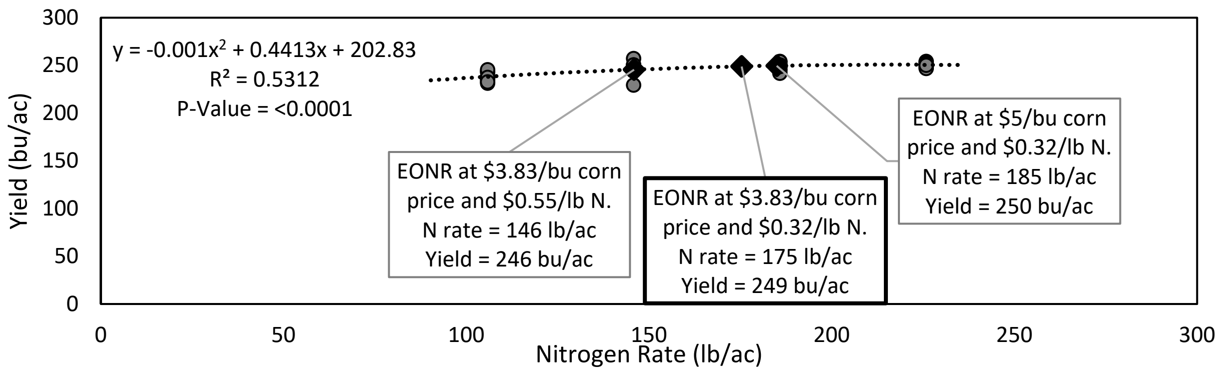


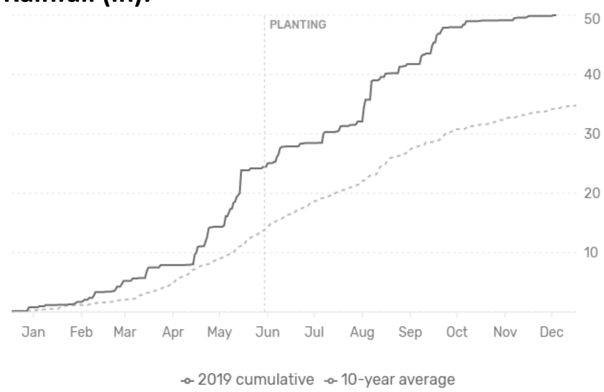
Figure 2. Yield versus nitrogen rate with economic optimum nitrogen rates (EONR) indicated at three price points.

Summary: At this year's corn price of $3.83/bu and an N price of $0.32/lb N, the economic optimum N rate was 175 lb N/ac yielded 249 bu/ac (Figure 2). Nitrogen use efficiency was highest for the 100 lb N/ac treatment, utilizing only 0.4 lb N to produce a bushel of corn.

This research was supported in part by an award from the USDA NIFA Agriculture and Food Research Initiative's Food Security Challenge Area program, award number 2016 − 68004 − 24769.

Determining Optimum Nitrogen Rate on Corn

Study ID: 0416147201903
County: Richardson
Soil Type: Nodaway silt loam occasionally flooded; Zook silty clay loam occasionally flooded
Planting Date: 6/13/19
Harvest Date: 11/9/19
Seeding Rate: 33,000
Row Spacing (in): 30
Variety: Pioneer® P1197
Reps: 5
Previous Crop: Soybean
Tillage: Tilled following flooding and soil deposition in May
Herbicides: ***Pre:*** 28 oz/ac WeedMaster® and 29 oz/ac glyphosate on 4/15/19 ***Post:*** 2.25 qt/ac Keystone® NXT, 5.3 oz/ac Callisto®, and 32 oz/ac glyphosate on 6/28/19
Seed Treatment: Poncho® 1250 + VOTiVO® and Raxil®
Foliar Insecticides: 2 oz/ac Province® and 4 oz/ac Brigade® 2 EC 8/23/19
Foliar Fungicides: 10 oz/ac Headline AMP® on 8/23/19
Fertilizer: 194 lb/ac 0-0-60, 91 lb/ac gypsum, and variable rate 11-52-0 (209-245 lb/ac in research blocks) on 4/15/19
Irrigation: None
Rainfall (in):



Introduction: The objective of this study was to utilize precision ag technology to conduct on-farm research on nitrogen rates. A variable rate nitrogen prescription was developed to apply five blocks of five nitrogen rates on the go as anydrous ammonia was applied (Figure 1). Plots were 300' long by 30' wide. The field received anhydrous ammonia on April 15, 2019 at 7" depth with strip-till following a previous crop of soybeans. As-applied fertilizing maps were used to evaluate the accuracy of fertilizer application. The field was flooded twice in May and 2-6" of soil was deposited on the field. The field was tilled and planted on June 13. The field also received a variable rate application of 11-52-0 on April 15, 2019 with N contribution in the research area ranging from 23 lb N/ac to 27 lb N/ac; therefore, values in the results table and graph reflect the total N applications of 130 lb N/ac, 160 lb N/ac, 190 lb N/ac, 220 lb N/ac and 240 lb N/ac.

Figure 1. Nitrogen prescription map (lb N/ac)

Throughout the growing season multispectral imagery was collected using a DJI™ Inspire 2 drone equipped with a MicaSense® RedEdge™ 5-band sensor. Imagery was obtained on July 13, July 20, August 3, and August 13. The normalized difference red edge (NDRE) index was calculated for each flight date. The objective of collecting drone imagery was to: 1) evaluate the potential of using imagery of varying nitrogen rate blocks applied with variable rate technology to direct in-season N management, 2) determine how low the lowest N rate needs to be to detect differences soon enough to make a timely in-season application, and 3) relate NDRE values for varying nitrogen rates to crop yield at the end of the season.

Yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. Additionally, yield data points from 50' on each end of the 300'-long blocks were removed to eliminate areas where fertilizer application did not closely match the target rate.

Results:

Anhydrous Ammonia Prescription Rate (lb N/ac)	Total N Rate (lb N/ac)	Moisture (%)	Yield (bu/ac)†	lb N/bu grain	Marginal Net Return‡ ($/ac)
105	130	18.3 A*	207 A	0.63 E	756.17 AB
135	160	18.1 AB	212 A	0.76 D	765.09 A
165	190	18.1 AB	206 A	0.93 C	734.21 AB
195	220	18.0 B	207 A	1.07 B	730.43 AB
215	240	18.0 AB	203 A	1.18 A	710.25 B
P-Value	-	0.060	0.576	<0.0001	0.080

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.28/lb N ($452/ton anhydrous).

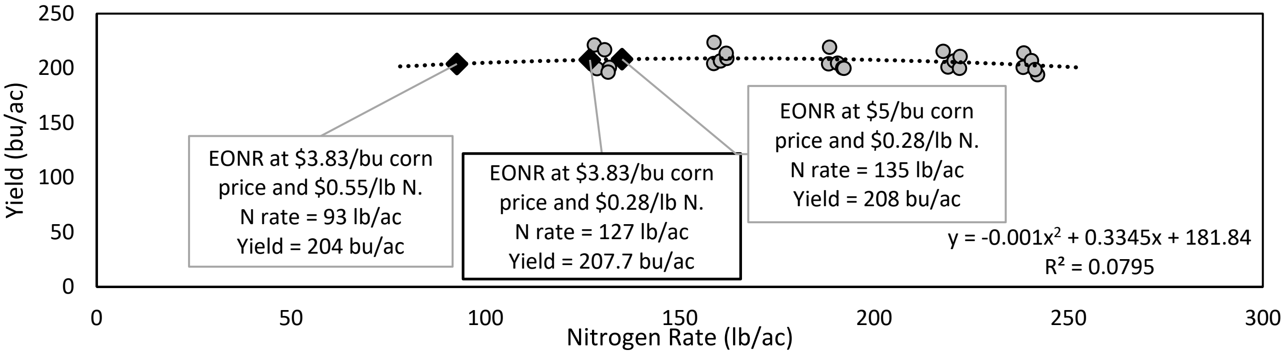


Figure 2. Yield versus nitrogen rate with economic optimum nitrogen rates (EONR) indicated at three price points.

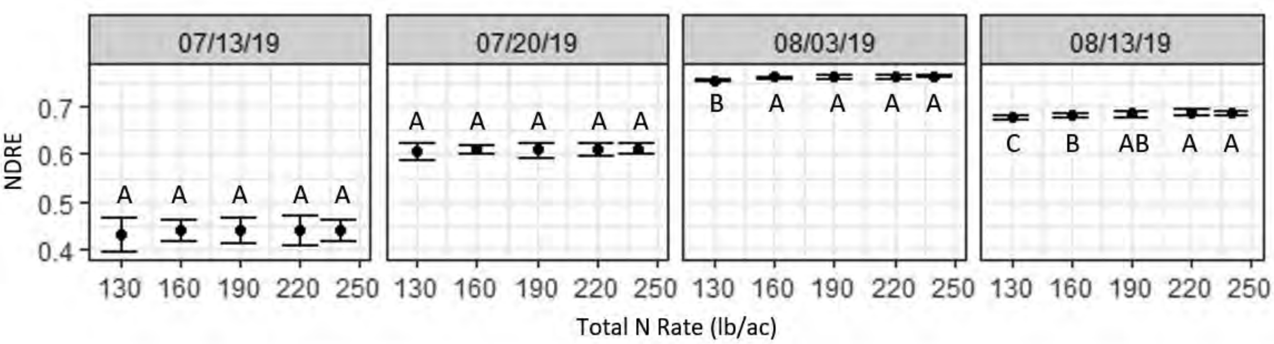


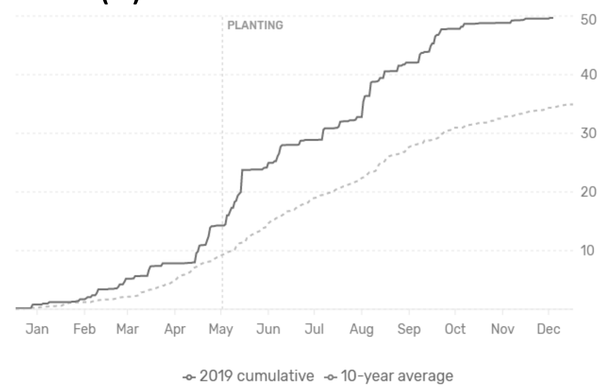
Figure 3. Normalized difference red edge (NDRE) index values for five nitrogen rates across four imagery dates with standard deviation indicated with bars. Significance letters apply within date; values with same letter are not significantly different at a 90% confidence level.

Summary:

- At this year's corn price of $3.83/bu and N price of $0.28/lb N, the economic optimum N rate was 127 lb/ac and yielded 207 bu/ac (Figure 2).
- Analysis of NDRE imagery showed no differences between the five N rates tested on July 13 and July 20 (Figure 3). On August 3, the lowest total N rate (130 lb N/ac) was significantly lower in NDRE than the other four rates. By August 13, the 160 lb N/ac rate had NDRE values lower than the 220 lb N/ac and 240 lb N/ac treatments. This demonstrated that for this year and the rates tested, the NDRE imagery was able to pick up on differences in N rate starting at the August 3 date.

Determining Optimum Nitrogen Rate on Corn

Study ID: 0416147201904
County: Richardson
Soil Type: Marshall silty clay loam 2-5% slopes; Marshall silty clay loam 5-12% slopes, eroded
Planting Date: 5/16/19
Harvest Date: 11/4/19
Seeding Rate: 33,000
Row Spacing (in): 30
Variety: Hoegemeyer® 8529 AM™
Reps: 5
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 28 oz/ac WeedMaster®, and 29 oz/ac glyphosate on 4/16/19 ***Post:*** 2.25 qt/ac Keystone® NXT, 5.3 oz/ac Callisto®, and 32 oz/ac glyphosate on 6/1/19
Seed Treatment: Poncho® 1250 + VOTiVO® and Raxil®
Foliar Insecticides: None
Foliar Fungicides: 10 oz/ac Headline AMP® on 7/29/19
Fertilizer: 114 lb/ac 0-0-60, 22 lb/ac gypsum, and variable rate 11-52-0 (155 to 255 lb/ac in research blocks) on 4/15/19; 1.0 gal/ac CoRoN® on 7/29/19
Irrigation: None
Rainfall (in):



Introduction: The objective of this study was to utilize precision ag technology to conduct on-farm research on nitrogen rates on a field with contour farming and terraces. A variable rate nitrogen prescription was developed to apply five blocks of five nitrogen rates on the go as anhydrous ammonia was being applied (Figure 1). Plots were approximately 300' long by 30' or 60' wide and matched the direction of planting, fertilizing, and harvesting. The field received anhydrous ammonia on April 10, 2019 at 7" depth with strip-till following a previous crop of soybeans. As-applied fertilizing maps were used to evaluate the accuracy of fertilizer application. The field also received a variable rate application of 11-52-0 on April 15, 2019, with N contribution in the research blocks ranging from 17 lb N/ac to 28 lb N/ac; therefore, values in the results table and graph reflect the total N applications of 113 lb N/ac, 143 lb N/ac, 174 lb N/ac, 202 lb N/ac, and 234 lb N/ac. Corn was planted on May 16. The field experienced erosion and silting from heavy rains in May. Corn stands were evaluated with aerial imagery and areas with N plots were only minimally impacted.

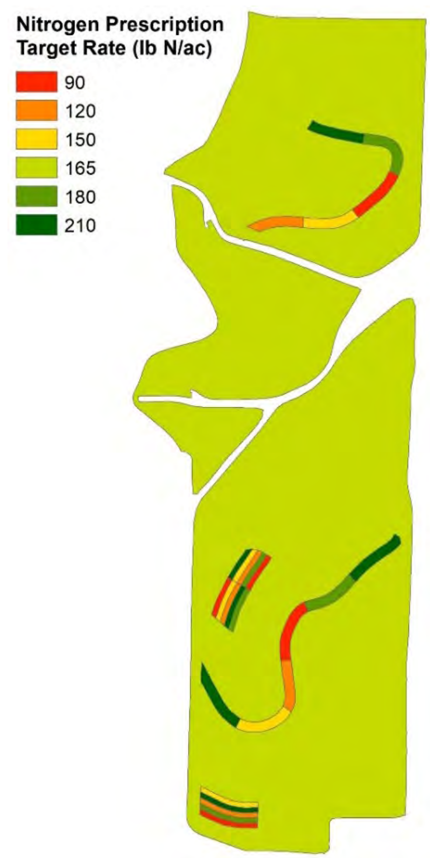


Figure 1. Nitrogen prescription map (lb N/ac)

Throughout the growing season multispectral imagery was collected using a DJI™ Inspire 2 drone equipped with a MicaSense® RedEdge™ 5-band sensor. Imagery was obtained on June 29, July 20, July 28, and August 4. The normalized difference red edge (NDRE) index was calculated for each flight date. The objective of collecting drone imagery was to: 1) evaluate the potential of using imagery of varying nitrogen rate blocks applied with variable rate technology to direct in-season N management, 2) determine how low the lowest N rate needs to be to detect differences soon enough to make a timely in-season application, and 3) relate NDRE values for varying nitrogen rates to crop yield at the end of the season.

Yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. Additionally, yield data points that correspond to areas where the fertilizer application rate was more than 15% above or below the target rate were eliminated.

Results:

Anhydrous Ammonia Prescription Rate (lb N/ac)	Total N Rate (lb N/ac)	Moisture (%)	Yield (bu/ac)†	lb N/bu grain	Marginal Net Return‡ ($/ac)
90	113	17.6 B	217 C	0.52 E	798.56 B
120	143	17.8 AB	231 B	0.62 D	844.56 A
150	174	17.5 B	233 AB	0.75 C	843.48 A
180	202	17.9 A	241 A	0.84 B	867.44 A
210	234	18.0 A	240 A	0.97 A	855.18 A
P-Value	-	0.002	<0.0001	<0.0001	0.001

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.28/lb N ($452/ton anhydrous).

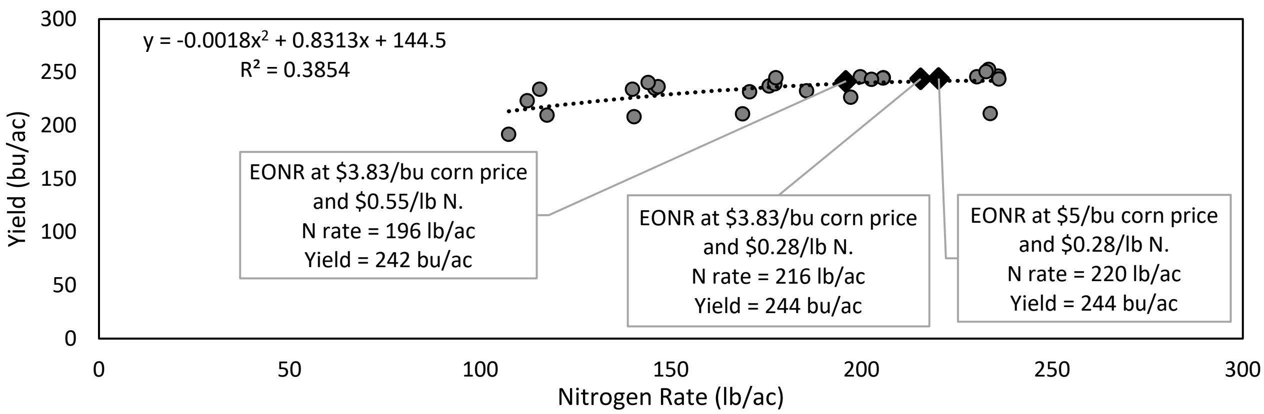


Figure 2. Yield versus nitrogen rate with economic optimum nitrogen rates (EONR) indicated at three price points.

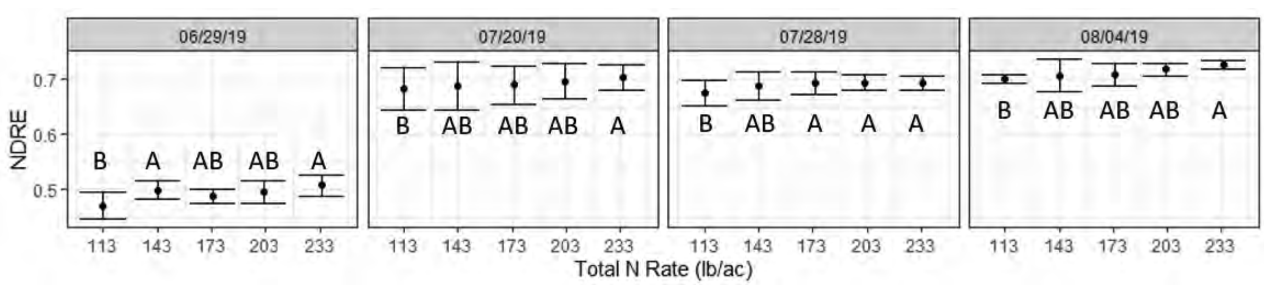


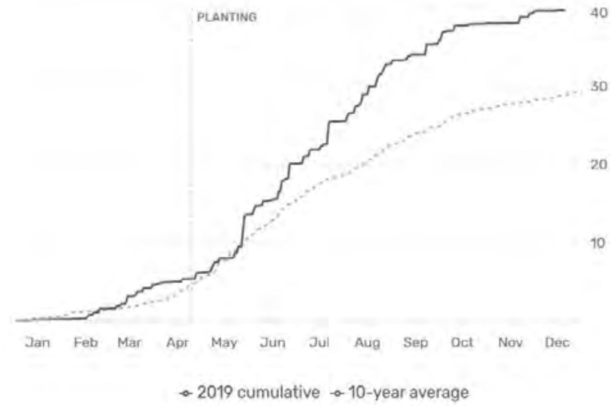
Figure 3. Normalized difference red edge (NDRE) index values for five nitrogen rates across four imagery dates with standard deviation indicated with bars. Significance letters apply within date; data points with the same letter are not significantly different at a 90% confidence level.

Summary:

- At this year's corn price of $3.83/bu and N price of $0.28/lb N, the economic optimum N rate was 216 lb/ac and yielded 244 bu/ac (Figure 2).
- Analysis of NDRE imagery showed the 113 lb N/ac treatment had lower NDRE values than higher N rates on several dates and as early as June 29, indicating this imagery could be used to guide in-season N applications. Lower NDRE values for the 113 lb N/ac rate were reflected in significantly lower yields.

Impact of N-Serve® with Anhydrous Ammonia Application

Study ID: 0718185201901
County: York
Soil Type: Hastings silt loam, 0-1% slopes; Uly-Hobbs silt loams, 11-30% slopes
Planting Date: 4/24/19
Harvest Date: 10/22/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: Pioneer® P1563AM™
Reps: 7
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 2 qt/ac Medal® II ATZ and 5 oz/ac Explorer™ on 4/23/19
Seed Treatment: None
Foliar Insecticides: 6.4 oz/ac Tundra® EC on 8/4/19
Foliar Fungicides: 8 oz/ac Delaro® on 8/4/19
Fertilizer: 180 lb/ac N as spring applied anhydrous ammonia on 4/10/19; 5 gal/ac 10-34-0 in-furrow 4/23/19
Irrigation: Pivot, Total: 1"
Rainfall (in):



Introduction: N-Serve® by Corteva Agriscience™, is a product with known efficacy for inhibiting nitrification (product information is provided at right). The chemical compound nitrapyrin in N-Serve® temporarily inhibits populations of the bacteria that convert ammonium to nitrite (*Nitrosomonas*) and nitrite to nitrate (*Nitrobacter*). These compounds protect against both denitrification and leaching by retaining fertilizer N in the ammonium form. Ammonium (NH_4^+) is a positively charged ion (cation) that can be held on negatively charged exchange sites in soils (such as in clays and organic matter); in comparison, nitrate (NO_3^-), which is negatively charged, can be converted to nitrous oxide (N_2O) or nitrogen gas (N_2) in waterlogged conditions, or can leach below the root zone with rain in well drained soils. You can learn more about nitrogen inhibitors at https://cropwatch.unl.edu/2019/nitrogen-inhibitors-improved-fertilizer-use-efficiency.

Product information from: https://s3-us-west-1.amazonaws.com/agrian-cg-fs1-production/pdfs/N-Serve_24_Label1d.pdf

The purpose of this study was to evaluate the impact of N-Serve® applied with anhydrous ammonia on crop yield and soil ammonium and nitrate. Anhydrous ammonia was applied at a rate of 180 lb N/ac on April 10, 2019 on ridge-tilled ground following a previous crop of soybeans. The study compared 180 lb N/ac with no inhibitor versus 180 lb N/ac with 1 qt/ac N-Serve® (recommended rate). Soil samples were taken on June 17 in V6-V7 corn. Corn was planted 5” off the anhydrous band and soil samples were collected 2" from the anhydrous band at 1', 2', and 3' depths in both the N-Serve® treatment and check in three replications of the study. Soil samples were analyzed for ammonium-N and nitrate-N.

Results:

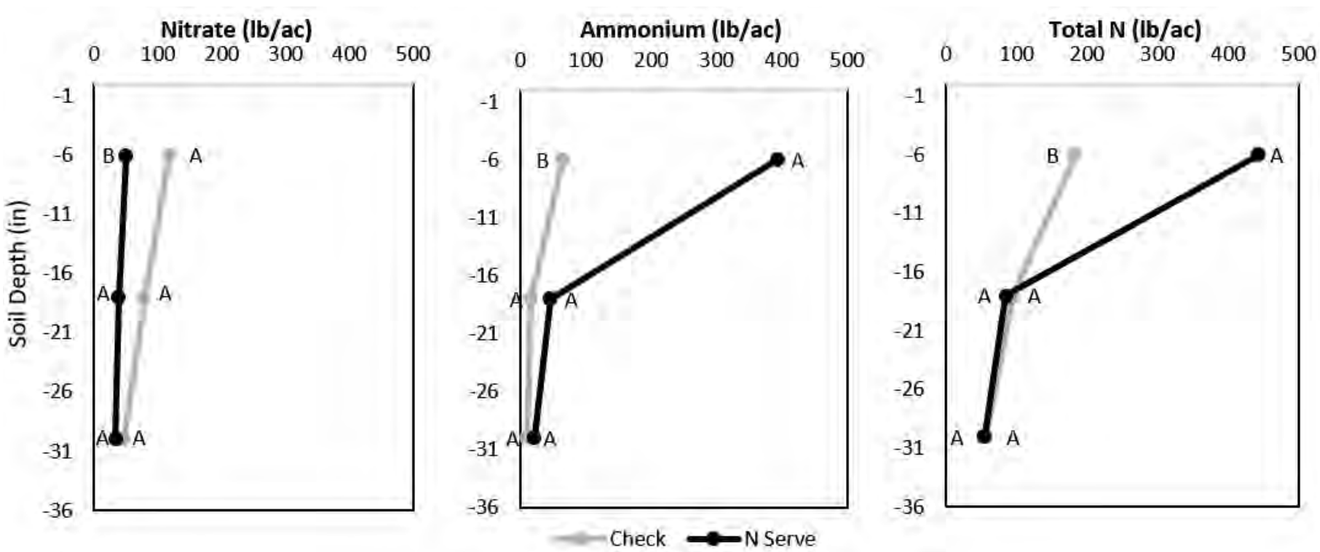


Figure 1. Soil ammonium-N and nitrate-N for check (180 lb N/ac anhydrous ammonia with no inhibitor) and N-Serve (180 lb N/ac anhydrous ammonia with 1 qt/ac N-Serve inhibitor) treatments on June 17 at 1', 2', and 3' depths. Within a sampling depth, points with the same letter are not statistically different at the alpha=0.1 level.

	Stand Count (plants/ac)	Stalk Rot (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	32,500 A*	13.21 A	17.9 A	250 A	957.74 A
N-Serve®	31,750 A	7.14 A	18.0 A	251 A	949.65 B
P-Value	0.182	0.190	0.436	0.370	0.036

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $11/ac ($47.95/gal) for N-Serve.

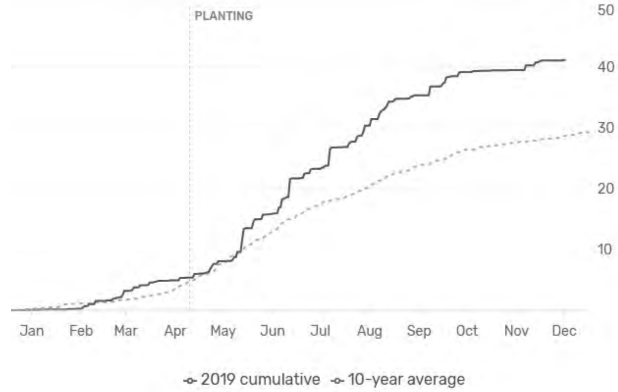
Summary:

- Soil samples in the top foot showed greater ammonium concentration where N-Serve® was used and lower nitrate concentration (Figure 1). This indicates that N-Serve® was slowing the conversion of ammonium to nitrate at the time of soil sampling (9 weeks after application). Deeper sampling depths did not show differences between the treatments.
- There were no differences in stand counts, stalk rot, grain moisture, or yield. Marginal net return was significantly lower for the N-Serve® treatment as additional product cost were not offset by an increase in yield.
- Agronomic benefits for a nitrification inhibitor may not be realized every year as rainfall dictates whether nitrogen will be leached, volatilized, or denitrified. This study will be conducted again in 2020.

Impact of N-Serve® with Anhydrous Ammonia Application

Study ID: 0118185201902
County: York
Soil Type: Hastings silt loam, 0-1% slopes
Planting Date: 4/14/2019
Harvest Date: 11/5/2019
Seeding Rate: 32,500
Row Spacing (in): 30
Variety: CROPLAN® CP5335VT2P/RIB
Reps: 6
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 3 pt/ac Lexar® on 5/2/2019
Fertilizer: 160 lb/ac N as anhydrous ammonia on 4/8/19

Irrigation: Pivot, Total: 1"
Rainfall (in):



Introduction: N-Serve® by Corteva Agriscience™, is a product with known efficacy for inhibiting nitrification (product information is provided at right). The chemical compound nitrapyrin in N-Serve® temporarily inhibits populations of the bacteria that convert ammonium to nitrite (*Nitrosomonas*) and nitrite to nitrate (*Nitrobacter*). These compounds protect against both denitrification and leaching by retaining fertilizer N in the ammonium form. Ammonium (NH_4^+) is a positively charged ion (cation) that can be held on negatively charged exchange sites in soils (such as in clays and organic matter); in comparison nitrate (NO_3^-), which is negatively charged, can be converted to N_2O or N_2 gases in waterlogged conditions, or can leach below the root zone with rain in well drained soils. You can learn more about nitrogen inhibitors at https://cropwatch.unl.edu/2019/nitrogen-inhibitors-improved-fertilizer-use-efficiency.

Product information from: https://s3-us-west-1.amazonaws.com/agrian-cg-fs1-production/pdfs/N-Serve_24_Label1d.pdf

The purpose of this study was to evaluate the impact of N-Serve® applied with anhydrous ammonia on crop yield and soil ammonium and nitrate. Anhydrous ammonia was applied at a rate of 160 lb N/ac on April 8, 2019 on no-tilled ground following a previous crop of soybeans. The study compared 160 lb N/ac with no inhibitor versus 160 lb N/ac with 1 qt/ac N-Serve® (recommended rate). Soil samples were taken on June 13 in V7 corn. Corn was planted 5" off the anhydrous band, and soil samples were collected 2" from the anhydrous band at 1', 2', and 3' depths in both the N-Serve® treatment and check in four replications of the study. Soil samples were analyzed for ammonium-N and nitrate-N.

Results:

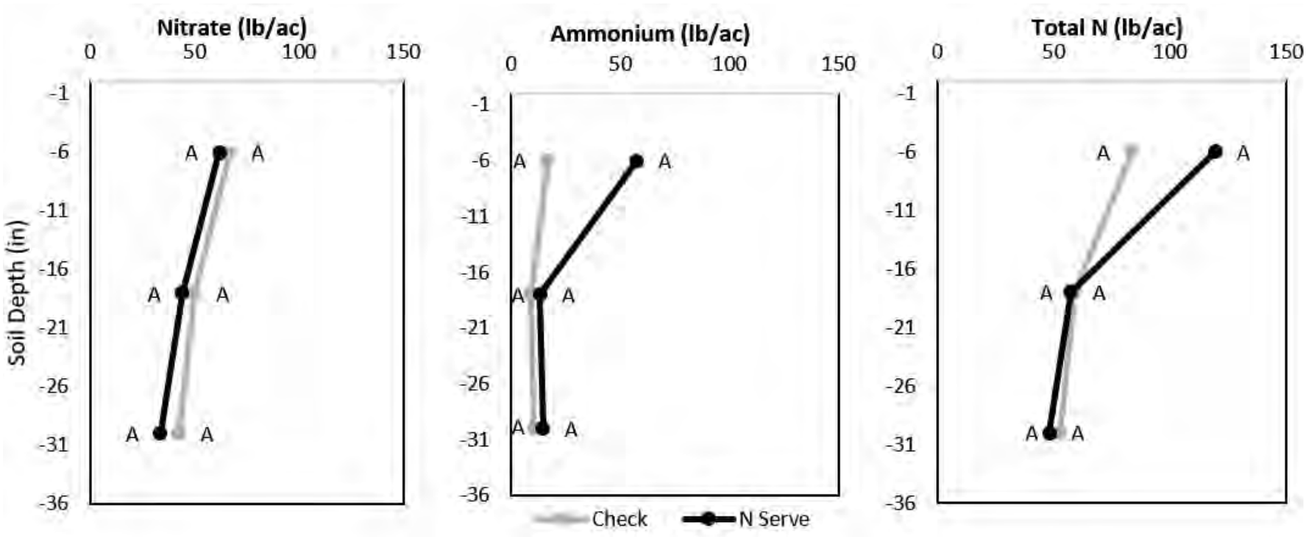


Figure 1. Soil ammonium-N and nitrate-N for check (160 lb N/ac anhydrous ammonia with no inhibitor) and N-Serve (160 lb N/ac anhydrous ammonia with 1 qt/ac N-Serve inhibitor) treatments on June 13 at 1', 2', and 3' depths. Within a sampling depth, points with the same letter are not statistically different at the alpha=0.1 level.

	Stand Count (plants/ac)	Stalk Rot (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	31,750 A*	12.08 A	15.0 A	264 A	1,010.51 A
N-Serve®	30,917 A	9.58 A	14.9 A	264 A	998.71 A
P-Value	0.080	0.638	0.084	0.908	0.131

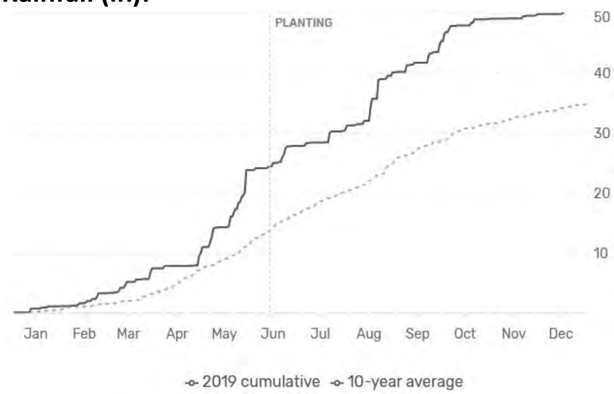
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $11/ac ($47.95/gal) for N-Serve.

Summary:

- Soil samples for ammonium and nitrate concentrations (taken 9 weeks after application) did not differ between where N-Serve® was used and where no inhibitor was used (Figure 1).
- Grain moisture was 0.1% drier where N-Serve® was used. Stand counts were also 833 plants/ac lower in the N-Serve® treatment.
- There was no difference in stalk rot, yield, or net return between the N-Serve® treatment and the check.
- Agronomic benefits for a nitrification inhibitor may not be realized every year as rainfall dictates whether nitrogen will be leached, volatilized, or denitrified. This study will be conducted again in 2020.

Impact of CENTURO™ Inhibitor with Anhydrous Ammonia Application

Study ID: 0416147201902
County: Richardson
Soil Type: Nodaway silty clay loam occasionally flooded; Zook silty clay loam occasionally flooded
Planting Date: 6/13/19
Harvest Date: 11/9/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: Pioneer® P1197
Reps: 16
Previous Crop: Soybean
Tillage: Tilled following flooding and soil deposition in May
Herbicides: ***Pre:*** 28 oz/ac WeedMaster® and 29 oz/ac glyphosate on 4/15/19 ***Post:*** 2.25 qt/ac Keystone® NXT, 5.3 oz/ac Callisto®, 32 oz/gal glyphosate on 6/28/19
Seed Treatment: Poncho® 1250 + VOTiVO® and Raxil®
Foliar Insecticides: 2 oz/ac Province, 4 oz/ac Brigade® 2 EC on 8/23/19
Foliar Fungicides: 10 oz/ac Headline AMP® on 8/23/19
Fertilizer: 170 lb N/ac as anhydrous ammonia, 194 lb/ac 0-0-60, 183 lb/ac 11-52-0, and 91 lb/ac gypsum on 4/15/19
Irrigation: None
Rainfall (in):



Introduction: CENTURO™ by Koch Agronomic Services LLC contains a product with known efficacy for inhibiting nitrification (product information is provided below). The chemical compound pronitridine in CENTURO™ temporarily inhibits populations of the bacteria that convert ammonium to nitrite (*Nitrosomonas*) and nitrite to nitrate (*Nitrobacter*). These compounds protect against both denitrification and leaching by retaining fertilizer N in the ammonium form. Ammonium (NH_4^+) is a positively charged ion (cation) that can be held on negatively charged exchange sites in soils (such as in clays and organic matter); in comparison nitrate (NO_3^-), which is negatively charged, can be converted to N_2O or N_2 gases in waterlogged conditions, or can leach below the root zone with rain in well drained soils. You can learn more about nitrogen inhibitors at https://cropwatch.unl.edu/2019/nitrogen-inhibitors-improved-fertilizer-use-efficiency.

CENTURO

Active Ingredients:	
Pronitridine (CAS RN 1373256-33-7)	14%
Other ingredients:	86%
Total:	100%

Contains 1.495 pounds of active ingredient per gallon

Product information from: https://kochagronomicservices.com/Solutions/agricultural-nutrient-efficiency/CENTURO/Documents/CENTURO-Specimen-Label.pdf?action=view

The purpose of this study was to evaluate the impact of CENTURO™ applied with anhydrous ammonia on crop yield and soil ammonium and nitrate. Anhydrous ammonia was applied at a rate of 170 lb N/ac on April 15, 2019 at 7" depth with strip-till following a previous crop of soybeans. The study compared 170 lb N/ac with no inhibitor versus 170 lb N/ac with CENTURO™ applied at 5 gal/ton anhydrous ammonia (recommended rate). The field was flooded twice in May and 2-6" of soil were deposited on the field. The field was tilled and planted on June 13.

Soil samples were taken on June 27, 10.5 weeks after anhydrous application, in V3 corn. Corn was planted on the anhydrous band and soil samples were collected across the inter-row area at 6" intervals (0", 6", 12", 18", 24", and 30" from the row). Samples were taken at 1' and 2' depths in both the CENTURO™ treatment and check in four replications of the study. Separate samples were taken from the south end of the field where soil is siltier and from the north end of the field where soil is sandier and closer to the Nemaha River. Soil samples were analyzed for ammonium-N and nitrate-N.

Results:

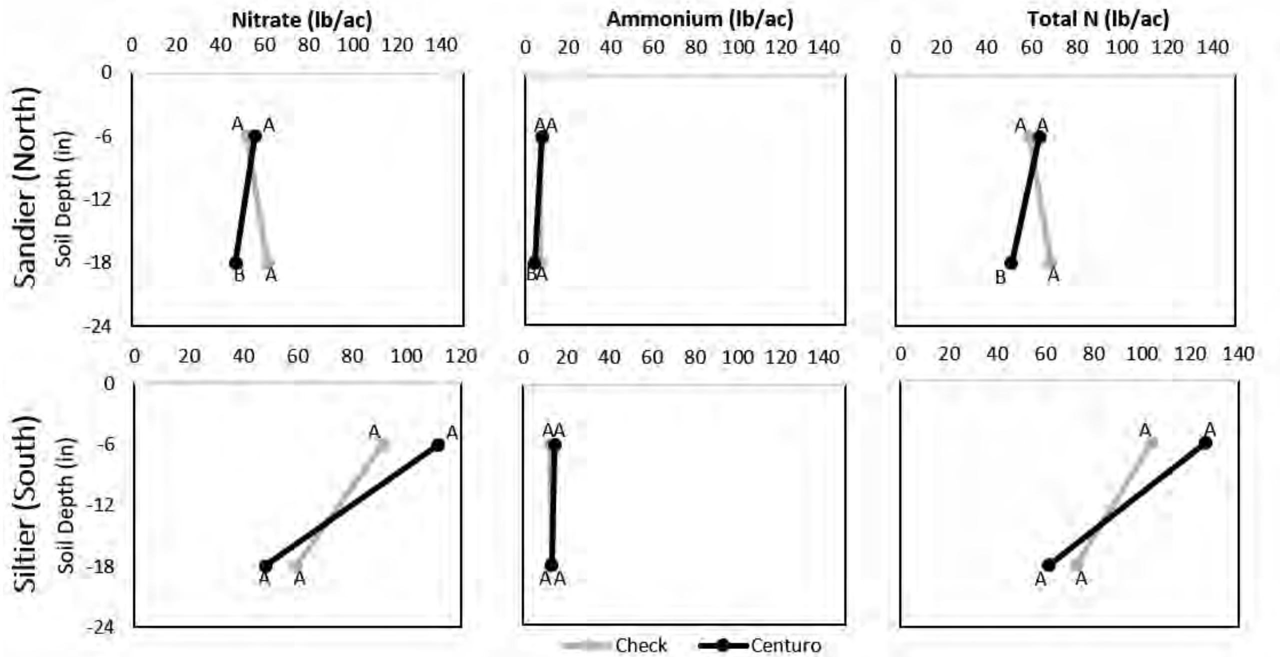


Figure 1. Soil ammonium-N and nitrate-N for check (170 lb N/ac anhydrous ammonia with no inhibitor) and CENTURO™ (170 lb N/ac anhydrous ammonia with CENTURO™ inhibitor) treatments on June 27 at 1' and 2' depths. Within a sampling depth, points with the same letter are not statistically different at the alpha=0.1 level.

	Stand Count (plants/ac)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	31,023 A*	18.5 A	209 A	798.81 A
CENTURO™	30,588 A	18.5 A	208 A	784.85 B
P-Value	0.645	0.547	0.478	0.004

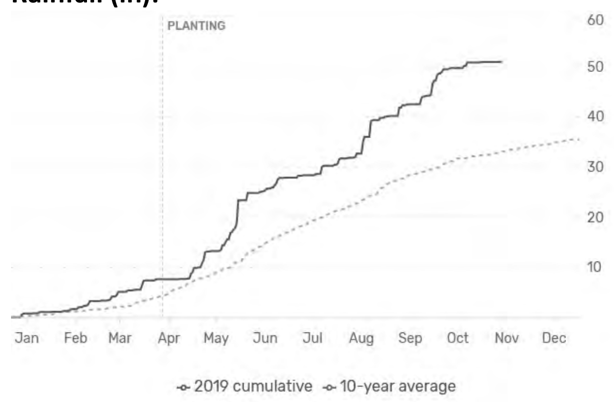
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $10.95/ac CENTURO™ ($21.12/gal)

Summary:

- Because up to 6" of soil was deposited on the field surface, the soil sampled in the top foot represents some new soil depositions, whereas the second foot represents some of what was originally the top foot of soil on the field. Soil samples indicated that the siltier soils retained more nitrogen compared to the sandier soil at the time of sampling (Figure 1). There was no inhibitor effect on ammonium and nitrate content at both depths in the siltier soil. In the sandier soil no differences were found in the top soil; however, unexpected results were found in the second foot of soil where the CENTURO™ treatment had lower NH_4 and NO_3 than the untreated check. Only one soil sample time provided a limited view of the response to CENTURO™; multiple sampling dates in 2020 studies may help better explain the effect of CENTURO™.
- There were no differences in stand count, moisture, or yield. Net return was reduced for the CENTURO™ treatment as the additional product cost was not offset by increased yield.
- N rate blocks in the same field showed optimum nitrogen rates were around 95 lb N/ac, notably lower than the 170 lb N/ac applied; therefore, a yield response to the inhibitor would not be expected as available N was likely in excess of the optimum N rate even with N loss for the no inhibitor treatment.

In-season UAN Application on Corn

Study ID: 0701147201902
County: Richardson
Soil Type: Marshall silty clay loam 2-6% slopes; Pohocco silty clay loam 6-11% slopes, eroded
Planting Date: 5/15/19
Harvest Date: 10/17/19
Seeding Rate: 27,512
Row Spacing (in): 30
Variety: Pioneer® P1197
Reps: 8
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 24 oz/ac Buccaneer® 5, 1.67 pt/ac Dual®, 0.67 pt/ac 2,4-D LV6, 3 pt/ac ATZ, 3.33 oz/ac Corvus®, and 1.7 lb/ac AMS on 5/17/19 ***Post:*** 24 oz/ac Buccaneer® 5, 1.7 lb/ac AMS, 2.5 oz/ac Meso Star, 2 oz/ac dicamba, and 1 pt/ac atrazine
Fertilizer: 170 lb N/ac as anhydrous ammonia in the spring; 5 gal/ac 10-34-0 with 1 qt/ac Zn with planting
Irrigation: None
Rainfall (in):



Introduction: This study evaluated a sidedress application of UAN. The entire field received 176 lb N/ac with preplant and planting N applications. UAN (32%) was applied at a rate of 30 lb actual N/ac on June 28, 2019.

Results:

	Total N (lb/ac)	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	176	57 A	16.0 A*	204 A	780.11 A
UAN Sidedress	206	57 A	15.9 A	206 A	768.41 A
P-Value	-	0.872	0.545	0.746	0.619

*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 $3.83/bu corn, $235/ton UAN, and $8.25 application cost.

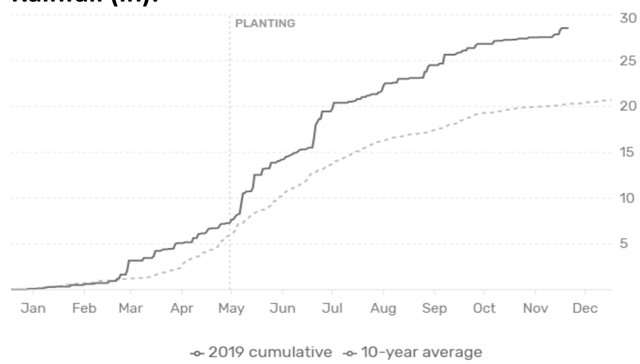
Stalk nitrate tests were collected on October 1 for the two treatments (one sample in the check, and one sample in the UAN sidedressed). The stalk nitrate for the check was 52 ppm nitrate-N, whereas the sidedressed was 404 ppm nitrate-N.

Summary: The addition of 30 lb N/ac as UAN did not result in differences in grain moisture, test weight, yield, or net return.

Impact of Streaming Nozzles versus 360 Y-DROP® for N Application in Corn

Study ID: 0881161201901
County: Sheridan
Soil Type: Bridget loam 0-1% slope; Keith loam gravelly substratum, 0-1% slope
Planting Date: 5/14/19
Harvest Date: 11/20/19
Seeding Rate: 35,000
Row Spacing (in): 30
Variety: Channel® 192-10STXRIB
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 32 oz/ac 5.4 lb glyphosate and 8 oz/ac 2-4D Ester on 5/1/19 ***Post:*** 32 oz/ac 5.4 lb glyphosate and 5 oz/ac Status® on 6/20/19

Fertilizer: 15 lb N/ac, 45 lb P_2O_5/ac, 3 lb S/ac, 0.5 lb Zn/ac, and 0.25 lb Mn/ac banded with planter; 75 lb N/ac and 5 lb S/ac top dressed through Y-DROP® or stream (replicated treatments) on 7/12/19; 95 lb N/ac and 7.5 lb S/ac was applied through fertigation
Irrigation: Pivot, Total: 5.54"
Rainfall (in):



Soil Test (May 2019) – 2 samples were taken in the study area:

	Soil pH 1:1	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI %	Nitrate-N ppm (0-8")	(8-24")	P1	P2	Olsen Bicarb P	S (ppm)	Zn (ppm)	Ammonium Acetate (ppm) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
North	8.0	0.3	L	2.3	5	6	12	102	8	6	1.8	639	4070	283	29	24.5	0	6.7	83.2	9.6	0.5
South	7.8	0.3	L	2.4	6	8	18	93	16	6	1.8	685	3361	324	33	21.4	0	8.2	78.5	12.6	0.7

Introduction: The goal of this study was to evaluate in-season nitrogen application methods. Standard streaming nozzles were compared to 360 Y-DROP® nozzles, which apply N at the base of the plant. 75 lb N/ac and 5 lb S/ac were applied on 7/12/19. Corn yield and net return were evaluated. Leaf burn was documented with pictures in the field.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Streaming Nozzle N Application	184 A*	695.37 A
Y-DROP® N Application	185 A	697.22 A
P-Value	0.513	0.796

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $8/ac for streaming application, and $11/ac Y-DROP application.

Figure 1. Images of leaf burn observed two weeks after in-season N application. Leaf burn was visible with streaming nozzle application (left), but not with Y-DROP® application (right).

Summary:

- There was no difference in yield or net return between the two application methods.
- Fertilizer burn on the leaves was noted in the streaming nozzle method of application, but not in the 360 Y-DROP® application method. Differences were documented with pictures taken two weeks following in-season N application (Figure 1).

Project SENSE – Sensors for Efficient Nitrogen Use and Stewardship of the Environment
2019 Research and 5 Year Summary Report

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) uses crop canopy sensors to direct variable-rate, in-season nitrogen application in corn. Over the first three years of the project, 52 sites were conducted with five partnering Natural Resources Districts (NRDs): Central Platte, Little Blue, Lower Loup, Lower Platte North, and Upper Big Blue. In 2018 and 2019, the project continued with fewer sites and sites were not constrained to a specific NRD or to irrigated fields. The 2019 sites are reported individually following this summary.

Nitrogen Management Challenges

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 (NUE) has remained static. This trend points to the need for adoption of available technologies such as crop canopy sensors for further improvement in NUE. Strategies that detect crop nitrogen status at early growth stages are promising to improve nitrogen fertilizer efficiency.

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 1). When used to detect plant health, light in both the visible (VIS; 400—700 nanometers [nm]) and near-infrared (NIR; 700—1,000 nm) portions of the electromagnetic spectrum are measured. These wavelengths are combined to create various vegetation indices (VI). In this study, the normalized difference red edge (NDRE) index was used in the algorithm to prescribe an in-season nitrogen recommendation rate.

Study Design

A high clearance applicator was equipped with an Ag Leader® Integra in-cab monitor and four OptRx® sensors (Figure 1). A master module enables connection between the OptRx® sensors, which are capturing the NDRE data, and Ag Leader® in-cab monitor, which is computing the recommended N rate. An application rate module communicates the target rate from the Ag Leader® monitor to the rate controller. The applicator was equipped with straight stream drop nozzles in order to apply UAN fertilizer to the crop as it was sensed (Figure 1).

Figure 1. High clearance applicator equipped with OptRx® crop canopy sensors, GPS, and drop nozzles (above) and active crop canopy sensor positioned over corn canopy (left, inset).

Project SENSE plots were arranged in a randomized complete block design with six replications (Figure 2). 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 (Figure 3) and variable-rate N was applied on-the-go. The collected data consisted of grower N rates, Project SENSE in-season N rates, and yield data, which were averaged by treatment strip. 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 (PFP_N) (lb grain/lb N fertilizer) and as lb N applied per bushel of grain produced.

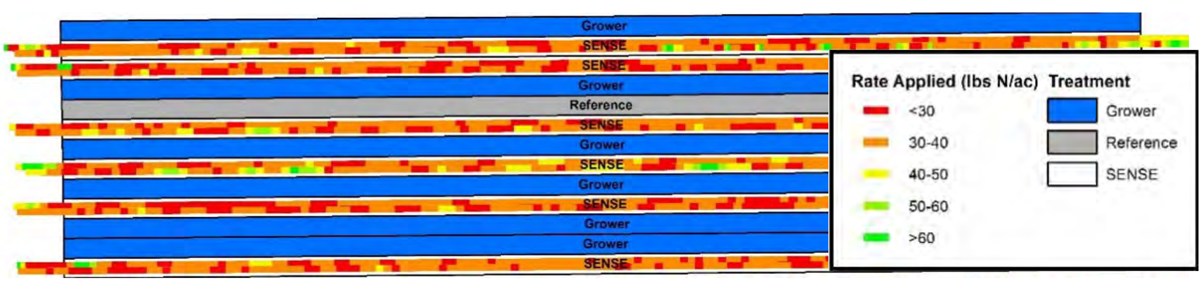


Figure 2. Treatment layout and applied N rate across one representative site.

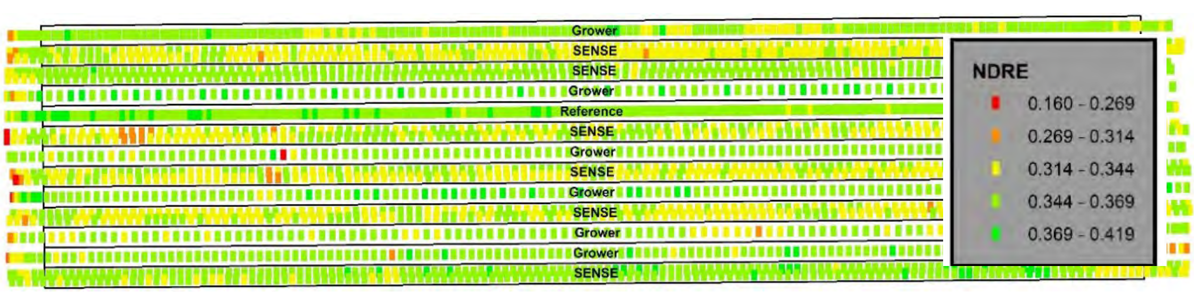


Figure 3. NDRE vegetative index values recorded with OptRx® sensor.

2015-2018 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 (least significant difference). Across the 51 sites (Table 1), ***the sensor-based approach used 29 lb-N/ac less*** than the cooperating growers' approaches; the result was an ***average of 1.1 bu/ac less corn produced using the sensor-based method***. In terms of productivity and NUE, the sensor-based approach produced an additional 15 lb-grain/lb-N compared to the cooperator approaches.

The sensor-based approach resulted in an average increase in profit compared to the grower approaches. At the higher N and corn prices ($0.65/lb-N and $3.65/bu) noted during the study (typically in 2015), ***the sensor-based approach was $14.75/ac more profitable.*** At lower N and corn prices ($0.41/lb-N and $3.15/bu) experienced in 2016 and 2017, ***the sensors were $8.41/ac more profitable compared to the grower approaches***. Input costs and crop revenues are important considerations regarding decisions about technology adoption; however, the sensors were a viable option for improving economic returns based on this study.

Table 1. Summary of 51 sites in 2015, 2016, 2017, and 2018 comparing sensor-based N management to the grower's traditional method.

	SENSE	Grower
Total N rate (lb-N/ac)	159.4 B*	188.1 A
Yield (bu/ac)	217.6 B	218.7 A
Partial Factor Productivity of Nitrogen (lb grain/lb-N)	83 A	68 B
Nitrogen Use Efficiency (lb-N/bu grain)	0.75 B	0.91 A
Partial Profitability ($/ac) [@3.65/bu and $0.65/lb-N]	$690.59 A	$675.83 B
Partial Profitability ($/ac) [@3.15/bu and $0.41/lb-N]	$620.06 A	$611.65 B

*Values with the same letter are not significantly different at a 95% confidence interval.

Further analysis found the active crop canopy sensor treatments often performed better in sandy soil types due to high N application rates by growers compared to the optimal nitrogen rate. In addition, fields where the base nitrogen rate was lower had greater nitrogen use efficiencies in the sensor-based system. Summaries for each site in 2015, 2016, 2017, and 2018 can be found at https://cropwatch.unl.edu/on-farm-research.

2019 Overview

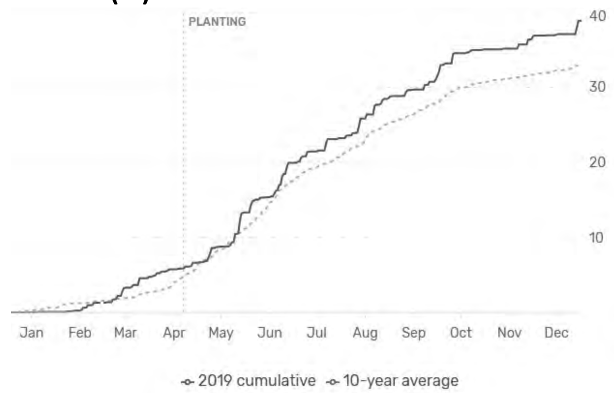
Five sites in 2019 were placed on non-irrigated fields to evaluate the SENSE methodology with increased temporal and spatial variability. The six replications of grower and sensor-based N strips with a high N reference strip were used in the randomized complete block design just as in the irrigated sites (Figure 4). The N was applied between V8 and V12 growth stage and no N inhibitor was used with the UAN. Throughout the season, aerial imagery, precipitation, and soil moisture data were logged, and at harvest, yield data were collected. In addition to the five non-irrigated fields, three sites continued the research on sensor-based N management on irrigated sites. Results of eight studies in 2019 are in the following pages of this report. Project SENSE will continue with further emphasis on sensor-based fertigation and drone-based sensors for improved timing and accuracy.

This research was supported by five Nebraska Natural Resources Districts: Central Platte, Little Blue, Lower Loup, Lower Platte North, and Upper Big Blue, The Nebraska Corn Board, and a USDA-NIFA grant.

Project SENSE (Sensor-based In-season N Management) on Irrigated Corn

Study ID: 0621023201901
County: Butler
Soil Type: Brocksburg sandy loam 0-2% slope; Muir silt loam rarely flooded; Thurman fine sandy loam 2-6% slopes; Zook silt loam 0-2% slope
Planting Date: 4/21/19
Harvest Date: 10/27/19
Seeding Rate: 33,000
Row Spacing (in): 30
Variety: Pioneer® P1563
Reps: 6
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 2.1 qt/ac Cinch® ATZ and 1 qt/ac 2,4-D ***Post:*** 3 oz/ac Laudis® and 32 oz/ac Roundup®
Seed Treatment: Poncho® 1250 + VOTiVO®
Foliar Fungicides: 8 oz/ac Delaro®

Fertilizer: 158 lb/ac 0-0-60 was applied in February. All other fertilizer applications that contained N are described in the introduction.
Irrigation: Pivot
Rainfall (in):



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 rate included 13 lb N/ac applied as 116 lb/ac of 11-52-0 in February, 71 lb N/ac applied as 20 gal/ac of 32% UAN applied on April 21, 21 lb N/ac applied as 100 lb/ac 21-0-0-24 at V6, 110 lb N/ac applied as 31 gal/ac 32% UAN at V6, and 28 lb N/ac applied as 8 gal/ac 32% UAN fertigation. The total grower rate was 243 lb N/ac.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, the base rate was 133 lb N/ac and consisted of applications of 13 lb N/ac applied as 116 lb of 11-52-0 in February, 71 lb N/ac applied as 20 gal/ac of 32% UAN applied on April 21, 21 lb N/ac applied as 100 lb/ac 21-0-0-24 at V6, and 28 lb N/ac applied as 8 gal/ac 32% UAN fertigation. Crop canopy sensing and application occurred on July 1, 2019 at the V12 growth stage. The field received 0.3" of rain on July 2, 2019. Across all Project SENSE treatments, the average N rate applied based on the in-season sensing was 89 lb N/ac. The average total N rate was 222 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/bu grain	Marginal Net Return‡ ($/ac)
Grower	243 A*	242 A	56 B	1.00 A	840.60 A
Project SENSE	222 B	240 A	61 A	0.93 B	840.67 A
P-Value	0.002	0.169	0.009	0.003	0.989

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.36/lb N.

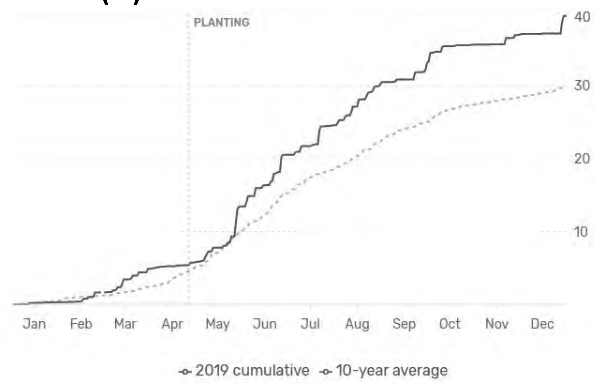
Summary:

- The Project SENSE N management was 21 lb N/ac lower than the grower's N management.
- There was no yield difference between the Project SENSE N management and the grower's N management.
- Project SENSE had higher partial factor productivity of N and used 0.1 lb N/ac less to produce a bushel of grain.
- Marginal net return was not different between the Project SENSE N management and the grower's N management.

Project SENSE (Sensor-based In-season N Management) on Irrigated Corn

Study ID: 0918185201901
County: York
Soil Type: Butler silt loam 0-1% slope; Hastings silt loam 0-1% slope; Hastings silt loam 1-3% slope; Fillmore silt loam frequently ponded
Planting Date: 4/26/19
Harvest Date: 10/25/19
Seeding Rate: 34,000
Row Spacing (in): 30
Variety: DEKALB® DKC60-88
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** Staunch® II, Roundup® ***Post:*** Callisto®, atrazine, Roundup®

Seed Treatment: Acceleron®
Foliar Fungicides: Quilt Xcel®
Irrigation: Pivot
Rainfall (in):



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 rate was 95 lb N/ac applied as 32% UAN on April 26 and 99 lb N/ac applied as 32% UAN at V8. The total grower N application rate was 194 lb N/ac.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 95 lb N/ac applied as 32% UAN on April 26 to establish the base rate. Crop canopy sensing and application occurred on June 29 at the V12 growth stage. The field received 0.33" of rain on July 5. Across all Project SENSE treatments, the average N rate applied based on the in-season sensing was 76 lb N/ac. The average total N rate was 171 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/bu grain	Marginal Net Return‡ ($/ac)
Grower	194 A*	250 A	72 B	0.78 A	886.92 A
Project SENSE	171 B	243 B	79 A	0.71 B	867.12 B
P-Value	<0.0001	0.002	<0.0001	<0.0001	0.008

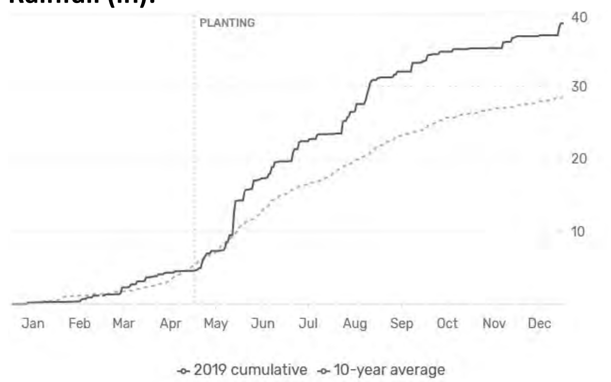
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.36/lb N.

Summary:

- The Project SENSE N management was 23 lb N/ac lower than the grower's N management.
- Yield for the Project SENSE N management was 7 bu/ac lower than the grower's N management.
- Project SENSE had higher partial factor productivity of N and improved nitrogen use efficiency.
- The yield loss was not offset by the lower N fertilizer costs for the Project SENSE N management; therefore, marginal net return was $19.80/ac lower for the Project SENSE N management.

Project SENSE (Sensor-based In-season N Management) on Irrigated Corn

Study ID: 0935035201901
County: Clay
Soil Type: Butler silt loam 0-1% slope; Crete silt loam 0-1% slope
Planting Date: 5/1/19
Harvest Date: 11/4/19
Seeding Rate: 32,500
Row Spacing (in): 30
Variety: Champion Seed 66A18 SS RIB
Reps: 6
Previous Crop: Corn
Tillage: Strip-Till
Herbicides: ***Post:*** 22 oz/ac glyphosate and 2.5 qt/ac Cadence® ATZ NXT on 5/22/19 to 6/01/19 (delays due to rain); 32 oz/ac Liberty® 280 SL on 6/15/19
Foliar Insecticides: 3 oz/ac Grizzly® Too (chemigation) on 7/22/19
Foliar Fungicides: 14 oz/ac Headline AMP® (chemigation) on 7/22/19
Irrigation: Pivot
Rainfall (in):



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. A significant hail and wind storm occurred on August 7th causing 30 to 40% defoliation and 4-6% green snap below the ear. Damage was uniform across treatments.

Grower Nitrogen Treatment: The grower rate was 106 lb N/ac applied as 32% UAN with strip-till application, 5.8 lb N/ac applied as 5 gal/ac 10-34-0 in-furrow with planting, and 106 lb N/ac applied as 32% UAN as a sidedress application at the V8 growth stage. The total grower application rate was 218 lb N/ac.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 106 lb N/ac applied as 32% UAN with strip-till application and 5.8 lb N/ac was applied as 5 gal/ac 10-34-0 in-furrow with planting for a total base rate of 112 lb N/ac. Crop canopy sensing and application occurred on June 29 at the V10 growth stage. Across all Project SENSE treatments, the average N rate applied based on the in-season sensing was 54 lb N/ac. The average total N rate was 166 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/bu grain	Marginal Net Return‡ ($/ac)
Grower	218 A*	149 A	38 B	1.46 A	492.65 B
Project SENSE	166 B	151 A	51 A	1.10 B	515.44 A
P-Value	<0.0001	0.570	<0.0001	<0.0001	0.024

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.36/lb N.

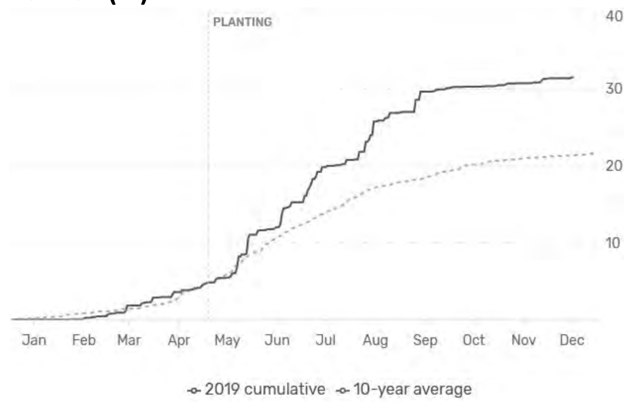
Summary:

- The Project SENSE N management was 52 lb N/ac lower than the grower's N management.
- There was no yield difference between the Project SENSE N management and the grower's N management.
- Project SENSE had higher partial factor productivity of N and used 0.36 lb N/ac less to produce a bushel of grain.
- Marginal net return was $22.79/ac greater for the Project SENSE N management than the grower's N management.

Project SENSE (Sensor-based In-season N Management) on Non-irrigated Corn

Study ID: 0078155201901
County: Saunders
Soil Type: Nodaway silt loam, occasionally flooded; Tomek, silt loam, 0-2% slopes; Yutan, eroded-Aksarben silty clay loam, 2-6% slopes; Pohocco-Pahuk complex, 6-11% slopes, eroded
Planting Date: 5/3/19
Harvest Date: 11/1/19
Seeding Rate: 27,020
Row Spacing (in): 30
Variety: Pioneer® P1138AM™
Reps: 6
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 32 oz/ac Staunch® II and 32 oz/ac Roundup® on 5/5/19 ***Post:*** 2.73 lb/ac AMS, 3 oz/ac Laudis®, and 15.4 oz/ac atrazine 4L with 4.7 oz/ac Hel-Fire® on 6/14/19

Seed Treatment: LumiGEN™
Foliar Insecticides: 2.03 oz/ac Baythroid® on 5/5/19
Foliar Fungicides: 14 oz/ac Trivapro® on 7/12/19
Irrigation: None
Rainfall (in):



Soil Test (July 2019):

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/ac (0-8")	Mehlich P-III ppm P	Sulfate-S ppm S	Ammonium Acetate (ppm) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
6.9	-	0.27	NONE	3.5	3.1	7	7	9.1	201	3084	513	11	20.3	0	3	76	21	0
7.1	-	0.23	NONE	3.5	3.4	8	6	7.2	214	2745	584	12	19.0	0	3	72	25	0
6.1	6.7	0.09	NONE	3.4	2.9	7	9	9.2	259	1850	253	6	14.9	19	4	62	14	0
7.0	-	0.12	NONE	3.1	2.8	7	9	6	290	2134	301	5	13.9	0	5	77	18	0
6.2	6.8	0.13	NONE	3.8	3.8	9	8	8.3	270	2445	354	6	17.8	11	4	68	17	0
7.0	-	0.17	NONE	3.2	3.6	9	10	8.0	285	3126	577	8	21.2	0	3	74	23	0
6.3	6.8	0.13	NONE	3.3	2.8	7	8	7.9	254	2600	392	8	18.6	9	3	70	18	0
6.2	6.7	0.13	NONE	3.2	2.2	5	5	8.6	239	2707	483	7	21.6	16	3	62	19	0
6.3	6.7	0.09	NONE	3.3	2.1	5	5	8.3	227	2649	370	7	17.5	15	3	65	16	0
6.3	6.7	0.13	NONE	3.9	3.8	9	11	8.1	367	2649	370	7	20.8	17	5	63	15	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 rate was 38 lb N/ac applied as 10 gal/ac 32% UAN and 2 gal/ac ammonium thiosulfate (ATS) on May 5, 2019. An additional application was made with a 360 Y-DROP® on July 3, 2019. It contained 33.3 gal/ac UAN 32%, 3 gal/ac ATS (12-0-0-6), 32 oz/ac Zn, 32 oz/ac B, 16 oz/ac 6% Mn. The final application was foliar applied CoRoN® (10-0-10) on July 12, 2019. The average total N rate was 160 lb N/ac.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 38 lb N/ac applied as 10 gal/ac 32% UAN and 2 gal/ac ATS on May 5, 2019. Crop canopy sensing and application occurred on July 3, 2019 at the V10 growth stage. The nitrogen source applied in-season was 32% UAN with 3 gal/ac ATS (12-0-0-6), 32 oz/ac Zn, 32 oz/ac B, 16 oz/ac 6% Mn. Across all Project SENSE treatments, the average N rate applied based on the in-season sensing was 88 lb N/ac. The average total N rate was 126 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	160 A*	17.7 A	207 A	73 B	0.77 A	735.52 A
Project SENSE	126 B	17.7 A	203 A	90 A	0.62 B	730.25 A
P-Value	<0.0001	0.485	0.154	0.001	0.001	0.653

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.36/lb N.

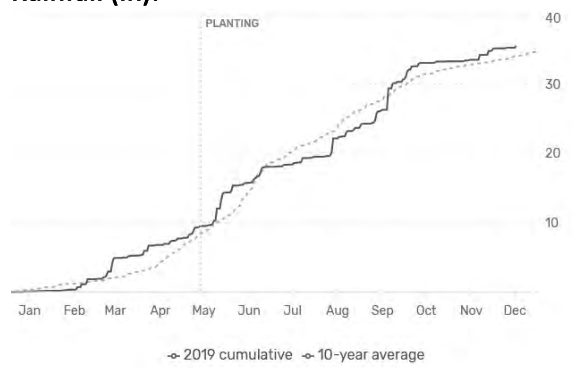
Summary:

- The Project SENSE N management was 34 lb N/ac lower than the grower's N management.
- There was no grain moisture or yield difference between the Project SENSE N management and the grower's N management.
- Project SENSE had higher partial factor productivity of N and used 0.15 lb N/ac less to produce a bushel of grain.
- 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) on Non-irrigated Corn

Study ID: 0103053201901
County: Dodge
Soil Type: Moody silty clay loam, 2-6% slopes; Moody silty clay loam, 6-11% slopes, eroded
Planting Date: 5/13/19
Harvest Date: 10/24/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: Fontanelle Hybrids® 10D308
Reps: 7
Previous Crop: Soybean
Tillage: No-Till

Irrigation: None
Rainfall (in):



Soil Tests (June 2019):

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/ac (0-8")	Mehlich P-III ppm P	Sulfate-S ppm S	Ammonium Acetate (ppm) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
5.7	6.5	0.10	NONE	3.3	6.1	15	15	9.7	258	2679	414	10	22.4	22	3	60	15	0
5.9	6.8	0.11	NONE	3.1	4.5	11	12	6.2	216	3357	616	12	24.3	7	2	69	21	0
5.9	6.6	0.11	NONE	3.4	6.4	15	24	9.2	296	2445	291	8	19.6	21	4	62	12	0
6.0	6.7	0.12	NONE	3.5	7.2	17	18	11.5	261	2956	410	8	21.8	13.	3	68	16	0
6.0	6.5	0.16	NONE	4.0	9.7	23	77	8.6	338	2391	286	8	20.2	25	4	59	12	0
5.8	6.6	0.15	NONE	3.4	8.1	19	29	10.2	230	2657	465	10	21.7	18	3	61	18	0
5.8	6.4	0.14	NONE	3.6	8.7	21	24	12.2	265	2672	398	10	23.4	26	3	57	14	10
6.0	6.6	0.15	NONE	3.6	10.3	25	34	11.7	282	2642	376	10	20.7	17	3	64	15	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. A rye cover crop was planted in mid-October at a rate of 40 lb/ac and terminated at the end of May.

Grower Nitrogen Treatment: The grower rate was 130 lb N/ac split applied as 32% UAN on May 13, 2019 and 32% UAN on June 13, 2019.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 35 lb N/ac was applied as 32% UAN on May 13, 2019. Crop canopy sensing and application occurred on July 2, 2019 at the V10 growth stage. Across all Project SENSE treatments, the average N rate applied based on the in-season sensing was 94 lb N/ac. The average total N rate was 102 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	130 A*	14.6 A	262 A	113 B	0.50 A	954.70 A
Project SENSE	102 B	14.6 A	249 B	136 A	0.41 B	915.61 B
P-Value	<0.0001	0.385	0.027	0.0001	<0.0001	0.056

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.36/lb N as UAN.

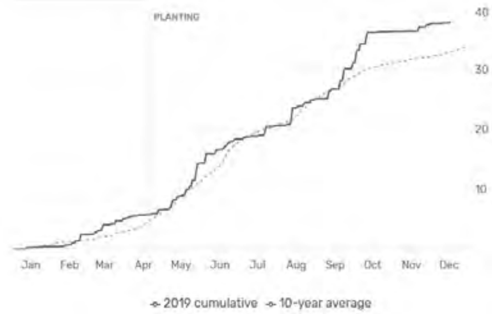
Summary:

- The Project SENSE N management used 28 lb N/ac less than the grower's N management.
- Yield was 13 bu/ac lower for the Project SENSE N management.
- Project SENSE had a higher partial factor productivity of N and used fewer pounds of N to produce a bushel of grain.
- The grower's N management resulted in $39/ac greater profitability compared to the Project SENSE N management.

Project SENSE (Sensor-based In-season N Management) on Non-irrigated Corn

Study ID: 0546155201901
County: Saunders
Soil Type: Yutan, eroded-Judson complex, 6-11% slopes; Yutan, eroded-Aksarben silty clay loam, 2-6% slopes; Nodaway silt loam, occasionally flooded; Judson silt loam, 2-6% slopes
Planting Date: 4/20/19
Harvest Date: 10/22/19
Seeding Rate: 29,000
Row Spacing (in): 30
Variety: DEKALB® DKC63-57
Reps: 5
Previous Crop: Soybean

Tillage: No-Till
Irrigation: None
Rainfall (in):



Soil Samples (June 2019):

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/ac (0-8")	Mehlich P-III ppm P	Sulfate-S ppm S	Ammonium Acetate (ppm) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
6.2	6.8	0.35	NONE	3.3	20.1	48	29	14.1	301	2822	396	56	20.5	10	4	69	16	1
4.8	5.9	0.28	NONE	4.5	11.4	27	11	25.4	238	2429	295	63	26.1	41	2	47	9	1
5.0	6.4	0.35	NONE	3.6	29.6	71	25	18.0	326	2179	288	33	20.2	29	4	54	12	1
5.4	6.0	0.17	NONE	4.8	9.9	24	18	25.5	222	2772	322	101	27.6	37	2	49	10	2
4.9	5.9	0.25	NONE	3.7	33.6	81	30	27.5	194	1745	185	98	22.4	50	2	39	7	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: The grower rate was 120 lb N/ac applied as anhydrous ammonia on April 17, 2019.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 35 lb N/ac was applied as anhydrous ammonia on April 17, 2019. Crop canopy sensing and application occurred on July 8, 2019 at the V12 growth stage. Across all Project SENSE treatments, the average N rate applied based on the in-season sensing was 76 lb N/ac. The average total N rate was 111 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	120 A*	16.8 A	232 A	108 B	0.52 A	848.11 A
Project SENSE	111 B	16.9 A	225 B	113 A	0.50 B	823.00 B
P-Value	0.002	0.169	0.054	0.049	0.044	0.054

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $0.36/lb N as UAN, and $0.32/lb N as anhydrous ammonia.

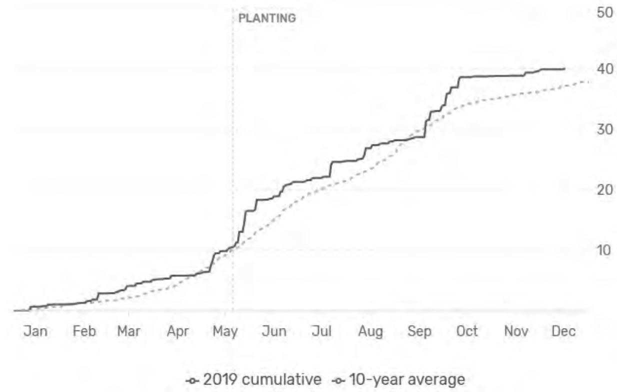
Summary:

- The Project SENSE N management was only 9 lb N/ac lower than the grower's N management and utilized split-N application while the grower's management utilized only one preplant N application.
- Yield was 6.5 bu/ac lower for the Project SENSE N management compared to the grower's N management. Poorer performance for the Project SENSE N management at this site may be due to a later in-season N application (July 8) with only 35 lbs of N applied prior to this application.
- Project SENSE had a slightly higher partial factor productivity of N and used slightly fewer pounds of N to produce a bushel of grain.
- The grower's N management resulted in a $25/ac increase in profitability. Marginal net return only took into account the varying price of N fertilizer sources and rates; the cost of an additional in-season application for the Project SENSE N management compared to the grower's N management was not included.

Project SENSE (Sensor-based In-season N Management) on Non-irrigated Corn

Study ID: 0816025201901
County: Cass
Soil Type: Wymore silty clay loam, 0-2% slopes; Wymore silty clay loam, 3-6% slopes, eroded
Planting Date: 5/20/19
Harvest Date: 11/8/19
Seeding Rate: 27,600
Row Spacing (in): 30
Variety: DEKALB® DKC66-75 RIB
Reps: 6
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 16 oz/ac 2,4-D, 17lb/100/ac AMS, 2.1 qt/ac Bicep II Magnum®, 32 oz/ac Durango®, and 2 qt/ac MSO on 5/3/19 ***Post:*** 2 pt/ac Callisto®, 17 lb/100/ ac AMS, 2 qt/ac crop oil concentrate on 6/17/19
Seed Treatment: Acceleron® and ILeVO®

Foliar Insecticides: None
Foliar Fungicides: 2 oz/ac Stratego® on 6/17/19
Fertilizer: 33 lb N/ac and 156 lb P/ac as 11-52-0; 400 lb/ac ag lime
Irrigation: None
Rainfall (in):



Soil Tests (November 2018):

			Bray P1	Sulfate-S	Ammonium Acetate (ppm)					% Base Saturation			
Soil pH 1:1	Buffer pH	OM %	ppm P	ppm S	K	Ca	Mg	Zn	CEC me/100g	H	K	Ca	Mg
6.1	6.7	3.3	8	6	278	2385	263	2.1	17.2	13.9	4.1	69.3	12.7
6.2	6.7	3.6	5	8	264	2427	302	2.8	17.4	11.9	3.9	69.7	14.5
6.1	6.7	3.4	5	9	219	2039	298	2.2	15.4	14.1	3.6	66.2	16.1
6.1	6.7	3.7	8	6	213	2497	301	2.7	18.0	13.7	3.0	69.4	13.9
6.1	6.6	4.6	74	6	497	2875	344	13.8	21.5	13.9	5.9	66.9	13.3
6.6	6.9	3.7	51	7	455	2424	258	6.2	16.4	5.9	7.1	73.9	13.1
5.9	6.6	3.5	6	6	243	2332	244	5.4	17.2	16.8	3.6	67.8	11.8
6.1	6.7	3.3	4	6	222	2158	227	3.8	15.5	14.5	3.7	69.6	12.2

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: The grower rate was 33 lb N/ac applied with 11-52-0 early spring and 176 lb N/ac applied as anhydrous ammonia on April 22, 2019.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 33 lb N/ac was applied with 11-52-0 early spring and 75 lb N/ac was applied as anhydrous ammonia on April 22, 2019. Crop canopy sensing and application occurred on July 10, 2019 at the V13 growth stage. Across all Project SENSE treatments, the average N rate applied based on the in-season sensing was 55 lb N/ac. The average total N rate was 163 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	209 A*	15.6 A	197 A	53 B	1.06 A	687.60 A
Project SENSE	163 B	15.6 A	199 A	69 A	0.82 B	706.55 A
P-Value	<0.0001	0.796	0.659	0.0001	0.0002	0.227

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $0.37/ lb N as 11-52-0, $0.36/lb N as UAN, and $0.32/lb N as anhydrous.

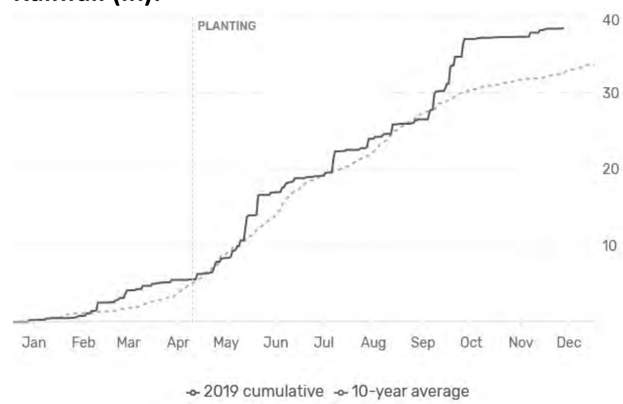
Summary:

- The Project SENSE N management used 46 lb N/ac less than the grower's N management, and utilized split-N application while the grower's management utilized only one preplant N application.
- Yield was not different between the Project SENSE N management and the grower's N management.
- Project SENSE resulted in a higher partial factor productivity of N and used 0.24 fewer pounds of N to produce a bushel of grain.
- There was no difference in marginal net return between the two management approaches. Marginal net return only took into account the varying price of N fertilizer sources and rates; the cost of an additional in-season application for the Project SENSE N management compared to the grower's N management was not included.

Project SENSE (Sensor-based In-season N Management) on Non-irrigated Corn

Study ID: 0849155201901
County: Saunders
Soil Type: Tomek silt loam, 0-2% slopes; Yutan silty clay loam, terrace, 2-6% slopes, eroded
Planting Date: 4/24/19
Harvest Date: 10/31/19
Seeding Rate: 28,000
Row Spacing (in): 30
Variety: DEKALB® DKC60-88RIB
Reps: 6
Previous Crop: Soybean
Tillage: No-Till

Irrigation: None
Rainfall (in):



Soil Tests (June 2019):

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/ac (0-8")	Mehlich P-III ppm P	Sulfate-S ppm S	Ammonium Acetate (ppm) K	Ca	Mg	Na	CEC me/100g	% Base Saturation H	K	Ca	Mg	Na
4.9	6.1	0.29	NONE	3.6	19.5	47	6	11.4	296	2367	476	20	25.5	35	3	46	16	0
5.2	6.3	0.26	NONE	3.7	20.2	49	5	13.5	216	2080	269	9	20.1	34	3	52	11	0
5.6	6.5	0.19	NONE	3.1	5.3	13	4	9.3	275	2601	493	38	22.8	21	3	57	18	1
5.5	6.4	0.22	NONE	4	12.6	30	32	12	391	2460	267	8	21.6	28	5	57	10	0
5	6	0.2	NONE	3.7	14.7	35	10	12.2	282	2040	229	8	22.9	44	3	45	8	0
5	6.1	0.28	NONE	3.4	22.7	55	11	12.4	203	2039	357	26	22.4	38	2	46	13	0
5.3	6.3	0.3	NONE	3.7	14.7	35	5	11.4	306	2786	475	8	26	28	3	54	15	0
5.5	6.5	0.32	NONE	3.6	21.7	52	23	11.3	371	2558	454	7	22.7	23	4	56	17	0
5.3	6.5	0.25	NONE	4.1	10.6	26	6	12.5	271	2677	450	7	23.2	23	3	58	16	0
5.5	6.6	0.2	NONE	3.8	7.6	18	5	11.6	206	2034	296	8	17.6	25	3	58	14	0
5.1	6.1	0.21	NONE	4.1	17.4	42	5	13.9	231	1999	267	7	21.6	41	3	46	10	0
5.1	6.1	0.25	NONE	4.4	12.7	31	5	14.6	253	2515	460	7	25.9	34	3	48	15	0
4.9	6	0.21	NONE	4	17.4	42	11	16.6	241	1719	234	6	20.9	46	3	41	9	0
5.5	6.5	0.21	NONE	3.9	11.9	29	8	13.7	238	2165	334	7	19.3	26	3	56	14	0
4.9	6.1	0.29	NONE	3.5	29.2	70	8	14.7	286	2031	259	7	22.3	41	3	46	10	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 grower rate was 140 lb N/ac applied as anhydrous ammonia on April 16, 2019.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 75 lb N/ac was applied as anhydrous ammonia on April 16, 2019. Crop canopy sensing and application occurred on July 3, 2019 at the V11 growth stage. Across all Project SENSE treatments, the average N rate applied based on the in-season sensing was 40 lb N/ac. The average total N rate was 115 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	140 A*	14.8 A	193 A	77 B	0.73 A	694.34 A
Project SENSE	115 B	14.7 B	190 A	92 A	0.61 B	687.16 A
P-Value	0.0001	0.049	0.246	0.001	0.0004	0.513

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $0.36/lb N as UAN, and $0.32/lb N as anhydrous ammonia.

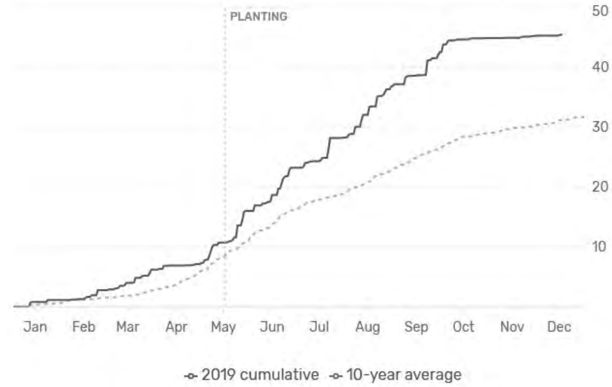
Summary:

- The Project SENSE N management was 25 lb N/ac lower than the grower's N management and utilized split-N application while the grower's management utilized only one preplant N application.
- Yield was not different between the Project SENSE N management and the grower's N management.
- Project SENSE had higher partial factor productivity of N and used 0.12 lb/ac less N to produce a bushel of grain.
- There was no difference in marginal net return. Marginal net return only took into account the varying price of N fertilizer sources and rates; the cost of an additional in-season application for the Project SENSE N management compared to the grower's N management was not included.

In-season Nitrogen Application on Corn Following Rye Cover Crop

Study ID: 0710067201901
County: Gage
Soil Type: Kennebec silt loam, occasionally flooded
Planting Date: 5/16/19
Harvest Date: 10/21/19
Seeding Rate: 24,000
Row Spacing (in): 30
Variety: Pioneer® P1751AMT™ and Channel® 216-36STXRIB
Reps: 5
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 32 oz/ac Roundup Ultra® MAX, 9 oz/ac Verdict®, and 9 oz/ac metolachlor with 1 pt/ac methylated soybean oil, 17 lb AMS/100 gal solution, and 0.5 lb citric acid/100 gal solution applied at 8 gal/ac solution on 5/23/19 ***Post:*** 1.5 qt/ac mesotrione and 32 oz/ac Roundup Ultra® with 17 lb AMS/100 gal solution, 0.5 lb citric acid/100 gal solution and 1 gal crop oil/100 gal solution applied at 15 gal/ac

Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 45 gal/ac 32% UAN (153 lb N/ac) on 4/28/19, 5 gal/ac 10-34-0 (5.8 lb N/ac) at planting 5/16/19
Irrigation: None
Rainfall (in):



Soil Tests (May 2019 - 1 sample in study area):

pH	BpH	CEC	1:1 S Salts	OM	Nitrate-N (lb N/ac)		K	S	Zn	Fe	Mn	Cu	Ca	Mg	Na	H	K	Ca	Mg	Na	Mehlich P-III
		meq/100g	mmho/cm	%	0-8 in	8-26 in	---------------------------ppm								------------------------	-----------%				----------	---ppm--
5.7	6.5	17.1	0.14	2.9	10	31	136	16.6	1.08	79.5	26.8	1.32	1914	277	12	28	2	56	14	0	14

Introduction: This study evaluated in-season nitrogen requirements for corn planted into cereal rye cover crop. The study site is non-irrigated with no-till residue management. The Elbon cereal rye cover crop was drilled in 7.5" spacing in October 2018 after corn harvest at a rate of 55 lb/ac. The field was grazed by cattle for 30 days in November and December 2019 and 45 days from April 1 to May 15. Corn was planted into the green cereal rye regrowth. Preplant fertilizer (153 lb N/ac) was knifed into the green cereal rye before planting and 5 gal/ac 10-34-0 (5.8 lb N/ac) was applied as starter with planting. The total fertilizer application to all plots before in-season application was 159 lb N/ac. The rye was 2' tall at planting and was terminated soon after planting.

The study tested in-season nitrogen sidedress applied as ammonium sulfate (21% N, 24% S) and urea (46% N) and rates of 50 lb N/ac and 100 lb N/ac. In-season applications were made on June 10 on V4 corn. For yield analysis, two rows of 15-foot length were hand harvested, shelled, and weighed. After sidedressing and several rain events it was observed that the plots that received ammonium sulfate looked greener compared to the urea plots.

Figure 1. Corn growing in terminated rye cover crop at time of hand application of nitrogen (June 10).

Results:

Two hybrids were planted in the study area. Yield was analyzed to test for interactions between hybrid and nitrogen treatment with the GLIMMIX procedure in SAS® 9.4 (SAS Institute Inc., Cary, NC). No interaction was present; therefore, both hybrids were included in the analysis and the analysis was conducted for nitrogen treatment as the only factor.

	Stand Count (plants/ac)	Ear Count (ears/ac)	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Preplant N only	23,000 A*	22,884 A	59 A	12.9 A	185 B	707.11 A
50 lb N/ac Urea	22,767 A	23,000 A	59 A	13.2 A	191 AB	700.09 A
100 lb N/ac Urea	23,116 A	23,232 A	59 A	12.9 A	194 AB	689.97 A
50 lb N/ac AMS	24,045 A	24,394 A	59 A	13.5 A	211 A	760.16 A
100 lb N/ac AMS	23,348 A	23,929 A	59 A	12.9 A	203 AB	688.26 A
P-Value	0.491	0.436	0.784	0.829	0.089	0.292

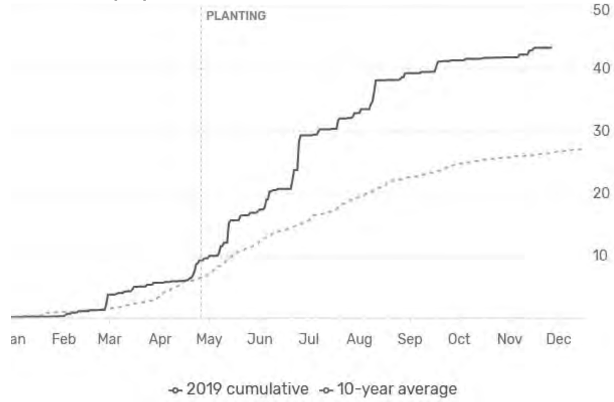
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $345/ton AMS ($0.82/lb N), $430/ton urea ($0.47/lb N), and $6.43/ac broadcast application.

Summary:

- There was no difference in harvest stand counts, ear counts, test weight, or grain moisture for the fertilizer rates and sources evaluated.
- Yield for the 50 lb N/ac ammonium sulfate treatment was higher than the preplant only treatment.
- There was no difference in net return between the nitrogen rates and sources evaluated.

Nitrogen Application to Corn Following Cover Crops

Study ID: 0731061201901
County: Franklin
Soil Type: Kenesaw silt loam, 0-1% slope; Kenesaw silt loam, 1-3% slope
Planting Date: 5/10/19
Harvest Date: 10/15/19
Seeding Rate: 32,000
Row Spacing (in): 30
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** Roundup® on 5/25/19 ***Post:*** Halex® GT on 6/10/19
Seed Treatment: Poncho®
Foliar Insecticides and Fungicides: None
Irrigation: Pivot, Total: 2"
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 was to better understand N management of corn following cover crops. Nitrogen was applied as urea broadcast at V6 at four rates: 0, 100, 175, and 250 lb N/ac. Additionally, the 0 lb N/ac treatment was split so that half had a rye cover crop preceding it, and half did not (therefore the 0 lb N/ac treatment with no cover crop was not randomized). Plots were 80 feet wide and 200 feet long, with the exception of the 0 lb N/ac treatments, which were only 40 feet wide. For treatments that had cover crops preceding corn, the cover crop was rye planted on November 15, 2018. Corn was planted on May 10, 2019 and cover crops were terminated with herbicide on May 25, 2019 at a height of 18". Yield was collected for each plot by hand harvesting.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
0 lb/ac N Following No Cover Crop	245 A*	939.31 A
0 lb/ac N Following Cover Crop	219 B	837.81 B
100 lb/ac N Following Cover Crop	247 A	905.09 AB
175 lb/ac N Following Cover Crop	242 A	855.71 B
250 lb/ac N Following Cover Crop	262 A	904.89 AB
P-Value	0.001	0.013

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.40/lb of N. Cover crop costs differences were not included in net return analysis.

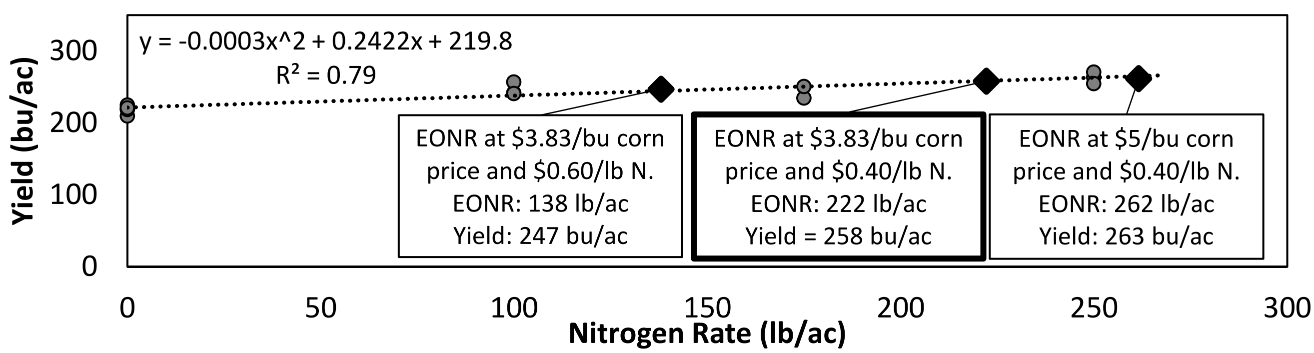


Figure 1. Yield versus nitrogen rate based on the four cover crop nitrogen rate treatments.

Summary: Yield for the 0 lb N/ac treatment with a cover crop was lower than yield for the 0 lb N/ac treatment without a cover crop. For the treatments with cover crops, at a corn price of $3.23/bu and N price of $0.40/lb, the optimum N rate was 222 lb/ac.

Sensor-based Nitrogen Fertigation

Introduction

In 2019, growers participating in the Nebraska On-Farm Research Network experimented with using imagery to direct responsive nitrogen (N) application to corn through fertigation. The adoption of technology such as sensors mounted on an aerial platform may be used to improve N use efficiency by responding to actual plant N need. There were five sites in 2019 (Figure 1).

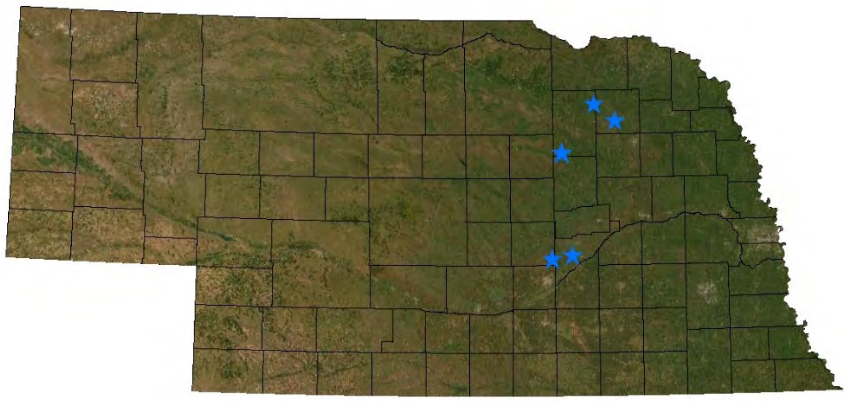


Figure 1. Sensor-based nitrogen fertigation research site locations.

Managing Variability with Drone-based Sensors

Nitrogen need varies spatially within a field and from year to year. This study utilized a Parrot® Sequoia multispectral sensor, which captures imagery in four bands: green, red, red edge, and near-infrared. These bands allow the normalized difference vegetation index (NDVI) and the normalized difference red edge (NDRE) index to be calculated. These vegetation indices are correlated with crop biomass and nitrogen status, and therefore can inform growers about the crop's N need. The Parrot Sequoia was mounted on a senseFly eBee fixed wing drone (Figure 2). Pre-programmed flight paths were developed and autonomously flown on a weekly basis.

Figure 2. senseFly eBee fixed wing drone (left) and Parrot® Sequoia sensor (top right).

Study Design

The experiments were arranged in a randomized complete block design with four replications of three treatments: the grower's traditional N management, a risk-averse sensor-based fertigation approach, and a risk-tolerant fertigation approach (Figure 3). The treatments were applied in 15° sectors on half of a quarter section under pivot irrigation. Between the V5 and V7 growth stages, a UAN fertilizer sidedress application was made with a high clearance applicator to establish small *indicator blocks* – 80-feet by 80-feet portions of the field that included four N application rates offset from the bulk. These indicator blocks function as early indicators of an N deficiency. The four N rates included in the indicator blocks were 30 lb/ac less than the bulk sector rate, equal to the bulk sector rate, 30 lb/ac greater than the bulk sector rate, and 60 lb/ac greater than the bulk sector rate. Four indicator blocks were established in each treatment sector. The difference between the risk-averse and risk-tolerant management was the amount of observed N deficiency in the indicator blocks, which was required before initiating fertigation. For the risk-averse fertigation treatment, N fertigation was triggered when one indicator block showed N deficiency; this approach may better protect yield as N is applied more frequently. For the risk-tolerant fertigation treatment, N fertigation was triggered when three indicator blocks showed N deficiency; this approach may better guard against excess N applications by only applying N when several indicator blocks agree that N is needed.

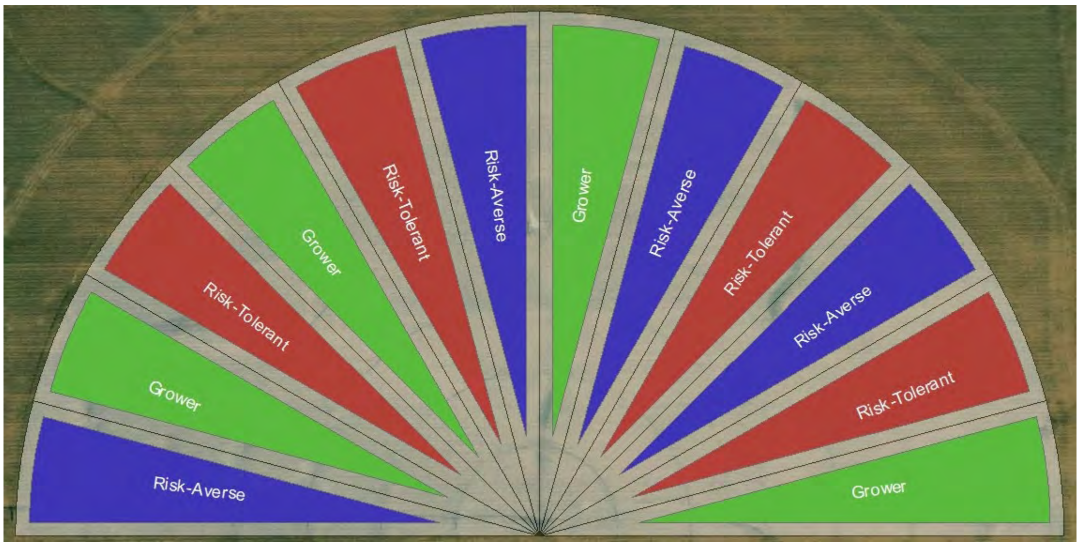


Figure 3. Experiment design with four replications of three treatments (grower's traditional management and the risk-tolerant and risk-averse sensor-based fertigation approaches) arranged in sectors.

Each field site was equipped with a variable injection rate fertilizer pump on the center pivot system (Figure 4). UAN fertilizer from an in-field tank was injected to irrigation water through the injection pump in order to *fertigate* the corn. Sensor-based fertigation management began when the total amount of N applied up to that point in the season was 60 lb/ac less than the grower's total target N rate. Therefore, the time during the season when sensor-based management began, varied based on standard grower management. Ultimately, the method provides the opportunity for sensor-based management to save up to 60 lb/ac of N versus the grower's standard management. The fertigation timings for the two sensor-based approaches were determined using the drone imagery, which was captured and analyzed weekly. If indicator plots in a given sector suggested that an N application was needed, fertigation was initiated at a rate of 30 lb N/ac. Only the sectors that indicated N application was

Figure 4. Center pivot system equipped with a variable injection rate fertilizer pump.

needed received fertilizer; therefore, on a given fertigation date, it was possible for only one of the sectors in a given treatment to receive N, or for all four sectors of a given treatment to receive N. Fertigation applications were allowed to occur up to the R3 growth stage. Fertigation applications were not allowed to occur in consecutive weeks to allow the crop enough time to take up and incorporate applied nitrogen and therefore reduce the risk of excess fertilizer applications. The grower management was determined by the grower.

Data Analysis

Yield for the plots was recorded with calibrated yield monitors. Following harvest, yield data were post-processed using the Yield Editor software (USDA) to remove erroneous data points, and then the average yield from each sector was extracted. Yield from indicator plots was included in the analysis as they are a necessary element of this N fertilization method. Because the indicator plots occurred in all three treatments, they impacted yield equally. Statistical analysis and Tukey's HSD (honest significant difference) mean separation was completed with R (R Core Team, 2019).

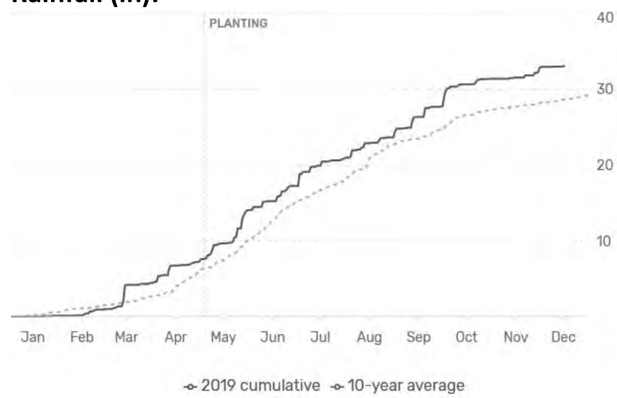
Continuing On

Subfield and sub-sector analyses of these studies will be completed to determine which soil and management variables have the most significant impact on the effectiveness of sensor-based fertigation. Climatological variables such as temperature and precipitation during the growing season will also be evaluated alongside N application data to better understand the impact of fertigation event timing on study outcomes. This study will continue in 2020 on as many as 6 sites, and will continue through at least 2021. Future iterations of the project will focus on exploring earlier season sensor-based management, integrating satellite imagery, addressing sub-sector variability, quantifying nitrate losses, and improving process efficiency through automation. Presentations on this method and its associated technology will be given at field demonstration days during 2020.

The sensor-based fertigation project is made possible through support from the Nebraska Corn Board and a USDA-NIFA grant.

Sensor-based Nitrogen Fertigation

Study ID: 0036139201901
County: Pierce
Soil Type: Elsmere fine sand; Boelus-Loretto complex 0-2% slope; Thurman loamy fine sand 2-6% slopes; Thurman loamy fine sand 0-2% slope; Thurman-Valentine complex
Planting Date: 5/3/19
Harvest Date: 10/18/19
Seeding Rate: 33,000
Row Spacing (in): 30
Variety: Pioneer® P1379AM™
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 1.5 qt/ac Cinch® ATZ Lite, 0.75 oz/ac Sharpen®, and 45 oz/ac Abundit™ Extra with 2 lb/ac AMS and 20 oz/ac crop oil concentrate on 5/14/19 ***Post:*** 4 oz/ac Realm® Q, 8 oz/ac atrazine, and 22 oz/ac Abundit™ Extra with 4 oz/ac CHS Unlocked™ and 2 lb/ac AMS, on 6/14/19
Seed Treatment: VOTiVO® and NUTRIO™ UNLOCK®
Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: Pivot, Total: 14.4"
Rainfall (in):



Introduction: Corn nitrogen management may be improved by using sensors or imagery to detect and respond to corn nitrogen need during the growing season. This study used weekly aerial imagery to monitor indicator plots with lower N rates. Sensor-based fertigation management began once the cumulative N applied was 60 lb/ac less than the grower's total target N for the season. If indicator plots demonstrated nitrogen deficiency, a fertigation application of 30 lb/ac was triggered. This study compared the grower's standard N management with two reactive, sensor-based fertigation approaches as follows:

Grower Nitrogen Treatment: 43 lb N/ac was applied at planting on May 3, 2019 from 10 gal/ac 8-20-5-5-0.5, 4 gal/ac 3-18-18, 8 gal/ac 32-0-0, and 2 gal/ac 12-0-0-26. An additional 40 lb N/ac (as 32% UAN) was applied on June 17, 2019 with a high clearance applicator. Applications of N were made through fertigation with 32% UAN as follows: 30 lb N/ac on June 7, 30 lb N/ac on July 10, 17 lb N/ac on July 12, 23 lb N/ac on July 18, 21 lb N/ac on July 24, and 30 lb N/ac on August 2 for a total of 151 lb N/ac through fertigation. The total N applied to the grower N managment was 234 lb N/ac.

Risk-Averse Fertigation Treatment: This approach triggered N fertigation when one indicator block showed N deficiency and therefore may better protect yield by applying N more frequently. The base rate of N was 113 lb N/ac, which was established with 43 lb N/ac (from 10 gal/ac 8-20-5-5-0.5, 4 gal/ac 3-18-18, 8 gal/ac 32-0-0, and 2 gal/ac 12-0-0-26) applied at planting on May 3, 2019, 30 lb N/ac (applied as 32% UAN via fertigation) on June 7, and 40 lb N/ac (applied as 32% UAN on June 17). Fertigation events with 32% UAN were completed on four dates: 30 lb N/ac on July 10, 17 lb N/ac on July 12, 23 lb N/ac on July 18, and 21 lb N/ac on July 24, each to all four replications. Sensor-based fertigation management began after the July 24 application. A sensor-based fertigation application with 32% UAN was triggered on August 2 at 30 lb N/ac to two of the four replications. The total applied as sensor-based fertigation was 15 lb N/ac and the total applied over the growing season was 219 lb N/ac.

Risk-Tolerant Fertigation Treatment: This approach triggered N fertigation when three indicator blocks showed N deficiency and may better guard against excess N applications by only applying N when several indicator blocks agree that N is needed. The base rate of N was 113 lb N/ac, which was established with 43 lb N/ac (from 10 gal/ac 8-20-5-5-0.5, 4 gal/ac 3-18-18, 8 gal/ac 32-0-0, and 2 gal/ac 12-0-0-26) applied at planting on May 3, 2019, 30 lb N/ac (applied as 32% UAN via fertigation) on June 7, and 40 lb N/ac (applied as 32% UAN on June 17). Fertigation events with 32% UAN were applied on four dates: 30 lb N/ac on July 10, 17 lb N/ac on July 12, 23 lb N/ac on July 18, and 21 lb N/ac on July 24, each to all four replications. Sensor-based fertigation management began after the July 24 application. Aerial imagery indicated that a fertigation application was not necessary for any of the four replications on August 2. The total applied as sensor-based fertigation was 0 lb N/ac through fertigation and the total applied over the growing season was 204 lb N/ac.

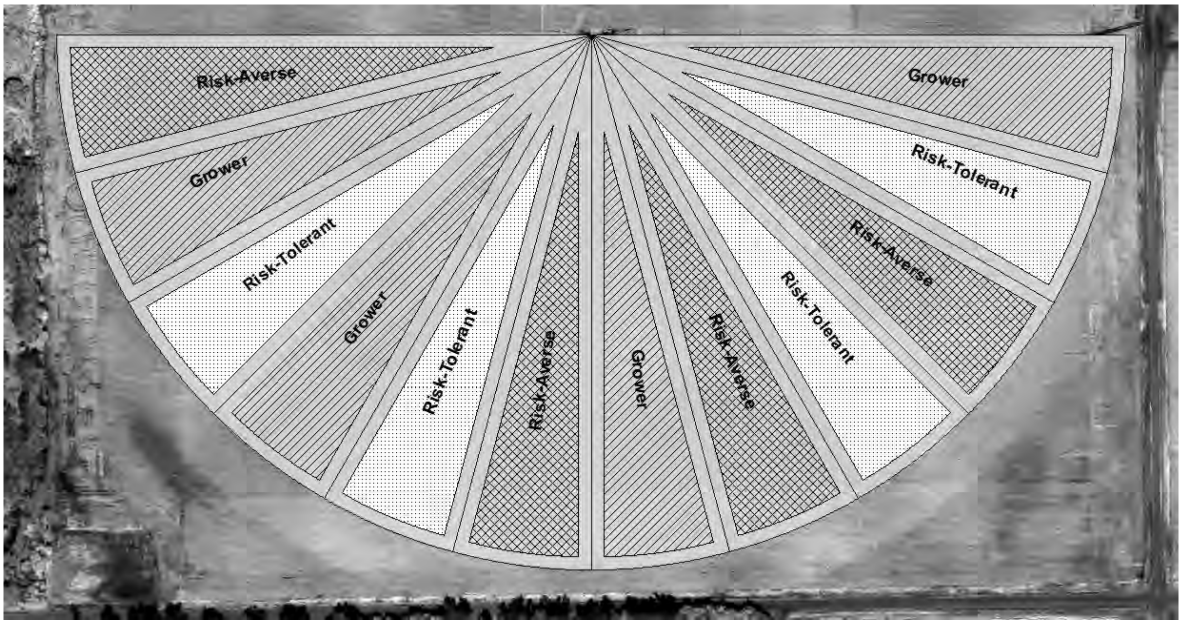


Figure 1. Experiment layout showing four replications of three treatments arranged in sectors.

Results:

N Management Strategy	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	234 A*	19.3 A	257 A	62 B	0.91 A	890.67 A
Risk-Averse Fertigation	219 AB	19.4 A	257 A	66 AB	0.85 AB	898.19 A
Risk-Tolerant Fertigation	204 B	19.1 A	255 A	70 A	0.80 B	893.64 A
P-Value	0.01	0.746	0.918	0.101	0.093	0.966

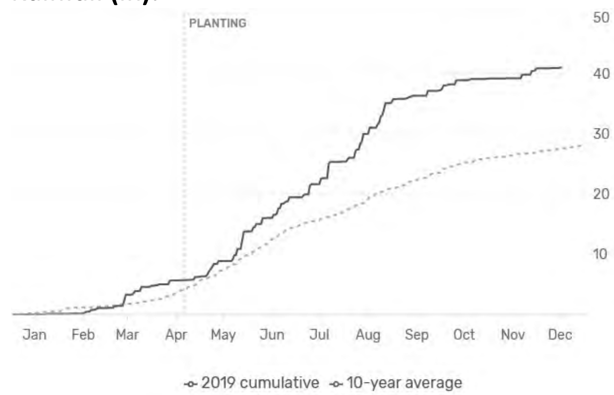
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.40/lb N.

Summary:

- At this site, the risk adverse fertigation approach applied 15 lb/ac less N than the grower's N management, whereas the risk tolerant fertigation approach applied 30 lb/ac less N than the grower's N management.
- There was no yield difference between the sensor-based fertigation approaches and the grower's N management.
- The risk tolerant sensor-based fertigation approach had greater N efficiency compared to the grower's N management.
- There was no difference in profitability between the grower's N management and the two sensor-based fertigation approaches.

Sensor-based Nitrogen Fertigation

Study ID: 0207121201901
County: Merrick
Soil Type: O'Neill loam 0-2% slope; Lockton loam rarely flooded; Brocksburg loam 0-2% slope; O'Neill sandy loam 0-2% slope
Planting Date: 4/20/19
Harvest Date: 9/27/19
Seeding Rate: 29,400
Row Spacing (in): 30
Variety: Pioneer® P1828Q™ and P1366Q™
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Post:*** 1 pt/ac Atrazine, 2.5 qt/ac Acuron® and 32 oz/ac glyphosate with 1 pt/ac MSO and 1.875 lb/ac AMS on 5/4/19
Seed Treatment: None
Foliar Insecticides: 4 oz/ac Mustang® Maxx with 0.5 pt/ac LIBERATE® surfactant on 7/18/19, 5 oz/ac Hero® on 8/4/19
Foliar Fungicides: 5 oz/ac Absolute® Maxx with 0.5 pt/ac LIBERATE® on 7/18/19
Irrigation: Pivot, Total: 2.8"
Rainfall (in):



Introduction: Corn nitrogen management may be improved by using sensors or imagery to detect and respond to corn nitrogen need during the growing season. This study used weekly aerial imagery to monitor indicator plots with lower N rates. Sensor-based fertigation management began once the cumulative N applied was 60 lb/ac less than the grower's total target N for the season. If indicator plots demonstrated nitrogen deficiency, a fertigation application of 30 lb/ac was triggered. This study compared the grower's standard N management with two reactive, sensor-based fertigation approaches as follows:

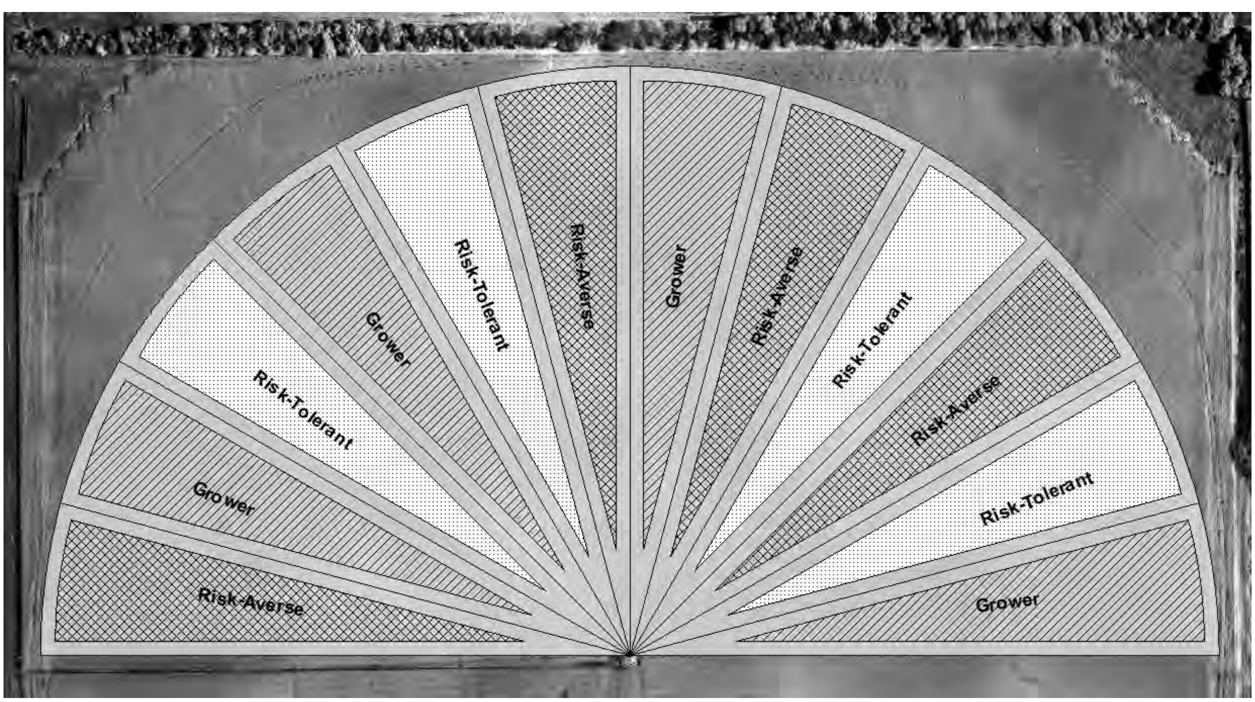


Figure 1. Experiment layout showing four replications of three treatments arranged in sectors.

Grower Management: The grower's standard N management plan involved applying 40 lb N/ac as starter at planting and 90 lb N/ac as 28-0-0-5 on June 5. The total N applied was 130 lb N/ac.

Risk-Averse Fertigation Treatment: This approach triggered N fertigation when one indicator block showed N deficiency and therefore may better protect yield by applying N more frequently. The base rate of N was 70 lb N/ac (40 lb N/ac as starter at planting and 30 lb N/ac as 28-0-0-5 on June 5). Sensor-based fertigation management began after the June 5 application. Sensor-based fertigation with 28-0-0-5 was triggered on two dates: 30 lb N/ac on July 3 and 30 lb N/ac on July 19 with all four replications receiving applications on both dates. Total sensor-based fertigation was 60 lb N/ac and the total applied during the growing season was 130 lb N/ac.

Risk-Tolerant Fertigation Treatment: This approach triggered N fertigation when three indicator blocks showed N deficiency and may better guard against excess N applications by only applying N when several indicator blocks agree that N is needed. The base rate of N was 70 lb N/ac (40 lb N/ac as starter at planting and 30 lb N/ac as 28-0-0-5 on June 5). Sensor-based fertigation management began after the June 5 application. Sensor-based fertigation with 28-0-0-5 was triggered on three dates: 30 lb N/ac on July 3 to one of four replications, 30 lb N/ac on July 19 to three of four replications, and 30 lb N/ac on July 27 to one of four replications. Total sensor-based fertigation was 37.5 lb N/ac and the total applied during the growing season was 108 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	130 A	18.5 A	211 A	91 A	0.62 A	757.79 A
Risk-Averse Fertigation	130 A	19.4 A	201 A	87 A	0.70 A	716.68 A
Risk-Tolerant Fertigation	108 B	19.2 A	199 A	105 A	0.55 A	717.80 A
P-Value	0.012	0.819	0.87	0.374	0.469	0.896

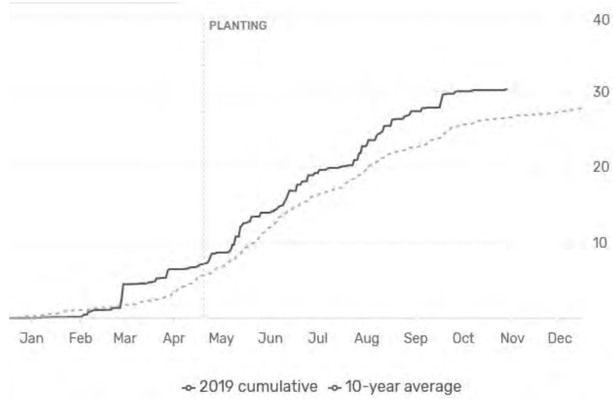
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.40/lb N.

Summary:

- At this site, the risk adverse fertigation approach applied the same amount of N as the grower's N management, while the risk tolerant fertigation approach applied 22 lb/ac less N than the grower's N management.
- There was no yield, N efficiency, or net return difference between the sensor-based fertigation approaches and the grower's N management.

Sensor-based Nitrogen Fertigation

Study ID: 0568003201901
County: Antelope
Soil Type: Loretto sandy loam 0-3% slope; Valentine fine sand 9-24 percent rolling slopes; Thurman loamy fine sand 2-6% slopes; Thurman-Valentine complex undulating; Boelus loamy fine sand 0-2% slope; Boelus loamy fine sand 2-6% slopes
Planting Date: 5/4/19
Harvest Date: 11/2/19
Seeding Rate: 30,000 to 33,000
Row Spacing (in): 30
Variety: Channel® 213-19 STXRIB & VT2PRIB
Reps: 3
Previous Crop: Corn
Tillage: Disk, Harrow
Herbicides: ***Pre:*** 32 oz/ac atrazine 4L, 24 oz/ac Durango®, and 12 oz/ac Verdict® with 1.1 lb/ac AMS and 0.13 gal/ac MSO on 5/4/19 ***Post:*** 24 oz/ac Durango®, 3 oz/ac Explorer™, and 1.5 qt/ac atrazine 4L with 9 oz/ac crop oil on 6/5/19
Foliar Insecticides and Fungicides: None
Irrigation: Pivot, Total: 8"
Rainfall (in):



Introduction: Corn nitrogen management may be improved by using sensors or imagery to detect and respond to corn nitrogen need during the growing season. This study used weekly aerial imagery to monitor indicator plots with lower N rates. Sensor-based fertigation management began once the cumulative N applied was 60 lb/ac less than the grower's total target N for the season. If indicator plots demonstrated nitrogen deficiency, a fertigation application of 30 lb/ac was triggered. This study compared the grower's standard N management with two reactive, sensor-based fertigation approaches as follows:

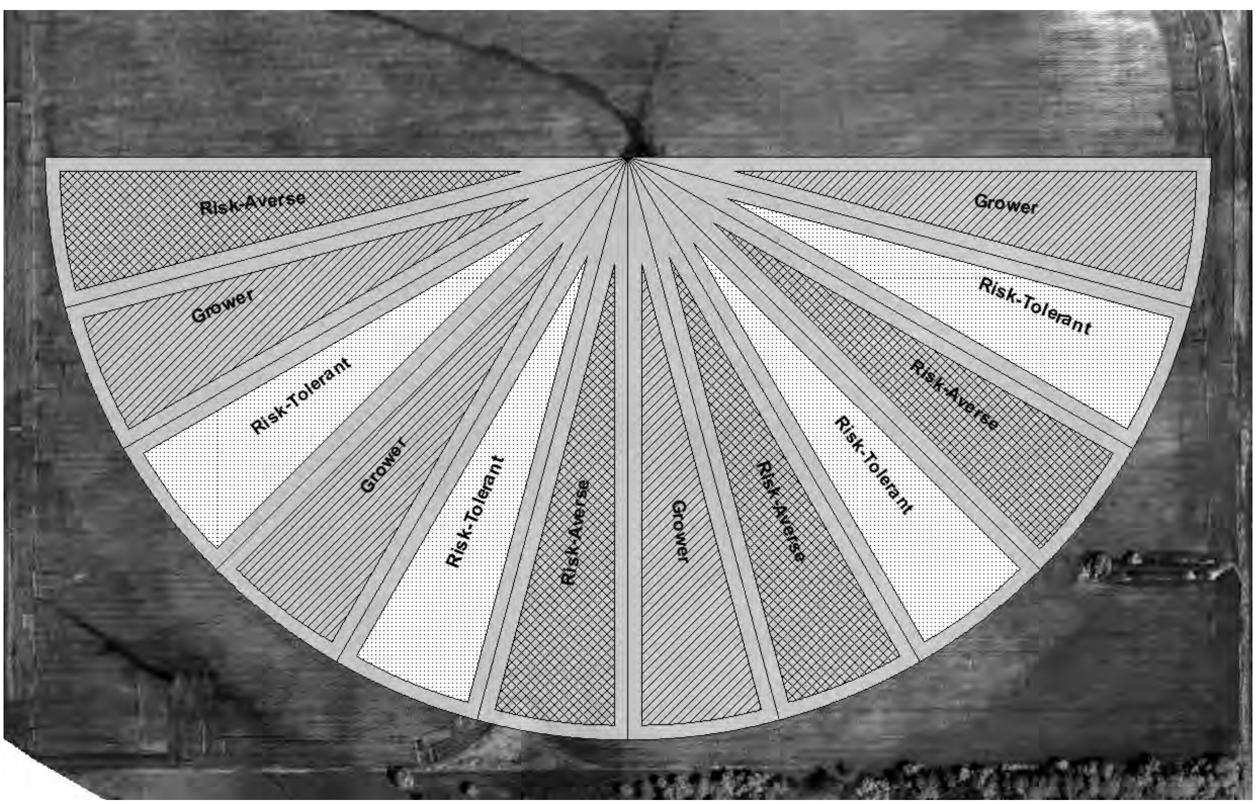


Figure 1. Experiment layout showing four replications of three treatments arranged in sectors. Due to an error, only three replications are considered in this analysis.

Grower Management: 40 lb N/ac was applied on May 4 at planting, 30 lb N/ac was applied as 32-0-0-5 on June 12, and 120 lb N/ac was applied as 32-0-0-5 on June 13. The June 13 application was used to establish indicator blocks. UAN (32-0-0-5) was applied through fertigation on two dates: 30 lb N/ac on July 11 and 30 lb N/ac on July 31. The total N applied was 250 lb N/ac. This total N rate exceeded the total N target rate of 230 lb N/ac, which was determined prior to the season.

Risk-Averse Fertigation Treatment: This approach triggered N fertigation when one indicator block showed N deficiency and therefore may better protect yield by applying N more frequently. The base rate of N was 170 lb N/ac, which was established with 40 lb N/ac on May 4 at planting, 30 lb N/ac applied as 32-0-0-5 on June 12, and 100 lb N/ac applied as sidedress with 28-0-0-5 on June 13. Sensor-based fertigation management began after the June 13 application since this brought the applied N rate to 170 lb N/ac, 60 lb N/ac less than the 230 lb N/ac target total N rate. Sensor-based fertigation with 32-0-0-5 was triggered on three dates: 30 lb N/ac was applied July 11 to all three replications, 30 lb N/ac was applied July 26 to two of three replications, and 30 lb N/ac was applied on August 6 to one of three replications. Total sensor-based fertigation was 60 lb N/ac and the total applied during the growing season was 230 lb N/ac.

Risk-Tolerant Fertigation Treatment: This approach triggered N fertigation when three indicator blocks showed N deficiency and may better guard against excess N applications by only applying N when several indicator blocks agree that N is needed. The base rate of N was 170 lb N/ac, which was established with 40 lb N/ac on May 4 at planting, 30 lb N/ac applied as 32-0-0-5 on June 12, and 100 lb N/ac applied as sidedress with 28-0-0-5 on June 13. Sensor-based fertigation management began after the June 13 application since this brought the applied N rate to 170 lb N/ac, 60 lb N/ac less than the 230 lb N/ac target total N rate. Sensor-based fertigation with 32-0-0-5 was triggered on two dates: 30 lb N/ac was applied on July 22 to one of three replications and 30 lb N/ac was applied on July 31 to one of three replications. The total applied through sensor-based fertigation was 20 lb N/ac, and the total applied over the growing season was 190 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	250 A*	18.0 A	245 A	55 A	1.02 A	837.55 A
Risk-Averse Fertigation	230 AB	18.7 A	242 A	60 A	0.96 A	833.06 A
Risk-Tolerant Fertigation	190 B	18.0 A	228 A	68 A	0.84 A	797.10 A
P-Value	0.044	0.243	0.327	0.23	0.208	0.613

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.40/lb N.

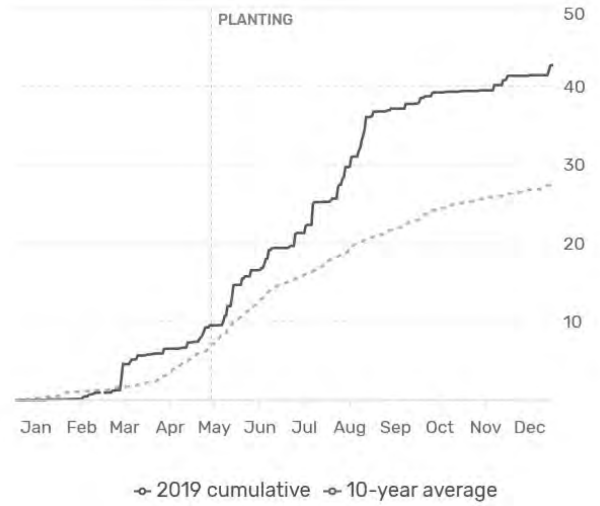
Summary:

- At this site, the risk adverse fertigation approach applied 20 lb/ac less N than the grower's N management, while the risk tolerant fertigation approach applied 60 lb/ac less N than the grower's N management.
- There was no yield, N efficiency, or marginal net return difference between the sensor-based fertigation approaches and the grower's N management.

Sensor-based Nitrogen Fertigation

Study ID: 0815093201902
County: Howard
Soil Type: Valentine-Thurman complex 0-17% slopes; Thurman loamy fine sand 2-6% slopes; Libory-Boelus loamy fine sand; Kenesaw silt loam 1-6% slopes; Kenesaw silt loam 0-1% slope; Thurman loamy fine sand 0-2% slope; Ortello loamy fine sand 1-6% slopes
Planting Date: 5/13/19
Harvest Date: 10/19/19
Seeding Rate: 35,000
Row Spacing (in): 30
Variety: Pioneer® P0339AMXT™
Reps: 4
Previous Crop: Corn
Tillage: No-Till

Irrigation: Pivot, Total: 6.9"
Rainfall (in):



Introduction: Corn nitrogen management may be improved by using sensors or imagery to detect and respond to corn nitrogen need during the growing season. This study used weekly aerial imagery to monitor indicator plots with lower N rates. Sensor-based fertigation management began once the cumulative N applied was 60 lb/ac less than the grower's total target N for the season. If indicator plots demonstrated nitrogen deficiency, a fertigation application of 30 lb/ac was triggered. This study compared the grower's standard N management with two reactive, sensor-based fertigation approaches as follows:

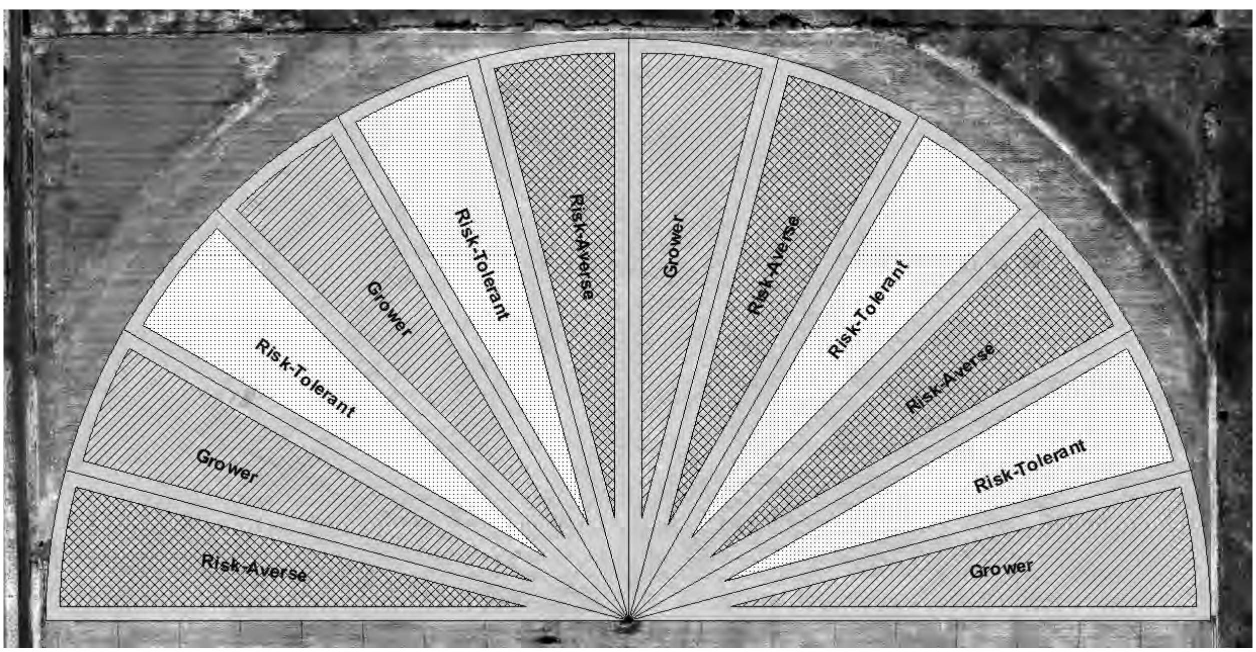


Figure 1. Experiment layout showing four replications of three treatments arranged in sectors.

Grower Management: The grower's standard N management plan involved applying 36 lb N/ac as starter at planting, 21 lb N/ac as fertigation on June 16, 30 lb N/ac as sidedress on June 20, 27 lb N/ac as fertigation on July 14, 30 lb N/ac as fertigation on July 18, and 56 lb N/ac as fertigation on July 23. The total N applied was 200 lb N/ac.

Risk-Averse Fertigation Treatment: This approach triggered N fertigation when one indicator block showed N deficiency and therefore may better protect yield by applying N more frequently.

Risk-Tolerant Fertigation Treatment: This approach triggered N fertigation when three indicator blocks showed N deficiency and may better guard against excess N applications by only applying N when several indicator blocks agree that N is needed.

At this site, the risk-averse and risk-tolerant treatments resulted in the same N management. For both, 36 lb N/ac was applied as starter at planting. Standard grower management applied an additional 134 lb N/ac (21 lb N/ac as fertigation on June 16, 30 lb N/ac as sidedress on June 20, 27 lb/ac as fertigation on July 14, and 30 lb N/ac as fertigation July 18). The July 23 fertigation was applied at a rate of 30 lb N/ac, which was less than the grower's rate of 56 lb N/ac, in order to bring the cumulative N applied to 174 lb/ac. This was 60 lb/ac less than the grower's target total N rate. Though sensor-based fertigation management started at this point, an application wasn't made the week of July 29 because fertigation events in sensor-based management sectors were not allowed in consecutive weeks. On the week of August 5, the crop was observed at the R2 growth stage, outside of the allowable interval for sensor-based applications. Therefore, no sensor-based applications were made on this site and the total N applied during the growing season was 174 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	200 A	15.9 A	157 A	44 A	1.30 A	520.90 A
Risk-Averse Fertigation	174 B	15.0 A	171 A	55 A	1.08 A	586.55 A
Risk-Tolerant Fertigation	174 B	15.2 A	160 A	52 A	1.15 A	543.62 A
P-Value	<0.0001	0.111	0.828	0.383	0.440	0.781

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.40/lb N.

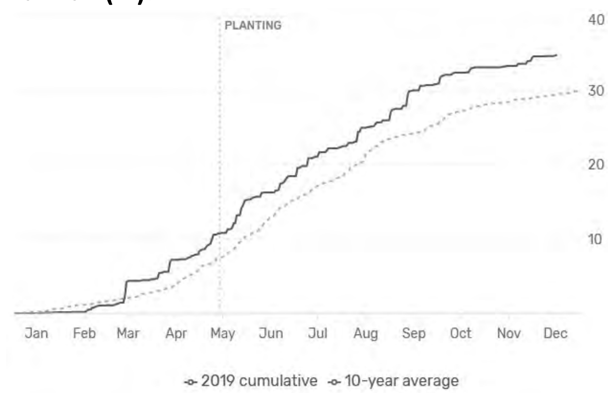
Summary:

- At this site, the risk adverse and risk tolerant fertigation approach applied 26 lb/ac less N than the grower's N management.
- There was no yield, N efficiency, or net return difference between the sensor-based fertigation approaches and the grower's N management.

Sensor-based Nitrogen Fertigation

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

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



Introduction: Corn nitrogen management may be improved by using sensors or imagery to detect and respond to corn nitrogen need during the growing season. This study used weekly aerial imagery to monitor indicator plots with lower N rates. Sensor-based fertigation management began once the cumulative N applied was 60 lb/ac less than the grower's total target N for the season. If indicator plots demonstrated nitrogen deficiency, a fertigation application of 30 lb/ac was triggered. This study compared the grower's standard N management with two reactive, sensor-based fertigation approaches as follows:

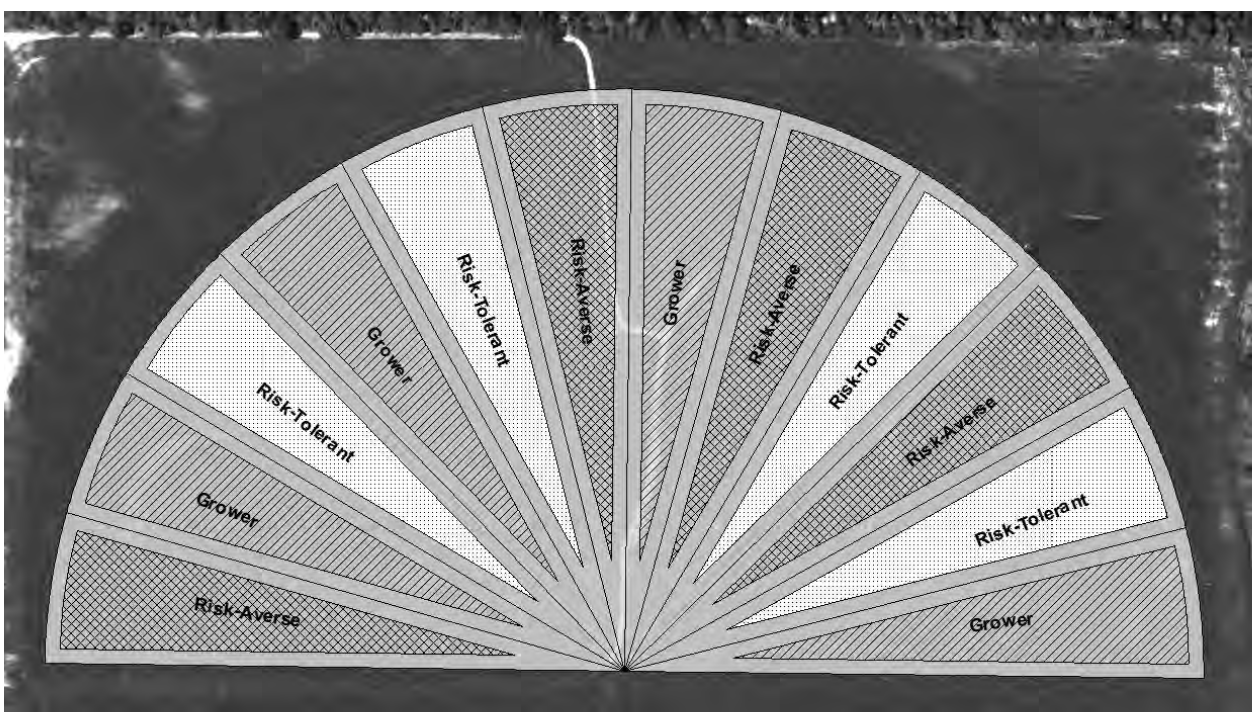


Figure 1. Experiment layout showing four replications of three treatments arranged in sectors.

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

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

Risk-Tolerant Fertigation Treatment: This approach triggered N fertigation when three indicator blocks showed N deficiency and may better guard against excess N applications by only applying N when several indicator blocks agree that N is needed. The base rate of N was 90.2 lb N/ac, which was established with 20.2 lb N/ac (applied as 8-20-3-6-0.4) on May 13 at planting, 30 lb N/ac (applied as 5 gal/ac 32% UAN, 5 gal/ac 10-34-0, and 5 gal/ac 12-0-0-26) on June 16, and 40 lb N/ac (applied as 32% UAN) on June 18. An additional fertigation application of 28.3 lb N/ac with 32% UAN was made on July 11 under the grower's standard N management. Sensor-based fertigation management began after the July 11 fertigation, which brought the cumulative N applied to 119 lb/ac, 60 lb/ac less than the grower's target total N rate. Sensor-based fertigation with 32% UAN was triggered on July 31 and 30 lb N/ac was applied to only one of four replications. The total applied through sensor-based fertigation was 8 lb N/ac, and the total applied over the growing season was 126 lb N/ac.

Results:

N Management Strategy	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡ ($/ac)
Grower	179 A*	15.9 A	235 A	74 B	0.76 A	828.99 B
Risk-Averse Fertigation	171 A	15.6 A	240 A	79 B	0.71 A	852.43 AB
Risk-Tolerant Fertigation	126 B	15.8 A	243 A	109 A	0.52 B	879.66 A
P-Value	0.001	0.454	0.404	0.0003	0.003	0.093

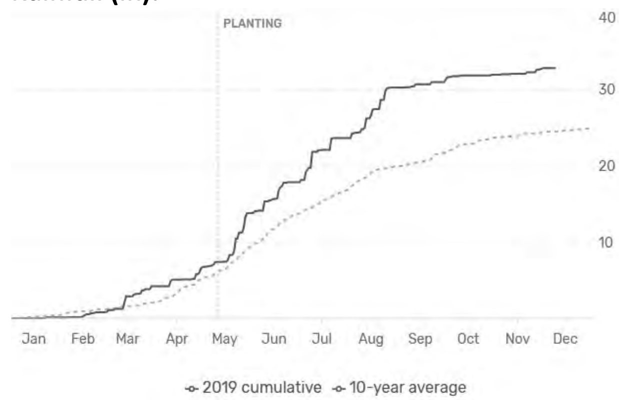
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.40/lb N.

Summary:

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

Impact of Nutrien Ag Solutions™ Extract on Nitrogen Use and Corn Yield

Study ID: 0805047201901
County: Dawson
Soil Type: Hall silt loam, 0-1% slope; Hord silt loam, 0-1% slope
Planting Date: 5/11/19
Harvest Date: 11/13/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: Pioneer® P1093AMXT™
Reps: 9
Previous Crop: Corn
Tillage: Strip-Till
Herbicides: ***Pre:*** 32 oz/ac Durango®, 1.5 qt/ac FulTime®, 8 oz/ac Sterling Blue®, 0.75 lb/ac atrazine late May ***Post:*** 32 oz/ac Durango®, 1.5 qt/ac Resicore®, 0.5 lb/ac atrazine mid-June
Foliar Fungicides: 10 oz/ac Headline AMP® aerially applied approximately Aug 1
Irrigation: Pivot, Total: 5"
Rainfall (in):



Soil Test (Feb 2019):

Soil pH 1:1	Soluble Salts 1:1 mmho/cm	OM %	Nitrate – N ppm N	Nitrate lb N/A	Mehlich P-III ppm P	$CaPO_4$ SO_4-S ppm	Ammonium Acetate (ppm) K	Ca	Mg	Na	Sum of Cations me/100g	DPTA (ppm) Zn	Fe	Mn	Cu
7.5	0.6	3.1	6	14	29	3	586	3200	288	29	20	1.6	14.9	9.0	0.7
7.4	0.3	2.9	9	22	112	6	665	3047	272	28	19	2.6	19.2	6.6	0.7
7.4	0.3	3.1	8	19	34	4	586	2764	243	29	17	2.3	11.8	6.4	0.6
7.4	0.3	3.0	9	22	37	4	662	3053	258	28	19	1.4	14.8	8.0	0.5

Introduction: Nutrien Ag Solutions™ Extract is a proprietary blend of the biocatalyst Accomplish® LM and ammonium thiosulfate (product information at right). The product claims to maximize nutrient release from crop residues and soil. The hypothesis was that Extract Powered by Accomplish™ would result in reduced fertilizer needs. To test this hypothesis, treatments were established with and without Extract and with a full and reduced fertilizer rate. Nutrien Ag Solutions™ Extract was applied at 1 gal/ac on April 9, 2019 to the Extract treatment strips.

Product information from: https://s3-us-west-1.amazonaws.com/agrian-cg-fs1-production/pdfs/Extract_6-0-0_Label3.pdf

The whole field received 35 gal/ac of a 65:25:10 blend of 32% UAN, 10-34-0, and 12-0-0-26S (ammonium thiosulfate) on April 22, 2019 with an Orthman® strip-till implement. This resulted in a total of 93 lb N/ac, 35 lb P/ac, and 10 lb S/ac. An additional 5 gal/ac of 10-34-0 was applied at planting resulting in a total of 6 lb N/ac and 20 lb P/ac. The whole field also received fertigation at brown silk and early milk (approximately August 1 and 10) for a total of 20 gal/ac of 9:1 blend of UAN and 12-0-0-26S. This resulted in a total of 67 lb N/ac and 6 lb S/ac. Sidedress rates on June 14 were varied to establish the full and reduced fertilizer treatments. Sidedress was a 9:1 blend by volume of 32% UAN and 12-0-0-26S (ammonium thiosulfate). The full rate received 33 gal/ac of the blend, which resulted in 109 lb N/ac and 9.5 lb S/ac. The reduced rate received 19 gal/ac of the blend, which resulted in 70 lb N/ac and 5.5 lb S/ac. Sidedress was completed with a coulter, injected 4-5" to the side of the row, at a depth of 2-3". In total, the full rate received 275 lb N/ac, 55 lb P/ac, and 25.5 lb S/ac while the reduced rate received 236 lb N/ac, 55 lb P/ac, and 21.5 lb S/ac.

This field had 8% green snap early July and 19% wind damage in the fall (no difference in damage across treatment strips).

Results:

	Total N (lb/ac)	Stand Count (plants/ac)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
No Extract - Full fertilizer	275	34,407 A*	18.4 A	225 A	817.09 A
No Extract - Reduced fertilizer	236	34,296 A	18.4 A	221 AB	820.77 A
Extract - Full fertilizer	275	34,370 A	18.3 A	221 AB	777.35 B
Extract - Reduced fertilizer	236	34,037 A	18.2 A	217 B	784.09 B
P-Value	-	0.743	0.471	0.014	<0.0001

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $13.86/ac for Extract, $8/ac for Extract application, $26.49/ac for reduced fertilizer, and $46.01/ac for full fertilizer.

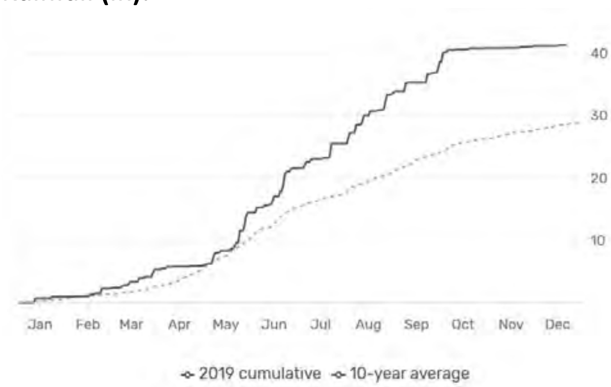
Summary:

- Stand counts and grain moisture did not differ between the treatments.
- The use of Extract did not result in a yield increase at the full or reduced fertilizer rates when compared to the no Extract treatments.
- For the no Extract treatments, the reduced fertilizer rate yielded as much as the full fertilizer treatment indicating that the lower fertilizer rate was sufficient.
- The use of Extract significantly reduced marginal net return due to the additional cost of the product and application and no yield increase.

Nitrogen Applied to Wheat at Heading

Study ID: 0932095201901
County: Jefferson
Soil Type: Crete silt loam, 1-3% slope; Crete silty clay loam, 3-7% slope
Planting Date: 9/28/19
Harvest Date: 7/15/19
Seeding Rate: 1.35 million seeds/ac
Row Spacing (in): 9
Variety: AM Eastwood
Reps: 7
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 0.75 oz/ac Harmony® Extra at early vegetative stage in spring
Foliar Fungicides: 4 oz/ac propiconazole at early vegetative; Quilt Xcel® at flag leaf; Prosaro® at early flowering

Fertilizer: 100 lb N/ac and 8.5 lb S/ac in early spring
Irrigation: None
Rainfall (in):



Introduction: The purpose of this study was to evaluate the addition of N to wheat at heading. 100 lb N/ac was applied prior to planting. The study evaluated adding an additional 20 lb N/ac as 46% urea, which was hand applied at heading on June 24, 2019. The field received approximately 0.34" rain on June 26. The field was harvested with a plot combine. Wheat yield and protein were evaluated.

Results:

	Kernel Weight (1000/lb)	Weight of 1000 Kernels (g)	Test Weight (lb/bu)	Moisture (%)	Protein Dry Basis, NIR (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	11.2 A*	41 A	58 A	10.7 A	12.0 A	90 B	329.42 A
20 lb N/ac at heading	11.2 A	40 A	58 A	10.6 A	12.3 A	93 A	325.94 A
P-Value	0.786	0.749	0.186	0.477	0.103	0.062	0.495

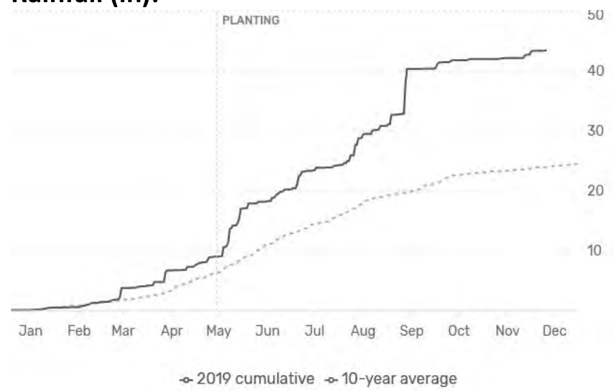
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $3.65/bu wheat, $0.40/lb N, and $6.43/ac in-season N application (for this study urea was hand applied to simulate broadcast application; therefore, a broadcast application rate is included in the cost).

Summary:

- There was a 3 bu/ac yield increase for the 20 lb N/ac treatment.
- Harvest moisture, test weight, protein, kernel weight, and net return were not impacted.

Impact of Manure and Cedar Mulch on Crop Production and Soil Properties

Study ID: 0921017201901
County: Brown
Soil Type: Johnstown fine sandy loam 0-2% slope
Planting Date: 5/14/19
Harvest Date: 11/5/19
Seeding Rate: 32,500
Row Spacing (in): 30
Variety: Croplan® CP4203
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Post:*** Resicore®, and 32 oz/ac Cornerstone® 5 Plus with 2 oz/ac InterLock®, 1.2 qt/ac Class Act® NG® and 1 qt/ac Max-IN® ZMB®
Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: Pivot, Total: 4.2"
Rainfall (in):



Introduction: In regions of intensive livestock production, such as Nebraska, significant amounts of livestock manure are produced and, at times, underutilized. Manure can be a reliable source of nutrients for crops, and it can also positively impact soil health when applied responsibly. Additionally, in Nebraska, populations of eastern redcedar trees (*Juniperus virginiana* L.) have multiplied substantially and are now an invasive species with negative ecological and economic impacts. Identifying alternatives for cedar trees management and utilization has become a priority for multiple agencies in the state. Thus, the goal of this research project was to document the effects of land-applied manure and cedar mulch on agronomic and soil health variables.

On-farm research plots were established near Ainsworth, NE, using a randomized complete block design with four replications. Four treatments were tested: (1) commercial fertilizer (control/check), (2) manure with cedar woodchips, (3) manure, and (4) cedar woodchips. Plots measured 350-feet in length and 20-feet in width to accommodate equipment size, and corn was planted. This is the first year of a 2-year study.

Treatments and Nutrients Applied:

Check: No manure or woodchips amendments were applied.
Manure + Woodchips: This treatment received 17 ton/ac of beef manure and 10 ton/ac of cedar woodchips, applied on May 11, 2019.
Manure: The manure treatments received 17 ton/ac of beef manure (surface application), applied on May 11, 2019.
Woodchips: The woodchip treatment received 10 ton/ac of cedar woodchips surface applied on May 11, 2019.

All treatments received the farmer's fertilization program, which consisted of: 19 lb/ac 11-52-0, 42 lb/ac 21-0-0-24, 45 lb/ac K-mag, 203lb/ac 34-0-0, 33 lb/ac 0-0-60, and 150 lb/ac pelletized lime. Fertilizer applied as starter in 2019 included 74 lb/ac 32% UAN, 118 lb/ac 10-34-0, and 38 lb/ac 12-0-0-26. Anhydrous ammonia was applied at a rate of 135 lb/ac. Fertilizer applied with cultivation included 118 lb/ac 32% UAN, and 19 lb/ac 12-0-0-26.

	Total nutrients received by treatment*			
	Nitrogen (lb N/ac)	Phosphorous (lb P_2O_5/ac)	Potassium (lb K_20/ac)	Sulfur (lb S/ac)
Check	271	50	30	35
Manure + Woodchips	305	139	190	48
Manure	305	139	190	48
Woodchips	271	50	30	35

* This calculation includes total nutrients from organic (manure) and inorganic (commercial fertilizers) sources.

Methods: For bulk density, a total of three samples were taken in three different rows within each rep (0-2" and 2-4"), and averaged. Sorptivity was also measured; sorptivity corresponds to the initial water infiltration in the soil, which is especially relevant to water capture in the soil profile. The higher a sorptivity value, the better the infiltration of the water in the system. For sorptivity, five measurements were made within each replication to a depth of 2.5 cm (~1.0 in), covering at least three different rows. One cm (~0.4 in) of water was poured in the ring and the period of time for infiltration to occur was timed with a stopwatch. For the chemical analysis in the top soil layers, approximately 15 random cores were taken within each plot, and composited in two depths (0-4" and 4-8"). For deeper layers, a total of three cores were randomly taken within each plot and composited in two depths (8-20" and 20-36"). All samples and measurements were taken after harvest, on November 24, 2019.

Results:

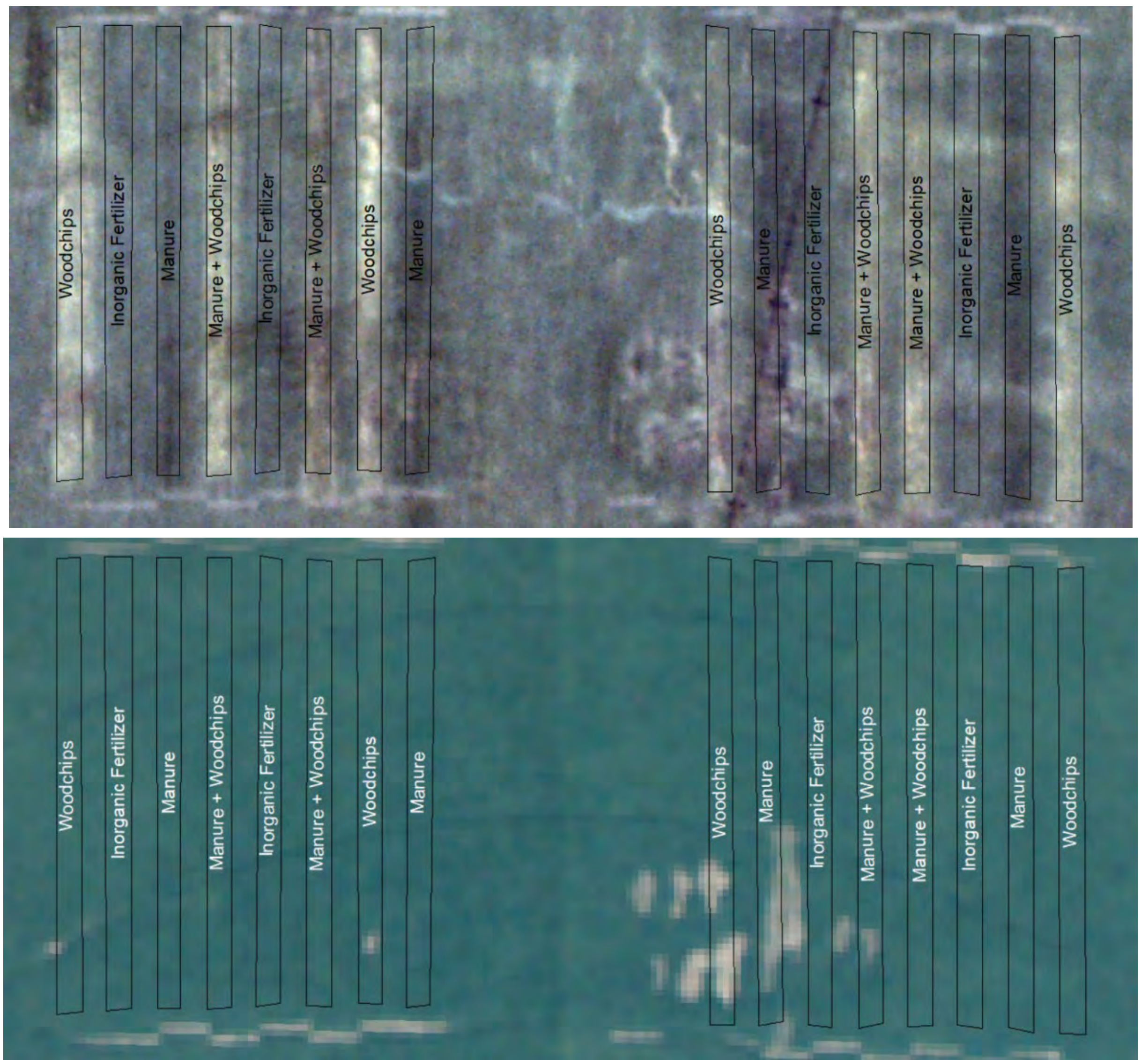


Figure 1. Aerial imagery from June 26, 2019 (top) and August 15, 2019 (bottom). Treatments receiving woodchips are visibly lighter in the June 26 imagery showing woodchips on the surface. By August 15, this difference is no longer visible and all treatments appear equally green.

	Moisture (%)	Yield (bu/ac)†	Bulk Density (g/cm^3)		Sorptivity	OM (%)	
			(0-2")	(2-4")	(cm s$^{-1/2}$)	(0-4")	(4-8")
Check	17.7 A*	225 A	2 A	2 A	0.12 B	1.58 B	0.95 A
Manure + Woodchips	17.8 A	222 A	2 A	2 A	0.21 A	1.85 A	0.98 A
Manure	17.7 A	220 A	2 A	2 A	0.15 AB	1.83 AB	0.95 A
Woodchips	17.9 A	209 A	2 A	2 A	0.19 A	1.60 AB	1.00 A
P-Value	0.585	0.336	0.173	0.899	0.022	0.031	0.797

	Soil Nitrate (ppm)				Soil P (ppm)		Soil K (ppm)	
	(0-4")	(4-8")	(8-20")	(20-36")	(0-4")	(4-8")	(0-4")	(4-8")
Check	7.2 BC	3.7 AB	3 A	4 AB	13 B	14 B	141 B	102 A
Manure + Woodchips	10.7 AB	3.9 AB	3 A	2 B	57 A	28 A	189 A	131 A
Manure	11.8 A	4.6 A	5 A	8 A	47 A	24 AB	192 A	132 A
Woodchips	6.5 C	3.3 B	4 A	5 AB	13 B	18 AB	139 B	110 A
P-Value	0.018	0.072	0.473	0.032	0.0002	0.050	0.011	0.213

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.

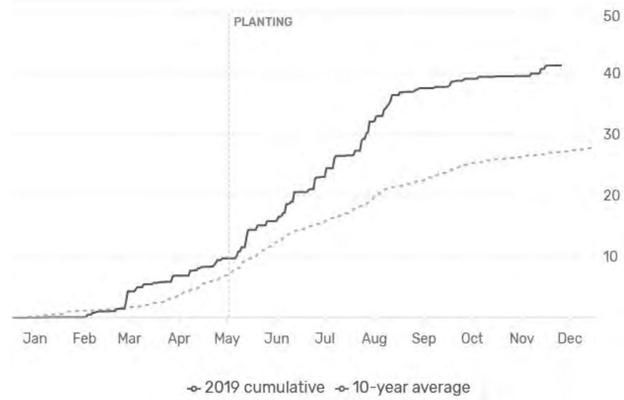
Summary:

- There were no corn yield or grain moisture differences between the treatments evaluated.
- There were some differences in sorptivity in the first year of the study: the treatments with woodchips (woodchip and manure + woodchip) had higher sorptivity than the check, which had only inorganic fertilizer.
- Organic matter at 0-4" was also higher for the manure + woodchip treatment compared to the check.
- Soil P and K at 0-4" was higher for the treatments that contained manure compared to the woodchip treatment and the check treatment.
- Soil N (nitrate) was also different with the manure treatment having higher soil N at 0-4" than the check and woodchip treatment. At the 4-8" depth, the manure treatment had higher soil N than the woodchip treatment. No differences were seen at the 8-20" depth.

This work is supported by the Daugherty Water for Food Global Institute, The Nebraska Department of Environment and Energy, and The Nebraska Environmental Trust, Project 18-203: Transforming Manure and Cedar Mulch from "Waste" to "Worth".

Impact of Manure and Cedar Mulch on Crop Production and Soil Properties

Study ID: 0925093201901
County: Howard
Soil Type: Hord silt loam 0-1% slope
Planting Date: 5/16/19
Harvest Date: 10/26/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC62-98RIB
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 1.8 qt/ac Bicep II Magnum® ***Post:*** 16 oz/ac DiFlexx®
Seed Treatment: None
Foliar Insecticides and Fungicides: None
Irrigation: Pivot, Total: 1.32" (0.33" 4 times)
Rainfall (in):



Introduction: In regions of intensive livestock production, such as Nebraska, significant amounts of livestock manure are produced and, at times, underutilized. Manure can be a reliable source of nutrients for crops and it can also positively impact soil health when applied responsibly. Additionally, in Nebraska, populations of eastern redcedar trees (*Juniperus virginiana* L.) have multiplied substantially and are now an invasive species with negative ecological and economic impacts. Identifying alternatives for cedar trees management and utilization has become a priority for multiple agencies in the state. Thus, the goal of this research project was to document the effects of land-applied manure and cedar mulch on agronomic and soil health variables.

On-farm research plots were established near Saint Paul, NE, using a randomized complete block design with four replications, to test four treatments: (1) commercial fertilizer (control/check), (2) manure with cedar woodchips, (3) manure, and (4) cedar woodchips. Plots measured 350-feet in length and 40-feet in width to accommodate equipment size, and corn was planted. This is the first year of a 2-year study.

Treatments and Nutrients Applied:

Check: No amendments were applied. To compensate the P and N received by the plots where manure was applied, this treatment also received 100 lb/ac of AMS, 138 lb/ac of 11-52-0, 250 lb/ac of potash, and 132 lb/ac of ESN (44-0-0).
Manure + Woodchips: This treatment received 21 ton/ac of beef manure, and 12 ton/ac of cedar woodchips, both on January 31, 2019.
Manure: The manure treatment received 21 ton/ac of beef manure (surface application) on January 31, 2019.
Woodchips: The woodchips treatment received 12 ton/ac of cedar woodchips, applied on January 31, 2019. To compensate the P and N received by the plots where manure was applied, this treatment also received 100 lb/ac of AMS, 138 lb/ac of 11-52-0, 250 lb/ac of potash, and 132 lb/ac of ESN (44-0-0).
All treatments received the farmers management of 1000 lb/ac lime applied pre-planting, 3 gal/ac of 7-21-3 starter as Midwestern BioAg™ L-CBF liquid carbon-based monopotassium phosphate, 12 gal/ac 32% UAN at planting, and 30 gal/ac of 32% UAN applied through fertigation (split into three applications).

	Total nutrients received by treatment*			
	Nitrogen (lb N/ac)	Phosphorous (lb P_2O_5/ac)	Potassium (lb K_20/ac)	Sulfur (lb S/ac)
Check	245	79	151	24
Manure + Woodchips	245	178	357	24
Manure	245	178	357	24
Woodchips	245	79	151	24

* Includes total nutrients from organic (manure) and inorganic (commercial fertilizers) sources.

Methods: Light horizontal tillage was done after harvest, with cover crop planting (rye). Soil measurements and samples were taken after tillage was implemented. For bulk density, a total of three samples were taken in three different rows within each rep (0-2” and 2-4”), and averaged. For the chemical analysis in the top soil layers, approximately 15 random cores were taken within each plot, and composited in two depths (0-4” and 4-8”). For deeper layers, a total of three cores were randomly taken within each plot and composited in two depths (8-20” and 20-36”). All samples and measurements were taken after harvest, on November 3, 2019.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)	Bulk Density		OM (%)	
			(0-2”)	(2-4”)	(0-4”)	(4-8”)
Check	180 A*	549.70 A	2 A	2 A	2.68 A	1.75 A
Manure + Woodchips	168 A	-1,675.74 C	2 A	2 A	2.73 A	1.83 A
Manure	164 A	399.67 B	2 A	2 A	2.45 A	1.55 A
Woodchips	171 A	-1,574.15 C	2 A	2 A	2.70 A	1.68 A
P-Value	0.733	<0.0001	0.316	0.403	0.533	0.280

	Soil Nitrate (ppm)				Soil P (ppm)		Soil K (ppm)	
	(0-4”)	(4-8”)	(8-20”)	(20-36”)	(0-4”)	(4-8”)	(0-4”)	(4-8”)
Check	12.5 B	4.5 B	4 A	3 A	20 B	7 A	329 AB	213 A
Manure + Woodchips	12.3 B	5.6 AB	3 A	3 A	31 AB	8 A	392 A	276 A
Manure	17.2 A	7.2 A	4 A	4 A	35 AB	8 A	264 B	209 A
Woodchips	11.4 B	3.7 B	2 A	2 A	41 A	11 A	335 AB	223 A
P-Value	0.021	0.021	0.605	0.886	0.067	0.765	0.097	0.262

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn, $138.81/ac for control treatment fertilizer, $227.97/ac for manure treatment fertilizer, $2,229.20/ac for woodchip treatment, and $2,318.40/ac for woodchip and manure treatment.

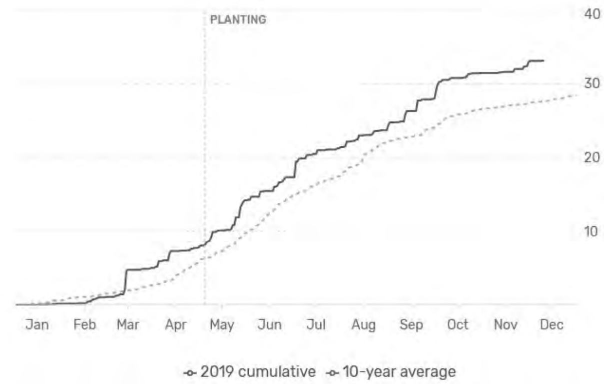
Summary:

- There was no difference in yield between the treatments evaluated.
- Net return was highest for the check inorganic fertilizer treatment. The manure was pro-rated over 4 years according to N availability. Mulch expense was very high due to costs of cedar woodchips and transportation, and was not pro-rated as good information does not yet exist to indicate how many years this should be prorated over. For this specific study, a source of woodchips located far away from the research site was used. Using a local source may reduce these costs.
- Of the soil properties measured, only P and K in 0-4" and N in the 0-8" range showed differences between treatments. The inorganic fertilizer check had lower P than the woodchip treatment; the manure treatment had lower K than the manure + woodchip treatment; the manure treatment had higher N than all other treatments in the 0-4" depth and higher N than the check and woodchip treatment in the 4-8" depth.

This work is supported by the Daugherty Water for Food Global Institute*, the Nebraska Department of Environment and Energy, and* The Nebraska Environmental Trust, Project 18-203: Transforming Manure and Cedar Mulch from “Waste” to “Worth”.

Impact of Manure and Cedar Mulch on Crop Production and Soil Properties

Study ID: 0924139201901
County: Pierce
Soil Type: Ortello sandy loam terrace, 0-2% slope
Planting Date: 5/4/19
Harvest Date: 10/26/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: Pioneer® P1197
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 2.1 qt/ac Bicep II Magnum®, 1 qt/ac Roundup®, 0.66 pt/ac 2,4-D ***Post:*** 4 oz/ac Realm® Q, 1 qt/ac Roundup®, 0.5 fl oz/ac Callisto® at V4
Seed Treatment: Poncho® 1250 + VOTiVO®
Foliar Insecticides: 5 fl oz/ac Capture® via chemigation at R1
Foliar Fungicides: 10 fl oz/ac Quilt Xcel®, via chemigation at R2
Irrigation: Pivot, Total: 5.6"
Rainfall (in):



Introduction: In regions of intensive livestock production, such as Nebraska, significant amounts of livestock manure are produced and, at times, underutilized. Manure can be a reliable source of nutrients for crops and it can also positively impact soil health when applied responsibly. Additionally, in Nebraska, populations of eastern redcedar trees (*Juniperus virginiana* L.) have multiplied substantially and are now an invasive species with negative ecological and economic impacts. Identifying alternatives for cedar trees management and utilization has become a priority for multiple agencies in the state. Thus, the goal of this research project was to document the effects of land-applied manure and cedar mulch on agronomic and soil health variables.

On-farm research plots were established near Pierce, NE, using a randomized complete block design with four replications, to test three treatments: (1) commercial fertilizer (control/check), (2) manure and cedar woodchips, and (3) mulch. Plots measured 20-feet in length and 40-feet in width, and corn was planted. This is the first year of a 2-year study.

Treatments and Nutrients Applied:

Check: No organic amendments were applied (no beef slurry). On top of the farmer´s fertilization program, 196 lb/ac of 15-23-10 and 27.2 lb/ac of 32-0-4 were applied to balance out the N and P levels, relative to those plots where beef slurry was applied (“Manure” and “Manure + Woodchips” treatments).
Manure + Woodchips: This treatment received an average of 5,700 gal/ac of beef slurry on April 19, 2019, and 10 ton/ac of cedar woodchips applied on May 24, 2019 (both surface applications).
Manure: The manure treatment was beef slurry applied at an average of 5,700 gal/ac on April 19, 2019 (surface application).

All treatments received the following application as part of the farmer´s fertilization program: 200 lb/ac 8-20-5-5S-0.5zn at planting, 80 lb N/ac as ESN slow release (44% N) at V1, 75 lb N/ac as 30-0-0 2S at V6 via coulter injected sidedress, 35 lb N/ac as 30-0-0 2S at V10 via fertigation, 25 lb N/ac as 30-0-0 2S at V16 via fertigation, and 25 lb N/ac as 30-0-0 2S at R2 via fertigation.

	Total nutrients received by treatment*			
	Nitrogen (lb N/ac)	Phosphorous (lb P_2O_5/ac)	Potassium (lb K_2O/ac)	Sulfur (lb S/ac)
Check	294	85	31	15
Manure + Woodchips	292	83	136	20
Manure	292	83	136	20

*Includes total nutrients from organic (manure) and inorganic (commercial fertilizers) sources.

Methods: For bulk density, a total of three samples were taken in three different rows within each rep (0-2" and 2-4"), and averaged. Sorptivity was also measured; sorptivity corresponds to the initial water infiltration in the soil, which is especially relevant to water capture in the soil profile. The higher a sorptivity value, the better the infiltration of the water in the system. For sorptivity, five measurements were made within each replication to a depth of 2.5 cm (~1.0 in), covering at least three different rows. One cm (~0.4 in) of water was poured in the ring and the period of time for infiltration to occur was timed with a stopwatch. For the chemical analysis in the top soil layers, approximately 15 random cores were taken within each plot, and composited in two depths (0-4" and 4-8"). For deeper layers, a total of three cores were randomly taken within each plot and composited in two depths (8-20" and 20-36"). All samples and measurements were taken after harvest, on November 9, 2019.

Results:

	Yield (bu/ac)†	Bulk Density (g/cm^3)		Sorptivity	OM (%)	
		(0-2")	(2-4")	(cm s$^{-1/2}$)	(0-4")	(4-8")
Check	248 A*	2 A	2 A	0.14 A	1.40 A	0.80 B
Manure	241 A	2 A	2 A	0.17 A	1.70 A	1.03 A
Manure + Woodchips	238 A	2 A	2 A	0.19 A	1.65 A	0.88 AB
P-Value	0.562	0.555	0.831	0.195	0.149	0.084

	Soil Nitrate (ppm)				Soil P (ppm)		Soil K (ppm)	
	(0-4")	(4-8")	(8-20")	(20-36")	(0-4")	(4-8")	(0-4")	(4-8")
Check	11.1 A	7.1 B	6 A	11 A	39 A	36 A	148 B	130 B
Manure	19.6 A	15.0 A	7 A	4 A	50 A	45 A	255 A	198 A
Manure + Woodchips	18.1 A	8.5 B	6 A	6 A	42 A	29 A	223 A	130 B
P-Value	0.270	0.045	0.709	0.263	0.471	0.193	0.015	0.010

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

Summary:

- There was no yield difference between the treatments evaluated.
- Soil measurements for K and N from (4-8") where higher for the beef slurry treatment. Soil K was also higher in the 0-4" layer for the manure and manure + woodchips treatments.

This work is supported by the Daugherty Water for Food Global Institute, the Nebraska Department of Environment and Energy, and The Nebraska Environmental Trust, Project 18-203: Transforming Manure and Cedar Mulch from "Waste" to "Worth".

Plant Growth Regulators, Stimulants, & Biologicals

Impact of Conklin® Amplify-D® on Corn
Summary of 20 Sites in 2018 and 2019

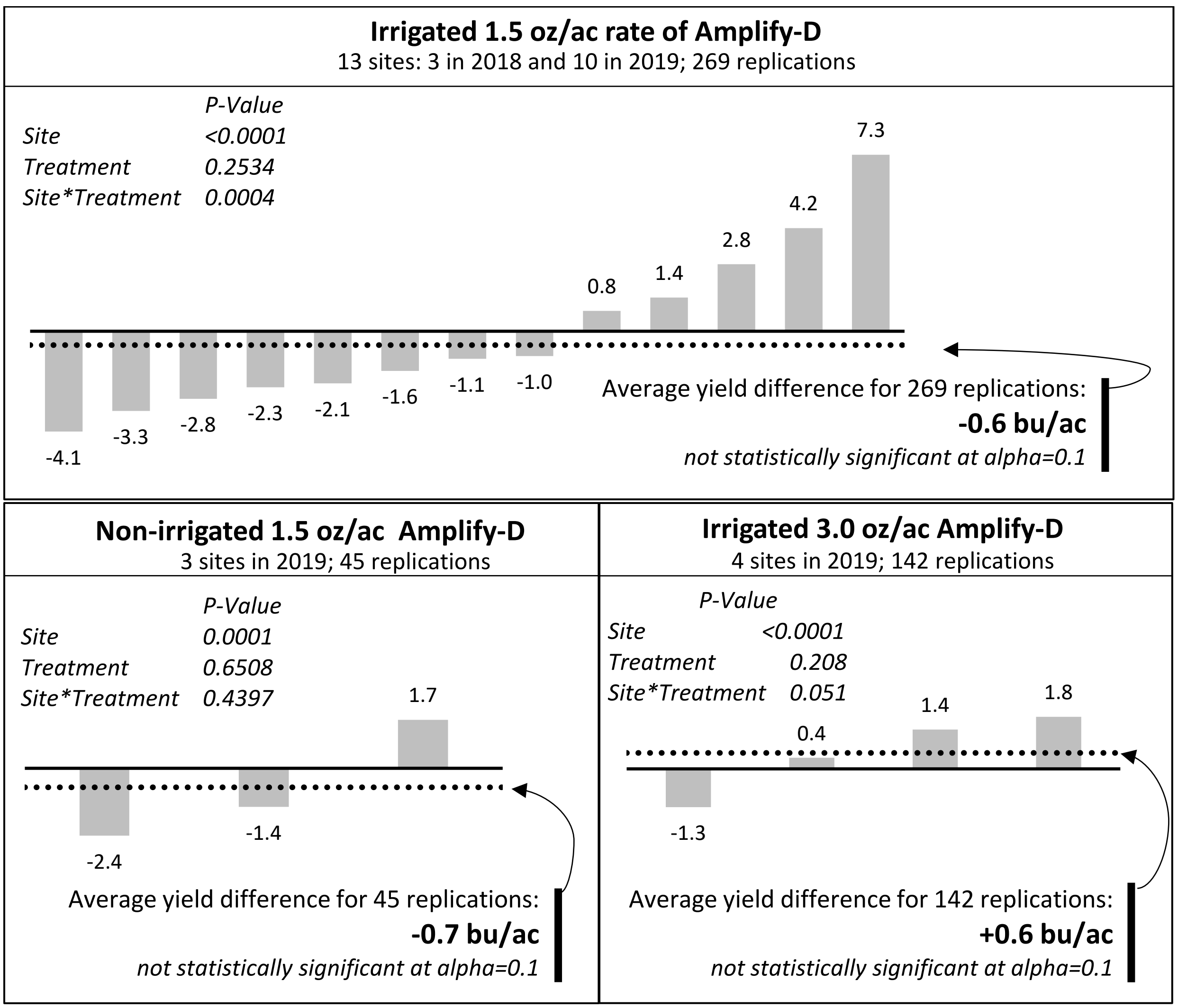
Introduction

The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac or 3.0 oz/ac in the planter box. Amplify-D® is a low analysis fertilizer advertised to aid in seed emergence, and enhanced seedling vigor. Product information is available at: https://www.conklin.com/product-catalog/agriculture/amplify-d-w-micronutrient.

Results

For analysis, sites were separated into irrigated and non-irrigated and 1.5 oz/ac and 3.0 oz/ac rate of Amplify-D®. Data from these studies were analyzed using the GLIMMIX procedure in SAS® 9.4 (SAS Institute Inc., Cary, NC). Mean separation was performed with Tukey's HSD (honest significant difference).

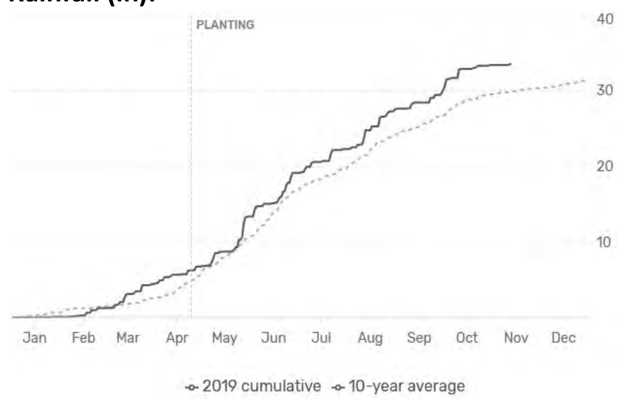
YIELD ADVANTAGE FOR AMPLIFY-D® (bu/ac)



When considering all sites together, there was no yield increase for using Amplify-D® in irrigated or non-irrigated conditions at rates of 1.5 oz/ac and 3.0 oz/ac. Because results varied greatly from site to site, individual reports for 2019 sites with detailed information about each location follow.

Impact of Conklin® Amplify-D® on Non-irrigated Corn

Study ID: 0085141201902
County: Platte
Soil Type: Gibbon silty clay loam, occasionally flooded; Grigston silt loam, occasionally flooded
Planting Date: 4/24/19
Harvest Date: 9/25-27/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC60-88
Reps: 23
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Post:*** 2 qt/ac Degree Xtra®, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, 6 oz/ac Sterling Blue®, and 56 oz/ac Halex® GT with Class Act® and Superb®
Seed Treatment: Acceleron® Basic 500
Fertilizer: 75 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn), 10 gal/ac of 32% UAN and thiosulfate blend with planter, 5 gal/ac of Kugler LS 6246s (6-24-6-1s) in-furrow, 22 gal/ac of 32% UAN and thiosulfate blend side-dressed with 360 Y-DROP® at V8 on 6/15/19
Irrigation: None
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:	
Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

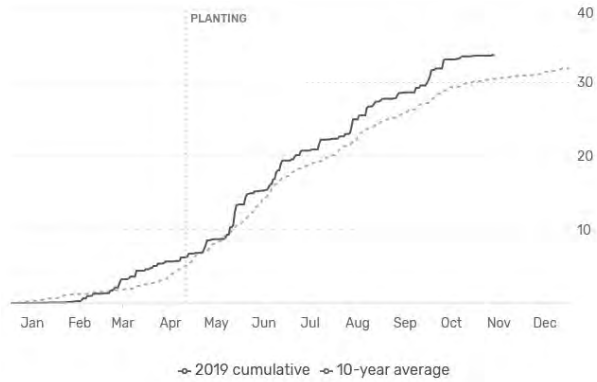
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	20.1 A*	191 A	730.99 A
Conklin® Amplify-D® (1.5 oz/ac)	20.2 A	193 A	735.86 A
P-Value	0.631	0.514	0.627

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $1.68/ac for Amplify-D®.

Summary: There was no difference in moisture, yield, or net return between the Amplify-D® treatment and the untreated check.

Impact of Conklin® Amplify-D® on Non-irrigated Corn

Study ID: 0085141201910
County: Platte
Soil Type: Gibbon-Gayville silty clay loams, occasionally flooded
Planting Date: 4/25/19
Harvest Date: 10/18/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC60-88
Reps: 10
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Post:*** 2 qt/ac Degree Xtra®, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, 6 oz/ac Sterling Blue®, and 56 oz/ac Halex® GT with Superb® HC and Class Act®
Seed Treatment: Acceleron® Basic 500
Fertilizer: 75 lb/ac MicroEssentials® SZ™ (12-40-0-10-1), 10 gal/ac of 32% UAN and thiosulfate blend with planter, 5 gal/ac of Kugler LS 6-24-6-1S in-furrow, 22 gal/ac of 32% UAN and thiosulfate blend on V8 corn with 360 Y-DROP® on 6/15/19
Irrigation: None
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:

Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

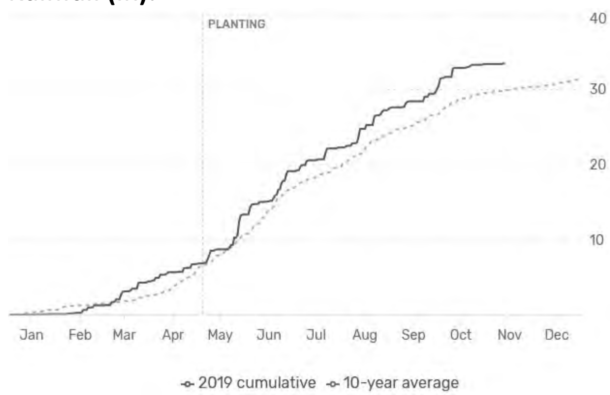
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	16.2 A*	196 A	749.71 A
Conklin® Amplify-D® (1.5 oz/ac)	16.2 A	193 A	738.93 B
P-Value	0.980	0.131	0.080

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $1.68/ac for Amplify-D®.

Summary: There was no difference in yield or moisture between the untreated check and the Amplify-D® treatment. The use of Amplify-D® resulted in a $10.78/ac decrease in net return compared to the untreated check.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201903
County: Platte
Soil Type: Gibbon silt loam, occasionally flooded; Grigston silt loam, rarely flooded
Planting Date: 5/3-4/19
Harvest Date: 10/29/19-11/4/19
Seeding Rate: 32,000
Row Spacing (in): 30
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 2 qt/ac Degree Xtra®, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with 3 oz/ac Class Act® and Superb® HC ***Post:*** 50 oz/ac Halex® GT, 16 oz/ac atrazine, and 22 oz/ac Roundup PowerMAX® with Class Act® at V6
Seed Treatment: Acceleron® Basic 500
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) and 100 lb/ac urea in April; 10 gal/ac 32% UAN and thiosulfate blend with planting, 5 gal/ac Kugler LS 624 (6-24-6-1) in-furrow; 50 gal/ac 32% UAN and thiosulfate side-dress on 6/15/19
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac in the planter box. At this site, the product was evaluated for three corn hybrids. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:

Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

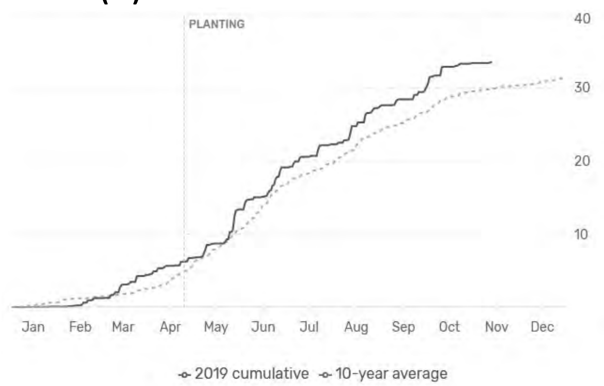
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
	DEKALB® DKC63-21 (24 replications)		
Check	15.3 B*	265 A	1,015.49 A
Conklin® Amplify-D® (1.5 oz/ac)	15.4 A	262 B	1,001.28 B
P-Value	0.006	0.0001	<0.0001
	DEKALB® DKC60-67 (21 replications)		
Check	15.2 A	243 A	931.82 A
Conklin® Amplify-D® (1.5 oz/ac)	15.2 A	241 B	919.60 B
P-Value	0.136	0.019	0.008
	DEKALB® DKC60-87 (9 replications)		
Check	14.8 B	243 A	929.37 A
Conklin® Amplify-D® (1.5 oz/ac)	15.1 A	239 B	911.89 B
P-Value	0.034	0.089	0.064

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $1.68/ac for Amplify-D®.

Summary: For DEKALB® DKC63-21, DEKALB® DKC60-67, and DEKALB® DKC60-87, the use of Amplify-D® significantly reduced yield by 3 bu/ac, 2 bu/ac and 4 bu/ac, respectively. Net return was lower where Amplify-D® was used compared to the untreated check.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201904
County: Platte
Soil Type: Grigston silt loam wet sub-stratum
Planting Date: 4/24/19
Harvest Date: 9/20-28/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKLAB® DKC60-88
Reps: 39
Previous Crop: Soybean
Tillage: Rolled before planting
Herbicides: ***Post:*** 2 qt/ac Degree® Xtra, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® HC and Class Act®
Seed Treatment: Acceleron® Basic 500
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 10 gal/ac 32% UAN and thiosulfate blend with planter, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 43 gal/ac of 32% UAN and thiosulfate blend with 360 Y-DROP® at V8 on 6/15/19
Irrigation: Gravity
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:	
Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

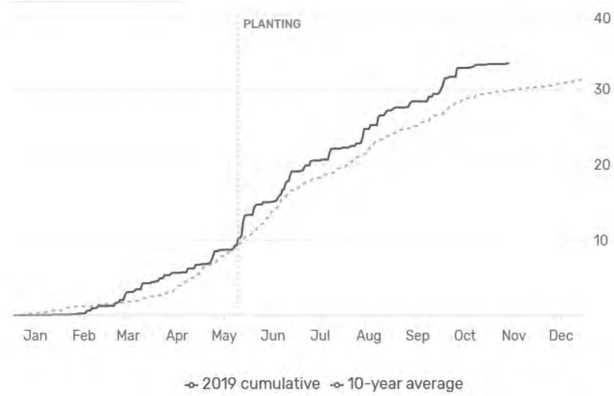
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	19.8 A*	243 A	930.80 A
Conklin® Amplify-D® (1.5 oz/ac)	20.2 A	242 A	924.87 A
P-Value	0.153	0.517	0.367

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $1.68/ac Amplify-D®.

Summary: There was no difference in moisture, yield, or net return between the untreated check and the Amplify-D® treatment.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201905
County: Platte
Soil Type: Grigston silt loam wet sub-stratum
Planting Date: 4/24/19
Harvest Date: 10/17-18/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC62-53
Reps: 14
Previous Crop: Soybean
Tillage: Rolled before planting
Herbicides: ***Post:*** 2 qt/ac Degree® Xtra, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® HC and Class Act®
Seed Treatment: Acceleron® Basic 500
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 10 gal/ac 32% Thiosulfate with planter, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 43 gal/ac of 32% UAN and thiosulfate blend with 360 Y-DROP® at V8 on 6/15/19
Irrigation: Gravity, Total: 7"
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:	
Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	16.3 A*	250 B	955.71 B
Conklin® Amplify-D® (1.5 oz/ac)	16.3 A	254 A	970.28 A
P-Value	0.918	0.012	0.021

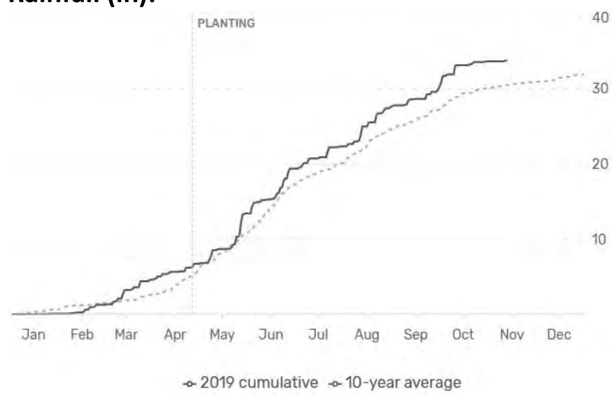
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $1.68/ac for Amplify-D®.

Summary: Amplify-D® resulted in a 4 bu/ac yield increase and $14.57 increase in marginal net return.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201906
County: Platte
Soil Type: Janude fine sandy loam, 0-1% slope; O-Neill fine sandy loam, 0-2% slope
Planting Date: 4/26/19
Harvest Date: 10/14/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC60-87
Reps: 16
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 2 qt/ac Degree Xtra®, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® HC and Class Act® ***Post:*** 50 oz/ac Halex® GT, 16 oz/ac atrazine, and 22 oz/ac Roundup PowerMAX® with Class Act® at V6
Seed Treatment: Acceleron® Basic 500

Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) and 100 lb/ac urea in April; 10 gal/ac 32% UAN and thiosulfate blend with planting, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 50 gal/ac 32% UAN and thiosulfate side-dress on 6/15/19
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:	
Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

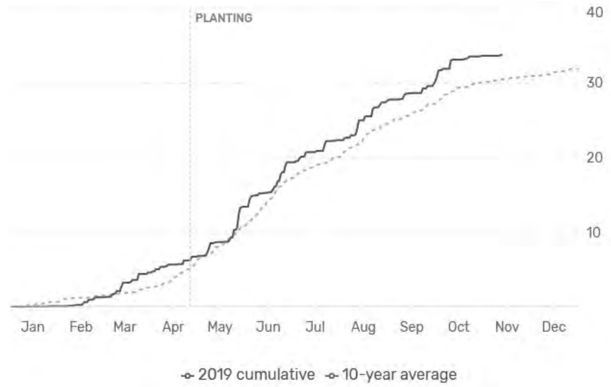
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	19.9 A*	226 A	866.89 A
Conklin® Amplify-D® (1.5 oz/ac)	19.9 A	224 B	857.02 B
P-Value	0.796	0.001	0.0002

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $1.68/ac for Amplify-D®.

Summary: The use of Amplify-D® resulted in a 2 bu/ac yield decrease and $9.87/ac decrease in net return.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201907
County: Platte
Soil Type: Gibbon-Gayville silty clay occasionally flooded; O'Neill fine sand 0-2% slope
Planting Date: 4/26/19
Harvest Date: 9/26/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC59-50
Reps: 9
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 2 qt/ac Degree Xtra®, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® HC and Class Act® ***Post:*** 50 oz/ac Halex® GT, 16 oz/ac atrazine, and 22 oz/ac Roundup PowerMAX® with Class Act® at V6
Seed Treatment: Acceleron® Basic 500
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) and 100 lb/ac urea in April; 10 gal/ac 32% UAN and thiosulfate blend with planter, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 50 gal/ac 32% UAN and thiosulfate blend side-dress on 6/15/19
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:	
Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

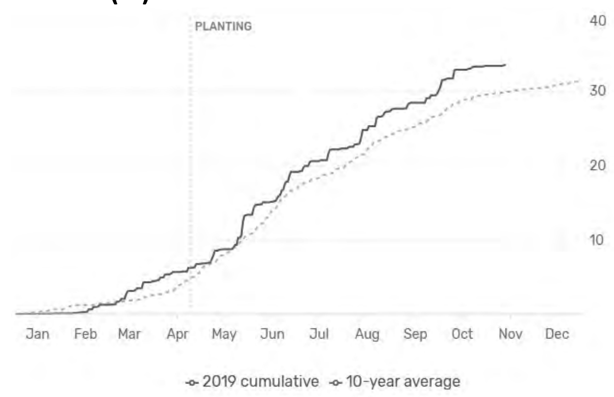
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	20.8 A	219 A	839.65 A
Conklin® Amplify-D® (1.5 oz/ac)	21.0 A	217 B	827.33 B
P-Value	0.146	0.057	0.033

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $1.68/ac for Amplify-D®.

Summary: The use of Amplify-D® resulted in a 2.7 bu/ac yield decrease and a $12.32/ac decrease in net return compared to the untreated check.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201908
County: Platte
Soil Type: Grigston silt loam wet sub-stratum, rarely flooded
Planting Date: 4/23/19
Harvest Date: 9/30/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC60-88
Reps: 16
Previous Crop: Soybean
Tillage: Rolled before planting
Herbicides: ***Post:*** 2 qt/ac Degree® Xtra, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® HC and Class Act®
Seed Treatment: Acceleron® Basic 500
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 10 gal/ac 32% UAN and thiosulfate blend with planter, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 43 gal/ac of 32% UAN and thiosulfate blend on V8 corn with 360 Y-DROP® on 6/15/19
Irrigation: Pivot, Total: 7"
Rainfall (in):



Introduction: The study was evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:	
Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

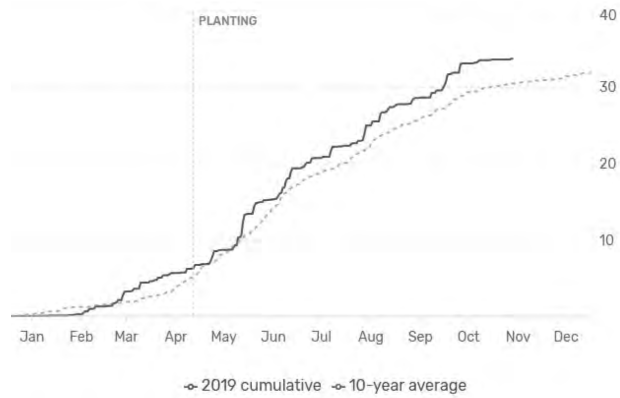
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	20.5 B*	234 B	896.41 A
Conklin® Amplify-D® (1.5 oz/ac)	20.7 A	241 A	922.53 A
P-Value	0.007	0.082	0.101

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $1.68/ac for Amplify-D®.

Summary: The use of Amplify-D® resulted in a 7 bu/ac yield increase. There was no difference in net return between the treatments tested.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201909
County: Platte
Soil Type: Gibbon silt loam occasionally flooded; Grigston silt loam wet sub-stratum
Planting Date: 4/26/19
Harvest Date: 9/28-30/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC60-88
Reps: 37
Previous Crop: Soybean
Tillage: Rolled before planting
Herbicides: ***Post:*** 2 qt/ac Degree® Xtra, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® HC and Class Act®
Seed Treatment: Acceleron® Basic 500
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 10 gal/ac 32% UAN and thiosulfate blend with planter, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 43 gal/ac of 32% UAN and thiosulfate blend on V8 corn with 360 Y-DROP® on 6/15/19
Irrigation: Gravity, Total: 7"
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:	
Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

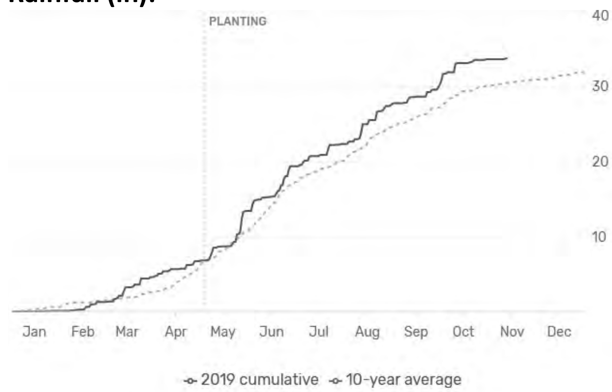
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	19.9 A*	246 A	943.72 A
Conklin® Amplify-D® (1.5 oz/ac)	20.0 A	244 B	933.22 B
P-Value	0.405	0.043	0.017

*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 adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $1.68/ac for Amplify-D®.

Summary: The use of Amplify-D® resulted in a 2 bu/ac yield decrease and $10.50/ac lower net return compared to the untreated check.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201911
County: Platte
Soil Type: Gibbon-Gayville silty clay loams, occasionally flooded; Grigston silt loam, wet sub-stratum, rarely flooded
Planting Date: 5/3/19
Harvest Date: 10/24/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC60-87
Reps: 14
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 2 qt/ac Degree Xtra®, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Class Act® and Superb® HC ***Post:*** 50 oz/ac Halex® GT, 16 oz/ac atrazine, and 22 oz/ac Roundup PowerMAX® with Class Act® at V6
Seed Treatment: Acceleron® Basic 500
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) and 100 lb/ac urea in April; 10 gal/ac 32% UAN and thiosulfate blend with planter, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 50 gal/ac 32% UAN and thiosulfate side-dress on 6/15/19
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 1.5 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:

Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

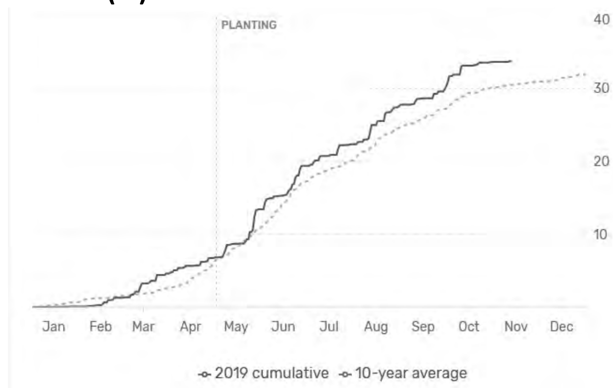
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	15.6 A*	235 A	899.69 A
Conklin® Amplify-D® (1.5 oz/ac)	15.6 A	234 A	893.67 A
P-Value	0.599	0.449	0.299

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $1.68/ac for Amplify-D®.

Summary: There was no difference in moisture, yield, or net return between the untreated check and the Amplify-D® treatment.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201912
County: Platte
Soil Type: Grigston silt loam, wet sub-stratum, rarely flooded
Planting Date: 5/2/19
Harvest Date: 10/23/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC64-34
Reps: 37
Previous Crop: Corn
Tillage: Rolled before planting
Herbicides: ***Post:*** 2 qt/ac Degree Xtra®, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® HC and Class Act®
Seed Treatment: Acceleron® Basic 500
Fertilizer: 100 lb/ac urea a month before planting, 10 gal/ac 32% UAN and thiosulfate mixture (90%/10%) with planter, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 50 gal/ac of 32% UAN and Thiosulfate mixture (90%/10%) with 360 Y-DROP® at V8 on 6/15/19
Irrigation: Pivot, Total: 5”
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 3 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:	
Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	17.0 A*	244 B	932.72 A
Conklin® Amplify-D® (3 oz/ac)	17.0 A	245 A	936.36 A
P-Value	0.293	0.016	0.196

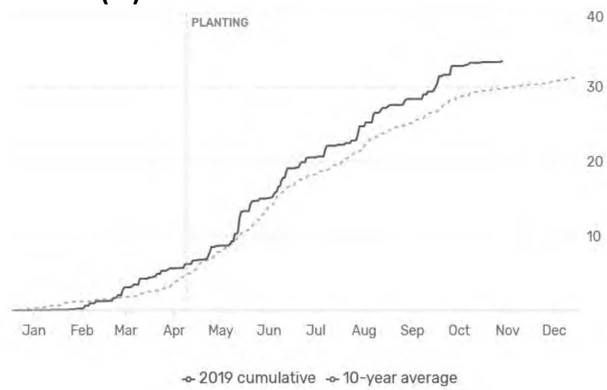
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $3.36/ac for Amplify-D®.

Summary: Amplify-D® resulted in a 1.8 bu/ac yield increase. There was no difference in moisture or net return between the treatments evaluated.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201913
County: Platte
Soil Type: Boel fine sandy loam, occasionally flooded; Inavale fine sandy loam, 0-3% slope
Planting Date: 4/23/19
Harvest Date: 10/24-25/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC64-35
Reps: 29
Previous Crop: Soybean
Tillage: Rolled before planting
Herbicides: ***Post:*** 2 qt/ac Degree® Xtra, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® HC and Class Act®
Seed Treatment: Acceleron® Basic 500

Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 10 gal/ac 32% UAN and thiosulfate blend with planter, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 43 gal/ac of 32% UAN and thiosulfate side-dress with 360 Y-DROP® at V8 on 6/15/19
Irrigation: Gravity, Total: 7"
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 3 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:

Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	15.2 A*	230 A	880.39 A
Conklin® Amplify-D® (3 oz/ac)	15.3 A	230 A	878.52 A
P-Value	0.303	0.670	0.593

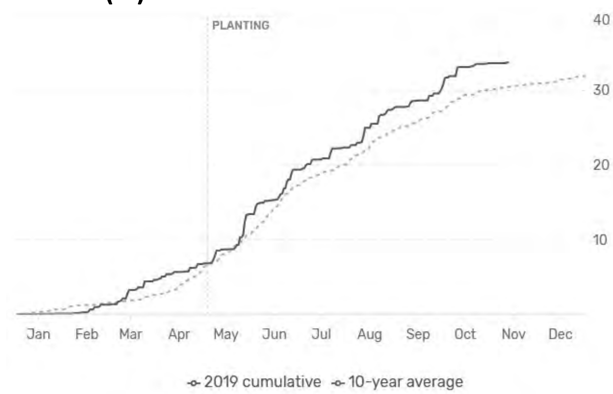
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $3.36/ac for Amplify-D®.

Summary: There was no difference in moisture, yield, or net return between the untreated check and the Amplify-D® treatment.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201914
County: Platte
Soil Type: O'Neill fine sandy loam, 0-2% slope
Planting Date: 5/3/19
Harvest Date: 10/28/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC64-34
Reps: 38
Previous Crop: Soybean
Tillage: Rolled before planting
Herbicides: ***Post:*** 2 qt/ac Degree® Xtra, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® HC and Class Act®
Seed Treatment: Acceleron® Basic 500

Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 10 gal/ac 32% UAN and thiosulfate blend with planter, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow product, 43 gal/ac of 32% UAN and thiosulfate with 360 Y-DROP® at V8 on 6/15/19
Irrigation: Gravity, Total: 7"
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 3 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:

Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

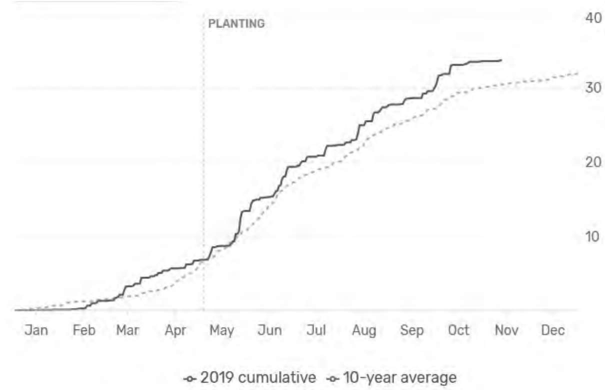
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	16.2 A*	249 A	955.06 A
Conklin® Amplify-D® (3 oz/ac)	16.2 A	251 A	956.97 A
P-Value	0.440	0.203	0.641

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $3.36/ac for Amplify-D®.

Summary: There was no difference in moisture, yield, or net return between the untreated check and the Amplify-D® treatment.

Impact of Conklin® Amplify-D® on Irrigated Corn

Study ID: 0085141201915
County: Platte
Soil Type: Grigston silt loam, wet sub-stratum, rarely flooded; Janude fine sandy loam, 0-1% slope
Planting Date: 5/3/19
Harvest Date: 10/24-29/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: DEKALB® DKC64-34
Reps: 38
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 2 qt/ac Degree Xtra®, 32 oz/ac Roundup PowerMAX®, 3 oz/ac Balance® Flexx, and 6 oz/ac Sterling Blue® with Superb® and 3 oz/ac Class Act® ***Post:*** 50 oz/ac Halex® GT, 16 oz/ac atrazine, 22 oz/ac Roundup PowerMAX®, and Class Act® at V6
Seed Treatment: Acceleron® Basic 500
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) and 100 lb/ac urea in April; 10 gal/ac 32% UAN and thiosulfate with planter, 5 gal/ac Kugler LS 624 (6-24-6-1S) in-furrow, 50 gal/ac 32% UAN and thiosulfate side-dress on 6/15/19
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The study is evaluating Conklin® Amplify-D® on corn. Amplify-D® was applied at a rate of 3 oz/ac in the planter box. The Amplify-D® guaranteed analysis is below.

Guaranteed analysis:

Total Nitrogen (N)	2.0%
Available Phosphoric Acid (P_2O_5)	10.0%
Calcium (Ca)	1.0%
Iron (Fe)	2.0%
Manganese (Mn)	0.5%
Zinc (Zn)	2.0%
Nutrients from:	Disodium Phosphate, Adenosine Monophosphate (AMP), Monosodium Phosphate, Calcium Carbonate, Ferrous Sulfate, Manganese Sulfate and Zinc Sulfate

Product information from: https://www.conklin.com/mwdownloads/download/link/id/175/

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	15.9 A*	234 A	895.90 A
Conklin® Amplify-D® (3 oz/ac)	15.9 A	233 A	887.41 B
P-Value	0.817	0.106	0.009

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $3.36/ac for Amplify-D®.

Summary: There was no difference in yield or moisture between the untreated check and the Amplify-D® treatment. Net return was $8.49/ac higher for the untreated check compared to Amplify-D®.

Impact of Conklin® Intensify® on Soybean
Summary of Five 2019 Sites

Introduction

The purpose of this study is to evaluate Conklin® Intensify®, a plant growth regulator containing gibberellic acid and indole-3-butyric acid. The guaranteed analysis is below. Intensify® was applied at a rate of 0.26 oz/ac with 5 gal/ac water in-furrow at planting.

INTENSIFY®

PLANT GROWTH REGULATOR • WATER SOLUBLE GRANULE

Active Ingredients:
Gibberellic acid.....................0.70% w/w
Indole-3-butyric acid ....0.64% w/w
Other Ingredients:.................98.66% w/w
Total: ....100.0% w/w

Contains a total of 0.0070 lb. of gibberellic acid and 0.0064 lb. of indole-3-butyric acid in 1 lb. of the product.

Product information from: https://www.conklin.com/mwdownloads/download/link/id/633/

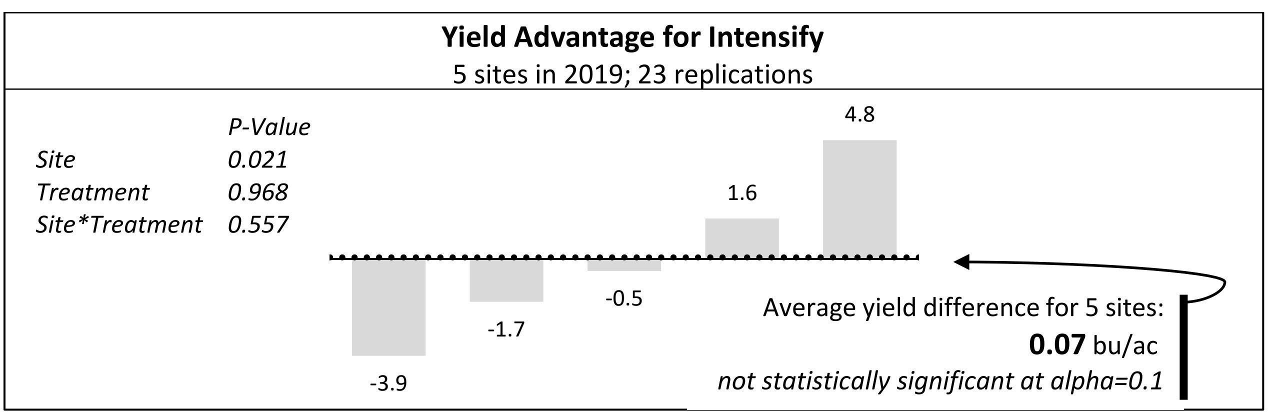
Results

Five studies were conducted in 2019 for a total of 23 replications. Data from these studies were analyzed together using the GLIMMIX procedure in SAS® 9.4 (SAS Institute Inc., Cary, NC). Mean separation was performed with Tukey's HSD (honest significant difference).

	Yield (bu/ac)†
Check	73.3 A*
Intensify®	73.4 A

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

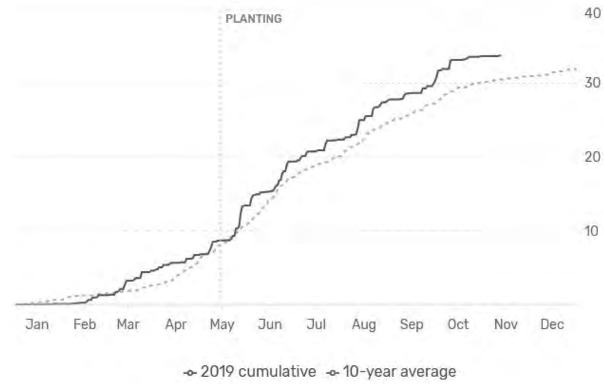
The sites had significantly different yields from each other (site term is statistically significant). However, there was no interaction of site and treatment and there was no statistically significant yield increase for using Intensify® when all five sites were considered together.



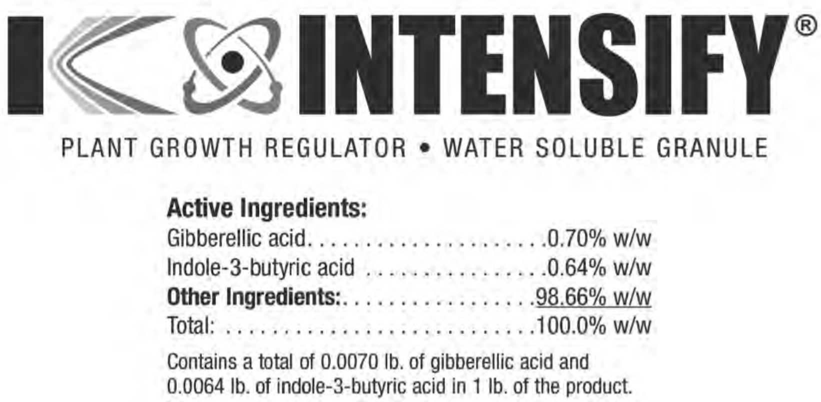
Individual reports for the five sites, with detailed information about each location follow.

Impact of Conklin® Intensify® on Non-irrigated Soybean

Study ID: 0085141201917
County: Platte
Soil Type: Gibbon silt loam occasionally flooded; Grigston silt loam wet sub-stratum
Planting Date: 5/14/19
Harvest Date: 10/7-9/19
Seeding Rate: 134,200
Row Spacing (in): 30
Variety: Golden Harvest® GH2788X
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 22 oz/ac XtendiMax®, 3 oz/ac Fierce®, and 32 oz/ac Roundup PowerMAX® with 13 oz/ac OnTarget® and 20 oz/ac Class Act® Ridion® ***Post:*** 22 oz/ac XtendiMax2®, 2 pt/ac Warrant®, 6 oz/ac Select®, and 32 oz/ac Roundup PowerMAX® with 20 oz/ac Class Act® Ridion® and 13 oz/ac OnTarget®
Foliar Insecticides: Leverage® 360 on 8/1/19
Foliar Fungicides: Stratego® YLD on 8/1/19
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 6 gal/ac 8-20-3-6-0.4 on surface with planter
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The purpose of this study is to evaluate Conklin® Intensify®, a plant growth regulator containing gibberellic acid and indole-3-butyric acid. The guaranteed analysis is below. Intensify® was applied at a rate of 0.26 oz/ac in-furrow with 5 gal/ac water.


INTENSIFY®

PLANT GROWTH REGULATOR • WATER SOLUBLE GRANULE

Active Ingredients:

Gibberellic acid	0.70% w/w
Indole-3-butyric acid	0.64% w/w
Other Ingredients:	98.66% w/w
Total:	100.0% w/w

Contains a total of 0.0070 lb. of gibberellic acid and 0.0064 lb. of indole-3-butyric acid in 1 lb. of the product.

Product information from: https://www.conklin.com/mwdownloads/download/link/id/633/

Results:

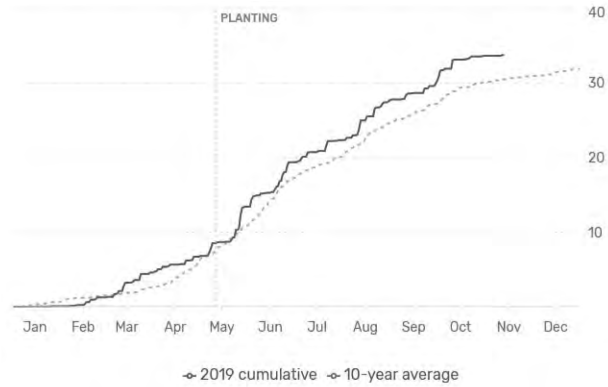
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	12.4 A	64 A	515.68 A
Conklin® Intensify	11.7 A	69 A	550.87 A
P-Value	0.104	0.588	0.621

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $3.58/ac for Intensify®.

Summary: There was no difference in grain moisture, yield, and net return between the Intensify® treatment and the untreated check.

Impact of Conklin® Intensify® on Irrigated Soybean

Study ID: 0085141201916
County: Platte
Soil Type: Gibbon silt loam, occasionally flooded; Grigston silt loam, wet sub-stratum
Planting Date: 5/11/19
Harvest Date: 10/14-15/19
Seeding Rate: 133,000
Row Spacing (in): 30
Variety: Asgrow® AG26X8
Reps: 4
Previous Crop: Corn
Tillage: Rolled before planting
Herbicides: ***Pre:*** 22 oz/ac XtendiMax®, 3 oz/ac Fierce®, and 32 oz/ac Roundup PowerMAX® with 20 oz/ac Class Act® Ridion® and 13 oz/ac OnTarget® ***Post:*** 22 oz/ac XtendiMax®, 6 oz/ac Select®, and 32 oz/ac Roundup PowerMAX® with 20 oz/ac Class Act® Ridion® and 13 oz/ac OnTarget®
Foliar Insecticides: Leverage® 360 on 8/1/19
Foliar Fungicides: Stratego® YLD on 8/1/19
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 6 gal/ac 8-20-3-6-0.4 on surface with planter
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The purpose of this study is to evaluate Conklin® Intensify®, a plant growth regulator containing gibberellic acid and indole-3-butyric acid. The guaranteed analysis is below. Intensify® was applied at a rate of 0.26 oz/ac in-furrow with 5 gal/ac of water.

INTENSIFY®

PLANT GROWTH REGULATOR • WATER SOLUBLE GRANULE

Active Ingredients:
Gibberellic acid......................0.70% w/w
Indole-3-butyric acid ....0.64% w/w
Other Ingredients:.................98.66% w/w
Total: ....100.0% w/w

Contains a total of 0.0070 lb. of gibberellic acid and 0.0064 lb. of indole-3-butyric acid in 1 lb. of the product.

Product information from: https://www.conklin.com/mwdownloads/download/link/id/633/

Results:

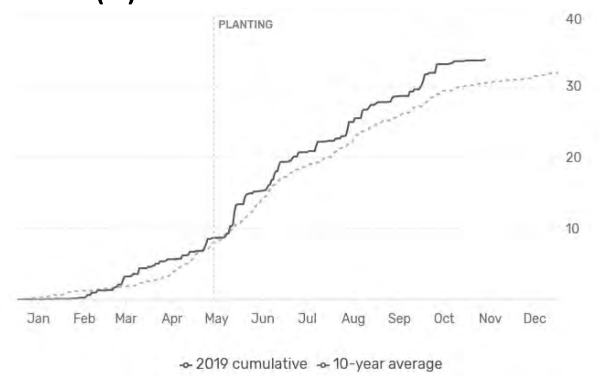
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	12.2 A	77 A	625.03 A
Conklin® Intensify	12.2 A	73 A	589.94 A
P-Value	0.813	0.14	0.113

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $3.58/ac for Intensify®.

Summary: There was no difference in grain moisture, yield, and net return between the Intensify® treatment and the untreated check.

Impact of Conklin® Intensify® on Irrigated Soybean

Study ID: 0085141201918
County: Platte
Soil Type: Gibbon-Gayville silty clay loams, occasionally flooded; Grigston silt loam, wet substratum, rarely flooded; O'Neill fine sandy loam, 0-2% slope
Planting Date: 5/13/19
Harvest Date: 9/30/19
Seeding Rate: 131,000
Row Spacing (in): 30
Variety: Asgrow® AG29X9
Reps: 4
Previous Crop: Corn
Tillage: Rolled before planting
Herbicides: ***Pre:*** 22 oz/ac XtendiMax®, 3 oz/ac Fierce®, and 32 oz/ac Roundup PowerMAX® with 20 oz/ac Class Act® Ridion® and 13 oz/ac OnTarget® ***Post:*** 22 oz/ac XtendiMax®, 6 oz/ac Select®, and 32 oz/ac Roundup PowerMAX® with 20 oz/ac Class Act® Ridion® and 13 oz/ac OnTarget®
Foliar Insecticides: Leverage® 360 on 8/1/19
Foliar Fungicides: Stratego® YLD on 8/1/19
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 6 gal/ac 8-20-3-6-0.4 on surface with planter
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The purpose of this study is to evaluate Conklin® Intensify®, a plant growth regulator containing gibberellic acid and indole-3-butyric acid. The guaranteed analysis is below. Intensify® was applied at a rate of 0.26 oz/ac in-furrow with 5 gal/ac water.

INTENSIFY®
PLANT GROWTH REGULATOR • WATER SOLUBLE GRANULE

Active Ingredients:
Gibberellic acid.....................0.70% w/w
Indole-3-butyric acid ....0.64% w/w
Other Ingredients:.................98.66% w/w
Total: ....100.0% w/w

Contains a total of 0.0070 lb. of gibberellic acid and 0.0064 lb. of indole-3-butyric acid in 1 lb. of the product.

Product information from: https://www.conklin.com/mwdownloads/download/link/id/633/

Results:

	Stand Count (plants/ac)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	112,328 B*	12.9 A	80 A	645.08 A
Conklin® Intensify	114,500 A	12.8 A	81 A	654.68 A
P-Value	0.086	0.792	0.109	0.198

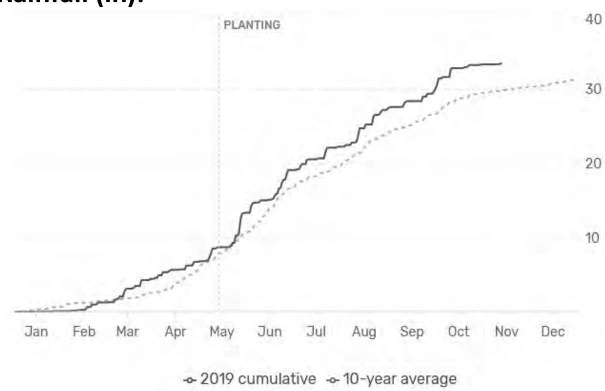
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $3.58/ac for Intensify®.

Summary:

- There was no difference in grain moisture, yield, and net return between the Intensify® treatment and the untreated check.
- Stand counts were higher for the Intensify® treatment than the untreated check.

Impact of Conklin® Intensify® on Irrigated Soybean

Study ID: 0085141201919
County: Platte
Soil Type: Gibbon silt loam, occasionally flooded; Janude fine sandy loam, 0-1% slope
Planting Date: 5/13/19
Harvest Date: 10/9-17/2019
Seeding Rate: 147,000
Row Spacing (in): 30
Variety: Golden Harvest® GH2788X
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 22 oz/ac XtendiMax®, 3 oz/ac Fierce®, and 32 oz/ac Roundup PowerMAX® with 20 oz/ac Class Act® Ridion® and 13 oz/ac OnTarget® ***Post:*** 22 oz/ac XtendiMax®, 2 pt/ac Warrant®, 6 oz/ac Select®, and 32 oz/ac Roundup PowerMAX® with 20 oz/ac Class Act® Ridion® and 13 oz/ac OnTarget®
Foliar Insecticides: Leverage® 360 on 8/1/19
Foliar Fungicides: Stratego® YLD on 8/1/19
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 6 gal/ac 8-20-3-6-0.4 on surface with planting
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The purpose of this study is to evaluate Conklin® Intensify®, a plant growth regulator containing gibberellic acid and indole-3-butyric acid. The guaranteed analysis is below. Intensify® was applied at a rate of 0.26 oz/ac in-furrow with 5 gal/ac of water.

INTENSIFY®

PLANT GROWTH REGULATOR • WATER SOLUBLE GRANULE

Active Ingredients:
Gibberellic acid. .0.70% w/w
Indole-3-butyric acid . . . . .0.64% w/w
Other Ingredients:. . . . . .98.66% w/w
Total: . . . . .100.0% w/w

Contains a total of 0.0070 lb. of gibberellic acid and 0.0064 lb. of indole-3-butyric acid in 1 lb. of the product.

Product information from: https://www.conklin.com/mwdownloads/download/link/id/633/

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	11.7 A*	71 A	573.42 A
Conklin® Intensify	11.7 A	69 A	555.94 A
P-Value	0.813	0.538	0.444

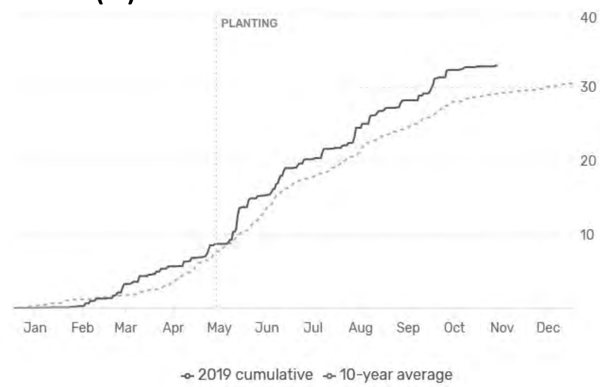
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $3.58/ac Intensify®.

Summary: There was no difference in grain moisture, yield, and net return between the Intensify® treatment and the untreated check.

Impact of Conklin® Intensify on Irrigated Soybean

Study ID: 0085141201920
County: Platte
Soil Type: Grigston silt loam wet sub-stratum; Janude fine sandy loam 0-1% slope
Planting Date: 5/13/19
Harvest Date: 10/15/19
Seeding Rate: 134,300
Row Spacing (in): 30
Variety: Asgrow® AG30X9
Reps: 5
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 22 oz/ac XtendiMax®, 3 oz/ac Fierce®, and 32 oz/ac Roundup PowerMAX® with 20 oz/ac Class Act® Ridion® and 13 oz/ac OnTarget® ***Post:*** 22 oz/ac XtendiMax®, 2 pt/ac Warrant®, 6 oz/ac Select®, and 32 oz/ac Roundup PowerMAX® with 20 oz/ac Class Act® Ridion® and 13 oz/ac OnTarget®

Foliar Insecticides: Leverage® 360 on 8/1/19
Foliar Fungicides: Stratego® YLD on 8/1/19
Fertilizer: 100 lb/ac MicroEssentials® SZ™ (12-40-0-10S-1Zn) in April, 6 gal/ac 8-20-3-6-0.4 on surface with planting
Irrigation: Pivot, Total: 5"
Rainfall (in):



Introduction: The purpose of this study is to evaluate Conklin® Intensify®, a plant growth regulator containing gibberellic acid and indole-3-butyric acid. The guaranteed analysis is below. Intensify® was applied at a rate of 0.26 oz/ac in-furrow with 5 gal/ac water.

INTENSIFY®

PLANT GROWTH REGULATOR • WATER SOLUBLE GRANULE

Active Ingredients:
Gibberellic acid.....................0.70% w/w
Indole-3-butyric acid ....0.64% w/w
Other Ingredients:.................98.66% w/w
Total: ....100.0% w/w

Contains a total of 0.0070 lb. of gibberellic acid and 0.0064 lb. of indole-3-butyric acid in 1 lb. of the product.

Product information from: https://www.conklin.com/mwdownloads/download/link/id/633/

Results:

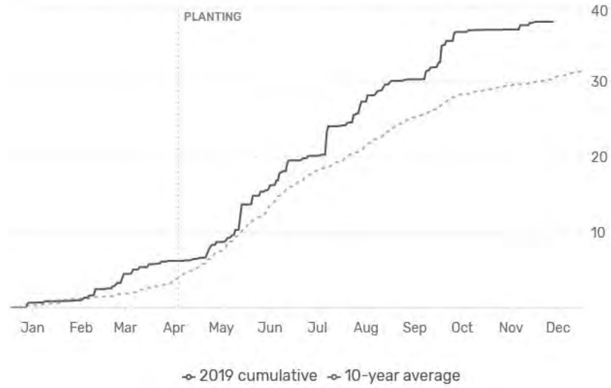
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	11.3 A*	75 A	610.13 A
Conklin® Intensify	11.4 A	75 A	602.64 A
P-Value	0.161	0.779	0.596

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 13% moisture.
‡Marginal net return based on $8.10/bu soybean and $3.58/ac Intensify®.

Summary: There was no difference in grain moisture, yield, and net return between the Intensify® treatment and the untreated check.

Impact of Holganix® Bio 800+ on Corn

Study ID: 0145159201901
County: Seward
Soil Type: Hastings silt loam, 0-1% slopes; Fillmore silt loam, frequently ponded
Planting Date: 4/18/2019
Harvest Date: 10/18/19
Seeding Rate: 32,000
Row Spacing (in): 30
Variety: Channel® 209-50
Reps: 7
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 2.3 qt/ac Volley®, 3 oz/ac Callisto®, 24 oz/ac glyphosate, and 8 oz/ac Cornbelt® Salvan® on 4/15/19 ***Post:*** 3 oz/ac Callisto®, 4 oz/ac Status®, and 16 oz/ac Vail®
Seed Treatment: Standard
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 150 lb N/ac as anhydrous ammonia in fall 2018, 70 lb P/ac, 12.5 lb S/ac in the spring, and 54 lb N/ac side-dress on 6/30/19
Irrigation: Pivot, Total: 1"
Rainfall (in):



Soil Test (Fall 2018 – 3 samples in study area)

Sample	pH	Buffer pH	OM	NO_3-N (0-2')	P1	K	Zn	S
			%	----------	----------	ppm	----------	----------
4	5.6	6.6	2.9	6.1	17	251	1.3	11
5	5.9	6.8	2.8	4.8	17	270	1.4	10
6	6.1	6.9	3.1	5.9	26	263	1.2	8

Introduction: The objective of this study was to evaluate Holganix® Bio 800+ on corn. The product was applied in-furrow at planting at a rate of 0.5 gal/ac. Product information is at right.

Holganix Bio 800+ Agriculture Guaranteed Analysis

Water	88.80%
Molasses	10.74%
Amino Acids	0.19%
Humic Acid	0.16%
Fulvic Acid	0.06%
Kelp	0.04%

Plant Growth Promoting Bacteria from the Bacteria Family of Lactobacillaceae include:

Species	**cfu[1]**
Lactobacillus acidifarinae	$1.4 * 10^6$
L. brevis	$3.9 * 10^9$
L. manihotivorans	$2.7 * 10^6$
L. parakefiri	$1.5 * 10^6$
L. pentosus	$1.1 * 10^7$
L. plantarum	$9.3 * 10^6$
L. rhamnosus	$1.8 * 10^6$

[1] Colony Forming Units

Product information from:
https://www.holganix.com/bio-800-agriculture

Results:

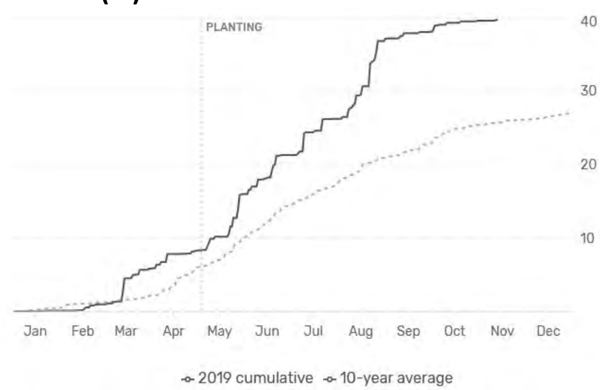
	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	15.6 A*	225 A	861.75 A
Holganix® Bio 800+	15.7 A	222 A	842.26 A
P-Value	0.108	0.421	0.203

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $8/ac Holganix Bio 800+.

Summary: There was no difference in grain moisture, yield, or net return between the Holganix® Bio 800+ treatment and the untreated check.

Impact of In-furrow Applied Mycorrhizae Fungi to Non-irrigated Corn

Study ID: 0908079201901
County: Hall
Soil Type: Hobbs silt loam, occasionally flooded, cool; Holdrege silty clay loam, 3-7% slopes eroded
Planting Date: 5/3/19
Harvest Date: 10/7/19
Seeding Rate: 24,500
Row Spacing (in): 30
Variety: Pioneer® P1151AM™
Reps: 7
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 1.25 qt/ac Resicore®, 32 oz/ac Durango® DMA, and 1 pt/ac atrazine 4L on 5/10/19 ***Post:*** 32 oz/ac Durango® DMA, 3 oz/ac Status®, and 1.5 pt/ac Warrant® on 6/14/19
Seed Treatment: Standard Pioneer® seed treatments
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 110 lb/ac 11-52-0 (dry) and 10 lb/ac 10% zinc (dry) in January 2019; 35 gal/ac 32-0-0 on 4/10/19; 4 gal/ac 10-34-0 in-furrow starter at planting
Note: Small amount (<5%) of wind damage from July storm.
Irrigation: None
Rainfall (in):



Introduction: This study evaluated MycoApply® EndoPrime™ on corn. MycoApply® EndoPrime™ SC was applied at a rate of 2 oz/ac mixed with 4 gal/ac 10-34-0 starter fertilizer and applied in-furrow during planting. Product active ingredients are at right. Data collected on this study included stand counts, stalk rot, yield, visual root differences, and marginal net return.

VALENT®

MycoApply EndoPrime™

Soil Amending Guaranteed Analysis

21.6% Total Active Ingredients
Glomus intraradices .... (5,625 propagules/g)
Glomus mosseae .... (5,625 propagules/g)
Glomus aggregatum .... (5,625 propagules/g)
Glomus etunicatum .... (5,625 propagules/g)
15% Humic acid derived from leonardite
78.4% Total Inert Ingredients (Other)

Results:

	Early Season Stand Count (plants/ac)	Late Season Stand Count (plants/ac)	Stalk Rot (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	22,571 A*	24,619 A	4.19 A	19.9 A	235 A	899.09 A
MycoApply Endoprime SC	21,619 B	23,619 A	4.19 A	19.5 B	226 B	857.46 B
P-Value	0.046	0.335	1	0.013	0.003	0.001

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $8.66/ac for Myco-Apply® EndoPrime™.

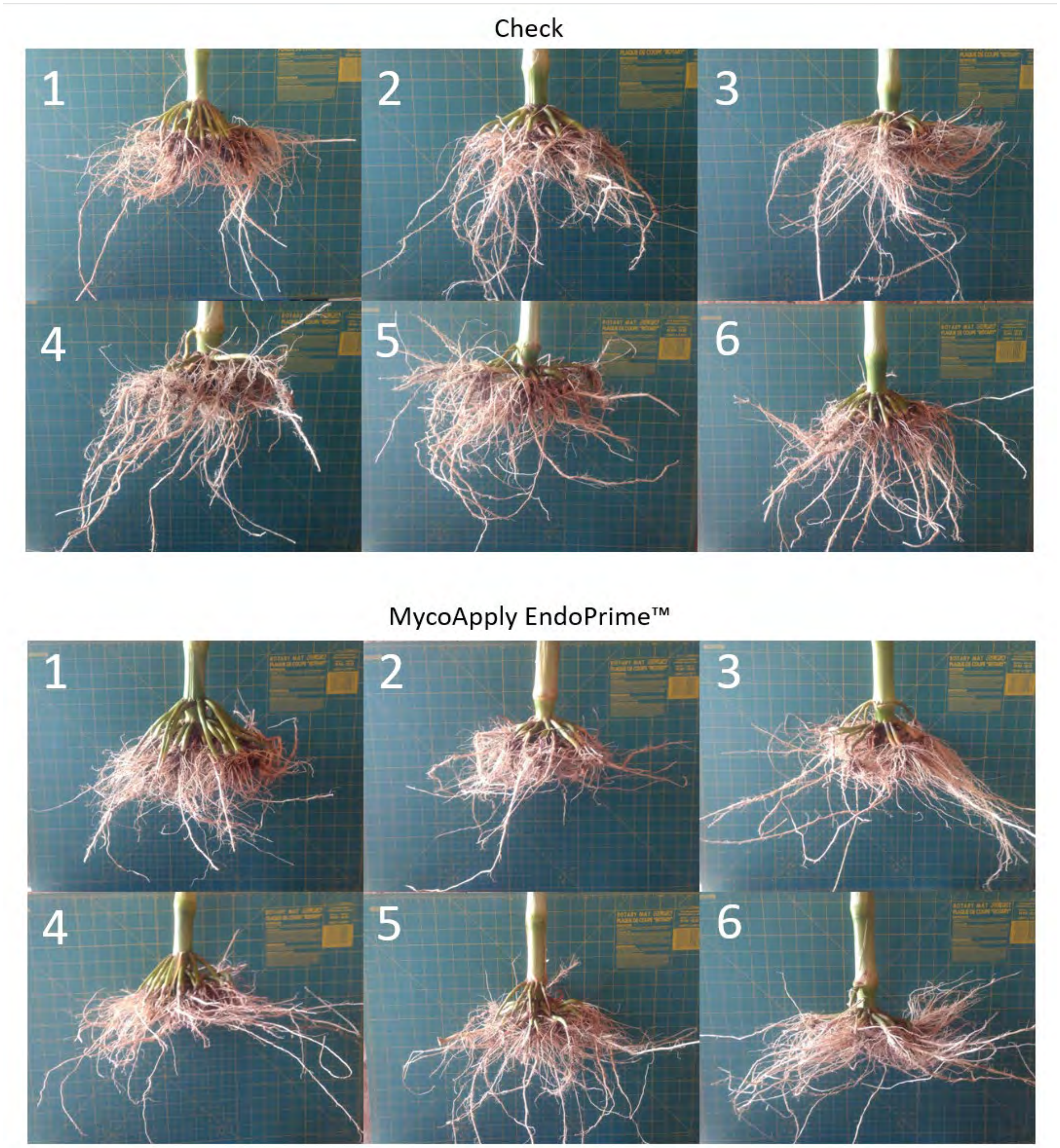


Figure 1. Root digs from six consecutive plants for check (top) and MycoApply® EndoPrime™ (bottom) taken on July 22, 2019. One replication was sampled and photographed.

Summary:

- Early season stand counts on June 5 showed a lower plant stand for the MycoApply® EndoPrime™ treatment compared to the untreated check. However, late season stand counts on September 30 showed no difference between the treatments. The same area was not counted for early and late stand counts.
- There was no difference in stalk rot between the MycoApply® EndoPrime™ treatment and the check.
- The use of MycoApply® EndoPrime™ resulted in lower yield (9 bu/ac) and lower net return ($41.63/ac) compared to the untreated check.

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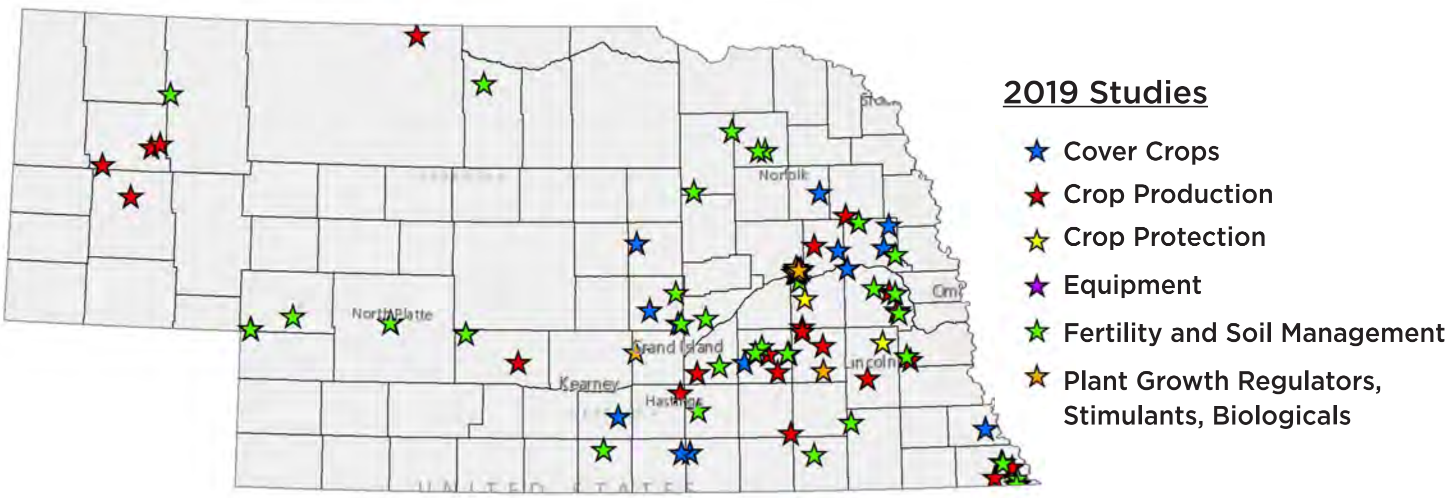
2019 STUDY LOCATIONS



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