2023 ON-FARM RESEARCH

RESULTS

NEBRASKA ON-FARM RESEARCH
EC3073

NEBRASKA ON-FARM RESEARCH NETWORK

2024 RESULTS UPDATE MEETINGS

Mead | Feb. 20 | Eastern Nebraska REEC
Beatrice | Feb. 21 | Holiday Inn
Alliance | Feb. 21 | Knight Museum & Sandhills Center
York | Feb. 27 | Holthus Convention Center
Kearney | Feb. 28 | Buffalo County Extension Office

Sponsored By:

NEBRASKA SOYBEAN CHECKOFF
Nebraska CornBoard
Nebraska CornGrowers ASSOCIATION
Nebraska Dry Bean Commission

NEBRASKA ON-FARM RESEARCH

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NEBRASKA ON-FARM RESEARCH NETWORK

UNL FACULTY, STAFF, AND GRADUATE STUDENTS INVOLVED WITH THE ON-FARM RESEARCH PROJECTS LISTED IN THIS REPORT

DIRECTOR

Laura Thompson

Extension Educator,
On-Farm Research Director

103 East 35th St., Ste. B
Falls City, NE 68355

402-245-2224
laura.thompson@unl.edu

COORDINATOR

Taylor Lexow

On-Farm Research Coordinator

103 East 35th St., Ste. B
Falls City, NE 68355

402-245-2222
tlexow2@unl.edu

EXTENSION EDUCATORS

Chuck Burr

Water & Cropping Systems Extension Educator

402 W State Farm Rd.
North Platte, NE 69101

308-696-6783
cburr1@unl.edu

Katja Koehler-Cole

Soil Health Management Extension Educator

1071 County Rd. G
Ithaca, NE 68033

402-624-8042
kkoehlercole2@unl.edu

Ritika Lamichhane

Water & Cropping Systems Extension Educator

1824 N St., Ste. 102
Auburn, NE 68305

402-274-4755
rlamichhane3@unl.edu

Bruno Lena

Water & Cropping Systems Extension Educator

2715 13th St.
Columbus, NE 68601

402-563-4901
bpatiaslena2@unl.edu

Mitiku Mamo

Water & Cropping Systems Extension Educator

57905 866 Rd.
Concord, NE 68728

402-584-2234
mmamo2@unl.edu

Steve Melvin

Water & Cropping Systems Extension Educator

1784 Fairgrounds Rd.
Central City, NE 68826

308-946-3843
steve.melvin@unl.edu

Nathan Mueller

Water & Cropping Systems Extension Educator

306 W 3rd St.
Wilber, NE 68465

402-821-2151
nathan.mueller@unl.edu

John Nelson

Water & Cropping Systems Extension Educator

444 Cherrycreek Rd., Ste. A
Lincoln, NE 68528

402-441-7180
jnelson158@unl.edu

Aaron Nygren

Water & Cropping Systems Extension Educator

1071 County Rd. G
Ithaca, NE 68033

402-624-8030
anygren2@unl.edu

Travis Prochaska

Water & Cropping Systems Extension Educator

466 Road 10
Schuyler, NE 68601

402-352-3821
tprochaska2@unl.edu

Jenny Rees

Water & Cropping Systems Extension Educator

2345 Nebraska Ave.
York, NE 68467

402-362-5508
jrees2@unl.edu

Ron Seymour

Water & Cropping Systems Extension Educator

2975 S. Baltimore Ave.
Hastings, NE 68901

402-461-7209
rseymour1@unl.edu

Sarah Sivits

Water & Cropping Systems Extension Educator

1002 Plum Creek Prkwy.
Lexington, NE 68850

308-324-5501
ssivits2@unl.edu

NEBRASKA ON-FARM RESEARCH NETWORK

UNL FACULTY, STAFF, AND GRADUATE STUDENTS INVOLVED WITH THE ON-FARM RESEARCH PROJECTS LISTED IN THIS REPORT

SPECIALISTS + PROFESSORS

Gary Stone

Water & Cropping Systems Extension Educator

4502 Ave. 1
Scottsbluff, NE 69361

308-632-1230
gstone2@unl.edu

John Thomas

Water & Cropping Systems Extension Educator

415 Black Hills Ave.
Alliance, NE 69301

308-762-5616
jthomas2@unl.edu

Todd Whitney

Water & Cropping Systems Extension Educator

1308 2nd St.
Holdrege, NE 68949

308-995-4222
twhitney3@unl.edu

Nicolas Cafaro La Menza

Plant Physiology, Weed, & Production Systems Specialist

402 W State Farm Rd.
North Platte, NE 69101

308-696-6700
nicolas.cafaro@unl.edu

Javed Iqbal

Nutrient Management & Water Quality Specialist

KEIM 312
Lincoln, NE 68583

402-472-1432
jiqbal2@unl.edu

Tamra Jackson-Ziems

Plant Pathology Specialist

PLSH 448
Lincoln, NE 68583

402-472-2559
tjackson3@unl.edu

Joe Luck

Precision Agriculture Engineer Specialist

CHA 204
Lincoln, NE 68583

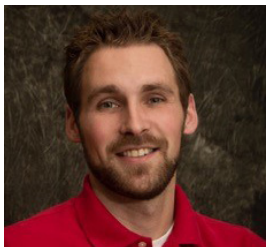
402-472-1488
jluck2@unl.edu

Dylan Mangel

Plant Pathology Specialist

PLSH 448D
Lincoln, NE 68583

402-472-2559
dylan.mangel@unl.edu



Justin McMechan

Crop Protection & Cropping Systems Specialist

1071 County Rd. G
Ithaca, NE 68033

402-624-8041
amcmechan2@unl.edu

Julie Peterson

Entomology Specialist

402 W State Farm Rd.
North Platte, NE 69101

308-696-6704
jpeterson42@unl.edu

GRAD STUDENTS

Mary Drewnoski

Beef Systems Specialist

ANSC C220F
Lincoln, NE 68583

402-472-6289
mdrewnoski2@unl.edu

Laila Puntel

Soil Fertility & Precisoin Agriculture Scientist

KEIM 102D
Lincoln, NE 68583

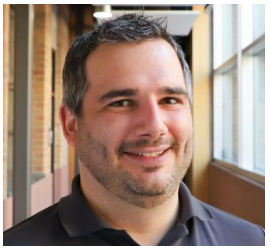
402-472-2811
lpuntel2@unl.edu

Taro Mieno

Agricultural Economics Assistant Professor

FYH 209
Lincoln, NE 68583

402-472-4134
tmieno2@unl.edu



Guillermo Balboa

Research Assistant Professor, Nutrient Management and Digital Ag

KEIM 162
Lincoln, NE 68583

402-472-2811
gbalboa7@unl.edu

Jose Guilherme Cesario Pereira Pinto

Graduate Research Assistant, Agronomy & Horticulture

jcesariopereirapin2@unl.edu

NEBRASKA ON-FARM RESEARCH NETWORK

UNL FACULTY, STAFF, AND GRADUATE STUDENTS INVOLVED WITH THE ON-FARM RESEARCH PROJECTS LISTED IN THIS REPORT

TECHNOLOGISTS + RESEARCH ASSISTANTS

Katie Bathke

Graduate Research Assistant, Mechanized Systems Management

kbathke3@unl.edu

Luzviminda Sazon

Graduate Research Assistant, Agronomy & Horticulture

lsazon2@huskers.unl.edu

Dean Krull

Research Technologist

215 N Kaufman Ave.
Grand Island, NE 68803

308-385-6282
dkrull1@unl.edu

Seth Norquest

Research Technologist

KEIM 371
Lincoln, NE 68583

402-245-2224
snorquest2@unl.edu

Abigail Lyons

Research Technologist

402 W State Farm Rd.
North Platte, NE 69101

308-969-6704
alyons6@unl.edu

Tyler Smith

Research Manger, ENREEC Farm Operations

1071 County Rd. G
Ithaca, NE 68033

402-624-8098
tyler.smith@unl.edu

Randy Lloyd

Research Facility Coordinator

402 W State Farm Rd.
North Platte, NE 69101

308-696-6729
randy.lloyd@unl.edu

Keena Crone

Farm Operations Manager

1071 County Rd. G
Ithaca, NE 68033

402-624-8019
kcrone2@unl.edu

Tyler Frederick

Assistant Farm Manager

1071 County Rd. G
Ithaca, NE 68033

402-624-8021
tyler.frederick@unl.edu

Ralph Arnold

Research Database Technician

103 East 35th St., Ste. B
Falls City, NE 68355

402-245-2224
ralph.arnold@unl.edu

REPORT, PROGRAM + RESEARCH ASSISTANTS

Sreeja Vinod

GIS Specialist

CHA 155
Lincoln, NE 68583

402-472-6168
svinod2@unl.edu

Faith Junck

On-Farm Research Media & Communication Intern

fjunck2@unl.edu

Connie Hansen

Events Coordinator

PLSH 362C
Lincoln, NE 68583

402-472-8747
chansen1@unl.edu

Emily Hanson

Undergraduate Research Assistant

CHA 200
Lincoln, NE 68583

402-472-1413
ehanson11@unl.edu

THANK YOU

to the cooperators involved with the on-farm research projects listed in this report!

Matt & Ryon Adams
Mark Allen
Don & Barb Batie
Bob & Brett Bendfeldt
Shane Bendfeldt
Corey Bennett
Steve & Trent Benzel
Loren Berger
Joe Birkel
Aaron Blase
Lon & Scott Bohn
Bryon Chvatal
Chris Cornelius
Andrew Eberspacher
ENREEC
Will Fellers
Dan Fitts
Brad & Jerry Gillming
Jay Goertzen
David & Matthew Grimes
Jay Hanson
Tim Hashman
Ken, Aaron, & Zach Herz
Ron Hrnchir
Mark Kottmeyer
Ryan Loseke
Brad & Ron Makovicka
Brent Melliger
Dave Merrell
Brad & Patty Morner
Monte Murkle
Steve Olson
Wes Plummer
Scott Richert
Jason Richters
Brent Robertson
Dale Schafer
Mark Schlechte
Lanny Schmid
Todd Schmieding
Kendall Siebert
Gregg & Scott Smyth
Glenn Spangler
Jack Spilker
Mike & John Spray
Brian & Jerry Stahr
Andrew Stech
Paula Sue & Ben Steffen
Dean Stevens
Nathan Thompson
Jon Walz
Craig Weber
Jesse Williams

Thank you also to the companies and businesses that assisted with the research projects.

NEBRASKA ON-FARM RESEARCH NETWORK

LAURA THOMPSON
Extension Educator and
On-Farm Research Director

laura.thompson@unl.edu
402-245-2224

INTRODUCTION

As I reflect on 2023 growing season, once again the resiliency and grit of Nebraska producers is evident. At the heart of this resilience are meaningful relationships that support, challenge, and inspire growth. These same relationships are what distinguishes the Nebraska On-Farm Research Network.

On-farm research provides an unparalleled avenue for accelerating understanding on topics that directly influence farm productivity and profitability. This research is not confined to laboratories or research stations; rather, it unfolds on fields across the state. The relevance of this approach makes the findings directly applicable to farm operations. Yet beyond the pages of high-quality and innovative research are the connections being made between agronomists, farmers, researchers, extension personnel, students, commodity organizations, industry, and more. This ability to co-create and learn together is the cornerstone of this effort and what truly sets it apart. In this space of shared knowledge, innovation accelerates to drive adoption of new products, practices, and technologies.

My gratitude extends to all the cooperators who were involved in the valuable research studies contained in this report. I also extend heartfelt thanks to the Nebraska Corn Board, Nebraska Corn Growers Association, Nebraska Soybean Board, and the Nebraska Dry Bean Commission for the financial support that makes the research, publication, and update meetings possible.

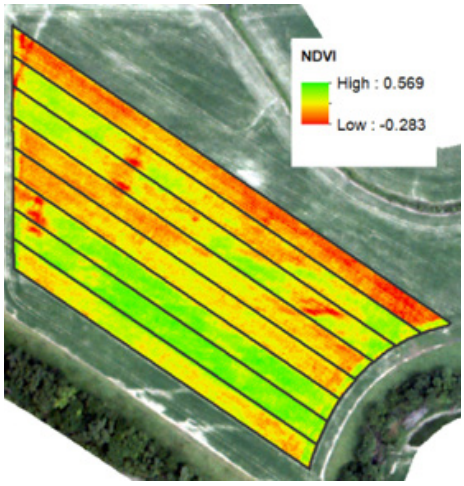
To those unfamiliar with the network, I extend a warm invitation. Whether you decide to actively participate in on-farm research, join discussions, or explore the rich array of research findings to gain valuable insights for your farm operation, the possibilities are extensive. If you have any further inquiries or would like to engage in discussions related to this report, please feel free to reach out to Laura Thompson, Director of On-Farm Research at Nebraska Extension. Discover more about our initiatives at on-farm-research.unl.edu, and connect with us on Facebook, Instagram, and Twitter. Wishing you a year filled with safety, prosperity, and innovative learning in 2024.

AERIAL IMAGERY

For many studies, aerial imagery was captured using a drone, airplane or satellite.

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-infared (NIR) wavebands as follows: NDVI = (NIR-Red) / (NIR+Red). This index is often correlated with 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 value 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 it 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.

STATISTICS 101

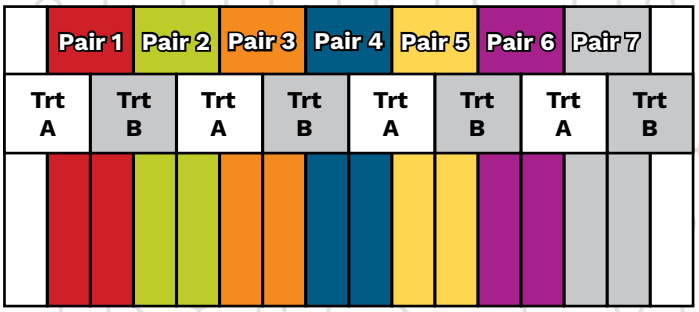
Replication: In statistics, replication is the repetition of an experiment observaton in same or similar conditions. Replication is important because it adds information about the reliability of the conclusions or estimates to be drawn from the data. The statistical methods that assess the reliability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

Randomization: Using random sampling is 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 on the right.

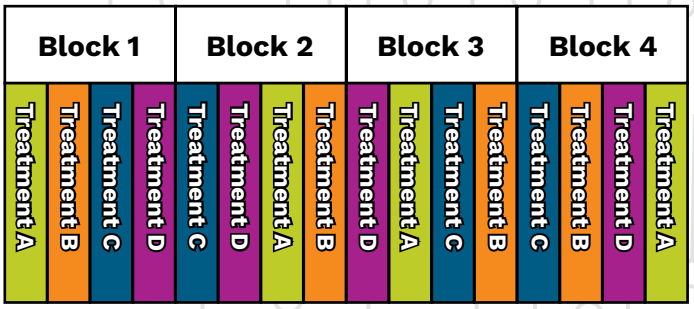
What is the P-Value? In field research studies we impose a treatment. This treatment may be a new product or practice that is being compared to a standard management. Both the treatments that we are testing and random error (such as field variability) influence research results (such as yield). You intuitively 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 Probability (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 whether the difference is due to error or the treatment. Hence, we have less confidence in the results being due to the treatment.

Paired Comparison Design



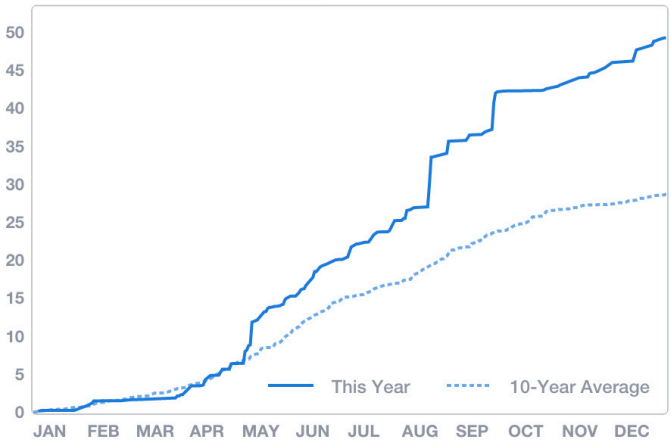
Randomized Complete Block Design



For these studies, we have chosen a cutoff P-Value of 10%. Therefore, if the P-value is greater than 10%, we declare that there are not statistically significant differences due to the treatments. If the value is less than 10%, we declare that differences between treatmnents 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 10% 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 the really are not. Conversely, if you lower the P-Value, you are more likely to miss real treatment differences.

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.

RAINFALL DATA



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

PROFIT CALCULATION

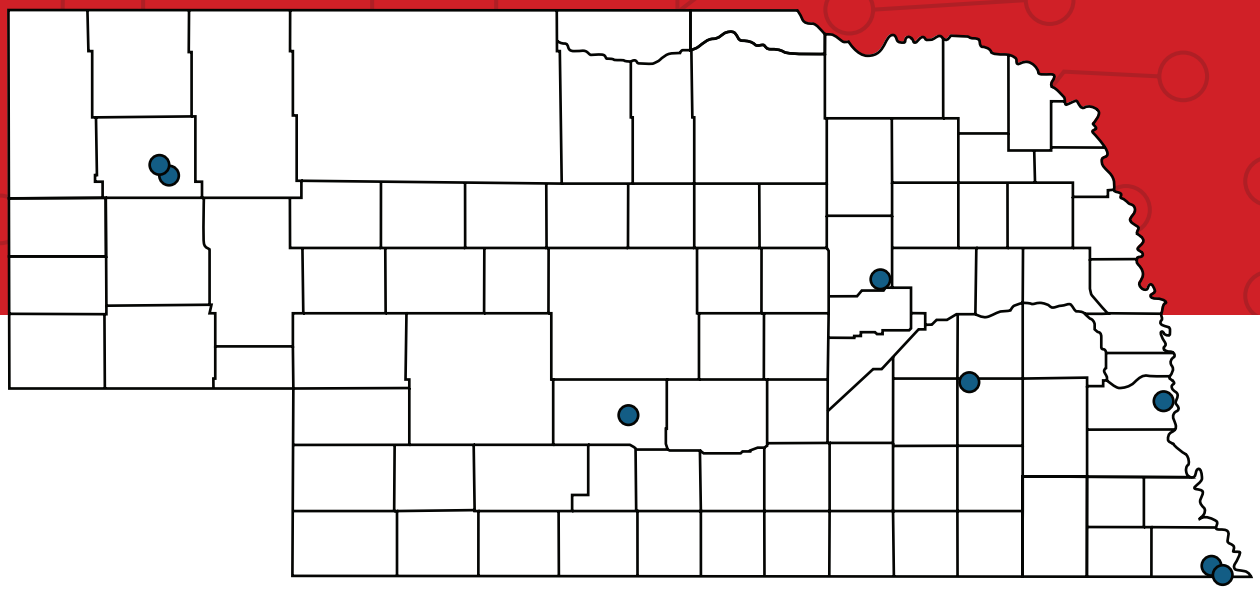
Many of our studies include a net return calculation. It is difficult to make this figure applicable to every producer. In order to calculate revenue for our research plots, we use input costs provided by the producer, application costs from Nebraska Extension's 2022 Nebraska Farm Custom Rates and an average commodity market price for 2023. Average market commodity prices for the 2023 report are:

Wheat:	$7.30/bu
Corn:	$5.91/bu
Soybeans:	$13.76/bu
Pinto Beans:	$38/cwt ($22.80/bu at 60 lb/bu)

For each study, net return is calculated as follows:
Net Return = gross income (yield x 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.

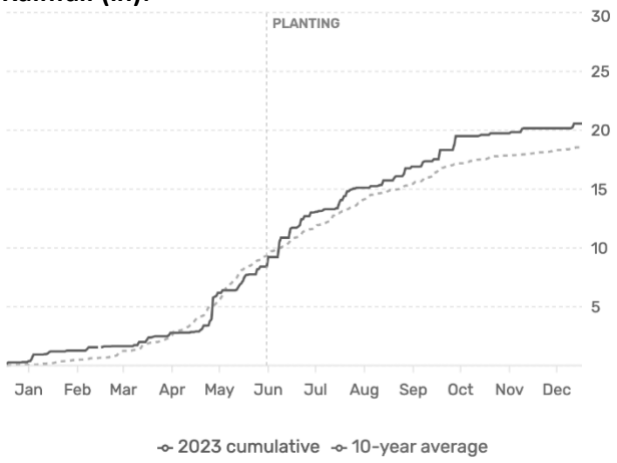
CROP PRODUCTION



Evaluating Visjon Biologics Exceed® Stic Inoculant on Pinto Beans

Study ID: 0152013202301
County: Box Butte
Soil Type: Keith loam; Alliance-Rosebud loam
Planting Date: 6/14/23
Harvest Date: 10/11/23
Seeding Rate (seeds/ac): 80,000
Row Spacing (in): 15
Variety: Rattler® Pinto
Reps: 6
Previous Crop: Corn
Tillage: Disked and rolled before planting
Herbicides: ***Pre:*** 30 oz/ac Prowl®, 15 oz/ac Outlook®, and 32 oz/ac Roundup® ***Post:*** 4 oz/ac Raptor®, 30 oz/ac Basagran®, and 15 oz/ac Select®;
Desiccant: Gramoxone on 9/26/23
Seed Treatment: Apron XL®, Maxim®, Rancona®, Vibrance®, Cruiser®
Foliar Insecticides: None

Fertilizer: 30 lb/ac N, 30 lb/ac P, 15 lb/ac S, and 1 lb/ac Zn
Irrigation: Pivot, 8"
Rainfall (in):



Baseline Soil Samples (March 2023):

	pH	OM LOI %	Nitrate –N ppm N	Bicarb– P ppm	Sulfate –S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/ 100g	Zn ppm	Fe ppm	Mn ppm	Cu ppm
0-8"	8.1	1.5	2.4	6	8	388	2040	242	44	13.4	1.6	4.6	3.4	0.4
8-36"	8.2	1.5	2.3	5	9	324	1800	215	54	11.9	1.3	2.7	1.0	0.3

Introduction: This study evaluated Exceed® Stic by Visjon Biologics, a dry inoculant product applied with dry edible bean seed at planting. This product is a culture of rhizobia (nitrogen-fixing bacteria) that will colonize the plant roots to gather and fix the "free" nitrogen of the air, making it available to the plants. The crop rotation of this field includes beans, which provides a natural residual inoculant, therefore this field had not been treated with an added inoculant in the past. Samples from each plot were analyzed for bean quality parameters. Harvest loss estimates were determined by taking counts in a one-square-foot frame randomly chosen in the harvested area, but equally representing the left, center, and right side of the header area behind the combine. Yield and net return were also evaluated.

Results:

	Stand Count (plants/ac)	% Pods >2" above ground	Split (%)	Small (%)	Foreign Material (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
No inoculant	73,253 A*	89 A	1.7 A	0.45 A	0.13 A	12.2 A	40 B	913 B
Inoculant	70,785 A	88 A	1.8 A	0.42 A	0.17 A	12.1 A	42 A	961 A
P-Value	0.599	0.504	0.763	0.709	0.494	0.567	0.008	0.009

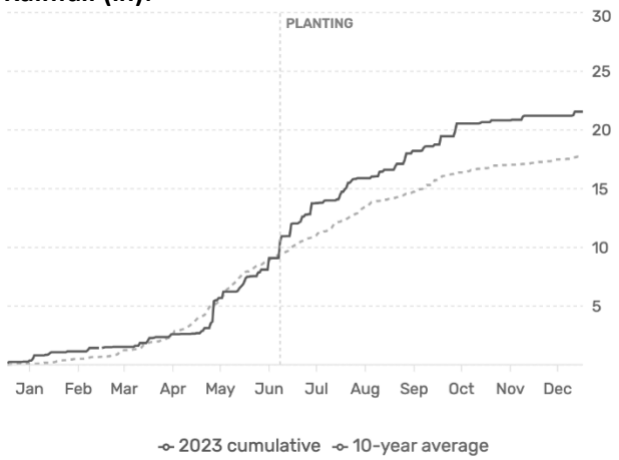
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 14% moisture.
‡Marginal net return based on $22.80/bu at 60 lb/bu and $1.79/ac for the inoculant.

Summary:

- The inoculant did not result in differences in stand counts, percent splits, percent small beans, percent foreign material, or percent of pods greater than two inches above the ground.
- Yield was 2 bu/ac greater for the inoculant treatment.
- Marginal net return was $48.14/ac greater for the inoculant treatment due to the increase in yield.

Pod Ceal® on Pinto Beans

Study ID: 0015013202301
County: Box Butte
Soil Type: Creighton very fine sandy loam 1-3% slope; Alliance loam 0-1% slope; Rosebud loam 1-3% slope; Alliance loam 1-3% slope
Planting Date: 6/22/23
Harvest Date: 10/20/23
Seeding Rate: 110,000
Row Spacing (in): 7.5
Variety: Gleam pinto bean
Reps: 4
Previous Crop: Corn
Tillage: 2 passes with disk, 1 pass with finisher w/dry spread fertilizer
Herbicides: ***Pre:*** Outlook® and Prowl® H20 on 6/20/23 ***Post:*** Raptor®, Varisto®, Basagran®, Outlook®, and Cleo® on 7/22/23 ***Desiccant:*** 2 oz/ac Sharpen®, 1 qt/ac 32% UAN, and 12 oz/ac MSO on 9/29/23
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 22.85 lb/ac N, 15.17 lb/ac P, 23 lb/ac S, 2.5 lb/ac Fe, and 1.49 lb/ac Zn on 6/6/23
Irrigation: Pivot, Total: 8-10"
Rainfall (in):



Baseline Soil Sample 0-8" (March 2023)

pH	OM LOI %	Nitrate–N (0-24") lb/ac	Olsen Bicarbonate–P ppm P	Sulfur–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g	Zn ppm	Fe ppm	Mn ppm	Cu ppm
7.8	1.9	100	24	17	553	2300	313	79	15.9	2.0	14	10	0.6

Introduction: Pod Ceal® by Miller® is a product applied on dry edible beans to reduce moisture intrusion into the pod. The product is a formulation of cyclohexane polymer concentrate, which forms an elastic, semi-permeable membrane on the pods. The intent is to reduce harvest loss due to shelling by preventing pods from popping open during natural wetting and drying prior to harvest. This producer was interested in evaluating Pod Ceal® on pinto beans to determine the impact on yield and harvest loss. Pod Ceal® was applied on September 29, 2023 at a rate of 1 pt/ac, and was compared to an untreated check. Both treatments received a Sharpen® desiccation application on September 29, 2023. The Pod Ceal® treatment and Sharpen® were applied in a tank mix. The field was harvested with a Gleaner® S77 combine with MacDon® FlexDraper® head.

Samples from each plot were analyzed for bean quality parameters. Harvest loss estimates were determined by taking counts in one-square-foot frames randomly chosen in the harvested area, but equally representing the left, center, and right side of the header area behind the combine.

Results:

	Harvest Loss (bu/ac)	Split (%)	Small (%)	Seeds per lb	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	4.6 B*	1 A	4 A	1,359 A	63 A	11.9 A	58 A	1,331 A
Pod Ceal®	5.4 A	1 A	4 A	1,345 A	62 B	11.6 B	56 A	1,274 A
P-Value	0.066	0.840	0.953	0.570	0.05	0.069	0.688	0.625

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 14% moisture.
‡Marginal net return based on $38/cwt ($22.80/bu at 60 lb/bu) for pinto beans and $10.38/ac for Pod Ceal®.

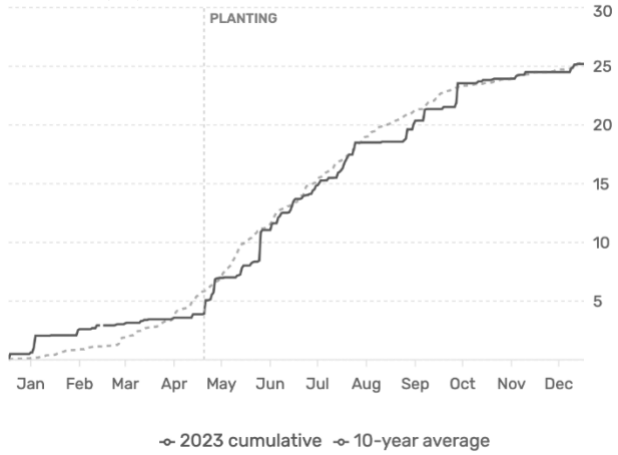
Summary:

- There was no difference in percent split, percent small, seeds per pound, yield, or net return between the Pod Ceal® treated beans and the untreated beans.
- The beans with Pod Ceal® had a greater harvest loss (0.7 bu/ac), lower test weight (0.5 lb/bu), and lower moisture (0.3%) compared to the untreated check.

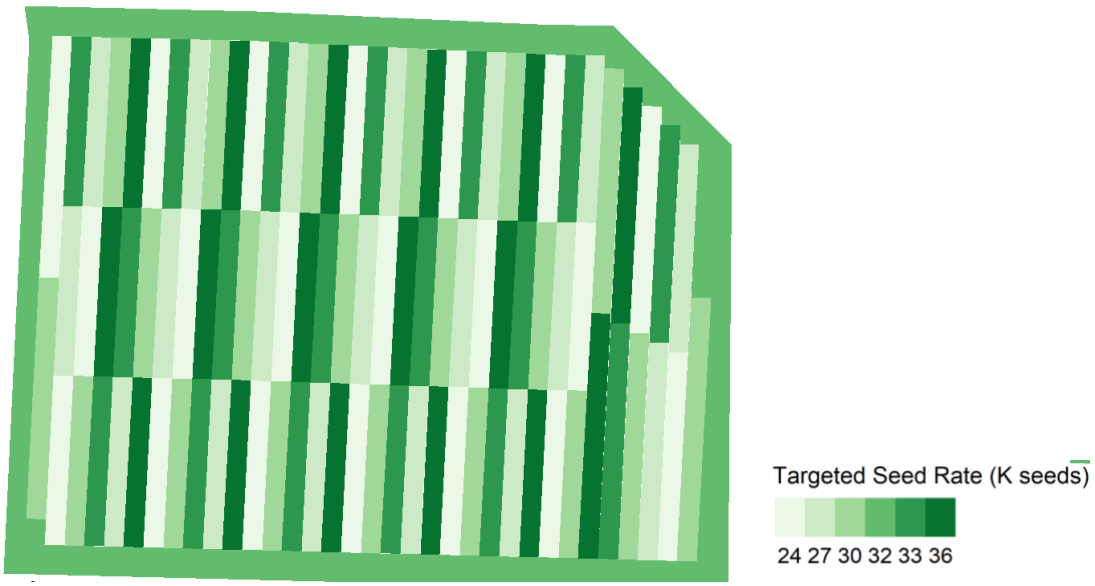
Data Intensive Farm Management: Corn Planting Population

Study ID: 0709047202307
County: Dawson
Soil Type: Cozad silt loam; Hall silt loam; Hord silt loam
Planting Date: 5/4/23
Harvest Date: 11/1/23
Seeding Rate: Variable
Row Spacing (in): 30
Hybrid: Pioneer® P1413AM
Reps: 17
Previous Crop: Soybean
Tillage: Strip-till
Herbicides: ***Pre:*** 2.3 qt/ac Harness Xtra® 5.6, 22 oz/ac Roundup® PowerMax, 8 oz/ac dicamba, 3 oz/ac mesotrione, and 12.8 oz/ac Padlock® Plus
Post: None
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: 15 gal/ac 32% UAN, 5 gal/ac 12-0-0-26 S, 12 gal/ac 10-34-0, and 0.25 gal/ac Zn Chelate on 4/20/23; 3 gal/ac Liftoff® and PivotBio® on 5/5/23; 25 gal/ac 32% UAN and 5 gal/ac 12-0-0-26 S on 6/28/23 (total N from all applications was 171 lb/ac)
Irrigation: Gravity, Total: 12"
Rainfall (in):



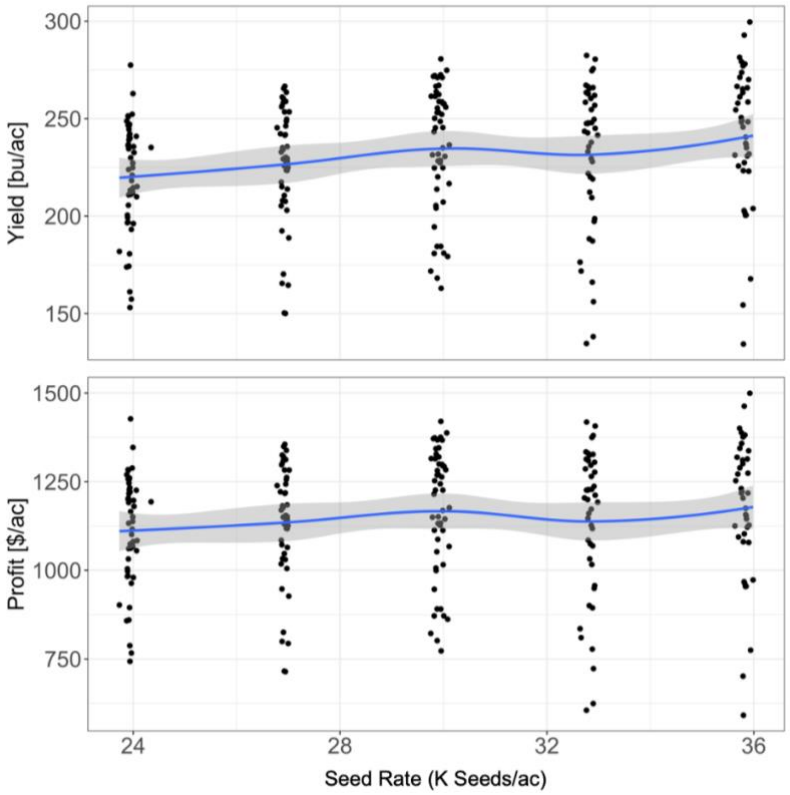
Introduction: Growers are interested in determining the optimum corn planting rate for corn yield and profitability. This research utilized precision agriculture technology for conducting planting rate on-farm research. This study tested five corn planting rates: 24,000 seeds/ac, 27,000 seeds/ac, 30,000 seeds/ac, 33,000 seeds/ac and 36,000 seeds/ac randomized and replicated in 30' wide by 260' long blocks across the field with the headlands planted at 32,000 seeds/ac (grower's standard rate) as shown in the figure below. Results from such trials can inform growers as to the most economic seeding rate for the field as a whole and the benefit of utilizing a variable-rate planting strategy in the future. A variable-rate prescription map was created and uploaded to the in-cab monitor to implement the study. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors. Stand counts were taken on May 31 at the V4 growth stage for four of the replications. Yield and net return were evaluated on a whole field basis and by field elevation and slope.



Results:

Target Seeding Rate (seeds/ac)	Actual Seeding Rate (seeds/ac)	Stand Count (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
24,000	23,930	24,250 C	220 B	1110.30 A
27,000	26,920	25,417 C	228 AB	1141.74 A
30,000	29,880	27,000 BC	234 AB	1161.70 A
33,000	32,800	29,583 AB	229 AB	1126.29 A
36,000	35,790	31,500 A	241 A	1178.37 A
P-Value	0.<0.0001	0.0001	0.011	0.153

*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 $5.50/bu corn and $4.125/K seeds.



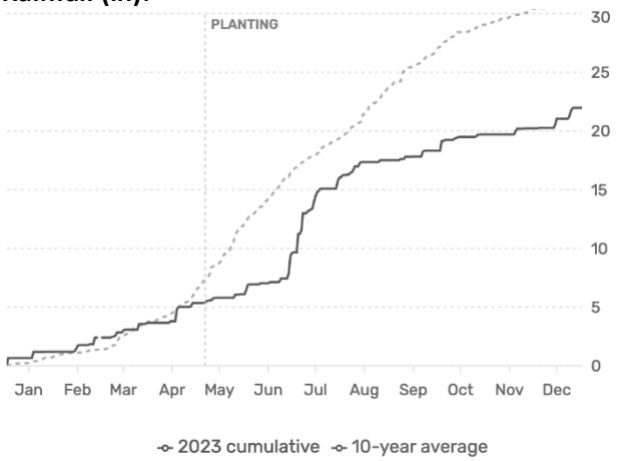
Summary:

- Yield responded positively to increased seeding rates with an increase from 24,000 seeds/ac to 36,000 seeds/ac resulting in an average yield increase of 21 bu/ac. The 36,000 seeds/ac treatment did not have a significantly higher yield compared to the 27,000 seeds/ac, 30,000 seeds/ac, or 33,000 seeds/ac treatments.
- There were no significant differences in marginal net return at the 0.90 confidence level. With a p-value approaching 0.1 (p=0.153), growers may want to consider the economic differences reported in the table. Using regression analysis (data not shown), switching from the grower's uniform seeding rate of 32,000 seeds/ac to the 36,000 seeds/ac rate represents an increase in profit of $67/ac.
- The study evaluated the yield and profit response based on field elevation and slope. Across all elevations and slopes in this field, the highest yielding and most profitable seeding rate was 36,000 seeds/ac indicating there was no benefit for variable rate seeding in this field during the study year.

Evaluating Soybean Maturity Groups

Study ID: 0802159202301
County: Seward
Soil Type: Hastings silt loam 0-1% slope; Fillmore silt loam frequently ponded
Planting Date: 5/6/23
Harvest Date: 9/21/23, 9/25/23, 9/28/23
Seeding Rate: 140,000
Row Spacing (in): 30
Reps: 4
Previous Crop: Corn
Tillage: Ridge-Till
Herbicides: ***Pre:*** 6 oz/ac Zidua® Pro, 2, 4-D, and 22 oz/ac Roundup® ***Post:*** 2 pt/ac Enlist One®, 22 oz/ac Roundup®, Section 3, AMS, and CVA Elite COC
Seed Treatment: Pioneer® premium seed treatment

Fertilizer: 150 lb/ac MEZ on 4/4/23
Irrigation: Gravity, Total: 9.13"
Rainfall (in):



Introduction: With early planting of soybean (in April or as close to May 1 as possible), growers are interested in planting both shorter-season and longer-season varieties to spread the risk load from weather impacts and harvest timing. A shorter-season variety can also aid in planting cover crops after harvest for grazing, erosion, or weed control. A longer-season variety may help take advantage of the longer growing season with higher yields. The goal of this study was to determine any impacts to yield and economics of planting soybean varieties to achieve optimal yields when planting early. This is the sixth year of evaluations of different soybean maturity groups, with dicamba-tolerant soybeans being compared in the past. This study compared Enlist tolerant soybean varieties including a groups 2.3 (Pioneer® P23A40E), 2.5 (Pioneer® P25A16E), 2.8 (Pioneer® P28A65E), and 3.0 (Pioneer® P30A75E). Soybeans were planted on May 6, 2023. The group 2.3 and 2.5 soybeans were harvested on September 21, 2023. Rain and drizzly weather impacted harvest timing of the group 2.8 and 3.0 soybeans. The group 2.8 and group 3.0 reps 1 and 2 were harvested on September 25, 2023, and the group 2.8 and group 3.0 reps 3 and 4 were harvested on September 28, 2023.

Photos: (left) Soybeans showing variation in maturity on September 7, 2023. (right) One of the farmer cooperators helping count pods and nodes on September 21, 2023.

Results:

	Harvest Stand Count (plants/ac)	Moisture (%)	Test Weight (lb/bu)	Nodes/plant	Pods/plant	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Group 2.3 (Pioneer® P23A40E)	88,000 A*	13.8 A	55 A	21 A	94 A	65 B	809 B
Group 2.5 (Pioneer® P25A16E)	106,000 A	15.3 A	54 A	19 A	67 A	67 B	849 B
Group 2.8 (Pioneer® P28A65E)	103,000 A	14.6 A	54 A	19 A	60 A	74 A	937 A
Group 3.0 (Pioneer® P30A75E)	96,667 A	16.0 A	54 A	19 A	51 A	73 A	929 A
P-Value	0.128	0.772	0.402	0.364	0.312	0.004	0.004

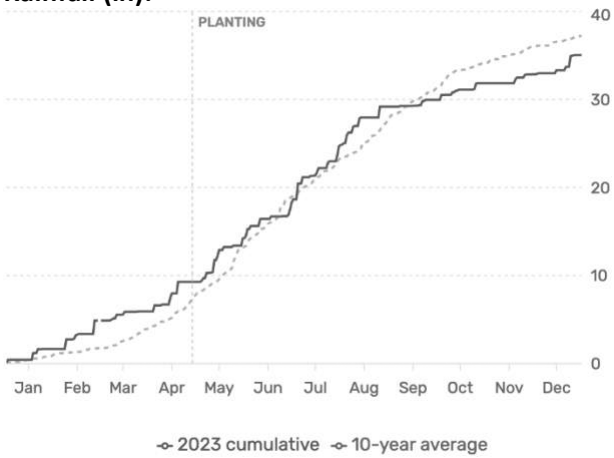
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $13.76/bu soybean, $77.62/ac for P23A40E, and $78.31/ac for P25A16E, P28A65E, and P30A75E.

Summary:

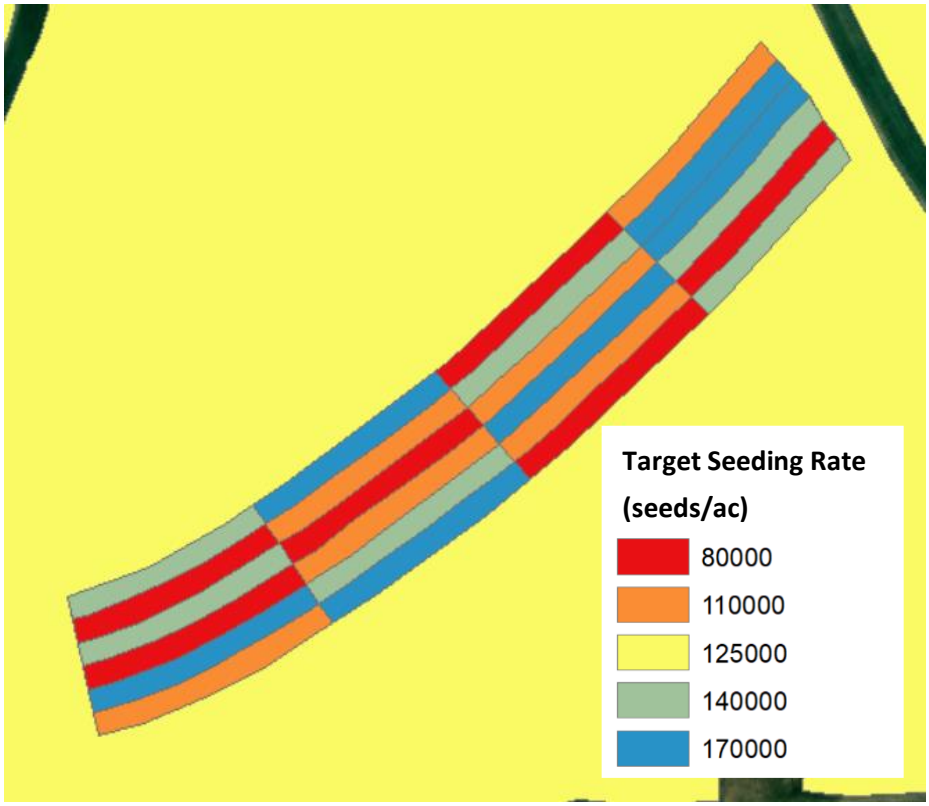
- Harvest stand counts, test weight, pod counts, node counts, and moisture did not differ among the varieties evaluated.
- Group 2.8 and group 3.0 yielded 6 to 9 bu/ac higher than the group 2.3 and group 2.5 soybeans.
- Marginal net return was greatest for the group 2.8 and group 3.0 soybeans.

Non-Irrigated Soybean Population Study

Study ID: 0510KS013202301
County: Brown, KS
Soil Type: Marshall silty clay loam 5-9% slopes; Marshall silt loam 2-5% slopes
Planting Date: 4/28/23
Harvest Date: 11/3/23
Seeding Rate: Variable
Row Spacing (in): 15
Variety: Pioneer® 42A84E
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 9 oz/ac Authority Supreme®, 21 oz/ac Envy 6 Max®, 20 oz/ac 2,4-D, and 12.8 oz/ac Firezone® on 4/10/23 ***Post:*** 32 oz/ac Enlist One®, 21 oz/ac Envy 6 Max®, 2.5 pt/ac Warrant®, 12 oz/ac clethodim, and 12.8 oz/ac Zaar® on 6/8/23
Foliar Insecticides: 1.9 oz/ac Province®II and 5.1 oz/ac Brigade® 2EC on 8/1/23
Foliar Fungicides: 4 oz/ac Priaxor® and 4 oz/ac propiconazole
Fertilizer: 125 lb/ac 11-52-0, 51 lb/ac 0-0-60, and 56 lb/ac gypsum in Feb. 2023
Irrigation: None
Rainfall (in):



Introduction: Previous on-farm research in Nebraska 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 80,000, 110,000, 140,000, and 170,000 seeds/ac. The remainder of the field was planted at 125,000 seeds/ac. Treatments were randomized and replicated in approximately 285' long by 30' wide blocks as shown on the seeding rate map to the right. A variable-rate prescription was created and uploaded to the in-cab monitor to implement the study. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors. The as-planted data were evaluated, and only areas where the recorded seeding rate was within 10% of the target seeding rate were included for yield analysis. Yield data points that were excluded from analysis occurred primarily along the transition zones between seeding rate treatments; no replications were removed. Stand counts were taken in each seeding rate on June 5, 2023. Stand counts, yield, and net return were evaluated.



Results:

Target Seeding Rate (seeds/ac)	Early Season Stand Count (plants/ac)	% of Target Seeding Rate Emerged	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
80,000 seeds/ac	70,333 C*	88 A	68 A	891 A
110,000 seeds/ac	84,389 BC	77 AB	66 A	849 A
140,000 seeds/ac	99,889 B	71 B	69 A	875 A
170,000 seeds/ac	116,778 A	69 B	65 A	804 A
P-Value	<0.0001	0.011	0.609	0.266

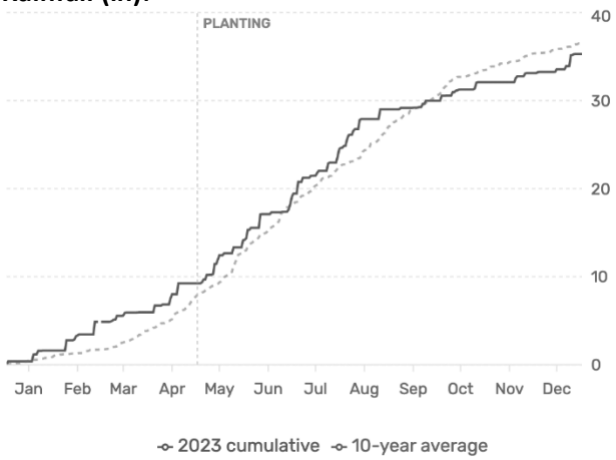
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $13.76/bu soybean and $75/140,000 seeds.

Summary:

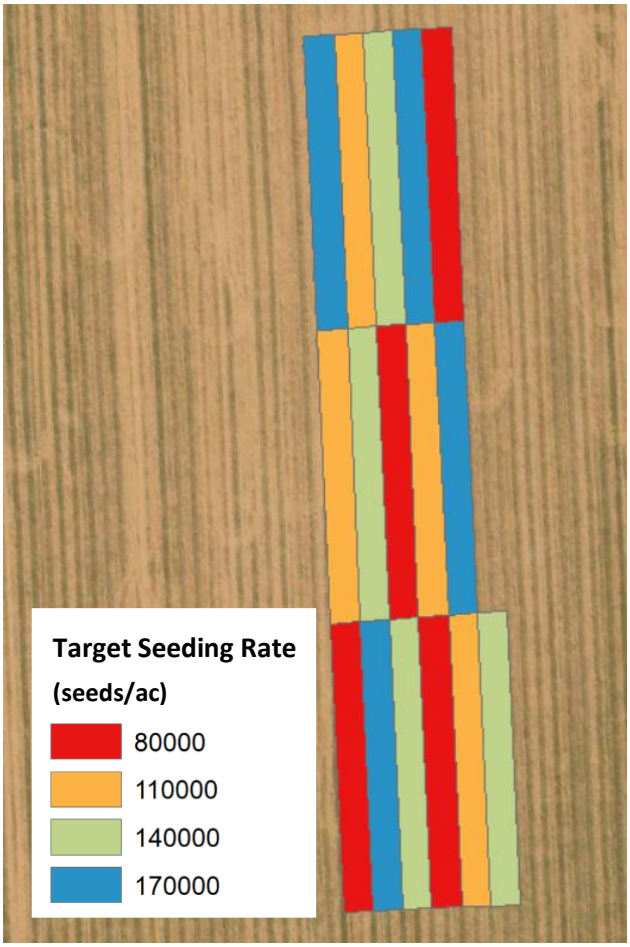
- The 80,000 seeds/ac treatment had a higher percent of target seeding rate emerge compared to the 140,00 and 170,000 seeds/ac treatments. There was a trend of decreasing percent emergence with increasing seeding rate.
- There was no difference in yield or net return among the seeding rates evaluated.

Non-Irrigated Soybean Population Study

Study ID: 0416147202302
County: Richardson
Soil Type: Kennebec silt loam rarely flooded; Zook silty clay loam occasionally flooded
Planting Date: 5/1/23
Harvest Date: 10/23/23
Seeding Rate: Variable
Row Spacing (in): 15
Variety: Pioneer® 37A18E
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 9 oz/ac Authority Supreme®, 12 oz/ac Envy 6 Max®, 20 oz/ac 2,4-D, 12.8 oz/ac Firezone® on 4/8/23 ***Post:*** 32 oz/ac Enlist One®, 21 oz/ac Envy 6 Max®, 2.5 pt/ac Warrant®, 12 oz/ac clethodim, and 12.8 oz/ac Zaar® on 6/8/23
Foliar Insecticides: 1.9 oz/ac Province® II and 5.1 oz/ac Brigade® 2EC on 8/1/23
Foliar Fungicides: 4 oz/ac Priaxor® and 4 oz/ac propiconazole on 8/1/23
Fertilizer: 47 lb/ac 11-52-0, 73 lb/ac 0-0-60, and 72 lb/ac gypsum
Irrigation: None
Rainfall (in):



Introduction: Previous on-farm research in Nebraska 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 80,000, 110,000, 140,000, and 170,000 seeds/ac. The remainder of the field received a variable-rate planting based on soil type. Treatments were randomized and replicated in approximately 300' long by 30' wide blocks as shown on the seeding rate map to the right. A variable-rate prescription was created and uploaded to the in-cab monitor to implement the study. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors. The as-planted data were evaluated, and only areas where the recorded seeding rate was within 10% of the target seeding rate were included for yield analysis. Yield data points that were excluded from analysis occurred primarily along the transition zones between seeding rate treatments; no replications were removed. Stand counts were taken in each seeding rate on June 5, 2023. Stand counts, yield, and net return were evaluated.



Results:

Target Seeding Rate (seeds/ac)	Early Season Stand Count (plants/ac)	% of Target Seeding Rate Emerged	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
80,000 seeds/ac	53,333 C*	67 A	72 A	948 A
110,000 seeds/ac	71,250 B	65 AB	72 A	934 A
140,000 seeds/ac	82,250 B	59 B	73 A	934 A
170,000 seeds/ac	104,500 A	62 AB	76 A	958 A
P-Value	<0.0001	0.0998	0.460	0.908

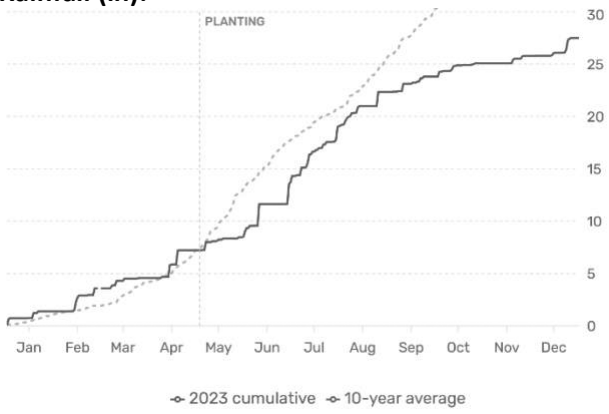
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $13.76/bu soybean and $75/140,000 seeds.

Summary:

- The 80,000 seeds/ac treatment had a greater percent of target seeding rate which emerged compared to the 140,000 seeds/ac treatment. All seeding rates had a relatively low percent emergence (59% to 67%).
- Consistent with previous findings, there was no yield difference among the seeding rates evaluated.
- There was no significant difference in marginal net return among the rates evaluated.

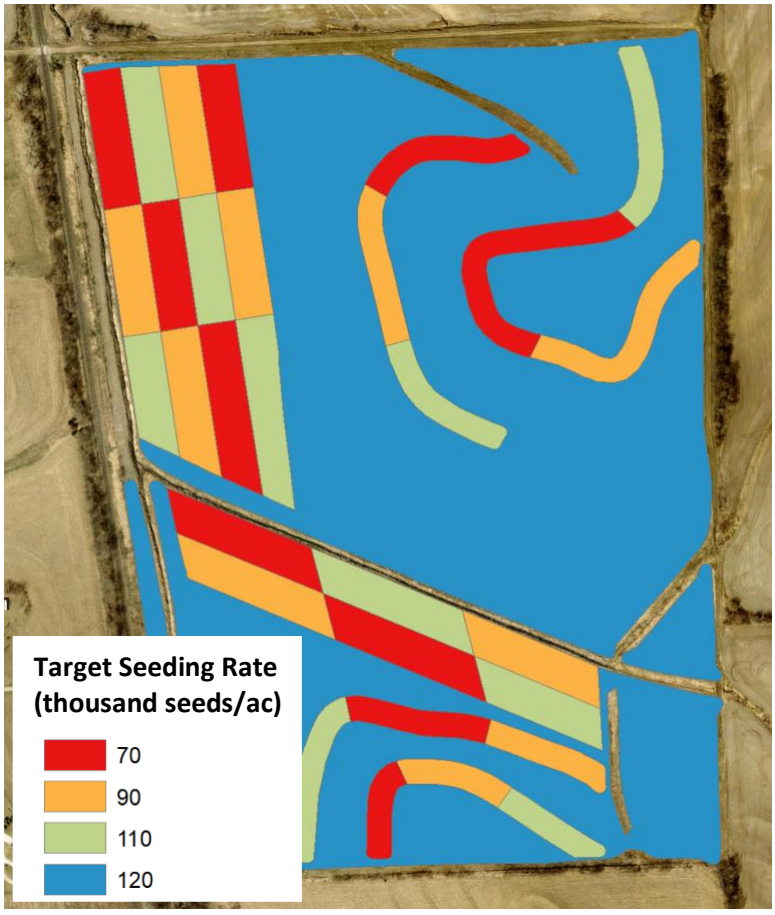
Non-Irrigated Soybean Population Study

Study ID: 1252025202303
County: Cass
Soil Type: Judson silt loam 2-6% slopes; Nodaway silt loam occasionally flooded; Colo-Nodaway complex frequently flooded
Planting Date: 5/3/23
Harvest Date: 10/23-24/23
Row Spacing (in): 15
Variety: Asgrow® AG35XF1
Reps: 10
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 6.4 oz/ac Authority® Supreme, 2 oz/ac Authority® XL, 8 oz/ac dicamba, 22 oz/ac Roundup PowerMAX® 3, and 16 oz/ac Efficax® in April 2023 ***Post:*** 48 oz/ac Warrant®, 32 oz/ac Liberty®, 3 oz/ac Resource®, 6 oz/ac Vaquero®, 7 oz/ac High Load®, and 3.43 lb/ac AMS in June 2023
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: Variable-rate applied according to grid sampling in February 2023 - 11-52-0 averaged 231 lb/ac, potash averages 118 lb/ac
Irrigation: None
Rainfall (in):



Introduction: Previous on-farm research in Nebraska 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 70,000, 90,000, and 110,000 seeds/ac. The remainder of the field was planted at 120,000 seeds/ac.

Treatments were randomized and replicated in approximately 450' long by 80' to 120' wide blocks as shown in the image at right. A variable-rate prescription was created and uploaded to the in-cab monitor to implement the study. Geospatial yield monitor data were collected at the end of the growing season and post-processed to remove errors. The as-planted data were evaluated, and only areas where the recorded seeding rate was within 10% of the target seeding rate were included for yield analysis. Yield data points which were excluded from analysis occurred primarily along the transition zones between seeding rate treatments; no replications were removed. Stand counts were taken in each seeding rate on June 5, 2023, in six of the replications. Stand counts, yield, and net return were evaluated.



Results:

	Early Season Stand Count (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
70,000 seeds/ac	53,000 B*	59 A	776 A
90,000 seeds/ac	73,000 A	58 A	749 AB
110,000 seeds/ac	80,000 A	55 A	701 B
P-Value	0.0003	0.193	0.061

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $13.76/bu soybean and $70.14/140,000 seeds.

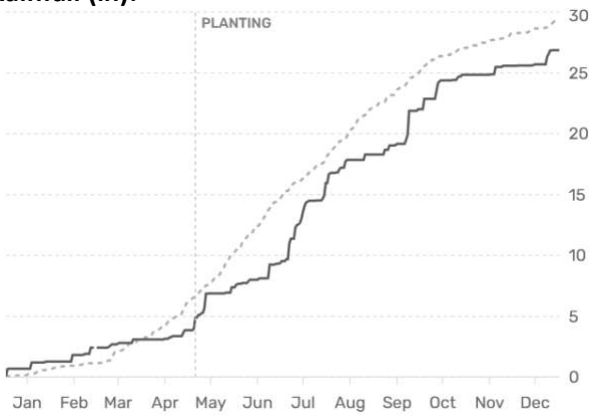
Summary:

- Stand counts were not different between the 90,000 and 110,000 seeding rates.
- Soybeans were very tall and lodged. There was no discernable difference in lodging severity among the seeding rates evaluated.
- Yields ranged from 55 to 59 bu/ac and were not significantly different among the seeding rates evaluated. The lowest seeding rate of 70,000 seeds/ac with a stand count of 53,000 plants/ac achieved the same yield as the higher seeding rates.
- Marginal net return for the lowest seeding rate of 70,000 seeds/ac was significantly greater ($75/ac) than marginal net return for the 110,000 seeds/ac treatment.

Irrigated Soybean Population Study

Study ID: 1528011202301
County: Boone
Soil Type: Nora silt loam 6-11% slopes, eroded; Crofton-Nora complex 11-17% slopes, eroded
Planting Date: 5/1/23
Harvest Date: 10/2/23
Seeding Rate: Variable
Row Spacing (in): 30
Variety: Asgrow® AG30XF2
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 26 oz/ac Roundup® PowerMAX 3, 10 oz/ac Sterling Blue®, 5 oz/ac Authority® First DF, 36 oz/ac Elite® All in MB, 0.5 pt/ac Elite® HSCOC, 3 oz/ac Zidua® SC, 12 oz/ac Section Three, 22 oz/ac Xtendimax®, and 30 oz/ac Roundup® PowerMAX 3
Foliar Fungicides: 8 oz Delano®, 4 oz MasterLock®, and 2.8 oz/ac Leverage® 360

Fertilizer: 100 lb/ac MESZ 12-40-0-10S-1Zn and 4.98 lb/ac 15% Borate/Boron
Note: Hail and high wind on 9/23/23
Irrigation: Pivot
Rainfall (in):



Introduction: Previous on-farm research in Nebraska has demonstrated that soybean planting rates of 80,000 to 120,000 seeds/ac resulted in the highest profitability. This producer was interested in evaluating the impact of soybean seeding rate on their own operation. Two seeding rates were evaluated, 115,000 seeds/ac and 140,000 seeds/ac (traditionally used by the grower). Seeding rate treatments were applied in field-length strips and replicated six times.

Results:

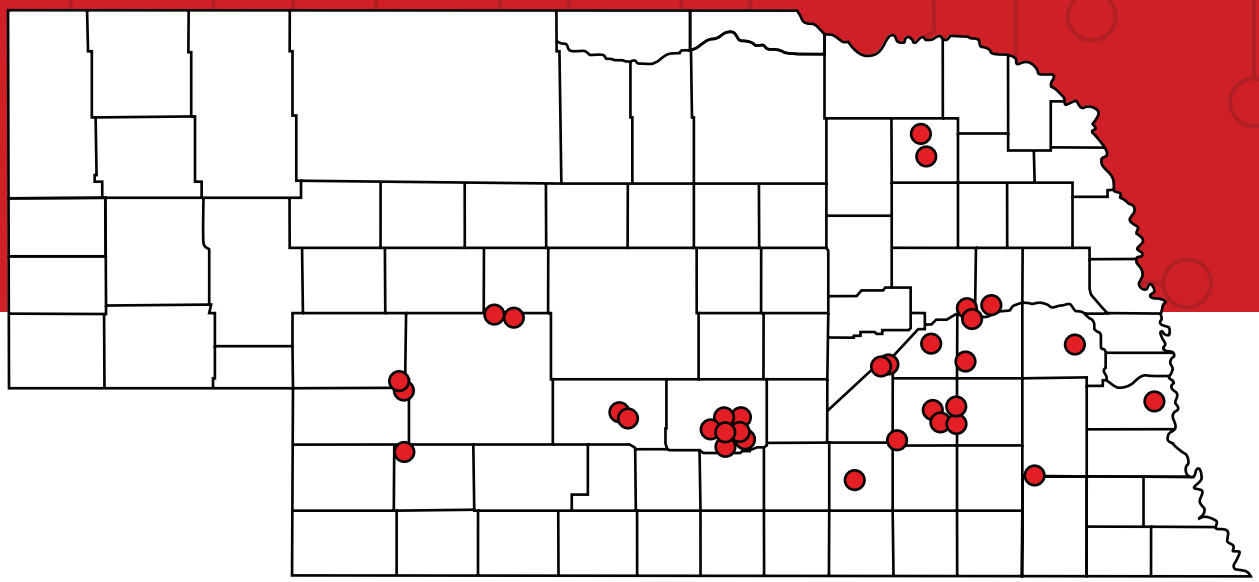
	Early Season Stand Count (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
115,000 seeds/ac	95,000 B*	76 A	981 A
140,000 seeds/ac	114,000 A	75 A	959 A
P-Value	0.004	0.583	0.247

*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 $9.25/bu soybean and $70.14 per 140,000 seeds.

Summary:

- Early season stand counts showed that plant emergence was 83% to 81% of the target seeding rate of 115,000 and 140,000 seeds/ac, respectively.
- Yield values were statistically the same between the two treatments indicating that there is an opportunity to reduce seeding rates with no substantial yield reduction.
- There was no statistical difference in net return; planting 115,000 seeds/ac was as profitable as planting 140,000 seeds/ac. The grower plans to expand this test in the future to look at more rates and find the optimal seeding rate.

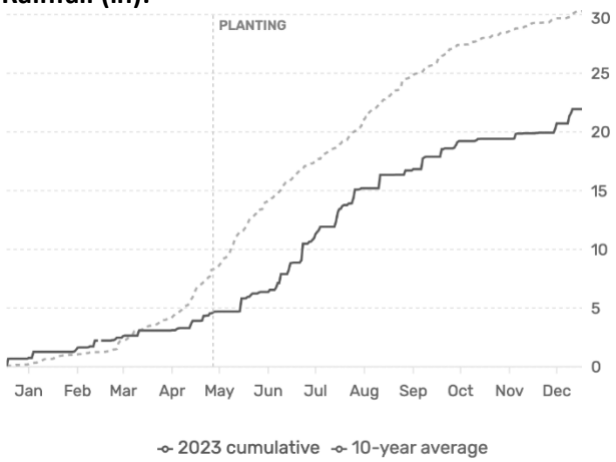
FERTILITY AND SOIL MANAGEMENT



Evaluating Pelletized Lime and Ammonium Sulfate - Year 1 Corn

Study ID: 1116081202302
County: Hamilton
Soil Type: Hastings silt loam
Planting Date: 5/11/23
Harvest Date: 10/17/23
Seeding Rate: 33,000
Row Spacing (in): 30
Hybrid: 114-01 White and 1474 White
Reps: 15
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 1.75 qt/ac Lexar® and 5 oz/ac 2, 4-D ***Post:*** 1.75 qt/ac Lexar®, 3 oz/ac Status®, and 32 oz/ac Roundup®
Foliar Insecticides: 8 oz/ac Capture® LFR

Fertilizer: 220 lb/ac N, 100 lb/ac P, 40 lb/ac S, and 2 lb/ac Zn
Note: There was some wind damage at harvest
Irrigation: Pivot
Rainfall (in):



Introduction: The study evaluated the impact of pelletized lime and ammonium sulfate as a calcium source on a Hastings silt loam soil. The fertilizer was applied with a dry broadcast spreader in mid-April and the crop was no-till planted. The nitrogen and sulfur rates were adjusted to keep the rates the same as that applied to the check strips. The treatments were as follows:

- Check – applied with dry spreader.
- Applied grower standard plus the pelletized lime and ammonium sulfate.

Grain moisture, yield, and marginal net return were evaluated for two hybrids, 114-01 White (9 replications) and 1474 White (6 replications). This is the first year of a two-year study. In year two, no additional application is planned and yield and net return impacts will be evaluted. The cost of the product is spread over two years.

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
		114-01 White (9 replications)	
Check	19.0 A*	229.3 A	1355.10 A
Pelletized Lime + Ammonium Sulfate	18.9 A	232.0 A	1362.10 A
P-Value	0.289	0.289	0.634
		1474 White (6 replications)	
Check	19.5 A	235.2 A	1389.90 A
Pelletized Lime + Ammonium Sulfate	19.5 A	241.8 A	1419.90 A
P-Value	0.972	0.447	0.555

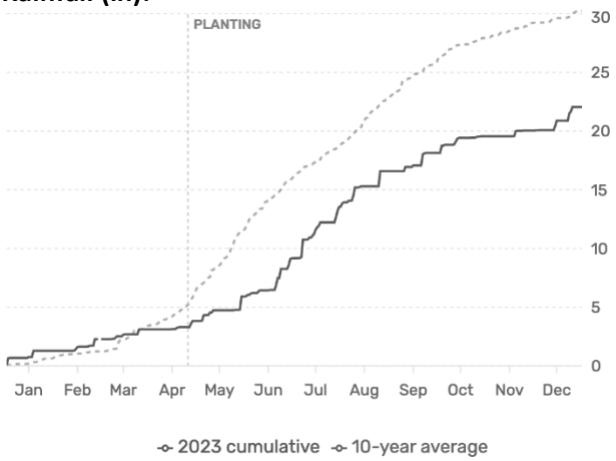
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn and $9.11/ac for pelletized lime and ammonium sulfate ($9.11/ac is half of the cost of the product; the study will continue next year and the other half of the cost will be considered in year two).

Summary:

- The addition of the pelletized lime and ammonium sulfate did not result in a yield increase compared to the untreated check.
- There was no difference in marginal net return between the treatments evaluated.

Evaluating Pelletized Lime and Ammonium Sulfate - Year 1 Soybeans

Study ID: 1116081202301
County: Hamilton
Soil Type: Thurman fine sandy loam; Ortello fine sandy loam
Planting Date: 4/25/23
Harvest Date: 9/27/23
Seeding Rate: 110,000
Row Spacing (in): 30
Variety: Paloma® 2E260 and Becks® 2630
Reps: 9
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 8 oz/ac sulfentrazone, 1.5 qt/ac Prowl®, 32 oz/ac Roundup®, and 48 oz/ac liquid AMS ***Post:*** 2 qt/ac Warrant®, 32 oz/ac Roundup®, 32 oz/ac Enlist®, 28 oz/ac Liberty®, and 48 oz/ac liquid AMS
Seed Treatment: Fungicide and insecticide
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 21 lb/ac N, 80 lb/ac P, 80 lb/ac K, 9 lb/ac S, and 2 lb/ac Zn
Irrigation: Pivot
Rainfall (in):



Introduction: The study evaluated the impact of pelletized lime and ammonium sulfate as a calcium source on a Thurman and Ortello fine sandy loam soil in the Platte River Valley. The fertilizer was applied with a dry broadcast spreader in mid-April and the crop was no-till planted. The nitrogen and sulfur rates were adjusted to keep the rates the same as that applied to the check strips. The treatments were as follows:

- Check-applied with dry spreader.
- Applied grower standard plus pelletized lime and ammonium sulfate.

Grain moisture, yield, and marginal net return were evaluated for two varieties, Paloma® 2E260 (4 replications) and Becks® 2630 (5 replications). This is the first year of a two-year study. In year two, no additional application is planned and yield and net return impacts will be evaluted. The cost of the product is spread over two years.

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
		Paloma® 2E260 (4 replications)	
Check	10.9 A*	88.9 A	1222.80 A
Pelletized Lime + Ammonium Sulfate	10.9 A	88.7 A	1188.50 A
P-Value	0.762	0.929	0.132
		Becks® 2630 (5 replications)	
Check	11.1 A	85.8 A	1180.20 A
Pelletized Lime + Ammonium Sulfate	11.4 A	86.9 A	1162.40 A
P-Value	0.436	0.262	0.194

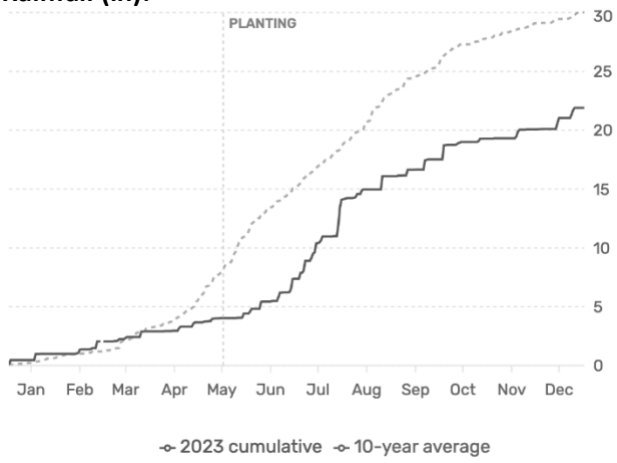
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $13.76/bu soybean and $32.70/ac for the pelletized lime and ammonium sulfate ($32.70/ac is half of the cost of the product; the study will continue next year and the other half of the cost will be considered in year two).

Summary:

- The addition of the pelletized lime and ammonium sulfate did not result in a yield increase compared to the untreated check.
- The marginal net return was not statistically different between the treatments.

Impact of CENTURO® Inhibitor with Anhydrous Ammonia Application in Corn

Study ID: 1111081202301
County: Hamilton
Soil Type: Hastings silt loam
Planting Date: 5/16/23
Harvest Date: 10/21/23
Seeding Rate: 29,000
Row Spacing (in): 36
Hybrid: Pioneer® P1563Q
Reps: 3
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 3.2 oz AGpHRx™ water treatment, 3 qt Lexar®, 8 oz dicamba, 6.4 oz 8 Ball MAXX, and 28 oz Roundup® on 5/30/23 ***Post:*** 3.2 oz AGpHRx™ water treatment, 2 oz Zidua®, and 28 oz Roundup® on 6/16/23
Seed Treatment: Pioneer® seed treatment
Foliar Insecticides: Tundra® sprayed for western bean cutworm toward end of July
Foliar Fungicides: Headline AMP® applied toward end of July
Irrigation: Pivot, Total: 13"
Rainfall (in):



Introduction: CENTURO™ by Koch™ Agronomic Services LLC contains a product with known efficacy for inhibiting nitrification. 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 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 N2O or N2 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.

After seeing other nitrification inhibitor study results, the grower wanted to evaluate the impact of CENTURO™ applied with anhydrous ammonia with a higher and lower rate of nitrogen to determine how it impacted crop yield and soil ammonium and nitrate. Anhydrous ammonia was applied at 120 lb/ac N and 160 lb/ac N on April 12, 2023. The study compared both application rates with no inhibitors versus with CENTURO™ applied at 10 gal/ton anhydrous ammonia.

The field was planted on May 16, 2023, with planting 6" from the anhydrous knife band. All treatments experienced some visible anhydrous burn; however, stand counts weren't significantly impacted. Stand counts were taken on October 5, 2023 and the field was harvested on October 21, 2023.

Soil samples were collected for ammonium and nitrate on April 18, June 22, and October 26, 2023. A total of five samples (directly from the anhydrous band and at 9" and 18" inches on either side of the anhydrous band) were collected from each treatment and each rep (3 reps total). Usually, only 0-12" is analyzed during the growing season for ammonium and nitrate and 0-36" is analyzed at the end of the season for nitrate. The Extension Educator sampling the field started sampling deeper on April 18 and chose to finish the reps. For consistency, the educator and grower decided to still sample down to 36" for the June and October sampling periods, but only sample one rep of 12-24" and 24-36". The 0-12" ammonium data for the June 22 sampling was taken from the three reps but accidentally not analyzed by the lab and thus has no statistical analysis. Only one rep was taken for the October 26 sampling, thus no statistical analysis.

Results:

	0-12”	12-24”	24-36”	0-12”	12-24”	24-36”
	April 18, 2023					
120 lb N/ac	18 A	10 A	5 A	190 A	77 A	30 A
120 lb N/ac with CENTURO™	19 A	7 A	3 A	65 A	18 A	16 A
160 lb N/ac	20 A	11 A	6 A	236 A	85 A	166 A
160 lb N/ac with CENTURO™	19 A	12 A	6 A	161 A	138 A	63 A
P-Value	0.954	0.425	0.349	0.293	0.652	0.469
	June 22, 2023					
120 lb N/ac	98 AB	42	10	19	20	20
120 lb N/ac with CENTURO™	68 B	71	25	1	8	16
160 lb N/ac	89 AB	62	26	18	19	20
160 lb N/ac with CENTURO™	107 A	68	35	31	10	13
P-Value*	0.087	N/A	N/A	N/A	N/A	N/A
	October 26, 2023					
120 lb N/ac	2	1	1	6	6	6
120 lb N/ac with CENTURO™	1	1	0	8	7	7
160 lb N/ac	5	2	3	6	19	9
160 lb N/ac with CENTURO™	2	1	4	9	7	11
P-Value**	N/A	N/A	N/A	N/A	N/A	N/A

*The lab analysis for the 0-12" Ammonium analysis for this set of samples was accidentally omitted.
**Only one rep was taken for the end of season samples, thus no statistical analysis is available.

	Stand Count (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
120 lb N/ac	28,333 A*	253 A	1,439 A
120 lb N/ac with CENTURO™	28,333 A	254 A	1,430 A
160 lb N/ac	27,667 A	256 A	1,435 A
160 lb N/ac with CENTURO™	27,667 A	254 A	1,410 A
P-Value	0.880	0.551	0.117

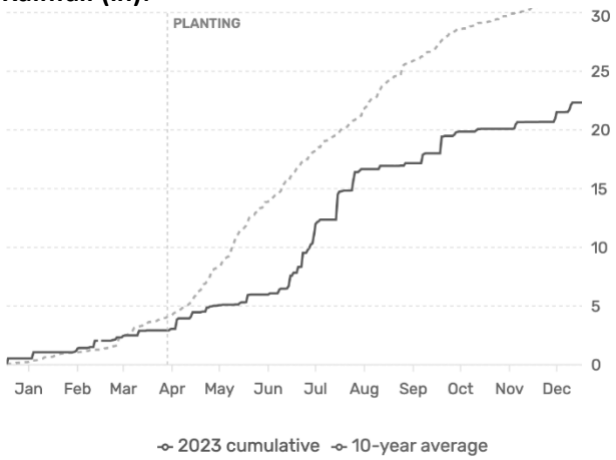
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn, $0.48/lb of N, and $15/ac for CENTURO®.

Summary:

- There were no differences in stand counts, yield, or net return between the four treatments. Applying 120 lb N/ac yielded the same as applying 160 lb N/ac with no effect of CENTURO™ application. For reference, the University of Nebraska-Lincoln N recommendation for corn for this field was 200 lb N/ac with an expected yield of 250 bu/ac.
- There were no differences between ammonium or nitrate levels for any treatment at any depth for the April 18 soil sampling. The June 22 sampling date showed a higher nitrate level with the 160 lb N/ac treatment with CENTURO™ than the 120 lb N/ac treatment with CENTURO™ at the 0-12" depth. Minimal soil nitrate and ammonium remained in the 0-36" soil profile via the October 26 sampling.

Impact of Nitrogen on Soybeans

Study ID: 0276185202303
County: York
Soil Type: Hastings silt loam
Planting Date: 4/12/23
Harvest Date: 9/18/23
Seeding Rate: 130,000
Row Spacing (in): 30
Variety: Pioneer® P28A65E
Reps: 4
Previous Crop: Corn
Tillage: Root slice before planting; row cultivation
Herbicides: ***Pre:*** 8 oz/ac Authority® Supreme on 4/12/23 ***Post:*** 3 pt/ac Warrant®, 1 qt/ac Durango®, 1 qt/ac Liberty®, and 1 qt/ac Enlist One® on 5/23/23; 6 oz/ac Target on 5/30/23; 1 qt/ac Liberty® and 1 qt/ac Enlist One® on 6/29/23
Seed Treatment: Unknown
Foliar Insecticides: 6.4 oz/ac Batallion® on 7/21/23
Foliar Fungicides: 6.8 oz/ac Approach Prima® on 7/21/23
Fertilizer: 200 lb/ac MAP (11-52-0) before planting
Irrigation: Pivot (water sample had 7 ppm K, 17.1 ppm nitrate, and 11 ppm sulfate in August 2023)
Rainfall (in):



Baseline Soil Samples (November 2022):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g	Zn ppm	Fe ppm	Mn ppm	Cu ppm
6.9	3.8	10.6	34	8.7	276	2027	266	64	13.3	1.65	19.4	6.2	0.44
6.8	3.7	7.8	25	9.8	242	1928	255	61	12.7	1.65	24.3	7.0	0.47

Introduction: Some studies have shown that in high-yielding soybeans, N-fixation may not meet the entire plant N need. Therefore, this producer was interested in evaluating the impact of N fertilizer on soybeans. In previous years, the producers had worked with Dr. Nicolas Cafaro La Menza and his students with small-plot nutrient studies in their fields. This year, they decided to compare the small-plot studies with a field-scale on-farm research study.

Small Plot: For the small-plot research, treatments of a check, 33 lb N/ac, and 700 lb N/ac were compared. The N in the 33 lb/ac N treatment was sidedressed by the farmer using 28% UAN solution at R2 (full flowering). The 700 lb/ac N was applied by broadcasting urea (46-0-0) split at V3-20%, R2-20%, R3-30%, and R5-30% stages. Soybean plants were sampled in the check plots to quantify stem N content around the flowering stage and results showed that the stem had 4.1 lb N/ac, which was the level of N found in a previous study to have low to no cost-effective yield response. A drone image collected around flowering is presented on next page (Figure 1) as RGB and NDVI; no difference was found between the treatment plots.

Field Scale: Nitrogen was applied at a rate of 33 lb N/ac as 28% UAN applied 8" to the side of plants on June 23, 2023, at R2. Stand counts were taken on Sept. 18, 2023. Soybean yield and net return were evaluated.

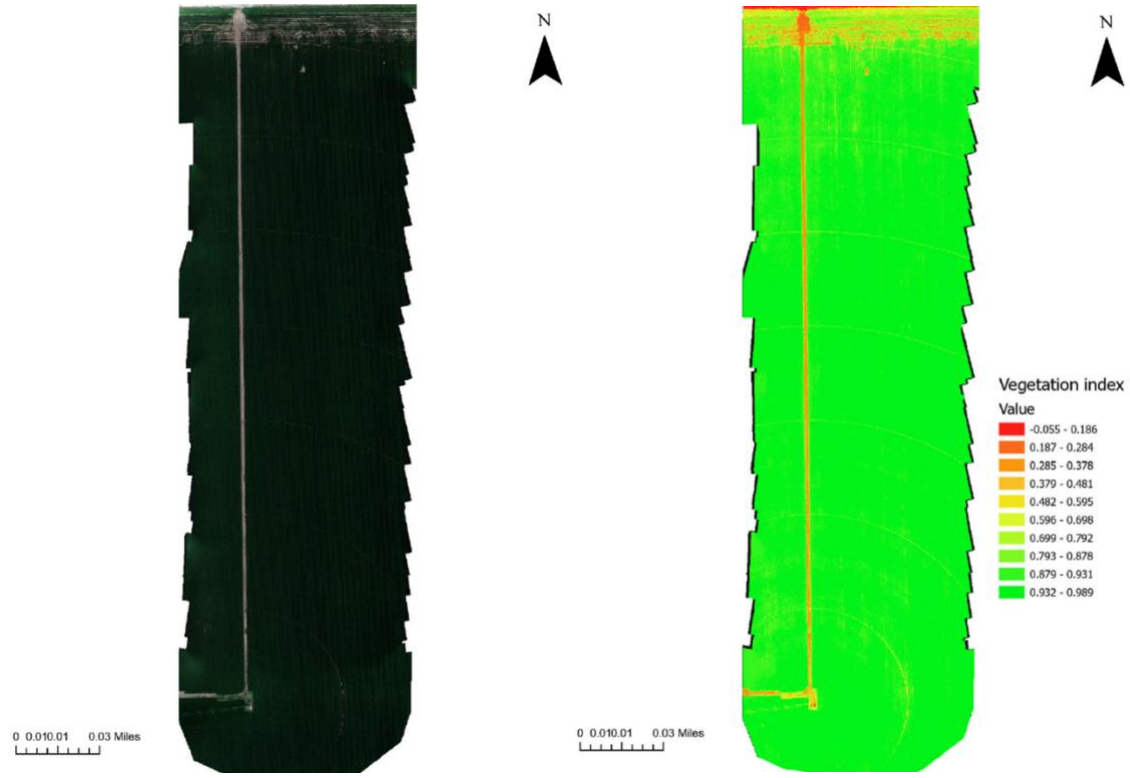
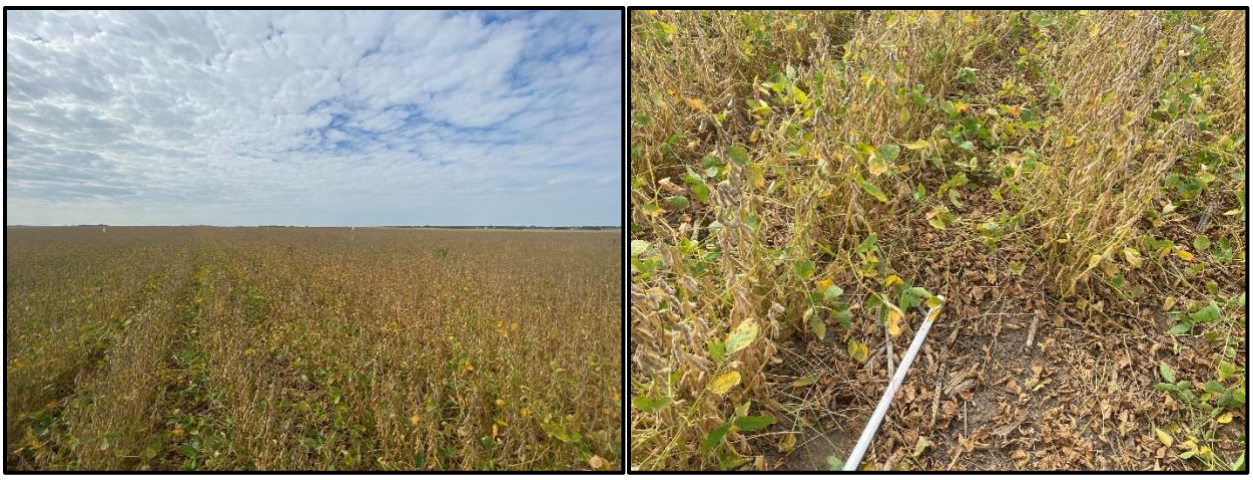


Figure 1. Drone image collected around flowering at 400 ft above ground level is presented as RGB and NDVI; no difference was found between the treatment plots.



Photos: (left) The small plot area located within the larger area of the field. (right) Plants removed from the small plot area for sampling.

Results:

	Harvest Stand Count (plants/ac)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
	Small Plot Results (located within the field)			
Check	88,209 A*	8.2 A	67 B	
33 lb N/ac	97,575 AB	7.9 A	66 B	
700 lb N/ac	99,753 B	8.2 A	88 A	
P-Value*	0.061	>0.294	<0.001	
	On-Farm Research Field Scale Results			
Check	106,125 A*	10.6 A	75 A	1,026 A
33 lb N/ac	110,250 A	11.3 A	73 A	968 B
P-Value	0.384	0.243	0.173	0.0142

*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 $13.76/bu soybean and $28.76/ac for the nitrogen fertilizer, and $9/ac for the application.

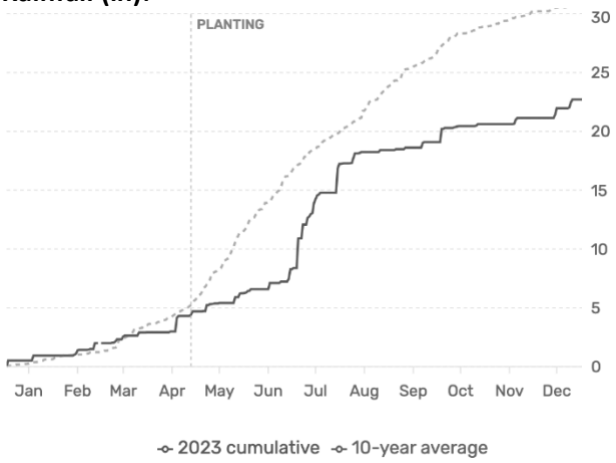
Summary:

- Small Plots: The check had significantly less plants per acre than the 700 lb/ac N treatment. The addition of 700 lb/ac N significantly increased yield compared to the check and 33 lb/ac N treatments in the small plot. This indicates that the field had N limitation but did not have a cost-effective yield response to the 33 lb/N applied at flowering. There were no differences in grain moisture.
- Field-scale Plots: The addition of 33 lb/ac N fertilizer did not result in a difference in stand counts, grain moisture, or soybean yield. Marginal net return was $58/ac lower for the N fertilizer treatment due to the cost of fertilizer.

Impact of Nitrogen on Soybeans

Study ID: 0918185202301
County: York
Soil Type: Fillmore silt loam; Hastings silt loam
Planting Date: 4/27/23
Harvest Date: 9/2/23
Seeding Rate: 140,000
Row Spacing (in): 30
Variety: Asgrow® AG27XF
Reps: 8
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 6 oz/ac Authority® Supreme ***Post:*** 36 oz/ac Liberty® and 12 oz/ac Outlook®
Seed Treatment: Cruiser-Maxx®, Saltro®
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: 8 gal/ac 10-34-0 and 1 gal/ac thiosulfate at planting
Irrigation: 8" with Pivot (15.3 ppm nitrate)
Rainfall (in):



Introduction: Some studies have shown that in high-yielding soybeans, N-fixation may not meet the entire plant N need. Therefore, this producer was interested in evaluating the impact of N fertilizer on soybeans. Nitrogen was applied at a rate of 33 lb N/ac as 11 gal/ac 28% UAN and 0.5 gal/ac 12-0-0-26 through sidedress application at R2. Water samples from the irrigation well taken on 8/28/23 showed 15.3 ppm nitrate, 6 ppm potassium, and 9 ppm sulfate. Soybean yield and net return were evaluated.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	56 A*	766 A
33 lb N/ac	56 A	758 A
P-Value	0.687	0.612

*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 $13.76/bu soybean and $15/ac for 33 lb N/ac treatment.

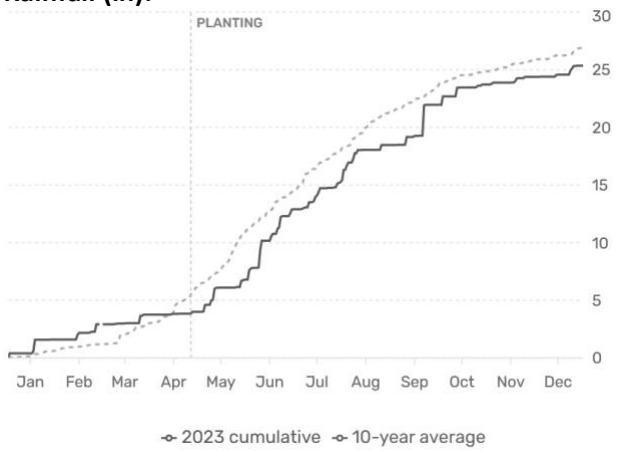
Summary:

- The addition of N fertilizer did not result in a yield increase compared to the untreated check.
- There was no difference in marginal net return. Marginal net return calculations only included the cost of N fertilizer and not the cost of application.
- Yields were lower than expected for irrigated soybeans; it is possible this was due to high disease pressure.

Determining Economically Optimum Nitrogen Rate on Corn

Study ID: 1527019202301
County: Buffalo
Soil Type: Hord silt loam
Planting Date: 4/26-27
Harvest Date: 10/15/23
Seeding Rate: 32,000
Row Spacing (in): 30
Hybrid: Channel® 217-01VT2RIB
Reps: 4
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 2 qt/ac Harness Xtra®, 3 oz/ac mesotrione with 1% COC, and 1% UAN on 5/10/23
Post: 1.25 qt/ac Harness Xtra®, 1 pt/ac atrazine, 1% COC, and 1% UAN on 6/7/23
Seed Treatment: Standard Channel® seed treatment

Foliar Insecticides: None
Foliar Fungicides: 7 oz/ac Veltyma®
Irrigation: Pivot
Rainfall (in):



Soil Samples 0-6" (Nitrate: 5/11/2023)

							-------Melich lll-------							
	pH	BpH	OM LOI %	Melich III P ppm	Nitrate – N ppm N	Sulfate-S ppm S	K	Ca	Mg	Na	CEC me/100g	Sand (%)	Silt (%)	Clay (%)
Zone 1	8.2	7.2	3.7	101	20.9	7.7	545	1889	264	15	13.1	32	44	24
Zone 2	5.5	6.7	4.1	92	38.4	8.2	620	1999	245	16	16.4	28	46	26
Zone 3	5.2	6.7	4.1	82	57.0	7.8	525	1969	240	14	16.0	32	44	24

Introduction: This study evaluated five different N rates to determine the economically optimum N rate (EONR). The field received a flat rate of 26.5 gal/ac of 28% UAN (78 lb N/ac) on April 4 through strip-till and 9.2 gal/ac 28% UAN (27 lb N/ac) on April 26, 2023. Nitrogen rate strips 870' to 1590' long by 60' were placed in the field as shown in the layout. The N rate trial was applied as 32% UAN on June 7, 2023, at rates of 0, 30, 60, 90, and 120 lb N/ac for total N rates of 105, 135, 165, 195, and 225 lb N/ac. As-applied fertilizer maps were used to evaluate the accuracy of fertilizer application. Yield monitor data were collected at the end of the growing season and post-processed to remove errors. Additionally, yield data points that corresponded to areas where the fertilizer application rate was more than 10% above or below the target rate were removed from the analysis.

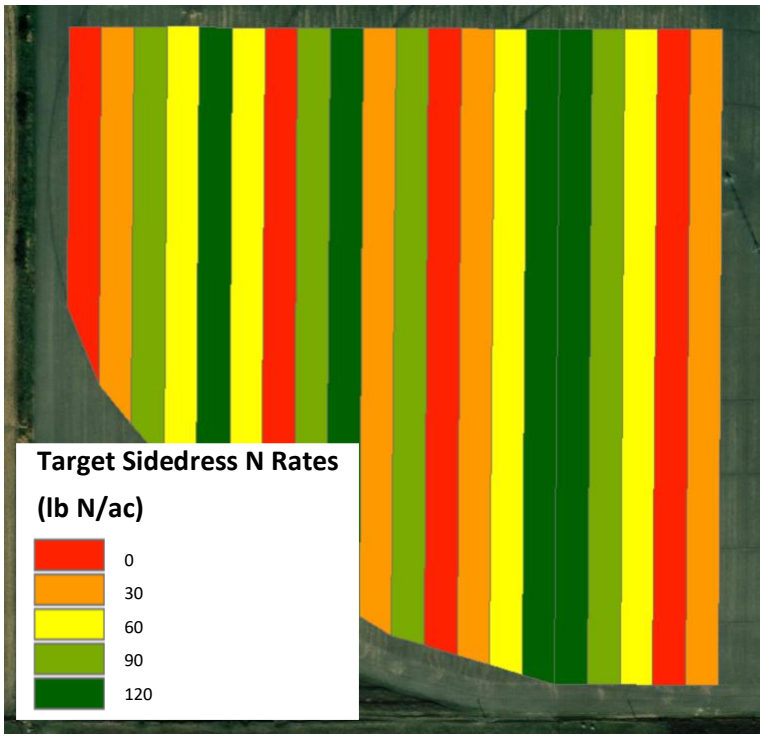


Figure 1. Trial layout with sidedress nitrogen rates ranging from 0 to 120 lb N/ac.

Results:

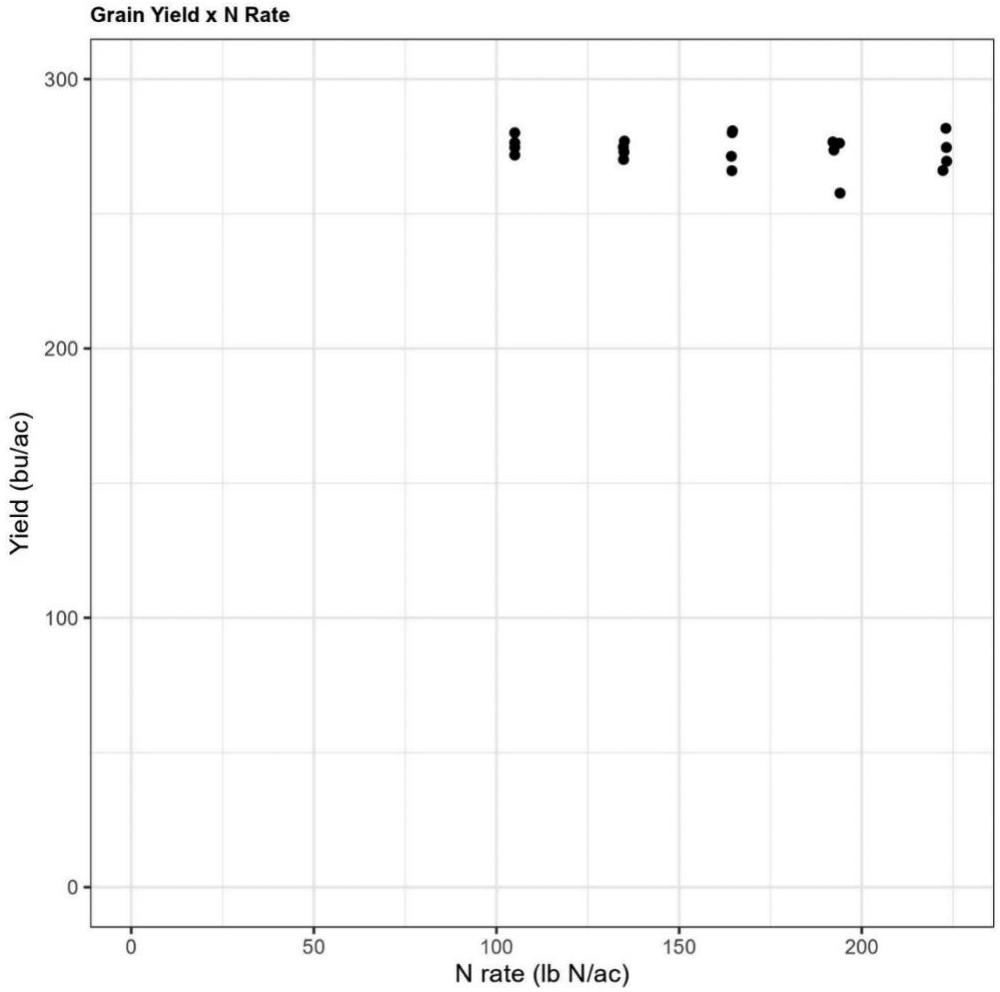


Figure 2. Observed corn yields at total nitrogen rates ranging from 105 to 225 lb N/ac.

Target Total N Rate (lb/ac)	As-Applied N Rate from Sidedress Application (lb/ac)	Total As-Applied N Rate From All Sources (lb/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
105	0 E*	105	276 A	1,540 A
135	30 D	135	274 A	1,503 AB
165	60 C	165	275 A	1,483 BC
195 (grower rate)	88 B	193	271 A	1,438 CD
225	118 A	223	273 A	1,424 D
P-Value	<0.0001	-	0.588	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 $5.91/bu corn and $0.65/lb N.

Summary:

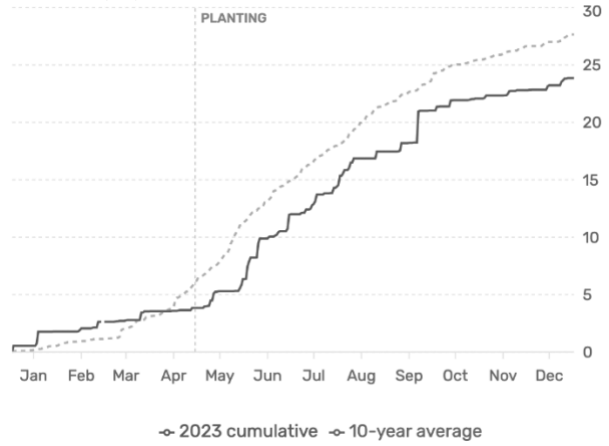
- As-applied rates were close to the target total N rates.
- Due to the lack of yield response to N fertilizer at the rates evaluated, the economic optimum N rate (EONR) could not be calculated. The lowest N rate of 105 lb/ac was able to achieve the same yield as the highest N rate of 225 lb/ac. Testing lower N rates in this field is necessary to determine the EONR response curve.
- The greatest marginal net return was realized for the lowest N rates of 105 and 135 lb/ac. Compared to the grower's standard N rate of 195 lb/ac, applying at the optimum N rate of 105 lb/ac represents a $102/ac increase in profit.
- The lowest N rate of 105 lb/ac resulted in a nitrogen requirement of 0.38 lb N per bushel of grain.
- For comparison, the University of Nebraska-Lincoln N recommendation for corn on this field at an expected yield of 280 bu/ac was 192 lb N/ac, which was 87 lb N/ac higher than the rate that was found to maximize yields in this study.
- By implementing N ramp strips such as the one in this study, growers can evaluate the performance of their N management program with data generated in their fields and capture within-field variability. This specific example shows that farmers can potentially reduce N rate to be more efficient in terms of N and increase profits while reducing the potential environmental impact of N fertilizer.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Determining Economically Optimum Nitrogen Rate on Corn

Study ID: 1255019202302
County: Buffalo
Soil Type: Hord silt loam; Gibbon silt loam
Planting Date: 4/29/23
Harvest Date: 10/10/23
Seeding Rate: 33,992
Row Spacing (in): 30
Hybrid: Dekalb® DKC64-64RIB
Reps: 5
Previous Crop: Corn
Tillage: Stalk chop, strip till
Herbicides: ***Pre:*** 2 qt/ac Degree Xtra®, 3 oz/ac Explorer®, 1% UAN, and 1% COC on 5/5/23 ***Post:*** 30 oz/ac Roundup®, 3 oz/ac Explorer®, 16 oz/ac 4L atrazine, 8 oz/ac Tough® 5EC, 8.5 lb/ac AMS, and 1% COC on 6/8/23
Seed Treatment: None

Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: Pivot, irrigation contains 21 ppm nitrate
Rainfall (in):



Soil Samples, 0-6" (5/30/2023)

						---------- Melich III ----------							
pH	BpH	OM LOI %	Melich-III P ppm	Nitrate lbs/ac	Sulfate -S ppm S	K	Ca	Mg	Na	CEC me/100 g	Sand (%)	Silt (%)	Clay (%)
7.0	7.2	2.6	56	32.6	14.4	197	1276	194	75	8.8	54	36	10
6.5	6.9	2.7	130	29.2	21.3	233	1421	228	89	11.4	48	38	14

Introduction: This study utilized variable-rate nitrogen (N) application technology to evaluate N rates. A variable-rate prescription was developed to apply blocks of rates approximately 440' long by 90' wide, as shown in the layout at right. The field received a flat rate of 6 gal/ac 10-34-0 on April 16, 2023, through strip-till and 4 gal/ac 10-34-0 plus 12 gal/ac 32% UAN at planting on April 29, 2023, which in total contributed 54 lb N/ac. The N rate trial was applied as 32% UAN on June 15, 2023, at rates of 18, 35, 57, 78, 96, 117, 139, and 156 lb N/ac for total N rates of 74, 92, 113, 134, 152, 173, 195, and 212 lb N/ac. As-applied fertilizer maps were used to evaluate the accuracy of fertilizer application. Yield monitor data were collected at the end of the growing season and post-processed to remove errors. Additionally, yield data points corresponding to areas

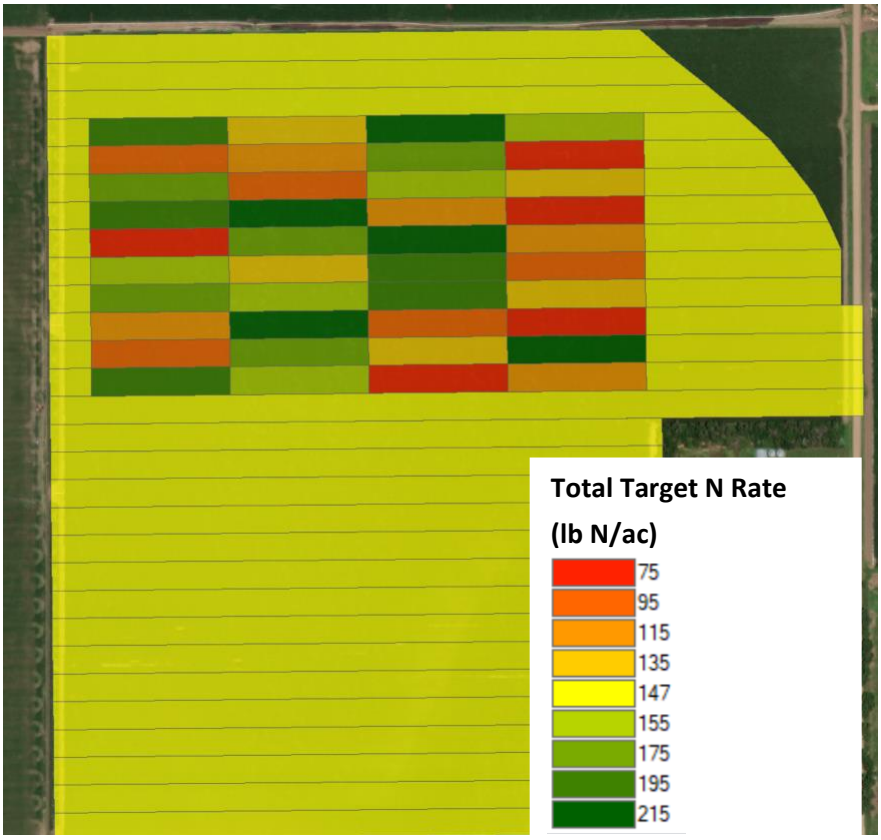


Figure 1. Trial layout with total target nitrogen rates ranging from 75-215 lb N/ac.

where the fertilizer application rate was more than 10% above or below the target rate were eliminated. The field was hailed upon late in the season, but the damage was not severe enough to trigger an insurance claim.

Results:

Target Total N Rate (lb N/ac)	As-Applied N Rate from Sidedress Application (lb/ac)	Total As-Applied N Rate From All Sources (lb/ac)	Yield (bu/ac)†	lb N/bu grain	Marginal Net Return‡ ($/ac)
74	23.5	78 E*	258 A	0.30 E	1,474 A
92	36.1	91 DE	265 A	0.34 E	1,506 A
113	56.6	112 D	263 A	0.43 D	1,481 A
134	84.4	141 C	263 A	0.54 C	1,466 A
152	104.0	160 B	263 A	0.61 B	1,450 A
173	107.3	164 B	269 A	0.61 B	1,483 A
195	120.7	177 AB	266 A	0.67 AB	1,458 A
212	139.8	196 A	271 A	0.72 A	1,476 A
P-Value	---	<0.0001	0.168	<0.0001	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 corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn and $0.65/lb N.

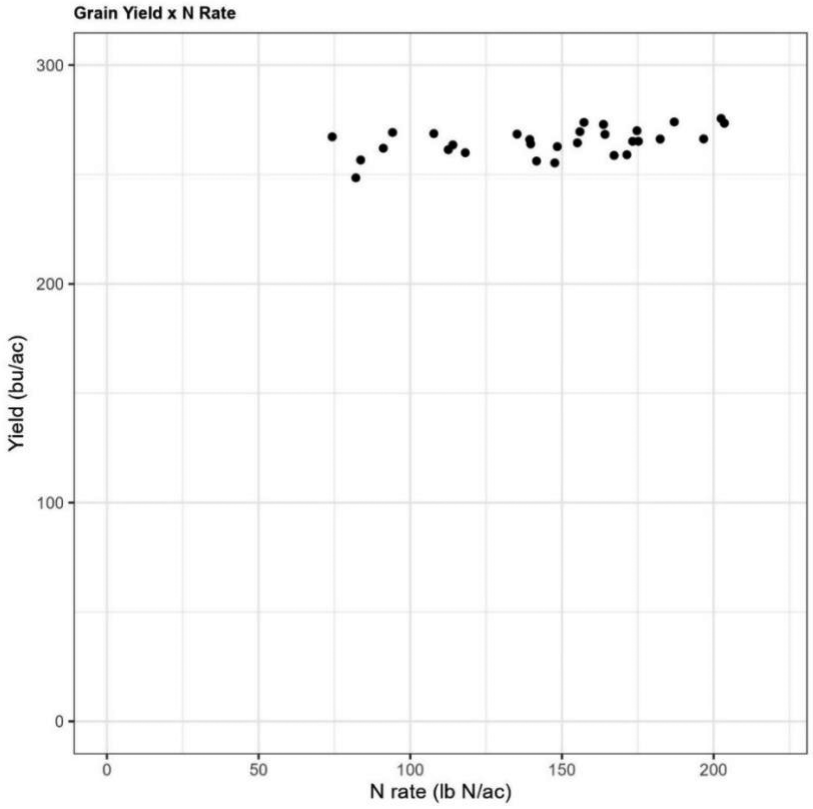


Figure 2. Observed corn yield at total nitrogen rates ranging from 78 to 196 lb N/ac.

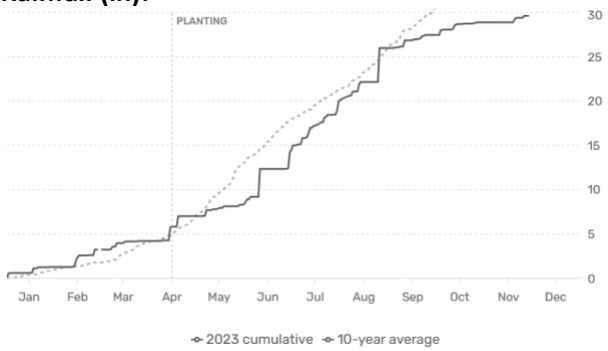
Summary:

- As-applied N rate for the sidedress treatment was lower than targeted at the higher prescribed N rates. This led to differences in the as-applied N rate compared to the target rate.
- Due to the lack of yield response to N fertilizer at the rates evaluated, the economic optimum N rate could not be calculated. The lowest treatment with a total as-applied N rate of 78 lb N/ac yielded as well as the highest treatment with a total as-applied N rate of 196 lb N/ac. Testing lower N rates in this field is necessary to determine the economic optimum N rate.
- For comparison, the University of Nebraska-Lincoln N recommendation for corn on this field for a yield goal of 270 bu/ac was 164 lb N/ac, which was 86 lb N/ac higher than the lowest rate that was found to maximize yields in this study.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Determining Economically Optimum Nitrogen Rate on Corn

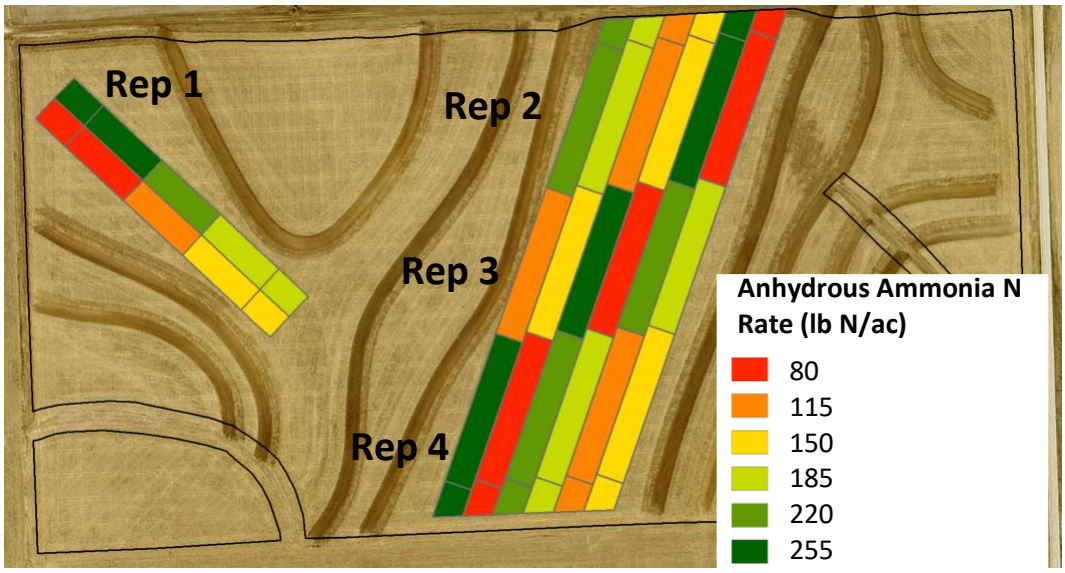
Study ID: 1252025202301
County: Cass
Soil Type: Marshall silty clay loam 2-6% slopes, eroded; Marshall silty clay loam 2-6% slopes.
Planting Date: 4/15/23
Harvest Date: 11/5/23
Seeding Rate: 32,000 seeds/acre
Row Spacing (in): 30
Hybrid: Dekalb® DKC66-06RIB
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 75 oz/ac Harness® MAX, 32 oz/ac Atrazine 4L, 22 oz/ac Roundup PowerMAX® 3, 6.4 oz/ac 2,4-D LV6, and 8 oz/ac Efficax® on 5/7/23
Seed Treatment: Standard treatment
Foliar Insecticides: None
Foliar Fungicides: 13.7 oz/ac Trivapro® applied aerially on 7/18/23
Fertilizer: 15 lb/ac sulfur as ATS on 5/7/23; 285 lb/ac MAP and 147 lb/ac potash VR applied according to grid sampling in February 2022
Irrigation: None
Rainfall (in):



Soil Samples, 0-6" (11/21/2022)

pH	BpH	OM LOI %	Melich-III P ppm	NO3 lb/ac	NH4 lb/ac	Sulfate-S ppm S	-------Melich III------- K	Ca	Mg	Na	CEC me/100g	Sand (%)	Silt (%)	Clay (%)
6.3	6.9	3.7	25	3	4	5.5	183	1775	205	8	12.5	17	56	27
6.6	7.2	3.9	30	8	4	5.8	250	1976	181	7	12.1	19	54	27
6.3	6.7	3.7	29	6	3	6.0	147	1649	205	7	13.1	19	56	25

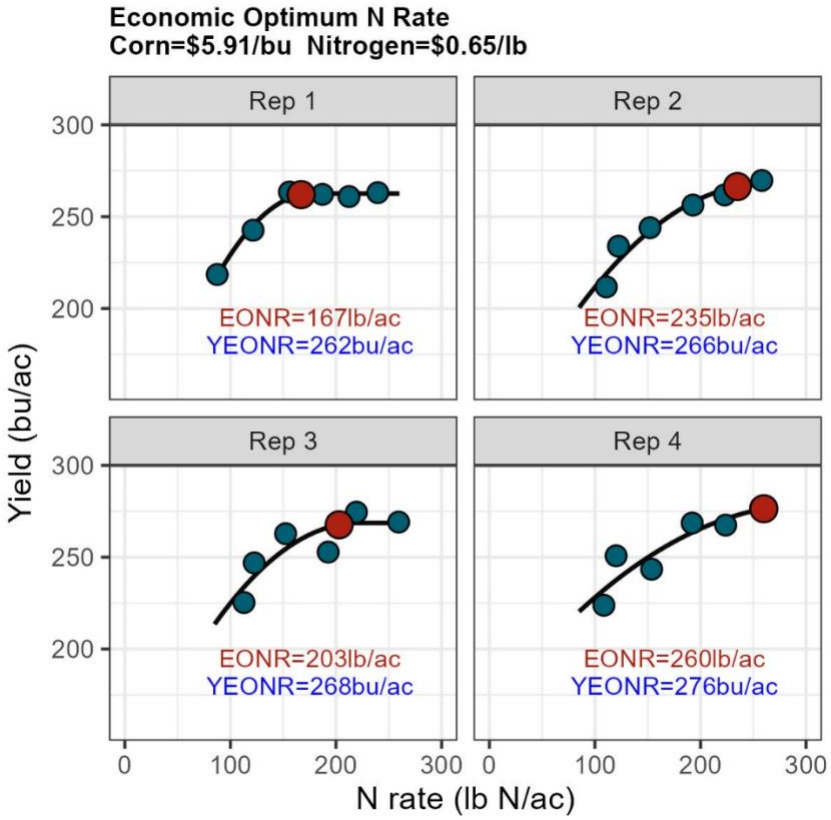
Introduction: This study utilized variable-rate nitrogen application technology to evaluate nitrogen rates. A variable-rate nitrogen prescription was developed to apply blocks of nitrogen rates approximately 200' to 380' long by 70' wide, as shown in the layout below. Nitrogen was applied as anhydrous ammonia on November 23, 2022, at 80, 115, 150, 185, 220, and 255 lb N/ac rates. As-applied fertilizer maps were used to evaluate the accuracy of fertilizer application. The field also received a flat rate of ammonium thiosulfate (ATS) with the pre-emerge herbicide application, which contributed 7 lb N/ac, for total N rates of 87, 122, 157, 192, 227, and 262 lb N/ac. Yield monitor data was collected at the end of the growing season and post-processed to remove errors. Additionally, yield data points corresponding to areas where the fertilizer application rate was more than 10% above or below the target rate were eliminated. The economic optimum nitrogen rate (EONR) was calculated.



Results:

Target N Rate from Anhydrous Ammonia (lb/ac)	Actual As-Applied Rate (Anhydrous Ammonia) + ATS Nitrogen Credits (lb N/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
87 lb N/ac	105 F	220 D	1,210 B
122 lb N/ac	122 E	244 C	1,336 A
157 lb N/ac	154 D	253 BC	1,367 A
192 lb N/ac	191 C	260 AB	1,374 A
227 lb N/ac	220 B	266 AB	1,387 A
262 lb N/ac	254 A	270 A	1,379 A
P-Value	<0.0001	<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 were corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn and $0.65/lb N.



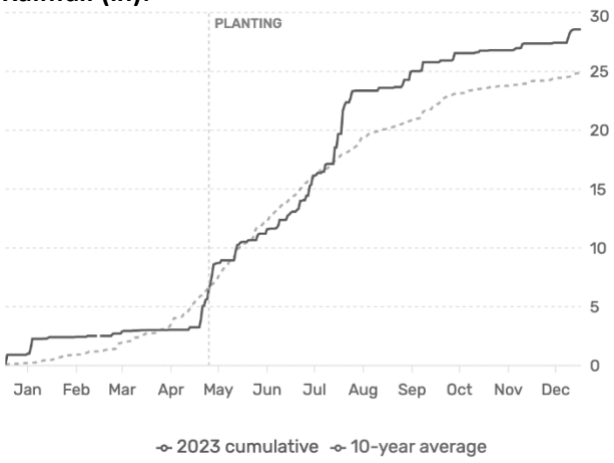
Summary:

- Traditionally, farmers have applied a single N rate across a field without accounting for field variability. In this particular experiment, the EONR ranged from 167 lb N/ac for replication 1 in the northwest part of the field to 260 lb N/ac (replication 4 in the south-central part of the field) and resulted in yields (YEONR) of 262 bu/ac to 276 bu/ac. The wide range of EONR observed indicates that variable-rate nitrogen may be beneficial in this field. For reference, with an expected yield of 270 bu/ac, the University of Nebraska-Lincoln N recommendation for the field ranged from 195 to 198 lb N/ac.
- Nitrogen efficiency at EONR ranged from 0.64 to 0.94 lb N/bu of grain.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Evaluating Nitrogen Rates for Corn Silage

Study ID: 1523111202301
County: Lincoln
Soil Type: Holdrege silt loam; Hersh fine sandy loam
Planting Date: 5/9/23
Harvest Date: 9/13/23-9/14/23
Seeding Rate: 32,000
Row Spacing (in): 30
Hybrid: Brevant® B03R87AM™
Reps: 3
Previous Crop: Oats
Tillage: Strip-till
Herbicides: ***Pre:*** None ***Post:*** Roundup®, Laudis®, Outlook® 2, Class Act®, Aatrex® 4L, and Sterling Blue® 2 on 6/12/23
Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: None
Note: Hail events on 7/14/23 and 7/24/23
Irrigation: Pivot, Total: 9"
Rainfall (in):



Introduction: This study evaluated the impact of additional nitrogen fertilizer on corn silage. The growers wanted to test whether N fertilization was falling short and used a SPAD meter to test it. The grower's standard management is 15 lb/ac of N at planting as 10-34-0, 10-0-0-26S, 0-0-25-17S (KTS), 8 gal Invictus®, and 12.28 gal CHE PLEX 95%. An additional 90 lb/ac N was applied as fertigation, split over three applications (June 11, June 26, and July 24, 2023). The study evaluated the addition of N in reference plots as urea broadcasted in between 30-inch rows on July 7, 2023, at V9 stage. Four N rates were evaluated (27 lb/ac, 54 lb/ac, 80 lb/ac, and 107 lb/ac) in addition to the grower's standard practice. SPAD meter readings were taken on the date of the application of treatments and 14 days after application. In each of the small treatment plots, 5 plants were harvested by hand on September 13, 2023 to quantify the yield, and moisture content. A small representative sample (1.1 lb) was collected and placed in a bag and then brought to the laboratory to assess silage quality in terms of moisture content (MC), dry matter (DM), crude protein (CP), acid detergent fiber (ADF), Neutral Detergent Fiber (NDF), and total digestible nutrients (TDN).

Results:

	SPAD reading (7/7/2023)	SPAD reading (7/21/2023)
0 lb N/ac	55.2 A*	45.1 A
27 lb N/ac	56.6 A	46.0 AB
54 lb N/ac	56.2 A	47.3 ABC
80 lb N/ac	56.2 A	47.5 C
107 lb N/ac	55.9 A	48.3 C
P-Value	0.866	0.021

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

	MC^ (%)	DM (%)	CP (%)	ADF (%)	NDF (%)	TDN (%)
0 lb N/ac	71.1 A*	28.9 A	7.8 A	35.7 A	59.9 A	62.8 A
27 lb N/ac	71.6 A	28.4 A	7.5 A	40.1 A	67.1 A	59.8 A
54 lb N/ac	70.0 A	29.9 A	7.5 A	36.7 A	62.3 A	62.1 A
80 lb N/ac	71.1 A	28.9 A	8.2 A	38.5 A	64.4 A	60.9 A
107 lb N/ac	71.0 A	29.0 A	7.2 A	38.3 A	64.3 A	61.0 A
P-Value	0.895	0.895	0.870	0.735	0.711	0.738

*Values with the same letter are not significantly different at a 90% confidence level.
^Silage quality includes moisture content (MC), dry matter (DM), crude protein (CP), acid detergent fiber (ADF), Neutral Detergent Fiber (NDF), and total digestible nutrients (TDN) in dry weight basis.

	Moisture (%)	Yield (ton/ac)†	Marginal Net Return‡ ($/ac)
0 lb N/ac	64.9 A*	9.2 A	459 A
27 lb N/ac	65.2 A	8.9 A	428 A
54 lb N/ac	63.4 A	8.8 A	409 A
80 lb N/ac	63.8 A	10.3 A	464 A
107 lb N/ac	64.4 A	9.4 A	405 A
P-Value	0.493	0.154	0.185

*Values with the same letter are not significantly different at a 90% confidence level.
†Ton per acre was dry weight basis.
‡Marginal net return based on $50/ton for silage and $0.61/lb N.

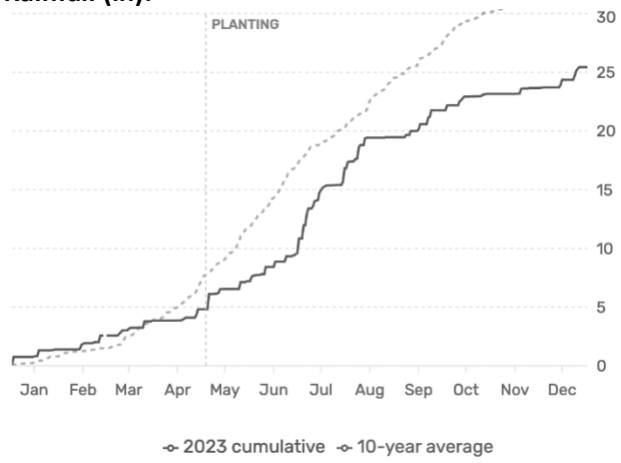
Summary:

- The additional nitrogen fertilizer showed an increase in SPAD readings between the 0 lb/ac-nitrogen rate and the highest N rate applied.
- However, there was no statistical difference between yield, silage quality, or net return compared to the grower's standard practice.

Evaluating Sidedress Nitrogen Rates on Gravity-Irrigated Corn

Study ID: 0085141202302
County: Platte
Soil Type: Grigston silt loam wet sub-stratum
Planting Date: 5/3/23
Harvest Date: 10/23/23
Seeding Rate: 36,000
Row Spacing (in): 30
Hybrid: Dekalb® DKC62-69
Reps: 4
Previous Crop: Corn
Tillage: Conventional Till

Irrigation: Gravity
Rainfall (in):



UNL suggested N-Rate: 222 lb N/ac based on a yield estimate of 250 lb/ac, 2.2% organic matter, 15 in. total irrigation, and 8 ppm of N in the groundwater.

Introduction: This study evaluated the impact of different nitrogen rates at sidedress. All treatments received 57 lb N/ac as urea on April 5, 2023, 24 lb N/ac at planting (May 3), and 30 lb N/ac pre-emerge.

The treatments were established with the sidedress application on May 27. The total amount of N before sidedress was 111 lb/ac. Three rates were tested:

1) 24 gal/ac resulting in 80 lb N/ac, for a total rate of 191 lb N/ac

2) 30 gal/ac resulting in 100 lb N/ac, for a total rate of 211 lb N/ac

3) 36 gal/ac resulting in 120 lb N/ac, for a total rate of 231 lb N/ac

Results:

	Stand Count (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
80 lb N/ac (total 191 lb N/ac)	34,375 A*	250 B	1,310 A
100 lb N/ac (total 211 lb N/ac)	34,125 A	257 A	1,332 A
120 lb N/ac (total 231 lb N/ac)	34,000 A	258 A	1,319 A
P-Value	0.911	0.026	0.2998

*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 $5.91/bu corn and $0.89/lb N (net return considers all N applied, not just sidedressed rate).

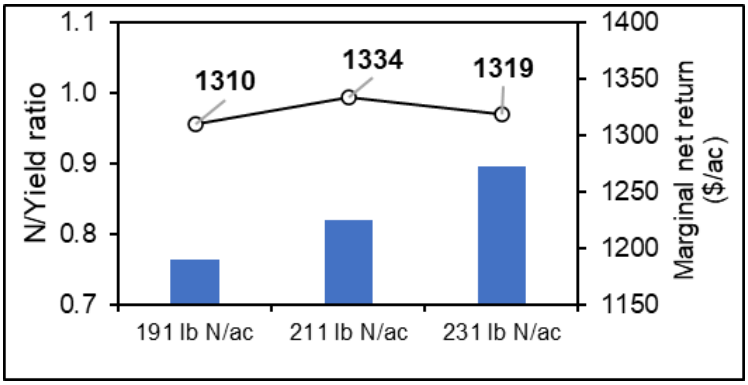


Figure 1. Average nitrogen use efficiency (N/Yield ratio; blue bars) and marginal net return (points) for three nitrogen application rates.

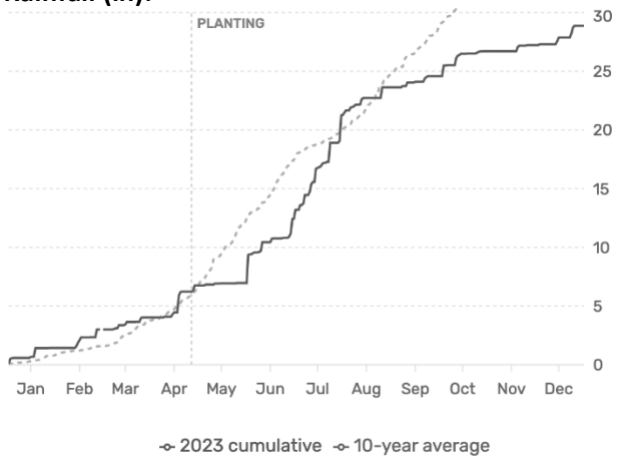
Summary:

- There were no differences in stand counts between the three sidedress rates evaluated.
- Yield was lower (7-8 bu/ac) for the lowest sidedress rate of 80 lb N/ac. There was no yield difference between the highest two sidedress rates, indicating that the 100 lb N/ac sidedress rate was sufficient.
- There were no significant differences in net return between the three sidedress rates evaluated.
- All treatments resulted in N/Yield ratio of less than 1 with larger net return at 100 lb N/ac treatment, suggesting that it is possible to lower N rates and maintain profitability.

Sensor-Based Nitrogen Management on Irrigated Corn

Study ID: 1524155202301
County: Saunders
Soil Type: Tomek silt loam
Planting Date: 4/26/23
Harvest Date: 10/21/23
Seeding Rate: 34,000
Row Spacing (in): 30
Hybrid: Dekalb® DKC63-91RIB
Reps: 5
Previous Crop: Soybean
Tillage: Reduced Tillage
Herbicides: ***Pre:*** 1.6 qt/ac Harness® Xtra and 3 oz/ac Balance® Flex on 5/3/23 ***Post:*** 25.6 oz/ac Class Act®, 32 oz/ac atrazine, 3 oz/ac Laudis®, 22.4 oz/ac Roundup® PowerMAX, 10 oz/ac Superb®, 32 oz/ac Symbol® Release, 2 oz/ac Interlock®, and 8 oz/ac Full Power® on 6/5/23
Seed Treatment: Base Dekalb® treatment

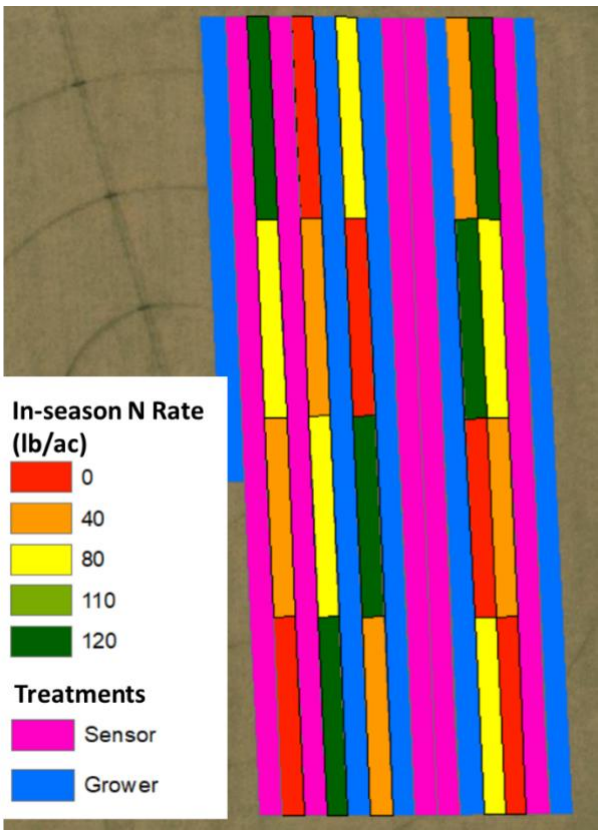
Foliar Insecticides: 4.8 oz/ac Brigade® at 50% brown silk
Foliar Fungicides: 6.4 oz/ac Veltyma® and 2 oz/ac Wetcit® at 50% brown silk
Irrigation: Pivot, Total: 6"
Rainfall (in):



Introduction: Corn nitrogen management may be improved by using sensors or imagery to account for within-field variability and respond to corn nitrogen needs during the growing season. This study used weekly aerial imagery obtained with a multispectral sensor on a quadcopter drone to determine the in-season nitrogen rate. This study compared the grower's standard nitrogen treatment and a sensor-based nitrogen approach while also including a nitrogen rate ramp to determine the economic optimum nitrogen rate (EONR) for the field (after harvest).

Grower Nitrogen Treatment: The field received a target base rate of 100 lb N/ac as anhydrous ammonia on April 7, 2023, and a target flat rate of 110 lb N/ac as 32% UAN on June 27, 2023. The as-applied data showed the average anhydrous ammonia rate was 107 lb N/ac and the average UAN rate was 109 lb N/ac for the grower treatment.

Sensor Nitrogen Treatment: The field had a target base rate of 100 lb N/ac as anhydrous ammonia applied on April 7, 2023. As-applied data showed the average anhydrous ammonia rate was 107 lb N/ac. During the base application, a high N rate strip was also applied at a rate of 200 lb N/ac to serve as a non-N-limiting reference. Aerial imagery was obtained with a multispectral sensor on a quadcopter drone to monitor the crop weekly from V7 to R5 growth stages. The imagery from June 23, 2023, was used to direct the in-season N application using the Holland-Schepers and UNL N algorithms. The sufficiency index was calculated from the aerial imagery and the UNL N algorithm was employed to generate an estimated optimum nitrogen rate input which was required in the Holland-Schepers algorithm. Credits for the anhydrous ammonia and previous crop of soybeans were also taken into consideration in this algorithm.



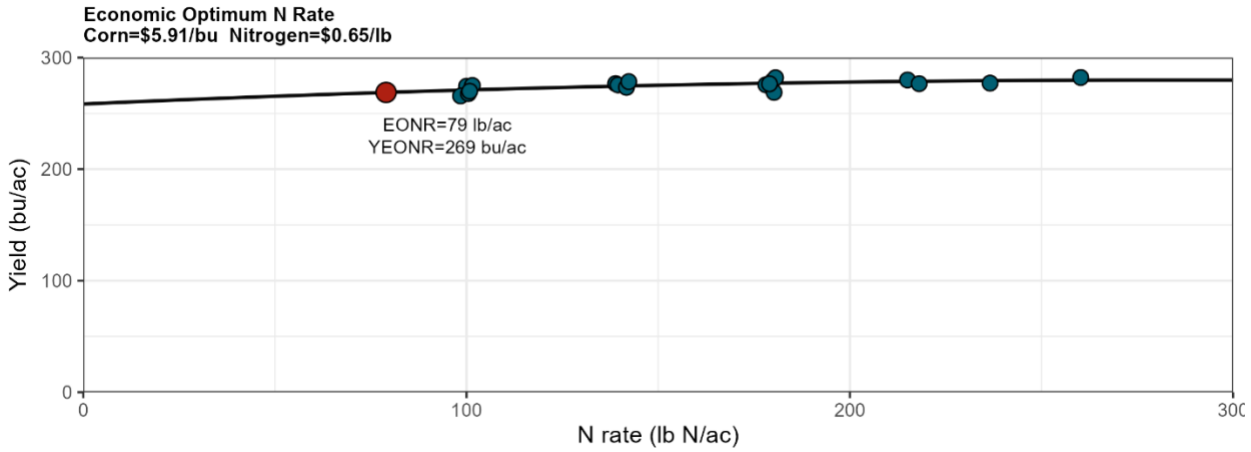
Based on the Holland-Schepers's algorithm, the sensor application called for 32 lb N/ac on all sensor plots. However, to manage risk, the grower determined he wanted a minimum rate of 40 lb N/ac in-season on the sensor-based treatments, more than the sensor recommended rate. Therefore, the in-season application of 40 lb N/ac was applied as 32% UAN on June 27, 2023, using a Hagie STS 12 with a coulter bar. As-applied data showed the average sensor-based in-season application was 41 lb N/ac.

Nitrogen Rate Ramps: During the in-season application, nitrogen rate ramps were also applied, with in-season N rates of 0, 40, 80, and 120 lb N/ac and were used to determine the economic optimum N rate (EONR) for the field to compare with the grower and sensor-based N rates. The treatment layout is shown on opposite page.

Results:

	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	215 A*	14.5 A	275 A	72 B	0.78 A	1,516 B
Sensor	148 B	14.3 B	276 A	105 A	0.54 B	1,561 A
P-Value	<0.0001	0.008	0.369	<0.0001	<0.0001	0.0006

*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 $5.91/bu corn, $0.43/lb N for anhydrous ammonia, and $0.6/lb N for 32% UAN.



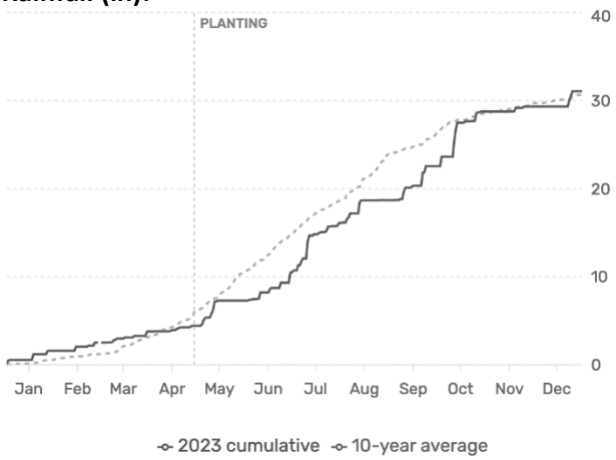
Summary:

- The sensor-based management N rate was 67 lb N/ac lower than the grower's traditional N management.
- There was no yield difference between the grower's traditional N management and the sensor-based management.
- Each unit of N applied by the sensor-based management produced 46% more grain (partial factor productivity of the fertilizer) compared to the grower management.
- Marginal net return was $45/ac greater for the sensor-based N management.
- The EONR calculated for the field was 79 lb N/ac, resulting in a yield of 269 bu/ac. The EONR was 69 lb/ac lower than the sensor-based N rate and 136 lb/ac lower than the grower's traditional N management.
- This on-farm yield experiment shows that by using a sensing technology capable of accounting for within-field and in-season variability, growers can produce corn more efficiently in terms of nitrogen and increase their profits, potentially reducing the environmental impact of N applications.

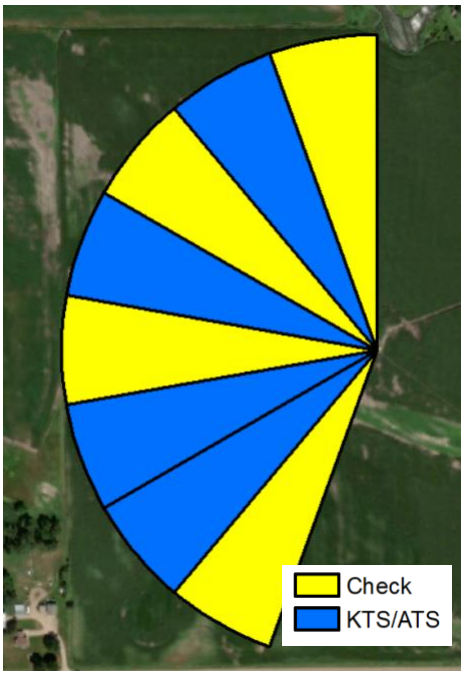
This research was completed as part of the CASNR Highest Distinction undergraduate requirements by student Emily Hanson.

Evaluating Crop Vitality® KTS® and Thiosulfate Fertilizers on V3 Soybeans

Study ID: 1256139202301
County: Pierce
Soil Type: Leshara silt loam; occasionally flooded
Planting Date: 4/29/23
Harvest Date: 9/29/23
Seeding Rate: 140,000
Row Spacing (in): 15
Variety: Pioneer® P20A22X
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** Afforia® and Enlite® on 4/17/23 ***Post:*** XtendiMax®, Intensity, and Roundup PowerMAX® 3 on 6/7/23
Seed Treatment: Standard Pioneer® seed treatment
Foliar Insecticides: None
Foliar Fungicides: Approach® at R1, Trivapro® at R3, and Brixen® at R4
Fertilizer: Hog effluent 3 years ago
Irrigation: Pivot, Total: 9"
Rainfall (in):



Introduction: The objective of this study was to evaluate the impact of V3 growth stage fertigation application on soybeans. The fertilizer treatment was a blend of 80% Crop Vitality® KTS® (potassium thiosulfate) with 20% ammonium thiosulfate (ATS). Treatment replications were applied as sectors through the pivot, as shown in the layout diagram at right. Yield and net return were evaluated.



Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	84 A*	1,161 A
80% KTS/20% ATS	85 A	1,116 B
P-Value	0.626	0.067

*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 $13.76/bu soybean and $54/ac for the fertilizer treatment.

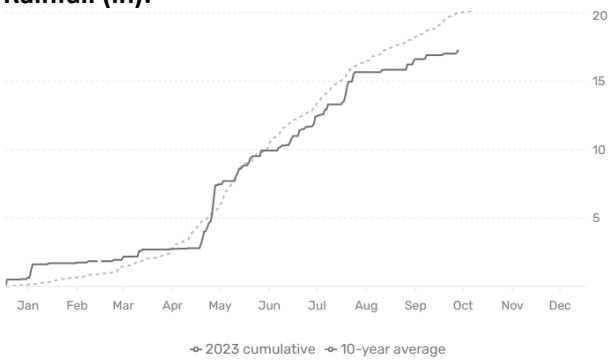
Summary:

- The addition of fertilizer via fertigation did not result in a yield increase compared to the untreated check.
- The marginal net return was $45/ac lower for the fertilizer treatment due to the cost of the product.

Sensor-based Nitrogen Management on Winter Wheat (21135S)

Study ID: 1398135202301
County: Perkins
Soil Type: Keith silt loam, 1-3 % slopes; Kuma silt loam, 1-3% slopes; Lodgepole silt loam, frequently ponded; Satanta very fine sandy loam, 1-3% slopes; Satanta very fine sandy loam, 3-6% slopes; Woodly fine sandy loam, 0-3% slopes; Woodly loamy fine sand, 0-3% slopes; Valent loamy sand, 3-9% slopes; Sarben loamy very fine sand, 6-9% slopes
Planting Date: 9/24/22
Harvest Date: 7/12/23
Seeding Rate: 90 lbs/acre
Row Spacing (in): 6
Variety: WestBred® Grainfield
Reps: 6
Previous Crop: Soybeans
Tillage: Turbo Till

Herbicides: ***Post:*** 0.1 oz/ac Patriot® and 5.3 oz/ac 2,4-D LV6 on 4/24/23
Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: None
Rainfall (in):



Soil Tests (April 18, 2023), 0-24"

							-------Melich III-------							
Depth	pH	BpH	OM	Nitrate -N	Melich P1	K	Ca	Mg	Na	S	CEC	Sand	Silt	Clay
in	1:1		LOI%	N ppm	ppm	ppm	ppm	ppm	ppm	ppm	me/100g	%	%	%
0-6	5.2	6.6	2.0	21.3	72.3	519	782	152	6.3	6.0	10.6	60.3	23.0	16.7
6-12	5.6	6.7	1.7	13.1	31.3	338	1357	235	7.7	2.5	12.1	56.7	24.0	19.3
12-18	6.3	7.0	1.8	13.2	19.7	284	1738	305	7.3	1.8	12.4	54.7	24.7	20.6
18-24	6.9	7.0	1.3	7.5	26.0	305	2017	324	8.0	1.9	13.9	56.3	24.3	19.4

Introduction: This study evaluated a sensor-based N management strategy for winter wheat compared to the grower's traditional N management. The experiment was arranged in a randomized complete block design with six replications of two treatments (Figure 1). The entire field received a two-by-two method application of urea, MAP, and Zn 36% at planting resulting in 39 lb N/ac. Soybeans failed to contribute N credits due to inadequate growth.

Treatments: The sensor-based N management strategy was compared to the grower's N management.

- *Grower's N management:* 36 lb N/ac was applied as 32% UAN at green-up on April 18th, 2023, for a total N rate of 75 lb N/ac.
- *Sensor-based N management (SENSE):* Crop canopy sensing and application occurred on April 18, 2023, with a high-clearance applicator equipped with Ag Leader® OptRx® sensors. UAN fertilizer was applied as the crop canopy was sensed (at jointing), with an average of 32 lb N/ac (ranging from 20 lb N/ac to 47 lb N/ac) recommended for a total of 71 lb N/ac. This method required a high N rate as reference at planting.
- *N rate ramps:* At the April 18 application date, two sets of six N rates were applied with N rates ranging from 0 to 100 lb N/ac, for total rates ranging from 39 to 139 lb N/ac (Figure 1). These N rate ramps were used to determine the observed economic optimum nitrogen rate (EONR data not shown).

As-applied fertilizer maps were used to evaluate the accuracy of fertilizer application, and only areas with high accuracy were included in the analysis. Hand samples were collected at harvest to determine grain protein. This field had a poor stand due to drought conditions which also affected grain yield.

Figure 1. Treatment layout with grower, sensor-based (SENSE), and nitrogen rate blocks (N_Ramp) with increasing N rates.

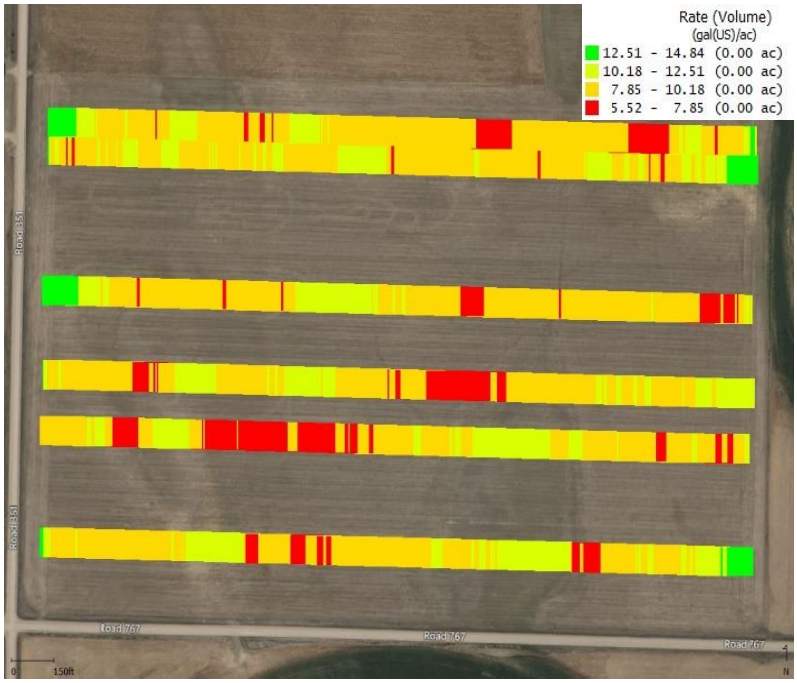


Figure 2. Nitrogen application prescription for sensor-based management applied on April 18, 2023. Note: 1 gallon of 32% UAN solution is equivalent to 3.54 lb of N.

Results:

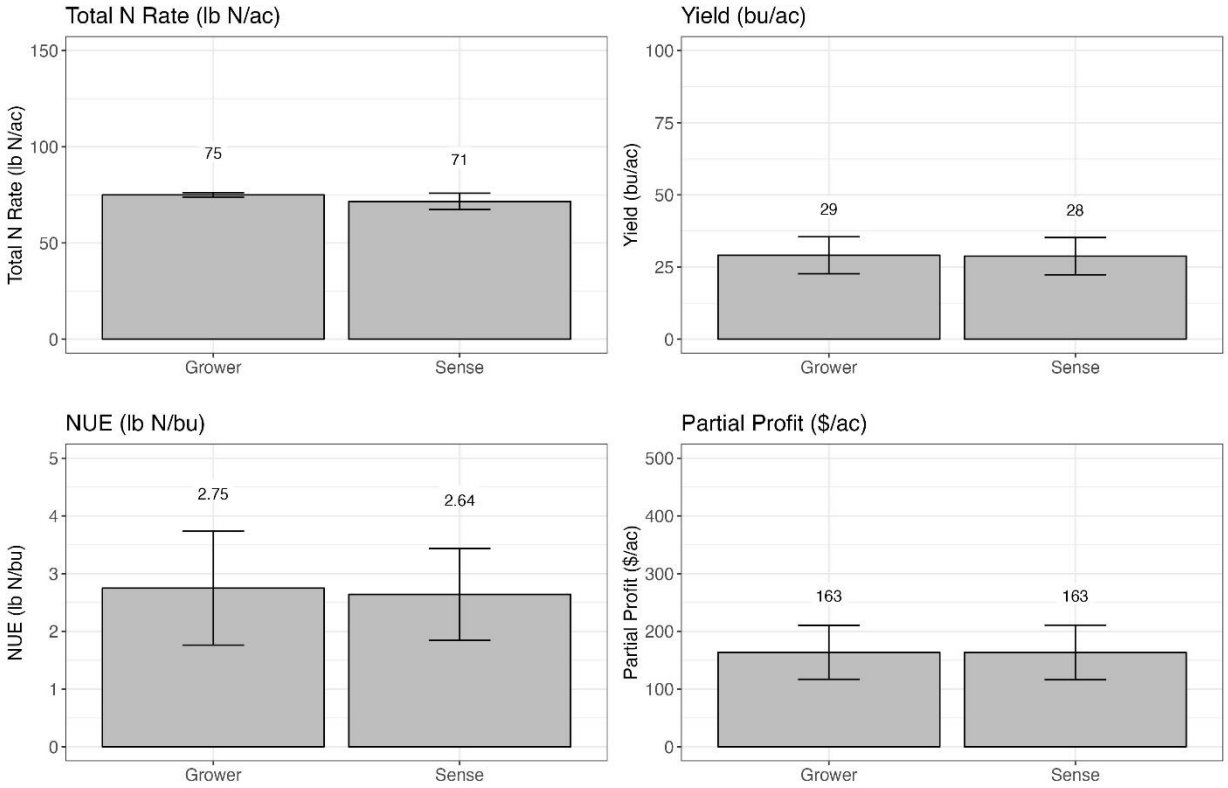


Figure 3. Total N rate, yield, nitrogen efficiency, and partial profit for the grower's and sensor-based N (SENSE) management. Vertical bars represent the standard deviation of the mean. Averages reported are means of all observations and will not be identical to the results in the table below, which are summarized first by replication. Partial profit calculations presented do not include the cost of the technologies used. To make this information relevant to your operation, technology upgrade costs should be considered.

	Total N rate (lb/ac)	Yield (bu/ac)†	Protein (%)	Nitrogen Efficiency (lb N/bu grain)	Partial Profit‡ ($/ac)
Grower N Management	75 *A	29 A	17.8 A	2.72 A	164 A
Sensor-based N Management	71 B	28 A	17.6 A	2.64 A	163 A
P-Value	<0.001	0.284	0.727	0.224	0.636

*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 were corrected to 13.5% moisture.
‡Marginal net return based on $7.30/bu wheat and $0.65/lb N.

Summary:

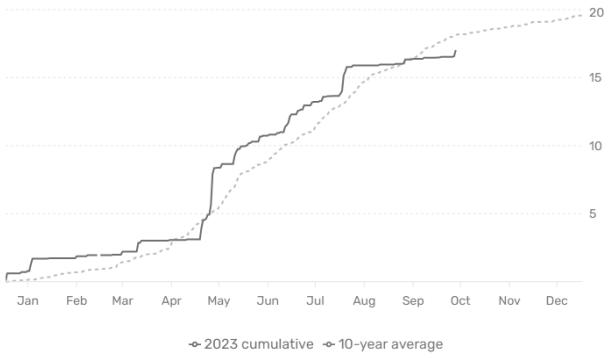
- The sensor-based approach recommended rates of N ranging from 20 lb N/ac to 47 lb N/ac to account for field variability as detected by the crop canopy sensors.
- The sensor-based approach recommended 4 lb N/ac less than the grower's traditional management with no differences in grain yield. Yields were low due to poor stands and drought conditions.
- Nitrogen efficiency and partial profits were not different between the sensor-based approach and the grower's traditional management.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Sensor-based Nitrogen Management on Winter Wheat (22835NE)

Study ID: 1398135202302
County: Perkins
Soil Type: McCash very fine sandy loam, 0-1% slopes; McCash very fine sandy loam, 1-3% slopes; Jayem loamy very fine sand, 0-3% slopes; Sarben loamy very fine sand, 0-3% slopes; Sarben loamy very fine sand, 3-6% slopes
Planting Date: 9/26/22
Harvest Date: 7/18/23
Seeding Rate: 90 lbs/acre
Row Spacing (in): 6
Variety: WestBred® Grainfield
Reps: 7
Previous Crop: Fallow
Tillage: Turbo Till on 9/15/22
Herbicides: ***Post:*** 0.1 oz/ac Patriot® and 5.3 oz/ac 2,4-D LV6 on 4/19/23

Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: None
Rainfall (in):



Soil Tests (April 18th, 2023), 0-24"

						-------Melich III-------								
Depth	pH	BpH	OM	Nitrate -N	Melich	K	Ca	Mg	Na	S	CEC	Sand	Silt	Clay
in	1:1		LOI%	N ppm	P1 ppm	ppm	ppm	ppm	ppm	ppm	me/100g	%	%	%
0-6	5.6	6.6	1.3	8.6	58.0	440	831	165	6.3	4.9	10.9	71.3	17.0	11.7
6-12	6.1	6.9	1.2	12.1	18.7	254	1319	235	8.3	1.5	11.0	70.7	15.6	13.7
12-18	6.1	6.9	1.4	8.9	29.3	274	1344	249	7.7	2.3	11.6	68.3	16.7	15.0
18-24	6.8	7.1	0.9	7.0	23.7	253	1776	317	8.7	2.0	12.9	68.3	17.4	14.3

Introduction: This study evaluated a sensor-based N management strategy for winter wheat compared to the grower's traditional N management. The experiment was arranged in a randomized complete block design with seven replications of two treatments (Figure 1). The entire field received a two-by-two method application of urea, MAP, and Zn 36% (zinc sulfate) at planting resulting in 39 lb N/ac.

Treatments: The sensor-based N management strategy was compared to the grower's N management.

- *Grower's N management:* 35 lb N/ac was applied as 32% UAN at green-up on April 18, 2023, for a total N rate of 74 lb N/ac.
- *Sensor-based N management (SENSE):* Crop canopy sensing and application occurred on April 18, 2023, with a high-clearance applicator equipped with Ag Leader® OptRx® sensors. UAN fertilizer was applied as the crop canopy was sensed (at jointing), with an average of 29 lb N/ac (ranging from 19 lb N/ac to 45 lb N/ac) recommended for an average total of 68 lb N/ac. This method required a high N rate as reference at planting.
- *N rate ramps:* At the April 18 application date, three sets of six N rates were applied with N rates ranging from 0 to 100 lb N/ac, for total N rates of 39 to 139 lb N/ac (Figure 1). These N rate ramps were used to determine the observed economic optimum nitrogen rate (EONR data not shown).

As-applied fertilizer maps were used to evaluate the accuracy of fertilizer application, and only areas with high accuracy were included in the analysis. Hand samples were collected at harvest to determine grain protein.

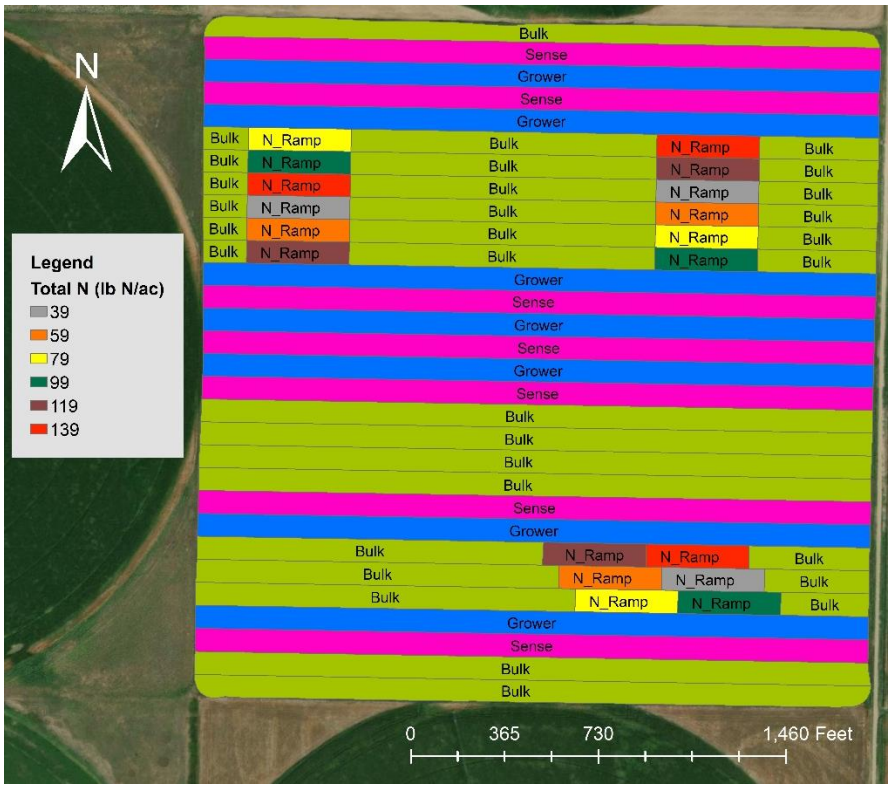


Figure 1. Treatment layout with grower, sensor-based (SENSE), and nitrogen rate blocks (N_Ramp) with increasing N rates.

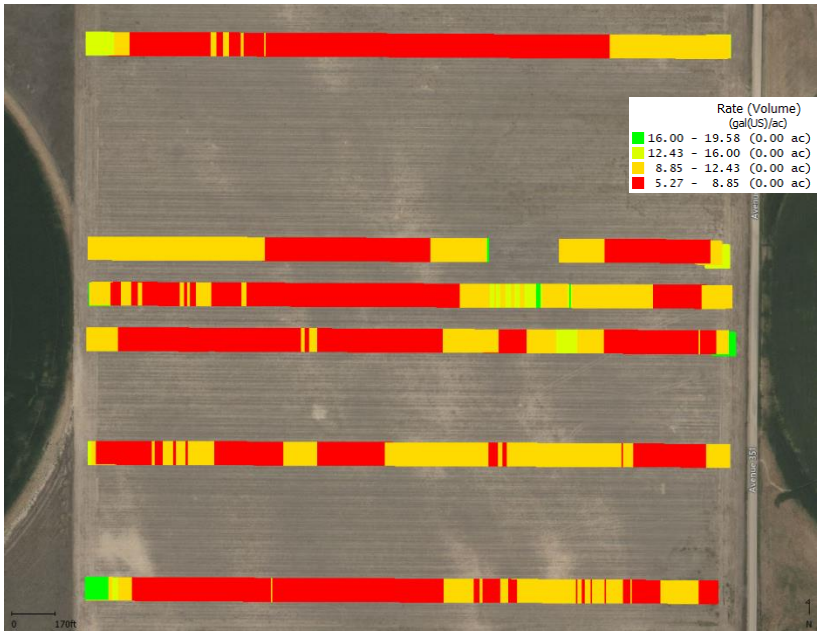


Figure 2. Nitrogen application prescription for sensor-based management applied on April 18, 2023. Note: 1 gallon of 32% UAN solution is equivalent to 3.54 lb of N.

Results:

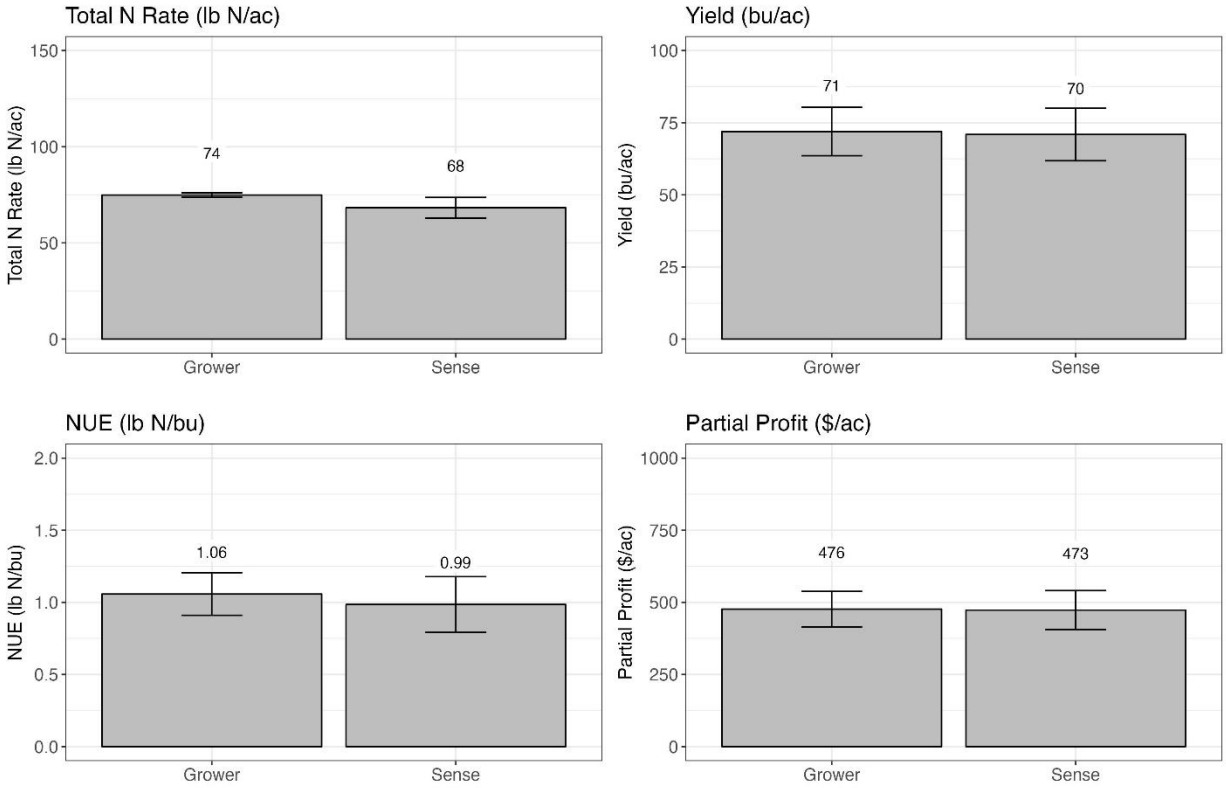


Figure 3. Total N rate, yield, nitrogen efficiency, and partial profit for the grower's and sensor-based N management. Vertical bars represent the standard deviation of the mean. Averages reported are means of all observations and will not be identical to the results in the table below, which are summarized first by replication. Partial profit calculations presented do not include the cost of the technologies used. To make this information relevant to your operation, technology upgrade costs should be considered.

	Total N rate (lb/ac)	Yield (bu/ac)†	Protein (%)	Nitrogen Efficiency (lb N/bu grain)	Partial Profit‡ ($/ac)
Grower N Management	74 A*	72 A	13.8 A	1.06 A	477 A
Sensor-based N Management	68 B	71 A	13.9 A	0.99 B	474 A
P-Value	<0.01	0.362	0.834	<0.01	0.688

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13.5% moisture.
‡Marginal net return based on $7.30/bu wheat and $0.65/lb N.

Summary:

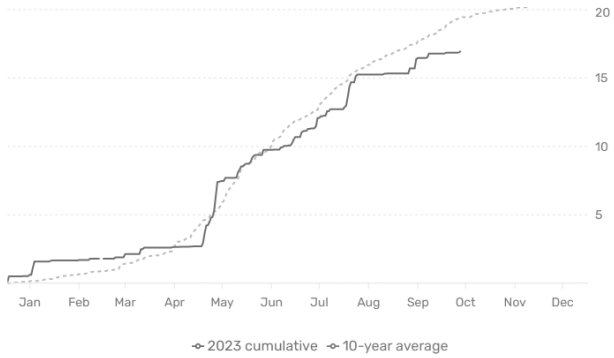
- The sensor-based approach recommended different rates of N (ranging from 19 lb N/ac to 45 lb N/ac) accounting for field variability, with higher rates where they were needed and lower rates where the crop index indicated a crop closer to the no limiting N.
- Average total N was lower for the sensor-based N management (within 6 lb/ac), resulting in greater N efficiency with no yield penalty.
- There was no difference in yield or partial profit.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Sensor-based Nitrogen Management on Winter Wheat (361235S)

Study ID: 1398135202303
County: Perkins
Soil Type: Lodgepole silt loam, frequently ponded; Satanta very fine sandy loam, 1-3% slopes; Woodly fine sandy loam, 0-3% slopes; Woodly loamy fine sand, 0-3% slopes; Valent loamy sand, 0-3% slopes; Valent loamy sand, 3-9% slopes; Valent sand, rolling
Planting Date: 9/24/22
Harvest Date: 7/12/23
Seeding Rate: 90 lbs/acre
Row Spacing (in): 6
Variety: WestBred® Grainfield
Reps: 9
Previous Crop: Fallow
Tillage: Turbo Till
Herbicides: ***Post:*** 0.1 oz/ac Patriot® and 5.3 oz/ac 2,4-D LV6 on 4/24/23

Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: None
Rainfall (in):



Soil Tests (April 18th, 2023), 0-24"

					-------Melich III-------									
Depth	pH	BpH	OM	Nitrate -N	Melich	K	Ca	Mg	Na	S	CEC	Sand	Silt	Clay
in	1:1		LOI%	N ppm	P1 ppm	ppm	ppm	ppm	ppm	ppm	me/100g	%	%	%
0-6	5.0	6.5	1.4	11.6	76.3	408	620	134	6.7	4.2	10.4	72.3	18	9.7
6-12	5.7	6.8	1.4	8.1	30.3	247	1256	228	7.0	2.7	11.0	64.7	21.6	14.3
12-18	6.6	7.0	1.3	7.4	21.0	232	1688	306	8.3	2.1	12.0	61.3	22.4	16.3
18-24	7.2	7.2	1.1	6.7	23.7	276	1879	312	7.7	1.7	12.7	64.7	21.0	14.3

Introduction: This study evaluated a sensor-based N management strategy for winter wheat compared to the grower's traditional N management. The experiment was arranged in a randomized complete block design with nine replications of two treatments (Figure 1). The entire field received a two-by-two method application of urea, MAP, and Zn 36% (zinc sulfate) at planting, resulting in 19 lb of N/acre.

Treatments: The sensor-based N management strategy was compared to the grower's N management.

- *Grower's N management:* 60 lb N/ac was applied as 32% UAN at green-up on April 18, 2023, for a total N rate of 79 lb N/ac.
- *Sensor-based N management (SENSE):* Crop canopy sensing and application occurred on April 18, 2023, with a high-clearance applicator equipped with Ag Leader® OptRx® sensors. UAN fertilizer was applied as the crop canopy was sensed (at jointing), with an average of 46 lb N/ac (ranging from 30 lb N/ac to 84 lb N/ac) recommended for an average total of 65 lb N/ac. This method required a high N rate as reference at planting.
- *N rate ramps:* At the April 18 application date, three sets of four N rates were applied with N rates ranging from 0 to 120 lb N/ac, for total N rates of 19 to 139 lb N/ac (Figure 1). These N rate ramps were used to determine the observed economic optimum nitrogen rate (EONR data not shown).

As-applied fertilizer maps were used to evaluate the accuracy of fertilizer application, and only areas with high accuracy were included in the analysis. Hand samples were collected at harvest to determine grain protein.

Figure 1. Treatment layout with grower, sensor-based, and nitrogen rate blocks (N_Ramp) with increasing N rates.

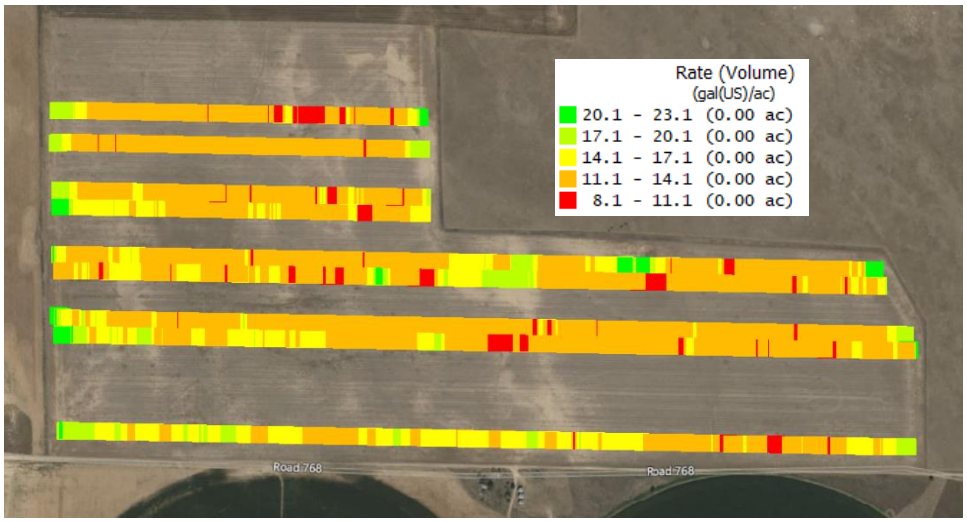


Figure 2. Nitrogen application prescription for sensor-based management (SENSE) applied on April 18, 2023. Note: 1 gallon of 32% UAN solution is equivalent to 3.54 lbs of N.

Results:

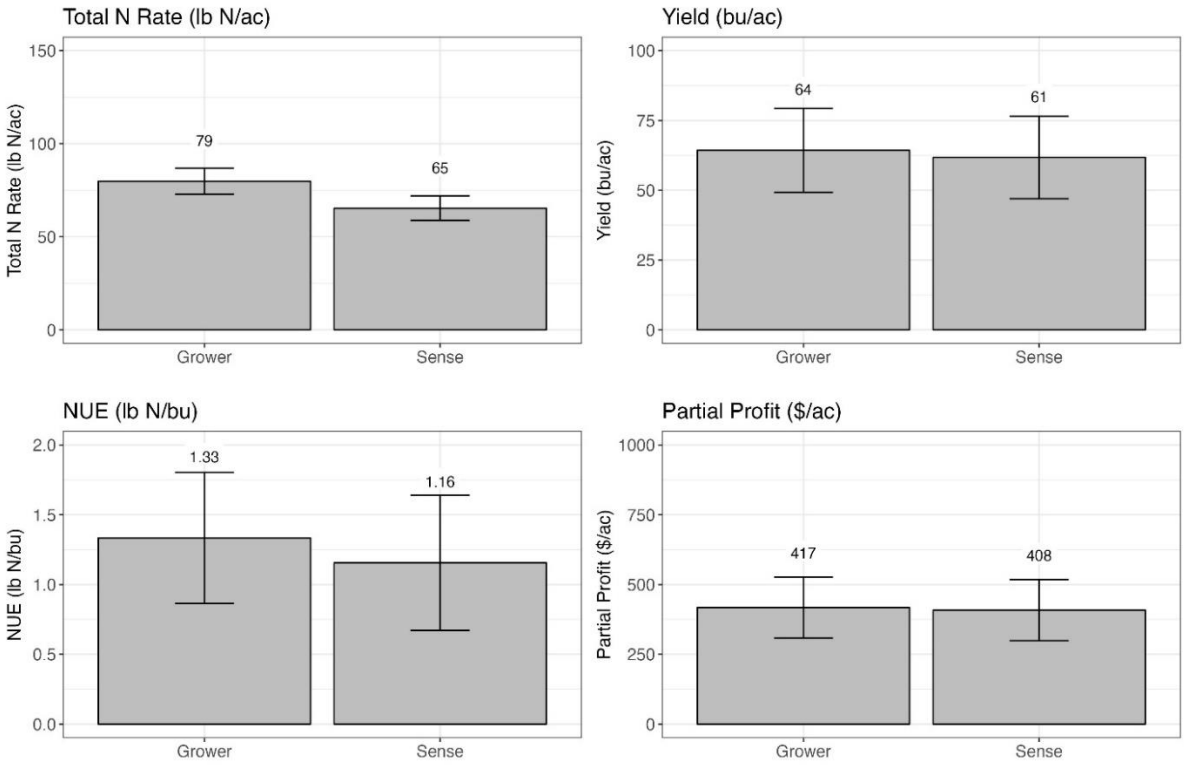


Figure 3. Total N rate, yield, nitrogen efficiency, and partial profit for the grower's and sensor-based N management (SENSE). Whiskers represent the standard deviation of the mean. Averages reported are means of all observations and will not be identical to the results in the table below, which are summarized first by replication. Partial profit calculations presented do not include the cost of the technologies used. To make this information relevant to your operation, technology upgrade costs should be considered.

	Total N rate (lb/ac)	Yield (bu/ac)†	Protein (%)	Nitrogen Efficiency (lb N/bu grain)	Partial Profit‡ ($/ac)
Grower N Management	79 *A	64 A	13.4 A	1.33 A	418 A
Sensor-based N Management	65 B	62 B	14.0 A	1.13 B	414 A
P-Value	<0.01	<0.10	0.625	<0.01	0.577

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13.5% moisture.
‡Marginal net return based on $7.30/bu wheat and $0.65/lb N.

Summary:

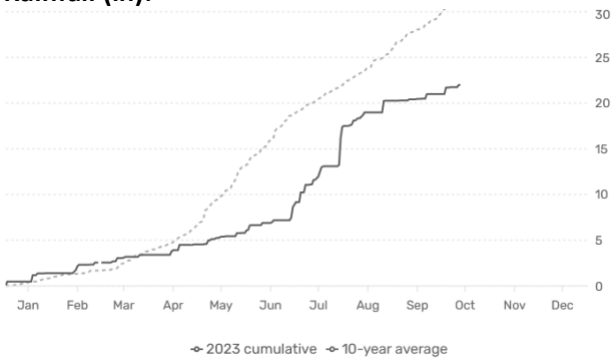
- The sensor-based N management approach resulted in a 14 lb/ac fertilizer reduction compared to the grower's traditional management. However, it also obtained slightly lower yield of 2-3 bu/ac compared to the grower's traditional management.
- The sensor-based N management recommended N rates ranging from 30 lb N/ac to 84 lb N/ac to account field variability, as indicated by the sensors.
- The sensor-based treatment resulted in improved N efficiency.
- Although the grower's N management obtained higher yields, the partial profit was the same compared to the sensor-based treatment.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Sensor-Based Nitrogen Management on Winter Wheat

Study ID: 1268067202301
County: Gage
Soil Type: Butler silt loam, 0-1% slopes; Crete silt loam, 0-1 % slopes; Judson silt loam, 2-6% slopes; Burchard-Steinauer clay loams, 6-11% slopes, eroded; Malmo, eroded-Pawnee complex, 6-11% slopes; Otoe silty clay, 6-11% slopes, eroded; Wymore silty clay loam, 0-2% slopes; Wymore silty clay loam, 2-6% slopes; Colo-Nodaway silty clay loams, frequently flooded; Nodaway silt loam, channeled, occasionally flooded
Planting Date: 10/12/22 and 10/13/22
Harvest Date: 7/10/23 – 8/15/23 due to adverse weather conditions
Row Spacing (in): 7.5
Seeding rate: 1.3 million seeds/acre
Variety: WestBred® WB4401
Reps: 10

Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Post:*** 0.8 oz/ac Affinity®
Seed Treatment: Vibrance® Extreme
Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: None
Rainfall (in):



Soil Tests (July 6, 2023), 0-24"

					-------Melich III-------									
Depth	pH	BpH	OM	Nitrate - N	Melich	K	Ca	Mg	Na	S	CEC	Sand	Silt	Clay
in	1:1		LOI %	N ppm	P1 ppm	ppm	ppm	ppm	ppm	ppm	me/100g	%	%	%
0-6	6.2	6.8	3.2	15.2	672	223	2678	452	18	7.4	19.9	21.8	44.8	33.5
6-12	6.5	7.0	3.0	8.2	28.2	227	3294	725	35	4.8	24.2	20.5	37.0	42.5
12-24	7.7	7.2	2.3	3.1	34	260	3477	739	40	4.3	24.4	21.0	43.0	36.0

Introduction: This study evaluated a sensor-based N management strategy for winter wheat compared to the grower's traditional N management. The experiment was arranged in a randomized complete block design with ten replications of two treatments (Figure 1). The entire field received a broadcast application of MAP, AMS, and potash in the fall resulting in 22 lb of N/acre. It's important to highlight that the study suffered winterkill damage in the field, affecting plants in the tillering stage. This damage introduced variability that may limit the interpretation of the results.

Treatments: The sensor-based N management strategy was compared to the grower's N management.

- *Grower's N management:* 79 lb N/ac was applied as 32% UAN at green-up on May 23, 2023, for a total N rate of 101 lb N/ac.
- *Sensor-based N management (SENSE):* A satellite image was captured using Planet® SkySat on May 20, 2023. The normalized difference vegetation index (NDVI) was calculated from the imagery (Figure 2). On the same date, in-field measurements were taken with a handheld Trimble® GreenSeeker® in selected locations in the bulk of the field to calibrate the imagery. The imagery and GreenSeeker® measurements were processed using the University of Nebraska-Lincoln winter wheat algorithm in the Ninja Ag platform. The variable-rate application averaging 71 lb N/ac (ranging from 52 lb N/ac to 92 lb N/ac) was applied on May 22, 2023, at jointing (Figure 1) for an average total of 95 lb N/ac.
- *N rate ramps:* At the March 30 application date, three sets of five N rates were applied with total N ranging from 0 to 120 lb N/ac, for total rates ranging from 22 to 142 lb N/ac (Figure 1). However, only one set was not affected by winterkill damage. These N rate ramps were used to determine the observed economic optimum nitrogen rate (EONR, data not shown).

As-applied fertilizer maps were used to evaluate the accuracy of fertilizer application, and only areas with high accuracy were included in the analysis. Hand samples were collected at harvest to determine grain protein.

Figure 1. Treatment layout with grower, sensor-based, and nitrogen rate blocks (N_Ramp) with increasing N rates. Nitrogen application prescription for sensor-based management was applied on May 22, 2023.

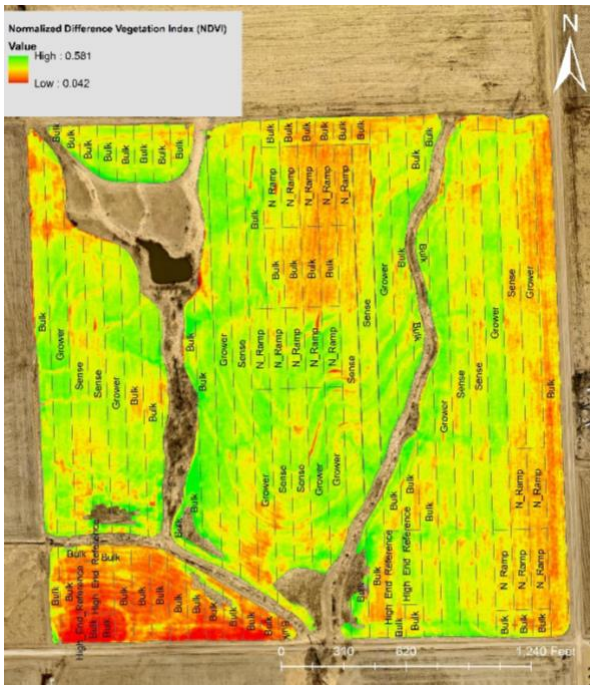


Figure 2. Normalized difference vegetation index (NDVI) values captured on May 20 using Planet® SkySat satellite imagery (50 cm resolution). From the 16 stand counts taken on April 4, 2023, across the field, the average was 630,000 plants per acre with poor areas as low as 270,000 to good areas as high as 1,190,000 plants/ac. Areas most impacted by winterkill were hilltops along the entire east side near the road and north-central portion reflected in the NDVI values. The portion of field to the southwest of the waterway was abandoned due to combination of wheat streak mosaic disease complex damage and winterkill (lowest NDVI area, red color in the image).

Results:

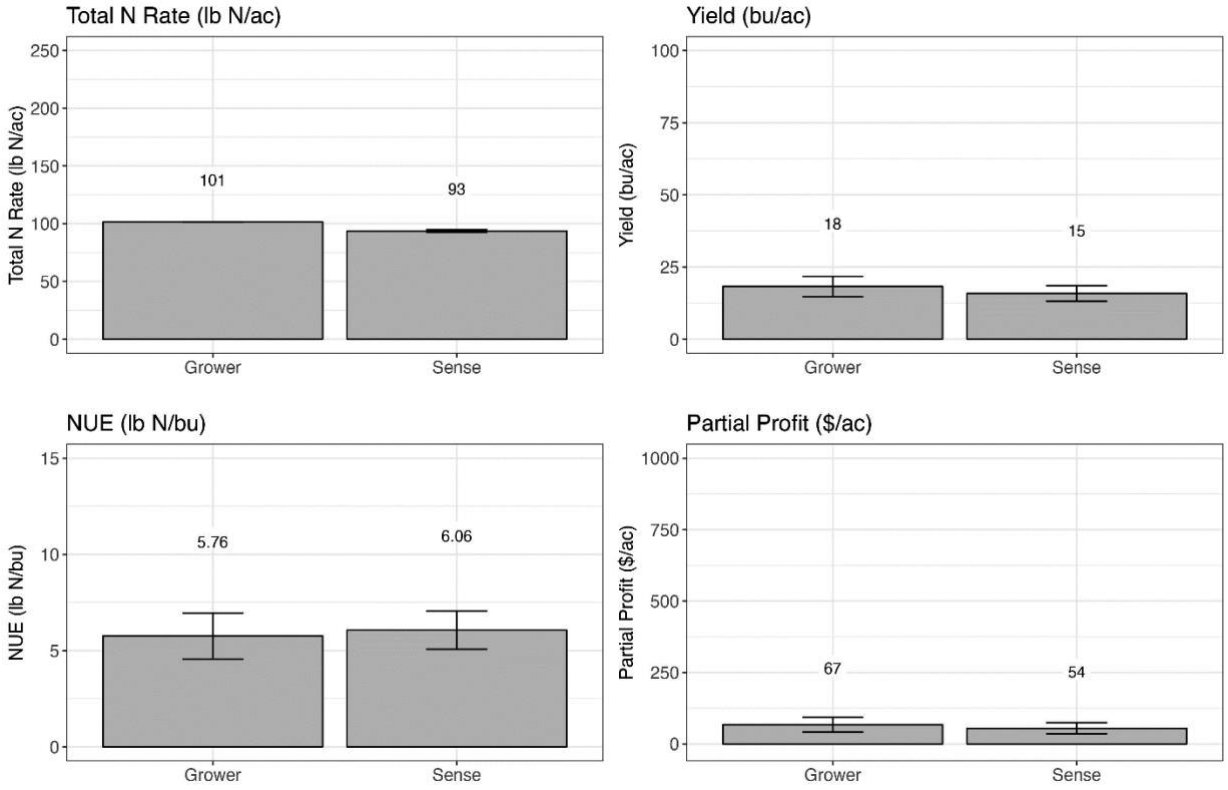


Figure 3. Total N rate, yield, nitrogen efficiency, and partial profit for the grower's N management and sensor-based N management. Vertical bars represent the standard deviation of the mean.

	Total N rate (lb/ac)	Yield (bu/ac)†	Protein (%)	Nitrogen Efficiency (lb N/bu grain)	Partial Profit‡ ($/ac)
Grower N Management	101* A	18 A	16.3 A	5.76 A	67 A
Sensor-based N Management	93 B	16 B	16.3 A	6.06 A	55 A
P-Value	<0.01	<0.10	0.991	0.519	0.181

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13.5% moisture.
‡Marginal net return based on $7.30/bu wheat and $0.65/lb N.

Summary:

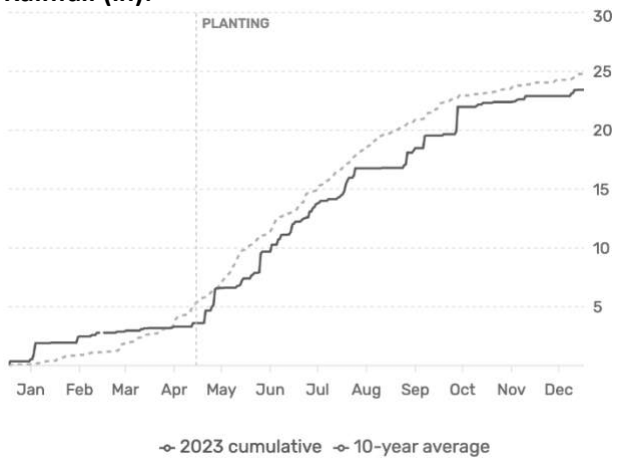
- The sensor-based approach applied 8 lb N/ac less than the grower's N management, however, yield was also 2 bu/ac lower.
- Although not significant, grower treatment presented a trend of more efficiency and higher partial profit (+$13/ac) than sensor-based treatment. Partial profit calculations presented do not include the cost of the technologies used. To make this information relevant to your operation, technology upgrade costs should be considered.
- Adverse harvest conditions and winterkill, and an early-season drought resulted in 23 acres of the trial area remaining unharvested.
- This field and area were in severe to extreme drought, according to the U.S. Drought Monitor (https://droughtmonitor.unl.edu/) from seeding in October through grain fill in June, which may have limited yield potential and N uptake. Additionally, there was minimal snow cover during the vernalization period.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Evaluating Adapt-N In-Season N Management on Irrigated Corn

Study ID: 0709047202306
County: Dawson
Soil Type: Cozad silt loam; Hord silt loam
Planting Date: 4/29/23
Harvest Date: 11/3/23
Seeding Rate: 31,000 seeds/acre
Row Spacing (in): 30
Hybrid: Pioneer® P1353Q
Reps: 7
Previous Crop: Soybean
Tillage: Strip-till
Herbicides: ***Pre:*** 2.3 qt/ac Harness® Xtra 5.6, 22 oz/ac Roundup PowerMAX® 3, 8 oz/ac dicamba, 3 oz/ac mesotrione, 12.8 oz/ac Padlock® Plus on 5/16/23 ***Post:*** 1.5 qt/ac Harness® Xtra, 22 oz/ac Roundup PowerMAX® 3, 3 oz/ac mesotrione, 3 oz/ac Stinger®, 5 oz/ac Status®, 12.8 oz/ac Padlock® Plus on 6/5/23

Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: Gravity, Total: 10"
Rainfall (in):



Soil Samples, 0-6" (Nitrate: 4/9/2023 | Other: 4/2/2021)

pH	BpH	OM LOI %	Olsen P - ppm	Nitrate – N ppm N	Sulfate-S ppm S	-------Melich III------- K	Ca	Mg	Na	CEC me/100g	Sand (%)	Silt (%)	Clay (%)
7.7	6.9	3.5	53	18.8	19	664	2215	459	102	17.0	28	51	20
8.5	6.9	2.0	17	20.3	57	351	1411	391	269	12.4	34	49	16
7.3	6.9	3.4	27	-	16	405	1805	304	61	12.9	30	55	14

Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N losses through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. Several digital agriculture tools are available to provide site-specific, variable-rate, in-season N recommendations. This study used Adapt-N from Yara International, a crop model-based N tool for in-season N application and compared it to the grower's typical N management. The whole field received:

1) 15 gal/ac 32-0-0 and 5 gal/ac 12-0-0-26S applied with strip-till on April 25, 2023
2) 3 gal/ac LiftOff® (8-27-4-1.2S-0.19Zn) applied at planting on April 29, 2023.

On June 27, the variable rate prescription of UAN 32% and 12-0-0-26S was applied. This application brought the total N rates to the rates seen in figure 1. The grower's average rate was 92 lb N/ac and the Adapt-N average rate was 82 lb N/ac. Nitrogen rate blocks were established at rates ranging from 63-213 lb/ac for use in determining the economically optimum N rate (EONR).

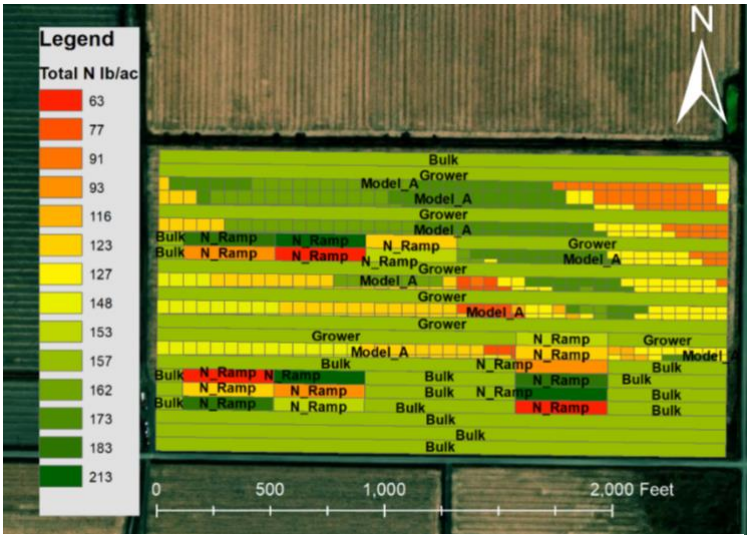


Figure 1. Sidedress prescription with target total N rates for Model and Grower strips.

Results:

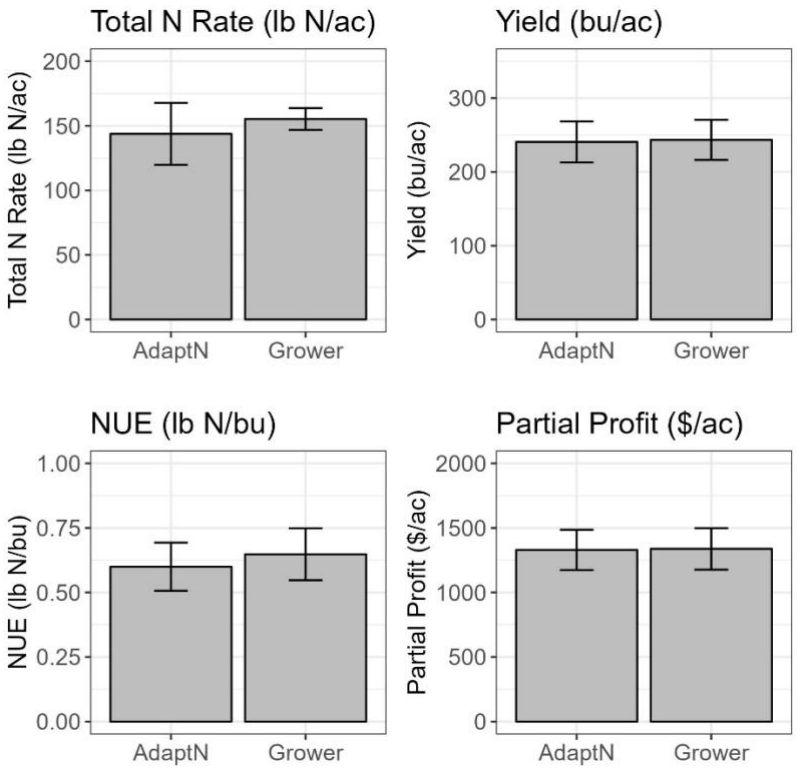


Figure 2. Total N rate, yield, nitrogen use efficiency (NUE), and partial profit for Adapt-N model and the grower's traditional management.

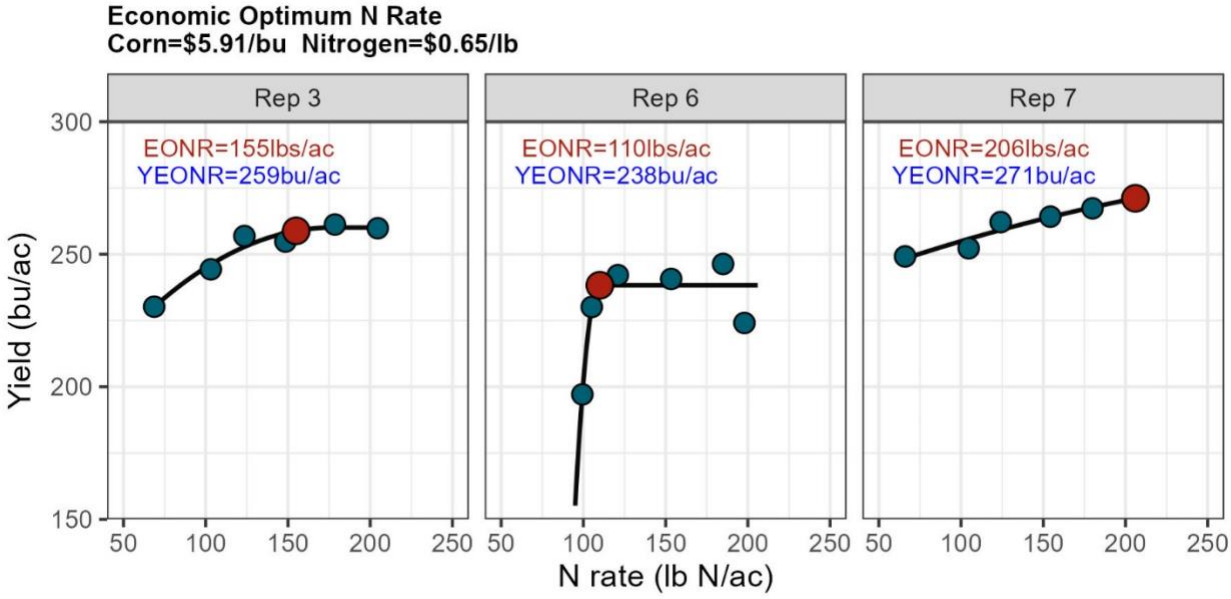


Figure 3. Economical optimum nitrogen rate (EONR) and yield at EONR (YEONR) for three reps. Values were calculated using $5.91/bu corn and $0.65/lb N.

	Total N rate (lb/ac)	Yield (bu/ac)†	Nitrogen Use Efficiency (lb N/bu grain)	Marginal Net Return‡ ($/ac)
Grower N Management	155 A	243 A	0.639 A	1,336 A
Adapt-N Management	145 B*	240 B	0.606 B	1,322 A
P-Value	0.017	0.073	0.044	0.186

*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 $5.91/bu corn and $0.65/lb N.

Summary:

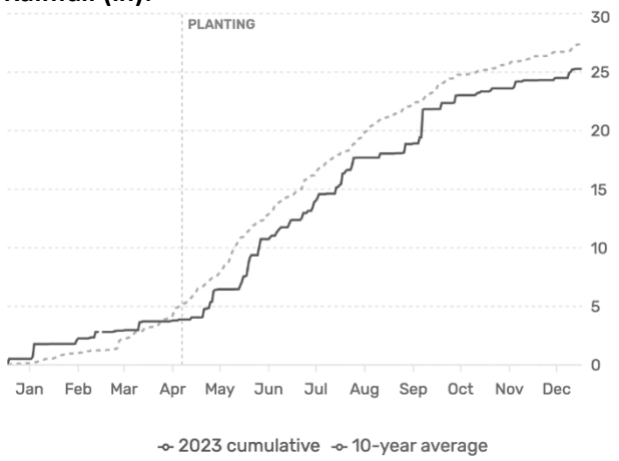
- The EONR for the field ranged from 110 lb N/ac to 206 lb N/ac indicating strategies which vary N rate spatially may have value in this field.
- The total N rate for the grower's traditional management was 10 lb/ac higher than the Adapt-N management.
- The lower N rate for the Adapt-N management resulted in a 4 bu/ac yield decrease.
- There was no difference in marginal net return between the grower's traditional management and the Adapt-N management.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Evaluating Adapt-N In-Season N Management on Irrigated Corn

Study ID: 1121019202301
County: Buffalo
Soil Type: Coly silt loam; Uly silt loam; Hobbs silt loam; Holdrege silt loam
Planting Date: 4/21/23
Harvest Date: 10/31/23-11/1/23
Seeding Rate: 35,000 seeds/acre
Row Spacing (in): 30
Hybrid: Channel® 213-19 VT2PRIB
Reps: 12
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 2 qt/ac Fultime®, 3 oz/ac Explorer®, 1 pt/ac MSO, and 8.5 lb AMS/100 gal
Post: 2 qt/ac Degree Xtra®, 3 oz/ac mesotrione, 1% COC, and 1% UAN
Seed Treatment: Standard Channel® seed treatments

Foliar Insecticides: None
Foliar Fungicides: 10 oz/ac propaz chemigated at R1
Note: Late July and mid-August wind events resulted in leaning plants
Irrigation: Pivot
Rainfall (in):



Soil Samples 0-6" (Nitrate: 4/20/2023)

pH	BpH	OM LOI %	Melich III P - ppm	Nitrate – N ppm N	Sulfate-S ppm S	-------Melich III------- K	Ca	Mg	Na	CEC me/100g	Sand (%)	Silt (%)	Clay (%)
6.6	7.2	4.6	152	27.6	3.5	593	2008	262	14	13.8	34	47	19
6.9	7.2	3.4	80	18.4	2.2	547	2132	324	14	14.8	30	47	23
7.1	7.2	3.8	69	15.6	2.7	479	2320	355	17	15.9	30	49	21
6.9	7.2	4.1	39	7.7	2.1	502	2030	288	18	13.9	34	45	21

Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N losses through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. There are several digital agriculture tools available to provide site-specific, variable-rate, in-season N recommendations. This study used Adapt-N from Yara International, a crop model-based N tool for in-season N application and compared it to the grower's typical N management. The whole field received:

1) 7.5 gal/ac 10-34-0, 0.5 gal/ac zinc, 9 gal/ac 28% UAN, 3 gal/ac S applied at strip-till (35 lb N/ac)
2) 4 gal/ac 10-34-0 in-furrow and 12 gal/ac 28% UAN dribbled at planting (40 lb N/ac)
3) 14 gal/ac 32% UAN fertigated 7/10/23 (50 lb N/ac).

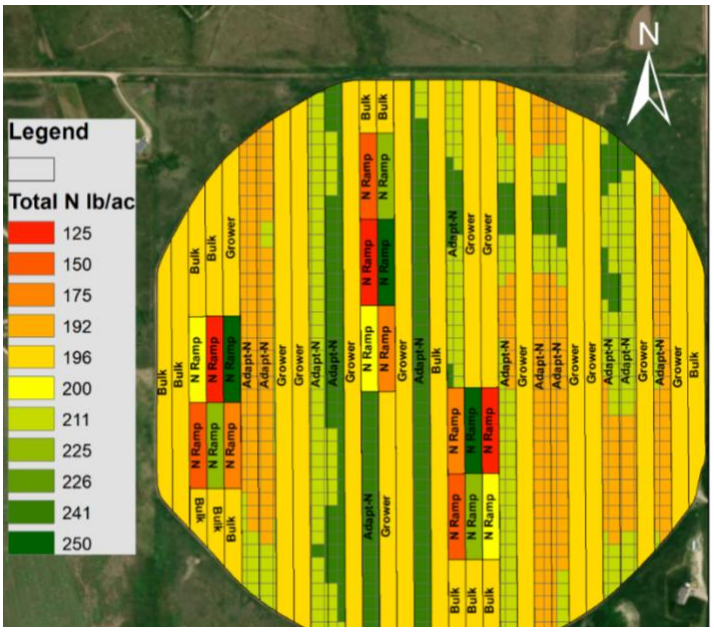


Figure 1. Sidedress prescription with total N target values.

On May 27, 32% UAN was injected via a coulter rig. The grower's rate was 70 lb N/ac and the Adapt-N variable-rate averaged 87 lb N/ac. Nitrogen rate blocks were established at rates ranging from 125-250 lb/ac for use in determining the economically optimum N rate.

Results:

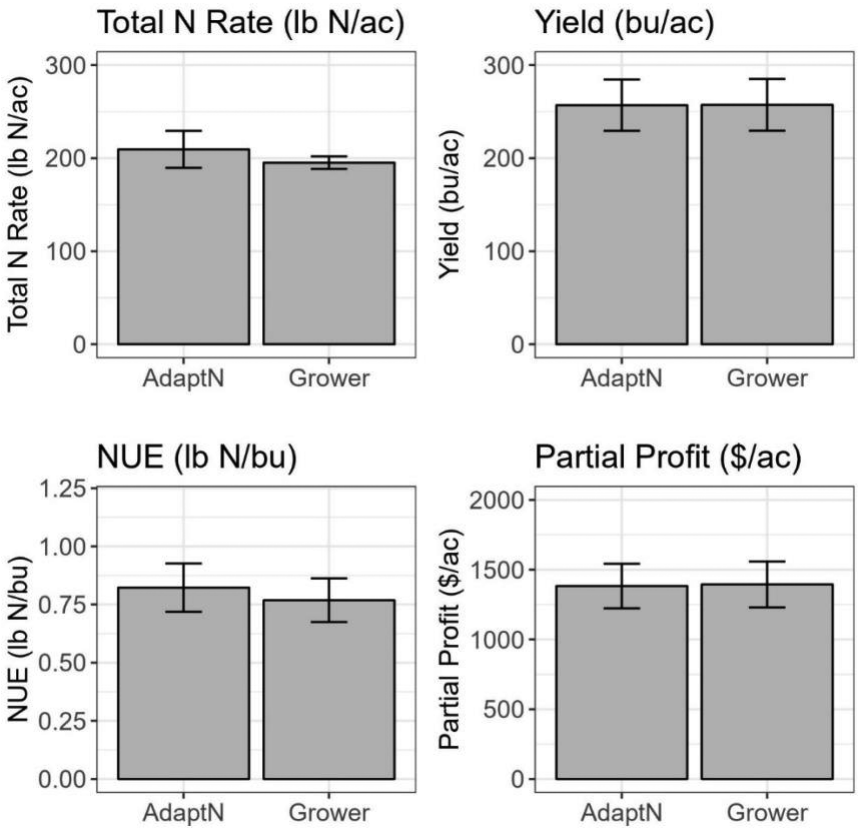


Figure 2. Total N rate, yield, nitrogen use efficiency (NUE), and partial profit for Adapt-N model and the grower's traditional management.

	Total N rate (lb/ac)	Yield (bu/ac)†	Nitrogen Efficiency (lb N/bu grain)	Marginal Net Return‡ ($/ac)
Grower N Management	195 B	257 A	0.762 B	1,390 A
Adapt-N Management	212 A*	258 A	0.823 A	1,385 A
P-Value	0.006	0.437	0.007	0.538

*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 $5.91/bu corn and $0.65 lb/N.

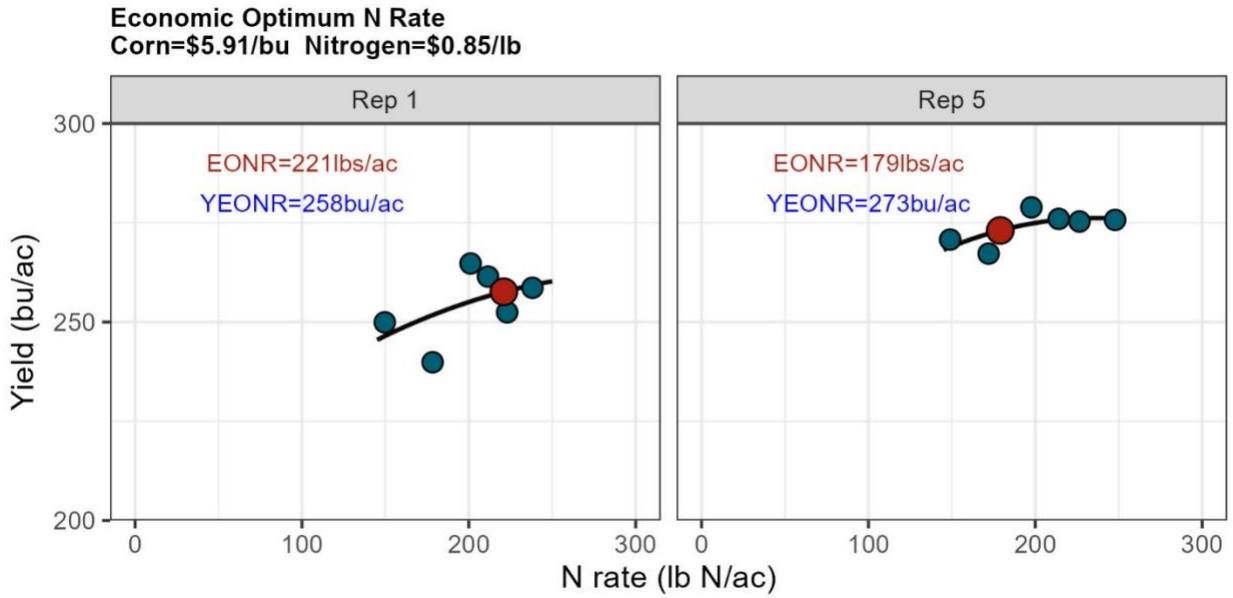


Figure 3. Economical optimum nitrogen rate (EONR) and yield at EONR (YEONR) calculated using $5.91/bu and $0.65/lb N.

Summary:

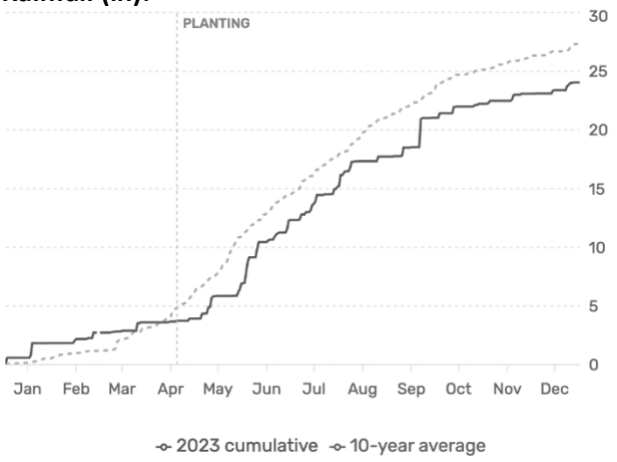
- The total N rate for the grower's traditional management was 17 lb/ac lower than the Adapt-N management. The higher N rate for the Adapt-N management did not result in a yield increase.
- There was no difference in marginal net return between the grower's traditional management and the Adapt-N management.
- Economically optimum N rate for two replications ranged from 179 to 221, showing potential for variable-rate N management in this field.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Evaluating Adapt-N In-Season N Management on Irrigated Corn

Study ID: 1121019202302
County: Buffalo
Soil Type: Hord silt loam; Hall silt loam
Planting Date: 4/19/23
Harvest Date: 10/27-28/23
Seeding Rate: 35,000 seeds/acre
Row Spacing (in): 30
Hybrid: Dekalb® 63-91 VT2PRIB
Reps: 8
Previous Crop: Soybean
Tillage: Strip-till (center section of the field strip till only, east and west edges ridged for gravity irrigation)
Herbicides: ***Pre:*** 2 qt/ac Fultime®, 3 oz/ac Explorer®, 1 pt/ac MSO, and 8.5 lb AMS/100 gal
Post: 2 qt/ac Degree Xtra®, 2 oz/ac mesotrione, 1% COC, and 1% UAN
Seed Treatment: Standard Channel® seed treatment

Foliar Insecticides: None
Foliar Fungicides: 10 oz/ac Propaz chemigated at R1
Irrigation: Pivot
Rainfall (in):



Soil Samples 0-6" (Nitrate: 4/20/2023)

	pH	BpH	OM LOI %	Melich III P - ppm	Nitrate – N ppm N	Sulfate -S ppm S	-------Melich III------- K	Ca	Mg	Na	CEC me/100g	Sand (%)	Silt (%)	Clay (%)
Zone 1	6.8	7.2	3.1	64	41.4	4.5	575	2205	306	25	15.2	27	52	21
Zone 2	6.9	7.2	3.6	63	26.4	5.4	509	2087	277	25	14.2	27	50	23
Zone 3	6.9	7.2	3.0	55	19.9	6.9	498	2108	296	27	14.4	29	52	19

Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N losses through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. There are several digital agriculture tools available to provide site-specific, variable-rate, in-season N recommendations. This study utilized Adapt-N from Yara International, a crop model-based N tool for in-season N application and compared it to the grower's typical N management (Figure 1). The whole field received a variable-rate application of 10-34-0 through strip till, 4 gal/ac 10-34-0 applied in-furrow at planting, and 12 gal/ac 28% UAN dribbled at planting for a total of 41 lb N/ac. On May 27, 32% UAN was injected via coulter rig. The grower's average rate was 71 lb N/ac and the Adapt-N average rate was 122 lb N/ac. Nitrogen rate blocks were also established at rates ranging from 41 to 166 lb N/ac for use in determining the economically optimum N rate (EONR).

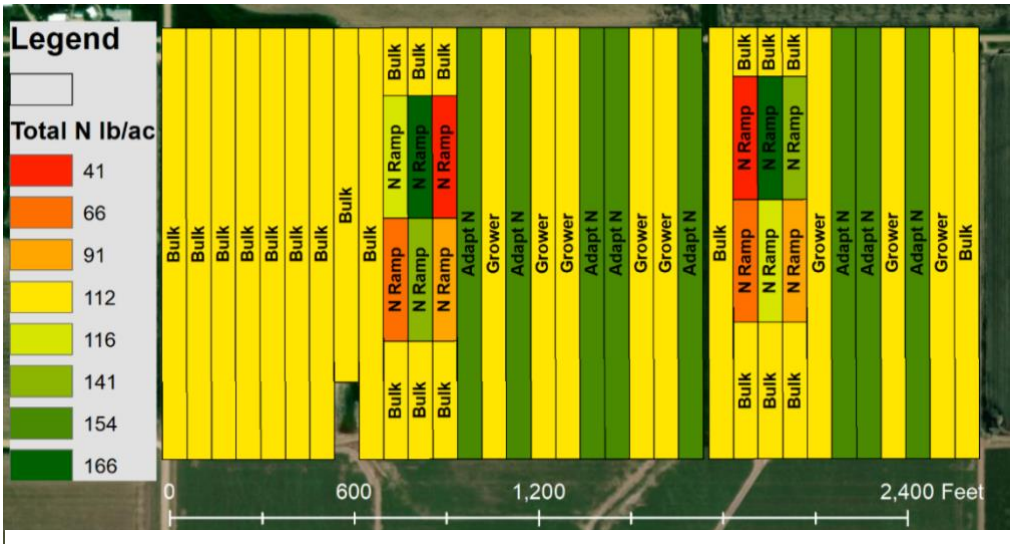


Figure 1. Treatment layout with Grower, Adapt-N, and N rate blocks (N Ramp.)

Results:

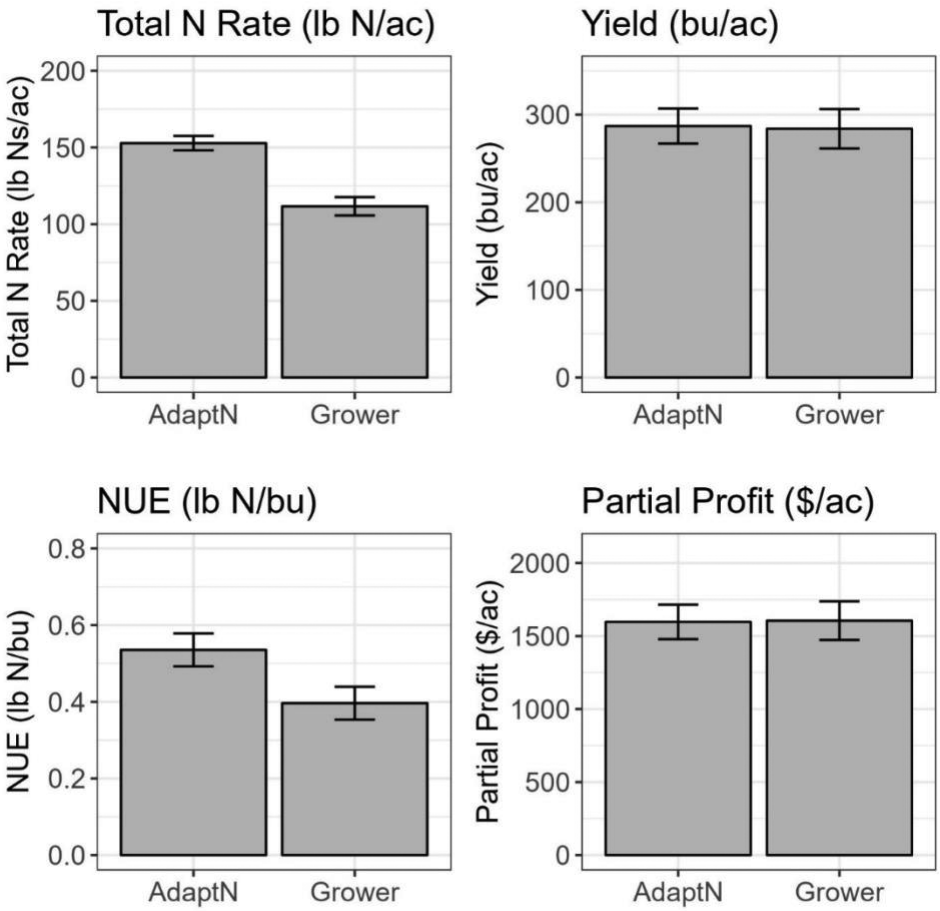


Figure 2. Total N rate, yield, nitrogen use efficiency (NUE), and partial profit for Adapt-N model and the grower's traditional management.

	Total N rate (lb/ac)	Yield (bu/ac)†	Nitrogen Efficiency (lb N/bu grain)	Marginal Net Return‡ ($/ac)
Grower N Management	112 B	284 A	0.393 B	1,604 A
Adapt-N Management	153 A*	287 A	0.533 A	1,598 A
P-Value	<0.0001	0.315	<0.0001	0.773

*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 $5.91/bu corn and $0.65/lb N.

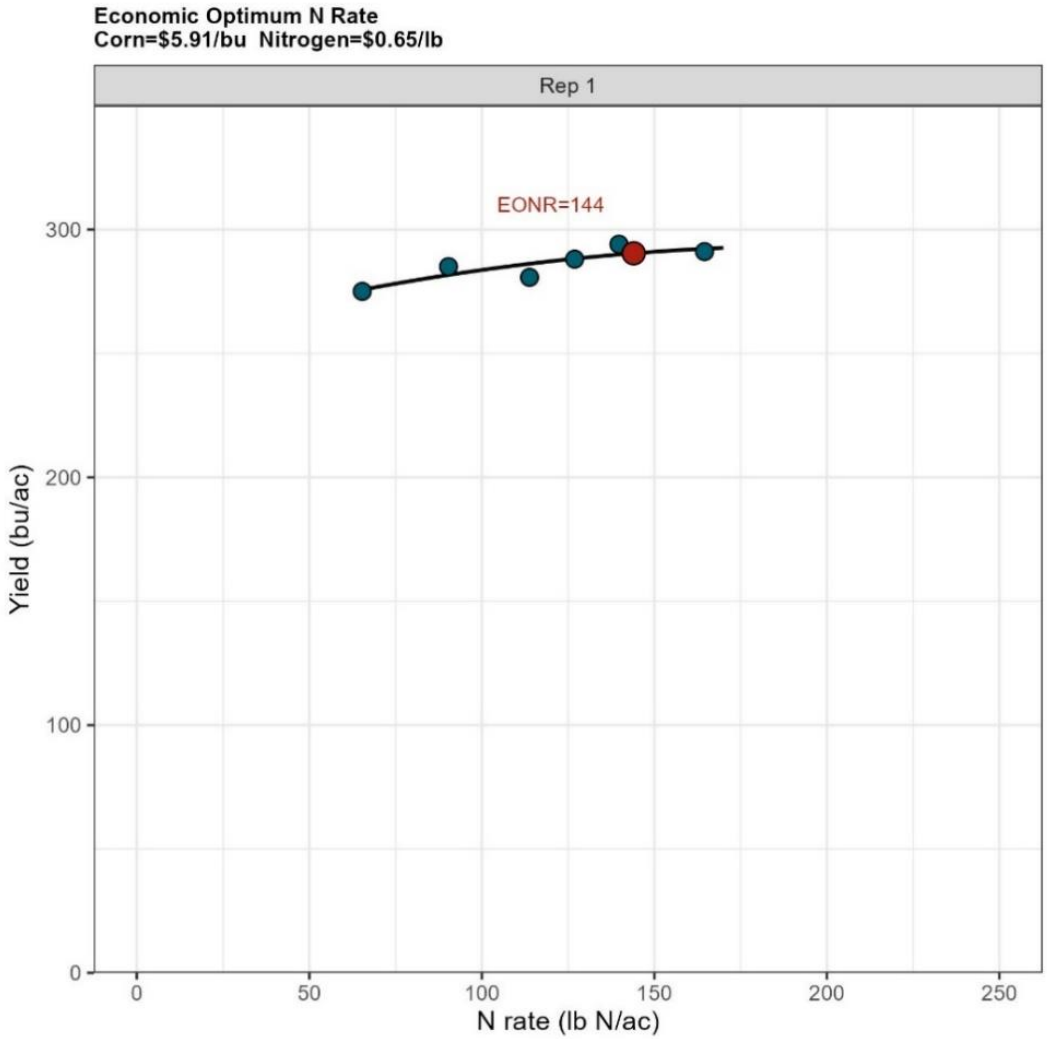


Figure 3. Economically optimum nitrogen rate for Rep 1 calculated using $5.91/bu corn and $0.65/lb N.

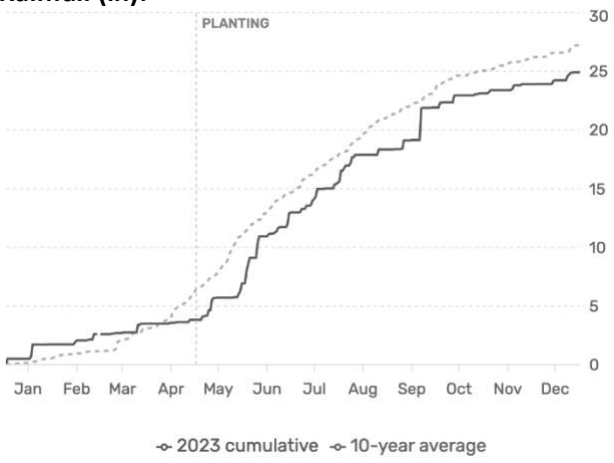
Summary:

- The total N rate for the Adapt-N management was 41 lb/ac higher than the grower's traditional management and did not result in a yield increase.
- There was no difference in marginal net return between the grower's traditional management and the Adapt-N management.
- The EONR for one replication was 144 lb N/ac, which was greater than the grower's typical N management. EONR was not able to be calculated for the second replication due to variability in the yield response.
- For reference, the University of Nebraska-Lincoln N recommendation for corn for this field was 163 lb N/ac with a 280 bu/ac yield goal. This was 19 lb N/ac higher than the rate that was found to maximize yields in this study.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

Study ID: 0195019202301
County: Buffalo
Soil Type: Wood River silt loam
Planting Date: 5/1/23-5/2/23
Harvest Date: 10/18/23-10/20/23
Seeding Rate: 35,000
Row Spacing (in): 30
Hybrid: Channel® 214-78 DGVT2P
Reps: 4
Previous Crop: Soybean
Tillage: Strip-till
Herbicides: ***Pre:*** 2 qt/ac Degree Xtra®, 3 oz/ac mesotrione, and 1% COC ***Post:*** 1.25 qt/ac Harness® Max, 1 pt/ac Atrazine, 8 oz/ac Tough®, 20 oz/ac Roundup PowerMAX® 3, and 8.5 lb AMS/100 gal
Seed Treatment: Standard Channel® seed treatments
Foliar Insecticides: None
Foliar Fungicides: 10.5 oz/ac azoxystrobin and propiconazole package mix applied at R1
Irrigation: Pivot
Rainfall (in):

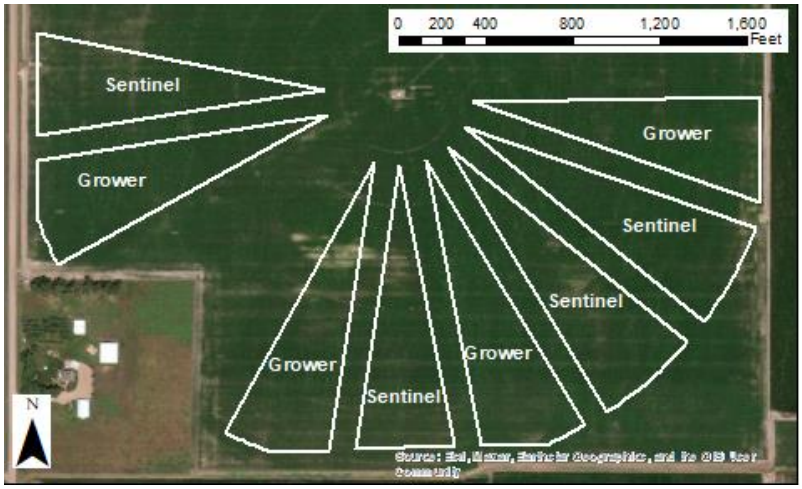


Baseline Soil Samples 0-6" (May 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
7.9	3.2	38.1	51	36.8	507	1687	281	154	12.8
7.6	3.6	60.9	145	19.6	650	2493	451	172	18.6

Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator blocks (small blocks established during the base N applications) with higher (+60 lb N/ac) and lower (-30 lb N/ac) rates were applied in the field on June 7, 2023 to monitor and determine when fertigation was needed.

If an N application was recommended by N-Time® the N applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with four paired sectors of each treatment (each sector was about 7 acres, buffered 60 feet internally to reduce sprinkler package overlap between sectors); the field trial layout is shown below.



Application Table: Nitrogen applied throughout the 2023 growing season (or in fall of 2022, as noted) is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring and directing N fertigation applications following the June 7, 2023 N application. Nitrogen applications directed by N-Time® are shaded in gray to the right of the double vertical lines in the table below.

	Nov. 2022	5/1	6/7	7/10	Total N Rate (lb/ac)
Treatment	----------*lb N/ac applied*----------				
Grower N Management	8.7[a]	51[b]	35[c]	21[c]	**115.7**
Sentinel Fertigation N-Time®	8.7[a]	51[b]	35[c]	-	**94.7**

[a] Product used was 10-34-0 applied with strip till

[b] Product used was 32-0-0 applied with planter

[c] Product used was 32-0-0

Results:

	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 N Management	115.7	16.3 A*	274 A	133 B	0.42 A	1,297 B
Sentinel Fertigation N-Time®	94.7	16.2 A	273 B	162 A	0.35 B	1,306 A
P-Value	N/A	0.541	0.092	<0.0001	<0.0001	0.026

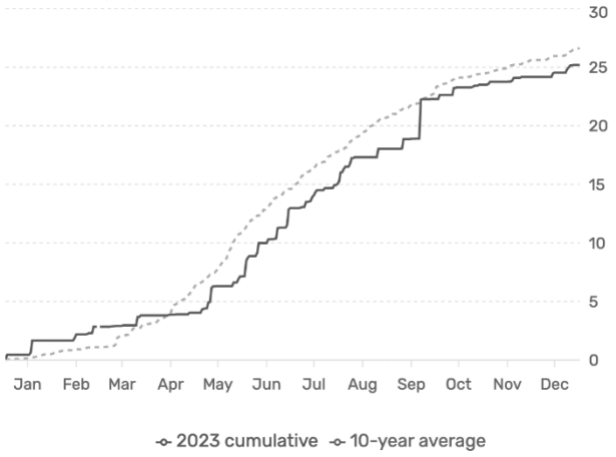
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5/bu corn $0.63/lb N.

Summary: The Sentinel Fertigation N-Time® management did not recommend any additional N applications beyond the grower base rate, which resulted in a 21 lb N/ac reduction in N fertilizer with a 1 bu/ac yield reduction. This resulted in a 22% increase in nitrogen use efficiency. Marginal net return was $9/ac greater for the Sentinel Fertigation N-Time® management.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

Study ID: 1253019202301
County: Buffalo
Soil Type: Leshara silt loam; Gibbon silt loam
Planting Date: 4/28/23-4/29/23
Harvest Date: 10/20/23
Seeding Rate: 32,350
Row Spacing (in): 30
Hybrid: Pioneer® P1278Q
Reps: 5
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 2 qt/ac Degree Xtra®, 3 oz/ac Explorer®, 1% MSO, 1% UAN ***Post:*** 1.25 qt/ac Harness Max®, 1 pt/ac Atrazine, 1% COC, 1% UAN
Seed Treatment: Standard pioneer seed treatments
Foliar Insecticides: 1.2 oz/ac Vantacor®
Foliar Fungicides: 10.5 oz/ac Propaz at VT
Irrigation: Pivot
Rainfall (in):

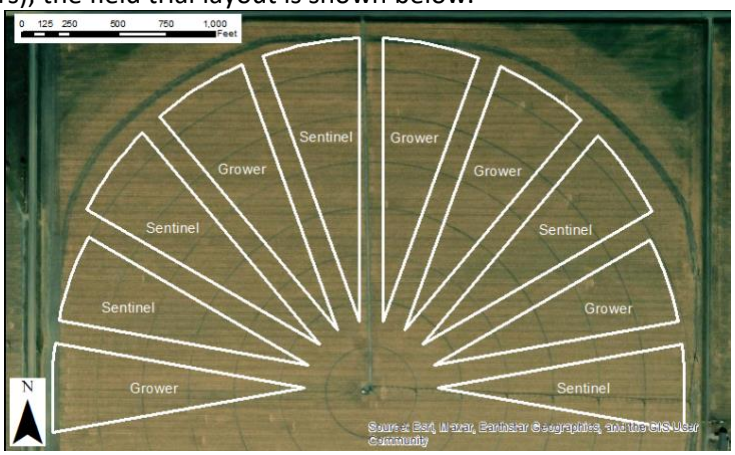


Baseline Soil Samples 0-6" (April 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
8.6	3	12.5	34	35.2	368	4235	324	77	25.2
8.6	2.8	13.8	16	35.1	329	4079	307	84	24.2
8.5	3	13.3	14	35.5	402	4982	387	82	29.5

Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator blocks (small blocks established during the base N applications) with higher (+60 lb N/ac) and lower (-30 lb N/ac) rates were applied in the field on June 7, 2023 to monitor and determine when fertigation was needed.

If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with five paired sectors of each treatment (each sector was about 7 acres, buffered 60 feet internally to reduce sprinkler package overlap between sectors); the field trial layout is shown below.



Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring and directing N fertigation applications following the June 7, 2023 N application; further N-Time® directed N applications are shaded in gray to the right of the double vertical lines in the table below. The applied values were averaged across all reps; therefore, if only three out of five replications triggered an application of 30 lb N/ac, a value of 18 lb N/ac is reported as the average treatment N application across replications.

	4/28	6/7	6/27	7/7	7/25	Total N rate (lb/ac)
Treatment	----------*lb N/ac applied*----------					
Grower N Management	53 [a]	71[b]	25[c]	23[c]	25[c]	**197**
Sentinel Fertigation N-Time®	53 [a]	71[b]	-	12[c]	18[c]	**154**

[a] Product used was 32% UAN via planting

[b] Product used was 32% UAN via Indicator block establishment

[c] Product used was 32% UAN

Results:

	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 N Management	197 A*	14.4 A	230 A	65 B	0.86 A	1,027 A
Sentinel Fertigation N-Time®	154 B	14.2 A	220 A	81 A	0.70 B	1,003 A
P-Value	0.011	0.608	0.128	0.016	0.011	0.361

*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 were corrected to 15.5% moisture.

‡Marginal net return based on $5/bu corn and $0.63/lb N.

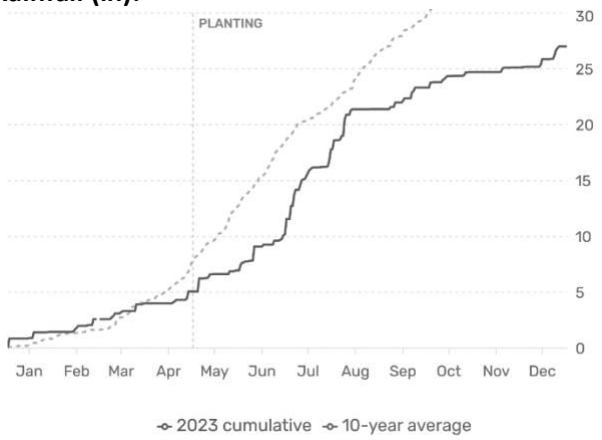
Summary: The Sentinel Fertigation N-Time® management resulted in a 43 lb N/ac reduction in N fertilizer with no statistical difference in yield resulting in a 25% increase in nitrogen use efficiency. It should be noted that the indicator block placement in one N-Time® sector on the west side of the field (located in a low producivity area) resulted in no N applications in that sector. Resulting yield loss in that one sector reduced overall average by about 5 bu/ac for the N-Time® sectors. There was no significant difference in marginal net return.

This research was partly supported by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

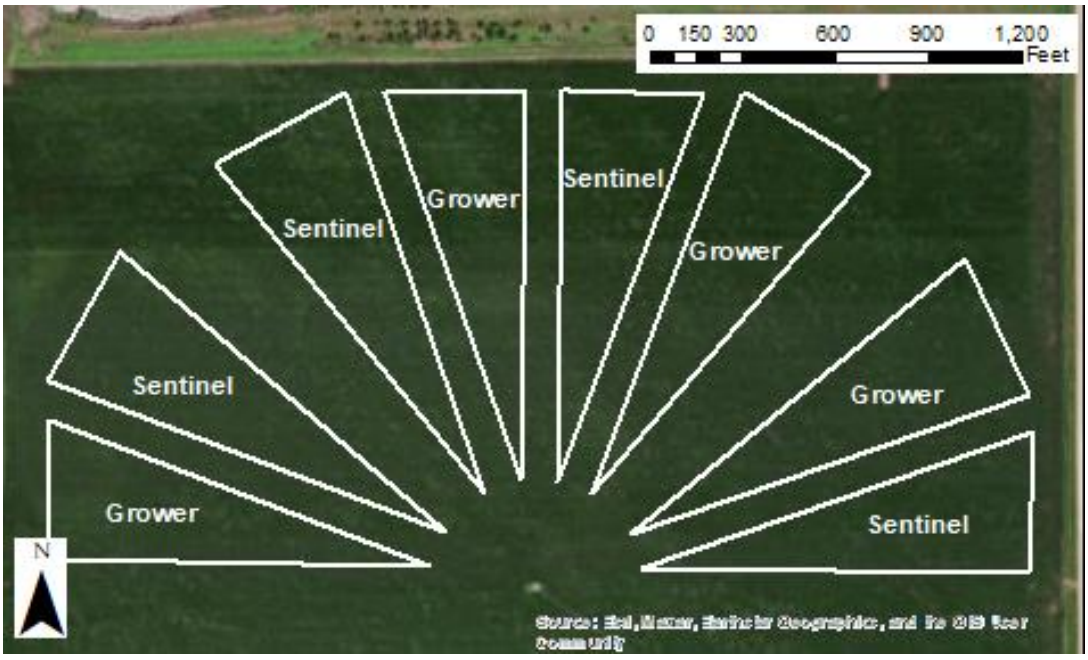
Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

Study ID: 0211023202301
County: Butler
Soil Type: Muir silt loam rarely flooded; Ovina-Thurman complex 0-6% slopes
Planting Date: 5/1/23
Harvest Date: 10/18/23
Seeding Rate: 34,000
Row Spacing (in): 30
Hybrid: Dekalb® DKC63-90
Reps: 4
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Post:*** 3 oz/ac Balance® Flexx and 24 oz/ac Roundup® on 5/17/23
Foliar Fungicides: 13.7 oz/ac Trivapro® on 7/18/23

Irrigation: Pivot
Rainfall (in):



Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator sectors (small slices established during the first fertigation event) with higher (+30 lb N/ac) and lower (-30 lb N/ac) N rates were applied in the field using a variable-rate injection pump on June 29, 2023. These indicator sectors were used to determine when additional fertigation is needed throughout the season. If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with four paired sectors (each sector was about 7 acres) of each treatment as shown in the map below.



Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring and directing N fertigation applications following the June 29, 2023 N application. N applications directed by N-Time® are shaded in gray to the right of the double vertical lines in the table below.

	4/12	6/16	6/29	7/10	Total N rate (lb/ac)
Treatment	*lb N/ac applied*				
Grower N Management	77[a]	32.5[b]	30[b]	34[b]	**173.5**
Sentinel Fertigation N-Time®	77[a]	32.5[b]	30[b]	-	**139.5**

[a] Product used was 32-0-0-0 via strip till

[b] Product used was 32-0-0-0 applied via fertigation

Results:

	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 N Management	174	15.3 A*	255 A	82 B	0.68 A	1,168 A
Sentinel Fertigation N-Time®	140	15.1 A	256 A	103 A	0.55 B	1,190 A
P-Value	N/A	0.156	0.929	0.0003	0.0002	0.168

*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 were corrected to 15.5% moisture.

‡Marginal net return based on $5/bu corn and $0.63/lb N.

Summary:

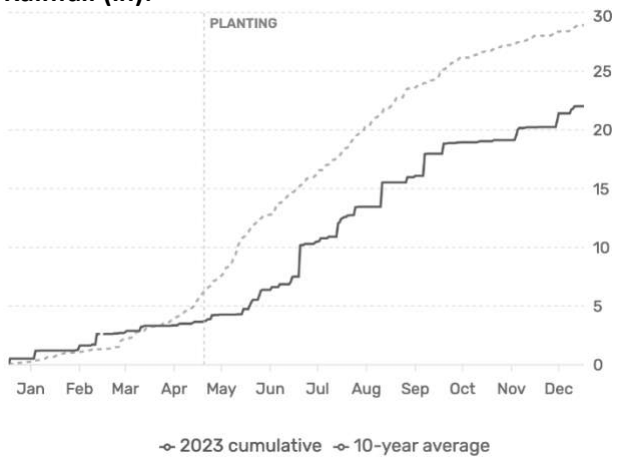
- The Sentinel Fertigation N-Time® management did not recommend additional N applications beyond the grower base rates, which resulted in a 34 lb N/ac reduction in N fertilizer with no impact on yield, resulting in a 26% increase in N use efficiency. There was no difference in marginal net return.
- Soil samples (24" depth) were collected in early December 2023 following harvest. Four grower and four Sentinel sectors were randomly selected for sampling and two composite samples were taken from each sector. Results indicated residual nitrate in the Sentinel sectors (average 9.2 ppm) was comparable to the grower sectors (average 9.7 ppm); the difference was not statistically significant.

This research was partly supported by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

Study ID: 0686035202303
County: Clay
Soil Type: Hastings silt loam
Planting Date: 5/3/23
Harvest Date: 9/29/23
Seeding Rate: Fontanelle® 11DT590 at 33,000 and Pioneer® P1185 at 34,000
Row Spacing (in): 30
Hybrid: Fontanelle® 11DT591 and Pioneer® P1185
Reps: 4
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 9.6 oz/ac MSO Extra, 0.9 lb/ac Spray-Start®, 40 oz/ac SureStart®, 3 oz/ac Cavallo® 4SC, and 32 oz/ac Glypex™ 5 Extra on 5/5/23 ***Post:*** 0.9 lb/ac Spray-Start®, 80 oz/ac Helmet® Maxx, and 32 oz/ac Glypex™ 5 Extra on 5/31/23
Seed Treatment: Standard treatments

Foliar Insecticides: 6.4 oz/ac Lambda CY and 3.8 oz/ac Batallion® chemigated on 7/18/23
Foliar Fungicides: 14 oz/ac Aquila® chemigated on 7/18/23
Irrigation: Pivot, Total: 12"
Rainfall (in):

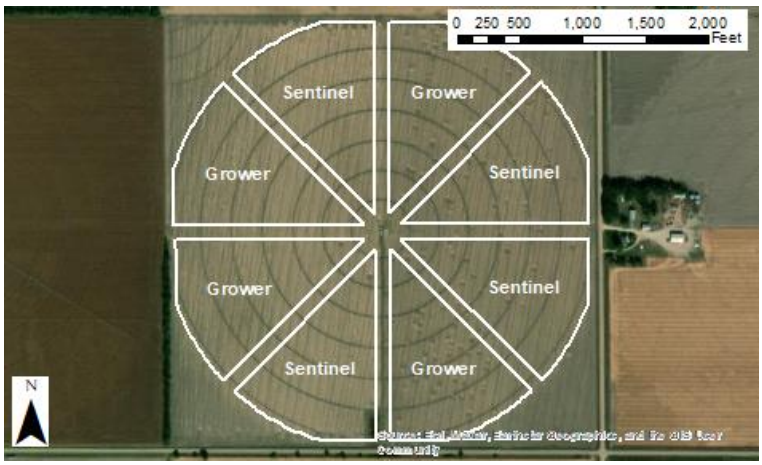


Baseline Soil Samples 0-6" (May 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
6	3.8	10.8	17	15.3	387	2173	267	43	16.9
6.2	3.5	28.2	20	13.4	379	2462	302	42	17.9
5.6	3.4	39.6	23	16.7	491	1883	230	41	16.1

Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator blocks (small blocks established during the base N applications) with higher (+60 lb N/ac) and lower (-30 lb N/ac) rates were applied in the field on April 6, 2023 to monitor and determine when fertigation was needed.

If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with four paired sectors of each treatment (each sector was about 22 acres, buffered 60 feet internally to reduce sprinkler package overlap between sectors); the field trial layout is shown below.



NOTE: Two different hybrids were planted on the east and west sides of the field, which affected both treatments equally; therefore, the analysis did not separate out the influence of the hybrids (allowing for statistical analysis of the four paired sectors).

Application Table: Nitrogen applied throughout the 2023 growing season (or in fall of 2022, as noted) is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring and directing N fertigation applications following the May 3, 2023 N application. Applications directed by N-Time® are shaded in gray to the right of the double vertical lines in the table below. The applied values were averaged across all reps; therefore, if only one out of four replications triggered an application of 32 lb N/ac, a value of 8 lb N/ac is reported as the average treatment N application across replications.

	Oct. 2022	4/6	5/3	6/17	6/26	6/27	Total N rate (lb/ac)
Treatment	*lb N/ac applied*						
Grower N Management	16.8[a]	118[b]	2.3[c]	82.9[d]	36[d]		**256**
Sentinel Fertigation N-Time®	16.8[a]	118[b]	2.3[c]	-	-	8[d]	**145**

[a] Product used was MESZ

[b] Product used was 28-0-0-5 (111.8 lb-N/ac) and AMS (6.3 lb-N/ac)

[c] Product was 10-34-0 starter at planting

[d] Product was 28-0-0-5

Results:

	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 N Management	256 A	16.4 A	285 A	62 B	0.90 A	1,264 B
Sentinel Fertigation N-Time®	145 B	15.9 B	276 B	107 A	0.53 B	1,289 A
P-Value	0.001	0.033	0.006	0.003	0.002	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 corrected to 15.5% moisture.

‡Marginal net return based on $5/bu corn and $0.63/lb N.

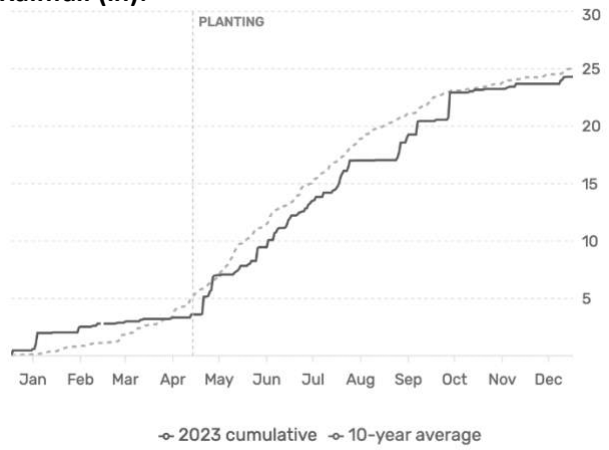
Summary: The Sentinel Fertigation N-Time® management recommended one 32 lb N/ac application in one sector (out of four) during the growing season. The grower N management program applied 111 lb N/ac more compared to the sensor-based approach, which resulted in a 9 bu/ac yield increase. N-Time management increased N use efficiency by 73%. Despite the lower yield for the Sentinel Fertigation N-Time® management, the nitrogen savings resulted in a $25/ac increase in marginal net return.

After harvest, soil samples (24" depth) were collected in early December 2023. Three grower and Sentinel sectors were randomly selected and two composite samples were taken from each sector. Results indicated significantly less residual nitrate in the Sentinel sectors (average 5.1 ppm) compared to the grower sectors (average 13.0 ppm).

This research was partly supported by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

Study ID: 0709047202305
County: Dawson
Soil Type: Cozad silt loam; Cozad silty clay loam; Hall silt loam; Rusco silt loam
Planting Date: 5/2/23
Harvest Date: 11/3/23
Seeding Rate: 33,000
Row Spacing (in): 30
Hybrid: Channel® 210-46STXRIB
Reps: 5
Previous Crop: Wheat
Tillage: Strip-till
Herbicides: ***Pre:*** 1.25 qt/ac Harness Xtra® 5.6, 22 oz/ac Roundup PowerMAX® 3, 8 oz/ac dicamba, and 12.8 oz/ac Padlock®Plus on 5/4/23 ***Post:*** 1.5 qt/ac Harness Xtra®, 22 oz/ac Roundup PowerMAX® 3, 3 oz/ac mesotrione, 3 oz/ac Stinger®, and 5 oz/ac Status® on 6/5/23
Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 25 gal/ac 32% UAN, 5 gal/ac 12-0-0-26S, 12 gal/ac 10-34-0, and 0.25 gal/ac Zn on 4/25/23, LiftOff® 3 gal/ac (8-27-4-1.2 S-0.19 Zn) on 5/2/23
Irrigation: Pivot, Total: 9"
Rainfall (in):

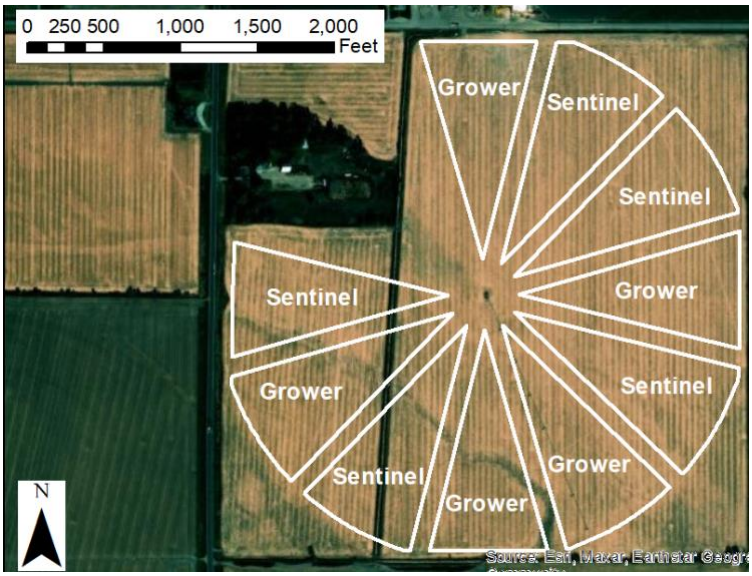


Baseline Soil Samples 0-6" (April 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
7.2	6.5	13.2	8	51.7	529	2127	373	73	15.4
5.4	3.5	25.8	20	77.2	411	1332	352	108	14.3
6.3	4.4	14.2	20	50.5	550	2193	388	78	16.7

Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator blocks (small blocks established during the base N applications) with higher (+60 lb N/ac) and lower (-30 lb N/ac) rates were applied in the field on April 24, 2023 to monitor and determine when fertigation was needed.

If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with five paired sectors of each treatment (each sector was about 13 acres, buffered 60 feet internally to reduce sprinkler package overlap between sectors); the field trial layout is shown at right.



Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring and directing N fertigation applications following the May 1, 2023 N application; N-Time® directed N applications are shaded in gray to the right of the double vertical lines in the table below.

	4/24	5/1	7/5	7/14	7/31	Total N Applied
Treatment	----------*lb N/ac applied*----------					
Grower N Management	109 [a]	35[b]	29[c]	29 [c]	33 [c]	**235**
Sentinel Fertigation N-Time®	109 [a]	35[b]	-	-	-	**144**

[a] Product used was 23-10-0-3 S + Zn via ground rig

[b] Product used was 32-0-0 UAN via burndown ground rig

[c] Product used was 90% 32% UAN/10% thiosulfate

Results:

	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 N Management	235	14.9 A*	251 A	60 B	0.94 A	1,109 A
Sentinel Fertigation N-Time®	144	15.0 A	249 A	97 A	0.58 B	1,154 A
P-Value	N/A	0.702	0.702	<0.0001	0.0002	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 were corrected to 15.5% moisture.

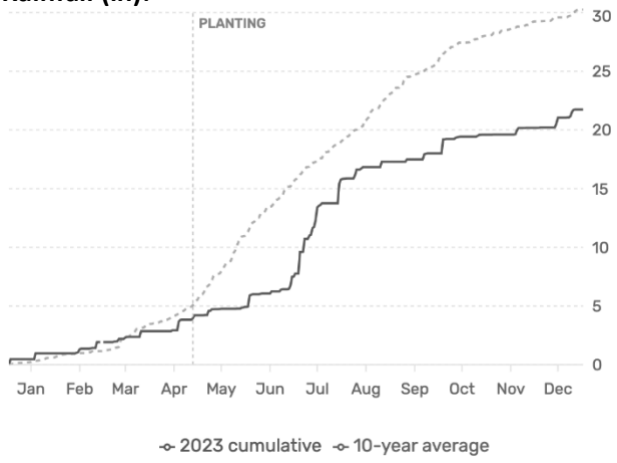
‡Marginal net return based on $5/bu corn and $0.63 lb/N.

Summary: The Sentinel Fertigation N-Time® management system called for no additional N applications during the growing season, which resulted in a 91 lb N/ac reduction with no difference in yield. Sentinel fertigation N-Time® increased N use efficiency by 62%. There was no significant difference in marginal net return.

This research was partly supported by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

Study ID: 0811185202301
County: York
Soil Type: Hastings silt loam
Planting Date: 4/27/23
Harvest Date: 10/10/23
Seeding Rate: 34,000
Row Spacing (in): 30
Hybrid: Pioneer® P1170AM
Reps: 5
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 1.5pt/ac atrazine, 2 qt/ac Lexar®, 24 oz/ac glyphosate, and 1 pt/ac Class Act® on 5/1/23
Seed Treatment: Ipconazole, Ethaboxam, L-2012R, Lumiva®, Lumisure®, Lumialza®
Foliar Insecticides: 6.4 oz/ac Brigade® 2EC and 4 oz/ac Mustang® MAX on 7/22/23
Foliar Fungicides: 13.7 oz/ac Trivapro® on 7/22/23
Note: 3-14% green snap in field
Irrigation: Pivot, Total: 13.8"
Rainfall (in):

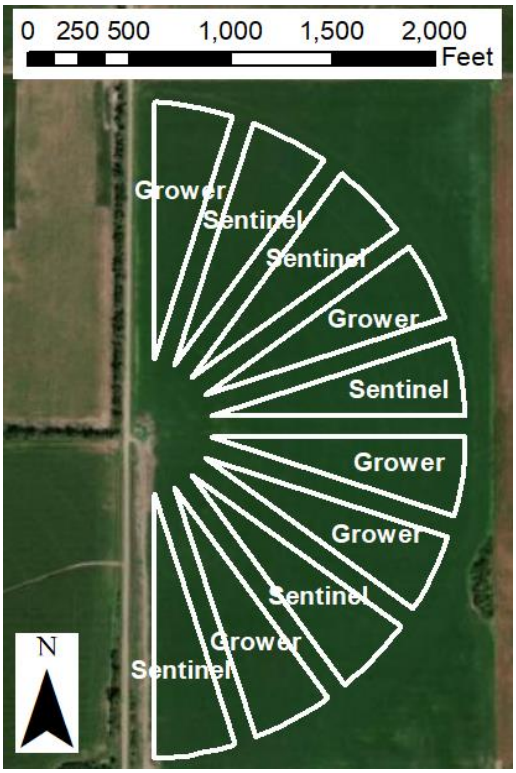


Baseline Soil Samples 0-6" (May 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
6.4	4	54.2	32	9.3	282	1877	250	35	13.3
6.1	3.9	60.4	59	8.1	296	1731	329	36	13.4
5.6	3.3	64.4	48	10.1	211	1537	201	40	12.7

Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator blocks (small blocks established during the base N applications) with higher (+60 lb N/ac) and lower (-30 lb N/ac) rates were applied in the field on April 5, 2023 to monitor and determine when fertigation was needed.

If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with four paired sectors of each treatment (each sector was about 6 acres, buffered 60 feet internally to reduce sprinkler package overlap between sectors); the field trial layout is shown at right.



Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring and directing N fertigation applications following the April 5, 2023 N application; N-Time® directed N applications are shaded in gray to the right of the double vertical lines in the table below.

	4/5	6/29	7/10	7/24	Total N Applied
Treatment	----------*lb N/ac applied*----------				
Grower N Management	120 [a]	16[b]	33 [b]	19 [b]	**188**
Sentinel Fertigation N-Time®	120 [a]	-	-	-	**120**

[a] Product used was NH3 for indicator block establishment

[b] Product used was 30-0-0-3 S

Results:

	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 N Management	188	15.5 A*	260 A	77 B	0.73 A	1,179 A
Sentinel Fertigation N-Time®	120	15.6 A	259 A	121 A	0.47 B	1,217 A
P-Value	N/A	0.385	0.837	<0.0001	<0.0001	0.161

	Stand Count (plants/ac)	Stalk Rot (%)	Green snap (%)	Total Digestible Nutrients (TDN) (%)	Crude Protein (%)
Grower N Management	32,000 A*	15.5 A	0	88.2 A	9.02 A
Sentinel Fertigation N-Time®	32,600 A	15 A	0	88.4 A	9.04 A
P-Value	0.578	0.924	N/A	0.45	0.871

*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 $5/bu corn and $0.63/lb N.

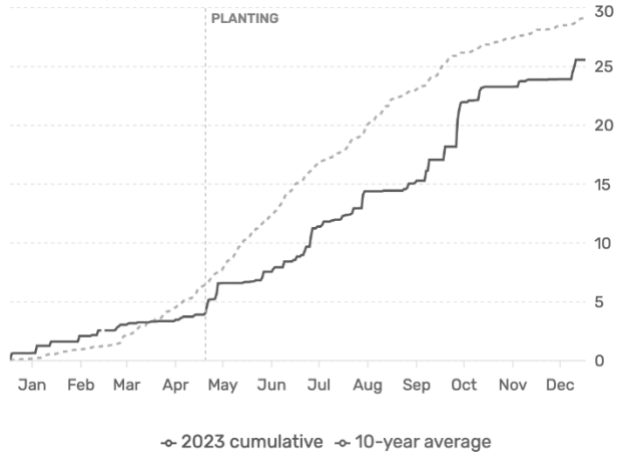
Summary: The Sentinel Fertigation N-Time® management did not recommend any additional nitrogen applications beyond the initial NH_3 base rate, which resulted in a 68 lb N/ac reduction in N fertilizer compared to the grower's traditional N management. With no yield difference, this resulted in a 57% increase in N use efficiency. There was no significant difference in marginal net return. There was also no significant difference in stand counts, stalk rot, total digestible nutrients, or crude protein based on samples taken during the growing season.

This research was partly supported by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

Study ID: 1256139202302
County: Pierce
Soil Type: Thurman loamy fine sand 2-6% slopes
Planting Date: 5/4/23
Harvest Date: 10/10/23
Seeding Rate: 33,000
Row Spacing (in): 30
Hybrid: Pioneer® P1413AM
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** Resicore XL®, Durango®, and atrazine on 5/4/23 ***Post:*** Resicore XL®, atrazine, and Durango® on 5/30/23
Seed Treatment: Unknown
Foliar Insecticides: Sniper® at VT (for western bean cutworm)
Foliar Fungicides: AzoxyProp at VT

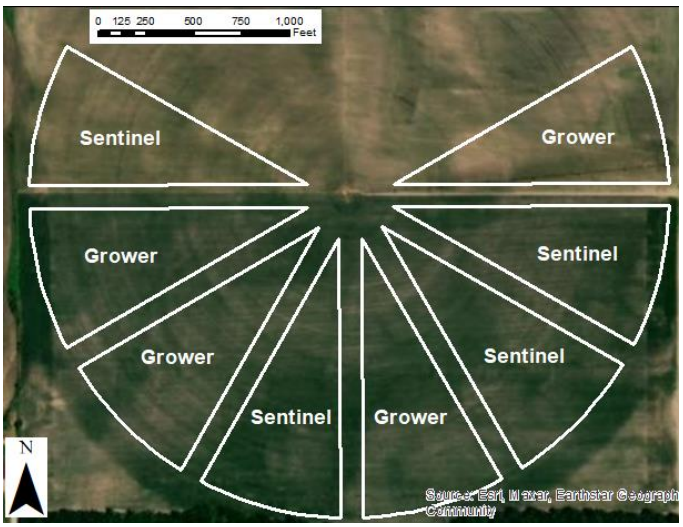
Fertilizer: Variable rate application of 0-0-45-9 averaging 167 lb/ac applied 3/25/23
Irrigation: Pivot, Total: 13"
Rainfall (in):



Baseline Soil Samples 0-6" (April 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
7	1.1	24.6	53	9.3	198	610	101	9	4.4
8	2.3	25.8	53	13.5	204	1246	138	19	8
8.7	1.9	15.1	38	7.9	241	895	123	12	6.2

Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator sectors (small slices established during the first fertigation event) with higher (+32 lb N/ac) and lower (-30 lb N/ac) N rates were applied in the field using a variable-rate injection pump on May 25, 2023 to determine when fertigation is needed. If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with four paired sectors of each treatment (each sector was about 12.5 acres buffered 60 feet internally to reduce sprinkler package overlap between sectors as shown in the image at right).



Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring N fertigation need following the May 25, 2023 N application (at double vertical line in table below). Applications to the Sentinel treatment on June 2, June 9, and June 18 were not directed by N-Time® but rather were flat rate applications for the entire field. The N-Time® directed N applications are indicated in the grey shaded portion of the table (June 25 and June 28). The applied values were averaged across all reps; therefore, if only one out of four replications triggered an application of 35 lb N/ac, a value of 8.75 lb N/ac is reported as the average treatment N application across replications.

	4/1	5/4	5/25	6/2	6/9	6/18	6/25	6/28	6/29	6/31	Total N rate (lb/ac)
Treatment	----------*lb N/ac applied*----------										
Grower N Management	10[a]	24.8[b]	36[b]	34.8[c]	16.7[c]	17.9[c]	-	35[d]	22[e]	3.5[e]	**201**
Sentinel Fertigation N-Time®	10[a]	24.8[b]	36[b]	34.8[c]	16.7[c]	17.9[c]	30[d]	8.75[d]	-	-	**179**

[a] Product used was 11-52-0

[b] Product used was 80% 32% UAN/20%Thiosul Blend

[c] Product used was 32% UAN/Thiosul Blend

[d] Product used was 32% UAN

[e] Product used was 95% 32% UAN/5% Thiosul blend

Results:

	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 N Management	201 A*	18.9 A	299 A	84 A	0.67 A	1,369 A
Sentinel Fertigation N-Time®	179 A	19.0 A	301 A	96 A	0.59 A	1,393 A
P-Value	0.189	0.280	0.654	0.160	0.122	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 corrected to 15.5% moisture.

‡Marginal net return based on $5/bu corn and $0.63/lb N.

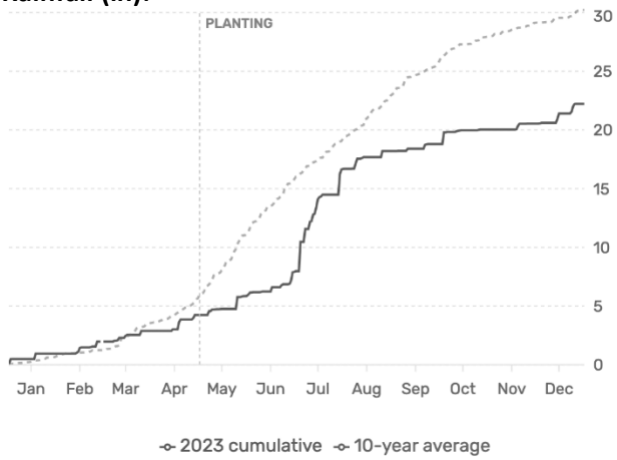
Summary: The Sentinel Fertigation N-Time® management did not apply a significantly lower N rate compared to the grower. The Sentinel N-Time® software began monitoring the field to determine N need on May 25, 2023; however, fertilizer was applied to the entire field on June 2, June 9, and June 18 that was not recommended by the N-Time® software. There would be greater potential for N savings using the N-Time® software if it was used to direct applications earlier in the season. Yield, nitrogen efficiency, and marginal net return were not significantly different between the Sentinel Fertigation N-Time® management and the grower's traditional management.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

Study ID: 1348159202301
County: Seward
Soil Type: Hastings silt loam 0-1% slope; Hall silt loam
Planting Date: 5/1/23
Harvest Date: 10/10/23
Seeding Rate: 32,960
Row Spacing (in): 30
Hybrid: Brevant® 12C01AM
Reps: 4
Previous Crop: Soybean
Tillage: Strip-till
Herbicides: ***Pre:*** 60 oz/ac Harness Max® and 44 oz/ac Roundup PowerMAX® on 5/5/23 ***Post:*** 30 oz/ac Harness Max® and 1 pt/ac Atrazine 4L on 6/2/23
Seed Treatment: None

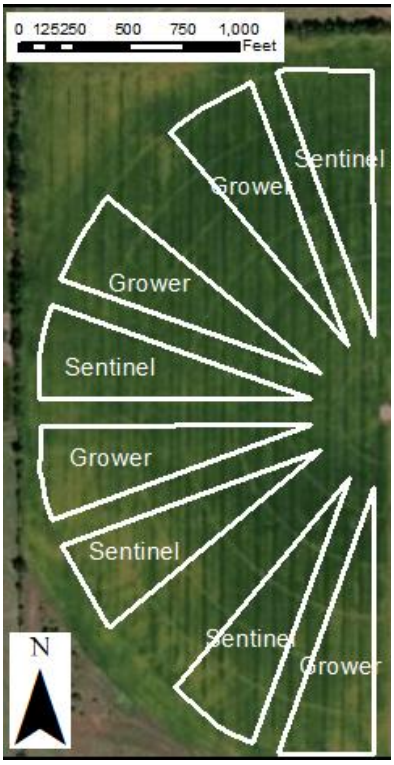
Foliar Insecticides: 2 oz/ac Mustang® Max on 5/5/23
Foliar Fungicides: Trivapro®
Note: Field was hailed on 7/5/23
Irrigation: Pivot
Rainfall (in):



Baseline Soil Samples 0-6" (May 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
6.1	3.4	61.9	52	22.2	302	1781	198	36	13.4
5.9	3.7	56.7	98	15.9	343	1772	220	34	13.7
5.6	4.1	70.8	103	27.5	359	1700	210	34	14.4

Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator sectors (small slices established during the first fertigation event) with higher (+30 lb N/ac) and lower (-30 lb N/ac) rates were applied in the field (using a variable rate injection pump) on June 9, 2023 to determine when fertigation is needed.



If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with four paired sectors of each treatment (each sector was about 6 acres, buffered 60 feet internally to reduce sprinkler package overlap between sectors as shown at right).

The field had a rye cover crop that was terminated on May 5, 2023.

Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring and directing N fertigation applications following the June 9, 2023 N application; further N-Time® directed N applications (see note in summary below) are shaded in gray to the right of the double vertical lines in the table below. The applied values were averaged across all reps; therefore, if only two out of four replications triggered an application of 30 lb N/ac, a value of 15 lb N/ac is reported as the average treatment N application across replications.

	4/6	4/6	5/5	6/9	6/21	7/26	Total N rate (lb/ac)
Treatment							
Grower N Management	58[a]	13[b]	17[c]	50[d]	34[e]	52[f]	**224**
Sentinel Fertigation N-Time®	52[a]	11[b]	17[c]	50[d]	-	15[f]	**145**

[a] Product used was Urea via Pre-Plant/Strip Till

[b] Product used was MAP

c Product used was 32-0-0 via Pre emerge herbicide

d Product used was 32%UAN via Indicator slices establishment app

e Product used was 30-0-0-3 S

f Product used was 32%UAN

Results:

	Total N rate (lb/ac)	Moisture (%)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lb N/bu grain	Marginal Net Return‡ ($/ac)
Grower N Management	224	15.2 A	248 A	62 B	0.91 A	1,097 A
Sentinel Fertigation N-Time®	145	15.1 B	230 B	89 A	0.64 B	1,056 A
P-Value	N/A	0.048	0.016	0.002	0.0001	0.109

	Stand Count (plants/ac)	Stalk Rot (%)	Green snap (%)	TDN (%)	Crude Protein (%)
Grower N Management	32,625 A	1.88 A	1 A	88 A	10 A
Sentinel Fertigation N-Time®	31,875 A	5.00 A	0 A	88 A	9 B
P-Value	0.659	0.579	0.391	0.353	0.059

*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 $5/bu corn and $0.63/lb N.

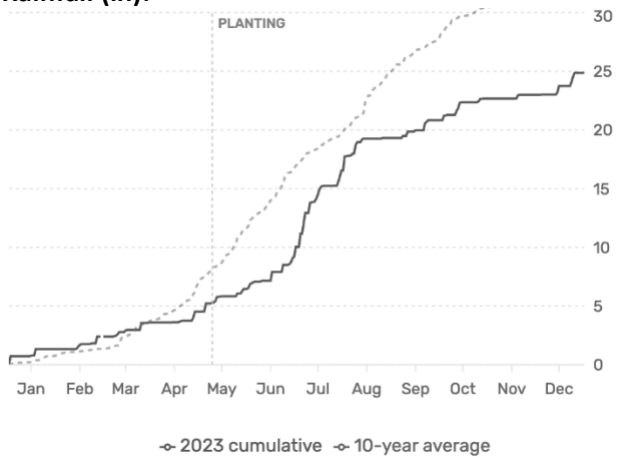
Summary:

- An error in field indicator blocks setup on the south half of the field resulted in a failure of half of the study area. The result was 5-6 fewer bushels per acre compared to the north half of the field. This error only impacted the Sentinel management.
- Stand counts, stalk rot, and green snap were not different between the Sentinel Fertigation N-Time® treatment and the grower's traditional management.
- The Sentinel Fertigation N-Time® management resulted in a 79 lb N/ac reduction in fertilizer which corresponded to an 18 bu/ac decrease in yield compared to the grower's traditional N management.
- The Sentinel Fertigation N-Time® management resulted in a 43% increase in nitrogen use efficiency.
- Crude protein was higher for the grower compared to the Sentinel Fertigation N-Time® management but total digestible nutrients (TDN) were not different between the treatments.
- There was no significant difference in marginal net return.

This research was partly supported by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

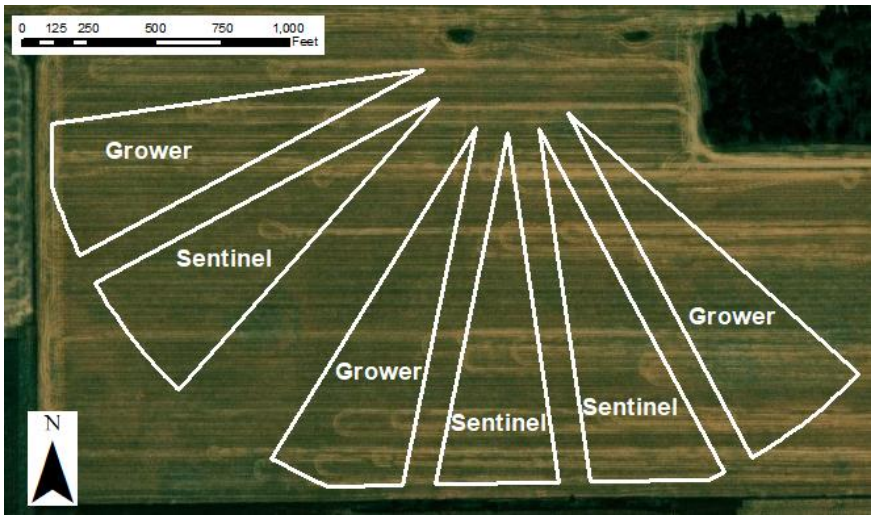
Study ID: 1408143202301
County: Polk
Soil Type: Hastings silt loam 1-3% slope
Planting Date: 5/9/23
Harvest Date: 10/7/23-10/14/23
Seeding Rate: 32,160
Row Spacing (in): 30
Hybrid: Dekalb® DKC63-90
Reps: 3
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** None ***Post:*** 31.59 oz/ac atrazine, 7.9 oz/ac Diflexx®, 21.73 oz/ac Roundup PowerMAX®, 11.86 oz/ac Trivolt®, and 9.48 oz/ac Redlock® on 5/18/23
Seed Treatment: Acceleron® 500
Foliar Insecticides: 6 oz/ac Frenzy Veloz® and 12 lb/ac Lockdown®
Foliar Fungicides: 6.8 oz Aproach® Prima, 32 oz/ac Accrue®, Aurora ETA 8oz/ac (Aurora Accrue 8% N, 3% S, 1% iron, 2% manganese, 3% Zn weight 10.8 lb/gal) on 8/1/23
Irrigation: Pivot, Total: 7.45"
Rainfall (in):



Baseline Soil Samples 0-6" (April 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
5	2.9	9	24	7.2	211	1582	173	6	14.3
4.8	3.1	10.3	27	7.8	267	1677	182	5	14.6
6.4	4.1	16.1	41	7.3	238	2089	262	8	13.4

Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator sectors (small slices established during the first fertigation event) with higher (+30 lb N/ac) and lower (-30 lb N/ac) N rates were applied in the field (using a variable rate injection pump) on July 15, 2023 and July 18, 2023 to determine when fertigation was needed. If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) was noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with four paired sectors of each treatment (each sector was about 7 acres buffered 60 feet internally to reduce sprinkler package overlap between sectors as shown at right).



Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring and directing N fertigation applications following the July 18, 2023 N application; further N-Time® directed N applications are shaded in gray to the right of the double vertical lines in the table below.

	5/9	5/11	7/15	7/18	7/21	7/25	Total N rate (lb/ac)
Treatment		*lb N/ac applied*					
Grower N Management	6.4 [a]	115[b]	22[c]	15.2 [c]	40 [d]	18.3[d]	**216.9**
Sentinel Fertigation N-Time®	6.4 [a]	115[b]	22[c]	15.2[c]	-	-	**158.6**

[a] Product used was starter fertilizer during planting

[b] Product used was blend of Urea/AMS/MAP via block establishment

[c] Blend of 32% UAN, thiosul & boron

[d] Product used was 26-0-0-8 S

Results:

	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 N Management	216.9	17.5 A	229 A	59 B	0.95 A	1,010 A
Sentinel Fertigation N-Time®	158.6	17.8 A	226 A	80 A	0.70 B	1,031 A
P-Value	-	0.454	0.371	0.002	0.002	0.277

	Stand Count (plants/ac)	Stalk Rot (%)	Green snap (%)	Total Digestible Nutrients (TDN) (%)	Crude Protein (%)
Grower N Management	29,167 A	5.83 A	3 B	89 A	9 A
Sentinel Fertigation N-Time®	24,667 B	7.50 A	13 A	88 A	9 A
P-Value	0.096	0.837	0.032	0.423	0.398

*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 $5/bu corn and $0.63/lb N.

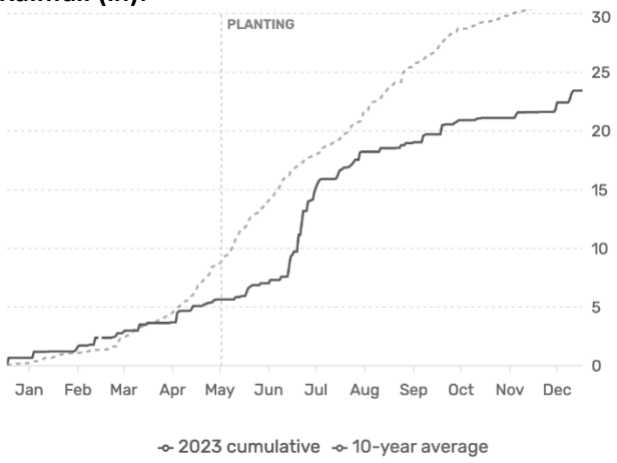
Summary:

- Stand counts were higher for the grower treatment compared to the Sentinel Fertigation N-Time® treatment.
- The Sentinel Fertigation N-Time® treatment had greater green snap.
- Crude protein and total digestible nutrients (TDN) were not different between the treatments.
- The Sentinel Fertigation N-Time® management recommended no further nitrogen applications during the growing season, which resulted in a 58 lb N/ac reduction in N fertilizer compared to the grower's N management with no difference in yield, resulting in a 36% increase in nitrogen use efficiency. There was no significant difference in marginal net return.

This research was partly supported by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

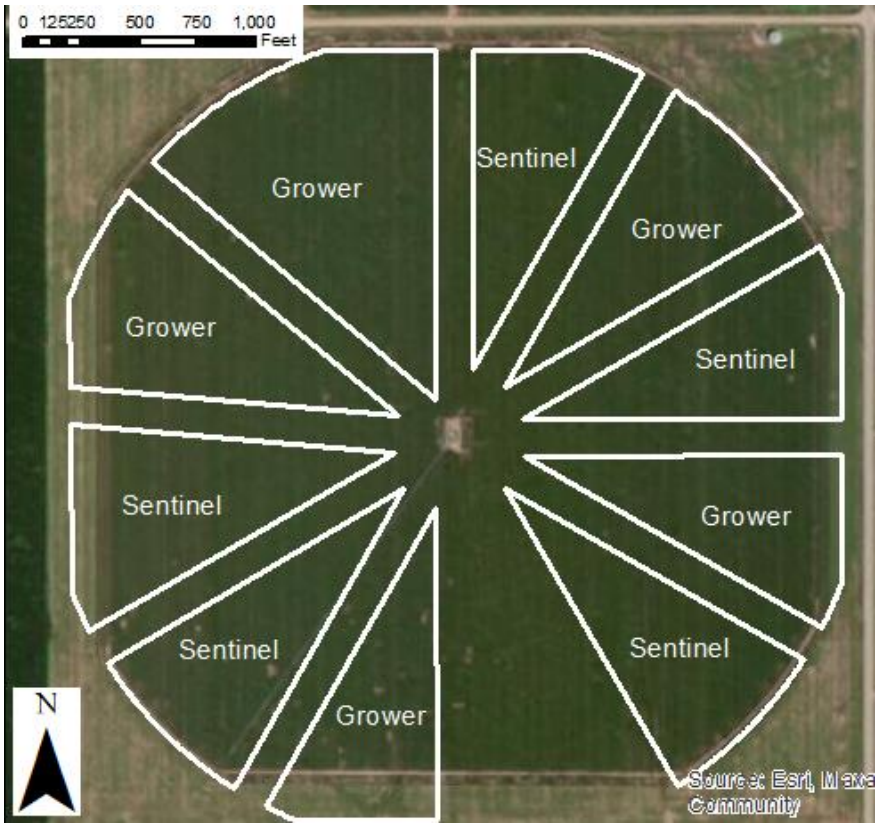
Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

Study ID: 1525023202301
County: Butler
Soil Type: Hastings silt loam 0-1% slope
Planting Date: Seitec® 6381 (75%), Pioneer® P1359
Harvest Date: 10/9/23
Seeding Rate: 33,000 seeds/acre
Row Spacing (in): 30
Hybrid: 5/16/23-5/17/23
Reps: 5
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 22 oz/ac Roundup PowerMAX®, 12 oz/ac Verdict, 6 oz/ac METHSOYOIL®, 1 pt/ac Syatos, 1 qt/ac Wex®, 3 lb/ac AMS, 2 oz/ac Interlock® ***Post:*** None
Seed Treatment: Unknown
Foliar Insecticides: 10 oz/ac Hero® on 7/29/23
Foliar Fungicides: 14 oz/ac Cover XL® on 7/29/23
Irrigation: Pivot, Total: 11.08"
Rainfall (in):



Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator blocks (small blocks established during the base N applications) with higher (+30 lb-N/ac) and lower (-30 lb-N/ac) nitrogen rates were applied in the field on May 16, 2023 to monitor and determine when fertigation was needed.

If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with five paired sectors of each treatment (each sector was about 12 acres, buffered 60 feet internally to reduce sprinkler package overlap between sectors); the field trial layout is shown at right.



Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring and directing N fertigation applications following the May 16, 2023 N application; further N-Time® directed N applications are shaded in gray to the right of the double vertical lines in the table below. The applied values were averaged across all reps; therefore, if only one out of four replications triggered an application of 32 lb N/ac, a value of 8 lb N/ac is reported as the average treatment N application across replications.

	5/ 16	6/20	6/28	8/4	Total N Applied
Treatment	*lb N/ac applied*				
Grower N Management	45[a]	45[b]	45[c]	49[c]	**184**
Sentinel Fertigation N-Time®	45[a]	45[b]	-	30[c]	**120**

[a] Product used was 90% 32% UAN/10%Thiosul blend applied via fertigation with Indicator block Rx
[b] Product used was 90% 32% UAN/10%Thiosul blend applied via sprayer application
[c] Product used was 90% 32% UAN/10%Thiosul blend

NOTE: for the grower sectors, the nitrogen application began on 6/28; however, there was a delay of 2-3 weeks to finalize the application (due to extensive rainfall).

NOTE: On 6/28, Sentinel recommended an N application, but that application was not performed due to software issues and then delayed due to rainfall.

Results:

	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 N Management	184	17.9 A*	274 A	83 B	0.67 A	1,254 A
Sentinel Fertigation N-Time®	120	17.3 B	261 B	122 A	0.46 B	1,230 B
P-Value	N/A	0.017	0.001	<0.0001	<0.0001	0.030

	Stand Count (plants/ac)	Stalk Rot (%)	Green snap (%)	TDN (%)	Crude Protein (%)
Grower N Management	30,900 A	1.00 A	6 A	89 A	9 A
Sentinel Fertigation N-Time®	32,200 A	0.00 A	2 A	89 A	9 A
P-Value	0.328	0.374	0.212	0.522	0.491

*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 $5/bu corn and $0.63/lb N.

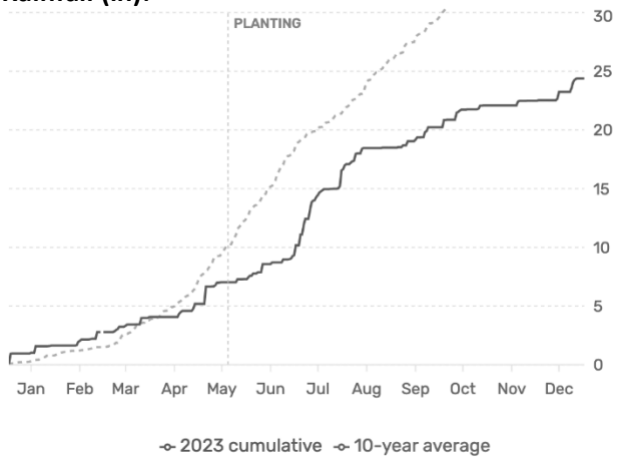
Summary:

- There were no differences in stand counts, stalk rot, or green snap between the two treatments.
- The total N rate was 64 lb/ac lower for the Sentinel Fertigation N-Time® management, which resulted in a 13 bu/ac yield decrease.
- Marginal net return was $24/ac greater for the grower N management.
- Total digestible nutrients (TDN) and crude protein did not differ between the treatments.
- The Sentinel Fertigation N-Time® management resulted in a 47% increase in nitrogen use efficiency

This research was partly supported by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery-Based Nitrogen Fertilization with Sentinel Fertigation N-Time®

Study ID: 1526037202301
County: Colfax
Soil Type: Alda fine sandy loam 0-1% slope
Planting Date: 5/19/23
Harvest Date: 11/3/23
Seeding Rate: 32,000 seeds/acre
Row Spacing (in): 30
Hybrid: Pioneer® P1366AM
Reps: 4
Previous Crop: Soybean
Tillage: Conventional Till
Herbicides: ***Pre:*** 2.25 qt/ac Lexar®, 17.6 oz/ac DiFlexx®, 56 oz/ac Roundup®, with 5 lb/ac ammonium sulfate in late May ***Post:*** 40 oz/ac Roundup® with 2.5 lb/ac ammonium sulfate on 6/12/23
Seed Treatment: Standard Pioneer® treatment
Foliar Insecticides: 6.4 oz/ac Bifenthrin2EC and 13.7 oz/ac Trivapro® in late August
Note: Minor wind damage
Irrigation: Pivot, Total: 13.5"
Rainfall (in):



Baseline Soil Samples 0-6" (May 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
5.1	1.7	35	63	23.2	161	578	80	17	7.7
5.6	1.8	30	115	20.6	227	535	77	17	6.7
5.9	1.5	16.5	43	17	142	677	98	17	6

Introduction: Corn nitrogen (N) management may be improved by using sensors or imagery to detect and respond to corn N needs during the growing season. Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator sectors (small slices established during the first fertigation event) with higher (+30 lb N/ac) and lower (-30 lb N/ac) N rates were applied in the field (using a variable rate injection pump) on June 23, 2023 to determine when fertigation was needed. If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season. This study compared the grower's standard N management to the Sentinel Fertigation N-Time® N management, with four paired sectors of each treatment (each sector was about 4 acres buffered 60 feet internally to reduce sprinkler package overlap between sectors as shown below) on two three-span half-pivots as shown below.

Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® began monitoring and directing N fertigation applications following the June 23, 2023 N application; further N-Time® directed N applications are shaded in gray to the right of the double vertical lines in the table below.

	5/25	6/23	6/27	7/10	7/20	Total N Applied
Treatment	----------*lb N/ac applied*----------					
Grower N Management	50 [a]	60[b]	70 [c]	25 [c]	-	**205**
Sentinel Fertigation N-Time®	50 [a]	60[b]	-	-	30 [c]	**140**

[a] Product used was 32-0-0-4 S via planter

[b] Product used was 32-0-0-4 S via fertigation for indicator slice establishment

[c] Product used was 32-0-0-4 S

Results:

	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 N Management	205	16.6 A*	233 A	64 B	0.88 A	1,036 A
Sentinel Fertigation N-Time®	140	16.2 B	235 A	94 A	0.60 B	1,087 A
P-Value	N/A	0.042	0.805	0.001	0.001	0.248

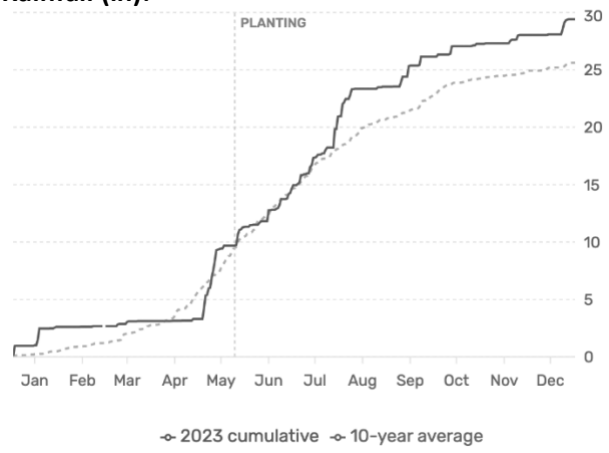
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre were corrected to 15.5% moisture.
‡Marginal net return based on $5/bu corn and $0.63/lb N.

Summary: The Sentinel Fertigation N-Time® management recommended only one additional nitrogen application beyond the initial base rates. This resulted in a 65 lb N/ac reduction in N fertilizer with no yield penalty. As a consequence, each unit of N applied produced more lb of grain, resulting in a 47% increase in nitrogen use efficiency. There was no statistically significant difference in marginal net return.

This research was partly supported by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery- and Model-Based Nitrogen Fertilization with Sentinel Fertigation N-Time® and Adapt-N

Study ID: 1231111202301
County: Lincoln
Soil Type: Hord silt loam 0-1% slope
Planting Date: 5/24/23
Harvest Date: 10/25/23, 10/31/23, 11/2/23
Seeding Rate: 32,000 seeds/acre
Row Spacing (in): 30
Hybrid: Pioneer® P0075
Reps: 5
Previous Crop: Soybean
Tillage: Strip-till
Herbicides: ***Pre:*** 16 oz/ac Armezon Pro®, 0.5 oz/ac Armezon®, and 32 oz/ac Atra-V™ 4L on 5/24/23
Post: 3 oz/ac Laudis®, 64 oz/ac Warrant®, and 6 oz/ac dicamba on 6/20/23
Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: Pivot
Rainfall (in):

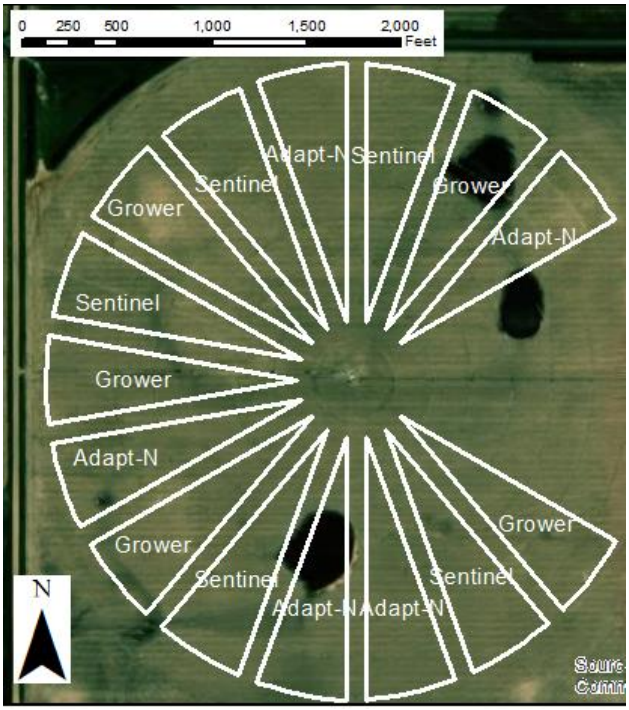


Baseline Soil Samples 0-6" (May 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
7.1	2.6	0.9	15	14.6	399	1739	175	26	11.3
7.5	2.8	0.1	30	16.5	449	1634	132	19	10.5
6.9	3.6	7.8	46	11.6	509	1879	141	19	12

Introduction: Corn nitrogen (N) management may be improved by using dynamic tools such as sensors, imagery, and crop models to respond to corn N needs during the growing season. These tools can account for field variability to improve nitrogen use efficiency and farmers' profits.

- Adapt-N is a dynamic crop modeling software that simulates crop growth and N requirements. Previously, Adapt-N has been evaluated for a single N application. In this study, Adapt-N was instead evaluated as a tool to monitor N throughout the season and direct N application(s) through fertigation.
- Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator blocks (small blocks established during the base N applications) with higher (+60 lb N/ac) and lower (-30 lb N/ac) nitrogen rates were applied in the field on May 26, 2023 to monitor and determine when fertigation was needed. If an N application was recommended by N-Time® the N (lb N/ac) applied via fertigation (typically 30 or 60 lb N/ac) was noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season.



Comparing Adapt-N and Sentinel Fertigation's N-Time® with the grower's current fertigation management allows for evaluation of the potential benefits of dynamic crop model N management and imagery-based management. Different sectors of the pivot may receive different recommendations. Five replicate sectors (each about 7 acres shown above) were included in the study for each of the three treatments (grower, Adapt-N and Sentinel). Note that one replicate block on the east side of the field was removed due to issues with a missed application in the Adapt-N sector.

Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (in lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® or Adapt-N began monitoring and directing N fertigation applications following the June 21, 2023 N application; further N-Time® or Adapt-N directed N applications are shaded in gray to the right of the double vertical lines in the table below. Applied values were averaged across all reps; therefore, if only two out of five replications triggered an application of 40 lb N/ac, a value of 16 lb-N/ac is reported as the average treatment N application across replications.

	4/21	6/9	6/21	7/24	8/12	Total N rate (lb/ac)
Treatment	----------*lb N/ac applied*---------					
Grower N Management	25[a]	43.5[b]	50[c]	37.5[b]	-	156
Sentinel Fertigation N-Time®	25[a]	43.5[b]	50[c]	-	-	119
Adapt-N	25[a]	43.5[b]	50[c]	16[b]	9[b]	144

[a] Product used was 31-0-0-1 S via stream

[b] Product used was 50-0-0-5 S +Mol

[c] Product used was 50-0-0-5 S +Mol via Indicator block Rx

Results:

	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 N Management	156 A*	16.5 A	232 A	83 C	0.67 A	1,064 A
Sentinel Fertigation N-Time®	119 C	16.5 A	226 B	106 A	0.52 C	1,056 A
Adapt-N	144 B	16.5 A	231 AB	91 B	0.62 B	1,065 A
P-Value	0.0002	0.876	0.058	0.0001	0.0003	0.681

*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 $5/bu corn and $0.63/lb N.

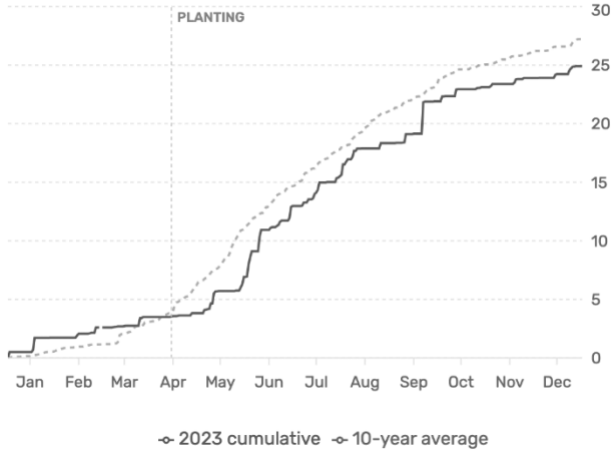
Summary:

- Compared to the grower's traditional management, the Adapt-N management resulted in a 12 lb N/ac reduction with no yield decrease. Meanwhile, the Sentinel Fertigation N-Time® management resulted in a 37 lb N/ac reduction and a 6 bu/ac yield decrease.
- Compared to the grower's traditional management, nitrogen efficiency was 10% greater when using the Adapt-N management and 28% greater when using the Sentinel Fertigation N-Time® management.
- There was no significant difference in marginal net return.

This research was partly supported by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Imagery- and Model-Based Nitrogen Fertilization with Sentinel Fertigation N-Time® and Adapt-N

Study ID: 0195019202302
County: Buffalo
Soil Type: Wood River silt loam; Hall silt loam; Hord silt loam
Planting Date: 4/14/23 & 4/17/23
Harvest Date: 10/3/23-10/6/23
Seeding Rate: 34,000
Row Spacing (in): 30
Hybrid: Channel® 211-11VT2PRIB
Reps: 4
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 2 qt/ac Degree Xtra®, 3 oz mesotrione, and 1% COC ***Post:*** 1.25 qt/ac Harness® Max, 1 pt/ac atrazine, 8 oz/ac Tough®, 20 oz/ac Roundup PowerMAX® 3, and 8.5 lb AMS/100 gal
Seed Treatment: Standard Channel® seed treatments
Foliar Insecticides: None
Foliar Fungicides: 10.5 oz/ac azoxystrobin and propiconazole package mix applied at R1
Irrigation: Pivot
Rainfall (in):



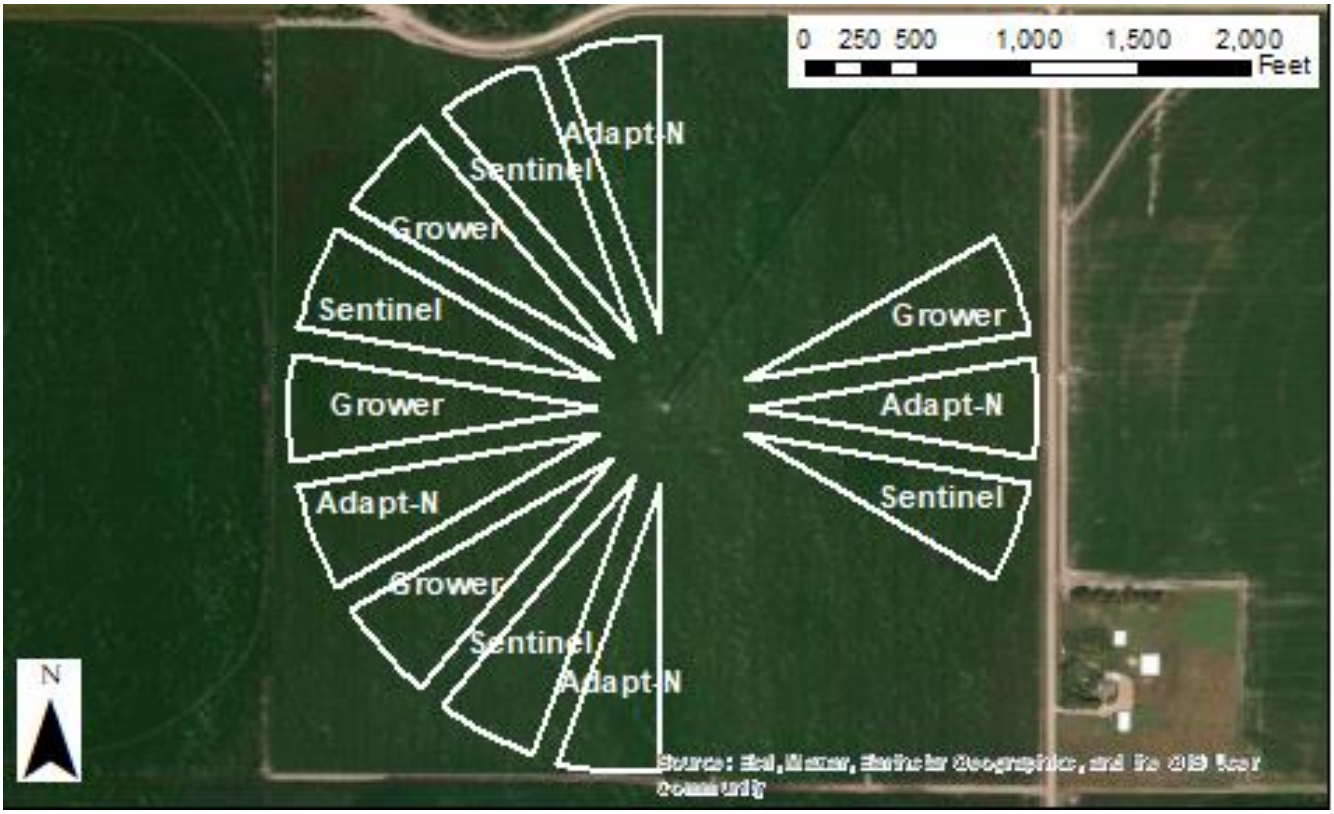
Baseline Soil Samples 0-6" (May 2023):

pH	OM LOI %	Nitrate–N ppm N	M3–P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g
7.6	3.3	41.9	73	22	567	2031	305	125	14.7
7.6	3	29.1	69	25.5	500	1691	277	111	12.5
8.1	2.8	20.1	58	30.6	554	1741	274	124	12.9

Introduction: Corn nitrogen management may be improved by using dynamic tools such as sensors, imagery, and crop models to respond to corn N needs during the growing season.

- Adapt-N is a dynamic crop modeling software that simulates crop growth and N requirements. Previously, Adapt-N has been utilized to direct single N applications. In this study, Adapt-N was instead used as a tool to monitor N throughout the season and direct N application(s) through fertigation.
- Sentinel Fertigation's N-Time® application analyzes multispectral images to deliver fertigation scheduling recommendations. Indicator blocks (small blocks established during the base N applications) with higher (+60 lb N/ac) and lower (-30 lb N/ac) rates were applied in the field on May 26, 2023 to monitor and determine when fertigation was needed. If an N application was recommended by N-Time® the N applied via fertigation (typically 30 or 60 lb N/ac) is noted in the application table below. Note that different Sentinel sectors of the pivot may receive different recommendations throughout the growing season.

Evaluating Adapt-N and Sentinel Fertigation's N-Time® with the grower's current fertigation management evaluates the potential benefits of dynamic crop model N management and imagery-based management. Different sectors of the pivot may receive different recommendations. Four replicate sectors (each about 8 acres shown below) were included in the study for each of the three treatments (grower, Adapt-N and Sentinel). Note that two replicate blocks were removed due to issues with the harvest data and the lack of yield data points in those sectors.



Application Table: Nitrogen applied throughout the 2023 growing season is included in the table below. N applications (lb N/ac) are noted by date, along with products applied at those instances. Sentinel N-Time® or Adapt-N began monitoring and directing N fertigation applications following the May 26, 2023 N application. Applications directed by N-Time® or Adapt-N are shaded in gray to the right of the double vertical lines in the table below. Applied values were averaged across all reps; therefore, if only one out of four replications triggered an application of 30 lb N/ac, a value of 7.5 lb N/ac is reported as the average treatment N application across replications.

	3/23	4/14	5/26	7/6	7/13	7/21	7/26	Total N rate (lb/ac)
Treatment	*lb N/ac applied*							
Grower N Management	8.7[a]	51[b]	35[c]	21[c]	-	42.5[c]	28[c]	**186**
Sentinel Fertigation N-Time®	8.7[a]	51[b]	35[c]	-	-	-	7.5[c]	**102**
Adapt-N	8.7[a]	51[b]	35[c]	30[c]	30[c]	40[c]	-	**195**

[a] Product used was 10-34-0 applied with strip till
[b] Product used was 32-0-0 applied with planter
[c] Product used was 32-0-0

Results:

	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 N Management	186 A	17.5 A*	268 A	81 B	0.70 A	1,221 B
Sentinel Fertigation N-Time®	102 B	17.3 A	266 A	148 A	0.38 B	1,266 A
Adapt-N	195 A	17.1 A	266 A	77 B	0.73 A	1,209 B
P-Value	N/A	0.696	0.881	<0.0001	<0.0001	0.0416

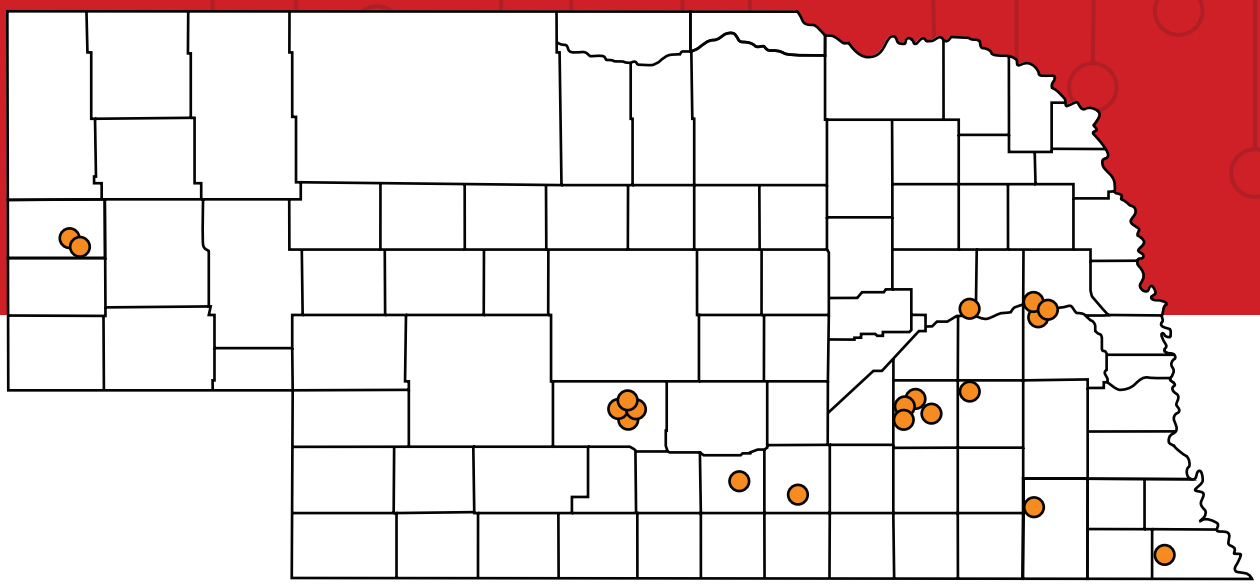
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5/bu corn and $0.63/lb N.

Summary:

- Compared to the grower's traditional management, the Adapt-N management resulted in a 9 lb N/ac increase in N while the Sentinel Fertigation N-Time® management resulted in an 84 lb N/ac reduction in N, both with no statistical difference in yield.
- Compared to the grower's traditional management, N efficiency was 5% lower when using the Adapt-N management and 83% greater when using the Sentinel Fertigation N-Time® management.
- Net return for the Sentinel Fertigation N-Time® management was $45/ac greater than the grower's traditional management. There was no difference in net return between the Adapt-N management and the grower's traditional management. Subscription and technology costs to implement the Sentinel Fertigation N-Time® or Adapt-N management were not included in this calculation.

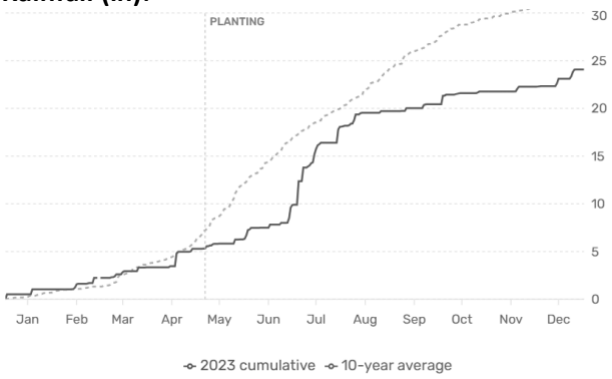
This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

NON-TRADITIONAL PRODUCTS



Biological Treatment Study in Irrigated Corn

Study ID: 1395159202302
County: Seward
Soil Type: Muir silt loam; Hall-Olbut
Planting Date: 5/6/23
Harvest Date: 10/16/23
Seeding Rate: 32,000
Row Spacing (in): 30
Hybrid: Sietec® 6345
Reps: 3
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 8.5 pt/ac Surestart®, 1 pt/ac atrazine, and 18 oz/ac Buccaneer™ K on 5/8/23
Post: 2 qt/ac generic Lexar on 6/7/23
Seed Treatment: Poncho® 250
Foliar Insecticides: 10 oz/ac Hero® on 7/24/23
Foliar Fungicides: 14 oz/ac Aframe® Plus on 7/24/23
Fertilizer: 37 gal/ac 32% UAN and thiosulfate on 6/9/23 for normal rate; 26 gal/ac 32% UAN and thiosulfate on 6/9/23 for 40 lb/ac reduced rate; 15 gal/ac 32% UAN and thiosulfate on all acres at planting
Note: Entire field had rye cover crop which was terminated with glyphosate at planting
Irrigation: Pivot
Rainfall (in):



Introduction: With increasing nitrogen costs, this study evaluated several biological products at different nitrogen rates to determine any impacts on yield and economics. This is the second year of this study with the treatments remaining on the same strips. Based on the Year 1 results, the following changes were made in Year 2: No starter fertilizer applied in the Check, Johnson-Su, and Pivot Bio treatments; adding a low N rate for the check treatment; the use of Liquid Pro + Zn instead of Turned Compost treatment; and higher N rates being corn on corn. Yield goal was 230 bu/ac with UNL N recommendation of 183 lb N/ac. The treatments this year were as follows:

1. Check High (nothing applied in-furrow; total of 188 lb N/ac)
2. Check Low (nothing applied in-furrow; total of 144 lb N/ac)
3. Johnson-Su High (Johnson-Su applied at 8 gal/ac in-furrow; total of 188 lb N/ac)
4. Johnson-Su Low (Johnson-Su applied at 8 gal/ac in-furrow; total of 144 lb N/ac)
5. Liquid Pro + Zn High (Liquid Pro + Zn in-furrow; total of 188 lb N/ac)
6. Liquid Pro + Zn Low (Liquid Pro + Zn in-furrow; total of 144 lb N/ac)
7. Pivot Bio PROVEN® 40 High (Pivot Bio PROVEN® 40 applied in-furrow; total of 188 lb N/ac)
8. Piovt Bio PROVEN® 40 Low (Pivot Bio PROVEN® 40 applied in-furrow; total of 144 lb N/ac)

At planting, all treatments received 15 gal/ac 32% UAN and thiosulfate. No starter fertilizer was applied on the check, Johnson-Su, or Pivot Bio PROVEN 40® treatments. On June 9, 2023, the "low" treatments received 26 gal/ac 32% UAN and thiosulfate while the "high" treatments received 37 gal/ac 32% UAN and thiosulfate. The total N applied to the low treatments was 144 lb N/ac while the total N applied to the high treatments was 188 lb N/ac.

Johnson-Su compost was produced as an aerobic static compost made from straw and cow manure (https://www.csuchico.edu/regenerativeagriculture/bioreactor/bioreactor-instructions.shtml). It was extracted into water at a rate of 3 lb compost/8 gal of water and applied at 8 gal extract/ac. Biology from the compost is believed to improve fertility and help release soil nutrients.

Pivot Bio PROVEN® 40 is a N-fixing bacterial inoculant that is expected to fix 40 lb N/ac over the growing season. Biological N fixation for cereal crops has potential to increase N efficiency and decrease N loss.

Creating Compost Extract

Results:

	Harvest Stand Count (plants/ac)	Stalk Rot (%)	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	32,000 A*	39.17 AB	59 A	16.3 A	245 A	1,419 A
Reduced Check	31,500 A	29.17 AB	59 A	16.0 A	233 A	1,379 A
Johnson-Su High	31,833 A	38.33 AB	59 A	16.7 A	242 A	1,392 A
Johnson-Su Low	30,167 A	58.33 A	59 A	15.5 A	227 A	1,334 A
Liquid pro + Zn High	31,500 A	30.00 AB	58 A	16.9 A	244 A	1,384 A
Liquid pro + Zn Low	30,833 A	37.50 AB	59 A	16.3 A	237 A	1,373 A
Pivot Bio PROVEN® 40 High	32,667 A	30.83 AB	58 A	15.9 A	244 A	1,391 A
Pivot Bio PROVEN® 40 Low	31,667 A	21.67 B	59 A	15.9 A	237 A	1,383 A
P-Value	0.669	0.072	0.409	0.314	0.886	0.990

*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 $5.91/bu corn, $0.78/lb N, $20/ac for Pivot Bio PROVEN® 40, $5/ac for Johnson-Su, and $27.50/ac for Liquid Pro + Zn.

Summary:

- There were no differences in stand counts, moisture, test weight, yield, or net return between the treatments.
- The Johnson-Su Low treatment had higher stalk rot than the Pivot Bio PROVEN® 40 Low treatment.

Summary of Previous Year (2022)

Phospholipid fatty acid (PLFA) and Haney tests for the check and biological treatments at 0-8” depth taken on September 7, 2022, for one replication. No stats due to one rep.

	Total Biomass (ng/g)	Diversity Index	Total Bacteria Biomass (ng/g)	Total Fungi Biomass (ng/g)	Solvita® (ppm C)	Haney Soil Health Score
	---------- 2022 ----------					
Check	4040	1.02	1376	60	102.3	12.9
Johnson-Su High	3230	0.95	1108	24	125.8	16.4
Turned Compost High	2728	0.80	841	17	111.8	15.7
Pivot Bio	4381	1.11	1559	97	141.7	19.6

Summary of Previous Year (2022) - Continued

Treatments:

1. Check (total 142 lb N/ac): 48 lb N/ac with 2.75 gal/ac AgroLiquid® Pro-Germinator® 9-24-3-0.1% Iron and 0.25 gal zinc sulfate (4%) applied at planting and 94 lb N/ac applied as 32% UAN and thiosulfate on June 23.

2. Johnson-Su Compost High (total 106 lb N/ac): 48 lb N/ac at planting with 8 gal/ac compost extract in-furrow and 58 lb N/ac applied as 32% UAN and thiosulfate on June 23.

3. Johnson-Su Compost Low (total 48 lb N/ac): 48 lb N/ac at planting with 8 gal/ac compost extract in-furrow.

4. Turned Compost High (total 106 lb N/ac): 48 lb N/ac at planting with 8 gal/ac compost extract in-furrow and 58 lb N/ac applied as 32% UAN and thiosulfate on June 23.

5. Turned Compost Low (total 48 lb N/ac): 48 lb N/ac at planting with 8 gal/ac compost extract in-furrow.

6. Pivot Bio PROVEN® 40 (total 106 lb N/ac): 48 lb N/ac with 2.75 gal/ac AgroLiquid® Pro-Germinator® 9-24-3-0.1% Iron and 0.25 gal zinc sulfate (4%) applied at planting and 58 lb N/ac applied as 32% UAN and thiosulfate on June 23. Pivot Bio PROVEN® 40 was applied with starter at planting.

	Stand Count (plants/ac)	Stalk Rot (%)	Test Weight (lb/bu)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	31,500 A*	31.88 C	58 A	16.0 A	235 A	1,399 A
Johnson-Su High	31,500 A	46.88 BC	58 A	15.4 A	220 AB	1,365 A
Johnson-Su Low	31,000 A	75.63 A	58 A	14.9 A	167 C	1,095 C
Turned Compost High	30,500 A	58.25 AB	58 A	15.5 A	212 AB	1,315 AB
Turned Compost Low	29,625 A	59.38 AB	58 A	15.6 A	164 C	1,068 C
Pivot Bio Proven® 40	31,625 A	61.88 AB	58 A	15.6 A	195 B	1,155 BC
P-Value	0.276	0.004	0.659	0.697	<0.0001	0.0001

*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 $6.57/bu corn, $6/ac for Turned compost, $4/ac for Johnson-Su, $21/ac for Pivot Bio PROVEN® 40, $1.27/lb of sidedress N, and $28/ac for starter.

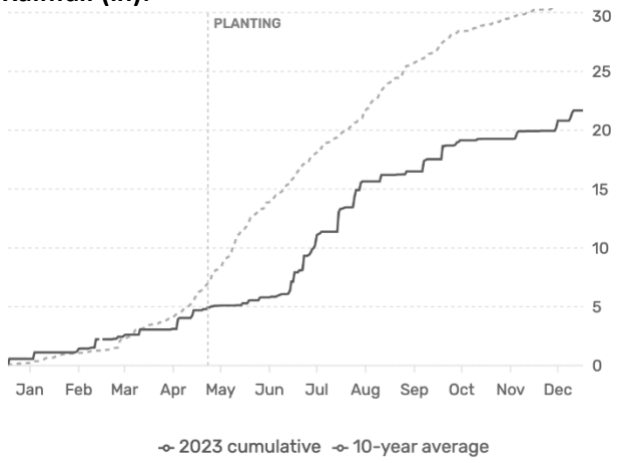
Summary:

- There were no differences in stand counts, grain moisture, or test weight among the treatments evaluated.
- Stalk rot varied greatly among the treatments and was lowest for the check treatment.
- The check treatment had the highest yield. Yields for Johnson-Su and turned compost were significantly higher when the treatment had an additional 58 lb N/ac compared to the same treatments with no sidedress N. The Pivot Bio PROVEN® 40 with 58 lb N/ac, Johnson-Su with no sidedress, and turned compost with no sidedress all yielded significantly lower than the check.
- The highest net return was for the check treatment but was not significantly different than Johnson-Su with sidedress and turned compost with sidedress. Johnson-Su with sidedress and turned compost with sidedress were significantly more profitable than the same treatments with no sidedress. Pivot Bio PROVEN® 40 with sidedress, Johnson-Su without sidedress, and turned compost without sidedress all had significantly lower net return than the check.

Biological Treatment Study in Irrigated Corn

Study ID: 0276185202301
County: York
Soil Type: Hastings silt loam
Planting Date: 5/7/23
Harvest Date: 10/10/23
Seeding Rate: 32,000
Row Spacing (in): 30
Hybrid: Pioneer® P1170AM
Reps: 4
Previous Crop: Soybean
Tillage: Row stalker before planting; cultivated and hilled
Herbicides: ***Pre:*** 2.6 qt/ac Keystone® and 6 oz/ac Callisto® on 5/7/23 ***Post:*** 1 oz/ac Impact®, 1 pt/ac atrazine, and 1 qt/ac Roundup® on 6/2/23
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: 200 lb N/ac as anhydrous ammonia applied in fall 2022
Irrigation: Pivot
Rainfall (in):



Baseline Soil Samples 0-10" (October 2022):

pH	OM LOI %	Nitrate–N ppm N	M3-P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g	Zn ppm	Fe ppm	Mn ppm	Cu ppm
6.5	3.3	9.0	41	12.7	305	1696	237	64	12.8	2.35	41.4	7.9	0.71
5.1	3.3	10.9	75	16.8	393	1664	356	33	21.7	1.23	71	29.4	1.01

Introduction: With increasing nitrogen costs prompting producers to look for alternatives, this study evaluated a biological product to determine any impacts on yield and economics. This study evaluated a homemade compost extract applied in-furrow at 7 gal/ac at planting and compared it to an untreated check. The compost extract contained: 7 gallons of compost extract (equating 2 lb of actual compost), 0.25 lb dry fish amino acid, and 12 oz of SEA-CROP®, an ocean mineral concentrate. Both treatments received 200 lb N/ac as anhydrous ammonia in the fall of 2022. The University of Nebraska-Lincoln N recommendation for a 270 bu/ac yield goal for this field was 201 lb N/ac. Often the nitrogen rate is reduced when comparing biological treatments to determine any impacts; however, the nitrogen was applied in the fall and it was decided to try this study in the spring therefore N rates are the same among treatments. Stand counts, green snap, and stalk rot were evaluated on October 10, 2023. Yield and net return were evaluated.

Results:

	Harvest Stand Count (plants/ac)	Greensnap (%)	Stalk Rot (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	32,375 A*	2 A	1.88 A	15.7 B	279 A	1,646 A
Homemade Compost Extract	32,500 A	1 A	3.13 A	15.9 A	274 A	1,614 A
P-Value	0.718	0.182	0.604	0.080	0.181	0.107

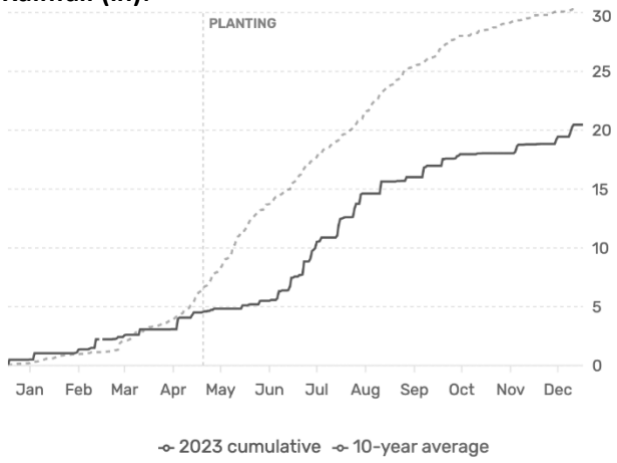
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn and $7.68/ac for compost extract.

Summary:

- There were no differences in stand count, stalk rot, or green snap between the treatments evaluated.
- Use of the compost extract did not result in differences in yield or net return compared to the untreated check.

Biological Treatment Study in Irrigated Corn

Study ID: 0916185202301
County: York
Soil Type: Hastings silt loam
Planting Date: 5/4/23
Harvest Date: 9/28/23
Seeding Rate: 32,000
Row Spacing (in): 36
Hybrid: Pioneer® P1185Q
Reps: 4
Previous Crop: Corn
Tillage: Ridge-till/Root slicer early April
Herbicides: ***Pre:*** Outlook® on 5/15/23 ***Post:*** Zidua® applied first week of June
Seed Treatment: Standard Pioneer treatment package
Fertilizer: 10 gal/ac 10-34-0 banded on 3/24/23; 110 lb N/ac as anhydrous ammonia on the biological treatments, 170 lb N/ac as anhydrous ammonia on the check treatment
Irrigation: Pivot
Rainfall (in):



Background Haney Soil Tests 0-8" (March 2023):

pH	OM LOI %	Soil Respiration CO_2-C ppm C	Total Nitrogen ppm N	Organic Nitrogen ppm N	Total Organic Carbon ppm C	Soil Health Calculation
7.3	3.9	95.5	37.3	28.0	227	16.89

Introduction: With increasing nitrogen costs prompting producers to look at alternatives, this study evaluated two biological products at different nitrogen rates to determine any impacts on yield and economics. No noticeable differences were observed throughout the growing season between treatments. With the goal of increasing soil microbes, there is also the realization they may increase decomposition of soil carbon. To aid in offsetting carbon loss, the entire field was interseeded with dutch white clover (8 lb/ac) on April 4, 2023. The treatments in the study are:

1) Check which received 170 lb N/ac as anhydrous ammonia on March 25, 2023.

2) 7 gallons/ac homemade compost extract in-furrow at planting (2 lb of compost in 7 gallons of water, ¼ lb dry fish amino acid, 8 oz humic acid, 12 oz SEA-CROP®), which received 110 lb N/ac as anhydrous ammonia on March 25, 2023.

3) 6 gallons/ac HyprGrow by Elevate Ag in-furrow at planting (1.5 gallons HyprGrow, ¼ lb dry fish amino acid, 4.5 gal water), which received 110 lb N/ac as anhydrous ammonia on March 25, 2023.

The anhydrous ammonia application was made 10" from the planting row. Yield and net return were evaluated.

Photos: (Top left): Dutch white clover emerging (May 9, 2023); (top middle) Good clover growth between corn rows (July 19, 2023); (top right) Clover matted down late in season. A few waterhemp were observed in the corn row but otherwise the field was fairly weed-free (September 6, 2023). (lower left): In ridge-till systems, black nightshade can be problematic. The field was not ridged in 2023, however, enough seed was present in the seedbank to have heavier nightshade pressure in portions of the field.

While this is a biological study, no differences were observed amongst the treatments in the corn. However, biomass samples of the clover taken Sept. 11, 2023, resulted in 160 lb/ac biomass, 38 lb/ac carbon, and 3 lb/ac nitrogen.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	249 A*	1,345 A
Elevate Ag HyprGrow	246 A	1,361 A
Homemade Compost Extract	246 A	1,369 A
P-Value	0.548	0.228

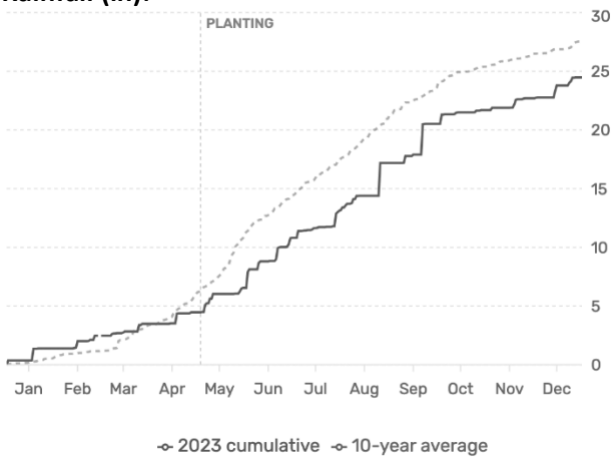
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn, $7.13/ac for homemade compost extract, $14.65/ac for Elevate Ag HyprGrow, and $0.73/lb N.

Summary: There were no differences in yield or net return among the treatments evaluated. This study will continue on the same strips for a few years.

Evaluating BLACKMAX® 22 and EXTRACT Powered by Accomplish® on Corn

Study ID: 1404001202301
County: Adams
Soil Type: Hastings silt loam 0-1% slope
Planting Date: 5/3/23
Harvest Date: 10/1/23
Seeding Rate: 33,500
Row Spacing (in): 36
Hybrid: Channel® 216-82STX
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 4 oz/ac Balance® Flexx, 1 qt/ac atrazine, 26 oz/ac glyphosate, and 4.8 oz/ac Hel-Fire® ***Post:*** 1.5 qt/ac Harness® MAX, 1 pt/ac atrazine, 10 oz/ac Diflexx, 26 oz/ac glyphosate, and 4.8 oz/ac Hel-fire®
Seed Treatment: Acceleron®
Foliar Insecticides: None
Foliar Fungicides: Delaro® and MasterLock® on 7/24/23 via aerial application

Fertilizer: 94.5 lb/ac 12-39-0-6 and 8.86 lb/ac 85% sulfur in winter; 160 lb N/ac as 32% UAN pre-plant; 5 gal/ac 10-34-0 at planting; 70 lb N/ac as 32% UAN fertigated
Irrigation: Pivot, Total: 9
Rainfall (in):



Introduction: Two plant nutrition products manufactured by Loveland Products were tested for their effect on corn yield. EXTRACT Powered by Accomplish® (EXTRACT PBA) and BLACKMAX ® 22 were each applied at planting with 10-34-0 starter fertilizer at a rate of 64 oz/ac. A combination of two products was also applied at planting with 10-34-0 starter fertilizer at a rate of 64 oz/ac of each product. The treatments were compared to an untreated check. EXTRACT PBA is a blend of Accomplish® LM, a fertilizer biocatalyst, and an N source that promotes the release of nutrients from crop residue and soils. The goal of the product is to optimize plantability and crop emergence, and extend nutrient availability later into the growing season. The goal of BLACKMAX® 22 is to enhance applied nutrient availability and uptake, nutrient mineralization and solubility, and promote beneficial soil microbes.

Early season stand counts were taken on June 15, 2023. There was green snap in the field observed on July 10, 2023, with an estimated 3-5% of plants damaged above the ear and 0-1% damaged below the ear. Stand counts, lodging, yield, and net return were evaluated. This is the second year this grower has evaluated these products.

Results:

	Stand Count (plants/ac)	Lodging (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	29,625 A*	1 A	16.4 A	234 A	1,384 A
BLACKMAX® 22	29,000 A	1 A	16.5 A	235 A	1,379 A
EXTRACT PBA	26,625 A	1 A	16.4 A	232 A	1,362 A
BLACKMAX® 22 + EXTRACT PBA	30,625 A	2 A	16.4 A	231 A	1,348 A
P-Value	0.471	0.198	0.861	0.282	0.096

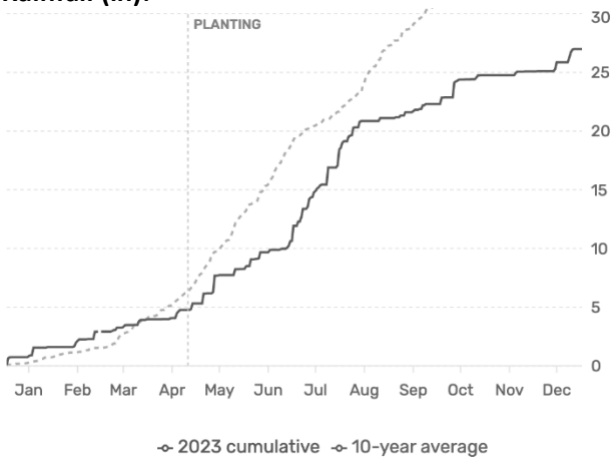
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn, $11/ac for BLACKMAX® 22, and $6.50/ac for EXTRACT PBA.

Summary:

- There were no differences in stand counts, lodging, moisture, yield, or net return among the treatments evaluated.
- These results are consistent with the previous year of the study (located in an adjacent but different field), which also observed no differences in stand counts, moisture, yield, or net return among the treatments.

Evaluating the Impact of Spraytec Fulltec Plus™ Seed Treatment on Soybeans

Study ID: 0007155202301
County: Saunders
Soil Type: Kenridge silty clay loam occasionally flooded; Judson silt loam 2-6% slopes; Yutan, eroded-Judson complex complex 6-11% slopes
Planting Date: 4/25/23
Harvest Date: 9/28/23
Seeding Rate: 140,000
Row Spacing (in): 15
Hybrid: Stine® 28EC32
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 16 oz/ac 2,4-D LV6, 32 oz/ac Sunphosate® 5 Max, and 6 oz/ac Zidua® Pro with 16 oz/ac MSO, 2 oz/ac Fulltec™ Adjuvant on 4/24/23 ***Post:*** 4.93 oz/ac Clethodim® 2EC, 32 oz Liberty® 280SL, 32 oz/ac Enlist One®, 32 oz/ac COC, 3 oz/ac Fulltec™ Adjuvant on 6/21/23
Seed Treatment: UAS N-Compass SDS-WM (w/Heads Up®)
Foliar Insecticides: 4 oz/ac Lambda Cy and 4 oz/ac Fulltec Cube IR™ on 7/21/23
Foliar Fungicides: None
Fertilizer: 105 lb/ac 0-0-60
Irrigation: None
Rainfall (in):



Introduction: This study used a paired comparison design with 6 replications to evaluate the impact of Spraytec Fulltec Plus™ seed treatment with a fungicide and insecticide seed treatment versus a fungicide and insecticide seed treatment alone (check treatment). Fulltec Plus™ is a nutritional package with macro and micro nutrients along with agents to protect against SDS and nematodes. This study evaluated yield and net return of the seed treatment.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Fulltec Plus™	59 A*	802 A
Check	57 B	786 B
P-Value	0.032	0.084

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $13.76/bu soybean and $6/ac for Fulltec Plus™ seed treatment.

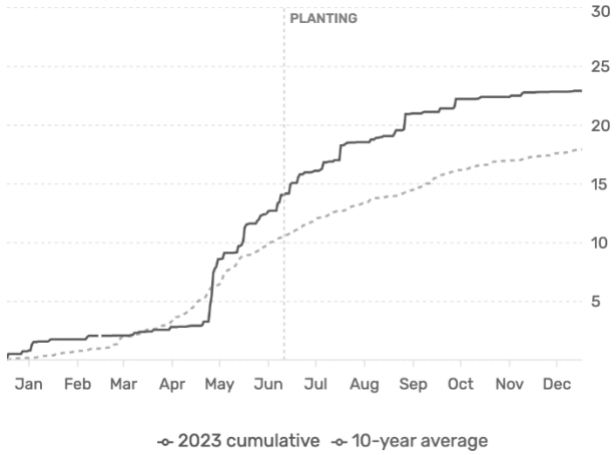
Summary:

- The Fulltec Plus™ seed treatment yielded 1.6 bu/ac more than the check treatment.
- The Fulltec Plus™ seed treatment resulted in a $16/ac greater marginal net return.

Evaluating the Impact of Spraytec® Fulltec Foliar Products on Dry Edible Bean Production

Study ID: 1517157202301
County: Scotts Bluff
Soil Type: Mitchell silt loam
Planting Date: 6/25/23
Harvest Date: 10/10/23
Seeding Rate: 85,000
Row Spacing (in): 30
Variety: Seminis® SV6139
Reps: 5
Previous Crop: Corn
Tillage: Grazed by cattle over winter, stalks chopped, disked twice in spring
Herbicides: ***Pre:*** Outlook®, Prowl® ***Post:*** Raptor®, Basagran®, with Fulltec® Oil
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: 18 gal/ac starter (30 lb/ac N, 40 lb/ac P, 10 lb/ac K), Embella®, and Spectra®
Irrigation: Gravity
Rainfall (in):



Introduction: This study evaluated the impact of Spraytec® Fulltec Ultra™ and Impulse™ applied foliarly versus an untreated check.

- Fulltec Ultra™ provides manganese and is designed to prevent white mold and manganese deficiency and was applied at a rate of 5.5 oz/ac on July 22, 2023, at the V3 to V4 growth stage.
- Fulltec Impulse™ provides a high concentration of plant nutrients to promote vigorous plant growth and reduce plant stress and was applied at a rate of 5 oz/ac on August 19, 2023 at the R2 to R3 growth stage. The applications were made by a drone (image below) in 30' swaths.

The field was originally planted on May 28, but had to be replanted on June 26 due to a wind and hail event. There was an additional hail event on September 10, 2023.

The applications were made by a drone (image below) in 30’ swaths.

Results:

	Split (%)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	2 A*	12.2 A	49 B	1,113 A
Fulltec Ultra™ + Impulse™	2 A	11.9 A	52 A	1,162 A
P-Value	0.410	0.148	0.075	0.175

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 14% moisture.
‡Marginal net return based on $38/cwt ($22.80/bu at 60 lb/bu) and $22.25/ac for the Fulltec treatments.

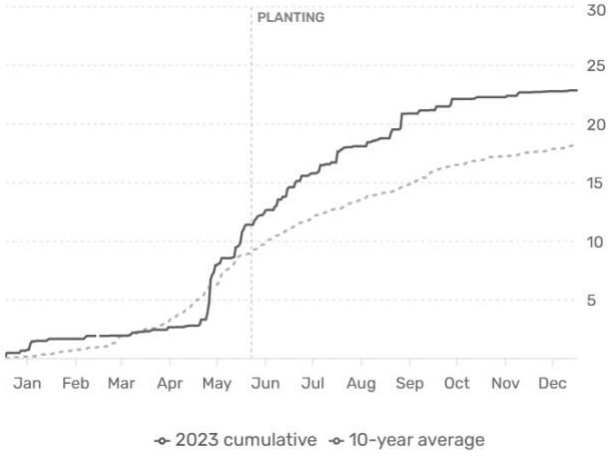
Summary:

- There were no differences in percent splits and bean moisture between the check and Fulltec treatment.
- The yield for the Fulltec treatment was 3 bu/ac greater than the untreated check.
- There was no significant difference in marginal net return between the treatments.

Evaluating the Impact of Spraytec® Fulltec Foliar Products on Dry Edible Bean Production

Study ID: 1529157202301
County: Scotts Bluff
Soil Type: Mitchell silt loam 0-1% slope;
Planting Date: 6/6/23
Harvest Date: 9/19/23
Seeding Rate: 100,000
Row Spacing (in): 22
Variety: Seminis® SV6139
Reps: 4
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 24 oz/ac Prowl® as burndown; 24 oz/ac Prowl®, 12 oz/ac Outlook®, and 24 oz/ac Roundup® applied preplant ***Post:*** Raptor® and Basagran®
Fertilizer: 30 lb N/ac, 30 lb P/ac, and 5 lb S/ac

Irrigation: Pivot
Rainfall (in):



Introduction: This study evaluated the impact of Spraytec® Fulltec Impulse™ and Cube™ applied foliarly versus an untreated check.

- Fulltec Impulse™ provides a high concentration of plant nutrients to promote vigorous plant growth and reduce plant stress and was applied at a rate of 5 oz/ac on July 23, 2023, at the V3 to V4 growth stage.
- Fulltec Cube™ is designed to improve plant health and make plants more resistant to fungal and bacterial diseases and was applied at a rate of 5 oz/ac on Aug. 17, 2023, at the R2 to R3 growth stage.

The applications were made by a drone (image below) in 30' swaths.

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	9.7 A*	61 A	1,385 A
Fulltec Impulse™ and Cube™	9.7 A	61 A	1,339 A
P-Value	0.912	0.906	0.444

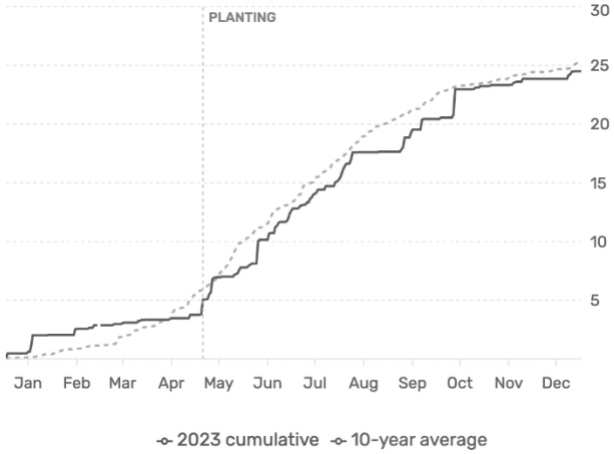
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 14% moisture.
‡Marginal net return based on $38/cwt ($22.80/bu at 60 lb/bu) and $53.49/ac for Impulse™ and Cube™.

Summary: There was no difference in moisture, yield, or net return between the Fulltec treatments and the untreated check.

Impact of Agnition Procure® and Generate® on Corn

Study ID: 0709047202301
County: Dawson
Soil Type: Cozad silt loam; Hord silt loam
Planting Date: 5/5/23
Harvest Date: 11/1/23
Seeding Rate: 31,000
Row Spacing (in): 30
Hybrid: Channel® 214-22STXRIB
Reps: 5
Previous Crop: Soybean
Tillage: Strip-till
Herbicides: ***Pre:*** 1.25 qt/ac Harness® Xtra 5.6, 22 oz/ac Roundup PowerMAX® 3, 8 oz/ac dicamba, and 3 oz/ac Padlock® Plus on 5/8/23 ***Post:*** 1.5 qt/ac Harness® Xtra 5.6, 22 oz/ac Roundup PowerMAX® 3, 3 oz/ac mesotrione, 3 oz/ac Stinger®, and 5 oz/ac Status® on 6/5/23
Seed Treatment: PivotBio®
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: 15 gal/ac 32-0-0, 5 gal/ac 12-0-0-26S, 12 gal/ac 10-34-0, 0.25 gal/ac Zinc Chelate on 5/1/23; 3 gal/ac LiftOff; fertigated with 9 gal/ac of 32-0-0 and 1 gal/ac 12-0-0-26S on 7/5/23 and 7/14/23 and 10 gal/ac 32-0-0 on 7/31/23
Irrigation: SDI, Total: 9"
Rainfall (in):



Baseline Soil Samples 0-8" (March 2023):

pH	OM LOI %	Nitrate–N ppm N	M3-P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g	Zn ppm	Fe ppm	Mn ppm	Cu ppm
6.7	3.8	14.6	63	10.1	441	1614	249	18	11.4	1.39	14.2	5.5	0.39
5.9	3.7	16.6	27	10.2	426	1329	181	14	11.8	1.4	14.3	8.9	0.33

Introduction: The purpose of this study was to evaluate the impact of Agnition Procure® and Generate® on corn yield and net return. These products are formulated with a patented Microbial Catalyst® technology with a goal of improving root mass, emergence, stress tolerance, plant health, photosynthesis, energy production, and yield. In this study, the products were applied as a foliar treatment at a rate of 1 pt/ac during the post-emergence herbicide application on June 6, 2023. Stand counts were taken on June 12, 2023, when the corn was in the V6 growth stage.

Results:

	Early Season Stand Count (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	30,533 A*	255 A	1,508 A
Procure® + Generate®	30,000 A	257 A	1,501 A
P-Value	0.347	0.646	0.713

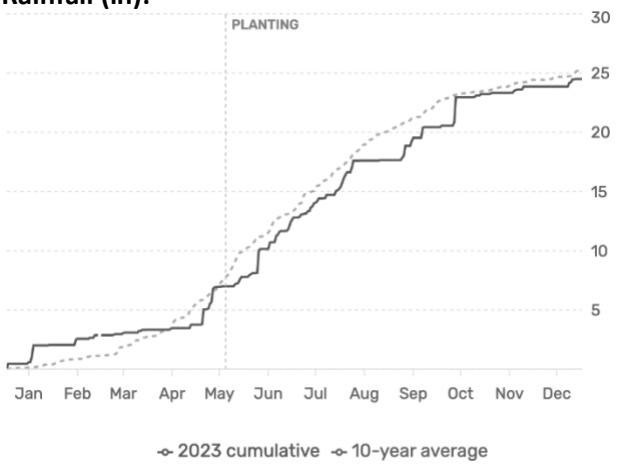
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn and $15.5/ac for Generate® and Procure®.

Summary: There were no statistically significant differences in stand counts, yield, or net return between the Procure® and Generate® treatment and the untreated check.

Impact of Agnition Procure® and Generate® Foliar Applications on Soybeans

Study ID: 0709047202302
County: Dawson
Soil Type: Cozad silt loam
Planting Date: 5/19/23
Harvest Date: 10/5/23
Seeding Rate: 120,000
Row Spacing (in): 30
Variety: Pioneer® P28A65E
Reps: 5
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 1 pt/ac Warrant®, 2.5 oz/ac Anthem® MAXX, 22 oz/ac Roundup PowerMAX® 3, 16 oz/ac 2,4-D LV6, 9.6 oz/ac Padlock® Plus, and 5 oz/ac Absil on 5/20/23 ***Post:*** 1.5 qt/ac Warrant®, 32 oz/ac Enlist One®, 32 oz/ac Liberty®, 16 oz/ac clethodim, 3 lb/ac AMS, and 10 oz/ac Corporal on 6/12/23
Seed Treatment: Lumigen®

Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 5 gal/ac 12-0-0-26S and 5 gal/ac 10-34-0 on 5/19/23
Irrigation: Pivot, Total: 7"
Rainfall (in):



Baseline Soil Samples 0-8"(March 2023):

pH	OM LOI %	Nitrate–N ppm N	M3-P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g	Zn ppm	Fe ppm	Mn ppm	Cu ppm
7.4	3.3	13.3	45	17.7	461	2361	325	47	15.9	1.70	10.5	2.4	0.43
6.9	3.8	11.8	79	16.4	422	2019	308	42	13.9	2.04	17.2	3.0	0.53
7.0	4.4	17.0	104	21.4	566	2691	438	49	18.8	2.32	22.3	3.2	0.74
7.1	3.4	14.4	54	19.7	359	1995	364	59	14.2	1.08	9.4	2.1	0.43

Introduction: The purpose of this study was to evaluate the impact of Agnition Procure® and Generate® on soybean yield and net return. These products are formulated with a patented Microbial Catalyst® technology with a goal of improving root mass, emergence, stress tolerance, plant health, photosynthesis, energy production, and yield. In this study, the products were applied as a foliar treatment at a rate of 1 pt/ac during the post-emergence herbicide application on June 12, 2023. Stand counts were taken on June 15, 2023.

Results:

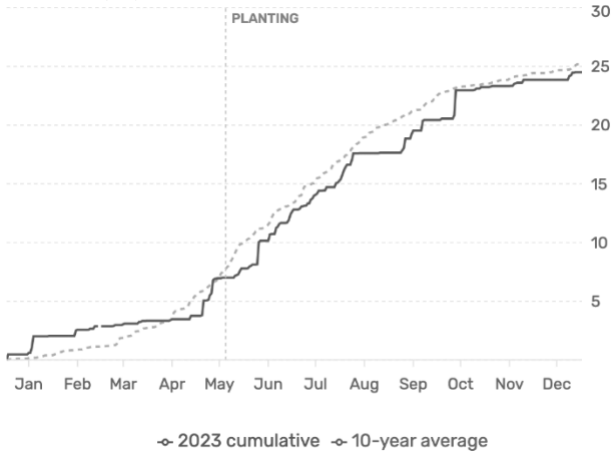
	Early Season Stand Count (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	107,400 A*	79 A	1,085 A
Generate® + Procure®	106,267 A	79 A	1,068 A
P-Value	0.633	0.943	0.244

*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 $13.76/bu soybean and $15.50/ac for Procure® and Generate®.

Summary: There were no statistically significant differences in stand counts, yield, or net return between the Procure® and Generate® treatment and the untreated check.

Impact of Agnition Procure® and Generate® In-Furrow Applications on Soybeans

Study ID: 0709047202303
County: Dawson
Soil Type: Cozad silt loam
Planting Date: 5/19/23
Harvest Date: 10/5/23
Seeding Rate: 120,000
Row Spacing (in): 30
Variety: Channel® CT2773E
Reps: 5
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 1 pt/ac Warrant®, 2.5 oz/ac Anthem® Maxx, 22 oz/ac Roundup PowerMAX® 3, 16 oz/ac 2,4-D LV6, 9.6 oz/ac Padlock® Plus, and 5 oz/ac Absil on 5/20/23 ***Post:*** 1.5 qt/ac Warrant®, 32 oz/ac Enlist One®, 32 oz/ac Liberty®, 16 oz/ac clethodim, 3 lb/ac AMS, and 10 oz/ac Corporal on 6/8/23
Seed Treatment: Lumigen®
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 5 gal/ac 12-0-0-26S and 5 gal/ac 10-34-0 on 4/26/23
Irrigation: Gravity, Total: 6"
Rainfall (in):



Baseline Soil Samples 0-8" (March 2023):

pH	OM LOI %	Nitrate–N ppm N	M3-P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g	Zn ppm	Fe ppm	Mn ppm	Cu ppm
7.5	3.8	39.4	51	42.9	488	2038	427	140	15.6	1.62	10.7	2.9	0.52
7.8	3.5	9.0	82	33.9	401	2000	334	79	14.2	1.69	7.5	1.7	0.44

Introduction: The purpose of this study was to evaluate the impact of Agnition Procure® and Generate® on soybean yield and net return. These products are formulated with a patented Microbial Catalyst® technology with a goal of improving root mass, emergence, stress tolerance, plant health, photosynthesis, energy production, and yield. In this study, the products were applied as an in-furrow treatment with starter fertilizer at planting on May 19, 2023 and were compared to starter fertilizer alone (check). Stand counts were taken on June 7, 2023.

Results:

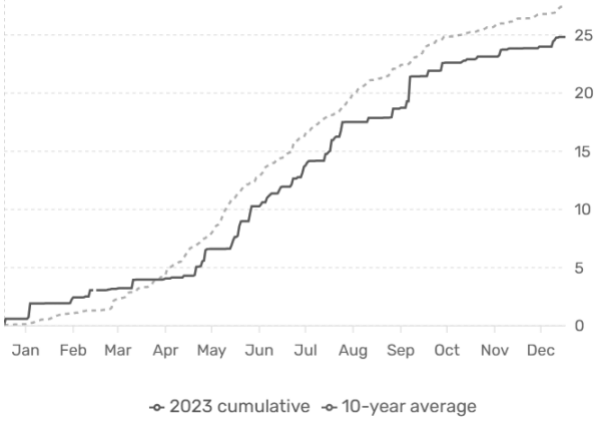
	Early Season Stand Count (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	93,933 A*	76 A	1,045 A
Generate® + Procure®	98,000 A	74 A	998 A
P-Value	0.218	0.547	0.384

*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 $13.76/bu soybean and $15.50/ac for Procure® and Generate®.

Summary: There were no statistically significant differences in stand counts, yield, or net return between the Procure® and Generate® treatment and the untreated check.

Impact of Triad™ on Wheat

Study ID: 0249019202301
County: Buffalo
Soil Type: Holdrege silt loam 1-3% slope; Uly silt loam 6-11% slopes; Coly silt loam 6-11% slopes
Planting Date: 9/30/23
Harvest Date: 7/23/23
Seeding Rate: 1,500,000
Row Spacing (in): 10
Variety: WestBred® 4699
Reps: 5
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Post:*** 2 oz/ac Zidua® on 5/5/23
Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 3 gal/ac 10-34-0, 10 lb/ac 11-52-0, 50 lb/ac 0-0-60, 60 lb/ac 21-0-0-26S, 35 lb/ac K Mag, and 30 lb/ac gypsum on 9/30/23; 200 lb/ac 46-0-0, 125 lb/ac 21-0-0-24 on 3/22/23; 10 gal/ac 32-0-0 + 2 gal/ac 10-34-0 on 5/10/23
Note: Dry winter and severe cold, dry spring
Irrigation: None
Rainfall (in):



Introduction: Triad™ by Rosen's Inc. is a plant hormone product containing cytokinin (as kinetin), gibberellic acid, and indole-3-butyric acid. The product is designed to enhance plant health and growth. Triad™ was applied at a rate of 1 qt/ac on September 25, 2022 in-furrow with 3 gal/ac of 10-34-0. Wheat stands, yield, and net return were evaluated.

Results:

	Early Season Stand Count (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	875,333 A*	22 A	160 A
Triad	842,667 A	21 A	134 B
P-Value	0.520	0.171	0.004

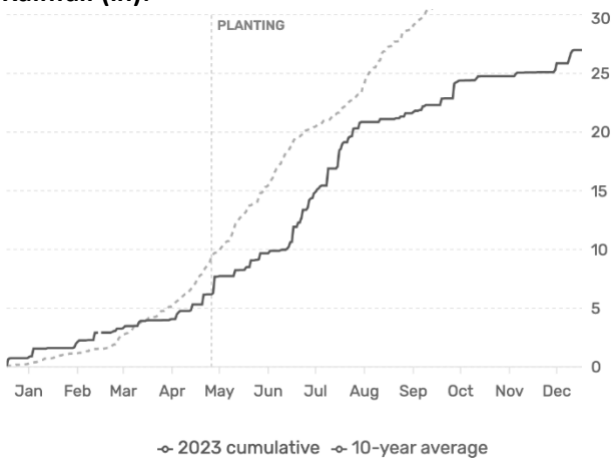
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 14% moisture.
‡Marginal net return based on $7.30/bu wheat and $19/ac for Triad™.

Summary:

- The use of Triad™ did not result in differences in stand count or yield compared to the untreated check.
- Due to the additional cost of the product, the Triad™ treatment resulted in a $26/ac decrease in net return compared to the untreated check.

Impact of Sound Agriculture's SOURCE™ on Non-Irrigated Corn

Study ID: 0007155202302
County: Saunders
Soil Type: Yutan, eroded-Judson complex Choose Soil Texture 6-11% slopes; Pohocco silty clay loam 11-17% slopes
Planting Date: 5/10/23
Harvest Date: 10/22/23
Seeding Rate: 26,000
Row Spacing (in): 15
Hybrid: Channel® 214-22STX
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 3 qt/ac Stalwart® 3W on 5/11/23
Post: 8 oz/ac GCS Atrazine 4L, 0.75 oz/ac Impact®, 40 oz/ac Sunphosate® 5 Max, with 1gal/100 gal MSO Absorb and 2 oz/ac Fulltec® adjuvant on 6/14/23
Seed Treatment: Basic fungicide and insecticide
Foliar Insecticides: None
Foliar Fungicides: 12.8 oz/ac Cover XL® and 4 oz/ac Bifenthrin 2EC with 2.7 oz/ac Fulltec® Cube
Fertilizer: 160 lb/ac 11-52-0; 35 gal/ac 32% UAN and 5 gal/ac thiosulfate (129 lbs N + 14 lbs S) on 5/11/23
Irrigation: None
Rainfall (in):



Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N losses through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. SOURCE™ by Sound Agriculture is designed to stimulate microbes to allow producers to reduce fertilizer N application and increase yields. SOURCE™ was applied with the post emerge herbicide on June 14. This study used a paired comparison design with six replications to compare SOURCE™ to an untreated check. The total N rate on the field was 129 lbs N/ac. For reference, the University of Nebraska-Lincoln N recommendation on this field was 144 lbs N/ac. Corn was planted on May 10, 2023.

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	15.4 A*	207 B	1,221 A
Source	15.3 A	208 A	1,216 A
P-Value	0.376	0.009	0.159

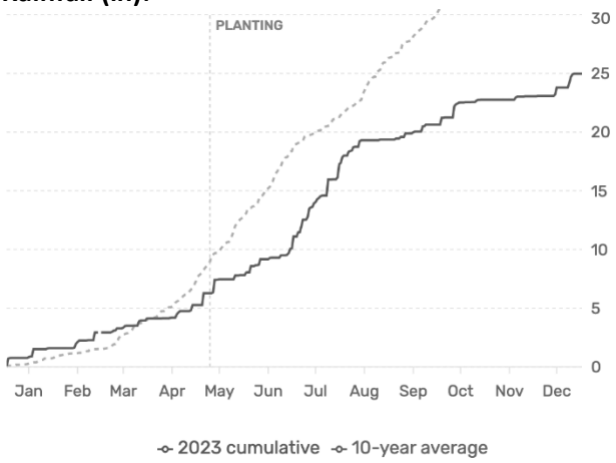
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn and $15/ac for SOURCE™.

Summary:

- There was no difference in grain moisture between the SOURCE™ treatment and the untreated check.
- The SOURCE™ treatment yielded 1.8 bu/ac higher than the check.
- There was no difference in marginal net return between the treatments evaluated.

Impact of Sound Agriculture's SOURCE™ on Two Hybrids of Irrigated Corn

Study ID: 0007155202303
County: Saunders
Soil Type: Wann fine sandy loam occasionally flooded; Gibbon silt loam 0-2% slope
Planting Date: 5/9/23
Harvest Date: 10/13/23
Seeding Rate: 34,000
Row Spacing (in): 15
Hybrid: Channel® 214-22STX and Channel® 207-87VT2
Reps: 8
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 3 qt/ac Stalwart® 3W on 5/10/23 ***Post:*** 8 oz/ac GCS Atrazine 4L, 0.75 oz/ac Impact®, and 40 oz/ac Sunphosate® 5 Max with 1 gal/100 gal MSO Absorb and 2 oz/ac Fulltec® adjuvant on 6/6/23
Seed Treatment: Basic fungicide and insecticide
Foliar Insecticides: None
Foliar Fungicides: 12.8oz/ac Cover XL® and 4 oz/ac Bifenthrin 2EC with 2.7 oz/ac Fulltec® adjuvant
Fertilizer: 11-52-0 variable rate application with an average of 246 lb/ac; 58.5 gal/ac 32% UAN with 6.5 gal/ac thiosulfate (213 lb N/ac + 19 lbs S) on 5/10/23
Irrigation: Pivot, Total: 6 inches
Rainfall (in):



Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N loss through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. SOURCE™ by Sound Agriculture is designed to stimulate microbes to allow producers to reduce fertilizer N application and increase yields. SOURCE™ was applied with the post emerge herbicide on June 6. This study compared SOURCE™ to an untreated check. The total N rate on the field was 213 lb N/ac. For reference, the UNL nitrogen rate was 253 lb N/ac. Corn was planted on May 9, 2023.

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
		Channel® 214-22STX (4 replications)	
Check	15.2 A*	252 A	1,490 A
Source	15.2 A	256 A	1,499 A
P-Value	0.761	0.359	0.712
		Channel® 207-87VT2 (4 replications)	
Check	14.2 A	241 A	1,423 A
Source	14.2 A	237 A	1,387 A
P-Value	0.809	0.352	0.155

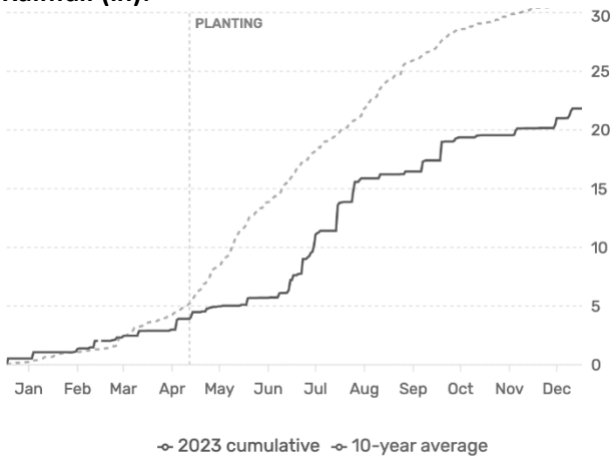
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn and $15/ac for SOURCE™.

Summary: The SOURCE™ application did not result in significant differences in moisture, yield, or net return for either hybrid evaluated.

Impact of Pivot Bio PROVEN® 40 at a Reduced N Rate on Corn

Study ID: 1248185202301
County: York
Soil Type: Hastings silt loam 1-3% slope
Planting Date: 4/26/23
Harvest Date: 10/10/23
Seeding Rate: 32,500 irrigated, 25,000 non-irrigated
Row Spacing (in): 30
Hybrid: Dekalb® DKC59-82 RIB
Reps: 3
Previous Crop: Soybean
Tillage: Planted no-till on ridges. Not cultivated in 2023.
Herbicides: ***Pre:*** Degree Xtra® and Balance Flexx®
Post: Status®, Roundup® PowerMAX, atrazine, and Harness® MAX

Fertilizer: 150 lb N/ac as pre-plant anhydrous ammonia; 5 gal/ac 6-24-6 at planting
Irrigation: Pivot
Rainfall (in):



Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N losses through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. Pivot Bio PROVEN® 40 is an N-fixing bacterial inoculant that is expected to fix 40 lb N/ac over the growing season. Biological N fixation for cereal crops has potential to increase N efficiency and decrease N loss. The objective of this study was to evaluate Pivot Bio PROVEN® 40 on corn yield and net return. Pivot Bio PROVEN® 40 was applied at a rate of 12.8 oz/ac in-furrow with 5 gal/ac of 6-24-6 at planting and was compared to 5 gal/ac of 6-24-6 without Pivot Bio PROVEN® 40. The product was evaluated at a N rate of 150 lb/ac. The grower planned to add a side dress application of 20 lb N/ac in season with the cultivator (for a total of 170 lb N/ac) but decided to forego that application due to drought this year. The UNL N recommendation for this field, with a 260 bu/ac yield goal, was 163 lb N/ac. Due to severe drought stress in the non-irrigated portion of the field, only the irrigated yields are included in this data. All the emergence and harvest stand counts were taken from the non-irrigated portion of the field by the youth and that data is not shown here.

Photos: (left) Farmer cooperators sharing with youth about their study and agronomic practices. (right) Youth taking final emergence counts between the check and Pivot Bio Proven treatments in the non-irrigated portion of the field. The Innovative Youth Corn Challenge (https://cropwatch.unl.edu/youth/cornchallenge) sponsored by the Nebraska Corn Board is a great way to involve youth in on-farm research!

Results:

	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check Reduced N	14.2 A*	254 A	1,503 A
Pivot Bio Proven®, Reduced N	14.3 A	253 A	1,472 A
P-Value	0.478	0.861	0.414

*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 $5.91/bu corn and $25/ac for Pivot Bio PROVEN® 40.

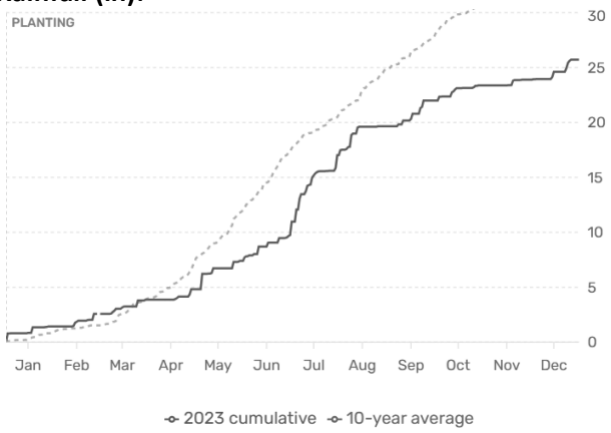
Summary: The addition of Pivot Bio PROVEN® 40 did not result in a difference in moisture, yield, or net return.

This study was completed as part of the Innovative Youth Corn Challenge by the team Crop Science Investigation (CSI)-York

Impact of Pivot Bio PROVEN® 40 at Different Nitrogen Rates on Corn

Study ID: 0085141202301
County: Platte
Soil Type: Janude fine sandy loam 0-1% slope; Gibbon silt loam 0-2% slopes, occasionally flooded
Planting Date: 5/10/23
Harvest Date: 10/24/23
Seeding Rate: Variable-rate
Row Spacing (in): 30
Hybrid: Dekalb® DKC 115-33 and Dekalb® DKC 64-64
Reps: 6
Previous Crop: Corn
Tillage: Conventional Till

Irrigation: Pivot
Rainfall (in):



Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N loss through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. Pivot Bio PROVEN® 40 is an N-fixing bacterial inoculant that is expected to fix 40 lb N/ac over the growing season. Biological N fixation for cereal crops has potential to increase N efficiency and decrease N loss. The objective of this study was to evaluate Pivot Bio PROVEN® 40 on corn yield and net return. Pivot Bio PROVEN® 40 was applied at a rate of 12.8 oz/ac in-furrow with starter fertilizer and was compared to an untreated check. The product was evaluated at different N rates as follows:

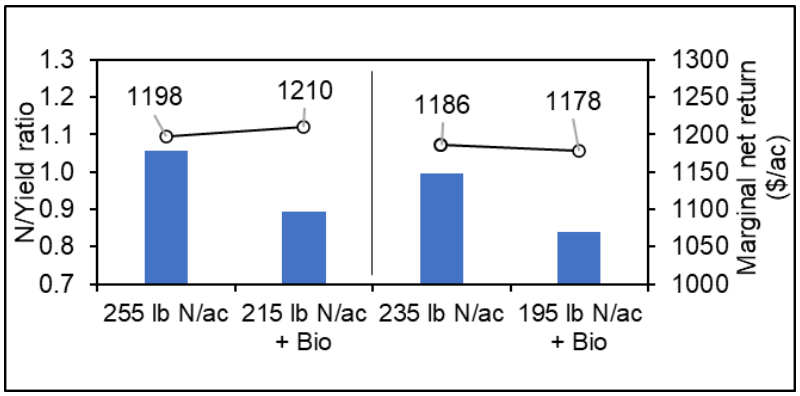
- 255 lb N/ac with no Pivot Bio
- 215 lb N/ac with Pivot Bio
- 235 lb N/ac with no Pivot Bio
- 195 lb N/ac with Pivot Bio

Prior to implementing the treatments, a total of 85 lb N/ac was applied (55 lb N/ac on March 25, 2023, and 30 lb N/ac at planting). The remainder of each rate (110, 130, 150, or 170 lb N/ac) was applied according to the treatment totals on June 2, 2023. Additionally, the study was conducted on two different hybrids in this field, Dekalb® DKC 64-64 and Dekalb® DKC 115-33.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
	DKC 64-64 (Hybrid 1)	
255 N No Pivot Bio	251 AB*	1,259 BC
215 N Pivot Bio	248 B	1,254 C
235 N No Pivot Bio	254 A	1,294 A
195 N Pivot Bio	250 B	1,281 AB
P-Value	0.012	0.003
	DKC 115-33 (Hybrid 2)	
255 N No Pivot Bio	232 A	1141 B
215 N Pivot Bio	234 A	1168 A
235 N No Pivot Bio	219 B	1084 C
195 N Pivot Bio	215 B	1078 C
P-Value	<0.0001	<0.0001

*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 $5.91/bu corn, $21/ac for Pivot Bio PROVEN® 40, and $0.89/lb N.

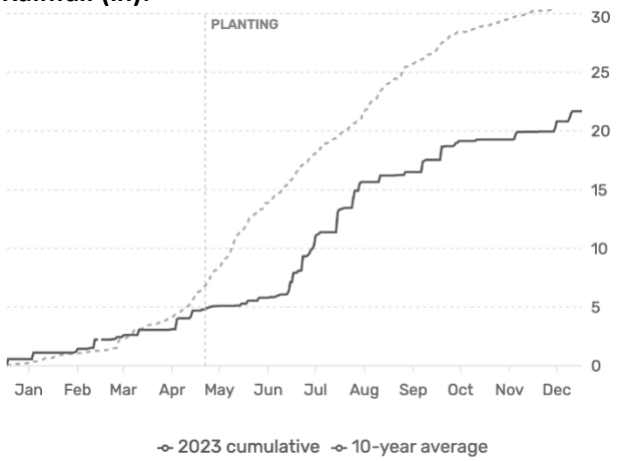


Summary:

- For Hybrid 1, the 235 lb N/ac treatment without Pivot Bio PROVEN® 40 resulted in greater yields than the 215 lb N/ac and 195 lb N/ac treatment with Pivot Bio PROVEN® 40. The additional fertilizer in the 255 lb N/ac without Pivot Bio PROVEN® 40 did not result in an increase in yield compared to the 235 lb N/ac without Pivot Bio PROVEN® 40 treatment. The 235 lb N/ac treatment without Pivot Bio PROVEN® 40 and the 195 lb N/ac with Pivot Bio PROVEN® 40 resulted in the greatest marginal net returns.
- For Hybrid 2, the 255 lb N/ac treatment without Pivot Bio PROVEN® 40 and the 215 lb N/ac treatment with Pivot Bio PROVEN® 40 resulted in the same yield. The highest marginal net return was realized for the 215 lb N/ac treatment with Pivot Bio PROVEN® 40.
- When averaging the results of both hybrids (chart above), two interesting findings emerged. First, nitrogen use efficiency was improved when Pivot Bio was applied, compared to the equivalent treatment (+40 lb N/ac no Pivot Bio). Second, marginal net return differed by +$12/ac and -$6/ac when using Pivot Bio compared to its treatment counterpart. The 215 lb N/ac rate with Pivot Bio resulted in the largest net return among all treatments indicating that it may be feasible to obtain greater net returns with better nitrogen use efficiency, potentially reducing the risks of nitrogen leaching.

Impact of Pivot Bio PROVEN® 40 at Two Nitrogen Rates on Corn

Study ID: 0276185202302
County: York
Soil Type: Hastings silt loam
Planting Date: 5/6/23
Harvest Date: 10/18/23
Seeding Rate: 32,000
Row Spacing (in): 30
Hybrid: Pioneer® P1278Q
Reps: 4
Previous Crop: Corn
Tillage: Row stalker before planting; cultivated and hilled
Herbicides: ***Pre:*** 2.6 qt/ac Keystone® and 6 oz/ac Callisto® on 5/6/23 ***Post:*** 1 oz/ac Impact®, 1 pt/ac atrazine, and 1 qt/ac Roundup® on 6/2/23
Foliar Insecticides: 8 oz/ac Brigade®
Foliar Fungicides: 10 oz/ac Hero®
Irrigation: Pivot
Rainfall (in):



Baseline Soil Samples (October 2022):

	pH	OM LOI %	Nitrate–N ppm N	M3-P ppm P	Sulfate–S ppm S	K ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g	Zn ppm	Fe ppm	Mn ppm	Cu ppm
0-10"	6.1	3.0	6.0	17	7.5	363	2088	380	82	17	1.39	28.5	12.1	0.49
0-10"	6.8	3.3	8.8	18	7.7	375	2076	299	80	14.2	2.72	19.4	7.2	0.47
10-24"	-	-	5.8	-	-	-	-	-	-	-	-	-	-	-

Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N loss through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. Pivot Bio PROVEN® 40 is an N-fixing bacterial inoculant that is expected to fix 40 lb N/ac over the growing season. Biological N fixation for cereal crops has potential to increase N efficiency and decrease N loss. The objective of this study was to evaluate Pivot Bio PROVEN® 40 on corn yield and net return. Pivot Bio PROVEN® 40 was applied at a rate of 12.8 oz/ac in-furrow without starter fertilizer and was compared to an untreated check without starter fertilizer. The product was evaluated at the grower's full N rate of 205 lb N/ac and a reduced N rate of 165 lb N/ac, applied as anhydrous ammonia in the fall. The UNL N rate for a 270 bu/ac yield goal on this field is 200 lb N/ac. Stand counts were collected on May 16, 2023, and October 4, 2023. Stalk rot, yield, and marginal net return were evaluated. End of season soil nitrate tests were also taken October 23 for 0-8" and 8-24" depths.

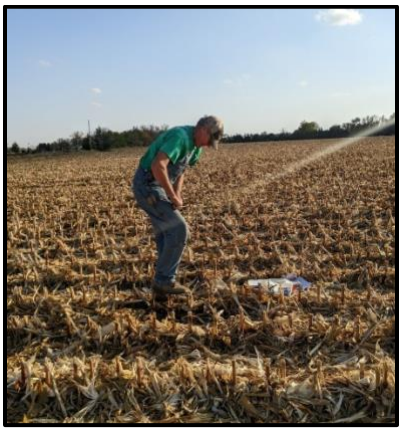


Photo: One of the farmer-cooperators taking end-of-season nitrate samples on October 23, 2023.

Results:

	Emergence Count (plants/ac)	Stalk Rot (%)	Harvest Stand Count (plants/ac)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Full N Check	29,333 A*	3.33 A	29,333 A	15.3 A	261 AB	1,356 BC
Full N + Pivot Bio PROVEN®	28,333 A	3.33 A	29,000 A	15.3 A	262 A	1,343 C
Reduced N Check	28,667 A	3.33 A	28,667 A	15.2 A	258 B	1,377 A
Reduced N + Pivot Bio PROVEN®	27,667 A	5.00 A	28,333 A	15.2 A	261 AB	1,375 AB
P-Value	0.820	0.978	0.820	0.623	0.076	0.005

	Nitrate 0-8" (ppm)	Nitrate 8-24" (ppm)	Nitrate 0-8" (lb/ac)	Nitrate 8-24" (lb/ac)
Full N Check	16.1 A	22.5 A	38.7 A	107.7 A
Full N + Pivot Bio PROVEN®	15.4 A	32.7 A	37.0 A	156.7 A
Reduced N Check	9.0 B	16.6 A	21.7 B	79.3 A
Reduced N + Pivot Bio PROVEN®	14.4 AB	29.1 A	34.7 AB	139.3 A
P-Value	0.034	0.0354	0.5185	0.5176

*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 $5.91/bu corn, $20/ac for Pivot Bio PROVEN® 40, and $0.90/lb N.

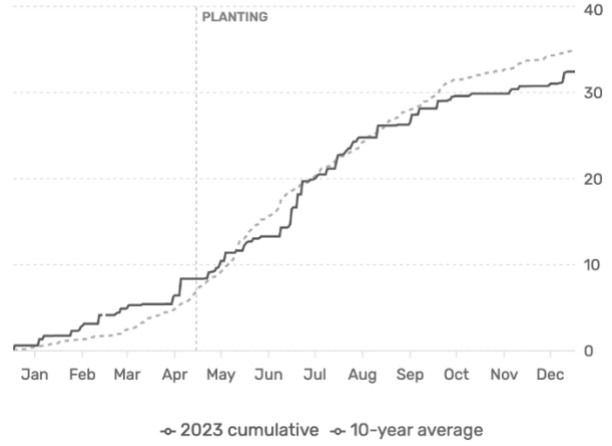
Summary:

- Stand counts and stalk rot did not differ among the treatments evaluated.
- The reduced N with no Pivot Bio PROVEN® 40 resulted in a 4 bu/ac yield loss compared to the full N treatment with Pivot Bio PROVEN® 40. The full N rate did not have a yield difference between the with and without Pivot Bio PROVEN® 40 treatment and the reduced N rate did not have a yield difference between the with and without Pivot Bio PROVEN® 40 treatment.
- Marginal Net return was lowest for the full N treatment with Pivot Bio PROVEN® 40 due to the increased costs associated with this treatment. The most profitable treatment was the reduced N rate, with or without Pivot Bio PROVEN® 40.
- Soil nitrate results showed greater residual nitrate in the top 8" for the full N treatments compared to the reduced N check. Residual nitrate in the reduced N Pivot Bio treatment was not different from the residual nitrate in the reduced N check or the full N treatments. There were no significant differences among treatments for soil nitrate from 8 to 24".

Impact of Pivot Bio PROVEN® 40 at Six Nitrogen Rates on Corn

Study ID: 1519147202301
County: Richardson
Soil Type: Kennebec silt loam; Zook silty clay loam
Planting Date: 4/29/23
Harvest Date: 10/30/23
Seeding Rate: 29,000
Row Spacing (in): 30
Hybrid: Hoegemeyer® 8707
Reps: 5
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 44 oz/ac Resicure®, 8 oz/ac Rifle®, and 1 lb/ac atrazine on 5/2/23 ***Post:*** none
Seed Treatment: None
Foliar Insecticides: none
Foliar Fungicides: 14 oz/ac Azoxyprop® Xtra on 7/19/23

Fertilizer: Treatment blocks at various rates applied on 12/1/22 as anhydrous ammonia, 5 gal/ac 10-34-0 starter at planting, 12-0-0-26 S (contributing 9 lb N/ac) with herbicide on 5/2/23
Irrigation: None
Rainfall (in):



Soil Samples 0-6" (Sampled on 12/5/22, except nitrate which was sampled 4/20/23; all samples were between band):

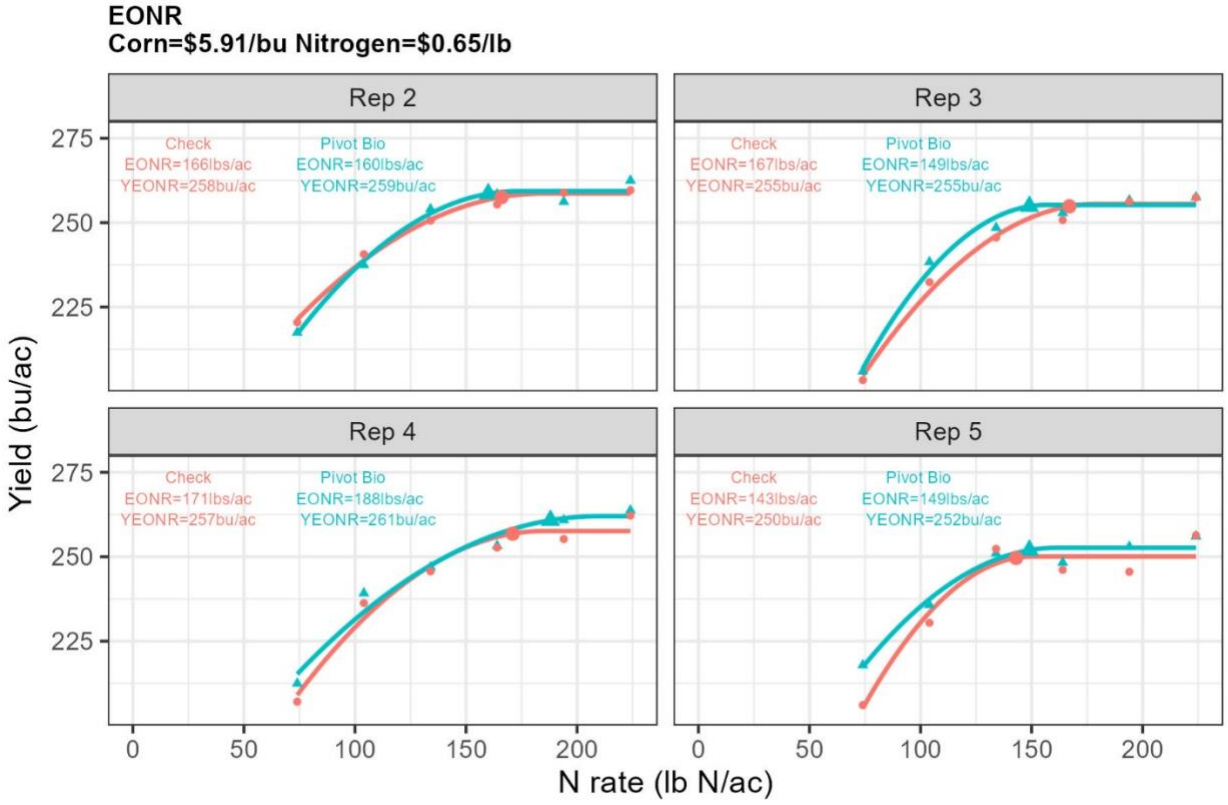
							------Melich lll------							
pH	BpH	OM LOI %	Melich III P ppm	NO3 – N ppm N	NH4 – N ppm N	Sulfate-S ppm S	K	Ca	Mg	Na	CEC me/100g	Sand (%)	Silt (%)	Clay (%)
6.4	6.8	3.3	23	6	2	6.2	106	1696	158	11	11.6	29	50	21
6.7	7.2	3.6	35	4	0.7	5.7	146	2264	202	9	13.4	21	52	27
7.5	7.2	2.9	22	10	0.6	5.8	102	1983	160	8	11.5	39	52	9

Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N loss through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. Pivot Bio PROVEN® 40 is an N-fixing bacterial inoculant that is expected to fix 40 lb N/ac over the growing season. Biological N fixation for cereal crops has potential to increase N efficiency and decrease N loss. The objective of this study was to evaluate Pivot Bio PROVEN® 40 on corn yield, net return, and the potential for N rate reduction. Pivot Bio PROVEN® 40 was applied with starter at planting with 10-34-0 starter fertilizer and was compared to an untreated check with just starter fertilizer. All treatments received 9 lb N/ac on May 2, 2023, through a herbicide application (12-0-0-26 S) and 5 lb N/ac on April 29, 2023 from 10-34-0 starter fertilizer application at planting. The Pivot Bio PROVEN® 40 treatment was evaluated at six N rates, with the N rate treatments applied on December 1, 2022, at rates of 60, 90, 120, 150, 180, and 210 lbs N/ac with anhydrous ammonia for total N rates of 74, 104, 134, 164, 194, and 224 lb N/ac. The economic optimum N rate (EONR) was calculated for the check treatment and Pivot Bio PROVEN® 40 treatment for four replications where a quadratic plateau model could be fit.

Results:

Treatment	Yield (bu/ac)†	lb N/bu grain	Marginal Net Return‡ ($/ac)
Check + 74	210 G	0.35 F	1,191 D
Check + 104	235 F	0.44 E	1,321 BC
Check + 134	245 DE	0.55 D	1,362 ABC
Check + 164	249 BCD	0.66 C	1,367 AB
Check + 194	254 ABCD	0.77 B	1,375 AB
Check + 224	259 AB	0.87 A	1,383 A
Pivot Bio® + 74	217 G	0.34 F	1,213 D
Pivot Bio® + 104	236 EF	0.44 E	1,309 C
Pivot Bio® + 134	249 CD	0.54 D	1,363 ABC
Pivot Bio® + 164	251 ABCD	0.66 C	1,358 ABC
Pivot Bio® + 194	257 ABC	0.76 B	1,373 AB
Pivot Bio® + 224	261 A	0.86 A	1,374 AB
P-Value	<0.0001	<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 $5.91/bu corn, $0.63/lb N, and $20/ac for Pivot Bio PROVEN® 40.



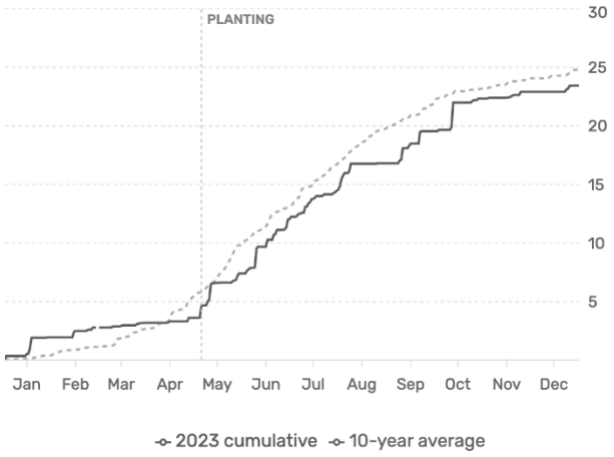
Summary:

- The use of Pivot Bio PROVEN® 40 would be expected to reduce the EONR. In two replications (Rep 2 and Rep 3) Pivot Bio PROVEN® 40 resulted in lower EONR than the check treatment (average of 12 lb/ac lower) with no difference in yield at EONR (YEONR). In two replications (Rep 4 and Rep 5) Pivot Bio PROVEN® 40 resulted in higher EONR than the check treatment (12 lb/ac higher) and YEONR was slightly higher (2 to 4 bu/ac) for the Pivot Bio PROVEN® 40 treatment.

This research was supported in part by an award from the USDA-NRCS Conservation Innovation Grants, On-Farm Conservation Innovation Trials, award number NR203A750013G014.

Impact of Pivot Bio PROVEN® 40 at Six Nitrogen Rates on Corn

Study ID: 0709047202304
County: Dawson
Soil Type: Cozad silt loam
Planting Date: 5/5/23
Harvest Date: 11/3/23
Seeding Rate: 34,000
Row Spacing (in): 30
Hybrid: Channel® 214-22STXRIB
Reps: 6
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 2.3 qt/ac Harness Xtra® 5.6, 22 oz/ac Roundup PowerMAX® 3, 8 oz/ac Dicamba, 3 oz/ac mesotrione, and 12.8 oz/ac Padlock Plus® applied as burndown on 5/16/23 ***Post:*** None
Seed Treatment: PivotBio
Foliar Insecticides: None
Foliar Fungicides: None
Irrigation: Gravity, Total: 8"
Rainfall (in):



Soil Samples 0-6" (Nitrate: 4/19/2023 | Other: 5/17/2022)

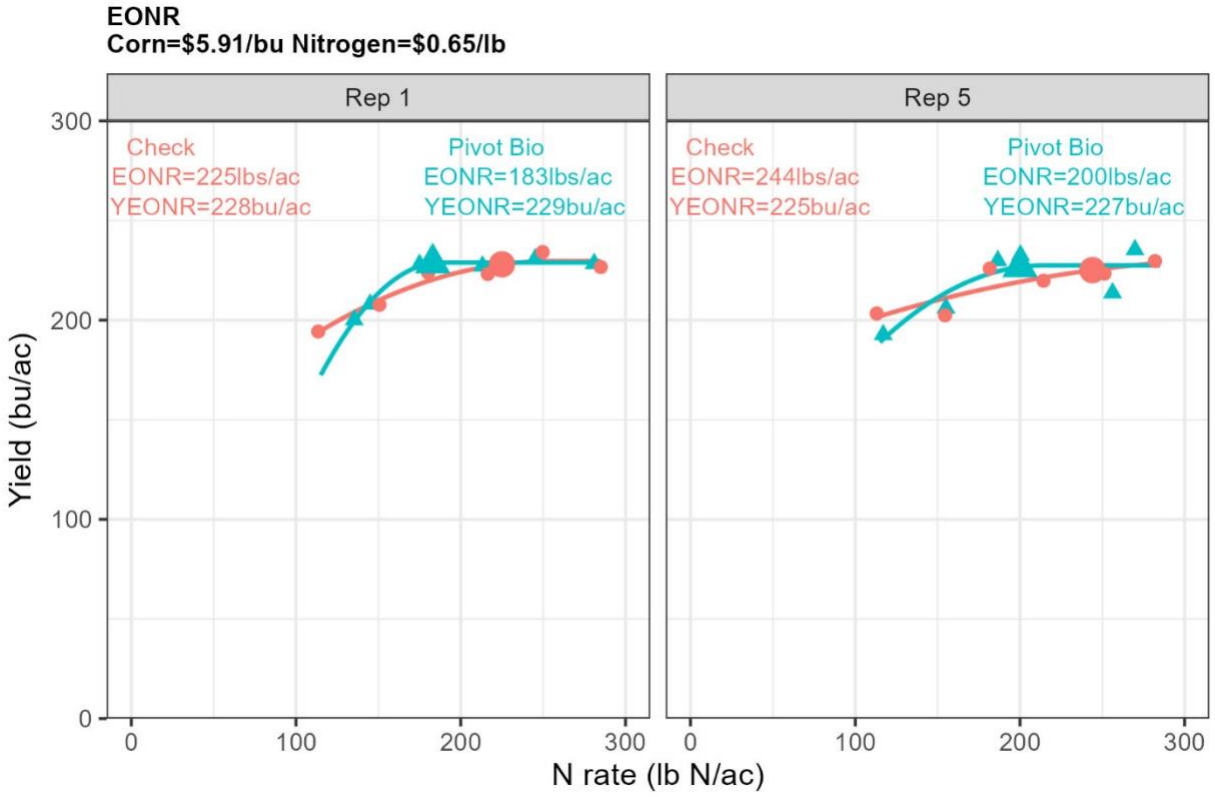
								-------Melich lll-------						
pH	BpH	OM LOI %	Nitrate-N Ppm N	Olsen P ppm	Bray P1 ppm	Sulfate-S ppm S	K	Ca	Mg	Na	CEC me/100 g	Sand (%)	Silt (%)	Clay (%)
6.7	6.9	3.4	26.7	30	68	19	480	2319	315	44	16.3	32	47	20
6.2	6.7	3.3	20.2	6	11	17	372	2003	395	76	16.6	24	54	22
6.1	6.6	4.1	21.8	17	36	17	578	2915	611	95	25.1	36	44	20

Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N loss through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. Pivot Bio PROVEN® 40 is an N-fixing bacterial inoculant that is expected to fix 40 lb N/ac over the growing season. Biological N fixation for cereal crops has potential to increase N efficiency and decrease N loss. The objective of this study was to evaluate Pivot Bio PROVEN® 40 on corn yield, net return, and the potential for N rate reduction. Pivot Bio PROVEN® 40 was applied on the seed at planting with 8-27-4 (2 lb N/ac) starter fertilizer and was compared to an untreated check with just starter fertilizer. All treatments received 73 lb N/ac on April 20, 2023, in a strip-till application (32% UAN, 10-34-0, and 12-0-0-26S blend) and 35 lb N/ac on May 16, 2023, from 32% UAN carrier for herbicide application. The Pivot Bio PROVEN® 40 treatment was evaluated at six N rates, with the N rate treatments applied on June 28, 2023, at rates of 0, 35, 70, 105, 140, and 175 lb N/ac using a UAN and ammonium thiosulfate blend for total N rates of 110, 145, 180, 215, 250, and 285 lb N/ac. The economic optimum N rate (EONR) was calculated for the check treatment and Pivot Bio PROVEN® 40 treatment for two replications where a quadratic plateau model could be fit.

Results:

Treatment and Target N rate (lb/ac)	Total N rate (lb/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check - 110	113.53 A	203.8 DE	1108 AB
Check - 145	153.0 C	208.1 BCDE	1100 AB
Check - 180	179.5 D	220.9 ABC	1153 A
Check - 215	214.3 E	225.4 A	1150 A
Check - 250	249.2 F	220.8 ABC	1093 AB
Check - 285	282.6 G	224.0 AB	1084 AB
Pivot Bio - 110	126.2 B	198.6 E	1043 B
Pivot Bio - 145	159.8 C	206.5 CDE	1061 AB
Pivot Bio - 180	184.4 D	222.2 ABC	1132 AB
Pivot Bio - 215	211.0 E	222.9ABC	1114 AB
Pivot Bio - 250	243.6 F	216.4 ABCD	1048 B
Pivot Bio - 285	268.0 H	227.0 A	1090 AB
P-Value	<0.0001	<0.0001	0.010

*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 $5.91/bu corn, $0.65/lb N, and $24/ac for Pivot Bio PROVEN® 40.

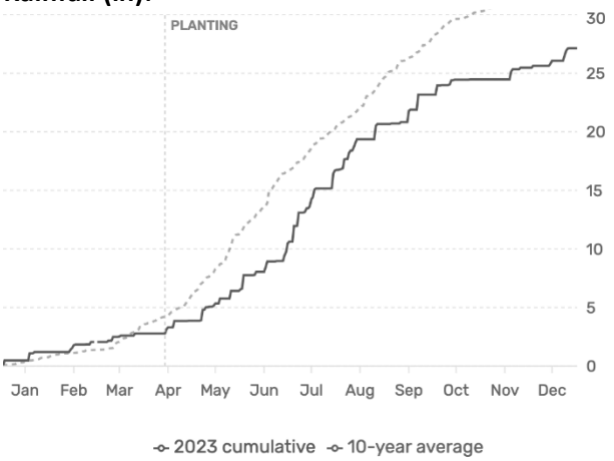


Summary:

- The EONR for the Pivot Bio PROVEN® 40 treatment was 42 to 44 lb/ac lower than the check treatment. Estimated yields obtained at EONR were similar between the Pivot Bio PROVEN® 40 treatment and the check.

Impact of Pivot Bio PROVEN® 40 at Three Nitrogen Rates on Corn

Study ID: 1226067202301
County: Gage
Soil Type: Kennebec silt loam occasionally flooded; Muscotah silty clay loam occasionally flooded; Nodaway silt loam channeled, occasionally flooded
Planting Date: 4/13/23
Harvest Date: 10/16/23
Seeding Rate: 32,000
Row Spacing (in): 30
Hybrid: Dekalb® DKC66-75
Reps: 5
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 30 oz/ac Roundup® PowerMAX 3, 1.7 lb/ac AMS, 16 oz/ac MSO, and 6 oz/ac Rifle® on 4/17/23 ***Post:*** 48 oz/ac Resicore®, 2 oz/ac Radiate®, 2 lb/ac AMS, 22 oz/ac Roundup® PowerMAX 3, 6 oz/ac Liberate®, 1 lb/ac MMTS, and 16 oz/ac atrazine 4F on 5/23/23
Seed Treatment: 500-B-ECD
Foliar Insecticides: None
Foliar Fungicides: 13.8 oz/ac Trivapro® and 1 lb/ac MMTS on 7/18/23
Fertilizer: 5 gal/ac (5 lb N) 10-18-4 on 4/13/23; 10 gal/ac (12 lb N) 10-34-0 and 6 gal/ac 12-0-0-26 (8 lb N) on 5/17/23
Irrigation: Pivot, Total: 10"
Rainfall (in):



Soil Samples 0-6" (Nitrate: 4/3/2023)

						----------Melich lll----------							
pH	BpH	OM LOI %	Melich III P - ppm	Nitrate – N ppm N	Sulfate-S ppm S	K	Ca	Mg	Na	CEC me/100g	Sand (%)	Silt (%)	Clay (%)
6.2	6.7	3.0	21	3	5.6	268	1789	263	46	14.7	24	50	26
6.1	6.8	2.6	18	1.6	5.3	132	1383	213	42	11.6	28	54	18
6.3	6.8	2.9	16	5.7	2.9	266	2035	303	49	15.9	26	52	22

Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N loss through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. Pivot Bio PROVEN® 40 is an N-fixing bacterial inoculant that is expected to fix 40 lb N/ac over the growing season. Biological N fixation for cereal crops has potential to increase N efficiency and decrease N loss. The objective of this study was to evaluate Pivot Bio PROVEN® 40 on corn yield and net return. Pivot Bio PROVEN® 40 was applied at a rate of 12.8 oz/ac in-furrow with 5 gal/ac 10-18-4 (5 lb N/ac) starter fertilizer and was compared to an untreated check with just starter fertilizer. The check treatment was evaluated at two N rates (175 lb/ac and 115 lb/ac) and the Pivot Bio PROVEN® 40 treatment was evaluated at two 30 lb/ac reduced N rates (145 lb/ac and 85 lb/ac). The various treatment N rates were applied on May 17, 2023 with 28% UAN. All treatments also received 10-34-0 and 12-0-0-26 S applied using a coulter machine on May 17, 2023, which totaled 20 lb N/ac. The field was planted into green cereal rye that was 4" tall and had been grazed by cattle in March.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Full N Check (200 lb N/ac)	246 A	1,326 A
Pivot Bio Proven® -30 (170 lb N/ac)	243 A	1,324 A
Reduced N Check (140 lb N/ac)	239 A	1,316 A
Pivot Bio Proven®, Reduced N -30 (110 lb N/ac)	220 B	1,225 B
P-Value	<0.0001	0.0006

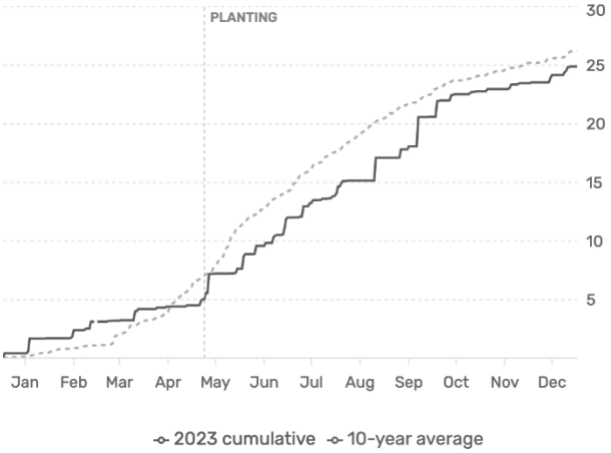
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 15.5% moisture.
‡Marginal net return based on $5.91/bu corn, $25/ac for Pivot Bio PROVEN® 40, and $0.65/lb N.

Summary: The reduced N treatment at 110 lb N/ac with Pivot Bio PROVEN® 40 resulted in a yield decrease compared to the other treatments. There was no difference between the other three treatments in yield or marginal net return.

Impact of Pivot Bio PROVEN® 40 at Three Nitrogen Rates on Corn

Study ID: 0064099202301
County: Kearney
Soil Type: Holdrege 3-6% slopes; Hobbs
Planting Date: 5/8/23
Harvest Date: 10/17/2023
Seeding Rate: 32,000
Row Spacing (in): 30
Hybrid: Channel® 214-22STXRIB
Reps: 4
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 2 qt/ac Fulltime® and 2/3 pt/ac 2,4-D 6 LVE on 4/17/23 ***Post:*** 2.5 qt/ac Acuron®, 32 oz/ac Roundup® Ultra MAX and 5 oz/ac Status® on 5/30/23
Foliar Insecticides: None
Foliar Fungicides: Fungicide applied by plane on 7/20/23

Fertilizer: 100 lb/ac 11-52-0 broadcast March 2023; 4 gal/ac 10-34-0 applied in-furrow at planting; 32% UAN sidedressed on 6/9/23; 25 lb N/ac applied through fertigation on 7/3/23 and 7/21/23
Irrigation: Pivot, Total: 10”
Rainfall (in):



Introduction: Nitrogen fertilizer is a significant input in corn systems. Additionally, N loss through leaching, volatilization, and denitrification pose environmental concerns and reduce profit. Pivot Bio PROVEN® 40 is an N-fixing bacterial inoculant that is expected to fix 40 lb N/ac over the growing season. Biological N fixation for cereal crops has potential to increase N efficiency and decrease N loss. The objective of this study was to evaluate Pivot Bio PROVEN® 40 on corn yield and net return. Pivot Bio PROVEN® 40 was applied as a seed treatment and compared to a check. Both the Pivot Bio PROVEN® 40 treatment and check were evaluated at three sidedress nitrogen rates, 90 lb/ac, 130 lb/ac, and 170 lb/ac applied as 32% UAN on June 9. All treatments also received 65 lb N/ac from 11-52-0 in March, 10-34-0 starter at planting, and two fertigation applications of 25 lb N/ac as 32% UAN.

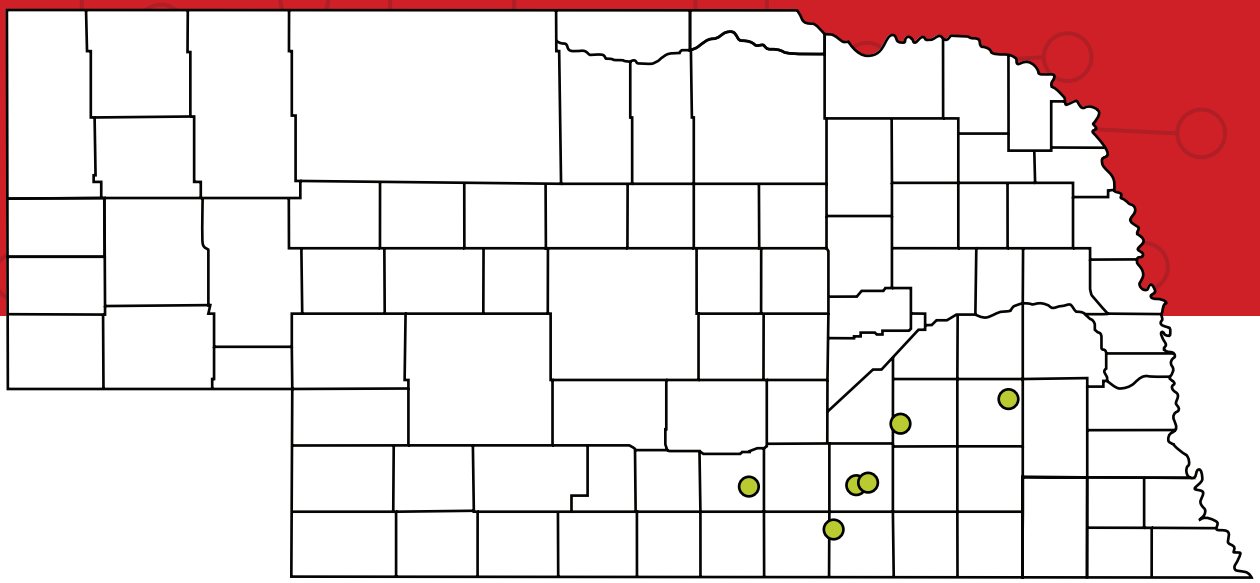
Results:

	Stand Count (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
155 lb N/ac – No Pivot Bio	32,375 A*	248 A	1,362 A
155 lb N/ac – Pivot Bio	32,000 A	260 A	1,409 A
195 lb N/ac – No Pivot Bio	31,875 A	255 A	1,375 A
195 lb N/ac – Pivot Bio	31,875 A	249 A	1,317 A
235 lb N/ac – No Pivot Bio	31,625 A	251 A	1,327 A
235 lb N/ac – Pivot Bio	30,875 A	268 A	1,409 A
P-Value	0.727	0.142	0.296

*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 $5.91/bu corn, $0.67/lb N, and $26/ac for Pivot Bio PROVEN®.

Summary: There were no differences in stand count, yield, or net return between the with and without Pivot Bio PROVEN® 40 treatment or the N rates evaluated. The lowest N rate of 155 lb N/ac yielded as well as the highest N rate of 235 lb N/ac.

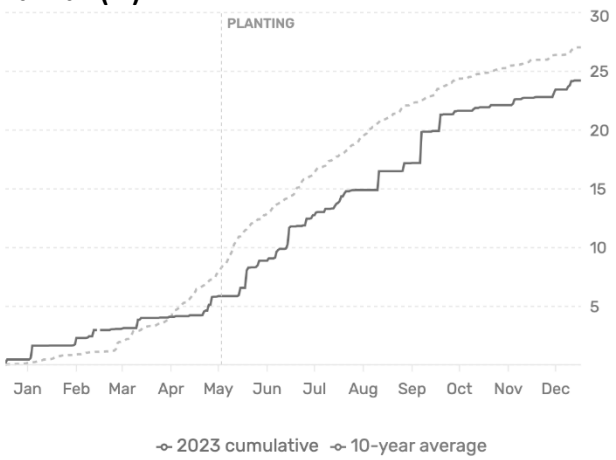
COVER CROPS



Long-term Evaluation of Cereal Rye Cover Crop

Study ID: 0064099202302
County: Kearney
Soil Type: Kenesaw silt loam; Hersh fine sandy loam
Planting Date: 5/17/23
Harvest Date: 10/1/2023
Seeding Rate: 160,000
Row Spacing (in): 15
Hybrid: Prairie Valley® 2620XF
Reps: 4
Previous Crop: Seed Corn
Tillage: No-Till
Herbicides: ***Pre:*** 40 oz/ac Roundup® PowerMAX on 5/4/23; 3.25 oz/ac Zidua®, 20oz/ac Flumioxazin, 12.8 oz/ac Engenia®, and 19.2 oz/ac Volacept® on 5/18/23 ***Post:*** 32 oz/ac Liberty® and 3 pt/ac Warrant® on 6/15/23; 32 oz/ac Liberty® on 6/26/23
Seed Treatment: Saltro® and fungicide by Aurora Coop

Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 100 lb/ac 11-52-0 in March 2023
Irrigation: Pivot, Total: 10 inches
Rainfall (in):



Introduction: This study compared the effects of a cereal rye cover crop on the following cash crop yield. This is the seventh year of the study, with cereal rye and check strips maintained in the same location from year to year. Rye was drilled in 10" rows on September 5, 2022, at a rate of 1 bu/ac. From November 2022 through April 10, 2023, sheep grazed on the cover crop. The rye was terminated with the pre-plant herbicide application of 40 oz/ac Roundup® PowerMAX on 5/4/23. The rye was approximately 18-24" tall at the time of termination. Soybeans were planted in 15" rows with a Kinze® 2600 planter on May 15, 2023. Soybean stand counts were taken on June 15 and October 2. Soybeans were harvested on October 1, and yield and moisture were recorded. Soil samples were collected for all replications of the study following harvest in late October 2023 to determine the impact of the cereal rye cover crop on soil organic matter after seven years.

Results:

	Soil OM (0-8") (%)	Early Season Stand Count (plants/ac)	Harvest Stand Count (plants/ac)	Moisture (%)	Soybean Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
No Rye	1.5 A*	134,979 A	117,998 A	8.4 A	78 A	1,070 A
Cover Crop - Rye	1.4 A	123,223 A	120,610 A	8.4 A	74 B	1,004 B
P-Value	0.690	0.191	0.816	0.638	0.027	0.015

*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 $13.76/bu soybean and $13/ac for the cover crop treatment.

Summary:

- There were no differences in stand counts or grain moisture between the rye cover crop treatment and the untreated check.
- Soil organic matter was 1.4-1.5% and was not greater where the cover crop had been planted for seven years.
- The rye cover crop treatment resulted in a 4 bu/ac lower soybean yield compared to the no rye cover crop.

- Marginal net return was $66/ac lower for the rye cover crop treatment when considering yield loss and cover crop costs. The marginal net return presented here does not include potential increase in revenue due to the sheep grazing.

Summary of Previous Years

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. The field was replanted on May 17, 2018, due to poor stand resulting from fertilizer salt injury.

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.

2019

In year three (2019), cover crops were drilled on November 1, 2018, following corn harvest. The rye was terminated with glyphosate on May 5, 2019, at a height of approximately 12". Soybeans were planted into the strips on May 13, 2019.

Results:

	Moisture (%)	Soybean Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	11.9 A	86 B	694.94 A
Cover Crop - Rye	11.9 A	87 A	674.64 B
P-Value	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 of Previous Years, Continued

2020

In year four (2020), yields were not reported.

2021

In year five (2021), cover crops were drilled on September 2, 2020, following corn harvest. Sheep grazed on the rye from January 1 to April 1, 2021. The rye was terminated with herbicide on April 26. The rye was approximately 30" tall at the time of termination. Soybeans were planted into the strips on May 2, 2021.

Results:

	Rye Biomass (lb/ac)	June 27 Stand Count (plants/ac)	Sept. 28 Stand Count (plants/ac)	Grain Moisture (%)	Soybean Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	-	144,123 A	139,333 A	11.2 B*	92 A	1,085 A
Cover Crop – Rye	2,248	145,865 A	141,075 A	11.4 A	92 A	1,053 B
P-Value	-	0.719	0.572	0.015	0.813	0.015

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $11.80/bu soybean and $30/ac for cover crop seed and drilling cost.

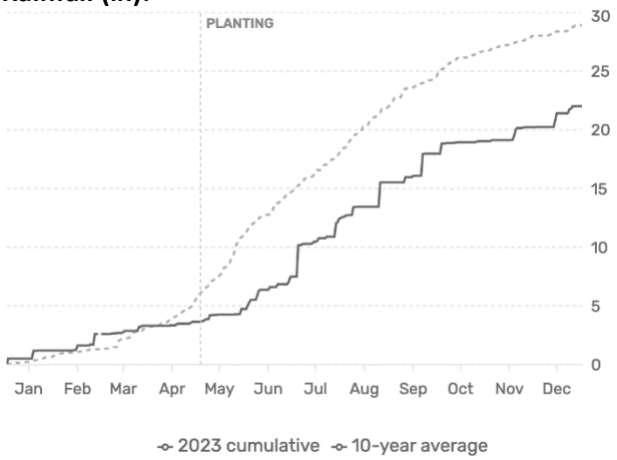
2022

In year six (2022), yields were not reported.

Evaluating the Impact of Perennial Clover Cover Crop - Year 2 (Corn)

Study ID: 0686035202302
County: Clay
Soil Type: Crete silt loam 0-1% slope; Fillmore silt loam frequently ponded; Scott silt loam frequently ponded; Hastings silt loam 0-1% slope
Planting Date: 5/3/23
Harvest Date: 9/18/23
Seeding Rate: 32,000
Row Spacing (in): 30
Hybrid: Pioneer® P1082AM
Reps: 3
Previous Crop: Soybean
Tillage: Strip-till
Foliar Fungicides: 10.5 oz/ac Aquilla®, 6.4 oz/ac Lambda- cyhalothrin, and 3.8 oz/ac Bifenthrin on 7/18/23

Fertilizer: 72 lb N/ac injected in strip as 28-0-0-5 on 4/7/23; 53 lb N/ac fertigated as 28-0-0-5 on 6/19/23; 46 lb N/ac fertigated as 28-0-0-5 on 6/24/23
Irrigation: Pivot, Total: 11.2"
Rainfall (in):



Introduction: The objective of this study was to evaluate the impact of a perennial clover cover crop on yield and economics of a corn/soybean system. This is the second year of the study, with 10 lb/ac Mammoth red clover planted on March 16, 2022. In year one, soybeans were planted and in year two corn was planted. The clover cover crop treatments and no cover crop treatments locations were maintained throughout the study. In November 2022, the clover treatments had a strip-till application through them, reducing the clover. By spring 2023, the red clover struggled to survive between the strip-till operation and drought conditions. However, yellow sweetclover appeared in large numbers, most likely from seed contamination. The yellow sweetclover wasn't desireable to the farmer and he used two applications of glyphosate to spray it out. By harvest 2023, no clover remained in the corn field.

Figure 1. From left to right: a) Drying soybeans with clover cover crop on Sept. 23, 2022, b) Clover remaining after soybean harvest and strip-till application on Nov. 8, 2022, c) Clover in corn – most is yellow sweetclover contamination on June 7, 2023, d) Dead clover residue between corn rows before harvest on Sept. 18, 2023.

Herbicide and insecticide applications varied between the clover cover crop and check strips and are as follows:

Cover Crop Herbicide Plan: 3.25 oz/ac Zidua® SC and 22 oz/ac Glyphosate on May 2, 2023; 3.25 oz/ac Zidua® SC and 22 oz/ac Glyphosate on May 30, 2023.

Check Herbicide and Insecticide Plan: 40 oz/ac SureStart® 2, 3 oz/ac Cavallo® 4 SC, 36 oz/ac Glyphosate, and bifenthrin with 9.6 oz/ac MSO Xtra HL on May 4, 2023; 80 oz/ac Helmet® Maxx and 32 oz/ac Glyphosate on May 30, 2023.

Stand counts, stalk rot, grain moisture, yield, and net return were evaluated in 2023. Clover and weed biomass was not collected in 2023 due to lack of biomass. In the first year of the study, soil samples were collected for baseline soil tests on Sept. 26, 2022. Biomass was also collected the same day by collecting clover and weed plant samples from a 18.75 sq. ft. area in the clover and check treatments. Nutrient analysis was conducted for the clover to determine biomass N. It was found the clover biomass contained 30 lb of nitrogen. The goal is to maintain these cover crop blocks for at least three years to determine the impact on crop yield within the cropping system, profitability from any reductions in herbicide and/or fertilizer inputs, and soil health over time.

Results:

	Harvest Stand Count (plants/ac)	Stalk Rot (%)	Moisture (%)	Corn Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	30,833 A	0.83 A	16.1 A	251 A	1,427 A
Clover	31,333 A	0.00 A	16.2 A	240 A	1,377 A
P-Value	0.8	0.423	0.604	0.241	0.321

*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 $5.91/bu corn, $40.29/ac for herbicide applications on the clover cover crop treatment, and $53.26/ac for herbicide and insecticide applications on the check treatment.

Summary:

- In year two of the study, there were no differences in corn stand counts, stalk rot, moisture, yield, or net return between the check and cover crop treatment. Net return considered only the differential costs of herbicide and insecticide applications between the treatments in year two, as cover crop seeding costs were accounted for in year one of the study.

Previous Year (2022) Results

Harvest stand counts, grain moisture, soybean yield, and marginal net return for check and clover cover crop treatments.

	Harvest Stand Count (plants/ac)	Moisture (%)	Soybean Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	72,833 A*	9.2 B	74 A	955 A
Clover Cover Crop	76,167 A	10.2 A	68 B	905 A
P-Value	0.791	0.032	0.066	0.155

*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 $13.97/bu soybean, $48.58/ac for herbicides in the check treatment, $34.32/ac for herbicides in the cover crop treatment, $30/ac for cover crop seed, and $17/ac for cover crop drilling.

Basic soil tests collected on Sept. 26, 2022, for check and cover crop at 0-8” depth.

	pH	Buffer pH	OM LOI %	lb N /ac	K ppm	Sulfate-S ppm	Zn ppm	Fe ppm	Mn ppm	Cu ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g	%H Sat	%K Sat	%Ca Sat	%Mg Sat	%Na Sat	Mehlich P-III ppm P
Check	6.1	6.8	3.1	22	267	10.8	3.2	45.5	14.8	0.72	2131	238	44	15.5	13	4	69	13	1	16
Cover Crop	6.1	6.7	3.3	20	297	12.6	6.9	64.4	16.7	0.91	2236	253	53	17.4	18	4	64	12	1	35

Previous Year (2022) Results (continued)

PLFA (phospholipid fatty acid) and Haney test at a 0-8" depth for the no cover crop check and cover crop on Sept. 26, 2022. Total microbial biomass and fungal species are used as indicators of soil quality. The Solvita® test measures carbon dioxide emitted from microbes. The Haney soil health score is an aggregated indicator of soil health. Data was only collected for one replication; therefore, a statistical analysis was not completed.

	Total Biomass (ng/g)	Diversity Index	Total Bacteria Biomass (ng/g)	Total Fungi Biomass (ng/g)	Solvita® (ppm CO2-C)	Haney Soil Health Score
Check	1763	1.46	748	165	138	16.5
Clover Cover Crop	2581	1.49	1152	288	185	20.8

Summary:

- There were no differences in soybean stand counts between the check and cover crop treatment.
- Grain moisture was 1% wetter for the soybeans growing in the cover crop treatment.
- There was severe hail damage on June 7. Following the hail, the clover cover crop recovered faster than the soybeans, which resulted in the clover being taller than the soybeans at harvest. Yield was impacted, with the cover crop treatment yielding 6 bu/ac less than the check treatment.
- There were no significant differences in net return.
- The clover produced 1,037 lb/ac of biomass, which contained 459 lb/ac of C and 31 lb/ac of N.

Economics of Clover in Soybean/Corn System (2 Years)

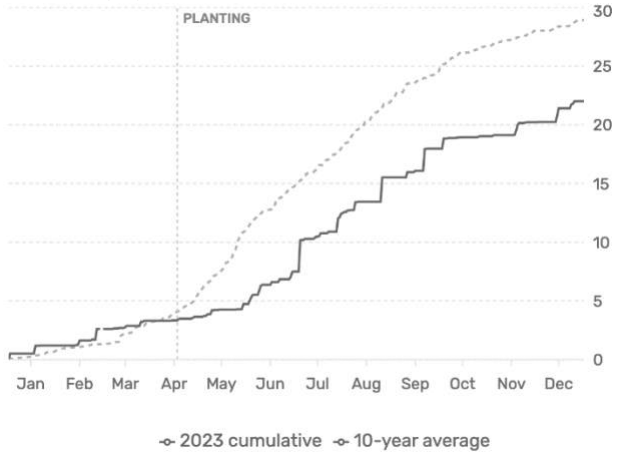
	Check ($/ac)	Clover ($/ac)
	Year 1	
Herbicide Cost	-$48.58	-$34.32
Clover Cost		-$30.00
Clover Seeding Cost		-$17.00
Yield (Marginal Net Return)	(74 bu/ac X $13.97/bu) = $985.20	(68 bu/ac X $13.97/bu) = $888.79
	Year 2	
Herbicide + Insecticide	-$53.26	-$40.29
Yield (Marginal Net Return)	(251 bu/ac X $5.91/bu) = $1,430.15	(240 bu/ac X $5.91/bu) = $1,378.11
2-Year Revenue ($/ac)	**$2,313.51**	**$2,145.29***

*In year one of the clover system, the N fertilizer rate could potentially be reduced in accordance with the anticipated N provided by the clover cover crop. It was estimated that the clover cover crop would provide 31 lb N/ac. At a N fertilizer cost of $0.65/lb, this represents an opportunity cost of $20.15/ac. Because the grower did not reduce N during the study, it is unknown whether the N reduction would result in a yield impact; therefore, values in the above table do not include this opportunity cost. If this opportunity cost is considered, this would result in a 2-year revenue of $2,165.44/ac for the clover cover crop system.

Evaluating the Impact of Perennial Clover Cover Crop - Year 2 (Soybeans)

Study ID: 0686035202301
County: Clay
Soil Type: Crete silt loam 0-1% slope; Fillmore silt loam frequently ponded; Hastings silt loam 0-1% slope
Planting Date: 4/17/23
Harvest Date: 9/18/23
Seeding Rate: 140,000
Row Spacing (in): 30
Variety: Pioneer® P25A16E
Reps: 3
Previous Crop: Corn
Tillage: Strip-till
Seed Treatment: Fungicide, insecticide, inoculant
Foliar Fungicides: None
Fertilizer: None

Irrigation: Pivot, Total: 9.4"
Rainfall (in):



Introduction: The objective of this study was to evaluate the impact of a perennial clover cover crop. This is the second year of the study. The perennial clover cover crop treatment was established with 10 lb/ac Mammoth red clover planted on March 16, 2022. The clover cover crop treatment and no cover crop treatment locations were maintained throughout the study. In year one, corn was planted and in year two soybeans were planted. The corn data from year one was not included because two different corn hybrids were used. In November 2022, the clover strips had a strip-till application through them, reducing the clover stand. By spring 2023, the red clover struggled to survive due to the strip-till pass and drought conditions.

Herbicide and insecticide applications varied between the clover cover crop and check strips and are as follows:

Cover Crop Herbicide and Insecticide Plan: 3.25 oz/ac Zidua® SC and 22 oz/ac Glyphosate on April 19, 2023; 3.25 oz/ac Zidua® SC and 22 oz/ac Glyphosate on May 20, 2023; 2 oz/ac Zidua® SC on June 13, 2023.

Check Herbicide and Insecticide Plan: 3.25 oz/ac Anthem® Maxx and 32 oz/ac Glyphosate on April 19, 2023; 3 lb/ac AMS, 32 oz/ac Enlist® One, 43 oz/ac Glufosinate, 64 oz/ac Arrest® CS, and Bifenthrin with 9.6 oz/ac bean oil on May 22, 2023; 3 lb AMS, 64 oz Arrest® CS, 12 oz Clethodim, and Bifenthrin on June 22, 2023.

Stand counts, grain moisture, yield, and net return were evaluated. Soil samples were collected for baseline PLFA (phospholipid fatty acid) and Haney soil test at a 0-8” depth for the no cover crop and cover crop treatments on September 26, 2022 in the first year of the study. Total microbial biomass and fungal species are used as indicators of soil quality. The Solvita® test measures carbon dioxide emitted from microbes. The Haney soil health score is an aggregated indicator of soil health. Samples were combined across the replications; therefore, a statistical analysis was not completed.

Biomass was determined by collecting clover and weed plant samples from a 18.75 sq. ft. area in the clover and no cover crop treatments following corn harvest in year one of the study. Nutrient analysis for nitrogen and carbon were analyzed from the biomass. The goal is to maintain these cover crop blocks for at least three years to determine the impact on crop yield within the cropping system, profitability from any reductions in herbicide and/or fertilizer inputs, and soil health over time.

Photos: (Top left) Year 1 had excellent clover establishment and weed suppression in corn; (Top right) Some clover removed via strip till in Nov. 22. (Lower left) June 2023, Year 2 of sporadic clover in soybeans with some yellow sweetclover contamination appearing. (Lower middle) July 2023, Minimal clover observed under canopy after canopy closure. (Lower right) September 2023, Soybean ready for harvest with minimal clover present. Some lambsquarter present as weeds.

Results:

2022	Total Biomass (ng/g)	Diversity Index	Total Bacteria Biomass (ng/g)	Total Fungi Biomass (ng/g)	Solvita® (ppm CO2-C)	Haney Soil Health Score
Check	2687.04	1.424	1100.71	210.75	261	26.35
Clover	2282.42	1.507	894.18	258.51	215.4	22

2023	Harvest Stand Count (plants/ac)	Moisture (%)	Soybean Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	100,833 A*	11.6 A	77 A	953 A
Clover	97,500 A	12.3 A	72 A	938 A
P-Value	0.575	0.184	0.132	0.637

*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 $13.76/bu soybean, $50.50/ac for herbicide and insecticide application for the clover treatment, and $102.67/ac for herbicide and insecticide applications for the check treatment.

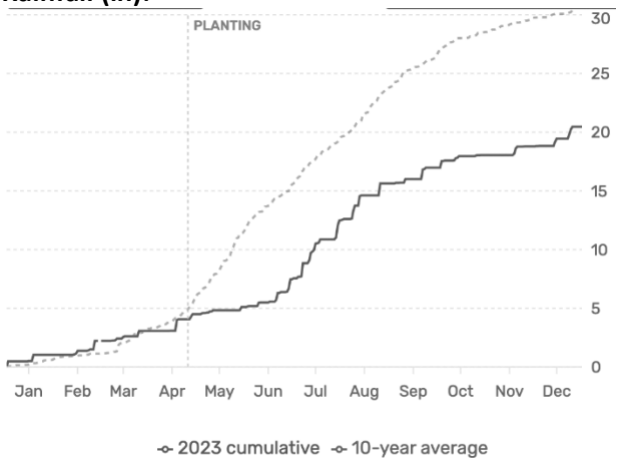
Summary:

- Following corn harvest in year one of the study, the clover cover crop produced an average of 646 lb/ac of biomass, which contained 268 lb/ac of C and 21 lb/ac of N (average of two replications sampled). Minimal clover remained in the field at harvest and no clover biomass was sampled in year two.
- In year two of the study, there were no differences in soybean stand counts, moisture, yield, or net return between the check and cover crop treatment. Net return considered only the differential costs of herbicide and insecticide applications between the treatments in year two, as cover crop seeding costs were accounted for in year one of the study.
- The strip-till application was observed to reduce red clover stand. In order to avoid this, growers may consider eliminating strip-till applications or experimenting with other cover crops which may be more tolerant of mechanical damage.

Evaluating the Impact of Interseeding Perennial Cover Crop in Corn

Study ID: 0916185202302
County: York
Soil Type: Hastings silt loam
Planting Date: 4/25/23
Harvest Date: 10/10/23
Seeding Rate: 32,000
Row Spacing (in): 36
Hybrid: Pioneer® P1278Q
Reps: 4
Previous Crop: Corn
Tillage: Ridge-Till
Herbicides: ***Pre:*** 12.4 oz/ac generic Lexar banded with planter ***Post:*** Zidua® first week of June
Seed Treatment: Standard Pioneer® treatment package
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: 10 gal/ac 10-34-0 banded on 3/24/23; 170 lb N/ac as anhydrous ammonia
Irrigation: Pivot, Total: 13.5
Rainfall (in):



Soil Tests: September 2022 for check and interseeded cover crop at 0-8" depth.

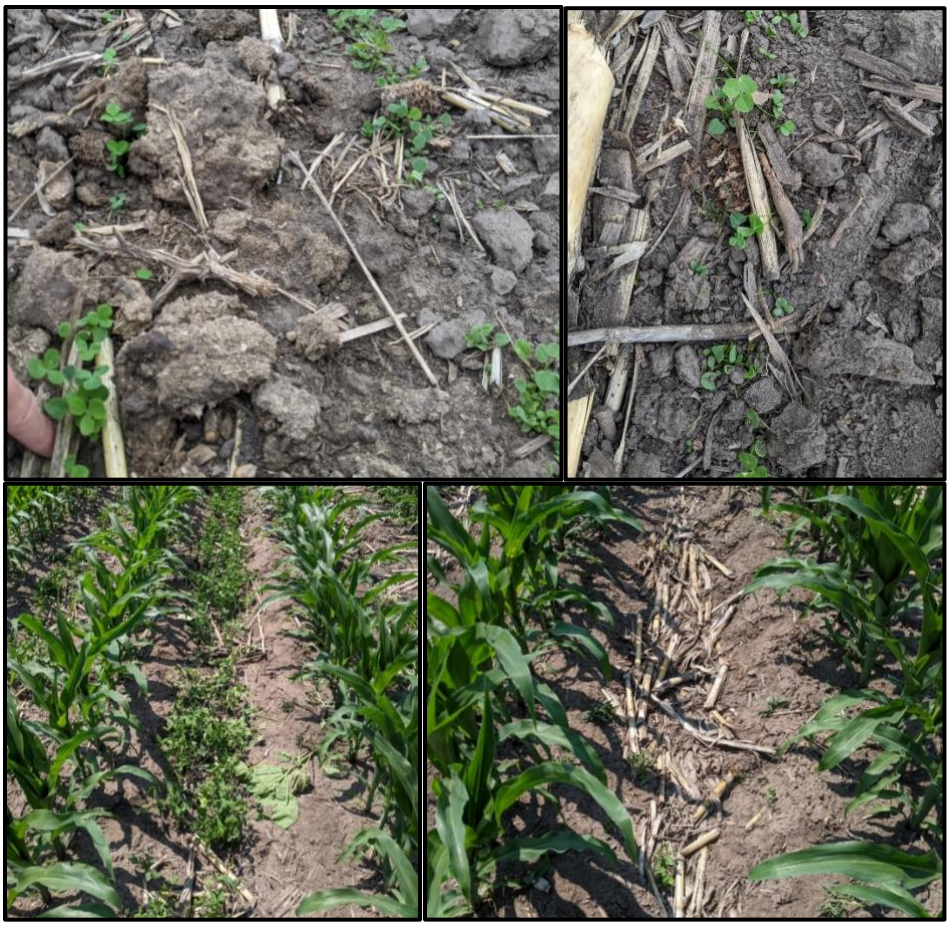
	pH	Buffer pH	OM LOI %	Nitrate -N ppm N	lbs N/A	K ppm	Sulfate -S ppm	Zn ppm	Fe ppm	Mn ppm	Cu ppm	Ca ppm	Mg ppm	Na ppm	CEC me/100g	%H Sat	%K Sat	%Ca Sat	%Mg Sat	%Na Sat	Mehlich P-III ppm P
Check	6.6	7.2	3.6	4.9	12	381	10.1	1.86	39.9	10.3	0.81	2530	324	47	16.5	0	6	77	16	1	14
Interseeded1	6.0	6.7	3.6	15.6	37	353	14.3	2.09	53.5	16.4	0.86	2315	262	49	17.9	17	5	65	12	1	13
Interseeded2	6.1	6.7	3.3	10.1	24	317	12	1.79	55.1	16.7	0.81	2087	227	41	16.3	18	5	64	12	1	13

Introduction: This field had been used for interseeding of annual cover crops the previous four years. Because of the cost of seed and interseeding annual cover crops each year, the grower decided to evaluate the impact of a perennial cover crop on the corn crop in hopes of eliminating that yearly cost. The cover crop strips remained in the same locations as previous years and were planted on April 3, 2023, following anhydrous ammonia application. Two cover crop treatments were evaluated:

1) 5 lb/ac Medium red clover and 5 lb/ac Dutch White clover

2) 5.5 lb/ac AberLasting white clover with 15 lb/ac Kentucky bluegrass

With the dry conditions at the soil surface, 0.4" of irrigation was applied on April 6, 2023. Cover crop emergence was observed on April 13, 2023. Cover crop establishment was good in May due to the help of irrigation but without subsequent rain/irrigation, the Kentucky bluegrass died off by early June. Biomass samples of weeds and clover for each treatment were collected on Sept. 11, 2023. Cover crop biomass, corn yield, and net return were evaluated.



Photos: (Top left) Treatment 1 of clover on May 9 (Top right) Treatment 2 of grass and clover on May 9 (Lower left) Treatment 1 of healthy clover on June 6; (Lower right) Treatment 2 on June 6, Kentucky bluegrass died out due to drought and minimal clover was present leading to weeds later in the season.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	238 A*	1,406 A
Kentucky bluegrass + AberLasting Clover	238 A	1,368 B
Red + White Clover	239 A	1,331 C
P-Value	0.721	0.0002

	Weed Biomass (lb/ac)	Weed C (lb/ac)	Weed N (lb/ac)	CoverCrop Biomass	CoverCrop C (lb/ac)	CoverCrop N (lb/ac)
Kentucky bluegrass + AberLasting Clover	286 A*	101.6 A	6.34 A	0 A	0 A	0 A
Red + White Clover	294 A	116.9 A	4.62 A	0 A	1 A	0.05 A
P-Value	0.976	0.873	0.575	0.184	0.250	0.192

*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 $5.91/bu corn, $80.75/ac for the Kentucky Bluegrass and AberLasting clover treatment, and $39.50/ac for the medium red clover and dutch white clover treatment.

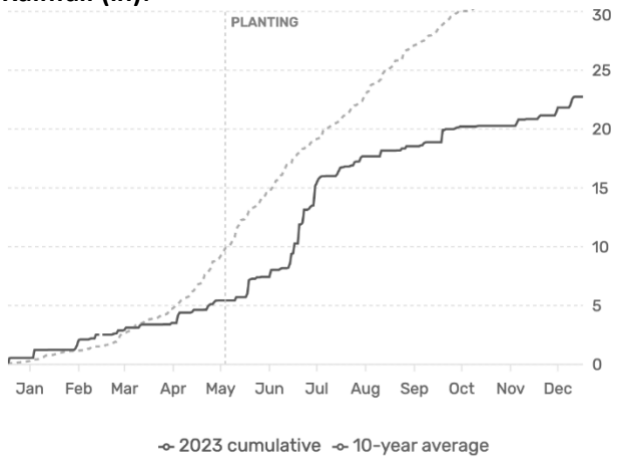
Summary:

- There were no significant differences in corn yield between the interseeded cover crop treatments and the no cover crop check.
- Net return was $37.90/ac and $74.90/ac lower for the cover crop treatments due to increased input costs, for the Kentucky Bluegrass and AberLasting clover and medium red and white clover, respectively.
- Minimal biomass remained of the cover crop in both treatments. The treatment with Kentucky Bluegrass died out because the soil surface didn't remain moist.

Evaluating the Impact of 30" versus 60" Corn Row Spacing for Interseeding Cover Crop

Study ID: 1521159202301
County: Seward
Soil Type: Hastings silt loam 0-1% slope; Hastings silty clay loam 3-7% slopes
Planting Date: 5/18/23
Harvest Date: 9/29/23
Seeding Rate: 28,000 in 30", 24,500 in 60" (60" row spacing used planter setting of 49,000 seeds/ac)
Row Spacing (in): 30" and 60"
Hybrid: Pioneer® P9998AM
Reps: 3
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** glyphosate and 2, 4-D LV Est on 5/9/23 ***Post:*** 0.9 gal/ac Liberty®, 0.9 gal/ac Roundup® PowerMAX, and 0.02 gal/ac Outlook® on 6/30/23 were applied to the 30" check treatment only; no post applications were made to the interseeded treatments

Seed Treatment: Fungicide seed treatments, Ipconazole, Ethaboxam, L-2012R, Lumivia, Lumisure, Lumialza
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 85 lb/ac 32% UAN with 12-0-0-26 thiosulfate at burndown on 5/9/23
Irrigation: None
Rainfall (in):



Introduction: Wider corn row spacing may provide a better opportunity for establishment and growth of cover crops. This study compared two row spacings and two seeding rates. The three treatments were:

1) corn planted at 30" row spacing and a population of 28,000 seeds/ac

2) corn planted at 30" row spacing and a population of 28,000 seeds/ac with cover crops interseeded

3) corn planted at 60" row spacing and a population of 24,500 seeds/ac with cover crops interseeded. (To achieve the same seeds/ac rate as the 30" treatments, the producer would have needed to use a planter setting of 56,000 seeds/ac resulting in high within row plant density. Due to drought conditions, the producer chose to lower this rate to 75% of the 30" treatment rate, resulting in a planter setting of 49,000 seeds/ac and achieving an actual seeding rate of 24,500 seeds/ac with the 60" row spacing.)

Cover crops were planted on June 8, 2023, in V3 corn with a CrustBuster® Speed King Inc. drill, with units tied up to not run over standing corn. The species mixture contained by weight 5% Iron Clay cowpeas, 5% mung beans, 5% common vetch, 5% Tender Teff grass, 5% Tetilia/Tetra Prime Italian ryegrass, 3% impact forage collards, 2% purple top turnip, 3% african cabbage, 5% baldy safflower, 17% mancan buckwheat, 3% super bee phacelia, 3% decorative gourd mix, 12% brown flax, 14% red clover, and 14% white clover. The target seeding rate was 20 lb/ac. Drought impacted the cover crop germination and emergence.

Photos: (left) Interseeding cover crop at V3 using a CrustBuster® drill with units tied up over the corn rows. (right) View of the 60” vs. 30” corn rows after interseeding cover crops. Some sunflowers and volunteer soybeans were present at time of interseeding.

Watermark™ soil moisture sensors were installed on June 30, 2023, at depths of 6”, 12”, 24”, and 36”. The dry conditions made installation difficult. On September 15, 2023, biomass data (lbs/ac and nutrient analysis) were collected from cover crop and weed plant samples from a 12.5 sq. ft. area in the 60” cover crop strips and 6.25 sq. ft. area in the 30” cover crop strips.

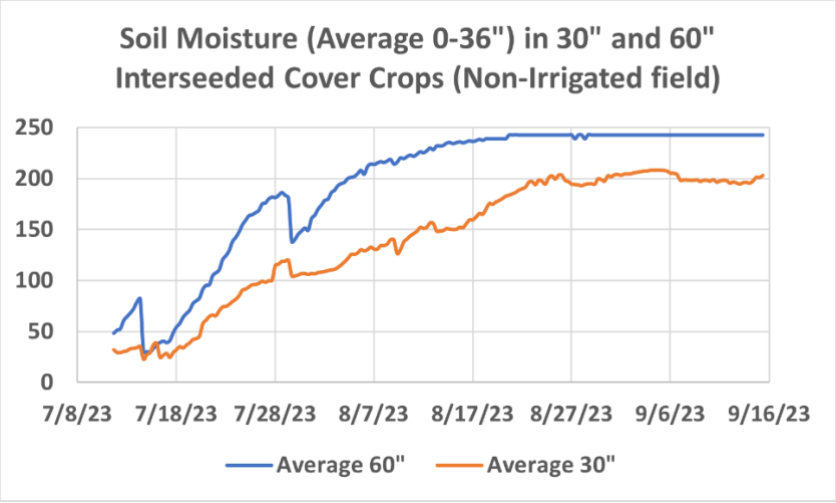
Photos: (Top left) Cover crops in 60” rows on June 30; (Top middle) Cover crops in 30” rows on June 30. (Top right) Covers in 60” rows on July 11; (Lower left) Covers in 60” rows on July 29, (Lower middle) Covers/weeds on September 15 with farmer cooperator standing in 60” rows; (Lower right) Covers/weeds on September 15 in 30” rows.

Results:

	Weed Biomass (lb/ac)	Weed Carbon (lb/ac)	Weed Nitrogen (lb/ac)	Cover Crop Biomass (lb/ac)	Cover Crop Carbon (lb/ac)	Cover Crop Nitrogen (lb/ac)
30" Interseeded	340 A	141 A	5 A	160 A	70 A	4 A
60" Interseeded	2,400 A	1030 A	22 A	740 A	313 A	12 A
P-Value	0.143	0.141	0.121	0.140	0.144	0.187

	Stand Count (plants/ac)	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
30" Check	24,167 A*	12.5 A	56 A	80 A	475 A
30" Interseeded	25,333 A	12.2 A	55 A	81 A	429 A
60" Interseeded	21,833 B	12.4 A	56 A	67 B	345 B
P-Value	0.027	0.326	0.918	0.029	0.009

*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 $5.91/bu corn and $51.75/ac for the cover crop treatments.



Summary:

- The 60" interseeded treatment had a stand of 21,833 plants/ac while the 30" treatments averaged 24,750 plants/ac.
- There were no differences in corn test weight or moisture among the treatments evaluated.
- Yield was 13 to 14 bu/ac lower for the 60" interseeding treatment. There was no yield difference between the 30" interseeded treatment and the 30" check treatment.
- Marginal net return was $84/ac to $130/ac lower for the 60" interseeded treatment due to the decreased yields and increased seed cost over the check treatment.
- There were no significant differences in weed biomass, weed carbon, weed nitrogen, cover crop biomass, cover crop carbon, or cover crop nitrogen between the 30" interseeded treatment and 60" interseeded treatment.
- Greater soil moisture loss was observed the entire growing season in the 60” rows versus 30” rows that were interseeded with cover crops. It is hypothesized that the greater exposed soil surface area in the 60” rows resulted in more evaporative losses.

Effects of Grazing Cover Crops in a Three-Year Non-Irrigated Rotation
7-year summary report

Study ID: 0720129202301
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 monetary costs while retaining soil benefits. This study evaluated three treatments: grazed cover crop (or corn residue, 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. Cover crops were only planted following the wheat phase of the rotation. Cool-season cover crops were planted after wheat in the first 6 years of this study. The second 6 years of the study will include warm-season cover crops after wheat to determine any economic differences. Watermark™ soil moisture sensors were installed to determine treatment impacts for each growing season. Soil physical and health parameters of each treatment were taken at the beginning of the study and every three years for comparison over time. An economic analysis is provided for the system each year, and the economics will be tracked over time.

Year 1 (2017 Corn)

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	1.50 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 soil moisture in the cover crop treatments was around 35% depleted (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 Palmer amaranth emerge 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 Soybean)

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 water stress than the non-grazed treatments (Figure 1).

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

Table 4. 2018 soybean yield results.

	Stand Count (plants/ac)	Test Weight	Grain 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 Wheat)

Following soybean harvest in October 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 were 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. The cover crop was planted on September 4, 2019, due to the rain and wet field. Three-year follow-up soil analyses 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)	Grain 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 analyses 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 CO_2-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 the 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 on soil bulk density 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.

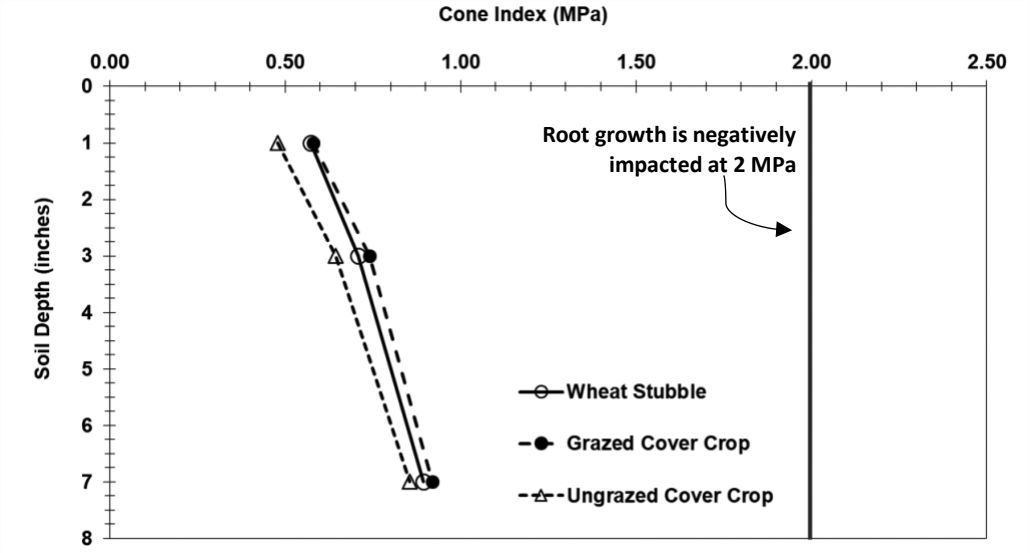
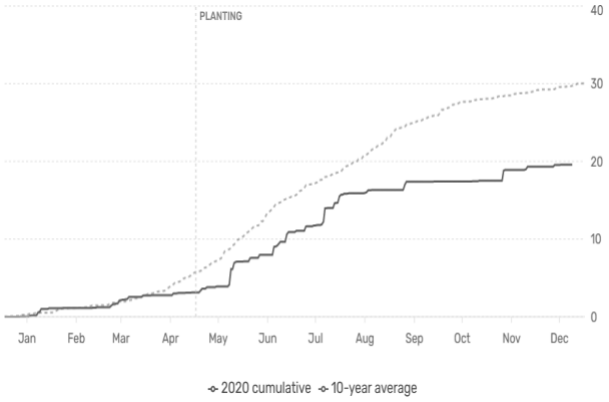


Figure 2. Three-year follow-up soil cone index values by treatment taken August 5, 2019. The line on the far right represents where root growth is negatively impacted, because roots are no longer able to easily penetrate through the soil.

Year 4 (2019 Cool-Season Cover Crop and 2020 Corn)

Following wheat harvest, 20 ton/ac manure were applied, then a cool-season cover crop was planted on September 3, 2019. Cover crop contained 10 lb/ac winter peas, 25 lb/ac winter triticale, 25 lb/ac black oats, 1.3 lb/ac collards, and 1.3 lb/ac turnip. Nine bulls grazed the cover crop for 23 days. However, only 8.7 AUM were available, which was less than the 19.0 AUM in 2016 due to the wet fall, late planting, and minimal growth. Cover crop was 8" at time of termination by 32 oz Roundup®, 8 oz/ac dicamba, 0.5 lb/ac atrazine, and 4 oz/ac Balance® Flexx on 3/20/20. Manure application on a wet field resulted in deep ruts. This may have impacted corn emergence and stand counts the following spring.



For the corn crop, 190 lb/ac N as anhydrous ammonia were applied on March 15, 2020. Pioneer® P1244 was planted no-till on May 1, 2020, at a seeding rate of 25,000 seeds/ac in 30" rows. Six gallons of starter fertilizer (10-34-0) were applied in-furrow at planting. Post-emergent herbicides included 0.5 lb/ac atrazine, 30 oz/ac DiFlexx® DUO, and 32 oz/ac of Roundup. On August 20, 2020, Headline AMP® was applied for southern rust at 10 oz/ac. Harvest occurred on October 13, 2020. All treatments had a full soil moisture profile at the beginning of the 2020 growing season. By the end of August, all treatments had reached 50% depletion (Figure 3). There were no differences among treatments for stand counts, percent stalk rot,

percent moisture, and test weight. The corn in the ungrazed wheat stubble yielded more than the cover crop treatments (Table 7).

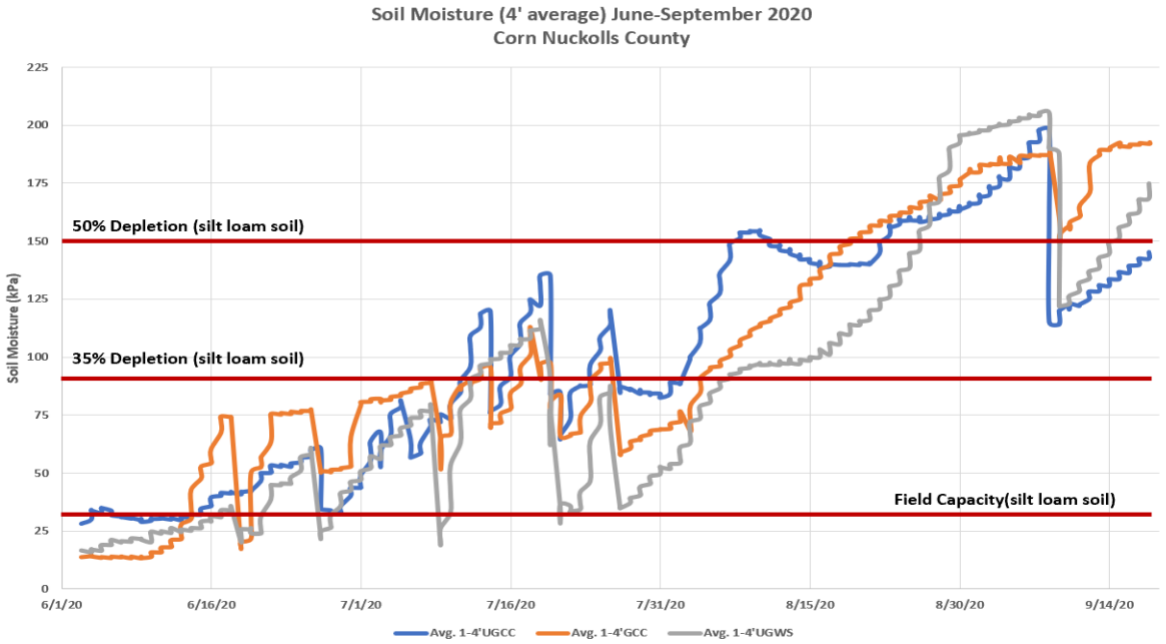


Figure 3. Soil moisture depletion for June-September 2020 corn in Nuckolls County. All treatments began the season with soil moisture at or above field capacity. The ungrazed cover crop (UGCC) and grazed cover crop (GCC) treatments reached 50% depletion by mid-August with the ungrazed wheat stubble (UGWS) reaching 50% depletion toward the end of August.

Table 7. 2020 corn yield results.

	Stand Count (plants/ac)	Stalk Rot (%)	Grain Moisture (%)	Test Weight	Corn Yield (bu/ac)†
Cover Crop—Non-grazed	16,875 A	0 A	13.8 A	60.1 A	215 B
Cover Crop/Stubble—Grazed	18,000 A	0 A	13.6 A	60.3 A	216 B
Stubble—Non-grazed	18,125 A	2.5 A	13.6 A	60.2 A	227 A
P-Value	0.4355	0.454	0.2648	0.9201	0.0057

*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 5 (2021 Soybeans)

Following corn harvest, no cover crops were planted. In the previously established grazed cover crop treatment, cattle grazed on the corn stalks. The two previously established non-grazed treatments remained non-grazed. Soybean were planted in 15" row spacing on May 5, 2021, across all treatments. The variety was Pioneer® 25A04 and the rate was 140,000 seeds/ac. This location had good rain in 2021, so there was no moisture stress observed across treatments as was observed in 2018. The soybeans were harvested on September 21 and 22, 2021. There were no significant difference in the stand count, moisture, or soybean yield in 2021.

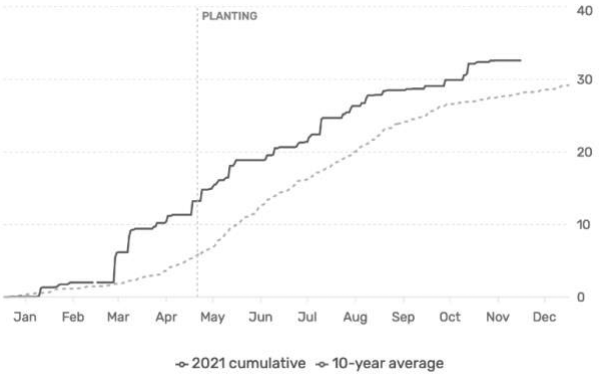
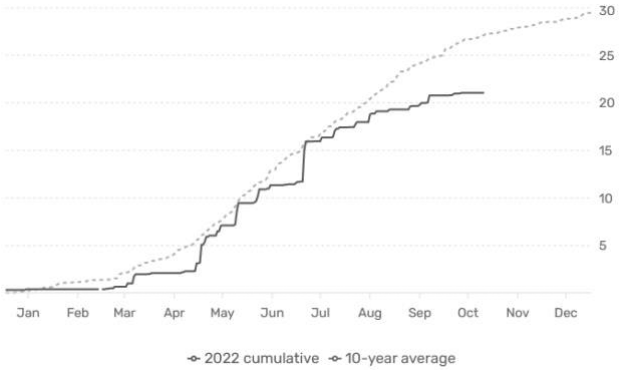


Table 8. 2021 soybean yield results.

	Stand Count (plants/ac)	Moisture (%)	Soybean Yield (bu/ac)†
Cover Crop—Non-grazed	109,333 A*	10.4 A	63 A
Cover Crop/Stubble—Grazed	103,333 A	10.4 A	67 A
Stubble—Non-grazed	112,000 A	10.4 A	66 A
P-Value	0.498	0.756	0.200

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13% moisture.

Year 6 (2022 Wheat and Warm-Season Cover Crop)



Following soybean harvest in September 2021, Wesley wheat was planted on October 3, 2021, at a seeding rate of 120 lb/ac and row spacing of 7.5". The field received 80 lb N/ac as a spring topdress application. The wheat experienced a dry winter and spring followed by a May 22, 2022, frost. Wheat was short and only around ankle high at flag leaf. Wheat was harvested on July 7, 2022, and yield and grain moisture were recorded. For the 2022 wheat crop, there was no difference in harvest stand counts, stalk rot, grain moisture, test weight, or yield (Table 9). A warm-season cover crop was planted on August 3, 2022, with 9.4 lb/ac forage soybeans, 4.7 lb/ac German millet, 6.25 lb/ac sorghum-sudangrass, and 2.5 lb/ac radish. The cover crop winter-killed. In December 2022, 57 head of heifers grazed the 9.6-acre grazed cover crop area for 12 days for a total of 684 grazing days. Economics for the total system are described below and shown in Table 10.

Table 9. 2022 wheat yield results.

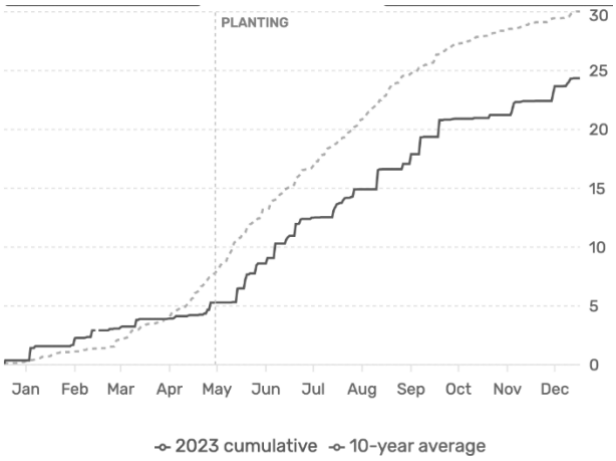
	Test Weight (lb/bu)	Moisture (%)	Wheat Yield (bu/ac)†
Cover Crop – Non-grazed	56.6 A	8.9 A	68 A
Cover Crop/Stubble – Grazed	56.7 A	9.0 A	67 A
Stubble – Non-grazed	56.8 A	8.9 A	69 A
P-Value	0.752	0.262	0.861

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

Summary:

- For the 2022 wheat crop, there were no differences in test weight, moisture, or yield between the three treatments.
- The field was planted to a warm-season cover crop following wheat harvest. The goal is to have six additional years of this study with two cycles of warm-season cover crops to determine any economic impacts of warm-season vs. cool-season cover crops in this crop/livestock system.

Year 7 (2023 Corn)



This will be the final year of this research project. While the goal was one more rotation with a warm season cover crop, the drought in 2023 impacted these plans and the crop rotation. The warm season cover crop mentioned previously winter-killed. The pre-emergence herbicide contained 32 oz/ac Roundup®, 8 oz/ac dicamba, 0.5 lb/ac atrazine, and 4 oz/ac Balance Flexx® on March 16, 2023.

For the corn crop, 190 lb/ac N as anhydrous ammonia was applied on March 10, 2023. Pioneer® P1122 was planted no-till on May 14, 2023, at a seeding rate of 25,000 seeds/ac in 30" rows. Six gallons of starter fertilizer (10-34-0) were applied in-furrow at planting. Post-emergent herbicides included 0.5 lb/ac atrazine, 30 oz/ac DiFlexx® DUO, and 32 oz/ac of Roundup® on May 22, 2023. Average rainfall from April 1 to September 1 is 17.16 inches. In 2023 the average rainfall from April 1 to September 1 was 11.57 inches, or 67% of normal. Coupled with the lack of spring subsoil moisture, there was significant drought stress. Significant drought led to hand harvest of this field on September 1, 2023. Corn was hand-harvested from the center two rows of 25' each (total of 50') with stand counts and percent stalk rot collected. The corn was placed into mesh bags to dry until it could be shelled. There was no stalk rot found for any treatments/reps in the field. There were no differences among treatments for percent moisture or test weight. The corn in the ungrazed wheat stubble had higher stand counts than the corn in the grazed cover crop. Corn yield was significantly greater for the non-grazed stubble compared to non-grazed cover crop which had a 33 bu/ac yield reduction and the grazed cover crop which had a 72 bu/ac yield reduction (Table 10).

Photo: (Left) Stalks in the grazed cover crop treatment with few to no ears present. (Right) Air drying hand-harvested ears before shelling. One plot only had 2 ears in 50' of row.

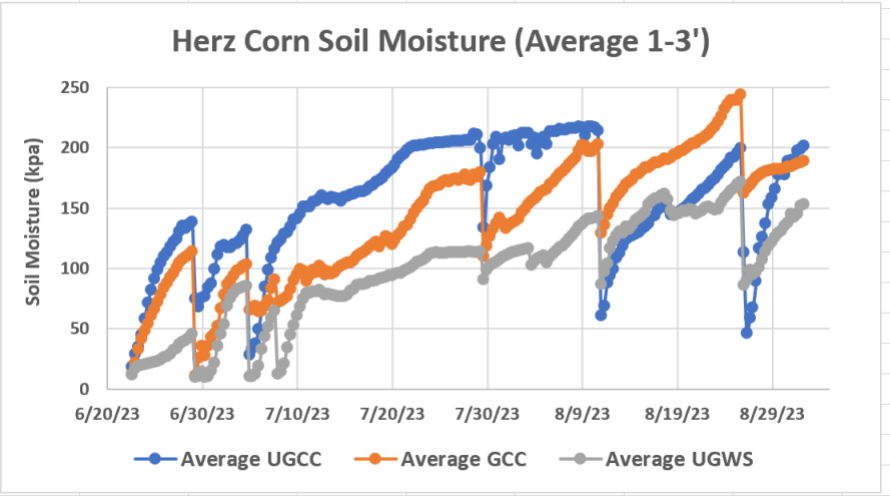


Figure 4. Soil moisture depletion (average of 0-36") for June-August 2023 corn in Nuckolls County. All treatments began the season with soil moisture below field capacity in the three-foot soil profile. In fact, there was no moisture below 22" when the soil moisture sensors were installed. The ungrazed cover crop (UGCC) treatment reached 50% depletion (150 kpa) by July 10, grazed cover crop (GCC) treatment by July 25, and ungrazed wheat stubble (UGWS) by August 17.

Table 10: 2023 Hand Harvest Corn Yield Results.

	Stand Count (plants/ac)	Moisture (%)	Test Weight (lb/bu)	Corn Yield (bu/ac)†
Cover Crop – Non-grazed	19,000 AB	22.5 A	50 A	67 B
Cover Crop/Stubble – Grazed	12,000 B	22.3 A	51 A	28 C
Stubble – Non-grazed	19,750 A	22.4 A	51 A	100 A
P-Value	0.078	0.922	0.631	0.003

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

Summary:

- For the 2023 corn crop, there were no differences in moisture or test weight. The corn in the ungrazed wheat stubble had higher stand counts than the corn in the grazed cover crop. The corn in the ungrazed wheat stubble yielded significantly more than the corn in grazed and ungrazed cover crop treatments. The corn in the ungrazed cover crop yielded higher than the corn in the grazed cover crop.
- There was greater soil moisture in the three-foot profile for the corn in the ungrazed wheat stubble in comparison to the cover crop treatments in 2023. The soil moisture profile of the ungrazed cover crop had greater water use than the other treatments until early August when the soil moisture profile of the grazed cover crop treatment became the most depleted. We have no good explanation for this.

We extend appreciation to the farmer-cooperator for helping with hand-harvest, Bayer Research at Waco for mesh bags, and UNL South Central Ag Lab for the use of their mechanical thresher.

7 Year Summary: The ungrazed wheat stubble was the most economical treatment ($27.17/ac greater than the grazed cover crop and $198.85/ac greater than the ungrazed cover crop; see analysis and table below). During dry years, the ungrazed wheat stubble had greater soil moisture retention which resulted in greater yields and greater revenue. Grazing provided a tangible economic benefit compared to the

ungrazed cover crop treatment. However, the grazed treatment had reduced revenue due to the cost of hauling water 15 miles for livestock. Further, in years in which cool season cover crops were utilized, cover crop biomass production was low, resulting in limited grazing potential. Following this long-term study, the cooperators chose to continue to utilize wheat, cover crops, and grazing in the field in order to increase crop diversity, maintain soil cover and living roots, and provide grazing for livestock.

Key Observations:

- It is important to consider the economical implications of logistics when determining the potential of alternative cropping systems. This was evidenced in the lost revenue due to the distance for hauling water in this study.
- Warm versus cool season cover crops should be considered in accordance with climate and desired grazing time.
- In non-irrigated systems, cover crop water use may result in reduced subsequent crop yields, particularly in dry years when the soil moisture profile isn't replenished following cover crop termination.
- A consistent and reliable method to assign economic benefits to organic matter, weed or erosion control, and microbial populations has not been established which limits comprehensive economic analysis of the system.

Multi-Year Economic Analysis (2016 cover crop to 2023 cover crop)

2016 Cover Crop: 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 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 Corn: The economic analysis had no input differences for any of the treatments for corn production. University of Nebraska Lincoln (UNL) Corn Budget 21 (EC872, 2017 Nebraska Crop Budgets, revised November 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 Soybean: The inputs were the same for the soybeans planted into all the previous treatments. UNL Budget 56 (EC872, 2018 Nebraska Crop Budgets, revised November 2017) was used, which states a $315.82/ac total cost. A market year average price of $7.40/bu was used.

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

2019 Cover Crop: Cost for spraying the wheat stubble was $18 ($9/ac application and $9/ac herbicide cost). Costs for the non-grazed cover crop treatments were $49.42/ac ($31.42/ac for seed and $18/ac for drilling). Costs for grazed cover crop treatments were $64.00/ac ($49.42/ac for the cover crop seed and planting, $5/ac for fencing, and $9.58/ac for water). Water cost was calculated based on hauling water (5.75 trips at $16/trip, which included cost of water).

Costs for the grazed cover crop treatments equaled $54.78/AUM (49.42*9.6=474.43/8.66AUM from what was grazed=54.78). Value of the forage was estimated to be $84.80/ac (based on rental rates of $53/pair/month [1.25 AUMs] or $42.40 AUM). Forage production was limited in the fall of 2019 compared to 2016 due to a wet summer that delayed wheat harvest, which, in turn, delayed cover crop planting. A cool fall led to less growth. Nine bulls grazed the cover crop for 23 days. However, only 8.7 AUM were available, which was less than the 19.0 AUM in 2016 due to the wet fall, late planting, and minimal growth.

2020 Corn: The economic analysis had no input differences for any of the treatments for corn production. UNL Corn Budget 23 (EC872, 2020 Nebraska Crop Budgets, revised November 2019) was the closest that fit this operation, so a total cost/ac of $452.10 and a market year average price of $3.51 were 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.

2021 Soybean: The inputs were the same for the soybeans planted into all the previous treatments. UNL Budget 58 (EC872, 2021 Nebraska Crop Budgets, revised November 2020) was used, which states a $410.69 total cost. A market year average price of $11.80/bu soybean was used.

2022 Wheat: The inputs were the same for the wheat planted into all the previous treatments. UNL Budget 76 (EC872, 2022 Nebraska Crop Budgets, revised November 2021) was the closest available to these production practices. It stated a $299.40/ac total cost. A market year average price of $9.58/bu was used.

2022 Cover Crop: Cost for spraying the wheat stubble was $22.32 ($9/ac application and $13.32/ac herbicide cost). Costs for the non-grazed cover crop treatments were $47.11/ac ($29.11/ac for seed and $18/ac for drilling). Costs for grazed cover crop treatments were $72.11/ac ($47.11/ac for the cover crop seed and planting, $5/ac for fencing, and $20.00/ac for water). Water cost was calculated based on hauling water (12 water trips at $16/trip, which included cost of water). Costs for the grazed cover crop treatments equaled $23.62/AUM ($47.11/ac x 9.6 ac = $452.26. $452.26/19.15 AUM from what was grazed = $23.62/AUM.). The value of the grazed cover crop treatment was estimated to be $86.13/ac (based on rental rates of $53/pair/month [1.25 AUMS] or $42.40/AUM). The value was determined by considering 57 head of heifers grazed a 9.6 ac area for 12 days resulting in 684 grazing days. Because heifers were grazed rather than cows, the AUM was calculated to be 19.15. Factoring in the value of the grazing, the grazed cover crop treatment had an overall value of $14.02/ac ($86.13-$72.11 = $14.02).

2023 Corn: The inputs were the same for the corn planted in all the previous treatments. UNL Budget 23 (EC872, 2023 Nebraska Crop Budgets, revised November 2022) is the closest fit to this field situation. One of the items on the budget is “crop insurance” at a cost of $38.00/acre. Because of drought, the grower contacted crop insurance and the field was cut for silage. The crop insurance is revenue based, and in this case all the treatments would have been paid an indemnity. The revenue guarantee would have been the same for each treatment, therefore the returns would have been the same for each treatment.

Table 11. Seven crop year economic analysis summary of this study, presented in $/ac.

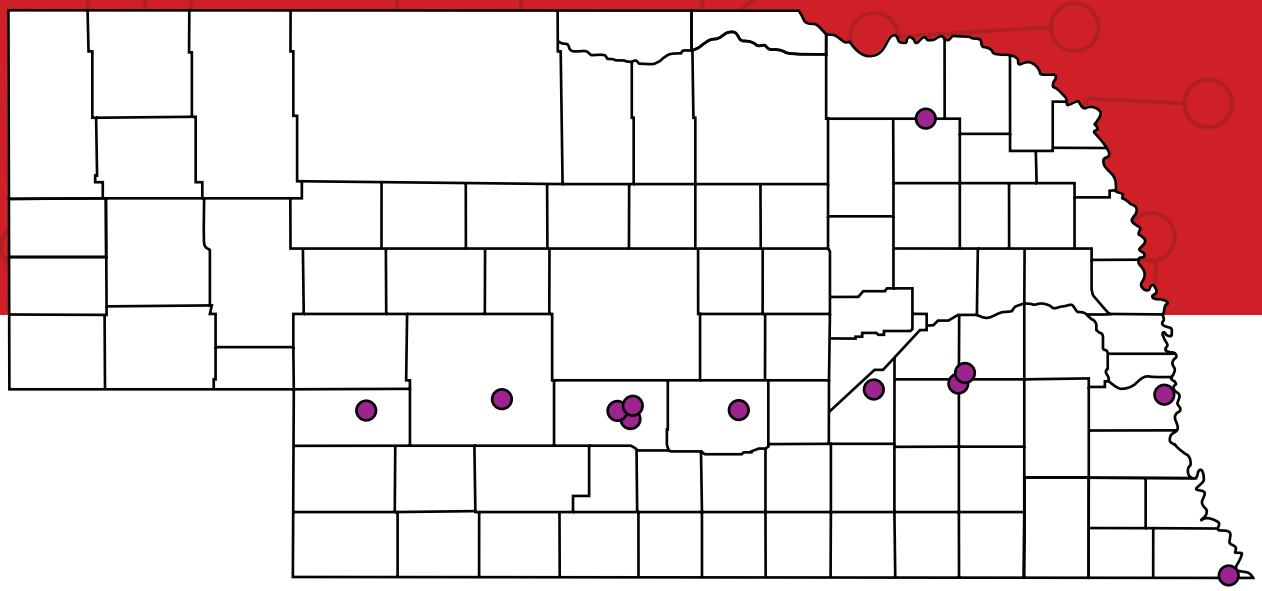
	2016 Cover	2017 Corn	2018 Soy	2019 Wheat	3-Year Total
Cover Crop—Non-grazed	-$46.64	$211.35	$54.18	$59.56	**$278.45**
Cover Crop/Stubble—Grazed	$22.86	$210.05	-$19.82	$59.56	**$272.65**
Stubble—Non-grazed	-$18.00	$227.10	$68.98	$55.91	**$333.99**

	2019 Cover	2020 Corn	2021 Soy	2022 Wheat	6-Year Total
Cover Crop—Non-grazed	-$49.42	$302.55	$332.71	$352.04	**$1216.33**
Cover Crop/Stubble—Grazed	$20.80	$311.06	$379.91	$342.46	**$1326.88**
Stubble—Non-grazed	-$18.00	$344.67	$368.11	$361.62	**$1390.39**

	2022 Cover	2023 Corn	7-Year Total
Cover Crop—Non-grazed	-$47.11	*$14.26*	*$1183.48*
Cover Crop/Stubble—Grazed	$14.02	*$14.26*	*$1355.16*
Stubble—Non-grazed	-$22.32	*$14.26*	*$1382.33*

Photo: Farmer-cooperator collecting soil samples during his seven-year study.

CROP PROTECTION



Innovative Corn Rootworm Management
Corteva-UNL Collaboration

County: Dawson (3 fields) and Perkins (2 fields)
Planting Date: April 24 – May 8, 2023
Harvest Date: October 3 – November 10, 2023
Row Spacing (in): 30
Reps: 5

Previous Crop: Corn
Chemical applications: Farmers applied according to conventional management.
Irrigation: Center Pivot Irrigation

Introduction: The western corn rootworm (WCR) is a major pest of continuous corn in Nebraska that has evolved resistance to multiple types of control strategies. Biological control can be an alternative and/or complementary control strategy together with conventional insecticides and Bt traits. WCR biological control can be achieved by entomopathogenic nematodes (EPNs- tiny worms that kill insects) and predatory insects. The planting of cover crops can support soil health, promote larger populations of predatory insects, and support EPNs. Therefore, our objectives are to determine whether the application of persistent EPNs and the adoption of cover crops can improve pest management and soil health. We measured the establishment and persistence of entomopathogenic nematodes in the soil after application, root feeding injury from WCR, and soil health measures.

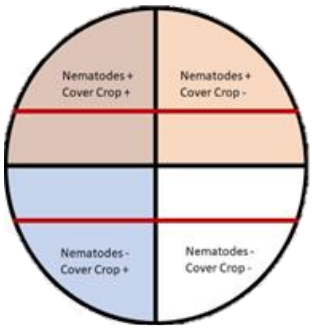


Figure 1. Field design for each 132 acre pivot.

Five on-farm research sites were identified in early 2022 in the Madrid and Lexington, Nebraska, areas. Each site consisted of a center pivot covering approximately 132 acres of irrigated continuous corn. At one site, the pivot was divided into four treatments: 1) cover crop, 2) entomopathogenic nematodes, 3) cover crop + entomopathogenic nematodes, and 4) untreated control. At the remaining four sites, the cover crop treatment was restricted; therefore, only the nematode-applied and non-nematode treatments were implemented. Each grower managed WCR at their fields using Bt traits/and or insecticides as they normally did (conventional management), but three fields contain two strips of non-Bt corn without at-plant insecticides running through each quarter of the field (check strips- red lines on Fig. 1).

Two species of beneficial nematodes (EPNs) (Persistent BioControl, *Steinernema feltiae* 'NY 04' = 17 million/acre and *Heterorhabditis bacteriophora* Oswego = 25 million/acre) were applied to each field via center pivot irrigation systems or ground rig sprayer in late May of 2022. At the cover crop site, inter-seeded cover crops were planted at the V4 growth stage of corn. This cover crop was a mix of annual ryegrass, winter rye, rapeseed, flax, buckwheat, cowpeas, and red clover. Sampling for beneficial nematodes and monitoring of corn rootworm and beneficial insect populations was completed during the summers of 2022 and 2023, including:

- Nematode baiting soil sampling (Figure 2) for the presence of entomopathogenic nematodes before and after application
- Plant emergence cage sampling to determine the survival of WCR from belowground larvae to emerging adults.
- Root injury sampling to determine feeding damage from corn rootworm larvae.

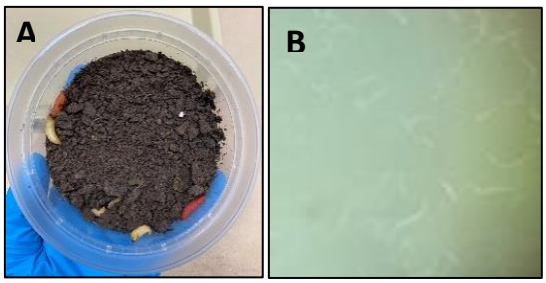


Figure 2. A) Larvae infected with EPNs. Baiting assays were created using soil samples collected in the fields. Wax moth larvae turned brick red or brown, indicating an infection with EPNs. **B) White trap containing EPNs.** The presence of EPNs was confirmed under the microscope for larvae that showed visual symptoms of infection. Nematodes were collected for further identification.

For more information regarding Entomopathogenic Nematodes and Persistent BioControl, please visit https://www.persistentbiocontrol.com/.

Results:

Figure 3. Inter-seeded cover crops. A) June 9, 2023. **B)** June 20, 2023. **C)** July 20, 2023. **D)** Aug. 8, 2023. All photos from D. Batie.

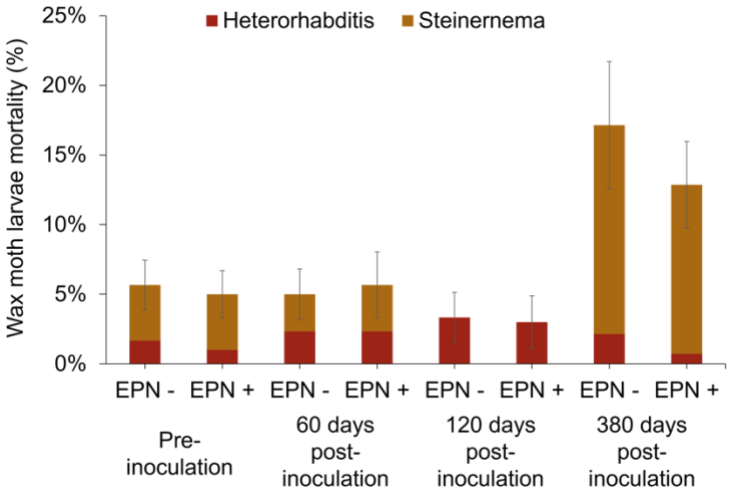


Figure 4. Percent of wax moth larval mortality. There were no statistically significant differences based on nematode treatment, however EPN detection was highest 380 days post inoculation.

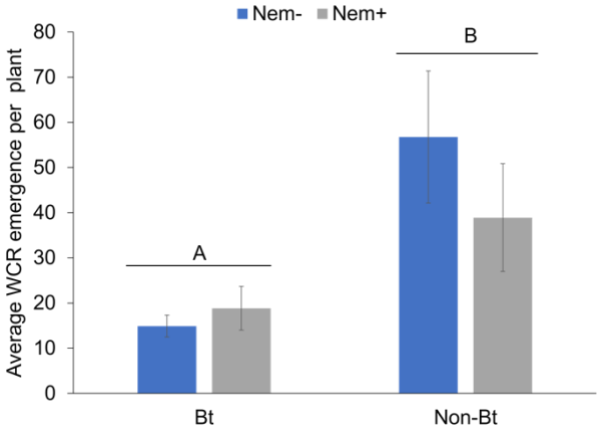


Figure 5. WCR emergence per plant. Average adult beetle emergence was significantly affected by Bt traits, but there was no significant effect of EPN treatment on WCR

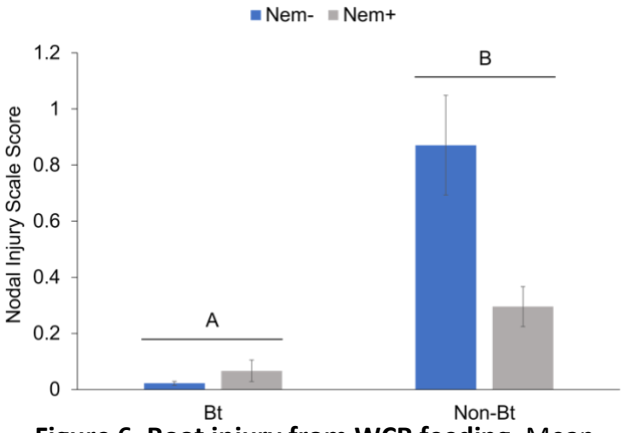


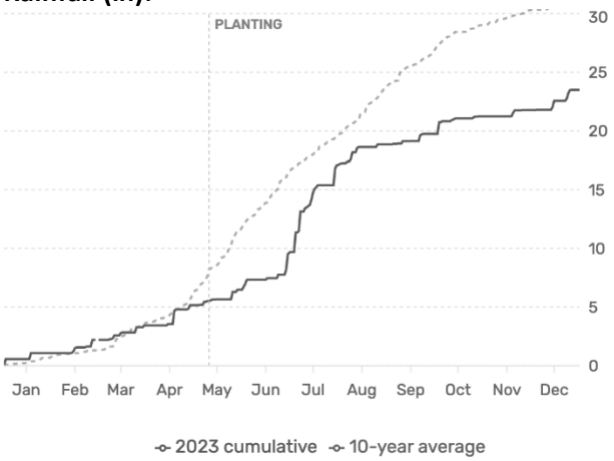
Figure 6. Root injury from WCR feeding. Mean root injury was measured using the 0-3 nodal injury scale. Root injury was significantly affected by Bt traits, but there was no significant effect of EPN treatment.

Summary:

- Unexpectedly, there were no statistically significant differences based on EPN treatment for the percent of larvae with EPNs up to 380 days post-inoculation or on the WCR emergence per plant and root injury. However, there was a trend toward fewer WCR beetles emerging from non-Bt corn plants where EPNs were applied, and a corresponding trend toward lower root damage on non-Bt plants where nematodes were applied.
- Factors such as poor or slow establishment of nematode populations following application, application failure due to equipment malfunction or environmental conditions, and competition with native nematode populations or other soil organisms are potential explanations of these results.
- This is the second year of a three-year study. Future work includes another year of data as well as molecular ID of the nematodes recovered from the fields to determine if the applied nematodes or native strains are present.

Comparing Standard Soybean Seed Treatment to a Biological Seed Treatment

Study ID: 1525185202303
County: York
Soil Type: Hastings silt loam 0-3% slope; Hastings silty clay loam 6-11% slopes; Hobbs silt loam 0-2% slope
Planting Date: 5/10/23
Harvest Date: 10/23/23
Seeding Rate: 165,000
Row Spacing (in): 10" twin rows on 30" centers for a 20" gap
Variety: Pioneer® P30A75E
Reps: 8
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Early Post:*** 30 oz Roundup® PowerMAX 3, 32 oz Enlist®, 4 oz Anthem Maxx®, 3 lb AMS, 2 oz Interlock®, 1 qt Wex®, and 1 pt Syntose FA® with 18 gal water on 5/27/23 ***Post:*** 20 oz Roundup® PowerMAX 3, 1 qt Enlist®, 8 oz Clethodim, 1 pt Mn, 1 pt Syntose FA®, 3 pt Warrant®, 0.27 oz Intensity®, and 2 oz Interlock® with 20 gal water on 6/30/23
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: None
Irrigation: Pivot, Total: 4.25"
Rainfall (in):



Introduction: Some producers have been interested in alternative methods of protecting seed from insects and disease beyond traditional insecticide/fungicide seed treatments. This can be due to cost, impacts to pollinators, soil microbes and the environment, or human safety. There's also interest in using seed treatments for disease suppression from white mold and sudden death syndrome. This study compared using a standard soybean seed treatment versus a biological seed treatment. This is the second field this grower has tested, and it was planted 8 days later than the first field. The treatments were:

Standard Seed Treatment: *Pioneer's full seed treatment with ILEVO. Standard seed treatment was applied by the seed dealer.*

Biological Seed Treatment: *Blend of 2 oz PhycoTerra® ST, 1 oz Heads Up®, 1 oz N-Gage Ultra ST, 0.75 oz Bio ST VPH in 100 gal solution. In a second tank, 2 oz of Exceed Soybean Inoculant was used per 100 gal. Biological seed treatment was applied by the grower.*

Each treatment was seeded for a 20' width with a twin row planter on 10" spacings with eight replications. Rye was drilled after corn harvest with the intention of using a roller crimper for better weed control. The rye was not as thick and did not have the quantity of biomass the grower's other field did. However, to avoid soybean injury, the rye was not terminated with a roller crimper. The rye reduced soil moisture in the surface and soybeans were irrigated early to help with emergence. After termination of the rye on May 27, the rye provided excellent weed control in the field. Yield, grain moisture, test weight, harvest stand counts, and net return were evaluated.

Photos: (Top left) Rye on May 19 with soybean just beginning to emerge. (Top right) Biomass came on quickly as can be seen in this photo on June 5, with headed out rye biomass on the ground and soybean growing through it.

Results:

	Harvest Stand Count (plants/ac)	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Standard Seed Treatment	145,200 A*	9.7 A	56 A	65.7 B	876 B
Biological Seed Treatment	147,200 A	9.7 A	56 A	67.1 A	915 A
P-Value	0.854	0.763	0.165	0.002	<0.0001

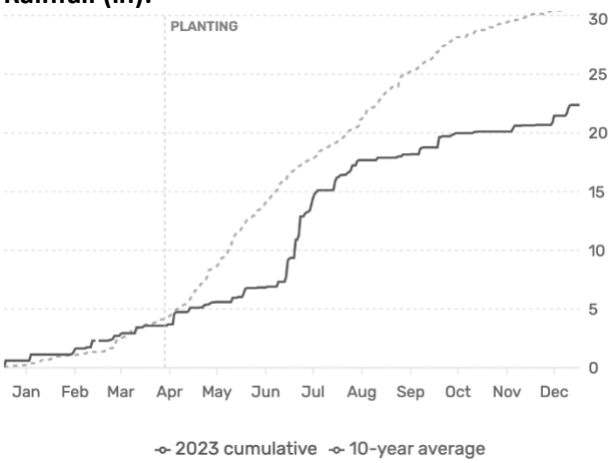
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $13.76/bu soybean, $28/ac for the standard seed treatment, and $9.20/ac for the biological seed treatment.

Summary:

- There were no differences between the two treatments for harvest stand count, grain moisture, or test weight.
- Yield for the biological seed treatment was 1.4 bu/ac higher than the standard seed treatment.
- Marginal net return was $39/ac greater for the biological seed treatment compared to the standard seed treatment.

Comparing Standard Soybean Seed Treatment to a Biological Seed Treatment

Study ID: 1525159202302
County: Seward
Soil Type: Hastings silt loam 0-1% slope; Fillmore silt loam
Planting Date: 5/2/23
Harvest Date: 9/28/23
Seeding Rate: 165,000
Row Spacing (in): 10” twin rows on 30” centers for a 20” gap
Variety: Pioneer® P23A40E
Reps: 7
Previous Crop: Seed corn
Tillage: No-Till into green planted rye
Herbicides: ***Early Post:*** 30 oz Roundup® PowerMAX, 32 oz Enlist®, 4 oz Anthem Maxx®, 3 lb AMS, 2 oz Interlock®, 1 qt Wex®, and 1 pt Syntose FA® with 18 gal water on 5/26/23 ***Post:*** 20 oz Roundup® PowerMAX 3, 1 qt Enlist®, 8 oz clethodim, 1 pt manganese, 1 pt Syntose FA®, 3 pt Warrant®, 0.27 oz Intensity®, and 2 oz Interlock® with 20 gal water on 6/28/23
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: None
Irrigation: Pivot, Total: 9.6"
Rainfall (in):



Introduction: Some producers are interested in alternative methods of protecting seeds from insects and disease beyond traditional insecticide/fungicide seed treatments. This can be due to cost, impacts to pollinators, soil microbes and the environment, or human safety. There’s also interest in using seed treatments for disease suppression from white mold and sudden death syndrome. This study compared using a standard soybean seed treatment versus a biological seed treatment in a field with a history of white mold. The treatments were as follows:

Standard Seed Treatment: *Pioneer’s full seed treatment with ILEVO. Standard seed treatment was applied by the seed dealer.*

Biological Seed Treatment: *Blend of 2 oz PhycoTerra® ST, 1 oz Heads Up®, 1 oz N-Gage Ultra ST, 0.75 oz Bio ST VPH in 100 gal solution. In a second tank, 2 oz of Exceed Soybean Inoculant was used per 100 gal. Biological seed treatment was applied by the grower.*

Each treatment was seeded for a 20’ width with a twin row planter on 10” spacings with seven replications. Rye had been planted after seed corn harvest in the field with the intention of using a roller crimper for better weed control. Due to the extra time for biomass growth after seed corn, the rye got very tall and the soybean were stretching for sunlight. Cotyledons ranged from 2-3" above the soil surface with unifoliolates around 4-5.5” above the soil surface. The agronomist and educator advised the farmer to avoid roller crimping to avoid damage to the soybean. The goal was to take emergence counts for the two treatments but the rye biomass and twin rows made this task difficult and only one rep was taken. The soybean lodged by harvest, so no harvest stand counts were taken. Due to the drought, the soybean had to be irrigated early and often as a result of the height and biomass of the rye which used up the surface moisture.

Following termination on May 26, the rye seemed to provided excellent weed control and contribute to white mold suppression. Because the rye didn't lie down well, it created a slower harvest with so much material going through the draper header.

Yield, grain moisture, test weight, and net return were evaluated. Early season stand counts were also collected for one replication but not at harvest due to lodging.

Photos: (Top left) Tall and pollinating rye on May 19, 2023. (Top middle) Soybean with full traditional seed treatment with Ilevo with some halo effect. (Top right) Soybean with biological seed treatment. (Lower left) Early season stand counts. (Lower middle) Soybean with 2.5" from soil level to cotyledons. (Lower right) Harvesting lodged soybean with significant rye residue.

Results:

	Stand Counts (5/19/23)	Stand Counts (6/5/23)	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Standard Seed Treatment	92,000	132,000	10.2 A*	56 A	62 A	828 A
Biological Seed Treatment	94,000	138,000	10.2 A	56 A	61 A	830 A
P-Value	N/A	N/A	0.1996	0.766	0.102	0.845

*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 $13.76/bu soybean, $28/ac for the standard seed treatment, and $9.20/ac for the biological seed treatment.

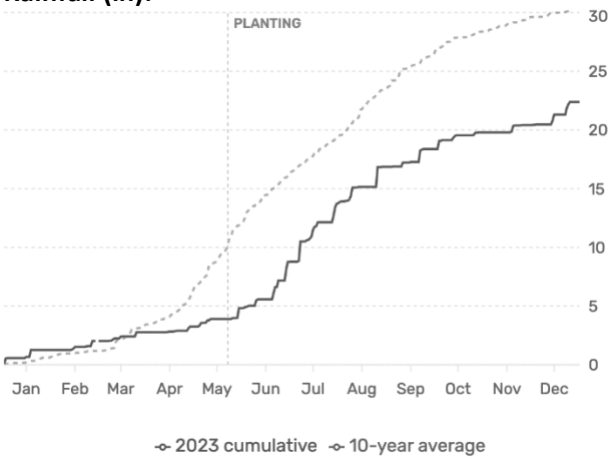
Summary:

- It was difficult to take the early season stand counts in May due to the rye; therefore, counts may not be as accurate. Later irrigations resulted in additional soybean emergence leading to higher stand counts in June.
- There were no differences in moisture, test weight, yield, or net return between the two seed treatments.

Comparing Standard Soybean Seed Treatment to a Biological Seed Treatment

Study ID: 1525081202304
County: Hamilton
Soil Type: Holder silt loam 1-3% slope
Planting Date: 5/22/23
Harvest Date: 11/1/23
Seeding Rate: 200,000
Row Spacing (in): 10" twin rows on 30" centers for a 20" gap
Variety: Golden Harvest® GH3373E3
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 8 oz/ac Authority Supreme®, 30 oz/ac Roundup®, 32 oz/ac Enlist®, and 6 oz/ac AMS on 5/23/23 ***Post:*** 32 oz/ac Liberty®, 32 oz/ac Enlist®, 16 oz/ac Roundup® PowerMAX, 12 oz/ac Volunteer®, 3 pt/ac Warrant®, and 14 oz/ac AMS on 6/28/23

Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: None
Irrigation: Pivot, Total: 6.7"
Rainfall (in):



Introduction: Some producers are interested in alternative methods of protecting seed from insects and disease beyond traditional insecticide/fungicide seed treatments. This can be due to cost, impacts to pollinators, soil microbes and the environment, or human safety. There's also interest in using seed treatments for disease suppression from white mold and sudden death syndrome. This study compared a standard soybean seed treatment to a biological seed treatment. This is the third field the grower tested this, and it was planted 20 days later than the first field. The treatments were:

Standard Seed Treatment: *Golden Harvest's full seed treatment with Saltro. Standard seed treatment was applied by the seed dealer.*

Biological Seed Treatment: *Blend of 2 oz PhycoTerra® ST, 1 oz Heads Up®, 1 oz N-Gage Ultra ST, 0.75 oz Bio ST VPH in 100 gal solution. In a second tank, 2 oz of Exceed Soybean Inoculant was used per 100 gal. Biological seed treatment was applied by the grower.*

Each treatment was seeded for a 20' width with a twin row planter on 10" spacings with six replications. Harvest stand counts, grain moisture, test weight, yield, and net return were evaluated.

Results:

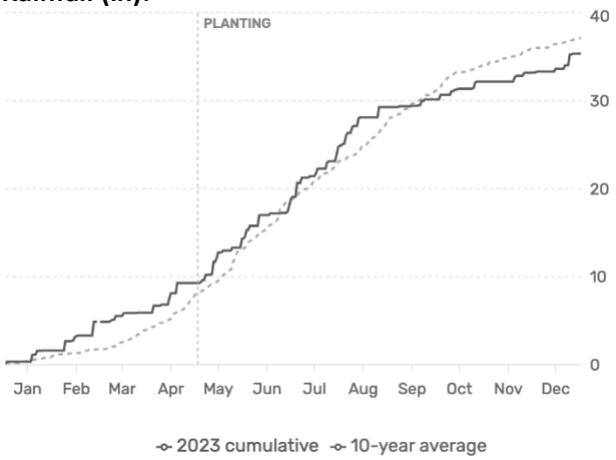
	Harvest Stand Count (plants/ac)	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Standard Seed Treatment	147,625 A*	13.9 A	57 A	69 A	931 A
Biological Seed Treatment	146,375 A	13.8 A	57 A	68 A	931 A
P-Value	0.906	0.899	0.177	0.195	0.942

*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 $13.76/bu soybean, $16.63/ac for the standard seed treatment, and $9.20/ac for the biological seed treatment.

Summary: There were no differences in stand counts, test weight, moisture, yield, or net return between the seed treatments evaluated.

Comparing Anthem® MAXX vs Authority® Supreme Herbicides on Soybeans

Study ID: 0416147202301
County: Richardson
Soil Type: Monona silt loam 1-6% slopes
Planting Date: 5/2/23
Harvest Date: 11/1/23
Seeding Rate: 137,800
Row Spacing (in): 15
Variety: Pioneer 37A18E
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 4 oz/ac Anthem® MAXX (for Anthem® MAXX treatment), 8 oz/ac Authority® Supreme (Authority® Supreme treatment), 21 oz/ac Envy 6 Max®, 20 oz/ac 2, 4-D, and 12.8 oz/ac Firezone® on 4/11/23 ***Post:*** 32 oz/ac Enlist One®, 21 oz/ac Envy 6 Max®, 2.5 pt/ac Warrant®, 12 oz/ac clethodim, and 12.8 oz/ac Zarr® on 6/8/23
Foliar Insecticides: 1.9 oz/ac Province® II and 5.1 oz/ac Brigade® 2EC on 8/1/23
Foliar Fungicides: 4 oz/ac Priaxor® and 4 oz/ac propiconazole on 8/1/23
Fertilizer: 147 lb/ac 11-52-0, 73 lb/ac 0-0-60, and 72 lb/ac gypsum Feb 2023
Irrigation: None
Rainfall (in):



Introduction: This study evaluated two herbicides on soybean, Anthem® MAXX and Authority® Supreme by FMC. Treatments were arranged in a paired comparison design. The herbicide application strips were 1,400' long by 100' wide. From each 100' applied width, two 25' combine passes were harvested and used to determine yield. The grower had previously observed that visible stress to soybean might be greater when Authority® Supreme was used. Therefore, the grower was interested in comparing the impact of the two herbicides. Anthem® MAXX was applied at a rate of 4 oz/ac and Authority® Supreme was applied at a rate of 8 oz/ac. Each herbicide was applied with 21 oz/ac Envy 6 Max®, 20 oz/ac 2, 4-D, and 12.8 oz/ac Firezone® on April 11, 2023. Yield and marginal net return were evaluated.

Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Anthem® MAXX	73.7 B	994 B
Authority® Supreme	75.4 A*	1,018 A
P-Value	0.024	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 corrected to 13% moisture.
‡Marginal net return based on $13.75/bu soybean, $19.86/ac for Authority® Supreme, and $20.06/ac for Anthem® MAXX.

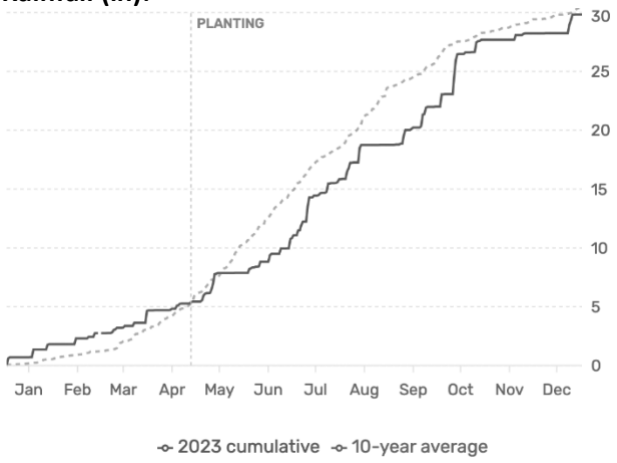
Summary:

- The Authority® Supreme treatment resulted in 1.7 bu/ac higher yield compared to the Anthem® MAXX treatment.
- The increase in yield resulted in a $24/ac increase in marginal net return for the Authority® Supreme treatment.

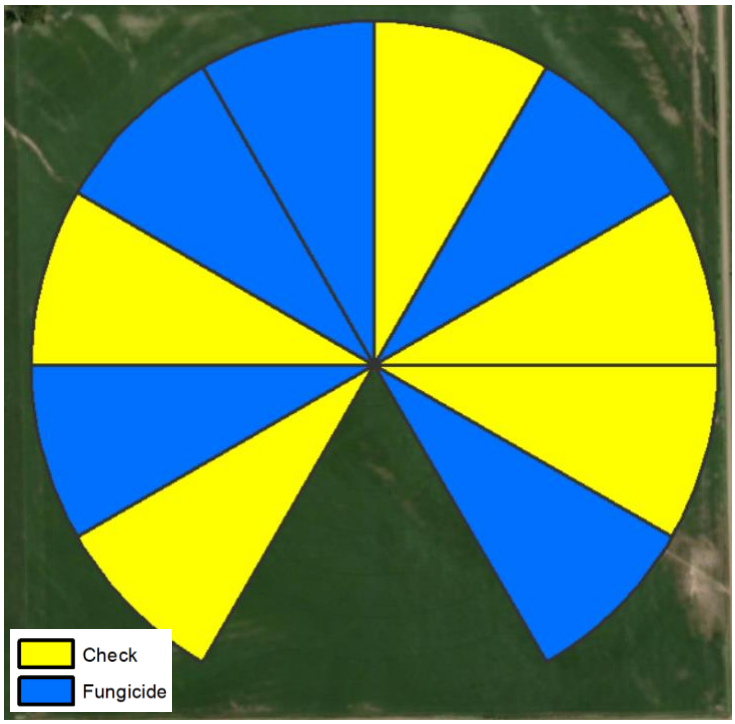
Evaluating a Chemigated Fungicide Application on Soybeans

Study ID: 1256139202302
County: Pierce
Soil Type: Crofton-Nora complex 6-11% slopes
Planting Date: 4/27/23
Harvest Date: 9/29/23
Seeding Rate: 140,000
Row Spacing (in): 15
Variety: Pioneer ® P20A22X
Reps: 5
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** Afforia® and Enlite® on 4/17/23
Post: Extendimax®, Intensity®, and Roundup® PowerMAX 3 on 6/8/23
Seed Treatment: Standard Pioneer® seed treatment
Foliar Fungicides: Approach® at R1

Fertilizer: Variable-rate application averaging 115 lb/ac of 0-0-45-9 and 112 lb/ac 11-52-0 on 3/25/23
Irrigation: Pivot, Total: 9"
Rainfall (in):



Introduction: This study evaluated the impact of a fungicide application on soybean. The fungicide evaluated was Trivapro® by Syngenta® applied at a rate of 13.7 oz/ac at R3 growth stage around July 20, 2023. Treatment replications were chemigated in sectors through the pivot as shown in the layout diagram at right. The entire field received Corteva® Approach® at R1. Yield and net return were evaluated.



Results:

	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	72 A*	992 A
Trivapro®	77 A	1,046 A
P-Value	0.116	0.208

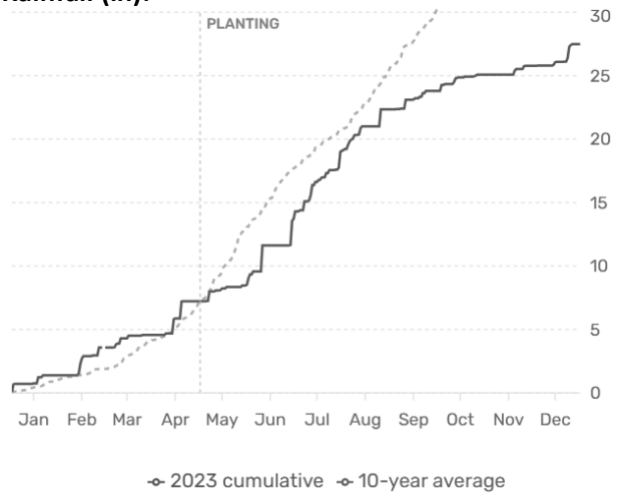
*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $13.76/bu soybean and $18/ac for Trivapro® fungicide.

Summary: The fungicide application did not result in a significant difference in yield or marginal net return.

Impact of Foliar Fungicide Application on Soybean

Study ID: 1252025202402
County: Cass
Soil Type: Marshall silty clay loam
Planting Date: 5/1/23
Harvest Date: 10/10/23
Seeding Rate: 120,000
Row Spacing (in): 15
Variety: Golden Harvest® GH3883XF
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 6.4 oz/ac Authority® Supreme, 2 oz/ac Authority® XL, 8 oz/ac dicamba, 22 oz/ac Roundup PowerMAX® 3, and 16 oz/ac EFFICAX® on 4/26/23 ***Post:*** 48 oz/ac Warrant®, 32 oz/ac Liberty®, 3 oz/ac Resource®, 6 oz/ac Vaquero®, 7 oz/ac High Load®, and 3.43 lb/ac AMS on 6/14/23
Seed Treatment: Dealer treated, products unknown

Fertilizer: MAP and potash variable-rate applied according to grid sampling on 1/27/23 - average MAP rate was 275 lb/ac and average potash rate was 165 lb/ac
Irrigation: None
Rainfall (in):



Introduction: This study evaluated the impact of a foliar fungicide application compared to an untreated control on soybean. The fungicide, Miravis® Neo, was applied at a rate of 13.7 oz/ac with 15 gal/ac carrier and a surfactant. The foliar fungicide treatment was arranged in a randomized complete block design with four replications. The application was made by ground machine at the R3 growth stage. Foliar disease severity was visually assessed on Aug. 21, 2023. Foliar disease severity, yield and net return were evaluted.

Results:

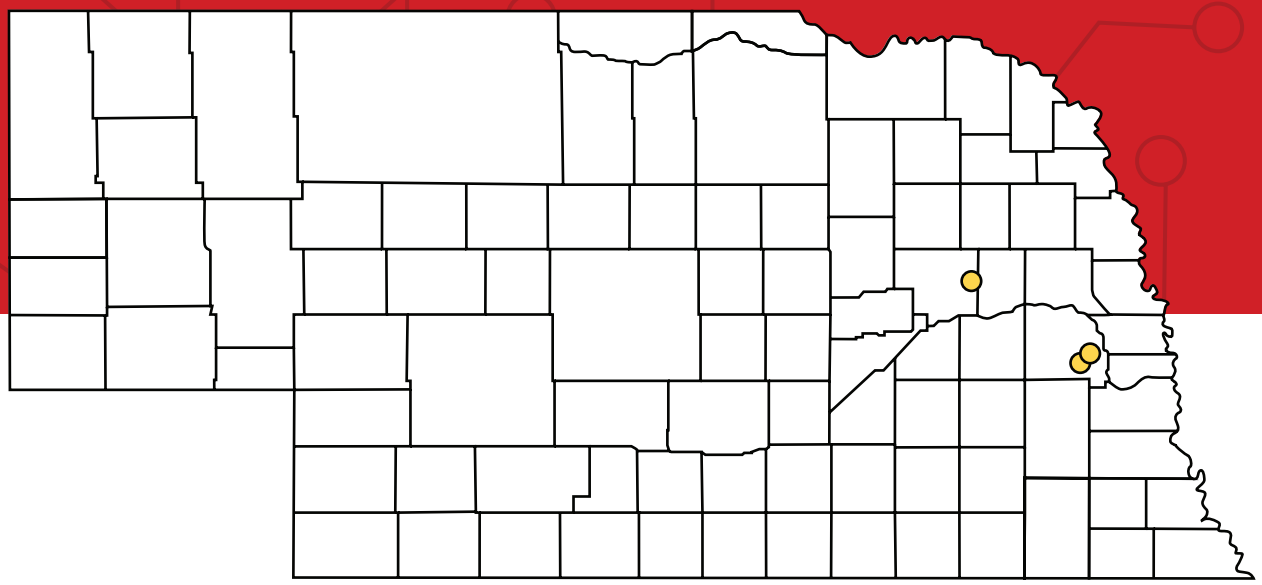
	Frogeye Leaf Spot Disease Severity (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
Check	3.5 A*	66 A	902 A
Miravis® Neo Fungicide	1.0 B	68 A	904 A
P-Value	0.096	0.187	0.936

*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 $13.76/bu soybean and $35/ac for fungicide treatment.

Summary:

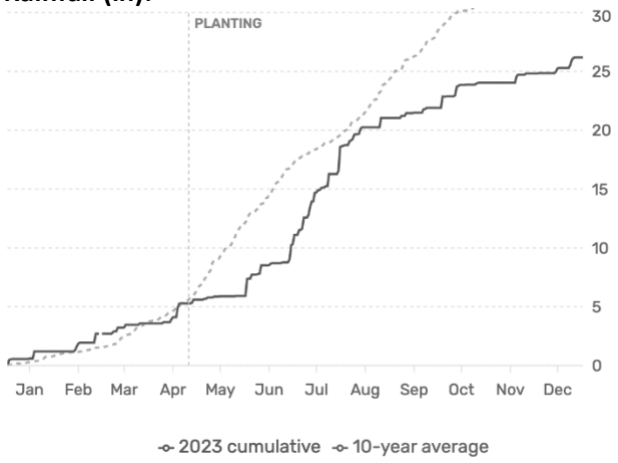
- There was low disease pressure but the fungicide treatment resulted in lower frogeye leafspot disease severity (2.5% lower).
- There was no significant difference in yield or marginal net return.

EQUIPMENT



Evaluating an Improved Singulation Disc at Four Seeding Rates in Irrigated Soybeans

Study ID: 1266155202302
County: Saunders
Soil Type: Fillmore silt loam; Yutan silty clay loam; Filbert silt loam
Planting Date: 4/25/23
Harvest Date: 9/26/23
Row Spacing (in): 15
Variety: Pioneer® P25A16E
Reps: 16
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 3.86 oz/ac Metribuzin 75DF, 7.73 oz/ac Essensa, 23.18 oz/ac Enlist One®, and 15.6 oz/ac Roundup PowerMAX® 3 on 4/27/23 ***Post:*** None
Seed Treatment: LumiGEN®-FST
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: None
Irrigation: Pivot, Total: 4.8"
Rainfall (in):



Introduction: This study evaluated the farm's soybean seed disc; John Deere® A42586 ("Standard" treatment), which had 108 cells in three rows, and compared it to a new seed disc; John Deere® A105848 ("New" treatment), which had 64 holes in a single row and was designed to provide better seed singulation, improved population control, and lower coefficient of variation (CV). The trial was laid out with 8 randomized paired passes of each seed disc, and 2 randomized replications of 4 populations with 300' blocks in each pass. This resulted in 16 total replications of each population with both discs. The study evaluated the impact of the seed disc at the four seeding rates on stand counts, CV, moisture, yield, and marginal net return. Stand counts were taken in a 10-foot section of four rows. Coefficient of variation was assessed by measuring the distance between individual plants for a 10-foot section of a single row. Coefficient of variation equal to zero means that the plants are equally spaced. Yield and moisture were calculated by cleaning the yield map collected with a calibrated yield monitor.

Results: There was no interaction between seed disc and seeding rate for stand counts, plant spacing, plant spacing CV, yield, moisture, or net return, therefore the results for seed disc and seeding rate were analyzed separately.

	As-Applied Rate (seeds/ac)	Early Season Stand Count (plants/ac)	Late Season Stand Count (plants/ac)	Plant Spacing (in)	CV (in/in)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
		Singulation Disc						
Standard	129,860 A	93,760 A	91,723 A	4.2 A	0.69 A	11.8 A	75 A	985 A
New	129,250 A	92,962 A	88,027 A	4.7 A	0.71 A	11.6 B	74 B	965 B
P-Value	0.871	0.924	0.568	0.301	0.666	0.007	0.070	0.052
		Seeding Rate (seeds/ac)						
100,000	103,520 A	67,054 C	70,102 C	5.9 A	0.68 A	11.7 A	73 B	966 A
120,000	120,980 A	88,390 B	96,358 B	4.7 B	0.63 A	11.6 A	74 AB	972 A
140,000	138,340 A	106,387 A	99,565 A	3.8 C	0.73 A	11.8 A	77 A	996 A
160,000	155,380 A	111,612 A	103,484 A	3.5 C	0.76 A	11.6 A	75 AB	967 A
P-Value	<0.0001	<0.0001	0.0001	<0.0001	0.289	0.600	0.012	0.123

*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 $13.76/bu soybean, $56.88/140,000 seeds, and $0.86/ac for the new disc (a full set cost $2314.88 which was distributed over 900 acres and prorated over three years).

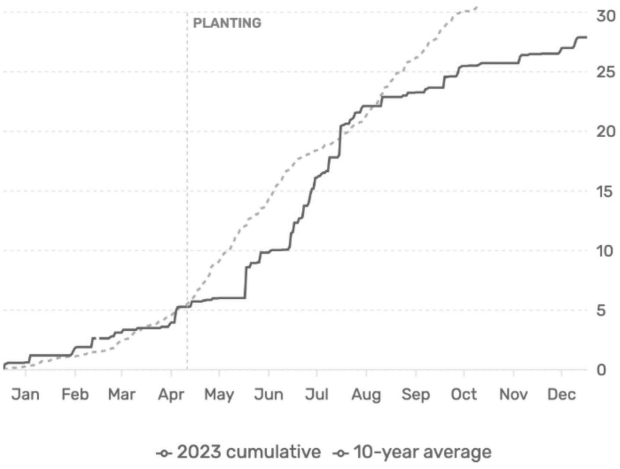
Summary:

- The new seed disc did not result in a difference in stand counts, plant spacing, or CV. The standard seed disc yielded 1 bu/ac more than the new seed disc.
- For seeding rates, the highest yield was obtained for the 140,000 seed/ac treatment but was not significantly different than the 120,000 or 160,000 seed/ac treatments. There was no difference in marginal net return.

Evaluating an Improved Singulation Disc at Four Seeding Rates in Non-Irrigated Soybeans

Study ID: 1266155202301
County: Saunders
Soil Type: Yutan silty clay loam; Filbert silt loam
Planting Date: 4/25/23
Harvest Date: 9/19/23
Row Spacing (in): 15
Variety: Pioneer® P25A16E
Reps: 6
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 3.66 oz/ac Metribuzin 75DF, 7.32 oz/ac Essensa, 10.07 oz/ac 2, 4-D LV6, and 14.64 oz/ac Roundup PowerMAX® 3 on 4/27/23 ***Post:*** None
Seed Treatment: LumiGEN®-FST
Foliar Insecticides: None
Foliar Fungicides: None

Fertilizer: None
Irrigation: None
Rainfall (in):



Introduction: This study evaluated the farm's soybean seed disc; John Deere® A42586 ("Standard" treatment), which had 108 cells in three rows, and compared it to a new seed disc; John Deere® A105848 ("New" treatment, which had 64 holes in a single row and was designed to provide better seed singulation, improved population control, and lower coefficient of variation (CV). The trial was laid out in 2 blocks that included 3 randomized paired field length passes of each seed disc, and 3 randomized replications of 4 populations in 300' blocks within the field length passes. This resulted in 6 total replications of each population with both discs. The study evaluated the impact of the seed disc at four seeding rates on stand counts, CV, moisture, yield, and marginal net return. Stand counts were taken for a 10-foot section of four rows. Coefficient of variation was assessed by measuring the distance between individual plants for a 10-foot section of a single row. Coefficient of variation equal to zero means that the plants are equally spaced. Yield and moisture were calculated by cleaning the yield map collected with a calibrated yield monitor.

Results:

There was no interaction between seed disc and seeding rate for yield, moisture, or net return, therefore the results were analyzed separately.

	As-Applied Rate (seeds/ac)	Moisture (%)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
		Singulation Disc		
Standard	128,719 A	9.1 A	57 A	729 A
New	130,326 A	9.1 A	57 A	724 A
P-Value	0.798	0.940	0.783	0.742
		Seeding Rate (seeds/ac)		
100,000	103,361 D	9.1 A	57 A	745 A
120,000	120,298 C	9.0 A	56 A	720 A
140,000	137,643 B	9.2 A	57 A	724 A
160,000	156,789 A	9.0 A	57 A	716 A
P-Value	<0.0001	0.834	0.858	0.480

*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 $13.76/bu soybean, $56.88/140,000 seeds, and $0.86/ac for the new disc (a full set cost $2314.88 which was distributed over 900 acres and prorated over three years).

There was an interaction between seed disc and seeding rate for stand counts and plant spacing, therefore these results were analyzed considering both seed disc and seeding rate together.

	Early Season Stand Count (plants/ac)	Late Season Stand Count (plants/ac)	Plant Spacing (in)	CV (in/in)
Standard – 100,000	77,214 BC	69,376 C	5.0 AB	0.65 A
Standard – 120,000	85,922 BC	80,407 BC	5.5 AB	0.77 A
Standard – 140,000	97,533 ABC	95,211 AB	4.2 AB	0.79 A
Standard – 160,000	123,658 A	114,950 A	3.4 B	0.75 A
New – 100,000	69,667 C	67,925 C	5.4 AB	0.65 A
New – 120,000	86,213 BC	76,633 BC	4.1 AB	0.90 A
New – 140,000	104,500 AB	98,404 AB	3.4 B	0.65 A
New – 160,000	89,406 BC	85,632 BC	6.2 A	0.81 A
P-Value	0.002	0.0004	0.013	0.529

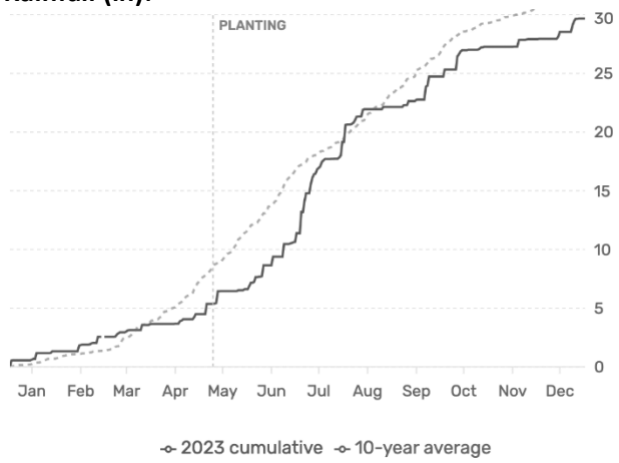
Summary:

- The new seed disc did not result in a difference in yield or net return.
- The lowest seeding rate of 100,000 seeds/ac resulted in the same yields as the higher seeding rates evaluated.
- Stand counts and plant spacing varied based on seed disc and seeding rate. Overall, the stand counts were variable and the highest seeding rate with the new disc had significantly lower stand counts than the highest seeding rate with the standard disc. All stand counts were notably lower than the target seeding rate. Plant spacing was also variable with the highest seeding rate with the new disc having a greater plant spacing than the highest seeding rate with the standard disc. This may be due to variability across the field given dry conditions, as well as the random locations picked for stand evaluations.
- There were no differences in CV across the discs and seeding rates evaluated.

Effect of Planter Downforce and Speed on Soybeans

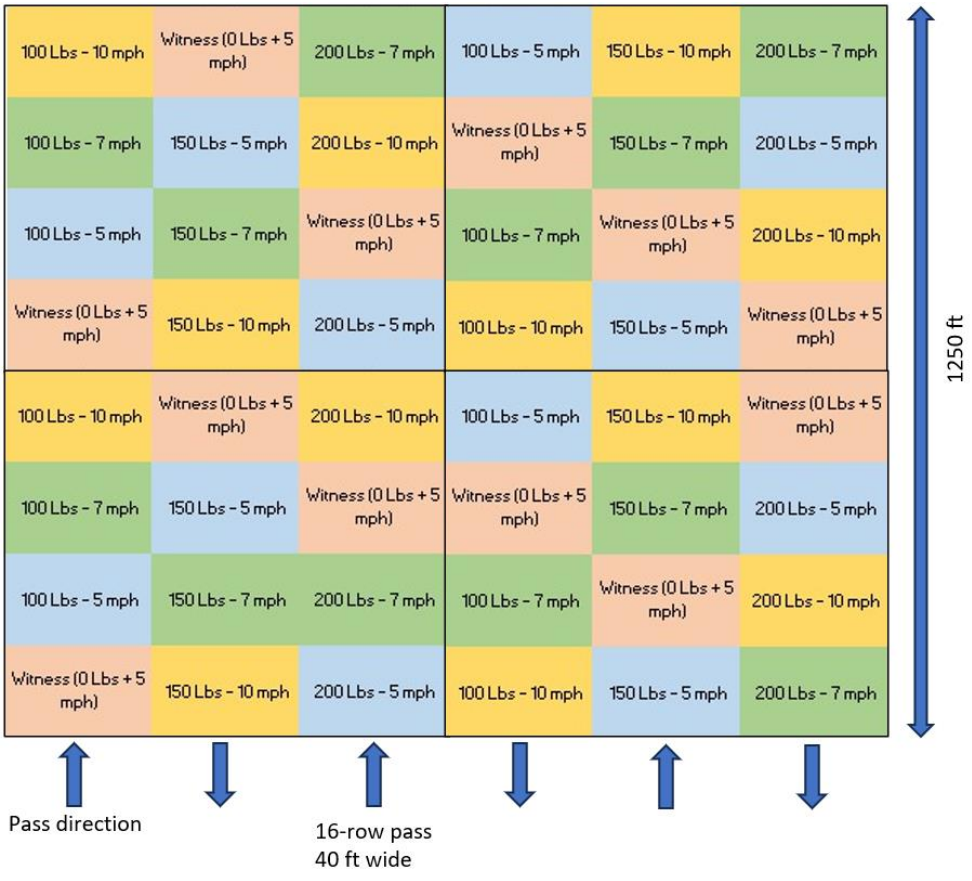
Study ID: 1520141202301
County: Platte
Soil Type: Nora-Crofton complex (silty clay loam and silt loam soils)
Planting Date: 5/9/23
Harvest Date: 10/15/23
Seeding Rate: 135,000
Row Spacing (in): 30
Variety: Channel® 3322RXF
Reps: 4
Previous Crop: Corn
Tillage: No-Till

Irrigation: Pivot
Rainfall (in):



Introduction: The amount of planter downforce varies by soil type. When planting, it is important to consider how much downforce is needed to break the soil resistance and place the seeds at the right depth to ensure uniform seedling emergence. Too little downforce when planting can lead to poor seed-to-soil contact and uneven emergence, whereas too much downforce can result in sidewall compaction and delayed emergence. Planting speed can also impact seed placement, emergence, and stand. Therefore, this study aimed to evaluate three downforce pressures, 100 lb, 150 lb, and 200 lb, at three planting speeds, 5 mph, 7.5 mph, and 10 mph. A 16-row John Deere® ExactEmerge™ planter was used to plant soybeans 2" deep. The seeding rate was 135,000 seeds/ac, and the field was planted on May 9, 2023.

The figure below shows the experiment layout with all the treatments and replications. Stand counts were assessed in all treatment plots on June 7 by counting the number of emerged plants in two 17’5” crop rows.



Results: There was no interaction between planting speed and downforce; therefore results are presented for each individually.

	Early Season Stand Counts (plants/ac)	Yield (bu/ac)†	Marginal Net Return‡ ($/ac)
		Downforce	
100 lb	103,083 AB*	75 A	1033 A
150 lb	100,667 B	72 AB	992 AB
200 lb	106,917 A	67 B	922 B
P-Value	0.034	0.063	0.063
		Speed	
5 mph	102,500 A	72 A	984 A
7.5 mph	105,000 A	72 A	985 A
10 mph	103,167 A	71 A	978 A
P-Value	0.595	0.990	0.990

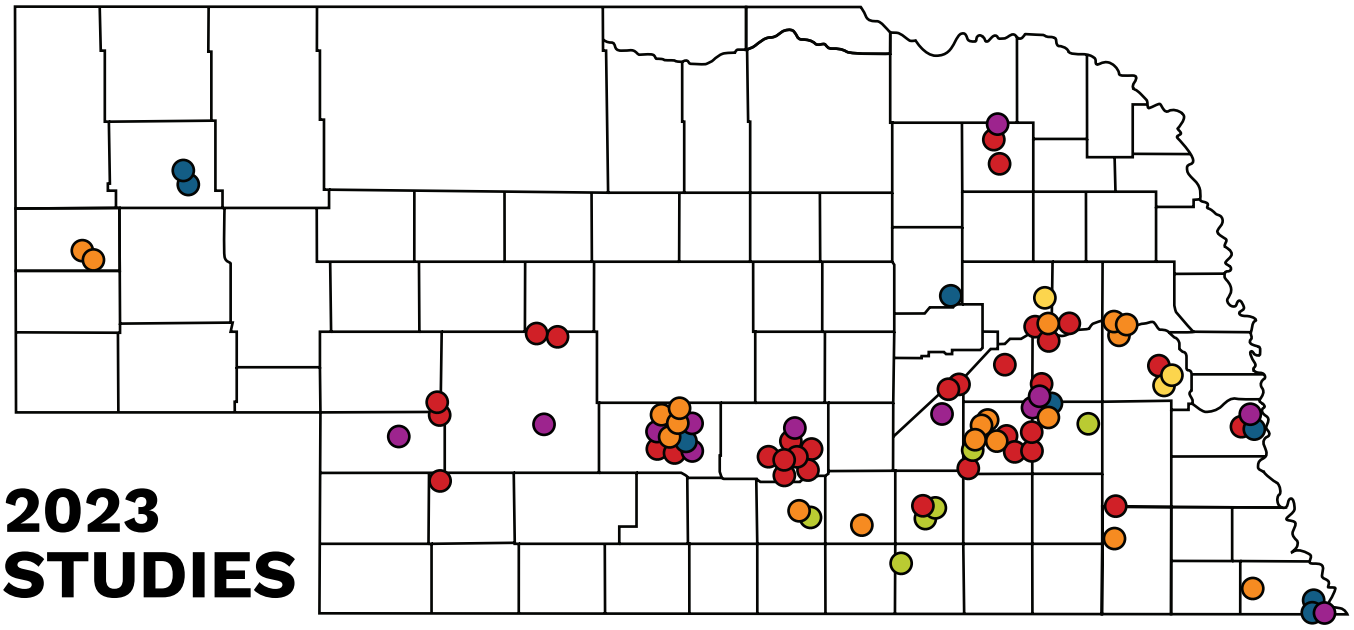
*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.
‡Marginal net return based on $13.76/bu soybean.

Summary:

- The lower than expected stand counts compared to the applied seeding rate (average emergence was 77% of the seeding rate) was likely due to a large amount of corn residue remaining from the previous year with many seeds found on top of the ground after planting.
- The 200 lb downforce resulted in higher stand counts compared to the 150 lb downforce.
- Yield decreased as downforce increased. The greatest yield was achieved at the 100 lb downforce, with an increase of 8 bu/ac compared to the 200 lb downforce.
- Net return was also greatest for the 100 lb downforce, resulting in a $111/ac increase in profit compared to the 200 lb downforce. The marginal net return reported is directly associated with yield because no costs were associated with the different downforce and speeds in the study. Producers may consider the value of reduced labor cost and more timely planting that can be achieved by planting faster.
- Speed did not affect any of the variables measured in this study, which indicates that the 10 mph speed resulted in similar yield and net return when compared to the other two speeds (5 and 7 mph).

NEBRASKA ON-FARM RESEARCH NETWORK

Working with Nebraska's producers to address critical production, profitability, and natural resource questions.



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