

2019 **eFields** Report

Ohio State Digital Ag Program



THE OHIO STATE
UNIVERSITY



COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES
COLLEGE OF ENGINEERING

eFields

“connecting science to fields”

eFields is a program at The Ohio State University dedicated to advancing production agriculture through the use of field-scale research. The 2019 eFields Report is a culmination of the research conducted over the past year on partner farms throughout Ohio. Current research is focused on precision nutrient management strategies and technologies to improve efficiency of fertilizer placement, enable on-farm evaluation, automate machine functionality, enhance placement of pesticides and seed, and to develop analytical tools for digital agriculture.

eFields has expanded from 39 on-farm research sites in 13 counties in 2017, to 95 on-farm research sites covering 25 counties in 2018, and now 88 on-farm research sites in 30 counties.

2019 Research Recap

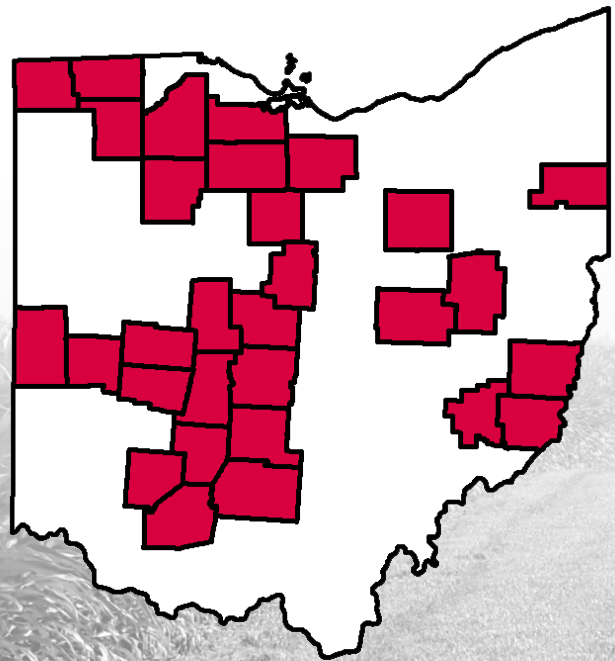
New for 2019

- Cover Crop Studies
- Irrigation Studies
- Production Budget Information
- Ag Crisis Page
- Farm Bill Update
- Planting Progress and Suitable Days

3,792 Total Acres

- 1,746 Corn
- 1,387 Soybean
- 54 Small Grains
- 503 Forages
- 102 Other Studies

30 Counties
88 On-Farm Research Sites



Disclaimer Notice: The information provided in this document is intended for educational purposes only. Mention or use of specific products or services, along with illustrations, does not constitute endorsement by The Ohio State University. The Ohio State University assumes no responsibility for any damages that may occur through adoption of the programs/techniques described in this document.

Editorial

Welcome to the 2019 edition of the Ohio State eFields Report. We would like to begin by extending our sincere thanks to all of those who have made the Ohio State eFields Research Report possible over the past three years. This project would not have happened without the support of our on-farm cooperators, Extension educators, field specialists, faculty, staff, students, industry partners, and countless others who have devoted their time, energy, and expertise. It is truly the collaborative nature of everyone that allows us to ultimately provide data-driven information to thousands of farmers and their advisors in a timely, relevant, and actionable manner.

The 2019 growing season presented a unique and challenging year for agricultural production across Ohio and the Midwest. This season made a mark in history as the 4th wettest year on record which led to an unprecedented 1.5 million unplanted acres in Ohio. The eFields team went into the year with 155 individual studies planned, but due to the excessive rainfall, delayed planting, and other factors affecting crops, 80 studies were withdrawn. Adapting to the conditions, team members and farm cooperators developed new study protocols that allowed information relevant to the 2019 season, including cover crops on prevented planting fields and alternative forages to fill emergency needs for livestock, to be collected. By the end of 2019, the eFields team was able to report on 88 studies from 30 counties. We are excited about this continued growth of the program and the eFields team, despite the challenges faced by the agricultural industry this year.

We hope the results of the trials conducted this past year will help us learn more about production agriculture in challenging years and improve our resiliency to extreme weather. The 2019 report covers more counties across Ohio and the topics have expanded to include additional production economics, small grains, forages, and farm technology. The eFields report has impacted 33 US states and 20 countries globally. You can find the library of eFields Reports ranging from 2017-2019 online at: go.osu.edu/efieldsreports.

We hope you find the 2019 eFields Report informative and valuable. If you are interested in cooperating with us in 2020 or have any feedback, please contact us at digitalag@osu.edu.

Sincerely,

The 2019 eFields Team

2017 eFields Report

OSU Digital Ag Program



The Ohio State University
OSU Digital Ag Program
@digitalag OSU Digital Ag Program
digitalag.osu.edu

*The eFields Report is published on an annual basis.
To view past reports, visit our website at
go.osu.edu/efieldsreports.*

CPAES

2018 eFields Report

Ohio State Digital Ag Program



The Ohio State University
College of Food, Agricultural, and Environmental Sciences
College of Engineering

Table of Contents

Get Involved	6
Ohio State Digital Ag Program.....	8
Report Guide	10
Calculations and Statistics.....	12
eFields Contributors.....	14
2019 Growing Season Weather	20
Planting Progress and Suitable Days.....	22
Ag Crisis Task Force.....	24
Ohio Farm Business Analysis.....	26
Ohio Crop Enterprise Budgets.....	28
Ohio Farm Custom Rates.....	30
Farm Bill Update.....	32
Grain Bin Safety	34
Ohio State Corn Research.....	36
Fungicide	38
High Speed Planting	40
Humic Acid	42
Irrigation Scheduling	44
Narrow Row and Seeding Rate	46
Nitrogen Decision.....	48
Nitrogen Placement Summary	52
Nitrogen Placement	53
Nitrogen Rate.....	56
Nitrogen Stabilizer.....	58
Nitrogen Timing and Rate	62
Phosphorus Placement and Timing	64
Pinch Row Compaction.....	66
Planter 2x2x2 vs. 2x2.....	72
Sidedress Nitrogen Placement	76
Sidedress Nitrogen Rate.....	78
Soil Moisture Sensors	80
Strip-Till at Variable Rates.....	82
Swine Manure Sidedress	84
Swine Manure Sidedress	86
Wing Downforce.....	88
Yield by Planting Date.....	90
Corn Seeding Rate - Summary.....	92
Seeding Rate Trials.....	93

Ohio State Soybean Research.....	102
Fungicide and Insecticide	104
Fungicide	106
Insecticide	108
Input Study	110
Logo Field	112
Planting Date, Fungicide, Insecticide	114
Row Width.....	122
Rye Termination	124
Seeding Rate Effects on SCN.....	126
Starter Phosphorus	128
Sulfur.....	130
Wing Downforce.....	134
Yield by Planting Date.....	136
Soybean Seeding Rate - Summary.....	138
Seeding Rate Trials.....	139
Ohio State Small Grain Research	146
Winter Barley and Soy After Barley.....	148
Nitrogen Management	150
Nitrogen Rate	152
Ohio State Forages Research.....	154
Cover Crop Summary	156
Cover Crops	157
Gibberellin Growth Regulator.....	182
Small Plot Forages.....	184
Ohio State Technology Research.....	186
Fertilizer Spreader Vane Shape	188
Accuracy of UAS Derived Map	190
UAS Image Processing Software.....	192
Ohio State Other Research.....	194
Farm of the Future Demonstration.....	194
Strip Intercropping.....	196
SCN Coalition	198
Soil Biological Response to BMPs.....	200
Voles in Cover Crops	202
Interseeding	204
Glossary	208
Industry Partners	216
Research Collaborators and Supporters	218

eFields

connecting science to fields

Are you interested in contributing to the 2020 eFields? If so, go to go.osu.edu/efields to review study implementation and tips and tricks. See below for details on how to get involved and who to contact. We look forward to working with you!

Growers

Growers interested in hosting on-farm research trials for publication in the annual research report should reach out to their county Agriculture and Natural Resources Extension Educator (agcrops.osu.edu/people). To view a list of those educators who are already involved, see page 14. Standard protocols for seeding rates, nitrogen rates, and other management practices have been developed for statewide implementation. Contact us today to find out how to get involved. Additional protocols and topics are being developed and can be customized to fit your needs!

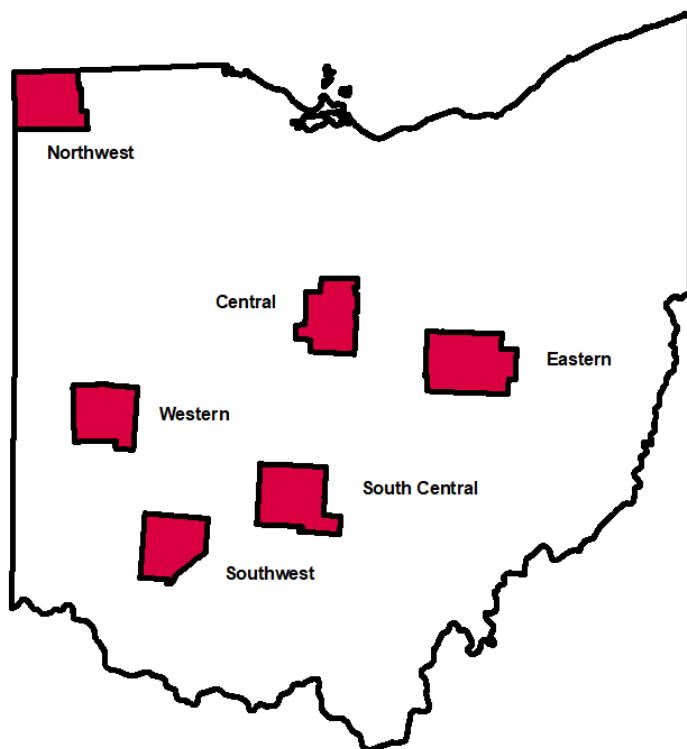
Industry Representatives

We are always looking for new partners in on-farm trials! If you are interested in determining how you can support Ohio On-Farm Research, reach out to your county Agriculture and Natural Resources Extension Educators, digitalag@osu.edu, or Dr. Elizabeth Hawkins (hawkins.301@osu.edu). We would love to discuss your involvement with the eFields program!

Extension Educators and Field Specialists

If you are a current ANR Educator and are interested in getting involved with eFields, contact us at digitalag@osu.edu, or reach out to Dr. Elizabeth Hawkins at hawkins.301@osu.edu.

2019 eFields Review Meetings



Southwest Region

February 10

Northwest Region

February 26

Central Region

February 27

South Central Region

March 9

Eastern Region

March 10

Western Region

March 16



Participation in eFields has allowed us to fine tune our populations based on soil types. We also enjoy the fact that we are able to conduct research that benefits our farm and is useful to other farmers across the state. We look forward to continuing our partnership with Ohio State University Extension and would encourage others to become involved in eFields.

- Spillman Farms LTD



Ohio State's on-farm research and eFields Report has given our farm the opportunity to see the promising benefits of sidedressing hog manure into a growing crop. Capturing nitrogen, reducing inputs, and improving margins are a few benefits from OSU's research. Surpassing our expectations, the research has shown the economic and environmental advantages, proving that our practices are sustainable.

- Stucke Farms



OSU's on-farm research and eFields Report have allowed us to reduce our input costs, maximize yield, and document our findings so other farmers may benefit. The eFields Report has helped us make sound decisions for seed and fertilizer but also precision farming equipment. We are confident that our time invested in on-farm research is profitable today and into the future.

-Brown Family Farms

OHIO STATE DigitalAg



ABOUT US

The Digital Agriculture program at The Ohio State University embodies the best of the land grant mission—creation, validation, and dissemination of cutting-edge agricultural production technologies. The central focus of this program is the interaction of automation, sensing, and data analytics to optimize crop production in order to address environmental quality, sustainability, and profitability. Research is focused on execution of site-specific nutrient management practices, development of handheld devices for in-field data capture, autonomous functionality of machinery, remote sensing solutions, and data analytics to enhance timing, placement and efficacy of inputs to cropping systems.

VISION

The Digital Agriculture Program at The Ohio State University strives to be the premier source of research-based information in the age of digital agriculture.

MISSION

- Uniting the private and public sectors to drive innovation for the benefit of farmers.
- Partnering with farmers to translate innovation into long-term profitability for production agriculture.
- Delivering timely and relevant information for the advancement of digital agriculture technologies.

WHAT IS DIGITAL AGRICULTURE?

The premise of digital agriculture includes the advancement of farm operations through implementation of precision agriculture strategies, prescriptive agriculture and data-based decision making. Digital Agriculture is a holistic picture of the data space in agriculture, trends related to services directing input management and the value of data usage for improving productivity and profitability of farm operations.

“Digital Agriculture” combines multiple data sources with advanced crop and environmental analyses to provide support for on-farm decision making.

Digital Ag Initiatives

“Helping growers make the most of Precision and Digital Ag technologies”

eFields focus areas are indicated by a red circle around each initiative.



PRECISION SEEDING

Utilizing the latest digital ag technologies to place every seed in an environment optimized for its growth and development.



ON-FARM RESEARCH

Deploying field-scale studies to advance production agriculture through efficiency and profitability using data-driven decisions.



PRECISION CROP MANAGEMENT

Management of crop inputs in a way that maximizes efficiency and profitability.



HARVEST TECHNOLOGIES

Taking advantage of available technologies to improve harvest efficiencies and improve data quality.



SOIL COMPACTION MANAGEMENT

Mitigation of soil compaction to enhance crop health and soil structure.



REMOTE SENSING

Providing the ability to remotely assess field conditions, crop health, nutrient needs, and productivity levels on a sub-field scale.



APPS FOR AGRICULTURE

Embracing the power of smart phones and tablets to utilize mobile applications and farm smarter.



PRECISION NUTRIENT MANAGEMENT

Ensuring that all applied nutrients are in a position to maximize crop uptake. Right source, right rate, right time, right place, right technology.



PRECISION LIVESTOCK

Making use of data and digital tools to manage or automate animal well-being, food safety, pasture sustainability, waste products and more.



DATA ANALYSIS AND MANAGEMENT

Developing a digital strategy and making actionable decisions using data, from operational insights to field execution.



OBJECTIVE

Find study information, objectives, study design, weather graph, and summary on the **left page**. Find results, summaries, project contact, and statistical summary on the **right page**.



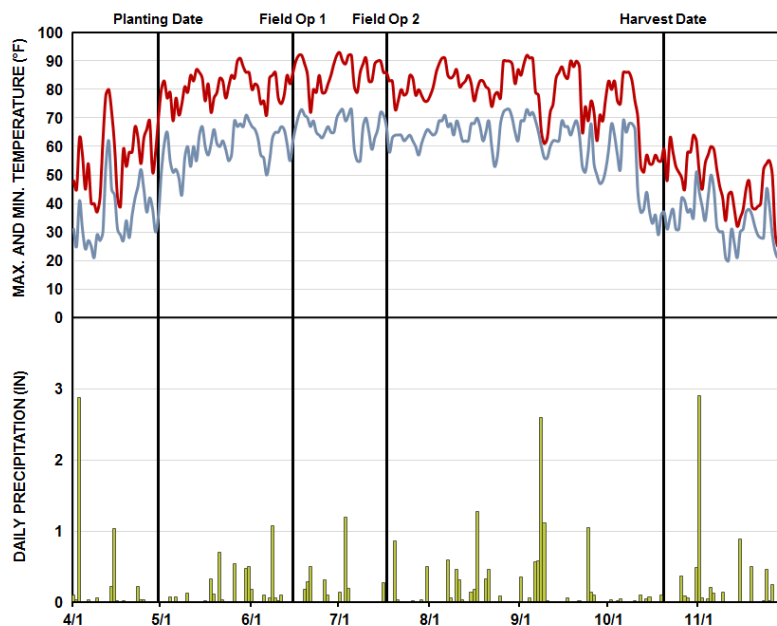
Location Box

Look to see the county where the study was conducted.

STUDY INFORMATION

Planting Date	6/3/17
Harvest Date	11/20/17
Variety	Beck's 6076V2P
Population	34,000 sds/ac
Acres	70.0
Treatments	5
Reps	7
Treatment Width	40 ft.
Tillage	Conventional
Management	Round-Up
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Crosby silt loam, 52% Celina silt loam, 48%

WEATHER INFORMATION



Growing Season Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.39	5.52	4.30	7.44	2.62	23.27
Cumulative GDDs	248.3	603.3	1211.9	1917.1	2506.3	2506.3

STUDY DESIGN

The study design provides a background on the study. This could include a brief history of research, observations that led to the implementation of this study, explanation of the study design, etc.



Here you will find visuals of the study with short descriptions.

OBSERVATIONS

The observations section of the report allows us to provide any relevant information that the researchers noticed throughout the growing season. Observations allow for a deeper understanding of the study results.



SUMMARY

- The summary section proves results and findings from the study.
- Thank you for taking the time to explore our 2019 eFields Report!



RESULTS

Treatments (XXX)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: CV:

TOOLS OF THE TRADE

This section allows us to display the tools and technology used to make each study possible.



PROJECT CONTACT

The Project Contact section provides the name of the researcher along with their email. We encourage you to contact them if you have questions about the study.

Calculations and Statistics

To effectively collect, analyze, and interpret data, statistical calculations were made for each eFields study when possible. All statistical calculations were conducted using the OSU PLOTS Research App or calculated using the ANOVA spreadsheet, using Fisher's Protected Least Significant Differences (LSD, $\alpha = 0.1$) method to determine if treatment differences are statistically significant.

Stand Counts and Harvest Data:

All stand counts were conducted for individual plots by counting the number of plants in 30 linear feet along two adjacent rows. All yield data was collected using calibrated yield monitors or weigh wagons. Data was processed and cleaned to ensure accuracy with yields adjusted to a standard moisture prior to analysis.

Take a look at this example from a study:

Results show the average of the response variable (i.e. yield) for each treatment.

Replication

- Allows one to estimate the error associated with carrying out the experiment itself.
- Without replication, it would be impossible to determine what factor contributed to any treatment differences.
- A minimum of 3 replications is required for a proper evaluation, with 4 or more recommended for field-scale research.

Treatments	Yield (bu/ac)
A	230 a
B	229 a
C	227 ab
D	225 b
	LSD 3.38
	CV 1.60%

Randomization

- Randomization is as important as replication to help account for any variations in production.
- Even if one replicates treatments, the conclusions you reach may not be correct if a treatment was always applied to the same part of the field.
- Randomization prevents data from being biased based on its location in a field.

LSD

Least Significant Difference is used to compare means of different treatments that have an equal number of replications. For this report, a significance level of 0.1 (or 10%) was used, which means when a treatment is statistically significant, a 90% confidence is attributed to that treatment actually being different from the comparison.

CV

Defined as the coefficient of variation, CV is a measure of the variability between treatment yields, reported as a percentage (%). CV is an indicator of data uniformity. Higher CV's indicate more treatment or environmental variability.

Explanation:

- For treatment A to be statistically significant from treatment B, they must differ by at least 3.38 bu/ac. (They do not, so they are not statistically different and are marked using the same letter). "NS" denotes not significant in the results table.
 - For treatment D to be statistically different from treatment A, they must differ by at least 3.38 bu/ac (here they differ by 5 bu/ac, so they are statistically significant and are marked using different letters).
- In this example, since treatment A is different from treatment D by 3.38 bu/ac, we are 90% certain that the results of the treatments were indeed different. Treatment differences are represented by using a letter beside the reported value. Since the averages for treatment A and treatment B differ by less than 3.38, we cannot conclude that the treatments are different from each other, so the same letter (eg. "a") is used to indicate they are the same.

For more information and examples on statistics and experimental setup, visit go.osu.edu/efieldsinvolved.

Return above analysis allows farmers to consider not only yield increase, but also economic return which ultimately impacts the farm's bottom line. For the studies where economics were calculated, return above is labeled in the right-most column of the results table. To standardize return above calculations state-wide, the OSU Extension budgets were used for a partial profit calculation. farmoffice.osu.edu

Seed Costs:

For the seeding rate studies, a uniform corn seed cost of **\$3.50/1,000 seeds** was used. Soybean seed cost was **\$0.428/1,000 seeds**. These are based on the Ohio Crop Enterprise Budgets developed by Barry Ward, OSU Extension. Learn more about the budgets on page 22.

Commodity Prices:

Price received was determined by the October WASDE (World Agricultural Supply and Demand Estimates) report with a corn price of **\$3.50/bu** and a soybean price of **\$8.60/bu**. We then calculated a 10% price increase and decrease to reflect price variability.

	Corn \$/bushel	Soybeans \$/bushel
Oct WASDE	3.50	8.60
10% Decrease	3.15	7.74
10% Increase	3.85	9.46

Nitrogen Costs:

A nitrogen cost of **\$0.32/lb** used in this report is from the 2019 Corn Production Budget. For the nitrogen timing studies, application costs were also considered. The average costs of application the report uses are from the 2019 Ohio Custom Farm Rates. Learn more about the 2019 custom rates on page 32.

Nitrogen Application Costs

Application Method	Rate (\$/ac)
Dry Bulk	6.30
Liquid Knife	9.50
Liquid Spray	7.20
Anhydrous	13.70
Late Season Coulters	13.20
Late Season Drops	11.30

Example economic calculator for corn seeding rate studies:

Average Price				
Seeding rate (sds/ac)	26,000	30,000	34,000	38,000
Cost of seed/1000	3.50	3.50	3.50	3.50
Total seed cost (\$)	91	105	119	133
Yield (bu/ac)	120	130	160	200
Bushel Price (\$/bu)	3.50	3.50	3.50	3.50
Gross Income (\$)	420	455	560	700
Return above seed (\$/ac)	329	350	441	567

The "Return above" line includes only the expense of what was being studied (i.e. seed cost) to provide a clear indication of economic return. To calculate your own economic return, you can access the eFields Economic Calculators at: go.osu.edu/econcalculator.

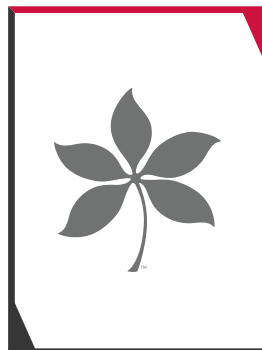
eFields Contributors



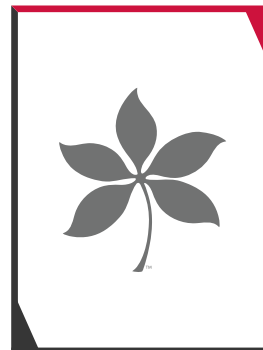
Glen Arnold
Associate Professor,
Field Specialist
Department of Extension



John Barker
Assistant Professor,
Extension Educator
Knox County
Department of Extension



Brooke Beam
Extension Educator
Highland County
Department of Extension



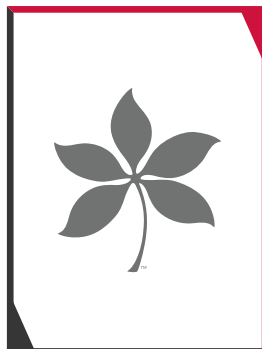
Amanda Bennett
Extension Educator
Miami County
Department of Extension



Jarrod Bowman
Student Assistant
Department of Food, Agricultural
and Biological Engineering



Ben Brown
Assistant Professor
Department of Agricultural,
Environmental, and
Development Economics



Steve Culman
Assistant Professor
School of Environment and
Natural Resources



Sam Custer
Extension Educator
Darke County
Department of Extension



Wayne Dellinger
Extension Educator
Union County
Department of Extension



Anne Dorrance
Associate Dean and Director
of the Wooster Campus
College of Food, Agricultural,
and Environmental Sciences



Amanda Douridas
Extension Educator
Champaign County
Department of Extension



Nate Douridas
Farm Manager
Molly Caren Agricultural Center



Mike Estadt
Extension Educator
Pickaway County
Department of Extension



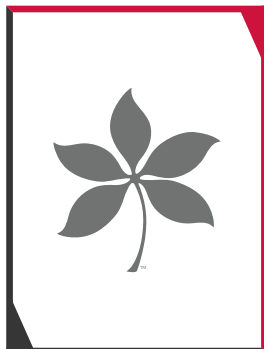
Ken Ford
Extension Educator
Fayette County
Department of Extension



John Fulton
Associate Professor
Department of Food,
Agricultural and Biological
Engineering



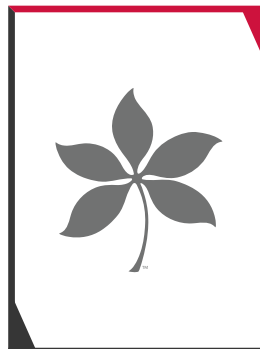
Al Gahler
Extension Educator
Sandusky County
Department of Extension



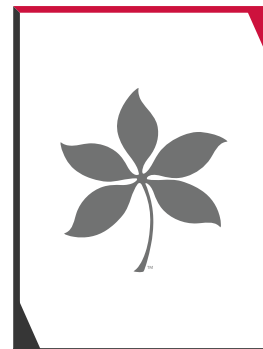
Mike Gastier
Extension Educator
Huron County
Department of Extension



Alysa Gauci
Graduate Research Associate
Department of Food,
Agricultural and Biological
Engineering



Christine Gelley
Extension Educator
Noble County
Department of Extension



Ryan Haden
Assistant Professor
Ohio State ATI



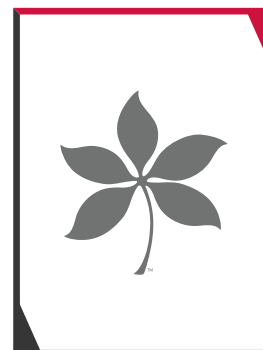
Will Hamman
Extension Educator
Pike County
Department of Extension



Jason Hartschuh
Extension Educator
Crawford County
Department of Extension



Elizabeth Hawkins
Assistant Professor,
Field Specialist
Department of Extension



Carri Jagger
Extension Educator
Morrow County
Department of Extension

eFields Contributors



Dee Jepsen
Associate Professor
Department of Food,
Agricultural and Biological
Engineering



Stephanie Karhoff
Extension Educator
Williams County
Department of Extension



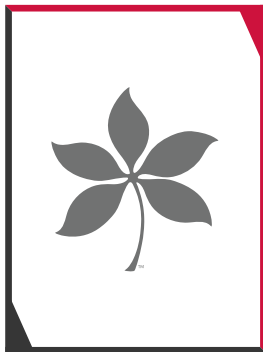
Sami Khanal
Assistant Professor
Department of Food,
Agricultural and Biological
Engineering



Andrew Klopfenstein
Sr. Research Associate Engineer
Department of Food,
Agricultural and Biological
Engineering



Alex Kutz
Student Assistant
Department of Food,
Agricultural and Biological
Engineering



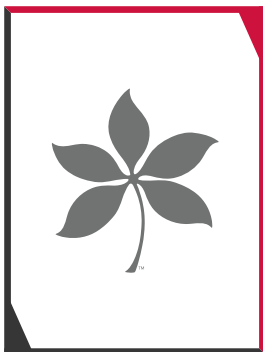
Mark Landefeld
Faculty Emeritus
Department of Extension



Elizabeth Landis
Student Assistant
Department of Food,
Agricultural and Biological
Engineering



Jenna Lee
Student Research Assistant
Department of Food,
Agricultural and Biological
Engineering



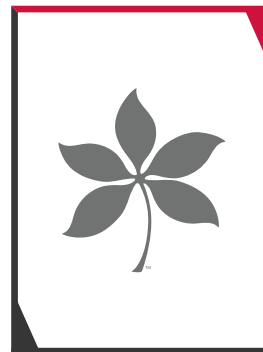
Rob Leeds
Extension Educator
Delaware County
Department of Extension



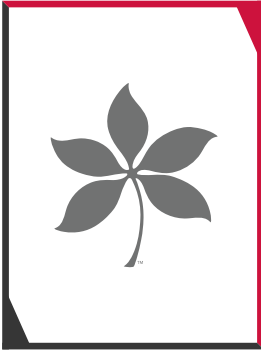
Ed Lentz
Professor, Extension
Educator
Hancock County
Department of Extension



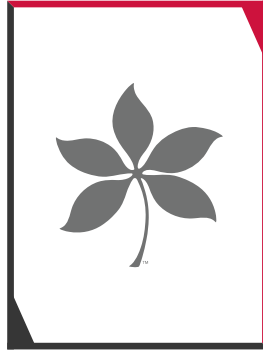
Rory Lewandowski
Extension Educator
Wayne County
Department of Extension



Dan Lima
Extension Educator
Belmont County
Department of Extension



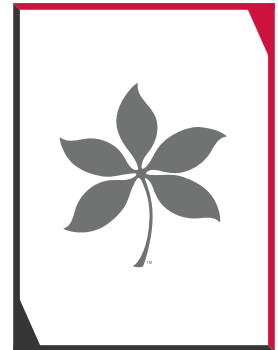
Alex Lindsey
Assistant Professor
Department of Horticulture and
Crop Science



Laura Lindsey
Associate Professor
Department of Horticulture and
Crop Science



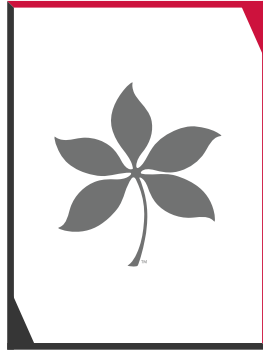
Ellie Logan
Program Assistant
Department of Food,
Agricultural and Biological
Engineering



Andrew Londo
Professor, Assistant Director
of Ag and Natural Resources
Department of Extension



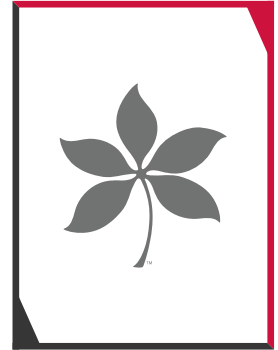
David Marrison
Associate Professor,
Extension Educator
Coshocton County
Department of Extension



Jeff McCutcheon
Assistant Director,
Operations
Department of Extension



Gigi Neal
Extension Educator
Clermont County
Department of Extension



Matthew Nussbaum
Program Assistant
Wayne County
Department of Extension



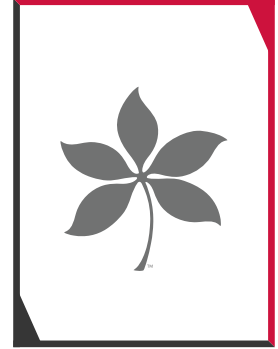
Tony Nye
Assistant Professor,
Extension Educator
Clinton County
Department of Extension



Lisa Pfeifer
Program Manager
Department of Food,
Agricultural and Biological
Engineering



Eric Richer
Assistant Professor,
Extension Educator
Fulton County
Department of Extension



Kaitlin Ruetz
Student Assistant
Fulton County
Department of Extension

eFields Contributors



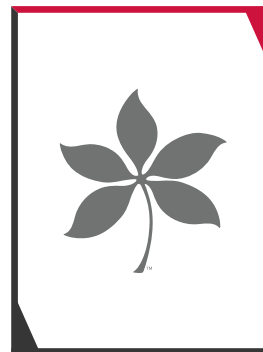
Garth Ruff
Extension Educator
Henry County
Department of Extension



Scott Shearer
Professor and Chair
Department of Food,
Agricultural and Biological
Engineering



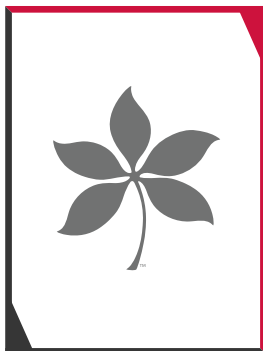
Dianne Shoemaker
Associate Professor, Field
Specialist
Department of Extension



Haley Shoemaker
Program Coordinator
Department of Extension



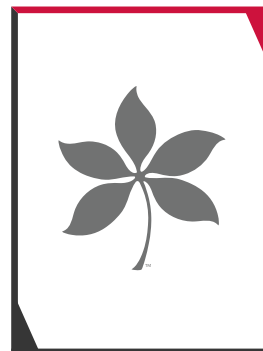
Chris Shoup
Graduate Research Associate
Department of Food,
Agricultural and Biological
Engineering



Jacci Smith
Extension Educator
Delaware County
Department of Extension



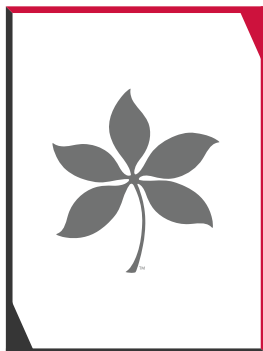
Angelina Sorice
Student Assistant
Department of Food,
Agricultural and Biological
Engineering



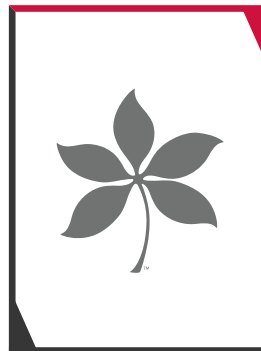
Alan Sundermeier
Professor, Extension Educator
Wood County
Department of Extension



Ryan Tietje
Research Associate Engineer
Department of Food,
Agricultural and Biological
Engineering



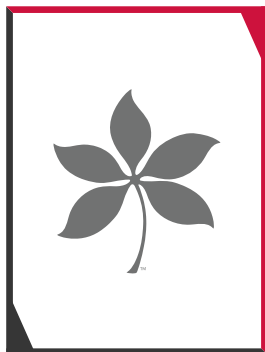
Kelley Tilmon
Associate Professor
Department of Entomology



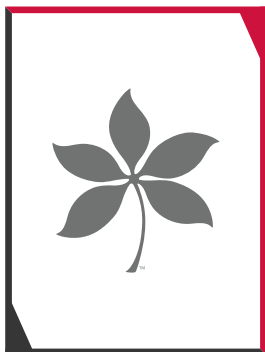
Catelyn Turner
Extension Educator
Monroe County
Department of Extension



Chip Tuson
Program Manager
Department of Food,
Agricultural and Biological
Engineering

**Barry Ward**

Assistant Professor, Leader,
Production Business
Management
Department of Extension

**Hallie Williams**

Extension Educator
Seneca County
Department of Extension

**Aaron Wilson**

Research Scientist
Department of Extension

**Chris Zoller**

Associate Professor,
Extension Educator
Tuscarawas County
Department of Extension

CFAES

Agronomy and Farm Management Podcast

Hosted by OSU Extension's Amanda Douridas and Elizabeth Hawkins

Stay on top of what is happening in the field and the farm office. This podcast takes a bi-monthly dive into specific issues that impact agriculture, such as: weather, land value, policies, commodity outlooks, and more.

New episodes released every other Wednesday
Listen and subscribe on iTunes or Stitcher
Learn more at go.osu.edu/AFM



THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES



Scan here
for iTunes!



Scan here
for Stitcher!



2019 Growing Season Weather

How does one summarize the weather of 2019 and its impact on agriculture in Ohio? Many consider this a year like no other, from brutally cold temperatures in January, to relentless spring rains, to late summer/early fall drought when farmers were desperately pleading for water on late maturing crops; this all coming on the heels of one of the wettest falls on record in 2018 with delayed harvest and fall planting. Many have seen it all this year!

Through autumn, 2019 ranks as the 19th warmest and 9th wettest on record for Ohio according to the National Centers for Environmental Information (<https://www.ncdc.noaa.gov/sotc/index.php>). This includes a 4 month stretch of the wettest previous 12-months on record (June 2018 – May 2019, July 2018 – June 2019, etc.). Overall, these conditions led to a number of issues including late planted small grains, winter injury and water damage, late or no planting of corn and soybeans this spring with large numbers of prevented planting acres, an early season lack of forages, negative impacts on fruits and vegetables, and a general disruption to the agricultural production cycle including planting, spraying, and harvesting. The following information summarizes the 2019 climate in Ohio to help contextualize the challenges and outputs from this tempestuous season.

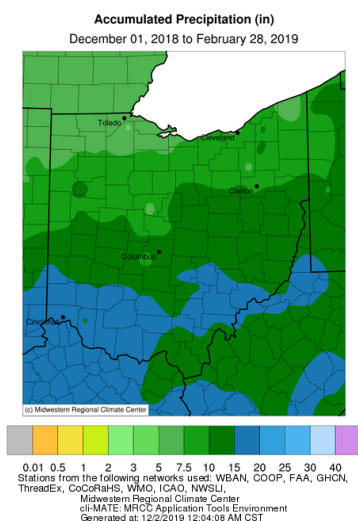


Figure 1. Total precipitation for winter (December 2018 - February 2019).

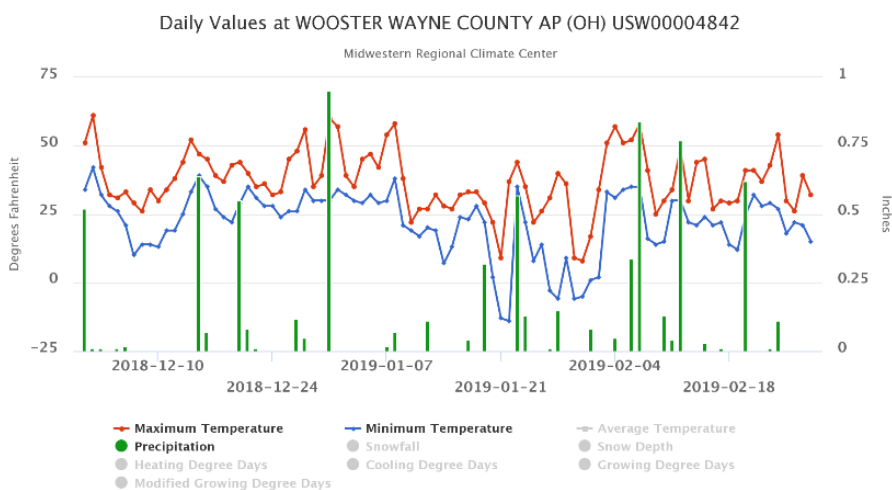


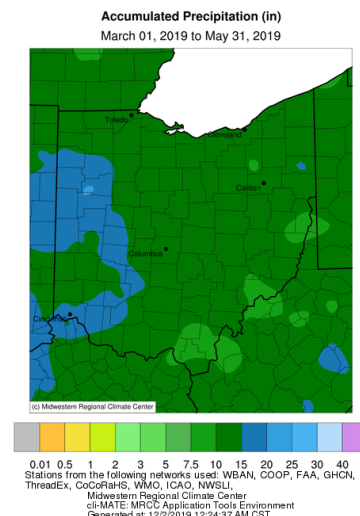
Figure 2. Daily highs, lows, and precipitation for Wooster, Ohio for December 2018 - February 2019.

Winter (December-February): Like the autumn of 2018, the winter of 2019 was wet, especially across the southern half of Ohio. Winter 2019 ranks as the 11th wettest on record for Ohio, with precipitation exceeding 15 inches across southern counties (Fig. 1), about 150-200 percent of normal. Only far northwestern counties experienced below average precipitation for the winter, with less than 7.5 inches falling during this time. These wet conditions led to persistently high stream flows and soil moisture differences compared to historical averages well into the 99th percentile.

Winter temperatures averaged above normal, mainly the result of a warm December and February. However, a short period of intense cold occurred during January, with frequent freeze-thaw cycles. An example of the December – February daily highs, lows, and precipitation for Wooster, Ohio is provided in Fig. 2.

Spring (March-May): Climatologically speaking, March-May 2019 ranks as the 36th warmest and 32nd wettest for the state. However, spring weather was not kind to farmers in west Central and northwest Ohio, as spring 2019 ranks as the 7th and 3rd wettest on record for these locations, respectively. Near St. Marys, Ohio in Auglaize County, a Community Collaborative Rain, Hail, and Snow Network (coco-rahs.org) observer reported over 20 inches of precipitation between March 1 and May 31, over half of that location's normal yearly rainfall (~36 inches) in just three months. Multiple observers across this part of the state reported more than 15 inches of precipitation for the season (Fig. 3). The frequency of the rainfall was also problematic, with many stations reporting 20-26 days of at least a trace of precipitation during the month of May. According to Cheryl Turner, statistician with NASS, Ohio had only seven suitable for fieldwork days during May. This kept planters out of the field and farmers struggling to complete necessary fieldwork.

Figure 3. (right) Total precipitation for spring (March – May 2019).



Accumulated Precipitation (in)
June 01, 2019 to June 30, 2019

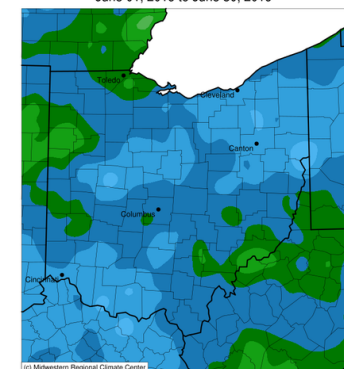
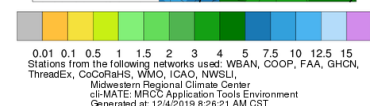


Figure 4. (left) Total precipitation for June 2019. Data Source NCEI. Images created by the Midwest Regional Climate Center.

Tools of the Trade

FARM (Field Application Resource Monitor)

This tool (farm.bpcrc.osu.edu) allows users to define their locations of interest and receive 12- and 24-hour precipitation forecasts (current and historical) to aid in the application of fertilizer, manure, and/or pesticides.



Summer (June-August): Summer 2019 started off much like the previous 12 months, as June ranks as the 5th wettest June on record for Ohio (1895-present). Many locations picked up over 10 inches of rainfall during the month, more than double their historical averages (Fig. 4). Conditions turned drier and warmer in July and August for many parts of the state, which may have been a benefit to some farmers as late planted crops were maturing but did cause some heat stress and dry soils in the worst regions (e.g., Champaign, Clark, Darke, Miami, and Shelby Counties). July temperatures were quite above average, flirting with 100 degrees Fahrenheit in a few places across the south. Overall, summer 2019 ranks as the 30th warmest and 12th wettest for the state.

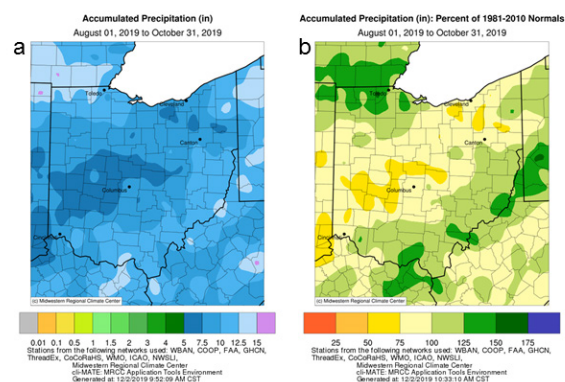
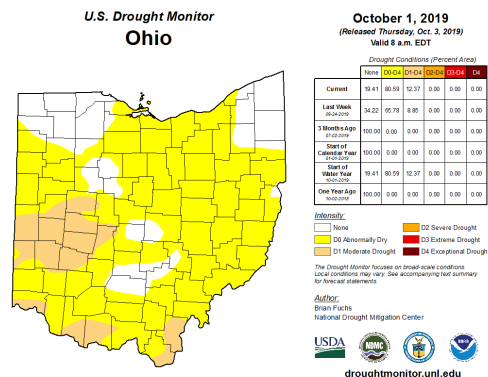


Figure 5. (left) a) Estimated total rainfall and b) Percent of the mean for Ohio for the period August 1 - October 31, 2019 based on station data (1895-2019).

Figure 6. (right) Peak D0-D4 depiction on the U.S. Drought Monitor on October 1, 2019.



Autumn (September-November): Autumn 2019 conditions are a stark contrast to those of 2018, where tropical activity kept the area completely saturated. Figure 5a shows the total accumulated precipitation between August 1st and October 31st. The driest areas (dark blue shading) are indicated over parts of the Miami Valley, Central Ohio, and parts of the northeast, where only 5-7.5 inches of rain fell during this time. This is roughly 50 percent of normal during this period (Fig. 5b). Other parts of Ohio remained saturated during this time (NW and SE Ohio – indicated by the green shading in Fig. 5b).

By the beginning of autumn 2019, conditions across much of the state were turning quite dry. Despite the fourth wettest start (January – June) in Ohio's modern climate history (1895-present), much of the state experienced abnormally dry to moderate drought conditions during late summer and autumn. According to the U.S. Drought Monitor (<https://droughtmonitor.unl.edu/>), Abnormally Dry (D0) conditions were introduced to southwest Ohio on August 6th, Moderate Drought (D1) conditions on September 10th, and at least some area of the state remained abnormally dry until November 12th (a total of 14 weeks). During this period, the peak coverage of D0-D1 was depicted on October 1st at 80.59 percent (Fig. 6). The peak D1 conditions were reported on October 15th and October 22nd at 26.05 percent.

By all accounts, the summer/autumn 2019 drought created a few agricultural impacts across the state including decreased soil moisture, crop stress, poor late season pasture conditions, low farm ponds, and a few combine fires during the harvest season. However, much cooler conditions (November 2019 ranks as the 14th coolest with temperatures 4-6 degrees Fahrenheit below average) and adequate rainfall alleviated the dry conditions by mid-November.

CONTACT

For questions about this information, contact Aaron B. Wilson (wilson.1010@osu.edu).

Planting Progress and Suitable Days

2019 Planting Progress in Ohio

Perhaps the greatest challenge the agriculture community faced in 2019 was extreme wet conditions, in particular during spring. Excessive rainfall and persistently elevated soil moisture delayed planting progress to record levels—represented through data collected by the National Agricultural Statistics Service (USDA-NASS).



eFields Collaborating Farm

OSU Extension

Statewide



Corn Planting Progress

Crop year 2019 went into the record book as the slowest corn planting progress since 1979. USDA NASS reported corn planting was completed in Ohio prior to the first week of June in 20 of the 40 years (50% of years) on record. When that mark was reached this year, Ohio had only planted 33% of planned corn acres. Farmers across Ohio struggled to find days suitable for planting, achieving 50% planted on June 9th. Corn planting stretched into July, something that has never been documented by USDA NASS. Figure 1 illustrates Ohio's corn planting progress from 1979 to 2019. It should be noted that some of the reported progress in 2019 reflects changes in planting intention, as 928,679 acres of corn went to prevented planting.

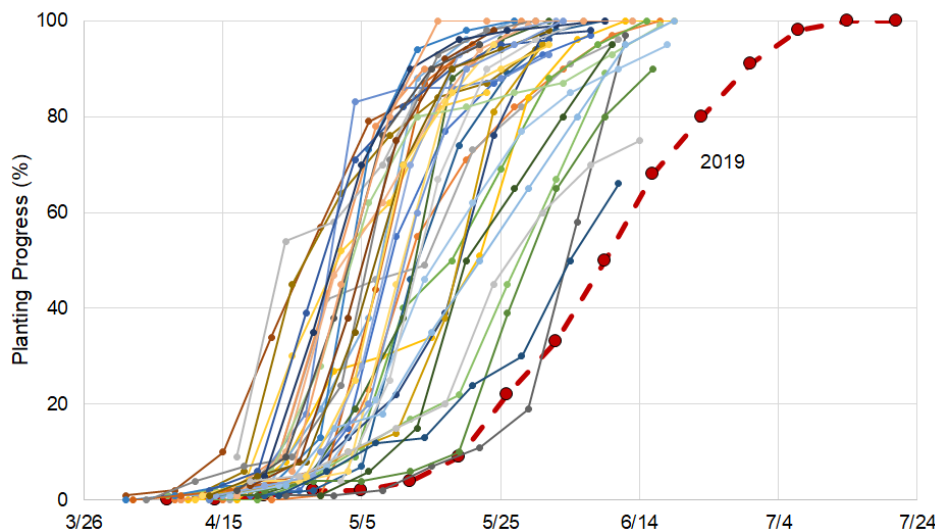


Figure 1. Ohio corn planting progress reported by USDA NASS from 1979 – 2019. 2019 progress is shown by the scarlet dashed line. Data source: USDA NASS

Table 1. Top five reported single week gain in corn planting progress (tie for 5th ranked). Data source: USDA NASS

Year	Week Ending	Planting Progress (%)	Single Week Progress (%)
2003	5/4/2003	83	65
2001	5/6/2001	73	60
2007	5/13/2007	88	50
1999	5/9/1999	71	47
2005	4/24/2005	54	45
1980	5/11/1980	70	45

In many years, the slow start to planting has been overcome by a break in the weather that allows farmers to catch up and make significant planting progress. Table 1 shows the largest gains in planting progress reported since 1979 statewide. In 2019, the largest gain in planting progress occurred the week ending June 16th across the state with 18% of corn acres planted. However, this progress could also be related to change in planting intentions as economic analysis suggested farmers should not plant past June 14th.

Soybean Planting Progress

Soybean planting progress was also hindered by the wet weather conditions. Figure 2 shows Ohio's soybean planting progress from 1979 to 2019. Planting pace was similar to the pace reported in 1981 and 1989. However, 2019 ultimately "won" as planting continued past mid-July before reaching completion. Coming off the best week of the season for planting, Ohio reached 50% planted on June 23rd. This was a single week gain of 19%, still well behind the best gains shown in Table 2.

Days Suitable for Fieldwork

In 2019, the continuous rainfall led to fewer than normal days suitable for fieldwork. Six of the eight months reported fell below the long term average. This trend contributed to the planting delays experienced across the state. The two months with greater than normal days available for fieldwork were September and October, leading to harvest progress to follow a normal pace despite the slow start. Figure 3 shows the number of days suitable for fieldwork for each month in 2019 compared to the long term average from 1995 to 2018.

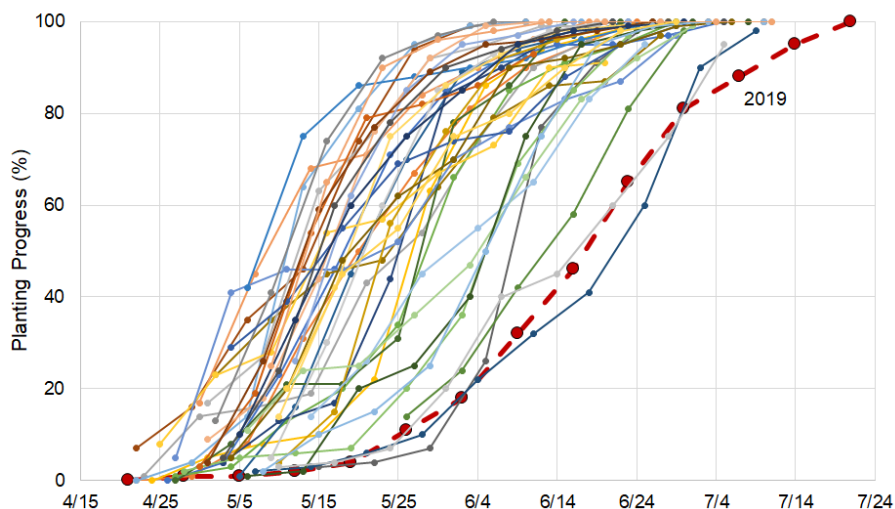
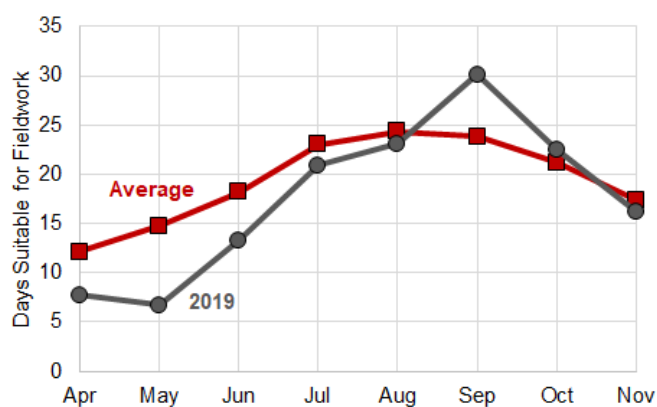


Figure 2. Ohio soybean planting progress reported by USDA NASS from 1979 – 2019. 2019 progress is shown by the scarlet dashed line.
Data source: USDA NASS

Table 2. Top five reported single week gain in soybean planting progress (tie for 5th ranked). Data source: USDA NASS

Year	Week Ending	Planting Progress (%)	Single Week Progress (%)
2011	6/12/2011	77	51
2007	5/13/2007	64	50
2008	6/1/2008	78	47
2001	5/6/2001	42	42
2016	5/29/2016	62	41
1998	5/24/1998	56	41

Figure 3. Monthly days suitable for fieldwork. The average number of days per month from 1995 to 2018 (scarlet squares) compared to the number of days available for fieldwork per month in 2019 (gray circles). Monthly totals are calculated based on weekly reports. Data source: USDA NASS

SUMMARY

In 2019, near record spring rains across west central and northwest Ohio, falling on already saturated ground, led to unprecedented delays in planting progress across Ohio. A record 1,564,611 acres remained unplanted at the end of the season.

PROJECT CONTACT

For inquiries about this project, contact Ben Brown (brown.6888@osu.edu), John Fulton (fulton.20@osu.edu), Aaron Wilson (wilson.1010@osu.edu), or Elizabeth Hawkins (hawkins.301@osu.edu).

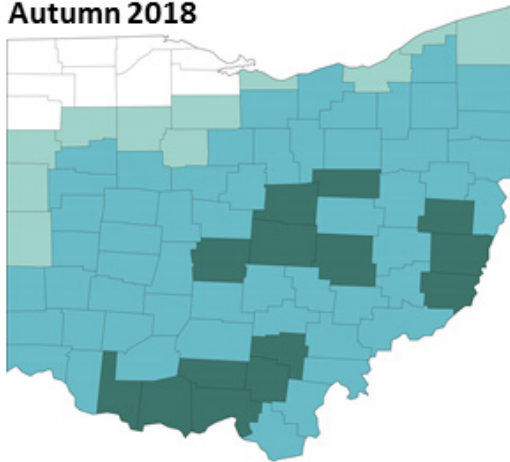
Ag Crisis Task Force

Historic precipitation from autumn 2018 through summer 2019 created Ohio's worst planting year on record and contributed to a near-record low level of hay to feed livestock in the state and across the Midwest. Coupled with low commodity and feed prices, and uncertainty about international tariffs on American agricultural goods, many Ohio farmers and producers are struggling.

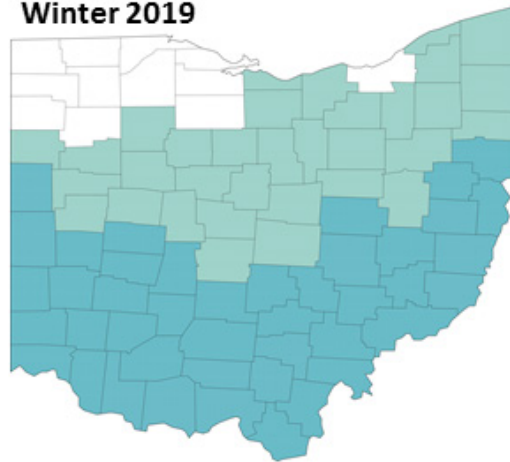


FARMING CRISIS UPDATES

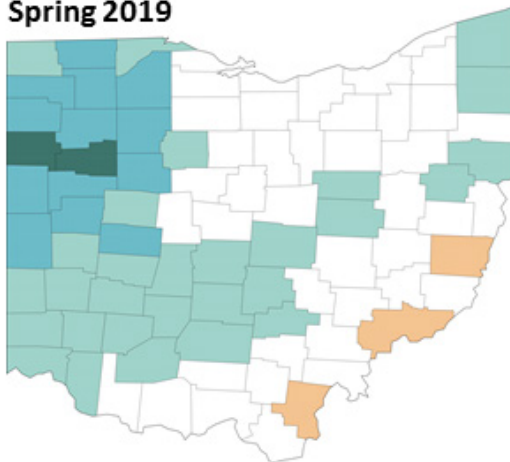
Autumn 2018



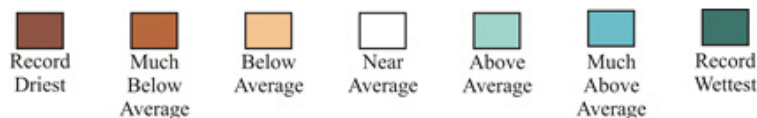
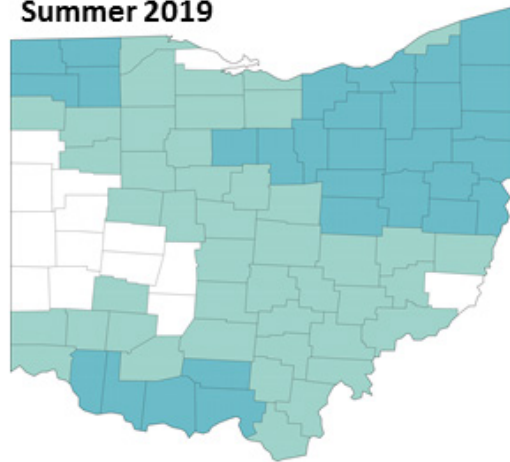
Winter 2019



Spring 2019



Summer 2019

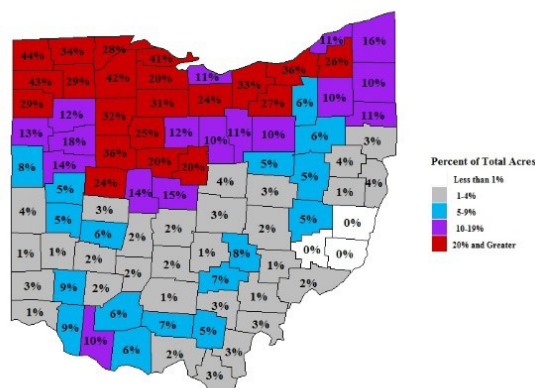


Data Source: NOAA National Centers for Environmental Information, *State of the Climate: National Climate Report* (<https://www.ncdc.noaa.gov/sotc/>).

Out of this tremendous need and at the discretion of Cathann A. Kress, The Ohio State University Vice President for Agricultural Administration and Dean of the university's College of Food, Agricultural, and Environmental Sciences (CFAES), the Ag Crisis Task Force (go.osu.edu/agcrisis) was convened. The task force comprises CFAES experts who can connect farmers, producers, and their families with Ohio State University Extension specialists or specialists within the community to offer the best science-based recommendations for and solutions to current issues.

Whether it is adapting to varied environmental conditions, changing insurance policies, navigating new tax laws, or understanding the U.S. trade policy's impact on agriculture, CFAES encourages farmers and producers to #LeanOnYourLandGrant.

Share of Acres Prevented from Planting- Ohio
All Crops, 2019



Data Source: Author Calculation using USDA Farm Service Agency Data

CHALLENGING TIMES FOR OHIO'S FARMERS

Steady rains and delayed harvests from autumn 2018 through winter 2019 threatened feed quality and quantity for Ohio's beef, dairy, poultry, and other livestock.

- Feed quality and quantity was highly variable going into spring 2019, and rain and below-normal temperatures continued to affect crops statewide.
- This further impacted the availability of high-quality feed. The first and, in some regions, the second cutting of hay was lost.
- Delayed corn and soybean planting past the insurance preventative planting date threatened grain supplies.
- Dairy farmers faced a fifth consecutive year of depressed milk prices while the cost of feeding their cows kept rising.
- Ohio's expected corn yield is down 27 bushels from last year to 160 bushels per acre, according to the U.S. Department of Agriculture. Total production is forecast at 414 million bushels. If realized, this will be the lowest Ohio corn production since 2008.
- Ohio soybean production is expected to total 205 million bushels, down 27% from last year, according to the USDA. The yield is forecast at 48 bushels per acre, down 8 bushels from last year. If realized, Ohio soybean production will be the lowest since 2008.

RESPONDING TO THOSE CHALLENGES

The Ag Crisis Task Force developed a webpage (go.osu.edu/agcrisis) as a one-stop resource that links all CFAES team websites into one portal where farmers and producers can quickly find answers to their emerging questions. On the webpage, resources are available for:

- farmers of grain and feed
- livestock, dairy, and forage producers
- grape, fruit, and vegetable growers
- digital agriculture

TOOLS OF THE TRADE

Ag Crisis Webpage

This one-stop resource features numerous CFAES team websites in one portal where farmers and producers can quickly find answers for questions emerging from new challenges one may be facing.



go.osu.edu/agcrisis

PROJECT CONTACT

For inquiries about this project, contact Anne Dorrance (dorrance.1@osu.edu), Andy Londo (londo.2@osu.edu), or Elizabeth Hawkins (hawkins.301@osu.edu).

Ohio Farm Business Analysis

OBJECTIVE

Help Ohio's farm families achieve financial success in today's challenging marketplace.



Ohio Farm Business Analysis

OSU Extension
Mahoning County

STUDY INFORMATION

In 2019, 47 farms with 43,456 crop acres completed an analysis for their farm as part of the 2018 Ohio Farm Business Analysis and Benchmarking Program. These farms provided detailed financial and production data to complete a whole farm analysis. 39 of the farms also completed an enterprise analysis for their crop enterprises. Farms ranged in size from 55 crop acres to more than 4,600 crop acres. The ten largest farms farmed an average of 2,300 acres each.

The 2018 summary contains enterprise reports for corn harvested as dry shelled corn and corn silage, soybeans, winter wheat harvested as grain, alfalfa hay, mixed hay, and small grain double crops harvested as silage. Results are reported by land tenure for owned acres and for cash rented acres. While there are some share rented acres, there are not enough to generate individual reports.

Find the full Crop Enterprise Report under the "Farm Profitability" tab at: farmoffice.osu.edu.



Shaded counties indicate farms participating in analysis.

STUDY DESIGN

A complete farm business analysis provides:

- Balance Sheets, cost and market
- Enterprise Analysis
- Income Statement, accrual adjusted
- Cost of Production
- Statement of Cash Flows
- per acre, per bushel, or per ton

Corn 2018; Cash Rented Land

Benchmark Report, 29 Enterprises

RankEm

	Group Median	Count	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Yield per acre (bu.)	182.97	29	117.76	150.36	157.94	163.86	176.00	183.29	189.29	193.36	212.87	256.00
Value per unit	3.55	29	3.18	3.43	3.50	3.50	3.54	3.56	3.64	3.79	3.79	3.98
Total product value	662.51	29	423.18	488.71	552.78	578.34	641.67	671.23	688.14	717.03	767.64	972.79
Crop insurance	0.00	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other crop income	1.34	14	0.87	0.89	1.00	1.12	1.28	1.57	1.92	2.28	6.91	101.05
Gross return	677.05	29	423.82	534.29	569.86	616.87	662.51	681.75	693.22	717.92	769.55	974.08
Seed and plants	93.34	28	148.64	148.64	143.41	109.38	94.19	92.55	79.71	70.37	65.74	55.78
Fertilizer	113.30	28	231.04	185.15	162.54	139.35	118.75	103.40	88.02	83.40	57.31	46.79
Crop chemicals	54.67	27	107.29	88.22	71.95	71.95	61.47	54.41	41.04	37.41	32.66	14.38
Crop insurance	13.00	21	54.68	29.33	18.57	17.36	14.66	11.97	10.80	7.30	4.37	0.76
Fuel & oil	33.12	29	73.33	62.35	36.21	36.21	33.30	32.71	30.55	27.39	24.84	12.14
Repairs	49.12	28	99.30	91.29	55.36	51.95	51.95	44.51	42.19	29.92	23.40	15.88
Custom hire	34.41	23	132.84	103.01	73.71	56.47	40.64	34.38	20.99	14.76	12.16	3.93
Land rent	137.00	29	252.60	200.48	180.64	166.94	153.94	135.70	104.85	95.94	77.78	43.74
Operating interest	7.22	24	30.49	30.49	25.92	14.88	8.94	5.60	4.15	3.69	1.74	0.57
Miscellaneous	1.83	20	16.50	9.93	7.23	4.37	2.29	1.51	1.43	1.43	1.08	0.15
Total direct expenses	592.87	29	887.19	776.78	678.38	662.66	601.58	591.28	556.54	492.47	454.40	305.19
Return over direct expenses	91.18	29	-255.31	-104.84	-50.55	52.39	84.19	97.21	151.14	198.43	226.48	282.42

OBSERVATIONS

The cost of production for corn and soybeans on owned and cash rented ground in Ohio for 2018 including averages for all farms, and averages of the high 20% sorted by net return per acre are shown below.

When data for more than 16 entities is available, the enterprise summary includes the average for all farms, and the average for the high 20% of farms based on net return per acre. When data from 12 or more farms is available, a benchmark report is also generated by crop and land tenure (owned or cash rented). Combined benchmark reports are included for corn, corn silage, soybeans, wheat and small grain silage.

Over time, net returns must be sufficient to provide a return to operator labor and management, cover principal payments, income tax liabilities, and provide for reinvestment in the business.

SUMMARY

- Average net returns for corn were positive in 2018, and while low, were considerably improved from 2017's negative returns. Half of the corn enterprises generated positive net returns. 14 farms generated more than \$100 per acre, averaging \$160 per acre.
- Average net returns for soybean enterprises were all greater than \$100, with 39 of 48 enterprises generating positive net returns. Net returns for the highest 25 enterprises ranged from \$99 to nearly \$300 per acre.
- All Ohio farms are encouraged to complete an analysis of 2019, even though it was not a "normal" year for many Ohio farms. Analyses are completed January through May, the earlier the better.

RESULTS

CORN	Owned Land	Rented Land - Avg.	Rented Land - High 20%
Per Acre, \$			
Direct Cost	468	574	466
Direct and Overhead Cost	653	688	572
Net Return	9.63	5.81	176.01
Per Bushel, \$			
Direct Cost	2.55	3.01	2.24
Direct and Overhead Cost	3.56	3.61	2.75
Average Yield	183.2	190.9	207.6
Value/Bushel	3.59	3.60	3.55

SOYBEANS	Owned Land	Owned Land - High 20%	Rented Land - Avg.	Rented Land - High 20%
Per Acre, \$				
Direct Cost	267	239	377	312
Direct and Overhead Cost	423	369	444	377
Net Return	124	248	110	239
Per Bushel, \$				
Direct Cost	4.99	4.14	6.89	5.47
Direct and Overhead Cost	7.90	6.38	8.11	6.61
Average Yield	53.6	57.8	54.7	57.0
Value/Bushel	8.95	9.06	8.85	8.94

TOOLS OF THE TRADE

2018 Ohio Farm Business Summary

A complete farm business analysis monitors profitability, working capital and net worth change. Enterprise Analysis gives you cost of production data to make the best-informed marketing and management decisions. Personalized benchmark reports identify opportunities to increase profitability.



go.osu.edu/FBA2018

PROJECT CONTACT

For inquiries about this project, contact Dianne Shoemaker (shoemaker.3@osu.edu) or Haley Shoemaker (shoemaker.306@osu.edu).

Ohio Crop Enterprise Budgets

What are Enterprise Budgets?

Enterprise Budgets have been developed by faculty of the College of Food, Agricultural, and Environmental Sciences for several decades. The 2019 Ohio Crop Enterprise Budgets were developed by Barry Ward, Leader, Production Business Management at Ohio State. The budgets are tools that growers can use to examine different scenarios on their operation to help in decision making. The Enterprise Budgets can be found on Excel spreadsheets that users can download. Growers can then input their own production and price levels to calculate their own outputs. As seen below, the budgets have color coded cells that will allow users to plug in their own numbers and calculate bottom lines for different scenarios.

ITEM	EXPLANATION			YOUR PROD. NUMBERS	PRICE PER UNIT	YIELD (bu/A) ¹			YOUR BUDGET	
						136	170	204	210	
RECEIPTS										
Corn ¹					\$3.70	/bu	503.94	629.74	755.54	777.00
ARC/PLC Payment ²							0.00	0.00	0.00	0.00
Crop Insurance Indemnity							0.00	0.00	0.00	0.00
MFP							0.00	0.00	0.00	0.00
TOTAL RECEIPTS						503.94	629.74	755.54	777.00	
VARIABLE COSTS										
Seed (kernels) ³	28000	32000	34000	34000	\$3.38	/1000	94.50	108.00	114.75	114.75
	Seed Cost Per Bag				\$270.00	/bag				
Fertilizer ⁴										
Starter Fertilizer							0.00	0.00	0.00	0.00
N (lbs.)	128.2	174.5	220.7	228.6	0.34	/lb	53.00	68.51	84.02	86.66
P ₂ O ₅ (lbs)	46.3	57.9	69.4	71.4	0.45	/lb	20.93	26.15	31.38	32.27
K ₂ O(lbs)	25.9	32.3	38.8	39.9	0.31	/lb	7.98	9.97	11.96	12.30
Lime(ton)		0.25		0.25	25	/ton	6.25	6.25	6.25	6.25
Chemicals ⁵	Herbicide						46.22	46.22	46.22	46.22
	Fungicide						0.00	0.00	0.00	0.00
	Insecticide						0.00	0.00	0.00	0.00
Drying ⁶	18.0	% moisture at harvest		0.041	/cent/bu/point		16.75	20.93	25.12	25.83
Hauling ⁷	\$0.172	/per bushel		30	miles		23.43	29.27	35.12	36.12
Fuel, Oil, Grease ⁸							13.75	13.75	13.75	13.75
Repairs ⁹							25.54	25.54	25.54	25.54
Crop Insurance ¹⁰							12.00	14.00	15.00	15.00
Miscellaneous ¹¹							5.10	5.10	5.10	5.10
Hired Custom Work ¹²							20.00	20.00	20.00	20.00
Hired Labor ¹³							0.00	0.00	0.00	0.00
Int. on Oper. Cap. ¹⁴		7	mo.		5.50%		9.41	10.57	11.52	11.64
TOTAL VARIABLE COSTS			-Per Acre				354.86	404.27	445.72	451.43
			-Per Bushel				2.61	2.38	2.18	2.15
FIXED COSTS										
Labor Charge ¹⁵	2.5	hours			15.00	/hr	37.50	37.50	37.50	37.50
Management Charge ¹⁶	5%	of gross revenue					25.20	31.49	37.78	38.85
Mach. And Equip. Charge ¹⁷							75.22	75.22	75.22	75.22
Land Charge ¹⁸		Rent					145.00	187.00	235.00	235.00
Miscellaneous ¹⁹							22.80	22.80	22.80	22.80
TOTAL FIXED COSTS							305.72	354.01	408.30	409.37
TOTAL COSTS			-Per Acre				660.57	758.28	854.02	860.80
			-Per Bushel				4.85	4.46	4.18	4.10
RETURN ABOVE VARIABLE COSTS ²⁰							149.08	225.47	309.82	325.57
RETURN ABOVE VARIABLE AND LAND COSTS							4.08	38.47	74.82	90.57
RETURN ABOVE TOTAL COSTS							-156.63	-128.54	-98.48	-83.80
RETURN TO LAND							-11.63	58.46	136.52	151.20
RETURN TO LABOR AND MANAGEMENT							-93.94	-59.55	-23.20	-7.45
RETURN TO LAND, LABOR AND MANAGEMENT							51.06	127.45	211.80	227.55

Cell Color Key:

Gold: Values may be changed to assist in computing the "Your Budget" Column using macros embedded within the spreadsheet.

Light Blue: Values will be calculated for the user based on data entered. These cells may be input manually, but macros will be overwritten!

Gray: Values are stand-alone cells that require direct input from the user.

Key points to remember when utilizing the budget sheets:

- The budgets represent common, workable, combinations of inputs that can achieve a given output.
- Amounts of seed, types and quantities of fertilizer, chemicals, and other items reflect University recommendations and the experience of many Ohio farmers.
- The combinations of inputs and prices presented will not likely precisely reflect any given farm.
- In practice, actual costs will be higher or lower than shown. Thus the most important column is “Your Budget”.

Characteristics of an Enterprise Budget:

- Estimates the costs and returns expected for a single enterprise.
- Represents one combination (from among hundreds available) of inputs such as seed, chemicals, and fertilizer to produce some level of output.
- A written plan for a future course of action including estimated costs and returns for that particular enterprise.
- Provides a format and a basis for developing enterprise budgets appropriate for a given farm situation.

Things not implied by an Enterprise Budget:

- It is not the only combination of inputs that can be used to produce this crop.
- It does not imply that anyone whose costs are different from this must have incorrect data or poor records.
- It does not imply that all producers can achieve these costs and yields. Different soil types, different ways in which the soil has been utilized and cared for in the past, and different weather in a given season all can cause the actual results to vary greatly from what is presented.

Yield Levels

Three yields are provided in each budget sheet. The middle yield is the long term trend yield for Ohio. The other two yields are 20% lower and higher than the middle yield. These yields levels reflect differing yield potential.

Variable Costs

Seed, fertilizer, and chemical requirements are based on agronomists' recommendations. Fertilizer amounts vary by yield level to reflect crop removal, based on typical soil test values for P_2O_5 and K_2O . These quantities and prices can be changed to reflect your soil tests and local prices to provide a more accurate estimate of your costs of production.

Fixed Costs

Five items are included as fixed costs, some of which may or may not be fixed for a particular operation. These items include labor, management, machinery and equipment, land, and miscellaneous charges.

Costing Methods

The budgets report all costs including cash, depreciation, and opportunity costs. Cash costs likely include categories such as seed, fertilizer, and chemical costs. Depreciation on machinery is included in the “Machinery and Equipment Charge.” Some items may contain opportunity costs, which reflect returns to a producer's labor, capital, and managerial resources. Opportunity costs should be included in budgeting because they account for the use of a producer's resources.

Pricing Methods

Prices for crops and inputs reflect estimates for the given year. Crop prices are estimates of harvest prices. No costs are included for grain storage. If an improved price is achieved by your farm due to storage or marketing strategies, then any increased costs to achieve that price should either be netted out of returns or added to costs.

Interpretation of Returns

All budgets report “return above variable costs” and “return above total costs”. Return above variable costs is useful in examining decisions that must be made within a year. Return above total costs would be used to examine “long-run” decisions.

ENTERPRISE BUDGETS

You can access the Ohio Crop Enterprise Budgets by visiting go.osu.edu/enterprise-budgets or by using the QR code to visit the site.

**PROJECT CONTACT**

For inquiries about this information, contact Barry Ward (ward.8@osu.edu).

Ohio Farm Custom Rates

Custom work is common in farming, especially for tasks that require specialized equipment or expert knowledge of that task. Barry Ward, Leader, Production Business Management, and John Barker, Extension Educator, worked together to develop the 2018 Ohio Farm Custom Rates. This publication provides an extensive list of average custom rates that were derived from a statewide survey of 352 farmers, custom operators, farm managers, and landowners. The Ohio Farm Custom Rates publication is a resource you can use on your operation as a reference in your economic analyses. All the provided rates (except where noted) include the implement and tractor if required, all variable machinery costs such as fuel, oil, lube, twine, etc., and the labor for the operation.

Some of the custom rates provided in the publication vary widely, due to the following variables:

- Type or size of equipment used
- Size and shape of fields
- Condition of the crop
- Skill level of labor
- Amount of labor needed in relation to the equipment capabilities
- Cost margin differences for full-time custom operators compared to farmers supplementing current income



The custom rates provided in the publication summarize the survey respondents. The reported numbers are the average (or mean), standard deviation, median, minimum, maximum, and range. Average custom rates are a simple average of all survey responses. As a custom provider, the average rates reported in this publication may not cover your total costs for performing the custom service. As a customer, you may not be able to hire a custom service for the average rate noted in this fact sheet. Calculate your own costs carefully before determining the rate to charge or pay. The data from this survey are intended to show a representative farming industry cost for specified machines and operations in Ohio. The Ohio Farm Custom Rates publication includes other resources that can help you calculate and consider the total costs of performing a given machinery operation.

The eFields nitrogen studies utilize the Ohio Farm Custom Rates to calculate return above total N. As you read through our nitrogen studies, you can reference these rates to better understand our calculations. Below is a sample of how we utilize these rates for our return above N calculations. The treatment data below is from the 2018 eFields Late Season Nitrogen study. The total nitrogen rate and yield were inputted in the Nitrogen Timing Calculator that is found in a downloadable Excel file at go.osu.edu/econcalculator.

Treatment: Rate 1

V2/V3 Application (lbs N/ac)	160
Late Application (lbs N/ac)	N/A
Total Application (lbs N/ac)	160
NDVI	0.84
Moisture (%)	17.8
Yield (bu/ac)	218

Nitrogen Timing Calculator

Total Nitrogen Rate in lbs/ac	160
Cost of N/lb	0.305
Total N Cost	48.80
Cost of Application in \$/ac	13.20
Yield	218
Price/bu	3.50
Gross Income	763
Return Above N (\$/ac)	714.2

In this example the "Late Season N Application - Coulters/ Acre" rate of \$13.20 was used to calculate the return above N. After inputting the application rate, yield, and total N rate into the calculator, the Return Above N for this treatment is \$714.20 per acre.

Below are various custom rates found in the Ohio Farm Custom Rates publication. Utilizing these rates can help you with decision making on your farm. See the full publication for rates not listed below.

Fertilizer Application - Ground	Avg	Std	Median	Max	Min	Range	
Dry Bulk / Acre	\$6.30	\$1.61	\$6.00	\$12.50	\$3.00	\$7.90	\$4.68
Liquid Knife / Acre	\$9.50	\$2.92	\$10.00	\$15.00	\$4.00	\$12.44	\$6.60
Liquid Spray / Acre	\$7.20	\$1.74	\$7.00	\$13.00	\$4.00	\$8.95	\$5.48
Anhydrous / Acre	\$13.70	\$5.74	\$13.78	\$36.00	\$5.00	\$19.42	\$7.94
Late Season N Application - Coulters / Acre	\$13.20	\$6.02	\$13.00	\$25.00	\$7.00	\$19.24	\$7.21
Late Season N Application - Drops / Acre	\$11.30	\$2.43	\$12.25	\$15.00	\$7.50	\$13.77	\$8.92
Variable Rate Fertilizer / Acre	\$7.90	\$2.67	\$7.00	\$20.00	\$3.50	\$10.55	\$5.22

Planting Operations - Conventional Till	Avg	Std	Median	Max	Min	Range	
Plant Corn 30" Rows / Acre	\$19.00	\$5.23	\$18.00	\$35.00	\$10.00	\$24.19	\$13.72
Plant Corn w/ Starter Fertilizer 30" Rows / Acre	\$19.30	\$5.03	\$19.10	\$35.00	\$6.00	\$24.31	\$14.25
Variable Rate Corn Planting / Acre	\$21.50	\$5.22	\$20.00	\$35.00	\$15.00	\$26.68	\$16.23
Plant Soybeans 15" or 30" Rows / Acre	\$18.50	\$3.45	\$18.50	\$30.00	\$10.00	\$21.92	\$15.02
Variable Rate Soybean Planting / Acre	\$20.60	\$3.39	\$20.00	\$26.00	\$16.00	\$23.97	\$17.19
Drill Soybeans / Acre	\$17.00	\$3.68	\$17.00	\$25.00	\$10.00	\$20.65	\$13.30
Drill Small Grains / Acre	\$15.90	\$4.28	\$16.75	\$23.00	\$5.00	\$20.20	\$11.64

Planting Operations - No-Till	Avg	Std	Median	Max	Min	Range	
Plant Corn 30" Rows / Acre	\$20.20	\$5.04	\$19.00	\$32.00	\$14.00	\$25.23	\$15.15
Plant Corn w/ Starter Fertilizer 30" Rows / Acre	\$20.50	\$4.94	\$20.00	\$35.00	\$6.00	\$25.39	\$15.50
Variable Rate Corn Planting / Acre	\$21.50	\$4.49	\$22.00	\$32.00	\$14.00	\$26.01	\$17.04
Plant Soybeans 15" or 30" Rows / Acre	\$18.70	\$3.60	\$19.75	\$26.00	\$10.00	\$22.31	\$15.12
Variable Rate Soybean Planting / Acre	\$20.70	\$4.34	\$22.00	\$27.00	\$10.00	\$25.04	\$16.36
Drill Soybeans / Acre	\$17.00	\$4.28	\$16.70	\$34.00	\$9.00	\$21.28	\$12.71
Drill Small Grains / Acre	\$16.60	\$4.95	\$15.00	\$36.00	\$8.50	\$21.49	\$11.60

ENTERPRISE BUDGETS

You can access the Ohio Farm Custom Rates by visiting go.osu.edu/customfarmrates or by using the QR code to visit the site.



PROJECT CONTACT

For inquiries about this information, contact Barry Ward (ward.8@osu.edu).

Farm Bill Update

The Agricultural Improvement Act of 2018 (The 2018 Farm Bill)

Signed into law December 20, 2018, The 2018 Farm Bill reauthorized many of the programs Ohio's agricultural producers have leaned on in the past for conservation implementation, marketing assistance loans, farm income support, dairy margin protection, crop insurance and many other programs. New to the 2018 Farm Bill were provisions to ramp up defense and prevention of animal diseases threatening the nation's livestock herds, increased funding for trade programs utilized by state and national commodity groups and several provisions related to new and beginning farmers, soil health, and good farming practices. The 2018 Farm Bill strengthened the federal dairy program by increasing coverage options under the Dairy Margin Coverage (DMC) Program and reducing producer paid premiums. Crop producers have the same suite of program as The 2014 Farm Bill- only instead of making one decision for all five years, The 2018 Farm Bill increases flexibility and risk protection by allowing a two year enrollment in 2019 and then annual enrollment starting in 2021. The 2018 Farm Bill sunsets in 2023.



eFields Collaborating Farm

OSU Extension

Statewide

Reviewing the 2014 Farm Bill- Agricultural Risk Coverage and Price Loss Coverage Elections

The 2014 Farm Bill authorized two commodity programs: the Agricultural Risk Coverage Program (ARC) and the Price Loss Coverage Program (PLC). The ARC program was available at the county and individual yield levels: ARC-Individual (ARC-IC) and ARC-County (ARC-CO). Producers were given a one-time election into the program or automatically defaulted into PLC. Ohio participation in all three programs is included in Table 1-the majority of Ohio's producers elected ARC-CO for corn, soybeans and wheat. Data provided by the Farm Service Agency (FSA).

Table 1. Ohio Election 2014-2018	ARC-CO	ARC-IC	PLC
Corn	98%	Less than 0.5%	2%
Soybeans	97%	Less than 0.5%	3%
Wheat	85%	Less than 0.5%	14%

Producers indicated through cross sectional surveys that there were several considerations when making program elections between 2014 and 2015, but the most frequent response was expected relative payments between the programs at the date of election. The ARC program sets a historical benchmark using an Olympic average of revenues from the five prior years and then triggers when the current year revenue falls below 86% of that historical benchmark. High prices witnessed early in the decade propped up the historical benchmarks for corn and soybeans making it likely that ARC-CO would trigger relatively large payment during the first couple years and then relatively small payments or nothing during the last couple of years. For all of Ohio's 88 counties that pattern was realized as prices declined throughout the period. Figure 1 illustrates counties where ARC-CO paid out more than PLC over the five year decision in red and counties where PLC paid out more than ARC-CO in purple. Soybean price did not fall low enough in any year to trigger a PLC payment. However, wheat prices fell below the \$5.50/bu. reference price every year except for 2014 at \$5.99/ bu. creating a higher relative payment for PLC over the five year period. It is likely Ohio producers were confident in ARC-CO for corn and soybeans and chose the same program for wheat.

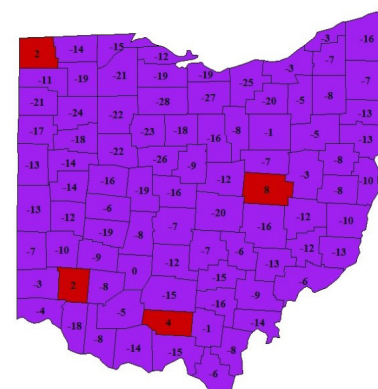
ARC-CO minus PLC Payments-Ohio Corn, 2014-2018 Rounded to the Nearest Dollar



ARC-CO minus PLC Payments-Ohio Soybeans, 2014-2018 Rounded to the Nearest Dollar



ARC-CO minus PLC Payments-Ohio Wheat, 2014-2018 Rounded to the Nearest Dollar



Looking at Decisions Now and in the Future

While the 2018 Farm Bill reauthorized the same two programs for crop producers- ARC for current revenue caused either by low yields or low prices compared to a historical benchmark and PLC for current prices below a set reference price -there are a couple changes producers need to be aware of in relation to ARC and PLC:

1. Historical yields for ARC-CO are trend adjusted similar to crop insurance, but ARC-IC historical yields are those reported.
2. County yield data is first received from the Risk Management Agency using crop insurance yields instead of the National Agricultural Statistics Service Survey Yields.
3. Reference price escalators exist for PLC, but higher commodity prices are needed to increase the reference price. Higher reference prices increase the probability of the current price falling below and triggering a payment.

Producers have until March 15, 2020 to elect ARC-CO, ARC-IC and PLC for program years 2019 and 2020; however, enrollment for program year 2020 extends to June 30, 2020. The extended enrollment for program year 2020 allows for those producers who make operational changes to their farms, but the election is still due March 15, 2020. Starting in program year 2021- producers will be allowed to make an annual election between October 1st and March 15th. The Ohio State University will provide update information each election period for producers, landowners and agribusinesses. There is a onetime update to PLC yields between October 1, 2019 and September 30, 2020. The PLC yield update is the landowner's decision and requires their signature on a FSA CCC-867 form. Higher PLC yields result in higher PLC payments if the program triggers in any given year and the producer as elected PLC for that commodity and operations.

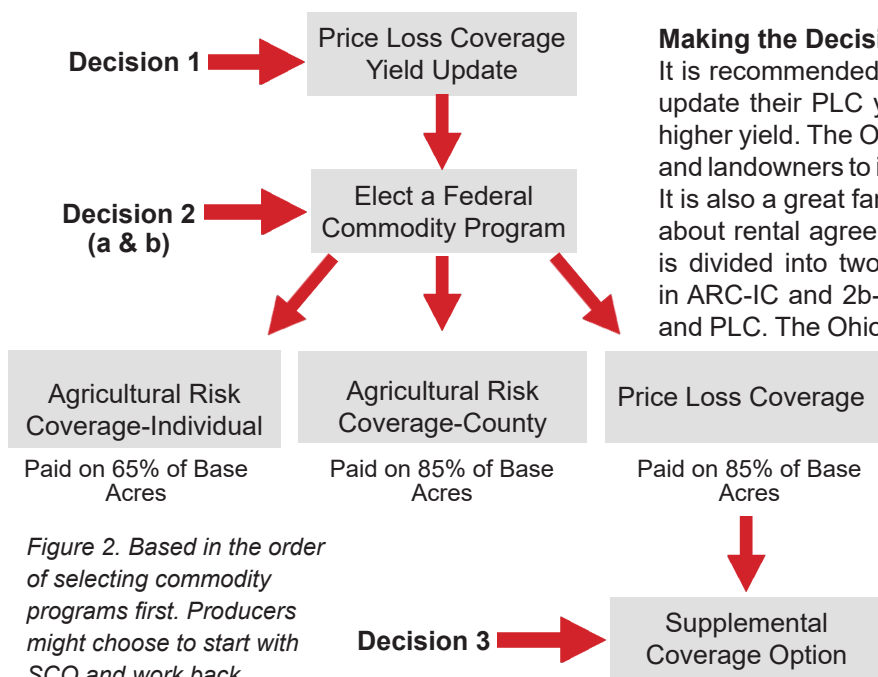


Figure 2. Based in the order of selecting commodity programs first. Producers might choose to start with SCO and work back.

Making the Decision

It is recommended that producers work with their landowners to first update their PLC yields on file with (FSA) if the update results in a higher yield. The Ohio State Farm Bill Decision tool- allows producers and landowners to input historical yields and evaluate the yield update. It is also a great farm management opportunity to visit with the owner about rental agreements and any future plans. The second decision is divided into two parts: 2a- do I want to put the entire operation in ARC-IC and 2b- if not ARC-IC then a decision between ARC-CO and PLC. The Ohio State Decision Tool assists in evaluation between the two. The third decision should be considered in coordination with the second decision as the Supplemental Coverage Option (SCO) available under the Federal Crop Insurance Cooperation, is only allowed when PLC is elected for a covered commodity. Providing an area band of coverage between a producer's individual yield or revenue insurance policy and 86%, an SCO policy can provide additional coverage for producers using crop insurance as a risk management tool.

The third decision should be considered in coordination with the second decision as the Supplemental Coverage Option (SCO) available under the Federal Crop Insurance Cooperation, is only allowed when PLC is elected for a covered commodity. Providing an area band of coverage between a producer's individual yield or revenue insurance policy and 86%, an SCO policy can provide additional coverage for producers using crop insurance as a risk management tool.

SUMMARY

The 2018 Farm Bill offers agricultural producers and landowners multiple decisions in 2019 including: PLC yield updates, ARC and PLC program election, SCO coverage, and coverage levels under DMC. Producers should visit with their landowner about PLC yield updates and elect a commodity program prior to March 15, 2020. Resources also available for dairy producers and agribusinesses.

PROJECT CONTACT

For questions about this information or other farm management related content, please contact Ben Brown (brown.6888@osu.edu).

WEATHER CONDITIONS CONTINUE TO AFFECT STORED GRAIN: A POTENTIAL FOR GRAIN ENGULFMENT



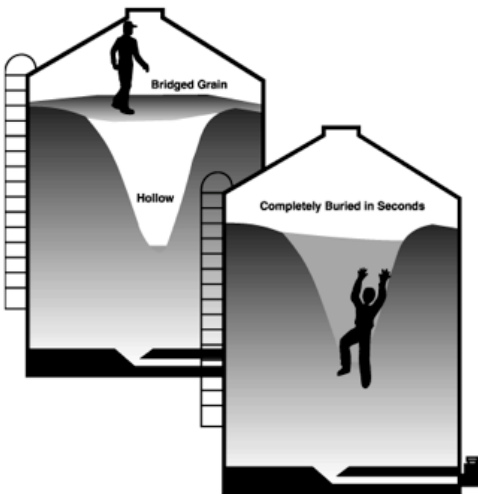
Department of Food, Agricultural
and Biological Engineering
Franklin County

Ohio farmers have had their challenges with the 2019 season. Late and wet planting, along with variable growing conditions throughout the summer, created a situation whereby grains were harvested at different stages of maturity and with higher moisture content. In some situations, grains were harder to dry or took longer to dry. Grain that goes into the bin with higher moisture content can freeze or bind, affecting grain flow efficiencies. Condensation during drying and storage processes can also create wet surfaces where bin fines accumulate. From these conditions, grain can become bridged or line the sidewall of the bin.

With such a wide variability of crop conditions, producers will need to monitor the crop condition and moisture test their product more frequently. During this time of increased attention on the crop, it is also important to establish best management practices for worker safety.

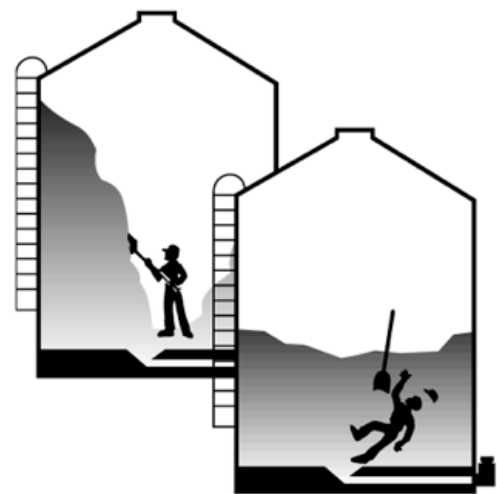
OUT OF CONDITION GRAIN CAN CAUSE DANGEROUS CONDITIONS

Both bridged grain and buildup of a vertical mass along the sidewall can create scenarios for potential engulfment.



Bridged Grain

Bridged grain is a condition where a hollow cavity is created under a crusted layer of grain. The surface over the cavity appears hard and can be extremely difficult to dislodge. The risk in this situation is for the entrant to fall when the grain is broken up, being buried under several feet of grain.



Collapse of a Vertical Mass

Grain can create a vertical mass along the sidewalls of the bin due to moisture, bin fines binding or poor grain quality. The risk for the entrant comes when the accumulated grain collapses like an avalanche around him or her.

SAFETY PROTOCOLS FOR BIN ENTRY

A no entry policy is the absolute best form of protection. Establish a culture of safety on the farm by training family and employees to follow safety protocols.

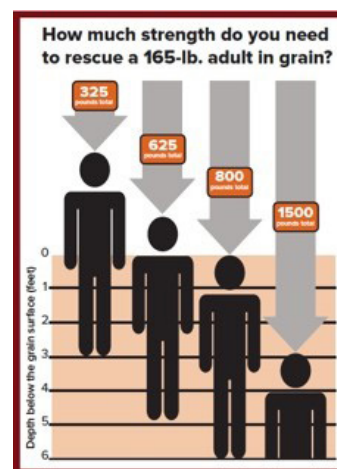
If entry must occur:

- Lockout any equipment that is associated with the bin being entered. Remove any potential for equipment to be started while a person is inside.
- Have an observer outside the bin and maintain constant visual communication during entry.
- Wear a harness and lifeline for fall protection.
- While completing tasks inside the bin always be aware of your surroundings and changing conditions.
- Do not by-pass or dismantle guards.
- Monitor the air quality in the bin.

RECOGNIZE ENGULFMENT HAZARDS OF GRAIN

It is not easy to pull a person out of grain. The rescuer needs to be able to pull the weight of the victim, plus the force of the grain surrounding the body, as shown in the figure at the right.

As grain encompasses the body, it exerts a force on the lungs and internal organs. When a person exhales, the grain fills in tighter around the chest. After each breath, lung capacity is diminished by compression from the grain. Eventually the body cannot move the grain away to maintain the necessary breathing rate to survive.



PREPLAN FOR SAFETY

Emergency Action Plans (EAPs) are an integral piece to saving time when incidents of entrapment or engulfment occur. Preplan so first responders can save crucial time.

- Know which fire departments in your area have been trained in grain bin rescue and where the nearest grain rescue tube is located.
- Invite the local fire department to your grain facilities to review your safety procedures.
- Create a map of the property. Number and label bins; also label fuel and electrical energy sources and other features of your facility.
- Store schematics of your bin system in a known location, with contact information for the vendor/installer.
- Post emergency numbers at the bin, including gas, electric, and other utility suppliers.

IN THE EVENT OF A GRAIN INCIDENT

Help expedite rescue:

- Turn off all augers.
- Call 9-1-1, then be ready to meet the rescue team and guide them to the emergency area.
- For victims engulfed inside a bin with an aeration blower, it is okay to turn on the air to increase ventilation; however, do not turn on any heat within the bin.
- Station someone at the bin entry to maintain visual and verbal communication.
- Remove any equipment that will create obstacles for rescue vehicles when they arrive. However, some equipment like front end loaders, skid loaders, and portable augers may be helpful and can be staged near the bin site.

SUMMARY

Proper management of stored grains is as much a science as it is an art. Sometimes even the best grain managers will find it difficult to prevent spoilage, hot spots, condensation on the top layer, and excessive fines. While it is possible to have a variety of changing conditions in stored grain, it is important to maintain a consistent safe entry approach to prevent injuries.

TOOLS OF THE TRADE

Safety Equipment for Bin Entry

- Wear a hard hat to protect against falling debris.
- Retrofit bins with load bearing fall protection systems.
- Wear a full body, 5-point harness attached to the fall protection or life line system.



PROGRAM CONTACT

For inquiries about Agricultural Safety and Health, contact Dee Jepsen (jepsen.4@osu.edu) or Lisa Pfeifer (pfeifer.6@osu.edu).



For 2019, eFields corn research was focused on improving the production and profitability of corn in the greater Ohio area. Some exciting and innovating projects were executed this year, with 36 unique studies being conducted across the state. 2019 eFields corn research investigated many of the topics listed in the eFields focus areas. Highlights include high speed planting, multi-hybrid planting, corn seeding rates, and many other innovative practices. Here is the 2019 eFields corn research by the numbers:

1,746 acres

36 of corn studies

For more corn research from The Ohio State University's Department of Extension, explore the following resources:

2019 Ohio Corn Performance Tests

The purpose of the Ohio Corn Performance Trials is to evaluate corn varieties for yield and other agronomic characteristics. This evaluation gives corn producers comparative information for selecting the best varieties for their unique production systems. For more information visit: go.osu.edu/corntrials.



Agronomic Crops Team - Corn Research

The Agronomic Crops Team performs interesting research studies on a yearly basis. Resources, fact sheets, and articles on corn research can be found here on the Agronomic Crops Team website: go.osu.edu/CropsTeamCorn.



The Ohio State Digital Ag Program

The Ohio State Digital Ag Program conducts studies related to all aspects of corn production. Research related to planting, inputs, and harvesting technology can be found on the Digital Ag website: digitalag.osu.edu.



Growth Stages - Corn

For all corn studies in this eFields report, we define corn growth stages as the following:

VE - Emergence - coleoptile is fully visible, yet no leaves are fully developed.

V1 - Full development of the first (flag) leaf, achieved when the collar of the leaf is fully visible.

VN - N fully developed leaves with collars visible.

VT - Tassels fully visible and silks will emerge in 2-3 days.

R1 - Silking - silks are visible and pollination begins.

R2 - Blister - silks darken and dry out, kernels are white and form a blister containing clear fluid.

R3 - Milk - kernels are yellow and clear fluid turns milky white as starch accumulates, kernels contain 80% moisture.

R4 - Dough - starchy liquid inside kernels has dough-like consistency, kernels contain 70% moisture and begin to dent at the top.

R5 - Dent - nearly all kernels are dented and contain about 55% moisture.

R6 - Black layer - physiological maturity is reached and kernels have attained maximum dry weight at 30-35% moisture.

Adapted from Stewart Seeds Corn and Soybean Growth Stages Guide, 2013.

Kernel fill during reproductive stages

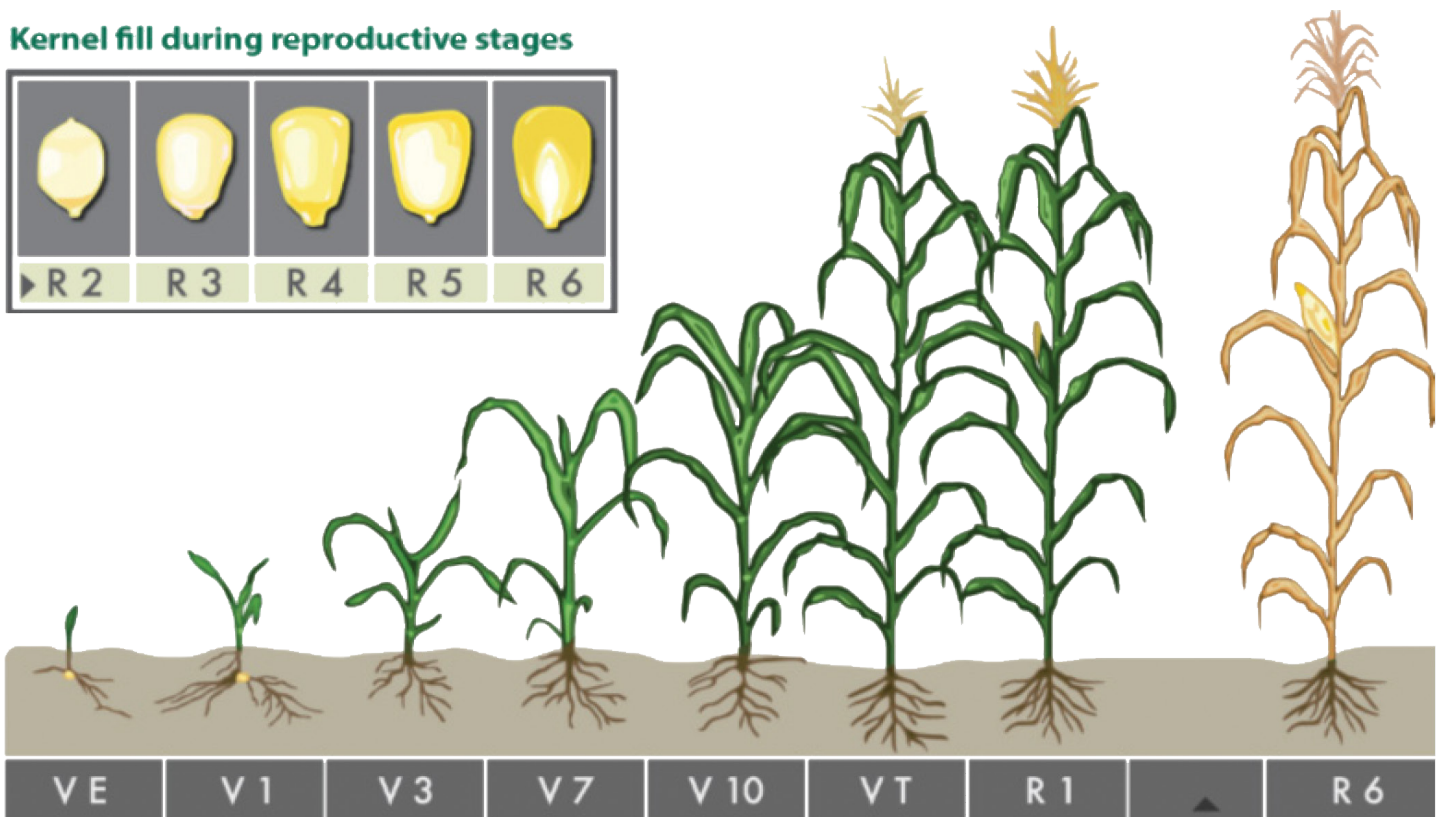


Image Source: University of Illinois Agronomy Guide, 1999.



OBJECTIVE

Measure the effects of foliar fungicide and its impacts on corn yield.



eFields Collaborating Farm

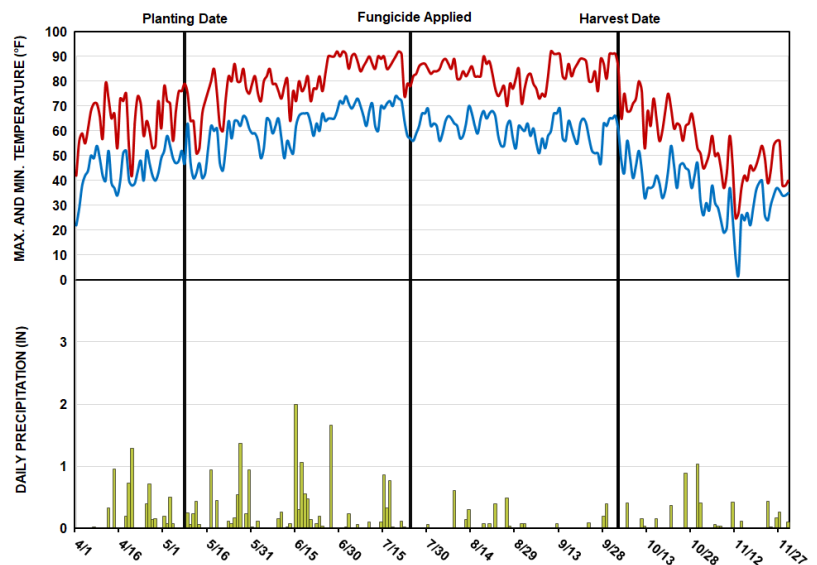
OSU Extension

Darke County

STUDY INFORMATION

Planting Date	5/8/2019
Harvest Date	10/3/2019
Hybrid	Becks 5140HR
Population	32,500
Acres	60
Treatments	2
Reps	3
Treatment Width	90 ft.
Tillage	No-Till
Management	Fertilizer, Fungicide, Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Crosby silt loam, 72% Celina silt loam, 15% Brookston silty clay loam, 13%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.98	6.78	7.13	2.70	2.20	0.82	24.61
Cumulative GDDs	209	653	1256	2057	2735	3354	3354

STUDY DESIGN

Experiment was a randomized block with three replications. Plots were 90 feet wide and field length. The center passes of the treatments were harvested for grain yield. The combine was calibrated in season. Fungicide Trivapro was applied at a rate of 13.7 oz per acre.



John Deere 4730 was used to make a late season application of Trivapro fungicide.

OBSERVATIONS

Gray leaf spot began to show at tassel and was significant at pollination. Heavy corn earworm pressure was observed across the field during a corn yield check the first week of August.



SUMMARY

- There was no significant difference at harvest in yield or moisture which may be a result of drought conditions late in the growing season that resulted in the crop dying before full maturity.



RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above (\$/ac)
No Foliar Fungicide	31,000	16.1	182 a	727
Foliar Fungicide	31,000	16.5	189 a	732
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 17.98 (NS) CV: 4.07%	

TOOLS OF THE TRADE

John Deere 4730

This high clearance sprayer (self-propelled) provides the capability to do a land application of a fungicide at VT reducing application costs to the grower.



PROJECT CONTACT

For inquiries about this project, contact Sam Custer (custer.2@osu.edu).



OBJECTIVE

Understand planter speed and its effects on emergence and corn yield.



eFields Collaborating Farm

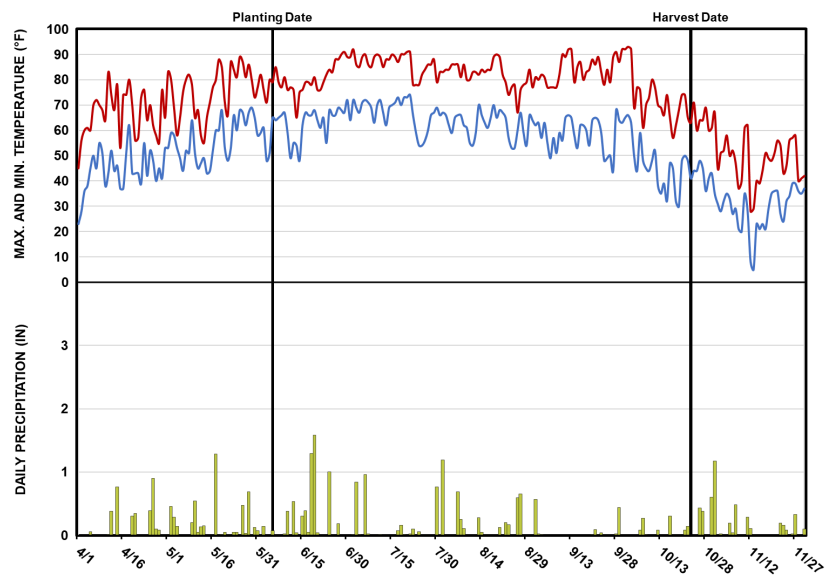
OSU Extension

Pickaway County

STUDY INFORMATION

Planting Date	6/5/2019
Harvest Date	10/23/19
Hybrid	6076SX
Population	36,000
Acres	86
Treatments	4
Reps	5
Treatment Width	40 ft.
Tillage	Minimal
Management	Fertilizer, Fungicide, Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Miamian silt loam, 60% Westland silty clay loam, 22% Eldean-Kendallville loams, 18%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.33	4.78	6.01	3.04	4.30	1.20	22.66
Cumulative GDDs	263	765	1390	2189	2873	3494	3494

STUDY DESIGN

High speed planter systems have become more common on modern planters. Some research has been done on the effect of speed with these new technologies on emergence and yield, but little research in Ohio. This study evaluates four speeds of planting in central Ohio and their effects on yield and emergence. Heavy downforce (150 lbs) was applied using a Precision Planting 20/20 SeedSense monitor via Delta Downforce.



Planting was conducted with a Case IH 2150 16-row planter with Precision Planting high speed technology components.

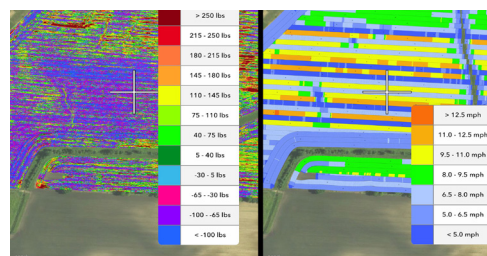
OBSERVATIONS

Spacing was not perfect on all speed treatments but consistent depth remained which is critical for even emergence. While planting conditions were less than ideal, consistent results were still shown in yield. Weather conditions after planting were extremely dry and hot, especially during pollination.



SUMMARY

- Stand counts confirm the yield results even at higher speeds, confirming that yield is not affected.
- There is a potential to put more money in the individual rows on a planter rather than putting more rows on the planter and achieve the same results.
- Similar trends have been observed in these yields over the last several years, increasing confidence in these findings.



RESULTS

Treatments (Speed MPH)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
5	25,830	21.9	200 a
7.5	27,560	22.1	201 a
10	28,000	22.1	201 a
12.5	27,200	21.8	196 b
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 3.99 CV: 1.77%

TOOLS OF THE TRADE

Precision Planting SpeedTube

Precision Planting's SpeedTube allows for increased speed and ensures spacing accuracy, while maximizing the planting window. The flighted belt "hand delivers seed to the furrow."



PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein (klopfenstein.34@osu.edu) or Ryan Tietje (tietje.4@osu.edu).

OBJECTIVE

To determine the impact of humic acid in starter fertilizer on corn yield.



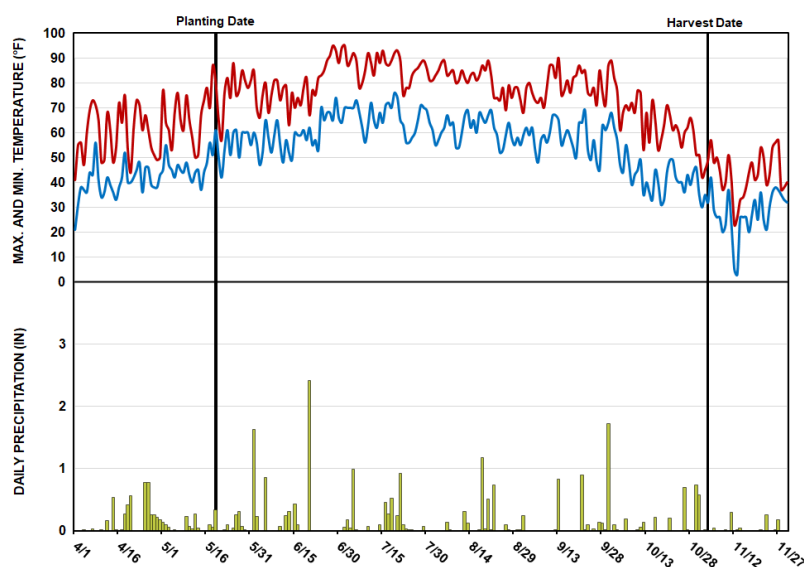
eFields Collaborating Farm

OSU Extension
Sandusky County

STUDY INFORMATION

Planting Date	5/19/2019
Harvest Date	11/3/2019
Hybrid	Pioneer P0506
Population	33,130
Acres	20
Treatments	2
Reps	4
Treatment Width	60 ft.
Tillage	Minimal
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Tedrow-Dixboro complex, 83% Colwood fine sandy loam, 10% Hoytville clay loam, 7%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.46	2.21	6.26	4.07	3.20	4.08	24.28
Cumulative GDDs	152	521	1074	1859	2502	3055	3055

STUDY DESIGN

This study evaluated the use of Dynahume humic acid in addition to the normal nitrogen starter fertilizer at the time of corn planting. DynaHume supplement is designed to form aggregates in soil to increase water infiltration, reduce drought stress - especially in poor soils - by increasing the water holding capacity of the soil, reduce nitrogen salt injury, and stabilize nitrogen, ultimately boosting yield and crop health. Yield data was collected at harvest on 4 replicated plots to compare yields of plots that received humic acid vs. those that did not. Nitrogen rates were equivalent on all reps in both treatments.



Demonstration of humic acid application with a Case IH 2150 16 row planter during planting.

OBSERVATIONS

There was no noticeable difference in the crop at emergence, nor throughout the growing season between the treated and untreated areas. There was no noticeable difference on the yield monitor at harvest.



SUMMARY

- No significant difference was noted in yield of the humic acid treated plots vs the non-treated plots.
- Additional replications in future years may be needed to validate the findings, but based on this study, humic acid had no impact on yield and would not be a sound input investment.



RESULTS

Treatments	Moisture (%)	Yield (bu/ac)
No Humic Acid	22	226 a
Humic Acid	22.2	226 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 2.25 (NS) CV: 0.60%

TOOLS OF THE TRADE

DynaHume

This humic acid supplement was added to the liquid starter fertilizer on the planter.



PROJECT CONTACT

For inquiries about this project, contact Al Gahler (gahler.2@osu.edu).



OBJECTIVE

To understand how soil moisture information can be used for scheduling pivot irrigation.



eFields Collaborating Farm

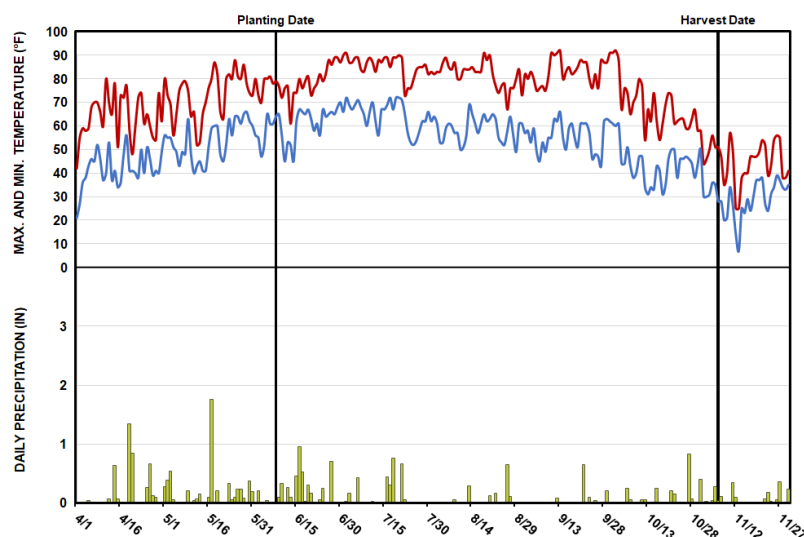
OSU Extension

Miami County

STUDY INFORMATION

Planting Date	5/16/19
Harvest Date	10/5/19
Hybrid	Ebberts 9121SSX
Population	28,000-44,000
Acres	111
Treatments	2
Reps	5
Treatment Width	60 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	15 in.
Soil Type	Eldean loam, 75% Westland silty clay loam, 15% Warsaw silt loam, 10%

WEATHER INFORMATION

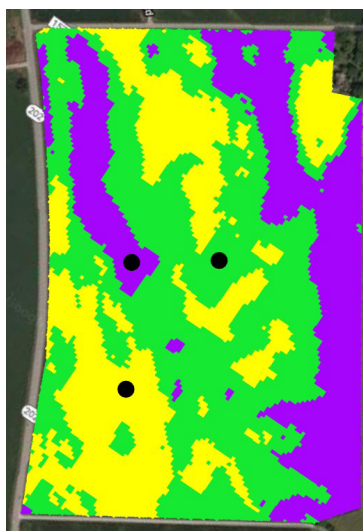


Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.31	5.35	5.45	2.16	4.70	0.88	22.85
Cumulative GDDs	163	634	1248	2024	2691	3299	3299

STUDY DESIGN

This study was conducted in a field with a center pivot and corn grown in 2019. The center pivot was equipped with a corner system to cover more area of the field. Three wireless soil moisture probes connected wirelessly to the internet were installed just after planting. Probes were positioned in each of three productivity or yield potential zones (high, medium and low) as illustrated in the figure. Each probe included a total of 9 sensor spaced 4 inches apart measuring soil moisture, temperature and salinity at each location. Daily data and graphs could be viewed using a mobile application that was used to monitor soil moisture within the soil profile plus schedule irrigation events. Yield monitor data was used to estimate final corn yield around each probe and compare irrigated and non-irrigated yields.



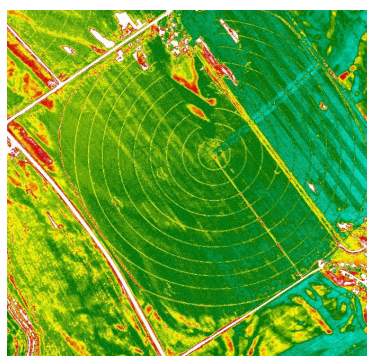
- Highest Productivity
- Medium Productivity
- Low Productivity

CPU - Crop Productivity Unit

As shown in the picture to the left, the black dots indicate the location of the moisture probes where data was collected.

OBSERVATIONS

The soil moisture and temperature probes provided key information during the growing season to schedule irrigation events in this field. Soil moisture varied between probes in terms of timing of measured changes from rain or irrigation events due to infiltration differences among the different soil characteristics at each probe. Though dry in late July and August, soil moisture was maintained to a level to minimize plant stress during the R growing stage. Irrigation events were scheduled through mid-September once black layer occurred.

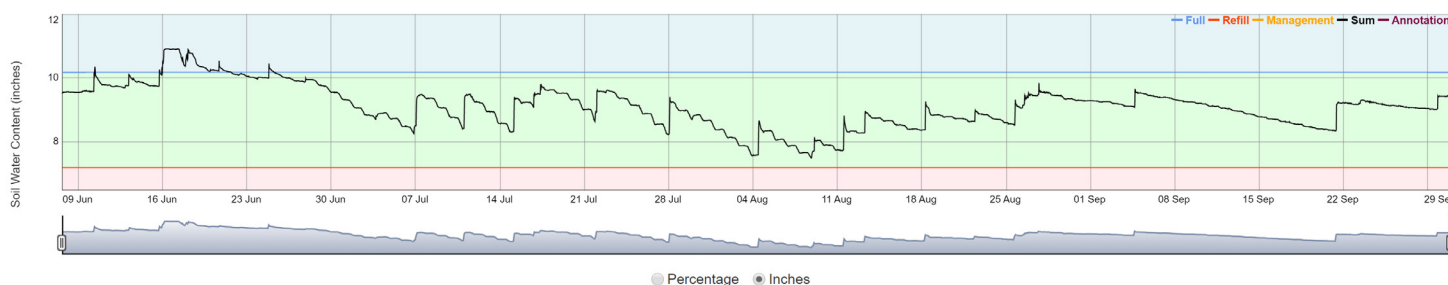


SUMMARY

- Grain yield and moisture were statistically different between irrigated and non-irrigated areas of the field. The average irrigated yield was 253 bu/ac whereas the non-irrigated yield of 86 bu/ac.
- The difference if irrigated versus non-irrigated yield was much greater in 2019 versus the 2018 corn study conducted in an adjacent and was contributed to the lack of rain during July and August when critical growth stages occurred.
- In general, irrigation was scheduled based on the current and predicted soil moisture levels among the three probes allowing the farm manager to be informed on when to start the pivot.

Treatments	Moisture (%)	Yield (bu/ac)
Irrigated	19.7	253 a
Non-irrigated	13.6	87 b
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 12.60 CV: 4.46%

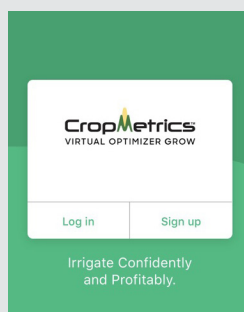
Soil Moisture Probe	Moisture (%)	Yield (bu/ac)
High Productivity (Purple)	20.3	261
Medium Productivity (Green)	18.4	249
Low Productivity (Yellow)	20.0	244



TOOLS OF THE TRADE

Crop Metrics Virtual Optimizer App

The crop metrics app combines multiple water management technologies such as moisture probe monitoring, pivot telemetry, weather data and forecasting, crop modeling, and irrigation record keeping into one powerful centralized location.



PROJECT CONTACT

For inquiries about this project, contact John Fulton (fulton.20@osu.edu).



OBJECTIVE

Determine the effects on yield of 15" in. and 30 in. row spacing with varying populations.



eFields Collaborating Farm

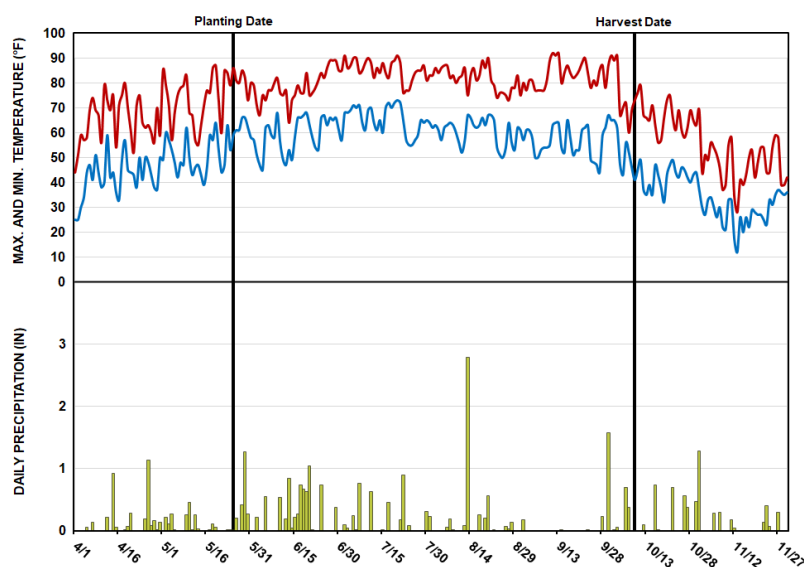
OSU Extension

Tuscarawas County

STUDY INFORMATION

Planting Date	5/25/2019
Harvest Date	10/9/2019
Hybrid	Pioneer 1197 AMXT RIB
Population	See Treatments
Acres	10
Treatments	4
Reps	3
Treatment Width	30 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Grass Cover Crop
Row Spacing	See Treatments
Soil Type	Glenford silt loam, 57% Orrville silt loam, 30% Coshocton-guernsey silt loams, 13%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.45	4.01	7.04	3.95	4.39	2.01	24.85
Cumulative GDDs	237	710	1273	2037	2685	3267	3267

STUDY DESIGN

In challenging years especially, corn plants can benefit from reduced competition. This study was designed to evaluate the potential yield benefits and compare row spacing and seeding rate combinations to determine the ideal pair.

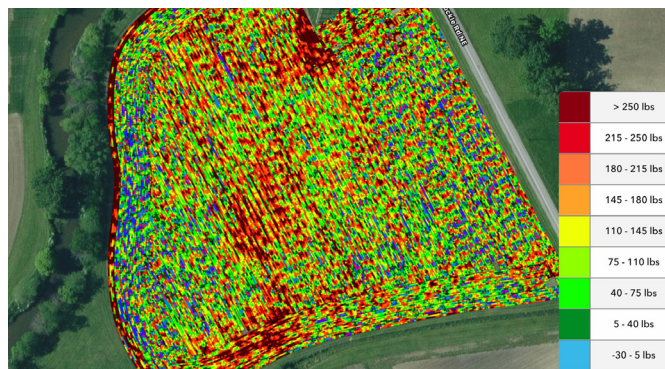
A complete block design was used in this study. The four treatments were 15 in. row low population at 16,200 seeds/acre (planted twice with a 30 in. planter), 15 in. row high population at 18,128 seeds/acre (planted twice with a 30 in. planter), 30 in. low populations at 32,400 seeds/acre, and 30 in. high population at 36,256 seeds/acre.



Four treatments were planted at various seeding rates and row spacings.

OBSERVATIONS

Regardless of population or row width, good standability was observed across the plot. The ears in the 30" rows appeared to be slightly smaller than those from the 15" rows. There was no observed difference in plant health between spacings or populations.



SUMMARY

- Based on the results of this plot, there were significant difference across the treatments.
- The 15 in. row high population plot resulted in the highest yield.
- Minimal differences in plant height were observed.



RESULTS

Treatments	Moisture (%)	Yield (bu/ac)
15" Low Population	15.0	214 b
15" High Population	15.0	229 a
30" Low Population	15.0	206 c
30" High Population	15.0	176 d
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 1.24 CV: 0.38%

TOOLS OF THE TRADE

Auto-Steer

Autosteer eliminated operator fatigue while making multiple passes through the field this season. Auto-Steer is a GPS guidance system that steers agricultural equipment with centimeter accuracy.



PROJECT CONTACT

For inquiries about this project, contact Chris Zoller (zoller.1@osu.edu).

OBJECTIVE

Develop a nitrogen decision strategy based on in-season information about the crop condition and nitrogen availability.



eFields Collaborating Farm

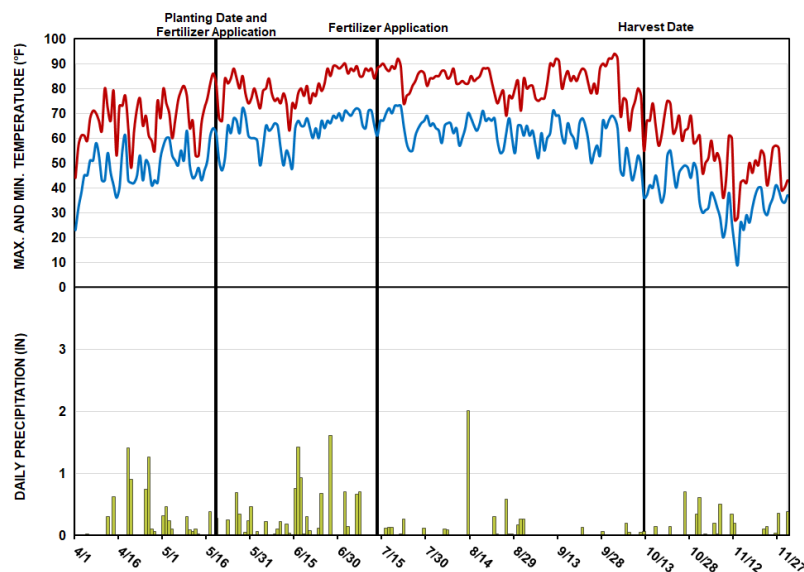
OSU Extension

Clinton County

STUDY INFORMATION

Planting Date	5/19/2019
Harvest Date	10/12/2019
Hybrid	Stewarts S660
Population	32,000
Acres	70
Treatments	7
Reps	4
Treatment Width	60 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Treaty silt clay loam, 56% Reesville silt loam, 44%

WEATHER INFORMATION

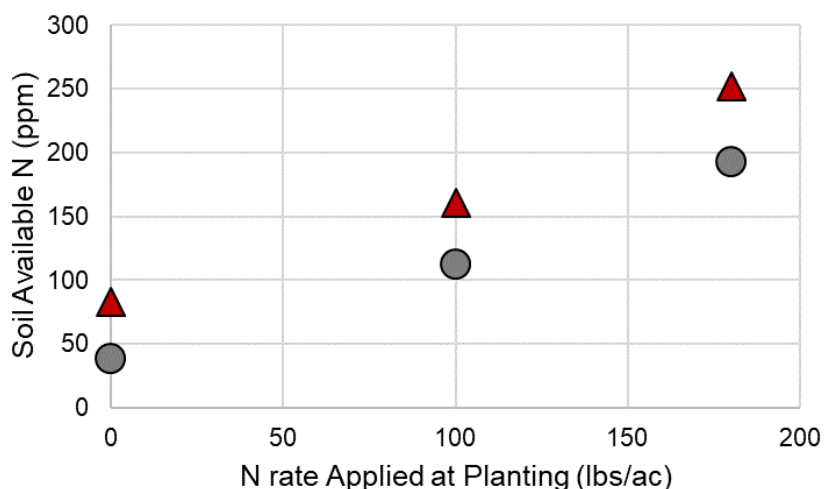


Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	5.48	4.44	6.83	3.05	3.61	0.48	23.89
Cumulative GDDs	257	753	1357	2160	2862	3520	3520

STUDY DESIGN

Nitrogen applications were planned for three timings in season: planting, V5, and/or V10. For the V5 and V10 timings, a base rate of 100 lbs N/ac was applied up front. Due to the excessive rainfall this site received in June, only one application pass was possible. No V5 applications were made. Six nitrogen rates were applied. Soil and tissue samples were collected to estimate the availability of nitrogen in the soil and determine if plant stress was occurring. All nitrogen was applied as UAN 32%.



OBSERVATIONS

This location received higher than normal rainfall in June and July and soil conditions were at or near saturation during those months. This led to a delay in the planned nitrogen applications, with no nitrogen applications made at V5. In August and September, the weather turned and it became very dry. The combination of challenging conditions across the season limited the yield potential for this field.

The soil samples generally showed higher nitrogen availability in areas where organic matter estimates were higher than 3%. However, areas of the field where water ponded showed reduced soil available nitrogen. Tissue samples collected at V5 showed all treatments exceeded the sufficiency level.

SUMMARY

- The heavy rains in the first half of the season led the the late season nitrogen applications out yielding the at planting application.
- A yield response was observed to nitrogen rate within the late season applications with yields increasing with higher rates.
- The organic matter estimates from the Precision Planting SmartFirmers were useful for identifying zones for soil sampling.



RESULTS

Treatments (lbs N/ac)	Moisture (%)	Yield (bu/ac)
180 lb/ac N at plant	18.0	149 d
40 lb/ac N late season	18.1	165 c
60 lb/ac N late season	18.3	174 c
80 lb/ac N late season	19.0	189 b
100 lb/ac N late season	19.2	194 ab
120 lb/ac N late season	19.2	201 a
140 lb/ac N late season	19.4	196 a
0 N	17.4	75 e
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 10.20 CV: 4.62%

TOOLS OF THE TRADE

Precision Planting FurrowForce

FurrowForce closes the furrow under all conditions and eliminates sidewall compaction. It provides row by row control of furrow closing to help manage closing quality under variable field conditions.



PROJECT CONTACT

For inquiries about this project, contact
Elizabeth Hawkins
(hawkins.301@osu.edu) or
Tony Nye (nye.1@osu.edu).

OBJECTIVE

Develop a nitrogen decision strategy based on in-season information about the crop condition and nitrogen availability.



eFields Collaborating Farm

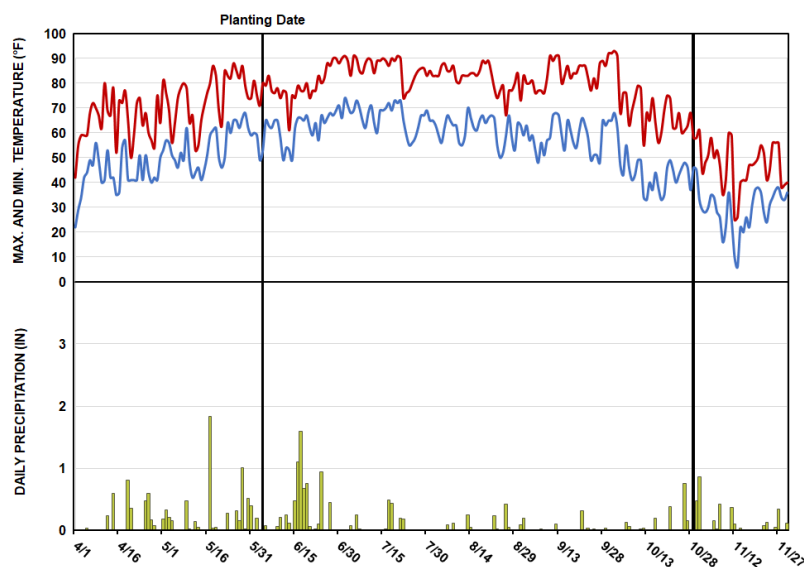
OSU Extension

Fayette County

STUDY INFORMATION

Planting Date	6/4/2019
Harvest Date	10/29/2019
Hybrid	SC10AGT96
Population	34,000
Acres	14
Treatments	5
Reps	4
Treatment Width	30 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Brookston silty clay loam, 73% Crosby silt loam, 27%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.36	6.22	7.10	1.66	1.35	0.72	20.41
Cumulative GDDs	238	706	1305	2097	2768	3386	3386

STUDY DESIGN

The study was originally designed to have an application at V5 - V7 and then another application at V10 - VT. But due to the time the plot was planted and the availability of equipment the study was modified to applying the entire rate of nitrogen at the V5 - V7 stage. The organic matter was determined at planting for <3% organic matter and >3% organic matter.



Soil samples were collected prior to nitrogen applications.

OBSERVATIONS

This location, as did the rest of Ohio, received above normal amount of precipitation in April and May which delayed planting until June 4, 2019. With the rain continuing throughout June the nitrogen applications were also delayed until July 16th. The Precision Planting SmartFirmer was utilized at planting to determine the organic matter. Soils with higher than 3% organic matter showed a slightly higher level of available nitrogen than the soils below 3% organic matter. However, both levels of organic matter were extremely low with no additional N applied at that point. At V5 the nitrogen application rates were applied but from that point drier weather became the pattern. However, the corn continued to grow and develop without showing signs of stress even in the hot days of August.

SUMMARY

- The yields in the plot showed a response to the amount of nitrogen applied. There was a lag in yield on the highest amount of nitrogen applied which would indicate a lack of moisture during the mid to late growing season.
- The return above N costs were consistent with the treatment yields. The dry weather in August and September could have changed the results.



RESULTS

Treatments (lbs N/ac)	Moisture (%)	Yield (bu/ac)	Return Above N (\$/ac)
0	16.7	132 c	540
50	16.1	148 b	587
100	16.7	160 b	617
150	17.0	165 a	619
200	18.0	176 a	646
250	16.5	168 a	595
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 12.18 CV: 5.92%	

TOOLS OF THE TRADE

Precision Planting SmartFirmer

The SmartFirmer enables on the go estimates of soil properties at planting. The estimates of soil organic matter were used to guide sampling for soil available nitrogen.



PROJECT CONTACT

For inquiries about this project, contact Ken Ford (ford.70@osu.edu) or Elizabeth Hawkins (hawkins.301@osu.edu).

OBJECTIVE

Consider multi-year data in management decisions, specifically by evaluating late season nitrogen placement methods to determine impact on corn yield.



eFields Collaborating Farm

OSU Extension

Clark County

STUDY DESIGN

This was a three year study investigating late season nitrogen placement at the Western Agricultural Research Station in Clark County, Ohio. These three placement methods are all currently available tools for late season nitrogen application. The studies were completed using a randomized complete block design with four replications each year. An upfront application of 28% UAN at 100lbs N/ac was provided as base to last until post-planting applications. A comparison to the standard farmer practice was achieved by applying 180 lbs N/ac pre-plant. The three late season placement treatments included an additional 8- lbs N/ac at the V10 growth stage.

The late season placement options were coulters-injected between each corn row, surface applied next to each row using the NutraBoss system, and finally a surface applied (center drop) in the center of each row.

SUMMARY

- Across all sites, the averages (bu/ac) were as follows: 210 for the standard practice, 220 for Coulter, 223 for Nutra-Boss, and 210 for center-drop.
- When combining the years, there was no statistical difference in yield or moisture for any of the treatments.

EXAMPLE FIELD LAYOUT

Proper experimental design is important to ensure the validity of the yield results at the end of the season. Plot replication and randomization make it possible for statistical analysis to account for the natural field variation that occurs. For this multi-year study, a minimum of three replications should be used and four replications are recommended. Plots should be randomized within each replication to eliminate bias due to plot order.



TOOLS OF THE TRADE

New Holland N Coulter Bar

This 36 ft late-season N coulters bar enables producers to put Nitrogen below the surface of the soil even at late growth stages. In this study, we used the bar to apply 28% UAN at the V10 growth stage.



PROJECT CONTACT

For inquiries about this project, contact John Fulton (fulton.20@osu.edu).

STUDY INFORMATION

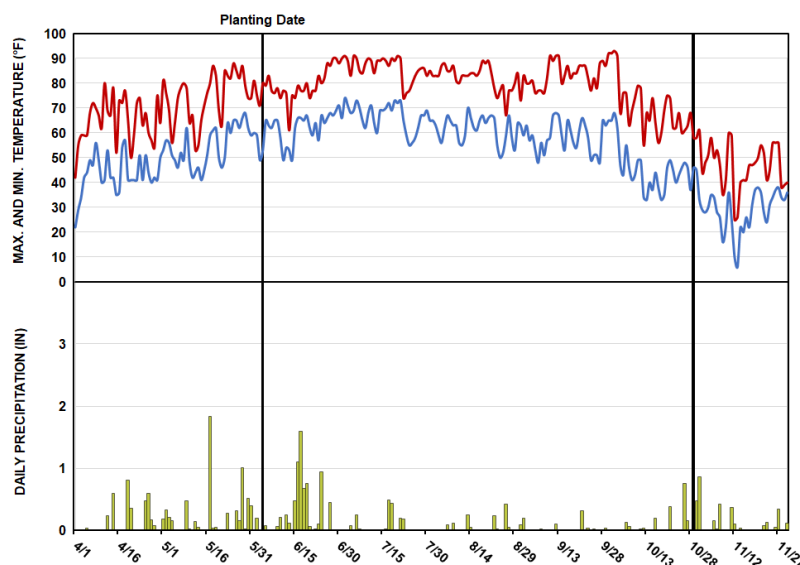
Planting Date	6/2/2016
Harvest Date	11/7/2016
Variety	Pioneer P0604 AM
Population	33,000
Acres	10
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Management	N/A
Previous Crop	Soybean
Row Spacing	30 in.
Soil Type	Strawn-crosby complex, 52% Kokomo silty clay, 48%



eFields Collaborating Farm

OSU Extension

Clark County



OBSERVATIONS

During the growing season, ample rain during the early growth stages provided a boost to growing crops. After the sidedress nitrogen application, a visual boost in crop vigor was observed equally for both the control (180 lb N) and the other treatments (100 lb N). This confirmed that there were no limiting factors in the crop prior to the late season application.

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	2.63	2.87	1.6	4.06	5.45	4.84	21.45
Cumulative GDDs	146	482	1163	1928	2704	3264	3264

SUMMARY

- The y-drop and late-season coulters treatments produced statistically significant higher yields when compared with the control and center of row treatments.
- Conditions after the late-season application were persistently dry. This could explain the lack of nitrogen uptake for the surface applied systems.

RESULTS

Treatments (Placement)	Planting Application (lbs N/ac)	V10 Application (lbs N/ac)	Moisture (%)	Yield (bu/ac)
Standard Practice	180	0	16.1	155 b
Coulter	100	80	15.8	181 a
Nutra-Boss	100	80	15.8	177 a
Center-drop	100	80	16.4	159 b
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 13.82 CV: 6.35%

STUDY INFORMATION

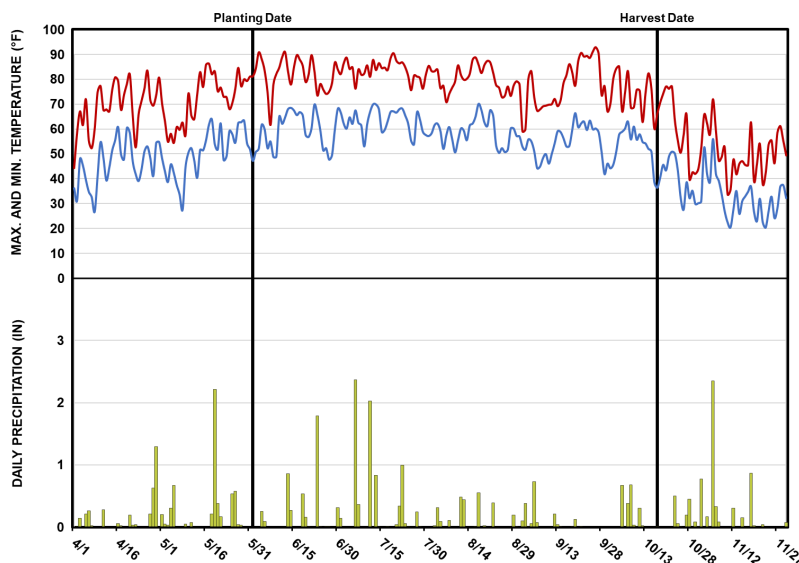
Planting Date	6/1/17
Harvest Date	10/17/17
Variety	P0825 AM
Population	34,000
Acres	10
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	No-Till
Management	N/A
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Kokomo silty clay, 48% Strawn-Crosby complex, 52%



eFields Collaborating Farm

OSU Extension

Clark County



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	2.63	2.87	1.6	4.06	5.45	4.84	21.45
Cumulative GDDs	146	482	1163	1928	2704	3264	3264

SUMMARY

- The y-drop and late-season coulters treatments produced statistically significant higher yields when compared with the control and center of row treatments.
- Conditions after the late-season application were persistently dry. This could explain the lack of nitrogen uptake for the surface applied systems.

RESULTS

Treatments (Placement)	Planting Application (lbs N/ac)	V10 Application (lbs N/ac)	Moisture (%)	Yield (bu/ac)
Standard Practice	180	0	22.0	216 b
Coulter	100	80	22.2	233 b
Nutra-Boss	100	80	22.1	232 a
Center-drop	100	80	22.2	214 b
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 7.86 CV: 2.71%

STUDY INFORMATION

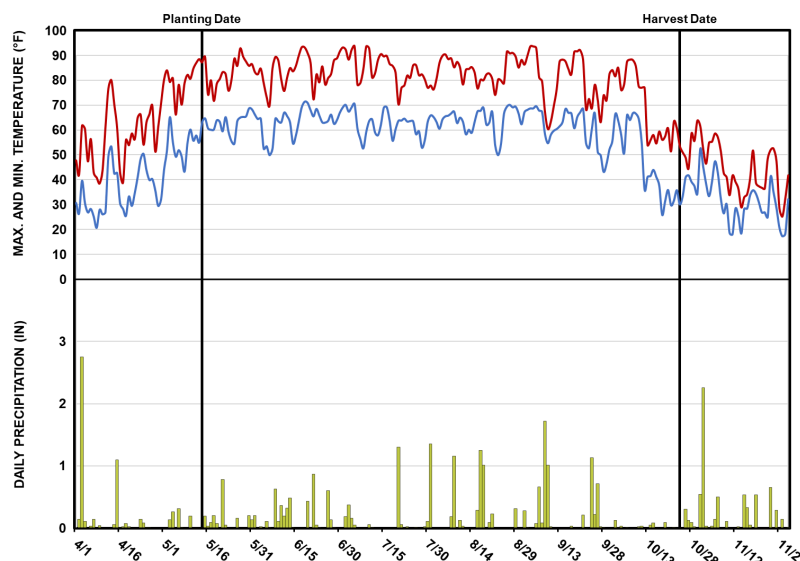
Planting Date	5/14/2018
Harvest Date	10/24/2018
Variety	P1197AM
Population	34,000
Acres	8
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	No-Till
Management	N/A
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Strawn-crosby complex, 52% Kokomo silty clay, 48%



eFields Collaborating Farm

OSU Extension

Clark County



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.73	2.8	4.54	3.71	4.68	6.18	26.64
Cumulative GDDs	60	674	1341	2052	2762	3338	3338

SUMMARY

- No statistical differences in yield were observed between late season nitrogen treatments or the all upfront treatments.
- Additionally, no statistical differences were noted between placement methods for the late season application.

RESULTS

Treatments (Placement)	Planting Application (lbs N/ac)	V10 Application (lbs N/ac)	Moisture (%)	Yield (bu/ac)
Standard Practice	180	0	14.2	259 a
Coulter	100	80	14.1	265 a
Nutra-Boss	100	80	14.4	257 a
Center-drop	100	80	14.5	257 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 14.57 (NS) CV: 4.40%

OBJECTIVE

Determine the effects of nitrogen rate on corn yield and profitability.



eFields Collaborating Farm

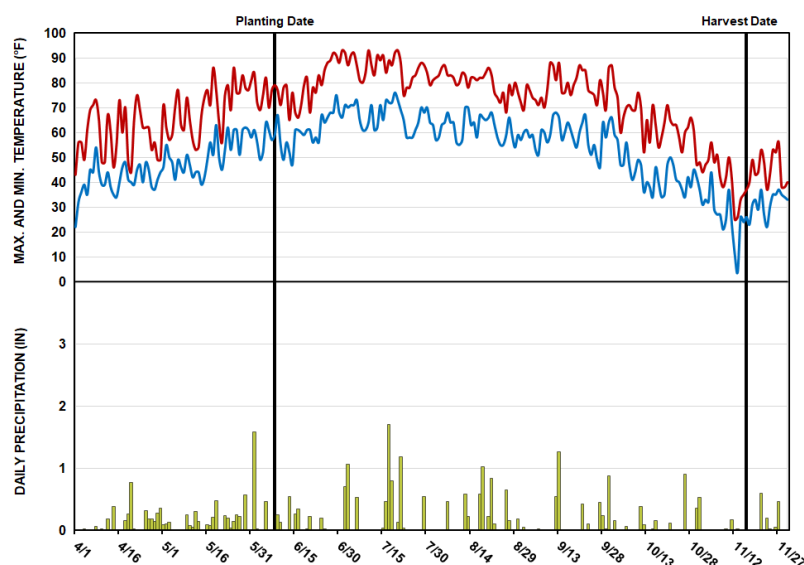
OSU Extension

Fulton County

STUDY INFORMATION

Planting Date	6/8/2019
Harvest Date	11/16/2019
Hybrid	Pioneer 0825 AM
Population	32,000
Acres	40
Treatments	3
Reps	3
Treatment Width	20 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30in.
Soil Type	Merrill loam, 50% Brady sandy loam, 25% Rimer loamy fine sand, 13% Blount loam, 12%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.39	3.68	4.06	7.20	5.05	4.02	27.40
Cumulative GDDs	148	514	1073	1864	2510	3063	3063

STUDY DESIGN

Three nitrogen rates were replicated three times in a complete block design. All treatments were planted no-till with commercial equipment and received the same herbicide treatments. All treatments received 30 units of nitrogen per acre at planting. The remainder of the nitrogen was applied as anhydrous ammonia (82-0-0) at sidedress or V5. Treatment rates were 100 lbs N, 150 lbs N, and 200 lbs N per acre.



Anhydrous application was completed by the collaborator at V5 growth stage.

OBSERVATIONS

Throughout the year, plant growth was monitored for any potential treatment differences. This corn was planted quite late for the region and continued to receive higher than average rainfall throughout the season. A Corn Stalk Nitrate Test (CSNT) was completed the week of harvest to evaluate nitrate-nitrogen levels as season end. Yields and moistures were determined by using a calibrated yield monitor.

SUMMARY

- A statistical yield difference was observed between the lowest nitrogen rate of 100 lbs/acre and the upper two rates (150 lbs and 200 lbs/acre).
- Corn stalk nitrate tests (CSNTs) at the end of the season indicated all treatments were starved for nitrogen.
- The highest CSNT was 40 ppm for one of the 200 lb/acre treatments. In 2019 in this trial, the 200 lb/acre rate was the economic optimum rate.

RESULTS

Treatments (Total lbs N)	NUE (lbs N/bu)	Moisture (%)	Yield (bu/ac)	Return Above (\$/ac)
100	.71	25.1	141 b	502
150	.91	25.5	165 a	578
200	1.17	25.7	172 a	588
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 11.68 CV: 7.02%	

TOOLS OF THE TRADE

Corn Stalk Nitrate Tests (CSNTs)

CSNTs are used to evaluate the effectiveness of a nitrogen management program. Sampling should be done 10 days after black layer, prior to harvest. Generally, <250 ppm NO₃- is considered a "low" level for stalk nitrates, 250-2,000 ppm is "optimal", and >2,000 ppm is excessive (Purdue CSNT guidelines).



PROJECT CONTACT

For inquiries about this project, contact Eric Richer (richer.5@osu.edu).

OBJECTIVE

Determine the benefit of nitrogen stabilizer when applied at V7 using Y-Drops when a split application is made at V7 and V14.



eFields Collaborating Farm

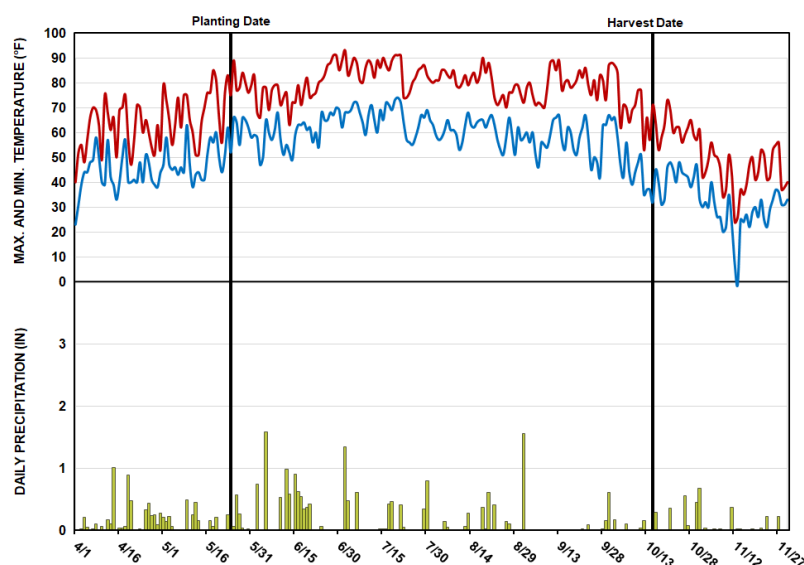
OSU Extension

Crawford County

STUDY INFORMATION

Planting Date	5/24/2019
Harvest Date	10/15/2019
Variety	Channel 203-01-VT2PRIB
Population	34,000
Acres	10
Treatments	2
Reps	4
Treatment Width	60 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Elliot silt loam, 75% Pewamo silty clay loam, 25%

WEATHER INFORMATION

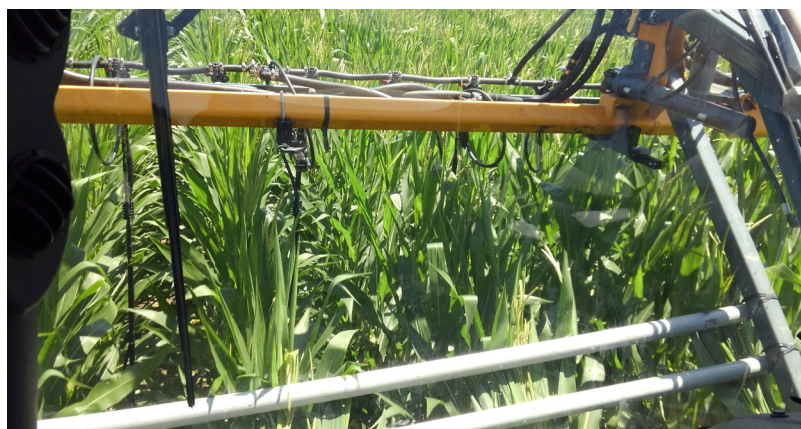


Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.93	3.68	7.72	5.01	2.22	2.48	26.04
Cumulative GDDs	177	581	1142	1911	2536	3084	3084

STUDY DESIGN

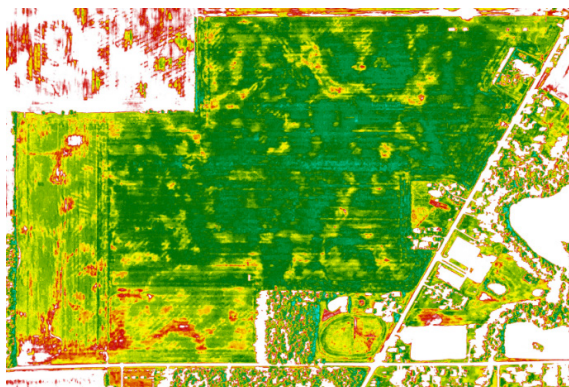
High clearance sprayers allow producers the option of applying nitrogen late in the season to help protect the nitrogen from losses. The first application of nitrogen at V7 has more potential for N loss than the latter application. Nitrogen stabilizer that protects from leaching and volatilization was applied with the V7 nitrogen application using y-drops. Nitrogen was applied in excessive rate of MRNT. Nitrogen applications were made at planting, V7, and V14, with stabilizer used at the V7 treatment.



High clearance sprayer equipped with Y-Drops allowed for application at V14 with minimal plant damage.

OBSERVATIONS

Growing conditions caused increased field variation this year. Some areas of the field showed visual moisture stress early in the growing season and variation in green color but not by treatment.



SUMMARY

- Using an N stabilizer with Y-Drops to help protect nitrogen from volatilization and leaching showed no significant increases in yield.
- Observed yield differences may have been due to field variation instead of treatment effect. Large rainfall events caused the fields to have large yield variation.



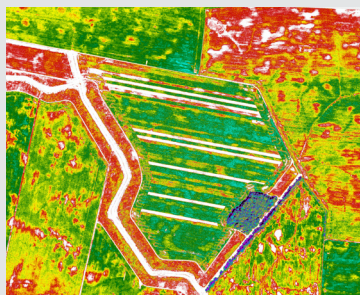
RESULTS

Treatments (lbs N/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
120 at V7 & 75 at V14	33,400	21.5	180 a
120 at V7 with Contain & 75 at V14	32,900	21.3	194 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 14.80 (NS) CV: 4.5%

TOOLS OF THE TRADE

AirScout Aerial Imagery

AirScout's web-interface and iPad based app allows for directive in-season scouting and crop vigor assessments. Aerial images throughout the growing season offer opportunities for proactive disease detection.



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu).

OBJECTIVE

Determine the benefit of nitrogen stabilizer when applied at V7 using Y-Drops when a split application is made at V7 and V14.



eFields Collaborating Farm

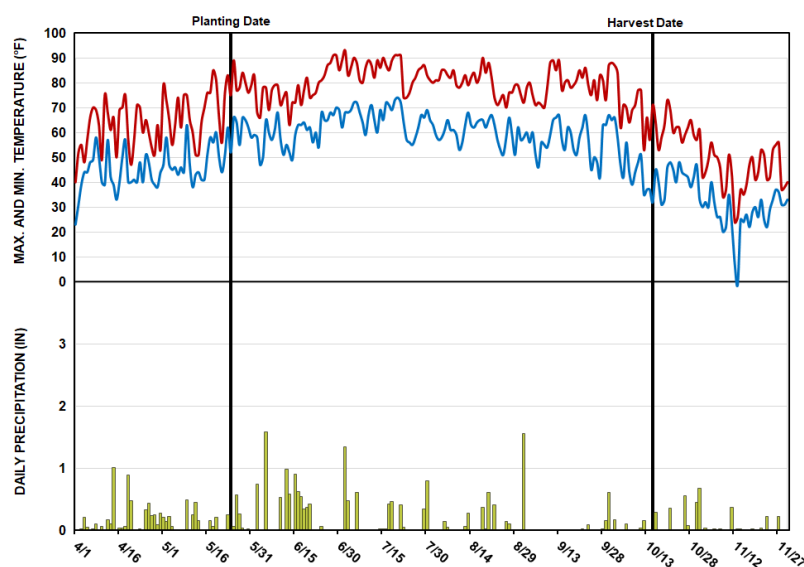
OSU Extension

Crawford County

STUDY INFORMATION

Planting Date	5/24/2019
Harvest Date	10/15/2019
Variety	Channel 203-01-VT2PRIB
Population	34,000
Acres	10
Treatments	2
Reps	4
Treatment Width	60 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Elliot silt loam, 75% Pewamo silty clay loam, 25%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.93	3.68	7.72	5.01	2.22	2.48	26.04
Cumulative GDDs	177	581	1142	1911	2536	3084	3084

STUDY DESIGN

Nitrogen stabilizers that protect from leaching and volatilization have been shown in many situations to be beneficial especially with surface nitrogen applications. Y-Drops place 28% close to the corn plant to help with protect the nitrogen and improve uptake. Split application timing of nitrogen also spreads out risk of losses. A stabilizer was applied with the V7 nitrogen application to determine if nitrogen needs more protection from losses than Y-Drops provide. Nitrogen applications were made at planting, V7 and V14, with stabilizer treatment used with the V7 treatment. Nitrogen rate was determined using MRNT.



Equipment outfitted with Y-Drop technology like the one shown above allow for late season applications.

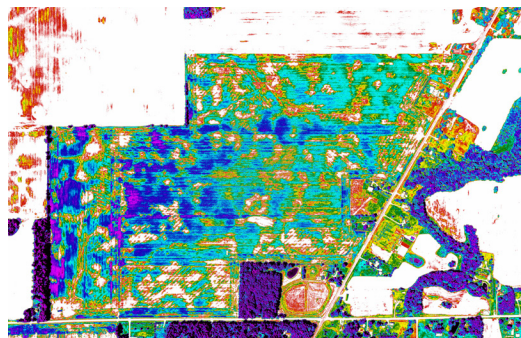
OBSERVATIONS

Throughout the growing season treatments looked similar. The 2019 growing season was wet and challenging causing increased field variation do to soil moisture.



SUMMARY

- Using a nitrogen stabilizer with Y-Drops to help protect nitrogen from volatilization and leaching did not show a statistically significant yield difference.
- By protecting the nitrogen from losses to the environment we can increase corn yields, putting the nitrogen into the plant and our grain bins.



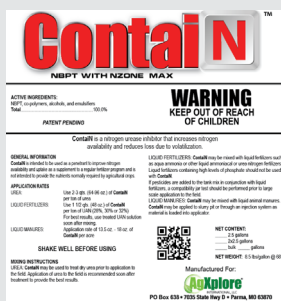
RESULTS

Treatments (lbs N/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
90 at V7 and 75 at V14	33,400	20.9	179 a
90 at V7 with Contain and 75 at V14	33,200	21.5	181 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 16.07 (NS) CV: 3.96%

TOOLS OF THE TRADE

ContainN

This nitrogen stabilizer was used to stop nitrogen volatilization and leaching. When nitrogen lays on the soil surface it may volatilize instead of making into the plant if a rain fall event doesn't help incorporate the nitrogen.



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu).

OBJECTIVE

Investigate the benefit of using three nitrogen application timings; planting, V7, and V14 versus two application timings at planting and V7.



eFields Collaborating Farm

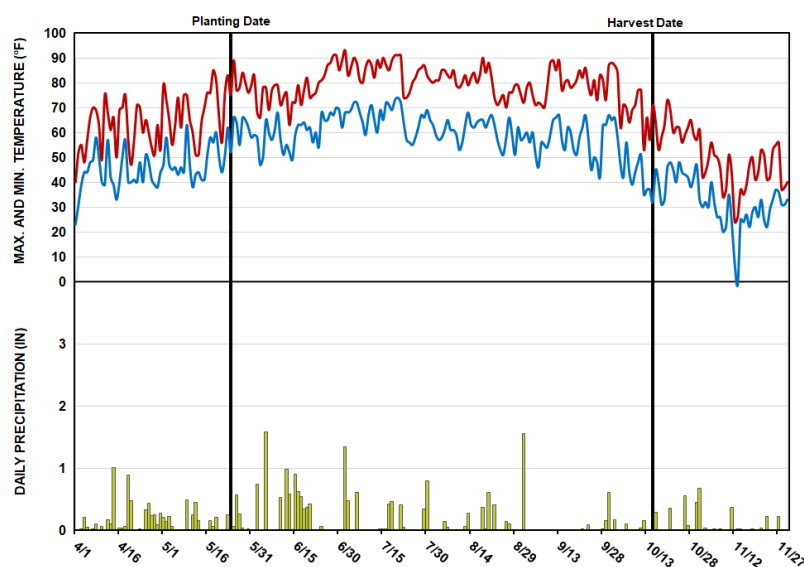
OSU Extension

Crawford County

STUDY INFORMATION

Planting Date	5/24/2019
Harvest Date	10/15/2019
Variety	Channel 209-15VT2PRIB
Population	34,000
Acres	50
Treatments	6
Reps	4
Treatment Width	60 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Elliot silt loam, 75% Pewamo silty clay loam, 25%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.93	3.68	7.72	5.01	2.22	2.48	26.04
Cumulative GDDs	177	581	1142	1911	2536	3084	3084

STUDY DESIGN

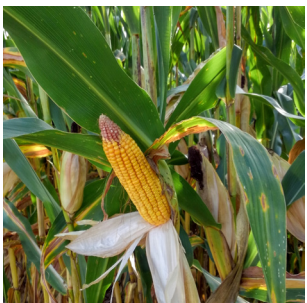
A Randomized Complete Block Split Block designs with four replications was used comparing nitrogen application timing of one application to two. Rates were determined using soil test and NDVI Sensors in order to make real time decisions on the amount of nitrogen needed to grow this years corn crop at each application timing. The later in the season that we make our final nitrogen rate decision the better we can estimate plant needs and losses in season.



Corn nitrogen trial at early soil testing stage.

OBSERVATIONS

High amounts of rain fall caused visual color differences and plant growth stage differences in wetter areas of the field. These areas were randomly distributed and not more prevalent in one treatment over the others. Soil test levels for nitrate and ammonia nitrogen showed 35 pounds of nitrogen at V5 and aerial imaging showed a greater need for nitrogen in the split plots with only 120 pounds on at V14 over the normal.



SUMMARY

- There was a significant difference between split applied and one time application. The MRNT nitrogen range was 170-205 lbs N.
- We saw our maximum yields at 210 pounds of nitrogen split applied.
- In wetter years the split nitrogen application method helps protect the nitrogen from environmental losses.



RESULTS

V7 Application (lbs N/ac)	V14 Application (lbs N/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
150	0	33,400	22.5	209 d
180	0	33,600	22.9	221 bc
210	0	34,200	21.6	223 b
120	75	33,400	21.9	210 d
120	90	33,700	23.1	231 a
120	120	33,100	22.1	233 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 6.89 CV: 2.10%

TOOLS OF THE TRADE

Tissue Testing

Tissue testing was used to identify nutrient deficiencies in the corn crop and if the plant was having able to take uptake nutrients effectively.



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu).

OBJECTIVE

To understand phosphorus uptake through various fertilizer application methods, timings, and strategies on corn production.



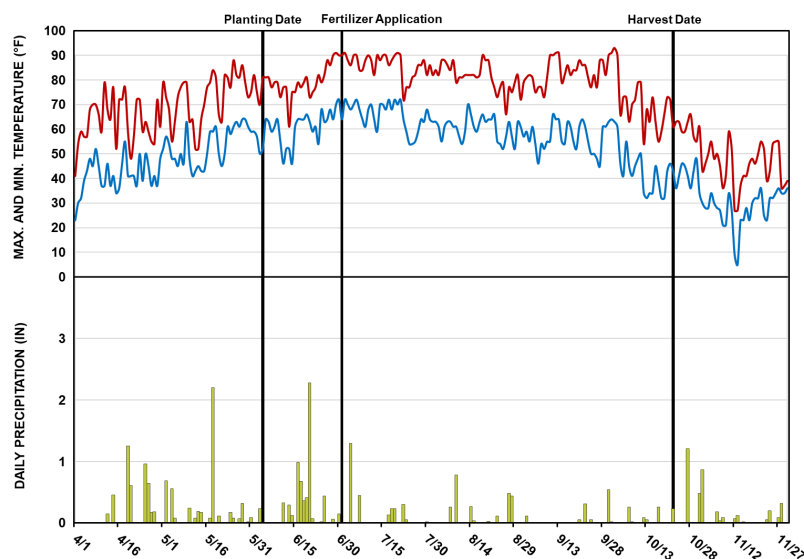
Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	6/4/2019
Harvest Date	10/22/2019
Variety	Dekalb DKC62-20RIB
Population	VRS 30,000-36,000
Acres	33
Treatments	6
Reps	4
Treatment Width	40 ft.
Tillage	Minimal
Management	Fertilizer, Fungicide, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Crosby-Lewisburg silt loams, 63% Kokomo silty clay loam, 37%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.43	5.17	6.44	2.72	2.43	1.10	22.29
Cumulative GDDs	209	644	1231	2005	2645	3233	3233

STUDY DESIGN

This study evaluated the uptake of phosphorus (P) in corn from fall placed dry fertilizer using strip till at two-year maintenance rates, two-year maintenance plus 75 lbs of MAP, spring planter applied 10-34-0 at 10 GPA and 20 GPA, along with 1-year maintenance rate. Combinations of Fall and Spring applied P with different sources (Fall=MAP and Spring=10-34-0). Fall MAP was applied with a prescription map based on crop removal and Spring placed P was applied using the planter and 2x2x2 technology. Whole plant samples were collected at the V5 growth stage on July 8th. Samples were dried and sent for lab analysis to estimate P uptake.

Treatment	Timing / Strategy	Placement	P Program	P Source
No P Application (control)	-	-	-	-
Fall Subsurface	Fall Only / Rx	Strip-Till Banded	2-year crop removal	MAP
Fall Subsurface +	Fall Only / Rx	Strip-Till banded	2-year crop removal + 75 lb/ac	MAP
Spring Planter	Spring Only / Rx	Planter 2x2x2	1-year corn removal	10-34-0
Spring Planter +	Spring Only	Planter 2x2x2	Typical planter placed P	10-34-0
Fall-Spring Split	Fall Rx + Spring Fixed-Rate	Fall = Strip-Till Banded using Rx; Spring = Planter 2x2x2 Fixed-rate	Typical Split P application: Fall 2-year crop removal plus spring 10 gal/ ac fixed	Fall = MAP; Spring = 10-34-0

OBSERVATIONS

Based on planting date (6/4), warm soils were present with growing conditions trending warmer. Soil fertility levels can be characterized as moderately low to maintenance levels in this field. Differences in plant biomass could be observed early in the growing season as verified through remote sensed imagery and field scouting but disappeared well before VT. This study, focused on P-uptake base on placement and timing, will be continued into 2020 when soybeans will be grown in this field.



SUMMARY

- There was no significant difference in corn yield and grain moisture at harvest among the different treatments.
- At these corn yields, P was not a limiting yield factor in this field for the 2019 growing season.
- There was a significant response to starter fertilizer in terms of plant mass and moisture content with larger plants at the V5 growth stage for those receiving starter fertilizer.
- P uptake (lb/ac) at V5 tended to be higher for treatments receiving starter fertilizer.

RESULTS

Treatment	Avg. Dry Matter/Plant (g)	Avg. Plant Moisture (%)	P Uptake (lb/ac)	Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
No P Application (control)	2.3	4.4	1.3	32,091	20.3	173 a
Fall Subsurface	2.4	4.7	1.0	32,890	20.4	170 a
Fall Subsurface +	2.3	4.4	1.2	33,317	20.5	169 a
Spring Planter	3.2	6.8	1.7	33,815	20.3	174 a
Spring Planter +	3.2	6.8	1.8	32,971	19.9	167 a
Fall-Spring Split	3.0	6.7	1.4	33,010	20.4	168 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.						LSD: 11.08 (NS) CV: 5.25%

TOOLS OF THE TRADE

Orthman 1tRipr Row Unit

This shank-style strip-till unit has an adjustable heavy duty shank that allows for seedbed preparation. Can be equipped with dry, liquid, or anhydrous fertilizer attachments. It can also place multiple products at varying depths.



PROJECT CONTACT

For inquiries about this project, contact Nate Douridas (douridas.2@osu.edu) or John Fulton (fulton.20@osu.edu).

Pinch Row Compaction



OBJECTIVE

Evaluate if utilizing tracks on the planter would reduce soil compaction or yield in corn.



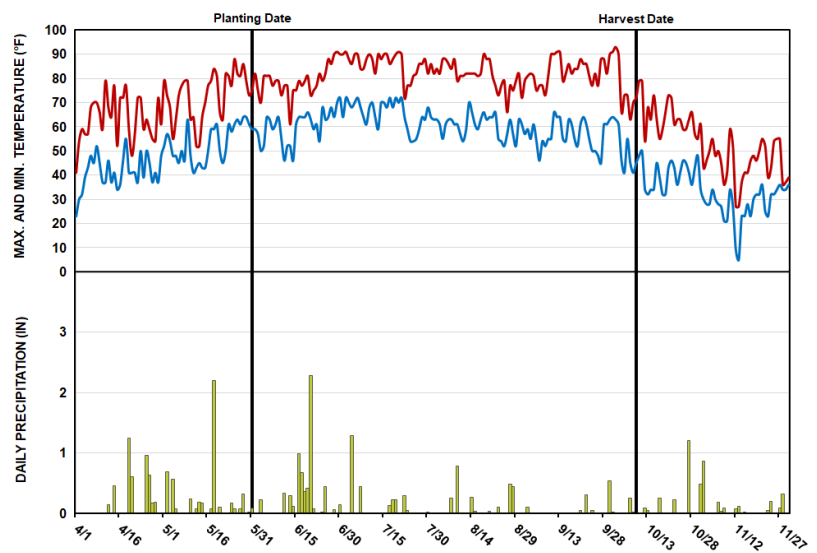
Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/31/2019
Harvest Date	10/9/2019
Variety	Pioneer P1197AM
Population	VRS 31,000-38,000
Acres	58
Treatments	2
Reps	12
Treatment Width	20 ft.
Tillage	Minimal
Management	Fertilizer, Fungicide, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Crosby-Lewisburg silt loams, 65% Kokomo silty clay loam, 35%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.43	5.17	6.44	2.72	2.43	1.10	22.29
Cumulative GDDs	209	644	1231	2005	2645	3233	3233

STUDY DESIGN

This study was completed using a 16-row John Deere 1770NT planter and an 8320R tractor. The Soucy tracks were installed on the planter to be used in the treatments in addition to treatments using the factory wheel and tire configuration. No starter fertilizer was used and the seed tank weight was kept at a constant 75%.



Planting was completed with a 16 row John Deere 1770NT planter and an 8320R tractor.

OBSERVATIONS

Slightly later than normal planting date.

Heavy soil at planting.

Growing season was not bad in terms of early season growing conditions but limited rainfall later in the year capped yield.

V4-V6 moderate pinch row compaction that followed through the rest of the year. Visual differences in plant height.

There were visual differences in ear size at harvest as shown in the image to the right. Wheeled planter ears are shown on the left, with wing row comparison on the right.

SUMMARY

- There were no statistically significant differences between treatments this year.
- Though there was no statistical difference, it was clear during harvest operations that there were visual differences in ear size and plant height between treatments.



RESULTS

Treatments	Stand Count (plants/ac)		Overall Soil Means		Medium Productivity Means		High Productivity Soil Means	
	Check	Pinch Row	Moisture (%)	Yield (bu/ac)	Moisture (%)	Yield (bu/ac)	Moisture (%)	Yield (bu/ac)
Tracked Planter	30,730	31,090	23.5	159 a	22.7	144 a	25.2	197 a
Wheeled Planter	30,500	31,780	23.5	157 a	22.8	145 a	25.8	198 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 11.29 (NS) CV: 10.20%		LSD: 7.56 (NS) CV: 7.50%		LSD: 9.63 (NS) CV: 6.60%

TOOLS OF THE TRADE

20/20 YieldSense

When paired with an iPad and the Climate FieldView app, YieldSense allows the grower to track varieties, populations or trials while harvesting. When treatments such as "tracked planter" are added during planting, it is possible to know instantly how that yield compared to the rest of the field.



PROJECT CONTACT

For inquiries about this project, contact Nate Douridas (douridas.2@osu.edu), John Fulton (fulton.20@osu.edu), Andrew Klopfenstein (klopfenstein.34@osu.edu), or Ryan Tietje (tietje.4@osu.edu).

OBJECTIVE

Evaluate if utilizing tracks on either the tractor or planter along with the Yetter TrackTill system would minimize the effects of soil compaction in cropping rows influenced by field traffic.



eFields Collaborating Farm

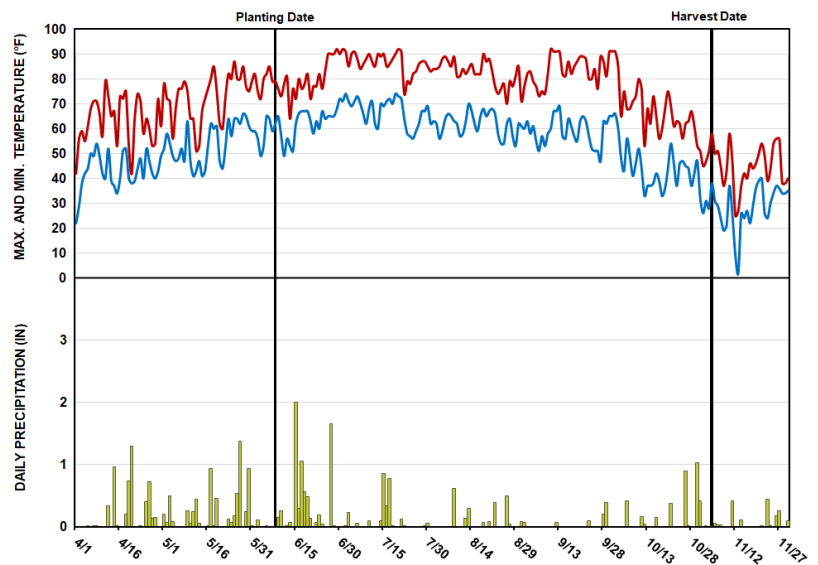
OSU Extension

Miami County

STUDY INFORMATION

Planting Date	6/8/2019
Harvest Date	11/4/19
Variety	Ebberts 9899SSX RIB
Population	36,000
Acres	77
Treatments	3
Reps	9
Treatment Width	60 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Crosby silt loam, 58% Brookston silty clay loam, 42%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.98	6.78	7.13	2.70	2.20	0.82	24.61
Cumulative GDDs	209	653	1256	2057	2735	3354	3354

STUDY DESIGN

This study was completed utilizing a 24-row 1770 NT John Deere planter and 8310R John Deere tractor. Soucy tracks were installed on the planter to be used in some treatments and original wheels on the planter were also used. The Yetter TrackTill System was also installed to investigate the ability to minimize the pinch row effect. A rocker switch was installed to raise and lower the TrackTill system from the operator's seat. The operational weight was 75% seed capacity and this was completed by changing the amount of starter carried on the planter.



John Deere 1770 24 row planter with Soucy tracks and Yetter TrackTill.

OBSERVATIONS

With the tires on the planter loaded in worked ground, the field was visibly more rutted, especially when backing.

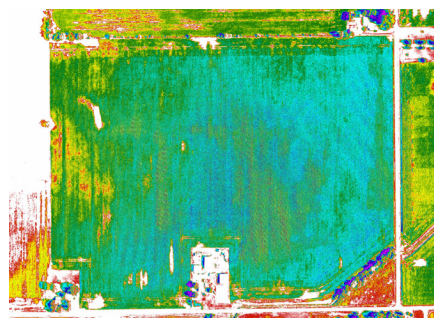
TrackTill added extra weight to the planter, but did a good job of loosening the soil after the planter passes.

Tracks left less impressions in the soil. Tires caused more displacement of soil than tracks.



SUMMARY

- When it turned dry late in the season, the higher compacted soil held more water resulting in an increased yield as you see below in the results table.
- There was no statistical difference between the wheeled planter with TrackTill up and the tracked planter with TrackTill up.
- The wheeled planter with TrackTill down yielded significantly lower.



RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
Wheeled Planter, TrackTill Up	33,048	22.5	197 a
Wheeled Planter, TrackTill Down	32,625	22.1	184 b
Tracked Planter, TrackTill Up	32,789	22.3	189 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 10.29 CV: 6.58%

TOOLS OF THE TRADE

Yetter TrackTill

This system "aerates" the ground after the tractor and planter have passed. TrackTill is a large, spiked wheel that lifts the ground between the rows helping to alleviate some of the pinch row compaction.



PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein (klopfenstein.34@osu.edu), John Fulton (fulton.20@osu.edu), or Ryan Tietje (tietje.4@osu.edu).

Pinch Row Compaction



OBJECTIVE

Evaluate if utilizing tracks on either the tractor or planter would reduce soil compaction or yield in cropping rows influenced by field traffic.



eFields Collaborating Farm

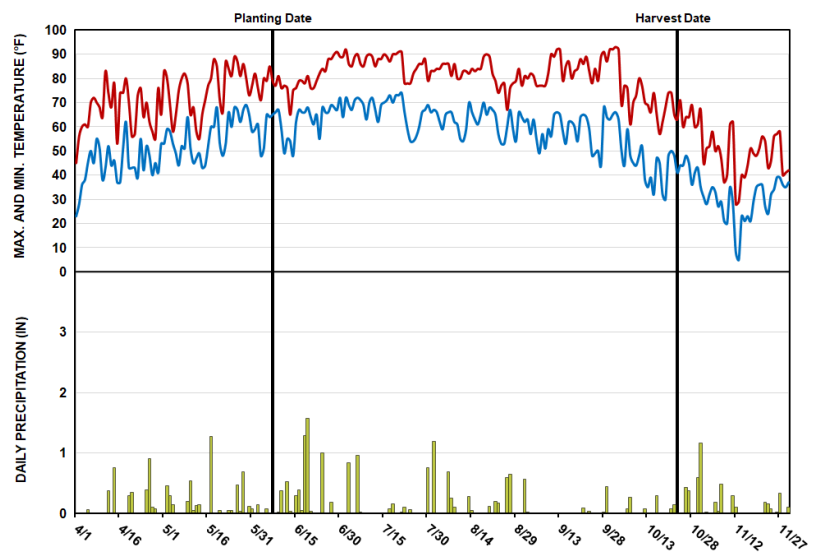
OSU Extension

Pickaway County

STUDY INFORMATION

Planting Date	6/7/2019
Harvest Date	10/23/19
Variety	6076 SX Beck's
Population	36,000
Acres	110
Treatments	2
Reps	8
Treatment Width	40 ft.
Tillage	Minimal
Management	Fertilizer, Fungicide, Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Miamian silt loam, 63% Westland silty clay loam, 23% Eldean loam, 14%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.33	4.78	6.01	3.04	4.30	1.20	22.60
Cumulative GDDs	263	765	1390	2189	2873	3494	3494

STUDY DESIGN

Tracked systems for planters have become popular options for attempting to reduce soil compaction in the rows adjacent to the paths of equipment travel. For this study the tracks and tires were switched on the planter. A Case IH Magnum 380 half track was used to pull both configurations.



Midway through tire/track conversion on Case IH 2150 planter with Soucy tracks.

OBSERVATIONS

Planting conditions were extremely wet.

Less soil disturbance was noted with tracks compared to tires.

Weight was added with seed bags between treatments to keep consistent weight on the planter through the duration of the study.

Current track model limits speed during transport, which could increase travel time between farms.

Several parts of the field were only passible with a tracked planter. In these areas tracks were used.



RESULTS

Treatments	Avg. Emergence (plants/ac)		Moisture (%)	Yield (bu/ac)
	Check	Pinch Rows		
Tracked Planter	28,670	29,170	156	156 a
Wheeled Planter	27,830	29,000	157	157 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 8.74 (NS) CV: 5.89%

SUMMARY

- There was no statistical difference in yield between the tracked and wheeled treatments.
- Several fields this spring were only passible with the tracked planter.
- There was a noticeable difference in stand counts for different the different planter types.



TOOLS OF THE TRADE

Soucy S-TECH 012P

The Soucy S-TECH planter track system provides the opportunity to reduce the amount of soil compaction while planting. These tracks increase the soil track contact surface, distributing the planter weight evenly.



PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein (klopfenstein.34@osu.edu) or Ryan Tietje (tietje.4@osu.edu).

Planter 2x2x2 vs. 2x2



OBJECTIVE

Evaluate the yield impacts of nitrogen placement on both sides of the furrow.



eFields Collaborating Farm

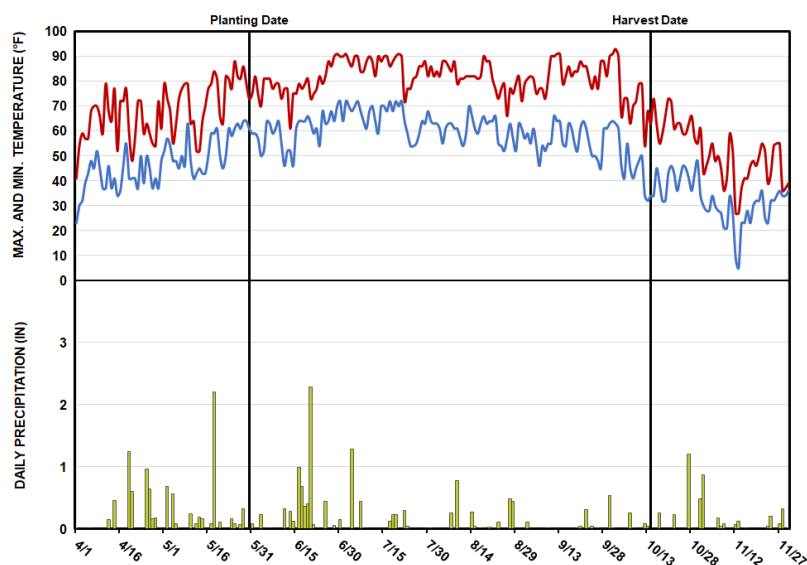
OSU Extension

Madison County

STUDY INFORMATION

Planting Date	5/30/2019
Harvest Date	10/14/19
Hybrid	Beck's 5460AM
Population	33,000
Acres	34
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Crosby-Lewisburg silt loam, 42% Eldean silt loam, 27% Kokomo silty clay loam, 31%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.43	5.17	6.44	2.72	2.43	1.10	22.29
Cumulative GDDs	209	644	1231	2005	2645	3233	3233

STUDY DESIGN

Farmers in Ohio have been looking for better ways to apply nutrients in a manner that increases the efficiency of crop uptake. In this study, traditional 2x2 (2 in. off the seed on one side and 2 in. deep) planter based applications and 2x2x2 (2 in. deep and 2 in. off the seed on both sides) the applications using 28% UAN were placed side-by-side and observations collected to compare results.



View of 2150 with Yetter 2968 2x2x2 as installed.

OBSERVATIONS

Planting conditions were very wet.

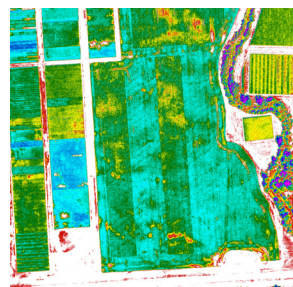
Conventional tillage required less downforce than no-till.

Row cleaners cleared the path for seed and 2x2 or 2x2x2 fertilizer in wet conditions at planting.



SUMMARY

- There was no significant difference in yield results this year.
- The Yetter system performed not only at 5 mph, but also 10 mph, where a majority of the field was planted.
- With this system, extra downforce is needed because of the added length to the back of the row unit.



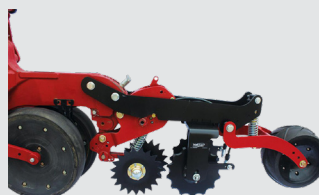
RESULTS

Treatments	Planting Rate (lbs N/ac)	Sidedress Rate (lbs N/ac)	Moisture (%)	Yield (bu/ac)
2x2	29	157	16.6	183 a
2x2x2	29	157	16.5	184 a
2x2x2	44	142	16.4	182 a
2x2x2	58	128	16.5	183 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 5.60 (NS) CV: 2.36%

TOOLS OF THE TRADE

Yetter 2968 2x2x2 Row Unit Kit

The Yetter 2968 Row-Unit Mount In-Between Dual Wheel Fertilizer Opener is one of the most flexible fertilizer openers on the market. Its dual-placement design ensures the plant has fertilizer wherever and whenever it needs it throughout the season on both sides of the row.



PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein (klopfenstein.34@osu.edu) or Ryan Tietje (tietje.4@osu.edu).

Planter 2x2x2 vs. 2x2



OBJECTIVE

Evaluate the yield impacts of nitrogen placement on both sides of the furrow.



eFields Collaborating Farm

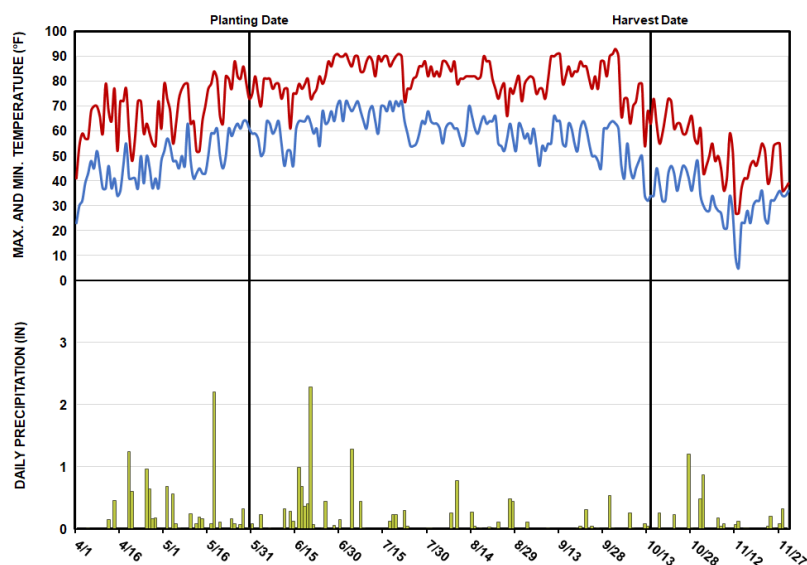
OSU Extension

Madison County

STUDY INFORMATION

Planting Date	5/30/2019
Harvest Date	10/14/19
Hybrid	Beck's 5460AM
Population	32,000
Acres	35
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Crosby-Lewisburg silt loam, 42% Eldean silt loam, 24% Kokomo silty clay loam, 34%

WEATHER INFORMATION

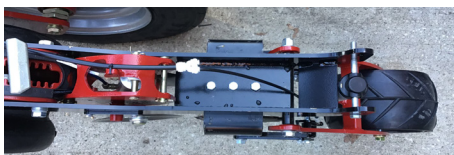


Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.43	5.17	6.44	2.72	2.43	1.10	22.29
Cumulative GDDs	209	644	1231	2005	2645	3233	3233

STUDY DESIGN

Farmers in Ohio have been looking for better ways to apply nutrients in a manner that increases the efficiency of crop uptake. In this study, traditional 2x2 (2 in. off the seed on one side and 2 in. deep) planter based applications and 2x2x2 (2 in. deep and 2 in. off the seed on both sides) the applications using 28% UAN were placed side-by-side and observations collected to compare results.



Case IH 380 half track Magnum 380 with Case IH 2150 16 row CASE planter executing 2x2x2 vs. 2x2 treatments in wet no-till soil.

OBSERVATIONS

Planting conditions were very wet.

No-till did not require as much downforce as conventional.

With too much downforce, plugging can occur between the blade and knife, especially in no-till conditions.

Row cleaners cleared the path for seed and 2x2 or 2x2x2 fertilizer in wet conditions at planting.



SUMMARY

- There was no significant difference in yield results this year.
- The Yetter system performed not only at 5 mph, but also 10 mph, where a majority of the field was planted.
- With this system, extra downforce is needed because of the added length to the back of the row unit.



RESULTS

Treatments	Planting Rate (lbs N/ac)	Sidedress Rate (lbs N/ac)	Moisture (%)	Yield (bu/ac)
2x2	29	157	17.1	185 a
2x2x2	29	157	17.4	189 a
2x2x2	44	142	17.3	191 a
2x2x2	58	128	17.2	187 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 12.86 (NS) CV: 5.28%

TOOLS OF THE TRADE

Precision Planting vApply HD

vApply HD is a system installed on each row on the planter to control the rate. This means that the rate can be varied on a row by row basis and is also compensated for curves and speed changes to make sure the target is achieved. This also gives control to reduce overlap.



PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein (klopfenstein.34@osu.edu) or Ryan Tietje (tietje.4@osu.edu).

OBJECTIVE

Determine the yield difference in sidedress application at V5 from the Y-Drop sidedress banded next to the corn row vs. in between the rows.



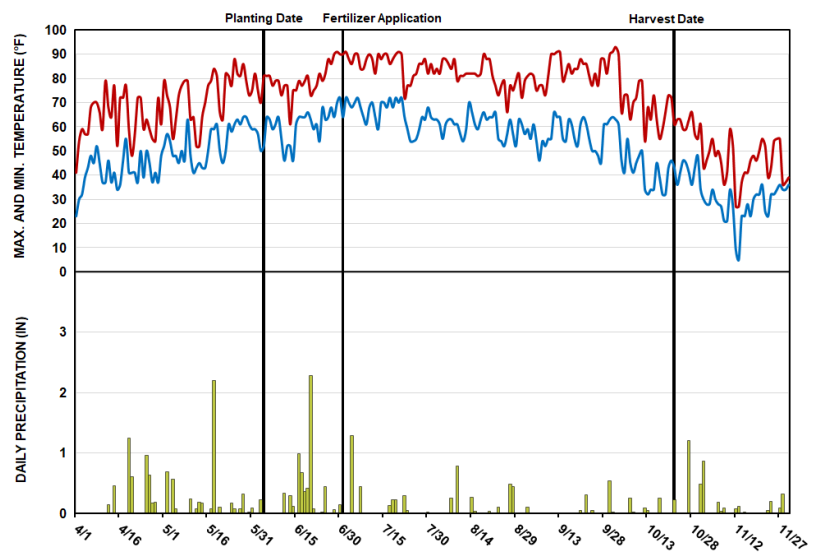
Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	6/4/2019
Harvest Date	10/22/2019
Variety	Dekalb DKC62-20RIB
Population	VRS 30,000-36,000
Acres	10
Treatments	2
Reps	4
Treatment Width	40 ft.
Tillage	Minimal
Management	Fertilizer, Fungicide, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Crosby-Lewisburg silt loams, 63% Kokomo silty clay loam, 37%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.43	5.17	6.44	2.72	2.43	1.10	22.29
Cumulative GDDs	209	644	1231	2005	2645	3233	3233

STUDY DESIGN

This study was completed using a J&M Nitro Gro 5016 applicator with the 360 Yield Center Y-Drop Sidedress. The study was implemented to see the difference in yield based on the application method. The center dribble was done to represent using a sprayer or another type of applicator capable of surface application between the rows. Soil in the study is generally 19 CEC, 2.7 OM, and 6.3 pH. This was an alternating strip trial design, not randomized complete block design.



Fertilizer was applied in two different placements, the center of the row as shown above, and on both sides of the row as shown on the following page.

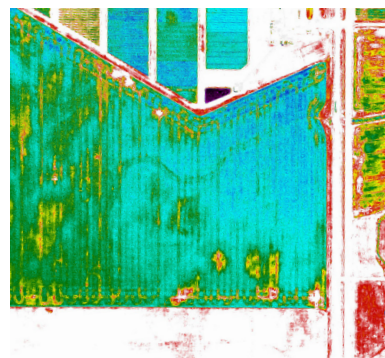
OBSERVATIONS

With a later than normal planting date this study experienced late season drought conditions that uniformly limited the yield. Early season growing conditions were average resulting in uniform stands. A 1.3" rain event occurred 2 days after application which would generally be enough to move applied nitrogen into the soil near the root zone regardless of application method.



SUMMARY

- There was no statistical difference in yield between treatments, which may have been influenced largely by the amount of rainfall that occurred after application.
- This work should be conducted again in the future to evaluate the opportunities of various application methods in different growing season and conditions.



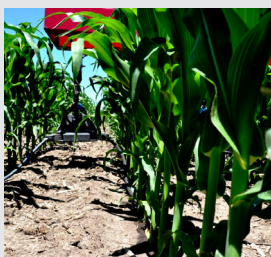
RESULTS

Treatments (Placement & Rate)	Moisture (%)	Yield (bu/ac)
Y-Drop® Sidedress on both sides of the row	19.8	179 a
Fertilizer sidedress dribbled between the rows	19.6	177 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 7.71 (NS) CV: 2.59%

TOOLS OF THE TRADE

360 Yield Center Y-Drop Sidedress

This attachment when installed on a sidedress bar will allow for banded liquid to be applied along both sides of the plant on the surface. It has a magnetic breakaway and adjustable height.



PROJECT CONTACT

For inquiries about this project, contact Nate Douridas (douridas.2@osu.edu) or John Fulton (fulton.20@osu.edu).

OBJECTIVE

Determine the usefulness and economic viability of using a pre-sidedress nitrogen test to guide nitrogen application rate and to observe the effect of nitrogen application timing on yield.



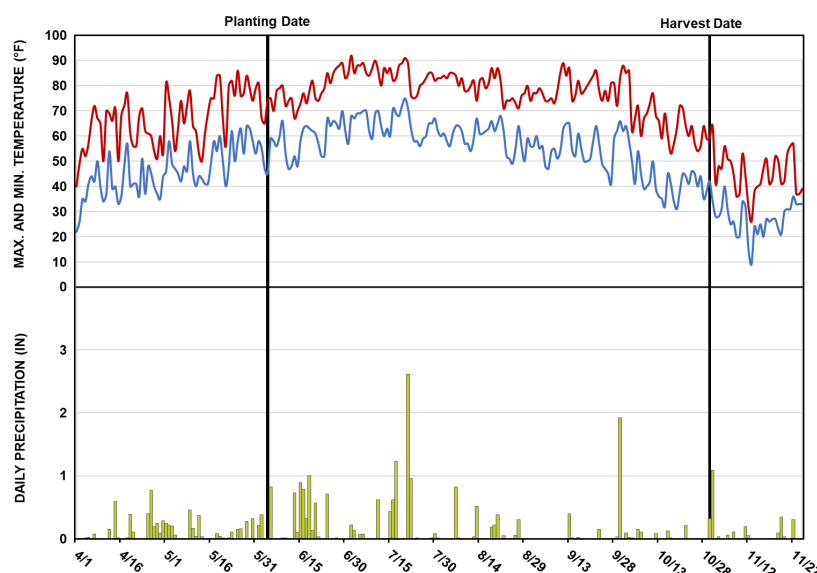
Ohio Agricultural Research
and Development Center

Wayne County

STUDY INFORMATION

Planting Date	6/4/2019
Harvest Date	10/30/2019
Variety	LG Seeds 5499 VT2 proRIB
Population	32,000
Acres	1
Treatments	5
Reps	4
Treatment Width	30 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Corn
Row Spacing	30 in.
Soil Type	Bogart loam, 56% Orville silt loam, 34% Jintown loam, 10%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.34	2.95	6.71	7.07	2.57	2.53	25.17
Cumulative GDDs	177	566	1096	1853	2463	2980	2980

STUDY DESIGN

Randomized complete block by the OSU Plots app, using five treatments and four replications. Plot width was 30 feet and length was 100 feet. All nitrogen treatments were based on the maximum return to nitrogen (MRTN) calculator located at: <http://cnrc.agron.iastate.edu/>. Specific treatments included 0 lbs of nitrogen at planting followed by a sidedress nitrogen treatment of either the MRTN rate or the MRTN rate minus a credit based on the pre-sidedress N soil test result (PSNT), which indicated a 20 lbs N/ac credit, 50 lbs of nitrogen at planting followed by either the remainder of the MRTN amount or the remainder of MRTN - the PSNT credit, and one treatment of the MRTN applied at planting with no nitrogen sidedress.



The sidedress equipment being used in the field, in the picture the operator is calibrating the ground driven pump by changing chain length.

OBSERVATIONS

The field has a history of yearly applications of dairy manure, typically surface applied. The pre-sidedress nitrate soil test is a tool that can be used to estimate N credit from fields with a history of manure application. The N rate was determined by using the Maximum Return to Nitrogen Rate (MRTN) calculator. The wet spring delayed planting until June 4. The pre-sidedress nitrate soil test (PSNT) was taken on June 27 when corn was at the V-4 growth stage. Test results showed an average of 10.24 ppm nitrate N, for which a 20 pound nitrogen credit/acre was provided. Plots designated as the PSNT treatments received a total of 157 lbs of N/acre (177-20). Sidedress N treatments were applied on July 2 with corn at the V-6 growth stage. A heavy rainfall of 6" within an approximately 2 hour period occurred on the evening of July 21. Plots also had quite a bit of feeding damage from deer, some plots with heavy feeding losses and plants trampled by deer.

RESULTS

Treatments (lbs N/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above N (\$/ac)
0+PSNT Sidedress	30,500	18.01	152 a	527
0+MRTN Sidedress	30,250	17.25	141 a	479
50+PSNT Sidedress	30,250	17.48	135 a	463
50+MRTN Sidedress	30,250	17.68	146 a	498
MRTN at Plant	32,000	18.11	101 a	327
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 56.67 (NS) CV: 32.66%	

SUMMARY

- No statistical differences in yields were observed between the treatments.
- The plots receiving the full MRTN had lower yields than the plots receiving some or all of their nitrogen application as a sidedress application at growth stage V-6.
- The PSNT is a tool that can be used on fields with a history of manure application. Dollars can be saved by reducing the N application without sacrificing yield.



go.osu.edu/19nd

TOOLS OF THE TRADE

Pre-Sidedress Nitrogen Test (PSNT)

PSNT was used to determine a nitrogen credit for the sidedress nitrogen treatment on this field that has a history of manure application. To learn more about using the PSNT to determine nitrogen recommendations on manured fields, see this article: go.osu.edu/PSNT.



PROJECT CONTACT

For inquiries about this project, contact
Rory Lewandowski
(lewandowski.11@osu.edu).



OBJECTIVE

Understand how soil moisture can be used for irrigation scheduling.



eFields Collaborating Farm

OSU Extension
Champaign County

STUDY INFORMATION FIELD A

Planting Date	5/22/2019
Harvest Date	Not Reported
Variety	Pioneer Seed Corn
Population	33,000
Acres	150
Tillage	Minimal
Management	Fertilizer, Herbicide, Insecticide, Fungicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Lippincott silty clay loam, 65% Fox silt loam, 25% Homer silt loam, 10%

STUDY DESIGN

Two soil moisture probes were located in an irrigated corn field. Each probe contained a total of nine sensors spaced four inches apart measuring soil moisture, temperature, and salinity within the soil profile.

- 1 probe placed in a good production area.
- 1 probe placed in a very well drained soil.

The Field Application Resource Monitor (FARM) uses advanced weather forecasting to advise farmers on when to apply fertilizers and pesticides (farm.bpcrc.osu.edu). The FARM forecast was compared to the in-field weather stations and the closest public station at the Dayton International Airport (KDAY).

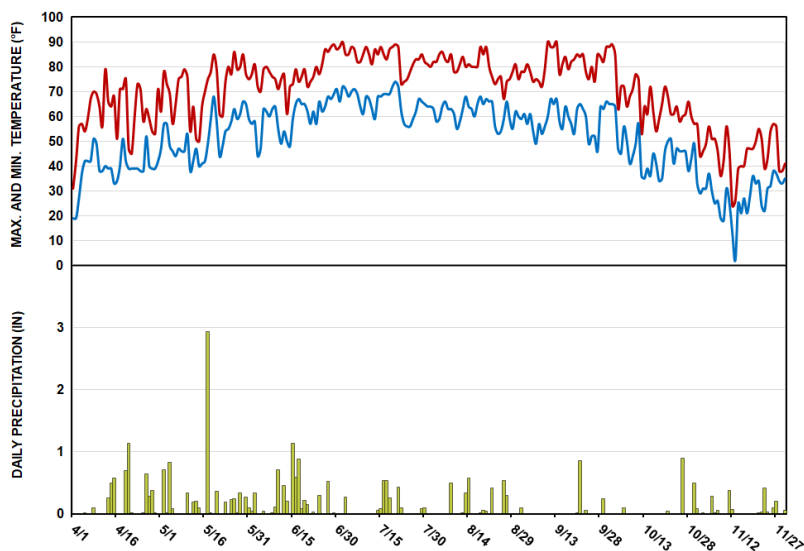
STUDY INFORMATION FIELD B

Planting Date	5/24/19 & 5/29/19
Harvest Date	10/3/19 -10/4/19
Variety	SC P9339R
Population	33,000
Acres	75
Tillage	Minimal
Management	Fertilizer, Herbicide, Insecticide, Fungicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Fox silt loam, 25% Homer silt loam, 35% Ionia silt loam, 18% Lippincott silty clay loam, 22%



Sensors were installed early in the season to monitor soil moisture and plan for irrigation scheduling.

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.61	7.12	5.80	2.45	2.77	1.26	24.01
Cumulative GDDs	95	474	1034	1796	2442	3032	3032

OBSERVATIONS

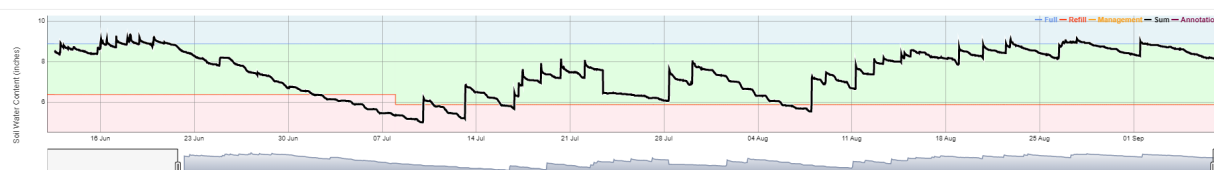
The Virtual Optimizer program through CropMetrics provided real time feedback on soil moisture. This enabled the farm to keep an eye on moisture levels and use it to determine when to run the irrigation system. The graphs show the vertical upward spikes when the irrigation was turned on as the sensor readings showed the field was at or below critical moisture levels. The app combines multiple water management technologies such as moisture probe monitoring, pivot telemetry, weather data and forecasting, crop modeling, and irrigation record keeping into one powerful centralized location. The app was used to determine when to turn the water on and off, simplifying the decision with quantifiable data.

SUMMARY

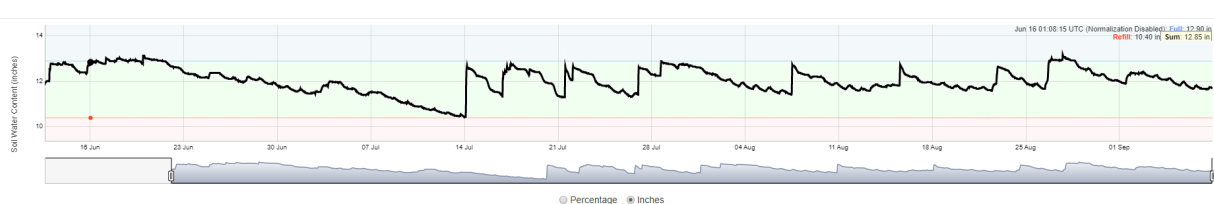
- Farmer used probes to schedule irrigation timing
- Sensor data provided value in tracking soil moisture by depth and understanding when to schedule irrigation

RESULTS

Field A



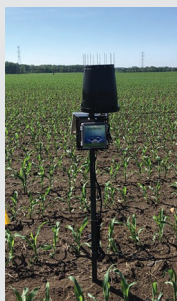
Field B



TOOLS OF THE TRADE

CropMetrics Weather Station with Probes

The CropMetrics field stations combine real-time measurements of soil moisture with rainfall data at a field level basis. In combination with their data visualization tools, these stations can inform precision irrigation decisions.



PROJECT CONTACT

For inquiries about this project, contact Amanda Douridas (douridas.9@osu.edu).

OBJECTIVE

Investigate the effects of phosphorus (MAP) rates applied via strip till on corn yield.



eFields Collaborating Farm

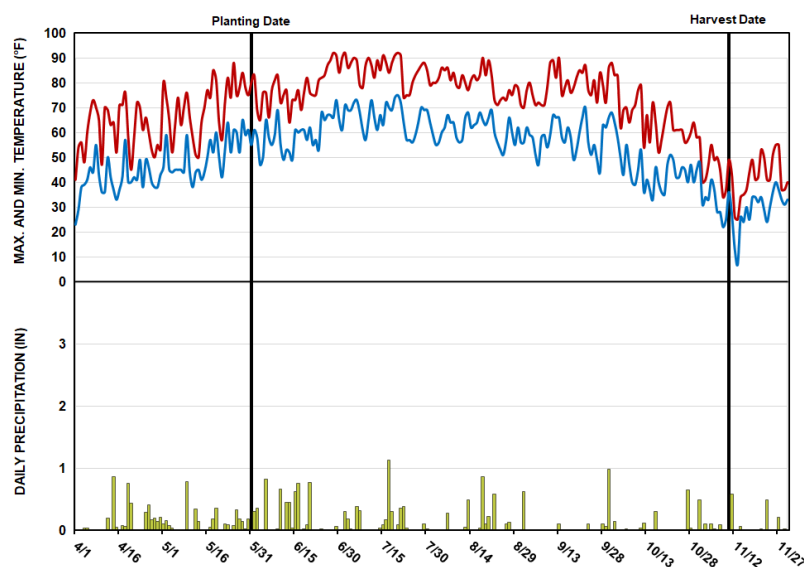
OSU Extension

Seneca County

STUDY INFORMATION

Planting Date	5/31/2019
Harvest Date	11/10/2019
Variety	Pioneer P0825AM
Population	28,000
Acres	40
Treatments	5
Reps	5
Treatment Width	60 ft.
Tillage	Minimal
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Glynwood silt loam, 59% Milton silt loam, 41%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.96	3.43	5.51	3.97	2.91	2.01	21.79
Cumulative GDDs	174	559	1109	1886	2517	3070	3070

STUDY DESIGN

Five phosphorous rates were replicated five times in a randomized complete block design. All treatments were applied via strip till and planted at the same population rate. All treatments received the same nitrogen (140 lbs anhydrous) and herbicide applications.



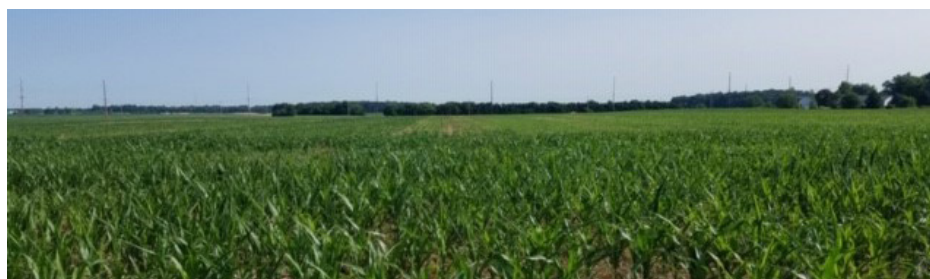
Randomized complete block layout was executed on the field as shown above.

OBSERVATIONS

Producer initially had difficulties lining up his strip tills with his 12 row planter and opted to use a 24 row planter instead for convenience. During the growing season we observed slightly increased growth and development on the high phosphorous treatments, but upon harvest, yields were not increased. Producer believes that previously having a cover crop may have reduced the soil's stored nitrogen for this growing crop.

SUMMARY

- No statistical differences were observed between all treatments. A positive trend yield response was observed at 100 lbs of MAP. However, average yields at 0, 200, 300 showed no difference despite increased cost of application.
- From these results, MAP phosphorous use, application location, and cost should be considered carefully in making phosphorous rate recommendations.



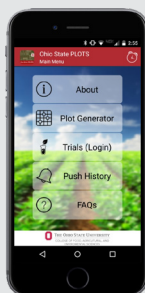
RESULTS

Treatments (lbs of MAP)	Moisture (%)	Yield (bu/ac)
0	24.2	166 a
50	24.5	163 a
100	23.0	173 a
200	23.5	169 a
300	23.5	167 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 10.63 (NS) CV: 5.74%

TOOLS OF THE TRADE

OSU PLOTS

The OSU PLOTS app allows users to design randomized and replicated on-farm research studies. Information and pictures can also be stored and statistical analysis completed on results. Results can be shared as a CSV, image, or email.



PROJECT CONTACT

For inquiries about this project, contact Hallie Williams (williams.6386@osu.edu).

OBJECTIVE

Evaluate the effectiveness of dragline application of liquid swine manure as an economic and environmental alternative to commercial corn sidedress fertilizer.



eFields Collaborating Farm

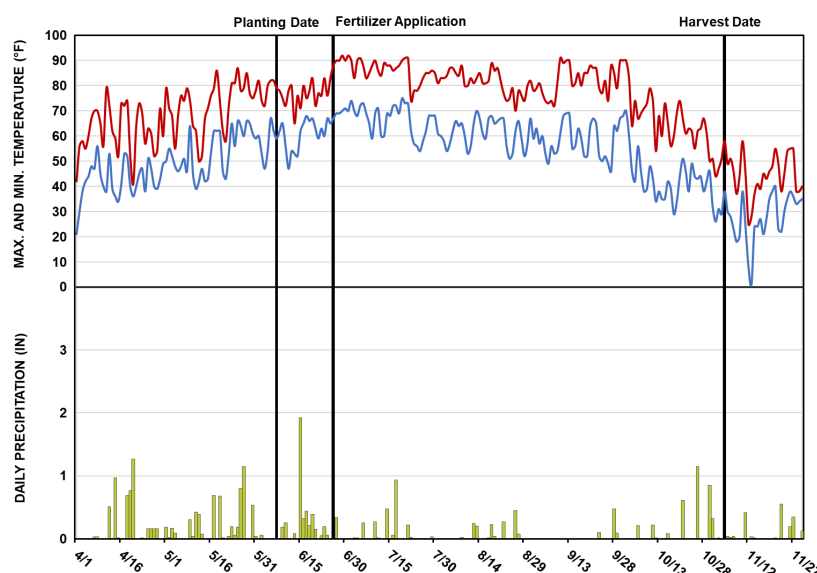
OSU Extension

Darke County

STUDY INFORMATION

Planting Date	6/7/2019
Harvest Date	11/4/2019
Variety	Golden Harvest E109R#-3000GT
Population	VR - Avg. 33,914
Acres	70
Treatments	2
Reps	3
Treatment Width	30 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Celina silt loam, 39% Crosby silt loam, 32% Brookston silty clay loam, 29%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.92	6.05	4.64	2.28	1.53	0.66	20.08
Cumulative GDDs	195	627	1234	2025	2682	3276	3276

STUDY DESIGN

In this study three replications were completed comparing the use of swine manure versus anhydrous at sidedress. Treatments were implemented at the V3 growth stage in this study. The combine was calibrated in season. Passes from the centers of the plots were harvested for treatment comparisons.



Manure sidedress was completed on the standing corn crop at V3 growth stage.

OBSERVATIONS

The stand count was compromised by two factors; 1. the late planting date and 2. the manure side dress applicator did not engage the sway blocks allowing the tool bar to be pulled sideways by the dragline hose resulting in a significant number of corn plants to be plowed out on in some areas of the field. This farm only received 4.32 inches of rain after it was side dressed on June 26 at V3.



SUMMARY

- The extreme weather conditions that this farm experienced in 2019 showed that manure when incorporated as a nitrogen source at side dress time will perform equally with anhydrous ammonium.



RESULTS

Source	Rate (lbs N/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
Swine Manure	200	27,000	19.6	163 a
Anhydrous	120	30,000	19.2	164 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 4.24 (NS) CV: 1.09%

TOOLS OF THE TRADE

Bazooka Farmstar Injection Toolbar

This toolbar was used with a 6 inch drag hose to inject manure into a standing corn crop at V3 growth stage.



PROJECT CONTACT

For inquiries about this project, contact Sam Custer (custer.2@osu.edu).

OBJECTIVE

Evaluate the effectiveness of dragline application of liquid swine manure as an economic and environmental alternative to commercial corn sidedress fertilizer.



eFields Collaborating Farm

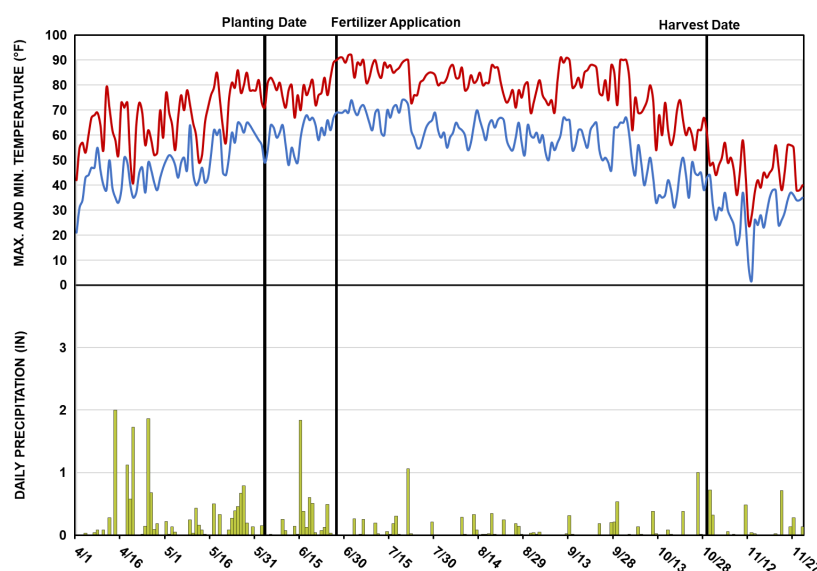
OSU Extension

Darke County

STUDY INFORMATION

Planting Date	6/3/2019
Harvest Date	10/29/2019
Variety	Pioneer 9998 AM
Population	35,800
Acres	40
Treatments	2
Reps	3
Treatment Width	30 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Pewamo silty clay loam, 66% Blount silt loam, 25% Patton silty clay loam, 9%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	8.90	5.17	4.83	2.58	1.71	1.56	24.75
Cumulative GDDs	182	598	1192	1975	2619	3200	3200

STUDY DESIGN

In this study three replications were completed comparing the use of swine manure versus anhydrous at sidedress. Treatments were implemented at the V3 growth stage in this study. The combine was calibrated in season. Passes from the centers of the plots were harvested for treatment comparisons.



Bazzooka Farmstar toolbar being prepped for dragline manure application.

OBSERVATIONS

The field was weed free and the stand was good post manure application. The dragline reduced the stand by about 3%.



SUMMARY

- In this year of extremes the manure sidedress performed very well as it has done in the past in years of extreme even with a late planting and late manure application.
- Seven years of manure sidedress dragline work with this cooperator showed an average yield boost over 18 bushels per acre per year.



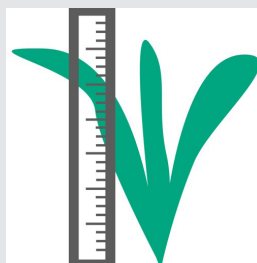
RESULTS

Source	Rate (lbs N/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
Swine Manure	200	31,000	19.1	195 a
28%	200	31,000	18.2	168 b
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 10.97 CV: 2.53%

TOOLS OF THE TRADE

Precision Planting Research Pogo

Precision Planting's Research Pogo allows growers to complete emergence stand counts as well as spacing for all crops and row spacings. This allows the Digital Ag Team to run metrics and complete analysis for different studies.



PROJECT CONTACT

For inquiries about this project, contact Sam Custer (custer.2@osu.edu).



OBJECTIVE

Investigate the agronomic benefits of distributing weight from the center section of a planter to the wings with wing downforce technology.



eFields Collaborating Farm

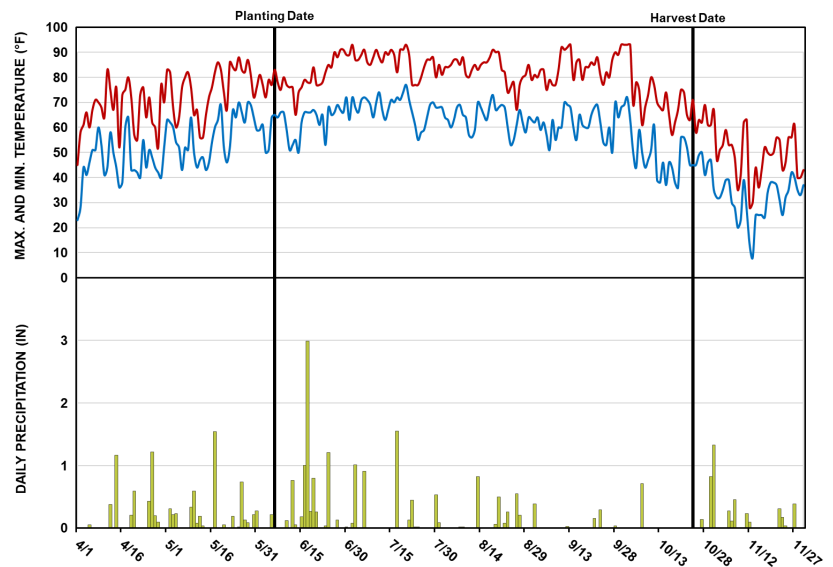
OSU Extension

Pickaway County

STUDY INFORMATION

Planting Date	6/6/2019
Harvest Date	10/24/19
Variety	Beck's 6076 SX
Population	36,000
Acres	87
Treatments	4
Reps	6
Treatment Width	40 ft.
Tillage	Minimal
Management	Fertilizer, Fungicide, Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Casco Rodman gravelly loam, 16% Edean Loam, 30% Ross silt loam, 35% Westland clay loam, 19%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.35	5.27	8.06	4.82	2.53	0.93	25.96
Cumulative GDDs	281	799	1417	2229	2941	3606	3606

STUDY DESIGN

This study used a 16 row Case IH Early Riser planter equipped with wing downforce. Four treatments ranging from 0-800 lbs were replicated three times using a Case IH 380 Magnum half track. Additional seed bags were used to make sure the weight was consistent between treatments on the planter.



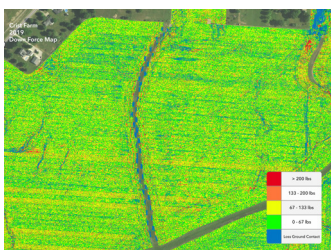
CASE 2150 planter utilizing wing downforce to plant study.

OBSERVATIONS

Transferring weight from the center of the planter to the wings provides more consistent downforce on each row unit which can lead to more consistent planting depth and emergence.

From the cab, at higher pressures the wings appeared to stay in the ground better, with less “floating” compared to 0 lbs of downforce.

A few weeks before harvest, a large windstorm went through and took some of the corn down.



SUMMARY

- There was no statistical difference in yield between treatments.
- Some ponding water early in the season and lack of rain late in the season were the only yield limiting factors.



RESULTS

Wing Downforce (lbs)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
0	30,600	20.1	198 a
300	28,333	20.2	196 a
600	28,000	20.1	198 a
800	30,833	20.3	198 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 2.99 (NS) CV: 0.95%

TOOLS OF THE TRADE

Miller Nitro 7370

The Miller Nitro with 72 inches of ground clearance allows growers to apply fungicide, nitrogen, and cover crop to the corn crop late in the growing season.



PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein (klopfenstein.34@osu.edu) or Ryan Tietje (tietje.4@osu.edu).



OBJECTIVE

To summarize the optimum corn planting window for Ohio with comparison to several US corn production states.



eFields Collaborating Farm

OSU Extension

Statewide

METHODS

The Ohio Agronomy Guide outlines the recommended planting window for corn for Ohio. Similarly, other state's Land-grant institutions report data that reflects planting date (PD) and the impact on corn yield. Ohio's corn planting date curve was compared to other 13 other state's within the US corn belt. Further, a polynomial regression line was fit to Ohio's data over the range of April 23rd to June 23rd and can be used to estimate potential yield based on planting date.

RESULTS

The recommended time for planting corn in Ohio is as follows (Ohio Agronomy Guide, 2018):

- Northern Ohio, April 15 to May 10
- Southern Ohio, April 10 to May 10.

Figure1 illustrates the optimum corn PD to the highest yield in Ohio is late April, the yield begin to decline gradually after May, approximately 1 to 1.5 bushels per day for planting delayed beyond the first week of May (2017 Ohio Agronomy Guide).

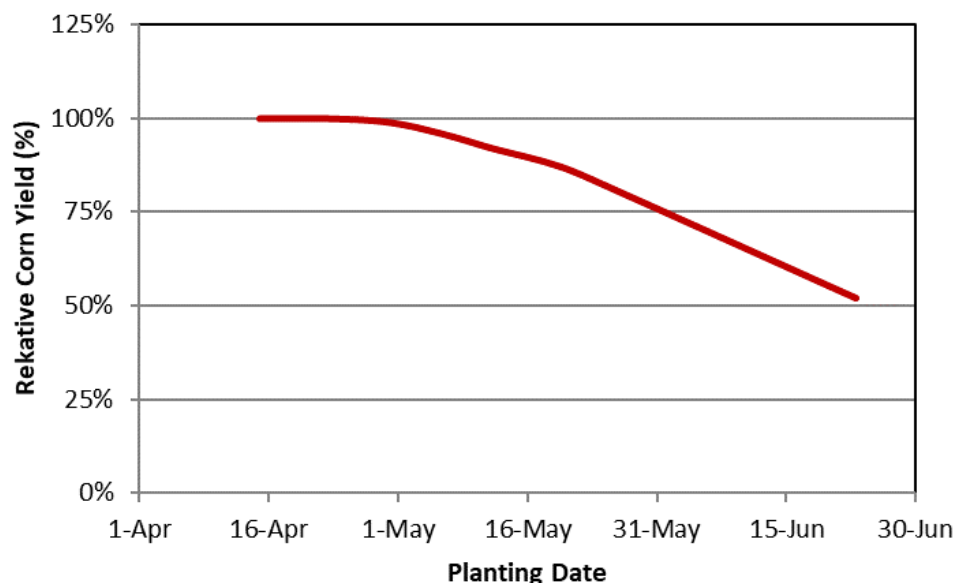


Figure1. Corn planting date effects yield (Ohio Agronomy Guide, 15th Edition, 2017).

$$y = -8e^{-0.05} x^2 + 7.0228x - 152952 \quad (R^2 = 0.9984) \quad \text{Equation 1}$$

Where y = % relative corn yield and x = planting date (PD) represented by a whole number starting from the date 1/1/1900. To use the equation, April 1 = 43556 and April 16 = 43,571.

Of all fourteen states evaluated from the eastern U.S., the corn planting date of Mississippi is the earliest, with the optimum planting date beginning on March 25 (Figure 2), then followed by Arkansas, Kansas, Tennessee, Missouri, Illinois, Kentucky and Iowa. The seventh and eighth ranked states by planting date are Ohio and Indiana, with the optimum time for planting corn beginning on April 20 and April 25, respectively. The last two states are Wisconsin and North Dakota, where the planting date for maximum potential yield will begin on May 1 and May 4, respectively.

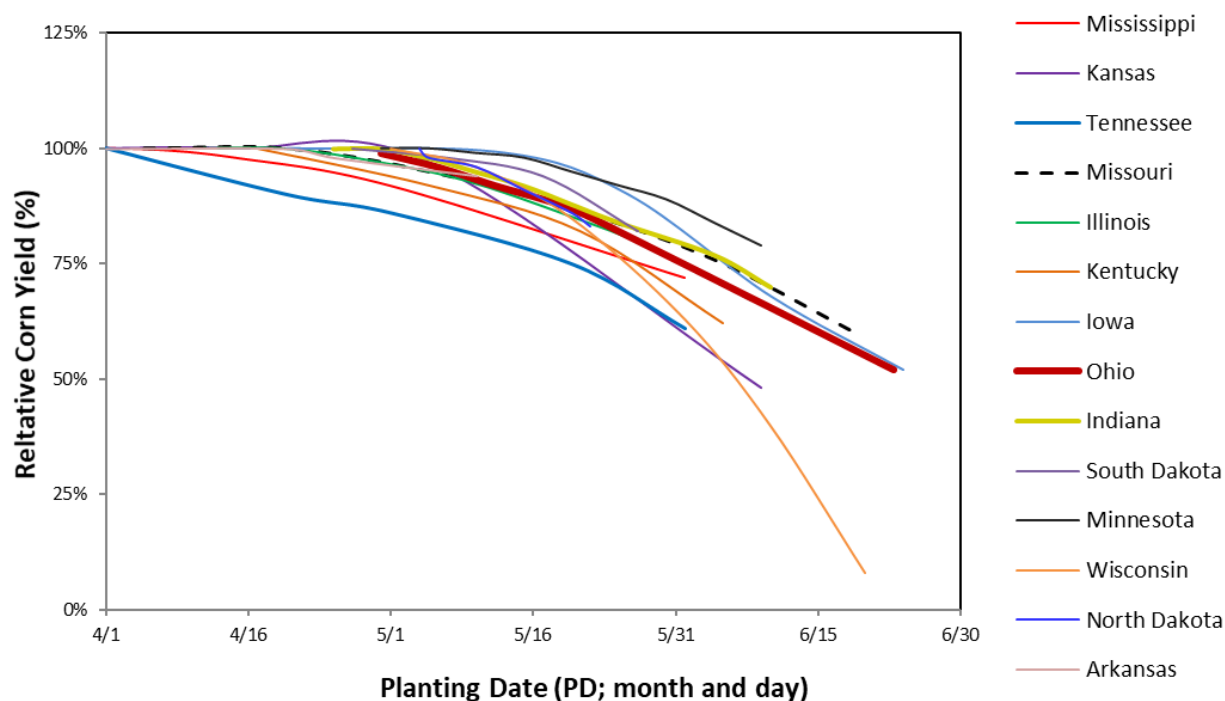


Figure 2. Corn planting dates versus yield for different US corn-producing states with Ohio highlighted with a scarlet color.

SUMMARY

- The optimum time for planting corn for highest yield potential in Ohio is between April 20 and May 10.
- The latest practical agronomic date to plant corn ranges from about June 15 in northern Ohio to July 1 in southern Ohio. Planting after these dates can greatly reduce yield.
- Weather impacts planting date along with corn yield so deviations from the average line are expected based on the growing conditions within an individual year.

Year	Yield (Bu/A)	Planting Period (Planting Date)
2014	176	April 23-June 14
2015	153	April 23-June 8
2016	159	April 20-June 6
2017	177	April 20-June 4
2018	187	April 22-June 10
2019	TBD	April 20-June 10

RESOURCES

- Ohio Agronomy Guide, 15th Edition, 2017. Bulletin 472. Ohio State University Extension. extensionpubs.osu.edu/ohio-agronomy-guide-15th-edition/
- USDA reports.
- Agronomy and Hand Guides from 13 land-grant institutions.

PROJECT CONTACT

For inquiries about this project, contact Alex Lindsey (lindsey.227@osu.edu).

This information was compiled by Yongying Sang, Visiting Scholar, Food, Agriculture and Biological Engineering (sang.68@osu.edu).



OBJECTIVE

Understand the yield impact of varying corn seeding rate within Ohio considering in-field variability and cultural practices implemented. Information from these trials are being used to improve management recommendations for growers throughout Ohio and help understand how variable-rate seeding may impact field by field profitability.

STUDY DESIGN

The primary recommendations for seeding rates in Ohio are determined by target final stands and average soil productivity. Variable rate seeding prescriptions have the potential to better match seeding rate to productivity zones in an effort to optimize profits. Field studies were implemented in a strip-trial format and replicated at least three times with the fields. Results for individual sites plus aggregated pooled analyses were conducted.

TOOLS OF THE TRADE

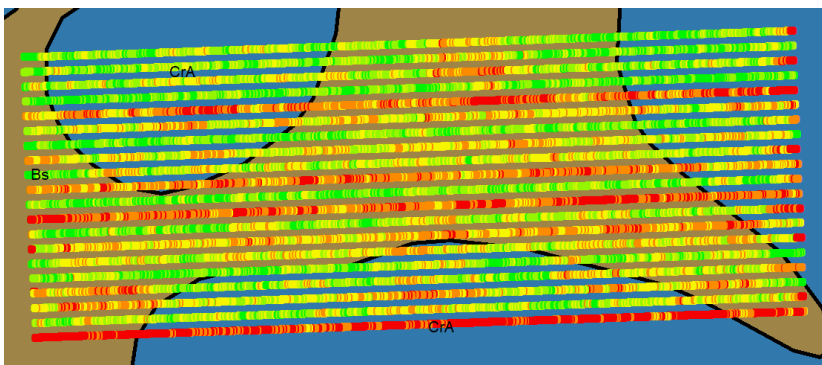
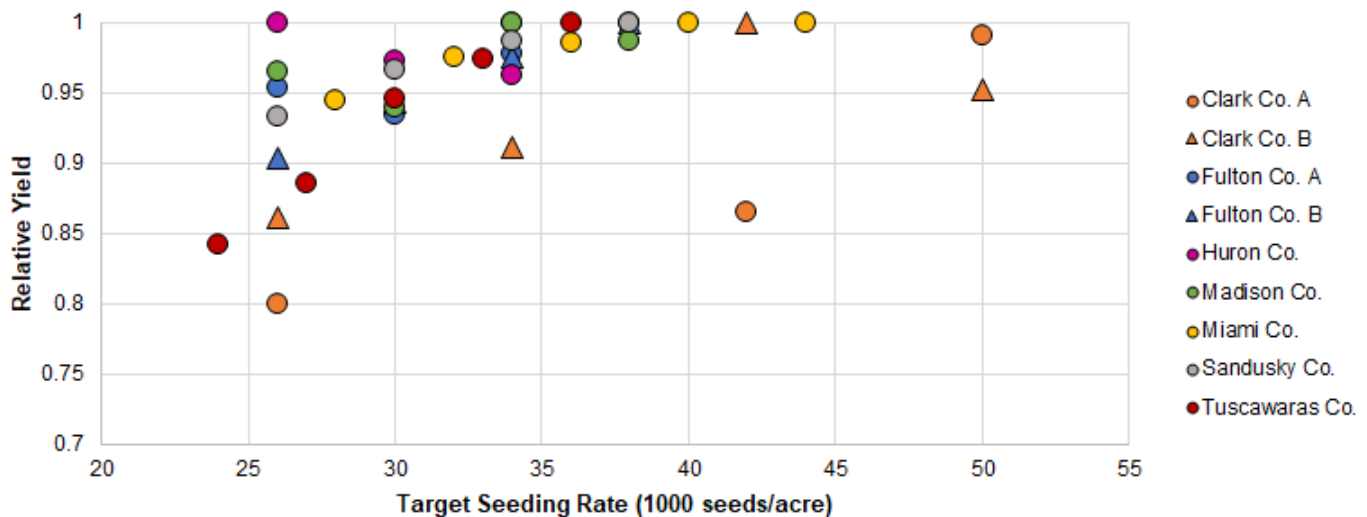
FieldView Cab

The FieldView Cab app for iPads is a farm management app for data collection and reporting. This app features real-time documentation of field operations.



SUMMARY

- Across all sites, the average corn stand was 93% of the target rate with individual sites ranging between 80% and 99%.
- Variation in corn yield was primarily caused by differences in location and not differences in seeding rate in 2019.
- There was a significant response to corn seeding rate at 6 out of 9 sites in 2019.



Spatial analysis of strip trials allows us to identify data layers that can help create variable rate prescriptions. This example shows the yield map from a seeding rate trial overlaying a USDA soil type map. In this field, the response to seeding rate did not vary based on soil type; therefore, soil type maps are likely not good data layer for making variable rate prescriptions in this field. The return on investment of variable rate seeding may be different for each field and each year. On-farm research like these trials can help collect farm-specific data to make sound decisions.

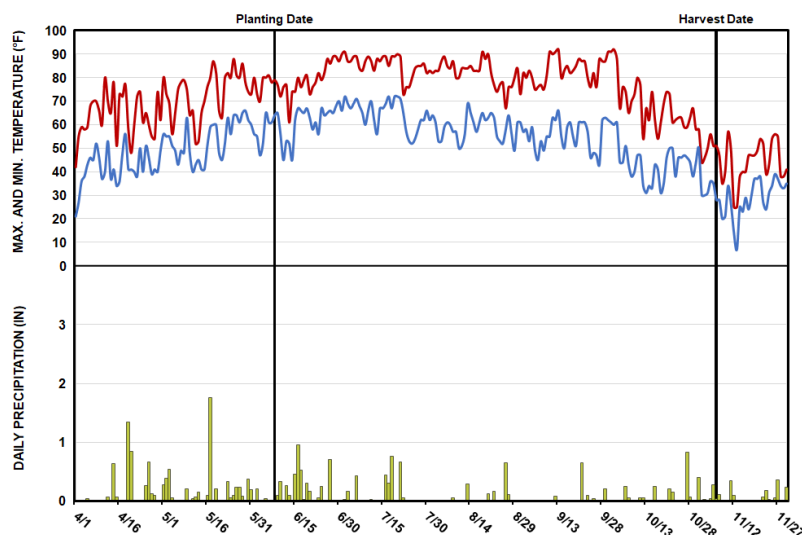
STUDY INFORMATION

Planting Date	6/8/19
Harvest Date	11/6/19
Variety	LG 59C46
Population	See Treatments
Acres	1
Treatments	4
Reps	4
Treatment Width	10 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Kokomo silty clay loam, 100%



Western Agricultural Research Station

Clark County A



PROJECT CONTACT

For inquiries about this project, contact John Fulton (fulton.20@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.2	5.41	4.45	2.87	1.41	1.10	19.44
Cumulative GDDs	222	671	1256	2018	2644	3225	3255

RESULTS

Treatments (seeds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
26,000	24,767	22.4	218 a	737
34,000	32,608	22.5	272 a	915
42,000	37,960	21.4	235 a	746
50,000	45,178	22.5	269 a	847
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 62.83 (NS) CV: 19.50%	



STUDY INFORMATION

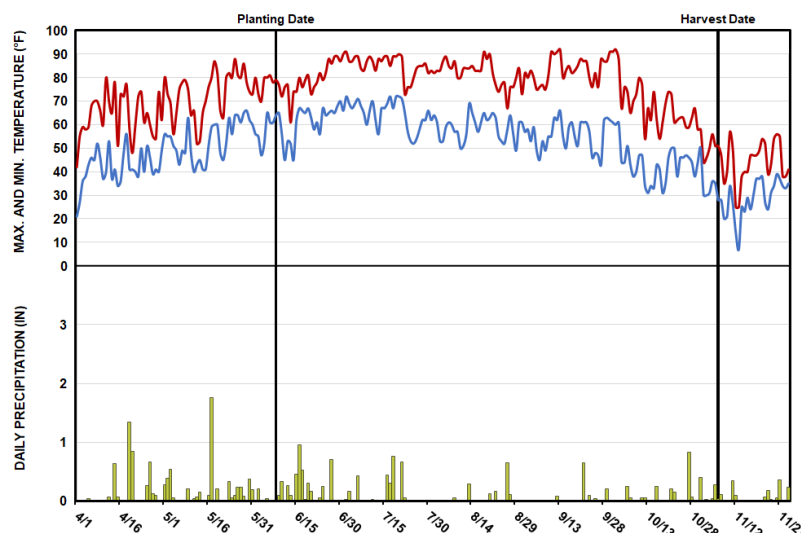
Planting Date	6/8/19
Harvest Date	11/6/19
Variety	LG 59C66
Population	See Treatments
Acres	1
Treatments	4
Reps	4
Treatment Width	10 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Kokomo silty clay loam, 100%



Western Agricultural Research Station

Clark County B

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact John Fulton (fulton.20@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.20	5.41	4.45	2.87	1.41	1.10	19.44
Cumulative GDDs	222	671	1256	2018	2644	3225	3225

RESULTS

Treatments (seeds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
26,000	25,389	21.8	209 a	703
34,000	30,368	21.7	220 a	717
42,000	36,591	21.3	242 a	773
50,000	45,054	21.8	231 a	703
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 24.11 (NS) CV: 8.25%	

STUDY INFORMATION

Planting Date	6/8/2019
Harvest Date	11/9/2019
Variety	Rupp D07-03
Population	See Treatments
Acres	9
Treatments	5
Reps	4
Treatment Width	15 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Gilford fine sandy loam, 47% Ottokee fine sand, 33% Tedrow loamy fine sand, 20%

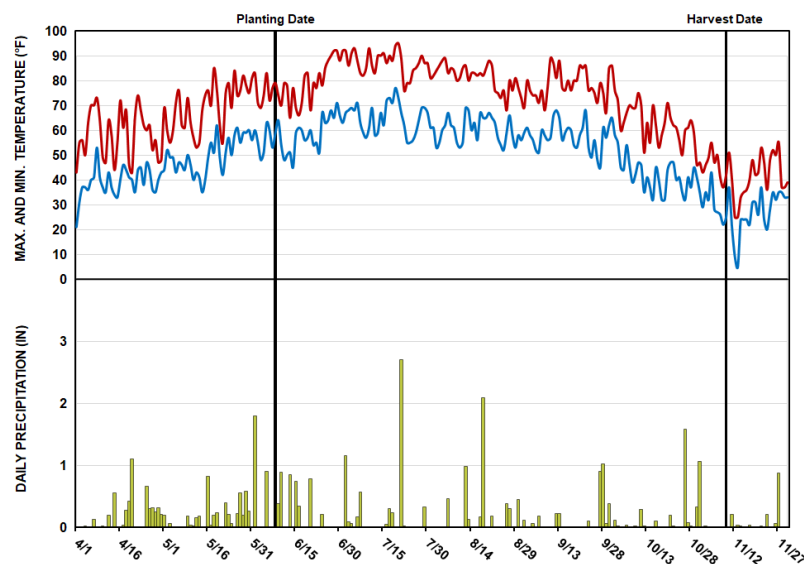


eFields Collaborating Farm

OSU Extension

Fulton County A

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Eric Richer (richer.5@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.91	4.67	6.93	5.78	5.20	3.40	30.89
Cumulative GDDs	141	482	1018	1783	2424	2958	2958

RESULTS

Treatments (seeds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
26,000	24,600	20.5	214 a	721
30,000	28,100	19.9	209 a	690
34,000	30,900	21.2	219 a	713
38,000	32,000	20.6	224 a	718
Variable Rate	30,200	20.2	222 a	N/A
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 14.20 (NS) CV: 4.30%	



STUDY INFORMATION

Planting Date	6/8/2019
Harvest Date	11/9/2019
Variety	Rupp D10-19
Population	See Treatments
Acres	9
Treatments	5
Reps	4
Treatment Width	15 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Gilford fine sandy loam, 47% Ottokee fine sand, 33% Tedrow loamy fine sand, 20%

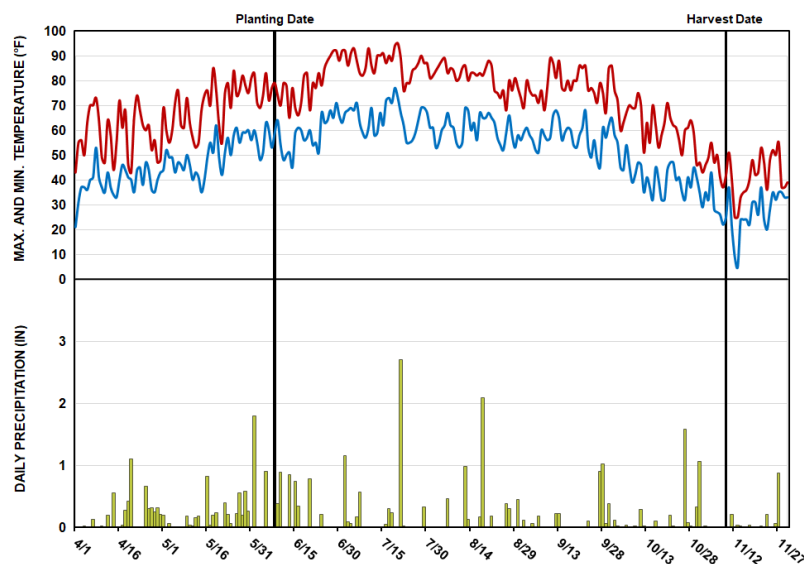


eFields Collaborating Farm

OSU Extension

Fulton County B

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Eric Richer (richer.5@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.91	4.67	6.93	5.78	5.20	3.40	30.89
Cumulative GDDs	141	482	1018	1783	2424	2958	2958

RESULTS

Treatments (seeds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
26,000	25,100	21	205 b	686
30,000	28,600	20.9	214 ab	707
34,000	32,000	21.3	221 a	720
38,000	36,800	20.4	227 a	728
Variable Rate	35,000	20.1	222 a	N/A
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 10.40 CV: 3.15%	

STUDY INFORMATION

Planting Date	5/10/2019
Harvest Date	10/19/2019
Variety	Pioneer P1197
Population	See Treatments
Acres	20
Treatments	3
Reps	3
Treatment Width	40 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Kibbie fine sand loam, 82% Colwood loam, 10% Pewamo silty clay loam, 8%

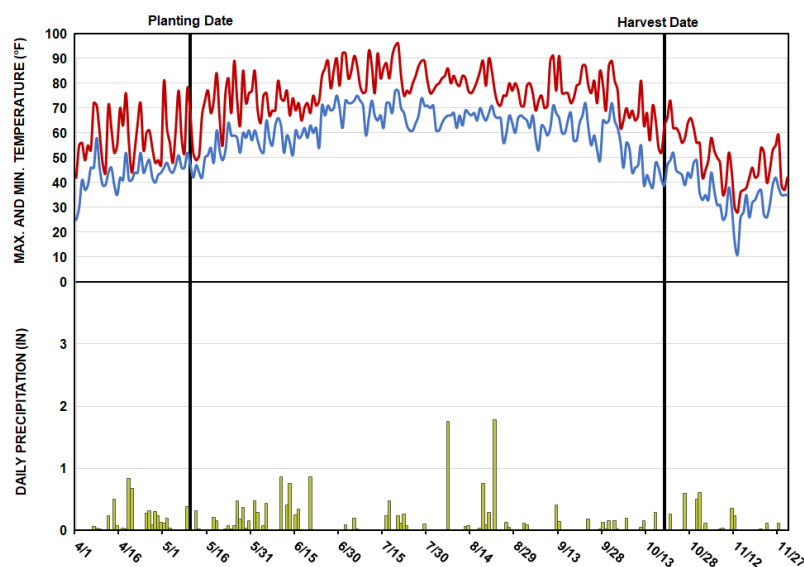


eFields Collaborating Farm

OSU Extension

Huron County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Mike Gastier (gastier.3@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.84	2.90	4.73	1.82	5.03	1.28	18.32
Cumulative GDDs	129	462	1001	1800	2498	3098	3098

RESULTS

Treatments (seeds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
26,000	26,067	17.7	215 a	726
30,000	29,833	18.1	209 b	689
34,000	34,067	17.7	207 b	668
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 4.30 CV: 1.18%	



STUDY INFORMATION

Planting Date	5/11/2019
Harvest Date	10/18/2019
Variety	LG5618VT2RIB
Population	See Treatments
Acres	227
Treatments	5
Reps	4
Treatment Width	60 ft.
Tillage	No-Till
Management	Fertilizer, Fungicide, Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Kokomo silty clay loam, 54% Crosby-Lewisberg silt loam, 46%

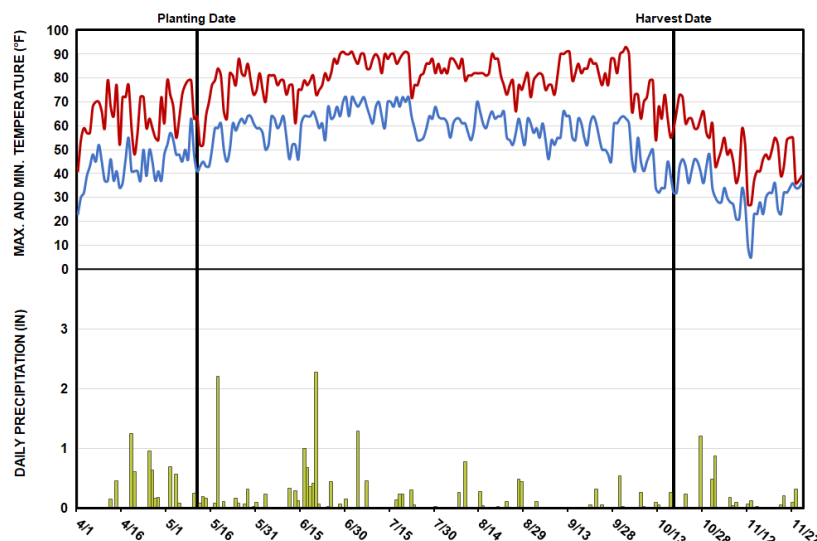


eFields Collaborating Farm

OSU Extension

Madison County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact John Fulton (fulton.20@osu.edu) or Jason Carey, Digital Ag Field Specialist, AgReliant (jason.carey@agrelant.com).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.43	5.17	6.44	2.72	2.43	1.10	22.29
Cumulative GDDs	209	644	1231	2005	2645	3233	3233

RESULTS

Treatments (seeds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
26,000	25,938	14.9	164 ab	532
30,000	29,438	14.7	160 b	503
34,000	33,188	14.7	170 a	527
38,000	37,250	14.8	168 ab	505
VR	32,438	14.8	166 ab	N/A
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 9.33 CV: 4.47%	

STUDY INFORMATION

Planting Date	5/16/2019
Harvest Date	10/5/2019
Variety	Ebberts 9121SSX
Population	See Treatments
Acres	111
Treatments	5
Reps	4
Treatment Width	60 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	15 in.
Soil Type	Eldean loam, 75% Westland silty clay loam, 15% Warsaw silt loam, 10%

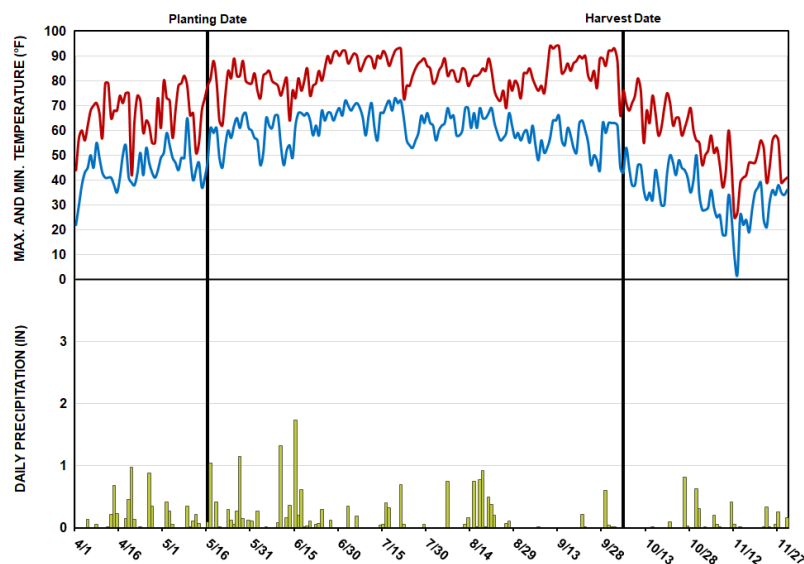


eFields Collaborating Farm

OSU Extension

Miami County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Amanda Bennett (bennett.709@osu.edu) or John Fulton (fulton.20@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.31	5.35	5.45	2.16	4.70	0.88	22.85
Cumulative GDDs	163	634	1248	2024	2691	3299	3299

RESULTS

Treatments (seeds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
28,000	26,929	19.8	242 a	822
32,000	30,530	19.7	250 b	838
36,000	34,086	19.6	253 bc	835
40,000	37,436	19.7	256 c	833
44,000	41,533	19.4	257 c	823
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 4.09 CV: 1.29%	



STUDY INFORMATION

Planting Date	5/26/2019
Harvest Date	11/4/2019
Variety	Pioneer P0506
Population	See Treatments
Acres	27
Treatments	4
Reps	4
Treatment Width	60 ft.
Tillage	Minimal
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Hoytville Clay loam, 45% Nappanee silt loam, 34% Kibbie fine sandy loam, 11% Haskins sandy loam, 10%

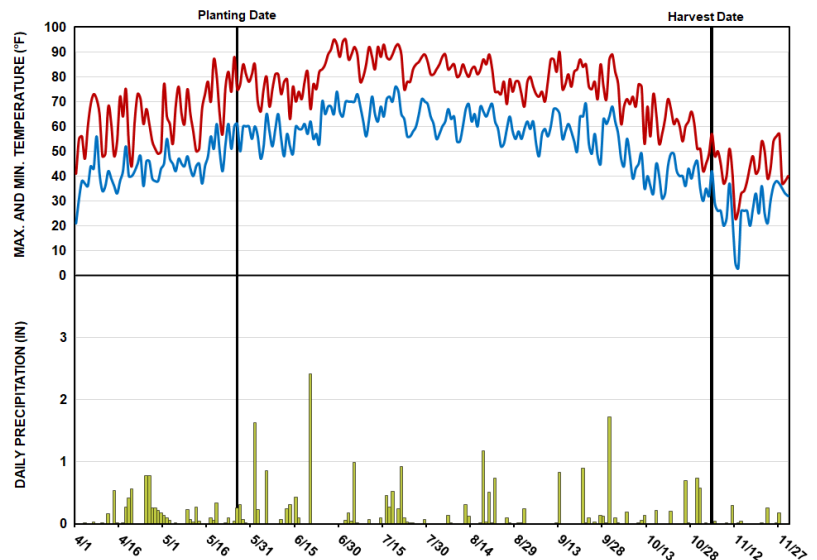


eFields Collaborating Farm

OSU Extension

Sandusky County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Al Gahler (gahler.2@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.46	2.21	6.26	4.07	3.20	4.08	24.28
Cumulative GDDs	152	521	1074	1859	2502	3055	3055

RESULTS

Treatments (seeds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
26,000	21,500	20.4	177 a	582
30,000	23,750	20.4	183 ab	590
34,000	25,375	20.6	187 b	592
38,000	31,375	20.3	190 b	589
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 7.71 CV: 3.23%	

STUDY INFORMATION

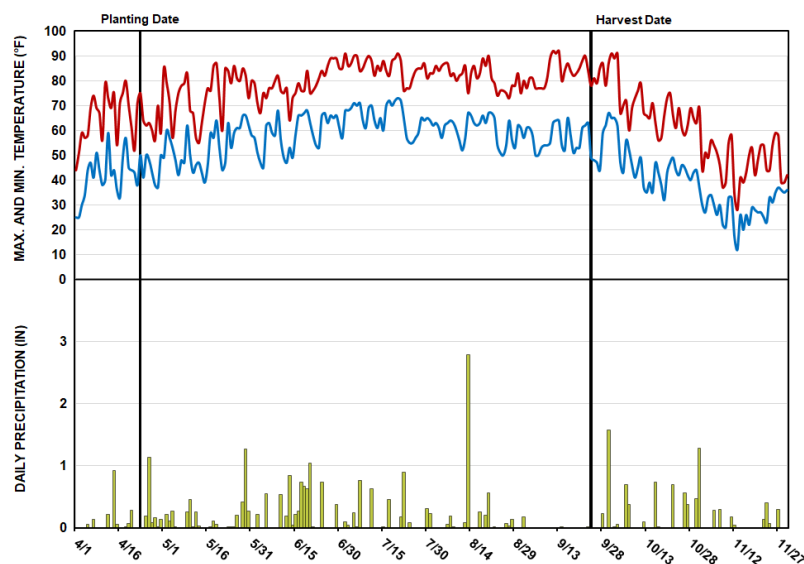
Planting Date	4/23/2019
Harvest Date	9/24/2019
Variety	Channel 210-95STX
Population	See Treatments
Acres	77
Treatments	4
Reps	4
Treatment Width	30 ft.
Tillage	No-Till
Management	Yes
Previous Crop	Soybeans
Row Spacing	30 in.
Soil Type	Chili silt loam, 84% Conotton gravelly loam, 16%



eFields Collaborating Farm

OSU Extension
Tuscarawas County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Chris Zoller (zoller.1@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.45	4.01	7.04	3.95	4.39	2.01	24.85
Cumulative GDDs	237	710	1273	2037	2685	3267	3267

RESULTS

Treatments (seeds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
24,000	22,080	24.8	236 a	813
27,000	26,600	24.4	248 b	848
30,000	28,800	24.4	265 c	902
33,000	31,350	24.1	273 d	922
36,000	34,920	24.6	280 e	938
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 5.42 CV: 1.65%	



For 2019, eFields soybean research was focused on improving the production and profitability of soybeans in the greater Ohio area. Some exciting and innovating projects were executed this year, with 23 studies being conducted across the state. 2019 soybean research presented in eFields covers both precision seeding and compaction management Digital Ag Team initiatives. Below are highlights of some of the 2019 eFields soybean research:

1,387 acres

23 soybean studies

For more soybean research from The Ohio State University's Department of Extension, explore the following resources:

2019 Ohio Soybean Performance Tests

The purpose of the Ohio Soybean Performance Trials is to evaluate soybean varieties for yield and other agronomic characteristics. This evaluation gives soybean producers comparative information for selecting the best varieties for their unique production systems. For more information visit: go.osu.edu/OhioSoybean.



Agronomic Crops Team - Soybean Research

The Agronomic Crops Team performs interesting research studies on a yearly basis. Resources, fact sheets, and articles on soybean research can be found here on the Agronomic Crops Team website: go.osu.edu/CropsTeamSoybean.



The Ohio State Digital Ag Program

The Ohio State Digital Ag Program conducts studies related to all aspects of the soybean production cycle. Research related to soybean planting, inputs, and harvesting technology can be found on the Digital Ag website: digitalag.osu.edu.



Growth Stages - Soybeans

For all soybean studies in this eFields report, we define soybean growth stages as the following:

VE - Emergence - Cotyledons appear above the soil surface and provide nutrients for 7 to 10 days.

VC - Cotyledons have fully expanded and unifoliate leaves have unfolded.

V1 - First Trifoliate: Second true node, first node at which a trifoliate leaf is produced. Nodules visible.

V2 - Two fully developed trifoliates unfolded. The plant is roughly 8 in. tall. Nodules are actively fixing nitrogen. Cotyledons have fallen off plant.

V3 - V4 - A dramatic increase in the number of nodules visible on roots takes place by these stages.

V5 - VN - Lateral roots extend 15 in. away from main stem and grow to the center of 30 in. rows. Branches begin developing on the lowest nodes. Total number of nodes the plant may produce is set at V5.

R1 - Beginning Bloom - one flower is open at any node on the main stem.

R2 - Full Bloom - An open flower at one of the two uppermost nodes of the main stem with a fully developed leaf.

R3 - Beginning Pod - Pods are 3/16 in. long at one of the four uppermost nodes on the main stem.

R4 - Full Pod - Pod is 3/4 in. long at one of the four uppermost nodes on the main stem. This the most critical period for seed yield.

R5 - Beginning Seed - Seed in one of the four uppermost nodes with fully developed leaves is 1/8 in. long.

R6 - Full Seed - Pod containing a green seed filling the pod cavity is present at one of the top four nodes.

R7 - Beginning Maturity - One normal pod on the main stem has reached its mature pod color.

R8 - Full Maturity - Ninety-five percent of the pods on the plant have reached their mature color. Approximately 5 to 10 days of good drying weather is needed to bring crop to less than 15% moisture.

Adapted from Stewart Seeds Corn and Soybean Growth Stages Guide, 2013.

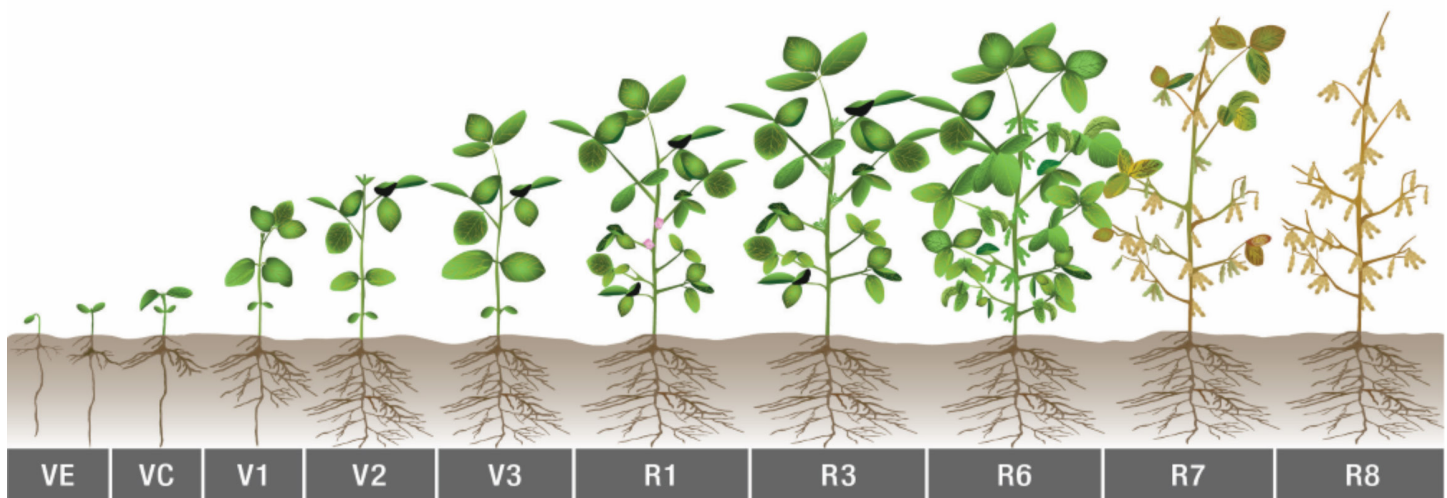


Image Source: University of Illinois Agronomy Guide, 1999.



OBJECTIVE

Measure soybean yields to show impacts of fungicide and insecticide treatments.



eFields Collaborating Farm

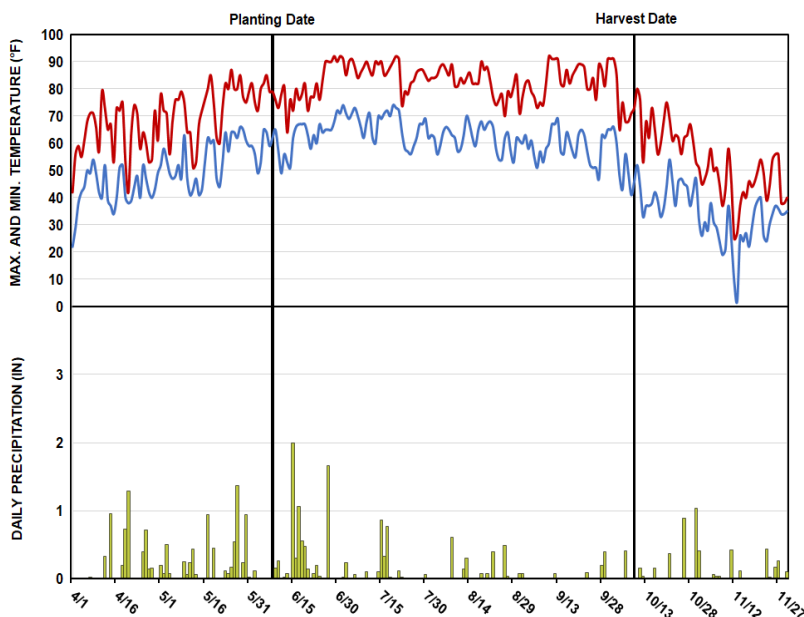
OSU Extension

Darke County

STUDY INFORMATION

Planting Date	6/8/2019
Harvest Date	10/9/2019
Variety	Beck's 387R4
Population	165,000
Acres	20
Treatments	3
Reps	3
Treatment Width	60 ft.
Tillage	No-Till
Management	Fungicide, Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	15 in.
Soil Type	Crosby silt loam, 63% Celina silt loam, 19% Brookston silty clay loam, 18%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.98	6.78	7.13	2.70	2.20	0.82	24.61
Cumulative GDDs	209	653	1256	2057	2735	3354	3354

STUDY DESIGN

This study was organized as a randomized complete block with three replications. Treatment widths were 90 feet at field length. Combine yield monitor was used for measurement of yields and it was calibrated in season.



Application of fungicide treatment was completed on July 24 at a rate of 13.7 ounces per acre.

OBSERVATIONS

Light Frogeye pressure and very little insect pressure was observed.

Defoliation of leaves within and outside of the treatments was less than 20% in both the vegetative and reproductive plant stages.

SUMMARY

- There was a statistical difference in moisture levels across treatments with the fungicide treatment being the driest this year.
- There was no statistical difference in yield in 2019 which may be attributed to very light frogeye and insect pressure.



RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above (\$/ac)
No Application	141,000	12.1	55 a	479
Fungicide Only	140,500	11.9	54 a	449
Fungicide and Insecticide	142,500	12.0	57 a	477
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 3.06 (NS) CV: 3.17%	

TOOLS OF THE TRADE

DJI Phantom Drone

Drones, such as this DJI Phantom can be a useful tool not only to identify color differences in research plots, but also to identify problem areas in a field that may be affected by pests or disease. Identifying these areas can allow for a "directed scouting" approach.



PROJECT CONTACT

For inquiries about this project, contact Sam Custer (custer.2@osu.edu).



OBJECTIVE

Determine soybean yield response to foliar fungicide.



eFields Collaborating Farm

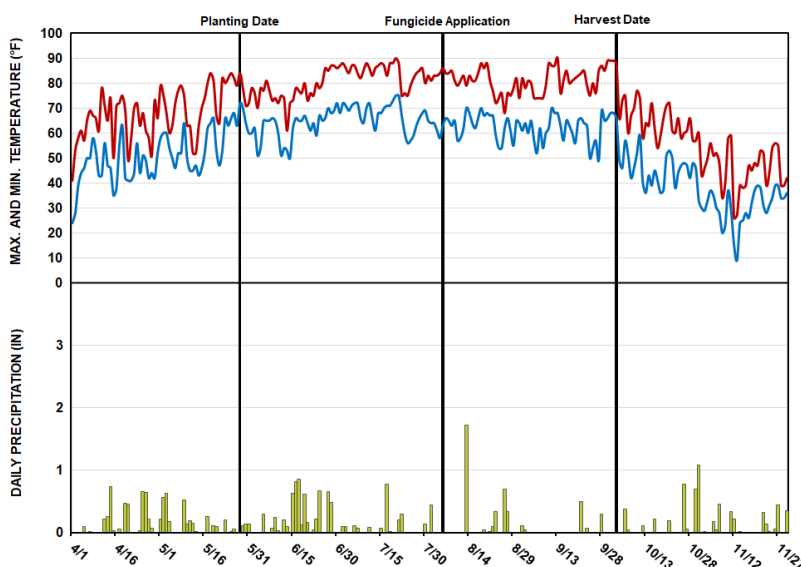
OSU Extension

Highland County

STUDY INFORMATION

Planting Date	5/28/2019
Harvest Date	10/3/2019
Variety	Pioneer P39T28X
Population	170,000
Acres	36
Treatments	2
Reps	3
Treatment Width	90 ft.
Tillage	No-Till
Management	Fungicide, Insecticide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Celina-Xenia silt loam, 60% Miami silt loam, 22% Brookston silt loam, 19%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.94	3.69	6.18	1.93	3.68	1.01	20.43
Cumulative GDDs	235	707	1301	2098	2770	3404	3404

STUDY DESIGN

Frogeye leaf spot was diagnosed in this field during in-season scouting. Fungicide was applied in replicated strips across the field to control the disease and yield impacts.

Treated plots consisted of the following spray rates: 15 gal water/ac, 3/4 lb Array (AMS), 6.8 oz/ac Approach Prima fungicide, 3.2 oz/ac Proaxis insecticide, and 7 oz/ac Biplomat crop oil.



The field above was scouted in August. The field was barely over threshold for frog eye leaf spot with approximately 3-4 lesions in 25 feet of a row.

OBSERVATIONS

The field was scouted prior to spray application in early August. At this time frog eye lesions were observed on plant leaves throughout the field. The number of lesions exceeded the threshold triggering a recommendation to make a fungicide treatment. That treatment was made on August 5th. In general, the field looked healthy and yield potential was high.

Disease symptoms did not spread likely because of a combination of the fungicide treatment and weather conditions not being favorable.

SUMMARY

- Even though there was low disease pressure, there was still a significant yield response to the fungicide treatment.
- It is important to scout for disease pressure to see a return on investment.



RESULTS

Treatments	Moisture (%)	Yield (bu/ac)
No Application	11.7	66 b
Fungicide	11.6	69 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 1.69 CV: 1.05%

TOOLS OF THE TRADE

TTI11004-VP Turbo TeeJet Nozzle

The patented orifice design of this nozzle provides large, round passages to minimize plugging. Depending on the chemical, it produces large, air-filled drops through a Venturi air aspirator resulting in less drift.



PROJECT CONTACT

For inquiries about this project, contact Brooke Beam (beam.49@osu.edu).



OBJECTIVE

Understand the effects of foliar insecticides on soybeans and its impact on yield.



eFields Collaborating Farm

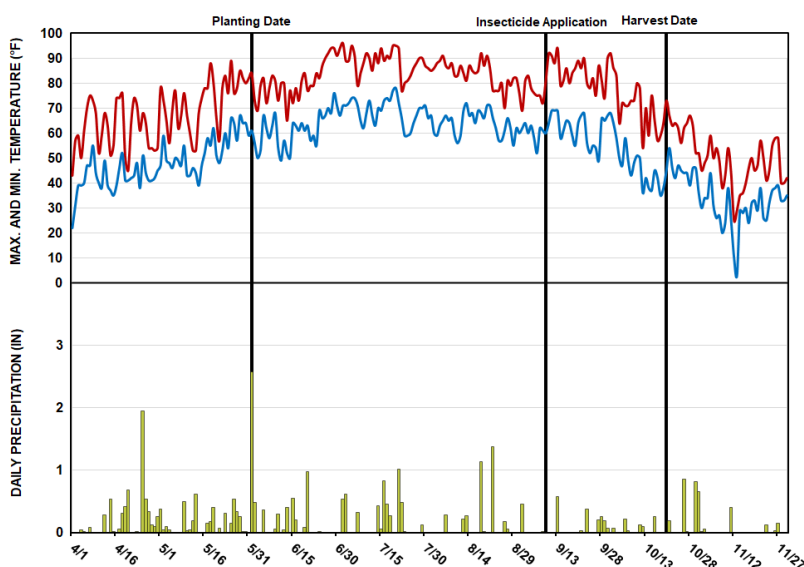
OSU Extension

Hancock County

STUDY INFORMATION

Planting Date	6/1/2019
Harvest Date	10/20/2019
Variety	USA282 LL
Population	107,488
Acres	1
Treatments	2
Reps	5
Treatment Width	45 ft.
Tillage	No-Till
Management	Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Pewamo silty clay loam, 75% Blount-Houcktown complex, 14% Blount silt loam, 11%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	5.69	4.29	6.02	5.15	3.54	2.15	26.84
Cumulative GDDs	183	611	1222	2060	2784	3421	3421

STUDY DESIGN

Study consisted of 2 treatments with 5 replications. Treatments consisted of no insecticide versus foliar insecticide treatment applied at Growth Stage R5. Plots were 45 feet wide and 800 feet long. The center 25 feet was harvested for grain yield. Yields were measured by a weigh wagon using a J Star Model 5 Scale. Harvest grain moisture was measured by an Agrontronix E-T-N moisture tester. Cavalry insecticide was applied at the rate of 2 oz/ac.



Field flags were used to identify and mark the locations of treatments in the field.

OBSERVATIONS

Soybean field matured earlier than other fields in the area, thus the concern that late feeding pod insects may move into this field first. Minimal insect activity was noted at the time of insecticide application except for a few leaf feeding insects, such as Japanese beetles and grasshoppers.

SUMMARY

- There was no evidence of pod feeding insects, such as stink bugs and bean leaf beetle at harvest.
- Insecticide application did not increase soybean yields.



RESULTS

Treatments	Moisture (%)	Yield (bu/ac)
Insecticide	9.5	69 a
No Insecticide	9.5	69 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 3.80 (NS) CV: 4.10%

TOOLS OF THE TRADE

Portable Weigh Wagon

Portable weigh wagons are an important tool in many studies to accurately measure grain weight at harvest.



PROJECT CONTACT

For inquiries about this project, contact Ed Lentz (lentz.38@osu.edu).

OBJECTIVE

Determine the effect of applying various soybean inputs in season on yield and economic outcomes. This includes sidedress and foliar applications.



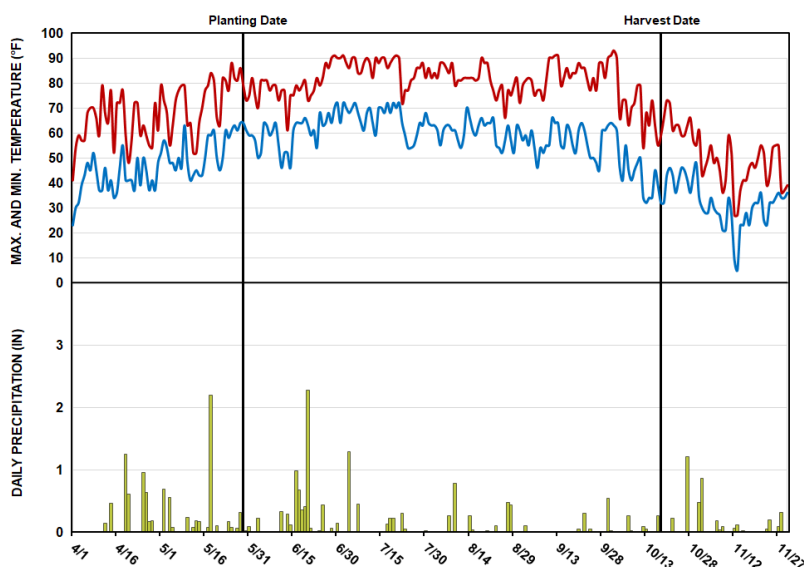
Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/29/2019
Harvest Date	10/18/2019
Variety	LGC3411RX
Population	140,000
Acres	58
Treatments	5
Reps	4
Treatment Width	120 ft.
Tillage	Minimal
Management	Fungicide, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	30 in.
Soil Type	Crosby-lewisburg silt loams, 60% Kokomo silty clay loams, 40%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.43	5.17	6.44	2.72	2.43	1.10	22.29
Cumulative GDDs	209	644	1231	2005	2645	3233	3233

STUDY DESIGN

This study was designed to evaluate the yield responses and economic outcomes of sidedress and foliar applied products to 30" soybeans in season. Thio-sul was used for a sulfur source applied at V3. Three Sunrise PCT products were evaluated including NutraBurst, FolrFeed, and GrainMaker. These were applied either Y-Drop Sidedress and/or foliar over the row by treatment. The average soil test levels for the study site are 3.8 OM, 15 CEC, 6.7 pH.



PCT mix was applied with Y-Drop at sidedress.

OBSERVATIONS

With a slightly later than normal planting date this study experienced late season drought conditions that uniformly limited the yield. Early season growing conditions were average resulting in uniform stands. Treatment applications were successful both sidedress and foliar. Treatments were bundled together based on availability and ease of application.

The extremely dry mid and later season this study experienced may have influenced yield enough to minimize the differences between treatments.



SUMMARY

- The PCT foliar mix treatment yield was significantly lower than the other treatments.
- In the future a study could be performed with more economical bundles of products or single product applications to manage ROI opportunity.



RESULTS

Treatments	Moisture (%)	Yield (bu/ac)	Return Above (\$/ac)
Thio-Sul	12.1	51 a	442
PCT Sidedress Mix	12.0	49 a	371
Check	12.0	48 a	432
PCT Foliar Mix	12.0	42 b	331
PCT NutraBurst Foliar	12.0	47 a	418
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 4.21 CV: 7.04%	

TOOLS OF THE TRADE

John Deere R4038 Sprayer with ExactApply Technology

The John Deere Sprayer used for the in season foliar application in this study provided individual nozzle control, turn compensation, pulse rate modulation, and nozzle by nozzle lighting. These attributes all assisted in product application.



PROJECT CONTACT

For inquiries about this project, contact Nate Douridas (douridas.2@osu.edu).

OBJECTIVE

To maximize yield potential of soybeans through strategic placement of varieties in different crop management zones.



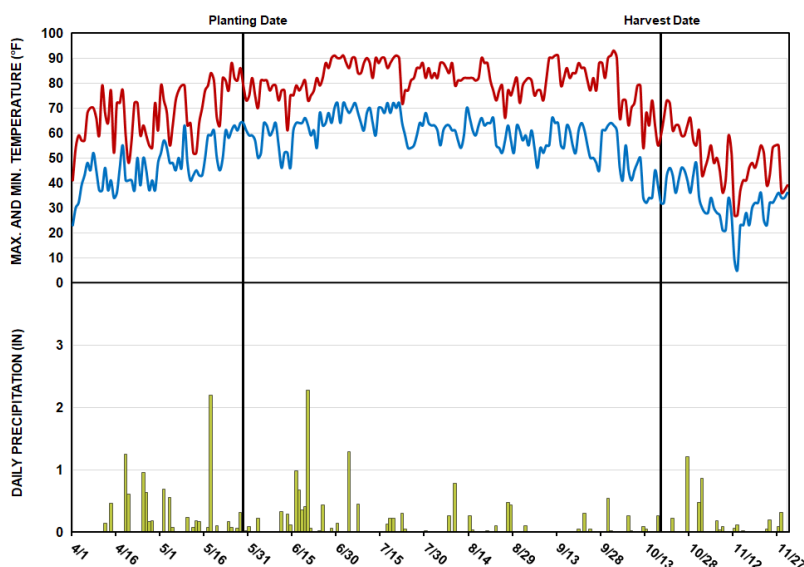
Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/26/2019
Harvest Date	10/18/2019
Variety	Pioneer P39T28X and Pioneer P31A22X
Population	120,000-170,000
Acres	109
Treatments	
Reps	
Treatment Width	
Tillage	Minimal
Management	Fungicide, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	30 in.
Soil Type	Crosby-lewisburg silt loams, 60% Kokomo silty clay loams, 40%

WEATHER INFORMATION

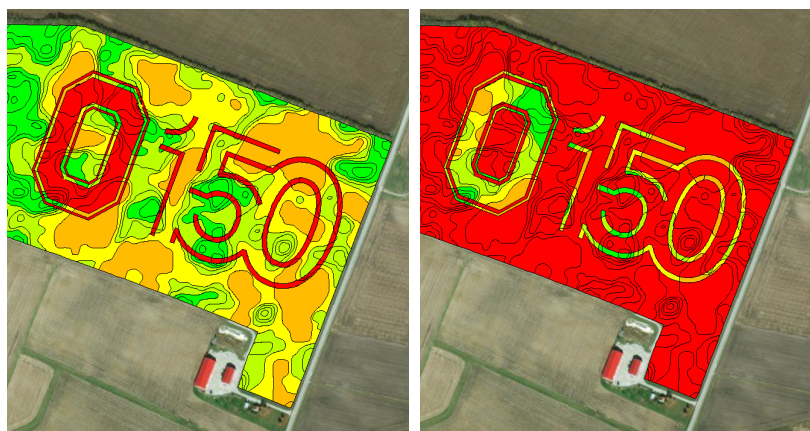


Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.43	5.17	6.44	2.72	2.43	1.10	22.29
Cumulative GDDs	209	644	1231	2005	2645	3233	3233

STUDY DESIGN

This year is the celebration of 150 years of The Ohio State University. With the huge success of the soybeans last year creating the world's largest script Ohio, there was no question soybeans would be used in 2019. This demonstration used the Precision Planting vSet Select technology with dual meters on each row unit. The planter can plant two different maturity beans at any time based on GPS location. This creates the design when the "logo" has reached maturity and begun to dry down while the other maturity is at the tail end of the vegetative stage and still green, thus creating the color differentiation. Ag Leader SMS Advanced computer software program was used to create the variably rate population and multi-variety prescriptions.



Two seeding prescriptions were used at the time of planting; variety prescription and population prescription.

OBSERVATIONS

Because of the late planting date the 30" rows never completely canopied making the logo more difficult to at the year of the growing season compared to years past.

The shorter growing season because of the late planting date did not allow as much time between maturity stages and therefore the resulting image is not as vibrant as last year.

SUMMARY

- There was only one opportunity to plant the logo field this year, and it was much later than ideal timing.
- Even though the same maturities were used as last year with the late timing the logo didn't turn out nearly as vibrant as it did last year.
- It was still a good way to demonstrate the current technology on planters and how far it has come over the years.



Prescription Generation

The SMS Advanced software package was used to generate a compound prescription of two varieties and variable rate seeding with four different rates. These prescriptions were then executed through the Precision Planting 20/20 SeedSense display. 30 in. row spacing was used to create the display.

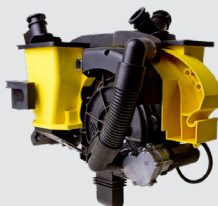
Variety Selection

The varieties selected for this study were chosen based off of the maturity dates for each variety. The varieties used in this year's design were 3.1 and 3.9 relative maturity soybeans, which made the sesquicentennial celebration logo shown above.

TOOLS OF THE TRADE

Precision Planting vSet Select Meter

vSet Select from Precision Planting is a dual seed meter technology that plants seed variety and population based off a prescription. This technology has allowed the logo to be planted since 2019.



PROJECT CONTACT

For inquiries about this project, contact Nate Douridas (douridas.2@osu.edu), Andrew Klopfenstein (klopfenstein.34@osu.edu), or Ryan Tietje (tietje.4@osu.edu).



OBJECTIVE

Evaluate a standard soybean production system compared to an enhanced soybean production system.



eFields Collaborating Farm

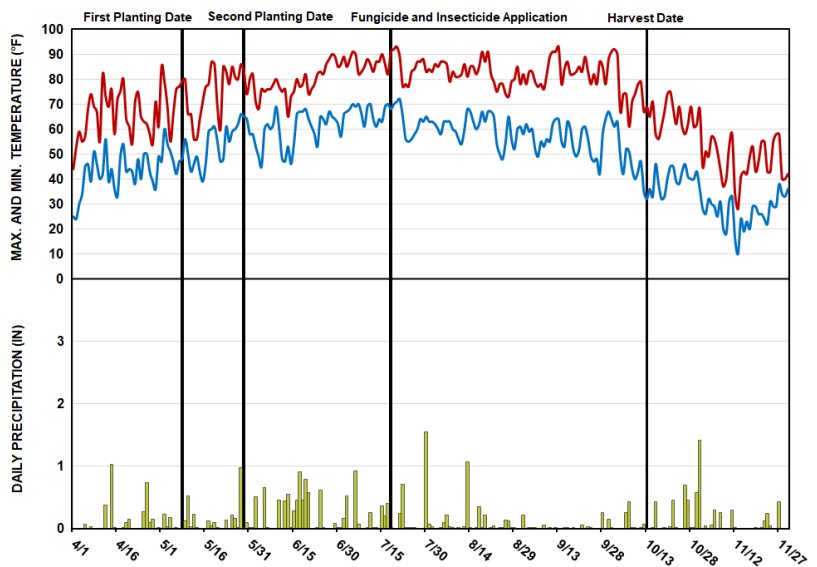
OSU Extension

Coshocton County

STUDY INFORMATION

Planting Date	5/8/2019 (1 st planting) 5/29/2019 (2 nd planting)
Harvest Date	10/13/2019
Variety	P38A98X
Population	130,000 & 160,000
Acres	38
Treatments	2
Reps	3
Treatment Width	35 ft.
Tillage	Minimal
Management	Fungicide, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Euclid silt loam, 59% Nolin silt loam, 20% Watertown sandy loam, 14% Chili loam, 7%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.06	3.26	6.82	5.57	2.43	0.86	22.00
Cumulative GDDs	229	688	1256	2016	2674	3258	3258

STUDY DESIGN

This study was organized as a randomized complete block design with three replications of treatments. Treatments included:

- 1) Standard production system
 - a. Soybeans planted in mid-to late May
 - b. Seeding rate of 160,000 seeds/acre
- 2) Enhanced production system
 - a. Soybeans planted in late April to mid-May
 - b. Seeding rate of 130,000 seeds/acre
 - c. Foliar fungicide and insecticide application at the R3 growth stage



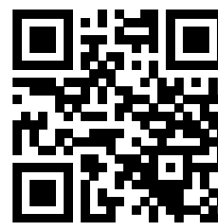
This study had two planting dates, one in early May and the other in late May. Soybeans from the first planting can be seen in foreground with second planting being executed in background.

OBSERVATIONS

The spring of 2019 was challenging for research trials due to excessive rain. However, we were able to meet the goal of planting the plots three weeks apart. The final stand count of the enhanced systems planting (early) may have been reduced due to excessive field moisture at planting. Throughout the year, plant growth was monitored for any potential treatment differences. No significant disease or insect differences were observed. The entire plot did exhibit moderate pressures from Marestalk and Giant Ragweed. Drier conditions in late summer helped both systems.

SUMMARY

- The objective of this trial was to evaluate a standard soybean production system compared to an enhanced soybean production system.
- The enhanced system, planted at 130,000 acres with a foliar fungicide & an insecticide application at R3 was compared to the standard system planted 3 weeks later at 160,000 with no R3 foliar treatment.
- At harvest, there was no significant difference in yield between the two systems.



go.osu.edu/19botg

RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above (\$/ac)
Enhanced	107,000	13.5	60 a	452
Standard	132,967	12.7	56 a	435
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 7.24 (NS) CV: 5.28%	

TOOLS OF THE TRADE

Priaxor

In this study, Priaxor fungicide was applied at a rate of 4 oz/ac. It is designed to provide more consistent performance and advanced plant health benefits.



PROJECT CONTACT

For inquiries about this project, contact David Marrison (marrison.2@osu.edu).



OBJECTIVE

Evaluate a standard soybean production system compared to an enhanced soybean production system.



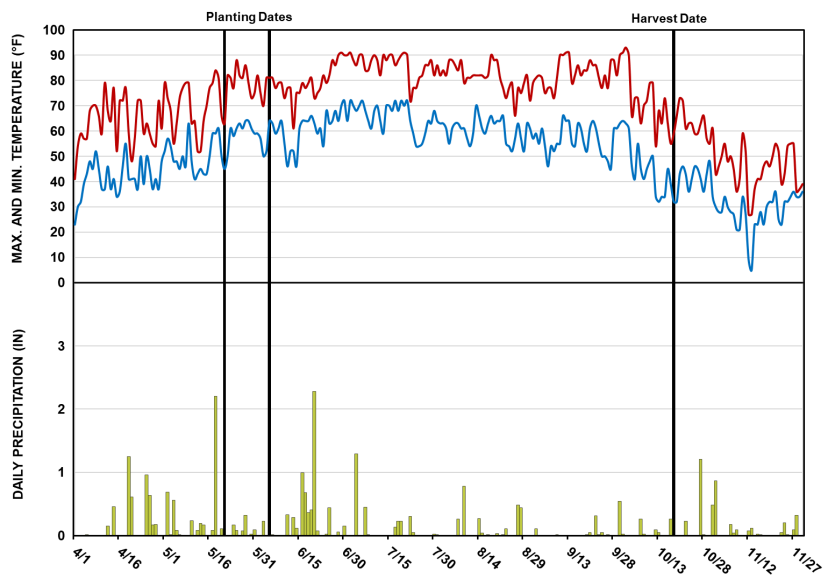
Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/21/2019 (1 st planting) 6/5/19 (2 nd planting)
Harvest Date	10/18/2019
Variety	Asgrow AG36X6
Population	130,000 and 165,000
Acres	75
Treatments	2
Reps	3
Treatment Width	75 ft.
Tillage	Minimal Till
Management	Fungicide, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Crosby-lewisburg silt loam, 41% Kokomo silty clay loam, 32% Westland silty clay loam, 27%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.43	5.17	6.44	2.72	2.43	1.10	22.29
Cumulative GDDs	209	644	1231	2005	2645	3233	3233

STUDY DESIGN

This study was organized as a randomized complete block design with three replications of treatments. Treatments included:

- 1) Standard production system
 - a. Soybeans planted in mid-to late May
 - b. Seeding rate of 160,000 seeds/acre
- 2) Enhanced production system
 - a. Soybeans planted in late April to mid-May
 - b. Seeding rate of 130,000 seeds/acre
 - c. Foliar fungicide and insecticide application at the R3 growth stage



Planting was conducted with a John Deere ExactEmerge planter.

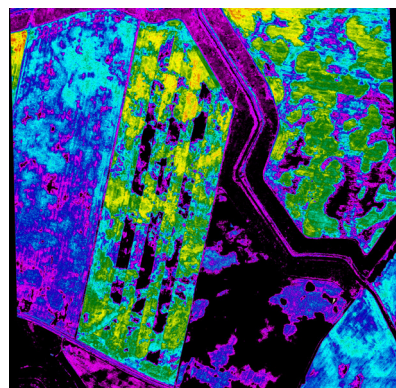
OBSERVATIONS

After a long delay past the anticipated planting date, this study field was established in late May/early June with good growing conditions and moisture. July through September were abnormally dry for the location. This evenly reduced yield across all treatment. The enhanced plot could have been harvested 7 days earlier but this was not done. Low moisture was seen at harvest on both. Very little disease and insect pressure was observed in the area during the growing season.

The middle two 35' passes were harvested from each 120' planting treatment and used to report these result.

SUMMARY

- In 2019 after a later planted study than anticipated, a statistical difference in management strategy was observed.
- The early planting date with fungicide and insecticide applied produced 4 bu/ac more than the standard management.



RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above (\$/ac)
Enhanced	131,111	10.8	54 a	470
Standard	104,000	10.5	50 b	450
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 2.39 CV: 1.93%	

TOOLS OF THE TRADE

John Deere ExactEmerge Planter

The John Deere ExactEmerge planter allows for accurate planting at 10 MPH while providing excellent singulation, turn compensation, and row by row section control.



PROJECT CONTACT

For inquiries about this project, contact Nate Douridas (douridas.2@osu.edu).



OBJECTIVE

Evaluate a standard soybean production system compared to an enhanced soybean production system.



eFields Collaborating Farm

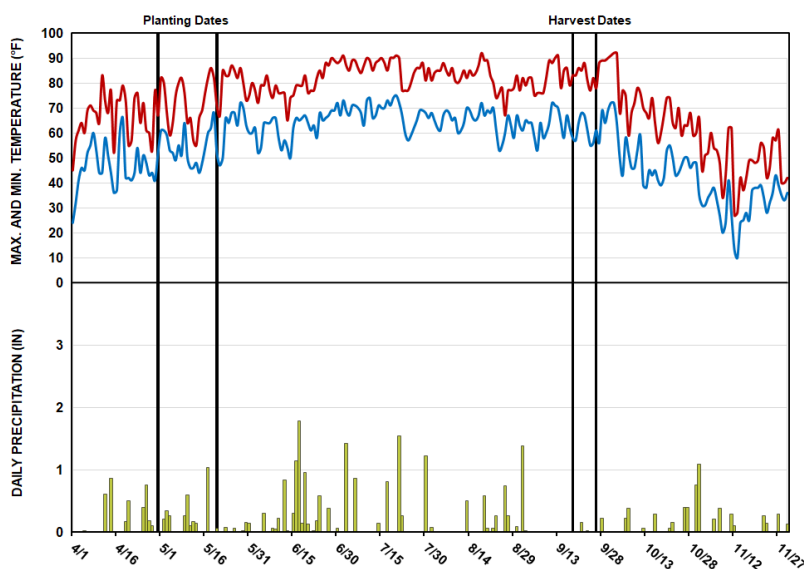
OSU Extension

Pickaway County

STUDY INFORMATION

Planting Date	4/30/2019 (1 st planting) 5/20/2019 (2 nd planting)
Harvest Date	9/18/2019 (1 st harvest) 9/26/2019 (2 nd harvest)
Variety	LGC3411RX
Population	140,000
Acres	58
Treatments	5
Reps	4
Treatment Width	120 ft.
Tillage	Minimal
Management	Fungicide, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	30 in.
Soil Type	Rossburg silt loam, 38% Sloan silty clay loam, 29% Eldean loam, 28% Ross silt loam, 5%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.66	3.69	7.25	6.28	2.67	1.82	25.37
Cumulative GDDs	283	790	1414	2236	2955	3631	3631

STUDY DESIGN

This study was organized as a randomized complete block design with three replications of treatments. Treatments included:

- 1) Standard production system
 - a. Soybeans planted in mid-to late May
 - b. Seeding rate of 160,000 seeds/acre
- 2) Enhanced production system
 - a. Soybeans planted in late April to mid-May
 - b. Seeding rate of 130,000 seeds/acre
 - c. Foliar fungicide and insecticide application at the R3 growth stage



Harvest was done using a modern Case IH combine with yield monitoring technology.

OBSERVATIONS

The early planting date reached full canopy earlier which improved weed control as well as maximized light interception which helped increase the soybean yield. Disease and insect pressure were minimal.



SUMMARY

- Previous soybean research has indicated that early planting date, before May 1, can help achieve maximum yield. Additionally, lower seeding rates in previous soybean research has shown comparable yields, which increases profitability.
- In this study the early planting date, which also had the lowest seeding rate had nearly a 10 bushel per acre advantage over the later planting date and increased seeding rate.

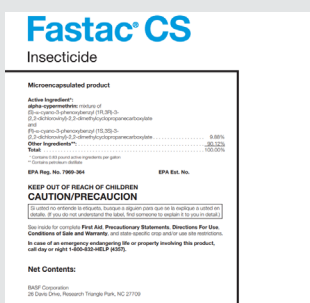
RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above (\$/ac)
Enhanced	99,000	11.3	57 a	425
Standard	156,000	10.0	48 b	363
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 1.95 CV: 1.56%	

TOOLS OF THE TRADE

Fastac

Fastac Insecticide was applied to this study at the R3 growth stage at a rate of 3.2 oz/ ac. It works on a broad spectrum of piercing, sucking and chewing insect pests by acting on the nervous system of insects.



PROJECT CONTACT

For inquiries about this project, contact Will Hamman (hamman.41@osu.edu).



OBJECTIVE

Evaluate a standard soybean production system compared to an enhanced soybean production system.



eFields Collaborating Farm

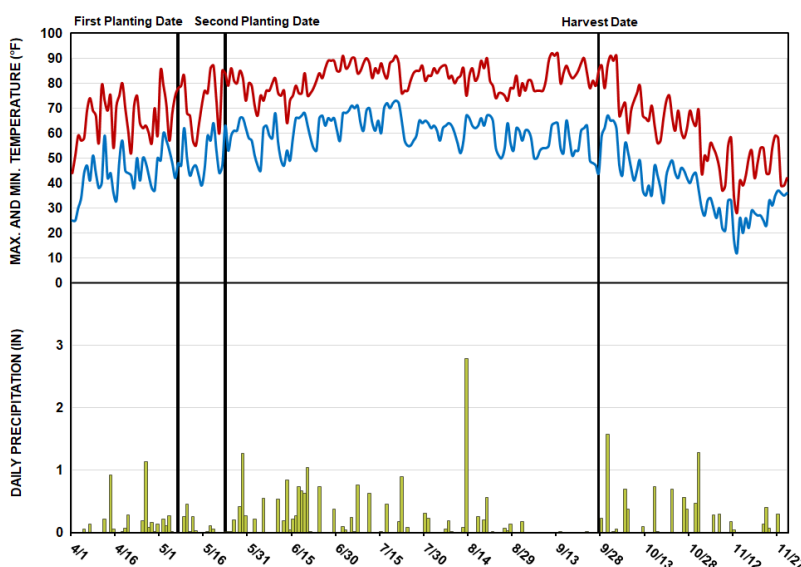
OSU Extension

Tuscarawas County

STUDY INFORMATION

Planting Date	5/7/2019 (1 st planting) 5/23/2019 (2 nd planting)
Harvest Date	9/27/2019
Variety	Hubner 24-38R2X
Population	130,000 & 160,000
Acres	58
Treatments	2
Reps	4
Treatment Width	30 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Sparta loamy fine sand, 33% Weinbach silt loam, 31% Wheeling loam, 30% Conotton gravelly loam, 6%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.45	4.01	7.04	3.95	4.39	2.01	24.85
Cumulative GDDs	237	710	1273	2037	2685	3267	3267

STUDY DESIGN

This study was organized as a randomized complete block design with three replications of treatments. Treatments included:

- 1) Standard production system
 - a. Soybeans planted in mid-to late May
 - b. Seeding rate of 160,000 seeds/acre
- 2) Enhanced production system
 - a. Soybeans planted in late April to mid-May
 - b. Seeding rate of 130,000 seeds/acre
 - c. Foliar fungicide and insecticide application at the R3 growth stage



The first planting of soybeans in this study was completed on May 7, 2019 at a rate of 130,000 seeds per acre.

OBSERVATIONS

Plants were monitored throughout the season for signs of insect and/or disease damage. There was no evidence of insect feeding or disease development in the plot. There was also no noticeable difference in plant appearance prior to and following fungicide applications.

SUMMARY

- No visual symptoms of significant disease development or insect feeding was evident in this plot. There was no difference in disease development between the seeding rates.
- The higher seeding rate (160,000) seeds per acre resulted in five bushels more per acre compared to the lower (130,000) seeds per acre rate.



RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above (\$/ac)
Enhanced	118,300	13.0	62 b	470
Standard	149,000	13.0	67 a	534
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 3.56 CV: 2.32%	

TOOLS OF THE TRADE

Row Crop Tires

The tractor for this study was retrofitted with the 12.5 inch wheels and tires to reduce the amount of damage to 15 inch soybeans during spray applications. No visual damage occurred to the crop during application.



PROJECT CONTACT

For inquiries about this project, contact Chris Zoller (zoller.1@osu.edu).



OBJECTIVE

Evaluate the yield as a function of 15, 20, and 30 inch soybean spacing.



eFields Collaborating Farm

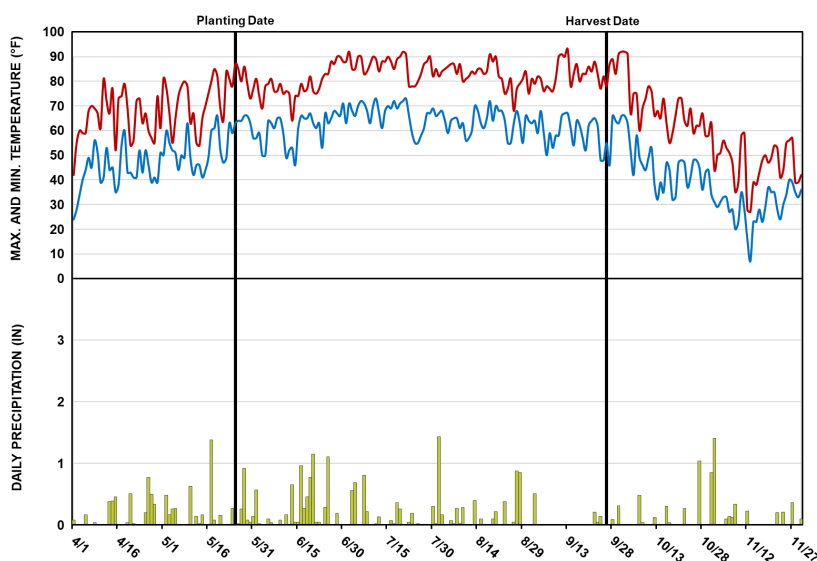
OSU Extension

Pickaway County

STUDY INFORMATION

Planting Date	5/25/2019
Harvest Date	9/26/2019
Variety	366L4 Beck's
Population	140,000
Acres	247
Treatments	3
Reps	8
Treatment Width	120 ft.
Tillage	Minimal
Management	Fungicide, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	See Treatments
Soil Type	Crosby silt loam, 34% Westland silty clay loam, 25% Warsaw loam, 28% Thackery silt loam, 12%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.91	5.53	7.05	3.72	5.27	1.31	26.79
Cumulative GDDs	239	701	1292	2086	2792	3421	3421

STUDY DESIGN

The goal of this study was to evaluate the yield effect of 15, 20 and 30 in. row spacings on soybeans. This trial was conducted in a 247 acre soybean field in a randomized complete block design. Some growers are looking to get to a consistent row spacing between corn and soybeans for flexibility between planting equipment, which helped drive the need for this study.

This field followed multi row width corn last year, with respective row spacings aligned.



Case IH 2140 splitter planter planted 15 and 30 in. rows.

OBSERVATIONS

Weeds were minimal for all treatments.

All treatments compensated for different row spacings and reached full canopy.

High temperatures and little rainfall during flowering were yield limiting factors.

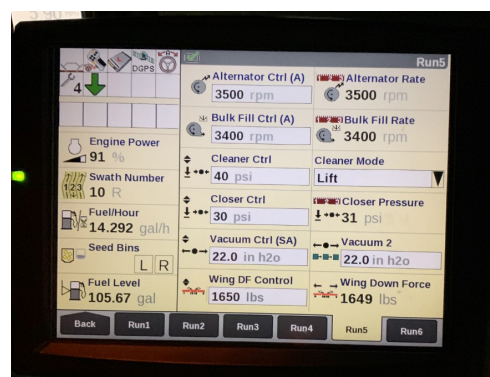
All sprayer passes were made on an angle in order to avoid disrupting the treatments.

Planter settings had to be adjusted through Case IH Pro 700 when switching row widths for a 2140 planter.

The use of FieldView Cab allowed the planters to share as-applied maps. This allowed for easy data collection and harvest for the fall.

SUMMARY

- There were no statistical differences in yield between treatments.
- Further investigation is needed to determine the viability of using the same row spacing for corn and soybeans.



RESULTS

Treatments	Moisture (%)	Yield (bu/ac)
15 in.	10.4	60 a
20 in.	10.2	60 a
30 in.	10.2	61 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 3.82 (NS) CV: 4.60%

TOOLS OF THE TRADE

Geringhoff TrueFlex Razor

A 40 ft. head was used to harvest this trial. This head has a 3 section reel as well as a 3 section frame which helps it harvest in challenging terrain. This head was also equipped with an Integrated Air System which is a blast of air behind the cutter bar that blows crop back into the header onto the gathering belt.



PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein (klopfenstein.34@osu.edu) or Ryan Tietje (tietje.4@osu.edu).



OBJECTIVE

Determine the effect on soybean yield and moisture when comparing cereal rye termination using a crimper versus no crimper.



eFields Collaborating Farm

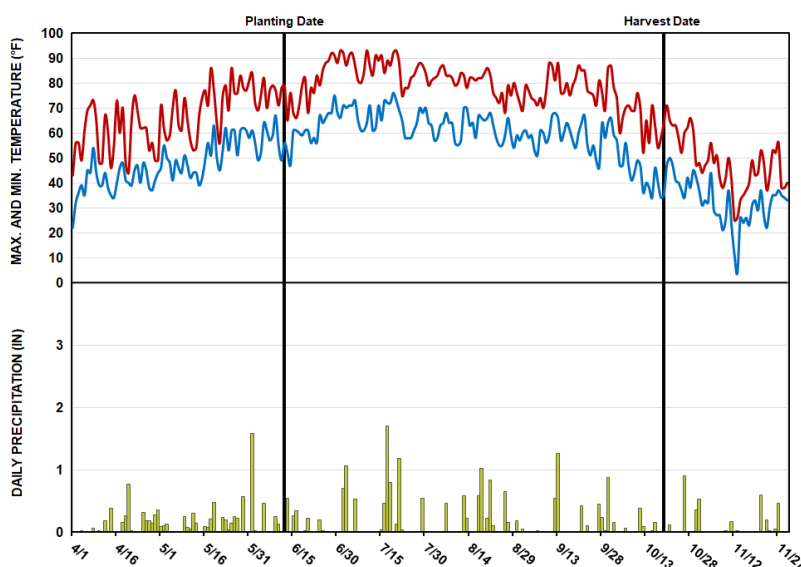
OSU Extension

Fulton County

STUDY INFORMATION

Planting Date	6/12/2019
Harvest Date	10/19/2019
Variety	Rupp 28XT37
Population	192,000
Acres	28
Treatments	2
Reps	5
Treatment Width	30 in.
Tillage	No-Till
Management	Herbicide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Blount loam, 57% Pewamo clay loam, 31% Glynwood loam, 12%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.39	3.68	4.06	7.20	5.05	4.02	27.40
Cumulative GDDs	148	514	1073	1864	2510	3063	3063

STUDY DESIGN

As more and more cover crops are being adopted in Ohio, growers are evaluating a variety of methods to terminate them. Cereal rye (rye) that is allowed to grow more biomass in the spring, generally adds more organic matter to the soil. This study compared using a crimper termination system after rye had flowered (late) versus the normal practice of chemical termination with a burndown herbicide (early).



Cereal rye was monitored for the proper crimping time.

OBSERVATIONS

The early burndown treatment was applied on June 5th prior to planting on June 12th. Crimper termination occurred the same day as planting as the 2019 planting season was delayed due to excessive moisture. The crimping conditions were more moist than preferred, but the rye killed quite well as it had certainly reached anthesis. In the future, the goal is to move the burndown, planting, and crimping dates earlier in the season. Field conditions did not allow an “early” burndown application (early May) like was planned for this trial and all residual herbicides were pulled out in exchange for using the Xtend platform. Seeding of cover crop rye at a rate of at least 70-100 lbs continues to be a best practice based on observations.

SUMMARY

- No statistical difference in yields or moistures were observed in this trial for the second year in a row.
- Repeating this trial will add to the validity of the results.



RESULTS

Treatments (Termination Method)	Moisture (%)	Yield (bu/ac)
Chemical	12.1	62 a
Crimper	12.0	63 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 4.43 (NS) CV: 4.18%

TOOLS OF THE TRADE

Roller-Crimper

This tool needs to have blades arranged in a Chevron-pattern (curved) so that it will roll smoothly without throwing soil. Several manufacturers make these in front-mount, rear-mount, or pull-type designs. The crimping effect terminates standing rye that has flowered and lays it down to create a weed suppressing, moisture retaining mat.



PROJECT CONTACT

For inquiries about this project, contact Eric Richer (richer.5@osu.edu).



OBJECTIVE

Determine if the seeding rate affects the population level of Soybean Cyst Nematode in a long standing continuous soybean field.



eFields Collaborating Farm

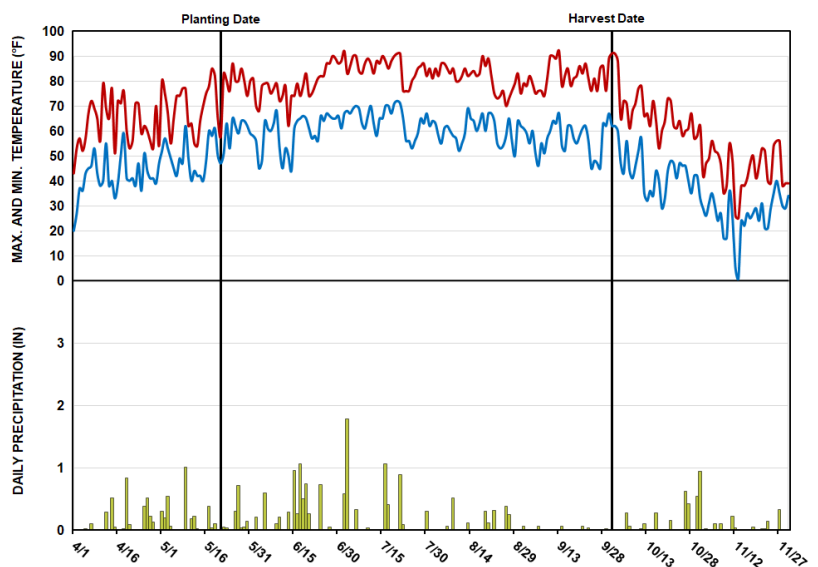
OSU Extension

Delaware County

STUDY INFORMATION

Planting Date	5/21/2019
Harvest Date	10/1/2019
Variety	Buckeye 2337LLGT
Population	See Treatments
Acres	18
Treatments	3
Reps	3
Treatment Width	60 ft.
Tillage	No-Till
Management	Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	20 in.
Soil Type	Cardington silt loam, 55% Bennington silt loam, 45%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.24	4.46	6.04	5.51	2.13	0.35	21.73
Cumulative GDDs	204	636	1201	1960	2595	3174	3174

STUDY DESIGN

This study was designed as a randomized complete block having three replications. Plot width was 60 ft. and plot length was 1424 ft. Stand counts were taken 30 days post planting. Soybean Cyst Nematode (SCN) soil samples were taken randomly throughout each plot 30 days after planting. SCN soil samples were taken again immediately following harvest randomly in each plot. Treatments consisted of seeding rates of 120,000, 140,000, and 160,000.



The trial was designed with three treatments replicated randomly three times. Modern equipment can read this prescription and automatically change rates.

OBSERVATIONS

The baseline SCN soil samples (6-21-19) results were 66.667 eggs/100cc of soil for the 120,000 seeds/ac trial, 40 eggs/100cc of soil for the 140,000 seeds/ac trial, and 13.3333 eggs/100 cc of soil for the 160,000 seeds/ac trial.

The after harvest SCN Soil Samples were low. The 120,000 seeds/ac trial had an average of 13.33 eggs/100cc of soil, the 140,000 seeds/ac trial had 0 eggs/100cc of soil and the 160,000 seeds/ac trial had 0 eggs/100cc of soil.

SUMMARY

- There was no significant yield difference between treatments.
- The seed variety used was a resistant variety. This could explain why the after harvest SCN counts were so low.



go.osu.edu/19scnpr

RESULTS

Treatments (plants/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
120,000	119,283	11.9	57 a
140,000	137,402	11.9	57 a
160,000	144,952	11.9	57 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 2.86 (NS) CV: 2.9%

TOOLS OF THE TRADE

John Deere DB 60 Planter

This planter was used for the trial and allowed us to change the population rate very easily. The ease of use aided in the feasibility to do on-farm research.



PROJECT CONTACT

For inquiries about this project, contact Jacci Smith (smith.11005@osu.edu) or Rob Leeds (leeds.2@osu.edu).

OBJECTIVE

Determine if state phosphorus fertilizer produces a yield advantage in soils with soil test phosphorus levels in the maintenance or higher range.



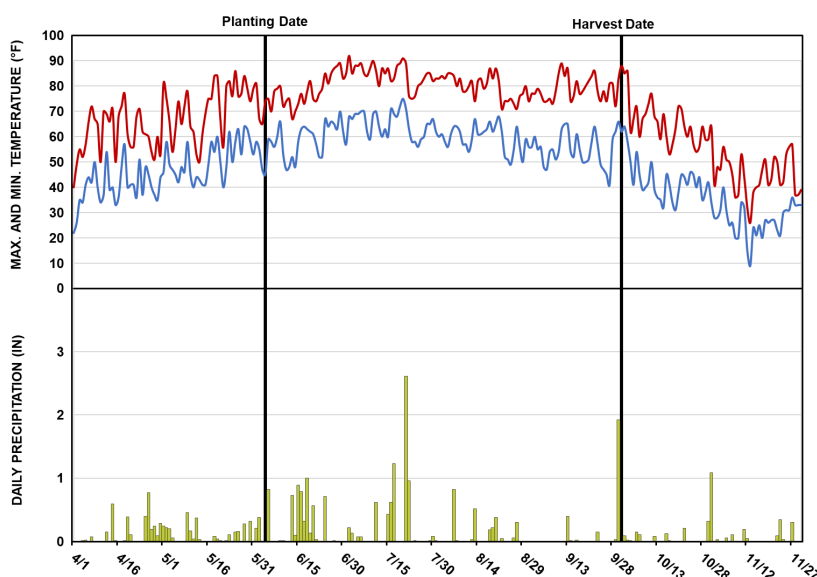
**Ohio Agricultural Research
and Development Center**

Wayne County

STUDY INFORMATION

Planting Date	6/4/2019
Harvest Date	10/1/2019
Variety	Synergy 28RY3
Population	140,000
Acres	1
Treatments	2
Reps	4
Treatment Width	30 ft.
Tillage	Conventional
Management	Fertilizer, Herbicide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Bogart loam, 57% Orville silt loam, 36% Jintown loam, 12%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.34	2.95	6.71	7.07	2.57	2.53	25.17
Cumulative GDDs	177	566	1096	1853	2463	2980	2980

STUDY DESIGN

The study was designed as a randomized complete block design using the OSU PLOTS app, with two treatments and four replications. The first treatment was no starter phosphorous fertilizer and the second treatment utilized starter phosphorous fertilizer. The starter fertilizer rate was based on a yield goal of 55 bu/acre and a phosphorous crop removal of 44 lbs/ac of P_2O_5 . The starter fertilizer material was MAP (11-52-0) applied at 85 lbs/ac.



Shown above is the applicator used in this study to broadcast phosphorous to manage the levels in-season.

OBSERVATIONS

This is a field with a history of manure application. The field soil test phosphorous level is 49 ppm Bray P1 or approximately 66 M-3.

No visual differences were observed between the plots receiving starter phosphorous and those plots without a starter phosphorous application. There was a heavy rainfall event that dumped several inches of rain within a couple of hours on the evening of July 21.

Although plots were planted at 140,000 plants/ac, across both treatments the final, harvest plant population was under 100,000 plants/ac.

SUMMARY

- There was no significant difference in yield between treatments.
- The starter phosphorous plots had a higher average stand count and harvest moisture percentage compared to the no starter P plots but there was no statistical difference in yield between the treatments.



RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
No Starter Phosphorus	86,000	13.7	59 a
Starter Phosphorus	93,000	14.2	58 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 1.40 (NS) CV: 1.46%

TOOLS OF THE TRADE

Variable Rate Granular Fertilizer Air Applicator

This tool was used to make the phosphorous starter fertilizer applications of MAP at OARDC.



PROJECT CONTACT

For inquiries about this project, contact
Rory Lewandowski
(lewandowski.11@osu.edu).

OBJECTIVE

Investigate the effect of sulfur applied at planting using 2x2 spacing.



eFields Collaborating Farm

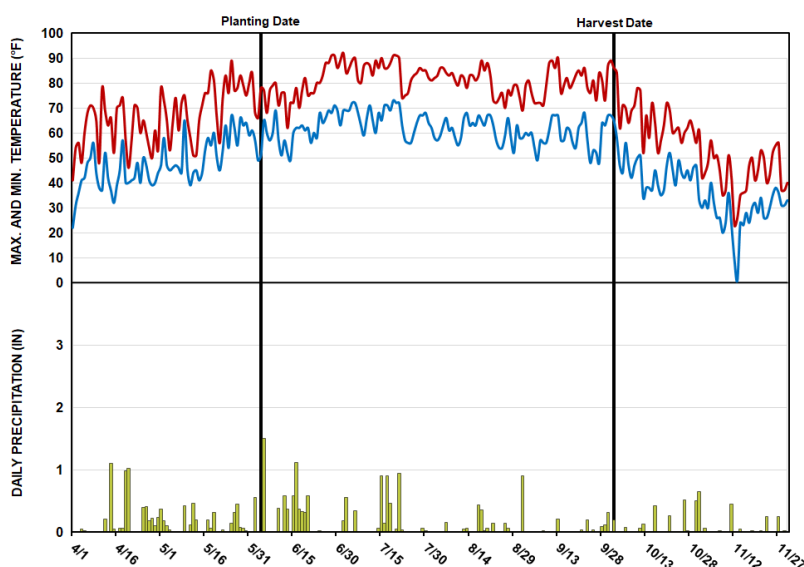
OSU Extension

Crawford County

STUDY INFORMATION

Planting Date	6/4/2019
Harvest Date	10/2/2019
Variety	Pioneer P25A82C
Population	138,000
Acres	15
Treatments	2
Reps	4
Treatment Width	70 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Corn
Row Spacing	Twin Row 30 in.
Soil Type	Blount silt loam, 60% Pewamo silty clay loam, 40%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	5.14	3.64	6.77	4.71	1.56	1.95	23.77
Cumulative GDDs	181	586	1150	1924	2569	3143	3143

STUDY DESIGN

A randomized complete block trial with four replications was used to account for field variability. Sulfur rates of 20 lbs/ac as ammonium thiosulfate was applied to the treatment to match the amount used in other studies. Nitrogen was applied to both plots so that only sulfur would be a factor in this trial.

Nitrogen fixation is partially dependent on sulfur availability in the soil. Because less sulfur is being deposited from the atmosphere, some studies have shown a benefit to soybean yield by adding sulfur. The ideal timing to apply sulfur would be during another field operation such as using 2x2 spacing during planting.



No-till twin row corn and soybean planter used in the sulfer study.

OBSERVATIONS

Both treatments visually looked the same throughout the year. A tissue test was conducted at R1 with both samples being in the normal range. The treated plots showed slightly higher tissue sulfur.

SUMMARY

- There was a significant difference in yield from adding starter sulfur in the form of Thio-sul.
- By applying starter with the planter 2x2 no extra field passes were required.



RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above (\$/ac)
Control	129,300	12.5	62 b	N/A
20 lbs. Sulfur	130,200	12.7	65 a	9
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 2.30 CV: 1.61%	

TOOLS OF THE TRADE

Planter Row Monitor

The PM300 row monitor allows for seed singulation during planting by delivering accurate row and ground speed measurements.



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu).

OBJECTIVE

Evaluate the effectiveness of a foliar feed sulfur application using a sprayable ammonium sulfate at R1 and R3 growth stages to improve yields.



eFields Collaborating Farm

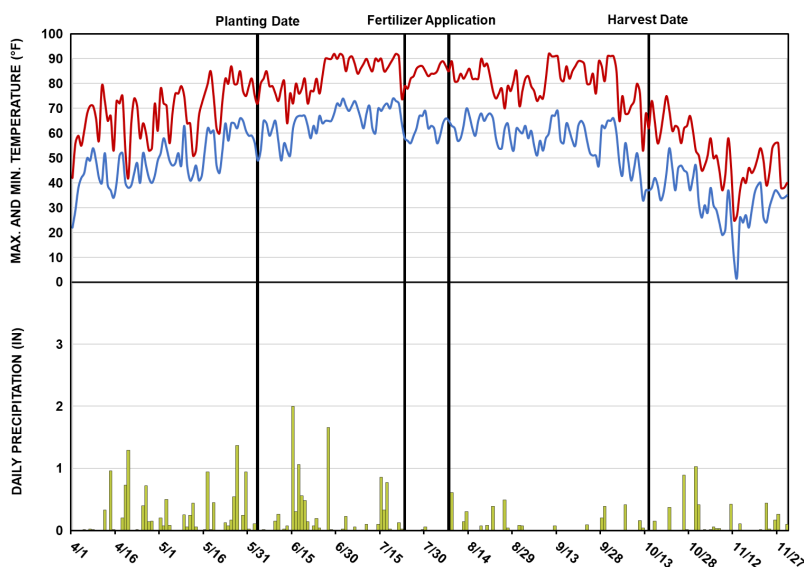
OSU Extension

Darke County

STUDY INFORMATION

Planting Date	6/3/2019
Harvest Date	10/14/2019
Variety	Rogers 389
Population	200,000
Acres	54
Treatments	3
Reps	3
Treatment Width	90 ft.
Tillage	No-Till
Management	Fertilizer, Fungicide, Herbicide, Insecticide
Previous Crop	Soybeans
Row Spacing	15 in.
Soil Type	Crosby silt loam, 76% Brookston silty clay loam, 19% Celina silt loam, 5%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.98	6.78	7.13	2.70	2.20	0.82	24.61
Cumulative GDDs	209	653	1256	2057	2735	3354	3354

STUDY DESIGN

In this study 3 replications were completed comparing the use of ammonium sulfate at R1 and R3 to no application. The combine was calibrated in season. Passes from the center of the plots were harvested for treatment comparisons.



Ammonium sulfate was emulsified into a sprayable product for the sulfur application.

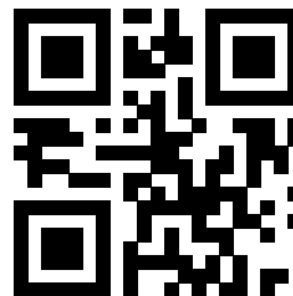
OBSERVATIONS

Due to the soybeans being non-GMO, weed pressure was high, requiring the post spray with Cobra. The applications of Cobra, and the ammonium sulfate burned the soybeans significantly.

The 2019 growing season did not allow for this project to work in a high yield environment. The limiting factors were poor planting conditions, excess rain early and drought conditions late.

SUMMARY

- There was no significant difference in yield between treatments in 2019.
- We did learn that we did not adversely affect yield with wither treatment.
- Rescue treatment of soybeans did not significantly affect yield.



go.osu.edu/19s

RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above (\$/ac)
No Treatment	141,000	11.4	43 a	379
Sulfur at R1 and R3	141,000	11.4	43 a	356
Sulfur at R3	141,000	11.3	42 a	351
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 2.88 (NS) CV: 3.17%	

TOOLS OF THE TRADE

Induction Tank

An induction tank was used to emulsify the Ammonium Sulfate (AMS) into a sprayable product. AMS is a dry product and not designed to be used at the levels needed for this sulfur application. By using the induction tank, we were able to thoroughly blend it in to our water carrier and successfully spray the combination.



PROJECT CONTACT

For inquiries about this project, contact Sam Custer (custer.2@osu.edu).



OBJECTIVE

Understand the potential agronomic benefits of planter wing downforce technology.



eFields Collaborating Farm

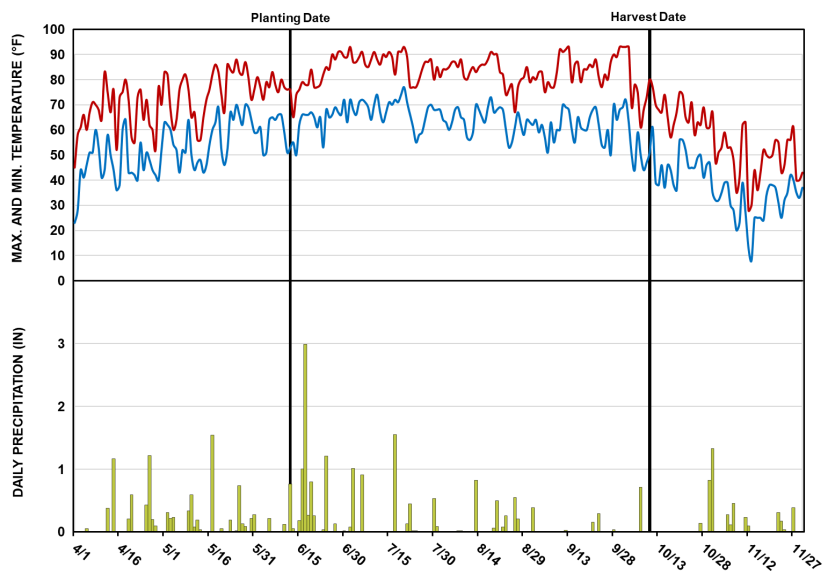
OSU Extension

Pickaway/Ross County

STUDY INFORMATION

Planting Date	6/12/2019
Harvest Date	10/10/2019
Variety	Beck's 3442 FP
Population	135,000
Acres	232
Treatments	4
Reps	5
Treatment Width	80 ft.
Tillage	No-Till
Management	Fungicide, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Ross silt loam, 32% Eldean loam, 31% Westland clay loam, 20% Casco-Rodman gravelly loam, 17%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.35	5.27	8.06	4.82	2.53	0.93	25.96
Cumulative GDDs	281	799	1417	2229	2941	3606	3606

STUDY DESIGN

Wing downforce control systems have recently been encouraged for modern planters as a means to prevent planter wings from rising during the planting operation and reduce the weight of the center section of the planter. Potentially, as the planter moves through the field, the wings of the planter can lift, resulting in less than optimal performance of the outside rows. Additionally, the weight from the center section of the planter can cause pinch row compaction on the center rows decreasing yield.



Case IH 2140 16/32 15 in. planter was used to execute treatments.

OBSERVATIONS

Transferring weight from the center of the planter to the wings provides more consistent downforce on each row unit which can lead to more consistent planting depth and emergence.

From the cab, at higher pressures the wings appeared to stay in the ground better, with less “floating” compared to 0 lbs of downforce.



SUMMARY

- There was a statistical difference between treatments this year, with the 0 lb downforce treatment yielding the highest, followed by 1,350 lbs downforce, 1,800 lbs downforce, and then 900 lbs downforce.



RESULTS

Treatments (lbs)	Moisture (%)	Yield (bu/ac)
0	13.2	67 a
900	13.0	58 b
1350	13.5	63 ab
1800	13.2	61 ab
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 5.14 CV: 7.32%

TOOLS OF THE TRADE

Wing Downforce

Hydraulic cylinders are added to the planter to help transfer weight from the center section of the planter to the wings, redistributing the weight more evenly across the entire bar. This can lead to more even emergence, better seed to soil contact, and consistent seeding depth.



PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein (klopfenstein.34@osu.edu) or Ryan Tietje (tietje.4@osu.edu).



OBJECTIVE

To analyze planting date as a limitation to soybean yield.



eFields Collaborating Farm

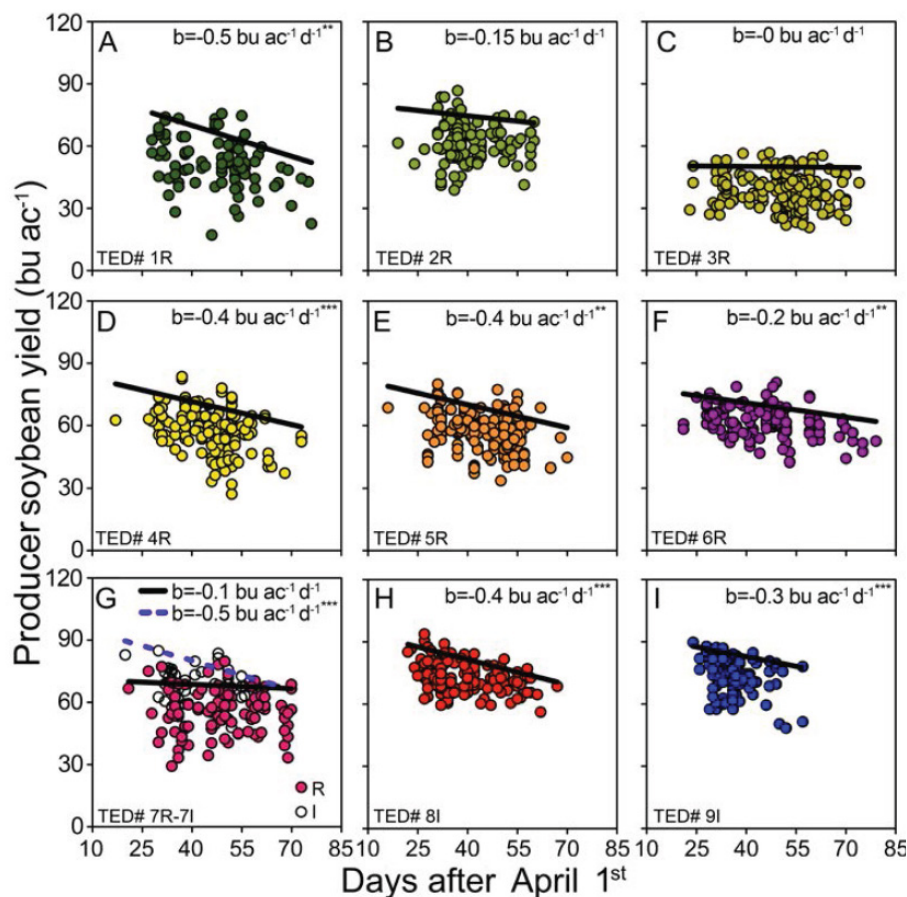
OSU Extension

Statewide

In 2016, a survey project was initiated by soybean researchers across the Midwest (and funded by the North Central Soybean Research Program) to identify limitations to soybean yield.

Across the Midwest, planting date was the most consistent management factor that influenced soybean yield. Figure 1 shows the relationship between soybean yield and planting date (Panel A = primarily northern Ohio; Panel B = primarily central and southern Ohio). In northern Ohio, soybean yield was reduced by 0.5 bushel/acre/day for every day planted after the end of April. In central/southern Ohio, soybean yield was reduced by 0.15 bushel/acre/day for every day planted after the end of April.

Figure 1. Producer soybean yield plotted against planting date in nine environments. (Ohio consists of primarily environment A and B.)



Small plot research conducted in Ohio shows a similar relationship (Figure 2). In Clark County (WARS location), soybean yield was reduced 0.6 bushel/acre/day for each day planted after the initial planting date. However, in Wood County (NWARS), soybean yield was the same regardless of planting date. Planting date is important and usually influences soybean yield, but not necessarily in every environment and year. When water is limiting during pod set (R3 to R5 growth stage), yield response to planting date may be negligible.

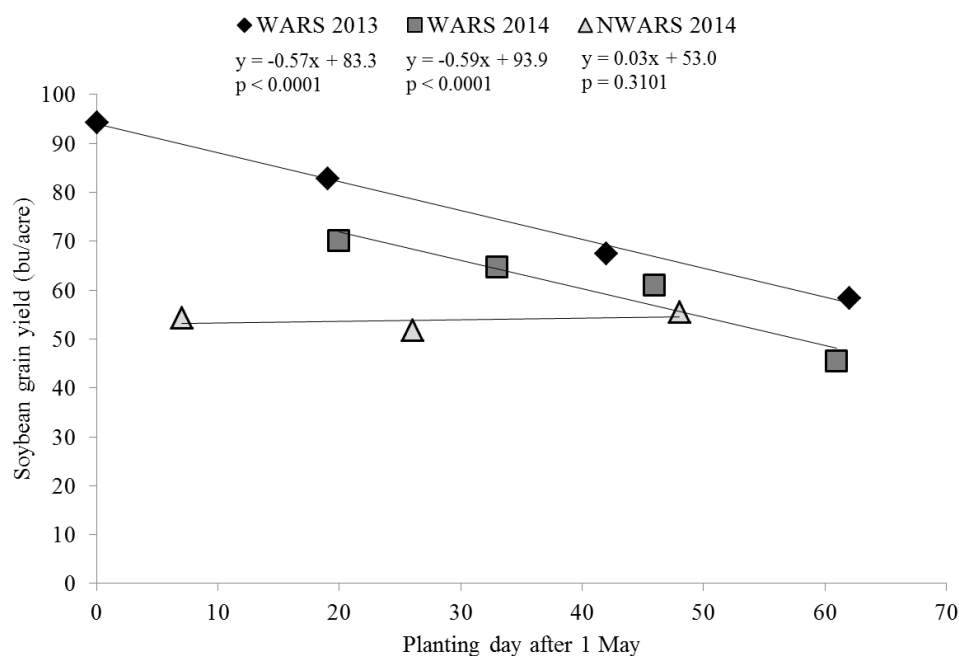


Figure 2. Effect of soybean planting date on soybean grain yield at the Western Agricultural Research Station (WARS) in 2013 and 2014 and the Northwest Agricultural Research Station (NWARS) in 2014.

Timely planting is important for canopy closure which increases light interception, improves weed control, and helps retain soil moisture. However, planting too early (before field conditions are adequate) is risky. Damping-off from disease and pressure from bean leaf beetle are concerns to keep in mind, as well as the possibility of a late spring frost.

Timely planting is important for canopy closure which increases light interception, improves weed control, and helps retain soil moisture. However, planting too early (before field conditions are adequate) is risky. Damping-off from disease and pressure from bean leaf beetle are concerns to keep in mind, as well as the possibility of a late spring frost.

Other factors that were found to influence soybean yield included foliar fungicide and foliar insecticide. (These products are often tank-mixed, so we could not separate the effects of the two products.)

To validate the results of our project, on-farm trials were established in 2019 to further examine the effect of soybean planting date and foliar fungicide + foliar insecticide. This 'Boots on the Ground' project compared two management systems:

1. Normal system- Planting mid to late May at 160,000 seeds/acre
2. Improved system- Planting in early May at 130,000 seeds/acre with a foliar fungicide + foliar insecticide application at the R3 growth stage

REFERENCES

Hankinson, M.W.; L.E. Lindsey, and S.W. Culman. 2015. Effect of planting date and starter fertilizer on soybean grain yield. *Crop, Forage, and Turfgrass Management*. doi:10.2134/cftm2015.1078

Rattalino Edreira, J.I., S. Mourtzinis, S.P. Conley, A.C. Roth, I.A. Ciampitti, M.A. Licht, H. Kandel, P.M. Kyveryga, L.E. Lindsey, D.S. Mueller, S.L. Naeve, E. Nafziger, J.E. Specht, J. Stanley, M.J. Staton, and P. Grassini. 2017. Assessing Causes of Yield Gaps in Agricultural Areas with Diversity in Climate and Soils. *Agricultural and Forest Meteorology*. 247:170-180.

PROJECT CONTACT

For inquiries about this project, contact Laura Lindsey (lindsey.233@osu.edu).



OBJECTIVE

Understand the yield impact of varying soybean seeding rate within Ohio considering in-field variability and cultural practices implemented. Information from these trials are being used to improve management recommendations for growers throughout Ohio and help understand how variable-rate seeding may impact field by field profitability.

STUDY DESIGN

The primary recommendations for seeding rates in Ohio are determined by target final stands and average soil productivity. Variable rate seeding prescriptions have the potential to better match seeding rate to productivity zones in an effort to optimize profits. Field studies were implemented in a strip-trial format and replicated at least three times with the fields. Results for individual sites plus aggregated pooled analyses were conducted.

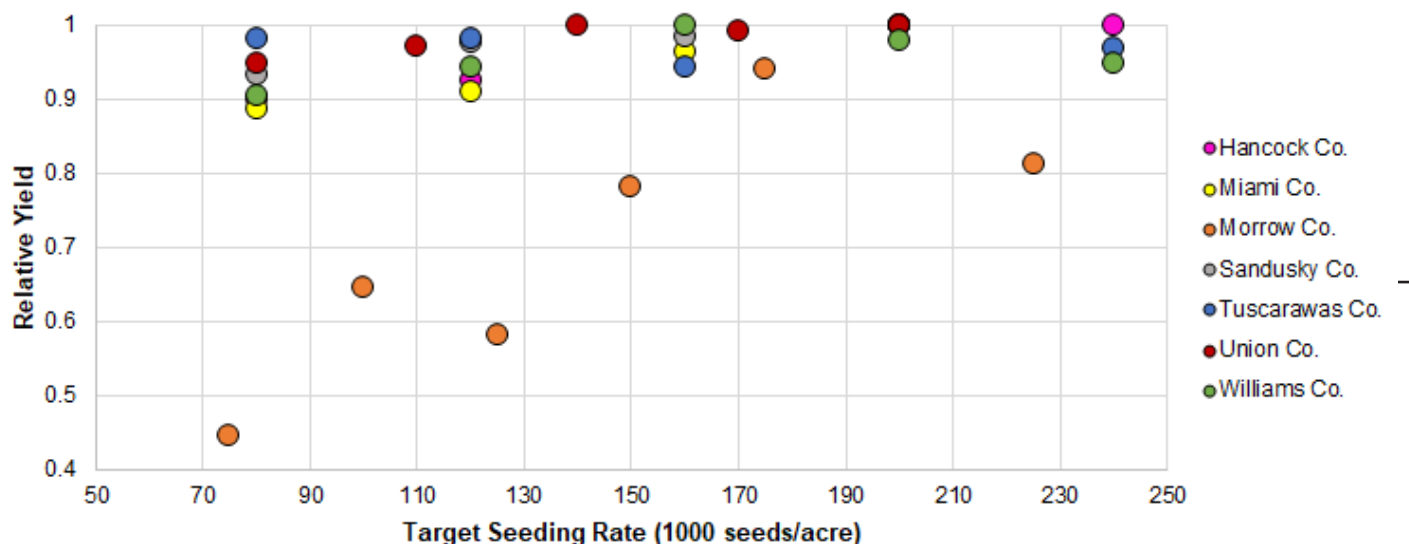
TOOLS OF THE TRADE



Sound information and data to improve decision-making for soybean variety selection, target seeding rate, and final population.

SUMMARY

- Across all sites, the average soybean stand was 76% of the target rate with individual sites ranging between 50% and 98%.
- Variation in soybean yield was primarily caused by differences in location and not differences in seeding rate in 2019.
- There was a significant response to soybean seeding rate at 5 out of 7 sites in 2019.



THREE-YEAR SUMMARY

If farmers choose to reduce seeding rate by 40,000 seeds per acre (160,000 to 120,000 assuming no yield loss)

- Seed costs savings: \$17.12 per acre (\$0.428 per 1,000 seeds)
- 5.1 million acres of soybeans in Ohio: \$87 million

2019: 122 treatments

- 7 fell below 90% of relative yield
- 16 fell below 95% of relative yield

2018: 90 treatments

- 6 fell below 90% of relative yield
- 13 fell below 95% of relative yield

2017: 51 treatments

- 2 fell below 90% of relative yield
- 11 fell below 95% of relative yield

STUDY INFORMATION

Planting Date	6/26/2019
Harvest Date	10/23/2019
Variety	F2F2G-298A
Population	See Treatments
Acres	1
Treatments	3
Reps	3
Treatment Width	35 ft.
Tillage	No-Till
Management	Herbicide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Aurand loam, 54% Fox loam, 35% Hoytville clay loam, 10%

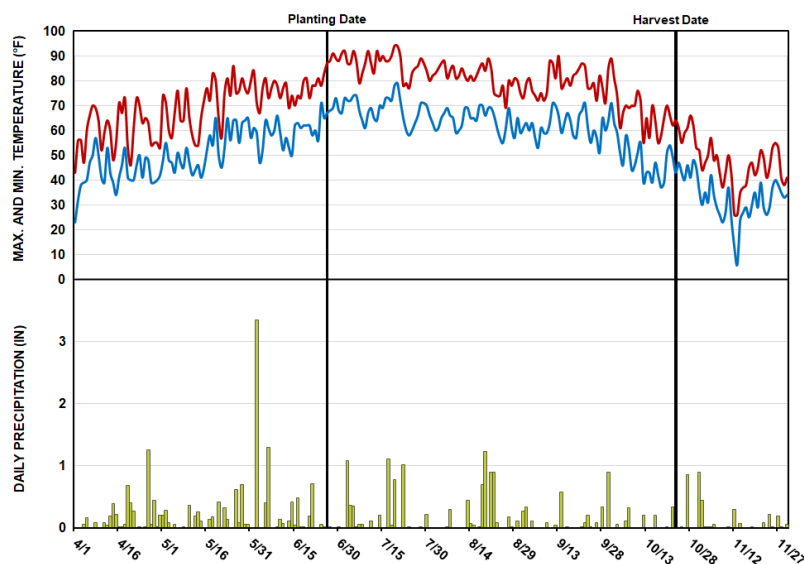


eFields Collaborating Farm

OSU Extension

Hancock County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact
Ed Lentz (lentz.38@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.63	4.18	7.36	5.42	4.97	3.07	29.63
Cumulative GDDs	162	555	1139	1962	2664	3276	3276

RESULTS

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
80,000	60,000	12.3	59 a	496
120,000	85,000	12.3	61 a	494
240,000	168,000	12.2	66 a	487
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 7.00 (NS) CV: 6.48%	



STUDY INFORMATION

Planting Date	5/16/2019
Harvest Date	9/26/2019
Variety	Ebberts 1931E3
Population	See Treatments
Acres	126
Treatments	4
Reps	4
Treatment Width	60 ft.
Tillage	No-Till
Management	Fungicide, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Eldean loam, 83% Warsaw silt loam, 12% Eldean-Casco gravelly loam, 5%

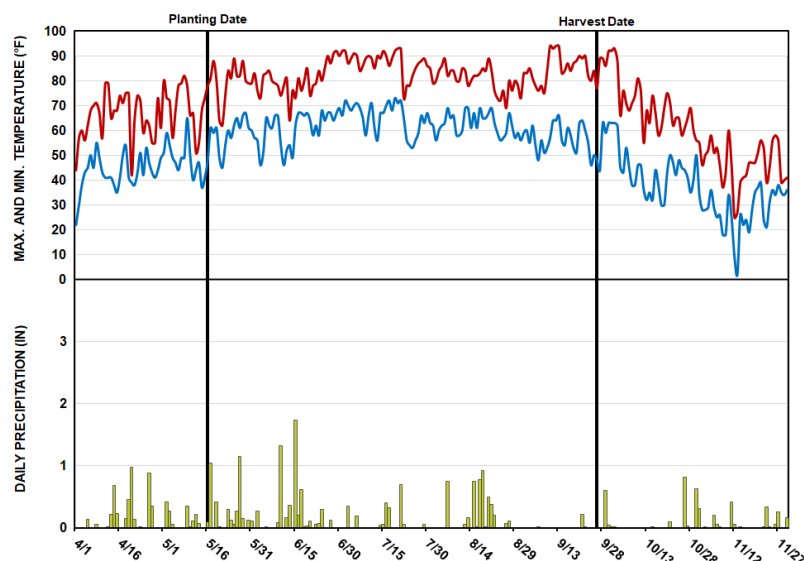


eFields Collaborating Farm

OSU Extension

Miami County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Amanda Bennett (bennett.709@osu.edu) or John Fulton (fulton.20@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.31	5.35	5.45	2.16	4.70	0.88	22.85
Cumulative GDDs	163	634	1248	2024	2691	3299	3299

RESULTS

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
80,000	51,857	10.4	59 b	497
120,000	69,696	10.2	61 b	498
160,000	93,758	10.0	64 a	508
200,000	116,658	10.1	67 a	517
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 2.43 CV: 3.00%	

STUDY INFORMATION

Planting Date	6/12/2019
Harvest Date	10/19/2019
Variety	Seed Consultants SC9277R
Population	See Treatments
Acres	5
Treatments	7
Reps	3
Treatment Width	30 ft.
Tillage	No-Till
Management	Herbicide
Previous Crop	Corn
Row Spacing	7.5 in.
Soil Type	Centerburg silt loam, 74% Amanda silt loam, 15% Bennington silt loam, 11%

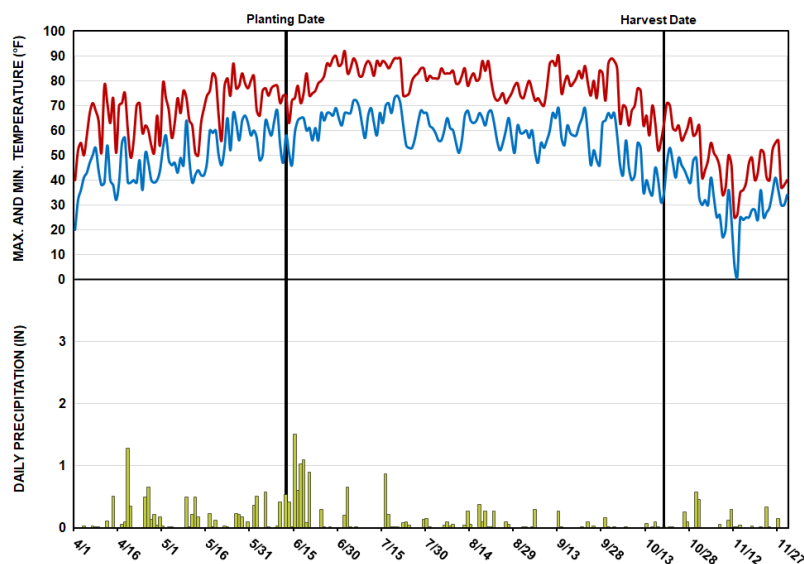


eFields Collaborating Farm

OSU Extension

Morrow County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact
Carri Jagger (jagger.6@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.20	2.55	8.37	2.52	1.78	0.92	20.34
Cumulative GDDs	185	600	1156	1905	2529	3095	3095

RESULTS

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
75,000	44,222	11.4	12 b	76
100,000	63,583	11.4	17 b	110
125,000	54,806	11.4	15 b	82
150,000	69,111	11.4	20 ab	116
175,000	56,917	11.4	24 a	141
200,000	116,417	11.4	26 a	148
225,000	109,111	11.4	21 a	93
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 8.65 CV: 30.81%	



STUDY INFORMATION

Planting Date	6/9/2019
Harvest Date	10/13/2019
Variety	Pioneer P33A24
Population	See Treatments
Acres	25
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	Minimal
Management	Herbicide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Hoytville clay loam, 65% Dunbridge sandy loam, 23% Millsdale silty clay loam, 12%

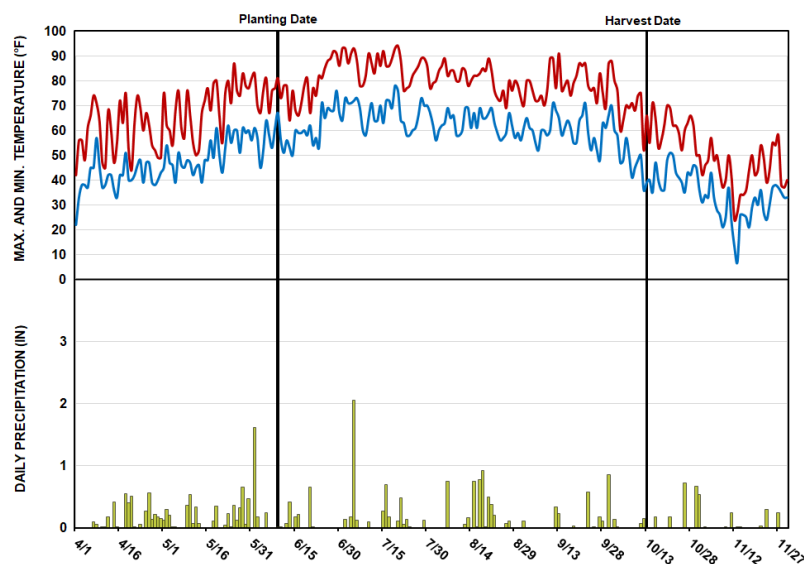


eFields Collaborating Farm

OSU Extension

Sandusky County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact
Al Gahler (gahler.2@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.80	4.74	3.61	4.65	4.70	2.43	23.93
Cumulative GDDs	150	502	1054	1847	2514	3093	3093

RESULTS

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
80,000	61,750	13.2	68 c	576
120,000	94,750	13.2	71 b	588
160,000	122,500	13.2	72 b	575
200,000	153,000	13.1	73 a	570
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 1.24 CV: 1.35%	

STUDY INFORMATION

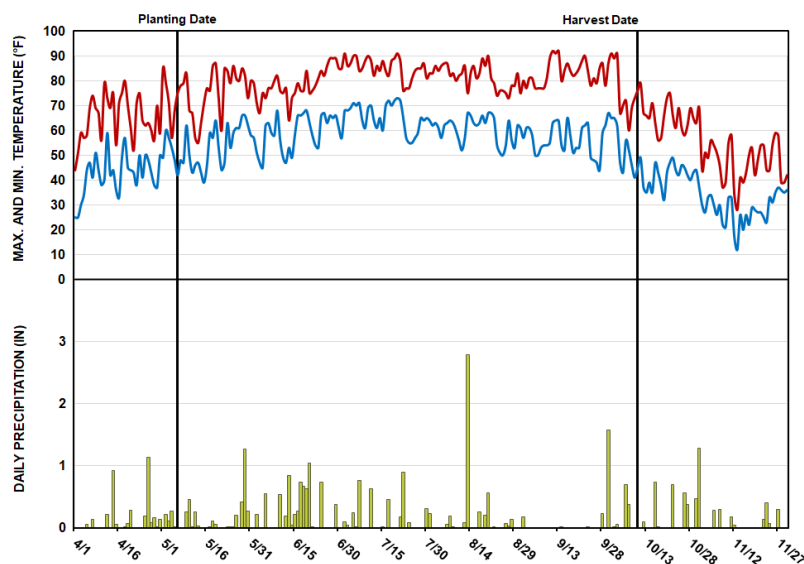
Planting Date	5/6/2019
Harvest Date	10/10/2019
Variety	Hubner 24-38R2X
Population	See Treatments
Acres	20
Treatments	5
Reps	4
Treatment Width	30 ft.
Tillage	No-Till
Management	Fertilizer, Herbicide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Rush silt loam, 44% Weinbach silt loam, 33% Wheeling loam, 23%



eFields Collaborating Farm

OSU Extension
Tuscarawas County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact
Chris Zoller (zoller.1@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.45	4.01	7.04	3.95	4.39	2.01	24.85
Cumulative GDDs	237	710	1273	2037	2685	3267	3267

RESULTS

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
80,000	63,000	13.0	69 a	587
120,000	106,500	13.0	69 a	570
160,000	149,700	13.0	66 a	526
200,000	174,700	13.0	70 a	544
240,000	226,500	13.0	68 a	509
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 5.21 (NS) CV: 6.03%	



STUDY INFORMATION

Planting Date	6/1/2019
Harvest Date	9/28/2019
Variety	Becks 3215
Population	See Treatments
Acres	48
Treatments	5
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Management	Fertilizer, Fungicide, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	20 in.
Soil Type	Brookston silty clay loam, 93% Odell-Lewisburg complex, 7%

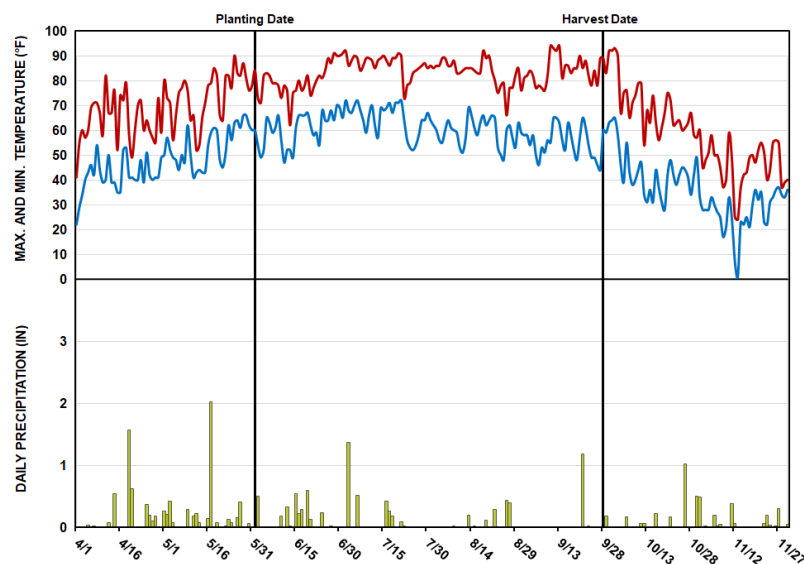


eFields Collaborating Farm

OSU Extension

Union County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Wayne Dellinger (dellinger.6@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.77	4.93	3.13	2.90	1.53	1.43	17.69
Cumulative GDDs	219	670	1265	2037	2691	3281	3281

RESULTS

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
80,000	80,750	12.0	59 a	497
110,000	107,000	12.0	60 ab	493
140,000	136,750	12.0	62 b	498
170,000	167,500	11.9	62 b	485
200,000	191,500	12.0	62 b	472
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 2.18 CV: 2.83%	

STUDY INFORMATION

Planting Date	7/2/2019
Harvest Date	11/8/2019
Variety	Pioneer P34T50
Population	See Treatments
Acres	114
Treatments	5
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Management	Fertilizer, Fungicide, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	20 in.
Soil Type	Blount loam, 65% Pewamo silty clay loam, 30% Haskins loam, 5%

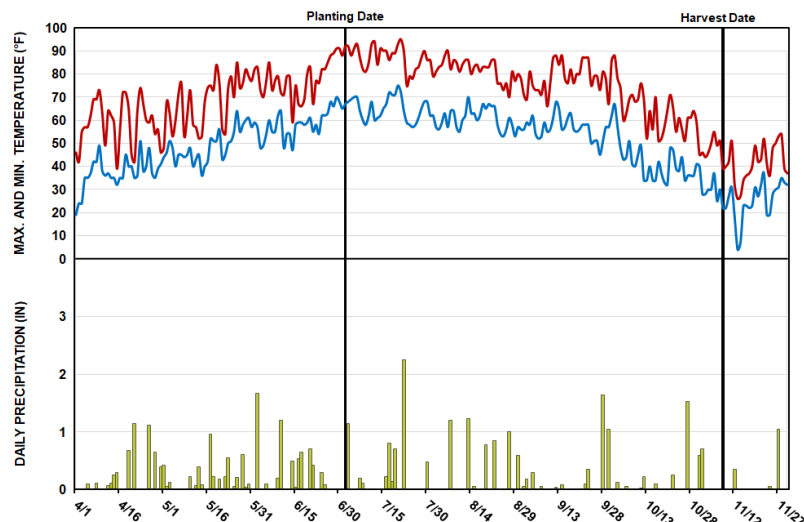


eFields Collaborating Farm

OSU Extension

Williams County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact
Stephanie Karhoff (karhoff.41@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.99	4.58	6.43	6.09	5.76	3.87	31.72
Cumulative GDDs	61	337	882	1703	2359	2888	2888

RESULTS

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed (\$/ac)
80,000	67,000	16.6	48 c	398
120,000	102,000	16.4	50 bc	399
160,000	139,000	16.5	53 a	409
200,000	175,000	16.4	52 ab	382
240,000	212,000	16.4	50 bc	347
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 2.00 CV: 4.30%	



For 2019, eFields small grains research was focused on improving the production and profitability of wheat and malting barley in Ohio. Some exciting and innovating projects were executed this year, with 3 studies being conducted across the state. 2019 small grains research presented in eFields covers both precision crop and nutrient management Digital Ag Team initiatives. Below are highlights of some of the 2019 eFields grain grains research:

54 acres of small grains

3 small grains studies

For more small grains research from The Ohio State University's Department of Extension, explore the following resources:

2019 Ohio Wheat Performance Tests

The purpose of the Ohio Wheat Performance Test is to evaluate wheat varieties for yield and other agronomic characteristics. This evaluation gives wheat producers comparative information for selecting the best varieties for their unique production systems. For more information visit: go.osu.edu/OhioWheat.



Agronomic Crops Team - Wheat Research

The Agronomic Crops Team performs interesting research studies on a yearly basis. Resources, fact sheets, and articles on wheat and barley research can be found here on the Agronomic Crops Team website: go.osu.edu/CropsTeamWheat and go.osu.edu/CropsTeamBarley.



The Soybean and Small Grain Crop Agronomy Program

The Soybean and Small Grain Crop Agronomy Program in the Department of Horticulture and Crop Science at The Ohio State University is directed by Dr. Laura Lindsey. The goal of the research program is to meet the needs of Ohio farmers through research-based agronomic recommendations. Research related to small grains planting, cropping inputs, and harvesting technology can be found on the program's website: stepupsoy.osu.edu/home.



Growth Stages - Small Grains

For all wheat and barley trials in this eFields report, we define growth stages as the following:

Feekes 1.0 - Germination period to the first emerged leaf.

Feekes 2.0 – Tillers become visible.

Feekes 3.0-4.0 – Tiller formation.

Feekes 5.0 – Strongly erect leaf sheaths. Growing point is still below the soil surface.

Feekes 6.0 – First node visible. The growing point is above this node. Tiller production is complete.

Feekes 7.0 – Second node visible. Rapid stem elongation is occurring.

Feekes 8.0 – Flag leaf visible.

Feekes 9.0 – Flag leaf completely emerged and leaf ligule is visible.

Feekes 10.0 – Boot stage. Head is fully developed and can be seen in the swollen section of the lead sheath below the flag leaf.

Feekes 10.5 – Heading and flowering. Head is fully emerged.

Feekes 10.5.1 – Early flowering, anthers are extruded in the center of the head.

Feekes 10.5.2 – Mid flowering, anthers are extruded in the center and top of the head.

Feekes 10.5.3 – Late flowering, anthers are extruded in the center, top, and base of the head.

Feekes 11.0 – Ripening.

Feekes 11.1 – Milk stage.

Feekes 11.2 – Mealy stage.

Feekes 11.3 – Hard kernel.

Feekes 11.4 – Harvest ready.

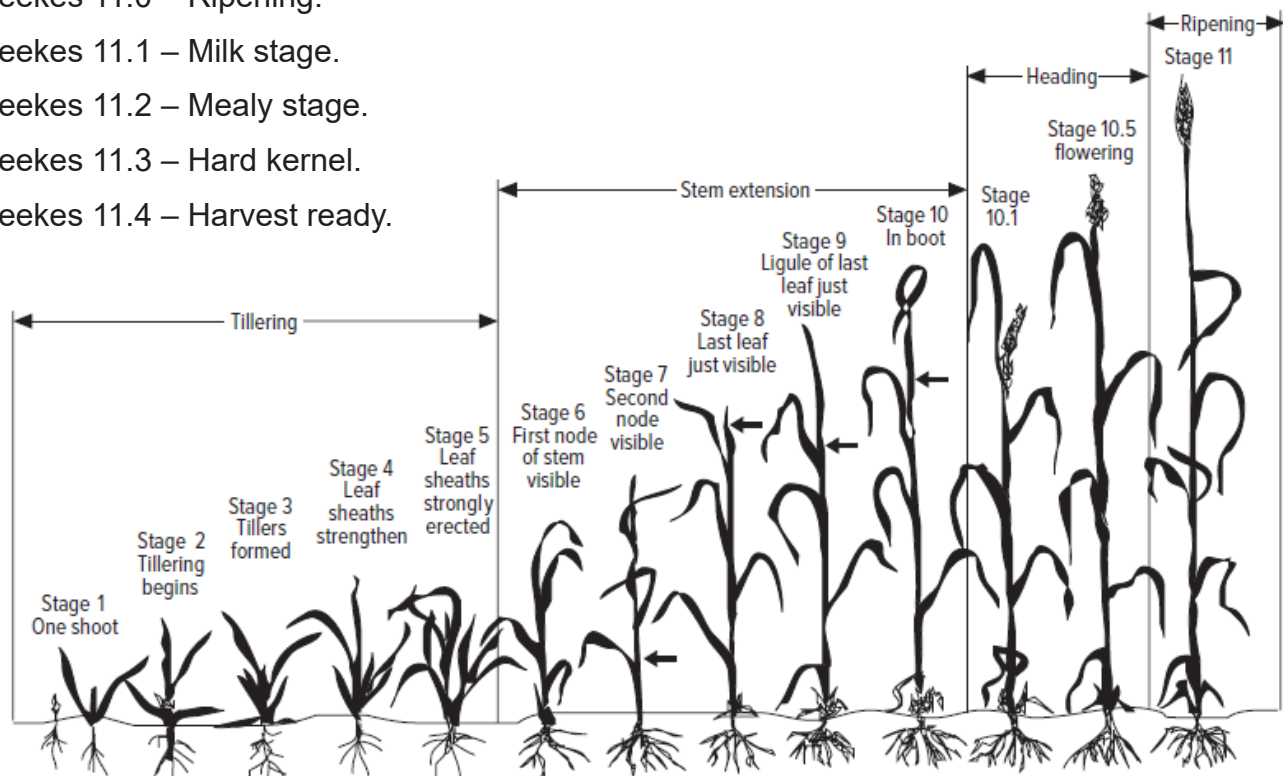


Image adapted from: *Ohio Agronomy Guide, 15th Edition.*



OBJECTIVE - WINTER BARLEY

Determine if high quality, high yielding winter barley can be grown at field-scale in Northwest Ohio.



eFields Collaborating Farm

OSU Extension

Fulton County

STUDY INFO. - BARLEY QUALITY AND YIELD

	Average	Range
Planting Date	10/12/2018	10/2/2018 - 10/20/2018
Avg. Field Size (ac)	50	14-110
Acres Kept	41	7.5-110
Population (mill sds/ac)	1.36	1.2-1.6
Total Nitrogen (#)	73	38-39

STUDY DESIGN - BARLEY QUALITY AND YIELD

Several Northwest Ohio growers have been participating in field-scale winter (malting) barley production research since 2018 in an effort to determine yield and production economics. All barley fields considered were planted with the variety Puffin. Growers were asked to plant barley within 10 days of Hessian fly-free date (September 22 for NW Ohio) if possible. Fields were soil tested and nutrients applied accordingly on a per site basis. Each grower applied approximately 20-30 lbs of starter nitrogen and 60-80 lbs of spring nitrogen. All field operations were performed with commercial equipment. In 2018, eight growers across nine sites participated in this study (see 2018 eFields Report). In 2019, 13 growers in seven Northwest Ohio counties planted 22 field sites. Simple averages of key data points like moisture, yield, straw yield, protein, germination and DON were calculated.

RESULTS - BARLEY QUALITY AND YIELD

	2019		2018
Production Data	Average	Range	Average
Harvest Date	7/6/2019	6/26/2019 - 7/15/2019	6/26/2019
Moisture	13.7	11.9 - 16	13.5
Grain Yield (bu/ac)	50.6	12 - 86	86.0
Straw Yield (T/ac)	0.55	0.22 - 0.95	1.01
Quality Data	Average	Range	Average
Protein (9.5%-12.5%)	10.4	9.2 - 12.05	11.6
Plump (>95%)	91.6	80 - 96.8	87.7
Germination (>95%)	97.4	94 - 100	98.5
DON (<1 ppm)	4.6	0.5 - 9.3	0.45

OBJECTIVE - SOY AFTER BARLEY

Determine the double-crop soybean yield after winter barley.

STUDY INFO. - SOY AFTER BARLEY

Simultaneously, growers who wished to participate were asked to create a 'paired-site' field of first crop soybeans adjacent to their barley field with the goal of comparing yields of double crop soybeans after barley to the yield of first crop beans (check). In 2019, six growers across eight fields (different varieties) participated in these paired sites. Due to the wetness of 2019 and subsequent delay in small grains harvest, only one grower with a nearby wheat field was able to plant double crop soybeans after wheat for comparison. Due to few replications, this data was not included. Simple averages of key data points like plant date, harvest date, seeding rate, moisture, final stand and yield were calculated for comparison.



The image above demonstrates the variability in growth stage that contributed to the high DON issues (fungicide efficacy) observed in the study.

RESULTS - PAIRED SITES

	First Crop		Second Crop	
	Average	Range	Average	Range
Plant Date	6/24/2019	6/19/2019 - 6/29/2019	7/2/2019	6/22/2019 - 7/15/2019
Population (mill sds/ac)	170	150 - 192	197	180 - 220
Harvest Date	10/27/2019	10/7/2019 - 11/5/2019	11/12/2019	11/6/2019 - 11/26/2019
Moisture (%)	12.4	11.4 - 13.5	15.4	12.2 - 24.7
Yield (bu/ac)	49.8	44.3 - 59	30.5	9.8 - 42.8

SUMMARY

- Data are from one year of production and should be interpreted as such.
- Average winter barley yields across all sites were 86.5 bu/ac with average key quality characteristics of 11.6% protein, 88% plump, 99% germination and .5 ppm DON.
- While only planted 6 days earlier on average, yields of double crop soybeans following barley averaged 36.6 bu/ac, compared to 19.5 bu/ac following wheat. First crop soybeans alone (check) yielded 59.3 bu/ac in comparison.
- Additional data from more sites and multi-year data are needed to validate these results.

TOOLS OF THE TRADE

Farmer Peer Learning Cohorts

Cohorts allow like-minded growers to work together and share ideas, observations, management practices and data on a topic. Data for this study is a result of the 2018-2019 Northwest Ohio On Farm Research Cohort for Malt Barley. Each field served as a replication and randomization. This cohort has learned valuable information through communication and research together.

PROJECT CONTACT

For inquiries about this project, contact Eric Richer (richer.5@osu.edu).

OBJECTIVE

Evaluate the yield response of soft red winter wheat to various spring nitrogen systems.



eFields Collaborating Farm

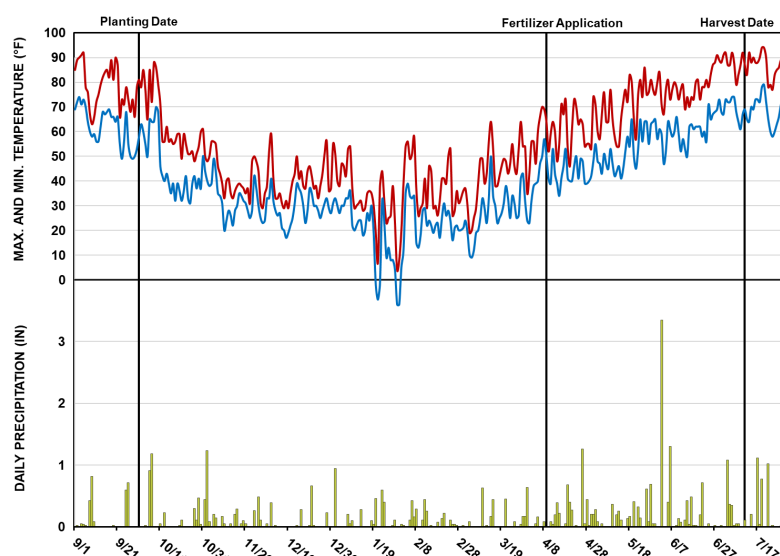
OSU Extension

Hancock County

STUDY INFORMATION

Planting Date	10/1/2018
Harvest Date	7/11/2019
Variety	AGI 2017B
Population	1.8 million
Acres	2
Treatments	4
Reps	4
Treatment Width	10 ft.
Tillage	Minimal
Management	Fertilizer
Previous Crop	Soybeans
Row Spacing	7.5 in.
Soil Type	Hoytville silty clay loam, 100%

WEATHER INFORMATION



Growing Season Weather Summary

	OCT	NOV-FEB	MAR	APR	MAY	JUN	Total
Precip (in.)	3.46	11.45	2.95	4.63	4.18	7.36	34.03
Cumulative GDDs	275	314	342	504	897	1481	1481

STUDY DESIGN

Producers are encouraged to utilize various nitrogen stabilizers to improve nitrogen efficiency and increase yields. This particular study compared four systems: Urea-ammonium nitrate (UAN) alone, UAN plus the nitrification inhibitor Instinct II, UAN plus the bio-stimulant Radiate, and a split application of UAN applied at greenup and early stem elongation (Feekes GS 7). All treatments receive 90 lb/A of spring N. The split application received 40 lb at greenup and 50 lb/A at Feekes 7. Center 11 rows of each plot were harvested for yield. Experimental design was a completely randomized block replicated four times.



Above is one treatment width of the soft red winter wheat nitrogen management study. Four treatments were applied to the plots.

OBSERVATIONS

Excessive rainfall fell during the growing season, particularly during April and May. There was a high probability for nitrogen loss from the field, which should favor the nitrogen stabilizer products and split application.

SUMMARY

- Yields were considerably less than most years for this location, probably a result of the excess rainfall and the potential for nitrogen loss
- There were no statistical differences among treatments
- Yields were not increased by using a nitrification inhibitor, a bio-stimulant, or a split application compared to UAN alone
- More research needs to be completed before adopting nitrogen stabilizers and biostimulants as a standard practice in wheat production

RESULTS

Treatments	Moisture (%)	Yield (bu/ac)
UAN	10.0	48 a
UAN + Instinct II	10.7	52 a
UAN + Radicate	10.5	47 a
Split UAN Application	10.4	50 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 5.60 (NS) CV: 8.80%

TOOLS OF THE TRADE

Research combine

Besides harvesting grain, the research combine will also provide grain weight, grain moisture, and test weight data for further analysis of the study.



PROJECT CONTACT

For inquiries about this project, contact Ed Lentz (lentz.38@osu.edu).

OBJECTIVE

Evaluate the yield response of spring nitrogen rate for soft red winter wheat.



eFields Collaborating Farm

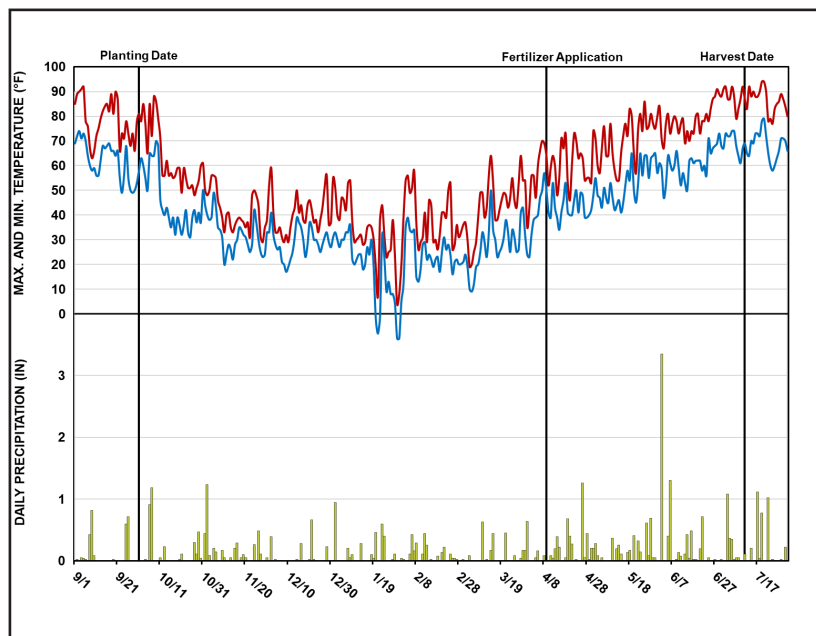
OSU Extension

Hancock County

STUDY INFORMATION

Planting Date	10/1/2018
Harvest Date	7/11/2019
Variety	AGI 2017B
Population	1.8 million
Acres	2
Treatments	7
Reps	4
Treatment Width	10 ft.
Tillage	Minimal
Management	Fertilizer
Previous Crop	Soybeans
Row Spacing	7.5 in.
Soil Type	Hoytville silty clay loam, 100%

WEATHER INFORMATION

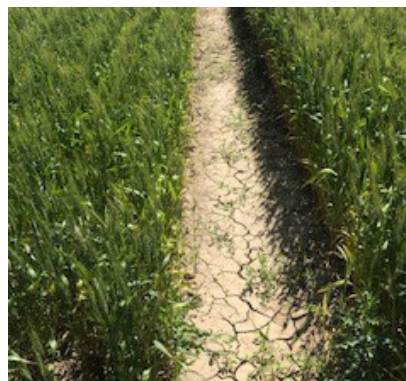


Growing Season Weather Summary

	OCT	NOV-FEB	MAR	APR	MAY	JUN	Total
Precip (in.)	3.46	11.45	2.95	4.63	4.18	7.36	34.03
Cumulative GDDs	275	314	342	504	897	1481	1481

STUDY DESIGN

Producers rely on university research to apply the proper rate of nitrogen for optimal wheat yields and to reduce the risk of nutrient loss into the environment. Few nitrogen rate studies have been completed in recent years in the Eastern Corn Belt. Seven nitrogen rate treatments were applied as urea-ammonium nitrate soon after greenup. All treatments received 30 pounds of nitrogen per acre prior to planting. Center 11 rows of each plot were harvested for yield. Experimental design was a completely randomized block replicated four times.



Above is a comparison of two treatments in the nitrogen rate study.

OBSERVATIONS

Excessive rainfall fell during the growing season, particularly in April and May. Amount of nitrogen available to the crop was most likely reduced by the excessive water and lost from the field or root zone.

SUMMARY

- Grain yields significantly increased with larger nitrogen rates until the 90 pound per acre rate.
- Yields were similar for treatments larger than the 70 pound rate.
- Most likely yields were reduced by excessive rainfall resulting in less nitrogen available for the crop

RESULTS

Treatments (lbs/N)	Moisture (%)	Yield (bu/ac)
0	11.3	26 c
40	10.8	42 b
70	10.3	42 b
90	10.0	48 ab
110	9.9	50 ab
130	10.0	48 a
150	10.5	50 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 6.50 CV: 12.22%

TOOLS OF THE TRADE

Counters

Counters can be a useful tool to keep track of counting plants, tillers, or wheat heads.



PROJECT CONTACT

For inquiries about this project, contact Ed Lentz (lentz.38@osu.edu).



Forage Research

For 2019, eFields Forage research was focused on increasing forage production in Ohio through summer annuals, nutrient management and growth regulators. Some exciting and innovating projects were executed this year, with 21 unique studies being conducted across the state. 2019 Forage research presented in eFields covers both precision nutrient management and species selection Digital Ag Team initiatives. Below are highlights of some of the 2019 eFields Forage research:

503 acres of forage

21 forage studies

For more Forage research and feeding management from The Ohio State University's Department of Extension, explore the following resources:

2019 Ohio Forage Performance Tests

The purpose of the Ohio Forage Performance Test is to evaluate Forage varieties of Alfalfa, Annual Ryegrass, and Cover crops for yield and other agronomic characteristics. This evaluation gives Forage producers comparative information for selecting the best varieties for their unique production systems. For more information visit:
go.osu.edu/OhioForages.



2019 Ohio Forage
Performance Tests

Agronomic Crops Team - Forages Research

The Agronomic Crops Team performs interesting research studies on a yearly basis. Resources, fact sheets, and articles on alfalfa, winter annuals, and summer annuals can be found here on the Agronomic Crops Team website:
go.osu.edu/CropTeamForages.



Agronomic Crops Team
Forage Research



Forage Team



Dairy Team



Beef Team

Species for Planting by Mid-July

Corn Plant Silage	Highest single cut forage yield potential of all choices. Silage quality will be lower than with normal planting dates. Risk will be getting it harvested at right moisture for good fermentation.
Forage Sorghum Sorghum Sudangrass Sudangrass	Best harvested as silage. Brown midrib (BMR) varieties are best for lactating cows. Conventional varieties are okay if BMR seed is not available. Can produce 3-4 tons of dry matter/acre. Risk of prussic acid (hydrogen cyanide gas) if frosted.
Soybean Silage	Reasonable alternative to replace alfalfa forage. Check seed treatment and herbicide labels, many restrict forage use.
Teff Grass	Best suited to beef and sheep; lower yield than sorghum grasses. Can harvest as hay or silage.
Millets	Best suited to beef and sheep; many produce a single harvest. Best harvested as silage. Pearl millet does not produce prussic acid after frost damage.
Mixtures of annual grasses with soybean	Best harvested as silage. Mixtures of sorghum grasses or millets or even oats and spring triticale with soybean are feasible and can improve forage quality characteristics.

Species for Planting July 24 to Mid-September

Oat or Spring Triticale	Can be mowed and wilted to correct harvest moisture. Harvesting as hay can be challenging. Earlier planting dates provide more autumn yield.
Oat or Spring Triticale Plus Winter Cereals	Winter cereals (Winter rye, Winter wheat, Winter triticale) can be added to oat or spring triticale to add a forage harvest early next spring. Winter rye can also contribute a little extra autumn yield to the mixture.
Oat or Spring Triticale Plus Field Peas	Field peas can improve forage quality (especially crude protein content) but will increase seed cost.
Italian Ryegrass	Earlier planting dates provide more autumn yield. Excellent forage quality in the fall. Potential for three harvests next year starting in late April.



OBJECTIVE

Delayed planting conditions led many growers to plant cover crops as an emergency forage for mechanical harvest. Average yield and yield ranges for many species can be found below.



eFields Collaborating Farm

OSU Extension

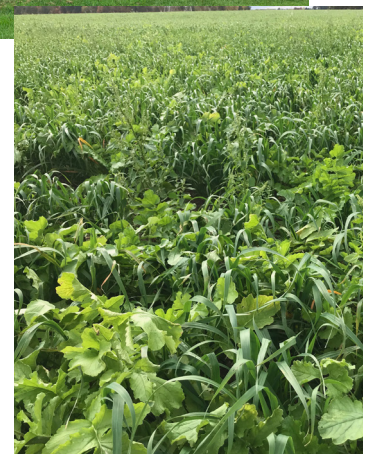
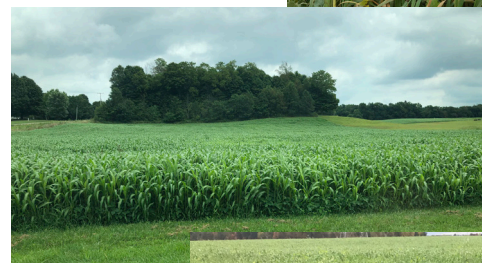
State Wide

Species	Avg. Yield (tons/ac)	Yield Range (tons/ac)
Oats	0.88	0.45-1.37
Oats/Peas	0.59	0.36-0.76
Oats/Radish	0.73	0.27-1.1
Oats/Rye/Turnip	0.80	0.70-0.87
Spring Triticale	1.11	1.02-1.19
Wheat	1.51	0.80-1.11
Cereal Rye	0.66	0.33-1.09
Teff	1.93	1.15-2.49
Italian Ryegrass	0.85	0.81-0.89
Corn	7.40	1.78-14.29
Forage Sorghum	3.07	2.2-3.24
BMR Sorghum Sudan	1.96	1.14-4.07
Sorghum Sudan	2.50	0.99-4.6
Millet	0.94	0.56-2.57
Corn/Soybean	1.50	0.54-3.46
Soybean	1.94	1.05-3.04
Peas	1.13	0.72-1.15
12 Way Mix	0.29	0.18-0.36



go.osu.edu/forages19

Forage nutritional analysis results and economic information is available by following the link or QR code above.



TOOLS OF THE TRADE

Unverferth Cover Crop Seeder

The Unverferth Cover Crop Seeder option was used in multiple locations alone and pulled behind tillage equipment to evenly distribute cover crop seed in a single pass and prepare soils for upcoming spring. This allows for high speed application and better seed to soil contact.



STUDY INFORMATION

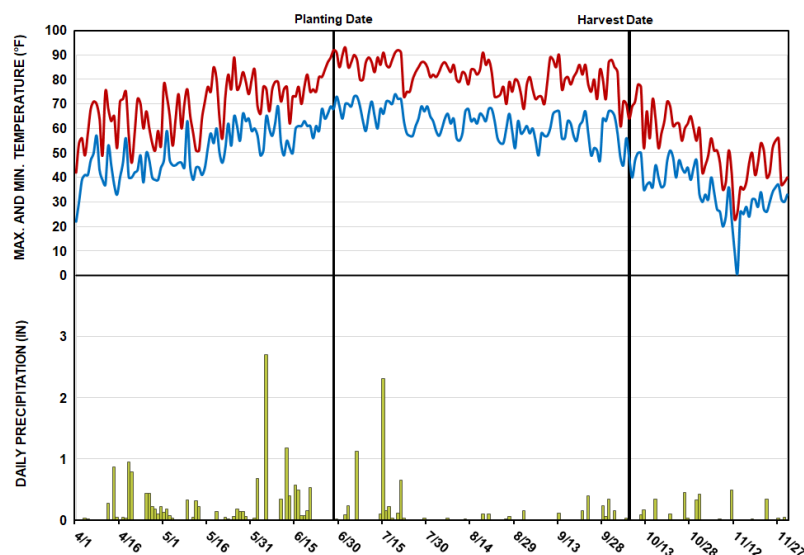
Crop Type	Corn
Planting Date	6/28/2019
Harvest Date	10/7/2019
Variety	DKC43-46
Population	44,000
Acres	45
Treatments	1
Reps	4
Treatment Width	Whole Field
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Cardington silt loam, 56% Tiro silt loam, 25% Bennington silt loam, 19%



eFields Collaborating Farm

OSU Extension
Crawford County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.68	2.19	7.28	5.17	0.33	1.48	21.13
Cumulative GDDs	178	574	1137	1919	2574	3145	3145

RESULTS

Replication	Canopy Height (in)	Weed Presence (rating)	Est. Yield (bu/ac)
1	60	1	150
2	62	1	102
3	70	1	145
4	66	1	123



STUDY INFORMATION

Crop Type	Corn
Planting Date	6/30/2019
Harvest Date	10/7/2019
Variety	DKC 44-80
Acres	30
Treatments	1
Reps	4
Treatment Width	Whole Field
Previous Crop	Soybeans
Row Spacing	15 in.
Soil Type	Tiro silt loam, 47% Lykens silt loam, 24% Sebring silt loam, 18% Bennington silt loam, 11%

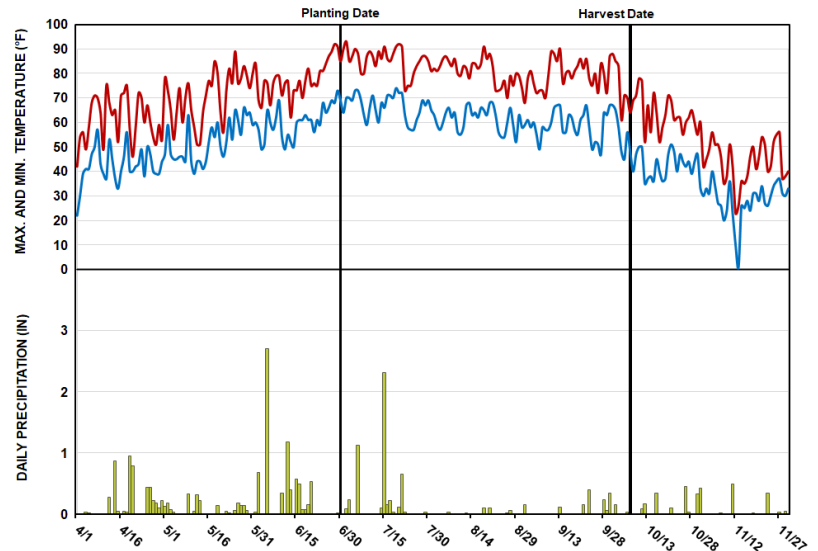


eFields Collaborating Farm

OSU Extension

Crawford County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.68	2.19	7.28	5.17	0.33	1.48	21.13
Cumulative GDDs	178	574	1137	1919	2574	3145	3145

RESULTS

Replication	Canopy Height (in)	Weed Presence (rating)	Est. Yield (bu/ac)
1	73	1	136
2	77	1	122
3	64	1	120
4	62	1	127

STUDY INFORMATION

Crop Type	Corn/Soybeans
Planting Date	7/26/2019
Sample Date	10/4/2019
Variety	AG27X7, AG30X8, AG33X8, AG34X9, AG36X6, AG38X8; DKC50-84, DKC52-68, DKC55-53, DKC58-35, DKC62-20
Acres	0.14
Treatments	2
Reps	1
Treatment Width	36 in. x 36 in. each
Previous Crop	Soybeans
Row Spacing	7.5 in.
Soil Type	Mitiwanga silt loam, 91% Bogart loam, 9%

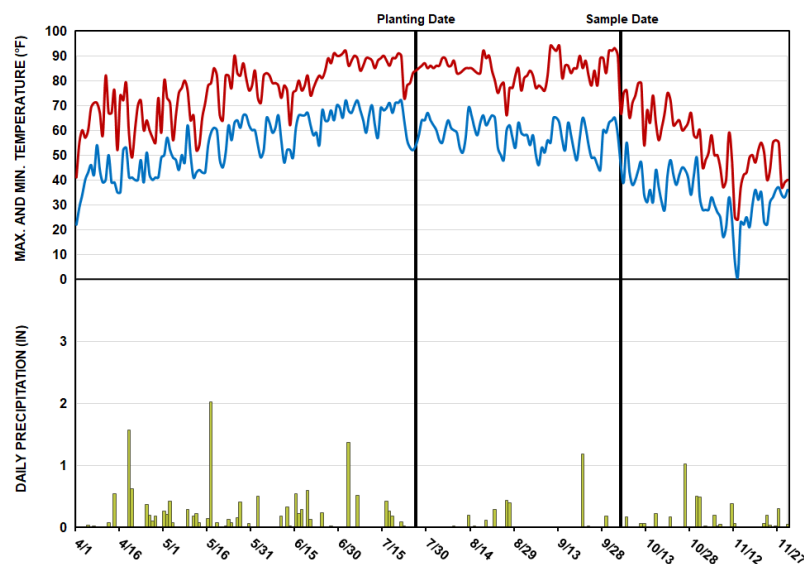


eFields Collaborating Farm

OSU Extension

Wayne County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Matthew Nussbaum (nussbaum.53@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.77	4.93	3.13	2.90	1.53	1.43	17.69
Cumulative GDDs	219	670	1265	2037	2691	3281	3281

RESULTS

Population (lbs/ac)	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
50	69	45 in./20 in.	1	0.54
75	85	50 in./22 in.	1	0.98



STUDY INFORMATION

Crop Type	Corn/Soybeans
Planting Date	7/26/2019
Sample Date	10/4/2019
Variety	AG27X7, AG30X8, AG33X8, AG34X9, AG36X6, AG38X8; DKC50-84, DKC52-68, DKC55-53, DKC58-35, DKC62-20
Acres	0.21
Treatments	1
Reps	1
Treatment Width	36 in. x 36 in. each
Previous Crop	Soybeans
Row Spacing	15 in.
Soil Type	Mitiwanga silt loam, 91% Bogart loam, 9%

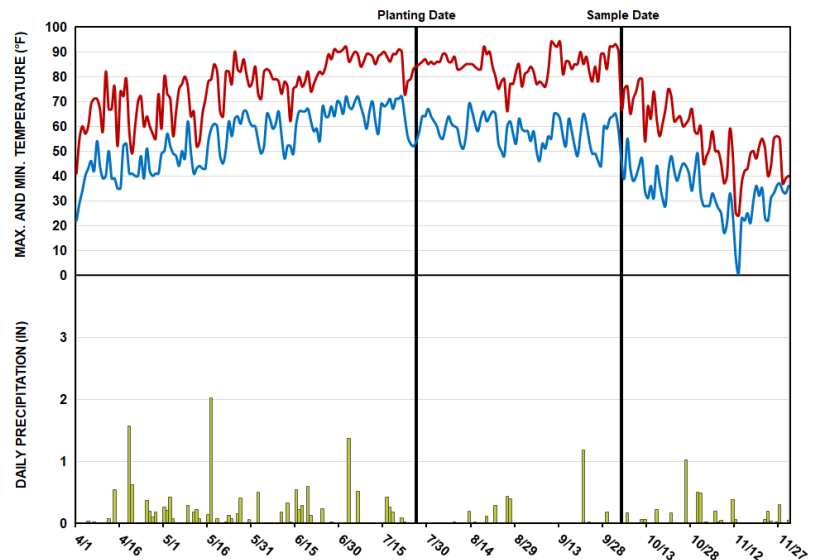


eFields Collaborating Farm

OSU Extension

Wayne County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Matthew Nussbaum (nussbaum.53@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.77	4.93	3.13	2.90	1.53	1.43	17.69
Cumulative GDDs	219	670	1265	2037	2691	3281	3281

RESULTS

Population (seeds/ac)	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
140,000	76	46 in./18 in.	1	0.82
240,000	81	40 in./20 in.	1	0.81
480,000	85	40 in./20 in.	1	1.07

STUDY INFORMATION

Crop Type	Corn/Soybeans
Planting Date	7/26/2019
Sample Date	10/4/2019
Variety	AG27X7, AG30X8, AG33X8, AG34X9, AG36X6, AG38X8; DKC50-84, DKC52-68, DKC55-53, DKC58-35, DKC62-20
Acres	0.21
Treatments	1
Reps	1
Treatment Width	36 in. x 36 in. each
Previous Crop	Soybeans
Row Spacing	Broadcast
Soil Type	Mitiwanga silt loam, 91% Bogart loam, 9%

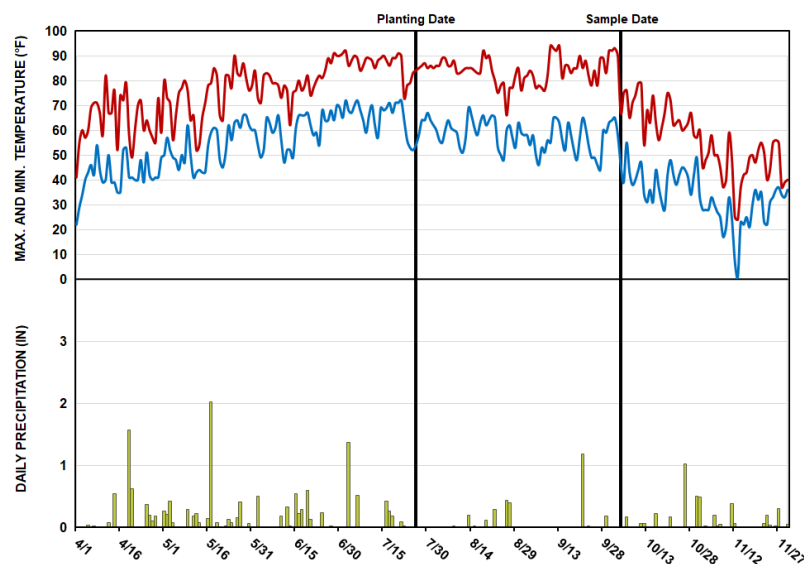


eFields Collaborating Farm

OSU Extension

Wayne County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Matthew Nussbaum (nussbaum.53@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.77	4.93	3.13	2.90	1.53	1.43	17.69
Cumulative GDDs	219	670	1265	2037	2691	3281	3281

RESULTS

Population (lbs/ac)	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
75	75	45 in./21 in.	1	0.68
150	84	45 in./22 in.	1	0.91
300	87	50 in./24 in.	1	1.01



STUDY INFORMATION

Crop Type	Corn/Soybeans
Planting Date	6/17/2019
Sample Date	10/9/2019
Acres	10
Treatments	1
Reps	4
Treatment Width	10 ft.
Previous Crop	Soybeans
Row Spacing	7.5 in.
Soil Type	Hoytville clay loam, 100%

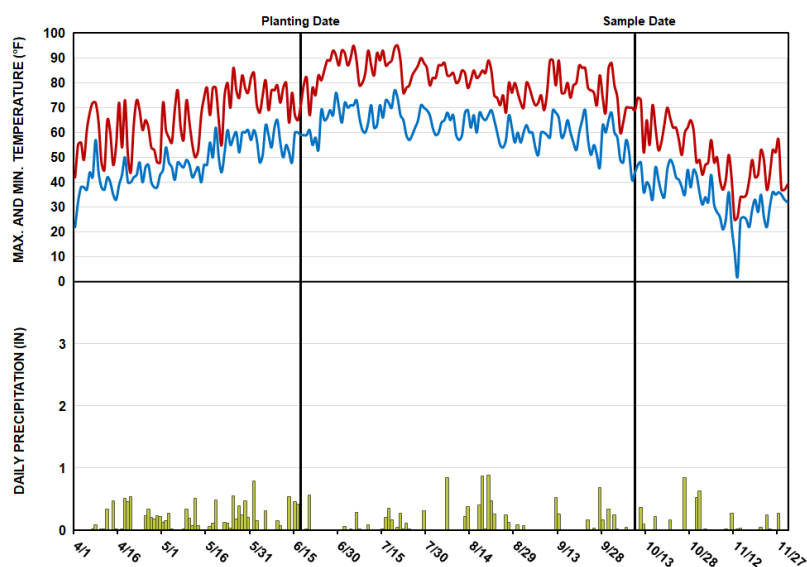


eFields Collaborating Farm

OSU Extension

Wood County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Alan Sundermeier (sundermeier.5@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.88	4.72	3.46	1.96	4.80	2.22	21.04
Cumulative GDDs	141	490	1039	1836	2504	3067	3067

RESULTS

Replication	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
1	80	30	1	1.82
2	75	24	1	2.82
3	80	40	1	3.12
4	70	36	1	3.46

CFAES

Experience the premier outdoor agricultural education and industry exposition.



2020 FARM SCIENCE REVIEW

SEPT. 22–24

**MOLLY CAREN
AGRICULTURAL CENTER
LONDON, OHIO**

Tickets available preshow
for \$7 online or from
OSU Extension offices
and local agribusinesses.
\$10 at the gate. Children 5
and under are free.

IF YOUR BUSINESS IS AGRICULTURE, OUR BUSINESS IS YOU.



THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES



#FSR20 // fsr.osu.edu

OBJECTIVE

Determine the yield effect from various nitrogen rates applied to oats.



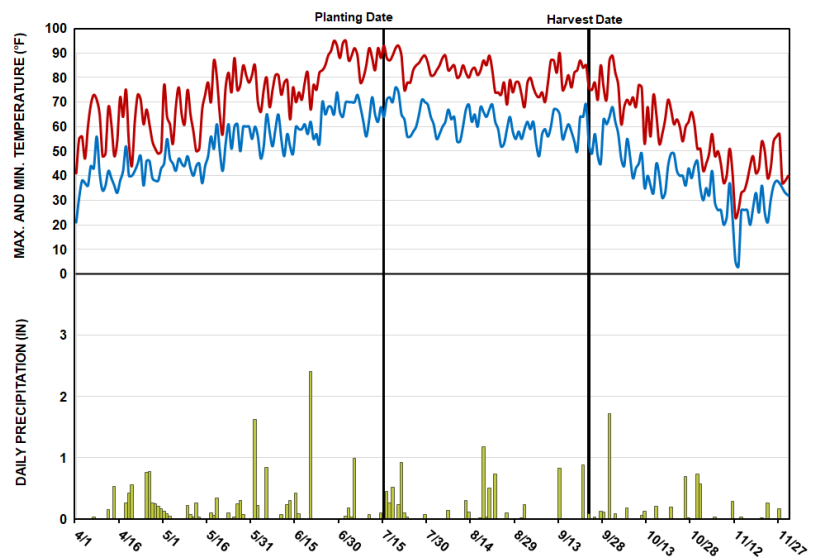
eFields Collaborating Farm

OSU Extension
Sandusky County

STUDY INFORMATION

Crop Type	Oats
Planting Date	7/15/2019
Harvest Date	9/23/2019
Acres	1
Treatments	3
Reps	3
Treatment Width	10 ft.
Tillage	Conventional
Previous Crop	Soybeans
Row Spacing	7.5 in.
Soil Type	Hoytville clay loam, 100%

WEATHER INFORMATION

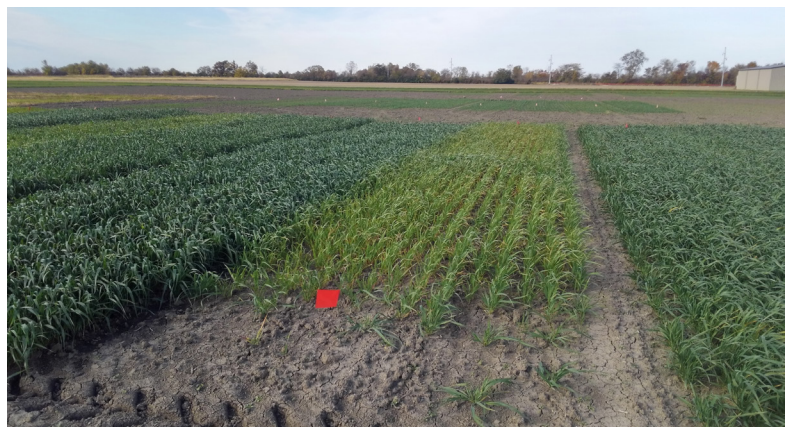


Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.46	2.21	6.26	4.07	3.20	4.08	24.48
Cumulative GDDs	152	521	1074	1859	2502	3055	3055

STUDY DESIGN

This trial was designed as a small plot randomized trial due to the lack of forage equipment available to us with a yield monitor. The plots were hand harvested and dried to calculate tons per acre. Plots were sampled twice and averaged. 3 rates of urea nitrogen were applied, the most common practice is to apply 46 pounds of nitrogen or none. We applied none, 46 pounds, and 92 pounds of nitrogen.



Various nitrogen rates were applied to oats to compare yields at sampling time.

OBSERVATIONS

The nitrogen treatments had a much greener color than the zero nitrogen treatment. The Zero treatments also had more weeds with Canopeo showing a 40% difference in ground cover between the zero nitrogen and treated plots. At harvest oat crown rust was present across all plots.

SUMMARY

- Nitrogen application had a significant benefit compared to zero nitrogen.
- Doubling the rate from 46 to 92 pounds of nitrogen did not significantly increase yield.



RESULTS

Treatments (lbs N/ac)	Yield (tons/ac DM)
0	0.62 b
46	1.28 a
92	1.42 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.	
	LSD: 0.37 CV: 27.80%

TOOLS OF THE TRADE

Canopeo

This app can be used to quantify the percent canopy cover of live green vegetation for any agricultural crop, turf, or grassland based on downward-facing photos taken with your mobile device.



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu), Al Gahler (gahler.2@osu.edu), Mike Gastier (gastier.3@osu.edu), or Hallie Williams (williams.6386@osu.edu).

OBJECTIVE

Determine yield effect of applying various rates of nitrogen and fungicide to oats via a split plot arrangement.



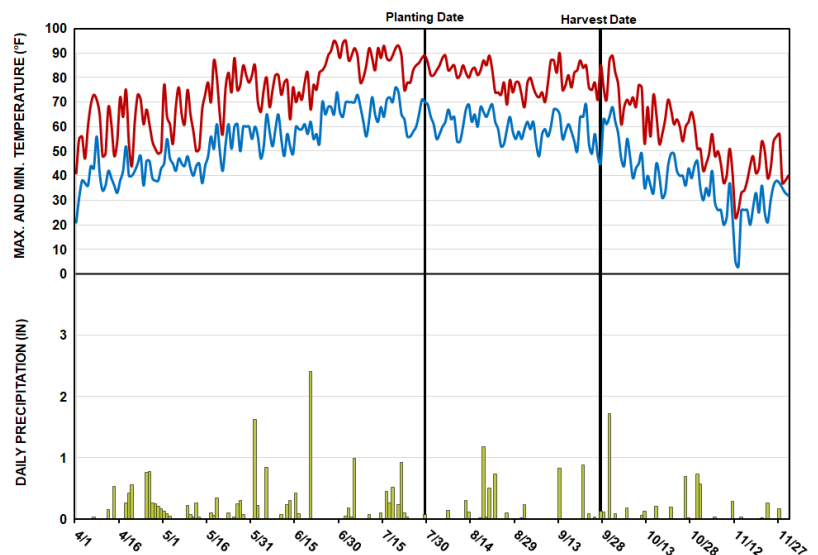
eFields Collaborating Farm

OSU Extension
Sandusky County

STUDY INFORMATION

Crop Type	Oats
Planting Date	7/29/2019
Harvest Date	9/27/2019
Acres	1
Treatments	6
Reps	3
Treatment Width	10 ft.
Previous Crop	Soybeans
Row Spacing	7.5 in.
Soil Type	Hoytville clay loam, 100%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.46	2.21	6.26	4.07	3.20	4.08	24.28
Cumulative GDDs	152	521	1074	1859	2502	3055	3055

STUDY DESIGN

This trial was designed as a small plot randomized trial do to the lack of forage equipment available to us with a yield monitor. The plots were hand harvested and dried to calculate tons per acre. Plots were sampled twice and averaged. 3 rates of nitrogen were applied as urea at planting. The most common practice is to apply 46 pounds of nitrogen or none. We applied none, 46 pounds, and 92 pounds. Fungicide was applied on half of each plot just after flag leaf emergence to protect the plants from crown rust.



Side by side view of non-treated (left) and fungicide treated (right) cover crop oats for forage.

OBSERVATIONS

Visual differences could be seen between nitrogen rates and Fungicide treatments. Disease ratings were taken at harvest to assess the amount of crown rust. Fungicide treatment had a significant effect on the amount of disease present at harvest.

SUMMARY

- Nitrogen application to oats has a significant yield benefit but increased nitrogen rates above 46 lbs did not increase yield.
- The fungicide application had a significant decrease in crown rust scores but did not statistically increase yield. Fungicide application showed a positive yield trend.



RESULTS

Treatments (lbs N/ac)	Yield (tons/ac DM)
0 lbs N, Untreated	0.86 c
0 lbs N, Fungicide	0.98 bc
46 lbs N, Untreated	1.52 abc
46 lbs N, Fungicide	1.95 a
92 lbs N, Untreated	1.68 ab
92 lbs N, Fungicide	2.22 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.	
LSD: 0.71 CV: 26.20%	

TOOLS OF THE TRADE

HarvestLab

Mounted on forage harvesters to record real-time forage moisture throughout the field. Information is used to make sure forage is harvested at the optimum storage moisture or for variable rate preservative application.



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu), Al Gahler (gahler.2@osu.edu), Mike Gastier (gastier.3@osu.edu), or Hallie Williams (williams.6386@osu.edu).

OBJECTIVE

Determine the yield effect from various nitrogen rates applied to oats.



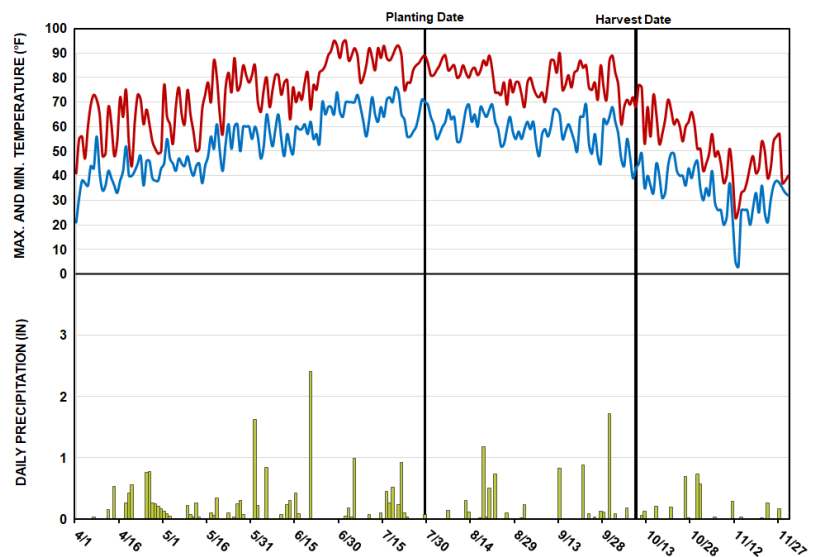
eFields Collaborating Farm

OSU Extension
Sandusky County

STUDY INFORMATION

Crop Type	Oats
Planting Date	7/29/2019
Harvest Date	10/9/2019
Acres	1
Treatments	3
Reps	3
Treatment Width	10 ft.
Previous Crop	Soybeans
Row Spacing	7.5 in.
Soil Type	Hoytville clay loam, 100%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.46	2.21	6.26	4.07	3.20	4.08	24.28
Cumulative GDDs	152	521	1074	1859	2502	3055	3055

STUDY DESIGN

This trial was designed as a small plot randomized trial do to the lack of forage equipment available to us with a yield monitoring capabilities. The plots were hand harvested and dried to calculate tons per acre. Plots were sampled twice and averaged. 3 rates of urea nitrogen were applied the most common practice is to apply 46 pounds of nitrogen or none. We applied none, 46 pounds, and 92 pounds.



Various nitrogen rates were applied to oats to compare yields at sampling time.

OBSERVATIONS

The nitrogen treatments had a much greener color than the zero nitrogen treatment. The Zero treatments also had more weeds with Canopeo showing a 53% difference in ground cover between the zero nitrogen and treated plots. At harvest oat crown rust was present across all plots. Rust was slowed down by fungicide application but lower leaves were infected. Some of the plants had leaves do to high disease pressure.

SUMMARY

- Nitrogen application of 92 lbs/ac had a significant increase in yield compared to zero nitrogen and 46 lbs of nitrogen.
- Yields were reduced in this trial compared to the same planting data harvested earlier possibly due to increased crown rust and lower yields falling off.



RESULTS

Treatments (lbs N/ac)	Yield (tons/ac DM)
0	0.70 b
46	0.72 b
92	1.30 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.	
LSD: 0.41 CV: 36.8%	

TOOLS OF THE TRADE

Forage Probe

Forage probes are used to get a representative sample of feed quality to be sent to a lab for forage analysis accounting for variable field conditions and forage quality. They are more effective than a grab sample.



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu).

STUDY INFORMATION

Crop Type	Oats
Planting Date	7/28/2019
Harvest Date	10/9/2019
Acres	60
Treatments	1
Reps	4
Treatment Width	15 ft.
Previous Crop	Corn
Row Spacing	7.5 in.
Soil Type	Hoytville clay loam, 100%

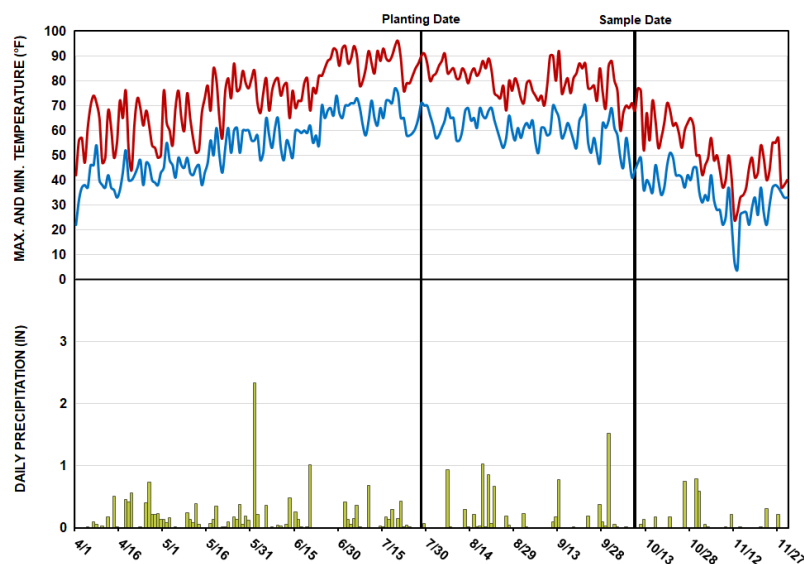


eFields Collaborating Farm

OSU Extension

Wood County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Alan Sundermeier (sundermeier.5@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.29	3.05	4.96	3.18	4.38	3.51	23.37
Cumulative GDDs	154	518	1074	1873	2545	3125	3125

RESULTS

Replication	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
1	33	10	1	0.79
2	62	13	1	0.46
3	33	10	1	0.88
4	54	10	1	0.61

STUDY INFORMATION

Crop Type	Oats/Peas
Planting Date	8/15/2019
Harvest Date	10/9/2019
Variety	Byron, Keystone, P1877
Acres	12
Treatments	1
Reps	3
Treatment Width	4 ft. x 4 ft.
Previous Crop	Wheat
Row Spacing	7.5 in.
Soil Type	Canfield silt loam, 91% Wooster-Riddles silt loam, 9%

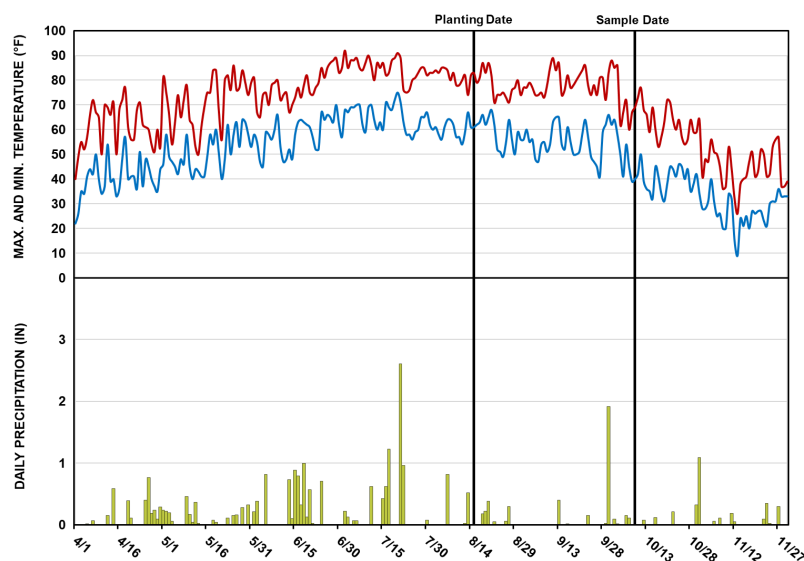


eFields Collaborating Farm

OSU Extension

Wayne County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Matthew Nussbaum (nussbaum.53@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.34	2.95	6.71	7.07	2.57	2.53	25.17
Cumulative GDDs	177	566	1096	1853	2463	2980	2980

RESULTS

Replication	Ground Cover(%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
1	45	7	1	0.76
2	36	7	1	0.66
3	25	7	1	0.36

STUDY INFORMATION

Crop Type	Oats/Radish
Planting Date	7/30/2019
Harvest Date	10/9/2019
Acres	55
Treatments	1
Reps	4
Treatment Width	15 ft.
Previous Crop	Corn
Row Spacing	7.5 in.
Soil Type	Hoytville clay loam, 90% Aurand loam, 10%

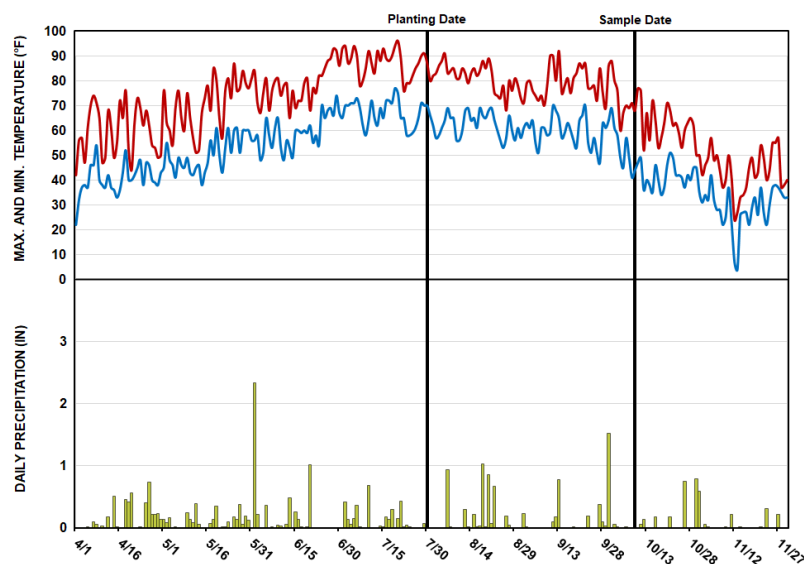


eFields Collaborating Farm

OSU Extension

Wood County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Alan Sundermeier (sundermeier.5@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.29	3.05	4.96	3.18	4.38	3.51	23.37
Cumulative GDDs	154	518	1074	1873	2545	3125	3125

RESULTS

Replication	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
1	88	9	1	0.50
2	64	8	1	0.27
3	71	10	1	1.01
4	44	7	1	0.84

STUDY INFORMATION

Crop Type	Oats/Radish
Planting Date	7/30/2019
Harvest Date	10/9/2019
Acres	55
Treatments	1
Reps	4
Treatment Width	15 ft.
Previous Crop	Corn
Row Spacing	7.5 in.
Soil Type	Hoytville clay loam, 100%

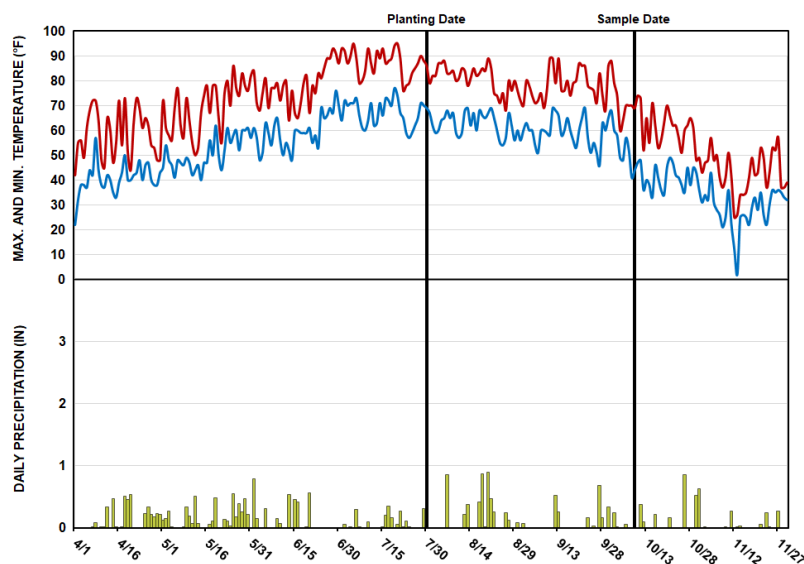


eFields Collaborating Farm

OSU Extension

Wood County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Alan Sundermeier (sundermeier.5@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.88	4.72	3.46	1.96	4.80	2.22	21.04
Cumulative GDDs	141	490	1039	1836	2504	3067	3067

RESULTS

Replication	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
1	66	12	1	0.67
2	93	18	1	0.93
3	70	14	1	1.12
4	72	12	1	0.46

STUDY INFORMATION

Crop Type	Oats/Rye
Planting Date	8/27/2019
Harvest Date	10/14/2019
Acres	10
Treatments	1
Reps	3
Treatment Width	4 ft. x 4 ft.
Previous Crop	Hay
Row Spacing	7.5 in.
Soil Type	Canfield silt loam, 75% Wooster-Riddles silt loam- 25%

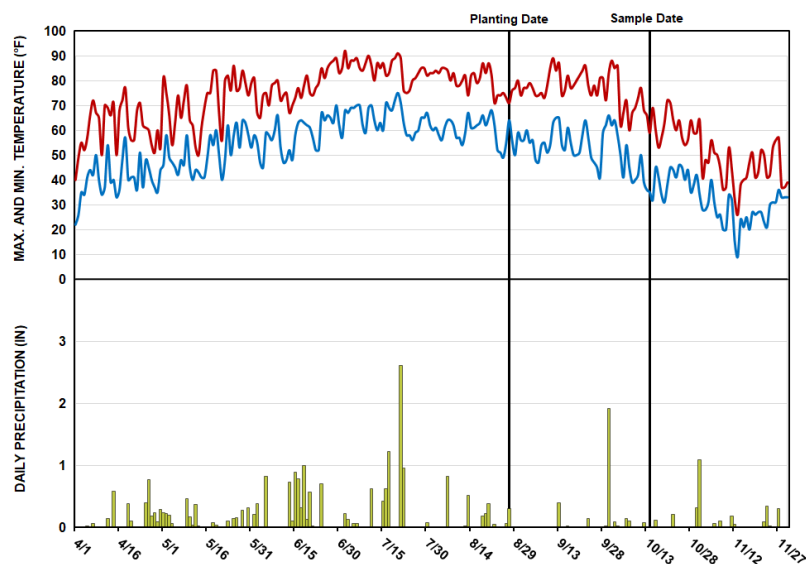


eFields Collaborating Farm

OSU Extension

Wayne County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Matthew Nussbaum (nussbaum.53@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.34	2.95	6.71	7.07	2.57	2.53	25.17
Cumulative GDDs	177	566	1096	1853	2463	2980	2980

RESULTS

Replication	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
1	43	6	1	0.87
2	6	3	1	0.70
3	12	3.5	1	0.82

STUDY INFORMATION

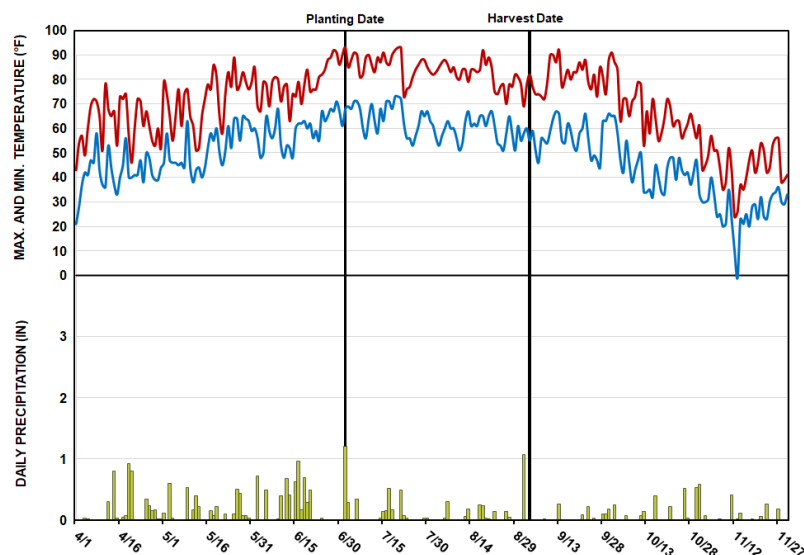
Crop Type	Pearl Millet
Planting Date	7/2/2019
Harvest Date	9/3/2019
Acres	50
Treatments	1
Reps	4
Treatment Width	20 in. x 20 in.
Previous Crop	Soybeans
Row Spacing	Broadcast
Soil Type	Blount silt loam, 36% Pewamo silty clay loam, 31% Glynwood silt loam, 20% Chili loam, 13%



eFields Collaborating Farm

OSU Extension
Crawford County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.05	3.92	6.02	3.54	1.44	2.12	21.09
Cumulative GDDs	191	603	1166	1927	2562	3120	3120

RESULTS

Replication	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
1	28	20	1	0.56
2	22	16	1	0.76
3	18	15	1	0.72
4	15	15	1	0.59

STUDY INFORMATION

Crop Type	Sorghum Sudan
Planting Date	7/7/2019
Harvest Date	9/6/2019
Acres	40
Treatments	1
Reps	4
Treatment Width	20 in. x 20 in.
Previous Crop	Soybeans
Row Spacing	7.5 in.
Soil Type	Blount silt loam, 62% Pewamo silty clay loam, 38%

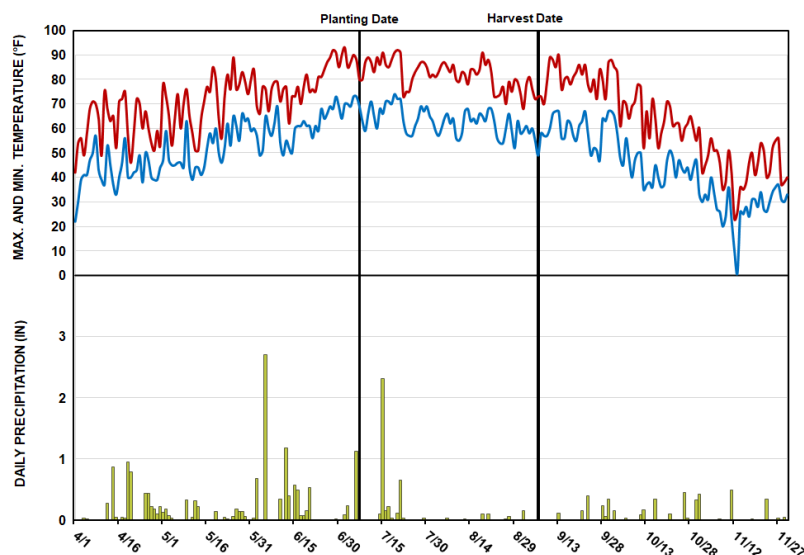


eFields Collaborating Farm

OSU Extension

Crawford County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.68	2.19	7.28	5.17	0.33	1.48	21.13
Cumulative GDDs	178	574	1137	1919	2574	3145	3145

RESULTS

Replication	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
1	96	54	2	4.21
2	98	62	1	3.14
3	99	73	1	2.77
4	94	63	1	1.68

STUDY INFORMATION

Crop Type	BMR Sorghum Sudan
Planting Date	7/20/2019
Harvest Date	9/14/2019
Acres	70
Treatments	1
Reps	4
Treatment Width	20 ft.
Previous Crop	Wheat
Row Spacing	7.5 in.
Soil Type	Hoytville silty clay loam, 61% Nappanee loam, 39%

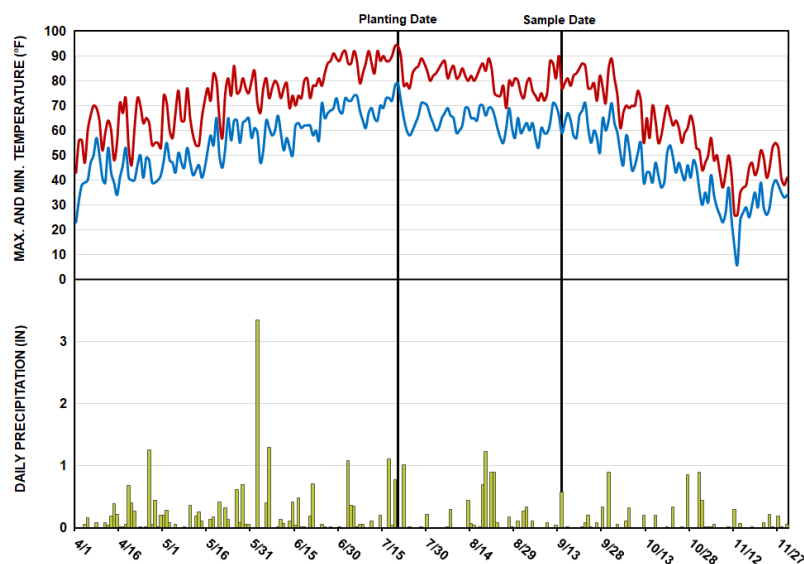


eFields Collaborating Farm

OSU Extension

Wood County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Alan Sundermeier (sundermeier.5@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.63	4.18	7.36	5.42	4.97	3.07	29.63
Cumulative GDDs	162	555	1139	1962	2664	3276	3276

RESULTS

Replication	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
1	100	38	1	1.40
2	100	42	1	1.14
3	100	45	1	1.25
4	100	40	1	1.45

STUDY INFORMATION

Crop Type	BMR Sorghum Sudan
Planting Date	7/30/2019
Harvest Date	9/14/2019
Acres	40
Treatments	1
Reps	4
Treatment Width	20 ft.
Previous Crop	Wheat
Row Spacing	7.5
Soil Type	Haskins and Digby till substratum, 44% Merrill loam, 32% Hoytville silty clay loam, 24%

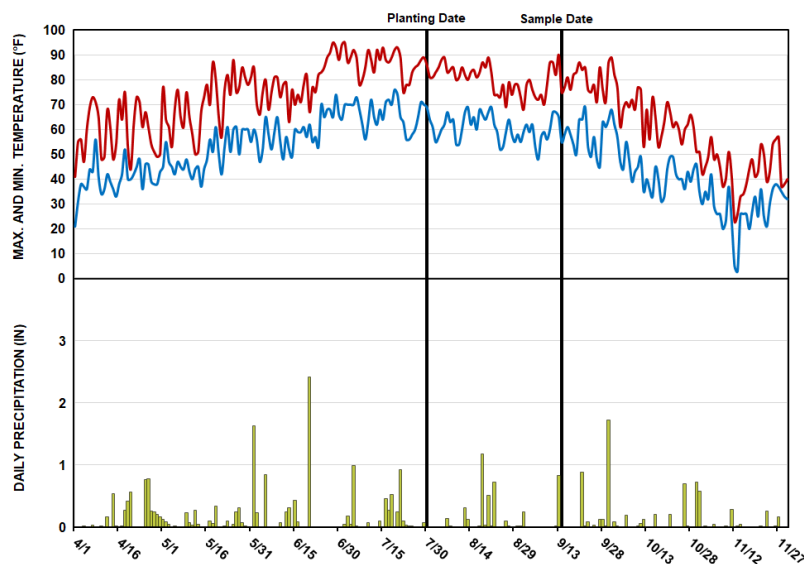


eFields Collaborating Farm

OSU Extension

Wood County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Alan Sundermeier (sundermeier.5@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.46	2.21	6.26	4.07	3.20	4.08	24.28
Cumulative GDDs	152	521	1074	1859	2502	3055	3055

RESULTS

Replication	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)
1	100	34	1
2	100	30	1
3	100	28	1
4	100	32	1

STUDY INFORMATION

Crop Type	9-Way Mix
Planting Date	7/20/2019
Harvest Date	10/14/19
Acres	20
Treatments	1
Reps	5
Treatment Width	N/A
Previous Crop	Wheat
Row Spacing	7.5
Soil Type	Glynwood-blount complex, 47% Morley loam, 37% Spinks loamy sand, 16%

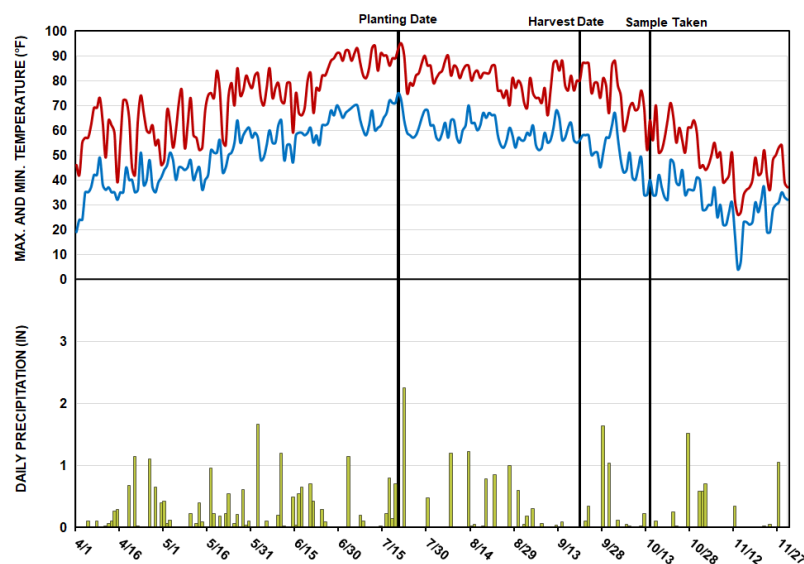


eFields Collaborating Farm

OSU Extension

Williams County

WEATHER INFORMATION



PROJECT CONTACT

For inquiries about this project, contact Stephanie Karhoff (karhoff.41@osu.edu).

Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.99	4.58	6.43	6.09	5.76	3.87	31.72
Cumulative GDDs	61	337	882	1703	2359	2888	2888

RESULTS

Replication	Ground Cover (%)	Canopy Height (in)	Weed Presence (rating)	Est. Yield (tons/ac)
1	67	30	1	0.26
2	92	28	1	0.36
3	86	33	1	0.18
4	59	33	1	0.30
5	67	35	1	0.36

OBJECTIVE

Plant multiple species of summer annuals to compare yield potential of crops as a source of winter feed.



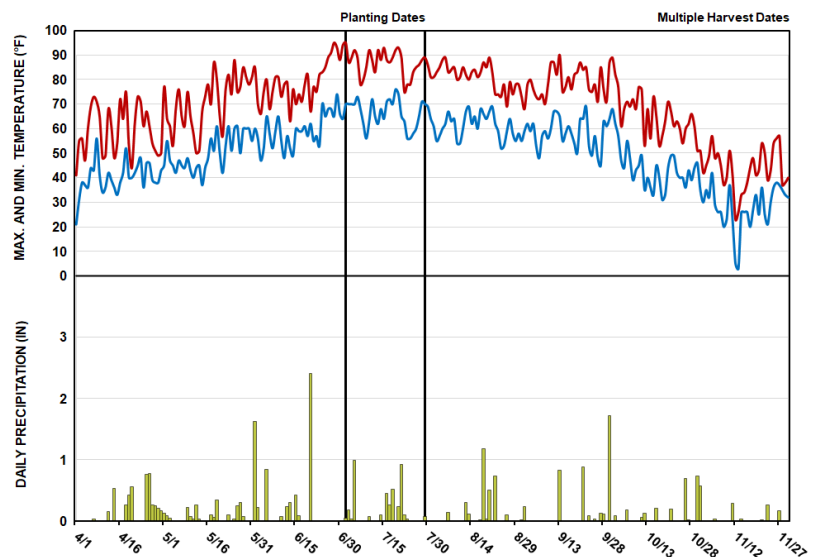
eFields Collaborating Farm

OSU Extension
Sandusky County

STUDY INFORMATION

Crop Type	9-way mix
Planting Date	7/2/19 & 7/29/19
Acres	1
Treatments	9
Reps	4
Treatment Width	10 ft.
Previous Crop	Soybeans
Row Spacing	7.5 in.
Soil Type	Hoytville clay loam, 100%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.46	2.21	6.26	4.07	3.2	4.08	24.28
Cumulative GDDs	152	521	1074	1859	2502	3055	3055

STUDY DESIGN

2019 was a unique and challenging year. Many producers were short on forage and looking for summer annuals that could be planted in July and harvested as winter feed.

Nine species of cover crops were planted in small plots using a grain drill for all species. Each species was planted at its recommended seeding rates but no fertilizer or herbicides were applied. The plots were planted in early July and late July and harvested at 60 and 80 days after planting. Neither planting date nor harvest date had an effect on yield so plots were only analyzed by species.



Four replications of the study were completed at the OARDC North Central campus.

OBSERVATIONS

All grass species showed nitrogen stress throughout the entire growing season. The two winter annuals, wheat and rye had very thin stands and were mostly weeds at harvest.

SUMMARY

- Species of summer annual had an effect on yield. Plots were very variable throughout every species, most likely due to visible nitrogen stress.
- While we would recommend producers use nitrogen on grass crops, each one needs a different rate to maximize yields which we did not do, to treat every crop the same. With nitrogen fertilizer, yields would be expected to improve.
- While the winter annual rye and wheat had yield, these plots were over 50% weeds and we would not recommend planting them in July.
- Straight peas would be a challenge to mechanically harvest and should be planted with a grass crop to hold the peas up.

RESULTS

Treatments (species)	Planted Rate (lbs/ac)	Yield (tons/ac DM)
Corn	25	3.73 a
Sorghum	30	2.84 ab
Teff	12	1.88 bc
Soybeans	90	1.65 bcd
Oats	80	1.41 cd
Millet	15	1.24 cd
Peas	100	0.98cd
Winter Wheat	80	0.48 d
Winter Rye	80	0.27 e
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.		LSD: 1.37 CV: 59.17%

TOOLS OF THE TRADE

Harvestlab

Harvestlab can be mounted on the forage harvester to record real time forage moisture in the field. This information can then be used to make sure forage is harvest at the optimum storage moisture or apply preservative when needed.



PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh (hartschuh.11@osu.edu), Al Gahler (gahler.2@osu.edu), Mike Gastier (gastier.3@osu.edu), or Hallie Williams (williams.6386@osu.edu).

OBJECTIVE

Assess the benefits of utilizing a hormone (gibberellin) treatment for plant growth with and without a traditional fertilizer.



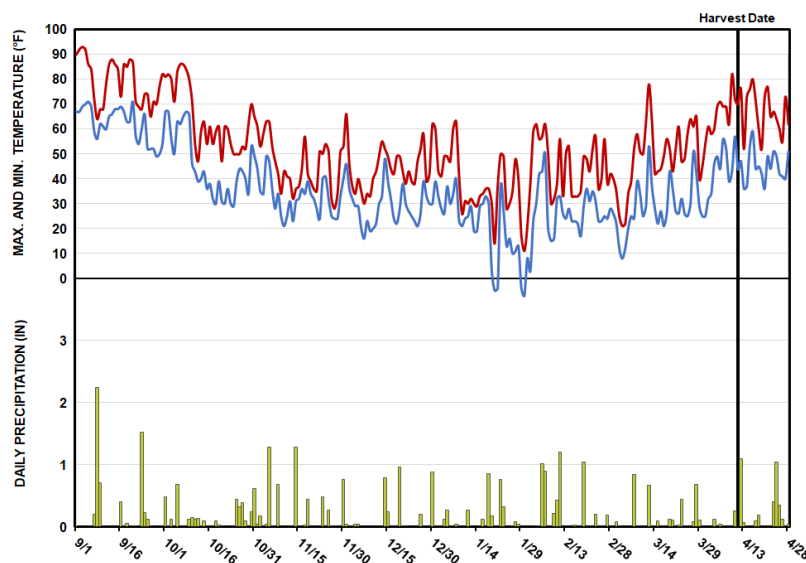
OARDC Eastern Agricultural Research Station

Noble County

STUDY INFORMATION

Harvest Date	4/11/2019
Variety	Cool-season, mixed forages
Population	N/A
Acres	<1
Treatments	4
Reps	4
Treatment Width	10 ft. x 50 ft.
Tillage	No-Till
Management	Fertilizer, Growth Regulator
Previous Crop	N/A
Row Spacing	N/A
Soil Type	Zanesville silt loam, 74% Vandailia-Guernsey silty clay loam, 17% Berks channery silt loam, 8%

WEATHER INFORMATION



Growing Season Weather Summary

	NOV	DEC	JAN	FEB	MAR	APR	Total
Precip (in.)	5.55	3.27	3.12	5.28	3.30	3.88	24.40
Cumulative GDDs	41	66	82	119	187	447	447

STUDY DESIGN

Gibberellins (GA) are compounds classified as plant growth regulators. This class of compounds has been shown to regulate multiple plant developmental factors such as breaking seed dormancy, stem and leaf elongation. Previous studies have demonstrated that gibberellin-based products have increased biomass in mixed forages before, but we wanted to test it against a typical fertilizer rate application.

Four treatments were implemented; a control with no added Urea or RyzUp, Urea applied at 100 lb./ac., RyzUp applied at 0.4 oz., and both RyzUp and Urea co-applied. Experimental plots were 10 ft. x 50 ft. with four replications arranged in a completely randomized design.



Trial was arranged by using 10 ft. x 50 ft. strips of each treatment.

OBSERVATIONS

RyzUp and Urea were both applied on March 14, 2019. The experiment concluded for the season on April 11.

Pasture mass was measured by taking 30 readings per experimental unit using a calibrated rising plate meter (RPM) before the treatment applications and on the final measurement date.

It should be noted that precipitation was not limiting during the experiment.

SUMMARY

- We suspect the combined growth effect of urea and GA is independent and not synergistic. GA acts on cell elongation and utilizes stored energy as fuel for leaf growth. Urea is a source for amino acid synthesis.
- Results of the 2019 trial did not show any significant differences among the treatments utilizing the 0.4 oz. rate of GA and 100 lbs. of urea to the control ($P < 0.05$).
- Our conclusion is thus that urea is a more consistent input to enhance early grazing.

RESULTS

Treatments	Yield (lb/ac DM)
Control	1210 a
RyzUp and Urea	1280 a
RyzUp	1128 a
Urea	1218 a
LSD letters for this trial are based on pairwise comparisons.	LSD: 119.60 (NS) CV: 6.40%

TOOLS OF THE TRADE

Rising Plate Meter

A rising plate meter is a tool used to measure forage mass.



PROJECT CONTACT

For inquiries about this project, contact Christine Gelley (gelley.2@osu.edu), Mark Landefeld (landefeld.6@osu.edu), Dan Lima (lima.19@osu.edu), Jeff McCutcheon (mccutcheon.30@osu.edu), or Catelyn Turner (turner.1630@osu.edu).

OBJECTIVE

Determine forage yield and feed quality of various species planted as cover crops on prevented plant acres.



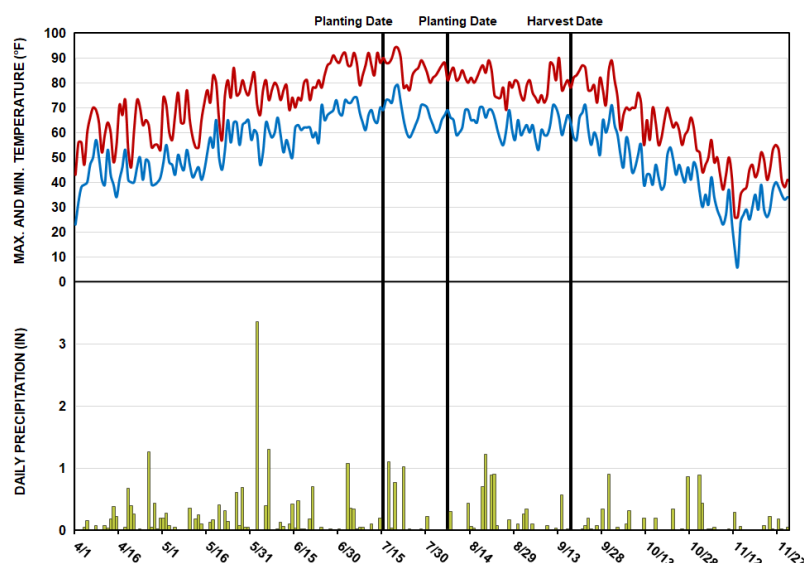
NW Ohio Agricultural Research and Development Center

Wood County

STUDY INFORMATION

Planting Date	7/15/19 and 8/6/19
Harvest Date	9/17/2019
Crop Type	See Treatments
Population	See Treatments
Acres	1
Treatments	9
Reps	2
Treatment Width	20 ft.
Tillage	Minimal
Management	Fertilizer
Previous Crop	Soybeans
Row Spacing	7 in.
Soil Type	Hoytville silty clay loam, 100%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.63	4.18	7.36	5.42	4.97	3.07	29.63
Cumulative GDDs	162	555	1139	1962	2664	3276	3276

STUDY DESIGN

As a demonstration plot at Northwest OARDC, nine different forage species were planted at suggested rates in Ohio Agronomy Guide. Summer annuals were planted on July 15 and winter annuals on August 5. After 60 days of forage growth, samples were taken to calculate yield and analyze feed value. Two forage samples were taken per plot and results averaged in the table.



Spring triticale and oats were planted as two of the treatments in this trial.

OBSERVATIONS

In the first 10 days post planting, the plots received 4.2 inches of rain. At 30 days post planting all species appeared yellowish in color and lacking of nitrogen. Significant growth occurred in late August and early September due to warmer and drier conditions.



Non-BMR and BMR Sorghum Sudan were also planted.

SUMMARY

- There are a variety of forages available that growers can plant in years when hay and corn silage yield and quality may be limited due to excessive rain fall.
- Growers should consider forage needs, harvest method, and planting dates to determine what annual forage species to plant.

RESULTS

Treatments (species)	Planted Rate (lbs/ac)	Avg. Yield (tons/ac)
Oats	60	1.01
Spring Triticale	100	1.11
Italian Ryegrass	20	0.85
Cereal Rye	100	0.44
BMR Sorghum Sudan	20	3.26
Non BMR Sorghum Sudan	20	2.57
Forage Sorghum	12	3.07
Pearl Millet	15	1.59
Teff	12	2.07

TOOLS OF THE TRADE

Forage Sampling Square

This 25" x 25" square constructed from PVC represents 1/10000th of an acre that can be used as a consistent sample size.



PROJECT CONTACT

For inquiries about this project, contact Garth Ruff (ruff.72@osu.edu), Jason Hartschuh (hartschuh.11@osu.edu), or Al Gahler (gahler.2@osu.edu).



Helping growers make the most of precision and digital ag technologies.

The Digital Ag program at The Ohio State University embodies the best of the land grant mission - creation, validation and dissemination of cutting-edge agricultural production technologies. The central focus of this program is the interactions of automation, sensing and data analytics to optimize crop production in order to address environmental quality, sustainability and profitability. The development of hand-held devices for in-field data collection, apps that aid in calibration of applicators, remote sensing and monitoring, and enhanced data analysis for shorter turnaround time.

For more technology research and information from The Ohio State University's Department of Food Agricultural and Biological Engineering and industry partners, explore the following resources:

2018 Free, Online Data and Tools for the Agricultural Community

Today's agricultural community relies on data and tools to help support decision making at the field level. Data-driven insights help agronomists and farmers to predict what is coming, and decide how to act upon this information more effectively, which can improve on-farm decision making and execution. Ohioline is The Ohio State University's Fact sheet database with helpful information on a variety of subjects. For the full database visit:

ohioline.osu.edu/findafactsheet



United Soybean Board - Tech Toolshed

On-farm technology and data management services help farmers maximize production and become more sustainable. Tech Toolshed is a soy checkoff resource to help you maximize the technology you currently have while integrating new technology and managing the data available. The USB- Tech Toolshed website can be found at:

unitedsoybean.org/techtoolshed/



The Ohio State Digital Ag Program

The Ohio State Digital Ag Program conducts studies related to all aspects of the corn production cycle. Research related to corn planting, cropping inputs, and harvesting technology can be found on the Precision Ag website: digitalag.osu.edu



Ohio No-Till Council

Experience and learn about cover crops, nutrient management, soil health, no-till equipment, digital ag, and other topics essentials for success.

2020 Events:

March 3-4

Conservation Tillage Conference
Ohio Northern University, Ada, OH

April 1

Ohio No-Till Spring Field Day
Fairfield County - David Brandt Farm
6100 Basil Western Road, Carroll, OH

August 19

Ohio No-Till Summer Field Evening
Highland County - Nathan Brown Farm
6110 Panhandle Road, Hillsboro, OH

August 20

Ohio No-Till Summer Field Morning
Madison County - Fred Yoder Farm
7050 Butler Avenue, Plain City, OH

December 3

Ohio No-Till Conference
Union County - Der Dutchman Restaurant
445 S. Jefferson Avenue, Plain City, OH



**OHIO
NO-TILL
COUNCIL**

Visit ohionotillcouncil.com to view event details and register.

Look for an updated "Ohio No-Till News" page in each mid-month issue of *Ohio's Country Journal*.



OBJECTIVE

Evaluate the effect of vane design on fertilizer distribution from dual-disc spinner spreaders.



eFields Collaborating Farm

OSU Extension

Statewide

STUDY INFORMATION

Fertilizer – Potash (KCl)

Treatments

- 4 different vane designs
- 3 disc speeds (600, 700 and 800 rpm)
- 2 application rates (200 and 400 lb/ac)

Reps – 4

STUDY DESIGN

A common dual-disc spinner spreader was used for this study with the spreader and control system calibrated prior to testing. Four different vane shapes were used in this study. The first two vanes were common to this type of spinner spreader which were tapered and open faced. However, Vane 1 had a forward tapered top edge at an angle of 32° while Vane 2 had a top edge which was tapered backwards at 15°. Vanes 3 and 4 both had C-channel cross sections with Vane 3 tapered from insides out but Vane 4 with a constant height. Treatments included application rates of 200 lb/ac and 400 lb/ac using three spinner disc speeds (600, 700 and 800 rpm). Stationary tests were conducted using a collection device mounted around the spinner discs and vanes to measure fertilizer particle exit points off the vanes. Standard pan testing served to evaluate material distribution and effective spread width. All tests used potash and were replicated 3 times.



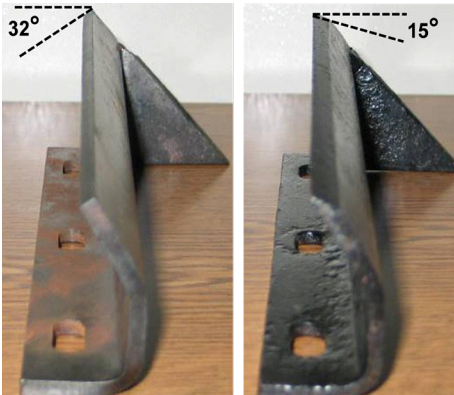
Collection device used for the stationary testing.



Pan testing was completed for each of the vane designs.

OBSERVATIONS

Differences in exit location of fertilizer from the spinner disc and vane combination were visually different during both the stationary and pan collection tests. In particular, ricocheting was visually different. Fertilizer ricocheting off these components is an uncontrolled aspect of material flow that negatively impacts spread distribution. Experiences from this study showed the importance of testing and properly designing the spinner disc and vanes to maintain uniform application of dry fertilizer across cropland and pastures especially as spinner disc speed increasing to attain higher spread widths.



Differences in the top edges between Vane 1 (left) and Vane 2 (right).



Illustration of Vane 3.



Illustration of Vane 4.

SUMMARY

- Results indicated that the level of ricocheting was significantly impacted by top edge design of a vane and increased with disc speed. The forward, upward facing top edge of Vane 1 caused on average, 26% of the material flow to be ricocheted by the vanes thereby inducing an uncontrolled nature of spread.
- However, the rearward facing top edge of Vane 2 reduced ricocheting by 13% plus generated a backward particle rotation for those contacting it. Ricocheting generated an uncontrollable aspect of the spread pattern with these particles applied along the centerline of the spreader.
- The effective spread width increased with disc speed. All four vane shapes generated equal effective spread widths of 18.3 and 21.3-m at 600 and 700 rpm, respectively. However, at 800 rpm, Vane 4 generated the greatest effective spread width of 24.4-m compared to 22.9-m for the other three vanes.
- The wider spread width for Vane 4 was contributed to the rectangular U cross-section maximizing the horizontal velocity of potash particles when exiting the vanes compared to the other three, more open faced vanes.
- Spread uniformity varied by vane shape with Vane 2 consistently generating the lowest CVs.

TOOLS OF THE TRADE

SpreadCAL

SpreadCAL is an APP being developed at The Ohio State University to support pan calibration of dry fertilizer spreaders. The APP utilizes a smartphone camera to estimate the amount of material captured within collection pans, then generate spread pattern results.



PROJECT CONTACT

For inquiries about this project, contact John Fulton (fulton.20@osu.edu).



OBJECTIVE

Understand the importance of Ground Control Points in UAS mapping.



OARDC - Snyder Farm
Wayne County

STUDY INFORMATION

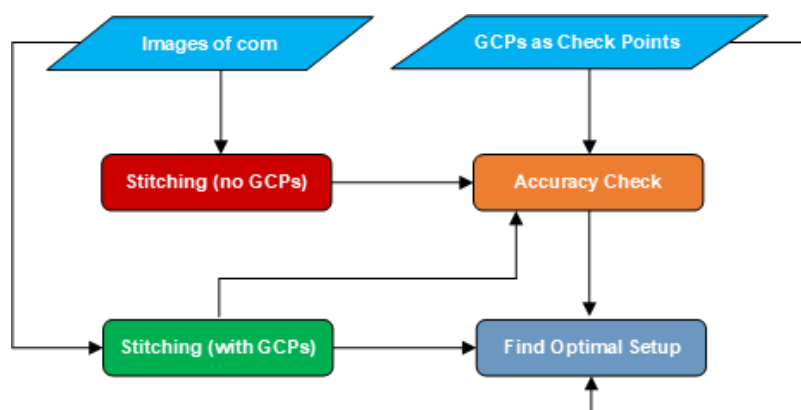
Flight Planning Software	DJI Pilot
Longitudinal Overlap	80%
Transversal Overlap	75%
Flight Time	6 mins
Flight Speed	1.5 m/s
Flight Height	200 ft.
Wind Speed	6 mph
Image Resolution	1.75 cm



In July 2019, a UAS flight was conducted to capture images of a corn field in Wooster, Ohio. Images were captured using a DJI Zenmuse X5S camera onboard a DJI Matrice 200 UAS at 200 ft altitude. Altogether, 144 images were collected. A set of high precision eight Ground Control Points (GCPs) based on AeroPoints technology were established on the ground prior to the flight.

A commercial software called Pix4D mapper was used to process UAS images. To determine the optimal number of GCPs required to increase the accuracy of the final stitched map, various combinations of GCPs, both distribution and number, were used while processing the images. The accuracy of the stitched map was determined using check points. GCPs that were not used during processing served as check points.

STUDY DESIGN



Distribution of GCPs on the field.

OBSERVATIONS

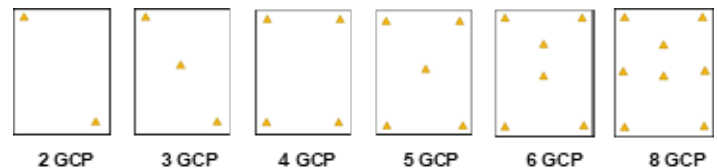
When no GCPs were used during image stitching process, the final map had average error of 6.5 feet (i.e., 2.75 meters). This means an object identified in a map can be off by 6.5 feet relative to its actual geographic location.

This error decreased while increasing the number of GCPs during the processing of images. GCPs distributed at each corner and one at the middle of the field provided optimal accuracy.



SUMMARY

- Stitching of images without using GCPs suffers from a few meters of shift. This may not be accurate for activities requiring precise location information.
- It is not possible to establish GCPs at multiple locations on the field. There is an additional cost associated with each extra GCP.
- An optimal solution is to establish at least one GCP at the middle and at each corner of the field.



Six different setups of GCPs

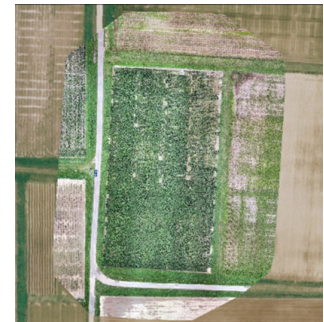
RESULTS



Stitched image based on no GCPs, with geo-rectified image in the background. Red circles illustrate misalignments between stitched and existing geo-rectified images.



Stitched image based on 5 GCPs



Stitched image based on 8 GCPs

TOOLS OF THE TRADE

DJI Matrice 200

This UAS is equipped with high performance motors paired with 17-inch propellers ensuring stable flight in strong winds. Compatibility with several multispectral and thermal sensors extends the imaging beyond visual spectrum.



PROJECT CONTACT

For inquiries about this project, contact Sami Khanal (khanal.3@osu.edu).



OBJECTIVE

Examine the performance of two widely used UAS image processing softwares - Agisoft and Pix4D.



OARDC - Snyder Farm
Wayne County

STUDY INFORMATION

Flight Date	7/8/2019
UAS Type	DJI Matrice 200
Camera	DJI Zenmuse X5S
Flight Planning Software	DJI Pilot
Longitudinal Overlap	80%
Transversal Overlap	75%
Flight Time	6 mins
Flight Speed	1.5 m/s
Flight Height	200 ft.
Wind Speed	6 mph
Image Resolution	1.75 cm
Total number of Images	144



UAS based geo-rectified map of a corn field.

A set of eight ground control points (GCPs) based on AeroPoints technology were established on the ground prior to the flight. Survey-grade location information of GCPs were used while processing images to generate geo-rectified (i.e., ortho-mosaic) map of the field. The computer with 64-bit operating system, 2.19 GHz processor and 32 GB RAM was used to process the images using Agisoft and Pix4D software.

STUDY DESIGN

Two performance parameters, including time required to generate an ortho-mosaic image and accuracy of the ortho-mosaic image were used to compare two software. Images were processed using three different point density settings (i.e., low, medium and high) in the software. Data on 8 GCPs were included during image processing.

Software	GCPs	Point Density Settings
Pix4D Mapper	No	Low, Medium
	Yes	High
Agisoft Photoscan	No	Low, Medium
	Yes	High

The common workflow for generating ortho-mosaic image in these software include image alignment and generation of dense point cloud. In addition to ortho-mosaic, these software generate digital elevation model (DEM) and vegetation indices map (if multispectral images were processed). While an ortho-mosaic image provides an accurate representation of the Earth's surface, DEM provides information about the topographic surface (e.g., elevation and slope). Vegetation indices map provides information on vegetation health.

The low to high point density settings indicate a collection of points representing a feature/object in an image. Although high point density setting improves the accuracy of the results, it requires more memory and time to process images.

OBSERVATIONS

Both of these software generate reports that provide estimates on various performance indicators, such as time required for each step during ortho-mosaic generation, number of points generated, ground resolution of DEM and ortho-mosaic, and the geometric accuracy of the ortho-mosaic based on GCPs.

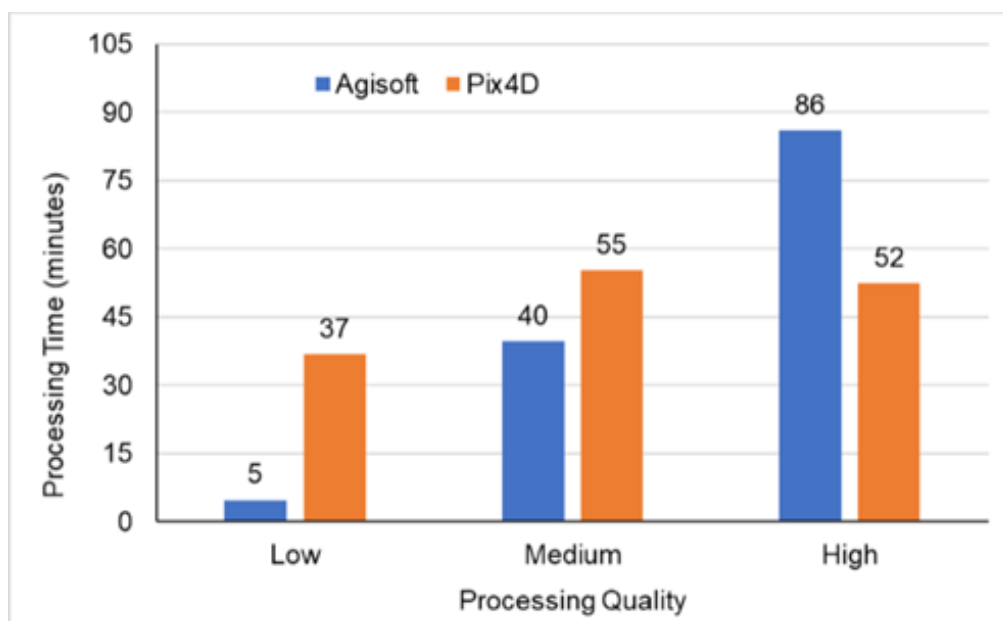
It costs \$4,990 for license of Pix4D Mapper or \$292 per month for annual subscription. However, the professional license of Agisoft cost only \$3,499 and \$179 for standard edition with no additional charges.

The geometric accuracy of the ortho-mosaic generated from Agisoft using GCPs was more accurate (Error = 2.27cm) than ortho-mosaic generated with Pix4D (Error = 5.2cm).

SUMMARY

- In general, the geometric accuracy of the ortho-mosaic generated using Agisoft was higher than the accuracy of ortho-mosaic generated using Pix4D.
- Agisoft generated ortho-mosaic much faster in low and medium quality settings, but was slower in high quality setting compared to Pix4D.
- Software cost is higher for Pix4D compared to Agisoft.
- Pix4D generates high quality ortho-mosaic much faster than Agisoft.
- Tradeoff in image quality versus time to generate ortho-mosaic should be considered while selecting one software over the other.

RESULTS



TOOLS OF THE TRADE

Pix4D and Agisoft Photoscan

These are two widely used UAS image processing softwares. They are used to generate DEM and ortho-mosaic images, and 3D models.



PROJECT CONTACT

For inquiries about this project, contact Sami Khanal (khanal.3@osu.edu).



OBJECTIVE

Demonstrate strip intercropping utilizing alternating strips of corn and soybeans to identify the relationship between them and maximize yield potential.



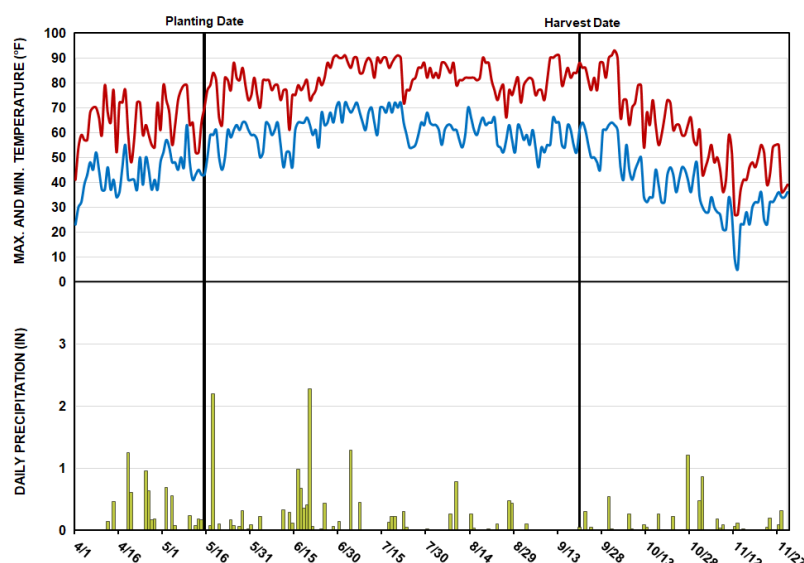
Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/15/2019
Harvest Date	9/20/2019
Hybrid	LG5499STXRIB
Variety	LGC2821RX
Population	Variable
Acres	10.5
Treatments	4
Reps	27
Treatment Width	10 ft.
Tillage	No-Till
Management	Fertilizer, Fungicide, Herbicide
Previous Crop	Corn after beans and beans after corn by strip
Row Spacing	15 in. Corn and Twin Row 30 in. Soybeans
Soil Type	Crosby-lewisburg silt loams, 67% Sloan silty clay loam, 21% Miami silt loam, 12%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	4.43	5.17	6.44	2.72	2.43	1.10	22.29
Cumulative GDDs	209	644	1231	2005	2645	3233	3233

STUDY DESIGN

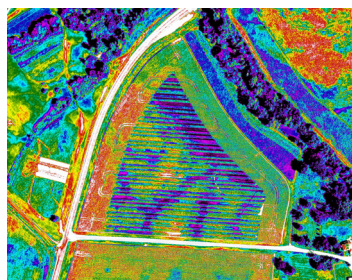
This year's Farm of the Future design was modified based on past results. The orientation remained East-West, outputting strips that had a northern half and southern half when harvested in 5 ft. sections, which had significant yield differences last year. To dive deeper, we planted 10 ft. strips to get further sunlight penetration in the canopy. The 20 ft. strips were replicated and planted as a baseline against last years yields. Contrary to last year, all corn was planted in 15 in. rows this year. Soybeans were planted in twin 30 in. rows for traffic in season. 20 ft. soybean strips were strategically placed every 120 ft. for spray operations throughout the growing season.



Aerial imagery clearly displayed the strips mid-season.

OBSERVATIONS

During field scouting, the northern half of the strips seemed to have a darker green color when compared to the southern strips that had a much lighter pale green. Northern strips also seemed to have a more consistent stand. The plots were virtually weed free all season long. Some soybean lodging was experienced in the higher productivity ground.



SUMMARY

- The strip intercropping approach continues to show some promise as in years past. The lack of timely rain and short season hybrids/varieties definitely had an effect and held this crop back.
- As you see, the northern portion of the strips continued to produce more yield as compared to the southern portion. Continued investigation is needed to determine the cause of this.



RESULTS

Crop	Spacing	Location	Moisture	Soybean Yield (bu/ac)	Soybean Yield (bu/ac)	Corn Yield (bu/ac)	Corn Yield (bu/ac)
Corn	15 in.	South	17.5	-	-	-	137 a
Corn	15 in.	North	17.5	-	-	-	159 b
Corn	15 in.	10 ft.	17.5	-	-	146 a	-
Corn	15 in.	20 ft.	17.5	-	-	141 ac	-
Corn	15 in.	Mono	17.5	-	-	131 bc	-
Soybeans	Twin Row 30 in.	South	8.9	-	34 a	-	-
Soybeans	Twin Row 30 in.	North	8.9	-	26 b	-	-
Soybeans	Twin Row 30 in.	10 ft.	8.9	29 a	-	-	-
Soybeans	Twin Row 30 in.	20 ft.	8.9	37 b	-	-	-
Soybeans	Twin Row 30 in.	Mono	8.9	32 a	-	-	-
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 4.90 CV: 13.40%	LSD: 2.39 CV: 17.00%	LSD: 15.77 CV: 10.00%	LSD: 9.83 CV: 14.60%

TOOLS OF THE TRADE

Harvest International Planter

This custom planter is one of the most high tech currently on the market. The Harvest International bar and row units are outfitted with multi-hybrid, hydraulic downforce, high speed capability, and more. This planter is a precursor to autonomous planting.



PROJECT CONTACT

For inquiries about this project, contact Nate Douridas (douridas.2@osu.edu), Andrew Klopfenstein (klopfenstein.34@osu.edu), or Ryan Tietje (tietje.4@osu.edu).



OBJECTIVE

Demonstrate strip intercropping utilizing alternating strips of corn and soybeans to identify the relationship between them and maximize yield potential.



eFields Collaborating Farm

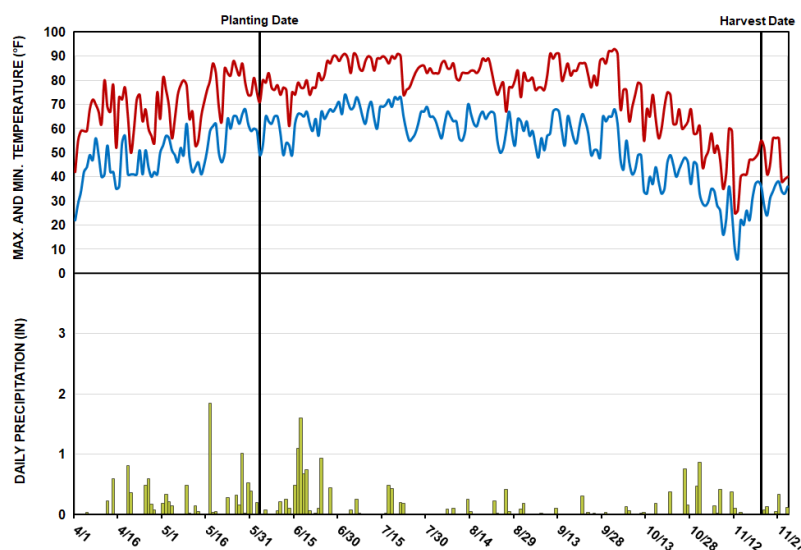
OSU Extension

Fayette County

STUDY INFORMATION

Planting Date	6/3/2019
Harvest Date	11/21/2019
Hybrid	Beck's 6049SX
Variety	Beck's 3486FP
Population	Corn - 41,000 Soybeans - 130,000
Acres	78
Treatments	4
Reps	86
Treatment Width	10 ft.
Tillage	Minimal
Management	Fertilizer, Herbicide
Previous Crop	Soybeans
Row Spacing	15 in. Corn and Twin Row 30 in. Soybeans
Soil Type	Ravenna silt loam, 100%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.36	6.22	7.10	1.66	1.35	0.72	20.41
Cumulative GDDs	238	706	1305	2097	2768	3386	3386

STUDY DESIGN

This was another demonstration of strip intercropping. Contrary to the other strip intercropping field you may have seen in this report, this field orientation was planted North-South, giving strips an East-West affect when harvested in 5 ft. sections. All treatments were 15 in. corn or twin row 30 in. soybeans. Within this field there was a 3.5 acre monoculture corn check block as well as a 24.8 acre soybean check block, both used as a baseline against the strips. The strips were 10 ft. as well as 20 ft. 20 ft. soybean strips were strategically placed so that they could be used as travel paths for spray application throughout the season.

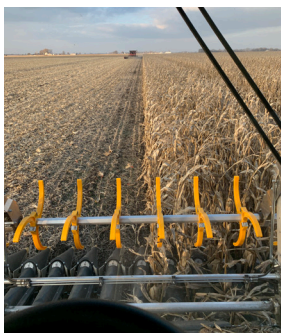


OBSERVATIONS

All treatments exhibited good weed control and would not be considered a yield limiting factor.

No tip back was observed on the corn ears, and no lodging was seen in the soybeans.

For the corn, 190 lbs N/ac was applied at planting via 2x2x2 and sidedress.



RESULTS

SUMMARY

- After several years of doing strip intercropping, results like this have never been seen before.
- The 10 ft. strips seem to be the sweet spot in width. With any wider strips, the sunlight could not be fully utilized. The soybeans suffered some yield reduction, but the increased yield on the corn seems promising.
- NUE was 0.79 lb N/bu corn.

ROI for Strip Intercropping for Ground Planted to Corn

Additional Revenue (74.3 bu/ac @ \$3.50/bu)	\$260.05/ac
Additional Seed Corn Cost	(\$37.50)/ac
Additional Herbicide Cost	(\$20.00)/ac
Soybean Yield Loss (10.0 bu/ac @ \$8.60/bu)	(\$86.00)/ac
Net Income	\$116.55/ac

Crop	Spacing	Location	Moisture	Soybean Yield (bu/ac)	Soybean Yield (bu/ac)	Corn Yield (bu/ac)	Corn Yield (bu/ac)
Corn	15 in.	West	18.4	-	-	-	249 a
Corn	15 in.	East	18.4	-	-	-	257 b
Corn	15 in.	10 ft.	18.4	-	-	262 a	-
Corn	15 in.	20 ft.	18.4	-	-	238 b	-
Corn	15 in.	Mono	18.4	-	-	225 c	-
Soybeans	Twin Row 30 in.	West	16.3	-	51 a	-	-
Soybeans	Twin Row 30 in.	East	16.3	-	48 a	-	-
Soybeans	Twin Row 30 in.	10 ft.	16.3	46 a	-	-	-
Soybeans	Twin Row 30 in.	20 ft.	16.3	50 b	-	-	-
Soybeans	Twin Row 30 in.	Mono	16.3	57 c	-	-	-
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.				LSD: 1.67 CV: 4.90%	LSD: 3.21 CV: 9.70%	LSD: 6.64 CV: 4.20%	LSD: 7.74 CV: 5.60%

TOOLS OF THE TRADE

Geringhoff Freedom Head

Higher yields mean higher populations, and a trend toward narrow row spacing. The Geringhoff Freedom Head allows for an easy transition from 30 in. rows to 15 in. rows. The low profile design makes it unmatched in down corn situations.



PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein (klopfenstein.34@osu.edu) or Ryan Tietje (tietje.4@osu.edu).



What's your number?

Take the test.  Beat the pest.

The **SCN Coalition**™

Funded by the soybean checkoff



eFields Collaborating Farm

OSU Extension

Statewide

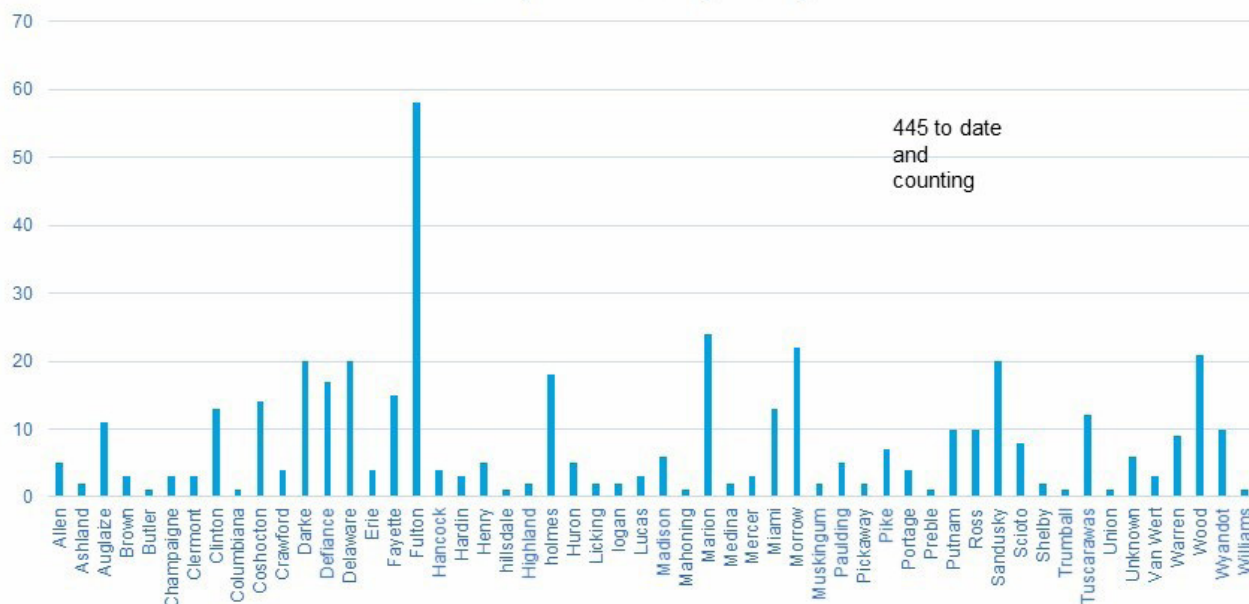
STUDY INFORMATION

In 2018 and 2019 Ohio farmers and educators have been sampling fields to assess the distribution of soybean cyst nematode in Ohio as well as determine which source of resistance (Peking vs PI 88788) will work. This is part of a nationwide effort through The SCN Coalition, which consists of university researchers, extension specialists, and ag company representatives who are concerned about the evolving threat from soybean cyst nematode. This effort is especially critical since SCN is becoming resistant to the PI 88788 source of resistance that is used in more than 90% of resistant varieties.

CFAES

Number of soil samples processed for SCN by county

Sample Numbers by County



THE OHIO STATE UNIVERSITY COLLEGE of FOOD, AGRICULTURAL, and ENVIRONMENTAL SCIENCES

RESULTS

SCN Population Level	Total Fields 2018	% Total Processed 2018	Fields in 2019	% of Total Processed 2019	TOTAL To Date	% of Total from all Samples Collected
None Detected	89	37.4	110	53.6	199	43.0%
Trace (40-200)	58	24.4	51	24.8	109	23.5
Low (200-2,000)	58	24.4	26	12.6	84	18.1
Moderate (2,000-5,000)	22	9.2	16	7.8	38	8.2
High (5,000+)	11	4.6	22	10.7	33	7.1
Total	238		225		463	
>200 eggs	91		64			

Overall, more than 50% of the fields sampled had detectable levels of SCN, but the troubling finding is that more than 33% of the fields are in the level where yield loss can be measured on susceptible varieties.

TOOLS OF THE TRADE

The SCN Coalition Website

Visit the SCN Coalition website at thescncoalition.com for more information on their recommendations, partners, research, and additional resources for managing soybean cyst nematode.



PROJECT CONTACT

For inquiries about this project, contact Anne Dorrance (dorrance.1@osu.edu).

ABSTRACT

It is now possible to accurately measure the soil biological response to best management practices. A site selected in south central Ohio compared tillage with a two-crop rotation to no-till with cover crops and a three-crop rotation (best management), and baseline sod. Biological indicators of PLFA total microbial biomass, bacteria, fungi, arbuscular mycorrhizal fungi, and respiration were all analyzed. In all comparisons, tillage had low biological measurements. The most striking result was tillage with 84ng/g total fungi, sod with 378 ng/g, and no-till with 620 ng/g. Best management practices can improve soil biology.

INTRODUCTION

A diversity of living organisms exists in the soil and are influenced by practices that effect soil functions. The biology of the soil can now be measured and quantified through laboratory soil health testing. Identifying and quantifying different soil organisms requires sophisticated methods and instruments that most soil labs do not have. The PLFA (phospholipid fatty acid) laboratory analysis is a very good indicator of soil biology. The primary goal of this manuscript is to demonstrate how biological indicators can be used to demonstrate the differences in different management systems. Simple illustrations and interpretations are provided as guidelines to be used for extension programming.

METHODS

Sample sites were selected in south central Ohio to represent three distinct soil management systems implemented in soils with similar taxonomic classes.

Tillage: This site represents a typical soil management system for this area. Crop rotation consists of corn and soybean. Tillage operations include chisel plow, disk chisel, and soil finisher. Remaining residue at time of planting would be less than 30% coverage of soil.

No-till: This site is unique and a model for ideal best management practices in soil management. Crop rotation consists of corn, soybean, and wheat. There are no tillage operations. Cover crops are utilized whenever possible within the grain crop rotation. A multi-species mixture of 10 or more cover crops are planted in August after wheat harvest. Corn is no-till planted into chemically terminated cover crops in the spring. Cereal rye is seeded into standing corn in early September. The following spring, soybeans are planted into cereal rye which is crimped and rolled then chemically terminated. Wheat is planted after soybean harvest. This soil management system has been practiced for over 20 years at this site.

Sod: This site represents a baseline soil property which is an example of the natural environment of the area. This site has been undisturbed for over 10 years and consists of fescue grass cover.

Three randomized soil samples were collected from each field on the same day in late September 2018 at all sites. Soil moisture was average with adequate rainfall in the previous week. Soil temperature was 65 degrees. These soil conditions are ideal for measuring soil biological response to best management practices.

The three soil samples from each field were composited into a single sample, packed with dry ice and shipped directly to Ward Laboratory, Kearney, Nebraska for analysis. <https://www.wardlab.com/>

RESULTS

The microbial biomass was assessed with the PLFA test (Figure 1). A well-functioning, healthy soil would contain higher amounts of microbes which provide nutrients to crops and naturally control some soil-borne pests and diseases. The tillage treatment measured 1490 ng/g total biomass compared to 4710 ng/g in sod and 5237 ng/g in no-till. Tillage destroys the soil environment needed to maintain soil microbes. Best management practices with no-till can exceed microbial biomass amounts found in baseline sod, resulting in a very healthy productive soil.

The relative proportions of fungi and bacteria under the three soil management systems are shown in Figure 2. The no-till system was associated with the greatest amount of total bacterial as well as fungal biomass, followed by sod, and the lowest in tillage. Compared to a tilled system, sod and no-till system had 4 times more fungal biomass, and 7 times more bacterial biomass. Furthermore, the ratio of fungal to bacterial biomass ranged from 0.11 in tilled system, to 0.15 in sod, and 0.22 in no-till system. As the ratio of fungi to bacteria increases, soil microbiome become more efficient in utilizing carbon and nutrients. Such carbon-efficient systems are also likely to release less carbon dioxide to the atmosphere. The results suggest that an undisturbed system such as no-till greatly enhances fungal biomass as well as the total microbial activity.

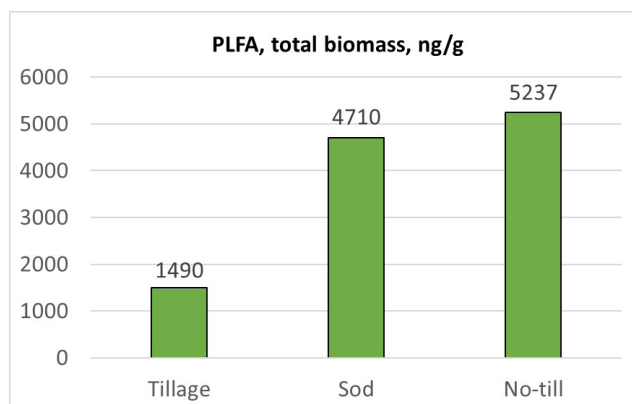


Figure 1. Phospholipid fatty acid (PFLA) in ng/g.

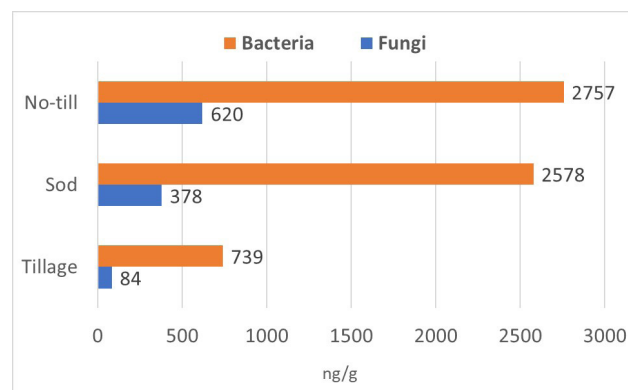


Figure 2. Bacteria and Fungi measurements in ng/g.

Arbuscular Mycorrhizal Fungi (AMF) are important to healthy plant growth. These fungi live on plant roots and grow out into the soil to capture nutrients which roots cannot access. Fungi depend on the plant for sugars for survival. By not disrupting the soil, AMF can multiply rapidly (Figure 3). The tillage treatment measured 29 ng/g AMF while sod had 150 ng/g and no-till measured 153 ng/g AMF. The AMF need to build a network of hyphae to reach soil nutrients. Tillage destroys this network resulting in low AMF measurements.

Soil biological response can also be measured using a soil respiration test. Soil samples are dried and rewetted then allowed to incubate for 24 hours to measure carbon dioxide respiration. Living soil microbes produce carbon dioxide through aerobic respiration. The amount of carbon dioxide release is directly proportional to the microbial biomass in the soil (Figure 4). The concentration of carbon dioxide under tillage treatment measured 19.8 ppm, 42.9 ppm in sod, and 41.6 ppm in no-till system respectively. These data further demonstrate the stark contrast in microbial biomass between a tilled versus no-till system.

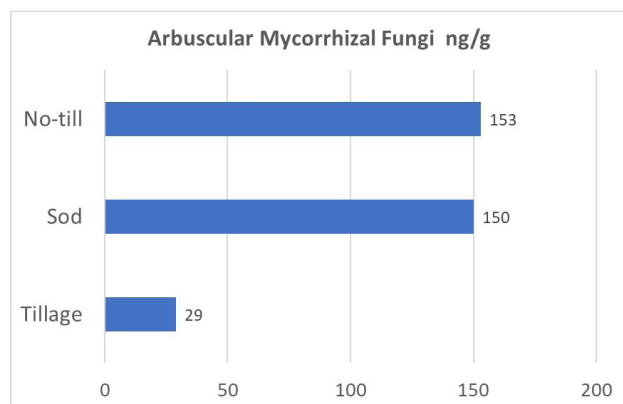


Figure 3. Arbuscular Mycorrhizal Fungi in ng/g.

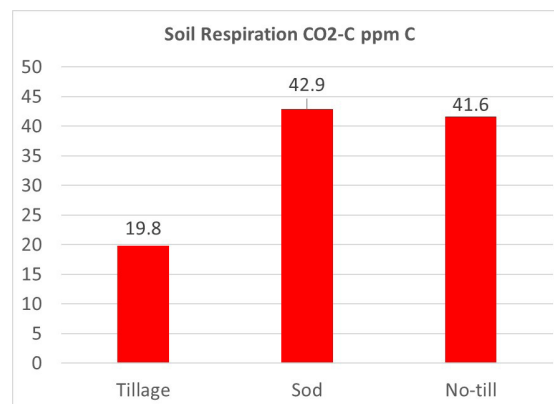


Figure 4. Soil Respiration burst test (24 hour) measurements expressed as parts per million carbon.

Measuring the biology of the soil allows one to determine the potential ability of the soil to supply nutrients and improve productivity. By analyzing phospholipid fatty acids (PLFA), the living microbial biomass and its components can be determined. Since microbial communities in the soil can change rapidly, one can compare soil management systems to determine best management practices to promote microbial activity. Tillage disrupts the hyphae of fungi established in the soil. These illustrations can help draw the following conclusions:

1. A PLFA test can clearly distinguish between a disturbed versus undisturbed soil management system.
2. An undisturbed system such as no-till promotes microbial and fungal biomass that is several folds greater than that in a disturbed system such as conventional tillage.
3. The undisturbed systems (no-till) were associated with greater ratios of fungal to bacterial biomass, compared to tilled.
4. A no-till system also promotes AMF compared to a tilled system.
5. A biologically active and fungal dominated system is more efficient in cycling the carbon and nutrients, resulting in lower carbon dioxide respiration rates. Thus, carbon dioxide can be used as an indicator of biological activity as well as the efficiency of the system.

PROJECT CONTACT

For inquiries, contact Alan Sundermeier (sundermeier.5@osu.edu) or Vinayak Shedekar (shedekar.1@osu.edu).



OBJECTIVE

Determine the severity of crop damage from voles and subsequent effect on soybean yield through variable seeding rates and methods of rye cover crop.



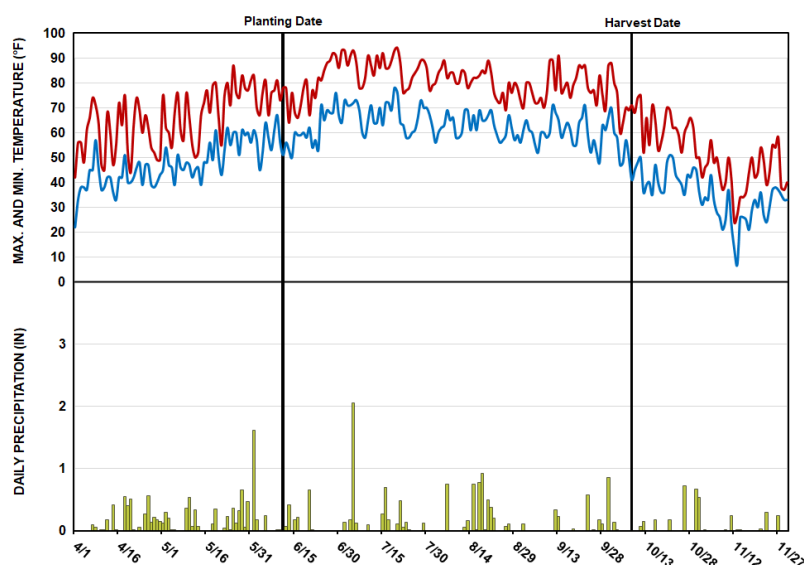
eFields Collaborating Farm

OSU Extension
Sandusky County

STUDY INFORMATION

Planting Date	6/11/2019
Harvest Date	10/8/2019
Variety	Pioneer P29A25X
Population	156,600
Acres	11
Treatments	4
Reps	4
Treatment Width	60 ft.
Tillage	Minimal
Management	Herbicide
Previous Crop	Corn
Row Spacing	15 in.
Soil Type	Hoytville clay loam, 59% Haskins sandy loam, 41%

WEATHER INFORMATION

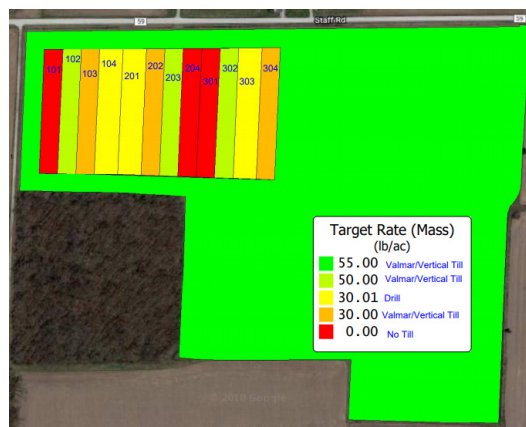


Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.80	4.74	3.61	4.65	4.70	2.43	23.93
Cumulative GDDs	150	502	1054	1847	2514	3093	3093

STUDY DESIGN

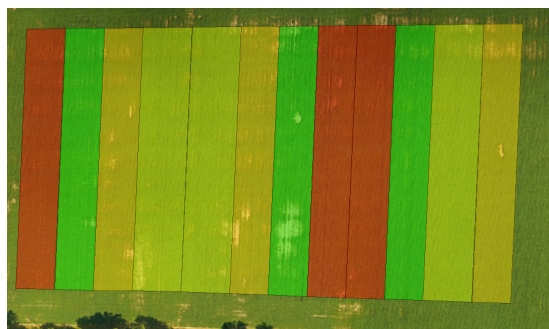
Vole damage has been a major issue in no-till soybean production, with many area farmers experiencing significant stand reduction in recent years, specifically in fields that were planted to cover crops prior to the soybean crop. Rye cover crop was seeded in 3 replicated plots, at rates of 0, 30, and 50 lbs per acre, using a standard no-till drill and a Valmar vertical till with seeder in order to establish variable stand density in the cover crop.



The study was designed to test the impact of different seeding rates and methods on vole damage.

OBSERVATIONS

It was a very challenging year with excess rainfall and moisture throughout the early and late spring, which may have had some effect on the stand of rye, as well as vole activity. Some places that appeared to have less dense stand of soybeans on aerial imagery were likely areas of water damage. There was no noticeable difference on the yield monitor at harvest.



Target Rate (Mass) (lb/ac)

55.00	Valmar/Vertical Till
50.00	Valmar/Vertical Till
30.01	Drill
30.00	Valmar/Vertical Till
0.00	No Till

Aerial view of plot in August showing crop damage within the different treatment areas.

RESULTS

Treatments	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
No Rye	91,000	14.0	67 a
30 lbs/ac Vertical Till	92,000	14.0	66 a
50 lbs/ac Vertical Till	92,000	14.0	65 a
30 lbs/ac Drilled	92,000	14.0	69 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 3.36 (NS) CV: 3.20%

TOOLS OF THE TRADE

Valmar Vertical Till

This trial utilized a Valmar Air seeder box on a Great Plains turbo-till. The Valmar seeder mounted on the turbo-till allows for incorporation of the rye cover crop seed, as well as easy adjustment to the seeding rate.



PROJECT CONTACT

For inquiries about this project, contact Al Gahler (gahler.2@osu.edu).

OBJECTIVE

Evaluate the effects of interseeding cover crops at the V5 stage in continuous corn during the 2015 and 2016 seasons.



eFields Collaborating Farm

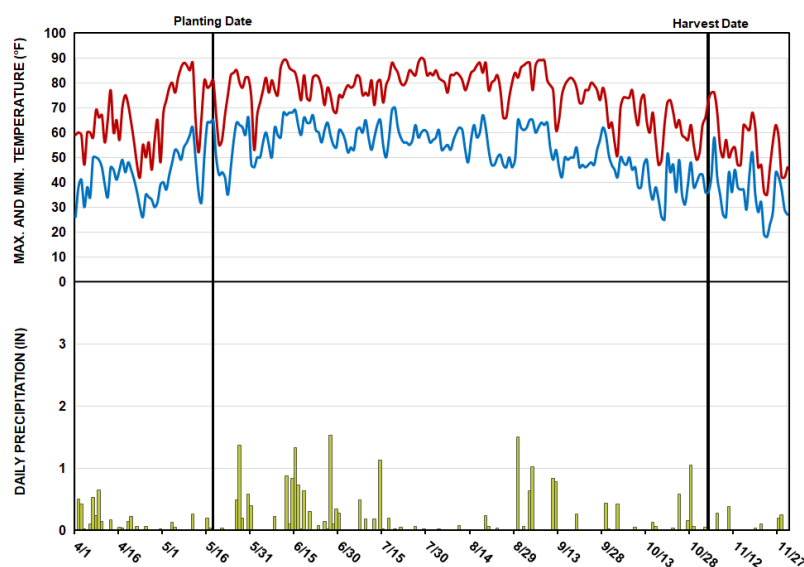
OSU Extension

Wayne County

STUDY INFORMATION

Planting Date	5/18/2015
Harvest Date	11/3/2015
Variety	Steyer Seeds 106RM, RR2
Population	32,000
Acres	1
Treatments	5
Reps	4
Treatment Width	10 ft.
Tillage	Minimum
Management	Fertilizer, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	30 in.
Soil Type	Ravenna silt loam, 100%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.39	3.77	7.58	2.39	1.97	4.09	23.19
Cumulative GDDs	156	636	1195	1805	2372	2869	2869

STUDY DESIGN

One of the main practical barriers to wider adoption of cover crops in corn cropping systems is the narrow window for planting cover crops after grain harvest. In this trial we used a high clearance drill to plant four cover crop species into continuous corn at the V5 stage. Cover crops were planted in three rows between 30 inch corn rows. The interseeder is also capable of applying glyphosate and side-dress fertilizer in the same pass planting pass. The effects of the interseeding treatments on cover crop biomass and corn grain yield were measured over two cropping seasons.



Cover crops were interseeded in three rows in between 30 in. corn rows as shown.

OBSERVATIONS

In 2015, wet conditions in May and June constrained corn early growth and a very dry August resulted in lower than average yields. Delayed canopy closure of the corn stand and moist soil conditions following interseeding allowed all the cover crop species to establish reasonably well.

Biomass measurements in November 2015 indicated that all four interseeded cover crop species were able to establish adequately beneath the corn canopy.

SUMMARY

- No significant differences in corn grain yields were observed and there was no evidence of any yield penalty associated with potential competition from the interseeded cover crops.
- Late April biomass measurements indicated that balansa clover, red clover and annual ryegrass all produced reasonably good spring cover prior to plowdown.
- Radish was completely winter killed as expected.

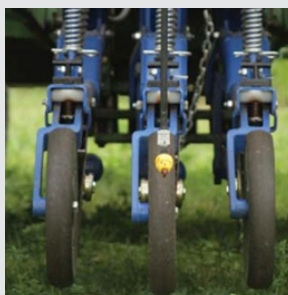
RESULTS

Treatments	CC Biomass Apr. 2015 (lb/ac)	CC Biomass Nov. 2015 (lb/ac)	2015 Yield (bu/ac)
Control - No CC	0	0	133 a
Radish - 10 lb/ac	0	651	143 a
Red Clover - 10 lb/ac	1184	642	133 a
Balansa Clover - 10 lb/ac	1435	580	145 a
Annual Ryegrass - 20 lb/ac	962	535	141 a
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 18.24 (NS) CV: 13.3%

TOOLS OF THE TRADE

InterSeeder Packing Wheels and Herbicide Nozzles

This study utilized a high clearance drill interseeder manufactured by InterSeeder Tech Inc. The nozzles are designed to apply glyphosate and sidedress fertilizer in the same pass as planting for cover crops.



PROJECT CONTACT

For inquiries about this project, contact Ryan Haden (haden.9@osu.edu).

OBJECTIVE

Evaluate the effects of interseeding cover crops at the V5 stage in continuous corn during the 2015 and 2016 seasons.



eFields Collaborating Farm

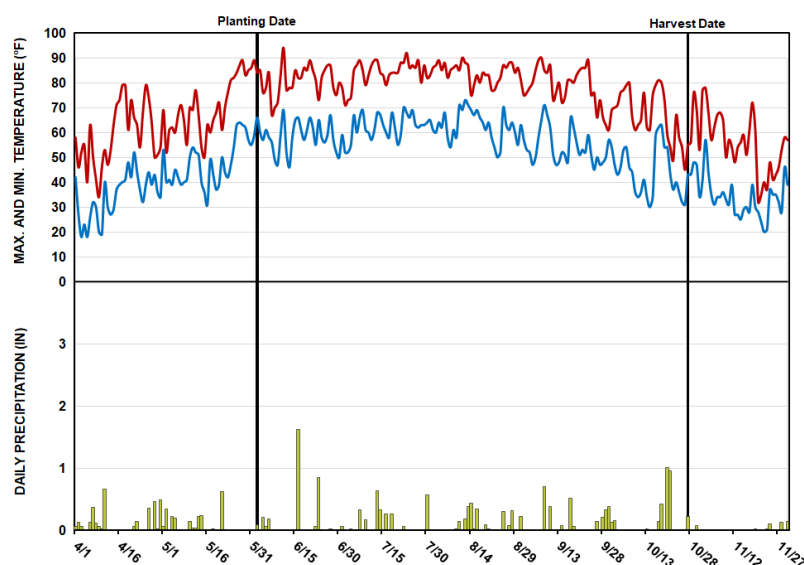
OSU Extension

Wayne County

STUDY INFORMATION

Planting Date	6/2/2016
Harvest Date	10/27/2016
Variety	Steyer Seeds 106RM, RR2
Population	32,000
Acres	1
Treatments	5
Reps	4
Treatment Width	10 ft.
Tillage	Minimum
Management	Fertilizer, Herbicide, Insecticide
Previous Crop	Corn
Row Spacing	30 in.
Soil Type	Ravenna silt loam, 100%

WEATHER INFORMATION



Growing Season Weather Summary

	APR	MAY	JUN	JUL	AUG	SEP	Total
Precip (in.)	3.19	2.19	3.13	2.72	2.63	2.83	16.69
Cumulative GDDs	154	494	1087	1791	2503	2996	2996

STUDY DESIGN

One of the main practical barriers to wider adoption of cover crops in corn cropping systems is the narrow window for planting cover crops after grain harvest. In this trial we used a high clearance drill to plant four cover crop species into continuous corn at the V5 stage. Cover crops were planted in three rows between 30 inch corn rows. The interseeder is also capable of applying glyphosate and side-dress fertilizer in the same pass planting pass. The effects of the interseeding treatments on cover crop biomass and corn grain yield were measured over two cropping seasons.



Cover crops were seeded using a high clearance drill.

OBSERVATIONS

Growing conditions for corn in 2016 were better than average and rapid canopy closure of the corn after V5 resulted in less favorable conditions for establishing interseeded cover crops.

SUMMARY

- During 2016, corn grain yields in the treatments with interseeded red clover and balansa clover were both significantly greater than the control (no cover crop).
- Corn grain yields in the radish and annual ryegrass treatments were marginally greater than the control, but not significantly different.
- The significantly greater yields in the legume treatments is likely due to increased N inputs from the spring plowdown of the red and balansa clovers previously interseeded in 2015.
- Measurements of cover crop biomass in the Fall of 2016 indicated that radish established more readily than the other cover crop species.

RESULTS

Treatments	CC Biomass Apr. 2016 (lb/ac)	CC Biomass Nov. 2016 (lb/ac)	2016 Yield (bu/ac)
Control - No CC	0	0	149 c
Radish @ 10 lb/ac	0	655	157 bc
Red Clover @ 10 lb/ac	1184	88	167 ab
Balansa Clover @ 10 lb/ac	1435	255	169 ab
Annual Ryegrass @ 20 lb/ac	962	299	158 abc
Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.			LSD: 9.69 CV: 7.50%

TOOLS OF THE TRADE

InterSeeder Planter Unit Coulters

This study utilized a high clearance drill interseeder manufactured by InterSeeder Tech Inc. The coulters on the drill allow the interseeder to achieve good seed to soil contact in a wide range of soil and residue conditions.



PROJECT CONTACT

For inquiries about this project, contact Ryan Haden (haden.9@osu.edu).

STATISTICS TERMS

C

CV (Coefficient variation): A measure of the variability between treatment yields. Calculated as a percentage.

I

Interpolation: Mathematical procedure for estimating unknown values from neighboring known data.

K

Kriging: An interpolation technique for obtaining statistically unbiased estimates of field characteristics, such as surface elevations, nutrient levels, or crop yields, from a set of neighboring points.

L

LSD (Least Significant Difference): Used to compare means of different treatments that have an equal number of replications. For this report, a significance level of 0.1 (or 10%) is used. This means, when a treatment is statistically significant, a 90% confidence is attributed to that treatment actually being different from the comparison.

M

Mean: The average value.

Median: The midpoint of a set of observed values.

P

P-Value: The probability of obtaining similar results if the null hypothesis is true.

R

Randomization: Helps account for any variations in production and prevents data from being biased based on its location in a field.

Replication: Allows for the estimation of the error associated with carrying out the experiment. A minimum of three replications is required for proper evaluation.

S

Standard Deviation: A measure of dispersion in the data set. The standard deviation is used to calculate the confidence intervals.

T

T-Test: Also called a Student's t-test. A statistical approach that can be used to determine if two treatments are different from each other.

OTHER TERMINOLOGY

A

AB Line: An imaginary reference line set for each field that a tractor/sprayer guidance system to follow. There are different reference lines that can be set in a field to fit a particular geography or layout.

Active Downforce: A system that automatically adjusts the force in the air spring circuit based on soil condition information gathered from row unit gauge wheel sensors.

Aerial Imaging: Photos taken, or images collected, from aircraft to assist growers and consultants in determining variations within an area of interest such as a farm field.

Agronomic Data: Represents data compiled from a specific farming operation or at the field level generally related to agronomy based information such as yield, population, hybrid, nutrient application. Agronomic Data is tied to the land or field where it was generated. Types of Agronomic Data include (but are not limited to) hybrid selections, plant populations, yield data, soils data, pesticide application details, and scouting information. Data generated from a yield monitor can be used to document yields, and for on-farm seed trials. In addition, yield monitor data can be used to make genetic, environmental, and management effect analyses. Soils data is being used to make fertilizer and regional environmental compliance decisions, while scouting data is being used to make spraying decisions as well as regional pest or disease analytics.

Algorithm: An ordered set of rules or instructions written as a computer program designed to assist in finding a solution to a problem. For example, an algorithm can be created to permit a microprocessor to relate sensor input to actuator output on board a crop chemical applicator.

Application Rate: Amount of seed distributed, expressed as a number, mass or volume of seed per unity of length or surface.

As-Applied Map: Is a map containing site-specific information about the location and rate of application for fertilizer or chemical input. Usually created with a GPS equipped applicator and data logger.

Automatic Section Control (Auto Swath): Turns application equipment OFF in areas that have been previously covered, or ON and OFF at headland turns, point rows, terraces, and/or no-spray zones such as grass waterways. Sections of a boom or planter or individual nozzles/rows may be controlled.

Autonomous Operation: Vehicle guidance without the need for human intervention. A tractor may be driven by a series of on-boards sensors and GPS for precision driving without damage to crops.

Auto-Steer: A GPS guidance system that steers agricultural equipment with centimeter accuracy. This level of accuracy requires real time kinematic (RTK) correction of GPS signals. Auto-steer is an add-on component for equipment. It includes both the GPS system to receive and process the signals, software and hardware to allow the input of control maps and the mechanical equipment to actually steer the tractor. Some new tractors are available “auto-steer ready.”

B

Base Map: A simple map that shows the boundaries of a field or section and information about any unique feature (sinkholes, or streams).

Base Station: The RTK-GPS receiver and radio that are placed in a stationary position, functioning as the corrections source for roving tractor units in an area. These stations can be either portable or permanently installed systems and their coverage can range from 5 to 10 miles depending on topographic conditions, antenna height, and radio-transmit power. Also called a reference station, is a receiver located at a surveyed benchmark. The base station calculates the error for each satellite and through differential correction, improves the accuracy of GPS positions collected at unknown locations by a roving GPS receiver.

Baud Rate: Rate at which information is transferred in a communication channel. Refers to the number of signal or symbol changes that occur per second. Higher baud rates have more bits per second transferred.

C

CAN-Bus (in tractors and implements): CAN-Bus is a high-speed, wired data network connection between electronic devices. The hardware/wiring of CAN-Bus networks are generally the same, while the protocols for communication can be different and vary depending on the industry where they are used. These networks are used to link multiple sensors to an electronic controller, which can be linked to relays or other devices on a single set of wires. This reduces the amount of wires needed for a system and allows for a cleaner way to connect additional devices as system demands change.

Cation Exchange Capacity (CEC): Represents the total quantity of negative charge that is available in the soil to attract positively-charged ions in the soil solution.

Cloud: A global network of servers, each with a unique function. The cloud is not a physical entity, but rather an extensive network of remote servers around the globe that are connected online and operate as a single ecosystem. One access a cloud platform online from any internet connected device.

Cloud Platform: Represents the hardware and software infrastructure for a cloud computing service that includes

application enabling users to create and manage their own accounts and data within their accounts and/or others. John Deere's Operation Center and Climate Corp's Fieldview would be example cloud platforms built for agriculture.

CLU (Common Land Unit boundary): The smallest unit of land that has a permanent, contiguous boundary, a common land cover and land management, a common owner and a common farmer in agricultural land associated with USDA farm programs (source USDA). CLU boundaries are delineated from relatively permanent features such as fence lines, roads and/or grassed waterways. They have attributes geospatially linked in a database format and also information in a tabular format, which is not geospatially referenced, but it can be queried for each producer.

Cluster sampling: A technique in which observation units in a population are aggregated into larger sampling units known as primary units.

Compact Measurement Record (CMR): Survey grade communication & differential corrections. There are three different forms (CMR, CMR+, and CMRx) and the difference between them is the amount of correction data that can be obtained due to the amount of satellites. It's common to see this term using Trimble GPS systems.

Confidence Interval: The confidence interval represents the range of values for a given level of significance.

Contour Map: Yield map that combines dots of the same intensity and/or yield level by interpolating (or kriging).

Coordinate System: Used in GPS/GNSS navigational systems to reference locations on Earth. There are many coordinate systems but frequently used ones include: latitude and longitude, Universal Transverse Mercator (UTM), and State Plane coordinate systems.

Continuously Operating Reference Station (CORS) [Network]: A network managed by the U.S. office of National Ocean Service (NOAA) to provide GNSS data consisting of carrier phase measurements throughout the United States. CORS eliminates the need for producers to purchase a personal base station, thereby lowering investment costs for RTK applications, and initial research has indicated that CORS can provide RTK-level correction within a 20 mile radius of the station's location. Because CORS data is transmitted over the internet there are no line of sight requirements as with radio transmitted signals.

Crop Practice: The customary and systematic husbandry actions undertaken in establishing and caring for the crop.

CV (Coefficient variation): A measure of the variability between treatment yields. Calculated as a percentage.

Glossary

D

Data Layer: A layer of information on a GIS map. A map can have many layers to present different types of information. For example, the first layer of a map may be a satellite image of an area. The next layer may have only lines that represent roads or highways. The next layer may contain topographic information and so forth.

Database: A collection of different pieces of georeferenced information (yield, soil type, fertility) that can be manipulated (layered) in a GIS model.

Differential Global Positioning System (DGPS): A method of using GPS which attains the position accuracy needed for precision farming through differential correction.

Differential Correction: Correction of a GPS signal that is used to improve its accuracy (to less than 100 m/~330 ft) by using a stationary GPS receiver whose location is known. A second receiver computes the error in signal by comparing the true distance from the satellites to the GPS measured distance

Digital Elevation Model (DEM): A digital representation of a surface, used for topography. A DEM is often used in reference to a set of elevation values representing the elevations at points in a rectangular- grid on the Earth's surface. Some definitions expand DEM to include any digital representation of the land surface, including digital contours.

Dilution of Precision (DOP): One of many quality measurements to evaluate solutions derived by a positioning receiver. This is a numeric value that relates relative geometries between positioning satellites as well as the geometries between the satellites and the receiver; the lower the value, the higher the probability of accuracy. DOP can be further classified to other variables: GDOP (three-dimensional position plus clock offset), HDOP (horizontal position), PDOP (three-dimensional position), TDOP (clock offset), and VDOP (vertical position). A DOP value of 4 or less is typically desired for best accuracy.

Directed Sampling: Simple technique of incorporating prior knowledge about soil variability into the sampling design to match sampling distribution and intensity with known soil patterns.

Downforce: Weight being measured by the gauge wheels for those row units equipped with a sensor.

E

Electromagnetic Spectrum: All wavelengths of electromagnetic energy including x-rays, ultraviolet rays, visible light, infrared light, microwaves, and radio waves.

Elevation: For agriculture applications, elevation typically represents the height above sea level for a physical object such as a field or farm structure. Elevation is

typically collected in meters but converted to feet within in-cab displays or farm software packages.

Experimental Design: The experiment planning procedure that results in the experimental layout. This process should be conducted prior to conducting the experiment.

E

Farm Management Information System (FMIS): A management information system designed to assist farmers and precision ag service providers to perform various tasks ranging from operational planning such as creating prescriptions along with implementation and documentation for assessment of performed field work.

Feature: A geographic component of the earth's surface that has both spatial and attribute data associated with it. Examples include a field, well, or waterway.

Field Capacity: The moisture content of soil in the field as measured two or three days after the thorough wetting of a well-drained soil by rain or irrigation water.

Field Trial: A test of a new technique or variety, including biotech-derived varieties, done outside the laboratory but with specific requirements on location, plot size, and methodology.

Fix: A single position calculated by a GPS receiver with latitude, longitude, altitude, time, and date.

G

Geographic Coordinate System: A reference system using latitude and longitude to define the locations of points on the surface of a sphere or spheroid.

Geographic Data: Data that contain not only the attribute being monitored but also the spatial location of the attribute. Also known as spatial data.

Geographic Information System (GIS): A computer based system that is capable of collecting, managing and analyzing geographic spatial data. This capability includes storing and utilizing maps, displaying the results of data queries and conducting spatial analysis. GIS is usually composed of map-like spatial representations called layers which contain information on a number of attributes such as elevation, land ownership and use, crop yield and soil nutrient levels.

Global Positioning System (GPS): A system using satellite signals (radio-waves) to locate and track the position of a receiver and/or antenna on the Earth. GPS is a technology that originated in the U.S. It is currently maintained by the U.S. government and available to users worldwide free of charge.

GLONASS (GLObal`naya NAVigatsionnaya Sputnickovaya Sistema): The satellite-navigation network maintained by the Russian government. The English translation of this name is "GLObal NAVigation Satellite System," or more

commonly named “GLONASS.” Utilizing GLONASS enabled receivers for precision ag applications provides additional satellite coverage and often improved performance of guidance systems. See also GNSS. Russian version of the American GPS satellite system. It is a radio-based satellite navigation system operated for the Russian government by the Russian Space Forces with a constellation of 24 operational satellites in 2010.

GNSS: The collective group of satellite-based positioning systems.

GNSS Receiver: A computer-radio device that receives satellite information by radio waves to determine the position of the antenna relative to earth’s surface.

GNSS Satellite: A communication vehicle that orbits the earth. Satellites send time-stamped signals to GPS or GNSS receivers to determine positions on earth.

Grid Soil Sampling: Laying a grid over a map of a field and taking soil samples at the middle of each grid on the map. May be done at much higher densities (up to 42 samples per acre) to approximate the true spatial variability of a number of soil nutrient levels.

Ground Sampling Distance (GSD): Pixel size of remotely sensed imagery. Example: 30-meter; 1-meter; 20-centimeters.

Guidance: The determination of the desired path of travel (the “trajectory”) from the vehicle’s current location to a designated target, as well as desired changes in velocity, rotation and acceleration for following that path. There are two basic categories of guidance products: lightbar/visual guidance and auto-guidance. For lightbar/visual guidance, the operator responds to visual cues to steer the equipment based on positional information provided by a GPS. For auto-guidance, the driver makes the initial steering decisions and turns the equipment toward the following pass prior to engaging the auto-guidance mechanism. Auto-guidance can use differential correction such as WAAS, subscription services, and RTK. RTK is the most accurate level of auto-guidance available, typically +/- 1 inch. Benefits include improved field efficiency, reduced overlap of pesticide applications, time management and reduced driver fatigue. See also WAAS, Subscription Correction Signal and RTK.

H

Hybrid: The offspring of any cross between two organisms of different genotypes.

I

Industrial Internet: A term coined by Frost & Sullivan and refers to the integration of complex physical machinery with networked sensors and software. The industrial Internet draws together fields such as machine learning,

big data, the Internet of things, machine-to-machine communication and Cyber-physical system to ingest data from machines, analyze it (often in real-time), and use it to adjust operations. Some consider the evolution of digital agriculture today (e.g. 2015) as leading to the Industrial Internet in agriculture.

Internet: An international network comprised of many possible dispersed local and regional computer networks in which one can share information and resources. Developed originally for military and then academic use, it is now accessible through commercial on-line services to the general public.

Internet of Things (IoT): The network of physical objects or “things” embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. The Internet of Things (IoT) allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. Each thing is uniquely identifiable through its embedded computing system but is able to interpret within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020.

Interpolation: Mathematical procedure for estimating unknown values from neighboring known data.

ISOBUS: ISOBUS standard 11783 is a communication protocol for the agricultural industry that is used to specify a serial data network for control and communications on forestry or agricultural tractors and implements. ISOBUS-compliant tractors and implements come with round 9-pin connectors.

K

Kriging: An interpolation technique for obtaining statistically unbiased estimates of field characteristics, such as surface elevations, nutrient levels, or crop yields, from a set of neighboring points.

L

LANDSAT (LAND SATellite): A series of U.S. satellites used to study the earth’s surface using remote sensing techniques.

Legal Boundary: Area or parcel of land defined that is owned. Typically used for real estate transactions and tax purposes. Could differ significantly from an operational boundary due to tree and fence lines and the inclusion of woods or areas not farmed.

Lightbar: Is a navigation tool coupled with a GPS designed to keep the driver on-course. Applications include planting and fertilizer applications to reduce skips and

Glossary

Latitude: A north/south measurement of position perpendicular to the earth's polar axis.

Longitude: An east/west measurement of position in relation to the Prime Meridian, an imaginary circle that passes through the north and south poles.

LSD (Least Significant Difference): Used to compare means of different treatments that have an equal number of replications. For this report, a significance level of 0.1 (or 10%) is used. This means, when a treatment is statistically significant, a 90% confidence is attributed to that treatment actually being different from the comparison.

M

Machine Data: Data that is compiled using multiple sensors located on agricultural machinery. Most relate machine data to the information that can be collected from the CAN (controlled area network) on machines and implements. Machine data can also include guidance system information (autosteer, GPS path files, bearing, etc.), Variable rate control/technology and seeding rate controllers. Data in these forms is transmitted to Agricultural Technical Providers (ATPs) via CANBus, which is a high-speed, wired data network connection between devices. This device utilizes a single wire set to relay information, which reduces the amount of wires needed for a system and allows for a cleaner way to transfer data.

Management Zone: Management zones are created by subdividing a field into 10-20 acre areas with similar characteristics. Yield maps, soil texture maps, elevation data, EC data, sensor data and farmer knowledge can be used to create management zones in GIS software. There are several methods available for creating management zones.

Mass Flow Sensor: Is a sensor that measures grain flow in a yield monitor system.

Mean: The average value.

Median: The midpoint of a set of observed values.

Metadata: A term used to describe information about data. Metadata usually includes information on data quality, content, currency, lineage, ownership, and feature classification.

Moisture Sensor: Is a sensor that measures grain moisture in a yield monitor system.

N

National Marine Electronics Association (NMEA): Set communications standards for GPS data.

Near Infrared (NIR): The preferred term for the shorter wavelengths in the infrared region extending from about 750 nm to 2000 nm. Near infrared is the portion ranging

from 0.75 to 1.4 μm , short wave radiation is the portion of spectrum from 1.4 to 3 μm , mid-wavelength radiation is the portion of the spectrum from 3 to 8 μm , and long-wave radiation is the portion of the spectrum from 8 to 15 μm .

Normalized Difference Vegetation Index (NDVI): The ratio of the difference between the red and near-infrared bands divided by their sum used to identify and enhance the vegetation contribution in a digital remote sensing analysis; a simple graphical indicator that can be used to analyze remote sensing measurements and assess whether the target being observed contains live green vegetation or not.

NAVSTAR (NAVigation by Satellite Timing and Ranging): The U.S. based global navigation satellite system that was funded by taxpayers and controlled by the DOD.

O

OmniSTAR: A subscription based differential GPS source. Omnistar is a satellite-based DGPS source that requires a special GPS antenna.

On-Farm Research: Research that is conducted on a farm that is designed to answer specific questions. While not necessary, mistakes can be minimized by consulting with a statistician prior to the experiment.

Operational Boundary: Actual tilled or managed area in which inputs are purchased and cropping or livestock practices implemented.

P

Plant Spacing: Most commonly the distance in inches between plants within a row, but may be a consideration of distance both within and between rows.

Precision Agriculture: Precision agriculture is a farming management concept based on observing, measuring and responding to variability in crops. These variabilities contain many components that can be difficult to compute and as a result, technology has advanced to off-set these difficulties. Two types of technology can generally be found within precision agriculture: those which ensure accuracy, and those that are meant to enhance farming operations. By combining these two technologies, farmers are able to create a decision support system for an entire operation, thereby maximizing profits and minimizing excessive resource use. This may include managing crop production inputs (seed, fertilizer, lime, pesticides, etc.) on a site-specific basis to increase profits, reduce waste and maintain environmental quality.

Prescribed Application: The dispensing of a material or chemical into the field on a prescribed or predetermined basis. A prescription map is generated by an expert (grower and/or agronomist) based on information about

the field in use before an application. The prescription determines how much of something will be applied.

Prescription Map: A prescription map tells the rate controller how much product to apply based on the location of the equipment in the field. Commonly used for variable rate seeding, fertilizer, lime and irrigation.

Proximal Sensing: Remote sensing sensors are positioned very close to the target. These sensors could be in physical contact with the target to a few meters away.

P-Value: The probability of obtaining similar results if the null hypothesis is true.

R

Randomization: Helps account for any variations in production and prevents data from being biased based on its location in a field.

Rate Controller: An electronic device that varies the amount of chemical/plant nutrient applied to a given area.

Remote Sensing: The act of monitoring an object without direct contact between the sensor and object.

Replication: Allows for the estimation of the error associated with carrying out the experiment. A minimum of three replications is required for proper evaluation.

Resolution: A way of detecting variation. In remote sensing, one has spatial resolution (the variation caused by distance separating adjacent pixels), spectral resolution (the variation from the range of spectral responses covered by a wavelength band), and temporal resolution (the variation caused by time over the same location).

S

Scale: The ratio or fraction between the distance on a map, chart, or photograph and the corresponding distance on the ground. A topographic map has a scale of 1:24,000 meaning that 1 inch on the map equals 24,000 inches (2,000 feet) on the ground.

Singulation: The percentage of seeds properly singulated by a seed meter.

Site Specific Crop Management (SSCM): The use of yield maps, grid sampling and other precision tools to manage the variability of soil and crop parameters and aid decisions on production inputs (also referred to as Precision Farming).

Sensor Technologies: Sensor technology refers to on-the-go optical sensors used to measure crop status. These sensors utilize an active LED light source to measure NDVI (Normalized Difference Vegetative Index) to predict crop yield potential. NDVI values reflect the health or “greenness” of a crop and can also provide a relative biomass measurement. Data collected from these sensors are being used to direct variable rate nitrogen applications in grain crops and plant growth

regulator and defoliant in cotton.

Shortwave Infrared (SIR): Shortwave infrared (red), near infrared (green), and green (blue) used to show flooding or newly burned land.

Soil Electrical Conductivity (EC): A measurement that correlates with soil properties that affect crop productivity, including soil texture, cation exchange capacity (CEC), drainage conditions, organic matter level, salinity, and subsoil characteristics. EC is the ability of a soil to carry an electrical current. The EC measurement is dependent on how it is measured.

Soil Moisture Content: Moisture content (MC) is the weight of water contained soil. The moisture content is generally reported on the dry weight basis.

Spatial Data: Data that contains information about the spatial location (position) and the attribute being monitored such as yield, soil properties, plant variables, seed population, etc. Synonymous with geographic data.

Spatial Resolution: The size of the smallest object that can be distinguished by a remote sensing. A measure of the ability of a machine or device to vary application rate or treatment - defined by the smallest area in a field that can receive a treatment or input that is purposely different from that received by an adjacent area. The term also applies to measuring systems such as crop yield monitors.

Spatial Variability: Differences in field conditions, such as plant, soil, or environmental characteristics from one location in a field to another.

SSURGO (Soil SURvey GeOgraphic) Database: A digital version of the NRCS soil books. Each soil type is represented as a polygon and tied with associated soil type properties.

Standard Deviation: A measure of dispersion in the data set. The standard deviation is used to calculate the confidence intervals.

Strip Trial: Experiments that contain treatments that are applied in a strip across an entire field. On-farm replicated strip trials are field experiments that, when well executed, can be used to draw statistically valid cause and effect relationships between factors measured across and within fields.

I

Temporal Resolution: The time period over which data was collected. A measure of how often a remote-sensing system can collect data from a particular site on the ground. Also known as “frequency of coverage.” Some satellite systems return to the same location every 16 days, some every four or five days, and others daily, depending on their orbits. Airborne sensors (manned and unmanned) can be scheduled as desired.

Glossary

Temporal Variability: Fluctuations in field conditions, such as plant, soil, or environmental characteristics, from one point in time to another.

Terrain Compensation: An add-on feature for auto-guidance systems which correct position error that may occur when equipment travels over rolling terrain. Roll, pitch and yaw are commonly referred to when discussing terrain compensation. Roll refers to the change in elevation between the left and right sides of the vehicle; pitch refers to the change in elevation between the front and rear of the vehicle; and yaw refers to any sliding or turning motion of the vehicle to the left or right.

Thermal Infrared (TIR): Shown in gray tones to illustrate temperature. It measures radiation from the plant and soil surface.

T-Test: Also called a Student's t-test. A statistical approach that can be used to determine if two treatments are different from each other.

U

Universal Transverse Mercator (UTM): Coordinate system that represents the earth's spherical shape as 2-D zones that are evenly spaced grid lines.

Unmanned Aerial Vehicle (UAV): An unmanned aerial vehicle (UAV), commonly known as a drone and also referred to by several other names, is an aircraft without a human pilot aboard. The flight of UAVs may be controlled either autonomously by onboard computers or by the remote control of a pilot on the ground or in another vehicle. In agriculture, UAVs are typically used to survey crops. The available two types of UAVs, fixed-wing and rotary-wing, are both equipped with cameras and are guided by GPS. They can travel along a fixed flight path or be controlled remotely.

V

Variable Rate Technology (VRT): GPS and precise placement technology that uses an "application guidance" map to direct the application of a product to a specific, identifiable location within a field. Instrumentation such as a variable-rate controller for varying the rates of application of fertilizer, pesticides and seed as one travels across a field. VRT consists of the machines and systems for applying a desired rate of crop production materials at a specific time (and by implication, a specific location); a system of sensors, controllers and agricultural machinery used to perform variable-rate applications of crop production inputs; refers to a system that varies the rate of agricultural inputs such as seed, fertilizer and crop protection chemicals in response to changing local conditions.

Variety: A group of individuals within a species that differs from the rest of the species.

Vegetation Index (VI): A ratio created by dividing the red by the near-infrared spectral bands used to identify and enhance the vegetation contribution in a digital remote sensing analysis.

Variable Rate Application (VRA): Adjustment of the amount of crop input such as seed, fertilizer, lime or pesticides to match conditions (yield potential) in a field.

W

Wireless Communication: Data transfer and voice communications using radio frequencies or infrared light.

Y

Yield Calibration: Procedures used to calibrate a yield monitor for specific harvest conditions such as grain type, grain flow and grain moisture.

Yield Goal: The yield that a producer expects to achieve, based on overall management imposed and past production records.

Yield Limiting Factor: The plant, soil, or environmental characteristic or condition that keeps a crop from reaching its full yield potential within any specific area in a farm field.

Yield Mapping: Is a yield monitor coupled with a GPS. Each yield reading is tagged with a latitude and longitude coordinate, which is then used to produce a yield map. Refers to the process of collecting geo-referenced data on crop yield and characteristics, such as moisture content, while the crop is being harvested.

Yield Monitor: A yield-measuring device installed on harvest machines. Yield monitors measure grain flow, grain moisture, and other parameters for real-time information relating to field productivity.

Z

Zone Management: The information-based division of large areas into smaller areas for site specific management applications.

(Definitions from AgGlossary, PrecisionAg, Precision Ag Basics Book, University of Nebraska-Lincoln, Alabama Cooperative Extension System, and Ohio State Precision Ag)

We are tackling today's grand challenges in every corner of Ohio.

1

Sustaining Life

We focus on viable agriculture production, food security and safety, and environmental and ecosystem sustainability simultaneously.

2

One Health

We study the nexus where human, animal, plant, and environmental health intersect or interact.

3

Rural-Urban Interface

We explore the tensions and opportunities created in the communities, industries, policies, economies, and communications between rural and urban residents.

4

Leadership

We are preparing the next generation of scientists and leaders.



*The Ohio State University College of Food, Agricultural, and Environmental Sciences is Ohio State's cornerstone college. Through our research, teaching, and engagement with Ohioans and the world, **we sustain life.***



THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES

cfaes.osu.edu

COLUMBUS * WOOSTER * STATEWIDE

Acknowledgments

Industry Partners



Fowler Seed Marketing



HARVEST[™]
INTERNATIONAL INC



AES **JCB**
A DIVISION OF AMERICAN EQUIPMENT



MacDon
The Harvesting Specialists.

Martin-Till

Redline
—EQUIPMENT



MILLER
EQUIPMENT

 **Precision
Planting**[®]

PIONEER[®]
A DUPONT COMPANY

ORTHMAN



SALFORD



Smyth
WELDING
& MACHINE SHOP LTD.

STERLING
FARM EQUIPMENT

Waypoint[™]
ANALYTICAL 

SoucyTrack

Unverferth[®]
Manufacturing Company, Inc.

 **TOPCON**

Veris[®]
technologies



Yetter
FARM EQUIPMENT

Acknowledgments

Research Collaborators and Supporters

Derek Allensworth
Amos Aurand
Santiago Avila
Gary Babcock
Brad Baker
Doug Balbaugh
Mica Ballard
Jason Bane
Michael Beam - Beam Precision Ag
Dan Becker
Dave Bremke
Tim Brinkman
Scott Brown
Joe Callow
Carlene Farms
Todd Channell
Jared Chester
Clark Seeds
Trey Colley
Rachel Cornell
Mike Coutts
Dave Cunningham - Bridgewater Dairy
Ken Davis
Deer Run Farm
Travis Dellinger
Bethany Dickess
Nicolas Dubuc
Wayne Dunn
Durbin Farms LLC
Matt Falb
Nick Farquhar
Fayette County Agronomy Club
Fayette County Commissioners
Adam Fennig
Gary Fennig
Ryan Fisher
Jim Fowler
Dustin Friesen
G.A.B. Hamman Farms
Ted Gastier
Jake Geiger
Shawn Gerdaman
Justin Goubeaux
Richard Grener
Matt Guentter
Andrew Hagerty
Chris Hamilton
Mike Hannewald
Jon Hanson
Hardscrable Farms - Skinner Family
Harrod Farms
Hartschuh Dairy Farm
Steve Hayes
Les Heering
Aaron Hermann

Josiah Hoops
Dave Housholder
David Isler
Clint Jenkins
Matt Karhoff
Donnie Kelch
Brett Kenworthy
Gary Klopfenstein
Hilary Kordecki
Mike Kryling
Forrest Lang
David Lapp - Lapp Farms
Bill Lehmkuhl
Jacob Lesch
Jim Love
Holt Mallard
Ted Mallard
Jason Massie - Lapp Farms
McGuire Ag
Chuck McKay
Brad Miller
Luke Miller
Steve Miller
Tom Miller
Richard Minyo
David Mitchem
Molly Caren Agricultural Center
Morrow Soil and Water Conservation
District
Curt Mower
Cory Muhlbauer
Steve Murry
Michael Musselman
Erin Neal
Garrett Nowak
Gene Nussbaum
Ohio Agricultural Research and
Development Center: Eastern
Station Staff
Ohio Agricultural Research and
Development Center: North Staff
Ohio Agricultural Research and
Development Center: Northwest
Staff
Ohio Agricultural Research and
Development Center: Western
Staff
Ohio Agricultural Research and
Development Center: Wooster
Staff
Ohio State ATI
Overholser Farms
Byron Palitto
CJ Parker
Steve Payne

Denny Person
Radcliff Farms
Asa Radcliff
Dug Radcliff
Lee Radcliff
Mav Radcliff
Zak Ralston
Larry Richer
Bob Rine
Toby Ripberger
RT Farms
Yongying Sang
Tyler Schindel
Michael Schmenk
Ben Schmitmeyer
Brittany Schroeder
Garrick Schroeder
Rayhan Shaheb
Richard Shaw
Duane Shawk
Dave Shipley
Matt Simmons
Doug Simpson
Brad Snyder
Pat Snyder - Lapp Farms
Southwest Ohio Corn Growers
Spillman Farms LLC
Jeff Staab
Tom Stannard
Stucke Beef Farm
Matt Sullivan
Sunweb Farm
Scott Surbaugh
Brian Sutton
Jim Swartz
Kirk Swensen
Mike Sword
Randy Tietje
Rex Tietje
Ken Ulrich
Unger Farms
Brett Unverferth
Ramarao Venkentesht
Kyle Vennekotter
Bruce Watt
Jason Webster
Aaron Weinhold
Jeff Wherley
WI Miller and Sons
Chris Wiegman
David Wilson
Gary Wilson
Dane Woudema
Alex Wynn
Nick Zachrich

EARN A DEGREE THAT DOES MORE

- Agricultural Systems Management
- Construction Systems Management
- Food, Agricultural and Biological Engineering

The Department of Food, Agricultural, and Biological Engineering at The Ohio State University is an international leader in the advancement of the science and application of engineering in systems involving food, agriculture, biology, and ecology. The department provides a hands-on and supportive learning environment for students to specialize their education to prepare them for future careers using the latest principles, practices, and technology.

Ohio State ranks 7th nationally for Agricultural and Biological Engineering according to *U.S. News and World Report*.



fabe.osu.edu



fabe@osu.edu



[@OhioState FABE](https://www.instagram.com/OhioState_FABE)



THE OHIO STATE UNIVERSITY

DEPARTMENT OF FOOD, AGRICULTURAL
AND BIOLOGICAL ENGINEERING



eFields

connecting science to fields

eFields is a The Ohio State University program dedicated to advancing production agriculture through the use of field-scale research. eFields utilizes modern technologies and information to conduct on-farm studies with an educational and demonstration component used to help farmers and their advisors understand how new practices and techniques can improve farm efficiency and profitability. The program is dedicated to delivering timely and relevant, data-driven, actionable information to farmers throughout Ohio.

Contact Us

Ohio State Digital Ag Program
Agricultural Engineering Building
590 Woody Hayes Drive
Columbus, OH 43210



@OhioStatePA



digitalag.osu.edu



DigitalAg@osu.edu

Disclaimer Notice: The information provided in this document is intended for educational purposes only. Mention or use of specific products or services, along with illustrations, does not constitute endorsement by The Ohio State University. The Ohio State University assumes no responsibility for any damages that may occur through adoption of the programs/techniques described in this document.