CFAES

eFields 2018 Report

Ohio State Digital Ag Program

THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

COLLEGE OF ENGINEERING

eFields

Focus Areas

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

N-P-K

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

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 per-plant scale.

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

eFields

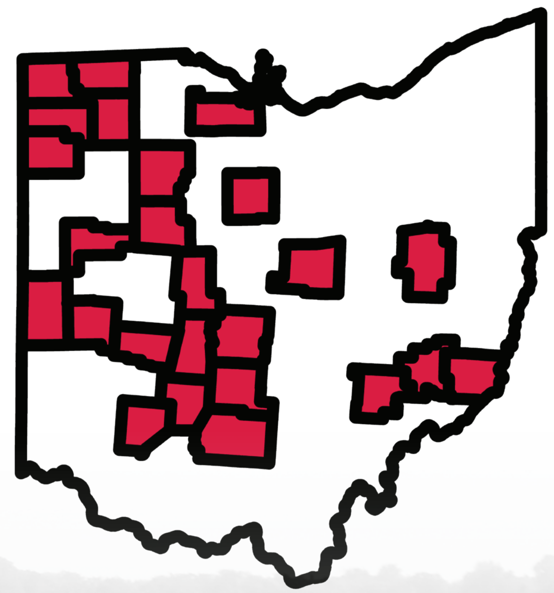
"connecting science to fields"

eFields is a program at The Ohio State University dedicated to advancing production agriculture through the use of field-scale research. The 2018 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.

Since the first report published in 2017, eFields has expanded from 39 on-farm research sites in 13 counties to 95 on-farm research sites covering 25 counties.

2018 Research Recap

25 Counties
95 on-farm research sites



New for 2018

- Economics analysis for selected studies
- Interactive QR codes for research summary videos
- Soybean fungicide trials
- World's largest script Ohio

5,624 Total Acres

- 3,160 Corn
- 2,124 Soybean
- 340 Other Trial Acres

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

Table of Contents

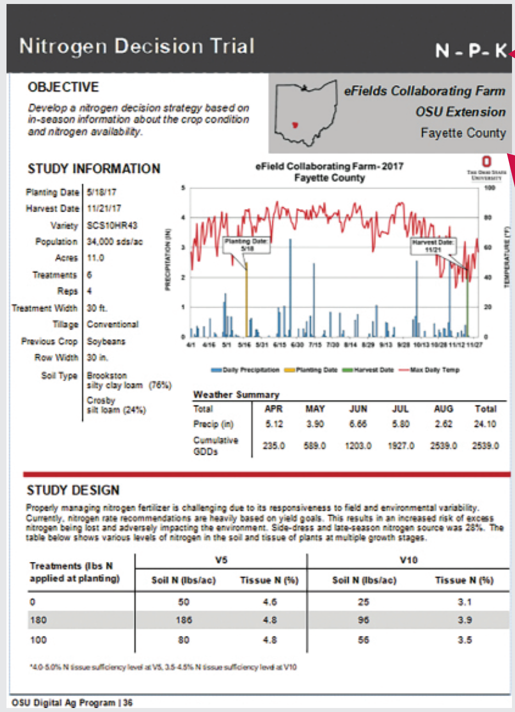
Report Guide

How to use this Report

Thank you for taking the time to explore our 2018 **eFields Report**. Corn studies begin on page 22, soybean studies begin on page 106, and all other studies start on page 158.

Page Navigation

Left Page
Find study specific information, including objectives, how the study was set up and growing conditions (weather graph and summary and study information) on the **left page.**

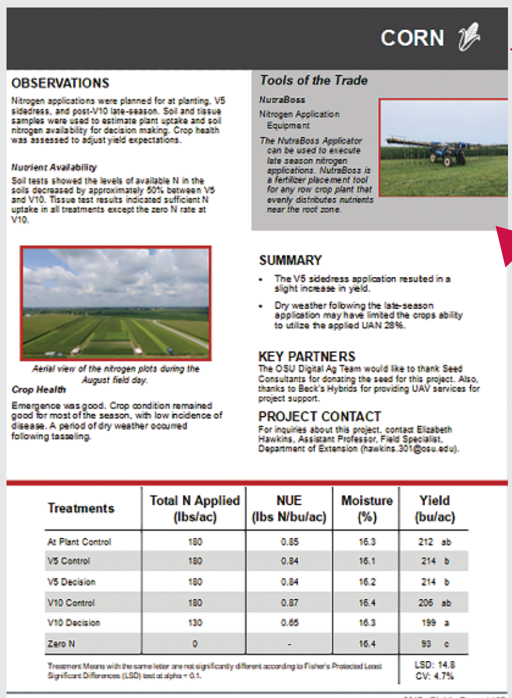


See the graphics on the **inside cover** for a brief description of our 2018 eFields focus areas. Icons in the upper right corner denote the associated eFields initiative for each study.

Check the location box to find where the study was conducted. A visual representation of the location is noted by the map of Ohio with the county highlighted in red.

Right Page
Find study specific observations, results, summaries, project contacts and statistical analysis on the **right page.**

Results are listed on the bottom of the left page. To better understand how each column was calculated, reference **page 8.**



To help you find what you're looking for, we have organized the report into three categories (denoted in the **top right** corner of each study). These categories include: *corn, soybean, and additional studies.*

Some studies will have a Tools of the Trade box under the category information. The Tools of the Trade highlights a tool that was integral in the study.

Get Involved

eFields
connecting science to fields

Are you interested in contributing to the 2019 eFields? If so, go to go.osu.edu/efields to review study implementation and tips & tricks. Below explains how to get more 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 & Natural Resources Extension Educator (agcrops.osu.edu/people). To view a list of those educators who are already involved, see page 10. Standard protocols for seeding rates and nitrogen rates are 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 interesting in determining how you can support Ohio On-Farm Research, reach out to your local county Agriculture & 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 agent 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.

2018 eFields Review Meetings:

Southwest: February 13, 2019; 9:00 am-Noon
Clinton County Extension Office: 111 South Nelson Ave. #2, Wilmington, OH 45177

Northwest: February 20, 2019; 9:00 am-Noon
Robert Fulton Ag Center: 8770 OH-108, Wauseon, OH 43567

East: February 27, 2019; 4:30 pm-8:30 pm
RG Drage Career Conference Center: 2800 Richville Dr. SW, Massillon, OH 44646

West Central: February 28, 2019; 9:00 am-Noon
Upper Valley Career Center, Adult Applied Technology Center: 8811 Career Dr., Piqua, OH 45356

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:
All stand counts were conducted for individual plots by counting the number of plants in 30 linear feet along two adjacent rows.

Harvest Data:
All yield data was collected using calibrated yield monitors. 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:

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

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.

Randomization
- Randomization is as important as replication to help account for any variations in production.
- Even if you replicated 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
The CV is defined as the coefficient of variation, and is a measure of the variability between the treatment yields. In this report it is calculated as a percentage.

Explanation:

- *For treatment A to be statistically significant from treatment B, they must differ by at least 3.38 bu/ac. (They are not, so they are not statistically different and are marked using the same letter).*
- *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).*

For this example, since treatment A is different from treatment D by 3.38 bu/ac, we are 90% certain that 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

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 corn seed cost of $3.50/1,000 seeds. Soybean seed cost was $0.428/1,000 seeds. These are based on budget developed by Barry Ward, OSU Extension.

Nitrogen Costs:
A nitrogen cost of $0.305/lb used in this report is from the 2018 Corn Production Budget. For the nitrogen timing studies, application costs were also considered. The average costs of application the report uses are from the 2018 Ohio Custom Farm Rates.

Nitrogen Application Costs

Application Method	Rate $/ac
Dry Bulk	6.3
Liquid Knife	9.5
Liquid Spray	7.2
Anhydrous	13.7
Late Season Coulters	13.2
Late Season Drops	11.3

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 $/1000 sds	Soybeans $/1000 sds
Oct WASDE	3.50	8.60
10% Decrease	3.15	7.74
10% Increase	3.85	9.46

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.

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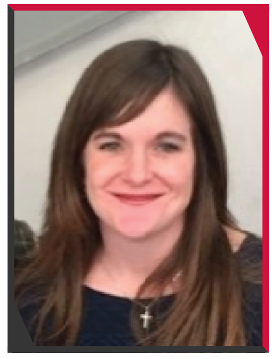

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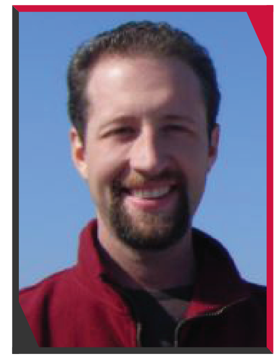

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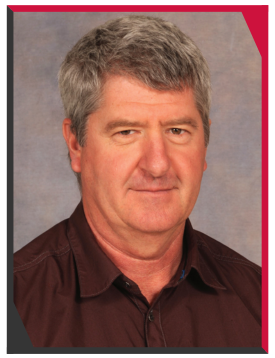

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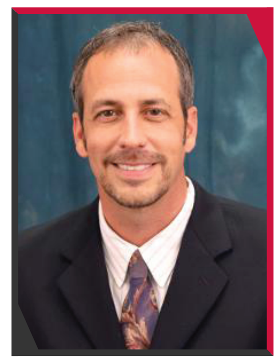

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ABOUT US

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 hand-held 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.

Ohio State Digital Ag Program

Digital Ag Initiatives

"Helping growers make the most of Precision and Digital Ag technologies"

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

N-P-K

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.

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

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

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

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

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

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

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

2018 Growing Season Weather

They say that "rain makes grain," but too much of a good thing can do more harm than good. Many locations across Ohio recorded their top 5 wettest years on record. Combined with warmer-than-average temperatures from May through October and minimal drought conditions, yield expectations were high. This is not to say there were not some weather challenges along the way, specifically for the latter part of harvest. The following summarizes the climate and describes a few of the weather challenges for the 2018 growing season.

GROWING SEASON LENGTH

For most locations across Ohio, the last date of freezing temperatures (32°F) in the spring occurred between April 21 and May 1, and the first date of freezing temperatures in the fall occurred between October 16 and October 25. Figure 1 shows growing season length defined by 28°F (Fig. 1a) and 32°F (Fig. 1b) interpolated across Ohio using stations in and surrounding the state. Growing season length defined by the number of days between 28ºF occurrence shows an additional two weeks to 30 days compared to the 32°F analysis. For the growing season defined by 32°F (28°F), this is approximately 10 (4) days longer than the long-term median and is consistent with the climate trends witnessed across the Midwest since the mid-twentieth century.

Spatially, the patterns are consistent with the topography and infrastructure of Ohio. Influence from larger cities (e.g., Toledo, Columbus), Lake Erie, forests, and even major highways (e.g., I-75) can modify surrounding temperatures and extend the season length. Colder valleys and areas of less development warm up slower in the spring and cool off faster in the fall, leading to a shorter growing season. It is important to note that this spatial interpolation is highly dependent on available station data, and in counties where the only station is in a more urban setting, surrounding areas may have had shorter growing season lengths.

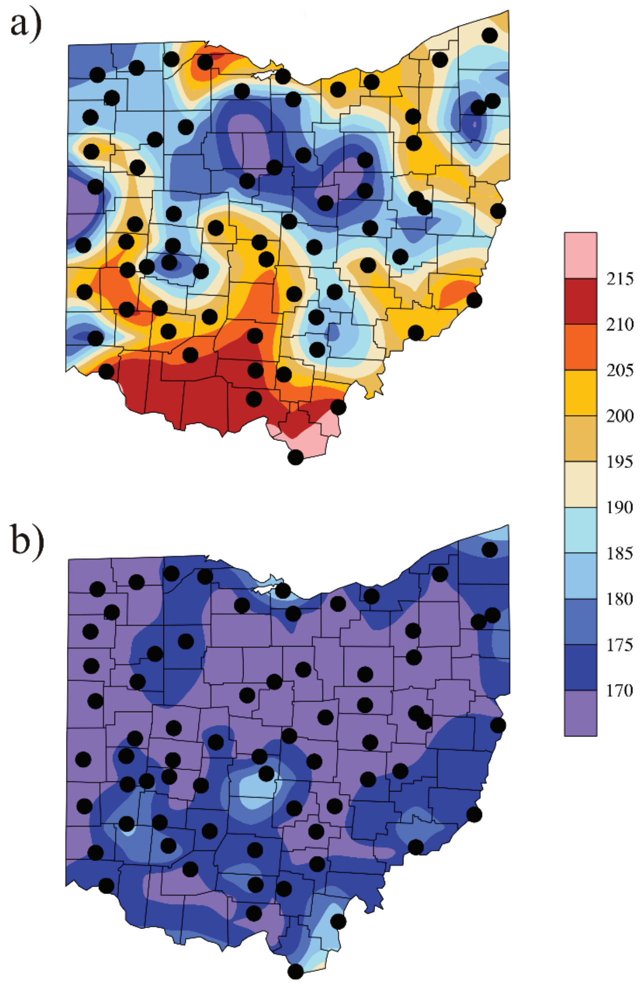


Figure 1. Growing season length defined by the number of days between a) 28°F and b) 32°F. Black dots represent station locations used to spatially interpolate across the state.

SEASONAL CLIMATE ROUND-UP

Spring (March-May): Ohio moved into the growing season with saturated soils, coming off the fourth warmest and second wettest February on record. That wet pattern continued throughout much of March and April, but temperatures remained on the cold side. In fact, Ohio had its 9th coldest April on record dating back to 1895 (Fig. 2a). The cool and wet conditions began to raise planting concerns for many farmers. This was quickly erased after an abrupt transition to record warmth in May across much of the Ohio Valley (Fig. 2b).

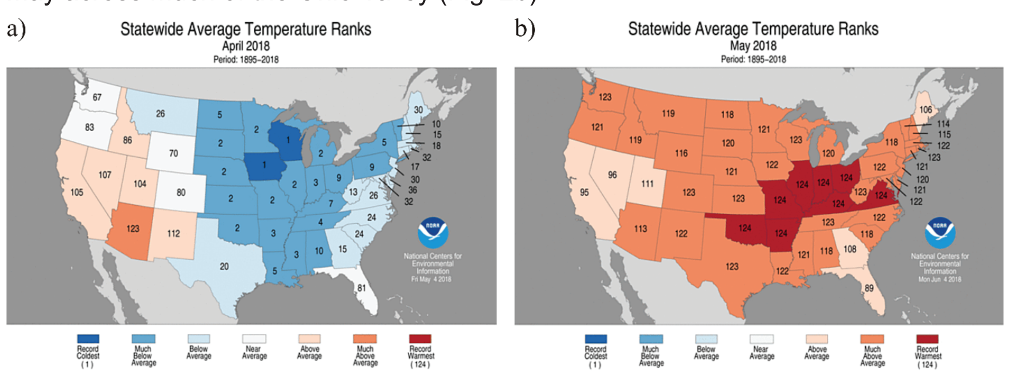
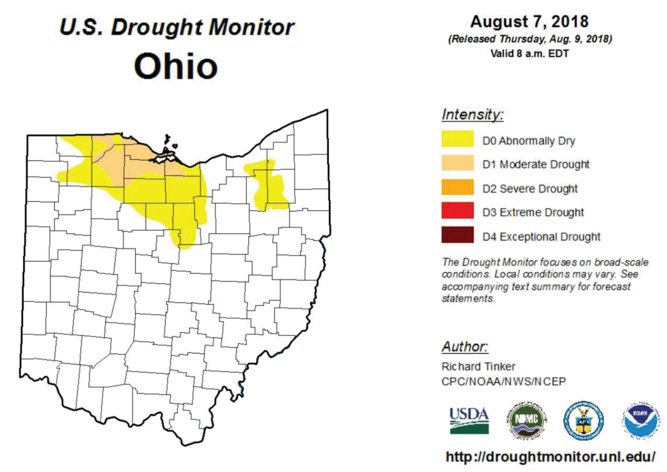


Figure 2: Statewide average temperature ranks (1895-2018) for a) April and b) May 2018. A rank of 1 denotes the coldest month on record and a rank of 124 denotes the warmest month on record. From the National Centers for Environmental Information.

OBSERVATIONS



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.

Figure 3 (left): Maximum extent of drought conditions as depicted by the U.S. Drought Monitor on August 7, 2018.

Summer (June-August): Summer of 2018 was not excessively warmer than average, but June ranked as the 4th warmest on record for Ohio. This warmth was largely driven by overnight low temperatures, with many nights remaining above 70°F. This warmth pushed growing degree days well ahead of schedule, and with near to above normal precipitation, many corn and soybean fields flourished across the southern two-thirds of the state. However, dry conditions across northwest Ohio during July (Fig. 3) greatly impacted producers still trying to catch up from the cold, wet spring. By July's end, some damage had already been done, especially to hay and vegetable growers.

Autumn (September-November): Ohio returned to very wet conditions in early September with the arrival of the remnants of Hurricane Gordon and Florence. Gordon brought a good soaking to almost the entire state on September 7-8, with upwards of 8" locally in southwest Ohio. Florence made it to the Ohio/Kentucky border on September 17th as a depression, dropping 2-4" across the southeastern counties. In addition to being the warmest September on record, these systems helped September 2018 rank as the 2nd wettest on record (1895-2018). October rainfall was closer to average, though temperatures remained warm (9th warmest). This allowed a good start to the fall harvest, with corn harvest running well ahead of the 5-year mean (though soybean harvest lagged behind). November turned very wet once again, with many locations throughout the state receiving 4-7" of rainfall for the month. November 2018 ranks as the 10th wettest on record, with the September-November period (Fig. 4) raking as the 3rd wettest. This had significant impacts on harvest, particularly soybeans which were already lagging and many farmers faced disease, fungus, and grain-quality issues as crops remained in the fields. By the end of November, many locations throughout Ohio had already recorded their top 3rd wettest year on record, with one month to go. This pushed many farmers to wait for the ground to freeze before finishing their harvests.

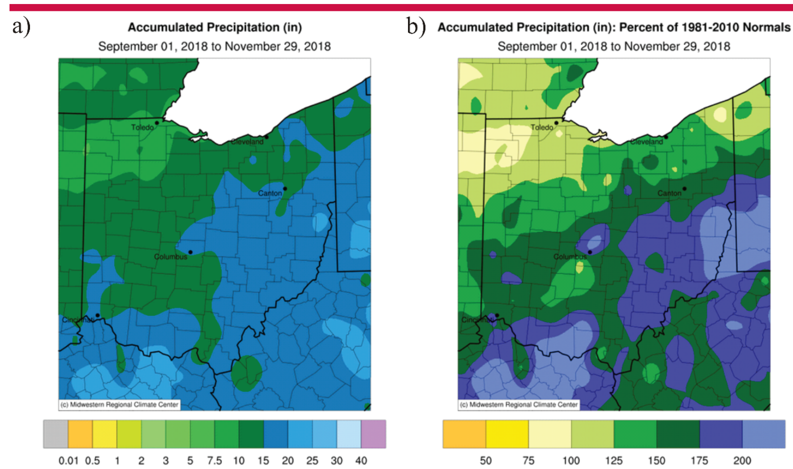


Figure 4: September-November a) precipitation totals and b) percent of mean (based on 1981-2010 average). Generated with the Midwest Regional Climate Center cli-MATE tool. (https://mrcc.illinois.edu/CLIMATE/index.jsp)

SUMMARY

- The growing season lasted between 165-190 days based on a 32°F threshold, and was about 10 days longer than the long-term median.
- Ohio soils were saturated entering spring, and cold, wet conditions persisted through April.
- Dry, warm weather allowed for rapid planting.
- Ohio returned to very wet conditions in early September with remnants of hurricanes.
- November's wet conditions (many locations receiving 4-7" of rainfall for the month) delayed harvest into December.

CONTACT

For questions about this information, contact Aaron B. Wilson, Research Scientist, Byrd Polar and Climate Research Center (wilson.1010@osu.edu).

Ohio Farm Business Analysis

OBJECTIVE

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

OSU Extension Ohio Farm Business Analysis

Headquarters Mahoning County

STUDY INFORMATION

In 2018, 42 farms with 32,626 crop acres participated in the 2017 Ohio Farm Business Analysis and Benchmarking Programs. These farms provided detailed financial and production data to complete a whole farm analysis. 34 of the farms also completed an enterprise analysis for their crop enterprises. Farms ranged in size from 60 crop acres to more than 2,200 crop acres. The ten largest farms consisted of an average of 1,597 acres each.

The 2017 summary contains enterprise reports for corn harvested as dry shell corn and corn silage, alfalfa hay, mixed hay, soybeans, winter wheat harvested as grain, 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. When data for more than 18 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, alfalfa hay, soybeans, wheat and small grain silage, combining data for all land tenures into one benchmark report.

Cost of Production for Corn on Owned and Rented Ground, Ohio 2017

CORN	Owned Land	Cash Rented Land	Rented Land-High 20%[1]
Per Acre ($)			
Direct Cost	497.04	570.71	543.79
Direct & Overhead Cost	676.87	689.86	613.86
Net Return	(67.78)	(51.13)	133.94
Per Bushel ($)			
Direct Cost	3.00	3.28	2.78
Direct & Overhead Cost	4.09	3.96	3.14
Average Yield	165	174	195
Value/Bushel	3.67	3.65	3.82

[1] Sorted by net return per acre

STUDY DESIGN

A complete farm business analysis provides:

- Balance Sheets
- Income Statement
- Statement of Cash Flows
- Enterprise Analysis
- Cost of Production per acre, bu., etc.
- Personalized Benchmark Reports

2017 Ohio Farm Business Summary with Crop Enterprise Analysis

Corn 2017; Owned Land

Benchmark Report, 17 Enterprises

	Group Median	Count	10%	20%
Yield per acre (bu.)	175.65	17	97.75	125.00
Value per unit	3.61	17	2.85	3.32
Total product value	618.75	17	278.60	418.75
Gross return	618.75	17	278.60	418.75
Seed	113.17	17	171.63	119.39
Fertilizer	128.17	17	231.13	166.67
Crop chemicals	56.40	17	99.38	85.96
Crop insurance	15.44	13	30.67	29.32
Fuel & oil	26.42	17	44.53	43.95
Repairs	44.14	17	112.29	102.81
Utilities	4.62	11	7.80	7.19
Operating interest	7.07	13	26.60	26.60
Total direct expenses	479.59	17	658.53	599.02
Return over direct expenses	198.79	17	-173.03	-65.63

These reports allow farmers to compare their performance against other Ohio farms. Farms that complete an analysis receive benchmark reports personalized for their farm.

Tools of the Trade

2017 Ohio Farm Business Summary

A complete farm business analysis monitors profitability, working capital and net worth change. Enterprise Analysis gives you the ability to make informed decisions. Personalized benchmark reports identify opportunities to increase profitability. go.osu.edu/FBA

SUMMARY

- There was a wide variation in net return per acre for corn grown on owned or rented ground. Less than half (22 of 46) corn enterprises generated positive net returns. The nine farms generating more than $100 per acre averaged $165.72 per acre.
- Average net returns for soybean enterprises were all positive, with 36 of 50 enterprises generating positive net returns. The highest 17 enterprises ranged from $100 to nearly $300 per acre.
- All Ohio farms are encouraged to complete an analysis of 2018. Analyses are completed January through May, the earlier the better.

PROJECT CONTACT

For inquiries about this project, contact Haley Shoemaker, Program Coordinator (shoemaker.306@osu.edu).

Cost of Production for Soybeans on Owned and Rented Ground, Ohio 2017

SOYBEANS	Owned Land	Cash Rented Land	Rented Land-High 20%[1]
Per Acre ($)			
Direct Cost	253.28	393.87	298.09
Direct & Overhead Cost	401.87	462.71	408.54
Net Return	91.29	28.44	128.56
Per Bushel ($)			
Direct Cost	4.93	7.76	5.45
Direct & Overhead Cost	7.82	9.12	7.46
Average Yield	51.38	50.74	54.74
Value/Bushel	9.54	9.55	9.81

[1] Sorted by net return per acre

RECOGNIZING EQUIPMENT HAZARDS

Even with all of the technological advances in agricultural equipment, consideration for hazards associated with equipment is important. Today's agricultural equipment is powerful, very efficient and versatile in how it can be used. No matter if it is spring planting, fertilizer application, pesticide application, or harvest, individuals can find themselves in a situation to be seriously injured by the equipment they are operating or working around.

Injuries from equipment can occur from some of the following reasons:

- Working on or around moving equipment (see example at right)
- Caught – in or caught – between equipment
- Working on equipment with stored energy (hydraulic systems, spring tension, electrical….)
- Inadequate guarding on equipment, or guards have been removed, exposing moving parts
- Incorrect hitching practices
- Not being visible to the equipment operator
- Unaware of approaching danger in the work environment

Manufacturers provide warning labels on the equipment to notify of a potential hazard points and usually dedicate a section of the operator's manual to safe operation. Reviewing the warning labels and operator's manual is essential to recognize equipment hazards associated with the equipment being operated.

There are eight identifiable equipment hazards that should be taken into account when operating or working with equipment, which are listed at the bottom of these pages.

Department of Food, Agricultural and Biological Engineering

Franklin County

Working in or around moving equipment.

HAZARDS AND INJURIES

A single piece of agricultural equipment can have a variety of these hazards, possibly all of them, as well as having the same hazard located in multiple locations around the piece of equipment as seen below.

Machinery with multiple hazards.

Equipment Hazard	Severity of Injury
Wrap Points (PTO)	.2 sec = 2' wrapped into machine
Pinch Points (Roller Chain Assembly)	.2 sec = 14' pulled into machine
Cut Points (Rotary Mower)	.2 sec = 10 cuts
Crush Points (Falling Equipment)	.2 sec = 1' object falls
Burn Points (156° Fahrenheit)	1 sec = 3rd degree burn
Thrown Object (Thrown at 200 mph)	1 sec = 293' travel distance
Stored Energy:	
Electricity (Travels at 186,282 miles/sec)	10 milliamp shock can be fatal
Spring Release (2lb spring @ 73.5 fps)	167 flbs force at impact
Hydraulic Systems	Up to 3000 psi pressurized systems

As stated in the chart above, the average person reacts to a potential hazard in .2 to .3 seconds. With the speed and power of the equipment being operated in today's agricultural industry, that minimal amount of time to react to a situation can still result in a traumatic injury.

Tools of the Trade

Manufacturer Safety Labels

Manufacturers provide labels on equipment to identify potential hazard points. It is the equipment operator's responsibility to review the warning labels and use the operator's manual to review any safety features and understand how the equipment operates.

PROJECT CONTACT

For more information, visit the OSU Agricultural Safety and Health Program website at agsafety.osu.edu or contact Kent McGuire, CFAES Safety and Health Coordinator, at 614-292-0588 or mcguire.225@osu.edu.

Wrap Points: Any exposed equipment component that rotates at high speed or with a high degree of torque. Injuries occur because of entanglement with the part. The most common wrap points are associated with drive shafts or power take - off shafts.

Shear/Cut Points: Shear points happen when two edges come together or move passed each other to create a cut. Cut points happen when a single edge moves rapidly and forcefully enough to make a cut or a solid object strikes a single edge. Injuries can range from severe cuts to amputation. Common equipment includes mower blades, disc coulters, cutter bars and parts with sharp edges.

Pinch Points: Any equipment that has two objects that come together with at least one of them moving in a circular motion. The point at which the two objects come together becomes the pinch point. Injuries can include abrasions, cuts, or being pulled further into the part. Most pinch points involve belts and pulleys, chains and sprockets, gear drives, or roller assemblies.

Thrown Objects: Occurs when material or objects are discarded from the equipment with great force. Injuries occur when the object strikes the individual. Objects can be thrown during mowing or harvesting processes, from discharge chutes, or tossed from rapidly rotating parts.

Crush Points: This occurs when two objects come together or a single object moves towards a stationary object creating a blunt impact. Injuries usually involve damage to tissue, bones, or internal organs. Crush points can include being caught under or between moving parts or equipment.

Free-Wheeling Parts: Some mechanical systems will take time to come to a complete stop, after the power source has been shut off. Many times these parts are moving silently after the equipment operator has dismounted the equipment. These parts can include rotary mower blades, flywheels, and equipment that must go through a full revolution or cycle to come to a complete stop.

Stored Energy: Any amount of potential energy waiting to be released. Injuries occur when the energy is unintentionally or unknowingly released. This can include pressurized hydraulic systems, pneumatic systems, electrical circuits, spring tension, and chemical reactions.

Burn Points: Any area on a piece of equipment that can generate enough heat to cause a burn to the skin if touched. It only takes 1 second to create a 3rd degree burn touching something at 156 degrees Fahrenheit. Common burn points include exhaust mufflers, engine or hydraulic fluids, friction of moving parts, and worn out bearing assemblies.

For 2018, 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 43 unique studies being conducted across the state. 2018 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 2018 eFields corn research by the numbers:

3,160 acres of corn

43 corn studies

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

2018 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 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.

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.

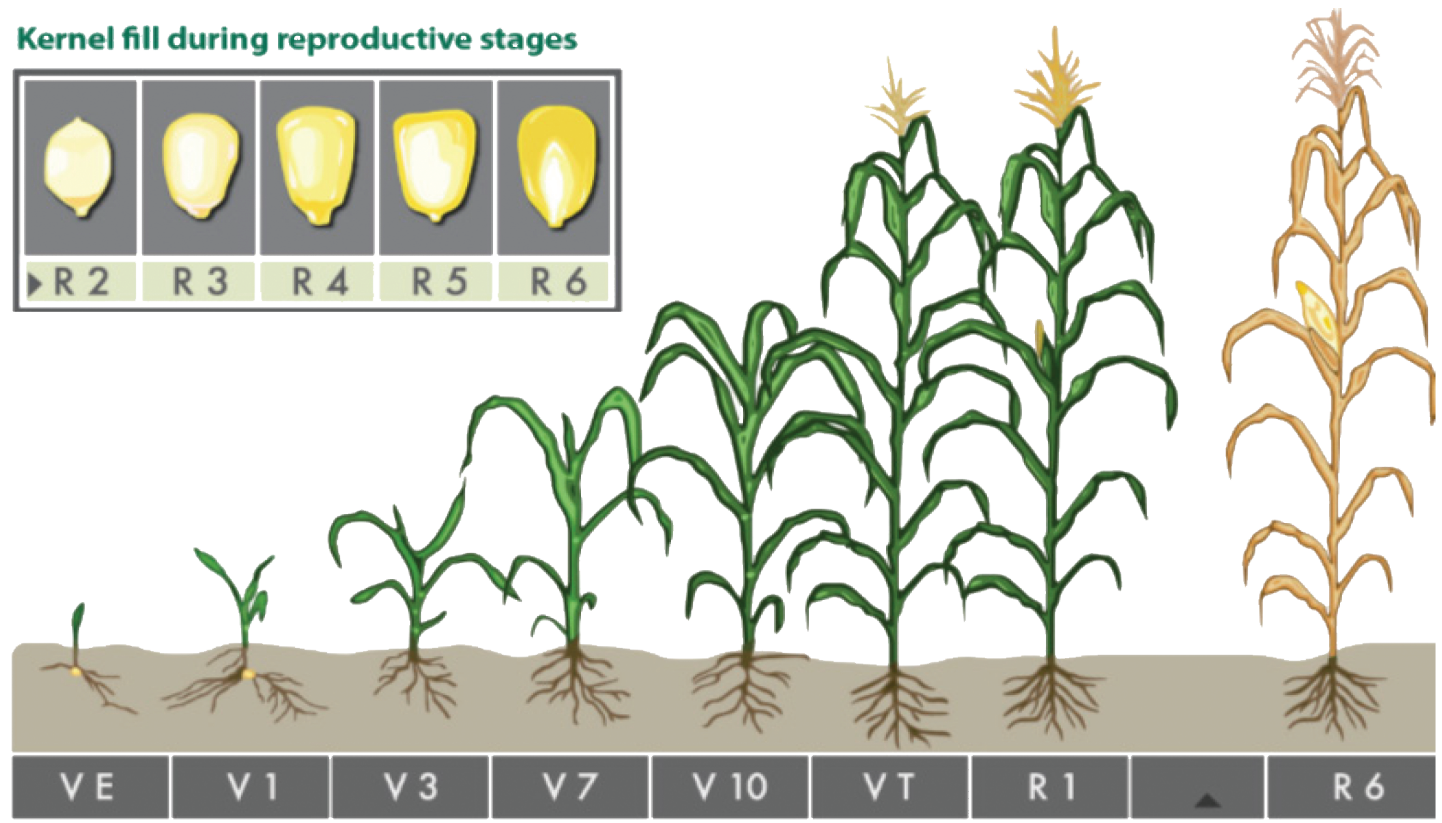


Image Source: University of Illinois Agronomy Guide, 1999.

OBJECTIVE

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

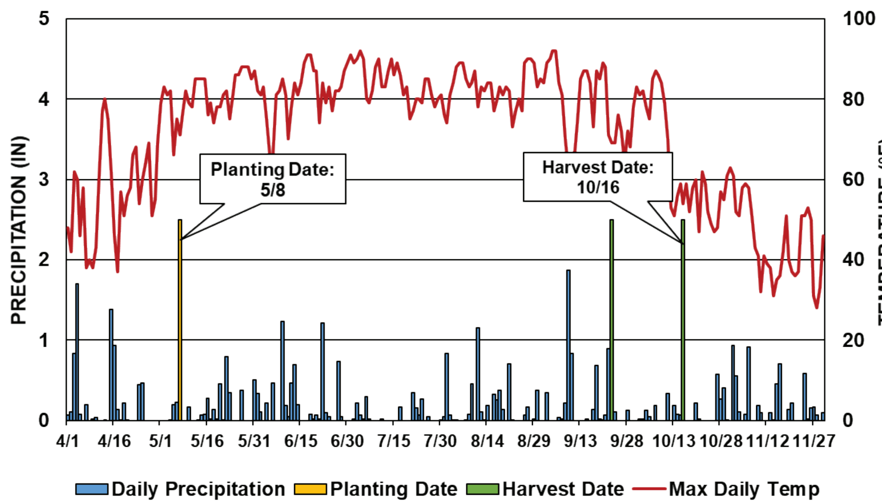
eFields Partner Farm

Beck's Hybrids

Pickaway County

STUDY INFORMATION

Planting Date	5/8/2018
Harvest Date	10/16/2018
Variety	Beck's 5840AM
Population	30,000
Acres	100
Treatments	5
Reps	6
Treatment Width	40 ft.
Tillage	No-Till
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Genesee silt loam, 53% Ross silt loam, 42% Eldean loam, 5%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

High speed planter systems have recently been adopted for modern planters. There is some research on the effect of speed with these new technologies on emergence and yield, but little research in Ohio. This study evaluates five speeds of planting corn in central Ohio and their effects on yield and emergence. Heavy downforce (150 lbs) was applied using a Precision Planting 20/20 SeedSense monitor.

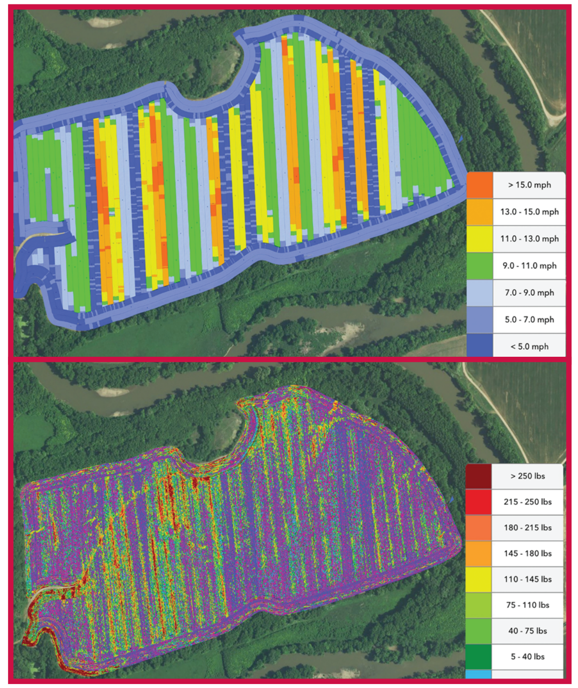
Treatments (Speed MPH)	Theoretical Capacity (ac/hr)
5	24
7.5	36
10	48
12.5	60
15	72

Check out a drone video of high speed planting using the QR code above or visit go.osu.edu/2018highspeed

OBSERVATIONS

Tillage was completed with a 32 ft. TM255 Case IH cultivator prior to planting to create soil variation and clod size in order to test planter in non-ideal conditions.

Throughout the year, plant growth was monitored for any potential treatment differences. No yield limiting factors were observed. Average emergences for each treatment were collected using Precision Planting POGOs as seen in the table at the bottom of the page.



Top: Speed map from Fieldview Cab
Bottom: Applied planter downforce from Fieldview Cab

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 reduces seeds ricocheting into the trench.

SUMMARY

- For the first time in three years, a statistical difference occurred between the treatments because of planter speed.
- Treatments 12.5 mph or above were not statistically different from each other in yield.
- The 15 mph treatment had statistically lower emergence than the other treatments.

Drone image taken during high speed planting.

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Food, Agricultural & Biological Engineering (klopfenstein.34@osu.edu) or Ryan Tietje, Research Associate Engineer (tietje.4@osu.edu).

Treatments (Speed MPH)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)
5	28,417 a	17.4	210 ab
7.5	29,000 a	17.3	213 a
10	28,167 a	17.4	210 ab
12.5	28,167 a	17.4	208 bc
15	25,583 b	17.3	203 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: 1812 CV: 6.53%		LSD: 4.55 CV: 2.32%

OBJECTIVE

Understand the value of localized weather forecast versus what the field actually received and understand how soil moisture information can be used for irrigation scheduling.

eFields Collaborating Farm

OSU Extension

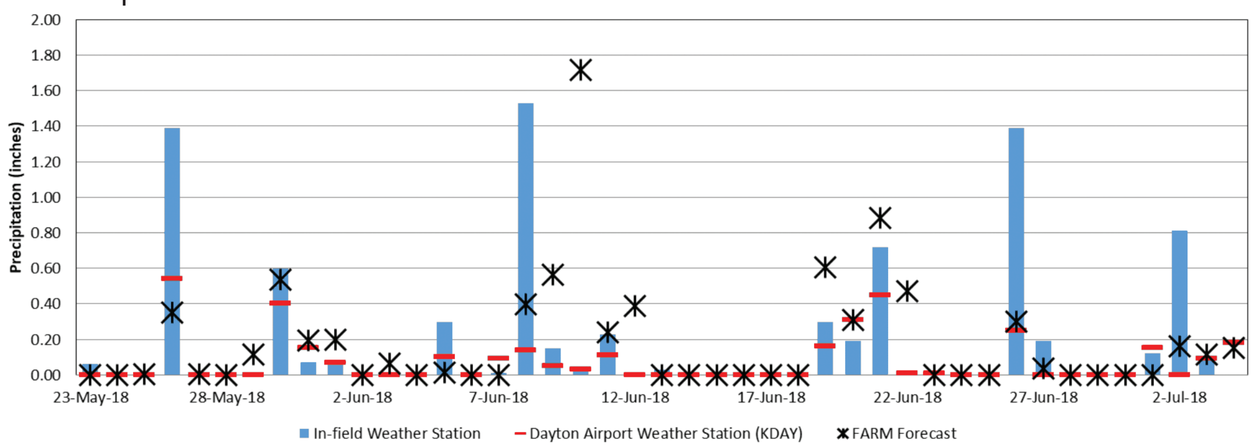
Miami County

STUDY INFORMATION

Planting Date	5/1/2018
Harvest Date	10/5/2018
Variety	Ebberts 9121SSX
Population	34,000
Tillage	Conventional
Previous Crop	Soybeans
Soil Type	Eldean loam, 80%; Warsaw silt loam, 12%

Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.78	3.04	3.06	3.32	3.97	18.17
Cumulative GDDs	142	777	1,464	2,192	2,948	2,948



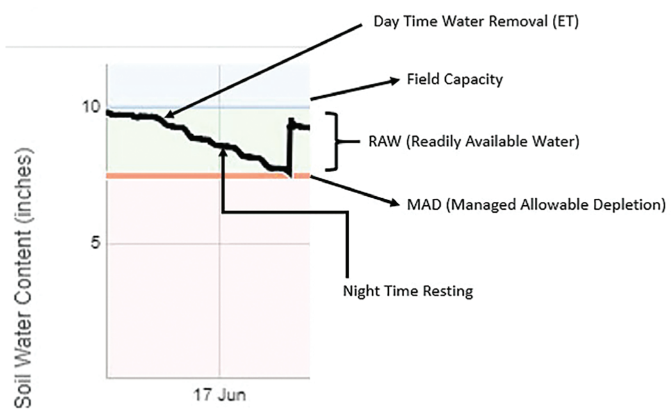
Precipitation Chart for the period of May 23 through July 4 comparing 1) in-field weather rain gauge, 2) local weather gauge located at the Dayton International Airport, and the FARM forecast tool.

STUDY DESIGN

Two soil moisture probes were located in an irrigated corn field. Each probe contained a total of 9 sensors spaced 4 in. 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).



Interpreting soil moisture profile data.

OBSERVATIONS

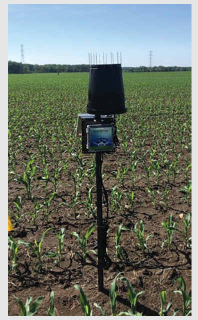
Soil moisture sensors provided key information along with weather forecasts for scheduling irrigation in this field. Soil moisture increased and decreased throughout the growing season. A few times in July and August, the desired soil moisture dropped below the managed allowable depletion (MAD). However, soil moisture was sufficient during R growing stages that occurred during early July and was sufficient through August.

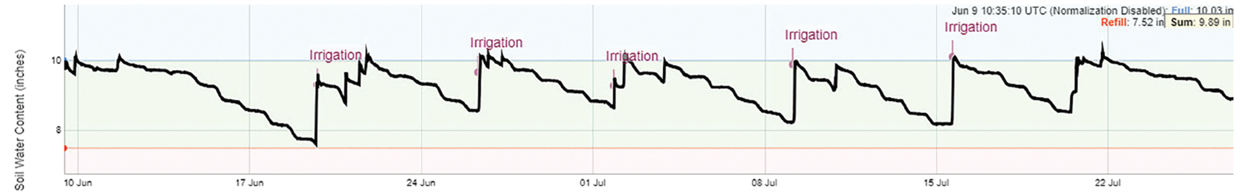
The corn crop had an uptake of 0.27 in/day on July 3, quickly increasing to 0.3 in/day on July 9 and increasing to 0.38 in/day by the second week of July.

Tools of the Trade

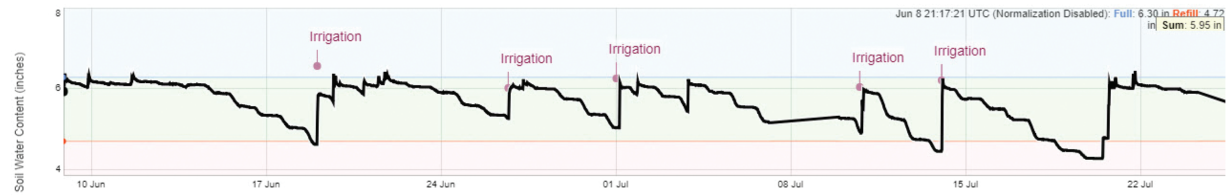
CropMetrics Weather Station w/ Probes

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.





Soil moisture profile data over the time period 6/9-7/22 (V14- R2) for the sensor located in high productivity area.



Soil moisture profile data over the time period 6/9-7/22 (V14- R2) for the sensor located in well drained soil.

Yield and Grain Moisture for Irrigated and Non-irrigated Areas

Treatments	Moisture (%)	Yield (bu/ac)
Irrigated	17.4 a	256 a
Non-irrigated	16.3 b	162 c
North Moisture Sensor	17.4	259
Non-irrigated area adjacent to North Moisture Sensor	16.4	185

Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.1.

Key:
Replicated Treatments
Spot Treatments

SUMMARY

- It is difficult to capture localized rainfall for a field.
- The Field Application Resource Monitor (FARM) weather forecast tool provided an acceptable forecast 80% of the time.
- All rain events do not have the same efficiency in terms of infiltration and refill of the soil profile.
- Irrigated corn provided a significantly higher yield with a mean of 256 bu/ac versus non- irrigated at 162 bu/ac.
- Grain moisture content at harvest was significantly different between irrigated and non-irrigated.
- Using the soil moisture data through the provided APP, irrigation events were scheduled 2 days in advance of normal scheduling protocol.

PROJECT CONTACT

For inquiries about this project, contact John Fulton, Associate Professor, Department of Food, Agricultural, and Biological Engineering (fulton.20@osu.edu).

OBJECTIVE

Determine the effect of nitrogen rate and nitrogen application at V17 on corn grain yield.

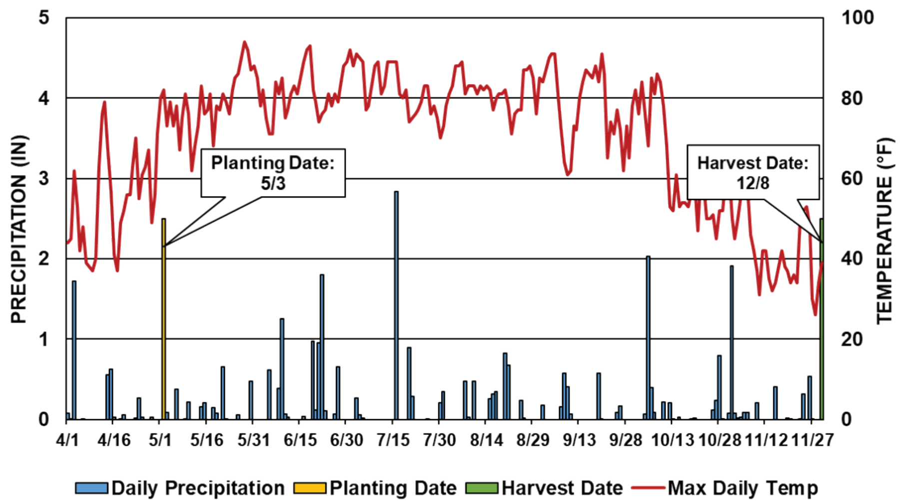
eFields Collaborating Farm

OSU Extension

Auglaize County

STUDY INFORMATION

Planting Date	5/3/2018
Harvest Date	12/8/2018
Variety	Croplan 6297
Population	30,500
Acres	51
Treatments	5
Reps	3
Treatment Width	40 ft.
Tillage	Field cultivation (twice)
Herbicide	Corvus, Durango, Atrazine 4L
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Blount silt loam, 47% Glynwood loam, 36% Pewamo silty clay loam, 17%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	7.06	4.94	3.65	21.58
Cumulative GDDs	117	669	1,330	2,016	2,728	2,728

STUDY DESIGN

The experiment was designed as a randomized complete block with 3 replications. Plot width was 40 ft. and plot length was 969 ft. The field was chiseled in the fall and field cultivated twice in the spring prior to planting. A total of 32.1 pounds of actual nitrogen was applied at planting in a 2 by 2 inch band from 8 gallons of 28-0-0 and 7 gallons of 10-34-0. On May 11, 29.9 lbs N/ac was applied broadcast as a weed and feed. On May 25, 82-0-0 was applied 8 in. deep according to treatment rates to V2 to V3 corn. On July 5, a GreenSeeker was used to capture NDVI data. On July 5, 28-0-0 was applied to V17 corn with a Y-DROP® system on a Hagie sprayer at 0, 20, or 40 lbs N/ac. The center 12 rows (30 ft.) were harvested with a John Deere combine.

Treatments	V2/V3 Application (lbs N/ac)	Late Application (lbs N/ac)	Total Application (lbs N/ac)
Rate 1	160	N/A	160
Rate 2	180	N/A	180
Rate 3	231	N/A	231
Rate 1 - Split Application	140	20	160
Rate 2 - Split Application	140	40	180

OBSERVATIONS

Corn health and development appeared good at the time of the V2-V3 nitrogen application.

There were no visual differences in the color of the corn at the time of the V17 nitrogen application.

Despite the late harvest, lodged corn was minimal with the exception of small areas.

Tools of the Trade

GreenSeeker

In order for late-season nitrogen applications to pay for themselves, we need a way to test the corn plants to know the current nitrogen status in the plant. One way to do this is to measure NDVI with a tool called the GreenSeeker.

Greenseeker technology allows for in-field adjustment of nitrogen rate based on real-time NDVI readings.

SUMMARY

- Applying nitrogen at V17 with the Y-DROP® system did not improve corn yield, however lower rates of nitrogen can be applied earlier in the season and a nitrogen application at V17 can maintain corn yield.
- The split application of 160 lbs N/ac yielded the same as all other treatments, providing the most efficient applied nitrogen use.
- There was no difference in NDVI values for the three nitrogen rates just before the nitrogen application at V17.

PROJECT CONTACT

For inquiries about this project, contact Jeff Stachler, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Auglaize County (stachler.1@osu.edu).

Treatments	NDVI	Moisture (%)	Yield (bu/ac)	Return Above N ($/ac)
Rate 1	0.84	17.8	218 a	714
Rate 2	0.85	18.0	229 a	746
Rate 3	0.85	17.9	224 a	731
Rate 1 - Split Application	0.85	17.9	228 a	741
Rate 2 - Split Application	0.85	18.0	229 a	755
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: Not significant CV: 2.76%	

Late Season Nitrogen Placement

N-P-K

Corn

OBJECTIVE

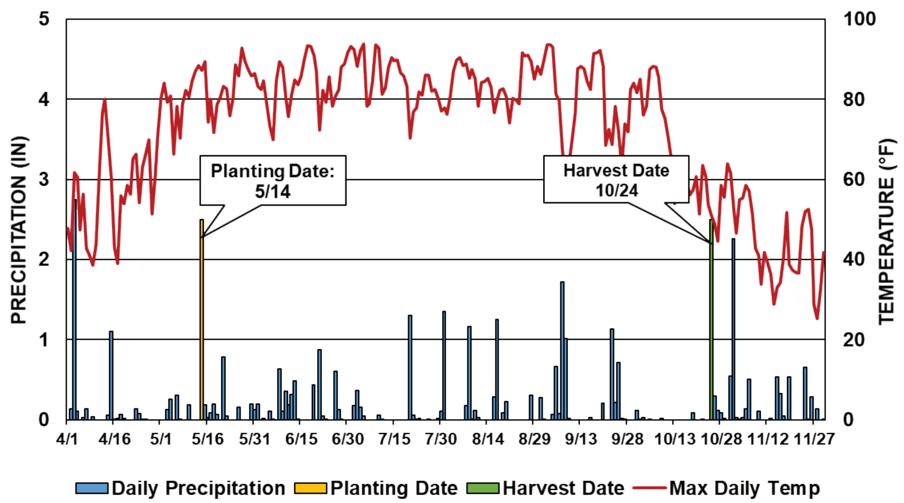
Evaluate late season nitrogen placement methods to determine impact on corn yield.

Western Agricultural Research Station

Clark County

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
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Strawn-Crosby complex, 72% Kokomo silty clay, 28%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.73	2.80	4.54	3.71	3.95	19.73
Cumulative GDDs	60	674	1,341	2,052	2,760	2,760

STUDY DESIGN

This is the third year 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. This study was completed using a randomized complete block design with four replications. An upfront application of 28% UAN at 100 lbs N/ac was provided as a 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 80 lbs N/ac at the V10 growth stage.

The late season placement options were coulter-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.

Late season application was conducted at V10 using NutraBoss applicators installed on a New Holland high clearance sprayer.

OBSERVATIONS

Throughout the year, plant growth was monitored for any potential treatment differences. No yield limiting factors were observed during scouting or using remote sensed imagery. This included before or after the late-season application. The ADVI is provided as verification post late season to verify no treatment differences.

No nitrogen deficiencies were observed for any of the placement treatments.

Final nitrogen placement of the NutraBoss application is shown above. Note the proximity of surface N band in relation to the crop row.

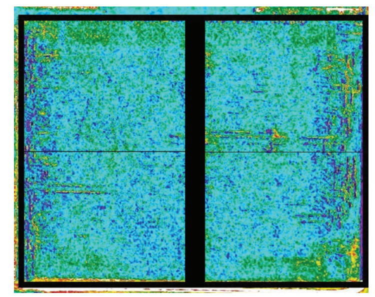
Tools of the Trade

NutraBoss Fertilizer Application Tool

The NutraBoss fertilizer applicator provides an opportunity to place fertilizer in dual bands in close proximity to crop rows. These applicators are compatible with many OEM sprayers.

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.



July ADVI imagery confirms that nitrogen deficiencies were not present at the time prior to application.

PROJECT CONTACT

For inquiries about this project, contact John Fulton, Associate Professor, Food, Agricultural & Biological Engineering (fulton.20@osu.edu).

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: Not significant CV: 3.77%

Late Season Nitrogen Placement

N-P-K

Corn

OBJECTIVE

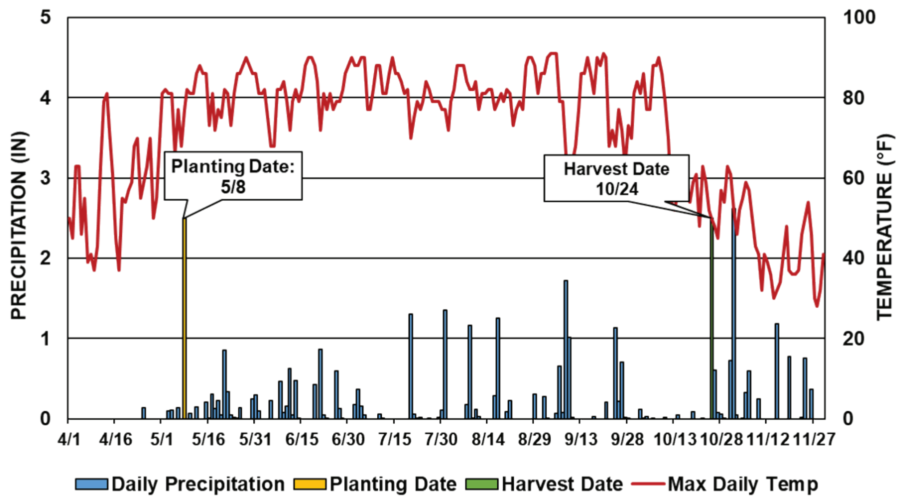
Evaluate the differences in application placement for late season nitrogen on corn.

Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/8/2018
Harvest Date	10/24/2018
Variety	LG5618STXRIB
Population	Variable-Rate
Acres	102
Treatments	3
Reps	7
Treatment Width	40 ft.
Tillage	No-Till
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Crosby-Lewisburn silt loam, 62% Kokomo silty clay, 38%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

During planting, 50 lbs N/ac was provided in the form of 2x2 using UAN 32%. A single total rate of nitrogen was used for comparing placement methods. Late season application was complete at the VT growth stage.

Treatments	Application Rate (lbs N/ac)
Late Season N-Drop	140
Late Season Coulter	140

Late season nitrogen machine getting set-up for application.

OBSERVATIONS

The growing season up to VT did not provide any free mineralized nitrogen and 50 lbs N/ac at planting was likely less than required by the crop to get to VT.

Some nitrogen stress was observed during late season application. Sufficient rainfall was received soon after application.

The corn was very tall at application, so boom would lay the corn over slightly. However, it recovered immediately and no effect was noted for the remainder of the growing season.

For reference, the 0 lbs N/ac check yielded 102 bu/ac and had a moisture content of 15.6%.

Late season nitrogen applications, depending on mineralization, can provide a finishing boost to the crop.

Tools of the Trade

New Holland N Coulter Bar

This 36 ft late season N coulter 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.

SUMMARY

- Based on this study, no statistical difference was found between the two treatment yields.
- Both treatments yielded much higher than the 0 lbs N/ac check.

RGB image from AirScout. The light colored strips are the 0 lbs N/ac check strips.

PROJECT CONTACT

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

Treatments (Placement and Rate)	Moisture (%)	Yield (bu/ac)
Late Season N-Drop	16.4	197 a
Late Season Coulter	16.2	179 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: Not significant CV: 8.90%

OBJECTIVE

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

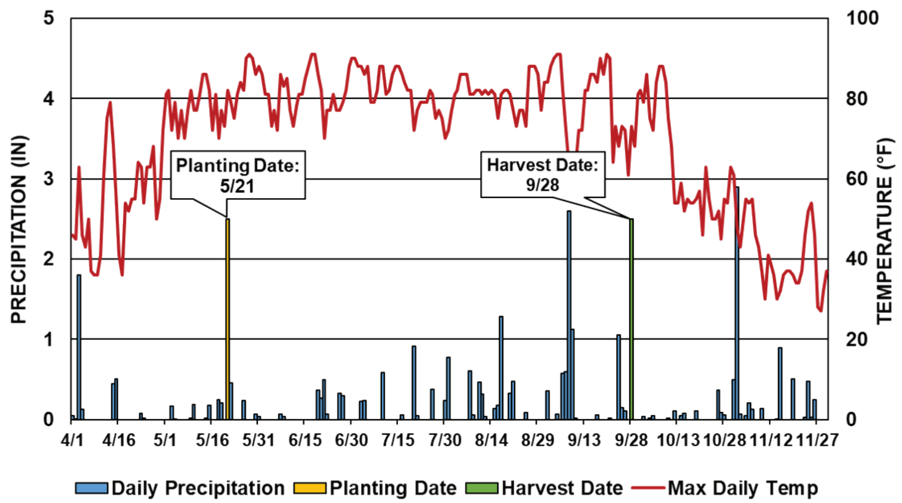
eFields Collaborating Farm

OSU Extension

Darke County

STUDY INFORMATION

Planting Date	5/21/2018
Harvest Date	9/28/2018
Variety	Dyna Grow 51vc54
Population	32,000
Acres	75
Treatments	2
Reps	3
Treatment Width	30 ft.
Tillage	No-Till
Previous Crop	Wheat
Row Width	30 in.
Soil Type	Crosby silt loam, 53% Brookston silty clay loam, 38% Celina silt loam, 5% Miamian silt, 4%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.03	1.85	1.94	3.46	3.97	15.38
Cumulative GDDs	113	692	1,349	1,997	2,677	2,677

STUDY DESIGN

In this study, four replications were completed comparing the use of swine manure versus anhydrous at sidedress. Treatments were implemented at the V4 growth stage in this study. The combine was calibrated in season. Passes from the center of the plots were harvested for treatment comparisons.

Treatments	Application Rate (lbs N/ac)
Swine Manure	200
Anhydrous	175

View from the cab for the manure sidedress dragline.

OBSERVATIONS

The 2018 early growing season was nearly perfect. Thus the corn plant was maturing very quickly, and the result was that sidedressing was completed in a late V4 stage, nearly too late.

Population was reduced by about 1,500 plants per acre as a result of the dragline at V4. Corn vegetative appearance was healthier looking in the manure treatments, possibly due to micro nutrients in the manure. However, manure sidedressed corn even out-yielded the corn that was not subject to the stress of the dragline.

Manure sidedress being completed on standing corn in V4 growth stage.

Tools of the Trade

Zoske's Manure Injection Toolbar

This manure toolbar was used along with a large drag hose to apply manure into a standing corn crop.

SUMMARY

- There was a point higher moisture with the swine manure treatment.
- There was a 17.5 bushel advantage in corn with the manure over the anhydrous.
- Economically with fertilizer savings and yield advantage, the was approximately a $150/ac gain with the manure side dress.

PROJECT CONTACT

For inquiries about this project, contact Sam Custer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Darke County (custer.2@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Swine Manure	23.6	264 a
Anhydrous	22.6	246 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: 4.13 CV: 0.97%

OBJECTIVE

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

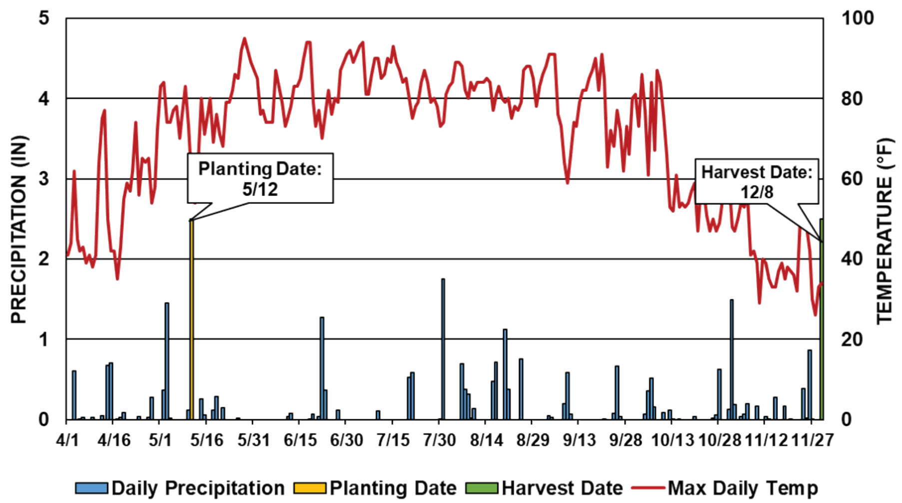
eFields Collaborating Farm

OSU Extension

Henry County

STUDY INFORMATION

Planting Date	5/12/2018
Harvest Date	12/8/2018
Variety	Becks 6127
Population	33,000
Acres	33
Treatments	2
Reps	3
Treatment Width	40 ft.
Tillage	Conventional Fall, No-Till Spring
Herbicide	Halex
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Hoytville silty clay loam, 100%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

STUDY DESIGN

Injecting manure nutrients into a growing crop can provide livestock producers a manure application method that works to satisfy the goals of 4R nutrient management. This experiment utilizes a complete block design with 3 replications. Plot widths are 20 ft. Plot lengths vary, as corn was planted at a 45 degree angle to accommodate the commercial manure applicator. Stand counts were taken at V4. A calibrated yield monitor was utilized for the collection of harvest data. Treatments consisted of 28% UAN and liquid swine finishing manure at a rate of 220 lbs. of total nitrogen.

Treatments	Application Rate (lbs N/ac)
Liquid Swine Manure	220
28% UAN	220

OBSERVATIONS

Throughout the year, plant growth was monitored for any potential treatment differences. No potential yield limiting observations were detected.

No differences in color were noted, and crop appeared healthy.

Two out of the three manure plots did have lower stand counts by 1,450 and 1,790 plants/ac. No stand difference was noted in the third plot.

Bazooka toolbar used to pull dragline and incorporate liquid manure.

Tools of the Trade

Ohio Agronomy Guide

Due to the possibility of population reduction as a result of dragline manure application if completed too late, it is important to be able to properly stage the crop. This guide includes information on how to determine crop growth stages and other information.

SUMMARY

- Corn sidedressed with 28% UAN produced a significant yield advantage by 9 bu/ac than corn fertilized with swine finishing manure at sidedress.
- Using manure to sidedress corn provides a timely opportunity to apply manure to a growing crop.
- Long term Ohio State research demonstrates that liquid swine manure is comparable to commercial sidedress fertilizer when evaluating corn yield.

PROJECT CONTACT

For inquiries about this project, contact Garth Ruff, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Henry County (ruff.72@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Liquid Swine Manure	17.7	198 b
28% UAN	17.7	207 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: 5.85 CV: 1.21%

OBJECTIVE

Maximize yield potential of corn through strategic placement of dual hybrids in different crop management zones.

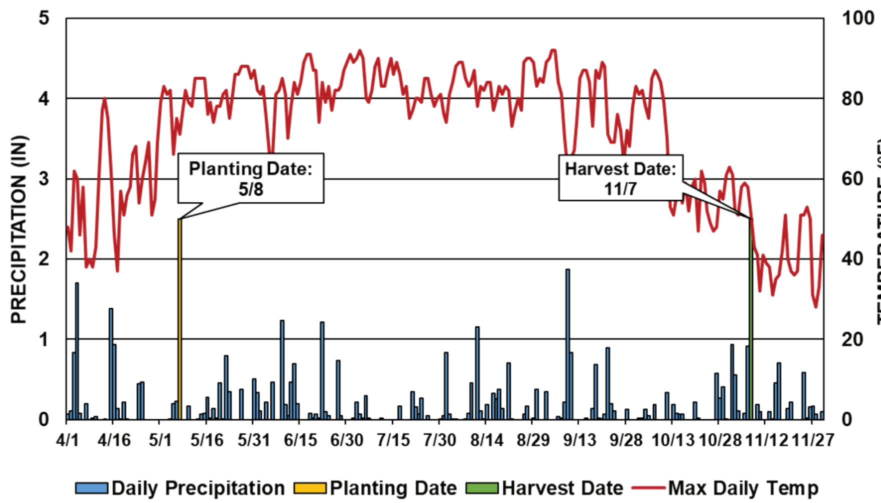
eFields Collaborating Farm

OSU Extension

Franklin County

STUDY INFORMATION

Planting Date	5/8/2018
Harvest Date	11/7/2018
Variety	Beck's 5840AM & 5829A4
Population	Variable-Rate
Acres	213
Treatments	3
Reps	8
Treatment Width	40 ft.
Tillage	No-Till
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Eldean silt loam, 52% Ockley silt loam, 21% Sleeth silt loam, 18% Miamian silt loam, 9%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

Multi-hybrid planting involves seeding two hybrids, as opposed to just one, in a field. Producers select an offensive hybrid, which is best suited for higher-yielding soils, and a defensive hybrid, which is better suited for tougher ground. One of the main difficulties with multi-hybrid planting for corn is matching the hybrids to soil landscapes. Multi-hybrid planting technology allows you to carry two hybrids and place them based on prescription written prior to growing season. Prescriptions can be based on a variety of factors including but not limited to yield history, DEM, CEC, OM, remote-sensed imagery, and more. Check strips and blocks were placed in the field to help analyze yield differences between the different hybrids. Placing strips in the field allows for the evaluation of any and all prescription methods that a grower, agronomist, and/or seed salesperson may have in mind.

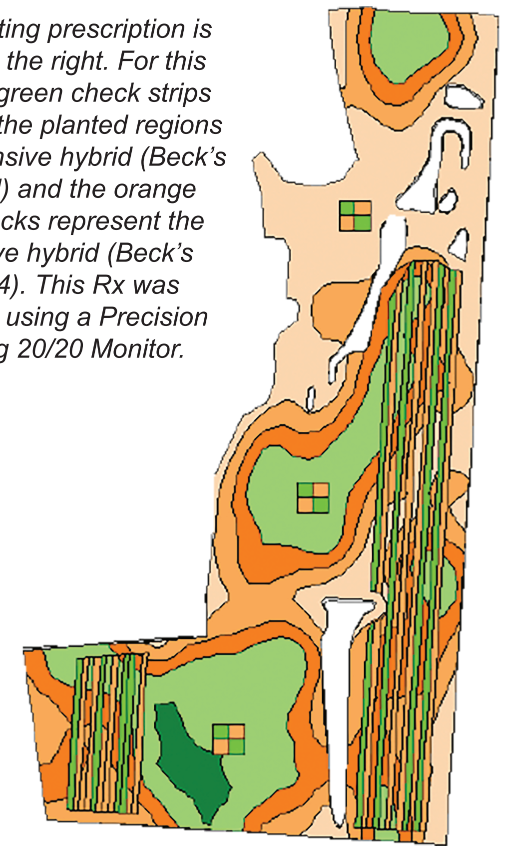
2018 protocol involved 0.25 to 0.5 acre blocks paired with strip checks. The treatments were selected to be a defensive and offensive hybrid, Post-planting scouting and aerial imagery confirmed proper execution of the planting prescription.

Treatments	Hybrid	Planted Acres	Avg. Planted Population
Offensive Hybrid	Beck's 5840AM	66.5	31,698
Defense Hybrid	Beck's 5829A4	146.1	32,039

OBSERVATIONS

The OSU Digital Ag Team has conducted numerous acres of research for multi-hybrid corn. This is one example from the 2018 growing season. Prescriptions were developed from all historical yield maps for corn and weighted 50% for bean yield history. Above average rainfall allowed for a healthy crop despite extreme variation in soil type and side slope seen in the field. This field was sidedressed with a Kuhn spinner spreader and dry urea.

The resulting prescription is shown to the right. For this field, the green check strips represent the planted regions of the offensive hybrid (Beck's 5840AM) and the orange strips/blocks represent the defensive hybrid (Beck's 5829A4). This Rx was executed using a Precision Planting 20/20 Monitor.



Tools of the Trade

mSet Meter

The Precision Planting mSet seed meter is a single meter with dual hopper compartments. A seed selector fills the meter and allows for transition between two hybrids, depending on the desired planting product.

SUMMARY

- If grower has not ever used variable rate seeding do not use multi hybrid.
- Growers must be ready for seed logistics more than ever before.
- Planter calibration and setup is critical or will cause gaps and offsets in field critical transition areas.
- No true defensive hybrids on market, currently overloaded with hybrids that are both and stay in the middle of genetics.
- Be prepared to make more planter adjustments based off seed shape and size as well as treatment.
- Be ready to fail and get hybrid placement wrong.
- Water and growing season affects results considerably.
- Seed coatings, seed treatments, biologicals will change economics on this technology.
- There were no advantages to planting multi-hybrid in this study this year.

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Food, Agricultural & Biological Engineering (klopfenstein.34@osu.edu) or Ryan Tietje, Research Associate Engineer (tietje.4@osu.edu).

Treatments	Moisture (%)	Field Yield Productivity Zones from Rx (bu/ac)				Avg. Yield Check Strips (bu/ac)
		Very Low	Low	Medium	High	
Offensive Hybrid	17.2	177	189	200	195	193
Defensive Hybrid	17.3	159	182	187	193	183
Prescription	17.3	156	176	184	184	188

Nitrogen Decision

N-P-K

OBJECTIVE

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

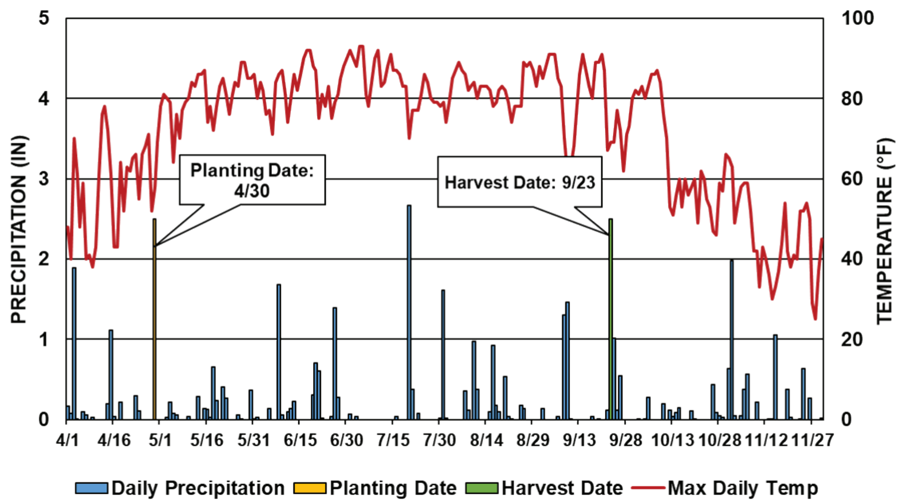
eFields Collaborating Farm

OSU Extension

Clinton County

STUDY INFORMATION

Planting Date	4/30/2018
Harvest Date	9/23/2018
Variety	P1197AM
Population	36,000
Acres	61
Treatments	8
Reps	4
Treatment Width	40 ft.
Tillage	Vertical Till (Fall) No-Till (Spring)
Herbicide	Resicore, Atrazine
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Treaty silt loam, 50% Fincastle silt loam, 35% Xenia silt loam, 15%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.32	3.04	5.72	4.91	4.05	22.04
Cumulative GDDs	158	781	1,466	2,169	2,892	2,892

STUDY DESIGN

Nitrogen applications were planned for three timings in season: planting, V5, and V10. For the V5 and V10 timings, a base rate of 84 lbs N/ac was applied up front and three rates of nitrogen were compared at each timing. Soil and tissue samples were collected to estimate the availability of nitrogen in the soil and determine if plant stress was occurring due to nitrogen deficiency. Rate decisions at each timing were determined by reviewing in-season data and past experience with the field. All nitrogen was applied as UAN 28%.

Treatments (lbs N up front)	V5		V10	
	Soil N (lb/ac)	Tissue N (%)	Soil N (lb/ac)	Tissue N (%)
0	51	4.1	37	3.5
210	230	5.5	166	3.2
84	174	5.3	53	3.1

*4.0-5.0% N tissue sufficiency level at V5, 3.5-4.5% N tissue sufficiency at V10

OBSERVATIONS

Crop Health

This location missed most of the heavy rains that plagued the rest of the area and was slightly dry going into July. Crop condition was excellent and yield potential was considered very high. Some root lodging was observed in several sidedress plots.

Nutrient Availability

Soil tests showed the levels of available nitrogen decreasing between the V5 and V10 sampling. At V10, the treatments fell below the nitrogen sufficiency range despite soil samples showing adequate available nitrogen. This may be caused by dry conditions in this field in late June and early July limiting plant uptake.

High clearance Hagie sprayer was used to conduct late season nitrogen application at the V10 growth stage.

Tools of the Trade

High Clearance Hagie Sprayer

The high clearance applicator makes it possible to apply nitrogen to a crop at a more advanced growth stage with minimal damage. This extends the nitrogen application window and can be used to potentially better match nitrogen timing and rates with crop needs.

SUMMARY

- Nitrogen timing appeared to have the greatest impact on yield this season, with the V5 sidedress applications resulting in the highest yield.
- A yield penalty was observed with the VT application. Next year the target stage for application will be moved up to avoid this yield impact.
- A significant yield difference was observed between the lowest nitrogen rate and rest at the VT application timing.

PROJECT CONTACT

For inquiries about this project, contact Elizabeth Hawkins, Assistant Professor, Field Specialist, Ohio State University Extension (hawkins.301@osu.edu).

Timing	Treatment Name	Total N Applied (lbs/ac)	Moisture (%)	Yield (bu/ac)
At Planting	Control	0	19.8	139 d
At Planting	Control	210	21.0	253 b
Sidedress - V5	Rate A	210	21.4	266 a
Sidedress - V5	Rate B	255	21.3	261 a
Sidedress - V5	Rate C	235	21.4	264 a
Late Season - VT	Rate A	210	21.3	250 b
Late Season - VT	Rate B	255	21.0	252 b
Late Season - VT	Rate C	198	21.0	243 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: 6.84
CV: 2.18%

OBJECTIVE

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

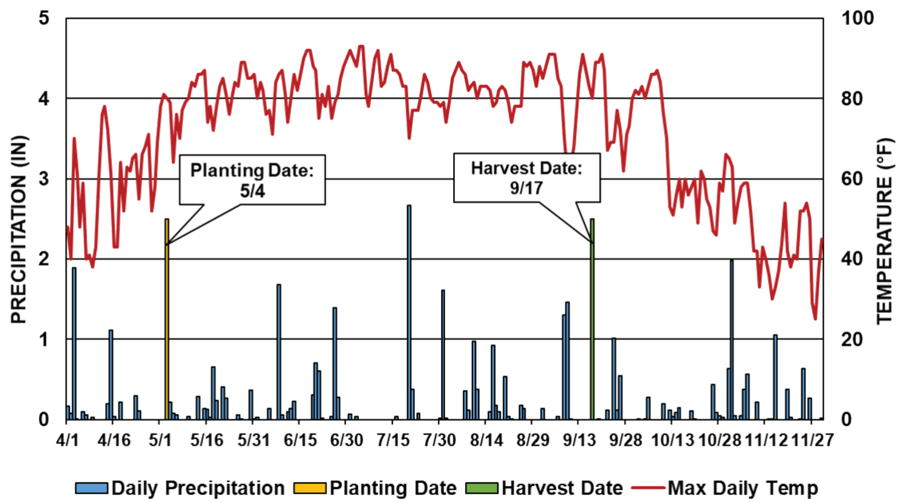
eFields Collaborating Farm

OSU Extension

Clinton County

STUDY INFORMATION

Planting Date	5/4/2018
Harvest Date	9/17/2018
Variety	Stewart S750 Non-GMO
Population	32,000
Acres	46
Treatments	4
Reps	4
Treatment Width	60 ft.
Tillage	Paratill deep vertical (Fall), Vertical (Spring)
Herbicide	Atrazine, Status, Capreno, Roundup
Pesticide	Capture, Province II
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Reesville silt loam, 65% Treaty silty clay, 14% Celina silt loam, 6%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.32	3.04	5.72	4.91	4.05	22.04
Cumulative GDDs	158	781	1,466	2,169	2,829	2,829

STUDY DESIGN

Nitrogen applications were planned for three timings in season: planting, V5, and V10. For the V5 and V10 timings, a base rate of 70 lbs N/ac was applied up front and three rates of nitrogen were compared at each timing. Soil and tissue samples were collected to estimate the availability of nitrogen in the soil and determine if plant stress was occurring due to nitrogen deficiency. Rate decisions at each timing were determined by reviewing in-season data and past experience with the field. All nitrogen was applied as UAN 32%.

Treatments (lbs N up front)	V5		V10	
	Soil N (lb/ac)	Tissue N (%)	Soil N (lb/ac)	Tissue N (%)
0	108	4.3	24	3.4
180	229	4.7	87	3.9
70	162	4.6	54	3.7

*4.0-5.0% N tissue sufficiency level at V5, 3.5-4.5% N tissue sufficiency at V10

OBSERVATIONS

Crop Health
Crop condition was excellent and yield potential was considered very high.

Nutrient Availability
Soil tests showed the levels of available nitrogen decreasing between the V5 and V10 sampling. Nitrogen deficiency was detected by tissue samples in the zero nitrogen treatment at V10; however the plots receiving the base rate of 70 lb/ac remained within the sufficiency range.

Harvest of the nitrogen decision plots was conducted with a Drago corn head on a Gleaner combine. Yield data was calibrated before use in analysis.

Tools of the Trade

Precision Planting SmartFirmer

The SmartFirmer provides a high resolution map of soil conditions, including organic matter, which is linked to nitrogen availability in the soil. This data can help to understand spatial differences in nitrogen needs and help inform VR nitrogen applications.

SUMMARY

- Nitrogen timing appeared to have the greatest impact on yield this season, the late-season application was made closer to target growth stage and resulted in the highest yield.
- Yield differences were observed based on the organic matter estimates from the SmartFirmer in areas of the field where no N was applied. When organic matter estimates were above 3%, the yield average was 30 bu/ac higher than when OM estimates were below 3%.

PROJECT CONTACT

For inquiries about this project, contact Elizabeth Hawkins, Assistant Professor, Field Specialist, Ohio State University Extension (hawkins.301@osu.edu).

Timing	Treatment Name	Total N Applied (lbs/ac)	Moisture (%)	Yield (bu/ac)
At Planting	Control	0	25.8	115 c
At Planting	Control	180	25.5	218 ab
Sidedress - V5	Rate A	180	25.9	240 a
Sidedress - V5	Rate B	200	25.8	232 ab
Sidedress - V5	Rate C	220	25.5	204 b
Late Season - V13	Rate A	180	25.7	232 ab
Late Season - V13	Rate B	200	26.2	252 a
Late Season - V13	Rate C	220	25.9	247 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: 35.54
CV: 10.53%

OBJECTIVE

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

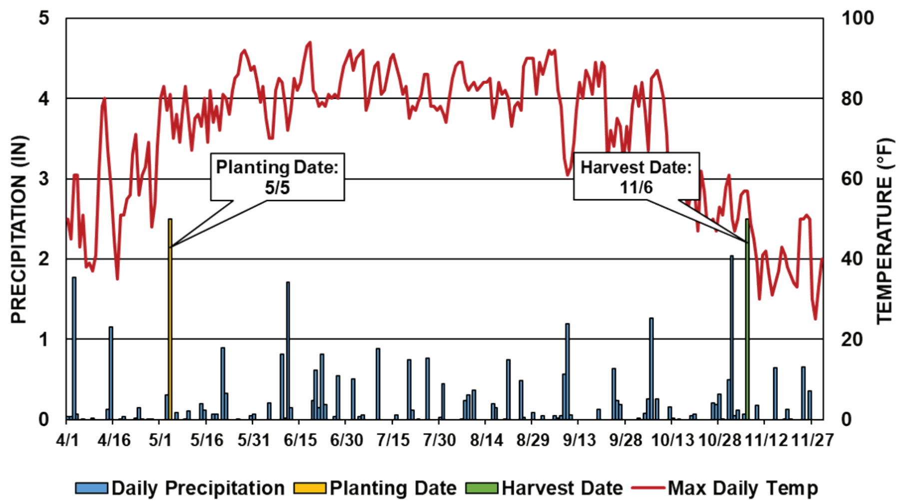
eFields Collaborating Farm

OSU Extension

Crawford County

STUDY INFORMATION

Planting Date	5/5/2018
Harvest Date	11/6/2018
Variety	Channel 209-51
Population	34,500
Acres	63
Treatments	6
Reps	4
Treatment Width	60 ft.
Tillage	No-Till
Herbicide	Atrazine, Bicep II
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Lauray silty clay loam, 39% Lykens silt loam, 17% Tiro silt loam, 14% Chili loam, 13% Pewamo silty clay loam, 6% Glynwood silt loam, 8%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.48	2.51	5.48	3.64	2.63	17.74
Cumulative GDDs	127	672	1,325	2,024	2,739	2,739

STUDY DESIGN

This experiment utilizes a randomized complete block split plot design with 4 replications. Plot widths were 60 ft. Calibrated yield monitor data was utilized for collection of harvest data. The combine was calibrated in season. Treatments consisted of two timings the first application of 28% was applied at V10 consisting of 189 lbs N/ac, 150 lbs N/ac, and 105 lbs N/ac. The second application consisted of one application of 75 lbs N/ac at V10 then a second application at VT of 75 lbs N/ac, 51 lbs N/ac, and 30 lbs N/ac. Applications rates were based on the farmers practice of using the MRNT tool, pulling soil nitrogen samples, tissue test, and NDVI readings.

Treatments (lbs N up front)	V10		VT	
	Soil N (lb/ac)	Tissue N (%)	Soil N (lb/ac)	Tissue N (%)
72	113	4.2	60	3.6
97	-	-	99	3.3

*4.0-5.0% N tissue sufficiency level at V5, 3.5-4.5% N tissue sufficiency at V10

OBSERVATIONS

Throughout the year, plant growth was monitored for any potential treatment differences.

Treatments were applied about three growth stages later than planned due to weather delays. The weather delayed application but it also kept the nitrogen cycle going allowing for more soil nitrogen to become plant available.

Some of the late season trials had tire damage from the applicator.

Late season N applications were conducted at the V10 and VT growth stages. Application rates ranged from 35 to 63 gal/ac of UAN 28%.

Tools of the Trade

In-season Tissue Sampling

Tissue sampling can help identify nitrogen deficiency in-season. Early detection of nitrogen deficiency stress can help determine if an additional in-season nitrogen application is needed.

SUMMARY

- Throughout southern Crawford County many yield records were set this fall thanks to well-timed rainfall events.
- Soil and tissue tests showed plenty of plant available nitrogen at the V10 application but marginal at VT. The late decision was potentially too late due to weather delays which may have lowered yields.

PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Crawford County (hartschuh.11@osu.edu).

Timing	Treatment Name	Total N Applied (lbs/ac)	Moisture (%)	Yield (bu/ac)
V10	Rate A	189	18.3	273 a
V10	Rate B	150	18.7	266 ab
V10	Rate C	105	19.2	262 b
VT	Rate A	150	19.3	255 bc
VT	Rate B	126	18.5	256 bc
VT	Rate C	105	18.1	248 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: 10.96
CV: 3.40%

OBJECTIVE

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

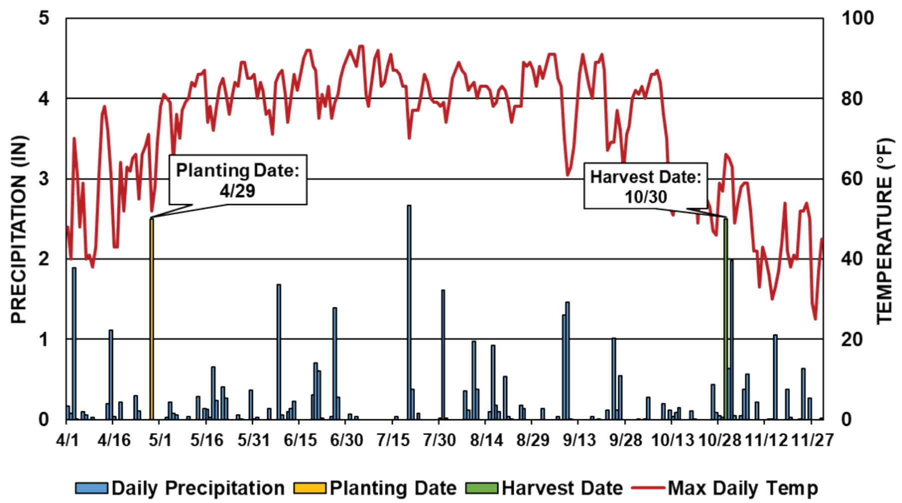
eFields Collaborating Farm

OSU Extension

Fayette County

STUDY INFORMATION

Planting Date	4/29/2018
Harvest Date	10/30/2018
Variety	Beck's 6158AM
Population	32,000
Acres	75
Treatments	8
Reps	5
Treatment Width	40 ft.
Tillage	Conventional
Herbicide	Corvis, Atrazine
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Treaty silty clay loam, 62% Crosby-Celina silt loam, 38%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.32	3.04	5.72	4.91	1.05	19.04
Cumulative GDDs	158	781	1,466	2,169	2,892	2,892

STUDY DESIGN

Nitrogen applications were planned for three timings in season: planting, V5, and V10. For the V5 and V10 timings, a base rate of nitrogen was applied up front and three rates of nitrogen were compared at each timing. Soil and tissue samples were collected to estimate the availability of nitrogen in the soil and determine if plant stress was occurring due to nitrogen deficiency. Due to rainfall in early June, the initial nitrogen application was not achieved. Base rates of nitrogen were applied with the V5 sidedress treatment. Rate decisions at each timing were determined by reviewing in-season data and past experience with the field. All nitrogen was applied as UAN 28%.

Treatments (lbs N up front)	V5		V10	
	Soil N (lb/ac)	Tissue N (%)	Soil N (lb/ac)	Tissue N (%)
0	65	4.9	20	2.8
180	-	-	41	3.9
70	-	-	37	3.6

*4.0-5.0% N tissue sufficiency level at V5, 3.5-4.5% N tissue sufficiency at V10

OBSERVATIONS

Crop Health

Due to consistent rainfall and above average heat throughout much of the summer, the crop developed very quickly. Crop condition was excellent and yield potential was considered very high. Harvest was delayed due to wet conditions. Because of this, some root lodging was observed and was most severe in the plots with high N at sidedress.

Nutrient Availability

Despite a delay in the planned up front nitrogen application, no nitrogen deficiency was observed at V5. A decrease in soil available nitrogen was observed at the time of V10 sampling. Several heavy rainfall events throughout June and July may explain this. Nitrogen deficiency was detected by tissue samples in the zero nitrogen treatment at V10; however the plots receiving the base rate of 70 lbs N/ac remained within the sufficiency range.

Late season applications were conducted at the VT growth stage.

Tools of the Trade

Soil Sampling

Soil sampling for nitrate and ammonium N can help determine the amount of nitrogen available to the crop during the season. This information is useful when making a decision to apply additional nitrogen in-season.

SUMMARY

- Nitrogen timing appeared to have the greatest impact on yield this season, with the V5 sidedress applications resulting in the highest yield.
- No significant yield differences were observed between rates at each timing. Higher rates may have contributed to root lodging.
- Heavy rainfalls after planting delayed the nitrogen application planned for near the time of planting.

PROJECT CONTACT

For inquiries about this project, contact Elizabeth Hawkins, Assistant Professor, Field Specialist, Ohio State University Extension (hawkins.301@osu.edu).

Timing	Treatment Name	Total N Applied (lbs/ac)	Moisture (%)	Yield (bu/ac)
At Planting	Control	0	14.6	83 e
At Planting	Control	180	15.1	237 bc
Sidedress - V5	Rate A	150	15.1	245 a
Sidedress - V5	Rate B	180	15.1	244 a
Sidedress - V5	Rate C	210	15.1	242 ab
Late Season - VT	Rate A	150	15.3	233 cd
Late Season - VT	Rate B	180	15.3	230 d
Late Season - VT	Rate C	210	15.3	234 cd

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: 6.16
CV: 2.39%

OBJECTIVE

Understand the factors, complexities, and realities related to successful and efficient in-season nitrogen management in Ohio.

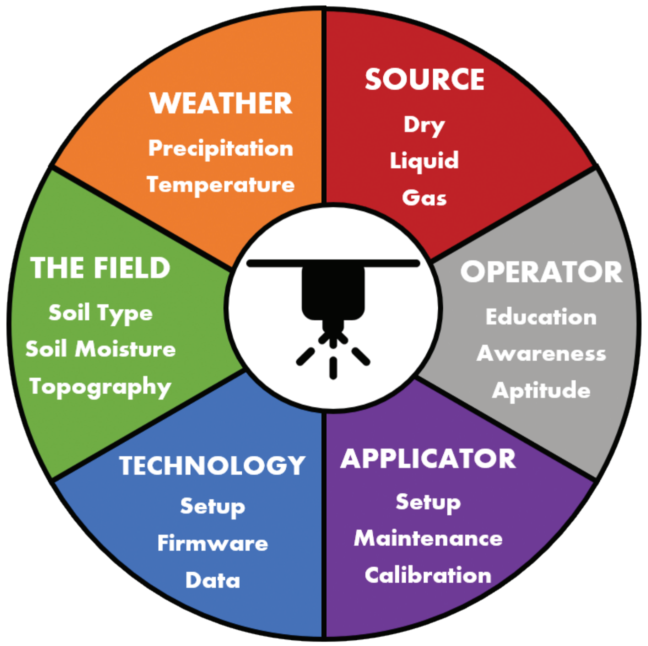
The Ohio State Digital Ag Program

Franklin County

STUDY INFORMATION

Managing nitrogen fertilizer is challenging due to field and seasonal variability both spatially and temporally. The amount of nitrogen available to the crop can vary based on field variability that includes soil type, temperature, texture and moisture. Modern corn hybrids have higher nitrogen use efficiencies (NUE). The ability to manage nitrogen accurately on a sub-field basis is important for successful farming operations. The Ohio State University Digital Ag team has been conducting research to understand what data can be used to improve in-season decision making for nitrogen rate and timing. In 2018, research was conducted on the following aspects of nitrogen management:

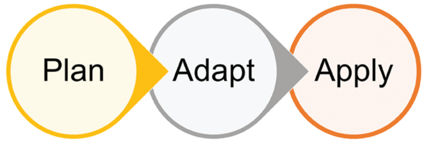
- **Timing:** Split-applications: planter applied, sidedress, late-season.
- **Placement**: Subsurface placement, dual-delivery, coulter placement, banding to reduce volatilization.
- **Rate**: Matching nitrogen rates with modern hybrid needs, evaluation of NUE for various rates of application.
- **Source:** Selection of an optimal N source can help minimize nitrogen loss and maximize crop utilization.



Nitrogen application for corn is affected by many factors, including but not limited to those illustrated in this figure.

ADAPTIVE N MANAGEMENT

When applying N to corn in Ohio, there are several options for application timing and methods. Advances in application technology have made it possible to apply nitrogen later in the season with minimal crop damage.



1. Plan
It is important to start off the season with a nitrogen budget that is realistic for each specific field or sub-field zones. Historical yield and field experience can be helpful in determining the final value of this budget. Application method and timing should be considered in the pre-season timeframe. At this point, you should have a "full deck of cards" and a strategic approach can complement a complete nitrogen management plan.

2. Adapt
Heading into the spring, an open mindset should be taken in the approach to adjustment of an N plan. If a split application is planned, your nitrogen budget should be re-evaluated after planting and before N application. Occasionally given the weather, yield potential and other cropping conditions, the total nitrogen rate can be adjusted.

3. Apply
Decisions related to N applications can be supported through the use of multiple data layers and digital technologies for an individual field. These can include:

- *On-the-go Nitrogen Sensing*
- *Late-season Application*
- *Variable-Rate*

Tools of the Trade

Encirca®
A digital farm and input management tool that uses historical data, soil, and weather information to provide allocation enhancement of inputs. Nitrogen modeling, weather analytics, and a variable-rate Rx generator are all available to assist management of nitrogen.

"N DECISION" TOOLBOX

- Historical Yield - calibrated, multiple years.
- Hybrid - NUE, previous performance.
- Farmer Knowledge - infield variability.
- Soil and Tissue Sampling - a snapshot of in-season nutrient availability and uptake.
- Soil types - variability, organic matter, water holding capacity.
- Aerial Imagery - N program validation, deficiency scouting.

SUMMARY

- New tools are being developed for N management.
- 2018 was a challenging year for N due to de-nitrification losses.
- See studies on the following pages for a more in-depth analysis on the factors related to N management in Ohio.

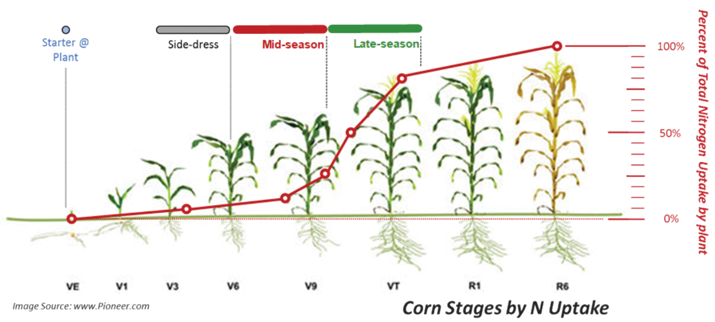
PROJECT CONTACT

For inquiries about this project, contact Elizabeth Hawkins, Assistant Professor, Field Specialist, Ohio State University Extension (hawkins.301@osu.edu).

STATE OF N MANAGEMENT

For 2018, much of Ohio experienced greater than average rainfall and warmer than average temperatures throughout the growing season. Because of this, the risk of nitrogen loss through de-nitrification and leaching was high. Frequent rains prevented some soils from drying between rainfall events potentially lowering the amount of soil nitrogen released due to mineralization. Here is an example in Franklin County:

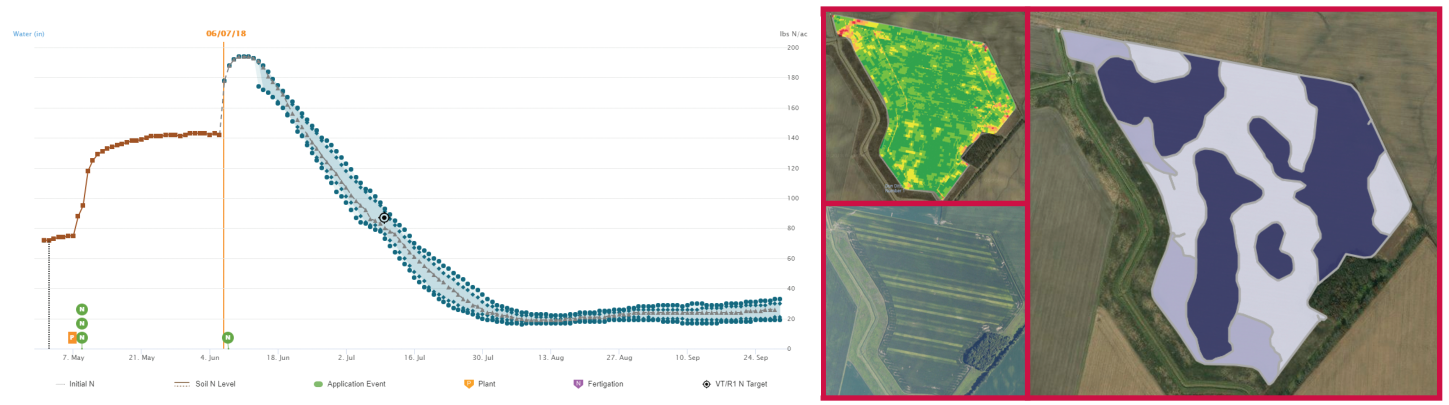
N Loss	2017	2018
Mineralization	Excellent	Poor
De-Nitrification	Neutral	Moderate
Volatilization	Moderate	Moderate



Nitrogen uptake in the plant accelerates exponentially after the V5 growth stage. Additionally, approximately 60% of N uptake occurs after V9.

EXAMPLE OF AN "N DECISION"

In this example, an N modeling tool (left), prior yield data (middle top), and in-season imagery (middle bottom) were used to develop the nitrogen application prescription (right). This Rx was generated using Encirca® services.



OBJECTIVE

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

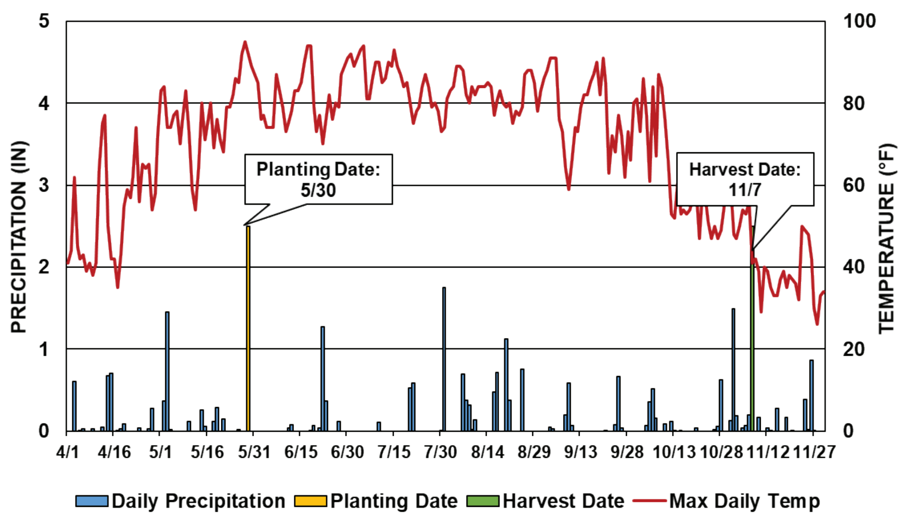
eFields Collaborating Farm

OSU Extension

Fulton County

STUDY INFORMATION

Planting Date	5/30/2018
Harvest Date	11/7/2018
Variety	Pioneer 306AM
Population	33,000
Acres	32
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Herbicide	Anthom ATZ, Atrizine, Roundup
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Hoytville clay loam, 44% Haskins loam, 23% Mermill loam, 20% Rimer loamy fine sand, 12%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

STUDY DESIGN

Nitrogen rate trials in corn have been conducted in Fulton County since 2014 across 15 sites. Generally, a collaborating farmer selects four to five incremental rates and replicates them a minimum of four times across a field. The most common rates are 100, 150, 200, 250 total lbs N/ac. When possible, the grower is asked to apply nitrogen at the outer limits (0 lbs and 300+ lbs) of the nitrogen curve to emphasize return on investment (ROI). The nitrogen source used in the trial is based on farmer preference. In 2018, the nitrogen source was anhydrous ammonia (82-0-0).

Treatments	Application Rate (lbs N/ac)
Treatment 1	100
Treatment 2	150
Treatment 3	200
Treatment 4	250

OBSERVATIONS

Throughout the year, plant growth was monitored for any potential treatment differences. While no yield limiting factors were observed, the lowest nitrogen rates showed up (lighter green) on aerial photography.

All sidedress nitrogen applications were injected as anhydrous ammonia (82-0-0) on June 20th. Approximately 0.31 inch of rain was observed in the 24 hours immediately after sidedress.

Corn Stalk Nitrate Tests (CSNT) were pulled 10 days after black layer to evaluate nitrate-nitrogen levels at season end. Yields and moistures were determined by using a calibrated yield monitor.

Anhydrous sidedress application completed by the collaborator.

Tools of the Trade

Corn Stalk Nitrate Tests (CSNTs)

CSNTs are used to evaluate the effectiveness of an N management program. Sampling should be done 1-3 weeks after black layer. Generally, <250 ppm is considered a "low" level for stalk nitrates, 250-2,000ppm is "optimal", and >2000 ppm is excessive. (Purdue)

SUMMARY

- In 2018, a very clear statistical yield difference was realized between all nitrogen rates.
- Despite statistical yield difference, the economic data suggests that there is no difference in Return On Investment among total nitrogen rates of 150-250 lbs/acre. The corn nitrogen rate decision should be based on the maximum return to nitrogen (see Corn Nitrogen Rate Calculator from Iowa State).
- Corn stalk nitrate tests indicated there was no statistical difference in nitrate-nitrogen levels at the 150-250 lbs N/acre rates. Optimal nitrate-nitrogen levels or higher were achieved at these rates. At the 100 lbs/acre rate, low or yield limiting nitrate-nitrogen levels were experienced (Purdue University recommendations).

PROJECT CONTACT

For inquiries about this project, contact Eric Richer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Fulton County (richer.5@osu.edu).

Treatments (lbs N/ac)	CSNT (ppm)	Moisture (%)	NUE (lbs N/bu)	Yield (bu/ac)	Yield Diff (bu/ac)	Return Above N ($/ac)
100	40 b	20.9 a	0.55	181 d	-	603
150	1573 ab	21.1 a	0.73	205 c	24	672
200	2613 a	21.1 a	0.95	210 b	29	674
250	1785 a	21.0 a	1.16	215 a	34	676
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: 4.06 CV: 1.55%		

OBJECTIVE

Investigate the effects of nitrogen sidedress rate on corn yield and profitability.

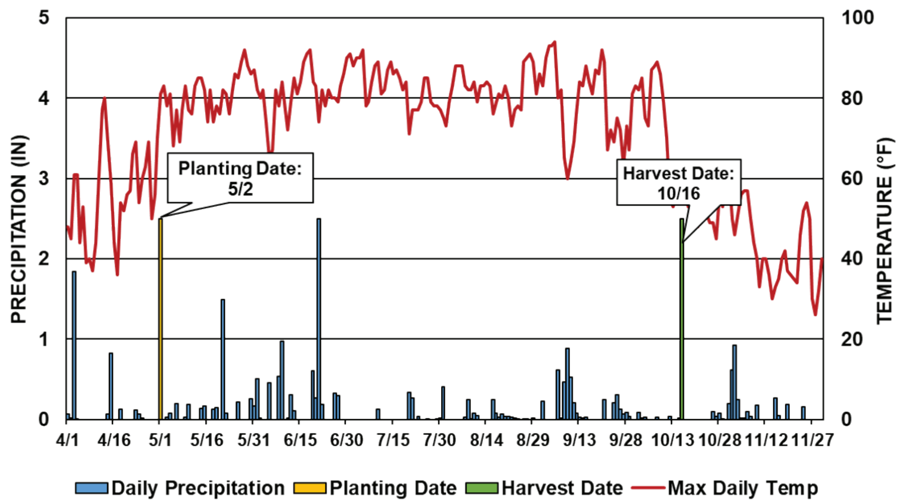
eFields Collaborating Farm

OSU Extension

Hardin County

STUDY INFORMATION

Planting Date	5/2/2018
Harvest Date	10/16/2018
Variety	Buckeye RR9177VT2P
Population	34,500
Acres	37
Treatments	5
Reps	3
Treatment Width	40 ft.
Tillage	No-till
Herbicide	Corvus, Atrazine
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Blount silt loam, 67% Pewamo silty clay loam, 33%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	7.06	4.94	3.65	21.58
Cumulative GDDs	117	669	1,330	2,016	2,728	2,728

STUDY DESIGN

Five nitrogen rates were replicated three times in a randomized complete block design. All treatments were no-till and received the same herbicide applications. 16 rows were planted in each plot. 32 lbs N/ac starter was applied at planting. Soil test values were pH 5.9, P 47 lb/ac, K 217 lb/ac. The corn was knife sidedressed 4 in. deep with the appropriate rates of urea ammonium nitrate (UAN) 28% nitrogen at the treatment levels of 0 lbs N, 100 lbs N, 150 lbs N, 200 lbs N, and 250 lbs N.

Treatments	Siddress Application Rate (lbs N/ac)	Total Applied N (lbs N/ac)
Treatment 1	0	32
Treatment 2	100	132
Treatment 3	150	182
Treatment 4	200	232
Treatment 5	250	282

OBSERVATIONS

Throughout the growing season, nitrogen rates showed little differences in color except for the 0 lbs N/ac.

Soil health sampling was done to analyze soil, corn stalk nitrate samples were taken to determine nitrogen use efficiency, and grain samples were taken to determine nitrogen crop removal and efficiency.

Final yields were analyzed to determine response to nitrogen sidedress rates.

Aerial view of this trial, which clearly illustrated color differences that resulted from the 0 lbs N/ac treatment.

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.

SUMMARY

- The highest return above nitrogen was the 150 lbs N sidedress with a yield of 205 bu/ac and grain moisture of 16.7%.
- Moderate weekly rains during the growing season made efficient use of nitrogen, making nutrient available to the corn roots.
- This study illustrated that higher applied N can increase yield but may not be the most profitable.

PROJECT CONTACT

For inquiries about this project, contact Mark Badertscher, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Hardin County (badertscher.4@osu.edu).

Treatments (Total lbs N/ac)	Moisture (%)	Yield (bu/ac)	Return Above N ($/ac)
32	16.2	136 c	466
132	16.7	197 b	649
182	16.7	205 ab	662
232	16.5	206 a	650
282	16.9	210 a	650
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: 8.43 CV: 2.91%	

OBJECTIVE

Determine the effect of nitrogen fertilizer rate on corn yield if no-till planted into standing cereal rye.

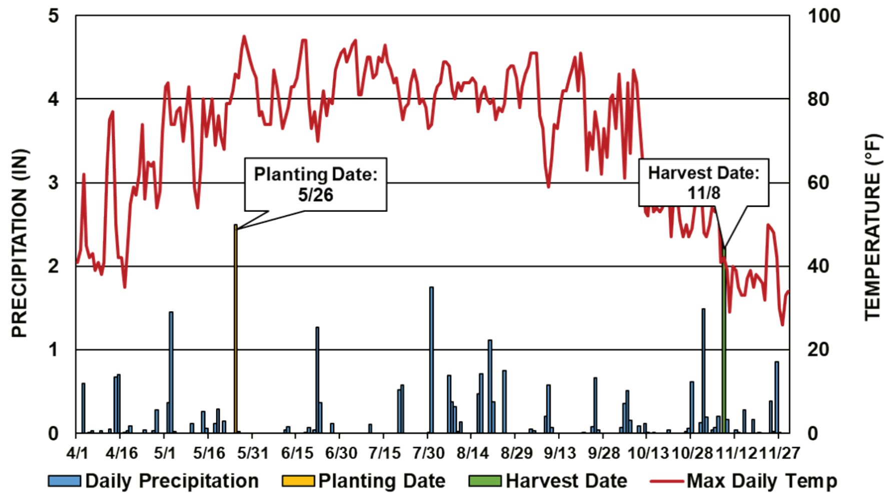
eFields Collaborating Farm

OSU Extension

Henry County

STUDY INFORMATION

Planting Date	5/26/2018
Harvest Date	11/8/2018
Variety	Pioneer P0843
Population	34,400
Acres	116
Treatments	5
Reps	4
Treatment Width	30 ft.
Tillage	No-till
Herbicide	Abundant Edge, Cinch ATZ, Atrazine, Sterling Blue
Previous Crop	Wheat
Row Width	30 in.
Soil Type	Hoytville clay, 95% Nappanee loam, 5%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

STUDY DESIGN

This study utilized a randomized complete block design with 4 replications. Plot widths were 30 ft. Plot lengths were 1,945 ft. Calibrated yield monitor was utilized for collection of harvest data. Harvest passes from the centers of plots were extracted for treatment comparisons. The combine was calibrated in season. Treatments consisted of total nitrogen fertilizer at the rate of 120, 160, 200, 240, and 280 lbs N/ac. 40 lbs of N was applied through the planter. The remainder was applied at side dress. Stand counts were collected at V5.

Treatments	Total Application (lbs N/ac)
Treatment 1	120
Treatment 2	160
Treatment 3	200
Treatment 4	240
Treatment 5	280

OBSERVATIONS

Yield potential for this trial was limited by several factors. Soil moisture played a major role in decreasing yield potential. The wet spring caused planting to be delayed. This location also experienced limited rainfall in late June and early July. Drought stress was observed during kernel determination and pollination.

Nitrogen stress was observed in the lower nitrogen rates with firing on the lower leaves. At the time of harvest stalk lodging was present across the majority of the field.

Overall, the low yields in this trial were caused primarily by weather challenges.

This nitrogen rate study was harvested with a Gleaner combine.

Tools of the Trade

Ohio State PLOTS App

The Ohio State 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.

Ohio State PLOTS

SUMMARY

- There appears to be a positive numerical yield response when total nitrogen is increased from 120 to 240 lbs. No yield response was detected at rates above 240 lbs of total N.
- At 120 lbs of total nitrogen, yield was significantly reduced.
- Nitrogen use efficiency and economics should be considered in making nitrogen rate recommendations.

PROJECT CONTACT

For inquiries about this project, contact Garth Ruff, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Henry County (ruff.72@osu.edu).

Treatments (lbs N/ac)	Moisture (%)	Yield (bu/ac)
120	19.1	98 c
160	19.2	107 b
200	19.0	109 b
240	18.6	113 a
280	18.8	111 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: 3.97 CV: 2.93%

OBJECTIVE

Determine the effect of nitrogen fertilizer rate on corn yield if no-till planted into standing cereal rye.

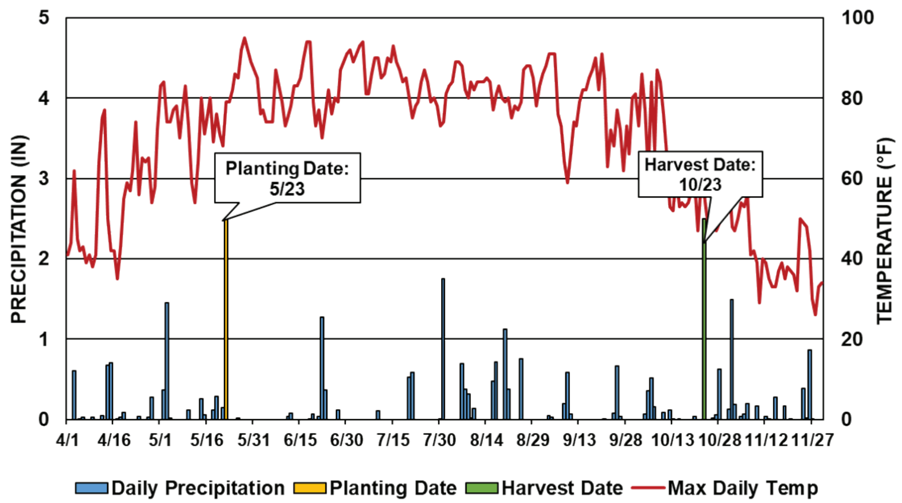
eFields Collaborating Farm

OSU Extension

Henry County

STUDY INFORMATION

Planting Date	5/23/2018
Harvest Date	10/23/2018
Variety	Select Seeds 1043, Pioneer 506
Population	32,000
Acres	77
Treatments	5
Reps	4
Treatment Width	30 ft.
Tillage	Strip-Till
Herbicide	Atrazine, 2, 4-D, Cropoil, RR Powermax
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Hoytville clay loam, 100%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

STUDY DESIGN

This experiment utilizes a randomized complete block design with 4 replications. Plot widths were 30 ft. Plot lengths were 1140 ft. Study was planted using a split planter. Calibrated yield monitor data was utilized for collection of harvest data. The combine was calibrated in season. Treatments consisted of total nitrogen fertilizer at 130, 170, 210, 250, and 290 lbs N/ac. 70 lbs of N was applied through the planter. The remainder was applied at side dress. Stand counts were taken at V5.

Treatments	Total Application (lbs N/ac)
Treatment 1	130
Treatment 2	170
Treatment 3	210
Treatment 4	250
Treatment 5	290

OBSERVATIONS

Despite late planting, this trial had even emergence and early season stand counts. This trial did not experience weather related stress in season and yield potential remained good.

Visual nitrogen stress was minimal during the season. Observations prior to harvest showed smaller ears with fewer rows of kernels and tip back being observed where lower rate of nitrogen were applied.

Tools of the Trade

Corn Nitrogen Rate Calculator

This tool will calculate the economic return to a nitrogen application with different corn and nitrogen prices to identify the most profitable rate. Visit the website and access the tool at cnrc.agron.iastate.edu.

CN RC

Harvesting of this N rate study.

SUMMARY

- There appears to a positive numerical yield response when total nitrogen is increased from 130 to 250 lbs.N/ac. No yield response was detected at rates above 250 lbs of total N/ac.
- At 130 lbs N/ac, yield was significantly reduced.
- Nitrogen use efficiency and economics should be considered in making nitrogen rate recommendations.

PROJECT CONTACT

For inquiries about this project, contact Garth Ruff, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Henry County (ruff.72@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)	Return Above N ($/ac)
Treatment 1	18.7	181 d	594
Treatment 2	18.8	199 c	645
Treatment 3	19.0	204 b	714
Treatment 4	18.9	209 a	732
Treatment 5	18.8	208 a	728
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: 2.48 CV: 0.98%	

OBJECTIVE

Determine the effects of nitrogen source on corn yield.

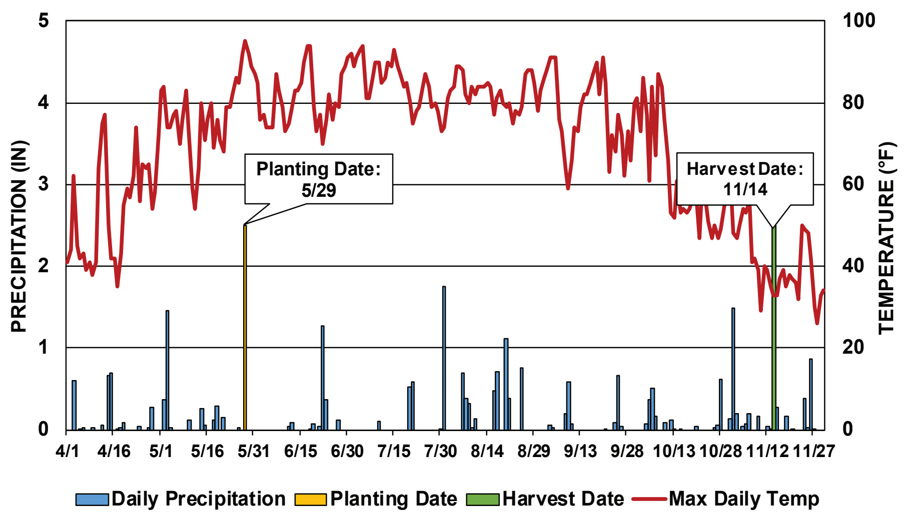
eFields Collaborating Farm

OSU Extension

Fulton County

STUDY INFORMATION

Planting Date	5/29/2018
Harvest Date	11/14/2018
Variety	Pioneer 0843AM
Population	33,000
Acres	129
Treatments	4
Reps	4
Treatment Width	30 ft.
Tillage	No-Till
Herbicide	Instigate, Cinch ATZ
Insecticide	Tombstone
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Mermill loam; 33% Blount loam, Erie-Huron Lake Plain, 25% Haskins loam, 7% Glynwood loam, 8%



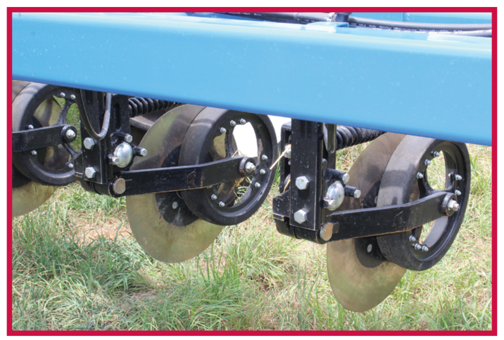
Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

STUDY DESIGN

High speed, low disturbance nutrient application systems have been recently adopted which allow for a variety of nitrogen products to be injected below the soil surface at sidedress. All nitrogen treatments were injected sub-surface. This study evaluated four nitrogen sidedress source systems after 80 lbs N/ac was applied at planting. At sidedress, 130 lbs N/ac was applied on all treatments.

Treatments	Application Rate	Total N (lbs/ac)	Equipment Set-up
28% UAN	129 gal/ac	210	Spray King
82% AA	159 lb/ac	210	Countryside Implements
46% Urea	283 lb/ac	210	John Deere 2510 H
45% ESN	289 lb/ac	210	John Deere 2510 H



Modified toolbar with high speed low disturbance coulters.

OBSERVATIONS

Throughout the year, plant growth was monitored for any potential treatment differences. No yield limiting factors were observed. All sidedress applications of nitrogen were made on June 28th. The soil had sufficient moisture on the day of application but only trace amounts of precipitation fell in the subsequent three weeks. Cornstalk nitrate tests were evaluated at 10 days post black layer to evaluate nitrate-nitrogen levels at maturity. Yields were determined by weigh wagon and commercial moisture checks.

go.osu.edu/nitrogensource

Sidedress application of corn for all three N sources was applied on June 28th.

Tools of the Trade

High Speed, Low Disturbance (HSLD) Nutrient Application Coulter

Many agricultural equipment companies offer high speed, low disturbance systems for placing nutrients below the surface. John Deere's 2510H is one toolbar that allows for dry, liquid or gas placement in an efficient and environmentally friendly way.

SUMMARY

- In 2018, no significant difference was found among all nitrogen sidedress sources. This data supports the agronomic theory that a corn plant will utilize any corn nitrogen source the same.
- Nitrogen use efficiency (NUE) was similar in all sidedress sources.
- Corn Stalk Nitrate Test (CSNT) levels indicated that yields in all treatments were not limited by nitrogen (Optimal rating = 250-2,000 ppm nitrate-nitrogen, Purdue University recommendations).
- Additional replications and year-over-year data will add to the validity of these results.
- Growers need to individually evaluate nitrogen sources based on safety, availability and economics.

PROJECT CONTACT

For inquiries about this project, contact Eric Richer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Fulton County (richer.5@osu.edu).

	2018 Data					2017 Data
Treatments	CSNT (ppm NO^{3}-N)	Moisture (%)	Yield (bu/ac)	Yield Diff (bu/ac)	NUE (lb N/bu)	Yield (bu/ac)
28% UAN	790	21.4	198 a	-	1.06	215 b
82% AA	1430	21.3	193 a	-4.4	1.09	231 a
46% Urea	375	21.5	194 a	-4.2	1.08	229 a
45% ESN	575	21.5	194 a	-4.1	1.08	225 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: Not significant CV: 1.84%			LSD: 5.87 CV: 2.01%

OBJECTIVE

Determine the effect of nitrogen timing on corn yield and commercial Nitrogen Use Efficiency (NUE).

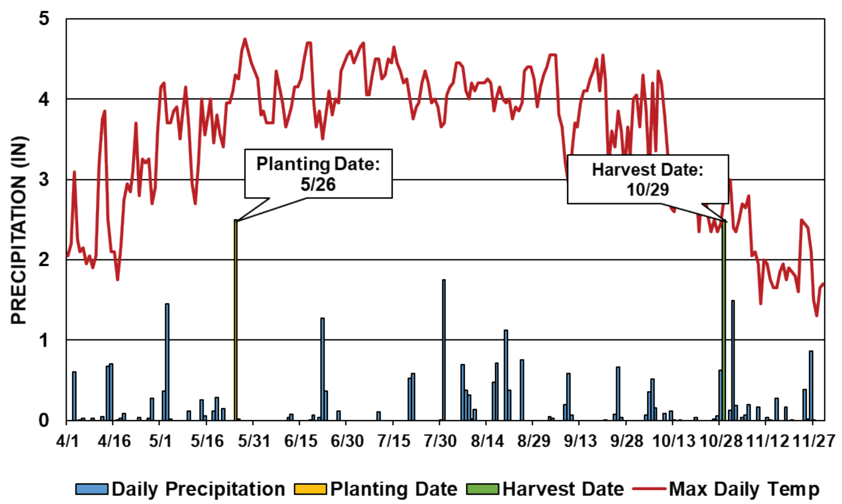
eFields Collaborating Farm

OSU Extension

Fulton County

STUDY INFORMATION

Planting Date	5/26/2018
Harvest Date	10/29/2018
Variety	Pioneer 0825AM
Population	33,000
Acres	143
Treatments	5
Reps	4
Treatment Width	60 ft.
Tillage	No-Till
Herbicide	Bicep II, fb Callisto GT
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Haskins loam, 25% Hoytville clay loam, 20% Mermill loam; 22% Rimer loamy fine sand, 18%



Weather Summary

	APR	MAY	JUN	JUL	AUG	Total
Total Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

STUDY DESIGN

High-clearance equipment has allowed producers to stretch the nitrogen application window. Since 2016, seven site years of data have been collected from late season trials in Fulton County. All sites had a yield goal of 210 bushels per acre. The check treatment is the farmer's normal practice of applying all remaining nitrogen at sidedress or approximately 5-leaf (V5) corn. As fewer source and equipment options are available for late season, the check treatments in these studies may have different sources or placements than the late season treatments. Reduced late season N applications were added to all sites in 2017. In 2018, a pre-plant nitrogen application was added at site 3. In 2018, research was only conducted at one site, reported here.

Treatments	Placement	Rate (total lbs N/ac)	Source
Check @ V5	Gas Injection	210	Anhydrous
Late N @ V12	Y-Drops ®	210	28% UAN
Split @ V5 & V12	Both	210	Both
Late N @ V12 (reduced)	Y-Drops ®	168	28% UAN
Pre-Plant	Gas Injection	210	Anhydrous

OBSERVATIONS

Throughout the growing season no yield limiting factors were observed in 2018.

Sidedress applications were made on June 18 and .6 inch of rain fell in the 48 hours immediately after application. Late season (Y-Drop®) application was completed on July 13 and .25" of rain fell seven days after application.

Corn stalk nitrate tests (CSNT) were pulled at 10 days post black layer and evaluated for nitrate-nitrogen levels.

Yields and moistures were determined by a calibrated yield monitor.

Late season nitrogen application.

Tools of the Trade

Y-DROP® Sidedress

Traditional sidedress methods apply nitrogen in the middle of the crop row, increasing the chance for loss. Utilizing Y-DROP sidedress allows for placement of N 2-3 inches from the stalk base and extends the window for application.

SUMMARY

- There was no difference in yield among pre-plant anhydrous, sidedress anhydrous (V5) or split N treatments. A statistical yield reduction was noticed with both full-rate and reduced-rate late N applications.
- Corn stalk nitrate tests in 2018 indicated that nitrate-nitrogen was not a yield limiting factor for any treatment (Purdue University recommendations).
- A full summary of the other four site-years can be found at go.osu.edu/fultonntiming. Results from these seven site years suggests that when equal amounts of nitrogen are applied either at sidedress or late season, there is no significant difference in yield 86% of the time (6 out of 7 years).
- When reduced rates of 168 lbs N/acre were analyzed against the check, there was a statistical difference in yield 50% of the time (2 of 4 years).

PROJECT CONTACT

For inquiries about this project, contact Eric Richer, Assistant Professor, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Fulton County (richer.5@osu.edu).

	2018 Data					2017 Data	2016 Data
Treatments	CSNT (ppm)	Yield (bu/ac)	Yield Diff. (bu/ac)	NUE (lbs N/bu)	Return Above N ($/ac)	Yield (bu/ac)	Yield (bu/ac)
Check @ V5	2,048	205 a	-	1.02	653	209 a	213 a
Late N @ V12	1,050	199 b	-6	1.05	632	212 a	211 a
Split @ V5 & V12	1,308	200 ab	-5	1.05	636	214 a	214 a
Late N @ V12 (reduced)	388	197 b	-8	0.85	638	211 a	N/A
Pre-Plant	818	202 ab	-3	1.04	643	N/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: 5.04 CV: 1.99%				LSD: Not significant CV: 1.43%	LSD: Not significant CV: 1.80%

Nitrogen Timing

OBJECTIVE

Determine the response of corn yield to sidedress nitrogen rates at different corn growth stages.

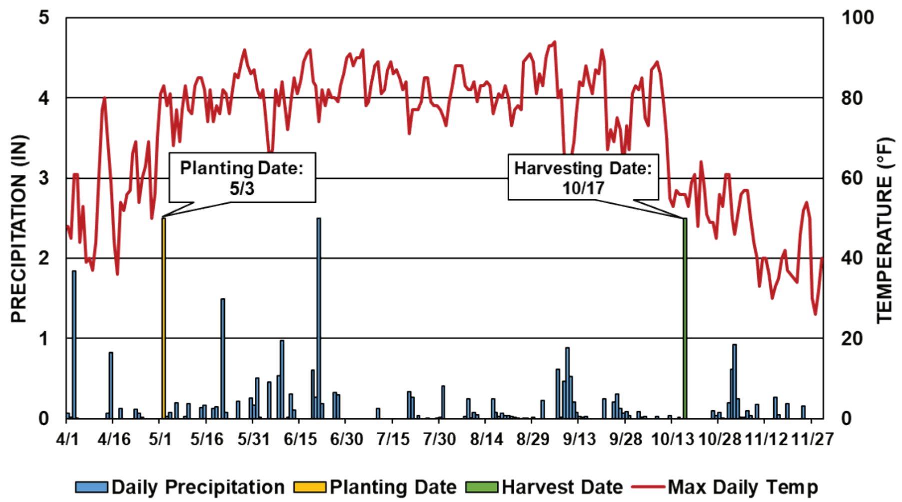
eFields Collaborating Farm

OSU Extension

Hardin County

STUDY INFORMATION

Planting Date	5/3/2018
Harvest Date	10/17/2018
Variety	Becks 5140, 6127A3
Population	32,000
Acres	60
Treatments	5
Reps	3
Treatment Width	60 ft.
Tillage	Vertical
Herbicide	Staunch, Roundup, Impact
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Blount silt loam, 66% Pewamo silty clay loam, 23% Kendalville silt loam, 6% Glynwood clay loam, 6%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	7.06	4.94	3.65	21.58
Cumulative GDDs	117	669	1,330	2,016	2,728	2,728

STUDY DESIGN

Three nitrogen rates were applied at three corn growth stages replicated three times in a randomized complete block design. All treatments received the same tillage and herbicide applications. 24 rows were planted in each plot. Seed used for this trial was Becks 5140 and 6127A3. 45 lbs N/ac starter nitrogen was applied at planting. Soil test values were pH 6.6, P 68ppm, K 124 ppm (Mehlich III). The corn was sidedressed using Y-DROP® with the appropriate rates of urea ammonium nitrate (UAN) 28% nitrogen at the treatment levels of 126 lbs N/ac @ V6, 126 lbs N/ac @ V10, 126 lbs N/ac @ V12, 94.5 lbs N/ac @ V12, and 63 lbs N/ac @ V12.

Treatment	Sidedress Application (lbs N/ac)	Total Application (lbs N/ac)
V12 - Low	63	108
V12- Medium	94.5	139.5
V10	126	171
V12 - High	126	171
V6	126	171

OBSERVATIONS

Rains did not allow a ground application of nitrogen sidedress at V8. Therefore, a ¾ rate was applied at V12. There was also a ½ rate at V12 instead of a 0 rate. Soil health sampling was done to analyze soil, corn stalk nitrate samples were taken to determine nitrogen use efficiency, and grain samples were taken to determine nitrogen crop removal and efficiency. Final yields were analyzed to determine response to nitrogen sidedress rates at different corn growth stages.

http://go.osu.edu/nitrogentiming

Late season nitrogen application

Tools of the Trade

Nitro sprayer with Y-Drops

High clearance Nitro sprayer allows for the grower to apply nitrogen late in the growing season. This machine is equipped with Y-DROP for placement of nutrients at the base of the corn plant.

SUMMARY

- The best response to nitrogen was the 42galsN sidedress at V6 with a yield of 255 bu/ac at 17.2% moisture and 126 lbs N/ac sidedress at V10 with a yield of 255 bu/ac at 17.3% moisture.
- There was no significant difference in yield at 126 lbs N/ac sidedress at V12 with a yield of 253 bu/ac at 17.1% moisture.

PROJECT CONTACT

For inquiries about this project, contact Mark Badertscher, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Hardin County (badertscher.4@osu.edu).

Treatment Timing	Moisture (%)	Yield (bu/ac)	Return Above ($/ac)
V12	16.7	237 c	810
V12	17.1	249 b	843
V10	17.3	255 a	854
V12	17.1	253 a	847
V6	17.2	255 a	854
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: 4.35 CV: 1.15%	

OBJECTIVE

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

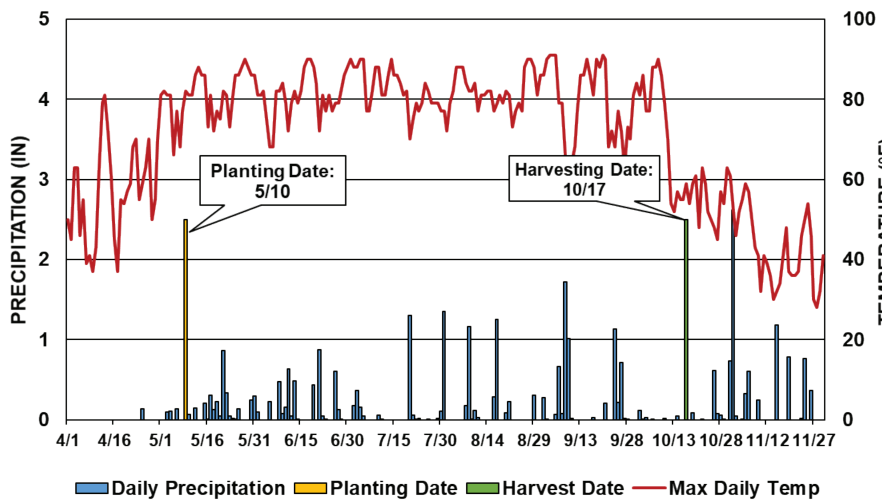
Molly Caren

Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/10/2018
Harvest Date	10/17/2018
Variety	Pioneer P1197AM
Population	Variable-Rate
Acres	64
Treatments	8
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Crosby-Lewisburg silt loam, 53% Kokomo silty clay loam, 46%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

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. Multiple combinations of these tracked systems were evaluated and the tested variations in equipment set-up can be observed in the table at the right. Planter was filled to 75% with seed.

Equipment Set-ups and Weights in Planting Mode

Tractor	Tractor Treatment	Planter Treatment	Tractor Weight (lbs)	Planter Weight (lbs)
8370R	Wheeled	Wheeled	41,590	8,855
8370R	Wheeled	Tracked	41,590	12,010
8320R	Tracked	Wheeled	44,520	8,855
8320R	Tracked	Tracked	44,520	12,010
8370RT	Tracked	Wheeled	42,199	8,855
8370RT	Tracked	Tracked	42,199	12,010
9420RX	Tracked	Wheeled	62,202	8,855
9420RX	Tracked	Tracked	62,202	12,010

OBSERVATIONS

Pinch Rows

Pinch row compaction is a common problem on most planter/tractor combinations and especially bulk fill planters. Pinch rows are defined as any row that would be influenced due to compaction of the soil that falls within the tractor and/or implements footprint. To evaluate the effects of planter/tractor combination on the pinch rows, spraying and tillage operations were completed at different headings. Additionally, the sidedress application was shifted to wing rows.

Growing Season

Throughout the growing season, the crop was monitored and no yield-limiting factors were observed. The field was scouted at multiple points throughout the growing season to investigate the effects of soil compaction on the "pinch rows" of the study.

Planter set-ups utilized in this study are shown above.

Tools of the Trade

John Deere 9420RX and 8370RT

The John Deere tractors used in this study featured row crop tracks. with 120 in. track spacing and operated with optimal power. The articulated design allowed for easy field navigation and road-ability.

SUMMARY

- No statistical differences were detected in the yields of any treatment for all soils.
- Yields in the high productivity zone saw one treatment with statistical significance (8320R Tracked/Tracked and 9420RX Tracked/Tracked) Data is reported as 6 center rows of the planter.

Tractors evaluated in this study included: John Deere 8370RT - top left, John Deere 8320R with Camso Tracks - top right, John Deere 9420RX - bottom left, John Deere 8370R Wheeled - bottom right.

PROJECT CONTACT

For inquiries, contact Andrew Klopfenstein, Senior Research Associate Engineer, Food, Agricultural & Biological Engineering (klopfenstein.34@osu.edu) or Nate Douridas, Farm Operations Manager, MCAC (douridas.2@osu.edu).

Treatments (Equipment Set-up)	Overall Soil Means (bu/ac)	Medium Productivity Soil Means (bu/ac)	High Productivity Soil Means (bu/ac)
8370R Wheeled, Wheeled Planter	206 a	164	226 ab
8370R Wheeled Tracked Planter	208 a	180	227 ab
8320R Tracks, Wheeled Planter	209 a	187	226 ab
8320R Tracks, Tracked Planter	214 a	187	232 a
8370RT, Wheeled Planter	203 a	182	219 ab
8370RT, Tracked Planter	205 a	178	221 ab
9420RX, Wheeled Planter	209 a	165	230 ab
9420RX, Tracked Planter	203 a	177	218 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: Not significant CV: 6.75%	*Statistics not completed due to insufficient sample points.*	LSD: 13.41 CV: 6.11%

OBJECTIVE

Evaluate if utilizing a tracked or wheeled planter along with the Yetter TrackTill system would minimize the effects of soil compaction in cropping rows influenced by field traffic.

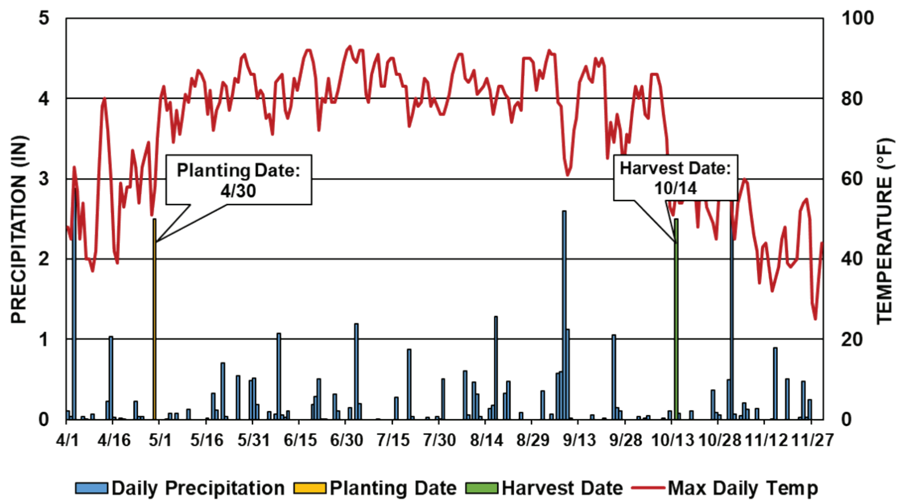
eFields Collaborating Farm

OSU Extension

Miami County

STUDY INFORMATION

Planting Date	4/30/2018
Harvest Date	10/14/2018
Variety	Ebberts 9292SSX
Population	35,000
Acres	76
Treatments	4
Reps	6
Treatment Width	60 ft.
Tillage	Conventional
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Eldean loam, 62% Genesee silt loam, 38%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.78	3.04	3.06	3.32	3.97	18.17
Cumulative GDDs	142	777	1,464	2,192	2,948	2,948

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.

Installation of the Yetter TrackTill system to help alleviate soil compaction issues caused by tractor/planter traffic.

OBSERVATIONS

Planting conditions were noted to be extremely dry for growing season. During planting, it was noticed that the TrackTill system created more soil disturbance behind the wheeled planter configuration. Throughout the growing season, the crop was under water and heat stress from lack of rain and high daily and nightly temperatures. Harvest was completed by harvesting the middle twelve rows out of each pass and then harvest the wing rows. Harvesting fought against significant issues in lodging and down corn across the field.

Left: 1770 NT planter utiilizing TrackTIll over the pinch rows affected by field traffic compaction.

Right: Close-up of TrackTIll system during planting.

Tools of the Trade

9010 Yetter TrackTill

The 9010 Yetter TrackTill is designed to minimize the pinch-row effect, which can negatively affect yields by fracturing compacted soil tracks from tires or tracks on equipment.

SUMMARY

- No statistical difference was observed for yield.
- Yield was weighted against wing rows to get six row center of strip harvest data seen in results below. This data is reported for six rows only.

Field operation of TrackTIll system in the tracked planter configuration.

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Food, Agricultural & Biological Engineering (klopfenstein.34@osu.edu) or Ryan Tietje, Research Associate Engineer (tietje.4@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Wheeled Planter, TrackTill Up	14.9	212 a
Wheeled Planter, TrackTill Down	14.9	205 a
Tracked Planter, TrackTill Up	15.0	208 a
Tracked Planter, TrackTill Down	14.9	208 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: Not significant CV: 6.02%

OBJECTIVE

Evaluate if utilizing a tracked or wheeled planter along with the Yetter TrackTill system would minimize the effects of soil compaction in cropping rows influenced by field traffic.

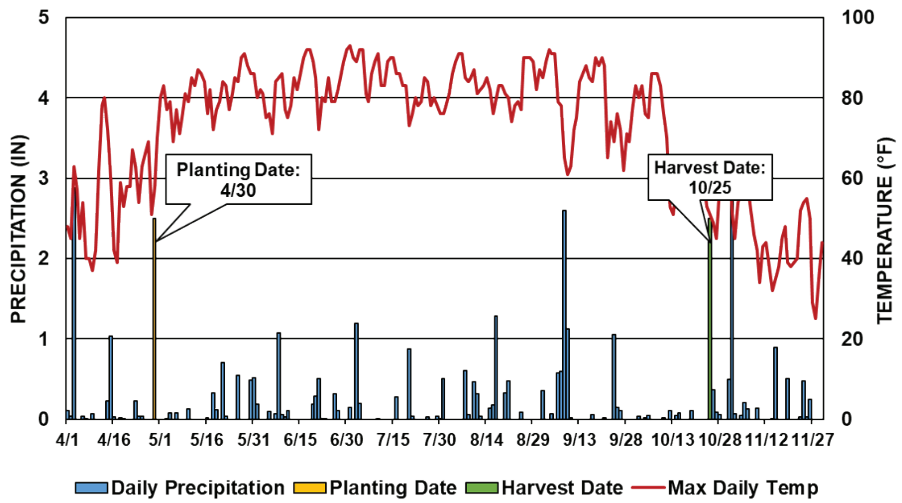
eFields Collaborating Farm

OSU Extension

Miami County

STUDY INFORMATION

Planting Date	4/30/2018
Harvest Date	10/25/2018
Variety	Ebberts 9292SSX
Population	35,000
Acres	98
Treatments	4
Reps	6
Treatment Width	60 ft.
Tillage	Conventional
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Genesee silt loam, 50% Ross silt loam, 37% Wea silt loam, 13%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.78	3.04	3.06	3.32	3.97	18.70
Cumulative GDDs	142	777	1,464	2,192	2,948	2,948

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.

Installation of the Yetter TrackTill system to help alleviate soil compaction issues caused by tractor/planter traffic.

OBSERVATIONS

Planting conditions were noted to be extremely dry for growing season. During planting, it was noticed that the TrackTill system created more soil disturbance behind the wheeled planter configuration. Throughout the growing season, the crop was under water and heat stress from lack of rain and high daily and nightly temperatures. Harvest was completed by harvesting the middle twelve rows out of each pass and then harvest the wing rows. Harvesting fought against significant issues in lodging and down corn across the field.

Installation of the Yetter TrackTill system to help alleviate soil compaction issues caused by tractor/planter traffic.

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.

SUMMARY

- No statistical difference was observed for yield.
- Yield was weighted against wing rows to get six row center of strip harvest data seen in results below. This data is reported for six rows only.

Field operation of TrackTIll system in the wheeled planter configuration.

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Food, Agricultural & Biological Engineering (klopfenstein.34@osu.edu) or Ryan Tietje (tietje.4@osu.edu)..

Treatments	Moisture (%)	Yield (bu/ac)
Wheeled Planter, TrackTill Up	15.1	243 a
Wheeled Planter, TrackTill Down	15.1	239 a
Tracked Planter, TrackTill Up	14.9	242 a
Tracked Planter, TrackTill Down	15.1	252 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: Not significant CV: 5.72%

OBJECTIVE

Evaluate if utilizing a tracked planter would reduce soil compaction in cropping rows influenced by field traffic.

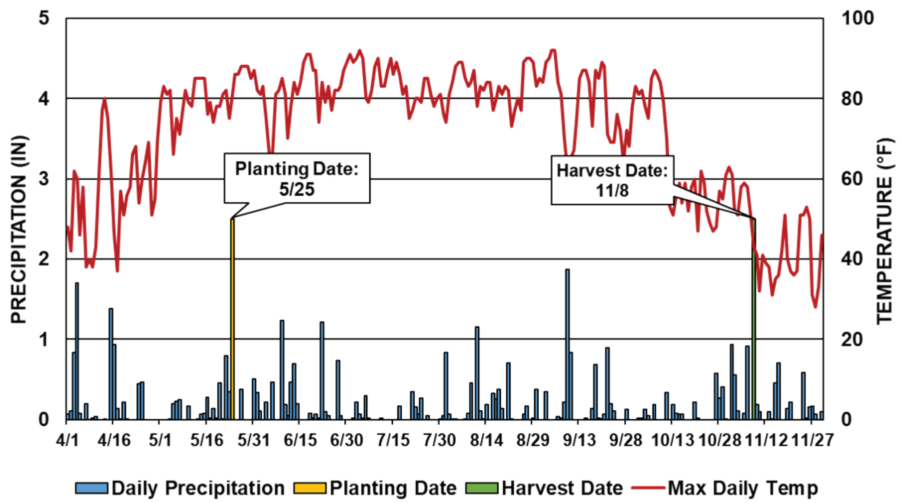
eFields Partner Farm

Beck's Hybrids

Pickaway County

STUDY INFORMATION

Planting Date	5/25/2018
Harvest Date	11/8/2018
Variety	Beck's 6274V2P
Population	32,000
Acres	55
Treatments	2
Reps	4
Treatment Width	80 ft.
Tillage	Conventional
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Eldean loam, 39% Westland clay loam, 37% Casco-Rodman complex, 24%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.8	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

Tracked systems for tractors and planters have become popular options for attempting to reduce soil compaction in the rows adjacent to the paths of equipment travel. Multiple combinations of these tracked systems were evaluated and the tested variations in equipment setup can be observed in the table to the right:

Traffic Systems

Treatment	Tractor	Planter
Wheeled Planter	340 Case IH Magnum RowTrac 18" Tracks	Standard Case IH 1245 Wheels
Tracked Planter	340 Case IH Magnum RowTrac 18" Tracks	Camso TTS 30/40 Tracks

Planting of the "Tracked Planter" treatment at the Beck's Hybrids location in London, OH. Soil moisture and temperature were found to be adequate during planting.

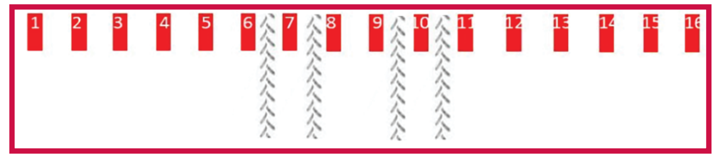
OBSERVATIONS

The Ohio State Precision Ag Team investigated the effects of planter track systems on corn.

This crop was located under center pivot irrigation. Due to diseases pressures late in the season, fungicide was aerial applied.

Pinch Rows

Pinch row compaction is a common problem on most planter/tractor combinations and especially bulk fill planters. Pinch rows are defined as any row that would be influenced due to compaction of the soil that falls within the tractor and/or implements footprint. To evaluate the effects of planter tracks or tires on the pinch rows.



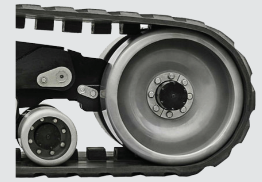
As seen above, rows 6, 7, 8, 9, 10, 11 are all affected by this compaction either by the tractor, planter, or both.

Growing Season

Throughout the growing season, the crop was monitored and no yield-limiting factors were observed. The field was scouted at multiple points throughout the growing season to investigate the effects of soil compaction on the "pinch rows" of the study. Minimal differences were observed in root growth and crop vigor.

Tools of the Trade

Camso TTS-35-2011 20" Tracks



This small frame series is uniquely designed to provide a large footprint in a small undercarriage package for superior flotation when compared to tires. The perfect choice for planters, fertilizer carts, and sprayers.

SUMMARY

- In 2018, wheels were shown to produce statistically significant higher yields.
- It is hypothesized that the tracked planter treatment resulted in lower yields due to the higher gross weight of the track system.
- Harvest was completed with Case IH 8240 with YieldSense.
- Results below are in 40 ft. widths (all 16 rows).

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Food, Agricultural & Biological Engineering (klopfenstein.34@osu.edu) or Ryan Tietje, Research Associate Engineer (tietje.4@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Wheeled Planter	17.5	235 a
Tracked Planter	17.4	229 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: 4.02 CV: 1.04%

Planter Wing Downforce

OBJECTIVE

Understand the potential agronomic benefits of planter wing downforce technology.

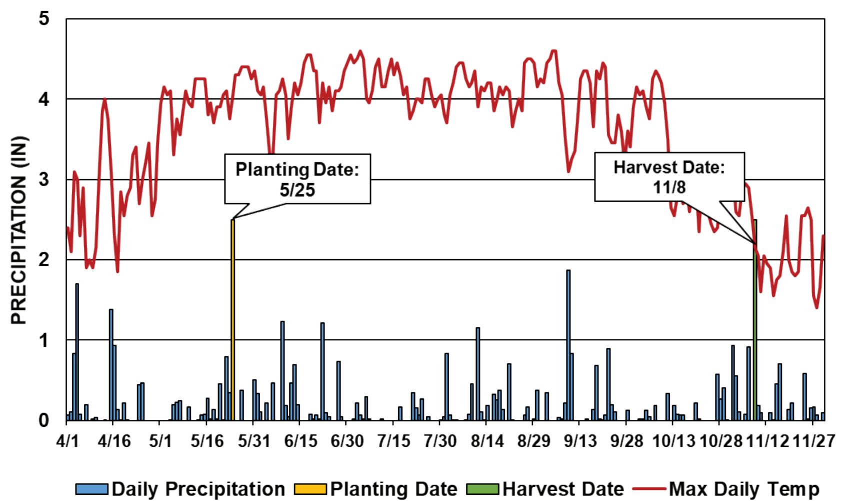
eFields Partner Farm

Beck's Hybrids

Pickaway County

STUDY INFORMATION

Planting Date	5/25/2018
Harvest Date	11/8/2018
Variety	6274V2P
Population	32,000
Acres	61
Treatments	4
Reps	4
Treatment Width	80 ft.
Tillage	Conventional
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Eldean loam, 39% Westland clay loam, 37% Casco-Rodman complex, 24%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

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 6 rows decreasing yield. For this study, a 16-row Case IH 2150 planter was used to investigate the effects of wing downforce technology. A 380 Case IH Magnum row track with 24 in. belts, and 120 in. track spacing was used. Downforce was set to 150 lbs.

Treatments	Applied Wing Downforce (lbs)
A	0
B	300
C	600
D	800

OBSERVATIONS

During planting, the wing downforce control system was observed to keep the planter wings level. Although there were no directly observed stand count differences, the row units refrained from 'floating' in the field. The Precision planting POGO stick and Research POGO App was used to collect emergence and stand count data during the growing season. A summary presented in the table below:

Treatments	Avg. Population (plants/ac)	Std. Dev.	CV
0 lbs	30,167	2,725	9%
300 lbs	31,583	2,746	9%
600 lbs	30,000	2,374	8%
800 lbs	29,333	2,640	9%

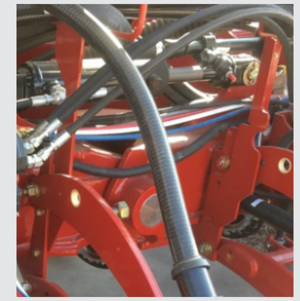
In spring, there were areas where wet spots in the field had to be avoided during the tillage pass and planting. It can be noted in an image from applied downforce map from Climate FieldView Cab.

This field was under center pivot irrigation. During harvest, there was significant lodging from extreme storm events over the summer.

Tools of the Trade

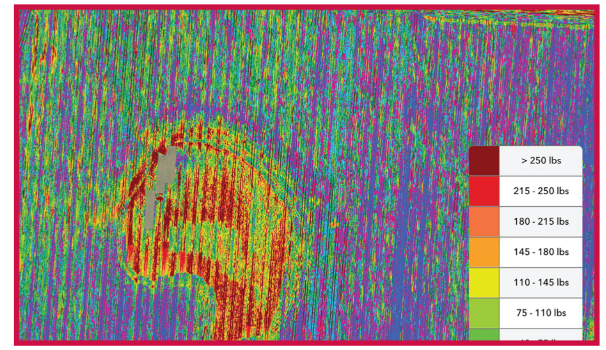
Case IH Wing Downforce Control System

The Case IH Wing Downforce Control System allows for on the go wing downforce control. This system provides optimal conditions for row units.



SUMMARY

- No statistically significant yield differences were observed with the different wing downforce levels.



Row-unit downforce map was shown to vary across the field with planter wing downforce.

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Food, Agricultural & Biological Engineering (klopfenstein.34@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
0 lbs	16.7	194 a
300 lbs	16.4	198 a
600 lbs	16.7	195 a
800 lbs	16.6	193 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: Not significant CV: 1.96%

Planter 2x2 vs. 2x2x2

N-P-K

Corn

OBJECTIVE

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

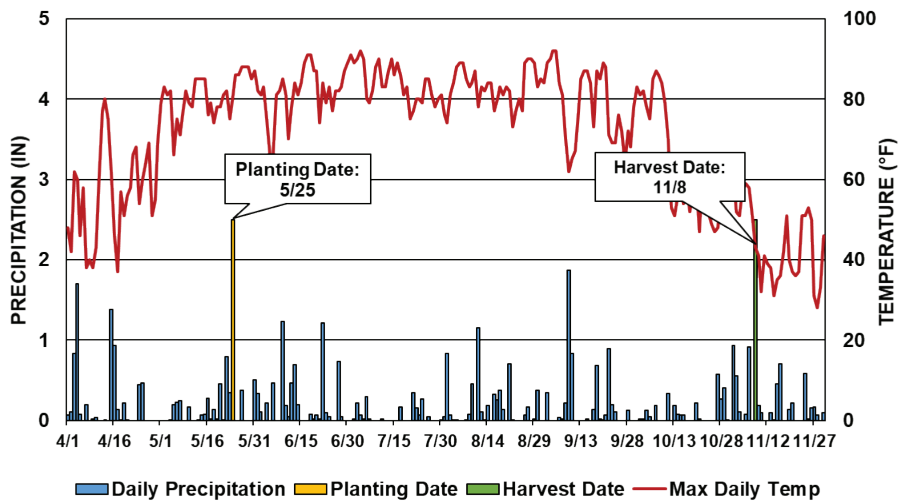
eFields Partner Farm

Beck's Hybrids

Pickaway County

STUDY INFORMATION

Planting Date	5/25/2018
Harvest Date	11/8/2018
Variety	Beck's 6274V2P
Population	32,000
Acres	70
Treatments	2
Reps	7
Treatment Width	80 ft.
Tillage	Conventional
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Hoytville clay loam, 66% Dunbridge sandy loam, 23% Millsdale silty clay loam, 11%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

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 planter based applications and 2x2x2 applications using 32% UAN and side-by-side observations collected to compare results.

Treatments (Placement)	App. Rate (gal/ac)	N Application (lbs N/ac)
2x2	10	35.5
2x2x2	10	35.5

Implementation of the 2x2x2 study on a Beck's Hybrids eFields partner farm in Pickaway County.

OBSERVATIONS

At planting, this system required more downforce to maintain proper seeding depth. During operation, the Precision Planting DeltaForce system was set to 150 lbs for the duration of the study. Additionally, it was noted that if this system is set incorrectly, plugging from rocks and residue can occur.

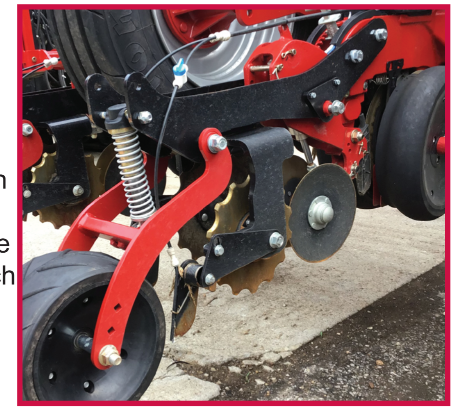
This crop was located under center pivot irrigation. No yield limiting factors were observed during the growing season.

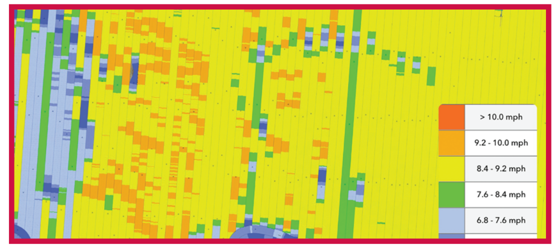
Tools of the Trade

Yetter 2968 2x2x2 Row Unit

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.

View of 2150 with Yetter 2968 2x2x2 as installed. As seen above 1/4 valves were used to turn the system on/off for each configuration.





Planting speed data from Climate FieldView showed that planter speed was maintained throughout operation.

SUMMARY

- No statistical differences in yield were observed.
- Further investigation is needed to determine if there are additional benefits from using 2x2x2 systems.
- First system we have tested that can run in No-Till/ Conventional Till systems, were found to have durability and ability o ran at speeds of 7.7mph.
- Average planting speed was 8.4 mph when speed set-point was at 9.0 mph.

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Food, Agricultural & Biological Engineering (klopfenstein.34@osu.edu) or Ryan Tietje, Research Associate Engineer (tietje.4@osu.edu).

Treatments (Placement)	Moisture (%)	Yield (bu/ac)
2x2	17.3	206 a
2x2x2	17.4	208 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: Not significant CV: 1.48%

OBJECTIVE

Evaluate the yield as a function of 15, 20, and 30 inch row corn spacing and seeding rates.

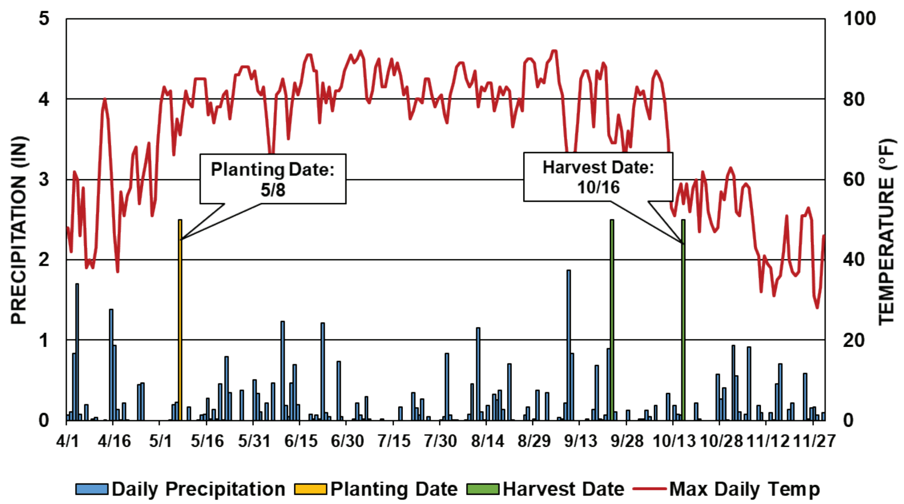
eFields Collaborating Farm

OSU Extension

Pickaway County

STUDY INFORMATION

Planting Date	5/8/2018
Harvest Date	10/16/2018
Variety	Beck's 6158AM
Population	Treatments
Acres	210
Treatments	6
Reps	4
Treatment Width	120 ft.
Tillage	Conventional
Previous Crop	Soybean
Row Width	Treatments
Soil Type	Crosby silt loam, 47% Westland silty clay loam, 33% Tachery silt loam, 17%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

Given the recent volatility in the grain markets it is increasingly important for growers to optimize the productivity of agricultural lands. Some growers are looking to increase plant populations with a corresponding reduction in row spacing as a means to increase returns to their operations. The vast majority of corn acres in the U.S. and Canada are planted in 30 in. rows with a small percentage of growers using 15, 20, or 22 in. narrow row spacing. The goal of this study was to evaluate the yield effect of 15, 20, and 30 in. row spacing with cooperating growers in Ohio.

Treatments	Row Spacing	Population
15 Low	15 in.	30,000
15 High	15 in.	34,000
20 Low	20 in.	30,000
20 High	20 in.	34,000
30 Low	30 in.	30,000
30 High	30 in.	34,000

OBSERVATIONS

Regardless of row spacing, good standability was observed. Spraying and sidedress were completed perpendicular to planting. Sidedress was broadcast Urea. Stand counts and growth staging were completed and showed minimal variation across treatments. Three Gerringhoff heads - 15 in., 20 in., and 30 in. - were used to complete harvest.

Top: 15 in. Gerringhoff head., Center: 20 in. Gerringhoff head., Bottom: 30 in. Gerringhoff head.

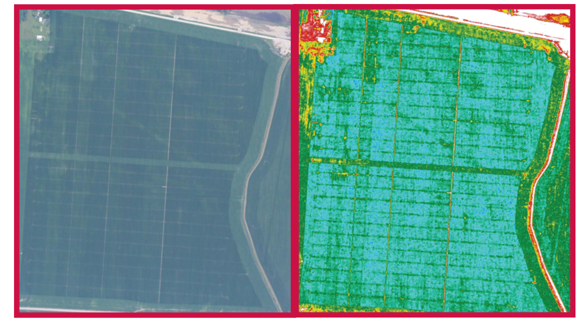
Tools of the Trade

Geringhoff Freedom Head

Higher yields mean higher populations, and a trend toward narrow row spacing. The Gerringhoff Freedom allows an easy transition from 30" rows to 15" rows. The low profile design makes it unmatched in down corn situations.

SUMMARY

- Based off the results, 15 in. corn at the lower population was statistically significant compared to populations of both 20 in. and 30 in. corn.
- Minimal variations in emergence, standability, and growth stages were observed across treatments.



AirScout imagery taken on June 25 looking at crop health and vigor between treatments (RGB - left, ADVI - right).

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Food, Agricultural & Biological Engineering (klopfenstein.34@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
15 Low	17.5	233 a
15 High	17.2	230 ab
20 Low	16.7	223 cd
20 High	16.6	222 cd
30 Low	16.6	224 cd
30 High	16.4	227 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: 4.55 CV: 1.62%

OBJECTIVE

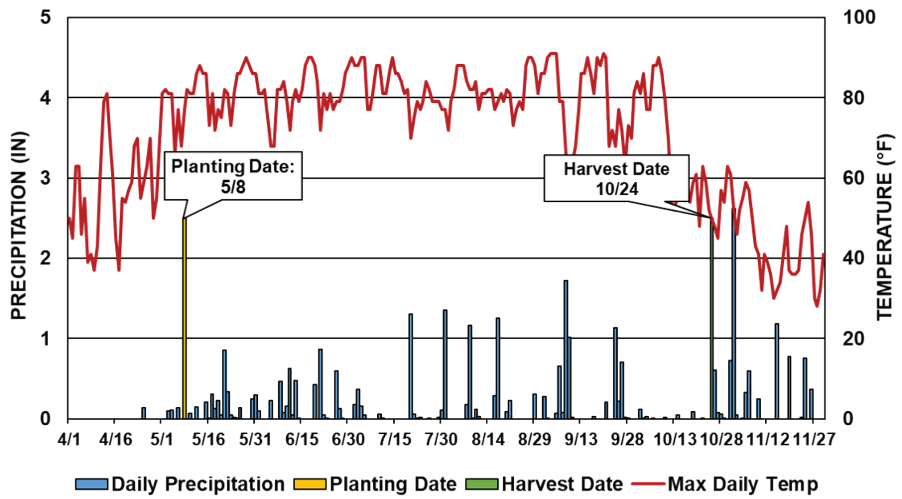
Evaluate the differences in application methods and rate for sidedress nitrogen on corn.

Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/8/2018
Harvest Date	10/24/2018
Variety	LG5618STXRIB
Population	Variable-Rate
Acres	102
Treatments	5
Reps	7
Treatment Width	40 ft.
Tillage	No-Till
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Crosby-Lewisburg silt loam, 62% Kokomo silty clay, 38%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

Corn sidedress equipment options allow producers to choose between middle of the row coulter/knife application and Y-DROP® Sidedress (from 360 Yield Center). For this study two rates of 32% UAN were evaluated at sidedress. A stabilizer for volatilization was included in all treatments. Sidedress timing was V8. All treatments received 50 lbs of nitrogen at planting in a 2X2 band. Yetter N-Keepers were used to close the knife slot on the coulter/knife applicator due to moist conditions.

Coulter sidedress application.

OBSERVATIONS

In this study, the growing season started out with excessive moisture and limited free mineralized nitrogen. Nitrogen applied at V7 sidedress was made plant available soon after application with sufficient rainfall. In the growing season remaining after sidedress application; lack of moisture and high nighttime temperatures contributed to yield reductions. During application; a reduction in fuel and required horsepower was observed using the Y-Drop SIdedress applicator.

Aerial image of sidedress treatment color differences.

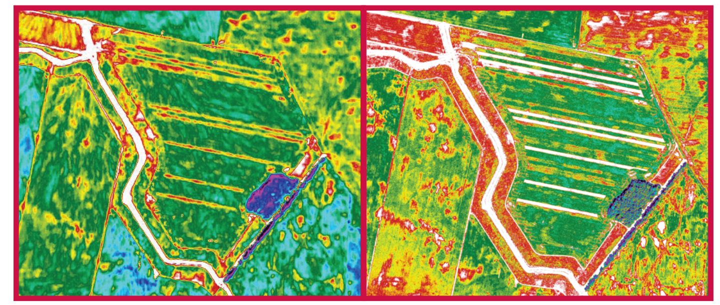
Tools of the Trade

J&M Manufacturing 5016 NitroGro Liquid Nitrogen Applicator

This applicator is typically used for sidedress application and features 34 in. of toolbar clearance. This allows for applications over an extended window of growth stages.

SUMMARY

- According to this study, treatments with different application methods but the same rate did not have statistically different yields.
- Treatments using the same application method but different application rates did show statistical differences.



Thermal (left) and ADVI (right) AirsScout images.

PROJECT CONTACT

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

Treatments (Placement and Rate)	Moisture (%)	Yield (bu/ac)
Y-Drop® Sidedress, 107 lbs N/ac	16.4	228 b
Y-Drop® Sidedress, 142 lbs N/ac	16.4	233 a
Coulter Sidedress, 107 lbs N/ac	16.3	224 b
Coulter Sidedress, 142 lbs N/ac	16.5	235 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: 5.15 CV: 1.73%

Sidedress Nitrogen Placement

N-P-K

Corn

OBJECTIVE

Evaluate the effects of various nitrogen application placement during the sidedress timeframe.

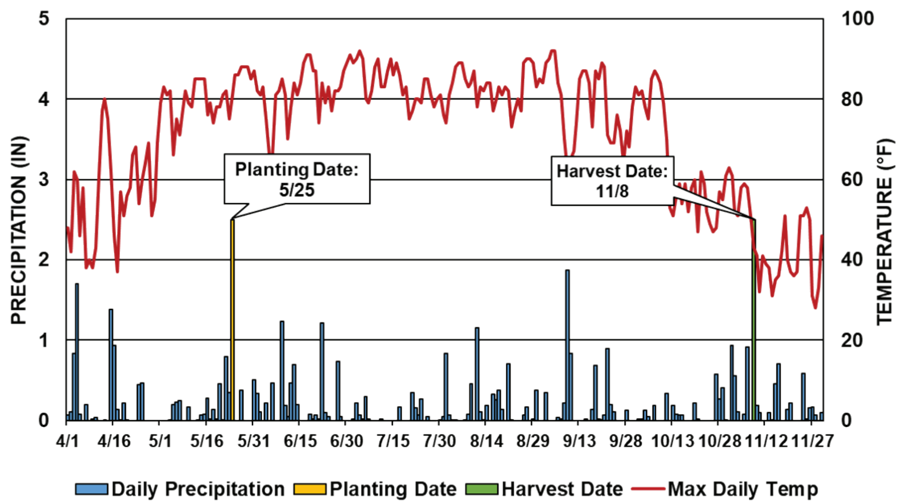
eFields Partner Farm

Beck's Hybrids

Pickaway County

STUDY INFORMATION

Planting Date	5/25/2018
Harvest Date	11/8/2018
Variety	Beck's 6274V2P
Population	32,000
Acres	70
Treatments	3
Reps	3
Treatment Width	80 ft.
Tillage	Conventional
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Eldean loam, 39% Westland clay loam, 37% Casco-Rodman complex, 24%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.8	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

This study featured three treatments. The first was a single coulter in the middle of the row. The second treatment was single coulter in the middle of the row and dual delivery together. The third treatment was dual delivery at the base of the row. 35 lbs N/ac (10 gal/ac of 32%) were applied using 2x2x2 at planting.

Treatments	Application Rate (lbs N/ac)
Single Coulter	183
Dual-Delivery	183
Drop Hoses Only	183

Sidedress application for this study was completed using a Case IH Magnum 250 Powershift tractor with a 1400 Unverferth NutriMax sidedress applicator.

OBSERVATIONS

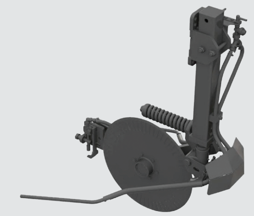
No visual nitrogen deficiencies were noticed throughout the growing season. The field was located under center pivot irrigation. 183 lbs N/ac was applied at V6. Using these systems, nitrogen was able to be uniformly applied to the target area. Application was done on a hot day, which could have caused volatilization of surface applied nitrogen. During harvest there were significant issues with lodged corn.

Top: Single coulter N placement.
Bottom: Dual-Delivery placement. The same configuration was used for the drop hoses only treatment, but no N was applied at coulter.

Tools of the Trade

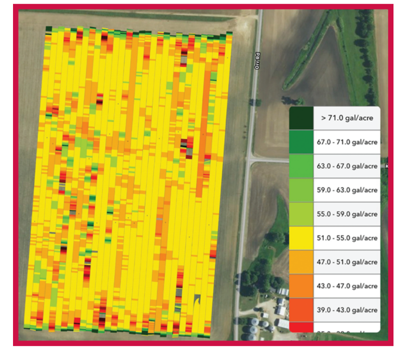
Unverferth Dual-Delivery System

This innovative system combines a Single-Coulter down the center of each row with two trailing hoses. It allows the operator to inject nitrogen into the soil down the middle of the row and apply on top of the soil right next to the plant root.



SUMMARY

- The influence of a single coulter proved to have a statistically significant yield advantage. No other conclusions can be drawn from the results.



As-applied map from Climate FieldView™ Cab using Climate FieldView™ Drive connected to diagnostic port.

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Food, Agricultural & Biological Engineering (klopfenstein.34@osu.edu) or Ryan Tietje (tietje.4@osu.edu).

Treatments (Coulter)	Moisture (%)	Yield (bu/ac)
Single Coulter	16.6	201 ab
Dual-Delivery	16.7	204 a
Drop Hoses Only	16.7	192 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: 6.69 CV: 2.86%

OBJECTIVE

Measure corn yield effect from added starter fertilizer, sulfur and zinc.

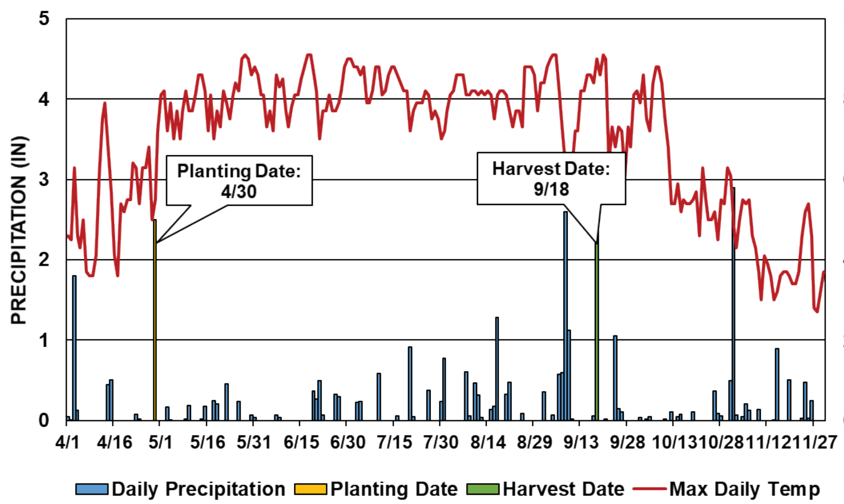
eFields Collaborating Farm

OSU Extension

Darke County

STUDY INFORMATION

Planting Date	4/30/2018
Harvest Date	9/18/2018
Variety	Becks 5140
Population	33,000
Acres	34
Treatments	5
Reps	3
Treatment Width	30 ft.
Tillage	No-Till (Fall), Conventional (Spring)
Herbicide	Lexar, Roundup
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Celina silt loam, 43% Crosby silt loam, 36% Brookston silty clay loam, 14% Crosby silt loam, 7%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.03	1.85	1.94	3.46	3.97	14.25
Cumulative GDDs	113	692	1,349	1,997	2,677	2,677

STUDY DESIGN

This study was designed as a randomized complete block with three replications. Plot width was 30 ft. Plot length was minimum of 500 ft. Combine was calibrated in season with yield monitor data used for crop yield. Soil test P was 4.4 ppm Bray P1 (15 ppm Mehlich 3).

Starter fertilizer was applied as 2x2 at planting.

Treatments	Application Rate
No Starter	None
28 Only	43 lb N/ac
28 & P	43 lb N/ac + 23 lb/ac
28, P, and Sulfur	43 lb N/ac + 23 lb/ac P + 2 gal/ac S
28, P, Sulfur, and Zinc	43 lb N/ac + 23 lb/ac P + 2 gal/ac S + 1 qt/ac Zn

OBSERVATIONS

Soil samples for each plot at planting. Some zones showed below critical level P and K. Tissue samples at silking showed sufficient levels for all nutrients except for a couple marginal scores for K. At V6 and V7, corn with starter was deeper green in color compared to the no treatment which was light green in color.

To view a short video about this research, use the QR code or visit the link below:

go.osu.edu/starterfertilizer

Starter fertilizer is applied using a pull-type applicator.

Tools of the Trade

John Deere GS3 Display

The GS3 display was used to facilitate this research trial by renaming the planted hybrids as a particular treatment. This method of hybrid tracking keeps the experiment layout spatially referenced throughout the year.

SUMMARY

- Harvest grain moisture levels were the highest in the no starter treatments.
- Statistically, there was no difference between 28% only; 28% and P; and 28%, P, S and Zn.
- Economically, the 28% & P showed the return on investment at $0.37/acre. The other treatments all resulted in a negative return over no starter fertilizer.

PROJECT CONTACT

For inquiries about this project, contact Sam Custer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Darke County (custer.2@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
No Starter	20.1	242 b
28 Only	19.6	245 ab
28 & P	19.4	248 a
28, P, and Sulfur	19.8	242 b
28, P, Sulfur, and Zinc	19.5	246 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: 4.01 CV: 1.09%

Starter Phosphorus Rate

N-P-K

Corn

OBJECTIVE

Determine the effects of phosphorous on corn yield, soil test level and profitability.

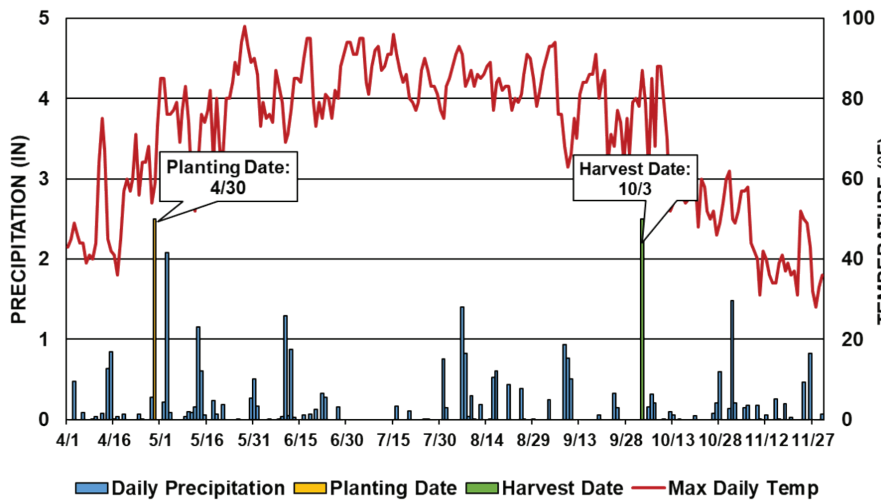
eFields Collaborating Farm

OSU Extension

Fulton County

STUDY INFORMATION

Planting Date	4/30/2018
Harvest Date	10/3/2018
Variety	DeKalb 5799, Pioneer 0506
Population	33,000
Acres	24
Treatments	2
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Herbicide	Cinch ATZ, Glyphosate
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Bixler loamy fine sand, 43% Colwood loam, 12% Mermill loam, 14% Sloan silty clay loam, 9% Wauseon fine sandy loam, 14%



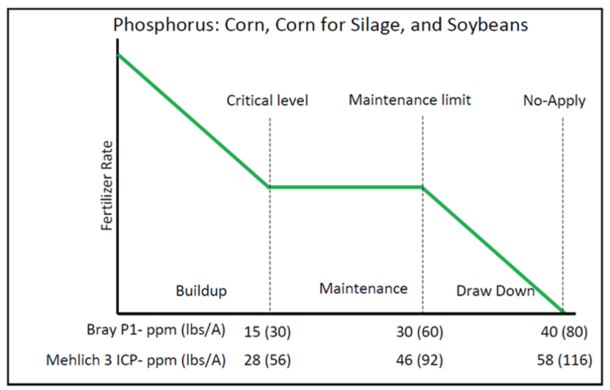
Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1261	1983	2698	2698

STUDY DESIGN

This trial is part of a 3 year study to evaluate the effects of starter phosphorus on corn when soils are in the soil test maintenance range (15-30 ppm Bray P1, 28-46 ppm Mehlich 3) or slightly above (see Figure 1). Two phosphorus starter rates were replicated four times in a randomized complete block design. In this study, the planter was split to include two varieties, plots were 8 rows wide and 2,500 ft. long. Starter phosphorus (as P_2O_5) treatments used in this study were 0 lbs/ac and 28 lbs/ac (7 gal/ac 10-34-0) and were applied with the planter only (2x2 placement).

All treatments were nitrogen-balanced at planting. Sidedress nitrogen treatments were the same across each treatment to achieve 200t total lbs N/ac. All studies were planted, sprayed, sidedressed and harvested with commercial farm equipment. Yield and moisture observations were taken with a calibrated yield monitor and shrunk to 15% moisture.



Tri-State Fertility Guide - Build, maintain, draw-down approach to phosphorus management.

OBSERVATIONS

Throughout each growing season, plant growth was monitored for any potential treatment differences. While no yield limiting factors were observed, each year weather provided unique, but 'normal' challenges.

Aerial photos were taken each July to see if any noticeable color differences could be observed. No inconsistent color patterns were observed. Ear leaf samples were pulled at green silk and tested for phosphorus concentration in two of the years. All P tissue samples were at sufficient levels (.30-.50%) according to the Ohio Agronomy Guide.

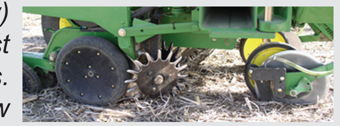
go.osu.edu/phosphorusrate

Aerial photography shows subtle variety and phosphorus color differences on July 17, 2018.

Tools of the Trade

2x2 Fertilizer Placement

Placing phosphorus with the planter (2x2 or in furrow) can be one of the best ways to avoid nutrient loss. Phosphorus is placed below the surface and near the seed for rapid nutrient uptake at the seedling stage of growth.



SUMMARY

- Data from this 3 year, on-farm trial suggests that when soil test phosphorus levels are in the maintenance range or higher, 28 lbs of starter phosphorus will show a significant difference in corn yield 17% of the time (1 out of 6 site years) when compared to a zero rate (see Table 1).
- As soil test phosphorus levels approach the critical level (15 ppm Bray P1, 28 ppm Mehlich 3), corn varieties will likely exhibit a greater response to phosphorus.
- Farmers are encouraged to know each field's soil test phosphorus levels prior to applying nutrients.

PROJECT CONTACT

For inquiries about this project, contact Eric Richer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Fulton County (richer.5@osu.edu).

	2018 Data 34 ppm BP1 (51 ppm Mehlich 3)					2017 Data 21 ppm BP1 (35 ppm M3)	2016 Data 33 ppm BP1 (49 ppm M3)
Treatments	**Application Rate (lbs P/ac)**	**Tissue Sample P (%)**	**Moisture (%)**	**Yield (bu/ac)**	**End of Season Soil BP1 (Mehlich 3) (ppm)**	**Yield (bu/ac)**	**Yield (bu/ac)**
Hybrid A - No P	0	0.34	20.0	209 b	16.3 (29.3)	143 a	181 a
Hybrid A - Starter P	28	0.33	19.1	215 a	18.8 (32.3)	143 a	179 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.NS indicates not significant.				LSD: 4.45 CV: 1.26%		LSD: NS CV: 7.10%	LSD: NS CV: 2.39%
Hybrid B - No P	0	0.32	20.6	208 a	15.0 (27.7)	158 a	192 a
Hybrid B - Starter P	28	0.37	20.1	215 a	18.8 (32.3)	148 a	200 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. NS indicates not significant.				LSD: NS CV: 3.38%		LSD: NS CV: 10.00%	LSD: NS CV: 4.02%

OBJECTIVE

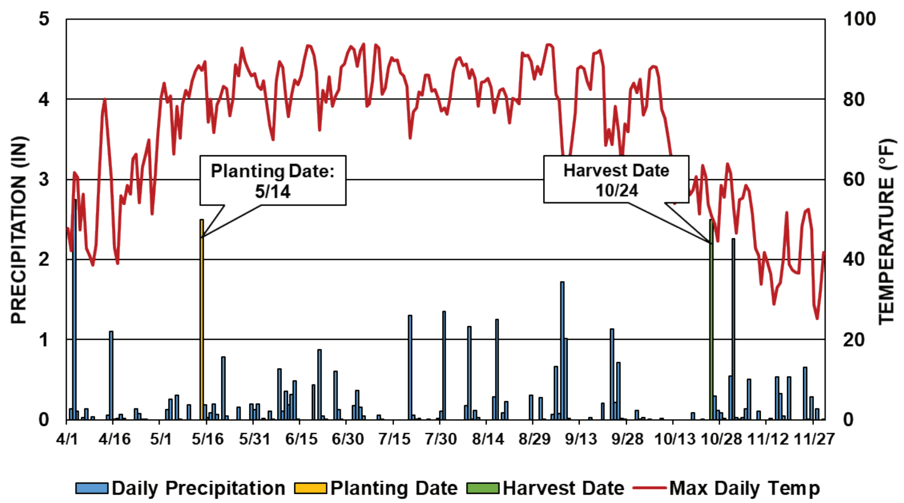
Understand planter downforce levels and the need to adjust when planting into a strip-till environment.

Western Agricultural Research Station

Clark County

STUDY INFORMATION

Planting Date	5/14/2018
Harvest Date	10/24/2018
Variety	SCS1098YHR
Population	34,000
Acres	10
Treatments	4
Reps	3
Treatment Width	40 ft.
Tillage	Spring Strip-Till
Herbicide	Roundup PowerMax, 2,4-D, Banvel
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Strawn-Crosby complex, 52% Kokomo silty clay, 48%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.73	2.80	4.54	3.71	3.95	19.73
Cumulative GDDs	60	674	1,341	2,052	2,760	2,760

STUDY DESIGN

Planter downforce systems have recently been adopted for modern planters. Substantial research has been done on recommended downforce (DF) levels for no-till managed fields, but little research for strip-till (ST) managed treatments. This study evaluated various downforce (DF) levels in strip-till managed treatments. Based on prior field data and system knowledge,three levels of down force pressure were selected for evaluation of seeding performance. A check for tillage was also evaluated with the no-till treatments.

Treatments	Tillage	DownForce (lbs)
Optimal	No-Till	100
Optimal	Strip-Till	100
Heavy	Strip-Till	195
Light	Strip-Till	50

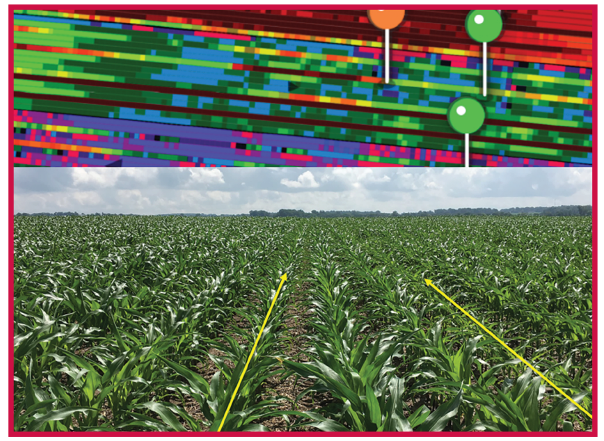
Planting into strips and using a CASE IH 2150 high speed planter. A Precision Planting 20/20 monitor was used to collect planting data.

OBSERVATIONS

Strip-till was conducted in March of 2018. A compacted layer was determined to reside at a depth of 8 inches in the test plot area. Shank depths 8 inches were selected to alleviate any soil compaction efforts. Row unit shanks depth appropriately shattered the field's existing compaction layer. This was verified through excavation and assessment of plant uniformity. While no yield benefits were reported, several items were noted to affect plant growth throughout the growing season.

Planter Downforce

RTX level correction was used to ensure planting occured in close relation to the existing strips. Ample nutrients, water, and lack of yield limiting factors contributed to the high production. Minimal variability between treatments was observed.



Monitoring of row unit downforce during planting revealed trends in as-planted data that showed previous field traffic patterns.

Tools of the Trade

FieldView™ Drive

The FieldView™ Drive collects operational data through the CAN port. This enables the producer to record data such as machine analytics, yield data, planting data, application data, and many other forms of ag data.

SUMMARY

- No significant yield benefits to utilizing different downforce control settings.
- Highest downforce level achievable did not over compact the soil.
- Planter performance for strip-till treatments required less over all downforce to maintain a consolidated seed bed.
- Compaction was not induced on corn regardless of high downforce levels.

PROJECT CONTACT

For inquiries about this project, contact Trey Colley, Precision Agriculture Program Manager, Food, Agricultural and Biological Engineering (digitalag@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Optimal No-Till	13.7	195 a
Optimal Strip-Till	13.8	195 a
Heavy Strip-Till	13.5	196 a
Light Strip-Till	14.1	192 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: Not Significant CV:4.58%

Strip-Till Downforce

Corn

OBJECTIVE

Understand planter downforce levels and the need to adjust when planting into strip-till environment.

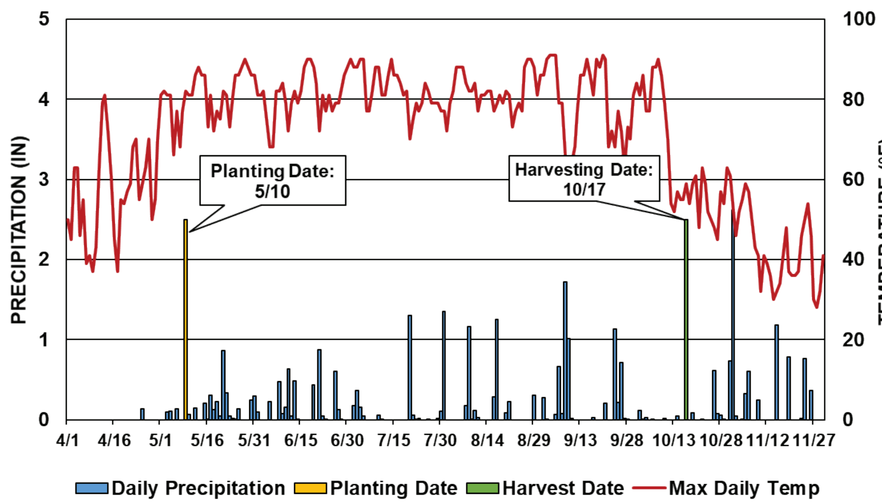
Molly Caren

Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/10/2018
Harvest Date	10/17/2018
Variety	P1197AM
Population	VRT 32,000-36,000
Acres	40
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	Spring Strip-Trip
Herbicide	RoundUp PowerMax, Status, Callisto
Fungicide	Headline AMP
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Crosby-Lewisburg silt loams, 71% Kokomo silty clay loam, 29%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

Planter downforce systems have recently been adopted for modern planters. Substantial research has been done on recommended downforce (DF) levels for no-till managed fields, but little research for strip-till (ST) managed treatments. This study evaluated various downforce (DF) levels in strip-till managed treatments.

Treatments	Applied Downforce (lbs)
Light	200
Optimal	300
Heavy	450
Active	Varies

Implementation of strip-till prior to planting using an Orthman 1-tRipr bar and a Salford ST-10 dual product granular fertilizer application system.

OBSERVATIONS

Strip-till was conducted in March of 2018. A compacted layer was determined to reside at a depth of 8 inches in the test plot area. Shank depths 8 inches were selected to alleviate any soil compaction efforts. Row unit shanks depth appropriately shattered the field's existing compaction layer.

RTK level correction was used to ensure planting occurred in close relation to the existing strips. Ample nutrients, water, and lack of yield limiting factors contributed to the high production. Minimal variability between treatments was observed.

Active control of planter row unit downforce visually was the most consistent of the various downforce levels. This on-the-go adjustment was the standard practice for the grower.

Planting into strips at the Molly Caren Agricultural Center using a 1775 NT 16-row planter equipped with Precision Planting tools to record and map downforce by each row.

Tools of the Trade

John Deere Individual Row Hydraulic Downforce Control (IRHD)

IRHD works as a closed-loop downforce system that reacts on an individual row basis to changing soil conditions, supporting increased ground contact, which can lead to improved seed depth consistency.

SUMMARY

- No significant yield benefits to utilizing different downforce control settings.
- Highest downforce level achievable did not over compact the soil.
- Planter performance for strip-till treatments required less over all downforce to maintain a consolidated seed bed.
- Compaction was not induced on corn regardless of high downforce levels.
- Active downforce control proved to be the most consistent during planting.

PROJECT CONTACT

For inquiries about this project, contact Nate Douridas, Farm Operations Manager, Food, Agricultural and Biological Engineering (douridas.2@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Light	16.7	211 a
Optimal	16.8	210 a
Heavy	16.7	211 a
Active	16.7	214 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: Not significant
CV: 1.98%

Strip-Till Fertilizer Placement

OBJECTIVE

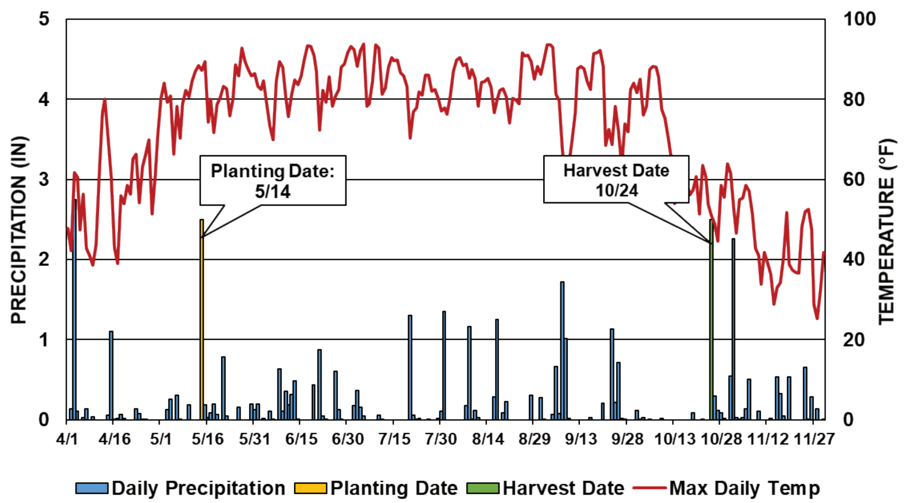
Understand the potential yield benefits of banding granular fertilizer at various depths throughout the soil profile.

Western Agricultural Research Station

Clark County

STUDY INFORMATION

Planting Date	5/14/2018
Harvest Date	10/24/2018
Variety	SCS1098YHR
Population	34,000
Acres	18
Treatments	6
Reps	4
Treatment Width	40 ft.
Tillage	Spring Strip-Till
Herbicide	Roundup PowerMax, Lexar EZ, Callisto, Status
Pesticide	Headline AMP
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Strawn-Crosby complex, 52% Kokomo silty clay, 48%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.73	2.80	4.54	3.71	3.95	19.73
Cumulative GDDs	60	674	1,341	2,052	2,760	2,760

OBSERVATIONS

Strip-till was conducted in March of 2018. A compacted layer was determined to reside at a depth of 8 inches in the test plot area. Shank depths 8 in. were selected to alleviate any soil compaction efforts. Row unit shanks depth appropriately shattered the field's existing compaction layer.

RTK level correction was used to ensure planting occurred in close relation to the existing strips. Ample nutrients, water, and lack of yield limiting factors contributed to the high production. Minimal variability between treatments was observed.

Fertilizer rates were varied by management zones with high-productivity zones receiving more fertilizer than others based on agronomist recommendations. The majority of treatments received a rate of 150 lbs P_2O_5/ac.

Strip-till implementation at the Western Agricultural Research Center. Shanks were adjusted for each of the fertilizer depth treatments.

Tools of the Trade

Orthman 1tRipr Row Unit

Shank-style strip-till unit Adjustable heavy duty shank allows for ideal seedbed preparation. Can be equipped with dry, liquid, or anhydrous fertilizer attachments. Can place multiple products at varying depths.

SUMMARY

- Proper shank depth settings drastically improve tillage performance.
- In this case, spring tillage and fertilizer application led to a an ideal seedbed preparation.
- Broadcast placement P/K treatment was found to be significant for 2018 at this farm.

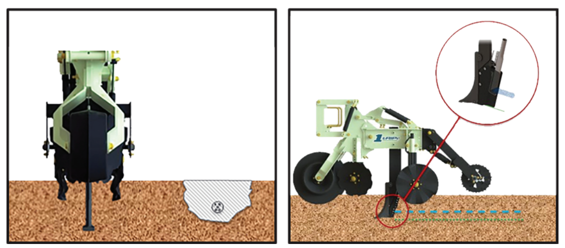
PROJECT CONTACT

For inquiries about this project, contact Trey Colley, Precision Agriculture Program Manager, Food, Agricultural and Biological Engineering (digitalag@osu.edu).

STUDY DESIGN

This study evaluated the effect of fertilizer depth when banding P and K. These depths were placed with a shank-style strip-till implement. `

Treatments	Tillage	Placement Depth (in.)
Broadcast (No-till)	No-Till	0
Broadcast	Strip-Till	0
Shallow	Strip-Till	0-3
Medium	Strip-Till	3-6
Deep	Strip-Till	6-9
None	Strip-Till	No Application



Application of fertilizer and soil profile impact for the shank-style strip-till implement.

Treatments	Moisture (%)	Yield (bu/ac)
Broadcast (No-till)	16.1	210 a
Broadcast	15.7	199 b
Shallow	15.2	195 b
Medium	15.3	200 b
Deep	15.1	202 ab
None	15.7	199 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: 9.23 CV: 3.71%

Strip-Till Fertilizer Placement

N-P-K

Corn

OBJECTIVE

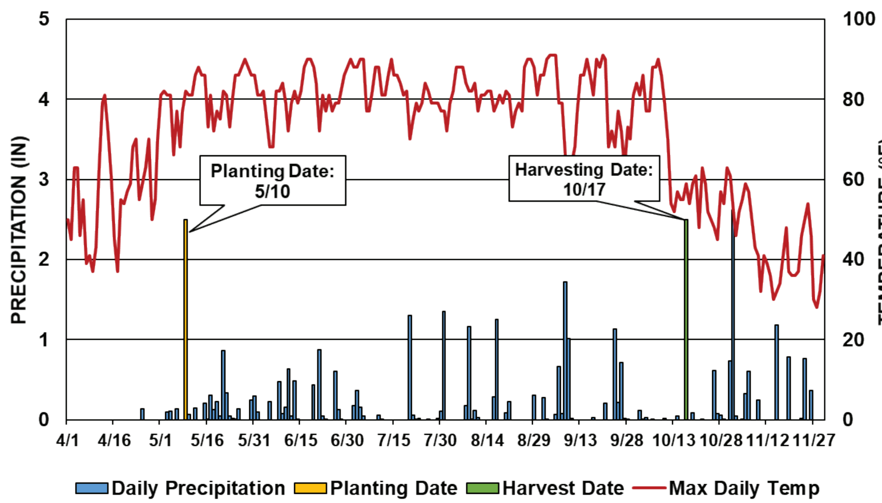
Understand the potential yield benefits of banding granular fertilizer at various depths throughout the soil profile.

Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/10/2018
Harvest Date	10/17/2018
Variety	P1197AM
Population	VRT 32,000-36,000
Acres	40
Treatments	5
Reps	4
Treatment Width	40 ft.
Tillage	Strip-Till
Herbicide	Roundup PowerMax, Lexar EZ, Callisto, Status
Pesticide	Headline AMP
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Crosby-Lewisburg silt loam, 84% Kokomo silty clay loam, 16%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

This study evaluated the effect of fertilizer depth when banding P and K. These depths were placed with a shank-style strip-till implement. `

Treatments	Placement Depth (in.)	P205 Rates (lb/ac)
Broadcast (no-till)	0	150
Broadcast	0	150
Shallow	0-3	150
Medium	3-6	150
Deep	6-9	150

Strip-Till during March 2018 at the Molly Caren Agricultural Center

OBSERVATIONS

Strip-till was conducted in March of 2018. A compacted layer was determined to reside at a depth of 8 inches in the test plot area. Shank depths 8 inches were selected to alleviate any soil compaction efforts. Row unit shanks depth appropriately shattered the field's existing compaction layer.

RTK level correction was used to ensure planting occurred in close relation to the existing strips. Ample nutrients, water, and lack of yield limiting factors contributed to the high production. Minimal variability between treatments was observed.

Fertilizer rates were varied by management zones with high-productivity zones receiving more fertilizer than others based on agronomist recommendations. The majority of treatments received a rate of 150 lbs P2O5/ac.

Strip-till implementation at the Molly Caren Agricultural Center. Shanks were adjusted for each of the fertilizer depth treatments.

Tools of the Trade

Salford ST-10 Dual Fertilizer Applicator

The Salford ST-10 applicator is capable of applying dual-products, at variable-rate. These implements have been used increasingly in Ohio as a means to place fertilizer below the soil surface.

SUMMARY

- Proper shank depth settings drastically improve tillage performance.
- In this case, spring tillage and fertilizer application led to a an ideal seedbed preparation.
- No statistically significant yields were observed for 2018 at this location.

PROJECT CONTACT

For inquiries about this project, contact Nate Douridas, Farm Operations Manager, Food, Agricultural and Biological Engineering (douridas.2@osu.edu).

Treatments (Fertilizer Placement)	Moisture (%)	Yield (bu/ac)
Broadcast (no-till)	17.3	214 a
Broadcast	13.6	210 a
Shallow	16.9	218 a
Medium	17.0	216 a
Deep	17.0	216 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: Not significant CV: 2.45%

OBJECTIVE

Understand the yield impact of varying corn seeding rates within Ohio considering in-field variability and cultural practices implemented. Information from this trial will be used to improve management recommendations for growers throughout Ohio understand how variable-rate seeding may impact field-by-field profit.

Tools of the Trade

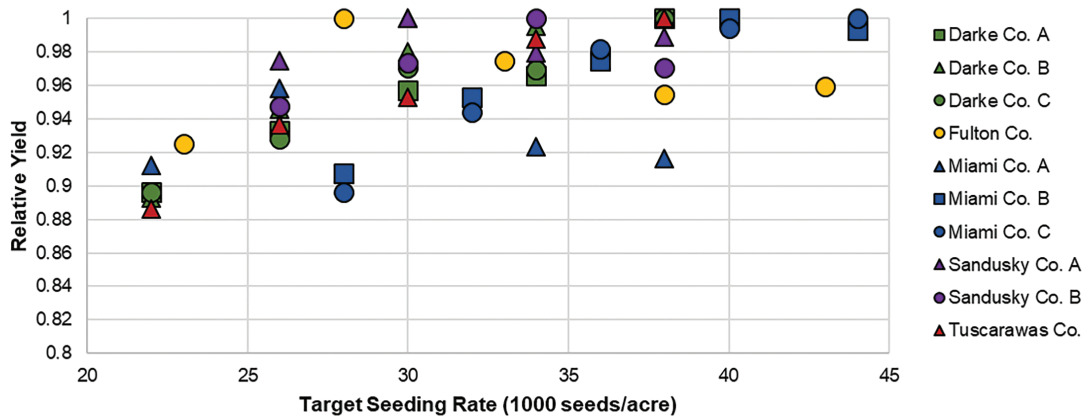
Sound information and data on corn hybrid selection and associated seeding rate for 1) planter or seeder, and 2) recommended final population.

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 within the fields. Results for individual sites plus aggregated pool analyses was conducted.

SUMMARY

- Across all sites, the average corn emergence was 96% with individual sites ranging between 93% to 98%.
- Variation in corn yield was caused by differences in location and differences in seeding rates in 2018.
- There was a significant response to corn seeding rates at 9 out of 10 sites in 2018.



Relative yield versus target seeding rate for each corn seeding rate trial location. Yield values were normalized to the maximum yield for each location.

EXAMPLE FIELD LAYOUT

To maximize learning, a minimum of five different seeding rates should be compared. More rates can be added, if adequate space is available. The seeding rates compared in the trial need to be different enough to have the potential to affect yield, a minimum difference of 4,000 seeds/acre between each treatment is recommended. It may be necessary to adjust these seeding rates slightly based on your equipment capabilities.

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 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.

Planter Pass	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Replication	1					2					3					4				
Plot ID	101	102	103	104	105	201	202	203	204	205	301	302	303	304	305	401	402	403	404	405
Description	32k	30k	38k	22k	26k	38k	26k	30k	22k	34k	22k	38k	26k	30k	34k	38k	30k	34k	22k	26k

STUDY INFORMATION

Planting Date	5/1/2018
Harvest Date	10/11/2018
Variety	Dekalb 6220
Population	Treatments
Acres	242
Treatments	5
Reps	3
Treatment Width	30 ft.
Tillage	Rip-Strip (Fall) Conventional (Spring)
Herbicide	Lexar, Roundup
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Miamian Silt Loam (45%) Brookston Silty Clay Loam (10%)

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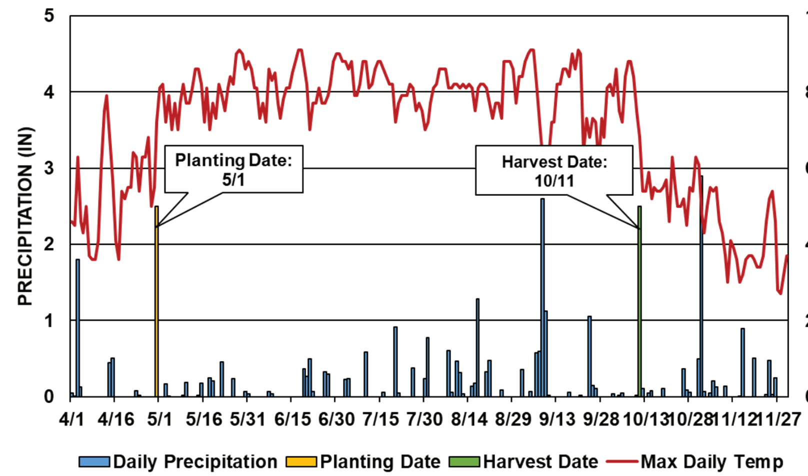
OSU Extension

Darke County - A



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.03	1.85	1.94	3.46	3.97	14.25
Cumulative GDDs	113	692	1,349	1,997	2,677	2,677

PROJECT CONTACT

For inquiries about this project, contact Sam Custer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Darke County (custer.2@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
22,000	21,417	15.4	207 d	648
26,000	25,500	15.5	219 c	676
30,000	31,083	15.4	227 b	690
34,000	31,583	15.5	231 a	690
38,000	37,333	15.5	232 a	679
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: 2.26 CV: 0.67%	

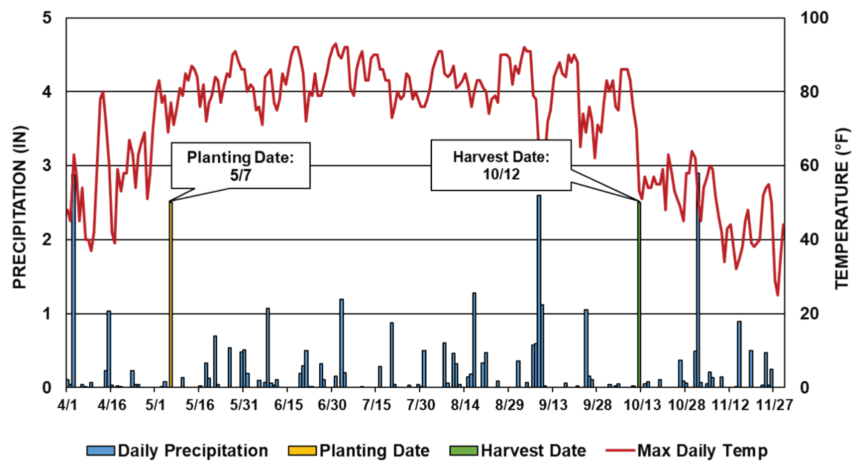
STUDY INFORMATION

Planting Date	5/7/2018
Harvest Date	10/12/2018
Variety	Channel 210-26VT2PRIB
Population	Treatments
Acres	86
Treatments	6
Reps	4
Treatment Width	30 ft.
Tillage	No-Till
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Crosby silt loam, 56% Brookston silty clay loam, 46%

eFields Collaborating Farm

OSU Extension

Darke County - B



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.78	3.04	3.06	3.32	3.97	18.17
Cumulative GDDs	142	777	1,464	2,192	2,948	2,948

PROJECT CONTACT

For inquiries about this project, contact Sam Custer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Darke County (custer.2@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
22,000	21,125	14.6	206 d	644
26,000	25,750	15.7	214 c	658
30,000	28,688	16.0	220 bc	665
34,000	32,625	16.1	222 b	658
38,000	36,688	16.1	229 a	669
Variable Rate	30,563	15.8	223 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: 6.49 CV: 2.39%	

STUDY INFORMATION

Planting Date	5/8/2018
Harvest Date	10/29/2018
Variety	P0483AM and P0977AM
Population	Treatments
Acres	62
Treatments	6
Reps	4
Treatment Width	40 ft.
Tillage	Minimum
Herbicide	Compreno, Aetrex, Roundup
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Celina silt loam, 38% Kokomo silty clay loam, 36% Crosby-Celina silt loam, 14% Sloan silt loam, 10%

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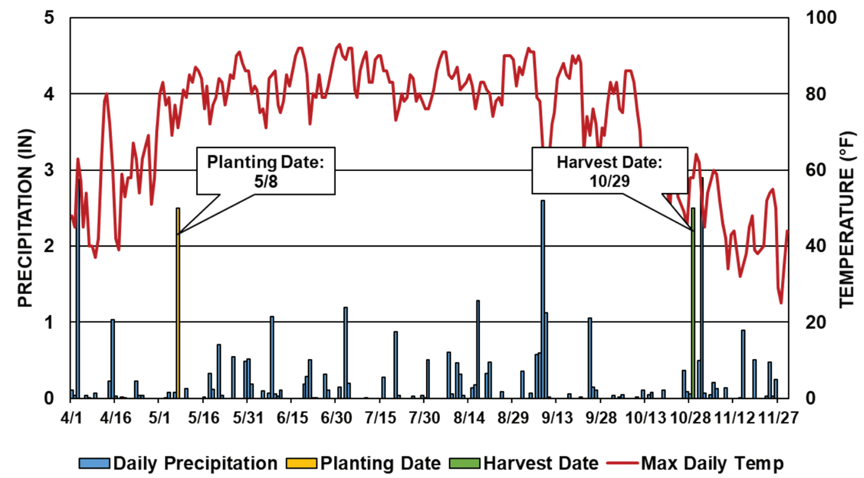
OSU Extension

Darke County - C



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.78	3.04	3.06	3.32	3.97	18.17
Cumulative GDDs	142	777	1,464	2,192	2,948	2,948

PROJECT CONTACT

For inquiries about this project, contact Sam Custer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Darke County (custer.2@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
22,000	21,125	16.1	227 c	718
26,000	20,250	15.9	235 b	732
30,000	24,938	16.3	246 a	756
34,000	30,000	16.4	246 a	742
38,000	31,813	16.3	253 a	753
Variable Rate	28,625	16.2	252 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: 7.72 CV: 2.57%	

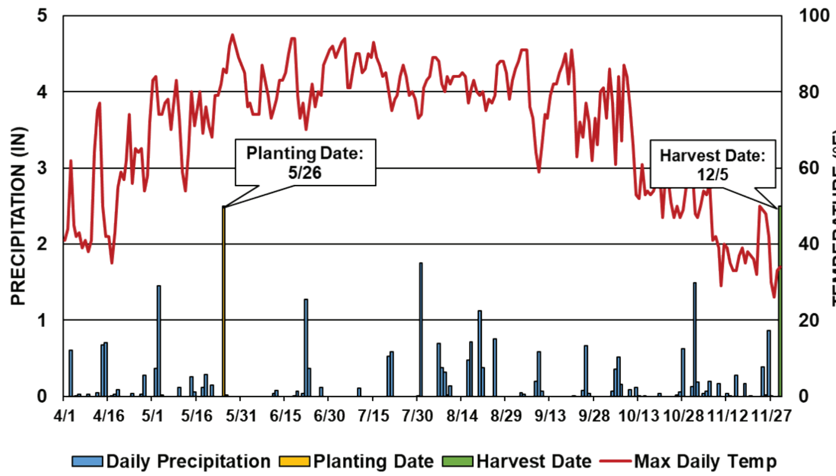
STUDY INFORMATION

Planting Date	5/26/2018
Harvest Date	12/5/2018
Variety	Pioneer 0843AM
Population	Treatments
Acres	35
Treatments	5
Reps	4
Treatment Width	30 ft.
Tillage	No-Till
Herbicide	Cinch ATZ, Instigate
Pesticide	Tombstone
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Blount loam, 48% Mermill loam, 22% Haskins loam, 13% Glynwood loam, 6% Sloan silty clay loam, 5% Rawson sandy loam, 4%

eFields Collaborating Farm

OSU Extension

Fulton County



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

PROJECT CONTACT

For inquiries about this project, contact Eric Richer, Assistant Professor, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Fulton County (richer.5@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
23,000	22,500	21.3	167 b	504
28,000	27,500	21.3	180 a	532
33,000	33,300	21.1	176 ab	501
38,000	37,250	20.7	172 ab	469
43,000	41,750	20.9	173 ab	455
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: 8.17 CV: 3.74%	

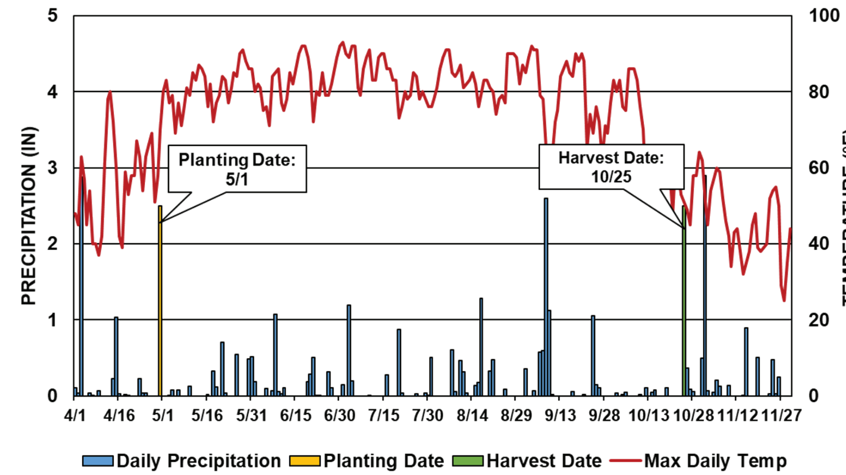
STUDY INFORMATION

Planting Date	5/1/2018
Harvest Date	10/25/2018
Variety	Channel 212-20 STX
Population	Treatments
Acres	65
Treatments	5
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Herbicide	Capreno, RoundUp
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Crosby silt loam, 66% Brookston silty clay loam, 34%

eFields Collaborating Farm

OSU Extension

Miami County - A



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.78	3.04	3.06	3.32	3.97	18.17
Cumulative GDDs	142	777	1,464	2,192	2,948	2,948

PROJECT CONTACT

For inquiries about this project, contact Amanda Bennett, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Miami County (bennett.709@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
22,000	21,925	15.9	229 b	725
26,000	24,974	15.9	241 ab	753
30,000	29,185	16.0	251 a	774
34,000	33,541	16.0	232 ab	693
38,000	36,155	15.9	230 ab	672
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: 21.93 CV: 7.36%	

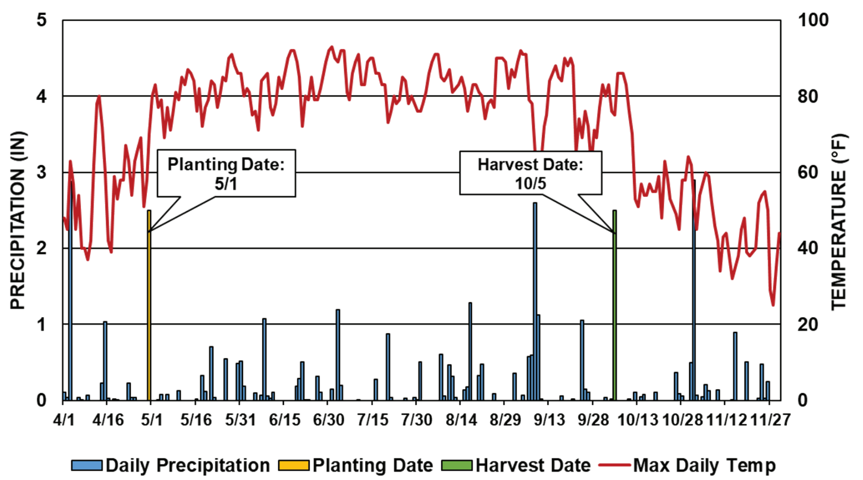
STUDY INFORMATION

Planting Date	5/1/2018
Harvest Date	10/5/2018
Variety	Ebberts 9121SSX
Population	Treatments
Acres	77
Treatments	5
Reps	4
Treatment Width	30 ft.
Tillage	Conventional
Herbicide	Brawl, Callisto
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Eldean loam, 80% Warsaw silt loam, 12%

eFields Collaborating Farm

OSU Extension

Miami County - B



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.78	3.04	3.06	3.32	3.97	18.17
Cumulative GDDs	142	777	1,464	2,192	2,948	2,948

PROJECT CONTACT

For inquiries about this project, contact Amanda Bennett, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Miami County (bennett.709@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($)
28,000	26,264	17.5	236 d	728
32,000	30,405	17.4	248 c	756
36,000	32,852	17.3	254 b	763
40,000	36,605	17.6	260 a	770
44,000	40,888	17.0	259 a	753
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: 2.80 CV: 0.88%	

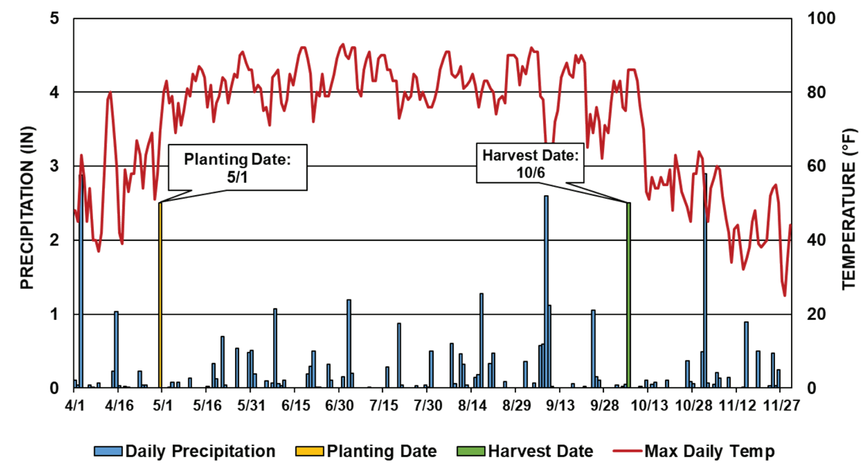
STUDY INFORMATION

Planting Date	5/1/2018
Harvest Date	10/6/2018
Variety	Ebberts 9121SSX
Population	Treatments
Acres	77
Treatments	5
Reps	3
Treatment Width	30 ft.
Tillage	Conventional
Herbicide	Brawl, Callisto
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Eldean loam, 80% Warsaw silt loam, 12%

eFields Collaborating Farm

OSU Extension

Miami County - C



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.78	3.04	3.06	3.32	3.97	18.17
Cumulative GDDs	142	777	1,464	2,192	2,948	2,948

PROJECT CONTACT

For inquiries about this project, contact Amanda Bennett, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Miami County (bennett.709@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
28,000	26,585	17.4	240 c	742
32,000	29,093	17.3	253 b	774
36,000	33,521	17.5	263 a	795
40,000	40,056	17.4	267 a	795
44,000	41,463	17.5	268 a	784
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: 5.66 CV: 1.44%	

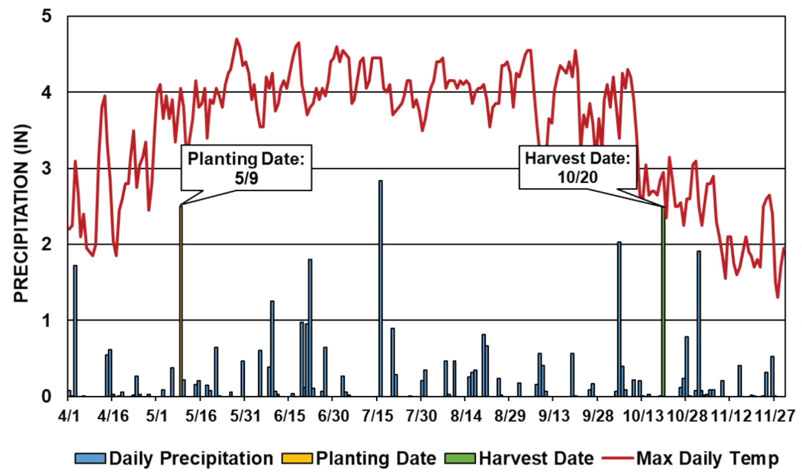
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Sandusky County - A

Planting Date	5/9/2018
Harvest Date	10/20/2018
Variety	Pioneer 0825AM
Population	Treatments
Acres	42
Treatments	4
Reps	4
Treatment Width	60 ft.
Tillage	Strip-Till
Herbicide	Stinger, Medal II ATZ, Powermax, Mesotrione
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Hoytville clay loam, 59% Millsdale silty clay loam, 13% Rimer loamy fine sand, 11% Del Rey silt loam, 8%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	5.04	2.54	5.04	2.66	3.91	19.19
Cumulative GDDs	690	1,254	1,944	2,683	3,443	3,443

PROJECT CONTACT

For inquiries about this project, contact Allen Gahler, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Sandusky County (gahler.2@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
26,000	27,375	17.4	195 a	592
30,000	29,000	17.5	200 a	595
34,000	33,375	17.7	195 a	564
38,000	33,500	17.6	197 a	557
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: Not significant CV: 7.51%	

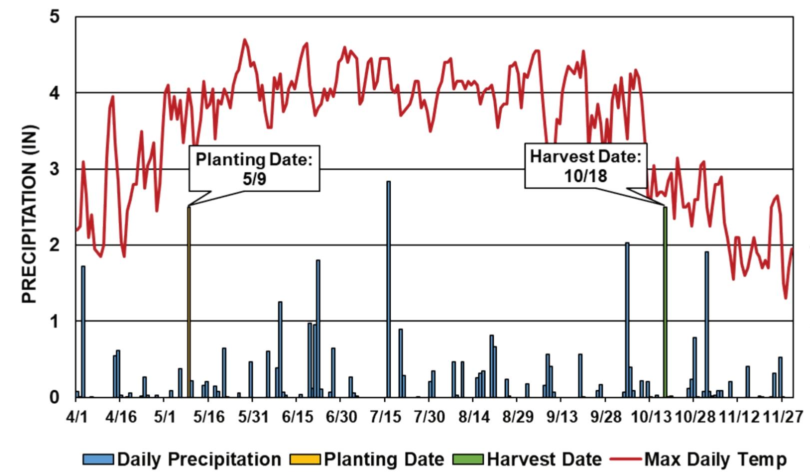
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Sandusky County - B

Planting Date	5/9/2018
Harvest Date	10/18/2018
Variety	Pioneer P0506AM
Population	Treatments
Acres	65
Treatments	4
Reps	4
Treatment Width	60 ft.
Tillage	Strip-Till
Herbicide	Stinger, Medal II ATZ, Powermax, Mesotrione
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Hoytville clay loam, 66% Dunbridge sandy loam, 23% Millsdale silty clay loam, 11%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	5.04	2.54	5.04	2.66	3.91	19.19
Cumulative GDDs	690	1,254	1,944	2,683	3,443	3,443

PROJECT CONTACT

For inquiries about this project, contact Allen Gahler, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Sandusky County (gahler.2@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
26,000	24,875	16.0	180 b	539
30,000	28,875	16.0	185 ab	543
34,000	32,125	16.1	190 a	546
38,000	36,750	16.0	185 ab	515
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: 8.49 CV: 3.53%	

Seeding Rate Trials

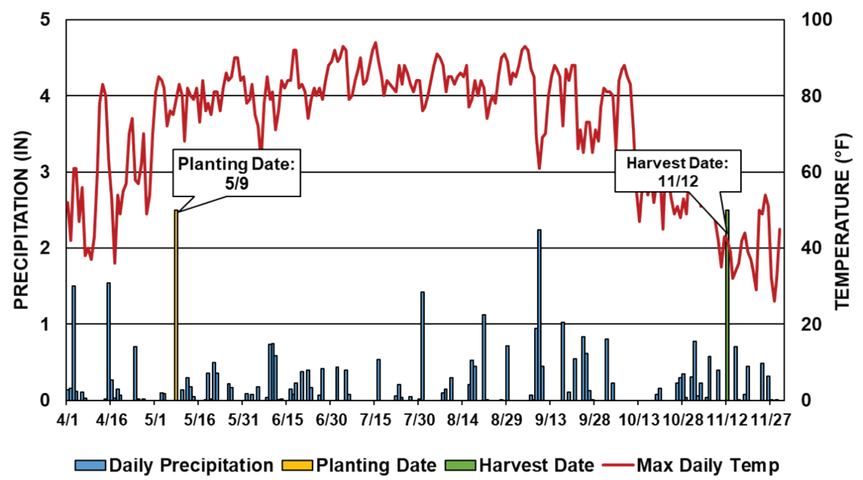
STUDY INFORMATION

Planting Date	5/9/2018
Harvest Date	11/12/2018
Variety	Pioneer P0843AM
Population	Treatments
Acres	16
Treatments	5
Reps	5
Treatment Width	30 ft.
Tillage	Vertical
Herbicide	Lexar EZ, Roundup, Atrazine
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Canfield silt loam, 57% Fitchville, 41% Sebring silt loam, 2%

eFields Collaborating Farm

OSU Extension

Tuscarawas County



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.88	2.49	4.37	3.24	3.57	18.55
Cumulative GDDs	146	741	1,373	2,101	2,830	2,830

PROJECT CONTACT

For inquiries about this project, contact Chris Zoller, Associate Professor, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Tuscarawas County (zoller.1@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($)
22,000	20,460	17.9	199 c	620
26,000	24,960	18.0	211 b	648
30,000	28,500	18.3	214 b	644
34,000	33,320	18.4	222 a	658
38,000	35,720	18.5	225 a	655
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: 6.99 CV: 2.96%	

For 2018, 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 33 unique studies being conducted across the state. 2018 soybean research presented in eFields covers both precision seeding and compaction management Digital Ag Team initiatives. Below are highlights of some of the 2018 eFields soybean research:

2,124 acres of soybeans

33 soybeans studies

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

2018 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, cropping inputs, and harvesting technology can be found on the Digital Ag website: digitalag.osu.edu.

Growth Stages:

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.

$V5-V_N$ - 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.

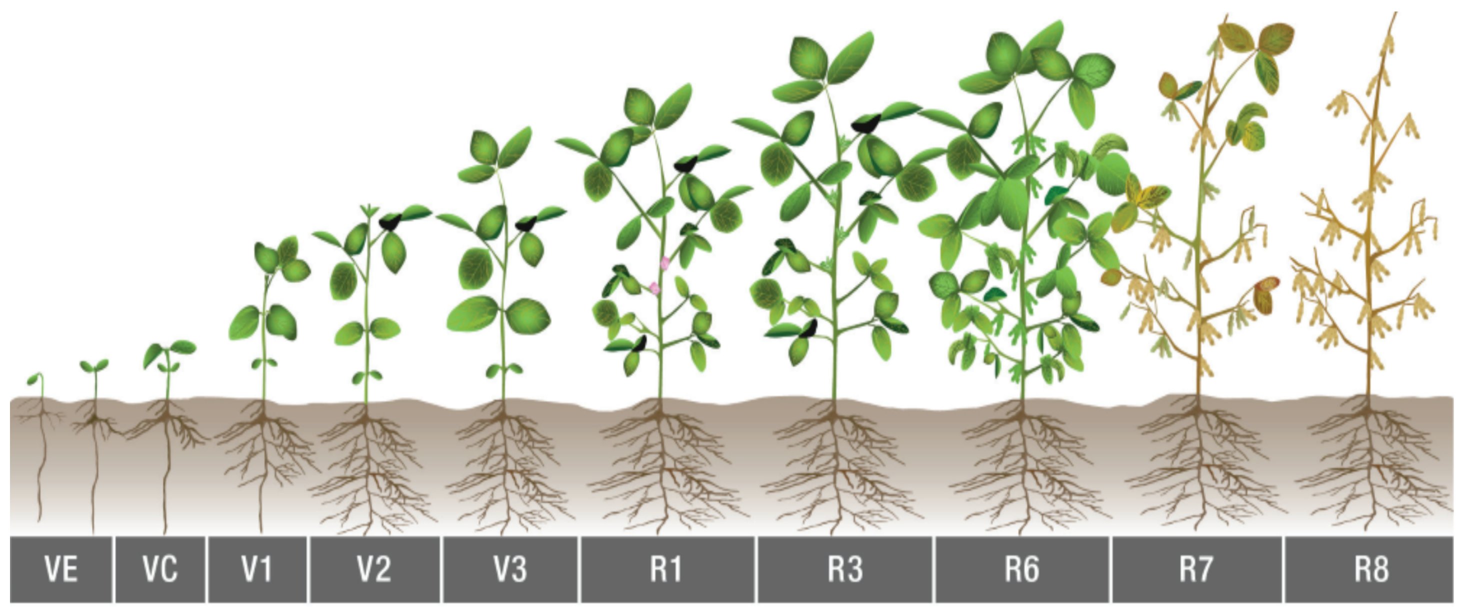
R5 - Beginning Seed - Seed in one of the four uppermost nodes with fully developed leaves is 1/8 in. long.

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.



OBJECTIVE

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

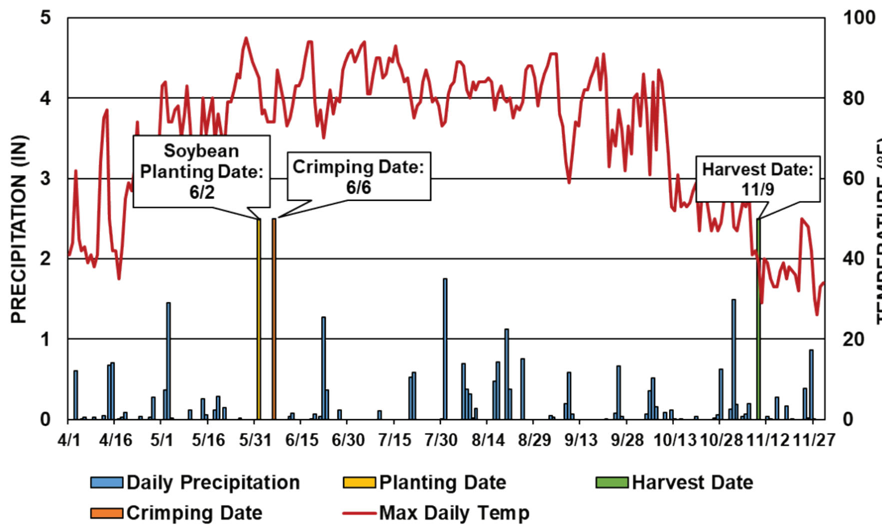
eFields Collaborating Farm

OSU Extension

Fulton County

STUDY INFORMATION

Soybean Planting Date	6/2/2018
Crimping Date	6/6/2018
Soybean Harvest Date	11/9/2018
Variety	Pioneer 31T02L
Population	110,000
Acres	5
Treatments	2
Reps	3
Treatment Width	40 ft.
Tillage	No-Till
Herbicide	Gramoxone, Liberty
Previous Crop	Corn
Row Width	30 in.
Soil Type	Granby, 65% Tedrow, 35%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

STUDY DESIGN

As more and more cover crops are being adopted in Ohio, growers are evaluating a variety of termination methods. 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 early herbicide burndown. Two sites were included in this study to increase validity of the results.

Treatments	Residual Herbicide	Post-Emerge Herbicide
Crimp (Late)	None	Glufonsinate
Chemical (Early Burndown)	None	Glufonsinate

OBSERVATIONS

This site was crimped on June 6 and after soybean planting. Gramaxone was used at this site to terminate both treatments, then followed by the crimper treatment on the same day.

Rye to be crimped should be planted at an increased rate in order to increase the amount of biomass to cover the soil surface. In this study, the crimper treatment followed the soybean rows in parallel. There may be additional gain in efficacy if crimping is conducted at an angle prior to soybean emergence. Finally, no subjective difference in weed pressure was observed between the treatments at either site.

Crimping rye two weeks after soybean planting with no observed damage to soybeans.

Tools of the Trade

Roller-Crimper

This tool, used in cover crop termination, needs to have blades in a Chevron-pattern (curved) so it will roll smoothly without throwing soil. The crimping terminates standing rye that has flowered to create a weed suppressing, moisture retaining mat.

SUMMARY

- No statistical difference in yields or moistures were observed at harvest.

Soybeans emerging through the mat of rye two weeks after crimping.

PROJECT CONTACT

For inquiries about this project, contact Eric Richer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Fulton County (richer.5@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Crimp (Late)	14.2	59 a
Chemical (Early)	14.3	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: Not significant CV: 5.19%

OBJECTIVE

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

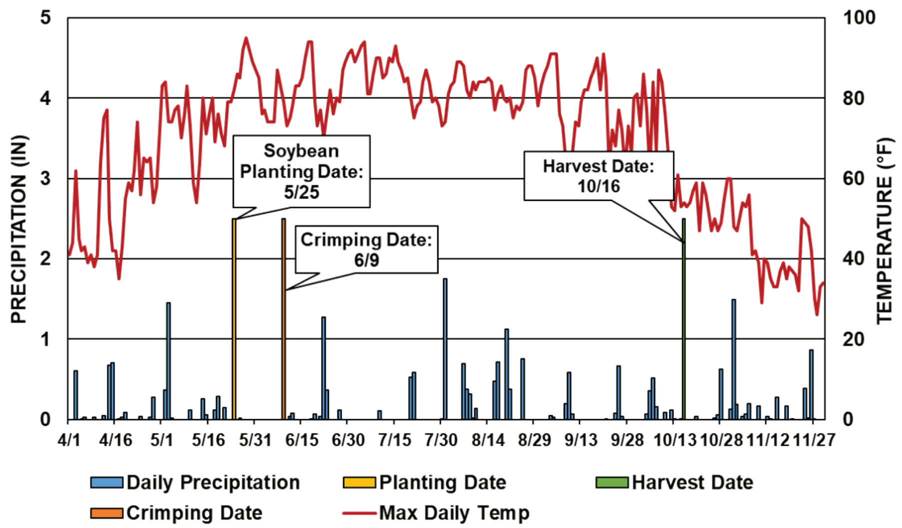
eFields Collaborating Farm

OSU Extension

Fulton County

STUDY INFORMATION

Planting Date	5/25/2018
Crimping Date	6/9/2018
Harvest Date	10/16/2018
Variety	Rupp 31XT40
Population	160,000
Acres	21
Treatments	2
Reps	3
Treatment Width	60 ft.
Tillage	No-Till
Herbicide	Valor, Metribuzin, Engenia, Glyphosate
Fungicide	TrivaPro
Previous Crop	Corn
Row Width	15 in.
Soil Type	Hoytville loam, 60% Mermill loam, 40%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

STUDY DESIGN

As more and more cover crops are being adopted in Ohio, growers are evaluating a variety of termination methods. 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 burndown termination with Glyphosate and Engenia (early). Two sites were included in this study to increase validity of the results.

Treatments	Residual Herbicide	Post-Emerge Herbicide
Crimp (Late)	None	Engenia, Glyphosate
Chemical (Early)	Valor, Metribuzin	Glyphosate, Clethodim

OBSERVATIONS

This site was crimped on June 9 and 15 days after soybean planting.

Rye to be crimped should be planted at an increased rate in order to increase the amount of biomass to cover the soil surface. In this study, the crimper treatment followed the soybean rows in parallel. There may be additional gain in efficacy if crimping is conducted at an angle prior to soybean emergence. Finally, no subjective difference in weed pressure was observed between the treatments at either site.

Tools of the Trade

Cereal Rye Cover Crop

Overwintering cover crops like cereal rye allow farmers to limit erosion from infrequent, heavy rainfall, add organic matter to their soil and reduce nitrate-nitrogen losses. Ahead of soybeans, cereal rye can suppress some annual weeds while increasing water holding capacity.

SUMMARY

- No statistical difference in yields or moistures were observed at harvest.

The shearing effect of the roller-crimper terminates rye after it has flowered.

Soybeans growing after cereal rye termination.

PROJECT CONTACT

For inquiries about this project, contact Eric Richer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Fulton County (richer.5@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Crimp (Late)	13.5	57 a
Chemical (Early)	13.3	59 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: Not significant CV: 4.39%

OBJECTIVE

Determine the effects of PCT Soy Foliar LITE on soybean grain yield.

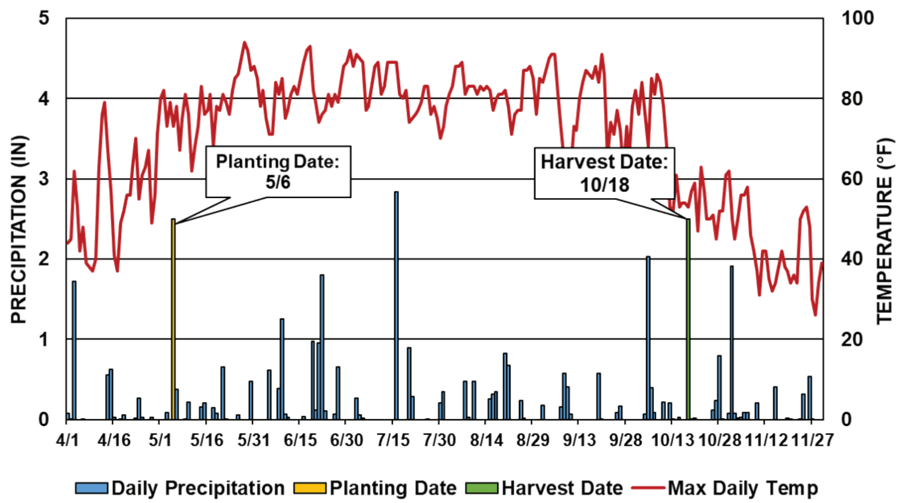
eFields Collaborating Farm

OSU Extension

Auglaize County

STUDY INFORMATION

Planting Date	5/6/2018
Harvest Date	10/18/2018
Variety	Croplan 3150
Population	175,000
Acres	65
Treatments	2
Reps	3
Treatment Width	90 ft.
Tillage	No-Till
Herbicide	Liberty
Previous Crop	Corn
Row Width	15 in.
Soil Type	Blount silt loam, 63% Pewamo silty clay loam, 32% Glynwood silt loam, 5%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	7.06	4.94	3.65	21.58
Cumulative GDDs	117	669	1,330	2,016	2,728	2,728

STUDY DESIGN

The study was designed as a randomized complete block having 3 replications. Plot width was 90 ft. and plot length was 844 ft. PCT Soy Foliar LITE was applied on July 13, 2018 at 1 gallon per acre to R3 soybean with a John Deere sprayer delivering a spray volume of 24 gallons per acre. PCT Soy Foliar LITE contains boron, manganese, nitrogen, phosphorus, potassium, cytokinin, gibberellin, phosphite, and sugars. The center 70 ft. of each plot was harvested with a John Deere combine equipped with a calibrated yield monitor.

Treatments	Application Rate (gal/ac)
No Foliar Product	None
PCT Soy Foliar LITE	1

OBSERVATIONS

At the time of the foliar application, plants appeared healthy and no deficiency symptoms were observed.

No visual differences were observed between treated and non-treated soybean plots during the season. The lack of response to the foliar feed application was likely due to sufficient nutrients.

Minimal disease, pest, or weed pressure was observed throughout the study, so confidence can be placed in any resulting yield differences being a factor of foliar feed application.

Soybeans should be evaluated in-season for nutrient deficiencies before completing foliar feed applications.

Tools of the Trade

Crop Nutrition Apps

This publication features a list of Apps used by farmers or their agronomic consultants to help with nutrient management including planning, scouting, evaluating stress and executing field applications.
go.osu.edu/CropNutritionApps

SUMMARY

- The application of PCT Soy Foliar LITE did not improve soybean yield.
- There were no moisture differences between treatments.
- For 2018, foliar feed was observed to not provide a productivity advantage. Economically, this treatment would negatively impact the bottom line of the producer.
- Nutrient deficiencies were not observed for this season, however, this product should be re-evaluted in a season or location where deficiencies are present in order to determine effectiveness.

PROJECT CONTACT

For inquiries about this project, contact Jeff Stachler Extension Educator, Agriculture and Natural Resources, Department of Extension (stachler.1@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
No Foliar Product	15.9	68 a
PCT Soy Foliar LITE	15.9	68 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: Not significant CV: 1.32%

OBJECTIVE

Determine the effects of PCT Soy Foliar LITE on soybean grain yield.

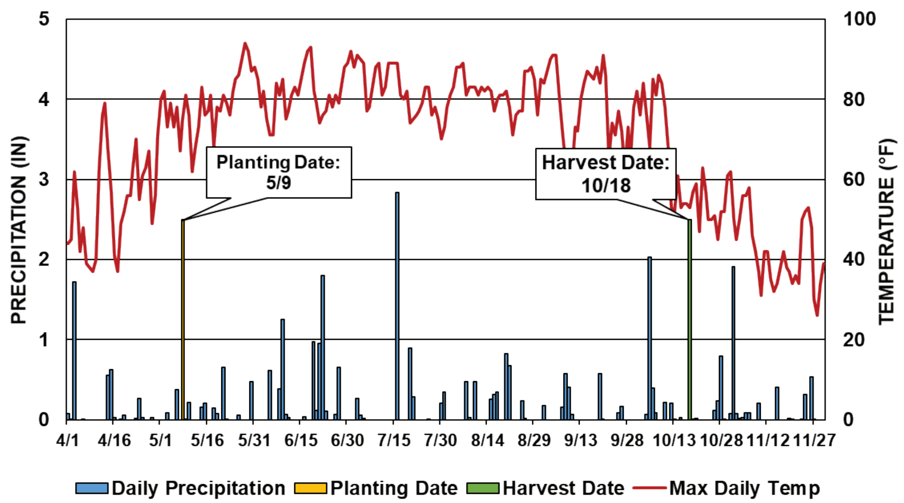
eFields Collaborating Farm

OSU Extension

Auglaize County

STUDY INFORMATION

Planting Date	5/9/2018
Harvest Date	10/18/2018
Variety	Stewart's 3337R2X
Population	175,000
Acres	39
Treatments	2
Reps	3
Treatment Width	60 ft.
Tillage	No-Till
Herbicide	Durango, LV6, Sonic, Metrixx
Previous Crop	Corn
Row Width	7.5 in.
Soil Type	Blount silt loam, 63% Glynwood silt loam, 32% Pewamo silty clay loam, 4%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	7.06	4.94	3.65	21.58
Cumulative GDDs	117	669	1,330	2,016	2,728	2,728

STUDY DESIGN

The study was designed as a randomized complete block having 3 replications. Plot width was 60 feet and plot length was 907 ft. PCT Soy Foliar LITE was applied on July 13, 2018 at 1 gallon per acre to R3 soybean with a John Deere sprayer delivering a spray volume of 15 gallons per acre. PCT Soy Foliar LITE contains boron, manganese, nitrogen, phosphorus, potassium, cytokinin, gibberellin, phosphite, and sugars. The center 35 ft. of each plot was harvested with a John Deere combine equipped with a calibrated yield monitor.

Treatments	Application Rate (gal/ac)
No Foliar Product	None
PCT Soy Foliar LITE	1

OBSERVATIONS

At the time of the foliar application, plants appeared healthy and no deficiency symptoms were observed.

No visual differences were observed between treated and non-treated soybean plots during the season. The lack of response to the foliar feed application was likely due to sufficient nutrients.

Minimal disease, pest, or weed pressure was observed throughout the study, so confidence can be placed in any resulting yield differences being a factor of foliar feed application.

A combine with a calibrated yield monitor was used to collect harvest data. In this study, no statistical differences are noted in the moisture or yield.

Tools of the Trade

Twinjet Spray Nozzle

Coverage of all plant material by the fungicide is extremely critical to maximizing effectiveness. Twinjet spray nozzles are one choice for obtaining proper coverage.

SUMMARY

- The application of PCT Soy Foliar LITE did not improve soybean yield.
- There were no moisture differences between treatments.
- For 2018, foliar feed was observed to not provide a productivity advantage. Economically, this treatment would negatively impact the bottom line of the producer.
- Nutrient deficiencies were not observed for this season, however, this product should be re-evaluted in a season or location where deficiencies are present in order to determine effectiveness.

PROJECT CONTACT

For inquiries about this project, contact Jeff Stachler, Extension Educator, Agriculture and Natural Resources, Department of Extension (stachler.1@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
No Foliar Product	14.5	65 a
PCT Soy Foliar LITE	14.4	64 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: Not significant
CV: 2.72%

Foliar Feed

N-P-K

Soybean

OBJECTIVE

Determine the impact of using four different types of foliar applied fertilizer on soybean yield.

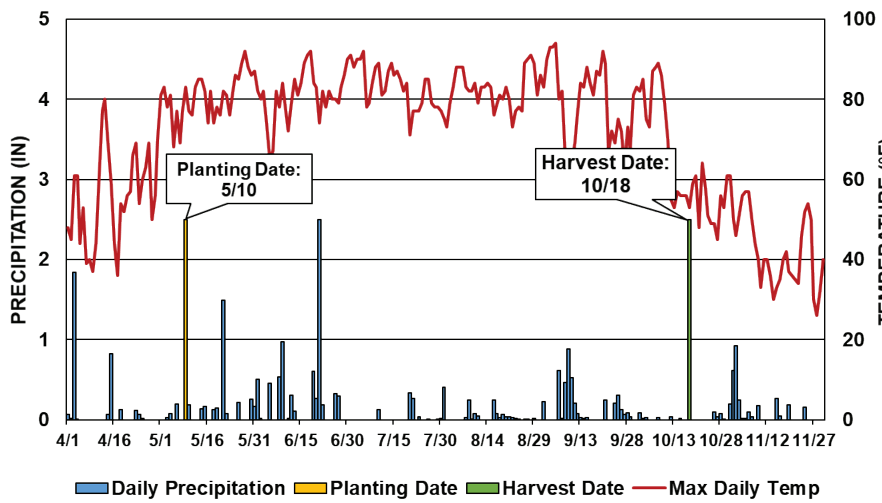
eFields Collaborating Farm

OSU Extension

Union County

STUDY INFORMATION

Planting Date	5/10/2018
Harvest Date	10/18/2018
Variety	Stewarts 3421RX
Population	170,000
Acres	4
Treatments	4
Reps	2
Treatment Width	120 ft.
Tillage	Vertical
Herbicide	Roundup, Powermax
Fungicide	QuiltXL
Previous Crop	Permethrin
Row Width	15 in.
Soil Type	Blount silt loam, 82% Glenwood silt loam, 13% Pewamo silty clay, 5%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.17	3.34	7.10	1.23	1.03	15.87
Cumulative GDDs	130	725	1,369	2,054	2,753	2,753

STUDY DESIGN

This experiment utilized a random design with two replications. The planting date was May 10, 2018 at 170,000 seeds per acre on 15 inch rows. Plot widths were 120 ft. Plot lengths were 980 ft. A calibrated weigh wagon was utilized for the collection of harvest data. Treatments consisted of Nachurs Finish Line at 2 qt/acre, Nachurs Triple Option at 2 gal/ac, Nachurs K-Fuel at 3.5 qt/ac, Nachurs Play Maker at 2.5 gal/ac, and no foliar application. Two applications of product were applied through the growing season with the first on June 14, 2018 and the second July 18, 2018. Plots were harvested on October 18, 2018.

Treatments	Application Rate (qt/ac)
Finish Line	2
Triple Option	8
K-Fuel	3.5
Play Maker	10
No Foliar Application	None

OBSERVATIONS

Plots with foliar applied fertilizer tended to achieve row closure sooner than the check plots. As the growing season progressed, the foliar applied fertilizer plots had a higher number of pods that were closer together as compared to the check. Plant height was consistent among all plots. Foliar applied fertilizer treatments tended to stay greener longer into the season when compared to the no foliar applied fertilizer plots and overall plant health appeared better.

The foliar feed application was conducted on June 14 and July 18 using a CaseIH high clearance sprayer.

This John Deere combine with a calibrated yield monitor was used to collect harvest data for this trial.

Tools of the Trade

Case IH High Clearance Sprayer

This sprayer allows for in-season application of crop protection and crop nutrition inputs. Row crop tires and spacing allow for minimal vehicle inflicted damage during field operations.

SUMMARY

- Overall plant health and pod number was better in foliar applied fertilizer plots in 2018.
- A yield difference was observed between the foliar applied products and the untreated areas other than K-Fuel. Three of the foliar feed treatments exhibited a statistically higher yields.
- An economic decision tool may be used to determine if yield increase justifies the cost of product and application.

PROJECT CONTACT

For inquiries about this project, contact Wayne Dellinger, Extension Education, Agriculture and Natural Resources, OSU Extension - Union County (dellinger.6@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Finish Line	14.0	71 a
Triple Option	13.9	70 a
K-Fuel	13.9	60 b
Play Maker	13.5	69 a
No Foliar Application	13.9	59 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: 2.89 CV: 2.07%

OBJECTIVE

Measure soybean yield response to foliar fungicide.

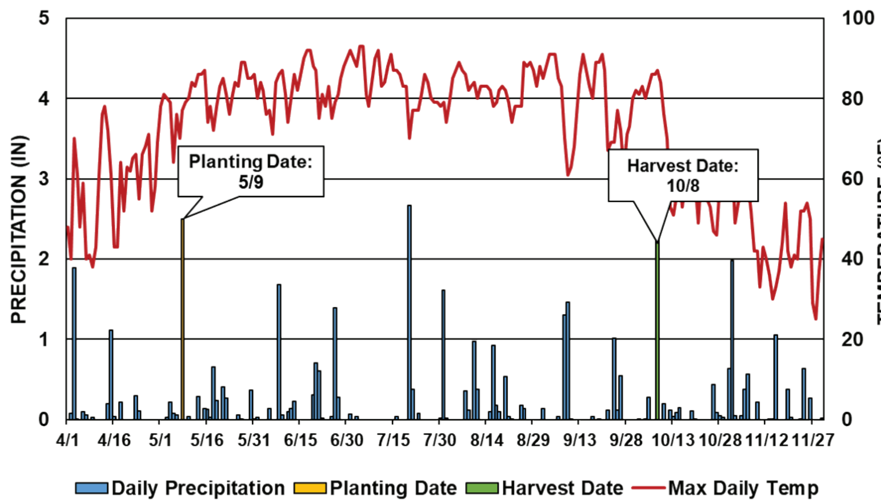
eFields Collaborating Farm

OSU Extension

Fayette County

STUDY INFORMATION

Planting Date	5/9/2018
Harvest Date	10/8/2018
Variety	Beck's 366
Population	Variable-Rate
Acres	78
Treatments	2
Reps	6
Treatment Width	90 ft.
Tillage	No-Till
Herbicide	Mertribuzin, Sharpen, 2,4-D, Metalachlor, Liberty
Fungicide	Azoxystrobin, Propiconazol
Previous Crop	Corn
Row Width	15 in.
Soil Type	Brookston silty clay, 49% Celina silt loam, 28% Crosby silt loam, 23%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.32	3.04	5.72	4.91	4.05	22.04
Cumulative GDDs	158	781	1,446	2,169	2,892	2,892

STUDY DESIGN

Frogeye leaf spot was diagnosed in this field in late July. Fungicide was applied during late R3 growth stage in replicated strips across the field to control the disease and reduce yield impacts.

Treatments	Application Rate (oz/ac)
Treated	14
Untreated	None

Soybean fungicide trial ready for harvest.

OBSERVATIONS

Disease ratings were taken prior to defoliation to determine if the fungicide helped control the severity of Frogeye Leaf Spot. Disease severity was higher in untreated areas of the field. Senescence and defoliation occurred earlier in untreated plots with the fungicide treated plots remaining greener later in the season.

The leaf on the left is from an untreated plot and the leaf on the right is from a treated plot. Differences in disease pressure were observed between treatments at the end of the season prior to defoliation.

Tools of the Trade

Crop Protection Apps

Apps can support crop protection by providing the ability to communicate information, assist with field scouting, collect and access data, and more. This publication provides a list of commonly used apps and their descriptions.
go.osu.edu/CropProtectionApps

SUMMARY

- Frogeye leaf spot was diagnosed in late July.
- A difference in disease severity was observed between untreated and treated plots, with higher severity occurring in the untreated plots.
- The yield was significantly higher in the treated plots than the untreated plots. In this study a 5 bu/ac advantage was found from using a fungicide to minimize Frogeye leaf spot.

PROJECT CONTACT

For inquiries about this project, contact Ken Ford, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Fayette County (ford.70@osu.edu).

Treatments	Frogeye Disease Rating (%)	Moisture (%)	Yield (bu/ac)
Treated	10	12.6	67 a
Untreated	26	12.6	62 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: 3.23 CV: 4.31%

OBJECTIVE

Measure soybean yield response to foliar fungicide.

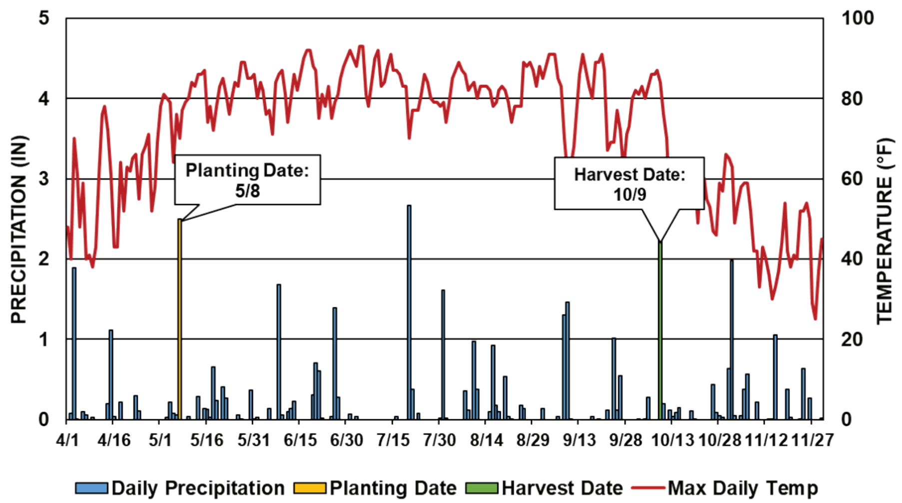
eFields Collaborating Farm

OSU Extension

Fayette County

STUDY INFORMATION

Planting Date	5/8/2018
Harvest Date	10/9/2018
Variety	Beck's 366
Population	Variable-Rate
Acres	67
Treatments	2
Reps	7
Treatment Width	90 ft.
Tillage	No-Till
Herbicide	Metribuzin, Sharpen, 2-4D, Metalachlor, Liberty
Fungicide	Azoxystrobin, Propiconazol
Previous Crop	Corn
Row Width	15 in.
Soil Type	Brookston silty clay, 71% Miamian silt loam, 20% Celina silt loam, 9%



Weather Summary

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Precip (in)	4.32	3.04	5.72	4.91	4.05	22.04
Cumulative GDDs	158	781	1,446	2,169	2,892	2,892

STUDY DESIGN

Frogeye leaf spot was diagnosed in this field in late July. Fungicide was applied during late R3 growth stage in replicated strips across the field to control the disease and reduce yield impacts.

Treatments	Application Rate (oz/ac)
Treated	14
Untreated	None

Calibrating the yield monitor prior to harvesting the foliar fungicide plot.

OBSERVATIONS

Disease ratings were taken prior to defoliation to determine if the fungicide helped control the severity of frogeye leaf spot. Disease severity was higher in untreated areas of the field. Senescence and defoliation occurred earlier in untreated plots with the fungicide treated plots remaining greener later in the season.

Tools of the Trade

Weigh Wagon

Calibrating your yield monitor is important to ensure accurate yield estimates. A weigh wagon is useful to quickly calibrate in the field prior to harvest.

When Frogeye was diagnosed in late July disease pressure was past the treatment threshold of 1-2 lesions per 25 ft. at R2.

SUMMARY

- A difference in disease severity was observed between untreated and treated plots, with higher severity occurring in the untreated plots.
- The yield response at this location was not statistically significant but the treated areas tended to yield more.
- Plant stand was highly variable in this field and likely reduced the chances of seeing a statistical difference in plot yields.

PROJECT CONTACT

For inquiries about this project, contact Ken Ford, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Fayette County (ford.70@osu.edu).

Treatments	Frogeye Disease Rating (%)	Moisture (%)	Yield (bu/ac)
Treated	10	13.3	64 a
Untreated	26	13.4	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: Not significant
CV: 4.93%

OBJECTIVE

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

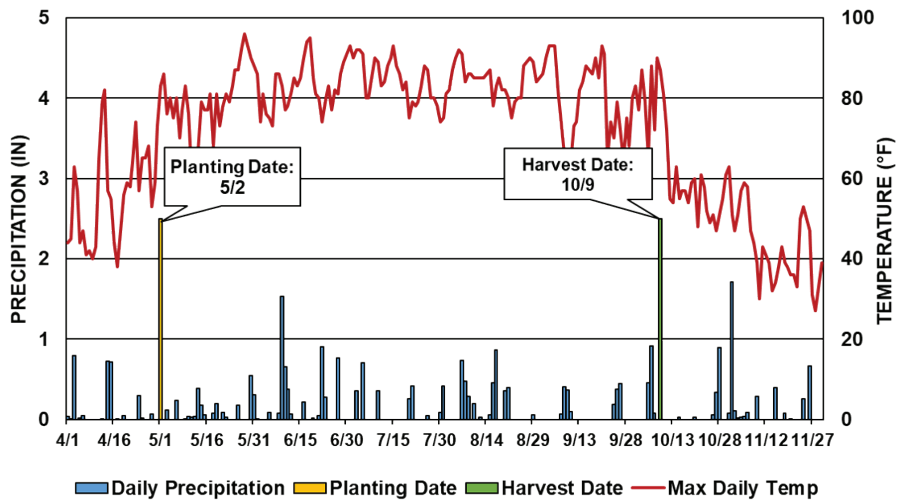
eFields Collaborating Farm

OSU Extension

Hancock County

STUDY INFORMATION

Planting Date	5/2/2018
Harvest Date	10/9/2018
Variety	USA 323LL
Population	150,000
Acres	72
Treatments	2
Reps	5
Treatment Width	25 ft.
Tillage	No-TIll
Herbicide	Glyphosate, Liberty
Previous Crop	Soybean
Row Width	15 in.
Soil Type	Blount silt loam, 79% Pewamo silty clay loam, 21%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.80	2.54	5.04	2.66	3.91	16.95
Cumulative GDDs	134	698	1,388	2,127	2,887	2,887

STUDY DESIGN

Experiment was a randomized block design with five replications. Plots were 30 feet wide and 510 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-hand moisture tester. Treatments consisted of no fungicide versus foliar fungicide applied at Growth Stage R3. Fungicide Trivapro was applied at the rate of 13.7 oz/acre.

Treatments	Application Rate (oz/ac)
No Foliar Fungicide	None
Foliar Fungicide	13.7

Application of foliar fungicide at during the R3 growth stage using a John Deere sprayer.

OBSERVATIONS

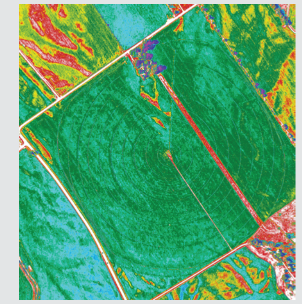
Stands were uniform across field. No disease was evident at time of fungicide application and harvest. Plots that received no fungicide were darker in color at harvest than those that received a fungicide treatment.

This picture of the field confirms that no disease was evident at the time of fungicide application.

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.



SUMMARY

- Foliar fungicide did not significantly increase soybean yield.
- Lack of disease pressure may be the reason yields did not increase from foliar fungicide.

PROJECT CONTACT

For inquiries about this project, contact Ed Lentz, Professor, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Hancock County (lentz.38@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
No Foliar Fungicide	13.3	71 a
Foliar Fungicide	13.2	75 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: Not significant
CV: 2.01%

OBJECTIVE

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

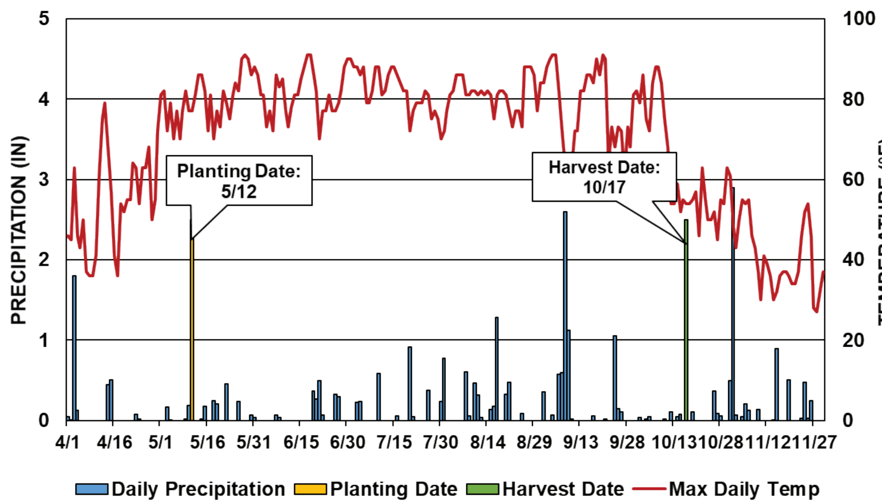
eFields Collaborating Farm

OSU Extension

Darke County

STUDY INFORMATION

Planting Date	5/12/2018
Harvest Date	10/17/2018
Variety	Asgrow 3832
Population	165,000
Acres	19
Treatments	3
Reps	3
Treatment Width	60 ft.
Tillage	No-Till
Herbicide	2,4-D, Roundup, Metrubuzin, Sonic
Fungicide	Trivapro
Pesticide	Province II
Previous Crop	Corn
Row Width	15 in.
Soil Type	Crosby silt loam, 83% Brookston silty clay loam, 17%



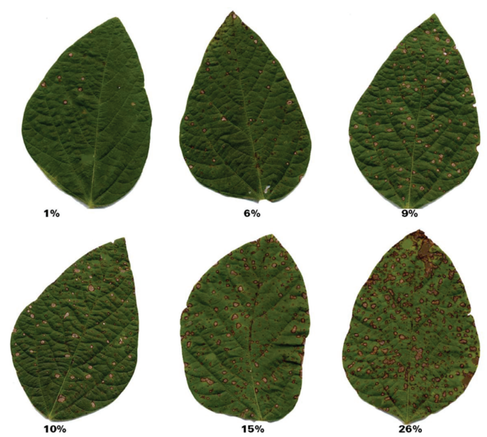
Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.03	1.85	1.94	3.46	3.97	14.25
Cumulative GDDs	113	692	1,349	1,997	2,677	2,677

STUDY DESIGN

This study was organized as a randomized complete block with three replications. Plot width was 60 ft. Plot length was field length. Combine yield monitor data was used utilized for measurement of soybean yields. Combine was calibrated in season where yield monitor data was used for crop yield.

Treatments	Products
Untreated	None
Fungicide	Trivapro (13.7 oz/ac)
Fungicide and Pesticide	Trivapro (13.7 oz/ac) and Province II (1.6 oz/ac)



To learn more about the identification of Frogeye Leaf Spot, use the QR code above or visit: ohioline.osu.edu/factsheet/AC-53

OBSERVATIONS

Heavy pressure of Frogeye leaf spot and stinkbugs were observed in the field. On July 2, Frogeye lesions were found in the soybeans at a pressure of about 6 lesions per 25 ft. of row. Treated areas appeared to have lighter pressure while untreated beans continued to show more Frogeye lesions. Record rainfall in July and August allowed for heavy infestation of tissue diseases.

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.

The first visible sign of Frogeye on a soybean leaf. Before damage is visible, the infection may have spread through the leaf.

SUMMARY

- There was no significant difference in moisture levels across all treatments.
- Statistically between the treatments, there was no difference between the fungicide only and the fungicide plus pesticide. However, both were significantly better than no treatment.
- Economically, value was identified in both a fungicide and fungicide plus pesticide treatment.

PROJECT CONTACT

For inquiries about this project, contact Sam Custer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Darke County (custer. 2@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Untreated	14.5	60 b
Fungicide	14.4	65 a
Fungicide and Pesticide	14.4	66 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: 3.70 CV: 3.32%

Fungicide Timing

OBJECTIVE

Determine the effect of applying a soybean fungicide at R2 versus R3 upon Frogeye disease pressure and soybean yield.

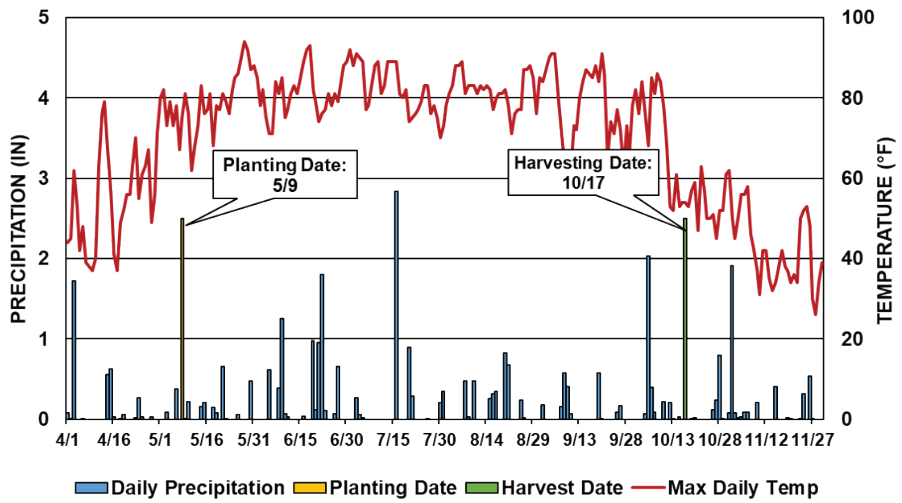
eFields Collaborating Farm

OSU Extension

Auglaize County

STUDY INFORMATION

Planting Date	5/9/2018
Harvest Date	10/17/2018
Variety	Wellman 1735 LL
Population	175,000
Acres	38
Treatments	3
Reps	3
Treatment Width	90 ft.
Tillage	No-Till
Herbicide	Liberty
Previous Crop	Corn
Row Width	7.5 in.
Soil Type	Blount silt loam, 76% Pewamo silt clay loam, 24%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	7.06	4.94	3.65	21.58
Cumulative GDDs	117	669	1,330	2,016	2,728	2,728

STUDY DESIGN

This trial was designed as a randomized complete block having three replications. Plot width was 90 ft. and plot length was 842 ft. The fungicide was applied with a John Deere sprayer equipped with Twinjet nozzles, calibrated to deliver 20 gal/ac and traveled 12.6 miles per hour. The fungicide, Quadris Top SBX, was applied at 9.0 fluid ounces per acre to soybean at R2 on July 3, 2018 and to soybean at R3 on July 15, 2018. A surfactant, 90/10 PCT NIS, was added to the fungicide mixture at 0.25% by volume. Disease pressure was evaluated on August 27, 2018. The center 70 ft. of each plot was harvested.

Treatments	Application Rate (fl oz/ac)
No fungicide	None
Quadris Top SBX at R2	9.0
Quadris Top SBX at R3	9.0

OBSERVATIONS

The soybeans at this location suffered excessive moisture stress at times during the growing season.

There was no Frogeye present at the time of the fungicide applications, however it did infest the study site as the season progressed. Seed quality was visibly poorer for the untreated plots.

Soybean field at the time of scouting. Recommended timing of treatment for Frogeye leaf spot is before R3.

Tools of the Trade

C.O.R.N Newsletter

This newsletter provides timely information on in-season conditions. Subscribe to receive information on when disease pressure is high in Ohio and tips for management.
go.osu.edu/cornsubscribe

SUMMARY

- Frogeye leaf spot was least evident when observed on August 27, 2018 when the Quadris Top SBX was applied at the R3 stage.
- Applying a fungicide at the R2 and R3 stage both showed a significant yield increase.
- There were no statistical differences in yield between timings of the fungicide application.

PROJECT CONTACT

For inquiries about this project, contact Jeff Stachler, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Auglaize County (stachler.1@osu.edu).

Treatments	Frogeye Disease Rating (%)	Moisture (%)	Yield (bu/ac)
No fungicide	11.1	14.3	61 b
Quadris Top SBX at R2	4.8	14.3	66 a
Quadris Top SBX at R3	2.2	14.3	67 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: 2.37 CV: 2.12%

OBJECTIVE

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

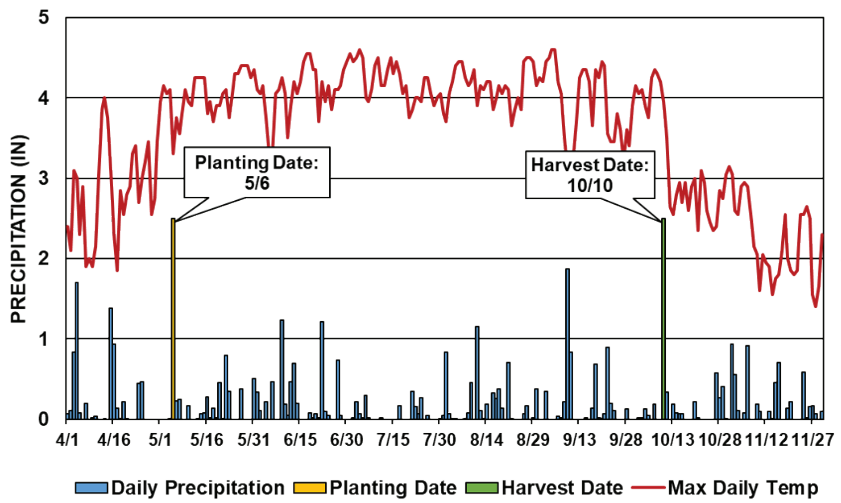
eFields Collaborating Farm

OSU Extension

Franklin County

STUDY INFORMATION

Planting Date	5/6/2018
Harvest Date	10/10/2018
Variety	Beck's 314L4 &296L4
Population	Variable-Rate
Acres	66
Treatments	3
Reps	4
Treatment Width	40 ft.
Tillage	No-Till
Previous Crop	Corn
Row Width	15 in.
Soil Type	Eldean silt loam, 58% Thackery silt loam, 41% Miamian silt loam, 1%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

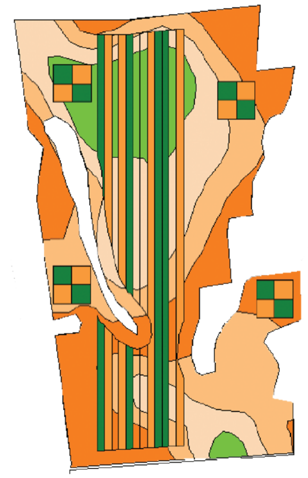
Multi-variety planting involves seeding two varieties, as opposed to just one, in a field. Producers select an offensive variety, which is best suited for higher-yielding soils, and a defensive variety, which is better suited for tougher ground. One of the main difficulties with multi-variety planting soybeans is matching the varieties to soil landscapes. Multi-variety planting technology allows you to carry two varieties and place them based on a prescription written prior to growing season. Prescriptions can be based on a variety of factors including but limited to yield history, DEM, CEC, OM, remote-sensed imagery, and more. Check strips and blocks were placed in the field to help analyze yield differences between the different varieties. Placing strips in the field allows for the evaluation of any and all prescription methods that a grower, agronomist, and/or seed salesperson may have in mind.

The 2018 protocol involved 0.25 to 0.5 acre blocks paired with strip checks. The treatments were selected to be a defensive and offensive variety, post-plant scouting and aerial imagery confirmed proper execution of the planting prescription.

Treatments	Variety	Planted Acres	Avg. Planted Population
Offensive Variety	Beck's 314L4	14.2	139,415
Defense Variety	Beck's 296L4	51.4	141,159

OBSERVATIONS

Above average rainfall allowed for a healthy crop despite extreme field variation seen in the field. Prescription zones were generated with all soybean yield history and 50% weighted corn history.



The resulting prescription is shown to the left. For this field, the green check strips represent the planted regions of the offensive variety (Beck's 314L4) and the orange strips/blocks represent the defensive variety (Beck's 296L4). This Rx was executed using a Precision Planting 20/20 Monitor.

Row track tractor 340 Case IH Magnum Rowtrac, 18" tracks, 120" spacing along with Case IH 1245 16/31 planter equipped with Precision Planting vSet Select components.

Tools of the Trade

Draper Headers

Draper heads have a more consistent feed, allowing for more even threshing, better cleaning result, and a smoother running machine. Draper heads used in soybean research this year include MacDon, Geringhoff, and Case IH 40' flex drapers.

SUMMARY

- If grower has not ever used variable rate seeding do not use multi-variety.
- Growers must be ready for seed logistics more than ever before.
- Planter calibration and setup is critical or will cause gaps and offsets in field critical transition areas.
- Mechanically, meters have little to no issues.
- No true defensive varieties on market, currently it is overloaded with varieties that are both and stay in the middle of genetics.
- Be prepared to make more planter adjustments based off seed shape and size as well as treatment.
- Be ready to fail and get variety placement wrong.
- Water and growing season affects results considerably.
- Seed coatings, seed treatments, biologicals will change economics on this technology.

PROJECT CONTACT

For inquiries, contact Andrew Klopfenstein, Senior Research Associate Engineer, Department of Food, Agricultural and Biological Engineering (klopfenstein.34@osu.edu) or Ryan Tietje, Research Associate Engineer (tietje.4@osu.edu).

Treatments (Variety)	Moisture (%)	Field Yield Productivity Zones from Rx (bu/ac)				Avg. Yield Check Strips (bu/ac)
		Very Low	Low	Medium	High	
Offensive Variety	14.2	47	65	69	75	68
Defensive Variety	14.3	46	65	71	74	69
Prescription	14.3	55	62	70	72	70

OBJECTIVE

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

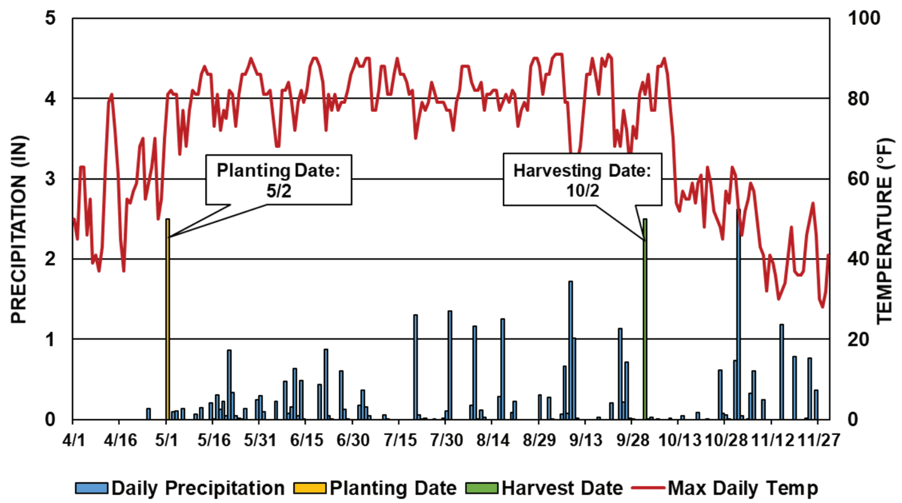
eFields Partner Farm

Beck's Hybrids

Madison County

STUDY INFORMATION

Planting Date	5/2/2018
Harvest Date	10/2/2018
Variety	Beck's 394L4
Population	150,000
Acres	39
Treatments	2
Reps	5
Treatment Width	40 ft.
Tillage	Conventional
Previous Crop	Corn
Row Width	15 in.
Soil Type	Crosby-Lewisburg silt loam, 41% Kokomo silty clay loam, 28% Miamian-Eldean silt loam, 25% Sloan silty clay loam, 6%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

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. This investigation evaluated the implementation of Camso tracks installed on a Case IH 1245 Early Riser Planter. The same tractor and planter were used throughout the study except for the installation of tracks in the "Tracked Planter" treatment.

Traffic Systems

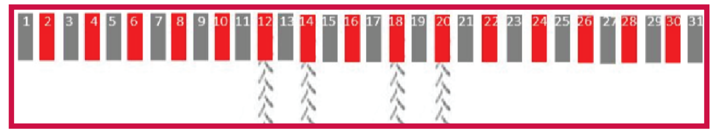
Treatment	Tractor	Planter
Wheeled Planter	340 Case IH Magnum RowTrac 18" Tracks	Standard Case IH 1245 Wheels
Tracked Planter	340 Case IH Magnum RowTrac 18" Tracks	Camso TTS 35-2011 20" Tracks

Planting of the "Tracked Planter" treatment at the Beck's Hybrids location in London, OH. Soil moisture and temperature were found to be adequate during planting.

OBSERVATIONS

The Ohio State Digital Ag Team has completed multiple pinch row studies for corn in previous years. For 2018, the team decided to investigate the effects of planter track systems on soybeans in conventionally tilled soils.

Pinch Rows
Pinch row compaction is a common problem on every planter/tractor combination and especially bulk fill planters. Pinch rows are defined as any row that would be influenced due to compaction of the soil that falls within the tractor and/or implements footprint.



As seen above, Rows 11, 12, 13, 14, 15, 17, 18, 19, 20, 21 are considered the "pinch rows" and are affected by compaction from either/both the tractor and planter.

Left: Traffic depressions by wheeled planter treatment.
Right: Traffic depressions left by tracked planter treatment.

Harvesting
This study was harvested with the use of Precision Planting YieldSense to ensure accurate data collection. In order to harvest the desired area of interest, a 40 ft. header was used to harvest the exact pass width of each test strip.

Tools of the Trade

340 Case IH Magnum RowTrac

This 340 Magnum RowTrac tractor was a favorite of the Ohio State Digital Ag Team during #Plant18. The RowTrac option performed well during all field conditions, helping to efficiently get power to the ground.

SUMMARY

- The two pinch row treatments were within a bushel and no statistical difference was noticed.
- Results are reported based on 40 ft. planter widths.

Map of downforce from Climate FieldView Cab.

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Department of Food, Agricultural and Biological Engineering (klopfenstein.34@osu.edu) or Ryan Tietje, Research Associate Engineer (tietje.4@osu.edu).

Treatments (Planter Type)	Moisture (%)	Yield (bu/ac)
Wheeled Planter	11.0	68 a
Tracked Planter	11.0	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: Not significant CV: 2.04%

OBJECTIVE

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

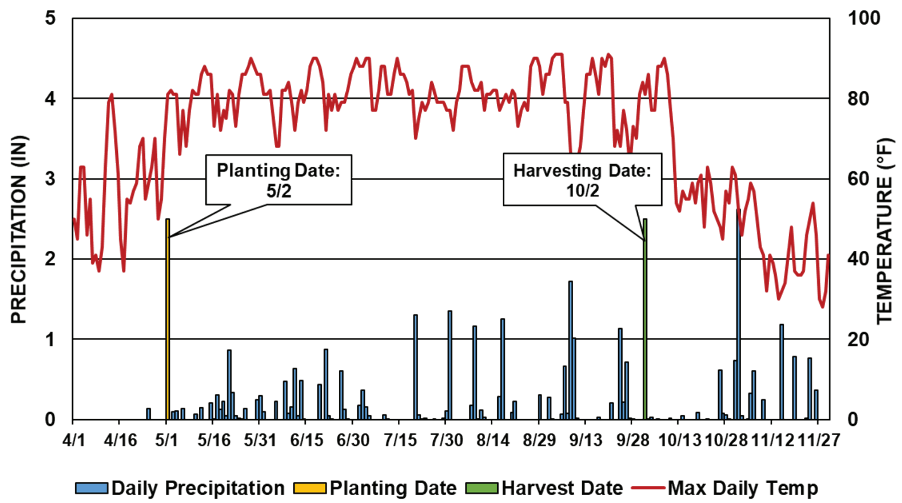
eFields Partner Farm

Beck's Hybrids

Madison County

STUDY INFORMATION

Planting Date	5/2/2018
Harvest Date	10/2/2018
Variety	Beck's 394L4
Population	150,000
Acres	39
Treatments	2
Reps	5
Treatment Width	40 ft.
Tillage	No-Till
Previous Crop	Corn
Row Width	15 in.
Soil Type	Crosby-Lewisburg silt loam, 43% Miamian silt loam, 19% Westland silty clay loam, 15% Sloan silty clay loam, 15% Eldean silt loam, 8%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

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. This investigation evaluated the implementation of Camso tracks installed on a Case IH 1245 Early Riser Planter. The same tractor and planter were used throughout the study except for the installation of tracks in the "Tracked Planter" treatment.

Traffic Systems

Treatment	Tractor	Planter
Wheeled Planter	340 Case IH Magnum RowTrac 18" Tracks	Standard Case IH 1245 Wheels
Tracked Planter	340 Case IH Magnum RowTrac 18" Tracks	Camso TTS 35-2011 20" Tracks

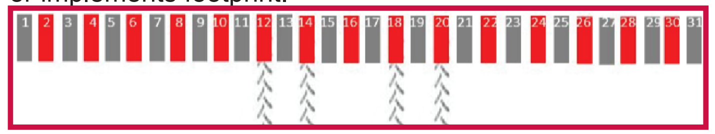
Planting of the "Tracked Planter" treatment at the Beck's Hybrids location in London, OH. Soil moisture and temperature were found to be adequate during planting.

OBSERVATIONS

The Ohio State Digital Ag Team has investigated multiple Pinch Row Studies for corn. For 2018, the team decided to investigate the effects of planter track systems on soybeans iin no-till soils.

Pinch Rows

Pinch row compaction is a common problem on every planter/tractor combination and especially bulk fill planters. Pinch rows are defined as any row that would be influenced due to compaction of the soil that falls within the tractor and/or implements footprint.



As seen above, Rows 11, 12, 13, 14, 15, 17, 18, 19, 20, 21 are considered the "pinch rows" and are affected by compaction from either/both the tractor and planter.

This study was harvested with the use of Precision Planting YieldSense to ensure accurate data collection. A 40 ft. header was used to harvest the exact pass width of each test strip.

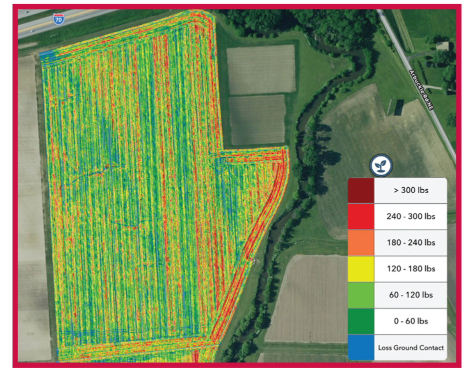
Tools of the Trade

FieldView™ Cab App

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

- The two pinch row treatments were within a bushel and no statistical difference was noticed.
- Results are reported based on 40 ft. planter widths.



Map of downforce from Climate FieldView Cab.

PROJECT CONTACT

For inquiries about this project, contact Andrew Klopfenstein, Senior Research Associate Engineer, Department of Food, Agricultural and Biological Engineering (klopfenstein.34@osu.edu) or Ryan Tietje, Research Associate Engineeri (tietje.4@osu.edu).

Treatments (Planter Type)	Moisture (%)	Yield (bu/ac)
Wheeled Planter	14.7	67 a
Tracked Planter	14.8	67 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: Not significant CV: 4.78%

OBJECTIVE

Understand the effect of added starter fertilizer on soybean yield.

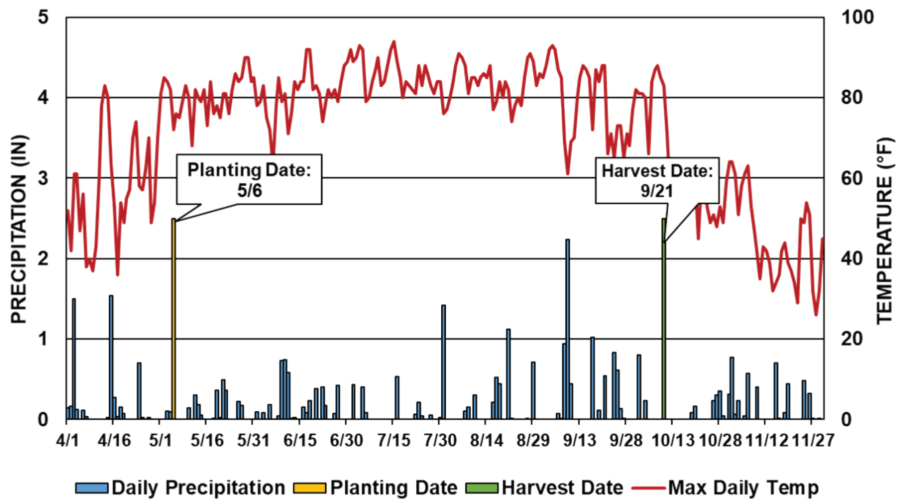
eFields Collaborating Farm

OSU Extension

Knox County

STUDY INFORMATION

Planting Date	5/6/2018
Harvest Date	9/21/2018
Variety	SC9277R
Population	145,000
Acres	90
Treatments	2
Reps	5
Treatment Width	60 ft.
Tillage	No-Till
Herbicide	Canopy, Metribuzin, 2-4,D, Glyphosate
Previous Crop	Corn
Row Width	15 in.
Soil Type	Bennington silt loam, 62% Centerburg silt loam, 30% Holly silt loam, 8%



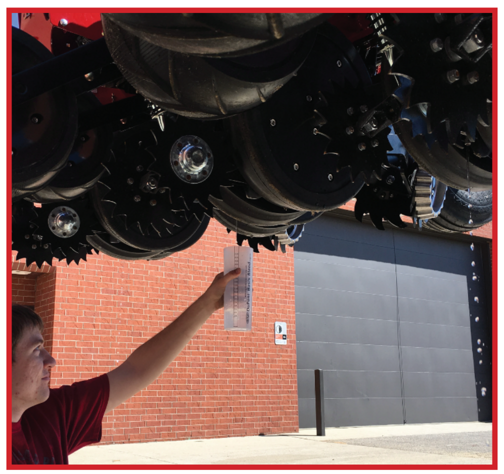
Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.88	2.49	4.37	3.24	3.57	18.55
Cumulative GDDs	146	741	1,373	2,101	2,830	2,830

STUDY DESIGN

This experiment utilized a randomized complete block design with five replications. Plot widths were 60 ft. Plot lengths were 200 ft. A calibrated yield monitor was utilized to collect harvest data. The combine was calibrated in season. Treatments consisted of starter fertilizer at the farmer's standard rate vs. no starter fertilizer.

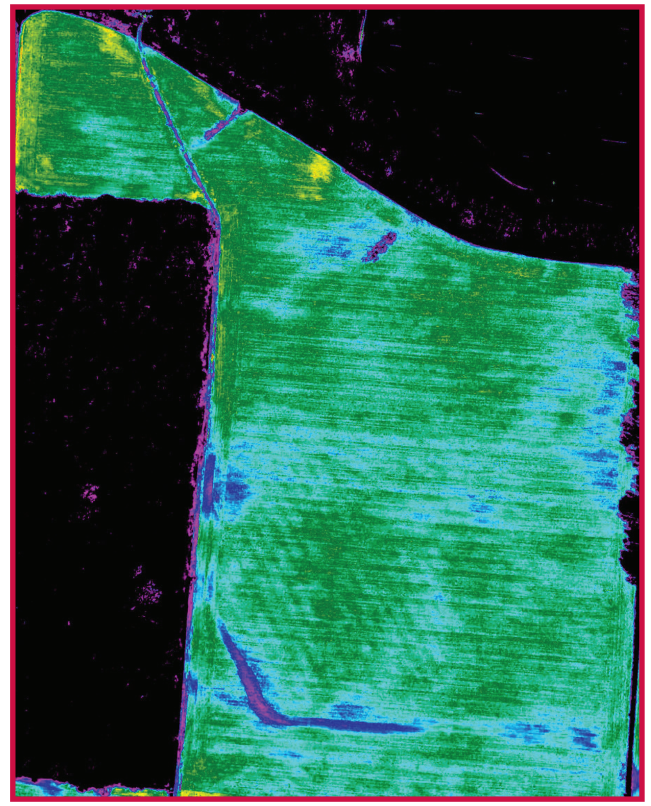
Treatments	Application Rate (lbs N/ac)
Starter - 28% UAN	60
No Starter	None



As with all fertilizer application systems, it is important to calibrate starter systems before going to the field.

OBSERVATIONS

Throughout the year, plant growth was monitored for any potential treatment differences. There were color differences observed in the treatments. The plots with starter fertilizer were greener in color throughout the growing season.



Drone imagery showed greener/healthier plants throughout the year with a starter application. However, this did not translate into higher yields.

Tools of the Trade

DJI Inspire Drone

Aerial imagery from drones such as the DJI Inspire can help better visualize spatial variation in crop health and can be used for targeted scouting.

SUMMARY

- No significant difference between yields was noted.
- There appears to be no response to the additional fertilizer within this field. This is likely because the soil test values were in the maintenance range.
- Economically, there is a $29.00 disadvantage (reduction in return) when applying starter fertilizer.

PROJECT CONTACT

For inquiries about this project, contact John Barker, Assistant Professor, Extension Educator, Ohio State University - Knox County (barker.41@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
Starter	11.5	65 a
No Starter	11.8	66 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: Not significant CV: 3.35%

Soybean Seeding Rate - Summary

Soybean

OBJECTIVE

Understand the yield impact of varying soybean seeding rates within Ohio considering in-field variability and cultural practices implemented. Information from this trial will be used to improve management recommendations for growers throughout Ohio understand how variable-rate seeding may impact field-by-field profit.

STUDY DESIGN

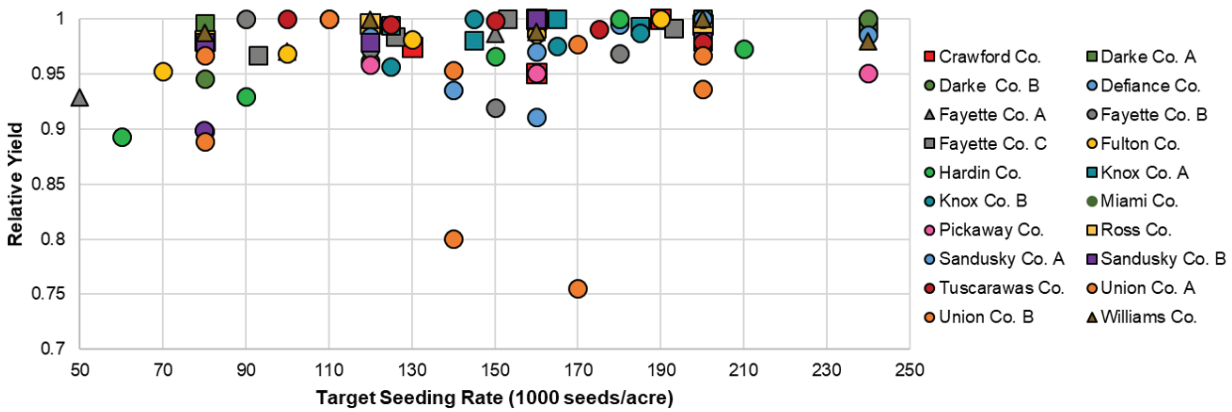
The primary recommendations for seeding rates in Ohio are determined by target final stands and "average" soil productivity. Variable-rate seeding prescriptions have the potential to better match seeding rate to productivity zones in an effort to optimize profits. Field studies were implemented in a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

Tools of the Trade

Sound information and data on soybean variety selection and associated seeding rate for 1) planter or seeder, and 2) recommended final population.

SUMMARY

- Across all sites, the average soybean emergence was 83% with individual sites ranging between 60% to 92%. Two locations observed plant counts higher than target seeding rates, likely due to limitations of planter metering.
- Variation in soybean yield was primarily caused by differences in location and not differences in seeding rates in 2018.
- There was a significant response to soybean seeding rate at 9 out of 20 sites in 2018.



Relative yield versus target seeding rate for each soybean seeding rate trial location. Yield values were normalized to to the maximum yield at each location.

EXAMPLE FIELD LAYOUT

To maximize learning, a minimum of five different seeding rates should be compared. More rates can be added, if adequate space is available. The seeding rates compared in the trial need to be different enough to have the potential to affect yield, a minimum difference of 40,000 seeds/acre between each treatment is recommended. It may be necessary to adjust these seeding rates slightly based on your equipment capabilities.

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 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.

Planter Pass	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Replication			1					2					3					4		
Plot ID	101	102	103	104	105	201	202	203	204	205	301	302	303	304	305	401	402	403	404	405
Description	80k	200k	160k	240k	120k	160k	120k	80k	120k	240k	120k	240k	80k	160k	200k	200k	240k	120k	80k	160k

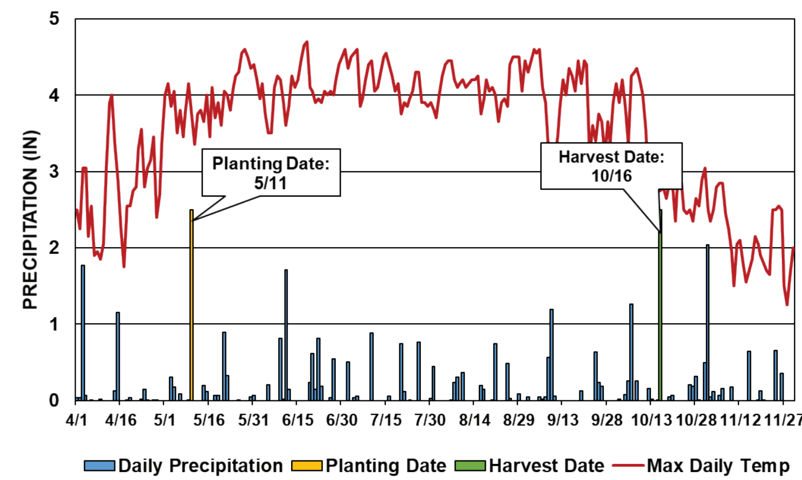
eFields Collaborating Farm

OSU Extension

Crawford County

STUDY INFORMATION

Planting Date	5/11/2018
Harvest Date	10/16/2018
Variety	Asgrow 30X6
Population	Treatments
Acres	90
Treatments	3
Reps	4
Treatment Width	90 ft.
Tillage	No-till
Herbicide	Warrant, Extendimax, Glyphosate
Previous Crop	Corn
Row Width	10 in.
Soil Type	Pewamo silty clay loam, 58% Bennington silt loam, 31% Cardington silt loam, 11%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.48	2.51	5.48	3.64	2.63	17.74
Cumulative GDDs	127	672	1,325	2,024	2,739	2,739

PROJECT CONTACT

For inquiries about this project, contact Jason Hartschuh, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Crawford County (hartschuh.11@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
130,000	119,750	13.4	71 b	557
160,000	135,500	13.4	70 c	529
190,000	176,000	13.4	73 a	547
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: 1.19 CV: 1.22%	

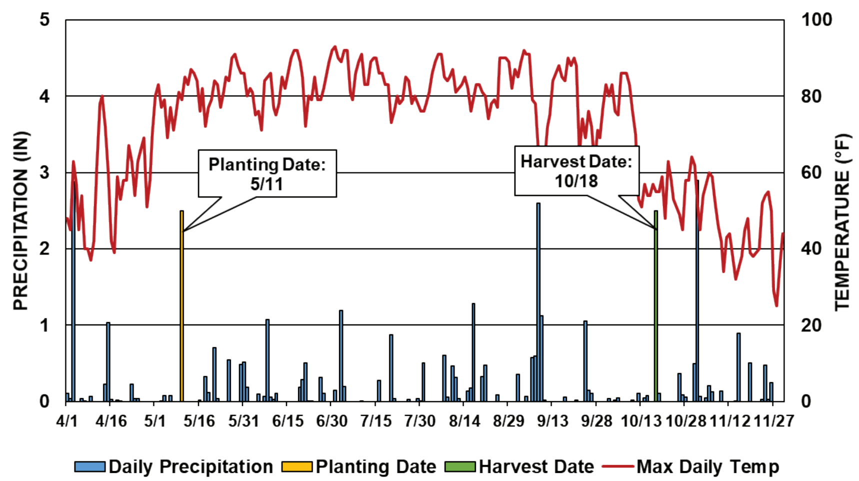
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Darke County - A

Planting Date	5/11/2018
Harvest Date	10/18/2018
Variety	Channel 3617 R2X
Population	Treatments
Acres	63
Treatments	6
Reps	4
Treatment Width	80 ft.
Tillage	No-Till
Previous Crop	Soybeans
Row Width	30 in.
Soil Type	Crosby silt loam, 68% Brookston silty clay loam, 32%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.78	3.04	3.06	3.32	3.97	18.17
Cumulative GDDs	142	777	1,464	2,192	2,948	2,948

PROJECT CONTACT

For inquiries about this project, contact Sam Custer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Darke County (custer.2@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
80,000	71,500	14.5	68 a	551
120,000	109,125	14.6	68 a	533
160,000	144,350	14.5	68 a	516
200,000	178,938	14.6	68 a	499
240,00	216,813	14.5	68 a	482
Variable Rate	123,750	14.5	72 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: Not significant CV: 2.64%	

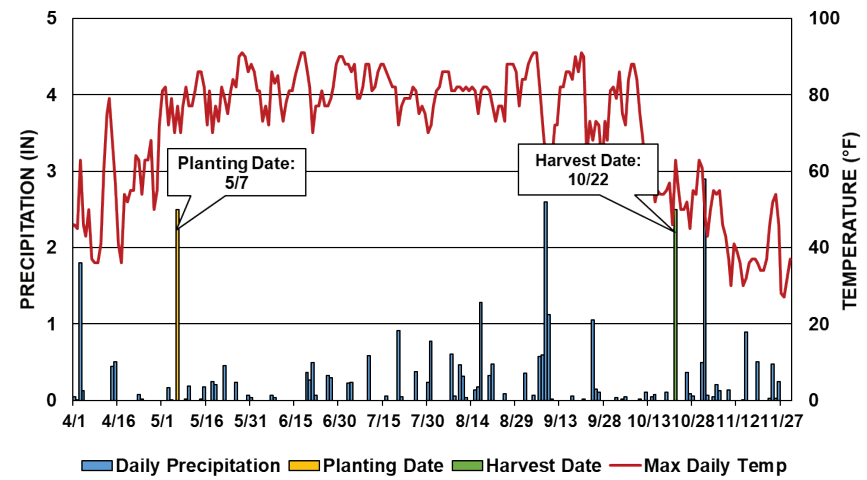
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Darke County - B

Planting Date	5/7/2018
Harvest Date	10/22/2018
Variety	Asgrow 3832
Population	Treatments
Acres	192
Treatments	5
Reps	3
Treatment Width	30 ft.
Tillage	No-Till
Herbicide	RoundUp, 2-4-D, Metribuzin, Sonic
Previous Crop	Corn
Row Width	15 in.
Soil Type	Crosby silt loam, 66% Celina silt loam, 18% Brookston silty clay loam, 13% Miamian silt loam, 3%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.03	1.85	1.94	3.46	3.97	14.25
Cumulative GDDs	113	692	1,349	1,997	2,677	2,677

PROJECT CONTACT

For inquiries about this project, contact Sam Custer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Darke County (custer.2@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
88,000	80,500	12.9	67 a	539
132,000	122,333	12.8	68 a	528
174,000	164,667	12.8	71 a	536
220,000	194,667	12.9	70 a	508
264,000	244,333	12.8	71 a	498
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: Not significant CV: 2.56%	

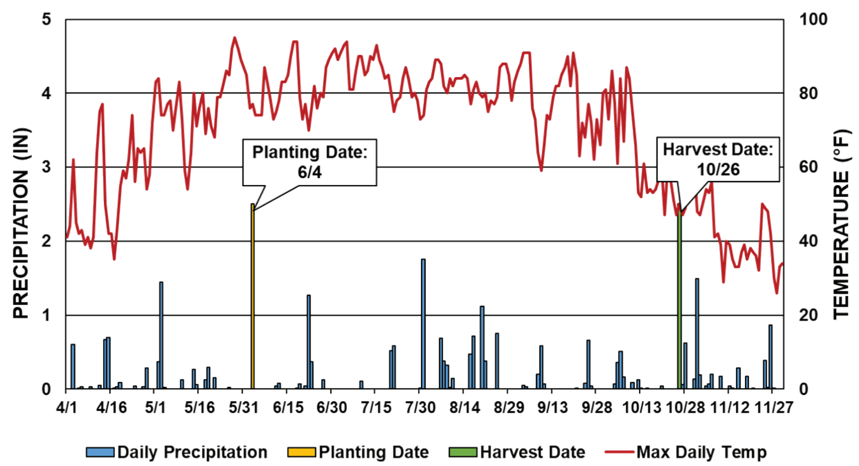
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Defiance County

Planting Date	6/4/2018
Harvest Date	10/26/2018
Variety	Asgrow 3231
Population	Treatments
Acres	29
Treatments	5
Reps	4
Treatment Width	30 ft.
Tillage	No-Till
Herbicide	Sharpen, Glyphosate, Brawl, Metribuzin
Fungicide	Acceleron
Previous Crop	Corn
Row Width	15 in.
Soil Type	Paulding clay, 55% Roselms silty clay, 45%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

PROJECT CONTACT

For inquiries about this project, contact Wm. Bruce Clevenger, Associate Professor, Extension Educator, Agriculture and Natural Resources, Area Leader, Ohio State University Extension- Defiance County (clevenger.10@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
140,000	155,267	13.8	40 a	282
160,000	163,200	13.8	39 a	264
180,000	180,200	13.8	42 a	287
200,000	195,500	13.9	43 a	280
240,000	225,533	13.8	42 a	258
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: Not significant CV: 8.95%	

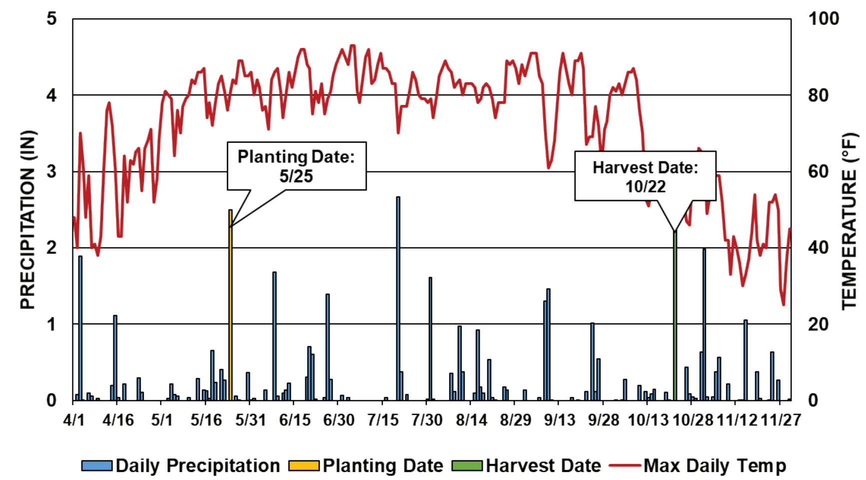
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Fayette County - A

Planting Date	5/25/2018
Harvest Date	10/22/2018
Variety	Seed Consultants SC3374LL
Population	Treatments
Acres	15
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	No-Till
Herbicide	Roundup, 2-4-D, Matador, Metribuzin, Liberty Link, Intensity, AMS
Previous Crop	Corn
Row Width	15 in.
Soil Type	Brookston silty clay loam, 74% Crosby silt loam, 25%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.32	3.04	5.72	4.91	4.05	22.04
Cumulative GDDs	158	781	1,466	2,169	2,892	2,892

PROJECT CONTACT

For inquiries about this project, contact Ken Ford, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension- Fayette County (ford.70@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
50,000	57,580	12.7	61 b	503
100,000	83,833	12.6	64 a	508
150,000	116,417	12.4	65 a	495
200,000	145,750	12.7	66 a	482
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: 2.62 CV: 3.15%	

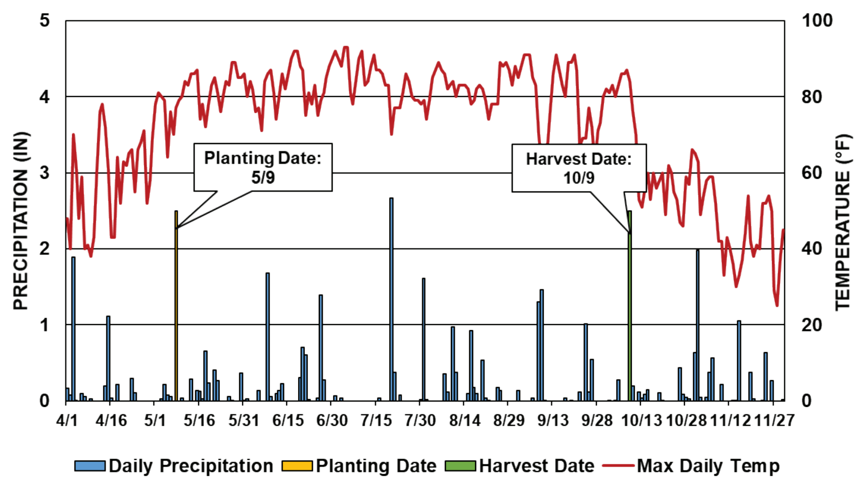
STUDY INFORMATION

Planting Date	5/9/2018
Harvest Date	10/9/2018
Variety	Seed Consultants SCS3357LL
Population	Treatments
Acres	28
Treatments	4
Reps	4
Treatment Width	60 ft.
Tillage	Vertical
Herbicide	Roundup, 2-4-D, Authority XL, Liberty, Clethodim
Previous Crop	Corn
Row Width	15 in.
Soil Type	Celina silt loam, 43% Brookston silty clay loam, 34% Crosby silt loam, 12%

eFields Collaborating Farm

OSU Extension

Fayette County - B



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.32	3.04	5.72	4.91	4.05	22.04
Cumulative GDDs	158	781	1,466	2,169	2,892	2,892

PROJECT CONTACT

For inquiries about this project, contact Ken Ford, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension- Fayette County (ford.70@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
93,000	53,240	12.8	65 a	519
126,000	75,891	12.8	66 a	514
153,000	80,054	12.8	67 a	511
193,000	110,642	12.8	66 a	485
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: Not significant CV: 3.57%	

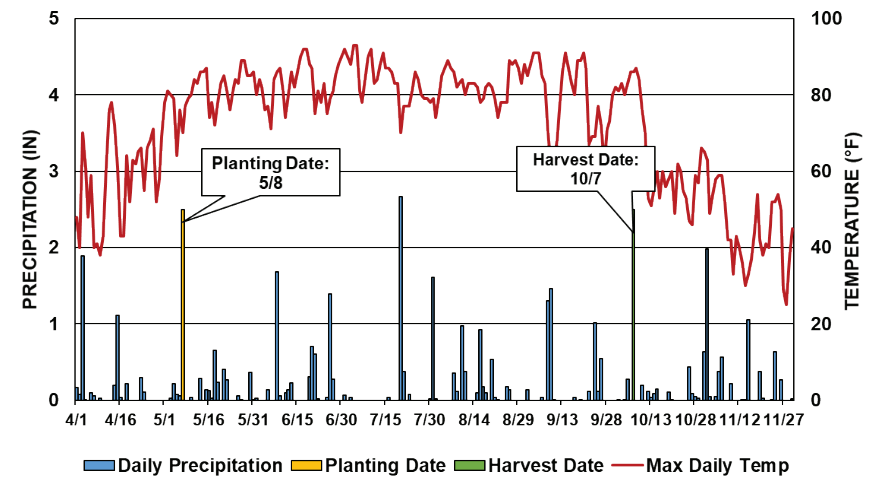
STUDY INFORMATION

Planting Date	5/8/2018
Harvest Date	10/7/2018
Variety	Becks 366
Population	Treatments
Acres	74
Treatments	4
Reps	3
Treatment Width	60 ft.
Tillage	No-Till
Herbicide	Metribuzin, Sharpen, 2-4-D, Metalachlor, Liberty
Previous Crop	Corn
Row Width	15 in.
Soil Type	Brookston silty clay, 72% Crosby silt loam, 23%, Westland silty clay loam, 5%

eFields Collaborating Farm

OSU Extension

Fayette County - C



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.48	2.51	5.48	3.64	2.63	17.74
Cumulative GDDs	127	672	1,325	2,024	2,739	2,739

PROJECT CONTACT

For inquiries about this project, contact Ken Ford, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension- Fayette County (ford.70@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
90,000	69,333	12.0	65 a	518
120,000	96,333	12.3	65 a	511
150,000	129,333	12.3	63 a	481
180,000	144,000	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: Not significant CV: 4.00%	

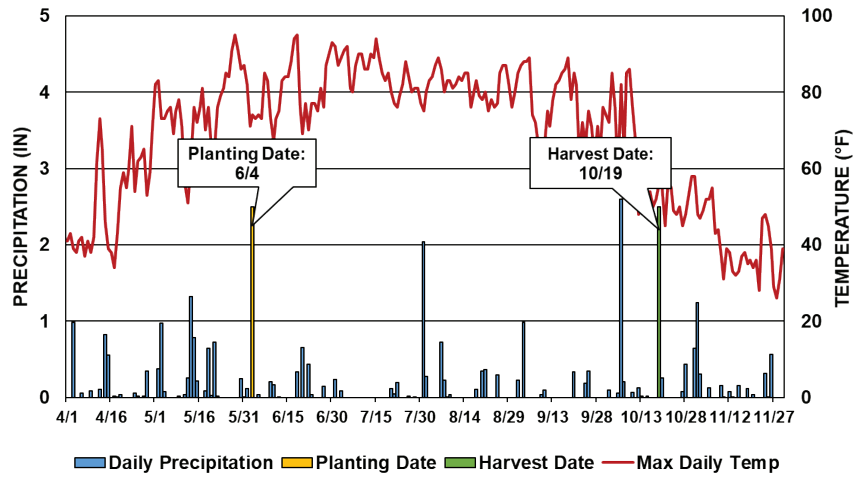
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Fulton County

Planting Date	6/4/2018
Harvest Date	10/19/2018
Variety	Beck's 315
Population	Treatments
Acres	63
Treatments	5
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Herbicide	Conquer, RoundUp PowerMax
Previous Crop	Corn
Row Width	30 in.
Soil Type	Hoytville clay loam, 44% Blount loam, 40% Haskins loam, 15%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.13	5.83	2.16	2.77	2.41	16.30
Cumulative GDDs	90	566	1,159	1,849	2,548	2,548

PROJECT CONTACT

For inquiries about this project, contact Eric Richer, Assistant Professor, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension- Fulton County (richer.5@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
70,000	66,125	13.0	63 c	512
100,000	91,125	13.0	64 bc	508
130,000	114,250	13.0	64 bc	495
160,000	143,375	12.9	65 ab	491
190,000	165,750	13.0	66 a	486
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: 1.73 CV: 2.14%	

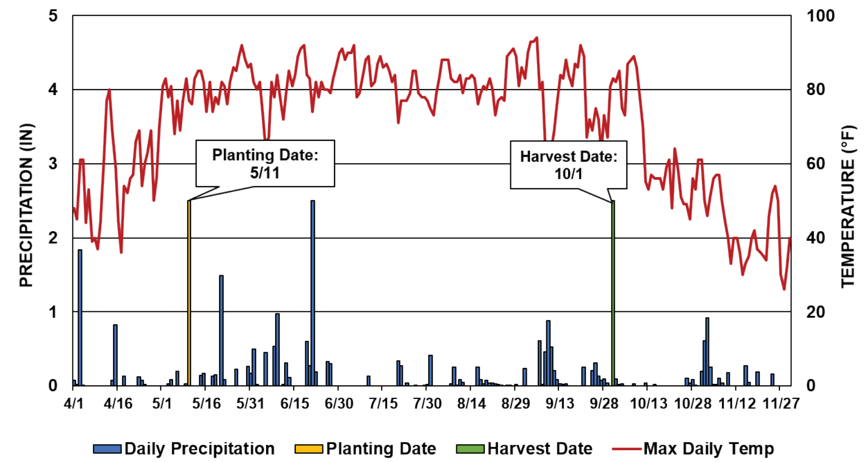
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Hardin County

Planting Date	5/11/2018
Harvest Date	10/1/2018
Variety	Beck's 296L4
Population	Treatments
Acres	156
Treatments	6
Reps	4
Treatment Width	60 ft.
Tillage	No-Till
Herbicide	Buckeneer Plus, Metribuzin
Previous Crop	Corn, Rye cover
Row Width	15 in.
Soil Type	McGuffey muck, 70% Roundhead muck, 17% Pewamo muck, 13%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	7.06	4.94	3.65	21.58
Cumulative GDDs	117	669	1,330	2,016	2,728	2,728

PROJECT CONTACT

For inquiries about this project, contact Mark Badertscher, Agriculture and Natural Resources Educator - Hardin County, (badertscher.4@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
60,000	51,250	12.5	67 c	551
90,000	75,750	12.1	70 bc	563
120,000	105,500	13.2	74 a	585
150,000	124,500	13.4	73 ab	564
180,000	129,750	13.3	76 a	577
210,000	182,500	12.3	74 a	547
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: 2.78 CV: 3.11%	

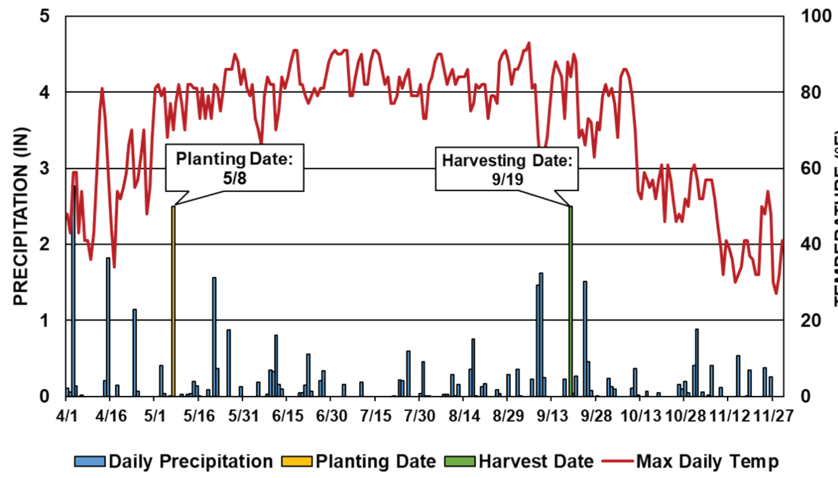
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Knox County - A

Planting Date	5/8/2018
Harvest Date	9/19/2018
Variety	SC9238R
Population	Treatments
Acres	19
Treatments	4
Reps	3
Treatment Width	40 ft.
Tillage	Vertical
Herbicide	2,4-D, Gramoxone, Prefix, Select, Durango
Previous Crop	Corn
Row Width	15 in.
Soil Type	Ockley silt loam, 66% Crane silt loam, 17% Fox Gravely loam, 14% Wooster silt loam, 3%



Use this QR code to access the corresponding eFields On-Farm Research video to this study. go.osu.edu/soybeanplantingrate

Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.49	3.93	3.38	1.87	2.38	18.05
Cumulative GDDs	133	723	1,363	2,078	2,802	2,802

PROJECT CONTACT

For inquiries about this project, contact John Barker, Extension Educator Agriculture/Amos Program - Knox County (barker.41@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
125,000	107,667	13.4	79 a	626
145,000	115,667	13.5	78 a	609
165,000	124,000	13.5	79 a	609
185,000	129,167	13.4	79 a	600
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: Not significant CV: 2.25%	

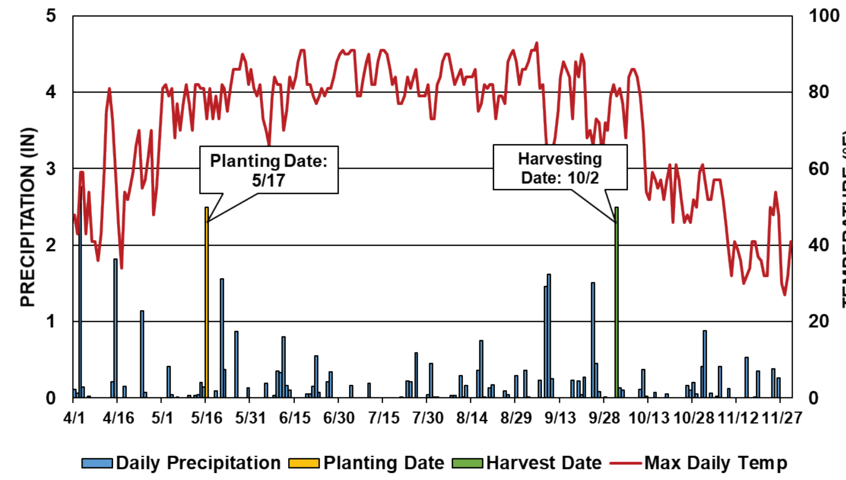
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Knox County - B

Planting Date	5/17/2018
Harvest Date	10/2/2018
Variety	P25A70R
Population	Treatments
Acres	54
Treatments	4
Reps	3
Treatment Width	40 ft.
Tillage	Vertical
Herbicide	2,4-D, Gramoxone, Prefix, Select, Durango
Previous Crop	Corn
Row Width	15 in.
Soil Type	Ockley silt loam, 48% Fox gravelly loam, 23% Bennington silt loam, 8% Centerburg silt loam, 4%



Use this QR code to access the corresponding eFields On-Farm Research video to this study. go.osu.edu/soybeanplantingrate.

Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.49	3.93	3.38	1.87	2.38	18.05
Cumulative GDDs	133	723	1,363	2,076	2,802	2,802

PROJECT CONTACT

For inquiries about this project, contact John Barker, Extension Educator Agriculture/Amos Program - Knox County (barker.41@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
125,000	109,833	14.6	67 b	523
145,000	125,333	14.7	70 a	540
165,000	141,500	14.8	68 ab	514
185,000	159,000	14.8	69 a	514
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: 1.94 CV: 1.78%	

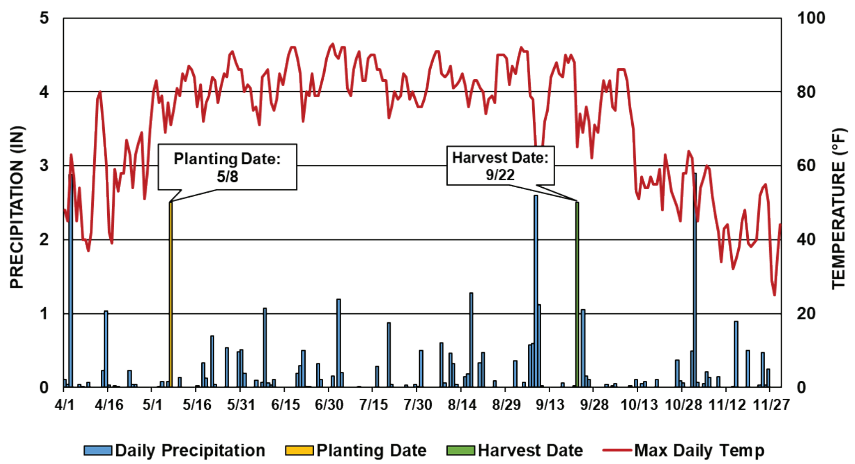
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Miami County

Planting Date	5/8/2018
Harvest Date	9/22/2018
Variety	Ebberts 339R2X
Population	Treatments
Acres	116
Treatments	4
Reps	4
Treatment Width	60 ft.
Tillage	No-Till
Previous Crop	Corn
Row Width	15 in.
Soil Type	Eldean loam, 74% Westland silty clay loam, 15% Warsaw silt loam, 9% Eldean-Casco gravelly loams 2%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.78	3.04	3.06	3.32	3.97	18.17
Cumulative GDDs	142	777	1,464	2,192	2,948	2,948

PROJECT CONTACT

For inquiries about this project, contact Amanda Bennett, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Miami County (bennett.709@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
80,000	60,889	11.1	79 b	645
120,000	85,583	11.1	79 b	628
160,000	105,028	11.1	81 a	628
200,000	128,806	11.0	79 b	594
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: 1.50 CV: 1.46%	

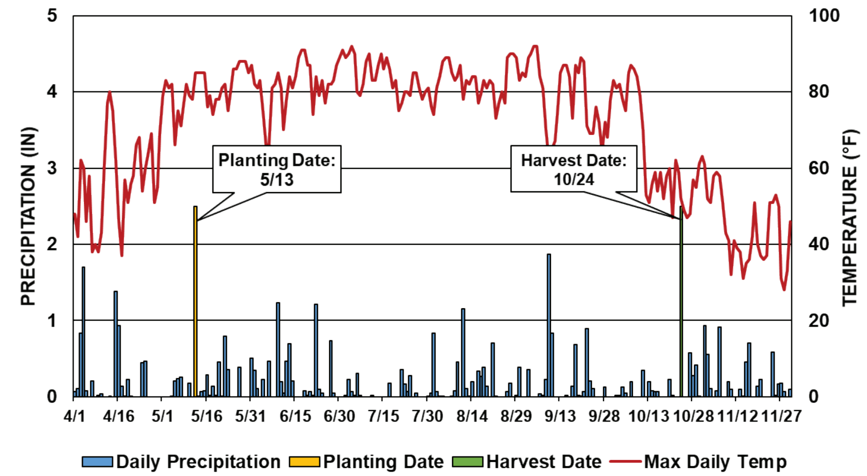
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Pickaway County

Planting Date	5/13/2018
Harvest Date	10/24/2018
Variety	P31A22X
Population	Treatments
Acres	70
Treatments	5
Reps	4
Treatment Width	40 ft.
Tillage	No-Till
Herbicide	2-4DB200, Roundup PowerMax
Previous Crop	Corn
Row Width	15 in.
Soil Type	Kokomo silty clay loam, 52% Miamian-Lewisburg silt loams, 27% Crosby silt loam, 21%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

PROJECT CONTACT

For inquiries about this project, contact Mike Estadt, Extension Educator, Agriculture and Natural Resources - Pickaway County, (estadt.3@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
80,000	58,758	11.4	53 c	422
120,000	96,703	11.4	57 b	439
160,000	125,211	11.3	56 bc	413
200,000	155,969	11.4	60 a	430
240,000	184,114	11.3	57 ab	387
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: 3.19 CV: 4.44%	

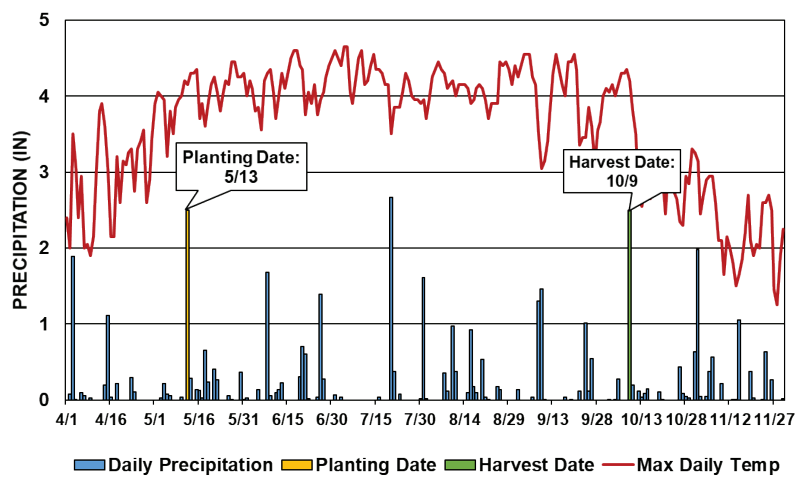
STUDY INFORMATION

Planting Date	5/13/2018
Harvest Date	10/9/2018
Variety	Pioneer 38T20X Xtend
Population	Treatments
Acres	154
Treatments	4
Reps	3
Treatment Width	40 ft.
Tillage	Conventional
Herbicide	Envive, Fexipan, Abundant, Edge
Previous Crop	Corn
Row Width	15 in.
Soil Type	Brookston silty clay loam, 54% Crosby silt loam, 32% Celina silt loam, 12% Miamian clay loam, 2%

eFields Collaborating Farm

OSU Extension

Ross County



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	4.32	3.04	5.72	4.91	4.05	22.02
Cumulative GDDs	158	781	1,466	2,169	2,892	2,892

PROJECT CONTACT

For inquiries about this project, contact Chris Bruynis, Associate Professor, Extension Educator, Agriculture & Natural Resources, Area Leader, Ohio State University Extension- Ross County (bruynis.1@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
80,000	57,111	12.3	60 a	482
120,000	87,333	12.2	61 a	473
160,000	114,333	12.2	61 a	456
200,000	147,000	12.2	61 a	439
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: Not significant CV: 1.94%	

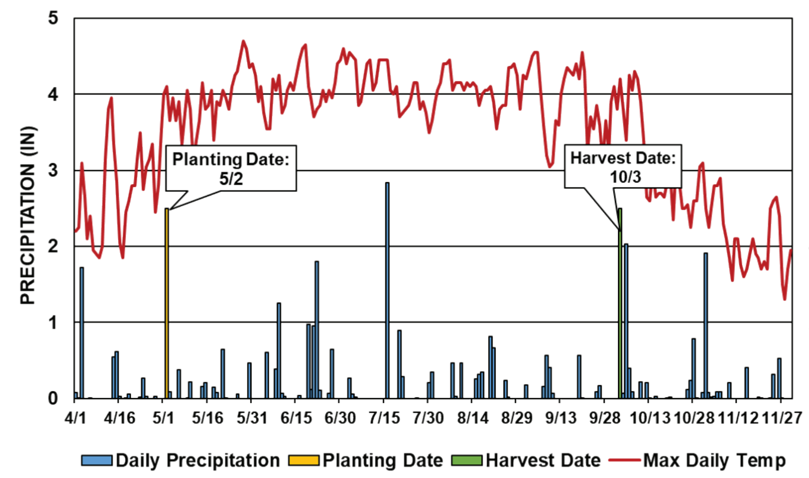
STUDY INFORMATION

Planting Date	5/2/2018
Harvest Date	10/3/2018
Variety	Pioneer P31A22X
Population	Treatments
Acres	42
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	No-TIll
Herbicide	Authority, RoundUp Xtendimax
Previous Crop	Corn
Row Width	15 in.
Soil Type	Tedrow-Dixboro complex, 57% Colwood fine sandy loam, 41% Tedrow loamy fine, 2%

eFields Collaborating Farm

OSU Extension

Sandusky County - A



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	7.06	4.94	3.65	17.93
Cumulative GDDs	117	669	1,330	2,016	2,728	2,728

PROJECT CONTACT

For inquiries about this project, contact Allen Gahler, Extension Educator, Agriculture & Natural Resources - Sandusky County (gahler.2@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
80,000	63,426	12.3	62 b	499
120,000	106,000	12.5	68 a	533
160,000	130,500	12.4	67 ab	508
200,000	155,750	12.4	69 a	508
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: 5.44 CV: 6.29%	

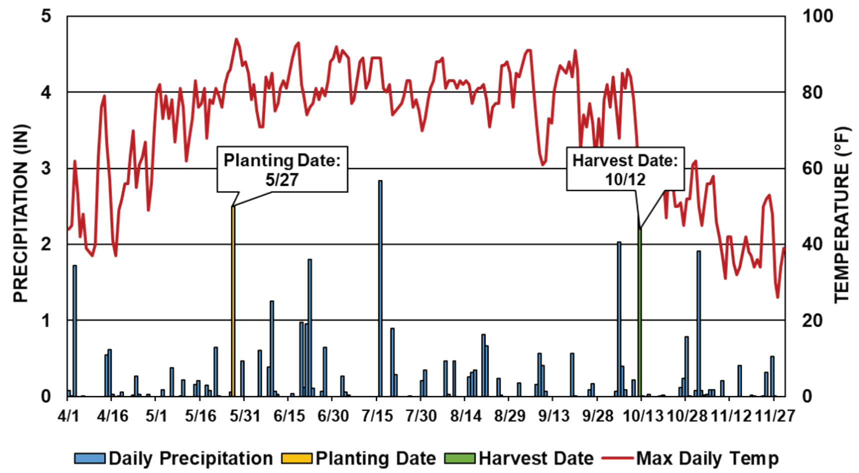
STUDY INFORMATION

Planting Date	5/27/2018
Harvest Date	10/12/2018
Variety	Pioneer P36T36X
Population	Treatments
Acres	55
Treatments	4
Reps	4
Treatment Width	40 ft.
Tillage	No-Till
Herbicide	Authority, RoundUp Xtendimax
Previous Crop	Corn
Row Width	15 in.
Soil Type	Hoytville clay loam, 55% Nappanee silt loam, 27% Haskins sandy loam, 12% Genford silt loam, 5%

eFields Collaborating Farm

OSU Extension

Sandusky County - B



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	7.06	4.94	3.65	17.93
Cumulative GDDs	117	669	1,330	2,016	2,728	2,728

PROJECT CONTACT

For inquiries about this project, contact Allen Gahler, Extension Educator, Agriculture & Natural Resources - Sandusky County (gahler.2@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
80,000	78,500	13.3	69 a	555
120,000	111,875	13.4	69 a	538
160,000	140,000	13.4	70 a	534
200,000	175,250	13.4	69 a	508

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: Not significant
CV: 2.26%

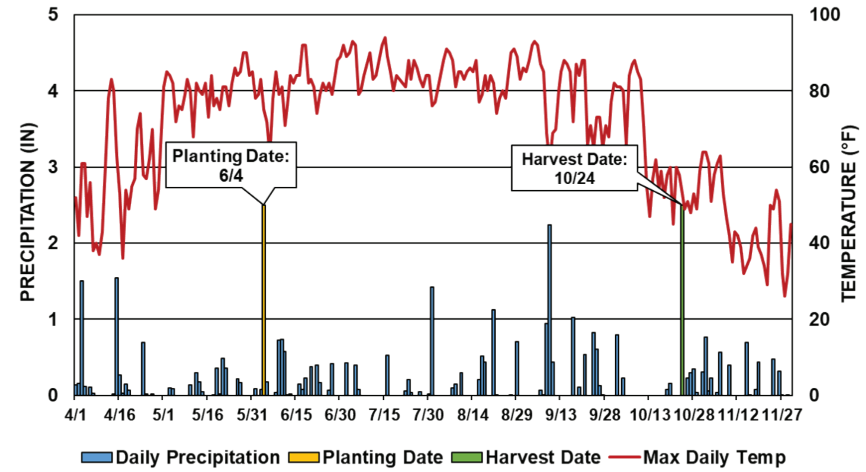
STUDY INFORMATION

Planting Date	6/4/2018
Harvest Date	10/24/2018
Variety	Channel 3417R2X
Population	Treatments
Acres	18
Treatments	5
Reps	4
Treatment Width	30 ft.
Tillage	Vertical
Herbicide	Roundup ExtendiMax Valor CLT
Previous Crop	Corn
Row Width	15 in.
Soil Type	Shoals silt loam, 68% Chagrin silt loam, 18% Lobdell silt loam, 14%

eFields Collaborating Farm

OSU Extension

Tuscarawas County



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	4.37	3.24	3.57	18.55
Cumulative GDDs	146	741	1,373	2,101	2,830	2,830

PROJECT CONTACT

For inquiries about this project, contact Chris Zoller, Assistant Professor, Extension Educator - Agriculture and Natural Resources, Tuscarawas County Extension Director (zoller.1@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
100,000	95,000	14.4	69 a	559
125,000	120,000	14.5	69 a	549
150,000	144,000	14.5	69 a	538
175,000	161,000	14.5	68 a	527
200,000	188,000	14.5	68 a	508

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: Not significant
CV: 2.13%

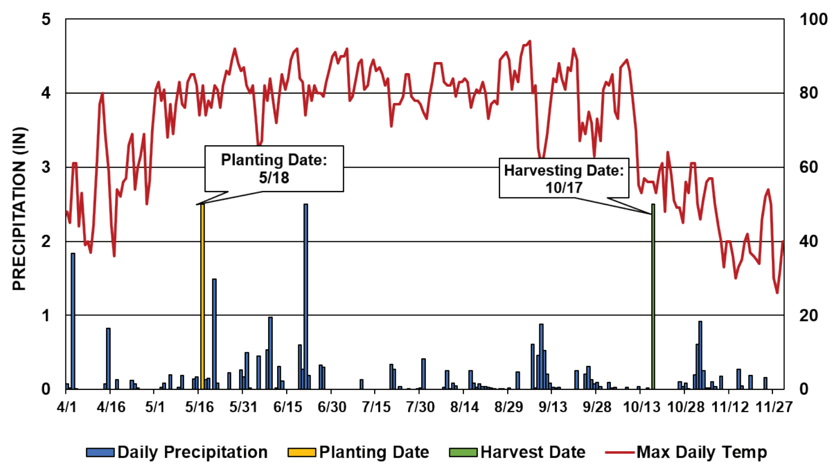
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Union County - A

Planting Date	5/18/2018
Harvest Date	10/17/2018
Variety	ShurGrow 3116
Population	Treatments
Acres	74
Treatments	5
Reps	3
Treatment Width	40 ft.
Tillage	Vertical
Herbicide	Metribuzin, Valor XLT, Zidua Pro, 2-4,D, Roundup
Previous Crop	Corn
Row Width	15 in.
Soil Type	Blount silt loam, 75% Pewamo silty clay loam, 23% Glynwood silt loam, 3%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.17	3.34	7.10	1.23	1.03	15.87
Cumulative GDDs	130	725	1,369	2,054	2,753	2,753

PROJECT CONTACT

For inquiries about this project, contact Wayne Dellinger, Extension Educator, Agriculture and Natural Resources - Union County (dellinger.6@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
90,000	47,800	14.0	37 a	280
120,000	65,800	13.9	41 a	301
150,000	72,600	13.9	33 a	220
180,000	85,100	13.8	31 a	190
210,000	98,736	13.9	39 a	246

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: Not significant
CV: 28.00%

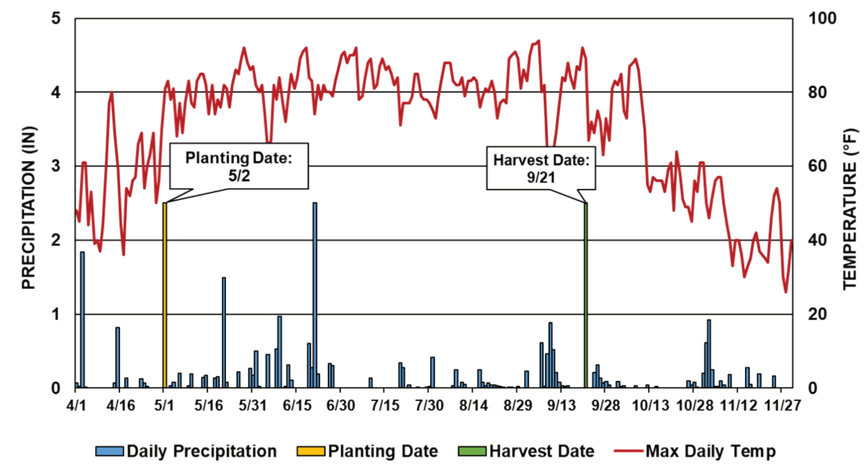
STUDY INFORMATION

eFields Collaborating Farm

OSU Extension

Union County - B

Planting Date	5/2/2018
Harvest Date	9/21/2018
Variety	ShurGrow 3316
Population	Treatments
Acres	15
Treatments	5
Reps	4
Treatment Width	40 ft.
Tillage	Vertical
Herbicide	Demtric 2-4,D, Roundup
Previous Crop	Corn
Row Width	20 in.
Soil Type	Brookston silty clay loam, 48% Crosby silt loam, 32%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.17	3.34	7.10	1.23	1.03	15.87
Cumulative GDDs	130	725	1,369	2,054	2,753	2,753

PROJECT CONTACT

For inquiries about this project, contact Wayne Dellinger, Extension Educator, Agriculture and Natural Resources - Union County (dellinger.6@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
80,000	67,100	13.6	47 a	370
110,000	83,500	13.5	49 a	374
140,000	105,600	13.6	47 a	344
170,000	120,000	13.6	48 a	340
200,000	145,000	13.6	47 a	318

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: Not significant
CV: 4.37%

Seeding Rate Trials

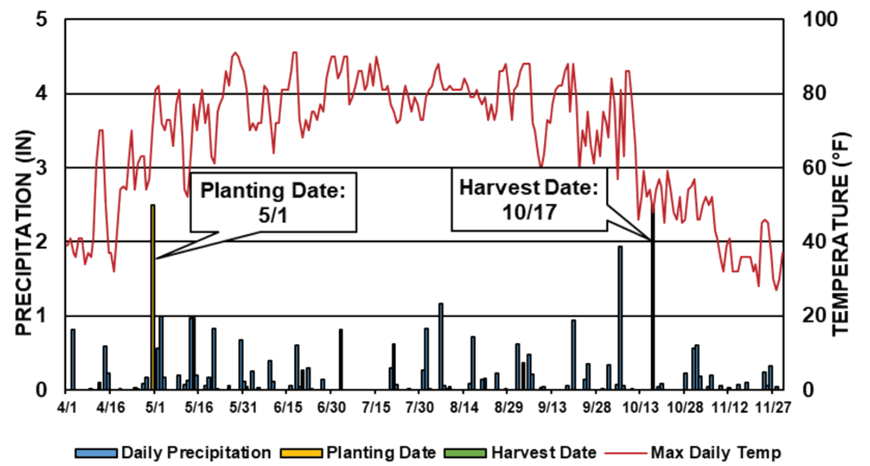
STUDY INFORMATION

Planting Date	5/1/2018
Harvest Date	10/17/2018
Variety	P39A825C
Population	Treatments
Acres	103
Treatments	5
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Herbicide	Enlite, TricorDF
Insecticide	Lambda T-2
Fungicide	Trivapro
Previous Crop	Corn
Row Width	20 in.
Soil Type	Blount loam, 77% Pewamo silty clay loam, 12% Glynwood loam, 5% Shoals loam, 5%

eFields Collaborating Farm

OSU Extension

Williams County



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.04	6.17	2.23	2.07	3.45	15.96
Cumulative GDDs	82	545	1,093	1,701	2,361	2,361

PROJECT CONTACT

For inquiries about this project, contact Wm. Bruce Clevenger, Extension Educator, Agriculture and Natural Resources - Ohio State University Extension - Williams County (clevenger.10@osu.edu).

Treatments (sds/ac)	Avg. Emergence (plants/ac)	Moisture (%)	Yield (bu/ac)	Return Above Seed ($/ac)
80,000	63,800	14.0	88 ab	723
120,000	81,500	14.0	89 a	714
160,000	104,300	13.9	88 ab	688
200,000	172,200	13.7	89 a	680
240,000	205,500	13.9	87 b	645
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: 1.51%	

OBJECTIVE

Evaluate the relationship between soil type, weed species, and nearby habitats with the presence of Asiatic garden beetle in field crop systems of Ohio and Michigan.

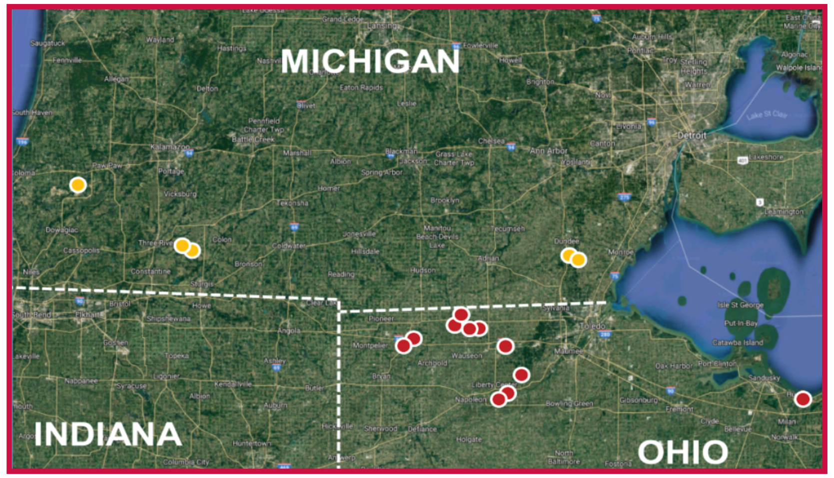
eFields Collaborating Farms

OSU Extension

Erie, Fulton, Henry, Lucas, and Williams Counties

STUDY INFORMATION

16 fields in total were sampled weekly throughout the 2018 growing season from a 5x4 grid established on ~4-5 acres (below) to understand the timing and duration of different AGB life stages.



Life Stage	Image	Sampling Method(s)	Sampling Time
Grub (1st, 2nd and 3rd instars)		1 golf hole cup cutter per plot	5/13/18-6/3018, 10/21/18-10/27/18
Pupa			
Adult		1 pitfall trap per plot; 1 milkjug per field side	6/17/18-8/4/18

Weather Summary - Wauseon, OH

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.64	5.87	3.5	1.05	4.88	17.94
Cumulative GDDs	102	619	1,266	1,996	2,755	2,755

Weather Summary - Centreville, MI

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.83	9.35	6.20	2.70	3.00	25.08
Cumulative GDDs	96	591	1,177	1867	2,559	2,559

STUDY DESIGN

The Asiatic garden beetle (AGB) is a generalist species which causes sporadic problems in turf grasses, ornamentals, vegetables., and most recently field crops in the sandy soils of Indiana, Michigan and Ohio. The current literature for AGB dates to the 1930s from horticultural systems in New Jersey and New York. The overall objective of this study was to establish an extensive sampling network throughout Ohio and Michigan to understand the seasonal population dynamics and geographical distribution of M. castanea with respect to the agroecosystem. Thirteen fields (11 corn and 2 soybean) were sampled weekly for grubs and/or adults in Michigan and Ohio from 4x5 grids established over a ~4-5 acre area of field with a known AGB history. Grubs were sampled from the week of May 13 through June 30 and again the week of October 21 using the golf hole cup cutter. Adults were trapped with pitfall traps (changed weekly) from June 17 through August 4. Additionally, migrating adults were captured with antifreeze milkjug traps used for western bean cutworm with one on each field edge per field. Soil composition and nutrient analyses were performed for each plot and weed species assessed.

AGB sampling methods: Clockwise from top left: 1) golf hole cup cutter for grubs, 2) antifreeze milkjug trap for adult dispersal, 3) pitfall trap for adult emergence.

RESULTS

Life Stage	J	F	M	A	M	J	J	A	S	O	N	D
Grub - 1st							■	■	■			
Grub - 2nd	■	■	■	■	■			■	■	■	■	■
Grub - 3rd	■	■	■	■	■	■			■	■	■	■
Pupa					■	■	■					
Adult						■	■	■	■			
Egg						■	■	■	■			

Timing of AGB life stages based on sampling (grubs via cup cutter and adults via pitfall traps) of corn and soybean fields.

Population Dynamics (Left)

- 2nd and 3rd instar grubs are able to survive through winter; the presence of either will dictate the grub feeding window
- Emerging and migrating adult populations reached peak size from June 24 through July 7
- The grubs begin pupating (stop feeding) and develop into adults starting in late May and early June, depending on the grubs instar

Soil (Right)

Approximately twice as many grubs and 8-9 times as many adults were sampled using the cup cutter and pitfall trap, respectively, throughout the season in sandy soils (sand and sandy loam) versus loamy soils (sandy loam) across all locations. Grub and adult numbers rapidly increased when soil sand content exceeded 80%.

Soil Type	Total Grubs Per Plot	Total Adults Per Plot
Sand	2.13 ± 0.60	65.69 ± 9.93
Loamy Sand	1.83 ± 0.22	51.67 ± 5.72
Sandy Loam	1.12 ± 0.29	7.40 ± 2.31

Weed Presence (Left)

Grubs and adults were found at similar rates in corn/soybean and weeds. AGB grubs were observed feeding on chickweed, marestail, giant ragweed, and volunteer wheat. AGB adult feeding was observed on marestail, palmer amaranth, pokeweed, giant ragweed, and Virginia creeper.

Sample Within Plot	Mean Grubs Per Golf Hole Cup Cutter
Soil in Row	0.61 ± 0.08
Weeds Within 1 m^2	0.49 ± 0.07

Left: Excessive feeding by AGB adults on marestail.

Adjacent Habitat	Sample Size	Mean Adults Per Milkjug Trap
Alfalfa	5	2.20 ± 1.20
Barley	5	0.40 ± 0.40
Corn	54	6.04 ± 1.38
Forest	47	5.85 ± 2.80
House	19	4.21 ± 1.78
Soybean	78	6.67 ± 1.87

Adult Dispersal (Left)

The number of AGB beetles trapped in the antifreeze milkjug traps was highest for traps placed adjacent to soybean and corn fields and forest patches, while houses which largely consist of turf and landscaping plants trapped about 2/3 as many beetles. Adjacent alfalfa and barley fields had the fewest beetles, however, they were the least represented habitat type.

PROJECT CONTACT

For inquiries about this project, contact Adrian Pekarcik, PhD Student, Ohio Agricultural Research and Development Center Entomology (pekarcik.4@osu.edu) or Kelley Tilmon, Associate Professor, OARDC Entomology (tilmon.1@osu.edu).

Crop Nutrition Apps

N-P-K

OBJECTIVE

The number of mobile applications (e.g. apps) developed and offered to support nutrient management continues to grow. Many of these apps can provide important information at the farm level. The Ohio State Digital Ag Program aimed to gather a list of apps that would represent those used by farmers or their agronomic consultants to help with nutrient management including planning, scouting, evaluating stress and executing field applications.

OVERVIEW

While the list developed is not comprehensive and it is likely new apps have been introduced, 82 apps were documented and categorized into 9 areas as follows:

Category	App Number
Nutrient Information and Calculators	39
Equipment Setup	4
Nozzle and Orifice Selection	4
Record Keeping	5
Soil Sampling	6
Field Data Management	3
News and Information	15
Weather	4
Field Area Apps	2

Ohio State

Digital Ag Program

Franklin County

A Farm Journal Media survey of more than 1,800 farmers revealed that 59% of farmers use a smartphone and 44% use a tablet, both of which are slightly ahead of the national averages of 58% and 42%, respectively.

SUMMARY

- 82 total crop nutrition apps were identified in this search.
- To view the full list, visit:

go.osu.edu/CropNutritionApps

PROJECT CONTACT

For inquiries about this project, contact Jenna Lee, Student Research Assistant, Department of Food, Agricultural and Biological Engineering (lee.7210@osu.edu).

HIGHLIGHTED APPS

Here are a few apps from the list that may be of special interest to Ohio farmers:

AgWorld Sampling App
Assist in intensive soil sampling jobs/ management

IPNI Nutrient Removal Calculator
Estimate crop nutrient removal for a variety of crops

AgPhD Fertilizer Removal App
Calculate nutrient amounts needed for yield target

OnMRK
Application documentation, spread/no-spread management

PLOTS
On-farm research for nutrient applications

FERT (Coming soon!)
Fertilizer calculator

SPREADCAL (Coming soon!)
P/K spreader calibration

Crop Protection Apps

OBJECTIVE

Many farmers and consultants today have a smartphone, iPad, tablet or similar device. Mobile applications (apps) have been developed for agriculture. These apps can be used to support crop protection by providing the ability to communicate information, assist with field scouting, collect and access data, and more. The Ohio State Digital Ag Program gathered a list of these apps to represent those commonly used by farmers and their advisors.

OVERVIEW

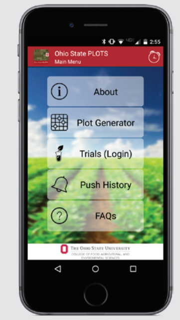
While the list developed is not comprehensive and it is likely new apps have been introduced, 71 apps were documented and categorized into 8 areas as follows:

Category	App Number
Weed, Disease, and Pest ID	7
Crop Protection Information	2
Tank Mix and Equipment Setup	7
Nozzle Selection	6
Scouting	23
Field Data Management	5
Weather	5
Other Apps	16

Tools of the Trade

Smartphones and Tablets

Mobile devices like smartphones and tablets can place information and data tools in the hands of farmers like never before. Apps are available to check weather, track equipment, monitor crop health, calculate crop nutrient uptake and requirements, and much more.



SUMMARY

- 71 total crop protection apps were identified in this search.
- To view the full list, visit:

go.osu.edu/CropProtectionApps

PROJECT CONTACT

For inquiries about this project, contact Jenna Lee, Student Research Assistant, Department of Food, Agricultural and Biological Engineering (lee.7210@osu.edu).

HIGHLIGHTED APPS

Here are a few apps from the list that may be of special interest to Ohio farmers:

FieldView Cab
Visualize planting data and support field scouting, imagery, and soil data

AgWorld Scout
Complete in-field scouting of crop health, pest pressure, and more

AgPhD Fertilizer Removal App
A guide to assist in identifying pests and save common pests for a farm

FARMserver
View and edit field data on-the-go.

Sprayer Calibration Calculator
Calibrate a sprayer (aerial and ground-based including turf and boomless setups)

Tank Mix Calculator
Generate tank mixes, includes 14,000 chemicals along with the ability to input others

Weather Underground
View hyper-local forecasts in addition to radar, satellite maps and severe weather alerts

OBJECTIVE

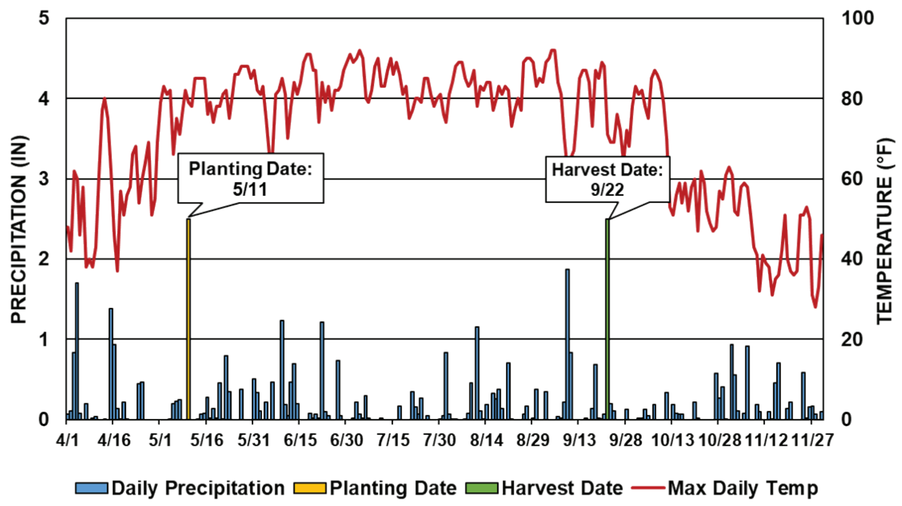
Demonstrate strip intercropping utilizing alternating 20 ft. strips of 30 in. corn, 15 in. corn, and 15 in. soybeans to identify the relationship between the corn and soybeans to maximize yield potential per acre.

Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/11/2018
Harvest Date	9/22/2018
Variety	Multiple Varieties
Population	Variable-Rate
Acres	15
Treatments	9
Reps	14 Soybean, 9 Corn
Treatment Width	20 ft.
Tillage	Vertical Tillage with Wheat Cover Crop
Herbicide	Roundup PowerMax, 2,4-D, Fierce, Dual 2 Magnum
Fungicide	Strategy YLD
Previous Crop	Corn and Soybean
Row Width	15 in. and 30 in.
Soil Type	Crosby-Lewisburg silt loam, 65% Sloan silty clay loam, 21% Miamian silt loam, 14%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

This study utilized a Harvest International planter toolbar with Precision Planting, Surefire Ag, and Yetter products to complete planting of this study. Planting populations ranged from 120,000-180,000 for soybeans and 30,000-57,000 for corn. The field layout alternated corn and soybeans. The corn was randomized between 15" and 30" treatments.

15 in. Corn in 20 ft. Strips																
Row Number	1	2	3	4	5	6	7	8	8	7	6	5	4	3	2	1
Population (% of Rx)	150	138	125	100	100	100	100	100	100	100	100	100	100	125	138	150

30 in. Corn in 20 ft. Strips								
Row Number	1	2	3	4	4	3	2	1
Population (% of Rx)	150	125	100	100	100	100	125	150

OBSERVATIONS

This field was planted in the east-west orientation. Interestingly, outside rows of corn facing north had significantly larger ears observed during yield estimates. Soybeans took a slight yield drop when paired with higher yielding corn. Sidedress of 15" corn became a challenge and was completed with a broadcast spreader of urea. Sidedress of 30" corn was applied with a traditional coulter injection system.

Top: The ears from the Farm of the Future that faced north (in the left half of the picture) were significantly larger than those facing south (in the right half of the picture). Bottom: View of strips from ground level taken August 16.

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.

SUMMARY

- There were large differences in yield between 15 in. and 30 in. corn.
- It appears this year that planting orientation had a large effect on north rows compared to south.
- Future studies need to find a better placement of nitrogen for 15 in. corn.

Combines used to harvest the Farm of the Future strip intercropping study.

PROJECT CONTACT

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

Crop	Spacing (in.)	Location	Moisture (%)	Soybean Yield (bu/ac)	30 in. Corn Yield (bu/ac)	15 in. Corn Yield (bu/ac)	All Corn Yield (bu/ac)
Corn	15	South	16.2	-	-	177 b	177 b
Corn	15	Middle	16.2	-	-	171 b	171 b
Corn	15	North	16.2	-	-	232 a	232 a
Corn	30	South	16.2	-	189 b	-	189 b
Corn	30	Middle	16.2	-	182 b	-	182 b
Corn	30	North	16.2	-	212 a	-	212a
Soybeans	15	South	11.6	54 ab	-	-	-
Soybeans	15	Middle	11.6	58 a	-	-	-
Soybeans	15	North	11.6	51 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: 5.31 CV: 15.19%	LSD: 15.19 CV: 9.51%	LSD: 25.95 CV: 16.32%	LSD: 22.78 CV: 14.81%

Logo Field

Soybean

OBJECTIVE

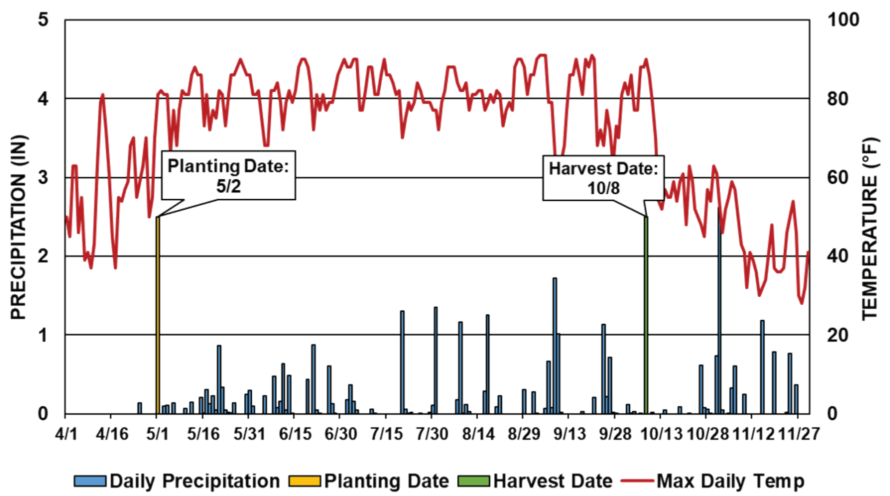
Execute a multi-variety seeding prescription to demonstrate advancements in modern precision seeding technologies.

Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

Planting Date	5/2/2018
Harvest Date	10/8/2018
Variety 1	P43A87X
Variety 2	P28T71X
Population	Variable-Rate
Acres	100
Treatment Width	40 ft.
Tillage	Vertical Till
Previous Crop	Corn
Row Width	30 in.
Soil Type	Crosby-Lewisburg silt loam (67%) Kokomo silty clay (33%)



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	6.65	3.96	6.28	1.80	5.38	24.07
Cumulative GDDs	138	769	1,431	2,156	2,888	2,888

STUDY DESIGN

Multi-variety planting technologies have provided an opportunity for producers to place different varieties of corn within the same planter pass. This can provide benefits by placing aggressive offensive hybrids in highly productive portions of the field, while simultaneously placing more conservative, defensive varieties in poorly productive areas of the field. In an effort to demonstrate these technologies, the Ohio State Precision Ag Team planted two varieties in a field on the Molly Caren Agricultural Center site.

Two seeding prescriptions were used at the time of planting; variety prescription and population prescription. The images above show the prescriptions for the P43A87X variety (left) and the P28T71X variety (right).

OBSERVATIONS

This is the fourth year that the Precision Ag Team has created a multi-hybrid or multi-variety design. This year offered new challenges as the design was done in soybeans rather than corn. In all the previous logos, the designs were visible with the changing tassel color and captured in an aerial image. This year, different maturing soybeans were used to make the Script Ohio design. With the great work of the field operations team we were able to successfully plant the world's largest script Ohio earning praise from Ohio State officials and attention from various media outlets.

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 the maturity dates for each variety. The varieties used in this year's design were 2.8 and 4.3 relative maturity soybeans, which made the Script Ohio pop from above.

Considerations

Careful execution of the seeding prescription is crucial to ensure the logo is properly displayed in the field. Here are some helpful hints for executing the prescription:

1. Ensure GPS offsets and meter calibrations are accurate.
2. Proper time delay settings ensure accurate transition between hybrids.
3. Maintain consistent speed across the field.
4. Maintain proper bulk fill and vacuum fan settings.

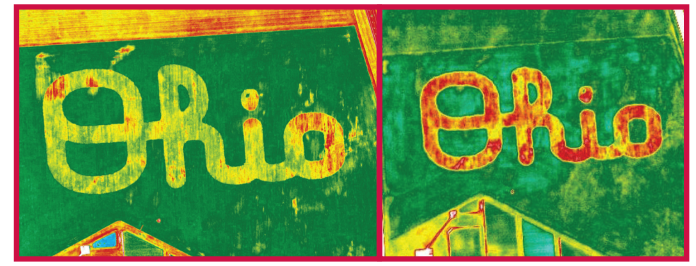
Tools of the Trade

SMS Advanced

SMS Advanced assists in managing information across many acres, fields and operations. The Digital Ag Team used this software package to create the multi-variety prescription that allowed the Script Ohio to become reality.

SUMMARY

- The multi-hybrid design was properly executed for the fourth consecutive year.
- We were able to create the world's largest Script Ohio.



Manned aerial imagery from AirScout taken during the growing season picked up differences in variety via ADVI (left) and thermal (right).

PROJECT CONTACT

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

- The letter width of the Script Ohio is 120 feet.
- The "Ohio" portion of the field is 17.3 acres.
- The entire length of the Script Ohio is 1,940 feet.
- The faster maturing soybeans could be seen from 6,000 feet above ground level and greater!
- If "The Best Damn Band in the Land" stood shoulder-to-shoulder in the dot of the Buckeye "i" in our Script Ohio, they would all fit, and would only spill over by 10 ft. on either side!

WHAT IS PALMER AMARANTH AND WHERE IS IT COMING FROM?

Palmer amaranth is an *Amaranthus* (pigweed) species that has become a devastating glyphosate-resistant weed problem in the South and parts of the Midwest over the past decade. It has caused substantial losses in crop yield and farm income, and a permanent increase in the cost of herbicide programs. Preventing additional Palmer Amaranth infestations in Ohio is a primary goal of the OSU weed science program, and will require efforts from the entire Ohio agricultural community.

There are several mechanisms for the movement of Palmer amaranth into Ohio:

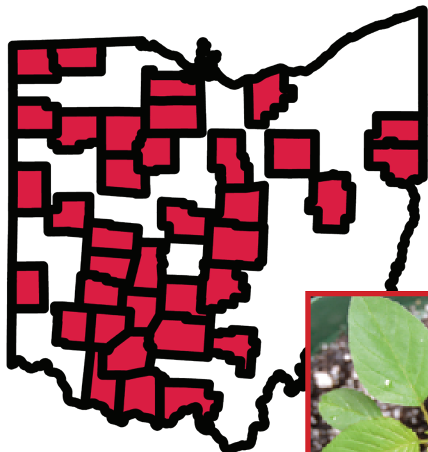
- Movement of equipment from Palmer-infested areas into Ohio
- The presence of Palmer seed in cotton-derived feed products that are transported from the south into Ohio, or in hay from Kansas
- The presence of Palmer seed in cover crop and wildlife seed that originates in areas infested with palmer amaranth, such as Texas and Kansas

Department of Horticulture and Crop Science

Franklin County

PALMER AMARANTH DISTRIBUTION - LATE 2018

Most counties shown on the map as "infested" (red square) have only a few populations of Palmer amaranth. In some cases only a few plants were found and the "infestation" has been completely remediated. Palmer is more widespread in several areas.



Palmer Amaranth findings:

- Near two dairies along the Madison-Fayette county line
- Wayne County east of Orrville
- Highland County east of Hillsboro
- Preble County
- Eastern Mahoning and Columbiana Counties

PREVENTATIVE ACTION

Know what Palmer amaranth looks like and if there is any in the neighborhood.

When purchasing used equipment, know where it has been used previously. Avoid purchase of combines that come from Palmer-infested areas. Know where custom harvesting equipment has been used.

Scout recently seeded CREP, wildlife, and similar areas for the presence of Palmer. For any intended seedings of this type, the Ohio Department of Agriculture will test seed lots for the presence of Palmer seed. They must pick the seed up from your operation (do not mail or drop off).

Avoid use of cotton feed products or hay that might contain Palmer amaranth seed - check with your feed supplier for more information. When using manure from another animal operation, know whether they are using cotton feed products or hay from Kansas.

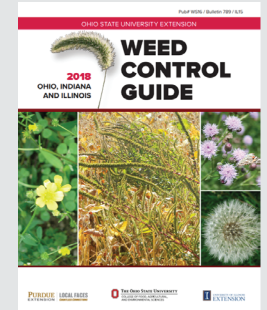
WHAT MAKES PALMER AMARANTH SUCH A PROBLEM?

- Female Palmer plants produce 100,000 to upwards of 500,000 seed
- Broad period of emergence - April to August
- Small seed that is well-adapted to minimum and no-tillage
- Rapid growth – up to 3 inches a day. Postemergence herbicides must be applied when Palmer plants are less than 3 inches tall
- Readily develops herbicide resistance
- Dioecious reproductive system (male and female plants). Obligate outcrossing results in rapid spread of herbicide resistance

Tools of the Trade

Weed Control Guide

The 2018 Ohio, Indiana, and Illinois Weed Control Guide provides information and suggestions on weed control and herbicide strategies for corn, soybeans, small grains, and forages. This edition includes a special section focusing on Palmer Amaranth.



HERBICIDE RESISTANCE IN PALMER AMARANTH

- Most populations of Palmer in Ohio are resistant to glyphosate (group 9) and ALS inhibitors (group 2). Palmer will not be controlled by burndown or postemergence applications of glyphosate alone. The addition of ALS inhibitors such as Classic and Pursuit will not improve control.
- Populations in the South have developed resistance to site 14 herbicides (fomesafen, Cobra, etc), and appear to be developing resistance to glufosinate (Liberty, Cheetah, Interline).
- Diversification of herbicide programs and preventing escapes from going to seed are essential to prevent the development of resistance to additional sites of action – use different sites of action in corn versus soybeans and multiple sites of action in postemergence treatments

Resources

Ohio Department of Agriculture: 614-728-6410
University of Illinois (free seed testing): web.extension.illinois.edu/plantclinic/downloads/herbicide.pdf
OSU and USB Take Action resources: u.osu.edu/osuweeds/ and takeactiononweeds.com

PROJECT CONTACT

For more information, contact Mark Loux, Professor, Department of Horticulture and Crop Science, Ohio State University (Loux.1@osu.edu).

PREVENTATIVE ACTION

Include residual herbicides in corn and soybean programs to control the early-emerging Palmer plants.

Scout fields starting in mid July for the presence of Palmer that escaped herbicide programs. Get help with identification if in doubt.

Plants without mature seed (black) should be pulled out (uprooted) or cut off just below soil and removed from field, and then burned or buried at least a foot deep or composted. Plants with mature seed should be bagged and removed from field.

Do not run the combine through Palmer patches that are discovered during harvesting.

Machine Learning for Soil Properties

OBJECTIVE

Estimate soil properties at a higher spatial resolution by integrating remotely sensed data and machine learning algorithms with field-based soil measurements.

Molly Caren

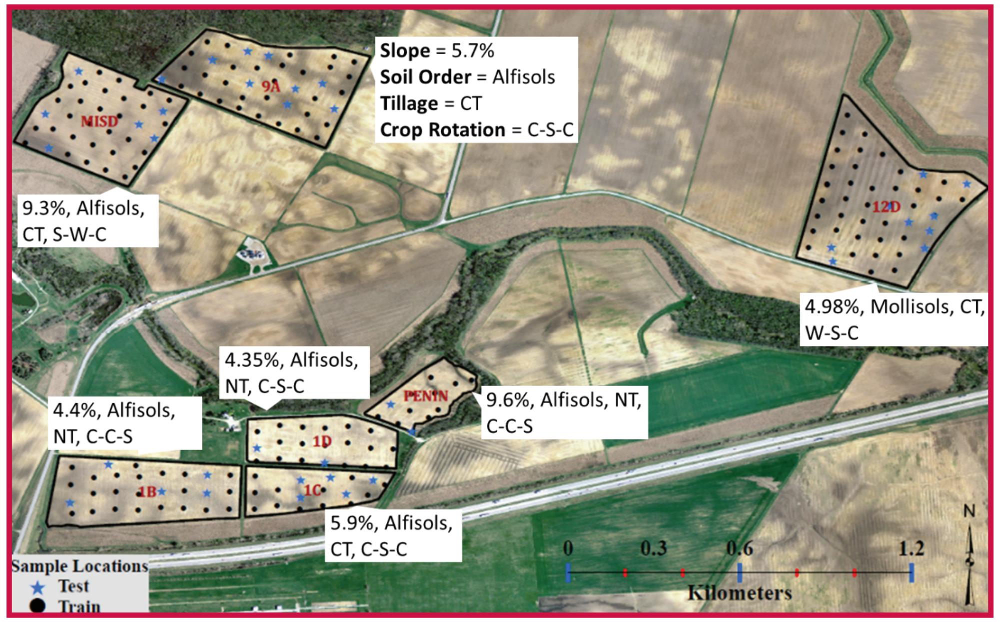
Agricultural Center

Madison County

STUDY INFORMATION

Total Fields	7
Total Acreage	172
Average Slope	6.3%
Tillage Types	5 - Conventional 2 - No Till
Total Samples	200
Average Samples	1.2/acre

Five soil properties, including soil organic matter (SOM), cation exchange capacity (CEC), potassium (K), magnesium (K), and pH were examined. Samples were collected on October 1, 2013. In each field, samples were taken at a depth of 18 cm on 1-acre intervals.

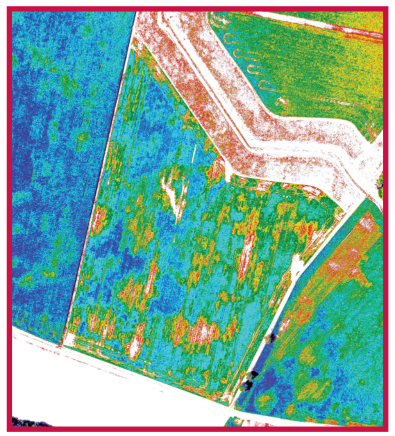


As seen above, black dots and blue stars within each field indicate spatial locations of soil samples used for model development and validation, respectively. The background image provides a multispectral displayed with a combination of red (R), green (G) and blue (B) spectral bands. Note: Tillage: NT – No Till; CT – conventional tillage (i.e., field cultivator was used prior to planting the crop). Crop Rotation: C - Corn; S - Soybean; W - Wheat.

STUDY DESIGN

Remotely sensed data used in this study included high spatial resolution multispectral images (with 0.30-m resolution), collected before corn planting in May of 2013 under the Ohio Statewide Imagery Program, and digital elevation model (DEM) (0.76-m resolution), available from the Ohio Geographically Referenced Information Program. Various soil and vegetation indices were calculated using the combination of spectral bands (red, green, blue and near-infrared) in the multispectral images. Terrain variables, such as slope and elevation, were extracted using the DEM data.

Seven statistical models, (1) Linear Regression Model, (2) Random Forest, (3 and 4) Support Vector Machine with Linear and Radial kernel functions, (5) Stochastic Gradient Boosting, (6) Neural Network, and (7) Cubist Model, were developed to estimate soil parameters. Individual spectral bands of imagery, soil and vegetation indices, soil color, and terrain variables were used as predictor variables in the models. Among the seven models, the model with the highest R^2 and lowest root mean square error (RMSE) was selected for final mapping of soil properties.

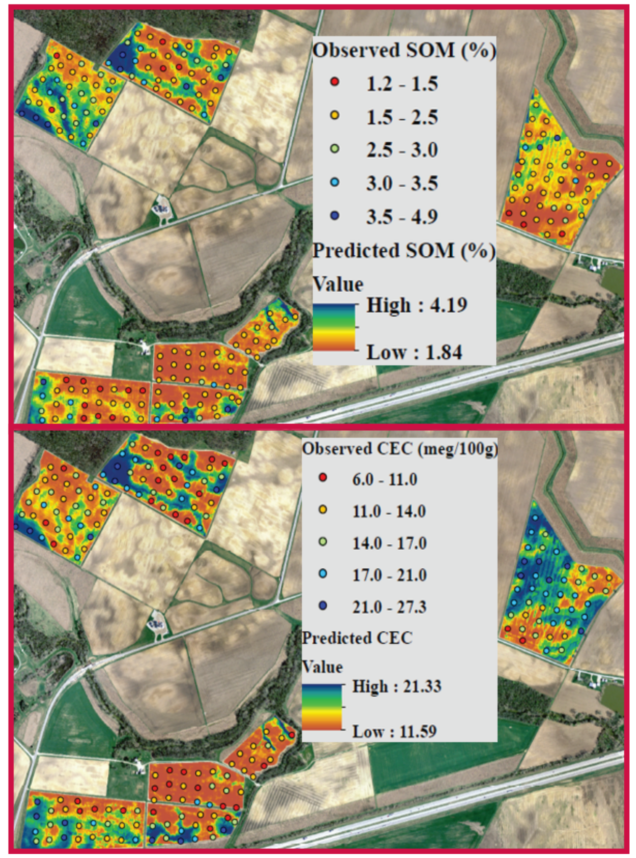


High resolution characterization of crop biomass from AirScout.

Additional Studies

OBSERVATIONS

Soil properties were highly correlated with the red, green and blue spectral bands of the remotely sensed imagery followed by soil and vegetation indices, and terrain properties of the fields. Some of the terrain properties, such as elevation were also explained by green and blue wavebands.



Maps showing predicted and observed SOM (top) and CEC (bottom).

Tools of the Trade

Machine Learning

Machine learning is an Artificial Intelligence (AI) technique that is designed to constantly self-improve allowing the algorithm, once trained, to evolve. It requires large amounts of data for the algorithm to learn and adjust and is becoming a technique used in agriculture.

Overall, machine-learning models performed better than linear regression models. For instance, during model development, the neural network algorithm performed better in prediction of SOM and CEC with a higher R^2 and lower RMSE than linear regression models.

SUMMARY

- High spatial resolution multispectral bare soil imagery in conjunction with topographic data can be used to estimate soil properties, better informing nutrient management plans.
- Machine-learning algorithms provided higher accuracy in estimation of soil properties than traditional linear regression algorithms.
- Remote sensing imagery may serve as an attractive alternative to field based soil sampling for estimating soil properties and creating high resolution maps.

PROJECT CONTACT

For inquiries about this project, contact Sami Khanal, Assistant Professor, Department of Food, Agricultural and Biological Engineering (khanal.3@osu.edu).

RESULTS

Statistical models used for estimation of five soil properties for all seven fields suggested that high resolution remotely sensed data could estimate CEC with relatively higher accuracy followed by SOM, Mg, K, and pH. Models explained high variability of some observed soil properties for some fields, but poorly for other fields. For instance, on average, models explained 64%, 60%, 22%, 19% and 13% variability of observed CEC, SOM, Mg, K and pH for all fields, respectively. For some fields, such as 1B and 9A, models explained >75% variability of observed SOM, but for other fields, such as 12D and PENIN, models explained <50% variability of observed SOM.

Field	Soil Property	RMSE	R^2
1B	SOM	0.43	0.85
1B	K	0.16	0.56
1C	Mg	3.25	0.55
1C	pH	0.45	0.73
PENIN	SOM	0.33	0.21
Overall	K	0.50	0.19
Overall	Mg	4.70	0.22
Overall	pH	0.62	0.13

Remote Sensing for Yield Estimation

OBJECTIVE

Understand the potential of remotely-sensed bare soil and topographic imagery, and machine learning algorithms for estimating crop yield.

Molly Caren Agricultural Center

Madison County

STUDY INFORMATION

The study used high spatial resolution multispectral imagery (with 0.30-m resolution), collected from a bare soil surface before planting in May of 2013 under the Ohio Statewide Imagery Program, and digital elevation model (DEM) data (0.76-m resolution), available from the Ohio Geographically Referenced Information Program.

STUDY DESIGN

Seven different statistical models (1) Linear Regression Model, (2) Random Forest, (3 and 4) Support Vector Machine with Linear and Radial kernel functions, (5) Stochastic Gradient Boosting, (6) Neural Network, and (7) Cubist Model, were developed by integrating yield monitor based corn yield data with the information derived from the multispectral imagery and DEM data. Prior to developing the models for corn yield estimation, yield monitor based corn yield data was checked for errors, and any identified removed. Among the seven models evaluated during the analyses, the model with the highest accuracy, measured in terms of R^2 and lowest error, was selected for final crop yield estimation.

Statistical Models Evaluated

1	Linear Regression Model
2	Random Forest
3	Support Vector Machine with Linear Kernel Functions
4	Support Vector Machine with Radial Kernel Functions
5	Stochastic Gradient Boosting
6	Neural Network
7	Cubist Model

OBSERVATIONS

Corn yield data was found to have higher correlation with soil indices derived from bare soil imagery than the soil properties and topographic (e.g., elevation and slope) characteristics of the field. Yield prediction models using bare soil imagery, topographic data, and soil properties explained 52% of the variability for the observed yield estimates. Models were found to capture the spatial variability of corn yield for most of the observed low and high yielding areas.

Data was collected from combine yield monitor and cleaned before completing analysis.

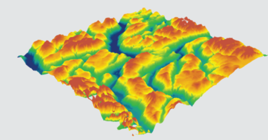
SUMMARY

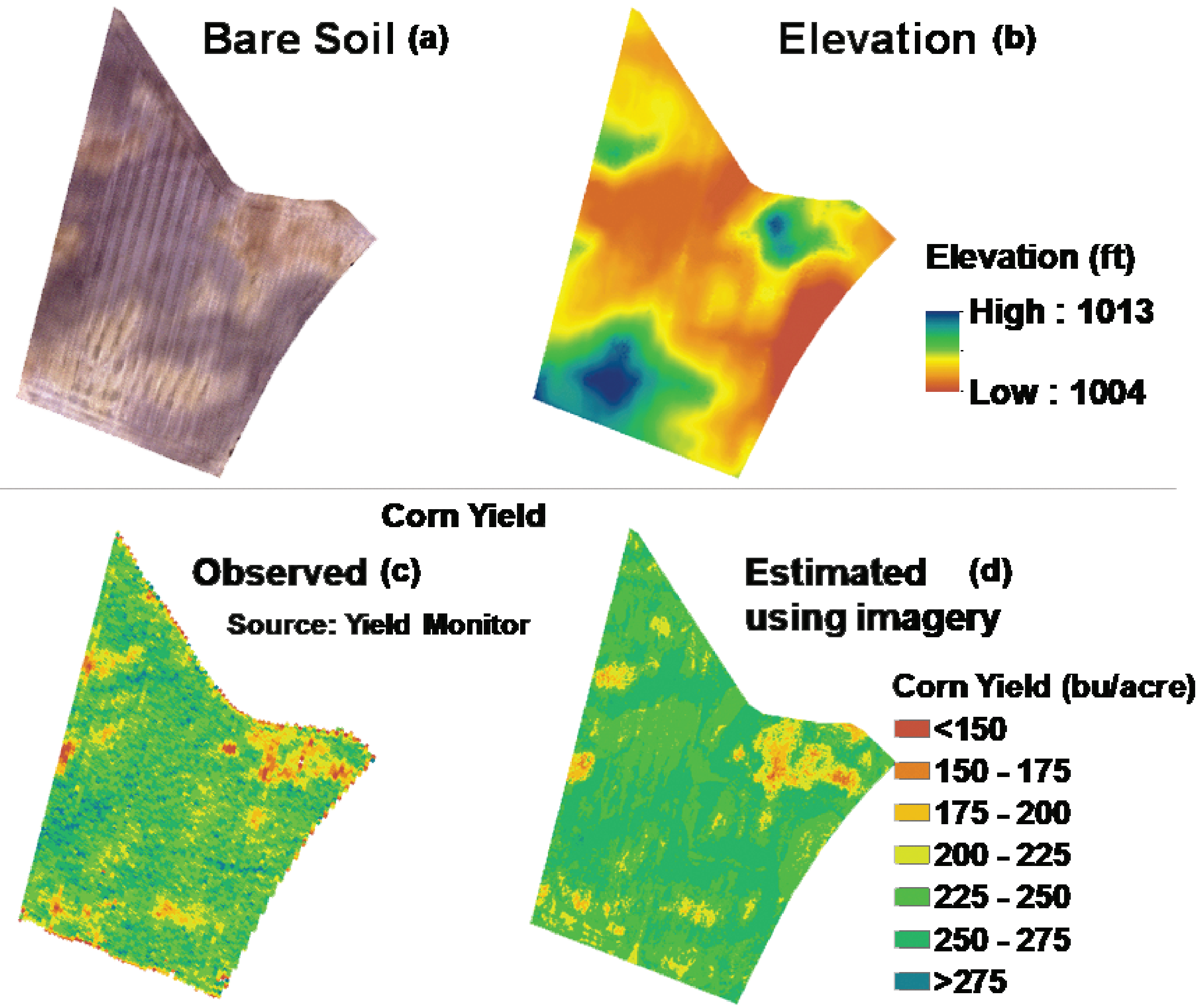
- In-field variability of crop yield can be captured with high spatial resolution (<1 meter) multispectral bare soil imagery in conjunction with terrain data.
- Crop yield estimates based on bare soil imagery and topographic data help farmers to identify areas of potential concerns prior to planting and manage them for improved crop productivity.
- Remotely sensed data can serve as a surrogate for combine yield monitoring systems.

Tools of the Trade

Digital Elevation Model

A Digital Elevation Model (DEM) is often used in reference to a set of elevation values representing 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.





(a) Bare soil multispectral imagery displayed with a combination of red (R), green (G), and blue (B) wavebands; (b) Elevation based on DEM data; (c) Observed corn yield data based on yield monitor; and (d) Estimated corn yield data.

PROJECT CONTACT

For inquiries about this project, contact Sami Khanal, Assistant Professor, Department of Food, Agricultural and Biological Engineering (khanal.3@osu.edu).

OBJECTIVE

Determine the effect of urea, urea plus a nitrogen stabilizer, and ammonium sulfate on a dry matter accumulation and forage quality.

eFields Collaborating Farm

OSU Extension

Monroe, Morgan, and Noble Counties

STUDY INFORMATION

	Woodsfield	Belle Valley	Pennsville
Site Location	Woodsfield, OH Monroe County	Belle Valley, OH Noble County	Pennsville, OH Morgan County
Application Date	8/6/2018	8/6/2018	8/6/2018
Harvest Date	11/4/2018	11/4/2018	11/4/2018
Treatments	4	4	4
Reps	4	4	4
Treatment Width	6 ft.	6 ft.	6 ft.
Tillage	None	None	None
Rainfall Within 1.25 Days	0.11 in.	0.22 in.	0.25 in.
Rainfall Within 30 Days	3.73 in.	3.68 in.	3.21 in.
Soil Test Results	pH - 6.2 P - 26 ppm K - 68 ppm	pH - 6.6 P - 18 ppm K - 130 ppm	pH - 7.0 P - 4 ppm K - 135 ppm
Previous Crop	Permanent mixed grasses	Predominant fescue grass	Predominant fescue grass
Soil Type	Zanesville silt loam	Lowell silt loam	Westgate silt loam

STUDY DESIGN

There were three locations (Monroe, Noble and Morgan Counties) with a randomized complete block design at each location with four (4) treatments, including a control, and four (4) replications of each treatment. Each plot was 6 ft. x 20 ft. The fields were mechanically harvested prior to treatments to a height of three inches. The control plots received no urea (46-0-0), urease inhibitor, or ammonium sulfate (21-0-0). For the other treatments, a total of 46 pounds/acre of nitrogen was used in each treatment in the following manner: 100 pounds urea/acre; 100 pounds urea/acre plus Agrotain® added at the labeled rate of one gallon* per ton of fertilizer; and 219 pounds/acre ammonium sulfate which was applied on August 6, 2018. The plots were harvested on November 4, 2018 to a height of three inches above ground level utilizing 2' x 2' subsamples from each plot. Each subsample was weighed fresh, and then taken to a laboratory for forage analysis.

Treatments	Application Rate (lbs N/ac)
Control	0
Urea	46
Urea + Agrotain	46
Ammonium Sulfate	46

OBSERVATIONS

Many livestock owners use the granular form of urea nitrogen during late summer and fall trying to increase forage growth for "stockpiled" forage. Livestock are then allowed to graze the "stockpile" at a later date when other forages no longer are growing or available. This practice extends the grazing season and reduces the need for higher priced stored feed. This was an identical study to one that was conducted in 2016 and 2017.

Research has demonstrated that urea nitrogen can be susceptible to volatilization when temperatures and humidity are high and no rainfall occurs to move the broadcast nitrogen (N) into the soil in a timely manner. Rainfall after the treatments were initiated occurred within 30 hours of the start of the study, reducing the potential to lose N to volatilization. For the month of August, rainfall at the three sites ranged from 3.21 in. to 3.73 in.

In the identical 2016 study, dry matter (DM) yields averaged 2,627 pounds/acre for the plots where no N was applied, 3,144 pounds/acre for the plots with 46 pounds of N in the form of urea applied, 3,459 pounds/acre for the plots with 46 pounds of N in the form of urea applied, with Agrotain® added, and 3,609 pounds/acre for the plots with 46 pounds of N in the form of ammonium sulfate applied. There was a significant difference between the control and the treatments ($P<0.05$) for yield, but not between the treatments. There was also a significant difference in CP between the control and the treatments, but not between the treatments. There were no significant differences with ADF and TDN.

Tools of the Trade

Portable Electric Fence

Utilizing portable electric fence and allocating a portion of the stockpiled grass can improve utilization from as low as 50% to as high as 90%.

SUMMARY

- There were significant differences in yield between the control and all of the treatments for the three site average, but not between the treatments.
- One needs to calculate the application costs, consider the costs and time to feed stored feed, and the utilization of the stockpiled forages and the stored feed.
- In many cases, stockpiling is a viable option to reduce costs and save time.

PROJECT CONTACT

For inquiries about this project, contact Chris Penrose, Professor, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Morgan County (penrose.1@osu.edu).

Treatments	Crude Protein (%)	Yield (lbs/ac)
Control	9.4	2,219 b
Urea	9.8	2,839 b
Urea + Agrotain	10.4	3,190 a
Ammonium Sulfate	10.1	2,870 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: 472 CV: 19.81%

Use the QR code above or visit the link below to view a summary video for this trial: go.osu.edu/stockpilingforages

OBJECTIVE

Determine the effect of sulfur applied to wheat on grain yield.

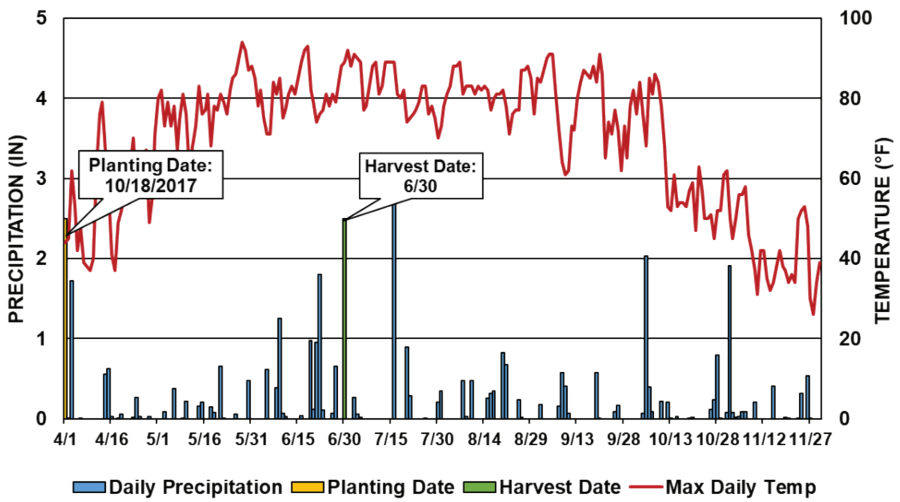
eFields Collaborating Farm

OSU Extension

Auglaize County

STUDY INFORMATION

Planting Date	10/18/2017
Harvest Date	6/30/2018
Variety	Croplan 9415
Population	1,050,000
Acres	23
Treatments	2
Reps	3
Treatment Width	45 ft.
Tillage	No-Till
Herbicide	Durango, Sharpen
Previous Crop	Soybean
Row Width	7.5 in.
Soil Type	Pewamo silty clay loam, 57% Blount silt loam, 43%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	3.44	2.49	7.06	4.94	3.65	21.58
Cumulative GDDs	117	669	1,330	2,016	2,728	2,728

STUDY DESIGN

The experiment was designed as a randomized complete block having 3 replications. Plot width was 45 feet and plot length was 525 feet. Poultry litter was applied in the fall at 3 tons/A. Sulfur was applied as ammonium thiosulfate at 20 pounds actual per acre on March 9, 2018. A total of 45 pounds of actual nitrogen per acre was applied by itself to the non-treated plots or with ammonium thiosulfate to the treated plots. An additional 54 pounds of actual nitrogen was applied April 13, 2018. The center 35 feet of the plot was harvested with a John Deere combine having a calibrated yield monitor.

Treatments	Application Rate (lbs/ac)
No Sulfur	0
Sulfur Applied	20

OBSERVATIONS

Wheat stand was a little thin at this site due to non-uniform planting depth.

Overall, the wheat crop appeared to be in good condition at the time of the fertilizer application.

There was no visual difference in color or height of the plants between the two treatments during the growing season.

No Fusarium head blight pressure was observed to interfere with plot treatments.

Calibrated combine yield and moisture sensors were used to harvest this project.

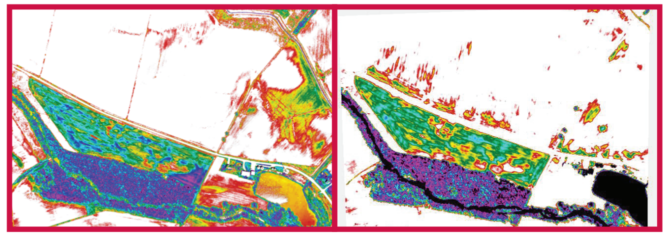
Tools of the Trade

Streamjet Nozzles

To reduce crop injury and provide more accurate fertilizer applications, a streamjet nozzle was used to apply the sulfur fertilizers to the standing crop.

SUMMARY

- The application of sulfur at 20 pounds actual per acre increased wheat yield 4.5 bushels per acre.
- The application of poultry litter in the fall did not provide enough sulfur during the growing season for the wheat.



AirScout aerial imagery such as ADVI (left) and thermal (right) can be used to scout for nutrient deficiencies in wheat.

PROJECT CONTACT

For inquiries about this project, contact Jeff Stachler, ANR Extension Educator - Auglaize County, Department of Extension (stachler.1@osu.edu).

Treatments	Moisture (%)	Yield (bu/ac)
No Sulfur	13.4	81 b
Sulfur Applied	13.4	85 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: 0.87 CV: 2.70%

OBJECTIVE

Determine the effects of corn insect traits on WBC damage and corn yield.

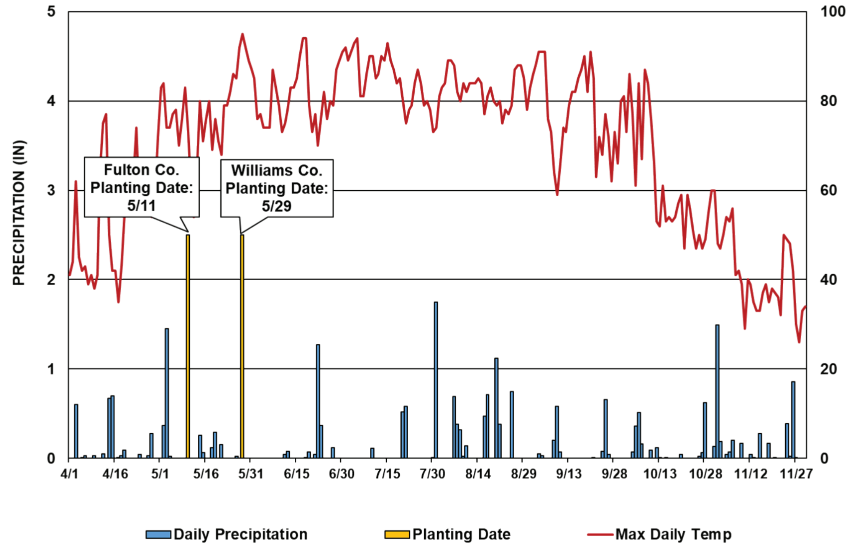
eFields Collaborating Farm

OSU Extension

Fulton & Williams Counties

STUDY INFORMATION

Fulton Co.		Williams Co.
5/11/2018	Planting Date	5/29/2018
Golden Harvest	Variety	Golden Harvest
33,000	Population	33,000
5.5	Acres	10
3	Treatments	3
4	Reps	4
20 ft.	Treatment Width	30 ft.
Minimum	Tillage	No-TIll
Cinch ATZ, Roundup	Herbicide	Roundup, 2,4-D
Soybeans	Previous Crop	Wheat and Multispecies cover crop
30"	Row Width	30"
Wauseon fine sand, 53% Colonie fine sand, 47%	Soil Type	Blount loam, 100%



Weather Summary

Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.57	2.86	2.00	2.97	4.98	15.38
Cumulative GDDs	111	620	1,261	1,983	2,698	2,698

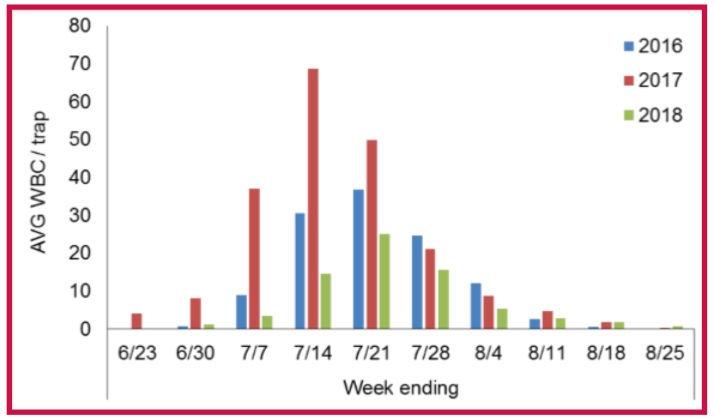
OBSERVATIONS

Overall in 2018, there was a decrease in WBC populations across the state of Ohio. Low population numbers were also observed during the scouting efforts.

Over the four week scouting period, Fulton Co. 1 had a total of four WBC egg masses all found on July 17 (1.6% of plants) and no larvae.

Location 2 had 2 egg masses found on July 10 (0.8%), July 18 (0.8%) and one egg mass and one plant with larvae on July 25 (0.8%).

These numbers indicate an overall low presence of WBC in both locations. For instance, the current recommendation for treatment in a field is when 8% or more of the plants inspected have eggs or larvae.



Average western bean cutworm (WBC) across the state of Ohio in 2016 (blue), 2017 (red) and 2018 (green).

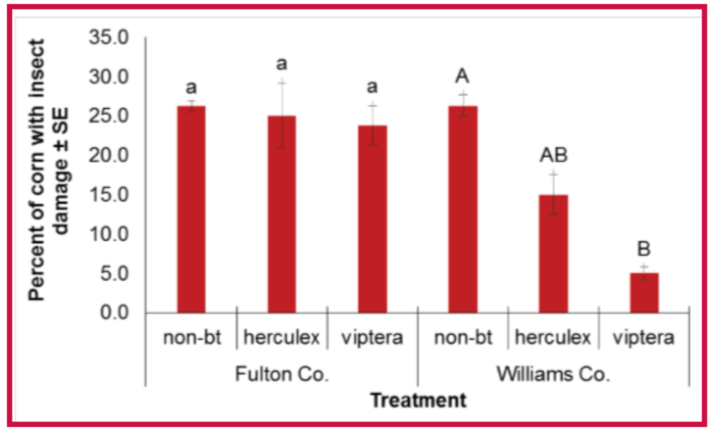
SUMMARY

Twenty plants per plot were hand harvested on October 8, 2018 in Fulton Co. and October 22, 2018 in Williams Co.

Each ear of corn was evaluated for insect feeding damage and sorted into two categories: corn with no damage and corn with damage. Percent of corn ears with damage was then calculated.

Results from the damage indicated no significant differences among treatments at Fulton Co. (P=0.9758).

However, at Location 2 (Williams Co.), there was significantly more insect damage in the non-bt corn (26.3%) compared to the viptera corn (5%) (P=0.0256).



Percent of Corn with insect damage ± standard error (SE) in the western bean cutworm trait trial in Fulton Co. and Williams Co., Ohio. Locations with the same letter are not significantly different.

Western Bean Cutworm

Western bean cutworm eggs (left); larva feeding damage (right).

Despite low WBC numbers, insect damage was observed in harvested corn at both locations. Overall, the total percentage of corn ears with insect damage was below 30% for both locations.

Despite the noticeable insect damage, there were no significant differences in yield for either location.

PROJECT CONTACT

For inquiries about monitoring, contact Amy Raudenbush, OARDC Entomology Research Associate (raudenbush.3@osu.edu). For inquires about this study, contact Eric Richer, Extension Educator, Agriculture and Natural Resources, Ohio State University – Fulton County (richer.5@osu.edu).

Location	Treatments	Moisture (%)	Yield (bu/ac)	% Plants with Insect Damage
Fulton Co.	Non-bt	18.9 a	135 a	26.3 a
	Herculex trait	18.3 b	114 a	25.0 a
	Viptera trait	18.4 b	123 a	23.8 a
Williams Co.	Non-bt	25.6 A	137 A	26.3 A
	Herculex trait	25.1 B	127 A	15.0 AB
	Viptera trait	25.4 A	136 A	5.0 B

Treatment Means with the same letter are not significantly different according to Fisher's Protected Least Significant Differences (LSD) test at alpha = 0.05.

Winter Barley Production

To determine field-scale efficacy of winter barley production and subsequent double-crop soybean production.

eFields Collaborating Farm

OSU Extension

Northwest Ohio

STUDY INFORMATION

County	Defiance	Fulton A	Fulton B	Fulton C	Fulton D	Hancock	Henry	Paulding A	Paulding B
Planting Date (2017)	10/4	9/29	10/4	9/30	9/28	9/30	9/26	9/28	9/30
Seeding Rate (lbs/ac)	133	149	126	132	152	135	122	141	141
Spring N Applied (lbs/ac)	75	83	90	84	46	90	80	80	80
Soil Type	Latty Clay	Lamson FSL	Hoytville Clay	Rimer LFS	Blount Loam	Blount Loam	Milgrove Loam	Hoytville SCL	Hoytville SCL
Drainage (ft.)	Random	40	25	30	40	40	40	30	50
Tillage	NT	C	NT	C	NT	C	NT	NT	NT

*NT = No-Till, C = Conventional

STUDY DESIGN

Winter Barley:
Several Northwest Ohio growers participated in field-scale winter (malting) barley production research in 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). Fields were soil tested and nutrients applied accordingly on a per site basis. Each grower applied approximately 20 lbs of starter nitrogen and 80 lbs of spring nitrogen. All field operations were performed with commercial equipment. Eight growers across nine sites participated in this study. Simple averages of key data points like moisture, yield, straw yield, protein, germination and DON were calculated.

Excellent growing conditions were experienced in the fall of 2017 for tiller development.

RESULTS

County	Defiance	Fulton a	Fulton b	Fulton c	Fulton d	Hancock	Henry	Paulding A	Paulding B
Harvest Date (2018)	6/25	6/28	6/26	6/26	6/26	6/28	6/25	6/26	6/29
Moisture (%)	12.9	12.9	13.4	13.5	14.7	13.0	13.7	15.5	12.4
Barley Yield (bu/ac)	57.9	105.6	99.9	85.7	94.6	72.9	83.0	98.7	79.7
Barley Straw Yield (ton/ac)	-	1.04	-	1.31	-	0.74	1.36	0.94	0.64

Soybeans After Barley

To determine field-scale efficacy of winter barley production and subsequent double-crop soybean production.

PROJECT CONTACT

For inquiries about this project, contact Eric Richer, Extension Educator, Agriculture and Natural Resources, Ohio State University Extension - Fulton County (richer.5@osu.edu)

STUDY INFORMATION

Soybeans 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). Eight growers across eleven sites (different varieties) participated in these paired sites. Additionally, four growers with five sites (different varieties) had a wheat field nearby their barley and planted double crop soybeans after wheat for comparison.

Generally, it was believed that conditions were favorable for raising winter barley in 2018, despite wet conditions in May and in the week prior to harvest. Soybeans planted after barley had plenty of moisture whereas soybeans planted after wheat experienced a period of dryness. Average August rainfall in the region was 5.6 inches. The first killing frost in Northwest Ohio occurred on October 16, 2018.

STUDY DESIGN

County	Tillage*	Variety	Maturity	Trait
Defiance	NT	SC9335	3.2	Roundup
Fulton A	CT	Brodbeck R333R2	3.3	Roundup
Fulton B	NT	P33A81PR	3.3	Plenish
Fulton C	CT	Iowa 3051	3.1	Non-GMO
Fulton D	CT	P31T11	3.1	Roundup
Fulton E	CT	Rupp 31XT40	3.1	Xtend
Fulton F	NT	P27T91PR	2.7	Plenish
Hancock	CT	Beck's 3559XT	3.5	Xtend
Henry A	NT	NuTech 3361L	3.3	Liberty
Henry B	NT	P92T50	2.5	Non-GMO
Paulding	NT	AGI 3501XT	3.5	Xtend

*NT = No-Till, C = Conventional

RESULTS - PAIRED SITES

Crop	Treatment	Plant Date	Seeding Rate (sds/ac)	Harvest Date	Moisture (%)	Stand (plants/ac)	Yield (bu/ac)
1st Crop Beans	Average	05/22	175k	10/17	14.0	113k	59
	Range	5/1-6/7	160-190k	10/5-11/23	11.0-18.5	85-130k	47-76
Soybean after Barley	Average	7/1	187k	11/17	18.7	139k	37
	Range	6/26-7/12	170-210k	10/25-12/12	14.3-25.0	115-173k	25-47
Soybean after Wheat	Average	7/7	197k	11/29	17.8	151k	20
	Range	7/5-7/12	180-215k	11/23-12/11	16.5-18.7	130-180k	7-31

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.

OBJECTIVE

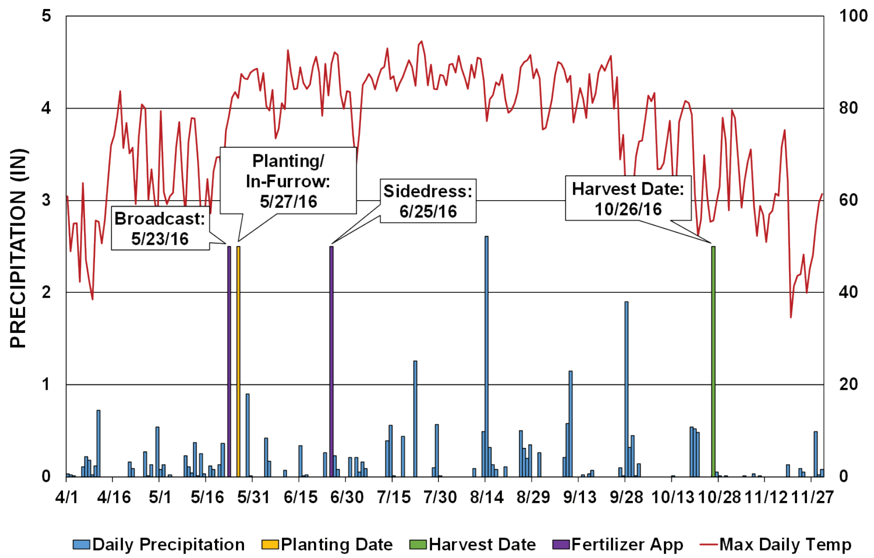
Examine the effects of 28-0-0 and 10-34-0 as in-furrow starter fertilizers when applied following preplant broadcast applications of 0-45-0 and/or 0-0-62.

Western Agricultural Research Station

Clark County

STUDY INFORMATION

Planting Date	5/27/2016
Harvest Date	10/26/2016
Variety	SC 1066 AMX
Population	34,000 sds/ac
Acres	2
Treatments	12
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Herbicide	Post: Lexar EZ, AMS, Glyphosate
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Strawn, 90% Crosby, 10%
2014 Mehlich 3 P	11.6 ppm
2014 Mehlich 3 K	87.8 ppm
2014 CEC	12.4
2014 pH	5.6



Weather Summary

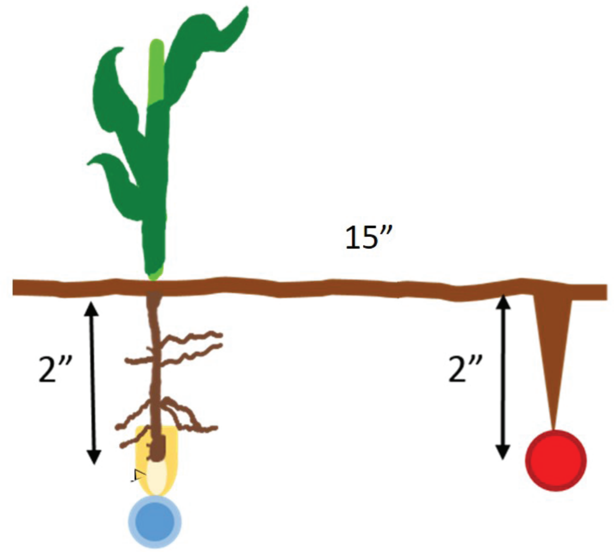
Total	APR	MAY	JUN	JUL	AUG	Total
Precip (in)	2.63	2.87	1.60	4.06	5.45	16.61
Cumulative GDDs	146	482	1,163	1,928	2,704	2,704

STUDY DESIGN

Treatments	Preplant Broadcast (60 lb Application Each)	In-Furrow Starter (28-0-0 at 2 gal/ac or 10-34-0 at 5 gal/ac)	Sidedress (lbs N/ac)
T1	None	None	180
T2	None	28-0-0	174
T3	None	10-34-0	174
T4	P	None	180
T5	P	28-0-0	174
T6	P	10-34-0	174
T7	K	None	180
T8	K	28-0-0	174
T9	K	10-34-0	174
T10	P and K	None	180
T11	P and K	28-0-0	174
T12	P and K	10-34-0	174

OBSERVATIONS

Seedling emergence was monitored by taking stand counts in each plot at the V3 stage to assess potential salt injury. Yield at 15.5% moisture was determined by mechanical harvest of the center two rows using a plot combine.



Placement of fertilizer in relation to the seed. In-furrow applications are denoted by the blue circle, while sidedress applications are noted by the red circle.

Tools of the Trade

Massey Ferguson 8XP Plot Combine

This 2-row plot combine was used to harvest the in-furrow trials. Western Ag It has been outfitted with weigh and collection systems by Kincaid (Haven, KS).

SUMMARY

- In-furrow starter fertilizers did not significantly increase corn yields.
- Stand counts and yields were both significantly decreased when 28-0-0 was applied in-furrow following preplant broadcast applications of K2O at 60 lbs per acre.
- Visual symptoms of surviving plants were consistent with salt injury, likely caused by a combination of the broadcast 0-0-60 and the in-furrow 28-0-0.
- Preplant broadcast application of 0-45-0 at 60 lbs P205 per acre did not significantly increase yield.
- Preplant broadcast application of 0-0-62 at 60 lbs K20 per acre significantly increased yield when 28-0-0 was not used as an in-furrow starter fertilizer.

PROJECT CONTACT

Contact Ryan Haden, Assistant Professor, Agricultural Technical Institute (haden.9@osu.edu) or Steve Culman, Assistant Professor, State Specialist, School of Environment and Natural Resources (culman.2@osu.edu).

Treatments	AVG. Emergence (plants/ac)	Yield (bu/ac)
T1	31,000	106 cd
T2	31,250	116 bcd
T3	30,750	133 bc
T4	33,000	120 bcd
T5	29,750	118 bcd
T6	29,500	135 bc
T7	31,750	146 ab
T8	24,250	90 d
T9	30,500	152 ab
T10	31,750	172 a
T11	24,750	122 bcd
T12	31,250	174 a

Treatment means with the same letters are not significantly different according to Fischer's Least Significant Differences (LSD) test at alpha = 0.05.

2017 In-Furrow Trial

OBJECTIVE

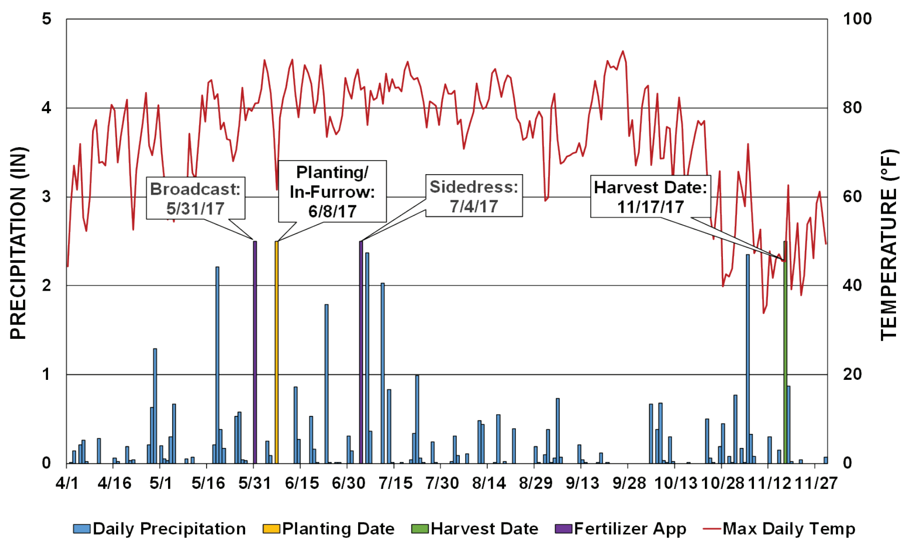
Examine the effects of 28-0-0 and 10-34-0 as in-furrow starter fertilizers when applied following preplant broadcast applications of 0-45-0 and/or 0-0-62.

Western Agricultural Research Station

Clark County

STUDY INFORMATION

Planting Date	6/8/2017
Harvest Date	11/17/2017
Variety	Pioneer 0825 AM
Population	32,000
Acres	2
Treatments	12
Reps	4
Treatment Width	40 ft.
Tillage	Conventional
Herbicide	Sharpen, Glyphosate, AMS, Realm Q, 2-4D, Liberty
Previous Crop	Soybean
Row Width	30 in.
Soil Type	Strawn, 90% Crosby, 10%
2014 Mehlich 3 P	9.3 ppm
2014 Mehlich 3 K	80.7 ppm
2014 CEC	10.9
2014 pH	6.1



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	235	571	1,144	1,900	2,580	2,580

STUDY DESIGN

Treatments	Preplant Broadcast (60 lb Application Each)	In-Furrow Starter (28-0-0 at 2 gal/ac or 10-34-0 at 5 gal/ac)	Sidedress (lbs N/ac)
T1	None	None	180
T2	None	28-0-0	174
T3	None	10-34-0	174
T4	P	None	180
T5	P	28-0-0	174
T6	P	10-34-0	174
T7	K	None	180
T8	K	28-0-0	174
T9	K	10-34-0	174
T10	P and K	None	180
T11	P and K	28-0-0	174
T12	P and K	10-34-0	174

OBSERVATIONS

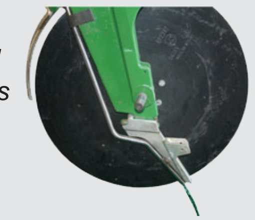
Seedling emergence was monitored by taking stand counts in each plot at the V3 stage to assess potential salt injury. Yield at 15.5% moisture was determined by mechanical harvest of the center two rows using a plot combine.

Massey Ferguson 8XP plot combine harvesting in-furrow trials. These plot combines are equipped with weighing and sample collection systems from Kincaid (Haven, KS).

Tools of the Trade

In-furrow Application System

These in-furrow applicators were used on the planter to place liquid fertilizer in the furrow. Attachments like the one shown here are available on most modern OEM planters.



SUMMARY

- In furrow starter fertilizers did not significantly increase corn yields or affect stand counts.
- Preplant broadcast application of 0-45-0 at 60 lb P_2O_5 per acre significantly increased yield relative to the treatment with 0 broadcast P_2O_5 and no in-furrow starter fertilizer.
- Preplant broadcast application of 0-0-62 at 60 lbs K_2O per acre significantly increased yield relative to the treatment with 0 lbs of broadcast P_2O_5 and no in-furrow starter fertilizer.
- Preplant broadcast application of both 0-45-0 and 0-0-62 in most cases significantly increased yield relative to treatments receiving either 0-45-0 and 0-0-62 alone.

PROJECT CONTACT

Contact Ryan Haden, Assistant Professor, Agricultural Technical Institute (haden.9@osu.edu) or Steve Culman, Assistant Professor, State Specialist, School of Environment and Natural Resources (culman.2@osu.edu).

Treatments	Avg. Emergence (plants/ac)	Yield (bu/ac)
T1	28,250	94 e
T2	30,250	121 de
T3	29,000	121 de
T4	31,000	165 cd
T5	29,750	153 cd
T6	28,000	133 cd
T7	30,250	156 cd
T8	29,250	151 cd
T9	28,250	149 cd
T10	29,250	202 ab
T11	29,250	195 ab
T12	29,250	212 ab

Treatment means with the same letters are not significantly different according to Fischer's Least Significant Differences (LSD) test at alpha = 0.05.

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 Down-force: 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.

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 Oceanic and Atmosperic Administration (NOAA), 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.

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.

De-nitrification: Process by which soil nitrogen is converted from nitrate to nitrite. Occurs most readily when soils are warm and waterlogged. Nitrite is susceptible to leaching and heavy rainfall can wash nitrogen out of root zone.

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.

Experimental Design: The experiment planning procedure that results in the experimental layout. This process should be conducted prior to conducting the experiment.

F

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: 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 interoperate 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.

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 overlaps. Typically, guidance is provided through a series of LED lights.

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.

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.

Mineralization: Process by which nitrogen in soil is converted from organic forms to plant available inorganic forms. Occurs most readily when soil temperatures are warm and soil experiences cycles of drying and re-wetting.

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.

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

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.

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 defoliants 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.

T

Temporal Resolution: The time period over which data was collected. A measure of how often a remote-sensing system can be available to collect data from a particular site on the ground. Also known as "frequency of coverage." Some satellite systems return to the same Earth location every 16 days, some every four or five days, and others provide daily coverage, depending on their orbits. Airborne sensors (manned and unmanned) can be scheduled as desired.

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 autoguidance 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, 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. The 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.

Volatilization: Process by which nitrogen is converted to ammonia gas, occurs when soils are warm and moist. Surface applications of N fertilizers are highly susceptible to volatilization.

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 environ mental 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, gain 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 Digital Ag*)

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.

C.O.R.N Newsletter: This newsletter provides timely information on in-season conditions. Subscribe to receive information on when disease pressure is high in Ohio and tips for management. go.osu.edu/cornsubscribe

Camso TTS-35-2011 20" Tracks: This small frame series is uniquely designed to provide a large footprint in a small undercarriage package for superior flotation when compared to tires. The perfect choice for planters, fertilizer carts, and sprayers.

Case IH High Clearance Sprayer: This sprayer allows for in-season application of crop protection and crop nutrition inputs. Row crop tires and spacing allow for minimal vehicle inflicted damage during field operations.

Case IH Wing Downforce Control System: The Case IH Wing Downforce Control System allows for on the go wing downforce control. This system provides optimal conditions for row units.

Cereal Rye Cover Crop: Overwintering cover crops like cereal rye allow farmers to limit erosion from infrequent, heavy rainfall, add organic matter to their soil and reduce nitrate-nitrogen losses. Ahead of soybeans, cereal rye can suppress some annual weeds while increasing water holding capacity.

Corn Nitrogen Rate Calculator: This tool will calculate the economic return to a nitrogen application with different corn and nitrogen prices to identify the most profitable rate. Visit the website and access the tool at cnrc.agron.iastate.edu.

Corn Stalk Nitrate Tests (CSNTs): CSNTs are used to evaluate the effectiveness of an N management program. Sampling should be done 1-3 weeks after black layer. Generally, <250 ppm is considered a "low" level for stalk nitrates, 250-2,000ppm is "optimal", and >2000 ppm is excessive. (Purdue)

Crop Nutrition Apps: This publication features a list of Apps used by farmers or their agronomic consultants to help with nutrient management including planning, scouting, evaluating stress and executing field applications. go.osu.edu/CropNutritionApps

Crop Protection Apps: Apps can support crop protection by providing the ability to communicate information, assist with field scouting, collect and access data, and more. This publication provides a list of commonly used apps and their descriptions. go.osu.edu/CropProtectionApps

CropMetrics Weather Station w/ 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.

Digital Elevation Model: A Digital Elevation Model (DEM) is often used in reference to a set of elevation values representing 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.

DJI Inspire Drone: Aerial imagery from drones such as the DJI Inspire can help better visualize spatial variation in crop health and can be used for targeted scouting.

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.

Draper Headers: Draper heads have a more consistent feed, allowing for more even threshing, better cleaning result, and a smoother running machine. Draper heads used in soybean research this year include MacDon, Geringhoff, and Case IH 40' flex drapers.

Encirca®: A digital farm and input management tool that uses historical data, soil, and weather information to provide allocation enhancement of inputs. Nitrogen modeling, weather analytics, and a variable-rate Rx generator are all available to assist management of nitrogen.

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.

FieldView™ Cab App: 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.

FieldView™ Drive: The FieldView™ Drive collects operational data through the CAN port. This enables the producer to record data such as machine analytics, yield data, planting data, application data, and many other forms of ag data.

Geringhoff Freedom Head: Higher yields mean higher populations, and a trend toward narrow row spacing. The Gerringhoff Freedom allows an easy transition from 30" rows to 15" rows. The low profile design makes it unmatched in down corn situations.

GreenSeeker: In order for late-season nitrogen applications to pay for themselves, we need a way to test the corn plants to know the current nitrogen status in the plant. One way to do this is to measure NDVI with a tool called the GreenSeeker.

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.

High Clearance Hagie Sprayer: The high clearance applicator makes it possible to apply nitrogen to a crop at a more advanced growth stage with minimal damage. This extends the nitrogen application window and can be used to potentially better match nitrogen timing and rates with crop needs.

High Speed, Low Disturbance (HSLD) Nutrient Application Coulter: Many agricultural equipment companies offer high speed, low disturbance systems for placing nutrients below the surface. John Deere's 2510H is one toolbar that allows for dry, liquid or gas placement in an efficient and environmentally friendly way.

In-furrow Application System: These in-furrow applicators were used on the planter to place liquid fertilizer in the furrow. Attachments like the one shown here are available on most modern OEM planters.

In-season Tissue Sampling: Tissue sampling can help identify nitrogen deficiency in-season. Early detection of nitrogen deficiency stress can help determine if an additional in-season nitrogen application is needed.

J&M Manufacturing 5016 NitroGro Liquid Nitrogen Applicator: This applicator is typically used for sidedress application and features 34 in. of toolbar clearance. This allows for applications over an extended window of growth stages.

John Deere 9420RX and 8370RT: The John Deere tractors used in the pinch row study featured row crop tracks. with 120 in. track spacing and operated with optimal power. The articulated design allowed for easy field navigation and road-ability.

John Deere GS3 Display: The GS3 display was used to facilitate this research trial by renaming the planted hybrids as a particular treatment. This method of hybrid tracking keeps the experiment layout spatially referenced throughout the year.

John Deere Individual Row Hydraulic Downforce Control (IRHD): IRHD works as a closed-loop downforce system that reacts on an individual row basis to changing soil conditions, supporting increased ground contact, which can lead to improved seed depth consistency.

Machine Learning: Machine learning is an Artificial Intelligence (AI) technique that is designed to constantly self-improve allowing the algorithm, once trained, to evolve. It requires large amounts of data for the algorithm to learn and adjust and is becoming a technique used in agriculture.

Manufacturer Safety Labels: Manufacturers provide labels on equipment to identify potential hazard points. It is the equipment operator's responsibility to review the warning labels and use the operator's manual to review any safety features and understand how the equipment operates.

Massey Ferguson 8XP Plot Combine: This 2-row plot combine was used to harvest the in-furrow trials. Western Ag It has been outfitted with weigh and collection systems by Kincaid (Haven, KS).

mSet Meter: The Precision Planting mSet seed meter is a single meter with dual hopper compartments. A seed selector fills the meter and allows for transition between two hybrids, depending on the desired planting product.

Tools of the Trade

New Holland N Coulter Bar: This 36 ft. late season N coulter 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.

NutraBoss Fertilizer Application Tool: The NutraBoss fertilizer applicator provides an opportunity to place fertilizer in dual bands in close proximity to crop rows. These applicators are compatible with many OEM sprayers.

Ohio Agronomy Guide: Due to the possibility of population reduction as a result of dragline manure application if completed too late, it is important to be able to properly stage the crop. This guide includes information on how to determine crop growth stages and other informations.

Ohio State PLOTS App: The Ohio State 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.

Orthman 1tRipr Row Unit: Shank-style strip-till unit Adjustable heavy duty shank allows for ideal seedbed preparation. Can be equipped with dry, liquid, or anhydrous fertilizer attachments. Can place multiple products at varying depths.

Portable Electric Fence: Utilizing portable electric fence and allocating a portion of the stockpiled grass can improve utilization from as low as 50% to as high as 90%.

Precision Planting SmartFirmer: The SmartFirmer provides a high resolution map of soil conditions, including organic matter, which is linked to nitrogen availability in the soil. This data can help to understand spatial differences in nitrogen needs and help inform VR nitrogen applications.

Precision Planting SpeedTube: Precision Planting's SpeedTube allows for increased speed and ensures spacing accuracy, while maximizing the planting window. The flighted belt reduces seeds ricocheting into the trench.

Roller-Crimper: This tool, used in cover crop termination, needs to have blades in a Chevron-pattern (curved) so it will roll smoothly without throwing soil. The crimping terminates standing rye that has flowered to create a weed suppressing, moisture retaining mat.

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.

Salford ST-10 Dual Fertilizer Applicator: The Salford ST-10 applicator is capable of applying dual-products, at variable-rate. These implements have been used increasingly in Ohio as a means to place fertilizer below the soil surface.

Smartphones and Tablets: Mobile devices like smartphones and tablets can place information and data tools in the hands of farmers like never before. Apps are available to check weather, track equipment, monitor crop health, calculate crop nutrient uptake and requirements, and much more.

SMS Advanced: SMS Advanced assists in managing information across many acres, fields and operations. The Digital Ag Team used this software package to create the multi-variety prescription that allowed the Script Ohio to become reality.

Soil Sampling: Soil sampling for nitrate and ammonium N can help determine the amount of nitrogen available to the crop during the season. This information is useful when making a decision to apply additional nitrogen in-season.

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.

Streamjet Nozzles: To reduce crop injury and provide more accurate fertilizer applications, a streamjet nozzle was used to apply the sulfur fertilizers to the standing crop.

Twinjet Spray Nozzle: Coverage of all plant material by the fungicide is extremely critical to maximizing effectiveness. Twinjet spray nozzles are one choice for obtaining proper coverage.

Unverferth Dual-Delivery System: This innovative system combines a Single-Coulter down the center of each row with two trailing hoses. It allows the operator to inject nitrogen into the soil down the middle of the row and apply on top of the soil right next to the plant root.

Weed Control Guide: The 2018 Ohio, Indiana, and Illinois Weed Control Guide provides information and suggestions on weed control and herbicide strategies for corn, soybeans, small grains, and forages. This edition includes a special section focusing on Palmer Amaranth.

Weigh Wagon: Calibrating your yield monitor is important to ensure accurate yield estimates. A weigh wagon is useful to quickly calibrate in the field prior to harvest.

Y-DROP® Sidedress: Traditional sidedress methods apply nitrogen in the middle of the crop row, increasing the chance for loss Utilizing Y-DROP sidedress allows for placement of N 2-3 inches from the stalk base and extends the window for application.

Yetter 2968 2x2x2 Row Unit: 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.

Zoske's Manure Injection Toolbar: This manure toolbar was used along with a large drag hose to apply manure into a standing corn crop for the manure sidedress study.

2017 Ohio Farm Business Summary: A complete farm business analysis monitors profitability, working capital and net worth change. Enterprise Analysis gives you the ability to make informed decisions. Personalized benchmark reports identify opportunities to increase profitability. go.osu.edu/FBA

2x2 Fertilizer Placement: Placing phosphorus with the planter (2x2 or in furrow) can be one of the best ways to avoid nutrient loss. Phosphorus is placed below the surface and near the seed for rapid nutrient uptake at the seedling stage of growth.

340 Case IH Magnum RowTrac: This 340 Magnum RowTrac tractor was a favorite of the Ohio State Digital Ag Team during #Plant18. The RowTrac option performed well during all field conditions, helping to efficiently get power to the ground.

9010 Yetter TrackTill: The 9010 Yetter TrackTill is designed to minimize the pinch-row effect, which can negatively affect yields by fracturing compacted soil tracks from tires or tracks on equipment.

Acknowledgments
eFields Research Collaborators and Supporters

Derek Allensworth

Doug Anderson

Eric Anderson

Steve Angles

Brad Ault

Mark Ault

Amos Aurand

Santiago Avila

Brad Baker

Mica Ballard

Beam Precision Ag

Rick Bell

Bernath Farms

Bond Farms:
Marvin, Neal, Andrew and Michael

Jim Braddock

Dave Bremke

Tim Brinkman

Scott Brown

Bryce Campbell

Heath Carlton

Jared Chester

Casey Cochran

Rachel Cochran

Ethan Conn

Scott Conrad

Darrison and Dean Cook

Rachel Cornell

Mike Couts

Dave Cunningham:
Bridgewater Farming

Joe Davlin

Bethany Dickess

Matt Eggers

Luke Davis

Megan Deam

Brian Farmer

Fayette County Agronomy Club

Adam Fennig

Gary Fennig

Jim Fowler

Dustin Friesen

Jeff Garrabrant

Jamal William Garcia

Mike Gastier

Byron Gearhart

Sydney Geberin

Shawn Gerdaman

Scott Gillen

Justin Goubeaux

Dale Green

Dick Grener

Matt Guentter

Matt Haar

Andrew Hagerty

Chad Hamilton

Mike Hannewald

Paul Harms

Travis Harrison

Harrod and Harrod Farms

Galen Harrod

Steve Hayes

Les Heeringa

Jeremy Heitz

Lisa Heitz

Nick Heitz

Ty Hissong

Randy Hoarberg

Josiah Hoops

Matt Karhoff

Don Keller

Brett Kenworthy

Brian Klever

Gary Klopfenstein

AJ Kropp

Forrest Lang

L & L Farms

Jan Leaders

Greg Lee

Ryan Lee

Rob Leeds

Bil Lehmkuhl

Jacob Lesch

Laura Lindsey

Matt Liskai

Ally Lombardo

Doug Loudenslager

Jim Love

Jerry McBride

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Aaron Overholser

Bryon Palitto

CJ Parker

Steve Payne

Denny Person

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Fred Pond

Asa Radcliff

Dug Radcliff

Lee Radcliff

Mav Radcliff

Radcliff Farms

Dillon Rall

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Larry Richer

Toby Ripberger

Ron Rockhold

Craig Rodgers

Kaitlin Ruetz

Tyler Schindel

Schweibert Farms

Michael Schmenk

Ben Schmitmeyer

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Garrick Schroeder

Seiler Farms

Richard Shaw

Dave Shipley

Matt Simmons

Doug Simpson

John Sites

Scott Sloan

Steven Snyder

Randy Brown and Sons

Shane Sowers

Southwest Ohio Corn Growers

Spillman Farms

Tom Stannard

Dan Stevenson

Mark Stucke

Kat Suggs

Matt Sullivan

Scott Surbaugh

Brain Sutton

Dave Swagler

Aaron Ticknor

Rex Tietje

Chris Turner

Ken Ulrich

Brett Unverferth

Dr. Ramaro Venkentesh

Kyle Vennekotter

Clayton Waddle

Wapakoneta FFA

Jason Webster

Jeff Wherley

Chris Wiegman

Dave Williams

Martha Winters

Bruce Wyatt

Alex Wynn

Nick Zachrich

Megan Zerrer

eFields Partners

AeroTrek Flight Academy

Agricultural Data Coalition

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Case IH

The Climate Corporation

Countryside Implements

CropMetrics Yield Optimization Technology

Ebberts

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Evolution Ag

Farmers Equipment Inc Urbana • Lakeview • Elida

Fennig Equipment

Franklin Equipment

Great Plains "Harvest Starts Here."

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Harvest International Inc

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Precision Agri Services Inc.

Precision Planting

Salford

Seed Consultants

SoucyTrack

SureFire Ag Systems

Topcon

Trimble

Unverferth Manufacturing Company, Inc.

Waypoint Analytical

Wellington Implement Since 1929

Yetter Farm Equipment

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. 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.

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