STONE SEED™

FIELD RESEARCH

MONMOUTH LEARNING CENTER

2019

WE KNOW ILLINOIS

Thank you for visiting the Bayer Crop Science Learning Center at Monmouth, Illinois this past summer! 2019 was a year of extremes across much of the region. Planting was severely delayed due to prolonged cold, wet conditions in the spring, followed by hot, dry conditions through much of the summer months. On the plus side, it provided us an opportunity to gather data that would not have been possible in a 'normal' year!

As always, our goal here at the Monmouth Learning Center is to provide you with up-to-date, relevant agronomic information that will benefit you and your operation. With that goal in mind, this booklet contains summaries from a number of our key trials and demonstrations around corn and soybean management systems.

For 2020, we will continue to strive to meet that goal with new trials and demonstrations around cover crops, nutrient management strategies, insect and weed resistance management, high yield management systems approaches, and many other aspects of crop production research. We also plan to continue showcasing our current and future technologies. We hope you find the information within these pages, as well as the rest of our field trials and demonstrations, to be valuable to you and your operation.

Please contact us if you have any questions about these summaries, or any of the other projects here at the Monmouth Learning Center.

Be sure to follow us on Facebook, Twitter, and YouTube where you can download digital and video versions of these summaries, and also access seasonal agronomic content and tour updates all year long.

Thank you once again, and we look forward to hosting you again in 2020!

Sincerely,

Troy Coziahr
Monmouth Learning Center Manager

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The reports in this book are arranged by crop: corn, then soybean. Each report is also tagged with one of these icons to quickly show you what it's about.

MONMOUTH LEARNING CENTER TEAM

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Corn Yield Response to Tillage

Trial Objective

- Different tillage practices are utilized by farmers for various reasons including:
  - Enhance residue decomposition
  - Control of pests
  - Conserve soil moisture
  - Deliver fertilizer to the root zone
  - Relieve soil compaction
- This trial has been repeated at the Monmouth Learning Center over the last three years to compare different tillage practices and to examine their impact on corn yield.

Research Site Details

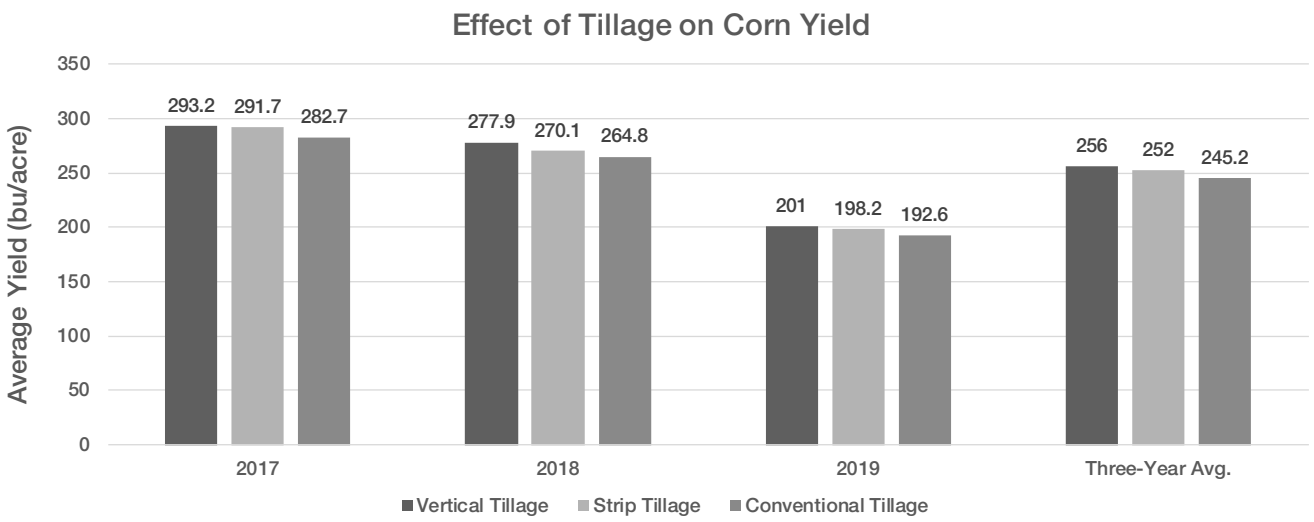
Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Monmouth, IL	Silt loam	Corn	Various	4/25/19	10/9/19	250	36K

- Two SmartStax® RIB Complete® corn products were planted:
  - 108-day RM
  - 114-day RM
  - No difference was noted in corn product response, so the results were averaged together.
- Three tillage practices were compared:
  - Conventional tillage with a chisel plow in the fall followed by one pass in the spring to prepare the seedbed for planting.
  - Strip tillage on 30-inch centers in the fall.
  - Vertical tillage in the fall.
- The experiment was replicated five times.
- Results were combined with the previous two years of data to produce a three-year average.

Understanding the Results

- In 2019, the conventionally-tilled plots underperformed compared to vertical tillage and strip tillage by 8.4 bu/acre and 2.8 bu/acre, respectively. These results were similar to previous years at the Learning Center (Figure 1).

Corn Yield Response to Tillage



Key Learnings

- Although the results were not substantially different, the tendency at the Monmouth Learning Center has been for conventional tillage to underperform compared to reduced tillage practices.
  - This may be a result of multiple factors such as improved soil structure in reduced tillage fields or better water conservation.
- Reduced tillage practices may provide additional benefits besides yield, such as:
  - Reduced soil erosion
  - Reduced nutrient loss
  - Reduced fuel costs
- Factors such as weather, soil type, or field topography may influence results. Consult your local Field Sales Representative or Technical Agronomist for recommendations for your farm.

ENVIRONMENT

Effect of Tillage and Cover Crops on Corn Yield

Trial Objective

- Different tillage practices are utilized by farmers for various reasons including to:
  - Enhance residue decomposition
  - Control pests
  - Conserve soil moisture
  - Deliver fertilizer to the root zone
  - Relieve compaction
- Farmers also utilize cover crops in their crop production system. Potential benefits of cover crops are:
  - Soil conservation (erosion control)
  - Soil moisture conservation
  - Weed suppression
  - Improved organic matter
  - Improved soil structure
  - Improved nutrient cycling
- In 2019, the Monmouth Learning Center established a trial to evaluate the interaction of certain tillage practices with the presence of a cover crop and the effect on corn yield. This is intended to be a long-term trial to monitor both yield and soil quality over time.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Monmouth. IL	Silt loam	Corn	Various	4/23/19	10/14/19	250	36K

- Five zones were established in the fall of 2018 (Figure 1):
  - Conventional tillage without a cover crop
  - No-till without a cover crop
  - No-till with a cover crop
  - Strip tillage without a cover crop
  - Strip tillage with a cover crop
- Cereal rye was sown in the relevant zones and respective tillage operations were performed in the fall of 2018.
- Following cover crop termination, a 114-day RM SmartStax® RIB Complete® corn blend product was planted in all plots.
- Grain was harvested and adjusted to 15% moisture.

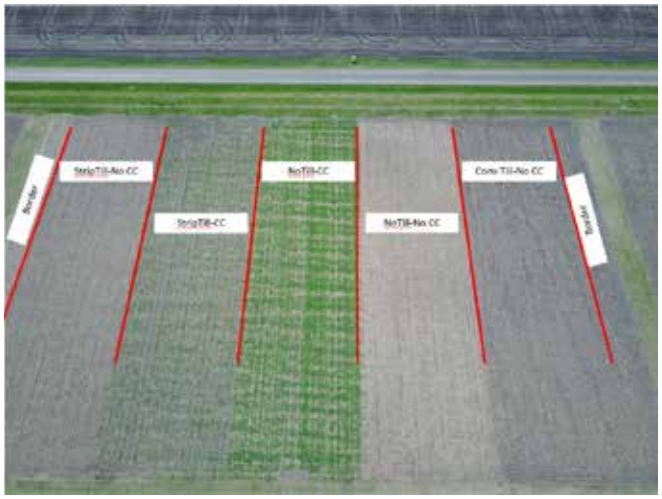


Figure 1. Map of tillage and cover crop plots. CC = cover crop.

Effect of Tillage and Cover Crops on Corn Yield

Figure 2. Average corn yield after being planted in various combinations of tillage with or without a cover crop.

Understanding the Results

- In this trial, no-till plots had the lowest corn yield (Figure 2). Prolonged cold temperatures prior to planting likely hindered residue decomposition and seedling emergence, potentially affecting yields in those plots.[1] Rising temperatures after planting likely promoted rapid residue decomposition, which could reduce the amount of nitrogen available during the early season as microbes utilize soil nitrogen when decomposing crop residue.[2]
- Yields were similar between the strip-tilled plots and the conventionally-tilled plot.

Key Learnings

- This was the first year of this trial; establishing tillage zones and improving soil structure and quality takes time.
- Cover crops may have other benefits beyond yield: moisture conservation, weed suppression, and nutrient cycling. These benefits are less tangible but may have an effect on profit potential.
- The Monmouth Learning Center has committed to conducting this study on a long-term basis to monitor the effects on yield and soil quality over time.

Sources

[1] Archontoulis, S. and Castellano, M. 2018. Soil water, residue, and nitrogen status entering the 2018 growing season. Iowa State University. https://crops.extension.iastate.edu/.

[2] University of Nebraska – Lincoln. 2017. Crop residue removal: impacts on yield. No-Till Farmer. https://www.no-tillfarmer.com.

Corn Response to Seeding Rate

Trial Objective

- Corn products can respond differently to seeding rates depending on their ability to 'flex' ear size and their ability to compete for resources.
- The Bayer Learning Center at Monmouth, Illinois conducts annual trials and demonstrations to illustrate different responses to seeding rates.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Monmouth, IL	Silt loam	Soybean	Conventional	6/7/19	10/29/19	250	28K, 32K, 36K, 40K

- Three different SmartStax® RIB Complete® corn blend products were planted at four seeding rates (seeds/acre):
  - 28,000
  - 32,000
  - 36,000
  - 40,000
- Plots were harvested and adjusted to 15% moisture.

Understanding the Results

- The three corn products in this demonstration typified the differences that we see across different products.
  - The 107-day relative maturity (RM) product yielded the lowest, did not respond positively to increased seeding rates, and lodged badly at higher seeding rates (Figures 1 and 2).
  - The 111-day RM product performed at the same level regardless of seeding rate.
  - The 116-day RM product responded positively to an increase in seeding rates, yielding the highest overall at the 40,000 seeds/acre seeding rate.

Key Learnings

- Individual corn products can respond differently to different seeding rates depending on several factors including:
  - Genetic ability to compete for resources
  - Pest pressure and trait packages
  - Weather and growing conditions
- Please consult your local Field Sales Representative or Technical Agronomist for specific recommendations for your farming operation.

Corn Response to Seeding Rate

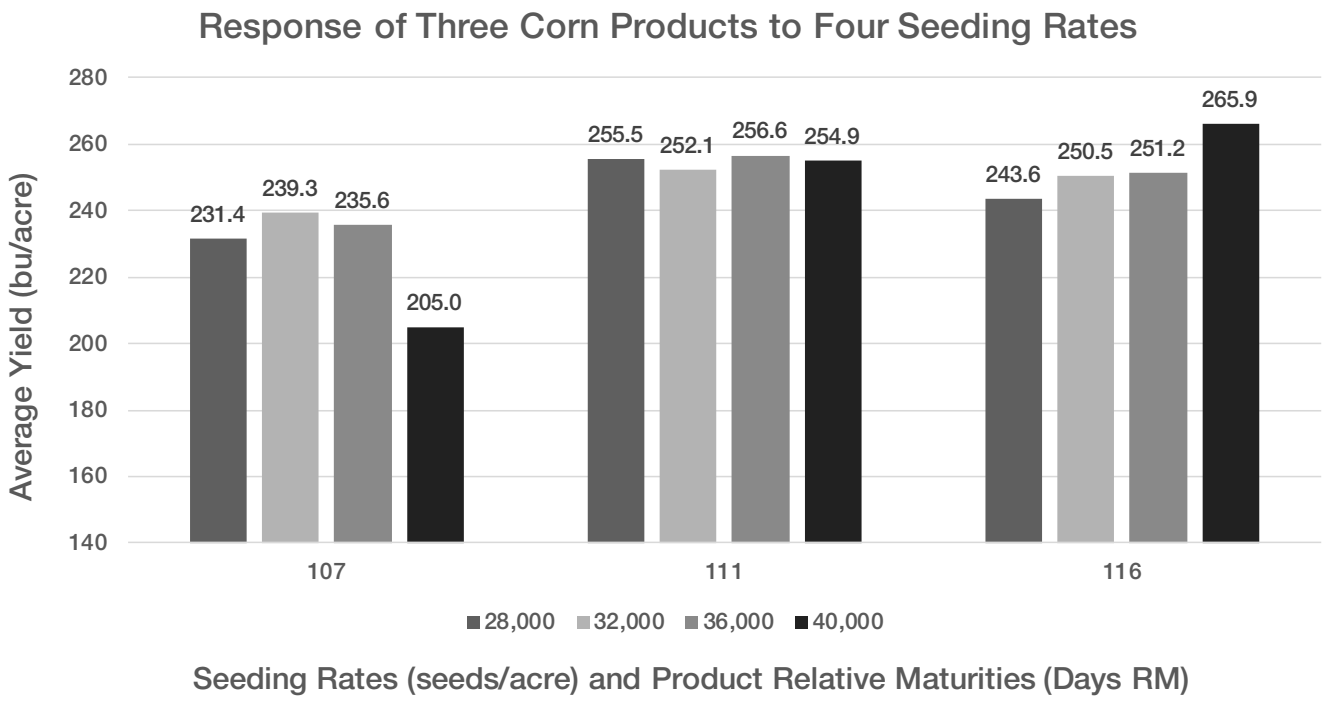


Figure 1. Average yield response of three corn products with different relative maturities to four seeding rates at the Bayer Learning Center at Monmouth, IL in 2019.

Figure 2. The 107-day RM product lodged badly at higher seeding rates.

ENVIRONMENT

Growth and Development of Late-Planted Corn

Trial Overview

- Field corn growth and development largely depends on temperature. The generally accepted method of tracking development is to calculate accumulated growing degree days (GDDs). Warm temperatures lead to rapid GDD accumulation.
- Black layer occurs at maturity and is the formation of a layer of dead cells where the kernel attaches to the cob (Figure 1). Once black layer forms, no further photosynthates can be delivered to the kernel – only drying down (loss of moisture) can occur.
- If a killing frost occurs before black layer, while the milk line is still visible, there can be a negative impact on yield potential (Figure 2).
- The 2019 planting season was extremely challenging throughout much of the Corn Belt. There were approximately 2 to 3 days with conditions conducive to planting in the months of April and May. Much of the crop was planted after June 3. The major delays in planting led to concerns of full-season hybrids having insufficient time to develop before the first killing frost.

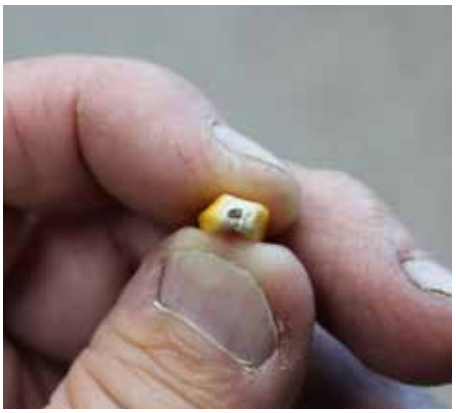


Figure 1. Dead cells where the kernel attaches to the cob indicate black layer and the beginning of grain dry down.

- Previous work at Purdue University indicated that late-planted corn can develop with fewer GDDs, helping to alleviate those concerns.[1]
- **Guidance was given to many farmers that switching to an earlier-season hybrid was not necessary in many cases based on the understanding that fuller-season hybrids could reach black layer before the first average frost date. However, as the growing season progressed, this accelerated development did not seem to take place.**

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Monmouth, IL	Silt loam	Soybean	Conventional	4/25/19 6/3/19	10/9/19 10/28/19	250	36K

- Two SmartStax® RIB Complete® corn blend products with relative maturities (RM) of 108-day and 114-day were planted on two different dates:
  - 4/25/19 (early)
  - 6/3/19 (late)
- Accumulated GDDs as well as elapsed calendar days were recorded for two key developmental stages: silking and black layer.

Growth and Development of Late-Planted Corn

Understanding the Results

- The 108RM corn product developed at a similar pace in both plantings. Key developmental stages were reached slightly sooner in the later planting, but not substantially different.
- The late planted 114RM corn product developed much faster during the vegetative stage – developing silks 170 GDDs sooner than that of the early planting. This is in line with expectations from the earlier research at Purdue.[1]
- However, during the reproductive stages, development in the 114RM product seemed to regress. Black layer was reached only 47 GDDs sooner in the late planting. This agrees with observations from throughout Illinois. In some instances, black layer reportedly occurred even later than normal.
- It is not entirely clear what caused this to occur, but there is some indication that reduced sucrose production as the leaves mature and die may be involved in triggering black layer.[2] If this is the case, warmer than normal temperatures in September led to increased stay-green and extended sucrose production. Consequently, there was delayed black-layer formation.
- Stay-green also may have been prolonged by plentiful rainfall, which came after a 6-week drought during July and early August, possibly stimulating increased photosynthesis and additional sucrose production.

Table 1a. Silking and black layer data from the 108RM corn product.

	EARLY	LATE	Difference
Planting Date	4/25/19	6/3/19	40 Days
Silking Date	7/14/19	7/30/19	The late-planted corn product reached silk stage 16 days later than the early-planted product
Silking GDD	1352	1341	The late-planted corn product reached silk stage 11 GDDs sooner than the early-planted product
Black Layer Date	9/11/19	10/1/19	The late-planted corn product reached black layer 20 days later than the early-planted product
Black Layer GDD	2619	2601	The late-planted corn product reached black layer 18 GDDs sooner than the early-planted product

Table 1b. Silking and black layer data from the 114RM corn product.

	EARLY	LATE	Difference
Planting Date	4/25/19	6/3/19	40 Days
Silking Date	7/21/19	8/1/19	The late-planted corn product reached silk stage 11 days later than the early-planted product
Silking GDD	1548	1378	The late-planted corn product reached silk stage 170 GDDs sooner than the early-planted product
Black Layer Date	9/18/19	10/7/19	The late-planted corn product reached black layer 19 days later than the early-planted product
Black Layer GDD	2747	2700	The late-planted corn product reached black layer 47 GDDs sooner than the early-planted product

Growth and Development of Late-Planted Corn

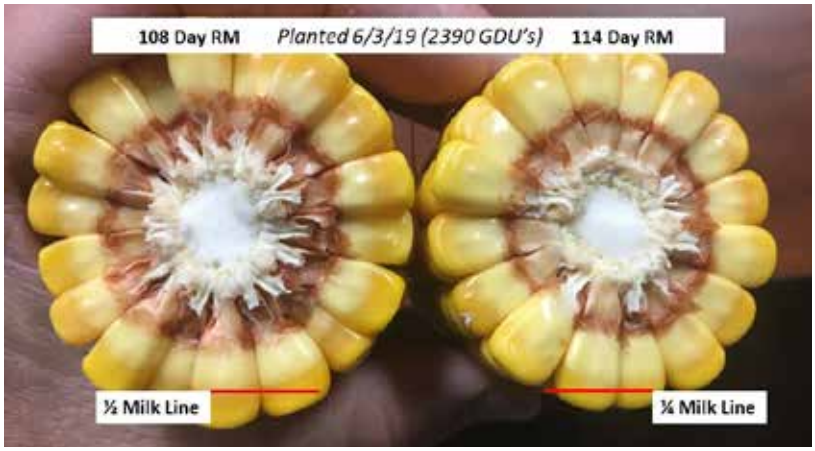


Figure 2. Milk line on kernels from the 108-day RM and 114-day RM corn products from the late planting date (6/3/19) showing the differences in maturity.

Key Learnings

- In many circumstances, late-planted corn can develop at an accelerated pace – reaching key growth stages with fewer accumulated GDDs. This possibility would increase the likelihood of black-layer development before a killing frost.
- This accelerated development may not happen every season, particularly in conditions that prolong stay-green and photosynthetic activity in the fall.
- Corn growth and development can be highly variable – consult your local Field Sales Representative or Technical Agronomist for product recommendations to fit your specific circumstances.

Sources (verified 11/2/2019)

[1] Nielsen, R.L. 2019. Hybrid maturity decisions for delayed planting. Corny News Network. Purdue University. https://www.agry.purdue.edu/ext/corn/news/timeless/hybridmaturitydelayedplant.html

[2] Afuakwa, J.J., Crookston, R.K., and Jones, R.J. 1983. Effect of temperature and sucrose availability on kernel black layer development in maize. Vol. 24(2). Pgs. 285-288.

When Should I Switch to an Earlier RM Hybrid?

Trial Objective

- The 2019 planting season was severely delayed across much of the Corn Belt. The majority of the corn crop in Illinois was not planted until after June 3.
- Farmers are asking for guidance around when they should consider switching to an earlier relative maturity (RM) hybrid to mitigate the risk of a killing frost before the corn crop could mature.
- The Bayer Learning Center at Monmouth, Illinois conducted a trial to evaluate the difference in yield and return over drying cost among a range of RMs planted on two different dates in June.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Monmouth, IL	Silt loam	Soybean	Conventional	6/3/19, 6/11/19	10/28/19	250	36K

- Six different corn products ranging from 95- to 114-day RM were planted on two different dates in 2019:
  - June 3
  - June 11
- All plots were harvested on October 28 and adjusted to 15% moisture.
- Yields were calculated and compared as was return over drying cost.

Understanding the Results

- Yields were consistently higher in the June 3 planting with the exception of the 108-day corn product (Figure 1).
  - Even though this product yielded higher in the later planting, higher drying costs led to the earlier planting date being more profitable.
  - Moisture was substantially higher across all plots planted on June 11 (Figure 1).
- Return over drying costs declined substantially from the June 3 to June 11 planting date (Figure 2).
  - However, returns for the later RM corn products were still higher than the two earliest RM corn products.

Key Learnings

- Corn products that were earlier in maturity than the typical RM range for the area (105- to 115-day RM) did not yield or return well compared to the corn products that fit the area in a ‘normal’ growing season.
- These results suggest that while switching from late-maturing to earlier-maturing hybrids may be justified by the 2nd week in June, farmers should still consider staying with a RM that fits their geography.
- Growing conditions are highly variable form year to year. Consult your local Technical Agronomist or Field Sales Representative for specific recommendations for your farm.

When Should I Switch to an Earlier RM Hybrid?

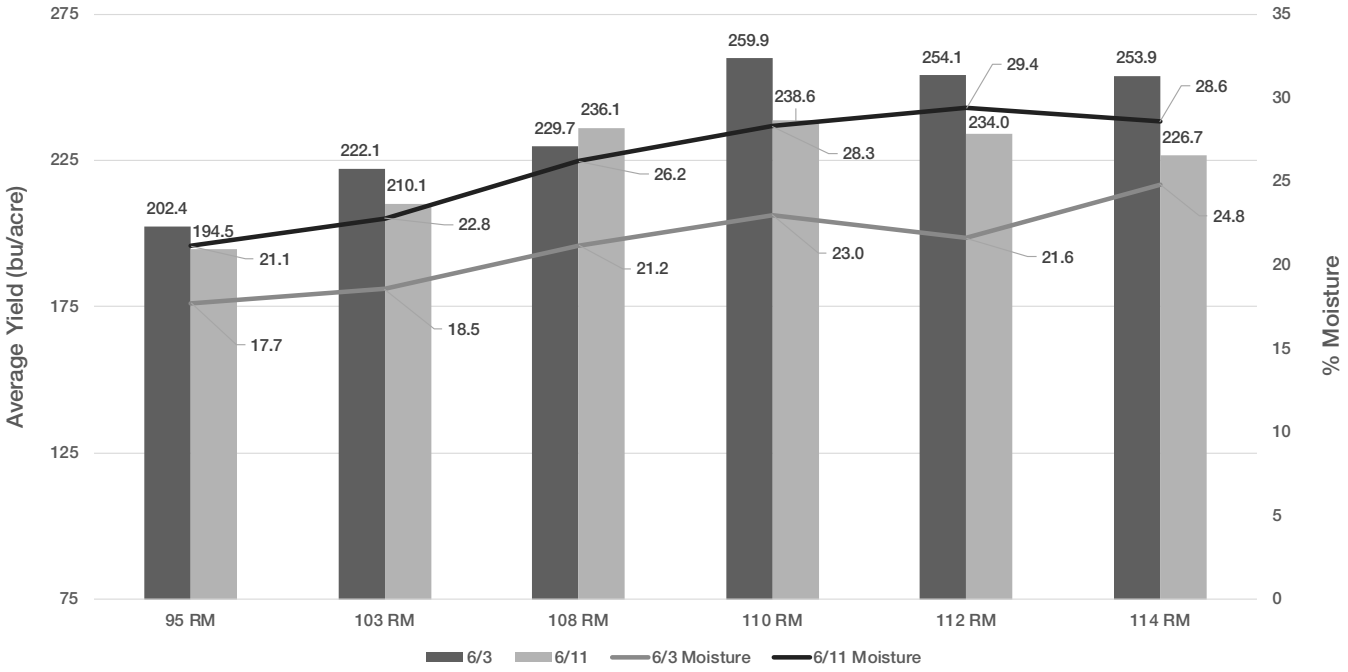
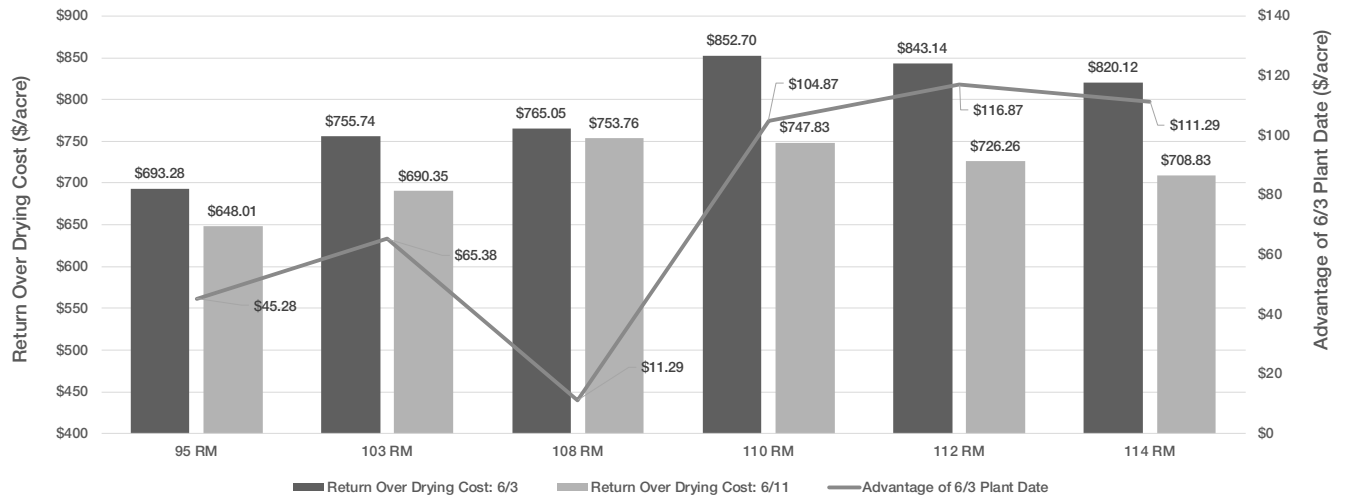


Figure 1. Average yields of each corn product at the two planting dates with moisture trendlines.



(Assumes $3.50 corn price; Drying cost of $.0275 per point above 15% moisture, per bushel)

Figure 2. The return over drying cost for each corn product at the two planting dates with the trendline showing the advantage of the June 3 planting date.

2019 Fantasy Farming Challenge

Trial Objective

- In 2013, the Monmouth Learning Center created an educational competition for area high school agriculture programs. Since that time, the Fantasy Farming Challenge has grown each year. In 2019, we had 22 participating schools from Illinois. Through this program, thousands of high school students have had the opportunity to learn more about crop production and the agriculture industry.
- The Challenge begins in February when students in the participating schools attend a presentation where they learn about basic corn production, the key decisions a grower must make every season, and the risks and costs associated with those decisions. From there, the students must design a corn production "field" and make the following key decisions:
  - Select a corn product from a list of several different genetic families and trait packages
  - Whether to add a soil insecticide
  - Planting date (early, mid, or late)
  - Seeding rate
  - Row spacing (20 or 30 inches)
  - Pounds of nitrogen/acre
  - Timing of nitrogen application (all preplant or split between preplant and in-season application)
  - Whether to apply a foliar fungicide
  - Most of these decisions have a cost associated with them, and there are several fixed costs for each plot based on equipment, fuel, herbicides, land rent, etc.
- Once their decisions have been submitted, the Learning Center staff plants each school's plot, implementing the production decisions of the students. During the season, each school takes a field trip to the Monmouth Learning Center to see their plot and learn more about agronomy as well as career opportunities in the industry.
- At the end of the season, all plots are harvested, yields are adjusted to 15% moisture, and the grain is sold on the cash market. There are two prizes given out: one is awarded to the school who produces the highest yield, and one is awarded to the school who returns the highest profit based on their decisions.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Monmouth, IL	Silt loam	Soybean	Conventional	See Table 1	10/8/19	250	See Table 1

2019 Fantasy Farming Challenge

Table. 1 Management Choices								
School	Maturity	Trait	Insecticide?	Seeding Rate	Row Spacing (inches)	Nitrogen Rate	Planting Date	Fungicide?
Riverdale	105 Day RM	VT2PRIB	N	35500	30	260	Early	N
Spoon River Valley	105 Day RM	VT2PRIB	N	42000	20	160/65	Mid	Y
Kewanee	103 Day RM	VT2PRIB	N	35000	20	150/100	Mid	Y
ROWVA	104 Day RM	SSRIB	N	38000	20	220	Early	Y
Princeville	104 Day RM	SSRIB	N	38000	30	120/60	Early	Y
Farmington	104 Day RM	SSRIB	N	38000	30	160/80	Early	Y
Mercer County	105 Day RM	VT2PRIB	Y	38000	30	90/165	Early	N
Sherrard	106 Day RM	VT2PRIB	N	39000	20	180/80	Early	N
AlWood	104 Day RM	SSRIB	Y	42000	20	60/90	Early	Y
West Central	104 Day RM	SSRIB	N	42000	20	100/120	Early	Y
Williamsfield	105 Day RM	VT2PRIB	N	37000	30	100/120	Early	Y
United	104 Day RM	SSRIB	N	37000	30	150/100	Early	Y
Wethersfield	104 Day RM	SSRIB	Y	36000	30	100/150	Early	N
Geneseo	104 Day RM	SSRIB	N	32000	30	100/150	Early	Y
Monmouth-Roseville	102 Day RM	VT2PRIB	N	40000	20	70/105	Early	Y
Cambridge	105 Day RM	VT2PRIB	N	34000	30	100/100	Early	Y
Galva	104 Day RM	SSRIB	N	39000	20	80/120	Mid	Y
Annawan	103 Day RM	SSRIB	Y	32000	30	160	Mid	Y
Rockridge	104 Day RM	SSRIB	N	38000	20	100/80	Mid	Y
Orion	105 Day RM	VT2PRIB	N	35000	30	70/150	Mid	N
Knoxville	102 Day RM	SSRIB	N	37000	30	100/100	Mid	N
VIT	103 Day RM	SSRIB	N	30000	30	60/140	Mid	N
SSRIB = SmartStax® RIB Complete® corn blend, VT2PRIB = VT Double PRO® RIB Complete® corn blend								

Understanding the Results

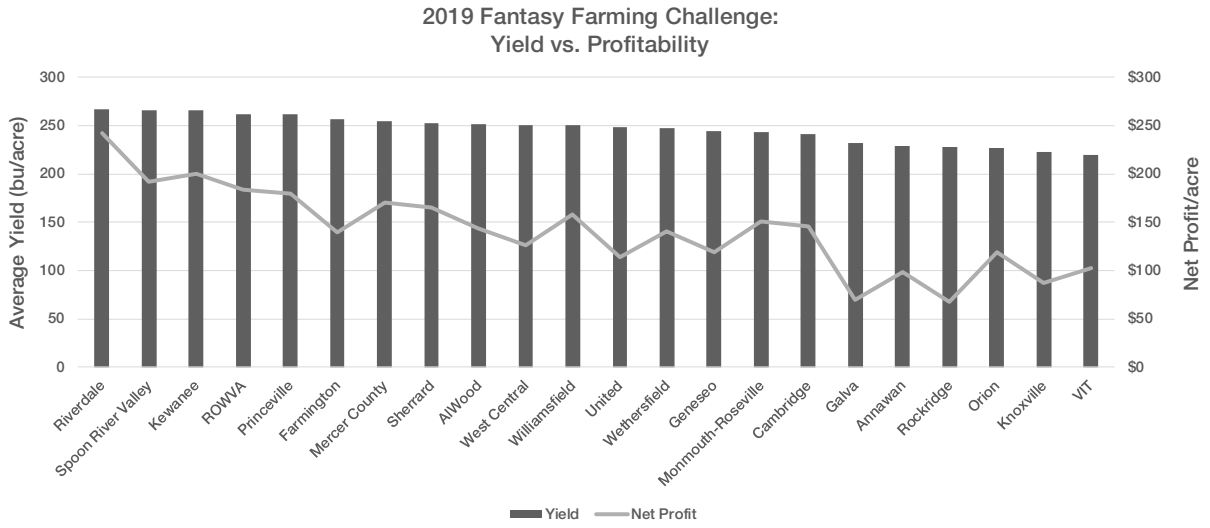


Figure 1. Average yields and net profits of the different plots in the 2019 Fantasy Farming Challenge.

2019 Fantasy Farming Challenge

- Corn maturity and trait package were not major factors with regard to yield. However, when analyzing profitability, the VT Double PRO® RIB Complete® corn blend trait packages tended to be the more profitable choice. This was not surprising as these plots were planted on soybean stubble, so corn rootworm was not a factor.
- Nitrogen management was also critical this year. Schools that went with 'front-heavy' applications of nitrogen tended to yield and perform better. Cutting back on nitrogen rates resulted in much lower productivity.
- For the most part, early planting outperformed later planting.
- The top five schools (yields) were within 6 bu/acre of each other but were separated by as much as $62.79 in net profit/acre.
- The plot with the highest per-acre cost was 6th in yield.
- Similarly, the plot with the lowest per-acre cost ranked 18 out of 22 in overall profitability.

Key Learnings

- These are excellent lessons for students in that the goal of a farmer is not just to produce high yields, but to do so efficiently and profitably. Continuing to add inputs does not guarantee higher yield and cutting costs does not necessarily lead to better profitability.
- It is very seldom in this competition that the highest yielding plot is also the most profitable, but in 2019 that was the case. Congratulations to the students at Riverdale High School in Port Byron, Illinois for putting together the winning plot! Thank you to all schools who participated, and we look forward to conducting this competition again in 2020!

Figure 2. Students from the Riverdale High School Agriculture program designed the highest yielding and most profitable plot in the 2019 Fantasy Farming Challenge.

FERTILITY

Nitrogen Placement During Sidedressing

Trial Objective

- There is an interest in better understanding nitrogen (N) placement during sidedressing and the potential effect on N uptake and yield.
- Nitrogen is a substantial cost in corn production. Understanding the optimal placement of sidedressed N can help farmers determine the application method best suited for their operation.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Monmouth, IL	Silt loam	Corn	Conventional	4/25/19	10/9/19	250	36K

- A 114-day RM SmartStax® RIB Complete® corn blend product was selected for this trial.
- The form of N used for all treatments was 32-0-0 UAN.
- 80 lb N/acre was applied prior to planting and incorporated.
- 100 lb N/acre was sidedressed with a urease inhibitor. Two sidedressing methods were used on June 26 at the V6 growth stage.
  - A rolling coulter applied N in the center of the row (Figure 1).
  - A 360 Y-DROP® system applied N next to the base of the plants (Figures 2 and 3).
- This trial included four replications.
- This trial has been conducted at the Bayer Learning Center at Monmouth, Illinois over the last four years (from 2016-2019).

Figure 1

A rolling coulter applying N in the center of the row.

Figure 2

A 360 Y-DROP® system applying N next to the base of the plants.

Figure 3

The location (dark line next to the base of the plants) where the 360 Y-DROP® system applied N.

Nitrogen Placement During Sidedressing

Understanding the Results

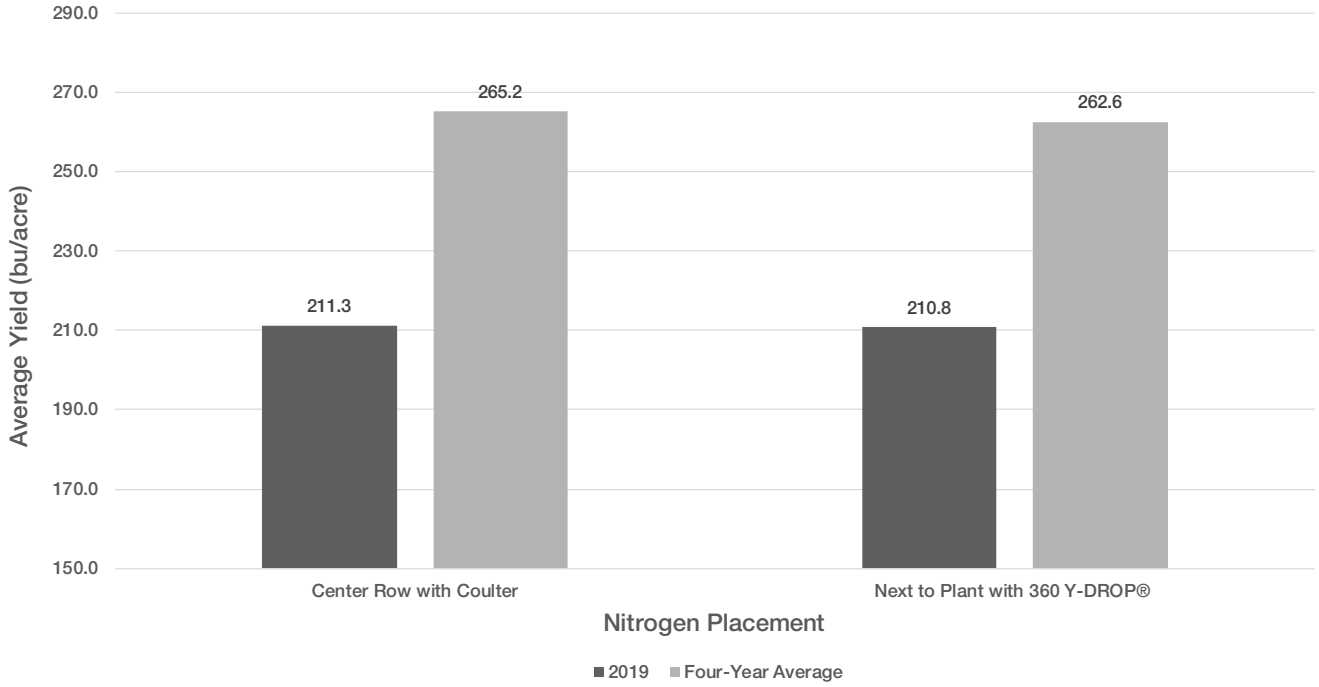


Figure 4. Average corn yield for N sidedressing placement in the center of the row with a coulter and next to the base of the plant with 360 Y-DROP® for 2019 and the four-year average.

- At this location, no clear advantage to either N application method has been seen at V6.
- This year at this location dry conditions followed application, but the data shows no effect with applying the N directly beside the row.

Key Learnings

- The timing for a rolling coulter application can be limited due to the height of the corn crop.
- 360 Y-DROP® can allow a wider application window for sidedressing later in the season.
- Yield differences may not be economically feasible when all costs are considered. Consider all local costs when making N management decisions.
- Individual corn products may have different responses to N application timing. Consult your local Field Sales Representative or Technical Agronomist for recommendations.

FERTILITY

Timing of Nitrogen Sidedress Applications

Trial Objective

- There is considerable interest in applying nitrogen (N) later in the growing season; therefore, farmers and agronomists want to know the best time to sidedress N for a later-season application.
- Nitrogen is a major investment in corn production and knowing when corn plants are most responsive to a N application can help farmers determine the optimal application time for the highest return on their investment.
- The Bayer Learning Center at Monmouth, Illinois has been conducting trials over the past four years to evaluate the impact of N sidedress timing.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Monmouth, IL	Silt loam	Corn	Conventional	4/25/19	10/9/19	250	36K

- A 114 RM SmartStax® RIB Complete® corn blend product was utilized in the trial.
- Nitrogen in the form of 32% UAN (32-0-0) was used as the N source.
- Before planting, 80 lb/acre of N was applied and incorporated.
- Nitrogen was sidedressed with a high-clearance sprayer using 360 Y-DROP® at an application rate of 100 lb/acre with a urease inhibitor at three growth stages:
  - V4 (four leaf collars)
  - V8 (eight leaf collars)
  - VT (tassel)
- The trial consisted of three replications.

Understanding the Results

- In 2019 at this location, sidedressing N at V4 resulted in significantly higher average yields than later timings.
- This result may have been due to the cold and wet conditions this spring limiting residue decomposition prior to planting. When temperatures increased after planting, rapid residue decomposition may have reduced N availability for the plants during the early season, as microbes utilize soil N as they decompose the residue.
- At this location, front-loading the N application resulted in higher average yields over the past four years.

Timing of Nitrogen Sidedress Applications

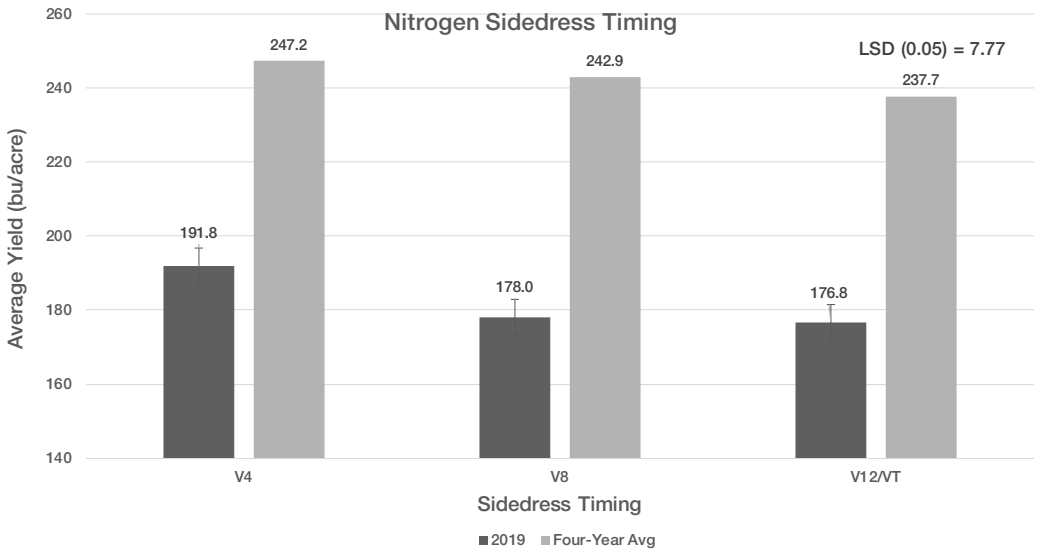


Figure 1. Average corn yield for 2019 and the four-year average for nitrogen sidedress application timing at the V4, V8, or V12/VT growth stage.

Key Learnings

- Including 360 Y-DROP® facilitated timing flexibility and later application of N in taller corn.
- The ideal timing of later-season N applications can change from year to year due to weather and environmental conditions.
- The presence of residue from the previous crop can interact with N management practices and yield potential.
- Individual hybrids may respond differently to N application timing. Consult your local Field Sales Representative or Technical Agronomist for recommendations.

Soybean Seeding Rate by Planting Date

Trial Objective

- Previous work at the Bayer Learning Center at Monmouth, Illinois has shown that planting date is an important factor affecting soybean yield potential.
- In most years, an earlier planting date could be a low-risk/high-return soybean management practice.
- A generally recommended practice is to increase soybean seeding rates when planting occurs later in the season.[1,2]
- In 2019, the Bayer Learning Center at Monmouth, Illinois conducted a trial to determine if seeding rate influences the average yield of soybean across multiple planting dates.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Monmouth, IL	Silt loam	Corn	Conventional	4/24/19, 6/3/19	10/15/19	80	40K, 80K, 120K, 160K

- Two Roundup Ready 2 Xtend® soybean products with relative maturities (RM) of 3.4 and 3.6 were planted on two planting dates at four different seeding rates.
- The planting dates were:
  - 4/24/19 (early)
  - 6/3/19 (late)
- The seeding rates/acre were:
  - 40,000
  - 80,000
  - 120,000
  - 160,000
- There were two replications for each treatment.
- Plots were kept weed-free.

Understanding the Results

- The soybean plant is rather versatile in its growth and development. As plant population decreases, the plants tend to branch and develop additional nodes to attempt to compensate (Figure 1).
- The yields of the two soybean products for each planting date were averaged together because the yields of each were very similar.

Soybean Seeding Rate by Planting Date

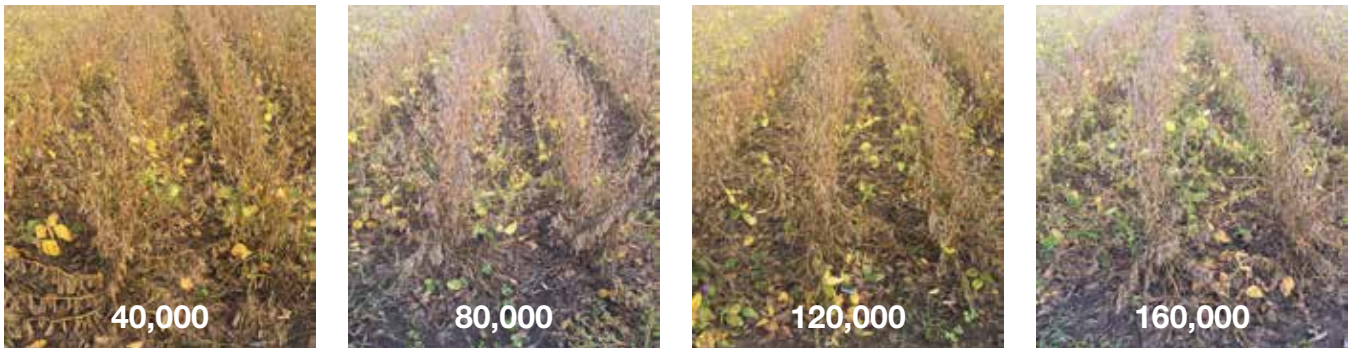


Figure 1. Plants tend to develop additional branches and nodes as seeding rates (population) decrease.

- In this trial, the April 24 planting date favored lower seeding rates, while the June 3 planting date favored higher seeding rates.
  - This response is in line with university recommendations.[1,2]
  - However, the higher overall average yields for the June 3 planting date are not typical of previous Bayer Learning Center results. Extreme weather conditions during the growing season may have contributed to this result.
- Return over seed cost was maximized at the 80,000 seeds/acre rate for the April 24 planting date, while 120,000 seeds/acre provided the highest return for the June 3 planting date.
  - These calculations assumed a soybean price of $9.50/bu and a seed cost of $69 for a 140,000 unit of seed.

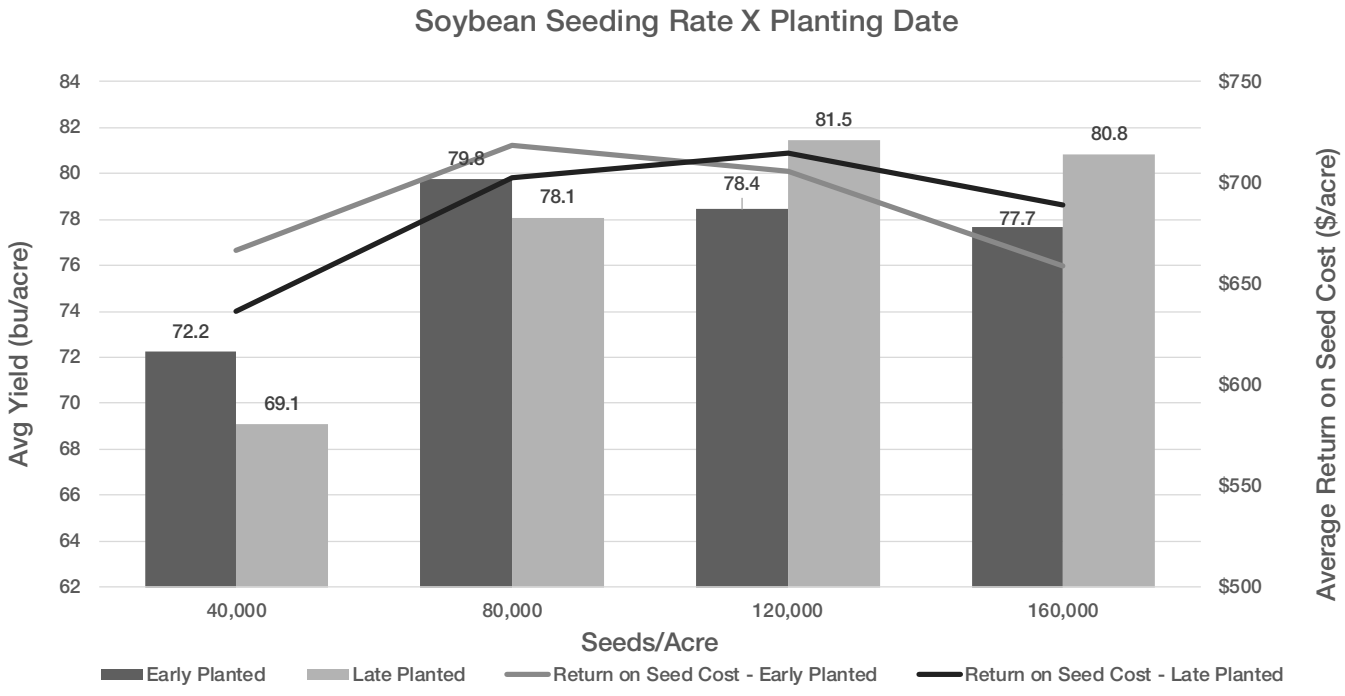


Figure 2. Comparison of average soybean yields for two planting dates and four seeding rates at the Bayer Learning Center at Monmouth, IL in 2019. The early planting date was April 24 and the late planting date was June 3.

Soybean Seeding Rate by Planting Date

Key Learnings

- These results suggest that:
  - Early planting of soybean may help maximize profitability. Early planting assumes that the soil and weather conditions are suitable for seedbed preparation and seed germination.
  - Late planting may require increased seeding rates to help optimize yield and profit potential.
- The optimum soybean seeding rate is highly variable from year to year.
- Contact your local Field Sales Representative or Technical Agronomist for planting recommendations for the current situation and year.

Sources (web sources verified 10/29/19):

[1]Staton, M. 2019. Late-planted soybean recommendations. Michigan State University Extension. https://www.canr.msu.edu/.

[2]Nafziger, E. 2019. Early-season soybean management for 2019. The Bulletin. University of Illinois. http://bulletin.ipm.illinois.edu/.

ENVIRONMENT

Impact of Soybean Seed Treatment and Planting Date

Trial Objective

- Improvements in soybean seed quality and seed treatments have led to increased yield potential in early-planted soybean crops. In favorable planting conditions, early-planted soybeans can out-perform later-planted soybeans.[1]
- Early-planted soybean plants may be at greater risk than late-planted soybean plants to injury from exposure to cold and wet conditions.
- The Monmouth Learning Center has conducted a trial for the past two years to evaluate the impact of a fungicide and insecticide seed treatment and planting date on soybean yield potential.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Monmouth, IL	Silt loam	Corn	Conventional	4/24/19, 6/3/19	10/15/19	80	130K
Monmouth, IL	Silt loam	Corn	Conventional	4/25/18, 5/18/18	10/18/18	80	130K

- A 3.6 MG Roundup Ready 2 Xtend® soybean product was selected for this trial.
- Four treatments were included in this study:
  - Treatment 1: Early-planted (4/24/19) untreated seed
  - Treatment 2: Early-planted treated seed with Acceleron® Seed Applied Solutions STANDARD (includes fungicides and insecticides)
  - Treatment 3: Late-planted (6/3/19) untreated seed
  - Treatment 4: Late-planted seed treated with Acceleron® Seed Applied Solutions STANDARD
- This trial consisted of two replications.
- Results were combined with 2018 trial data (Figure 2).

Understanding the Results

- For this location, planting later resulted in a higher average yield than earlier planting. However, this is not consistent with most trials conducted at the Monmouth Learning Center. The yields in the earlier planting date may have been affected by the prolonged cold, wet conditions in the spring of 2019.
- Seedlings treated with Acceleron® Seed Applied Solutions STANDARD appeared healthier and more vigorous after emergence (Figure 1).
- Over two years at this location, Acceleron® Seed Applied Solutions provided an average 8.8 bu/acre advantage in the early-planted plots, and an average 4.2 bu/acre advantage in the late-planted plots.

Impact of Soybean Seed Treatment and Planting Date

Key Learnings

- At this location, Acceleron® Seed Applied Solutions helped increase yield throughout the planting season.
- The yield response from seed treatments can vary from year to year; consult your local Field Sales Representative or Technical Agronomist for recommendations.
- Acceleron® Seed Applied Solutions can help ensure better seedling establishment and improved seeding vigor (Figure 1).

Figure 1. Soybean seedlings treated with Acceleron® Seed Applied Solutions STANDARD (left) and untreated seedlings (right) on May 16, 2019 at Monmouth Learning Center.

Source (verified 10/30/19)

[1] Nafziger, E. 2019. Early-season soybean management for 2019. University of Illinois Extension. http://bulletin.ipm.illinois.edu/?p=4491.

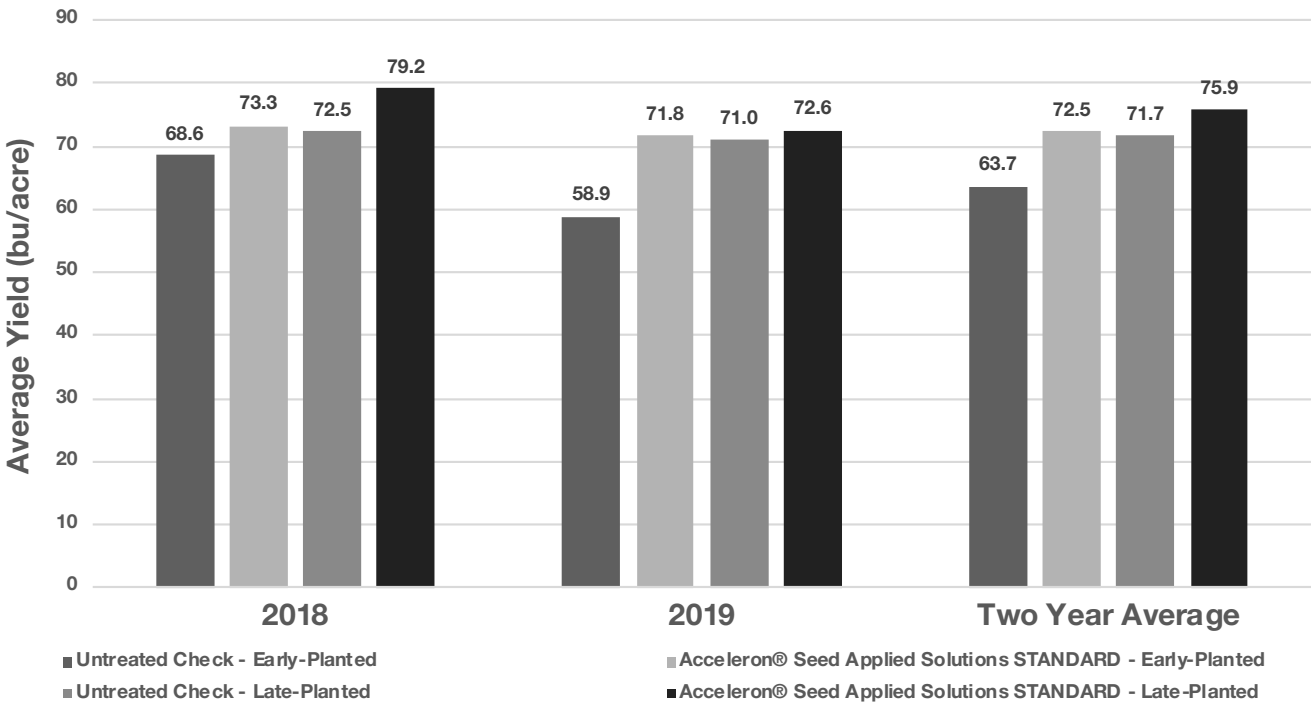


Figure 2. Average soybean yields for each treatment in 2018 and 2019 and averaged over the two years.

DISEASES

Fungicide and Planting Date in Soybean

Trial Objective

- Early planting may help maximize soybean yield potential when soil and weather conditions are suitable for seedbed preparation and seed germination.
- In many cases, the application of a foliar fungicide can protect plant health and help maintain yield potential.
- The Monmouth Learning Center has been conducting trials for the past two years to evaluate the effects of planting date and an application of Delaro® 325 SC foliar fungicide on soybean yield potential.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Monmouth, IL	Silt loam	Corn	Conventional	4/24/19, 6/3/19	10/15/19	70	130K
Monmouth, IL	Silt loam	Corn	Conventional	4/25/18, 5/18/18	10/17/18	70	130K

- A 3.6 MG Roundup Ready 2 Xtend® soybean product was planted on two dates each year of this experiment as indicated in chart above un planting date(s).
- Both plantings consisted of two treatments:
  - 8 oz/acre of Delaro® 325 SC fungicide applied at R3
  - An untreated check
- There were two replications of each treatment.
- Plots were harvested and adjusted to 13% moisture.
- Disease incidence was very low in the plots in 2019. A prolonged dry period from late June through early August may have been a major factor.

Understanding the Results

- In 2019, the late-planted plots yielded higher than the early-planted plots, which is not typical of the planting date trials conducted at the Learning Center. The early-planted plots may have been affected by the prolonged cold, wet conditions at the beginning of the 2019 growing season.
- Early plantings tended to benefit much more from the fungicide application.

Fungicide and Planting Date in Soybean

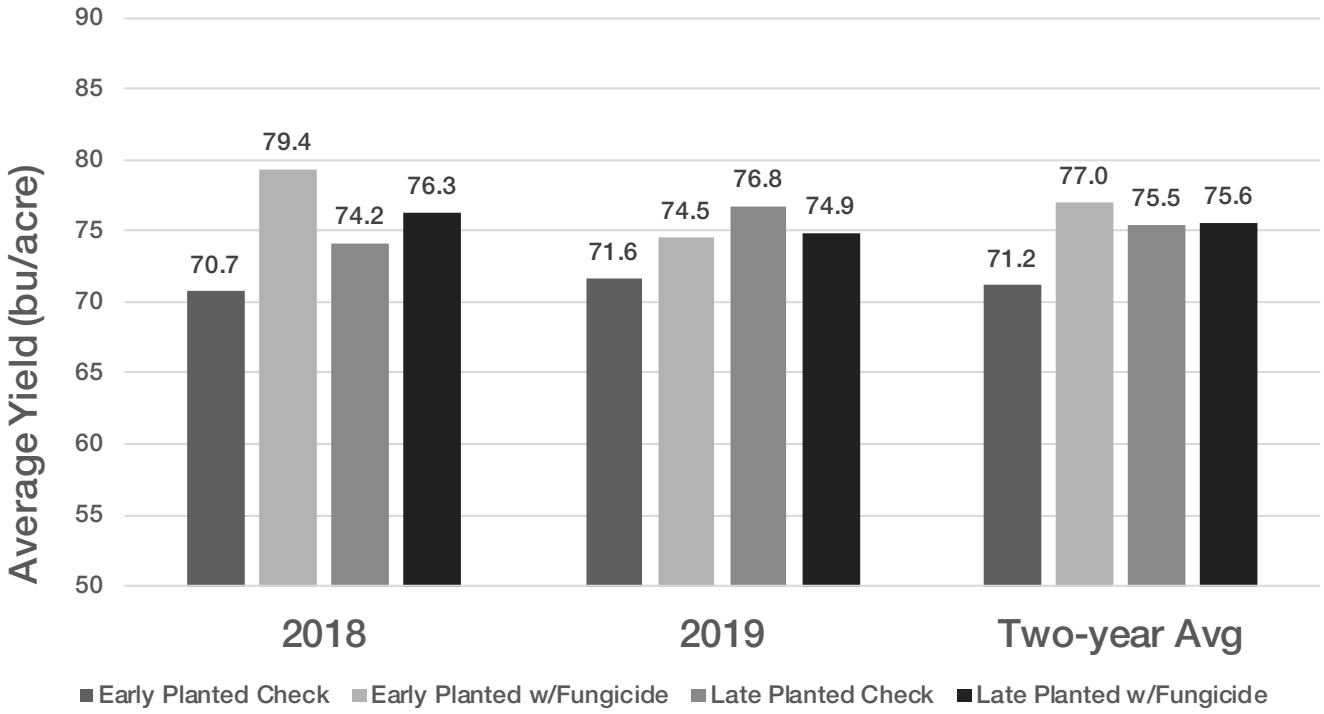


Figure 1. Soybean fungicide by planting date.

Key Learnings

- In Learning Center trials, over the majority of years, early planted soybean tends to outperform later-planted soybean.
- When planting early, it is important that soil and weather conditions are suitable for seedbed preparation and seed germination.
- Scouting regularly is always the best way to determine if a fungicide application will be beneficial.
- The benefit of a fungicide application will vary from year to year and individual fungicide application results may vary based on disease presence as well as weather and soil conditions. Consult your local Field Sales Representative or Technical Agronomist for recommendations.

Legal Statements

The information discussed in this report is from a single site, non-replicated demonstration. This informational piece is designed to report the results of this demonstration and is not intended to infer any confirmed trends. Please use this information accordingly.

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ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. It is a violation of federal and state law to use any pesticide product other than in accordance with its labeling. NOT ALL formulations of dicamba or glyphosate are approved for in-crop use with Roundup Ready 2 Xtend® soybeans. **ONLY USE FORMULATIONS THAT ARE SPECIFICALLY LABELED FOR SUCH USES AND APPROVED FOR SUCH USE IN THE STATE OF APPLICATION.** Contact the U.S. EPA and your state pesticide regulatory agency with any questions about the approval status of dicamba herbicide products for in-crop use with Roundup Ready 2 Xtend® soybeans or cotton with XtendFlex® Technology.

***B.t.* products** may not yet be registered in all states. Check with your seed brand representative for the registration status in your state.

IMPORTANT IRM INFORMATION: RIB Complete® corn blend products do not require the planting of a structured refuge except in the Cotton-Growing Area where corn earworm is a significant pest. See the IRM/Grower Guide for additional information. Always read and follow IRM requirements.

Performance may vary, from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields.

Roundup Ready® 2 Technology contains genes that confer tolerance to glyphosate. Roundup Ready 2 Xtend® soybeans contain genes that confer tolerance to glyphosate and dicamba. Glyphosate will kill crops that are not tolerant to glyphosate. **Dicamba** will kill crops that are not tolerant to dicamba. Contact your seed brand dealer or refer to the Monsanto Technology Use Guide for recommended weed control programs.

Before opening a bag of seed, be sure to read, understand and accept the stewardship requirements, **including applicable refuge requirements for insect resistance management,** for the biotechnology traits expressed in the seed as set forth in the Monsanto Technology/Stewardship Agreement that you sign. By opening and using a bag of seed, you are reaffirming your obligation to comply with the most recent stewardship requirements.

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