Effect of Fungicide on Yield and Plant Health

Trial Objective

- The application of a fungicide can protect corn plants from foliar diseases and increase overall plant health, which can lead to increased grain yield.
- Yield increases observed from the application of a fungicide greatly depend on corn product selection, as individual products respond differently to a fungicide application. While fungicide is often used as a high-yield management strategy, it can also be used to protect the yield of corn products with poor plant and stalk health ratings.
- The objective of this trail was to evaluate the impact that a fungicide application has on corn yield and late-season plant health.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Fungicide Date	Planting Rate
Atlantic, IA (southern set)	Silty Clay Loam	Soybean	Conventional	4/27/2018	10/31/2018	7/21/2018	35,000
Huxley, IA (both northern and southern sets)	Clay Loam	Soybean	Strip Till	5/9/2018	10/17/2018	7/17/2018	34,000
Marble Rock, IA (northern set)	Loam	Soybean	Strip Till	5/18/2018	10/24/2018	7/30/2018	36,000
Storm Lake, IA (northern set)	Silty Clay Loam	Soybean	Fall Vertical	5/8/2018	10/26/2018	7/24/2018	39,000
Victor, IA (southern set)	Silty Clay Loam	Soybean	Conventional	4/30/2018	10/27/2018	7/18/2018	35,000

- Ten DEKALB® corn products were divided into two sets based on relative maturity, with the northern set being located at Marble Rock, Storm Lake and Huxley, and the southern set being located at Atlantic, Victor and Huxley.
- Plots were planted as strip trials at four locations, with Huxley being arranged as a small-plot trial.
- The trial was replicated by location.
- Staygreen and disease ratings were collected during the growing season, and stalk strength and intactness were collected at harvest.
- Each site was sprayed with Delaro™ 325 SC fungicide (12 oz/acre) with a ground sprayer at brown silk.

Table 1. DEKALB® corn brand blends used in the trial with their associated ratings for stalk strength, staygreen, and harvest appearance. Ratings shown are general product ratings from the seed guide.

Corn Product	Stalk Strength	Staygreen	Harvest Appearance
DKC50-08RIB	3	3	4
DKC51-38RIB	3	2	2
DKC54-38RIB	2	3	3
DKC57-97RIB	2	2	2
DKC58-06RIB	4	2	2
DKC60-88RIB	3	3	3
DKC62-20RIB	3	4	4
DKC62-53RIB	3	4	5
DKC63-21RIB	3	3	3
DKC64-35RIB	1	1	1

Effect of Fungicide on Yield and Plant Health

Understanding the Results

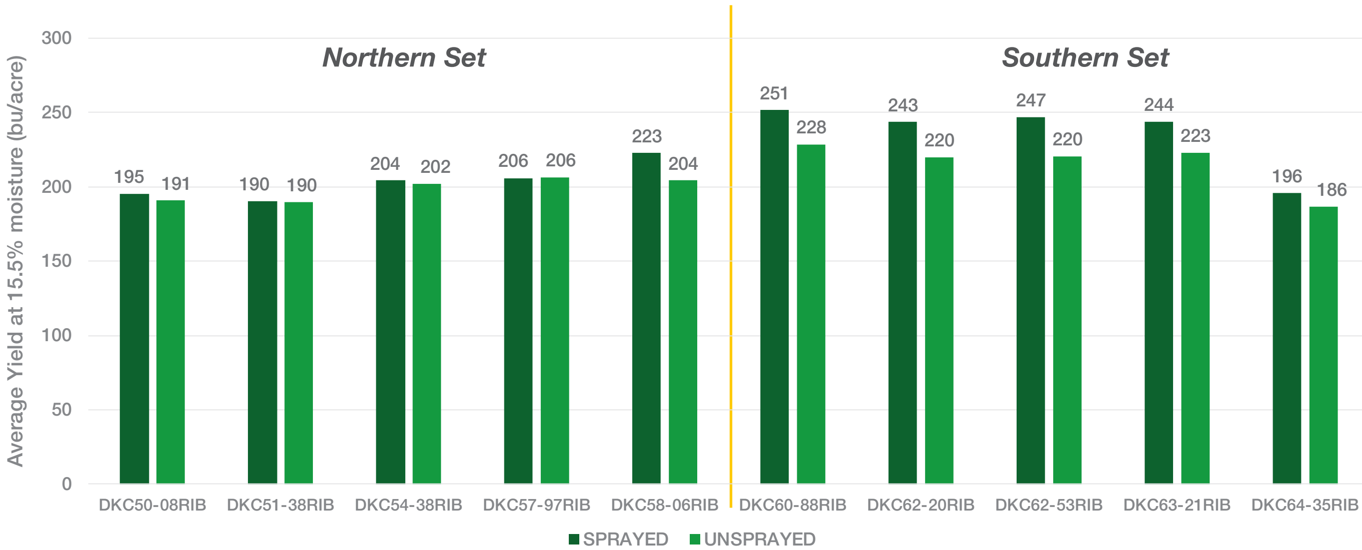

Figure 1. Yield of DEKALB® corn brand blends with and without fungicide.

- Across all corn products, spraying a fungicide offered a 13 bu/acre advantage vs. the unsprayed treatment. For this study, a 6.8 bu/acre response was considered a profitable response ($24/acre cost for fungicide application with $3.50 corn).
- Fungicide use also increased plant health, as the average staygreen and intactness ratings improved from 5 to 3 and 6 to 2, respectively, for the sprayed products compared to the unsprayed products (data not shown).
- Fungicide application had a minimal effect on grain moisture, with a 0.6% difference in moisture between the sprayed and unsprayed treatments.

Unsprayed ***Sprayed*** ***Unsprayed*** ***Sprayed***

Figure 2. Pictures of DKC62-53RIB brand blend taken on 9/11 (left) and at harvest (10/30) at Atlantic, IA.

Effect of Fungicide on Yield and Plant Health

What Does This Mean for Your Farm?

- The 2018 growing season saw a range of moisture and temperature extremes occur across Iowa. Generally, the research sites saw a wet June, a dry July, and a very wet late summer/harvest season. This led to high levels of stalk and plant health issues due to excess moisture, disease, and lack of nitrogen.
- Such conditions may explain why a fungicide application was profitable across nearly all corn products tested in 2018. While fungicides do not cure plant diseases, a timely application can prevent foliar diseases from infecting the upper canopy.
- The results of this study suggest that a healthier upper canopy lead to increased photosynthetic activity later in the growing season, which resulted in increased yield in corn products sprayed with fungicide. While plant health was notably improved by fungicide use, we did not observe dramatic differences in stalk health between sprayed and unsprayed corn products.
- This trial will be repeated in 2019, with more focus placed on potential stalk health benefits derived from applying fungicide.

Legal Statements

Trial Objective

- Since 2016, the Bayer Learning Center in Huxley, Iowa has engaged the Iowa FFA community in a farming contest dubbed the Fantasy Farming Challenge. The program allows students to make key decisions for a plot of corn to produce the highest yield and/or the highest profit.
- The students select several real-life crop production management decisions, each with an associated cost. The Learning Center plants each FFA chapters' plot using the selected management inputs. FFA chapters are invited to the Learning Center to see their plot and learn about Bayer Crop Science and the opportunities within agriculture.
- At the end of the 2018 season, each plot was harvested and 1st, 2nd, and 3rd place prizes were awarded for the highest yield and/or the highest profit.
- In 2018, 25 chapters participated in the program.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Huxley, IA	Clay loam	Soybean	Strip tillage	Various	09/28/2018	225	Various

- Each chapters' management decisions are shown in Table 1.
- Each plot was planted in 30-inch row spacing, 6 rows per chapter, and 375-ft long strips.
- Weed management was the same across all plots and consisted of a pre- and post-emergence program.

Understanding the Results

- Congratulations to our 2018 winners (Figure 1).
  - **Yield Winners**
    - ***1st*** Wilton ($1,000)
    - ***2nd*** Diamond Trail ($500)
    - ***3rd*** South Winneshiek ($250)
  - **Net Profit Winners**
    - ***1st*** Wilton ($1,000)
    - ***2nd*** Diamond Trail ($500)
    - ***3rd*** S.E. Polk ($250)
    - ***3rd*** Gilbert ($250)
- We look forward to another exciting program in 2019.

2018 FFA Fantasy Farming Challenge

Table 1. Management decisions of the 25 FFA chapters involved in the 2018 Fantasy Farming Challenge.

FFA Chapter	Corn Brand Blend Products	Seeding Rate (seeds/acre)	Planting Date	Nitrogen (lb/acre)	Side Dress	Starter Fertilizer	Soil Insecticide	Foliar Fungicide	Total Cost ($/acre) *	Yield Rank	Net Profit Rank
Wilton	DKC64-34RIB	37,500	Early	200	No	Yes	No	No	$ 712.83	1	1
Diamond Trail	DKC58-06RIB	34,000	Mid	240	Yes	No	No	No	$ 700.47	2	2
South Winneshiek	DKC61-86RIB	33,500	Mid	250	No	Yes	No	Yes	$ 750.69	3	8
Davis County	DKC64-34RIB	32,500	Early	185	Yes	Yes	No	Yes	$ 724.10	4	5
Corydon-Wayne	DKC64-34RIB	38,000	Mid	230	Yes	Yes	Yes	Yes	$ 808.15	5	15
Gilbert	DKC60-87RIB	36,000	Early	180	Yes	Yes	No	No	$ 692.06	6	4
SE Polk	DKC60-87RIB	33,000	Mid	200	Yes	Yes	Yes	No	$ 689.86	7	3
Rock Valley	DKC64-34RIB	34,000	Mid	165	No	Yes	Yes	No	$ 719.87	8	7
Collins-Maxwell	DKC63-21RIB	35,500	Mid	170	Yes	Yes	No	No	$ 712.01	9	6
Westwood	DKC63-21RIB	35,500	Mid	200	No	Yes	No	Yes	$ 747.96	10	10
Newton	DKC63-21RIB	34,000	Mid	170	Yes	No	No	Yes	$ 725.50	11	9
CAM	DKC54-38RIB	35,000	Early	240	Yes	Yes	Yes	Yes	$ 743.51	12	14
Linn-Mar	DKC64-34RIB	35,200	Mid	181	No	No	No	Yes	$ 728.13	13	13
Shenandoah-Davis-Rodgers	DKC60-87RIB	31,000	Early	160	Yes	No	Yes	No	$ 698.50	14	11
Kingsley-Pierson	DKC58-06RIB	34,000	Mid	180	Yes	No	No	Yes	$ 694.88	15	12
AC-GC	DKC64-34RIB	35,000	Mid	175	Yes	Yes	No	Yes	$ 743.96	16	19
Albia	DKC64-34RIB	32,000	Late	165	No	Yes	No	No	$ 743.80	17	20
Audubon	DKC60-87RIB	32500	Mid	155	Yes	Yes	Yes	Yes	$ 729.05	18	16
Roland Story	DKC64-34RIB	32500	Mid	160	Yes	Yes	No	Yes	$ 728.04	19	18
ADM	DKC64-34RIB	33000	Mid	155	Yes	No	No	Yes	$ 716.39	20	17
Charles City	DKC54-38RIB	34000	Mid	200	Yes	Yes	No	Yes	$ 713.47	21	21
Missouri Valley	DKC58-06RIB	35000	Mid	140	No	No	Yes	Yes	$ 686.81	22	22
Ballard	DKC54-38RIB	33000	Late	145	Yes	Yes	Yes	No	$ 697.97	23	23
SE Warren	DKC64-34RIB	38000	Mid	132	Yes	Yes	Yes	Yes	$ 709.07	24	24
GMG	DKC54-38RIB	34000	Mid	90	Yes	No	Yes	No	$ 645.63	25	25

Early, mid, and late planting dates were on 4/28/2018, 5/10/2018, and 5/24/2018, respectively.

*Chapters did not pay any cash amount to participate in the program. All costs associated with the program were paid by Bayer Crop Science.

2018 FFA Fantasy Farming Challenge

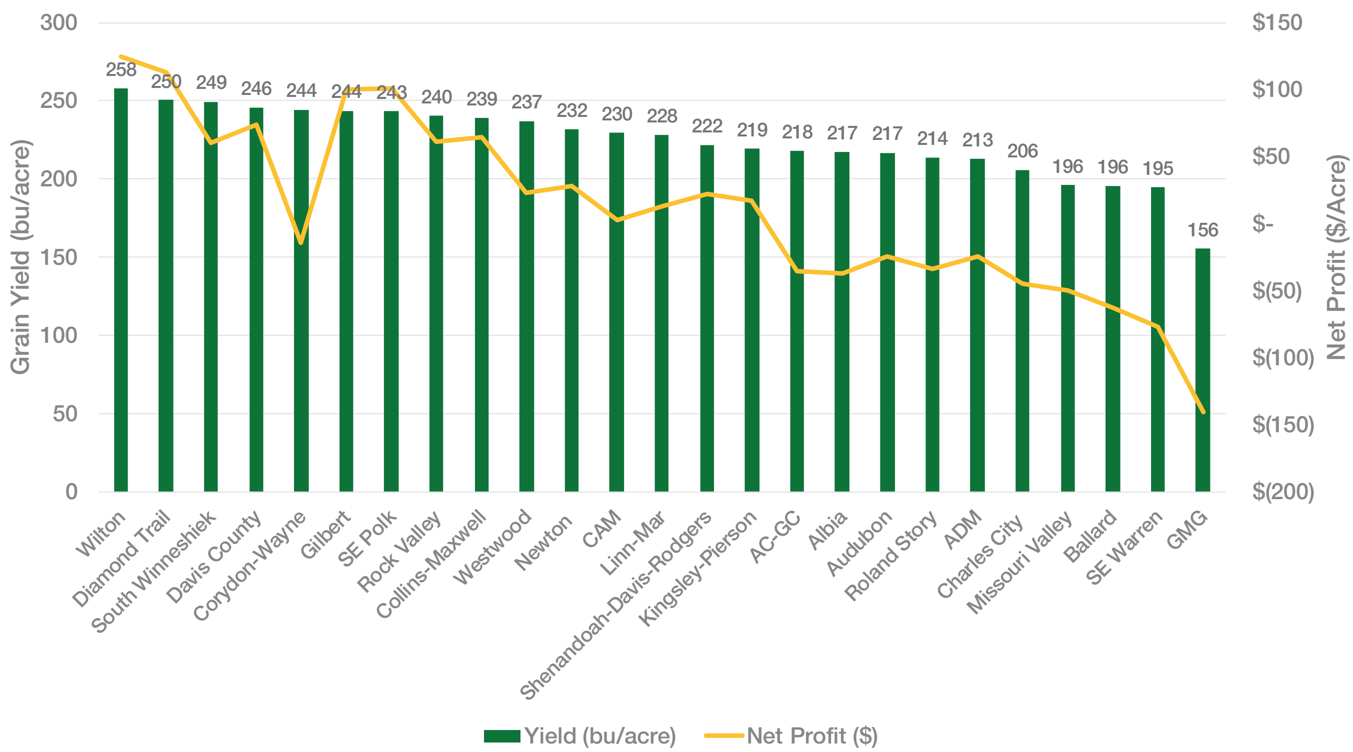

Figure 1. Yield and profit results of the 2018 FFA Fantasy Farming Challenge at the Bayer Learning Center at Huxley, IA.

What Does This Mean for Your Farm?

- Each growing season presents its own unforeseen challenges that make some well-intended decisions fall short. We hope students appreciate the challenges our farmers face each year.

Legal Statements

The information discussed in this report is from a single-site, replicated demonstration trial. 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.

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.

Comparison of Row Spacing by Management Practice

Trial Objective

- Generation of farm revenue requires the optimization of production inputs in a sustainable manner. Over the years, advances in agronomic research, including crop protection, germplasm, nutrition, and equipment technologies, have benefited farmers with more inputs than ever before.
- Deployment of these inputs should be carefully evaluated for each operation to determine their effects on yield, farm revenue, and the environment.
- With the current commodity prices, some farmers contemplate cutting operation costs by eliminating some inputs, while others consider certain inputs to be key to their success if used in an integrated system for the crop.
- The objective of this study was to compare low- and high-input corn management practices in two row-spacing systems.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Huxley, IA	Clay loam	Soybean	Conventional	5/10/2018	10/4/2018	225	33K, 38K

Two management treatments were tested:

1. Standard Management
   - 33,000 seeds/acre seeding rate
   - 140 lb/acre nitrogen pre-planting
2. Premium Management
   - 38,000 seeds/acre seeding rate ($25.50/acre for the additional 5,000 seeds/acre)
   - 140 lb/acre nitrogen pre-planting
   - 40 lb/acre nitrogen side-dressed at the V6 growth stage ($9.20/acre)
   - Delaro™ 325 SC fungicide application at the VT/R1 growth stage ($22/acre)

- The two treatments were tested in both 20-inch and 30-inch row spacing.
- A 113 RM and 114 RM corn product were used for this trial.
- The trial was carried out on 10-ft x 225-ft long plots with two replications.
- 32% UAN was used as the nitrogen source.
- The same pre- and post-emergence weed management program was used in both treatments.

Comparison of Row Spacing by Management Practice

Understanding the Results

- For the standard treatment, the plant population was higher in the 20-inch spacing than in the 30-inch spacing. For the premium treatment, the plant population was higher in the 30-inch spacing (Table 1).
- There were very minor differences in grain moisture content between the treatments in both row spacings (Table 1).
- The premium treatment substantially out yielded the standard treatment in both row spacings (Figure 1).
- The 20-inch spacing out performed the 30-inch spacing across all treatments (Figure 1).

Table 1. Average agronomic response of the standard and premium management treatments in 20-inch and 30-inch row spacing. Early stand count was taken at the V4 growth stage. Harvest population was taken a few days before harvesting.

Row Spacing (inches)	Management Treatment	Early Stand Count (1000 seeds/acre)	Harvest Population (1000 seeds/acre)	Grain Moisture (%)
20	Standard	33.13	34.75	19.13
	Premium	37.50	37	19.78
30	Standard	32.94	32.75	19.70
	Premium	38.00	39.75	19.45

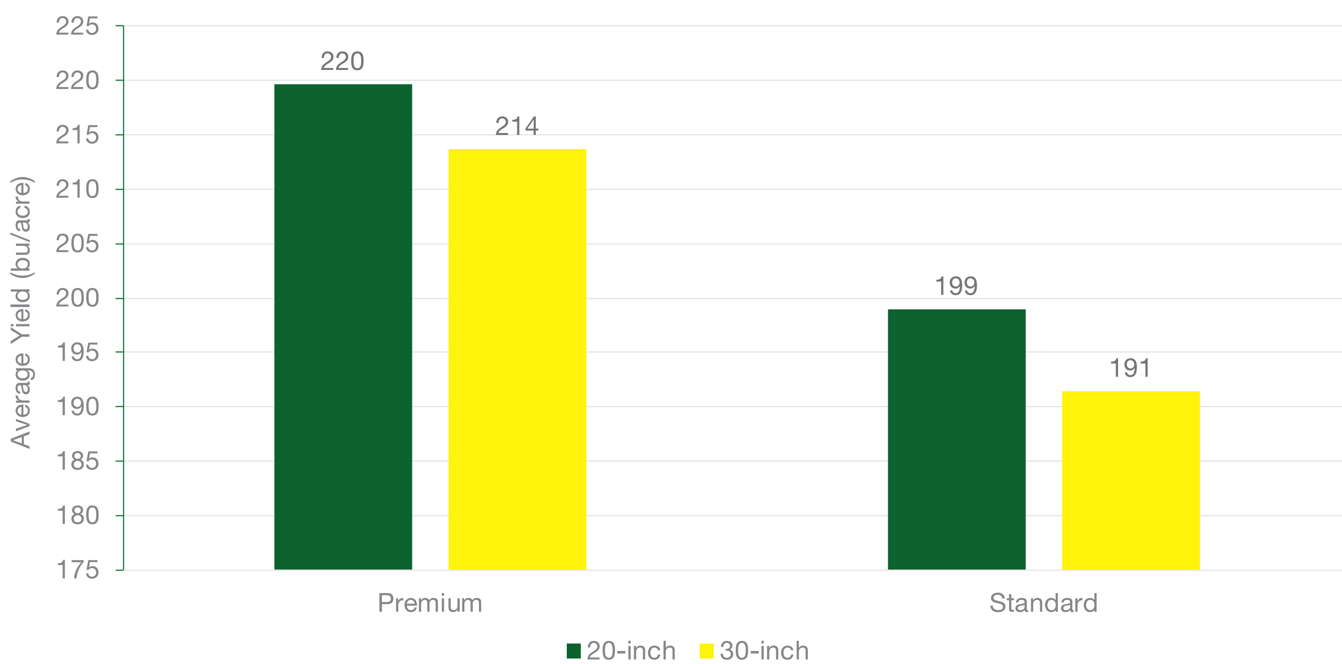

Figure 1. Average yield response of standard and premium management treatments in 20-inch and 30-inch row spacing.

Comparison of Row Spacing by Management Practice

What Does This Mean for Your Farm?

- At most production sites, 20-inch row spacing has been shown to be a better row spacing than 30-inch for corn production. Where equipment is available, 20-inch row spacing is recommended. In this trial, a yield advantage of 6 to 8 bu/acre was realized.
- In most corn operations, foliar fungicides, additional nitrogen, and a higher seeding rate often result in some form of yield increases. The question most often is whether the yield increases would be adequate to offset the cost of inputs. In this trial, at the current grain price of $3.74/bu, a minimum of 15 bu/acre was required to pay for the additional inputs of the premium treatment. Thus, the premium treatment was profitable in both row spacings, generating 6 to 8 bu/acre in net gain over the standard treatment (Figure 1).
- Crop yield response to farm inputs can be highly variable, often impacted by the cropping sequence, environmental conditions during the growing season, and the selected germplasm. It is advisable that they be used in an integrated manner to optimize their synergistic effects. In this trial, for example, an increased seeding rate would require additional nitrogen to meet the plant demand.

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Comparison of Corn Row Spacing and Seeding Rate - Storm Lake, IA

Trial Objective

- Several years of research have indicated that corn yield is positively correlated with plant population until a threshold is reached, beyond which yield decreases. Defining the population threshold for each corn product is difficult as it is highly impacted by several factors including row spacing, management practices, and the environmental conditions during the growing season.
- Adjusting row spacing is one method to spread plant spacing to maximize agronomics and plant-to-plant competition.
- The objective of this trial was to compare corn product yield at 20-inch and 30-inch row spacing at three seeding rates.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Storm Lake, IA	Silty clay loam	Soybean	No tillage	05/08/2018	09/28/2018	250	33K, 38K, 43K

- Four corn products (100 RM, 105 RM, 110 RM and 114 RM) were each planted at 33,000 (33K), 38,000 (38K), and 43,000 (43K) seeds/acre at both 20-inch and 30-inch row spacing.
- The trial was carried out in 10-ft-wide by 100-ft-long plots with two replications.
- A total fertilizer application consisted of 167-57-93-14-1 (N-P-K-S-Zn), of which 150 lb of nitrogen in the form of 32% UAN was applied in the spring.
- Weed management consisted of an early post-emergence program.
- No fungicide or insecticide were applied.

Understanding the Results

- Except for the 100 RM product, the seeding rate of 33K seeds/acre produced the highest yields in 20-inch row spacing (Figure 1), and 38K seeds/acre produced the highest yields in 30-inch row spacing (Figure 2).
- In both 20-inch and 30-inch row spacing, average yield (across all seeding rates) increased as the relative maturity of products increased, with up to a 40 bu/acre difference between the 100 RM and the 114 RM products in 20-inch row spacing (Figure 1) and a 27 bu/acre difference in 30-inch row spacing (Figure 2).
- Across all products, 20-inch row spacing substantially out-yielded 30-inch row spacing at all seeding rates (Figure 3). When averaged across all corn products, 33K seeds/acre was the highest yielding seeding rate in 20-inch row spacing and 38K seeds/acre was the highest yielder in 30-inch row spacing (Figure 3).

Comparison of Corn Row Spacing and Seeding Rate - Storm Lake, IA

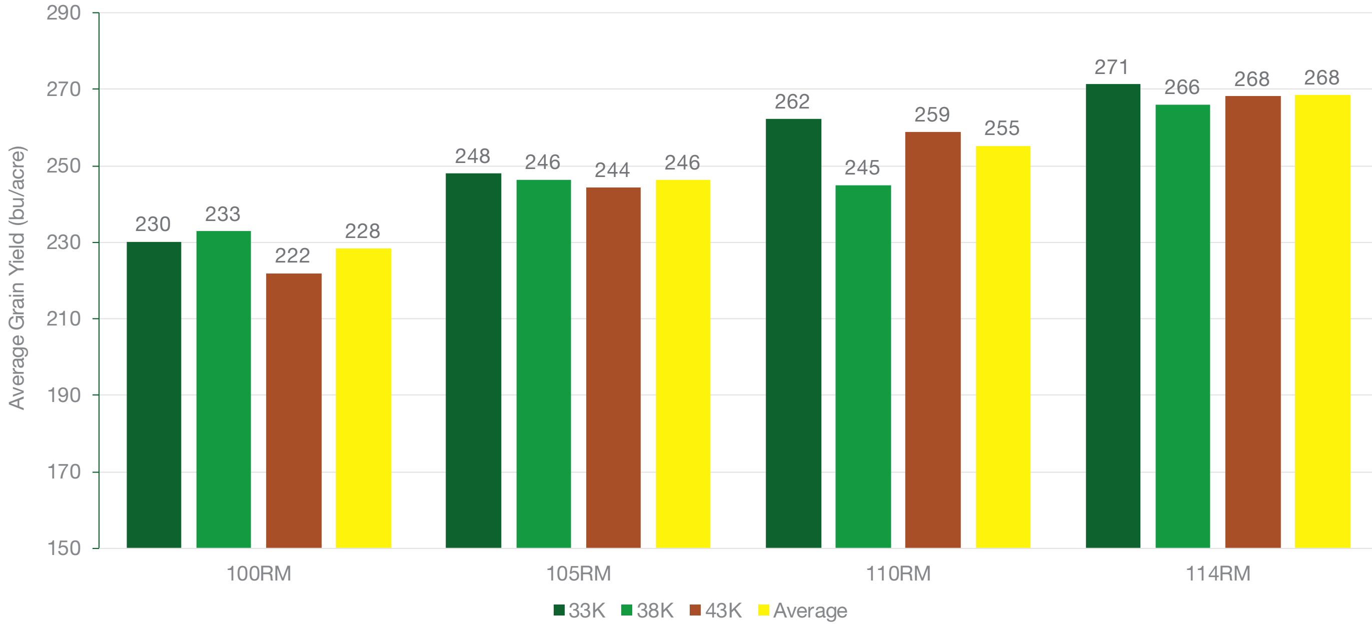

Figure 1. Effects of seeding rate on corn product performance in 20-inch row spacing.

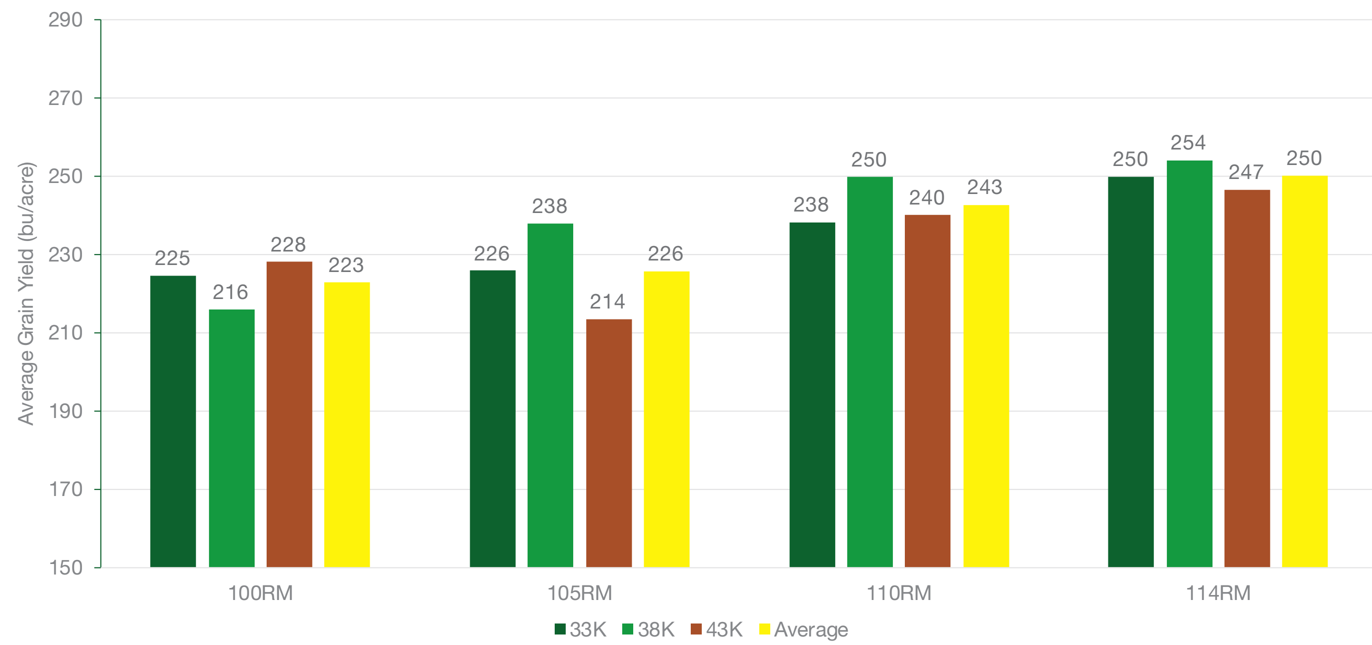

Figure 2. Effects of seeding rate on corn product performance in 30-inch row spacing.

Comparison of Corn Row Spacing and Seeding Rate - Storm Lake, IA

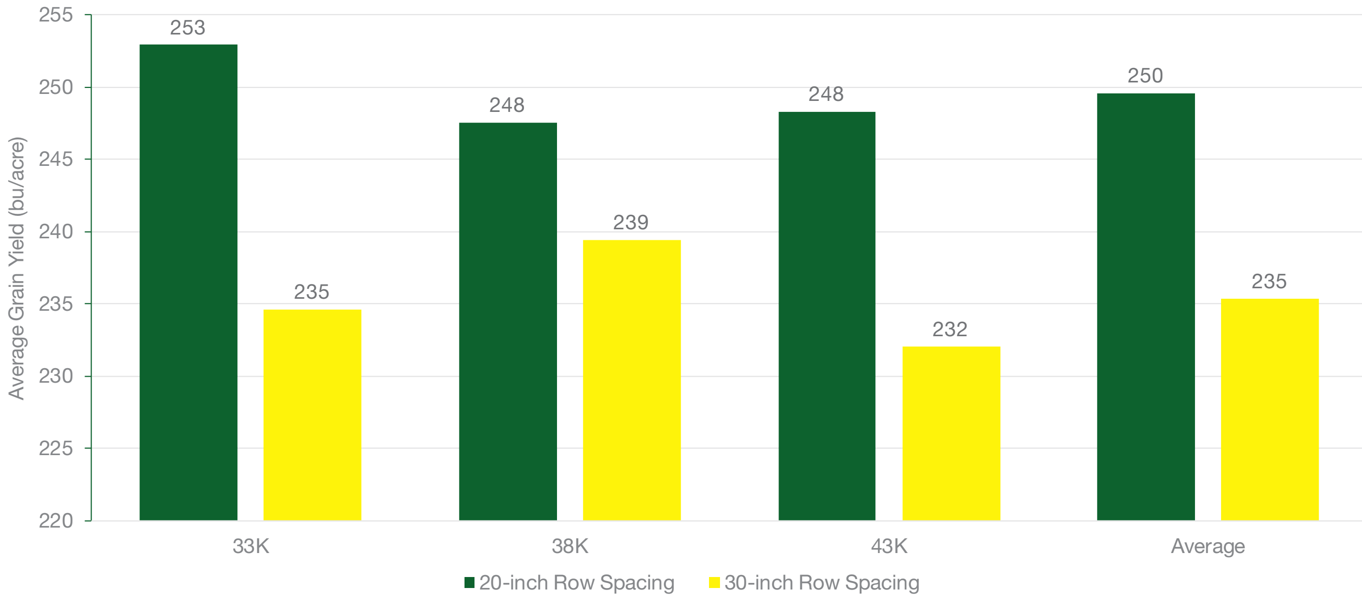

Figure 3. Effects of seeding rate and row spacing on corn product performance, averaged across all four corn products.

What Does This Mean for Your Farm?

- At most production sites, 20 inch rows has been shown to be a better row spacing than 30 inch rows for corn production. Where equipment is available, this option should be considered. In this trial, an average yield advantage of 15 bu/acre was realized with 20-inch row spacing (Figure 3).
- By rule of thumb, we consider a 6.25 bu/acre response in a 5K seeds/acre increment to be economical. Thus, 38K seeds/acre was only economical in the 105 and 110 RM products in 30-inch row spacing. All other configurations were most economical at the 33K seeds/acre seeding rate.
- The research site experienced a tremendous amount of rainfall during the growing season. Such growing conditions affects nutrient status and does not favor high populations, especially in narrow row spacing. This may be part of the reason for the poor performance of the 43K seeds/acre seeding rate across the products. However, this doesn't represent every year or what we should expect for a response next season.

Legal Statements

The Effects of Row Spacing and Seeding Rates on Corn Yield Potential

Trial Objective

- This trial was designed to provide farmers in southern Iowa row width comparisons (20- and 30-inch row width systems) on later maturity corn products in Iowa and to help determine the yield response of higher seeding rates within each row width system.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
2017 Victor, IA	Silty clay loam	Soybean	Conventional	4/22/17	10/9/17	250	33K, 38K, 43K
2018 Victor, IA	Silty clay loam	Soybean	Conventional	4/25/18	10/4/18	250	33K, 38K, 43K

- Five DEKALB® corn brand blends of 110 to 114 relative maturity were planted in two adjacent blocks at two different row spacings and at three different seeding rates within each row spacing:
  - 6-row, 30-inch row spacing planted at 33,000 (33K), 38,000 (38K), and 43,000 (43K) seeds/acre
  - 12-row, 20-inch row spacing planted at 33K, 38K, and 43K seeds/acre
- A variable row spacing Case IH® 1215 Early Riser® planter unit was used for all plantings at general planting depth settings.
- Both blocks received 150 lb/acre of anhydrous ammonia in the spring. Cultural practices were identical.
- Individual plots were approximately 200 feet long.

Understanding the Results

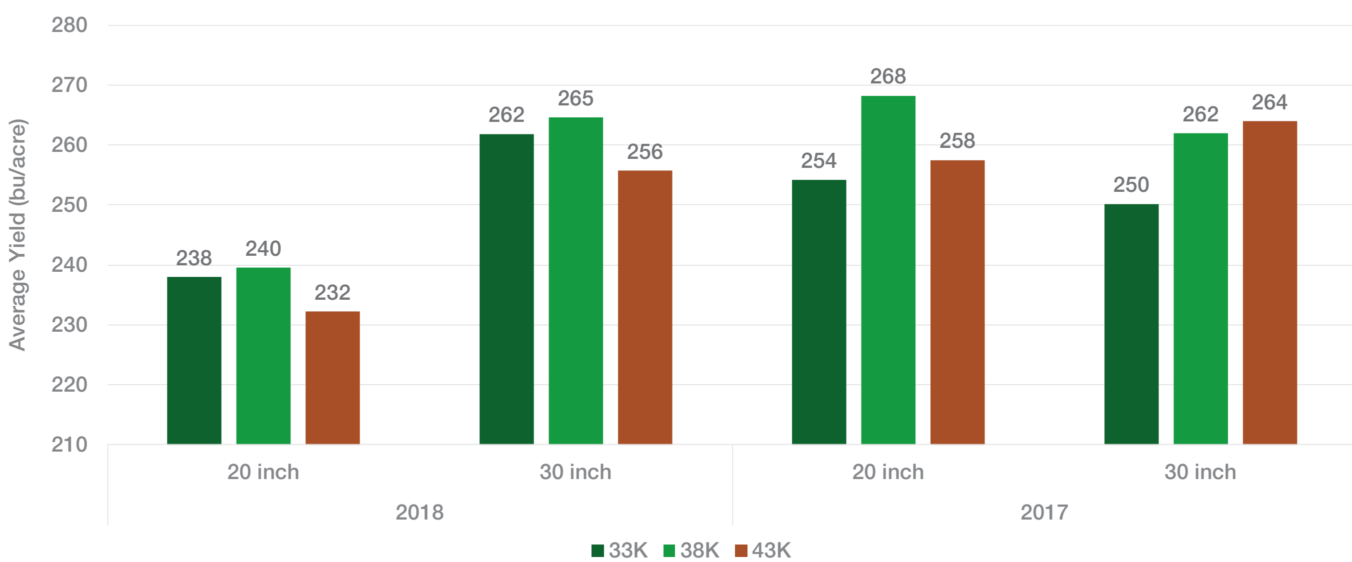

Figure 1. Average yields by row spacing and seeding rate of five DEKALB® corn brand blends in 2017 and 2018.

The Effects of Row Spacing and Seeding Rates on Corn Yield Potential

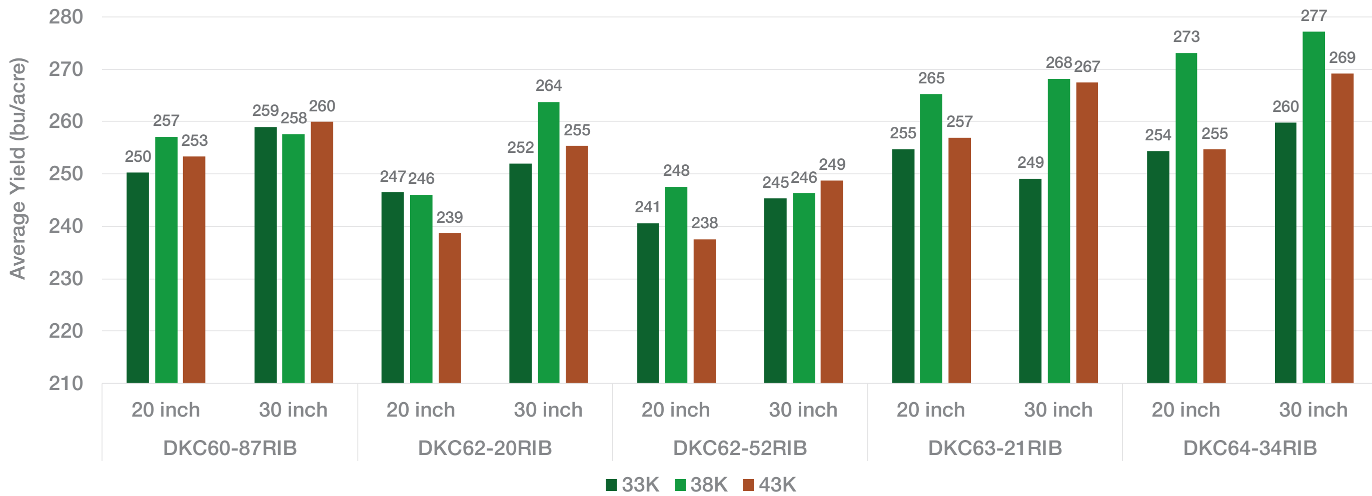

Figure 2. Yields of DEKALB® corn brand blends at each row spacing and seeding rate in 2018.

- Across all corn products, spraying fungicide offered a 13 bu/ac advantage vs the unsprayed treatment. For this study, a 6.8 bu/ac response was considered a profitable response ($24/ac cost for fungicide application with $3.50 corn).
- Fungicide use also increased plant health, as the average staygreen/intactness rating for the unsprayed products improved from 5 to 3 and 6 to 2 (respectively) when both compared to the products sprayed with fungicide.
- Fungicide application had a minimal effect on grain moisture, with a 0.6% difference in moisture between the sprayed and unsprayed.

Legal Statements

The information discussed in this report is from a single site, two-year 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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Tillage Systems in Corn and Soybean Production

Trial Objective

- Tillage systems and operations have evolved over the years to meet specific production and/or environmental objectives. Considerations, such as soil and water conservation, input costs, labor efficiency, timing of tillage, crop rotation, soil health, short- and long-term land usage, crop nutrient management, and weed and pest management, are some of the things that drive tillage decisions on the farm.
- With improvements in tillage implements and herbicide technologies, farmers have access to an array of tillage options, ranging from conventional tillage to minimum tillage to no-till. Many farms do not use a single tillage type for all operations. Instead, a different tillage type is often deployed to meet the productivity requirement of each piece of land. Once decided, the piece of land is managed with that tillage type for several years.
- As such, it becomes necessary to periodically evaluate the continued suitability of tillage systems.
- The objective of this trial was to evaluate corn and soybean productivity responses to conventional and strip tillage systems.

Research Site Details

Location	2018 Crop	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Huxley, IA	**Soybean**	Clay loam	Corn	Strip tillage and conventional	5/17/2018	10/19/2018	60	140K
Huxley, IA	**Corn**	Clay loam	Corn	Strip tillage and conventional	5/9/2018	9/27/2018	225	34K

- A 112 RM corn product and a 2.4 MG soybean product were used in the trial.
- The corn trial was on 60 x 500-ft long plots. The soybean trial was on 60 x 350-ft long plots. The trial was planted in 30-inch row spacing with two replications.
- Conventional tillage consisted of a chisel plow followed by a soil finisher. The chisel plow consisted of a two-gang disk unit followed by ripping shanks that went about 18 inches deep followed by a set of chisels to smooth out the soil surface and incorporate residue. The soil finisher unit was comprised of a disk gang, a cultivator, and tine harrow units.
- Strip tillage was carried out in conjunction with liquid nitrogen application. The strip-till bar unit consisted of a no-till coulter in the front, followed by a liquid nitrogen knife, followed by a Vulcan strip-till unit comprised of row cleaners, no-till coulters that penetrated 2-3 inches deep and 7 inches wide, and a rolling basket to break any large soil clumps and smooth the soil surface for planting.
- All tillage operations were carried out in the spring.
- All corn treatments received 140 lb/acre of nitrogen pre-planting, followed by a side dress of another 40 lb/acre at the VT growth stage. 32% urea ammonium nitrate (UAN) was used as the nitrogen source.
- Weed management consisted of pre- and post-emergence programs in both crops.
- Conventional tillage was used at the research site in previous years.

Tillage Systems in Corn and Soybean Production

Figure 1. The tillage systems used in the corn and soybean trials. Strip tillage is shown on the left for corn (top) and soybean (bottom). Conventional tillage is shown on the right for corn (top) and soybean (bottom).

Understanding the Results

Table 1. Effects of two tillage systems on the agronomic performance of corn and soybean. The early stand count was taken at the V4 growth stage. Harvest population was measured a few days before harvesting. Corn was planted at 34,000 seeds/acre and soybean at 140,000 seeds/acre.

Crop	Tillage	Early Stand Count (1000 seeds/acre)	Harvest Population (1000 seeds/acre)	Grain Moisture (%)
Corn	Conventional	34.3	34.6	17.04
	Strip	33.8	33.4	17.01
Soybean	Conventional	105.6	93.5	12.35
	Strip	103.9	98.8	12.25

- In both crops, tillage did not have a major impact on stand establishment and plant population (Table 1).
- Grain moisture content was not affected by tillage in either crop (Table 1).
- There was a substantial yield difference between tillage systems in both crops, with strip tillage out-yielding conventional tillage (Figure 2).

Tillage Systems in Corn and Soybean Production

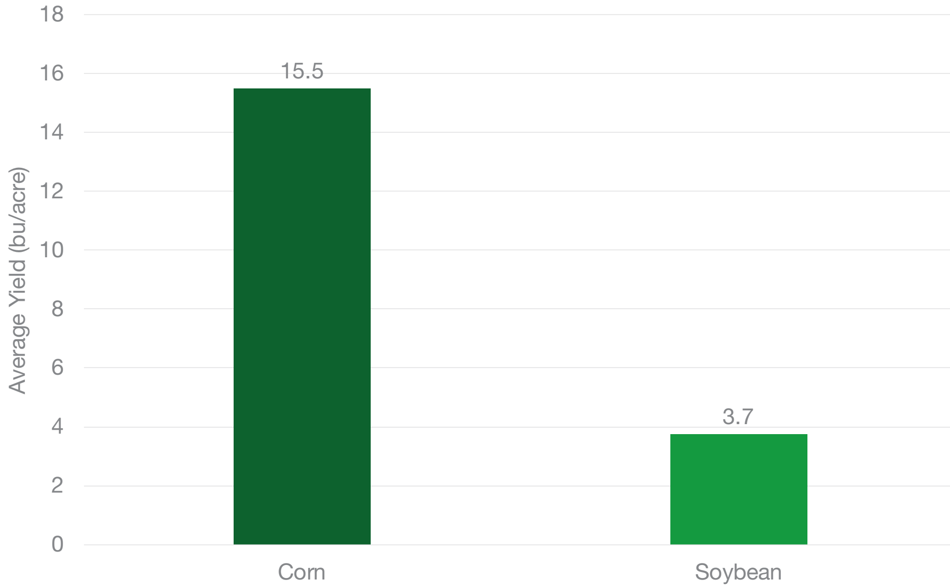

Figure 2. Average yield advantage of strip tillage over conventional tillage in corn and soybean production systems.

What Does This Mean for Your Farm?

- Conservation tillage practices, including strip tillage, allow for better water infiltration through the soil profile instead of the wash-off/run-off associated with conventional tillage systems. This improved soil moisture profile, along with its associated soil nutrients, could explain the difference in yield observed. This is especially true considering that the weather conditions at the research site during the trial were wet and rainy in May and June followed by a dry July.
- The advantages of strip tillage, such as improved soil heath, structure, and increased organic matter, cannot be the reason for the yield advantages realized as it takes several years for these soil characteristics to develop.
- It should be noted that crop yield response to tillage could be widely variable and site-specific, as impacted by environmental factors, soil type and drainage, and the cropping sequence. Thus, it requires multiple years of research to truly determine the productivity of tillage systems.
- Most tillage operations start in the fall after harvest and then are left to weather/over-winter before being finished off in the spring for planting. Due to environmental conditions, all tillage operations in this trial were carried out in the spring and thus may not fully reflect the exact effects of tillage on cropping systems. Therefore, this trial will be repeated in the coming years to determine the best tillage system for the site.
- Regardless of the crop chosen, the right tillage type should be the one that provides the best economic returns while still ensuring better environmental stewardship.

Legal Statements

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Cover Cropping and Tillage Systems in Soybean Production

Trial Objective

- In northern geographies, it is more difficult to get a cover crop established with the shorter growing season. Selecting an early maturing soybean product may allow time for better cover crop establishment, but could this practice negatively impact the yield potential of the farming operation?
- Eliminating a tillage pass through the field is another cropping system decision, but is there a yield penalty associated with no tillage?
- The objective of this study was to evaluate different cropping systems that integrate no-till, conventional tillage, cover crops, and product maturity selection.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Storm Lake, IA	Silty clay loam	Corn	Conventional & no tillage	5/24/18	9/17/18	70	140K

- Four cropping systems were evaluated:
  - System 1 – Early soybean maturity (1.1 MG), early cover crop establishment, and no tillage.
  - System 2 – Normal soybean maturity (2.4 MG), late cover crop establishment, and no tillage.
  - System 3 – Early soybean maturity (1.1 MG), no cover crop, and no tillage.
  - System 4 – Normal soybean maturity (2.4 MG), no cover crop, and conventional tillage.
- Plots were 20-ft wide and 340-ft long strip trials with five replications.
- Soybeans were planted into the cereal rye cover crop in the cover crop systems.
- Cereal rye was terminated with an early post-emergence herbicide program.
- All treatments were treated with the same late post-emergence herbicide program.

Understanding the Results

Figure 1. Field picture showing the established cereal rye cover crop used for the trial. Dense vegetation on the right is the early established cover crop and the sparse vegetation on the left is the late established cover crop. Picture was taken just before soybean planting.

Cover Cropping and Tillage Systems in Soybean Production

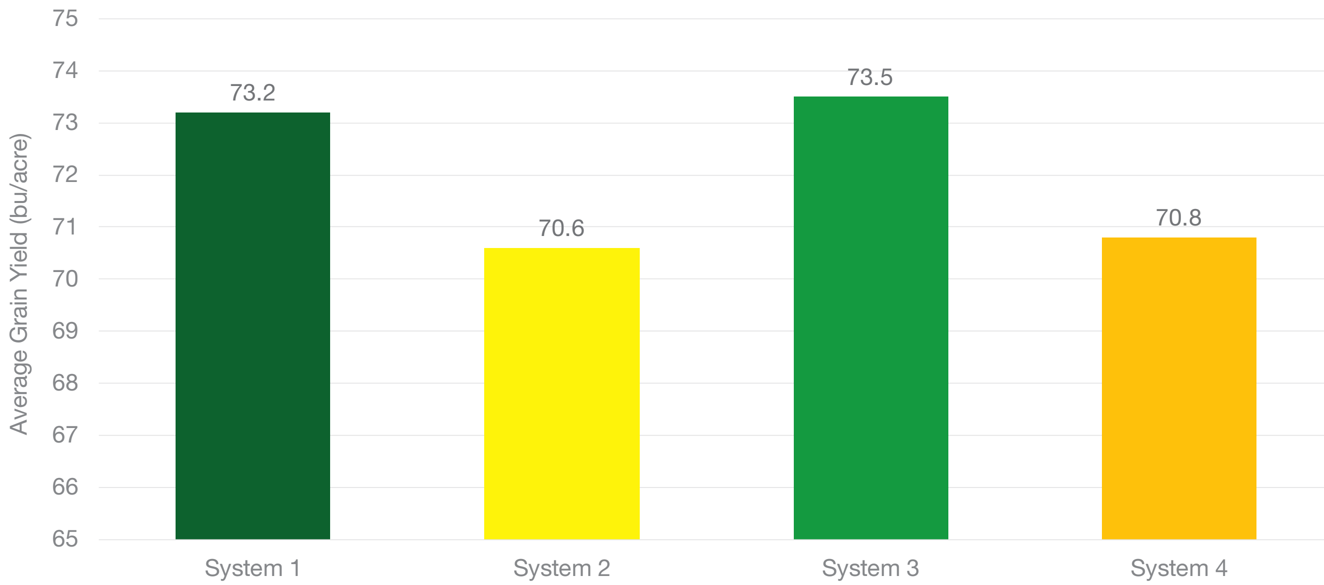

Figure 2. Average yields of four soybean cropping systems. Systems 1 and 2 are the cover crop trials with the early MG product (System 1) and normal MG product (System 2). System 3 is the early MG product in no-till, and System 4 is the normal MG product in conventional tillage.

- Figure 1 indicates that the time of cover crop establishment made a tremendous difference in cover crop biomass at the time of soybean planting.
- With the two cover crop systems, the early MG soybean product with early cover crop establishment (System 1) out-yielded the normal MG product and late cover crop establishment (System 2) (Figure 2).
- In this study, no tillage with an early MG soybean product (System 3) out-yielded conventional tillage with a normal MG soybean product (System 4).
- In all trials, each soybean product performed similarly across the systems; however, the early MG product (Systems 1 and 3) outperformed the normal MG product (Systems 2 and 4).

What Does This Mean for Your Farm?

- Choosing the proper genetics is the most vital component of any cropping system. In this trial, the early MG soybean product provided over a 2.5 bu/acre advantage over the normal MG product in the cover crop systems (Systems 1 and 2). Thus, if chosen properly, early-maturing soybeans could be a better fit in the cover crop system with little to no yield penalty.
- In this trial, no-till did not show any yield drag when compared to conventional tillage, thus saving money with less trips across the field. In some situations, no-till may provide a yield advantage in some years.

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Using 2018 Corn Rootworm Beetle Counts to Help Evaluate the Risk of an Infestation for 2019

Trial Objective

- The monitoring of corn rootworm (CRW) beetle numbers in current corn and soybean fields can be used to help assess the potential risk of a CRW infestation reaching economic damage levels in corn and soybean fields during the next growing season.
- Use of this information may help guide decisions regarding management strategies including corn and soybean product selection.
- The objective of this project was to measure adult CRW population levels in corn and soybean fields in 2018 to assist in risk evaluation for 2019.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
1499 fields	Drained or well drained	See Figure 1	Conventional	---	---	110-250	28K-36K

- One to four Pherocon® AM non-baited trapping sites were established at 1499 field locations across the corn growing areas of IA, IL, IN, OH, MI, WI, MN, ND, SD, NE, KS, MO, and CO (Figure 1, Top).
- The trapping sites were installed in the interiors of corn and soybean fields that encompassed a variety of crop and management histories (Table 1).
- The Pherocon® AM traps were refreshed at 5- to 10-day intervals for 2-8 consecutive weeks through CRW adult emergence, mating, and egg laying phases (late July through late September). Following each sampling interval, the counts of adult northern and western CRW beetles were recorded and used to calculate the average number of CRW beetles/trap/day by field.
- At the end of the collective sampling period, the maximum capture value for each field was determined and the data were used in further analyses.

Understanding the Results

Table 1. Location of 2018 CRW beetle monitoring fields by crop (top) and characterization of 2018 sampled fields by present crop and previous crop with average maximum daily captures for western and northern CRW beetles (bottom).

2017 Crop	Previous Crop	Number of Sampled Fields	Average peak number of Beetles/Trap/Day		
			Northern Corn Rootworm	Western Corn Rootworm	Total
Corn	Corn	181	0.27	3.85	4.11
Corn	Rotated	154	0.28	0.46	0.74
Corn	Not Specified	842	0.05	1.26	1.30
Total Corn	All Rotations	1177	0.18	1.78	1.97
Soybean	Corn	322	0.02	0.40	0.42
Corn and Soybean	All Rotations	1499	0.16	1.59	1.75

Using 2018 Corn Rootworm Beetle Counts to Help Evaluate the Risk of an Infestation for 2019

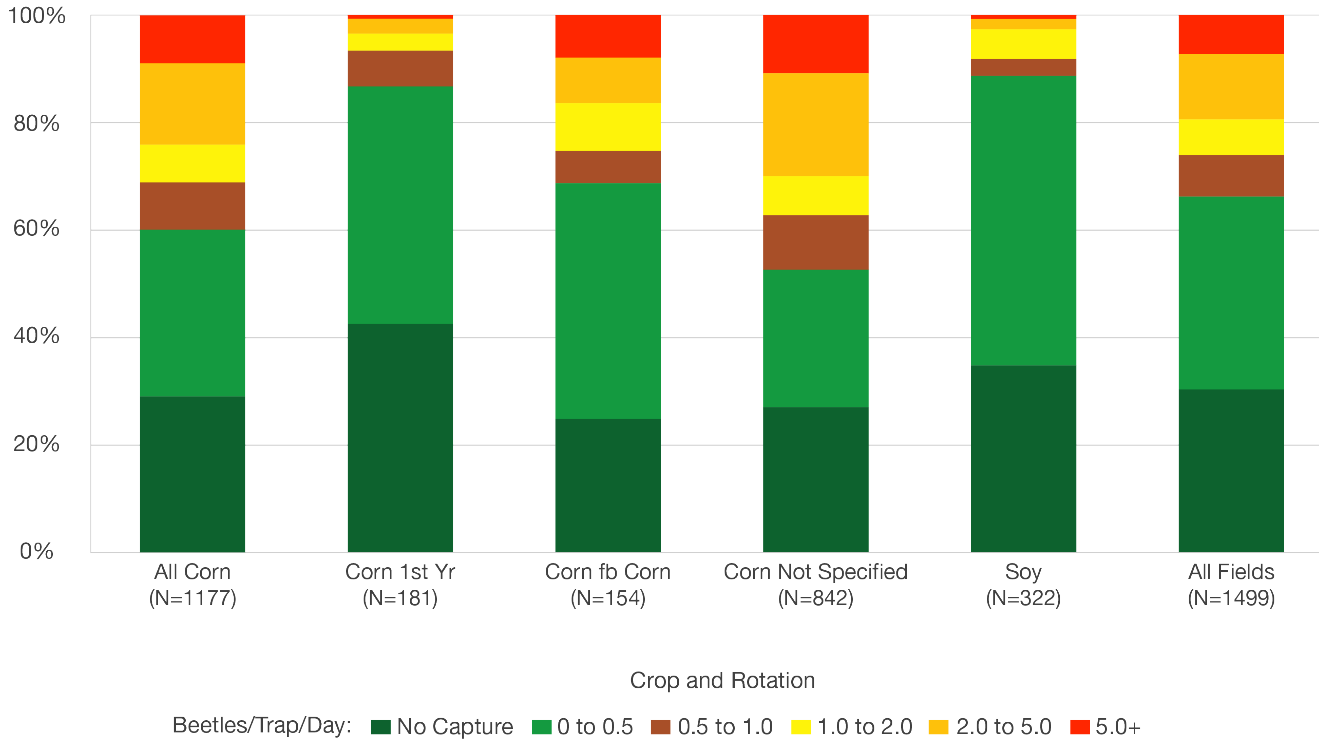

Figure 1. Average number of beetles per trap per day summarized by crop and rotation. Data in this graph is the result of field trials conducted on 1499 field plots in 10 different states in 2018.

Categories for CRW beetle counts are based on action thresholds (beetles/trap/day) suggested by Extension entomologists at the Universities of Illinois and Iowa State and provide economic damage (ED) potential for the following season.[1,2]

- Less than 2 beetles indicate a low risk of ED.
- Greater than 1 beetle suggests a low risk for ED but could indicate populations are increasing.
- Greater than 2 beetles indicate ED is likely if control measures are not used.
- Control measures include CRW *Bacillus thuringiensis* (*B.t.*)-protected corn products or soil-applied insecticides.
- Greater than 5 beetles indicate ED is very likely and populations are expected to be very high.

Using 2018 Corn Rootworm Beetle Counts to Help Evaluate the Risk of an Infestation for 2019

2018 CRW Beetle Survey Data.

- CRW populations were variable across the corn growing area. This suggests that environment and management are factors in determining CRW pressure levels.
- 19% of corn fields had counts exceeding the action threshold of 2 beetles/trap/day (Figure 1).
- 11% of the corn fields were approaching action threshold levels (Figure 1).
- Corn followed by corn had higher average maximum daily counts than 1st-year corn (4.7 vs. 0.74 beetles/trap/day (Table 1).
- 39% of continuous corn fields exceeded the action threshold (Figure 1).
- Counts from soybean fields in IL and eastern IA were low (0.42 beetles/trap/day) (Table 1).
- The threshold was exceeded in 5% of all soybean fields sampled (Figure 1).
- Counts of 0 were recorded in 14% and 38% of corn and soybean fields, respectively (Figure 1).

2018 Data Interpolation (Figure 2).

- Point data were interpolated to estimate populations and relative risk at the landscape level.
- To account for variations in sampling density and distribution, interpolations were based on average maximum values calculated within a systematic grid applied to the estimation area.
- On a broad scale, CRW populations, and consequently risk potential, is elevated in corn fields across eastern and southwest NE, northeast CO, west KS, southeast SD, as well as northwest, central, and east central IA.
- Corn rootworm populations continue to be relatively low in many parts of ND, MO, IL, and southern WI; however, localized hot spots can be found every year.
- Notable CRW beetle presence in soybean fields was isolated to small areas in north central IL and northeast IA.

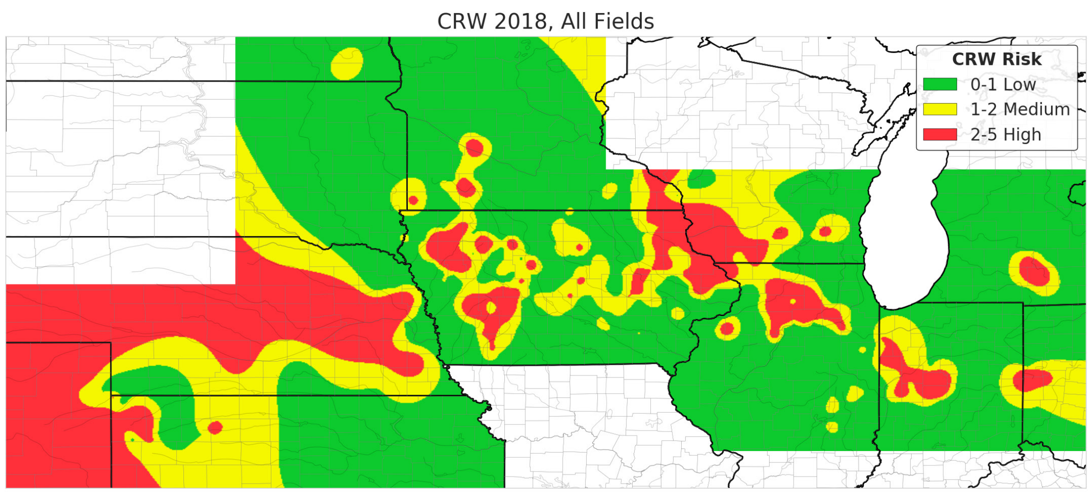

Figure 2. 2018 CRW trap counts taken from 1499 corn and soybean fields across the Corn Belt.

Using 2018 Corn Rootworm Beetle Counts to Help Evaluate the Risk of an Infestation for 2019

Comparison of 2017 vs. 2018 CRW Beetle Data (Figure 3)

- Absolute comparisons between 2017 and 2018 populations should be made with low confidence due to large differences in sampling intensity and distribution. However, trends may still be reliably identified.
- Areas with large populations (i.e. "hot spots") are consistent from year to year. Populations appear to have grown in some areas (e.g. IA) while are dissipating in others (e.g. portions of IL and southern WI).

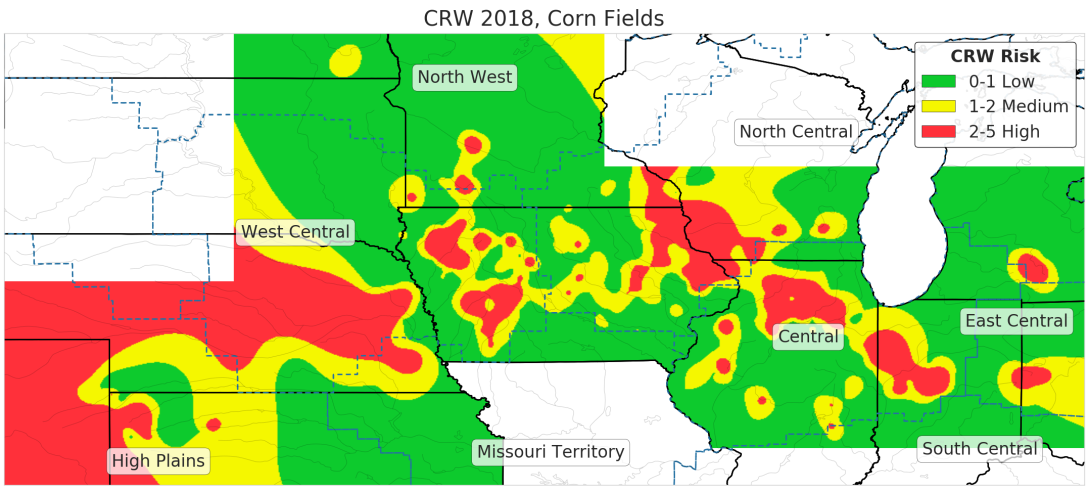

Figure 3. Corn root worm trap count from 1177 corn fields in 2018 (see the 2017 research report for previous CRW counts).

What Does This Mean for Your Farm?

- CRW pose a threat to yield and profit, making it a pest that cannot be ignored. University research has demonstrated that even a moderate level of CRW feeding can cause yield losses averaging 15% with losses up to 45% or more being possible.[3]
- In the absence of site-specific data, local/regional surveys may provide insight at the landscape level and can be used to make informed decisions regarding management and product selection decisions.
- Beetle numbers and infestation geographies change. Continue to monitor present and historical data to gain information regarding CRW infestation potential. Use this information to help prepare for the 2019 season by selecting *B.t.*-protected corn products to protect your risk of CRW larvae damaging roots the following year.

Using 2018 Corn Rootworm Beetle Counts to Help Evaluate the Risk of an Infestation for 2019

SOURCES

[1] Western corn rootworm. *Diabrotica virgifera virgifera* LeConte. Extension & Outreach. Department of Crop Sciences. University of Illinois. http://extension.cropsciences.illinois.edu/fieldcrops/insects/western_corn_rootworm.

[2] Hodgson, E. and Gassmann, A. 2016. Guidelines for using sticky traps to assess corn rootworm activity. Integrated Crop Management. Iowa State University. https://crops.extension.iastate.edu/cropnews/2016/06/guidelines-using-sticky-traps-assess-corn-rootworm-activity.

[3] Evaluating corn rootworm risk and economic impact. 2017. Agronomic Spotlight. Monsanto Company.

Websites verified 11/9/17. 171106192900

Legal Statements

For additional agronomic information, please contact your local brand representative. The information discussed in this report is from a multiple-site demonstration trial. 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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