2019 FIELD RESEARCH

Huxley Learning Center

Throughout the state in any given year, our products are put to the test in various research trials. These trials allow us to gain insights to help complete a year-long story of product performance, agronomic characteristics, and weather patterns. These weather patterns ultimately were the story in 2019.

We spend months planning out our research programs across the region, but as you know, our research is just as vulnerable to extreme weather conditions as the crops on your farm. As we were finishing planting our research in early June, we often wondered what we would learn from the research. While it wasn't an ideal year to get our crops planted, we were pleasantly surprised at harvest to find good data and some consistent insights.

Many of our research highlights in 2019 were in the soybean side of the business. In this research book we will dive into competitive soybean trait platforms along with a trial that looks at the factors to keep soybeans profitable on your farm.

The corn business also showed up with several highlights from 2019. We look at how our products respond to planting population, fungicide, and nitrogen. High yield management systems are also a key driver to keep the corn crop profitable.

Thanks again for your relationship in 2019 and look forward to working with you in 2020.

Market Development Technical Research Team

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

Comparison of Three Soybean Herbicide Tolerant Systems in Iowa and Minnesota

Trial Objective

- This trial was designed to evaluate the benefits of three competitive soybean systems: Roundup Ready® Xtend Crop System, LibertyLink® GT27™ System and Enlist™ Weed Control System with Enlist E3® Soybeans.
- Field observations collected were: yield (bu/acre) and weed control (%).

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	Corn	Strip tillage	6/3/19	10/25/19	65	140K
Manchester, IA	Silty clay loam	Corn	Conventional	5/16/19	10/16/19	65	140K
Mapleton, MN	Silty clay loam	Corn	Conventional	6/3/19	10/25/19	60	140K
Geneva, MN	Clay loam	Corn	Conventional	5/16/19	10/25/19	60	140K

- For each research location, three locally adapted soybean products were selected for each herbicide-tolerant system.
- The 10 ft x 200 ft plots were planted, sprayed, and harvested as strip trials.

Table 1. Herbicide systems and soybean product relative maturities used at each of the testing locations.

	Roundup Ready® Xtend Crop System	LibertyLink® GT27™ System	Enlist™ Weed Control System with Enlist E3® Soybeans	Location and Application Dates
	Herbicide Program	Herbicide Program	Herbicide Program	
PRE Application (at planting)	22 fl oz/acre XtendiMax® herbicide with VaporGrip® Technology + 48 oz/acre Warrant® Herbicide + 8 fl oz/acre Mauler® Herbicide	5 fl oz/acre Verdict® Powered by Kixor® herbicide	24 oz/acre Enlist One® Herbicide with Colex-D® Technology + 4 oz/acre Sonic® Herbicide	Huxley 5-7-19 Manchester 5-17-19 Mapleton 6-5-19 Geneva 5-16-19
POST Application (V3-V5)	22 fl oz/acre XtendiMax with VaporGrip Technology + 32 fl oz/acre Roundup PowerMAX® Herbicide* + 48 oz/acre Warrant Herbicide	32 fl oz/acre Liberty® 280 SL Herbicide + 36 oz/acre Durango® DMA® Herbicide + 12 fl oz/acre Outlook® Herbicide	56 oz/acre Enlist Duo® Herbicide with Colex-D Technology + 16 oz/acre Dual II Magnum® Herbicide + 32 fl oz/acre Liberty 280 SL Herbicide	Huxley 6-25-19 Manchester 6-30-19 Mapleton 6-19-19 Geneva 6-25-19
Late POST Application (if necessary)	N/A	N/A	32 fl oz/acre Liberty 280 SL Herbicide	Huxley N/A Manchester 7-8-19 Mapleton 7-8-19 Geneva N/A
Location	**Roundup Ready® Xtend Crop System**	**LibertyLink® GT27™ System**	**Enlist™ Weed Control System with Enlist E3® Soybeans**	**Planting Dates**
Huxley, IA	2.2, 2.5, 2.9	1.8, 2.0, 2.5	1.9, 2.4, 2.7	6-3-19
Manchester, IA	1.8, 2.2, 2.4	1.8, 2.0, 2.5	1.9, 2.4, 2.7	5-16-19
Mapleton, MN	1.4, 1.7, 2.1	1.5, 1.7, 2.0	1.3, 1.4, 1.9	6-3-19
Geneva, MN	1.4, 1.7, 2.1	1.5, 1.7, 2.0	1.3, 1.4, 1.9	5-16-19
*All tank mixes of XtendiMax with VaporGrip Technology + Roundup PowerMAX included Drift Reducing Adjuvant (0.5% v/v).				

Comparison of Three Soybean Herbicide Tolerant Systems in Iowa and Minnesota

Understanding the Results

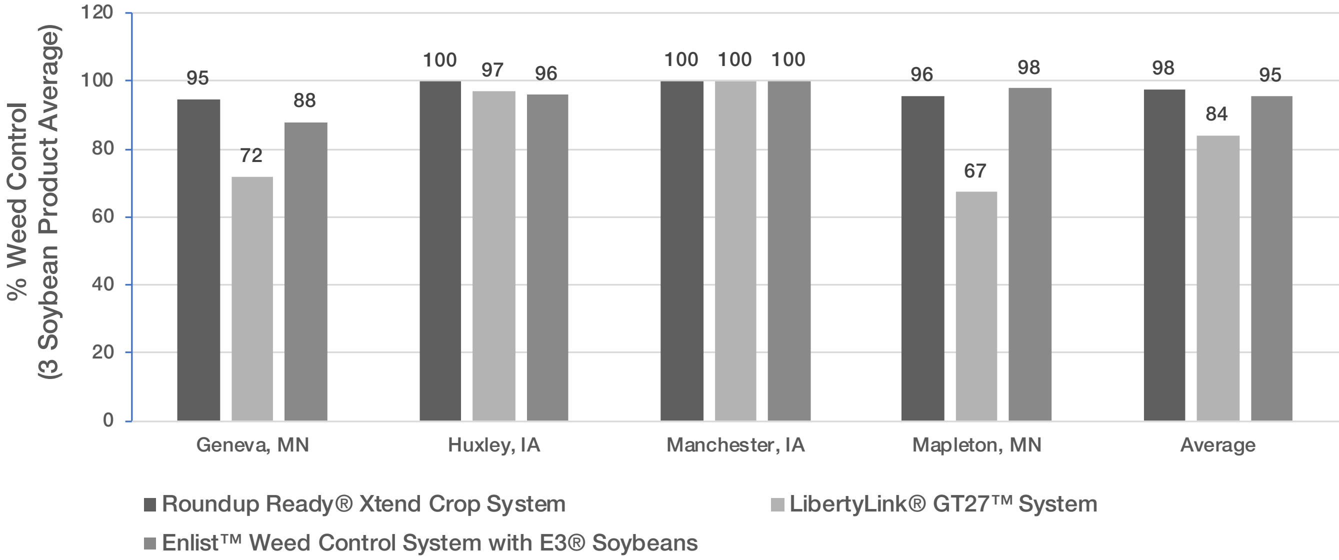


Figure 1. Percent weed control at crop canopy for the four locations. Data represent the average of the three soybean products used in each system and combine the control of the most prevalent broadleaf and grass weeds (velvetleaf (Abutilon theophrasti), waterhemp (Amaranthus rudis), lambsquarter (Chenopodium album), giant foxtail (Setaria faberi), and green foxtail (Setaria viridis)) at each location.

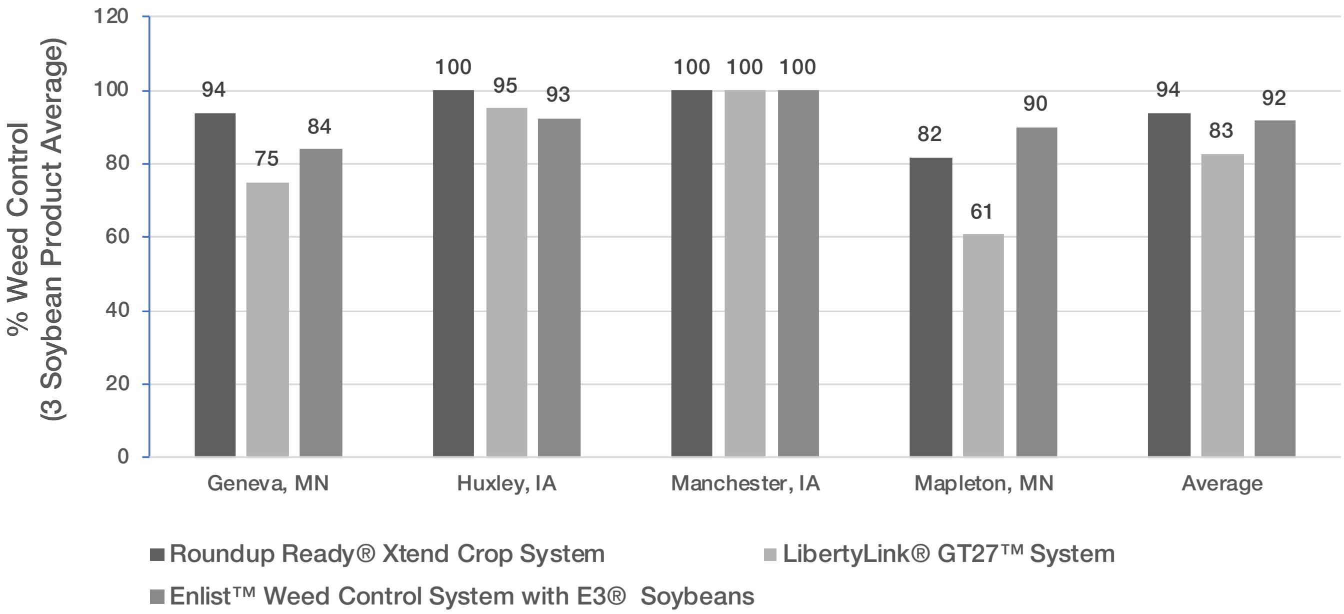


Figure 2. Percent weed control at crop harvest for the four locations. Data represent the average of the three soybean products used in each system and combine the control of the most prevalent broadleaf and grass weeds (velvetleaf, waterhemp, lambsquarter, giant foxtail, and green foxtail) at each location.

Comparison of Three Soybean Herbicide Tolerant Systems in Iowa and Minnesota

Figure 3. Harvest weed control at Huxley, IA for (left) Roundup Ready® Xtend Crop System, (middle) LibertyLink® GT27™ System, and (right) Enlist™ Weed Control System with Enlist E3® Soybeans.

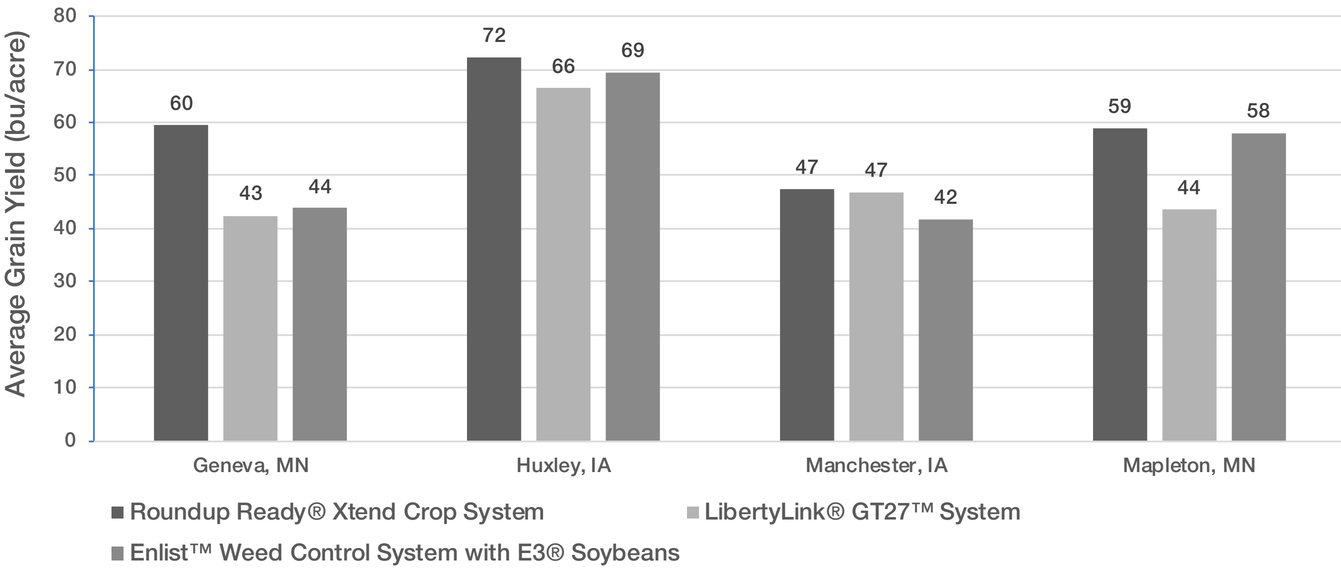


Figure 4. Average yield comparison of three soybean production systems in Iowa and Minnesota. Data represent the average yields of the three soybean products used in each system.

Understanding the Results

- Weed control at the time of both crop canopy (Figure 1) and harvest (Figures 2 and 3) was highest for the Roundup Ready® Xtend Crop System, then the Enlist™ Weed Control System, and lowest for the LibertyLink® GT27™ System.
- The Late POST application at Mapleton, MN did not substantially improve weed control in the LibertyLink® GT27™ System (Figures 1 and 2).
- The Roundup Ready® Xtend Crop System produced the highest average yield at all locations, followed by the Enlist™ Weed Control System with Enlist E3® Soybeans; except at Manchester, IA where the LibertyLink® GT27™ System out-yielded the Enlist™ Weed Control System (Figure 4).

Comparison of Three Soybean Herbicide Tolerant Systems in Iowa and Minnesota

Key Learnings

- Yield potential and weed control are two of the many factors to consider when deciding which soybean production system should be utilized on your farm.
- Farmers should make sure that their pre-emergence and post-emergence weed management programs include overlapping residual products for an effective season long control.
- Herbicide application timing and the environment have significant effects on weed control. Farmers should always endeavor to apply when weeds are less than 4 inches tall for the most effective control.

Optimizing Soybean Profitability in the Midwest

Trial Objective

- The optimum planting date for soybean in Iowa is believed to be the last week of April to the first week of May. Yet, questions remain regarding what soybean product maturity is the most profitable for early and later planting dates.
- Crop physiologists assert that planting later-maturing soybean products early is a good strategy to help increase soybean yields. Theoretically, this combination captures the most sunlight which can help produce a greater harvestable yield.
- The objective of this research was to better understand the optimum planting date (early or late) based on the relative maturity (RM) of the soybean product. An additional objective was to assess the effect of a fungicide application on soybean yield in both products and planting dates. This insight should help enable refined product placement and improve farm profitability.

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	Corn	Strip tillage	5/13/19 6/2/19	10/23/19 10/17/19	60	140K

- The experimental factors were as follows:
- Two planting dates:
  - early for the geographical area
  - late for the geographical area.
- Fungicide application:
  - Delaro® 325 SC fungicide (applied at R3 growth stage at a rate of 8 fl oz/acre)
  - untreated check.
- Two soybean products:
  - a 2.0 RM product (early product for the research location)
  - a 2.9 RM product (full-season product for the research location)
- Row spacing was 30 inches, plots were 15 ft wide x 250 ft long, and there were 4 replications.
- All other management practices, including seeding rate, tillage, and weed management, were the same for the whole trial.
- All plots were harvested the same day.

Understanding the Results

Table 1. Final harvest population and grain moisture of two soybean products as affected by planting date and fungicide application in central Iowa.				
Fungicide Treatment	**Planting Date**	**Product Relative Maturity**	**Harvest Population (000s plants/acre)**	**Harvest Grain Moisture Content (%)**
Delaro® 325 SC Fungicide (8 fl oz/acre at R3 growth stage)	5/13/19 (Early)	Early	111.0	12.2
		Late	101.5	11.9
	6/2/19 (Late)	Early	101.0	12.0
		Late	100.8	12.0
No Fungicide	5/13/19 (Early)	Early	96.3	11.5
		Late	96.3	11.5
	6/2/19 (Late)	Early	82.0	11.3
		Late	82.5	11.4

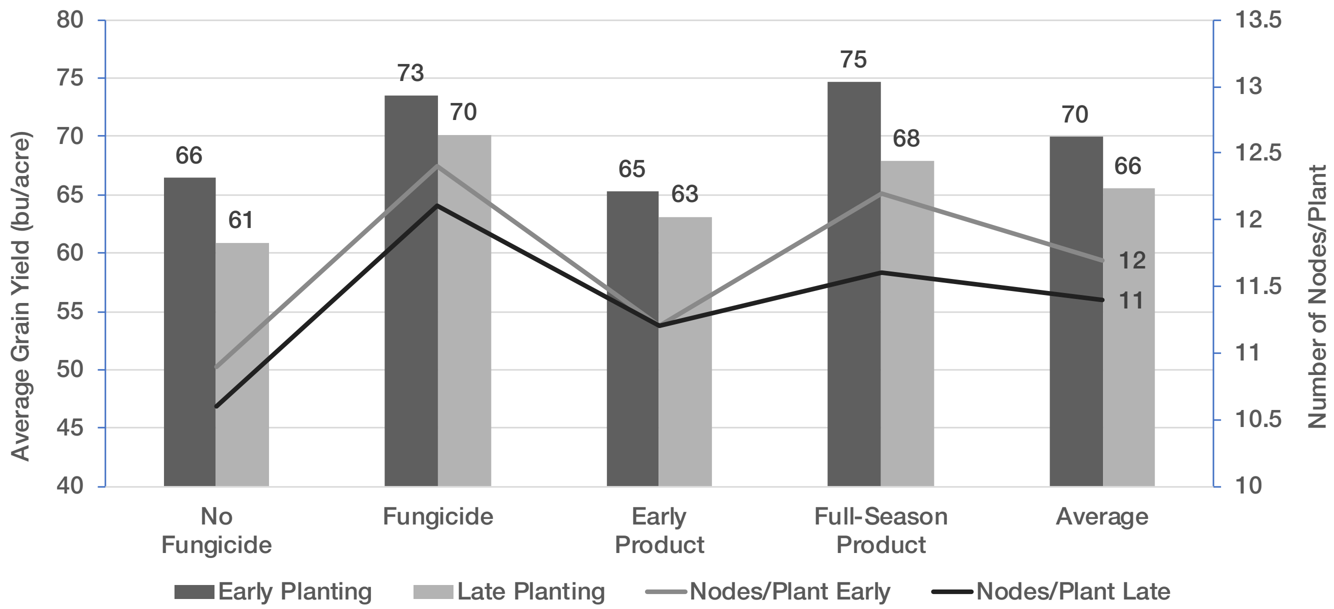


Figure 1. Effects of planting date on the number of nodes and yield of soybean products in central Iowa. Nodes were counted just before harvest. Planting dates were determined by environmental conditions. Average data represent planting date effect across both soybean product and fungicide treatments.

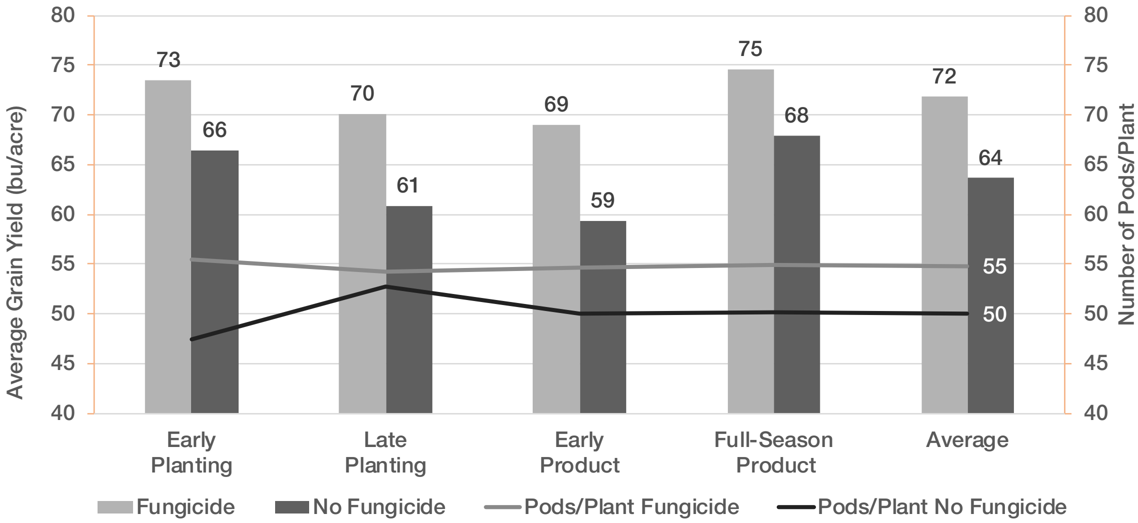


Figure 2. Effects of fungicide application on pod development and yield of soybean products in central Iowa. Pod number was counted just before harvest. Planting dates were determined by environmental conditions. Average data represent fungicide effect across both soybean product and planting date.

- Minor disease incidences observed across the entire research field included frogeye leaf spot (*Cercospora sojina*), Sudden Death Syndrome (SDS) (*Fusarium virgulifome*), and Cercospora leaf blight (*Cercospora kukuchii*).
- Across soybean products and fungicide treatments, early planting resulted in an average of 101,250 plants/acre at harvest compared to 91,565 plants/acre for late planting. Across products and planting dates, fungicide application resulted in a harvest population of 103,563 plants/acre versus 89,250 plants/acre in the unsprayed check (Table 1).
- Early planting resulted in higher average yields in both products (Figure 1).
- A fungicide application appears to improve node and pod counts, as well as average yield regardless of planting date and soybean product (Figure 2).
- A full-season product planted early and with a fungicide application produced the highest average yield (Figures 1 and 2).

Key Learnings

- In this trial, average grain yields were increased by a fungicide application and an early planting date. Farmers generally hope to get fields planted as early as the weather permits and these data confirm this to be a good practice.
- This trial suggests a full-season product planted early (whenever possible) should be the preferred practice to optimize soybean profitability.
- Fungicide application is an added cost; however, it may improve profit margins. With the current soybean grain price of $8.43/bu, about 3 bu/acre is required to pay for the fungicide used in this trial.
- Crop yield response to production inputs can be highly variable, often impacted by the environmental conditions during the growing season. Farmers are therefore advised to consult their trusted crop advisors when making input and planting decisions.

Yield Observations When Shifting to Earlier Relative Maturity Soybean Products

Trial Objective

- A growing trend for soybean growers is to plant "early" soybean products (south of their normal adaptation) earlier in the season and managing them at a higher level with seed treatments and foliar applications of fungicide and insecticide. This phenomenon, dubbed "relative maturity (RM) shift" is becoming increasingly important in some locations.
- Plots were 4 rows wide, 30 feet long, and treatments were replicated 3 times.
  - Earlier harvest
  - Earlier cover crop seeding
  - Risk management benefits
- The objective of this study was to determine the yield impact of planting "early" (for the location) RM soybean products compared to planting normal RM products for the location.

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	5/26/19	9/30/19, 10/8/19	65	175K
Marble Rock, IA	Silt loam	Corn	Strip tillage	6/3/19	10/17/19	55	152.5K
Huxley, IA	Clay loam	Corn	Conventional	6/6/19	10/11/19, 10/17/19	60	140K
Atlantic, IA	Silty clay loam	Corn	Conventional	5/16/19	10/17/19	70	150K
Victor, IA	Silty clay loam	Corn	Conventional	5/7/19	9/24/19, 10/17/19	65	140K

- The trial consisted of two sets – North and South.
- Each set had three Iowa locations:
  - North Set – Storm Lake, Marble Rock, and Huxley
  - South Set – Huxley, Atlantic, and Victor
- Each RM group consisted of three unique Asgrow® brand soybean products.
  - Three products were considered early RM for the location:
    - North Set – 1.1 to 1.7 RM
    - South Set – 2.0 to 2.3 RM
  - Three products were considered normal RM for the location:
    - North Set – 2.0 to 2.3 RM
    - South Set – 2.9 to 3.2 RM
  - The 2.0 to 2.3 RM group consisted of the same three products for both the North and South sets.

Yield Observations When Shifting to Earlier Relative Maturity Soybean Products

- The trial was a mix of plot sizes, replications (reps), and row spacings:
  - Storm Lake (4 reps)—six row strips, 20-inch spacing
  - Atlantic (2 reps) and Marble Rock (4 reps)—four row strips, 30-inch spacing
  - Huxley (3 reps)—six row strips, 30-inch spacing
  - Victor (2 reps)—eight row strips, 30-inch spacing
- During the growing season, all sites recorded 20+ inches of rainfall with Atlantic receiving 32 inches total.
- The Marble Rock site received several heavy rainfall events.

Understanding the Results

- Delayed planting dates in the spring and late rains in the fall favored the normal RM group at the sites tested in 2019.
- At the North locations, the normal RM group had a 6.0 bu/acre advantage over the early RM group (Figure 1) and at the South locations, the normal RM group had a 4.0 bu/acre advantage over the early RM group (Figure 2).

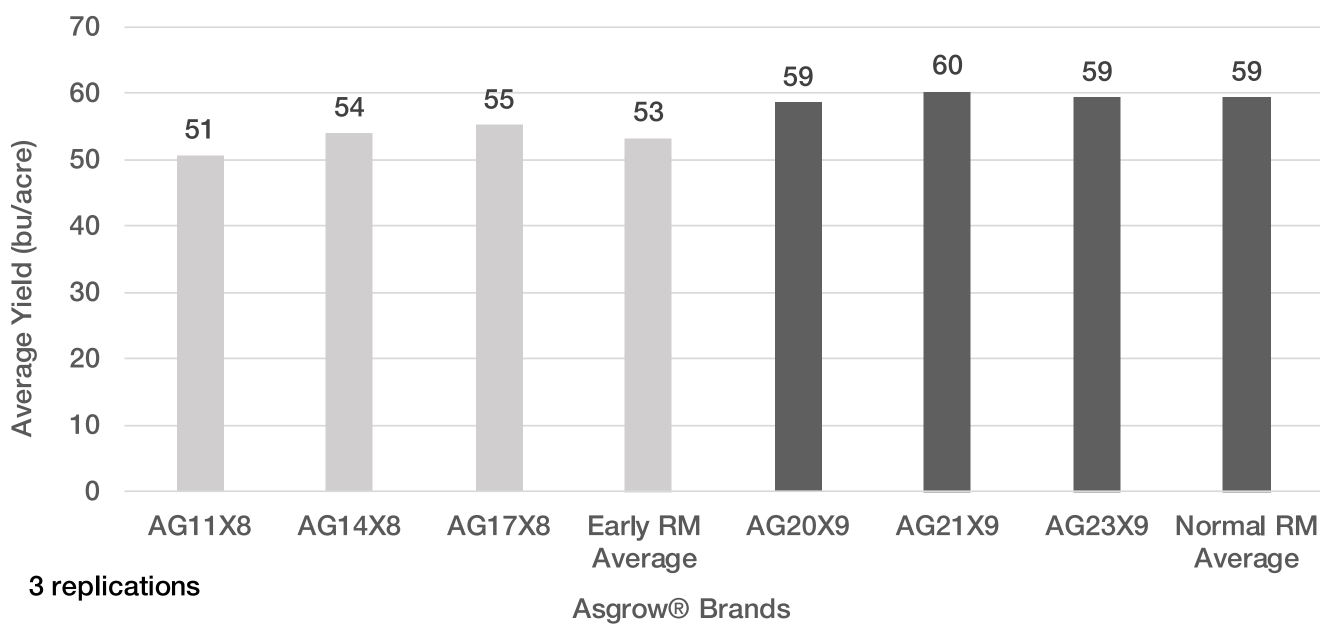


Figure 1. Relative maturity effects on the yield performance of six Asgrow® brand soybean products at the North locations (Storm Lake, Marble Rock, and Huxley, Iowa) in 2019.

Yield Observations When Shifting to Earlier Relative Maturity Soybean Products

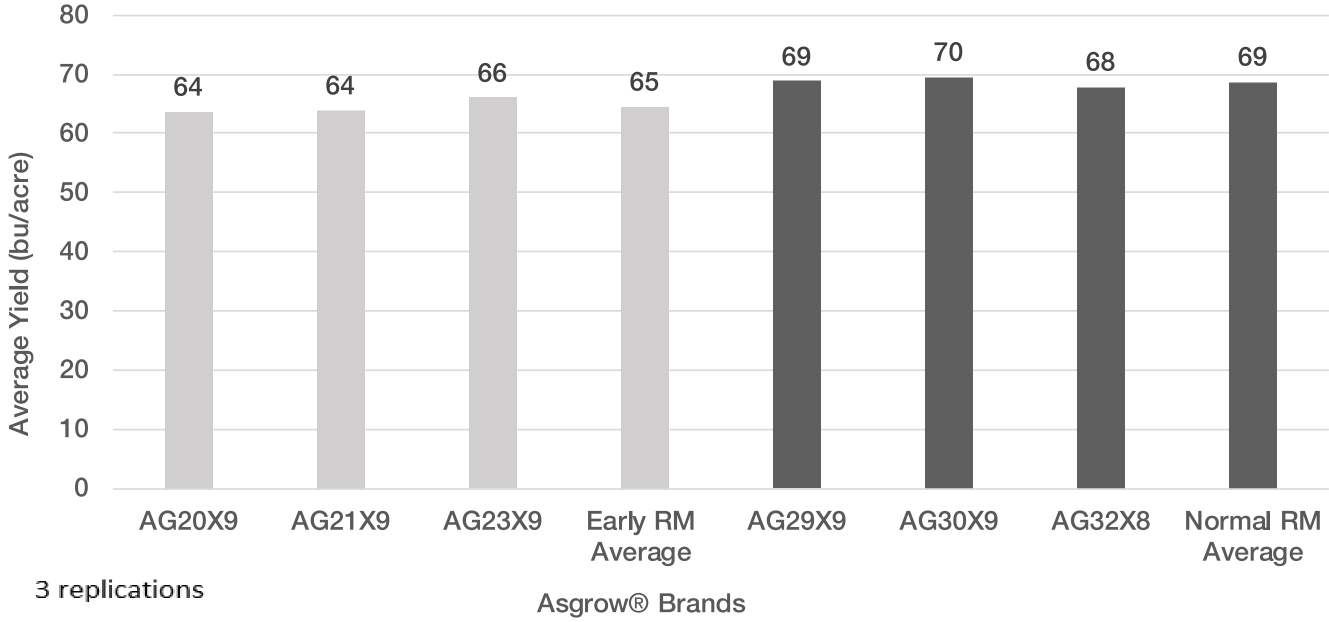


Figure 2. Relative maturity effects on the yield performance of six Asgrow® brand soybean products at the South locations (Huxley, Atlantic, and Victor, Iowa) in 2019.

Key Learnings

- In 2019, early RM products yielded, on average, 5.0 bu/acre less than normal RM products and yields ranged between 4 to 8 bu/acre less than normal RM products.
- In 2019, rainfall was plentiful with Marble Rock receiving the heaviest one-time event, and with Atlantic receiving over 32 inches total.
- The 2019 growing season favored the normal RM products, especially with a few delayed planting dates and excessive late-season rainfall that the normal RM group was able to utilize.
- More research needs to be conducted in the genetic pipeline to better understand which soybean products can be grown south of their main area of adaptability.
- It should be noted that a RM shift may not be for every operation and that its benefits could be defined in terms other than yield.

Tailored Solutions – Soybean Systems Management

Trial Objective

- Historically, soybeans have not been managed as intensively as corn, possibly resulting in sub-optimal yields and economic losses. Achieving higher yields in soybeans may require the dedication of resources, ranging from seed selection to pest management to fertility management.
- Such decisions should ultimately lead to improved yields and profitability to be sustainable. However, investing more inputs in soybean production in the current market situation is not appealing to most growers.
- The objective of this trial was to determine the economic value of two production systems:
    1. Grower standard system
    2. Premium system (high inputs)

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Huxley, IA	Clay loam	Corn	Strip tillage	5/13/19	10/18/19	60	125K, 150K

- Three soybean varieties with different maturity groups (MGs) were used for this trial. The varieties selected had a varied Relative Maturity (RM) spread for the location in order to help understand input response:
    - 2.0 MG (early variety for the research location)
    - 2.5 MG (mid-season variety for the research location)
    - 2.9 MG (full-season variety for the research location)
- Each soybean variety was planted at both the premium and grower standard systems.
- Grower Standard
    - 150,000 seeds/acre seeding rate
    - Seeds were treated with the Acceleron® Seed Applied Solutions STANDARD fungicide and insecticide treatments.
- Premium
    - 125,000 seeds/acre seeding rate
    - Seeds were treated with the Acceleron® Seed Applied Solutions STANDARD fungicide and insecticide treatments.
    - ILeVO® seed treatment
    - Foliar fungicide and insecticide application at R3
- The trial was carried out in 30-inch row spacing, 6 rows/treatment with 3 replications.
- Tillage and weed management were the same in both systems.

Table 1. Inputs and costs associated with the two production systems

Treatment	Input	2.0 MG Cost ($/acre)	2.5 MG Cost ($/acre)	2.9 MG Cost ($/acre)
Grower Standard	Seed	63.0	63.0	61.2
	Seed Treatment	7.0	7.0	7.0
	Total	70.0	70.0	68.2
Premium	Seed	52.5	52.5	51.0
	Seed Treatment	7.0	7.0	7.0
	ILeVo®	12.0	12.0	12.0
	Fungicide + Insecticide	22.0	22.0	22.0
	Total	93.5	93.5	92.0

Delaro® 325 SC fungicide was the fungicide used and Mustang® Maxx was the insecticide used.

Understanding the Results

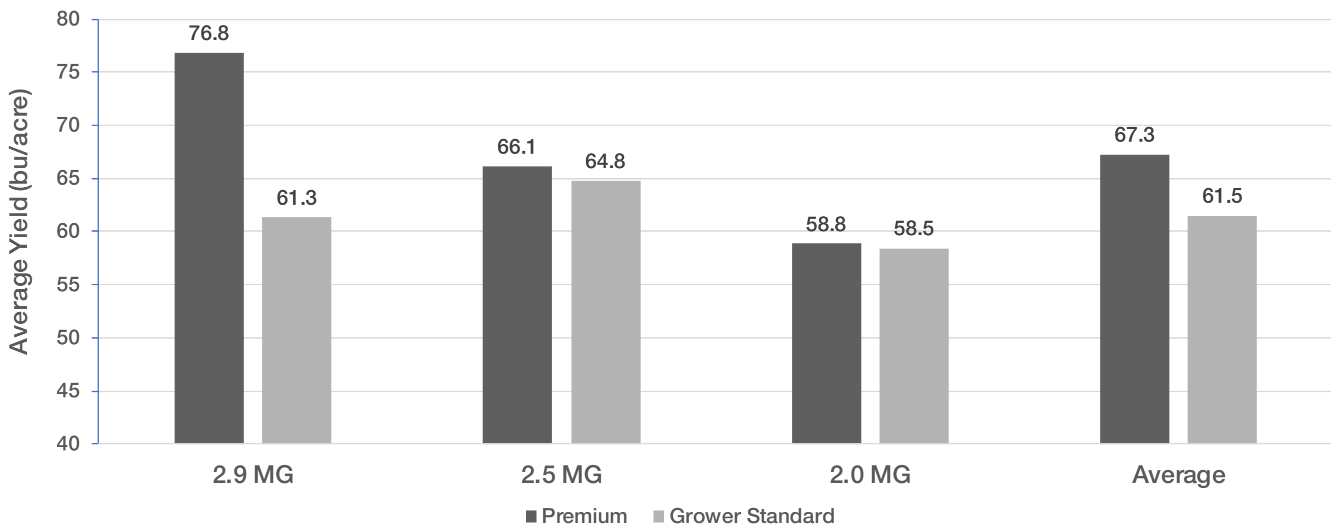


Figure 1. Yield response of three soybean varieties to two different production systems. Average represents the average yield of the three varieties for the production system.

- The premium system out-yielded the grower standard, producing an average of approximately 6 bu/acre more yield across all three soybean varieties.
- The full-season variety (2.9 MG) performed better than the other varieties in the premium system.
- With the current grain price of $8.43/bu, about 3 bu/acre is required to pay for the extra inputs of the premium system in all three varieties.

Key Learnings

- Crop yield response to production inputs can be highly variable, often impacted by the environmental conditions during the growing season. Farmers are therefore advised to consult their trusted crop advisors when making such decisions.

Effects of Tillage Systems in Corn and Soybean Production

ENVIRONMENT

Trial Objective

- When it comes to tillage, several factors are considered in the decision-making process including weed and pest management, soil and water conservation, and time and input costs.
- Today, farmers have access to an array of tillage options, ranging from conventional tillage to minimum tillage to no-till. Farm operations deploy different tillage types to meet the productivity and sustainability requirements of each piece of land. It is necessary to periodically evaluate the continued suitability of tillage systems for any piece of land.
- The objective of this trial was to evaluate the productivity of three tillage systems in both corn and soybean operations.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Huxley, IA	Clay loam	Soybean	Conventional, Strip tillage, No-till	5/9/18, 5/16/19	9/27/18, 10/30/19	220	34K
Huxley, IA	Clay loam	Corn	Conventional, Strip tillage, No-till	5/17/18, 5/16/19	9/27/18, 10/9/19	60	140K

- The trial was carried out in 2018 and 2019.
- In 2018, a 112 relative maturity (RM) VT Double PRO® RIB Complete® corn product and a 2.4 maturity group (MG) soybean variety were used for the trial.
- In 2019, a 112 RM SmartStax® RIB Complete® corn product and a 2.2 MG soybean variety were used for the trial.
- In both years and in both crops, the trials were carried out in 15 x 500 ft plots with 30-inch spacing and 6 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 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 to 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.
- Weed management and the amount of nitrogen applied were the same in all tillage systems.

Understanding the Results

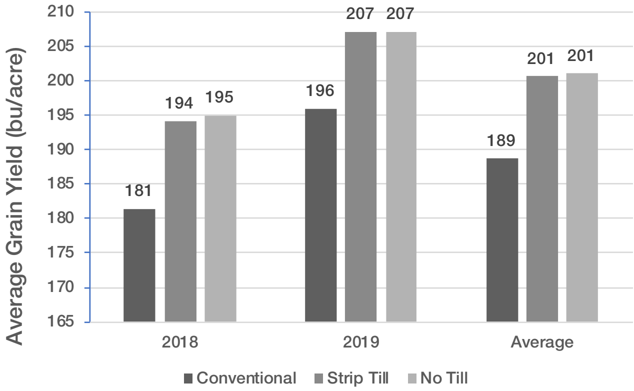


Figure 1. Corn yield response to three tillage systems over a two-year period in central Iowa.

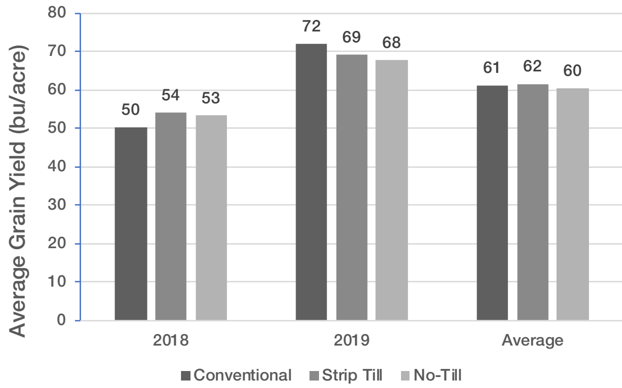


Figure 2. Soybean yield response to three tillage systems over a two-year period in central Iowa.

- Yields were generally higher in 2019 than in 2018 in both crops.
- In corn, yield was lowest for conventional tillage but nearly the same for strip tillage and no-till in both years (Figure 1).
- In soybean, yields were nearly the same for strip tillage and no-till in both years. While conventional tillage produced the lowest yield in 2018, it yielded the highest in 2019. On average, however, there wasn't much difference between the three systems over the two-year period (Figure 2).

Key Learnings

- Crop yield response to tillage can be widely variable and site-specific, often 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.
- This trial suggests that the type of tillage system is not a major factor in soybean production at the trial location. To save on production costs, however, no-till could be recommended if an efficient weed management strategy (such as chemical control) is available. In corn, strip tillage and no-till yielded 12 bu/acre better than conventional tillage over the two-year period, also suggesting that conventional tillage could be eliminated if an effective weed management strategy is available.
- Irrespective of the crop chosen, the right tillage type should be the one that provides the best economic returns while still ensuring better environmental stewardship.

Tailored Solutions – Corn Systems Management

Trial Objective

- Farm operations aim to maximize yield potential and profitability by careful deployment of inputs and practices with the best return on investment (ROI).
- With the current market trend, growers contemplate cutting production costs by eliminating or reducing some inputs.
- The objective of this trial was to determine the economic value of two production systems:
  1. Grower standard system
  2. Premium system (higher inputs)

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Huxley, IA	Clay loam	Soybean	Strip tillage	5/16/19	10/28/19	220	33K, 38K

- Three SmartStax® RIB Complete® corn blend products with different relative maturities (RMs) were used for this trial:
  - 108 RM
  - 112 RM
  - 114 RM
- Each product was planted at both the premium and grower standard systems.
  - Grower Standard
    - 33,000 seeds/acre seeding rate
    - 160 lb/acre nitrogen applied pre-plant
  - Premium
    - 38,000 seeds/acre seeding rate
    - 160 lb/acre nitrogen applied pre-plant
    - 40 lb/acre nitrogen side-dressed at V6
    - Foliar fungicide and insecticide application at VT/R1
- The trial was carried out in 30-inch row spacing, 6 rows/treatment with 2 replications.
- Tillage and weed management were the same in both systems.

Table 1. Inputs and costs associated with the two production systems				
Treatment	Input	108 RM Cost ($/acre)	112 RM Cost ($/acre)	114 RM Cost ($/acre)
Grower Standard	Seed	137.94	133.98	137.94
	Nitrogen	36.8	36.8	36.8
	Total	174.7	170.8	174.7
Premium	Seed	158.84	154.28	158.84
	Nitrogen	46.0	46.0	46.0
	Fungicide + Insecticide	22.0	22.0	22.0
	Total	226.8	222.3	226.8
32% UAN was used as the nitrogen source. Delaro® 325 SC fungicide was the fungicide used and Mustang® Maxx was the insecticide used.				

Understanding the Results

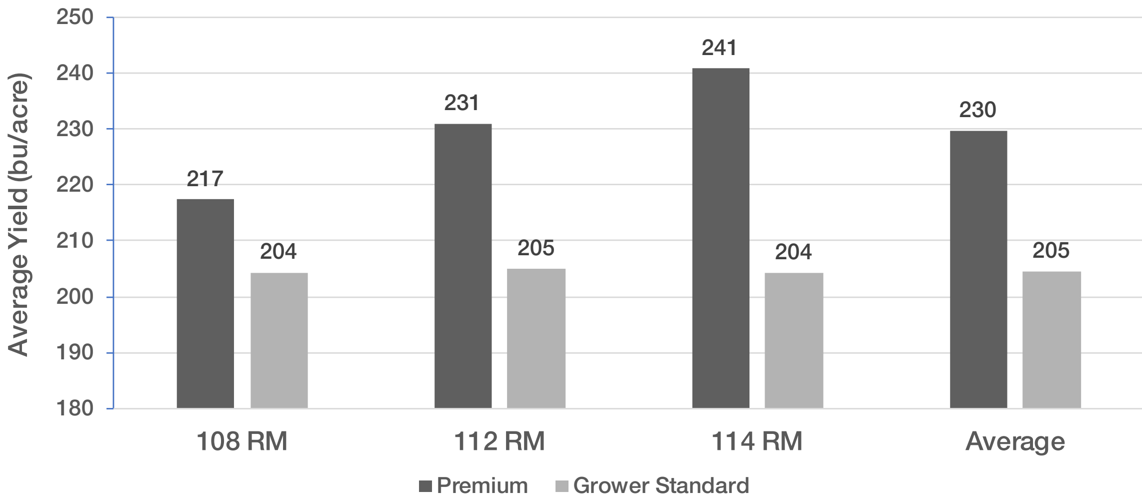


Figure 1. Yield response of the corn products to two different production systems. Average represents the average yield of the three corn products for each production system.

- The premium system out-yielded the grower standard, producing an average of 25 bu/acre more yield across all three corn products.
- In this trial, as we increased product relative maturity (RM), we saw a better response to higher management (greater inputs).
- With the current grain price of $3.50/bu, about 15 bu/acre is required to break even with the extra inputs in the premium system in all three corn products.

Key Learnings

- Crop yield response to production inputs can be highly variable, often impacted by the environmental conditions during the growing season. Farmers are therefore advised to consult their trusted crop advisors when making such decisions.

Corn Yield Response to Row Spacing and Seeding Rate

ENVIRONMENT

Trial Objective

- Row spacing is usually a standardized or fixed practice in most operations. Unlike nitrogen and weed management, which can be altered from year to year, most farmers don't vary their row spacing between years. This is due, in part, to high capital investment in farm equipment.
- Proper row spacing allows plants room to explore for nutrients and minimizes the adverse effects of competition from neighboring plants. In Iowa, and in most regions of the Midwest, 20 inches and 30 inches are the most common row spacing configurations.
- Coupled with seeding rate, row spacing impacts canopy closure and weed control, disease development, late-season plant standability, and ultimately yield potential. The objective of this trial was to evaluate the effects of 20- and 30-inch row spacings on corn yield at three different seeding rates.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Fungicide Timing	Seeding Rate (seeds/acre)
Atlantic, IA	Silty clay loam	Soybean	Minimum	4/26/19	10/14/19	230	30K 35K 40K
Huxley, IA	Clay loam	Soybean	Conventional	5/16/19	10/28/19	220	30K 35K 40K
Storm Lake, IA	Clay loam	Soybean	Conventional	5/3/19	10/24/19	250+	30K 35K 40K
Victor, IA	Silty clay loam	Soybean	Conventional	4/24/19	10/16/19	250	30K 35K 40K

- Forty-five corn products were chosen to represent the northern, central, and southern corn-growing regions of Iowa. Products were planted at 30,000 (30K), 35,000 (35K), and 40,000 (40K) seeds/acre seeding rates in both 20- and 30-inch row spacings.
- Tillage, weed management, and nitrogen management were the same for all products at the respective locations.
- The trial was conducted in 10-ft by 30-ft plots with two replications at each location.

Understanding the Results

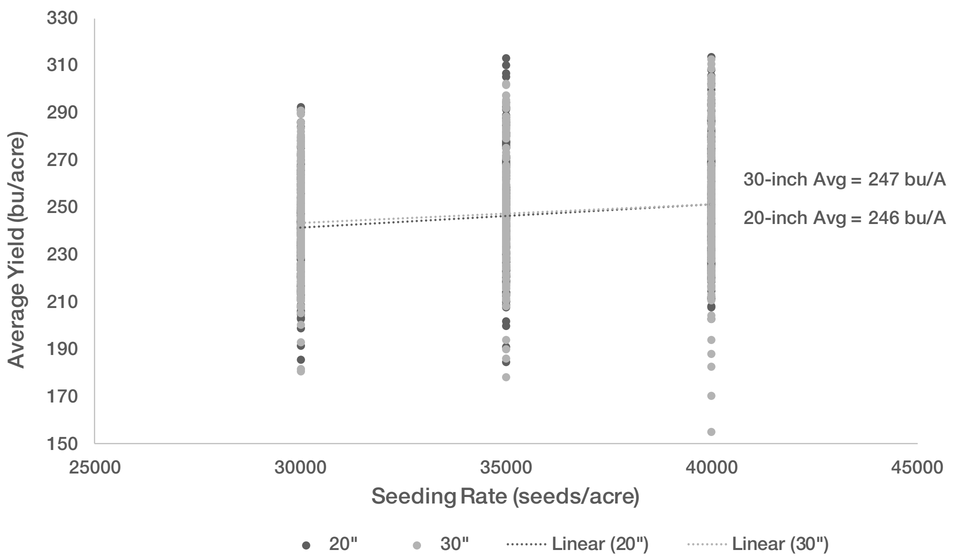


Figure 1. Effects of row spacing and seeding rate on the yield of corn products. Data represent 45 products from five growing regions in Iowa. The average yield represents the overall average across locations, products, and seeding rates.

Corn Yield Response to Row Spacing and Seeding Rate

Table 1. Summary of corn product performance due to row spacing and seeding rate.						
Row Spacing	Average Yield (bu/acre)			Grain Moisture Content (%)		
	30K	35K	40K	30K	35K	40K
20 inches	241	248	251	19.8	19.7	19.6
30 inches	243	248	251	19.9	19.8	19.8
Average	242	248	251	19.9	19.8	19.7

- There was a wide range of yield responses to seeding rate at each row spacing for the various products (Figure 1).
- In general, the average yield increased as the seeding rate increased in both row spacings. However, the two row spacings yielded nearly the same at each seeding rate, with an overall yield difference of just 1 bu/acre between them.
- Neither seeding rate nor row spacing had an impact on grain moisture content.
- In this trial, 58% of the products yielded higher in 30-inch row spacing than in 20-inch spacing at both the 30K and 35K seeding rates; whereas at the 40K seeding rate, 64% of the products yielded higher in 30-inch spacing than in 20-inch spacing.

Key Learnings

- In the past, each trial location has carried out several row spacing trials in which 20-inch row spacing consistently out-yielded 30-inch row spacing. However, those trials usually consisted of a limited number of products and that may, in part, be the reason for the different outcome of this study year.
- By virtue of plant configuration, 20-inches is expected to perform better than 30-inches, especially at higher seeding rates. It should be mentioned that with a few products, 20-inch row spacing out-yielded 30-inch row spacing at all seeding rates.
- Crop yield response to farm operations can be highly variable, often impacted by the environmental conditions during the growing season. Growers should make it a habit of testing new products/concepts on a small scale on their farm to see how it fits in their operation.
- Growers are also advised to consult their trusted agronomists and dealers in choosing the best products for their operation.

Corn Yield Response to Seeding Rate

Trial Objective

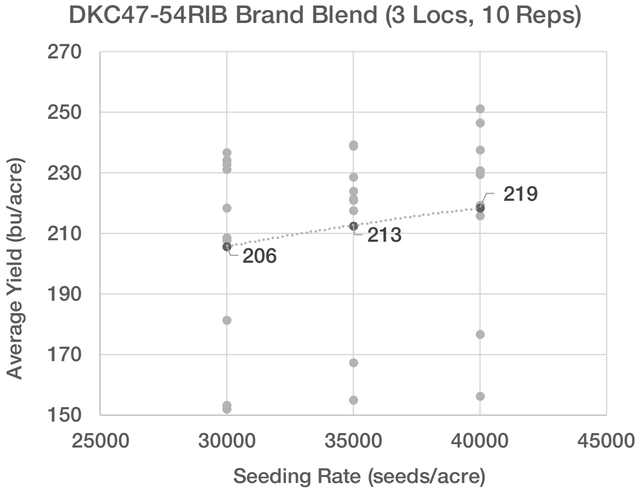
- In general, corn yield potential has continued to improve in the United States. Research has shown that corn yield has a positive correlation with planting density until a threshold is reached, beyond which yield decreases.[1] Defining the optimal density threshold for each corn product is difficult as it's highly affected by management practices and the environmental conditions during the growing season.
- Understanding the threshold is critical as it forms the basis for management decisions, such as nitrogen rate. The objective of this trial was to determine the optimum yield response of corn products to different seeding rates.

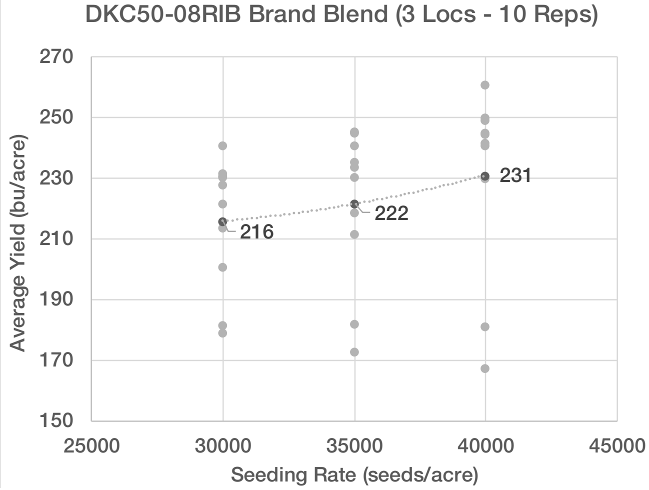
Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Atlantic, IA	Silty clay loam	Soybean	Minimum	04/26/19	10/14/19	230	30K 35K 40K
Huxley, IA	Clay loam	Soybean	Conventional	05/16/19	10/28/19	220	30K 35K 40K
Marble Rock, IA	Silty loam	Soybean	Strip tillage	05/07/19	10/18/19	200	30K 35K 40K
Storm Lake, IA	Clay loam	Soybean	Conventional	05/03/19	10/24/19	250+	30K 35K 40K
Victor, IA	Silty clay loam	Soybean	Conventional	04/24/19	10/16/19	250	30K 35K 40K

- Thirteen DEKALB® corn brand blends were selected to represent the northeast, northwest, central, southeast, and southwest growing regions of Iowa. Products were planted at 30,000, 35,000, and 40,000 seeds/acre.
- Tillage, weed control, and nitrogen management were the same for all products at the respective locations.
- The trial was conducted in 30-inch row spacing, with 10-ft x 30-ft plots per product and seeding rate at various replications based on the product (Figure 1).

Understanding the Results





Corn Yield Response to Seeding Rate

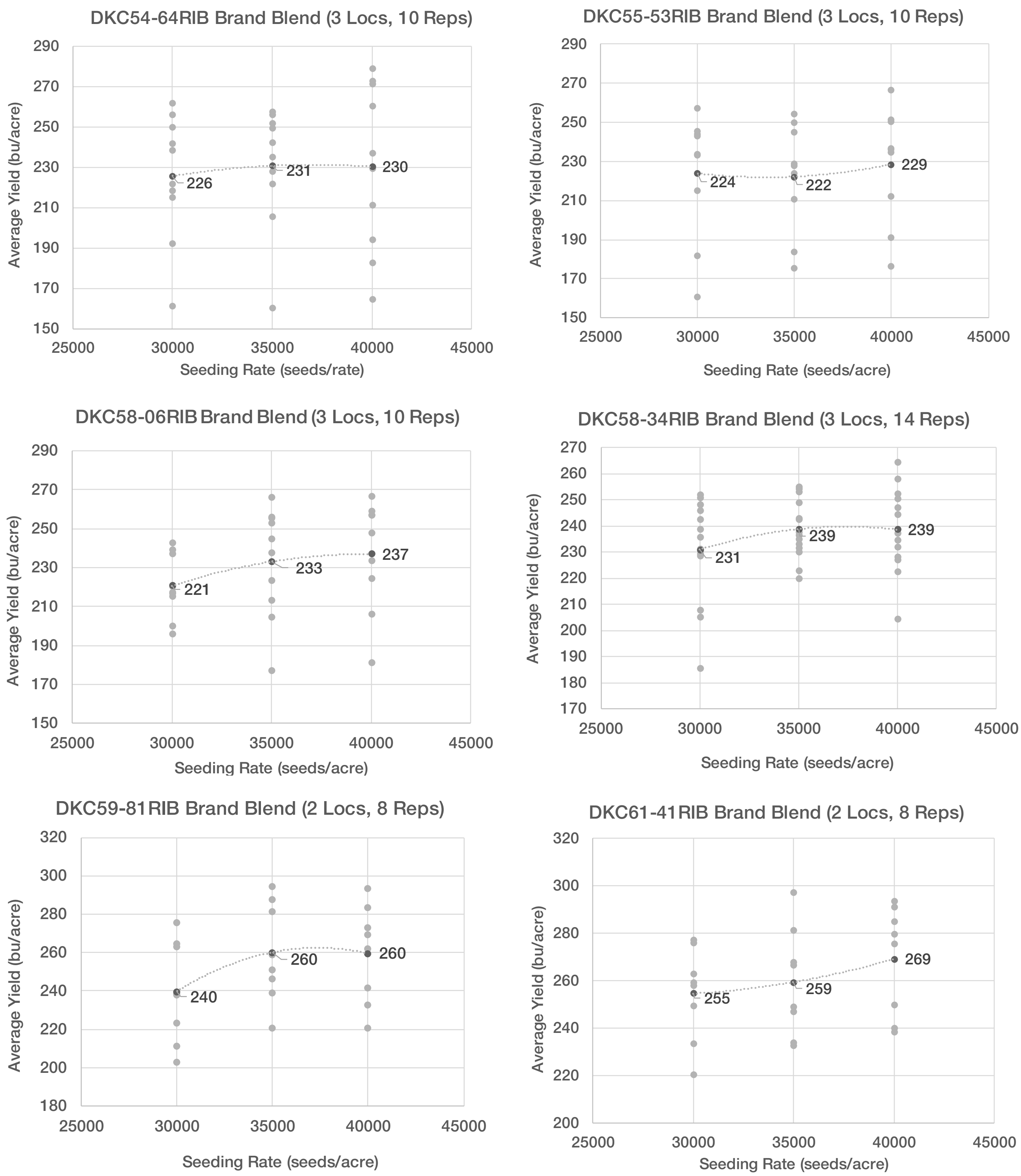
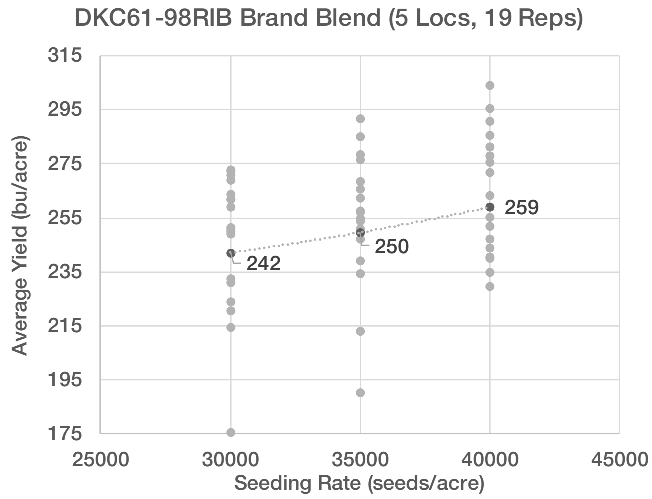
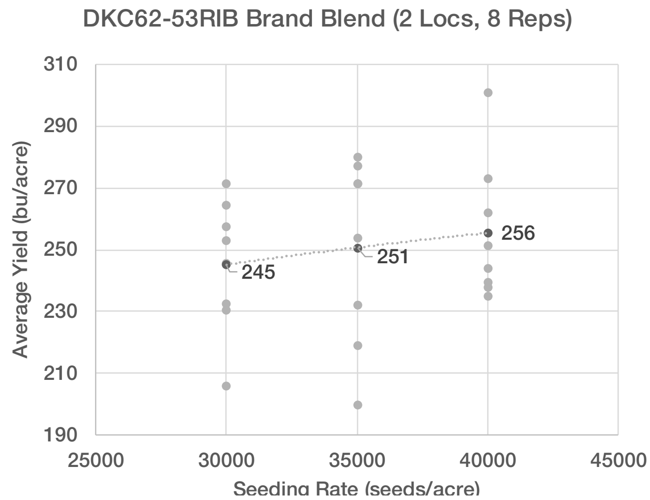
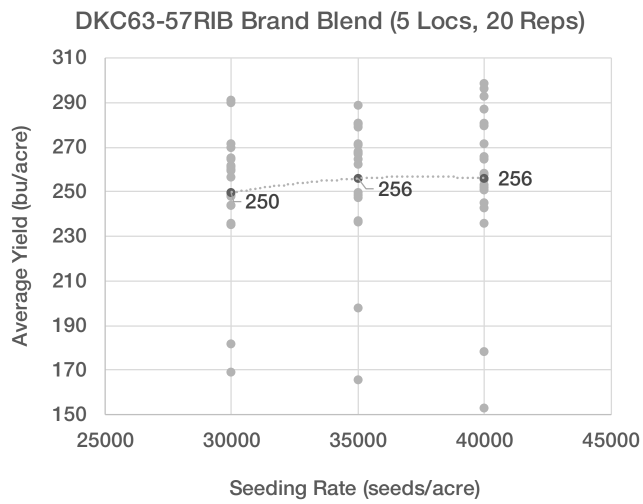


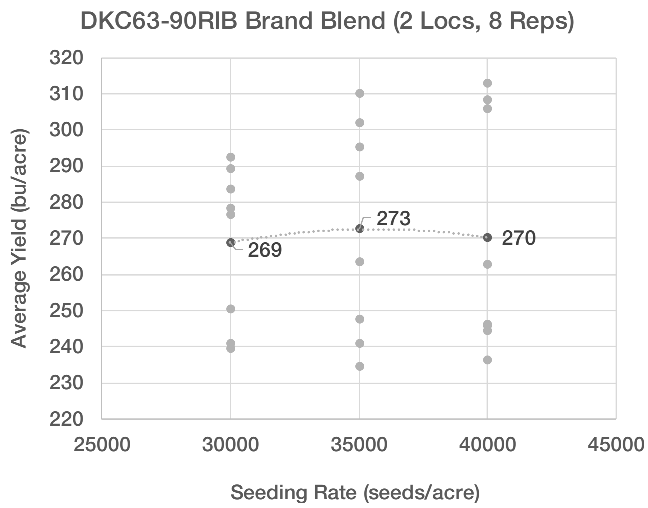
Figure 1. Yield response of DEKALB® corn brand blends to seeding rate in Iowa. The trendline indicates the average yield response at each seeding rate across the respective locations.

Corn Yield Response to Seeding Rate









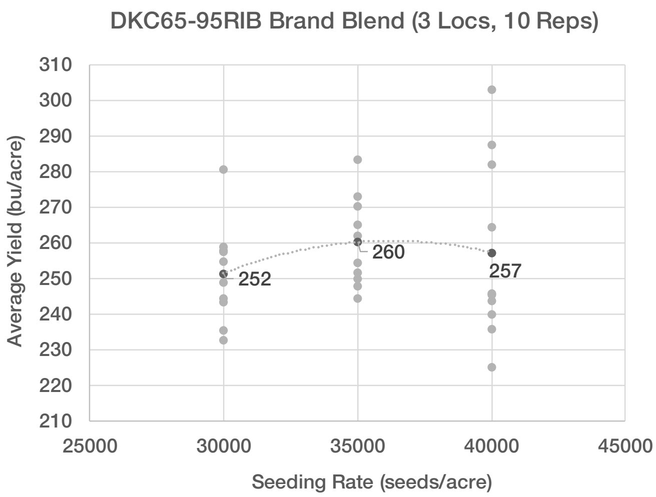


Figure 1. Yield response of DEKALB® corn brand blends to seeding rate in Iowa. The trendline indicates the average yield response at each seeding rate across the respective locations.

Corn Yield Response to Seeding Rate

- In 54% (7 out of 13) of the products, yield increased as seeding rate increased with the highest seeding rate (40,000 seeds/acre) having the highest yields.
- With the remaining products, yields were similar between the 35,000 and 40,000 seeds/acre seeding rates in three products (e.g. DKC58-34RIB brand blend), whereas yields decreased in the other three products (e.g. DKC63-90RIB brand blend) above the 35,000 seeds/acre seeding rate.
- Yields were lowest at the lowest seeding rate (30,000 seeds/acre) in all products except for DKC55-33RIB brand blend for this trial.

Key Learnings

- Several factors should be considered when selecting the seeding rate for a corn product. Key among these factors are plant standability, nitrogen fertility, and economic feasibility.
- In the current market environment, a 5 bu/acre yield increase is required for every 5,000 seeds/acre increase in seeding rate. Only 38% (5 out of 13) of the products tested produced an economic yield at the highest seeding rate (e.g. DKC50-08RIB and DKC61-98RIB brand blends).
- Crop yield response to operation inputs can be highly variable, often substantially impacted by the environmental conditions during the growing season. Growers should consider testing new products and concepts on a small scale on their farm to see how it fits in their operation.
- Bayer Crop Science uses an innovative planter technology called the Genetic Environment Narrative (GEN) planter to characterize corn product performance by evaluating yield response to plant density across different environments. The GEN planter provides the ability to simultaneously plant multiple corn products and quickly and accurately change planting populations as it moves across a field. These unique planting capabilities generate over one hundred thousand detailed yield observations each season across diverse growing conditions. This provides data to optimize product management recommendations for key corn growing regions in the United States. Please visit the population optimizer tool at https://www.dekalbasgrowdeltapine.com/en-us/dekalb/tools/optimize-my-seed.html for plant density recommendations for your region.
- Growers are also advised to consult their trusted agronomists and dealers in selecting the best products for their operation.

Source:

Nielsen, R.L. 2013. Thoughts about seeding rate for corn. Department of Agronomy, Purdue University. https://www.agry.purdue.edu/ext/corn/news/timeless/SeedingRateThoughts.html

Corn Product Response to Nitrogen Stress

Trial Objective

- The objective of this study was to characterize the yield response and harvest appearance of different corn products to nitrogen (N) stress.

Research Site Details

Locations	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Nitrogen Rate (low/high rate, lb/acre)
Storm Lake, IA	Silty clay loam	Soybean	Conventional	5/3/19	10/23/19	250	45/245
Marble Rock, IA	Loam	Soybean	Strip tillage	5/7/19	10/18/19	220	50/250
Huxley, IA	Clay loam	Soybean	Strip tillage	5/16/19	10/26/19	220	50/250
Victor, IA	Silty clay loam	Corn	Conventional	4/24/19	10/15/19	230	50/250
Atlantic, IA	Silty clay loam	Soybean	Conventional	4/25/19	10/14/19	250	50/250

- Sixteen DEKALB® corn brand blends were used in this study, an early relative maturity (RM) set (97-113 RM) and a late RM set (108-115 RM).
- The trial was set up as a split-plot design at each location with N rate as the blocking factor with 2 replications.
- Plot size was 4 rows at 30-inch row width, 35 feet long, and the center rows were harvested for data.
- Planting dates were near normal in the southern part of the state while slightly delayed across Northern Iowa.
- Nitrogen was applied before V3 stage. See the table above for N rates.

Understanding the Results

- Yield differences between products when grouped at the low N rate were not different statistically. The same was true of the high N rate.
- Products displayed N deficiency symptoms at the low N rate during most of the season.
- Yield differences within N rates can be attributed to germplasm by environmental interactions.
- Physical plant integrity i.e. harvest appearance of products at the high N rate aligned with the product guide rating. However, harvest appearance was slightly worse for products at the low N rate.

Corn Product Response to Nitrogen Stress

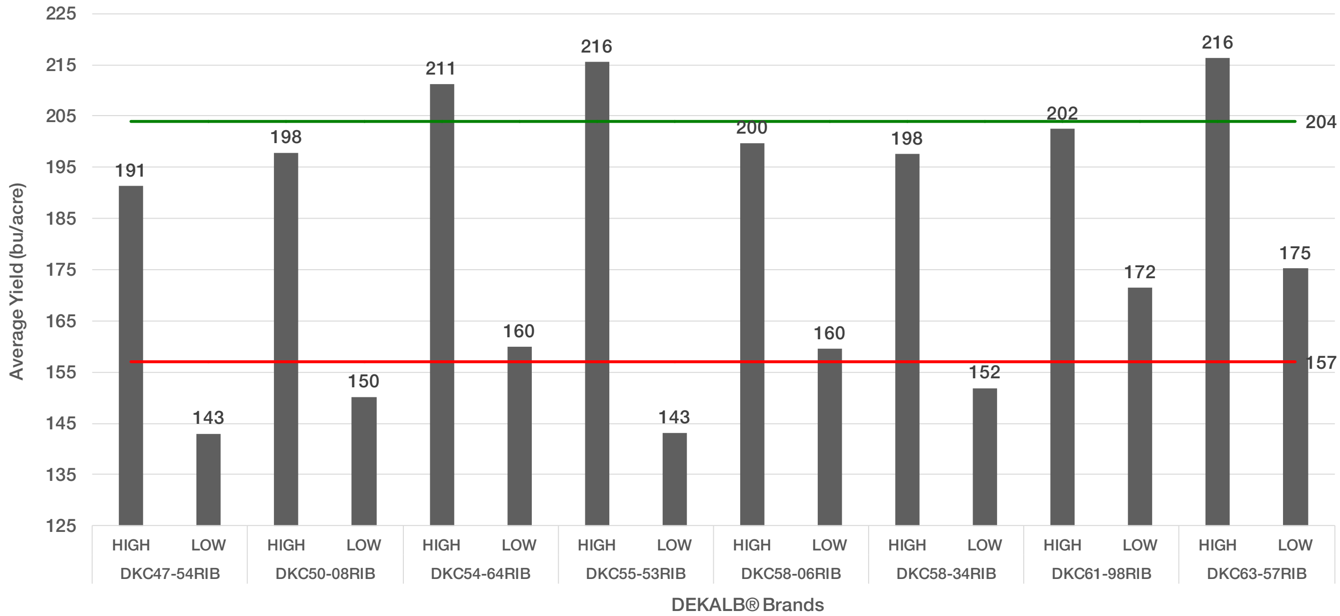


Figure 1. Performance of early RM corn products at high and low N rates in Northern Iowa. The average yield of the low N and high N treatments was 157 bu/acre (red line) and 204 bu/acre (green line), respectively.

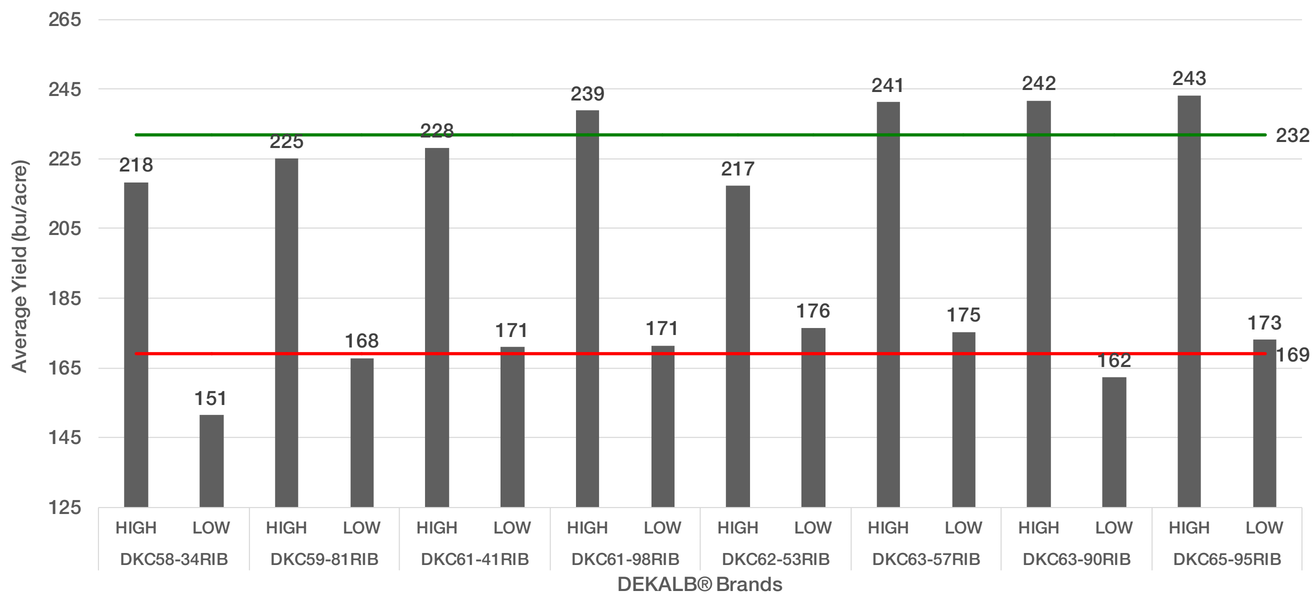


Figure 2. Performance of late RM corn products at high and low N rates in Southern Iowa. The average yield of the low N and high N treatments was 169 bu/acre (red line) and 232 bu/acre (green line), respectively.

Corn Product Response to Nitrogen Stress

Key Learnings

- This study could not confirm that there are differences in product sensitivity to either a yield-limiting low N rate or a crop-sufficient high N rate.
- This study suggests products have similar response to N rate; however, supplying adequate N and monitoring N losses is important for the best return on investment.
- Understand that environmental conditions such as seasonal rainfall, soil type, and temperature that can affect crop-available nitrogen.

Effect of Fungicide on Yield

Trial Objective

- Application of a fungicide has been shown to protect corn plants from foliar diseases and improve overall plant appearance, which may lead to increased grain yield.
- Yield increases observed from the application of fungicide in the absence of foliar disease greatly depends on the corn product, as individual products respond differently to fungicide application. While fungicide is often used as a high-yield management strategy, it can also be used to protect the yield of products with poor plant and stalk strength ratings.
- The objective of this study was to evaluate the impact fungicide application has on corn yield and good plant appearance.

Research Site Details

- Thirteen DEKALB® brand corn products were tested, broken out into two different sets based on relative maturity (RM). The northern set included products that ranged from 97 to 111 RM and the southern set included products that ranged from 108 to 115 RM.
- Marble Rock and Storm Lake were the north locations; Victor and Atlantic were the south locations. Due to its central location, both the northern and southern sets were located at Huxley, giving each product three locations.
- Plots were planted as strip trials at four of the locations, with Huxley being arranged as a small-plot trial.
- The locations served as replications.
- Each site was sprayed with USF0411 fungicide at 8 oz/acre with a ground sprayer at the R1 corn growth stage.
- Foliar disease and stalk quality ratings were taken at R4 growth stage and grain moisture and yield were collected at harvest.

Effect of Fungicide on Yield

Understanding the Results

Figure 1. Pictures of DEKLAB® DKC62-53RIB brand blend with and without USF0411 fungicide. Photos taken at the R4 growth stage (left) and pre-harvest (right). RIB is Refuge-In-a Bag.

- All research locations had some levels of corn disease incidence, with disease level averaging from low to moderate across locations. Gray leaf spot, Northern Corn Leaf Blight and Anthracnose stalk rot were the most predominant diseases across locations. Disease incidence was observed in both fungicide-treated and untreated plots, and there were no differences in disease incidence and severity between treatments.
- Late season stay green and intactness scores were taken but there were no differences observed between the fungicide-treated and untreated plots.
- Across all corn products, spraying fungicide resulted in an average of 12-13 bu/acre advantage vs. the unsprayed treatment (Figures 2 and 3). For this study, a 7 bu/acre response was considered a profitable response ($24/acre cost for fungicide application with $3.50 corn).
- Fungicide application had a small effect on grain moisture, with an overall average of 0.6% difference in moisture between the sprayed and unsprayed treatments. The total difference in moisture for the southern set was 0.4% vs. 0.7% for the northern set (Table 1).
- Three products; DKC58-34RIB, DKC59-81RIB and DKC61-98RIB were planted in both north and south locations to understand product response to fungicide at different geographies. When planted in the appropriate geography for their relative maturities (northern half of Iowa), DKC58-34RIB and DKC59-81RIB provided economic returns to fungicide application (Fig. 1). However, they did not provide economic response to fungicide when planted in the south (Fig. 2). DKC61-98RIB did not provide economic gains to fungicide application in the north but a good gain in the south where it is well suited for its relative maturity (Figures 1 and 2).

Effect of Fungicide on Yield

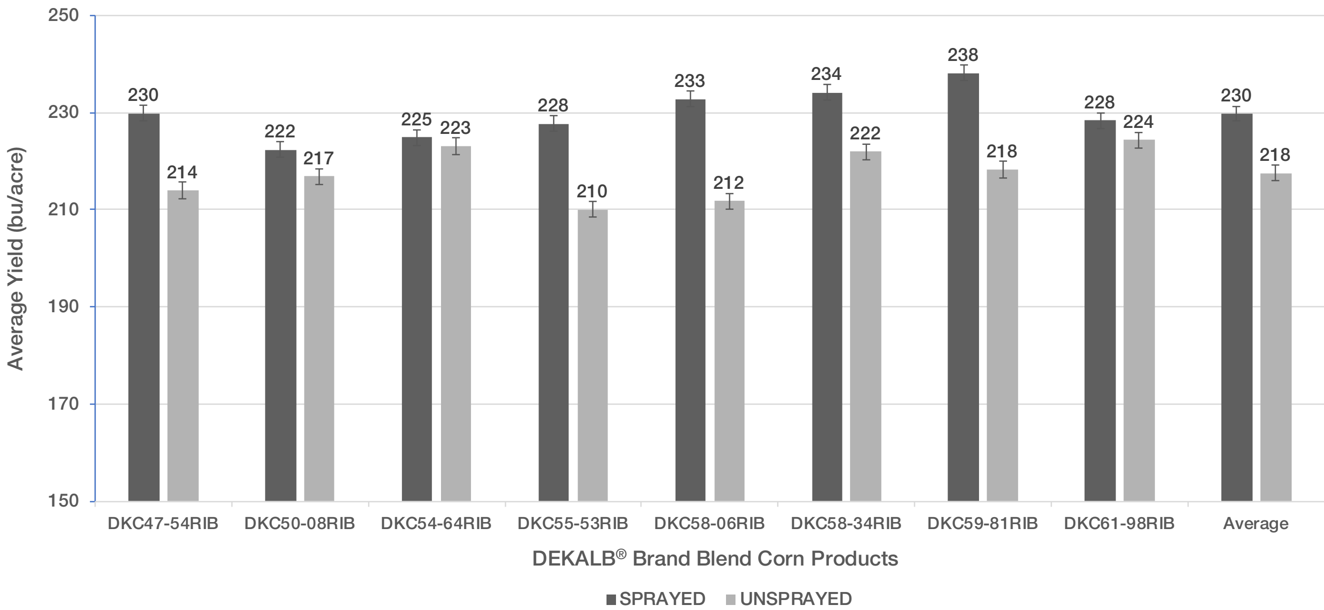


Figure 2. Response of DEKALB® brand north set products to USF0411 fungicide, adjusted to 15.5% grain moisture content. Standard error bars are shown. RIB is Refuge-In-a Bag.

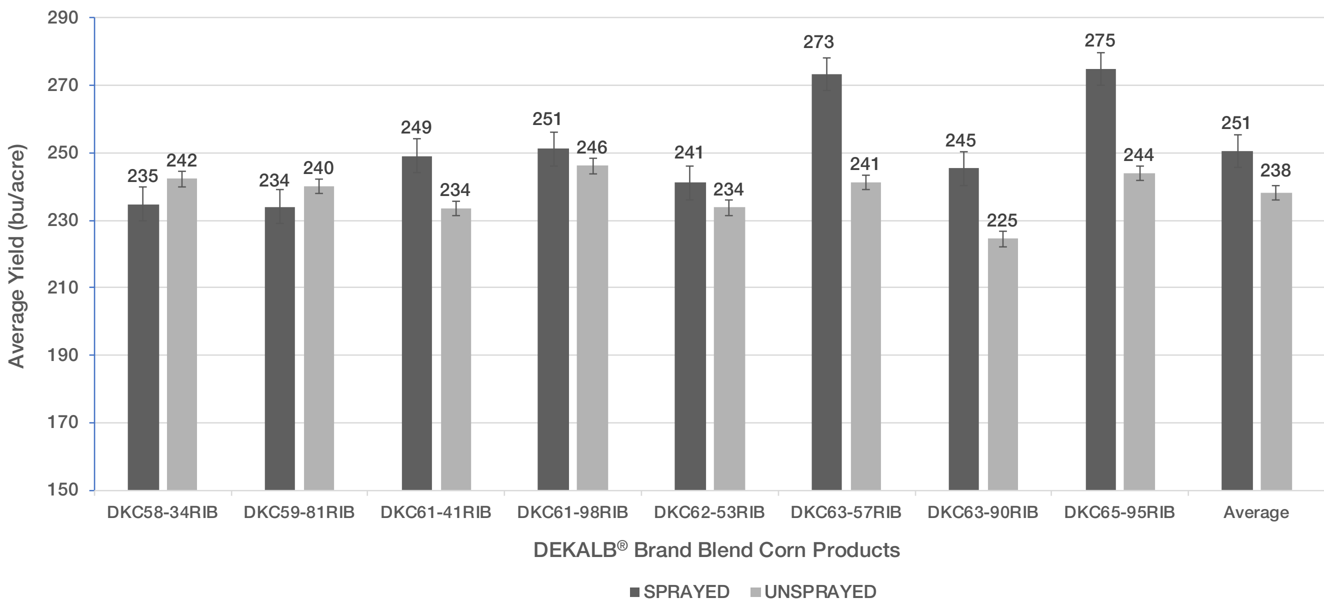


Figure 3. Response of DEKALB® brand south set products to USF0411 fungicide, adjusted to 15.5% grain moisture content. Standard error bars are shown. RIB is Refuge-In-a Bag.

Effect of Fungicide on Yield

Table 1. Effects of USF0411 fungicide on grain moisture content of DEKALB® brand corn blends in Iowa.					
Product	Grain Moisture Content (%) Northern Set		Product	Grain Moisture Content (%) Southern Set	
	SPRAYED	UNSPRAYED		SPRAYED	UNSPRAYED
DKC47-54RIB	18.2	17.7	DKC58-34RIB*	19.8	19.8
DKC50-08RIB	19.3	18.8	DKC59-81RIB*	19.8	19.7
DKC54-64RIB	19.0	18.5	DKC61-41RIB	20.5	19.7
DKC55-53RIB	20.4	19.5	DKC61-98RIB*	18.9	19.4
DKC58-06RIB	20.8	20.1	DKC62-53RIB	21.0	20.1
DKC58-34RIB*	20.2	19.6	DKC63-57RIB	20.7	20.0
DKC59-81RIB*	19.0	18.9	DKC63-90RIB	21.4	21.2
DKC61-98RIB*	21.5	19.8	DKC65-95RIB	21.6	21.2
Average	19.8	19.1	Average	20.5	20.1
*Indicates products that were grown in both north and south locations. RIB is Refuge-In-a Bag.					

Key Learnings

- The 2019 growing season saw a range of moisture and temperature extremes across the state of Iowa. Generally, the research sites experienced wet planting conditions, a hot and dry July, and a wet late summer/ harvest season. This led to some levels of stalk strength and plant appearance issues due to excess moisture, nutrient shortages, and prolonged harvest conditions.
- Such conditions may explain why fungicide was profitable across nearly all products tested in 2019. While plant appearance was notably improved by fungicide use, we did not observe dramatic differences in stalk strength between sprayed and unsprayed products. This could be due, in part, to improvements in our corn germplasm to inherently tolerate some of these adverse growing conditions.
- The results of this study suggest that fungicide application could promote a healthier upper canopy that would lead to increased photosynthetic activity and better plant stress tolerance, which might result in increased corn yields. To gain the full benefits of a fungicide, the right corn product should be selected for the growing region.
- Going forward, protecting yield and improving overall plant appearance with the use of a fungicide may be a management decision worth considering on your operation.

Legal Statements

Legal Statements

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