
DEKALB
ASGROW
2019 FIELD RESEARCH
Huxley Learning Center
BAYER

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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How to Use This Book

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

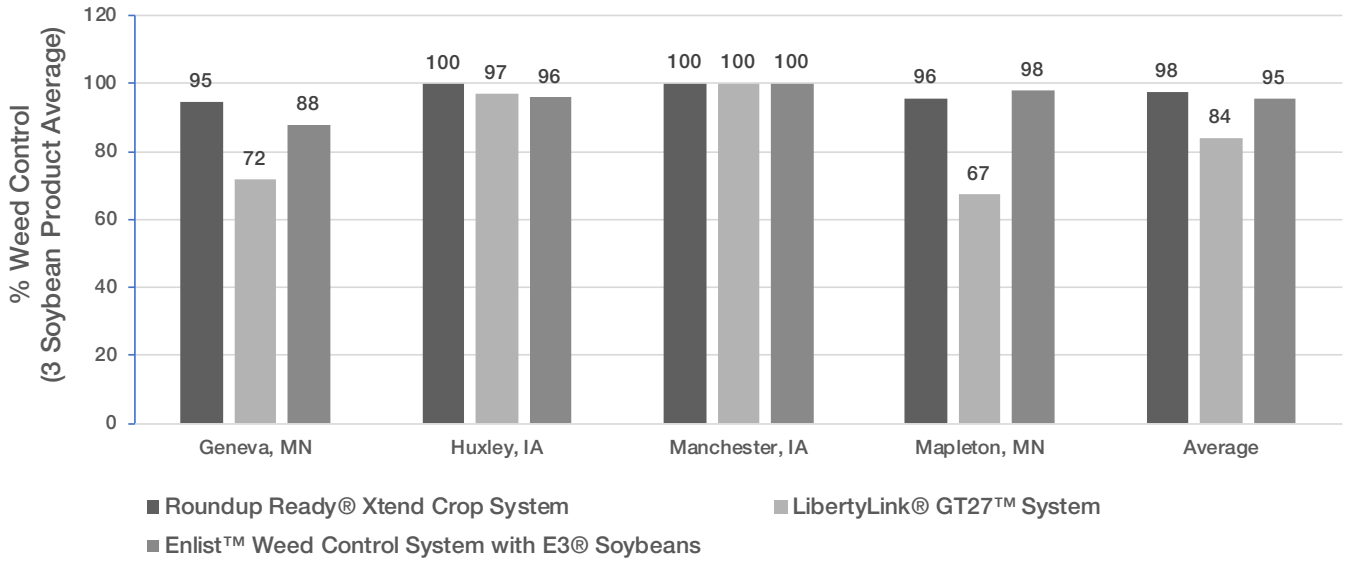

Figure 1. Percent weed control at crop canopy for the four locations. Data represent the average of the three soybean products used in each system and combine the control of the most prevalent broadleaf and grass weeds (velvetleaf (Abutilon theophrasti), waterhemp (Amaranthus rudis), lambsquarter (Chenopodium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

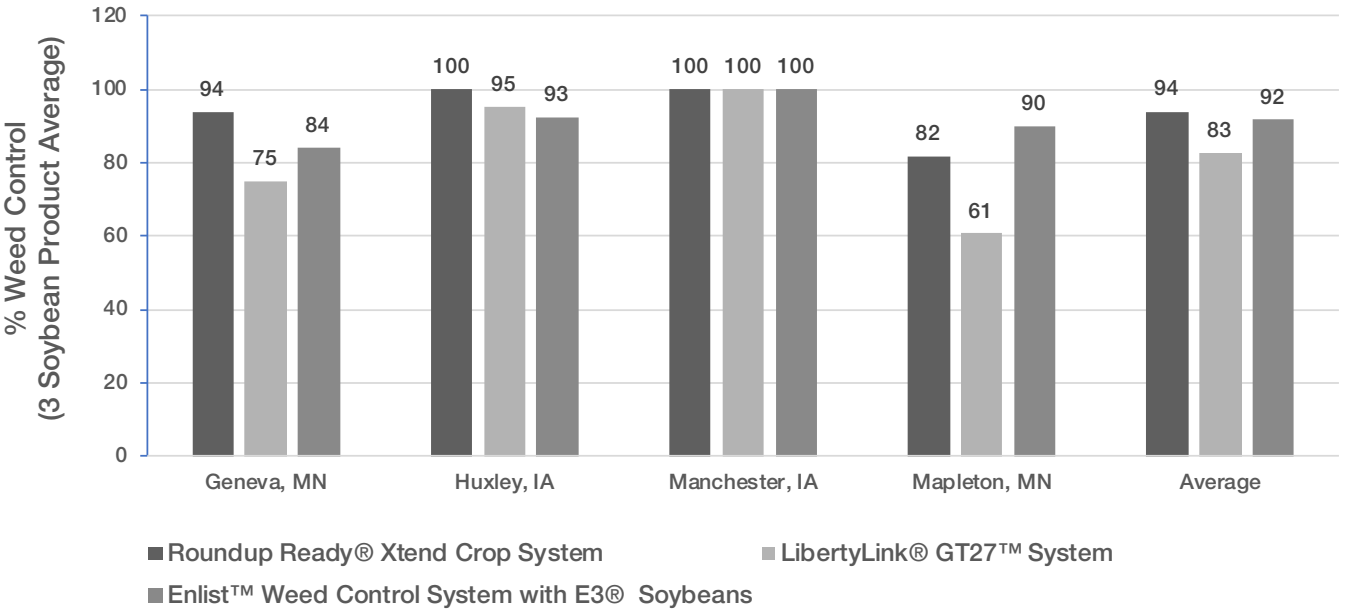

Figure 2. Percent weed control at crop harvest for the four locations. Data represent the average of the three soybean products used in each system and combine the control of the most prevalent broadleaf and grass weeds (velvetleaf, waterhemp, lambsquarter, giant foxtail, and green foxtail) at each location.

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.

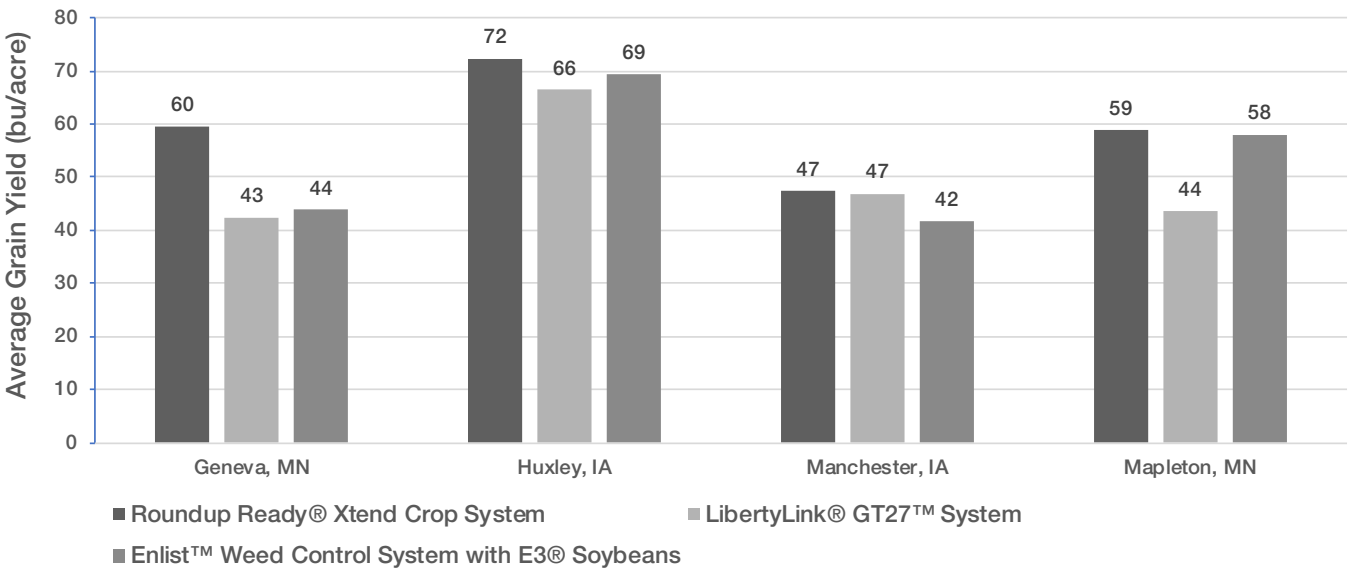

Figure 4. Average yield comparison of three soybean production systems in Iowa and Minnesota. Data represent the average yields of the three soybean products used in each system.

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

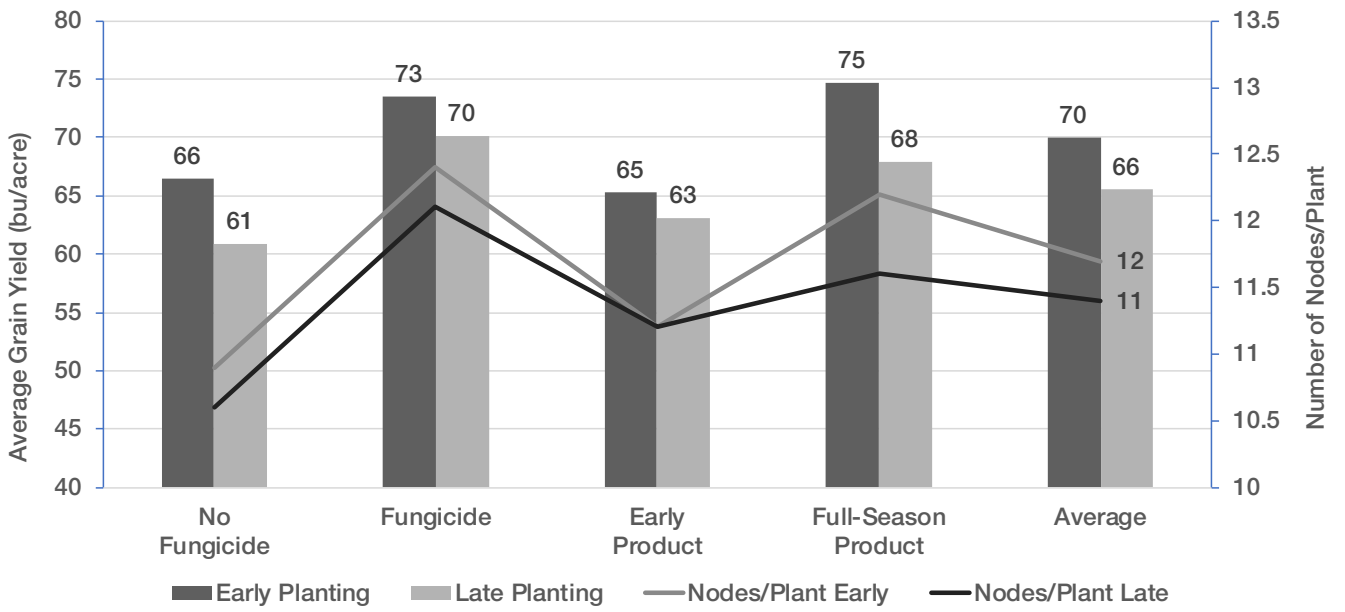

Figure 1. Effects of planting date on the number of nodes and yield of soybean products in central Iowa. Nodes were counted just before harvest. Planting dates were determined by environmental conditions. Average data represent planting date effect across both soybean product and fungicide treatments.

Optimizing Soybean Profitability in the Midwest

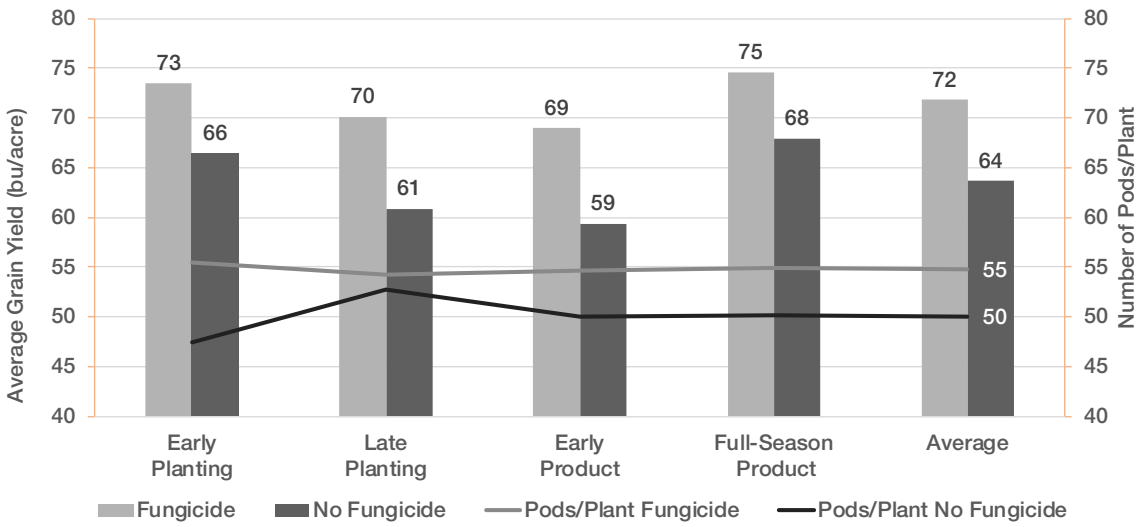

Figure 2. Effects of fungicide application on pod development and yield of soybean products in central Iowa. Pod number was counted just before harvest. Planting dates were determined by environmental conditions. Average data represent fungicide effect across both soybean product and planting date.

- 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).

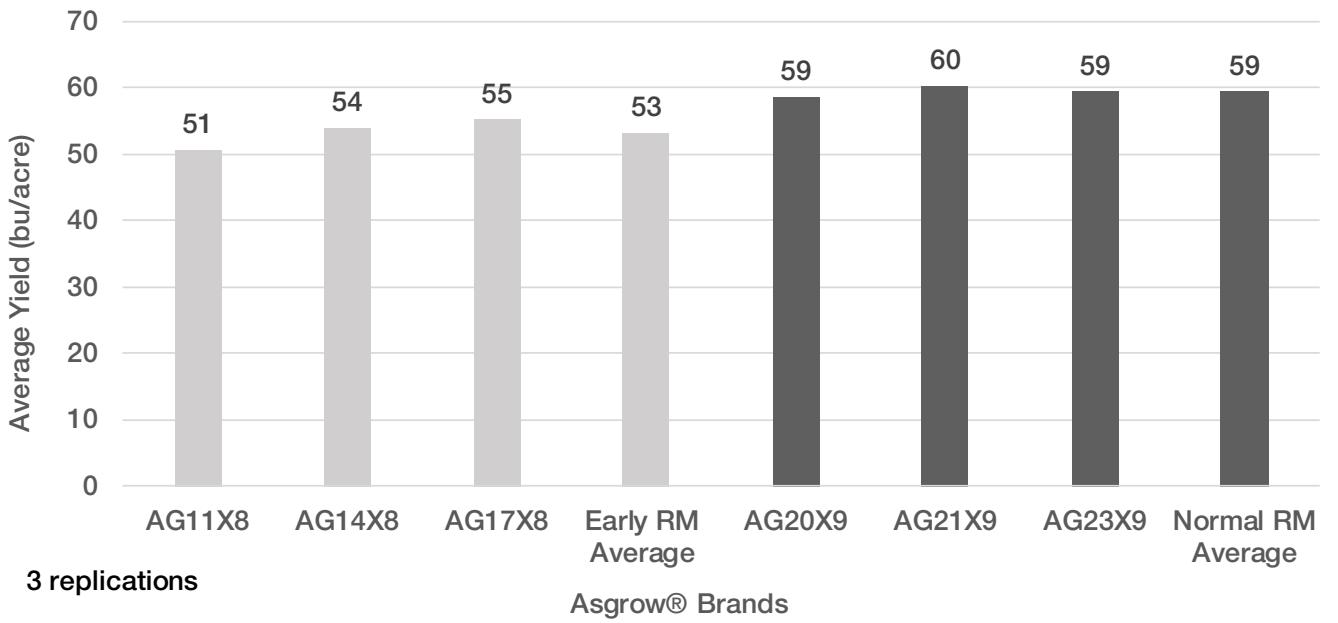

Figure 1. Relative maturity effects on the yield performance of six Asgrow® brand soybean products at the North locations (Storm Lake, Marble Rock, and Huxley, Iowa) in 2019.

Yield Observations When Shifting to Earlier Relative Maturity Soybean Products

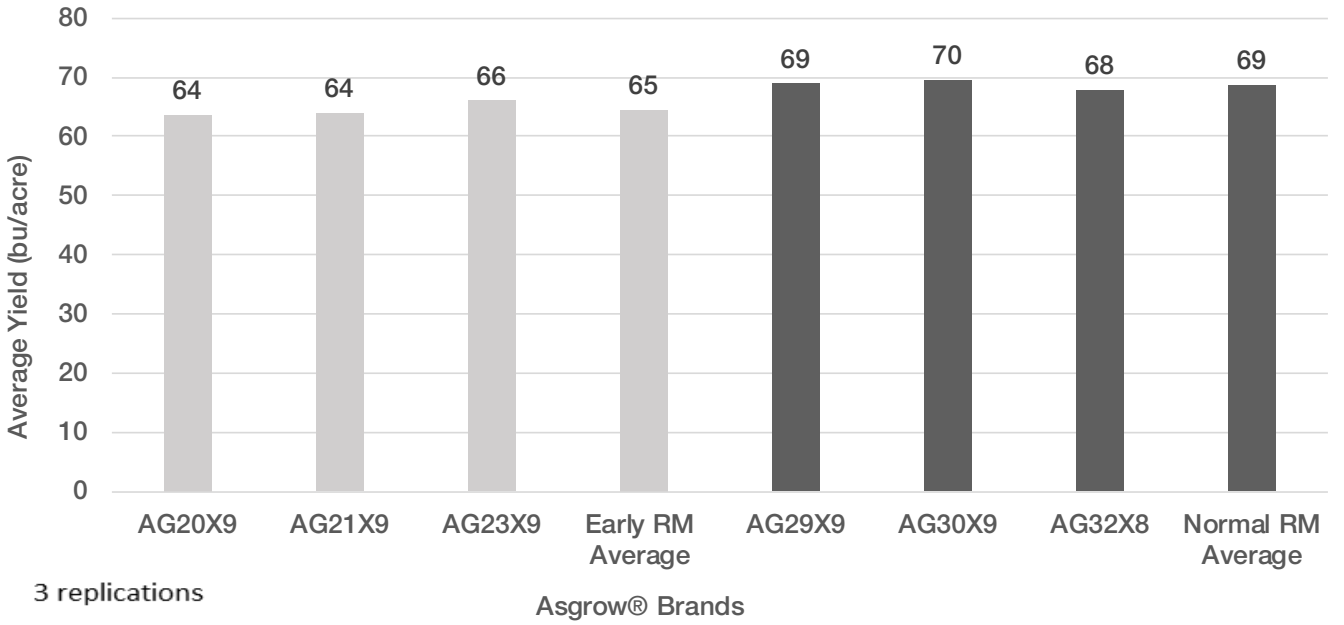

Figure 2. Relative maturity effects on the yield performance of six Asgrow® brand soybean products at the South locations (Huxley, Atlantic, and Victor, Iowa) in 2019.

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.

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

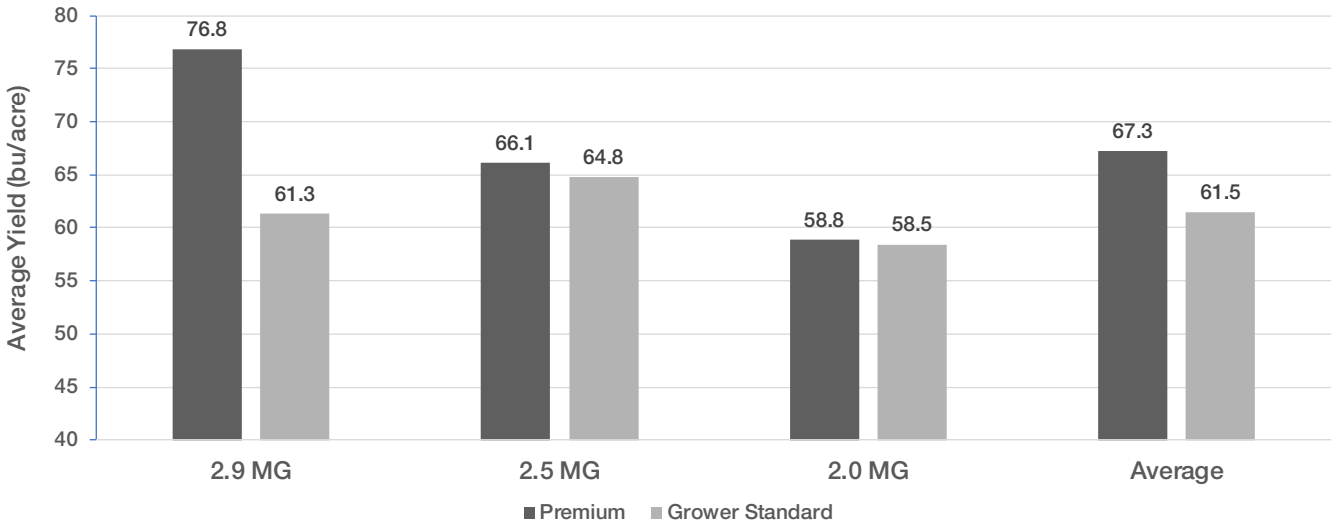

Figure 1. Yield response of three soybean varieties to two different production systems. Average represents the average yield of the three varieties for the production system.

- 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

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.

Effects of Tillage Systems in Corn and Soybean Production

Understanding the Results

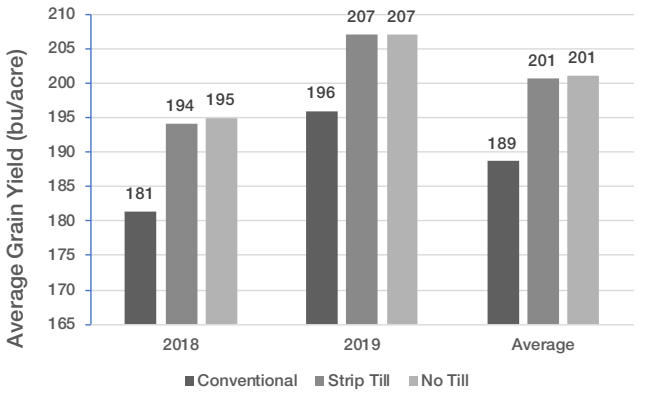

Figure 1. Corn yield response to three tillage systems over a two-year period in central Iowa.

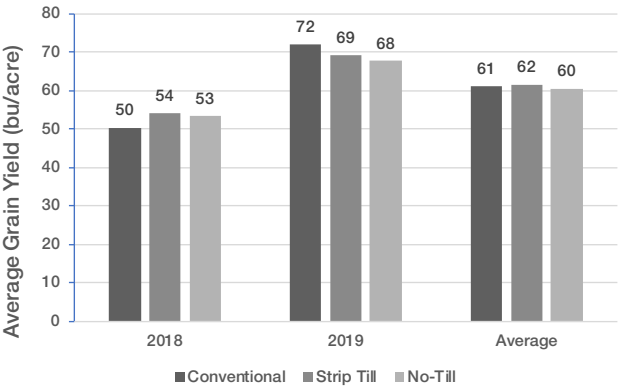

Figure 2. Soybean yield response to three tillage systems over a two-year period in central Iowa.

- 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.