2020 Field Research Report

Featuring 2019 Research and Results

Table of Contents

How Reports are Organized

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

Reports are grouped by geographic regions so you can view research specific to your general area.

Central Plains

Midwest

Illinois

National

In these truly unprecedented times, we would like to thank you for the critical role you play in agriculture. Times like these remind all of us of the important role we all play in working to ensure our food supply and that we cannot take that for granted. It is through the dedication, hard work, and commitment of farmers and ag value chain that this is possible and we thank you for all you do.

COVID aside, the 2020 season has proven once again to be a challenging one. It started early but then was delayed as cold and wet weather blanked much of the United States. These unpredictable situations do create opportunities for us in the research space to develop some unique and valuable insights. This edition of the Field Research Book contains results from research reports conducted by over 250 Market Development field researches.

Market Development is committed to helping our farmer customers better understand the Bayer product portfolio and how we use it to optimize performance on their farms. We recognize that each farm is unique, and that each farmer has different goals and management practices. That is why our field research is conducted across a wide range of environments with precision equipment under growing conditions to understand how our products and systems will perform at a local level for you on your farm.

Our integrated focus on seed genetics, weed management, insect control, disease management, seed protection and digital analytics combines modern science from Bayer with farmers' ingenuity to sustainably manage resources, improve productivity and increase farm profitability.

We hope you will find this research summary a valuable resource as you plan and prepare for the 2021 cropping season. We thank you again for all you do to support agriculture.

John Chambers
North America Regional Market Development Lead

Climate FieldView™ Platform: Impact of Delaro® 325 SC Fungicide on Corn Products

Trial Objective

- The objective of this study was to determine the impact of corn product and fungicide on corn yield when utilizing Climate FieldView™ digital technology.
- The study was conducted on a local farmer's irrigated pivot near Hershey, NE. This farmer had little to no experience with using Climate FieldView™ or a fungicide application on corn at the VT growth stage.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Hershey, NE	Sandy loam, Hord silt loam	Corn	Strip tillage	5/10/19	11/6/19	280	32K

- The trial was conducted on an irrigated pivot that was split in half with the same five corn products (a 105, 106, 108, 110, and 114 RM product) planted on each half.
- On half of the pivot, 11 fl oz/acre of Delaro® 325 SC fungicide was applied at VT growth stage (July 31) while the other half did not receive a fungicide application. Disease pressure was low with no diseases above an economic threshold level.
- Herbicide applications and fertility were constant throughout the field.
- Row spacing was 30 inches.
- Fieldview™ was utilized throughout the growing season to monitor crop health (Figure 1 and 2).

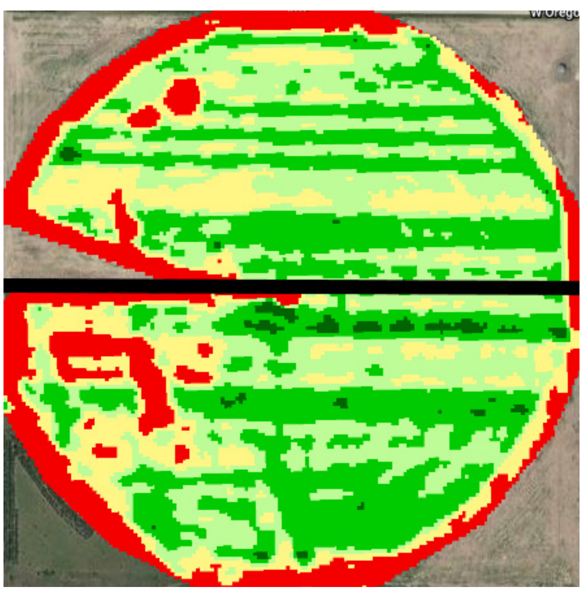

Figure 1. Climate Aerial field health image taken Aug 4 (bottom half received fungicide).

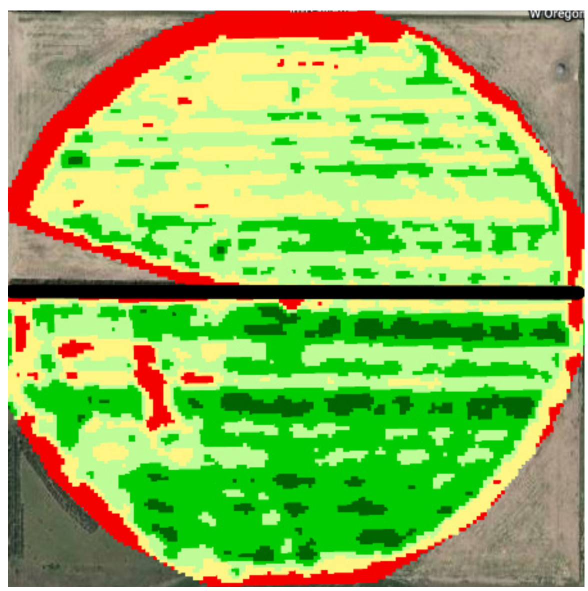

Figure 2. Climate Aerial field health image taken Aug 29.

Climate FieldView™ Platform: Impact of Delaro® 325 SC Fungicide on Corn Products

Understanding the Results

- Each of the five corn products responded positively to the fungicide application with all products yielding between 230 to 250 bu/acre (Table 1).

Table 1. Average yield and response to fungicide for all corn products.

Corn Product	Average Yield with Fungicide (bu/acre)	Average Yield without Fungicide (bu/acre)	Average Yield Response to Fungicide (bu/acre)	Grain Moisture with Fungicide	Grain Moisture without Fungicide
105RM	247	244	+3	14.9%	14.9%
106RM	245	242	+3	15.9%	15.9%
108RM	250	243	+7	16.0%	16.1%
110RM	245	237	+8	16.2%	16.3%
114RM	246	243	+3	17.8%	17.7%

Key Learnings

- The plots with the fungicide application had higher yields for all corn products even in a low disease pressure environment.
- FieldView™ allowed for an easier tracking of field health over the growing season and comparison of different corn management inputs at harvest.
- At harvest, grain moisture was 17.8% in the 114 RM product while grain moisture in the 105 RM product was 14.9% (Table 1).
- No change in grain moisture was seen with the fungicide application (Table 1).
- The plots with the fungicide application not only had increased yield, but the farmer visually saw a substantial improvement with stalk standability and less ear drop with the Delaro® 325 SC fungicide application. The improved corn growth with a fungicide can be seen in the FieldView imagery taken on August 29 (Figure 2).
- As a first-time user of FieldView, the farmer expressed a positive experience with being able to track corn product health over the growing season and measuring the impact of fungicide and corn product at harvest. The grower has reviewed his Climate FieldView subscription for the 2020 season.

Legal Statements

ENVIRONMENT

Corn Silage Response to Seeding Rate

Trial Objective

- Corn silage is a popular forage for ruminant animals because it is high in energy and digestibility. Maximizing tonnage is a key factor when farmers grow corn for silage.
- Using higher corn populations for silage may help manage phosphorus (P) in heavily manured areas.
- The objective of this study was to determine the effect of seeding rate on irrigated corn silage yield and P uptake.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Gothenburg, NE	Hord silt loam	Grain sorghum	Strip tillage	6/16/19	10/11/19	250	24K, 28K, 32K, 36K, 40K, 44K, 48K

- The study was set up as a randomized complete block with three replications.
- A 108-day relative maturity corn product was planted in 30-inch row spacing at 24,000, 28,000, 32,000, 36,000, 40,000, 44,000, and 48,000 seeds/acre.
- Corn was sprinkler irrigated and weeds were controlled as needed. No fungicides or insecticides were applied.
- Silage was hand-harvested one inch above the soil surface to provide a representative sample (Figures 1 and 2) and chopped with a silage chopper.
- Total biomass was collected and weighed, a subsample was dried, and dry matter weight was calculated for each seeding rate.
- Pounds of total P removed was then calculated.

Figure 1. 108RM corn product before silage cutting.

Figure 2. 108RM corn product after silage cutting.

Corn Silage Response to Seeding Rate

Understanding the Results

- Average silage dry matter yield increased significantly with increased seeding rates (Figure 3) with the highest tonnage recorded with the 48,000 seeds/acre population.
- Increased seeding rates also increased the lb/acre of P removed with the lowest amount recorded with the lowest population of 24,000 seeds/acre (Figure 4).

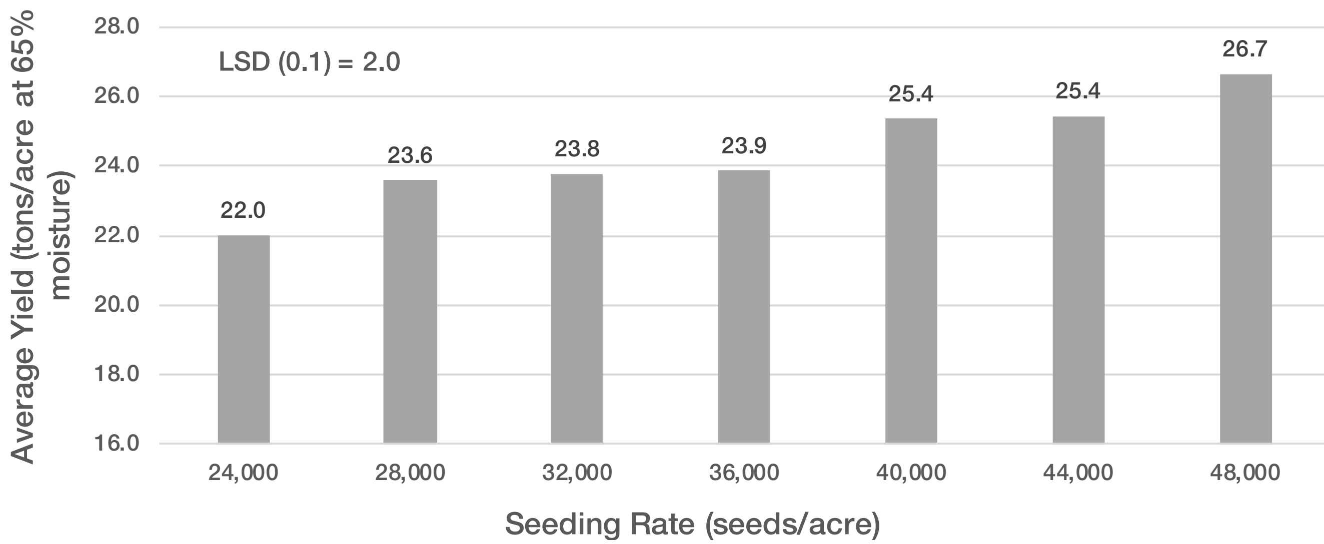

Figure 3. Average silage yield by seeding rate (tons/acre at 65% moisture).

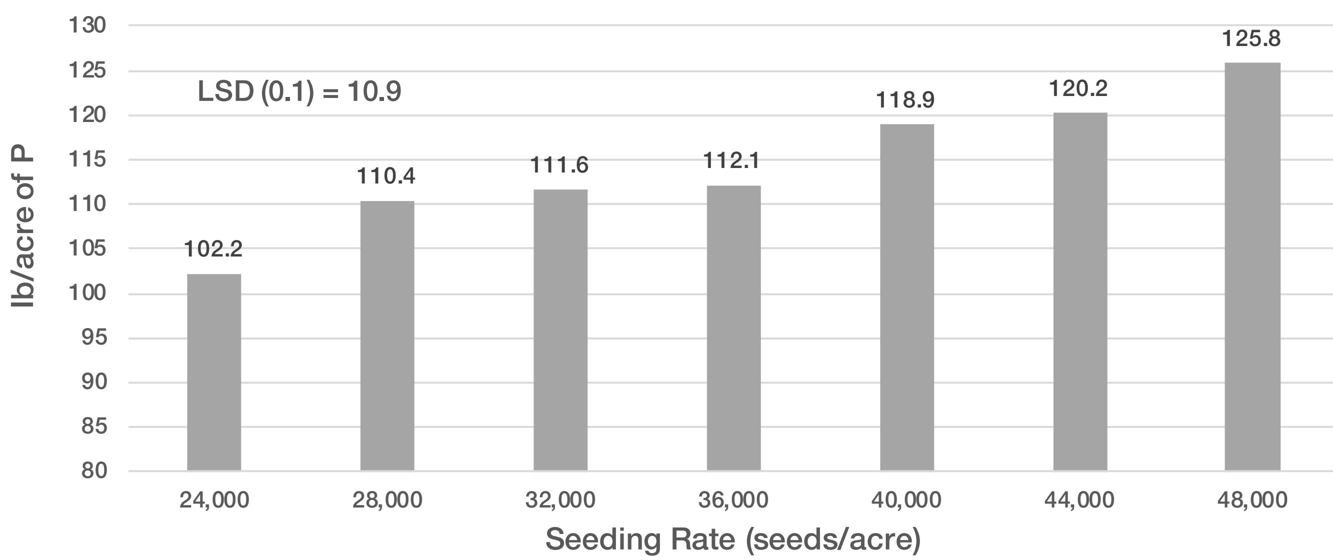

Figure 4. Phosphorus uptake by seeding rate.

Corn Silage Response to Seeding Rate

Key Learnings

- Using higher corn populations can be beneficial for increasing tonnage as well as removing P from the soil.
- Producers can utilize high corn silage populations to increase P removal and help manage soil P levels on fields where manure is applied.
- Monitoring crop P concentrations is essential for balancing feed rations and accurately estimating crop P removal, estimates that are in turn necessary for optimizing manure management and avoiding or mitigating soil P enrichment for protection of water resources. Increasing the amount of P removal in harvested crops can help slow the rate at which soil test P increases and help reduce the soil P over time.

Legal Statements

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ENVIRONMENT

Corn Product Silage Quality and Tonnage

Trial Objective

- Corn silage is an important feedstock for cattle producers across the Great Plains.
- Desirable corn products should produce high tonnage with favorable silage quality characteristics.
- In this study, the objective was to provide insights to farmers on which of the 22 corn products evaluated have high tonnage and good silage quality characteristics.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Gothenburg, NE	Hord silt loam	Grain sorghum	Strip	5/23/19	10/1/19	250	36K

- The study was set up as a randomized complete block with three replications.
- Twenty-two corn products were evaluated.
- Corn was sprinkler irrigated and weeds were controlled as needed. No fungicide or insecticide was applied.
- Silage quality was sampled for each corn product at ½ milk line. Sampling dates varied by relative maturity, but all sampling occurred in the last two weeks of September.
- Corn products were hand-harvested about four inches above the soil surface to provide a representative sample and were then chopped with a silage chopper.
- A subsample of the freshly-chopped material was collected and sent to Dairyland Laboratories Inc. for silage quality analysis.
- Total biomass was collected, weighed, and tonnage was determined for each corn product.

Understanding the Results

- Corn products did vary in silage quality and tonnage as there were significant differences in all parameters tested as reported in Table 1.

Figure 1. Short- and long-season corn products at harvest.

Corn Product Silage Quality and Tonnage

Key Learnings

- Producers should work with their local seed sales team to identify how their branded corn products performed in this study.

Table 1. Silage quality analysis metrics, performed by Dairyland Laboratories Inc.

Product	Wet t/a 65%	Dry t/a	% DM	% Starch	% NDF	NDFD 24	NDFD 48	uNDF 24	uNDF 240	IVSD 7hr	% ADF	% CP	TFA	Sugar	%TDN	Lignin % DM	NEL	NEG	2006 milk/ton
105RM	22.6	7.8	33.8	29.9	43.3	47.7	57.1	21.9	14.3	68.5	26.3	8	1.9	5.7	69	4	0.68	0.45	3136.3
108RM	28.8	9.9	33.9	32.8	40.4	47.4	57.3	20.6	13.1	68.2	24.2	7.8	2.1	6.3	70.4	3.5	0.70	0.47	3249
109RM	29.3	10.1	33.8	35.3	37.2	50.6	60.8	17.7	10.9	67.5	22	8.1	2.4	6.3	73.9	3	0.73	0.51	3498
110RM-B	29.7	10	32.4	25.9	44.9	50.3	59.3	21.7	13.6	69.4	26.9	8.4	1.6	6	68.4	3.8	0.67	0.44	3067
116RM-A	30.5	10.9	36.4	32.1	41.8	45.6	55.3	21.9	14	68.3	25.4	8.2	1.8	5.3	68.4	3.9	0.68	0.45	3101.7
120RM-A	29.9	11.1	31.5	25.9	43	45.5	55.4	22.6	14.2	67.9	26.7	8.9	1.6	6.8	66.4	3.9	0.65	0.42	2946
120RM-B	33.3	10	27.9	18.6	52.9	47.1	55.2	27.2	17.8	73	32.2	7.6	1.2	6.9	62.7	4.8	0.61	0.37	2671.7
97RM	24.3	8.4	34.3	33.3	40.3	44.9	55	21.3	14	67.9	24.1	8.2	2	6.2	70	3.8	0.70	0.47	3226
98RM	27.3	9.9	37.7	34.7	38.9	47.6	57.7	19.6	12.8	66.9	23.2	8.2	2.1	5.9	70.9	3.5	0.70	0.49	3280.7
110RM-B	30.2	9.9	30.7	26.9	44.2	49.2	58.4	21.6	14	69.1	26.6	8.5	1.8	6.4	68.6	3.9	0.67	0.45	3093.3
120RM-C	28.8	10.1	28.7	25	46.5	43.9	53.1	25.2	16.4	70.9	28.9	8	1.6	6.6	64.7	4.4	0.64	0.39	2840.3
117RM	30.7	11.1	38.1	36.6	36.6	45.2	55.9	19.4	12.5	66.7	21.4	8.3	2.3	6.5	71.4	3.4	0.71	0.50	3338.7
119RM	33.1	11.4	33.4	31.9	40.2	47	56.9	20.6	13	68.6	24.5	8.2	1.9	5.7	69.8	3.6	0.69	0.46	3205
114RM	31.4	11	35.2	28.2	40.3	50.6	60.1	19.1	12.3	66.8	23.7	9.8	1.8	6	70	3.6	0.68	0.47	3192
115RM	30.3	10.6	36.7	31.5	42	47.1	56.7	21.6	13.6	67.5	25.3	7.8	2	5.7	69.4	3.8	0.69	0.46	3177.3
116RM-B	30.3	10.7	36.1	35.3	37.9	46.2	56.5	19.7	12.8	67.3	22.6	8.1	2.3	6.2	71.4	3.4	0.71	0.48	3333.3
111RM	30.1	10.5	38.8	36.8	35.4	47.7	58.6	17.8	11.4	65.8	20.9	8.8	2.3	5.4	72	3.3	0.71	0.51	3360.7
114RM	33.9	11.8	35.4	32.9	39.5	46.8	56.9	20.2	12.8	68.4	23.5	8.4	1.9	5.7	70.2	3.6	0.69	0.47	3230.7
114RM COMP	33.2	10.9	33	32.1	36.7	57.4	67.8	15	8.8	66.6	21.3	8.7	2	6.9	75.3	2.4	0.73	0.53	3554.7
109RM COMP	23.9	8.2	34.4	38	35	52.3	63.3	15.7	9.4	65.9	20.2	8.3	2.2	6.2	75.4	2.6	0.74	0.54	3592.7
118RM COMP	32.4	11.6	38.1	39	34.5	46.9	58	17.7	10.9	66.9	20	8.6	2.4	5.8	73.2	3.1	0.73	0.52	3463.3
111RM COMP	29.0	10.4	36.9	39.8	34.7	49.6	60.3	16.9	10.5	68.3	20.1	8.3	2.3	5.5	74.5	3.1	0.74	0.53	3554
LSD P=.10	4	1.38	3.18	7.98	6.71	4.6	3.61	2.81	1.88	1.92	4.47	0.84	0.48	0.93	3.23	0.48	0.04	0.05	258.04

Wet t/a 65% – wet tonnage; Dry t/a – dry tonnage; DM – Dry Mater; NDF – Neutral Detergent Fiber; NDFD - incremented measurement of NDF; uNDF - undigested NDF residue; IVSD 7hr - in vitro starch digestibility after 7 hrs; ADF – Acid Detergent Fiber; CP – Crude Protein; TFA – Total Fat; TDN – Total Digestible Nutrients; NEL – Net Energy for Lactation; NEG – Net Energy for Gain

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ENVIRONMENT

Corn Relative Maturities and Response to Delayed Planting

Trial Objective

- A better understanding is needed regarding the response of individual corn products to late planting relative to their number of growing degree units (GDUs) required to reach silking and black layer.
- University publications have indicated that planting late can reduce the number of GDUs required for a corn product to reach black layer.
- This could lead to the ability to plant later relative maturity (RM) corn products than anticipated in a late-planting scenario using standard GDU accumulation estimates.
- This trial measured product performance and grain quality in a late-planted scenario to determine which RM would be the best choice for planting in mid-June.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Gothenburg, NE	Cozad silt loam	Soybean	Strip tillage	6/17/19	10/26/19 11/12/19 11/18/19	230	34K

- The study design was a randomized complete block with three replications of 7 treatments (7 corn products of differing RMs).
- Plot size measured 130 ft long x 10 ft wide with the center 2 rows harvested for data.
- Seven corn products with a wide range of maturities were chosen for the trial.
- Weeds were uniformly controlled with herbicides.
- Fungicides and insecticides were not used in the trial beyond the seed treatment package.
- During the growing season, pollination and black layer (if achieved) dates were recorded for each product.

Table 1. Corn relative maturity and GDU accumulation from planting to mid-pollination and black layer.

Relative Maturity (days)	GDUs to Mid Pollination	GDUs to Black Layer
76	1045	1900
86	1125	2140
96	1246	2400
101	1242	2535
106	1326	2650
111	1365	2775
116	1387	2910

Corn Relative Maturities and Response to Delayed Planting

Understanding the Results

- GDU accumulation for corn planted June 17 was near normal during June, July, and August; above average in September, and finished the growing season about 140 GDUs above normal.
- The trial growing season ended on October 10 with a hard freeze, which was three days ahead of the 30-year normal freeze date of October 13.
- Actual GDUs required to reach mid-pollination ranged from 54 to 95 less than projected, indicating that the crop was on track to finish earlier than the GDU requirements indicated (Table 2).

Table 2. Predicted and actual mid-pollination GDUs and dates.

Relative Maturity (days)	Predicted GDUs to Mid-Pollination	Actual GDUs to Mid-Pollination	GDU Difference	Predicted Mid-Pollination Date	Actual Mid-Pollination Date	Days Early
76	1045	950	-95	8/2/19	7/29/19	4
86	1125	1071	-54	8/5/19	8/3/19	2
96	1246	1152	-94	8/11/19	8/7/19	4
101	1242	1171	-71	8/11/19	8/8/19	3
106	1326	1256	-70	8/14/19	8/12/19	2
111	1365	1280	-85	8/16/19	8/13/19	3
116	1387	1325	-62	8/18/19	8/15/19	3

- Although the results are limited to three products, actual GDUs required to reach black layer ranged from 87 GDUs less to 213 GDUs more than expected to reach black layer (Table 3).

Table 3. Predicted and actual GDUs required to reach black layer.

Relative Maturity (days)	Predicted GDUs to Black Layer	Actual GDUs to Black Layer	Required GDU Difference	Predicted Black Layer Date	Actual Black Layer Date	Days Early or Late (-)
76	1900	2113	213	9/11/19	9/24/19	-13
86	2150	2212	62	9/25/19	9/29/19	-4
96	2400	2313	-87	10/28/19	10/10/19	18
101	2535	NA	NA	NP*	NA	NA
106	2650	NA	NA	NP*	NA	NA
111	2775	NA	NA	NP*	NA	NA
116	2910	NA	NA	NP*	NA	NA

*NP indicates that the corn was not predicted to reach black layer prior to the latest 30-year freeze date (November 5).

- The 76 RM product, positioned well out of its normal growing zone, required 13 calendar days longer to reach black layer.
- The 86 RM product, positioned closer to its normal growing zone in the Nebraska panhandle, required 4 calendar days longer than expected.
- The 96 RM product, positioned closer to its normal growing zone in the Nebraska panhandle, required 18 fewer calendar days than expected.
- A hard freeze occurred prior to the 101 RM and later RM products reaching black layer.

Corn Relative Maturities and Response to Delayed Planting

Table 4. Check dates of corn growth stage and the corresponding stage of each product.						
Relative Maturity (days)	8/29/19 Check	9/6/19 Check	9/17/19 Check	9/23/19 Check	10/2/19 Check	10/9/19 Check**
76	Early Dent	25% ML*	75% ML	95% ML	Mature	Mature
86	Dough	Early Dent	33% ML	66% ML	Mature	Mature
96	Late Milk	Dough	10% ML	33% ML	66% ML	95% ML
101	Milk	Dough	Full Dent	25% ML	50% ML	85% ML
106	Milk	Early Dough	Full Dent	25% ML	40% ML	75% ML
111	Early Milk	Milk	Early Dent	Full Dent	25% ML	50% ML
116	Blister	Milk	Hard Dough	Dent	15% ML	33% ML
GDU To Date	1627	1795	2023	2109	2257	2297
*ML = Milk line; **Maturation point at the time growth stopped by the hard freeze.						

- Because the freeze killed the plants early, yields and kernel quality were negatively impacted for the later RM products. It's estimated that corn that freezes at 50% milk line (ML) loses 12% of yield potential with yield losses increasing if the corn freezes at earlier growth stages (Table 4).[1]
- Effect on Yield (Figure 1):
  - Grain yield generally improved until the product RM reached 106 days and then became more variable.
  - Even though the 101 and 106 RM products were not mature on the freeze date they still provided more yield than the earlier RM products.
  - The 111 and 116 RM products froze at earlier growth stages, causing the products to be lower yielding.
- Effect on Moisture Content at Harvest (Figure 2):
  - The moisture content at harvest was influenced by the RM of each product with the earlier products ready to harvest sooner after the corn froze.
  - Harvest dates were 10/26/19 for the 76 and 86 RM products, 11/12/19 for the 96 to 106 RM products, and 11/18/19 for the 111 and 116 RM products.
  - The 76 to 106 RM products reached acceptable moisture content by their harvest date.
  - The 111 and 116 RM products would require additional drying prior to storage even with a later harvest date.

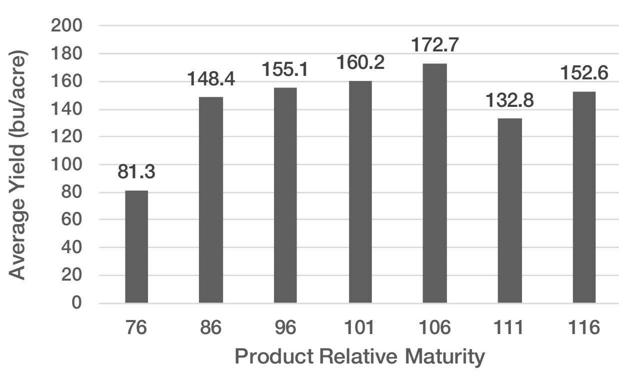

Figure 1. Grain yield at harvest of the 7 corn products used in the trial.

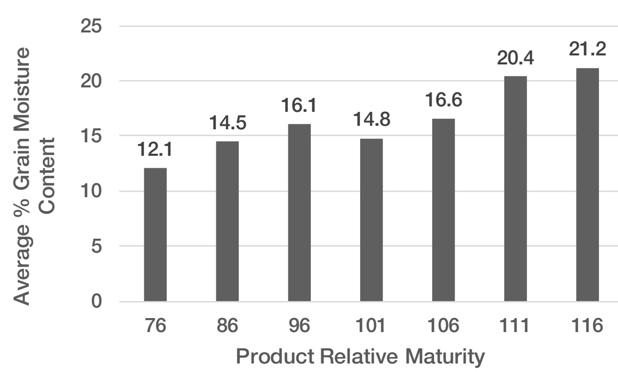

Figure 2. Average grain moisture content at harvest for the corn products. Harvest dates varied depending on when the moisture content of each product reached a harvestable state.

Corn Relative Maturities and Response to Delayed Planting

- Effect on Test Weight (Figure 3):
  - Test weight was acceptable for all products after drying except for the 111 and 116 RM entries that froze at 50 and 33% milk line, respectively.
  - No marketing challenges would be expected because of test weight in the 106 RM and lower RM products in this study.
  - The test weight visual inspection of the samples indicates that the grain from the 76 to 106 RM products (Figures 4 to 8) has adequate quality to grade as U.S. No. 1 yellow corn based on test weight.[2]
  - The 111 RM and 116 RM products (Figures 9 and 10, respectively) would pose marketing challenges because the test weight and likely total damage would cause the grain to fall into the U.S. No. 4 yellow corn grade or lower.[2]

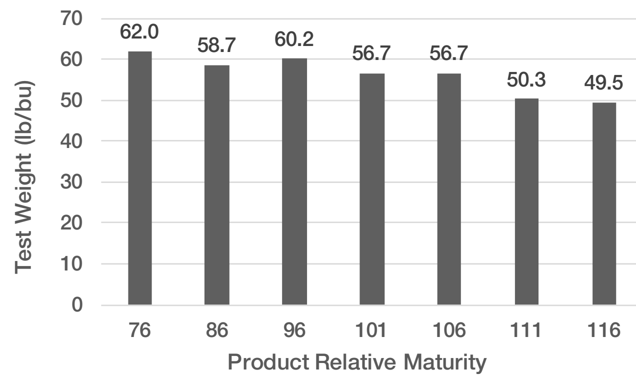

Figure 3. Test weight after grain samples were dried at room temperature to around 12% moisture.

Key Learnings

- The environment during the growing season plays an important role in the actual response of a corn product to mid-pollination and black layer formation.
- Late-planted corn appears to require less than expected GDUs to reach mid-pollination.
- Due to the limited number of corn products able to reach black layer, it's difficult to determine the effect of GDU requirement to reach black layer in central Nebraska. However, it did not appear that one can always expect black layer will be reached with fewer GDUs when planting late.
- Yield, harvest date, grain moisture content, and grain quality were all impacted by the product RM at the late planting date; however, a failure to reach black layer did not necessarily make the RM a poor choice.
- The 106 RM product provided the highest yields and acceptable grain quality in this trial, even though it did not reach black layer prior to the end of the growing season.
- It is important to remember that these results occurred with slightly above average GDU accumulation with a planting date of June 17 and a near normal frost date. Changes in GDU accumulation and a change in the frost date could dramatically change the outcome of these results.

Sources

[1]Frost. 2014. Corn agronomy. Where science meets the field. http://corn.agronomy.wisc.edu/.

[2]U.S. Standards. Subpart D—United States standards for corn. 1996. United States Department of Agriculture Grain Inspection, Packers and Stockyards Administration Federal Grain Inspection Service. https://www.gipsa.usda.gov/.

Legal Statements

Corn Relative Maturities and Response to Delayed Planting

Figure 4. The 76 RM product displaying excellent grain quality.

Figure 5. The 86 RM product displaying excellent grain quality. The red coloration of some kernels appears to be a product characteristic.

Figure 6. The 96 RM product displaying excellent grain quality.

Figure 7. The 101 RM product displaying good quality. Tip shrinkage has occurred because kernels were frozen before maturity.

Figure 8. The 106 RM product displaying good quality. Tip shrinkage has occurred because kernels were frozen before maturity.

Figure 9. The 111 RM product displaying poor quality. Shrinkage and kernel molds are prevalent, which are likely to result in quality discounts when sold.

Figure 10. The 116 RM product displaying poor quality. Shrinkage and kernel molds are prevalent, which are likely to result in quality discounts when sold.

ENVIRONMENT

White Corn Product Development

Background information on white corn

- **Agronomics** – Desired agronomic performance requirements for white corn are the same as those for yellow corn with yield potential being primary. Other important agronomic characteristics include high ratings for standability, disease tolerance, greensnap resistance, harvestability, and ear protection. Ample husk coverage can help protect food grade grain (ears) from insect and/or environmental damage. Data from yield trials across locations and years are collected to determine product performance under differing environmental conditions. Products with the highest yields and the best agronomics and stability are selected to advance within the developmental pipeline until a new product is identified.
- **Grain quality** – Several grain attributes including grain hardness, kernel size, shape, and color are measured to help determine acceptable food grade grain quality.
  - Test weight is a function of kernel hardness and size. The harder the kernel or the smaller the kernel the higher the test weight. Since food grade corn processors have a desired kernel size it is important to measure more than just the test weight to determine kernel hardness. Kernel hardness is also a factor of the crown size (starch cap), deepness of dent, and the amount of horneous endosperm. There are two types of endosperm within a corn kernel – horneous and floury (Figure 1). The ratio of these two endosperm types determines kernel hardness. A greater percentage of horneous endosperm results in harder grain, which is favorable compared to a higher percentage of floury endosperm, which causes a softer grain.
  - Kernel shape can help reduce mechanical damage to the kernels as they pass through the combine and other harvest/storage equipment. Kernels with rounded crown corners have less potential for damage.
  - A good white kernel color is desired. However, the development of white corn products with good color is more difficult than with yellow corn products. There are several modifying genes associated with color that cause varying degrees of lemony color in white corn as seen in Figure 2.

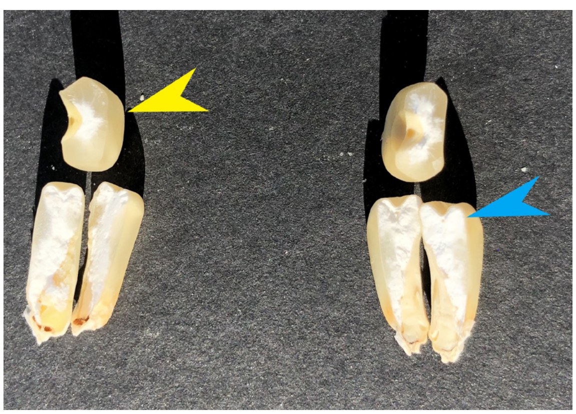

Figure 1. The yellow arrow depicts a kernel with a higher percentage of favorable horneous endosperm compared to the kernel depicted by the blue arrow that has a higher percentage of floury endosperm.

Figure 2. White corn kernels with varying degrees of lemony coloration.

White Corn Product Development

- **Processor approval** - Each food corn processor has acceptance criteria governed by the end use of the consumer product being produced. A grain sample of each newly developed and identified white corn product is given to the processor for evaluation within their system. Once the new white corn product passes their criteria requirements, it can become an approved white corn product for commercial production.
- This study was conducted to determine the performance of three commercially released white corn products compared to one (2018) and three (2019) experimental white corn products.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Gothenburg, NE	Hord silt loam	Soybean	Strip tillage	5/5/18, 5/15/19	11/19/18, 11/12/19	260	34K

- Six white corn products were evaluated in 2019; four of them were also evaluated in 2018.
- The studies in each year were a randomized complete block with three replications.
- Weeds were controlled uniformly across the study and no insecticide was applied in-crop.
- Corn was fully irrigated to meet the water needs of the crop in each year.

Table 1. Average yield (bu/acre) and test weight (lb/bu) of three commercially available white corn products and one experimental white corn product in 2018 and 2019 at the Bayer Learning Center at Gothenburg, Nebraska.

Commercial and Experimental White Corn Products by Relative Maturity (RM)	Year	Average Yield (bu/acre)	Average Test Weight (lb/bu)
112 RM Commercial Product	2019	264	62
	2018	279	59
Average		272	60
113 RM Commercial Product	2019	235	64
	2018	279	59
Average		257	62
116 RM Commercial Product	2019	243	65
	2018	284	59
Average		264	62
Experimental (111 RM)	2019	240	65
	2018	278	60
Average		259	63
Overall Averages		263	62

White Corn Product Development

Table 2. Average yield (bu/acre), moisture content (%), and test weight (lb/bu) of six white corn products in 2019 at the Bayer Learning Center at Gothenburg, Nebraska.			
Commercial and Experimental White Corn Products by Relative Maturity (RM)	Average Yield (bu/acre)	Average Harvest Moisture Content (%)	Average Test Weight (lb/bu)
Experimental (110 RM)	270	16.6	64
112 RM Commercial Product	264	17.2	62
Experimental (112 RM)	254	16.8	65
116 RM Commercial Product	243	17.6	65
Experimental (111 RM)	240	17.9	65
113 RM Commercial Product	235	17.8	64
Averages	251	17.3	64

Understanding the Results

- Realized average yields of the white corn products tested were very good in 2019 and 2018 (Table 1).
- 112 RM Commercial Product had the highest two-year average yield (second highest in 2019) but had the lowest average test weight in both years (Table 1).
- For the 2019 season, Experimental C had the highest average yield and the lowest average harvest moisture content along with a very good average test weight (Table 2).
- The average test weights ranged from 62 to 65 lb/bu among the entries. These values are very good for food grade corn (Tables 1 and 2).

Key Learnings

- The white corn products tested in this study had very good yield potential.
- White corn is an important product for food grade corn farmers in the area.
- Check with your sales team member to determine the best white corn product for your farm.

Legal Statements

ENVIRONMENT

Dryland Corn Yield Response to Increased Management

Trial Objective

- While farmers focus intensive management efforts on irrigated corn production, dryland corn is often managed much less intensively.
- This trial was conducted to see how dryland corn at different seeding rates responded to more intensive management, including additional sidedress nitrogen applied at the V8 growth stage and Delaro® 325 SC fungicide applied at R1.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Gothenburg, NE	Hord silt loam	Winter wheat	No-till	6/2/19	11/12/19	160	12K, 18K, 20K, 30K

- The study was set up as a split-split plot with fungicide as the whole plot, sidedress nitrogen as the sub-plot, and seeding rate as the sub-sub plot with each treatment replicated three times (Table 1).
- The plot size was relatively large, measuring 410 feet in length by 20 feet wide, with the entire trial size covering 10 acres.
- The sidedress nitrogen treatment of 60 lb N/acre was applied with 360® Y-DROPS sidedress as 32-0-0 on July 13, 2019 at the V8 growth stage.
- The Delaro® 325 SC fungicide treatment at 8 fl oz/acre was applied with a high clearance sprayer on August 9, 2019 at the R1 growth stage.
- Soil samples were taken and analyzed on April 16, 2019. The results measured 39 lb/acre of carryover N in the upper two feet of the soil profile.
- A 110 relative maturity DroughtGard® hybrids with VT Double PRO® technology corn product was used for the trial.
- The row spacing was 30 inches with plots 8 rows wide and the 6 center rows were harvested for yield.
- Nitrogen, phosphorus, and sulfur were broadcast over the trial area at rates of 90, 30, and 25 lb/acre, respectively, on April 23, 2019.
- Weeds were controlled as necessary and no additional fungicide or insecticide was applied.
- The weather was favorable for dryland corn with a good soil moisture profile at planting (3+ feet) and over 20 inches of rainfall during the growing season.
- There were a few challenges for corn during the season, including heavy rains increasing the potential for nitrogen leaching, good conditions for fungal disease development, a late dry period in September, and a hard-killing frost a few days earlier than normal.
- A hard freeze on October 10, 2019 ended the growing season when the corn was at ¾ milk line, so the grain was not quite at maturity.

Dryland Corn Yield Response to Increased Management

Table 1. Trial treatment combinations and the total nitrogen (N) in both applied and carryover forms.						
Treatment	Seeding Rate (seeds/acre)	Delaro® 325 SC Fungicide (fl oz/acre)	SIdedress N (lb/acre)	Spring Applied N (lb/acre)	Carryover N (lb/acre)	Total N (lb/acre)
1	12,000	8	0	90	39	129
2	18,000	8	0	90	39	129
3	24,000	8	0	90	39	129
4	30,000	8	0	90	39	129
5	12,000	8	60	90	39	189
6	18,000	8	60	90	39	189
7	24,000	8	60	90	39	189
8	30,000	8	60	90	39	189
9	12,000	0	0	90	39	129
10	18,000	0	0	90	39	129
11	24,000	0	0	90	39	129
12	30,000	0	0	90	39	129
13	12,000	0	60	90	39	189
14	18,000	0	60	90	39	189
15	24,000	0	60	90	39	189
16	30,000	0	60	90	39	189

Understanding the Results

- Yields increased with increasing inputs into this dryland corn system.
- Seeding rate had the largest impact on yield with yields increasing up to the 30,000 seeds/acre rate, which was the highest seeding rate tested (Figure 1).
- The average return per acre above the seeding rate also increased with higher seeding rates (Figure 1).
- The additional 60 lb/acre of sidedress nitrogen applied at the V8 growth stage increased yields over the standard spring applied nitrogen rate (Figure 4).
- With favorable weather conditions due to high rainfall, the additional nitrogen may have allowed more nitrogen to be available later in the growing season.
- Fertilizer and application costs totaled $34/acre and the corn return was $39/acre at a $3.50/bu corn price.
- Fungicide application at the R1 growth stage also significantly increased yield by about 8 bu/acre (Figure 5).
- The typical cost of Delaro® 325 SC fungicide and application was approximately $22.00/acre in 2019 and the added yield netted $26.95/acre at a corn price of $3.50/bu (Table 2).

Dryland Corn Yield Response to Increased Management

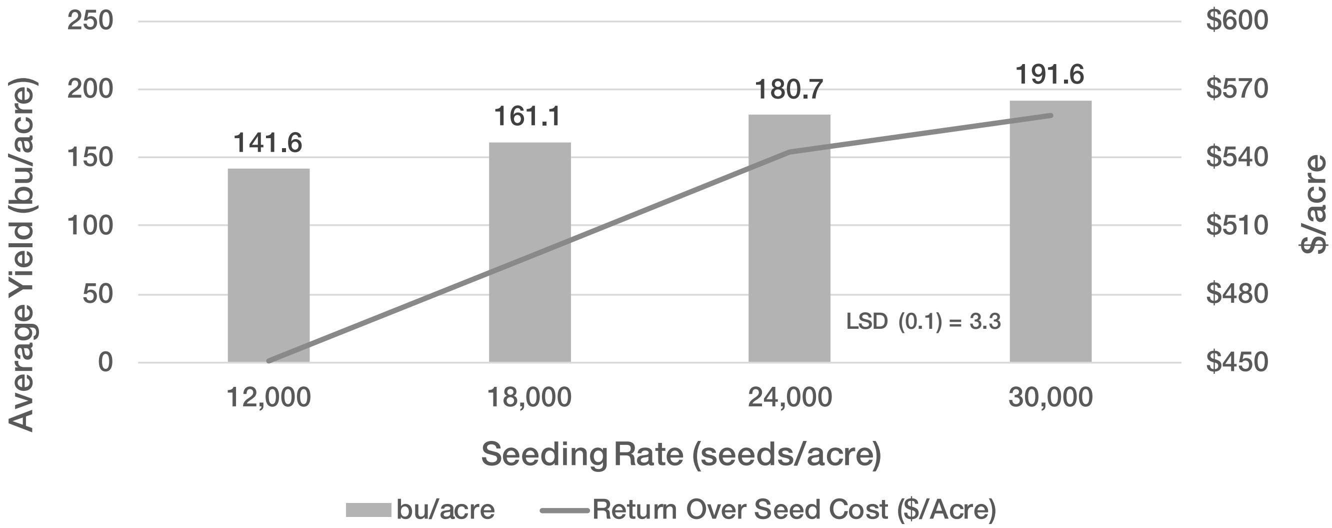

Figure 1. Corn yield and return ($/acre) over seed cost at four seeding rates.

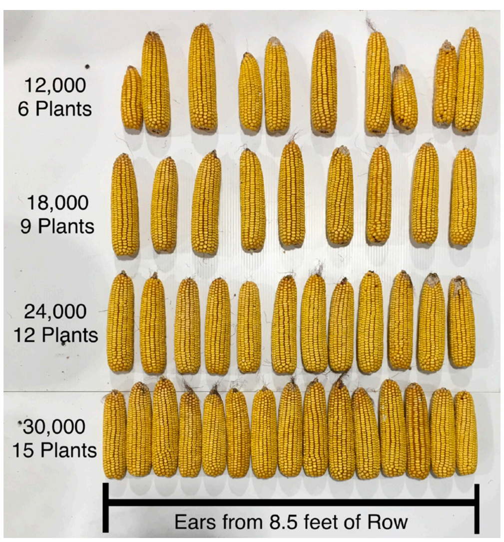

Figure 2. These ears were pulled from 8.5 feet of row showing multiple ears at the lowest seeding rate (12,000 seeds/acre), but more ears overall at the higher seeding rates. The smaller ears at the lowest seeding rate are the second ear on the main stalk or the tiller ear.

Figure 3. Two plants in the 12,000 seeds/acre seeding rate displaying tiller ears and two ears on the main stalk. This is a way that corn adapts to low populations, but the yield was still lower than that at higher seeding rates.

Dryland Corn Yield Response to Increased Management

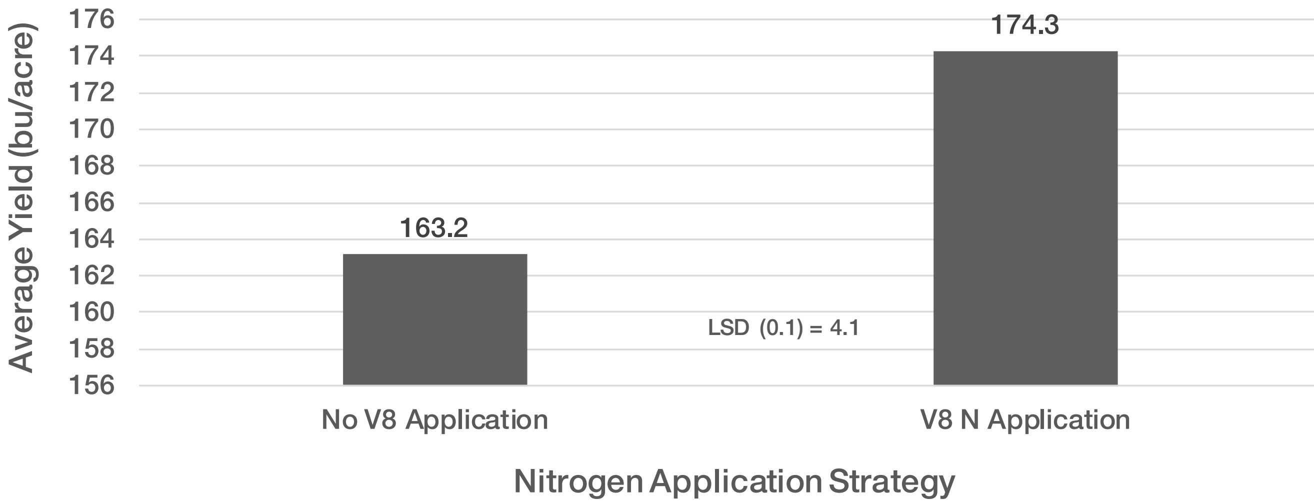

Figure 4. Yield response to additional sidedress nitrogen applied at the V8 growth stage.

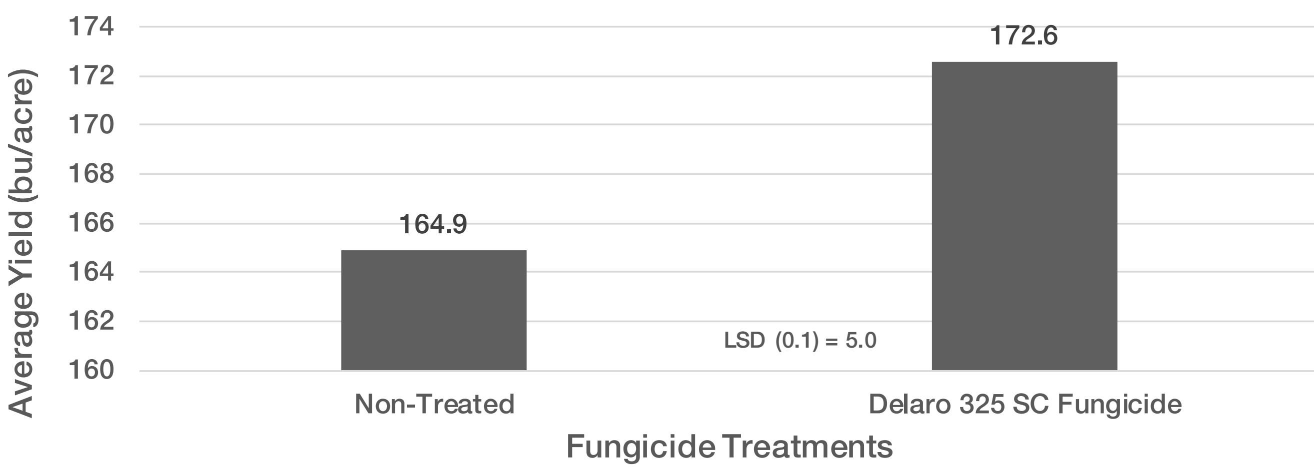

Figure 5. Corn yield with and without an application of Delaro® 325 SC fungicide at the R1 growth stage.

Dryland Corn Yield Response to Increased Management

Table 2. Average yield and net profit rankings of all treatments.							
Treatment	Seeding Rate (seeds/acre)	Delaro® 325 SC Fungicide (fl oz/acre)	SIdedress N (lb/acre)	Average Yield (bu/acre)	Yield Rank	Net Profit ($/acre)	Net Profit Rank
1	12,000	8	0	141.7	14	$428.95	14
2	18,000	8	0	161.5	11	$475.75	9
3	24,000	8	0	178.6	6	$513.10	6
4	30,000	8	0	188.9	4	$526.65	3
5	12,000	8	60	149.3	13	$421.55	15
6	18,000	8	60	166.5	9	$459.25	12
7	24,000	8	60	191	3	$522.50	4
8	30,000	8	60	203.4	1	$543.40	2
9	12,000	0	0	136.2	16	$431.70	13
10	18,000	0	0	152.5	12	$466.25	11
11	24,000	0	0	169.6	8	$503.60	8
12	30,000	0	0	176.9	7	$506.65	7
13	12,000	0	60	139.3	15	$408.55	16
14	18,000	0	60	164	10	$472.50	10
15	24,000	0	60	183.5	5	$518.25	5
16	30,000	0	60	197.2	2	$543.70	1
Net profit is based on a corn price of $3.50/bu, an 8 fl oz/acre Delaro® 325 SC fungicide treatment cost of $15/acre, a fungicide application cost of $7.00/acre, an additional 60 lb N/acre as 32-0-0 at $27.00/acre, and a sidedress nitrogen-application cost of $7.00/acre.							

Key Learnings

- Yields were improved by intensively managing dryland corn under these test conditions.
- All the decisions about how to intensively manage dryland corn acres do not need to be made early in the season and some can be made later in response to the growing environment.
    - The decision on whether to increase the seeding rate should be based on stored soil moisture at planting and the outlook for precipitation in long-term forecasts.
    - Additional sidedress nitrogen can be made at the V8 growth stage and even beyond with specialized equipment. Growing conditions should be evaluated throughout the season to determine if yield potential may warrant an application.
    - Finally, at the R1 growth stage, growing conditions can be evaluated to see if the yield potential and disease pressure warrants a fungicide application.

Legal Statements

Influence of Seeding and Irrigation Rates on Corn Product Performance in Northeast Nebraska

Trial Objective

- Information is needed on how seeding and irrigation rates influence corn product performance.
- This study was designed to assess corn products across multiple seeding rates and two irrigation environments to help growers select products and seeding rates for the irrigation environment on their farm.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Battle Creek, NE	Loamy sand	Corn	Conventional	5/2/19	10/28/19	215	Variable

- Ten corn products ranging from relative maturities (RM) of 108 to 113 were evaluated.
- The trial was a split-plot design with irrigation as the whole plot and corn product by seeding rate as the subplot. Treatment combinations were replicated twice.
- Two irrigation rates were used:
  - Full irrigation (100% FI) – 7.6 inches/acre
  - 50% of FI – 3.8 inches/acre
- In addition to irrigation, 23.7 inches of rainfall occurred during the growing season.
- For both irrigation rates, the 10 corn products were planted at 32, 36, and 40K (K=000s) seeds/acre.
- At 100% FI, the ten products were also planted at 24, 44, and 50K seeds/acre.
- At 50% FI, the ten products were also planted at 18, 28, and 48K seeds/acre.
- Weeds were managed uniformly, and no fungicides or insecticides were applied.

Understanding the Results

- The performance of each corn product under the different seeding rates stresses the importance of knowing the optimum seeding rate for each product (Table 1).
- As a general trend, yields were greater at higher seeding rates. However, on an individual product basis, 44,000 seeds/acre was better than 50,000 seeds/acre under 100% FI and 36,000 seeds/acre was better than 40,000 or 48,000 seeds/acre under 50% of FI for some products. Several products exhibited much better yield performance with 100% FI, three products had similar yields under both irrigation rates, and a couple products had better yield performance under 50% of FI.

Influence of Seeding and Irrigation Rates on Corn Product Performance in Northeast Nebraska

Table 1. Corn product performance (bu/acre) as influenced by seeding rate (K=000s/acre) and irrigation environment at Battle Creek, NE in 2019 (100% FI received a total of 31.3 inches/acre and 50% of FI received a total of 27.5 inches/acre).

		Planting Rates (000's/acre) and Average Yield (bu/acre) of Each Corn Product at Two Irrigation Rates								
Corn Product	Irrigation Rate	18K	24K	28K	32K	36K	40K	44K	48K	50K
108RM-A	FI		192		227	219	214	214		224
	50% FI	197		209	236	228	233		233	
108RM-B	FI		173		188	193	189	197		206
	50% FI	146		180	197	189	199		203	
109RM-E	FI		208		224	226	241	258		241
	50% FI	177		210	231	235	233		249	
111RM-A	FI		188		214	216	205	213		201
	50% FI	161		188	184	204	203		199	
111RM-D	FI		213		224	214	239	243		228
	50% FI	181		208	223	217	221		230	
111RM-E	FI		220		219	224	231	227		230
	50% FI	170		225	219	210	227		239	
112RM-A	FI		199		223	222	212	228		217
	50% FI	164		211	225	229	208		207	
112RM-B	FI		188		222	221	231	229		216
	50% FI	176		208	216	209	215		183	
113RM-B	FI		175		206	214	215	195		203
	50% FI	155		187	225	189	197		224	
113RM-E	FI		202		218	230	216	225		221
	50% FI	181		201	213	221	222		215	

Key Learnings

- Corn products differ in their response to irrigation amount and seeding rate.
- Producers should consider their irrigation and precipitation environment when making product and seeding rate decisions to achieve the best yield potential on that acre.
- Growers should consult their local seed sales team for information on how their branded products performed in the study.

Legal Statements

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FERTILITY

Corn Response to Nitrogen Rates

Trial Objective

- The optimum nitrogen (N) rate for corn can be difficult to determine for farmers. Inadequate N can cause a noticeable reduction in yield while excess N is unused by the crop. Also, unused N reduces the return on N investment.
- The objective of this study was to evaluate the response of corn products to six N rates.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Gothenburg, NE	Hord silt loam	Corn	Strip tillage	5/15/19	10/25/19	220	34K

- The study was set up as a split-plot design with four replications.
- The previous crop was corn, which depleted the soil profile of N and other nutrients. The residual N in the top two feet was 26 lb N/acre.
- Nitrogen rate was the whole plot factor with six rates of N: 0, 60, 120, 180, 240, and 300 lb/acre, which was applied with 360 Y-DROP® fertilizer tube attachments at the V5 corn growth stage on June 26th, 2019. No additional nutrients were applied to the plots.
- Corn product was the subplot with the three products evaluated ranging in maturity from 100 to 117 relative maturity.
- Weeds were uniformly controlled; no other pests were controlled in the study.
- Shelled corn weight and grain moisture were collected, and bushels per acre calculated.

Understanding the Results

- There was no N rate by corn product interaction, so data were averaged across corn products.
- The amount of N to produce one bushel of grain increased as the applied N rate increased. Compared to the first increments of applied N, more N was needed to make one bushel of grain at the greater rates of applied N (Figure 2).
- Application of 180 lb N/acre calculated 1.08 lb of N to make one bushel. This result coincides with the application recommendation of 1.0 to 1.2 lb N/acre calculated from fertility formulas based on the yield goal of a field.[1,2]
- Approximately 14 lb of N was needed to produce one bushel of grain with the greatest rate of applied N (300 lb/acre). In comparison, it took 1.6 lb of N to produce one bushel of grain with the lowest rate of applied N (60 lb/acre) (Figure 3).

Corn Response to Nitrogen Rates

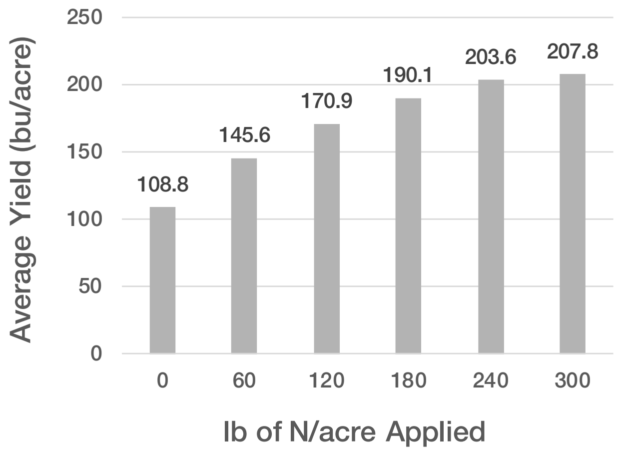

Figure 1. Yield response to N application rates. The positive yield response to additional N leveled off at the 240 lb N/acre rate with 91% of the yield potential achieved with the 180 lb N/acre rate.

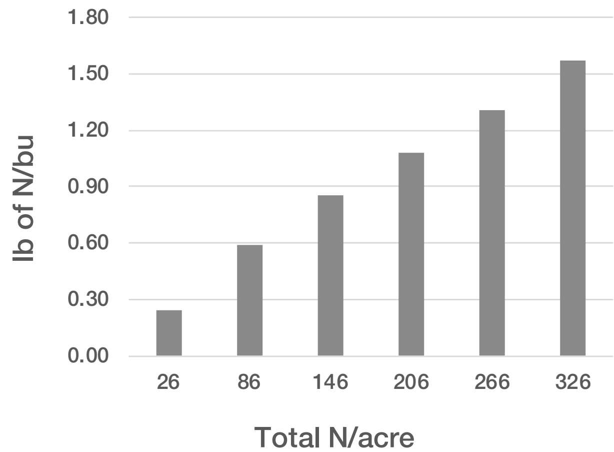

Figure 2. Pounds of N to make one bushel of grain based on total available N per acre (including soil residual N).

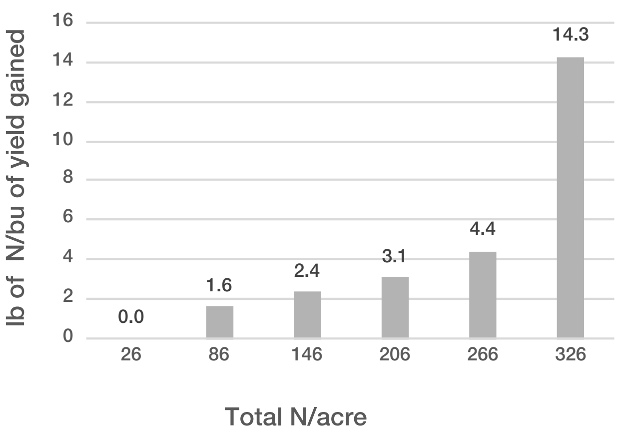

Figure 3. Total available N per bushel of yield gained over the previous treatment.

Key Learnings

- The law of diminishing returns is illustrated in this research with more value observed from the first 60 lb N/acre applied than the last 60 lb N/acre increment.
- Nitrogen application rates are a key factor in driving yield, but residual N should be considered to tailor the N rate for a specific field.
- While maximum yield potential is the goal of many operations, the value of the input in increasing crop yield needs to be carefully considered as farmers put together their fertility plans.

Sources: Web sources verified 11/9/19

[1] Nielsen, R.L. 2001. Optimizing fertilizer decisions. Corny News Network. Purdue University. https://www.agry.purdue.edu/ext/corn/news/articles.01/N_Use_Efficiency_0221.html.

[2] University of Maryland Cooperative Extension. 2009. Nutrient recommendations by crop. https://mda.maryland.gov/resource_conservation/Pages/default.aspx.

Legal Statements

DISEASES

Soybean Product Response to Delaro® 325 SC Fungicide

Trial Objective

- The objectives of this trial were to:
  - Evaluate if soybean products respond differently when given a fungicide application vs. no application.
  - Determine the impact of a fungicide application on soybean yield.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Gothenburg, NE	Hord silt loam	Corn	Strip tillage	5/16/19	10/16/19	90	160K

- The study was set up as a split plot with four replications where fungicide was the whole plot and soybean product was the subplot.
- Twenty-four soybean products, ranging in maturity from 2.0 to 3.5, were evaluated.
- Fungicide treatments included:
  - Untreated
  - Delaro® 325 SC fungicide applied at 10 fl oz/acre at the R3 growth stage
  - Two Delaro® 325 SC fungicide applications applied at 10 fl oz/acre at the R1 and R3 growth stage
- Plots were sprinkler irrigated and weeds were controlled chemically as needed.
- Some soybean diseases (Septoria brown spot, Phomopsis pod and stem blight, and Anthracnose) were observed at low levels but no soybean diseases were prevalent at an economic threshold.

Understanding the Results

- There was an interaction between soybean product and fungicide as detailed in Table 1. Some of the soybean products showed a large benefit to a Delaro® 325 SC fungicide application or two applications while other products showed no response.
  - A positive response to fungicide was observed 67% of the time with the single application of Delaro® 325 SC fungicide at the R3 growth stage and 79% of the time with the dual application at the R1 and R3 growth stage in a low disease pressure environment.
  - Ten of the soybean products had 4 bu/acre or more response to either the single or dual application as compared to the untreated soybean products.
  - The inconsistency in the yield response is similar to that observed in other studies when foliar diseases are below economic levels.[1] Soybean response to a fungicide is often higher when disease pressure is high.

Soybean Product Response to Delaro® 325 SC Fungicide

Table 1. Soybean Product Response to Delaro® 325 SC Fungicide			
	Yield Advantage/Disadvantage over Untreated (bu/acre)		
Soybean Products	**Delaro® 325 SC Fungicide at R3**	**Delaro® 325 SC Fungicide at R1 & R3**	**+4 bu/acre Response**
2.4MG-A	0.7	4.2	
2.6MG-A	4	3.6	
2.7MG-A	3.4	4.5	
2.9MG-A	-1	2.7	
2.9MG-B	1.8	-0.2	
3.0MG	7.7	4.5	
3.1MG	-1.9	1.6	
2.2MG	1.5	4.1	
2.4MG-B	6	4.7	
2.5MG-A	5.3	6.3	
2.7MG-B	1.8	3.2	
2.8MG-A	1.4	2.2	
2.8MG-B	-2.2	-4.1	
2.9MG-C	2.7	9.8	
3.3MG	-0.8	0.5	
2.0MG-A	2.4	3	
2.0MG-B	7.1	10.2	
2.4MG-C	-2.3	-1.2	
2.5MG-B	-1.3	-3.4	
2.6MG-B	1.9	5.2	
2.6MG-C	0.8	0.4	
2.7MG-C	-1.6	-0.5	
2.9MG-D	5.8	3.1	
3.5MG	-2.7	4.3	
Key	+4 bu/acre response to one of the Delaro 325 SC treatments	No +4 bu/acre response to one of the Delaro 325 SC treatments	

Soybean Product Response to Delaro® 325 SC Fungicide

Figure 1. A 3.0 MG soybean product untreated. Image taken in September 2019.

Figure 2. A 3.0 MG soybean product treated with Delaro® 325 SC fungicide at R3. Image taken in September 2019.

Figure 3. A 3.0 MG soybean product treated with Delaro® 325 SC fungicide at R1 and R3. Image taken in September 2019.

Key Learnings

- Soybean products tended to have different responses to an application or applications of Delaro® 325 SC fungicide compared to no fungicide applied.
- This is research from only one site and one year, but it does provide some insight into how a soybean product may respond to a fungicide application on a broader scale or in different geographies, climate or an increase/decrease in fungicidal pressure.
- Producers should consult with their local seed sales team to understand how their branded soybean product performed in this study and develop a plan on how to best manage it.

References

[1]Giesler, L.J. 2008. Deciding when to apply soybean fungicides. University of Nebraska. Institute of Agriculture and Natural Resources. https://cropwatch.unl.edu/deciding-when-apply-soybean-fungicides

Legal Statements

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ENVIRONMENT

Soybean Response to Planting Date

Trial Objective

- The purpose of this study was to evaluate how soybean product, planting date, and irrigation strategy interact to help farmers maximize soybean yield potential and return on investments.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Gothenburg, NE	Hord Silt loam	Corn	Strip tillage	4/29/19 5/13/19 6/4/19 6/24/19	10/8/19 10/8/19 10/8/19 10/14/19	85	180K

- The study was set up as a randomized split-split plot design with irrigation strategy as the whole plot, planting date as the sub plot, and soybean product as the sub-sub plot. Treatment combinations were replicated four times.
- Initially, there were four irrigation strategies. However, because of the timely rainfall throughout the growing season (27 inches from May 1 to September 1), irrigation was limited. A 0.8-inch difference between the four irrigation strategies resulted in no irrigation impact; therefore, the data was summarized across the treatments.
- Eight Roundup Ready 2 Xtend® soybean products with maturity groups (MG) of 2.4 to 3.3 MG were compared.
- The soybean products were planted at 180,000 seeds/acre on four different dates with a row spacing of 30 inches and irrigated.
- Weeds were controlled uniformly across the study and no fungicides or insecticides were used to control other pests.

Table 1. Average bu/acre reduction in yield response for each soybean product relative to planting date (darker green colors indicate less average yield loss).

	Planting Date			
Soybean Product	29-Apr	13-May	4-Jun	24-Jun
2.4MG-A	0	-1.1	-3.2	-13.5
2.5MG	0	-1.7	-5.5	-14.6
2.9MG-A	0	-0.6	-3	-14
3.3MG	0	0.1	-4.4	-18.8
2.4MG-B	0	-0.3	-0.9	-11.9
2.6MG-A	0	2.2	0.6	-11.9
2.9MG-B	0	3.1	-1.5	-14
2.6MG-B	0	-0.8	0	-12.4
LSD (0.1)	2.15			

Table 2. Average test weight (lb/bu) response for each soybean product relative to planting date (darker green colors indicate higher average test weights).

	Planting Date			
Soybean Product	29-Apr	13-May	4-Jun	24-Jun
2.4MG-A	62.7	63.1	62.7	64.8
2.5MG	63.3	63.5	63.5	65.0
2.9MG-A	63.1	63.2	62.9	63.7
3.3MG	59.5	58.8	61.3	59.7
2.4MG-B	62.9	63.2	63.1	65.0
2.6MG-A	63.0	62.9	62.0	64.1
2.9MG-B	63.3	63.1	62.8	64.2
2.6MG-B	63.0	63.0	63.0	64.9
LSD (0.1)	0.68			

BAYER

Soybean Response to Planting Date

Understanding the Results

- Soybean yield (Table 1) and test weight (Table 2) were impacted by an interaction of soybean product with planting date. As stated above, irrigation strategy had no influence.
- Higher yields were consistently observed with the earlier planting dates; some soybean products had higher yields with the planting dates of April 29 or May 13 or both compared to the June 24 planting date.
  - Based on the yields of previous research at the Gothenburg Learning Center, yields for the first two planting dates were less than anticipated (off by 5 to 10 bu/acre) due to a challenging growing environment, so the average yield loss for delaying soybean planting on June 4 was not as high. The season experienced cool, wet growing conditions and an early-season hail event on May 26. Final stands across all soybean products for the planting dates of April 29, May 13, June 4, and June 24 were 66.5K, 52.5K, 121K, and 111K plants/acre, respectively.
- Soybean test weights (Table 2) were impacted more by soybean product with planting date having some affect.

Figure 1. Overview of the study on September 19 at the Gothenburg Learning Center showing the impact planting date and soybean product has on soybean maturation.

Key Learnings

- Soybean products responded to planting date with some products recording their highest yield with the earliest planting date (April 29) while others had their highest yield with the second planting date (May 13). All products had their lowest yield with the last planting date (June 24).
- Farmers should work with their local seed salesman or agronomist to help determine which soybean product(s) are best suited to help maximize yield potential and return on investment for their farming operation.

Legal Statements

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WEED CONTROL

Soybean Product Response to PPO Herbicides

Trial Objective

- PPO herbicides, such as sulfentrazone and flumioxazin, are important residual herbicides in a soybean weed control program.
- Soybean injury from these herbicides has occurred early in the growing season, typically from cool, wet growing conditions.
- Questions have arisen if there are differences in how soybean varieties respond to these herbicides.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Planting Rate (seeds/acre)
Gothenburg, NE	Hord Silt loam	Corn	Strip tillage	6/3/19	10/14/19	80	160K

- The study was set up as a split plot with three replications where PPO herbicide was the whole plot and soybean product was the subplot.
- Nine soybean products (listed in Table 1), ranging in maturity from a 2.5 to 3.5 MG, were evaluated.
- PPO herbicides applied at planting (June 5, 2019) included:
  - Sulfentrazone at 0.3125 lb ai/acre
  - Flumioxazin at 0.096 lb ai/acre
  - Untreated
- Plots were sprinkler-irrigated and weeds were controlled as needed with no additional fungicide or insecticide applied.
- Plots were harvested, and yield was calculated.

Understanding the Results

- The main factors of the research, PPO herbicide treatment and soybean product, impacted yield.
  - Figure 1 reports the average yield across all soybean products, where sulfentrazone negatively impacted yield while the flumioxazin treatment and the untreated plot had similar yields.
  - Potential soybean injury from flumioxazin and sulfentrazone is dependent on weather conditions around application. In this instance, no response was observed from flumioxazin.
- Although the interaction of soybean product by PPO herbicide was not significant, the values are listed in Table 1 to provide additional insights.

Key Learnings

- PPO herbicides can impact soybean yield differently.
- Farmers should weigh the benefits of flumioxazin or sulfentrazone as part of their residual weed control program against the potential negative impact on yield these herbicides can sometimes cause.

Soybean Product Response to PPO Herbicides

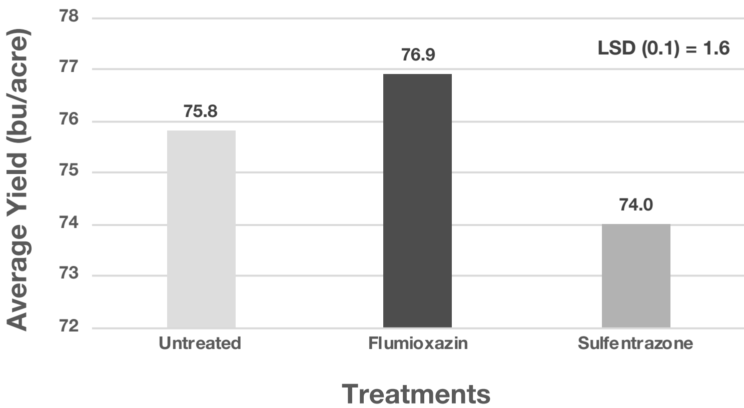

Figure 1. PPO herbicide impact on yield across all soybean products.

Table 1. Soybean product response to PPO herbicide treatment.		
Soybean Product	**Flumioxazin**	**Sulfentrazone**
	Yield Difference (bu/acre)*	
2.6MG	4.0	2.7
2.7MG	-3.2	0.3
2.9MG-A	1.1	-6.3
2.5MG-A	0.1	0
2.9MG-B	4.4	0.2
3.3MG	1.6	-4.0
2.5MG-B	0.1	-4.9
2.9MG-C	3.1	-5.9
3.5MG	-0.5	2.0
LSD (0.1)	**------------------NS------------------**	
***Difference in average yield from the untreated control.**		

Figure 2. No visual differences were observed late in the growing season across the entire study when comparing PPO treatments and soybean products.

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ENVIRONMENT

When Should I Switch to an Earlier RM Hybrid?

Trial Objective

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

Research Site Details

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

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

Understanding the Results

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

Key Learnings

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

When Should I Switch to an Earlier RM Hybrid?

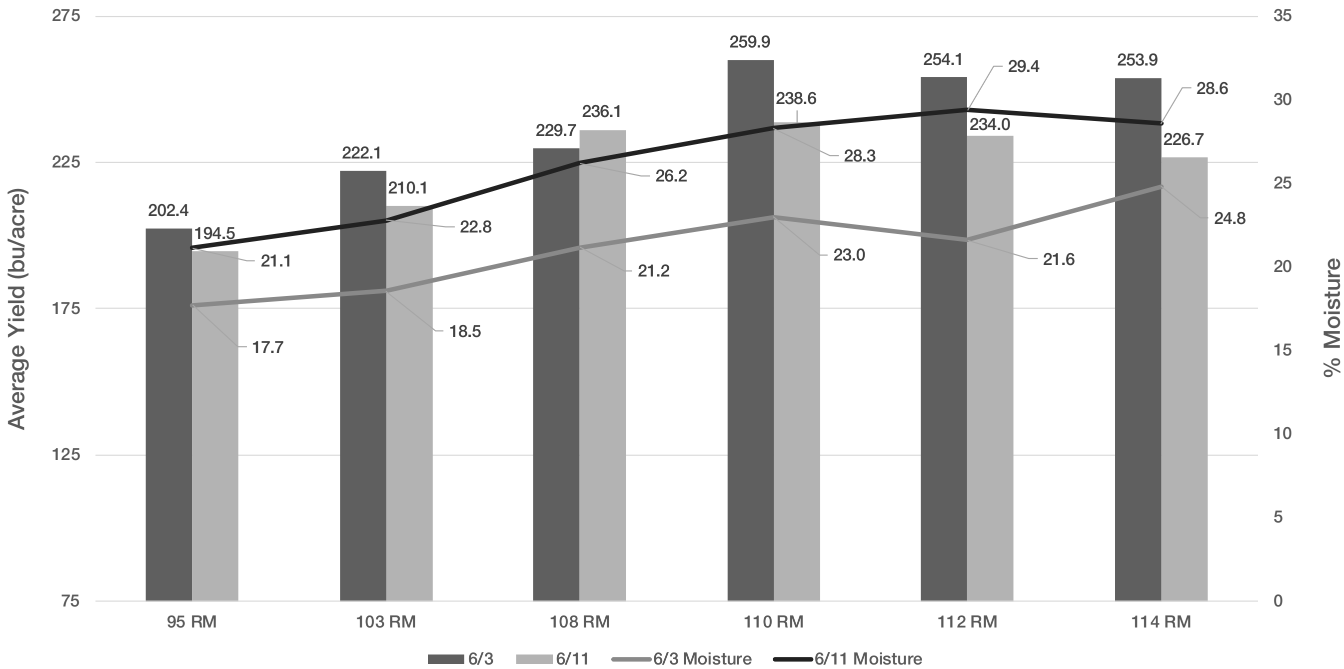

Figure 1. Average yields of each corn product at the two planting dates with moisture trendlines.

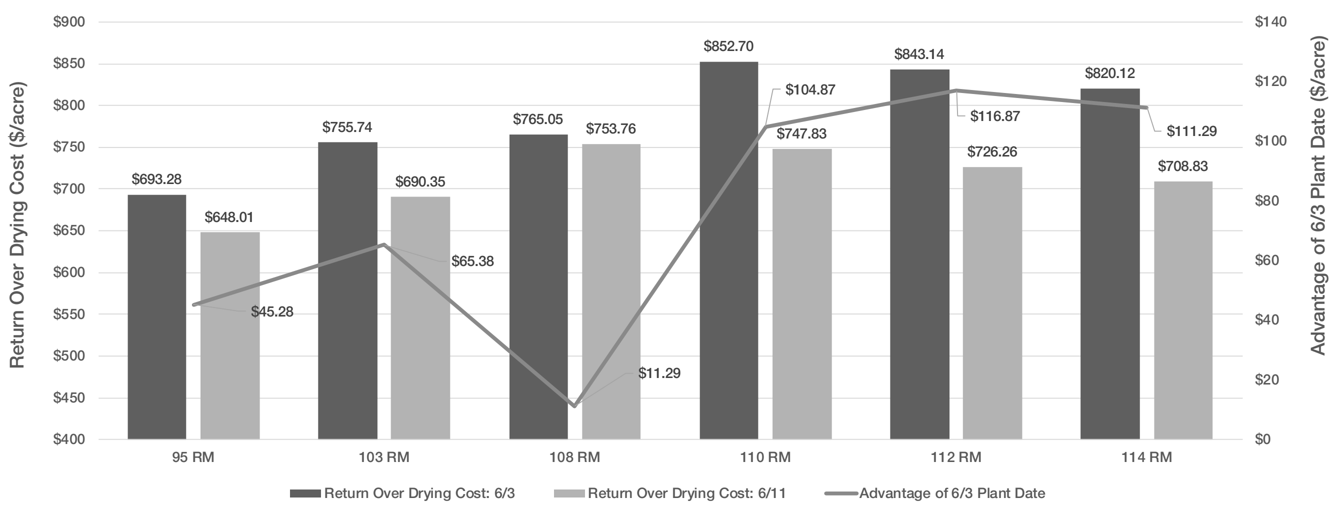

Figure 2. The return over drying cost for each corn product at the two planting dates with the trendline showing the advantage of the June 3 planting date.

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ENVIRONMENT

Corn Response to Seeding Rate

Trial Objective

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

Research Site Details

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

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

Understanding the Results

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

Key Learnings

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

Corn Response to Seeding Rate

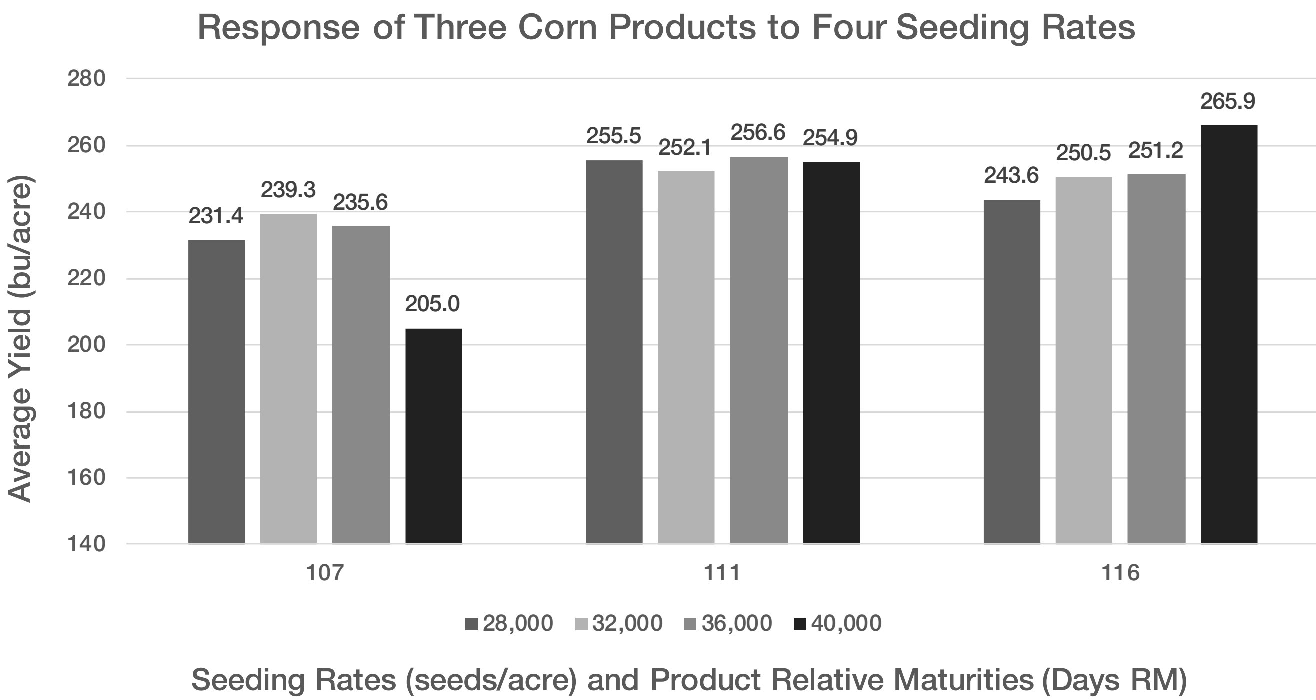

Figure 1. Average yield response of three corn products with different relative maturities to four seeding rates at the Bayer Learning Center at Monmouth, IL in 2019.

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

Legal Statements

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ENVIRONMENT

Growth and Development of Late-Planted Corn

Trial Overview

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

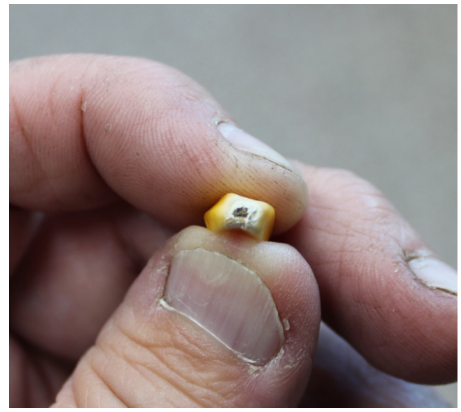

Figure 1. Dead cells where the kernel attaches to the cob indicate black layer and the beginning of grain dry down.

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

Research Site Details

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

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

Growth and Development of Late-Planted Corn

Understanding the Results

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

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

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

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

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

Growth and Development of Late-Planted Corn

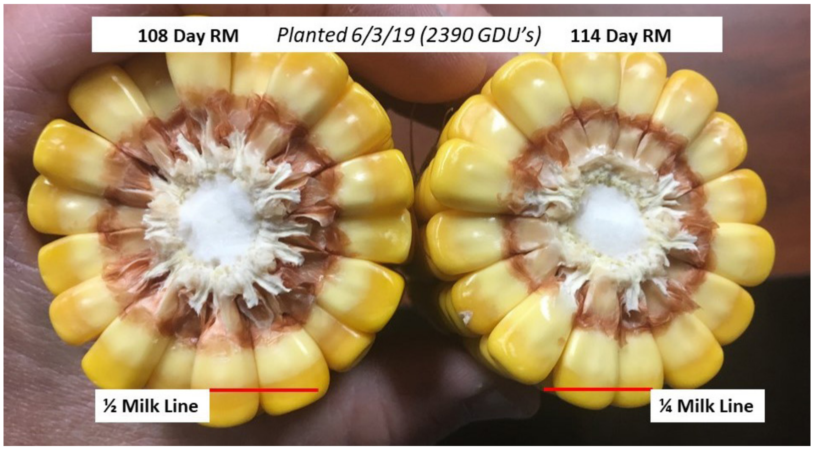

Figure 2. Milk line on kernels from the 108-day RM and 114-day RM corn products from the late planting date (6/3/19) showing the differences in maturity.

Key Learnings

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

Sources (verified 11/2/2019)

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

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

Legal Statements

FERTILITY

Timing of Nitrogen Sidedress Applications

Trial Objective

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

Research Site Details

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

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

Understanding the Results

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

Timing of Nitrogen Sidedress Applications

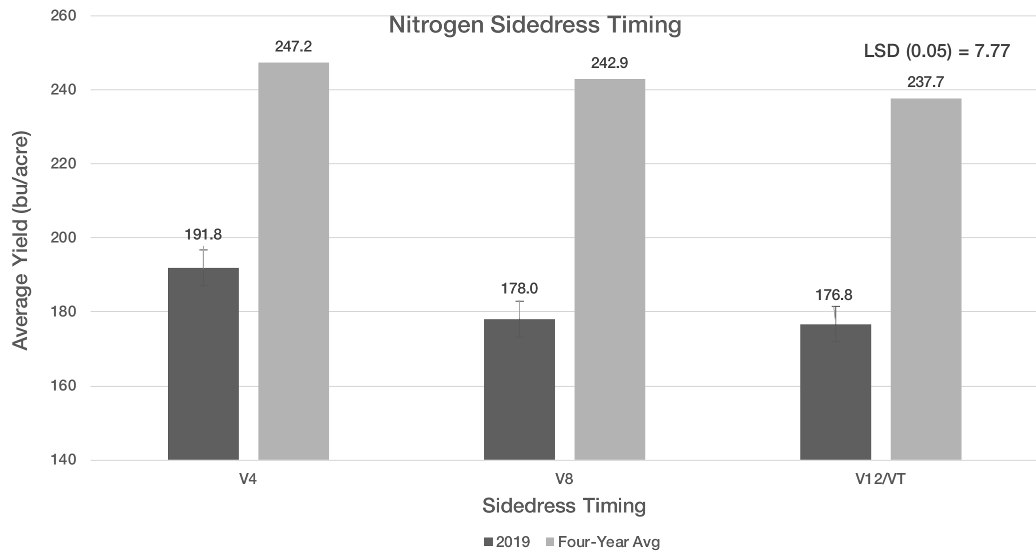

Figure 1. Average corn yield for 2019 and the four-year average for nitrogen sidedress application timing at the V4, V8, or V12/VT growth stage.

Key Learnings

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

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FERTILITY

Nitrogen Placement During Sidedressing

Trial Objective

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

Research Site Details

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

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

Figure 1

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

Figure 2

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

Figure 3

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

Nitrogen Placement During Sidedressing

Understanding the Results

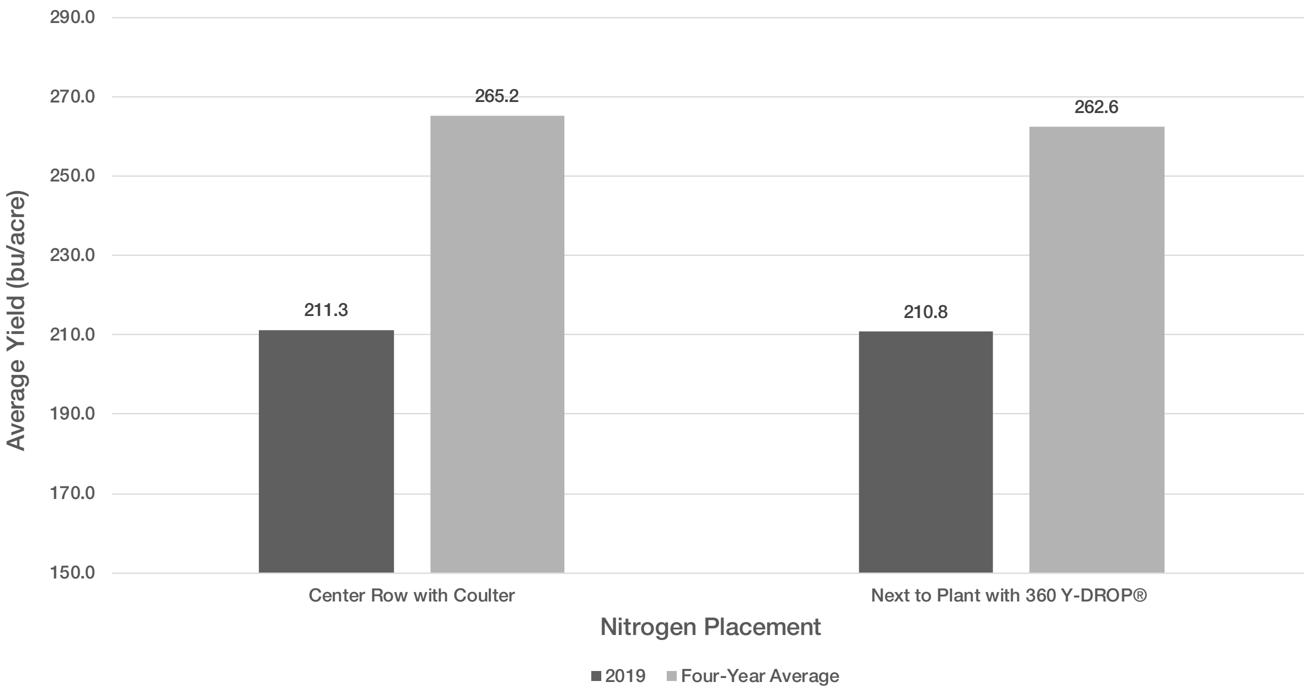

Figure 4. Average corn yield for N sidedressing placement in the center of the row with a coulter and next to the base of the plant with 360 Y-DROP® for 2019 and the four-year average.

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

Key Learnings

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

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DISEASES

Fungicide and Planting Date in Soybean

Trial Objective

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

Research Site Details

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

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

Understanding the Results

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

Fungicide and Planting Date in Soybean

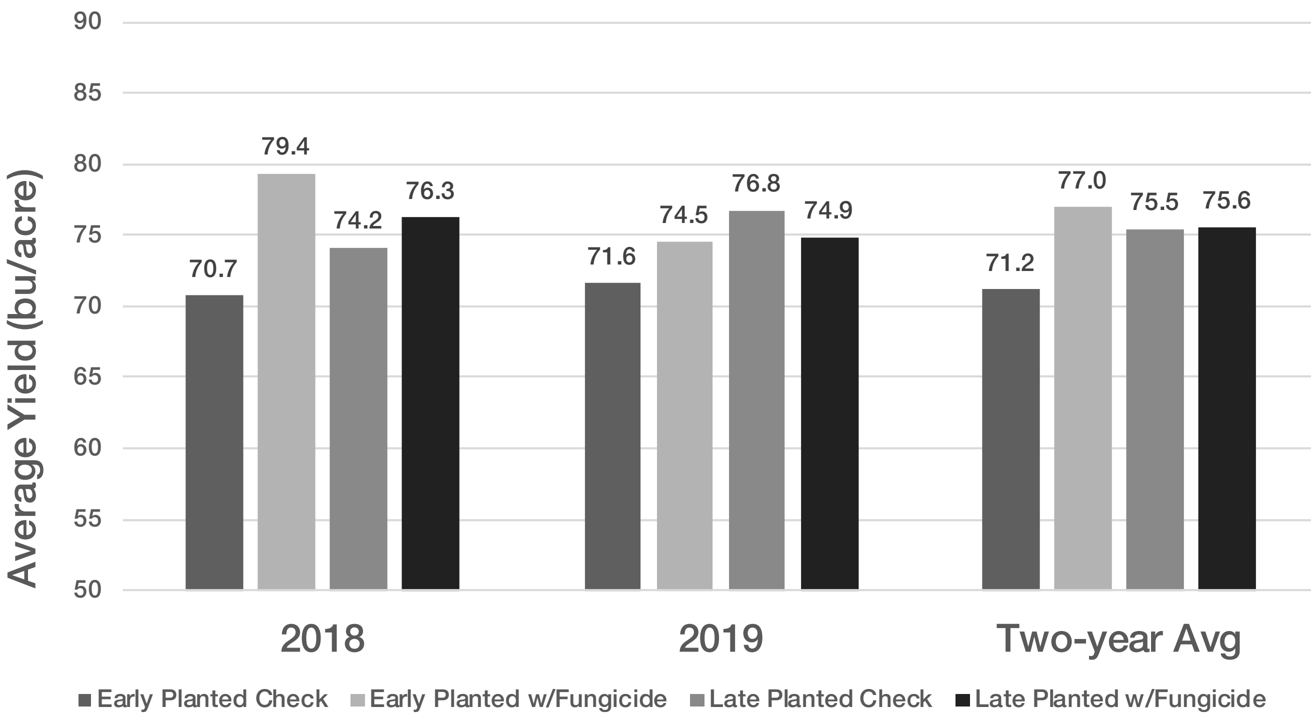

Figure 1. Soybean fungicide by planting date.

Key Learnings

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

Legal Statements

Soybean Seeding Rate by Planting Date

Trial Objective

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

Research Site Details

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

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

Understanding the Results

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

Soybean Seeding Rate by Planting Date

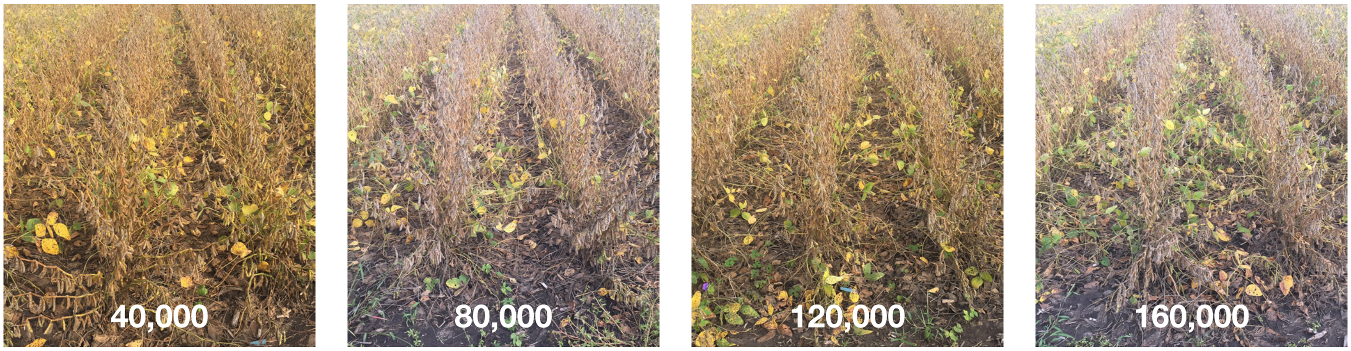

Figure 1. Plants tend to develop additional branches and nodes as seeding rates (population) decrease.

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

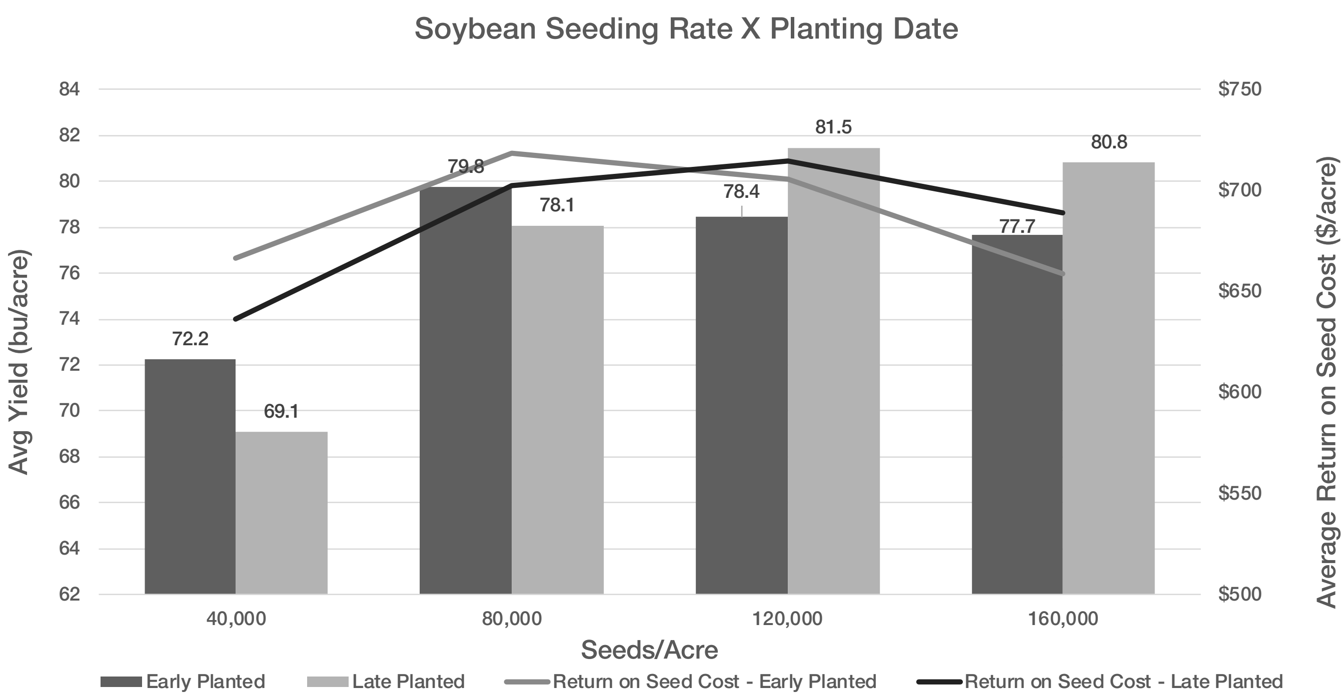

Figure 2. Comparison of average soybean yields for two planting dates and four seeding rates at the Bayer Learning Center at Monmouth, IL in 2019. The early planting date was April 24 and the late planting date was June 3.

Soybean Seeding Rate by Planting Date

Key Learnings

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

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

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

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

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ENVIRONMENT

Impact of Soybean Seed Treatment and Planting Date

Trial Objective

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

Research Site Details

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

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

Understanding the Results

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

Impact of Soybean Seed Treatment and Planting Date

Key Learnings

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

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

Source (verified 10/30/19)

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

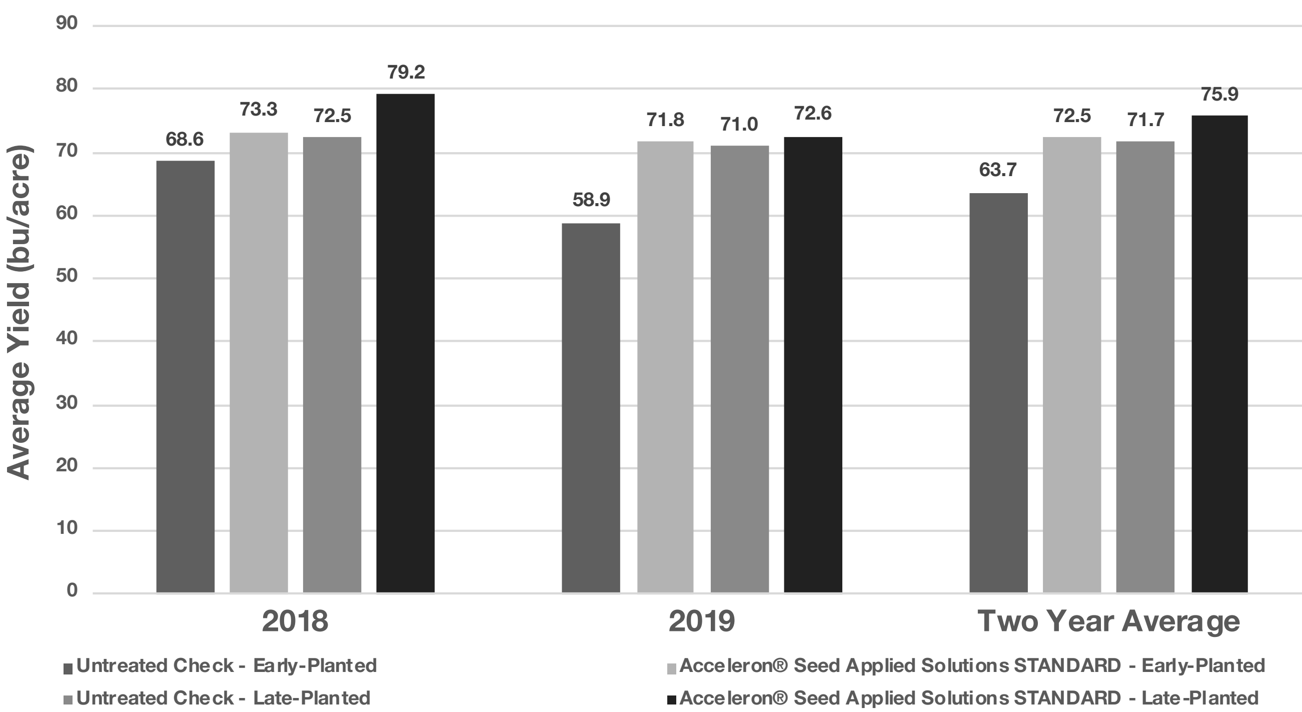

Figure 2. Average soybean yields for each treatment in 2018 and 2019 and averaged over the two years.

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ENVIRONMENT

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
  - 14 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.

Tailored Solutions – Corn Systems Management

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

- 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.

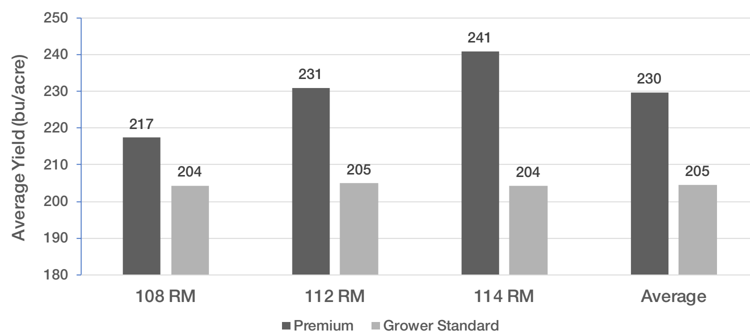

Figure 1. Yield response of the corn products to two different production systems. Average represents the average yield of the three corn products for each production system.

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.

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ENVIRONMENT

Corn Yield Response to Row Spacing and Seeding Rate

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.

Corn Yield Response to Row Spacing and Seeding Rate

Understanding the Results

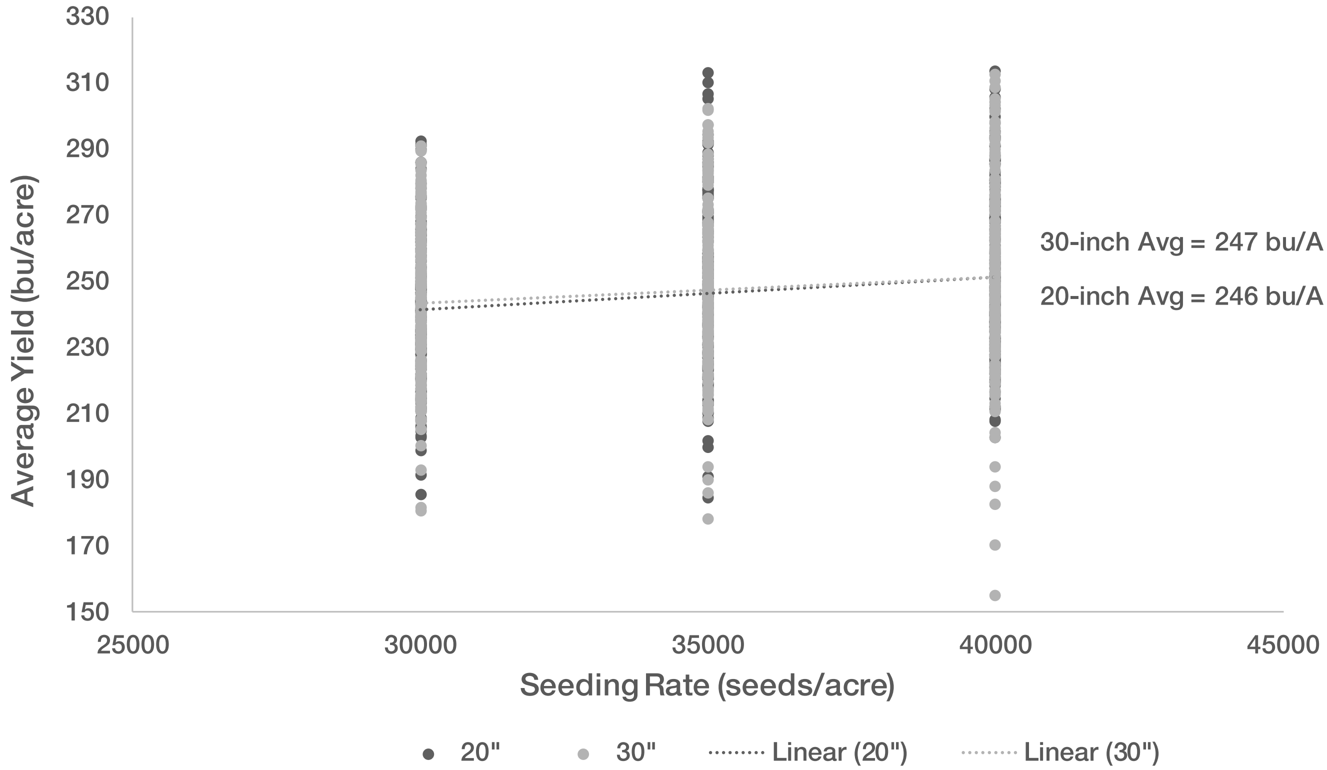

Figure 1. Effects of row spacing and seeding rate on the yield of corn products. Data represent 45 products from five growing regions in Iowa. The average yield represents the overall average across locations, products, and seeding rates.

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.

Corn Yield Response to Row Spacing and Seeding Rate

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.

Legal Statements

ENVIRONMENT

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

- 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.

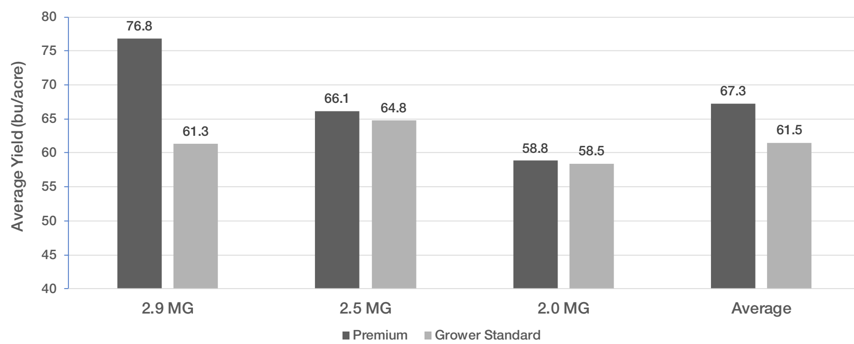

Figure 1. Yield response of three soybean varieties to two different production systems. Average represents the average yield of the three varieties for the production system.

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.

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ENVIRONMENT

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

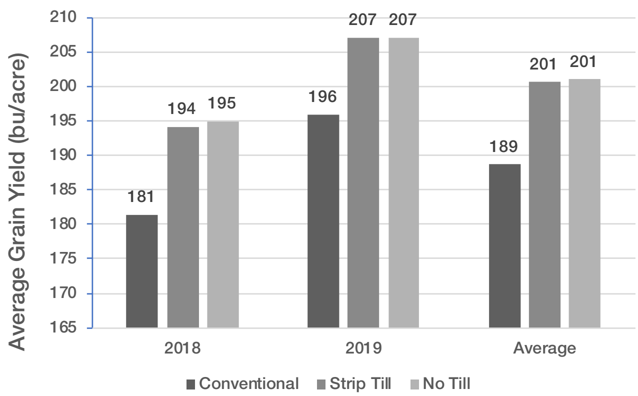

Figure 1. Corn yield response to three tillage systems over a two-year period in central Iowa.

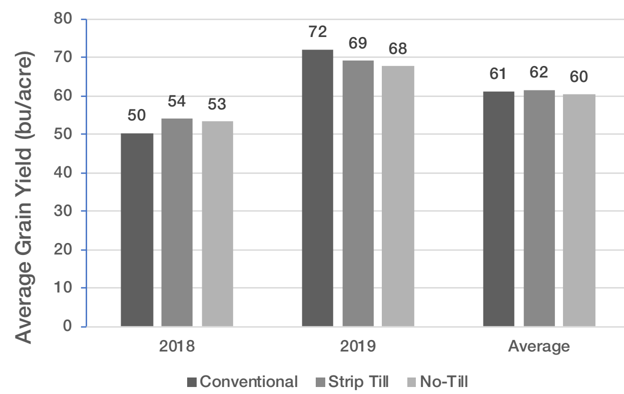

Figure 2. Soybean yield response to three tillage systems over a two-year period in central Iowa.

- 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.

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ENVIRONMENT

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

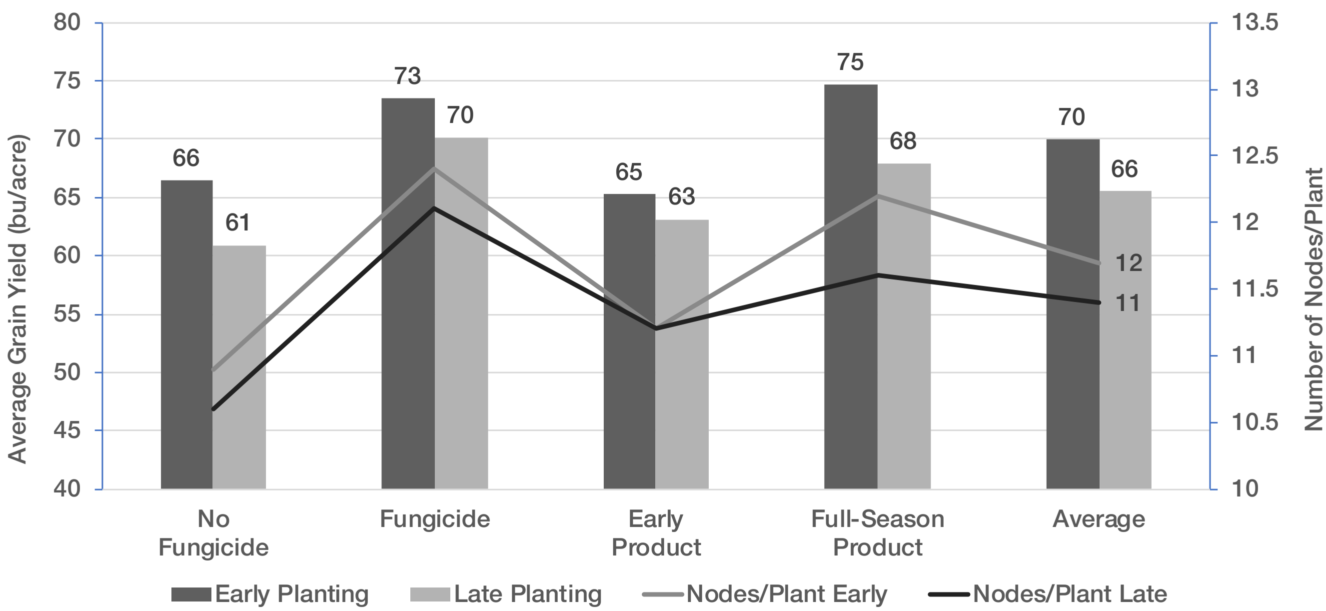

Figure 1. Effects of planting date on the number of nodes and yield of soybean products in central Iowa. Nodes were counted just before harvest. Planting dates were determined by environmental conditions. Average data represent planting date effect across both soybean product and fungicide treatments.

- 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).

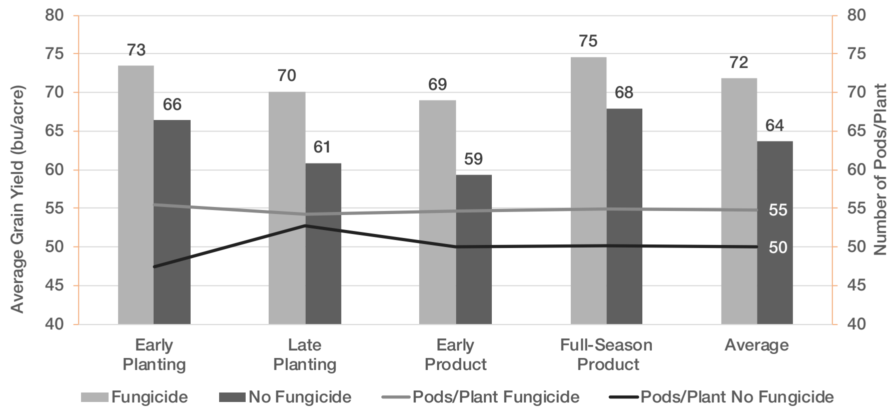

Figure 2. Effects of fungicide application on pod development and yield of soybean products in central Iowa. Pod number was counted just before harvest. Planting dates were determined by environmental conditions. Average data represent fungicide effect across both soybean product and planting date.

- 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.

Legal Statements

ENVIRONMENT

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.
- There are many benefits of planting "early" soybean products including:
  - 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 18 unique soybean products.
  - Nine products were considered early RM for the location:
    - North Set – 1.1 to 1.8 RM
    - South Set – 2.0 to 2.6 RM
  - Nine products were considered normal RM for the location:
    - North Set – 2.0 to 2.6 RM
    - South Set – 2.9 to 3.7 RM
  - The 2.0 to 2.6 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

- With later planting dates in 2019, the normal RM group showed a clear advantage of 6.0 bu/acre over the early RM group (Figure 1).
- Over the two years of this trial (2018-2019, Figure 2) the normal RM group had an average advantage of 3.8 bu/acre. In 2018, the early RM group had a yield advantage at three locations (Victor, Storm Lake, and Atlantic).

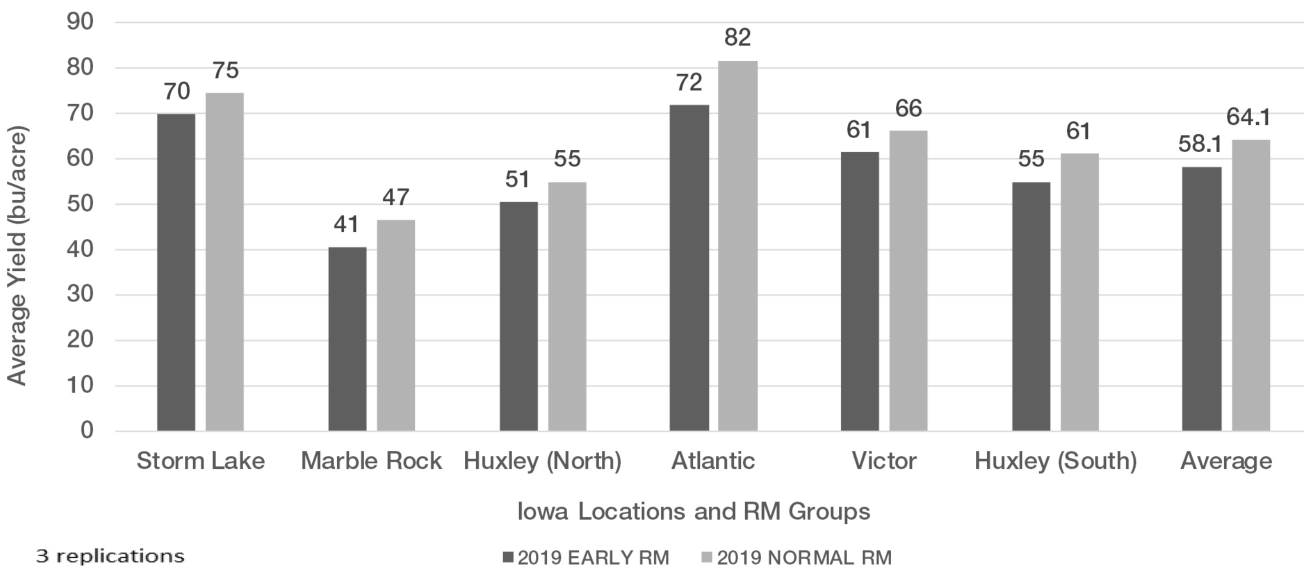

Figure 1. Relative maturity effects on the yield performance of 18 soybean products at Storm Lake, Marble Rock, Huxley (North and South sets), Atlantic, and Victor, Iowa in 2019. Data represents the average yields of nine products in each RM group for each location.

Yield Observations When Shifting to Earlier Relative Maturity Soybean Products

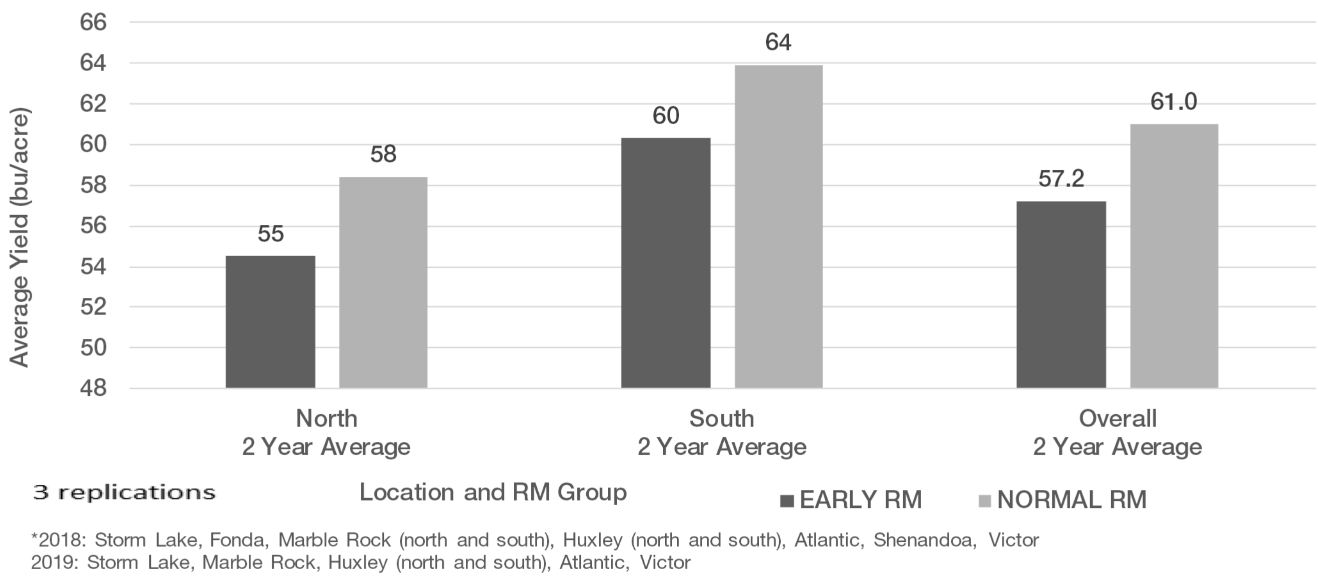

Figure 2. Relative maturity effects on the yield performance of soybean products at 15 site-year locations in Iowa. The results represent the average yields of nine products in each RM group for each location.

Key Learnings

- In 2019, the early RM products yielded, on average, 6.0 bu/acre less than the normal RM products and yields ranged between 4 to 11 bu/acre less than the 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 two-year data indicates that early RM soybean products can be competitive if the proper genetics are selected.
- 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.

Legal Statement

Corn Product Characterization in Different Planting Populations

Trial Objective

For over a decade, Bayer has been using an innovative planter technology, the Genotype by Environment Narrative planter (GEN), to help understand and characterize corn product performance in response to plant population and environment. This internally-developed tool provides the technical field teams the ability to simultaneously plant multiple corn products at different seeding rates across a field. These unique planting capabilities generate over 100,000 detailed yield observations each season across diverse growing conditions. This program provides data for our agronomy experts to optimize product performance and recommendations for all corn-growing regions in the United States. The objectives of this research were to:

- Evaluate all new Bayer corn products using seeding rates ranging from 18,000 to 50,000 seeds/acre across multiple locations in the United States.
- Provide growers with product-specific planting recommendations.
- Assess new products in as many yield environments as possible over a two-year period.
- Provide growers with insight for their specific situation and the product they selected.

Research Site Details

- Approximately 125 testing locations across the U.S. were used.
- Products were tested that are targeted by the regional field teams as important in that geography.
- Testing locations were selected to target diverse environments (yield environment, crop rotation, tillage practice, etc.).
- Agronomic management practices used in this study mimicked local best management practices.
- Products tested were both first-year commercial and pre-commercial corn products.
- The experimental design was a split-plot RCB with 2 replications. Corn hybrid = main plot; Seeding rate = sub plot.
- Small plots were used: four 35-foot rows per plot with a row width of 30 inches.
- Seeding rates were as follows:
  - Low-yielding acres: 18,000, 28,000, 32,000, 36,000, 40,000, and 48,000 seeds/acre
  - High-yielding acres: 24,000, 32,000, 36,000, 40,000, 44,000, and 50,000 seeds/acre

Understanding the Results

- Product-specific data on the response to plant population allows for customized recommendations for new corn products specific to a yield environment.
- Multiple years of data allow agronomists to determine the influence of weather on corn product performance. This adds to the robustness of the recommendations generated in this system.
- The relative responsiveness of a product to plant population can change depending on the yield environment and management.

Corn Product Characterization in Different Planting Populations

Key Learnings

The information generated in this program drives innovation within Bayer while it provides data to the farmers who rely on our premium genetics to deliver top yields. The data that these trials generate help growers optimize product placement and seeding rates of Bayer corn products to maximize the return on their investment in our corn products.

- Consult with your Technical Agronomist, who has access to this data, early in the year for information on the performance of all our newest products.
- Visit Climate FieldView™ seed scripts https://climate.com/2020-seed-scripts to see how this data is being used to develop specific corn product recommendations. Pairing the product-level seeding rate characterization with the specific agronomic environment of your operation can optimize your system.

Legal Statements

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INSECT CONTROL

Using 2019 Corn Rootworm Beetle Counts to Help Evaluate the Risk of an Infestation for 2020

Trial Objective

- 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 larval infestation reaching economic damage levels in corn fields during the next growing season.
- The objective of this study was to measure adult CRW populations in corn and soybean fields in 2019 to assist in risk evaluation for 2020.
- This information may help guide decisions regarding management strategies including corn product selection.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
1442 fields	Drained or well drained	See Figure 1	Various	Various	Various	110-250	Various

- One to four Pherocon® AM non-baited trapping sites were established at 1442 field locations across the corn-growing areas of IA, IL, IN, OH, MI, WI, MN, ND, SD, NE, KS, CO, and MO (Figure 1).
- The trapping sites were installed in the interiors of corn and soybean fields that encompassed a variety of crop and management histories. Soybean fields were sampled in parts of the corn-growing area to assess the potential risk associated with the variant western CRW, which is known to lay eggs in soybean fields.
- 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 analysis.

Understanding the Results

- Categories for CRW beetle counts are based on action thresholds (beetles/trap/day) suggested by Extension entomologists at the University of Illinois and Iowa State University (ISU) and provide the economic damage potential for the following season.[1,2]
- Less than 2 beetles/trap/day indicate a relatively low risk of economic damage
  - Greater than 1 beetle/trap/day suggests a low risk for economic damage but could indicate populations are increasing.
- Greater than 2 beetles/trap/day indicate the probability for economic damage is likely if control measures are not used.
- Greater than 5 beetles indicate that economic damage is very likely and populations are expected to be very high the following year.

Using 2019 Corn Rootworm Beetle Counts to Help Evaluate the Risk of an Infestation for 2020

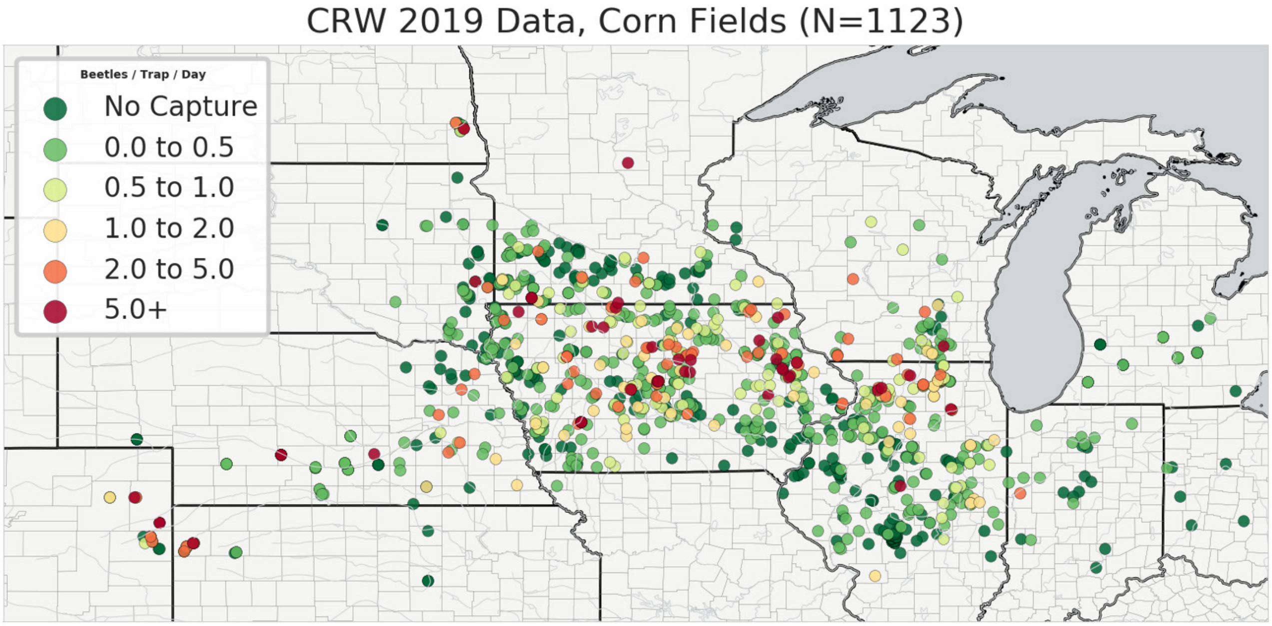

Figure 1a. Corn field locations for corn rootworm trapping in 2019.

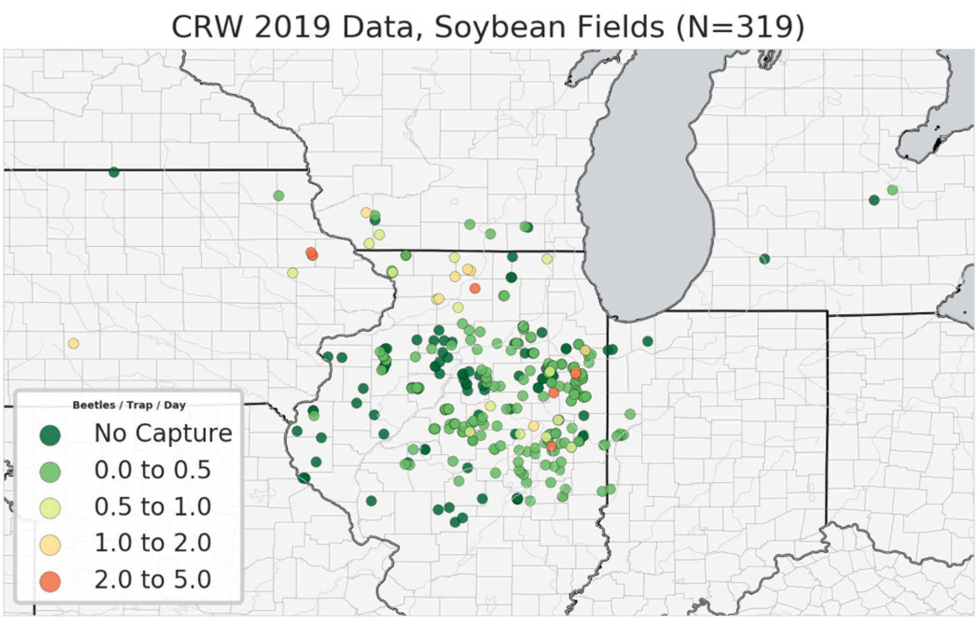

Figure 1b. Soybean field locations for corn rootworm trapping in 2019.

Using 2019 Corn Rootworm Beetle Counts to Help Evaluate the Risk of an Infestation for 2020

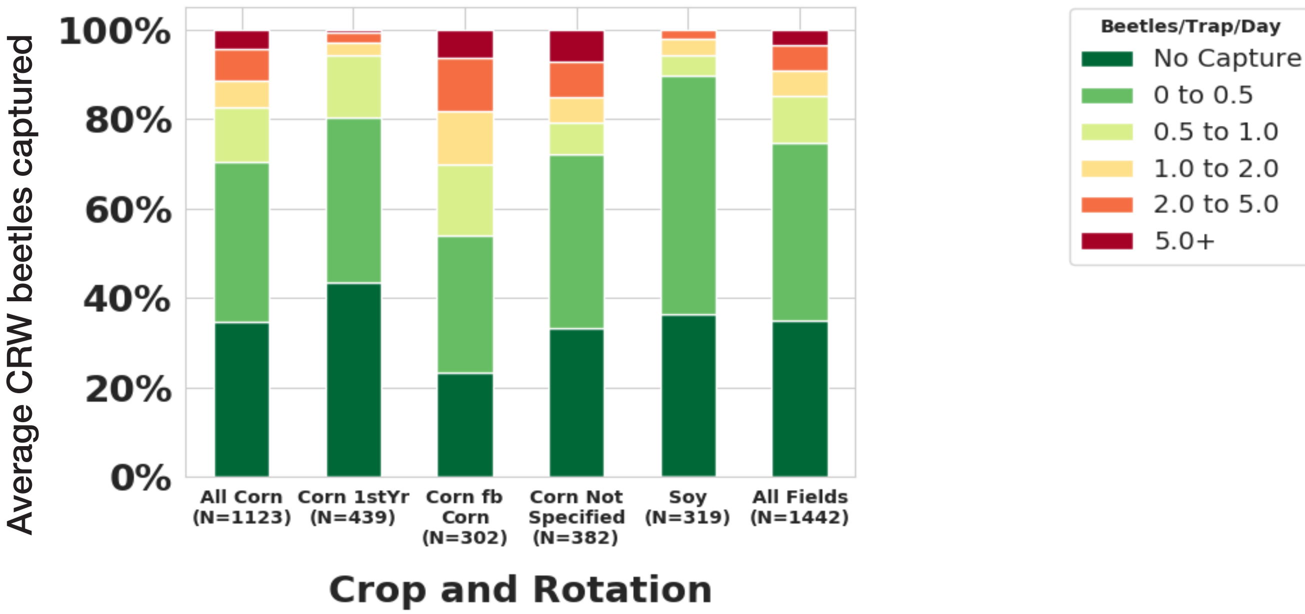

Figure 2. Overall summary of average corn rootworm beetles captured per trap per day.[1,2]. Data in this graph is the result of field trials conducted on 1442 field plots in 13 different states in 2019.

Table 1. Summary of field sampling and adult corn rootworm captures in 2019.			
2019 Crop	2018 Crop	Number of Sampled Fields	Average Peak Number of Corn Rootworm Beetles/Trap/Day
Total Corn	All Rotations	1123	0.89
Corn	Soybean	439	0.33
Corn	Corn	302	1.57
Corn	Not Specified	382	0.99
Soybean	Corn	319	0.25
Corn and Soybean	All Rotations	1442	0.75

2019 CRW Beetle Survey Data

- CRW populations were variable across the corn-growing area, which suggests that environment and management are factors in determining CRW pressure.
- 11.2% of corn fields had counts exceeding the economic threshold of 2 beetles/trap/day.
- 6% of the corn fields were approaching threshold levels.
- Corn followed by (fb) corn had higher average maximum daily counts than first-year corn (1.57 vs. 0.33 beetles/trap/day) (Table 1).
- 18% of continuous corn fields exceeded the economic threshold while less than 3% of first-year corn fields exceeded the threshold (Figure 2).
- Counts from soybean fields were low where no adults were captured in 36% of the fields and just less than 2% of the fields exceeded the threshold.
- Counts of 0 were recorded in 35% of corn.

Using 2019 Corn Rootworm Beetle Counts to Help Evaluate the Risk of an Infestation for 2020

2019 Data Interpolation

- 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 2020 risk potential, are potentially elevated in corn fields in central and southwest NE, northeast CO, northwestern KS, northwest, central, and east central IA, southwest WI, northern IL, southcentral and central MN, and southeastern ND (Figure 3).
- Corn rootworm populations are estimated to be relatively low in many parts of ND, SD, MN, IN, and central IL; however, localized hot spots can be found every year.
- CRW beetle presence in soybean fields was found to be above the threshold in a small area in north central IL and southern WI.

Comparison of 2018 vs. 2019 CRW Beetle Data (Figure 3a and b).

- Absolute comparisons between 2018 and 2019 populations should be made with limited confidence due to differences in sampling intensity and distribution. However, trends may still be reliably identified.
- Areas with large populations (i.e. "hot spots") are generally consistent from year to year.

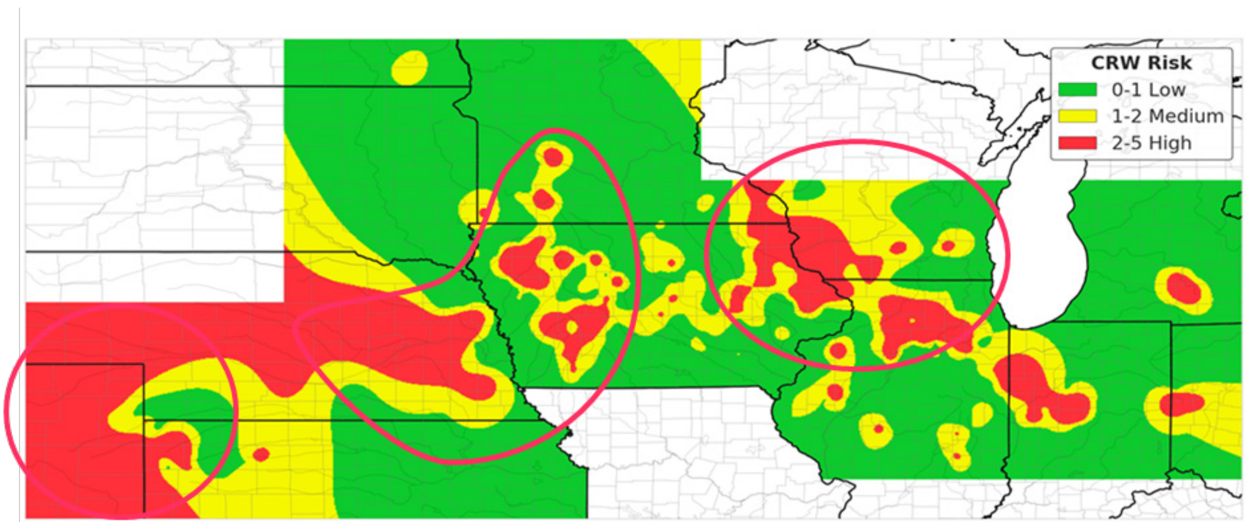

Figure 3a. Estimated corn rootworm risk in 2019 using interpolated 2018 corn rootworm counts from corn fields sampled (based on 1177 fields).

Using 2019 Corn Rootworm Beetle Counts to Help Evaluate the Risk of an Infestation for 2020

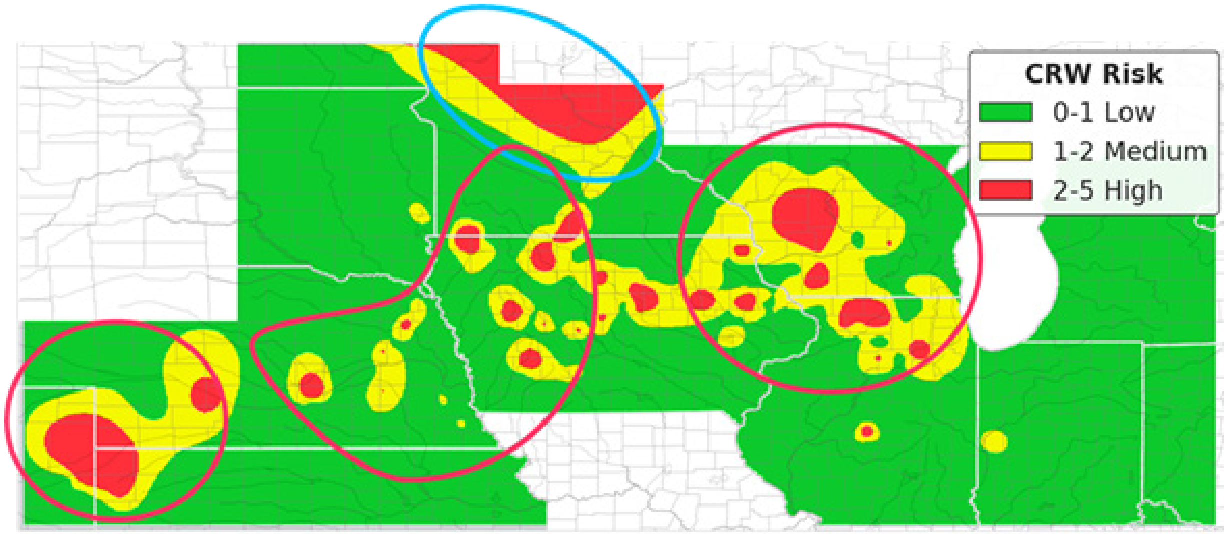

Figure 3b. Estimated corn rootworm risk in 2020 using interpolated 2019 corn rootworm counts from corn fields sampled (based on 1123 fields).

Key Learnings

- Corn rootworm is a persistent threat to yield and profit potential, 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 of 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 2020 season by selecting CRW *Bacillus thuringiensis* (*B.t.*)-protected corn products or soil-applied insecticides to help protect your crop against the risk of CRW larvae damaging roots and reducing your yield potential.

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-usingsticky-traps-assess-corn-rootworm-activity.

[3] Tinsley, N.A., Estes, R.E., and Gray, M.E. 2012. Validation of a nested error component model to estimate damage caused by corn rootworm larvae. Journal of Applied Entomology.

Legal Statements

DISEASES

Evaluation of Disease Management Systems in Soybean – Sudden Death Syndrome

Trial Objective

- Sudden death syndrome (SDS) is among the most devastating soil-borne diseases of soybean in the U.S. The disease has spread extensively and causes most of the soybean yield losses throughout the North Central Region. SDS is most severe when soybean is planted early into cool, wet soils, when heavy midsummer rains saturate the soil, and when soybean cyst nematode (SCN) is present.
- The objective of this study was to evaluate a system-based approach for SDS disease management supported by genetic resistance of germplasm and seed treatment options.

Research Site Details

- Select soybean products with varying levels of resistance to SDS were evaluated under two different Acceleron® Seed Applied Solution options:
  - STANDARD
  - STANDARD + ILeVO®
- Soybean products selected for this trial were classified as susceptible (S), moderately susceptible (MS), moderately resistant/moderately susceptible (MR/MS), moderately resistant (MR), or resistant (R) to SDS.
- Fields with a history of SDS were selected for this study.
- Plots were randomized within the trial.
- SDS disease ratings were taken at the R6 growth stage.
- Data from 2 years and a total of 11 locations with SDS symptoms were analyzed for this study, and the data shown below is the average of the 11 locations across 2 years. Most locations had mild to moderate SDS incidence and severity.

Understanding the Results

- Soybean products treated with Acceleron® STANDARD + ILeVO® resulted in significantly lower SDS disease incidence and severity and higher average yield compared to Acceleron STANDARD across all SDS disease classifications of products.
- Soybean products with enhanced resistance to SDS (i.e. resistant or moderately resistant) provided an average yield advantage of 4 bu/acre over susceptible genetics and showed substantially lower SDS disease incidence and severity.

Key Learnings

- ILeVO® seed treatment is the first and only solution currently available for SDS and continues to provide excellent SDS control and yield protection. Depending on SDS risk for your field, pairing with the right soybean products should be considered to help maximize yield potential.

Evaluation of Disease Management Systems in Soybean – Sudden Death Syndrome

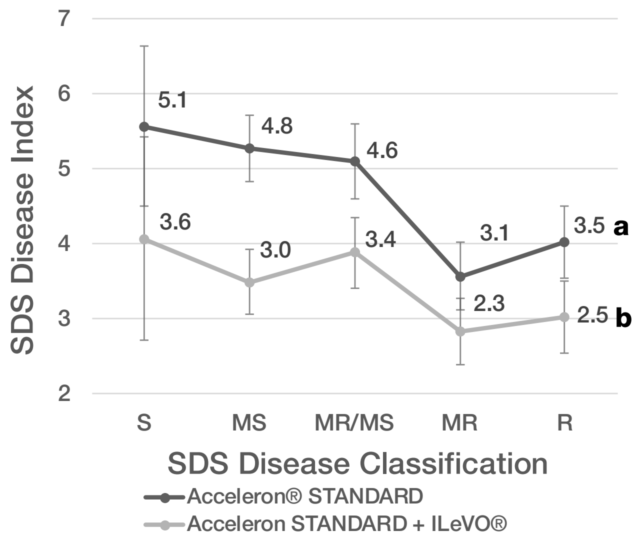

Figure 1. SDS disease index rating by Acceleron® Seed Applied Solution treatment and SDS disease classification of soybean products. SDS disease index: 1 = no disease, 9 = severe disease. Mean separation letters (a, b) denote statistically significant differences at an alpha = 0.1.

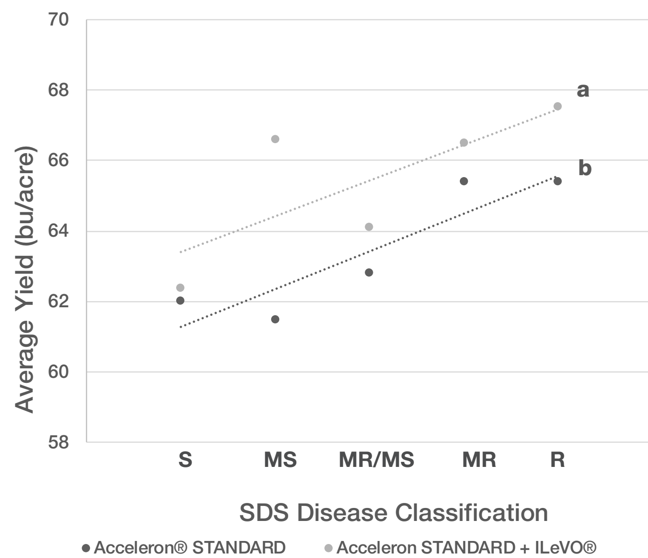

Figure 2. Average yield by Acceleron® Seed Applied Solution treatment and SDS disease classifications of soybean products. Mean separation letters (a, b) denote statistically significant differences at an alpha = 0.1.

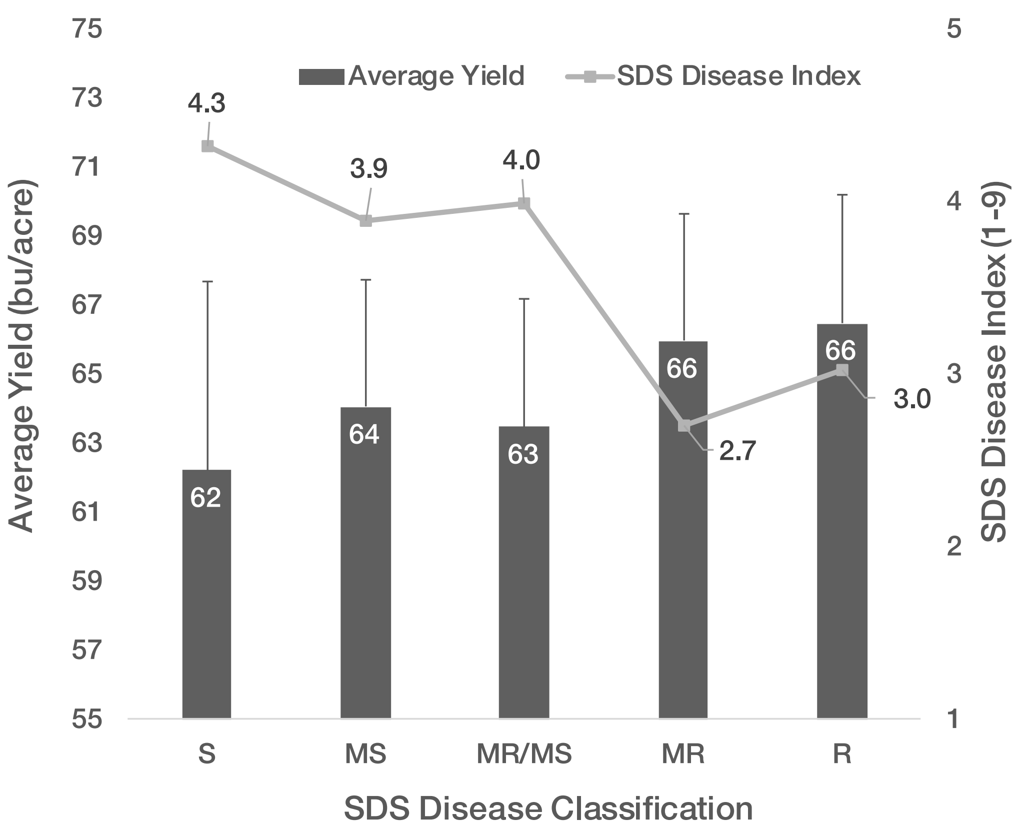

Figure 3. Average yield and SDS disease index ratings by SDS disease classification of soybean products across Acceleron® Seed Applied Solution treatments. SDS disease index: 1 = no disease, 9 = severe disease.

Evaluation of Disease Management Systems in Soybean – Sudden Death Syndrome

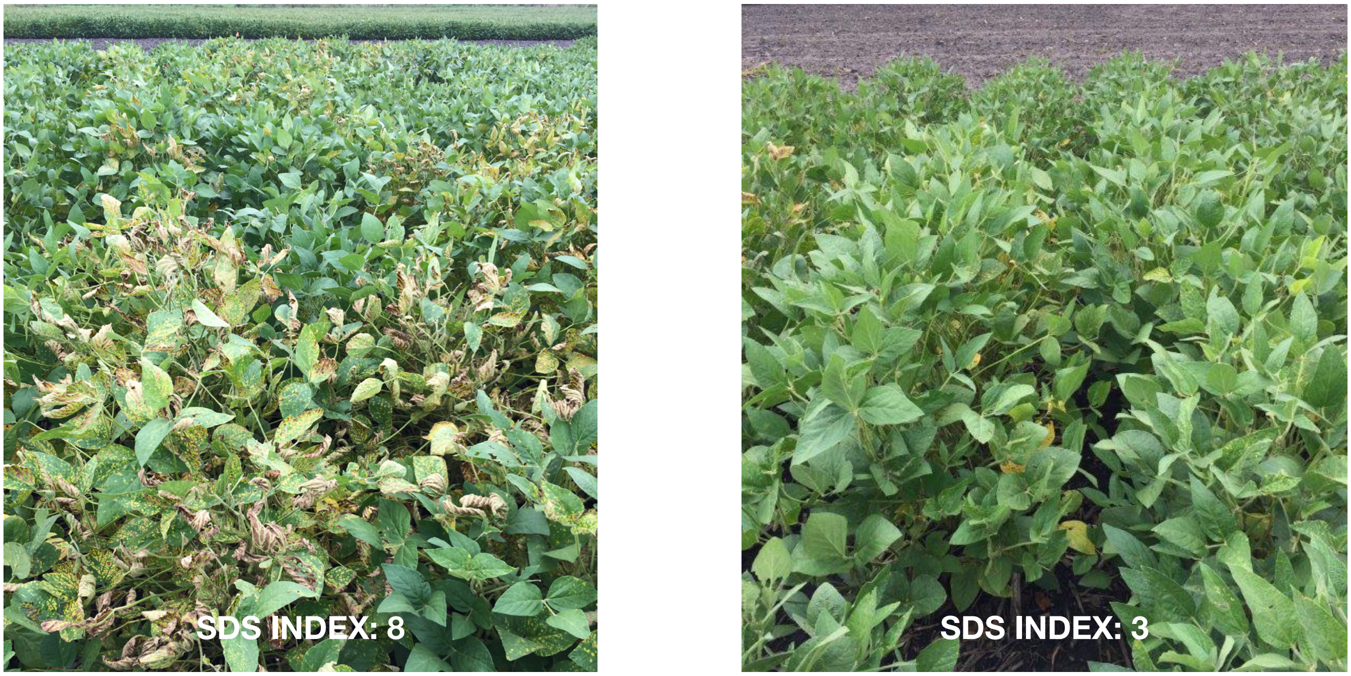

Figure 4. Comparison of the difference in soybean product SDS disease ratings and plant appearance. One product with an SDS disease rating of 8 (left) and another product with a rating of 3 (right). SDS disease index: 1 = no disease, 9 = severe disease.

Legal Statements

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DISEASES

Evaluation of Disease Management Systems in Soybean – White Mold

Trial Objective

- White mold (WM, also called Sclerotinia stem rot) is a significant problem in the U.S. North Central soybean production region and in Canada. Caused by the fungus *Sclerotinia sclerotiorum* that overwinters in the soil, WM is often recognized by fluffy, white growth on soybean stems. WM development is favored by cool, cloudy, wet, and humid weather at first flowering. The disease is more problematic in soybeans in high-yield environments where high plant populations, narrow row spacing, and an early-closing canopy are commonly used.
- The objective of this study was to evaluate a system-based approach for WM disease management supported by genetic resistance of germplasm and foliar fungicide.
- Select soybean products with varying levels of resistance to WM were evaluated under different fungicide management options.

Research Site Details

- Fields with a history of WM were selected for this study.
- Plots were planted in a split-plot design with fungicide treatment as the main plot and soybean product as the sub-plot.
- Fungicide treatments included:
  - Untreated
  - Application of Delaro® 325 SC fungicide (Group 3 + Group 11) at 8 oz/acre tank-mixed with Luna® Privilege (Group 7) fungicide at 2 oz/acre at R1
  - Application of Delaro 325 SC fungicide at 8 oz/acre tank-mixed with Luna Privilege fungicide at 2 oz/acre at R1 and R3
- Soybean products used were classified as susceptible (S), moderately susceptible (MS), moderately resistant/moderately susceptible (MR/MS), moderately resistant (MR), or resistant (R) to WM.
- Plots were randomized within the trial.
- WM disease ratings were taken at the R6 growth stage.
- Nine trial locations from 2019 with WM symptoms were analyzed for this study, and the data shown below is the average of the 9 locations. Most locations had mild to moderate WM incidence and severity.

Evaluation of Disease Management Systems in Soybean – White Mold

Understanding the Results

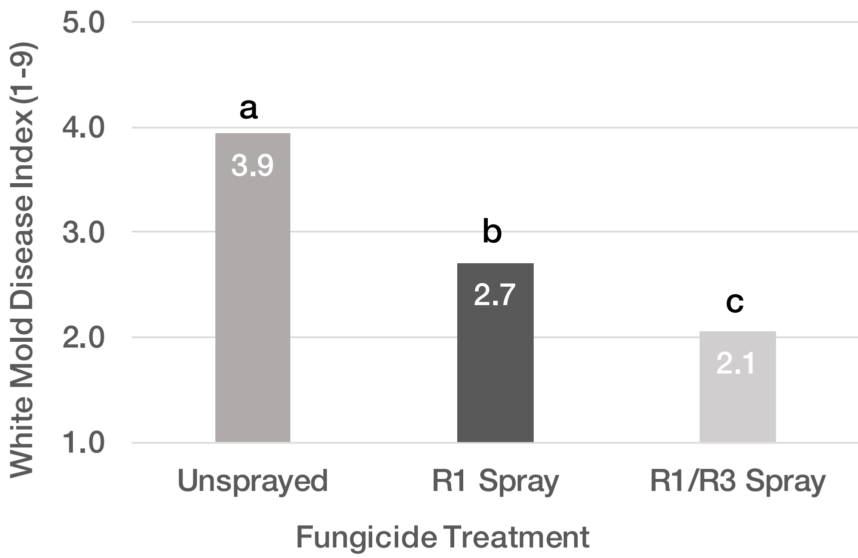


Figure 1. Average WM disease index rating for each fungicide treatment of Delaro® tank-mixed with Luna® Privilege. WM disease index: 1 = no disease, 9 = severe disease. Mean separation letters (a, b, c) denote statistically significant differences at an alpha = 0.05.

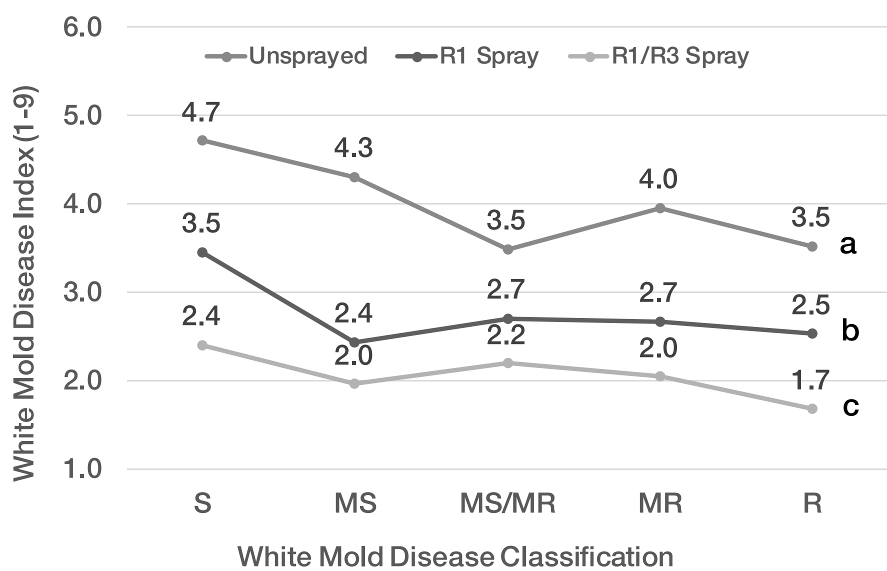


Figure 2. Average WM disease index rating by fungicide spray treatment and WM disease classification of soybean products. Fungicides: Delaro® tank-mixed with Luna® Privilege. WM disease index: 1 = no disease, 9 = severe disease. Mean separation letters (a, b, c) denote statistically significant differences at an alpha = 0.05.

Evaluation of Disease Management Systems in Soybean – White Mold

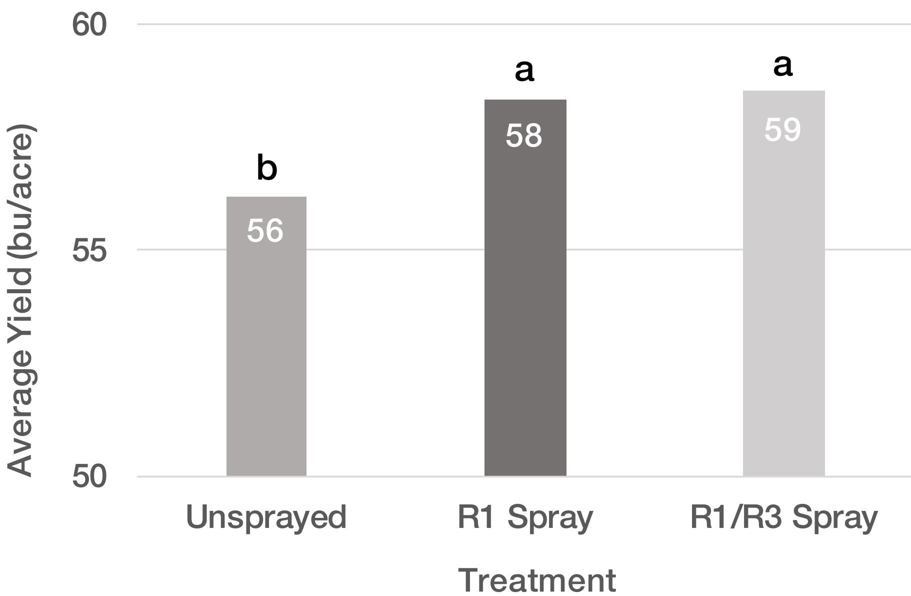


Figure 3. Average yield for each fungicide treatment across all soybean products and locations. Fungicides: Delaro® tank-mixed with Luna® Privilege. Mean separation letters (a, b) denote statistically significant differences at an alpha = 0.05.

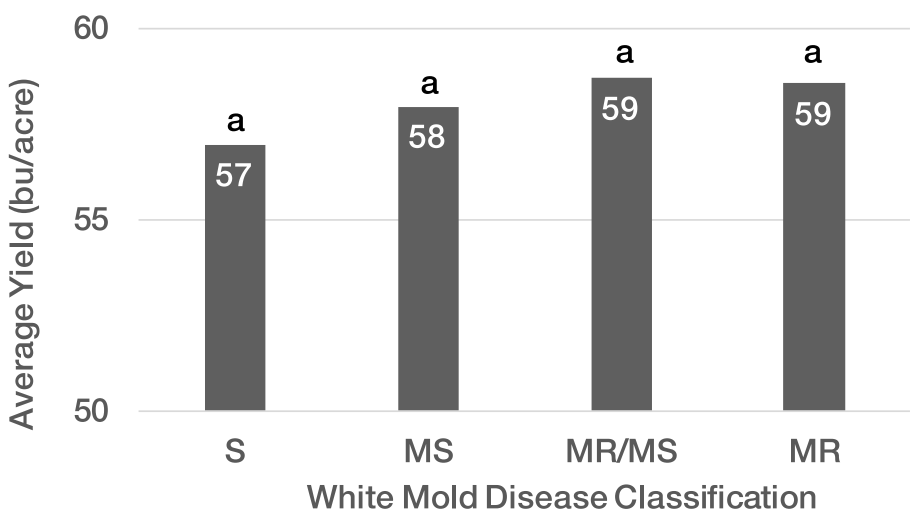


Figure 4. Average yield across all treatments for each WM disease classification of soybean products. Mean separation letters (a) denote statistically significant differences at an alpha = 0.05.

Evaluation of Disease Management Systems in Soybean – White Mold

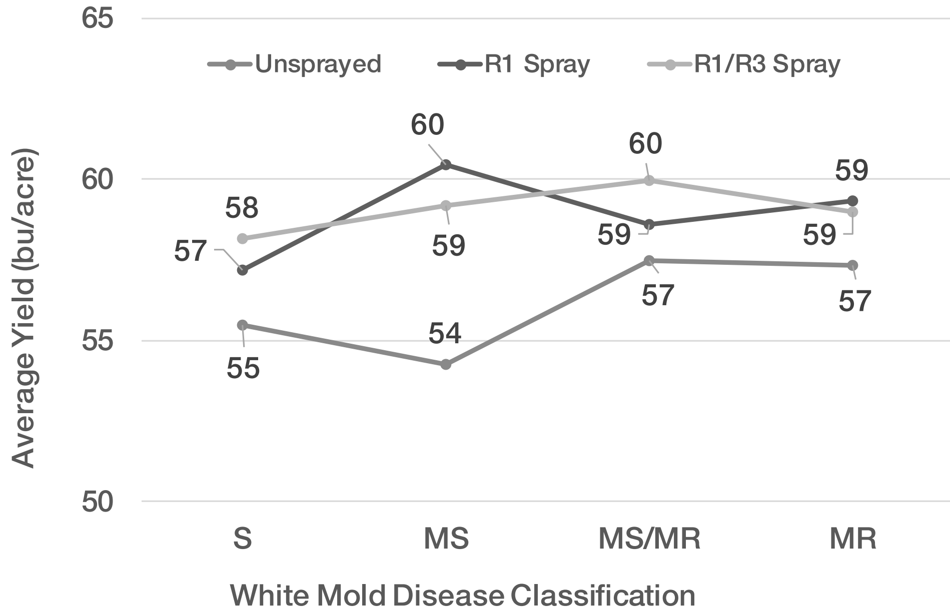


Figure 5. Average yield by fungicide treatment and WM disease classification of soybean products. Fungicides: Delaro® tank-mixed with Luna® Privilege.

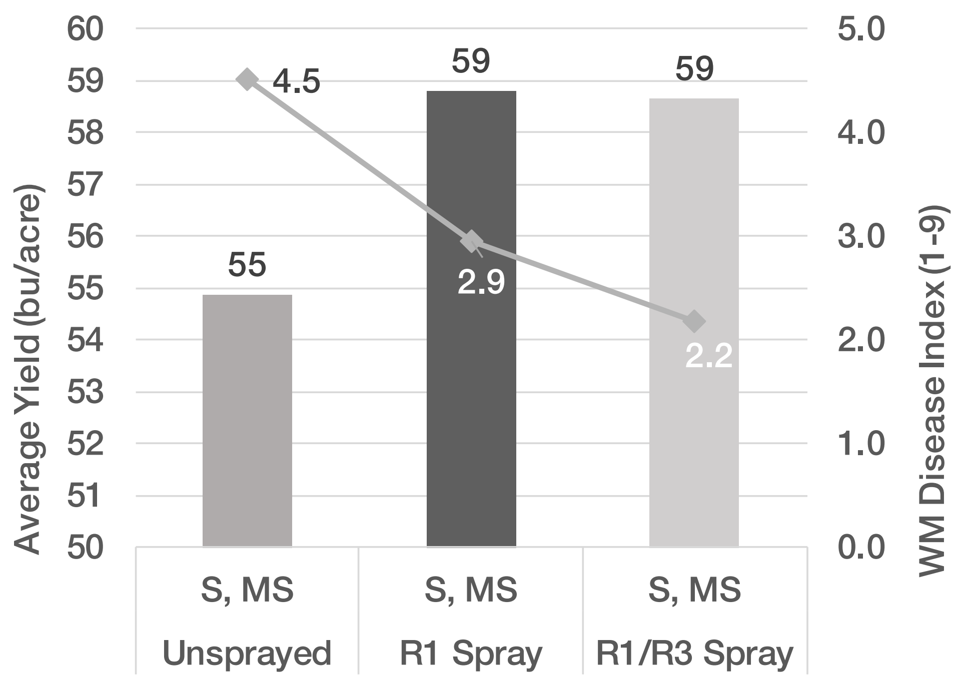


Figure 6. Average yield (bars) and WM disease index (line) of fungicide treatments for soybean products with below-average resistance to WM (S-susceptible, and MS-moderately susceptible only). Fungicides: Delaro® tank-mixed with Luna® Privilege. WM disease index: 1 = no disease, 9 = severe disease.

Evaluation of Disease Management Systems in Soybean – White Mold

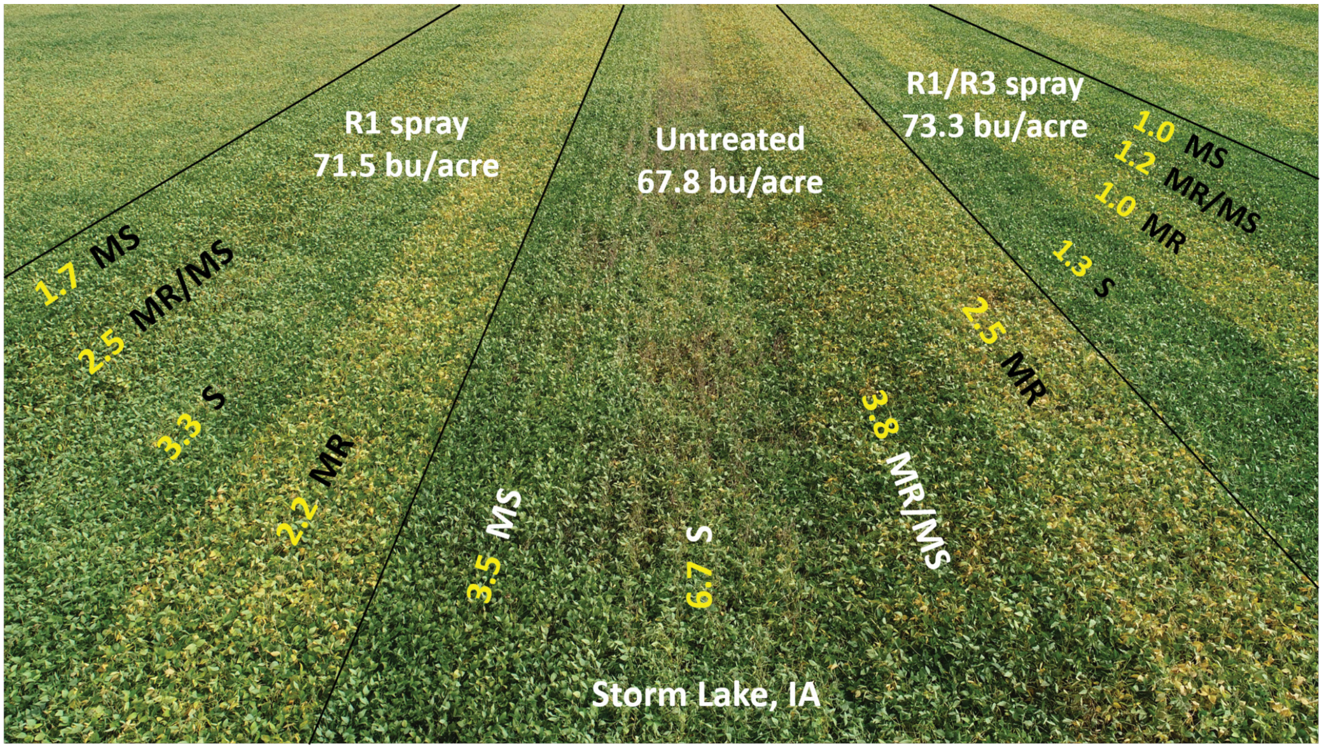
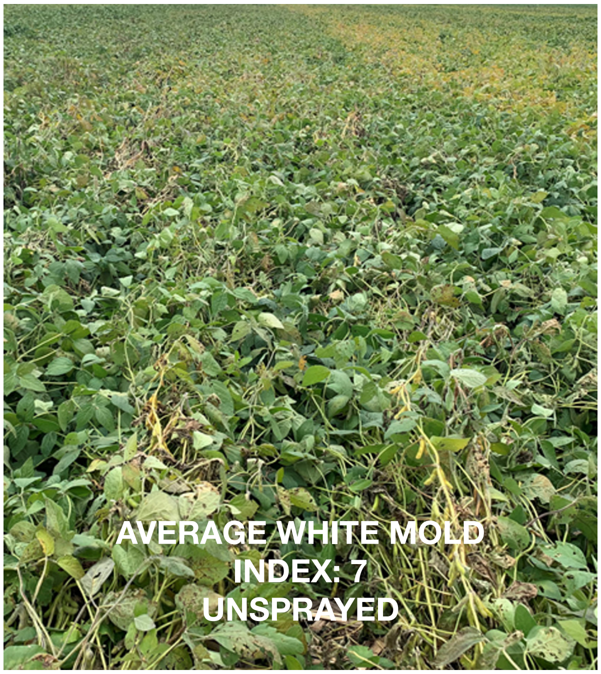


Figure 7. Aerial imagery showing visual differences of WM disease severity for each of the fungicide spray treatments and WM disease classification of products. Soybean products sprayed at R1 then followed by an R3 application yielded the highest and had the lowest WM disease index recorded in a location with relatively high WM incidence and severity (WM index numbers in yellow. WM disease index: 1 = no disease, 9 = severe disease). Fungicides: Delaro® tank-mixed with Luna® Privilege.

Evaluation of Disease Management Systems in Soybean – White Mold



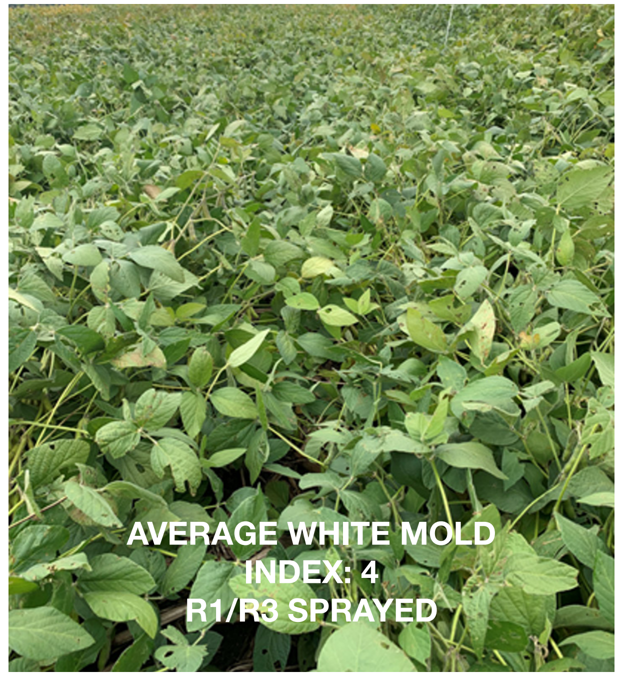


Figure 8. Side-by-side comparison of a soybean product susceptible to WM showcasing the effect of fungicide applications (R1 and R3) on WM disease control and plant health. Fungicides: Delaro® tank-mixed with Luna® Privilege. WM disease index: 1 = no disease, 9 = severe disease.

- Both fungicide treatments significantly contributed to WM disease suppression and an average yield advantage of 2 bu/acre over the unsprayed treatment.
- For soybean products with below-average resistance to WM, the fungicide treatments resulted in a 4 bu/acre yield advantage compared to the unsprayed treatment.
- Although not statistically significant, soybean products with enhanced resistance to WM provided an average yield advantage of 2 bu/acre over susceptible checks.

Key Learnings

- In a year with mild to moderate WM incidence and severity, and below-average fungicide performance based on adverse weather conditions, the use of fungicide consistently provided a yield advantage over the unsprayed treatment across soybean products, with the largest yield response observed in soybean products with below-average resistance to WM.

Legal Statements

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XtendiMax® herbicide with VaporGrip® Technology is part of the Roundup Ready® Xtend Crop System and is a restricted use pesticide. ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. It is a violation of federal and state law to use any pesticide product other than in accordance with its labeling. XtendiMax® herbicide with VaporGrip® Technology and products with XtendFlex® Technology may not be approved in all states and may be subject to use restrictions in some states. Check with your local product dealer or representative or U.S. EPA and your state pesticide regulatory agency for the product registration status and additional restrictions in your state. For approved tank-mix products and nozzles visit XtendiMaxApplicationRequirements.com.

Commercialization of XtendFlex® soybeans is dependent on multiple factors, including successful conclusion of the regulatory process. The information presented herein is provided for educational purposes only, and is not and shall not be construed as an offer to sell. Soybeans with XtendFlex® Technology contain genes that confer tolerance to glyphosate, glufosinate and dicamba. Glyphosate will kill crops that are not tolerant to glyphosate. Dicamba will kill crops that are not tolerant to dicamba. Glufosinate will kill crops that are not tolerant to glufosinate. Contact your seed brand dealer or refer to the Monsanto Technology Use Guide for recommended weed control programs.

NOT ALL formulations of dicamba or glyphosate are approved for in-crop use with Roundup Ready 2 Xtend® soybeans. ONLY USE FORMULATIONS THAT ARE SPECIFICALLY LABELED FOR SUCH USES AND APPROVED FOR SUCH USE IN THE STATE OF APPLICATION. Contact the U.S. EPA and your state pesticide regulatory agency with any questions about the approval status of dicamba herbicide products for in-crop use with Roundup Ready 2 Xtend® soybeans or cotton with XtendFlex® Technology.

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

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

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

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

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

Climate FieldView™ services provide estimates or recommendations based on models. These do not guarantee results. Consult your agronomist, commodities broker and other service professionals before making financial, risk management, and farming decisions. More information at http://www.climate.com/disclaimers. FieldView™ is a trademark of The Climate Corporation.

Insect Resistance Management
Planting Refuges, Preserving Technology

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

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