2022 Field Research

FEATURING 2021 RESEARCH AND RESULTS

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As I look back on the 2021 season and ahead to 2022, one word comes to mind: Excitement! Farmers produced the highest average corn yield on record (177 bushels per acre) and the largest soybean crop on record (4.44 billion bushels). Hopefully, you were able to maximize yields and profitability on your farm (with help from using Bayer products!). I'm just as excited to look ahead to 2022 and beyond. The Market Development Team at Bayer Crop Science works with leading genetics across our seed portfolio, innovative crop protection solutions and digital tools that aim to help agriculture push the envelope of what is possible.

It is this excitement that drives us to bring the best research and insights from Bayer agronomists, technical development representatives and research specialists to your farm. The goal of our research is to look deeper into the real-world challenges and opportunities that you experience on your farm to help streamline the recommendations and products that will help maximize yield potential and return on investment.

It is through that lens that I invite you to review the fourth edition of our Field Research Book. You will find results from local, regional, and national trials conducted by Bayer field representatives whose objective is to understand how farmers and Bayer can help improve decisions on the farm and navigate each growing season successfully and sustainably.

On behalf of Bayer Marketing Development, thank you for your business and we wish you a successful 2022.

John Chambers
Head of North America Market Development
Bayer Crop Science

The Channel Experience

As a Channel customer, you'll experience our full commitment to your success through year-round, hands-on service designed to help you make the right decisions for your crop. Using the latest technology, your Seedsman will work to understand the needs of your operation and make field-by-field recommendations to maximize the profitability of every acre. Because we understand that working to earn your trust every day pays off in increased yields and profits at the end of the season.

Expert Advice
all year long from a trusted team of advisors that includes Channel Seedsmen, agronomists and expert personnel.

Customized Service delivered through Channel Field Check Up Series visits at key stages of the growing season to help farmers maximize their profitability

Elite Seed Products
designed to perform in local conditions and developed with a rigorous selection process using field-proven, precision-breeding technology to help farmers maximize plant vigor and yield potential

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HOW TO USE THIS BOOK

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

Tar Spot Fungicide Timing Trial

Trial Objective

- Tar spot has been confirmed across a widespread area of the U.S. with reports of the disease in southern Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Nebraska, New York, northwest Ohio, Pennsylvania and Wisconsin.
- Cool, humid conditions with extended periods of leaf wetness promote tar spot development.
- This trial evaluated control of tar spot with different application timings of Delaro® 325 SC fungicide and Delaro® Complete fungicide.
- It is recommended to include fungicide applications with multiple modes of action to help mitigate yield loss from tar spot infection. Evaluation of these timings can help identify best management practices for control of tar spot.

Experiment/Trial Design

- Two trial locations in Michigan (Colon and Westphalia) were selected as areas that had a history of above average tar spot pressure.
- Treatments consisted of two corn products, 99 day RM and 102 day RM, of differing tar spot susceptibility (susceptible and less susceptible, respectively).
- Two products (Delaro® 325 SC fungicide and Delaro® Complete fungicide) with four different application timings (V5, R1, V5+R1, and R1+R3 corn growth stages) were used along with an untreated plot.
- Applications were made using a high clearance sprayer with 20 gallons/acre of water as carrier.
- Colon was an irrigated location and Westphalia was a rainfed location. Moisture load and frequency may have affected tar spot pressure.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Colon, MI	Sandy Loam	Corn	Conventional	4/27/21	9/10/21	300	36,000
Westphalia, MI	Loam	Soybean	Conventional	5/13/21	10/1/21	250	34,000

Corn Growth Stage at Application	Fungicide Rate & Product
Unsprayed	-
V7	6 fl oz/acre Delaro® 325 SC fungicide
V7+R1	6 fl oz/acre Delaro® 325 SC fungicide + 10 fl oz/acre Delaro® Complete fungicide
R1	10 fl oz/acre Delaro® Complete fungicide
R1+R3	10 + 10 fl oz/acre Delaro® Complete fungicide

Tar Spot Fungicide Timing Trial

Understanding the Results

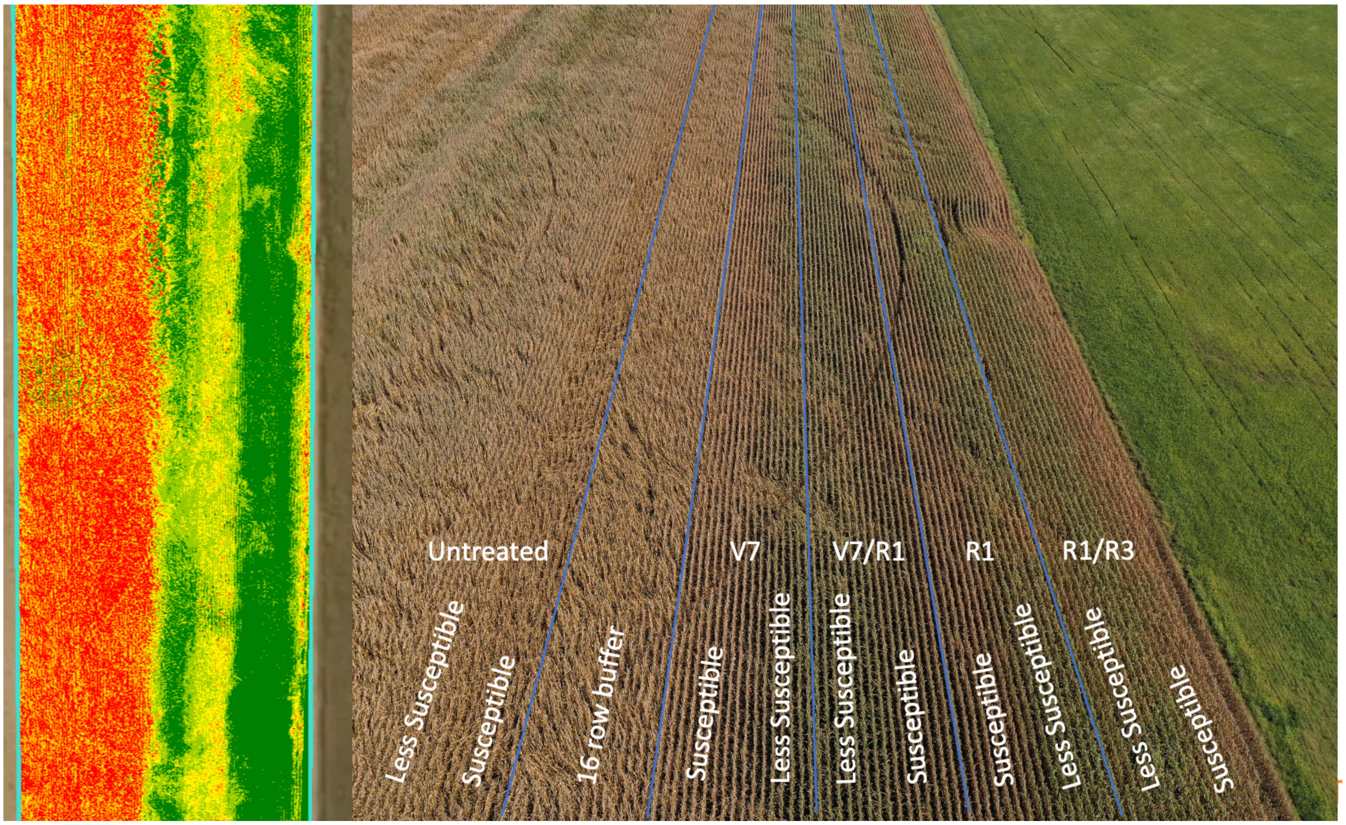

Figure 1. Aerial imagery of the trial at Colon, MI (2021). Normalized difference vegetation index (NDVI) of the trial on left and aerial photo of the trial with treatment labels on right.

Figure 2. Untreated susceptible corn product on left, and R1 and R3 treated less susceptible corn product on right at Colon, MI (2021).

Tar Spot Fungicide Timing Trial

Figure 3. Representative corn stalks of untreated susceptible corn product on left, and untreated less susceptible corn product on right at Colon, MI (2021).

- High tar spot pressure was present at Colon and moderate disease pressure at Westphalia.
- A fungicide application at R1 corn growth stage at either location provided the greatest yield increase (Tables 1 and 2).
- In this trial, the addition of a fungicide application at V7 corn growth stage provided improved stalk health at Colon with reduced stalk breakage in the end-of-season stalk push test (Table 1).
- A fungicide application increased the yield of the more susceptible corn product compared to less susceptible products (Figure 1).
- The addition of a second late-season application did not increase corn grain yields in Colon (Figure 1).

Figure 4. Representative corn stalks of R1 and R3 treated susceptible corn product on left and R1 and R3 treated less susceptible corn product on right at Colon, MI.

Tar Spot Fungicide Timing Trial

Table 1. End of season corn characteristics from Colon, MI (irrigated, corn on corn) tar spot fungicide timing trial.

Corn Product*	Corn Growth Stage at Fungicide Application	Percent Moisture	Average Yield (bu/acre)	Good Pith (%)**	Tar Spot Leaf Rating	Stalk Push Test (%)***	Intactness Score (1-9)	Lodging Score (1-9)
Susceptible	Untreated	19	205	30	5	75	8	6
Less Susceptible	Untreated	20	220	70	6	35	6	4
Susceptible	V7	20	236	40	7	15	7	4
Less Susceptible	V7	23	244	70	3	5	4	2
Susceptible	V7+R1	23	260	60	2	0	4	1
Less Susceptible	V7+R1	24	256	70	2	2	4	2
Susceptible	R1	22	262	60	2	1	4	1
Less Susceptible	R1	23	258	70	4	1	4	1
Susceptible	R1+R3	21	252	80	3	0	1	0
Less Susceptible	R1+R3	25	253	80	4	0	1	0

*Tar Spot Susceptibility
**Percent of 20 stalks that exhibited white, undeteriorated stalk tissue at 10-inch height from soil surface
***Push Test: % of stalks that break at R6 growth stage
All ratings are 1-9 scale with 1 = best

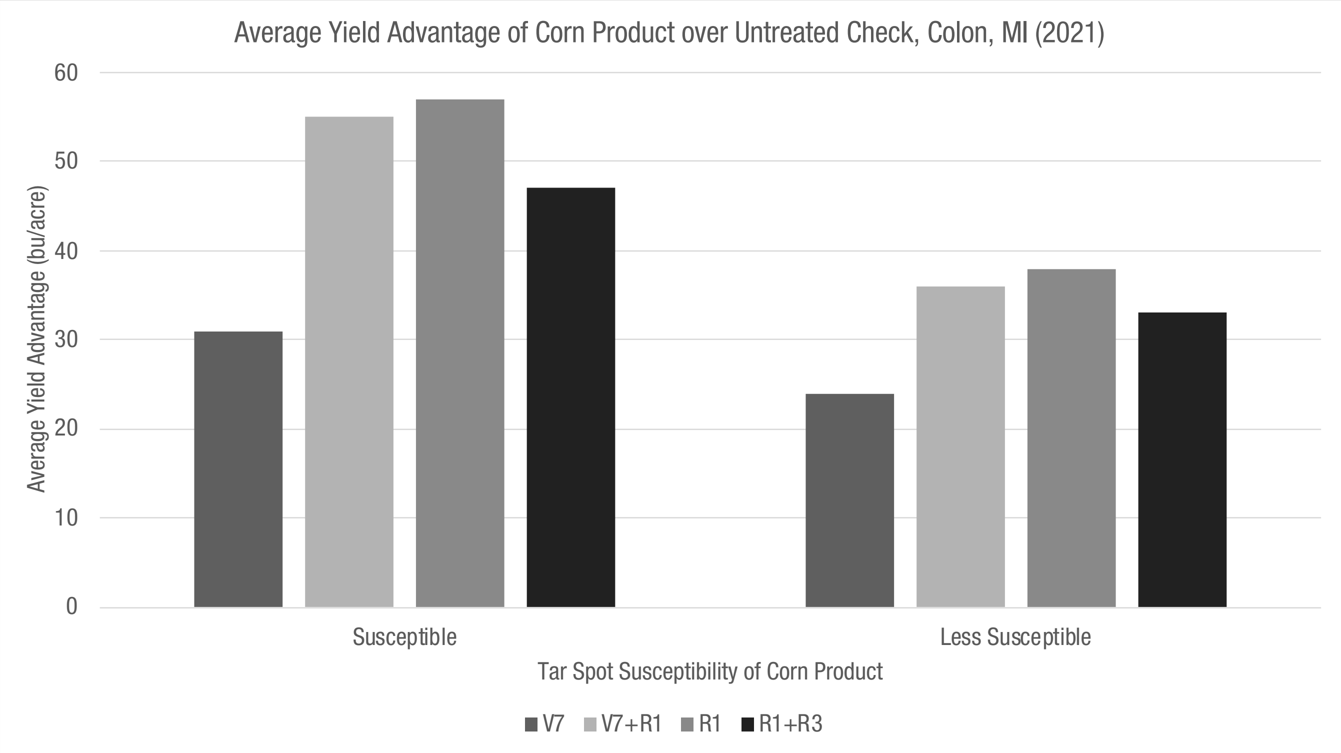

Figure 5. Average yield advantage of susceptible and less susceptible corn products at different fungicide timings over the untreated check in Colon, MI (2021).

Tar Spot Fungicide Timing Trial

Table 2. End of season corn characteristics from Westphalia, MI (non-irrigated, previous crop soybean) tar spot fungicide timing trial.								
Corn Product*	Corn Growth Stage at Fungicide Application	Percent Moisture	Average Yield (bu/acre)	Good Pith (%)**	Tar Spot Leaf Rating	Stalk Push Test (%)***	Intactness Score (1-9)	Lodging Score (1-9)
Susceptible	Untreated	22	205	40	6	5	2	0
Less Susceptible	Untreated	17	182	48	7	5	2	1
Susceptible	V7	21	187	60	6	0	1	0
Less Susceptible	V7	18	195	52	6	2	2	1
Susceptible	V7+R1	24	203	80	4	5	1	0
Less Susceptible	V7+R1	21	214	80	4	5	2	1
Susceptible	R1	26	209	76	5	0	1	0
Less Susceptible	R1	22	227	72	5	1	2	0
Susceptible	R1+R3	27	202	68	4	0	1	0
Less Susceptible	R1+R3	23	218	68	3	0	1	0

*Tar Spot Susceptibility
**Percent of 20 stalks that exhibited white, undeteriorated stalk tissue at 10-inch height from soil surface
***Push Test: % of stalks that break at R6 growth stage
All ratings are 1-9 scale with 1 = best

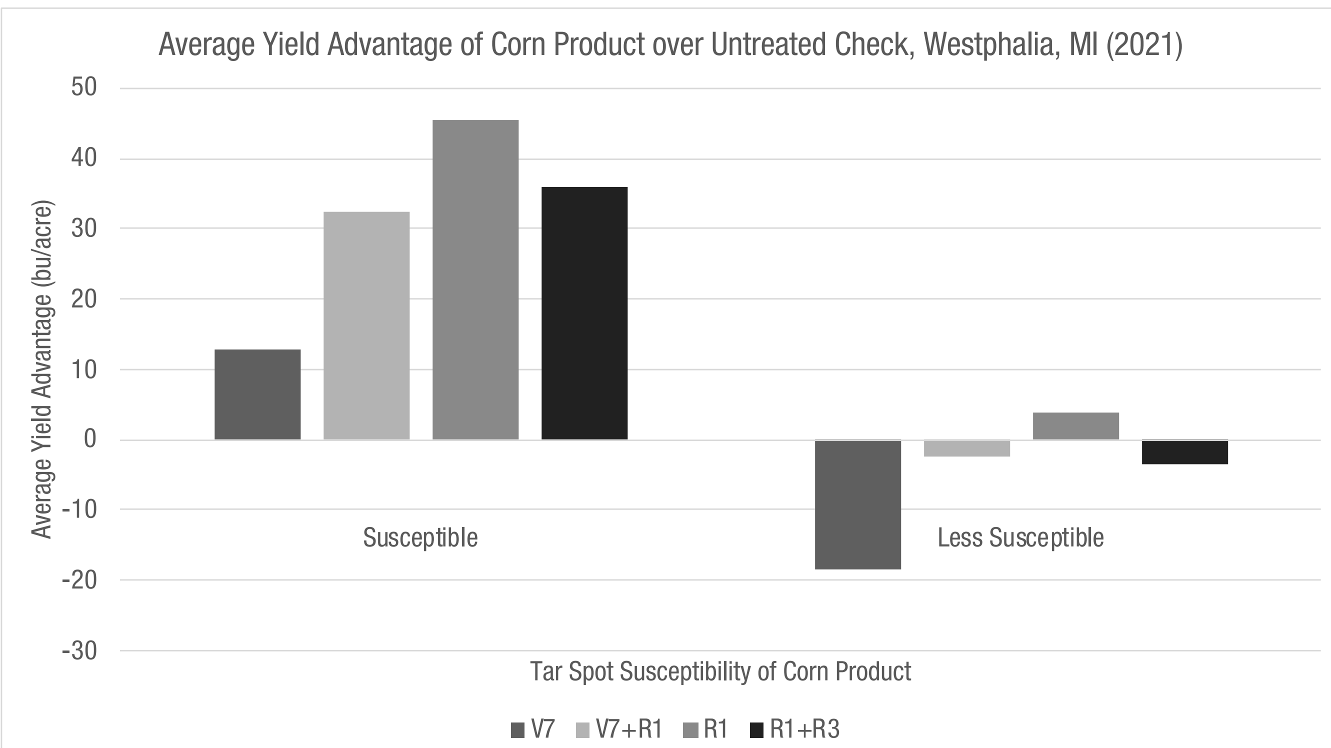

Figure 6. Average yield advantage of susceptible and less susceptible corn products at different fungicide timings over the untreated check in Westphalia, MI (2021).

Tar Spot Fungicide Timing Trial

Key Learnings

- Tar spot can substantially reduce yield potential, but the use of a Delaro® Complete fungicide at R1 can help prevent loss of yield potential.
- The application of a low rate of Delaro® 325 SC fungicide around V7 growth stage may help improve stalk health and late season stalk strength.
- Both susceptible and less susceptible corn products benefit from an application of Delaro® Complete fungicide in fields with greater tar spot disease pressure.

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

Legal Statment

Tar Spot Spray Timing Trials

Trial Objective

- Every year since first reported in the United States in 2015, regions of tar spot incidence have expanded. Tar spot has been repeatedly identified in counties where it has been previously reported and continues to expand to nearby counties every year. In 2020, tar spot expanded into new areas that included Missouri, Minnesota, Pennsylvania, and Ontario (Figure 1).
- In severe cases, losses from tar spot of 50 bushels per acre or more have been observed.[1]
- While fungicides have shown effectiveness in managing tar spot, timing of fungicide applications is important in successfully managing this disease.
- The objective of these trials was to determine the effectiveness of fungicide rate and timing on the management of tar spot in corn.

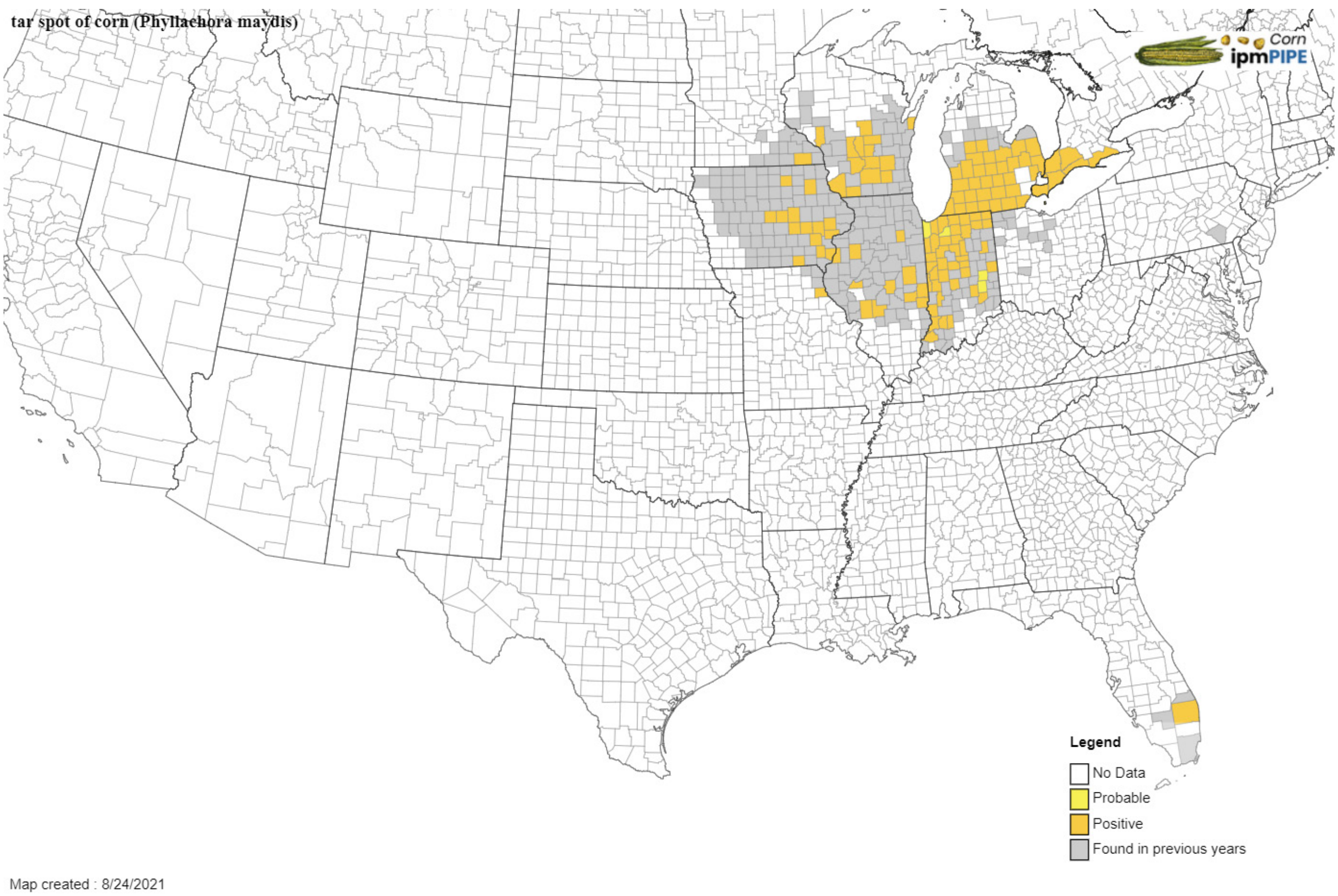

Figure 1. A map of current and previous tar spot infected areas as of August 2021 .

Source: https://corn.ipmpipe.org/tarspot/

Tar Spot Spray Timing Trials

Research Site Details

- 2018 Michigan State University Tar Spot Fungicide Trial (Ganges, MI)[2]
  - » For this trial, fungicide treatments were applied at the R3 growth stage on August 10, 2018.
  - » Treatments included:
    - — Nontreated control
    - — Headline® 2.09 SC fungicide
    - — Proline® 480 SC fungicide
    - — Delaro® 325 SC fungicide
  - » Tar spot disease severity was determined by estimating the percent leaf area with lesions on the ear leaf and ear leaf+2 (second leaf above the ear leaf) from 10 plants in the center two rows (five from each row) at 14 days after treatment (August 24) and 28 days after treatment (September 7).
  - » Tar spot was first noted in the field by the farmer on July 8, 2018. Disease was widespread throughout the field and found on every plant on Aug 10, 2018. Severe lodging was developing in areas of the field by September 7, 2018.

- 2018 Wisconsin Foliar Fungicide Trial (Arlington, WI)[3]
  - » Two 109-day relative maturity (RM) brown midrib (BMR) corn products were used.
  - » Treatments included:
    - — Nontreated control
    - — Proline® 480 SC fungicide applied at R1 and R2 growth stages
    - — Delaro® 325 SC fungicide applied at R1 and R2 growth stages
    - — Headline® AMP fungicide applied at R1 and R2 growth stages
    - — Miravis® Neo fungicide applied at R1 and R2 growth stages
    - — Miravis® Ace fungicide applied at R1 growth stage
    - — Topguard® fungicide applied at R1 growth stage
    - — Lucento® fungicide applied at R1 growth stage
  - » Tar spot severity was visually assessed as the average symptomatic percentage of ear leaves for five plants per plot with the aid of a standard area diagram; means for each plot were used in the analysis.

Tar Spot Spray Timing Trials

- 2019 University of Illinois Trial (Monmouth, IL)
  - For this trial, fungicide treatments were applied at the R5 growth stage.
  - Treatments included:
    - Nontreated control
    - Aproach® fungicide
    - Delaro® 325 SC fungicide
    - Miravis ® Neo fungicide
    - Tilt® fungicide
  - The growing season in 2019 was challenging, with early season rains delaying planting, followed by hot, drought conditions from VT through approximately R3.
  - Cooler, wetter weather in early September favored tar spot development late in the season, within a week of treatment applications.

- 2020 University of Illinois Trial (Monmouth, IL)
  - For this trial, fungicide treatments were applied at the R3 growth stage.
  - Treatments included:
    - Nontreated control
    - Affiance® Fungicide
    - Aproach® Fungicide
    - Aproach® Prima Fungicide 2.34 SC
    - Delaro® 325 SC fungicide
    - Miravis® Neo Fungicide
    - Proline® 480 SC fungicide
    - Revytek™ Fungicide
    - Trivapro® Fungicide
    - Delaro® Complete Fungicide
    - Veltyma™ Fungicide
    - Aproach + TILT® fungicide
    - Tilt® 3.6 EC fungicide
    - Lucento® Fungicide
    - Affiance® Fungicide + Badge® SC Fungicide
    - Domark® 230 ME Fungicide +Badge® SC Fungicide
  - Disease severity was visually rated as the percent leaf area infected from the ear leaf of five plants located within the center two rows of each plot on September 7 (R5) and September 15.
  - Tar spot developed rapidly increasing from 9.9% on September 7 to 25.3% on September 15.

Tar Spot Spray Timing Trials

- Effect of Tar Spot in Central Indiana Trial, 2020 (West Lafayette, IN)
  - » For this trial, fungicide treatments were applied at the V7 and VT/R1 growth stages.
  - » Treatments included:
    - — Nontreated Control
    - — Trivapro® 2.21 SE Fungicide
    - — Aproach® Prima 2.34 SC Fungicide
    - — Delaro® Complete Fungicide
    - — Veltyma™ 3.34 S Fungicide
    - — Miravis® Neo 2.5 SE Fungicide
  - » Tar spot stroma visually assessed percentage (0-100%) of leaf area on five plants in each plot at the ear leaf (EL).
  - » Tar spot chlorotic and necrotic symptoms visually assessed percentage (0-100%) of leaf area on five plants in each plot at the EL.

- 2019 Tar Spot Strip Trial
  - » This trial included 12 locations.
    - — 7604 Early Relative Maturity (RM) Set:
    - — 99 RM product, Susceptible*
    - — 102 RM product, Less Susceptible*
    - — 7604 Mid Relative Maturity Set:
    - — 113 RM product, Susceptible*
    - — 114 RM product, Less Susceptible*
  - » This trial included five fungicide application timings:
    1. Untreated control
    2. V5 growth stage
    3. R1 growth stage
    4. V5 + R1 growth stage
    5. R1 + R3 growth stage

Tar Spot Spray Timing Trials

- 2020 Tar Spot Strip Trial
  - This trial included eight locations.
  - 7606 Early Relative Maturity Set:
    - 99 RM product, Susceptible*
    - 102 RM product, Less Susceptible*
  - 7606 Mid Relative Maturity Set:
    - 113 RM product, Susceptible*
    - 114 RM product, Less Susceptible*
  - This trial included two fungicide treatment blocks:
    - Delaro® 325 SC Fungicide
    - Delaro® Complete Fungicide (tank mix of Delaro 325 SC Fungicide + Luna® Privilege Fungicide)
  - Spray treatments for each block of chemistry included:
    1. Unsprayed
    2. V5-V7 growth stage, application of Delaro® 325 SC Fungicide (6 oz/acre)
    3. V5-V7 growth stage, application of Delaro® 325 SC Fungicide (6 oz/acre) followed by R1 growth stage application of Delaro® Complete Fungicide.
    4. R1 growth stage, application of Delaro® Complete Fungicide.
    5. R1 growth stage, application of Delaro® Complete Fungicide tank mix followed by R3-R4 growth stage application of Delaro® Complete Fungicide.

*All corn products show susceptibility to tar spot. Those considered susceptible show more severe symptoms of tar spot earlier than those considered less susceptible.

Tar Spot Spray Timing Trials

Understanding the Results

2018 Michigan State Trial[2]

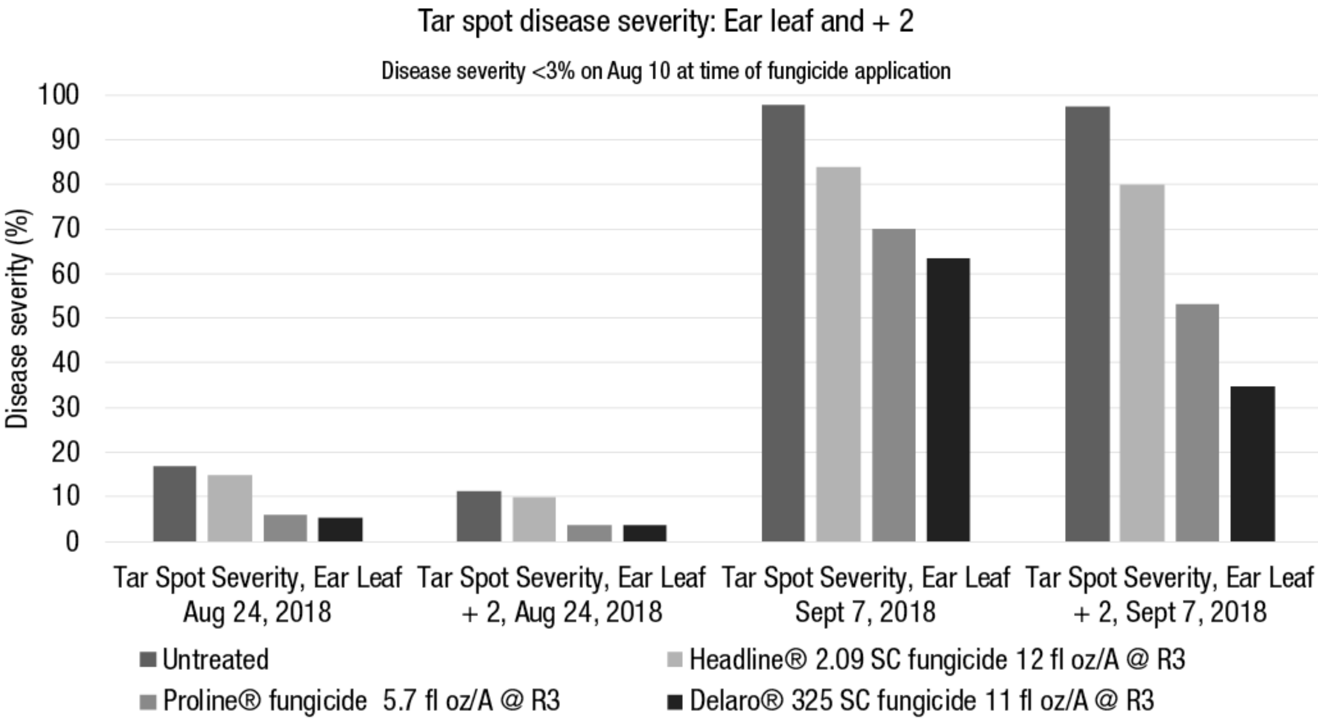

Figure 2. Effect of fungicide on tar spot disease severity in 2018, Ganges, Michigan.

- Initial ratings of the non-treated plots on August 10, 2018 found an average of 1.2% and 0.7% disease severity on the ear leaf and ear leaf+2, respectively. Disease severity rapidly increased over the next four weeks, with lesions essentially occupying the entire leaf of non-treated plots by September 7, 2018.
- Proline® fungicide and Delaro® 325 SC fungicide both significantly reduced foliar disease on the ear leaf and ear leaf+2 at the September 7, 2018, rating.

Tar Spot Spray Timing Trials

2018 Wisconsin Foliar Fungicide Trial[3]

Corn Product A TREATMENTS	Rate	Growth Stage Applied*	Tar Spot Severity (%)	LSD (alpha 0.05)
Proline® 480 SC fungcide	5.7 fl oz/acre	R2	8.625	abc
Delaro® 325 SC fungicide	8 fl oz/acre	R2	2	ef
Proline® 480 SC fungicide	5.7 fl oz/acre	R1	7.375	a-d
Headline® AMP fungcide	14.4 fl oz/acre	R2	1.375	e
Topguard® fungicide	10 fl oz/acre	R1	5.625	cde
Miravis® Ace fungicide	13.7 fl oz/acre	R1	6.25	b-f
Miravis® Neo fungicide	13.7 fl oz/acre	R1	6.875	a-d
Delaro® 325 SC fungicide	8 fl oz/acre	R1	4.25	cde
Lucento® fungicide	5 fl oz/acre	R1	5.75	bce
Headline® AMP fungcide	14.4 fl oz/acre	R1	2.75	def
Non-Treated			10.5	ab
Miravis® Neo fungicide	13.7 fl oz/acre	R2	5.5	cde
F-value			2.97	
P-value			0.0043	

*Growth stages include: R1-silking, R2- blister
Means followed by the same letter are not significantly different based on Fisher's Least Significant Difference (LSD; a =0.05).

Corn Product B TREATMENTS	Rate	Growth Stage Applied *	Tar Spot Severity (%)	LSD (alpha 0.05)
Delaro® 325 SC fungicide	8 fl oz/acre	R2	0.55	d
Lucento® fungicide	5 fl oz/acre	R1	0.775	cd
Proline® 480 SC fungicide	5.7 fl oz/acre	R1	1.15	bcd
Non-Treated			3.75	a
Miravis® Neo fungicide	13.7 fl oz/acre	R2	1.15	bcd
Miravis® Ace fungicide	13.7 fl oz/acre	R1	1	cd
Proline® 480 SC fungicide	5.7 fl oz/acre	R2	1	cd
Delaro® 325 SC fungicide	8 fl oz/acre	R1	1	cd
Headline® AMP fungicide	14.4 fl oz/acre	R2	0.55	d
Headline® AMP fungicide	14.4 fl oz/acre	R1	0.775	cd
Topguard® fungicide	10 fl oz/acre	R1	1.375	bcd
Miravis® Neo fungicide	13.7 fl oz/acre	R1	0.55	d
F-value			5.35	
P-value			<.0001	

*Growth stages include: R1-silking, R2- blister
Means followed by the same letter are not significantly different based on Fisher's Least Significant Difference (LSD; a=0.05).

Table 1. Average tar spot severity for fungicide treatments on two brown midrib corn products in Arlington, Wisconsin in 2018.

- Tar spot severity was significantly impacted by fungicide treatments (Table 1). Most treatments resulted in lower tar spot severity compared to not treating.

Tar Spot Spray Timing Trials

2019 University of Illinois Trial

	9/17/19		10/3/19			
Treatment and rate A^{-1}	**Senescence (%)**	**TS[z] (%)**	**Senescence (%)**	**TS (%)**	**Lodging (%)**	**Yield (bu A^{-1})**
Non-treated	23.7	1.2	71.8 a[y]	7.9 a	5	255.3
Aproach® fungicide (6 fl oz)	21.8	1.4	57.3 b	5.5 b	8	270.6
Delaro® 325 SC fungicide (8 fl oz)	26.3	0.3	53.5 b	2.9 cd	3	289.1
Miravis® Neo Fungicide (13.7 fl oz)	16.3	0.1	45.0	1.6 d	3	260.8
TILT® fungicide (2 fl oz)	30.0	0.3	60.0 b	3.7 cd	5	256.8
P >F	NS	NS	<.0001	<.0001	NS	NS

Table 2. 2019 University of Illinois trial results at the Northwestern Illinois Research and Demonstration Center in Monmouth, Illinois. A 110 RM corn product was planted June 3, 2019, and fungicide applied September 3, 2019, at the R5 growth stage. NS = not significant.

- All fungicides tested in this trial reduced tar spot severity and plant senescence relative to non-treated controls on four weeks after application (October 3, 2019).
- Delaro® 325 SC fungicide (8 fl oz), Miravis® Neo Fungicide (13.7 fl oz) and TILT® fungicide (2 fl oz) reduced tar spot severity significantly more than Aproach® fungicide (6 fl oz) four weeks after application.
- Miravis® Neo Fungicide (13.7 fl oz) provided the greatest reduction in plant senescence.
- No significant differences in lodging or yield were detected between fungicide treatments.

Tar Spot Spray Timing Trials

2020 University of Illinois Trial

Treatment	Rate (fl oz A-1)	SR 7 Sep (%)		TS 7 Sep (%)		TS 15 Sep (%)		Yield (bu A-1)
Non-treated Control		7.6	a	11.2	a	24.4	a	182.5
Affiance® Fungicide	10	0.4	b	3.1	b-f	15.7	bcd	190.0
Aproach® Fungicide	6	1.8	bcd	4.6	bcd	14.2	bcd	198.8
Aproach® Prima Fungicide 2.34 SC	6.8	0.6	cd	1.9	efg	13.1	bcd	176.5
Delaro® 325 SC fungicide	8	0.5	cd	2.2	d-g	5.7	e	202.7
Miravis® Neo Fungicide	13.7	0.8	cd	1.1	g	12.3	cd	183.4
Proline® 480 SC fungicide	5.7	3.2	b	4.6	bcd	18.6	abc	193.4
Revytek™ Fungicide	8	0.4	d	2.8	b-g	5.9	e	186.3
Trivapro® Fungicide	13.7	0.9	cd	5.6	bcd	15.7	bcd	198.6
Delaro® Complete Fungicide	8	0.6	cd	1.8	fg	4.0	e	193.6
Veltyma™ Fungicide	7	2.1	bcd	2.3	c-g	5.7	e	202.4
Aproach + TILT® fungicide	6 + 3	1.7	bcd	4.0	b-f	14.6	bcd	190.0
Tilt® 3.6 EC fungicide	3	6.7	a	5.0	bc	21.3	ab	202.6
Lucento® Fungicide	5	0.6	cd	5.4	b	16.0	bcd	188.4
Affiance® Fungicide + Badge® SC Fungicide	10 + 32	2.2	bc	2.1	d-g	13.3	bcd	195.1
Domark® 230 ME Fungicide + Badge® SC Fungicide	6 + 32	4.5	ab	4.3	b-e	11.7	d	185.0
	P(F)	<0.0001		<0.0001		<0.0001		0.15

Table 3. 2020 University of Illinois trial results at the Northwestern Illinois Research and Demonstration Center in Monmouth, Illinois. A 110 RM corn product was planted April 23, 2019, and fungicide applied July 28, 2020, at the R3 growth stage. Visual ratings of tar spot severity were taken at six weeks (September 7, 2020) and seven weeks (September 15, 2020) after application.

- All fungicides tested in this trial reduced tar spot severity relative to non-treated controls at both rating dates.
- No differences in average yield were detected, which may have been a result of a severe wind event in August that caused some leaning and lodged corn that increased variability in the trial.

Tar Spot Spray Timing Trials

2020 Effect of Tar Spot in Central Indiana Trial

Treatment[z]	Rate/A	Timing	Tar spot % stroma[y] 7-Oct	Tar spot % chlor/nec[x] 7-Oct	Yield[w] bu/A 6-Nov
Nontreated Control			25.60 a	44.75 a	225.8
Trivapro® 2.21 SE Fungicide	13.7 fl oz	VT/R1	4.75 b	3.90 b	221.7
Aproach® Prima 2.34 SC Fungicide	6.8 fl oz	VT/R1	4.90 b	2.70 b	229.1
Delaro® Complete Fungicide	8 fl oz	VT/R1	5.00 b	6.50 b	240.0
Delaro® Complete Fungicide	12 fl oz	VT/R1	2.61 b	1.75 b	221.9
Veltyma™ 3.34 S Fungicide	7 fl oz	VT/R1	2.36 b	0.85 b	227.0
Miravis® Neo 2.5 SE Fungicide	13.7 fl oz	VT/R1	4.65 b	1.45 b	225.3
p-value			<.0001	<.0001	0.4
LSD (0.05)[w]			2.95	7.91	NS

[z]Fungicide treatments were applied on 8-Jul at V7 (tassel) and on 8-Aug at VT/R1 (tassel/silk) growth treatments contained a non-ionic surfactant (Preference® adjuvant) at a rate of 0.25% v/v. [y]Tar spot stroma visually assessed percentage (0-100%) of leaf area on five plants in each plot at the ear leaf (EL). [x]Tar spot chlorotic and necrotic symptoms visually assessed percentage (0-100%) of leaf area on five plants in each plot at the ear leaf (EL). Means followed by the same letter are not significantly different based on Fisher's Least Significant Difference test (LSD; a=0.05). NS = not significant (a=0.05).

Table 4. Results from the 2020 fungicide timing trial at Purdue Agronomy Center for Research and Education (ACRE) in West Lafayette.[y] Tar spot stroma visually assessed percentage (0-100%) of leaf area on five plants in each plot at the ear leaf (EL), ear leaf.[x] Tar spot chlorotic and necrotic symptoms visually assessed percentage (0-100%) of leaf area on five plants in each plot at the ear leaf (EL). Means followed by the same letter are not significantly different based on Fisher's Least Significant Difference test (LSD; α=0.05). NS = not significant (α=0.05).

- For this trial, all fungicide treatments tested reduced tar spot symptoms on all leaves assessed. All fungicide treatments increased percent green over nontreated control.
- There were no significant differences between treatments for percent lodging, harvest moisture, test weight and average corn yield.

Tar Spot Spray Timing Trials

2019 Tar Spot Fungicide Timing Strip Trial

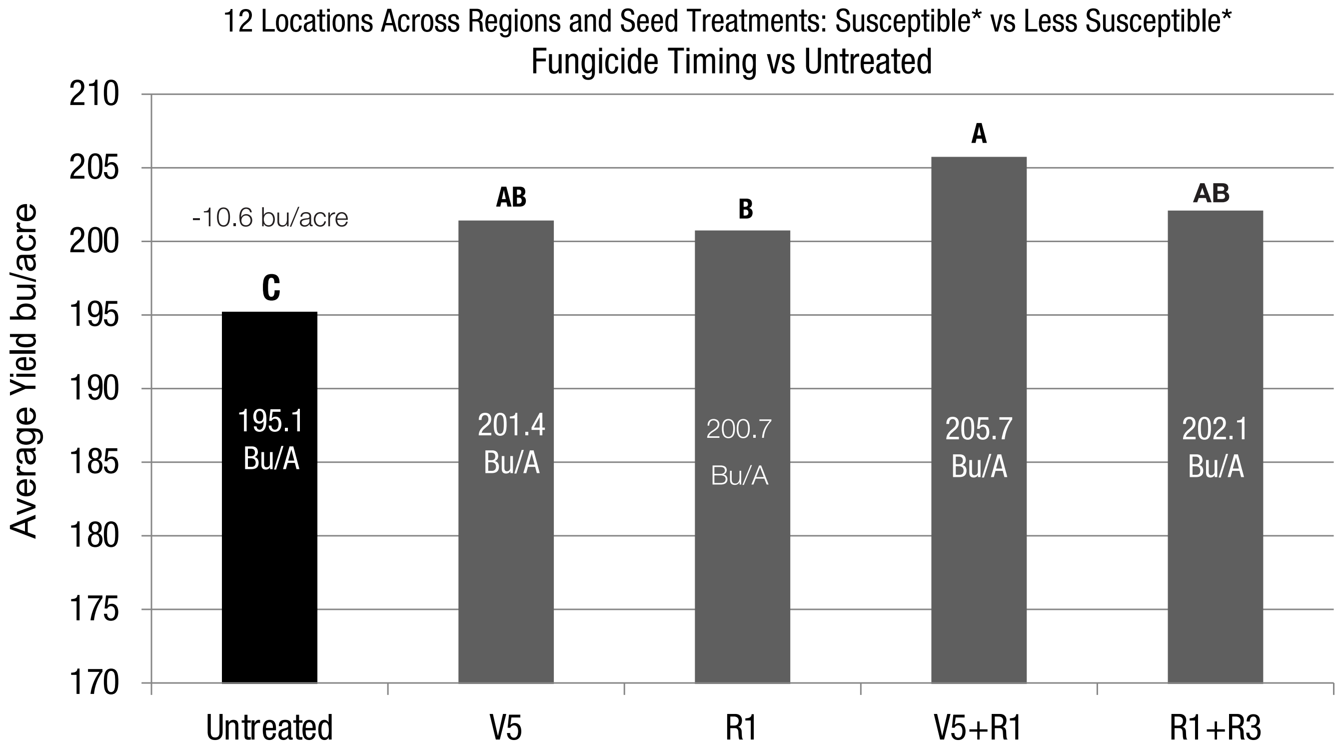

Figure 3. Results from the 2019 tar spot spray timing strip trial, which included 12 locations and tested fungicide application timing on susceptible* and less susceptible* corn products.

- Average yield was across all locations with yield reported.
- Moisture (MST) significant; only 0.3% point wetter for R1 and V5+R1 application timings compared to untreated; across all locations and treatments.
- In 2019, all spray timings responded better than the untreated control in a year with later season infection and lower severity in areas of previous tar spot incidence from the 2018 epidemic.

Tar Spot Spray Timing Trials

2020 Tar Spot Fungicide Timing Strip Trial

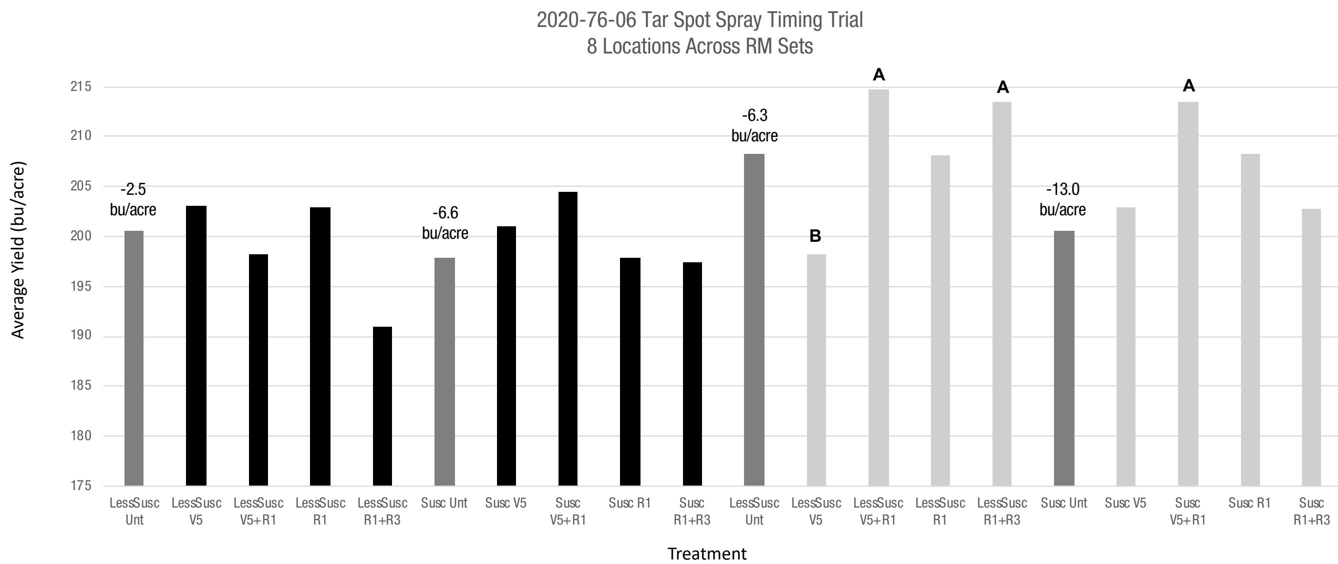

Figure 4. Results from the 2020 tar spot spray timing strip trial, which included eight locations and tested fungicide application timing on early and mid-relative maturity and susceptible* and less susceptible* corn products.

- Average yield reported across all eight locations with yield reported.
- Fungicide treatments did not have a large effect on harvest moisture although moisture was significant at only 0.4% point wetter for the R1+R3 or V5+R1 treatment timings compared to untreated.
- In 2020, most spray timings in this trial responded better than the untreated control in a year with low severity and widespread drought stress later in the season in areas of previous tar spot incidence.
- In this trial, Delaro® Complete (Delaro® 325 SC fungicide + Luna® Privilege Fungicide) had a higher yield response across all locations and treatments.

*All corn products show susceptibility to tar spot. Those considered susceptible show more severe symptoms of tar spot earlier than those considered less susceptible.

Tar Spot Spray Timing Trials

Key Learnings

- Across years, application of a high quality, multiple mode of action fungicide such as Delaro® Complete Fungicide helped to protect yield potential against tar spot compared to the untreated control.
- Timing of fungicide application is critical based on when disease pressure occurs.
- Early and continuous scouting in areas with previously reported disease is important for understanding disease pressure and planning timely fungicide applications if needed.
- Depending on when disease pressure occurs (early- to mid-season or later in the season), multiple fungicide sprays may be warranted.

Sources:

[1] Chilvers, M. July 1, 2020. Tar spot in the spotlight. Michigan State University Extension. https://www.canr.msu.edu/news/tar-spot-in-the-spotlight.

[2] Chilvers MI, McCoy AM, Byrne AM, Cornett H, Chang X, Noel ZA, Koeman S. 2018. Effect of fungicide on the management of tar spot of corn in Michigan. Plant disease management reports 13:CF016. Michigan State University.

[3] Reed H, Mueller B, Groves CL, Smith DL. July 26, 2021. Impact of foliar fungicides on disease and silage quality of brown midrib (BMR) corn hybrids in Wisconsin. Plant Health Reports. https://doi.org/10.1094/PHP-02-21-0019-RS.

Websites verified 08/24/2021.

Legal Statements

Yield Response of Channel® Brand Corn Products to Fungicide Applied at Flowering

Trial Objective

- Corn product yield responses to fungicide applied at the R1 growth stage varies. Understanding which corn products benefit most from a fungicide application can help guide management decisions by growers.
- This trial helped determine the magnitude of yield response of individual corn products.

Experiment/Trial Design

- An early relative maturity (RM) (less than or equal to 103 RM) corn product replicated trial was established in Mason, Michigan, and a late RM (greater than 103 RM) corn product trial was established in Colon, Michigan.
- Channel® brand corn products included in testing for Michigan were selected by Channel® Seedsmen.
- The trial in Mason was a split-plot design with three replications with corn product as the whole plot and fungicide as the sub-plot. This location was rainfed and did not receive irrigation.
- The trial in Colon was an irrigated strip trial with a single replication.
- An application of Delaro® Complete Fungicide (10 oz/acre) was made on 7/13/21 in Mason and 7/14/21 in Colon at the R1 corn growth stage. A high-clearance sprayer with 20 gal/acre of water as carrier was used.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Mason, MI	Loam	Soybean	Conventional	4/26/21	9/27/21	200	34,000
Colon, MI	Sandy Loam	Soybean	Conventional	4/27/21	9/18/21	250	36,000

Understanding the Results

- Mason received below average rainfall until late-June, followed by near-normal rainfall for the remainder of the season.
- Moderately high tar spot pressure was present in Colon and moderate pressure in Mason. The heightened pressure is Colon could be explained by the presence of consistent irrigation moisture.

Yield Response of Channel® Brand Corn Products to Fungicide Applied at Flowering

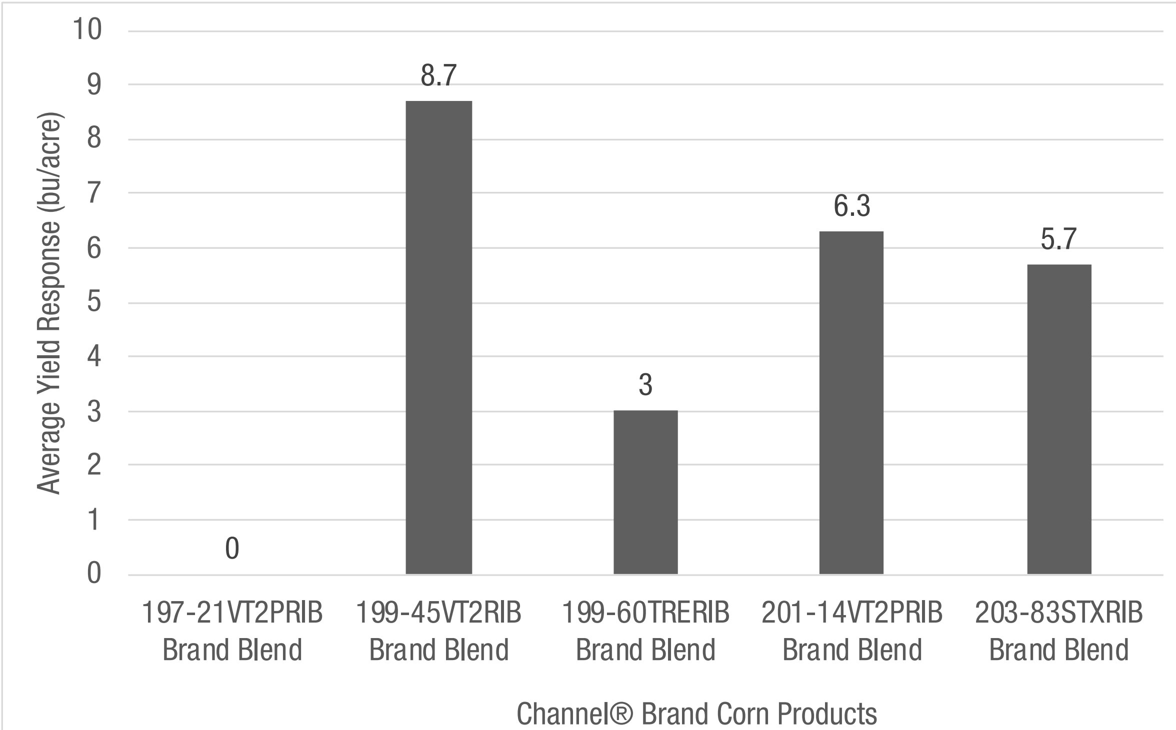

Figure 1. Yield response of Channel® corn products treated with fungicide at the R1 growth stage in Mason, MI.

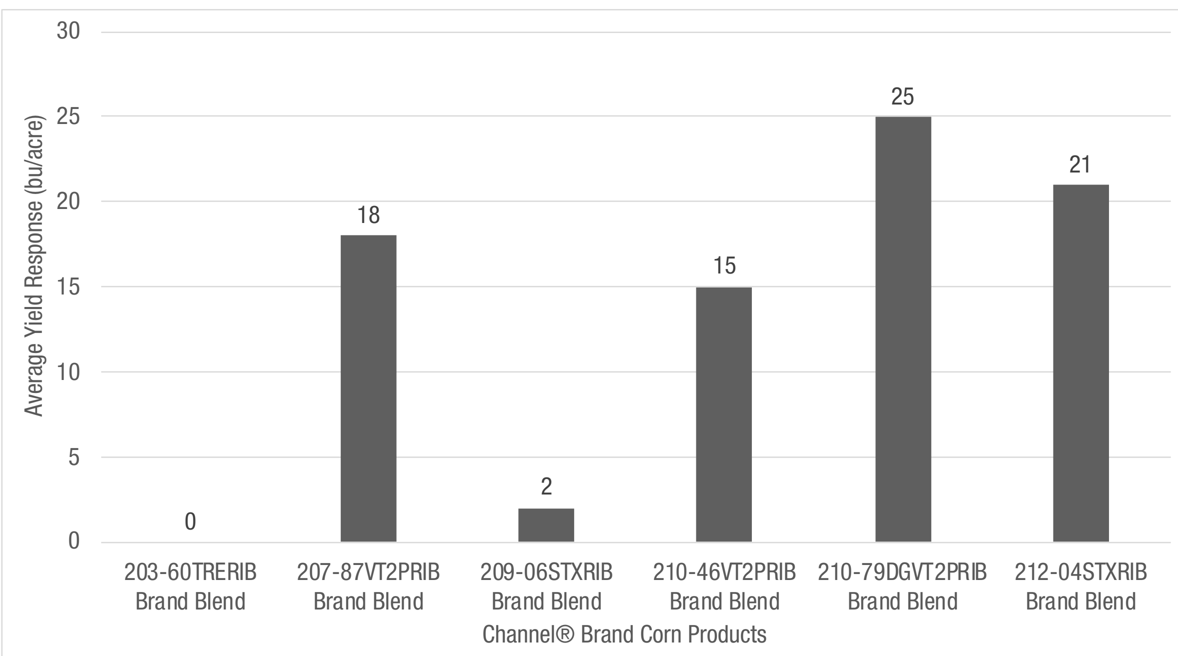

Figure 2. Yield response of Channel® corn products treated with fungicide at the R1 growth stage in Colon, MI.

Yield Response of Channel® Brand Corn Products to Fungicide Applied at Flowering

Key Learnings

- The average yield advantage to an application of Delaro® Complete Fungicide at R1 growth stage was 13 bu/acre.
- Fungicide applications tend to result in a yield increase; however, select corn products demonstrated a greater yield benefit from a fungicide application.
- Growers should first consider targeting corn products with the greatest response for fungicide applications.

The information discussed in this report is from a multiple site demonstration. This informational piece is designed to report the results of this demonstration and is not intended to infer any confirmed trends. Please use this information accordingly. 6026_R1_21_CH

Legal Statements:

Corn Response to Fungicide Application Timing

Channel®
Seedsmanship At Work®

Trial Objective

- Fungicides are often used to protect corn from disease and help producers reach higher yield potential, but there are multiple timings that the fungicide can be applied.
- The goal of this trial was to look at the yield impact of one or multiple applications Delaro® Complete Fungicide on three corn products.

Experiment/Trial Design

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-Till	4/26/2021	11/4/2021	280	36,000

Treatment (#)[1]	Corn Product	Fungicide Treatment	Fungicide Used	Rate/acre	Application Timing
1	115-RM	Untreated Control	None	Not Applicable	Not Applicable
2	109-RM				
3	113-RM				
4	115-RM	V6 + VT growth stages	Delaro® Complete Fungicide	4 fl oz	V6 (6/15/21)
5	109-RM				
6	113-RM		Delaro® Complete Fungicide	8 fl oz	VT (7/15/21)
7	115-RM	VT growth stage	Delaro® Complete Fungicide	8 fl oz	VT (7/15/21)
8	109-RM				
9	113-RM				

- The study was setup in a split-plot design with four replications. Fungicide treatments were the whole plot, and corn products were the sub-plot.
- A base fertilizer application of 25 lb/acre nitrogen (N), 60 lb/acre phosphorus (P), 25 lb/acre sulfur (S), 0.25 lb/acre zinc (Zn) was applied with a strip-till application across all treatments on April 23, 2021.
- A stream bar broadcast application of 100 lb/acre N was made on 5/12/2021.
- An additional 60 lb/acreN was applied with 360 Yield Center Y-drops on 6/18/2021 at the V7 growth stage. Weed control consisted of a VE application of 5 oz/acre Corvus® herbicide , 2.0 pt/acre Harness®, 1 qt/acre Atrazine 4L, and 1 qt/acre Roundup® PowerMAX on 5/8/21 followed by a post-emerge application of 3.0 oz/acre Laudis® herbicide, 3 pt/acre Warrant® Herbicide, and 12 oz/acre DiFlexx® herbicide, and 1 qt/ac Roundup® PowerMAX on 6/15/202. Weed control was excellent season long.
- Corn was sprinkler irrigated with a total of 5.5 inches of irrigation applied during the growing season.
- Dry conditions during the growing season led to little fungal disease development in the trial.
- Plots were combine harvested. Grain moisture content, test weight, and total weight were determined. Statistical analysis for Fisher's LSD was performed.

Corn Response to Fungicide Application Timing

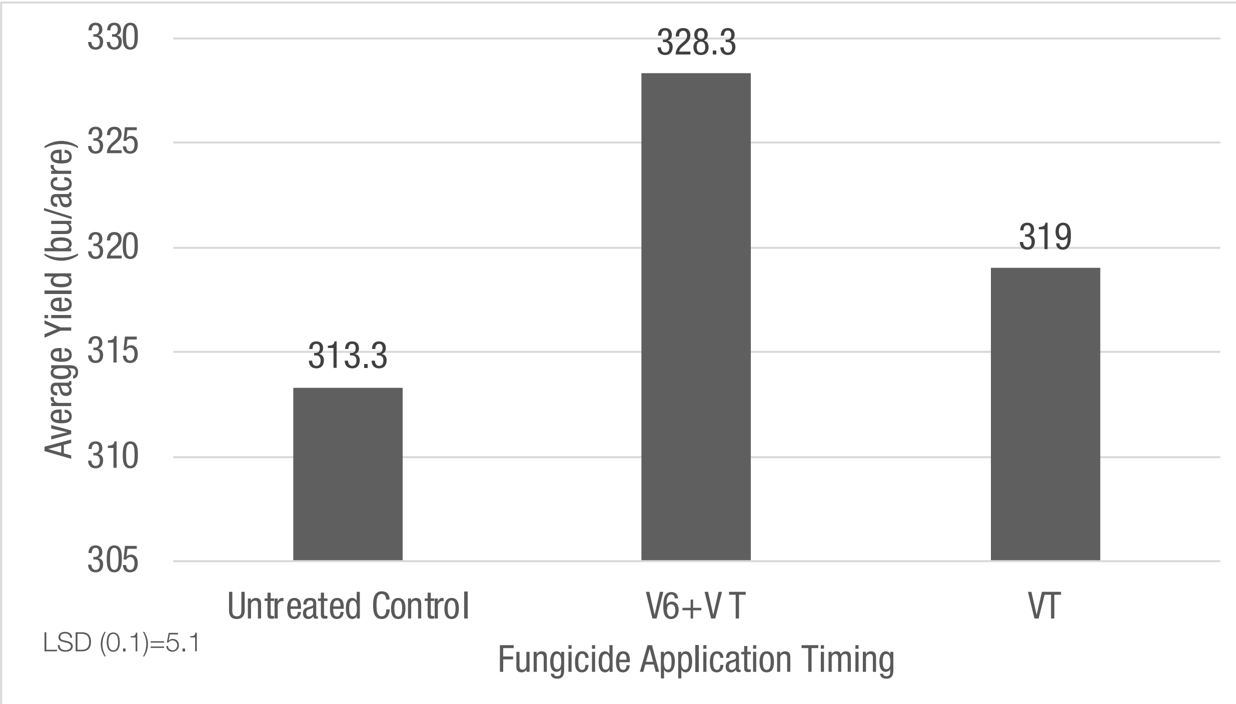

Figure 1. Average corn yields for three corn products as impacted by two fungicide rates and timings at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

Understanding the Results

- Yield was improved by both fungicide application timings over the untreated control even with the dry conditions and low disease pressure observed at the end of the growing season.
  - » The VT application alone showed a 5.7 bu/acre advantage over the untreated control.
  - » The V6+VT application had a 15 and 9.7 bu/acre advantage over the untreated control and VT application respectively.

Key Learnings

- The key benefit observed with Delaro® Complete Fungicide applications was an increase in corn yield for both application strategies.
- Applying an early V6 application of Delaro® Complete Fungicide along with a VT application in sequence provided the highest yields in this study.
- The yield improvement has been consistent across both the 2020 and 2021 growing seasons at the Bayer Water Utilization Learning Center in Gothenburg, NE.
- Farmers should check with their local Bayer Crop Science seeds sales team member to discuss the right corn product and management plan for their fields.

Corn Response to Fungicide Application Timing

Legal Statements

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6005_R7_21

Factors to Help Increase Rainfed Corn Success

Trial Objective

- The success of dryland corn production depends upon growing conditions and the management strategies employed by the farmer. To help maximize yield potential, the availability of soil moisture on rainfed acres is always an important factor.
- Dryland farmers have no control over how much moisture the environment provides through rainfall. However, through management practices they can greatly influence how much moisture is retained by the soil, is available to the crop, and how the limited water can directly impact yield potential.

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	No-till and Conventional-till	5/11/2021	10/25/2021	160	15,000; 20,000; 25,000

Table 1. Treatment Systems (greyed blocks are system treatment changes from previous treatment)

Treatment	Tillage	Seeds/acre	Corn Product	Crop Protection and Rate	Application Timing
Base	Conventional tillage	15,000	113 RM Roundup Ready® Corn 2	Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	Preemerge
				Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	At V7 corn
Residual	Conventional tillage	15,000	113 RM Roundup Ready® Corn 2	Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	Preemerge
				Degree® Xtra Herbicide (RUP)* (3 qt/acre)	Preemerge
				Balance® Flexx Herbicide (RUP)* (4 fl oz/acre)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	At V7 corn
				Warrant® Herbicide (1.5 qt/acre)	At V7 corn
				Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	At V7 corn
Seeding Rate	Conventional tillage	20,000	113 RM Roundup Ready® Corn 2	Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	Preemerge
				Degree® Xtra Herbicide (RUP)* (3 qt/acre)	Preemerge
				Balance® Flexx Herbicide (RUP)* (4 fl oz/acre)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	At V7 corn
				Warrant® Herbicide (1.5 qt/acre)	At V7 corn
				Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	At V7 corn

Factors to Help Increase Rainfed Corn Success

Treatment	Tillage	Seeds/acre	Corn Product	Crop Protection and Rate	Application Timing
No-till	No tillage	20,000	113 RM Roundup Ready® Corn 2	Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	Preemerge
				Degree® Xtra Herbicide (RUP)* (3 qt/acre)	Preemerge
				Balance® Flexx Herbicide (RUP)* (4 fl oz/acre)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	At V7 corn
				Warrant® Herbicide (1.5 qt/acre)	At V7 corn
				Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	At V7 corn
Tough Acre	No tillage	20,000	115 RM DroughtGard® Hybrids, VT Double PRO® RIB Complete Corn Blend	Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	Preemerge
				Degree® Xtra Herbicide (RUP)* (3 qt/acre)	Preemerge
				Balance® Flexx Herbicide (RUP)* (4 fl oz/acre)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	At V7 corn
				Warrant® Herbicide (1.5 qt/acre)	At V7 corn
				Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	At V7 corn
Enhanced Rate	No tillage	25,000	115 RM DroughtGard® Hybrids, VT Double PRO® RIB Complete Corn Blend	Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	Preemerge
				Degree® Xtra Herbicide (RUP)* (3 qt/acre)	Preemerge
				Balance® Flexx Herbicide (RUP)* (4 fl oz/acre)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	At V7 corn
				Warrant® Herbicide (1.5 qt/acre)	At V7 corn
				Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	At V7 corn
Out of Place**	No tillage	25,000	115 RM SmartStax® RIB Complete Corn Blend	Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	Preemerge
				Degree® Xtra Herbicide (RUP)* (3 qt/acre)	Preemerge
				Balance® Flexx Herbicide (RUP)* (4 fl oz/acre)	Preemerge
				DiFlexx® Herbicide (8 fl oz/acre)	At V7 corn
				Warrant® Herbicide (1.5 qt/acre)	At V7 corn
				Roundup PowerMax® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	At V7 corn

*Restricted Use Pesticide. **Out of Place system treatment has a high yielding corn product for an irrigated environment; however, it is not the best choice for a rainfed environment.

Factors to Help Increase Rainfed Corn Success

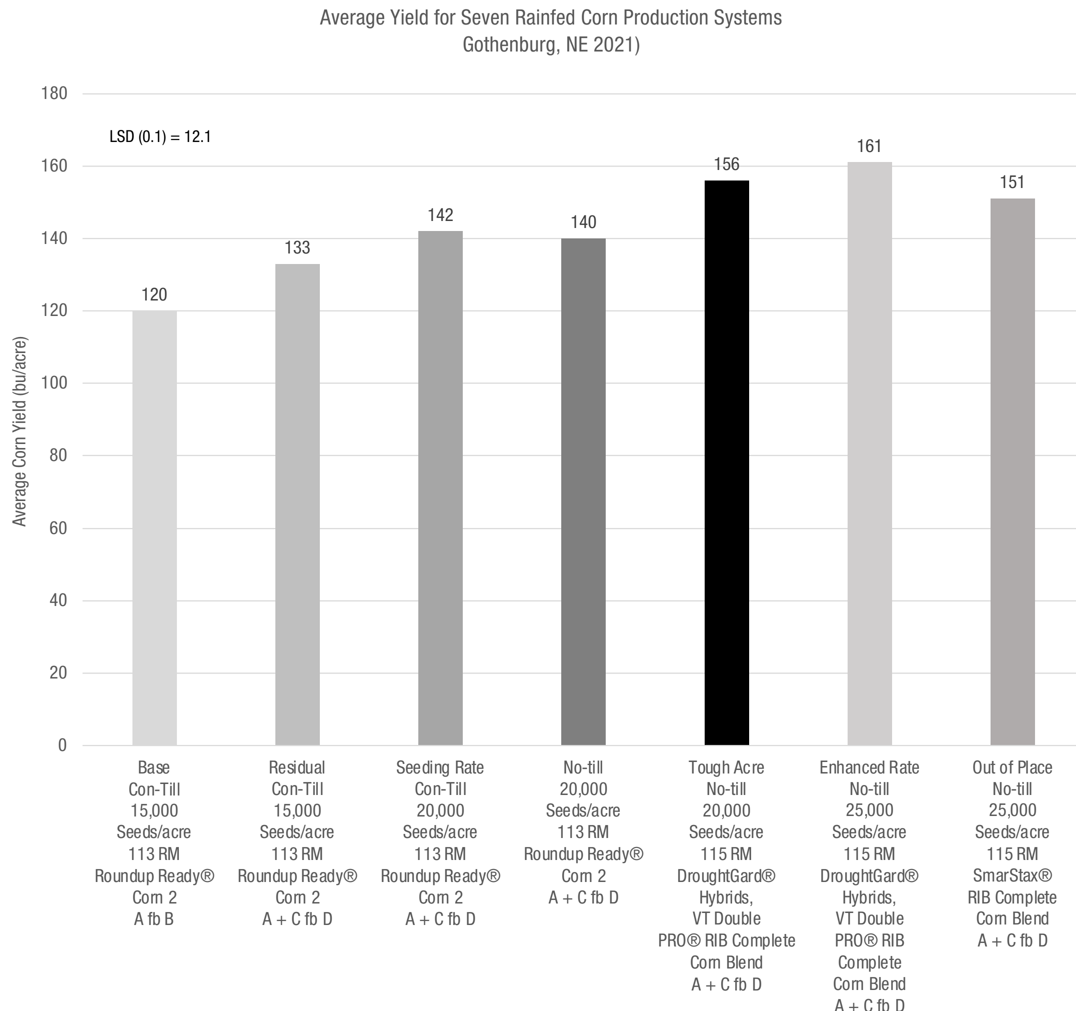
- The trial was a randomized complete block design with four replications of the seven treatments.
- The planter was a fully mounted 4-row, 30-inch planter units utilizing Precision Planting® DeltaForce® for downforce control and Precision Planting® vDrive® for seeding rate control.
- A base fertilizer application of 25 lb/acre Nitrogen (N), 50 lb/acre Phosphorous (P), 21 lb/acre Sulfur (S), and 0.2 lb/acre Zinc (Zn) was broadcast with stream bars across all treatments on April 13, 2021.
- A sidedress application of 60 lb/acre N was made on 6/21/2021.
- No insecticides were applied.
- Plots were combine-harvested.
- Grain moisture content, test weight, and total weight were determined.
- Statistical analysis for Fisher's LSD was performed.

Understanding the Results

Yield

- Yield was impacted by the treatment treatments; the lowest yield occurred with the Base Treatment (Figure 1). The Base Treatment was conventional tillage with no residual herbicides which resulted in considerable weed pressure (Figure 2).
- The Residual Treatment, which used residual herbicides at planting and at V7 growth stage increased yield significantly (Figure 1) and decreased weed pressure (Figure 3) over the Base Treatment.
- Yields for the Seeding Rate Treatment (conventional till, 20,000 seeds/acre, residual herbicides applied) and the No-till Treatment (20,000 seeds/acre, residual herbicides applied) tended to have higher yields than the Residual Treatment which was planted at 15,000 seeds/acre and used residual herbicides (Figure 1). The yields of the Seeding Rate, No-till, and Residual Treatments were significantly more than the Base Treatment (Figure 1).
- The 115 RM DroughtGard® Hybrids, VT Double PRO® RIB Complete Corn Blend product used in the Tough Acre Treatment provided significant value to the treatment by increasing yield by 14 to 16 bu/acre over the Seeding Rate and No-till Treatments, respectively (Figure 1).
- With the use of a 115 RM DroughtGard® Hybrids, VT Double PRO® RIB Complete Corn Blend product, the Enhanced Rate Treatment with a seeding rate of 25,000 seeds/acre demonstrated a 5 bu/acre average yield advantage over the Tough Acre Treatment with a seeding rate of 20,000 seeds/acre (Figure 1).
- The residual herbicide applications for the Enhanced Rate Treatment (Figure 4), Tough Acre Treatment, and Out of Place Treatment (Figure 5) kept weed growth in check.

Factors to Help Increase Rainfed Corn Success



System Treatments

fb = Followed by; A = Preemerge: Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal); B = At V7 Growth Stage: Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal); C = Preemerge: DiFlexx® Herbicide (8 fl oz/acre) + Degree® Xtra Herbicide (RUP)* (3qt/acre) + Balance® Flexx Herbicide (RUP)* (4 fl oz/acre); D = At V7 Growth Stage: DiFlexx® Herbicide (8 fl oz/acre) + Warrant® Herbicide (1.5 qt/acre) + Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal). *(RUP) = Restricted Use Pesticide

Figure 1. Average yield for seven rainfed corn production systems. Gothenburg, NE 2021.

Factors to Help Increase Rainfed Corn Success

Figure 2. The Base Treatment (conventional tillage and no residual herbicide) experienced considerable weed growth and had the lowest average yield of the seven treatments in the trial. Picture taken August 28, 2021 at Gothenburg, NE.

Figure 3. The Residual Treatment, which used residual herbicides applied at planting and V7 growth stage, demonstrated much improved weed control and the average yield was significantly higher compared to the Base Treatment. Picture taken August 28, 2021 at Gothenburg, NE.

Figure 4. The Enhanced Rate Treatment, which increased the seeding rate to 25,000 seeds/acre, had the highest average yield of the seven treatments in the trial; however, the average yield was not significantly different compared to the Tough Acre and Out of Place Treatments. Picture taken August 28, 2021 at Gothenburg, NE.

Figure 5. The average yield of the Out of Place Treatment was not significantly different than the average yields of Enhanced Rate and Tough Acre Treatments. Picture taken August 28, 2021 at Gothenburg, NE.

Key Learnings

- Farmers can realize a significant increase in yield for rainfed corn when the whole treatment is managed. There was a 41 bu/acre difference between the Base Treatment and the Enhanced Rate Treatment that incorporated good weed control, no-till, good corn product selection, and enhanced seeding rates.
- Farmers should work with their local seed sales team member to select a corn product that best fits their field treatment along with selecting a herbicide program that provides good weed control of the problematic weeds in their area.

Factors to Help Increase Rainfed Corn Success

Legal Statements

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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.

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Corn Yield Response to Crop Inputs

Trial Objective

- Additional crop inputs can always be added to a corn production system, but it is important to know which ones have the biggest impact on yield. Being able to compare the yield from various inputs and the costs associated with the inputs provides a means to decide the potential return on investing in specific inputs to boost corn yields.
- The objective of this study was to evaluate how corn yield is influenced by six different inputs added to a corn system, including adding each one to a base treatment or subtracting one from a treatment with all other inputs included.

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-till	4/30/2021	11/8/2021	300	32,000 & 40,000

- A 109 RM VT Double PRO® RIB Complete® corn blend was selected for the trial based on proven high yield potential.
- The study was a randomized complete block design with four replications and twelve management treatments (Table 1).
- Weeds were controlled uniformly across the study with an application of 32 fl oz/acre Roundup PowerMAX® Herbicide, 5 fl oz/acre Corvus® herbicide, 2 pt/acre Harness® Herbicide, and 1 qt/acre Atrazine 4L on May 4, 2021.
- A base fertilizer application of 30 lb nitrogen (N)/acre, 60 lb phosphorus (P)/acre, 25 lb sulfur (S)/acre, 0.25 lb zinc (Zn)/acre was strip-tilled across all treatments on April 23, 2021.
- A base application of 150 lb N/acre was applied with streamer bars on May 8, 2021.
- A total of 9 inches of irrigation was applied to meet the evapotranspiration needs of the crop.
- Stalk lodging and final stand counts were taken just prior to harvest.
- Plots were combine-harvested. Grain moisture content, test weight, and total weight were determined. Statistical analysis for Fisher’s LSD was performed.

Corn Yield Response to Crop Inputs

Table 1: Site Soil Test Information

Sample Depth	Soil pH	Sol Salts	Org Matter	Nitrate	P	K	Ca	Mg	Na	Sulfate
	1:1	mmho/cm	LOI-%	Lbs N/A	M-3P	ppm	ppm	ppm	ppm	ppm
0-8 in	6.8	0.28	3.0	18	19	471	1873	335	41	14.6
8-24 in	6.9	0.21	2.3	27	18	276	2174	409	49	15.4

Sample Depth	Zn	Fe	Mn	Cu	B	CEC	% Base Saturation				
	ppm	ppm	ppm	ppm		me/100	H	K	Ca	Mg	Na
0-8 in	1.38	14.7	5.7	0.40	0.50	13.5	0	9	69	21	1
8-24 in	0.47	8.4	4.4	0.36	0.46	15.2	0	5	72	22	1

Table 2. Management treatments

Treatment	Inputs
LM (Low Management)	32,000 seeds/acre
LM+Density	Change seeding rate to 40,000 seeds/acre
LM+VT Fungicide.	8 fl oz/acre Delaro® Complete fungicide at VT growth stage (7/16/2021)
LM+V6 and VT Fungicide.	4 fl oz/acre Delaro® 325 SC fungicide at V6 growth stage plus 8 fl oz/acre Delaro® Complete fungicide at VT growth stage.
LM+Nitrogen	40 lb/acre nitrogen (N) side-dressed at V6 plus 25 lb N/acre side-dressed at R2 growth stage
LM+Micronutrients	Micronutrients at 32 fl oz/acre and a Plant Growth Hormone at 2 fl oz/acre were applied at V10 growth stage
HM (High Management)	40,000 seeds/acre; Delaro® 325 SC fungicide was applied at 4 fl oz/acre at V6 growth stage; 8 fl oz/acre Delaro® Complete fungicide applied at VT growth stage, 40 lb N/acre sidedressed at V6 growth stage plus 25 lb N/acre sidedressed at R2 growth stage; Micronutrients at 32 fl oz/acre and a Plant Growth Hormone at 2 fl oz/acre applied at V10 growth stage
HM-Density	Change seeding rate to 32,000 seeds/acre.
HM-VT Fungicide	Remove Delaro® Complete fungicide applied at 8 fl oz/acre at VT growth stage
HM-V6 Fungicide	Remove Delaro® 325 SC fungicide applied at 5 fl oz/acre at V6 growth stage
HM-Nitrogen	Remove 40 lb/acre N sidedressed at V6 growth stage plus 25 lb/acre N side-dressed at R2 growth stage
HM-Micronutrients	Remove micronutrients at 32 fl oz/acre and a Plant Growth Hormone at 2 fl oz/acre applied at V10 growth stage

Corn Yield Response to Crop Inputs

Understanding the Results

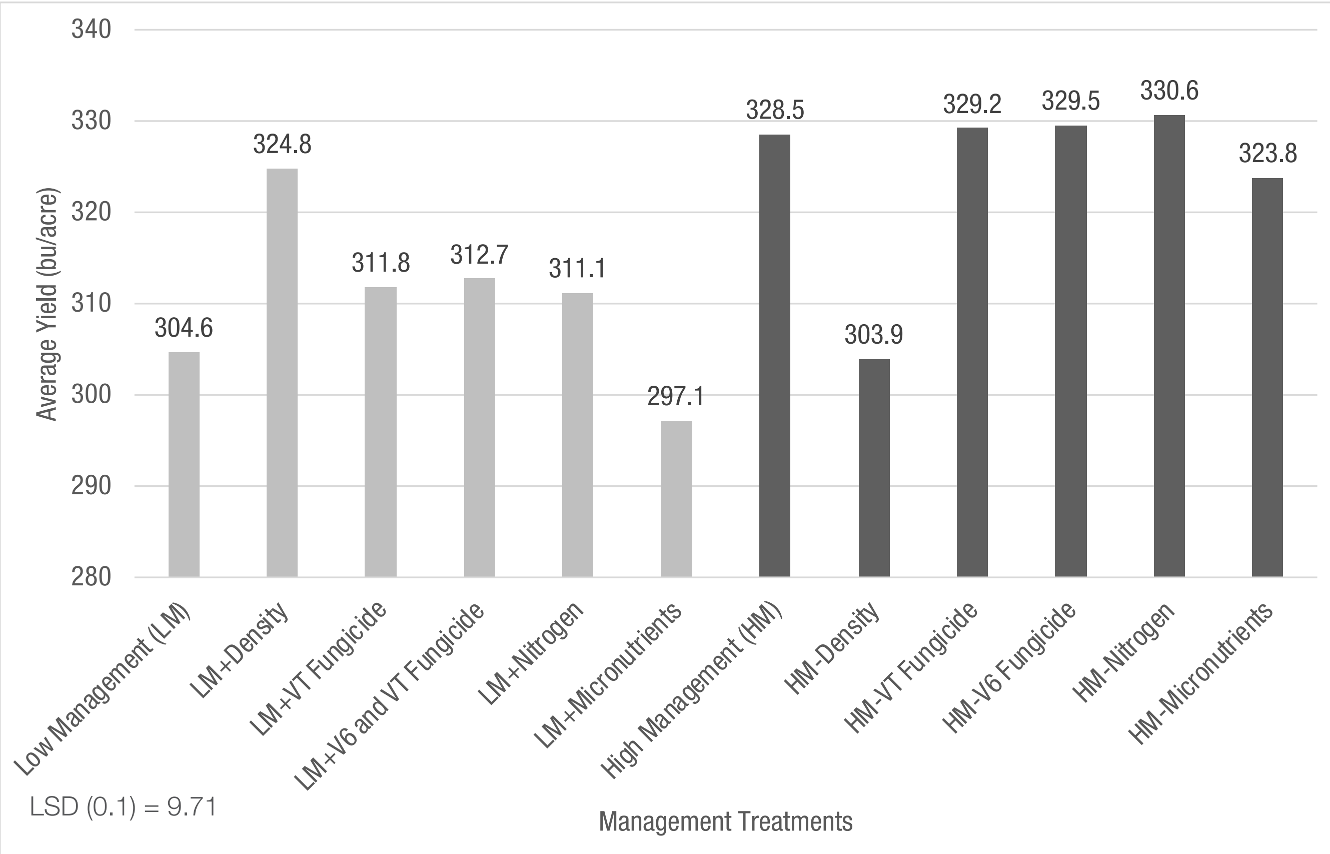

Figure 1. Impact of Management treatments on average corn yield.

Impact on Yield

- Comparing the two systems, the low management (LM) system yielded about 24 bushels per acre less than the high management (HM) system. Most of the increase in yield resulted from the increase in the seeding rate from 32,000 to 40,000 seeds per acre with the HM system (Figure 1).
  - » The additional seeds per acre improved yield 20 bushels per acre when comparing the yield of the LM treatment to the LM + Density treatment where seeding density was increased.
  - » High management treatments responded similarly across all treatments except when seeding rate was decreased in the HM-Density treatment. The yield difference comparing the decreased density treatment to the other HM treatments was approximately 25 bushels per acre.
  - » At $5.00 per bushel corn and a seed cost of $300 per 80K unit, the return on spending an extra $30.00 per acre on seed was over $100 dollars per acre in grain yield, which is very impactful.
  - » Other treatments such as the application of Delaro® 325 SC fungicide and Delaro® Complete fungicide, and extra nitrogen added additional yield to the LM treatment, but the increases were not significant at the P>0.1 significance level.

Corn Yield Response to Crop Inputs

» Figure 2 shows corn ears gathered in 5 feet of 30-inch rows from different treatments in the study. The different ear sizes illustrate the impact of increasing seeding rate on ear development. The corn product in this study showed very good ear size at both seeding rates, but 2 additional ears were present in 5 feet of row at the 40,000 seeds/acre seeding rate.

Figure 2 Ears harvested in 5 ft. of row. Top 11 ears from corn planted at 40,000 seeds/acre in LM+Density treatment. Bottom 9 ears harvested from corn planted at 32,000 seeds/acre. Note very stable ear size even at the high seeding rate.

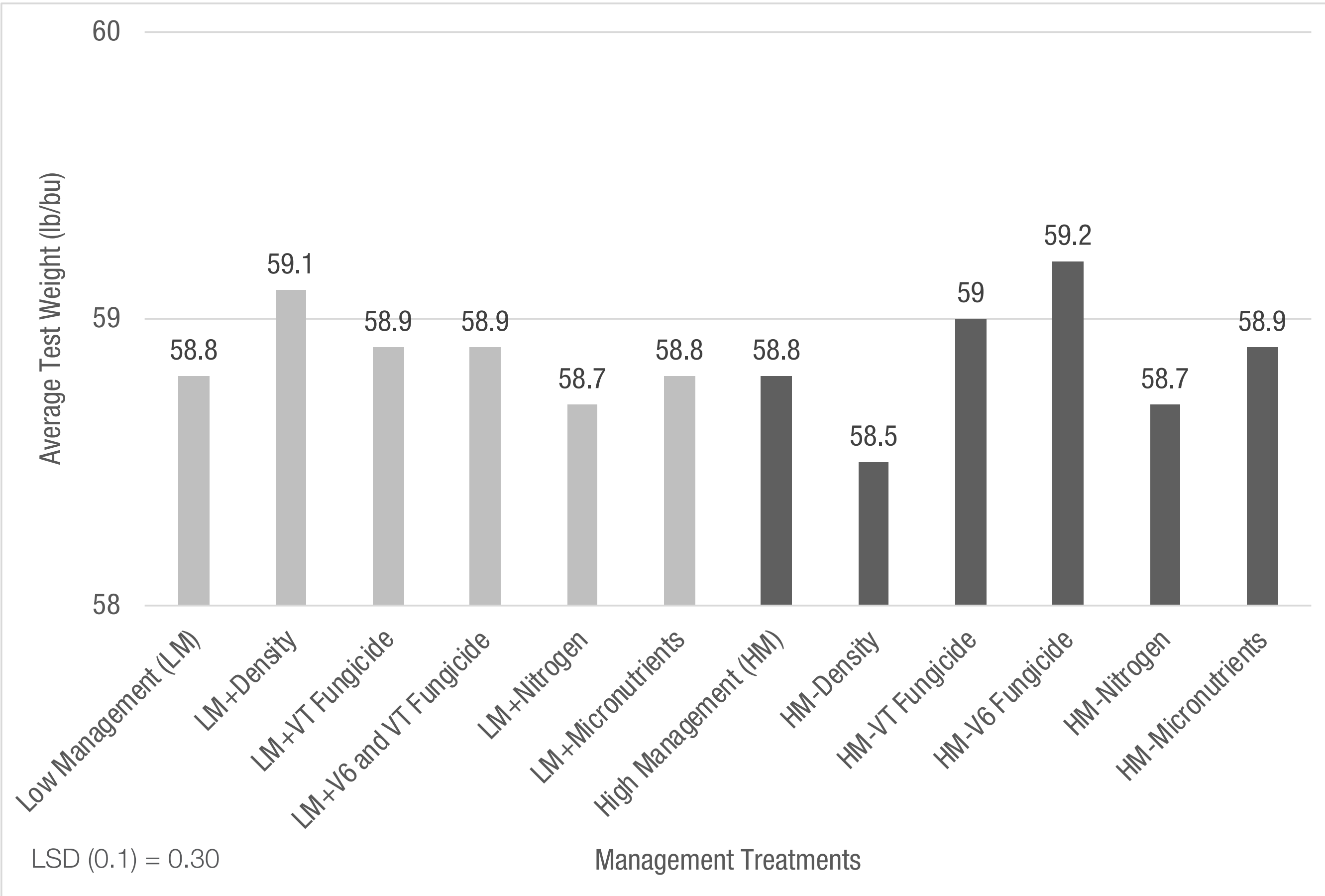

Figure 3. Impact of management treatments on corn test weight in 2021.

Test Weight

- Test weight only had a treatment range of 0.7 bu/acre over the entire trial, but there was some variation among the treatments (Figure 3).
- Test weight was improved when the seeding rate was increased in the LM+Density treatment, but other input additions to the LM treatment did not change the grain test weight then compared to LM.
- The HM treatment test weight was decreased when decreasing the seeding rate from the HM to the HM-Density treatment. Test weight was improved by removing the V6 fungicide application (HM-V6 Fung) compared to the HM treatment.

Corn Yield Response to Crop Inputs

Key Learnings

- Increasing the seeding rate from 32,000 seeds per acre to 40,000 seeds per acre had a large impact on yield and potential profitability with the corn product evaluated in this trial environment.
- One of the main concerns with increasing seeding rates is late season stalk lodging. However, no differences were seen in stalk lodging ratings in this study, and plants in all treatments averaged just under 1.5 on the rating scale (data not shown).
- An average 24 bu/acre yield increase was recorded for the High Management treatment with no additional inputs compared to the Low Management treatment with no additional inputs.
- Carefully weighing the cost of additional inputs to the expected returns is important in making economical decisions on the levels of management inputs, as grain prices and input prices fluctuate.

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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.

Corn Products Response to High pH Soils

Trial Objective

Corn products often respond differently to high pH soils. A high soil pH is generally classified as 7.6 or higher, and key nutrients, including iron, are tied up in these more alkaline soils. Products with a low tolerance to soils with a high pH can express iron deficiency chlorosis (IDC) resulting in symptoms such as yellow leaves, interveinal chlorosis, and stunted growth. Corn products vary in their tolerance to pH and can be considered susceptible, semi-tolerant, or tolerant to the effects of high soil pH. A better understanding of product performance under varying soil pH conditions is important for positioning products to maximize yield potential.

In Western Kansas and Eastern Colorado, high soil pH occurs due to the weathering of soil parent material that is high in calcium carbonate. The objective of this ongoing trial is:

- To determine the visual and yield response of a range of different corn products to high pH (7.6-8.5) soils.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Idalia, CO	Silt Loam	Sunflower	Strip Tillage	5/24/21	10/17/21	250	30,000
Goodland, KS	Silt Loam	Corn	Strip Tillage	5/13/21	10/12/21	230	30,000

- For this trial, a total of 92 different commercial and experimental Channel® brand corn products of varying relative maturities (RMs) were each planted in one pH block at each location.
  - » 4 products had RMs ranging from 93-day to 97-day.
  - » 22 products had RMs ranging from 98-day to 103-day.
  - » 29 products had RMs ranging from 104-day to 107-day.
  - » 32 products had RMs ranging from 108- to 112-day.
  - » 5 products had RMs ranging from 113-day to 114-day.
- Sixteen of the products tested in this study were Channel® RIB Complete® brand blend corn products; only the results of the Channel® products are shown in this report.
- A visual color rating of the foliage was taken at the V8 and VT growth stages:
  - » very dark green = 2
  - » pale-yellow color = 8
- The average yield of each individual product was compared to the average yield of all the products within the RM group.
- Each product was replicated 8 times at each location.
- Soil pH was determined by grid sampling each trial area at a 1/10th acre density.

Figure 1. Visual example showing the range in rating scale from 2 (dark green) to 8 (pale yellow) rating at the V8 growth stage.

Corn Products Response to High pH Soils

Understanding the Results

Table 1. Average yield of different Channel® brand blend seed corn products with a range of relative maturities (RM) grown in different soil pH conditions

Channel® Brand Blend Seed Corn Product	Relative Maturity (RM)	Average Soil pH Value	Average yield (bu/acre)	RM Yield Average (bu/acre)	Yield Difference	V8 Growth Stage Visual Color Rating	VT Growth Stage Visual Color Rating
193-91STXRIB	95	8.2	182.8	198.0	-15.2	4.1	3.8
197-21VT2PRIB	95	8.2	196.6	198.0	-1.4	4.1	4.4
197-27STXRIB	95	8.2	203.6	198.0	5.6	4.1	3.7
200-88STXRIB	100	8.2	198.3	217.8	-19.6	4.3	4.2
201-14VT2PRIB	100	8.2	220.3	217.8	2.5	4.2	4.1
203-60TRERIB	100	8.2	219.1	217.8	1.3	4.2	4.0
204-30VT2PRIB	105	8.2	197.6	216.3	-18.7	4.7	4.5
205-63STXRIB	105	8.2	207.8	216.3	-8.5	4.6	5.0
205-70STXRIB	105	8.2	205.8	216.3	-10.5	4.6	4.7
209-06STXRIB	110	8.2	214.3	215.1	-0.8	4.3	4.3
209-15STXRIB	110	8.2	213.1	215.1	-1.9	4.5	4.4
210-60TRERIB	110	8.2	232.1	215.1	17.0	4.0	4.4
211-30VT2PRIB	110	8.2	226.8	215.1	11.7	4.4	4.0
212-04STXRIB	110	8.2	209.2	215.1	-5.8	4.3	4.1
212-60TRERIB	110	8.2	226.5	215.1	11.5	4.1	4.3
214-22STXRIB	115	8.2	220.6	226.6	-6.0	4.5	4.5
105RM Check	105	8.3	177.4	216.3	-38.9	5.6	5.3
Average		8.2	208.9	213.5	-4.6	4.4	4.3

- The 105RM check, known to have poor performance on high pH soils, had the lowest yield compared to similar RM products at -38.9bu/acre (Table 1).
- Channel products 197-27STXRIB brand blend, 201-14VT2PRIB brand blend, 203-60TRERIB brand blend, 210-60TRERIB brand blend, and 211-30VT2PRIB brand blend yielded above the RM yield average (Table 1). In most cases, these products are recommended for high pH soils.
- Channel products 197-21VT2PRIB brand blend, 205-63STXRIB brand blend, 209-06STXRIB brand blend, 209-15STXRIB brand blend, 212-04STXRIB brand blend, and 214-22STXRIB brand blend had yield disadvantages less than 10 bu/acre when compared to the RM yield average (Table 1). These corn products are recommended for high pH soils.
- Channel products 193-91STXRIB brand blend, 200-88STXRIB brand blend, 204-30STXRIB brand blend, and 205-70STXRIB brand blend had yield disadvantages greater than 10 bu/acre when compared to the RM yield average, and it is recommended to use these products with caution on high pH soils (Table 1).

Corn Products Response to High pH Soils

Key Learnings

- High pH soils are typically found in areas with eroded topsoil and topography changes, and due to field variability, it can be difficult to compare yields between neutral and high pH areas of the field. Producers need to keep this in mind while making yield comparisons on their own farm.
- The importance of selecting a product able to tolerate high pH soils varies based on the proportion of high pH soil acres in each field and the range in pH within each field.
- The pH tolerance of any corn product is indicated by a visual color rating. However, color expression can also be influenced by other abiotic factors such as soil temperature, nutrient availability, and nutrient uptake. Producers should assess all potential problems when evaluating product performance under high pH soils and when selecting specific products for their fields.

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Impact of Limited Irrigation on Food Grade Corn

Trial Objective

- Producing corn suitable for snack food production can be more difficult than producing commodity corn suitable for broader markets.
- Selecting a corn product for food grade production may be limited to an approved list and often the premiums received for the grain is impacted by kernel characteristics important to snack food producers.
- This trial was developed to better understand food grade corn products in the local area and how the products respond to limited water environments in terms of yield potential and kernel quality.
- If lowering irrigation amounts has little impact on yield potential and kernel quality, that information could make it an easier decision to try reducing irrigation even to corn destined for a high-quality end use.

Experiment/Trial Design

Year	Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
2021	Gothenburg, NE	Hord silt loam	Soybean	Strip-Till	4/30/2021	11/04/2021	290	36,000

- This trial was set up as a split plot with irrigation as the whole plot-sub plot. Each treatment was replicated four times.
- Twelve corn products with either a food grade designation or listed as having high potential for a food grade designation were selected for the study.
- Irrigation was applied using a variable rate irrigation system on a linear move sprinkler programmed to provide 100%, 80%, or 60% of the crop water need per pass.
- The 100% irrigation treatment was managed conservatively so water was not over applied to the trial. A nearby moisture probe was used as well as hand probing to verify water treatments were completed correctly.
- On the season, the irrigation amounts were as follows (Figure 1):
  - » 100%: 6.0 inches
  - » 80%: 4.8 inches
  - » 60%: 3.6 inches
- Precipitation accumulation (Figure 1) was 15.25 inches on the growing season, but there was a long stretch from July 17th to August 18th with almost no precipitation. This occurred during the critical time of pollination and early grain fill, so a lack of water may have led to yield reducing stress. This was apparent in other trials at the Gothenburg Learning Center (GLC) that had dryland treatments compared to irrigated treatments.
- This trial was strip-tilled on 4/26/2021 and a base fertilizer application of 27 lbs of nitrogen (N/acre), 60 lbs of phosporus (P/acre), 25 lbs of sulfur (S/acre) and 0.25 lbs of zinc (Zn/acre) were strip-till applied.
- An additional application of 100 lbs N/acre was broadcast with a streamer bar on 5/5/2021 and 60 lbs N/acre was applied with 360 Y-DROP® on 6/15/2021.
- Plots were combine-harvested. Grain moisture content, test weight, and total weight were determined.
- Additional information was gathered on kernel quality by hand harvesting five ears randomly from row 1 of each plot, and the ears were used to rate kernel quality. Horneous endosperm (HE), crown, and dent ratings were given to each plot and recorded for analysis.

Impact of Limited Irrigation on Food Grade Corn

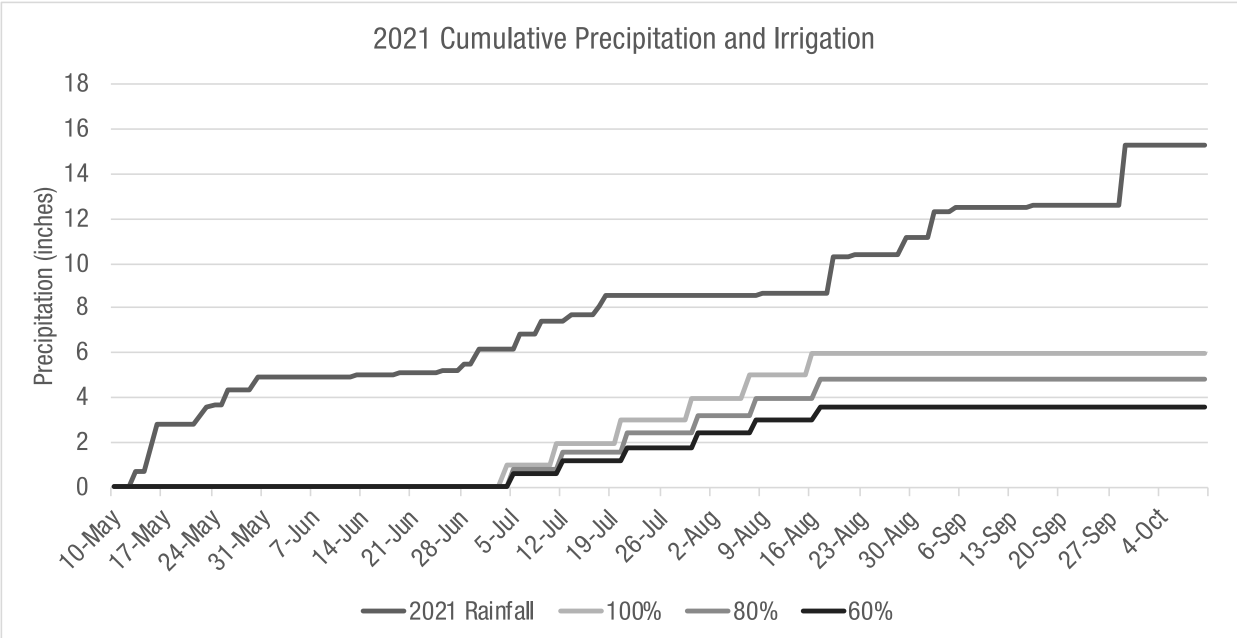

Figure 1. Precipitation and irrigation accumulation in 2021 at the Bayer Water Utilization Learning Center, Gothenburg, NE.

Understanding the Results

Corn Product Yield

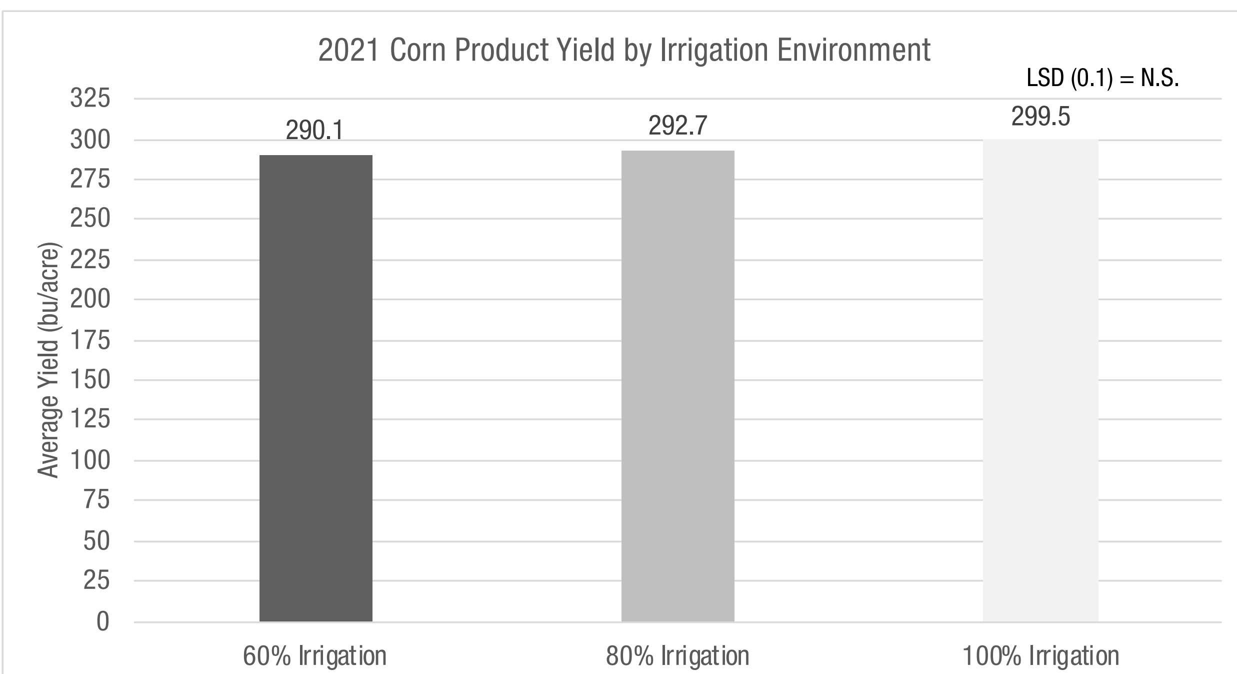

Figure 2. Average corn product yield by irrigation treatment at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

Impact of Limited Irrigation on Food Grade Corn

Table 1. Average corn yields by product and irrigation treatment and averaged across irrigation treatments at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).				
	Irrigation Treatments			
	100% (6.0 in)	80% (4.8 in)	60% (3.6 in)	Mean
Corn Product	bu/acre			
105RM	294.1	275.9	271.8	280.6
106RM-A	307.0	294.6	294.8	298.8
106RM-B	308.0	295.3	297.5	300.3
107RM-A	298.8	290.3	282.2	290.4
107RM-B	298.6	291.1	286.6	292.1
108RM	290.3	288.8	286.7	288.6
111RM	292.1	281.3	275.6	283.0
113RM	293.1	284.7	294.4	290.7
114RM	312.3	312.1	304.3	309.5
115RM-A	291.5	294.0	291.7	292.4
115RM-B	304.5	306.8	299.0	303.4
116RM	303.8	297.9	297.0	299.6
LSD (0.1)	--N.S.--			8.57

- The average corn yield across irrigation environments (Figure 2) did not significantly change although there was a trend toward lower average yields as irrigation amounts were reduced.
- When yields were evaluated by corn product (Table 1), there were differences between corn products.
- Minor yield and yield stability variation was observed in the corn products when the irrigation amount was reduced, but the differences were not statistically significant.

Grain Characteristics

- Some grain characteristics are difficult to evaluate with the combine, but they are important to snack food end users.
- The dent rating (Figures 3 and 4), crown rating (Figure 5), and horneous endosperm rating (Figure 6) were evaluated with hand harvested ears on a rating scale from 1 to 9 where 1 is the most desirable.

Figure 3. Kernels on a corn ear displaying very shallow, rounded dents to almost no dent, which is desirable for food grade use. This ear was rated a 3 for dent.

Figure 4. Kernels with a dent score of 7. Note the deep dents in the kernel tops and wrinkles in some of the dents. This is less desirable for some food grade uses.

Impact of Limited Irrigation on Food Grade Corn

Figure 5. Kernels with different crown scores. Note the upper kernels with a crown score of 2 where it is difficult to detect a crown on the kernel. The lower kernels have a crown score of 6 where the lighter colored crown of the kernel is clearly visible. A larger crown on the kernel is less desirable.

Figure 6. Two kernels with different horneous endosperm (HE) ratings when split. HE is the hard starch portion of the kernel while the soft endosperm is white floury starch that also makes up part of the kernel. A lower rating indicates more HE and a more desirable kernel for snack food processors.

Table 2. Grain characteristic measurements and ratings by irrigation treatment at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

	Grain Characteristics				
	Grain Moisture	Test Weight	Crown Rating	Dent Rating	Horneous Endosperm
Irrigation	%	lbs/bu	1-9	1-9	1-9
100%	15.1	59.7	4.4	4.5	4.8
80%	14.6	58.6	4.3	4.3	4.5
60%	14.9	59.6	4.5	4.6	4.6
LSD (0.1)	---N.S.-- ----				

- Like the average yield results of this trial, the irrigation treatment had no impact on characteristics like grain moisture and test weight at harvest. There was only about a 0.5% change in grain moisture across treatments and only a little more than a pound per bushel of variation in test weight.
- The crown, dent, and HE ratings were also not significantly changed by the irrigation treatment indicating that the amount of irrigation water did not impact processor acceptability for the rated characteristics. Grain moisture was higher in the longer maturity products at harvest with the 114 relative maturity (RM) through 116 RM products in the 16-17% range while all products 113RM and under were 15% or lower.
- Test weight did not differ significantly between corn products.
- The crown dent and HE ratings differed between corn products with all ratings 6 or lower showing products of consistent high quality for food grade uses.

Impact of Limited Irrigation on Food Grade Corn

Table 3. Grain characteristic measurements and rating by products at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).					
Product	Grain Characteristics				
	Grain Moisture	Test Weight	Crown Rating	Dent Rating	Horneous Endosperm Rating
	%	lbs/bu	1-9	1-9	1-9
105RM	13.5	59.6	6 .0	5.8	5.1
106RM-A	14.2	59 .0	5.3	5.3	5.2
106RM-B	14.8	60.2	4.2	4.3	4.2
107RM-A	14.2	59.9	5.8	5.4	5.7
107RM-B	14.4	60.1	4.3	4.3	4.7
108RM	14.1	60.5	3.5	3.5	3.6
111RM	14.1	60.1	5 .0	5.5	5.7
113RM	15.0	58.8	2.9	3.3	4.2
114RM	16.3	59.6	4.3	4.8	4.5
115RM-A	17.1	60.0	2.7	2.6	3.3
115RM-B	16.2	60.2	4.7	4.9	5.1
116RM	16.1	59.8	3.9	3.8	4.3
LSD (0.1)	0.93	---------NS-------	0.56	0.52	0.60

Key Learnings

- Irrigation did not significantly impact corn yield or grain quality characteristics at the irrigation levels present in this trial.
- This indicates that lowering irrigation levels across these corn products, if necessary, may be possible without impacting the grain quality characteristics.
- However, there are limits to this, at least on the yield side, as the 2021 dryland treatments at the Gothenburg Learning Center in similar research yielded significantly lower than the treatments with six inches of irrigation or more.
- Adding a dryland or very limited irrigation treatment to this test could be interesting to see if there is a point where grain quality for food-grade purposes starts to drop off.
- This research continues as we strive to increase water use efficiency by decreasing the total amount of water applied while maintaining high yield potential and food grade corn quality.

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Water Application Strategy, Tillage, and Corn Product Impacts on Yield

Trial Objective

- Deciding on when to begin irrigating and how often are critical factors of both corn yield potential and the costs associated with water application. Tillage also impacts irrigation and the cropping system because less residue cover on the soil can result in water loss through evaporation.
- The objective of this study was to compare different corn products under various tillage and irrigation regimens to help determine the most appropriate management systems for maximizing corn yield potential.

Research Site Details

Year	Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
2020	Gothenburg, NE	Hord silt loam	Corn	Strip-Till and Conventional-Till	5/10/2020	11/03/2020	210	36,000
2021	Gothenburg, NE	Hord silt loam	Corn	Strip-Till and Conventional-Till	5/11/2021	10/30/2021	210	36,000

Table 1: 2020 and 2021 trial treatments. Note that one of the irrigation treatments and corn products was switched out in 2021.

Year	Treatment	Irrigation	Tillage	Corn Product	Corn Product Release Year	Total Water Application (in)
2020	1	SatIrr (Satellite Irrigation)	Conventional-Till	Current 113 Relative Matuirty (RM)	2019	15.6
	2	SatIrr	Conventional-Till	Current 116 RM	2016	15.6
	3	SatIrr	Conventional-Till	Older 111 RM	1997	15.6
	4	SatIrr	Conventional-Till	Older 113 RM	2006	15.6
	5	SatIrr	Strip-Till	Current 113 RM	2019	15.6
	6	SatIrr	Strip-Till	Current 116 RM	2016	15.6
	7	SatIrr	Strip-Till	Older 111 RM	1997	15.6
	8	SatIrr	Strip-Till	Older 113 RM	2006	15.6
	9	Experimental	Conventional-Till	Current 113 RM	2019	14
	10	Experimental	Conventional-Till	Current 116 RM	2016	14
	11	Experimental	Conventional-Till	Older 111 RM	1997	14
	12	Experimental	Conventional-Till	Older 113 RM	2006	14
	13	Experimental	Strip-Till	Current 113 RM	2019	14
	14	Experimental	Strip-Till	Current 116 RM	2016	14
	15	Experimental	Strip-Till	Older 111 RM	1997	14
	16	Experimental	Strip-Till	Older 113 RM	2006	14
	17	Calendar	Conventional-Till	Current 113 RM	2019	18.9
	18	Calendar	Conventional-Till	Current 116 RM	2016	18.9
	19	Calendar	Conventional-Till	Older 111 RM	1997	18.9
	20	Calendar	Conventional-Till	Older 113 RM	2006	18.9
	21	Calendar	Strip-Till	Current 113 RM	2019	18.9
	22	Calendar	Strip-Till	Current 116 RM	2016	18.9
	23	Calendar	Strip-Till	Older 111 RM	1997	18.9
	24	Calendar	Strip-Till	Older 113 RM	2006	18.9

Water Application Strategy, Tillage, and Corn Product Impacts on Yield

Year	Treatment	Irrigation	Tillage	Corn Product	Corn Product Release Year	Total Water Application (in)
2021	1	SatIrr	Conventional-Till	Current 113 RM	2019	5.25
	2	SatIrr	Conventional-Till	Current 116 RM	2016	5.25
	3	SatIrr	Conventional-Till	Older 111 RM	1996	5.25
	4	SatIrr	Conventional-Till	Older 113RM	2006	5.25
	5	SatIrr	Strip-Till	Current 113 RM	2019	5.25
	6	SatIrr	Strip-Till	Current 116 RM	2016	5.25
	7	SatIrr	Strip-Till	Older 111 RM	1996	5.25
	8	SatIrr	Strip-Till	Older 113 RM	2006	5.25
	9	Soil Monitor	Conventional-Till	Current 113 RM	2019	3.55
	10	Soil Monitor	Conventional-Till	Current 116 RM	2016	3.55
	11	Soil Monitor	Conventional-Till	Older 111 RM	1996	3.55
	12	Soil Monitor	Conventional-Till	Older 113 RM	2006	3.55
	13	Soil Monitor	Strip-Till	Current 113 RM	2019	3.55
	14	Soil Monitor	Strip-Till	Current 116 RM	2016	3.55
	15	Soil Monitor	Strip-Till	Older 111 RM	1996	3.55
	16	Soil Monitor	Strip-Till	Older 113 RM	2006	3.55
	17	Calendar	Conventional-Till	Current 113 RM	2019	10
	18	Calendar	Conventional-Till	Current 116 RM	2016	10
	19	Calendar	Conventional-Till	Older 111 RM	1996	10
	20	Calendar	Conventional-Till	Older 113 RM	2006	10
	21	Calendar	Strip-Till	Current 113 RM	2019	10
	22	Calendar	Strip-Till	Current 116 RM	2016	10
	23	Calendar	Strip-Till	Older 111 RM	1996	10
	24	Calendar	Strip-Till	Older 113 RM	2006	10
	25	Calendar	Strip-Till	Current 113 RM	2019	10
	26	Calendar	Strip-Till	Current 116 RM	2016	10
	27	Calendar	Strip-Till	Older 111 RM2	1996	10
	28	Calendar	Strip-Till	Older 113 RM	2006	10

- The study was set up as a split-split plot with irrigation as the whole plot effect, tillage as the sub-plot effect, and corn product as the sub-sub plot effect. Each of the treatments was replicated three times in the trial.
- Table 1 lists all the treatments in 2020 and 2021.
- All treatments were planted in 30-inch rows.
- On 5/5/2020, 27.5 lb/acre N, 70 lb/acre P, and 15 lb/acre S was band applied in the conventional tillage blocks and strip till applied in the strip tillage blocks.
- On 5/5/2021, a base fertilizer application of 27 lb/acre N, 60 lb/acre P, 25 lb/acre S, 0.25 lb/acre Zn was band applied in the conventional tillage blocks and strip-till applied in the strip-tillage blocks.
- Additional Nitrogen was applied at 170 lb/acre in 2020 and 160 lb/acre in 2021. All nitrogen was applied at the V6 stage or earlier in both years.

Water Application Strategy, Tillage, and Corn Product Impacts on Yield

- Force® 3G insecticide was applied at 5.5 lb/acre uniformly in furrow to control corn rootworm in both years.
- Irrigation was applied using a variable rate irrigation system on a linear move sprinkler.
- Irrigation Recommendations information was as follows:
  - » Satellite Irrigation – irrigation recommendations generated from the analysis of corn growth from satellite imagery using proprietary algorithms.
  - » Experimental – experimental irrigation recommendation strategy.
  - » Calendar – recommendation was done by watching local producer start and end dates for irrigation.
  - » Soil Monitoring - recommendation was based on field observations with a hand probe and WaterMark sensors.
- Plots were combine-harvested. Grain moisture content, test weight, and total weight were determined. Statistical analysis for Fisher's LSD was performed.
- In 2021, additional plot ratings at harvest were taken including stalk lodging and stalk intactness. Stalk lodging ratings were a visual score of how many stalks were broken over below the ear, and intactness was a visual score of the number of tassels still upright in the corn at harvest.

Understanding the Results

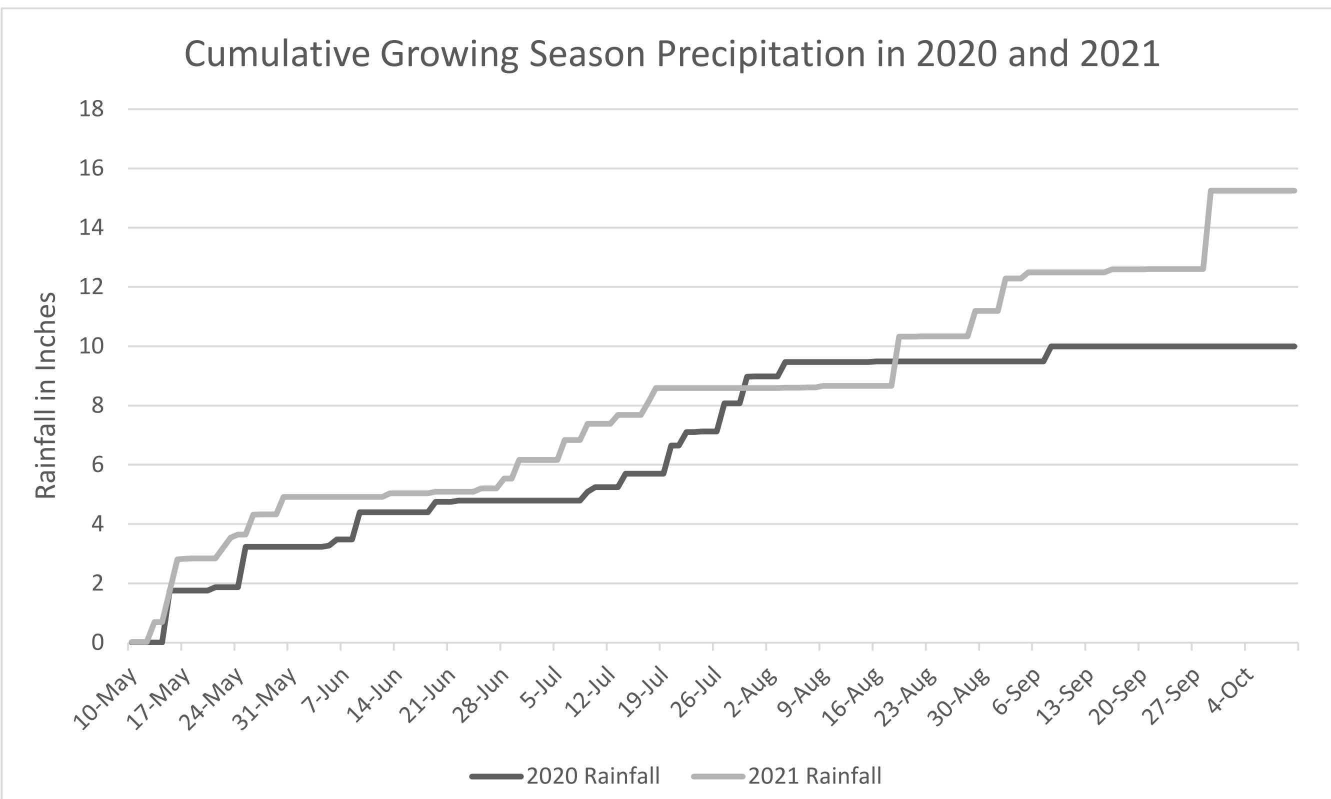


Figure 1: 2020 and 2021 rainfall patterns throughout the growing season from May to October

Water Application Strategy, Tillage, and Corn Product Impacts on Yield

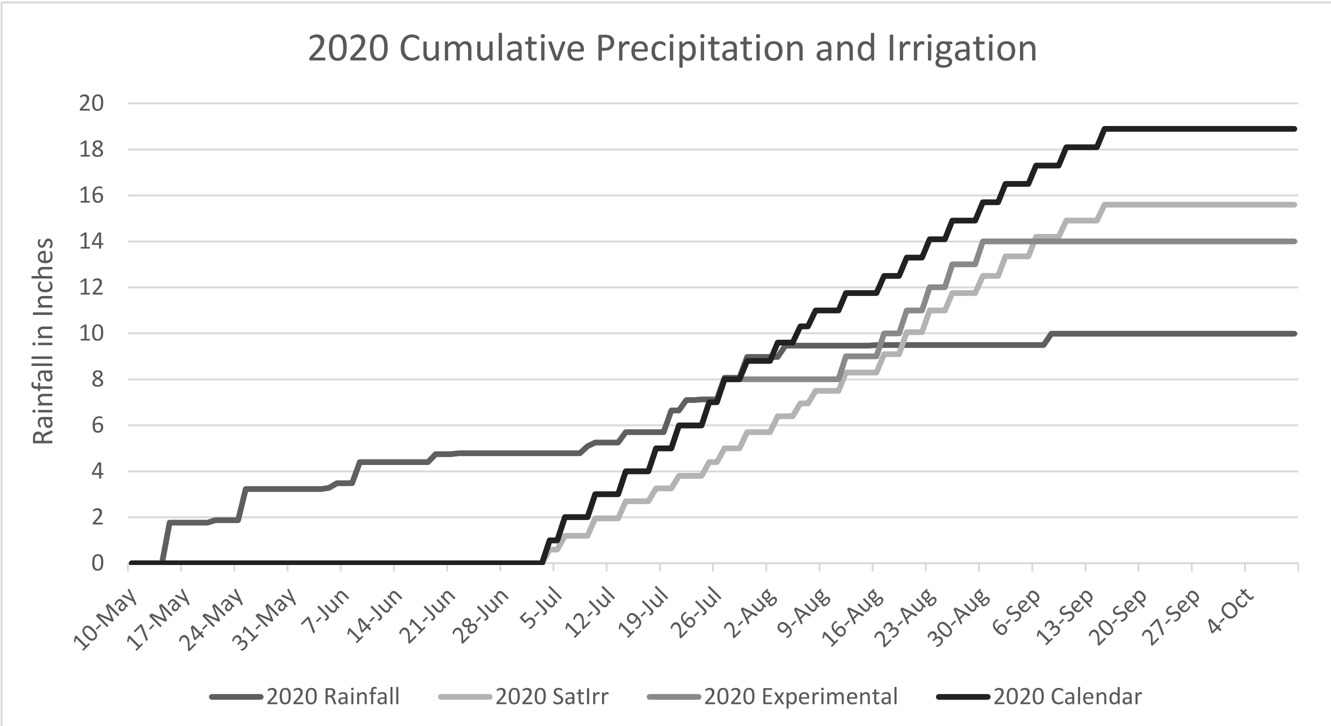


Figure 2: Irrigation totals were high for all three irrigation strategies in 2020

- 2020 and 2021 rainfall patterns were different in the total amount of rainfall that fell with 2020 showing about 10 inches of rainfall during the growing season and 2021 having 15.25 inches on the season (Figure 1). This reduced the irrigation applied in 2021 vs. 2020. Crop stress in 2020 occurred prior to corn tasseling and in the grain fill stage. In 2021, dry conditions from July 18th to August 18th during tassel and early grain fill caused severe crop stress.
- The different irrigation strategies did recommend varying levels of applied irrigation water (Figure 2).
- The calendar management strategy ended up at 18.9 inches on the season with consistent applications of water throughout the irrigation season from beginning to end.
- The Satellite Irrigation strategy recommended 15.6 inches of water applied. It was consistent throughout the season, but lower rates of water were recommended and applied each week.
- The lowest irrigation total was observed with the EXPERIMENTAL strategy that stopped irrigation earlier and accounted for rainfall in the late July timeframe as an opportunity to turn off the water for a few days.
- No significant differences were seen in corn yields between the three irrigation strategies, indicating that all strategies were supplying adequate irrigation water.
- Conventional tillage and no-tillage systems also had no impact on yield in 2020.
- The current corn products yielded substantially more than the older products in this study, demonstrating the impact of continued genetic improvements in corn products now commercially available (Figure 3).
- In economic terms, the advantage of modern corn products at a $5.00/bu amounts to about $420/unit of seed and $245/unit of seed when compared to the products released in 1997 and 2006, respectively.

Water Application Strategy, Tillage, and Corn Product Impacts on Yield

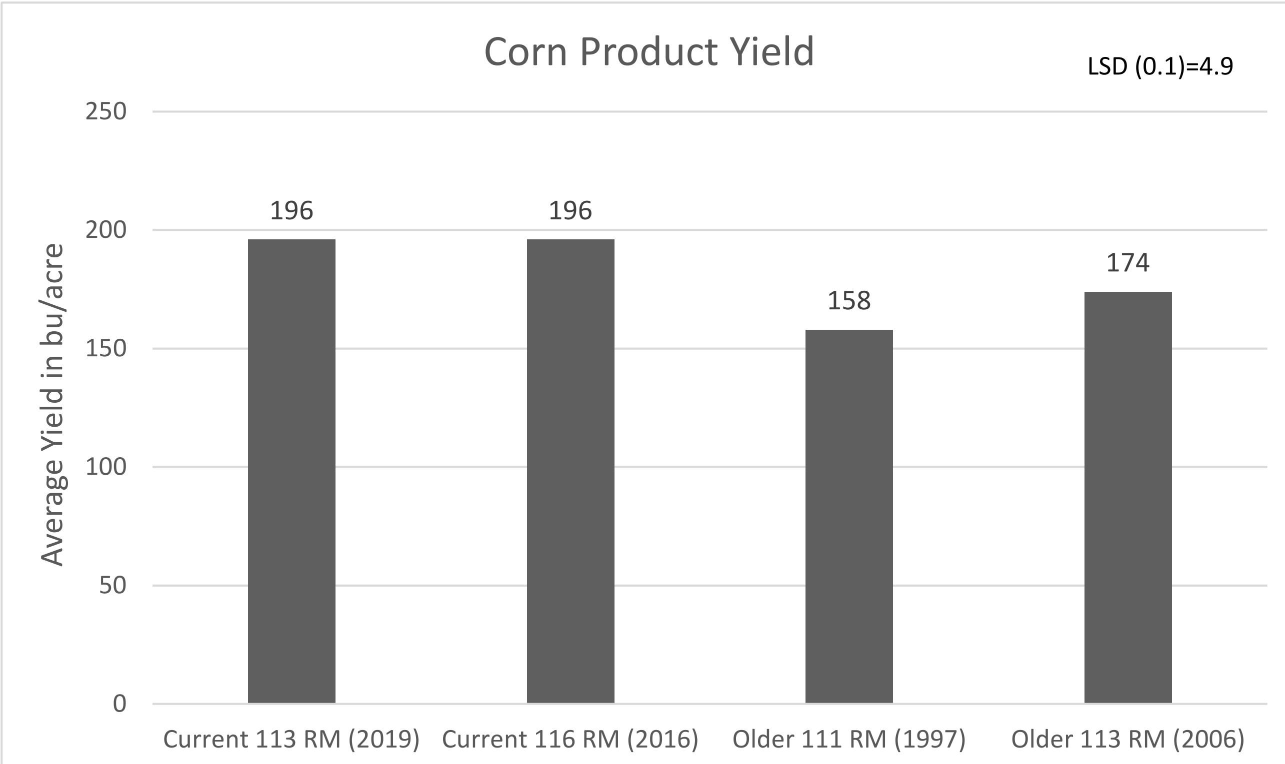


Figure 3: Average yields in 2020 for corn products with a range of relative maturities (RM) and different product ages.

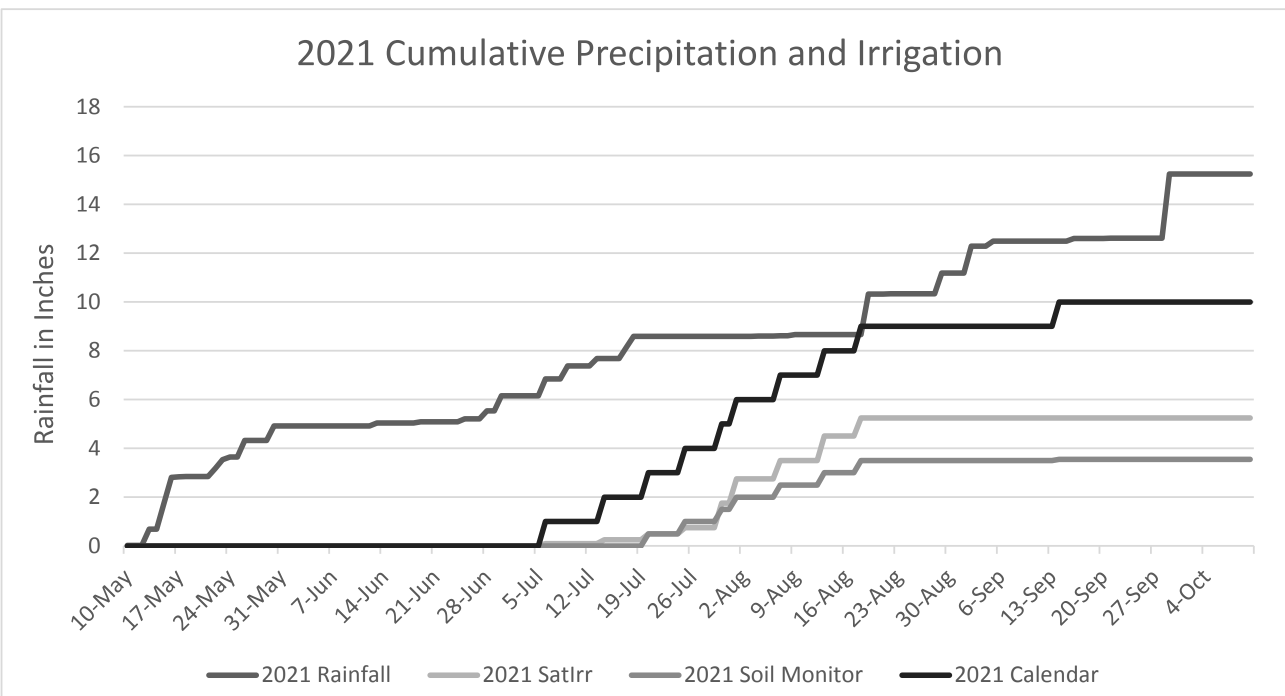


Figure 4: Because of increased late season rainfall in 2021 irrigation totals were reduced compared to the 2020 growing season.

Water Application Strategy, Tillage, and Corn Product Impacts on Yield

- In 2021, the growing season rainfall was 5.25 inches higher than in 2020 (Figure 1 vs. Figure 4) and it resulted in lower application levels with the three irrigation strategies.
- In 2021, the calendar management strategy was at 10.0 inches on the season with an earlier start to irrigation, more applied most weeks and a final 0.5” application late in the season (Figure 4).
- The Satellite Irrigation strategy recommended 5.25 inches of irrigation. It was consistent throughout the season, but recommended less per week, and it did not recommend a final irrigation at the end of the season
- The lowest irrigation total was observed with the soil monitor strategy that was similar to Satellite Irrigation but was just a little more conservative in the weekly recommendations. It ended with a total of 3.55 inches applied.
- Despite the difference in irrigation amount, no difference was seen in corn yield or stalk lodging between the irrgation strategies.
- One difference resulting from the irrigation treatment was improved plant intactness (Figure 5) with calendar management strategy, leading to better looking plants at harvest.
- Tillage practice had no impact on corn yield in 2021 which was consistent with 2020.

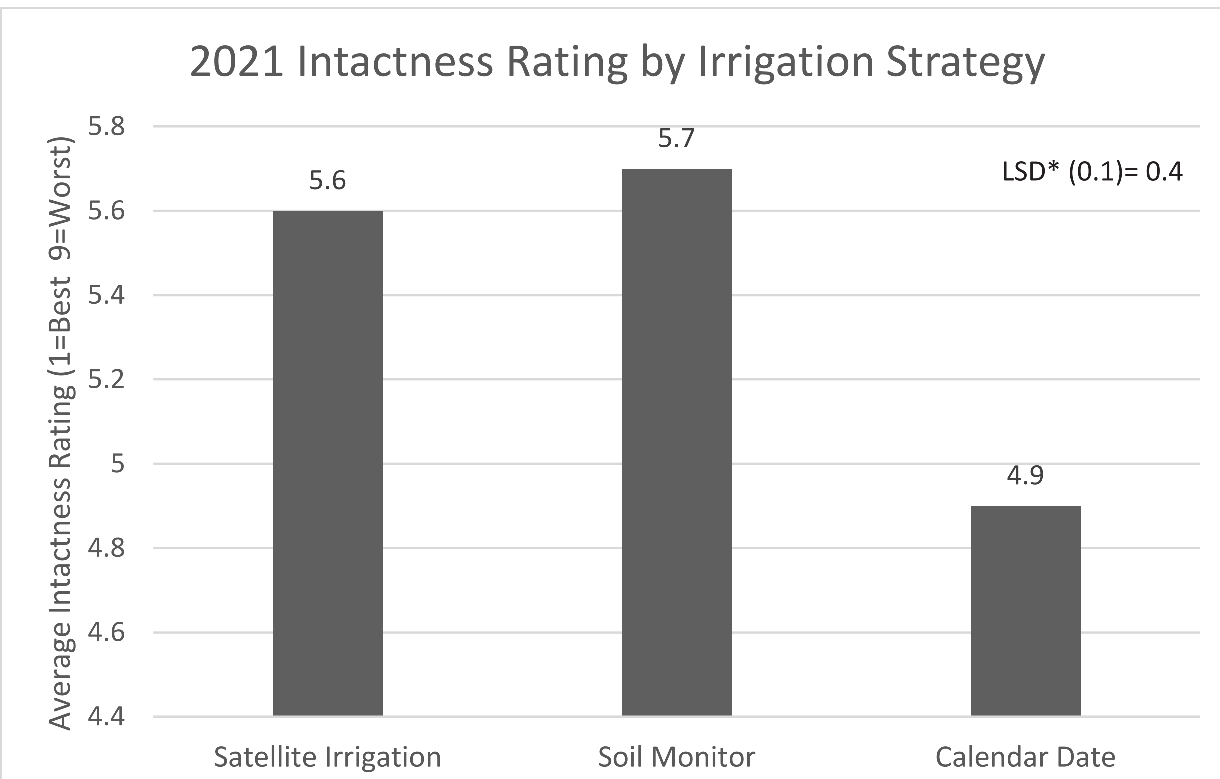


Figure 5: 2021 Average Intactness rating by irrigation strategy. *LSD (least significant difference) calculated as part of a larger trial containing 5 corn products

Water Application Strategy, Tillage, and Corn Product Impacts on Yield

- In 2021 corn products impacted both the stalk lodge rating and the corn yield.
- The stalk lodge ratings were taken just prior to harvest on a scale of 1-9, with 1 being near zero stalk lodge and 9 representing nearly all the plants lodged below the ear.
- It is notable that the modern 116RM product had a lower stalk lodge than the other products.
- Corn product yield was highest in the current products. As in 2020, the Older 113RM and Older 111RM2 products were well behind modern products in yield in the field environment (Figure 3).
- Again in 2021, there were no differences between the tillage treatments or the water application strategies, but unlike 2020, there were interactions that occurred between these factors and the corn products in terms of yield and stalk lodge.

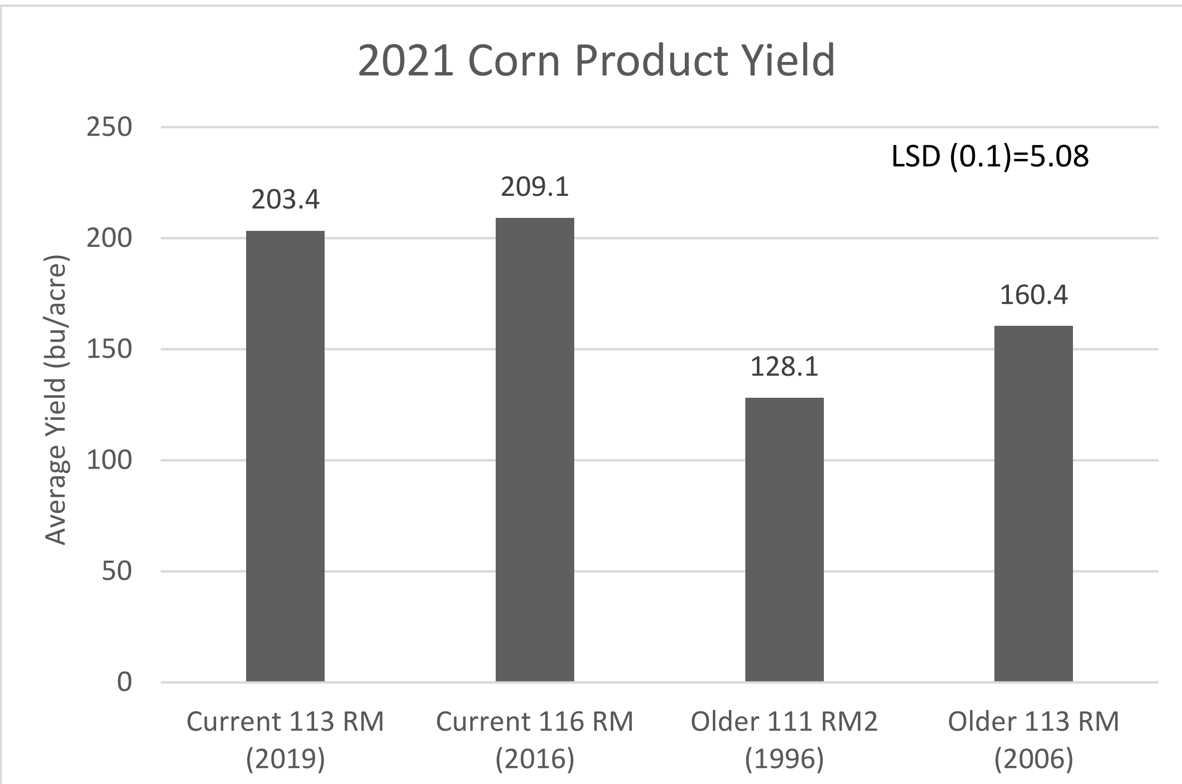


Figure 6: Average Corn Product yields in 2021 for corn products with a range of relative maturities and different product ages. *LSD (least significant difference) calculated as part of a larger trial containing 5 corn products

Water Application Strategy, Tillage, and Corn Product Impacts on Yield

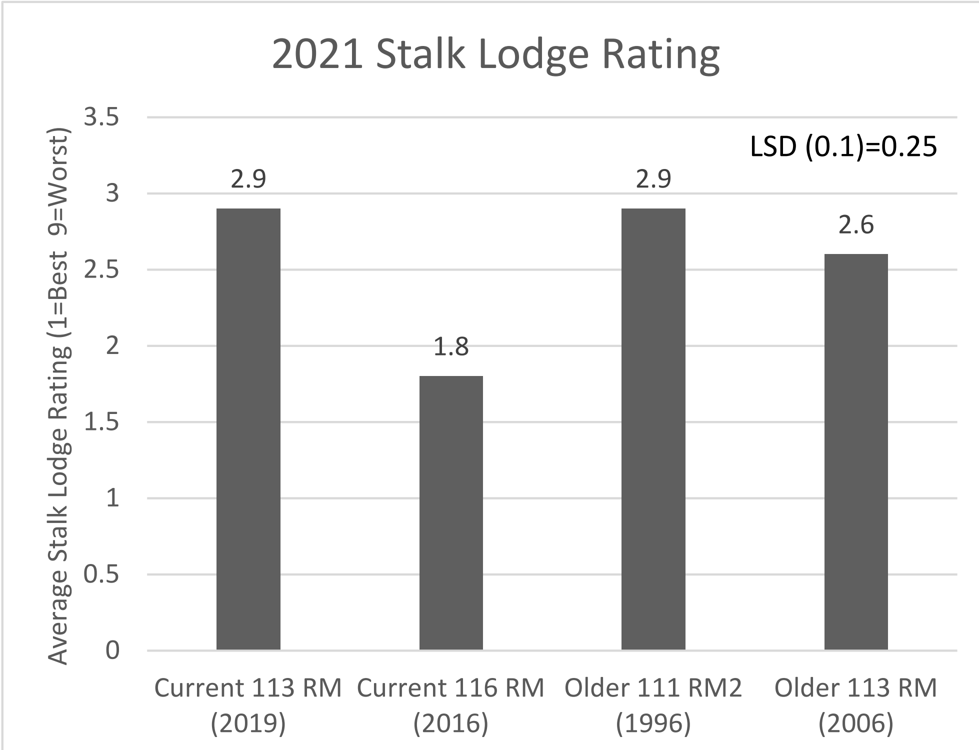


Figure 7: 2021 stalk lodging rating for corn products with a range of relative maturities and different product ages. *LSD (least significant difference) calculated as part of a larger trial containing 5 corn products

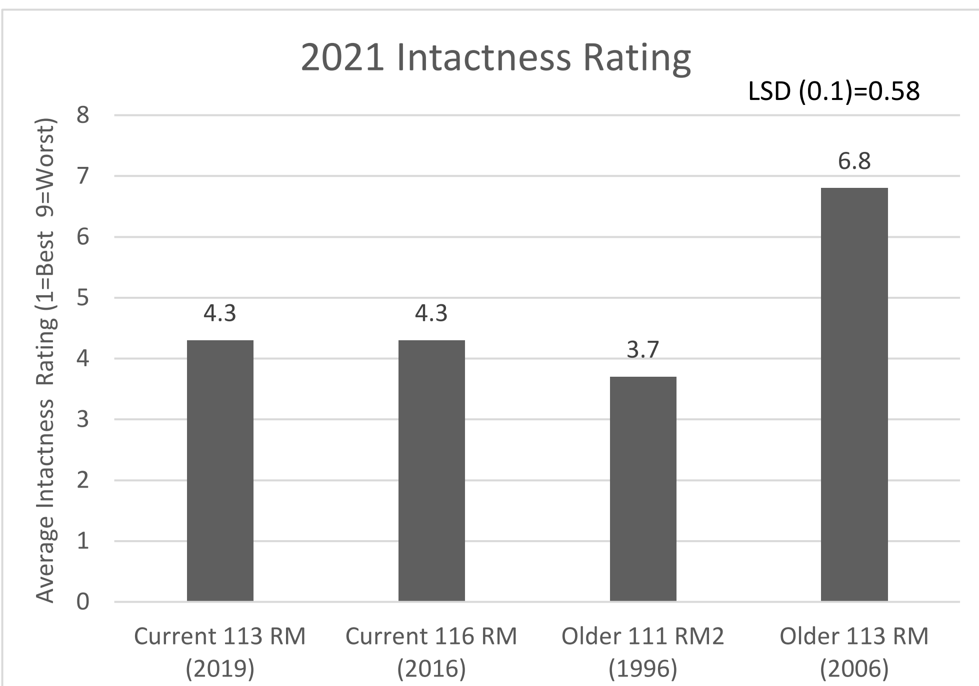


Figure 8: 2021 corn intactness ratings by corn products with a range of relative maturities and different product ages. *LSD (least significant difference) calculated as part of a larger trial containing 5 corn products

Water Application Strategy, Tillage, and Corn Product Impacts on Yield

- Similar to 2020, yield (Figure 6) was heavily correlated with the corn products being tested. The older 113RM and 111RM products had much lower yields relative to modern Current 113RM and 116RM products.
- Corn was still standing well even with the late October harvest date. A rating of 1 indicates that near zero lodged plants were observed in the plot (Figure 7).
- Intactness was impacted by the late harvest date. It does impact the harvest appearance of a field, but it has little effect on yield because the tassels or tops of the corn are gone above the ear. The best intactness rating was noted in the lowest yielding product (Figure 8).

Key Learnings

- Irrigation strategy can have a large impact on the amount of water applied in a trial but adding more water through irrigation does not necessarily result in higher yields. There is a point where there is very little return for the water applied.
- Using a strategy that did not rely on a calendarized starting date, followed by irrigation based on strategies with measurements of field data, saved water usage in 2020 and 2021.
- Current products provided much higher yields in the trial compared to older products, demonstrating the economic advantage that today's products have even with the same inputs supplied.
- This trial will continue in 2022.

Legal Statements

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

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. 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.

1021_R9_21

2021 Dryland Corn Planting Depth by Population Study – Beatrice, NE

Trial Objective

- Uneven corn emergence and uneven distribution of plants can result in reduced yield potential.
- Planter setup is a critical first step to successfully establishing corn yield potential.
- The objective of this demonstration was to illustrate the importance of properly adjusted planting equipment for seeding depth and recommended seeding rate to maximize stand establishment and yield potential.

Experiment/Trial Design

- The demonstration used a 109 day relative maturity (RM) and two113 day RM corn products.
- Each corn product was planted at 2 populations at 4 seeding depths:
  - » 25,000 and 30,000 seeds per acre planted at a1.0-inch, 1.75-inch, 2.25-inch, and 3.0-inch depths.
- The trial was planted with a Precision equipped planter with Delta Force
- Each entry consisted of six 30-inch rows by 220 feet in length.
- Yield data was captured with Precision Planting YieldSense and Climate FieldViewTM.
- Field received 13.7” of total precipitation from planting date to harvest date

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Beatrice, NE	Silt Clay Loam	Soybeans	No tillage	4/24/21	9/27/21	200	25,000 30,000

Figure 1. Left rows of center planted at 30,000 seeds per acre and at a 3-inch depth, right rows of center planted at 25,000 seeds per acre and at a 1- inch depth.

2021 Dryland Corn Planting Depth by Population Study – Beatrice, NE

Understanding the Results

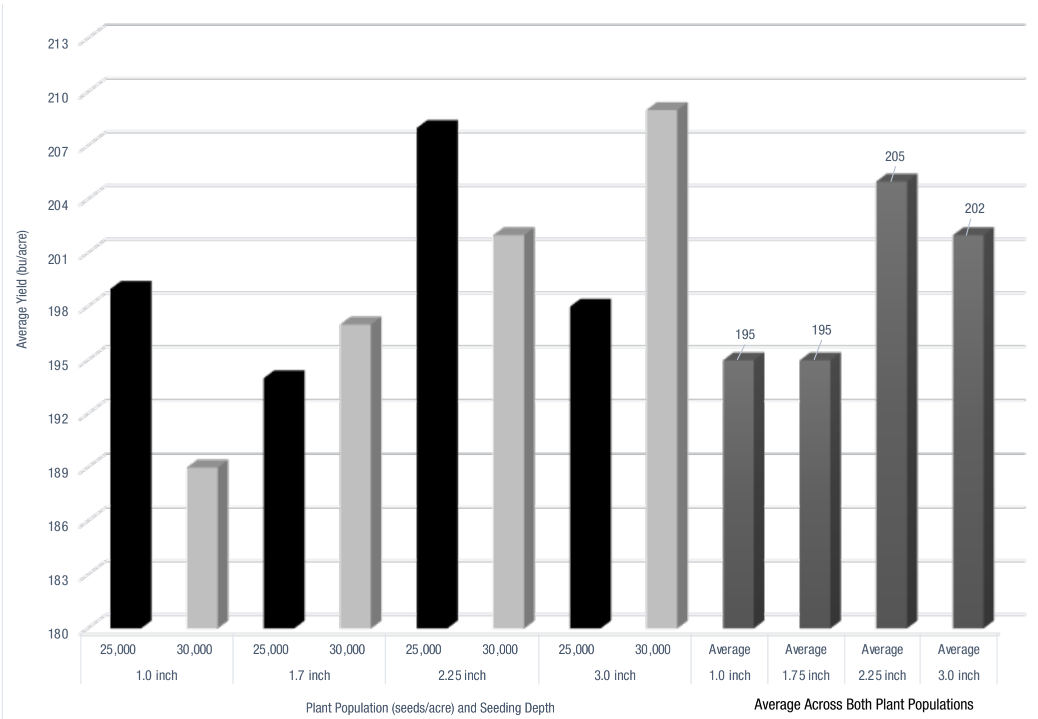


Figure 2. Corn yield performance averaged across 3 corn products planted at 2 different populations and 4 different depths. Beatrice, NE 2021.

Figure 3. Note delay in maturity as a result of planting depth. Image taken on August 23, 2021.

2021 Dryland Corn Planting Depth by Population Study – Beatrice, NE

- In this trial, the highest yield was achieved with a seed depth of 2.25-inch when averaged across all three corn products (Figure 2).
- At the higher population, yield increased as seeding depth increased across the entries.
- Emergence was faster at the 1.0-inch seeding depth; however, yield inconsistency across corn products also increased (Figure 2).
- Senescence was also impacted with seeding depth as moisture stress caused shallower rooted entries to mature quicker than deeper planted entries especially at 30,000 seeds per acre (Figure 3).

Key Learnings

- This demonstration illustrates that planter setup for proper seeding depth combined with following recommended planting populations for a given corn product and area can help maximize yield potential.

Legal Statements

A Long-term Research Study Investigating the Effect of Planting Date on Corn Yield Potential and Moisture Content in the Northern Plains

Trial Objective

- To determine how planting date can impact overall yield potential and how to utilize that data to help provide timely planting recommendations.
- This research was conducted with a goal of understanding the risks and benefits of planting corn at various timings throughout the spring in the Northern Plains (North and South Dakota).
- The goal of this study is to provide planting date guidance for maximizing yield potential.
- This data may be used as a reference guide to help growers make replant decisions when stands are reduced by frost or other factors.

Experiment/Trial Design

- On-going trial since 2009 across Northern Plains (North and South Dakota).
- This data is a summary of a small data set with limited locations. Values are based on averages and not significantly analyzed.
- To compare data across years, results are presented as a percentage of the maximum yield for the year and corn product.
- Trial Design: Non-replicated strip trials.

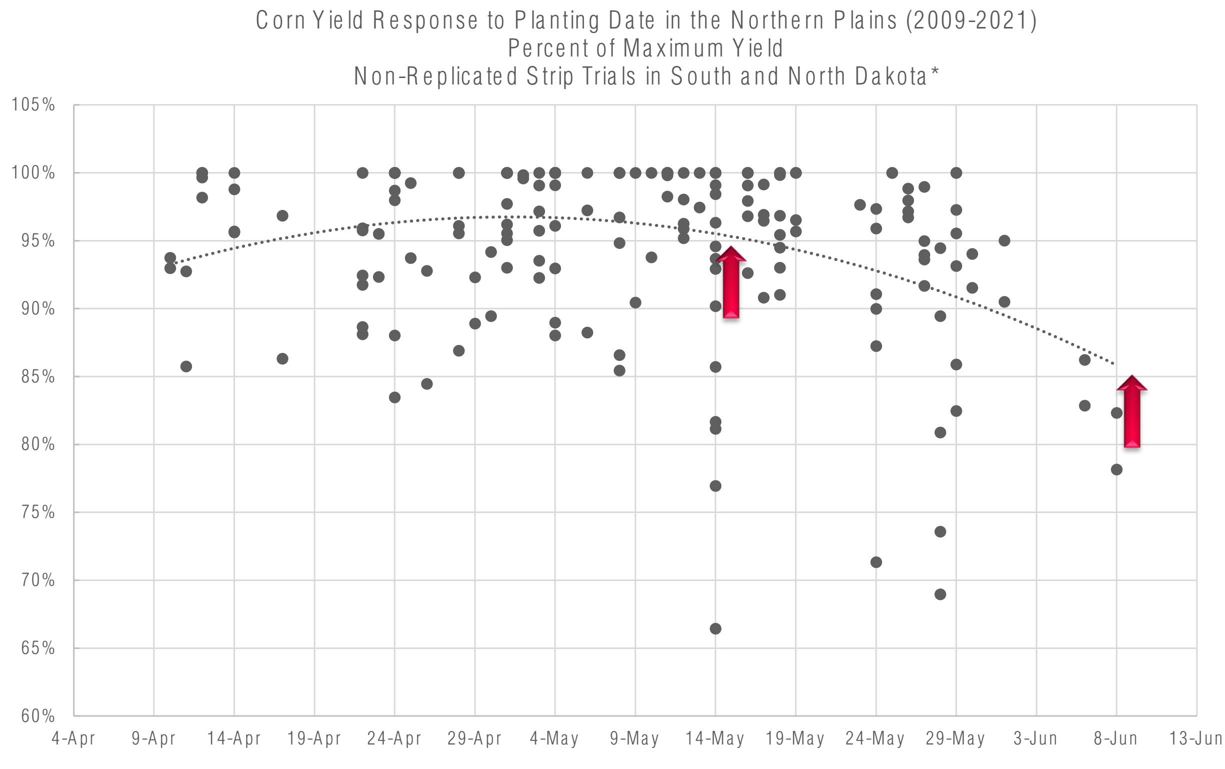
Year	Location
2009	Volga, SD
2010	Volga, SD
2011	NA*
2012	Watertown, SD
2013	Watertown, SD Redfield, SD Chester, SD
2014	NA*
2015	Chester, SD
2016	Berlin, ND Redfield, SD Chester, SD
2017	Carrington, ND Chancellor, SD Ethan, SD Redfield, SD
2018	Chancellor, SD Ethan, SD
2019	Washburn, ND
2020	Chancellor, SD Mitchell, SD Washburn, ND
2021	Litchville, ND Nash, ND Chancellor, SD Watertown, SD

*No data

A Long-term Research Study Investigating the Effect of Planting Date on Corn Yield Potential and Moisture Content in the Northern Plains

Understanding the Results

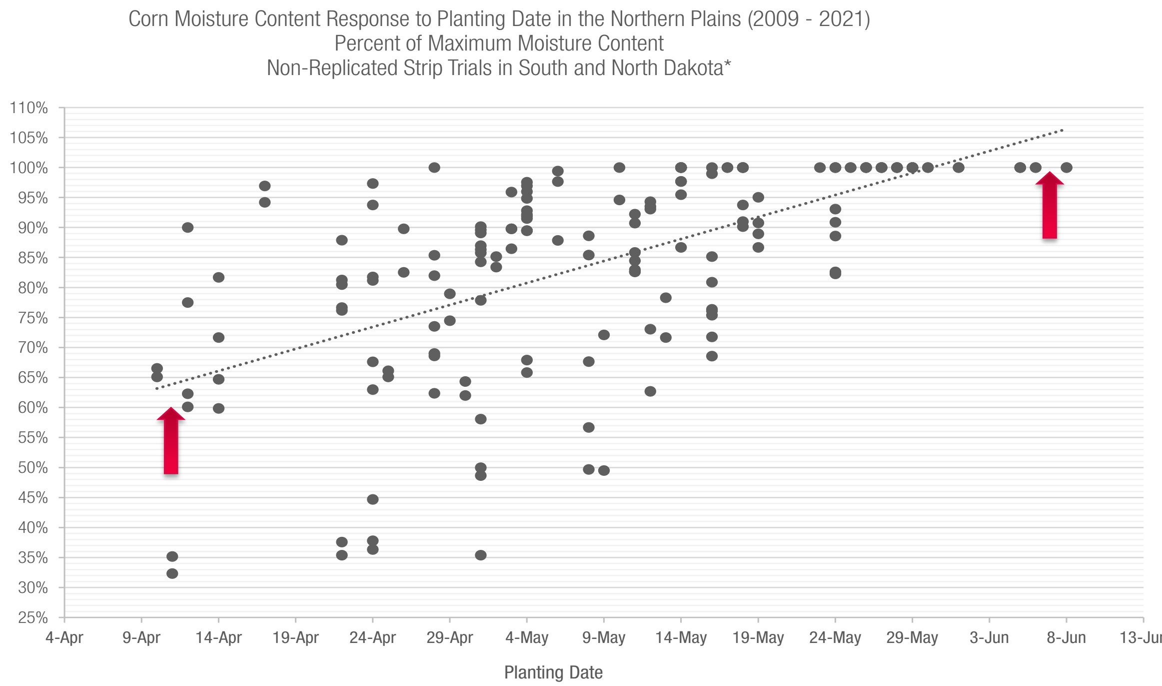
- The highest yields were attained when corn was planted from late April to the first part of May, with a steady decline as the season progressed (Figure 1).
- The potential to maximize yield decreased 10% from May 15th to June 10th (26 days), resulting in an average daily loss of 0.4% (Figure 1).
- Results show from the 10+ years of data moisture content has a linear response to planting date (Figure 2).
- From the first planting date (April 10th) to the last (June 10th), over those 60 days, moisture content increased by 35%, resulting in an average daily gain of moisture content by 0.6% (Figure 2.)



*2009 - Volga, SD; 2010 - Volga, SD; 2012 - Watertown, SD; 2013 - Watertown, SD, Redfield, SD, Chester, SD; 2015 - Chester, SD; 2016 - Berlin, SD, Redfield, SD, Chester, SD; 2017 - Carrington, ND, Chancellor, SD, Ethen, SD, Redfield, SD; 2018 - Chancellor, SD, Ethen, SD; 2019 - Washburn, ND; 2020 - Chancellor, SD, Mitchell, SD, Washburn, ND ; 2021 - Litchville, ND, Nash, ND, Chancellor, SD, Watertown, SD

Figure 1. After May 15th, the potential to maximize yield decreased 0.4% per day (identified as the time between the arrows).

A Long-term Research Study Investigating the Effect of Planting Date on Corn Yield Potential and Moisture Content in the Northern Plains



*2009 - Volga, SD; 2010 - Volga, SD; 2012 - Watertown, SD; 2013 - Watertown, SD, Redfield, SD, Chester, SD; 2015 - Chester, SD; 2016 - Berlin, SD, Redfield, SD, Chester, SD; 2017- Carrington, ND, Chancellor, SD, Ethen, SD, Redfield, SD; 2018 - Chancellor, SD, Ethen, SD; 2019 - Washburn, ND; 2020 - Chancellor, SD, Mitchell, SD, Washburn, ND; 2021 - Litchville, ND, Nash, ND, Chancellor, SD, Watertown, SD

Figure 2. On average, the percent moisture content increased 0.6% from the first planting date to the last (indicated by the arrows).

Key Learnings

- Over 10+ years of data, the data indicates that the optimum planting date to maximize corn yield potential is the end of April to first part of May (April 25th to May 10th).
- After May 15th, the capacity to maximize yield potential at 100% is greatly reduced (-0.4% per day).
- Moisture content appears to have a linear response to planting date over the 10+ years (later planting = higher moisture content).
- This data is to be used as a guidance for recommendations on optimum planting timeframe. Individual locations and years will vary.
- The best practice for planting corn in the Northern Plains, is when soil conditions (temperature and moisture) and the weather forecast are favorable.

Legal Statements

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3013_R18

Dryland Corn Seeding Rates Effect on Product Grain Yield

Trial Objective

- Selecting appropriate products and seeding rates are key to help achieve high yield potential in dryland corn production.
- Low corn populations can promote the formation of tillers (a.k.a. “suckers”). There is controversy as to whether tillers compensate for grain yield by producing more than one ear per plant.
- The objective of this trial was to determine the effect of corn seeding rate on tiller incidence and grain yield for different corn products.

Experiment/Trial Design

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Gothenburg, NE	Hord silt loam	Wheat	No-till	05/13/2021	11/09/2021	200	See below

- The trial was set up as a randomized complete block design with four replications.
- Nine corn products were evaluated with six Channel® and three Pioneer® brand corn products with relative maturities (RM) ranging from 100 to 112 days.
- The four corn seeding rates used were 12,000, 16,000, 20,000, and 24,000 seeds/acre.
- Tiller incidence was measured as a percentage of the number of plants that presented tillers relative to the total number of plants in the plot.
- Corn was fertilized with a stream bar before planting (04/06/2021) with 90 lb/acre of nitrogen (N), 40 lb/acre of phosphorus (P), and 20 lb/acre of sulfur (S). Nitrogen was also side-dressed on 06/22/2021 using Y-drops at 60 lb/acre.
- Weeds were controlled uniformly across the study area.

Dryland Corn Seeding Rates Effect on Product Grain Yield

Understanding the Results

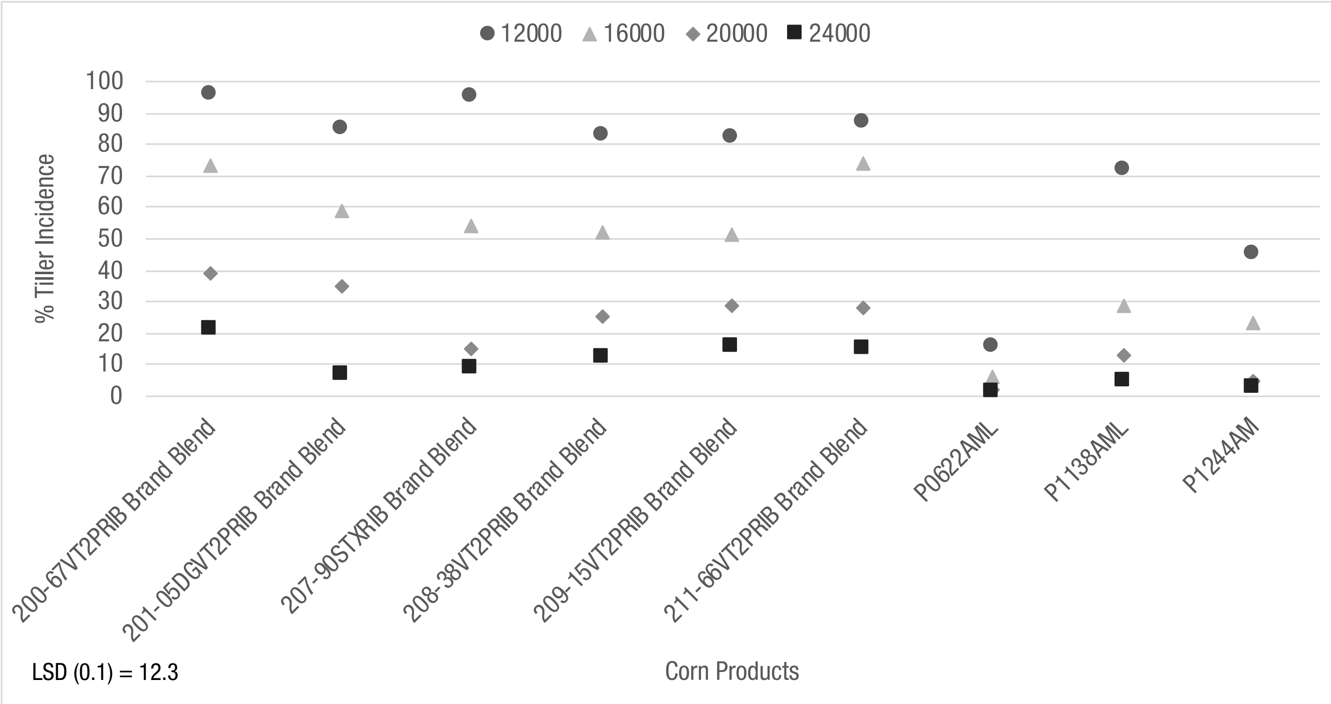

Figure 1. Tiller incidence (%) of different Channel® and Pioneer® brand corn products according to seeding rates in dryland conditions at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021). LSD (least significant difference) calculated as part of a larger trial containing 20 corn products.

- There was a significant interaction between product and seeding rate in tiller incidence in this study.
- Even though tiller incidence varied by corn products, a greater tiller incidence was observed under lower corn seeding rates of 12,000 and 16,000 seeds/acre compared to higher seeding rates of 20,000 to 24,000 seeds/acre (Figure 1).

Dryland Corn Seeding Rates Effect on Product Grain Yield

Table 1. Difference in tiller incidence according to seeding rate and product selection at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021). LSD (least significant difference) calculated as part of a larger trial containing 20 corn products.

Corn Product	Seeding rate (seeds/A)					
	12,000 to 16,000	12,000 to 20,000	12,000 to 24,000	16,000 to 20,000	16,000 to 24,000	20,000 to 24,000
	Difference in tiller incidence (%)					
200-67VT2PRIB Brand Blend	-23.0	-57.0	-75.0	-34.0	-52.0	-18.0
201-05DGVT2PRIB Brand Blend	-26.0	-50.0	-78.0	-24.0	-52.0	-28.0
207-90STXRIB Brand Blend	-41.0	-80.0	-86.0	-39.0	-45.0	-6.0
208-38VT2PRIB Brand Blend	-31.0	-58.0	-71.0	-27.0	-40.0	-13.0
209-15VT2PRIB Brand Blend	-31.0	-53.0	-66.0	-22.0	-35.0	-13.0
211-66VT2PRIB Brand Blend	-13.0	-59.0	-72.0	-46.0	-59.0	-13.0
P0622AML	-10.0	-14.0	-15.0	-4.0	-5.0	-1.0
P1138AML	-43.0	-59.0	-67.0	-16.0	-24.0	-8.0
P1244AM	-22.0	-40.0	-42.0	-18.0	-20.0	-2.0

RM, relative maturity. Shaded cells represent statistical significance at Least Square Difference (LSD) (0.1) = 12.3

- All Channel® brand corn products significantly reduced tiller incidence as the seeding rate increased. However, only one Channel® corn product, 207-90STXRIB, did not significantly reduce tiller incidence from 20,000 to 24,000 seeds/acre.
- The tiller incidence reduction from 12,000 to 20,000, and from 12,000 to 24,000 seeds/acre was significant for all Channel® and Pioneer® brand corn products evaluated (Table 1).
- There was a trend of greater corn grain yield as seeding rates were increased across corn products tested in this study (Figure 2).

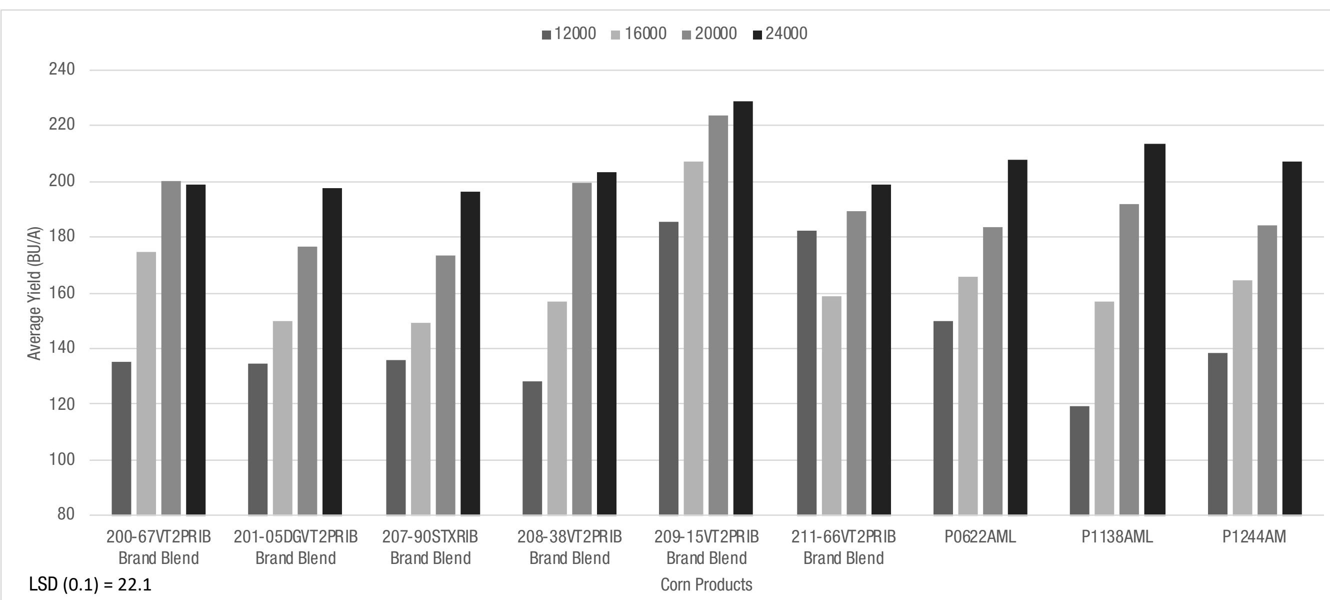

Figure 2. Average grain yield of Channel® and Pioneer® brand corn products according to seeding rates under dryland conditions at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021). LSD (least significant difference) calculated as part of a larger trial containing 20 corn products.

Dryland Corn Seeding Rates Effect on Product Grain Yield

Table 2. Difference in corn grain yield according to seeding rate and product selection at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021). LSD (least significant difference) calculated as part of a larger trial containing 20 corn products.

Corn Product	Seeding rate (seeds/A)					
	12,000 to 16,000	12,000 to 20,000	12,000 to 24,000	16,000 to 20,000	16,000 to 24,000	20,000 to 24,000
	Difference in grain yield (BU/A)					
200-67VT2PRIB Brand Blend	39.5	65.2	63.6	25.7	24.1	-1.6
201-05DGVT2PRIB Brand Blend	15.2	42.1	63.0	26.9	47.8	20.9
207-90STXRIB Brand Blend	13.6	37.5	60.3	23.9	46.7	22.8
208-38VT2PRIB Brand Blend	28.9	71.6	75.4	42.7	46.5	3.8
209-15VT2PRIB Brand Blend	21.3	38.2	43.1	16.9	21.8	4.9
211-66VT2PRIB Brand Blend	-23.5	6.9	16.6	30.4	40.1	9.7
P0622AML	15.5	33.7	57.9	18.2	42.4	24.2
P1138AML	37.8	72.6	94.1	34.8	56.3	21.5
P1244AM	26.1	45.4	68.7	19.3	42.6	23.3

RM, relative maturity. Shaded cells represent statistical significance at Least Square Difference (LSD) (0.1) = 22.1

- The corn grain yield response to seeding rate was product selection dependent. Most of the differences in grain yield between different seeding rate increments were observed from 12,000 to 20,000; 12,000 to 24,000; 16,000 to 20,000; and 16,000 to 24,000 seeds/acre (Table 2).
- The least grain yield differences in the corn products tested were observed from 12,000 to 16,000, and from 20,000 to 24,000 seeds/acre (Table 2).

Key Learnings

- Lower corn seeding rates yielded less than higher seeding rates and produced more tillers. Tillers did not compensate for grain yield.
- The presence of tillers was not associated with reduced corn grain yield as tiller incidence and yield was compared across products.
- Talk to your local Channel Seedsman to determine which corn products and seeding rates best fit your production system.

Legal Statements

Channel® Brand Corn Product Silage Tonnage and Quality

Trial Objective

Corn silage is an important feedstock for cattle producers and dairies across the Great Plains. Desirable corn products should produce high tonnage with favorable silage quality characteristics.

- The objectives of this study are:
  - » to evaluate different corn products covering a range of relative maturities for high tonnage and good silage quality characteristics.
  - » to provide insights to farmers on different product options to help maximize yield and quality potential.

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	5/1/2021	9/13/2021-9/21/2021	270	32,000

- The study was set up as a randomized complete block with three replications.
- Eight Channel® brand corn products with relative maturities from 100 to 115 were evaluated.
- Irrigation was applied as needed using sprinkler irrigation.
- Fertility included 27 lb. N/acre, 60 lb P/acre, 25 lb S/acre, and 0.25 lb Zn/acre applied with strip-till 4/27/21, followed by 120 lb N/acre applied with 360 Y-DROP® applicators on 6/24/21. Weeds were controlled as needed and no fungicides or insecticides were applied.
- Silage was harvested when most of the products were at approximately half to two-thirds-milk line using a silage chopper without a kernel processor. Total biomass was collected and weighed. A subsample of the freshly chopped material was collected and sent to Dairyland Laboratories Inc. for silage quality analysis.

Channel® Brand Corn Product Silage Tonnage and Quality

Understanding the Results

Table 1. Key yield and quality characteristics of 8 Channel® corn products evaluated to determine silage utility.

Products	% DM	% Starch	% NDF	NDFD 48	uNDF 24	uNDF 240	IVSD 7hr	% ADF	% CP	TFA	SUGAR	% TDN	Lignin % DM	NEL	NEG	2006 MILK/ TON
200-88STXRIB Brand Blend	42.67	41.92	32.78	58.61	16.39	9.45	65.6	19.69	8.58	2.62	2.37	68.98	3.08	0.68	0.55	3111
203-83STXRIB Brand Blend	42.21	45.06	30.63	63.8	13.88	7.52	65.75	17.58	8.23	3.02	2.27	72.2	2.45	0.71	0.59	3347
209-15STXRIB Brand Blend	36.79	42.31	30.87	64.2	13.83	7.8	68	17.93	8.94	2.81	1.68	75.92	2.6	0.75	0.58	3646
210-99STXRIB Brand Blend	37.45	44.41	29.7	64.79	13.19	6.95	68.69	17.13	8.45	2.97	1.7	76.66	2.43	0.76	0.59	3703
213-93STXRIB Brand Blend	43.79	42.16	32.51	62.14	15.23	8.01	66.97	20.36	8.45	2.56	2.32	69.03	2.77	0.67	0.56	3098
214-22STXRIB Brand Blend	44.71	43.12	31.45	61.3	15.09	8.43	67.1	19.43	8.39	2.57	2.52	68.52	2.78	0.66	0.56	3064
214-78DGVT2PRIB Brand Blend	43.86	39.08	35.23	62.46	16.11	9.17	68.03	21.16	8.11	2.4	2.53	69.11	2.95	0.67	0.55	3098
215-98STXRIB Brand Blend	40.14	40.74	33.74	60.6	16.33	9.29	67.73	20.47	7.91	2.46	2.23	71.28	2.97	0.7	0.55	3290
LSD (0.1)*	2.14	6.97	5.58	3.15	2.01	2.03	1.35	3.58	0.41	0.36	0.59	2.05	0.62	0.03	0.04	162.9

DM – Dry matter; 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.

*LSD (least significant difference) calculated as part of a larger trial containing 30 corn products

Channel® Brand Corn Product Silage Tonnage and Quality

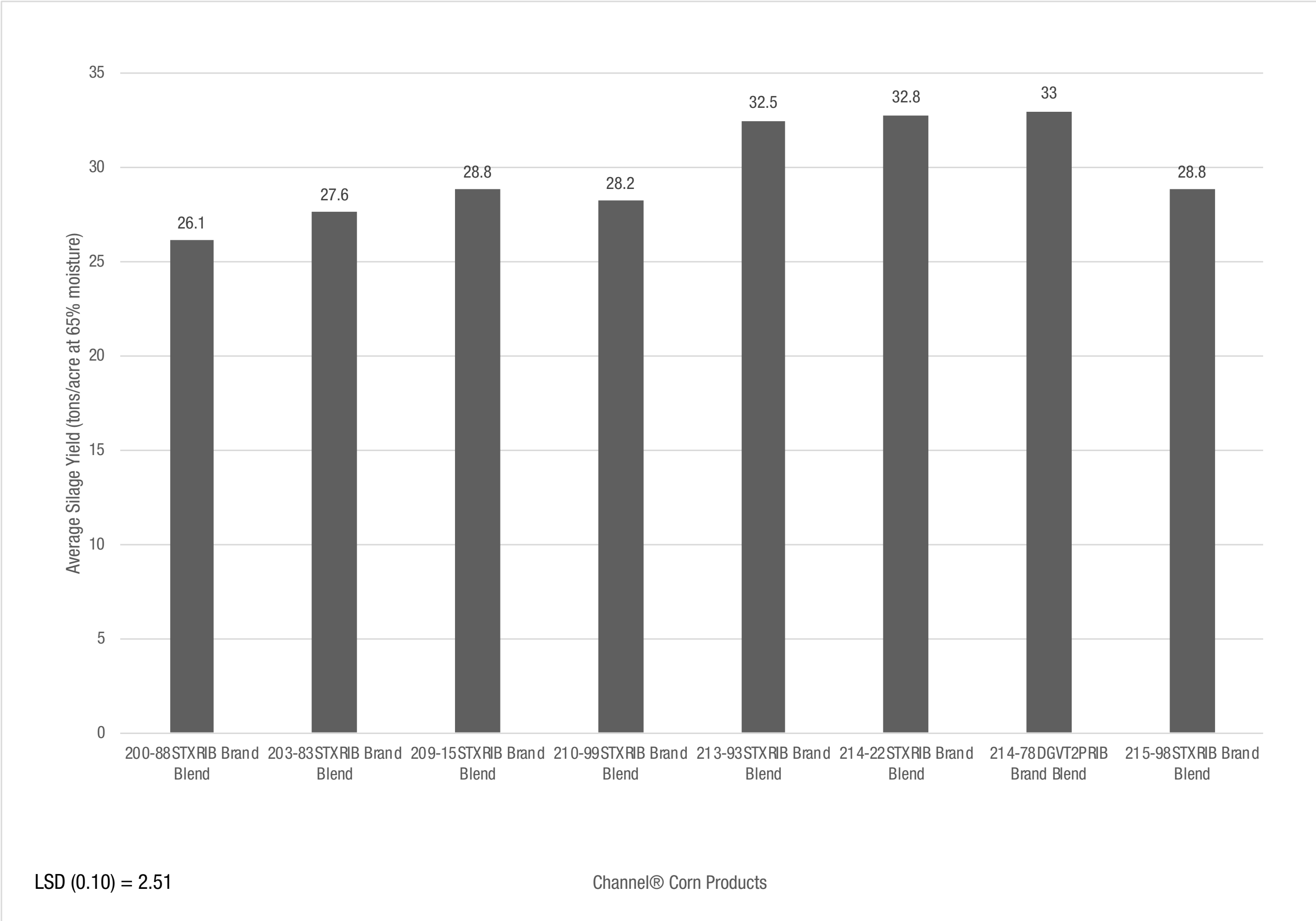

Figure 1. Average silage yield (tons/acre) for Channel® corn silage products spanning a wide range of relative maturities.

Results showed a general trend towards increasing yield potential as relative maturity increased from early maturing products to later maturing, with tonnage ranging from approximately 26 tons/acre for the earliest RM product tested to over 32 tons/acre for several of the corn products of 113RM or greater (Figure 1).

In terms of silage quality characteristics, results for each characteristic measured were highly dependent on the specific corn product and not related specifically to the relative maturity of the product. Table 1 lists all the quality characteristics for each corn product.

Key Learnings

- Corn product selection for silage production will depend on the RM, as well as agronomic and disease tolerance characteristics that the grower needs to suit their local environment and management practices.
- Each corn product, regardless of RM, has a specific set of quality characteristics and growers should consider all the product options within their optimal RM range to find products that fit their specific operation.
- Producers should work with their local seed sales team to identify the right corn product for their operation.

Channel® Brand Corn Product Silage Tonnage and Quality

Legal Statements

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Bayer is a member of Excellence Through Stewardship® (ETS). Bayer products are commercialized in accordance with ETS Product Launch Stewardship Guidance, and in compliance with Bayer's Policy for Commercialization of Biotechnology-Derived Plant Products in Commodity Crops. Commercialized products have been approved for import into key export markets with functioning regulatory systems. Any crop or material produced from this product can only be exported to, or used, processed or sold in countries where all necessary regulatory approvals have been granted. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted. Growers should talk to their grain handler or product purchaser to confirm their buying position for this product. Excellence Through Stewardship® is a registered trademark of Excellence Through Stewardship.

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. 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.

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.

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, whereas excess N can go unused. A balanced use of nitrogen (N), according to crop demands, is necessary to reduce N loss in the environment, reduce excessive vegetative growth of corn plants that can result in increased vulnerability to lodging, and increase the return on N investment.
- The objective of this trial was to evaluate the effects of N rates on corn.

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	05/06/2021	11/15/2021	250	36,000

- The trial design was a split-plot with N fertilizer as the whole plot and corn product as the subplot with four replications.
- A total of six N rates and three corn products were selected for this trial.
  - » N Rates: 0, 60, 120, 180, 240, and 300 lb/acre.
  - » Corn products: 113 RM, 115 RM, 113 RM-2
- The nitrogen fertilizer used was 32-0-0 and it was applied using a 360 Y-DROP on 06/29/2021.
- Weeds were uniformly controlled with herbicides and no other pesticides were applied.
- Test weight, moisture, and total shelled weight were collected to calculate yield.
- The grain yield was corrected to a standard of 15% moisture content.

Corn Response to Nitrogen Rates

Understanding the Results

- Plant lodging was high at higher N rates as observed in Figure 1.

Figure 1. Plant lodging of corn at higher N rates. Pictures were taken on 11/15/2021 at the Water Utilization Learning Center in Gothenburg, Nebraska

- For corn, plant lodging increased as the N rate increased, especially at and above 120 lb/acre, except for the corn product 115 RM (Figure 2).
- Lodging percentages did differ with different corn products (Table 1).

Corn Response to Nitrogen Rates

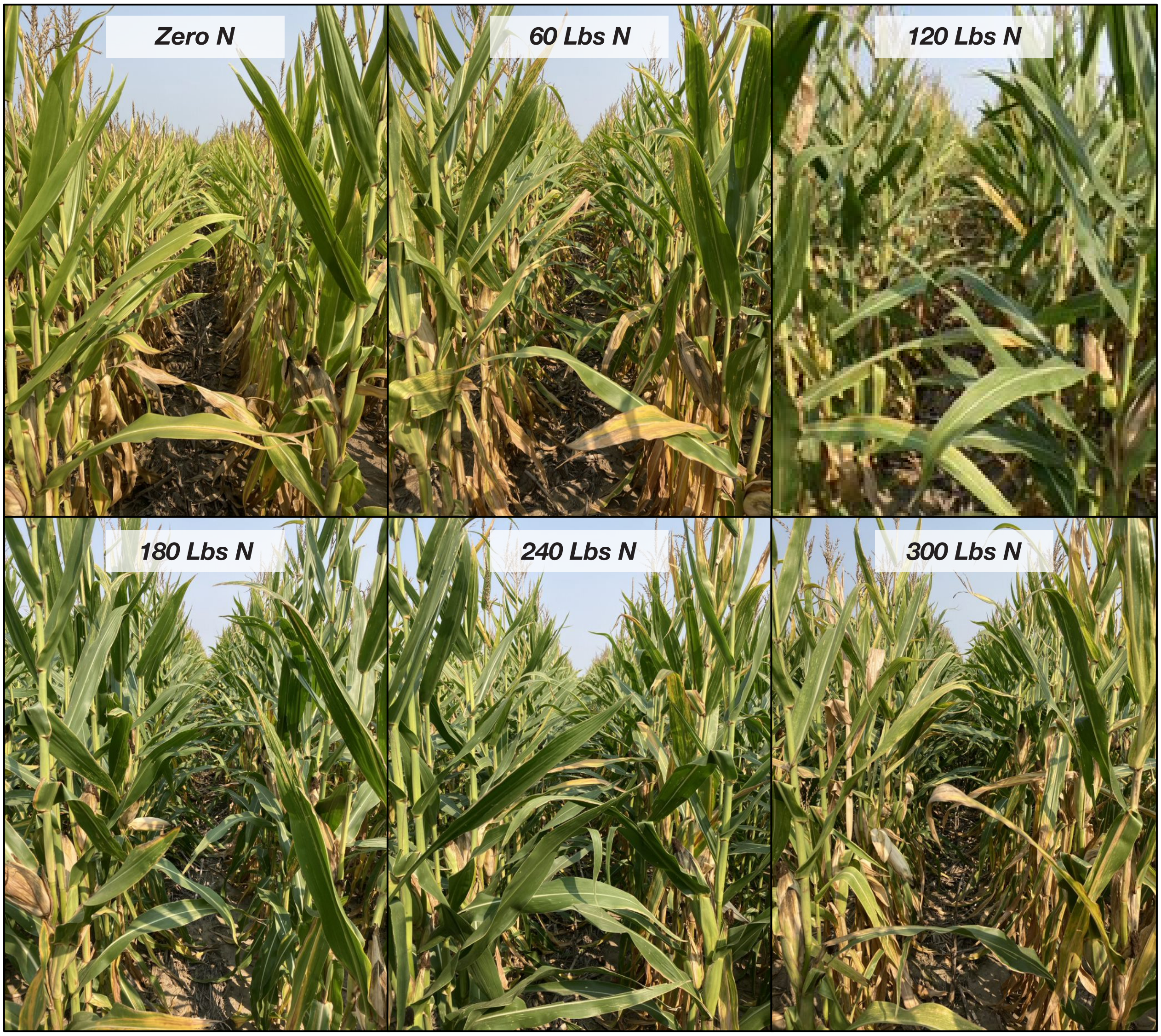

Figure 2. Nitrogen fertilization treatments in corn. Pictures were taken on 09/10/2021 at the Water Utilization Learning Center near Gothenburg, Nebraska.

- The greatest corn grain yield increase was observed in response to an incremental increase of N from 0 to 60 lb/acre and was observed across all corn products in this study (Table 2).
- There were no positive statistical differences in corn grain yield when N rates applied were above 120 lb/acre in this trial. Instead, two of the corn products had reduced yields because of excess lodging.

Corn Response to Nitrogen Rates

Table 1. Average lodging of corn products according to nitrogen rates.						
Product	Nitrogen Rate (lb/acre)					
	0	60	120	180	240	300
	Lodging (%)					
103 RM	33	39	51	80	92	83
113 RM	30	36	76	87	93	89
115 RM	34	31	21	22	38	43
Average	32	35	49	63	74	72

RM, relative maturity. Least significant difference (LSD) (0.1) = 13
*LSD (least significant difference) calculated as part of a larger trial containing 6 corn products

Table 2. Average grain yield of corn products according to nitrogen rates.						
Product	Nitrogen Rate (lb/acre)					
	0	60	120	180	240	300
	Yield (bu/acre)					
103 RM	102	160	167	159	148	152
113 RM	102	148	154	156	155	167
115 RM	87	167	199	211	189	193
Average	97	158	173	175	164	171

RM, relative maturity. Least significant difference (LSD) (0.1) = 24.6
*LSD (least significant difference) calculated as part of a larger trial containing 6 corn products

Key Learnings

- Higher nitrogen rates lead to excessive lodging which reduced harvestable yield. This can be especially true in fields that are corn-on-corn where there are other factors degrading the integrity of the stalk such as disease.
- Carefully matching nitrogen rate with corn product, yield potential and residual soil nitrogen is key to maximize potential benefit of N fertilizer while minimizing potential drawbacks.

Legal Statements

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Corn Characteristic Response to Nitrogen

Channel®
Seedsmanship At Work®

Trial Objective

- Many new corn products are developed each year as research and development pipelines aim to improve the corn portfolio and farmer choice. Farmers have a short time to become familiar with what nitrogen application strategy the corn product is most responsive to.
- Flex-ear corn products can adjust yield components and set more rows around on the cob, more kernels per row, or increase kernel depth if conditions are favorable. Increasing seeding rates to increase yield are recommended for fixed-ear corn products as the yield components do not change much.
- Agronomists make recommendations for corn products with high or low late-season plant health and ear flexibility. These corn characteristics may affect N uptake and allocation and impact corn yield potential. Additional information about N applications can help farmers improve their N management system for individual corn products.
- The objective of this study was to evaluate corn characteristics for a second year and compare results from year 1: (1) late season plant health and (2) corn ear flex and their influence on corn yield potential with different N application strategies.

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-till	4/26/2021	10/21/2021	290	36,000

- A soil test report on April 1, 2021, indicated 189 lb N/acre was recommended (31 lb N/acre in the top 2 ft of soil plus 40 lb N/acre legume credit) for a yield goal of 270 bu/acre.
- The study design was a split-plot with fertilizer as the whole plot and corn characteristics as the subplot with four replications.
- The trial was sprinkler irrigated.

Fertilizer Treatments:

- Up-front Nitrogen (N) – Strip-tilled 29 lb N/acre on 4/13/2021 and applied 160 lb N/acre with 360 Yield Center Y-Drops on 5/12/2021 when corn was at the V1 growth stage.
- Split N - Strip-tilled 29 lb N/acre on 4/13/2021 and applied 40 lb N/acre with the Y-Drops on 5/12/2021, followed by 120 lb N/acre applied by fertigation. The fertigation was split into 4 to 30 lb N/acre increments with applications on 6/29, 7/9, 7/27, and 8/6.

Corn Characteristic Treatments:

- Late-season plant health
  - » High – 105-day relative maturity (RM), 111RM, and 113RM
  - » Low – 110RM, 111RM, and 113RM
- Ear Flex
  - » High – 104RM, 113RM, and 113RM
  - » Low – 108RM, 109RM, and 113RM
- The study area also received 60 lb P/acre, 25 lb S/acre, and 0.25 lb Zn/acre with the 4/13/2021 strip-till application.

Corn Characteristic Response to Nitrogen

- Weeds were uniformly controlled with herbicides and no other pesticides were applied.
- Test weight, moisture, and total shelled weight were collected to calculate yield.
- Yield was corrected to a standard of 15% moisture content.

Understanding the Results

Late Season Plant Health

- The difference in how corn that was classified as either ‘high’ or ‘low’ for late season plant health responded to a split nitrogen (N) or the up-front N treatments is detailed in Figure 1.
  - » Corn products with “high” late-season plant health had greater yields from the split N treatment compared to the up-front N treatment. Corn products with “low” late-season plant health had no yield difference between the two N strategies.
  - » These results are similar to those observed in 2020.

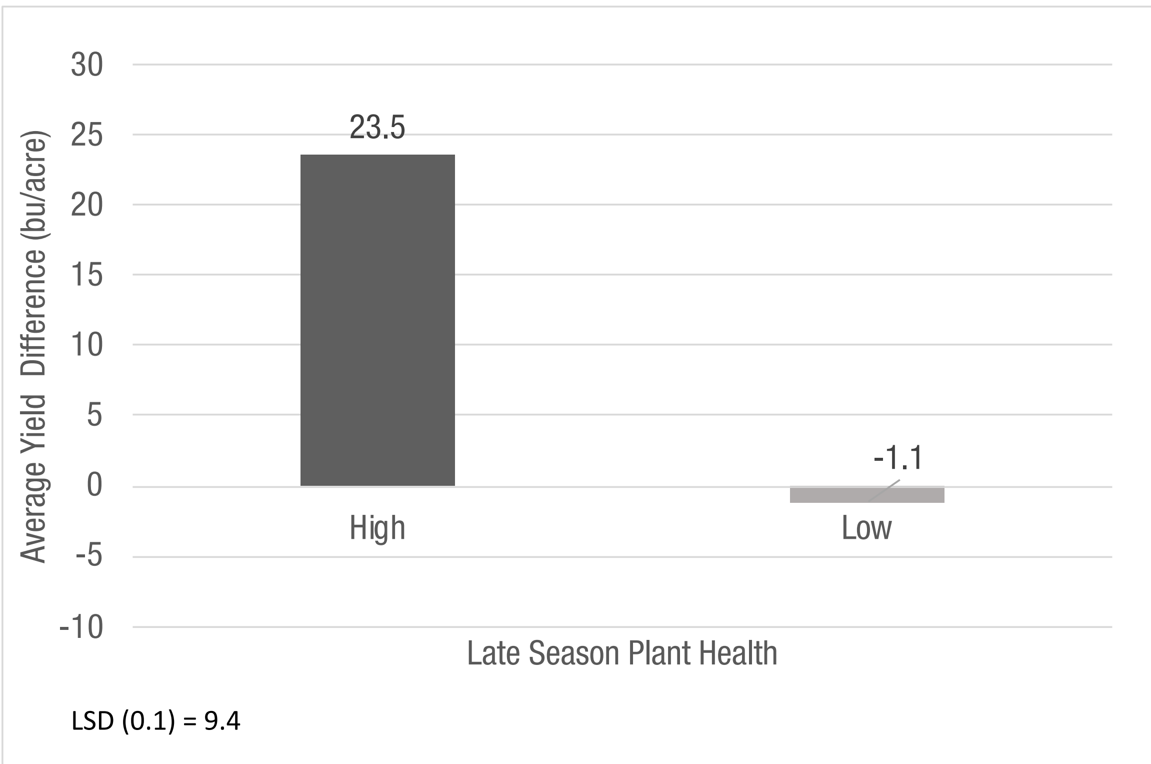

Figure 1. Response of late season plant health to nitrogen strategy. (Bars represent the split N application average yield minus the up-front N application average yield)

Ear Flex

- Corn rated either ‘high’ or ‘low’ for ear flex had a positive response to the split N application treatment with a significant difference observed for corn classified as ‘high’ ear flex. Corn rated with ‘low’ ear flex also had a positive response to the split N application but not to the same extent as corn rated with “high” ear flex (Figure 2).
- The differences were more pronounced than what was observed in 2020; however, the 2020 results with ‘high’ ear flex corn had a trend for higher yields with a split N application.

Corn Characteristic Response to Nitrogen

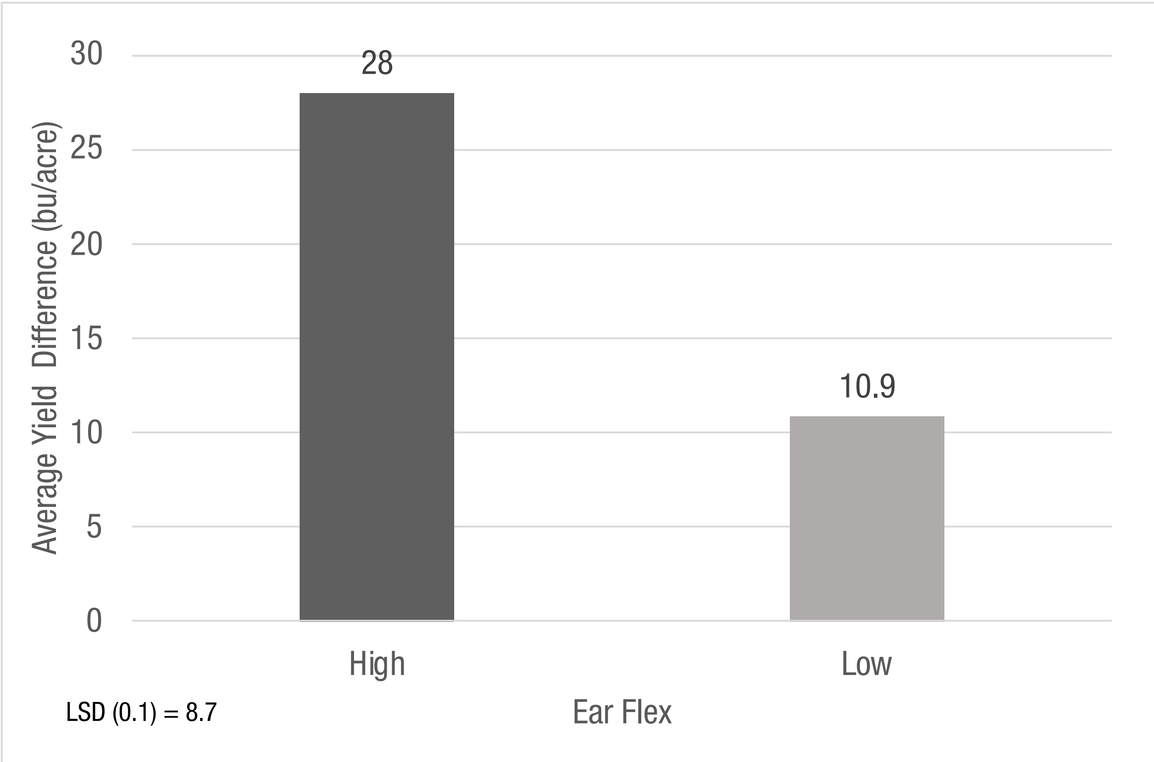

Figure 2. Response of corn ear flex to nitrogen strategy. (Bars represent the split N application average yield minus the up-front N application average yield)

Key Learnings

- Late season plant health - ‘High’ late season plant health had a consistent positive response to split N applications, whereas ‘Low’ late season plant health did not respond to split N applications in either 2020 or 2021.
- Ear Flex - Results varied between 2020 and 2021 on the impact that nitrogen strategy had on ‘high’ or ‘low’ ear flex. However, no negative response was observed from a split N application across either ‘high’ or ‘low’ ear flex products in either year.
- Testing to evaluate the response of corn characteristics to nitrogen strategy will continue in 2022.

Legal Statements

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1011_R6_21

Using 2021 Corn Rootworm Beetle Counts to Assess the Risk of Economic Injury in 2022

Channel®
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Trial Objective

- The objective of this study was to measure corn rootworm (CRW) beetle populations in corn and soybean fields in 2021 to assist in risk evaluation for 2022.
- The monitoring of CRW beetle numbers in current corn and soybean fields can be used to help assess the potential risk of CRW larval infestations reaching economic damage levels in the following corn crop.
- The data may help guide CRW larval management decisions, including corn product selection, for the next corn crop.

Research Site Details

Number of Fields	Soil Type	2021 Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
996	Various	Corn	Various	Various	Various	110 to 250	Various
295	Various	Soybean	Various	Various	Various	110 to 250	Various

- One to four Pherocon® AM non-baited trapping sites were established at 1291 field locations in corn and soybean fields across the corn-growing areas of CO, IA, IL, IN, KS, MI, MN, MO, NE, ND, OH, SD, and WI (Figure 1).
- The trapping sites were installed in the interiors of corn and soybean fields that encompassed a variety of crop and management histories (Figures 2 and 3). 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 changed at 5- to 10-day intervals for 2 to 8 consecutive weeks through CRW adult emergence, mating, and egg laying phases (late July through late September).
- Following each sampling interval, counts for northern and western CRW beetles were recorded and used to calculate the average number of CRW beetles/trap/day by field (Figure 4).
- At the end of the collective sampling period, the average capture value for each field was determined and the data were used in further analysis.

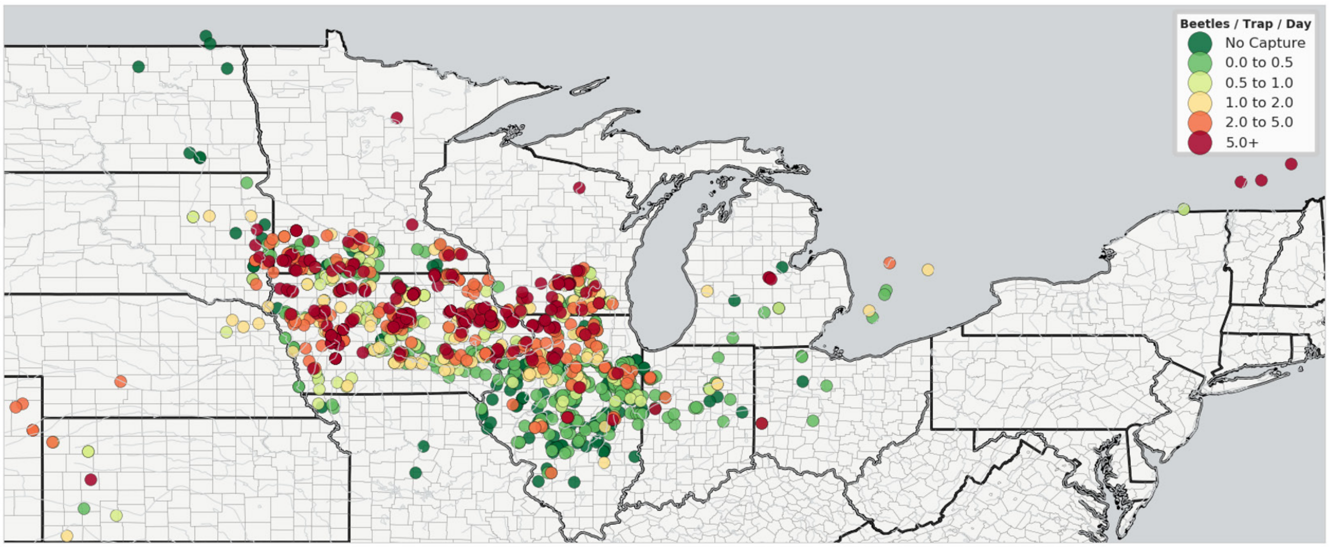
Understanding the Results

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 and provide the economic injury potential for the following season.1,2

- Less than 2 beetles/trap/day indicate a relatively low risk of economic injury.
- Greater than 1 beetle/trap/day suggests a low risk for economic injury but could indicate populations are increasing.
- Greater than 2 beetles/trap/day indicate the probability for economic injury is likely if control measues are not used.
- Greater than 5 beetles/trap/day indicate that economic injury is very likely and populations are expected to be very high the following year.

Using 2021 Corn Rootworm Beetle Counts to Assess the Risk of Economic Injury in 2022

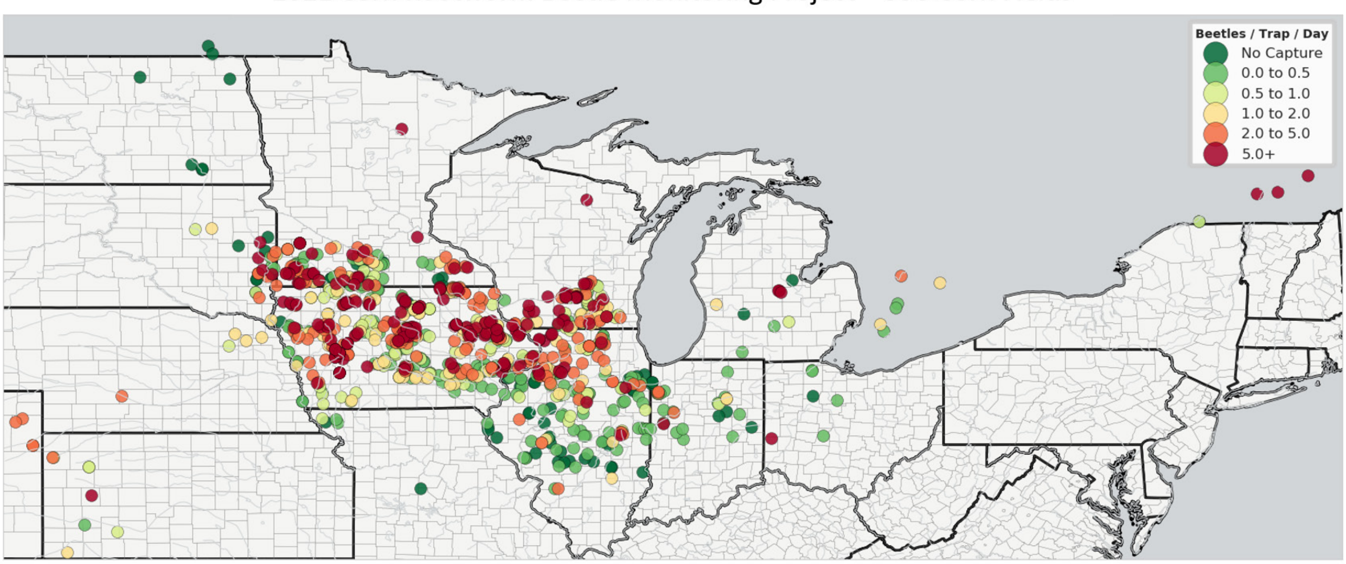
2021 Corn Rootworm Beetle Monitoring Project – 1291 Fields



Source: Iowa State University Extension - https://crops.extension.iastate.edu/cropnews/2016/06/guidelines-using-sticky-traps-assess-corn-rootworm-activity

Figure 1. Corn rootworm beetle trapping locations (corn and soybean fields) in 2021.

2021 Corn Rootworm Beetle Monitoring Project – 996 Corn Fields



Source: Iowa State University Extension - https://crops.extension.iastate.edu/cropnews/2016/06/guidelines-using-sticky-traps-assess-corn-rootworm-activity

Figure 2. Corn field locations for corn rootworm beetle trapping in 2021.

Using 2021 Corn Rootworm Beetle Counts to Assess the Risk of Economic Injury in 2022

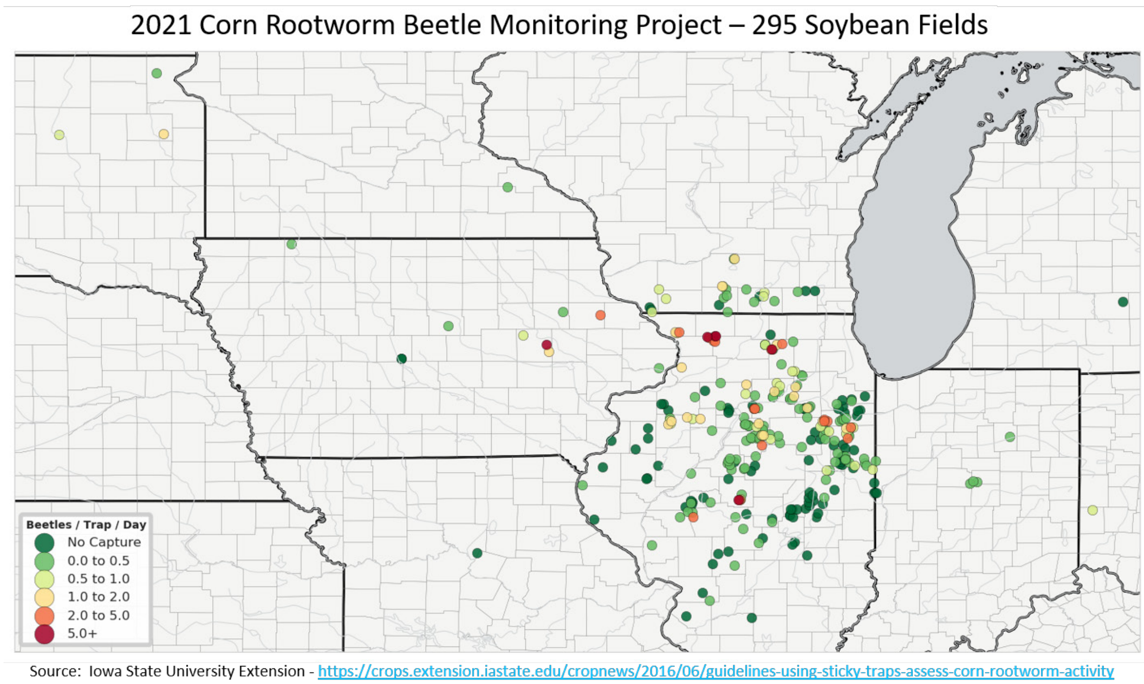


Figure 3. Soybean field locations for corn rootworm beetle trapping in 2021.

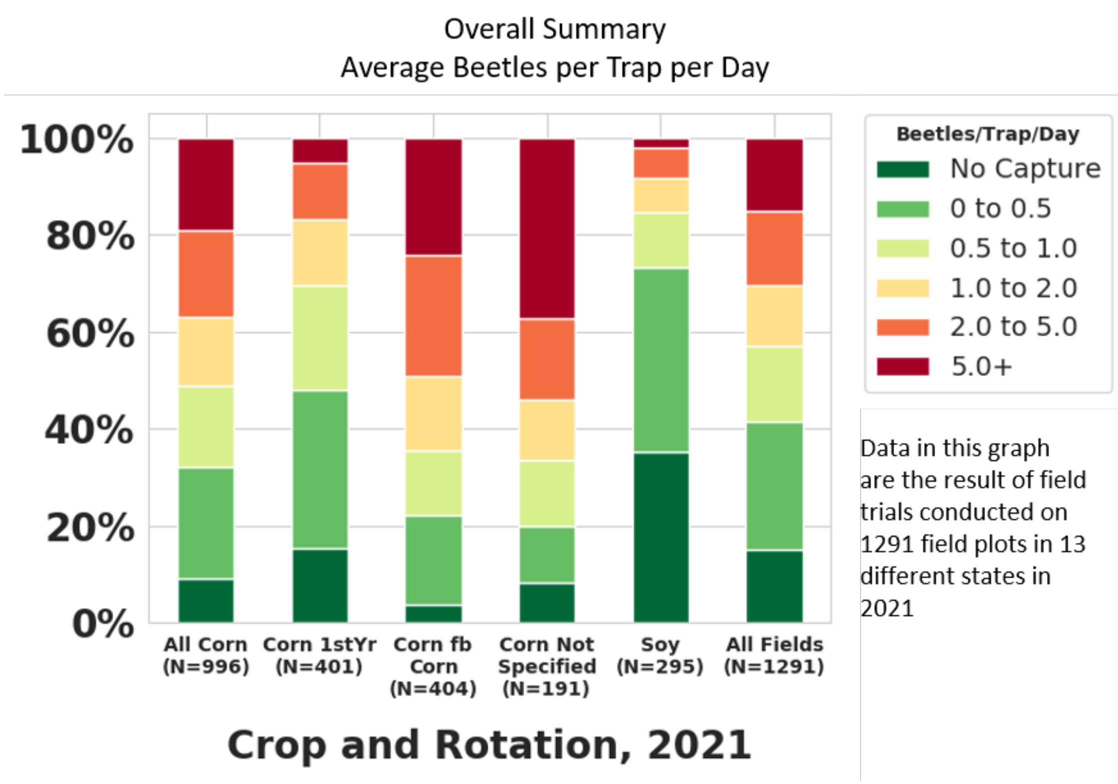


Figure 4. Overall summary of average corn rootworm beetles captured per trap per day in corn and soybean fields in 13 states (2021).[1,2]

Using 2021 Corn Rootworm Beetle Counts to Assess the Risk of Economic Injury in 2022

2021 Corn Rootworm Beetle Survey Data

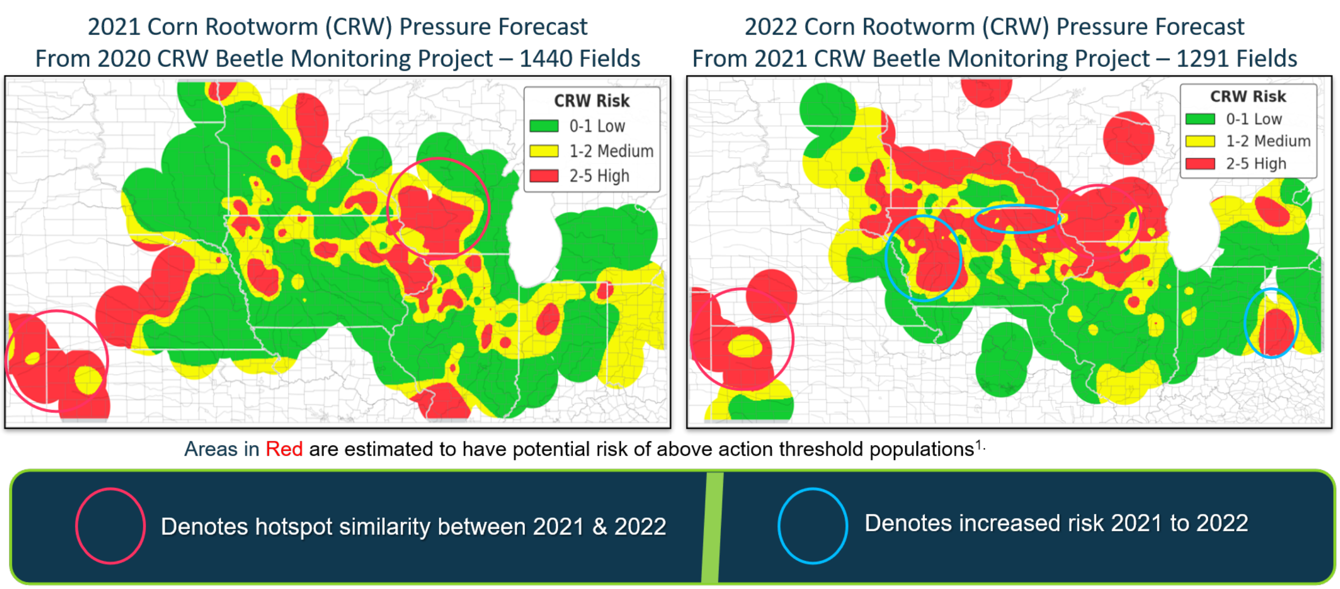
- Populations for CRW were variable across the corn-growing area, which suggests that environment and management affect CRW pressure (Figure 5, right).
- 38% of the corn fields had counts exceeding the economic threshold of 2 beetles/trap/day (up from 22% in 2020).
- 52% of the continuous corn fields sampled were above the economic threshold (up from 33% in 2020).
- 17% of the first-year corn fields were above the economic threshold (up from 4% in 2020). This is a dramatic change from the previous year.

Table 1. Summary of field sampling and corn rootworm beetle captures in 2021.

2021 Crop	2020 Crop	Number of Sampled Fields	Average Peak Number of Corn Rootworm Beetles/Trap/Day
Total Corn	All rotations	996	3.55
Corn	Soybean	401	1.23
Corn	Corn	404	4.75
Corn	Not Specified	191	6.13
Soybean	Corn	295	0.65
Corn and Soybean	All Rotations	1291	2.89

2021 Data Interpolation

- Point data 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 2022 risk potential, are possibly elevated in corn fields in west, central, and east central IA, southern MN, southwest, and southern WI, and northwestern IL (Figure 5, right).
- In comparison to 2021 CRW forecast (Figure 5, left), the risk for 2022 (Figure 5, right) appears to be greater over a broader area.



[1] Source: Iowa State University Extension - https://crops.extension.iastate.edu/cropnews/2016/06/guidelines-using-sticky-traps-assess-corn-rootworm-activity

Figure 5. Comparison of corn rootworm beetle pressure in 2021 and 2022. Risk is potentially higher for larval infestations in western and northeastern Iowa in 2022.

Using 2021 Corn Rootworm Beetle Counts to Assess the Risk of Economic Injury in 2022

2022 Corn Rootworm (CRW) Pressure Forecast
From 2021 CRW Beetle Monitoring Project – 295 Soybean Fields

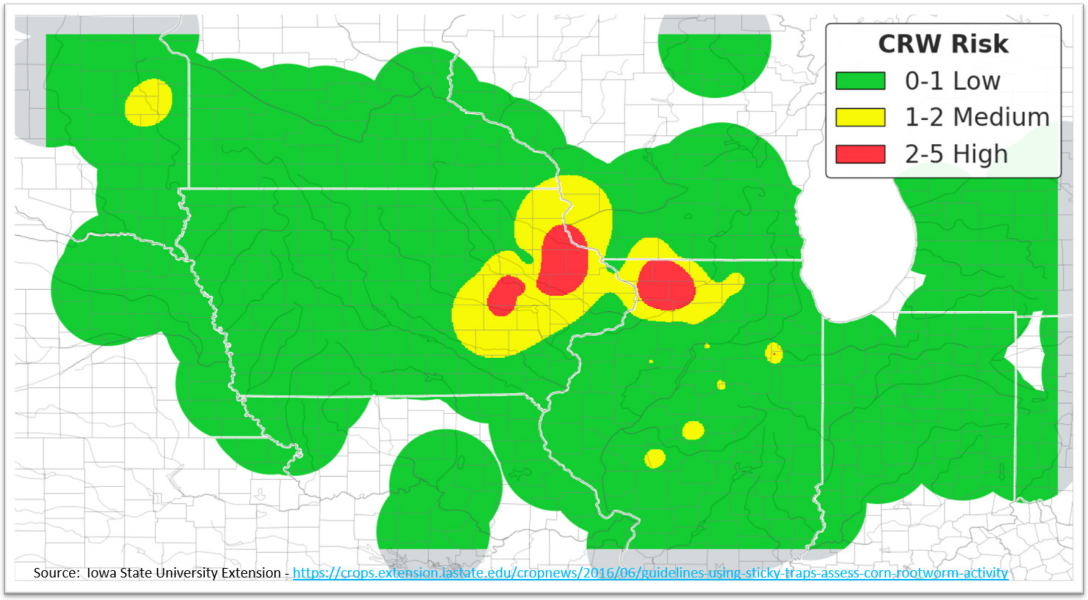


Figure 6. Corn rootworm beetle pressure in 295 soybean fields across the Midwest in 2021.

- Larval populations are estimated to be relatively low in many parts of ND, SD, MN, NE, KS, MO, IL, IN, MI, and OH; however, localized hot spots can be found every year (Figure 5, right).
- Adult CRW presence in soybean fields was found to be low in most sampled areas; however, there were some hot spots in northwestern IL (Figure 6).

Key Learnings

- Corn root injury from CRW larvae is a persistent and annual 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 larval feeding can cause yield losses averaging 15% with losses of 45% or more being possible.3
- In the absence of site-specific data, local and regional CRW beetle 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 larval potential. This information can be used to help prepare for the 2022 season and the selection of CRW Bacillus thuringiensis (B.t.)-protected corn products or soil-applied insecticides to protect your crop against the risk of CRW larvae damaging roots and reducing yield potential.

Sources

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

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

[3]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. Department of Crop Sciences, University of Illinois, Urbana, IL. Journal of Applied Entomology.

Legal Statements

Evaluation of Corn Rootworm Management in Nebraska

Trial Objective

- Evaluate the relative performance of commercially available, below-ground traits for corn rootworm protection.
- Demonstrate the value of below-ground, corn rootworm protection for reducing the potential of root damage.
- Highlight the improved corn rootworm control of trait platforms with multiple modes of action.

Experiment/Trial Design

- This single replication strip trial was conducted across four locations during the 2021 growing season.
- Sites were selected for a history of corn rootworm damage and typical planting dates for the area were targeted.
- Each location planted locally adapted corn products with relative maturities of 104 to 113 days. The corn product genetics varied by available trait.
  - » Below-ground corn rootworm protection traits in the trial were:
    - SmartStax® PRO Technology
    - SmartStax® Technology
    - Agrisure Duracade® Products
    - Qrome® Products
  - » VT Double PRO® Corn, which does not have below-ground corn rootworm protection, was used as a check.
- 10 consecutive plants from each entry in representative areas of the plot were collected at the R1 growth stage and assigned a root damage rating using the Iowa State Nodal Injury Scale (NIS03).
  - » NIS03 has a 0 to 3 scale
    - 0 = No Damage
    - 1 = 1 node or the equivalent of 1 node eaten within 1.5-inches of stalk
    - 2 = 2 nodes eaten within 1.5-inches of stalk
    - 3 = 3 nodes eaten within 1.5-inches of stalk
- A multi-trait corn leaf field test was performed on all samples to verify the presence of specific traits and to avoid any refuge plants biasing the data. All refuge plants were excluded from the data and an average NIS 0-3 was calculated for each entry based on the traited plants.
- Weeds were controlled uniformly across the study with no insecticides or fungicides being applied. Nutrient management was managed by the landowners according to their agronomic plan.
- % Stalk Lodging, % Root Lodging, Yield, and % Moisture observations were collected at each location along with NIS 0-3.

Nebraska Locations	Soil Type	Irrigation	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Pilger	Silty Clay Loam	Dryland	Corn	Conventional	5/24/21	9/23/21	200	30,000
Gothenburg	Silt Loam	Center Pivot	Corn	Strip-till	4/30/21	10/31/21	250	34,000
Columbus	Silt Loam	Center Pivot	Corn	No-till	5/13/21	10/23/21	220	31,000
Imperial	Silt Loam	Center Pivot	Corn	Strip-till	5/07/21	11/22/21	225	34,000

Evaluation of Corn Rootworm Management in Nebraska

Understanding the Results

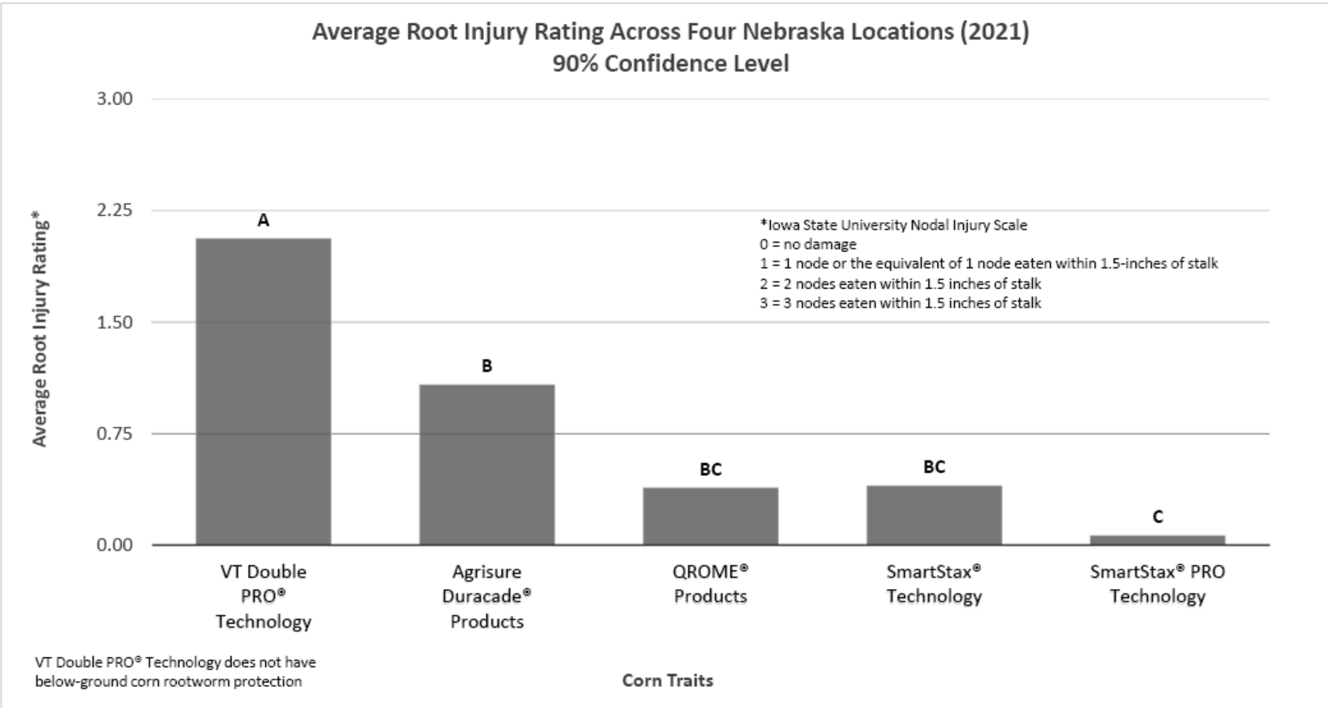


Figure 1. Average root injury rating across four Nebraska locations using the Iowa State University Nodal Injury Scale.

- The average NIS 0-3 score across the four locations shows a statistically significant reduction in root feeding between products with VT Double PRO® Technology (that contain no below-ground protection) and the products that contain a below-ground trait (Figure 1).
- The average NIS 0-3 score across the four locations for SmartStax® PRO technology products was significantly lower than the Agrisure Duracade® products. Although not statistically significant, the NIS03 score for SmartStax® PRO technology products trended lower than the SmartStax® corn and Qrome® Products scores.

Key Learnings

- This study illustrates that in a field with a history of corn rootworm pressure, planting a product with below-ground rootworm protection with multiple modes of action can significantly reduce the observed root feeding compared to a product with no below-ground trait for corn rootworm protection.
- SmartStax® PRO technology is the only trait platform tested that has below-ground insect protection with three modes of action. It did not statistically separate itself from the other below-ground trait platforms; however, its NIS03 score consistently trended better. Please reach out to your local agronomist for further insights.
- Management of corn rootworm requires a holistic approach that focuses on monitoring the life cycle and prevalence of the pest to determine the best pest control methods for the current and future growing seasons. Prior agronomic practices, like planting corn-on-corn, can create higher pest pressure than in rotated fields.
- Maintaining sound agronomic practices and planting corn products with corn traits that defend against corn rootworm should help provide the greatest protection to help preserve corn yield potential.

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Legal Statements

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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.

Effect of Dicamba Formulations and Planting Date on Different Corn Products

Trial Objective

- Dicamba, a growth regulator herbicide, is an effective broadleaf herbicide in corn. Producers should consider safened dicamba herbicide formulations to help protect yield potential and to help reduce plant stress from factors such as stalk brittleness or greensnap.[1]
- Planting date and corn product selection are some of the major drivers for high yield potential.
- The objective of this trial was to evaluate the yield potential impact on twenty different corn products when the products were planted on two different dates and safened and unsafened dicamba formulations were applied at V5 and V9 corn growth stages.

Experiment/Trial Design

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	05/05/2021 05/25/2021	11/7/2021	300	36,000

- Trial was a split-split-plot design with planting date as the whole plot, herbicide as the sub-plot, and corn product as the sub-sub plot with five replications.
- Two corn planting dates of May 5 and May 25 were targeted to provide corn at V9 and V5 growth stages when the dicamba applications were to be applied, respectively.
- Twenty corn products were planted (Tables 1 and 2).
- Residual herbicide program applied on May 22, 2021 to the study area included:
  - » Balance® flexx Herbicide (Restricted Use Pesticide) (4 oz/acre)
  - » Harness® herbicide (2 pts/acre)
  - » Atrazine 4L herbicide (1 qt/acre)
  - » Roundup PowerMAX® (1 qt/acre) + Ammonium Sulfate (AMS) (17 lb/100 gallon)
- Three herbicide/fungicide treatments were applied on June 23 to the V5 (May 25th - planted) and V9 (May 5th - planted) growth stage plants:
  - » A non-dicamba treated control:
    - Delaro® 325 SC fungicide (0.125 qt/acre) + Roundup PowerMAX® herbicide (1 qt/acre) + AMS (17 lb/100 gallon)
  - » An unsafened dicamba formulation (Bold):
    - Sterling Blue® herbicide (0.5 qt/acre) + Delaro® 325 SC fungicide (0.125 qt/acre) + Roundup PowerMAX® herbicide (1 qt/acre) + AMS (17 lb/100 gallon)
  - » A safened dicamba formulation (Bold):
    - DiFlexx® Herbicide (0.5 qt/acre) + Delaro® 325 SC fungicide (0.125 qt/acre) + Roundup PowerMAX® herbicide (1 qt/acre) + AMS (17 lb/100 gallon)
- Trial was sprinkler irrigated.
- Fertility program applied through strip-tillage before planting included 60 lb/acre phosphorus, 25 lb/acre sulfur, and 0.25 lb/acre zinc. Nitrogen was applied on 05/10/2021 using a stream bar at 100 lb/acre and side-dressed on 06/21/2021 with 60 lb/acre using 360 Y-DROP®.

Effect of Dicamba Formulations and Planting Date on Different Corn Products

Understanding the Results

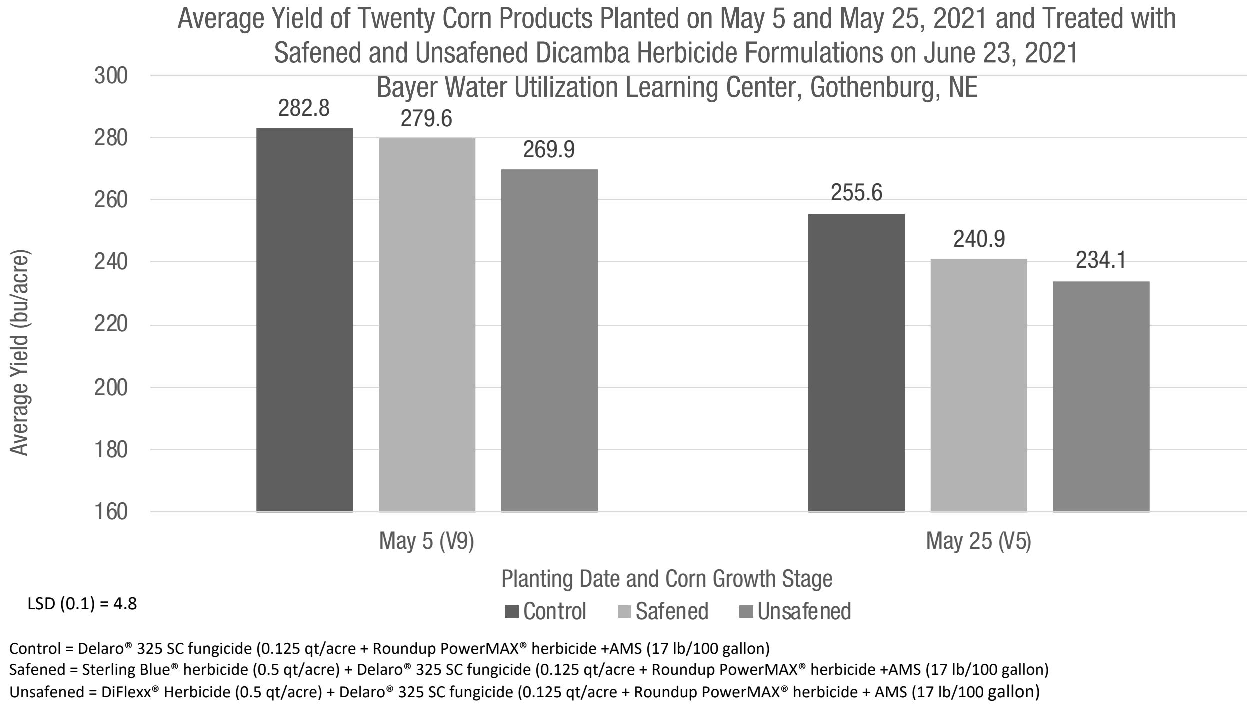

Figure 1. Average yield by different dicamba herbicide formulations and corn growth stage across corn products.

- Early planted corn (May 5) did not have a difference in grain yield between the safened dicamba formulation and the control treatment (Figure 1).
- Corn products with the safened dicamba formulation produced an average 9.7 and 6.8 bu/acre greater yield than the unsafened dicamba formulation treatment when corn was planted on May 5 and May 25, respectively (Figure 1).
- Greater average yields were observed when corn was planted early (May 5) compared to late (May 25) (Figure 1 and Table 1).
- Although planting corn late (May 25) reduced average grain yield significantly, it is important to consider that the safened dicamba formulation had significantly higher average yields than the unsafened dicamba formulation when applied to the May 5 corn at the V9 growth stage with a similar trend observed on the corn planted on May 25 at the V5 growth stage (Figure 1).

Effect of Dicamba Formulations and Planting Date on Different Corn Products

Table 1. Average grain yield of corn products according to planting date and averaged across dicamba treatments. Bayer Water Utilization Learning Center, Gothenburg, NE. (2021)

Product	Planting Date 2021		Difference
	May 5	May 25	
	Yield (bu/acre)	Yield (bu/acre)	(bu/acre)
104 RM	278.9	240.5	38.4
105 RM-A	281.2	249.4	31.8
105 RM-B	261.3	244.1	17.2
106 RM	283.9	258.9	25.0
107 RM-A	281.9	255.3	26.6
107 RM-B	290.2	257.6	32.6
107 RM-C	290.2	263.0	27.2
107 RM-E	248.8	213.4	35.4
107 RM-D	246.8	212.4	34.4
109 RM	285.5	254.5	31.0
110 RM-A	302.6	240.7	61.9
110 RM-B	284.4	244.9	39.5
111 RM-A	298.1	263.7	34.4
111 RM-B	279.4	243.3	36.1
112 RM-A	270.9	252.8	18.1
112 RM-B	270.8	247.3	23.5
112 RM-C	209.3	175.9	33.4
114 RM-A	306.4	255.7	50.7
114 RM-B	292.0	243.5	48.5
116 RM	286.1	254.1	32.0
Average	277.4	243.6	33.9

RM = Relative Maturity. Least Significant Difference (LSD) (0.1) = 8.4

Table 2. Average grain yield of corn products according to dicamba herbicide formulation treatments across planting dates. Bayer Water Utilization Learning Center, Gothenburg, NE (2021)

Product	Dicamba Treatment*		Difference
	Safened	Unsafened	
	Yield (bu/acre)	Yield (bu/acre)	(bu/acre)
104 RM	255.6	245.8	9.8
105 RM-A	264.9	255.2	9.7
105 RM-B	249.2	246.4	2.8
106 RM	276.3	255.0	21.3
107 RM-A	265.5	266.0	-0.5
107 RM-B	270.5	273.3	-2.8
107 RM-C	276.0	278.3	-2.3
107 RM-E	225.6	228.4	-2.8
107 RM-D	227.7	225.7	2.0
109 RM	270.9	267.8	3.1
110 RM-A	277.0	263.3	13.7
110 RM-B	266.1	251.9	14.2
111 RM-A	281.4	272.4	9.0
111 RM-B	262.5	256.5	6.0
112 RM-A	258.8	242.1	16.7
112 RM-B	256.8	246.8	10.0
112 RM-C	188.3	182.5	5.8
114 RM-A	285.6	267.2	18.4
114 RM-B	274.7	255.2	19.5
116 RM	271.3	260.3	11.0

RM = Relative Maturity. Least Significant Difference (LSD) (0.1) = 10.0

*Control = Delaro® 325 SC fungicide (0.125 qt/acre + Roundup PowerMAX® herbicide +AMS (17 lb/100 gallon); Unsafened = Sterling Blue® herbicide (0.5 qt/acre) + Delaro® 325 SC fungicide (0.125 qt/acre + Roundup PowerMAX® herbicide +AMS (17 lb/100 gallon); Safened = DiFlexx® Herbicide (0.5 qt/acre) + Delaro® 325 SC fungicide (0.125 qt/acre + Roundup PowerMAX® herbicide +AMS (17 lb/100 gallon (all applied June 23, 2021)

- All corn products reached significantly higher average yields with the May 5 planting date compared to the May 25 planting date (Table 1).
- Greater average yield variability was observed with May 5 planting date with five products over 290.0 bu/acre and a low average yield of 246.8 bu/acre.
- Average yields were less variable across the corn products with the May 25 planting date (Table 1).
- Eight out of 20 corn products reached significantly higher yields (more than 10 bu/acre) when treated with the safened versus the unsafened dicamba formulation (Table 2). No corn product reached significantly higher yields when treated with the unsafened compared to the safened dicamba formulation (Table 2).

Effect of Dicamba Formulations and Planting Date on Different Corn Products

Key Learnings

- In this study, the safened dicamba formulation treatment with DiFlexx® Herbicide produced a greater average yield than the unsafened dicamba formulation.
- In addition, the safened dicamba formulation showed greater average yield in 40% of the products tested when compared to the unsafened dicamba formulation.
- Farmers should be encouraged to use DiFlexx® herbicide as an option for early weed control in corn to help lower the risk for potential crop damage and decreased yield that can be observed when using unsafened dicamba herbicide products.
- Preference should be given to planting corn early such as the May 5 planting date as it increased yield 33.9 bu/acre, on average, for all corn products tested compared to the May 25 planting date.

Sources

[1]Bayer Water Utilization Learning Center Research Book. 2020. Dicamba Formulation Impact on Corn. Gothenburg, NE.

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Long-Term Limited Irrigated Crop Rotation at Gothenburg, NE

Trial Objective

- Crop rotation is an effective way to help reduce pests (insect, disease, and weed) pressure, increase crop residue, and build organic matter in the soil. Crop residue and organic matter can help improve water-holding capacity and nutrient availability for the next crop.
- The objective of this study was to determine the effect of crop rotation on yield potential in a limited irrigation environment where no more than 4 inches of irrigation water was applied to the crop each year.

Research Site Details

- This trial was located at Gothenburg, NE on a silt loam soil type and includes data from 2015 through 2020.
- Randomized complete block design with three replications.
- The rotational crops used were corn, winter wheat, soybean, and grain sorghum.
- Rotation treatments (Table 1):
  - » Continuous Corn (CC)
  - » Wheat followed by (fb) Corn (WC)
  - » Corn fb Soybean (CS)
  - » Wheat fb Corn fb Corn (WCC)
  - » Corn fb Grain Sorghum (CGS)
- All crops in a rotation were present in each year of the study.
- Irrigation was applied with a subsurface drip irrigation system with no more than 4 inches of irrigation water applied to the crop each year from 2015 to 2018. No irrigation was applied to any rotation in 2019 because of adequate rainfall and in 2020 due to mechanical issues within the drip irrigation system.
- Adequate fertility was applied each year and pesticides were applied as needed per crop. The average input costs for fertility and pesticide applications are provided in Figure 5.

Table 1. Description of treatments and crop rotation.

Treatment	Crop Rotation	Product (Relative Maturity (RM), Maturity Group (MG))	Seeding Rate	Year of Rotation
Continuous Corn (CC)	Corn	102 RM	24,000 seeds/acre	All years
Wheat followed by (fb) Corn (WC)	Wheat	WestBred® WB-Grainfield Brand	120 lb/acre	1
	Corn	102 RM	24,000 seeds/acre	2
Corn fb Soybean (CS)	Corn	102 RM	24,000 seeds/acre	1
	Soybean	2.4 MG	160,000 seeds/acre	2
Wheat fb Corn fb Corn (WCC)	Wheat	WestBred® WB-Grainfield Brand	120 lb/acre	1
	Corn	110 RM	26,000 seeds/acre	2
	Corn	102 RM	24,000 seeds/acre	3
Corn fb Grain Sorghum (CGS)	Corn	105 RM	26,000 seeds/acre	1
	Sorghum	Early MG	65,000 seeds/acre	2

Long-Term Limited Irrigated Crop Rotation at Gothenburg, NE

Figure 1. Drone image of crop rotation treatments, Gothenburg, NE (July 27, 2020).

Table 2. Tillage type, planting date, and harvest date information for each crop by year.

Year	Crop	Tillage Type	Planting Date	Harvest Date
2015	Corn	Strip-till	5/14/2015	10/26/2015
	Soybean	Strip-till	5/25/2015	10/15/2015
	Wheat	No-till	10/23/2014	7/15/2015
	Grain Sorghum	Strip-till	6/1/2015	11/24/2015
2016	Corn	Strip-till	5/7/2016	10/20/2016
	Soybean	Strip-till	5/16/2016	9/28/2016
	Wheat	No-till	11/3/2015	8/1/2016
	Grain Sorghum	Strip-till	5/29/2016	11/21/2016
2017	Corn	Strip-till	5/26/2017	10/25/2017
	Soybean	Strip-till	5/31/2017	10/13/2017
	Wheat	No-till	10/28/2016	7/14/2017
	Grain Sorghum	Strip-till	5/26/2017	11/5/2017
2018	Corn	Strip-till	5/17/2018	10/25/2018
	Soybean	Strip-till	5/17/2018	10/20/2018
	Wheat	No-till	10/27/2017	7/21/2018
	Grain Sorghum	Strip-till	5/30/2018	11/15/2018
2019	Corn	No-till	6/6/2019	11/12/2019
	Soybean	No-till	6/6/2019	10/24/2019
	Wheat	No-till	11/2/2018	7/18/2019
	Grain Sorghum	No-till	6/8/2019	11/14/2019
2020	Corn	Strip-till	5/9/2020	10/28/2020
	Soybean	Strip-till	5/8/2020	11/2/2020
	Wheat	No-till	11/10/2019	7/15/2020
	Grain Sorghum	Strip-till	5/28/2020	10/24/2020

Long-Term Limited Irrigated Crop Rotation at Gothenburg, NE

Understanding the Results

Table 3. Grain price per bushel for a specific day of sale from 2015 to 2020.				
Date	Corn	Soybean	Wheat	Grain Sorghum
7/20/2015	-	-	$4.80	-
11/16/2015	$3.30	$7.87	-	$2.92
7/15/2016	-	-	$2.95	-
11/15/2016	$2.93	$8.94	-	$2.23
7/20/2017	-	-	$4.11	-
11/15/2017	$2.95	$8.71	-	$2.80
7/20/2018	-	-	$4.53	-
11/15/2018	$3.35	$7.66	-	$2.83
7/15/2019	-	-	$3.64	-
11/15/2019	$3.52	$8.21	-	$2.76
7/20/2020	-	-	$3.90	-
11/16/2020	$3.98	$10.93	-	$4.80

*All corn, soybean, and wheat prices were provided by Country Partners Cooperative, Gothenburg, NE for the day specified. The grain sorghum prices from 2015 to 2018 were provided by Country Partners Cooperative, Farnam, NE and from 2019 to 2020 by AgValley Cooperative, Eustis, NE for the day specified.

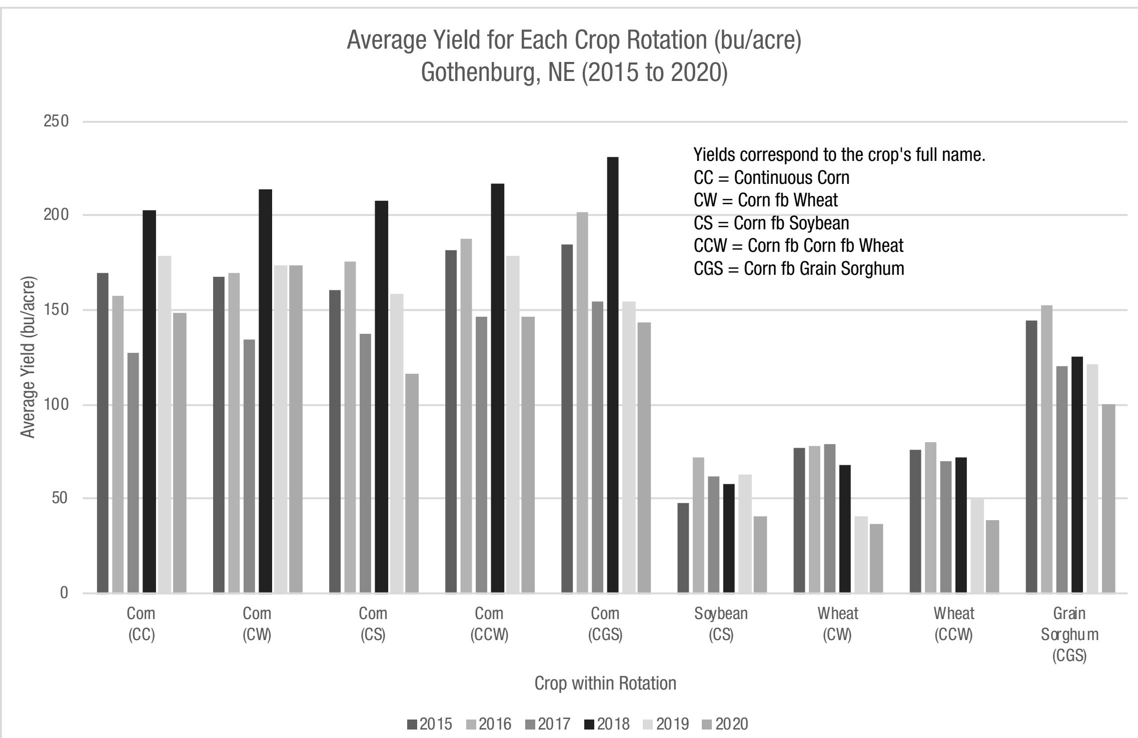

Figure 2. Average annual yield of each crop within a crop rotation treatment. No irrigation applied to any rotation in 2019 because of adequate rainfall and in 2020 due to mechanical issues within the drip irrigation system.

Long-Term Limited Irrigated Crop Rotation at Gothenburg, NE

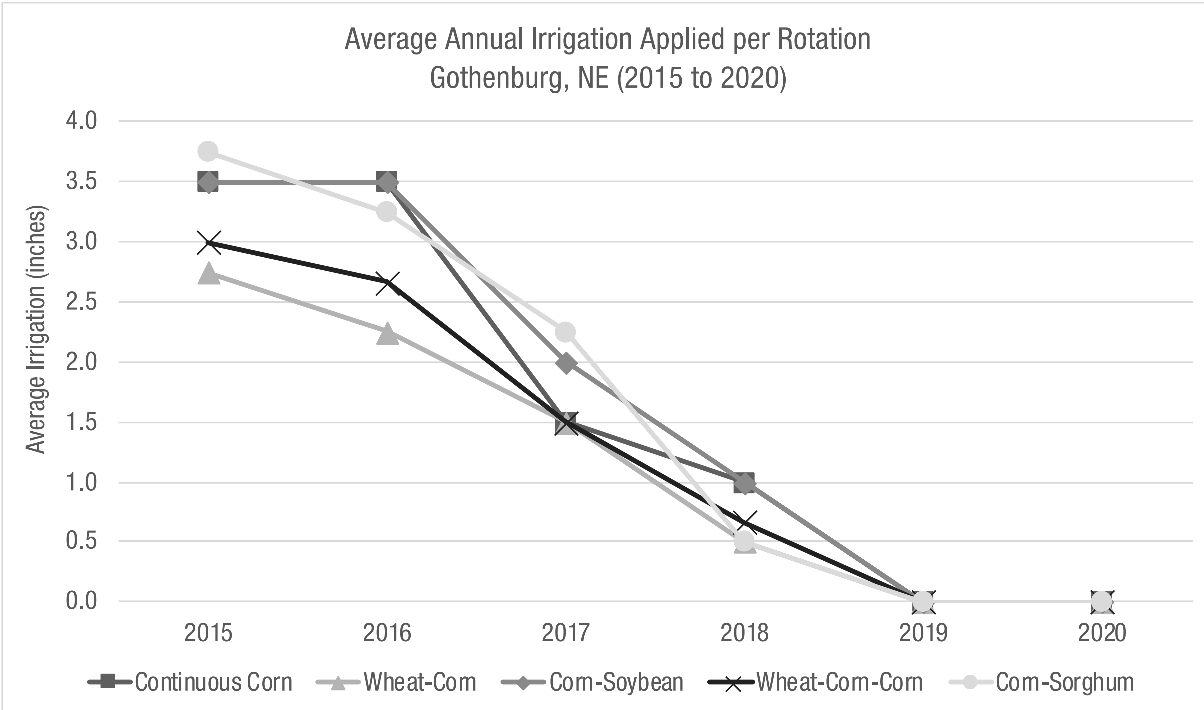

Figure 3. Average amount (inches) of irrigation water applied to each treatment annually. No irrigation applied to any rotation in 2019 because of adequate rainfall and in 2020 due to mechanical issues within the drip irrigation system.

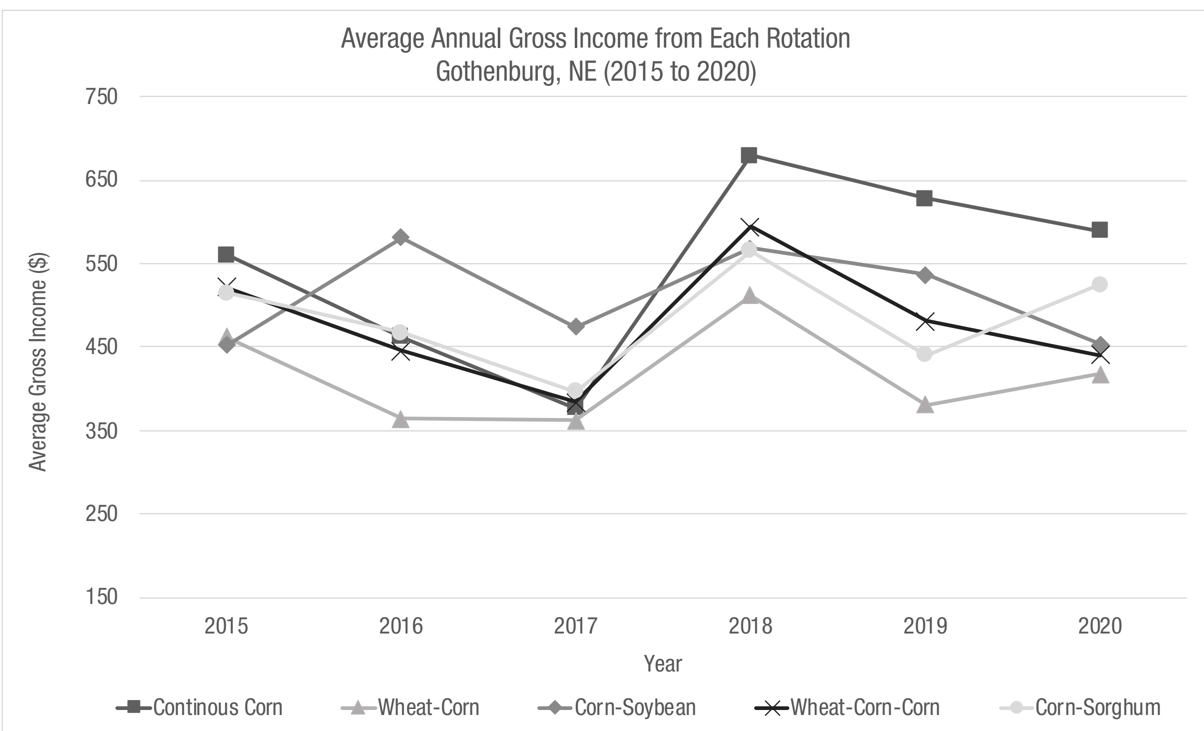

Figure 4. Average gross income (dollars) per acre from crop rotation treatments from 2015 to 2020. Gross income was calculated using grain prices from Table 3.

Long-Term Limited Irrigated Crop Rotation at Gothenburg, NE

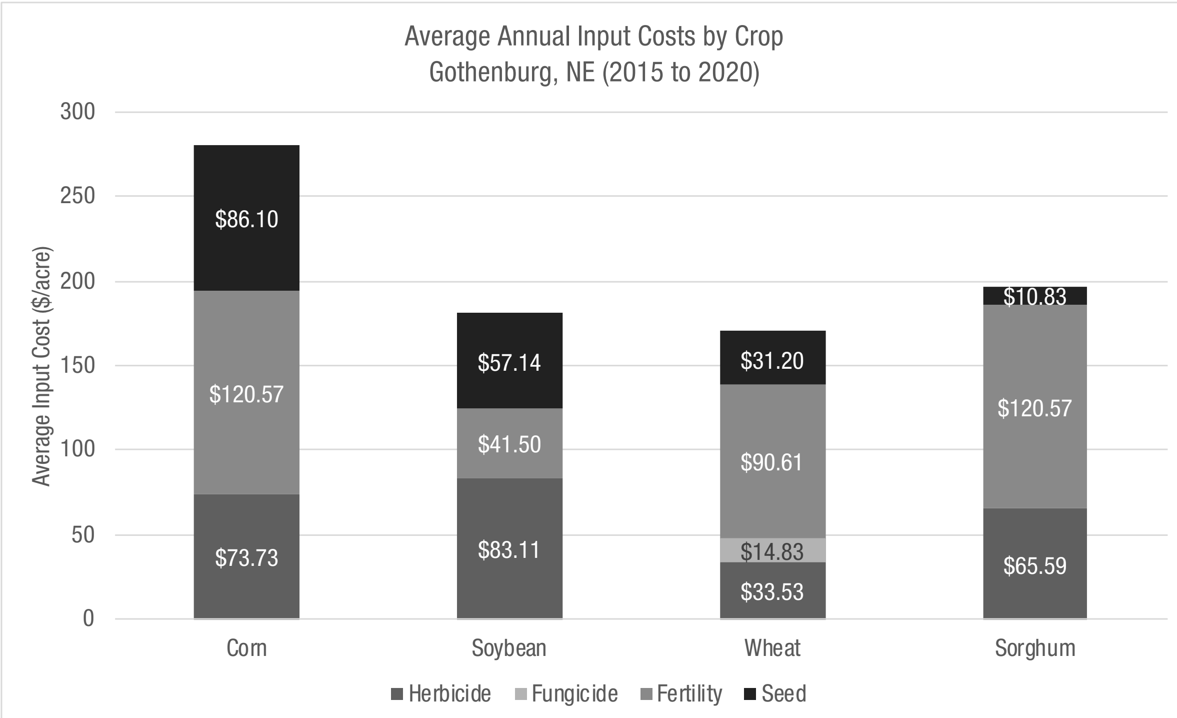

Figure 5. Average annual input costs per acre from 2015 to 2020 for each crop. Input costs are classified as herbicide, fungicide, fertility, and seed.

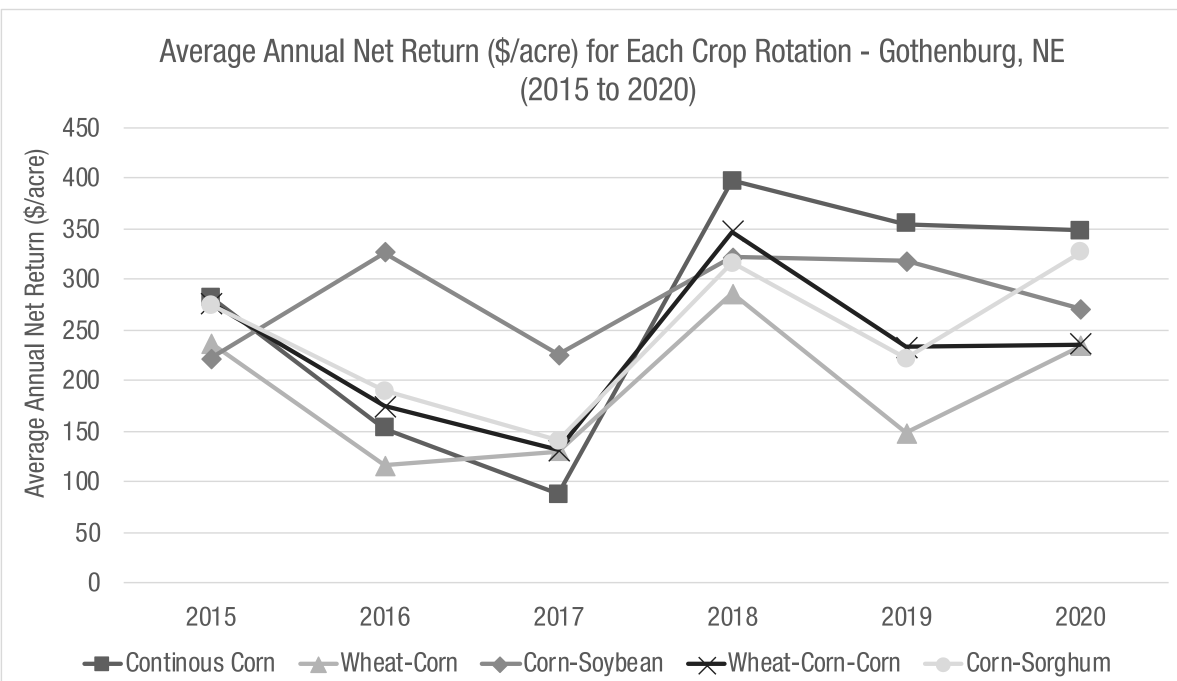

Figure 6. Average net return on investment per acre for each crop rotation treatment from 2015 to 2020. Average net return was calculated by subtracting the average input cost per treatment (Figure 5) from the gross income per treatment (Figure 4).

Long-Term Limited Irrigated Crop Rotation at Gothenburg, NE

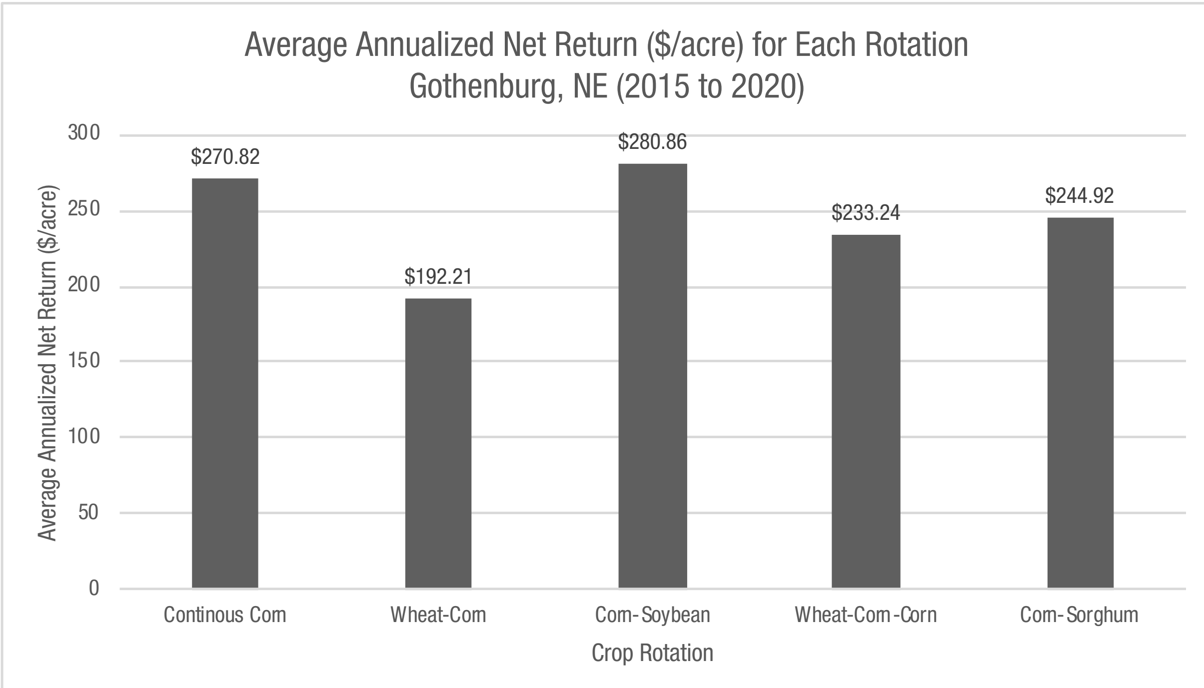

Figure 7. Average annualized net return on investment per acre for each crop rotation treatment.

- There did not appear to be a correlation between annual irrigation applied and gross and net returns for any crop rotation (Figures 3, 4, and 6).
- From 2015 to 2017, all crop rotations generated comparable gross income except for the Corn-Soybean rotation which produced a greater gross income. The continuous corn rotation produced the greatest gross income from 2018 to 2020, and the Wheat-Corn rotation consistently produced the lowest gross income (Figure 4).
- Corn required the largest input costs per acre followed by sorghum, soybean, and wheat, respectively. Fertility was the largest input cost for corn, sorghum, and wheat, while herbicides were the largest for soybean (Figure 5).
- In 2015, all crop rotations produced comparable net returns. The Corn-Soybean rotation produced the greatest net return from 2016 to 2017, followed by the Continuous Corn rotation from 2018 to 2020 (Figure 6).
- Over the six-year study, on average, the Corn-Soybean rotation produced the greatest net return per acre followed by the Continuous Corn rotation (Figure 7).

Key Learnings

- The gross and net returns for each crop rotation were comparable in 2015, which may be a result of it being the first year of each crop rotation.
- The lower gross income and net return values from 2016 to 2017 were due to low corn grain prices in those years.
- The largest net return was for the Corn-Soybean rotation. This rotation can benefit farmers by helping to reduce disease and insect pressure. Lower pest pressure should decrease pesticide input cost over the next six years of the study.

Long-Term Limited Irrigated Crop Rotation at Gothenburg, NE

- Continuous Corn provides a large net return but is likely to have increased pest pressure and increased pesticide input costs depending on the environment and pest pressure.

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Corn and Soybean Planting Timing Decisions

Trial Objective

- Widespread adoption of quality seed treatments in soybeans has led to increasingly early planting of soybeans by growers across the midwestern United States. For example, in 2021 by May 2, Illinois growers had completed 41% of soybean planting, compared to 14% average for the previous 5 years[1].
- Early in the planting season, growers are often faced with the decision of whether to plant corn or soybeans first.
- This research was conducted with a goal of understanding the risks and benefits of planting corn and soybeans at various timings throughout the spring.

Research Site Details

- Corn and soybeans were planted on simultaneous dates in both 2020 and 2021.
- In 2020, a 3.6 relative maturity (RM) soybean product was planted and in 2021 a 3.5 RM product was used.
- In 2020, a 114 day RM corn product was planted, while the 2021 data includes an average of 113 and 114 day RM corn products at each planting date.
- In both 2020 and 2021, heavy frost reduced the soybean stands in the earliest planting dates.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Roanoke, IL	Silt Loam	Corn	Conventional	3/7/20, 4/6/20, 4/20/20, 5/9/20, 6/1/20, 6/15/20	10/7/20, 10/15/20	75	140,000
Roanoke, IL	Silt Loam	Soybean	Conventional	4/6/20, 4/20/20, 5/9/20, 6/1/20, 6/15/20	9/24/20, 10/8/20, 10/20/20	240	36,000
Roanoke, IL	Silt Loam	Corn	Conventional	3/10/21, 4/6/21, 4/19/21, 5/3/21, 5/14/21, 5/24/21, 6/7/21, 6/15/21	10/18/21	75	140,000
Roanoke, IL	Silt Loam	Soybean	Conventional	4/6/21, 4/19/21, 5/3/21, 5/14/21, 5/24/21, 6/7/21, 6/15/21	9/15/2, 9/16/2, 9/30/21	240	36,000

Corn and Soybean Planting Timing Decisions

Understanding the Results

- To compare data across years, results are presented as a percentage of the maximum yield for the year and corn/soybean product.
- Although soybean stands can be reduced in early plantings (Figure 1), the surviving plants have additional time to grow compared to later plantings and can still attain high yields (Figure 2).
- In 2021, emerged soybeans endured freezing temperatures for 2 consecutive nights (Figure 3) after emergence, killing 25.9% of them. Final stand was 67,846 plants per acre, with a yield of 77.7 bushels/acre (98.9% of maximum).
- Soybean yield is consistently highest in early plantings, with a steady decline in progressively later plantings, while corn yield shows a peak with too early and too late plantings negatively impacting performance (Figure 4).
- These data support the increasingly accepted practice of planting soybeans early in the growing season and waiting until conditions are more favorable for planting corn.

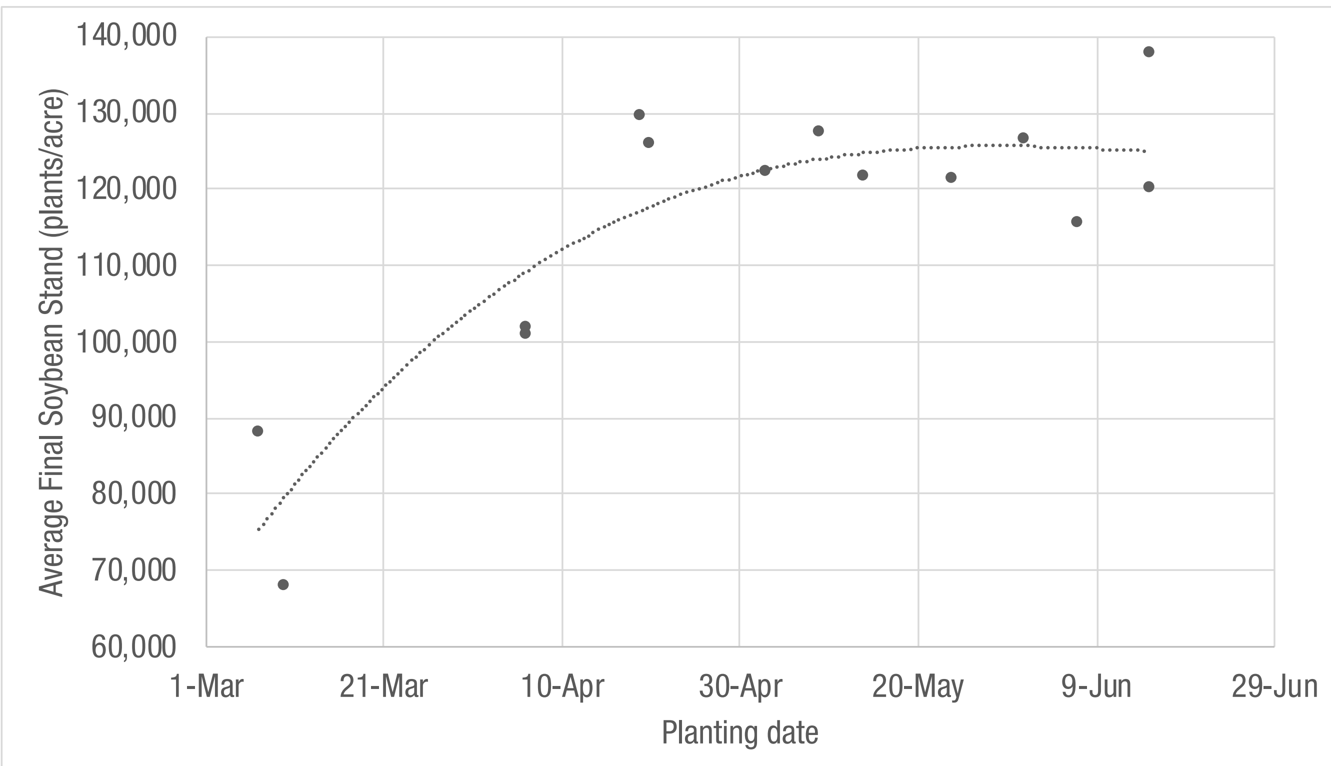


Figure 1. Average final soybean stands across planting dates and years (2020 and 2021).

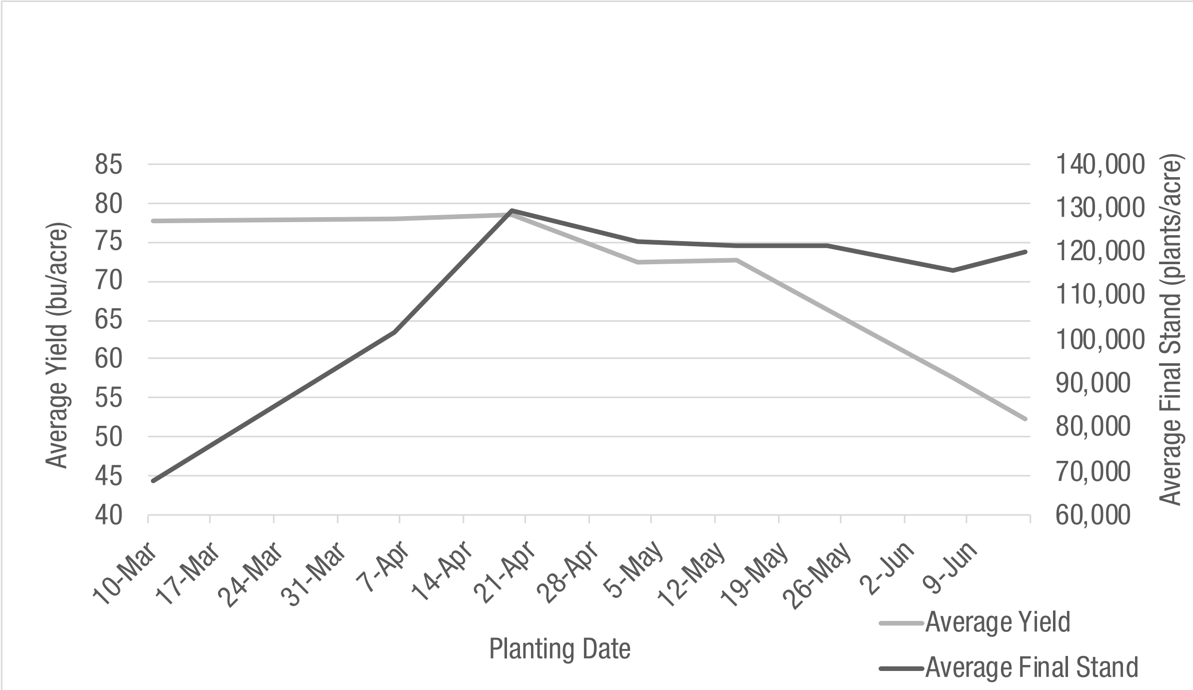


Figure 2. Average yield and average final stand count of 3.5 RM soybean across planting dates in 2021.

Figure 3. Frost on soybean seedlings after two consecutive nights of below freezing temperatures which resulted in a 25.9% stand reduction.

Corn and Soybean Planting Timing Decisions

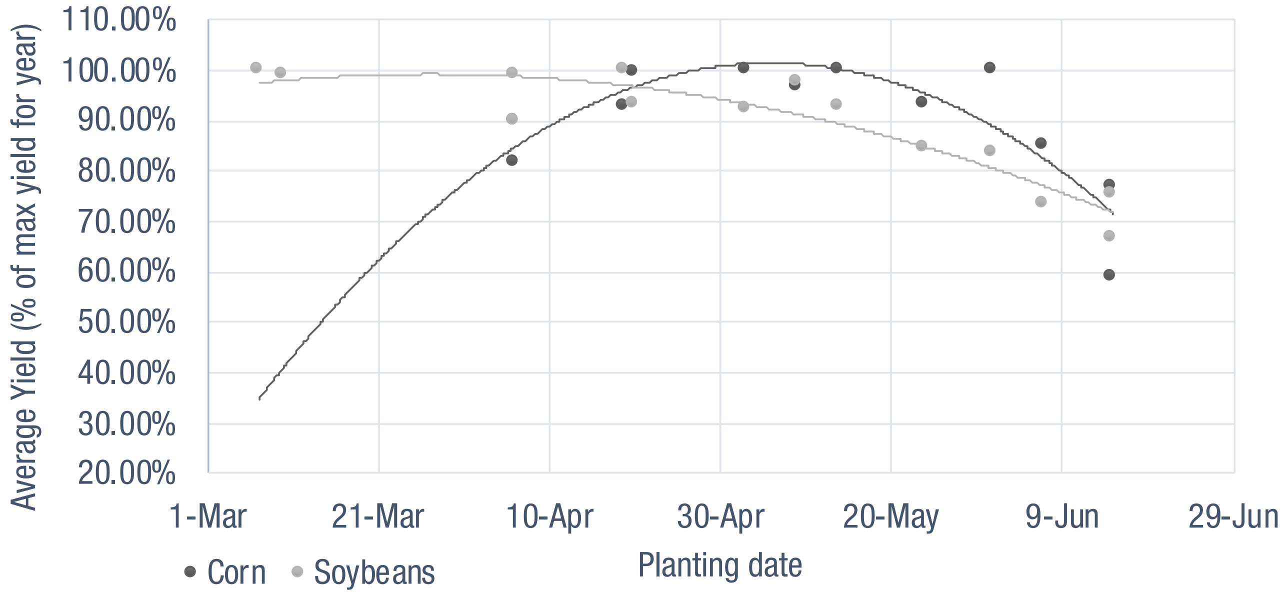


Figure 4. Relative performance of corn and soybeans at different planting dates combined over years in 2020 and 2021.

Key Learnings

- Generally, soybeans can be planted when soil moisture conditions are satisfactory, regardless of soil temperature and weather forecast. Corn, however, should only be planted when soil conditions (temperature and moisture) and the weather forecast are favorable.

Sources:

[1]USDA National Agricultural Statistic Service. https://www.nass.usda.gov/Statistics_by_State/Illinois/Publications/Crop_Progress_&_Condition/2021/20210503-IL-Crop-Progress.pdf

Legal Statements

Evaluation of Disease Management Systems in Soybean – Sudden Death Syndrome

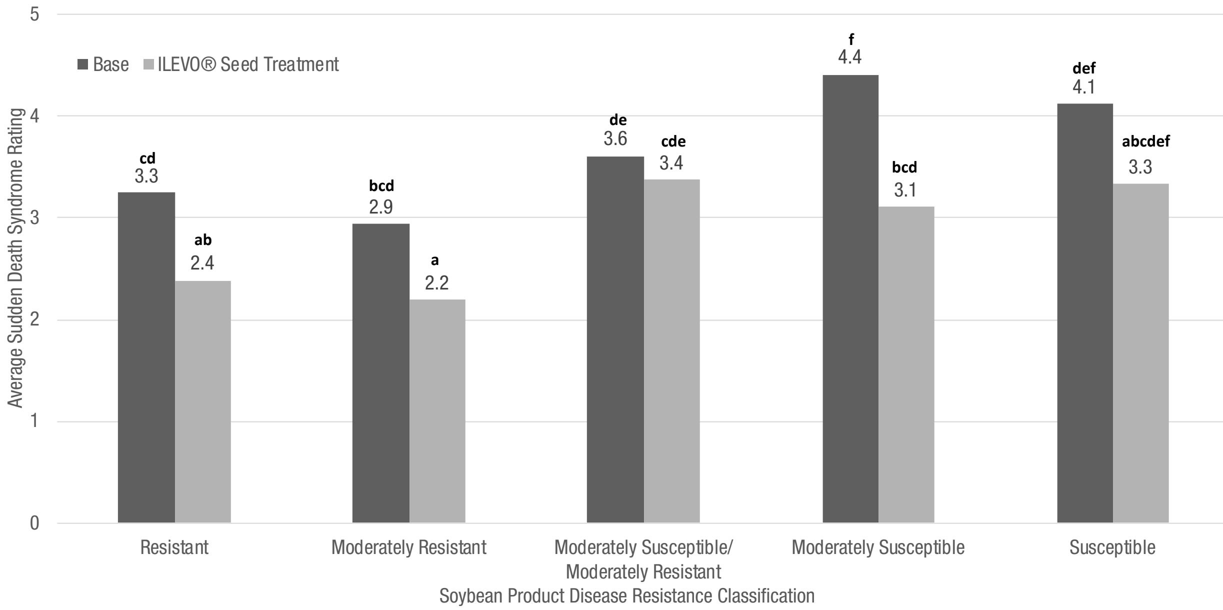
- Sudden death syndrome (SDS) is among the most devastating soil-borne diseases of soybean in the U.S. The disease has spread extensively and causes high soybean yield losses throughout the North Central Region. SDS is most severe when soybean is planted early into cool, wet soils, when heavy midsummer 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 Solutions options:
  - STANDARD
  - STANDARD + ILEVO® Seed Treatment
- 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 collected from 2018 through 2020 and a total of 15 locations with SDS symptoms were analyzed for this study. Locations were from across the North Central growing region including IN, KS, MO, IL, IA, KY, and NE. Most locations had mild to moderate SDS incidence and severity.

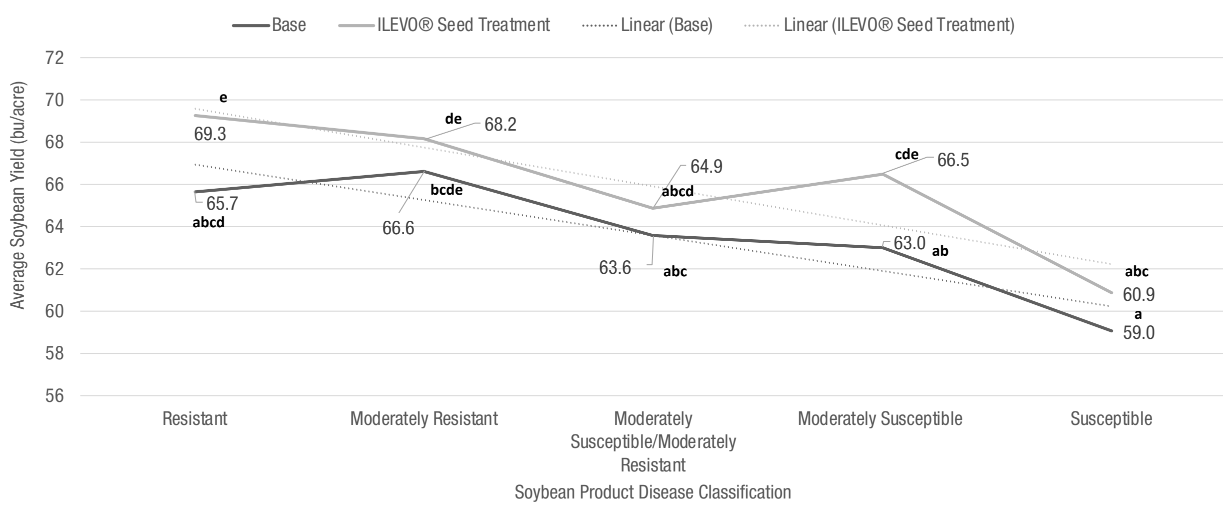
Evaluation of Disease Management Systems in Soybean – Sudden Death Syndrome

Understanding the Results



Base = Acceleron® STANDARD Seed Applied Solutions in 2019 and 2020; Acceleron® STANDARD Seed Applied Solutions + Poncho® Votivo® in 2018.
ILEVO® = Acceleron® STANDARD Seed Applied Solutions plus ILEVO® Seed Treatment in 2019 and 2020; Acceleron® STANDARD Seed Applied Solutions + Poncho® Votivo® + ILEVO® Seed Treatment in 2018.
SDS disease index: 1 = no disease, 9 = severe disease.

Figure 1. Sudden Death Syndrome disease index rating by Acceleron® Seed Applied Solutions treatment and SDS disease classification of soybean products. Mean separation letters (a, b) denote statistically significant differences at an alpha = 0.1.

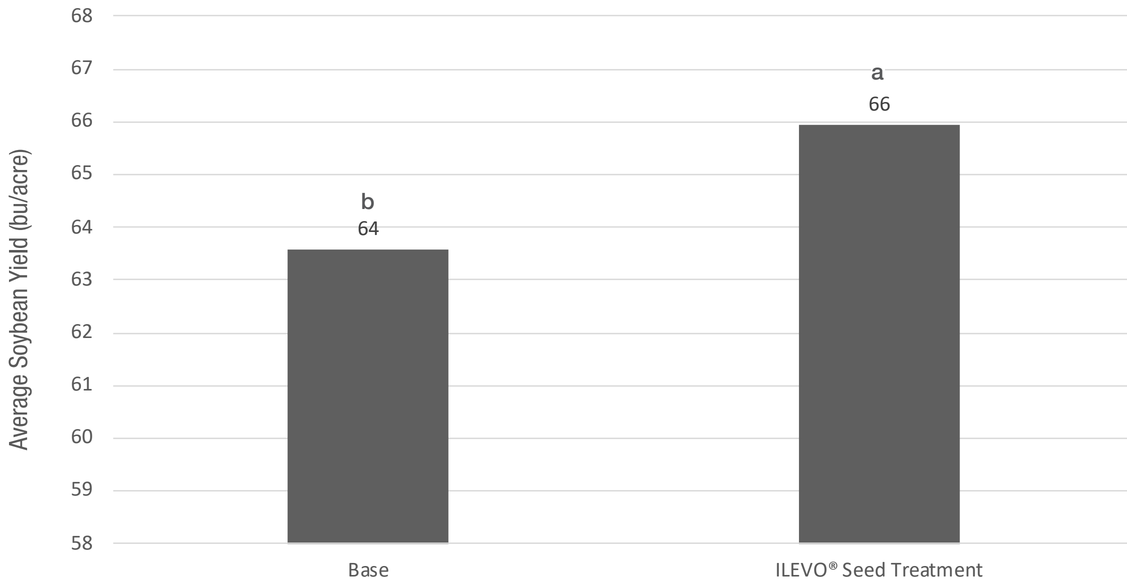


Base = Acceleron® STANDARD Seed Applied Solutions in 2019 and 2020,; Acceleron® STANDARD Seed Applied Solutions + Poncho®/Votivo® in 2018

ILEVO® = Acceleron® STANDARD Seed Applied Solutions plus ILEVO® Seed Treatment in 2019 and 2020,; Acceleron® STANDARD Seed Applied Solutions + Poncho®/Votivo® + ILEVO® Seed Treatment in 2018

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

Evaluation of Disease Management Systems in Soybean – Sudden Death Syndrome



Base = Acceleron® STANDARD Seed Applied Solutions in 2019 and 2020,; Acceleron® STANDARD Seed Applied Solutions + Poncho®/Votivo® in 2018
ILEVO® = Acceleron® STANDARD Seed Applied Solutions plus ILEVO® Seed Treatment in 2019 and 2020,; Acceleron® STANDARD Seed Applied Solutions + Poncho®/Votivo® + ILEVO® Seed Treatment in 2018

Figure 3. Effect of seed treatment on average soybean yield measured across soybean products, location, and years (2018 through 2020). Mean separation letters (a, b) denote statistically significant differences at an alpha = 0.1.

SDS index: 8

SDS index: 3

Figure 4. Comparison of the difference in soybean product SDS disease incidence and severity. 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.

Evaluation of Disease Management Systems in Soybean – Sudden Death Syndrome

In locations where the most susceptible soybean product and the base seed treatment had an average SDS rating of at least 3:

- There was a significant ILEVO® Seed Treatment effect on SDS management and yield potential. Soybeans with ILEVO® seed treatment had yields 2 bu/acre greater than the untreated check.
- Genetics with enhanced resistance to SDS coupled with ILEVO® provided a significant yield advantage over moderately susceptible soybean products without ILEVO® Seed Treatment and susceptible products with or without ILEVO® seed treatment.

Key Learnings (R)

- ILEVO® Seed Treatment is a potential solution currently available for sudden death syndrome (SDS) and continues to provide excellent management of SDS and protect yield potential. Depending on SDS risk for your field, pairing with the right soybean products should be considered to help maximize yield potential.

Legal Statements

The information discussed in this report is from a multiple site, unreplicated research protocol. This informational piece is designed to report the results of this demonstration and is not intended to infer any confirmed trends. Please use this information accordingly.

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. EACH ACCELERON® SEED APPLIED SOLUTIONS OFFERING is a combination of separate individually registered products. FOR SOYBEANS, EACH ACCELERON® SEED APPLIED SOLUTIONS OFFERING is a combination of separate individually registered products containing the active ingredients: BASIC Offering: metalaxyl, fluxapyroxad, and pyraclostrobin. STANDARD Offering: metalaxyl, fluxapyroxad, pyraclostrobin, and imidacloprid.

Not all products are registered in all states and may be subject to use restrictions. The distribution, sale, or use of an unregistered pesticide is a violation of federal and/or state law and is strictly prohibited.

The distribution, sale, or use of an unregistered pesticide is a violation of federal and/or state law and is strictly prohibited. Not all products are approved in all states.

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.

Evaluation of Disease Management Systems in Soybean – White Mold

Trial Objective

- White mold (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, white mold is often recognized by fluffy, white growth on soybean stems. White mold development is favored by cool, cloudy, wet, and humid weather at first flowering. The disease tends to be more prevalent 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 white mold disease management supported by genetic resistance of germplasm and foliar fungicide.
- Select soybean products with varying levels of resistance to white mold were evaluated under different fungicide management options.

Research Site Details

- Fields with a history of white mold 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
  - » Fungicide applied at R1 growth stage
  - » Fungicide applied at R1 and R3 growth stages
- The fungicide products used in 2019 and 2020 were Delaro® 325 SC fungicide (Group 3 + Group 11) at 8 oz/acre tank-mixed with Luna® Privilege Fungicide (Group 7) at 2 oz/acre at R1 growth stage. Delaro® Complete Fungicide (Group 3 + Group 7 + Group 11) was used at 8 oz/acre in 2021.
- Soybean products used were classified as susceptible (S), moderately susceptible (MS), moderately resistant/moderately susceptible (MR/MS), moderately resistant (MR), or resistant (R) to white mold.
  - » Resistant soybean products were left out of most yield data analyses because they were not planted in 5 out of the 18 locations.
- Plots were randomized within the trial.
- White mold disease ratings were taken at the R6 growth stage.
- 69 trial locations from 2019-2021 were planted for this study. Of these, 18 locations (26%) were included in the analysis below because they had moderate to high white mold pressure.
  - » Note: Moderate to high white mold pressure locations were categorized as such if the most susceptible untreated soybean product at that location had a white mold rating of 3 or higher at the R6 growth stage.

Evaluation of Disease Management Systems in Soybean – White Mold

Understanding the Results

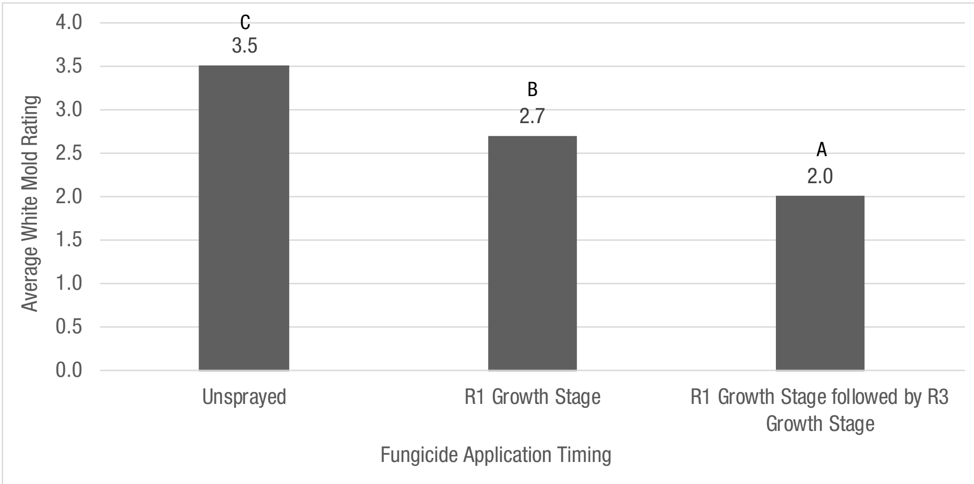


Figure 1. Average white mold disease index rating for each fungicide treatment of Delaro® fungicide tank-mixed with Luna® Privilege Fungicide (2019-2020) or Delaro® Complete Fungicide (2021). White mold disease index: 1 = no disease, 9 = severe disease. Mean separation letters (a, b, c) denote statistically significant differences at an alpha = 0.1.

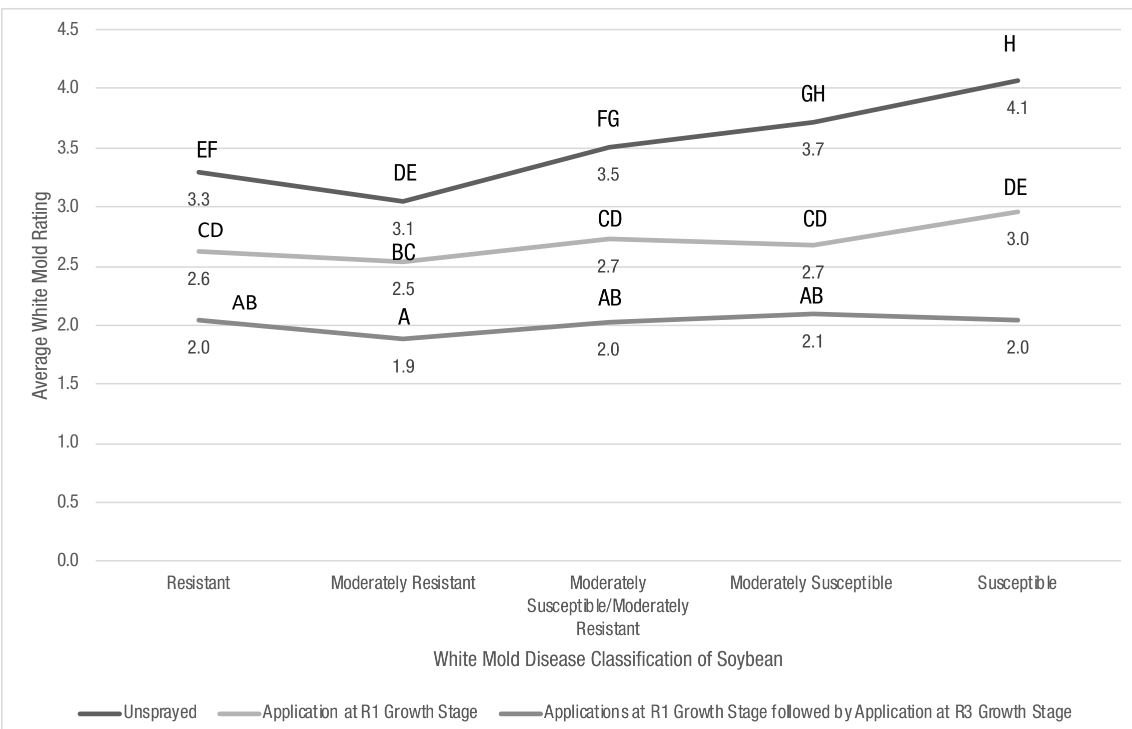


Figure 2. Average white mold disease index rating by fungicide spray treatment and white mold disease classification of soybean products. Fungicides: Delaro® 325 SC fungicide tank-mixed with Luna® Privilege fungicide (2019-2020) or Delaro® Complete Fungicide (2021). WM disease index: 1 = no disease, 9 = severe disease. Mean separation letters (a through h) denote statistically significant differences at an alpha = 0.1.

Evaluation of Disease Management Systems in Soybean – White Mold

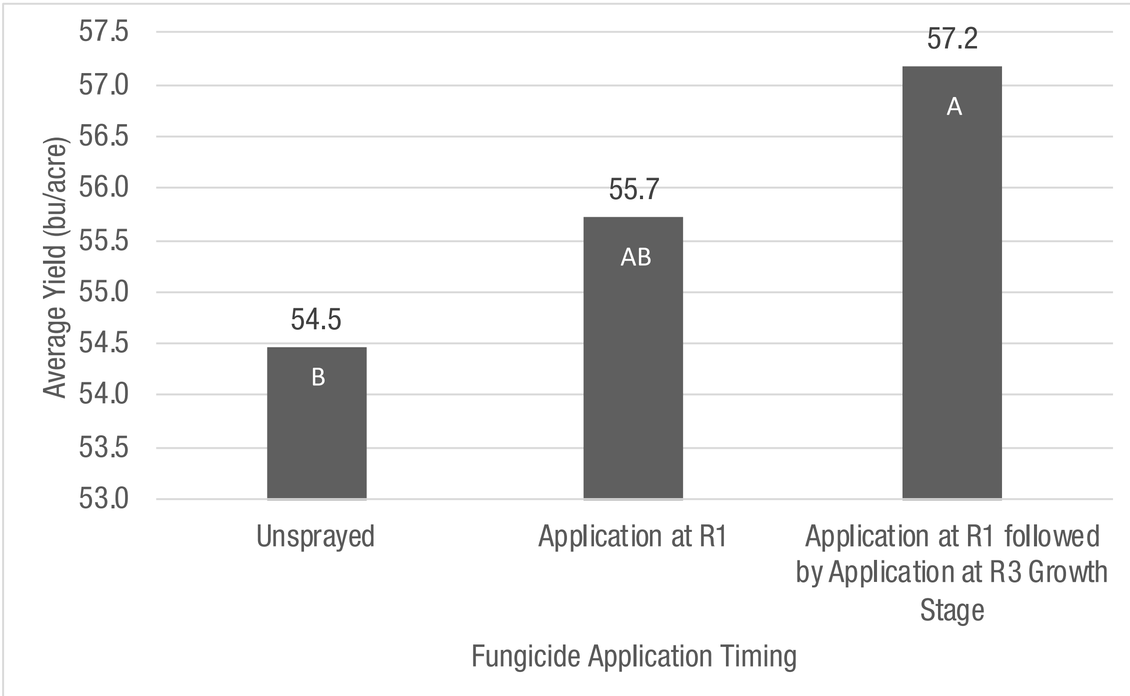


Figure 3. Average yield for each fungicide treatment across all soybean products and locations. Fungicides: Delaro® 325 SC fungicide tank-mixed with Luna® Privilege Fungicide (2019-2020) or Delaro® Complete Fungicide (2021). Mean separation letters (a, b) denote statistically significant differences at an alpha = 0.1.

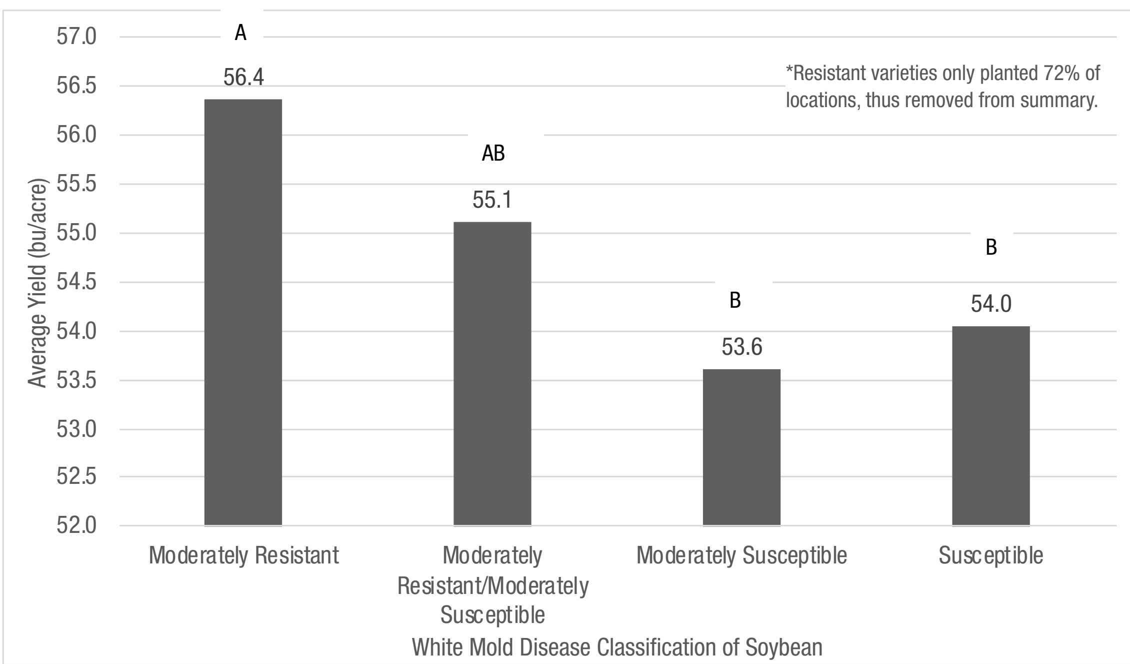


Figure 4. Average yield of treatments for each white mold disease classification of soybean products. Mean separation letters (a) denote statistically significant differences at an alpha = 0.1.

Evaluation of Disease Management Systems in Soybean – White Mold

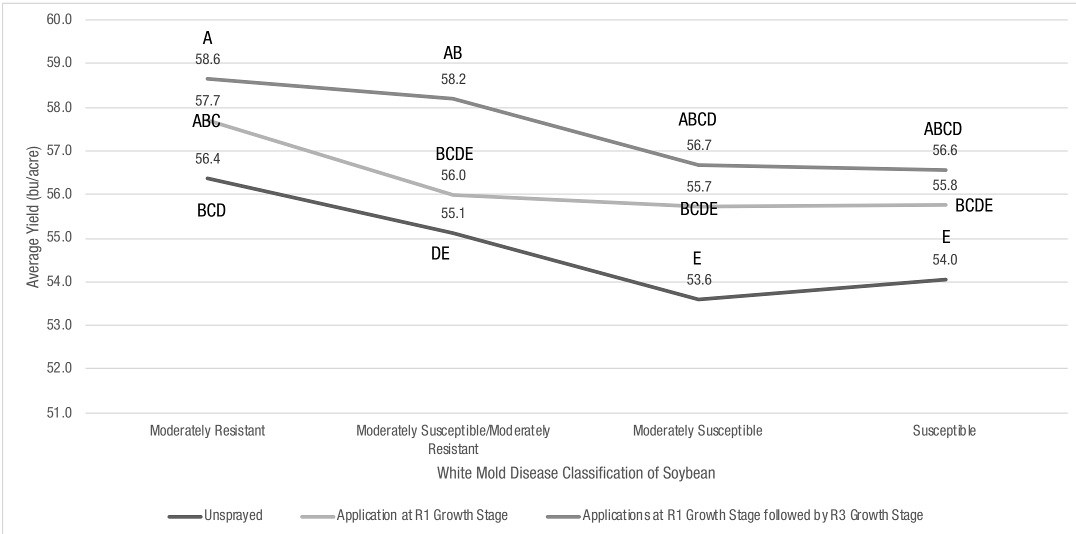


Figure 5. Average yield by fungicide treatment and white mold disease classification of soybean products. Fungicides: Delaro® fungicide tank-mixed with Luna® Privilege Fungicide (2019-2020) or Delaro® Complete Fungicide (2021).

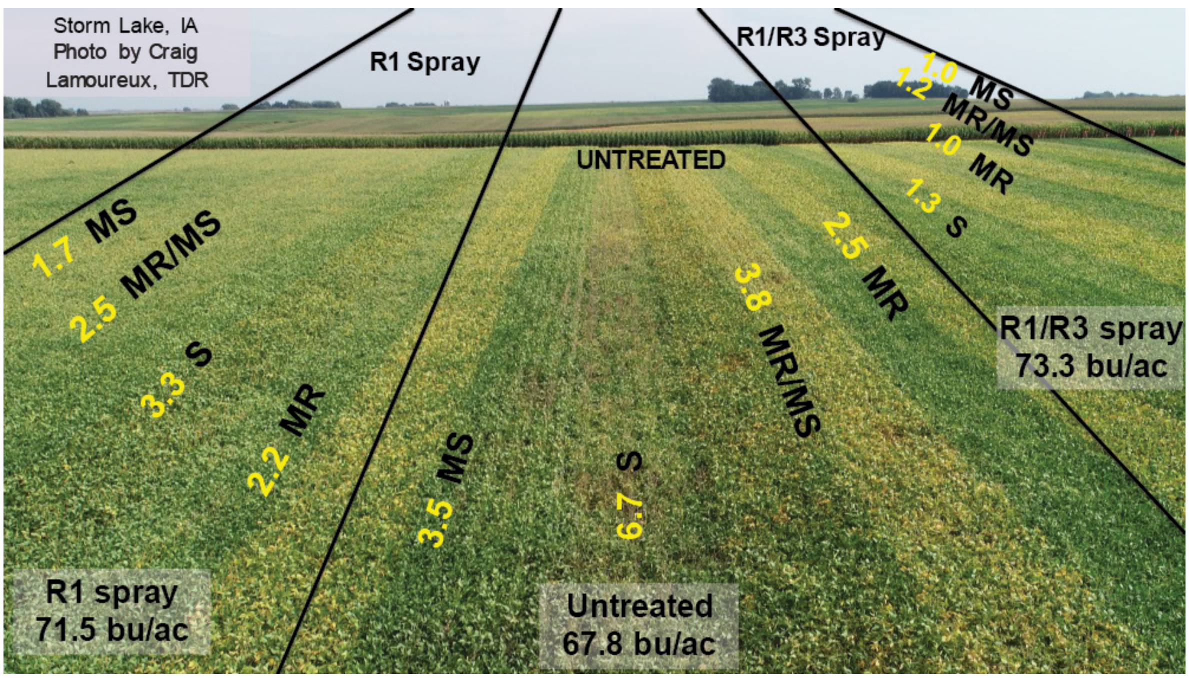


Figure 6. Aerial imagery from 2019 showing visual differences of white mold disease severity for each of the fungicide spray treatments and white mold disease classification of products. Soybean products sprayed at R1 growth stage then followed by an application at R3 growth stage yielded the highest and had the lowest white mold disease index recorded in a location with relatively high white mold incidence and severity (white mold index numbers in yellow. White mold disease index: 1 = no disease, 9 = severe disease). Fungicides: Delaro® fungicide tank-mixed with Luna® Privilege Fungicide. Soybean susceptibility: S= susceptible; MS = moderately susceptible; MR=moderately resistant.

Evaluation of Disease Management Systems in Soybean – White Mold

Figure 7. Side-by-side comparison of a soybean product susceptible to white mold showcasing the effect of fungicide applications (R1 and R3 growth stages) on white mold disease management and plant health. Fungicides: Delaro® fungicide tank-mixed with Luna® Privilege Fungicide. White mold disease index: 1 = no disease, 9 = severe disease.

Key Learnings

- Within the three years of data, there was strong white mold disease suppression in response to fungicide applications at R1 growth stage followed by application at R3 growth stage, resulting in a significant advantage of more than 2.7 bu/acre over the unsprayed treatment.
- Moderately Resistant soybean products had a 2.8 and 2.4 bu/acre advantage over Moderately Susceptible and Susceptible varieties, respectively.
- Delaro® Complete fungicide is a management option to help manage white mold and protect yield potential. This fungicide paired with the right soybean product should be considered to reach yield potential goals.

Legal Statements

Managing Frogeye Leaf Spot

Trial Objective

- Frogeye leaf spot (FLS) is caused by the fungus *Cercospora sojina*, which survives in soybean residue left on the soil surface and in infected soybean seeds. FLS has become a common, economically important disease in the hot, humid regions of the southeastern United States. Recently, incidences of FLS have become more common in northern regions of the United States where susceptible soybean products are commonly grown.
- The objective of this study was to evaluate a system-based approach for FLS disease management supported by native resistance of germplasm and foliar fungicide.
- Select soybean products with varying levels of resistance to FLS were evaluated under different fungicide management options.

Research Site Details

- This study was conducted at 14 locations in 7 states (IN, IL, KY, MS, MO, NC, OH) in fields with a history of FLS.
- Plots were planted in a strip trial
  - » One replication per location
  - » Experimental unit size ranged from 0.25 to 1 acre
  - » Alpha level of 0.1 was used for mean separation
- Fungicide treatments included:
  - » Untreated
  - » Application at R3 growth stage of Delaro® 325 SC fungicide at 8 oz/acre, Delaro® Complete Fungicide at 8 oz/acre or Stratego® YLD Fungicide at 4 oz/acre.
- Soybean products used were classified as susceptible (S), moderately susceptible (MS), moderately resistant/moderately susceptible (MR/MS), moderately resistant (MR), or resistant (R) to FLS.
- Plots were randomized within the trial.
- FLS disease ratings were taken at the R6 growth stage.
- 33 trial locations from 2020 and 2021 were planted for this study. Of these, 14 locations (42%) were included in the analysis below because they had slight to moderate frogeye leaf spot pressure.

Managing Frogeye Leaf Spot

Understanding the Results

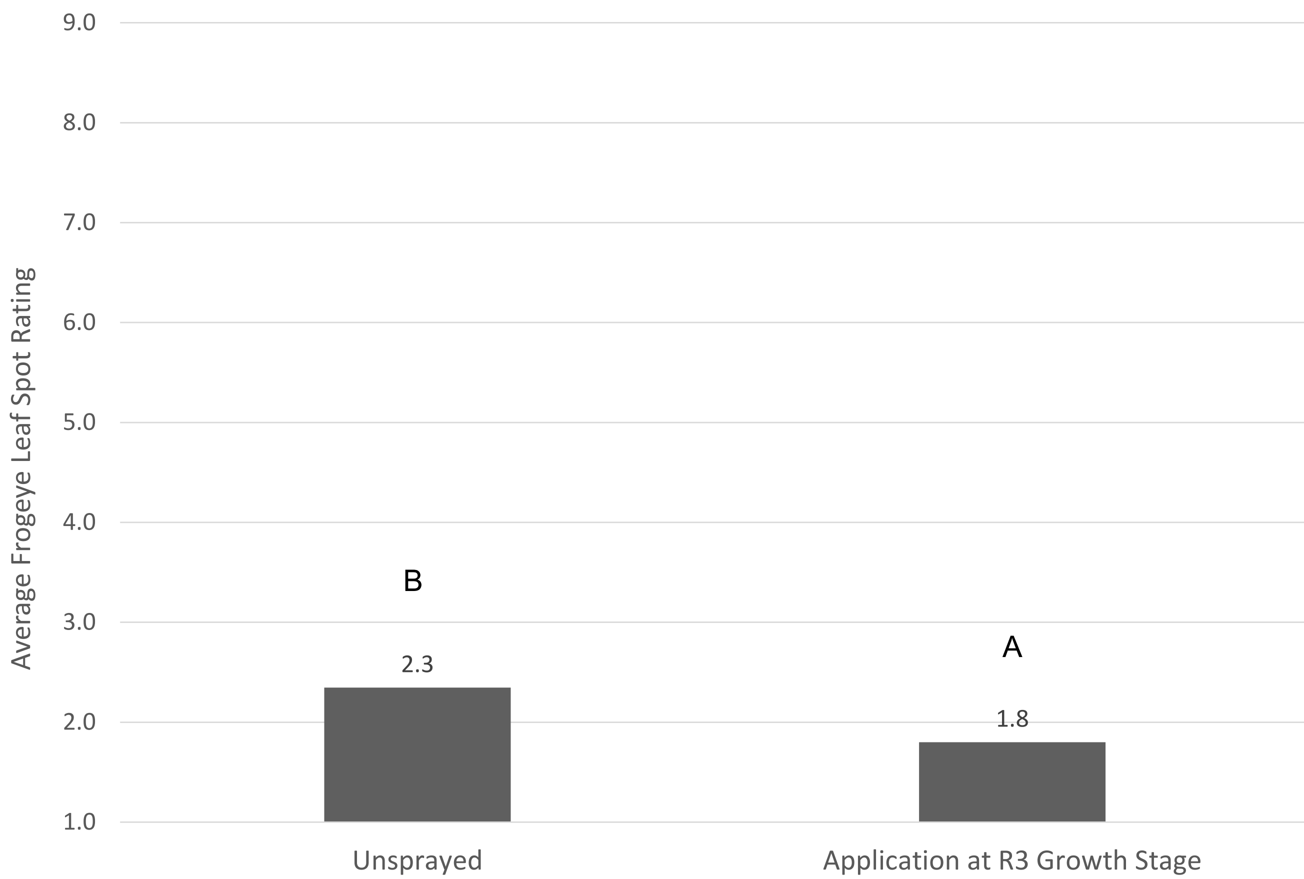


Figure 1. Average frogeye leaf spot disease index rating comparing untreated and fungicide treatment: Delaro® 325 SC fungicide at 8 oz/acre (in 2020) or Delaro® Complete Fungicide at 8 oz/acre (in 2021) [in both years, Stratego® YLD fungicide at 4 oz/acre was applied in the three southern locations]. FLS disease index: 1 = no disease, 9 = severe disease. Mean separation letters (a, b) denote statistically significant differences at an alpha = 0.1.

Managing Frogeye Leaf Spot

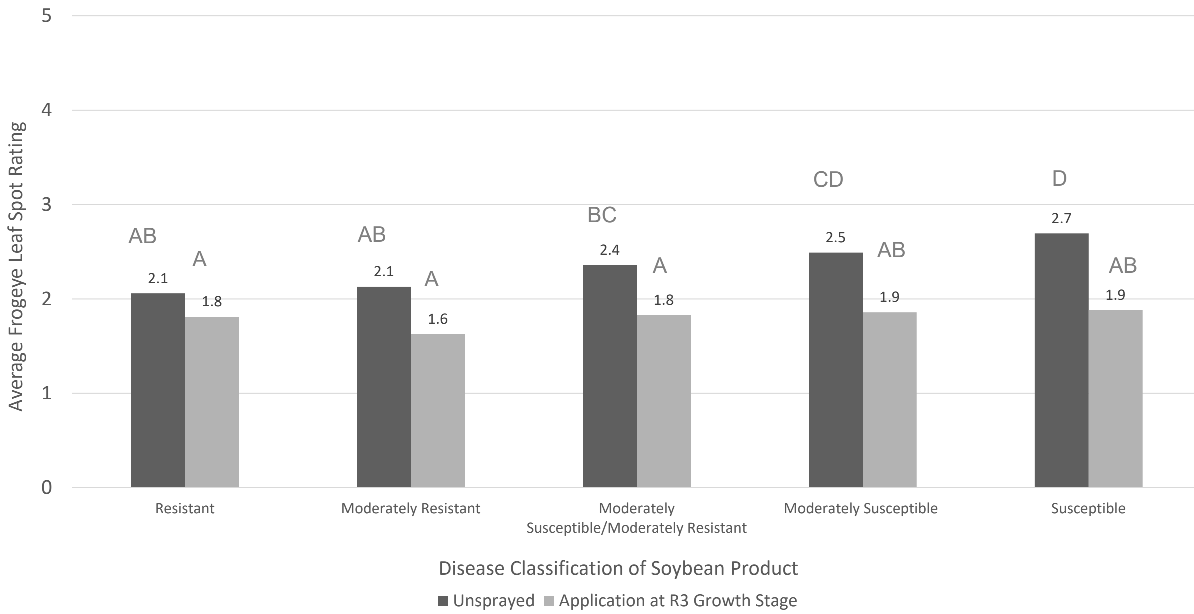


Figure 2. Average frogeye leaf spot (FLS) disease index rating by fungicide spray treatment and FLS disease classification of soybean products. Fungicide treatment: Delaro® 325 SC fungicide at 8 oz/acre (in 2020) or Delaro® Complete Fungicide at 8 oz/acre (in 2021) [in both years, Stratego® YLD fungicide at 4 oz/acre was applied in the three southern locations]. FLS disease index: 1 = no disease, 9 = severe disease. Mean separation letters (a through h) denote statistically significant differences at an alpha = 0.1.

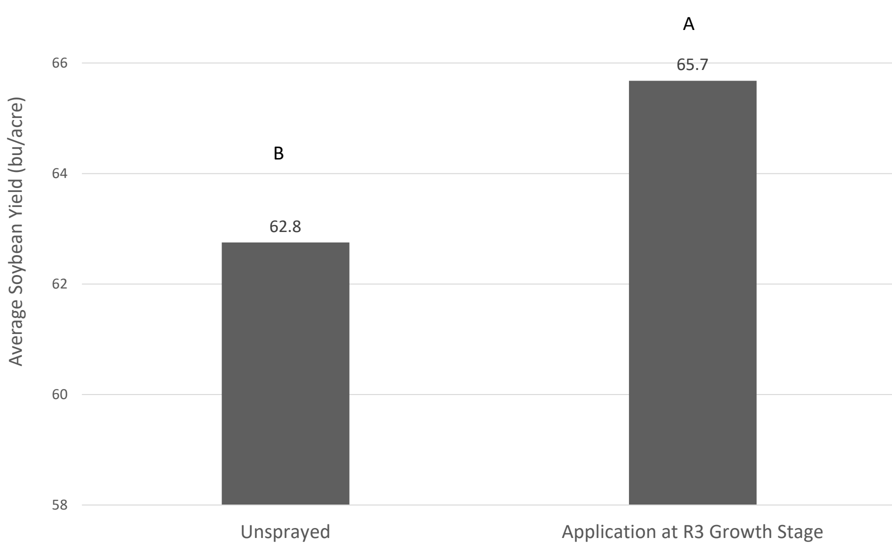


Figure 3. Average yield for each fungicide treatment across all soybean products and locations. Fungicide treatment: Delaro® 325 SC fungicide at 8 oz/acre (in 2020) or Delaro® Complete Fungicide at 8 oz/acre (in 2021) [in both years, Stratego® YLD fungicide at 4 oz/acre was applied in the three southern locations]. Mean separation letters (a, b) denote statistically significant differences at an alpha = 0.1.

Managing Frogeye Leaf Spot

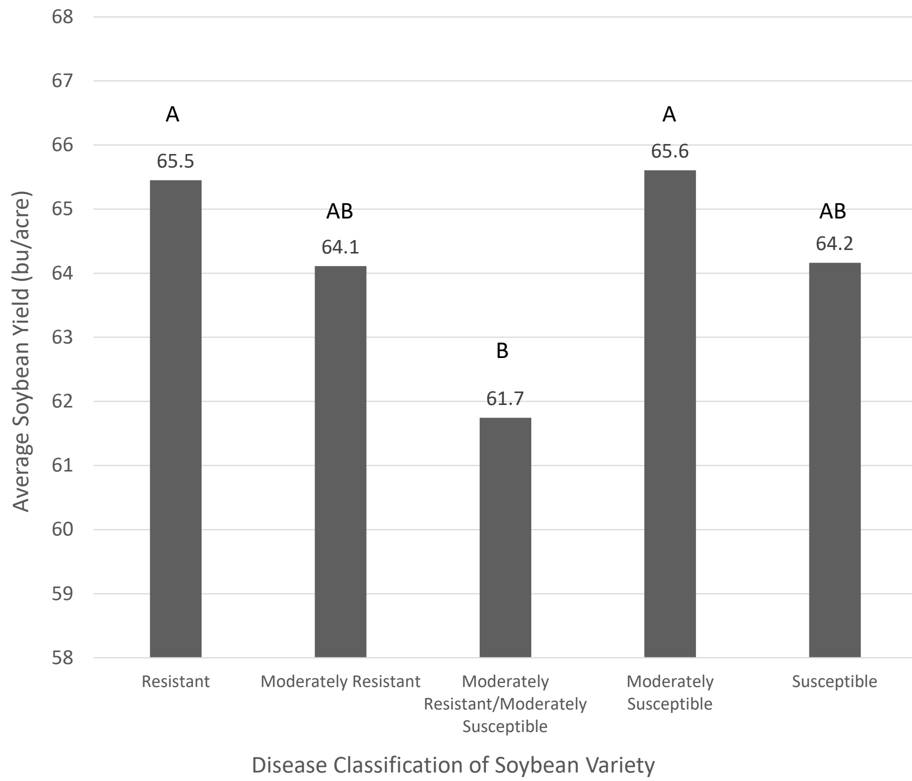


Figure 4. Average yield of treatments for each frogeye leaf spot disease classification of soybean products. Mean separation letters (a) denote statistically significant differences at an alpha = 0.1.

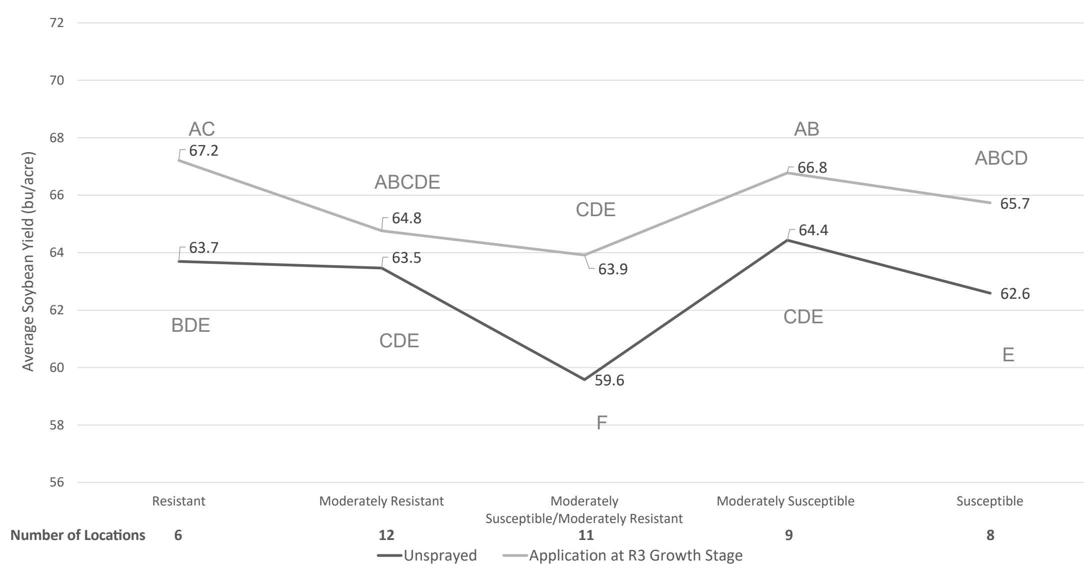


Figure 5. Average yield by fungicide treatment and frogeye leaf spot disease classification of soybean products. Fungicide treatment: Delaro® fungicide at 8 oz/acre (in 2020) or Delaro® Complete fungicide at 8 oz/acre (in 2021) [in both years, Stratego® YLD fungicide at 4 oz/acre was applied in the three southern locations]. Included is number of locations analyzed in each data point.

Managing Frogeye Leaf Spot

Key Learnings

- There was a strong fungicide effect on FLS disease suppression. Yield results showed a significant advantage of nearly 3 bu/acre for soybeans sprayed with fungicide compared to the unsprayed treatment.
- Genetics with enhanced resistance to FLS did not demonstrate a consistent yield advantage in this data set. However, soybean products with enhanced resistance had decreased FLS disease index ratings in the unsprayed plots.
- The Bayer fungicide products applied to soybeans at R3 growth stage consistently provided a yield advantage over the unsprayed treatment across soybean genetics in these trials in which FLS was present.

Legal Statements

How planting rate and fungicide application affect yield and disease development in soybeans

Trial Objective

- Improvements in soybean genetics, planting technology, and weed control systems have led to lower planting rate recommendations for soybean growers over the past decade.[1]
- Fungicide use in soybeans is steadily increasing.[2]
- Some growers may wonder if fungicide is more beneficial in higher populations, which have a higher potential for disease development or vice versa.[3]
- The goal of this research was to determine how planting rate and fungicide application interact and affect yield and disease development in soybeans.

Experiment/Trial Design

- This research was conducted at Bayer Crop Science FOCUS sites in Illinois counties, Kendall, Woodford, McLean, and Macon from 2019 - 2021.
- 32 soybean products from 2.2-3.9 maturity group (MG) were planted, with different products used at different locations and in different years.
- All seed was treated with Acceleron® Seed Applied Solutions STANDARD and ILeVO® Seed Treatment.
- Seeding rates ranged from 60,000 to 160,000 planted seeds per acre.
- Four replications of this trial were planted at each location.
- Fungicide applied varied by location and trial year. All fungicides were applied at the R3 growth stage.
- Standard fertility and weed management practices were followed.
- The 2019 growing season was very cool and wet through early June, leading to delayed planting for many growers. Hot and dry conditions were prevalent in July and August, and excessive rainfall returned in September and October.
- In both 2020 and 2021, there was sufficient moisture in the early part of the growing season, but very dry conditions throughout August and into September.

How planting rate and fungicide application affect yield and disease development in soybeans

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Roanoke, IL	Silt loam	Corn	Conventional	6/3/19	10/14/19	65	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Carlock, IL	Silt loam	Corn	Conventional	6/4/19	10/15/19	65	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Covell, IL	Silt loam	Corn	Conventional	5/20/19	10/14/19	65	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Roanoke, IL	Silt loam	Corn	Conventional	6/1/20	10/15/20	70	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Newark, IL	Silt loam	Corn	Conventional	6/2/20	10/16/20	70	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Covell, IL	Silt loam	Corn	Conventional	5/11/20	10/9/20	75	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Danvers, IL	Silt loam	Corn	Conventional	5/11/20	10/7/20	75	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Warrensburg, IL	Silt loam	Corn	Conventional	4/16/21	9/30/21	80	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
El Paso, IL	Silt loam	Corn	Conventional	5/1/21	10/23/21	75	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Covell, IL	Silt loam	Corn	Conventional	5/8/21	11/7/21	75	60,000; 80,000; 100,000; 120,000; 140,000; 160,000

How planting rate and fungicide application affect yield and disease development in soybeans

Understanding the Results

- On average, across populations in the 3 years in this research, fungicide application provided an average yield increase of over 5 bushels and delivered additional profit of $41.47 per acre (Figure 1).
- The most profitable configuration was a planting rate of 120,000 seeds/acre combined with an R3 fungicide application (Figure 1).
- Without a fungicide application, a seeding rate of 160,000 seeds/acre was required for maximum yield and profitability potential. This rate provided $42.60 less income per acre than the 120,000 rate with fungicide applied (Figure 1).
- Disease pressure was also fairly low in this trial. Overall, fungicide application helped reduce disease development by around 20% based on general disease ratings (Figure 2). This rating incorporates both disease incidence and severity, with a rating of 1 indicating no disease, and 9 being worst.

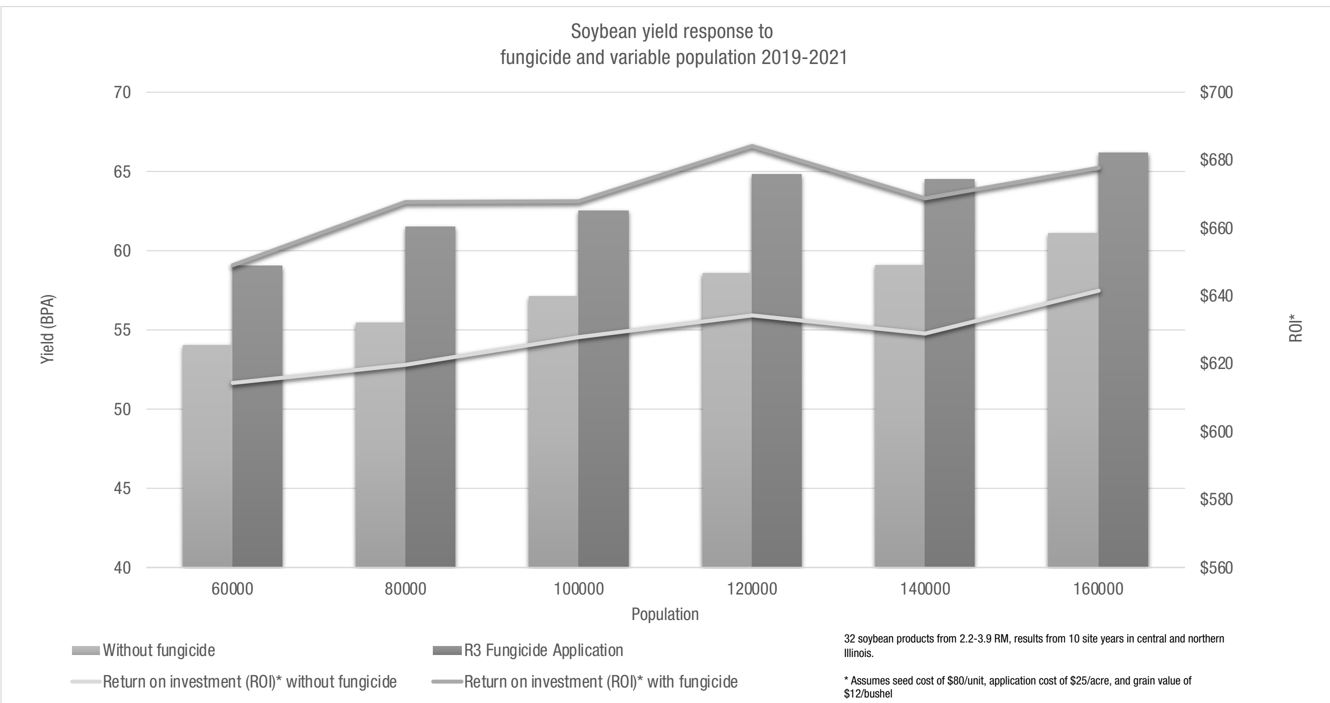


Figure 1. Average yield response of soybean to fungicide application and plant population, 2019-2021.

How planting rate and fungicide application affect yield and disease development in soybeans

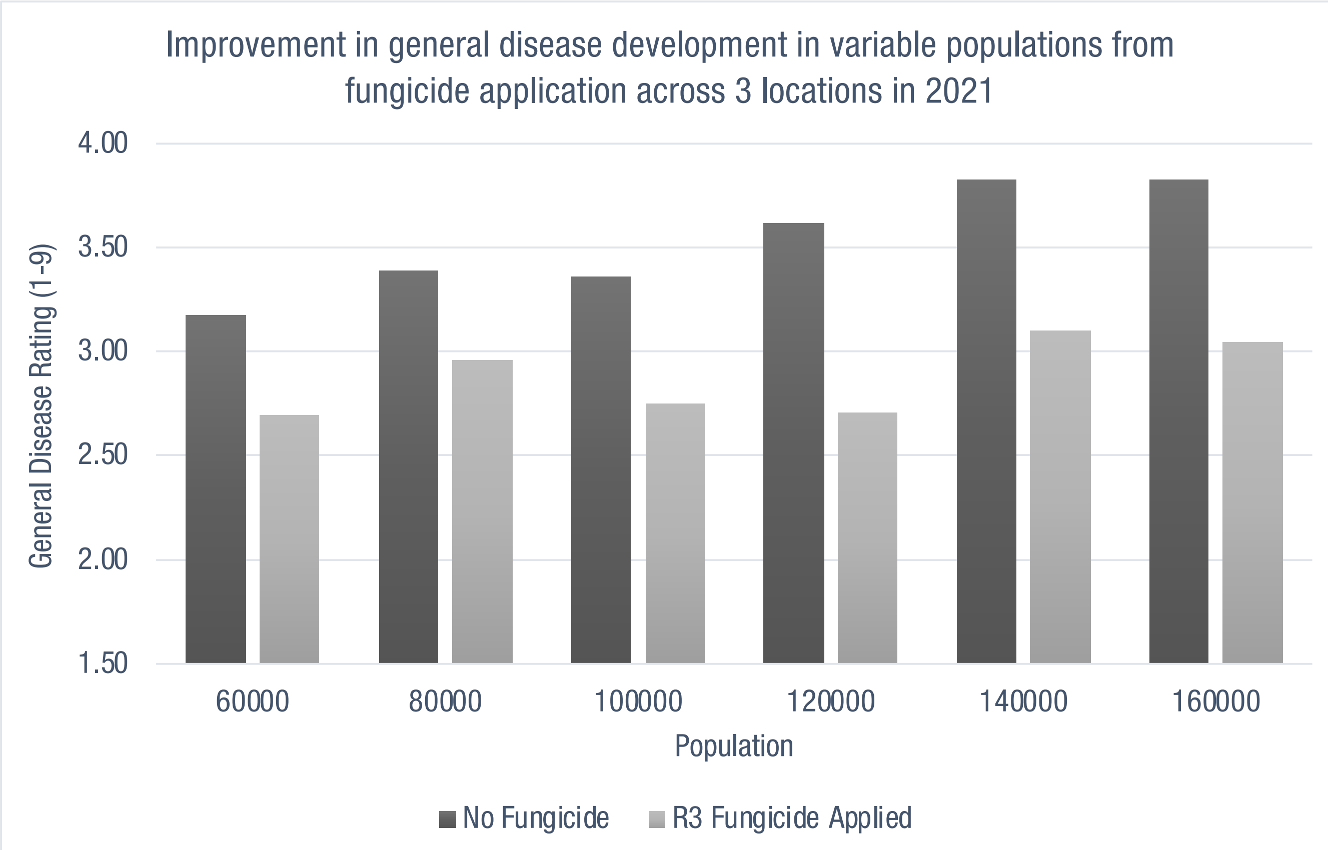


Figure 2. Effect of fungicide on disease development in variable plant populations across 3 locations in 2021.

Key Learnings

- Higher populations can lead to increased yield potential but may also increase the risk of disease development.
- The results of this study show that fungicide application at the R3 growth stage resulted in an increase in yield potential across planting populations, even when disease pressure was not high. Understanding how these benefits help contribute to return on investment is beneficial to help growers get the most out of soybean products.
- In this study, planting soybeans at populations of 120,000 to 160,000 seeds/acre combined with the use of a foliar fungicide at R3 should be considered to help maximize both yield and profit potential.

How planting rate and fungicide application affect yield and disease development in soybeans

Sources:

[1]Pedersen, P. Optimum plant population in Iowa. Iowa State University. https://crops.extension.iastate.edu/files/article/OptimumPlantPop_000.pdf

[2]Geisler, L.J., and Miller, J.J. 2017. Managing foliar diseases in soybean. Nebraska Extension. https://extensionpublications.unl.edu/assets/html/g1862/build/g1862.htm

[3]Porter, S. 2019. Five reasons to stop your higher soybean population. Illinois Soy Advisor. https://www.ilsoyadvisor.com/on-farm/ilsoyadvisor/5-reasons-stop-your-higher-soybean-population

Legal Statements

Managing Sudden Death Syndrome in Soybean

Trial Objective

- Evaluate a system-based approach for Sudden Death Syndrome (SDS) management in soybean.
- Compare the yield benefit and SDS suppression of three commercially available seed treatments.
- Explore the benefits of using a seed treatment along with selecting SDS tolerant soybean products to help maximize yield potential in fields with a history of SDS infestation.

Experiment/Trial Design

- Trials were conducted over two years at four locations (1 in 2020 and 3 in 2021).

Nebraska Locations	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Battle Creek	Loamy Sand	Corn	Conventional	5/14/21	10/05/21	70	150,000
Utica	Silt Loam	Corn	Conventional	5/10/21	9/28/21	90	150,000
Hooper (Site 1)	Silty Clay Loam	Corn	No Till	5/13/21	9/27/21	80	140,000
Hooper (Site 2)	Silty Clay Loam	Corn	No Till	5/15/20	10/01/20	80	135,000

- Trial locations had a history of SDS.
- The trial design was a single replication split plot strip trial where the product was the whole plot and seed Typical planting dates for the area were targeted.
- Five soybean products, respectively, were planted at Hooper, NE (Site 2) in 2020 and Battle Creek, NE in 2021. Three soybean products, respectively, were planted at Utica, NE and Hooper, NE (Site 1) in 2021.
- At each location, the soybean products were planted with three seed treatments:
  - » Acceleron® Seed Applied Solutions Standard* + Acceleron® IX-409 Insecticide Seed Treatment
  - » Acceleron® Seed Applied Solutions Standard* + Acceleron® IX-409 Insecticide Seed Treatment + ILeVO® Seed Treatment
  - » Acceleron® Seed Applied Solutions Standard* + Acceleron® IX-409 Insecticide Seed Treatment + Saltro® Seed Treatment.

*Acceleron® Seed Applied Solutions Standard is a combination of Acceleron® DX-109 Fungicide Seed Treatment/Acceleron® D-109 Fungicide Seed Treatment, Acceleron® DX-309 Fungicide Seed Treatment, and Acceleron® DX-612 Fungicide Seed Treatment/Acceleron® D-612 Fungicide Seed Treatment.

- Weeds were controlled uniformly across the study with no foliar insecticides or fungicides applied. Nutrient management was managed by landowner according to their agronomic plan.
- All sites were irrigated using center point pivots.
- Sudden Death Syndrome field ratings (1 to 9) with 1 = good and 9 = poor based on field incidence and severity were taken at each site at the R6 growth stage (average of three locations within each treatment) (Table 1).

Table 1. Sudden Death Syndrome Field Rating Scale

		Severity		
	Percent	Mild (1-3)	Moderate (4-6)	Severe (7-9)
Incidence	0	1	1	1
	5	2	2	3
	10	2	3	4
	20	2	3	5
	30	3	4	6
	40	3	5	6
	50	3	6	7
	60	4	7	8
	70	4	8	8
	80	5	8	9
	90	5	9	9
	100	5	9	9

Managing Sudden Death Syndrome in Soybean

Understanding the Results

- The combined average yields of the soybean products tested, across the four locations showed no yield response to the seed treatments (Figure 1 and Table 3).
- When the data was separated by SDS incidence, the locations with SDS (Table 2) had a positive yield response trend with the addition of ILeVO® seed treatment or Saltro® seed treatment (Table 3).
- The locations with no SDS incidence (Table 2) showed no response with the addition of ILeVO® seed treatment and a slight negative trend in yield response with the addition of Saltro® seed treatment (Table 3).

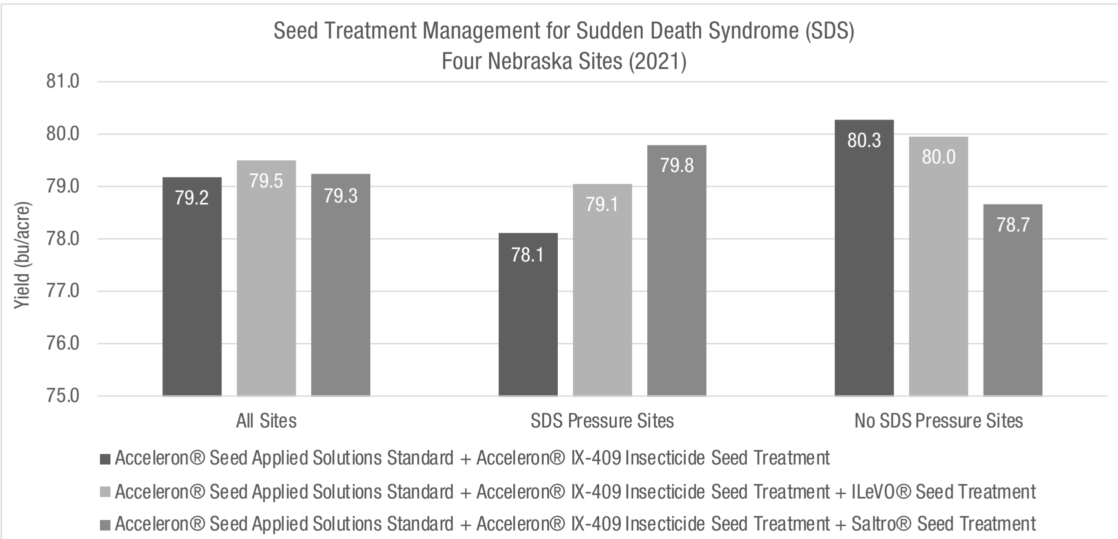


Figure 1. Average soybean yield separated by sudden death syndrome (SDS) pressure for three soybean seed treatments at four sites in Nebraska (2020 and 2021). Acceleron® Seed Applied Solutions Standard is a combination of Acceleron® DX-109 Fungicide Seed Treatment/Acceleron® D-109 Fungicide Seed Treatment, Acceleron® DX-309 Fungicide Seed Treatment, and Acceleron® DX-612 Fungicide Seed Treatment/Acceleron® D-612 Fungicide Seed Treatment.

Table 2. Average Sudden Death Syndrome (SDS) Field Rating Across Soybean Products by Nebraska Location*

Seed Treatment	SDS Field Rating by Location and (Year)			
	Battle Creek (2021)	Utica (2021)	Hooper (Site 1) (2021)	Hooper (Site 2) (2020)
Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide	1	1	5.2	3.2
Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide + ILeVO® Seed Treatment	1	1	4.2	2.8
Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide + Saltro® Seed Treatment	1	1	4.3	2.4

*Data is separated by SDS pressure for three soybean seed treatments at four sites in Nebraska (one site in 2020 and three sites in 2021). Acceleron® Seed Applied Solutions Standard is a combination of Acceleron® DX-109 Fungicide Seed Treatment/Acceleron® D-109 Fungicide Seed Treatment, Acceleron® DX-309 Fungicide Seed Treatment, and Acceleron® DX-612 Fungicide Seed Treatment/Acceleron® D-612 Fungicide Seed Treatment.

Managing Sudden Death Syndrome in Soybean

Table 3. Average soybean yield and Sudden Death Syndrome (SDS) rating across the soybean products used in the trial at each site. *			
	Seed Treatment	Average Yield (bu/acre)	SDS Field Rating
All Sites	Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide	79.2	2.5
	Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide + ILeVO® Seed Treatment	79.5	2.1
	Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide + Saltro® Seed Treatment	79.3	2.1
SDS Pressure Sites	Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide	78.1	3.9
	Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide + ILeVO® Seed Treatment	79.1	3.3
	Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide + Saltro® Seed Treatment	79.8	3.2
No SDS Pressure Sites	Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide	80.3	1.0
	Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide + ILeVO® Seed Treatment	80.0	1.0
	Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide + Saltro® Seed Treatment	78.7	1.0

*Data is separated by SDS pressure for three soybean seed treatments at four sites in Nebraska (one site in 2020 and three sites in 2021). Acceleron® Seed Applied Solutions Standard is a combination of Acceleron® DX-109 Fungicide Seed Treatment/Acceleron® D-109 Fungicide Seed Treatment, Acceleron® DX-309 Fungicide Seed Treatment, and Acceleron® DX-612 Fungicide Seed Treatment/Acceleron® D-612 Fungicide Seed Treatment.

- The response to individual seed treatments varied by individual soybean product; however, because of the limited replications of each soybean product across locations, analysis was done as an aggregation of soybean products.

Key Learnings

- Sudden Death Syndrome in soybean is a challenging disease to manage and can cause yield loss in fields with SDS incidence.
- Selecting soybean products with the highest level of SDS resistance is one of the most important management Agronomic management such as crop rotation, minimizing compaction, and reduction of excessive soil moisture can help reduce the impact of soybean SDS.
- Although no dramatic yield improvement was found with the addition of ILeVO® seed treatment or Saltro® seed treatment, sites with observed SDS incidence showed positive trends in yield response.
- A grower should always consult their local sales representative and agronomist to select the appropriate soybean product(s) to help manage the impact of SDS along with optional seed treatments for potentially improved protection.

Managing Sudden Death Syndrome in Soybean

Legal Statements

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ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. FOR SOYBEANS, EACH ACCELERON® SEED APPLIED SOLUTIONS OFFERING is a combination of separate individually registered products containing the active ingredients: BASIC Offering: metalaxyl, fluxapyroxad, and pyraclostrobin. STANDARD Offering: metalaxyl, fluxapyroxad, pyraclostrobin, and imidacloprid.

The distribution, sale, or use of an unregistered pesticide is a violation of federal and/or state law and is strictly prohibited. Not all products are approved in all states.

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.

Yield Observations When Shifting to Earlier Relative Maturity Soybeans

Research Description

Trial Overview

- There continues to be a growing trend of growers planting early maturity soybean products and managing them at a higher level with seed treatments and foliar applications of fungicide and insecticide. This shift to earlier soybean maturity groups is becoming increasingly important in some locations.
- There are many benefits of planting early soybeans including, but not limited to, earlier harvest timing, earlier cover crop seeding, and risk management benefits.

Objective

- Determine the yield impact of soybean product selection against the normal maturity group products for the location.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date(s)	Potential Yield (bushels/acre	Planting Rate (seeds per acre)
Storm Lake, IA	Silty Clay Loam	Corn	Conventional	5-6-21	9-18-21 9-21-21	65	160,000
Marble Rock, IA	Silt Loam	Corn	Strip-Till/Cover crop	5-2-21	10-1-21 10-4-21	60	150,000
Atlantic, IA	Silty Clay Loam	Corn	Conventional	4-27-21	10-6-21	70	150,000
Victor, IA	Silty Clay Loam	Corn	Conventional	4-30-21	9-28-21 9-30-21	65	140,000

Site Notes

- Trial was divided into 2 sets – North & South
- A total of 4 trial locations with 2 North locations and 2 South locations
  - North Set – Storm Lake and Marble Rock, Iowa
  - South Set – Atlantic and Victor, Iowa
- Each maturity group set consisted of 3 Channel® brand soybean products.
  - Three early maturity group (MG) soybean products:
    - North Set – 1.2 to 1.9 MG (1220RXF brand, 1421RXF brand, 1921RXF brand)
    - South Set – 2.2 to 2.5 MG (2221RXF brand, 2321RXF brand, 2521RXF brand)
  - Three normal maturity group soybean products:
    - North Set – 2.2 to 2.5 MG (2221RXF brand, 2321RXF brand, 2521RXF brand)
    - South Set – 2.7 to 3.4 MG (2721RXF brand, 3222RXF brand, 3421RXF brand)
- Plot size, replications, and row spacings varied depending on location.
  - Storm Lake (2 replications)—6 rows at 20-inch spacing
  - Atlantic (3 replications)—8 rows at 30-inch spacing

Yield Observations When Shifting to Earlier Relative Maturity Soybeans

- » Marble Rock (3 replications)—6 rows at 30 -inch spacing
- » Victor (2 replications)—8 rows at 30-inch spacing
- Rainfall in 2021 was timely and arrived during the soybean reproductive stages across all locations.

Understanding the Results

- With earlier planting dates in 2021 and rainfall events from late June through September, the effects of maturity group on soybean yield potential pointed to a clear yield advantage for the Normal maturity group set at all locations.
- The north locations normal MG set had an 8 bushel/acre advantage over the early MG set (Figure 1) and in the southern locations the normal MG set had a 6 bushel/acre advantage over the early MG set (Figure 2).

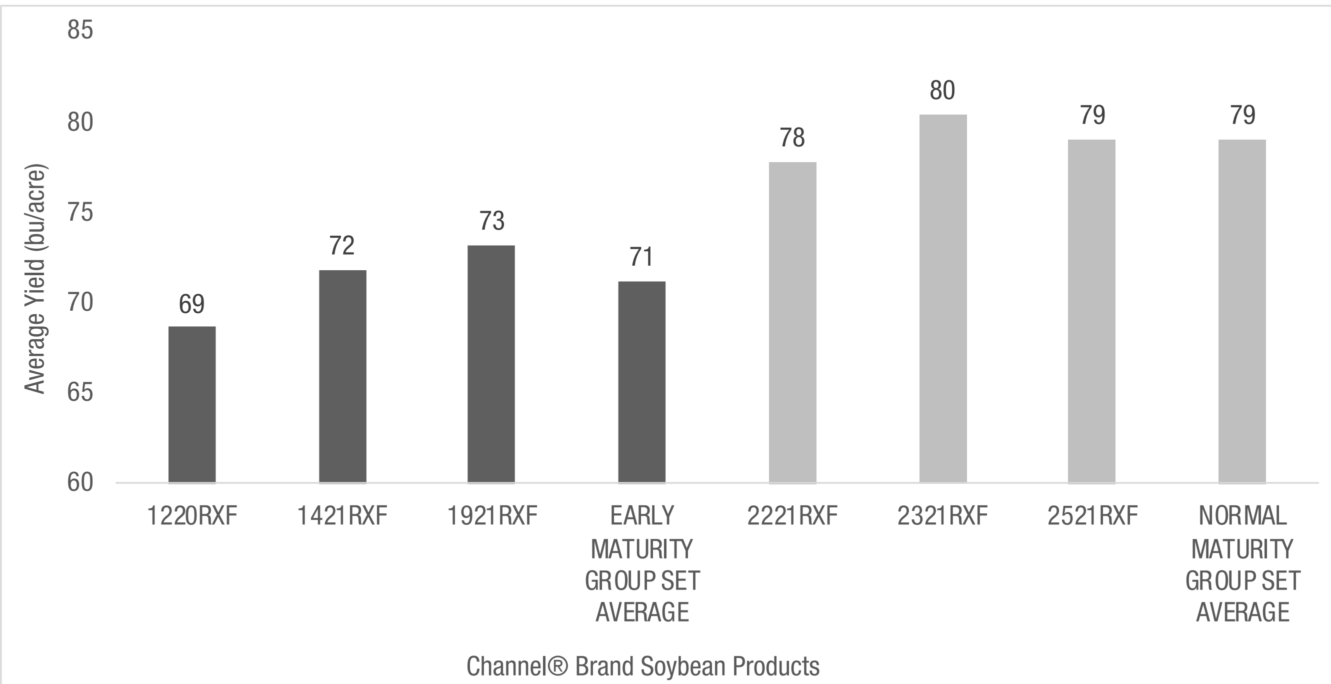

Figure 1. Effect of maturity group (MG) on Channel® brand soybean product performance in northern Iowa (2021).

Yield Observations When Shifting to Earlier Relative Maturity Soybeans

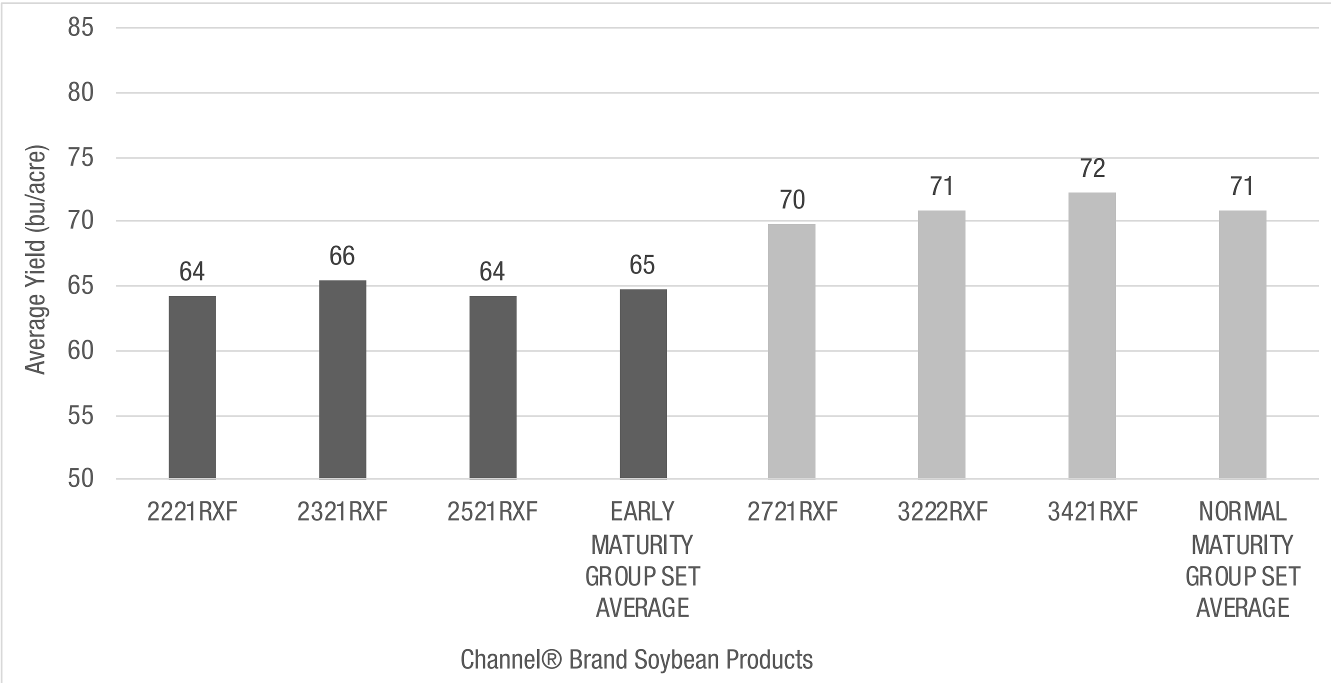

Figure 2. Effect of maturity group (MG) on Channel® brand soybean product performance in southern Iowa (2021).

What Does This Mean for Your Farm?

- In this study, the early MG soybean products averaged 6 to 8 bushel per acre less than normal MG soybean products with a range of 4 to 11 bushel per acre less than normal MG products.
- Late season rainfall in 2021 was ideal, providing ample moisture during reproductive stages to maximize yield potential especially for the normal MG soybean products varieties at all locations.
- More research needs to be done in the genetic pipeline to better understand which soybean products will move south.
- It should be noted that shifting to an earlier MG group may not be for every operation and that benefits could be defined in terms other than yield such as early harvest and establishment of cover crop.

Legal Statement

Yield Observations When Shifting to Earlier Relative Maturity Soybeans

Effect of soybean seeding rate and row spacing on yield and profitability

Trial Objective

- Improvements in soybean genetics, planting technology, and weed control systems have led to lower planting rate recommendations for soybean growers[1] over the past decade.
- Although yields generally increase with increasing planting rates, commodity prices affect which planting rate will be most economical.
- This research was conducted with a goal of understanding the impact of plant population and row spacing on yield and grower profitability.

Experiment/Trial Design

- This research was conducted at Bayer Crop Science FOCUS sites in Illinois counties, Kendall, Dekalb, and Woodford from 2019-2021.
- Sixteen 2.2-2.9 maturity group (MG)soybean products were planted, with different soybean products used in different years.
- Seeding rates ranged from 60,000 to 160,000 planted seeds per acre.
- Four replications of this trial were planted at each location and year.
- The 2019 growing season was very cool and wet through early June, leading to delayed planting for many growers. Hot and dry conditions were prevalent in July and August, and excessive rainfall returned in September and October.
- In both 2020 and 2021, there was sufficient moisture in the early part of the growing season, but very dry conditions throughout August and into September.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Roanoke, IL	Silt loam	Corn	Conventional	6/3/19	10/14/19	70	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Newark, IL	Silty clay loam	Corn	Conventional	6/8/19	10/25/19	65	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Roanoke, IL	Silt loam	Corn	Conventional	6/1/20	10/15/20	70	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Waterman, IL	Silt loam	Corn	Conventional	5/21/21	10/22/21	70	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Roanoke, IL	Silt loam	Corn	No-till	5/20/21	10/12/21	70	60,000; 80,000; 100,000; 120,000; 140,000; 160,000

Effect of soybean seeding rate and row spacing on yield and profitability

Understanding the Results

- On average, over the 3 years in this research, the highest yielding configuration was 160,000 seeds/acre, planted in 20-inch rows (Figure 1).
- Based on soybean grain value of $12/bushel, the most profitable planting configuration is also 160,000 planted seeds/acre in 20-inch rows (Figure 1).
- When a soybean commodity value of $8/ bushel is used for calculations (Figure 2), a planting rate of 160,000 seeds/acre is still the most profitable. However, the profitability curve is relatively flat at planting rates from 120,000 to 160,000

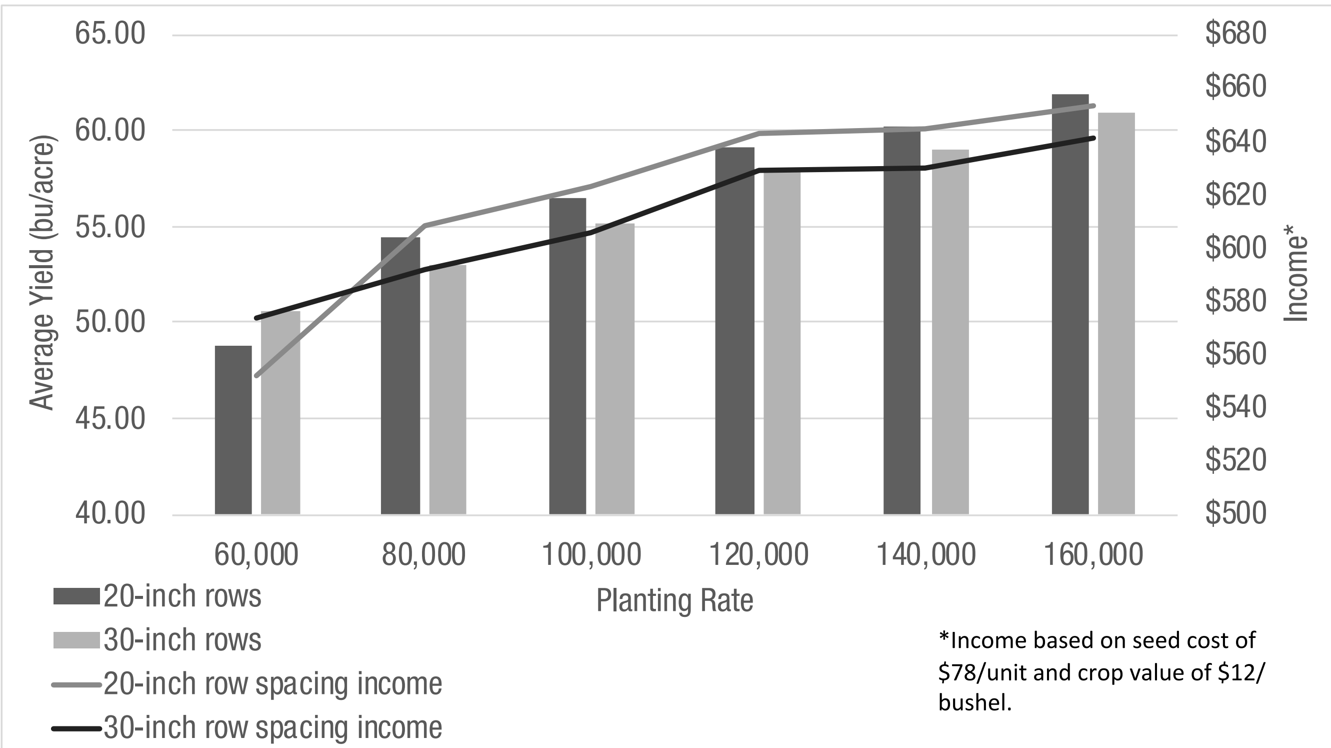

Figure 1. Average soybean performance and profitability under different row widths and seeding rates in Illinois, 2019-2021.

Effect of soybean seeding rate and row spacing on yield and profitability

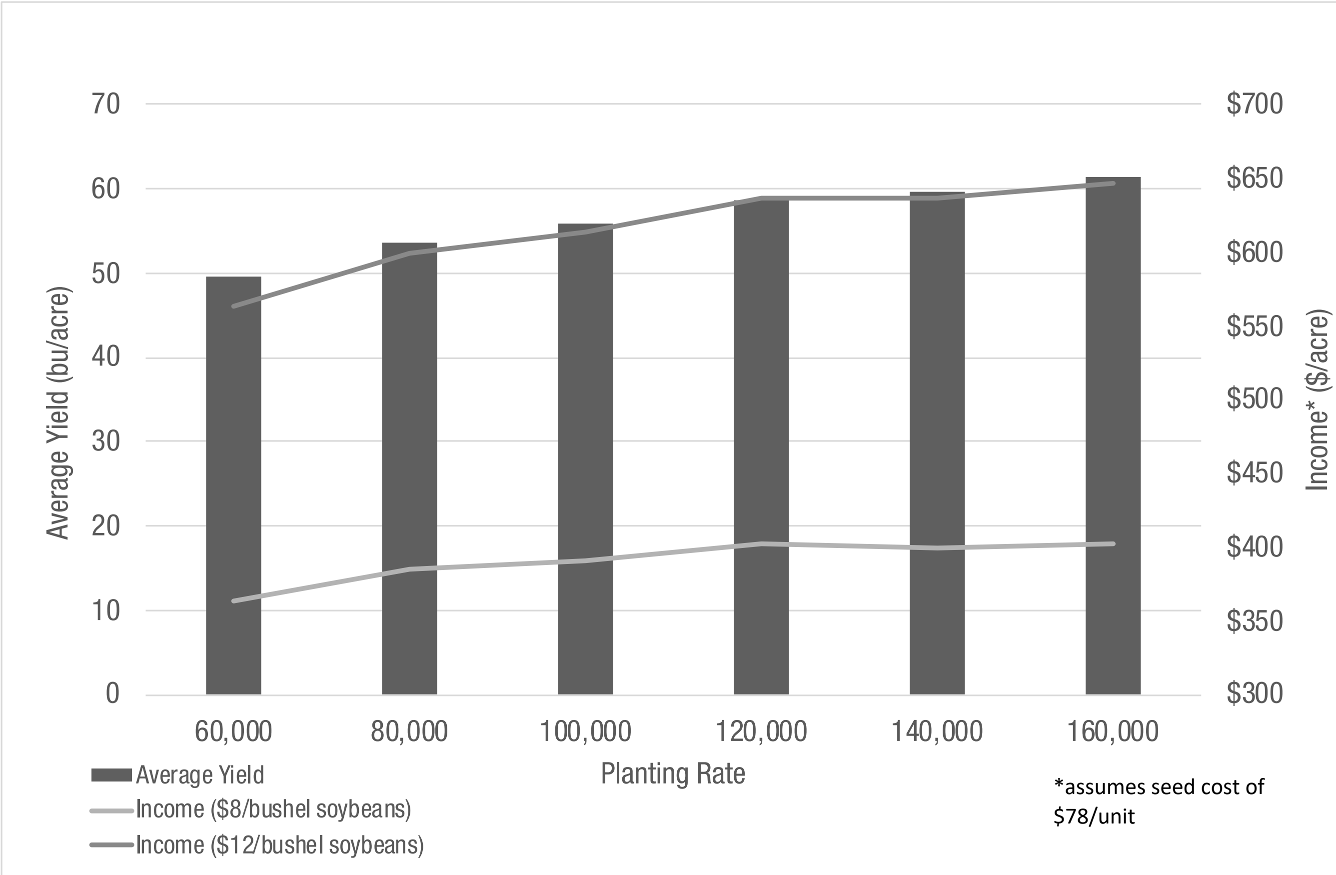

Figure 2. Effect of commodity price on average profitability of different planting rates in Illinois, 2019-2020.

Key Learnings

- Although the average planting date in this research was later than growers would typically wish to plant, the results are representative of what we see in earlier plantings; there is typically less yield effect related to a correlation between planting dates and planting rates than generally accepted2.
- Although a planting rate of 120,000 seeds/acre will sometimes be sufficient to maximize profitability, growers wishing to increase yield or anticipating higher commodity prices may increase planting rates up to 160,000 without incurring much additional risk from an income perspective.

Sources

[1]Licht, M. Soybean plant population. Iowa State University. https://crops.extension.iastate.edu/encyclopedia/soybean-plant-population

[2]Pedersen, P. Optimum plant population in Iowa. Iowa State University. https://crops.extension.iastate.edu/files/article/OptimumPlantPop_000.pdf

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Planting Speed Impact on Soybean Yield

Trial Objective

Can altering planting speed affect soybean yield? There are claims that reduced planting speed can result in noticeable soybean yield increases. A 2020 Bayer study showed that a planting speed reduction from 4.5 mph to 3.0 mph resulted in a higher average yield.[1]

- Objective - Conduct a second-year study to evaluate the effect of planting speed 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	5/12/2021	10/6/2021	95	100,000 & 160,000

- Treatments consisted of three planting speeds and two seeding rates for a total of six treatments.
  - Planting speed – Planter passes were mapped using the Climate FieldView™ (Figure 1).
    - 1.5 miles per hour (mph)
    - 3.0 mph
    - 4.5 mph
  - Seeding rates
    - 100,000 seeds/acre
    - 160,000 seeds/acre

Figure 1. Speed of planter passes as reported in Climate FieldView™. The plot area is highlighted in red.

Planting Speed Impact on Soybean Yield

- The study was setup as a randomized complete block with four replications of each of the six treatments. All planting speed by seeding rate combinations were evaluated.
- A soybean product with a relative maturity of 2.5 was planted in all treatment combinations.
- The planter utilized was a fully mounted four row 30” planter row units utilizing Precision Planting® DeltaForce® for downforce control and Precision Planting® vDrive® for seeding rate control.
- A base fertilizer application of 60 lb/acre of phosphorus, 25 lb/acre sulfur, 0.25 lb/acre zinc was strip-tilled across all treatments on April 5, 2021.
- The plots were sprinkler irrigated to meet the evapotranspiration needs of the crop.
- Weeds were controlled and no fungicides or insecticides were applied.
- Plots were combine-harvested. Grain moisture content, test weight, and total weight were determined. Statistical analysis for Fisher’s LSD was performed.

Understanding the Results

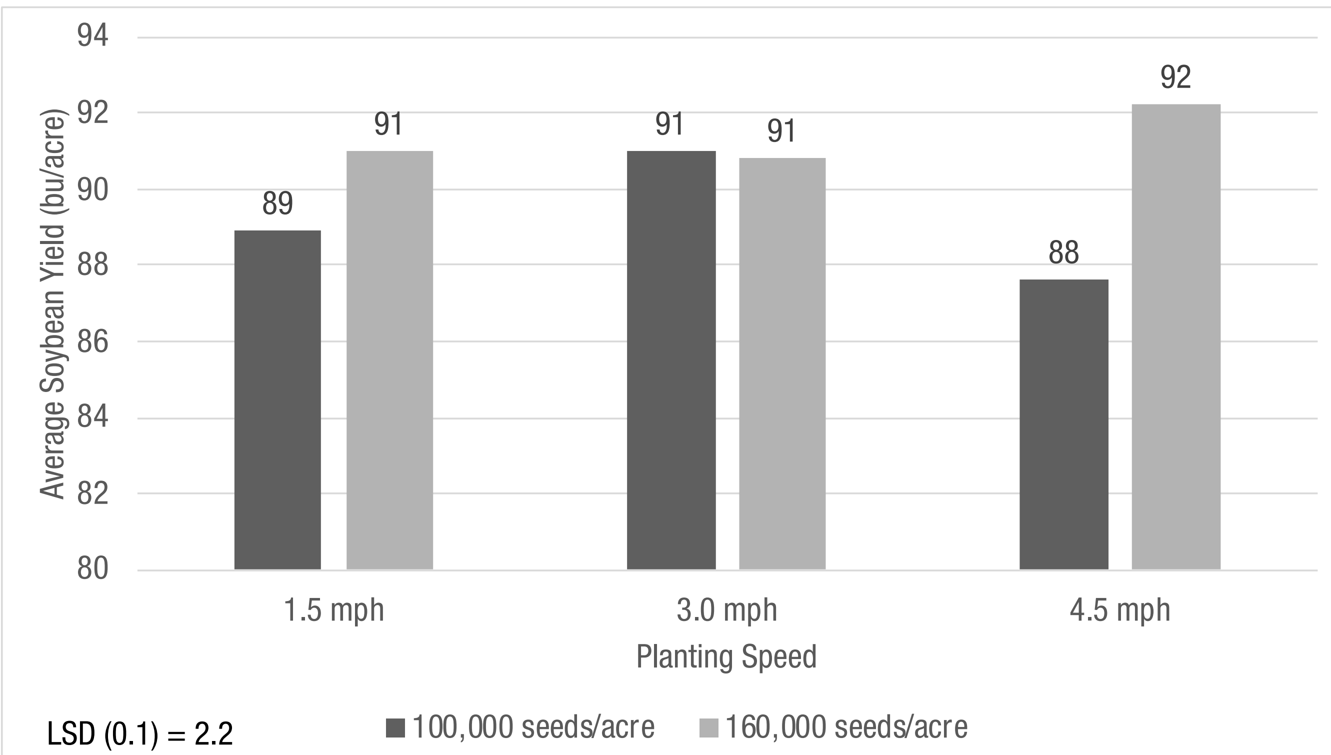


Figure 2. 2021 average soybean yield response to planting speed and seeding rate at Bayer Learning Center in Gothenburg, NE.

Planting Speed Impact on Soybean Yield

- Neither planting speed or seeding rate affected soybean test weight or grain moisture (data not shown).
- There was a significant interaction between planting speed and seeding rate (Figure 2) which is different than the results from 2020[1].
  - The 3.0 mph speed had consistently higher yields which aligns with the results from the 2020 study.
  - The difference between 2021 and 2020 study can be observed in the results from the 4.5 mph speed. The highest yield in 2021 of an average of 92 bu/acre, was obtained when planting at the 4.5 mph speed with 160,000 seeds/acre rate. The lowest yield of an average of 88 bu/acre was obtained planting at the same speed but with a seeding rate of 100,000 seeds/acre.
  - One possible explanation for the difference in yield when planting speed changes could relate to the uniformity of seed spacing. With the lower seeding rate and higher planting speed, plant to plant spacing may have had a significant impact on yield.

Key Learnings

- Planting speed and seeding rate impacted soybean yield in the second year of this single-site study.
- Consistently higher yields were obtained in both 2020 and 2021 when the planting speed was 3.0 mph regardless of seeding rate.

Sources

[1] Planting Speed Effect on Soybean Yield. 2020. https://www.dekalbasgrowdeltapine.com/en-us/agronomy/planting-speed-effect-on-soybean-yield.html

Legal Statements

High Input Soybean Production

Trial Objective

- With crop budgets tight, farmers must continually evaluate what inputs provide the most value to their operation.
- The objective of this study was to evaluate how soybean yield potential is influenced by twelve different management treatments.

Experiment/Trial Design

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-till	5/1/21 6/3/21	10/7/21	90	160,000 220,000

- A 2.9 MG XtendFlex® Soybean product was sprinkler irrigated to meet the water needs of the crop and planted on 30-inch rows.
- The study was setup as a randomized complete block with four replications with twelve management treatments (Table 1).
- Weeds were controlled uniformly across the study.
- A base fertilizer application of 60 lb/acre Phosphorous (P), 25 lb/acre Sulfur (S), and 0.25 lb/acre Zinc (Zn) was strip-tilled across all treatments on April 23, 2021.
- Soybean lodging was rated prior to harvest on a scale of 1 to 9 with 1 = no lodging and 9 = severe lodging.
- Plots were combine-harvested.
- Grain moisture content, test weight, and total weight were determined.
- Statistical analysis for Fisher's LSD was performed.

Table 1. Management Treatments

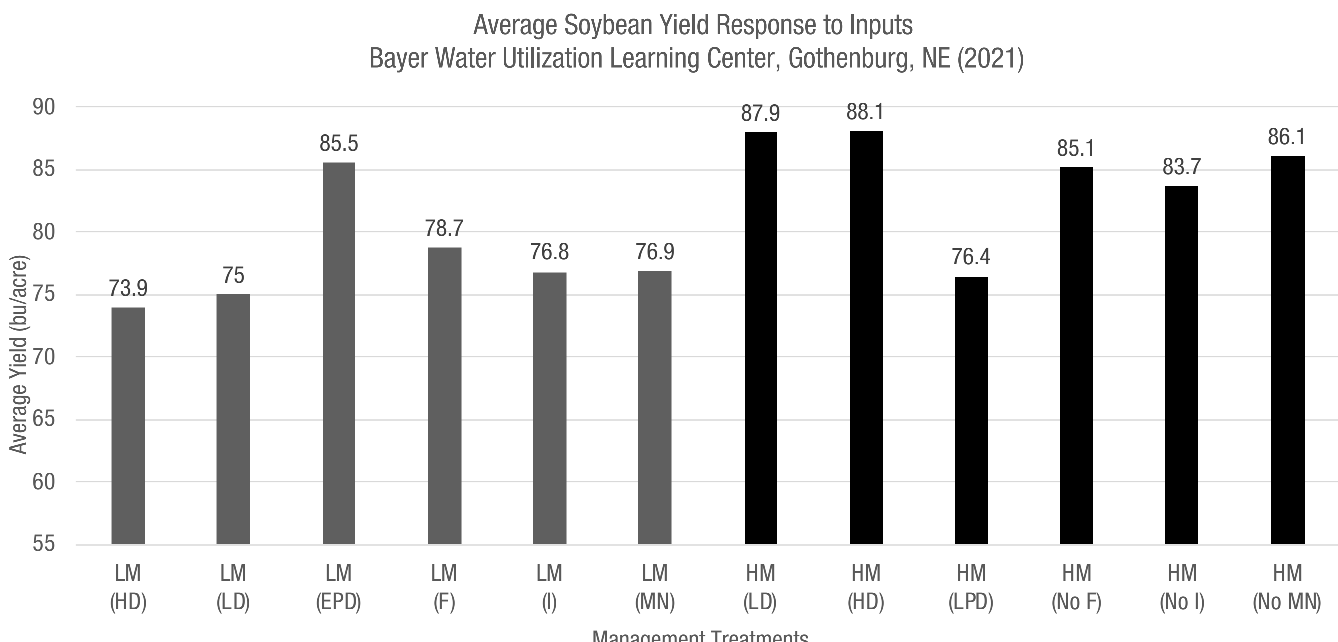
Treatment	Seeds/acre	Planting Date	Delaro® Complete Fungicide (8 fl oz/acre applied at R3 growth stage)	Leverage® 360 Insecticide (2.8 fl oz/acre applied at R3 growth stage)	Micronutrients at 64 fl oz/acre and Plant Growth Hormone at 2 fl oz/acre applied at R3 growth stage
Low Management (LM)	220,000	6/3/21	NO	NO	NO
LM + Low Density	160,000	6/3/21	NO	NO	NO
LM + Early Planting Date	220,000	5/6/21	NO	NO	NO
LM + Fungicide	220,000	6/3/21	YES	NO	NO
LM + Insecticide	220,000	6/3/21	NO	YES	NO
LM + Micronutrients	220,000	6/3/21	NO	NO	YES
High Management (HM)	160,000	5/6/21	YES	YES	YES
HM + High Density	220,000	5/6/21	YES	YES	YES
HM + Late Planting Date	160,000	6/3/21	YES	YES	YES
HM - Fungicide	160,000	5/6/21	NO	YES	YES
HM - Insecticide	160,000	5/6/21	YES	NO	YES
HM - Micronutrients	160,000	5/6/21	YES	YES	NO

High Input Soybean Production

Understanding the Results

Yield – Figure 1

- The average increase in yield for all HM treatments compared to all LM treatments was 6.8 bu/acre.
- The highest soybean yields were consistently observed with the May 1 planting date compared to the June 3 date. When the date was moved to the earlier planting in the LM treatments, a 11.6 bu/acre increase was recorded. For the HM treatments, a reduction of 11.5 bu/acre was recorded when changing from the May 1 planting date to June 3. In previous years, research at the Gothenburg Learning Center showed an end of April planting date through the first week of May for soybean has consistently produced higher yields than other planting dates.
- An application of Delaro® Complete Fungicide at the R3 growth stage increased yield over the LM treatment by 4.8 bu/acre and a reduction of 2.8 bu/acre was recorded when Delaro® Complete Fungicide was removed from the HM treatment.
- An application of Leverage® 360 Insecticide at the R3 growth stage increased yield over the LM treatment by 2.9 bu/acre and a reduction of 4.2 bu/acre was recorded when 360 Insecticide was removed from the HM treatment.
- A micronutrient application provided an increase in yield with LM treatments but did not significantly increase yield with the HM treatments.
- Increasing the density from 160,000 to 220,000 seeds/acre did not increase yield.



LSD (0.1) = 2.44

LM = Low Management (No Inputs at 220,000 seeds/acre); HM = High Management (All Inputs at 160,000 seeds/acre)
Density (seeds/acre): Low (LD) = 160,000; High (HD) = 220,000; Planting Date: Early (EPD) = 5/6/21; Late (LPD) = 6/3/21
Fungicide (F) = Delaro® Complete Fungicide (8 fl oz/acre at R3); Insecticide (I) = Leverage® 360 Insecticide (2.8 fl oz/acre at R3):
(MN) = Micronutrients at 64 fl oz/acre and Plant Growth Hormone at 2 fl oz/acre at R3)

Figure 1. Average soybean yields as impacted by management treatments at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

High Input Soybean Production

Test Weight – Figure 2

- The average increase in test weight for all HM treatments compared to all LM treatments was 0.8 lb/bu.
- The May 1 planting date had a positive impact on test weight compared with the June 6 planting date by increasing test weight by 1.5 lb/bu over the LM treatment and decreasing test weight by 1.1 lb/bu compared to the HM treatment.

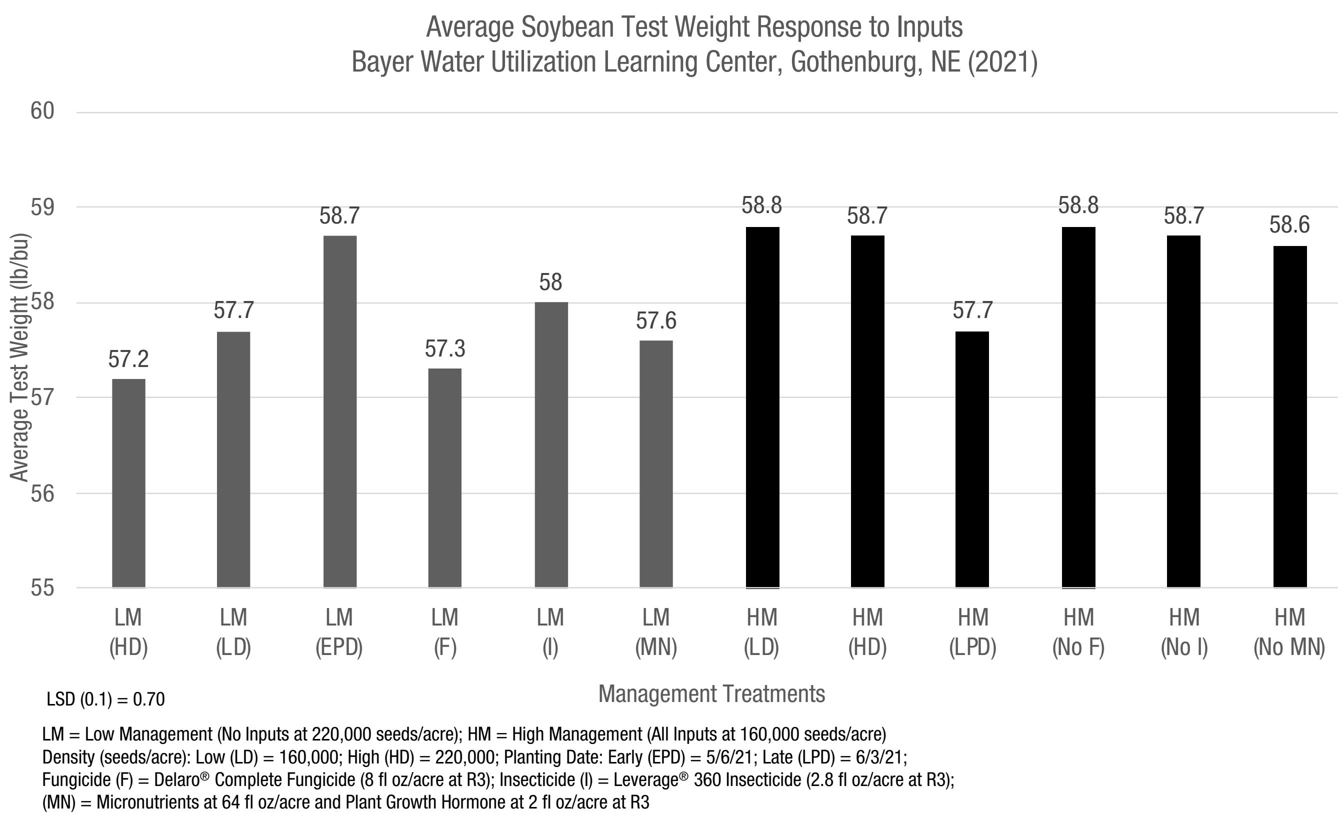


Figure 2. Average soybean test weight as impacted by management treatments at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

High Input Soybean Production

Lodging – Figure 3

- The average reduction in lodging for all HM treatments compared to all LM treatments was 1.3.
- Even though the May 1 planting was in the field a month longer than the June 6 planting, there was a 1.2-point reduction in lodging for the LM treatment.

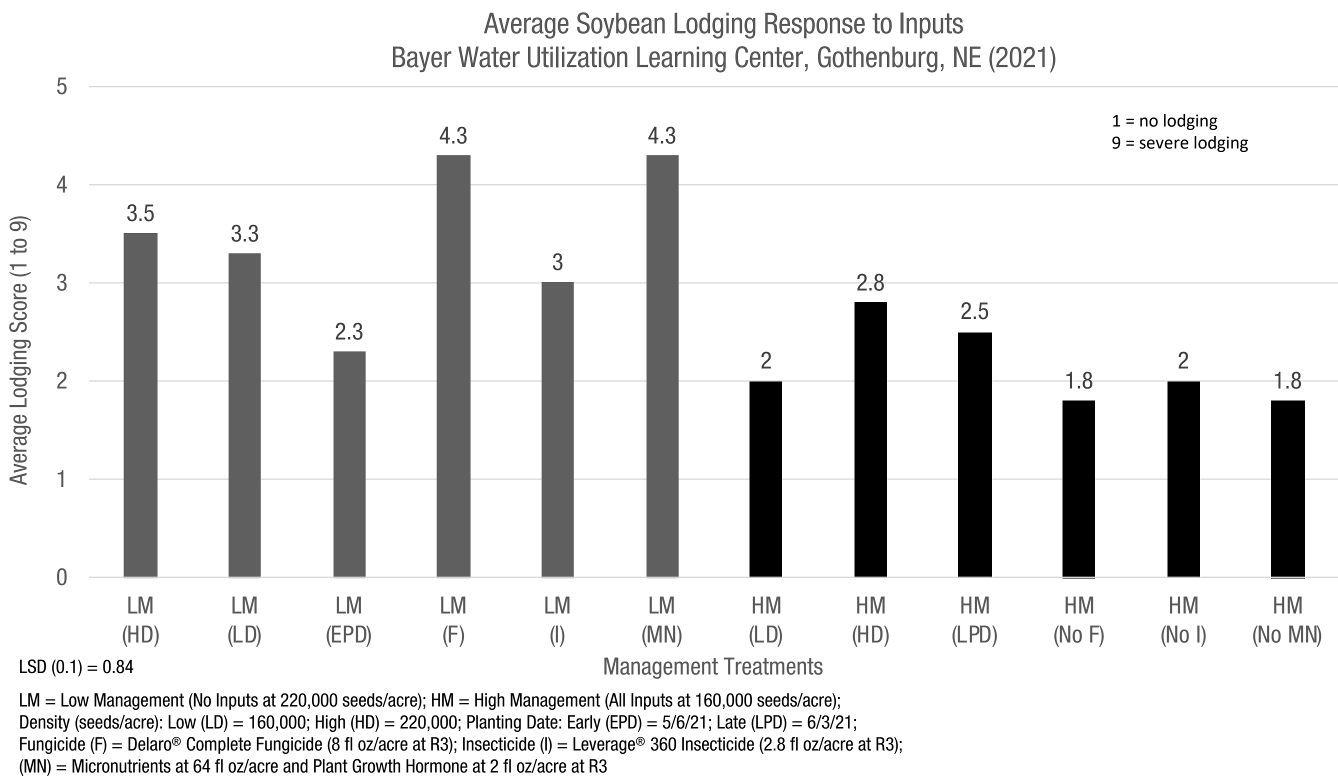


Figure 3. Average soybean lodging as impacted by management treatments at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

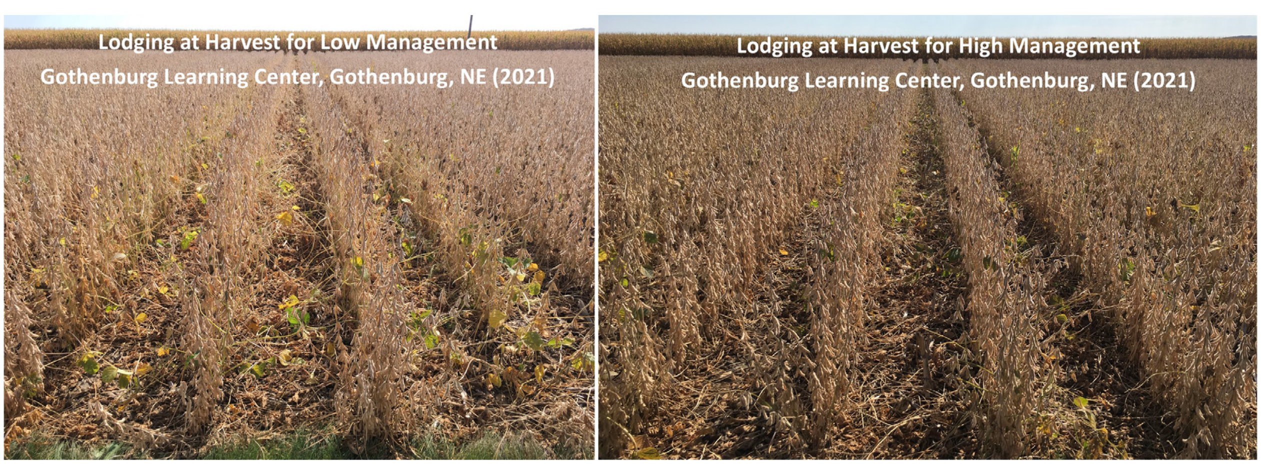


Figure 4. Lodging comparison for low management (left) and high management (right) at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

High Input Soybean Production

Figure 5. Aerial view of lodging differences between planting dates. Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

Key Learnings

- The earlier planting date of May 1 had increased yield potential and test weight across all treatments compared to the June 6 planting. There was also a trend that the later planting had increased potential for lodging.
- Delaro® Complete Fungicide and Leverage® 360 Insecticide increased yield potential in both LM and HM treatments.
- A 14 bu/acre yield increase was recorded for the HM treatment compared to the LM treatment.
- Farmers should carefully weigh the value of soybean inputs as high yields can be realized with additional inputs.

High Input Soybean Production

Legal Statements

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ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. It is a violation of federal and state law to use any pesticide product other than in accordance with its labeling. NOT ALL formulations of dicamba, glyphosate or glufosinate are approved for in-crop use with products with XtendFlex® Technology. 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 products with XtendFlex® Technology.

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.

Products with XtendFlex® Technology contains 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 Bayer Technology Use Guide for recommended weed control programs.

Leverage® 360 is a restricted use pesticide. Not all products are registered in all states and may be subject to use restrictions. The distribution, sale, or use of an unregistered pesticide is a violation of federal and/or state law and is strictly prohibited. Check with your local dealer or representative for the product registration status in your state. Bayer, Bayer Cross, Delaro®, Leverage®, Roundup Ready 2 Xtend®, Roundup Ready 2 Yield® and XtendFlex® are registered trademarks of Bayer Group. LibertyLink® and the Water Droplet Design® is a trademark of BASF Corporation. For additional product information call toll-free 1-866-99-BAYER (1-866-992-2937) or visit our website at www.BayerCropScience.us. Bayer CropScience LP, 800 North Lindbergh Boulevard, St. Louis, MO 63167. 3011_R16

A long-term research project evaluating the benefits of early planted soybeans

Trial Objective

- Largely due to the widespread adoption of treated soybean seed, growers now plant soybeans increasingly earlier than ever before. For example, Illinois farmers had 41% of their soybean crop planted by May 2, 2021, compared to the previous 5-year average of 14%.[1]
- This research was conducted with a goal of understanding not only the yield impact of planting soybeans at different dates, but also the agronomic characteristics which enable early planted soybeans to have higher yield potential.
- The main driver of yield potential increase in early planted beans is the ability for the plants to create more nodes before flowering[2]. We measured the number of nodes created and days to flowering to better understand this interaction.

Research Site Details

- This research was conducted at Bayer Crop Science FOCUS sites in Illinois counties, Kendall, Piatt, Sangamon, and Woodford from 2018-2021.
- Five soybean products, ranging in relative maturity (RM) from 2.6 to 3.6 were evaluated, although not all products were planted at every location or in every year.
- All seed was treated with Acceleron® Seed Applied Solutions STANDARD and ILeVO®.
- Standard fertility and weed management practices were followed, and plots were harvested as they matured.

A long-term research project evaluating the benefits of early planted soybeans

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Roanoke, IL	Silt loam	Corn	Conventional	4/25/18, 5/8/18, 5/23/18	9/24/18, 10/4/18	70	140k
Auburn, IL	Silt loam	Corn	Conventional	5/2/18, 5/22/18	9/29/18	70	140k
Monticello, IL	Silt loam	Corn	Conventional	5/1/18, 5/14/18, 6/1/18	10/23/18	70	140k
Roanoke, IL	Silt loam	Corn	Conventional	4/9/19, 4/23/19, 5/7/19, 5/18/19, 6/3/19, 6/18/19	10/9/19, 10/23/19	70	140k
Roanoke, IL	Silt loam	Corn	Conventional	3/7/20, 4/6/20, 4/20/20, 5/9/20, 6/1/20, 6/15/20	10/7/20, 10/15/20	70	140k
Monticello, IL	Silt loam	Corn	Conventional	4/8/20, 4/23/20	10/6/20	70	140k
Newark, IL	Silt loam	Corn	Conventional	4/8/20, 4/23/20, 5/8/20, 5/29/20	10/15/20	65	115k
Roanoke, IL	Silt loam	Corn	Conventional	3/10/21, 4/6/21, 4/19/21, 5/3/21, 5/14/21, 5/24/21, 6/7/21, 6/15/21	10/18/21	75	100k, 120k, 140k

Understanding the Results

- To compare data across years, results are presented as a percentage of the maximum yield for the year, location, and product. The highest yields are attained from earlier planting, with a steady decline as the season progresses. (Figure 1).
- Although it is possible for later planted soybeans to attain satisfactory yield, there is much greater yield variation than in fields which are planted earlier (Figure 1).
- Stand reduction can occur in early planting situations (Figure 2), but as shown in this research, the earlier plantings can have greater yield potential than later ones, even with lower final populations.
- Flowering date in soybeans is influenced by daylength and is often assumed to occur on a specific date regardless of planting date, but multiple factors combine to influence the actual date at which flowering occurs[3]. Figure 3 illustrates that the period between planting and flowering is greatly reduced when planting later.
- The earlier soybeans are planted, the more time they have to grow vegetatively and create nodes which are the foundation for maximizing yield potential (Figure 4).

A long-term research project evaluating the benefits of early planted soybeans

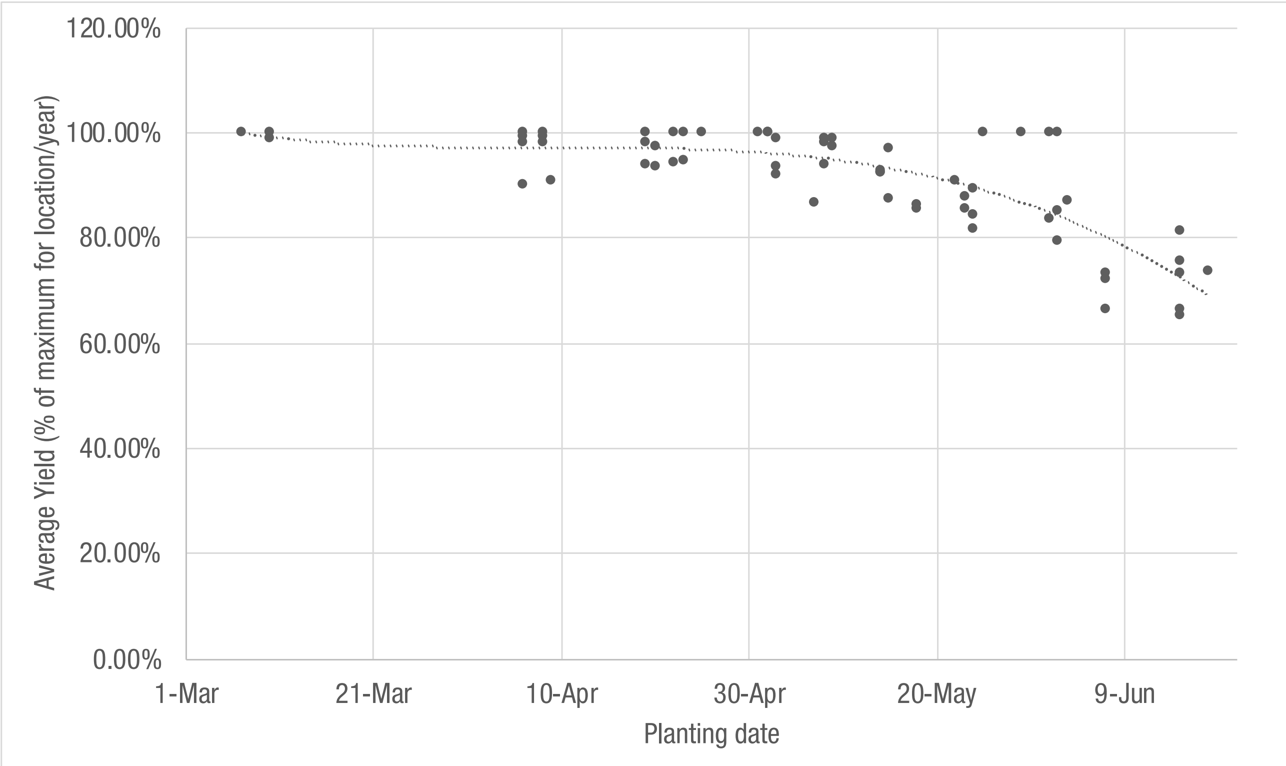

Figure 1. Average soybean yield response to planting date combined over years, 2018

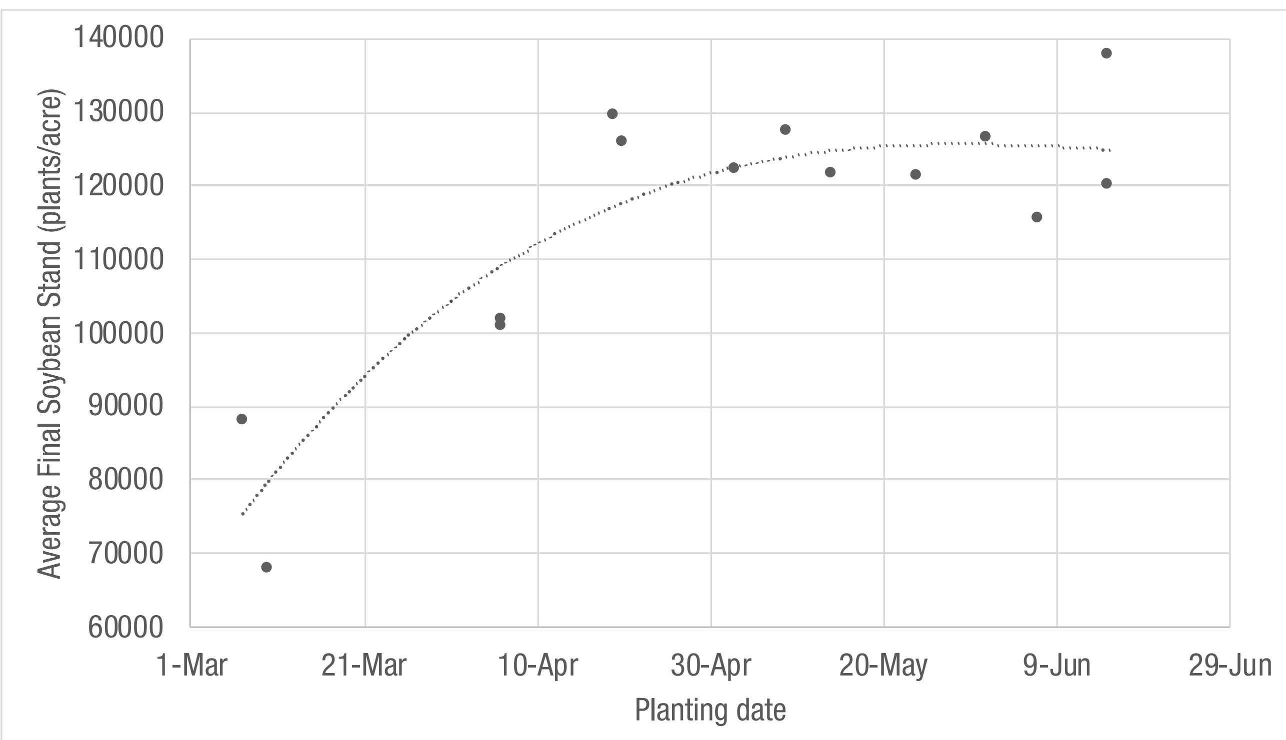

Figure 2. Average final soybean stands of 140,000 planted population across multiple planting dates, 2020-2021

A long-term research project evaluating the benefits of early planted soybeans

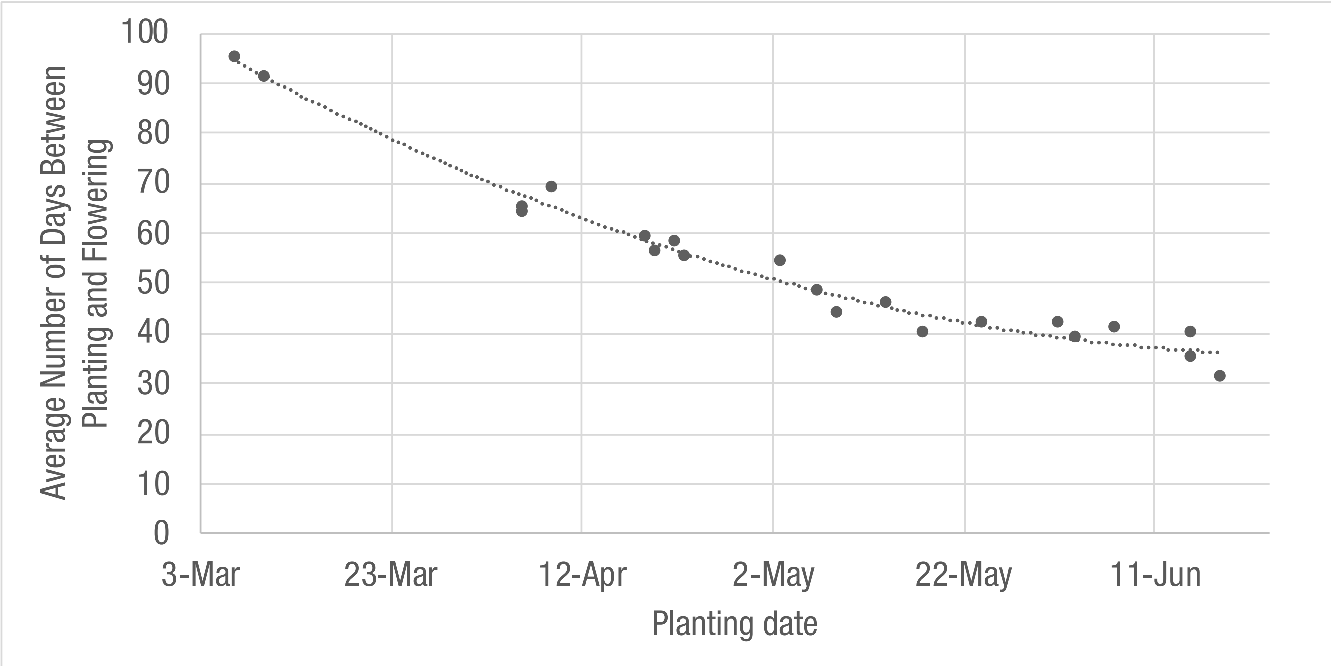

Figure 3. Average number of days to flower in soybeans based on planting date, 2019-2021.

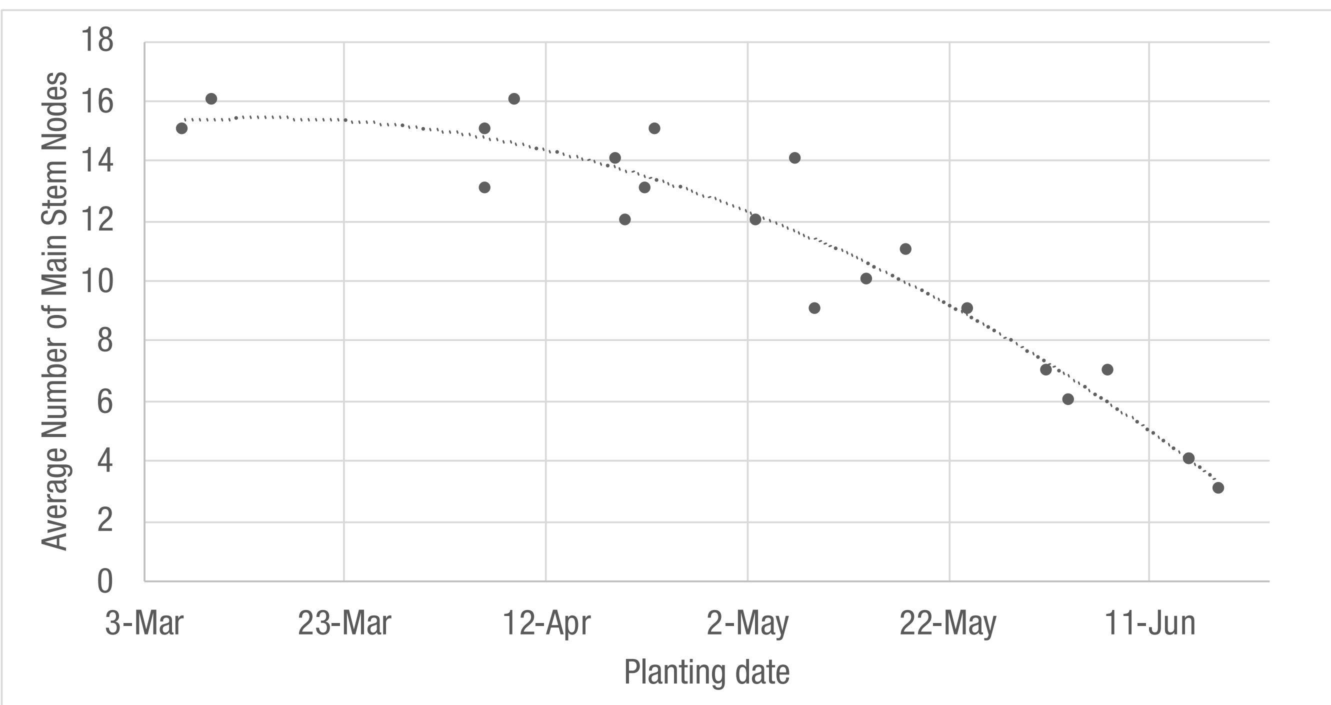

Figure 4. Effect of planting date on average number of main stem nodes created by July 10, 2019-2021.

A long-term research project evaluating the benefits of early planted soybeans

Key Learnings

- Although sometimes later planted beans attain satisfactory yield, there is much greater variation than in fields which are planted earlier.
- This research found that even though there was not always a large yield advantage to planting earlier, there was rarely a yield penalty. To reach maximum yield potential, it is critical that seeds are properly protected with quality seed treatment[4]
- This research found that early planted soybeans have a longer period between planting and flowering, providing higher yield potential by creation of additional nodes. Conversely, later planting dates have reduced the time between planting and flowering, and less yield potential.

Sources

[1]USDA National Agricultural Statistic Service. https://www.nass.usda.gov/Statistics_by_State/Illinois/Publications/Crop_Progress_&_Condition/2021/20210503-IL-Crop-Progress.pdf

[2]Bastidas, A.M., Setiyono, T.D., Dobermann, A., Cassman, K.G., Elmore, R.W., Graef, G.L. and Specht, J.E. 2008. Soybean sowing date: The vegetative, reproductive, and agronomic impacts. Crop Science. Volume 48.

[3]Hu, M. and Wiatrak, P. 2012. Effect of planting date on soybean growth, yield, and grain quality: review. Agronomy Journal. Volume 104.

[4]Rees J. and Specht, J. 2020. Understanding the soybean germination process for early planted soybean decisions. https://cropwatch.unl.edu/2020/understanding-soybean-germination-process-early-planted-soybean-decisions

Legal Statements

Should I replant my soybeans?

Trial Objective

- As midwestern farmers continue to plant soybeans progressively earlier than ever before, the risk of emerged seedlings encountering frost increases.
- Largely due to the widespread adoption of treated soybean seed, growers now plant soybeans increasingly earlier than ever before; Illinois farmers had 41% of their soybean crop planted by May 2, 2021 compared to the previous 5-year average of 14%[1]
- These early planting dates increase the risk of frost damage to emerged seedlings. The median date of the last 32°F freeze is April 25 in Woodford County[2] where this research was conducted.
- The goal of this research was to help growers make replant decisions when stands are reduced by frost or other factors.

Experiment/Trial Design

- This research was conducted at the Bayer Crop Science FOCUS site in Woodford County in 2020 and 2021.
- A 3.6 relative maturity (RM) soybean product was planted in 2020 and a 3.5 RM variety in 2021.
- Plots were planted as early as soil conditions allowed in the spring. In 2020, a significant frost occurred on May 2, and in 2021 temperatures below 28°F occurred on consecutive days of April 20 and 21. The "replant" comparisons were planted as soon as soil conditions allowed after the frosts.
- All seed was treated with Acceleron® Seed Applied Solutions STANDARD and ILeVO®.
- Standard fertility and weed management practices were followed, and plots were harvested as they matured.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Roanoke, IL	Silt loam	Corn	Conventional	3/7/20, 5/9/20	10/7/20	70	140,000
Roanoke, IL	Silt loam	Corn	Conventional	3/10/21, 5/3/21	10/18/21	75	140,000

Understanding the Results

- Figure 1 highlights the importance of evaluating frost damage over a period of several days, as many severely damaged plants can survive and even thrive (Figure 1).
- Over the two years included in the study, an average of 77,957 plants remained after frost, while an average of 124,775 remained in the replant comparison (Figure 2).
- In both seasons, the surviving plants were fairly evenly distributed across the trial area.
- Even with significantly reduced overall stand (which was a result of both delayed emergence and frost damage to the seedlings), the March plantings outperformed the replants by an average of 3.5 bushels/acre (Figure 2).

Should I replant my soybeans?

Figure 1. Damage and regrowth in soybean seedlings after heavy frost on morning of April 21, 2021.

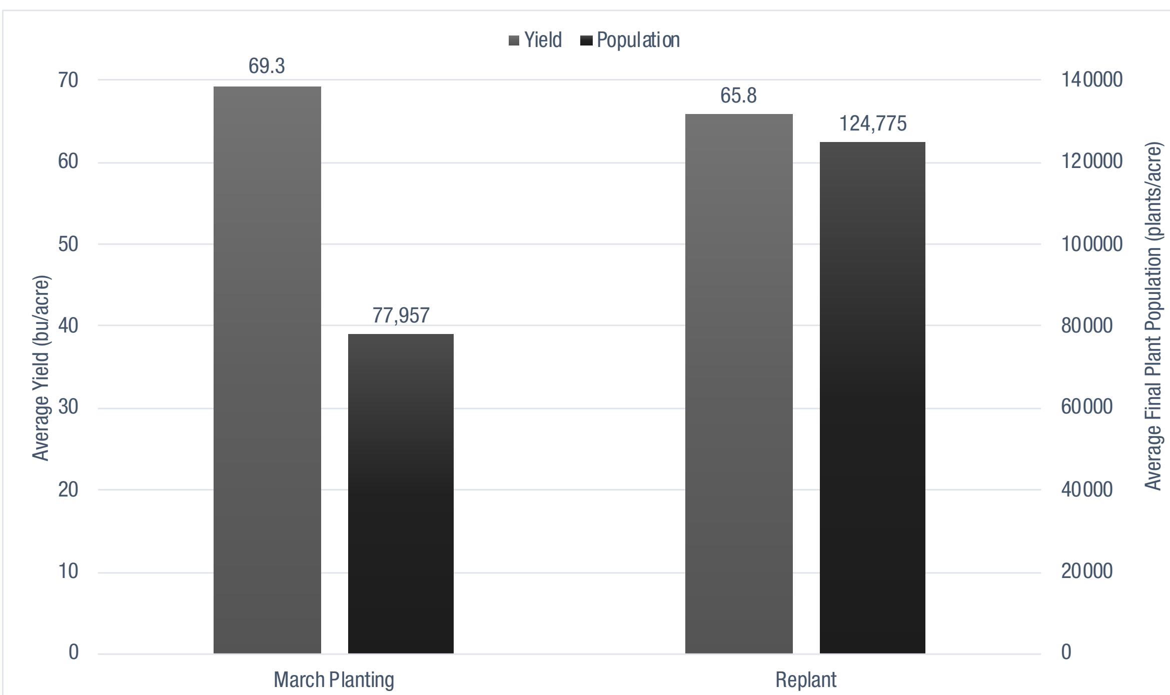

Figure 2. Soybean yield of original planting with reduced stand after frost damage versus replanted soybeans, 2020-2021.

Should I replant my soybeans?

Key Learnings

- When evaluating frost damage, it can take several days to determine the extent of the loss[3].
- In this study, due to soybeans ability to branch and produce additional podding sites with increased room to grow, the lower final population with an earlier planting date outperformed the higher population planted later.

Sources

[1]USDA National Agricultural Statistic Service. https://www.nass.usda.gov/Statistics_by_State/Illinois/Publications/Crop_Progress_&_Condition/2021/20210503-IL-Crop-Progress.pdf

[2]Angel, J. Illinois frost dates and growing season. Illinois State Climatologist. https://www.isws.illinois.edu/statecli/frost/spring-freeze-32-median.png

[3]Potter, B., Bongard, P., Naeve, S., and Gunsolus, J. 2018. Spring Frost. University of Minnesota Extension. https://extension.umn.edu/growing-soybean/spring-frost

Legal Statements

Effect of row width and planting rate on yield, lodging, and disease development in soybeans

Channel®
Seedsmanship At Work®

Trial Objective

- Improvements in soybean genetics, planting technology, and weed control systems have led to lower planting rate recommendations for soybean growers over the past decade.[1]
- The goal of this research was to determine how planting rate and row spacing interact and affect lodging, disease development, and yield in soybeans

Experiment/Trial Design

- This research was conducted at Bayer Crop Science FOCUS sites in Illinois counties: Kendall, Dekalb, and Woodford from 2019-2021.
- Sixteen 2.2-2.9 maturity group (MG) soybean products were planted, with different products used in different years.
- Soybean products were all treated with Acceleron® Seed Applied Solutions STANDARD + ILeVO® Seed Treatment
- Seeding rates ranged from 60,000 to 160,000 planted seeds per acre.
- Four replications were planted at each location.
- Standard fertility and weed management practices were followed.
- The 2019 growing season was very cool and wet through early June, leading to delayed planting for many growers. Hot and dry conditions were prevalent in July and August, and excessive rainfall returned in September and October.
- In both 2020 and 2021, there was sufficient moisture in the early part of the growing season, but very dry conditions throughout August and into September.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Roanoke, IL	Silt loam	Corn	Conventional	6/3/19	10/14/19	70	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Newark, IL	Silty clay loam	Corn	Conventional	6/8/19	10/25/19	65	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Roanoke, IL	Silt loam	Corn	Conventional	6/1/20	10/15/20	70	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Waterman, IL	Silt loam	Corn	Conventional	5/21/21	10/22/21	70	60,000; 80,000; 100,000; 120,000; 140,000; 160,000
Roanoke, IL	Silt loam	Corn	No-till	5/20/21	10/12/21	70	60,000; 80,000; 100,000; 120,000; 140,000; 160,000

Effect of row width and planting rate on yield, lodging, and disease development in soybeans

Understanding the Results

- On average, over the 3 years in this research, yield increased with increased planting rates (Figure 1).
- The highest yielding configuration was 160,000 seeds/acre, planted in 20-inch rows (Figure 1).
- Except for the lowest planting rate of 60,000 seeds/acre, soybeans planted into 20-inch rows exhibited higher yields than those planted in 30-inch rows (Figure 1).
- Although lodging pressure was low in this trial, we saw increased lodging at higher seeding rates. Row width had no effect on lodging severity (Figure 2).
- Disease pressure was also low in this trial. Overall, disease pressure was lower in the 30-inch row spacing than 20-inch and increased with increasing populations (Figure 3).

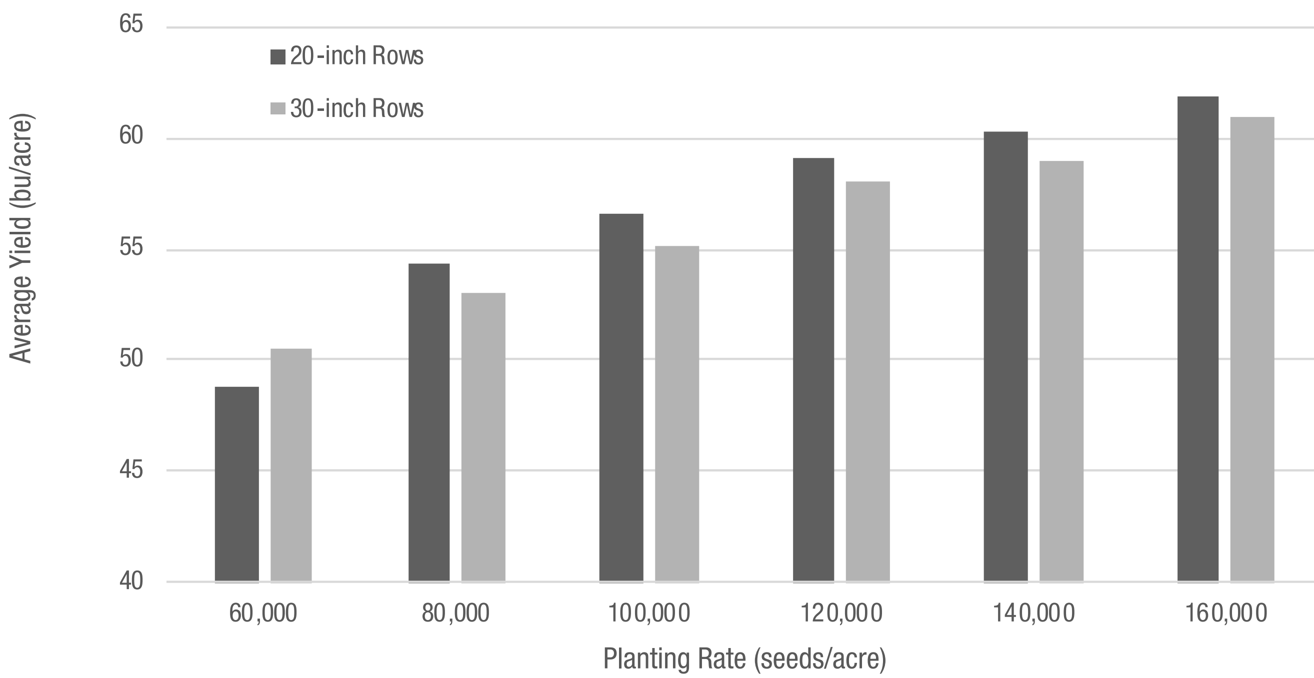

Figure 1. Average soybean yield at different row widths and seeding rates, 2019-2021.

Effect of row width and planting rate on yield, lodging, and disease development in soybeans

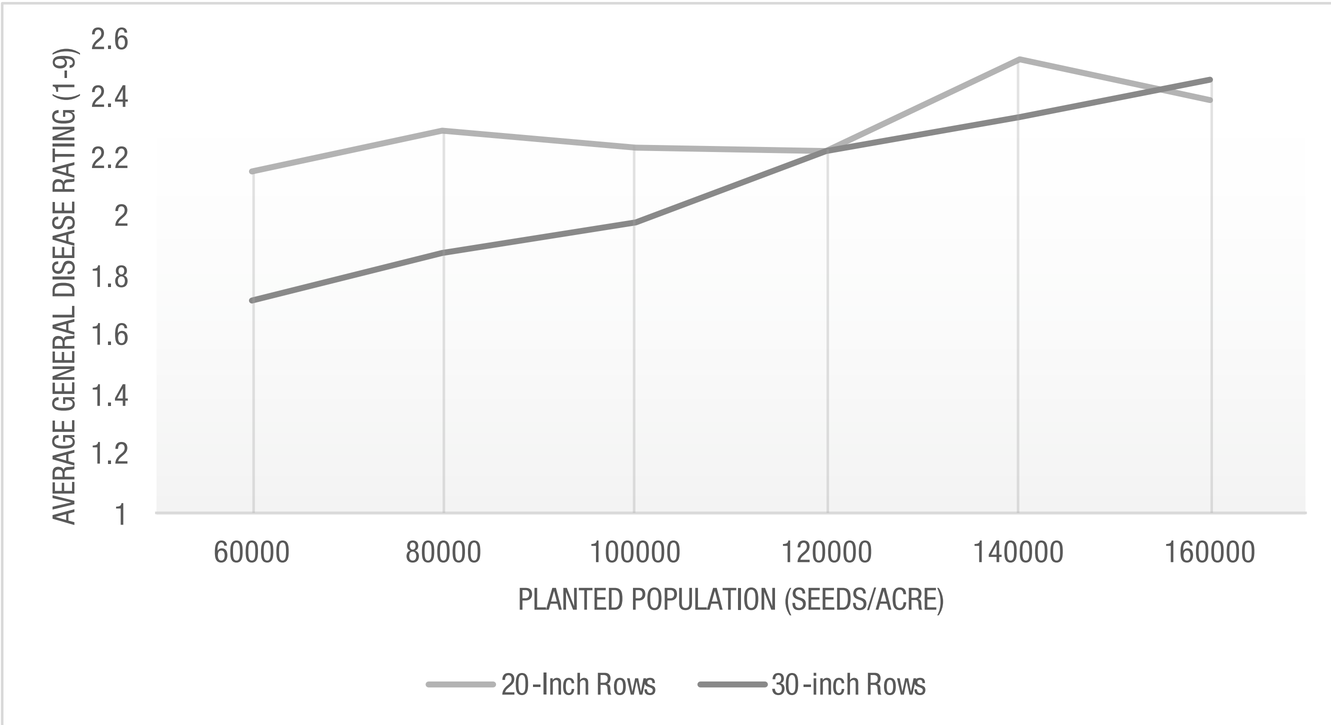

Figure 2. Effect of row width and planting rate on soybean lodging, 2020-2021.

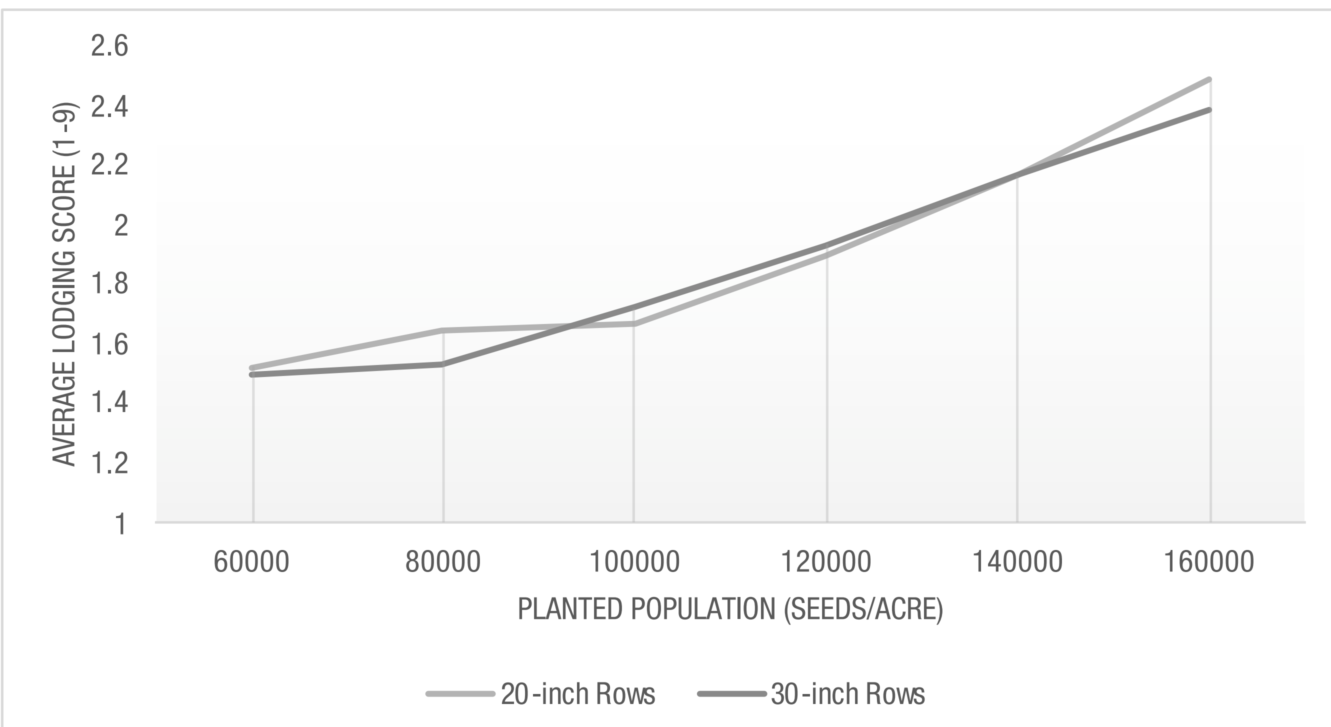

Figure 3. Effect of row width and planting rate on soybean disease development, 2020-2021.

Effect of row width and planting rate on yield, lodging, and disease development in soybeans

Key Learnings

- Soybean growers can capture additional yield by planting soybeans into 20” rows.
- Higher populations lead to increased yield, but also increase the risk of agronomic problems such as lodging and disease development.

Source

[1]Pedersen, P. Optimum plant population in Iowa. Iowa State University. https://crops.extension.iastate.edu/files/article/OptimumPlantPop_000.pdf

Legal Statements

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

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. 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.

Ultra-Early Soybean Planting Date Demonstration

Trial Objective

- Recent on-farm research, adoption of seed treatments, and the ability of soybeans to create more nodes before flowering has led farmers to plant soybeans earlier in the spring to help maximize yield potential.
- Costs of replanting includes seed and fuel, but also the time and labor to make additional passes across fields.
- This trial compared ultra-early to normal planting dates for soybeans in Michigan.

Experiment/Trial Design

- A demonstration trial was established with a single replication and strip-plot design with a 3.0 maturity group (MG) soybean.
- There were five planting dates in 2021: March 9th, March 22nd, April 6th, April 15th, and May 1st.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Mason, MI	Loam	Corn	Conventional	Multiple	9/30/21	70	140,000

Understanding the Results

- A hard frost occurred the morning of April 2nd killing most of the emerged soybeans from March 9th and 22nd planting dates (Figure 1).
- The March 9th and 22nd planting date treatments had very few plants remaining at harvest but produced 10 and 14 bu/acre, respectively.
- The greatest yield was obtained from the April 6th planting date (Figure 2).

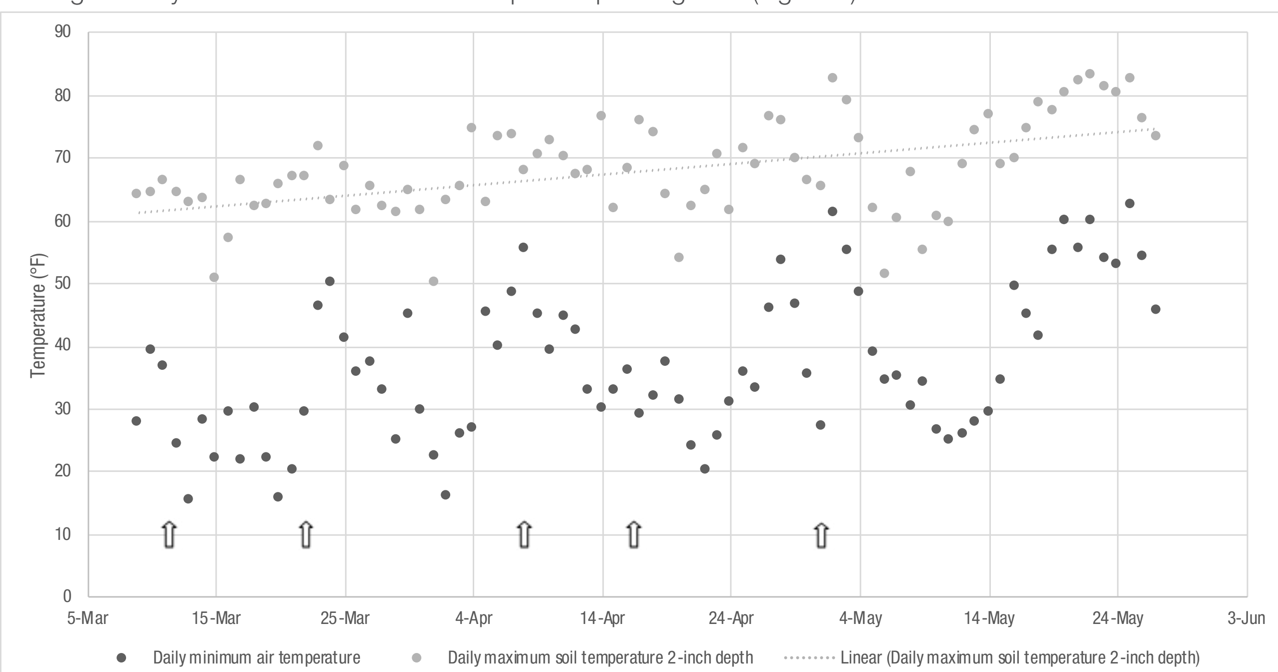

Figure 1. Daily minimum air and maximum soil (2-inch depth) temperatures (°F) in 2021.

Ultra-Early Soybean Planting Date Demonstration

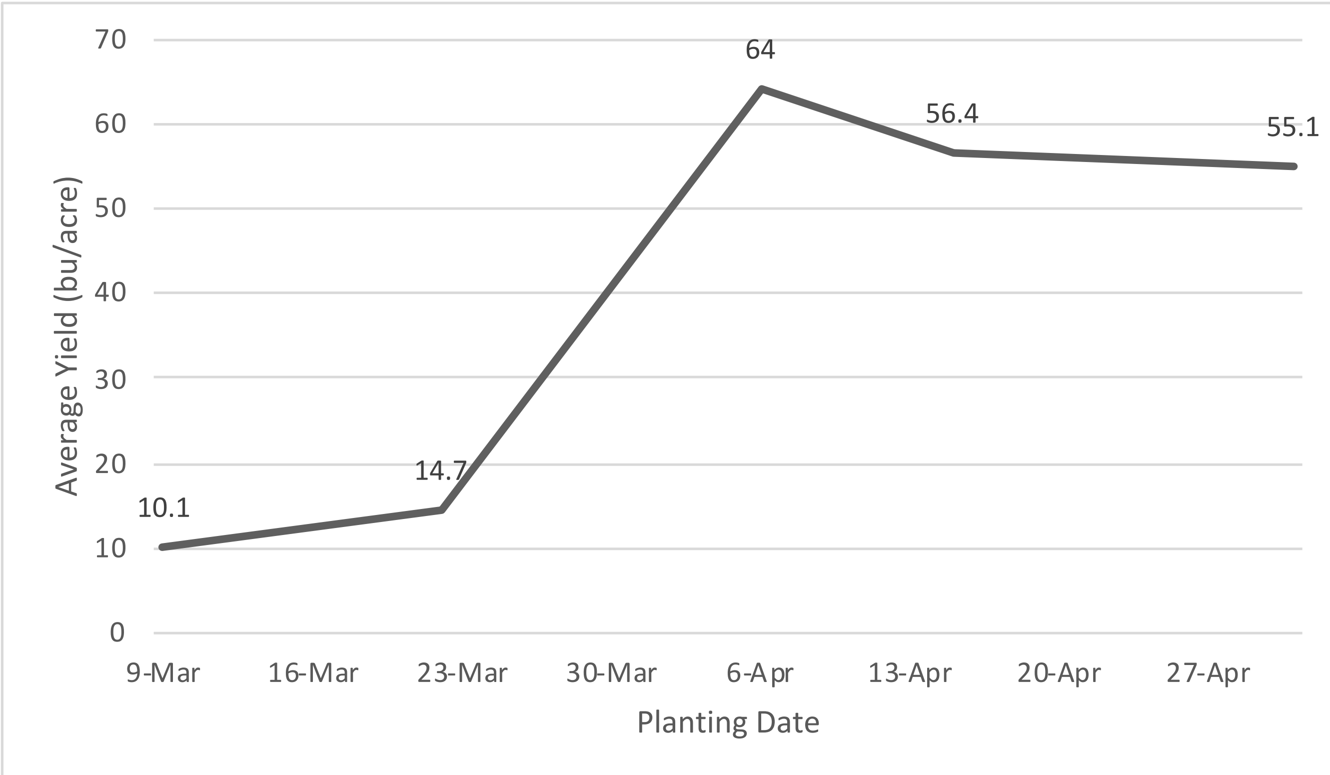

Figure 2. Planting date effect upon yield of five planting dates in Mason, MI in 2021.

Key Learnings

- Warmer soil temperature trends occurring later in the spring buffer cold night-time temperatures and provide protection for young seedlings.
- Early-season risk due to frost damage is greater in soybean than corn, due, in part, to rapid epigeal emergence of soybeans that expose the tender growing point of the hypocotyl.
- Early planting of soybeans can produce greater yields, but growers should allow soil temperatures to increase and watch the near-term forecasts to reduce the risk of having early stands killed by frost.
- The wet, cool soil conditions often associated with early planting can also result in increased levels of seed decay, damping off, and root rot diseases. Therefore, it's important that seeds are protected by a quality seed treatment.
- Although not statistically different, planting early (April 6th planting date) resulted in a numerically higher yield.

Legal Statements

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A Long-term Research Study Investigating the Effect of Planting Date on Soybean Yield Potential in the Northern Plains

Trial Objective

- This research was conducted with an objective of understanding the risks and benefits of planting soybean at various times throughout the spring.
- The goal of this study is to provide planting date guidance for to help maximize yield potential.
- This data may be used as a reference guide to help growers make replant decisions when stands are reduced by frost or other factors.

Experiment/Trial Design

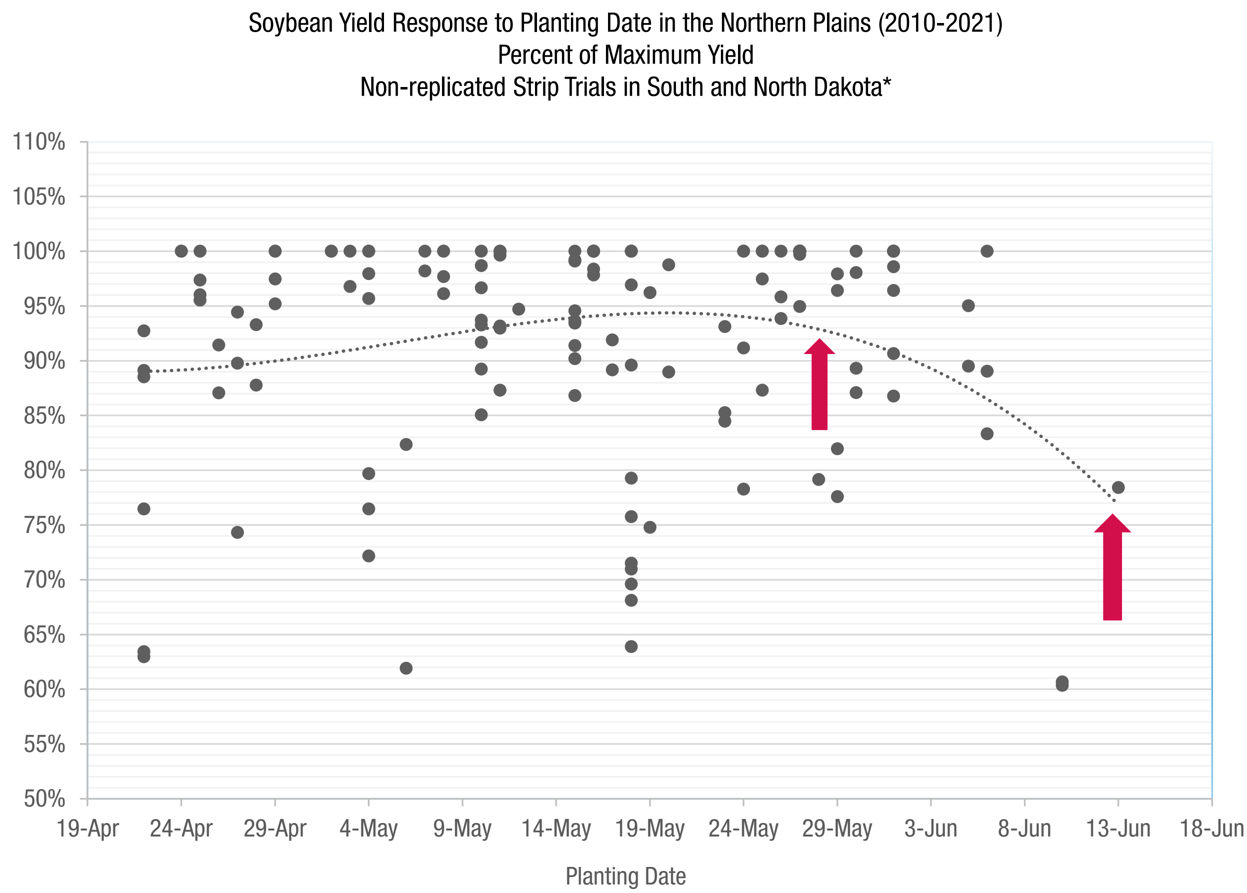
- On-going trial since 2010 across Northern Plains (North and South Dakota).
- This data is a summary of a small data set with limited locations. Values are based on averages and not significantly analyzed.
- To compare data across years, results are presented as a percentage of the maximum yield for the year and corn product.
- Trial Design: Non-replicated strip trials.

Year and Location of Strip Trials	
Year	Location
2010	Chancellor, SD
2011	Chancellor, SD
2012	NA*
2013	Watertown, SD Redfield, SD
2014	Chester, SD Ethan, SD
2015	NA*
2016	Berlin, ND Chester, SD
2017	Carrington, ND Chancellor, SD Watertown, SD Redfield, SD
2018	Chancellor, SD Ethan, SD Redfield, SD
2019	Chancellor, SD
2020	Chancellor, SD Mitchell, SD Washburn, ND
2021	Litchville, ND Nash, ND Carrington, ND Chancellor, SD Watertown, SD Mitchell, SD
*No data	

A Long-term Research Study Investigating the Effect of Planting Date on Soybean Yield Potential in the Northern Plains

Understanding the Results

- The highest yields were attained when soybean was planted from late April to Mid-May, with a steady decline as the season progressed (Figure 1).
- The potential to maximize yield decreased 20% from May 25th to June 15th (20 days), resulting in an average daily loss of 1.0% (Figure 1).



2010 - Chancellor, SD; 2011 - Chancellor, SD; 2013 - Redfield, SD, Watertown, SD; 2014 - Chester, SD, Ethan, SD; 2016 - Berlin, ND, Chester, SD; 2017 - Carrington, ND, Chancellor, SD, Redfield, SD, Watertown, SD; 2018 - Chancellor, SD, Ethan, SD, Redfield, SD; 2019 - Chancellor, SD; 2020 - Chancellor, SD, Mitchell, SD, Watertown, SD; 2021 - Carrington, ND, Litchville, ND, Nash, ND, Chancellor, SD, Mitchell, SD, Watertown, SD.

Figure 1. After May 25th, the potential to maximize yield decreased 1.0% per day (identified as the time between the arrows).

A Long-term Research Study Investigating the Effect of Planting Date on Soybean Yield Potential in the Northern Plains

Key Learnings

- Over 10+ years of data, the data indicates that the optimum planting date to maximize soybean yield has a larger timeframe than corn. The data supports the increasingly accepted practice of planting soybean early in the growing season and waiting until conditions are more favorable for planting corn. Please see A Long-term Research Study Investigating the Effect of Planting Date on Corn Yield Potential and Moisture Content in the Northern Plains (link to the 3013_R18_21_corn research report).
- After May 25th, the potential to maximize yield at 100% is greatly reduced (-1.0% per day).
- This data is to be used as a guidance for recommendations on optimum planting timeframe. Individual locations and years will vary.
- Generally, soybean seed can be planted when soil moisture conditions are satisfactory, regardless of soil temperature and weather forecast.

Legal Statements

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The Effect of Seeding Rate and Planting Date on Irrigated XtendFlex® Soybeans

Trial Objective

- XtendFlex® Soybeans are a new technology that was recently released for producers. Given that this technology has only undergone one growing season as a commercial product, various questions have arisen about product vigor under different agronomic practices and weather conditions.
- The objective of this study was to determine the effect of planting date and seeding rate on three XtendFlex® Soybean 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	Corn	Strip-Tillage	See below	See below	80	See below

- The trial was arranged as a randomized split-split plot design with planting date as the whole plot, seeding rate as a sub plot, and soybean product as the sub-sub plot.
- Planting Dates
  - » 4/5/2021, 4/19/2021, 5/1/2021, 6/7/2021, and 6/21/21
- Seeding Rates
  - » 40,000, 80,000, 120,000, 160,000, 200,000, and 240,000
- Soybean Products
  - » 2.5 Maturity Group (MG) XtendFlex® Soybean product
  - » 2.7 MG XtendFlex® Soybean product
  - » 2.9 MG XtendFlex® Soybean product
- Soybeans were irrigated throughout growing season.
- 60 lb phosphorus (P)/acre, 25 lb sulfur (S)/acre, 0.25 lb zinc (Zn)/acre were applied through strip-tillage application prior to planting.
- Weeds were controlled uniformly across the study.
- Harvest Dates
  - » 9/27/2021, 9/28/2021, 9/29/2021, 10/10/2021, and 10/16/2021

The Effect of Seeding Rate and Planting Date on Irrigated XtendFlex® Soybeans

Understanding the Results

Planting date (results averaged by soybean product over all seeding rates)

- The highest soybean yields were consistently observed with early planting dates (especially in April and May) (Figure 1).
- The longer maturity group (MG) products (2.7 and 2.9 MG) had higher yields on April 5 and April 19 planting dates compared to the shorter MG soybean product (2.5 MG) (Figure 1).
- There was no difference in yield between the 2.7 and 2.9 MG products regardless of planting date (Figure 1).
- The June 21 planting date had a negative impact on yield on all soybean products (Figure 1).

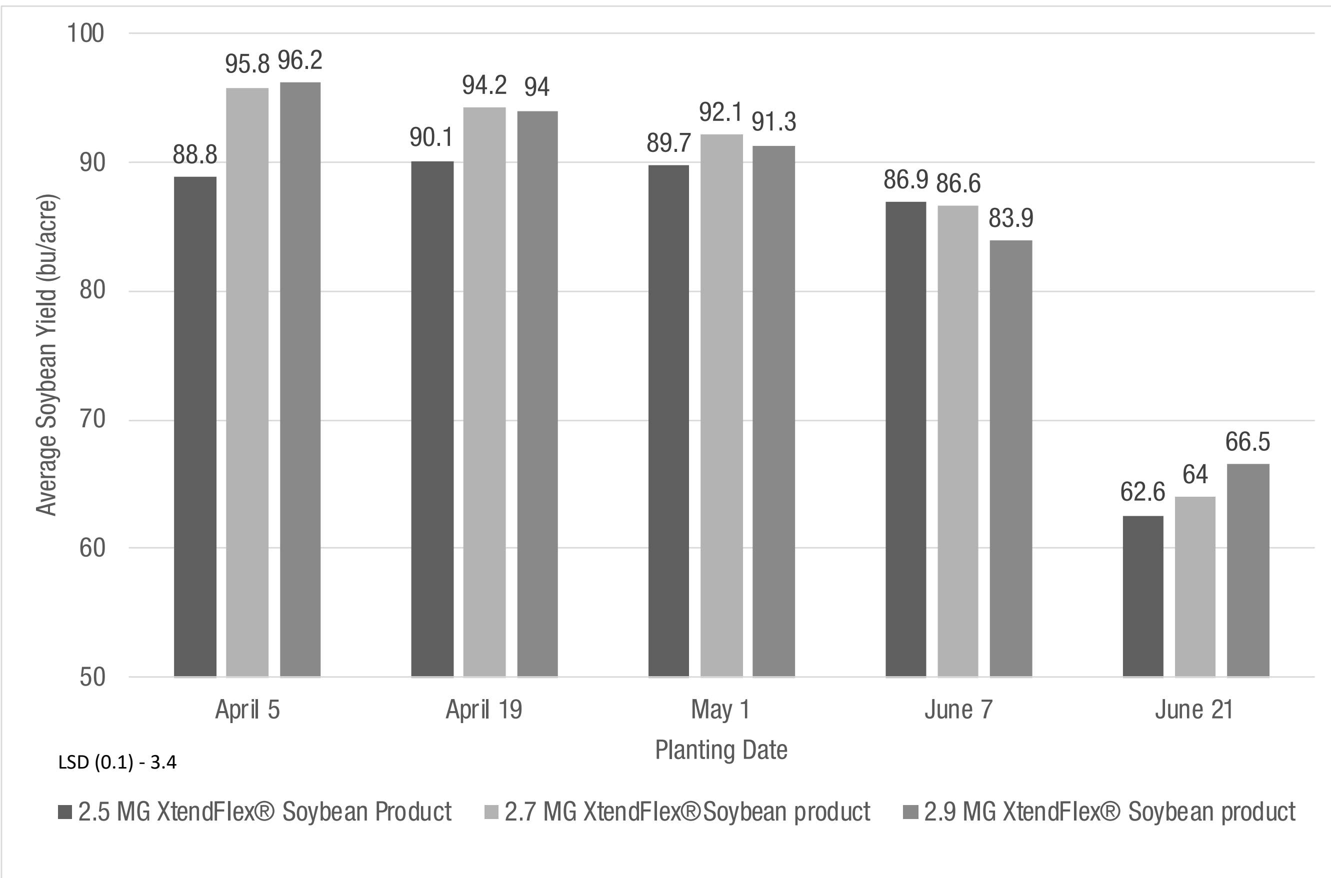


Figure 1. Average soybean yields as impacted by planting date and soybean product at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

The Effect of Seeding Rate and Planting Date on Irrigated XtendFlex® Soybeans

Seeding rate (results averaged over planting dates)

- Soybean seeded at 40,000 seeds/acre had the lowest yields across all soybean products (Figure 2).
- The 2.5 MG soybean product had similar yields within the range of 80,000 to 240,000 seeds/acre (Figure 2).
- The 2.7 MG soybean product average yield increased steadily within the 80,000 to 200,000 seeds/acre range and then declined significantly at the higher seeding rate of 240,000 seeds/acre (Figure 2).
- No difference in yield was observed from 80,000 to 200,000 seeds/acre for the 2.9 MG soybean product. The highest average yield was obtained with the 240,000 seeds/acre rate (Figure 2).

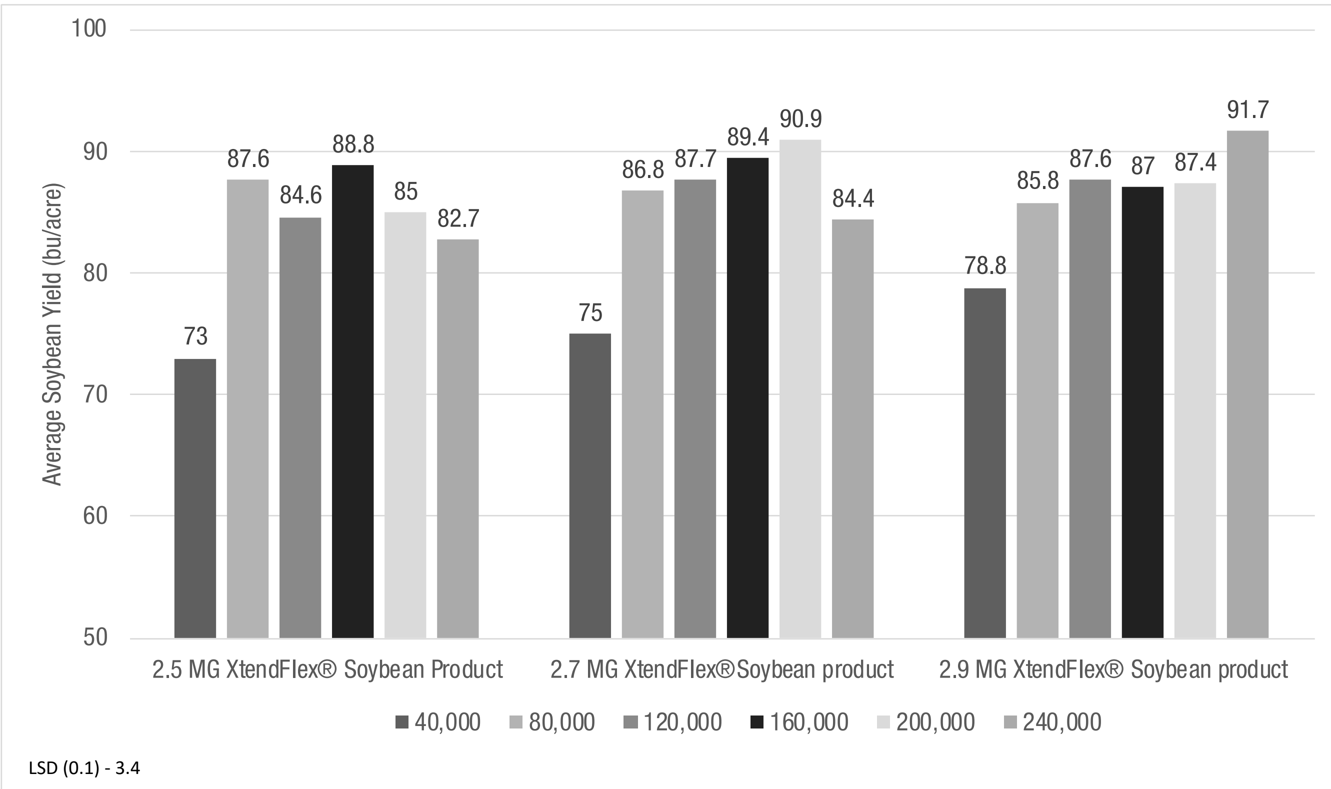


Figure 2. Average soybean yields as impacted by seeding rate and soybean product at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

The Effect of Seeding Rate and Planting Date on Irrigated XtendFlex® Soybeans

Key Learnings

- For this study, plots planted at the earlier planting dates had higher yields across all soybean products, especially in the 2.7 and 2.9 MG. Late planting (June 21) had a negative impact on yield regardless soybean maturity group.
- Depending on soybean product, irrigated XtendFlex® Soybeans planted in the range of 160,000 to 240,000 seeds/acre helped maximize yield potential.
- Farmers should work with their local seeds sales team member to help identify the best adapted XtendFlex® Soybean product for their production systems.

Legal Statements

Influence of Soybean Seeding Rate when Planted into Wet Soil Conditions

Trial Objective

- Tough, wet soil conditions where the ground has excessive moisture at planting followed by dry conditions can cause soil crusting occasionally during the spring. This challenging environment can cause difficulty in obtaining a consistent soybean stand.
- The objective of this study was to determine the potential benefits of increasing soybean seeding rates to increase stand establishment and subsequent yield potential in challenging, wet field conditions.

Experiment/Trial Design

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	05/28/2021	10/05/2021	80	See Below

- The study used a randomized split-plot design with four replications where soybean seeding rate was the whole plot, and soybean product was the sub-plot.
- Seeding Rates (seeds/acre)
  - » 40,000, 80,000, 120,000, 160,000, 200,000, and 240,000
- Soybean Products
  - » 2.5 maturity group (MG) XtendFlex® soybean product
  - » 2.7 MG XtendFlex® soybean product
  - » 2.9 MG XtendFlex® soybean product
- The study was irrigated throughout growing season.
- Fertilizer (lb/acre) applied through strip-tillage prior to planting included 60 lb phosphorous, 25 lb sulfur, and 0.25 lb zinc.
- Weeds were controlled uniformly across the study.
- Excessive rain occurred prior to planting on May 28th. Soil conditions were wet, but planting was pushed in order to move planting along. The closing wheels on the planter may have caused some compaction over the seed furrow. After the 0.6" of rain on May 30th, minimal rainfall occurred in June. During the first half of June, daily high temperatures climbed into the 80's, 90's, and even low 100's with daytime relative humidity as low as 19% led to significant soil crusting, over the seed furrow. Thinly planted soybean seeds had a more difficult time emerging while seeds planted at a higher population were able to push through the crust together.

Influence of Soybean Seeding Rate when Planted into Wet Soil Conditions

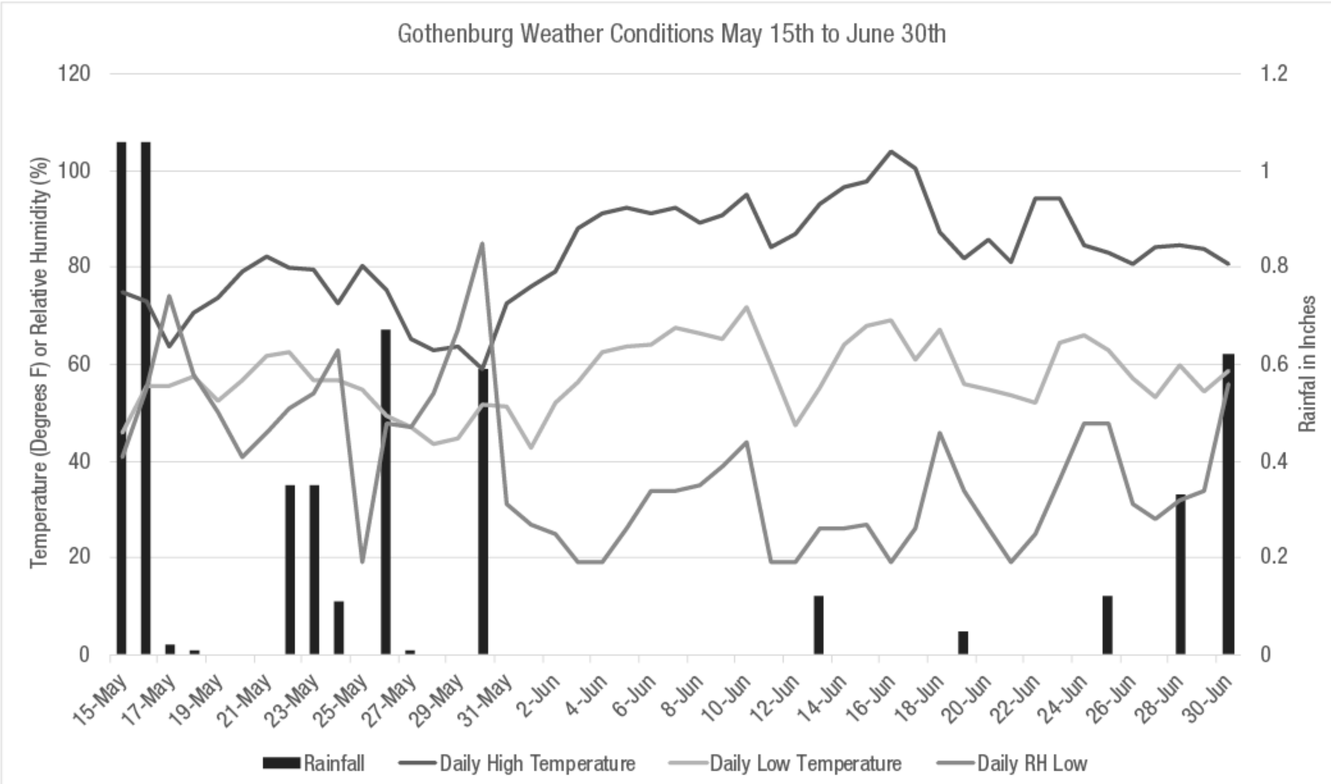


Figure 1 provides an overview of the weather conditions prior to, during, and after planting.

Influence of Soybean Seeding Rate when Planted into Wet Soil Conditions

Understanding the Results

- Soybean grain yield was positively impacted by increased seeding rate (Figure 2).
- The 40,000 seeds/acre seeding rate resulted in the lowest average yield among the six seeding rates (Figure 2).
- The 80,000 and 120,000 seeding rates/acre resulted in similar average yields which were 82% and 98% greater than the 40,000 seeds/acre rate, respectively (Figure 2).
- The average yield in the plots with the 160,000 seeds/acre rate was 46% and 34% greater than the 80,000 and 120,000 seeding rates, respectively (Figure 2).
- The average yield in the plots with the 200,000 and 240,000 seeding rates/acre reached statistically similar grain yields and were 21% and 36% greater compared to the 160,000 seeds/acre rate, respectively (Figure 2).
- Representative pictures (Figure 3) show the difference in the soybean stands of the 2.5 Maturity Group soybean on September 21, 2021.

Key Learning

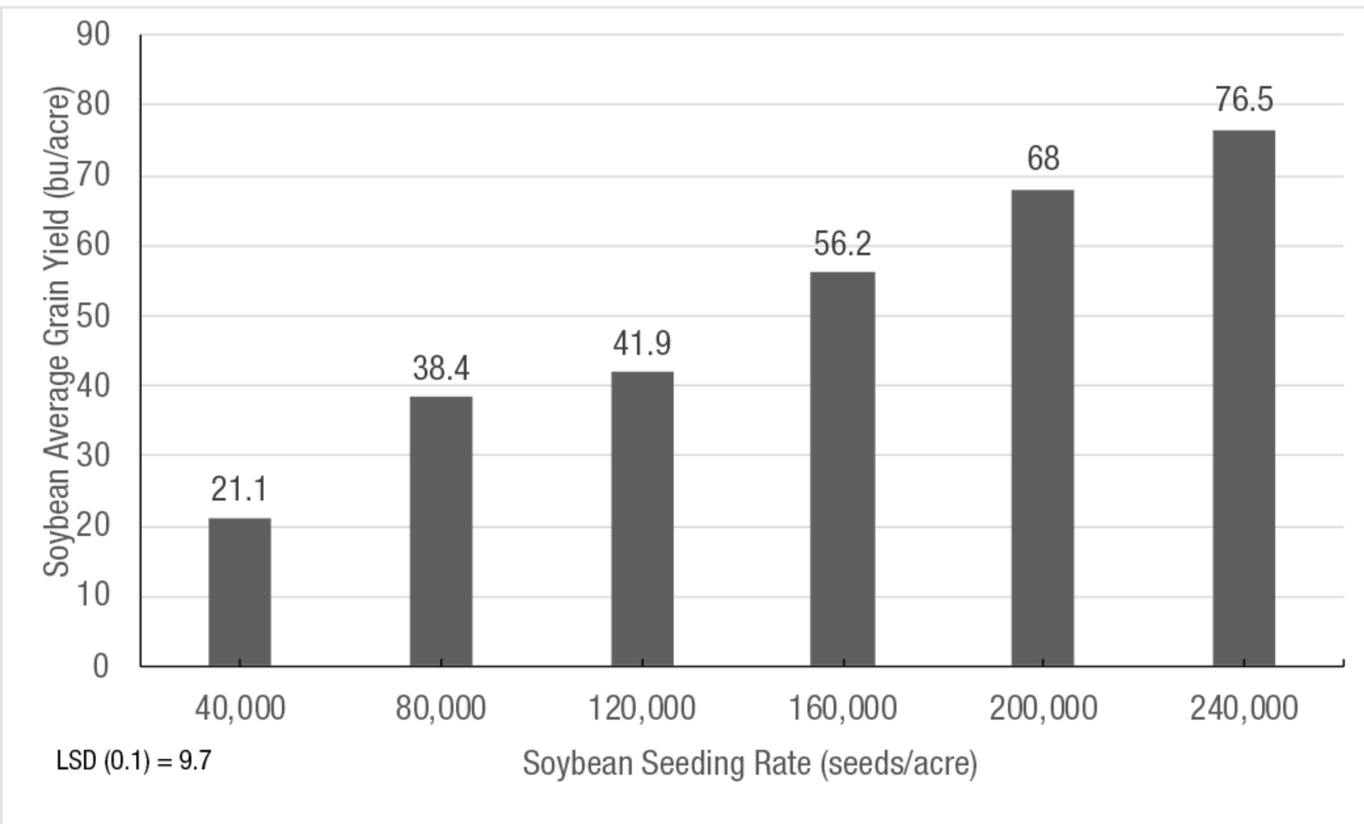


Figure 2. Average soybean yield resulting from six seeding rates at the Bayer Water Utilization Learning Center, Gothenburg, NE. 2021

Influence of Soybean Seeding Rate when Planted into Wet Soil Conditions

Figure 3. Comparison of 2.5 maturity group soybean stands at planting rates of 40,000, 80,000, 120,000, 160,000, and 200,000 seeds/acre on September 21, 2021, at the Bayer Water Utilization Learning Center, Gothenburg, NE.

Influence of Soybean Seeding Rate when Planted into Wet Soil Conditions

- Higher soybean seeding rates (e.g., 200,000 and 240,000 seeds/acre) resulted in increased grain yield and should be considered when planting under tough/wet conditions in the spring. Other research from Gothenburg on soybean seeding rate indicates the optimal seeding rate would be 160,000 seeds/acre when the seed is planted in more favorable soil conditions.
- Farmers should work with their local seeds sales team members to help identify the best adapted soybean product for their production systems.

Legal Statements

Evaluating the use of defoliant to improve soybean harvest

Trial Objective

- Some high-yielding soybean products have good late season health which can manifest itself in green stems, making them more difficult to harvest.
- Use of a defoliant may help dry out the plants faster and allow greater ease of harvest.
- There may be other situations in which a defoliant could provide benefits including facilitating the use of fuller season soybeans, improving harvest timing, or increasing odds of cover crop establishment through an earlier harvest.
- This research project was designed with a goal of evaluating the impact of defoliant application on soybean yield and harvest timing.

Experiment/Trial Design

- This research was conducted at Bayer Crop Science research sites in Illinois Counties: Adams, Woodford, Stark, Dekalb, and Kendall.
- Eight soybean products ranging from 2.7 to 3.8 maturity group (MG) were used, with different products at each location.
- Standard fertility and weed management practices were followed.
- Defol® 5 (sodium chlorate) was applied at a rate of 4.8 quarts/acre in a 20 gallon/acre carrier volume.
- Defoliant was applied at the R6.5 growth stage, which is occurs 7-10 days after R6 and is defined as the timing in which the seed easily separates from the protective membrane within the pod[1].
- Late September and early October were hot and dry across the northern half of Illinois, leading to quicker than normal soybean maturation.
- Plots were harvested as soon as feasible after reaching maturity.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Roanoke, IL	Silt loam	Corn	Conventional	4/14/21	10/18/21	75	140,000
Liberty, IL	Silt loam	Soybean	Conventional	5/5/21	9/23/21	85	140,000
Bradford, IL	Silt loam	Corn	Conventional	4/6/21	9/17/21	85	140,000
Waterman, IL	Silty clay loam	Corn	Conventional	5/14/21	10/18/21	70	140,000
Newark, IL	Clay loam	Corn	Conventional	5/27/21	10/23/21	70	140,000

Evaluating the use of defoliant to improve soybean harvest

Understanding the Results

- There was no negative association between defoliant use and soybean yield (Table 1). Overall, the average yield of the treated strips was 69.2 bu/ acre, while the untreated strips averaged 68.7 bu/acre.
- There was no significant difference in moisture between treated and untreated (Table 1). It should be noted that most of the locations were not able to be harvested immediately when maturing, so the grain moistures had time to equalize.
- A fairly large range in maturity response to defoliant was observed, ranging from no benefit to 9 days, with an average of 2.4 days earlier (Table 1). This response was probably confounded by abnormally rapid maturation of the soybean crop across the state in 2021.

Location	Maturity Group	Defoliant Application Date	Harvest Date	Days Saved at Harvest	Defoliant Yield (bu/ acre)	Untreated Yield (bu/ acre)	% Moisture (defoliant)	% Moisture (Untreated)
Waterman, IL	2.7	9/24/21	9/27/21	3	63.6	63.2	12.4	12.6
	2.8	9/24/21	10/4/21	9	63.7	59.5	13.1	12.9
	3.5	9/24/21	9/29/21	4	63.1	61.3	12.2	12.4
Newark, IL	3.6	9/11/21	9/20/21	0	65.4	65.6	12.4	12.5
	3.5	9/11/21	9/20/21	0	64.8	61.7	12.5	12.4
	3.7	9/11/21	9/20/21	0	65.4	62.7	12.0	12.0
	3.8	9/11/21	9/20/21	0	65.9	68.3	12.4	12.2
Bradford, IL	2.7	9/10/21	9/17/21	0	85.0	86.0	11.9	11.8
Roanoke, IL	3.5	9/16/21	9/22/21	9	76.6	76.2	10.0	9.8
	4.5	9/22/21	10/13/21	1	65.8	69.0	10.4	10.6
Liberty, IL	3.8	9/16/21	9/23/21	0	82.1	81.9	12.0	12.6
Average				2.4	69.2	68.7	11.9	12.0

Key Learnings

- Defoliant application can be made without negatively impacting soybean yield in situations where it would potentially benefit a grower's operation.
- Benefits to harvest timing may vary based on application time and fall weather.

Source

[1]Irby, T., Allen, T., Bond, J., Catchot, A., Gore, J., Cook, D., Krutz, J. Golden, B., 2016. Identifying late season soybean growth stages. Mississippi State University Extension. https://www.mississippi-crops.com/2016/08/19/identifying-late-season-soybean-growth-stages/

Legal Statements

Iron Deficiency Chlorosis Tolerance in Channel® Brand Soybean Products Grown on Calcareous Soils

Channel®
Seedsmanship At Work®

Trial Objective

- Soybean growers gauge chlorosis response of soybean varieties to calcareous soils and growing conditions. Soybean product selection is one of the most efficient management tools to help combat iron deficiency chlorosis (IDC) in soybean production.
- To address the need for updated information on soybean product responses, this research evaluated nine commercially available soybean products for tolerance to IDC.
- The objective of this study was to determine local soybean products with increased tolerance to IDC and gain perspective of regional product IDC ratings for the Central Plains region.

Experiment/Trial Design

- Trial location was identified based on the occurrence of IDC in previous soybean crops as observed by the farmer cooperator. The previous crop was double-crop corn.
- Weeds were controlled uniformly across the study.
- Irrigation was estimated as 8 inches for the crop growing season.
- Soil pH ranged from 8 to 8.2.
- The study was a strip trial design evaluating 9 Channel® brand soybean products.
- Plots consisting of 6 rows and soybeans were planted into 30-inch rows at a depth of 1.5 inches.
- A 9-point scale was employed to score the severity of IDC symptoms, with a score of
  - » 1 = Excellent: green no yellowing
  - » 2 = Very Strong: little to no yellowing
  - » 3 = Strong: minimal yellowing
  - » 4 = Average: mild yellowing
  - » 5 = Above Average: moderate interveinal chlorosis
  - » 6 = Below Average: pronounced interveinal chlorosis
  - » 7 = Weak: severe interveinal chlorosis
  - » 8 = Very Weak: predominantly yellow
  - » 9 = Poor: dead meristems or plants

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Assaria, KS	New Cambria Silty Clay	Corn	Conventional	6/21/21	10/20/21	80	150,000

Iron Deficiency Chlorosis Tolerance in Channel® Brand Soybean Products Grown on Calcareous Soils

Channel® Brand Soybean Product	Trait	Maturity Group	Harvest Moisture (%)	Test Weight (lbs/bu)	Average Yield (bu/acre)	Iron Deficiency Chlorosis (IDC) Rating
3222RXF	XtendFlex® Soybeans	3.2	10.1	53.2	61.4	Strong
3322RXF	XtendFlex® Soybeans	3.3	9.3	58.5	49.6	Above Average
3622RXF	XtendFlex® Soybeans	3.6	9.1	59.6	59.4	Average
3721RXF/SR	XtendFlex® Soybeans with Sufonylurea (SR) herbicide resistance	3.7	9.2	56.2	56.5	Average/Above Average
3922RXF/SR	XtendFlex® Soybeans with Sufonylurea (SR) herbicide resistance	3.9	9.6	57.4	57.7	Below Average
4121RXF/SR	XtendFlex® Soybeans with Sufonylurea (SR) herbicide resistance	4.1	9.6	59.1	56.6	Strong
4320RXF	XtendFlex® Soybeans	4.3	9.6	59.9	60.8	Above Average
4422RXF/SR	XtendFlex® Soybeans with Sufonylurea (SR) herbicide resistance	4.4	10.1	56.6	57.4	Average
4720RXF	XtendFlex® Soybeans	4.7	12.7	49.4	63.7	Above Average

Understanding the Results

- All soybean products tested showed IDC tolerance at some level. Yield differences between soybean products is due to relative maturity as well as IDC rating.
- Overall, soybean yielded well despite the extended periods of drought in the area during the 2021 growing season.
- Seasonal rainfall accumulation was 27.6 inches, approximately 4 inches less than the 10-year average.
- Growers applied irrigation more often this year as compared to the last 3 years in this field.

Key Learnings

- All the soybean products in this study exhibited some level of tolerance to IDC. The difference in one product to the next is a result of a complex interaction between plant physiological response to soil characteristics, topography, weather, and irrigation practices. Screening soybean products for iron-deficiency chlorosis is critical for farmers with fields with a history of Fe chlorosis.
- Reduced plant growth due to any IDC symptoms can have a negative effect on yield potential. Significant yield reductions have been attributed to IDC throughout the north central United States. Planting soybean products with increased IDC tolerance is an effective technique to help protect against yield losses related to IDC.
- Correcting IDC can be very difficult, the most important management consideration is to identify products with increased IDC tolerance to help minimize plant stress. Selecting the best soybean product for fields with a history of IDC helps to decrease plant death rates and increases the likelihood of plants to recover from iron-deficiency chlorosis.

Legal Statements

Iron Deficiency Chlorosis Tolerance in Channel® Brand Soybean Products Grown on Calcareous Soils

where import is not permitted. Growers should talk to their grain handler or product purchaser to confirm their buying position for this product. Excellence Through Stewardship® is a registered trademark of Excellence Through Stewardship.

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, glyphosate or glufosinate are approved for in-crop use with products with XtendFlex® Technology. 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 products with XtendFlex® Technology.

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.

Products with XtendFlex® Technology contains 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 Bayer Technology Use Guide for recommended weed control programs.

Rainfed Soybean Production Systems (2021)

Trial Objective

- The success of a rainfed soybean crop can be determined by one factor such as missing a late-season herbicide application. When water is the driving factor for potentially high yields, good management is a key.
- The objective of this study was to evaluate the impact of five rainfed soybean production systems that may or may not include treatment factors such as tillage, herbicides, fertility, and a fungicide on yield potential.

Experiment/Trial Design

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	Conventional-till & No-Till	05/12/21	10/16/21	45	160,000

- A 2.5 maturity group XtendFlex® soybean product was planted into a rainfed field with no additional supplemental moisture and subjected to five crop production systems (Table 1). Two of the systems were conventional till and three were no-till.
- The trial was a randomized complete block design with four replications of the five treatments.
- The planter was a fully mounted 4-row, 30-inch planter utilizing Precision Planting® DeltaForce® for downforce control and Precision Planting® vDrive® for seeding rate control.
- A base fertilizer application of 50 lb/acre Phosphorous (P), 21 lb/acre Sulfur (S), and 0.2 lb/acre Zinc (Zn) was broadcast with stream bars across all treatments on April 13, 2021.
- No insecticides were applied.
- Plots were combine-harvested.
- Grain moisture content, test weight, and total weight were determined.
- Statistical analysis for Fisher's LSD was performed.

Rainfed Soybean Production Systems (2021)

Table 1. Treatment Systems (Bold print indicates treatment changes from previous treatment; light and dark gray blocks indicate chemistry was applied pre-emerge, but separately on the same day – May 15).			
Treatment	Tillage	Crop Protection	Application Timing
Base	Conventional till	Roundup PowerMAX® Herbicide (32 fl oz/acre) + Ammonium Sulfate (AMS) (17 lb/100 gal)	Pre-emerge on May 15
		Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	4 weeks after planting
Residual	Conventional till	Roundup PowerMAX® Herbicide (32 fl oz/acre) + **XtendiMax® Herbicide with VaporGrip® Technology (Restricted Use Pesticide)* (22 fl oz/acre) + OnTarget® (Drift Reduction Agent) (DRA) (0.5% v/v) + Sentris™ (Volatility Agent) (VRA) (8 fl oz/acre)**	Pre-emerge on May 15
		Zidua® SC Herbicide (4 fl oz/acre) + Valor® Herbicide (3 oz/acre) + Dimetric® Liquid Herbicide (8 fl oz/acre)	Pre-emerge on May 15
		Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	4 weeks after planting
No-till	**No-till**	Roundup PowerMAX® Herbicide (32 fl oz/acre) + XtendiMax® Herbicide with VaporGrip® Technology (Restricted Use Pesticide)* (22 fl oz/acre) + OnTarget® (DRA) (0.5% v/v) + Sentris™ (VRA) (8 fl oz/acre)	Pre-emerge on May 15
		Zidua® SC Herbicide (4 fl oz/acre) + Valor® Herbicide (3 oz/acre) + Dimetric® Liquid Herbicide (8 fl oz/acre)	Pre-emerge on May 15
		Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal)	4 weeks after planting
Post residual	No-till	Roundup PowerMAX® Herbicide (32 fl oz/acre) + XtendiMax® Herbicide with VaporGrip® Technology (Restricted Use Pesticide)* (22 fl oz/acre) + OnTarget® (DRA) (0.5% v/v) + Sentris™ (VRA) (8 fl oz/acre)	Pre-emerge on May 15
		Zidua® SC Herbicide (4 fl oz/acre) + Valor® Herbicide (3 oz/acre) + Dimetric® Liquid Herbicide (8 fl oz/acre)	Pre-emerge on May 15
		Roundup PowerMAX® Herbicide (32 fl oz/acre) + **XtendiMax® Herbicide with VaporGrip® Technology (Restricted Use Pesticide)* (22 fl oz/acre) + OnTarget® (DRA) (0.5% v/v) + Sentris™ (VRA) (8 fl oz/acre) + Warrant® Herbicide (48 fl oz/acre)**	4 weeks after planting
Fungicide	No-till	Roundup PowerMAX® Herbicide (32 fl oz/acre) + XtendiMax® Herbicide with VaporGrip® Technology (Restricted Use Pesticide)* (22 fl oz/acre) + OnTarget® (DRA) (0.5% v/v) + Sentris™ (VRA) (8 fl oz/acre)	Pre-emerge on May 15
		Zidua® SC Herbicide (4 fl oz/acre) + Valor® Herbicide (3 oz/acre) + Dimetric® Liquid Herbicide (8 fl oz/acre)	Pre-emerge on May 15
		Roundup PowerMAX® Herbicide (32 fl oz/acre) + XtendiMax® Herbicide with VaporGrip® Technology (Restricted Use Pesticide)* (22 fl oz/acre) + OnTarget® (DRA) (0.5% v/v) + Sentris™ (VRA) (8 fl oz/acre) + Warrant® Herbicide (48 fl oz/acre)	4 weeks after planting
		Delaro® 325 SC Fungicide (8 fl oz/acre)	R3 growth stage

* XtendiMax® herbicide with VaporGrip® Technology is part of the Roundup Ready® Xtend Crop System, is a restricted use pesticide and must be used with VaporGrip® Xtra Agent (or an equivalent volatility reduction adjuvant). For approved tank-mix products (including VRAs and DRAs), nozzles and other important label information visit XtendiMaxApplicationRequirements.com.

Rainfed Soybean Production Systems (2021)

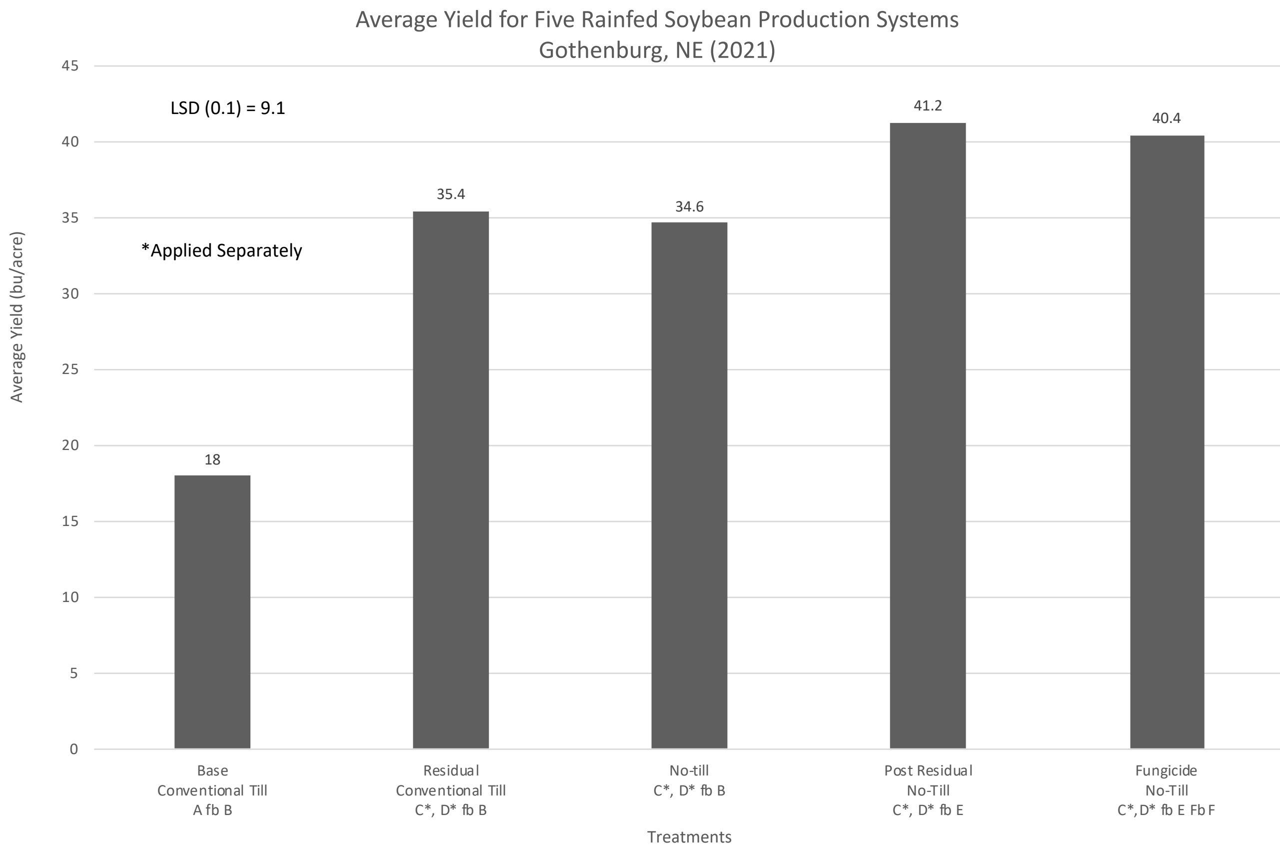
Understanding the Results

Yield

- The lowest average yield of the soybean production systems was observed with the base system (Figure 1). The base system was a conventional tillage system with no residual herbicides which had very high weed pressure (Figure 2).
- The residual herbicides, Zidua® SC Herbicide, Valor® Herbicide, and Dimetric® Liquid Herbicide plus XtendiMax® Herbicide with VaporGrip® Technology (a restricted use pesticide that must be used with VaporGrip® Xtra Agent* or and equivalent reduction agent) applied at planting almost doubled yield potential over the base system; however, late season weeds were problematic (Figures 1 and 3).
- Yields trended higher with the post residual treatments and very low weed pressure was observed in the plots at harvest (Figure 4).

* XtendiMax® herbicide with VaporGrip® Technology is part of the Roundup Ready® Xtend Crop System, is a restricted use pesticide and must be used with VaporGrip® Xtra Agent (or an equivalent volatility reduction adjuvant). For approved tank-mix products (including VRAs and DRAs), nozzles and other important label information visit XtendiMaxApplicationRequirements.com.

Rainfed Soybean Production Systems (2021)



fb = followed by; A* = Pre-Emerge: Roundup PowerMAX® herbicide (32 fl oz/acre) + AMS[1] (17 lb/100 gal); B = 4 Weeks after Planting: Roundup PowerMAX® herbicide (32 fl oz/acre) + AMS (17 lb/100 gal); C* = Preemerge: XtendiMax® Herbicide with VaporGrip® Technology*** (RUP) (22 fl oz/acre) + On Target® (DRA)[2] (0.5% v/v) + Sentris® (VRA)[3] (8 fl oz/acre); D*: Pre-emerge: Zidua® SC Herbicide (4 fl oz/acre) + Valor® Herbicide (3 oz/acre) + Dimetric® Liquid Herbicide (8 fl oz/acre); E = 4 Weeks after Planting: XtendiMax® Herbicide with VaporGrip® Technology** (RUP) (22 fl oz/acre) + On Target® (DRA) (0.5% v/v) + Sentris® (VRA) (8 fl oz/acre) + Warrant® Herbicide (48 fl oz/acre); F = At R3 Growth Stage: Delaro® 325 SC Fungicide (8 fl oz/acre); *Pre-emerge applications applied separately on May 15; [1]AMS = Ammonium sulfate; [2]DRA = Drift Reduction Agent; [3]VRA = Volatility Reduction Agent

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Figure 1. Average yield for five rainfed soybean production systems at Gothenburg, NE in 2021.

Rainfed Soybean Production Systems (2021)

Figure 2. Weed growth in the base system was dramatic because of conventional tillage and no herbicide applications.

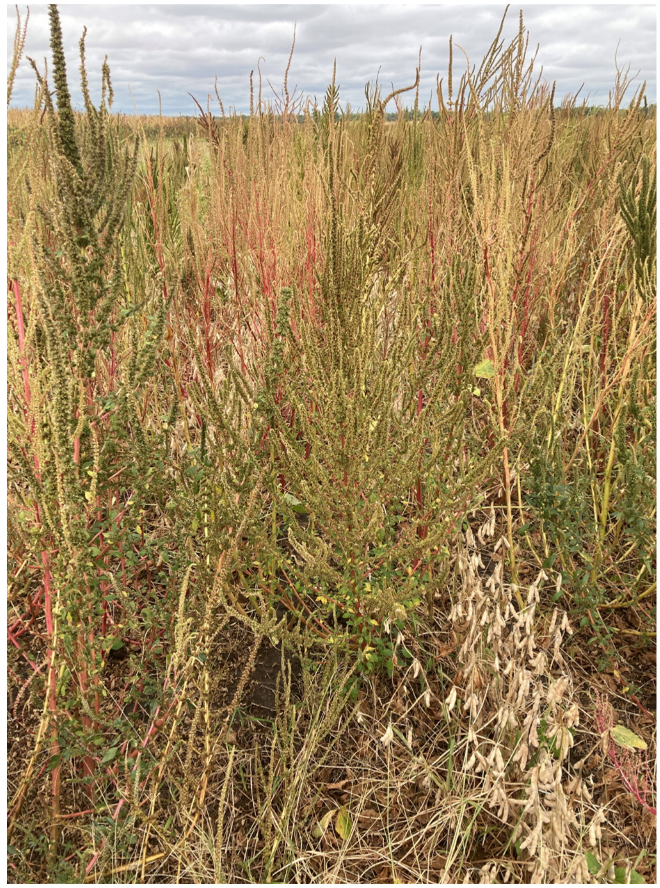


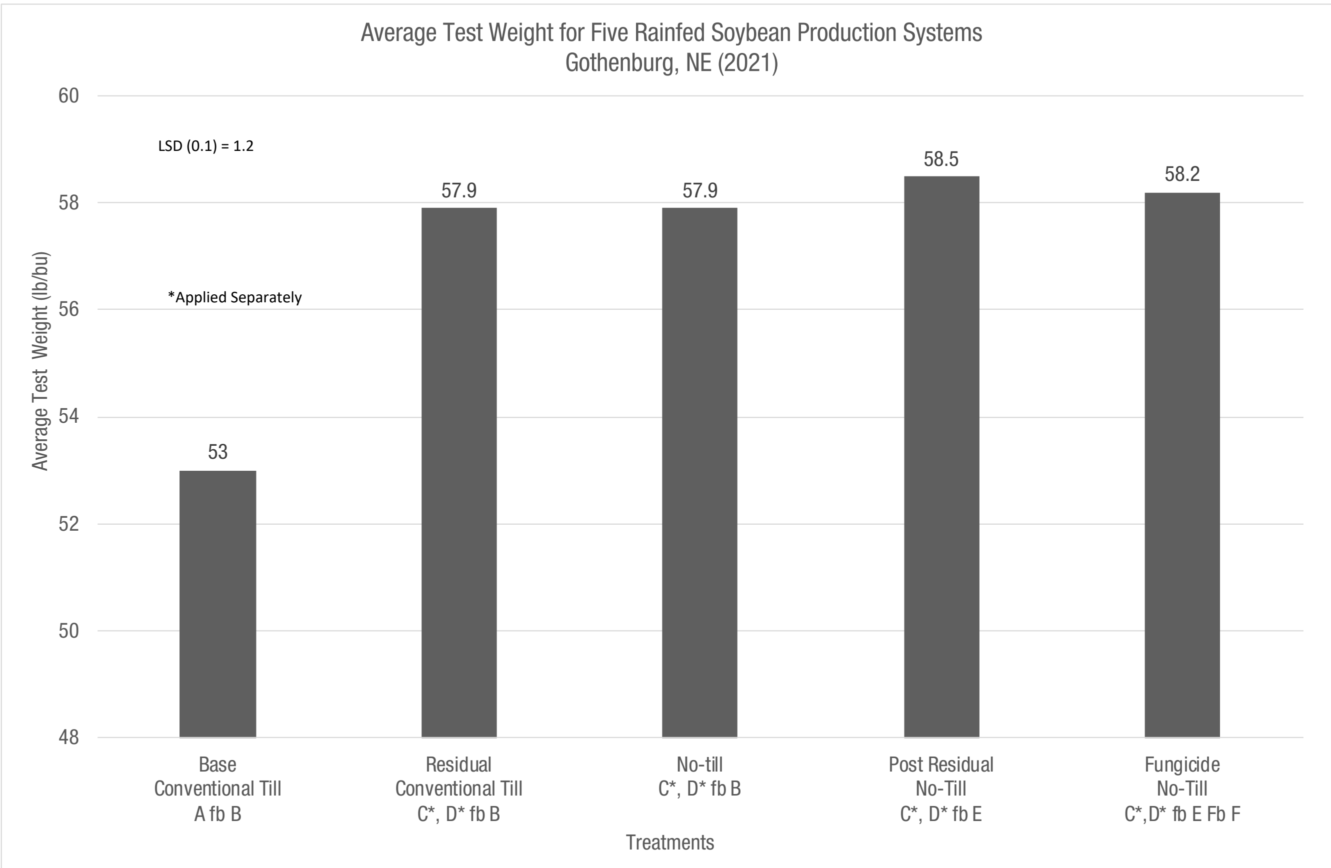
Figure 3. Late-season weeds were problematic when no residual herbicides were applied after planting during the post application timing; however, yields were almost double those of the base system.

Figure 4. Very low weed pressure was observed with the post residual treatments and yields trended higher.

Rainfed Soybean Production Systems (2021)

Test Weight

- The lowest test weight was recorded with the base system which had high levels of weed pressure at harvest. Grain quality was decreased due to excessive weed seed.



fb = followed by; A* = Pre-Emerge: Roundup PowerMAX® herbicide (32 fl oz/acre) + AMS[1] (17 lb/100 gal); B = 4 Weeks after Planting: Roundup PowerMAX® herbicide (32 fl oz/acre) + AMS (17 lb/100 gal); C* = Preemerge: XtendiMax® Herbicide with VaporGrip® Technology*** (RUP) (22 fl oz/acre) + On Target® (DRA)[2] (0.5% v/v) + Sentris® (VRA)[3] (8 fl oz/acre); D*: Pre-emerge: Zidua® SC Herbicide (4 fl oz/acre) + Valor® Herbicide (3 oz/acre) + Dimetric® Liquid Herbicide (8 fl oz/acre); E = 4 Weeks after Planting: XtendiMax® Herbicide with VaporGrip® Technology** (RUP) (22 fl oz/acre) + On Target® (DRA) (0.5% v/v) + Sentris® (VRA) (8 fl oz/acre) + Warrant® Herbicide (48 fl oz/acre); F = At R3 Growth Stage: Delaro® 325 SC Fungicide (8 fl oz/acre); *Pre-emerge applications applied separately on May 15; [1]AMS = Ammonium sulfate; [2]DRA = Drift Reduction Agent; [3]VRA = Volatility Reduction Agent

**XtendiMax® herbicide with VaporGrip® Technology is part of the Roundup Ready® Xtend Crop System, is a restricted use pesticide and must be used with VaporGrip® Xtra Agent (or an equivalent volatility reduction adjuvant). For approved tank-mix products (including VRAs and DRAs), nozzles and other important label information visit XtendiMaxApplicationRequirements.com.

Figure 5. Average test weight for five rainfed soybean production systems at Gothenburg, NE in 2021.

Rainfed Soybean Production Systems (2021)

Key Learnings

- Farmers should evaluate their soybean production system for procedures to help maximize water retention and to decrease weed growth that competes for water.
- The layering of residual herbicides had the biggest impact on yield potential in this rainfed soybean trial.
- Including a residual herbicide at planting and four weeks after planting provided excellent weed control at harvest, increased yield potential, and reduced the number of potential weed seeds for the following crop.

Legal Statements

XtendFlex® Soybean Systems Trial

Trial Objective

- Highlight the outstanding weed control of the XtendFlex® soybean system.
- Showcase the yield performance of the XtendFlex® soybean system.
- Gain a better understanding of the value of a whole system approach to soybean management.
- Explore the benefits of in-season soybean disease management with an application of Delaro® Complete fungicide at R3 growth stage.

Experiment/Trial Design

- Randomized Complete Block Design with three replications.
- Soybean products varied by location and were based on appropriate maturity group for the local markets.
- Treatments
- Basic Offer
  - » Locally adapted Bayer company soybean product.
  - » Acceleron® Seed Applied Solutions Standard* + Acceleron® IX-409 Insecticide Seed Treatment
  - » Herbicide Program
- PRE: Warrant® Herbicide (48 fl oz/acre) + Mauler® Herbicide (8 fl oz/acre)
- POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + Ammonium Sulfate (AMS) (17 lb/100 gal) + Warrant® Herbicide (48 fl oz/acre)
- POST: XtendiMax® herbicide with VaporGrip® Technology (Restricted Use Pesticide) (RUP)** (22 fl oz/acre) + OnTarget® (Drift Reduction Agent) (DRA) (0.5% v/v) + Sentris™ (Volatility Agent) (VRA) (8 fl oz/acre).
- Premier Offer
  - » Locally adapted Bayer company soybean product.
  - » Acceleron® Seed Applied Solutions Standard* + ILeVO® Seed Treatment.
  - » Herbicide Program
- PRE: Warrant® Herbicide (48 fl oz/acre) + Mauler® Herbicide (8 fl oz/acre).
- POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal) + Warrant® Herbicide (48 fl oz/acre).
- POST: XtendiMax® herbicide with VaporGrip® Technology (RUP)** (22 fl oz/acre) + OnTarget® (DRA) (0.5% v/v) + Sentris™ (VRA) (8 fl oz/acre).
  - » Foliar Fungicide
- Delaro® Complete Fungicide (8 fl oz/acre) at R3 growth stage.
- Grower Standard
  - » Locally adapted, widely used soybean product.
  - » Herbicide Program
- PRE: Authority® Supreme Herbicide (8 fl oz/acre).
- POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal).

XtendFlex® Soybean Systems Trial

- POST: XtendiMax® herbicide with VaporGrip® Technology (RUP)** (22 fl oz/acre) + OnTarget® (DRA) (0.5% v/v) + Sentris™ (VRA) (8 fl oz/acre).

*Combination of Acceleron® DX-109 Fungicide Seed Treatment/Acceleron® D-109 Fungicide Seed Treatment, Acceleron® DX-309 Fungicide Seed Treatment, and Acceleron® DX-612 Fungicide Seed Treatment/Acceleron® D-612 Fungicide Seed Treatment.

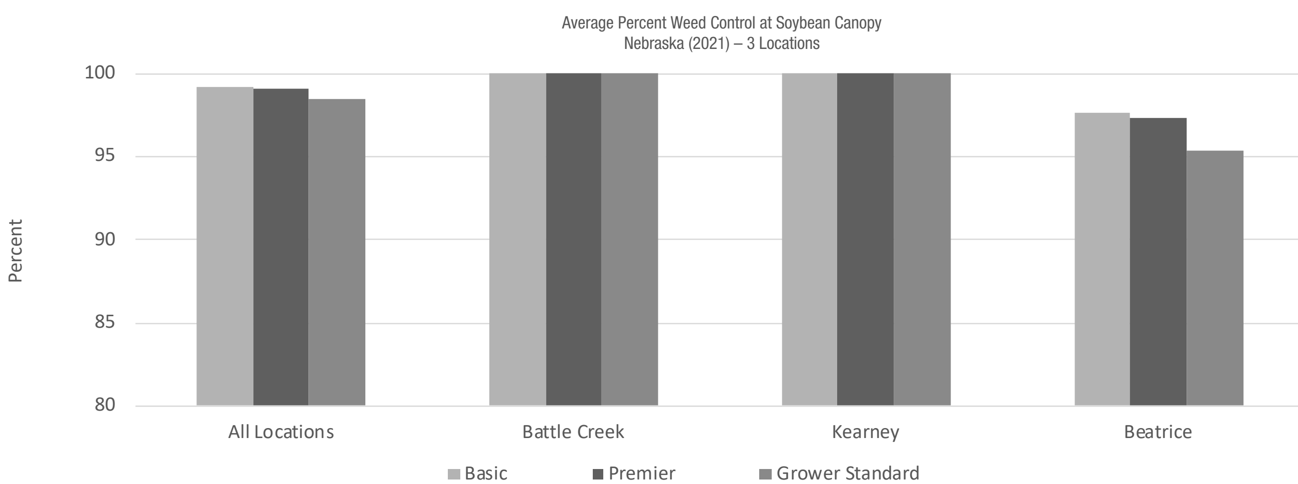
** XtendiMax® herbicide with VaporGrip® Technology is part of the Roundup Ready® Xtend Crop System, is a restricted use pesticide and must be used with VaporGrip® Xtra Agent (or an equivalent volatility reduction adjuvant). For approved tank-mix products (including VRAs and DRAs), nozzles and other important label information visit XtendiMaxApplicationRequirements.com.

- Disease Ratings, % Weed control, yield, and moisture data were collected at each location.

Nebraska Locations	Soil Type	Previous Crop	Tillage Type	Irrigation	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Battle Creek	Loamy Sand	Corn	Conventional	Center Pivot	5/17/21	10/05/21	75	150,000
Beatrice	Silty Clay Loam	Corn	No-till	Dryland	5/06/21	10/03/21	65	140,000
Kearney	Silt Loam	Corn	Conventional	Center Pivot	5/11/21	9/28/21	75	150,000

Understanding the Results

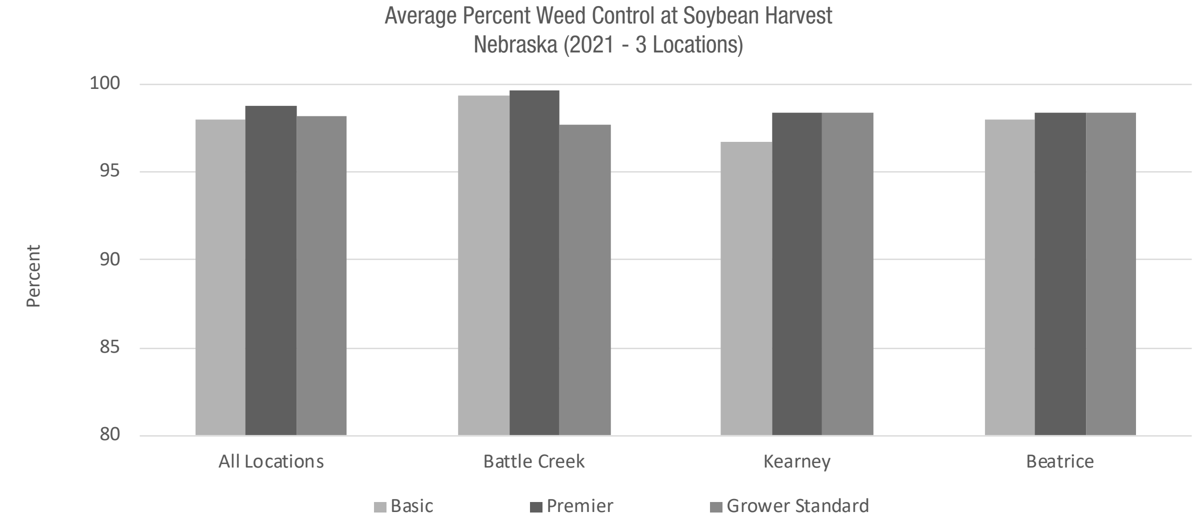
- The Roundup Ready® Xtend Crop System can provide season long, broad spectrum weed control by implementing overlapping residual herbicides and planting into clean, weed-free field conditions (data not shown).
- Weed control was consistently acceptable across all treatments (Figure 1).



Basic Treatment: Bayer company soybean product; Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide, Herbicides: PRE: Warrant® Herbicide (48 fl oz/acre) + Mauler® Herbicide (8 fl oz/acre); POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + Ammonium Sulfate (AMS) (17 lb/100 gal) + Warrant® Herbicide (48 fl oz/acre); POST: XtendiMax® herbicide with VaporGrip® Technology (Restricted Use Pesiticide) (RUP) (22 fl oz/acre) + OnTarget® (Drift Reduction Agent) (DRA) (0.5% v/v) + Sentris™ (Volatility Agent) (VRA) (8 fl oz/acre). Premier Treatment: Same as Basic Treatment except ILeVO® Seed Treatment replaced Acceleron® IX-409 Insecticide and Delaro® Complete Fungicide (8 fl oz/acre) was applied at R3 growth stage. Grower Standard Treatment: Locally adapted soybean product; Herbicides: PRE: Authority® Supreme Herbicide (8 fl oz/acre); POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal); POST: XtendiMax® herbicide with VaporGrip® Technology (RUP) (22 fl oz/acre) + OnTarget® (DRA) (0.5% v/v) + Sentris™ (VRA) (8 fl oz/acre).

Figure 1a. Average percent of weed control at soybean canopy.

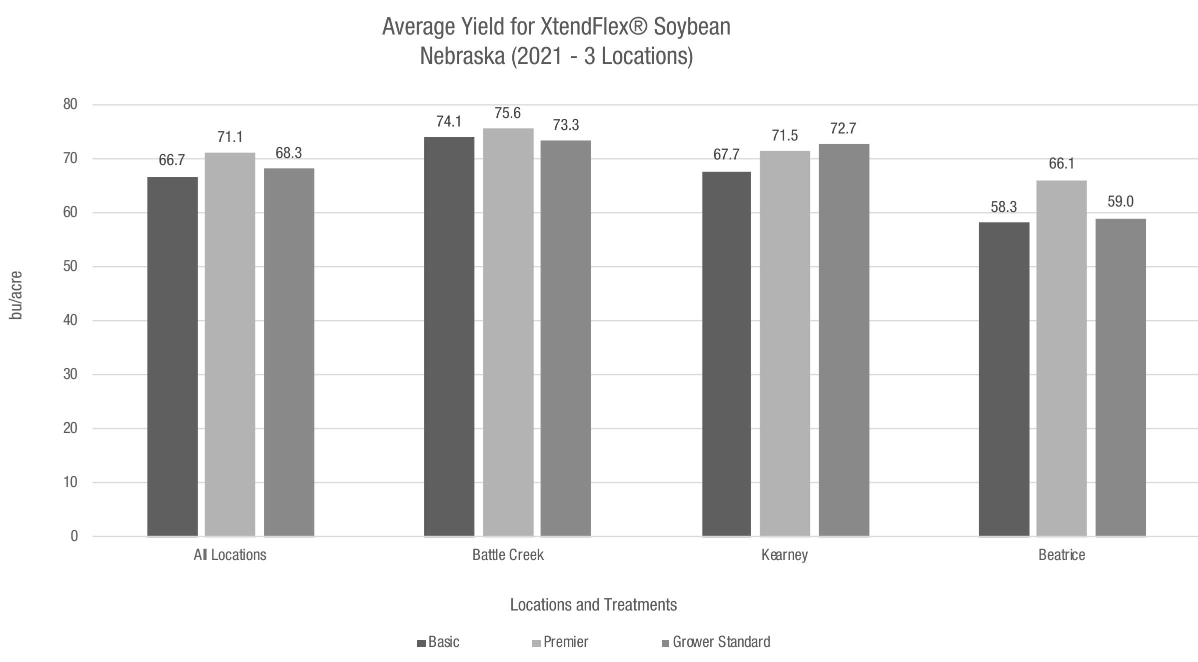
XtendFlex® Soybean Systems Trial



Basic Treatment: Bayer company soybean product; Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide, Herbicides: PRE: Warrant® Herbicide (48 fl oz/acre) + Mauler® Herbicide (8 fl oz/acre); POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + Ammonium Sulfate (AMS) (17 lb/100 gal) + Warrant® Herbicide (48 fl oz/acre); POST: XtendiMax® herbicide with VaporGrip® Technology (Restricted Use Pesiticide) (RUP) (22 fl oz/acre) + OnTarget® (Drift Reduction Agent) (DRA) (0.5% v/v) + Sentris™ (Volatility Agent) (VRA) (8 fl oz/acre). **Premier Treatment**: Same as Basic Treatment except ILeVO® Seed Treatment replaced Acceleron® IX-409 Insecticide and Delaro® Complete Fungicide (8 fl oz/acre) was applied at R3 growth stage. Grower **Standard Treatment**: Locally adapted soybean product; Herbicides: PRE: Authority® Supreme Herbicide (8 fl oz/acre); POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17

Figure 1b. Average percent of weed control at soybean harvest.

- Disease pressure was inconsequential at each of the locations.
- Yield response between treatments varied by location (Figure 2).

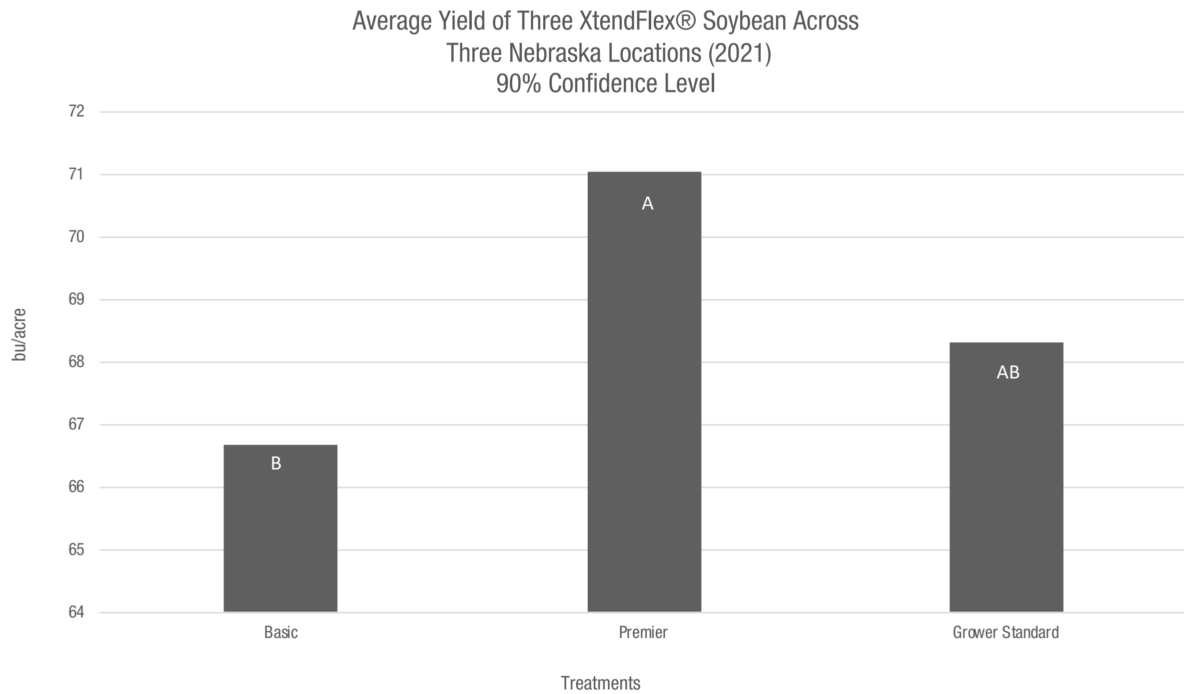


Basic Treatment: Bayer company soybean product; Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide, Herbicides: PRE: Warrant® Herbicide (48 fl oz/acre) + Mauler® Herbicide (8 fl oz/acre); POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + Ammonium Sulfate (AMS) (17 lb/100 gal) + Warrant® Herbicide (48 fl oz/acre); POST: XtendiMax® herbicide with VaporGrip® Technology (Restricted Use Pesticide) (RUP) (22 fl oz/acre) + OnTarget® (Drift Reduction Agent) (DRA) (0.5% v/v) + Sentris™ (Volatility Agent) (VRA) (8 fl oz/acre). **Premier Treatment:** Same as Basic Treatment except ILeVO Seed Treatment replaced Acceleron® IX-409 Insecticide and Delaro® Complete Fungicide (8 fl oz/acre) was applied at R3 growth stage. **Grower Standard Treatment:** Locally adapted soybean product; Herbicides: PRE: Authority® Supreme Herbicide (8 fl oz/acre); POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal); POST: XtendiMax® herbicide with VaporGrip® Technology (RUP) (22 fl oz/acre) + OnTarget® (DRA) (0.5% v/v) + Sentris™ (VRA) (8 fl oz/acre).

Figure 2. Average yield for three XtendFlex® soybean systems in Nebraska (2021).

XtendFlex® Soybean Systems Trial

- The Across Location average yields showed the improved yield performance of the Premier Offer treatment relative to the other treatments (Figure 3).
  - » At a 90% confidence level the Premier Offer treatment showed statistically significant yield improvement from the Basic Offering but not the Grower Standard treatment (Figure 3).



Basic Treatment: Bayer company soybean product; Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide, Herbicides: PRE: Warrant® Herbicide (48 fl oz/acre) + Mauler® Herbicide (8 fl oz/acre); POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + Ammonium Sulfate (AMS) (17 lb/100 gal) + Warrant® Herbicide (48 fl oz/acre); POST: XtendiMax® herbicide with VaporGrip® Technology (Restricted Use Pesiticide) (RUP) (22 fl oz/acre) + OnTarget® (Drift Reduction Agent) (DRA) (0.5% v/v) + Sentris™ (Volatility Agent) (VRA) (8 fl oz/acre). **Premier Treatment**: Same as Basic Treatment except ILeVO® Seed Treatment replaced Acceleron® IX-409 Insecticide and Delaro® Complete Fungicide (8 fl oz/acre) was applied at R3 growth stage. **Grower Standard Treatment**: Locally adapted soybean product; Herbicides: PRE: Authority® Supreme Herbicide (8 fl oz/acre); POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + AMS (17 lb/100 gal); POST: XtendiMax® herbicide with VaporGrip® Technology (RUP) (22 fl oz/acre) + OnTarget® (DRA) (0.5% v/v) + Sentris™ (VRA) (8 fl oz/acre).

Figure 3. Average yields across the three locations demonstrated the advantage of the Premier Treatment at a 90% Confidence Level. (Battle Creek, Beatrice, and Kearney, Nebraska, 2021)

Key Learnings

- In this trial soybean product selection along with an in-season fungicide application consistently provided the highest yields.
- In-season fungicide applications can provide enhanced disease protection along with potentially improved yield performance.
- A grower should always consult their local sales representative and agronomist to select the appropriate variety for their specific environmental conditions and yield goal.

Legal Statements

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

Bayer is a member of Excellence Through Stewardship® (ETS). Bayer products are commercialized in accordance with ETS Product Launch Stewardship Guidance, and in compliance with Bayer's Policy for Commercialization of Biotechnology-Derived Plant Products in Commodity Crops. Commercialized products have been approved for import

Early Applications of XtendiMax® Herbicide with VaporGrip® Technology, a Restricted Use Pesticide, in the Roundup Ready® Xtend Crop System in Conventional Tillage Systems

Trial Objective

- Determine if XtendiMax® herbicide with VaporGrip® Technology, a restricted use pesticide, provides a broadacre benefit of residual weed control when used in conjunction with pre-emergence (PRE) residual herbicides in a conventionally tilled soybean system.

Research Site Details

- There were 15 research sites in 2021 chosen by University researchers in 12 states (AR, IA, IL, LA, MI, MN, MO, NC, ND, NE, SD, WI) with 11 sites providing useable data, representing various soil types and environmental conditions.
- The protocol included conventional tillage prior to planting to remove existing weeds.
- Pre-emergence (PRE) products were applied at either planting or prior to soybean emergence.
- There were no post-emergence (POST) applications to determine the effective length time of PRE residual products.
- Weed control was evaluated 14, 21, and 35 days after treatment (DAT).

Treatment	Pre-emergence herbicide treatment (applied at planting or prior to emergence)
1	MON 301668† (30 fluid ounces/acre) + Mauler® herbicide (8 fluid ounces/acre)
2	MON 301668† (30 fluid ounces/acre)
3	Warrant® Ultra Herbicide (50 fluid ounces/acre)
4	Fierce® EZ herbicide (6 fluid ounces/acre)
5	Valor® EZ herbicide (2 fluid ounces/acre)
6	Authority® MTZ DF herbicide (10 ounces/acre)
7-12*	Repeat of 1-6 with the addition of XtendiMax® herbicide with VaporGrip® Technology (22 fluid ounces/acre)

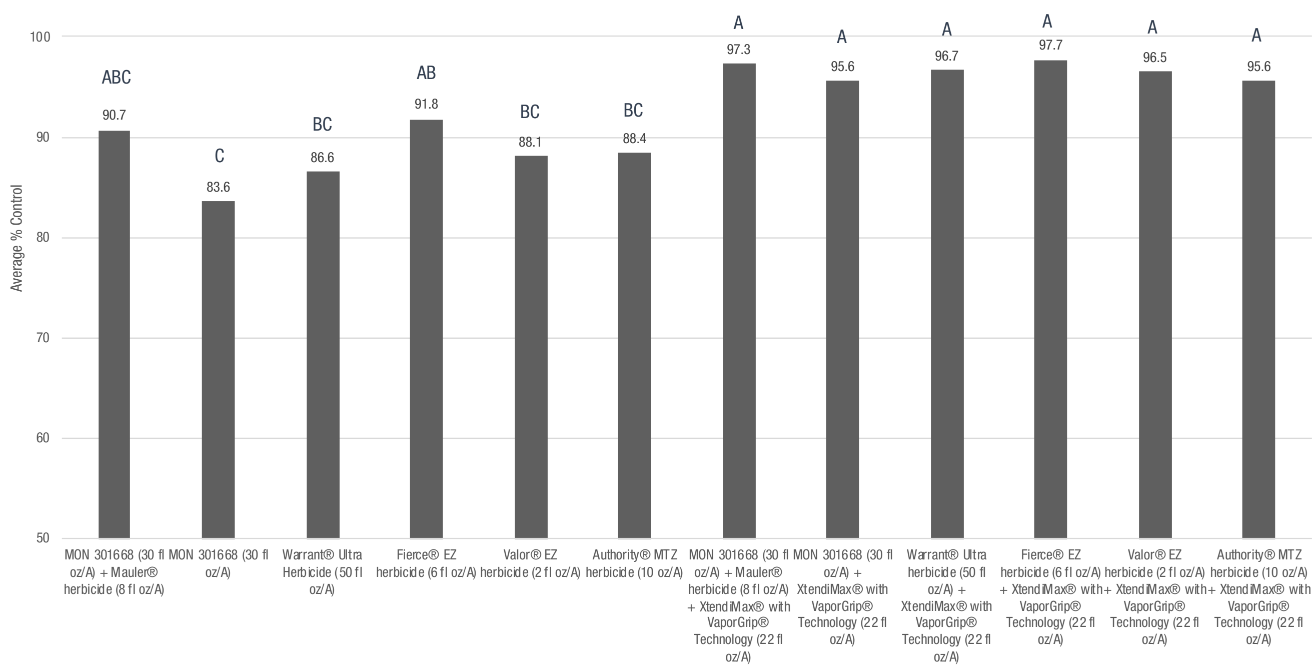
*All applications with XtendiMax® herbicide with Vaporgrip® Technology were tank-mixed with an approved VRA and DRA where required.

†MON 301668 is an experimental formulation of encapsulated acetochlor. The information presented herein is provided for educational purposes only and is not and shall not be construed as an offer to sell, or a recommendation to use, any unregistered pesticide for any purpose whatsoever.

Early Applications of XtendiMax® Herbicide with VaporGrip® Technology, a Restricted Use Pesticide, in the Roundup Ready® Xtend Crop System in Conventional Tillage Systems

Understanding the Results

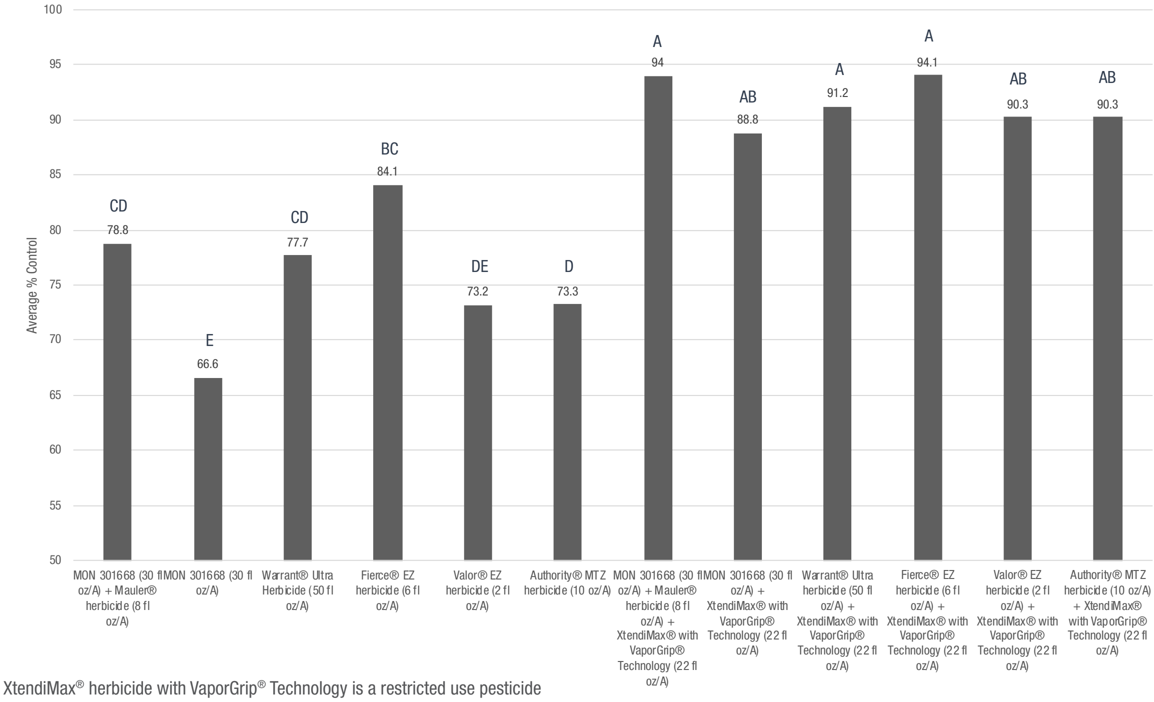
- At 21 days after treatment (DAT), the percent broadleaf weed control ranged from 83 to 92% for the pre-emerge products only and 95 to 97% control for pre-emerge with the addition of XtendiMax® herbicide with VaporGrip® Technology (Figure 1). However, the control across all locations with the addition of XtendiMax® herbicide with VaporGrip® Technology was more consistent. At 35 DAT, control was more consistent across locations and improved over base PRE applications (Figure 2).
- At 21 days after application, treatments of MON 301886, Warrant Ultra Herbicide, Valor EZ herbicide, and Authority MTZ herbicide were all improved with the addition of XtendiMax® herbicide with VaporGrip® Technology (Figure 1). All products with the addition of XtendiMax® herbicide with VaporGrip® Technology provided a higher level of control at 35 days post application than base PREs alone (Figure 2).
- Focusing on *Amaranthus* species only 35 days after application, Fierce® EZ herbicide, Valor® EZ herbicide, and Authority® MTZ herbicide were improved with the addition of XtendiMax® herbicide with VaporGrip® Technology (Figure 3).
- Focusing on large-seeded broadleaf species, the addition of XtendiMax® herbicide with VaporGrip® Technology significantly improved control in 5 out of 6 PRE products at 21 days after application and all products at 35 days post application (Figures 4 and 5).



XtendiMax® herbicide with VaporGrip® Technology is a restricted use pesticide

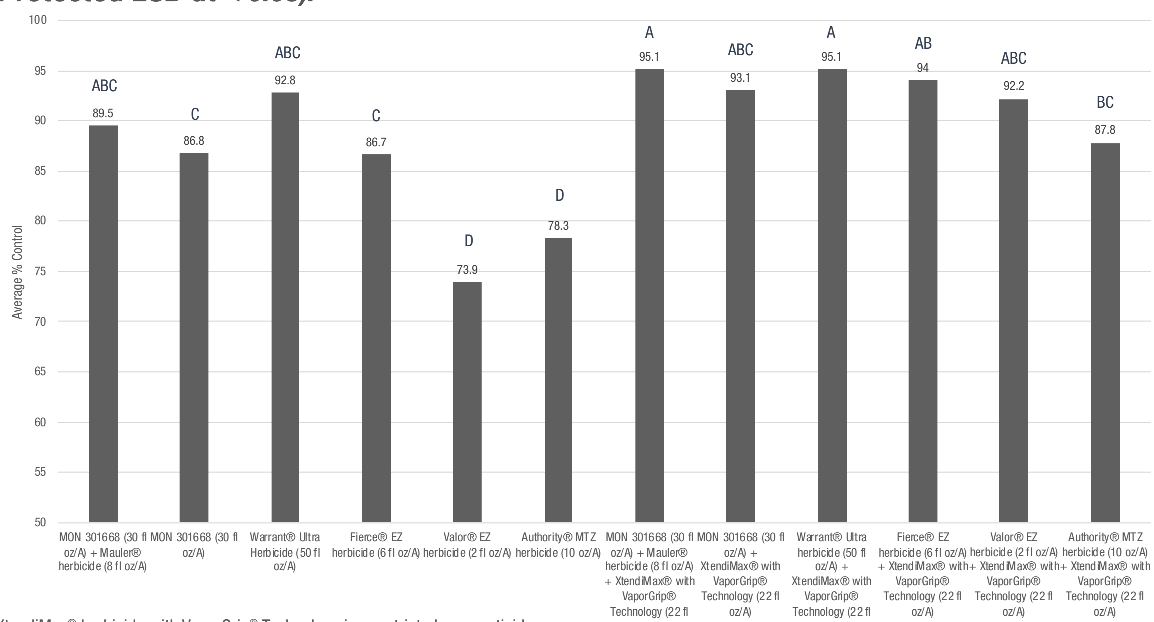
Figure 1. Average percent control of broadleaf weeds with pre-emergence products alone and with XtendiMax® herbicide with VaporGrip® Technology, a restricted use pesticide, at 8 locations 21 days after application. (Averages followed by same letter are not significantly different using Fishers Protected LSD at < 0.05).

Early Applications of XtendiMax® Herbicide with VaporGrip® Technology, a Restricted Use Pesticide, in the Roundup Ready® Xtend Crop System in Conventional Tillage Systems



XtendiMax® herbicide with VaporGrip® Technology is a restricted use pesticide

Figure 2. Average percent control of broadleaf weeds with pre-emerge products alone and with XtendiMax® herbicide with VaporGrip® Technology at 9 locations 35 days after application. (Averages followed by same letter are not significantly different using Fishers Protected LSD at < 0.05).



XtendiMax® herbicide with VaporGrip® Technology is a restricted use pesticide

Figure 3. Average percent control of Amaranthus species with pre-emerge products alone and with XtendiMax® herbicide with VaporGrip® Technology at 7 locations 35 days after application. (Averages followed by same letter are not significantly different using Fishers Protected LSD at < 0.05).

Early Applications of XtendiMax® Herbicide with VaporGrip® Technology, a Restricted Use Pesticide, in the Roundup Ready® Xtend Crop System in Conventional Tillage Systems

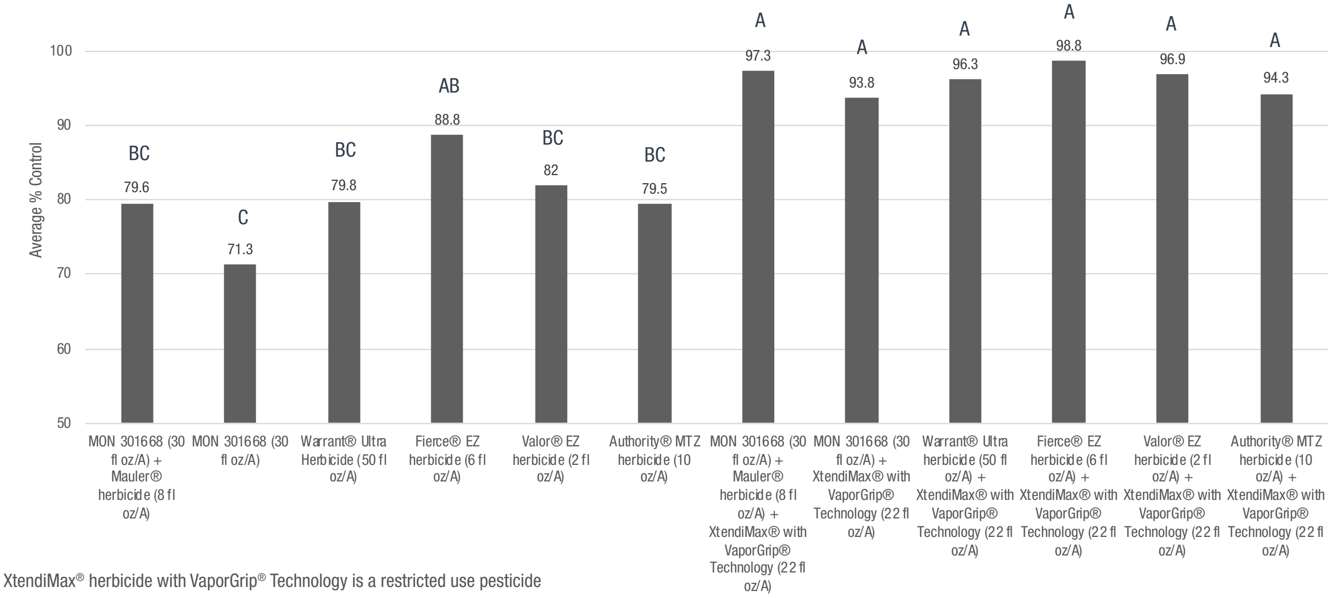


Figure 4. Average percent control of large-seeded broadleaf species with pre-emerge products alone and with XtendiMax® herbicide with VaporGrip® Technology at 7 locations 21 days after application. (Averages followed by same letter are not significantly different using Fishers Protected LSD at < 0.05).

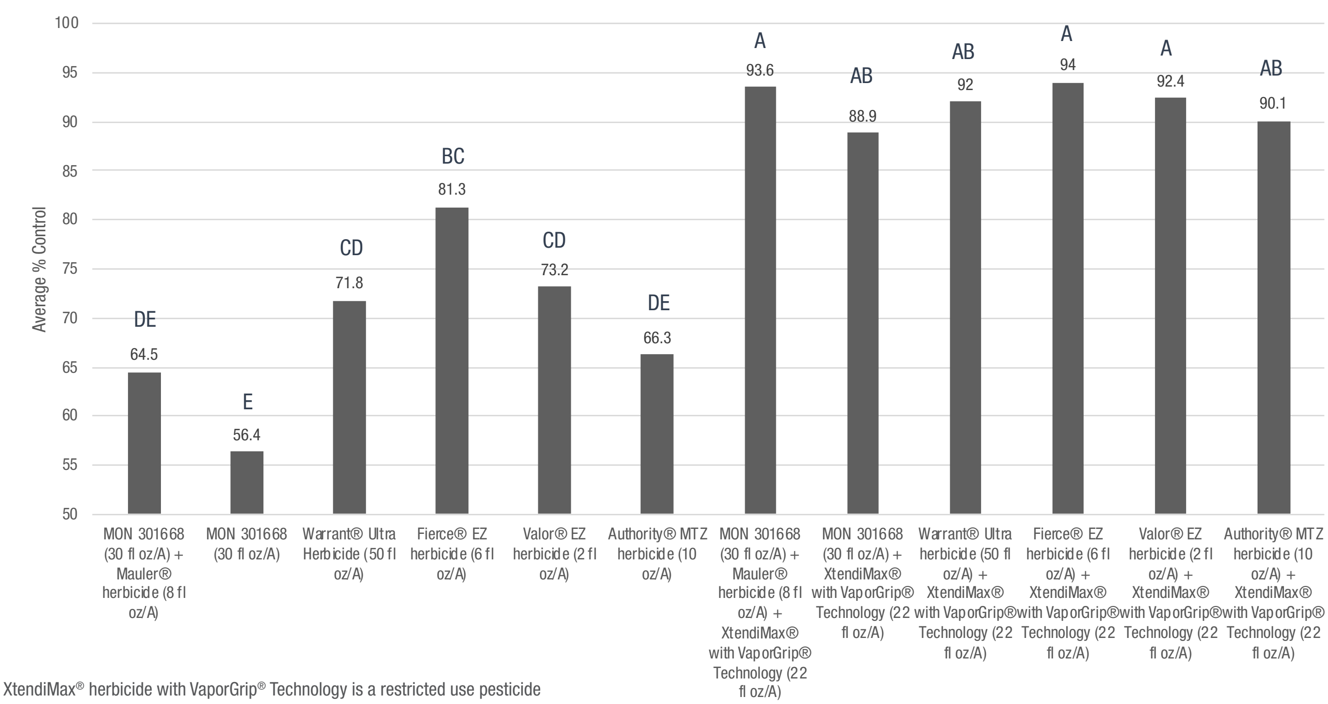


Figure 5. Average percent control of large-seeded broadleaf species with pre-emerge products alone and with XtendiMax® herbicide with VaporGrip® Technology at 8 locations 35 days after application. (Averages followed by same letter are not significantly different using Fishers Protected LSD at < 0.05).

Early Applications of XtendiMax® Herbicide with VaporGrip® Technology, a Restricted Use Pesticide, in the Roundup Ready® Xtend Crop System in Conventional Tillage Systems

Key Learnings

- The addition of XtendiMax® herbicide with VaporGrip® Technology increased control of broadleaf weeds in almost all cases, but particularly in large-seeded species such as giant ragweed, morning glory species, and velvetleaf at both 21 days and 35 days post application.
- Control of problematic *Amaranthus* species (Palmer amaranth, waterhemp, pigweeds) was improved with the addition of XtendiMax® herbicide with VaporGrip® in three of the six pre-emerge products at 35 days post application.

Legal Statements

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*Commercialization 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, or a recommendation to use, any unregistered pesticide for any purpose whatsoever. It is a violation of federal law to promote or offer to sell an unregistered pesticide.

XtendiMax® herbicide with VaporGrip® Technology is part of the Roundup Ready® Xtend Crop System, is a restricted use pesticide and must be used with VaporGrip® Xtra Agent (or an equivalent volatility reduction adjuvant). For approved tank-mix products (including VRAs and DRAs), nozzles and other important label information visit XtendiMaxApplicationRequirements.com.

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. 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.

XtendiMax® is a restricted use pesticide. Not all products are registered for use in all states and may be subject to use restrictions. The distribution, sale, or use of an unregistered pesticide is a violation of federal and/or state law and is strictly prohibited. Check with your local dealer or representative for the product registration status in your state. Tank mixtures: The applicable labeling for each product must be in the possession of the user at the time of application. Follow applicable use instructions, including application rates, precautions and restrictions of each product used in the tank mixture. Not all tank mix product formulations have been tested for compatibility or performance other than specifically listed by brand name. Always predetermine the compatibility of tank mixtures by mixing small proportional quantities in advance. Bayer, Bayer Cross, Roundup Ready®, VaporGrip®, Warrant® and XtendiMax® are registered trademarks of Bayer Group. Authority® is a trademark of FMC Corporation. Fierce® , Mauler® and Valor® are registered trademarks of Valent U.S.A. Corporation. All other trademarks are the property of their respective owners. For additional product information call toll-free 1-866-99-BAYER (1-866-992-2937) or visit our website at www.BayerCropScience.us. Bayer CropScience LP, 800 North Lindbergh Boulevard, St. Louis, MO 63167. 4001_R8