2022 FIELD RESEARCH BOOK

FEATURING 2021 RESEARCH RESULTS

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

How to Use This Book

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

DISEASES | ENVIRONMENT | FERTILITY | INSECT CONTROL | WEED CONTROL

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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.

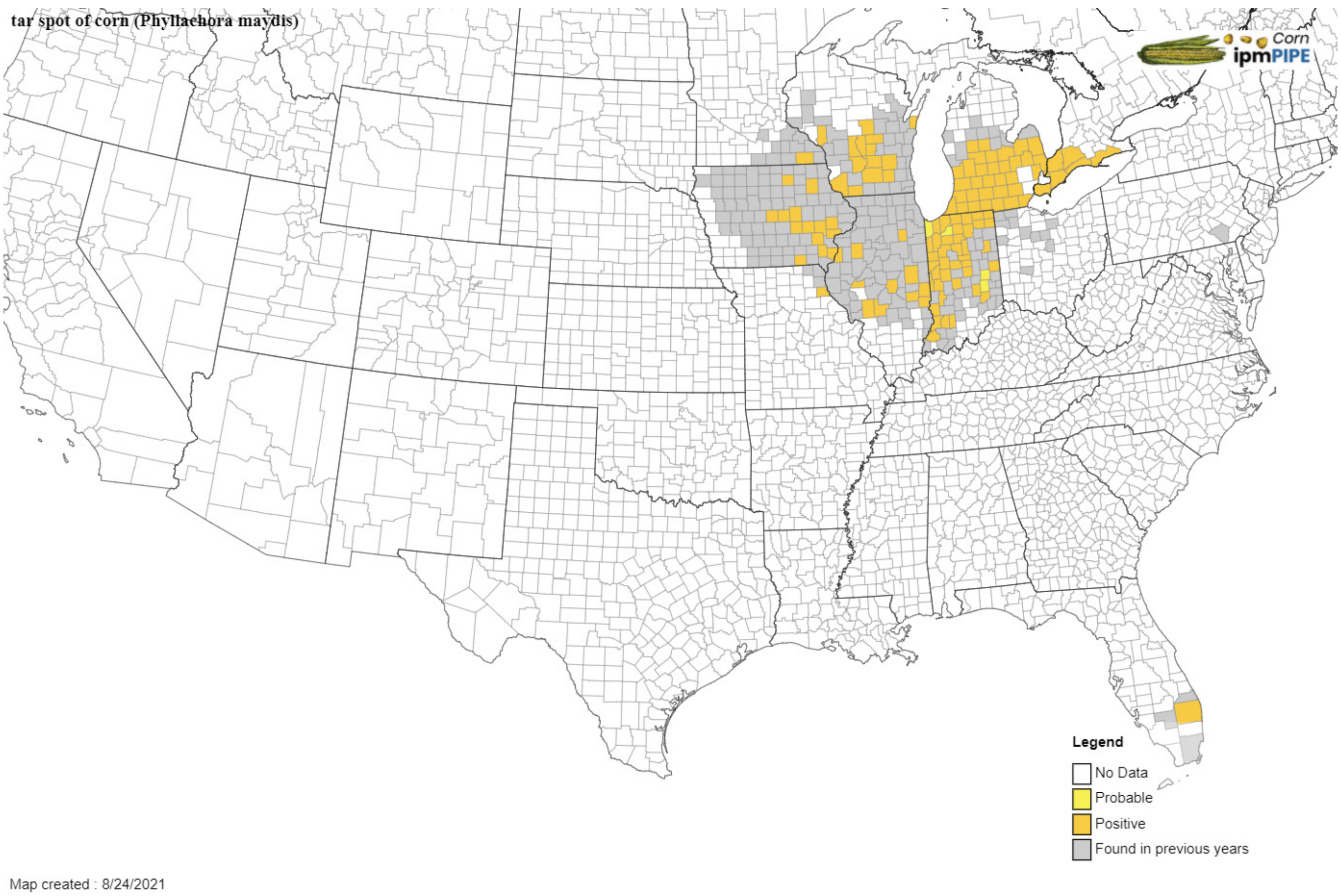

Figure 1. A map of current and previous tar spot infected areas as of August 2021 .

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]

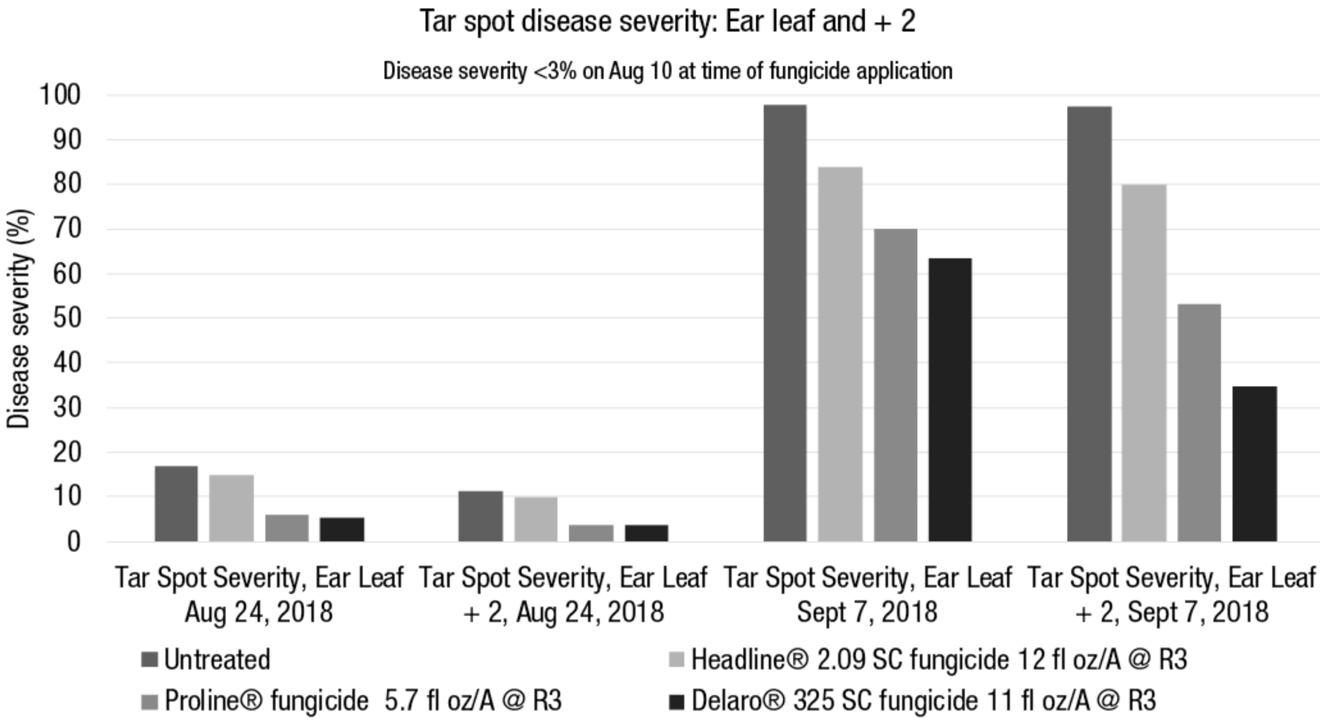

Figure 2. Effect of fungicide on tar spot disease severity in 2018, Ganges, Michigan.

- 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 fungicide	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 fungicide	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 fungicide	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

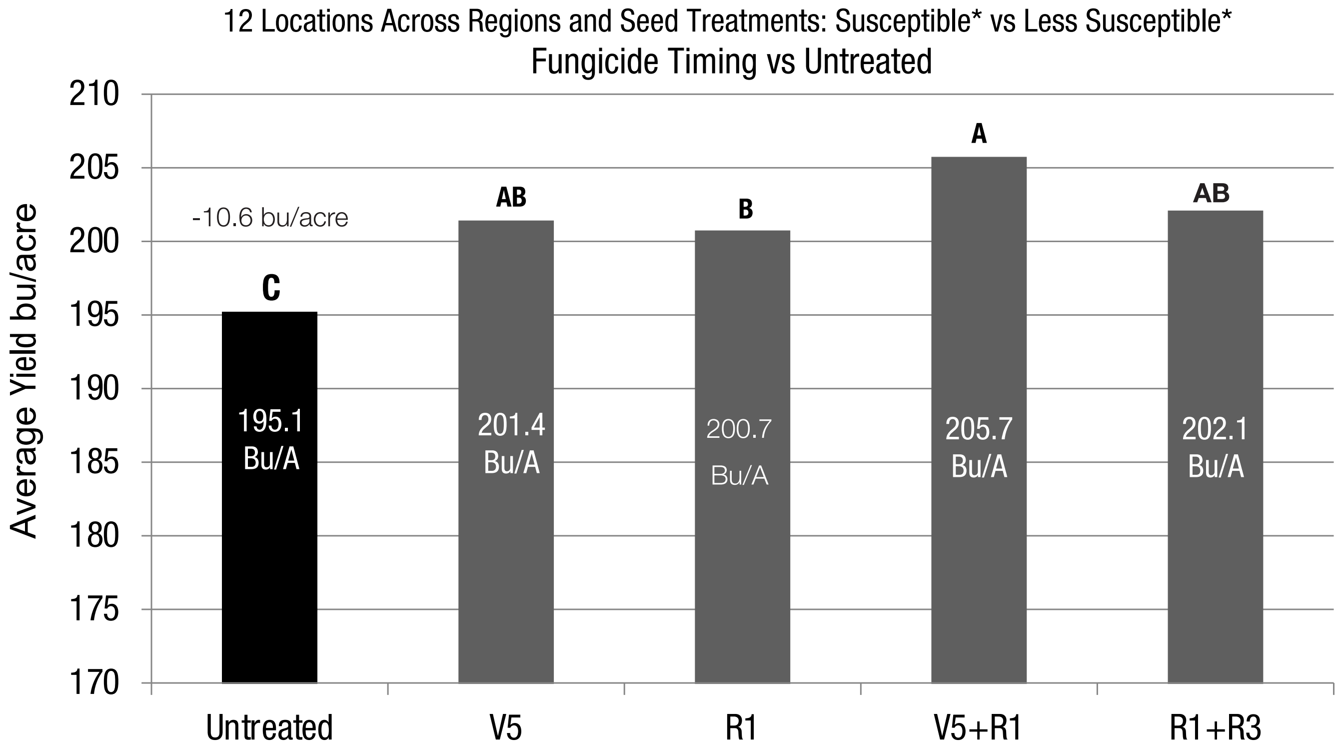

Figure 3. Results from the 2019 tar spot spray timing strip trial, which included 12 locations and tested fungicide application timing on susceptible* and less susceptible* corn products.

- 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

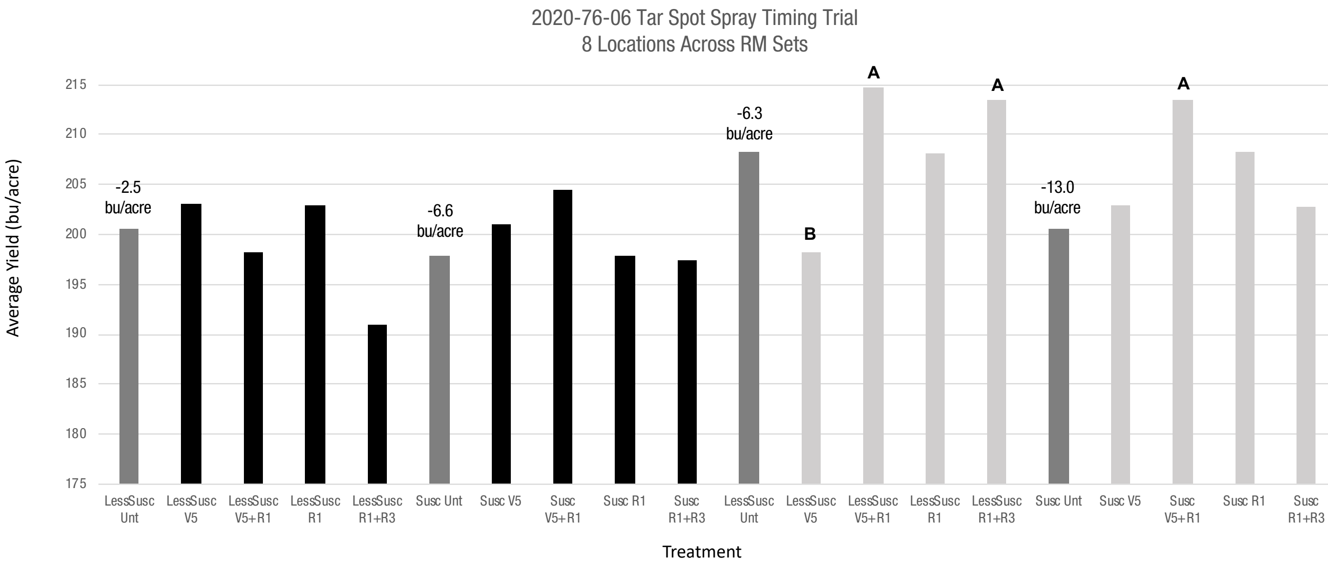

Figure 4. Results from the 2020 tar spot spray timing strip trial, which included eight locations and tested fungicide application timing on early and mid-relative maturity and susceptible* and less susceptible* corn products.

- 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

The information discussed in this report is from a multiple site, non-replicated strip trials. 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.

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6005_R12

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 DEKALB® brand corn products DKC49-72RIB Brand Blend and DKC52-34RIB Brand Blend 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

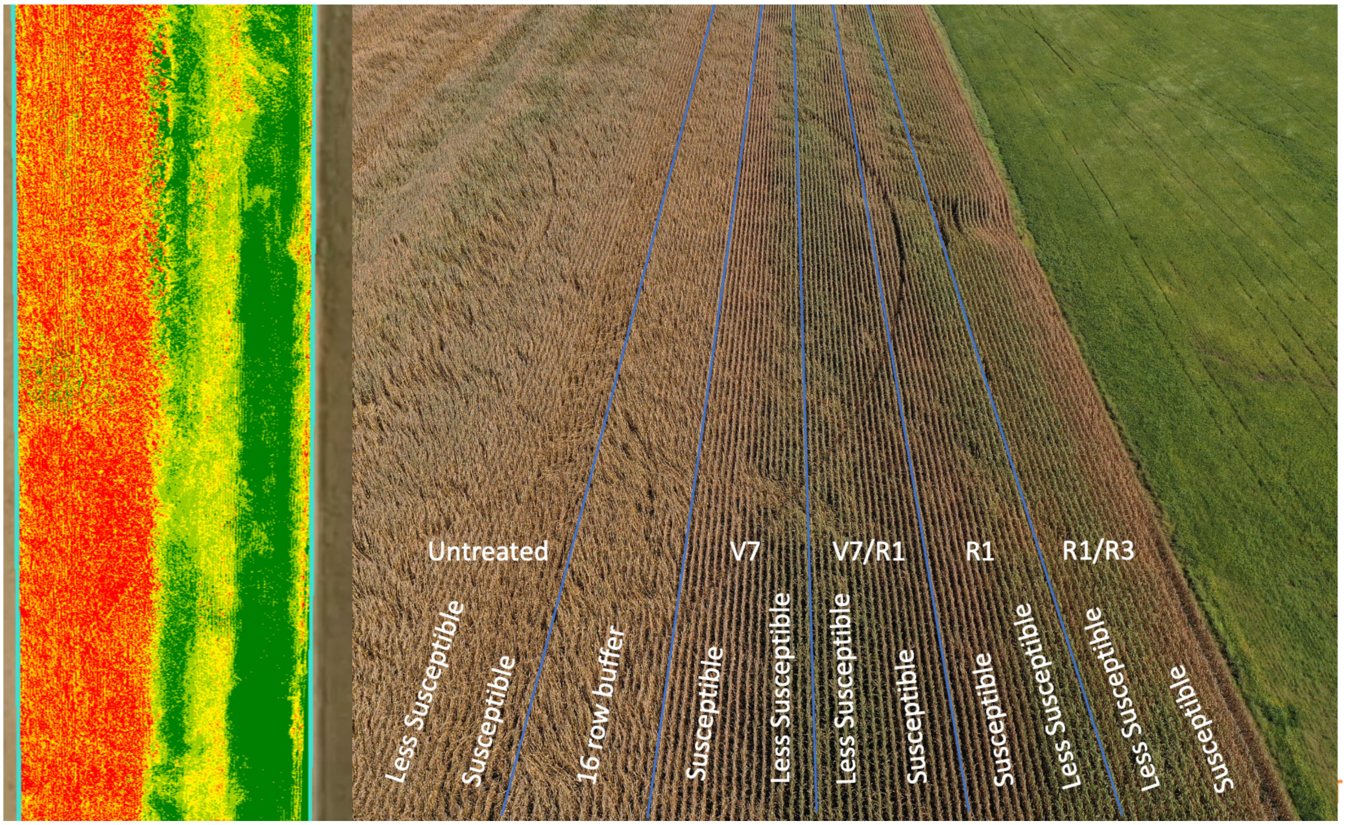

Figure 1. Aerial imagery of the trial at Colon, MI (2021). Normalized difference vegetation index (NDVI) of the trial on left and aerial photo of the trial with treatment labels on right.

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

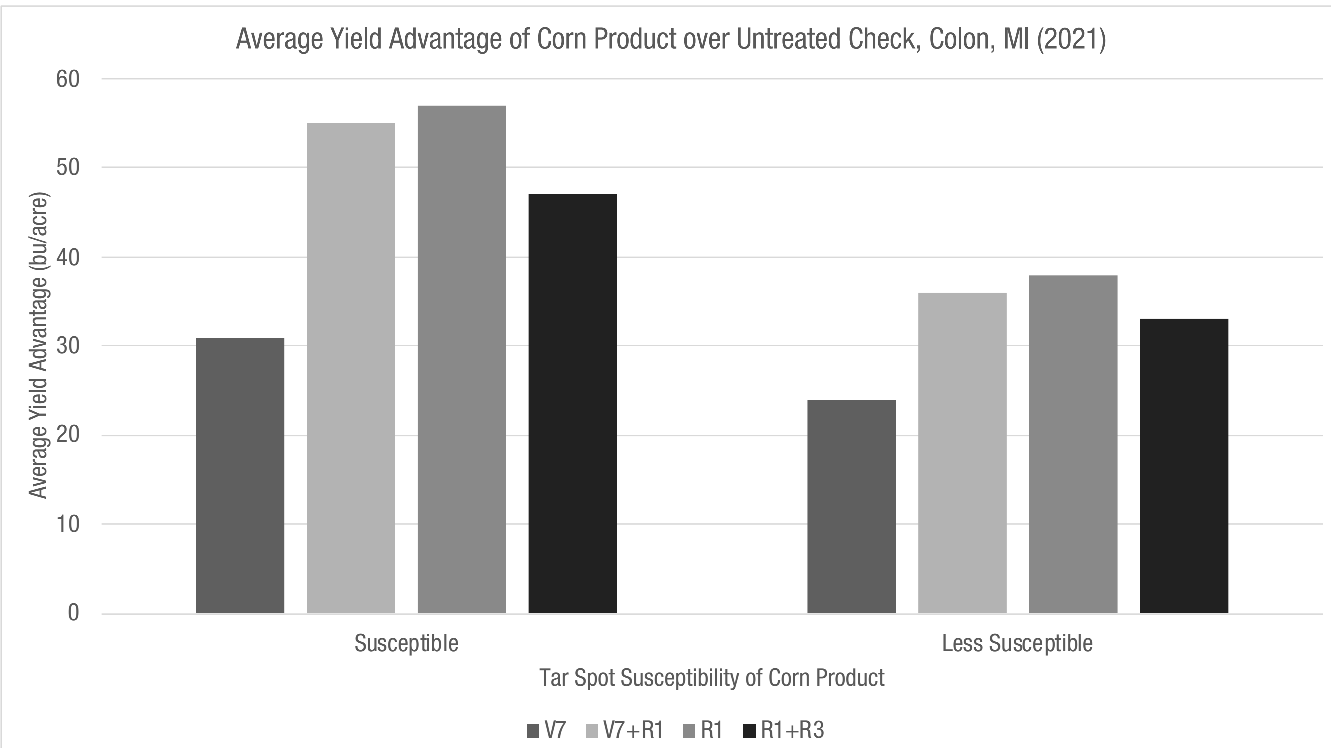

Figure 5. Average yield advantage of susceptible and less susceptible corn products at different fungicide timings over the untreated check in Colon, MI (2021).

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

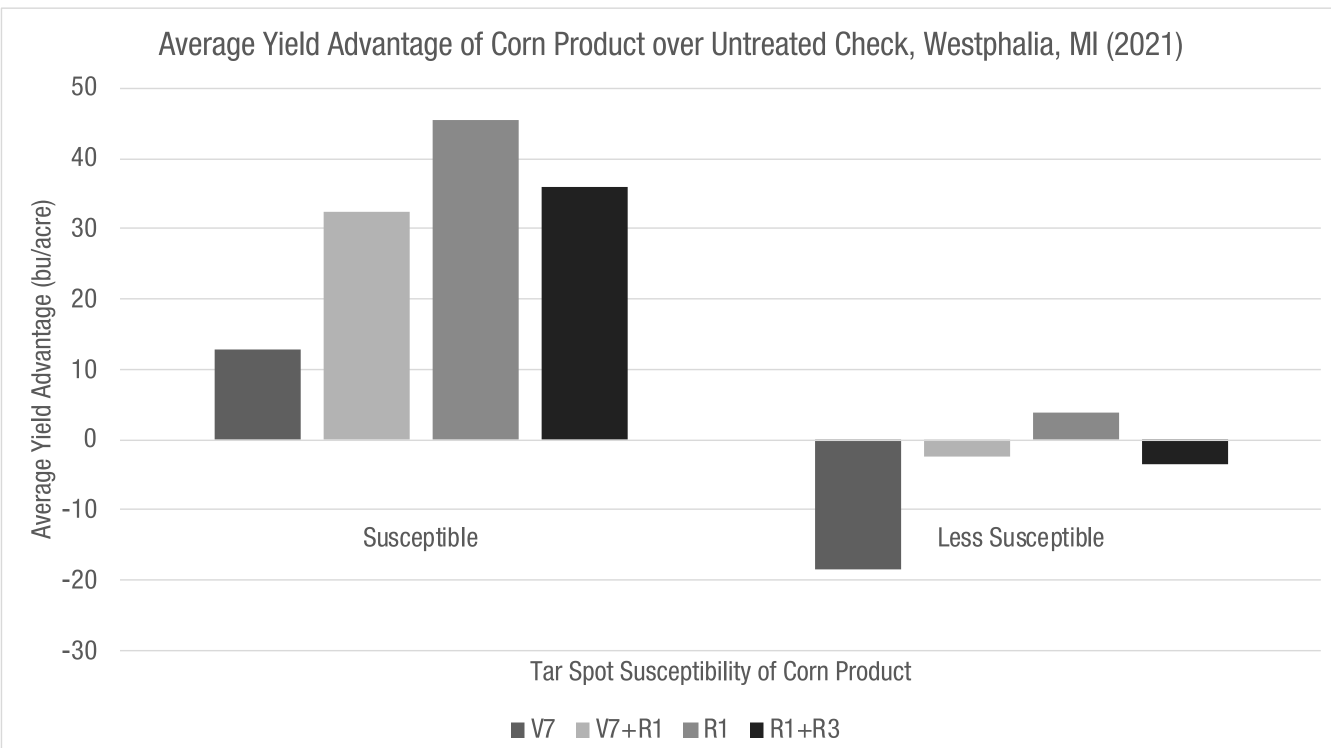

Figure 6. Average yield advantage of susceptible and less susceptible corn products at different fungicide timings over the untreated check in Westphalia, MI (2021).

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

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.

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. Bayer, Bayer Cross, DEKALB® and Delaro® are registered trademarks of Bayer Group. 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. 5006_R1_21_DK

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

Trial Objective

- Corn products yield response to fungicide applied at the R1 growth stage varies. Understanding which corn products to target with fungicides should help ease management decisions by growers.
- This trial helped determine the magnitude of yield response from individual corn products.

Experiment/Trial Design

- An early relative maturity (RM) (less than or equal to 103 day RM) corn product replicated trial was established in Mason, Michigan and a late RM (greater than 103 day RM) corn product trial was established in Colon, Michigan.
- DEKALB® brand corn products for Michigan were selected by local agronomists.
- The trial in Mason was a split-plot design with three replications with hybrid as the whole plot and fungicide as the sub-plot. This location received rainfall without irrigation.
- The trial in Colon was irrigated with a 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 using a high-clearance sprayer with 20 gal/acre of water as carrier.

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

- Below average rainfall was received until late-June and then near-normal for the remaining season in Mason.
- 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 DEKALB® Brand Corn Products to Fungicide Applied at Flowering

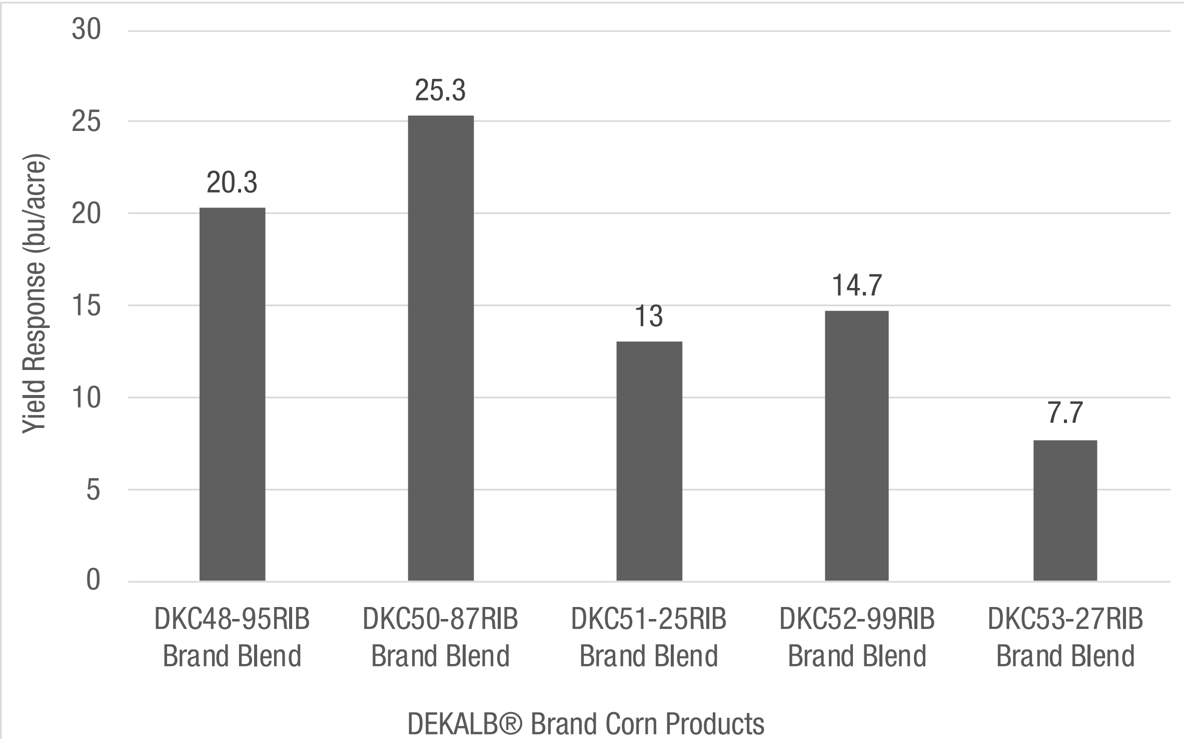

Figure 1. Yield response of DEKALB® brand corn products treated with fungicide at the R1 growth stage in Mason, MI.

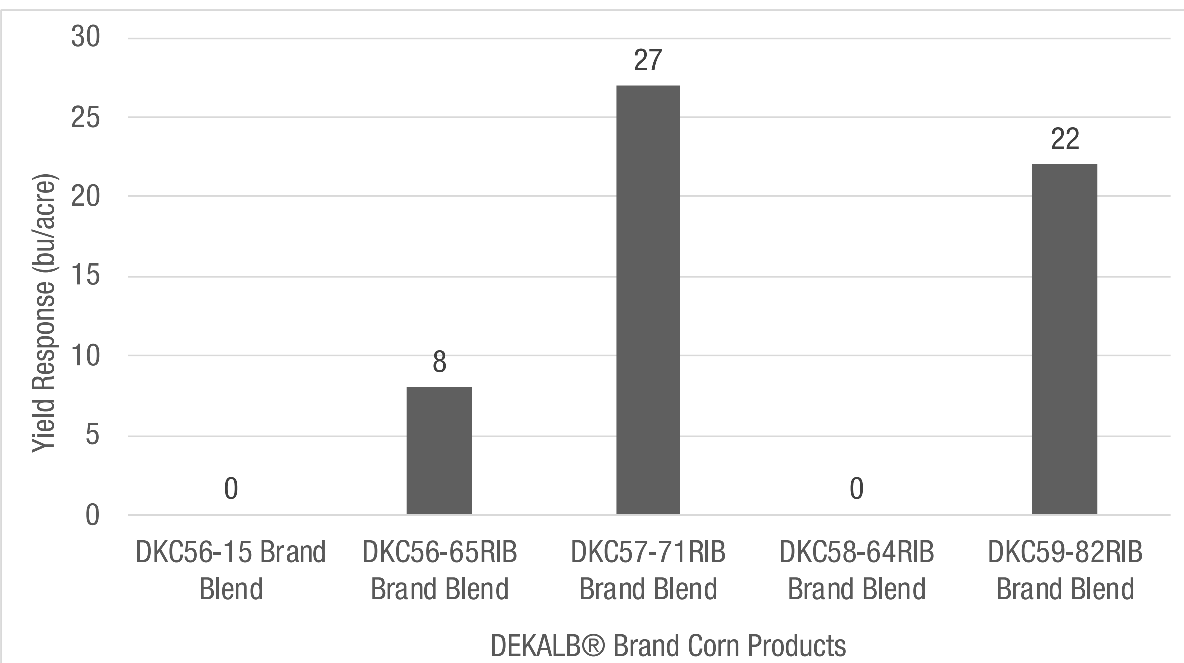

Figure 2. Yield response of DEKALB® brand corn products treated with fungicide at the R1 growth stage in Colon, MI.

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

Key Learnings

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

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Legal Statements:

Corn Response to Fungicide Application Timing

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		Delaro® Complete Fungicide	8 fl oz	VT (7/15/21)
6	113-RM				
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

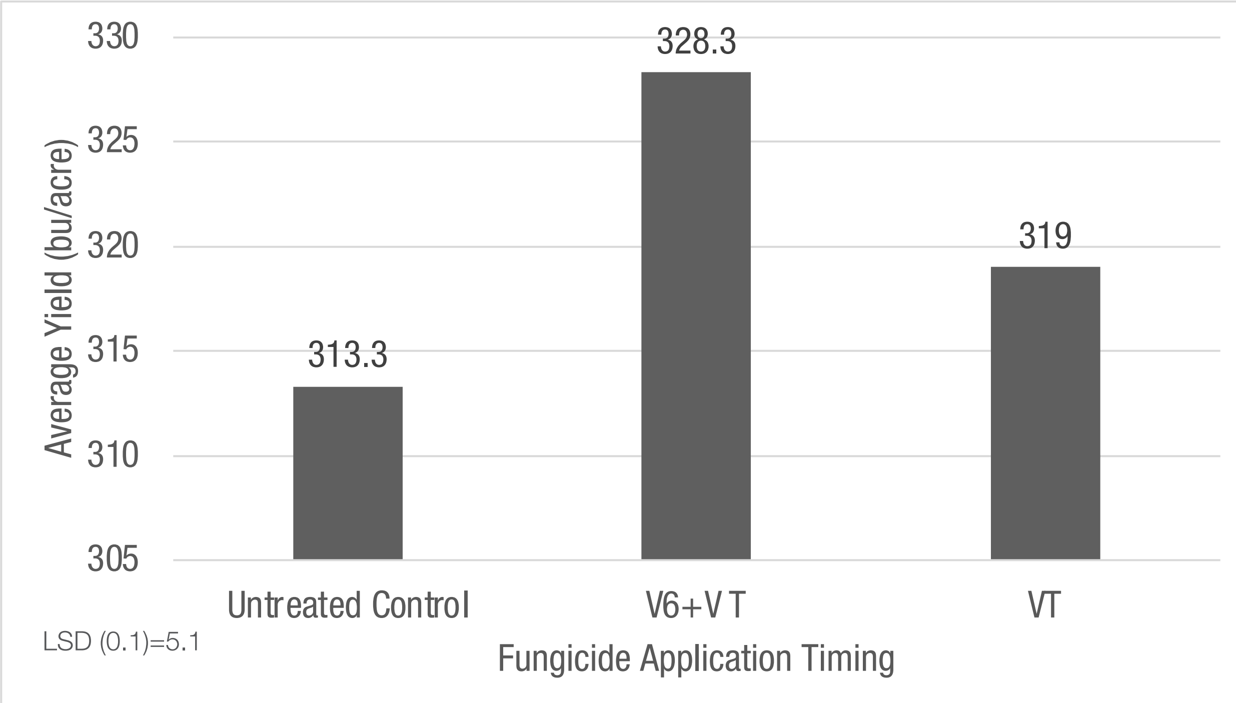


Figure 1. Average corn yields for three corn products as impacted by two fungicide rates and timings at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

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

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

6005_R7_21

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.

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

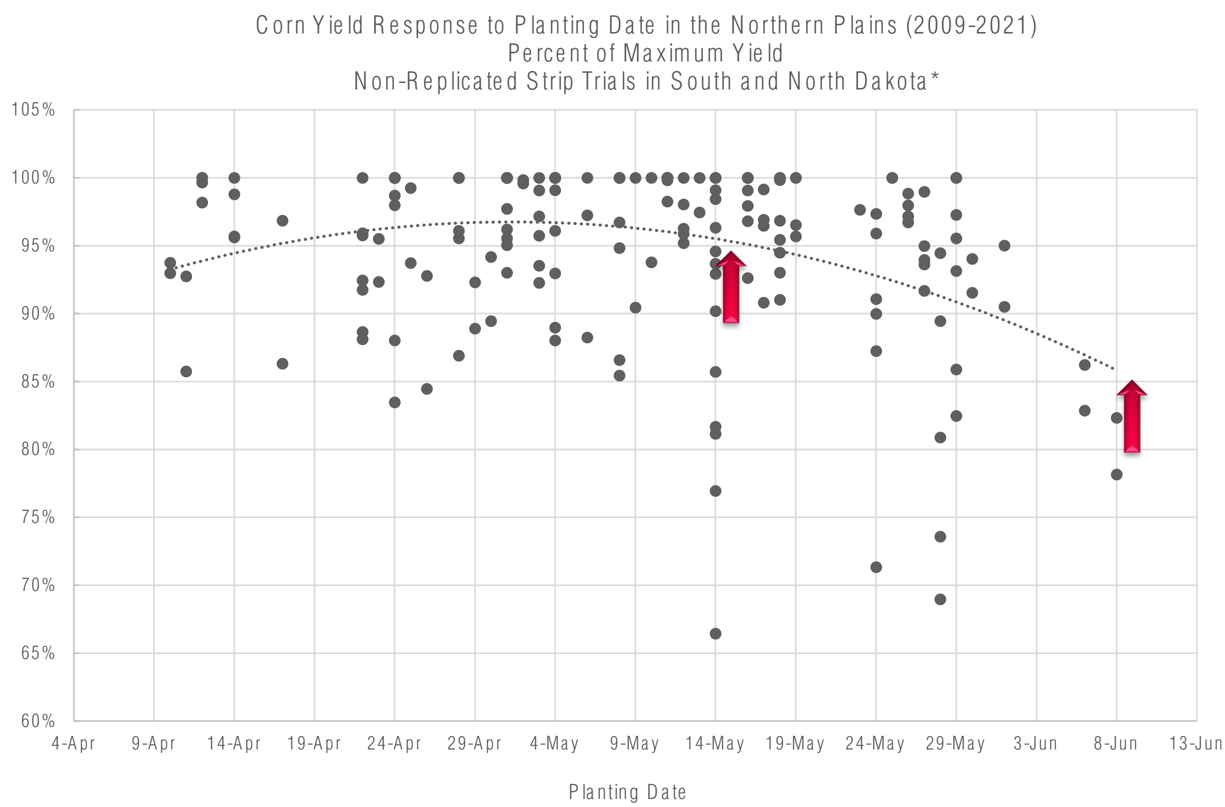
Experiment/Trial Design

- 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.

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

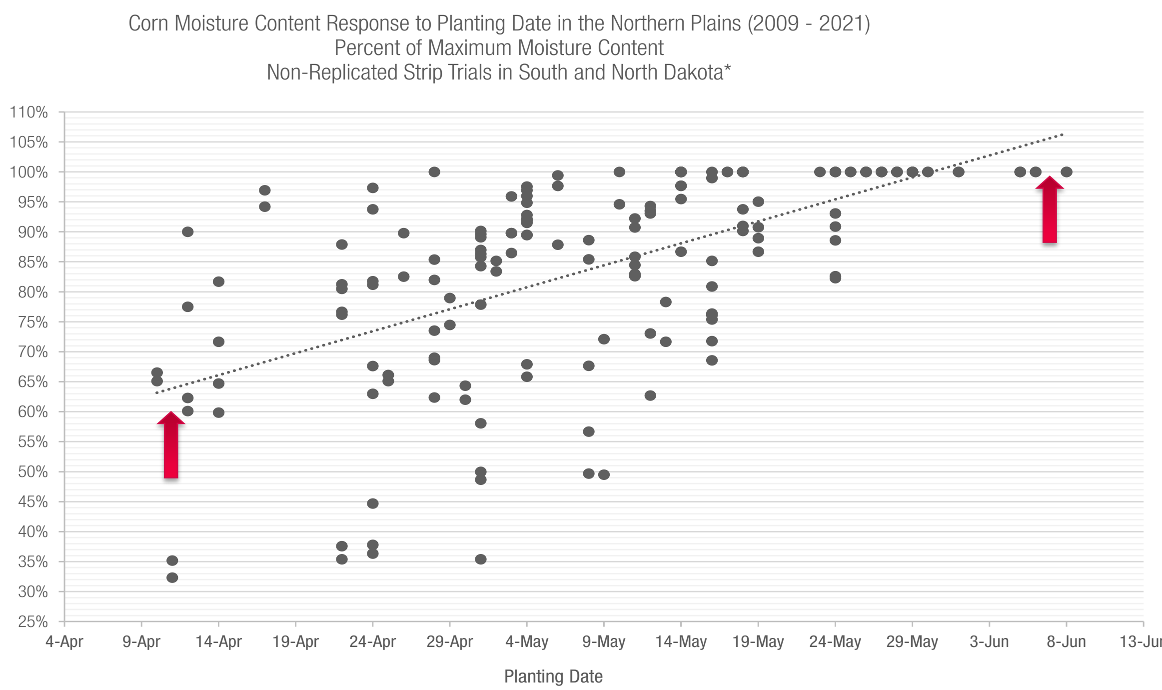


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Figure 2. On average, the percent moisture content increased 0.6% from the first planting date to the last (indicated by the arrows).

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

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.

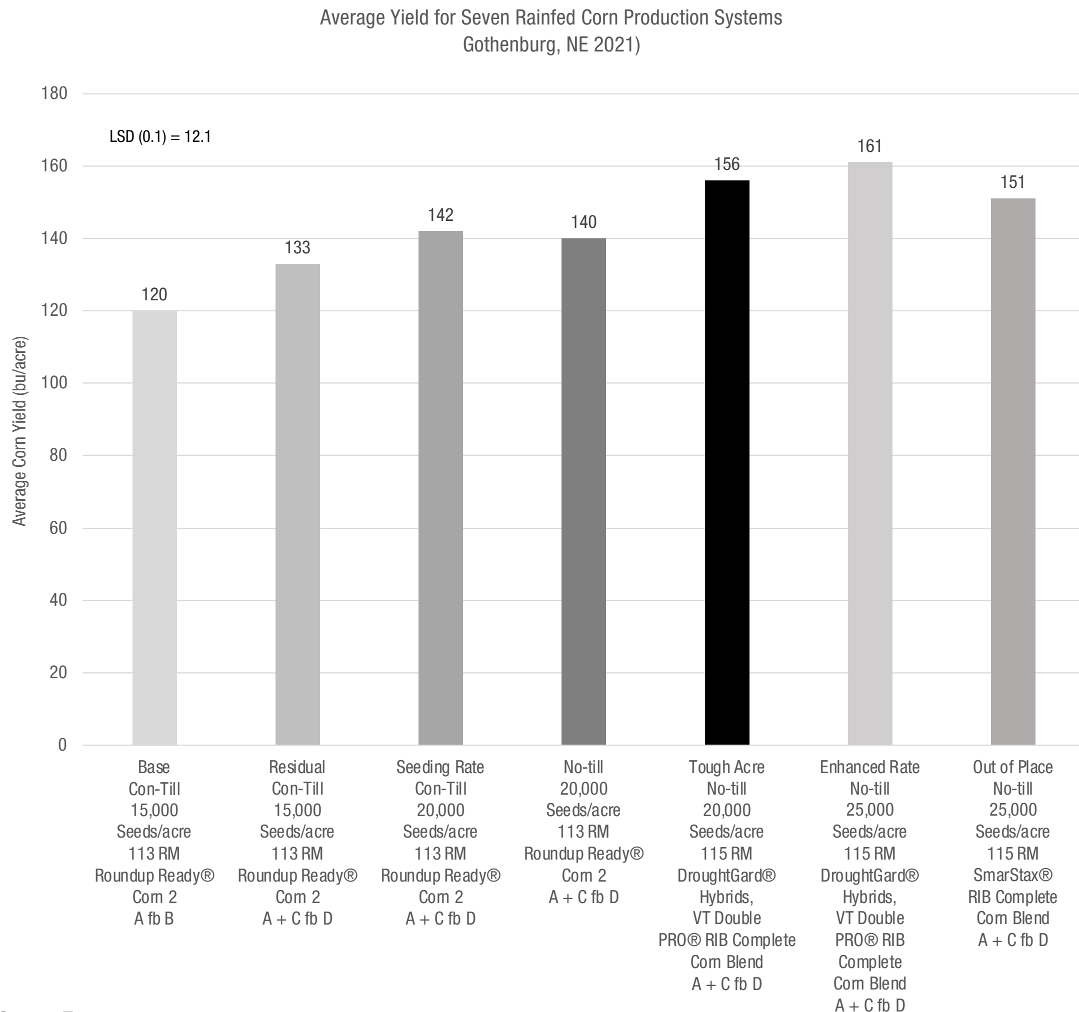
Factors to Help Increase Rainfed Corn Success

- 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.



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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Insect Resistance Management
Planting Refuges, Preserving Technology

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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

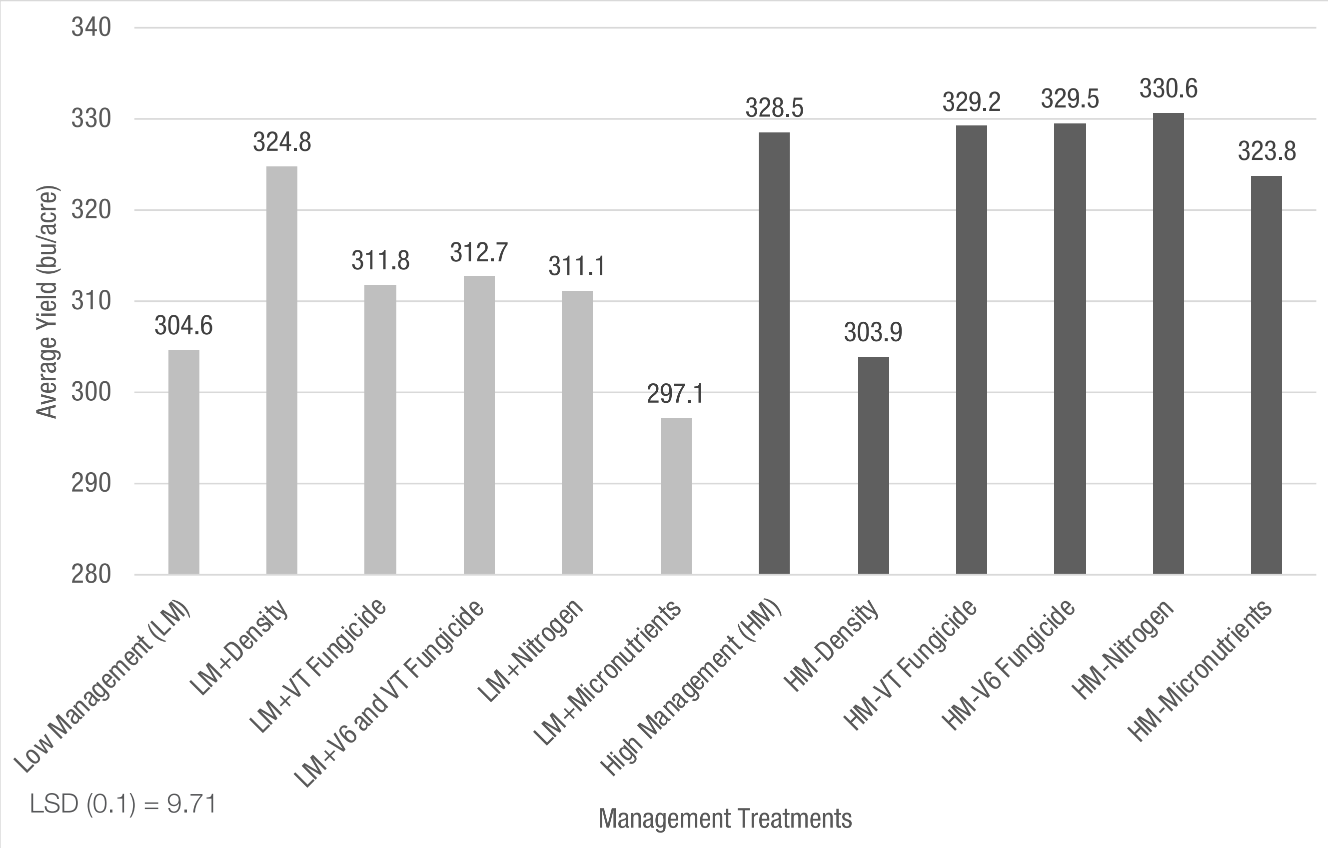

Figure 1. Impact of Management treatments on average corn yield.

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.

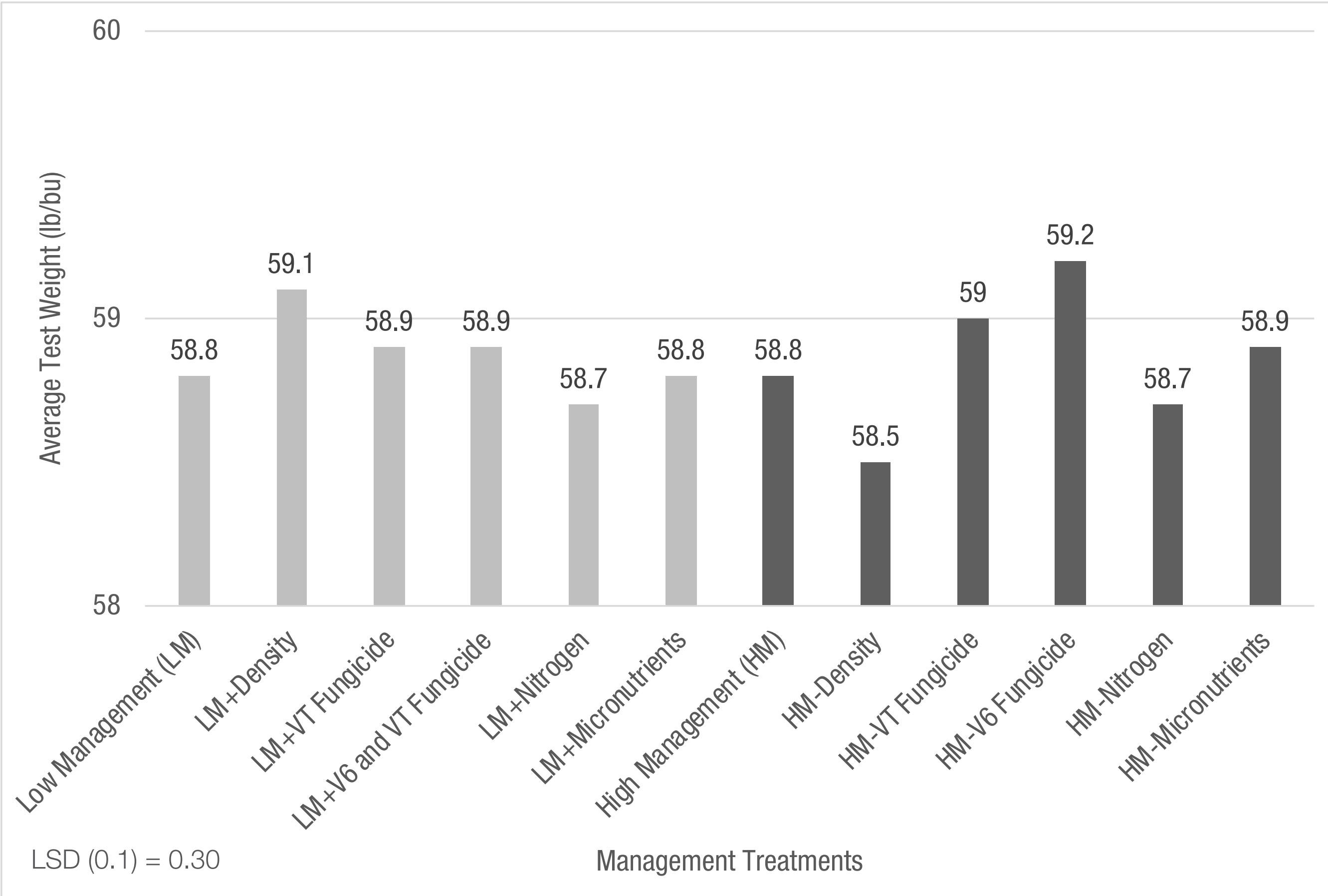

Figure 3. Impact of management treatments on corn test weight in 2021.

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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Roundup Ready 2 TECHNOLOGY

RESPECT THE REFUGE ®

DEKALB 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. Corn products vary in their tolerance to pH and can be considered low tolerant, semi-tolerant, or tolerant to the effects of high soil pH. 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. 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, the source of the high soil pH is excess lime from high calcium carbonate concentrations in the soil parent material resulting from eroded sidehills and cut areas in fields, 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 DEKALB® brand corn products of varying relative maturities (RMs) were each planted in one pH block in the field.
  - » 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.
- 20 of these products were DEKALB® RIB Complete® brand blend corn products; only the results of the DEKALB® brand products are shown in this report.
- A visual color rating (Figure 1) of the foliage was taken at the V8 and VT growth stage:
  - » very dark green = 2
  - » pale-yellow color = 8
- 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.

DEKALB Corn Products Response to High pH Soils

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

DEKALB Corn Products Response to High pH Soils

Understanding the Results

Table 1. 2021 Average yield of different DEKALB® brand blend corn products with a range of relative maturities (RM) grown in different soil pH conditions.

DEKALB® RIB Complete® Brand Blend Corn Product	Average Soil pH Value	Average Yield (bu/acre)	V8 Growth Stage Visual Color Rating	VT Growth Stage Visual Color Rating	Placement Recommendation
DKC48-68RIB	8.2	202.1	4.1	3.8	
DKC50-87RIB	8.2	191.4	4.4	4.1	
DKC51-91RIB	8.2	202.6	4.5	4.3	
DKC51-98RIB	8.2	198.2	4.1	4.0	
DKC52-99RIB	8.2	225.2	4.3	4.2	
DKC54-38RIB	8.3	177.4	5.6	5.3	
DKC54-64RIB	8.2	207.4	4.5	4.5	
DKC55-37RIB (silage only product)	8.2	201.3	4.2	4.0	
DKC56-15RIB	8.2	215.8	3.9	4.2	
DKC56-65RIB	8.3	213.4	4.0	4.2	
DKC57-29RIB	8.2	228.6	4.8	4.4	
DKC58-64RIB	8.2	220.0	4.4	4.1	
DKC59-81RIB	8.2	223.5	4.1	4.3	
DKC61-40RIB	8.1	224.6	4.3	4.0	
DKC62-22RIB	8.2	217.2	3.9	4.0	
DKC62-69RIB	8.2	215.4	4.4	4.7	
DKC62-89RIB	8.1	228.8	4.3	4.8	
DKC63-90RIB	8.2	215.3	4.1	4.3	
DKC64-44RIB (silage only product)	8.2	202.7	4.1	4.1	
DKC64-64RIB	8.2	224.8	4.5	4.6	
Average	8.2	211.8	4.3	4.3	
Highly Recommended	Recommended	Use with Caution	Not Recommended		

- DKC54-38RIB brand blend was the poor performance check on high pH soils and it has the lowest yield of all corn products in the trial at 177.4 bu/acre, this product is not recommended for high pH soils.
- DKC48-68RIB brand blend, DKC51-91RIB brand blend, and DKC61-40RIB brand blend all maintained healthy plant color and above average yield potential when compared to similar maturity products. These products are highly recommended for high pH soils.

DEKALB Corn Products Response to High pH Soils

- Corn products DKC50-87RIB brand blend, DKC51-99RIB brand blend, DKC52-99RIB brand blend, DKC54-64RIB, DKC55-37RIB brand blend, DKC56-15RIB brand blend, DKC56-65RIB brand blend, DKC58-64RIB brand blend, DKC59-81RIB brand blend, DKC62-22RIB brand blend, DKC63-90RIB brand blend, and DKC64-44RIB brand blend had slightly above average visual appearance and comparable yields to similar maturity products. These products are recommended for high pH soils.
- DKC57-29RIB brand blend, DKC62-69RIB brand blend, DKC62-89RIB brand blend and DKC64-64RIB brand blend had slightly below average visual appearance throughout the growing season. It is recommended to use these products with caution on high pH soils.

Key Learnings

- High pH soils are typically found in areas with eroded topsoil and topography changes and in those situations, it can be difficult to compare yield potential 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.

Legal Statements

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

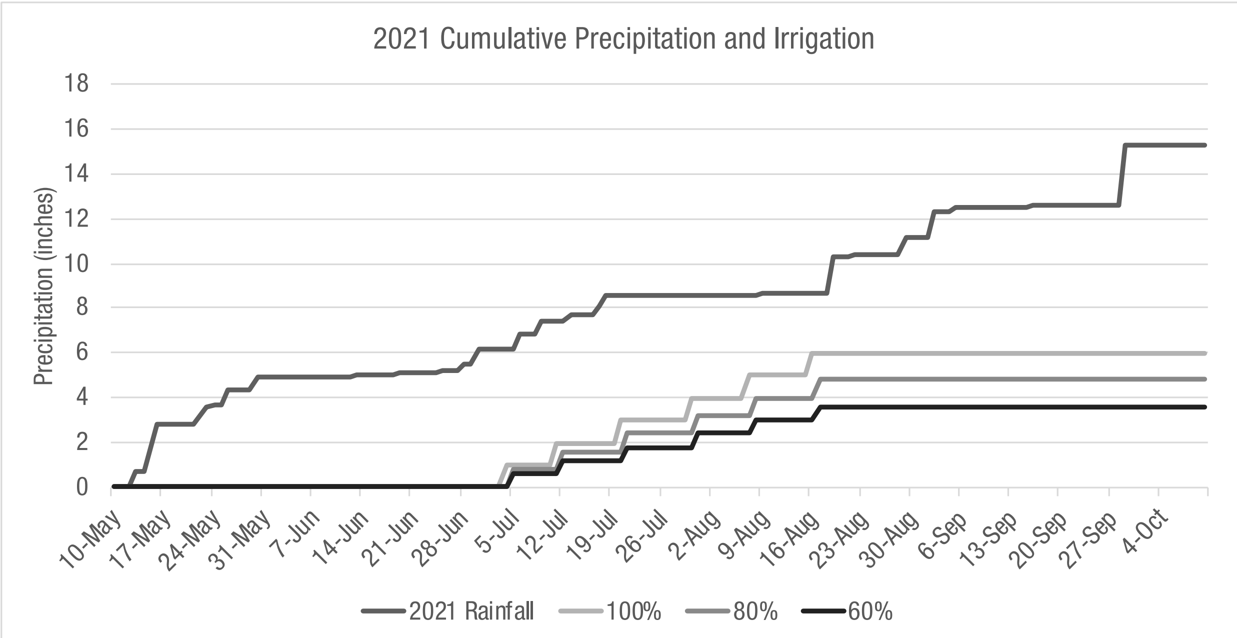

Figure 1. Precipitation and irrigation accumulation in 2021 at the Bayer Water Utilization Learning Center, Gothenburg, NE.

Understanding the Results

Corn Product Yield

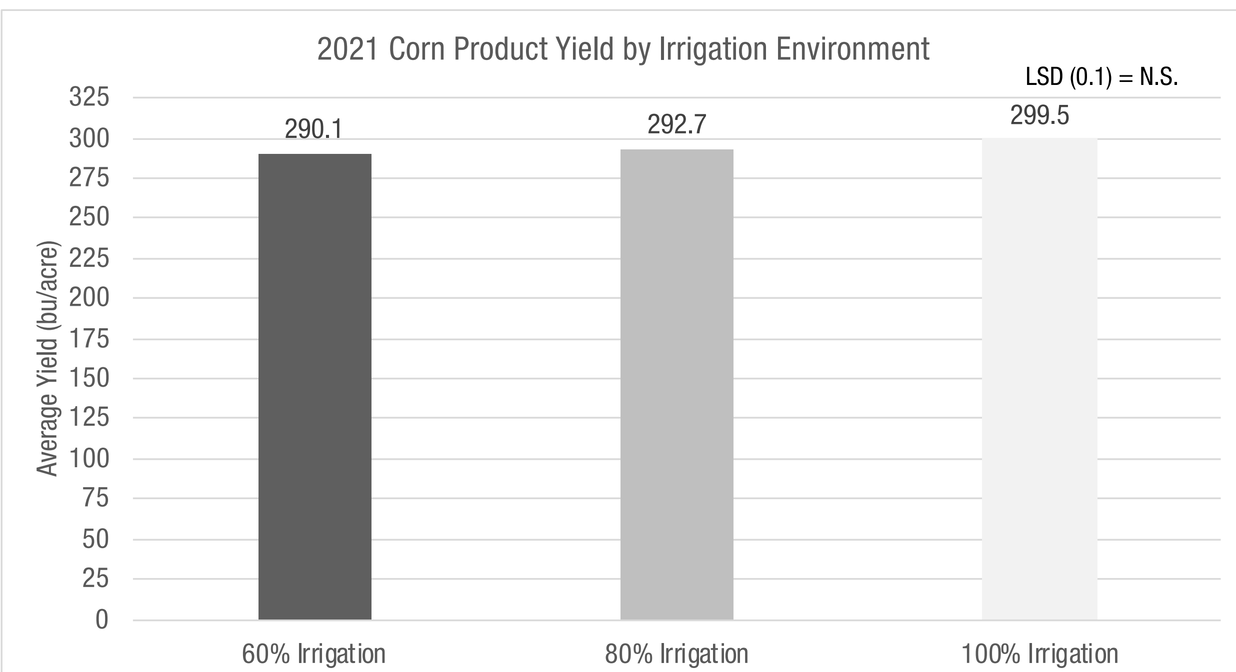

Figure 2. Average corn product yield by irrigation treatment at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

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.

Legal Statements

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

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

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

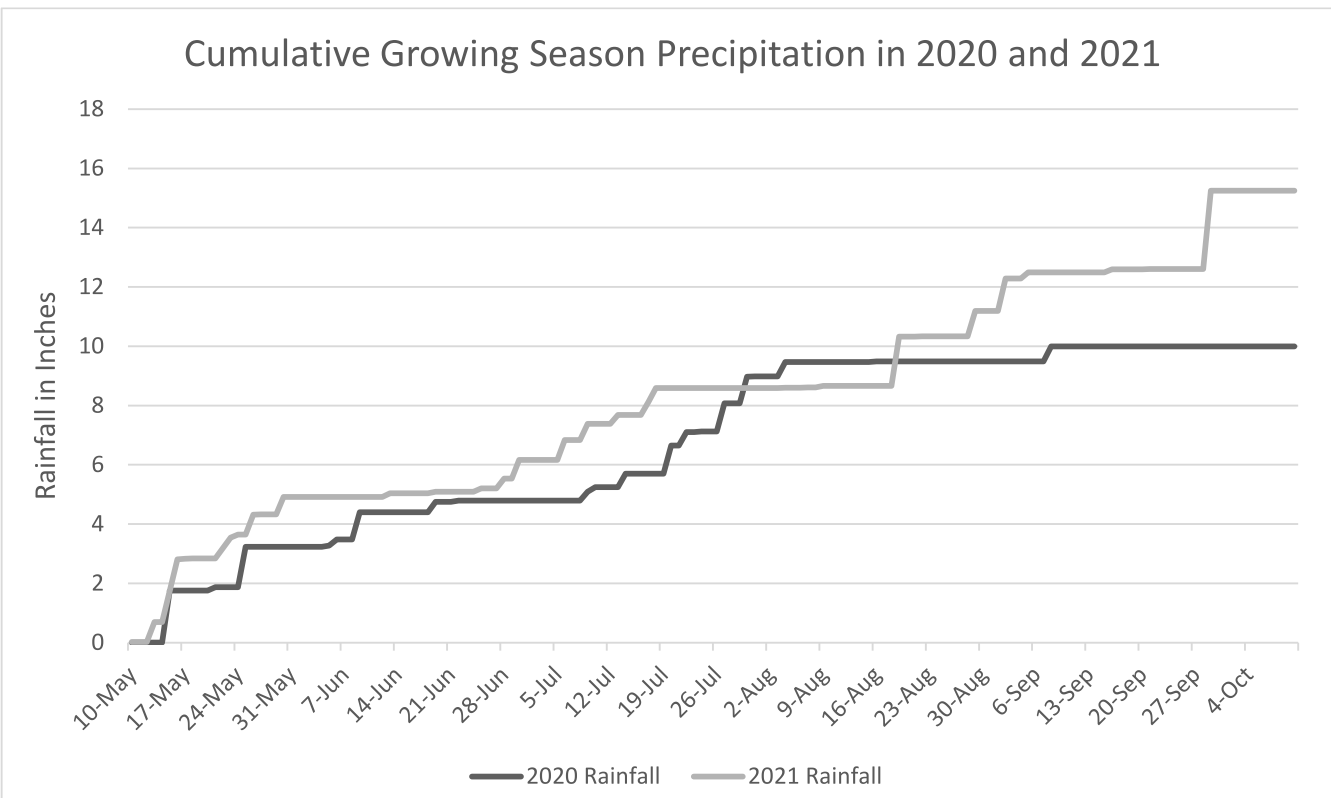

Figure 1: 2020 and 2021 rainfall patterns throughout the growing season from May to October

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

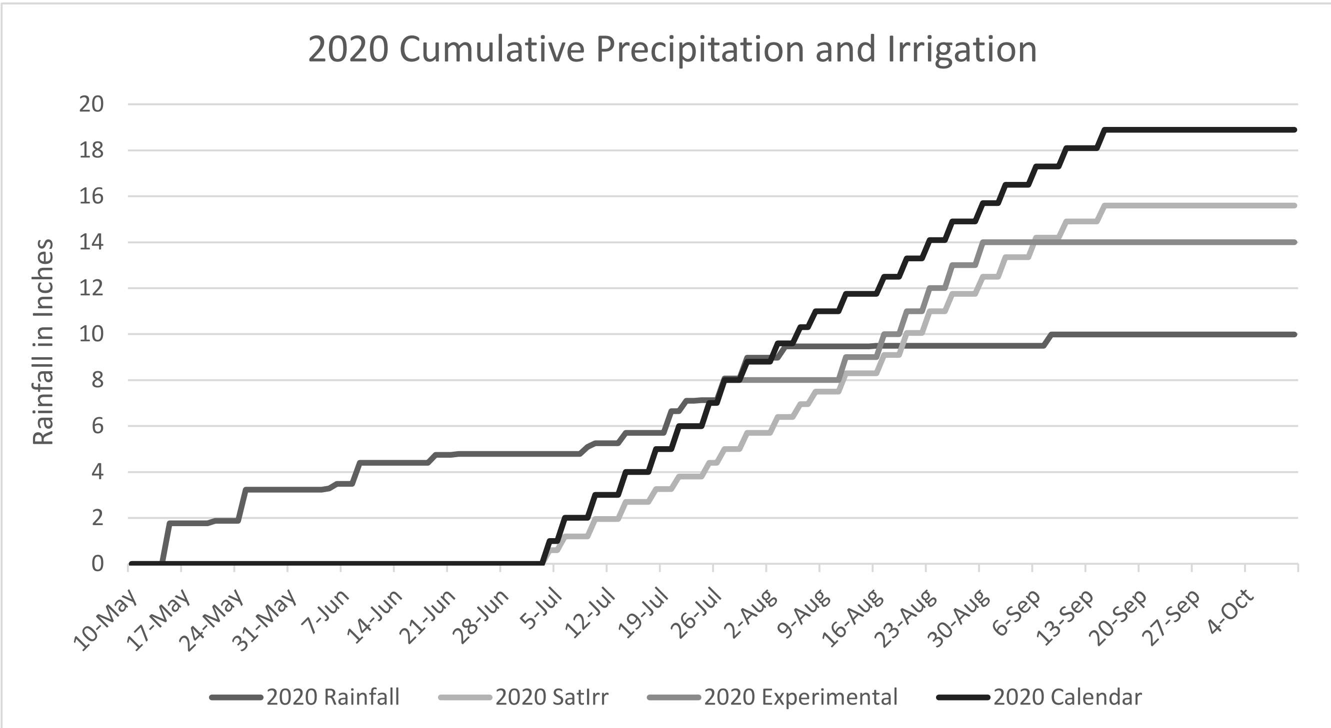

Figure 2: Irrigation totals were high for all three irrigation strategies in 2020

- 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.

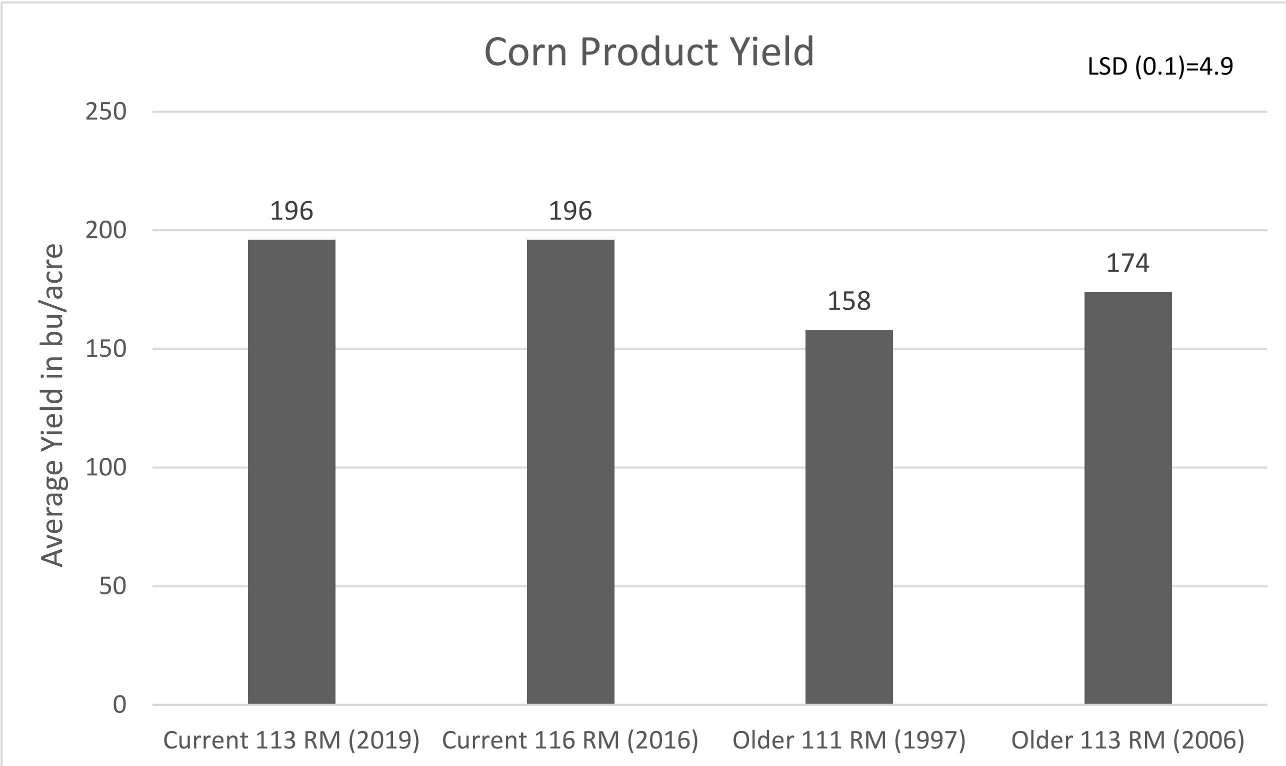

Figure 3: Average yields in 2020 for corn products with a range of relative maturities (RM) and different product ages.

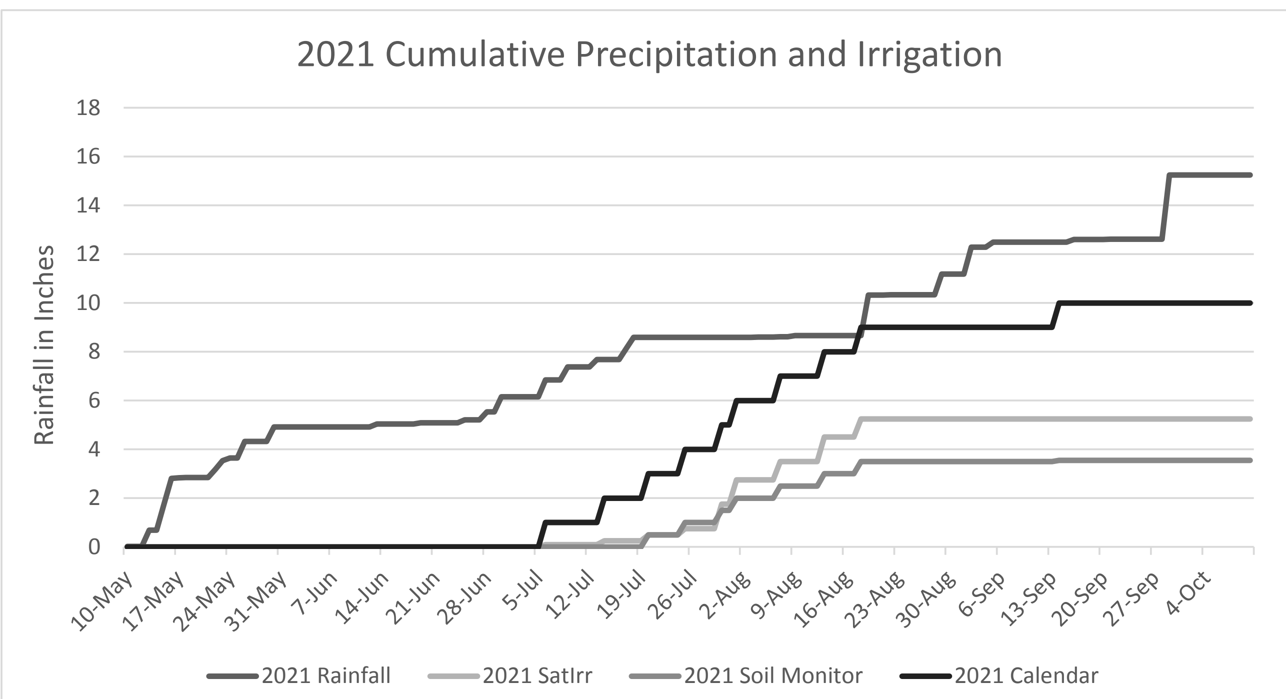

Figure 4: Because of increased late season rainfall in 2021 irrigation totals were reduced compared to the 2020 growing season.

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.

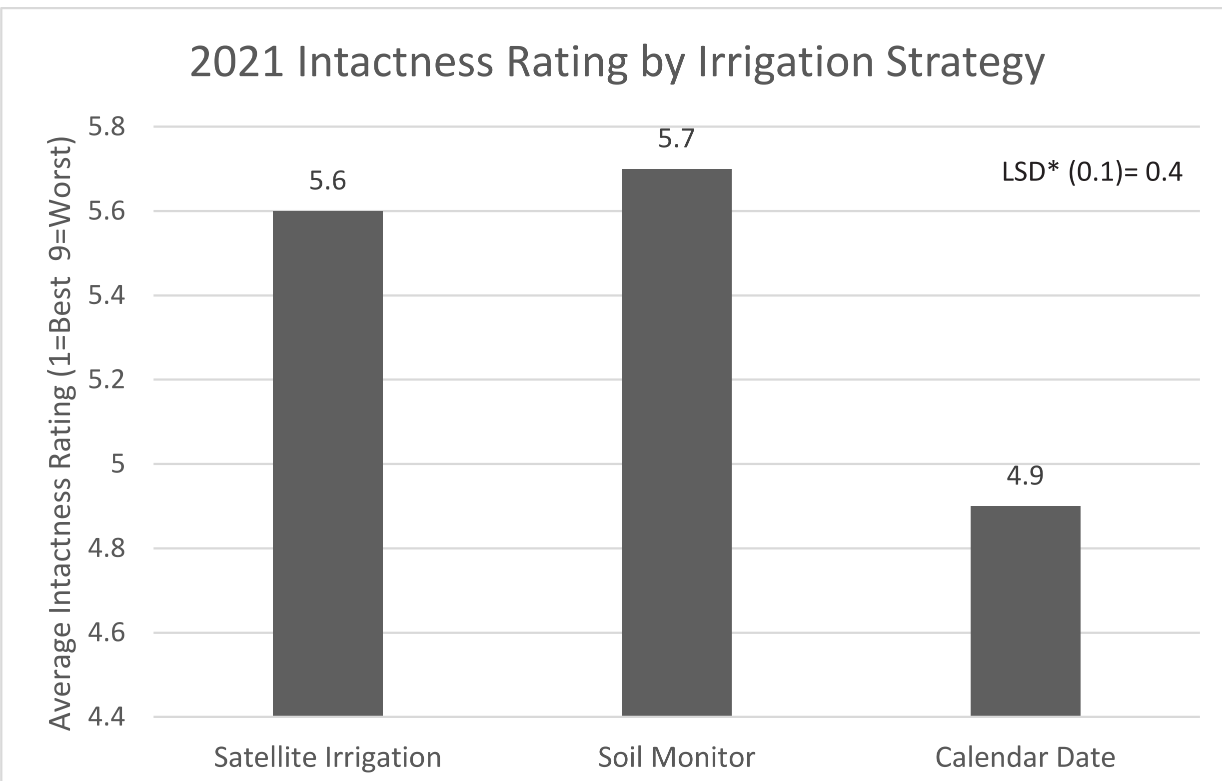

Figure 5: 2021 Average Intactness rating by irrigation strategy. *LSD (least significant difference) calculated as part of a larger trial containing 5 corn products

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.

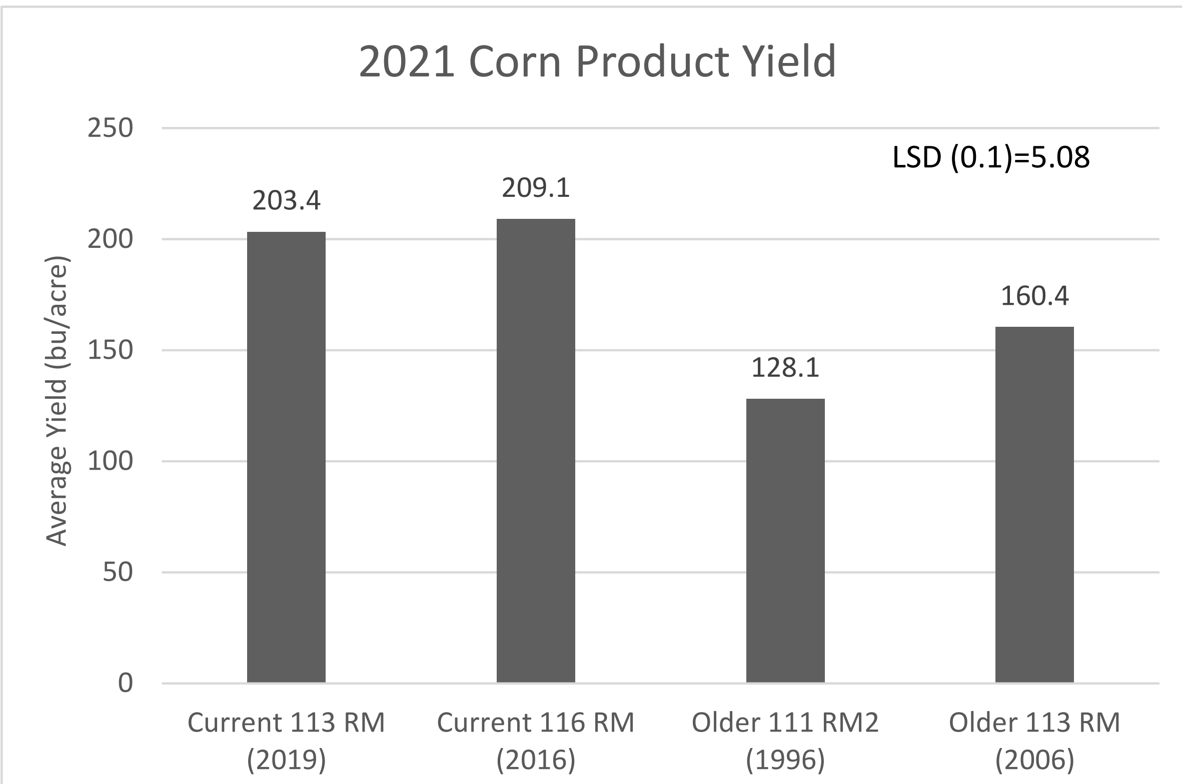

Figure 6: Average Corn Product yields in 2021 for corn products with a range of relative maturities and different product ages. *LSD (least significant difference) calculated as part of a larger trial containing 5 corn products

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

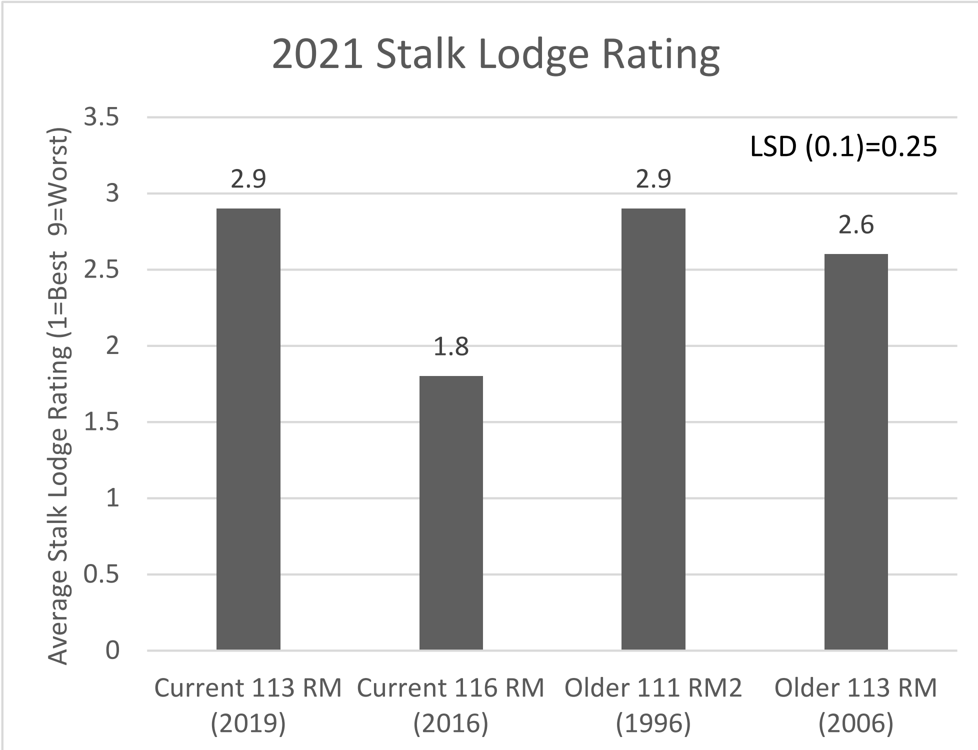

Figure 7: 2021 stalk lodging rating for corn products with a range of relative maturities and different product ages. *LSD (least significant difference) calculated as part of a larger trial containing 5 corn products

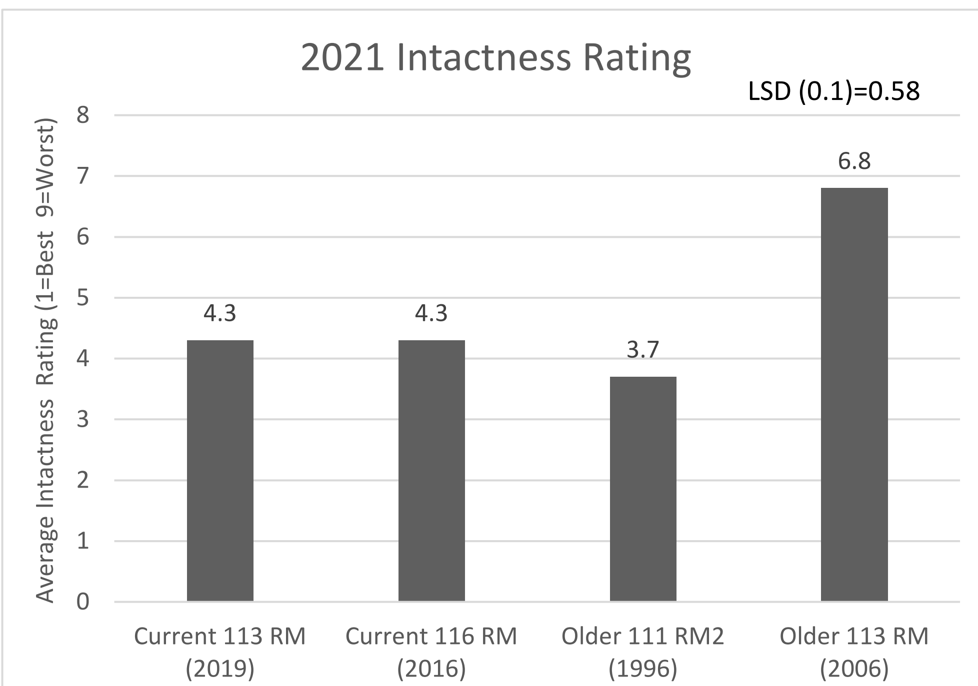

Figure 8: 2021 corn intactness ratings by corn products with a range of relative maturities and different product ages. *LSD (least significant difference) calculated as part of a larger trial containing 5 corn products

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

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

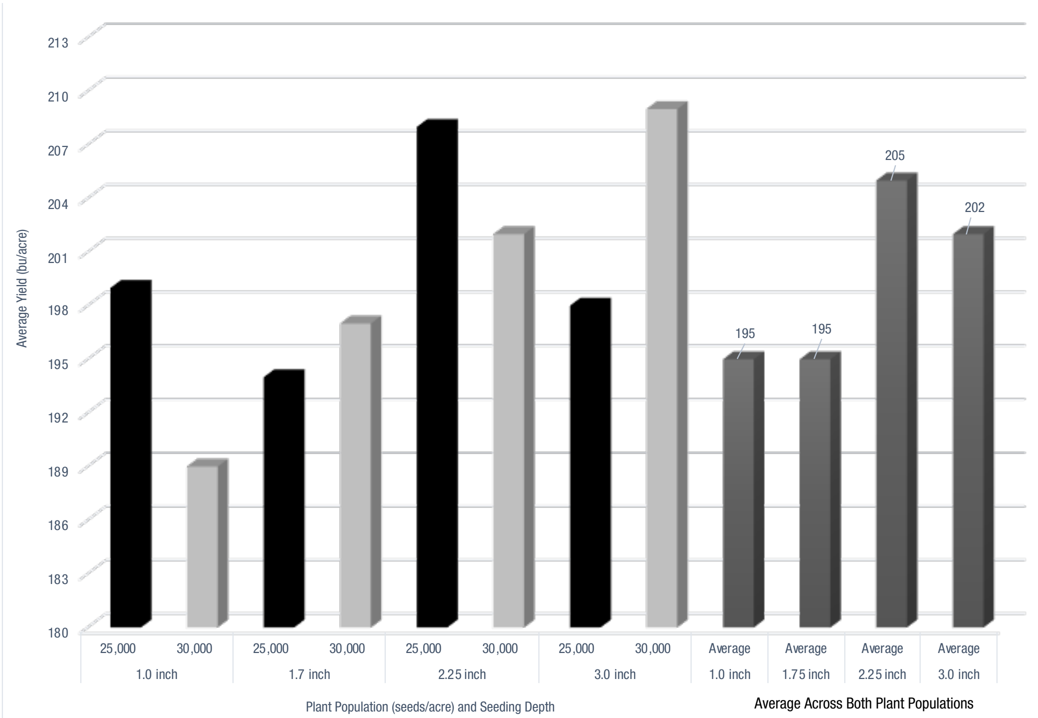

Figure 2. Corn yield performance averaged across 3 corn products planted at 2 different populations and 4 different depths. Beatrice, NE 2021.

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

Dryland Corn Seeding Rates Effect on Product Grain Yield

Trial Objective

- Selecting the appropriate products and seeding rates is 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 these tillers compensate for grain yield when 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.
- Eleven DEKALB® RIB Complete® brand blends and three Pioneer® brand products were evaluated with relative maturities (RM) ranging from 102 to 114 days (Table 1).
- 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/ nitrogen (N)/acre, 40 lb phosphorus (P)/acre, and 20 lb of sulfur (S)/acre. Nitrogen was also side-dressed on 06/22/2021 using Y-drops at 60 lb (N)/acre.
- Weeds were controlled uniformly across the study area.

Dryland Corn Seeding Rates Effect on Product Grain Yield

Understanding the Results

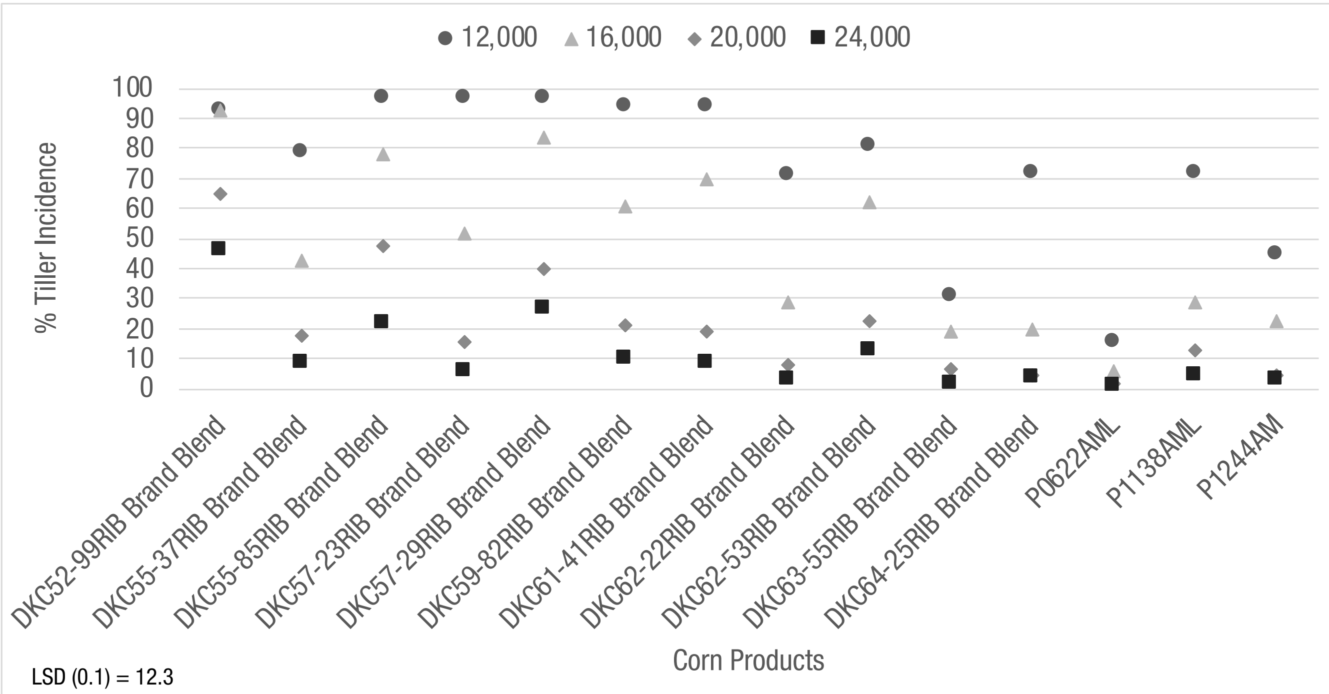

Figure 1. Tiller incidence (%) of DEKALB® brand and Pioneer® brand corn products according to seeding rates in dryland conditions. LSD (least significant difference) calculated as part of a larger trial containing 20 corn products at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

- There was a significant interaction between product and seeding rate in tiller incidence in this study.
- Even though tiller incidence was variable by corn products, a greater tiller incidence was observed under lower corn seeding rates of 12,000 and 16,000 seeds/acre compared to the 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/acre)					
	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 (%)					
DKC52-99RIB Brand Blend	-22.0	-35.0	-51.0	-13.0	-29.0	-16.0
DKC55-37RIB Brand Blend	-46.0	-59.0	-74.0	-13.0	-28.0	-15.0
DKC55-85RIB Brand Blend	-28.0	-47.0	-93.0	-19.0	-65.0	-46.0
DKC57-23RIB Brand Blend	-25.0	-34.0	-43.0	-9.0	-18.0	-9.0
DKC57-29RIB Brand Blend	-30.0	-56.0	-78.0	-26.0	-48.0	-22.0
DKC59-82RIB Brand Blend	-36.0	-46.0	-52.0	-10.0	-16.0	-6.0
DKC61-41RIB Brand Blend	-44.0	-57.0	-84.0	-13.0	-40.0	-27.0
DKC62-22RIB Brand Blend	-40.0	-51.0	-61.0	-11.0	-21.0	-10.0
DKC62-53RIB Brand Blend	-51.0	-61.0	-70.0	-10.0	-19.0	-9.0
DKC63-55RIB Brand Blend	-21.0	-26.0	-29.0	-5.0	-8.0	-3.0
DKC64-25RIB Brand Blend	-39.0	-49.0	-62.0	-10.0	-23.0	-13.0
P0622AML	-12.0	-17.0	-19.0	-5.0	-7.0	-2.0
P1138AML	-15.0	-16.0	-20.0	-1.0	-5.0	-4.0
P1244AM	-4.0	-5.0	-6.0	-1.0	-2.0	-1.0

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

- The tiller incidence reduction from 12,000 to 20,000, and from 12,000 to 24,000 seeds/acre was significant for all DEKALB® brand and competitor corn products in this trial (Table 1).
- The least tiller incidence reduction was observed from 20,000 to 24,000 seeds/acre (Table 1).
- The product DKC63-55RIB brand blend was the most consistent in terms of tiller incidence among DEKALB® brand corn products (Figure 1 and Table 1).

Dryland Corn Seeding Rates Effect on Product Grain Yield

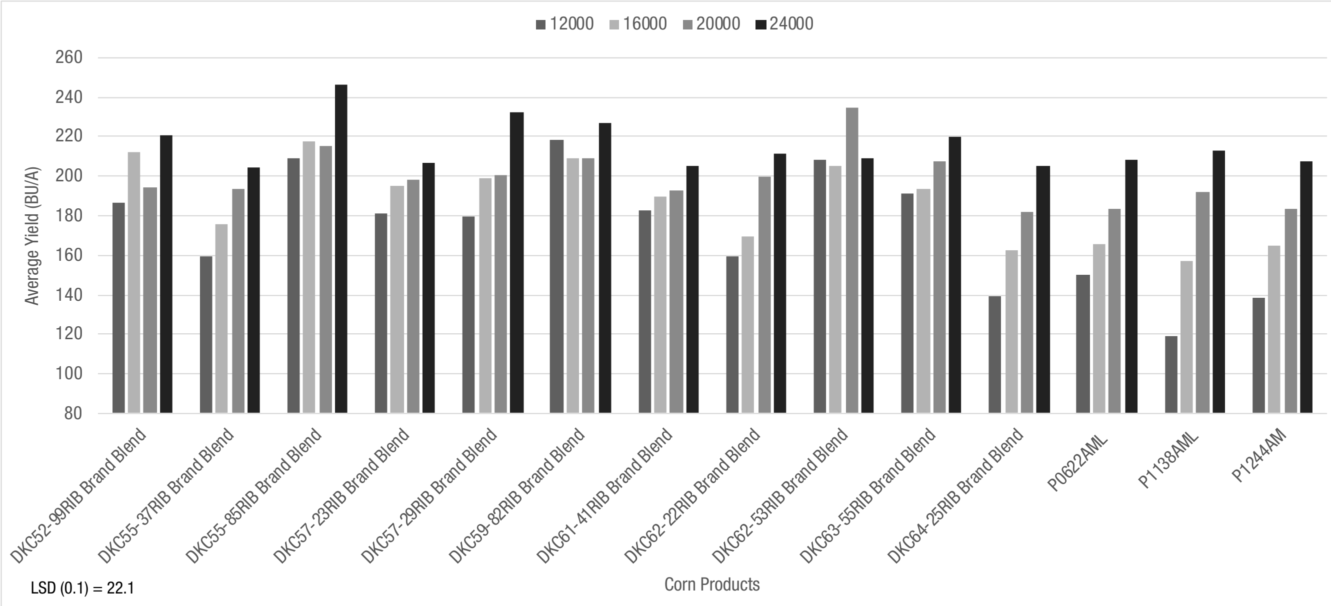

Figure 2. Average grain yield of DEKALB® brand and Pioneer® brand corn products according to seeding rates under dryland conditions. LSD (least significant difference) calculated as part of a larger trial containing 20 corn products at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

- There was a trend of increased corn grain yield potential as seeding rates were increased in all DEKALB® brand and competitor products in this study, except products DKC59-82RIB brand blend and DKC62-53RIB brand blend (Figure 2).

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.

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)					
DKC52-99RIB Brand Blend	25.4	7.5	34.2	-17.9	8.8	26.7
DKC55-37RIB Brand Blend	16.2	34.2	45.0	18.0	28.8	10.8
DKC55-85RIB Brand Blend	8.2	6.4	37.1	-1.8	28.9	30.7
DKC57-23RIB Brand Blend	13.9	16.6	25.3	2.7	11.4	8.7
DKC57-29RIB Brand Blend	20.0	21.3	53.0	1.3	33.0	31.7
DKC59-82RIB Brand Blend	-9.5	-9.5	8.4	0.0	17.9	17.9
DKC61-41RIB Brand Blend	7.3	10.2	22.6	2.9	15.3	12.4
DKC62-22RIB Brand Blend	10.0	40.7	52.2	30.7	42.2	11.5
DKC62-53RIB Brand Blend	-2.8	26.3	0.9	29.1	3.7	-25.4
DKC63-55RIB Brand Blend	2.4	16.6	28.7	14.2	26.3	12.1
DKC64-25RIB Brand Blend	23.6	42.7	66.3	19.1	42.7	23.6
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

Dryland Corn Seeding Rates Effect on Product Grain Yield

- 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 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 16,000 to 20,000 seeds/acre (Table 2).
- DKC59-82RIB brand blend did not show differences in grain yield relative to the seeding rate used (Table 2).

Key Learnings

- Lower corn seeding rates produce more tillers but had reduced grain yield potential.
- Even though more tillers were observed in lower populations, tillers did not compensate for grain yield. However, the presence of tillers was not associated with reduced corn grain yield.
- Talk to your local DEKALB® brand representative to determine which corn product and seeding rate best fit your production system.

Legal Statements

DEKALB® Brand Corn Product Silage Tonnage and Quality

Trial Objective

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

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

- The study was set up as a randomized complete block with three replications.
- 10 DEKALB® brand corn products with relative maturities from 105 to 120 were evaluated.
- Corn was sprinkler irrigated.
- 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.

DEKALB® Brand Corn Product Silage Tonnage and Quality

Understanding the Results

Table 1. Key yield and quality characteristics of 10 DEKALB® RIB Complete® brand blend corn products evaluated to determine silage utility.

Corn Products	TON @ 65%	% DM	% Starch	% NDF	NDFD 48	uNDF 24	uNDF 240	IVSD 7hr	% ADF	% CP	TFA	SUGAR	% TDN	Lignin % DM	NEL	NEG	2006 MILK/ TON
DKC55-37 RIB Brand Blend	29.2	45.71	46.5	27.83	59.64	14.18	7.73	65.96	16.76	8.52	2.78	2.76	69.4	2.52	0.68	0.58	3145
DKC58-34 RIB Brand Blend	26.5	41.64	42.89	31.05	62.23	14.6	8.09	66.99	18.34	8.34	2.58	2.47	71.47	2.67	0.7	0.57	3295
DKC59-07 RIB Brand Blend	29.6	39.97	44.32	30.82	62.03	14.62	8.34	67.66	18.32	8.16	2.92	1.8	73.23	2.69	0.72	0.58	3440
DKC61-40 RIB Brand Blend	26.3	46.96	42.61	31.46	62.43	14.73	8.09	67.53	18.61	8.34	2.66	2.91	69.4	2.69	0.67	0.57	3126
DKC61-80 RIB Brand Blend	30	37.86	45.03	29.64	62.85	13.85	7.76	66.91	17.49	8.58	3.05	2.08	75.64	2.6	0.75	0.59	3634
DKC63-90 RIB Brand Blend	29.7	43.28	44.97	29.52	60.21	14.69	7.87	66.93	18.21	8.64	2.74	2.31	69.79	2.62	0.68	0.57	3173
DKC64-44 RIB Brand Blend	32	46.66	46.15	29.1	61.42	14.03	7.6	66.57	17.75	8.51	2.73	2.52	69.61	2.59	0.68	0.58	3152
DKC67-66 RIB Brand Blend	31.1	40.08	42.55	32.84	57.25	17.35	10.69	67.56	20.3	8.11	2.76	1.96	70.6	3.42	0.7	0.54	3265
DKC69-16 RIB Brand Blend	31.5	41.47	30.81	42.07	61.44	19.18	11.95	67.73	25.85	8.17	2.05	2.63	67.69	3.9	0.65	0.5	2981
DKC70-64 RIB Brand Blend	27.3	38.92	33.64	37.71	57.18	19.32	12.11	68.16	23.12	8.45	2.23	3.44	68.99	3.85	0.68	0.5	3135
LSD (0.1)*	2.51	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

DEKALB® Brand Corn Product Silage Tonnage and Quality

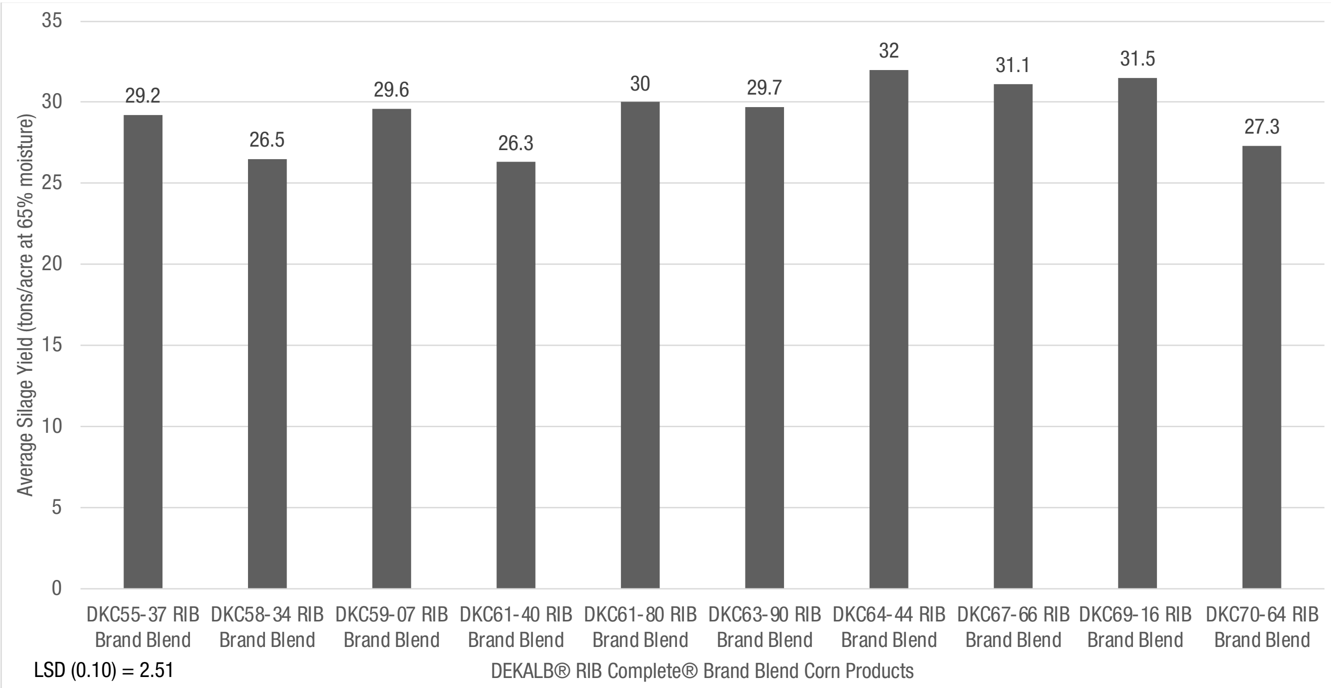

Figure 1. Average silage yield (tons/acre) for DEKALB® RIB Complete® brand blend corn products spanning a wide range of relative maturities.

Results showed a general trend towards increasing yield as relative maturity increased from early maturing to later maturing corn products, with tonnage ranging from approximately 26 tons/acre for the some of the earlier RM product to 32 tons/acre for several of the hybrids of 114RM or greater (Figure 1).

Milk/ton was not correlated with relative maturity of the products being tested since some of the earlier products had higher levels of milk/ton than later maturing products. The highest milk/ton value of 3634 resulted from a silage corn product with a RM of 111, while the lowest milk/ton value resulted from a silage corn product with a RM of 119. % TDN correlated with milk/ton but not directly with RM. (Table 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 of the quality characteristics for each corn product.

Key Learnings

- Growers should work with their local seed sales team to identify the right corn product for their operation
- Corn product selection for silage production will depend on the RM that the grower needs to suit the geography.
- Each corn product, regardless of RM, has a specific set of fiber quality characteristics and growers should consider all of the product options within their optimal RM range to ensure they find products that fit their specific operation.

DEKALB® Brand Corn Product Silage Tonnage and Quality

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.

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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.

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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.

Does the Day of Corn Emergence Matter?

Trial Objective

- Research and experience have shown that uniform corn emergence helps maximize yield potential.
- Although a great effort is spent to establish a uniform corn stand, sometimes emergence delays can occur due to equipment, soil conditions, weather conditions, planting depth, and seed quality.
- Growers would like to know at what point an emergence delay begins to impact yield.
- This trial was established to help evaluate the impact of emergence timing on corn yield potential.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Scott, MS	Commerce Silt Loam	Cotton	Conventional	4/7/2021	8/24/2021	250	36,000

- DKC70-27 Brand was planted at a depth of 2.5 inches and a seeding rate of 36,000 seeds per acre using standard parameters with commercial planting equipment.
- Corn emergence began 5 days after planting (DAP).
- A total of 13 samples were taken starting at first emergence. Samples were taken from 20 feet of corn row (Figure 1).
- Every emerged plant was marked at a similar time each day, typically at 9:00 in the morning (Figure 2).
- Plants were marked for 5 days and tagged into sample treatments (Figure 3).
- Corn ears were hand harvested at maturity and separated into samples representing each day of emergence up to 11 DAP or greater. A total of 639 ears were harvested and shelled.
- Ears were hand shelled and samples were weighed in grams and averaged by sample across the experiment to estimate the impacts of day of emergence on corn grain yield.
- All grain weights were corrected to a standard moisture of 15.5%.

Figure 1. Corn row sampled showing marked emerged plants.

Figure 2. Corn plants were marked as they emerged over a 5-day period.

Figure 3. Corn plants were tagged into samples starting at first emergence.

Does the Day of Corn Emergence Matter?

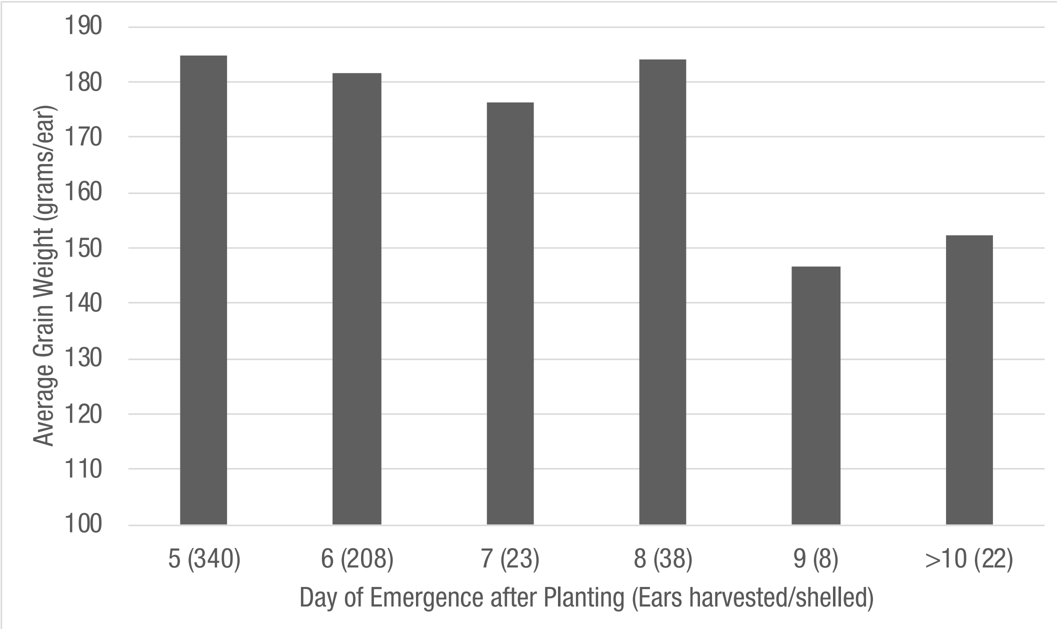

Figure 4. Average corn grain weight per ear as influenced by day of emergence after planting.

Understanding the Results

- Averaged across the samples, 93.4% of the planted seeds established a plant or ear.
- The final stand in the experiment averaged 33,803 plants or ears per acre.
- This experiment had an average yield of 230.9 bushels per acre as calculated from the hand shelled grain weights across the samples. This was very close to the machine harvested field average of a neighboring corn experiment, indicating that the samples were representative of commercial production.
- No reduction in grain weight per ear was observed through the first 4 days of emergence (5 to 8 DAP) (Figure 4).
- On day 5 of emergence (9+ DAP) ear size was reduced by approximately 20% compared to the earlier emerging plants (Figure 4).
- Non-synchronous pollination did not appear to be a factor in this experiment. All of the sampled plants pollinated with some yielding less possibly due to competition and shading effects from neighboring plants. Plant to plant competition likely had a greater impact on later emerging plants.

Key Learnings

- In this trial, yield impacts were not observed between corn plants emerging during the first 8 days after planting.
- Growers should aim for uniform plant emergence; however, based on this trial, a few days of variation in plant emergence may not have a substantial impact on yield potential.

Legal Statements

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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.

I'm ready to plant, but should I? Corn Planting Based on Date, Corn Product, Seeding Rate and Seeding Depth

Trial Objective

- Historically, corn growers in the Southern United States plant as soon as field conditions permit with little regard to forecasted weather conditions.
- Early planting can help promote early pollination, good ear fill conditions, and earlier harvest timing; however, corn is often exposed to cool, wet weather during stand establishment.
- A 2021 trial was planted at Scott, Mississippi on three dates to evaluate planting early into stressful conditions (a typical planting date), planting during favorable conditions, and planting late.
- Corn plants were evaluated for plant emergence, plant characteristics (ear height), and average yield across the treatments.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Scott, MS	Commerce Silty Clay Loam	Soybean	Conventional	3/12/2021 4/5/2021 5/10/2021	8/25/2021 8/25/2021 9/8/2021	200 250 200	DKC67-44 Brand: 32,000 and 34,000 DKC65-99 Brand: 34,000 and 37,500

  - Field work and inputs followed local standards.
  - 275 lbs of nitrogen was surface applied as a 28-0-0-5 fertilizer product.
  - Corn was planted in 38-inch single row configuration.
  - Trial was designed as a single replicate, single location trial.
- Two DEKALB® corn products were planted:
  - DKC67-44 Brand (VT Double PRO® Technology)
  - DKC65-99 Brand (Trecepta® Technology)
- Each product was planted on three planting dates:
  - March 12, 2021 – Planted into cool, wet, marginal conditions.
  - April 5, 2021 – Planted into ideal conditions.
  - May 10, 2021 – Ideal conditions but considered late planting for the local area.
- Two seeding rates per corn product were planted. The lower seeding rate represents a lower than recommended rate for the product planted. The higher seeding rate was targeted to exceed ideal seeding rates as indicated by previous experience and data.
- No lodging or bird predation was recorded in the trial. Effects on yield are measured effects on plant development and grain fill during the growing season.

Understanding the Results

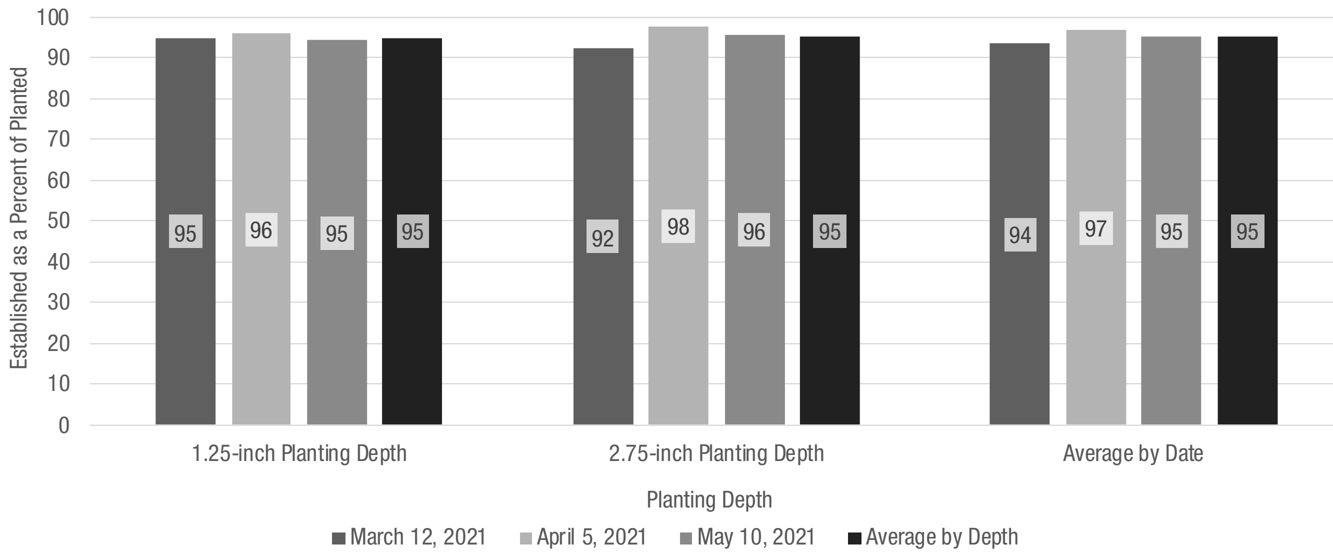

Figure 1. Averaged across populations and both corn products, plant establishment as a percent of planted kernels based on seeding depths and planting dates.

Stand Establishment

- The 2.75-inch planting depth on the March 12th planting date trended lower (92 percent established) compared to other dates (95 to 98 percent established).
- Stand establishment did not vary greatly across planting date by planting depth interactions but was numerically reduced at the deeper planting depth on the early planting date.

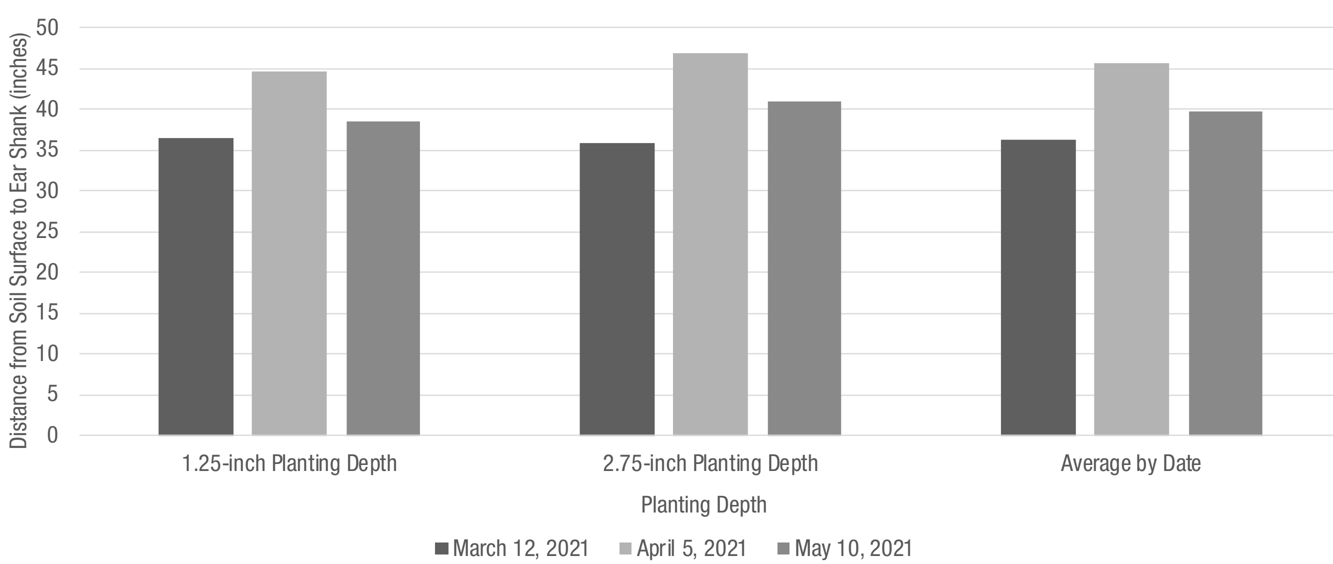

Figure 2. Averaged across both corn products, distance from soil surface to ear shank based on seeding depth and planting date.

I'm ready to plant, but should I?
Corn Planting Based on Date, Corn Product, Seeding Rate and Seeding Depth

Ear Height

- **Planting depth** had minimal, if any, influence on ear height.
- **Planting date** may have had an influence on ear height, which may have been due to either good or stressful conditions that followed.
  - » The early planting date (March 12, 2021) had the lowest ear height at 36 inches.
  - » The mid-planting date (April 5, 2021) had the highest ear height at 46 inches.
  - » The late planting date (May 10, 2021) had an intermediate height at 40 inches from soil surface to ear shank.

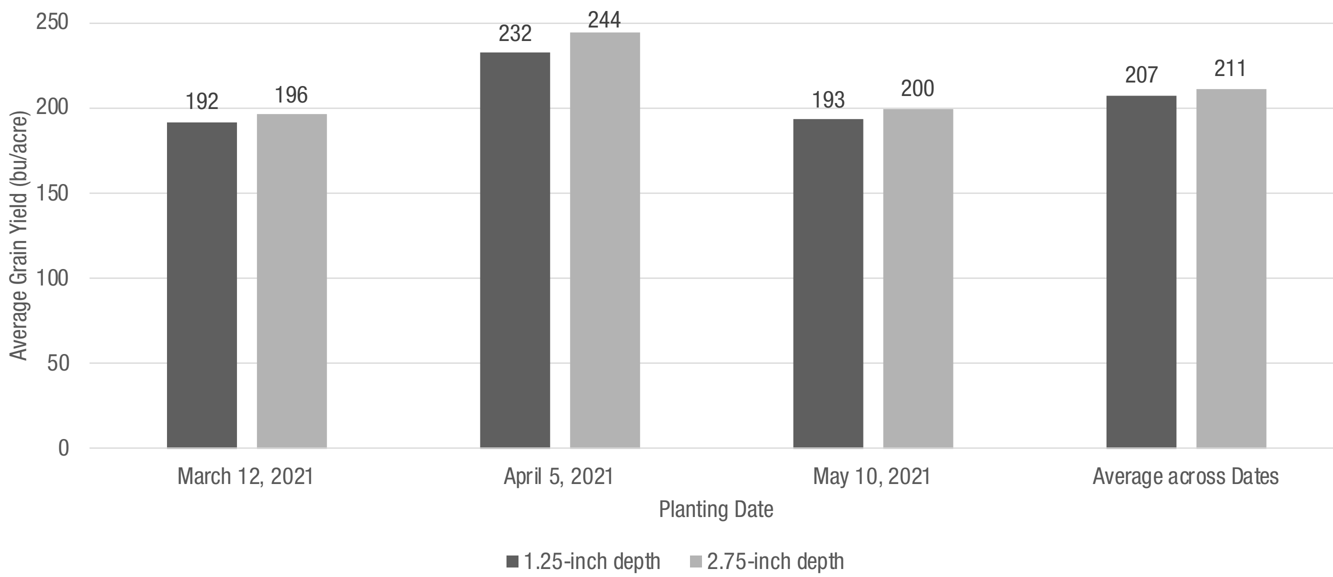

Figure 3. Averaged across both corn products, grain yield (at 15.5% kernel moisture) based on planting date and seeding depth.

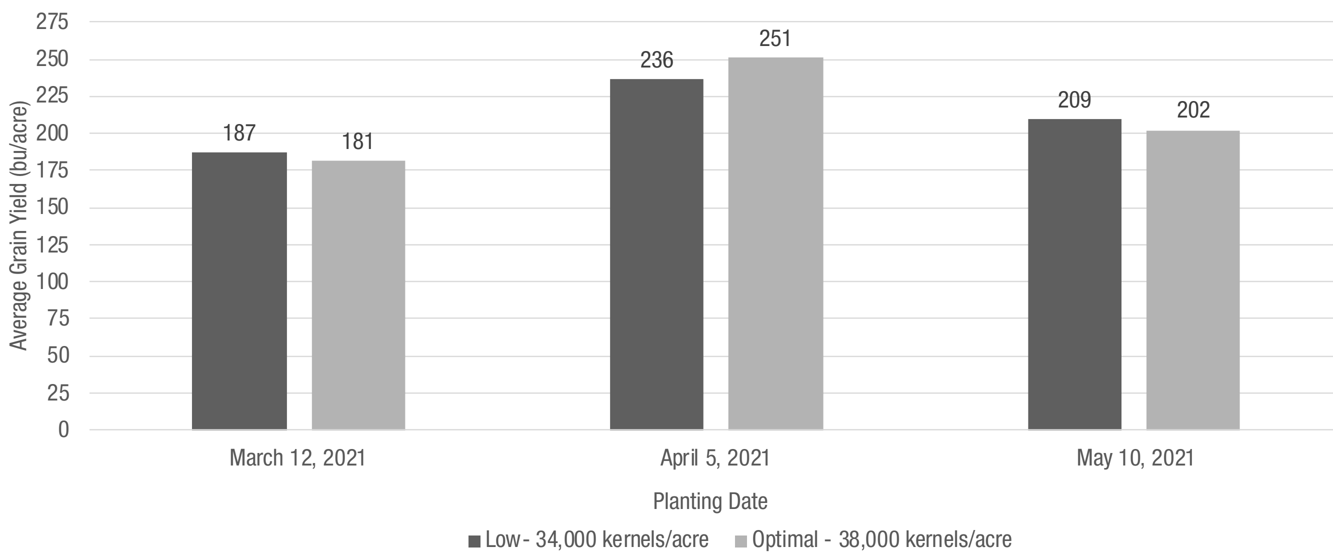

Figure 4. Effect of planting date and seeding rate on average grain yield (at 15.5% kernel moisture) of DKC65-99 Brand.

I’m ready to plant, but should I?
Corn Planting Based on Date, Corn Product, Seeding Rate and Seeding Depth

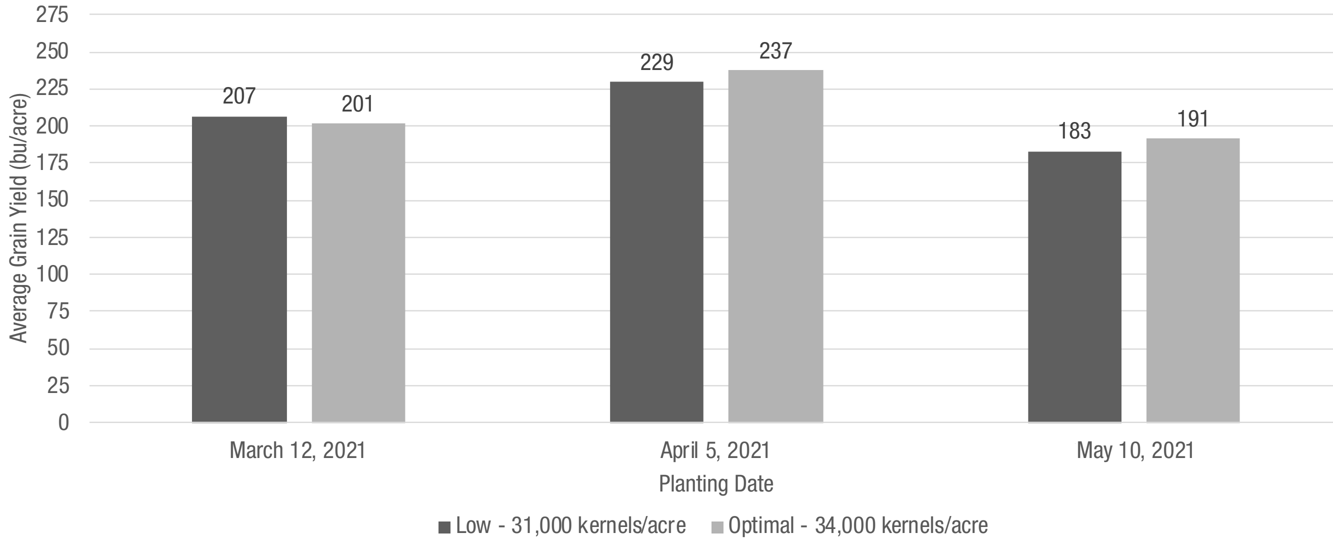

Figure 5. Effect of planting date and seeding rate on average grain yield (at 15.5% kernel moisture) of DKC67-44 Brand.

Grain Yield

- Corn planted with the 2.75-inch **planting depth** yielded numerically more than corn planted at the 1.25-inch depth across planting dates and tested corn products. Yield response ranged from 4 to 14 bu/acre with higher yields at deeper planting.
- **Corn products** tested demonstrated average yields of 179 to 259 bu/acre across the tested treatment combinations.
- Both corn products tested had greater responses to higher **seeding rates** on the April 5th planting date. The March 12th and May 10th dates showed reduced responses to seeding rates but were also lower yielding.
- **Planting date** was the most influential yield factor across this demonstration.
    - » The March 12th planting date averaged 194 bu/acre across all treatments.
    - » The May 10th planting date yielded a similar result at 197 bu/acre.
    - » The April 5th planting date was the highest yielding date for this trial at 238 bu/acre.
        - » A yield gain of 44 bu/acre from the April 5th planting date, combined with $5.38/bu corn prices, provides a potential return or loss of $236.72/acre for timely, well executed planting.
- The yield gain may be due to more favorable growing conditions during germination and establishment. Stands were reduced by 500 and 1200 plants per acre for the March 12th and May 10th dates, as compared to the April 5th date. This does not account for the variations in yield measured here.

I'm ready to plant, but should I? Corn Planting Based on Date, Corn Product, Seeding Rate and Seeding Depth

Key Learnings

- When possible, growers should avoid determining planting decisions solely on field moisture status or calendar date. These data indicate planting should be delayed until conditions improve if forecast conditions do not favor the development of healthy plants.
- For this demonstration, planting depth did not have a large impact on stand establishment regardless of planting date and conditions. However, previous Scott Learning Center research has demonstrated positive benefits from deeper corn planting: reduced bird predation, increased rooting and standability. For these reasons, growers should consider deeper rather than shallower planting depths.
- Planting depth should be maintained deeper than 2 inches regardless of conditions. This often means setting the planter deeper than targeted to account for field conditions.
- Planting into harsh growing conditions early could lead to an increased risk of replanting. Later planting dates yielded similar to the earliest planting date; therefore, delayed planting could be an acceptable alternative to very early plantings during poor growing conditions.
- Growers should account for equipment factors, 7- to 10-day weather forecasts, and risk tolerance before making planting decisions.

Legal Statements

Evaluation of DEKALB® Brand Corn Products –(2021)

Trial Objective

- Each season, the Bayer Learning Center at Scott, Mississippi evaluates market leading corn products for adaptability to the southern corn growing region (Figure 1).
- These experiments are conducted at Scott on different alluvial delta soil types. The Buckshot site is a heavy clay and the Highway site is deep sand.
- Yield potential and plant characteristics (ear height and weight) are important factors to consider when selecting a corn product for your operation.

Figure 1. DEKALB® brand yield trial at Scott, MS (2021).

Evaluation of DEKALB® Brand Corn Products – (2021)

Research Site Details

- » All field work, tillage, and herbicides were per local standards .
- » 275 lbs/acre of nitrogen (N) was applied to both experiments as liquid 28-0-0-5.

- There were 20 DEKALB® Brand products planted:
  - » DKC62-08 Brand (SmartStax® Corn)
  - » DKC62-53 Brand (VT Double PRO® Corn)
  - » DKC62-70 Brand (VT Double PRO® Corn)
  - » DKC62-89 Brand (Trecepta® Corn)
  - » DKC64-35 Brand (VT Double PRO® Corn)
  - » DKC65-84 Brand (SmartStax® Corn)
  - » DKC65-95 Brand (VT Double PRO® Corn)
  - » DKC65-99 Brand (Trecepta® Corn)
  - » DKC66-18 Brand (VT Double PRO® Corn)
  - » DKC66-75 Brand (VT Double PRO® Corn)
  - » DKC66-94 Brand (Roundup Ready® Corn 2)
  - » DKC67-37 Brand (SmartStax® Corn)
  - » DKC67-44 Brand (VT Double PRO® Corn)
  - » DKC67-72 Brand (VT Double PRO® Corn)
  - » DKC67-94 Brand (Trecepta® Corn)
  - » DKC68-48 Brand (SmartStax® Corn)
  - » DKC68-69 Brand (VT Double PRO® Corn)
  - » DKC68-95 Brand (SmartStax® Corn)
  - » DKC69-99 Brand (Trecepta® Corn)
  - » DKC70-27 Brand (VT Double PRO® Corn)

- Plots were single replicate planted in 38-inch wide six row strips.
  Row length varied from 360 to 600 feet long, and ranged from 0.16 to 0.26 acre/plot.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Scott, MS	Buckshot (45 CEC)	Cotton	Conventional	4/6/2021	8/25/2021	250	37500
Scott, MS	Highway Field (15 CEC)	Cotton	Conventional	4/6/2021	8/25/2021	300	37500

- Data collected:
  - » Buckshot Site
    - » Average yield (bu/acre) determined by harvesting entire plot with commercial combine and moisture content corrected to 15.5%.
  - » Highway Site
    - » Average yield (bu/acre) determined by harvesting entire plot with commercial combine and moisture content corrected to 15.5%.
    - » Ear height – The height of 10 ears per product was measured from the ground to the ear shank.
    - » Ear weight – 10 ears per product were weighed.

Evaluation of DEKALB® Brand Corn Products – (2021)

Understanding the Results

- Plots averaged 92% stand establishment post emergence.
- Buckshot Site
    - » Yields were excellent in these soil types for 2021 with an average yield of 224 bu/acre.
    - » Several products tested had average yields in excess of 230 bu/acre indicating that the DEKALB® Brand offers several new and existing products that can yield well in heavy soils.

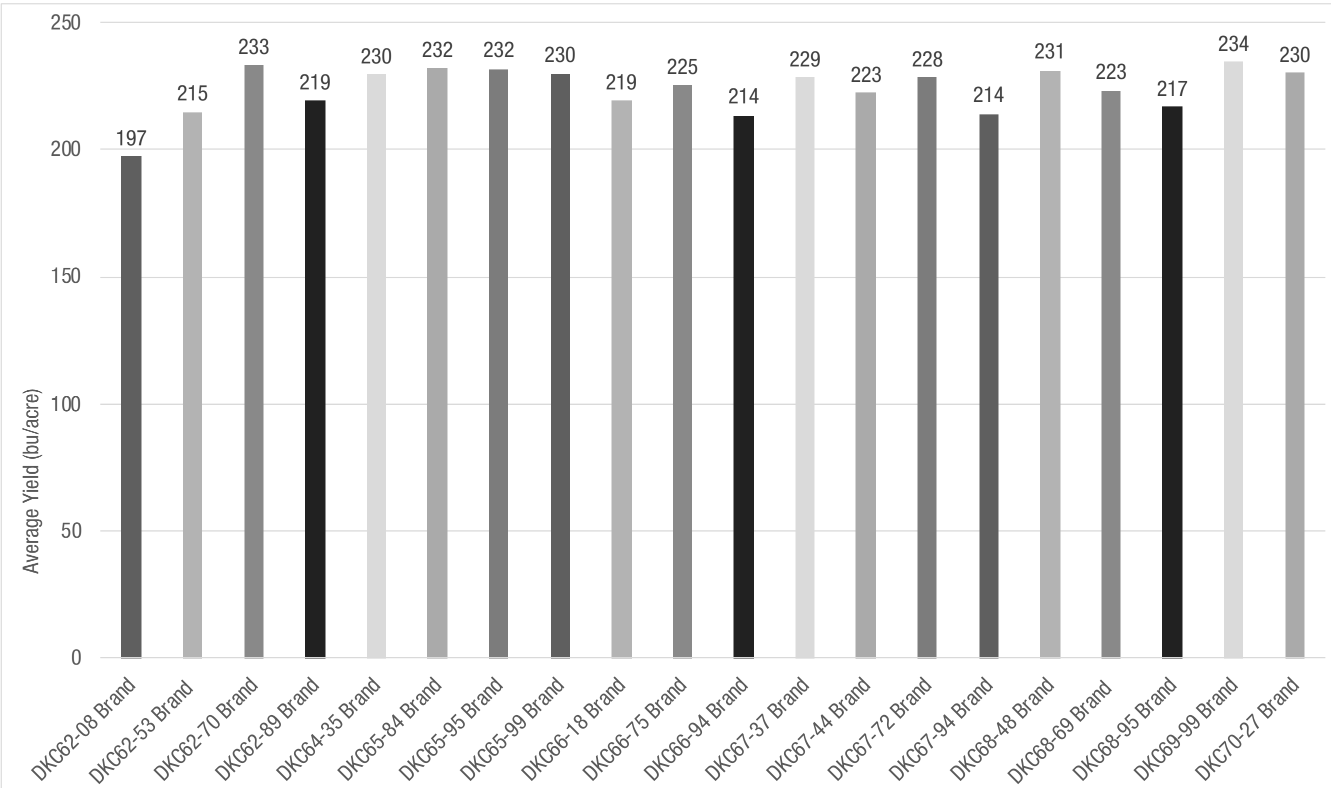

Figure 2. Average DEKALB® brand yield (bu/acre) at the Bayer Learning Center at Scott, MS Buckshot Field (2021) at 15.5% moisture content.

- Highway Site
    - » Yields at this location were higher than the Buckshot location with an average yield of 256 bu/acre.
    - » The highest average yields in this trial were in the 280 bu/acre range with several products (8 of 20) demonstrating average yields in excess of 260 bu/acre. In this trial, 15 of 20 tested products yielded more than 250 bu/acre.
    - » Ear height varied by up to 13 inches (23%) across the tested products.
    - » Ear weight varied by up to 50 grams (21%) across the tested products.

Evaluation of DEKALB® Brand Corn Products – (2021)

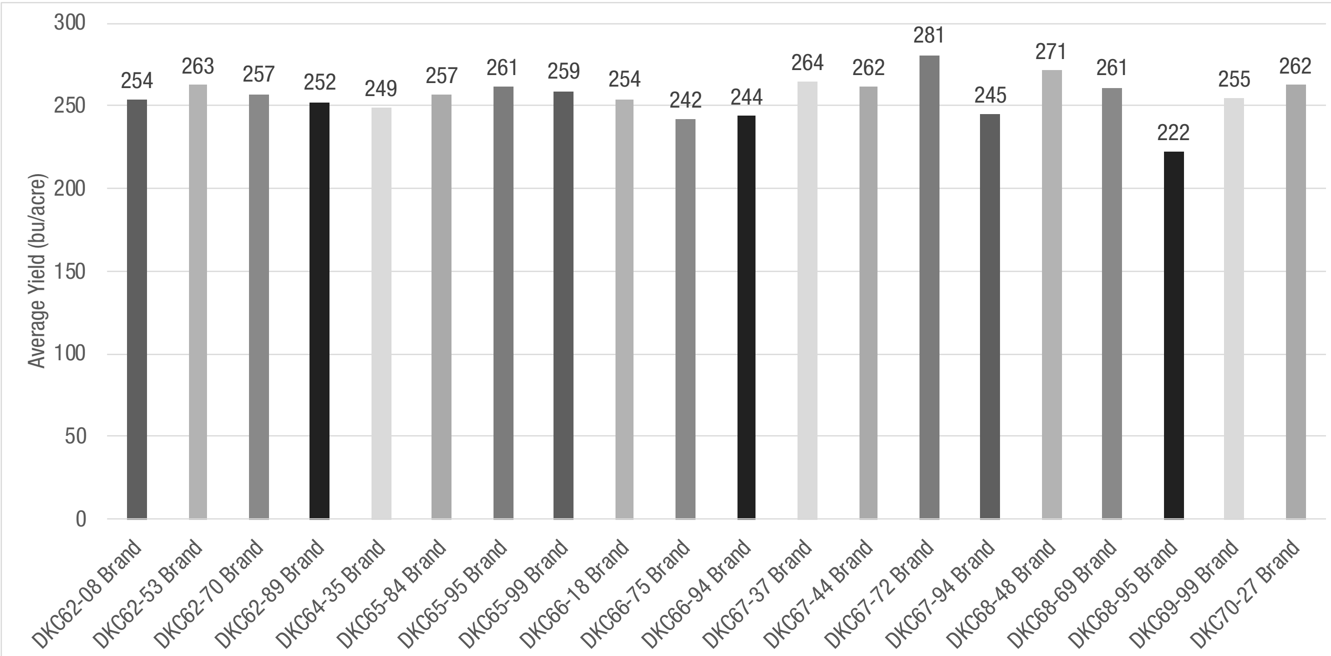

Figure 3. Average DEKALB® brand yield (bu/acre) at the Bayer Learning Center at Scott, MS Buckshot Field (2021) at 15.5% moisture content.

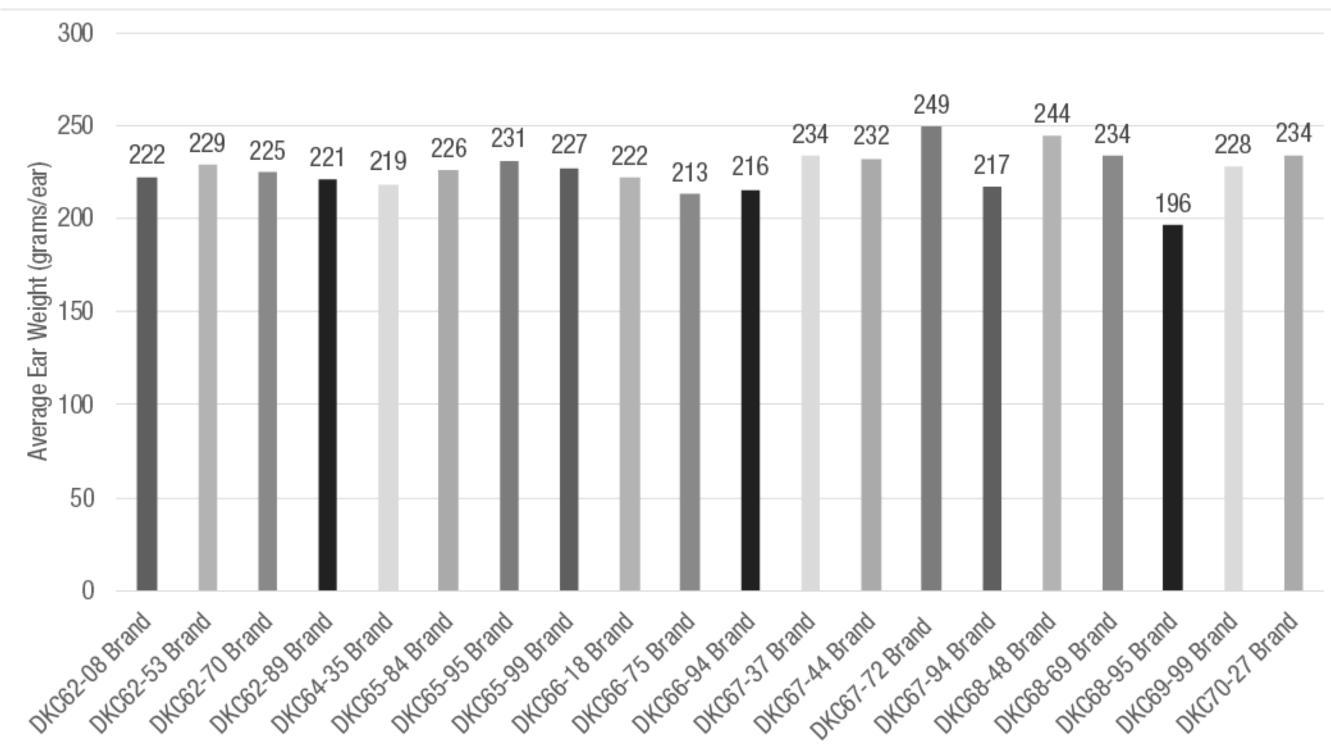

Figure 4. DEKALB® brand average ear weight (grams/ear) of 10 ears per product at the Bayer Learning Center at Scott, MS (Highway Field - 2021).

Evaluation of DEKALB® Brand Corn Products – (2021)

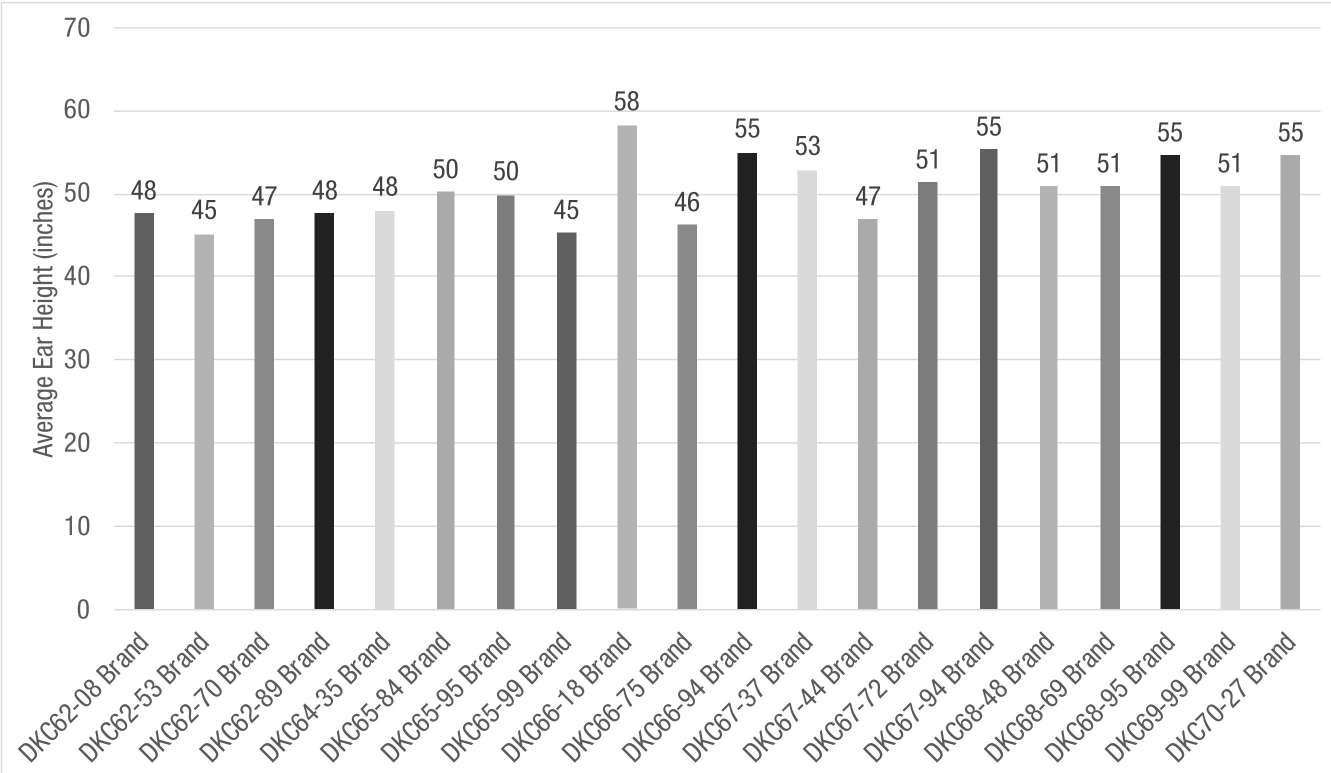

Figure 5. DEKALB® brand average ear height (inches) of 10 ears per product from ground to shank base at the Bayer Learning Center at Scott, MS (Highway Field - 2021).

Key Learnings

- Based on the average ear height, ear weight, and yield data from this trial, the DEKALB® brand offers a robust lineup of corn products that fit the diverse soil types of the Mississippi Delta.
- Growers should consider their personal preferences, product yield potential, and individual plant characteristics when selecting corn products for the 2022 growing season.

Evaluation of DEKALB® Brand Corn Products – (2021)

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.

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.

Yield Potential of DEKALB® Corn Products to Seeding Rate - 2021

Trial Objective

- Each season the Bayer Learning Center near Scott, Mississippi (SLC) evaluates a new class of corn products for adaptability to the southern corn growing region and their response to planting population.
- The evaluations are conducted at the SLC on soils with very high yield potential which are representative of the alluvial delta.
- Yield potential and plant characteristics (height, ear size) are very important factors to consider when choosing a corn product for your operation. Both height and ear size can have an influence on lodging potential and should be carefully considered when choosing a corn product to plant for 2022.
- The objective of this trial was to evaluate the yield potential and standability of DEKALB® corn products to planting populations.

Research Site Details

  - » All field work, tillage and herbicides were per local standards.
  - » The standard 275 lbs N applied to both experiments as liquid 28-0-0-5
- Products planted
  - » DKC62-70 BRAND
  - » DKC62-89 BRAND
  - » DKC65-84 BRAND
  - » DKC65-99 BRAND
  - » DKC66-18 BRAND
  - » DKC67-94 BRAND
  - » DKC68-48 BRAND
  - » DKC68-69 BRAND
  - » DKC68-95 BRAND
  - » DKC69-99 BRAND
  - » DKC70-27 BRAND
  - » The trial was conducted as a single strip plot and each plot was approximately 0.125 acre.
  - » Commercial harvest machinery
  - » All yields were corrected to 15.5% moisture

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Scott, MS	Commerce/Forrestdale Silt Loam	Cotton	Conventional	4/6/2021	8/25/2021	300	30,500 33,500 37,500 41,500

Yield Potential of DEKALB® Corn Products to Seeding Rate - 2021

- Planted on 38-inch single rows
- Trials averaged 97% stand establishment.
- Plant characteristics were measured since many growers often ask those questions. They can combine with other corn product characteristics to have an influence on lodging potential.
- Data collected as follows:
  - » Yield obtained by commercial combine via whole plot harvest – corrected to 15.5% moisture
  - » Established plant population counted on two 10 foot sections of row mid-season and converted to plants per acre.
  - » Ear height (inches) – Prior to harvest ear height from the soil line to the ear shank was measured on 10 ears per plot.
  - » Ear weight (grams shelled corn/ear) – Prior to harvest 10 ears were collected and shelled for ear weight estimations by corn product.

Understanding the Results

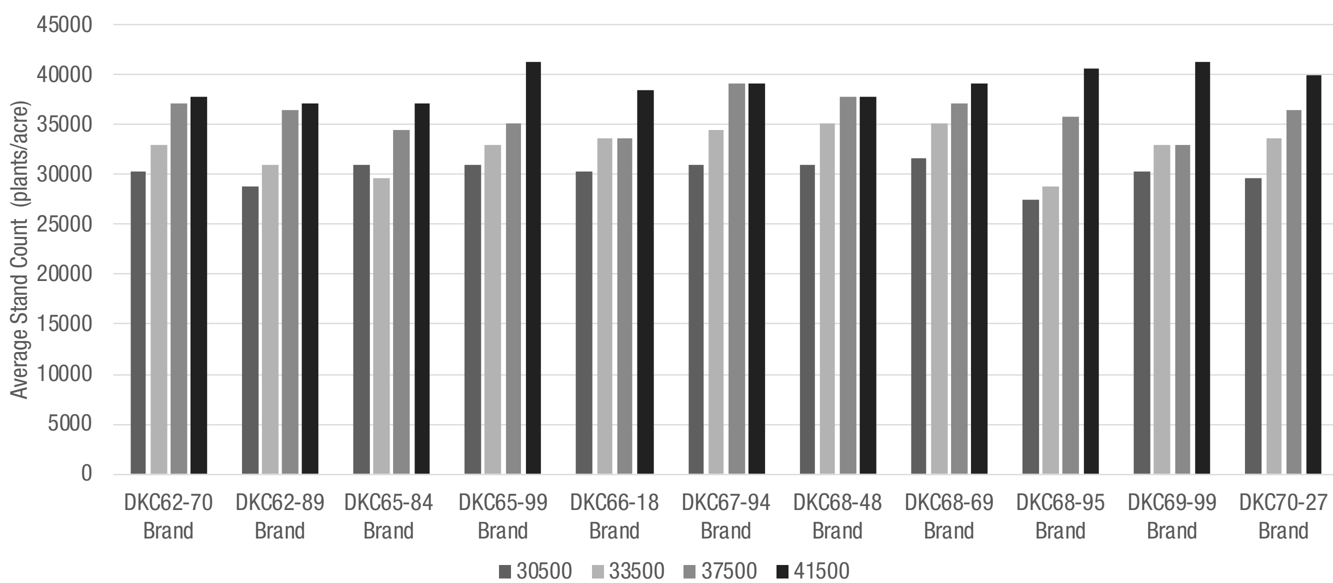

Figure 1. 2021 average stand count of 11 DEKALB® corn products by planting population near Scott, Mississippi.

Yield Potential of DEKALB® Corn Products to Seeding Rate - 2021

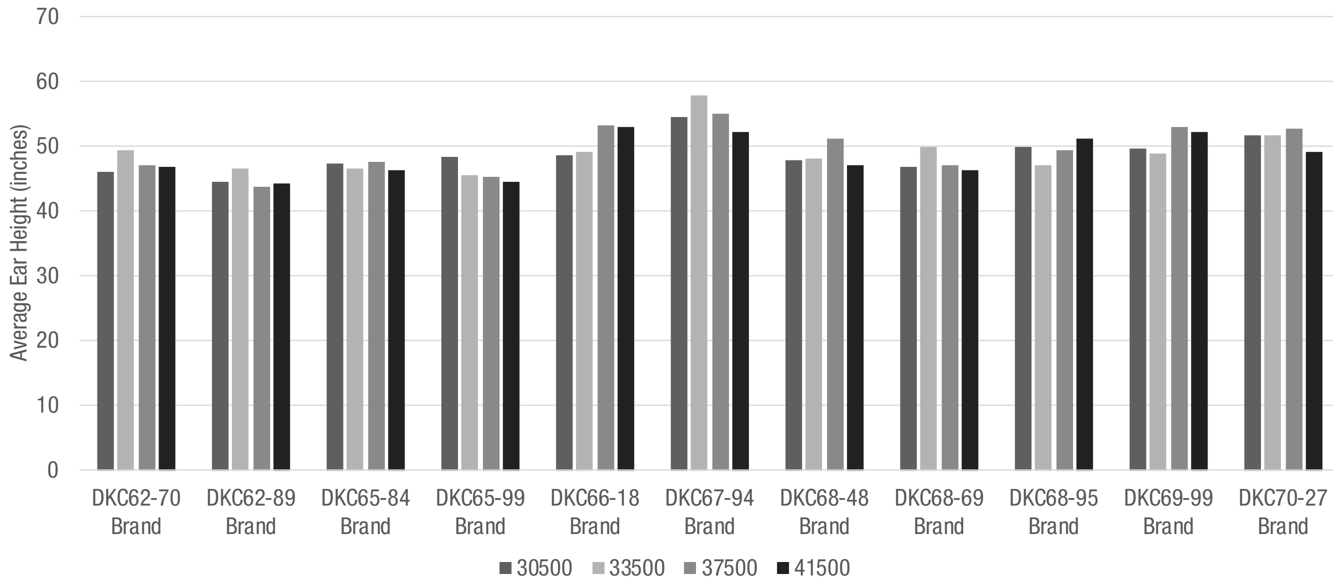

Figure 2. 2021 average ear height of 11 DEKALB® corn products by planting population near Scott, Mississippi.

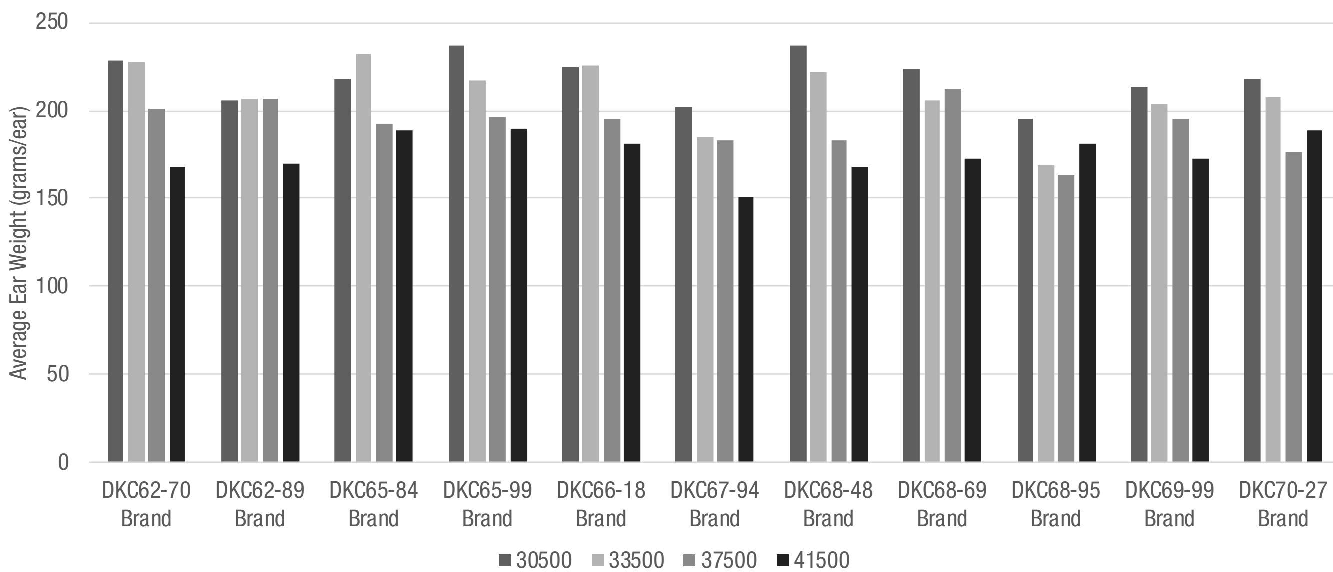

Figure 3. 2021 average ear weight of 11 DEKALB® corn products by planting population near Scott, Mississippi.

Yield Potential of DEKALB® Corn Products to Seeding Rate - 2021

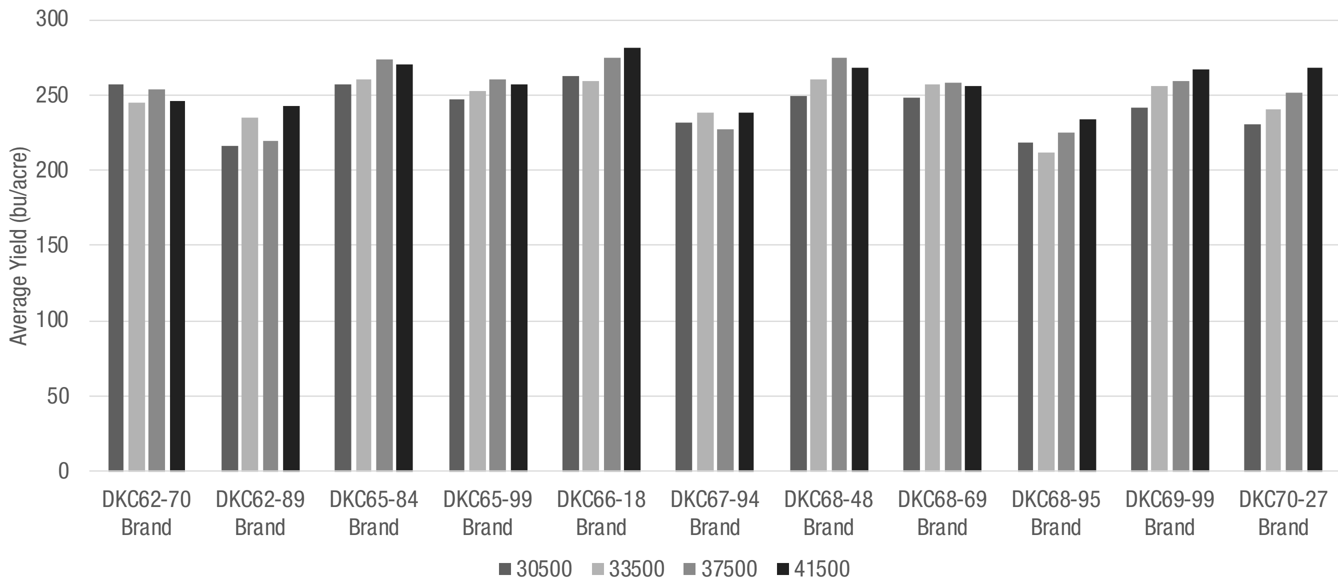

Figure 4. 2021 average yields of 11 DEKALB® corn products by planting population near Scott, Mississippi.

Table 1. 2021 economic effect of seeding rate on corn productivity near Scott, Mississippi. This data is from a single site, non-replicated trial. Average gross income was adjusted for seed cost using an estimated $3.75 per 1,000 seed across all corn products, and corn price at $5.82/bu.

	Corn Seeding Rate (seeds/acre)							
DEKALB® Corn Brand	30500	33500	37500	41500	30500 vs 37500 Average Yield Difference (bu/acre)	$ Gross Increase (or Decrease) per acre	Seed Cost (per 7000 seeds)	Net return on investment 30500 vs 37500 seeds per acre
DKC62-70 Brand	256.9	245.3	254.2	246.5	(2.72)	$ (15.83)	$26.25	$ (42.08)
DKC62-89 Brand	215.8	235.0	219.8	242.8	4.00	$ 23.26	$ 26.25	$(2.99)
DKC65-84 Brand	256.7	260.2	274.1	270.7	17.40	$101.26	$26.25	$75.01
DKC65-99 Brand	247.3	253.0	260.4	257.2	13.17	$76.66	$26.25	$50.41
DKC66-18 Brand	262.9	259.4	275.3	281.4	12.46	$72.51	$26.25	$46.26
DKC67-94 Brand	232.1	238.0	227.1	238.3	(4.98)	$(28.98)	$26.25	$(55.23)
DKC68-48 Brand	249.2	260.0	274.8	268.2	25.61	$149.07	$26.25	$122.82
DKC68-69 Brand	248.2	257.6	258.1	255.5	9.91	$57.67	$26.25	$31.42
DKC68-95 Brand	218.7	212.2	225.5	234.1	6.87	$39.97	$26.25	$13.72
DKC69-99 Brand	242.1	255.9	259.8	266.9	17.78	$103.50	$26.25	$77.25
DKC70-27 Brand	230.7	240.3	251.7	267.7	20.99	$ 122.16	$26.25	$95.91

Yield Potential of DEKALB® Corn Products to Seeding Rate - 2021

Yields across this entire study averaged 250 bu/acre across all corn products and populations. This is exceptional corn for the delta system. A typical grower would expect an average yield of 200 to 220 bu/acre on this soil type.

- **Stand Establishment** – This entire experiment averaged 97% for final stand (Figure 1).
- **Plant Population** – Across all planted products and populations, typical responses to population were observed in that, yield generally increased as population increases. However, individual corn products did respond somewhat differentially to increasing population.
  - » Across all the tested products, an average increase of 11 bu/acre was observed when increasing population from 30,500 to 38, 500 seeds/acre (Figure 4).
  - » Considering seed costs of $3.75/1000 seeds and $5.82/bu (cash price at harvest) the net return improvement is $37.50 for all tested products (Table 1). Net gain is higher for some products than others and growers should carefully evaluate each product for response to plant population.
  - » Negative consequences from increasing population can also be present. They were not present in this demonstration, but growers should also carefully consider population effects on fertility management and potential standability issues with corn products chosen for their operations.
- **Ear Height** – Up to 14 inches variability (32%) in ear height was recorded across the tested corn product by population combinations (Figure 2).
- **Ear Weight** – Up to 86.7 grams variability (57.6%) in ear weight was recorded across the tested products with ears typically being reduced in size as population increases (Figure 3).
- **Yield** - The top end yields in this environment for 2021 were around 280 bu/acre with a range from 212 to 281 bu/acre (Figure 4).

Key Learnings

- Knowing the optimal seeding rate of a corn product can help maximize yield potential and profitability. This research can help growers evaluate DEKALB® corn product seeding rates for their operations.
- Our observations at Scott Learning Center show that corn products can and do respond favorably to higher seeding rates. However, high plant populations can result in lodging and exacerbate harvest difficulties. Conversely, full yield potential may not be realized with lower than optimal seeding rates.
- Growers should carefully evaluate each new corn product planted for its response to population in standability, yield and net return with multiple years and locations used for reference.
- Seeding rate should be adjusted based on field yield potential levels and soil types, as well as the potential return on investment.
- From 2021 ear height, ear weight and yield data we can infer that DEKALB® offers a robust lineup of corn products well suited to the Mississippi Delta region.

Growers should consider personal preferences and yield potential in combination with plant characteristics when choosing corn products. Contact your local Field Sales Representative or Technical Agronomist for planting recommendations for the current situation and year.

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Response of DEKALB® Brand Roundup Ready® Corn 2 Products to Seeding Rate

Trial Objective

- When planting DEKALB® brand *Bt* (*Bacillus thuringiensis*) technology insect resistant corn products in cotton growing regions, 20% of a grower's corn production area must be planted with a non-*Bt* (refuge) corn product. Because DEKALB® brand *Bt* products are resistant to glyphosate, the refuge corn product should be a Roundup Ready® Corn 2 technology product.
- Yield potential and plant characteristics (plant and ear height, ear size, population adaptability) are important factors to consider when selecting *Bt* and refuge corn products for your operation. These characteristics can have an influence on lodging potential and should be carefully considered when selecting a refuge corn product to plant along with *Bt* products in 2022.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Scott, MS	South 40 Field – 30 CEC – Commerce Silty Clay Loam	Soybean	Conventional	4/6/2021	8/25/2021	300	30000 34000 38000 41000

- Experiments were conducted on the South 40 Field at the Bayer Learning Center at Scott, MS on soils with very high yield potential and representative of the alluvial delta.
- All field work, tillage, and herbicides were per local standards.
- 275 lbs/acre of nitrogen was applied to both experiments as liquid 28-0-0-5.
- This trial was designed as a single replicate strip plot planted as six rows 1300 feet long, or around 0.625 acre/plot.
- There were seven DEKALB® brand products planted:
    - DKC62-05 Brand (Roundup Ready® Corn 2)
    - DKC65-93 Brand (Roundup Ready® Corn 2)
    - DKC65-99 Brand (Trecepta® Corn)
    - DKC66-94 Brand (Roundup Ready® Corn 2)
    - DKC67-70 Brand (Roundup Ready® Corn 2)
    - DKC68-24 Brand (Roundup Ready® Corn 2)
    - DKC70-25 Brand (Roundup Ready® Corn 2)
- Each product was planted on 38-inch single rows at four different seeding rates:
    - 30,000 seeds/acre
    - 34,000 seeds/acre
    - 38,000 seeds/acre
    - 41,000 seeds/acre

Response of DEKALB® Brand Roundup Ready® Corn 2 Products to Seeding Rate

- Data were collected as follows:
  - » Whole plots were harvested with the use of a commercial combine and corrected to 15.5% moisture content to determine yield data.
  - » Established plants/acre for each product was determined mid-season by counting the number of plants in ten feet at two locations and averaged.
  - » Ear height was determined by measuring the height (in inches) from the soil line to the ear shank of 10 plants per product and averaged.
  - » Ear weight was determined by shelling 10 ears per product, measuring the weight, and providing an average.

Understanding the Results

- Yield: Average yield of all products in the study was 241 bu/acre which was exceptional for the Delta system. The highest yield was 274.58 and the lowest was 212.51 (Table 1 and Figure 1).
- Seeding Rates: Across all planted products and seeding rates, a typical response to seeding rate was observed in that yield generally increased as seeding rate increased. However, individual corn products responded differently as seeding rates increased.
  - » Across all tested products, an average increase of 11 bu/acre was observed when seeding rates were increased from 30,000 to 38,000/acre (Table 1 and Figure 1).
    - » Considering seed costs of $3.75/1,000 seeds (VT Double PRO® Corn) and $3.00/1,000 seeds (Roundup Ready® Corn 2) and $5.82/bu (recent cash price) the gross return improvement is $67.14 for all tested products (Table 1). Net gain is higher for some products than others. Growers should carefully evaluate each product.
    - » Negative consequences from increasing seeding rates can be present. They were not present in this demonstration; however, growers should carefully consider the effects of seeding rates on fertility management and potential standability issues for the products selected for their operations.
- Stand Establishment: This experiment averaged 98% stand establishment (Figure 2).
- Ear Height: Up to 14 inches of variability (32%) in ear height was recorded across the tested products and seeding rate combinations (Figure 3).
- Ear Weight: Up to 108.3 grams variability (44%) in ear weight was recorded across the tested products with ears typically becoming smaller as seeding rates increased (Figure 4).

Response of DEKALB® Brand Roundup Ready® Corn 2 Products to Seeding Rate

DEKALB® Brand Corn Product	Average Yield (bu/acre at 15.5% Moisture Content) and Four Seeding Rates				Average Yield (bu/acre)	Gain in bu/acre from 30,000 to 38,000 seeds/acre	Gross $ Return from 30,000 to 38,000 seeds/acre	Seed Cost ($) (1000 seeds)	Average Net $ Return from 30,000 to 38,000 seeds/acre
	30,000	34,000	38,000	41,000					
DKC62-05	221.77	226.92	236.37	239.37	231.11	14.60	84.98	24.00	60.98
DKC65-93	246.80	250.86	257.15	264.84	254.91	10.35	60.26	24.00	36.26
DKC65-99	253.57	260.92	269.79	274.58	264.71	16.22	94.40	30.00	64.40
DKC66-94	212.51	219.70	229.17	231.73	223.28	16.66	96.96	24.00	72.96
DKC67-70	239.61	247.42	242.91	248.46	244.60	3.30	19.20	24.00	-4.80
DKC68-24	219.33	215.71	235.94	219.46	222.61	16.61	96.65	24.00	72.65
DKC70-25	239.95	241.02	242.96	249.60	243.38	3.02	17.56	24.00	-6.44
Averages	233.36	237.51	244.90	246.86	240.66	11.54	67.14	24.86	42.29

Table 1. Yield (bu/acre) performance and gross and net dollar return for seven DEKALB® brand products when seeding rates/acre were increased from 30,000 to 41,000 at the Bayer Learning Center at Scott, MS (South 40 Field – 2021).

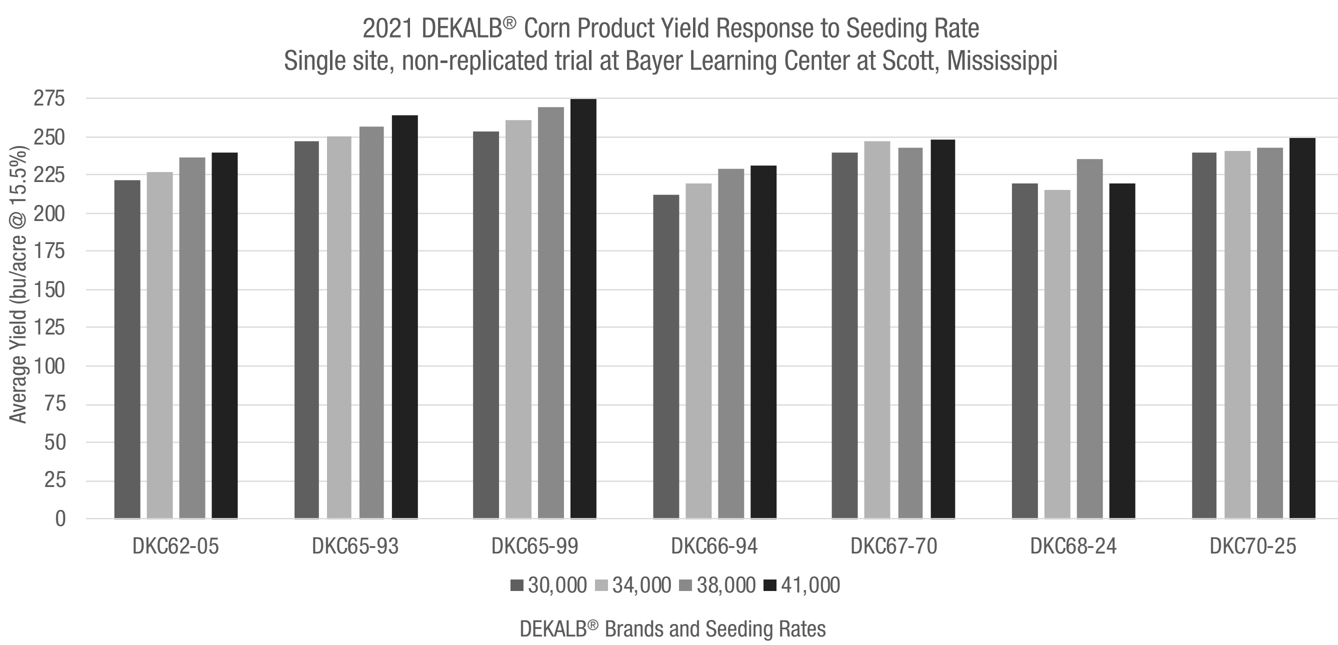

Figure 1. Yield (bu/acre at 15.5% moisture content) of seven DEKALB® brand corn products at four seeding rates at the Bayer Learning Center at Scott, MS (South 40 Field – 2021).

Response of DEKALB® Brand Roundup Ready® Corn 2 Products to Seeding Rate

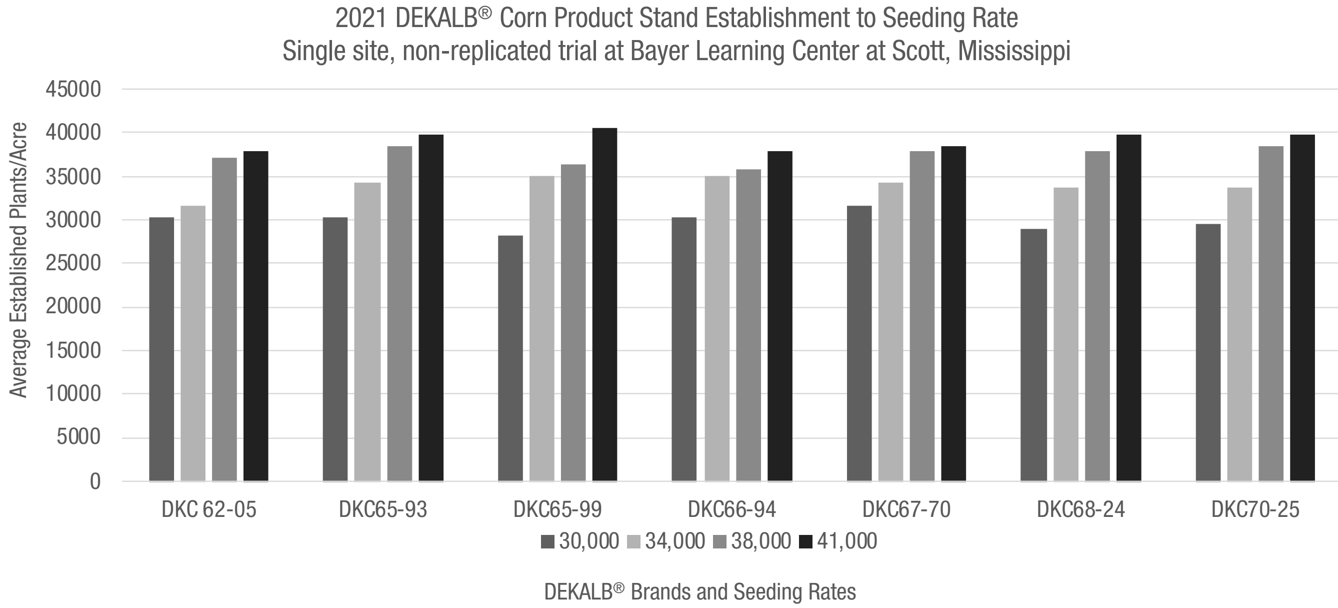

Figure 2. Average established plants/acre for each DEKALB® brand product at four seeding rates at the Bayer Learning Center at Scott, MS (South 40 Field – 2021).

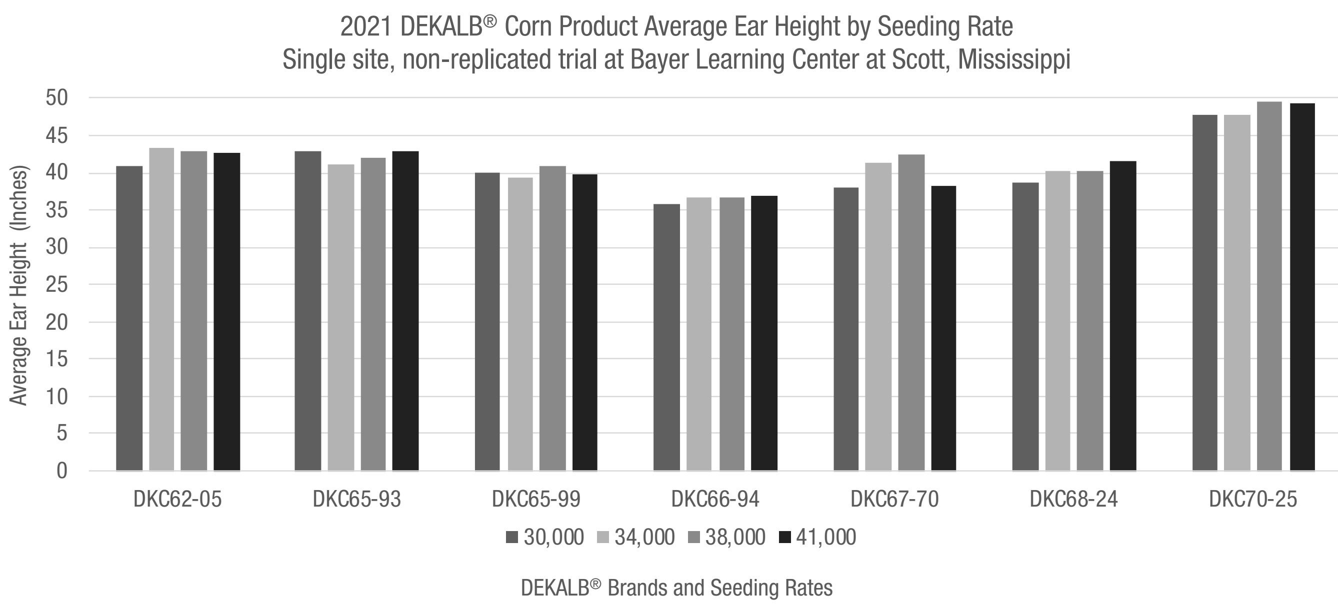

Figure 3. Average ear height (inches from ground to ear shank) for each DEKALB® brand product at four seeding rates at the Bayer Learning Center at Scott, MS (South 40 Field – 2021).

Response of DEKALB® Brand Roundup Ready® Corn 2 Products to Seeding Rate

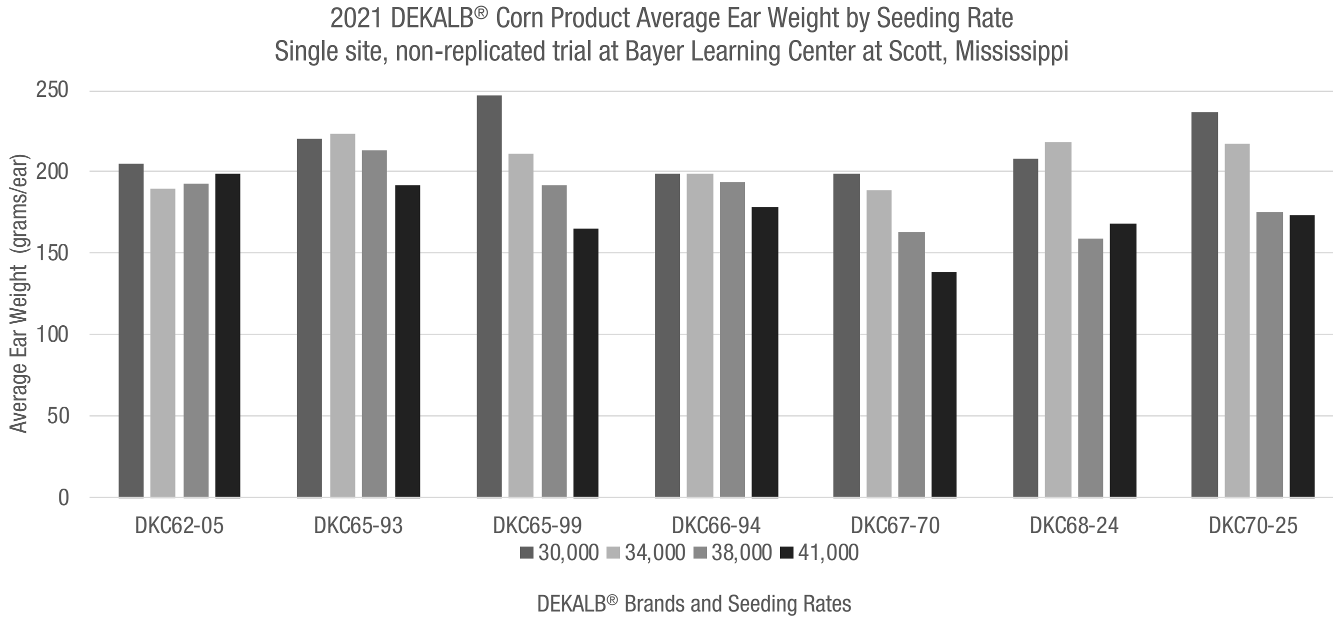

Figure 4. Average ear weight (grams/ear) for each DEKALB® brand product at four seeding rates at the Bayer Learning Center at Scott, MS (South 40 Field – 2021).

Key Learnings

- Plant characteristics were measured to provide useful information to growers. This information along with other product characteristics, such as disease resistance, can help growers select products that can help reduce the potential for lodging.
- As demonstrated in previous research at the Bayer Learning Center at Scott, MS, seeding rate continues to be a primary contributor (along with product selection) to help increase yield potential across most of the tested products. For this reason, growers should carefully evaluate the potential net return for increased seeding rates when selecting products to plant on their farms.
- From the 2021 ear height, ear weight, and yield data, we can infer that the DEKALB® brand offers a robust lineup of corn products well suited to the Mississippi Delta.
- Growers should consider their personal preferences and the product yield potential in combination with the plant characteristics measured in this study when choosing a product for the 2022 growing season.
- Adherence to the Insect Resistance Management (Refuge) program is paramount for maintaining access to and viability of corn and cotton traits in the cotton growing region into the future.

Response of DEKALB® Brand Roundup Ready® Corn 2 Products to Seeding Rate

Legal Statements

How do Twin Rows and Plant Population Impact Corn Yield Potential? 2021

Trial Objective

- Twin row planting for corn production continues to come up as a decision point in southern corn production.
- Bayer Learning Center at Scott, Mississippi has evaluated twin row vs single row plantings in corn production for several seasons. Previous studies showed only a marginal benefit to twin row configuration in most cases.
- During 2021, a non-replicated plot was established at the Bayer Learning Center at Scott, Mississippi to evaluate the response of DEKALB® Brand corn products to various populations as well as single versus twin row production systems.

Research Site Details

- Study planted on Field B2 at the Bayer Learning Center at Scott, MS (SLC). All Agronomic inputs per local standards.
- 275 lb/acre of nitrogen (N) surface applied as 28-0-0-5.
- Four DEKALB® Brand products planted.
  - » DKC65-95 Brand
  - » DKC67-37 Brand
  - » DKC67-44 Brand
  - » DKC70-27 Brand
- Plots were single replicate, planted in single row 38-inch row crop planting units with Precision Planting® VSet2 Meters and plates installed.
- Twin row plots planted on 38-inch rows x 7.5-inch twins with Precision Planting VSet2 meters. This planter does not stagger as a traditional Monosem planter.
- Seeding rates of products planted included 32,000, 35,000 and 38,000 seeds per acre.
- Average yield (bu/acre) determined by harvesting entire plot with commercial combine and moisture content corrected to 15.5%.

Understanding the Results

- Relatively small differences were observed when comparing yield potential between the twin row and single row planting system (Figure 1). And while no penalty for planting twin rows was observed it should be noted that no advantage existed in this case regardless of planting population or corn product planted (Figure 2).

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Scott, MS	Commerce silty clay loam	Soybean	Conventional	4/19/2021	9/9/2021	225	32000 35000 38000

How do Twin Rows and Plant Population Impact Corn Yield Potential? 2021

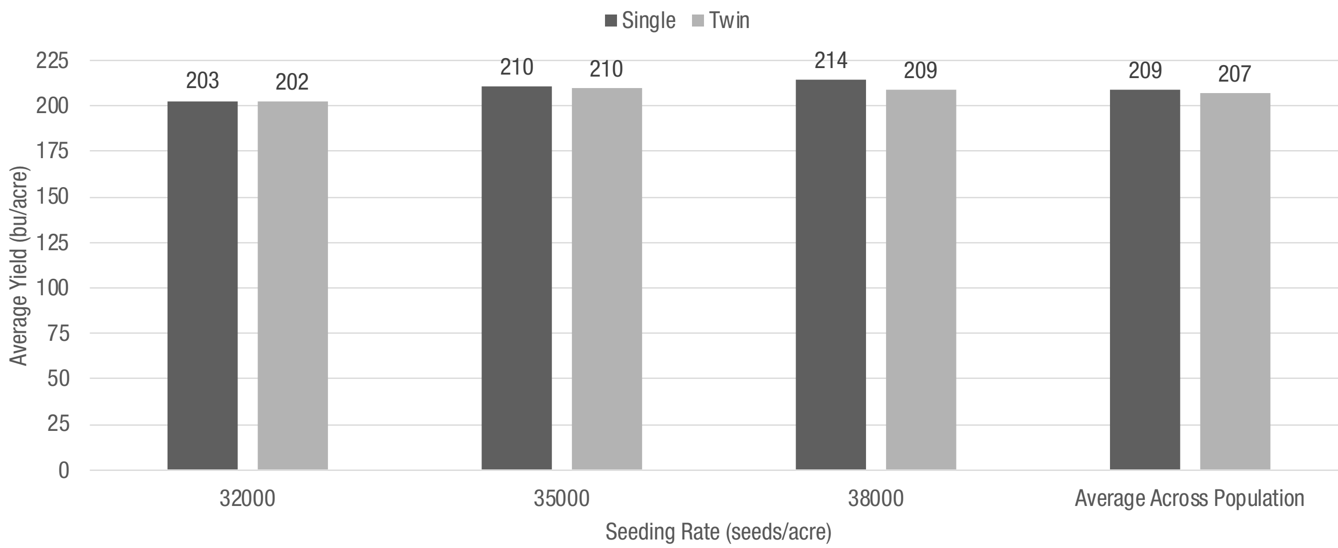

Figure 1. Average yield (bu/acre at 15.5% moisture content) over all products for twin row and single row planting systems and seeding rates of 32,000, 35,000, and 38,000. Bayer Learning Center, Scott, MS (2021).

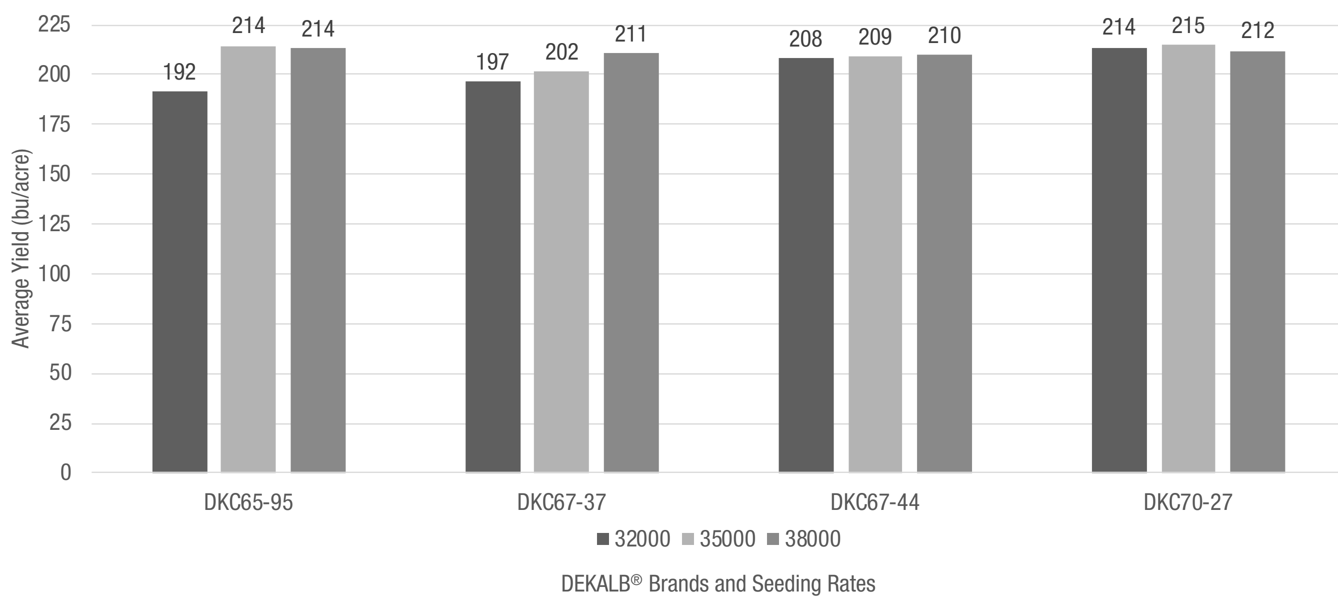

Figure 2. Average product yield (bu/acre at 15.5% moisture content) based on seeding rates 32,000, 35,000, and 38,000 and planting systems of twin row and single row planters. Bayer Learning Center, Scott, MS (2021).

ENVIRONMENT

How do Twin Rows and Plant Population Impact Corn Yield Potential? 2021

Key Learnings

- The twin row corn planting system can be difficult to use due to concerns with equipment setup, bed preparation, planting depth and corn product selection. Yield data can vary from year to year with various row spacings depending on environmental conditions. Data from this 2021 study indicated that well-adjusted single row planters yielded as well as twin row, in most cases, and are generally easier to use on a practical basis.
- In this study, there was a positive response to population observed with some of the tested corn products. The most important decisions to make, regardless of row spacing, are those of product selection and planting population.

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Insect Resistance Management
Planting Refuges, Preserving Technology

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RESPECT THE REFUGE

Roundup Ready® 2 TECHNOLOGY

Evaluating the Interaction of Corn Product, Seeding Rate, and Planting Depth

Trial Objective

- Two of the most important factors to consider when planting corn are product yield response to population and regional responses to planting depth.
- These factors can only be established at planting and should be carefully considered at that time.
- Maximum yield potential can be limited when plant population is reduced intentionally by planting a low population or from bird predation, poor rooting, lodging, or other agronomic factors.

Research Site Details

- Study planted on Field D5 at the Bayer Learning Center at Scott, MS (SLC).
- All agronomic, herbicide, and fertility practices were per local standards.
- Study was planted on 38-inch single rows as a single replicate strip plot design (0.35 acres/plot).
- A total of 275 lb/acre of nitrogen (N) was applied.
- Products planted
  - » DKC67-44 Brand (VT Double PRO® Corn)
  - » DKC70-27 Brand (VT Double PRO® Corn)
- Plot area is sandy with a cation exchange capacity (CEC) averaging less than 10 which can be a very stressful environment for crops.
- Plots were harvested using commercial machinery and grain weights were adjusted to 15.5% moisture content.
- Plant establishment averaged about 93% across all planted plots.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Scott, MS	Cravasse loamy sand/Mhoon silt loam	Cotton	Conventional	4/7/2021	8/28/2021	250	28000 32000 36000 40000

Understanding the Results

Planting Depth (Figure 1)

- Planting depth did not have a major impact on the yield of either product across populations.
  - » This should not be viewed as an endorsement of shallow planting. This study had limited bird predation, bed erosion, and lodging prior to harvest. These factors typically favor deeper planting depths.
  - » The primary conclusion regarding planting depth should be that deeper planting did not penalize yield in 2021. Previous SLC work has shown great advantage to deeper planting in previous years. Deeper plantings depths should be the rule not the exception.

Evaluating the Interaction of Corn Product, Seeding Rate, and Planting Depth

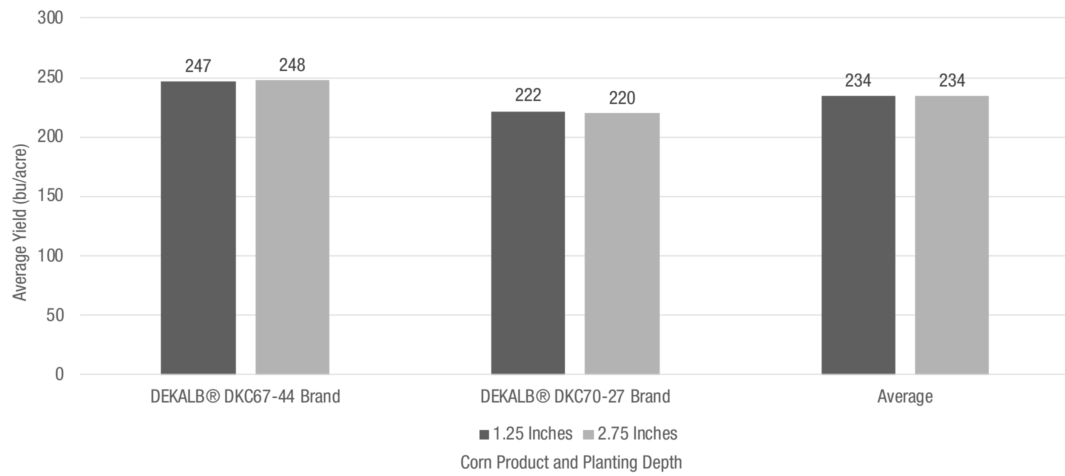

Figure 1. Average product yield (bu/acre @ 15.5% moisture content) based on planting depths of 1.25 and 2.75 inches and seeding rates of 28,000, 32,000, 36,000, and 40,000. Bayer Learning Center at Scott, MS (2021) (D5 Field).

Population (Figure 2)

- In this trial, neither product responded greatly for yield at seeding rates over 32,000 seeds/acre and planting depths of 1.25 and 2.75 inches.
  - » Both products responded positively to an increase in seeding rate from 28,000 to 32,000 seeds/acre.
  - » This is a typical result for DEKALB® DKC67-44 Brand; however, previous work has shown DEKALB® DKC70-27 Brand respond positively to population increases. This result may be due to the stressful nature of this field and the adaptation of DEKALB® DKC67-44 Brand to stressful environments.
  - » A primary conclusion from this study is that 32,000 seeds/acre should be the minimum seeding rate for both products tested.

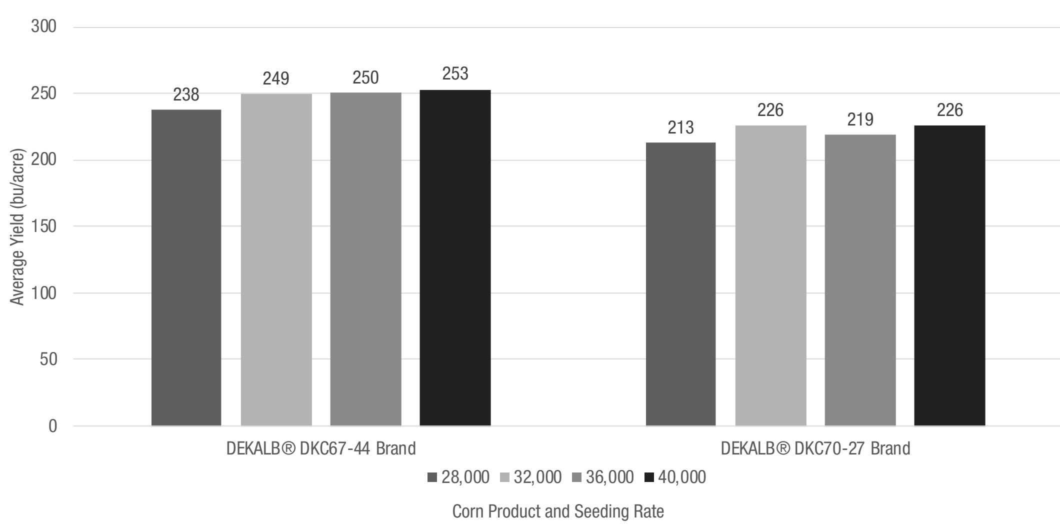

Figure 2. Average product yield (bu/acre @ 15.5% moisture content) based on seeding rates of 28,000, 32,000, 36,000, and 40,000 and planting depths of 1.25 and 2.75 inches. Bayer Learning Center, Scott, MS (2021) (D5 Field)

Evaluating the Interaction of Corn Product, Seeding Rate, and Planting Depth

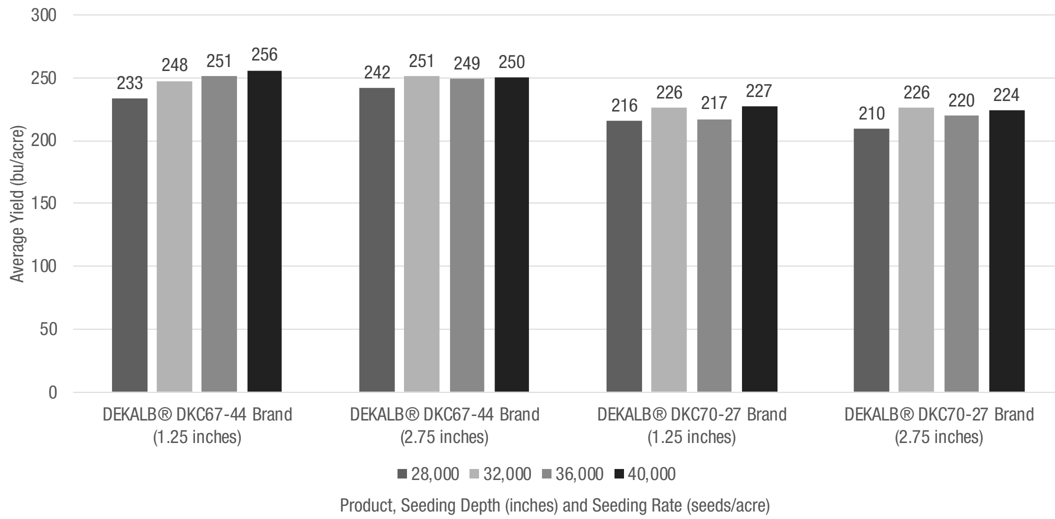

Figure 3 . Average product yield (bu/acre @ 15.5% moisture content) for each product based on seeding rates of 28,000, 32,000, 36,000, and 40,000 and planting depths of 1.25 and 2.75 inches. Bayer Learning Center, Scott, MS (2021) (D5 Field)

Key Learnings

- At this location, average yields were not penalized by deeper planting with any population and product combination in 2021.
- The long-term benefits from deeper planting can include better rooting, reduced bird predation, and more uniform stand establishment. For these reasons planting depth should be carefully considered when planting corn.
- Corn product adaptation should be carefully considered when selecting a product based on region, soil type, and stress tolerances.

Legal Statements

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

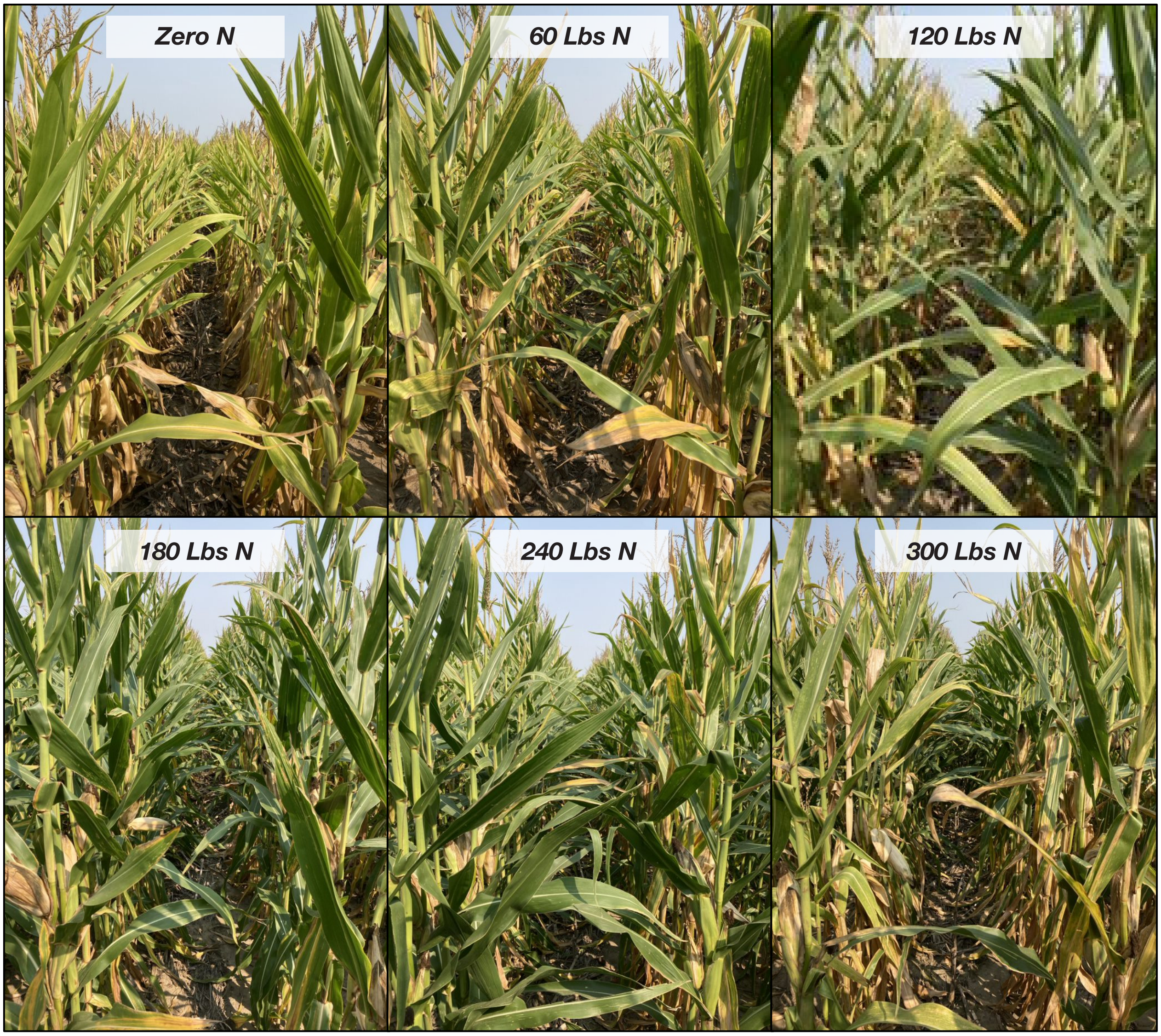

Figure 2. Nitrogen fertilization treatments in corn. Pictures were taken on 09/10/2021 at the Water Utilization Learning Center near Gothenburg, Nebraska.

- 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.

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1011_R10_21

Corn Characteristic Response to Nitrogen

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.

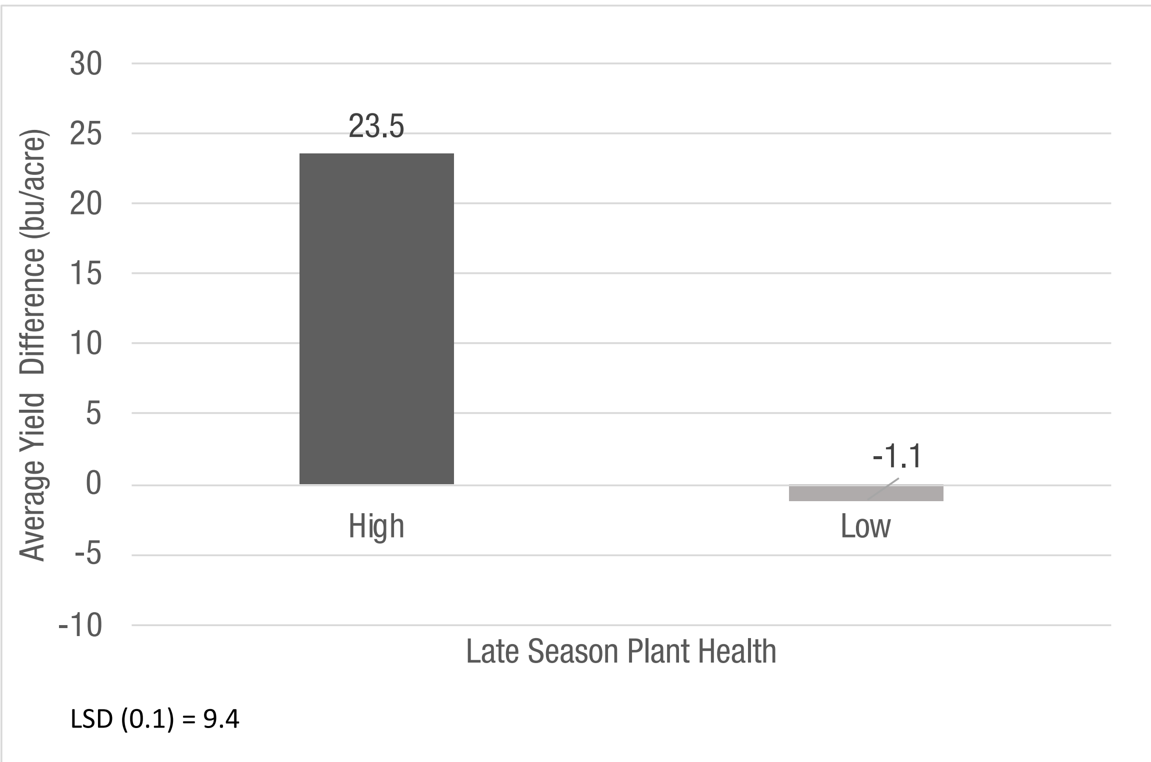

Figure 1. Response of late season plant health to nitrogen strategy. (Bars represent the split N application average yield minus the up-front N application average yield)

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

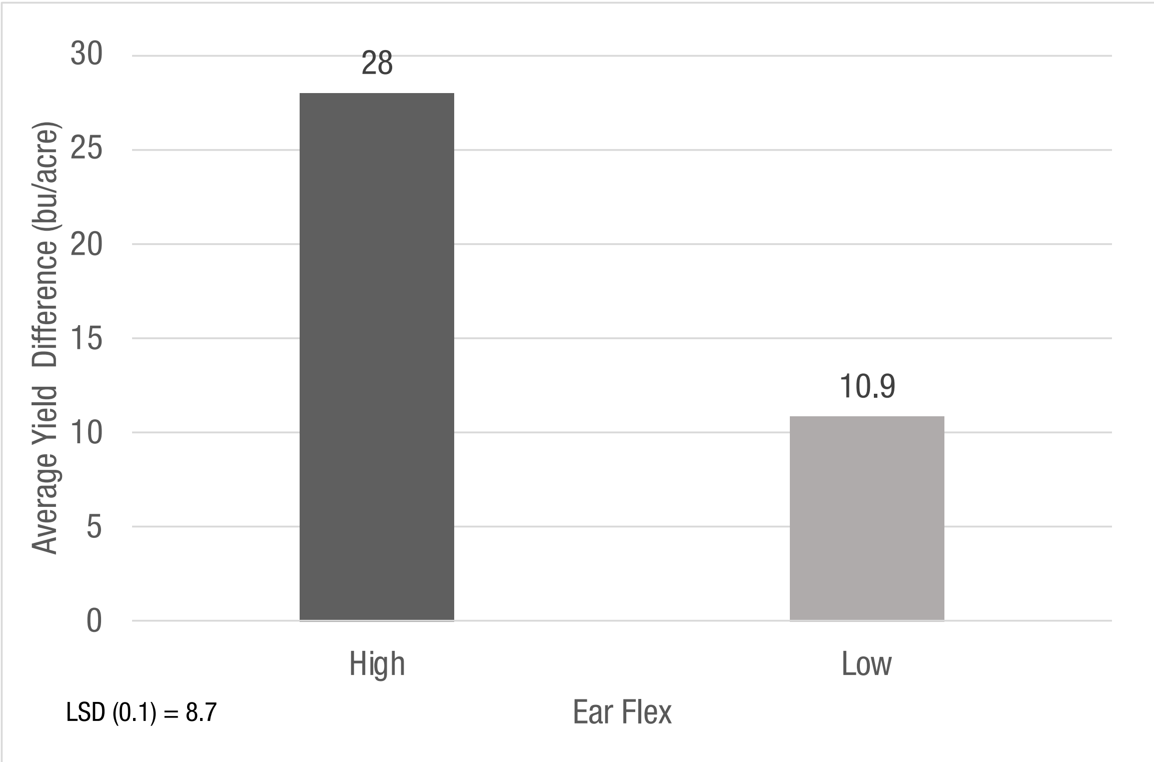

Figure 2. Response of corn ear flex to nitrogen strategy. (Bars represent the split N application average yield minus the up-front N application average yield)

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.

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1011_R6_21

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

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

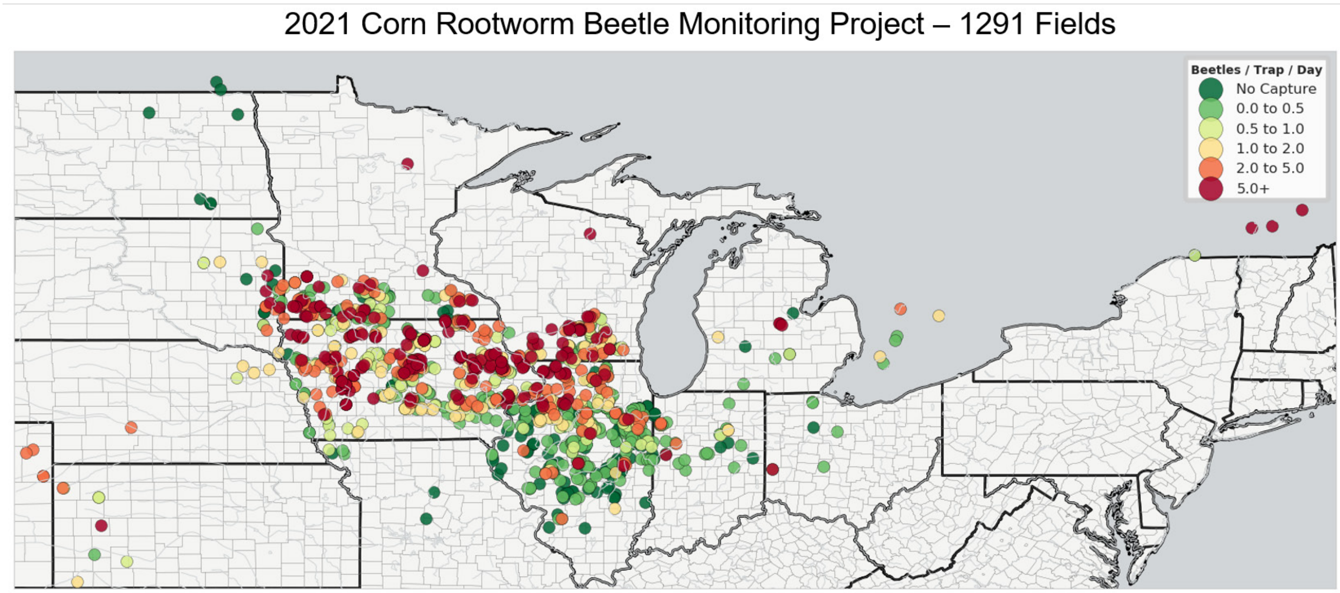
- One to four Pherocon® AM non-baited trapping sites were established at 1291 field locations in corn and soybean fields across the corn-growing areas of CO, IA, IL, IN, KS, MI, MN, MO, NE, ND, OH, SD, and WI (Figure 1).
- The trapping sites were installed in the interiors of corn and soybean fields 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

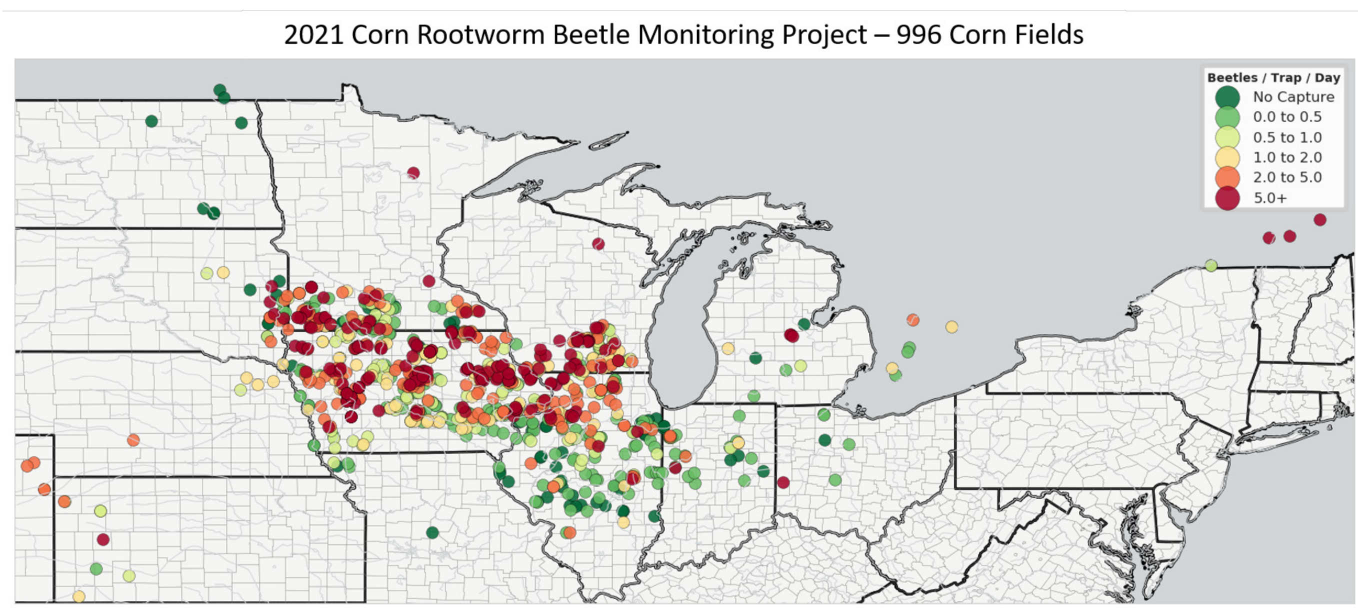
- Less than 2 beetles/trap/day indicate a relatively low risk of economic injury.
- Greater than 1 beetle/trap/day suggests a low risk for economic injury but could indicate populations are increasing.
- Greater than 2 beetles/trap/day indicate the probability for economic injury is likely if control 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



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.



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

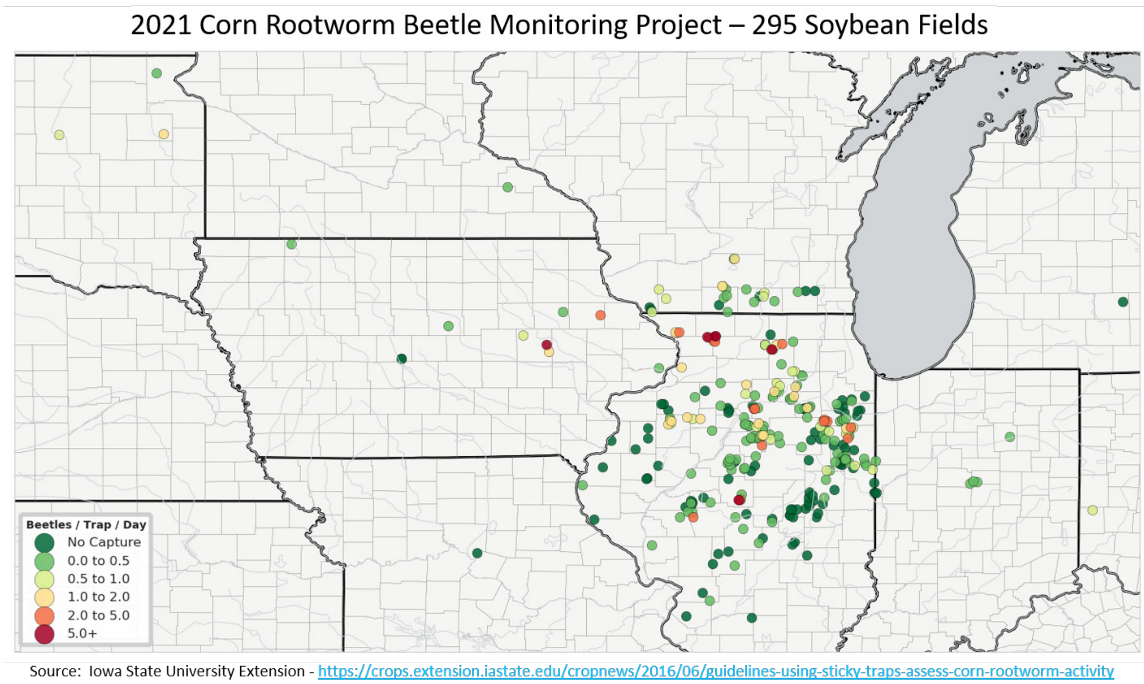


Figure 3. Soybean field locations for corn rootworm beetle trapping in 2021.

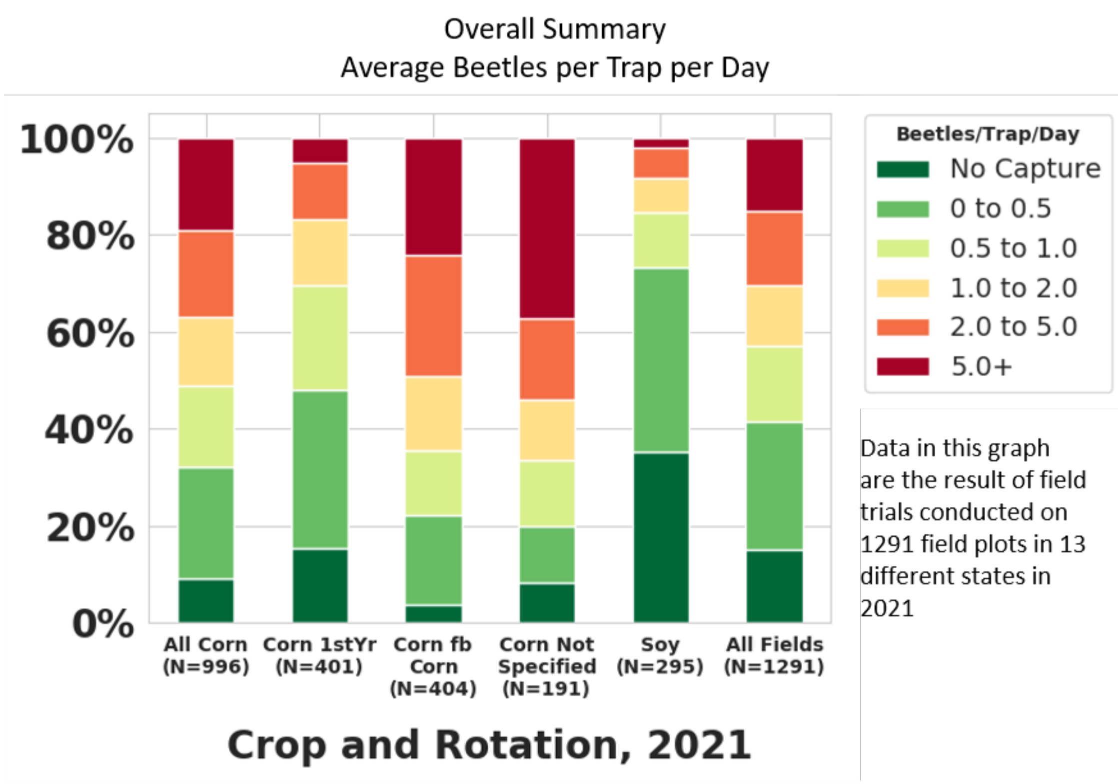


Figure 4. Overall summary of average corn rootworm beetles captured per trap per day in corn and soybean fields in 13 states (2021). [1,2]

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.

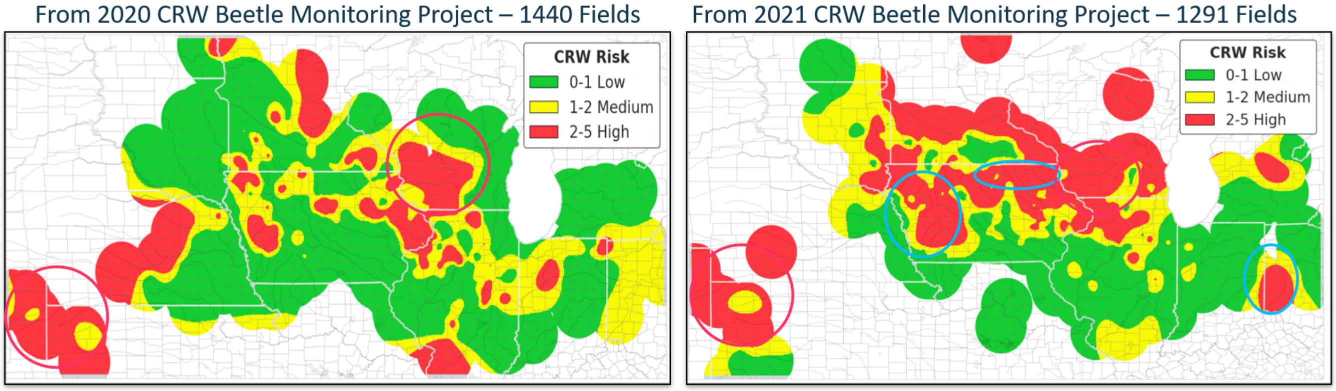
2021 Crop	2020 Crop	Number of Sampled Fields	Average Peak Number of Corn Rootworm Beetles/Trap/Day
Total Corn	All rotations	996	3.55
Corn	Soybean	401	1.23
Corn	Corn	404	4.75
Corn	Not Specified	191	6.13
Soybean	Corn	295	0.65
Corn and Soybean	All Rotations	1291	2.89

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.

2021 Corn Rootworm (CRW) Pressure Forecast
From 2020 CRW Beetle Monitoring Project – 1440 Fields

2022 Corn Rootworm (CRW) Pressure Forecast
From 2021 CRW Beetle Monitoring Project – 1291 Fields



Areas in Red are estimated to have potential risk of above action threshold populations[1].

Denotes hotspot similarity between 2021 & 2022

Denotes increased risk 2021 to 2022

[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

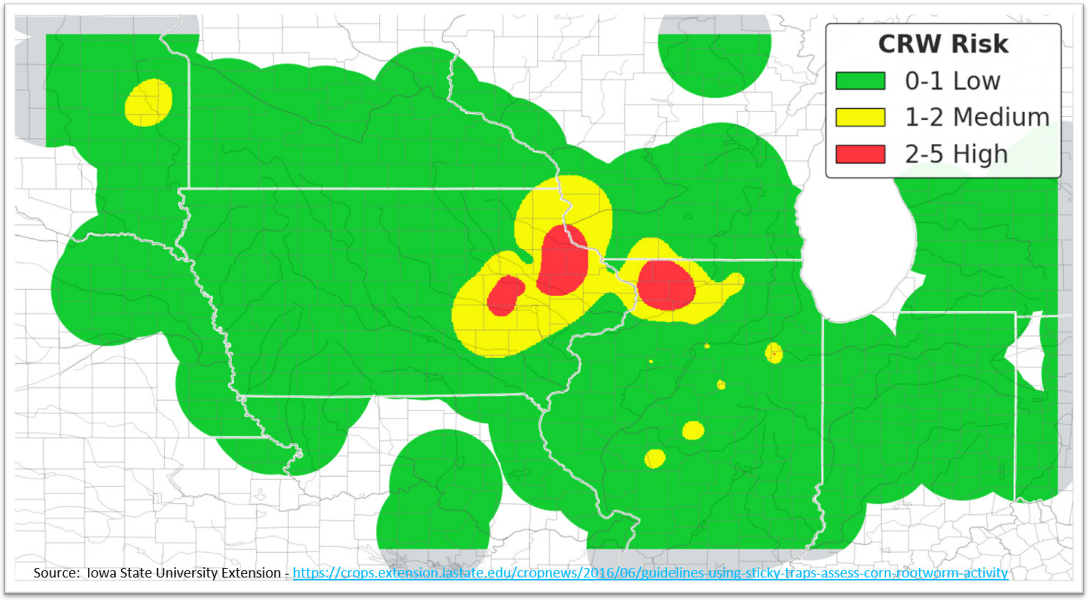


Figure 6. Corn rootworm beetle pressure in 295 soybean fields across the Midwest in 2021.

- 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.

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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

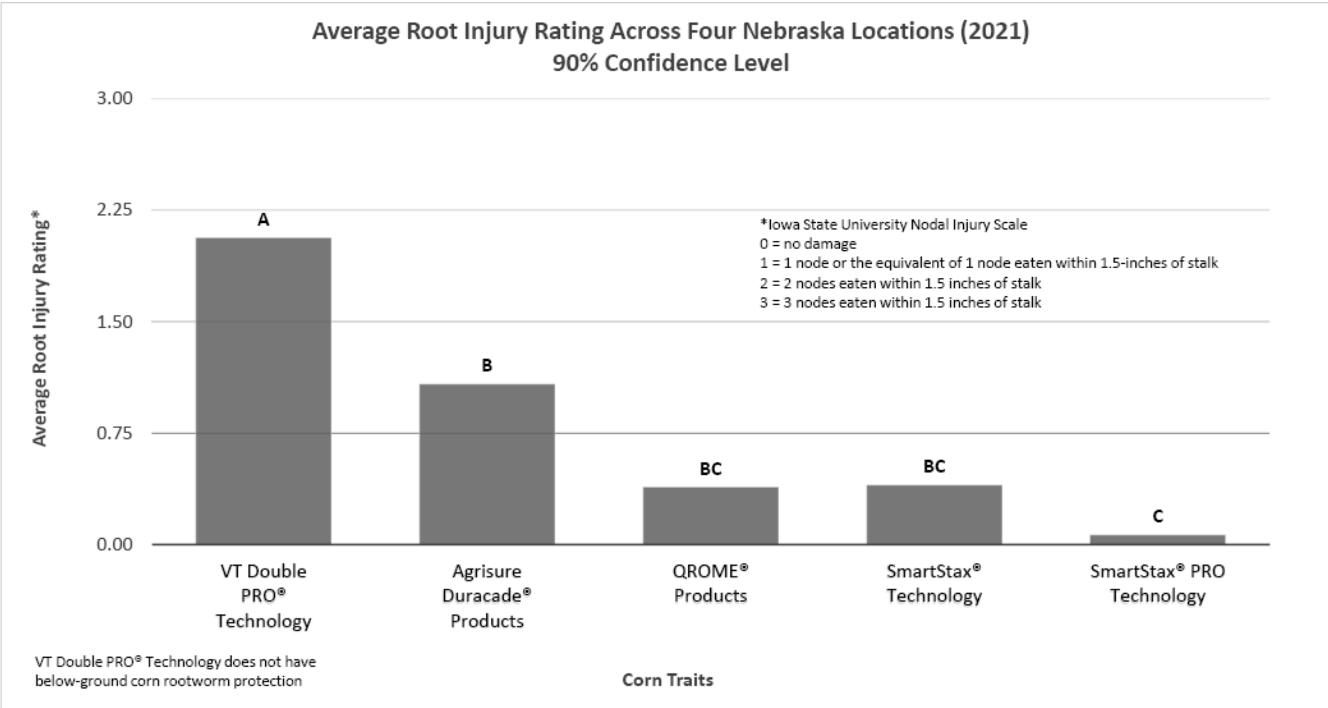

Figure 1. Average root injury rating across four Nebraska locations using the Iowa State University Nodal Injury Scale.

- 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.

Evaluation of Corn Rootworm Management in Nebraska

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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

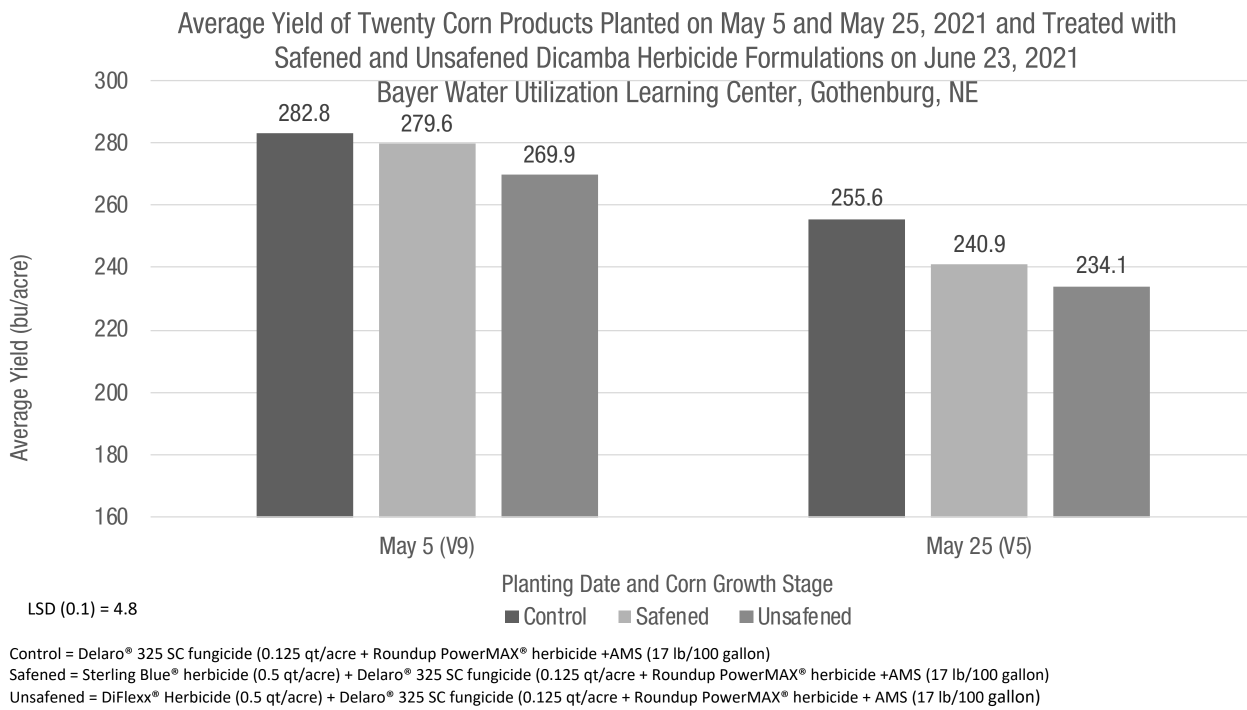


Figure 1. Average yield by different dicamba herbicide formulations and corn growth stage across corn products.

- 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.

Legal Statements

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.

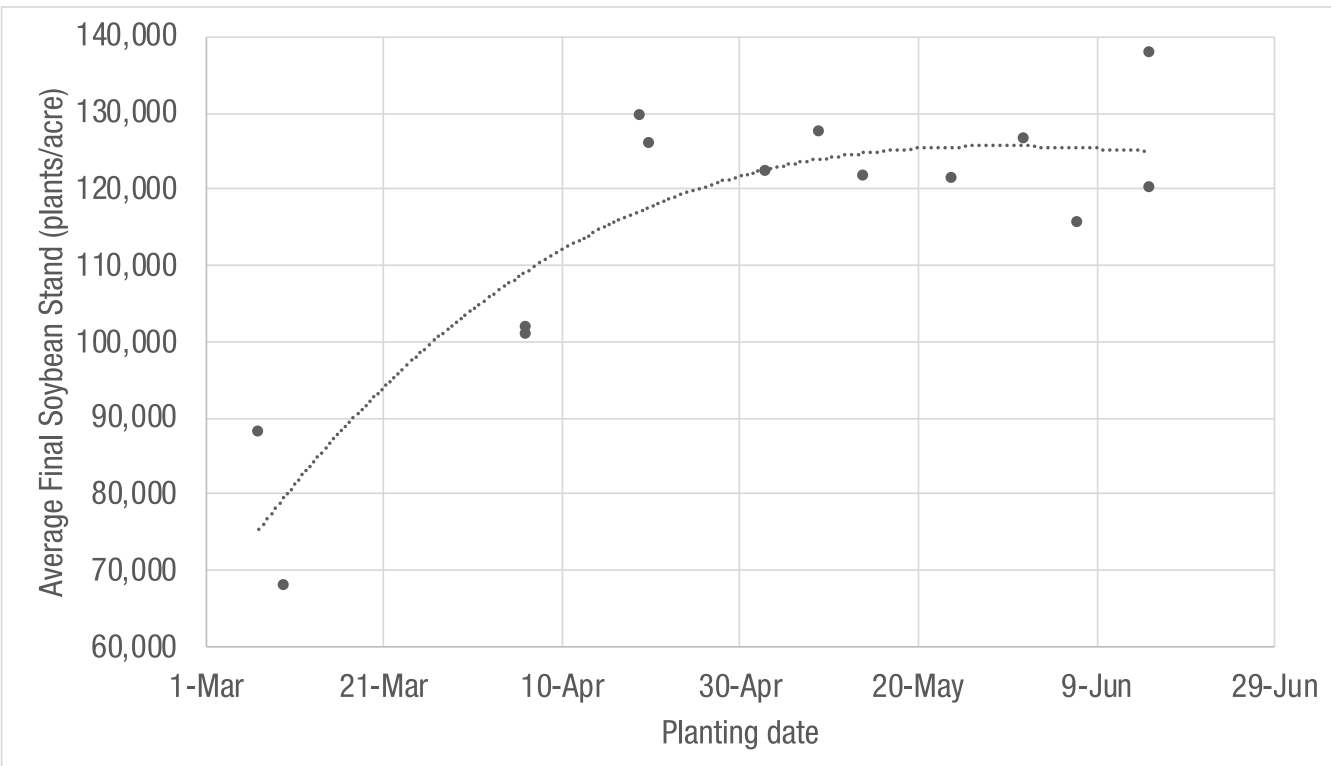


Figure 1. Average final soybean stands across planting dates and years (2020 and 2021).

Corn and Soybean Planting Timing Decisions

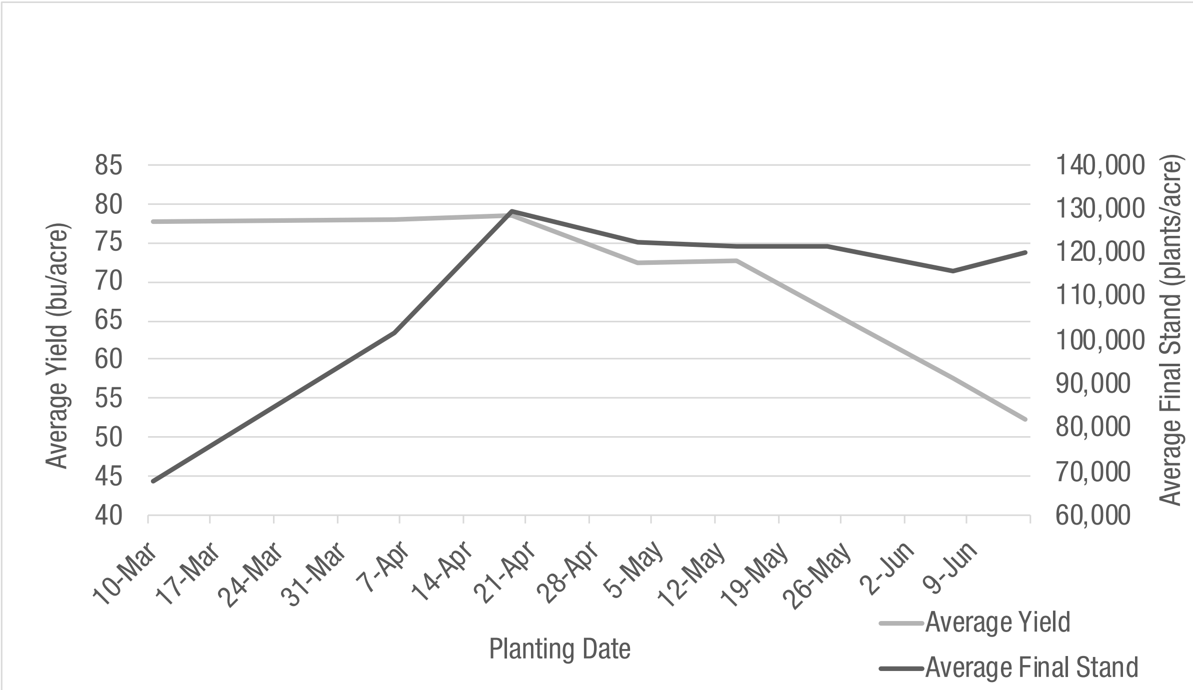


Figure 2. Average yield and average final stand count of 3.5 RM soybean across planting dates in 2021.

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

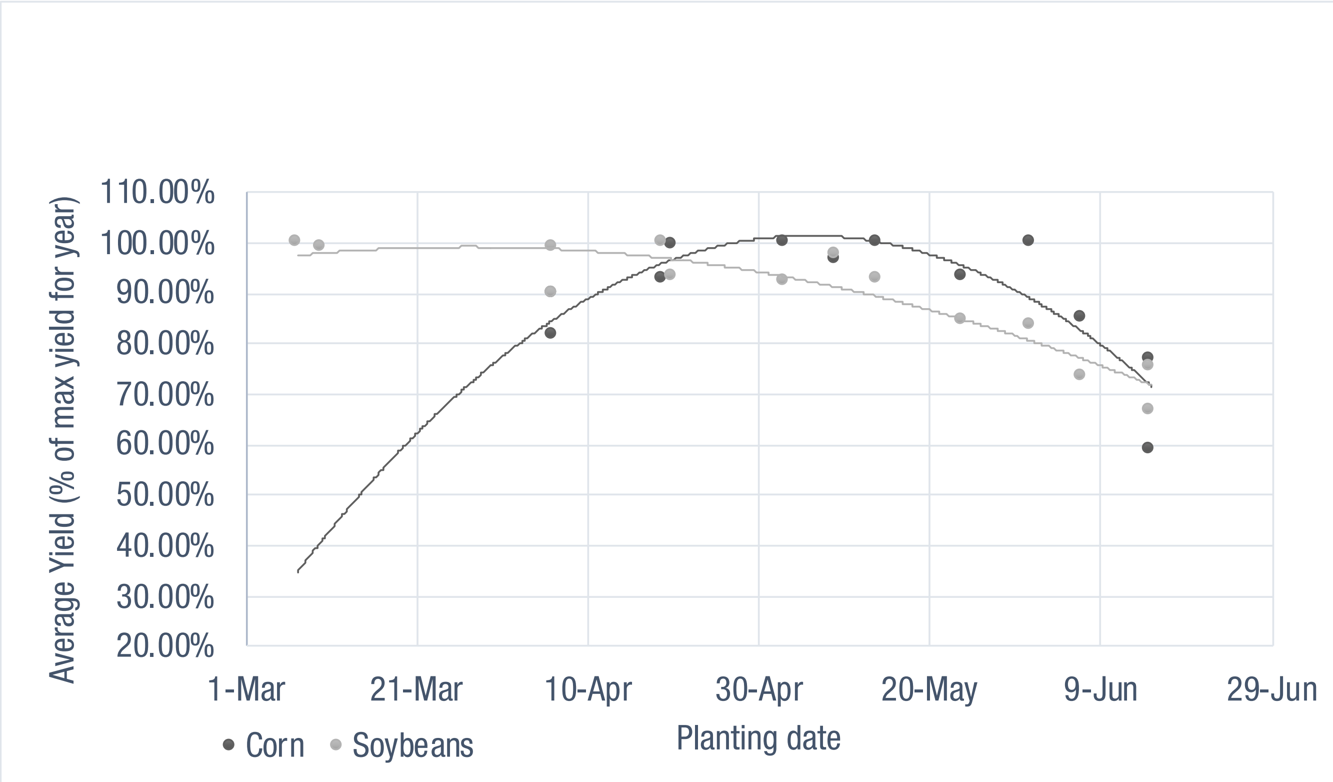


Figure 4. Relative performance of corn and soybeans at different planting dates combined over years in 2020 and 2021.

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

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.

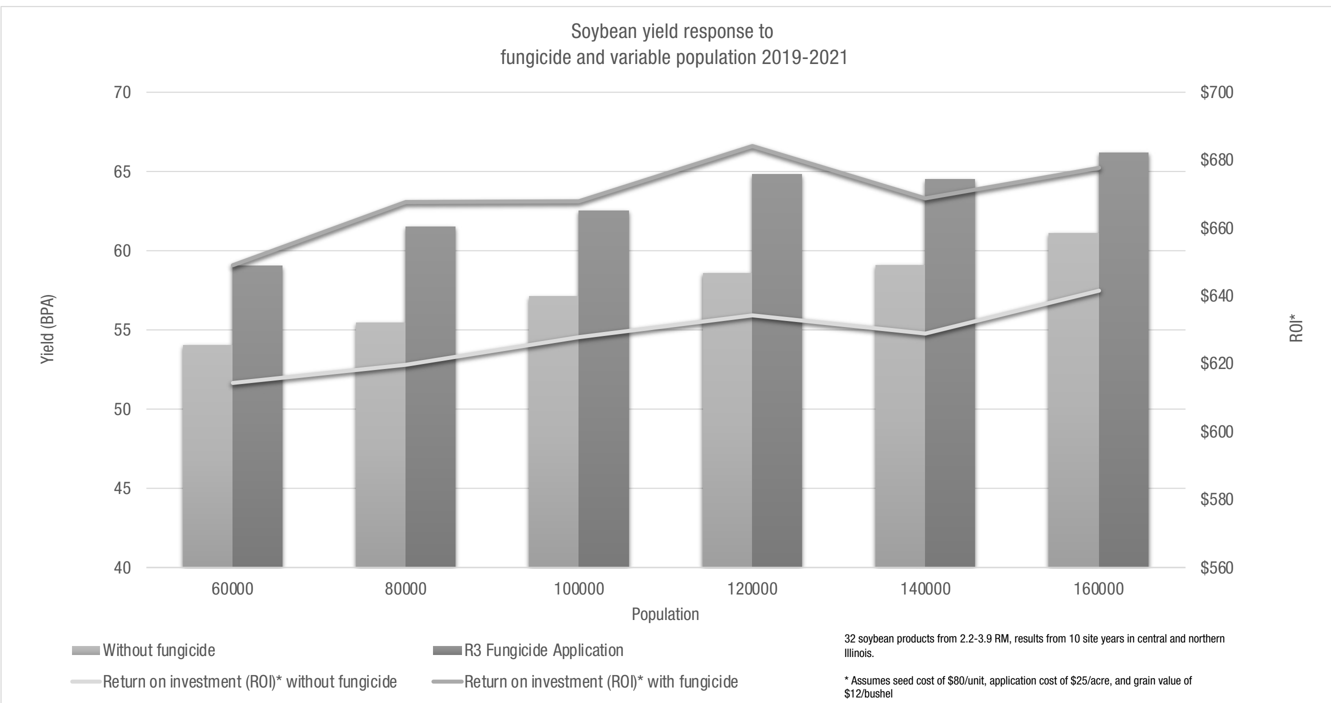


Figure 1. Average yield response of soybean to fungicide application and plant population, 2019-2021.

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

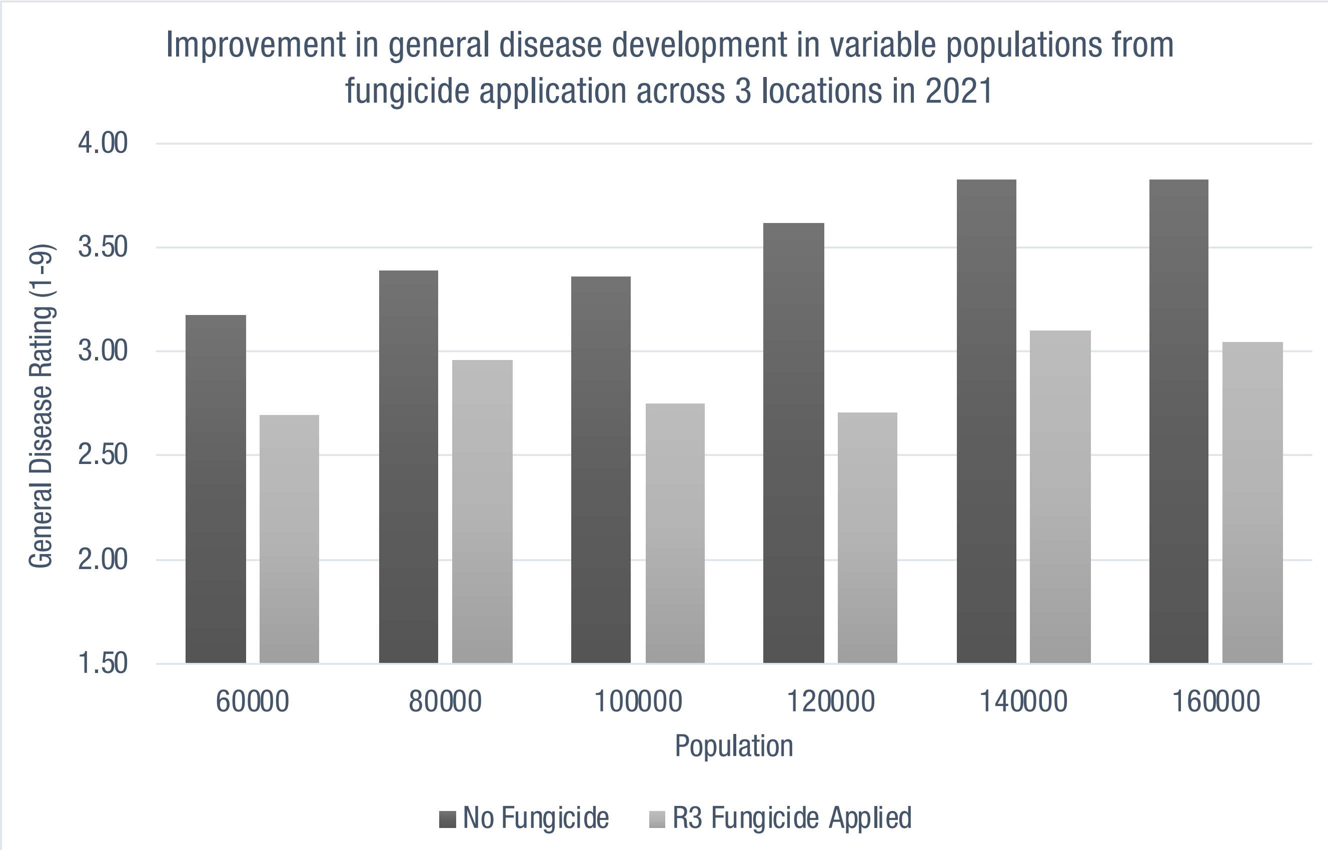


Figure 2. Effect of fungicide on disease development in variable plant populations across 3 locations in 2021.

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

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. 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.

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.

Evaluation of Disease Management Systems in Soybean – Sudden Death Syndrome

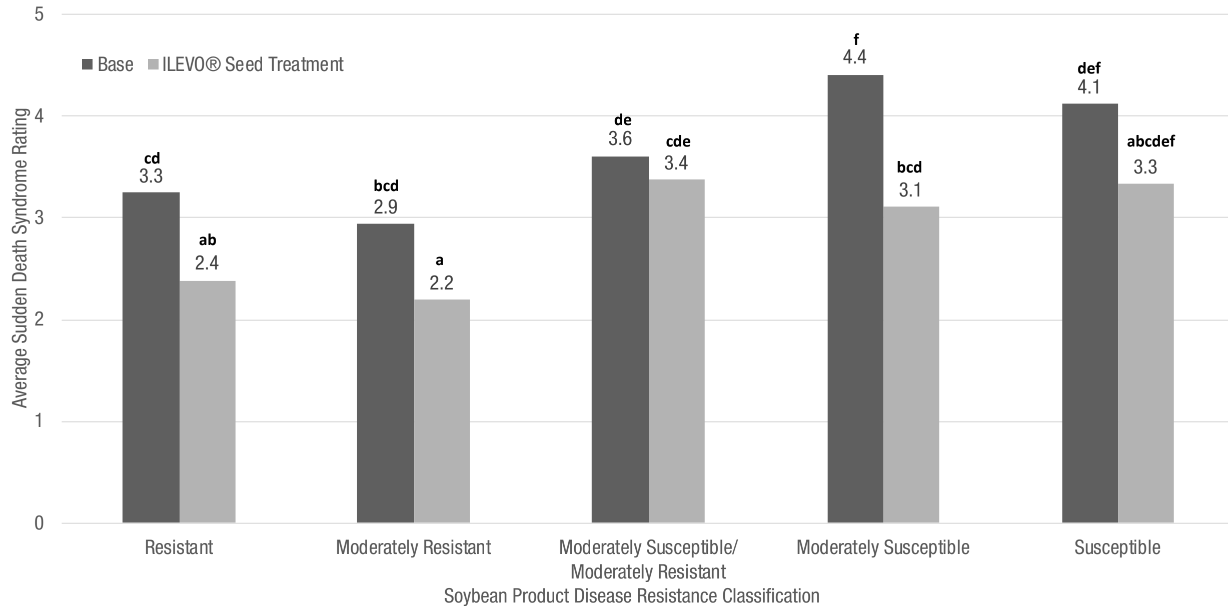
- Sudden death syndrome (SDS) is among the most devastating soil-borne diseases of soybean in the U.S. The disease has spread extensively and causes high soybean yield losses throughout the North Central Region. SDS is most severe when soybean is planted early into cool, wet soils, when heavy midsummer 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.

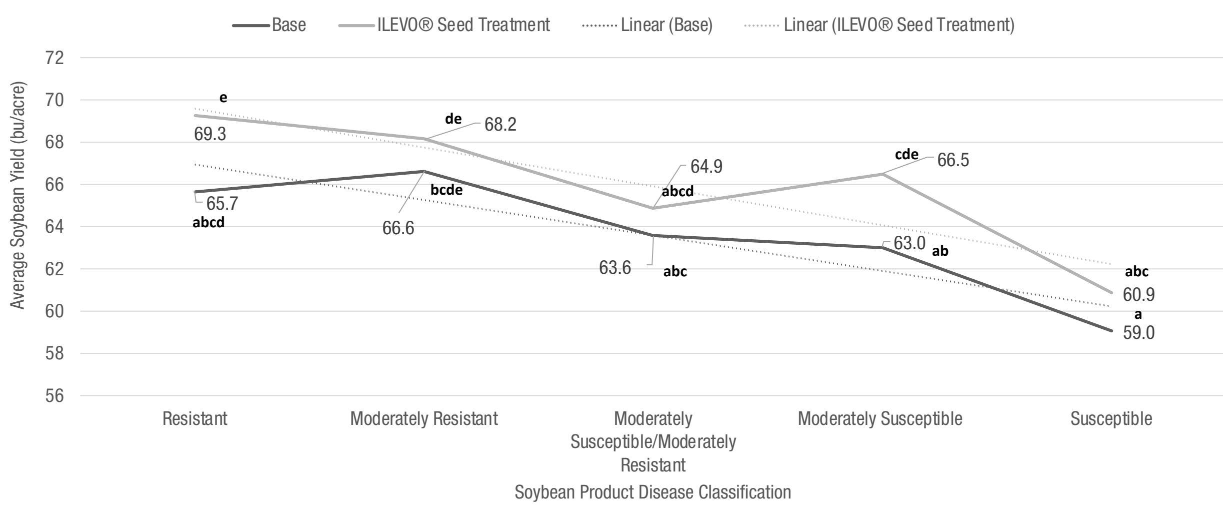
Evaluation of Disease Management Systems in Soybean – Sudden Death Syndrome

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.

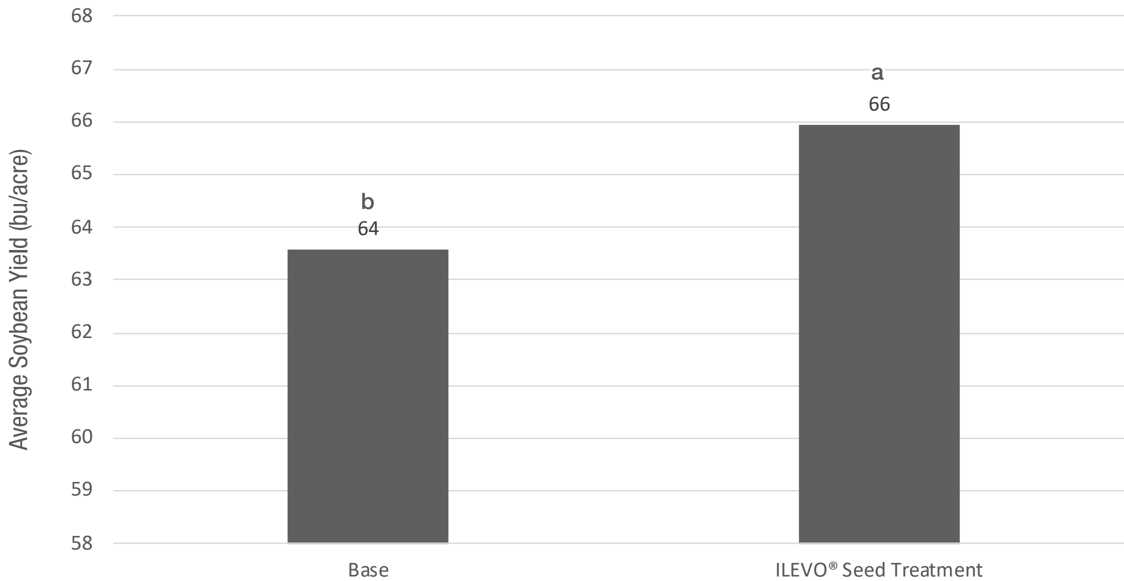


Base = Acceleron® STANDARD Seed Applied Solutions in 2019 and 2020,; Acceleron® STANDARD Seed Applied Solutions + Poncho®/Votivo® in 2018

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.

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

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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

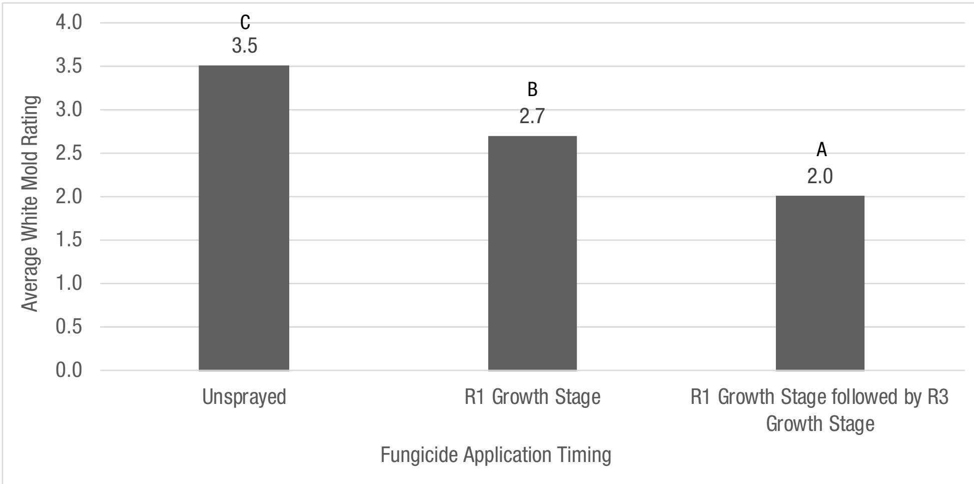


Figure 1. Average white mold disease index rating for each fungicide treatment of Delaro® fungicide tank-mixed with Luna® Privilege Fungicide (2019-2020) or Delaro® Complete Fungicide (2021). White mold disease index: 1 = no disease, 9 = severe disease. Mean separation letters (a, b, c) denote statistically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

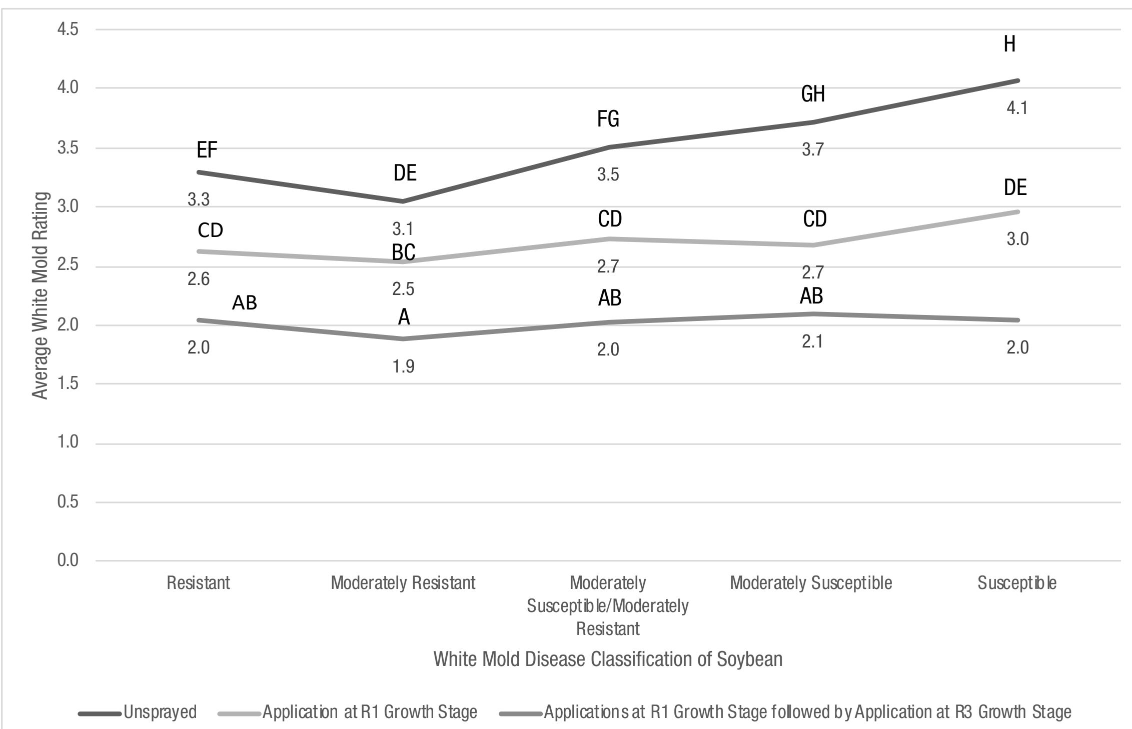


Figure 2. Average white mold disease index rating by fungicide spray treatment and white mold disease classification of soybean products. Fungicides: Delaro® 325 SC fungicide tank-mixed with Luna® Privilege fungicide (2019-2020) or Delaro® Complete Fungicide (2021). WM disease index: 1 = no disease, 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

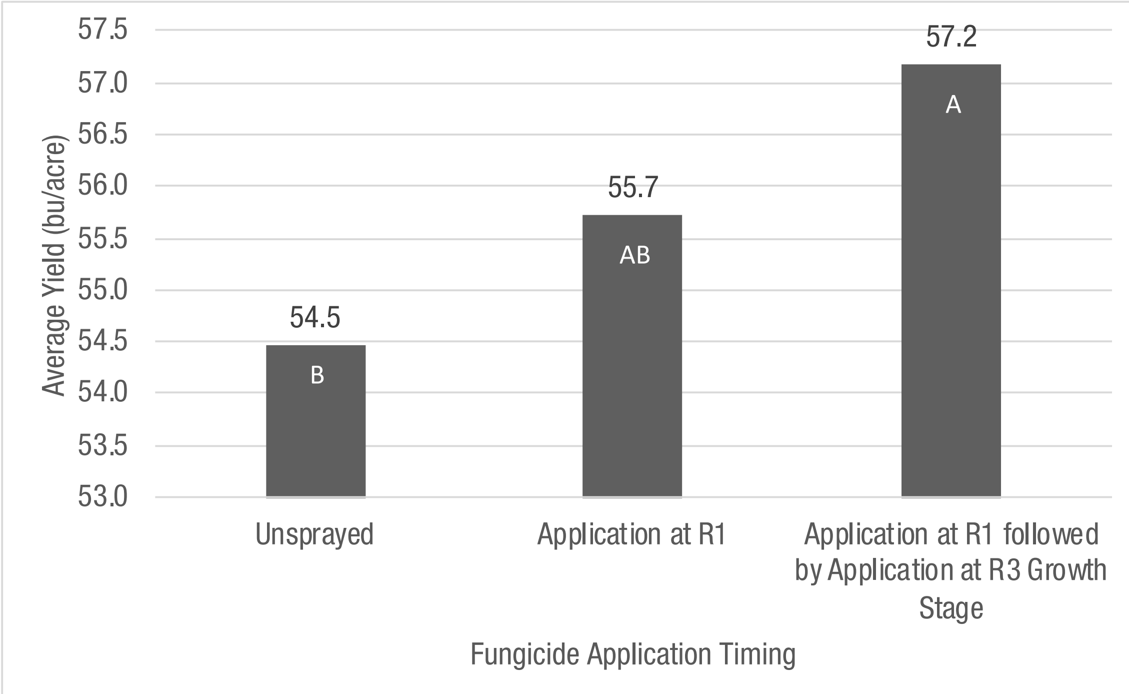


Figure 3. Average yield for each fungicide treatment across all soybean products and locations. Fungicides: Delaro® 325 SC fungicide tank-mixed with Luna® Privilege Fungicide (2019-2020) or Delaro® Complete Fungicide (2021). Mean separation letters (a, b) denote statistically significant differences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

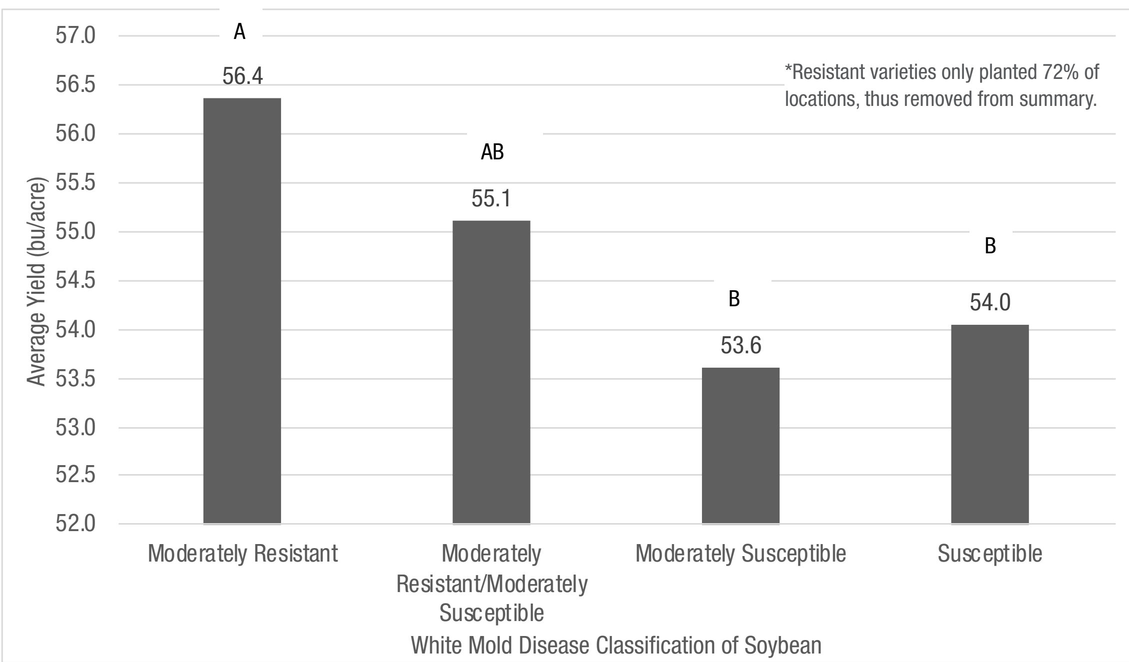


Figure 4. Average yield of treatments for each white mold disease classification of soybean products. Mean separation letters (a) denote statistically significant differences at an alpha = 0.1.

Evaluation of Disease Management Systems in Soybean – White Mold

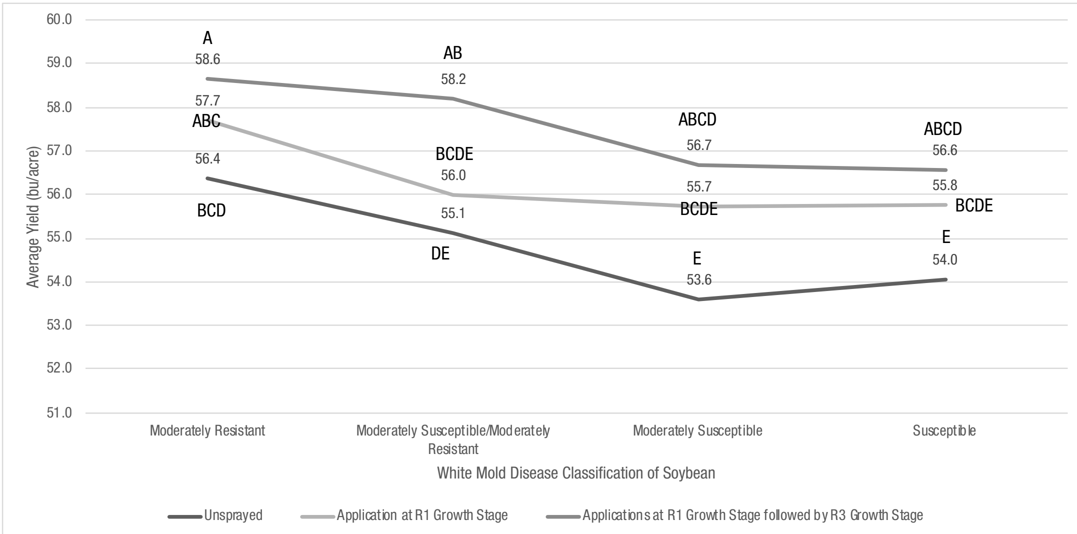


Figure 5. Average yield by fungicide treatment and white mold disease classification of soybean products. Fungicides: Delaro® fungicide tank-mixed with Luna® Privilege Fungicide (2019-2020) or Delaro® Complete Fungicide (2021).

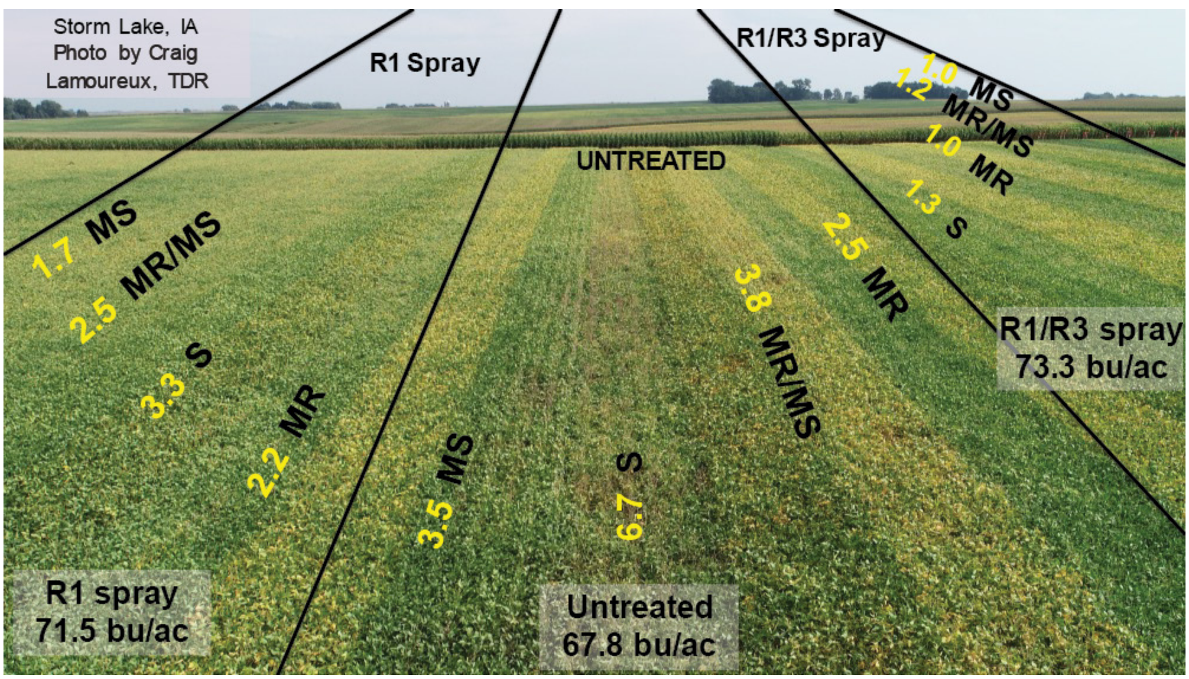


Figure 6. Aerial imagery from 2019 showing visual differences of white mold disease severity for each of the fungicide spray treatments and white mold disease classification of products. Soybean products sprayed at R1 growth stage then followed by an application at R3 growth stage yielded the highest 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

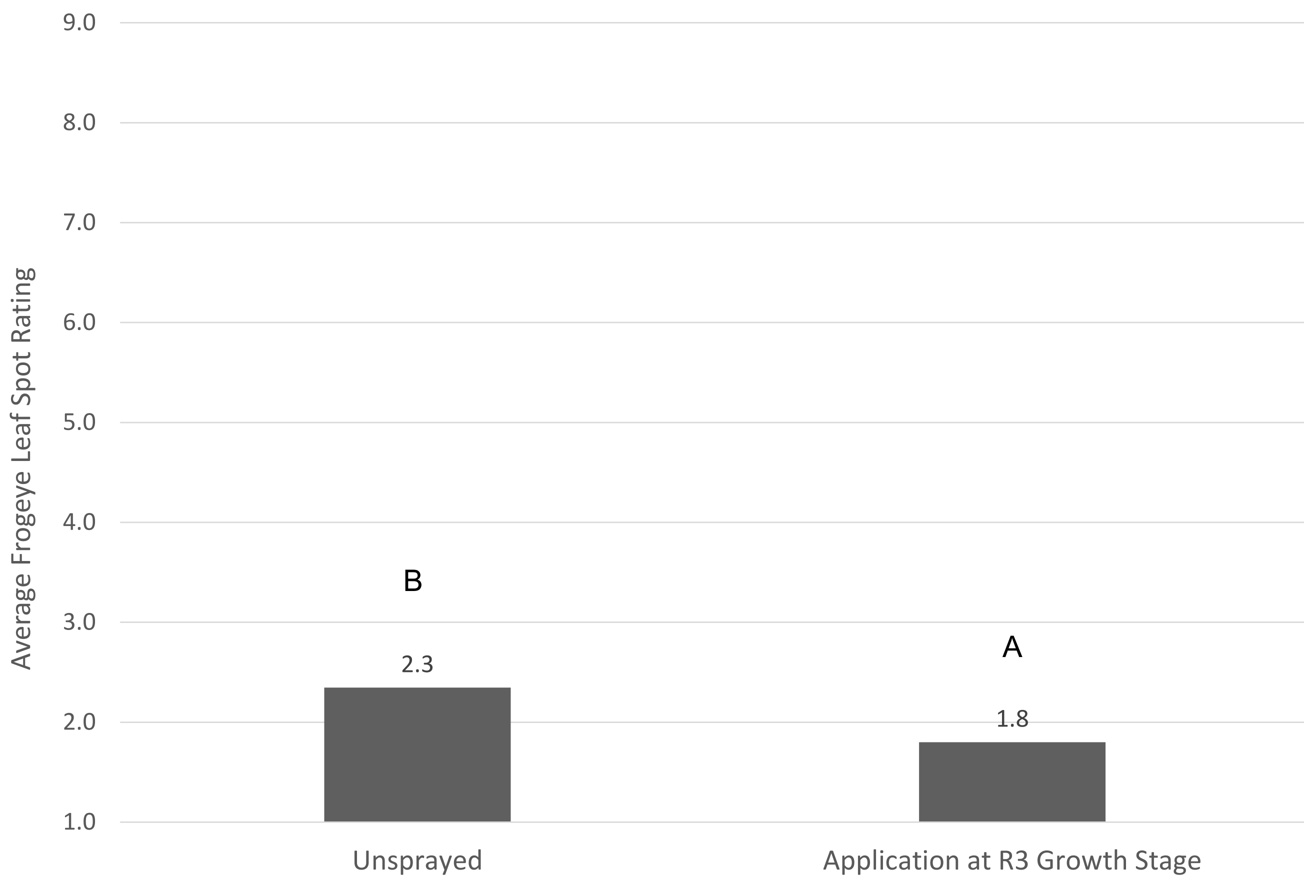


Figure 1. Average frogeye leaf spot disease index rating comparing untreated and fungicide treatment: Delaro® 325 SC fungicide at 8 oz/acre (in 2020) or Delaro® Complete Fungicide at 8 oz/acre (in 2021) [in both years, Stratego® YLD fungicide at 4 oz/acre was applied in the three southern locations]. 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

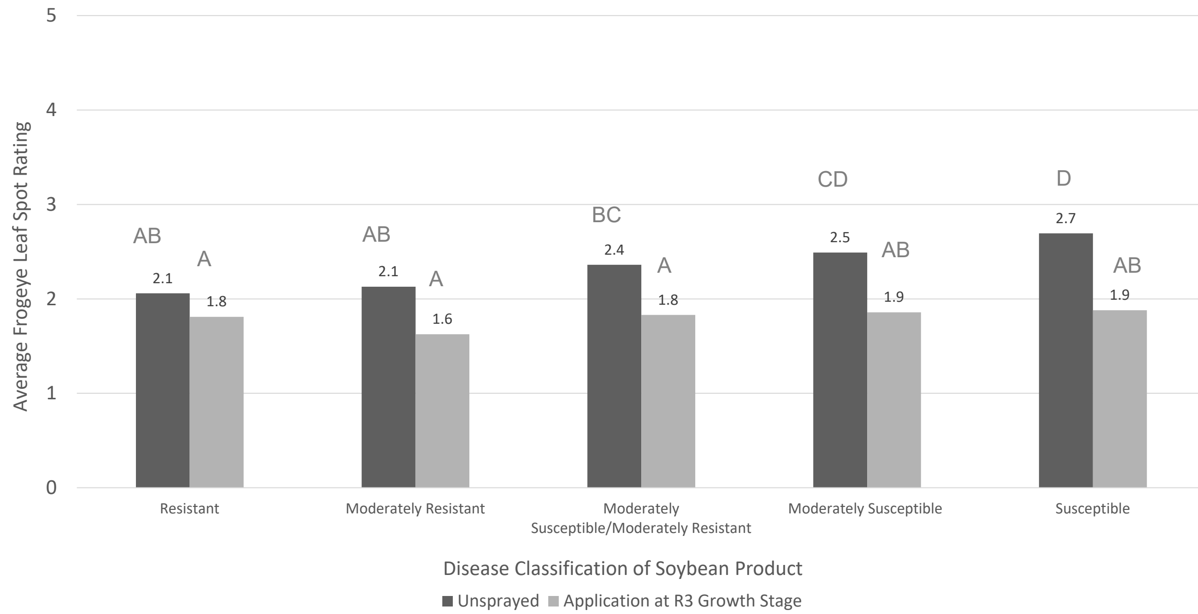


Figure 2. Average frogeye leaf spot (FLS) disease index rating by fungicide spray treatment and FLS disease classification of soybean products. Fungicide treatment: Delaro® 325 SC fungicide at 8 oz/acre (in 2020) or Delaro® Complete Fungicide at 8 oz/acre (in 2021) [in both years, Stratego® YLD fungicide 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.

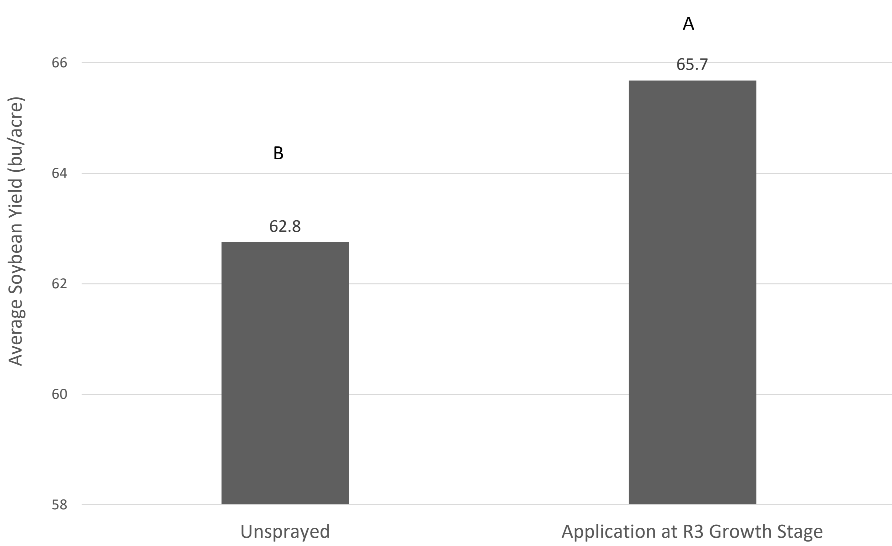


Figure 3. Average yield for each fungicide treatment across all soybean products and locations. Fungicide treatment: Delaro® 325 SC fungicide at 8 oz/acre (in 2020) or Delaro® Complete Fungicide at 8 oz/acre (in 2021) [in both years, Stratego® YLD fungicide at 4 oz/acre was applied in the three southern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

Managing Frogeye Leaf Spot

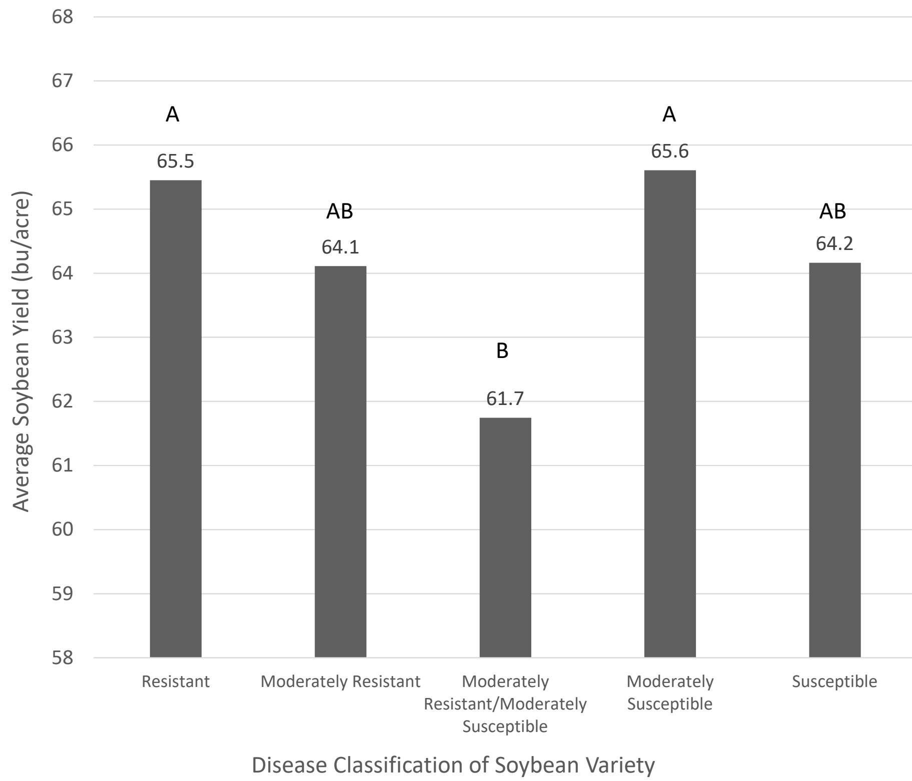


Figure 4. Average yield of treatments for each frogeye leaf spot disease classification of soybean products. Mean separation letters (a) denote statistically significant differences at an alpha = 0.1.

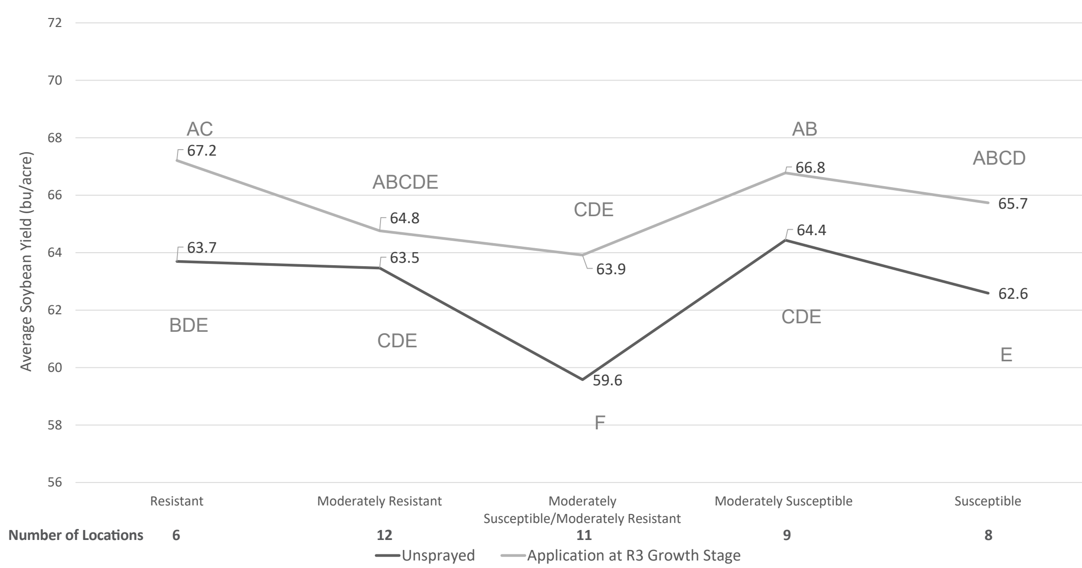


Figure 5. Average yield by fungicide treatment and frogeye leaf spot disease classification of soybean products. Fungicide treatment: Delaro® fungicide at 8 oz/acre (in 2020) or Delaro® Complete fungicide at 8 oz/acre (in 2021) [in both years, Stratego® YLD fungicide at 4 oz/acre was applied in the three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

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).

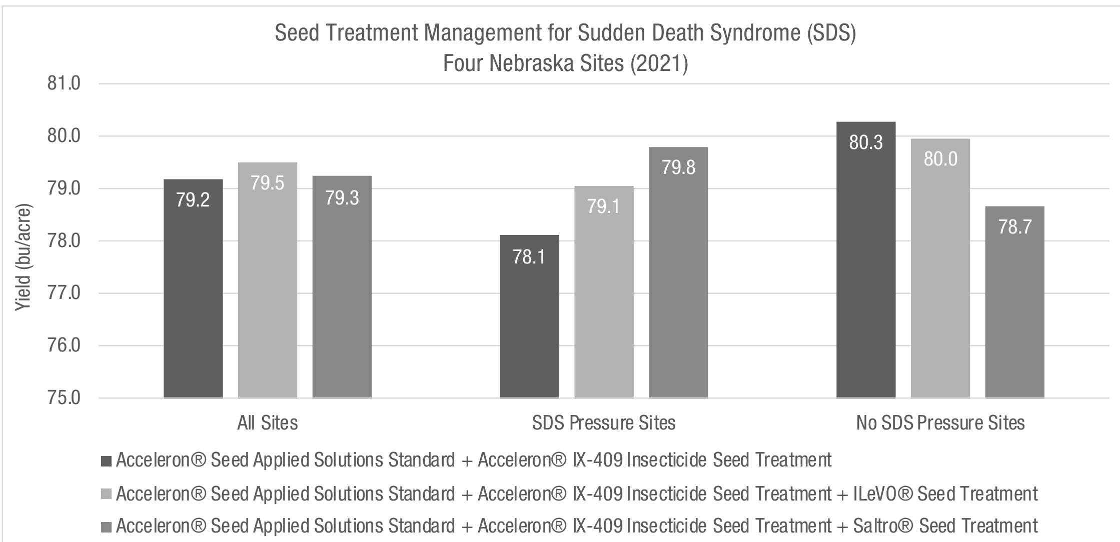


Figure 1. Average soybean yield separated by sudden death syndrome (SDS) pressure for three soybean seed treatments at four sites in Nebraska (2020 and 2021). Acceleron® Seed Applied Solutions Standard is a combination of Acceleron® DX-109 Fungicide Seed Treatment/Acceleron® D-109 Fungicide Seed Treatment,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

The information discussed in this report is from a multiple site, non-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. 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.

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.

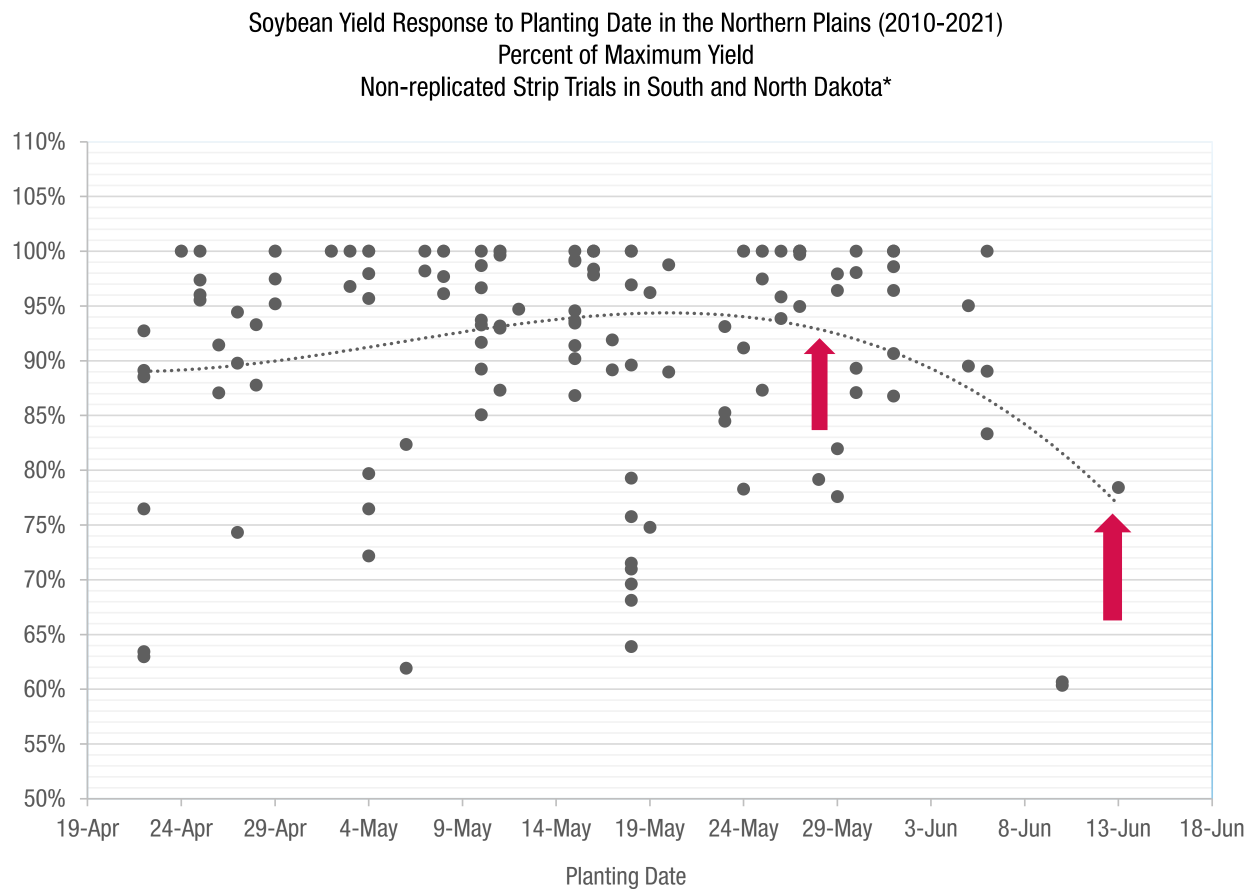
Year and Location of Strip Trials	
Year	Location
2010	Chancellor, SD
2011	Chancellor, SD
2012	NA*
2013	Watertown, SD Redfield, SD
2014	Chester, SD Ethan, SD
2015	NA*
2016	Berlin, ND Chester, SD
2017	Carrington, ND Chancellor, SD Watertown, SD Redfield, SD
2018	Chancellor, SD Ethan, SD Redfield, SD
2019	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

The information discussed in this report is from a multiple site, non-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.

Yield Observations When Shifting to Earlier Relative Maturity Soybeans

Research Description

Trial Overview

- We continue to see a growing trend of growers planting early soybeans 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.

Overview

- Determine the yield impact of early 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 (bu/acre)	Planting Rate (seeds/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 Asgrow® brand soybean products
  - Three early maturity group (MG) soybean products.
    - North Set – 1.0 to 1.8 MG (AG10XF1 brand, AG13XF0 brand, AG18XF1 brand)
    - South Set – 2.0 to 2.6 MG (AG20XF1 brand, AG24XF1 brand, AG26XF1 brand)
  - Three normal maturity group soybean products
    - North Set – 2.0 to 2.6 MG (AG20XF1 brand, AG24XF1 brand, AG26XF1 brand)
    - South Set – 2.7 to 3.5 MG (AG27XF1 brand, AG31XF1 brand, AG35XF1 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
  - Marble Rock (3 replications)—6 rows at 30 -inch spacing

Yield Observations When Shifting to Earlier Relative Maturity Soybeans

» 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 MG set at all locations (Figure 1).
- At the northern locations the normal MG set had an 8 bushels per acre advantage over Early MG set (Figure 1) and in the Southern locations the normal MG set had a 9 bushel per acre advantage over the Early MG set (Figure 2).

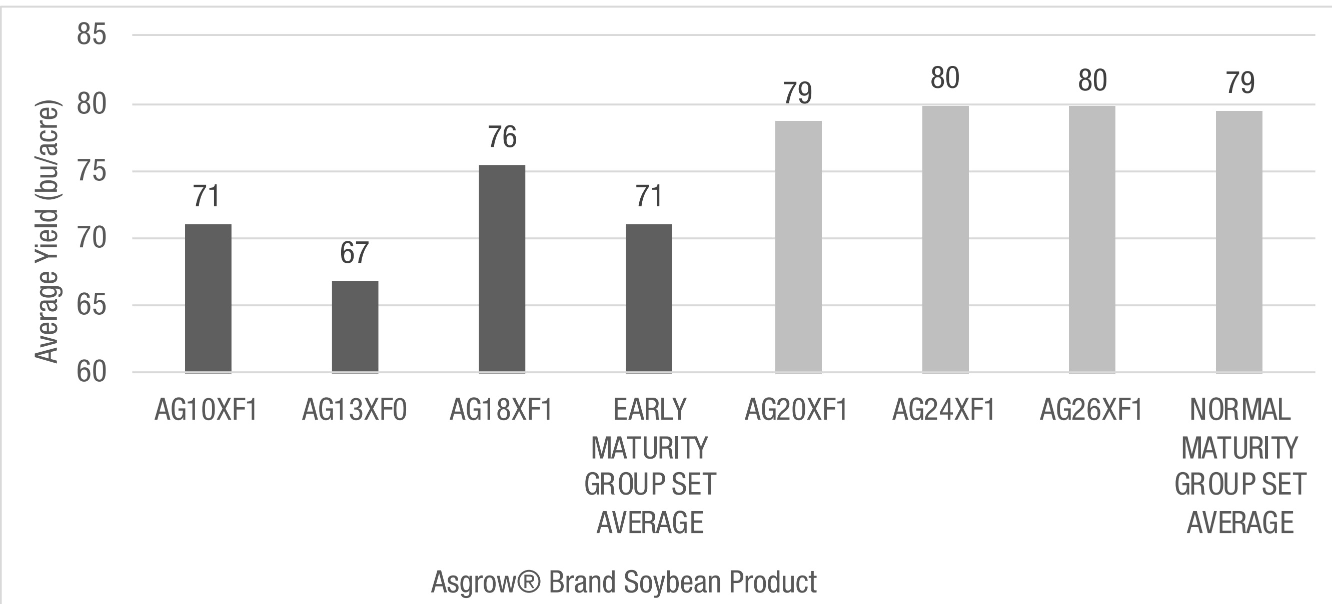


Figure 1. Effect of maturity group on Asgrow® brand soybean product performance in northern Iowa (2021).

Yield Observations When Shifting to Earlier Relative Maturity Soybeans

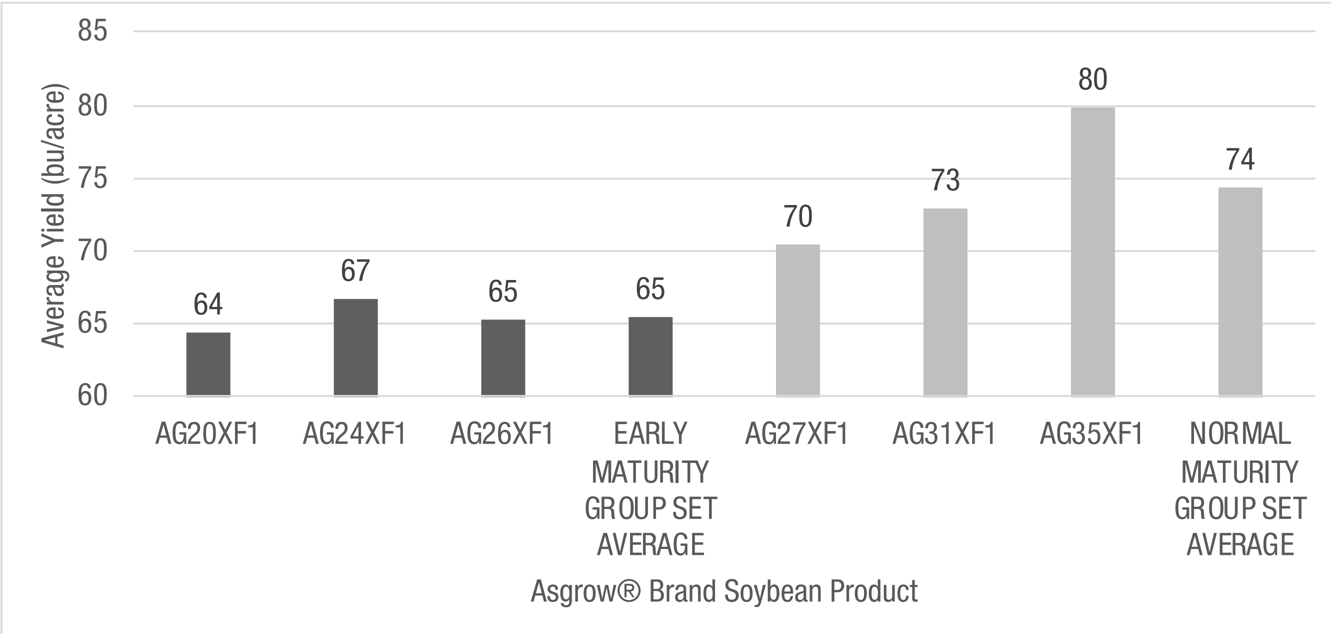


Figure 2. Effect of maturity group on Asgrow® brand soybean product performance in southern Iowa (2021).

What Does this Mean for Farm?

- In this study, the early MG soybean products averaged 8 to 9 bu/acre less than the normal MG soybean products with a range of 3 to 16 bu/acre less than normal MG products.
- Late season rainfall in 2021 was ideal, providing ample moisture during reproductive stages to maximize yield potential especially the normal MG soybean products at all locations.
- More research is needed 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.

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

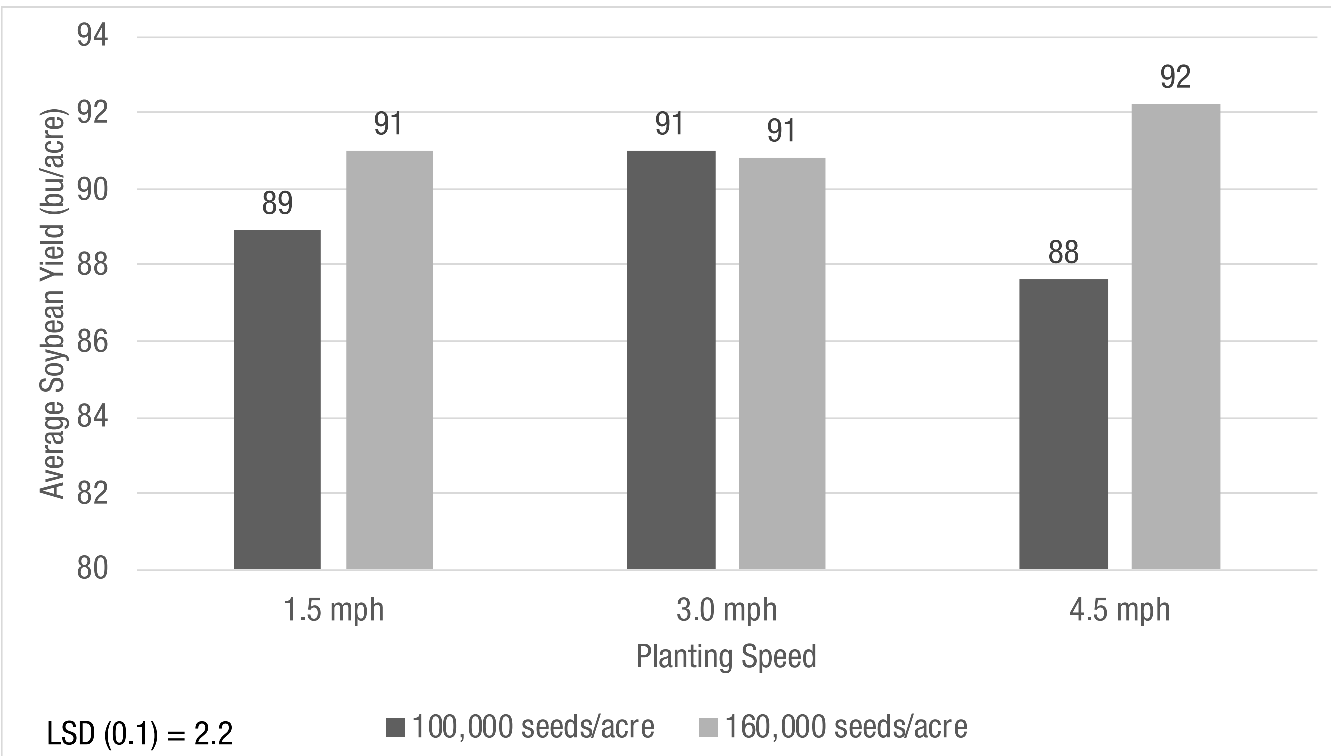


Figure 2. 2021 average soybean yield response to planting speed and seeding rate at Bayer Learning Center in Gothenburg, NE.

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 20201.
  - » 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

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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

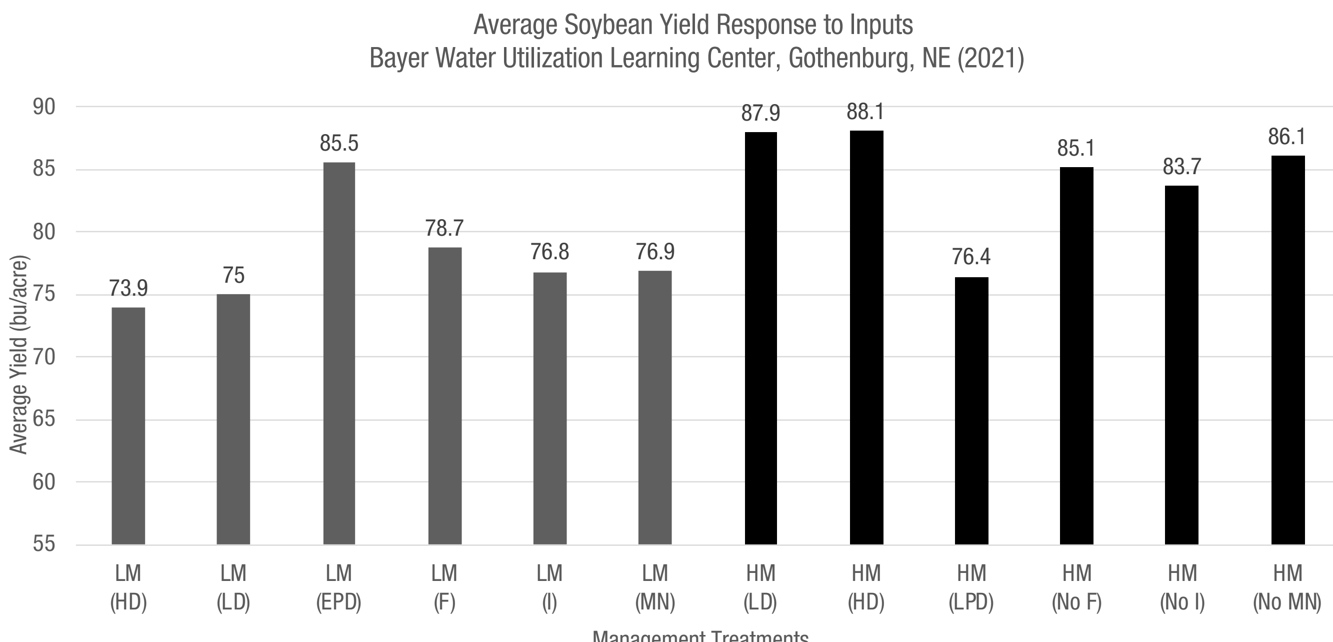
Treatment	Seeds/acre	Planting Date	Delaro® Complete Fungicide (8 fl oz/acre applied at R3 growth stage)	Leverage® 360 Insecticide (2.8 fl oz/acre applied at R3 growth stage)	Micronutrients at 64 fl oz/acre and Plant Growth Hormone at 2 fl oz/acre applied at R3 growth stage
Low Management (LM)	220,000	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).

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.

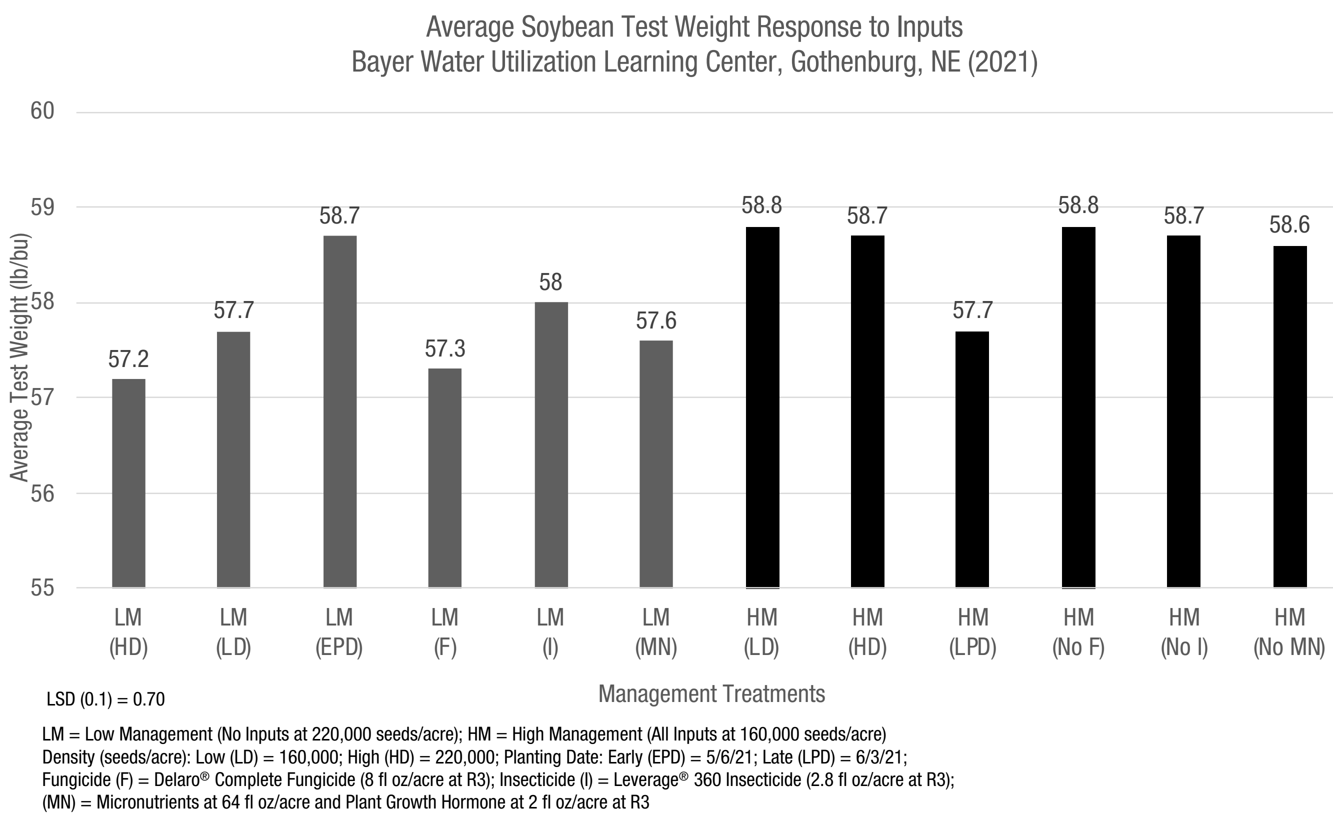


Figure 2. Average soybean test weight as impacted by management treatments at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

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.

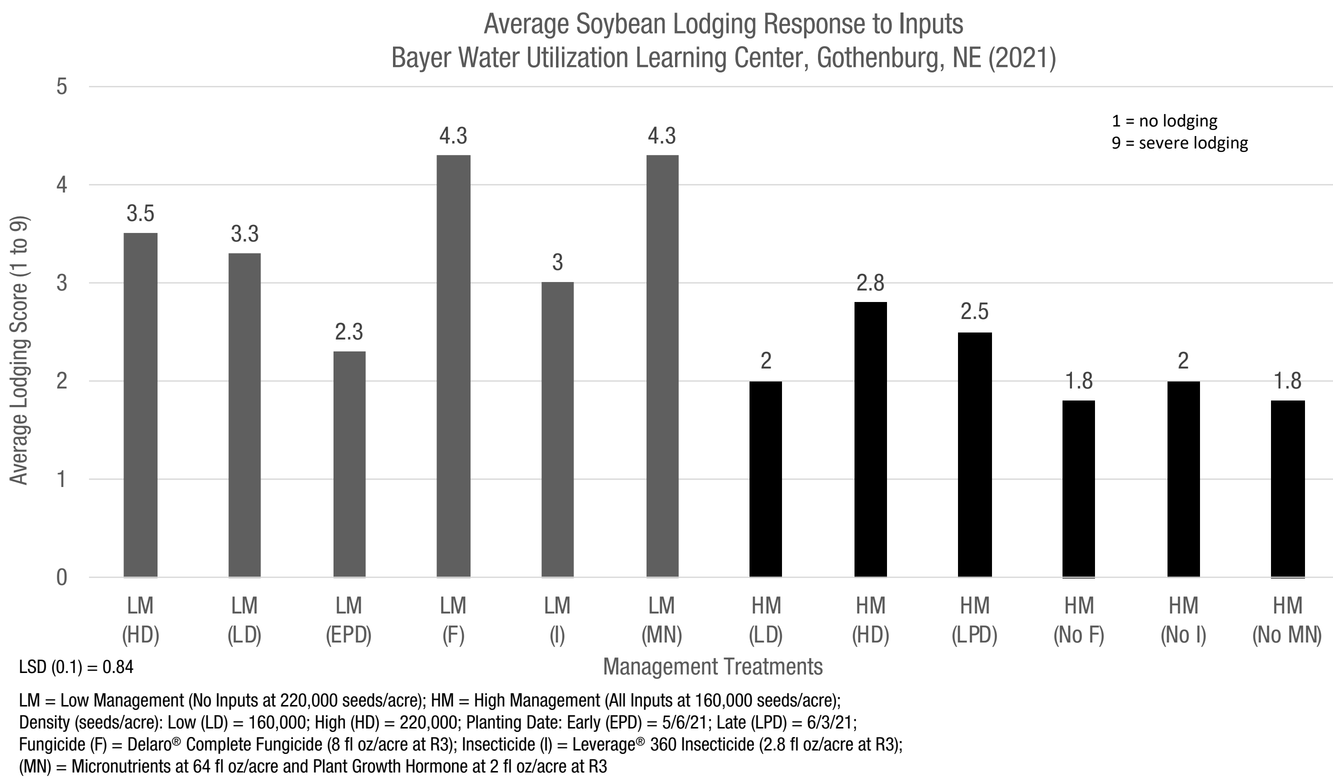


Figure 3. Average soybean lodging as impacted by management treatments at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

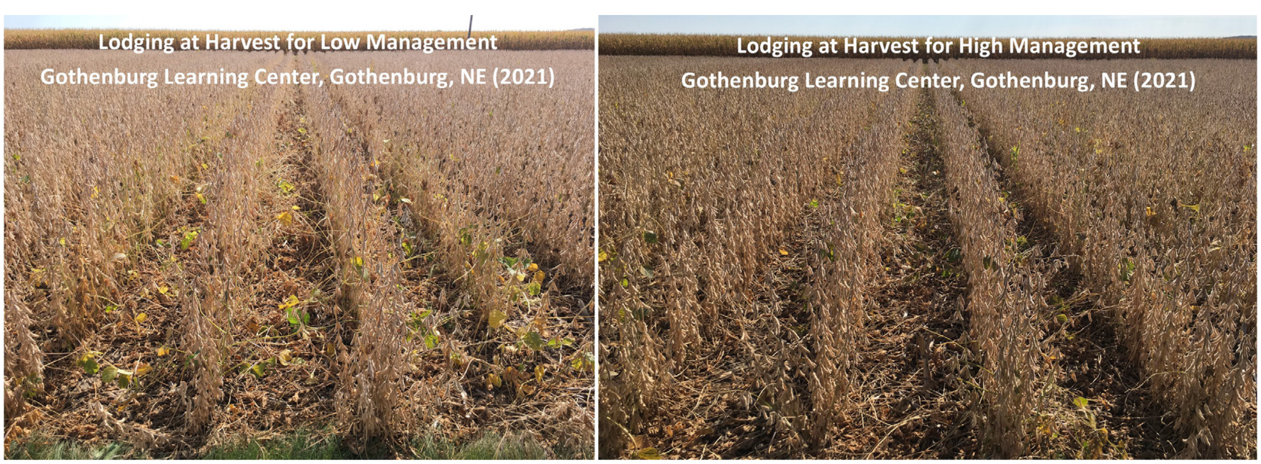


Figure 4. Lodging comparison for low management (left) and high management (right) at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

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.

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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.

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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).

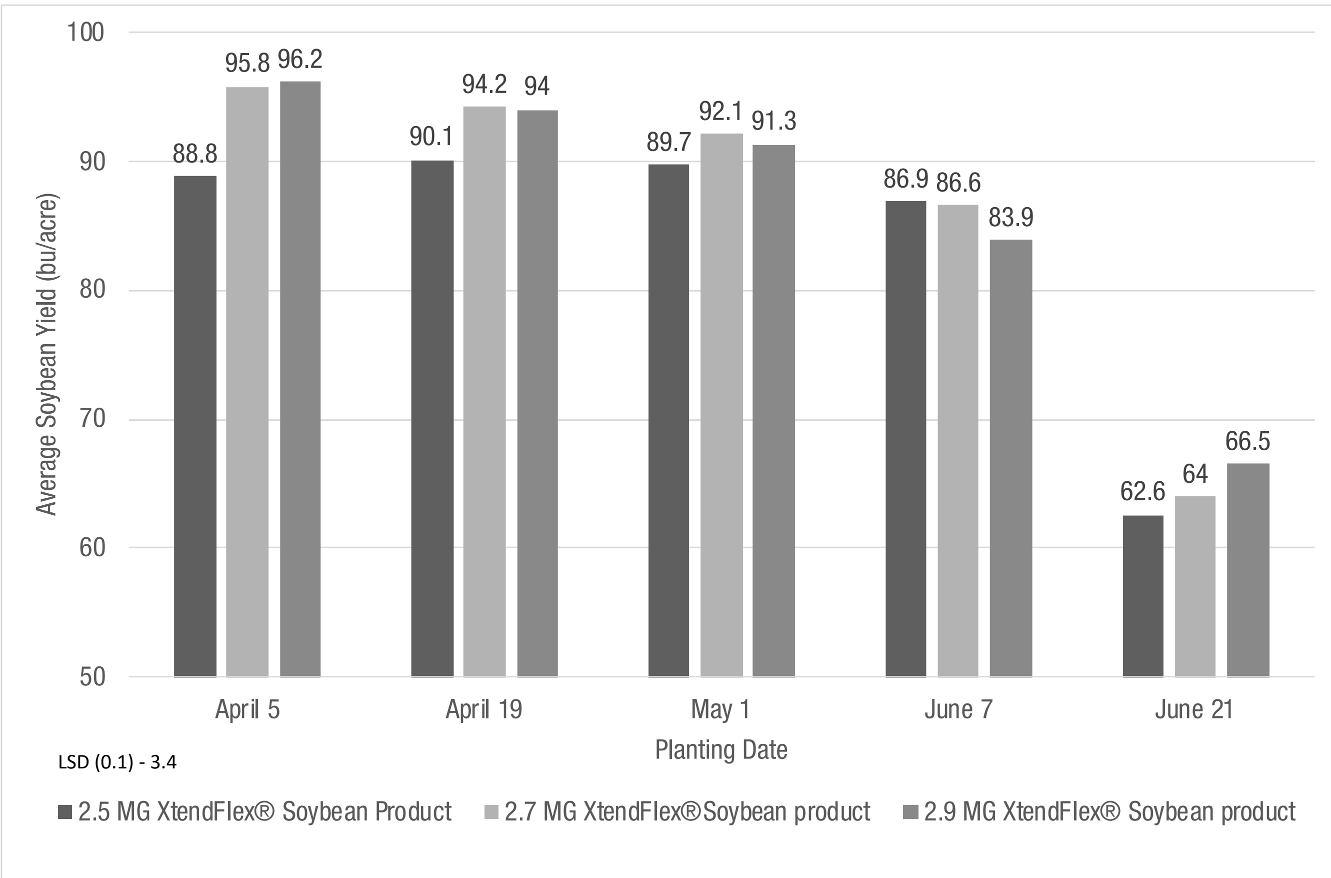

Figure 1. Average soybean yields as impacted by planting date and soybean product at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

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).

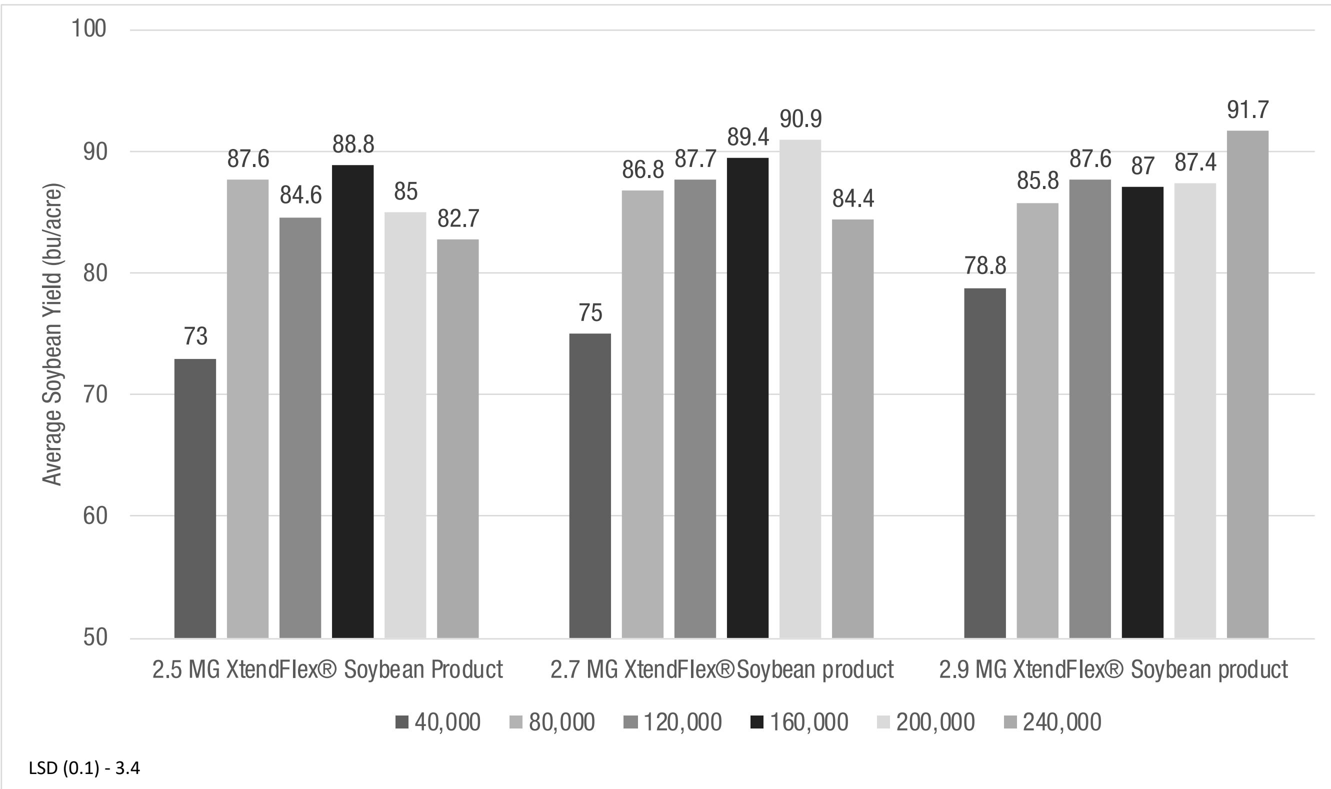

Figure 2. Average soybean yields as impacted by seeding rate and soybean product at the Bayer Water Utilization Learning Center, Gothenburg, NE (2021).

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.

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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

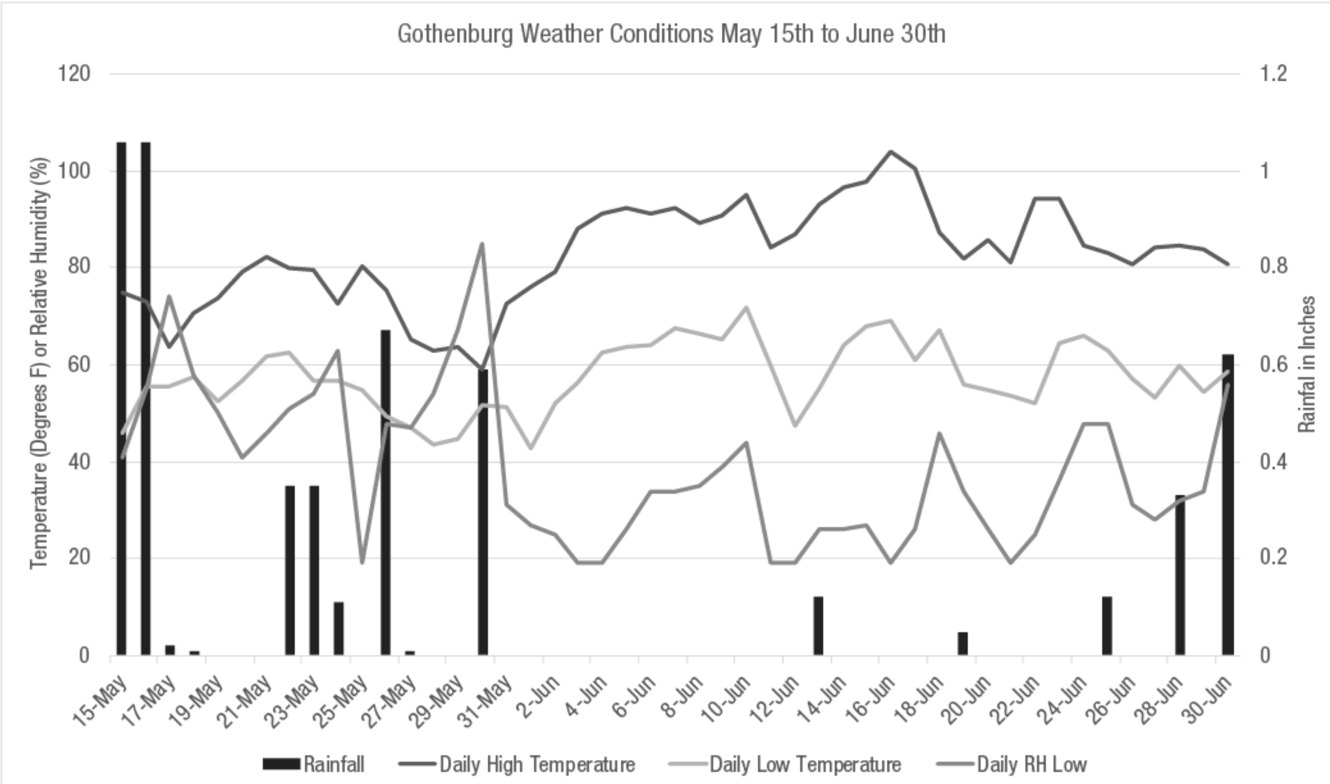

Figure 1 provides an overview of the weather conditions prior to, during, and after planting.

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

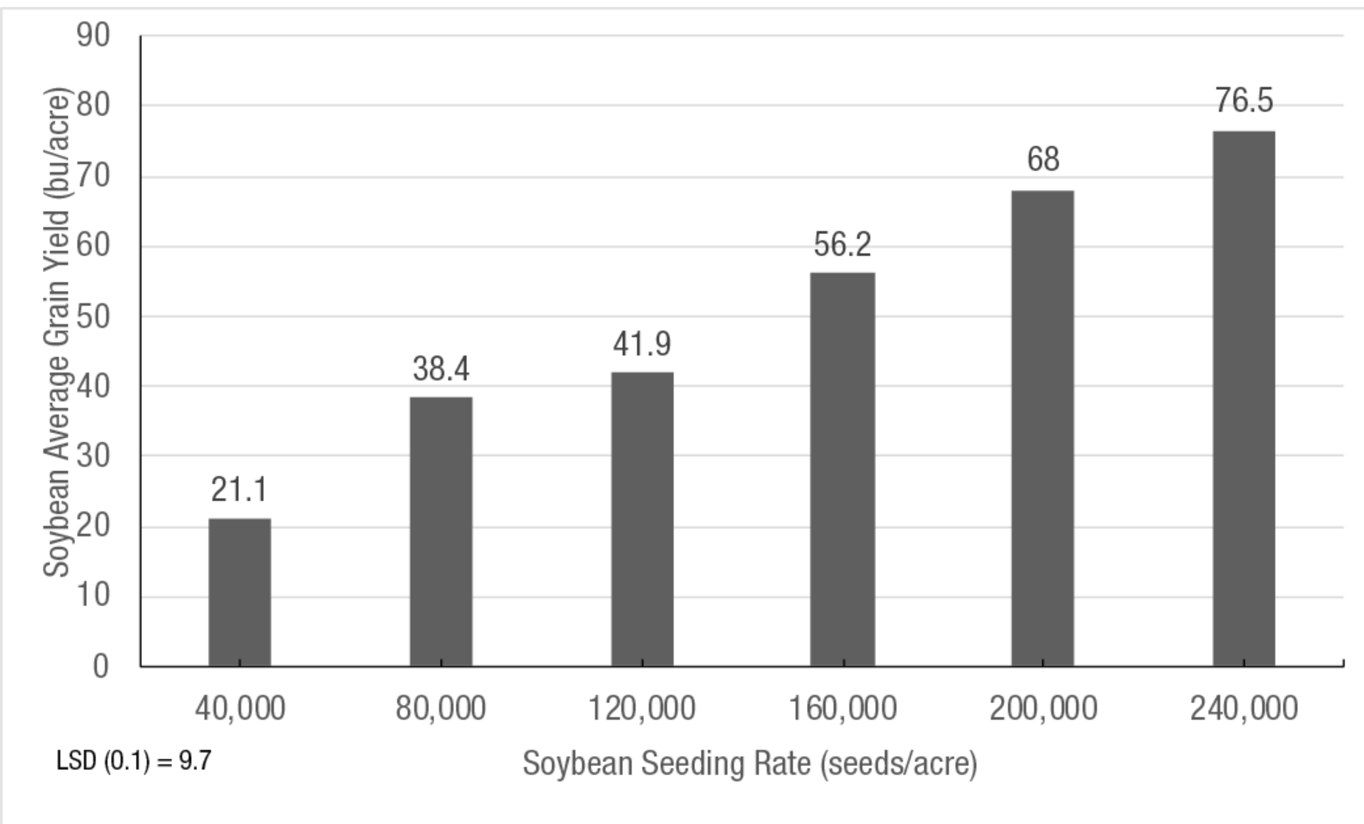

Figure 2. Average soybean yield resulting from six seeding rates at the Bayer Water Utilization Learning Center, Gothenburg, NE. 2021

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

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

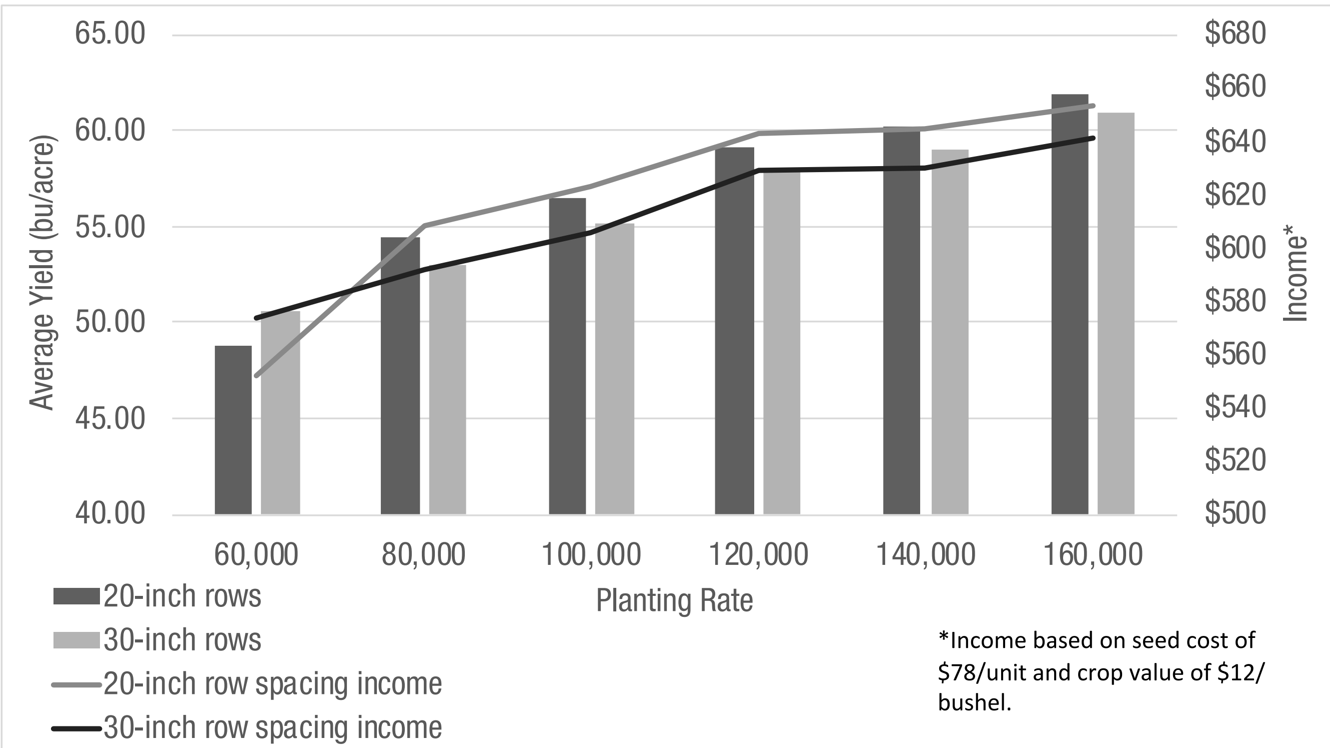

Figure 1. Average soybean performance and profitability under different row widths and seeding rates in Illinois, 2019-2021.

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

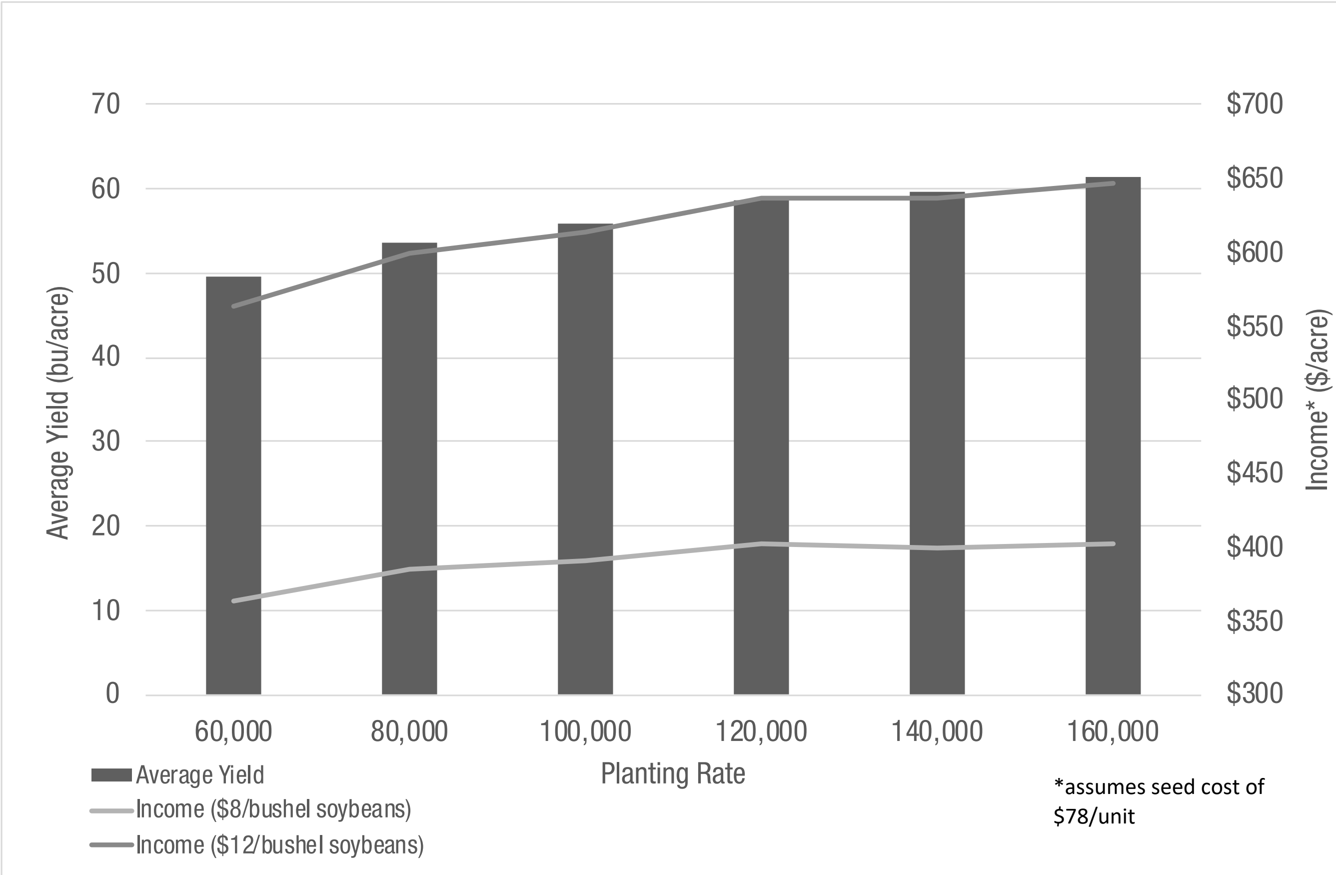

Figure 2. Effect of commodity price on average profitability of different planting rates in Illinois, 2019-2020.

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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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).

ENVIRONMENT

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

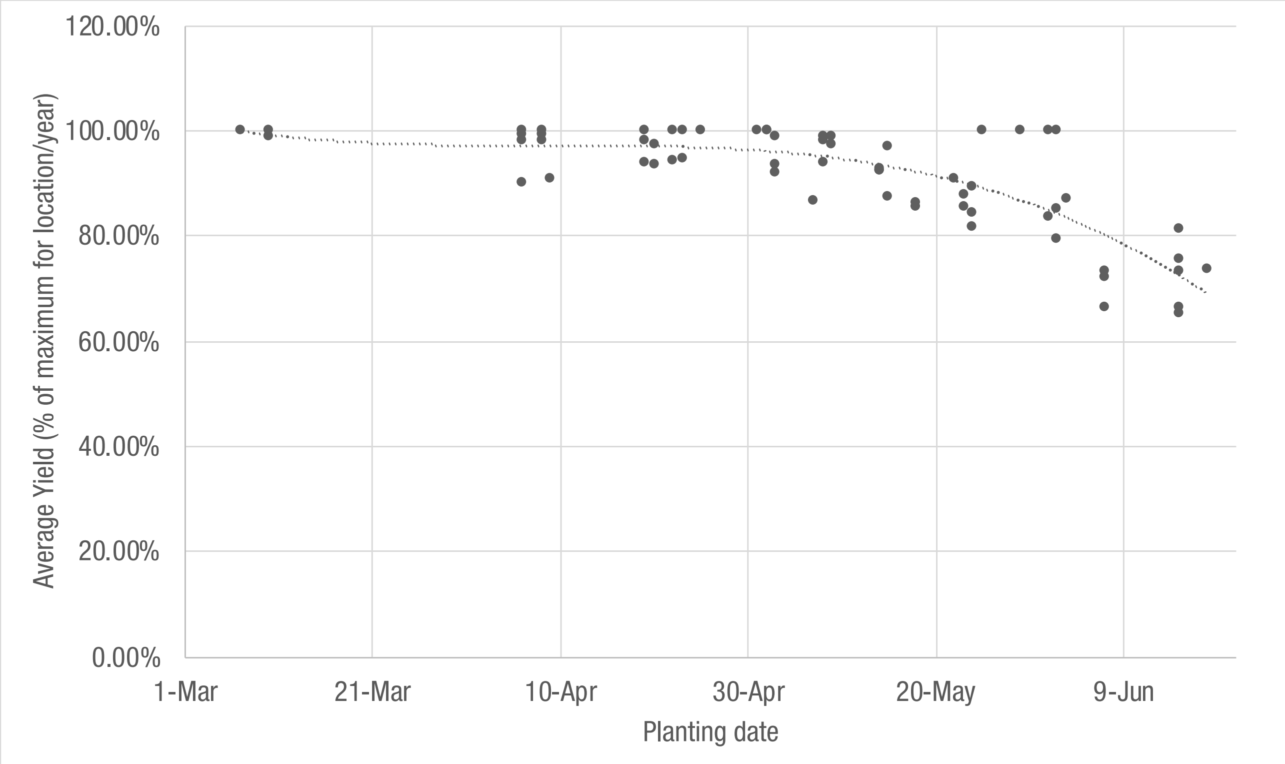

Figure 1. Average soybean yield response to planting date combined over years, 2018

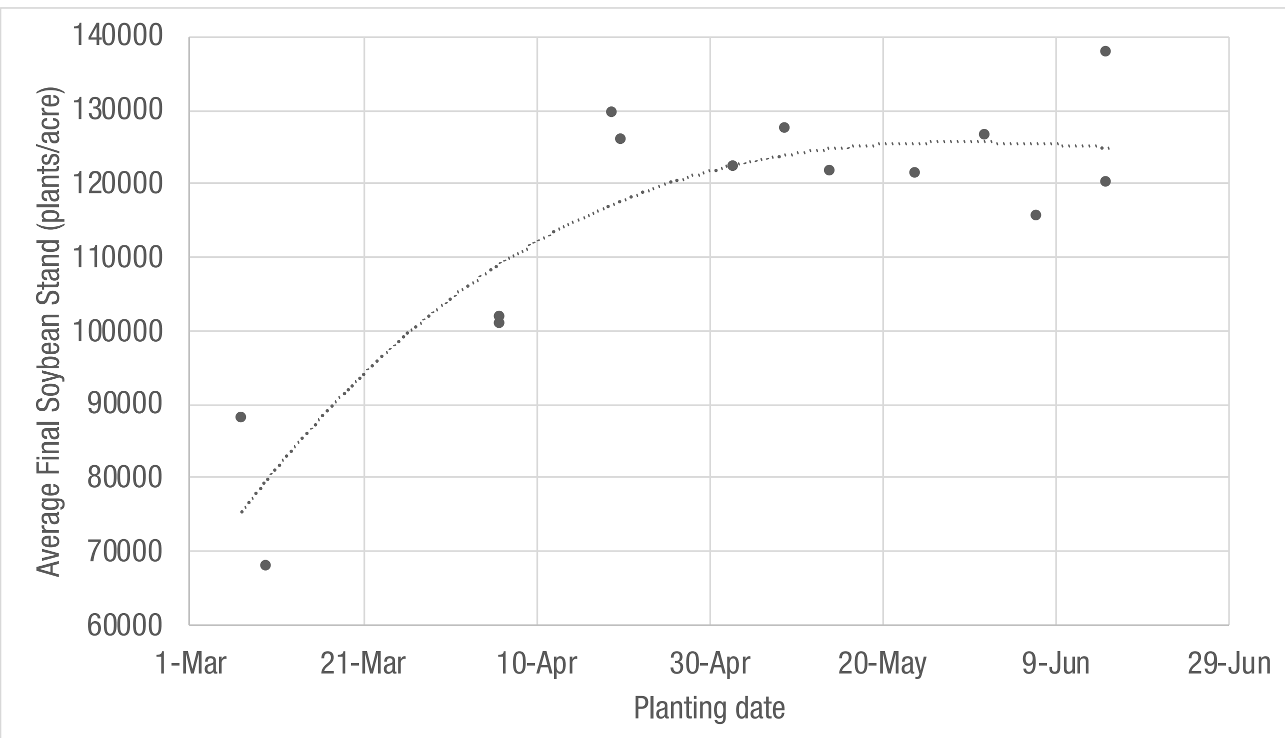

Figure 2. Average final soybean stands of 140,000 planted population across multiple planting dates, 2020-2021

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

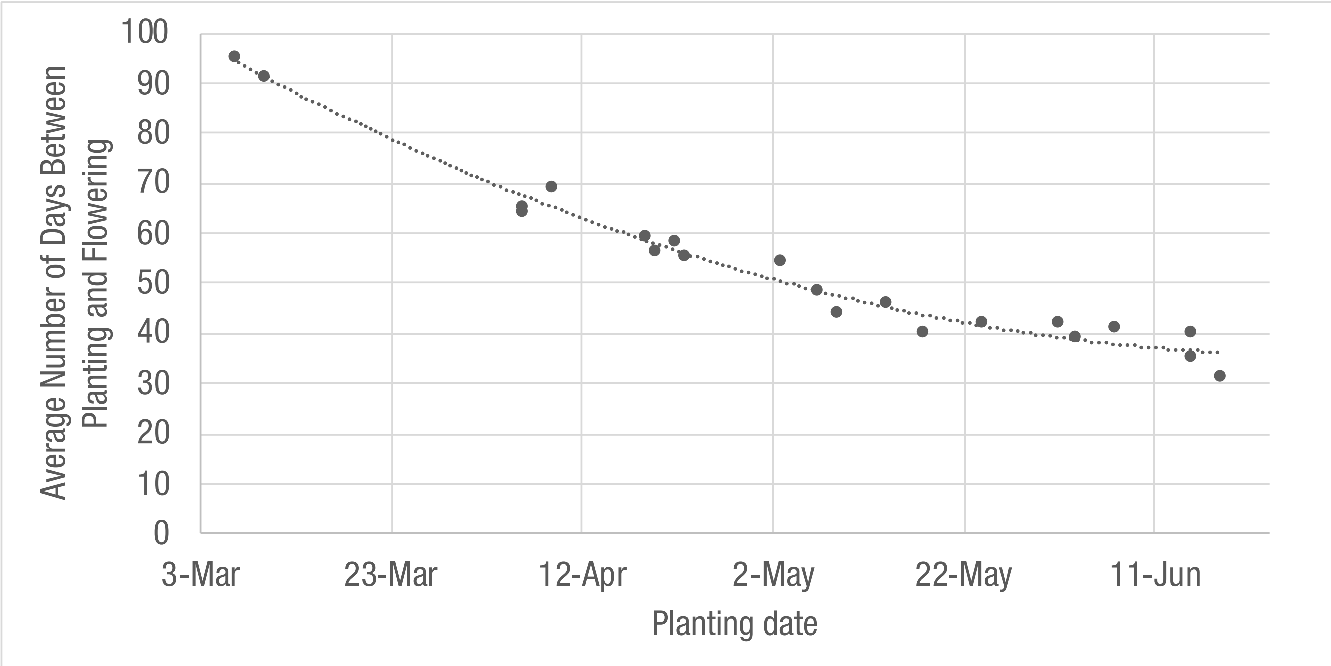

Figure 3. Average number of days to flower in soybeans based on planting date, 2019-2021.

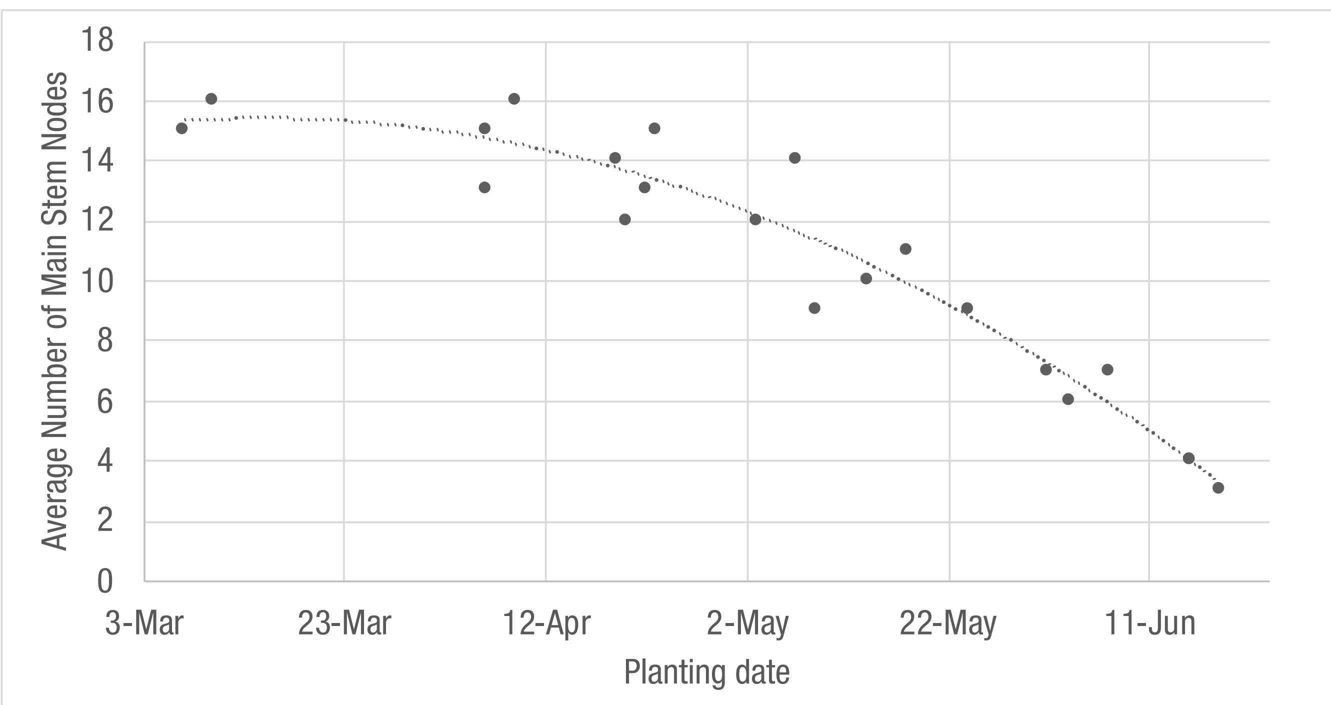

Figure 4. Effect of planting date on average number of main stem nodes created by July 10, 2019-2021.

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

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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.

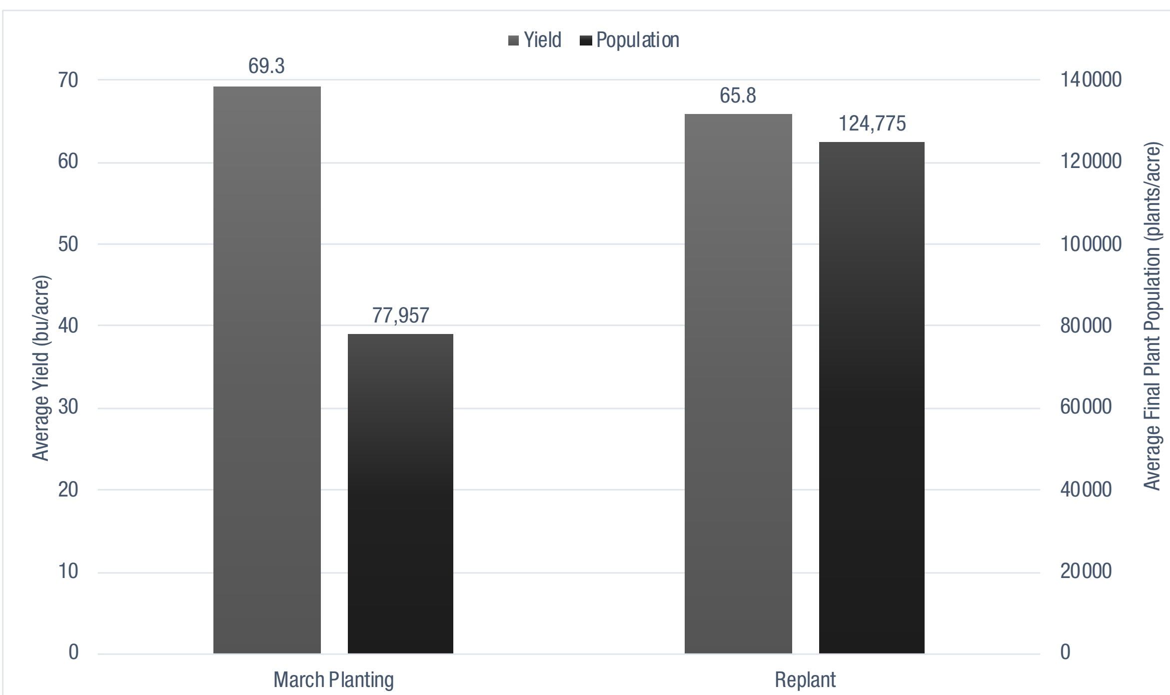

Figure 2. Soybean yield of original planting with reduced stand after frost damage versus replanted soybeans, 2020-2021.

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

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Effect of row width and planting rate on yield, lodging, 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]
- 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).

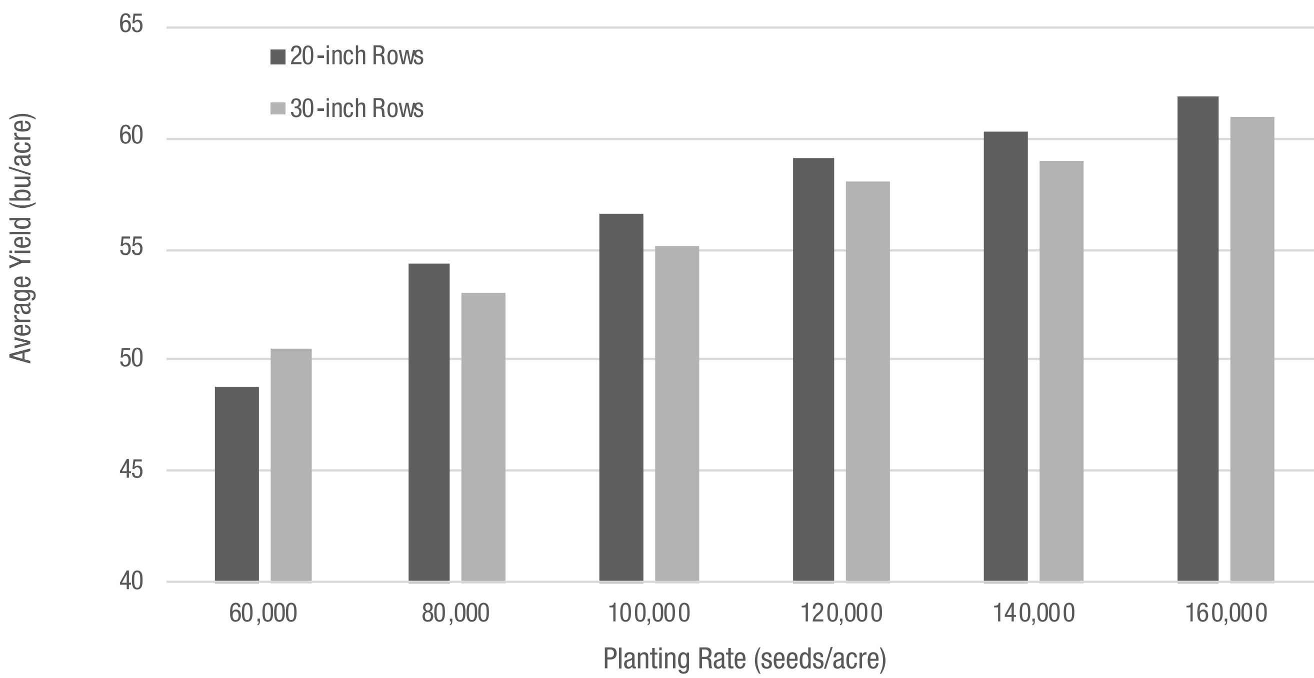

Figure 1. Average soybean yield at different row widths and seeding rates, 2019-2021.

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

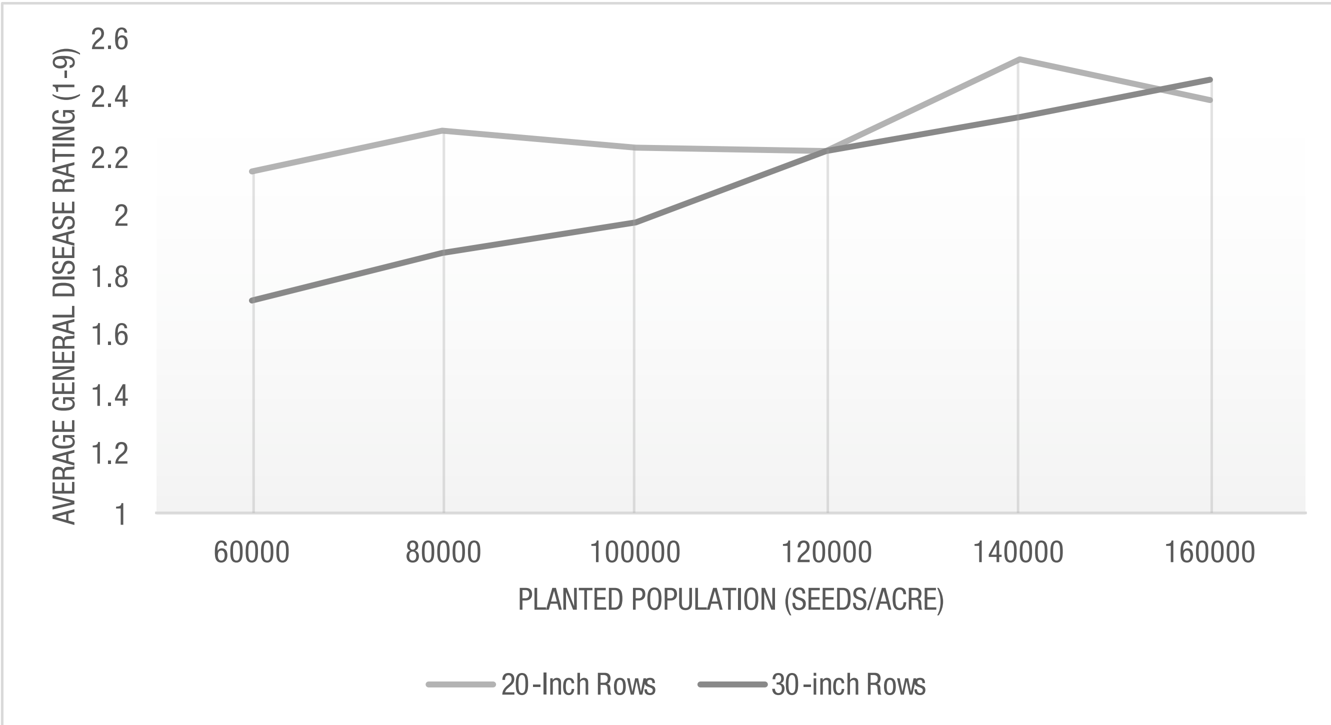

Figure 2. Effect of row width and planting rate on soybean lodging, 2020-2021.

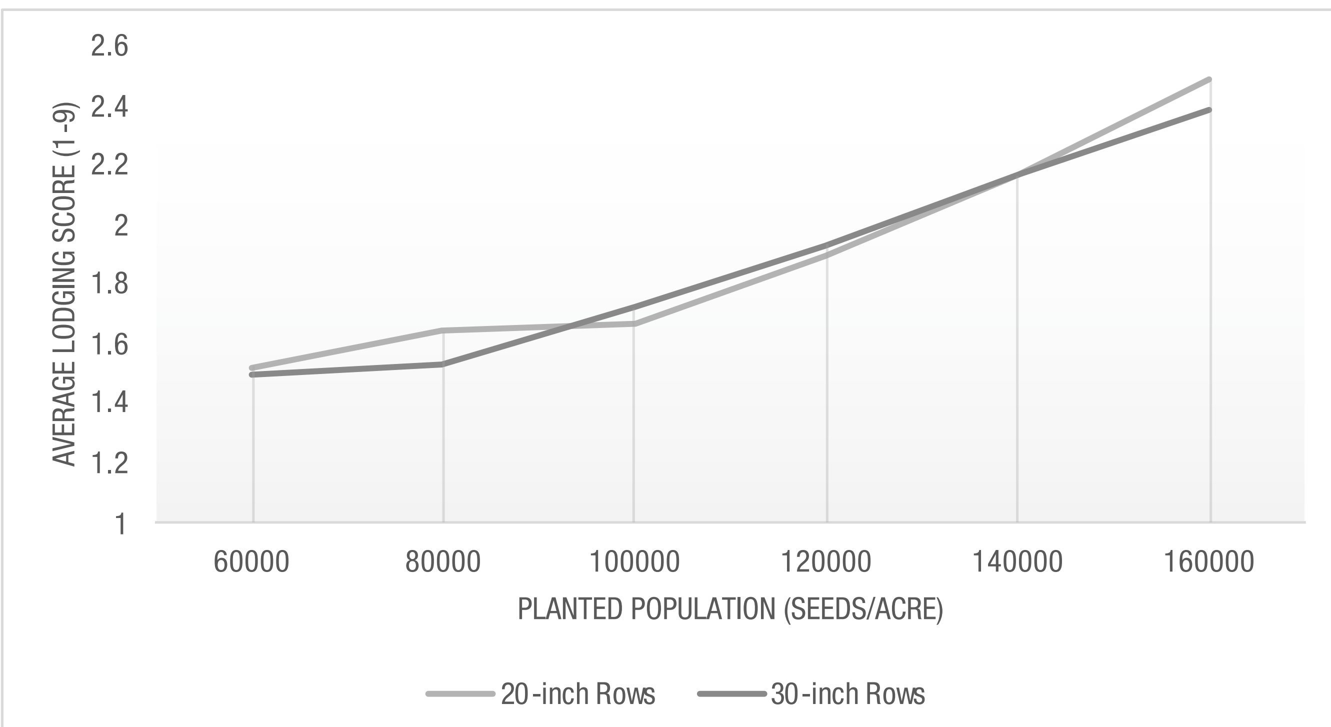

Figure 3. Effect of row width and planting rate on soybean disease development, 2020-2021.

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

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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

Skips and Planting Errors in Soybean (2021) Bayer Learning Center at Scott, MS

Trial Objective

- Each season many soybean growers are faced with making replanting decisions.
- Skippy stands from weather events, equipment malfunctions, and various other difficulties introduce skips, gaps, and variability into many soybean fields.
- Previous work has shown that a soybean stand has tremendous ability to compensate for stand variability. Particularly when gaps are generally smaller than the row spacing (30 to 40 inches).
- This study was undertaken to consolidate previous experience and revalidate older data when applied to newer germplasm.
- In many cases, replanting can likely be avoided thereby saving the associated expense and trouble.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Scott, MS	Commerce Silt Loam	Corn	Conventional	5/26/2021	9/8/2021	75	Various

- All agronomic decisions and crop inputs were per local standards.
- Planted on 38-inch beds in a twin row configuration 7.5 inches apart.
- Products planted:
  - » Asgrow® AG46XF0 Brand
  - » Asgrow® AG47XF0 Brand
  - » Planting Configuration Treatments
  - » 120,000 seeds/acre (Untreated Check (UTC))
  - » 105,000 seeds/acre (Missing Twin)
  - » 90,000 seeds/acre (2 Missing Twins)
  - » 90,000 seeds/acre (Missing Row)
  - » 80,000 seeds/acre (20-inch skips)
  - » 80,000 seeds/acre (30-inch skips)
  - » 80,000 seeds/acre (40-inch skips)
  - » 60,000 seeds/acre (30-inch skips)
  - » 60,000 seeds/acre (40-inch skips)
  - » 40,000 seeds/acre (40-inch skips)
- In field variability was introduced using a variety of techniques. For the missing row and missing twin treatments, rows were simply not planted.

Skips and Planting Errors in Soybean (2021) Bayer Learning Center at Scott, MS

Figure 1. Picture of missing twin treatment which was seeded to represent 105,000 seeds/acre. Scott, MS (2021).

Figure 2. Picture of two missing twin rows treatment which was seeded to represent 90,000 seeds/acre. Scott, MS (2021)

Figure 3. Picture of missing row treatment which was seeded to represent 90,000 seeds/acre. Scott, MS (2021)

Figure 4. Example of the uniformly skippy stands can be planted with the "skipulator". This picture is an example of the 20-inch skip treatment at 80,000 seeds/acre.

Figure 5. Measurement to demonstrate accuracy of the "skipulator" planting system. In this case, the target was a 40-inch skip and was close.

Figure 6. Measurement to demonstrate accuracy of the "skipulator" planting system. In this case, the target was a 40-inch skip and was close.

- For skip treatments, a spread sheet, referred to as the "Skipulator" (vs a calculator) was used to calculate planting parameters to introduce the desired skip treatments into plots. In short, it takes the desired skip size or seeding rate into account and generates the number of planter plate cells to block or provides the seeding rate to enter into the planting equipment to achieve the target seeding rate with the skips desired for each treatment (Figures 1 thru 6).
- Harvested using commercial equipment and yields were corrected to 13.5% moisture content for reporting.

Understanding the Results

- Across the trial, the average yield ranged from 62.4 to 74.2 bu/acre at 13.5% moisture content (Figure 7).
- On average, the soybean plants demonstrated an ability to compensate for much of the introduced variability in the missing row and in-row skip treatments (Figures 7, 8, and 9).
- Numerically, the highest yielding treatments in the demonstration tended to be some of the skippy treatments as compared to the untreated check. This is likely due to the miscellaneous foliar diseases that developed during the season. Skips and missing rows tended to minimize some of these disease issues during 2021. Regardless of the favorable yields associated with skips and missing rows, skips should not be introduced as a planting practice.

Skips and Planting Errors in Soybean (2021)
Bayer Learning Center at Scott, MS

- This data reinforces the ability of soybean plants to compensate for planting errors and skippy stands.
- There was one low yielding plot in this demonstration (60,000 seeds/acre with 40-inch skips in Asgrow® AG46FX0 Brand) that had a hot sandy spot across the plot (Figure 9).

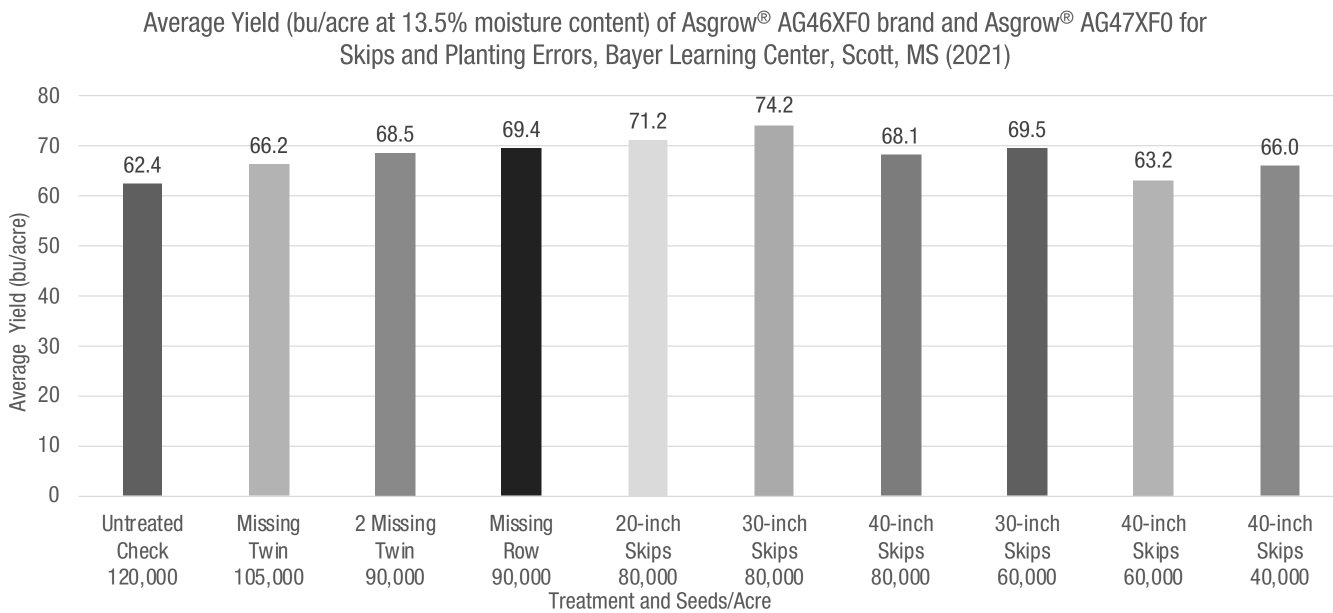

Figure 7. Average yield of Asgrow® AG46FX0 brand and Asgrow® AG47FX0 brand for various skips and planting errors in seeding rates. Bayer Learning Center, Scott, MS (2021).

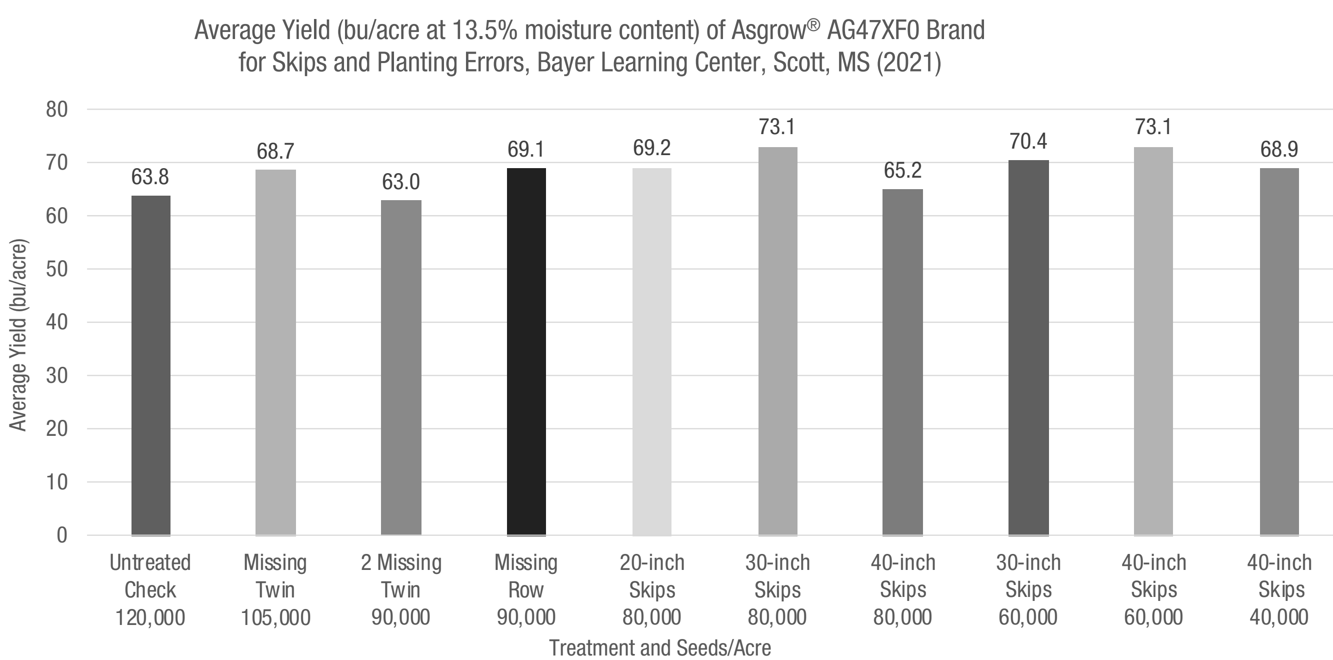

Figure 8. Average yield of Asgrow® AG47FX0 brand for various skips and planting errors in seeding rates. Bayer Learning Center, Scott, MS (2021).

Skips and Planting Errors in Soybean (2021) Bayer Learning Center at Scott, MS

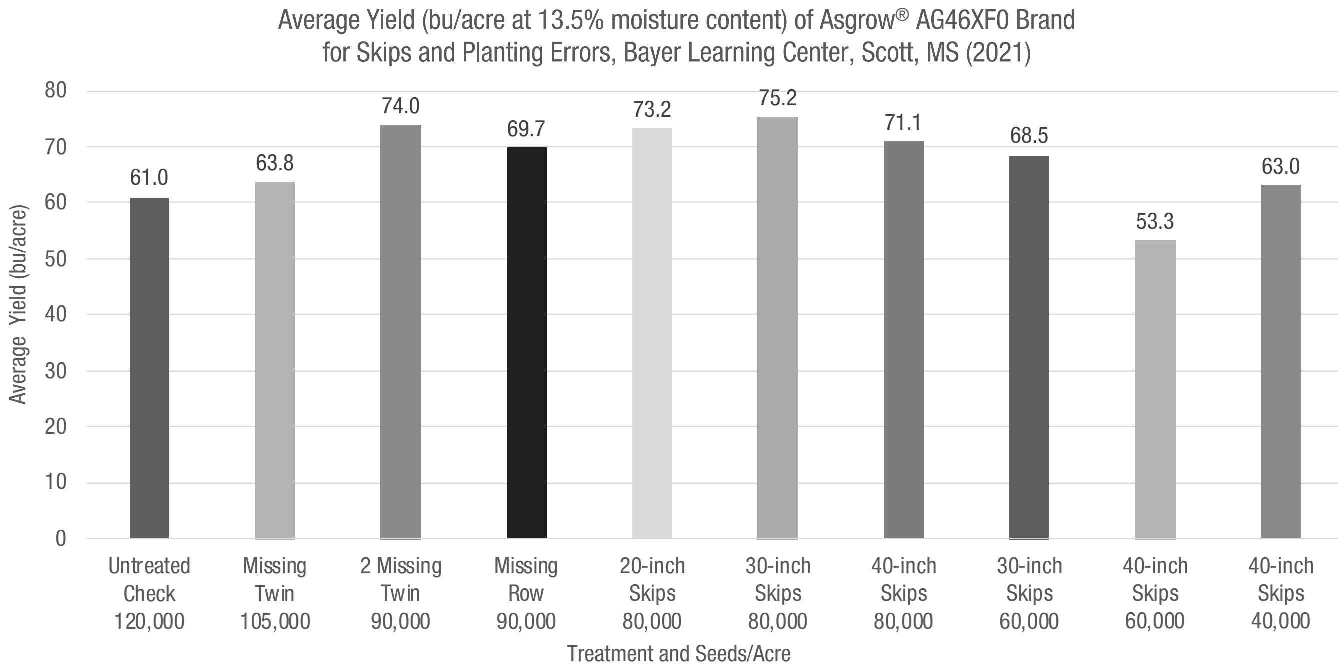

Figure 9. Average yield of Asgrow® AG46FX0 brand for various skips and planting errors in seeding rates. Bayer Learning Center, Scott, MS (2021).

Key Learnings

- Soybean plants continue to demonstrate a tremendous ability to compensate for planting errors and poor emergence when those events occur.
- Growers should carefully consider weed control implications when making soybean replanting decisions. Extra herbicide applications and in some cases, replanting could be recommended to maintain acceptable levels of weed control.
- Many factors should be carefully considered when deciding to replant a soybean field. It is likely that many fields can be managed to acceptable outcomes without replanting.
- Please consult your local Asgrow® brand representative or agronomist for further information.

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Evaluation of Asgrow® Brand Soybean Products on Different Soil Types in the Delta

Trial Objective

- Each season the Bayer Learning Center at Scott, Mississippi evaluates a new class of soybean products for yield potential in the local production system.
- A -group of Asgrow® brand soybeans with XtendFlex® Technology were evaluated in this system in 2021 and compared to current local standard soybean products.
- Two very different soil types are represented in this work:
  - » light, hot sand (commerce silt loam)
  - » heavy, cracking clay (sharkey clay).
- The purpose of this work is to help identify strong performing soybean products for planting on these soils in 2022.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Scott, MS Highway Cut	Commerce Silt Loam, 15 Cation Exchange Capacity (CEC)	Cotton	Conventional	4/20/2021	As Ready -Dessicated	100	120,000
Scott, MS House Cut	Commerce Silt Loam, 15 CEC	Corn	Conventional	4/20/2021	As Ready – Dessicated	100	120,000
Scott, MS Buckshot	Sharkey Clay, 45 CEC	Corn	Conventional	4/20/2021	As Ready - Dessicated	100	120,000

- Field work, planting dates, pest and nutrient management followed local standards.
- Highway Cut Field Location: 11 soybean products were planted on twin rows 7.5-inches apart (seed beds 38-inches apart) on commerce silty loam soil.
  - » AG35XF1 Brand
  - » AG38XF1 Brand
  - » AG43X0 Brand
  - » AG44XF1 Brand
  - » AG45XF0 Brand
  - » AG46XF0 Brand
  - » AG46X6 Brand
  - » AG47XF0 Brand
  - » AG48X9 Brand
  - » AG48XF0 Brand
  - » AG53X0 Brand

Evaluation of Asgrow® Brand Soybean Products on Different Soil Types in the Delta

- House Cut Field Location: 18 soybean products were planted on twin rows 7.5-inch apart (seed beds 38 inches apart) on commerce silty loam soil.
  - AG35XF1 Brand
  - AG38XF1 Brand
  - AG41XF2 Brand
  - AG42XF1 Brand
  - AG43X0 Brand
  - AG43XF2 Brand
  - AG44XF2 Brand
  - AG45XF0 Brand
  - AG46XF0 Brand
  - AG46X6 Brand
  - AG47XF0 Brand
  - AG47XF2 Brand
  - AG48X9 Brand
  - AG48XF0 Brand
  - AG48XF2 Brand
  - AG53X0 Brand
  - AG53XF2 Brand
  - AG56XF2 Brand
- Buckshot Field Location: 18 soybean products were planted on twin rows 7.5-inch apart (seed beds 38 inches apart) on commerce silty loam soil.
  - AG35XF1 Brand
  - AG38XF1 Brand
  - AG41XF2 Brand
  - AG42XF1 Brand
  - AG43X0 Brand
  - AG43XF2 Brand
  - AG44XF2 Brand
  - AG45XF0 Brand
  - AG46XF0 Brand
  - AG46X6 Brand
  - AG47XF0 Brand
  - AG47XF2 Brand
  - AG48X9 Brand
  - AG48XF0 Brand
  - AG48XF2 Brand
  - AG53X0 Brand
  - AG53XF2 Brand
  - AG56XF2 Brand
- Statistical design was a single replication, strip plot design with plot size between 0.25 to 0.6 acre.
- Soybeans were desiccated prior to harvest using Mississippi State Extension recommendations for products, rates, and timings.
- Fields were harvested with a commercial combine and grain moisture was corrected to 13.5% for presentation.

Evaluation of Asgrow® Brand Soybean Products on Different Soil Types in the Delta

Understanding the Results

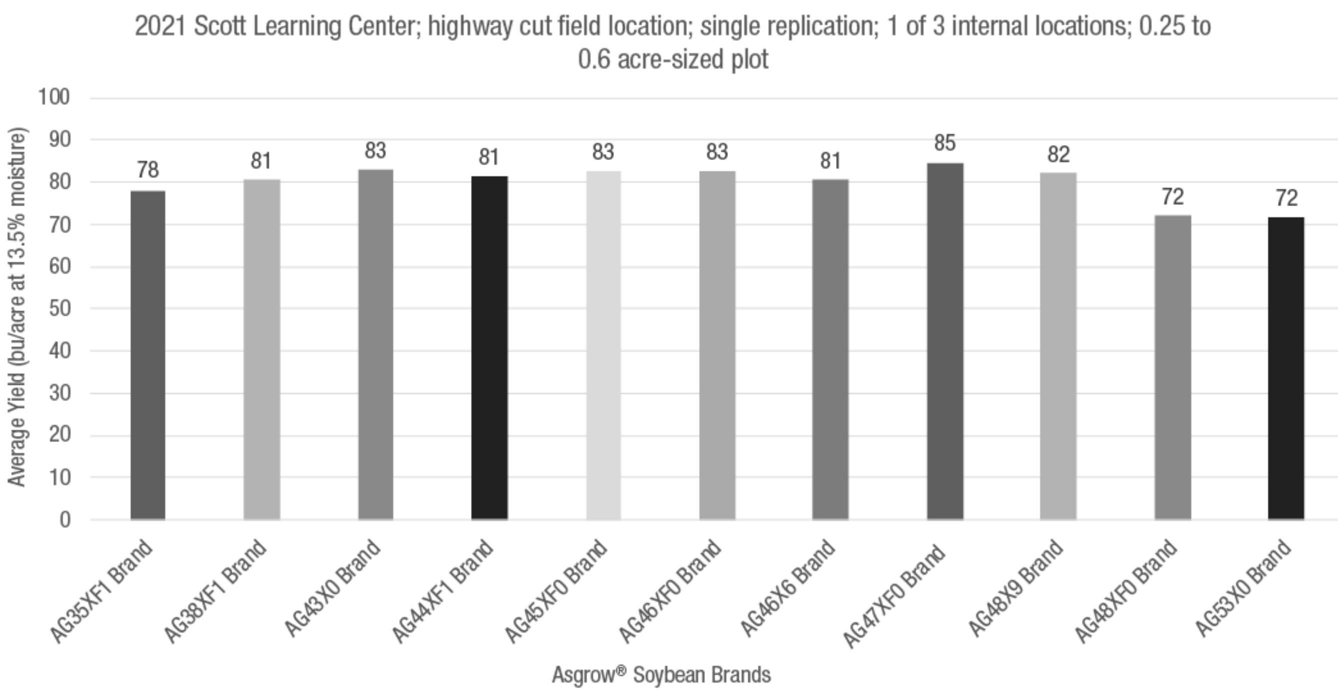

Figure 1. Yield evaluations of 11 Asgrow® soybean brands in 2021 at the highway cut field location at Scott, Mississippi. Grown on commerce silt loam soil with 15 cation exchange capacity.

- Overall, at this location, the soybean products had an average yield of 79.88 bu/acre.

Evaluation of Asgrow® Brand Soybean Products on Different Soil Types in the Delta

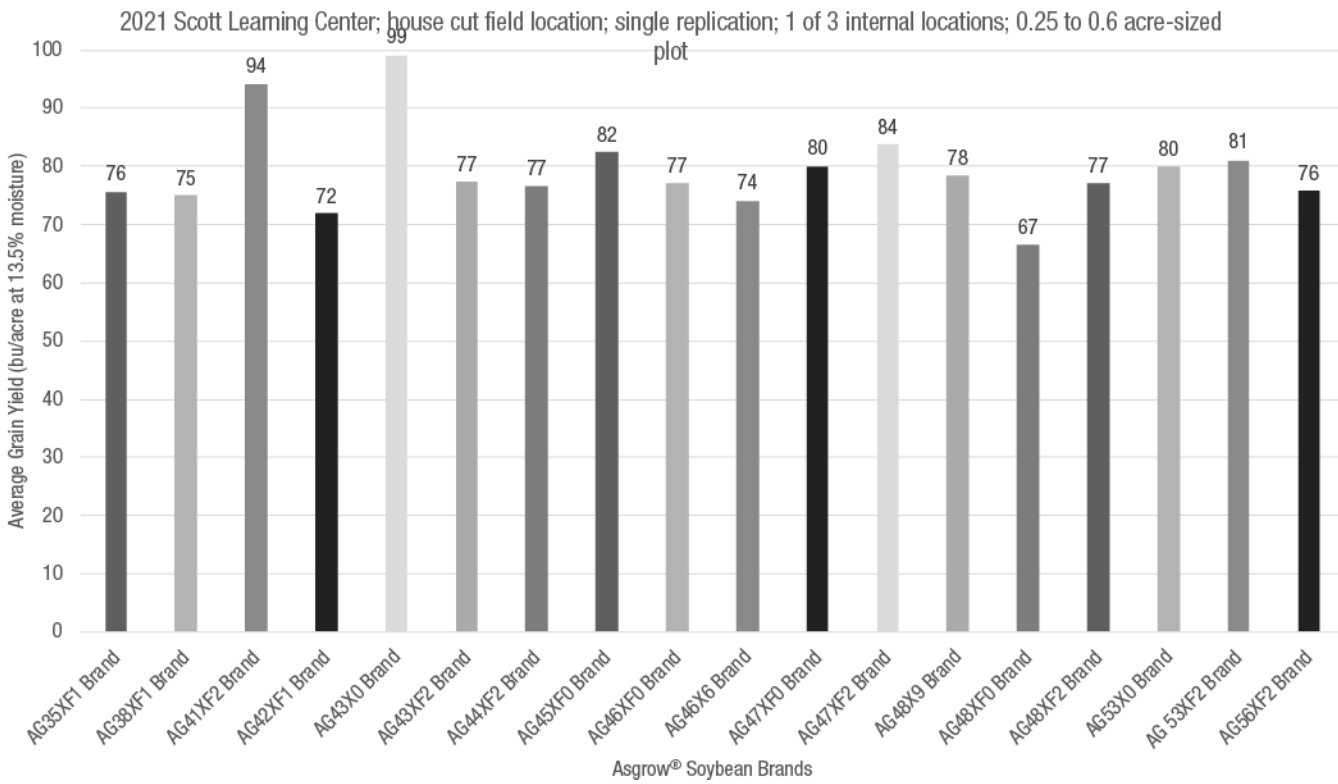

Figure 1. Yield evaluations of 11 Asgrow® soybean brands in 2021 at the highway cut field location at Scott, Mississippi. Grown on commerce silt loam soil with 15 cation exchange capacity.

- Overall, at this location, the soybean products had an average yield of 79.22 bu/acre.

Evaluation of Asgrow® Brand Soybean Products on Different Soil Types in the Delta

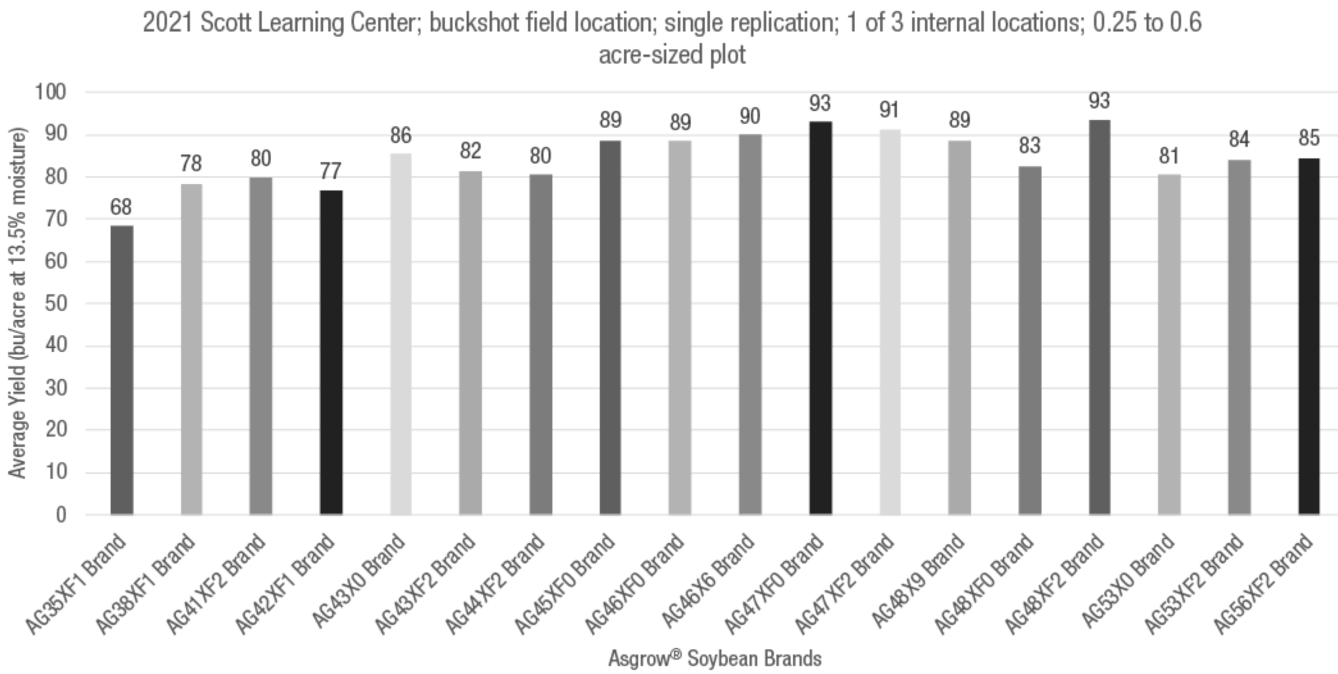

Figure 3. Yield evaluations of 18 Asgrow® soybean brands at the buckshot field location at Scott, Mississippi. Grown on sharkey clay soil with 45 cation exchange capacity.

- Overall, at this location, the soybean products had an average yield of 84.25 bu/acre.

Key Learnings

- From this work it appears that Asgrow® brand has developed a strong set of offerings for the 2022 growing season that fit many of the soil types and production systems of the Mid-South region.
- Please see your local Asgrow® brand seed representative for more information.

Evaluation of Asgrow® Brand Soybean Products on Different Soil Types in the Delta

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. 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.

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.

Planting Date in Southern Soybeans Scott Learning Center - 2021

Trial Objective

- During the early 1990's, soybean producers in the Mid-south began selecting soybeans from the maturity groups 4 and 5 and started planting in mid-April. This was opposed to the historical pattern of planting soybeans from the maturity groups 5.5 to 7 during the late May to June period.
- Adoption of earlier planting dates with earlier maturity groups has led to the highest recorded yield potential due to reduced stresses during pod fill and the utilization of early season rainfall which was missed with later planting systems.
- Soybeans develop during relatively mild conditions and receive May to June rainfall which is typically missed with later planting dates.
- This trial was planted to evaluate the average soybean yield response to early and late planting dates across a broad range of maturity groups.

Research Site Details

- All agronomic, weed, and insect control practices were per local standards.
- Planted on raised beds 38-inch single rows apart.
- Asgrow® brand products planted
  - AG18XF1 Brand
  - AG20XF1 Brand
  - AG25XF1 Brand
  - AG30XF0 Brand
  - AG35XF1 Brand
  - AG36XF0 Brand
  - AG36XF1 Brand
  - AG38XF0 Brand
  - AG38XF1 Brand
  - AG40XF0 Brand
  - AG40XF1 Brand
  - AG41XF1 Brand
  - AG41XF2 Brand
  - AG42XF0 Brand
  - AG42XF1 Brand
  - AG43X0 Brand
  - AG45XF0 Brand
  - AG46XF0 Brand
  - AG46X6 Brand
  - AG48X9 Brand
  - AG48XF0 Brand
  - AG52XF0 Brand
- Trial was setup as strip plot design with one replication.
- Conditions at planting:
  - April Planting – Normal but relatively cooler at emergence compared to the May planting date. Development and bloom occurred during earlier, milder conditions.
  - May Planting – Warm conditions during emergence but relatively harsh conditions during growth and development.

Planting Date in Southern Soybeans Scott Learning Center - 2021

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Scott, MS	Silty Clay Loam	Corn	Conventional	4/21/2021 5/24/2021	As Ready – desiccated per University Extension recommendations	80	120,000

Understanding the Results

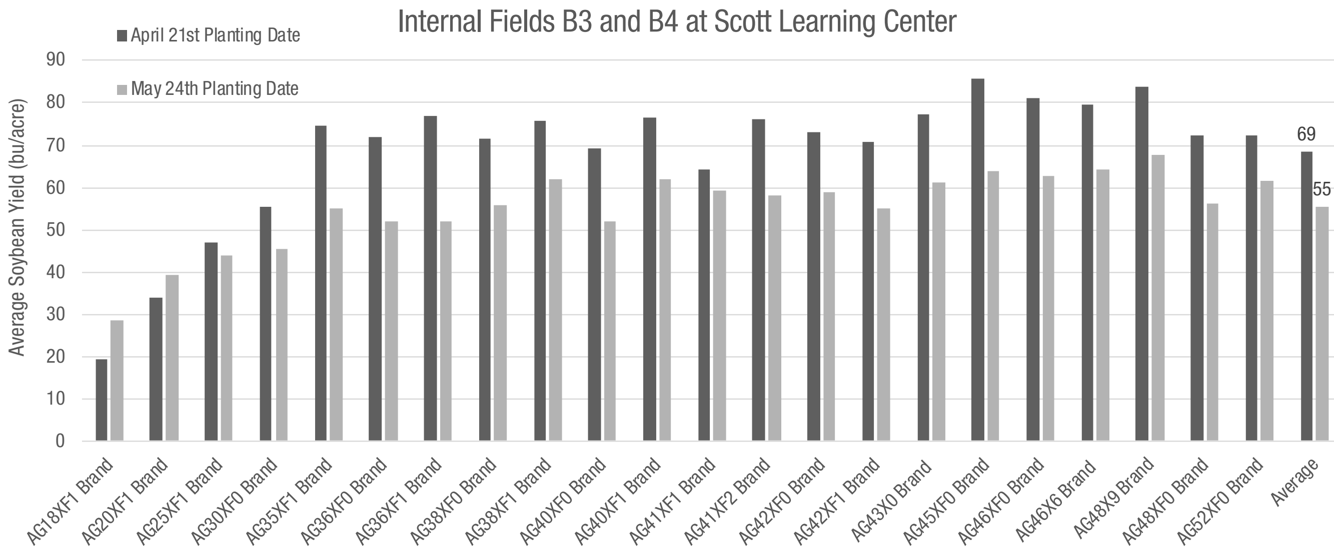

Figure 1. Soybean yield of 22 Asgrow® brand soybean products with early (April 21st) and late (May 24th) planting dates. Yield adjusted to 13.5% moisture. Bayer Learning Center, Scott, MS (2021).

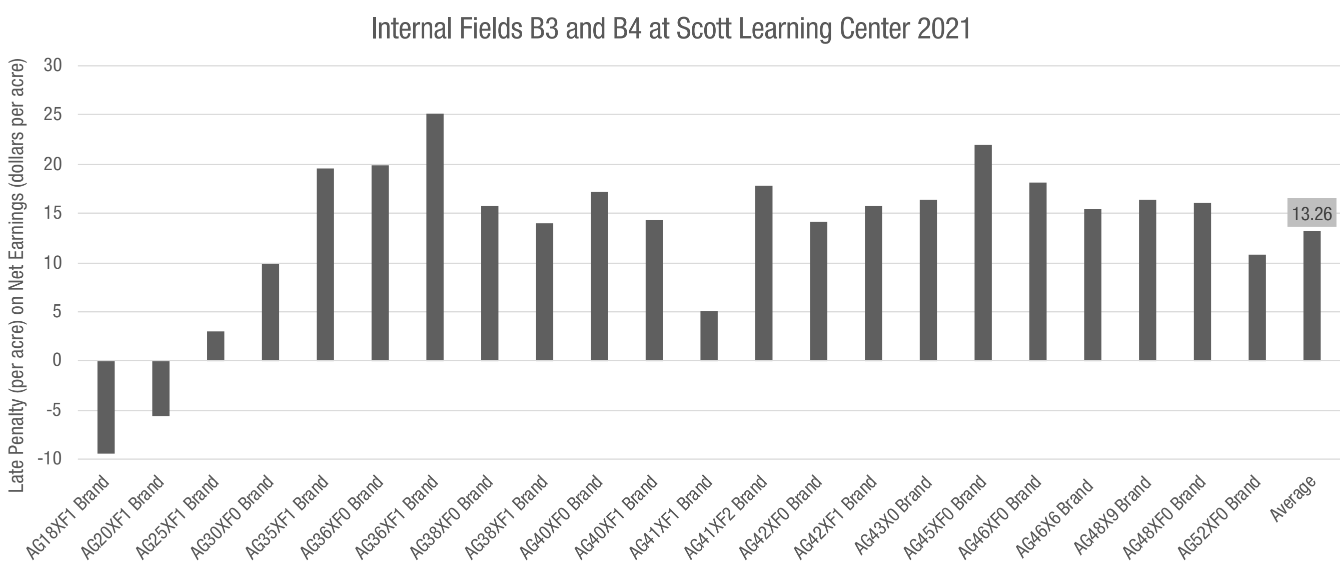

Figure 2. Net earnings penalty for early planting date (April 21st) compared to late planting (May 24th). Bayer Learning Center, Scott, MS (2021).

Planting Date in Southern Soybeans
Scott Learning Center - 2021

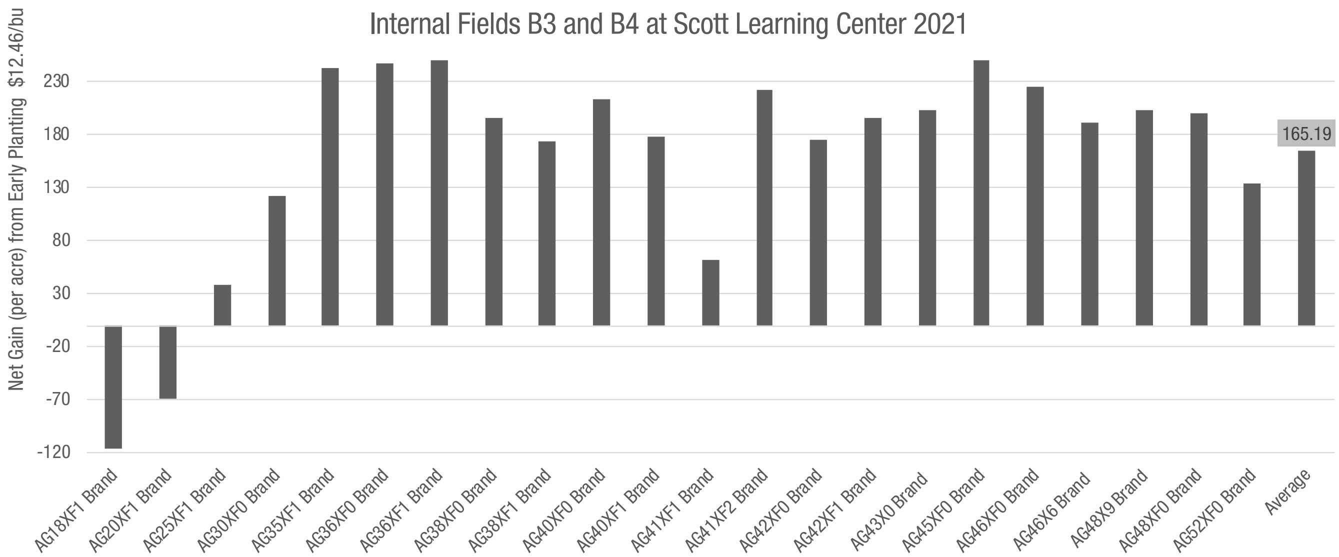

Figure 3. Net earnings gain for early planting date (April 21st) compared to late planting date (May 24th). Bayer Learning Center, Scott, MS (2021).

- Planting Date – The average yields were 69 bu/acre when planting on 4/21/2021 and 55 bu/acre planting on 5/24/2021.
  - » This provided a net yield gain of 13 bu/acre in favor of the April planting date.
  - » At $12.46/bu the net dollar gain for early planting was an average of $165.19/acre across the tested products for early planting.
- Variety Influences
  - » Planting date – Across both dates, the regionally predominate maturity groups (4.3 to 4.8) were the highest yielding.
  - » Some of the earlier MG products (earlier than MG 2.5) responded negatively to early planting. Regardless, these products are not well adapted to the south.
- Variety Selection – Varieties from the 3.5 to 3.8 MG are grown in the south to spread harvest timing without significant loss of yield potential. Harvest efficiency is increased while reducing input costs and weather risk. In this trial, earlier soybean products demonstrated relatively good yield potential on both planting dates.

Planting Date in Southern Soybeans Scott Learning Center - 2021

Key Learnings

- Early- to mid-planting dates appear to be optimal for southern soybean varieties.
- Soybean varieties from the maturity groups 4.3 to 4.8 were the highest yielding products planted on both dates.
- Growers should carefully evaluate varieties in earlier maturity groups for regional adaptation.
- Please see your local Asgrow® brand representative for more information.

Legal Statements

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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).

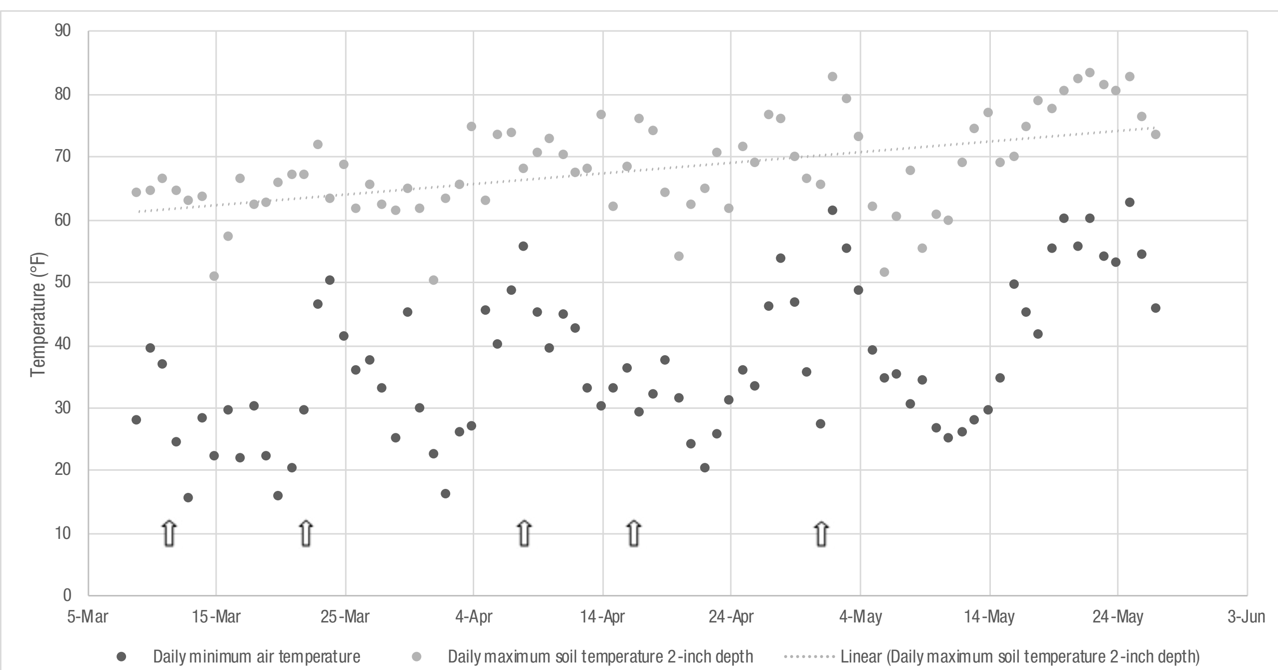

Figure 1. Daily minimum air and maximum soil (2-inch depth) temperatures (°F) in 2021.

Ultra-Early Soybean Planting Date Demonstration

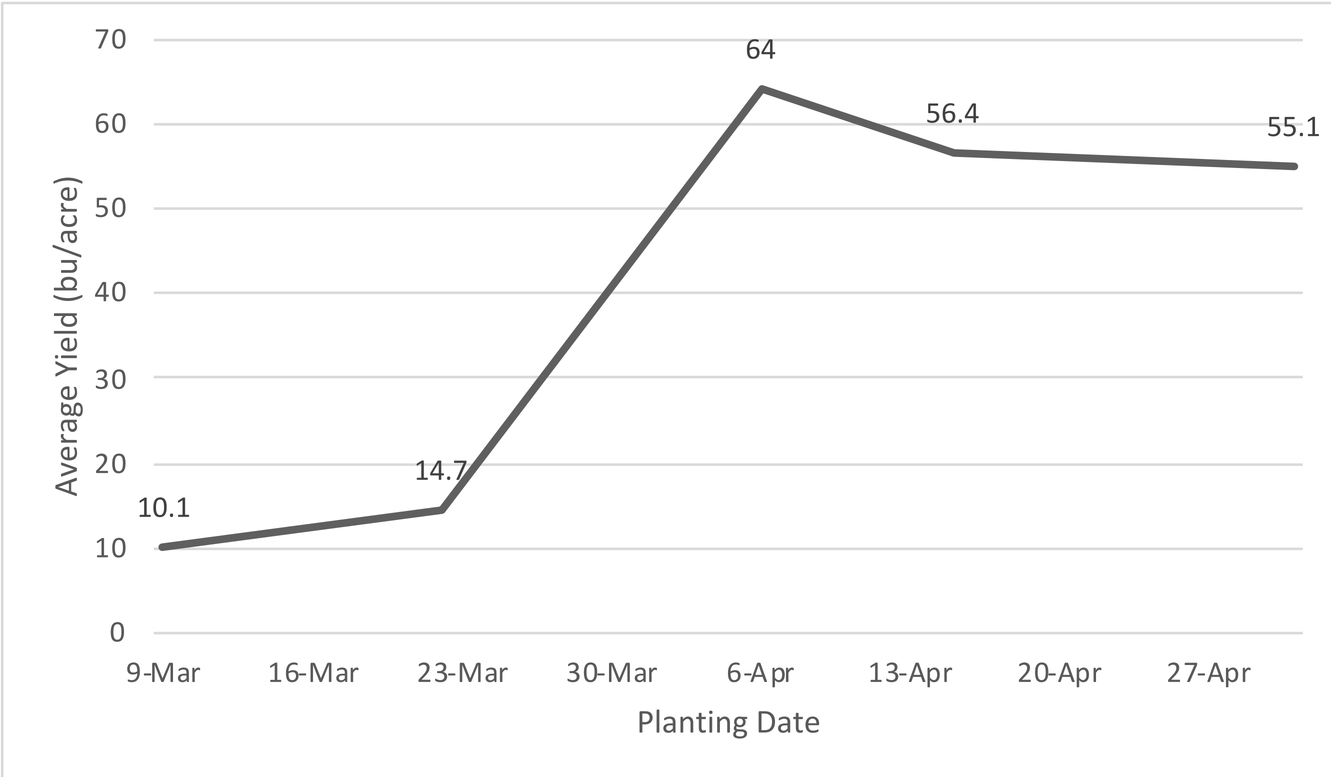

Figure 2. Planting date effect upon yield of five planting dates in Mason, MI in 2021.

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.

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Iron Deficiency Chlorosis Tolerance in Soybean Products Grown on Calcareous Soils

Trial Objective

- Soybean growers gauge chlorosis response of soybean products to calcareous soils and growing conditions. Soybean product selection is one of the most efficient management tools to 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 greater tolerance to IDC and gain perspective of product IDC ratings for the Central Plains region.

Trial Design

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

- Trial location was identified based on 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 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

Iron Deficiency Chlorosis Tolerance in Soybean Products Grown on Calcareous Soils

Understanding the Results

Table 1. Soybean grain moisture, test weight, yield, and IDC ratings according to maturity group.

Maturity Group	Grain Moisture (%)	Test Weight (lb/bu)	Yield (bu/acre)	Iron Deficiency Chlorosis (IDC) Rating
3.2	10.1	53.2	61.4	Strong
3.3	9.3	58.5	49.6	Above Average
3.6	9.1	59.6	59.4	Average
3.7	9.2	56.2	56.5	Average/Above Average
3.9	9.6	57.4	57.7	Below Average
4.1	9.6	59.1	56.6	Strong
4.3	9.6	59.9	60.8	Above Average
4.4	10.1	56.6	57.4	Average
4.7	12.7	49.4	63.7	Above Average

- 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 higher IDC tolerance is an effective technique to protect against yield losses related to IDC.
- Correcting IDC can be very difficult, and the most important management consideration is to identify products with greater IDC tolerance to minimize plant stress. Selecting the best soybean product for fields with a history of IDC decreases plant death rates and increases the likelihood of plants to recover from iron-deficiency chlorosis.

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1006_R2_21

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).

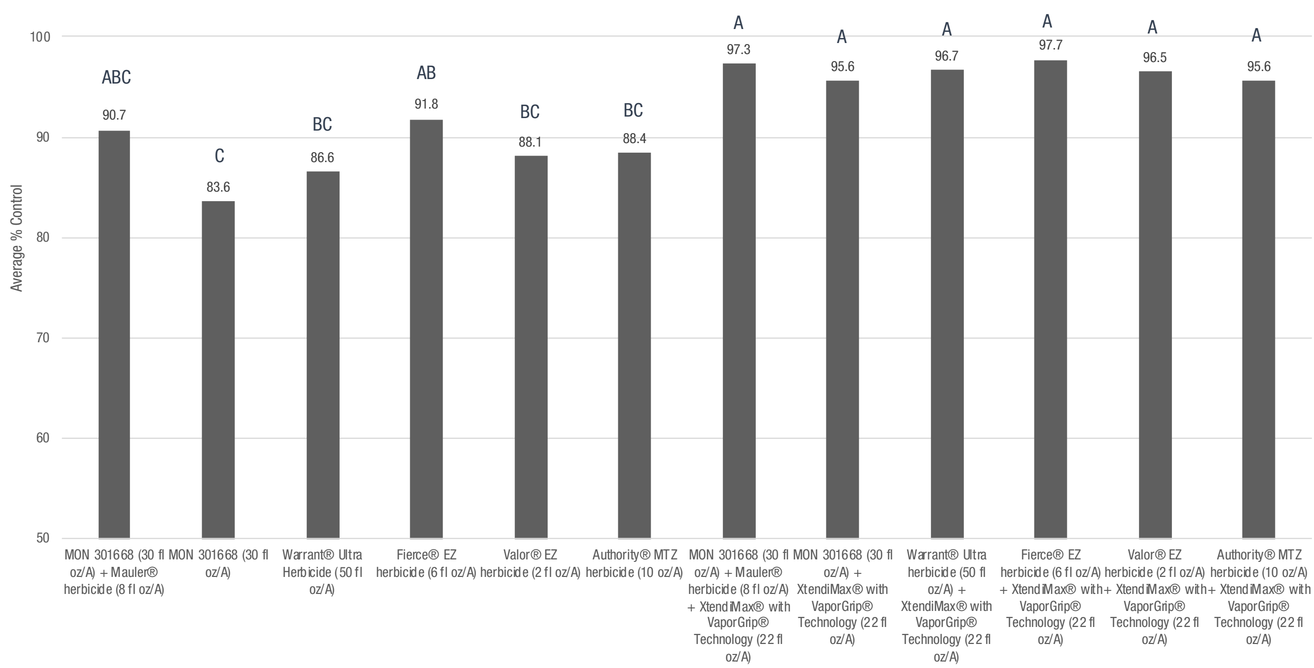
Treatment	Pre-emergence herbicide treatment (applied at planting or prior to emergence)
1	MON 301668† (30 fluid ounces/acre) + Mauler® herbicide (8 fluid ounces/acre)
2	MON 301668† (30 fluid ounces/acre)
3	Warrant® Ultra Herbicide (50 fluid ounces/acre)
4	Fierce® EZ herbicide (6 fluid ounces/acre)
5	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.

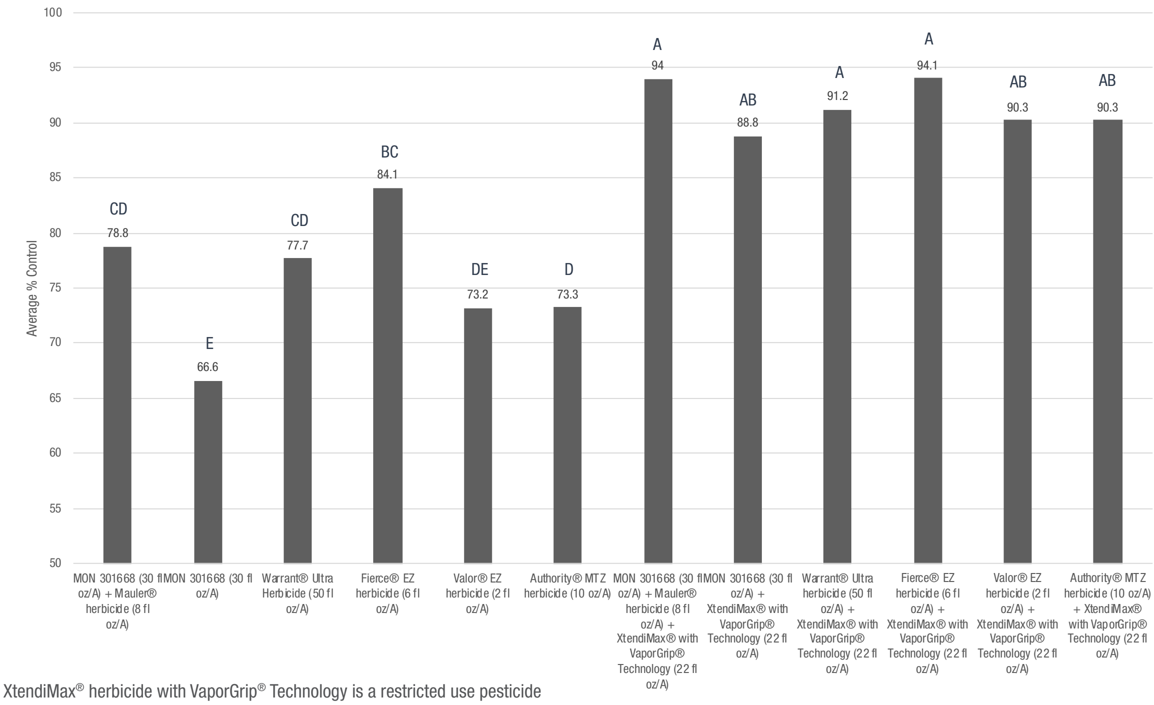
Understanding the Results

- 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).



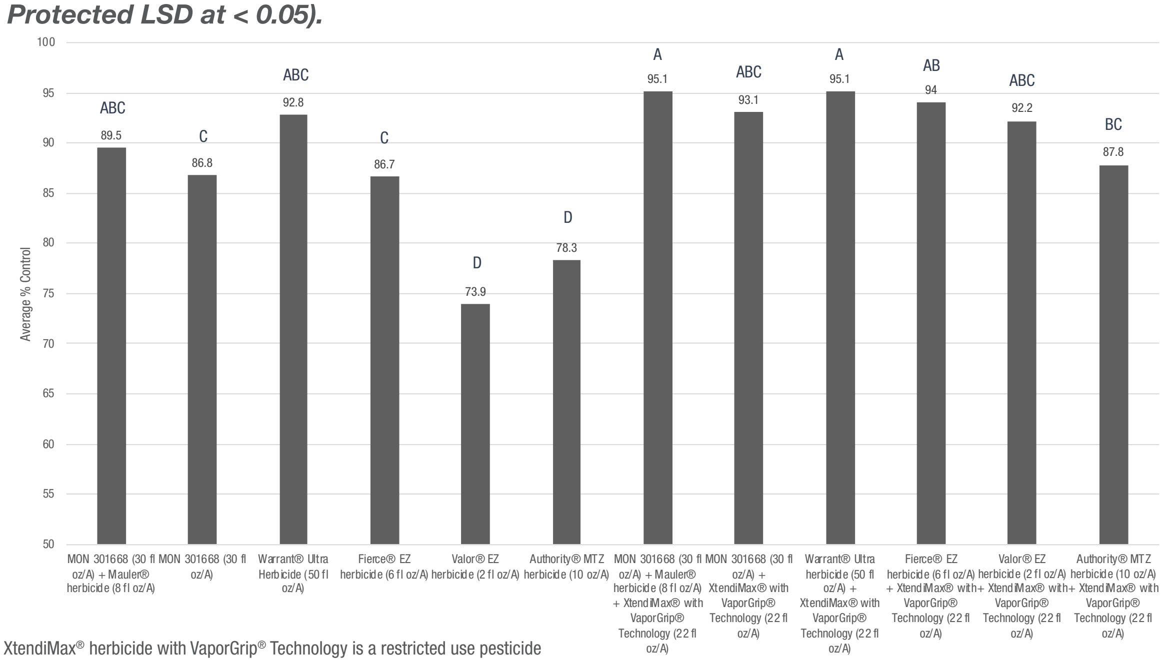
XtendiMax® herbicide with VaporGrip® Technology is a restricted use pesticide

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).



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

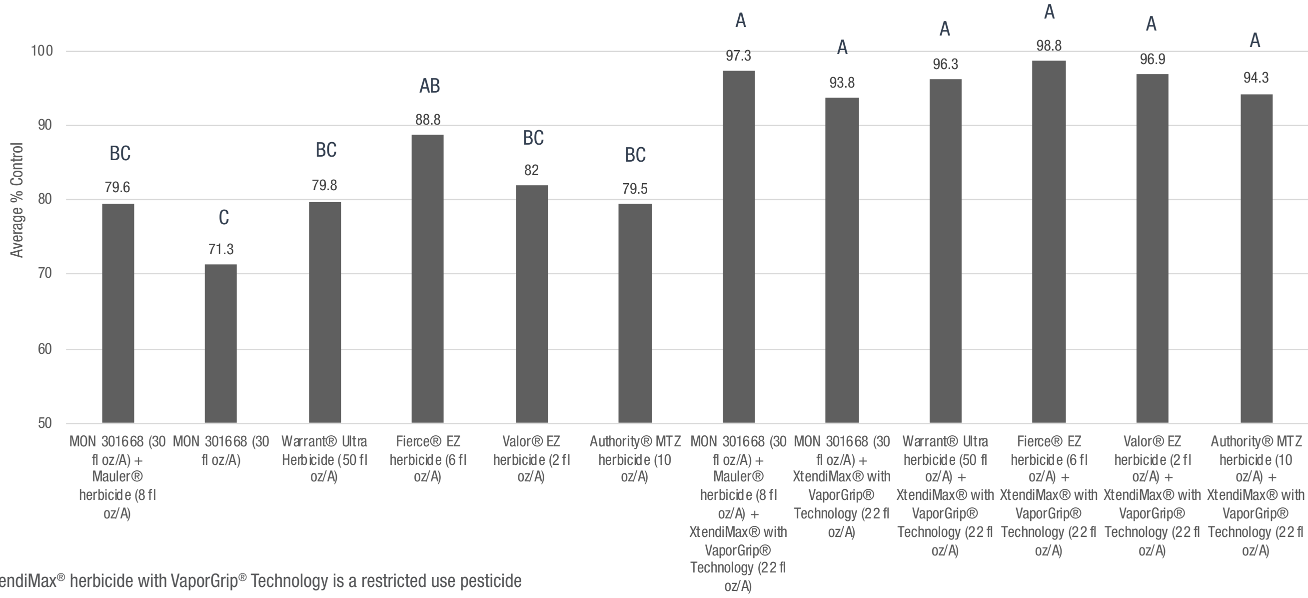
Figure 2. Average percent control of broadleaf weeds with pre-emerge products alone and with XtendiMax® herbicide with VaporGrip® Technology at 9 locations 35 days after application. (Averages followed by same letter are not significantly different using Fishers Protected LSD at < 0.05).



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

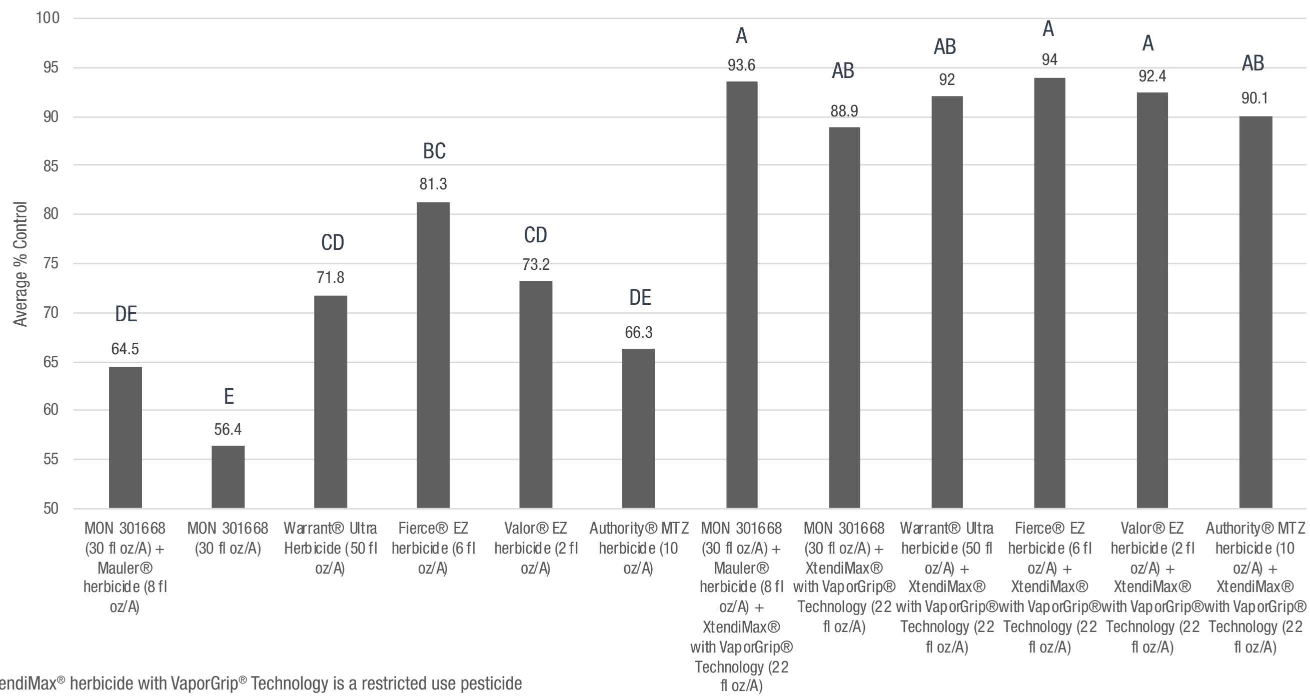
Figure 3. Average percent control of Amaranthus species with pre-emerge products alone and with XtendiMax® herbicide with VaporGrip® Technology at 7 locations 35 days after application. (Averages followed by same letter are not significantly different using Fishers Protected LSD at < 0.05).

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



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

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).



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

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

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).

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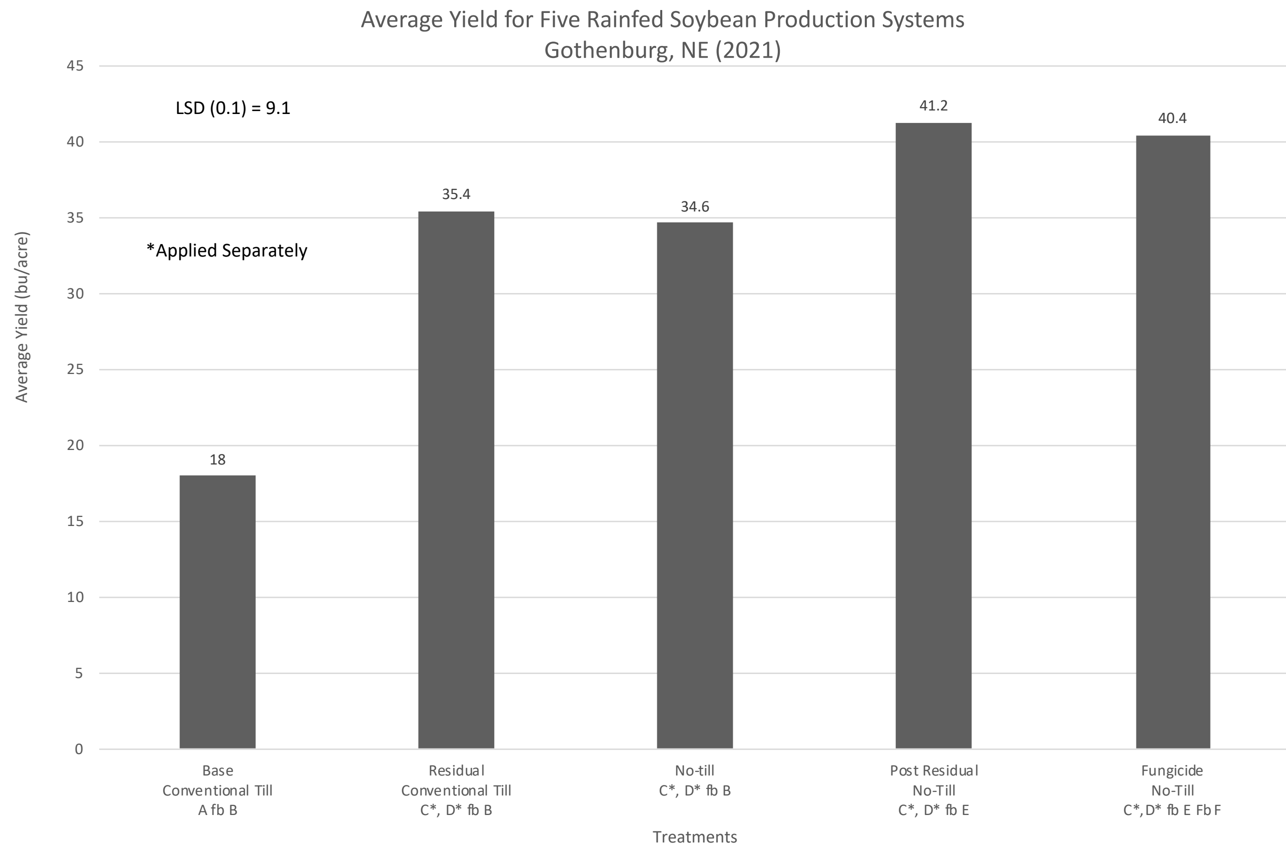
Rainfed Soybean Production Systems (2021)



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.

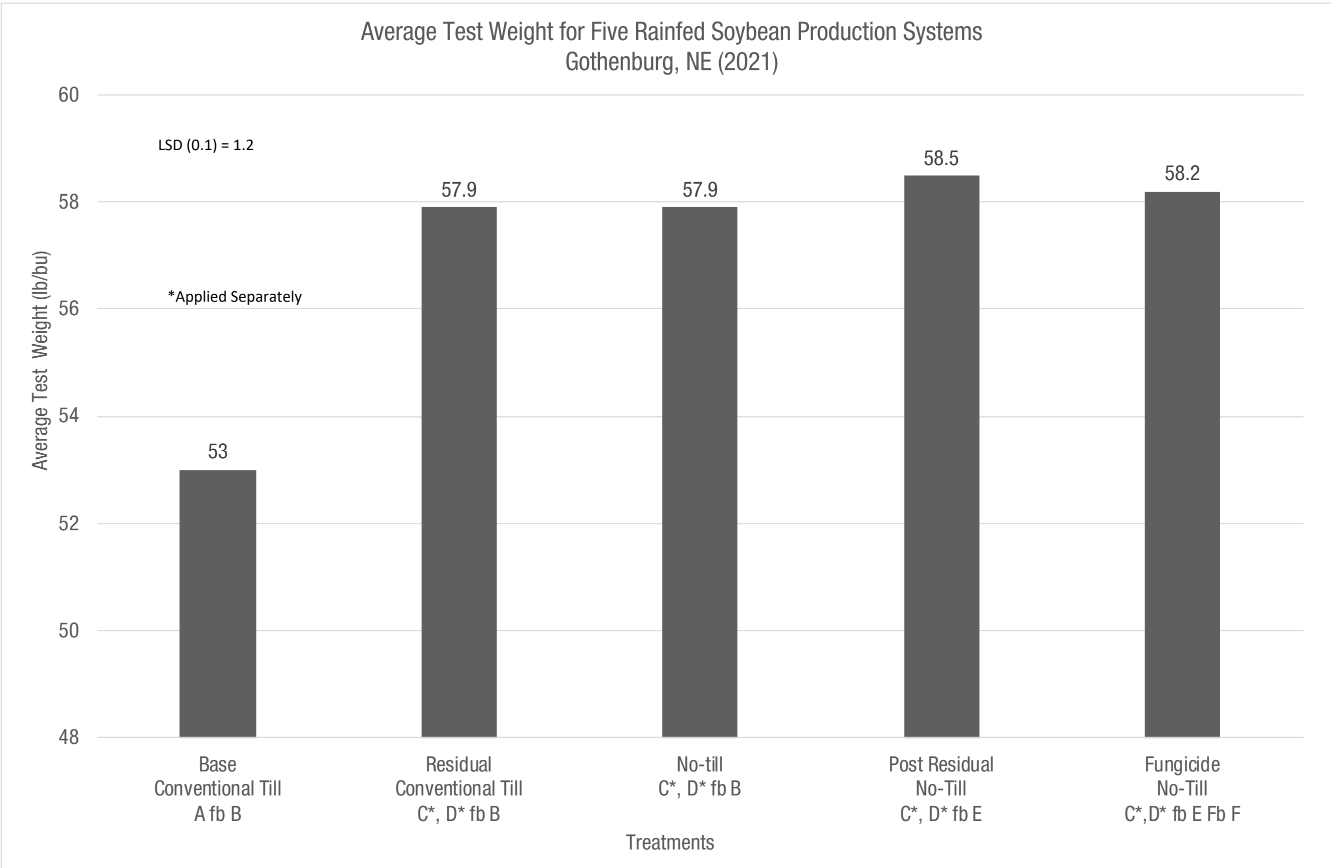
Rainfed Soybean Production Systems (2021)

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

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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

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

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.

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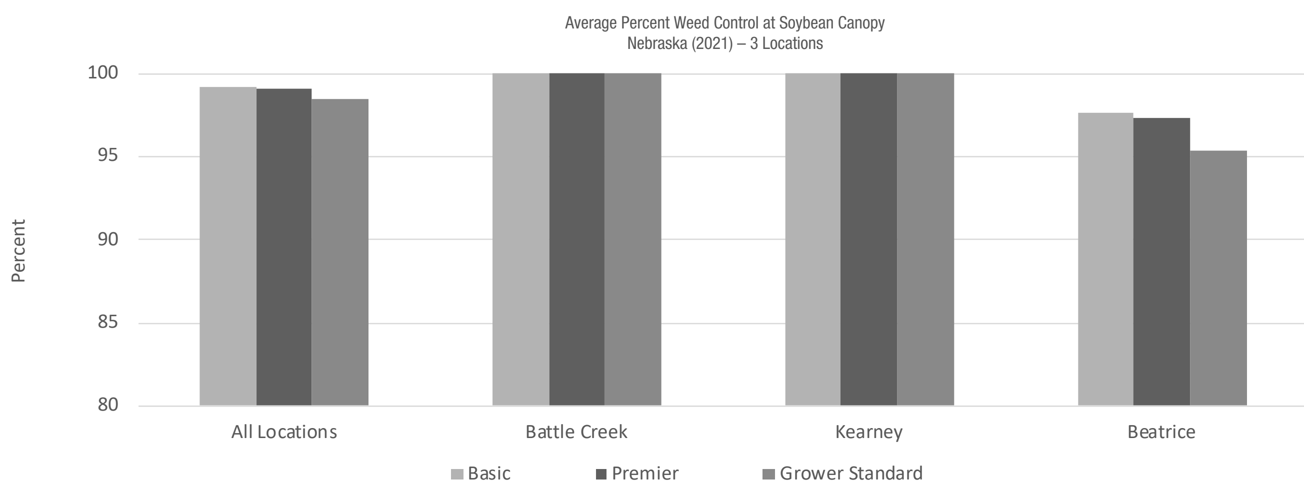
- Disease Ratings, % Weed control, yield, and moisture data were collected at each location.

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

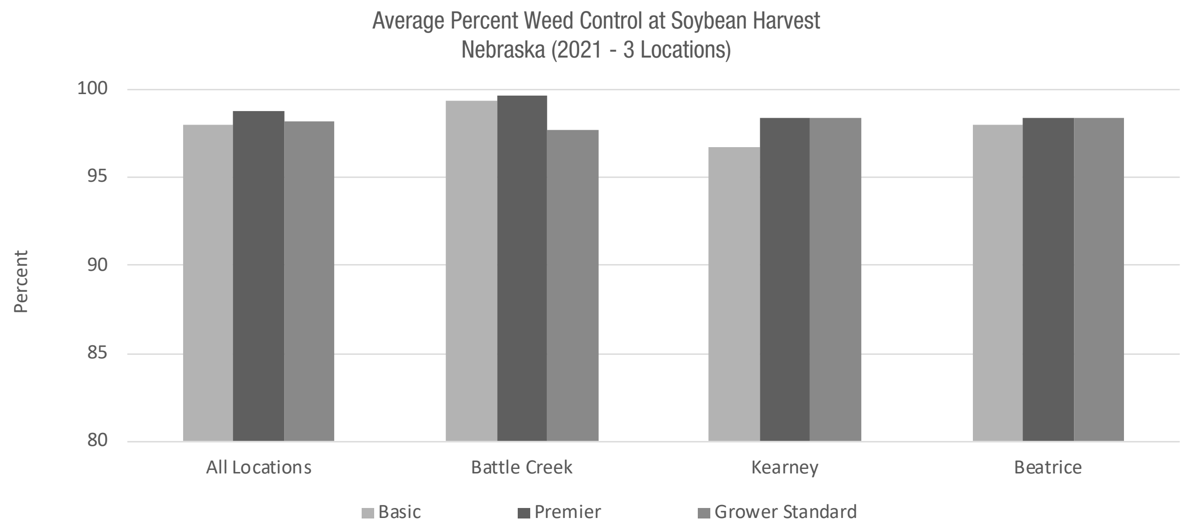
- The Roundup Ready® Xtend Crop System can provide season long, broad spectrum weed control by implementing overlapping residual herbicides and planting into clean, weed-free field conditions (data not shown).
- Weed control was consistently acceptable across all treatments (Figure 1).



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.

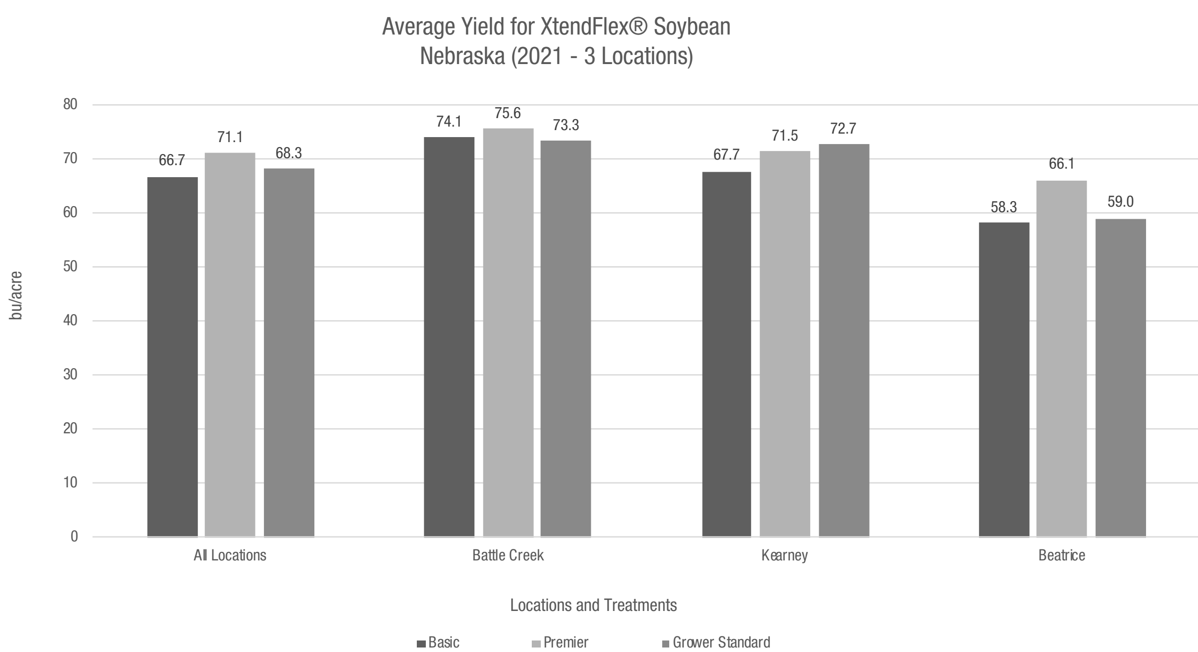
XtendFlex® Soybean Systems Trial



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).

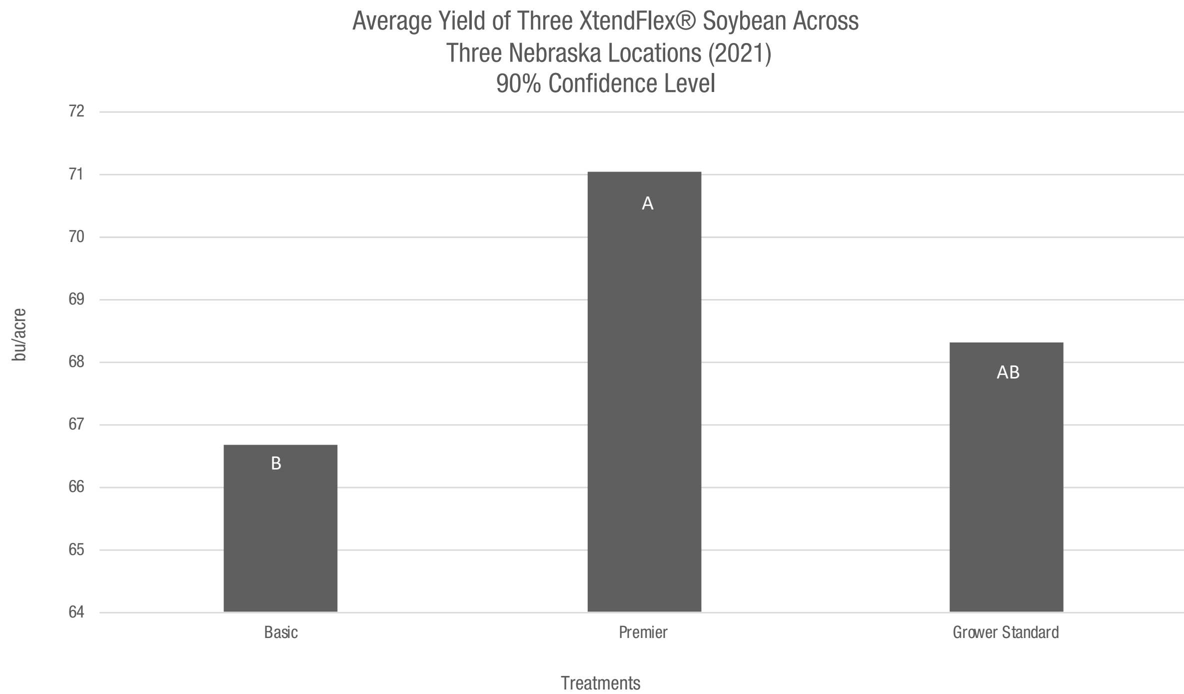


Basic Treatment: Bayer company soybean product; Acceleron® Seed Applied Solutions Standard + Acceleron® IX-409 Insecticide, Herbicides: PRE: Warrant® Herbicide (48 fl oz/acre) + Mauler® Herbicide (8 fl oz/acre); POST: Roundup PowerMAX® Herbicide (32 fl oz/acre) + Ammonium Sulfate (AMS) (17 lb/100 gal) + 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

Cotton Trials to Evaluate Row Configurations, Cotton Boll Locule Development, and Agronomic Interactions Involving Variety, Seeding Rate, and Row Configuration in Relation to Boll Locule Development

Trial Objective

Part I – Cotton Row Configuration

- Cotton planted on wider rows (up to 80-inches apart) has been a major point of discussion around the cotton industry for several years.
- Wide row and skip row plantings have several potential advantages over solid planting like equipment standardization across crops, reduced potential for excess vegetative growth via reduced plant to plant competition, and reductions in input costs from lower seeding cost and or banding of inputs.
- Questions remain regarding variety selection, appropriate management, and yield potential in wider row cotton plantings.
- This study was initiated at the Bayer Learning Center at Scott, MS to evaluate the potential of wide row cotton plantings in the production system.

Part II – Investigations into the Five Locule Boll

- A long-standing cotton mystery has been the five locule boll, which occurs at some level in most cotton fields.
- Questions regarding five locule bolls versus four locule bolls include:
  - Do five locule bolls weigh more than four locule bolls?
  - Do five locule bolls produce more seed and/or lint per boll than four locule bolls?
  - What is the relative fiber quality of five versus four locule bolls?
  - What contribution do five locule bolls make to lint yield?
  - What factors can potentially influence the development of five locule bolls?

Figure 1. Four and five locule bolls. Scott, MS (2021)

- This study was an offshoot of the row configuration work in this document.
- This work helps to explain the agronomic impacts on boll locule number and some of the compensatory mechanisms that cotton shows at reduced populations.
- Some variety effects were also evaluated and are included in this analysis.

Part II B – Agronomic Interactions

- Inherent to this work, several agronomic factors including seeding rates, planting density down the row, variety, and row configuration had an influence on five locule development.

Cotton Trials to Evaluate Row Configurations, Cotton Boll Locule Development, and Agronomic Interactions Involving Variety, Seeding Rate, and Row Configuration in Relation to Boll Locule Development

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (lb/acre)	Seeding Rate (seeds/acre)
Scott, MS	Silty/Sandy, Clay Loam	Corn	Conventional	5/15/2021	10/15/2021	1750	See Below

- Plots were approximately one acre each.
- Weed and insect controls were applied at local standard rates and timings.
- Nitrogen at a rate of 85 lb/acre was applied as 28-0-0-5 (N-P-K-S).
- Row configurations planted:
  - 38-inch Solid
  - 38-inch Skip Row (2:1) – 2 rows planted, 1 row skipped
  - 76-inch Wide Row (1:1) – Effectively 1:1 skip row 38-inch
    (This is planted as a proxy for 60-inch rows which is how wide row cotton is being planted. The Learning Center does not have 30-inch equipment and cannot effectively plant 60-inch rows due to drainage issues on 30-inch beds; therefore, 76-inch rows are used.)
- Deltapine® brand cotton varieties planted:
  - DP 2020 B3XF (early to mid-maturity)
  - DP 2127 B3XF (early to mid-maturity)
  - DP 2038 B3XF (mid-maturity)
  - DP 1646 B2XF (mid-maturity to full season)
  - DP 2055 B3XF (full season)
- Seeding rates per land acre:
  - 20,000
  - 30,000
  - 40,000
  - 50,000
- Mepiquat chloride 4.2% plant growth regulator (PGR) was applied at labeled rates to the row configuration treatments on dates relative to growth stage (9, 14, and 17 nodes):
  - 38-inch Solid
    - 6/22/2021 – 9 nodes - 12 fl oz/acre
    - 7/6/2021 – 14 Nodes - 12 fl oz/acre
    - 7/19/2021 – 17 nodes - 16 fl oz/acre
  - 76-inch Wide Row (1:1)
    - 6/22/2021 – 9 nodes - 10 fl oz/acre
    - 7/6/2021 – 14 Nodes - 10 fl oz/acre
    - 7/19/2021 – 17 nodes - 16 fl oz/acre

- 38-inch Skip Row (2:1)
  - 6/22/2021 – 9 nodes - 10 fl oz/acre
  - 7/6/2021 – 14 Nodes - 10 fl oz/acre
  - 7/19/2021 – 17 nodes - 16 fl oz/acre

- The plots were intensively managed by row configuration. Each system was given the best chance for high lint yield potential in the Delta environment as water, mepiquat chloride, and defoliation were all independently managed for each production system.
- The 2021 early growing season at Scott, MS was harsh with large rainfall events and cloudy weather. This should have been an advantage for the alternative row configurations; however, the data collected did not support any advantage.
- Plots were machine harvested for lint yield after defoliation.

Data collected

- All plots were monitored for growth and development throughout the season.
- Box Mapping – All plots were positionally mapped to evaluate fruiting profile and boll parameters such as seed weight, seed number, and fiber quality:
  - Fruiting profile of the variety x seeding rate x row configuration combinations.
  - Sample ginning – All box mapping samples were bulked, ginned, and sent through High Volume Instrument (HVI) testing for both turnout and fiber quality evaluations.
  - Delinting – Mapping samples were segregated by treatment combination, locule number, and bulked together by locule cohort before ginning. After ginning, seeds were weighed fuzzy (in bulk), delinted, counted, and weighed post delinting (black) for reporting. This was done primarily to evaluate the influence of locule number on seed and lint weight and corresponding influences on lint yield and fiber quality.

Figure 2. Boll segregation process (left) and buckets (right) showing number of four locule bolls (red bucket) and five locule bolls (white bucket). Scott, MS (2021)

Cotton Trials to Evaluate Row Configurations, Cotton Boll Locule Development, and Agronomic Interactions Involving Variety, Seeding Rate, and Row Configuration in Relation to Boll Locule Development

Understanding the Results

- **Part I-Row Configuration Evaluations and Observations**
  - » Row configuration
    - » The 38-inch solid configuration produced an average yield of 1564 lb lint/acre (Figure 3).
    - » The 76-inch (1:1) wide row (Figure 4) and 38-inch (2:1) skip row (Figure 5) treatments showed somewhat reduced average lint yields of 1151 to 1193 lb lint/acre, respectively.

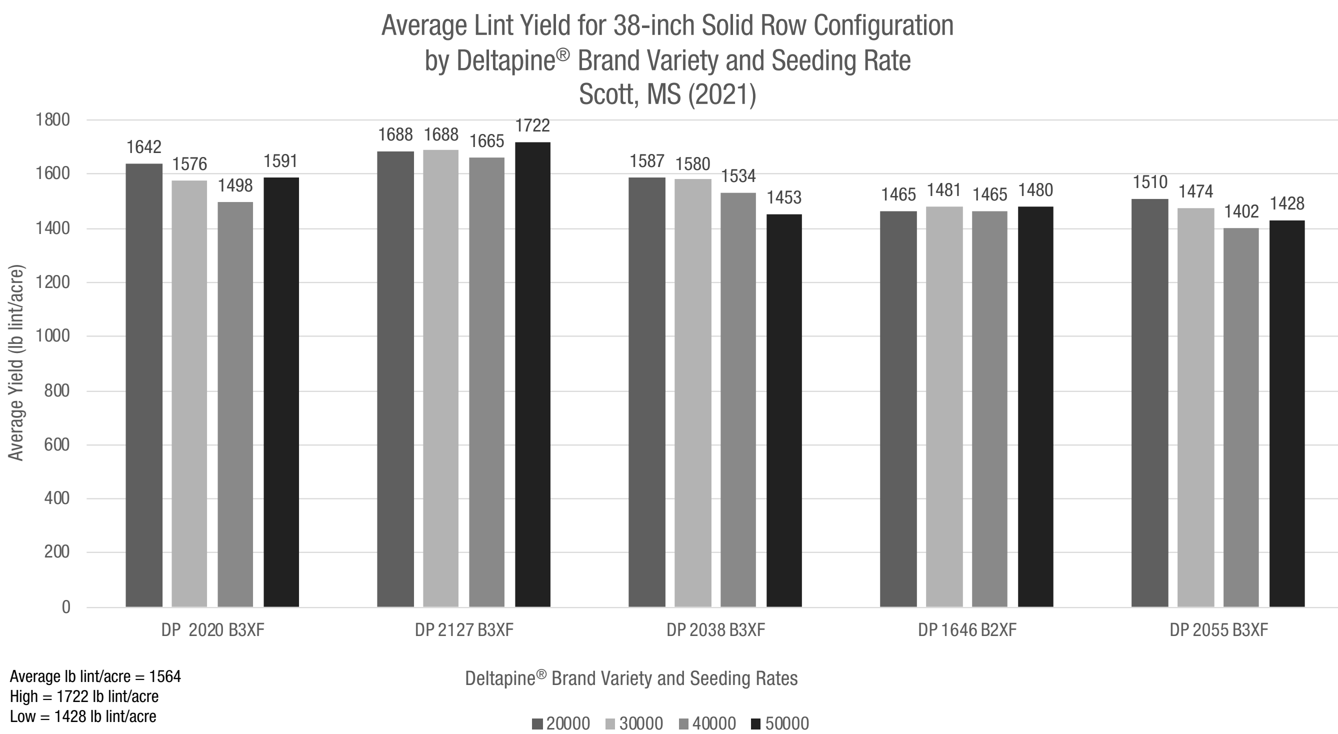


Figure 3. Average lint yield for 38-inch solid row configuration by Deltapine® brand variety and seeding rate. Scott, MS (2021)

Cotton Trials to Evaluate Row Configurations, Cotton Boll Locule Development, and Agronomic Interactions Involving Variety, Seeding Rate, and Row Configuration in Relation to Boll Locule Development

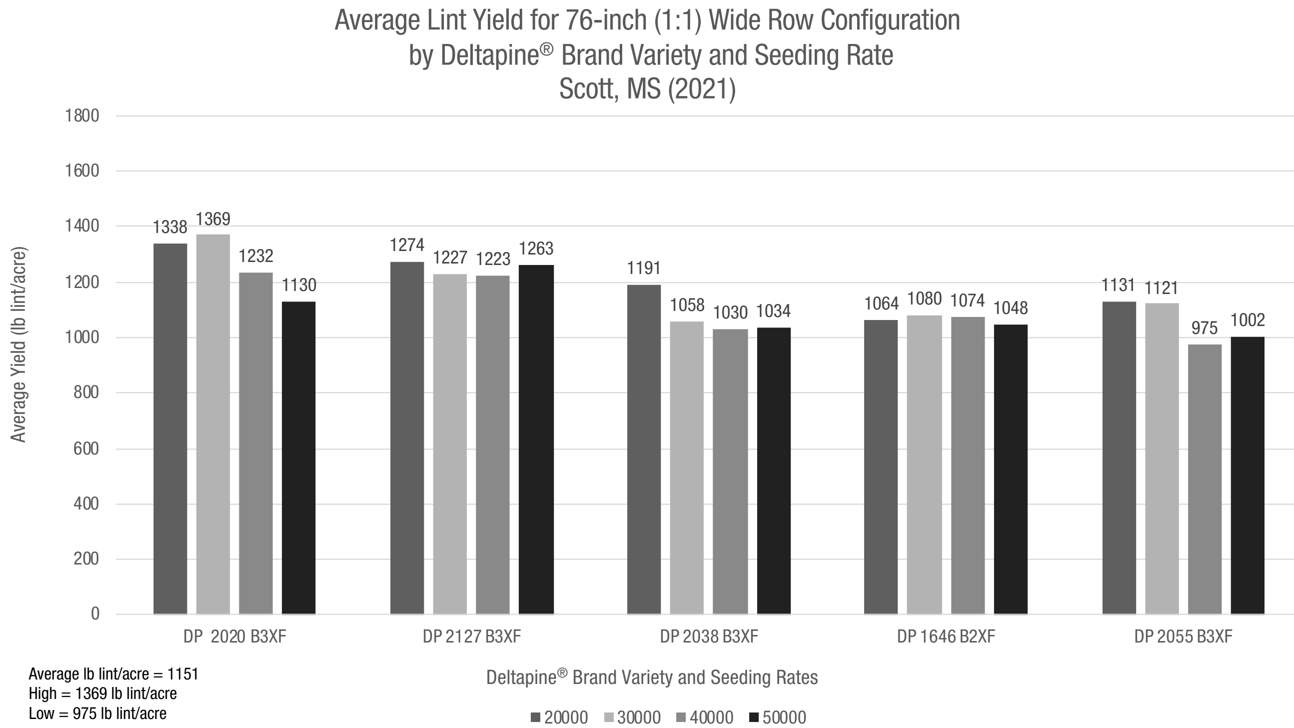


Figure 4. Average lint yield of 76-inch (1:1) wide row configuration by Deltapine® brand variety and seeding rate. Scott, MS (2021)

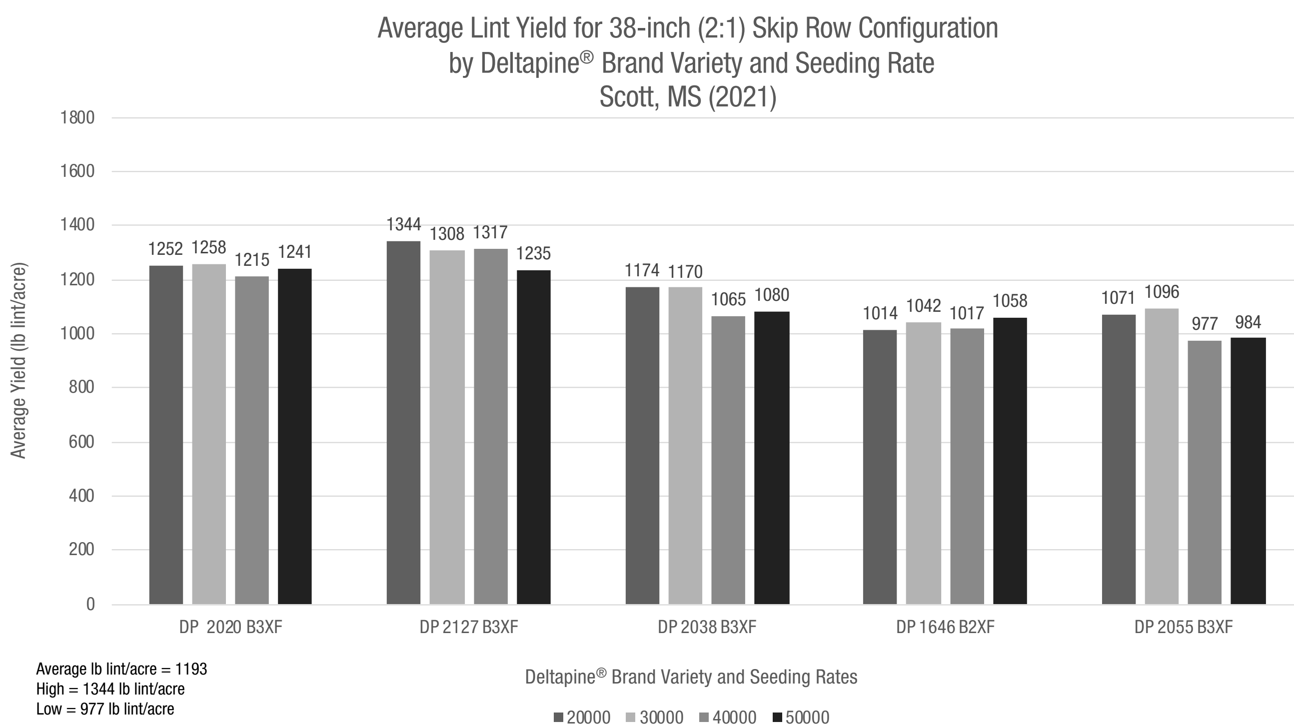


Figure 5. Average lint yield of 38-inch (2:1) skip row configuration by Deltapine® brand variety and seeding rate. Scott, MS (2021)

- Comments about results:
  - While the solid plantings were higher yielding, several of the wider/skip row treatment combinations showed average yields of 1300+ lb lint/acre. Growers should acknowledge this limitation before pursuing either alternative row spacing as a production practice.
  - Variety selection should be carefully evaluated before selecting a variety for wide row production.
  - An important note – these differences are likely to narrow as row configuration moves closer to 60-inches but may also remain. Further investigation is warranted.
- Seeding Rates:
  - Seeding rate is a factor many growers use to moderate vegetative development and supplement or improve the effectiveness of PGR applications.
  - Seeding rate appears to be optimized in this study between 30,000 to 40,000 seeds/acre. This agrees with commercial practice.
  - It appears that reducing the seeding rate in solid row plantings does not greatly decrease yield potential.
  - Yields appeared to be slightly higher in the 76-inch wide rows (1:1) at the lowest seeding rates but at levels of 300 to 400 lb lint/acre lower than in the solid plantings (Figure 4). This points out one fundamental limitation of the wide row planting.
  - Growers should carefully evaluate seeding rate decisions and variety response when a change is being considered. However, cotton yield potential appears to be very high even at relatively low seeding rates.

- **Part II - Investigations into the Five Locule Boll**
  - In the previously discussed row configuration study, the plots were positionally mapped and the bolls were grouped into cohorts of either four or five locule containing bolls.
  - Six-row feet from each plot, which contained a varying number of plants depending on seeding rate and emergence, were mapped. Data not shown.
  - 11,633 bolls were mapped, categorized, delinted, and counted from the plots.
    - 10,105 bolls were categorized as four locule (86.4%).
    - 1,528 bolls were categorized as five locule (13.4%).
  - Bolls were weighed, ginned, High Volume Instrument (HVI) testing completed on the fiber, seed delinted, and seeds were counted.
    - Boll size evaluations and data from this step included:
      - Seed cotton/boll in grams (significantly more for five locule bolls) (Figure 6).
      - Lint/boll in grams (significantly more for five locule bolls) (Figure 7).
      - Number of seed/boll (significantly more for five locule bolls) (Figure 8).
      - Number seed/locule (similar for four and five locule bolls) (Figure 9).
      - Turnout - % Lint versus seed cotton (similar for four and five locule bolls) (Figure 10).
      - Fiber quality - Length, strength, micronaire, and uniformity (all similar for four and five locule bolls) (Figures 11 and 12).

Cotton Trials to Evaluate Row Configurations, Cotton Boll Locule Development, and Agronomic Interactions Involving Variety, Seeding Rate, and Row Configuration in Relation to Boll Locule Development

» Gross conclusions:

- **Five locule bolls are roughly 20% larger versus four locule bolls including seed cotton weight, lint weight, and seed weight.**
- **The fiber quality of five and four locule bolls is similar.**

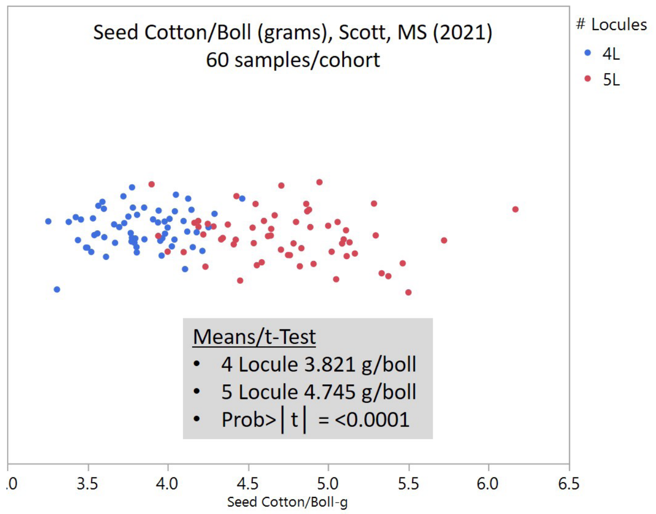


Figure 6. Weight (grams) of seed cotton four and five locule bolls at Scott, MS (2021).

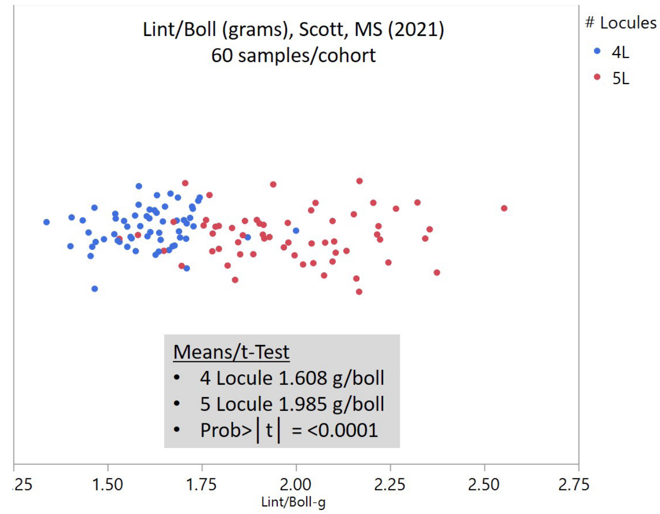


Figure 7. Lint weight (grams) for four and five locule bolls at Scott, MS (2021).

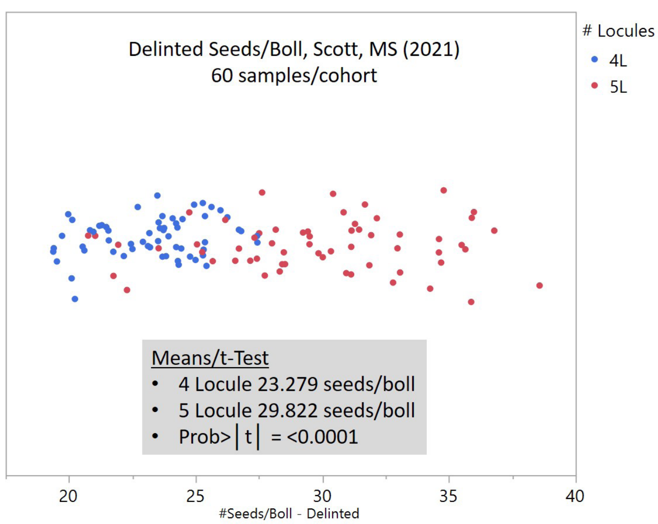


Figure 8. Delinted seeds per four and five locule bolls, Scott, MS (2021).

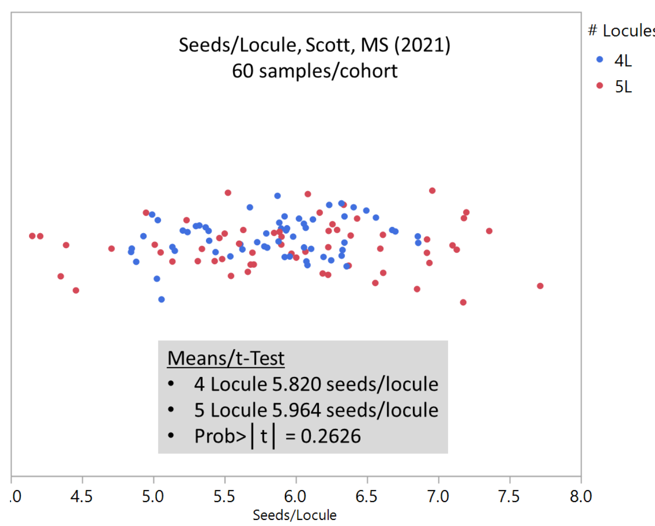


Figure 9. Counted seeds per locule in four and five locule bolls, Scott, MS (2021).

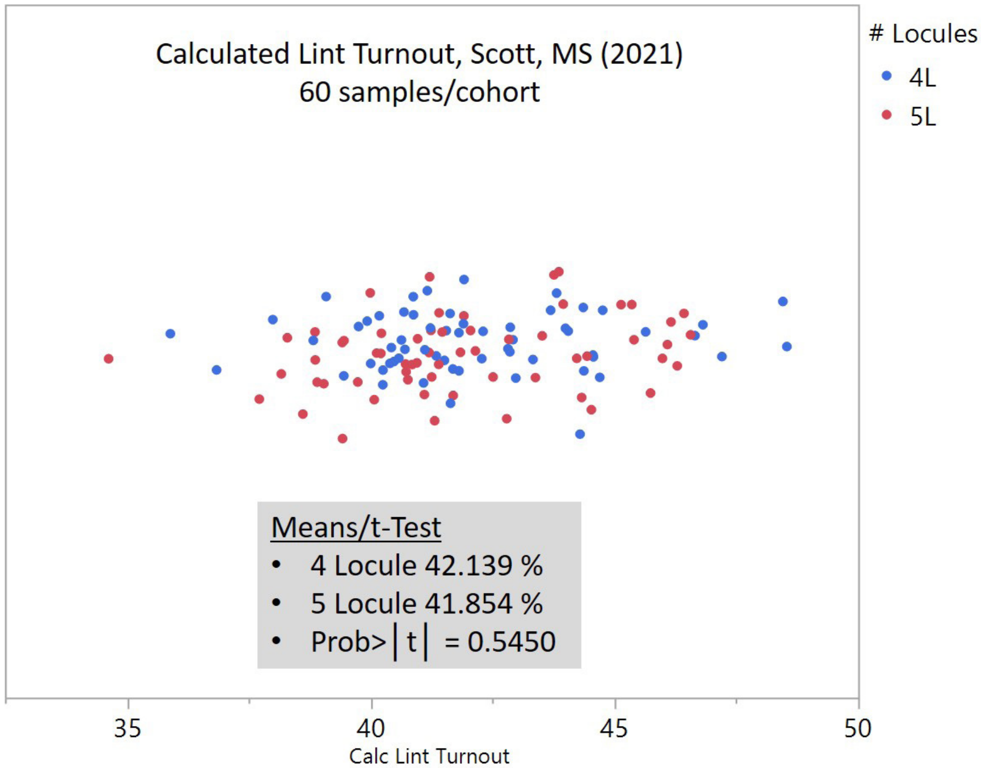


Figure 10. Calculated lint turnout for four and five locule bolls, Scott, MS (2021)

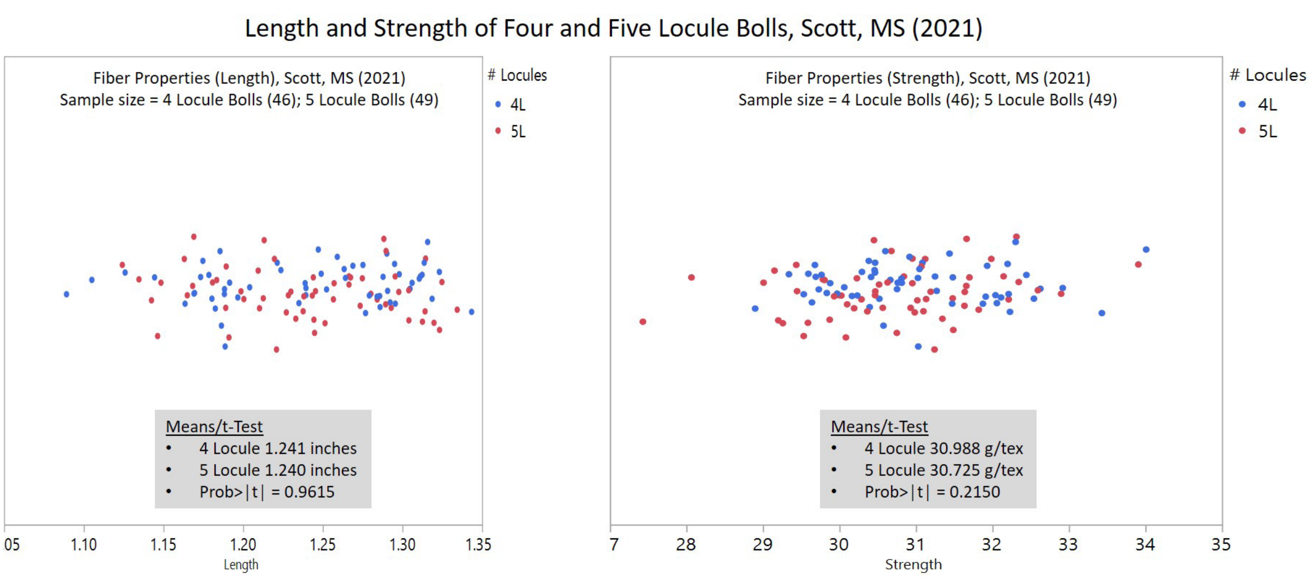


Figure 11. Length and strength of four and five locule bolls, Scott, MS (2021).

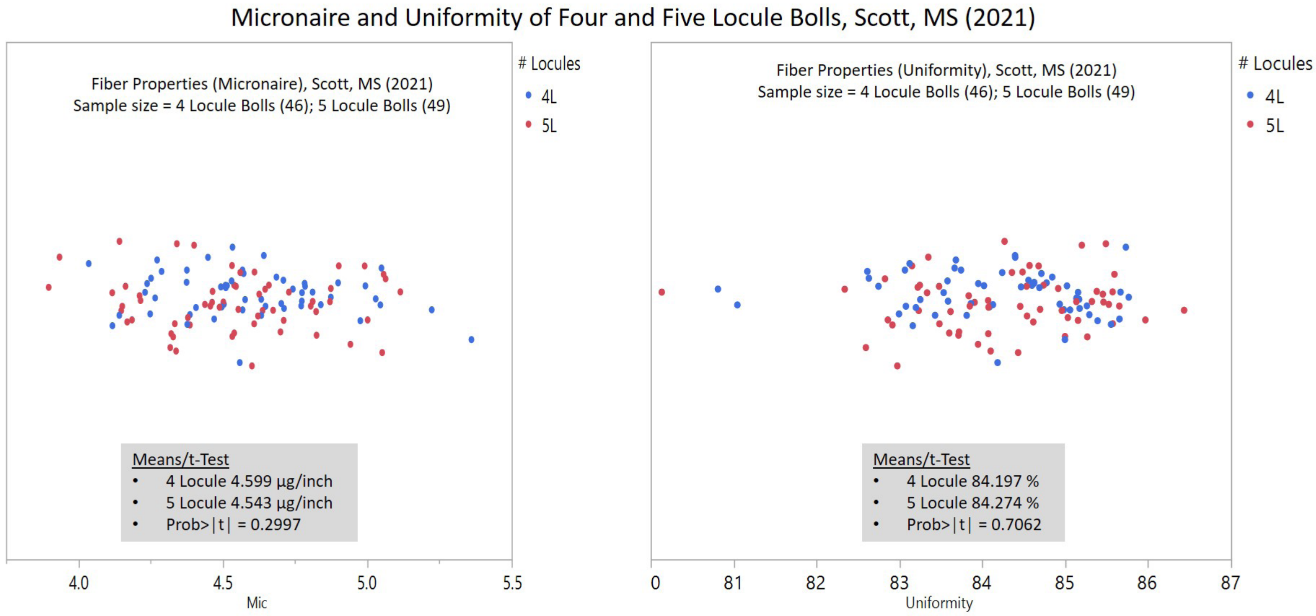


Figure 12. Micronaire and uniformity of four and five locule bolls, Scott, MS (2021).

- **Part II B – Agronomic influences on locule development in cotton.**
  - » Background – Historical (1920's) and recent literature indicates that locule (4 or 5) determination occurs about 24-28 days prior to bloom.[1,2] Most cotton bolls in *Gossypium hirsutum* start with 5 locules and drop to 4 based on carbohydrate status. Typically less available energy leads to reductions in locule number from 5 to 4. The determination is based mainly on the status of carbohydrate production; higher carbohydrate amounts preserve more five locule bolls (Figure 1).
  - » Factors to consider in carbohydrate availability – All field effects that influence the production and availability of carbohydrates should be considered including:
    - » Reduced production – Due to cloudy weather, fertility availability, water logging, drought and other factors.
    - » Plant to plant competition – This leads to increased vegetative development and can decrease carbohydrates availability, particularly when not managed properly. It is also a primary driver of why differences among populations were observed.
    - » Vegetative growth – Any factor that leads to excess vegetative development can reduce carbohydrate availability to the rest of the plant. This can be managed using PGRs and for that reason PGR use is a factor to consider here since it is primarily used to balance vegetative and reproductive growth.

Cotton Trials to Evaluate Row Configurations, Cotton Boll Locule Development, and Agronomic Interactions Involving Variety, Seeding Rate, and Row Configuration in Relation to Boll Locule Development

- Agronomic influences on locule development in cotton:
  - Variety
    - Variety is a huge component for locule number determination.
    - Some varieties (particularly DP 2038 B3XF in this study) produce more (as much as 3X) five locule bolls through various seeding rates (Table 1). This may explain the impact on yield potential and the increase (mysterious) in turnout in some fields.
    - The percentage of five locule bolls appears to range from very few (4%) to around 35% depending on the variety x row configuration x seeding rate combination.
    - Table 1 data is averaged **across the 38-inch Skip Row (2:1) and 38-inch solid plantings** since they were numerically similar.

Table 1. Average percent of five locule bolls by variety and seeding rates averaged across the 38-inch skip row (2:1) and 38-inch solid row configurations at Scott, MS (2021).

	Seeds/acre and Percent of Five Locule Bolls			
Variety	20,000	30,000	40,000	50,000
DP 2020 B3XF	15.39	13.92	15.39	9.37
DP 2127 B3XF	25.21	16.66	14.07	13.82
DP 2038 B3XF	35.72	19.66	23.97	20.61
DP 1646 B2XF	20.99	13.51	13.44	8.23
DP 2055 B3XF	14.06	10.81	4.28	7.63
Grand Total	22.27	14.91	14.23	11.93

  - Averaged across the three row configurations, varieties, and seeding rates in the trial, five locule bolls accounted for 13.43% of the bolls which contributed 16.03% of the harvested dry weight for a yield gain associated to five locule bolls of 2.62% (Table 2).
    - This gain can be scaled to the number of five locule bolls contained in each treatment combination to roughly estimate the contribution made to yield.

Table 2. Average percent of five locules for each seeding rate and average percent harvested weight attributed to five locule bolls at Scott, MS (2021).*

Seeding Rate Seeds/acre	Average Percent of Five Locule Bolls for Each Seeding Rate	Average Percent of Harvested Weight Attributed to Five Locule Bolls
20,000	18.62	21.99
30,000	12.80	15.42
40,000	11.94	14.30
50,000	10.34	12.40
Grand Total	13.43	16.03

*Averaged across the three row configurations.

- Seeding Rate
  - Seeding rate effects on locule development appeared similar in all three row configurations but at different magnitudes. The 76-inch wide row (1:1) cotton had a lower percentage of five locule bolls in almost all cases but with similar trends to the 38-inch skip row (2:1) and 38-inch solid (Table 3). This is likely a result of increases in down-the-row density (plant-to-plant competition) versus the other row spacings. The data below is averaged across varieties and the three row configurations.
  - Less plant to plant competition (lower population) can be the trigger for improving carbohydrate availability. There seems to be a plant density (down the row not the land acre) effect, which is why the 76-inch wide row (1:1) spacing responded differently. We must remember that even though the row configurations contain similar numbers of plants on the land acre they are as much as half the distance apart down the row. This apparently introduces plant to plant competition that can cause a long-lasting impact throughout the growing season.
- Row Configuration
  - The data below is averaged across variety and seeding rate within the row configurations.
  - 38-inch solid row and 38-inch skip row (2:1) plantings were similar in the percentage of five locule bolls (Table 3).
  - The 76-inch (1:1) row plantings developed about 50% less (8.60%) five locule bolls versus the 38-inch solid and 38-inch (2:1) skip row plantings which were 16.87% and 14.80%, respectively (Table 3).
    - This is likely the result of increased plant to plant competition down the row in the 76-inch (1:1) plantings and will be focus of further research.
  - Similar percentage increases of relative dry weight can be attributed to five locule bolls in the three row configurations (Table 3).
    - **An explanation may be that the average percentage of five locule bolls equals the percentage of the bolls in the treatment combination with five locules. The average percentage of five locule boll weight is the percentage of the dry weight that they contributed to yield.**

Table 3. Average percentage of five locule bolls and average percentage of dry weight attributed to five locule bolls within three row configurations at Scott, MS (2021).

Row Configurations	Average Percentage of Five Locule Bolls	Average Percentage of Dry Weight Attributed to Five Locule Bolls
76-inch wide row (1:1)	8.60	10.70
38-inch skip row (2:1)	14.80	17.40
38-inch solid	16.87	19.98

Cotton Trials to Evaluate Row Configurations, Cotton Boll Locule Development, and Agronomic Interactions Involving Variety, Seeding Rate, and Row Configuration in Relation to Boll Locule Development

Key Learnings

- Wider row spacings can produce acceptable yields; however, potential yield may be limited versus solid plantings.
- Growers should carefully consider variety selection and placement when choosing a wide row or skip row configuration.
- Seeding rate management appears to be a useful tool for managing vegetative development in cotton without greatly sacrificing yield potential.
- **Five locule bolls, when present, are roughly 20% bigger, have similar fiber qualities, and offer greater contributions to yield potential than four locule bolls when considered on an individual basis; however, all bolls are important and four locule bolls remain the primary contributors to yield potential.**
- Agronomic factors that include variety selection, seeding rates, row configuration, drought, irrigation, and other factors influence the development and number of five locule bolls.
- Please see your local Deltapine® brand representative for more information.

Sources:

[1] Robertson, B., Bednarz, C., and Burmester, C. 2007. Growth and development – first 60 days. Cotton Physiology Today. Vol. 13, No. 2. National Cotton Council. https://www.cotton.org/tech/physiology/cpt/plantphysiology/upload/Growth-and-Development-First-60-Days-NOSUBSCRIBE.pdf.

[2] Oosterhuis, D., Stewart, M., and Guthrie, D. 1994. Cotton fruit development: The boll. Cotton Physiology Today. Vol. 5. No. 7. National Cotton Council. https://www.cotton.org/tech/physiology/cpt/plantphysiology/upload/CPT-Aug94-REPOP.pdf.

Legal Statements

Evaluation of Deltapine® Brand Commercial and Non-Commercial Cotton Products at Scott, MS

Trial Objective

- The objective of this study was to evaluate current Deltapine® brand commercial and non-commercial cotton products for adaptation to the Mid-Southern production system.

Research Site Details

- The cotton products were evaluated across the normal range of maturities and determinacy typical of the Deltapine® lineup. Included in the testing were two cotton products from the Class of 2021 New Product Evaluator (NPE) group. This type of testing helps to identify which non-commercial candidates perform the best across the different soil types.
- This trial was a single replicate study (0.2 acre/plot) conducted at Scott, MS on two radically different Delta soil types:
  - The Highway Cut site is a silty sand soil.
  - The Buckshot Field is a heavy clay soil.
- Deltapine® Brand Products and NPE Products Planted:
  - DP 1908 B3XF
  - DP 2012 B3XF
  - DP 2115 B3XF
  - DP 1518 B2XF
  - DP 1820 B3XF
  - DP 2020 B3XF
  - DP 1725 B2XF
  - DP 2127 B3XF
  - 20R734 B3XF (NPE candidate)
  - DP 2038 B3XF
  - DP 1840 B3XF
  - DP 2141NR B3XF
  - DP 2239 B3XF
  - 20R745NR B3XF (NPE candidate)
  - DP 1646 B2XF
  - DP 2055 B3XF
- All weed, insect and agronomic inputs were per local standards.
- Machine harvested.
- Fiber samples submitted to High Volume Instrument (HVI) Lab for turnouts and fiber quality evaluations.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (lb/acre)	Seeding Rate (seeds/acre)
Scott, MS Highway Cut	Commerce/Forestdale Silt Loam, 15 CEC	Corn	Conventional	5/14/2021	10/9/2021	1600	35,000
Scott, MS Buckshot Field	Sharkey Clay, 45 CEC	Corn	Conventional	5/17/2021	10/11/2021	1200	40,000

Evaluation of Deltapine® Brand Commercial and Non-Commercial Cotton Products at Scott, MS

- Agronomic Notes about each site.
  - Highway Cut – This is a very deep silty sand that represents the traditional "cotton soils" of the Delta. It is characterized by very aggressive growth conditions, particularly when planted in cotton following corn. For this reason, plant growth regulator (PGR) use and population are particularly useful for managing vegetative development.
  - 4.2% mepiquat chloride (PGR) application dates and rates:
    - 6/25/2021 - 16 fl oz/acre.
    - 7/12/2021 - 16 fl oz/acre.
    - 7/24/2021 - 16 fl oz/acre.
  - 80 lb/acre of 28-0-0-4 (N-P-K-S) applied.
  - Buckshot Field – This is an abusive environment for cotton production. The soils are typically too wet or too dry. For this study, one stress followed the other with waterlogging conditions, soon followed by a threat of premature cutout due to drought and finishing with good production conditions.
  - 4.2% mepiquate chloride (PGR) application dates and rates:
    - 7/20/2021 - 8 fl oz/acre.
    - 8/15/2021 - 12 fl oz/acre.
  - 130 lb/acre of 28-0-0-4 applied in two applications: 100 lb/acre of N applied at planting and in response to flooding and associated fertilizer loss, 35 lb/acre was applied at layby as a supplement.

Understanding the Results

- The two sites and the 2021 production season were characterized with poor fruiting low in the plants (although they were two very different agronomic cases) followed by a period of excellent fruit accumulation through mid- and late season. For this reason, early and mid-maturity products seemed to perform well, particularly in the Highway Cut site.
- In the Buckshot Field, fruiting profiles were radically different than the Highway Cut site and as a result the differences in yield were narrowed with a broader group of products appearing to tolerate and recover from the stresses.
- Fruit retention in lower nodes (nodes 6 to 10) was very low to zero at both sites. The Buckshot Field is a particularly odd case where retention was low, then too high causing the potential for premature cutout.
- Highway Cut
  - Due to agronomic complications from 2021, the early- to mid-season products seemed to perform better at the Highway Cut site. This is a typical result in very growthy, difficult to manage production systems. Yield at this site averaged 1210 lb lint/acre with a high of 1543 lb lint/acre and a low of 706 lb lint/acre (Figure 1).
  - Gross revenue ($/acre) tracked closely to lint yield/acre (Figure 2).

Evaluation of Deltapine® Brand Commercial and Non-Commercial Cotton Products at Scott, MS

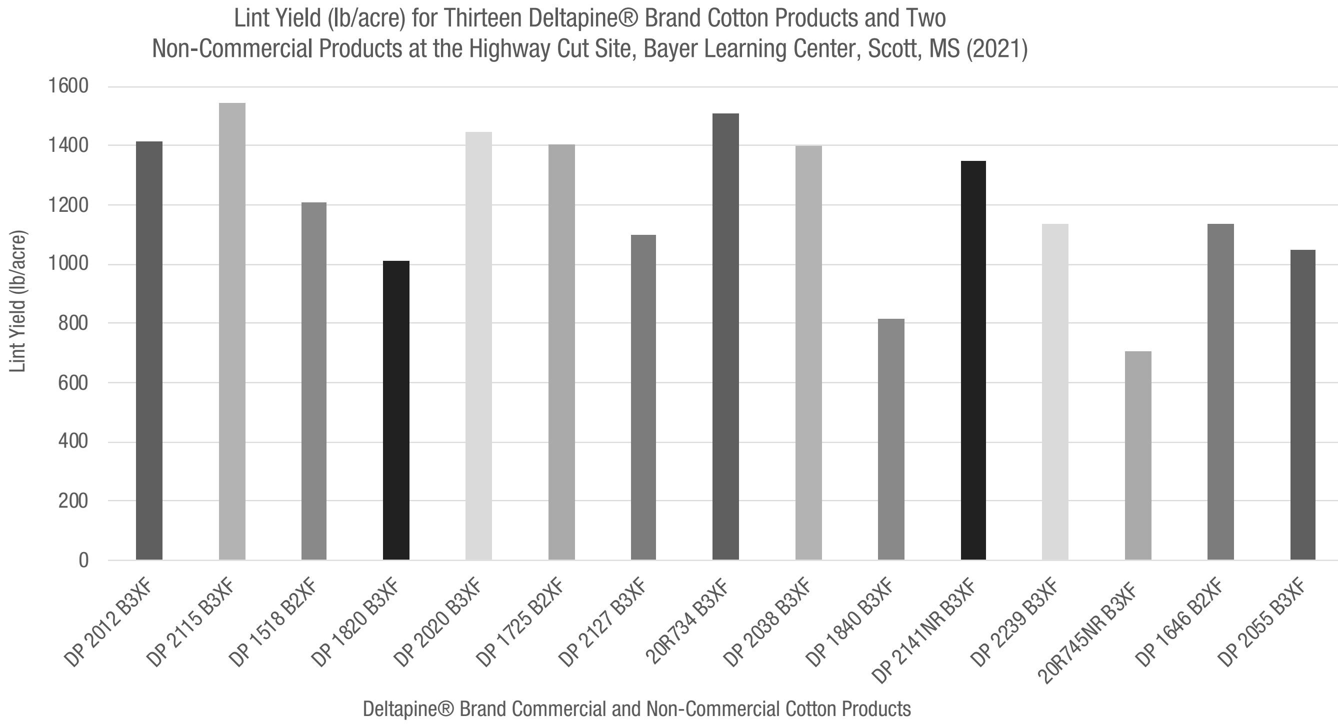


Figure 1. Lint Yield at the Highway Cut site, Bayer Learning Center, Scott, MS (2021).

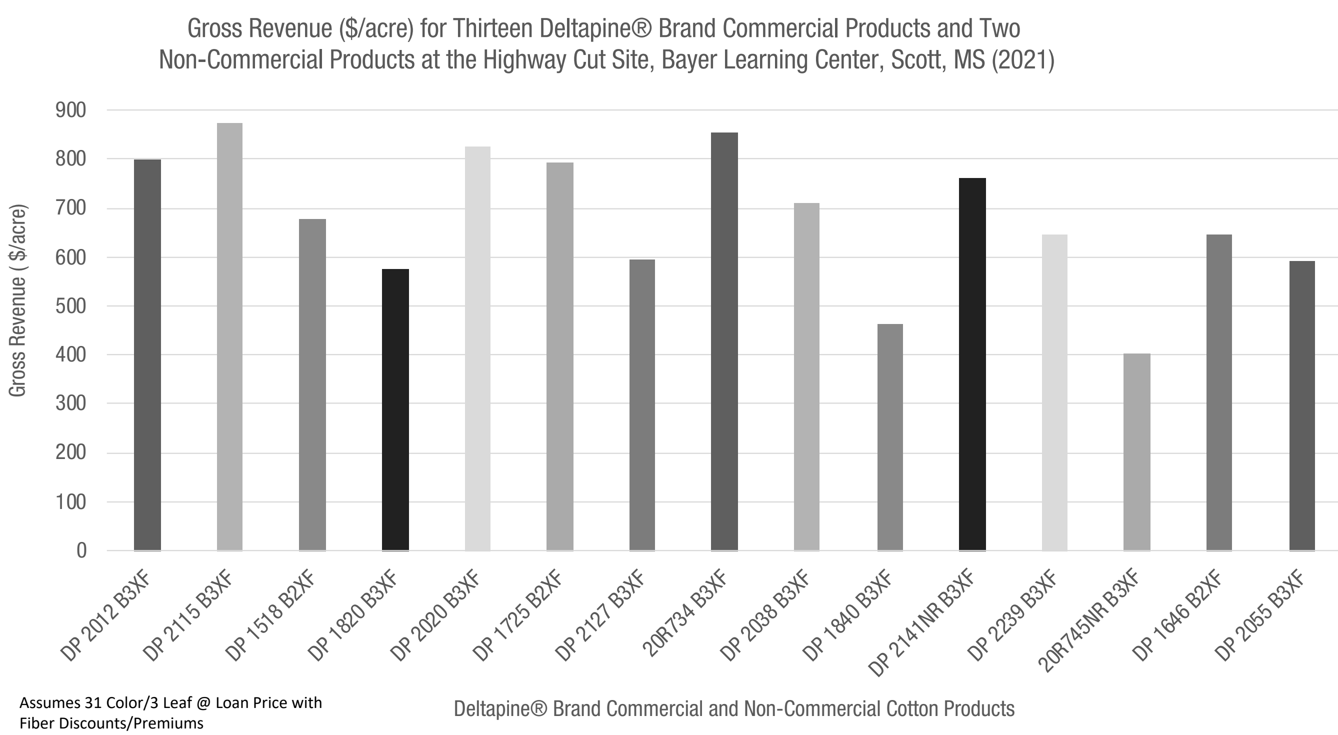


Figure 2. Gross revenue ($/acre) at the Highway Cut site, Bayer Learning Center, Scott, MS (2021).

Evaluation of Deltapine® Brand Commercial and Non-Commercial Cotton Products at Scott, MS

- Buckshot Field
  - » The agronomic situation in this field was entirely different and required differential management; however, it still recovered and established an average yield of 899 lb lint/acre with a high of 1117 lb lint/acre and a low of 712 lb lint/acre (Figure 3).
    - Prebloom – Extreme rainfall events waterlogged this location for much of the prebloom period resulting in restricted growth.
    - Bloom – At and just after bloom, this location dried out and began to recover from the excess water stress, then became too dry which led to a potential for premature cutout. Additionally, a high lygus infestation removed much of the existing fruit causing the following intense management steps to be initiated:
- At minimum fruiting (under 10% square retention), insect control was initiated along with relatively low rates of PGR and a minimally wetting irrigation was applied.
- After treatment, the cotton plants began to recover from both excess water stress, drought stress, and insect damage.
  - » Mid-Late Season – The Buckshot Field fruited as expected and established an acceptable yield potential (1100 lb/acre) because of the dynamic in-season management.
    - Gross revenue ($/acre) tracked closely to lint yield/acre (Figure 4).

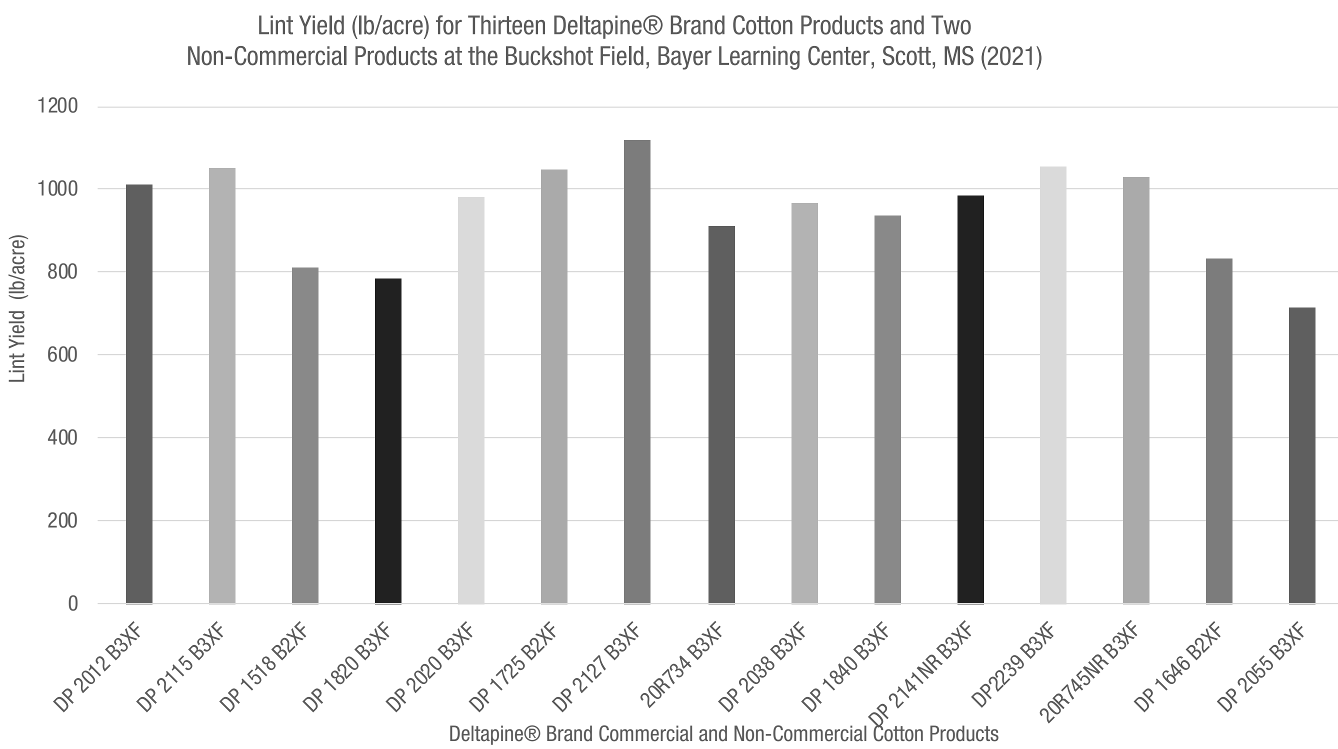


Figure 3. Lint yield at the Buckshot Field, Bayer Learning Center, Scott, MS (2021).

Evaluation of Deltapine® Brand Commercial and Non-Commercial Cotton Products at Scott, MS

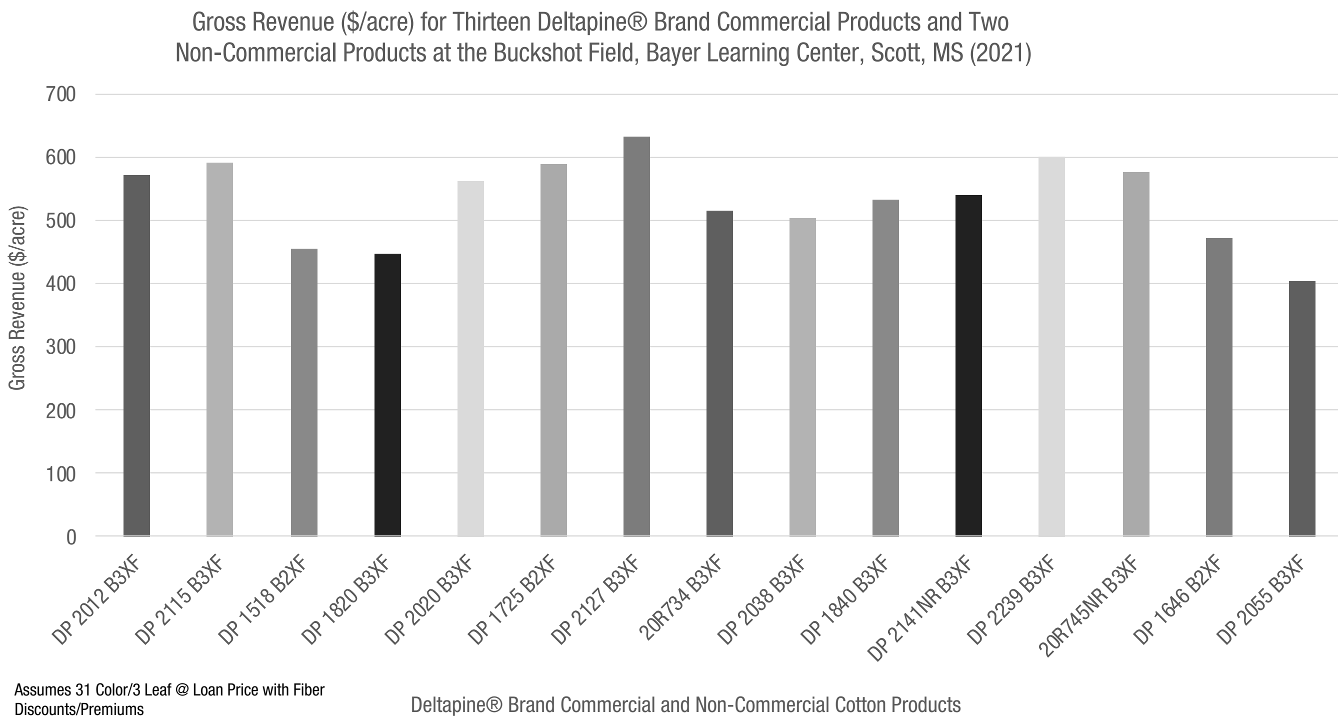


Figure 4. Gross revenue ($/acre) at the Buckshot Field, Bayer Learning Center, Scott, MS (2021).

Key Learnings

- Current Deltapine® brand products and some of the new NPE class products appear to offer growers excellent candidates for either tested production system even though very specific considerations should be given when choosing a cotton product to plant.
- When choosing a cotton product(s) to plant, growers should carefully consider the entire package including PGR management required, yield, agronomic traits, and inherent fiber quality potential. As shown in the gross revenue slides, it appears new and emerging Deltapine® brand products offer excellent potential in southern production systems.
- Please contact your local Bayer representative for more information.

Legal Statements

The information discussed in this report is from a multiple site, unreplicated 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 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. 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.

Evaluation of Deltapine® Brand Commercial and Non-Commercial Cotton Products at Scott, MS

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

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.

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.

LIBERTY LINK®

RESPECT THE REFUGE

Roundup Ready® 2 TECHNOLOGY

Response of Deltapine® Brand Cotton Products to Different Plant Growth Regulator (PGR) Regimens

Trial Objective

- The objective of this study at the Bayer Learning Center at Scott, MS was to evaluate the response of Deltapine® brand cotton products to different plant growth regulator (PGR) regimens.
- PGR response is a very important characteristic to consider when choosing a cotton product to plant.
- From this work, we hope to increase the amount of information for managing new and existing products.
- Proper PGR management helps optimize Deltapine® brand cotton product return on investment.

Research Site Details

- All weed, insect, and agronomic inputs were per local recommendations except PGR applications.
- 110 lb/acre of nitrogen (N) applied as 28-0-0-4 (N-P-K-S) before layby.
- PGR Regimens:
  - » Untreated Check (UTC) - no PGR applied.
  - » Passive Regimen - Represents the more passive PGR treatments typically applied two weeks later and at reduced application rates compared to aggressive treatments.
    - Application dates, timing, and rates for 4.2% mepiquat chloride:
    - 7/6/2021 - 14 nodes - 10 fl oz/acre.
    - 7/19/2021 - 17 nodes - 12 fl oz/acre.
    - 7/30/2021 - 20 nodes - 12 fl oz/acre.
  - » Aggressive Regimen – PGR applications that are the most biologically and legally aggressive which usually begin at 8 to 9 nodes and at relatively high application rates.
    - Application Dates, timing, and rates for 4.2% mepiquat chloride:
    - 6/22/2021 - 9 nodes - 16 fl oz/acre.
    - 7/6/2021 - 14 Nodes - 16 fl oz/acre.
    - 7/19/2021 - 17 nodes - 16 fl oz/acre.
- Deltapine® Brand Products:
  - » DP 1908 B3XF (very early to early maturity)
  - » DP 2012 B3XF (early maturity)
  - » DP 2115 B3XF (early maturity)
  - » DP 1820 B3XF (early to mid-maturity)
  - » DP 2020 B3XF (early to mid-maturity)
  - » DP 1725 B2XF (early to mid-maturity)
  - » DP 2127 B3XF (early to mid-maturity)
  - » DP 2038 B3XF (mid-maturity)
  - » DP 1840 B3XF (mid-maturity to full season)
  - » DP 2141NR B3XF (mid-maturity to full season)

Response of Deltapine® Brand Cotton Products to Different Plant Growth Regulator (PGR) Regimens

- » o DP 2239 B3XF (mid-maturity to full season)
- » o DP 1646 B2XF (mid-maturity to full season)
- » o DP 2055 B3XF (full season)

- Trial was a single replicate study (0.1 acre/plot), machine harvested, and site turnouts (from adjacent experiments) were used to estimate lint yields.

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (lb/acre)	Seeding Rate (seeds/acre)
Scott, MS	Commerce Sandy Loam	Corn	Conventional	5/14/2021	10/10/2021	1700	42000

Understanding the Results

- For 2021 cotton production, very harsh early season growing conditions were followed by good growing conditions. The characteristics of the season included:
  - » On time planting.
  - » A very wet early season leading to poor early fruit set in all tested products.
  - » After the early rains ended, cotton crops at the Learning Center began to fruit normally and ultimately showed very good yield potential.
  - » Data from 2021 shows a similar response to previous years but requires a somewhat different interpretation.
- Plant Heights: Across the products tested, the Aggressive and Passive Regimens showed similar reductions in growth of about 10-inches (18%) compared to the UTC plots (Figure 1). This is typical for previous years as well.*

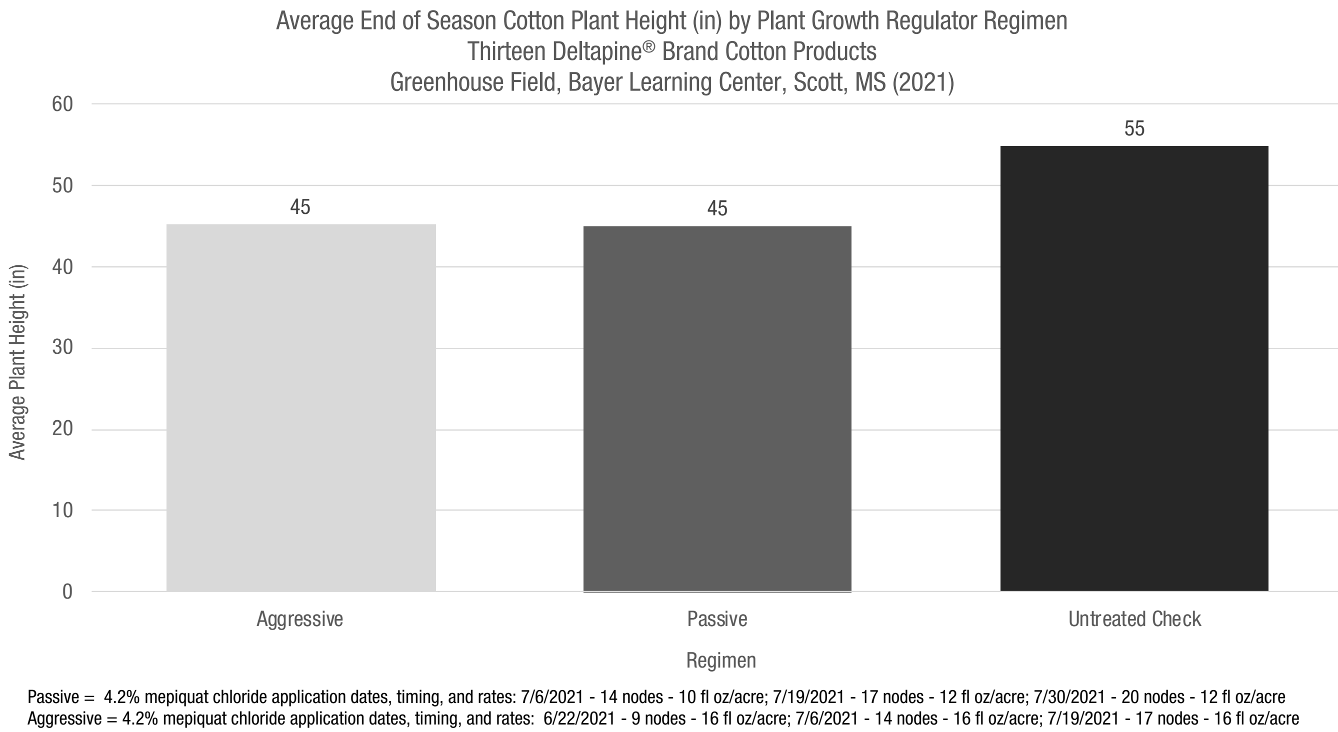


Figure 1. Average end of season plant height (in) by Plant Growth Regulator Regimen for thirteen Deltapine® brand cotton products. Greenhouse Field, Bayer Learning Center, Scott, MS (2021).

Response of Deltapine® Brand Cotton Products to Different Plant Growth Regulator (PGR) Regimens

- Lint Yield: The UTC plots averaged 1139 lb lint/acre. This improved to 1274 lb lint/acre (135 lb/acre or 12% increase) in the Passively managed plots and 1366 lb lint/acre (227 lb/acre or 20% increase) in the aggressively managed plots across all products (Figure 2).

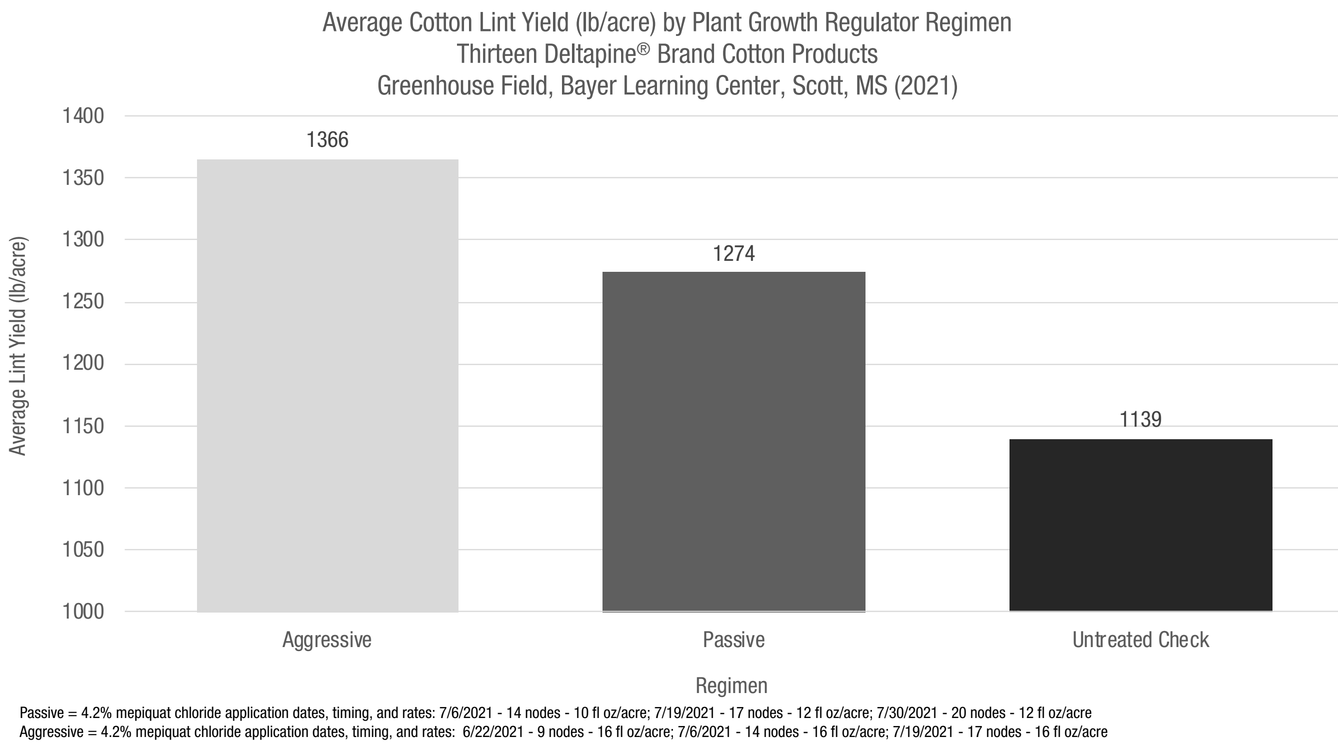
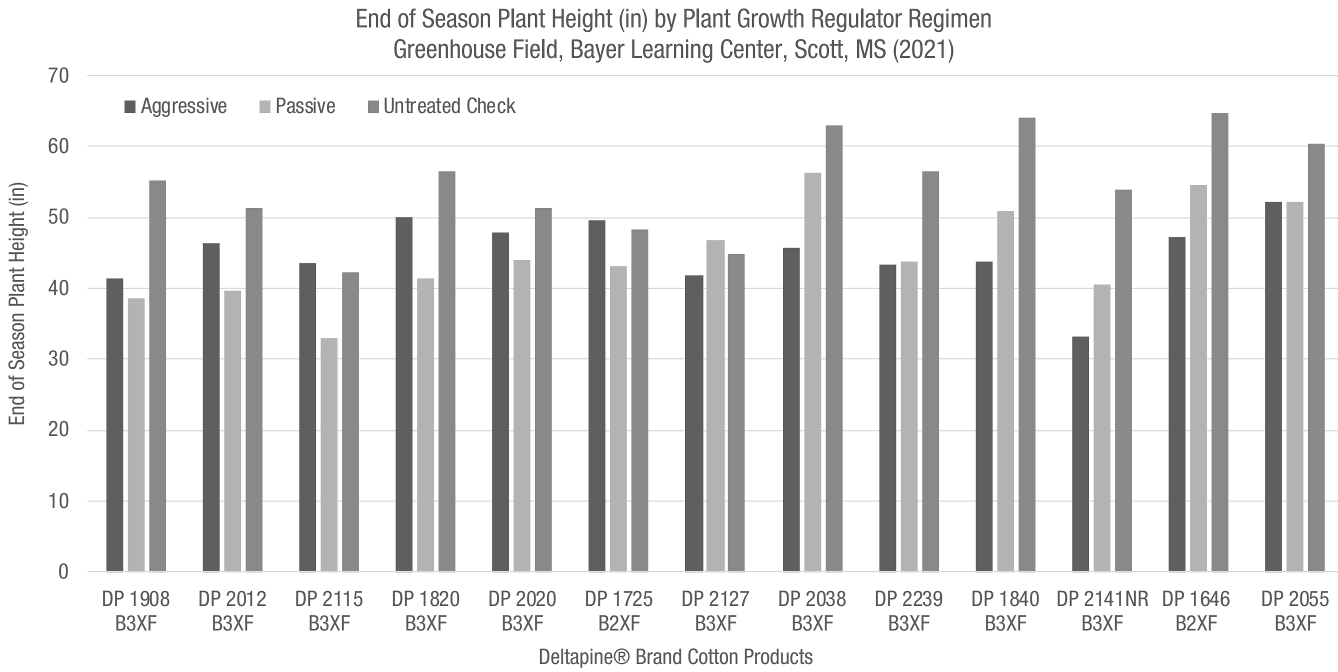


Figure 2. Average cotton lint yield (lb/acre) by Plant Growth Regulator Regimen for thirteen Deltapine® brand cotton products. Greenhouse Field, Bayer Learning Center, Scott, MS (2021).

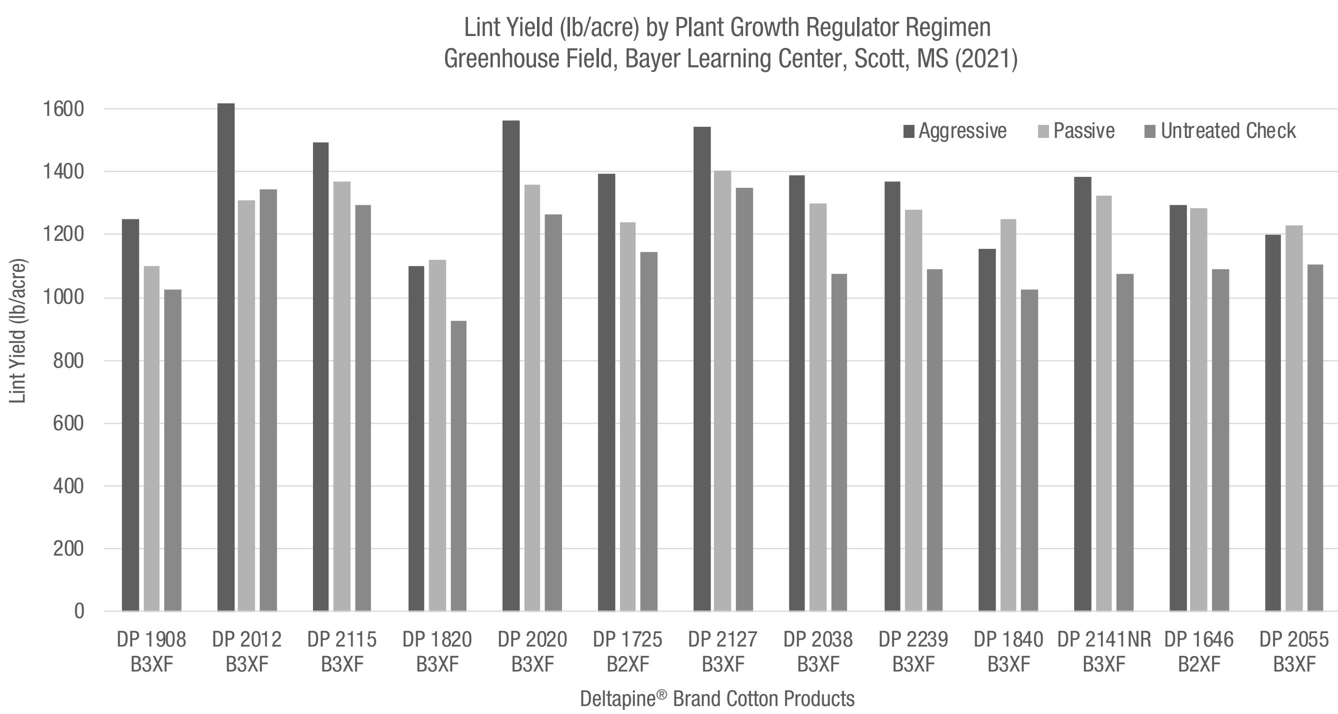
- Growing conditions, fruiting, and PGR effects on plant height:
  - » 2021 had unique growing conditions and discussions of interactions with those conditions are necessary for correct data interpretation.
    - Early, more determinate products:
- In many years, these will be some of the taller products in the UTC treatments. During 2021 they were not; the earlier products, while having a reduced fruit load very early, began to fruit and recover from early season stresses sooner than later products. Therefore, resumption of early season growth combined with good fruiting conditions afterwards and aggressive PGR use effectively limited mid-season vegetative development in the more determinate products, i.e. they are more responsive to the PGR applications (Figure 3). Interestingly, most of the tested products yielded more when managed aggressively even when considering these factors (Figure 4).
  - » Later, less determinate products:
- As in previous seasons, these products showed the potential to continue or resume growth when stresses were removed. Therefore, they were some of the taller products in the UTC plots during 2021. This points out the need for situational awareness of product background, in-season fruiting profile, weather, and PGR response when making management decisions (Figures 3 and 4).

Response of Deltapine® Brand Cotton Products to Different Plant Growth Regulator (PGR) Regimens



Passive = 4.2% mepiquat chloride application dates, timing, and rates: 7/6/2021 - 14 nodes - 10 fl oz/acre; 7/19/2021 - 17 nodes - 12 fl oz/acre; 7/30/2021 - 20 nodes - 12 fl oz/acre
Aggressive = 4.2% mepiquat chloride application dates, timing, and rates: 6/22/2021 - 9 nodes - 16 fl oz/acre; 7/6/2021 - 14 nodes - 16 fl oz/acre; 7/19/2021 - 17 nodes - 16 fl oz/acre

Figure 3. End of season plant height (in) for thirteen Deltapine® brand cotton products by Plant Growth Regulator Regimen. Greenhouse Field, Bayer Learning Center, Scott, MS (2021).



Passive = 4.2% mepiquat chloride application dates, timing, and rates: 7/6/2021 - 14 nodes - 10 fl oz/acre; 7/19/2021 - 17 nodes - 12 fl oz/acre; 7/30/2021 - 20 nodes - 12 fl oz/acre
Aggressive = 4.2% mepiquat chloride application dates, timing, and rates: 6/22/2021 - 9 nodes - 16 fl oz/acre; 7/6/2021 - 14 nodes - 16 fl oz/acre; 7/19/2021 - 17 nodes - 16 fl oz/acre

Figure 4. Lint yield for thirteen Deltapine® brand cotton products by Plant Growth Regulator Regimen. Greenhouse Field, Bayer Learning Center, Scott, MS (2021).

Response of Deltapine® Brand Cotton Products to Different Plant Growth Regulator (PGR) Regimens

- Product PGR Sensitivity:
  - » Across the range of tested products, the earlier products showed reduced response (as measured by % height reduction at the season end) to the aggressive PGR applications (Figures 5 and 6). This appears to conflict with results from previous years; however, when the 2021 fruiting profile is considered it can be explained. The earlier products recovered from the early season stresses and began to fruit as the first dose of aggressive PGR was applied. These two factors combined to manage plant height in those products through the rest of the season. In other words, they weren't growing as aggressively, where the less determinate products kept growing and thereby demonstrated a somewhat increased height reduction response to the aggressive PGR treatments.

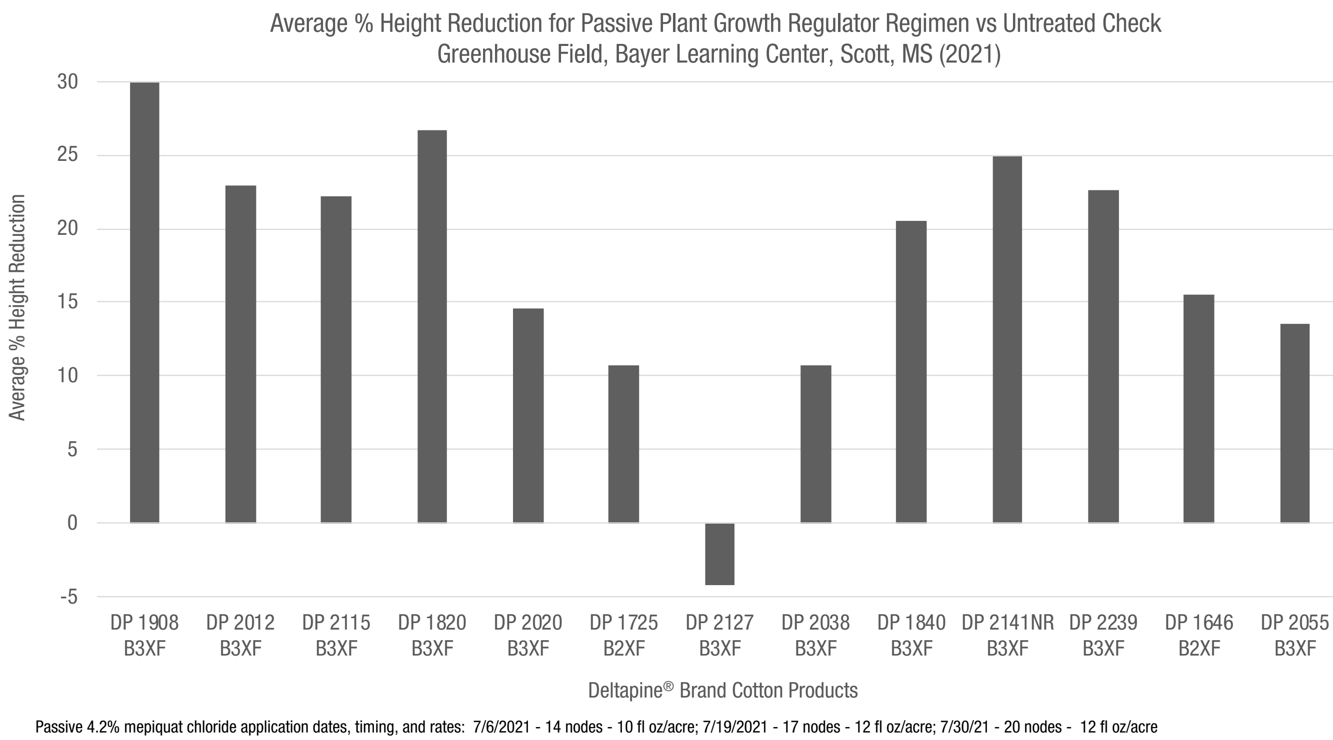


Figure 5. Average % height reduction for aggressive plant growth regulator regimen for thirteen Deltapine® brand cotton products. Greenhouse Field, Bayer Learning Center, Scott, MS (2021).

Response of Deltapine® Brand Cotton Products to Different Plant Growth Regulator (PGR) Regimens

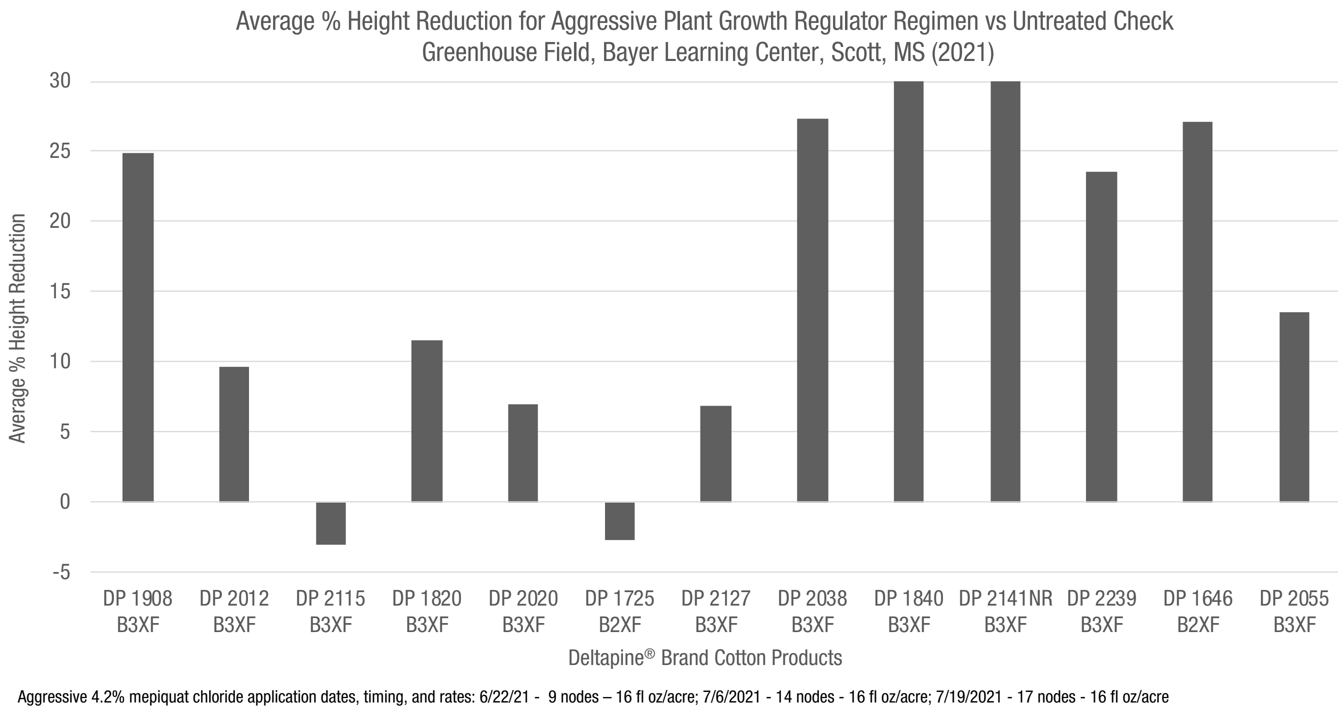


Figure 6. Average % height reduction for passive plant growth regulator regimen for thirteen Deltapine® brand cotton products. Greenhouse Field, Bayer Learning Center, Scott, MS (2021).

- All of this points to the need for individual field management, products, and cases with a continued focus on the differential responses among products.

Key Learnings

- In response to the applied PGR regimens, the tested products responded as expected in height reduction and showed improvements in yield potential in the study.
- PGR responses and application remain very important factors when considering a cotton product to plant for 2022.
- Each product, field, farm, and agronomic case should be managed individually.
- Please contact your local Bayer representative for more details.

Legal Statements

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

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Response of Deltapine® Brand Cotton Products to Different Plant Growth Regulator (PGR) Regimens

A Meta-Analysis of Cotton Response to Plant Growth Regulators from the Scott Learning Center 2011-2021

Trial Objective

- Scott Learning Center (SLC) conducts studies each season to evaluate the response of new and existing cotton products to plant growth regulator (PGR) mepiquat chloride applications.
- A diverse set of varieties from across the cotton belt are tested each season representing the diversity in growth habit and determinacy present in current Deltapine® brand cotton products.
- Historically, differential responses have been observed among the group of varieties tested.
- This work is a summary of those responses from the long-term data from 2011 through 2021.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (lb/acre)	Seeding Rate (seeds/acre)
Scott, MS	Commerce/ Forestdale silt loam	Corn	Conventional	May 1 or later	Vary	1900	41,000 to 45,000

- A total of 10 to 18 Deltapine® brand cotton products were tested each season.
- These studies were set up to encourage excessive vegetative growth due to strong background fertility levels, the previous corn crop, irrigation, and relatively high rates of nitrogen fertility (100 to 120 lb/acre of actual nitrogen soil applied as 32% liquid N).
- All agronomic inputs (weed control, insect control and irrigation) were per local standards for each treatment.
- There was no PGR trial in 2014 and no passive regime in the 2012 trial.
- All PGR plots were treated with labeled but varying rates and application timings of currently available mepiquat chloride (standard 4.2% formulation). These application rates and timings were used to separate differences in Deltapine® brand cotton variety responses and not necessarily to provide specific guidance on PGR management for an individual field, farm, or variety.
- Application regimes (Table 1) included:
  - » Untreated with PGR
  - » Passive Treatments – represents relatively lower rate/later timing
  - » Aggressive Treatments – Applied at labeled timings and within the max product use per season 48 ounces /acre.
- The various treatments are used to separate possible differences in varietal response not necessarily to provide specific guidance specific.
- Growth characteristics of Deltapine® brand cotton products tested were evaluated by:
  - » Stand establishment: monitored for normal emergence (data not presented)
  - » Plant growth: monitored in season
  - » End-of-season plant height: 10 plants/plot measured at harvest

Table 1. Passive and aggressive PGR treatment rates and application timings.

Regime	Treatment	Number of Cotton Nodes at PGR application	PGR Rate (ounces/acre)
Passive	1	10-12	8-10
	2	15-17	10-12
	3	20-21	16
Aggressive	4	8-9	16
	5	12-13	16
	6	15-16	16

A Meta-Analysis of Cotton Response to Plant Growth Regulators from the Scott Learning Center 2011-2021

- » Height reduction from either the passively or aggressively managed treatments versus the untreated check.
- » Representative turnouts from trials at the SLC were used to estimate lint yield/acre to evaluate yield effects of PGR treatments.

Analysis conducted in two parts for 2021

Part 1

Deltapine cotton variety sensitivity to PGRs – PGR application growth reduction was calculated as the percentage that plant height was reduced when compared to the untreated plot.

- Cotton varieties were then characterized by the percent growth reduction to indicate PGR sensitivity within each year as either:
  - » More Responsive – Cotton varieties considered more responsive were the top 50% in plant height of the Deltapine cotton varieties within the year tested.
  - » Less Responsive– Cotton varieties considered less responsive were the bottom 50% in plant height of the Deltapine cotton varieties within the year tested.

Part 2 Regression Analysis

- Varietal Characterization – for the purposes of this analysis Growth Reduction was calculated as the percentage that plant height was reduced in the Aggressively managed plots vs the untreated.
- Used as an indication of sensitivity to PGR and each variety in the testing series - data not shown.
- Varieties were then segmented by percent growth reduction as an indication of PGR sensitivity within each season as either:
- More Responsive – Cotton varieties considered more responsive were the top 50% of the Deltapine cotton varieties within the year tested. Less Responsive – Cotton varieties considered less responsive were the bottom 50% of the Deltapine cotton varieties within the year tested.
- Cotton products were further segmented into cohorts based upon untreated plant heights.
  - » TALL in the untreated plots – those varieties with plant heights in the upper 50% of the population.
  - » SHORT in the Untreated plots – those varieties with plant heights in the lower 50% of the population.

Understanding the Results

All conclusions from this data are highly interactive with the production system and environmental conditions during each growing season and should be viewed as such.

A Meta-Analysis of Cotton Response to Plant Growth Regulators from the Scott Learning Center 2011-2021

Part 1 Results

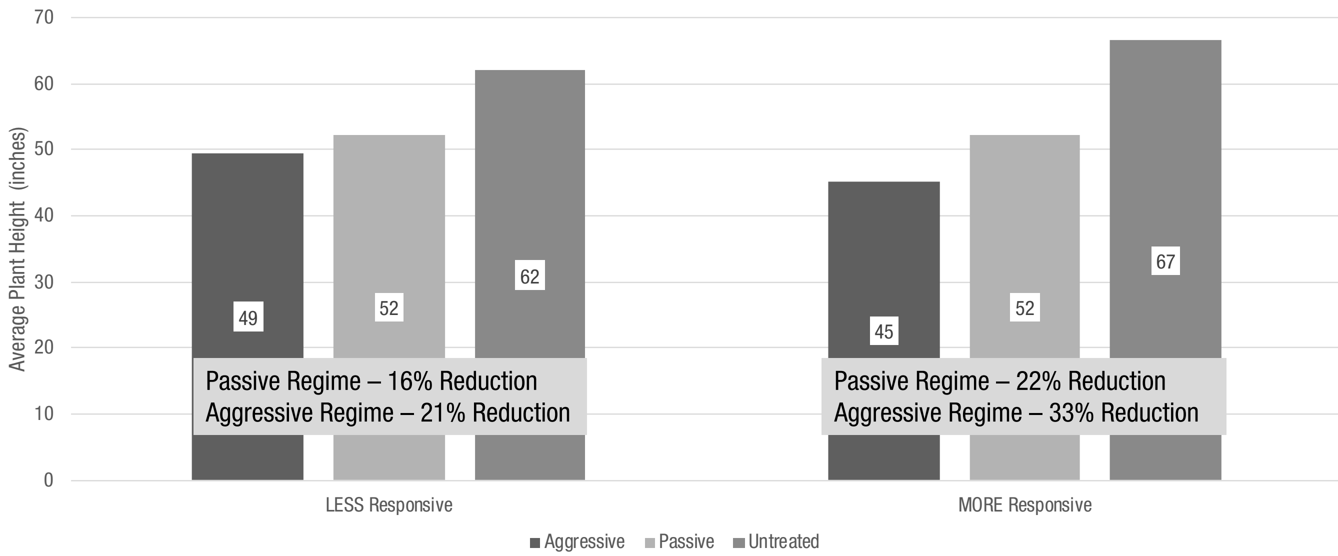

Figure 1A. Average cotton plant height by PGR regime from 2011 through 2021.

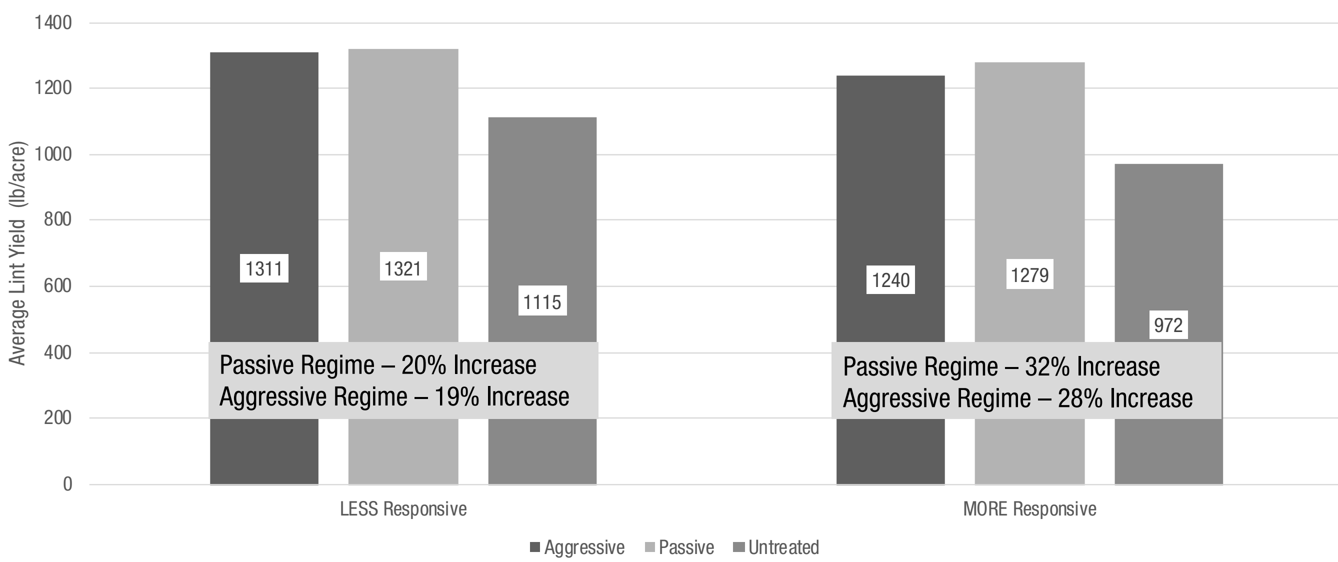

Figure 1B. Average cotton yield by PGR regime from 2011 through 2021.

A Meta-Analysis of Cotton Response to Plant Growth Regulators from the Scott Learning Center 2011-2021

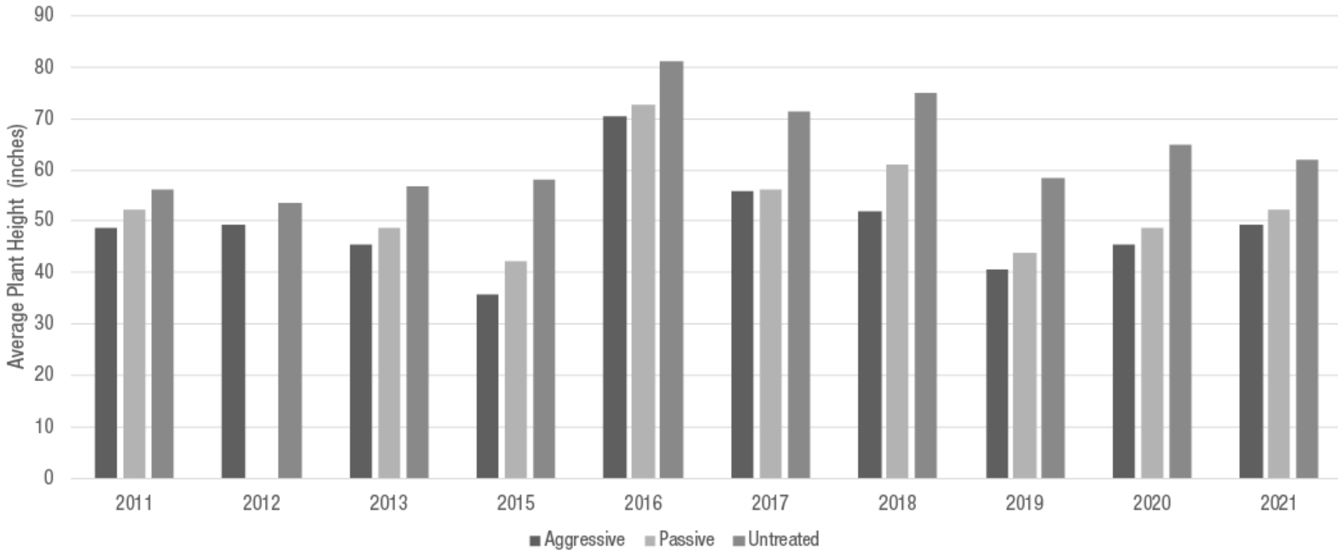

Figure 2A. Average Plant Height of Less Responsive Deltapine® brand cotton varieties by PGR regime from 2011 through 2021.

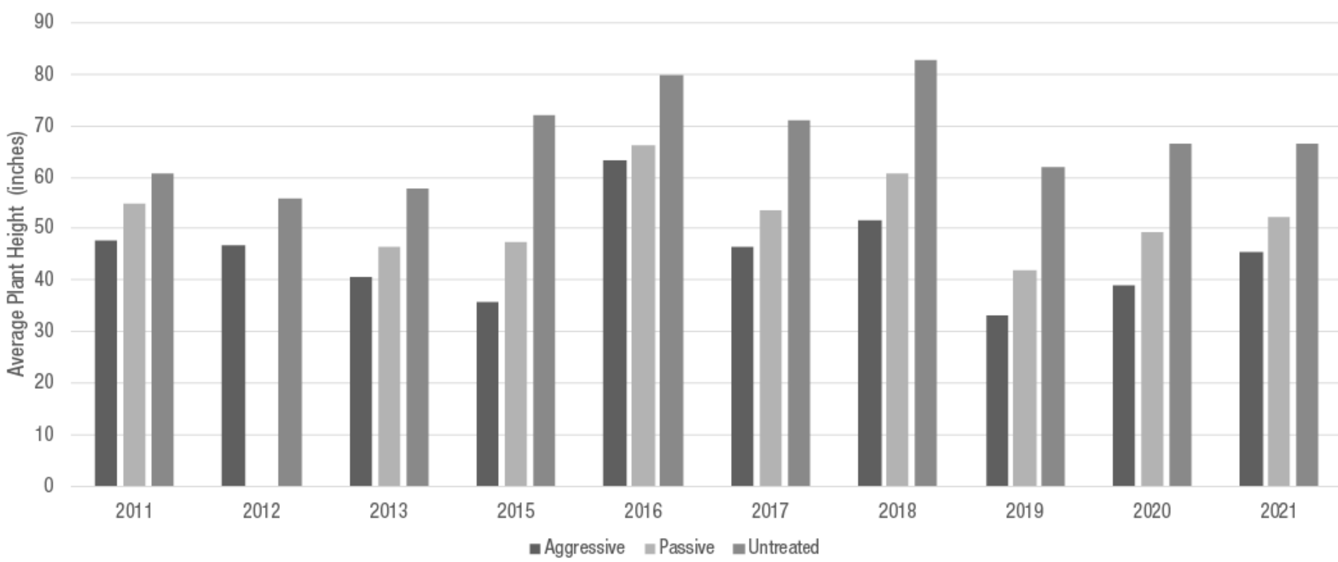

Figure 2B. Average plant height of More Responsive Deltapine® brand cotton varieties by PGR regime from 2011 through 2020.

A Meta-Analysis of Cotton Response to Plant Growth Regulators from the Scott Learning Center 2011-2021

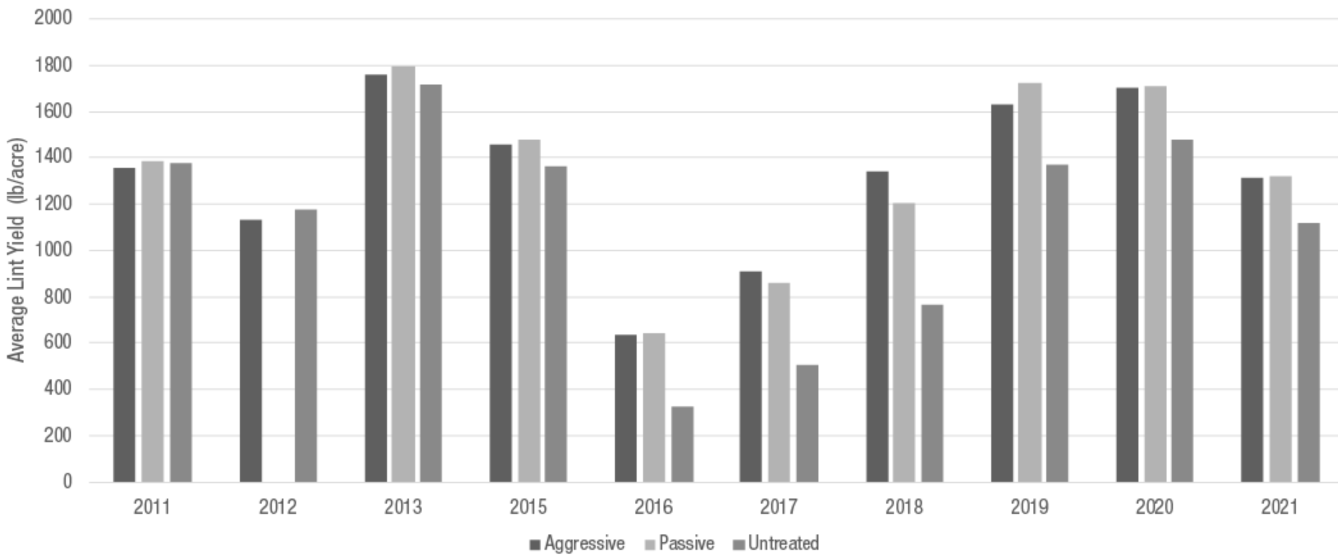

Figure 3A. Average Lint Yield of Less Responsive Deltapine® brand cotton varieties by PGR regime from 2011 through 2021.

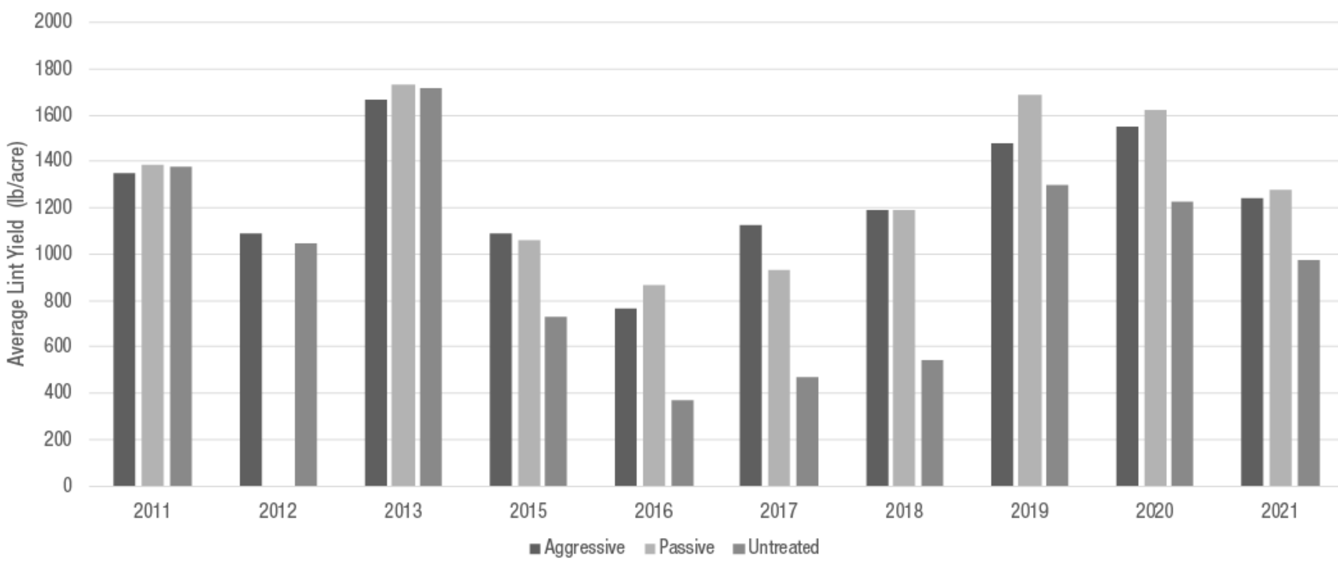

Figure 3B. Average Lint Yield of More Responsive Deltapine® brand cotton varieties by PGR regime from 2011 through 2021.

Plant height observations

- Over the testing series, in response to the aggressive regime PGR applications Less Responsive varieties showed an average reduction in height of 21% where More Responsive products showed a reduction in 33% indicting a difference in responsiveness between categories (Figure 1A).
- The Passive PGR regime treatment response was intermediate in both More and Less Responsive categories
- Yearly summaries of PGR application regime impact on plant height are shown in Figures 2A and 2B.

A Meta-Analysis of Cotton Response to Plant Growth Regulators from the Scott Learning Center 2011-2021

Lint yield observations

- The Less Responsive cotton varieties demonstrated slightly higher yield potential than the More Responsive cotton varieties in all PGR regimes (Figure 1B).
- Over the testing series, in response to either PGR application compared within response category, both Less and More Responsive varieties showed a numerically similar yield increase (Figure 1B)
- However More Responsive products showed a numerically larger increase in yield vs Less Responsive products – 28% vs 19%.(Figure IB)
- Across the range of testing, the Less Responsive products, which are generally more difficult to manage, demonstrated higher yield potential than More Responsive varieties.
- Local variety adaptation likely plays a role in the observed responses.

Part 2 Results

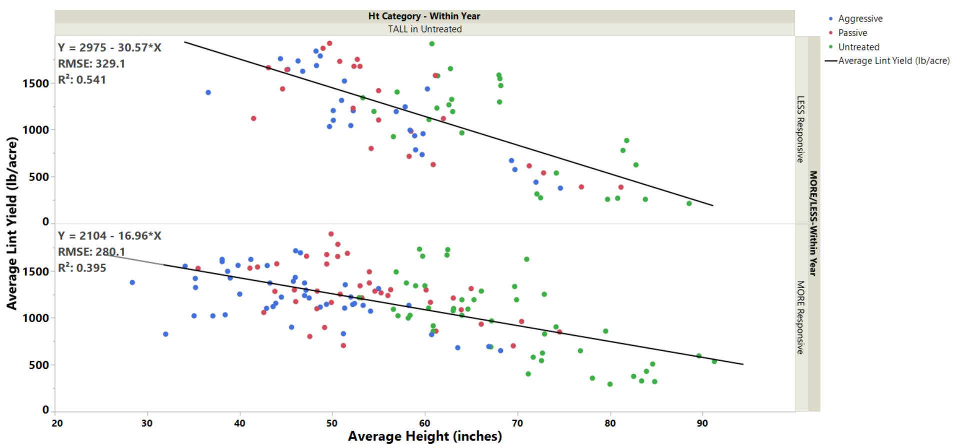

Figure 4A. Linear regression of average lint yield versus average height in Less Responsive and More Responsive Deltapine® brand cotton varieties from 2011 through 2021 at the Scott Learning Center. (Student t-test was significant at P=0.0003).

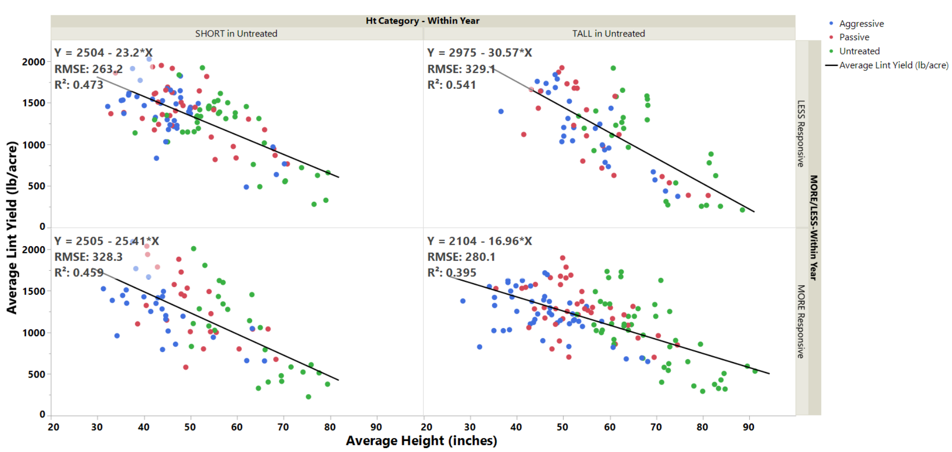

Figure 4B. Linear regression of average lint yield versus average height in Less Responsive and More Responsive Deltapine® cotton varieties from 2011 through 2021 at the Scott Learning Center. (Student t-test was significant at P=0.0003).

A Meta-Analysis of Cotton Response to Plant Growth Regulators from the Scott Learning Center 2011-2021

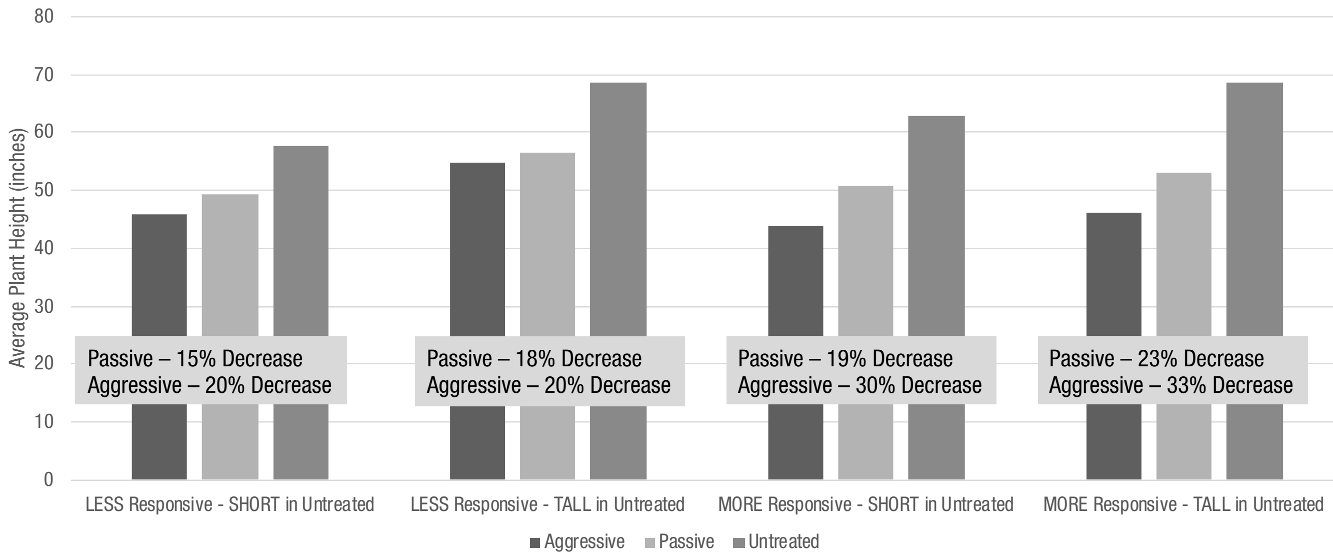

Figure 5A. Average cotton plant height by PGR regime from 2011 through 2021.

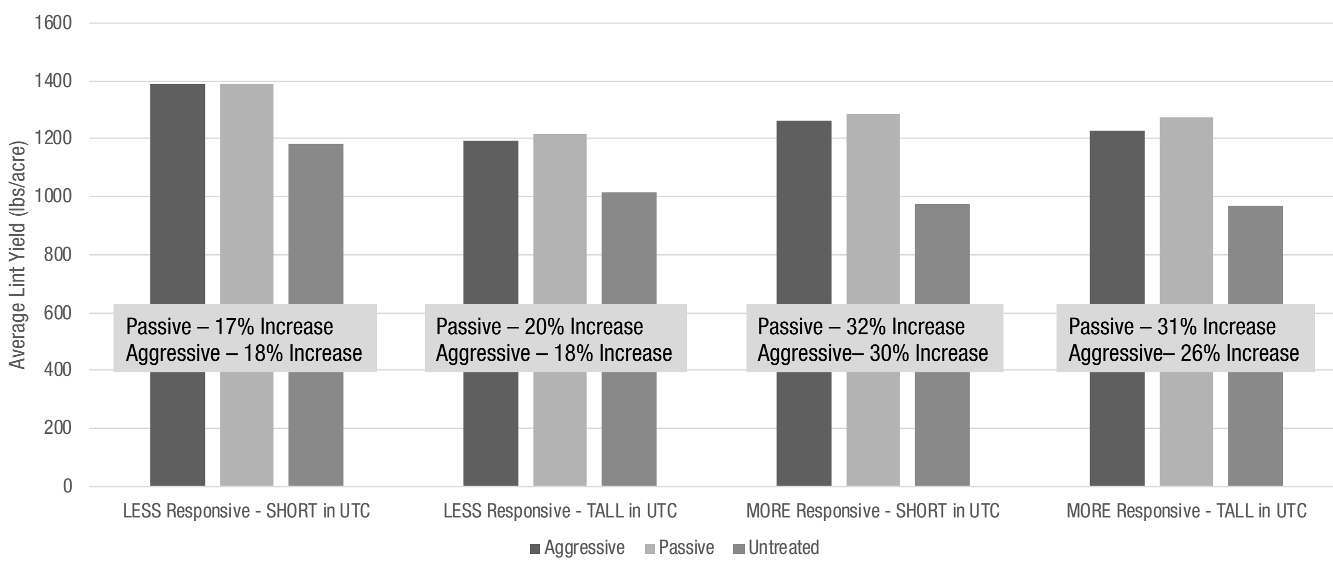

Figure 5B. Average cotton yield by PGR regime from 2011 through 2021.

- The Less Responsive cotton products showed a statistically significant greater decrease in average yield potential than the More Responsive cotton varieties in response to excessive height (Figure 4B).
- SHORT cohorts (regardless of PGR response) showed a decrease in average yield of 24 lb lint/acre/inch to increasing height (Figure 4B).

» Approximately 15% more of the yield variability can be accounted for in height (as measured by R2) in the LESS responsive varieties when comparing the TALL vs SHORT varieties.

» A statistically significant difference in the yield response to final plant height was observed between response classes (student's t P=0.0003; 205 df)

A Meta-Analysis of Cotton Response to Plant Growth Regulators from the Scott Learning Center 2011-2021

   - TALL cohorts demonstrated differential responses to increasing height
- Differences in slope between categories
   - TALL-MORE Responsive = - 16.96 lb lint/acre/inch
   - TALL-LESS Responsive= - 30.57 lb lint/acre/inch
- It's important to note that even TALL / Less Responsive varieties can be managed to the high yield potential ranges of the More Responsive or SHORT varieties within the maximum labeled rate of mepiquat chloride (Figure 4B).
- The yield response due to additional height is likely a function of the effect of the plant allocating energy to vegetative growth, the shading that occurs from neighboring plants, and associated fruit shed. Plants can also shade themselves as a result of excess height. An individual fruiting structure (squares particularly) is photosynthetically independent of the plant and if shaded, is more likely to shed just after bloom due to the lack of available sugar. Bolls are not independent, and the plant senses their need for sugar (to make carpals, seed and lint) hormonally. If it's not there for whatever reason, the boll will shed in the week or so after bloom. That's why this is all a big cascade of an effect. None of it occurs due to a single cause (Figure 6).
- When creating management plans for Less Responsive cotton varieties, early and timely applications of PGRs at appropriate rates are even more important.
- When the cotton variety sensitivity to PGR is known, a management system can be built factoring in their growth tendencies.
- To help obtain optimal value from the cotton varieties and the traits they contain, this information should be considered for every cotton variety, field, and farm.

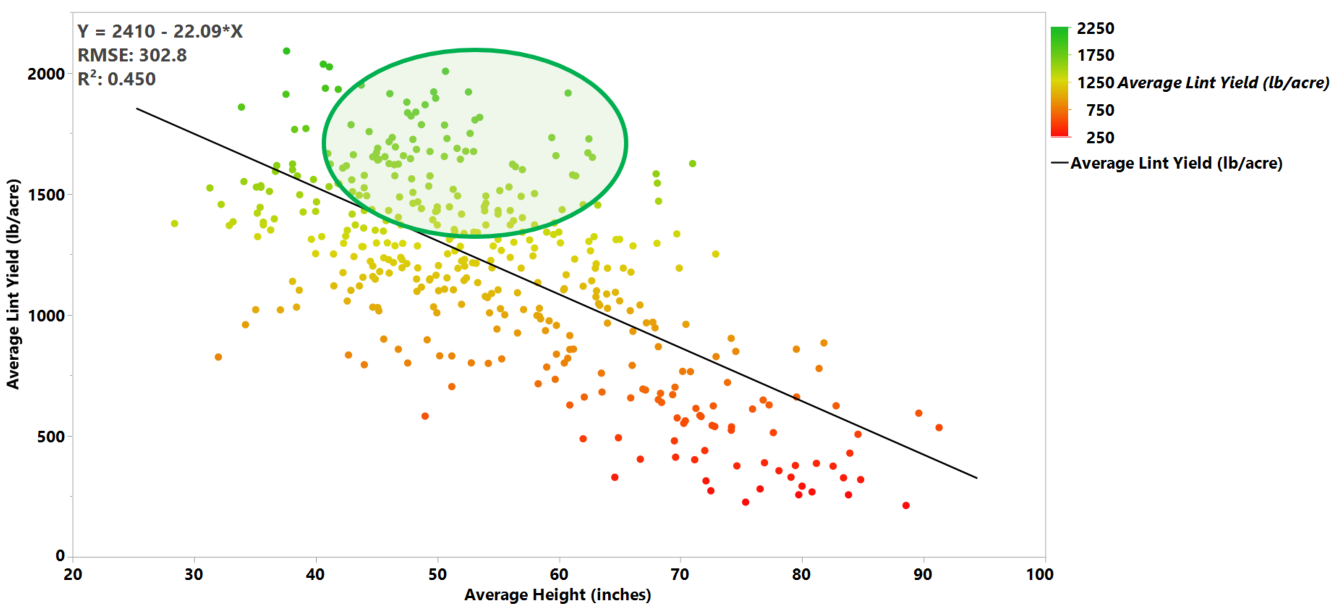

Figure 6. Linear regression of average lint yield versus average height of Deltapine® cotton varieties from 2011 through 2021 at the Scott Learning Center.

A Meta-Analysis of Cotton Response to Plant Growth Regulators from the Scott Learning Center 2011-2021

Key Learnings

- All conclusions from this data are highly interactive with production system and should be viewed as such.
- Across this range of testing, several conclusions can be drawn:
  - » The MORE Responsive cotton products demonstrated as much as 10% greater height reduction in the Aggressive regime vs untreated when compared to the LESS Responsive products. Figure 5A
  - » The LESS Responsive TALL products showed a significantly greater decrease in yield than the MORE Responsive TALL products in response to excessive height = -31 lb/inch vs -17 lb/inch. Figure 4A and4B
- PGR use in cotton crops is a tool that can be used to help manage excessive vegetative development and increase yield.
- Significant differences exist in the response of cotton variety classes to PGR application.
- For this reason, understanding the PGR sensitivity of cotton varieties is essential in developing a management plan for the product planted on a given farm or field.

Legal Statements

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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.