MICHIGAN Soybean

ON-FARM RESEARCH REPORT

2023

MICHIGAN SOYBEAN COMMITTEE, 3055 W M-21, ST. JOHNS, MI 48879

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MICHIGAN SOYBEAN COMMITTEE ON-FARM RESEARCH

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THANK YOU to the farmer cooperators for contributing their land, equipment and time during the busy planting and harvest seasons to help improve Michigan soybean production.

For more information on participating in the 2024 Michigan Soybean On-Farm Research program, contact Mike Staton at (269) 673-0370 extension 2562 or staton@msu.edu.

2023 marks the 13th season of the Michigan Soybean On-Farm Research program, made possible by the checkoff investments of Michigan soybean producers. This year, 38 farmers around the state conducted on-farm research trials within 12 projects. Contained in this publication you'll find the results from 52 individual trial locations. The research projects were developed with producer input and represent some of the most challenging production issues growers are facing.

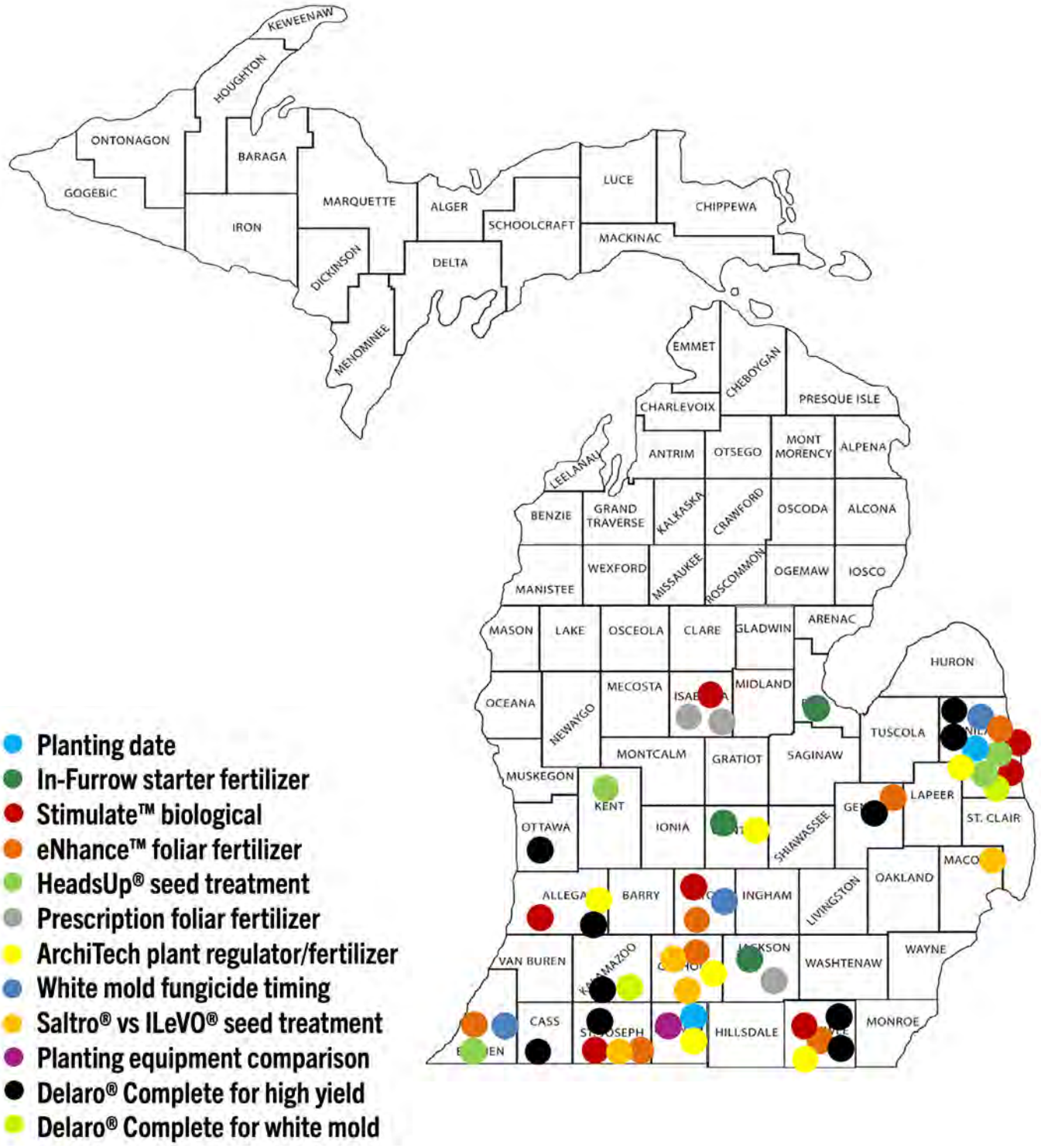
Most of the projects were conducted at multiple locations and, in some cases, across several years, improving the reliability of the results presented in this research report.

Agronomic and economic data is presented for each treatment. Breakeven yields utilized the projected USDA 2023-2024 average soybean price of $12.90 per bushel, the manufacturers' suggested retail prices for all product(s) and application costs associated with the treatments.

Conducting these trials would not be possible without the strong partnership between the Michigan Soybean Committee (MSC) and Michigan State University Extension (MSUE). One example is the unique collaboration between MSUE and MSC to jointly fund Mike Staton, MSUE statewide soybean educator and on-farm research program coordinator. MSC has also provided funding for four MSU Extension educators (Eric Anderson, Phil Kaatz, Monica Jean and Jenna Falor) who were instrumental in lining up trials and working with on-farm cooperators. We also want to thank MSC's summer intern Rachel Drobnak, as she collected and organized soil samples and took stand counts for the trials.

Dr. Arnold Saxton, Professor Emeritus, University of Tennessee, provided the SAS statistical procedure used for analyzing the 2023 trial results and provided valuable input regarding experimental design and statistical analysis.

2023 On-Farm Trial Locations



- Planting date
- In-Furrow starter fertilizer
- Stimulate™ biological
- eNhance™ foliar fertilizer
- HeadsUp® seed treatment
- Prescription foliar fertilizer
- ArchiTech plant regulator/fertilizer
- White mold fungicide timing
- Saltro® vs ILeVO® seed treatment
- Planting equipment comparison
- Delaro® Complete for high yield
- Delaro® Complete for white mold

Introduction to Experimental Design, Statistical Analysis and Interpretation

The Michigan Soybean On-Farm Research program designs and analyzes field research trials enabling Michigan soybean producers to reliably evaluate the performance and profitability of new products, equipment and practices on their farms. Developing and implementing trials requires sound experimental design which is the first step to generating meaningful and reliable results from on-farm research trials. One of the most common and effective designs is called the randomized complete block design (RCBD). The RCBD is also one of the easiest for cooperators to implement. The RCBD reduces the experimental error by grouping or blocking all the treatments to be compared within replications. Increasing the number of replications generally increases the sensitivity of the statistical analysis by reducing the experimental error. The on-farm research program encourages cooperators to use at least four replications, but six replications is preferred for trials comparing only two treatments.

Another important aspect of a good experimental design is the concept of randomization. Randomly assigning the order of the treatments within each block removes bias from treatment averages or means and reduces experimental error. Figure 1 shows the actual RCBD design that was used in the 2023 white mold fungicide application timing trials and demonstrates the principles outlined above. Note how each treatment is included and randomized within the replications. All of the trials comparing three or more treatments utilized the RCBD with four replications of each treatment, unless stated otherwise. The treatments in all the trials comparing two treatments were alternated (not randomized within each block) and replicated at least four times.

Figure 1. The randomized complete block design used for the 2023 white mold fungicide application timing trials.

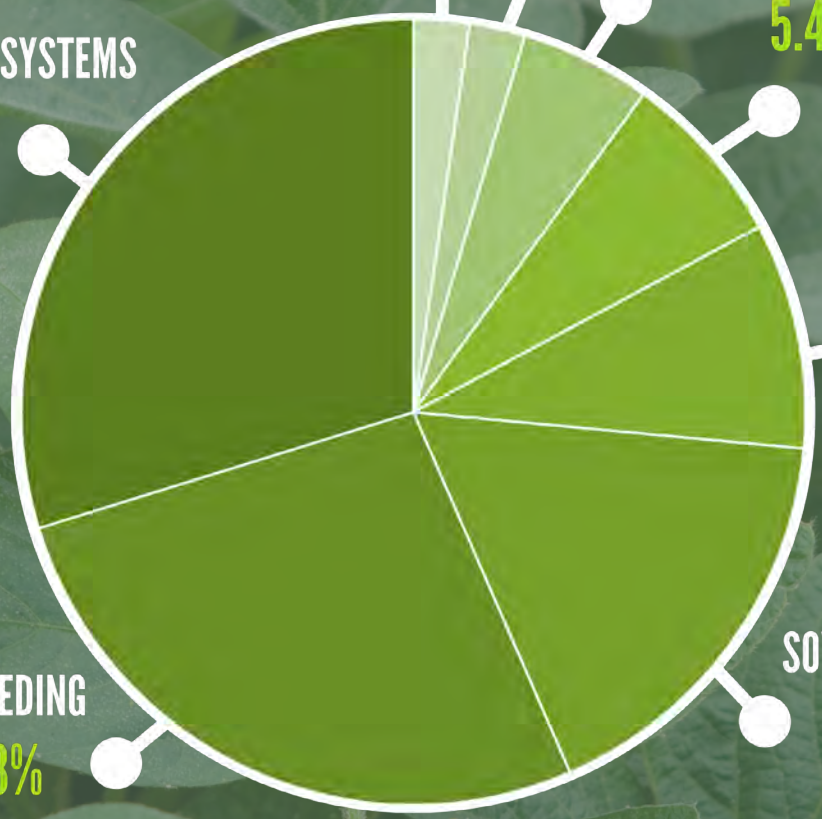
R1	7 days	14 days	Control	7 days	Control	14 days	R1	7 days	14 days	R1	Control	7 days	R1	14 days	Control
Replication 1				Replication 2				Replication 3				Replication 4			

After the trials were harvested, the GLIMMIX procedure within SAS was used to determine if the differences in measurable variables such as yield were due to the treatments or other outside factors. We set our confidence level at 90 percent for all statistical analysis as designated by $LSD_{0.10}$ (Least Significant Difference). Whenever the difference between two or more yields or other measurable variables is greater than the $LSD_{0.10}$, we can say that the difference is due to the treatment. This is always true in trials comparing only two treatments. However, the $LSD_{0.10}$ can falsely indicate statistical significance whenever more than two treatments are compared. The risk of this occurring increases with the number of treatments compared. There is an example of this situation in this publication (the Eaton location on page 29). If the yield of two treatments differs by less than the $LSD_{0.10}$ listed, we cannot say with a reliable degree of confidence that it is due to the treatment.

Letters are used in the tables and an asterisk (*) or bold type are used in the figures in this publication to identify yields or other measurements that are statistically different. When no letters are listed or the same letter appears next to the yield or other measurable condition, the difference between the treatments is not statistically significant. Only the statistically significant yield increases are mentioned in the text in this report. All other yield differences (no matter how large) are not due to the applied treatment and should be ignored.

In many cases, a given trial like the planting rate trial, will be conducted at multiple locations and over multiple years. This greatly improves the reliability of the information produced.

MICHIGAN SOYBEAN COMMITTEE FY23 FUNDED RESEARCH CATEGORIES



The Michigan Soybean Committee funds over $650,000 in soybean production research each year using soybean checkoff dollars. Funding is divided among the categories listed above to provide well-rounded research that is relevant to Michigan soybean farmers.

MICHIGAN SOYBEAN COMMITTEE

Planting Date Trial

Purpose: Early planting is an important management practice for producing high-yielding soybeans. However, many Michigan soybean producers believe that planting early is risky and have not fully adopted the practice. The question is, do the benefits of early planting outweigh the risks? The purpose of this trial was to evaluate the yield and income benefits of early-planted soybeans from 2019 to 2023.

Procedure: This trial compared soybeans planted at an early date for the area vs. soybeans planted at a normal planting date for the area. There were three locations in 2019, eight locations in 2020, 10 locations in 2021, two locations in 2022 and two locations in 2023. The early planting dates at nine of the locations are considered very early whereas the early planting dates at the other sites are consistent with the current MSU recommendations for planting soybeans during the last week of April and the first week of May if soil conditions are conducive (Table 1). All other factors were kept the same to isolate the effect of planting date in these trials.

Results: Only the 2021 to 2023 locations are presented in Tables 1 and 2. Early planting increased soybean yield by an average of 3.5 bushels per acre at 10 of the sites (Table 2). However, early planting reduced yields at one location in 2021 and both locations in 2022. The average yield reduction at these locations was 4.7 bushels per acre. Yield was not affected by planting date at the other 12 locations. When all 25 sites were combined and analyzed, early planting increased soybean yield by 1.5 bushels per acre. These results support the recommendation for planting soybeans early as they demonstrate the potential for producing higher yields without significantly increasing the risk of experiencing yield reductions. This information should increase producers' confidence in planting soybeans earlier and help them manage weather risk in the spring by extending the soybean planting window.

We want to thank Dr. Manni Singh and the North Central Soybean Research Program (NCSRP) for their role in making this research possible.

Table 1. Background information for the planting date trials conducted from 2021 to 2023

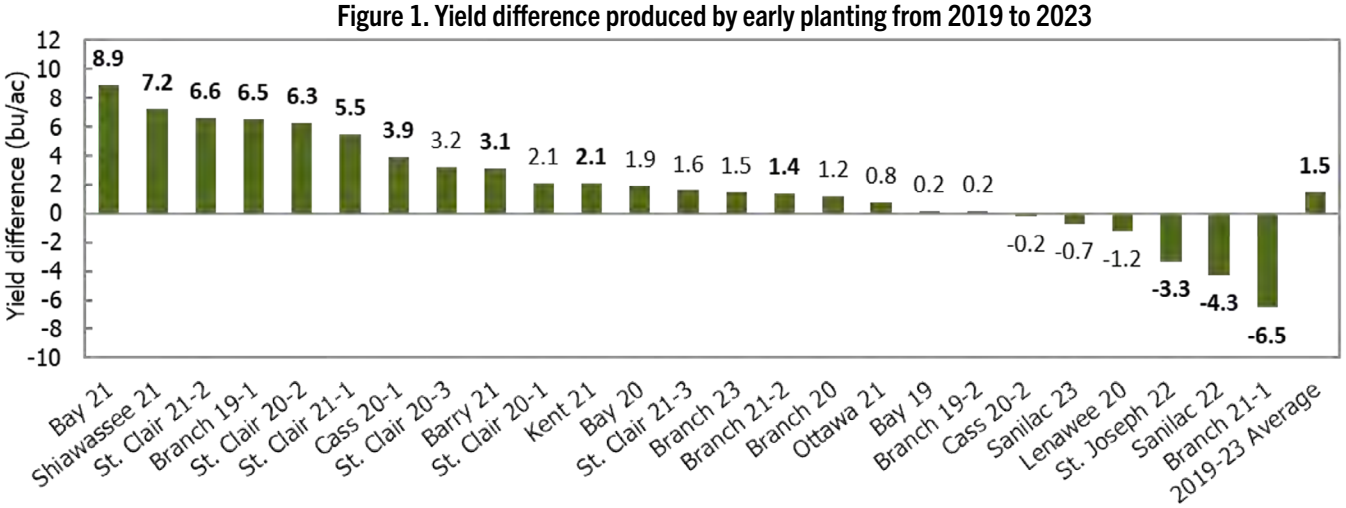
Location	Early planting date	Normal planting date	Tillage Fall/Spring	CEC (meq/100g)	Planter	Previous crop	Seed treatment	Row width
Bay 21	April 18	May 18	DR/FC	12.0	JD 1790	Corn	None	20
Shiawassee 21	May 9	May 23	CP/SF	5.5	JD 1790	Corn	None	15
St. Clair 21-2	May 10	May 30	DR/VT	15.4	Case IH 950	Corn	Quad, N Force, N Hibit	22
St. Clair 21-1	May 2	May 19	NT	10.5	JD 1990	Corn	LumiGEN Technologies	15
Barry 21	April 26	May 17	NT	--	JD 1780	Barley	Equity VIP + Dyna Start	30
Kent 21	April 21	May 17	DR/D,R	7.2	Case 500 T	Corn	None	20
St. Clair 21-3	May 2	May 18	NT	11.5	JD 1795	Corn	LumiGEN Technologies	15
Branch 23	April 19	May 4	NT	10.4	JD1690	Corn	LumiGEN Technologies	15
Branch 21-2*	April 7	May 16	D/SF,R	5.2	JD DB60	Seed corn	LumiGEN Technologies	20
Ottawa 21*	April 26	May 15	NT	6.2	JD 7000	Corn	None	30
Sanilac 23	April 14	May 9	DR/HSD	7.0	JD DB60	Corn	Seed Shield Max	20
St. Joseph 22*	May 13	May 29	/D,CP,SF	6.0	JD 7000	Soybean	None	30
Sanilac 22	May 13	May 25	VT/FC	13.7	JD 1592	Corn	None	15
Branch 21-1	April 8	May 5	NT	7.4	JD 1690	Corn	LumiGEN Technologies	15

CP - chisel plow, FC - field cultivator, NT - no-till, VT - vertical tillage, SF - soil finisher, DR - disk ripper, D - disk R - roller, HSD - high speed disc
* These were irrigated sites.

Table 2. The effect of planting date on soybean yield and income from 2021 to 2023

Location	Early planting date	Normal planting date	LSD $_{0.10}$	Yield difference
	---------- Yield (bu/ac) ----------			Yield (bu/ac)
Bay 21	66.3 a	57.5 b	4.5	8.9
Shiawassee 21	61.5 a	54.3 b	5.0	7.2
St. Clair 21-2	59.7 a	53.1 b	3.7	6.6
St. Clair 21-1	51.5 a	46.0 b	3.3	5.5
Barry 21	58.1 a	55.0 b	2.8	3.1
Kent 21	74.1 a	72.1 b	1.6	2.1
St. Clair 21-3	47.0	45.4	4.4	1.6
Branch 23	65.7	64.1	2.8	1.5
Branch 21-2	70.7 a	69.3 b	1.3	1.4
Ottawa 21	53.0	52.2	1.4	0.8
Sanilac 23	63.4	64.1	6.5	-0.7
St. Joseph 22	34.5 b	37.8 a	1.5	-3.3
Sanilac 22	39.3 b	43.6 a	2.8	-4.3
Branch 21-1	45.9 b	52.4 a	4.0	-6.5
2021 - 2023 Average	**56.1 a**	**55.0 b**	**1.1**	**1.1**
	---------- Income ($/ac) ---------			
Average income	**$724**	**$710**		

Figure 1. Yield difference produced by early planting from 2019 to 2023



Bold numbers indicate that the yield difference was statistically significant at these locations.

Severe freeze injury

Freeze-damaged soybean producing new shoots

In-Furrow Product Trial

Purpose: Producers consistently rank nutrient management as a high priority for on-farm research and mention starter fertilizer specifically. They want to know if applying nutrients in-furrow at planting is a profitable practice. They also want to identify the most profitable nutrients and application rates for this placement method. The purpose of this trial was to evaluate how various products applied in-furrow affected soybean yield and income in 2023.

Procedure: Two treatments (in-furrow product vs. an untreated control) were compared at three locations in 2023. This project is different than most of our on-farm research projects in that the cooperators selected the product and application rates they wanted to evaluate on their farms (Table 1). We collected baseline soil samples from each site and the nutrient levels are reported in Table 2. Final stand counts were also taken as soybean seed is sensitive to salt injury and final stands could be adversely affected by products applied in contact with the seed.

Results: None of the in-furrow products increased soybean yield in 2023. Because of this, income was reduced at each location. Losses ranged from $1 to $44 per acre based on the cost of the product applied at each location (Table 3).

Final plant stands were not affected by the in-furrow products at two of the locations. However, the in-furrow application reduced final stands by more than 30,000 plants per acre at the Bay location (Table 4).

We want to thank Herbruck's for providing the heat-treated poultry fertilizer crumbles applied at the Jackson location.

Table 1. Background information for the in-furrow trials conducted in 2023

Location	Tillage Fall/spring	Planting date	In-furrow product analysis	In-furrow product application rate	Broadcast fertilizer analysis and application rate
Clinton	NT	May 18	3-5-4 + micros	6 gallons/acre	None
Jackson	NT	May 16	*4-3-2	11 pounds/acre	None
Bay	CP/FC	April 25	4-13-17	2 gallons/acre	None

CP - chisel plow, NT - no-till, FC - field cultivator

*Heat-treated poultry fertilizer crumbles were applied at this location.

Table 2. Soil test levels at the in-furrow trial locations

Location	Organic Matter	CEC	Phosphorus	Potassium	Soil pH
	Percent	meq/100g	--------- Parts per million ---------		1:1
Clinton	2.8	11.0	**19**	**96**	6.7
Jackson	1.7	4.8	42	**78**	**5.9**
Bay	2.5	8.4	54	145	6.4

Bold figures indicate low or very low soil test levels.

Table 3. The effect of various in-furrow products on yield and income in 2023

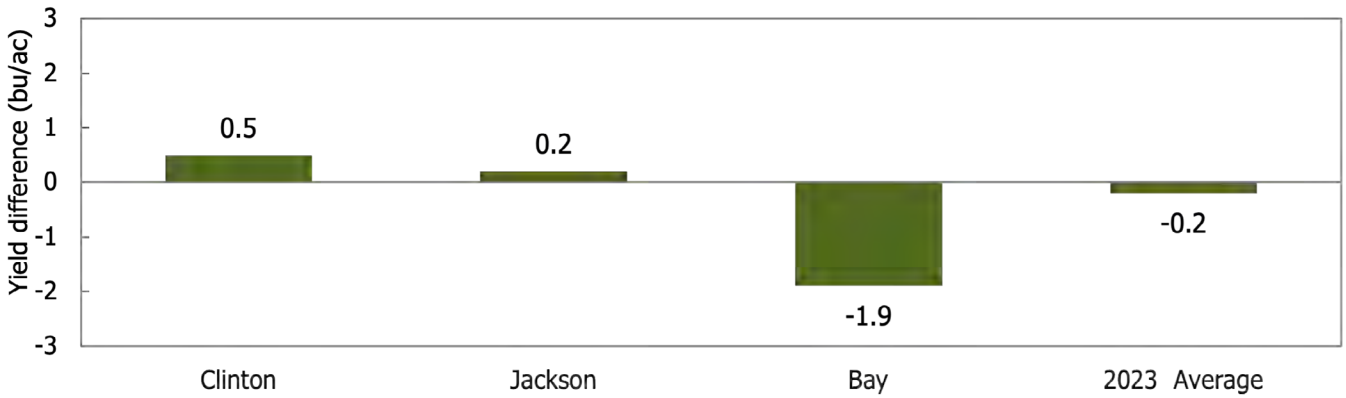
Location	Control	In-furrow	LSD $_{0.10}$	Yield difference	Net return to in-furrow products
	---------- Yield (bu/ac) ---------			Yield (bu/ac)	$/acre
Clinton	72.4	72.9	2.7	0.5	-44.00
Jackson	59.7	59.9	4.8	0.2	-1.00
Bay	68.9	67.0	2.0	-1.9	-14.00
Average	**67.0**	**66.8**	**1.5**	**-0.2**	**-19.60**

Net return is based on the specific in-furrow product and application rate for each location.

Table 4. The effect of various in-furrow products on final plant stands in 2023

Location	Control	In-furrow	LSD $_{0.10}$	Stand difference
	---------- Stand (plants/ac) --------			Stand (plants/ac)
Clinton	91,100	93,300	11,000	2,200
Jackson	193,300	192,500	54,700	-800
Bay	79,100 a	48,300 b	15,800	-30,800
Average	**120,700**	**111,800**	**14,500**	**-18,900**

Figure 1. Yield difference produced by various in-furrow products in 2023



The yield difference was not statistically significant at any location.

Heads Up® Biological Seed Treatment Trial

Purpose: Heads Up is a biological seed treatment distributed by Heads Up Plant Protectants Inc. It is being promoted as being part of white mold and sudden death syndrome (SDS) management strategies. The purpose of this trial was to determine the effect of Heads Up seed treatment on soybean yield and income in 2022 and 2023.

Procedure: Soybean seed treated with Heads Up was compared to seed from the same seed lot without Heads Up. This trial was conducted by placing the Heads Up-treated seed in half of the planter and untreated seed in the other half at seven locations.

Results: Neither white mold nor SDS occurred at detectable levels at any of the 2022 locations. Despite this, the Heads Up seed treatment increased soybean yields by 2 bushels per acre at two locations (Branch 22-2 and Allegan 22) in 2022. White mold and SDS pressure was minimal in the 2023 trial locations also. Yield was not affected at any of the four locations conducted in 2023. When all eight locations were combined and analyzed, the Heads Up seed treatment did not increase soybean yield or income.

We want to thank Heads Up Plant Protectants Inc. for providing the Heads Up and local seed dealers for treating the seed for these trials.

Table 1. Planting dates, varieties, planting rates and row spacings at the trial locations

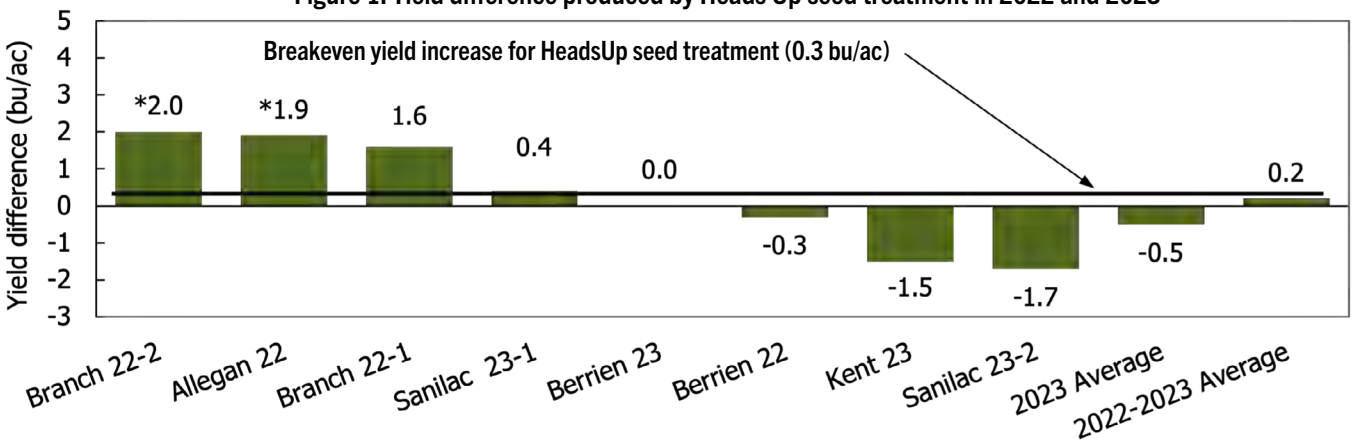
Location	Soybean variety	White mold resistance/tolerance of soybean variety	Planting date	Planting rate (seeds/ac)	Row spacing	Base Seed Treatment
Branch 22-2	Channel 2420RFX	**4** (1=excellent and 9=poor)	May 31	140,000	30″	None
Allegan 22	Channel 2420RFX	**4** (1=excellent and 9=poor)	May 19	140,000	30″	Acceleron standard
Branch 22-1	Pioneer P30A46PR	**4** (9=excellent and 1=poor)	May 18	130,000	30″	None
Sanilac 23-1	Renk G2270E	**7** (9=excellent and 1=poor)	May 22	145,000	15″	Eclipse US Duo-F IM
Berrien 23	Pioneer P31T64E	**3** (9=excellent and 1=poor	May 15	155,000	15″	LumiGEN FI
Berrien 22	Pioneer P28T14E	**4** (9=excellent and 1=poor)	May 30	155,000	15″	LumiGEN FI
Sanilac 23-2	Dairyland 2188E	**4** (1=excellent and 9=poor)	May 23	150,000	15″	N-Compas FI UAS
Kent 23	DF Seeds DF203N	**4** (1=excellent and 9=poor)	May 19	124,500	15″	My Yield DriveF

Table 2. Heads Up biological seed treatment effect on soybean yield and income in and 2022 and 2023

Location	Untreated control	Heads Up	LSD $_{0.10}$	Yield difference
	---------- Yield (bu/ac) ----------			Yield (bu/ac)
Branch 22-2	67.3 b	69.3 a	1.4	2.0
Allegan 22	27.1 b	29.0 a	0.9	1.9
Branch 22-1	68.3	69.9	2.2	1.6
Sanilac 23-1	56.5	56.9	0.7	0.4
Berrien 23	67.4	67.4	2.2	0.0
Berrien 22	64.9	64.6	1.4	-0.3
Kent 23	60.3	58.8	3.5	-1.5
Sanilac 23-2	57.5	55.8	2.7	-1.7
2022-2023 Average	**58.7**	**58.9**	**0.6**	**0.2**
	---------- Income ($/ac) ----------			
Average income	**$757**	**$756**		

Heads Up seed treatment cost in 2023 was $4.00 per acre

Figure 1. Yield difference produced by Heads Up seed treatment in 2022 and 2023



*The yield difference between the Heads Up seed treatment and the control was statistically significant at these locations.

Sclerotia

White Mold

ILeVO® vs. Saltro® Seed Treatment Trial

Purpose: Sudden Death Syndrome (SDS) is spreading in Michigan, and the most effective management tactics are variety selection and seed treatment. The purpose of this trial was to compare the relative effects that two commercially available SDS seed treatments (ILeVO from BASF and Saltro from Syngenta) had on SDS foliar disease symptoms, yield and income.

SDS foliar symptoms

Procedure: This trial had two treatments (base seed treatment with ILeVO vs. the same base seed treatment with Saltro). This trial was conducted by placing the ILeVO-treated seed in half of the planter and the Saltro-treated seed in the other half. There were four locations in 2022 and four more in 2023. All sites had a history of having SDS. We sampled all fields to determine the soybean cyst nematode (SCN) population levels.

Results: Visible SDS symptoms were difficult to detect in any of the trials conducted in 2022. SDS was more prevalent in Michigan in 2023 but pressure was still low at all trial locations. SCN was not detected at the Calhoun 22-2 and St. Joseph 22 locations. Low SCN levels were found at the Calhoun 22-1, Calhoun 23-1, Calhoun 23-2 and St. Joseph 23 locations and moderate levels were found at the Macomb 22 and Macomb 23 locations.

The ILeVO produced 2.6 bushels per acre more than the Saltro at one location (Calhoun 22-2). However, the yields produced by the two seed treatments were comparable at the other seven locations. When all eight locations were combined and analyzed, yield was not affected by the seed treatments. This is consistent with research results generated by Dr. Martin Chilvers, MSU Extension field crops pathologist, and his colleagues across the U.S. Both ILeVO and Saltro have been proven to protect soybean yield in fields having a history of SDS.

We want to thank BASF and Syngenta for providing the products for these trials and the seed dealers that treated the seed.

Table 1. Key background information for the ILeVO vs. Saltro seed treatment trials

Location	Planting date	Tillage (Fall/ Spring)	Variety	SDS tolerance	SCN resistance source	Baseline SCN population
Calhoun 22-2	May 10	/HSD	Stine 24EA12	Average/Good	PI88788	0=None
Calhoun 23-1	May 6	/HSD	Stine 29EF02	Good	PI88788	1=Low
St. Joseph 22	May 19	DR/FC,R	DF260N	3 (1=excellent and 9=poor)	PI88788/ 437654	0=None
Calhoun 22-1	May 12	/HSD	Stine 28EC32	Good	PI88788	1=Low
Calhoun 23-2	May 10	/HSD	Stine 24EA12	Average/Good	PI88788	1=Low
St. Joseph 23	May 10	NT	Partners PB3121E3	2.3 (average)	PI88788	1=Low
Macomb 23	May 31	VT (1x)	Pioneer P23A40E	6 (9=excellent and 1=poor)	PI88788	2=Moderate
Macomb 22	June 21	VT	Pioneer P24T35E	4 (9=excellent and 1=poor)	Peking	2=Moderate

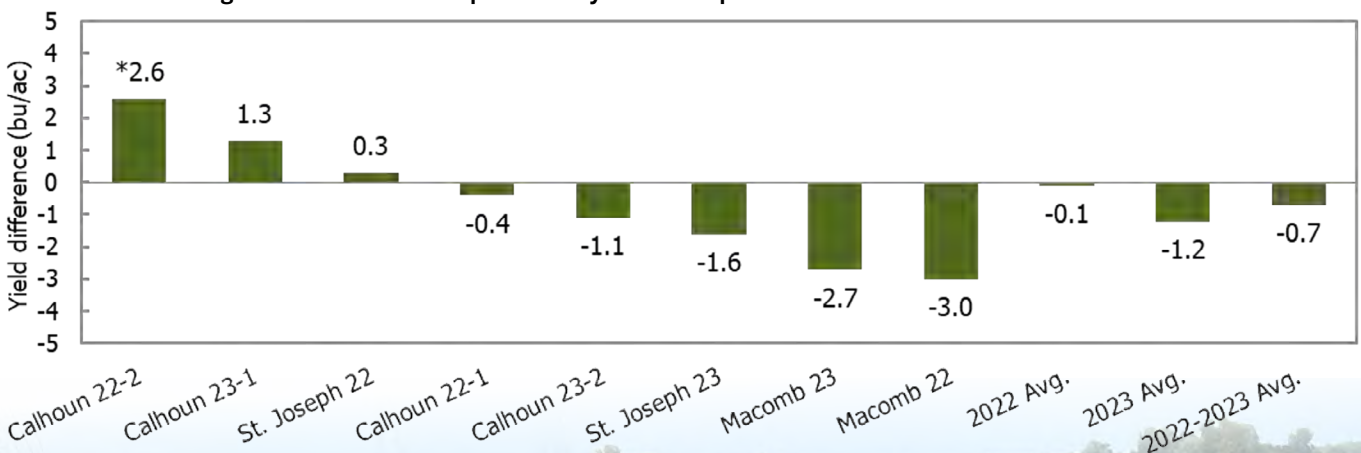
D - disk, HSD - high speed disk, VT - vertical till, DR - disk ripper, R - roller, FC - field cultivator

Table 2. The effect of ILeVO and Saltro seed treatments on soybean yield and income in 2022 and 2023

Location	Base seed treatment with ILeVO	Base seed treatment with Saltro	LSD $_{0.10}$	Yield difference
	---------- Yield (bu/ac) ----------			Yield (bu/ac)
Calhoun 22-2	82.4 a	79.8 b	0.9	2.6
Calhoun 23-1	67.9	66.6	5.0	1.3
St. Joseph 22	104.3	104.0	1.4	0.3
Calhoun 22-1	66.9	67.4	1.8	-0.4
Calhoun 23-2	52.6	53.7	2.4	-1.1
St. Joseph 23	41.7	43.3	2.3	-1.6
Macomb 23	23.2	25.9	3.9	-2.7
Macomb 22	33.4	36.4	3.2	-3.0
Average	**59.0**	**59.7**	**0.8**	**-0.7**
	---------- Income ($/ac) ---------			
Average income	**$748**	**$755**		

ILeVO cost in 2023: $13.00/140,000 seeds
Saltro cost in 2023: $14.85/140,000 seeds

Figure 1. Yield difference produced by ILeVO compared to Saltro seed treatment in 2022 and 2023



*The yield difference was statistically significant at this location.

Field view of SDS infection

Planting Equipment Comparison Trial

Purpose: Soybeans are planted using a wide variety of planters, air seeders and drills. This planting equipment is also set up for different row spacing configurations. Some producers have multiple pieces of planting equipment on the farm and want to know which planting equipment performs best and under what conditions. These producers also want to know if they can plant soybeans with all their available planting equipment at the same time to ensure timely planting. Other producers are replacing existing planting equipment and want to know what is the most versatile and beneficial to their farm. The purpose of this trial was to compare any two pieces of planting equipment of the cooperating producers' choosing to determine how different planting equipment affected soybean yield.

Procedure: One trial was conducted in 2020 (Hillsdale 20), two trials were conducted in 2022 (Branch 22 and Lenawee 22), and one trial was conducted in 2023 (Branch 23). The Hillsdale 20 trial compared a John Deere 1770 30-inch row planter to a John Deere 1690 15-inch row air seeder. At the Branch 22 and Branch 23 locations, a John Deere 1770 NT 30-inch row planter was compared to a John Deere 1590 box drill set up for 15-inch rows. The Lenawee location compared a Horsch Maestro split-row planter set for 15-inch rows to a White 5100 30-inch row planter. At the Hillsdale 20, Branch 22 and Branch 23 locations, both pieces of planting equipment being compared were set to deliver the same seeding rate. At Lenawee, the Horsch planter dropped 15,000 fewer seeds per acre than the White planter. Stand counts were taken at all locations to determine how the planting systems affected final plant stands.

Results: Soybean yield was not affected by planting equipment at any of the four locations. Final plant stands were also comparable for the planting equipment compared at each location except for Branch 23. At this location, final plant stands from the drill were 23,000 plants per acre higher than those from the planter. This was probably due to a calibration error on the drill. Due to the narrower row configuration, the air seeder, box drill and split-row planter would be expected to perform better in lower yielding environments and when planting after the first week of June. The 30-inch row planters would most likely perform better when planting in fields that have a history of white mold, are prone to crusting or have marginal soil conditions.

Table 1. Background information for the planting equipment comparison trials conducted in 2020, 2022 and 2023

Location	*Tillage Fall/spring	Planting date	Previous crop	Variety	Seed treatment
Hillsdale 20	Spring HSD	April 22	Corn	Specialty Hybrids 2752 R2X	Base fungicide mix
Branch 22	Spring CP, SF	May 20	Corn	Pioneer P30A46PR	None
Lenawee 22	NT	June 4	Corn	Pioneer P30T99E	None
Branch 23	Spring CP, SF	May 13	Corn	Pioneer P27A26PR	None

*HSD - high speed disk, CP - chisel plow, SF - soil finisher

Table 2. Planting rate, final plant stands and soybean yield in Hillsdale County in 2020

	JD 1770 planter (30”)	JD 1690 air seeder (15”)
Planting rate (seeds/ac)	135,000	135,000
Final plant stand (plants/ac)	81,300	78,800
Yield (bu/ac)	63.8	64.5

Table 3. Planting rate, final plant stands and soybean yield in Branch County in 2022

	JD 1770 NT planter (30”)	JD 1590 drill (15”)
Planting rate (seeds/ac)	130,000	130,000
Final plant stand (plants/ac)	63,100	68,300
Yield (bu/ac)	54.9	56.0

Table 4. Planting rate, final plant stands and soybean yield in Lenawee County in 2022

	White 5100 planter(30”)	Horsch Maestro 1632 planter (15”)
Planting rate (seeds/ac)	135,000	120,000
Final plant stand (plants/ac)	90,800	93,000
Yield (bu/ac)	50.5	49.7

Table 5. Planting rate, final plant stands and soybean yield in Branch County in 2023

	JD 1770 NT planter (30”)	JD 1590 drill (15”)
Planting rate (seeds/ac)	130,000	130,000
Final plant stand (plants/ac)	72,600 b	95,300 a
Yield (bu/ac)	64.5	63.9

STIMULATE™ Biological Trial

Purpose: STIMULATE is a biological product distributed by GARRCO Products Inc. It contains 29 strains of microorganisms and is marketed as improving plant health, stimulating growth, increasing fertilizer efficiency, and enhancing soil tilth. The purpose of this trial was to evaluate how adding STIMULATE to a planned post-emergence herbicide application affected soybean yield and income in 2022 and 2023.

Procedure: Two treatments were compared in this trial (post-emergence herbicides with STIMULATE vs. the same herbicides without STIMULATE) at 10 locations in 2022 and seven locations in 2023. The STIMULATE was applied at 8 ounces per acre (determined by GARRCO representatives). Application timing was determined by the cooperator and based on optimizing weed control. Application dates, herbicides and herbicide application rates for each site are presented in Table 1. To keep sprayer tracks from affecting the results, tracks were either present or absent in all the harvested strips in each trial.

Results: The foliar application of STIMULATE did not affect soybean yield at any of the trial locations. Because of this, net income was reduced by the cost of the product ($6.25 per acre). One possible explanation for the lack of a positive economic response was that the 8-ounce application rate is half the minimum rate listed on the product label.

We want to thank GARRCO Products Inc. for donating and delivering the product for these trials.

Table 1. Application dates, herbicides and herbicide application rates in 2022 and 2023

Location	Application date	Tank-mixed herbicides and application rates
Eaton 23	July 15	Roundup PowerMAX 3 @ 32 oz/ac, Clethodim @ 8 oz/ac
Lenawee 23	July 9	None
St. Joseph 23	June 21	Clethodim @ 10.5 oz/ac, Fomesafen @ 10.5 oz/ac, 28% UAN @ 32 oz/ac
St. Joseph 22	July 14	Engenia @ 12.8 oz/ac, Roundup @ 20 oz/ac
Sanilac 23-1	June 24	Roundup PowerMAX 3 @ 24 oz/ac, Enlist One @ 32oz/ac
Allegan 22-2	July 28	Roundup @ 30 oz/ac
Van Buren 22	June 20	Enlist Duo @ 64 oz/ac, plus 5-13-8 @ 32 oz/ac
Sanilac 23-2	June 10	Roundup PowerMAX @ 32 oz/ac
Isabella 22	July 22	Roundup @ 32 oz/ac, Liberty @ 32 oz/ac, Smoke @ 48 oz/100 gal
Lapeer 22	June 12	Enlist One @ 32 oz/ac, Roundup @ 28 oz/ac, Avatar @ 12 oz/ac
Allegan 22-1	June 22	Sequence @ 32 oz/ac, Enlist One @32 oz/ac
Calhoun 22	July 8	Enlist One @ 32 oz/ac, Roundup @ 22 oz/ac
Lenawee 22-1	July 13	Cobra @ 12 oz/ac
Isabella 23	August 11	Glyphosate @ 45 oz/ac, Enlist One @32 oz/ac, Smoke @ 32 oz/100 gal
Allegan 23	June 16	Glyphosate @ 12 oz/ac

Information from Otsego 22 and Lenawee 22-2 was not available.

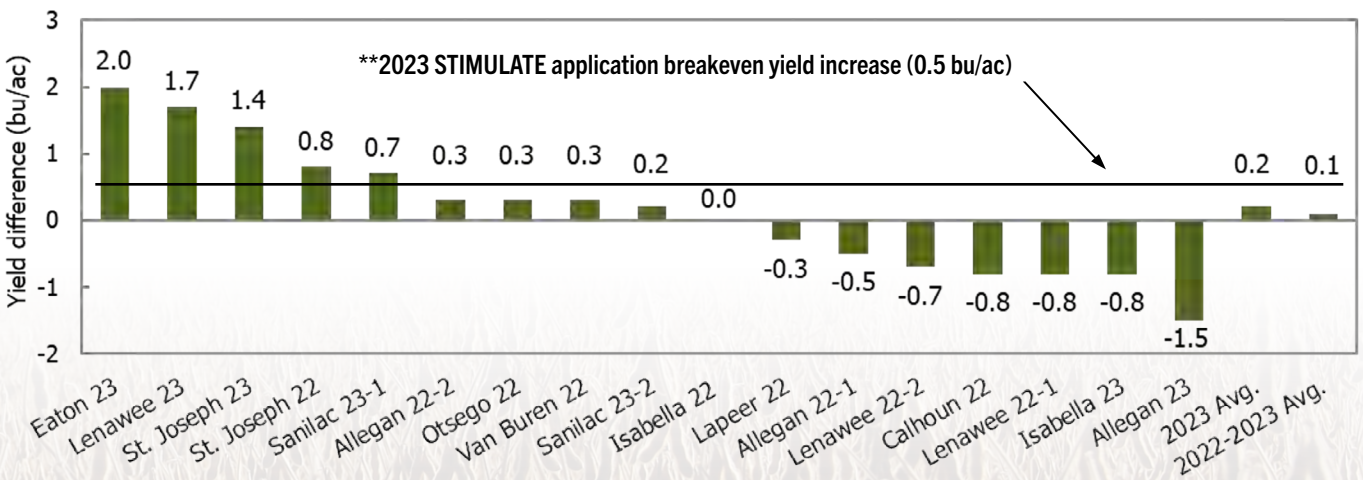
Table 2. The effect of a single application of STIMULATE biological on soybean yield and income in 2022 and 2023

Location	Untreated control	STIMULATE	LSD $_{0.10}$	Yield difference
	-------- Yield (bu/ac) ----------			Yield (bu/ac)
Eaton 23	48.4	50.4	3.7	2.0
Lenawee 23	79.9	81.6	8.2	1.7
St. Joseph 23	68.8	70.2	1.4	1.4
St. Joseph 22	51.3	52.1	2.3	0.8
Sanilac 23-1	60.3	61.0	4.0	0.7
Allegan 22-2	25.3	25.6	1.9	0.3
Otsego 22	26.5	26.8	2.4	0.3
Van Buren 22	27.5	27.8	3.4	0.3
Sanilac 23-2	49.1	49.3	2.1	0.2
Isabella 22	60.0	60.0	1.7	0.0
Lapeer 22	31.4	31.1	1.5	-0.3
Allegan22-1	75.0	74.5	2.9	-0.5
Lenawee 22-2	58.8	58.1	2.9	-0.7
Calhoun 22	61.2	60.4	3.0	-0.8
Lenawee 22-1	46.0	45.2	2.2	-0.8
Isabella 23	62.1	61.3	4.0	-0.8
Allegan 23	71.1	69.6	2.9	-1.5
2022-2023 Average	**52.8**	**52.9**	**0.7**	**0.1**
	---------- Income ($/ac) ----------			
***Average income**	**$681**	**$676**		

STIMULATE cost: $6.25 per acre

* The application cost was not included because STIMULATE was tank-mixed with a planned post-emergence herbicide application.

Figure 1. Yield difference from a foliar application of STIMULATE biological in 2022 and 2023



The yields for the STIMULATE and the untreated control were not significantly different at any of the locations.

** Application cost is not included.

ArchiTech Growth Regulator Trial

Purpose: ArchiTech is a liquid fertilizer and plant growth regulator combination distributed by AgXplore. It contains 10% nitrogen, 5% phosphorus, 5% potassium, and trace amounts of boron, copper, manganese, molybdenum and zinc. ArchiTech is promoted as improving photosynthesis, plant growth and plant development. It is also marketed as mitigating abiotic stresses. The purpose of this trial was to evaluate how adding ArchiTech to a planned post-emergence herbicide application affected soybean yield and income in 2023.

Procedure: Two treatments were compared in this trial (post-emergence herbicide plus ArchiTech vs. the same post-emergence herbicide without ArchiTech). The trial was conducted at six locations in 2023. We collected soil samples from every trial and presented the nutrient levels in Table 2. To keep sprayer tracks from affecting the results, tracks were either present or absent in all harvested strips in each trial.

Results: The foliar application of ArchiTech did not significantly affect soybean yield at any of the locations. Due to the lack of a yield increase, income was reduced by $12 per acre (product cost).

We want to thank AgXplore for donating and delivering the product for these trials.

Table 1. Application dates, herbicides and herbicide application rates in 2023

Location	Application dates	Tank-mixed herbicides and application rates
Allegan	June 29	Enlist Duo @ 32 oz/ac
Clinton	July 4	Fomesafen @ 16 oz/ac, Clethodim @ 12 oz/ac, COC @ 1%
Branch	June 10	Inflame @ 32 oz/ac, AMS @ 1.75 lb/ac
Sanilac	June 19	RoundUp PowerMAX @ 32 oz/ac
Calhoun	July 11	RoundUp @ 26 oz/ac
Lenawee	July 24	Clethodim @ 10 oz/ac, Cobra @ 12 oz/ac

Table 2. Soil test levels for phosphorus, potassium, zinc, manganese and boron at the trial locations in 2023

Location	Organic Matter	CEC	Phosphorus	Potassium	Zinc	Manganese	Boron
	Percent	meq/100g	---------- Parts per million ----------				
Allegan	2.7	11.6	74	191	5.7	56	0.6
Clinton	2.5	10.1	30	**95**	3.7	34	**0.4**
Branch	1.8	7.2	20	106	**2.9**	47	**0.3**
Sanilac	2.7	8.9	22	124	**2.1**	34	0.6
Calhoun	2.3	8.2	85	163	8.5	47	**0.4**
Lenawee	2.5	9.5	25	**92**	**2.7**	31	**0.3**

Bold figures indicate low or very low soil test levels.

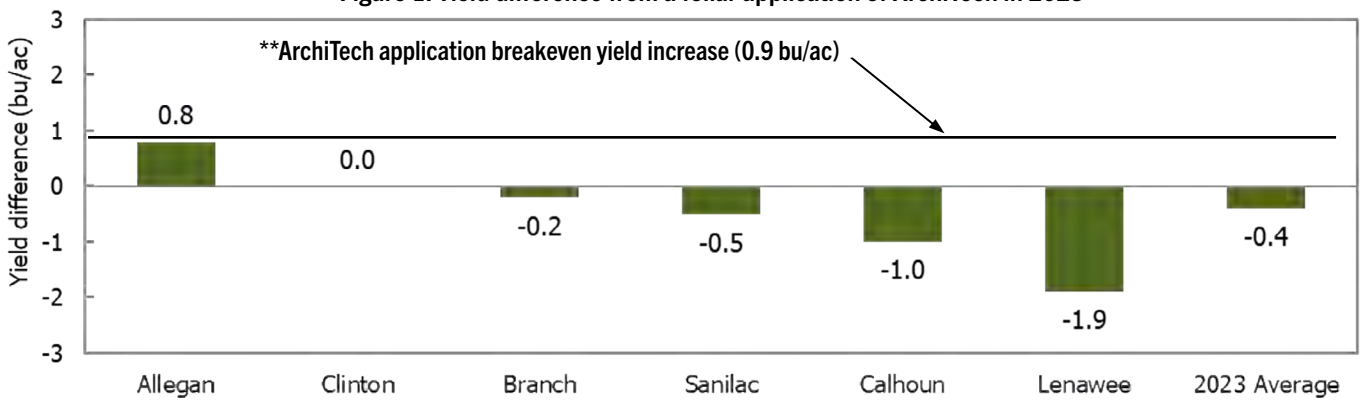
Table 3. The effect of a single application of ArchiTech on soybean yield and income in 2023

Location	Untreated control	ArchiTech	LSD $_{0.10}$	Yield difference
	-------- Yield (bu/ac) ----------			Yield (bu/ac)
Allegan	75.3	76.1	2.1	0.8
Clinton	45.2	45.2	4.6	0.0
Branch	62.6	62.4	1.2	-0.2
Sanilac	41.6	41.1	6.0	-0.5
Calhoun	45.8	44.8	1.5	-1.0
Lenawee	60.8	58.9	5.5	-1.9
2023 Average	**55.2**	**54.8**	**1.3**	**-0.4**
	---------- Income ($/ac) ----------			
***Average income**	**$712**	**$700**		

ArchiTech cost = $12.00 per acre

* The foliar fertilizer application cost was not included because it was tank-mixed with a planned foliar fungicide application.

Figure 1. Yield difference from a foliar application of ArchiTech in 2023



The yield difference was not statistically significant at any locations.

**The application cost is not included.

Prescription Foliar Fertilizer Trial

Purpose: Producers consistently rank nutrient management as a high priority for on-farm research. One of the frequently identified practices is the use of in-season plant tissue sampling to develop field-specific foliar fertilizer recommendations. The purpose of this trial was to evaluate how various field-specific prescription foliar fertilizers affected soybean yield and income in 2022 and 2023.

Procedure: Two treatments (field-specific foliar fertilizers based on in-season plant tissue samples vs. an untreated control) were compared at four locations in 2022 and three locations in 2023. We collected baseline soil samples from each site and information regarding broadcast fertilizer applications. Helena developed field-specific foliar fertilizer recommendations based on plant tissue sampling done at the R2 growth stage.

Results: The prescription foliar fertilizer did not increase soybean yields at any of the locations. However, the yield of the prescription foliar fertilizer treatment was 2.1 bushels per acre lower than the control at the Sanilac location. Due to the lack of a positive yield response, the prescription foliar fertilizer applications were not profitable in 2022 or 2023.

We want to thank Helena for collecting and submitting plant tissue samples, developing the field-specific foliar fertilizer recommendations, and providing and delivering the products applied in this project.

Table 1. Soil test levels at the prescription foliar fertilizer trial locations

Location	Organic Matter	CEC	Phosphorus	Potassium	Sulfur	Manganese	Boron	Soil pH
	Percent	meq/100g	---------- Parts per million ----------					1:1
Isabella 23-2	2.0	10.0	33	**102**	8	35	**0.4**	6.7
Isabella 22	3.1	15.0	48	224	10	33	0.9	6.9
Jackson 22	2.3	7.1	27	130	9	51	**0.5**	6.2
Isabella 23-1	2.3	8.7	61	130	10	32	**0.4**	6.6
Jackson 23	2.3	6.4	47	108	9	50	**0.3**	6.5
Eaton 22	2.1	7.9	27	**101**	9	45	**0.5**	6.9
Sanilac 22	2.7	8.8	**12**	154	9	32	**0.4**	6.4

Bold figures indicate low or very low soil test levels.

Table 2. Plant tissue nutrient levels used to develop prescription foliar fertilizer recommendations

Location	N	P	K	S	Ca	Mg	B	Cu	Fe	Mn	Zn
	---------- Percent ----------						---------- Parts per million ----------				
Isabella 23-2	4.98	0.39	2.10	0.29	1.00	0.34	61	**7**	103	36	30
Isabella 22	*5.62*	0.50	1.80	0.30	1.11	0.55	43	**8**	140	44	41
Jackson 22	*5.68*	0.56	*2.33*	0.31	1.11	0.46	39	9	128	*107*	43
Isabella 23-1	4.54	0.38	2.40	0.32	0.88	0.31	35	**9**	137	56	27
Jackson 23	5.11	0.41	2.13	0.27	1.13	0.44	35	8	104	79	35
Eaton 22	4.43	0.47	1.95	0.27	0.91	0.46	42	**7**	171	65	36
Sanilac 22	4.49	0.26	1.98	0.27	1.33	0.56	39	**7**	75	46	32

Bold figures indicate low or very low nutrient levels.
Italic figures indicate high nutrient levels.
All other figures indicate sufficient nutrient levels.

Table 3. Prescription foliar fertilizer and broadcast fertilizer analyses and application rates

Location	Prescription fertilizer analyses and application rates	Broadcast fertilizer analyses and application rates
Isabella 23-2	8-30-2 with trace micros @ 1qt/ac; Axilo Mn 13% @ 0.5 lb/ac	None since spring of 2022
Isabella 22	0-0-29 @ 1qt/ac; 4-0-0-33%Cu @ 12oz/ac	Spring application of 6-19-28@ 250 lbs/ac
Jackson 22	8-30-2 @ 1qt/ac; 10%Zn-4.5%Mn-.9%B-.5%Mo @ 1lb/ac	None
Isabella 23-1	0-0-29 with trace micros @ 1qt/ac; Axilo Mg 6% @ 0.5 lb/ac	Spring application of 7-8-27-7 @ 250 lbs/ac
Jackson 23	10-0-0-10 with trace B @ 3pt/ac	None
Eaton 22	10-0-10 @ 1 gal/ac; 8-30-2 @ 1qt/ac	Fall application of 0-0-60 @ 200 lbs/ac
Sanilac 22	8-30-2 @ 1qt/ac; 4-0-0-33%Cu @ 12oz/ac	None

Table 4. Application and rainfall information for the prescription foliar fertilizer locations

					*Rainfall totals and hours of rain for July and August	
Location	Application date	Spray volume (GPA)	Nozzle pressure (PSI)	Groundspeed (mph)	Rainfall (inches)	Hours of rain (hrs)
Isabella 23-2	August 3	18.2	45	9.2	11.5	115
Isabella 22	August 9	15	35	11	12.5	116
Jackson 22	July 30	15	63	10	13.0	97
Isabella 23-1	August 11	12	41	13	11.5	115
Jackson 23	August 16	15	60	8	9.1	92
Eaton 22	August 18	20	65	8	8.2	115
Sanilac 22	August 19	15	40	9	6.9	59

*Rainfall data was obtained from the nearest MSU Enviroweather station.

Figure 1. Yield difference produced by various prescription foliar fertilizers in 2022 and 2023

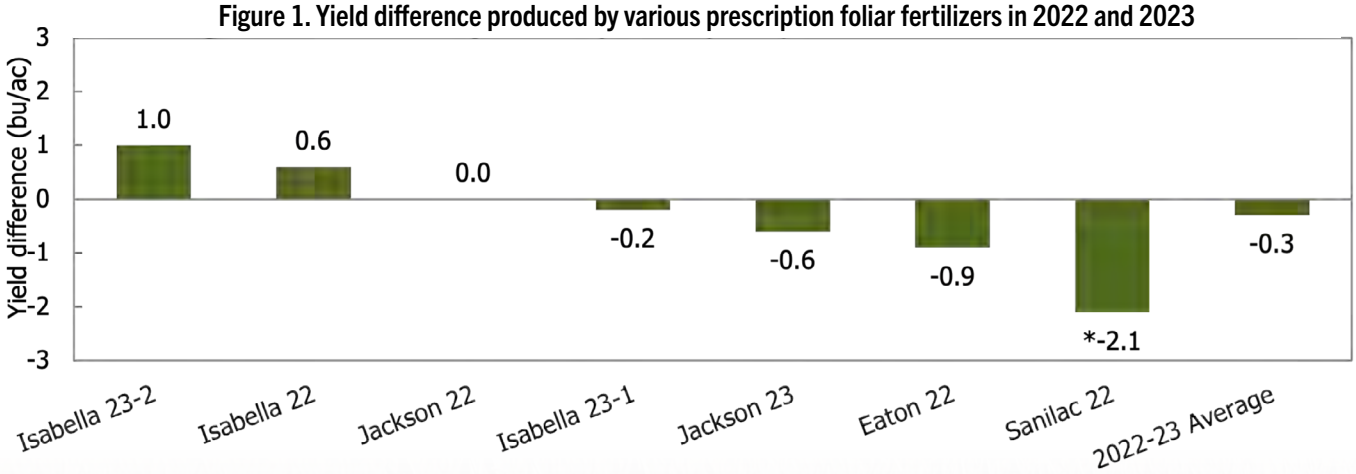


Table 5. The effect of various prescription foliar fertilizers on yield and income in 2022 and 2023

Location	Control	Prescription foliar fertilizer	LSD $_{0.10}$	Yield difference	*Net return to foliar fertilizer
	---------- Yield (bu/ac) ---------			Yield (bu/ac)	$/acre
Isabella 23-2	60.0	61.0	5.1	1.0	-14.60
Isabella 22	42.3	42.9	2.2	0.6	-20.80
Jackson 22	67.2	67.2	2.1	0.0	-25.58
Isabella 23-1	60.3	60.1	2.0	-0.2	-13.00
Jackson 23	75.9	75.3	2.2	-0.6	-8.20
Eaton 22	33.5	32.6	2.8	-0.9	-19.80
Sanilac 22	57.1 a	55.0 b	1.6	-2.1	-20.20
2022-23 Average	**56.6**	**56.3**	**0.8**	**-0.3**	**-17.45**

Net return is based on the specific prescription foliar fertilizer and application rate for each location.

* Does not include fertilizer application costs.

eNhance™ Foliar Fertilizer Trial

Purpose: eNhance is a liquid fertilizer distributed by AgroLiquid. It contains 7% nitrogen, 8.7% sulfur, and trace amounts of manganese and zinc. eNhance is promoted as being an excellent source of crop available sulfate. The purpose of this trial was to evaluate how adding eNhance to a planned foliar fungicide application affected soybean yield and income in 2022 and 2023.

Procedure: Two treatments were compared in this trial (foliar fungicide plus eNhance vs. the same foliar fungicide without eNhance) at 11 locations in 2022 and seven locations in 2023. We collected soil samples from every trial and presented the sulfur, manganese and zinc soil test levels in Table 1. Application dates, application characteristics, and rainfall information for each site are presented in Table 2. To keep sprayer tracks from affecting the results, tracks were either present or absent in all the harvested strips in each trial.

Results: The foliar application of eNhance increased soybean yield by 2.4 bushels per acre at the Berrien 22 location. However, it reduced yield by 1.8 bushels per acre at the Genesee 23 location. Soybean yields were not significantly affected at the other sixteen locations. When all 18 locations were combined and analyzed, the foliar fertilizer did not significantly affect soybean yields. These results are consistent with results from previous Michigan on-farm trials where only 10% of the 150 foliar fertilizer trials conducted between 2009 and 2022 were profitable.

The eNhance fertilizer increased income by $26.00 per acre at the Berrien location. However, when all 18 locations were combined, the addition of the fertilizer was not profitable.

We'd like to thank AgroLiquid for donating and delivering the product for these trials.

Sulfur deficient field

Sulfur deficient plant

Table 1. Soil test levels for sulfur, manganese and zinc at the eNhance foliar fertilizer trial locations in 2023

Location	Organic Matter	CEC	Sulfur	Manganese	Zinc
	Percent	meq/100g	---------- Parts per million ----------		
Eaton	2.2	8.9	**7**	42	6.1
Lenawee	2.7	9.5	8	36	**2.3**
Berrien	1.9	6.5	10	54	**2.7**
Calhoun	2.1	8.0	9	47	6.9
St. Joseph	1.3	6.0	**7**	67	3.7
Sanilac	2.7	10.4	8	28	3.2
Genesee	2.1	8.4	9	75	**2.3**

Bold figures indicate low or very low soil test levels.

Table 2. Application dates, volume, pressure, groundspeed and rainfall information for the eNhance trial locations in 2023

					*Rainfall totals and hours of rain for July and August	
Location	**Application date**	**Spray volume (GPA)**	**Nozzle pressure (PSI)**	**Groundspeed (mph)**	**Rainfall (inches)**	**Hours of rain (hrs)**
Eaton	August 1	20	65	10	10.0	88
Lenawee	August 11	20	55	11	9.9	78
Berrien	July 11	20	40	9	10.1	71
Calhoun	July 19	20	45	10	9.0	92
St. Joseph	August 3	17	50	8	8.2	78
Sanilac	July 31	15	40	10	8.4	200
Genesee	August 28	10	30	10	14.6	100

*Rainfall data was obtained from the nearest MSU Enviroweather station.

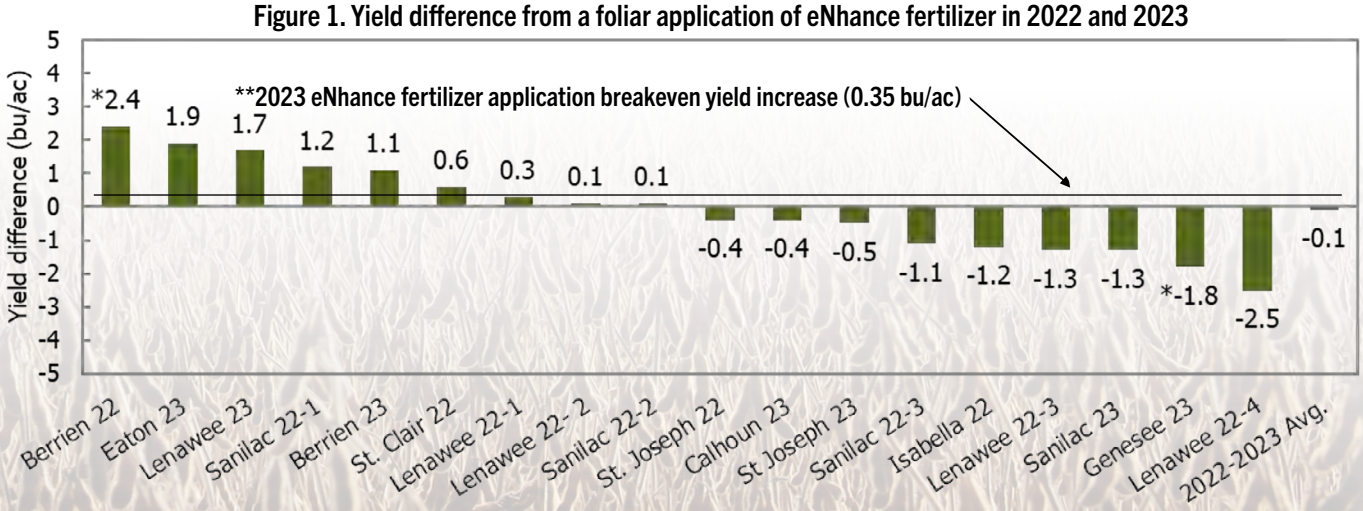
Table 3. The effect of a single application of eNhance foliar fertilizer on soybean yield and income in 2023

Location	**Untreated control**	**eNhance**	**LSD $_{0.10}$**	**Yield difference**
	-------- Yield (bu/ac) ----------			Yield (bu/ac)
Eaton	49.5	51.4	2.4	1.9
Lenawee	60.4	62.1	3.4	1.7
Berrien	73.4	74.5	2.7	1.1
Calhoun	52.7	52.3	1.5	-0.4
St. Joseph	69.2	68.7	2.2	-0.5
Sanilac	55.0	53.7	2.0	-1.3
Genesee	55.7 a	53.9 b	1.6	-1.8
Average	**62.3**	**62.2**	**0.5**	**-0.1**
	---------- Income ($/ac) ----------			
***Average income**	**$804**	**$798**		

eNhance cost: $4.50 per acre

* The foliar fertilizer application cost was not included because it was tank-mixed with a planned foliar fungicide application.

Figure 1. Yield difference from a foliar application of eNhance fertilizer in 2022 and 2023



*The yield difference was statistically significant at these locations.

** The application cost is not included.

Delaro® Complete Foliar Fungicide High Yield Trial

Purpose: Delaro Complete is a new foliar fungicide from Bayer Crop Science that is being promoted as having more consistent disease control and improving plant health and yield potential. The purpose of this trial was to evaluate how a foliar application of Delaro Complete affected soybean yield and income when not specifically applied to manage white mold in 2023.

Frogeye leaf spot

Procedure: A foliar application of Delaro Complete was compared to an untreated control at 10 locations in 2023. The Delaro Complete was applied at 8 ounces per acre at the R3 growth stage (one pod 3/16" long on one of the upper most nodes on the main stem having unrolled leaves). Application dates, application characteristics, and rainfall information for each site were gathered and are presented in Table 1. To eliminate sprayer tracks from affecting the results, tracks were either present or absent in all the harvested strips in each trial.

Results: The foliar application of Delaro Complete increased soybean yields at eight of the 10 individual trial locations (Table 2). Yield increases at individual trials ranged from 0.9 to 7.9 bushels per acre. When all 10 locations were combined and analyzed, the fungicide application increased soybean yields by 3 bushels per acre.

After accounting for product and application costs, the fungicide was profitable at six of the individual locations. The additional income ranged from $7 to $68 per acre at these locations. The fungicide application was also profitable when all 10 locations were combined with average income being increased by $5 per acre.

We would like to thank Bayer Crop Science for donating the products for these trials.

Table 1. Application dates, volume, pressure, groundspeed, and rainfall information for the Delaro Complete trial locations

					*Rainfall totals and hours of rain for July and August	
Location	Application date	Spray volume (GPA)	Nozzle pressure (PSI)	Groundspeed (mph)	Rainfall (inches)	Hours of rain (hrs)
Kalamazoo	August 2	16	60	12	10.4	79
Sanilac 1	July 31	20	50	8	8.4	200
Allegan	August 1	20	50	8	7.4	70
Sanilac 2	August 2	15	40	11	8.4	200
Cass	July 24	20	60	4	8.8	81
Ottawa	July 25	15	50	10	9.8	67
St. Joseph	July 31	20	50	9	8.2	78
Lenawee 2	August 4	20	45	6	9.9	78
Genesee	August 28	10	30	10	14.6	100
Lenawee 1	August 19	15	40	11	9.9	78

*Rainfall data was obtained from the nearest MSU Enviroweather station.

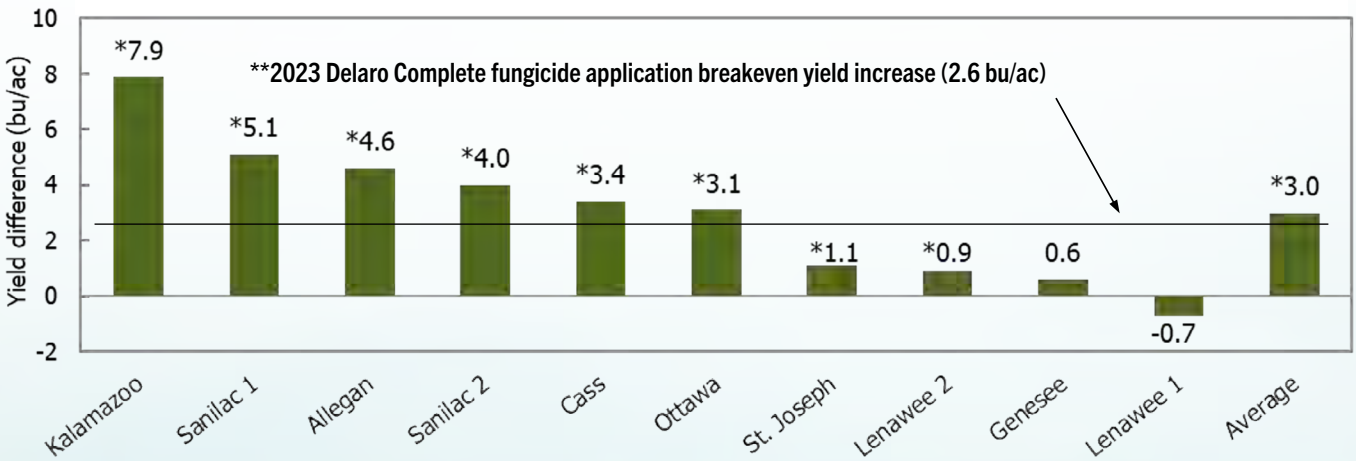
Table 2. The effect of a single R3 application of Delaro Complete on soybean yield and income in 2023

Location	Untreated control	Delaro Complete	LSD $_{0.10}$	Yield difference
	-------- Yield (bu/ac) ----------			Yield (bu/ac)
Kalamazoo	48.2 b	56.1 a	4.9	7.9
Sanilac 1	58.9 b	64.0 a	2.2	5.1
Allegan	64.4 b	69.0 a	1.7	4.6
Sanilac 2	59.7 b	63.7 a	2.0	4.0
Cass	60.0 b	63.4 a	0.9	3.4
Ottawa	65.9 b	69.0 a	1.7	3.1
St. Joseph	73.5 b	74.6 a	1.1	1.1
Lenawee 2	65.3 b	66.2 a	0.6	0.9
Genesee	54.4	55.0	5.3	0.6
Lenawee 1	59.8	59.1	2.9	-0.7
Average	**61.0 b**	**64.0 a**	**0.9**	**3.0**
	---------- Income ($/ac) ----------			
Average income	**$787**	**$792**		

Delaro Complete cost: $22.19 per acre

Application cost: $11.00 per acre

Figure 1. Yield difference from a foliar application of Delaro Complete fungicide in 2023



*The yield difference was statistically significant.

** A $11.00 per acre application cost was included.

Delaro® Complete Foliar Fungicide White Mold Trial

Purpose: Delaro Complete is a new foliar fungicide from Bayer Crop Science that is being promoted as providing protection from white mold, having more consistent disease control, and improving plant health and yield potential. The purpose of this trial was to evaluate how a foliar application of Delaro Complete affected soybean yield and income in 2023 when specifically applied to manage white mold.

White mold

Procedure: A single foliar application of Delaro Complete was compared to an untreated control at two locations in 2023. Both locations had a history of white mold. The Delaro Complete was applied at 8 ounces per acre at the R1 growth stage (one open blossom on 50% of the plants). Application dates, application characteristics and rainfall information for each site were gathered and are presented in Table 1. To eliminate sprayer tracks from affecting the results, tracks were either present or absent in all harvested strips.

Results: White mold pressure was rated as moderate to high at both locations. The foliar application of Delaro Complete increased soybean yields by more than 12 bushels per acre at one of the two trial locations (Table 2). However, yield was not affected by the fungicide at the Sanilac location. When both locations were combined and analyzed, the fungicide application increased soybean yield by 7 bushels per acre.

After accounting for product and application costs, the fungicide application increased income by $57 per acre when both locations were combined.

We want to thank Bayer Crop Science for donating the products for these trials.

Table 1. Planting dates, planting rates, row spacing, and fungicide application dates at the trial locations

Location	Soybean variety	White mold resistance/tolerance of soybean variety	Planting date	Planting rate (seeds/ac)	Row spacing	Application dates
Kalamazoo	Specialty 3015XF	**4** (1=excellent and 9=poor)	May 22	146,400	15″	July 20
Sanilac	LG 1735	**3** (4=excellent and 1=bad)	May 15	165,000	15″	July 10

Table 2. Application dates, volume, pressure, groundspeed and rainfall information for the Delaro Complete trial locations

					*Rainfall totals and hours of rain for July and August	
Location	Application date	Spray volume (GPA)	Nozzle pressure (PSI)	Groundspeed (mph)	Rainfall (inches)	Hours of rain (hrs)
Kalamazoo	July 20	16	60	12	10.39	79
Sanilac	July 10	12	50	6	8.39	200

*Rainfall data was obtained from the nearest MSU Enviroweather station.

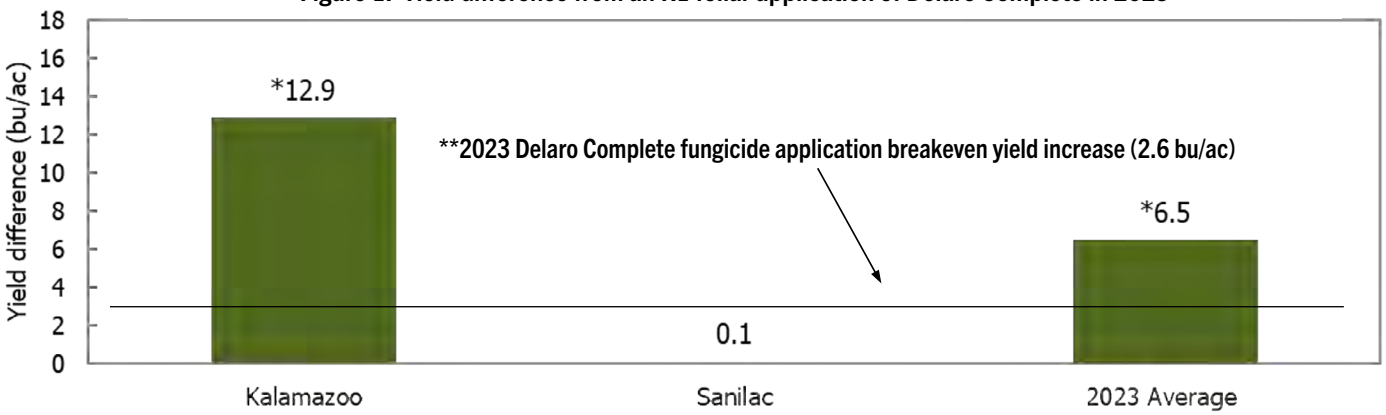
Table 3. The effect of a single application of Delaro Complete applied at R1 on soybean yield and income in 2023

Location	Untreated control	Delaro Complete	LSD $_{0.10}$	Yield difference
	-------- Yield (bu/ac) ----------			Yield (bu/ac)
Kalamazoo	54.9 b	67.8 a	2.4	12.9
Sanilac	46.4	46.5	0.7	0.1
Average	**50.7 b**	**57.2 a**	**3.4**	**6.5**
	---------- Income ($/ac) ----------			
Average income	**$654**	**$705**		

Delaro Complete cost: $22.19 per acre

Application cost: $11.00 per acre

Figure 1. Yield difference from an R1 foliar application of Delaro Complete in 2023



*The yield difference was statistically significant.

** An $11.00 per acre application cost was included.

Heavily infested white mold field
Photo: Dr. Marty Chilvers, MSU

White Mold Fungicide Application Timing Trial

Purpose: Foliar fungicides can be an important tactic for reducing yield loss from white mold, especially when combined with other effective management practices such as planting resistant/tolerant varieties, planting in wide rows, reducing planting rates, making tillage decisions, and managing irrigation water. Properly timing fungicide applications is essential for success but can be challenging for producers. The purpose of this trial was to determine the effect of fungicide application timing on soybean yield and income in 2023. Another goal was to use yield data from this trial to validate Sporecaster, a relatively new white mold apothecia prediction app for smart phones.

White mold apothecia

Procedure: The trial compared three different fungicide application timings to an untreated control at three locations previously infested with white mold. The application timings were: R1 (one open flower on 50% of the plants); 7 days after R1; and 14 days after R1. Propulse® fungicide was applied at a rate of 6 ounces per acre for all application timings. We entered the dates for the three application timings into the Sporecaster app to determine the apothecia risk level for the dates and locations.

Bird's nest apothecia
(Often confused with white mold apothecia)

Results: White mold did not occur at the Berrien location and was very low at the Eaton location. However, there was moderate disease pressure at the Sanilac site. Consequently, the fungicide performed best at this location with all three application timings increasing soybean yields and income compared to the untreated control. At this location, the later two application timings increased yield and income over the R1 application timing. Yields were increased above the untreated control by 4.3 bushels per acre for the R1, 6.7 bushels per acre for the 7 days after R1 timing, and 6.3 bushels per acre for the 14 days after R1 timing. Income was increased by $29 per acre at the R1 timing, by $60 per acre at 7days after R1, and by $55 per acre at 14 days after R1. None of the fungicide application timings increased yields over the untreated control at the other two locations. However, when all three locations were combined, the later two application timings increased yields by 2.5 to 2.7 bushels per acre compared to the untreated control.

The Sporecaster app recommended a fungicide application at all locations for all three application timings. However, the risk was the highest for the Sanilac location.

We want to thank Bayer Crop Science for providing the Propulse and Dr. Martin Chilvers, MSU Extension field crop pathologist, for his input regarding application timing.

Table 1. Planting dates, planting rates, row spacing, and fungicide application dates at the trial locations

Location	Soybean variety	White mold resistance/tolerance of soybean variety	Planting date	Planting rate (seeds/ac)	Row spacing	Application dates
Berrien	Becks 2333XF	**6** (9=excellent and 1=poor)	May 12	135,000	15	July 11, 18, and 25
Sanilac	DynaGro S21EN81	**7** (9=excellent and 1=poor)	May 14	130,000	20	July 10, 17, and 24
Eaton	Specialty 2504	**4** (9=excellent and 1=poor)	May 21	140,000	15	August 1, 8, and 15

Table 2. Sporecaster white mold apothecia development forecasts at the trial locations

Location	R1	7 days post R1	14 days post R1
	---------- Apothecia development forecast (percent) ----------		
Berrien	60	40	44
Sanilac	75	59	60
Eaton	44	47	52

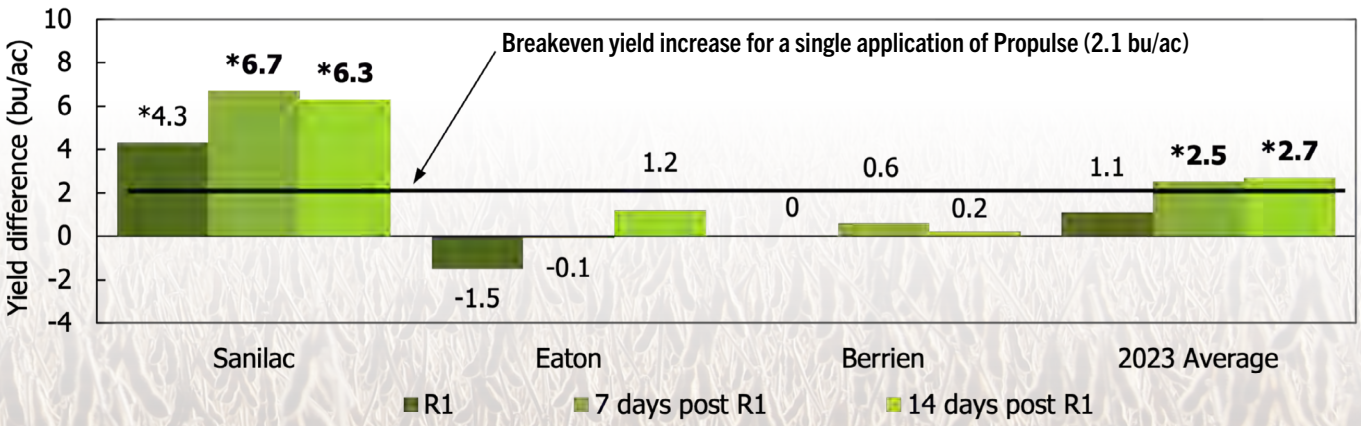
Fungicide applications are typically recommended when apothecia development forecasts are higher than 40%

Table 3. White mold foliar fungicide application timing effect on soybean yield and income in 2023

Location	Untreated control	R1	7 days post R1	14 days post R1	LSD $_{0.10}$
	---------- Yield (bu/ac) ----------				
Berrien	77.0	77.0	77.6	77.2	2.4
Sanilac	71.5 c	75.8 b	78.2 a	77.8 a	1.0
Eaton	46.5	44.9	46.4	47.7	2.2
Average	**64.9 b**	**66.0 b**	**67.5 a**	**67.6 a**	**1.4**
	---------- Income ($/ac) ----------				
Average income	**$837**	**$823**	**$844**	**$845**	

Propulse fungicide cost for a single application: $15.70 per acre
Application cost: $11.00 per acre

Figure 1. Yield difference produced by a single fungicide application at three different timings when compared to the untreated control in 2023



*The yield difference between the fungicide application timings and the control were statistically significant at these locations.
Bold type indicates that the yield differences between the later application dates and the R1 application date were statistically significant at these locations.

Do Deer Have a Sweet Tooth?

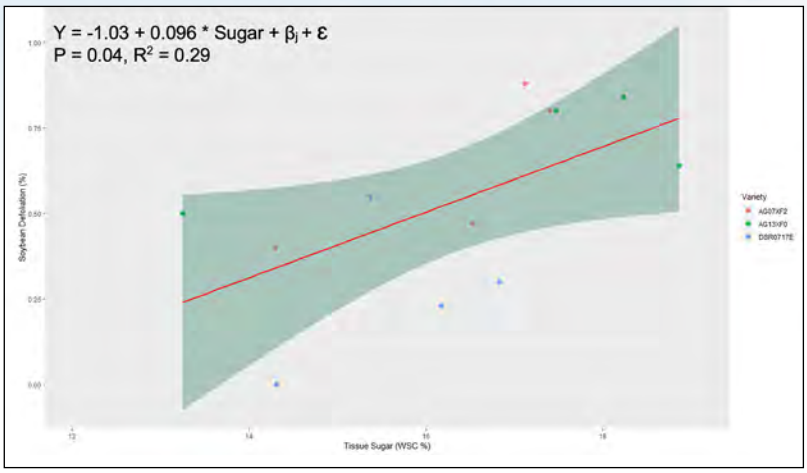
Dr. James DeDecker, MSU Extension

Anyone that has grown multiple varieties of soybeans in the same field understands that pests often demonstrate variety preferences. This phenomenon is especially pronounced among vertebrate pests like white-tailed deer. Past research has found that deer prefer mixed diets with a significant proportion of cultivated legumes and tend to prefer plant species or varieties with higher levels of digestible dry matter, greater nutritive value and lower concentrations of anti-quality factors like tannins and terpenes. Unfortunately, soybeans align well with the dietary requirements and preferences of deer, which can lead to dramatic reductions in soybean yield where significant browsing occurs.

Since 2015, MSU Extension has received generous support from the Michigan Soybean Committee to investigate the impact of deer damage on soybean production systems. Our work has included exclusion studies to identify factors influencing deer pressure and yield loss, deer repellent efficacy trials, and most recently the gathering of data to explain deer preferences among soybean varieties. We first sought to understand the interaction of soybean quality and deer feeding in 2019 by correlating deer damage in a small-plot soybean variety trial to forage quality of the soybean leaves analyzed by Dairyland Labs. Of fifteen forage quality parameters measured, only water-soluble carbohydrates (i.e., sugar) was correlated with soybean defoliation.

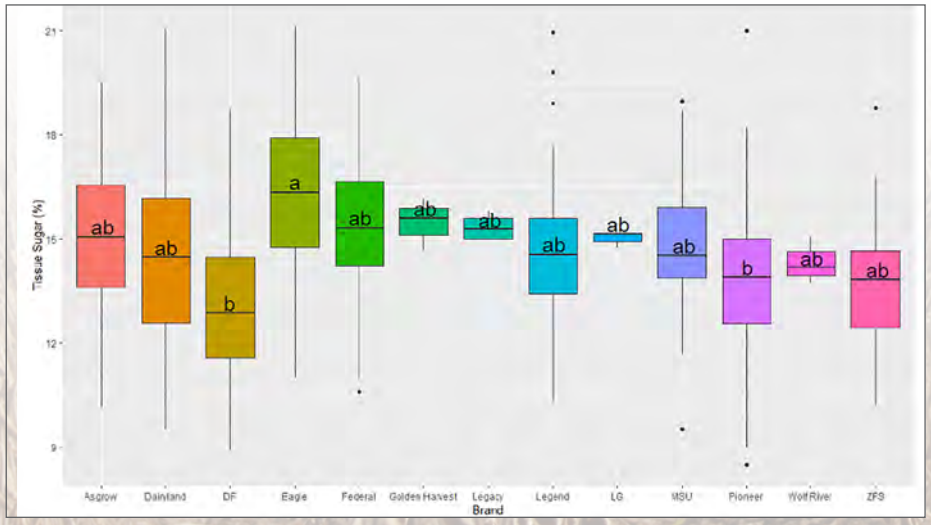
In 2021, we followed up by conducting a replicated deer preference study to test the hypothesis that deer will preferentially browse soybeans based on tissue sugar concentration. Three soybean varieties were planted in replicated 8-row strips at the MSU Forestry Innovation Center in Hyde, MI. Deer damage was rated three times during the V1-V6 growth stages. Tissue sugar concentration and deer damage varied significantly among varieties and spatially among replicates. Deer damage was correlated with tissue sugar concentration at V5 (Figure 1). These results bolstered our confidence that sugar could be used to select high- or low-palatability soybean varieties for deer management.

Figure 1. Deer damage by soybean tissue sugar concentration at V5 in 2021



Since 2019, we have also been compiling data on sugar levels in soybean varieties entered in our annual Early Maturity Soybean Variety Trial. While not conclusive due to limited sample size, it appears that soybean varieties and seed brands differ significantly in average tissue sugar concentration (Figure 2). Soybean tissue sugar concentration has not been correlated with growing year, maturity group or yield.

Figure 2. Tissue sugar concentration by soybean brand across 2019 and 2022



Our work on deer feeding preferences raises important questions about how variety differences could be leveraged to reduce deer damage on Michigan soybean farms. The basic approach we envision is high-sugar soybeans being used as a trap crop to protect a low-sugar cash crop field. This could be implemented as sacrifice food

plots or field buffers/headlands being planted to forage soybeans or another high-sugar line. In fact, this strategy is already being tested in research conducted by Dr. Luke Macaulay, a wildlife management specialist with the University of Maryland. However, it is clear that other factors like field size, soybean location (i.e., field edge), adjacent habitat quality and deer numbers all have greater influence on deer damage than soybean nutritive value or sugar concentration. Therefore, more research is needed to determine if deer preferences will hold up at field scale and whether soybean sugar differences can be successfully implemented as a deer management tool by soybean seed suppliers and commercial producers.

Red Crown Root Rot: A New Threat to Soybean Production

Marty Chilvers, Austin McCoy and Sunao Ochi, Michigan State University Field Crops Pathology

Red crown rot is caused by the fungal pathogen *Calonectria ilicicola*, which was first identified in the United States on peanuts in 1965 and is now a prominent pathogen throughout the peanut growing region of the United States. In 1972 *C. ilicicola* was identified causing red crown rot of soybean for the first time in the United States. Alarmingly red crown rot appears to be moving into more northern climates with reports of soybean fields with severe disease occurrence and significant yield losses in Kentucky, Illinois and Indiana, including counties in mid-northern Indiana.

Foliar symptoms of red crown root rot are like that of sudden death syndrome, typically presenting during late reproductive growth stages. Small chlorotic (yellow) blotches on leaf tissue will begin to form that will eventually expand into interveinal chlorosis and necrosis (below photos). In severe cases wilting, loss of leaves and premature senescence can occur. While not always present, dark red structures (perithecia) and a maroon coloration of the soybean stem at the soil line are indicative of red crown rot.

Red crown rot 'signs' of red perithecial fruiting bodies on the outside of a soybean stem (Sunao Ochi)

To date, little to nothing is known about why this disease is moving northward, and why it is now impacting soybean. If you suspect red crown rot, be sure to submit a sample to MSU Plant and Pest Diagnostic Services (www.canr.msu.edu/pestid) or contact us directly at chilvers@msu.edu to help us keep ahead of this disease in Michigan.

Red crown rot symptomatic soybean plants that appear similar to SDS in Pike county, Illinois in 2023 (Sunao Ochi).

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