MICHIGAN SOYBEAN ON-FARM RESEARCH

2020

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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 2021 on-farm research program, contact Mike Staton at 269.673.0370 extension 2562 or staton@msu.edu.

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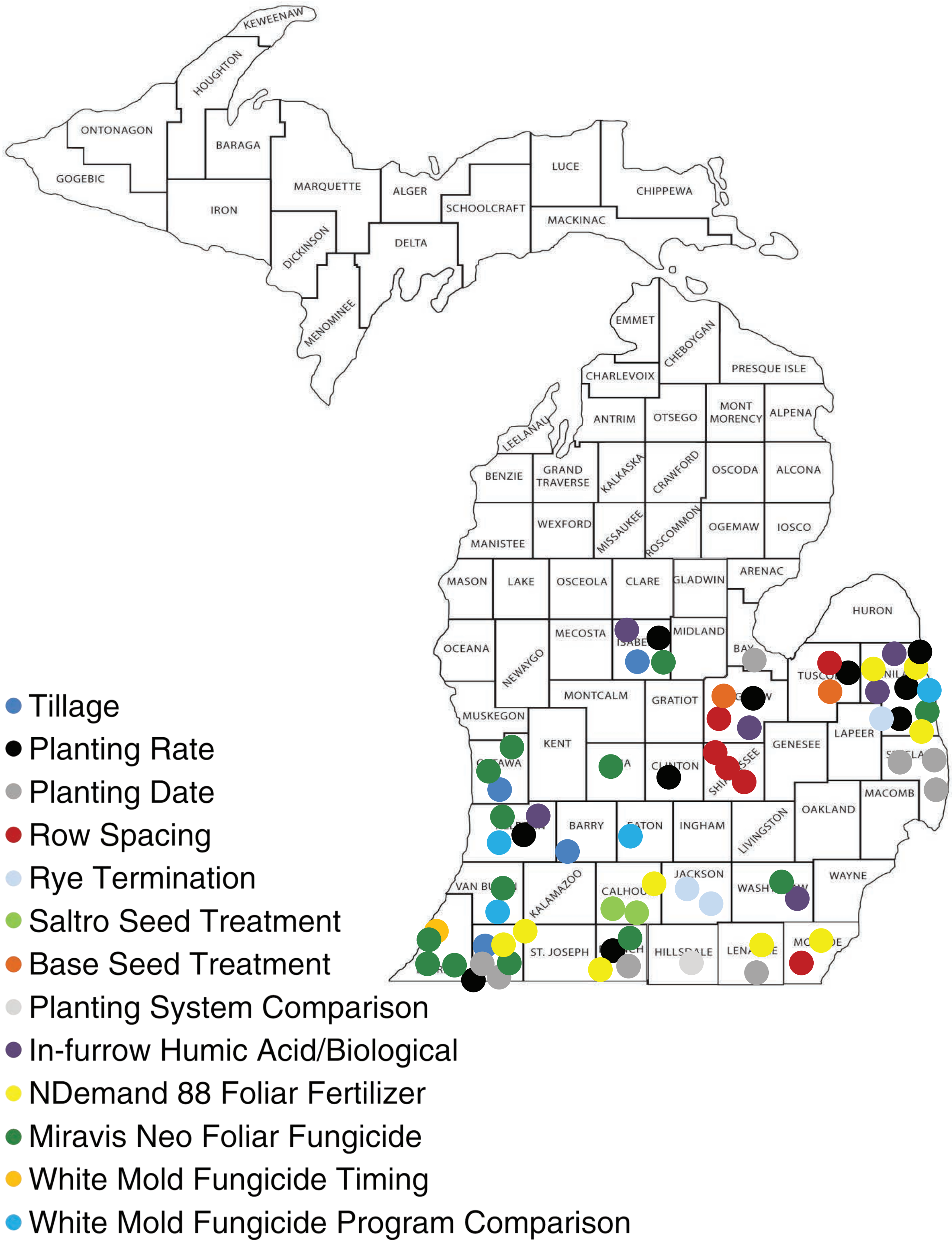
This year, the Michigan Soybean On-Farm Research Program, a program made possible by the checkoff investment of Michigan soybean producers, worked with 54 producers around the state to conduct on-farm research trials within 13 projects. Contained in this publication you'll find results from 70 individual trial locations. The research projects were developed with producer input and represent some of the most challenging production issues growers face. 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. Break-even yields utilized the projected USDA 2020-2021 average soybean price of $10.40 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 strong partnerships. One example is the unique collaboration between Michigan State University Extension (MSUE) and the Michigan Soybean Committee (MSC) to jointly fund Mike Staton, MSUE state-wide soybean educator and on-farm research program coordinator. This program would also not be possible without the efforts of Ned Birkey and Dan Rajzer with whom MSC contracts to implement trials. Ty Bodeis, MSC soybean production specialist, took final plant stand counts, rated white mold trials for white mold incidence, rated Saltro trials for SDS, collected soil samples for nutrient analysis and compiled other valuable information presented in this report. We also want to thank MSU Extension educators, Roger Betz, Paul Gross and Phil Kaatz for their efforts in making this research possible.

Dr. Arnold Saxton, Professor Emeritus, University of Tennessee, provided the SAS statistical procedure used for analyzing the 2020 trial results and provided valuable input regarding experimental design and statistical analysis.

2020 ON-FARM TRIAL LOCATIONS



Introduction to Experimental Design, Statistical Analysis and Interpretation

The 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 2020 planting rate trials and demonstrates the principles outlined above. Note how each planting rate is included and randomized within the replications. All of the 2020 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 in the 2020 planting rate trials.

80K	**100K**	**130K**	**160K**	**100K**	**160K**	**80K**	**130K**	**100K**	**80K**	**160K**	**130K**	**160K**	**100K**	**130K**	**80K**
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% 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 are two examples of this situation in this publication (the Sanilac 20-3 site in Table 3 on page 7 and the St. Joseph 19 site in Table 2 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 (*) is 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.

Planting System Comparison Trial

Purpose: Soybeans are planted using a wide variety of planters and drills and in different row spacing configurations. Some producers have multiple pieces of planting equipment on the farm and want to know which planting system (combination of equipment and row spacing) performs best and under what conditions. Other producers are replacing existing planting equipment and want to know what planting system is the most versatile and beneficial to their farm. The purpose of this trial was to compare any planting systems the cooperating producers wanted to compare on their farm to determine how various planting systems affect yield and income.

Procedure: Three trials were originally planned for 2020, but two were cancelled due to complications with new planters. The one trial that was conducted in 2020 compared a John Deere 30-inch row planter to a John Deere 15-inch row air seeder. Both pieces of planting equipment were set to deliver the same seeding rate. Stand counts were taken to determine how the planting systems would affect final plant stands.

Results: The yields produced by the two planting systems were essentially the same in this trial. However, the 1770 planter increased final stands by 2,500 plants per acre. The purchase price of a new 30' base level John Deere planter and a 30' John Deere air seeder are about equal. However, the operating cost of the air seeder is higher as it requires a tractor with 25 percent more PTO horsepower. Due to the narrower row configuration, the air seeder would be expected to perform better in lower yielding environments and when planting after the first week of June. The planter 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 system comparison trial conducted in 2020

Location	*Tillage Fall/spring	Planting date	Planting rate	Previous crop	Variety	Seed treatment
Hillsdale	Spring VT	April 22	135,000	Corn	Specialty Hybrids 2752 R2X	Base fungicide mix

VT = vertical tillage (Degelman Pro-Till operated at a depth of 3.5 inches)

Table 2. The effect of two planting systems on yield and income in 2020

Location	JD 1770 Planter	JD 1690 Air seeder	LSD $_{0.10}$	Yield difference
	--------- Yield (bu/ac) ---------			Yield (bu/ac)
Hillsdale	63.8	64.5	1.9	0.7
	---------- Income ($/ac) ---------			
Income	**$664**	**$671**		

The purchase price of a new base model 30' planter and a new 30' air seeder are essentially the same. However, operating costs for the air seeder are probably higher due to its 25 percent higher PTO horsepower requirement.

Table 3. The effect of row spacing on final plant stands in 2020

Location	JD 1770 Planter	JD 1690 Air seeder	LSD $_{0.10}$	Stand difference
	------ Plant stand (plants/ac) ------			Plant stand (plants/ac)
Hillsdale	81,300 a	78,800 b	1,036	2,500

Planter type and row spacing should be adapted to field characteristics and management.

Planting Rate Trial

Purpose: Soybean planting rates was the highest ranked topic identified by soybean producers for evaluation in on-farm research trials. Producers were interested in evaluating the effect of reduced planting rates on soybean yields and income. There are two main factors driving the increased interest in reducing soybean planting rates – seed cost and white mold. The purpose of this trial was to evaluate how reducing planting rates will affect soybean yield and income across multiple years and yield environments.

Procedure: We conducted 58 planting rate trials from 2015 to 2020. Nine of these were conducted in 2020. Four target planting rates (80,000, 100,000, 130,000 and 160,000 seeds per acre) were compared in all years. Stand counts were taken at all locations, with the exception of the Cass and Isabella sites, to determine actual final plant stands at each location. We used projected market prices and conservative seed costs to determine the income (gross income minus seed cost) produced by the four planting rates.

Results: In 2020, the 160,000 planting rate out-yielded the 130,000 rate at one of the nine sites, the 100,000 rate at two locations and the 80,000 rate at four locations (Table 3). Severe stand reductions caused by soil crusting, slugs and poor emergence strongly favored the higher planting rates at the Sanilac 2 location (Table 2). When all the 2020 locations were combined and analyzed, the 160,000 rate and the 130,000 rate produced essentially the same yield, exceeding the 100,000 rate by less than two bushels per acre and the 80,000 rate by only four bushels per acre. In 2020, the 130,000 planting rate produced the most income, followed by the 100,000 rate. The 160,000 rate came in third beating the 80,000 rate by only $5.00 per acre (Table 3).

Figure 1. Planting rate effects on soybean yield and income in 2020 compared to the 6-year average (2015 to 2020)

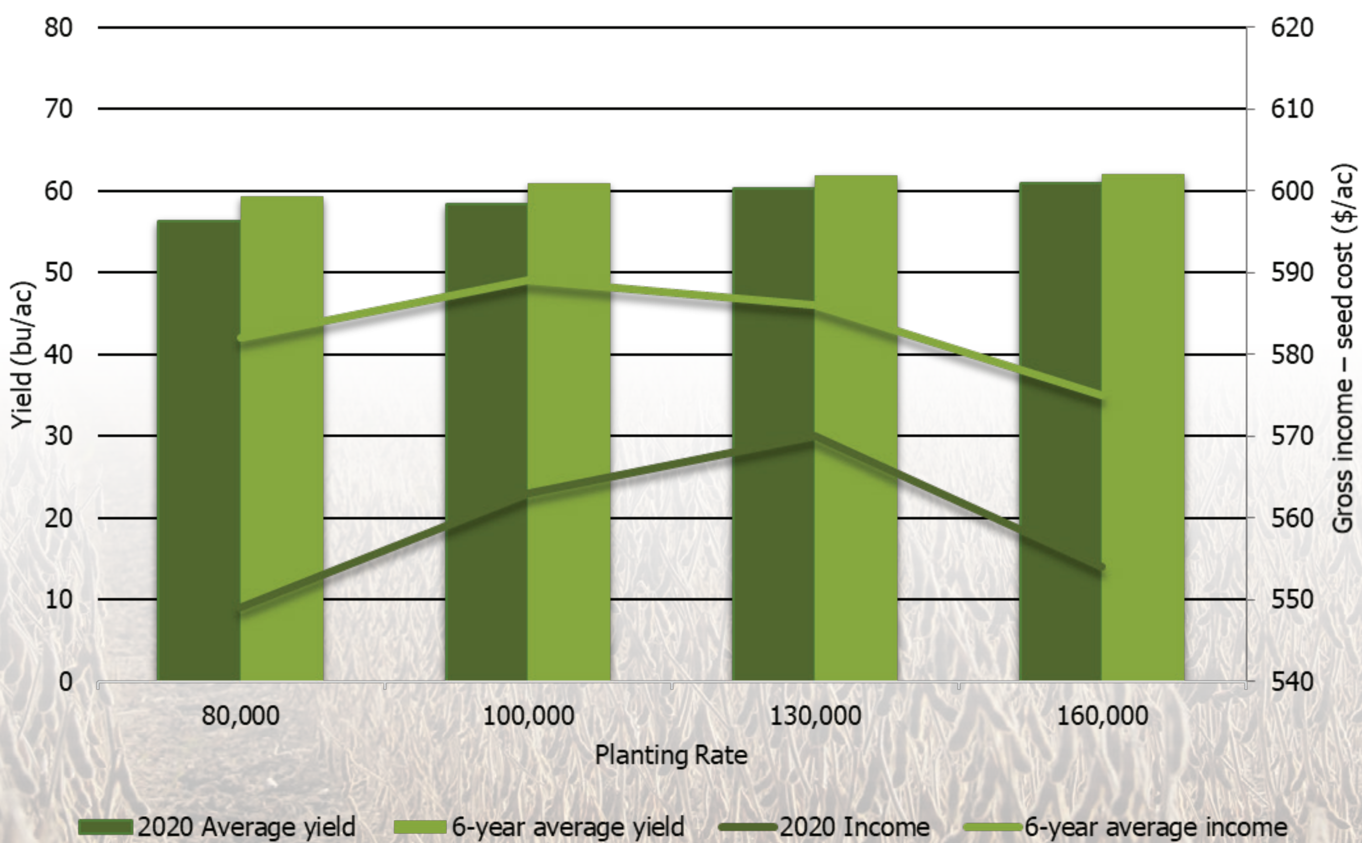


Table 1. Tillage, planting equipment, row spacing, CEC, planting date, planting depth and seed treatment in 2020

Location	Tillage operations (fall/spring)	Planter/drill	Row spacing	CEC	Planting date	Planting depth	Seed treatment
Branch	NT	JD 1770	30	5.8	April 28	1.5	None
Sanilac 1	VT/VT	JD DB44	22	8.9	April 28	1.75	LumiGEN Technologies
Cass	D	Case IH 1200	30	33.1	May 6	1.5	None
Clinton	NT	Kinze 3500	15	9.6	May 8	1.5	LumiGEN Technologies
Isabella	VT/--	JD N540C	15	12.3	April 20	1.5	Escalate
Sanilac 2	NT	JD 1790	15	5.2	May 14	1.5	DFender
Sanilac 3	CP/VT	Case IH 4120	20	14.5	May12	1.25	LumiGEN Technologies
Allegan	--/CP, D	JD 1795	15	6.2	June 19	1.5	LumiGEN Technologies
Saginaw	DR/FC	JD 7100	15	6.4	June 3	1.5	LumiGEN Technologies

FC = field cultivator, NT = no-till, VT = vertical tillage, D = Disc, CP = chisel plow, and DR = disc ripper

Table 2. Target planting rates and actual plant stands in 2020

	------------------ Target planting rate (seeds/ac) ------------------			
Location	**80,000**	**100,000**	**130,000**	**160,000**
	------------------ Actual plant stands (plants/ac) ------------------			
Branch	62,526	74,448	91,455	100,876
Sanilac 1	78,215	98,109	122,779	149,949
Clinton	73,864	90,538	106,045	127,220
Sanilac 2	36,765	46,770	72,614	88,204
Sanilac 3	64,777	84,661	105,044	129,805
Allegan	56,024	63,527	85,703	100,209
Saginaw	69,196	84,536	104,877	126,387
2020 Average	**63,052**	**77,512**	**98,359**	**117,521**
	---------------------- Average stand loss (%) ----------------------			
	21	22	24	26

Stand counts were not taken at the Cass and Isabella locations.

Table 3. Effect of four planting rates on soybean yield and income in 2020

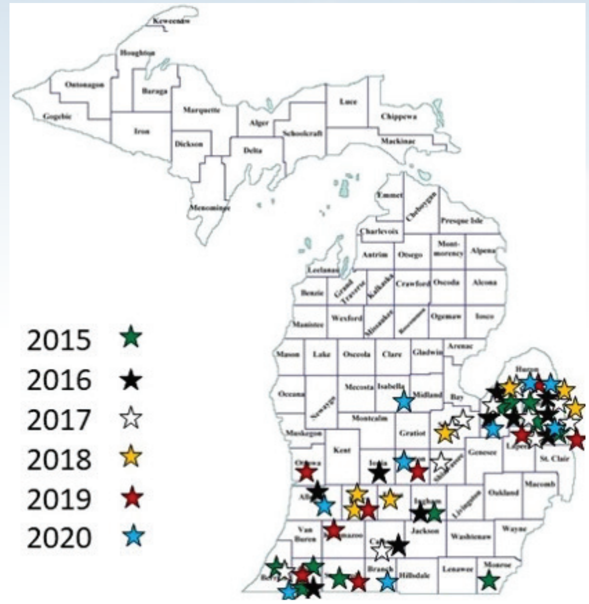
	------------- Target planting rate (seeds/ac) -------------				
Location	**80,000**	**100,000**	**130,000**	**160,000**	**$LSD_{0.10}$**
	---------------- Yield (bushels/ac) --------------				
Branch	41.4 c	43.9 a	42.8 ab	42.4 bc	1.3
Sanilac 1	75.9 b	79.1 a	79.6 a	81.0 a	2.1
Cass	58.3	57.0	60.1	59.0	3.6
Clinton	57.6	58.7	59.7	63.0	8.3
Isabella	51.5	53.6	54.9	53.3	4.2
Sanilac 2	57.8 d	64.2 c	69.1 b	72.6 a	2.9
Sanilac 3	64.8	64.8	66.6	67.0	2.0
Allegan	33.5 c	35.8 b	39.1 a	39.3 a	1.6
Saginaw	65.1 b	68.8 a	70.9 a	70.0 a	3.5
2020 Average yield	**56.2 c**	**58.4 b**	**60.3 a**	**60.1 a**	**1.3**
	----------------- Income ($/ac) ----------------				
Average income	**$549**	**$563**	**$570**	**$554**	

Seed cost = $62 per 140,000 seed unit

Reducing Soybean Planting Rates

Michigan soybean producers have consistently identified planting rates as the highest priority topic to evaluate in on-farm replicated trials. Furthermore, the producers wanted to evaluate the effect of low planting rates on soybean yield and income. The two factors driving the increased interest in reducing soybean planting rates are seed cost and white mold. To help Michigan soybean producers make planting rate decisions, the Michigan Soybean On-Farm Research Program conducted a total of 58 on-farm replicated trials from 2015 to 2020. Please see Figure 1 for the trial locations.

Figure 1. Soybean planting rate trial locations



Eleven planting rate trials were conducted each year from 2015 to 2017, seven trials were conducted in 2018 and nine trial were conducted in 2019 and 2020. Four target planting rates (80,000, 100,000, 130,000 and 160,000 seeds per acre) were compared at all but one location where the lowest rate was not included. Stand counts were taken to determine actual final plant stands at each location in all years. To calculate the income (gross income minus seed cost) generated by each planting rate, we used the USDA projected prices and average seed costs for treated seed for each year. None of the varieties planted in the trials were straight line or thin line plant types and a complete seed treatment was used at 47 of the locations.

Because we conducted the trials over six years, we learned how the planting rates performed over a range of growing conditions. Planting and emergence conditions were nearly ideal in 2015 but were much more challenging in the following years as evidenced by the average stand loss shown in Table 1. Statewide record yields were achieved in 2015 and again in 2016. However, yields declined significantly in 2017 due to excessive early rains and a lack of rain in August and September. Yields rebounded in 2018 but fell again in 2019 due to planting delays and dry weather in August. 2020 yields varied tremendously due to variable rainfall in August.

Table 1. Average stand loss in the planting rate trials

Year	Average stand loss for all planting rates (percent)
2015	12
2016	18
2017	22
2018	26
2019	22
2020	23

Table 2 shows the average yield and income for all 58 locations. When all 58 sites were combined, the yields from the highest two planting rates were nearly identical and they beat the 100,000 seeds per acre planting rate by one bushel per acre and the 80,000 rate by only 2.8 bushels per acre. The 100,000 seeds per acre planting rate generated the most income while the 160,000 rate produced the least income.

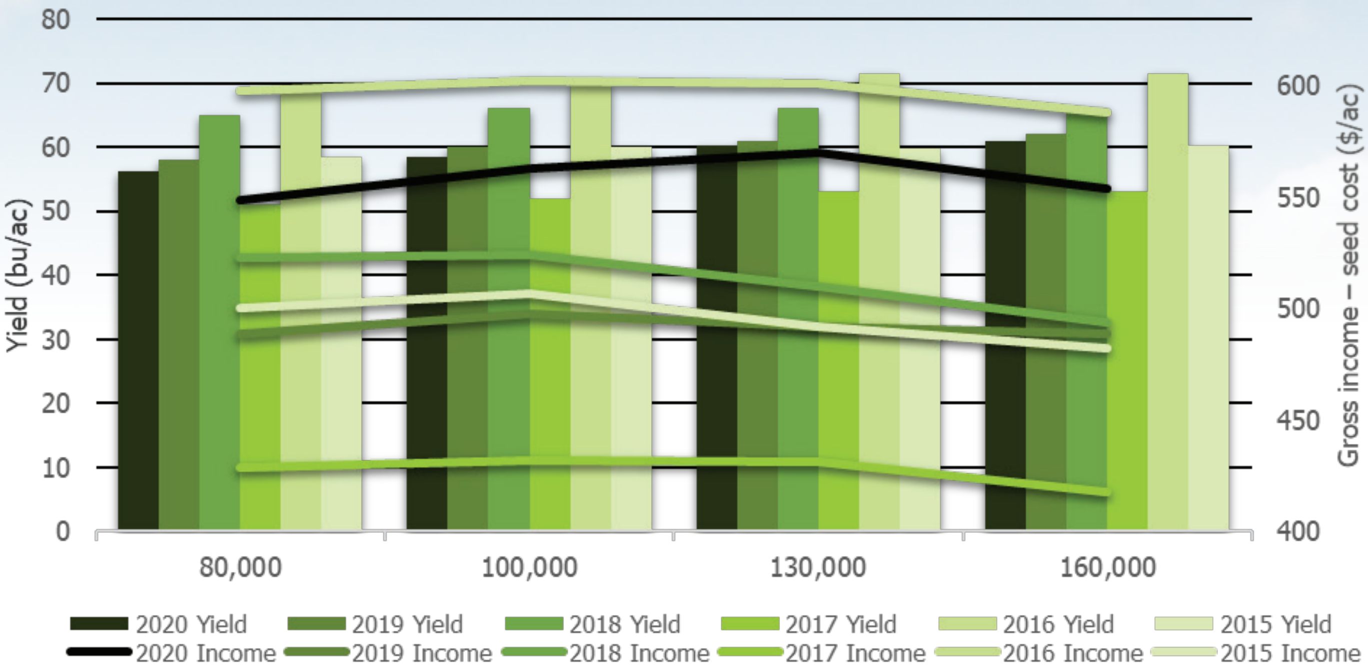
Table 2. Planting rate effects on average yield and income from 2015 to 2020 (all 58 locations)

Planting rate	Average yield (bu/ac)	*Gross income - seed cost ($/ac)
80,000	59.3 c	$582
100,000	60.9 b	$589
130,000	61.8 a	$586
160,000	62.1 a	$575

*Using 2020 figures for seed cost ($62/140,000 seed unit) and market price ($10.40/bushel)

The effects of soybean planting rates on yield and income by year are shown in Figure 2. The bars represent yield and the lines represent income. The figure clearly shows the year-to-year variability in both yield and income. It also shows that the lowest two planting rates were the most profitable in 2015 and 2018 and the highest planting rate was the least profitable each year except for 2020.

Figure 2. Planting rate effect on soybean yield and income from 2015 to 2020

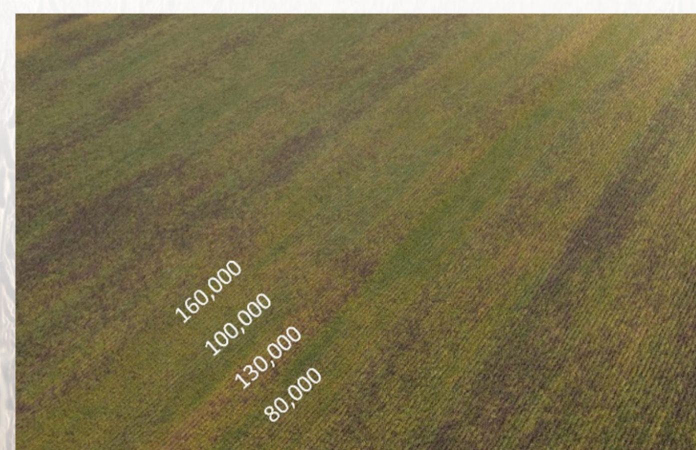


Two of the trials were infested with white mold, which showed that reducing soybean planting rates can also be an effective management practice for reducing yield and income losses from white mold (Table 3). At both sites, the lowest planting rate produced nearly $90.00 per acre more income than the highest planting rate. Figure 3 shows how planting rates affected white mold in the 2018 Saginaw location. This site was planted in 30-inch rows.

Table 3. Soybean planting rate effects on yield and income at two locations infested with white mold

Planting rate	Yield (bu/ac)		Income ($/ac)	
	2015 Sanilac 2	2018 Saginaw	*2015 Sanilac 2	*2018 Saginaw
80,000	63.2 a	66.2 a	$622	$653
100,000	61.1 b	66.5 a	$591	$648
130,000	61.5 b	64.3 a	$582	$612
160,000	57.9 c	61.2 b	$531	$565
$LSD_{0.10}$	1.7	2.4		

Figure 3. Drone image showing planting rate effects on white mold incidence at the 2018 Saginaw trial



Nearly half of the planting rate trials were conducted in Tuscola and Sanilac Counties, so the Thumb area has been well represented. However, we are looking for sites in mid-Michigan, southwest Michigan and southeast Michigan for 2021 as we want producers in these areas to have local research results. We also want to collect enough data to make specific planting rate recommendations based on management practices such as tillage intensity, seed treatments, planting date, row spacing, etc. This trial is easy to conduct when the planter is equipped with electric or hydraulic variable rate drives. Please contact Mike Staton by phone at 269.673.0370 ext. 2562 or by email at staton@msu.edu if you are interested in conducting a soybean planting rate trial on your farm in 2021.

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 in 2019 and 2020.

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 and eight locations in 2020. The early planting dates at the Branch and Bay 20 sites 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: Early planting increased soybean yield by an average of 5.5 bushels per acre at three of the sites (Table 2). However, planting date did not affect soybean yield at the other eight sites. When all 11 sites were combined and analyzed, early planting increased soybean yield by 2.0 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 in 2019 and 2020

Location	Early planting date	Normal planting date	Tillage Fall/Spring	CEC (meq/100g)	Planter	Previous crop	Seed treatment	Row width
Branch 19-1*	April 4	May 5	VT/--	4	JD 1790	Corn	LumiGEN Tech, ILeVO	15
St. Clair 20-2	May 4	May 30	NT	6	JD 1990	Corn	Cruiser Maxx, Vibrance	7.5
Cass 20-1	April 28	May 16	--/D (2x)	4	JD 490**	Corn	Escalate, ILeVO	Twin 12
St. Clair 20-3	May 7	May 22	D/VT	10	Case IH 850	Corn	Quad IM, Nhibit	22
St. Clair 20-1	April 26	May 23	NT	7.5	JD 1795	Corn	LumiGEN Technologies	15
Bay 20	April 18	May 18	DR/FC,R	14	JD 1790	Corn	None	20
Branch 20*	April 11	May 6	VT/--	5	JD DB60	Seed Corn	LumiGEN Tech, ILeVO	20
Bay 19	April 25	May 15	DR/FC,R	14	JD 1790	Corn	Agrishield	20
Branch 19-2	March 29	May 5	NT	5	JD 1790	Corn	LumiGEN Tech, ILeVO	15
Cass 20-2	April 28	May 16	--/D (2x)	4	JD 490**	Corn	Escalate, Nemasect	Twin 12
Lenawee 20	May 7	June 2	NT	--	Kinze	Wheat	None	30

CP = chisel plow, FC = field cultivator, NT = no-till, VT = vertical tillage, SF = soil finisher, DR = disc ripper, D = disc and R = roller

* These were irrigated sites.

** This planter has been modified to plant twin 12" rows on 36" centers.

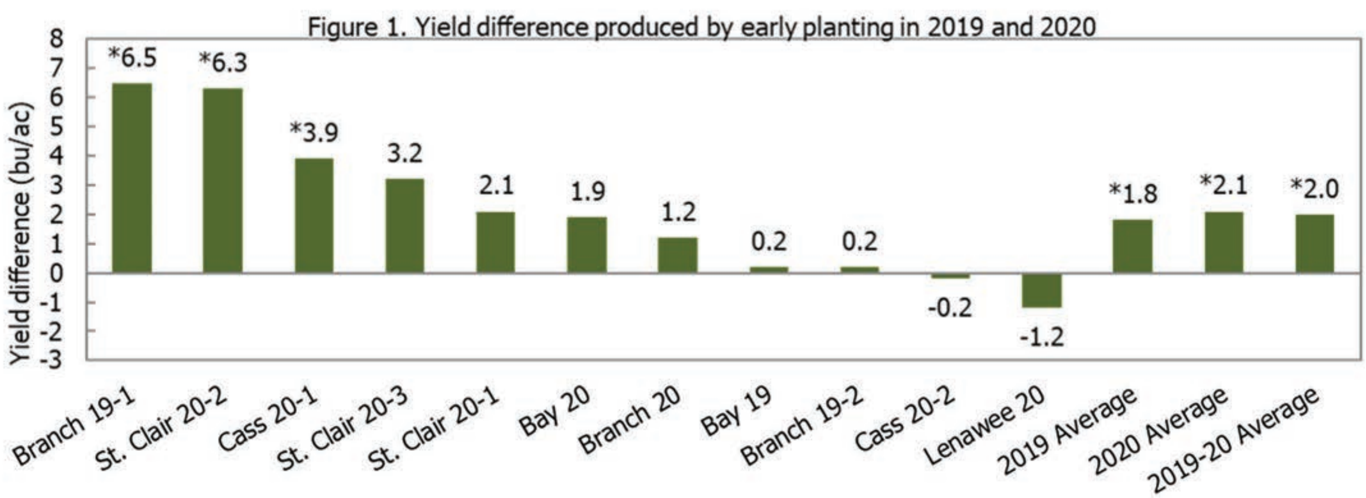
Severe freeze injury to soybean

Freeze injury to unifoliate leaves

Freeze damaged soybean plant producing new shoots

Table 2. The effect of planting date on soybean yield and income in 2019 and 2020

Location	Early planting date	Normal planting date	LSD 0.10	Yield difference
	----------- Yield (bu/ac) ----------			Yield (bu/ac)
Branch 19-1	74.3 a	67.8 b	1.7	6.5
St. Clair 20-2	54.6 a	48.3 b	4.2	6.3
Cass 20-1	44.3 a	40.4 b	1.2	3.9
St. Clair 20-3	68.2	65.0	3.5	3.2
St. Clair 20-1	64.7	62.6	5.2	2.1
Bay 20	73.3	71.4	2.2	1.9
Branch 20	76.7	75.5	4.3	1.2
Bay 19	43.9	43.7	1.7	0.2
Branch 19-2	57.9	57.7	3.1	0.2
Cass 20-2	34.9	35.1	1.5	-0.2
Lenawee 20	53.2	54.4	1.6	-1.2
2019-2020 Average	**58.6 a**	**56.6 b**	**0.8**	**2.0**
	----------- Income ($/ac) ---------			
Average income	**$609**	**$589**		



*The yield difference was statistically significant at these locations.

Soybeans are more resilient than some expect in early planting conditions.

Base Seed Treatment Trial

2020 Base Seed Treatment trial (treated seed on right)

Purpose: The purpose of this trial was to provide an opportunity for cooperators to evaluate the performance of the base seed treatment (multiple fungicides plus an insecticide) of their choosing on their farms from 2017 to 2020.

Procedure: This trial compared two treatments (a base seed treatment including multiple fungicides plus an insecticide vs. untreated seed). Eight trials were conducted in 2017, 13 in 2018, eight in 2019 and two in 2020. The cooperators worked closely with their seed dealers to ensure that all seed planted in each trial was the same variety and came from the same seed lot. We also took final stand counts to determine the effect that seed treatments had on soybean stands.

Results: Base seed treatments increased soybean yield at two locations in 2017, five in 2018, two in 2019 and one in 2020. The Saginaw 19 site showed a yield increase of 10.1 bushels per acre (Table 2) which is an outlier compared to the other 30 sites. The very high clay content (CEC of 18 meq/100g) combined with heavy rainfall events following planting may have contributed to the large yield increase. The site was also injured by a delayed pre-emergence herbicide application in 2019. At the Cass 19-2 site, the seed treatment reduced yield by 2.8 bushels per acre.

When all 31 sites were combined and analyzed, the complete seed treatments increased soybean yields by 1.4 bushels per acre. This is slightly more than the 1.3 bushels per acre required to recoup the cost of a base fungicide plus insecticide seed treatment costing $14.00 per acre.

The seed treatments led to significantly higher final plant stands at eight of the 31 locations (two in 2017, three in 2018, two in 2019 and one in 2020). However, seed treatment significantly reduced plant stands at one location in 2019 as the treated seed did not plant at the same rate as the untreated seed. When all sites were combined and analyzed, the base seed treatments increased plant stands by 4,800 plants per acre.

We appreciate the help provided by local seed dealers.

Phytophthora root and stem rot damage to soybeans

Close up of soybeans damaged by *Phytophthora*

Table 1. 2020 Seed treatments, varieties, phytophthora genes/tolerance rating, tillage practices and planting dates.

Location	Seed treatment	Variety	Phytophthora gene/tolerance	Tillage fall/spring	Planting date
Saginaw 20	Stine XP F+I	Stine 19GA02	None/Very good	NT	May 4
Sanilac 20	DFender	DF 227	1a/1.8 (1=best, 5=worst)	NT	May 14

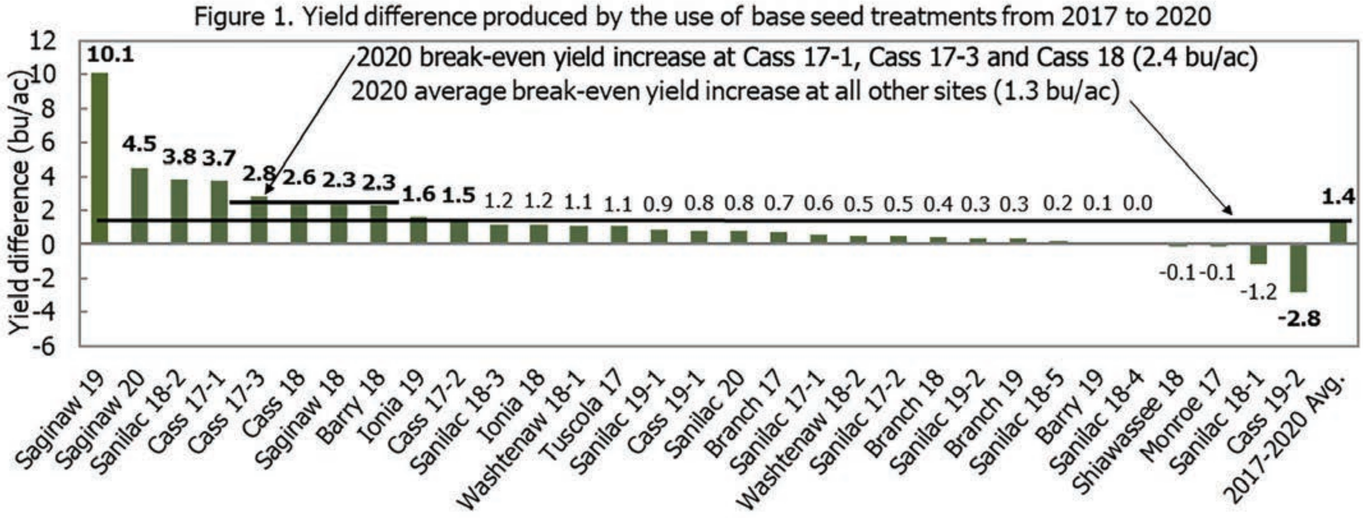
CP = chisel plow, FC = field cultivator, NT = no-till, VT = vertical tillage, SF = soil finisher and DR = disc ripper

Table 2. The effect of base seed treatments on soybean yield and income in 2020

Location	Untreated control	Treated seed	LSD $_{0.10}$	Yield difference
	--------- Yield (bu/ac) --------			Yield (bu/ac)
Saginaw 20	51.1 b	55.6 a	3.3	4.5
Sanilac 20	57.8	58.6	2.7	0.8
Average (2020)	**54.5 b**	**57.1 a**	**2.1**	**2.5**
	-------- Income ($/ac) -------			
***Average income**	**$567**	**$580**		

*Using an average cost for base seed treatments (fungicide mix + insecticide) of $14.00 per acre

Figure 1. Yield difference produced by the use of base seed treatments from 2017 to 2020



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

Table 3. The effect of base seed treatment on final plant stands in 2020

Location	Untreated control	Treated seed	LSD $_{0.10}$	Stand difference
	-------- Plant stand (plants/ac) --------			(plants/ac)
Saginaw 20	70,700 b	80,600 a	5,173	9,900
Average (2017-2020)	**99,300 b**	**104,100 a**	**1,752**	**4,800**

Stand counts were not taken at the Sanilac 20 location.

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 evaluate the effect that Saltro, a new seed treatment from Syngenta, had on SDS foliar disease symptoms, yield and income.

Procedure: This trial compared two treatments (base seed treatment with Saltro vs. the same base seed treatment without Saltro). This trial was conducted at two locations having a history of SDS. We sampled both fields to determine the soybean cyst nematode (SCN) population levels and rated each treatment for SDS.

Results: The Saltro seed treatment increased soybean yields at both sites with an average yield increase of 3.8 bushels per acre. Saltro also increased income by $26.00 per acre, making this a profitable investment at these locations having a history of SDS.

There were two additional points these trials demonstrated. The first is that the Saltro seed treatment increased yields even though SDS-tolerant varieties were planted at both sites. The second is that SCN was not detected at either site, supporting the concept that SDS can occur in fields without detectable SCN populations.

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

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

Location	Planting date	Tillage	Variety	SDS tolerance	SCN resistance source	Base seed treatment	Baseline SCN population
Calhoun 2	April 24	VT	Stine 30EA23	Very good	PI88788	Vibrance Trio	Zero detected
Calhoun 1	April 24	VT	Stine 28EA02	Good	PI88788	Vibrance Trio	Zero detected

VT = vertical tillage

Table 2. The effect of Saltro seed treatment on soybean yield and income in 2020

Location	Base seed treatment without Saltro	Base seed treatment with Saltro	LSD $_{0.10}$	Yield difference
	----------- Yield (bu/ac) ----------			Yield (bu/ac)
Calhoun 2	61.2 b	65.3 a	2.4	4.1
Calhoun 1	59.4 b	62.9 a	2.0	3.5
Average	**60.3 b**	**64.1 a**	**1.3**	**3.8**
	----------- Income ($/ac) ---------			
Average income	**$627**	**$653**		

Saltro cost in 2020 = $13.25/140,000 seeds

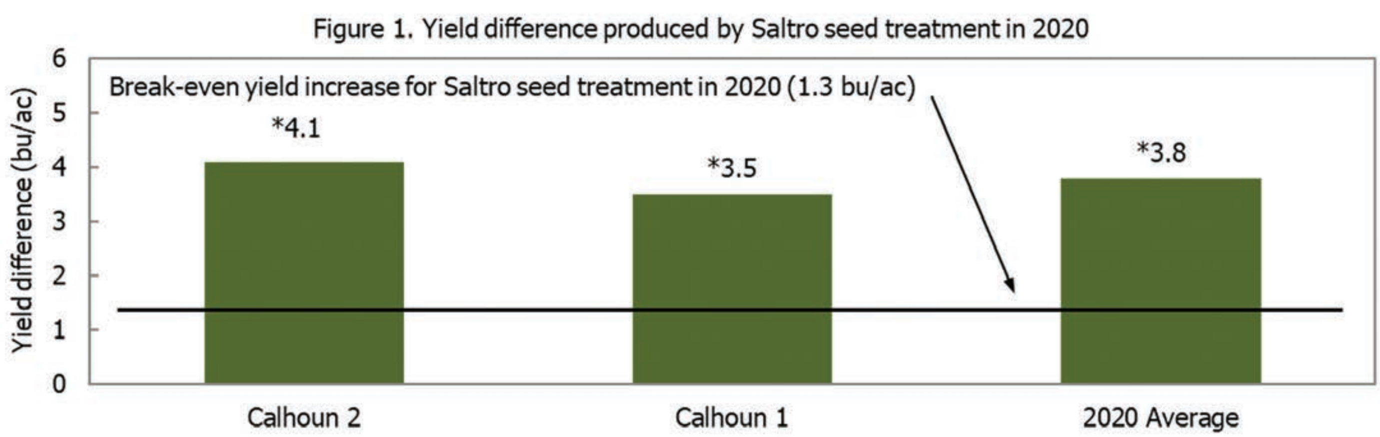
Table 3. The effect of Saltro seed treatment on Sudden Death Syndrome foliar symptoms at the Calhoun 2 site in 2020

Treatment	SDS incidence (percent of plants infected)	*SDS disease severity index (DSI rating)
Base seed treatment without Saltro	38.3 a	11.9 a
Base seed treatment with Saltro	16.7 b	4.4 b
LSD $_{0.10}$	8.5	3.2

* SDS disease severity rating (DSI) is calculated using the following formula: incidence x a visual severity rating ÷ 9.

SDS at the Calhoun 2 trial (left side is treated)

Close up of SDS foliar symptoms



*The yield difference was statistically significant at these locations.

Saltro improved soybean yield by almost four bushels per acre where SDS foliar symptoms were present.

Row Spacing Trial

Purpose: Many of the soybean acres in the state are planted in 15-inch rows using planters equipped with interplant units. These planters are significantly more expensive than planters of comparable width set up for 30-inch rows and producers want to know if the extra expense is justified. The purpose of this trial was to evaluate how two common row spacings affected soybean yield and income in 2019 and 2020.

Procedure: Two row spacings (15 inches and 30 inches) were compared at two locations in 2019 and six sites in 2020. All trials were planted with planters equipped with interplant units and planting rates were kept the same (approximately 130,000 seeds/acre) regardless of row spacing except for the Saginaw 20 site. Stand counts were taken to determine the effect row spacing would have on final plant stands.

Harvesting Tuscola County row spacing trial

Results: The 15-inch rows produced higher yields than the 30-inch rows at three of the eight sites. When all locations were combined, the 15-inch rows produced 2.1 bushels per acre more than the 30-inch rows. Final plant stands were significantly different at four sites (Table 3). Operator and equipment error were responsible at two of these. At the Tuscola 20 site, the guidance system was off causing some of the 15-inch rows to be planted directly on the previous year's corn rows. At the Saginaw 20 site, the planting rate was not adjusted when moving from 15-inch to 30-inch rows. The 30-inch rows may perform better in fields with a history of white mold or prone to crusting.

Table 1. Background information for the row spacing trials conducted in 2019 and 2020

Location	Tillage Fall/spring	Planter/drill	Previous crop	Planting date	Variety	Plant type/canopy width
Shiawassee 20-1	CP/SF	JD 1790 12/24	Corn	May 7	GH 2610E3	Medium
Tuscola 19	CP/FC, R	JD 1790 12/23	Corn	May 11	Pioneer P24A80	5 (9=bushy, 1=narrow)
Shiawassee 19	CP/FC	JD 1790 12/24	Corn	May 15	LG 2942	Medium Bush
Tuscola 20	NT	JD 1790 12/23	Corn	May 6	DF 5173 NR2Y	Medium
Shiawassee 20-3	DR/FC	JD 1795 16/32	Wheat	May 12	Dyna Gro 2409	Moderately bushy
Shiawassee 20-2	CP/SF	JD 1790 12/24	Corn	May 7	GH 2041X	Medium
Monroe 20	--/D	JD 1780 12/23	Corn	April 28	Wellman 6928E	2.4 (1=narrow, 5=bushy)
Saginaw 20	NT	JD 1790 16/32	Corn	May 4	Dairyland 2259E	4 (1=bushy, 9=narrow)

CP = chisel plow, FC = field cultivator, NT = no-till, VT = vertical tillage, SF = soil finisher, DR = disc ripper, D = disc and R = roller

30-inch row soybeans

Row spacing trial in Shiawassee County

Roger Betz, MSU Farm Management educator, generated a partial budget comparing the economics of purchasing a 12/24 interplant planter vs. a 12-row 30-inch planter. This analysis showed that the 15-inch rows increased income by $448 per year over the life of the planter. The assumptions used in the analysis are listed below:

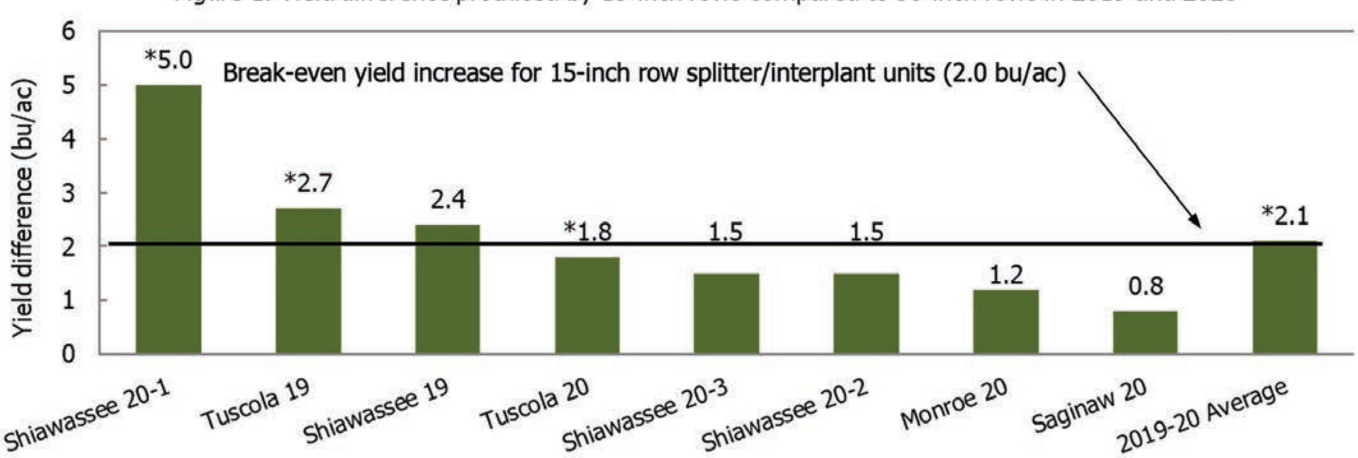
- 15 percent rate of return on investment
- 2.1 bushels per acre yield increase
- Soybean market price of $9.00 per bushel (10-year projection)
- 500 acres of soybeans per year
- Planter life of 10 years
- $50,000 higher cost for the interplant planter
- $7500 salvage value

Table 2. The effect of row width on soybean yield and income in 2019 and 2020

Location	15-inch rows	30-inch rows	LSD 0.10	Yield difference
	----------- Yield (bu/ac) ----------			Yield (bu/ac)
Shiawassee 20-1	49.3 a	44.3 b	2.1	5.0
Tuscola 19	59.2 a	56.5 b	1.3	2.7
Shiawassee 19	32.8	30.4	3.6	2.4
Tuscola 20	63.0 a	61.2 b	0.8	1.8
Shiawassee 20-3	64.1	62.6	2.4	1.5
Shiawassee 20-2	62.5	61.0	2.2	1.5
Monroe 20	49.9	48.7	2.6	1.2
Saginaw 20	66.5	65.7	1.7	0.8
2019-2020 Average	**55.9 a**	**53.8 b**	**0.6**	**2.1**
	----------- Income ($/ac) ---------			
Average income	**$564**	**$560**		

Increased cost per acre to own and operate a 12/24 15-inch row planter given 500 acres of soybeans per year for 10 years = $18.00 per acre.

Figure 1. Yield difference produced by 15-inch rows compared to 30-inch rows in 2019 and 2020



*The yield difference was statistically significant at these locations.

Table 3. The effect of row spacing on final plant stands in 2019 and 2020

Location	15-inch rows	30-inch rows	LSD 0.10	Stand difference
	----- Plant stand (plants/ac) -----			Plant stand (plants/ac)
Shiawassee 20-1	110,200	104,600	5,979	5,600
Tuscola 19	114,200	111,500	2,912	2,700
Shiawassee 19	95,100 a	85,300 b	6,904	9,800
Tuscola 20	83,500 b	104,500 a	7,142	-21,000
Shiawassee 20-3	124,200	126,400	4,949	-2,200
Shiawassee 20-2	90,900 a	86,000 b	2,019	4,900
Saginaw 20	102,800 a	57,300 b	9,906	45,500
2019-2020 Average	**101,800**	**97,700**	**4,202**	**4,100**

Stand counts were not taken at the Monroe 20 trial location.

Tillage Trial

Purpose: The purpose of this trial was to evaluate how a single pass of any tillage implement selected by the trial cooperators affected soybean yield and income in 2019 and 2020.

Procedure: A single tillage pass was compared to an untilled control at two locations in 2019 and three locations in 2020. A fourth trial conducted in 2020 compared a spring chisel plowing followed by a soil finisher to an untilled control. All tillage operations were performed in the spring and the tillage tools used at each site are listed in Table 1. We took stand counts to determine the effect tillage operations would have on final plant stands.

Water erosion in soybeans

Results: Tillage increased soybean yield at only one of the six locations (Table 2). The 3.5 bushel per acre increase at this site increased income by $17.00 per acre. However, the tillage operations were not profitable at the other five locations. When all six sites were combined and analyzed, tillage increased yield by 1.3 bushels per acre but did not increase income. This is consistent with tillage research results from the northern U.S., Canada and in Michigan. The soybean yield increase produced by tillage operations is typically not enough to outweigh the lower costs and the conservation benefits of no-till.

Tillage produced mixed results on final plant stands. At the Barry 20 site, the two tillage operations increased stands by 16,700 plants per acre. At the Isabella 20 site, a single pass of a disk reduced the final stand by 3,500 plants per acre.

Despite the lack of consistent economic returns to tillage, many producers feel that tilling the soil prior to planting soybeans offers other benefits including: improved marestail control; improved planter/drill performance; and the ability to dry out the soil surface and allow earlier planting under wet soil conditions. There are conflicting reports about how spring tillage affects spring planting progress. Some producers feel that operating a high-speed disk like the Pro-Till at very shallow depths has allowed them to plant sooner. Others feel that a stale seedbed or untilled soil facilitated earlier planting.

Table 1. Background information for the tillage trials conducted in 2019 and 2020

Location	Tillage tool	Planter/drill	Previous crop	Planting date	Seed treatment	Row width
Ottawa 20	Vertical tillage	JD 7000	Corn	May 25	Escalate	30″
Barry 20	Chisel, finisher	JD1780	Corn	May 7	None	30″
Isabella 20	JD 230 disk	JD 750	Corn	June 8	Nforce ST	15″
Shiawassee 19	Degelman Pro-Till	JD 1990	Corn	June 18	LumiGEN Tech	15″
Isabella 19	JD 230 disk	JD 750	Corn	June 8	Eclipse, Quad IM	15″
Cass 20	Soil finisher	JD 1790	Corn	May 21	None	15″

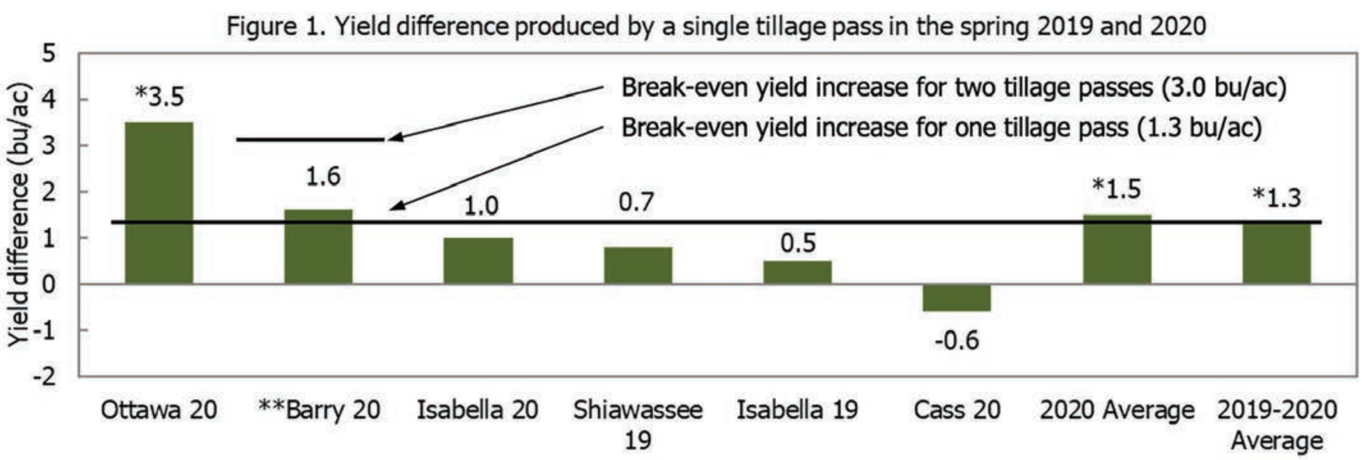
Table 2. The effect of a single spring tillage pass on soybean yield and income in 2019 and 2020

Location	Untilled control	Single tillage pass	LSD $_{0.10}$	Yield difference
	------------ Yield (bu/ac)	-----------		Yield (bu/ac)
Ottawa 20	58.3 b	61.8 a	1.3	3.5
Barry 20	32.6	34.2	2.5	1.6
Isabella 20	48.9	49.9	1.6	1.0
Shiawassee 19	55.8	56.6	1.6	0.8
Isabella 19	55.3	55.8	0.8	0.5
Cass 20	35.3	34.7	2.3	-0.6
2019-2020 Average	**47.6 b**	**48.9 a**	**0.6**	**1.3**
	------------ Income ($/ac)	----------		
Average income	**$495**	**$495**		

Cost of one tillage pass = $14.00 per acre

Degelman Pro-Till 33/40

Soybeans do not respond to tillage in many cases.



*The yield difference was statistically significant at this location.

** Tillage at the Barry site included two passes – chisel plow followed by a soil finisher.

Table 3. The effect of a single spring tillage pass on soybean plant stand in 2019 and 2020

Location	Seeding rate	Untilled control	Single tillage pass	LSD $_{0.10}$	Stand difference
	Seeds/acre	Final plant stand (plants per acre)			Plants per acre
Ottawa 20	96,000	81,200	80,400	3,384	-800
Barry 20	120,000	54,000 b	70,700 a	15,297	16,700
Isabella 20	130,000	58,200 a	54,700 b	3,059	-3,500
Shiawassee 19	165,000	118,700	119,300	19,205	600
Isabella 19	154,000	72,800	77,300	11,606	4,500
Cass 20	156,000	107,000	108,200	4,916	1,200
Average		**82,500**	**84,500**	**3,114**	**2,000**

Rye Termination Timing Trial

Purpose: Cover crop acres are increasing in Michigan and cereal rye is one of the most popular covers. Planting soybeans prior to terminating rye cover crops is gaining popularity as it has been shown to help manage herbicide-resistant marestail and may also reduce the severity of white mold infestations. The purpose of this trial is to evaluate rye cover termination timing effects on soybean yield and income in 2020.

Soybeans growing through terminated rye
Photo credit: Dean Baas

Procedure: This trial compared two treatments (planting before terminating a rye cover crop vs. planting after terminating the rye cover). Three rye cover crop termination trials were conducted in 2020. We took final stand counts to determine the effect that rye termination timing had on soybean stands.

Results: Rye termination timing did not affect soybean yields at any of the individual trial locations or when all three sites were combined and analyzed. Final plant stands were also unaffected by rye termination timing. The results from these trials are positive, as it gives producers greater flexibility regarding the cover crop termination timing without a yield penalty.

Table 1. Planting dates, planting rates, planter/drill, rye termination dates and burndown herbicides

Location	Planting date	Planting rate	Planter/drill	Early rye termination date	Late rye termination date	Burndown herbicide
Jackson 1	May 21	140,000	White 9936	May 4	May 22	Glyphosate
Sanilac	May 31	155,000	Kinze 3500	May 26	June 1	Roundup, Antaris, Metribuzin
Jackson 2	May 21	140,000	White 9936	May 4	May 22	Glyphosate, Zidua Pro

Table 2. The effect of rye cover crop termination timing on soybean yield and income in 2020

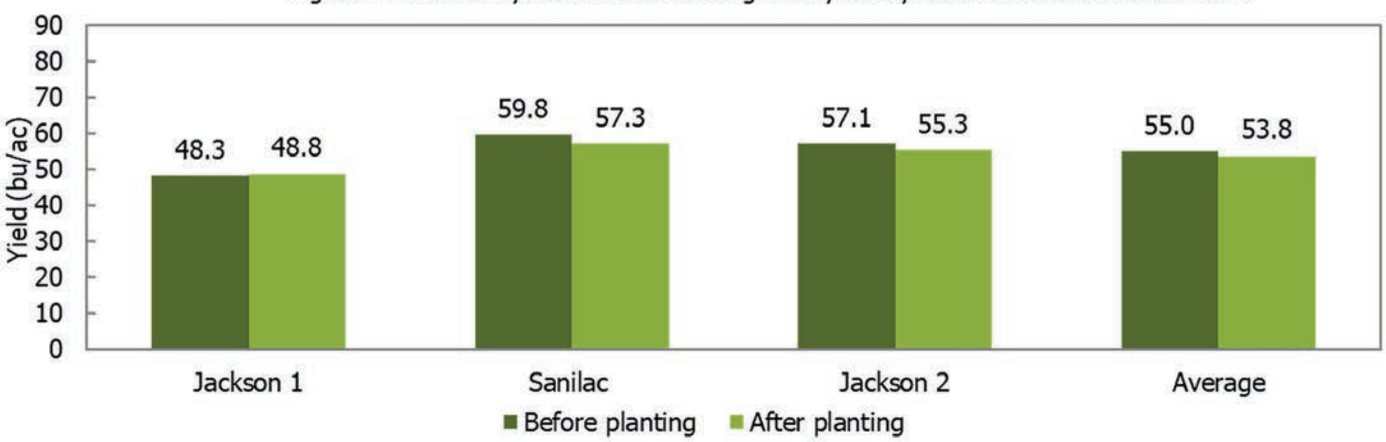
Location	Controlled prior to planting	Controlled after planting	LSD $_{0.10}$	Yield difference
	----------- Yield (bu/ac)	----------		Yield (bu/ac)
Jackson 1	48.3	48.8	2.1	0.5
Sanilac	59.8	57.3	2.6	-2.5
Jackson 2	57.1	55.3	3.9	-1.8
Average	**55.0**	**53.9**	**1.6**	**-1.1**
	----------- Income ($/ac)	---------		
Average income	**$572**	**$561**		

Termination timing of rye cover crops prior to soybean emergence did not affect soybean yield.

Table 3. The effect of rye cover crop termination timing on final plant stands in 2020

Location	Controlled prior to planting	Controlled after planting	LSD $_{0.10}$	Stand difference
	------- Plant stand (plants/ac) -------			Plant stand (plants/ac)
Jackson 1	78,200	77,400	4,272	-800
Sanilac	118,900	121,500	9,159	2,600
Jackson 2	73,100	76,300	6,651	3,200
Average	**89,900**	**91,900**	**3,533**	**3,000**

Figure 1. Effect of rye termination timing on soybean yield at three locations in 2020



The termination timing dates did not significantly affect soybean yields at any of the locations.

Planting soybeans green

Photo credit: Dean Baas

NDemand® 88 Trial

Purpose: NDemand 88 is a liquid fertilizer marketed by Wilbur Ellis that is compatible with the post-emergence herbicides labeled in Michigan. The purpose of this trial was to evaluate how tank mixing the foliar fertilizer with various post-emergence herbicides affected soybean yield and income in 2020.

Field view of manganese deficient soybeans

Procedure: This trial compared two treatments (post-emergence herbicide(s) mixed with NDemand 88 vs. the same post-emergence herbicide(s) applied without NDemand 88) at ten locations in 2020. NDemand 88 was applied at one quart per acre. The analysis of NDemand 88 is 10-8-8 plus 2 percent sulfur, 0.25 percent boron, 0.06 percent copper, 0.25 percent manganese and 0.25 percent zinc. Soil samples were collected from each location and key nutrient levels for each site are presented in Table 1. Planting dates, fertilizer applications, herbicide names and rates and application dates for each site are listed in Table 2.

Results: The NDemand 88 produced a statistically significant yield increase at one location (Sanilac-1) in 2020 and when all 10 individual trial sites were combined and analyzed. Due to the low cost of the product ($4.12 per acre) and the fact that we did not add an additional application cost, the NDemand 88 application was profitable at Sanilac-1 and when all sites were combined.

We want to thank Wilbur Ellis for contributing the NDemand 88 for this trial.

Table 1. Soil test levels at the 2020 NDemand 88 trial locations

Location	CEC	Phosphorus	Potassium	Sulfur	Zinc	Soil pH
	meq/100g	-------------	Parts per million	--------------	Percent	1:1
Sanilac-1	6.5	**12**	144	**6**	4.0	7.1
Sanilac-2	7.2	**7**	198	**6**	4.7	6.9
Cass-3	5.0	33	214	**4**	4.1	6.8
Cass-1	3.6	106	123	**3**	5.6	6.9
Cass-2	5.0	33	214	**4**	4.1	6.8
Calhoun	5.4	80	119	**4**	7.3	6.8
Van Buren	6.0	48	231	9	4.0	6.0
Lenawee	12.0	52	130	9	4.3	6.5
Sanilac-3	8.3	**15**	118	**7**	4.1	7.0
Monroe	12.0	29	111	9	4.0	6.0

Bold figures indicate low or very low soil test levels.

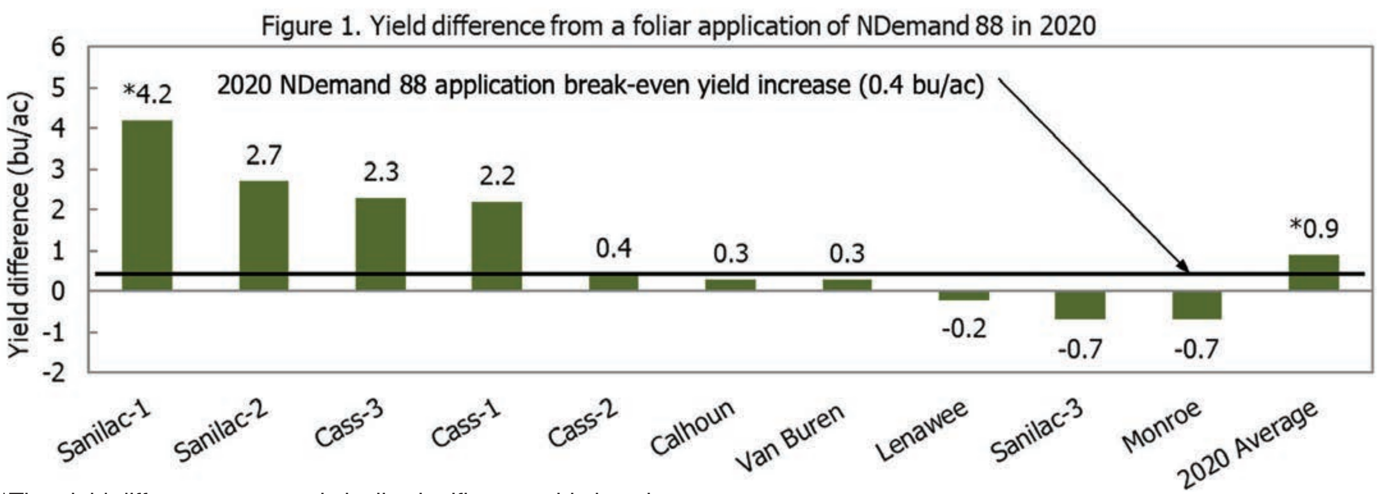
Table 2. Planting dates, fertilizers applied, herbicides and application dates at the trial locations

Location	Planting date	Fertilizer applied, rate	Herbicides, rates per acre	Application date
Sanilac-1	May 7	0-0-60, 200 lbs/ac	Roundup PowerMax, 32 oz	July 14
Sanilac-2	May 3	0-0-60, 200 lbs/ac	Reflex, 1pt/ac & Raptor, 5 oz	June 30
Cass-3	May 13	None	Volunteer, 6 oz, Liberty, 32 oz, Diplomat, 1qt	June 24
Cass-1	May 14	9-23-30, 150 lbs/ac	Glyphosate, 1qt	July 7
Cass-2	May 22	None	Volunteer, 6 oz, Liberty, 32 oz, Diplomat, 1qt	June 24
Calhoun	May 10	21-0-0-24,	Roundup, 32 oz, Lightning,32 oz	June 29
Van Buren	June 2	0-0-60, 125 lbs/ac	Glyphosate, 1qt	July 2
Lenawee	May 7	10-20-10, 3gals/ac	Cornerstone Plus	July 8
Sanilac-3	May 5	None	Basagran, 24 oz, Cadet, 0.5 oz & Clethodim, 8 oz	June 22
Monroe	May 7	None	Glyphosate, 42 oz	July 7

Table 3. The effect of a single application of NDemand 88 on soybean yield and income in 2020

Location	Untreated control	NDemand 88	LSD 0.10	Yield difference
	------- Yield (bu/ac) ---------			Yield (bu/ac)
Sanilac-1	44.5 b	48.7 a	2.7	4.2
Sanilac-2	37.8	40.5	3.1	2.7
Cass-3	67.1	69.4	4.8	2.3
Cass-1	29.1	31.3	3.5	2.2
Cass-2	67.7	68.1	3.8	0.4
Calhoun	34.7	35.0	2.5	0.3
Van Buren	52.7	53.0	2.2	0.3
Lenawee	51.4	51.2	1.4	-0.2
Sanilac-3	70.7	70.0	1.1	-0.7
Monroe	58.2	57.5	1.2	-0.7
Average	**51.5 b**	**52.4 a**	**0.6**	**0.9**
	----------- Income ($/ac) ---------			
Average income	**$536**	**$541**		

NDemand 88 cost = $4.12 per acre



*The yield difference was statistically significant at this location.

Foliar fertilizers are more likely to be profitable when a low cost product is combined with an existing sprayer pass.

Close-up of manganese deficient soybeans

Miravis® Neo Foliar Fungicide Trial

Purpose: Miravis Neo is a new foliar fungicide from Syngenta that is being promoted as having broad disease control and promoting plant health. The purpose of this trial was to evaluate how a foliar application of Miravis Neo affected soybean yield and income in 2020.

Procedure: A foliar application of Miravis Neo was compared to an untreated control at fourteen locations in 2020. The Miravis Neo was applied at 13.7 ounces per acre at the R3 growth stage. Application dates, application characteristics and rainfall information for each site was gathered and is 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 Miravis Neo increased soybean yields at five of the 15 individual trial locations. When all 15 locations were combined and analyzed, the fungicide application increased soybean yields by two bushels per acre.

After accounting for product and application costs, the fungicide was profitable at only two of the locations and was not profitable when all sites were combined. The lack of a consistent economic response to the foliar fungicide is probably due to the fact that foliar diseases such as Frogeye leaf spot are not common in Michigan and the dry weather reduced the potential for disease development.

We want to thank Syngenta for donating the products for these trials.

Table 1. Application dates, volume, pressure, groundspeed and rainfall information for the Miravis Neo 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)**
Cass	July 15	16	45	5	5.50	45
Berrien-1	July 29	20	60	7	5.14	48
Berrien-2	July 25	20	35	9	5.14	48
Branch	August 10	20	60	9	5.96	45
Sanilac-1	July 20	20	50	7	5.65	59
Sanilac-2	July 9	20	40-50	9	5.65	59
Washtenaw	July 24	30	40	3	5.21	67
Allegan	July 20	25	45	8.6	5.95	47
Ionia	July 14	15	35	11	8.11	58
Ottawa-2	July 9	15	50-60	9-10	6.18	37
Van Buren	August 6	20	35	5	5.86	47
Isabella	July 23	18.2	40	8.6	3.56	74
Berrien-3	July 31	20	45	7	5.14	48
Ottawa-1	July 9	15	50-60	9-10	6.18	37

*Rainfall data was obtained from the nearest MSU Enviroweather station

Foliar fungicide use without significant soybean disease pressure did not consistently increase yields.

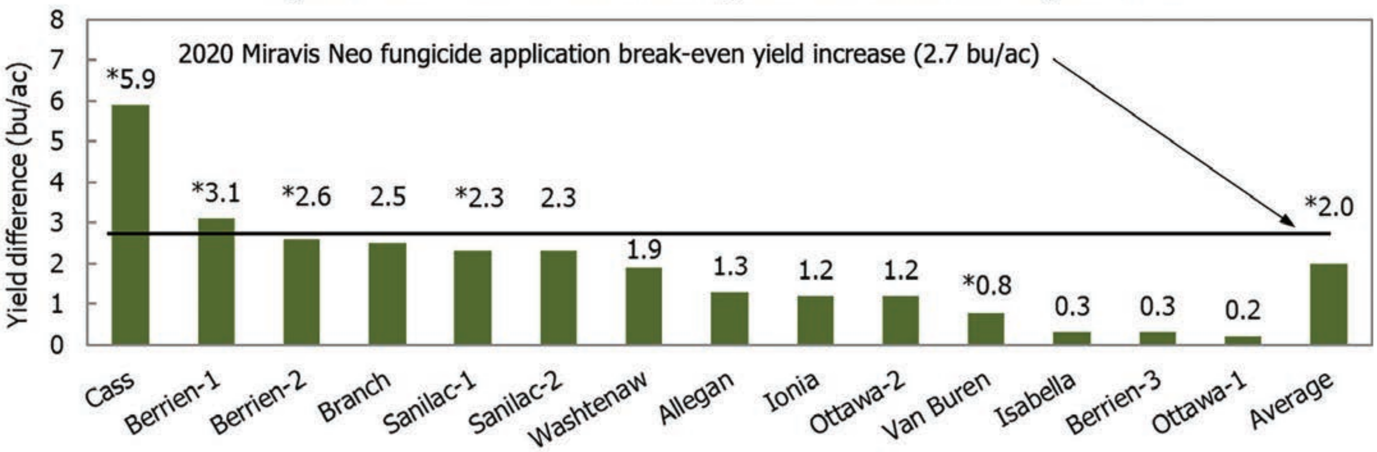
Table 2. The effect of a single application of Miravis Neo on soybean yield and income in 2020

Location	Untreated control	Miravis Neo	LSD 0.10	Yield difference
	-------- Yield (bu/ac) ----------			Yield (bu/ac)
Cass	54.2 b	60.1 a	3.2	5.9
Berrien-1	71.9 b	75.0 a	2.0	3.1
Berrien-2	46.8 b	49.4 a	2.5	2.6
Branch	65.6	68.1	2.7	2.5
Sanilac-1	63.1 b	65.4 a	1.7	2.3
Sanilac-2	60.4	62.7	3.1	2.3
Washtenaw	58.2	60.1	2.0	1.9
Allegan	64.8	66.1	1.9	1.3
Ionia	44.5	45.7	1.5	1.2
Ottawa-2	64.1	65.3	3.2	1.2
Van Buren	47.7 b	48.5 a	0.7	0.8
Isabella	40.5	40.8	2.3	0.3
Berrien-3	48.3	48.6	1.3	0.3
Ottawa-1	61.7	61.9	2.2	0.2
Average	**56.5 b**	**58.5 a**	**0.6**	**2.0**
	------------ Income ($/ac) ----------			
Average income	**$588**	**$580**		

Miravis Neo cost = $20.00 per acre

Application cost = $8.00 per acre

Figure 1. Yield difference from a foliar application of Miravis Neo fungicide in 2020



*The yield difference was statistically significant at these locations.

White Mold Fungicide Comparison Trial

Purpose: Fungicides can be an important tool for managing white mold. This trial evaluated the effect of two foliar fungicide programs on soybean yields and income in 2019 and 2020.

Procedure: This trial consisted of three treatments: 1) sequential applications of Cobra® followed by Aproach®; 2) a single application of Propulse®; and 3) an untreated control. The trial was conducted at three locations in 2019 and four locations in 2020. All products were applied at labeled rates (6 ounces per acre for Cobra, 9 ounces per acre for Aproach and 8 ounces per acre for Propulse). The Cobra was applied when the first blossoms appeared and the Aproach and Propulse were applied 10 to 14 days later. To eliminate sprayer tracks from affecting the results, tracks were either present or absent in all the harvested strips in a given trial. White mold incidence was also determined.

Results: All seven sites had a history of white mold. However, environmental conditions favoring disease development did not occur at any of the locations, resulting in very low incidence of white mold. These sites demonstrate how the foliar fungicide programs affected soybean yield and income in the absence of white mold pressure. Propulse increased soybean yields over the untreated control at four of the seven locations (Sanilac 19, Allegan 19, Van Buren 20 and Eaton 20) and when all seven sites were combined (Table 2). However, the Cobra followed by Aproach program did not perform better than the untreated control at any of the sites and reduced yield at the Van Buren 20 site, possibly due to a later than recommended application of Cobra. This is consistent with previous research conducted in Michigan which concluded that Cobra improved yield when white mold occurred, but reduced yield when the disease did not develop. The Propulse treatment was profitable at the Sanilac 19 and the Allegan 19 sites using the $10.40 per bushel commodity price. Propulse was also profitable at the Eaton 20 location when adding the $5.00 per bushel premium for the natto beans grown at this site.

We want to thank Valent, Bayer Crop Science and Corteva Agriscience for donating products.

White mold apothecia

Immature bird's nest apothecia
Photo: Dr. Martin Chilvers

Mature bird's nest apothecia
Photo: Dr. Martin Chilvers

The lower cost fungicide program was more profitable in years of reduced white mold pressure.

Table 1. Varieties, 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	Row spacing	*Application dates
Sanilac 19	AG23X8	4 (1 = excellent, 9 = poor)	May 24	140,000	20″	7/22 & 8/6
St. Joseph 19	AG30X6	6 (1 = excellent, 9 = poor)	June 2	139,000	20″	7/30 & 8/8
Allegan 19	DF 278	1.5 (1 = best, 5 = worst)	May 15	130,000	Twin 7″	7/11 & 7/22
Van Buren 20	Dyna Gro 28GL80	5 (1 = poor, 9 = excellent)	June 6	155,000	15″	7/25 & 8/6
Allegan 20	DF 278	1.5 (1 = best, 5 = worst)	May 12	130,000	Twin 7″	7/6 &717
Eaton 20	NG 9430	Very poor	June 1	140,000	15″	7/28 & 8/6
Sanilac 20	AG21X7	5 (above average)	May 11	150,000	20″	7/13 & 7/28

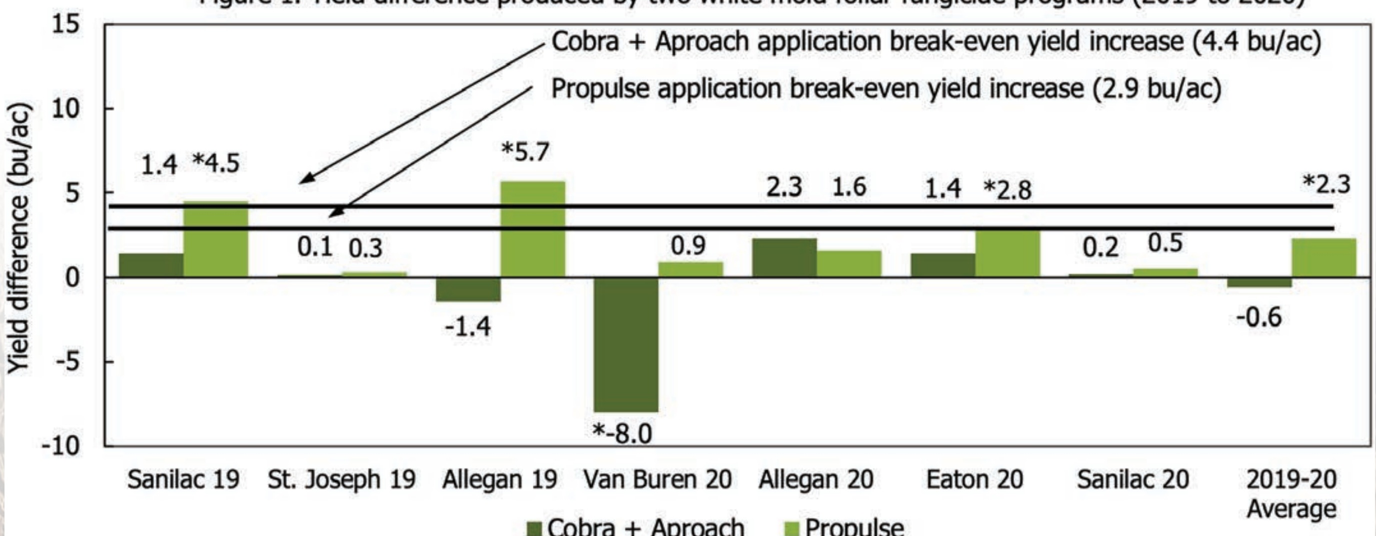
* The first application date is for Cobra and the second date is for Aproach and Propulse

Table 2. White mold foliar fungicide program effect on soybean yield and income in 2019 and 2020

	Untreated control	Cobra + Approach	Propulse	LSD $_{0.10}$
	------------------- Yield (bu/ac) ------------------			
Sanilac 19	53.8 b	55.2 b	58.3 a	2.9
St. Joseph 19	66.5	66.6	66.8	2.9
Allegan 19	67.9 b	66.5 b	73.6 a	1.6
Van Buren 20	52.8 a	44.8 b	53.7 a	3.0
Allegan 20	66.7	69.0	68.3	3.4
Eaton 20	44.6 b	46.0 ab	47.4 a	1.5
Sanilac 20	57.2	57.4	57.7	3.3
Average	**58.5 b**	**57.9 b**	**60.8 a**	**1.2**
	----------------- Income ($/ac) -----------------			
Average income	**$608**	**$557**	**$602**	

Cobra + Aproach cost = $29.32 per acre, Propulse cost = $22.19 per acre, application cost = $8.00 per acre

Figure 1. Yield difference produced by two white mold foliar fungicide programs (2019 to 2020)



*The yield difference between the fungicide programs and the control was statistically significant at these locations.
The yield difference between the fungicide programs was statistically different at only the Sanilac 19, Allegan 19 and Van Buren 20 locations.

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 resistant/tolerant varieties, wide rows, reduced planting rates, tillage decisions and irrigation water management. Properly timing fungicide applications is essential for success but challenging for producers. The purpose of this trial was to determine the effect that fungicide application timing had on soybean yield and income in 2018, 2019 and 2020. Another goal was to use the yield data from this trial to validate Sporecaster, a new white mold apothecia prediction app for smartphones.

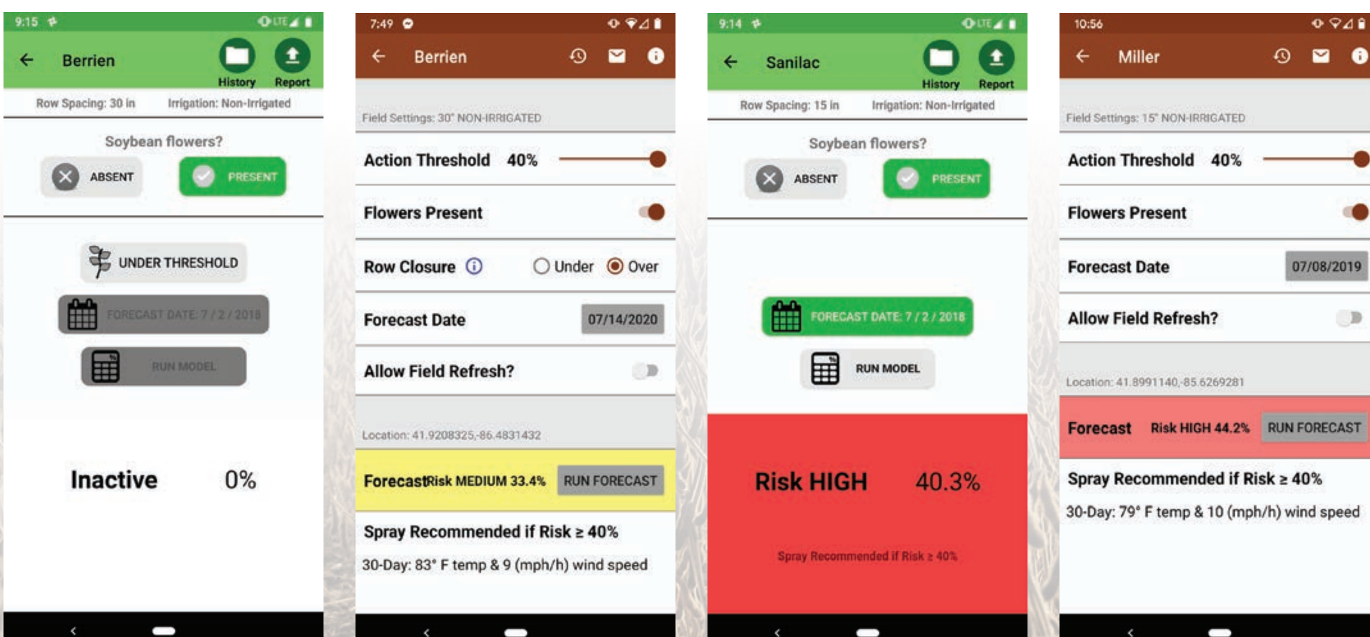
Procedure: The trial compared three fungicide application timings to an untreated control at four locations previously infested with white mold. The application timings were: R1 (one open flower on 50 percent of the plants; R3 (one pod >3/16" long on any of the upper four nodes on the main stem); and R1 followed by R3. Aproach® fungicide was applied at a rate of 9 ounces per acre for all application timings. We entered the dates for the R1 and R3 applications into the Sporecaster app to determine the apothecia risk level for the dates and locations. White mold incidence was also determined at all locations.

Results: White mold did not occur at the Sanilac 18 and St. Joseph 19 sites but was present at low levels at Berrien 18 and Berrien 20. The sequential application of Aproach produced a higher yield than the R3 timing, the R1 timing and the untreated control at the Berrien 18 site. The R3 timing also produced a higher yield than the R1 timing and the control at this site. Despite the absence of white mold at the Sanilac 18 site, the sequential application produced a higher yield than the R1 timing and the control. When the product and application costs were subtracted from the gross income for each treatment, the income ranking for the treatments was: control > R3 > R1+R3 > R1.

The Sporecaster app recommended spraying at R1 at the Sanilac 18 and St. Joseph 19 sites but not at the Berrien 18 and Berrien 20 sites. However, the hot, dry weather occurring in July 2018 and 2019 prevented white mold from developing. At R3, Sporecaster recommended spraying only at the Berrien 18 and Berrien 20 sites which was consistent with the yield data and white mold pressure at this site in 2018 but not in 2020.

We want to thank Corteva Agriscience for providing the Aproach fungicide and Dr. Martin Chilvers for his input.

Screenshots generated by running the Sporecaster app for the four trials are shown below.



White mold control with fungicides can be improved with the disease modeling app Sporecaster.

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

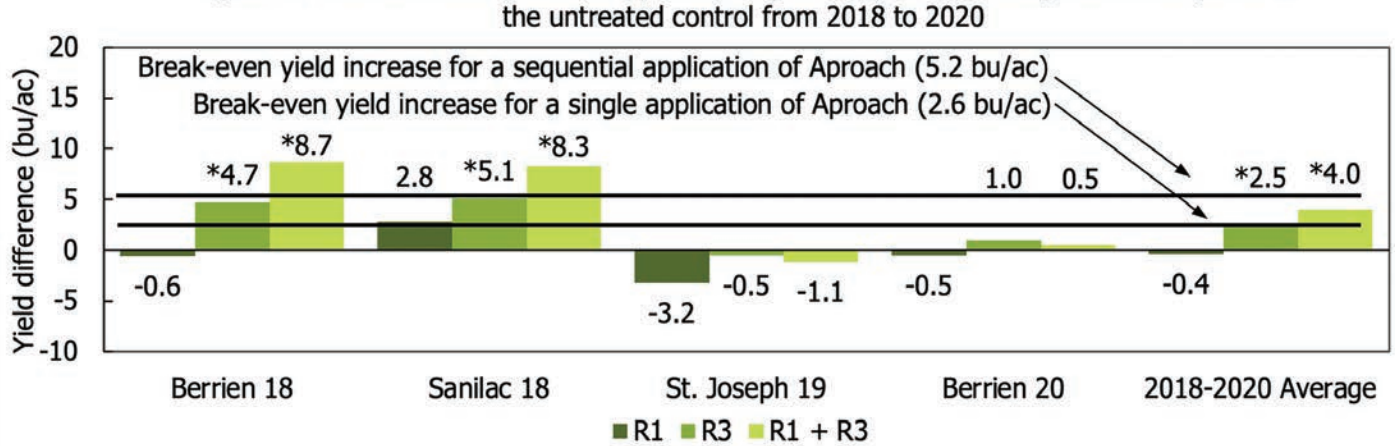
Location	Soybean variety	White mold resistance/tolerance of soybean variety	Planting date	Planting rate (seeds/ac)	Row spacing	Application dates
Berrien 18	NuTech 7240-DA26	6 (1=excellent and 9=poor)	May 26	130,000	30″	July 2 and August 11
Sanilac 18	Asgrow AG19X8	4 (1=excellent and 9=poor)	May 13	130,000	20″	July 2 and July 14
St. Joseph 19	Pioneer P25A82L	5 (9=excellent and 1=poor)	May 16	130,000	Twin 8″	July 8 and July 24
Berrien 20	Beck's 2442 FP	6 (9=best and 1=worst)	May 11	135,000	30″	June 28 and July 14

Table 2. White mold foliar fungicide application timing effect on soybean yield and income in 2018, 2019 and 2020

Location	Untreated control	R1	R3	R1 + R3	LSD $_{0.10}$
	------------------ Yield (bu/ac) ------------------				
Berrien 18	74.5 c	73.9 c	79.3 b	83.2 a	3.8
Sanilac 18	63.9 c	66.8 bc	69.0 ab	72.2 a	4.4
St. Joseph 19	71.8	68.6	71.3	70.7	2.3
Berrien 20	73.2	72.7	74.2	73.7	3.3
Average	**70.9 b**	**70.5 b**	**73.4 a**	**74.9 a**	**1.9**
	------------------ Income ($/ac) -----------------				
Average income	**$737**	**$705**	**$736**	**$724**	

Aproach fungicide cost for a single application = $19.48 per acre, application cost = $8.00 per acre

Figure 1. Yield difference produced by three fungicide application timings when compared to the untreated control from 2018 to 2020



*The yield difference between the fungicide application timings and the control were statistically significant at these locations. The yield difference between the R3 and the R1 + R3 application timings was statistically significant at the Berrien 18 site and when both 2018 locations were combined. However, these two treatments were not different at the other locations or when all four sites were combined.

In-furrow Biological and Humic Acid Trial

Purpose: Soybean producers are looking to increase their income by managing soybeans more intensively. Producers having in-furrow application capability on their planters or drills are looking for a product or combination of products that are safe and profitable. Wilbur Ellis recommends that two of their products, Nutrio Unlock® (biological) and Puric™ Prime Max (humic acid) be combined and applied in-furrow. The purpose of this trial was to evaluate how these products affected soybean yield and income in 2020.

Procedure: Two treatments (Nutrio Unlock plus Puric Prime Max applied in-furrow vs. an untreated control) were compared at seven sites in 2020. Both products were applied at one pint per acre.

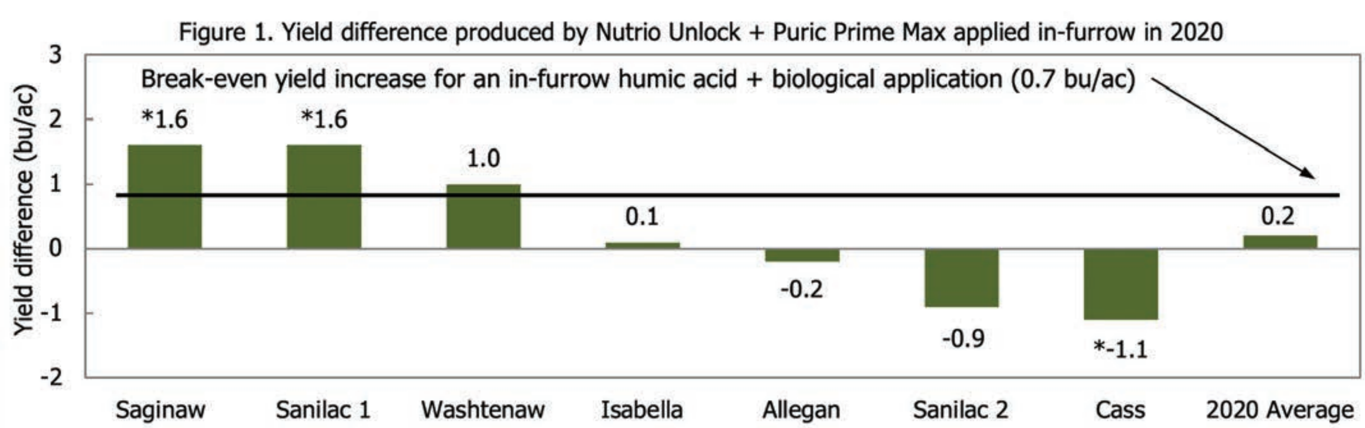
Results: The in-furrow application increased soybean yields by 1.6 bushels per acre at the Saginaw and Sanilac locations. The in-furrow application was also profitable at these two sites, increasing income by nearly $10.00 per acre. However, the in-furrow treatment reduced yield by 1.1 bushels per acre at the Cass site and reduced income at this site by $18.00 per acre. When all seven sites were combined and analyzed, there was no clear advantage or disadvantage to the in-furrow application.

We would like to thank Wilbur Ellis for donating the products for these trials.

Table 1. The effect of Nutrio Unlock and Puric Prime Max applied in-furrow on yield and income in 2020

Location	**Control**	**In-Furrow**	**LSD $_{0.10}$**	**Yield difference**
	------------ Yield (bu/ac) ---------			Yield (bu/ac)
Saginaw	66.3 b	67.9 a	1.2	1.6
Sanilac 1	71.1 b	72.8 a	0.9	1.6
Washtenaw	56.7	57.7	1.7	1.0
Isabella	63.1	63.2	1.2	0.1
Allegan	57.8	57.6	3.3	-0.2
Sanilac 2	67.2	66.3	2.5	-0.9
Cass	43.3 a	42.2 b	0.6	-1.1
2020 Average	**60.8**	**61.0**	**0.6**	**0.2**
	------------ Income ($/ac) ----------			
Average income	**$632**	**$628**		

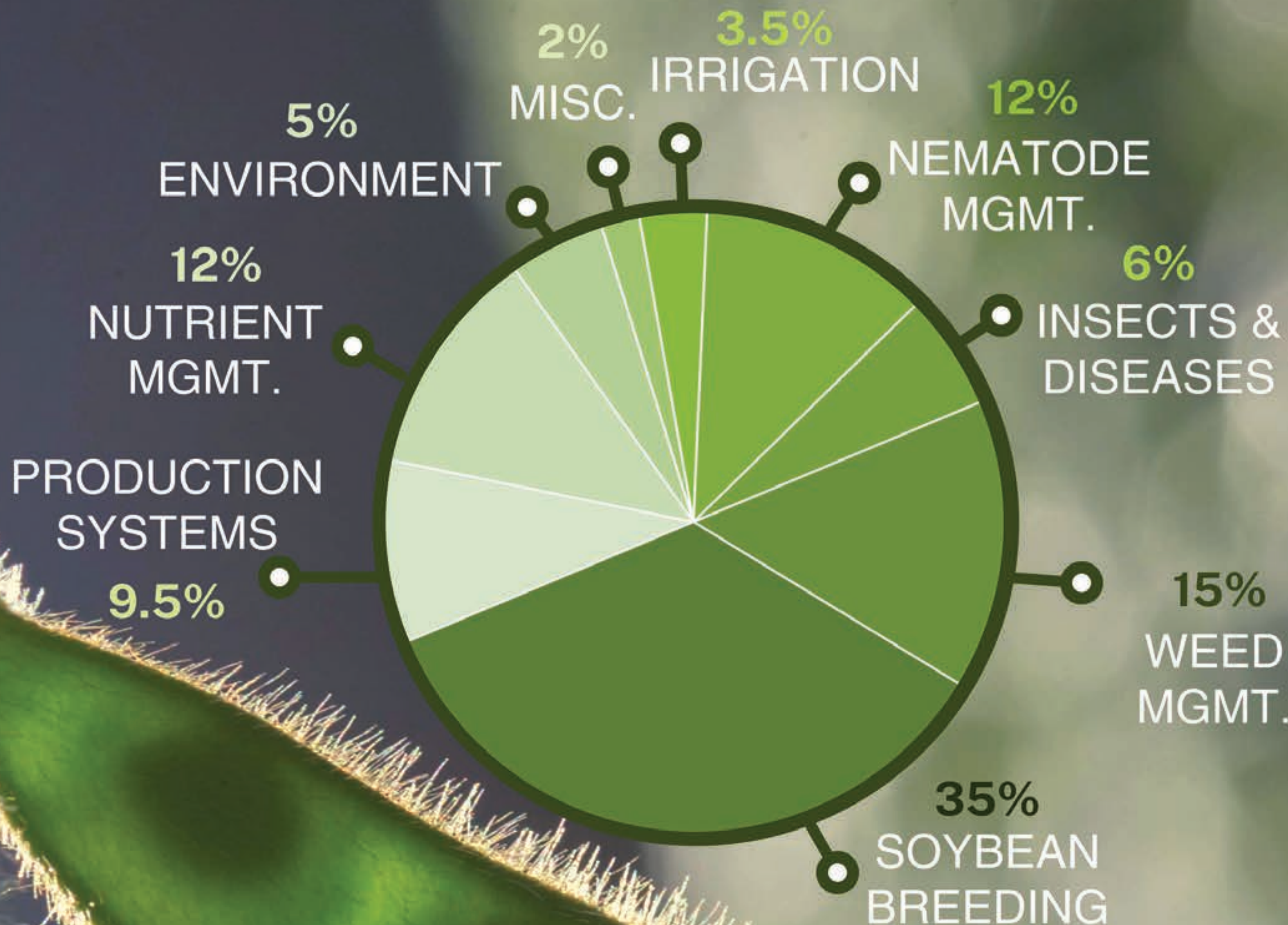
Nutrio Unlock cost = $4.00 per acre and Puric Prime Max cost = $2.75 per acre



*The yield difference was statistically significant at these locations.

Biological products placed in-furrow may fit specific situations but widespread use may not be cost effective.

MICHIGAN SOYBEAN COMMITTEE FUNDED RESEARCH



The Michigan Soybean Committee funds nearly $500,000 in soybean production research each year using soybean checkoff dollars. Funding is divided among the categories listed above to provide well-rounded research results for Michigan soybean farmers.

MICHIGAN SOYBEAN COMMITTEE

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"THE ONLY CONSTANT IN LIFE IS CHANGE."

Ned Birkey and Dan Rajzer have made a great impact on our Michigan Soybean On-Farm Research Program over the years. Their knowledge and experience in Michigan field crop production has provided many benefits, not only to the farms they worked with, but also to all Michigan soybean growers who were able use the results of the trials they worked on. We wish Dan and Ned the very best in their retirement and thank them for their work over the years.