2016 On-Farm Research Report

SMaRT
Soybean Management and Research Technology

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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 2017 SMaRT project, contact Mike Staton at (269) 673-0370 extension 2562 or staton@msu.edu.

2016 marks the sixth season of the SMaRT research program, made possible by the checkoff investment of Michigan soybean producers. This year, 61 producers around the state conducted on-farm research trials within 10 project areas. Contained in this publication you'll find the results from 72 individual trial locations. The research projects were developed with producer input and represent some of the most challenging production issues confronting producers. 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. The projected USDA 2016-17 average soybean price of $9.20 per bushel and average 2016 prices for the product(s) and application costs associated with the treatments were used to determine the breakeven yields presented in the figures.

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 Promotion Committee (MSPC) to jointly fund Mike Staton, MSUE state-wide soybean educator and SMaRT project coordinator. This program is also not possible without the efforts of Ned Birkey, in southeast MI, and Dan Rajzer, in southwest MI, with whom MSPC contracts to implement SMaRT trials and who are essential to this project's success. Matt Singer, MSPC intern, collected soil samples for soybean cyst nematode testing, soil samples for baseline soil test levels, plant tissue samples and other valuable information presented in this report. We also want to thank Martin Nagelkirk and Kevin Gould of MSU Extension for their efforts in making this research possible.

Dr. Arnold Saxton with the University of Tennessee provided the SAS statistical procedure used for analyzing the 2016 trial results and provided valuable input regarding experimental design and statistical analysis.

Michigan Soybean Committee, PO Box 287, Frankenmuth, MI 48734

2014 - 2016 Broadcast Gypsum Trial

Purpose: Interest in the use of gypsum is increasing in Michigan. Gypsum is one of the oldest soil amendments and is an excellent source of calcium and sulfur, both of which are essential crop nutrients. Calcium deficiency symptoms in field crops have never been identified in Michigan. However, sulfur can be low in coarse-textured soils low in organic matter. The purpose of this trial was to evaluate the short-term and long-term effects of broadcast gypsum on crop yields in typical Michigan rotations.

Procedure: Broadcast gypsum was compared to an untreated control at one location in 2014, 10 locations in 2015 and one location in 2016 that were planted to soybeans. At two more locations (Sanilac 14 and Saginaw 15), the gypsum was applied prior to planting corn. The gypsum was applied in the spring at all locations except the Sanilac 14 site where it was applied following wheat harvest in 2014. The gypsum application rate for each location was based on the soil's cation exchange capacity (CEC). One half ton per acre was applied when the CEC was below 10 meq/100g, one ton per acre was applied at CECs between 10 and 15 meq/100g and two tons per acre were applied when the CEC exceeded 15 meq/100g. Baseline soil samples were collected from nine sites and plant tissue samples were collected from eight sites. The plant tissue samples were taken at R1 to R2. Treated and untreated strips were geo-referenced at nine sites so we could evaluate the residual effects of gypsum on crop yields and soil infiltration rates.

Table 1. The effect of a spring broadcast gypsum application on soybean yield and income in 2014, 2015 and 2016

Location	**Untreated control**	**Broadcast gypsum**	**LSD $_{0.10}$**	**Yield difference**
	------------------ Yield (bu/ac)	------------------		Yield (bu/ac)
Presque Isle 14	25.4 b	31.9 a	2.0	6.5
Monroe 15-2	51.7	53.8	4.1	2.1
Monroe 15-3	43.2	45.3	6.9	2.1
Washtenaw 16	40.0 b	41.0 a	0.9	1
Branch 15-1	55.5	56	0.9	0.5
Monroe 15-1	46.3	45.8	3.3	-0.5
Hillsdale 15	68.7	67.7	7.5	-1
Clinton 15	60.9	59.9	2.3	-1
Presque Isle 15	38.2 a	36.8 b	0.9	-1.4
Cass 15-2	51.5	49.4	3.4	-2.1
Branch 15-2	54.3 a	52.1 b	1.9	-2.2
Cass 15-1	52.0 a	49.5 b	1.7	-2.5
2014-2016 Average	**49.0**	**49.1**	**0.9**	**0.1**
	------------------ Income ($/ac)	----------------		
Average income	**$451**	**$414**		

Gypsum price = $18.00 per ton
Trucking cost = $13.00 per 100 miles
Application cost = $7.15 per acre

Table 2. Baseline soil test levels for nine of the broadcast gypsum trials conducted in 2014, 2015 and 2016

Location	**Organic Matter (%)**	**Magnesium (ppm)**	**Calcium (ppm)**	**CEC (meq/100g)**	**Sulfur (ppm)**	**Magnesium Saturation (%)**	**Calcium Saturation (%)**
Cass 15-1	15.9	165	2600	24.4	13	5.6	53.3
Clinton 15	3.4	310	2100	13.4	15	19.2	78.1
Monroe 15-3	4.1	365	2150	14.2	8	21.5	75.9
Monroe 15-2	2.6	205	1500	10.8	13	15.9	69.7
Monroe 15-1	3.2	215	1850	11.4	11	15.8	81.4
Hillsdale 15	2.7	220	1350	10.1	7	18.1	66.7
Branch 15-2	2.2	145	800	6.8	8	17.9	59.1
Presque Isle 14	--	87	822	5.1	--	14.3	81.3
Presque Isle 15	2.0	170	1750	10.5	8	13.5	83.6
Washtenaw 16	--	206	1032	9.9	--	24.2	71.4

2014 - 2016 Broadcast Gypsum Trial

Results: Broadcast gypsum increased soybean yields by 6.5 bushels per acre over the untreated control at the Presque Isle location in 2014. The sulfur provided by the gypsum was responsible for the large yield increase at this site. However, in 2015 the broadcast gypsum application did not significantly increase soybean yields at any of the locations and decreased yields at three locations (figure 1). The plant tissue results help explain the lack of a yield response from the gypsum in 2015. Except for the nitrogen concentration at the Cass 15-1 location, the levels for nitrogen, calcium and sulfur were considered sufficient in the untreated control treatments. In 2016, gypsum did improve soybean yields by one bushel per acre over the untreated control at the Washtenaw 16 site. The gypsum application was not profitable at any of the sites in the growing season the gypsum was applied in 2015 and 2016. However, the 2015 gypsum application did improve 2016 wheat yield by 8.2 bushels per acre at one site and 2016 corn yield by 9.1 bushels per acre at another site (table 4). The 2015 gypsum application did not improve soil infiltration rates in 2016 at any of the nine locations (table 5).

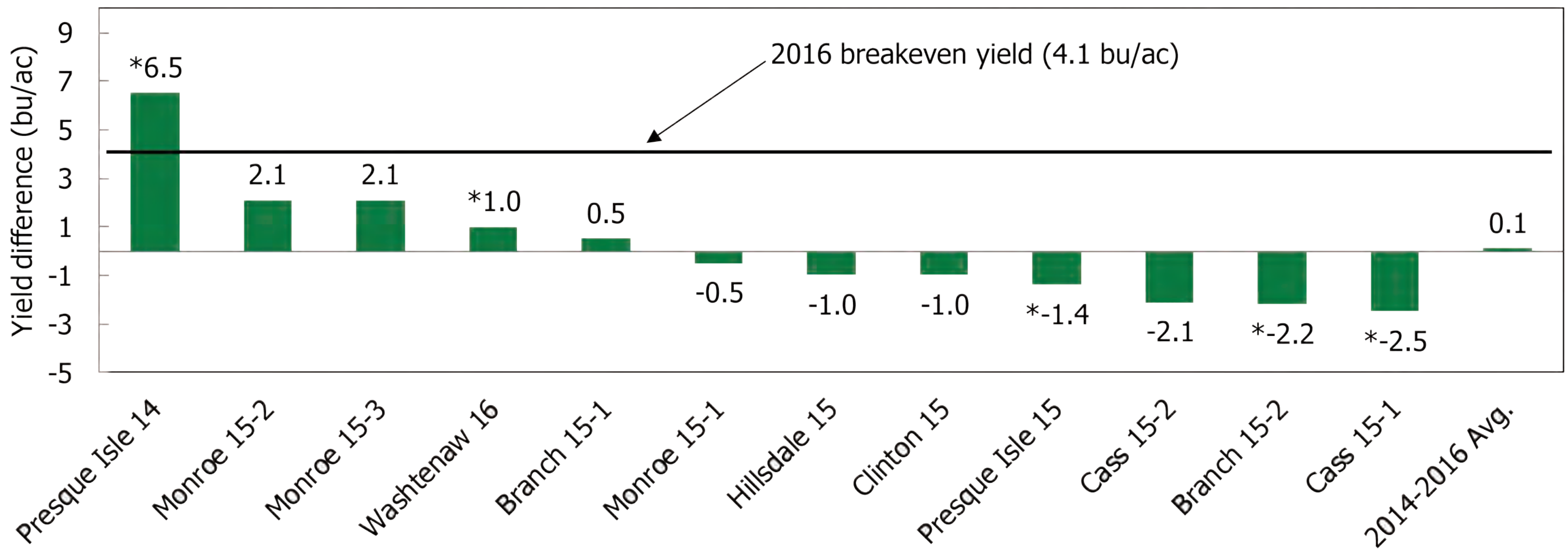
We want to thank Gypsoil for providing and delivering the gypsum for the 2015 and 2016 trials and James Dedecker, Martin Nagelkirk, Dan Rajzer and Ned Birkey for coordinating these trials.

2014 -2016 Gypsum trial locations

Table 3. Nitrogen, calcium and sulfur plant tissue levels for eight of the broadcast gypsum trials conducted in 2014 and 2015

Location	**Plant tissue nitrogen (%)**		**Plant tissue calcium (%)**		**Plant tissue sulfur (%)**	
	Untreated control	Broadcast gypsum	Untreated control	Broadcast gypsum	Untreated control	Broadcast gypsum
Cass 15-1	4.68	4.74	1.26 b	1.35 a	0.33 b	0.47 a
Clinton 15	5.06	5.01	1.28	1.27	0.32 b	0.37 a
Monroe 15-3	5.75 a	5.04 b	1.18	1.23	0.37	0.36
Monroe 15-2	5.86 a	5.46 b	1.25	1.28	0.37 b	0.39 a
Hillsdale 15	4.99	5.47	1.26	1.23	0.28 b	0.36 a
Branch 15-2	5.16	5.07	1.09	1.16	0.31	0.32
Presque Isle 14	4.01	4.72	1.14	1.26	0.19	0.30
Presque Isle 15	4.97	4.84	1.01	1.06	0.34 b	0.36 a

Figure 1. Yield difference between a broadcast application of gypsum and the untreated control



* The yield difference was statistically significant at these locations

Table 4. Residual effects of a single broadcast gypsum application on crop yields in 2016

Location	Gypsum application timing	2016 Crop	Untreated control	Broadcast gypsum	LSD $_{0.10}$
			---------- Yield (bu/ac) ----------		
Sanilac 14	Summer 2014	Soybean	65.8	64.8	4.4
Monroe 15-2	Spring 2015	Soybean	44.7	45.8	4.1
Average		**Soybean**	**55.2**	**55.3**	**2.4**
Monroe 15-3	Spring 2015	Wheat	81.0	84.4	10.4
Monroe 15-1	Spring 2015	Wheat	81.9 b	90.1 a	7.2
Average		**Wheat**	**81.5 b**	**87.3 a**	**5.0**
Clinton 15	Spring 2015	Corn	187.9	185.2	7.0
Cass 15-2	Spring 2015	Corn	174.8 b	183.9 a	3.4
Cass 15-1	Spring 2015	Corn	181.7	181.2	18.4
Average		**Corn**	**181.9**	**183.5**	**5.2**

Table 5. Residual effects of a single broadcast gypsum application on soil infiltration rates in 2016

Location	Gypsum application timing	Untreated control	Broadcast gypsum	LSD $_{0.10}$
		----- *Infiltration rate (minutes) -----		
Monroe 15-3	Spring 2015	9	22	21
Monroe 15-1	Spring 2015	2	18	38
Hillsdale 15	Spring 2015	2	2	1
Branch 15-2	Spring 2015	9	6	8
Cass 15-2	Spring 2015	1	2	1
Monroe 15-2	Spring 2015	4	4	3
Clinton 15	Spring 2015	16	27	40
Sanilac 14	Summer 2014	17	33	62
Saginaw 15	Spring 2015	7	6	4
Average		**8**	**13**	**6**

*Time required for one inch of water to infiltrate into a saturated soil

2016 Radiate® Trial

Purpose: Radiate from Loveland Products Inc. contains two plant growth hormones, Indole-3-butyric acid (auxin) and Kinetin (cytokinin) and is marketed as improving early season vigor, promoting shoot and root growth and reducing early season stress. The purpose of this trial was to evaluate the effect of a single application of Radiate on soybean yields and income in 2016.

Procedure: A single foliar application of Radiate was compared to an untreated control at 18 locations in 2016. The Radiate was applied at 2 oz per acre from V3 through V5 at all locations.

Results: The Radiate significantly increased yields by 6.3 bushels per acre at one location (Ionia 2) in 2016. When all sites were combined and analyzed, the yields produced by the Radiate and the untreated control were essentially equal. A single foliar application of Radiate was profitable at one location in 2016.

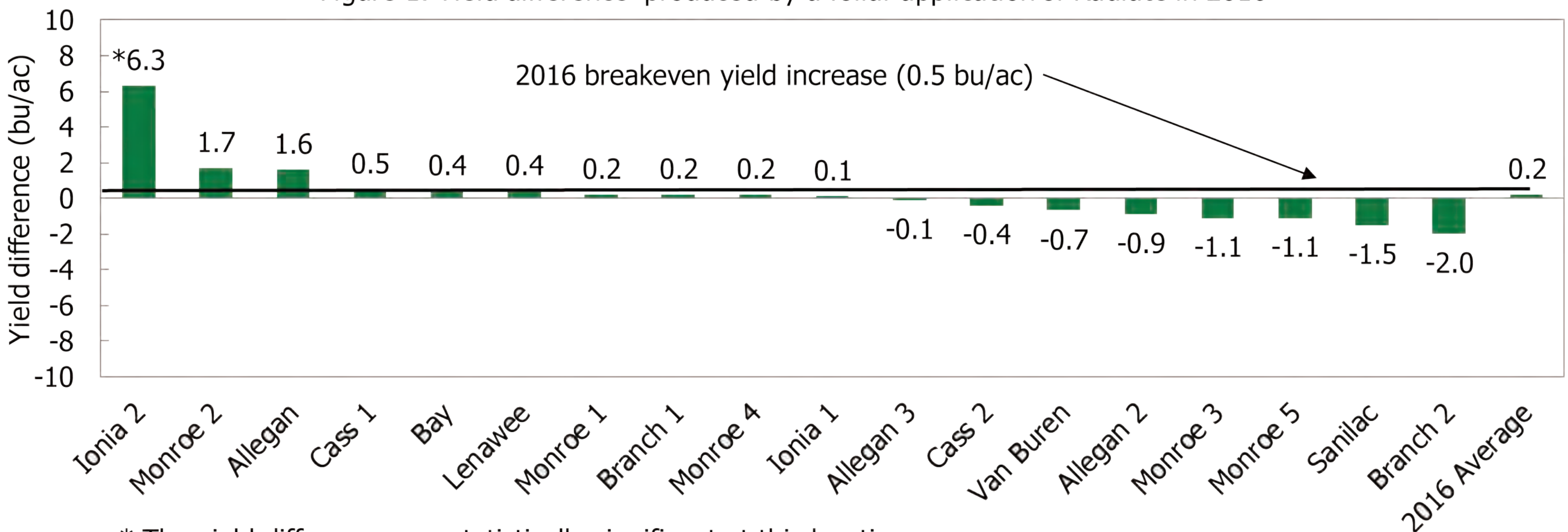
We want to thank Crop Production Services of Munger and Loveland Products Inc. for providing and delivering the Radiate and Ned Birkey and Dan Rajzer for coordinating these trials.

Table 1. The effect of a single foliar application of Radiate on soybean yield and income in 2016

Location	Untreated control	Radiate	LSD $_{0.10}$	Yield difference
	------------------ Yield (bu/ac)	-----------------		Yield (bu/ac)
Ionia 2	67.4 b	73.7 a	2.6	6.3
Monroe 2	62	63.7	3.7	1.7
Allegan 1	59.9	61.5	8.9	1.6
Cass 1	49.7	50.2	3.2	0.5
Bay	77.9	78.3	1.7	0.4
Lenawee	63.6	64.0	2.1	0.4
Monroe 1	55.6	55.8	1.4	0.2
Branch 1	69.2	69.4	0.5	0.2
Monroe 4	63.7	63.9	1.3	0.2
Ionia 1	77.6	77.7	0.4	0.1
Allegan 3	73.7	73.7	2.5	-0.1
Cass 2	36.5	36.1	2.5	-0.4
Van Buren	55.1	54.2	5.7	-0.7
Allegan 2	45.2	44.3	6.9	-0.9
Monroe 3	69.2	68.1	2.9	-1.1
Monroe 5	57.9	56.8	7.6	-1.1
Sanilac	64.5	63.0	2.5	-1.5
Branch 2	67.7	65.7	7.2	-2
Average	**62.0**	**62.2**	**0.7**	**0.2**
	------------------- Income ($/ac)	-----------------		
Average income	**$570**	**$568**		

Radiate cost = $4.50 per acre
Application cost was not included as Radiate is compatible with all post-emergence herbicides

Figure 1. Yield difference produced by a foliar application of Radiate in 2016



* The yield difference was statistically significant at this location

2015 - 2016 Planting Rate Trial

Purpose: Soybean planting rates was one of the highest ranking topics identified by soybean producers for evaluation in the SMaRT trials. The 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 low planting rates will affect soybean yield and income and 2015 and 2016.

Procedure: Eleven planting rate trials were conducted in 2015 and 11 more were conducted in 2016. Four target planting rates (80,000, 100,000, 130,000 and 160,000 seeds per acre) were compared at 10 sites and the highest three planting rates were compared at the Sanilac 3 location in 2015. All of the 2016 sites evaluated all four planting rates. Stand counts were taken to determine actual final plant stands at each location in both years.

2015 and 2016 Planting rate trial locations

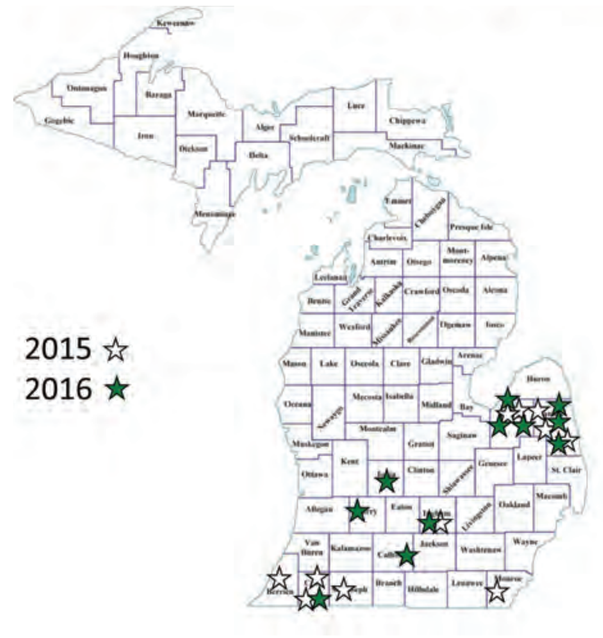
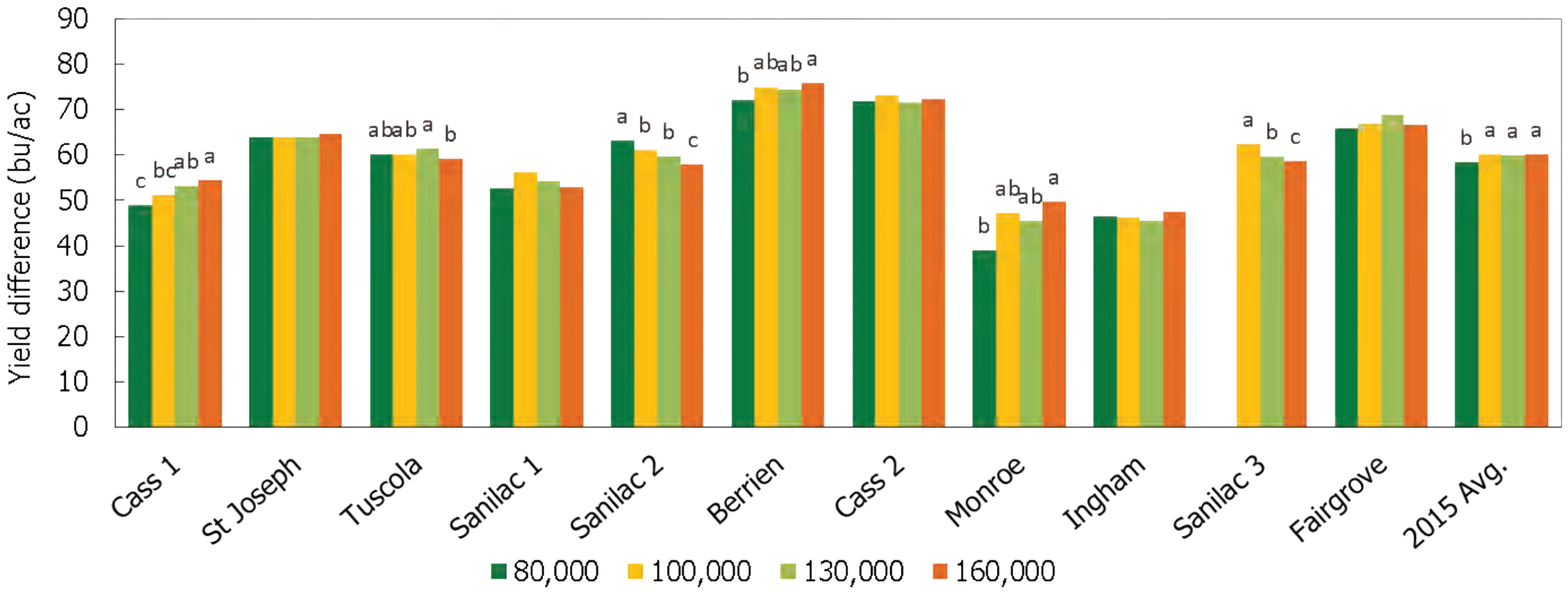


Table 1. Effect of four planting rates on soybean yield and income in 2015

	------------------ Target planting rate (seeds/ac) ------------------				
Location	**80,000**	**100,000**	**130,000**	**160,000**	**$LSD_{0.10}$**
	-------------------- Yield (bushels/ac) --------------------				
Cass 1	48.9 c	51.1 bc	53.3 ab	54.5 a	2.4
St. Joseph	63.8	63.9	64.0	64.7	1.1
Tuscola	60.1 ab	60.1 ab	61.5 a	59.1 b	2.2
Sanilac 1	52.7	56.2	54.2	53.0	5.1
Sanilac 2	63.2 a	61.1 b	59.8 b	57.9 c	1.7
Berrien	72.1 b	75.0 ab	74.5 ab	75.9 a	3.7
Cass 2	72.0	73.1	71.6	72.4	1.6
Monroe	38.9 b	47.3 ab	45.6 ab	49.8 a	9.7
Ingham	46.5	46.3	45.6	47.6	5.6
Sanilac 3	--	62.4 a	59.8 b	58.8 c	1.0
Fairgrove	65.8	66.9	69.0	66.6	4.0
Average Yield	**58.4 b**	**60.1 a**	**59.9 a**	**60.2 a**	**1.4**
	-------------------- Income ($/ac) --------------------				
Average Income	**$500**	**$507**	**$492**	**$482**	

Seed cost = $60 per 140,000 seed unit

Figure 1. Effect of four planting rates on soybean yields at 11 locations in 2015



2015 - 2016 Planting Rate Trial

Results: The planting rate trials produced mixed results in 2015 at the individual locations. At three sites, the 160,000 planting rate produced the highest yield. However, it also produced the lowest yield at two other locations. The lowest three planting rates each produced the highest yield at three different trials. When all the locations were combined and analyzed, the yield for 80,000 planting rate was 1.8 bushels per acre lower than the 100,000, 130,000 and 160,000 planting rates. However, there was no difference in the yields produced by the highest three planting rates.

The more challenging conditions occurring in 2016 favored the higher planting rates. The 160,000 planting rate beat the 80,000 rate at six locations, the 100,000 rate at four locations and the 130,000 at two locations. The 130,000 rate beat the 80,000 rate at five sites, the 100,000 rate at two sites and the 160,000 rate at two sites. When all the 2016 locations were combined and analyzed, the two highest planting rates produced identical yields and they yielded 1.3 bushels per acre higher than the 100,000 rate and 2.7 bushels per acre more than the 80,000 rate. When all 22 sites (2015 and 2016) were combined and analyzed, the highest three planting rates produced similar yields and beat the lowest rate by 1.5 to 2.2 bushels per acre.

Projected market prices and conservative seed costs were used to determine the income (gross income – seed cost) produced by the four planting rates. In 2015, the lowest two planting rates generated more income per acre than the higher two planting rates. In 2016, the lowest three planting rates were more profitable than the highest planting rate.

Further research is needed to determine how lowering planting rates will affect soybean yield and income across a wide range of tillage systems, planting systems, soil types and weather conditions.

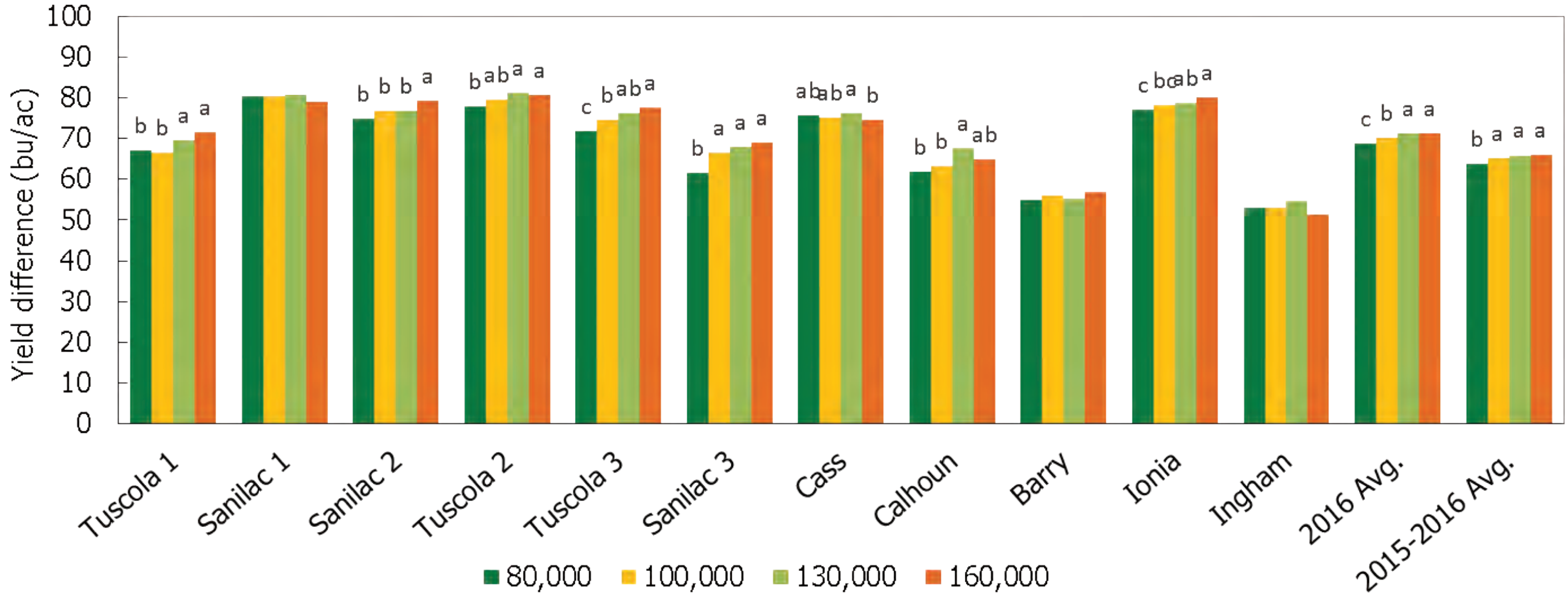
We want to thank Martin Nagelkirk, Dan Rajzer and Ned Birkey for coordinating these trials.

Table 2. Effect of four planting rates on soybean yield and income in 2016

	------------------- Target planting rate (seeds/ac) ------------------				
Location	**80,000**	**100,000**	**130,000**	**160,000**	**$LSD_{0.10}$**
	--------------------- Yield (bushels/ac) --------------------				
Tuscola 1	67.2 b	66.6 b	69.7 a	71.7 a	2.5
Sanilac 1	80.3	80.5	80.7	79.0	2.4
Sanilac 2	75.0 b	76.9 b	76.9 b	79.3 a	2.1
Tuscola 2	78.0 b	79.7 ab	81.2 a	80.7 a	2.6
Tuscola 3	71.9 c	74.7 b	76.4 ab	77.7 a	2.6
Sanilac 3	61.6 b	66.7 a	68.1 a	69.2 a	3.2
Cass	75.6 ab	75.3 ab	76.2 a	74.5 b	1.5
Calhoun	62 b	63.3 b	67.8 a	64.8 ab	4.2
Barry	55.0	56.1	55.3	56.8	3.6
Ionia	77.0 c	78.3 bc	78.9 ab	80.1 a	1.4
Ingham	53.0	53.0	54.7	51.4	5.9
Average Yield	**68.7 c**	**70.1 b**	**71.4 a**	**71.4 a**	**0.9**
	-------------------- Income ($/ac) -------------------				
Average Income	**$598**	**$602**	**$601**	**$588**	

Seed cost = $60 per 140,000 seed unit

Figure 2. Effect of four planting rates on soybean yields at 11 locations in 2016



2015 - 2016 Planting Rate Trial

Table 3. Target planting rates and actual plant stands in 2015

	------------------ Target planting rate (seeds/ac) ------------------			
Location	**80,000**	**100,000**	**130,000**	**160,000**
	------------------ Actual plant stands (plants/ac) ------------------			
St. Joseph	69,800	82,600	110,100	138,100
Cass 1	79,100	85,100	122,900	133,100
Sanilac 3	--	98,800	116,700	143,900
Cass 2	78,300	91,200	123,000	150,000
Berrien	78,500	97,400	129,500	150,600
Sanilac 1	63,200	79,400	113,200	138,400
Sanilac 2	71,600	90,500	117,300	136,200
Tuscola	54,500	80,300	100,800	126,600
Monroe	51,500	71,000	92,300	105,800
Ingham	79,900	100,200	136,500	180,000
Fairgrove	73,300	92,300	121,700	151,300
Average (all locations)	**70,000**	**88,100**	**116,700**	**141,300**
	---------------------- Average stand loss (%) ----------------------			
	13	12	10	12

Figure 3. Planting rate effects on soybean yield and income in 2015 and 2016

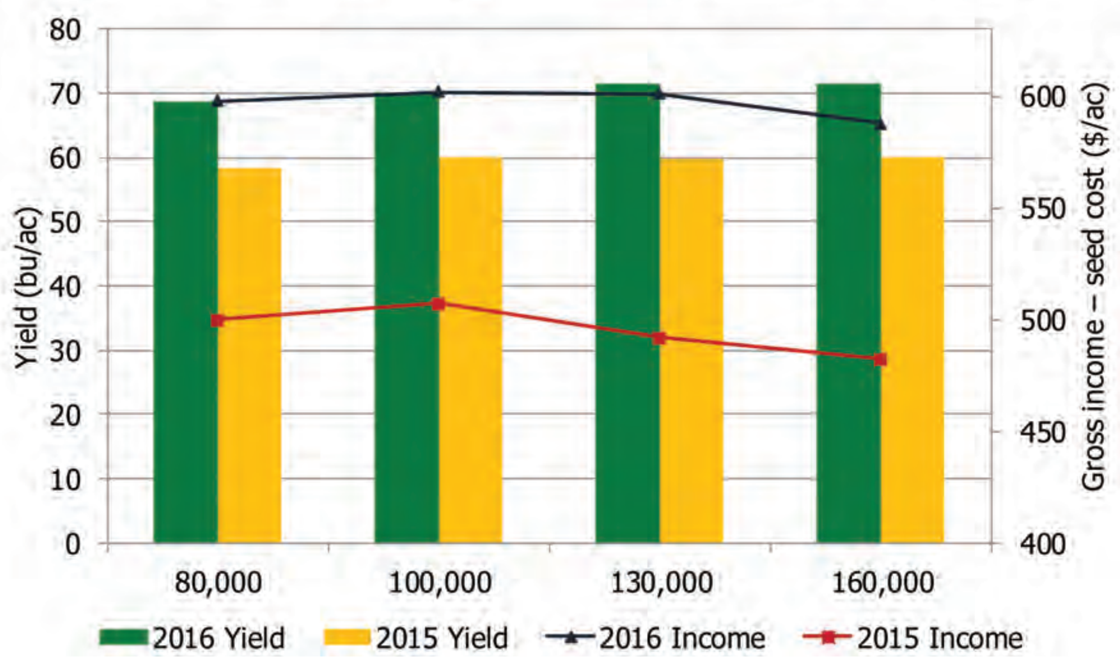


Table 4. Target planting rates and actual plant stands in 2016

	------------------ Target planting rate (seeds/ac) ------------------			
Location	**80,000**	**100,000**	**130,000**	**160,000**
	------------------ Actual plant stands (plants/ac) ------------------			
Tuscola 1	66,000	84,900	99,700	128,200
Sanilac 1	77,100	93,600	120,700	149,100
Sanilac 2	59,200	72,700	90,700	124,900
Tuscola 2	66,600	76,700	98,300	118,300
Tuscola 3	65,000	80,000	107,700	122,600
Sanilac 3	59,800	78,200	117,700	150,900
Cass	75,300	91,900	117,000	142,300
Calhoun	57,300	74,500	86,800	115800
Barry	59,000	77,200	106,000	130,000
Ionia	69,900	87,500	107,200	128,200
Ingham	79,400	87,500	117,700	138,200
Average (all locations)	**66,800**	**82,200**	**106,300**	**131,700**
	---------------------- Average stand loss (%) ----------------------			
	17	18	18	18

2015 - 2016 Planting Rate Trial

Table 5. Tillage operations, planting equipment, row spacing, planting date, planting depth and seed treatment for all 2015 planting rate locations

Location	Tillage operations	Planter/drill	Row spacing	Planting date	Planting depth	Seed treatment
Cass 1	No-till	JD 750	15″	May 13	1″	PPST 120 + PPST 2030
St. Joseph	Strip tillage	Monosem NG4	Twin 8″	April 29	1.5″	PPST 120 + PPST 2030
Tuscola	No-till	JD 1790	15″	May 21	1.25″	Bacillus subtilus & Bacillus pumilus
Sanilac 1	CP (fall) & 2X FC (spring)	Case IH 1250	30″	May 21	1.75″	Poncho/VOTiVO
Sanilac 2	CP (fall) & FC (spring)	John Deere 1790	15″	May 5	1.25″	Acceleron + Poncho/VOTiVO
Berrien	Disk (fall & spring)	JD 1770	30″	May 22	1″	Cruiser Maxx
Cass 2	Deep rip (fall) & FC (spring)	JD 1790	15″	May14	1″	PPST 120 + PPST 2030
Monroe	CP (fall) & FC (spring)	JD 1780	15″	May 9	1″	Tag Team
Ingham	Strip till	Great Plains YP825A	Twin 7″	May 13	1.5″	Acceleron + Poncho/VOTiVO
Sanilac 3	Disk rip (fall) & FC (spring)	JD DB60	20″	May1	1.25″	PPST 2030
Fairgrove	CP (fall) & 2X FC (spring)	JD 7200 with Kinze planter units	28″	May 19	1″	Clariva Complete Beans

No-tilling soybeans in Tuscola County

Table 6. Tillage operations, planting equipment, row spacing, planting date, planting depth and seed treatment for all 2016 planting rate locations

Location	Tillage operations	Planter/drill	Row spacing	CEC	Planting date	Planting depth	Seed treatment
Tuscola 1	No-till	JD 1790	15″	9.6	May 19	1.25″	Evergol Energy SB, Goucho/Allegience
Sanilac 1	Fall rip, spring field cultivator	JD DB44	22″	8.7	May 21	1.5″	Seed Shield + First Up
Sanilac 2	Fall rip, spring VT (2x)	JD 1780	20″	7.9	May 7	1.5″	Insecticide + fungicide
Tuscola 2	Fall chisel, spring field cultivator	JD 1790	15″	16	May 9	1.5″	Cruiser Maxx
Tuscola 3	Fall chisel, spring field cultivator	JD 1790	15″	6	May 9	1.5″	Cruiser Maxx
Sanilac 3	Fall chisel, spring field cultivator	GP 35-3000	24″	9.4	May 20	1.25″	None
Cass	Chisel and fit	JD 1790	15″	6.2	May 23	1″	Pioneer Premium
Calhoun	No-till	JD 1770	30″	5.1	May 16	1″	None
Barry	Chisel, disk, packer	Case IH 1250	30″	5-6	June 2	1.75″	Vault
Ionia	Fall rip, spring field cultivator	JD 1990 CCS	15″	6.6	May 19	1″	Insecticide + Fungicide
Ingham	Strip-till	GP YP825	Twin 7″	21.9	May 25	1.5″	Poncho/VOTiVO

2014 - 2016 Potassium Thiosulfate Starter Fertilizer Trial

Purpose: Past university research results and fertilizer recommendations indicate that soybeans are less likely than corn to respond to starter fertilizer. Starter fertilizer trials (2x2 and in-furrow) conducted by the SMaRT program have produced similar results with only seven out of 27 trials showing a positive yield increase. However, a 2x2 starter applied in a trial conducted in 2013 increased soybean yields by 6 bushels per acre on a coarse-textured soil in Kent County. The starter fertilizer contained nearly 50 pounds of actual K_2O per acre. In 2014 potassium thiosulfate starter fertilizer increased yields by 3.2 bushels per acre when averaged over two locations and in 2015, it increased soybean yields at three locations but also decreased yields at one site. The purpose of this trial was to measure the effect of a potassium thiosulfate starter fertilizer on soybean yields when evaluated across many different environments from 2014 through 2016.

Procedure: Potassium thiosulfate (0-0-25-17) applied at planting was compared to an unfertilized control at two locations in 2014, 11 locations in 2015 and four locations in 2016. The potassium thiosulfate was applied at three gallons per acre in a 2x2 band at planting at all locations except the Calhoun site where the starter was dribbled on the surface two inches from the row. A third treatment was added at the Calhoun location in 2016 (potassium thiosulfate plus 6 gallons of 28% UAN). Baseline soil samples (table 2) were collected at all sites and plant tissue samples were taken from both the fertilized and unfertilized strips at all locations at the R1 to R2 growth stages.

Table 1. The effect of a potassium thiosulfate starter fertilizer on soybean yield and income in 2014, 2015, and 2016

Location	**Untreated control**	**Potassium thiosulfate starter**	**LSD $_{0.10}$**	**Yield difference**
	------------------ Yield (bu/ac)	------------------		Yield (bu/ac)
Calhoun16	65.4	69.7	5.5	4.3
St. Joseph 15	61.9 b	65.5 a	2.1	3.6
Sanilac 14	24.1	27.6	4.2	3.5
Bay 14	44.6 b	47.5 a	2.6	2.9
Hillsdale 15	40.5 b	42.7 a	1.5	2.2
Lake 15	38.6	40.6	3.7	2.0
Berrien 15	48.3 b	49.7 a	1.3	1.4
Sanilac 15-2	60.5	61.8	1.9	1.3
Van Buren 15-2	53.4	54.2	2.4	0.8
St. Clair 15	53.0	53.4	4.4	0.4
Bay 15	57.1	57.3	4.1	0.2
Sanilac 16	51	50.7	2.4	-0.3
Van Buren 16	59.9	59.3	3.9	-0.6
Cass 16	61.5	60.7	1.6	-0.8
Clinton 15	61.1	59.5	3.1	-1.6
Van Buren 15-1	62.3 a	60.4 b	1.5	-1.9
Sanilac 15-1	53.2	50.1	4.8	-3.1
Average (2014 – 2016)	**52.6 b**	**53.6 a**	**0.6**	**1.0**
	------------------ Income ($/ac)	-----------------		
Average income	**$484**	**$478**		

Potassium thiosulfate cost = $15.00 per acre

Table 2. Baseline soil test levels for the potassium thiosulfate starter fertilizer trials conducted in 2015 and 2016

Location	**Organic matter (%)**	**Phosphorus (ppm)**	**Potassium (ppm)**	**Soil pH**	**CEC (meq/100g)**	**Sulfur (ppm)**
Bay 15	2.7	46	270	7.8	22.2	**8
Berrien 15	1	118	86	6	3.9	**6
Clinton 15	2.5	33	102	6.5	7.9	11
Hillsdale 15	3.1	69	107	6.7	9.5	10
Lake 15	--	14	*52	5.9	7.6	--
Sanilac 15-1	3.7	36	108	6.5	11.2	10
Sanilac 15-2	4.1	25	*102	6.8	11.7	**8
St. Clair 15	3.8	56	180	6.4	10.8	14
St. Joseph 15	1.1	104	107	6.5	3.5	**6
Van Buren 15-1	1.6	72	101	5.8	5.7	**7
Van Buren15-2	2	32	139	5.7	5.3	**8
Cass 16	1.5	65	90	6.5	3.3	10
Calhoun 16	1.8	28	95	6.3	6.2	5
Sanilac 16	--	40	88	6.3	5.8	**8
Van Buren 16	1.8	118	136	5.7	5.7	11

* Potassium soil test levels were below the critical level at these sites

**Sulfur soil test levels were considered low at these sites

2014 - 2016 Potassium Thiosulfate Starter Fertilizer Trial

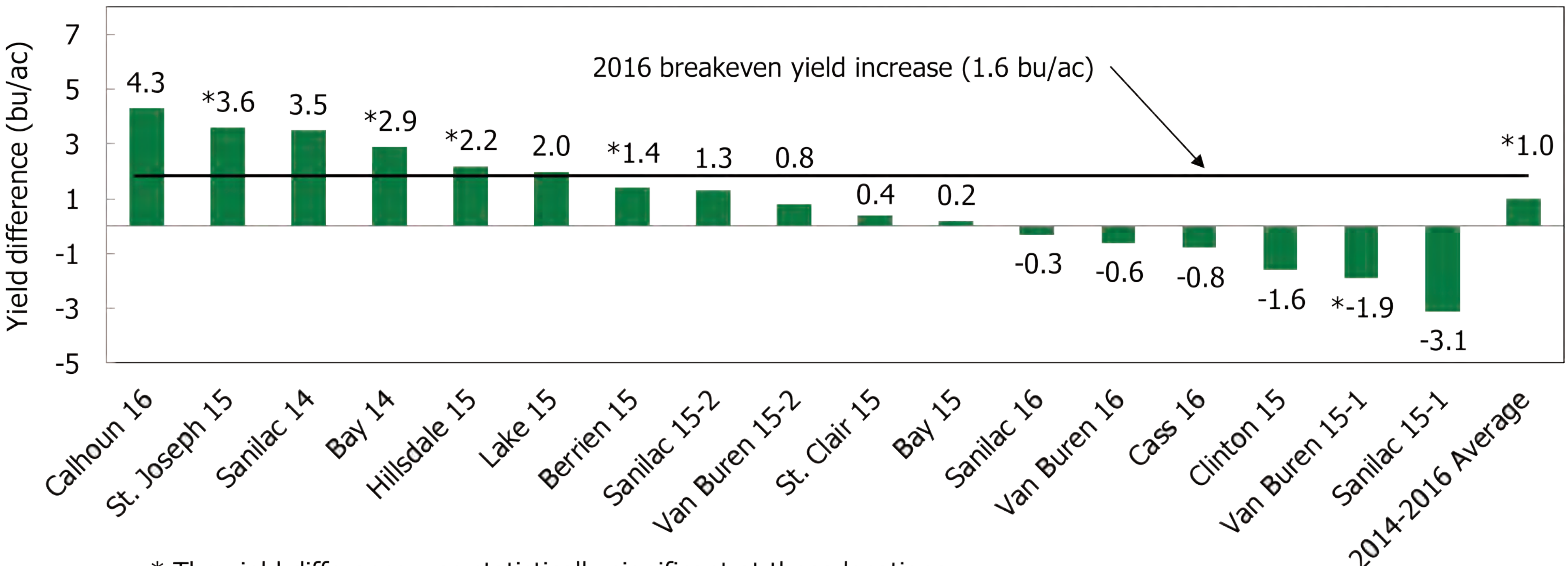
Results: In 2016, the potassium thiosulfate starter fertilizer did not produce significantly higher soybean yields than the untreated control at any of the four locations (figure 1). Adding 28% UAN did not improve the performance of the potassium thiosulfate. When all 17 locations were combined and analyzed, the starter fertilizer increased soybean yield by one bushel per acre, which will not cover the cost of the fertilizer. One possible explanation for the lack of response to the starter fertilizer was that the potassium soil test levels exceeded the critical levels at all four sites (table 2). Once the critical level has been reached, the soil contains enough potassium to produce 95 to 97% of its yield potential. The critical potassium soil test level is easily calculated using the following equation [(2.5 x CEC) + 75]. Plant tissue samples also showed that the potassium and sulfur levels were well above the sufficiency levels for these nutrients in both the fertilized and unfertilized treatments at every location in 2015 and 2016.

This practice may be more beneficial on coarse-textured soils or soils having low potassium and/or sulfur soil test levels.

We want to thank Tessenderlo Kerley and Wilbur Ellis in Marlette for providing and delivering the fertilizer for this trial. We also want to thank Dan Rajzer, Ned Birkey, and Martin Nagelkirk for coordinating these trials.

2014 to 2016 Potassium thiosulfate starter fertilizer trial locations

Figure 1. Yield difference due to a potassium thiosulfate starter fertilizer in 2014, 2015 and 2016



* The yield difference was statistically significant at these locations

Table 3. Application dates, application rates and fertilizer analyses for the last broadcast potassium fertilizer applications at the potassium thiosulfate starter fertilizer trials conducted in 2014, 2015, and 2016

Location	Application date	Application rate (lbs./ac)	Fertilizer analysis
Bay 14	Fall 2011	300	0-0-60
Bay 15	Fall 2014	300	0-0-60
Berrien 15	Spring 2015	150	0-0-60
Cass 15-1	Spring 2015	100	0-0-60
Cass 15-2	Spring 2015	150	0-0-60
Clinton 15	Spring 2015	242	9-23-31
Hillsdale 15	Fall 2014	*120 & 188	0-0-60
Lake 15	Spring 2015	160	0-0-60
Sanilac 14	Fall 2013	200	0-0-60
Sanilac 15-1	Fall 2013	*75 – 341 (field average was 114)	0-0-62
Sanilac 15-2	Spring 2015	200	5-26-31
St. Clair 15	Fall 2014	150	0-0-60
St. Joseph 15	Spring 2015	150	0-0-60
Cass 16	Spring 2016	150	0-0-60
Calhoun 16	Spring 2015	2 tons of chicken manure	--
Sanilac 16	Spring 2016	200	7-11-36-4.6S
Van Buren 16	Spring 2016	100	0-0-60

* Variable rate application

2016 ILeVO® Seed Treatment Trial

Purpose: Soybean producers have identified seed treatments as a high priority for evaluation in SMaRT on-farm research trials. ILeVO, a relatively new seed treatment from Bayer Crop Science, was selected because Sudden Death Syndrome (SDS) is increasing in Michigan. The purpose of this trial was to evaluate the effect of ILeVO seed treatment on soybean yields and income in fields having a history of (SDS).

Procedure: This trial compared two treatments (a complete seed treatment without ILeVO vs. the same complete seed treatment with ILeVO). We worked with seed dealers, MSU Extension staff and independent crop consultants to identify fields having a history of SDS that would be planted to soybeans in 2016 when selecting the seven trial locations. The cooperating producers worked closely with their seed dealers to ensure that all seed planted in each trial was the same variety and came from the same lot. All seed treatments were applied by local seed dealers and the ILeVO was applied at 1.18 oz per 140,000 seeds.

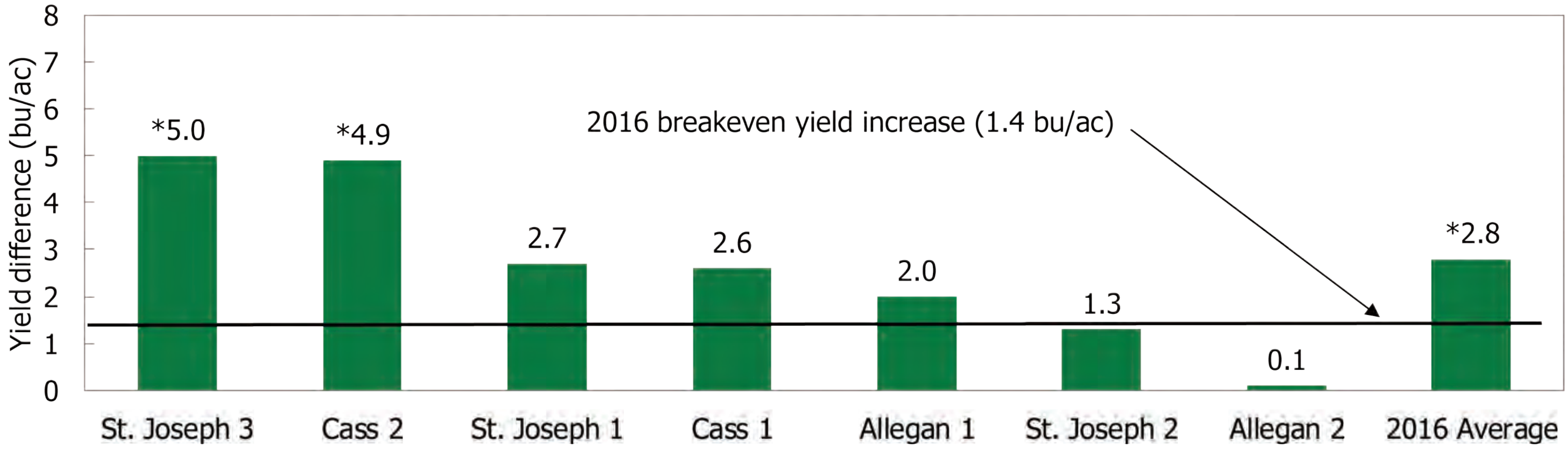
Soil samples were collected from each treatment after planting and again before harvest to determine the effect of the two seed treatments on soybean cyst nematode (SCN) population development. We made sure that the SCN soil samples were taken from the same locations for both sampling dates. The number of SCN eggs and juveniles found in the pre-harvest sample (PF) was divided by the number of SCN eggs and juveniles in the post-planting sample (PI) to determine the SCN reproductive index (PF/PI) for each seed treatment at each site. When the reproductive index is less than one, the treatment reduced the SCN population.

Table 1. The effect of a ILeVO seed treatment on soybean yield and income in 2016

Location	Untreated control	ILeVO	LSD $_{0.10}$	Yield difference
	------------------ Yield (bu/ac)	------------------		Yield (bu/ac)
St. Joseph 3	66.8 b	71.8 a	2.3	5.0
Cass 2	52.0 b	56.9 a	4.5	4.9
St. Joseph 1	52.2	54.9	4.2	2.7
Cass 1	27.2	29.8	4.6	2.6
Allegan 1	67.7	69.6	2.2	2.0
St. Joseph 2	72.7	74.0	2.5	1.3
Allegan 2	62.2	62.3	4.2	0.1
Average	**57.2 b**	**60.0 a**	**1.1**	**2.8**
	------------------ Income ($/ac)	----------------		
Average Income	**$526**	**$540**		

ILeVO cost = $12.45 per 140,000 seed unit

Figure 1. Yield difference produced by ILeVO seed treatment in 2016



* The yield difference was statistically significant at these locations

2016 ILeVO® Seed Treatment Trial

Results: The occurrence of above-ground symptoms of SDS was minimal at all of the sites in 2016. Despite this, the ILeVo seed treatment increased soybean yields by 5 bushels per acre at two of the seven locations (figure 1). The numerical yield increases occurring at the other five sites were not statistically significant. However, when all seven sites were combined and analyzed, ILeVO increased soybean yields by 2.8 bushels per acre and increased income by $14.00 per acre. ILeVO's effect on SCN population development was mixed in 2016 (table 2). SCN development was numerically reduced in the ILeVO treatment at three locations and numerically increased at two locations.

We want to thank Bayer Crop Science for providing and delivering some of the ILeVO and Dan Rajzer for coordinating these trials. We also appreciate the help provided by local seed dealers.

2016 ILeVO trial locations

SDS foliar symptoms

Table 2. ILeVO seed treatment effects on SCN population development in 2016

Location	SCN population after planting (PI)		SCN population before harvest (PF)		SCN reproductive index (PF/PI)	
	Control	ILeVO	Control	ILeVO	Control	ILeVO
	---------------- SCN Eggs and juveniles per 100 cm^3 of soil -------------------					
St. Joseph 3	--	--	2,070	1,225	--	--
Cass 2	470	440	5,450	3,372	12	7.7
St. Joseph 1	440	235	39,150	40,900	89	174
Cass 1	15	4	1,690	626	113	156
Allegan 1	21	30	5,470	2,240	260	75
St. Joseph 2	81	51	2,947	1,735	36	34
Allegan 2	0	0	0	0		

2016 Field Rolling Trial

Purpose: Field rolling is a common practice on many farms in Michigan. Its appeal is largely due to the fact that rolling reduces stone damage to combines and operator fatigue during harvest operations. Most producers roll soybeans after planting and prior to emergence. This is a very narrow window in some years and producers are wondering if they can safely roll soybeans during the early vegetative stages. There is also growing speculation that rolling soybeans between the V1 and V3 stages may stress the plants and actually increase yield. The purpose of the 2016 field roller trials was to determine the effect of field rolling at various growth stages on soybean yields.

Procedure: Field rolling trials were conducted at seven locations in 2016. The cooperating producers were encouraged to choose the rolling treatments they wanted to compare on their farms (table 1). Stand counts were taken in all treatments at four of the seven locations to determine if rolling affected final stand.

Table 1. The effect of field rolling at various growth stages on soybean yield in 2016

Location	Unrolled control	Pre-emerge	First trifoliate	Second trifoliate	Third trifoliate	LSD $_{0.10}$
	------------------------- Yield (bu/ac) -------------------------					
Bay	68.0 b	68.0 b	71.9 a			1.5
Lenawee	60.0 b	63.6 a	62.8 a			2.4
Monroe 1	54.7			55.6		7.8
Monroe 2	54.3				54.8	1.2
Monroe 3	69.8		70.2			3.2
Tuscola	78.7	79.6	79.8			1.7
Sanilac		61.5 b	67.6 a		60.7 b	5.0

Table 2. The effect of field rolling at the V1 growth stage on soybean yield, income and final stand in 2016

Location	Unrolled control	First trifoliate	LSD $_{0.10}$	Yield difference	Unrolled control	First trifoliate	LSD $_{0.10}$
	----- Yield (bu/ac) -----			Yield (bu/ac)	Final stand (plants/ac)		
Bay	67.9 b	71.9 a	2.4	4.0	127,200	123,900	6,874
Lenawee	60.0	62.3	3.1	2.3	98,100	103,000	31,269
Tuscola	78.7	79.8	1.1	1.1	87,900	85,500	7,606
Monroe 3	70.2	69.8	3.2	-0.4	--	--	--
Average	**69.3 b**	**70.9 a**	**1.3**	**1.6**	**104,600**	**104,000**	**6,144**
	------- Income ($/ac) -------						
Average income	**$638**	**$644**					

Field rolling cost = $7.90 per acre

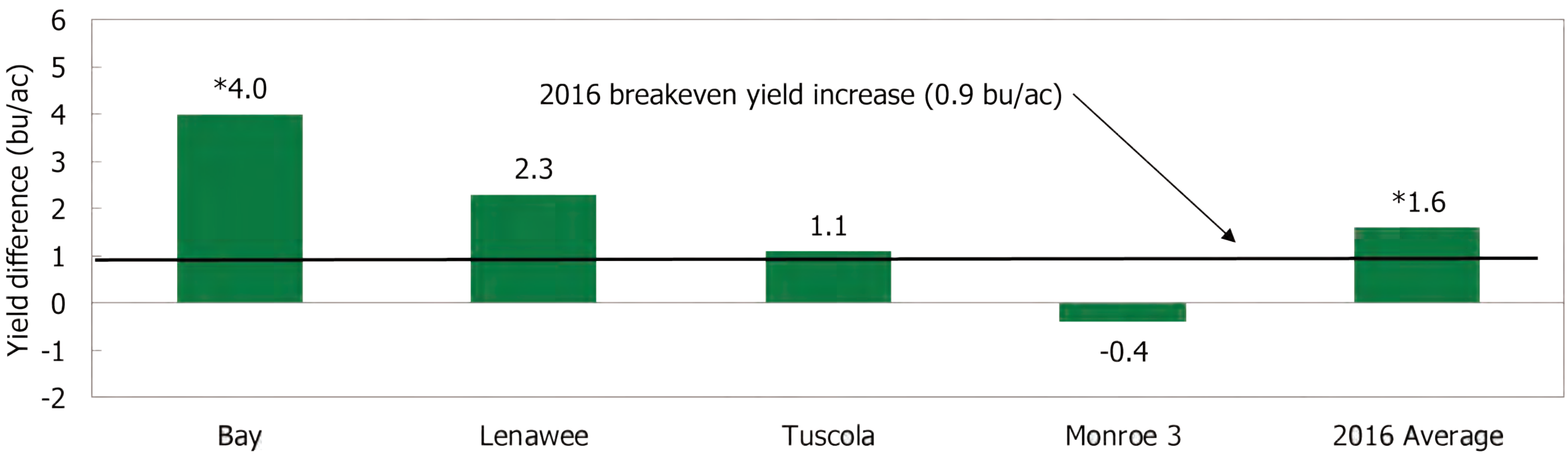
2016 Field Rolling Trial

Results: Field rolling did not adversely affect soybean yields at any of the six locations that included an unrolled control treatment. In fact, rolling at the V1 stage increased yields by 4 bushels per acre at the Bay County location and by 2.8 bushels per acre at the Lenawee site (table 1). The pre-emergence treatment also increased yields by 3.6 bushels per acre over the unrolled control in the Lenawee trial. Table 2 and figure 1 summarize the four sites that compared an unrolled control to rolling at the V1 stage. When all four sites were combined and analyzed, rolling at V1 increased soybean yields by 1.6 bushels per acre and income by $6.00 per acre. Final plant stands were not affected by rolling at any of the sites in 2016 for which this information was collected (table 2).

We want to thank the Center for Excellence, Martin Nagelkirk and Ned Birkey for coordinating these trials.

2016 Field rolling trial locations

Figure 1. Yield difference produced by field rolling at the V1 growth stage in 2016



* The yield difference was statistically significant at this location

2016 White Mold Foliar Fungicide Comparison Trial

Purpose: *Sclerotinia Stem Rot* or white mold can cause significant yield reductions in soybeans grown in Michigan. However, the incidence and severity of the disease vary tremendously by year and location. Three factors determine the incidence and severity of white mold: 1) presence and quantity of disease inoculum; 2) environmental conditions favorable to disease development; and 3) a susceptible host. The purpose of this trial was to determine the effect of two commercially available foliar fungicides on soybean yields.

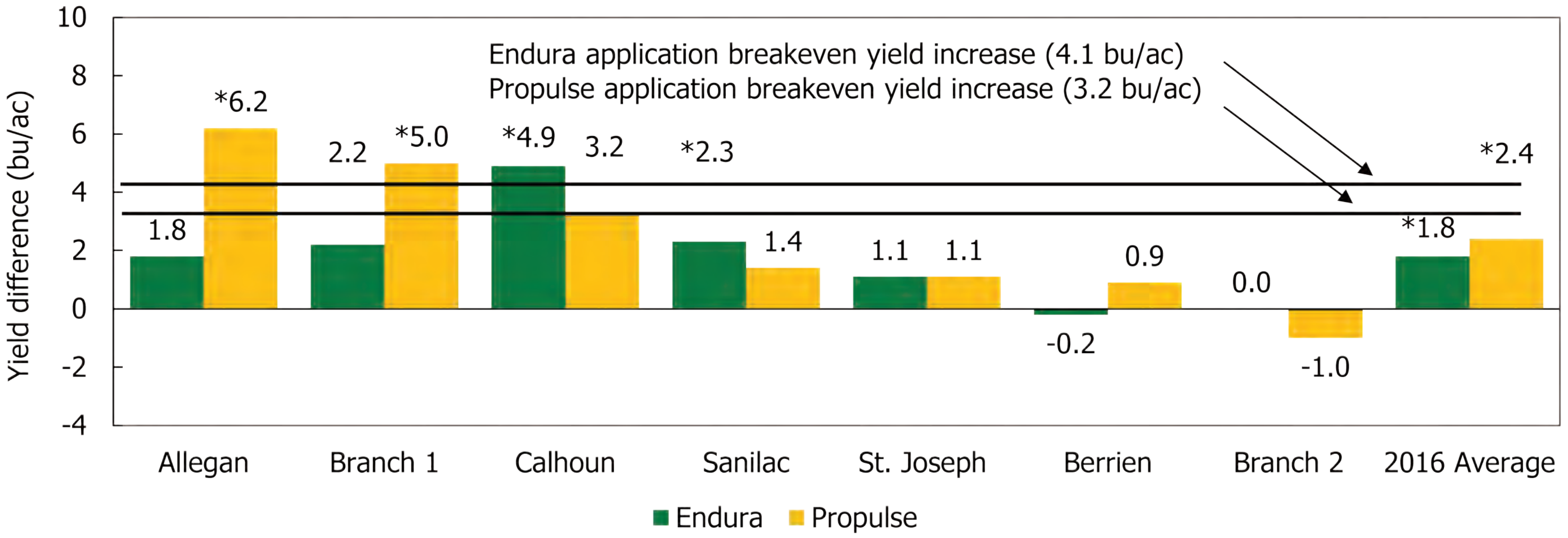
Procedure: This trial consisted of three treatments: 1) Endura®, 2) Propulse® and 3) an untreated control and was conducted at seven locations. Both fungicides were applied at 6 oz per acre about one week after the appearance of the first blossoms. All sprayers were equipped and operated to optimize spray droplet deposition in the canopy. White mold incidence was determined at all locations by counting 100 consecutive plants and recording the number of diseased plants. All counts were taken from approximately the same location in each treatment.

Table 1. White mold foliar fungicide effect on soybean yield and income in 2016

Location	Untreated control	Endura	Propulse	$LSD_{0.10}$
	------------------ Yield (bu/ac) ------------------			
Allegan	54.7 b	56.5 ab	60.9 a	5.3
Branch 1	76.1 b	78.3 ab	81.1 a	4.9
Calhoun	61.3 b	66.3 a	64.6 ab	3.7
Sanilac	66.8 b	69.1 a	68.1 ab	2.3
St. Joseph	73.0	74.1	74.1	2.0
Berrien	86.7	86.5	87.7	3.3
Branch 2	63.0	63.0	62.0	2.0
Average	**68.8 b**	**70.6 a**	**71.2 a**	**1.3**
	------------------ Income ($/ac) ------------------			
Average Income	**$633**	**$612**	**$625**	

Endura cost = $30.00 per acre
Propulse cost = $22.25 per acre
Application cost = $7.50 per acre

Figure 1. Yield difference produced by two white mold foliar fungicides in 2016



*The yield difference between the fungicides and the control was statistically significant at these locations
The yield difference between the two fungicides was never statistically significant in 2016

2016 White Mold Foliar Fungicide Comparison Trial

Results: All seven sites had a history of white mold. Environmental conditions favoring white mold development occurred at the Allegan, Branch 1 and Branch 2 locations with overall disease pressure being rated as low to moderate. However, white mold incidence was very low at the other four sites. These four trials demonstrate how the foliar fungicides affect soybean yields and income in the absence of significant white mold pressure. Propulse increased soybean yields compared to the untreated control at the Allegan and Branch 1 locations by 6.2 and 5.0 bushels per acre respectively (figure 1). Endura increased yields compared to the untreated control at the Calhoun and Sanilac locations by 4.9 and 2.3 bushels per acre respectively. Despite the large numerical differences occurring at some locations, the yields produced by the two fungicides were never statistically different. When all seven locations were combined and analyzed, both the foliar fungicides increased soybean yields over the untreated control and were not different from each other. Both fungicides significantly reduced white mold incidence at the Branch 1 and Calhoun locations (table 3). Propulse was profitable at Allegan and Branch 1 and Endura was profitable at Calhoun. However, neither product was profitable at the locations having very low disease pressure.

2016 White mold foliar fungicide program comparison trial locations

White mold is a complex disease and foliar fungicides can be a part of a comprehensive management plan that includes resistant varieties, reduced planting populations, row spacing greater than 20 inches, no-tillage, irrigation water management and crop rotation. However, foliar fungicides used alone will not consistently manage white mold.

We want to thank Bayer Crop Science for providing the Propulse, BASF for providing Endura and, Martin Nagelkirk, Dan Rajzer, and Ned Birkey for coordinating these trials.

Table 2. Planting dates, planting rates, row spacing and fungicide application dates at the trial locations

Location	Planting date	Planting rate	Row spacing	Application date
Allegan	May 19	150,000	Twin 7.5" rows	July 15
Branch 1	--	165,000	15"	July 5
Calhoun	May 5	166,000	15"	July 22
Sanilac	May 7	130,000	20"	July 13
St. Joseph	May 21	130,000	Twin 7" rows	July 13
Berrien	May 18	140,000	30"	July 6
Branch 2	May 7	190,000	15"	July 14

apothecia

sclerotia

Table 3. Foliar fungicide effect on white mold incidence in 2016

Location	Untreated Control	Endura	Propulse	LSD $_{0.10}$
	-------------- White mold disease incidence (% infected) --------------			
Branch 1	25 a	3 b	11 b	12
Calhoun	58 a	16 b	25 b	27.5

2016 Prescription Foliar Fertilizer Trial

Purpose: Soybean producers identified prescription foliar fertilization based on soil or plant tissue sampling as a high priority for the 2016 SMaRT trials. The AgroLiquid company agreed to collaborate on this project. The purpose of this trial was to determine the effect of field-specific prescription foliar fertilization on soybean yields and income in 2016.

Procedure: Field-specific prescription foliar fertilizer mixtures were compared to an unfertilized control at nine locations in 2016. The field-specific prescription foliar fertilizer mixtures (table 3) were developed by AgroLiquid and based on soil nutrient levels (table 2) at each of the trial locations. The application timing was also determined by AgroLiquid and was based on row spacing. Foliar fertilizers were applied at V4 (fourth trifoliate leaf) where the row spacing was 15 inches or less and at R1 (one open flower on 50% of the plants) where row spacing was more than 15 inches.

Table 1. The effect of a single application of a prescription foliar fertilizer on soybean yield in 2016

Location	**Unfertilized control**	**Foliar fertilizer**	**$LSD_{0.10}$**	**Yield difference**
	-------------- Yield (bu/ac)	--------------		Yield (bu/ac)
Cass	27.2 b	28.7 a	1.3	1.5
Ionia	65.4 b	66.8 a	1.0	1.4
Gratiot	71.9	73.1	1.5	1.2
St. Joseph	57.2	58.0	2.2	0.8
Van Buren	61.7	62.2	4.1	0.5
Lenawee 2	45.3	45.4	6.9	0.1
Monroe	67.0	66.9	1.0	-0.1
Lenawee 1	75.2	74.7	1.4	-0.5
Sanilac	54.1	52.6	5.2	-1.5
Average	**58.4**	**58.7**	**0.9**	**0.3**

field sprayer in soybeans

Table 2. Soil test levels at the 2016 prescription foliar fertilizer trial locations

Location	**O.M.**	**P**	**K**	**Mg**	**Ca**	**pH**	**CEC**	**S**	**Zn**	**Mn**
	%	--------------- ppm	---------------			1:1	meq/100g	--------- ppm	--------	
Cass	1.4	93	172	93	1057	6.7	6.5	**8**	2.1	**4**
Ionia	2.1	50	152	241	1243	6.6	9.3	**8**	1.9	**7**
Gratiot	2.8	27	165	248	1593	7	10.6	17	2.4	**4**
St. Joseph	1	64	99	79	665	6	5.1	23	1.8	**7**
Van Buren	1.5	29	162	81	719	5.9	5.7	13	1.4	16
Lenawee 2	2.1	99	177	179	975	6.1	8	**10**	1.7	**3**
Monroe	2.4	49	177	193	1131	6	9.2	13	2.5	**4**
Lenawee 1	2.7	16	141	254	1712	6.2	12.6	15	1.4	**5**
Sanilac	3.7	31	244	227	2460	7.9	14.9	20	1.8	**2**

Bold figures indicate low or very low soil test levels.

2016 Prescription Foliar Fertilizer Trial

Results: The prescription foliar fertilizer treatment significantly increased soybean yields at two of the nine locations in 2016. However, the yield increases were not large enough to cover the cost of the foliar fertilizer mixture at these sites (figure 1). The lack of a profitable response to foliar fertilization in these trials is most likely due to the medium to high soil test levels for most of the nutrients at the trial locations. However, sulfur levels were low at three locations and manganese levels were low or very low at eight locations. These results are consistent with previous university research trials conducted over the past 40 years showing that foliar fertilization of soybeans is rarely profitable. One exception is when foliar applications of manganese are applied to plants displaying visible manganese deficiency symptoms.

We want to thank AgroLiquid for providing and delivering the products and Martin Nagelkirk, Dan Rajzer and Ned Birkey for coordinating these trials.

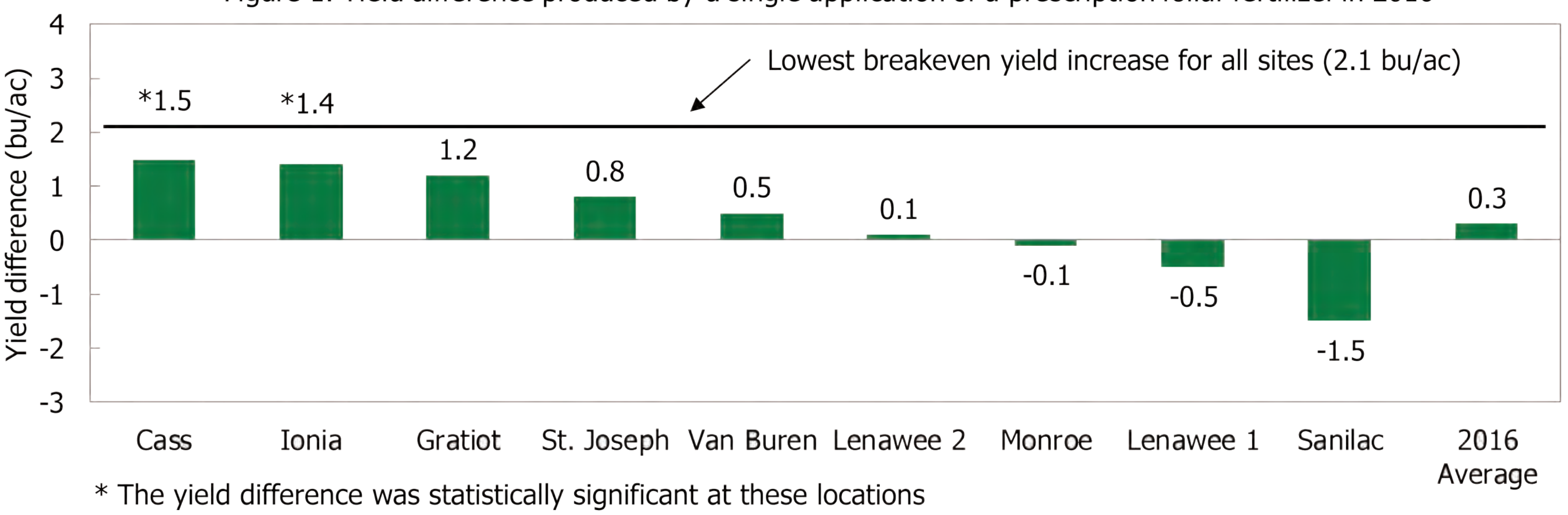
2016 Prescription foliar fertilizer trial locations

Table 3. Prescription foliar fertilizer products, application rates and costs for each location

Location	Foliar fertilizer products and application rates	Foliar fertilizer cost
		----- $/ac -----
Cass	1.5 gal/ac of fertiRain, and 1 qt/acre of Manganese	$19.10
Ionia	1.5 gal/ac of fertiRain, 2 qt/acre of Manganese, and 2 qt/ac of LiberateCa	$28.70
Gratiot	1.5 gal/ac of fertiRain, and 1 qt/acre of Manganese	$19.10
St. Joseph	1.5 gal/ac of fertiRain, and 1 qt/acre of Manganese	$19.10
Van Buren	1.5 gal/ac of fertiRain, 1 qt/acre of Manganese, and 1 qt/ac of LiberateCa	$19.50
Lenawee 2	1.5 gal/ac of fertiRain, 2 qt/acre of Manganese, and 2 qt/ac of LiberateCa	$28.70
Monroe	1.5 gal/ac of fertiRain, 2 qt/acre of Manganese, and 1 qt/ac of LiberateCa	$20.80
Lenawee 1	1 gal/ac of fertiRain, 1 gal/ac of Sure-K, and 2 qt/acre of Manganese	$21.40
Sanilac	1.5 gal/ac of fertiRain, and 1 qt/acre of Manganese	$19.10

Analyses of the foliar fertilizer products are listed below:
fertiRain: 12-3-3 plus 1.5% S, 0.10% Fe, 0.05% Mn, and 0.10% Zn
LiberateCa: 3% calcium from calcium sulfate
Manganese: 4% manganese from manganese sulfate
Sure-K: 2-1-6

Figure 1. Yield difference produced by a single application of a prescription foliar fertilizer in 2016



* The yield difference was statistically significant at these locations

2015 - 2016 Blackmax ™ 22 Trial

Purpose: Soybean producers are looking for ways to become more profitable and they want to know if commercially available products such as Blackmax 22 from Loveland Products Inc. will help them meet this objective. Blackmax 22 contains a humin component, a carbohydrate package, humic and fulvic acids and potassium. It is advertised as increasing nutrient availability, moderating salt toxicity, improving plant and microbial activity and increasing crop yields. The purpose of this trial was to evaluate the effect of a single application of Blackmax 22 on soybean yields and income in 2015 and 2016.

Procedure: A single foliar application of Blackmax 22 was compared to an untreated control at eight locations in 2015 and four locations in 2016. The Blackmax 22 was applied at one gallon per acre between the V3 and V5 or between the R1 and R3 growth stages in 2015 and between V3 and V5 in 2016. All sprayers were equipped and operated to optimize spray droplet deposition in the canopy.

Table 1. The effect of a single foliar application of Blackmax 22 on soybean yield and income in 2015

Location	**Untreated control**	**Blackmax 22**	**LSD $_{0.10}$**	**Yield difference**
	------------------ Yield (bu/ac)	------------------		Yield (bu/ac)
Monroe 1	52.4	55.9	5.5	3.5
Monroe 2	44.0	47.5	6.3	3.5
Lenawee	53.9	56.0	3.9	2.1
Monroe 3	26.8	28.8	3.4	1.9
Calhoun	71.8	72.8	2.9	1.0
Bay 1	51.6	52.1	1.7	0.5
Bay 2	39.4	39.3	1.8	-0.1
Ionia	65.3	65.1	3.9	-0.2
Washtenaw	36.3	36.0	3.5	-3.3
Average	**49.1 b**	**50.4 a**	**0.9**	**1.3**
	------------------ Income ($/ac)	-----------------		
***Average income**	**$453**	**$444**		

Blackmax 22 cost = $20.00 per acre
*Application cost was not included

Table 2. The effect of a single foliar application of Blackmax 22 on soybean yield and income in 2016

Location	**Untreated control**	**Blackmax 22**	**LSD $_{0.10}$**	**Yield difference**
	------------------ Yield (bu/ac)	------------------		Yield (bu/ac)
Allegan	44.3	45	7	0.7
Monroe	67.0	67.0	2.7	-0.1
Washtenaw	33.7	33.3	7.3	-0.3
Branch	63.5	63.1	2.7	-0.5
Average	**52.1**	**52.1**	**1.7**	**0.0**
	------------------ Income ($/ac)	-----------------		
***Average income**	**$479**	**$459**		

Blackmax 22 cost = $20.00 per acre
*Application cost was not included

2015 - 2016 Blackmax ™ 22 Trial

Results: The Blackmax 22 treatment did not significantly increase soybean yields at any of the eight sites conducted in 2015 or any of the four sites conducted in 2016. When the locations were combined and analyzed, the Blackmax 22 treatment produced 1.3 bushels per acre more than the untreated control in 2015 and produced the same yield as the untreated control in 2016. When all locations (2015 and 2016) were combined and analyzed, the Blackmax 22 produced 0.9 of a bushel per acre more than the untreated control. Because the breakeven yield increase for Blackmax 22 is 2.2 bushels per acre without the application cost, a single application of Blackmax 22 was not profitable.

We want to thank Crop Production Services and Loveland Products Inc. for providing and delivering the Blackmax 22 and Ned Birkey and Dan Rajzer for coordinating these trials.

2015 and 2016 Blackmax 22 trial locations

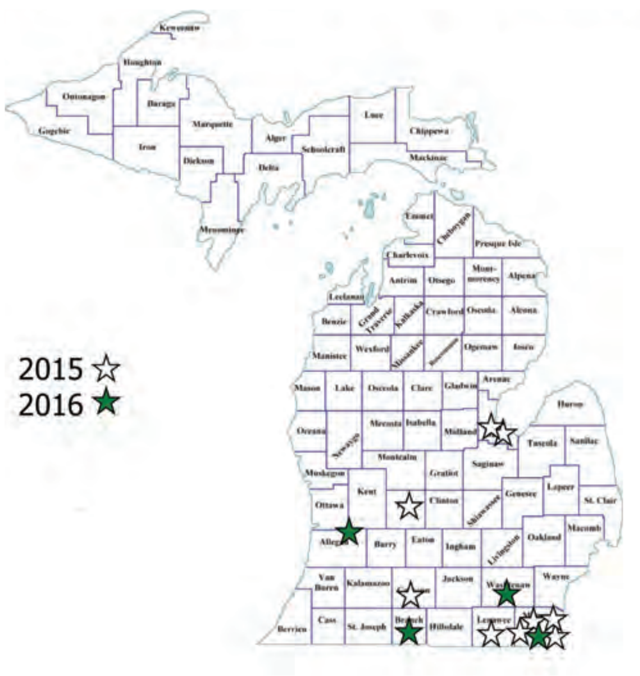
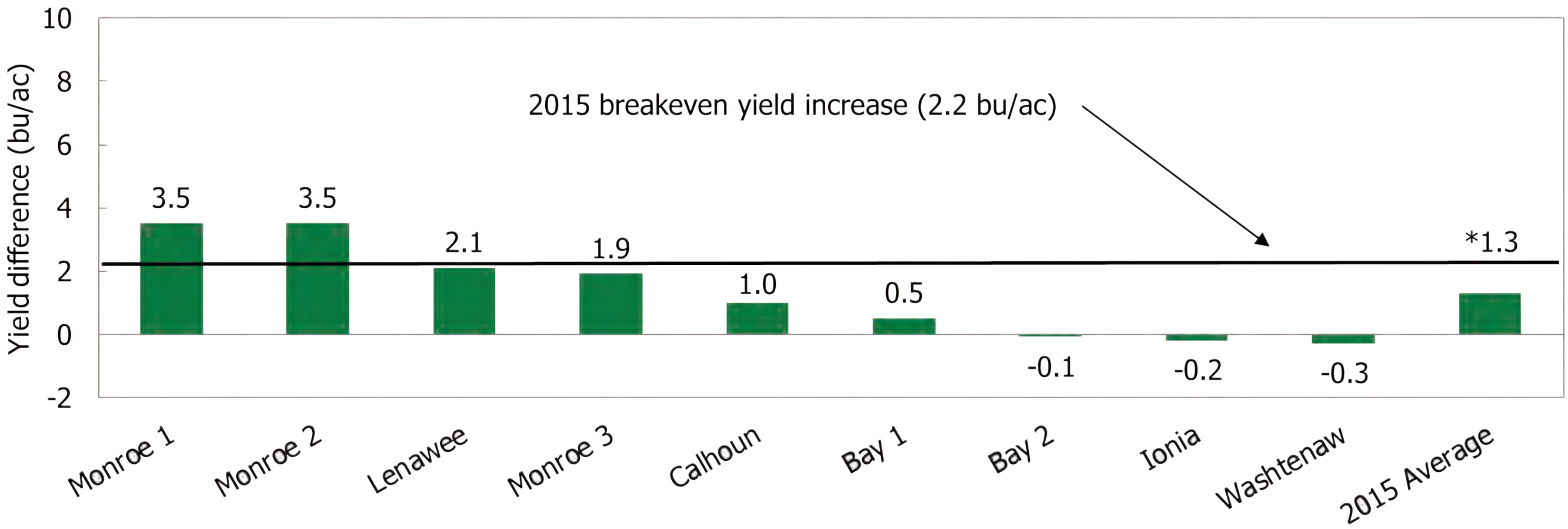
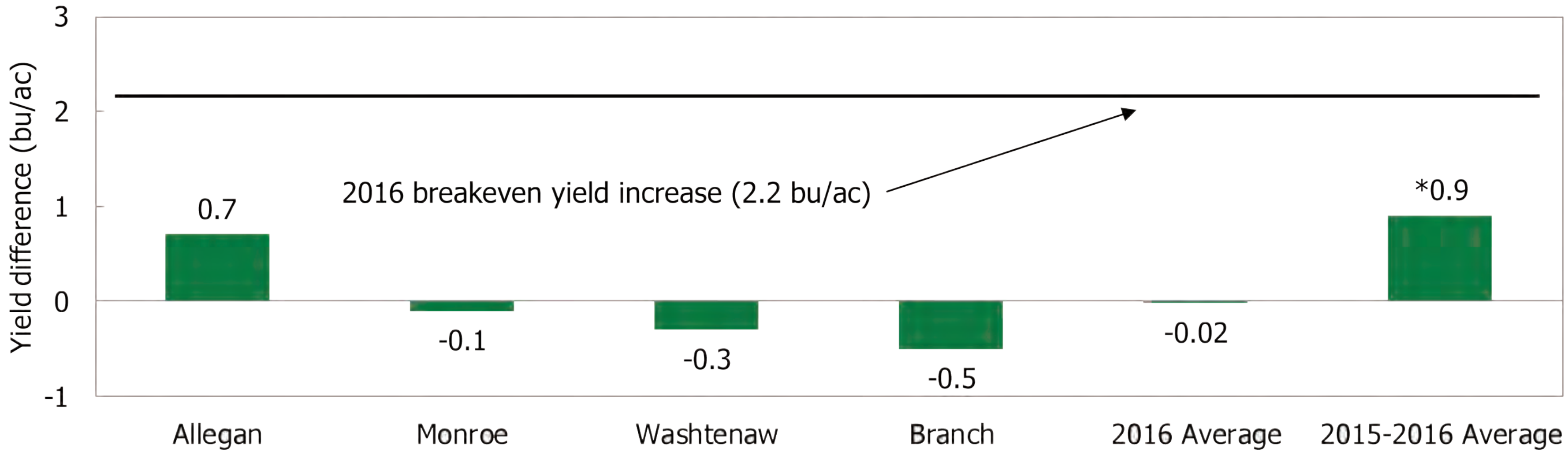


Figure 1. Yield difference produced by a foliar application of Blackmax 22 in 2015



* The yield difference was statistically significant at this location

Figure 2. Yield difference produced by a foliar application of Blackmax 22 in 2016



* The yield difference was statistically significant at this location

2014 - 2016 Intensive Management Trial

Purpose: Soybean producers are trying to improve soybean yields and many are willing to manage the crop more intensively to achieve this goal. University researchers have collaborated to conduct intensive management or "kitchen sink" trials in recent years. These trials are designed to determine which products and management practices contribute to higher soybean yields. Nearly all of the research has been done in small plots. The purpose of this trial was to determine the effect of an intensive management treatment (seed treatment followed by a foliar three-way tank mixture application) on soybean yields in 2014, 2015 and 2016.

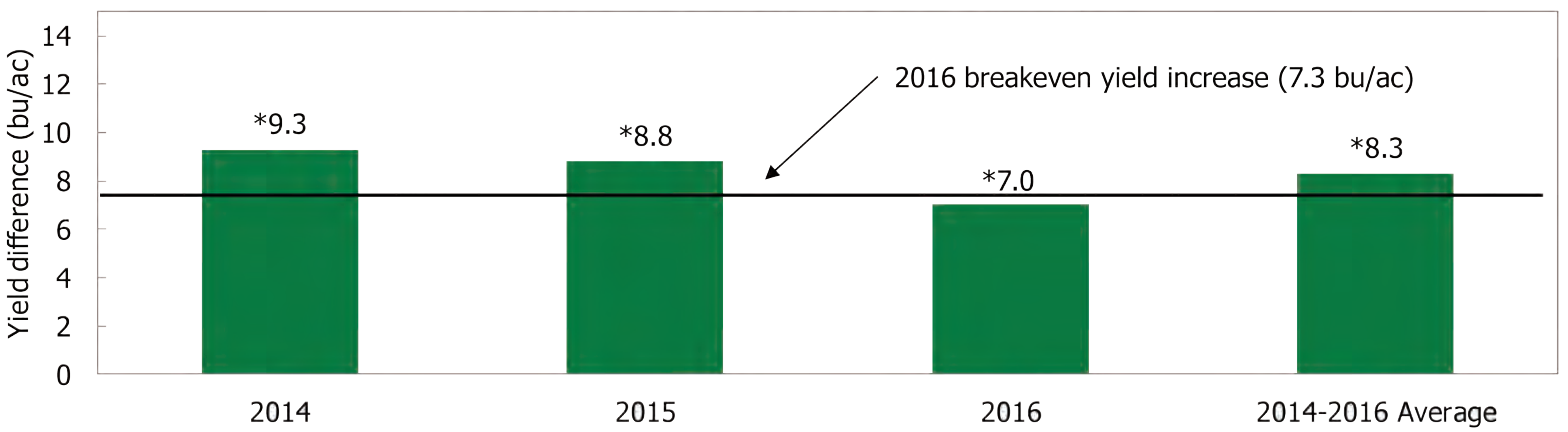
Procedure: An intensive management treatment (seed treatment followed by a foliar three-way tank mixture application) was compared to an untreated control treatment (no seed treatment and no foliar tank-mix application) by the same producer at one location in 2014, 2015, and 2016. The seed treatment was Poncho®/VOTiVO® and Acceleron® in 2014 and 2015 and Clariva™ Complete plus Acceleron in 2016. The Acceleron was a combination of three fungicides (pyraclostrobin, metalaxyl, fluxapytoxad). The same foliar tank mixture was applied each year of the project and included Priaxor™ (fungicide) from BASF, Fastac™ (insecticide) from BASF and PhosFix™ 7-4-9 (fertilizer) from the Andersons Inc. Priaxor was applied at 4 ounces per acre, Fastac was applied at 3.8 ounces per acre and PhosFix was applied at 1 quart per acre. The foliar applications were made at R3 and the sprayer was driven through the untreated control treatments to prevent tire tracks from being a factor.

Table 1. Intensive soybean management effects on soybean yields and income in Sanilac County in 2014 through 2016

Treatment	**2014**	**2015**	**2016**	**2014 - 2016 Average**	***2014 - 2016 Average income**
	----------------- Yield (bu/ac) -----------------				------- $/ac ------
Untreated control	53.0 b	65.8 b	66.3 b	61.7 b	$568
Intensive management	62.3 a	74.5 a	73.3 a	70.0 a	$577
$LSD_{0.10}$	2.6	1.1	2.5	1.2	

*Using 2016 soybean prices, product costs and application costs
Acceleron and Clariva Complete seed treatment cost = $26.00 per acre
Priaxor fungicide cost = $18.60 per acre
Fastac insecticide cost = $4.10 per acre
PhosFix (7-4-9) cost = $10.50 per acre
Foliar application cost = $7.50 per acre

Figure 1. Yield difference due to intensive management practices (seed treatment followed by a foliar tank mixture)



* The yield difference was statistically significant in these years.

2014 - 2016 Intensive Management Trial

Results: The intensive management treatment increased soybean yields by 9.3 bushels per acre in 2014, by 8.8 bushels per acre in 2015 and by 7 bushels per acre in 2016 at one location in Sanilac County (figure 1). The seed treatments used in the intensive management program also increased plant stands by nearly 31,000 plants per acre in 2014, by more than 19,000 plants per acre in 2015 and by nearly 10,000 plants per acre in 2016 (table 2). The higher plant stands were probably not responsible for the yield increase as plant stands in the untreated control were adequate to maximize yield. The intensive management treatment generated $26.00 per acre more income than the untreated control treatment in 2014, $12.00 per acre more than the untreated control treatment in 2015, but was less profitable than the untreated control in 2016.

We want to thank BASF and the Andersons Inc. for providing and delivering the products and Martin Nagelkirk for coordinating this trial.

2014 through 2016 intensive management trial locations

Table 2. Intensive soybean management effects on plant stands at harvest in Sanilac County in 2014 through 2016

Treatment	2014	2015	2016	2014 - 2016 Average
	-------------- Plant stand at harvest (plants/ac) --------------			
Untreated control	142,900 b	147,300 b	145,800 b	145,400 b
Intensive management	173,700 a	166,500 a	155,400 a	165,100 a
$LSD_{0.10}$	18,000	1,004	4,359	7,755

Drone image of the 2016 intensive management trial

Introduction to Experimental Design, Statistical Analysis and Interpretation

Producers will often evaluate new products or practices by comparing them side by side in two strips or by splitting a field in half. This practice can introduce a tremendous amount of experimental error and may not produce reliable information regarding the performance of the product or practice. The information generated is heavily influenced by factors other than the practice or product being evaluated. Good experimental design followed by careful statistical analysis can eliminate much of the experimental error and help determine the actual performance of the new practice, equipment, or product.

Developing and implementing a sound experimental design 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 to lay out in the field. The RCBD reduces the experimental error by grouping or blocking all of the treatments to be compared within replications. This design improves the likelihood that all the treatments are compared under similar conditions. Blocking the treatments together and replicating the blocks across the field is a simple and effective way to account for variability in the field. Increasing the number of replications generally increases the sensitivity of the statistical analysis by reducing the experimental error. The SMaRT program encourages cooperators to use at least four replications.

Another important aspect of a good experimental design is the concept of randomization. Randomly assigning the order of the treatments within each block is critical to removing bias from treatment averages or means and reducing experimental error. Figure 1 shows the actual RCBD design that was used in the 2016 planting rate trials. It demonstrates the principles outlined above. Note how each planting rate is included and randomized within the replications. All of the 2016 trials comparing three or more treatments utilized the RCBD with four replications of each treatment unless stated otherwise in the procedure section. The treatments in all of 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 2016 SMaRT 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 measureable variables such as yield are due to the treatments or a result of other outside factors. It is important to look at the Least Significant Difference (LSD 0.10) when you interpret the information contained in the tables and graphs in this publication.

The LSD 0.10 is a calculated figure that producers can use to determine with a confidence level of 90% that the difference between two or more treatments is due to the treatments and not other factors. We are again using an LSD 0.10 for 2016. If the yield of two treatments differs by less than the LSD listed, the difference cannot be statistically attributed to a difference in the treatments.

Letters are used in the tables and an asterisk (*) is used in the graphs 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.

The SMaRT 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. 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.

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