2015 SMaRT Research Report

SMaRT
Soybean Management and Research Technology

Mike Staton, MSU Extension Soybean Educator
Mark Seamon, MSPC Research Coordinator

CONTENTS

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 2016 SMaRT project, contact Mike Staton at (269) 673-0370 extension 2562 or staton@msu.edu.

2015 marks the fifth season of the SMaRT research program, made possible by the checkoff investment of Michigan soybean producers. This year, 65 producers around the state conducted on-farm research trials within 11 projects. Contained in this publication you'll find the results from 86 individual trial locations. The research projects were developed with producer input and represent some of the most important challenges producers face. Most of the projects were conducted at multiple locations and, in some cases, across several years improving the reliability of the results.

Agronomic and economic data is presented for each treatment. The projected USDA 2015-16 average soybean price of $9.15 per bushel and average 2015 prices for the product(s) and application costs associated with the treatments were used to determine the breakeven yields presented in the graphs.

Conducting these trials would not be possible without strong partnerships. Mike Staton serves as the SMaRT project coordinator though a unique partnership between Michigan State University (MSU) Extension and the Michigan Soybean Promotion Committee (MSPC). As state-wide soybean educator based in Allegan County, half of his salary, benefits and operating budget is supplied by the Michigan Soybean checkoff. 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 are essential to this project's success. Brian Stiles, MSPC research technician and Kate Knowlton and Ryan Walker, MSPC interns 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, James Dedecker, Paul Gross, Marilyn Thelen, Bob Battel, George Silva, Kevin Gould and James Vincent 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 when analyzing the 2015 trial results and provided valuable input regarding experimental design and statistical analysis.

All photos of field sprayers were made possible by Green Valley Agricultural Inc. of Wayland.

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

NON-PROFIT
US POSTAGE
PAID
PERMIT 20
FRANKENMUTH, MI

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 not been identified in Michigan. However, sulfur can be low in coarse-textured soils low in organic matter and legumes such as soybeans are the most likely crops to respond to sulfur applications. 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 and 10 locations in 2015 that were planted to soybeans. At two more locations (Sanilac and Saginaw), the gypsum was applied prior to planting corn. Yields from these two locations will be published in future SMaRT research reports. The gypsum was applied in the spring at all locations except the Sanilac 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 have been geo-referenced at most of the locations and crop yields will be monitored throughout the crop rotation.

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

Location	**Untreated Control**	**Broadcast Gypsum**	**LSD $_{0.10}$**
	------------------ Yield (bu/ac) ------------------		
Presque Isle 15	38.2 a	36.8 b	0.9
Cass 2	51.6	49.4	3.4
Presque Isle 14	25.3 b	31.9 a	2.0
Hillsdale	68.7	67.7	7.5
Cass 1	52.0 a	49.5 b	1.7
Clinton	60.9	59.9	2.3
Monroe 1	46.2	45.8	3.3
Branch 1	55.5	56.0	0.9
Branch 2	54.3 a	52.1 b	1.9
Monroe 2	51.7	53.8	4.1
Monroe 3	43.3	45.3	6.9
Average	**49.8**	**49.8**	**1.0**
	------------------ Income ($/ac) ------------------		
Average Income	**$456**	**$418**	

Soybean price = $9.15 per bushel
Gypsum price = $18.00 per ton
Trucking cost = $13.00 per100 miles
Application cost = $7.15 per acre

Table 2. Baseline soil test levels for eight of the broadcast gypsum trials conducted in 2015

Location	**Organic Matter (%)**	**Magnesium (ppm)**	**Calcium (ppm)**	**CEC (meq/100 g)**	**Sulfur (ppm)**	**Magnesium Saturation (%)**	**Calcium Saturation (%)**
Cass 1	15.9	165	2600	24.4	13	5.6	53.3
Clinton	3.4	310	2100	13.4	15	19.2	78.1
Monroe 3	4.1	365	2150	14.2	8	21.5	75.9
Monroe 2	2.6	205	1500	10.8	13	15.9	69.7
Monroe 1	3.2	215	1850	11.4	11	15.8	81.4
Hillsdale	2.7	220	1350	10.1	7	18.1	66.7
Branch 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

Broadcast Gypsum Trial

Results: The broadcast gypsum increased soybean yields by 6.5 bushels per acre over the untreated control at the Presque Isle location in 2014. It was determined that 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 (figure 1). In fact, the soybean yields in the gypsum treatments were significantly lower than the untreated control at three locations. The plant tissue results may help explain the lack of a yield response from the gypsum in 2015 (table 3). Except for the nitrogen concentration at the Cass 1 location, the levels for nitrogen, calcium and sulfur were considered sufficient in the untreated control treatments. Due to the lack of a positive yield response, the gypsum application was not profitable at any of the sites tested in 2015.

It is important to note that the yield information presented in this report represents only the short-term effects of gypsum on soybean yields. Additional monitoring will be required to determine the long-term effects of broadcast gypsum applications on crop yields and soil physical properties.

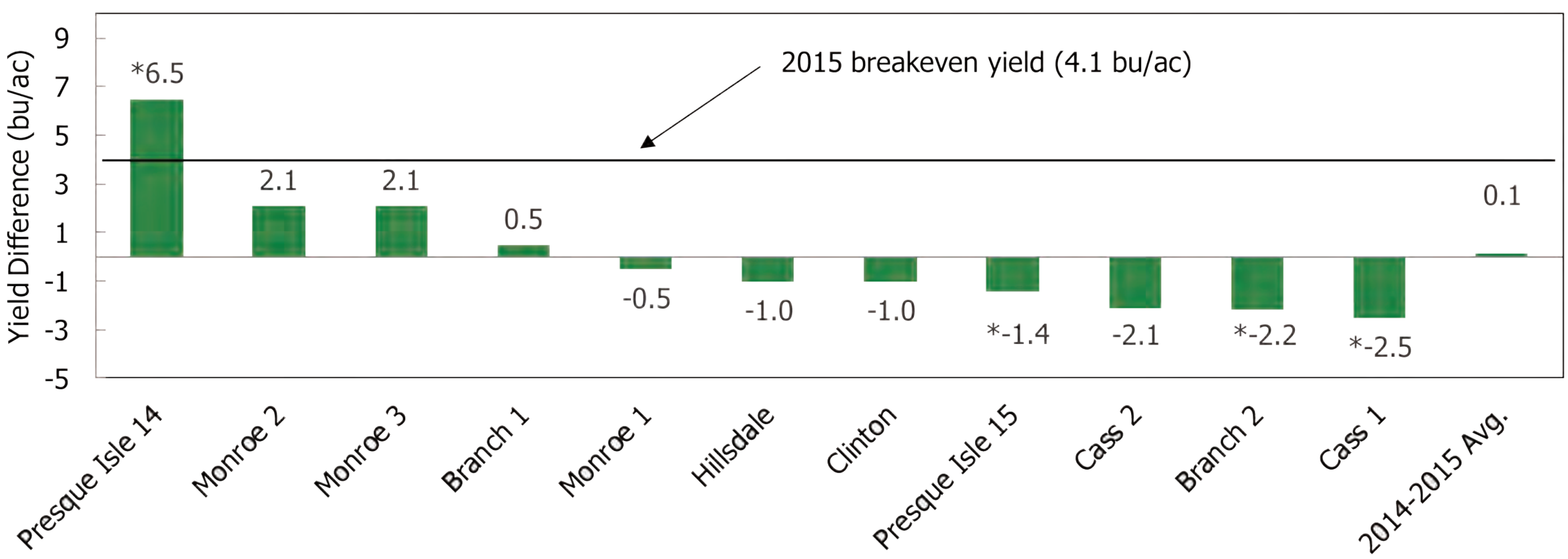
We want to thank Gypsoil for providing and delivering the gypsum for the 2015 trials and James Dedecker, Dan Rajzer and Ned Birkey for coordinating these trials

2014 and 2015 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 1	4.68	4.74	1.26 b	1.35 a	0.33 b	0.47 a
Clinton	5.06	5.01	1.28	1.27	0.32 b	0.37 a
Monroe 3	5.75 a	5.04 b	1.18	1.23	0.37	.036
Monroe 2	5.86 a	5.46 b	1.25	1.28	0.37 b	0.39 a
Hillsdale	4.99	5.47	1.26	1.23	0.28 b	0.36 a
Branch 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

Planting Rate Trial

Purpose: Soybean planting rates was one of the highest ranking topics identified by soybean producers for evaluation in the 2015 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. Research has shown that lower planting rates can be an important way to manage white mold. The purpose of this trial was to evaluate how low planting rates will affect soybean yield and income and 2015.

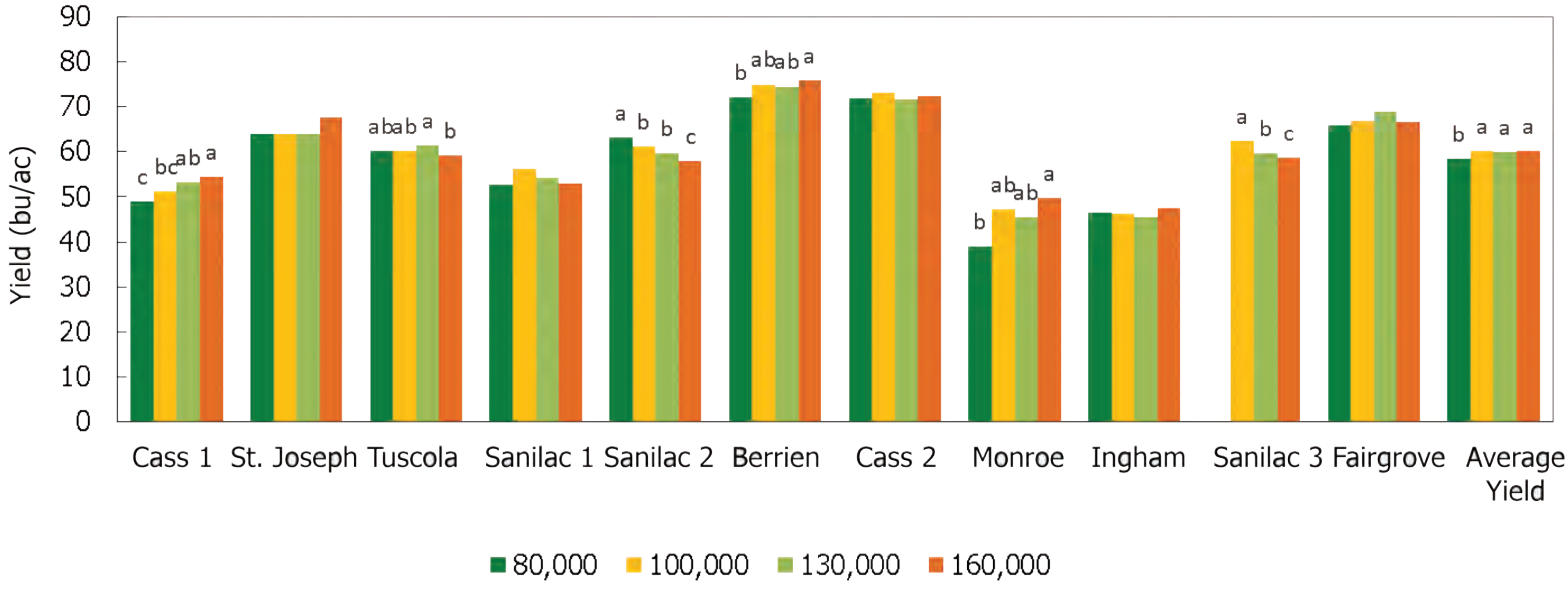
Procedure: Eleven planting rate trials were conducted in 2015. Four target planting rates (80,000, 100,000, 130,000 and 160,000 seeds per acre) were compared at 10 sites and the highest three planting rates were compared at the Sanilac 3 location. Stand counts were taken approximately 30 days after planting to determine actual plant stands at each location.

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**	

Soybean price = $9.15 per bushel
Seed cost = $60 per 140,000 seed unit

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



Planting Rate Trial

Results: The planting rate trials produced mixed results at the individual locations. At three sites, the 160,000 population 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 yields produced by the highest three planting rates. 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. The excellent plant stands and early planting season probably contributed to the excellent performance of the low planting rates. Actual plant stands were within 13% of the target population. In previous SMaRT planting rate trials, actual plants stands were more than 20% lower than the target population.

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.

2015 Planting rate trial locations

Tuscola planting rate trial

Table 2. Target planting rates and actual plant stands 30 days after planting in 2015

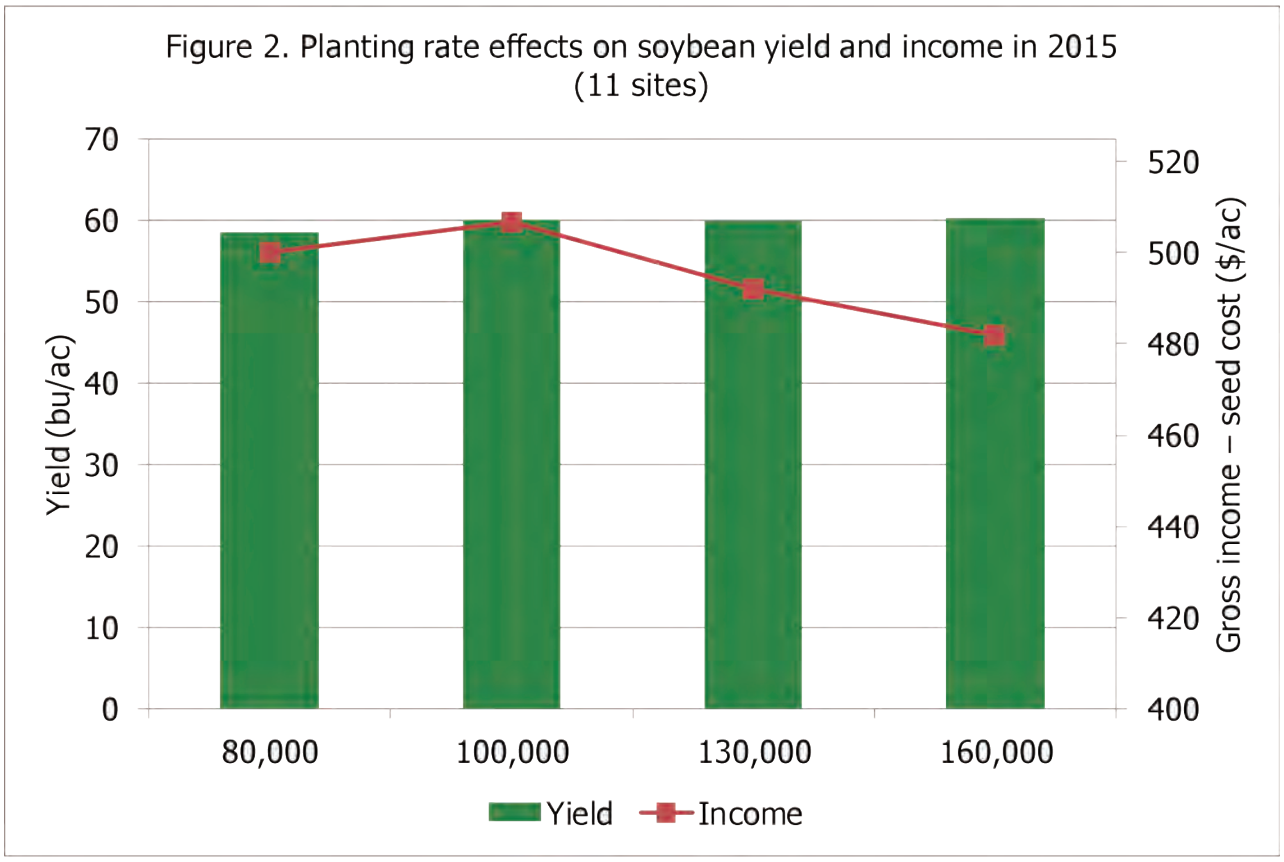
	------------------ Target Planting Rate (seeds/ac) ------------------			
Location	**80,000**	**100,000**	**130,000**	**160,000**
	----------- Actual Plant Stands 30 Days After Planting (plants/ac) ----------			
St. Joseph	69,800	82,600	110,100	138,100
Cass 1	79,100	85,100	122,900	133,100
Sanilac 3	--	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

Planting Rate Trial

Table 3. 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

Sanilac planting rate trial



Row Spacing Trials

Purpose: Soybean producers have been moving away from drilling soybeans in narrow rows to planting them with unit planters or air seeders in 15 to 30 inch rows. Increasing seed costs, increased planting capacity and a trend for narrow rows to promote white mold are some of the factors driving the move away from narrow row soybeans. University pathologists recommend row widths wider than 20 inches if white mold management is the primary reason for considering wider rows. The purpose of these trials was to evaluate the effect of row spacing on soybean yields in 2015.

2015 Row spacing trial locations

Procedure: Two row spacing trials were conducted in 2015. In Sanilac County, 15 inch rows were compared to 30 inch rows. Both row spacings were planted with a Case IH 1250 Early Riser planter set up for 30 inch rows. We tried to plant both row spacings at 140,000 seeds per acre. To plant the 15 inch rows, we cut the seeding rate in half and made another pass with the planter units running down the center of the previously planted 30 inch rows. The additional soil compaction and soil being thrown by rows cleaners may have led to a slightly lower plant population in the 15" rows at this site (124,000 vs 140,000).

In Ionia County, we compared 7.5 inch rows to 15 inch rows. Again, both row spacings were planted with the same piece of planting equipment (John Deere 1990 air seeder). The goal was to keep the seeding rate the same for both treatments. Stand counts were taken approximately 30 days after planting to determine the actual plant population in each treatment. Based on the stand counts, the population in the 15" rows was 150,000 plants per acre and the population in the 7.5 rows was 230,700 plants per acre.

Results: Row spacing did not significantly affect soybean yield at either location. However, the 15 inch rows tended to yield slightly higher than the other row spacings. Based on previous research conducted across the U.S., we would not expect to see a yield difference between 7.5 and 15 inch rows. However, the Sanilac County trial results are inconsistent with the results of other row spacing comparisons which showed that 15 inch rows produced 3.6 bushels per acre more than 30 inch rows. The fact that we had to double plant the 15 rows in this trial may have reduced the yield potential of this treatment.

We want to thank Kevin Gould and Martin Nagelkirk for coordinating these trials.

Figure 1. Row spacing effects on soybean yields in 2015

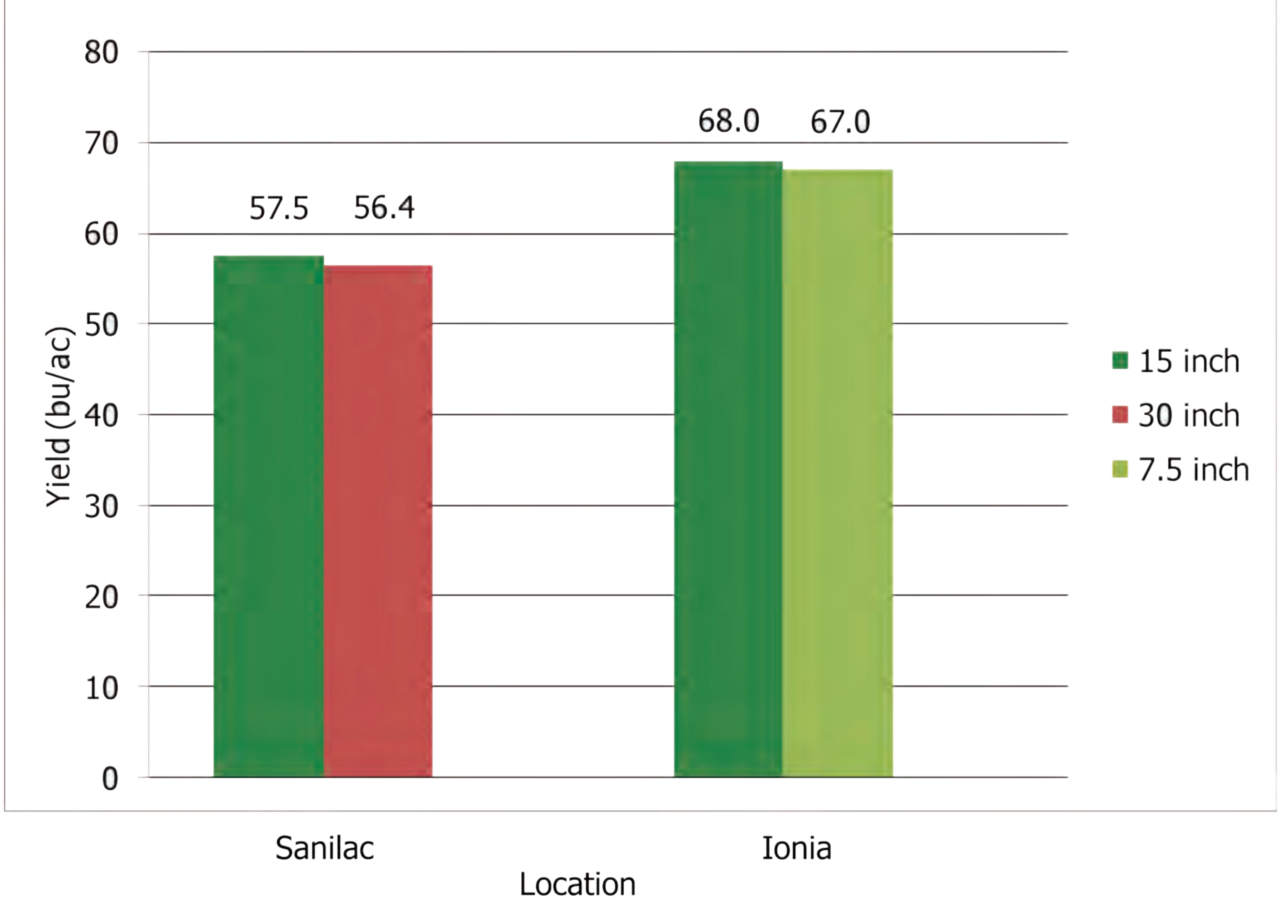


Table 1. Effect of row spacing (30' vs 15") and plant stand on soybean yields at one site in Sanilac County in 2015

Treatment	Plant Stands (plants/ac)	Yield (bu/ac)
30 inch rows	140,000	56.4
15 inch rows	124,000	57.5
$LSD_{0.10}$	--	2.1

Table 2. Effect of row spacing (15" vs 7.5") and plant stand on soybean yields at one site in Ionia County in 2015

Treatment	Plant Stands (plants/ac)	Yield (bu/ac)
15 inch rows	150,000	68.0
7.5 inch rows	230,700	67.0
$LSD_{0.10}$	--	1.9

Clariva™ Complete Seed Treatment Trial

Purpose: Syngenta's Clariva consists of naturally occurring soil bacteria (*Pasturia nishizawae*) having a unique, direct mode of action on soybean cyst nematodes (SCN). It was available as Clariva Complete Beans seed treatment in the U.S. in 2014. The Clariva Complete Beans seed treatment includes Clariva and CruiserMaxx® + Vibrance™. For optimum performance, the Clariva Complete Beans seed treatment should be applied to SCN-resistant varieties. The purpose of this trial was to evaluate the effect of the *Pasturia nishizawae* contained in Clariva Complete Beans on SCN populations and soybean yields in 2014 and 2015.

Procedure: Two seed treatments (Clariva Complete Beans and CruserMaxx + Vibrance) were applied to SCN-resistant soybean seed and compared at four locations in Michigan in 2014 and two more locations in 2015. The seed treatments were selected to isolate the effects of *Pasturia nishizawae*. Each treatment was replicated six times in the Ingham trial, three times in the TARE (Thumb Agriculture Research and Extension) trial in St. Clair and four times in the rest of the trials. A randomized complete block experimental design was used at each location. SCN soil samples were collected from each treatment after planting and again before harvest to determine the effect of the seed treatments on SCN populations. We made sure that the SCN soil samples from each sampling date were taken from the same locations. 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. When the reproductive index is less than one, the treatment reduced the SCN population.

Table 1. Clariva Complete Beans and CruiserMaxx + Vibrance seed treatment effects on soybean yield in 2014 and 2015

Treatment	*Ingham	*Tuscola	*St. Clair	*Sanilac	Cass	Saginaw	**Average
	-------------------------- Yield (bu/ac) ---------------------------						
CruiserMaxx + Vibrance	51.6	51.4	49.5	54.8	36.4	60.6	49.9
Clariva Complete Beans	52.2	52.9	48.4	54.1	35.4	56.7	49.4
$LSD_{0.10}$	2.1	5.9	5.1	2.4	4.6	6.5	1.8

*2014 locations
** Average includes the 2014 Ingham and Tuscola sites only as SCN was not detected at the St. Clair and Sanilac sites and both 2015 sites

SCN females (cysts) on soybean roots

Clariva™ Complete Seed Treatment Trial

Results: The Clariva Complete Beans seed treatment did not improve soybean yields at any of the six locations when compared to the CruiserMaxx + Vibrance seed treatment (table 1). This was not surprising for two of the TARE locations (Sandusky and St. Clair) as SCN was not detected at these sites. However, SCN was present at the TARE site in Tuscola County and the Ingham County site in 2014 and both of the 2015 locations. When these four locations, were combined and analyzed, the Clariva Complete Beans seed treatment did not affect soybean yields. In fact, soybean yields tended to be numerically lower but not statistically lower in the Clariva Complete Beans treatment at 3 of the four locations where SCN was detected. The nematode sampling results are presented in table 2. Although the nematode data was not statistically analyzed, it appears that the Clariva Complete Bean seed treatment did not affect SCN development at the three sites having the highest SCN levels.

We want to thank Syngenta and Heasley Seeds for providing the product for the Ingham County location in 2014 and the Cass and Saginaw locations in 2015. We also want to thank Dan Rajzer and Bob Battel for coordinating the Cass County and TARE sites.

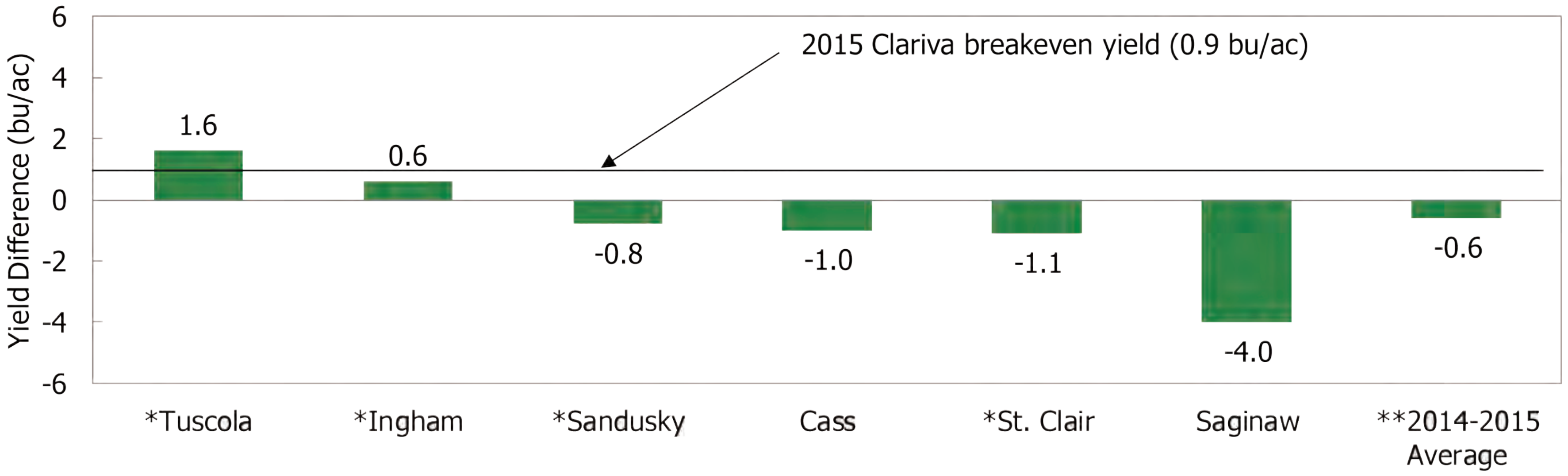
2014 & 2015 Clariva complete beans trial locations

Table 2. Clariva Complete Bean and CruiserMaxx Plus Vibrance seed treatment effects on SCN population development in 2014 and 2015

Location	SCN Population After Planting (PI)		SCN Population Before Harvest (PF)		SCN Reproductive Index (PF/PI)	
	CruiserMaxx Plus Vibrance	Clariva Complete Beans	CruiserMaxx Plus Vibrance	Clariva Complete Beans	CruiserMaxx Plus Vibrance	Clariva Complete Beans
	---------------- SCN Eggs and Juveniles per 100 cm^3 of soil -------------------					
*Ingham	1310	1793	4250	4880	3.24	2.72
Cass	180	225	1139	1420	6.33	6.31
Saginaw	100	61	1567	581	15.67	9.52

* 2014 location

Figure 1. Yield difference due to adding Clariva to CruiserMaxx Plus Vibrance in 2014 and 2015



*2014 locations
** Includes the 2014 Tuscola and Ingham locations and both 2015 locations
Soybean price = $9.15 per bushel
Clariva Complete Beans seed treatment cost = $26.80 per acre
CruiserMaxx + Vibrance seed treatment cost = $16.10 per acre

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 project have produced similar results with only four out of 16 trials showing a positive yield increase. However, a 2x2 starter applied in a trial conducted in 2013 increased soybean yields by six 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. 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 in 2015.

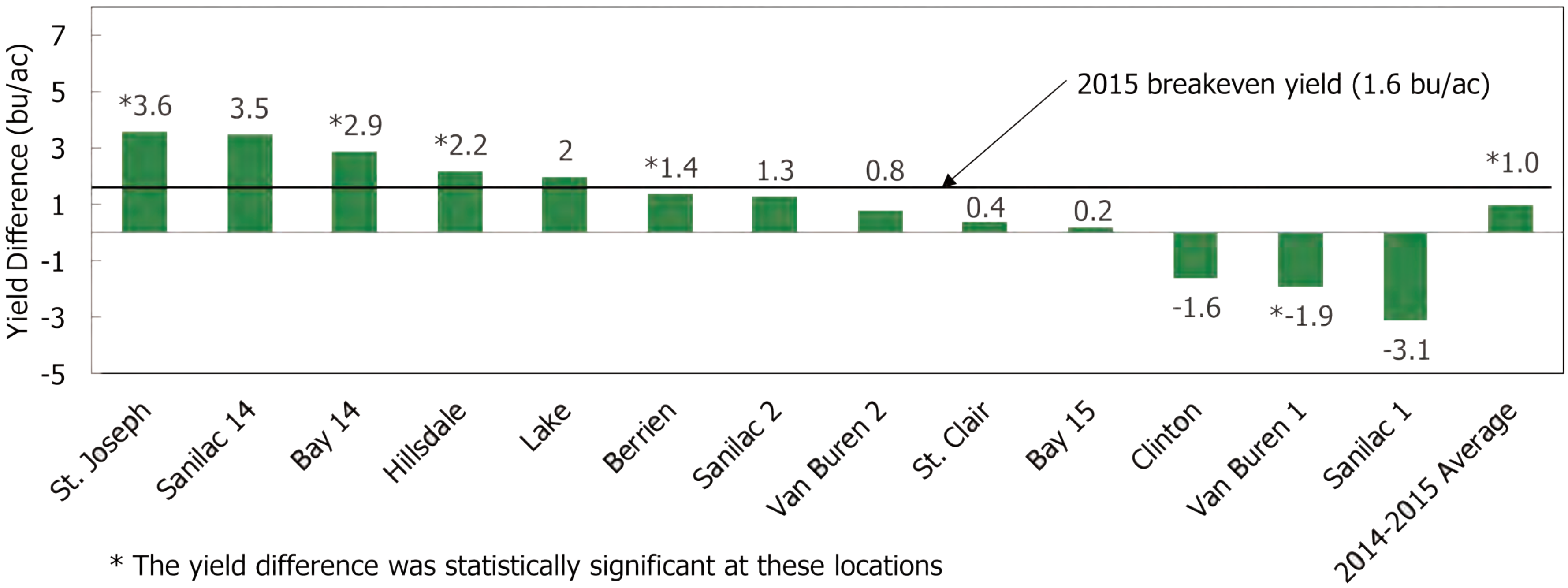
Procedure: Potassium thiosulfate (0-0-25-17) applied in a 2x2 band at planting was compared to an unfertilized control at two locations in 2014 and 11 locations in 2015. The potassium thiosulfate was applied at three gallons per acre. Base line soil samples were collected and plant tissue samples were 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 and 2015

Location	**Untreated Control**	**Potassium Thiosulfate Starter Fertilizer**	**LSD $_{0.10}$**
	------------------ Yield (bu/ac)	------------------	
Bay 14	44.5 b	47.5 a	2.6
Bay 15	57.2	57.3	4.1
Berrien	48.3 b	49.7 a	1.3
Clinton	61.1	59.5	3.1
Hillsdale	40.5 b	42.7 a	1.5
Lake	38.6	40.6	3.7
Sanilac 1	53.2	50.1	4.8
Sanilac 14	24.1	27.6	4.2
Sanilac 2	60.5	61.8	1.9
St. Clair	53	53.4	4.4
St. Joseph	61.9 b	65.5 a	2.1
Van Buren 1	62.3 a	60.4 b	1.5
Van Buren 2	53.4	54.2	2.4
Average	**50.6 b**	**51.6 a**	**0.7**
	------------------ Income ($/ac)	-----------------	
Average Income	**$463**	**$457**	

Soybean price = $9.15 per bushel
Potassium Thiosulfate cost = $15.00 per acre

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



* The yield difference was statistically significant at these locations

Potassium Thiosulfate Starter Fertilizer Trial

Results: In 2015, the potassium thiosulfate starter fertilizer produced significantly higher soybean yields than the untreated control at three of the 11 sites (27% of the time) and was profitable at only two of these (figure 1). The starter fertilizer also decreased yields at one location. When all 13 locations were combined and analyzed, the starter fertilizer increased soybean yield by only 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 but two 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.

This practice may be more beneficial on coarse-textured soils or soils having potassium soil test levels below the critical level.

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, Marilyn Thelen and Martin Nagelkirk for coordinating these trials.

2014 & 2015 Potassium thiosulfate starter fertilizer trial locations

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

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

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

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

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	Spring 2015	150	0-0-60
Cass 1	Spring 2015	100	0-0-60
Cass 2	Spring 2015	150	0-0-60
Clinton	Spring 2015	242	9-23-31
Hillsdale	Fall 2014	*120 & 188	0-0-60
Lake	Spring 2015	160	0-0-60
Sanilac 14	Fall 2013	200	0-0-60
Sanilac 1	Fall 2013	*75 – 341 (field average was 114)	0-0-62
Sanilac 2	Spring 2015	200	5-26-31
St. Clair	Fall 2014	150	0-0-60
St. Joseph	Spring 2015	150	0-0-60

* Variable rate application

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.

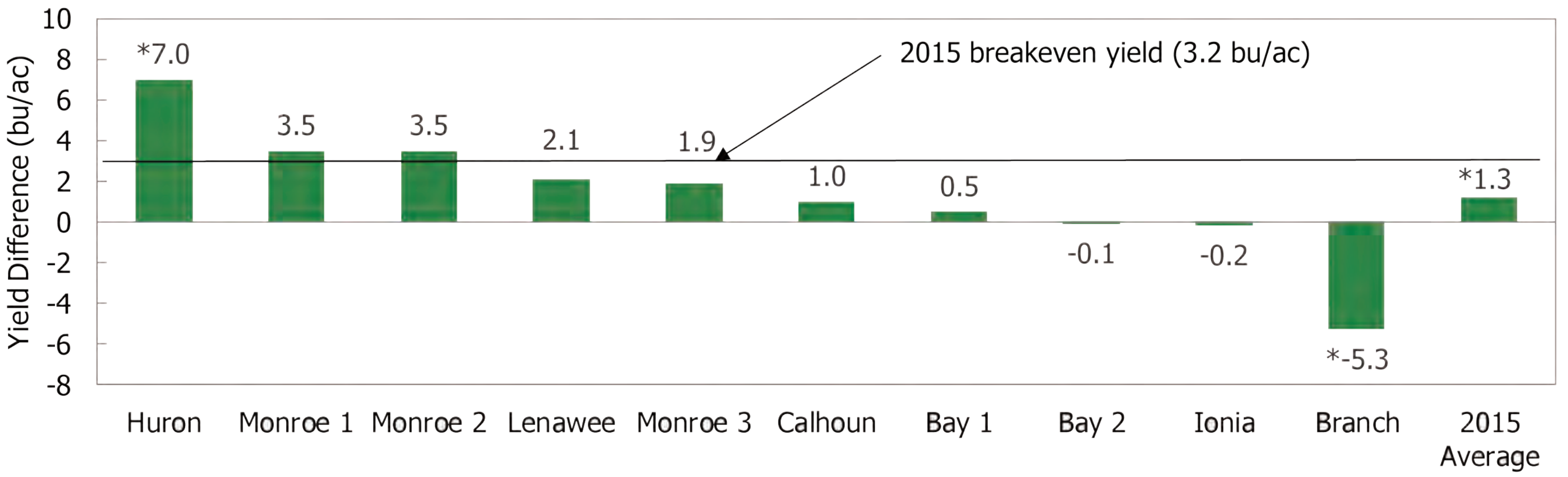
Procedure: A single foliar application of Blackmax 22 was compared to an untreated control at 10 locations in 2015. The two treatments were replicated five times at the Ionia and Calhoun locations, three times at the Lenawee 1 location and four times at all other locations. The Blackmax 22 was applied at one gallon per acre between the V3 and V5 or between the R1 and R3 growth stages. All sprayers were equipped and operated to optimize spray droplet deposition in the canopy. Tire tracks were either present in the harvest area for every treatment or not present in any of the harvested areas depending on how individual trials were set up.

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 (bu/ac)	------------------	
Monroe 1	52.4	55.9	5.5
Ionia	65.3	65.1	3.9
Lenawee	53.9	56.0	3.9
Bay 1	51.6	52.1	1.7
Bay 2	39.4	39.3	1.8
Monroe 2	44.0	47.5	6.3
Calhoun	71.8	72.8	2.9
Monroe 3	26.8	28.8	3.4
Branch	56.9 a	51.6 b	3.1
Huron	23.8 b	30.8 a	3.1
Average	**48.6 b**	**49.9 a**	**1.1**
	------------------- Income ($/ac)	-----------------	
Average Income	**$445**	**$427**	

Soybean price = $9.15 per bushel
Blackmax 22 cost = $22.00 per acre
Application cost = $7.50 per acre

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



* The yield difference was statistically significant at these locations

Blackmax™ 22 Trial

Results: The Blackmax 22 treatment produced mixed results in 2015. It increased soybean yields by 7 bushels per acre at the Huron County site but decreased yields by 5.3 bushels per acre at the Branch County location (figure 1). When all 10 locations were combined and analyzed, the Blackmax 22 treatment produced 1.3 bushels per acre more than the untreated control. Because the breakeven yield for Blackmax 22 in 2015 is 3.2 bushels per acre including the application cost, only the Huron County site was profitable.

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

2015 Blackmax 22 Trial Locations

Combines running at the 2015 Soybean Harvest Equipment Field Day near Blissfield

White Mold Foliar Fungicide Program Comparison Trial

Purpose: *Sclerotina 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 fungicide programs on soybean yields when white mold was likely to occur.

Procedure: This trial consisted of three treatments: 1) Endura applied at R1 followed by Priaxor 10 days later, 2) Aproach applied at R1 and again at R2 or 10 days after R1, and 3) an untreated control. The treatments were replicated four times in a randomized complete block experimental design at three locations. Endura was applied at 8 ounces per acre, Priaxor was applied at 4 ounces per acre and Aproach was applied at 9 ounces per acre per application. All sprayers were equipped and operated to optimize spray droplet deposition in the canopy. Tire tracks were either present in the harvest area for every treatment or not present in any of the harvested areas depending on how individual trials were set up. 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 program effect on soybean yield in 2015

Treatment	**Allegan**	**Berrien**	**Ionia**	**Average**
	-------------------------- Yield (bu/ac) ---------------------------			
Untreated Control	71.4 b	74.1 b	63.0 a	69.4 b
Aproach + Aproach	75.5 a	76.0 a	63.2 a	71.6 a
Endura + Priaxor	74.9 a	76.9 a	64.2 a	72.0 a
$LSD_{0.10}$	2.9	1.1	4.1	1.4

Soybean price = $9.15 per bushel
Aproach followed by Aproach cost = $42.00 per acre
Endura followed by Priaxor cost = $50.50 per acre
Application cost = $7.50 per acre per application

Table 2. Planting dates, planting rates, row spacings and fungicide application dates for the 2015 white mold foliar fungicide comparison trials

	Allegan	**Berrien**	**Ionia**
Planting date	May 19	May 10	May 2
Planting rate	155,000	140,000	180,000
Row spacing	Twin 7.5″ rows	30″	15″
First application date	July 16	July 5	July 1
Second application date	July 24	July 16	July 8

Table 3. White mold foliar fungicide program effect on white mold incidence in 2015

Treatment	**Allegan**	**Berrien**	**Ionia**	**Average**
	------------- White Mold Disease Incidence (% infected) ----------------			
Untreated Control	0	1	8	0.7
Aproach + Aproach	1	0	7	2.3
Endura + Priaxor	0	1	1	2.6
$LSD_{0.10}$	0.8	1.2	11.8	2.7

White Mold Foliar Fungicide Program Comparison Trial

Results: All three sites had a history of white mold and environmental conditions favoring white mold development occurred prior to the R1 growth stage at all locations. In fact, white mold apothecia were found at the Ionia site on June 31 (see photo). However, the actual incidence of white mold was very low at all three locations (table 3). Because of this, these trials demonstrate how the two foliar fungicide programs affect soybean yields and income in the absence of significant white mold pressure. Both fungicide programs produced similar yield increases over the untreated control at two of the three locations (table 1). When all three locations were combined, both the foliar fungicide programs again increased soybean yields over the untreated control and were not different from each other. Due to the lack of disease pressure and, breakeven yields of 7.1 bushels per acre for Endura and Priaxor and 6.3 bushels per acre for two applications of Aproach, neither of the two foliar fungicide programs were profitable at these three sites in 2015.

2015 White mold foliar fungicide program comparison trial locations

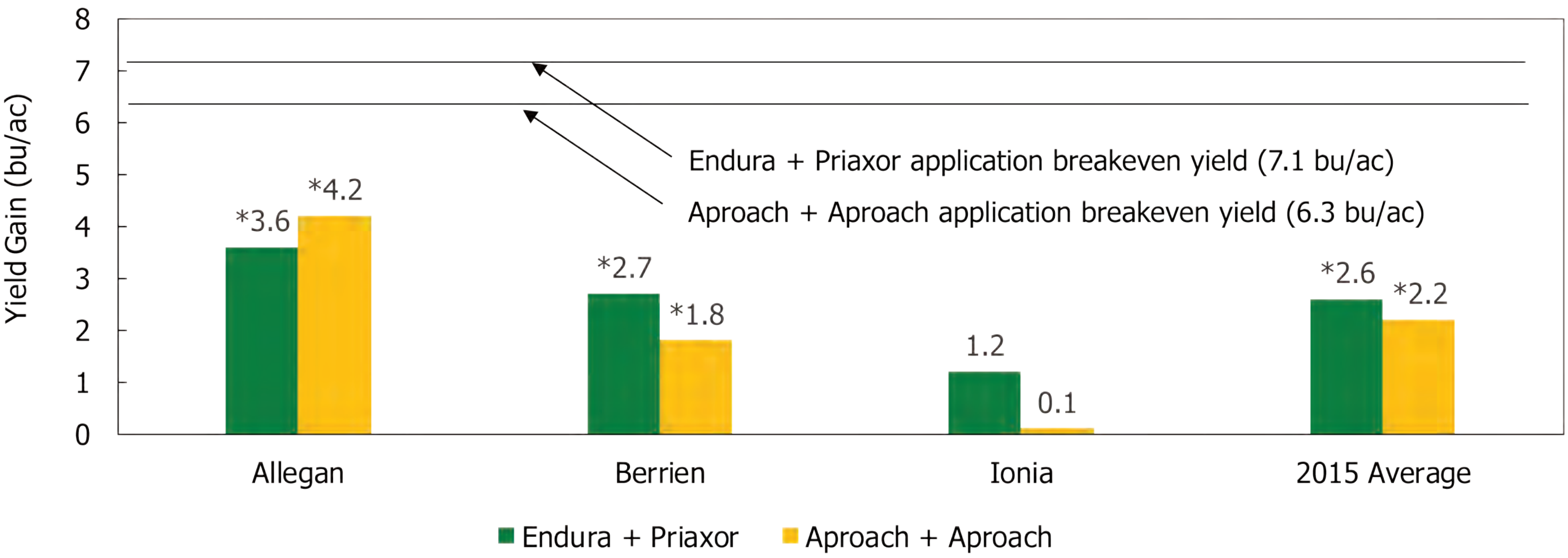
White mold is a complex disease and foliar fungicides can be a part of a comprehensive management plan that includes resistant varieties, reduced planting populations, row spacing greater than 20 inches, no-tillage, irrigation water management and crop rotation. However, foliar fungicides used alone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

We want to thank Dupont for providing and delivering the Aproach foliar fungicide, BASF for providing and delivering the Endura and the Priaxor, and Kevin Gould and Dan Rajzer, for coordinating these trials.

Sclerotia

Apothecia

Figure 1. Yield gain produced by two white mold foliar fungicide programs at three sites in 2015



* The yield gain was statistically significant at these locations

Endura White Mold Foliar Fungicide Trial

Purpose: *Sclerotina Stem Rot* or white mold caused significant yield reductions in soybeans grown in Michigan in 2014. 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 a single application of Endura fungicide on soybean yields when white mold was likely to occur.

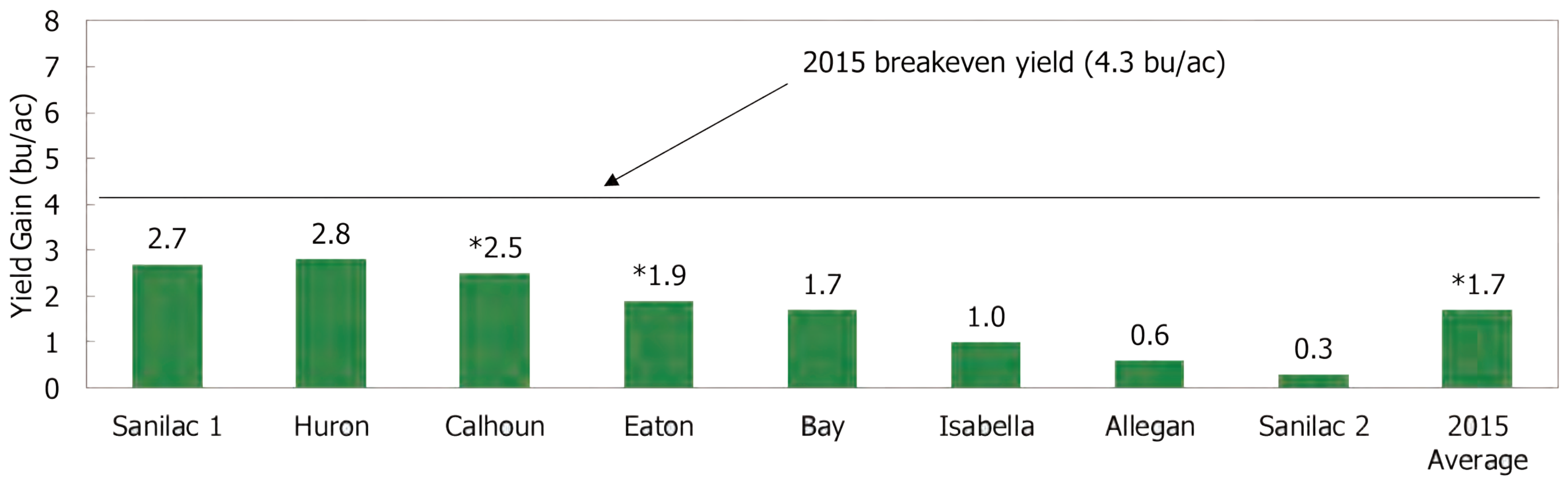
Procedure: This trial compared a single application of Endura fungicide applied at R1 to an untreated control at eight sites in 2015. The treatments were replicated seven times at the Isabella site, six times at the Calhoun site, three times at the Arenac site and four times in all the other locations. All sprayers were equipped and operated to optimize spray droplet deposition in the canopy. Tire tracks were either present in the harvest area for every treatment or not present in any of the harvested areas depending on how individual trials were set up. White mold incidence was determined at most of the 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. The effect of a single application of Endura fungicide on soybean yield and income in 2015

Location	**Untreated Control**	**Endura Fungicide**	**LSD $_{0.10}$**
	------------------- Yield (bu/ac) ------------------		
Eaton	53.5 b	55.4 a	1.5
Sanilac 1	64.2	66.9	5.5
Sanilac 2	63.5	63.8	1.9
Isabella	59.9	60.9	1.8
Bay	50.2	51.9	2.5
Calhoun	69.9 b	72.5 a	2.1
Allegan	72.2	72.8	2.0
Huron	49.6	52.5	9.1
Average	**60.4 b**	**62.1 a**	**1.0**
	------------------- Income ($/ac) -----------------		
Average Income	**$553**	**$529**	

Soybean price = $9.15 per bushel
Endura fungicide cost = $32.00 per acre
Application cost = $7.50 per acre

Figure 1. Yield gain due to applying Endura fungicide at R1 in 2015



* The yield gain was statistically significant at these locations

Endura White Mold Foliar Fungicide Trial

Results: All eight sites had a history of white mold and environmental conditions favoring white mold development occurred prior to the R1 growth stage at all locations. However, the actual incidence of white mold was very low at all locations (table 3). Because of this, these trials demonstrate how a single application of Endura affects soybean yields and income in the absence of significant white mold pressure. The Endura tended to increase soybean yields at all of the locations. However, the increase was statistically significant at only two of the eight locations. Due to the lack of disease pressure and a break even yield of 4.3 bushels per acre, the Endura application was not profitable at any of the locations in 2015.

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 and may reduce income in the absence of white mold disease pressure.

We want to thank BASF for providing and delivering the Endura and Paul Gross, George Silva, Dan Rajzer and Ned Birkey for coordinating these trials.

2015 Endura white mold trial locations

Foliar fungicide application to R3 soybeans

Table 2. Planting dates, planting rates, row spacings and fungicide application dates for the 2015 Endura white mold foliar fungicide trials

	Eaton	Sanilac 1	Sanilac 2	Isabella	Bay	Calhoun	Allegan	Huron
Planting date	May 3	May 6	May 1	May 3	June 5	May 24	May 19	May 19
Planting rate	160,000	120,000	140,000	138,000	150,000	168,000	155,000	130,000
Row spacing	15″	15″	20″	15″	30″	14″	Twin 7.5″	28″
Application date	July 20	July 6	July 5	July 12	July 20	July 11	July 16	July 20

Table 3. Endura white mold foliar fungicide effect on white mold incidence in 2015

Treatment	Eaton	Sanilac 1	Sanilac 2	Isabella	Calhoun	Allegan	Average
	------------- White Mold Disease Incidence (% infected) ----------------						
Untreated Control	3.5 a	1.0	1.5	1.8	0	2.5	1.6
Endura	1.5 b	1.0	0.3	0.3	0	1.3	0.7
LSD$_{0.10}$	1.7	2.9	2.2	1.5	--	1.8	0.6

Priaxor™ Foliar Fungicide Trial

Purpose: Priaxor, a new foliar fungicide marketed by BASF, has been advertised as providing more consistent performance and advanced plant health benefits than other fungicides. Priaxor is rated as providing excellent control of *Septoria brown spot*, the most common soybean disease in Michigan. The purpose of this trial was to evaluate the effect of a single foliar application of Priaxor on soybean yield in 2014 and 2015.

Procedure: A single foliar application of Priaxor was compared to an untreated control at 13 locations in Michigan in 2014 and eight locations in 2015. The Priaxor was applied at four ounces per acre between the R2 and R4 growth stage in 2014. In 2015, all Priaxor applications were made at the R3 growth stage. All sprayers were equipped and operated to ensure adequate canopy penetration and leaf coverage. The sprayers were driven through the untreated control treatments to ensure that tire tracks were not a confounding factor.

Table 1. The effect of a single foliar fungicide (Priaxor) application on soybean yield and income in 2014

Location	**Untreated Control**	**Priaxor**	**LSD $_{0.10}$**
	------------------- Yield (bu/ac) ------------------		
Branch	40.4 b	45.0 a	1.6
Monroe 1	57.3 a	61.1 a	4.1
Monroe 2	47.4 a	47.6 a	2.3
Washtenaw	40.6 a	43.5 a	4.0
Monroe 3	66.1 b	70.2 a	2.5
Ingham 1	71.7 b	75.1 a	2.5
Cass 1	47.4 a	48.2 a	2.8
Lenawee 1	76.9 b	80.1 a	2.8
Cass 2	39.6 a	41.7 a	2.3
Lenawee 2	33.9 b	38.1 a	2.1
Lenawee 3	50.5 b	51.7 a	0.9
Ingham 2	69.0 a	64.9 a	7.6
Tuscola	17.0 a	16.8 a	6.3
Average	**51.3 b**	**53.2 a**	**1.0**
	------------------- Income ($/ac) -----------------		
Average Income	**$513**	**$507**	

2014 Soybean price = $10.00 per bushel
Priaxor fungicide cost = $17.54 per acre
Foliar application cost = $7.50 per acre

Table2. The effect of a foliar application of Priaxor fungicide on soybean yield and income in 2015

Location	**Untreated Control**	**Priaxor Fungicide**	**LSD $_{0.10}$**
	------------------- Yield (bu/ac) ------------------		
Cass 1	41.6	42.9	2.7
Van Buren	50.7	53.2	2.7
Cass 2	44.7	46.4	4.1
Lenawee	54.3	55.3	1.4
Bay 1	74.6 b	79.0 a	0.4
Bay2	75.3	76.1	2.4
Monroe 1	51.9 b	56.4 a	4.0
Monroe 2	53.0	57.6	7.4
Average	**55.8 b**	**58.4 a**	**1.0**
	------------------- Income ($/ac) -----------------		
Average Income	**$511**	**$508**	

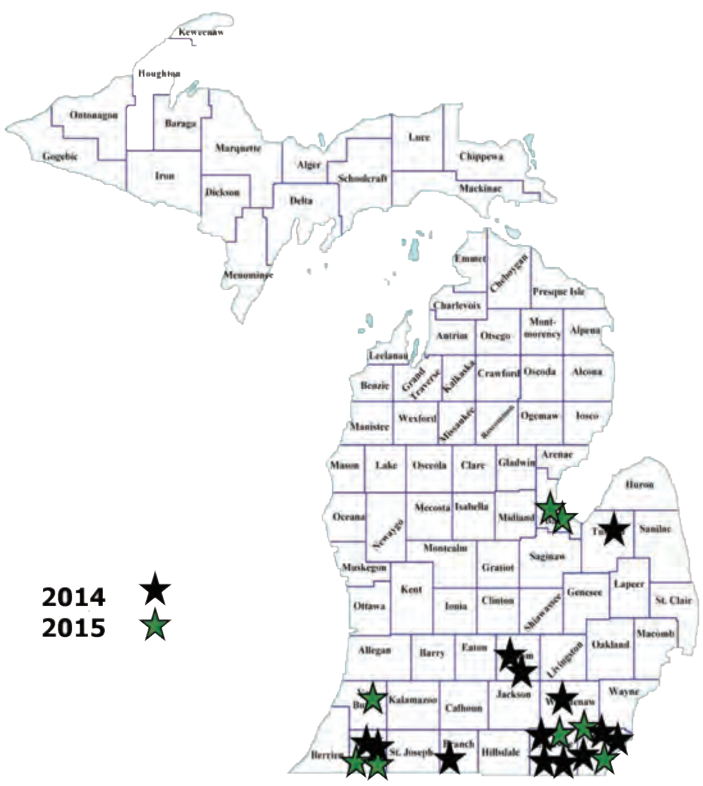
Soybean price = $9.15 per bushel
Priaxor fungicide cost = $18.50 per acre
Foliar application cost = $7.50 per acre

Priaxor™ Foliar Fungicide Trial

Results: A single foliar application of Priaxor produced higher soybean yields than the untreated control at six of the 13 locations in 2014 and at two locations in 2015. When all of the 2014 locations were combined and analyzed, the Priaxor treatment increased soybean yields by 1.9 bushels per acre compared to the untreated control. When all the 2015 locations were combined and analyzed, the average yield gain from the Priaxor fungicide application was 2.6 bushels per acre. With the projected soybean price and current product and application costs, this is just below the breakeven point. In 2014, seven of the 10 locations were profitable, while in 2015, three of the eight locations were profitable.

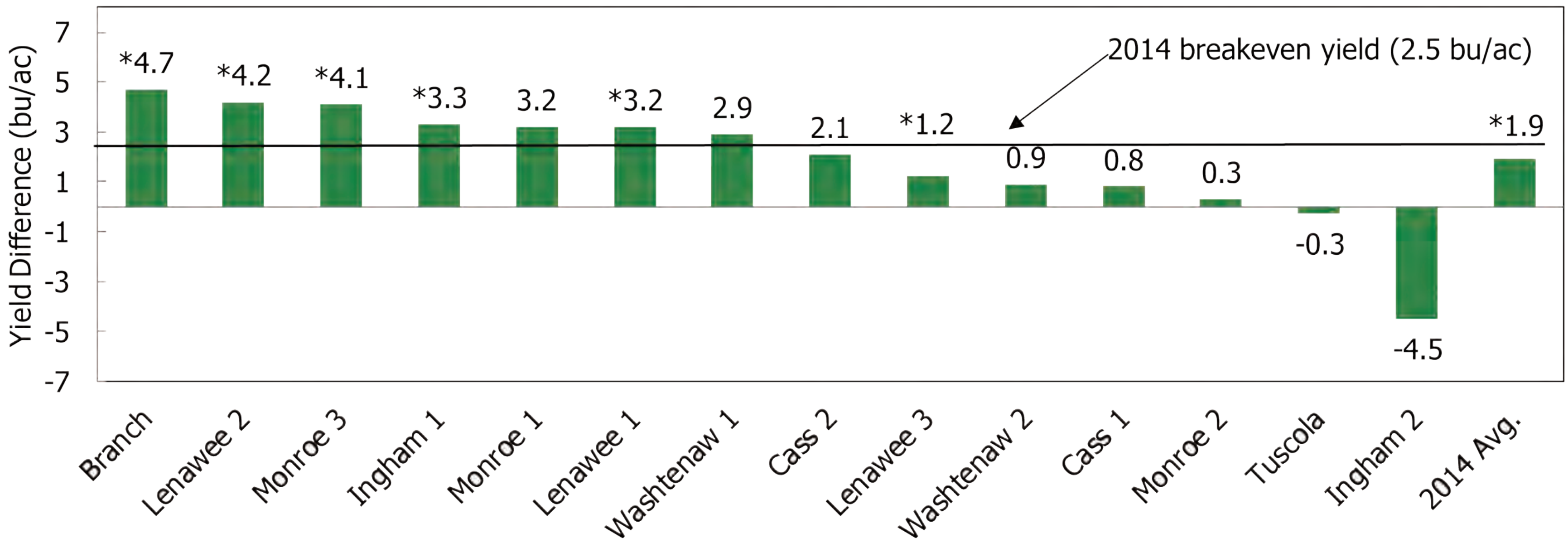
We want to thank BASF for providing and delivering the product and Dan Rajzer, Ned Birkey and Loren Collison for coordinating these trials.

2014 and 2015 Priaxor trial locations



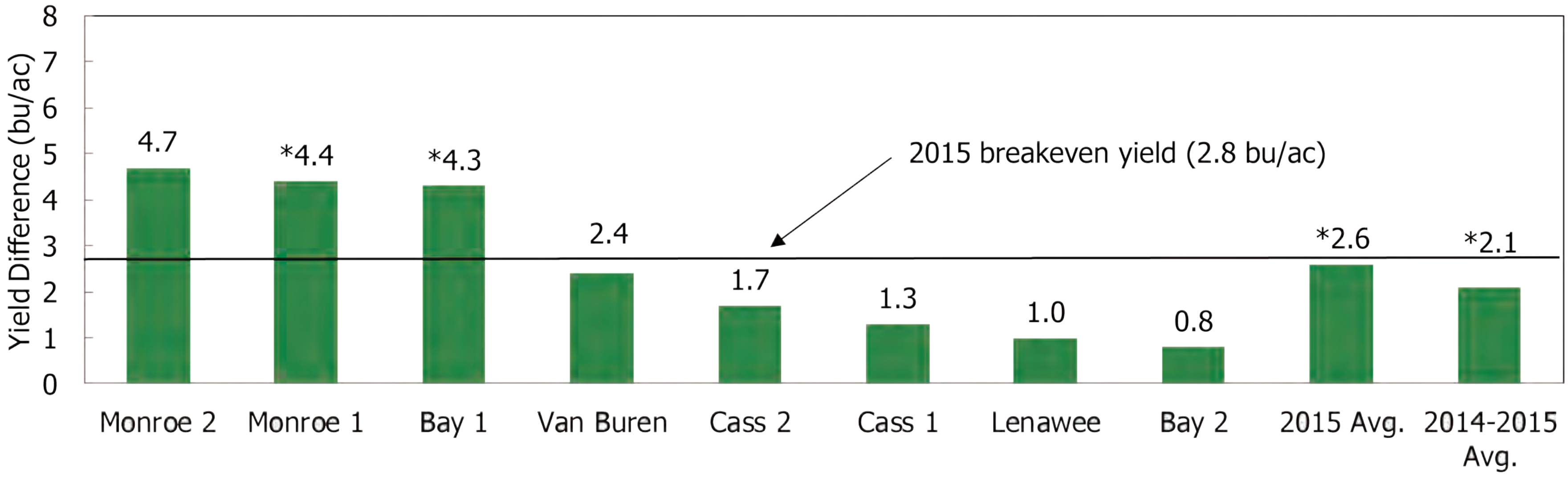
Septoria brown spot
Photo credit:
Dr. Martin Chilvers

Figure 1. Yield difference produced by a foliar application of Priaxor fungicide at R2-R4 in 2014



* The yield difference was statistically significant at these locations

Figure 2. Yield difference produced by a foliar application of Priaxor fungicide at R3 in 2015



* The yield difference was statistically significant at these locations

Foliar Tank Mixture Trial

Purpose: The SMaRT project has evaluated the performance of numerous foliar products in past trials. In nearly all of these trials, a single foliar product has been compared to an untreated control. Soybean producers have requested that the SMaRT project compare a three-way tank mixture including a fungicide, an insecticide and a fertilizer to an untreated control. The producers expressed two reasons for conducting this type of trial: 1) the products may have a synergistic effect when tank-mixed and 2) foliar applications of tank mixtures are becoming more common. The purpose of this trial was to evaluate the effect of a foliar application including a fungicide, an insecticide and a fertilizer on soybean yield and income in 2014 and 2015.

Procedure: A single foliar application including a fungicide, an insecticide and a fertilizer was compared to an untreated control at 10 locations in 2014 and another 17 locations in 2015. The treatments were replicated four times at most locations. However one trial was replicated five times in 2014 and in 2015 one trial was replicated eight times. The products included in the foliar tank mix were Priaxor™ (fungicide) from BASF, Fastac™ (insecticide) from BASF and PhosFix™ 7-4-9 (fertilizer) from the Andersons Inc. Priaxor was applied at four ounces per acre, FastAct was applied at 3.8 ounces per acre and PhoFix was applied at two pints per acre. The foliar applications were made at R3 and all sprayers were driven through the untreated control treatments to prevent tire tracks from being a factor.

Table 1. The effect of a foliar tank mixture application (fungicide, insecticide and fertilizer) on soybean yield and income in 2015

Location	**Untreated Control**	**Foliar Tank Mixture**	**LSD $_{0.10}$**
	------------------- Yield (bu/ac)	------------------	
St. Joseph	74.0 b	77.8 a	2.8
Ionia	69.2 b	72.5 a	1.4
Van Buren	58.0	57.5	5.8
Cass 1	40.6	43.2	4.7
Lenawee 1	54.6	58.0	4.6
Allegan	49.2	51.2	3.2
Lenawee 2	57.0	59.2	4.6
Monroe	68.4 b	73.1 a	2.7
Isabella 1	53.2 b	61.4 a	2.1
Isabella 2	53.4 b	58.4 a	0.7
Cass 2	44.9	45.8	2.7
Cass 3	49.1	47.8	1.9
Barry 1	45.4	45.7	6.8
Barry 2	47.7 b	52.4 a	4.0
Berrien	56.4	56.8	2.0
Wayne	25.3	30.0	10.3
Huron	23.8	26.2	4.4
2015 Average	**51.1 b**	**54.0 a**	**0.8**
	------------------- Income ($/ac)	-----------------	
Average Income	**$468**	**$452**	

Soybean price = $9.15 per bushel
Priaxor fungicide cost = $18.50 per acre
Fastac insecticide cost = $4.10 per acre
PhosFix (7-4-9) cost = $12.50 per acre
Foliar application cost = $7.50 per acre

Foliar application to soybean at the R3 growth stage

Foliar Tank Mixture Trial

Results: The foliar tank mixture increased soybean yields at six of the 10 locations in 2014 and six of the 17 locations in 2015. The statistically significant yield increases for each location ranged from 2.8 bushels per acre to 9.8 bushels per acre in 2014 and from 3.4 to 8.3 bushels per acre in 2015. The 2014 average yield increase was 4.7 bushels per acre and in 2015 it was 2.9 bushels per acre. Using yearly adjusted soybean prices and product and application costs, the foliar tank mixture was profitable at five of the ten sites in 2014 (figure 1). In 2015, three of the 17 locations were profitable (figure 2). Further research will be needed to determine why the foliar application produced such a wide range of yield responses among the locations.

We want to thank BASF and the Andersons Inc. for providing and delivering the products and Paul Gross, Martin Nagelkirk, Kevin Gould, and Dan Rajzer, Ned Birkey for coordinating these trials. Crop Production Services of Lake Odessa applied the foliar tank mixture at the Barry County sites at no cost.

2014 & 2015 Foliar tank mixture trial locations

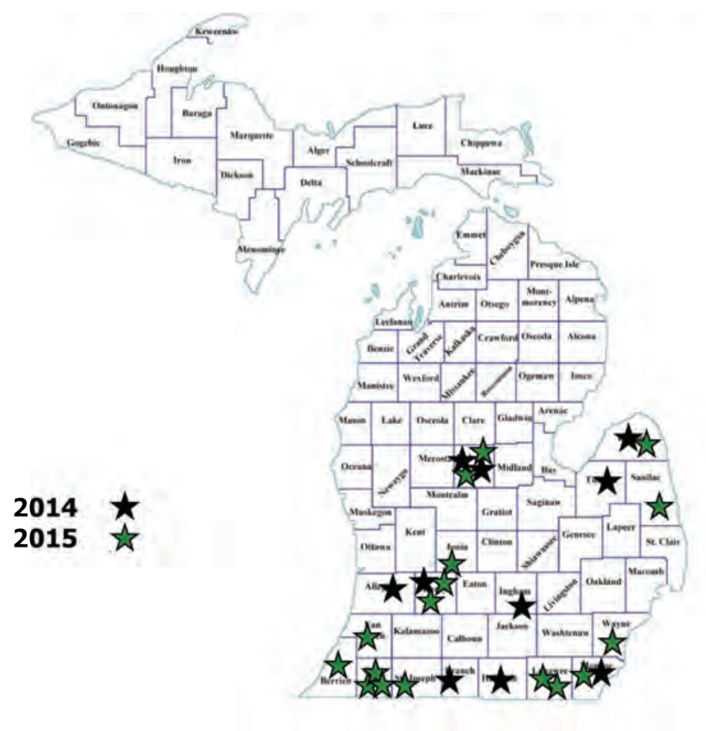
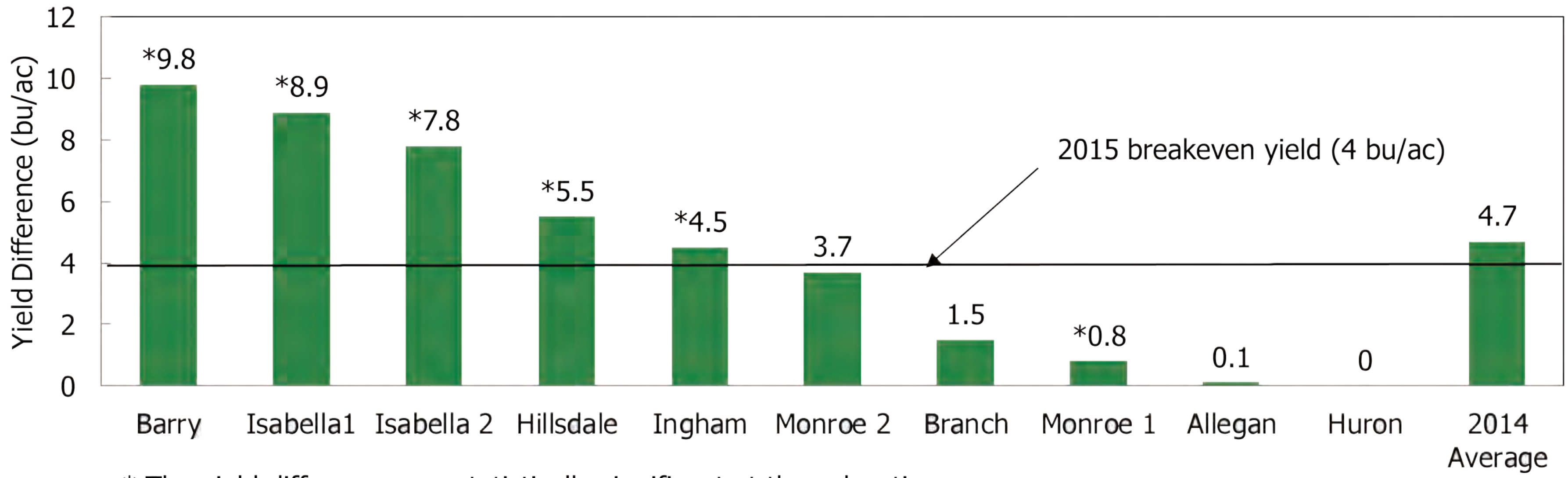
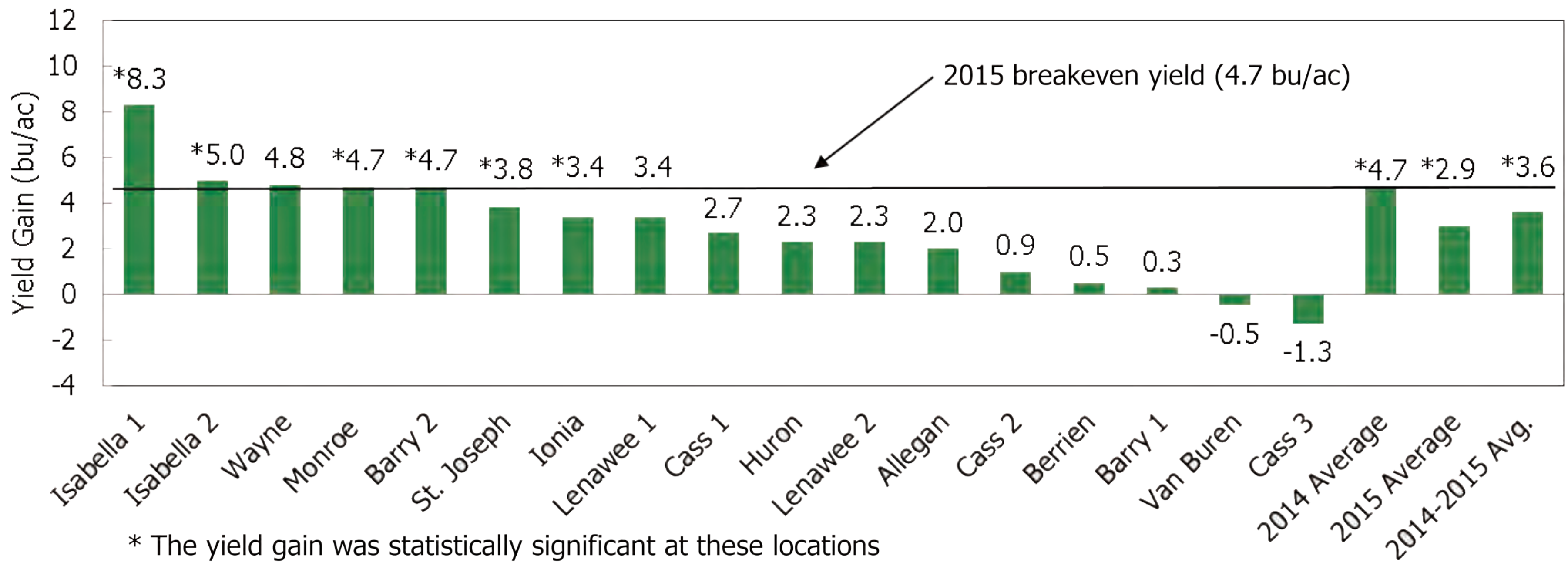


Figure 1. Yield difference due to a foliar application of a three-way foliar tank mixture at R3 in 2014



* The yield difference was statistically significant at these locations

Figure 2. Yield gain due to a foliar application of a three-way foliar tank mixture at R3 in 2015



* The yield gain was statistically significant at these locations

Intensive Soybean 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 and 2015

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) at one location in 2014 and 2015. The seed treatment was Poncho®/VOTiVO® and Acceleron®. The Acceleron was a combination of three fungicides (pyraclostrobin, metalaxyl, fluxapytoxad). The foliar tank mix included Priaxor™ (fungicide) from BASF, Fastac™ (insecticide) from BASF and PhosFix™ 7-4-9 (fertilizer) from the Andersons Inc. Priaxor was applied at four ounces per acre, Fastac was 3.8 ounces per acre and PhoFix was applied at two pints 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 and 2015

Treatment	2014	2015	2014 & 2015 Average	*2014 & 2015 Average Income
	------------------ Yield (bu/ac) ------------------			--------$/ac --------
Untreated Control	53.0 b	65.8 b	59.4 b	$543
Intensive management	62.3 a	74.5 a	68.4 a	$557
$LSD_{0.10}$	2.6	1.1	1.2	

*Using 2015 soybean prices and product and application costs
Soybean price = $9.15 per bushel
Poncho/VOTiVO/Acceleron seed treatment cost = $26.00 per acre
Priaxor fungicide cost = $18.50 per acre
Fastac insecticide cost = $4.10 per acre
PhosFix (7-4-9) cost = $12.50 per acre
Foliar application cost = $7.50 per acre

Table 2. Intensive soybean management effects on plant stands at harvest in Sanilac County in 2014 and 2015

Treatment	2014	2015	2014 & 2015 Average
	---------- Plant stand at harvest (plants/ac) ----------		
Untreated control	142,900 b	147,300 b	145,100 b
Intensive management	173,700 a	166,500 a	170,100 a
$LSD_{0.10}$	18,000	1,004	7,755

2014 Intensive Soybean Management Trial

Control

Intensive management

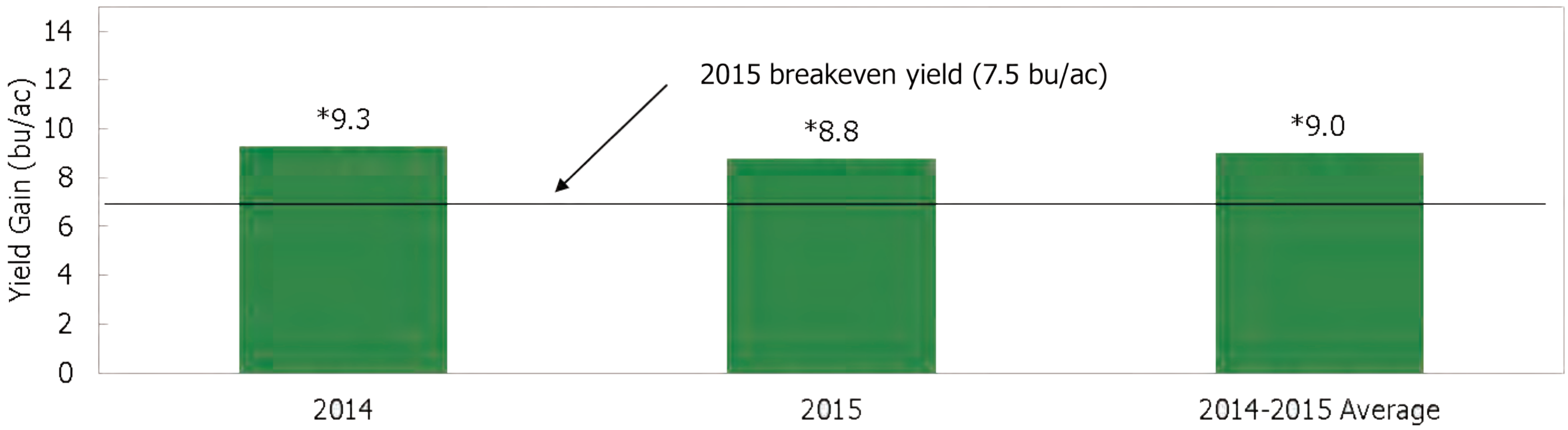
Intensive Soybean Management Trial

Results: The intensive management treatment increased soybean yields by 9.3 bushels per acre at one location in Sanilac County in 2014 and by 8.8 bushels per acre in 2015 (figure 1). Intensive management also increased plant populations by nearly 31,000 plants per acre in 2014 and by 19,000 plants per acre in 2015 (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 and $12.00 more than the untreated control treatment in 2015. Additional research is needed to see if this type of intensive manage will continue to be profitable across multiple locations and years.

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

2014 & 2015 Intensive management trial locations

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



* The yield gain was statistically significant in these years.

Foliar application to soybeans at R3

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 2015 planting rate trials. It demonstrates the principles outlined above. Note how each planting rate is included and randomized within the replications. All of the 2015 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 four times.

Figure 1. The randomized complete block design used in the 2015 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 the SAS statistical software was used to determine if the differences in measurable 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 2015. 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 Priaxor foliar fungicide trial will be conducted at multiple locations and over multiple years. This greatly improves the reliability of the information produced.

Michigan Soybean Promotion Committee
The Soybean Checkoff

MICHIGAN STATE UNIVERSITY | Extension