

Economics of Weed Control Programs for non-GMO Soybean, 2016 Christy L. Sprague

A field trial sponsored by the Michigan Soybean Promotion Committee (MSPC) was conducted in 2016 at the MSU Agronomy Research Farm in E. Lansing to compare weed control, soybean injury, soybean yield, and economic returns of potential programs in non-GMO (conventional) soybean. Soil-applied (PRE) herbicide programs were designed to provide control of dominant weed species found in Michigan soybean fields. Twenty different soil-applied (PRE) herbicide programs were applied immediately after soybean planting. The soil-applied herbicide programs were scouted for weed escapes and postemergence (POST) herbicides were applied to control escaped weeds. Treatments were evaluated for crop injury and weed control ~28 days after planting (DAP). At this time plots were also scouted for POST herbicide treatments. There were several plots that were not ready to be sprayed and these plots were treated 4 days after the POST treatments are were called LPOS timings. At the time of the LPOS applications the POST treatments were evaluated and two treatments were treated for common lambsquarters and common ragweed (LLPOS applications). Postemergence (POST, LPOS, LLPOS) herbicides were chosen based on weeds that were no longer controlled from the PRE applications. POST herbicides and rates were selected based on the weeds that needed to be controlled. For example, if common ragweed was the escaped weed a herbicide like Flexstar or Cobra was applied. Herbicide rates were adjusted to weed size. Site characteristics and herbicide application timings are described in Table 1. Table 2 describes the herbicide programs evaluated. The maximum soybean yield was 79 bu/A and yield loss due to weeds was extremely high. The weedy (untreated) yield was 16.6 bu/A, resulting in a yield loss of 62.4 bu/A (79%). Table 3 contains the data for soybean injury, weed control, herbicide program costs, soybean yield, and economic returns.

Table 1. Site description.

Crop	Soybean
Variety	MCIA 2308N
Soil Texture	Loam
Soil pH	7.2
Soil Organic Matter	2.9
Dominant Weeds	ANGR, CHEAL, AMAPO, AMBEL ¹ , ABUTH
Planting Date	May 9
Application Timings:	
PRE	May 9
POST	June 9
LPOS	June 13
LLPOS	June 21
Evaluation Times	Soybean injury – 45 d after planting & 7, 14, & 28 d after POST Weed control prior to harvest (56 d after POST)

Abbreviations: ANGR = giant foxtail, CHEAL = c. lambsquarters, AMAPO = Powell amaranth, AMBEL = c. ragweed, ABUTH = velvetleaf.

¹The c. ragweed population at this location is ALS-resistant (Group 2).

Table 2. non-GMO soybean herbicide programs evaluated in 2016.

PRE TREATMENT	POST TREATMENT	LATE POST TREATMENT	ABBREVIATED FORM
Valor (2.5 oz) + Prowl H2O (2 pt)	Cobra (8 fl oz) + SelectMax (12 fl oz) + COC (0.5%) + AMS (2.5 lb)	Harmony SG (0.13 oz) + NIS (0.25%) + AMS (2.5 lb)	Valor+Prowl fb. Cobra+Select fb. Harm
Fierce (3 oz)	Cadet (0.5 fl oz) + Basagran (1.5 pt) + SelectMax (12 fl oz) + COC (0.5% v/v)	Cobra (8 fl oz) + COC (0.5%)	Fierce fb. Cadet+Basa+Select fb. Cobra
Fierce (3 oz) + Metribuzin (6 oz)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	none	Fierce+Metri fb. Flex+Select
Fierce XLT (4 oz)	none	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Fierce XLT fb. Flex+Select
Trivence (6 oz) + Metribuzin (1.4 oz)	Synchrony (0.375 oz) + Assure II (8 fl oz) + NIS (0.25%)	none	Trivence (6) fb. Synch+Assure
Trivence (8 oz)	Prefix (2 pt) + SelectMax (9 fl oz) + NIS (0.25%)	none	Trivence (8) fb. Prefix+Select(9)
Sonic (6 oz) + Boundary (1.5 pt)	none	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Sonic+Boundary fb. Flex+Select
Zidua PRO (6 fl oz)	none	Cobra (8 fl oz) + Select Max (12 fl oz) + COC (0.5%)	Zidua PRO fb. Cobra+Select
BroadAxe XC (32 fl oz)	FirstRate (0.3 oz) + SelectMax (9 fl oz) + NIS (0.25%) + AMS (2.5 lb)	none	BroadAxe fb. FirstRate+Select(9)
Boundary (2.4 pt)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	none	Boundary fb. Flexstar+Select
Prefix (2 pt) + Metribuzin (6 oz)	none	Cobra (8 fl oz) + Fusilade DX (12 fl oz) + COC (0.5%) + AMS (2.5 lb)	Prefix+Metri fb. Cobra+Fusilade
Warrant Ultra (50 fl oz) + Metribuzin (6 oz)	SelectMax (9 fl oz) + COC (1%)	Cadet (0.9 fl oz) + COC (1%)	Warr Ult+Metri fb. Select(9) fb. Cadet
Afforia (2.5 oz) + Metribuzin (5 oz)	Synchrony (0.375 oz) + Assure II (8 fl oz) + NIS (0.25%)	none	Afforia+Metri fb. Synch+Assure
Authority MTZ (14 oz)	SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	none	Auth MTZ fb. Select(9)
Authority MTZ (14 oz)	Flexstar (1 pt) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	none	Auth MTZ fb. Flex+Select(9)
Authority MTZ (14 oz)	Anthem MAXX (3 fl oz) + Flexstar (1 pt) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	none	Auth MTZ fb. Anth MX+Flex+Select(9)
Authority MTZ (14 oz) + Dual II Magnum (1 pt)	Marvel (7.25 fl oz) + COC (1%)	none	Auth MTZ+Dual fb. Marvel
Authority MTZ (14 oz) + Anthem MAXX (3 fl oz)	Marvel (7.25 fl oz) + COC (1%)	none	Auth MTZ+Anth MX fb. Marvel
Valor (2 oz) + Metribuzin (8 oz)	Warrant Ultra (3 pt) + SelectMax (12 fl oz) + NIS (0.25%)	none	Valor+Metri fb. Warrant Ult+Select
Metribuzin (5 oz) + Dual II Magnum (1.33 pt) + Linex (1 pt)	Ultra Blazer (1.5 pt) + Assure II (8 fl oz) + NIS (0.25%)	none	Metri+Dual+Linex fb. Blazer+Assure

Table 3. Soybean injury, weed control, program costs, soybean yield, and economic returns for non-GMO herbicide programs, 2016.

Herbicide Programs ⁴	Soybean injury							All Weeds (≥80%)	Costs ¹ (\$/A)	Yield (bu/A)	Economic Returns ² (\$/A)
	28 DAP 14 DAT		Prior to harvest (56 d after POST)				Yield				
	(%)	(%)	% control								
Valor + Prowl fb. Cobra + Select fb. Harm	6	13	75	93	100	76	100	NO	\$81.18	67.4§	\$626.52
Fierce fb. Cadet + Basa + Select fb. Cobra	9	24	66	80	100	78	100	NO	\$83.17	58.9	\$535.28
Fierce + Metri fb. Flex + Select	6	8	76	75	100	83	100	NO	\$58.49	64.6	\$619.81
Fierce XLT ³ fb. Flex + Select	14	15	90	100	100	98	100	YES	\$56.64	70.3§	\$681.51*
Trivence (6) fb. Synch + Assure	4	5	60	100	100	35	100	NO	\$44.32	42.4	\$400.88
Trivence (8) ³ fb. Prefix + Select (9)	7	16	65	100	100	85	100	NO	\$53.05	62.9	\$607.74
Sonic + Boundary fb. Flex + Select	2	12	90	100	100	99	100	YES	\$79.51	79.0**	\$749.99**
Zidua PRO fb. Cobra + Select	0	18	80	96	100	96	100	YES	\$69.24	72.6*	\$693.06*
BroadAxe fb. FirstRate + Select (9)	2	3	85	100	100	5	100	NO	\$66.74	39.5	\$348.01
Boundary fb. Flexstar + Select	2	8	82	86	100	82	100	YES	\$58.21	71.2*	\$689.39*
Prefix + Metri fb. Cobra + Fusilade	1	21	83	68	100	97	93	NO	\$56.70	75.4*	\$735.00*
Warrant Ult + Metri fb. Select (9) fb. Cadet	2	26	79	79	100	73	100	NO	\$64.85	61.6	\$581.95
Afforia + Metri fb. Synch + Assure	4	10	60	96	100	61	100	NO	\$42.93	42.9	\$407.52
Auth MTZ fb. Select (9)	0	0	83	100	100	5	100	NO	\$45.33	30.4	\$273.87
Auth MTZ fb. Flex + Select (9)	0	7	79	100	100	76	95	NO	\$53.10	69.2§	\$673.50*
Auth MTZ fb. Anth MX + Flex + Select (9)	0	16	77	100	100	82	100	NO	\$70.19	69.6§	\$660.61§
Auth MTZ + Dual fb. Marvel	2	14	25	100	100	23	100	NO	\$62.82	30.0	\$252.18
Auth MTZ + Anth MX fb. Marvel	0	11	23	100	100	59	100	NO	\$66.20	38.0	\$332.80
Valor + Metri fb. Warrant Ult + Select	8	12	81	81	100	72	95	NO	\$62.84	61.7	\$585.01
Metri + Dual + Linex fb. Blazer + Assure	1	10	60	90	100	55	88	NO	\$70.19	47.0	\$423.31
<i>Untreated</i>	0	0	0	0	0	0	0	NO	---	16.6	\$174.30

Abbreviations: ANGR = giant foxtail, CHEAL = c. lambsquarters, AMAPO = Powell amaranth, AMBEL = c. ragweed, ABUTH = velvetleaf, fb. = followed by.

¹ Herbicide costs = avg. of price lists; App. cost = \$7.50/A; seeding rate = 152,000 seeds/A. Weed control costs = Herbicide \$ + Additive \$ + Application \$.

² Crop selling price = \$9.00/bu + non-GMO premium \$1.50/bu (December 2016). Economic return = (Yield x Price) – Weed Control Costs.

** Highest yielding and highest economic returns. * Values are not significantly different from the highest value within that column. § Values not different from the second highest values in that column.

³ The use rates of Fierce XLT and Trivence exceed the rates that should be used on a soil with a pH of 7.2. If soil pH is greater than 6.8 do not apply Fierce XLT. If the soil pH is from 7 to 7.6 do not exceed 6 oz/A of Trivence or rotational crops may be impacted and there is a greater chance of crop injury.

⁴ Many herbicide programs have long rotation restrictions to more sensitive crops, i.e., sugarbeet, alfalfa, potatoes, etc. Consult the Table 12 in the MSU Weed Control Guide for Field Crops (E-434) or the herbicide label for crop rotation restrictions.

General Observations and Interpretation:

Each year weather has a major impact on the overall outcomes of the various herbicide programs for this study. This year early in the growing season there was 1.16-inches of rain within one week of planting and the soil-applied (PRE) herbicide applications. This rainfall provided some initial incorporation of the PRE herbicides and helped manage some of the smaller seeded broadleaf weeds. Soybean injury was generally low from the PRE treatments and ranged from 0 to 14%, 28 DAP. Injury was greatest from treatments that contained flumioxazin, either applied alone as Valor or in the premixtures, Fierce, Fierce XLT, Afforia, and Trivence. Based on precipitation there were some initial differences between and PRE herbicide treatments. At 30 DAP, four of the 20 treatments had better weed control and therefore the POST treatments for these herbicides were applied four days later. These treatments were Fierce XLT, Sonic + Boundary, Zidua PRO, and Prefix + Metribuzin. Each of these PREs had good initial grass activity and provided at least 80% control of common ragweed. After the initial rainfall, conditions became extremely dry less and rainfall was less than 1-inch through the end of July. Due to the dry weather and overall poor control this year, several different POST treatments were examined. Treatments were chosen to control the weeds that had escaped control from the PRE herbicide treatments and they were primarily annual grasses, common ragweed, and some common lambsquarters. Flexstar, Cobra, Ultra Blazer, Marvel, Cadet, Warrant Ultra, Prefix, Synchrony, FirstRate, and Basagran + Cadet were applied alone or in combination with a POST grass herbicide (i.e., Assure II or SelectMax) to control common ragweed. Some of these herbicide treatments caused significant leaf burn. Soybean injury from the POST treatments ranged from 0 to 26%, 14 DAT. Treatments with Cobra or Cadet generally provided the greatest soybean injury. All soybean recovered from POST herbicide injury by 28 DAT, with the exception of the two treatments that had two POST applications, Cobra + Select Max followed by Harmony (6%), and Cadet + Basagran + Select Max followed by Cobra (14%). Dry conditions at the time of the POST application followed by later season rains that promoted late-season grass emergence affected overall weed control. Treatments that relied on a Group 2 herbicide (ALS-inhibitor) for common ragweed control were not effective, since the common ragweed population was resistant to ALS-inhibitors. The total cost of the programs ranged from \$42.93 to \$83.17 (herbicide + application costs). Only four of the 20 treatments provided greater than 80% control of all the weeds present. These treatments included a PRE herbicide treatment that had grass activity and a POST herbicide application with Select Max + Flexstar or Cobra. In most cases, 12 fl oz/A of Select Max with a crop oil concentrate was needed for effective POST annual grass control. Soybean yield ranged from 30 to 79 bu/A for all herbicide treatments. Three of four of these programs were amongst the four highest yielding programs. The other had slightly lower common lambsquarters control. Four additional programs were similar to the second highest yielding program. All of the higher yielding programs were amongst the programs with the highest economic returns. There were two additional programs that were not amongst the highest yielding that were similar to the programs with the highest economic returns for a total of six of the 20 programs examined. Yield was more of a factor for economic returns than herbicide program costs, with the exception of one program that had two POST herbicide applications. Yield appeared to be mostly affected by annual grass and common ragweed control. Our recommendation when growing non-GMO soybean is to plan on a two-pass program (PRE fb. POST). These programs have consistently provided better weed control, yield, and economic returns, even with the added herbicide and application cost.