

## Economics of Weed Control Programs for non-GMO Soybean, 2015

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A field trial sponsored by the Michigan Soybean Promotion Committee (MSPC) was conducted in 2015 at the MSU 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. Throughout the growing season each treatment was evaluated for soybean injury and weed control. The soil-applied herbicide programs were scouted for weed escapes and postemergence (POST) herbicides were applied to control escaped weeds. POST herbicide programs were designed to demonstrate and answer grower questions on some of the different POST tank-mix options for control of the primary weed escapes. 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 67.9 bu/A and yield loss due to weeds was extremely high. The weedy (untreated) yield was 24.4 bu/A, resulting in a yield loss of 43.5 bu/A (64%). Table 3 contains the data for soybean injury, weed control, herbicide program costs, soybean yield, and economic returns.

*Table 1.* Site description.

<b>Crop</b>	Soybean
<b>Variety</b>	MCIA 2308N
<b>Soil Texture</b>	Loam
<b>Soil pH</b>	7.1
<b>Soil Organic Matter</b>	2.7
<b>Dominant Weeds</b>	ANGR, CHEAL, AMBEL, ABUTH, SINAR
<b>Planting Date</b>	May 7
<b>Application Timings:</b>	
<b>PRE</b>	May 7
<b>POST</b>	June 19
<b>Evaluation Times</b>	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, AMBEL = c. ragweed, ABUTH = velvetleaf, SINAR = wild mustard.

**Table 2.** non-GMO soybean herbicide programs evaluated in 2015.

<b>PRE TREATMENT</b>	<b>POST TREATMENT</b>	<b>ABBREVIATED FORM</b>
Valor (2.5 oz) + Prowl H <sub>2</sub> O (2 pt)	Cobra (8 fl oz) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Valor + Prowl fb. Cobra + Select
Fierce (3.75 oz)	Cobra (8 fl oz) + COC (1%) + AMS (2.5 lb)	Fierce fb. Cobra
Valor XLT (4 oz) <sup>b</sup> + Zidua (2.5 oz)	None	Valor XLT + Zidua
Trivence (8 oz) <sup>b</sup> + Zidua (2.5 oz)	None	Trivence (8) + Zidua
Trivence (10 oz) <sup>b</sup>	Flexstar (12 fl oz) + Assure II (7 fl oz) + COC (1%) + AMS (2.5 lb)	Trivence (10) fb. Flex + Assure
Boundary (2.4 pt)	Flexstar (1 pt) + COC (1%) + AMS (2.5 lb)	Boundary fb. Flexstar
Python (0.8 oz) + Boundary (2 pt)	Flexstar (1 pt) + COC (1%) + AMS (2.5 lb)	Python + Bound fb. Flexstar
Authority MAXX (6 oz) + Boundary (2 pt)	Ultra Blazer (1 pt) + NIS (0.25%) + AMS (2.5 lb)	Auth MX + Bound fb. Blazer
Canopy (2.25 oz) + Prefix (2 pt) <sup>c</sup>	Flexstar (12 fl oz) + COC (1%) + AMS (2.5 lb)	Canopy + Prefix fb. Flexstar
OpTill Pro (2 oz + 10 fl oz) + Outlook (8 fl oz) + Metribuzin (5 oz)	Cobra (8 fl oz) + COC (1%) + AMS (2.5 lb)	OpTill Pro + Outlook + Metri fb. Cobra
Metribuzin (5 oz) + Dual II Magnum (1.33 pt) + Linex (1 pt)	Marvel (7.25 fl oz) + COC (1%) + AMS (2.5 lb)	Metri + Dual + Linex fb. Marvel
Sonic (6.4 oz) + Warrant (3 pt)	Flexstar (1 pt) + COC (1%) + AMS (2.5 lb)	Sonic + Warrant fb. Flexstar
Tricor (8 oz) + Satellite (2 pt)	Ultra Blazer (1.5 pt) + SelectMax (9 fl oz) + NIS (0.25%)	Tricor + Satell fb. Blazer + Select
Tricor (8 oz) + Satellite (2 pt)	Storm (1.5 pt) + SelectMax (9 fl oz) + NIS (0.25%)	Tricor + Satell fb. Storm + Select
Authority MTZ (16 oz)	Marvel (7.25 fl oz) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ fb. Marvel + Select
Authority MTZ (16 oz)	Flexstar (1 pt) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ fb. Flexstar + Select
Authority MTZ (16 oz)	Cadet (0.5 fl oz) + Basagran (10 fl oz) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ fb. Cadet + Basagran + Select
Authority MTZ (13 oz) + Command (21 fl oz)	Marvel (7.25 fl oz) + COC (1%)	Auth MTZ + Comm fb. Marvel
Authority MTZ (13 oz) + Anthem MAXX (3 fl oz)	Marvel (7.25 fl oz) + COC (1%)	Auth MTZ + Anthem MX fb. Marvel
Authority MTZ (13 oz) + Dual II Magnum (1 pt)	Marvel (7.25 fl oz) + SelectMax (9 fl oz) + COC (1%)	Auth MTZ + Dual fb. Marvel + Select

<sup>a</sup> 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.

<sup>b</sup> The use rates of Valor XLT and Trivence exceed the rates that should be used on a soil with a pH of 7.1. The rate of Valor XLT should be 2.5 oz/A and the rate of Trivence should not exceed 6 oz/A or rotational crops may be impacted and there is a greater chance of crop injury.

<sup>c</sup> The treatment of Prefix followed by Flexstar exceeds the maximum limit of fomesafen in a year that can impact rotational crops. Cobra or Ultra Blazer would be a better followup herbicide treatment for common ragweed control in this situation.

**Table 3.** Soybean injury, weed control, program costs, soybean yield, and economic returns for non-GMO herbicide programs, 2015.

Herbicide Programs	Soybean injury							All Weeds (≥90%)	Costs <sup>1</sup> (\$/A)	Yield (bu/A)	Economic Returns <sup>2</sup> (\$/A)	
	45 DAP	14 DAT	Prior to harvest (56 d after POST)				Yield					Returns <sup>2</sup>
	(%)	(%)	% control									
Valor + Prowl fb. Cobra + Select	10	25	89	96	93	98	99	NO	\$66.10	59.6	\$500.10	
Fierce fb. Cobra	20	34	77	98	91	99	99	NO	\$55.10	50.5	\$424.65	
Valor XLT <sup>3</sup> + Zidua	29	15	87	99	76	99	99	NO	\$47.20	51.1	\$438.25	
Trivence (8) <sup>3</sup> + Zidua	25	18	89	99	77	99	99	NO	\$49.20	49.0	\$416.30	
Trivence (10) <sup>3</sup> fb. Flex + Assure	23	23	98	99	98	99	99	YES	\$54.25	61.3	\$528.10	
Boundary fb. Flexstar	2	11	98	98	98	99	99	YES	\$46.05	66.6*	\$586.65*	
Python + Bound fb. Flexstar	6	19	99	99	99	99	99	YES	\$52.50	65.1*	\$565.95*	
Auth MX + Bound fb. Blazer	25	35	98	99	94	99	99	YES	\$68.20	54.0	\$444.80	
Canopy + Prefix fb. Flexstar <sup>4</sup>	8	16	99	99	99	99	99	YES	\$38.70	63.8*	\$567.40*	
OpTill Pro + Outlook + Metri fb. Cobra	15	30	88	99	91	99	99	NO	\$65.75	59.0	\$494.75	
Metri + Dual + Linex fb. Marvel	1	18	96	99	96	99	99	YES	\$59.40	63.2*	\$541.00*	
Sonic + Warrant fb. Flexstar	15	20	97	99	98	99	99	YES	\$68.00	59.2	\$494.40	
Tricor + Satell fb. Blazer + Select	1	18	99	99	94	99	99	YES	\$55.80	64.9*	\$560.75*	
Tricor + Satell fb. Storm + Select	1	15	93	99	81	99	99	NO	\$55.15	67.9**	\$589.90**	
Auth MTZ fb. Marvel + Select	1	33	95	99	84	99	99	NO	\$58.85	62.1*	\$531.10*	
Auth MTZ fb. Flexstar + Select	0	15	96	99	97	99	99	YES	\$54.35	67.2*	\$584.05*	
Auth MTZ fb. Cadet + Basagran + Select	1	34	90	99	63	99	99	NO	\$58.35	39.6	\$317.85	
Auth MTZ + Comm fb. Marvel	0	13	98	99	99	99	99	YES	\$72.90	63.7*	\$532.25*	
Auth MTZ + Anthem MX fb. Marvel	10	20	92	99	89	99	99	NO	\$64.70	63.0*	\$533.80*	
Auth MTZ + Dual fb. Marvel + Select	2	19	96	99	83	99	99	NO	\$67.10	64.2*	\$542.80*	
<i>Untreated</i>	0	0	0	0	0	0	0	NO	—	24.4	\$231.80	

Abbreviations: ANGR = giant foxtail, CHEAL = c. lambsquarters, AMBEL = c. ragweed, ABUTH = velvetleaf, SINAR = wild mustard, fb. = followed by.

<sup>1</sup> Herbicide costs = avg. of price lists; App. cost = \$7.50/A; seeding rate = 150,000 seeds/A. Weed control costs = Herbicide \$ + Additive \$ + Application \$.

<sup>2</sup> Crop selling price = \$8.00/bu + non-GMO premium \$1.50/bu (December 2015). Economic return = (Yield x Price) – Weed Control Costs.

\* Values are not significantly different from the highest value within that column. \*\* Highest yielding and highest economic returns.

<sup>3</sup> The use rates of Valor XLT and Trivence exceed the rates that should be used on a soil with a pH of 7.1. The rate of Valor XLT should be 2.5 oz/A and the rate of Trivence should not exceed 6 oz/A or rotational crops may be impacted and there is a greater chance of crop injury.

<sup>4</sup> The treatment of Prefix followed by Flexstar exceeds the maximum limit of fomesafen. Cobra or Ultra Blazer would be a better followup herbicide treatment for common ragweed control.

### ***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 high amounts of rain (2.9-inches) within two weeks of the soil-applied (PRE) herbicide applications. This allowed for good incorporation of the herbicides for good weed control, but it also caused significant soybean injury. Soybean injury ranged from 8 to 39%, 30 DAP and 0 to 29%, 45 DAP. Treatments that contained flumioxazin (Valor), chlorimuron, and/or pyroxasulfone (Zidua) tended to have the greatest amount of soybean injury. Additionally, the tank-mixtures of OpTill Pro + Outlook + Metribuzin and Sonic + Warrant had significant injury. The greater injury from Valor XLT and Trivence tank-mixtures with Zidua may be caused by the too high of rates of these herbicides for the soil pH at this site. The use rates of Valor XLT should not exceed 2.5 oz/A and the use rate of Trivence should not exceed 6 oz/A on soils with pH greater 6.8 and 7.0, respectively. All PRE treatments resulted in excellent control of common lambsquarters, velvetleaf and wild mustard. Treatments that contained metolachlor either as Dual or in a premixture, Warrant, pyroxasulfone (Zidua or Anthem Max), or Outlook provided good to excellent giant foxtail control at the time of the POST treatment, 45 DAP and did not need a postemergence grass herbicide application. Common ragweed needed to be controlled in all treatments with the exception of Valor XLT + Zidua and Trivence + Zidua. These treatments did not have a followup POST herbicide application. Flexstar, Cobra, Ultra Blazer, Marvel, Storm, and Basagran + Cadet were applied alone or in combination with a POST grass herbicide (i.e., Assure II or SelectMax) to control common ragweed. These herbicides caused significant leaf burn, that was sometimes greater in treatments with excessive injury from the PRE herbicides. Weed control was good to excellent (>80%) with all treatments, exception of four treatments (Table 3). Ten of the 20 herbicide treatments provided >90% control of all weeds at the end of the season. The total cost of the programs ranged from \$38.70 to \$72.90 (herbicide + application costs). Soybean yield ranged from 39.6 to 67.9 bu/A for all herbicide treatments. There were 11 of the 20 herbicide programs that provided high yields (not different from the highest yielding program). All of these treatments were also amongst the programs with top economic returns. Yield was more of a factor for economic returns than herbicide program costs. Yield appeared to be mostly affected by soybean injury in three instances and from weed control in four instances and potentially both in two instances. 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.