

## Economics of Weed Control Programs for non-GMO Soybean, 2014

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A field trial sponsored by the Michigan Soybean Promotion Committee (MSPC) was conducted in 2014 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. Seventeen 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 72.8 bu/A and yield loss due to weeds was extremely high. The weedy (untreated) yield was 25.1 bu/A, resulting in a yield loss of 47.7 bu/A (66%). 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>	ZFS 1326
<b>Soil Texture</b>	Loam
<b>Soil pH</b>	6.8
<b>Soil Organic Matter</b>	4.0
<b>Dominant Weeds</b>	ANGR, CHEAL, AMAPO, AMBEL, ABUTH
<b>Planting Date</b>	May 21
<b>Application Timings:</b>	
<b>PRE</b>	May 22
<b>POST</b>	June 14
<b>LPOS</b>	June 16
<b>Evaluation Times</b>	Soybean injury – 20 d after planting & 7, 14, & 28 d after POST
	Weed control prior to harvest (28 d after POST)

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

**Table 2.** non-GMO soybean herbicide programs evaluated in 2014.

<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 (0.5%) + AMS (2.5 lb)	Valor + Prowl fb. Cobra + Select
Fierce (3.75 oz)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Fierce fb. Flex + Select
Valor XLT (4 oz) + Zidua (2.5 oz)	Ultra Blazer (1.5 pt) + SelectMax (12 fl oz) + COC (0.5%) + AMS (2.5 lb)	Valor XLT + Zidua fb. Blazer + Select
Trivence (8 oz) + Zidua (2.5 oz)	FirstRate (0.3 oz) + Assure II (7 fl oz) + COC (1%) + AMS (2.5 lb)	Trivence (8) + Zidua fb. FirstRate + Assure
Trivence (10 oz)	Flexstar (1 pt) + Assure II (7 fl oz) + COC (1%) + AMS (2.5 lb)	Trivence (10) fb. Flex + Assure
Boundary (2.4 pt)	Flexstar (1 pt) + Harmony SG (0.125 oz) + Select Max (12 fl oz) + COC (1%)	Boundary fb. Flex + Harm + Select
Python (0.8 oz) + Boundary (2 pt)	Synchrony XP (0.375 oz) + Assure II (7 fl oz) + NIS (0.25%) + AMS (2.5 lb)	Python + Bound fb. Synchrony + Assure
Authority MAXX (6 oz) + Boundary (2 pt)	Flexstar (1 pt) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MX + Bound fb. Flex + Select
Canopy (2.25 oz) + Prefix (2 pt)	SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb) - POST Flexstar (1 pt) + Harmony SG (0.125 oz) + NIS (0.25%) + AMS (2.5 lb) - LPOS	Canopy + Prefix fb. Select fb. Flex + Harm
OpTill Pro (2 oz + 10 fl oz) + Outlook (8 fl oz) + Metribuzin (5 oz)	Assure II (7 fl oz) + COC (1%) + AMS (2.5 lb) - POST Cobra (8 fl oz) + Harmony SG (0.125 oz) + NIS (0.25%) + AMS (2.5 lb) - LPOS	OpTill Pro + Outlook + Metri fb. Assure fb. Cobra + Harm
Metribuzin (5 oz) + Dual II Magnum (1.33 pt) + Linex (1 pt)	Raptor (5 fl oz) + COC (1%) + AMS (2.5 lb)	Metri + Dual + Linex fb. Raptor
Sonic (6.4 oz) + Warrant (3 pt)	Cobra (8 fl oz) + SelectMax (12 fl oz) + COC (0.5%) + AMS (2.5 lb)	Sonic + Warrant fb. Cobra + Select
Authority MTZ (13 oz) + Warrant (3 pt)	Flexstar (1 pt) + Fusilade DX (12 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ + Warrant fb. Flex + Fusilade
Authority MTZ (13 oz)	Marvel (7.25 fl oz) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ fb. Marvel + Select
Authority MTZ (13 oz) + Dual II Magnum (1 pt)	Marvel (7.25 fl oz) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ + Dual fb. Marvel + Select
Authority MTZ (13 oz) + Anthem (6 fl oz)	Marvel (7.25 fl oz) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ + Anthem fb. Marvel + Select
Authority MTZ (13 oz) + Command (20 fl oz)	Marvel (7.25 fl oz) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ + Command 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.

**Table 3.** Soybean injury, weed control, program costs, soybean yield, and economic returns for non-GMO herbicide programs, 2014.

Herbicide Programs	Soybean injury						All Weeds (≥90%)	Costs <sup>1</sup> (\$/A)	Yield (bu/A)	Economic Returns <sup>2</sup> (\$/A)	
	20 DAP	7 DAT	Prior to harvest (28 d after POST)								
	(%)	(%)	% control								
Valor + Prowl fb. Cobra + Select	6	23	91	93	99	99	99	YES	\$65.35	70.2*	\$741.95*
Fierce fb. Flex + Select	7	20	98	99	99	99	99	YES	\$59.58	72.4*	\$773.02*
Valor XLT + Zidua fb. Blazer + Select	9	44	98	99	99	98	99	YES	\$83.92	63.8	\$649.78
Trivence (8) + Zidua fb. FirstRate + Assure	6	0	85	92	99	97	99	NO	\$57.86	71.0*	\$758.64*
Trivence (10) fb. Flex + Assure	6	19	93	99	99	99	99	YES	\$59.10	72.8**	\$778.10**
Boundary fb. Flex + Harm + Select	3	36	96	99	99	99	99	YES	\$64.00	66.5	\$700.75
Python + Bound fb. Synchrony + Assure	2	20	82	99	99	80	99	NO	\$58.43	65.5	\$694.82
Auth MX + Bound fb. Flex + Select	2	15	98	99	99	98	99	YES	\$75.65	72.6*	\$759.25*
Canopy + Prefix fb. Select fb. Flex + Harm	2	28	98	99	99	99	99	YES	\$62.13	68.4	\$724.47
OpTill Pro + Outlook + Metri fb. Assure fb. Cobra + Harm	0	29	92	99	99	94	99	YES	\$88.36	69.6*	\$712.04
Metri + Dual + Linex fb. Raptor	3	16	99	99	99	83	99	NO	\$70.63	70.6*	\$741.27*
Sonic + Warrant fb. Cobra + Select	2	20	95	96	99	99	99	YES	\$85.81	71.8*	\$739.89*
Auth MTZ + Warrant fb. Flex + Fusilade	3	19	97	99	99	99	99	YES	\$72.81	71.0*	\$743.69*
Auth MTZ fb. Marvel + Select	0	35	91	99	99	97	99	YES	\$55.96	71.3*	\$763.99*
Auth MTZ + Dual fb. Marvel + Select	3	35	98	99	99	99	99	YES	\$69.91	67.2	\$702.89
Auth MTZ + Anthem fb. Marvel + Select	2	35	96	98	99	99	99	YES	\$73.28	68.6	\$715.62
Auth MTZ + Command fb. Marvel + Select	0	35	98	99	99	98	99	YES	\$79.57	68.5	\$708.18
<i>Untreated</i>	0	0	0	0	0	0	0	NO	—	25.1	\$288.65

Abbreviations: ANGR = giant & yellow foxtail, CHEAL = c. lambsquarters, AMAPO = Powell amaranth, AMBEL = c. ragweed, ABUTH = velvetleaf, 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 = \$10.00/bu + non-GMO premium \$1.50/bu (December 2014). 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.

### ***General Observations and Interpretation:***

Weather had a major impact on the overall outcome of the various herbicide programs. Early in the growing season there was less than 0.75-inches of rain within two weeks of the soil-applied (PRE) herbicide applications. This resulted in not very good incorporation of the soil-applied herbicides and overall control of grasses and common ragweed were affected. Annual grass control ranged from 63 to 91%, 20 day after planting (DAP) and common ragweed control ranged from 52 to 88%. Common lambsquarters control was also variable. Soybean injury was low due to the lower rainfall and ranged from 0 to 9%, 20 DAP. The PRE treatment that resulted in the greatest soybean injury was a combination of Valor XLT + Zidua, which would be equivalent to the new premixture, Fierce XLT. Different POST herbicide treatments were selected based on the weeds that needed to be controlled after the PRE treatments. Soybean injury was greatest 7 days after the POST treatments (DAT). For the majority of POST treatments, soybean injury ranged from 15 to 44%. By 14 DAT, soybean injury was less than 10% with most treatments, except where Harmony or Marvel were applied and injury was still between 15 and 25%. The POST treatment of Ultra Blazer caused the most injury (40%), 14 DAT. This was likely due to the use of crop oil concentrate as the adjuvant, if a non-ionic surfactant would have been used soybean injury would have been much less. This treatment also resulted in shorter plants and the lowest yield at the end of the season for all the herbicide treatments (a 12% yield reduction compared with the highest yielding treatment). All but three of the POST herbicide programs provided good to excellent control of the remainder of the weeds. The total cost of the PRE fb. POST programs ranged from \$55.96 to \$88.36 (herbicide + application costs). Soybean yield ranged from 63.8 to 72.8 bu/A for all herbicide treatments. There were 10 of the 17 herbicide programs that provided high yields (not different from the highest yielding program). All but one of these treatments were also amongst the programs with top economic returns. Yield was more of a factor for economic returns than herbicide program cost with the exception of one program. Yield to mostly be affected by soybean injury from Ultra Blazer, and in some cases Harmony and Marvel. 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.