

Economics of Weed Control Programs for non-GMO Soybean, 2018 Christy L. Sprague

A field trial sponsored by the Michigan Soybean Promotion Committee (MSPC) was conducted in 2018 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 at 21 and 34 days after planting (DAP). Treatments were scouted and POST herbicide treatments were applied accordingly. Postemergence herbicides were chosen based on weeds that were no longer controlled from the PRE applications. 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 70 bu/A. The weedy (untreated) yield was 53.9 bu/A, resulting in a yield loss of 16.1 bu/A (23%). 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	ZFS 1326
Soil Texture	Loam
Soil pH	6.8
Soil Organic Matter	2.2
Dominant Weeds	ANGR, CHEAL, AMAPO, AMBEL, ABUTH,
Planting Date	June 5
Application Timings:	
PRE	June 5
POST	July 11
Evaluation Times	Soybean injury – 21 d after planting & 7, 14, & 28 d after POST Weed control prior to harvest (28 d after POST)

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

Table 2. non-GMO soybean herbicide programs evaluated in 2018.

PRE TREATMENT	POST TREATMENT	ABBREVIATED FORM
Metribuzin (6 oz)	Harmony (0.125 oz) + Flexstar (1 pt) + SelectMax (12 fl oz) + NIS (0.25%) + AMS (2.5 lb)	Metri (6) fb. Harm+ Flex+Select (12)
Boundary (2.4 pt)	Flexstar (1 pt) + COC (1%) + AMS (2.5 lb)	Boundary (2.4) fb. Flex
Authority Elite/BroadAxe XC (32 fl oz)	Synchrony XP (0.375 oz) + Flexstar (1 pt) + NIS (0.125%) + AMS (2.5 lb)	Auth Elite/BroadAxe fb. Synch+Flex
Sonic (6 oz) + Boundary (1.5 pt)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Sonic+Bound (1.5) fb. Flex+Select (12)
Surveil (3.5 oz) + Metribuzin (6 oz)		Surveil + Metri (6)
Valor (2.5 oz) + Prowl H2O (2 pt)	Cobra (10 oz) + COC (0.5%)	Valor (2.5)+Prowl fb. Cobra (10)
Fierce (3 oz)	Cobra (10 oz) + COC (0.5%)	Fierce fb. Cobra (10)
Fierce MTZ (16 fl oz)		Fierce MTZ
Valor XLT (3 oz)		Valor XLT
Valor XLT (2 oz) + Valor (1.5 oz)	Flexstar (1 pt) + SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	Valor XLT+Valor(1.5) fb. Flex+Select (9)
Authority MTZ (14 oz)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ fb. Flex+Select (12)
Authority Supreme (9.8 fl oz)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Auth Sup fb. Flex+Select (12)
Authority MTZ (14 oz) + Command 3ME (1 pt)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ+Comm fb. Flex+Select (12)
Zidua PRO (6 fl oz)		Zidua PRO
Afforia (2.5 oz) + Metribuzin (5 oz)	Ultra Blazer (1.5 pt) + NIS (0.25%)	Afforia+Metri (5) fb. Blazer
Trivence (8 oz)		Trivence
Prefix (2 pt) + Metribuzin (6 oz)	Cadet (0.9 fl oz) + COC (1%) + AMS (2.5 lb)	Prefix+Metri (6) fb. Cadet
Warrant Ultra (50 fl oz) + Metribuzin (6 oz)	Resource (6 fl oz) + COC (1%) + AMS (2.5 lb)	Warr Ult+Metri (6) fb. Resource
Authority MTZ (14 oz)	Cadet (0.6 fl oz) + Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ fb. Cadet (0.6)+Flex+Select (12)
Authority MTZ (14 oz)	Anthem MAXX (3.25 fl oz) + Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Auth MTZ fb. Anth MX+Flex+Select (12)

Table 3. Soybean injury, weed control, program costs, soybean yield, and economic returns for non-GMO herbicide programs, 2018.

Herbicide Programs ⁴	Soybean injury		ANGR	CHEAL	AMAPO	AMBEL	ABUTH	All Weeds (≥90%)	Costs ¹ (\$/A)	Yield (bu/A)	Economic Returns ² (\$/A)
	21 DAP	7 DAT	Prior to harvest (28 d after POST)								
	(%)	(%)	% control								
Metri (6) fb. Harm+ Flex+Select (12)	3	34	98	93	99	95	99	YES	\$44.16	62.6	\$613.14
Boundary (2.4) fb. Flex	2	16	93	97	100	100	100	YES	\$50.48	66.2*	\$644.62§
Auth Elite/BroadAxe fb. Synch+Flex	5	28	100	97	100	89	99	NO	\$60.79	60.8	\$577.61
Sonic+Bound (1.5) fb. Flex+Select (12)	4	14	100	98	100	100	100	YES	\$80.25	65.9*	\$611.70
Surveil + Metri (6)	5	0	100	100	100	100	100	YES	\$33.78	68.2*	\$682.32*
Valor (2.5)+Prowl fb. Cobra (10)	7	23	99	98	100	96	97	YES	\$55.65	64.3	\$619.50
Fierce fb. Cobra (10)	4	22	98	89	100	97	98	NO	\$54.97	64.2	\$619.13
Fierce MTZ	7	1	100	95	100	91	98	YES	\$32.00	61.6	\$614.80
Valor XLT	7	2	100	100	100	90	97	YES	\$23.40	64.0	\$648.60§
Valor XLT+Valor(1.5) fb. Flex+Select (9)	3	12	97	100	100	100	100	YES	\$49.46	68.3*	\$667.69*
Auth MTZ fb. Flex+Select (12)	3	17	100	100	100	100	100	YES	\$55.87	66.8*	\$645.53§
Auth Sup fb. Flex+Select (12)	2	14	100	100	98	100	100	YES	\$69.63	62.4	\$585.57
Auth MTZ+Comm fb. Flex+Select (12)	5	15	100	100	100	100	100	YES	\$74.38	66.2*	\$620.72
Zidua PRO	5	2	98	100	100	100	100	YES	\$42.77	64.5	\$634.48§
Afforia+Metri (5) fb. Blazer	3	10	97	98	100	87	95	NO	\$49.13	65.2*	\$635.47§
Trivence	3	1	98	98	100	93	97	YES	\$27.40	70.0**	\$707.60**
Prefix+Metri (6) fb. Cadet	4	18	100	95	100	98	100	YES	\$43.71	63.5	\$623.04
Warr Ult+Metri (6) fb. Resource	5	16	99	95	100	98	100	YES	\$50.38	65.4*	\$636.32§
Auth MTZ fb. Cadet (0.6)+Flex+Select (12)	5	25	100	98	100	100	100	YES	\$61.45	64.5	\$615.80
Auth MTZ fb. Anth MX+Flex+Select (12)	4	20	95	96	100	99	100	YES	\$74.58	64.5	\$602.67
Untreated	0	0	0	0	0	0	0	NO	--	53.9	\$565.95

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 = \$8.00/A; seeding rate = 155,000 seeds/A. Weed control costs = Herbicide \$ + Additive \$ + Application \$.

² Crop selling price = \$9.00/bu (January 2019) + 1.50/bu non-GMO premium. 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 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 can impact outcomes of the various herbicide programs examined in the non-GMO soybean study. However, overall results between years remain fairly consistent. Due to early-season rainfall, soybean was planted later than normal (June 5) at the East Lansing location. The delayed planting combined with lower rainfall in the first couple of weeks of July led to lower than normal weed densities. Weed densities were ~1 weed per square foot of annual grass, common lambsquarters, Powell amaranth, common ragweed, and velvetleaf. Rainfall was <0.75-inch within the first two weeks of planting and applying the PRE herbicides. This rainfall provided incorporation of the PRE herbicides, and contributed to initial differences between the treatments. Soybean injury was generally low from the PRE treatments and was <10% at the 21 and 34 DAP evaluations. Out of the 20 PRE herbicide treatments, five treatments provided excellent control of all weeds at the time of the POST, so no POST was applied. These treatments were Surveil + Metribuzin (3.5 + 6 oz), Fierce MTZ (16 fl oz), Valor XLT (3 oz), Zidua PRO (6 fl oz), and Trivence (8 oz). Weed control remained excellent (>90%) with these treatments through the last evaluation. The weed that escaped control from the PRE treatments was predominately common ragweed. There were seven out of the 20 PRE treatments that provided >90% control of common ragweed at the time of the POST application. These treatments were flumioxazin (Valor) premixtures, Zidua Pro, or were premixes with fomesafen (Prefix and Warrant Ultra). Common ragweed control this year from these PRE herbicides was higher than years past at the time of POST, due to the lower numbers of common ragweed present in this trial. Some treatments did not provide adequate control of velvetleaf, annual grasses and common lambsquarters at the time of the POST treatments. POST treatments were chosen to control the weeds that had escaped control from the PRE herbicide treatments. The POST herbicides provided varying levels of soybean injury and weed control. The total cost of the programs ranged from \$23.40 to \$80.25 (herbicide + application costs). The more inexpensive programs were treatments that did not need followup POST applications. Soybean injury from POST treatments ranged from 10-34%, 7 DAT and by 28 DAT only one treatment Harmony + Flexstar + SelectMax + NIS+ AMS still exhibited significant injury (8%). This was mostly in the form of stunted soybeans. By 28 days after the POST treatments, all but three treatments provided greater than 90% control of all weed species. In most cases common ragweed was the escape, but control was still greater than 85%. Overall soybean yield for the different herbicide programs was fairly close, ranging from 60.8 to 70 bu/A. Nine of the 20 of these herbicide programs ranked amongst the highest yielding. All of the higher yielding programs, with the exception of one provided greater than 90% weed control. In some cases the programs that did not rank amongst the highest yielding had higher soybean injury from the POST herbicide treatments. Normally this is not a factor but with the later planting and drier conditions throughout July, soybean may not have had the opportunity to fully recover from the POST herbicide applications. This year the highest yielding program was also the program with the highest economic returns. All of the higher yielding programs, with the exception of one, were amongst the programs with the highest or 2nd highest economic returns. Yield was more of a factor for economic returns than herbicide program costs, with the exception of one program that was the most expensive herbicide program. 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.