

Economics of Weed Control Programs for non-GMO Soybean, 2019 Christy L. Sprague

A field trial sponsored by the Michigan Soybean Promotion Committee (MSPC) was conducted in 2019 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. Two additional total postemergence programs were applied when weeds were approximately 2-inches tall these are referred to as early postemergence (EPOS) programs. 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 ~28 days after planting (DAP) and EPOS treatments were applied. Due to the wet cool spring POST herbicide applications after the PRE treatments did not need to be sprayed until 46 DAP. At this time plots were also scouted for POST herbicide treatments. 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. There were several plots that did not need to be sprayed and were evaluated as PRE only treatments for the entire season. Site characteristics and herbicide application timings are described in Table 1. Table 2 describes the herbicide programs evaluated. The maximum soybean yield was 51.8 bu/A and yield loss due to weeds was extremely high. The weedy (untreated) yield was 15.7 bu/A, resulting in a yield loss of 36.1 bu/A (70%). 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	ZFS1326
Soil Texture	Loam
Soil pH	6.6
Soil Organic Matter	2.5
Dominant Weeds	ANGR, CHEAL, AMBEL ¹ , ABUTH, SINAR
Planting Date	May 15
Application Timings:	
PRE	May 16
EPOS	June 12
POST	July 1
Evaluation Times	Soybean injury – 28 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 2019.

PRE TREATMENT	POST TREATMENT	ABBREVIATED FORM
Fierce (3 oz)		Fierce
Fierce MTZ (16 oz)		Fierce MTZ
Valor XLT (2 oz) + Valor (1.5 oz)		Valor XLT + Valor
Zidua PRO 6 (fl oz)		Zidua PRO
Trivence (8 oz)		Trivence
Prefix 2 pt + Metribuzin (6 oz)		Prefix + Metribuzin
Warrant Ultra (50 fl oz) + Metribuzin (6 oz)		Warrant Ultra + Metribuzin
	Synchrony XP (0.5 oz) + Cobra (8 fl oz) + Assure II (9 fl oz) + COC (0.5%) + AMS (2.5 lb)	Synch XP + Cobra + Assure
	Basagran (1.6 pt) + Ultra Blazer (1 pt) + Select Max (12 fl oz) + COC (1%) + AMS (2.5 lb)	Basagran + Blazer + Select
Boundary (2.4 pt)	Flexstar (12 fl oz) + COC (1%) + AMS (2.5 lb)	Boundary fb. Flexstar
BroadAxe SC (32 fl oz)	Flexstar (1 pt) + COC (1%) + AMS (2.5 lb)	BroadAxe SC fb. Flexstar
Sonic (6 oz) + Boundary (1.5 pt)	Cobra (8 fl oz) + COC (0.5%)	Sonic + Boundary fb. Corba
Surveil (3.5 oz) + Metribuzin (6 oz)	Assure II (7 fl oz) + COC (1%)	Surveil + Metri fb. Assure
Dimetric Charged (16 fl oz)	SelectMax (9 fl oz) + NIS (0.25%) + AMS (2.5 lb)	Dimetric Charged fb. Select
Valor (2.5 oz) + Prowl H2O (2 pt)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Valor + Prowl fb. Flex + Select
Valor XLT (4 oz)	Cobra (8 fl oz) + COC (0.5%)	Valor XLT fb. Cobra
Authority MTZ (14 oz)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Authority MTZ fb. Flex + Select
Authority Supreme (9.8 fl oz)	Marvel (7.25 fl oz) + COC (1%) + AMS (2.5 lb)	Authority Sup fb. Marvel
Matador (3.9 pt)	Harmony SG (0.125 oz) + Flexstar (1 pt) + SelectMax (12 fl oz) + COC (0.5%) + AMS (2.5 lb)	Matador fb. Harm + Flex + Select
Moccasin MTZ (2.67 pt)	Ultra Blazer (1.5 pt) + NIS (0.25%)	Moc MTZ fb. Blazer
Tripzin ZC (2 pt)	Ultra Blazer (1.5 pt) + NIS (0.25%)	Tripzin ZC fb. Blazer
Command 3ME (21 fl oz) + Moccasin MTZ (2.5 pt)	Ultra Blazer (1.5 pt) + NIS (0.25%)	Command + Moc MTZ fb. Blazer

Table 3. Soybean injury, weed control, program costs, soybean yield, and economic returns for non-GMO herbicide programs, 2019.

Herbicide Programs ³	Soybean Injury							All Weeds	Costs ¹	Yield	Economic Returns ²
	28 DAP	46 DAP	Prior to harvest (56 d after POST)				(≥90%)				
	(%)	(%)	% control								
Fierce (PRE only)	38	8	90	100	100	86	100	NO	\$30.07	51.8**	\$529.37**
Fierce MTZ (PRE only)	33	3	88	100	100	81	100	NO	\$34.35	45.2*	\$453.81*
Valor XLT + Valor (PRE only)	39	17	89	100	100	85	100	NO	\$25.48	45.1*	\$461.60*
Zidua PRO (PRE only)	13	3	89	100	100	77	100	NO	\$30.65	45.8*	\$463.99*
Trivence (PRE only)	34	5	87	100	100	87	100	NO	\$29.12	45.2*	\$459.04*
Prefix + Metribuzin (PRE only)	17	3	99	99	100	96	96	YES	\$28.91	43.7*	\$443.05*
Warrant Ultra + Metribuzin (PRE only)	7	0	98	100	100	90	90	YES	\$35.75	38.4	\$378.97
Synch XP + Cobra + Assure (EPOS)	0	5	70	83	100	24	90	NO	\$35.88	49.2*	\$495.48*
Basagran + Blazer + Select (EPOS)	0	7	55	69	100	24	90	NO	\$44.19	41.3*	\$401.85
Boundary fb. Flexstar	19	2	100	97	100	100	98	YES	\$53.69	44.2*	\$423.67*
BroadAxe SC fb. Flexstar	23	2	99	100	100	100	100	YES	\$61.58	48.5*	\$462.22*
Sonic + Boundary fb. Corba	26	6	99	100	100	98	100	YES	\$79.71	40.0	\$352.29
Surveil + Metri fb. Assure	35	10	92	100	100	86	100	NO	\$53.28	41.4*	\$393.84
Dimetric Charged fb. Select	36	4	96	99	100	95	98	YES	\$44.70	48.5*	\$479.10*
Valor + Prowl fb. Flex + Select	43	5	94	100	100	100	100	YES	\$61.51	46.0*	\$435.29*
Valor XLT fb. Cobra	30	13	92	100	100	100	99	YES	\$52.74	48.2*	\$467.82*
Authority MTZ fb. Flex + Select	5	0	100	100	100	100	100	YES	\$71.41	51.6*	\$485.87*
Authority Sup fb. Marvel	9	8	100	100	100	98	100	YES	\$65.55	39.1	\$356.73
Matador fb. Harm + Flex + Select	1	0	92	91	100	48	93	NO	\$61.42	35.1	\$317.66
Moc MTZ fb. Blazer	14	2	100	100	100	92	98	YES	\$48.15	48.0*	\$470.25*
Tripzin ZC fb. Blazer	15	0	100	100	100	85	98	NO	\$42.12	51.2*	\$510.84*
Command + Moc MTZ fb. Blazer	13	1	100	100	100	100	100	YES	\$72.52	44.2*	\$404.84
Untreated	0	0	0	0	0	0	0	NO	---	15.7	\$169.56

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

¹Herbicide costs = avg. of price lists; App. cost = \$8.00/A; seeding rate = 156,000 seeds/A. Weed control costs = Herbicide \$ + Additive \$ + Application \$.

²Crop selling price = \$9.30/bu + non-GMO premium \$1.50/bu (January 2020). 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.

³Many 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. This year was cool and wet up to and soon after planting. Weed densities were extremely high in this trial. There was ~99 annual grasses, six common lambsquarters, one Powell amaranth, 24 common ragweed, and one velvetleaf per square foot. Rainfall within the first two weeks of planting and application of the PRE herbicides was 1.53 inches. An additional 6.79 inches of rainfall fell prior to the POST herbicide applications. Overall rainfall provided good incorporation of the PRE herbicides and contributed to initial differences between the treatments. This year soybean injury from the PRE herbicides was relatively high due to the cool temperature and excessive rainfall. Any treatment that contained flumioxazin (Valor or Valor premixes) resulted in soybean injury between 30 and 40%, 28 DAP. Soybean injury was also observed with several other treatments. However, by the time of the POST herbicide treatments 46 DAP only the treatments Valor + Valor XLT, Dimetric Charged, and Valor XLT had 10% injury or higher. Out of the 20 PRE herbicide treatments, seven treatments provided excellent control of all weeds at the time of the POST, so no POST was applied. These treatments were Fierce, Fierce MTZ, Valor + Valor XLT, Zidua PRO, Trivence, Prefix + Metribuzin, and Warrant Ultra + Metribuzin. Weed control remained excellent (>90%) with only Prefix + Metribuzin, and Warrant Ultra + Metribuzin through the last evaluation. However, all other PRE treatments provided greater than 80% control, with the exception of Zidua PRO on common ragweed. The weed that escaped control from the PRE treatments was predominately annual grasses and common ragweed. Some treatments did not provide adequate control of velvetleaf 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 herbicide programs ranged from \$25.48 to \$79.71 (herbicide + application costs). The more inexpensive programs were treatments were the PRE only treatments or one of the one-pass EPOS treatments. Neither of the EPOS programs resulted in >90% weed control. Soybean injury from POST treatments ranged from 3 to 26%, 7 DAT and by 28 DAT soybean injury was insignificant. Twelve of the 22 herbicide treatments evaluated resulted in greater than 90% weed control at the end of the season. There was a significant range in costs of the programs. Overall soybean yield was variable in this trial and 18 of the 22 herbicide programs evaluated ranked amongst the highest yielding. All but three of the highest yielding programs were amongst the programs with the highest economic returns. Of the three higher yielding programs that were not in the highest economic returns, program costs and yield toward the lower range of the higher yields were factors. This year with the excessive rainfall that we had several of our PRE programs held throughout the season and ranked amongst the highest yield and economic returns. However, this is not always the case. In general, it is important to plan on a two-pass program (PRE fb. POST) when growing non-GMO soybean. Throughout the years these programs have consistently provided better weed control, yield, and economic returns, even with the added herbicide and application cost.