

Economics of Weed Control Programs for non-GMO Soybean, 2020

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A field trial sponsored by the Michigan Soybean Promotion Committee (MSPC) was conducted in 2020 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 ~21 and 35 days after planting (DAP). After the 35 DAP evaluation, POST herbicide treatments were selected and sprayed to control escaped weeds. Any PRE treatments that provided greater than 95% control 35 DAP were not treated with a POST herbicide application. 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 four treatments that did not need to be sprayed with a POST herbicide 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 57 bu/A and yield loss due to weeds was high. The weedy (untreated) yield was 30.6 bu/A, resulting in a yield loss of 26.4 bu/A (46%). 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	6.8
Soil Organic Matter	2.6
Dominant Weeds	ANGR, CHEAL, AMAPO, AMBEL ¹ , ABUTH, SOLPT
Planting Date	May 26
Application Timings:	
PRE	May 26
POST	June 29
Evaluation Times	21 & 35 d after planting 7, 14, & 28 d after POST & at harvest

Abbreviations: ANGR = giant foxtail & barnyardgrass, CHEAL = c. lambsquarters, AMAPO = Powell amaranth, AMBEL = c. ragweed, ABUTH = velvetleaf, SOLPT = eastern black nightshade.

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

Table 2. non-GMO soybean herbicide programs evaluated in 2020.

PRE TREATMENT	POST TREATMENT	ABBREVIATED FORM
Sonic (6 oz) + Boundary (1.5 pt)		Sonic + Boundary
Authority Edge (10 fl oz) + Metribuzin (6 oz)		Auth Edge + Metri
Zidua PRO (6 fl oz)		Zidua PRO
Prefix (2 pt) + Metribuzin (6 oz)		Prefix + Metri
Boundary (2.4 pt)	Flexstar (1 pt) + COC (1%) + AMS (2.5 lb)	Boundary fb. Flexstar
BroadAxe SC (32 fl oz)	Marvel (7.25 fl oz) + COC (1%) + AMS (2.5 lb)	BroadAxe fb. Marvel
Surveil (3.5 oz) + Metribuzin (6 oz)	SelectMax (9 fl oz) + NIS (0.25%) + COC (1%)	Surveil + Metri fb. Select (9)
Dimetric Charged (12 fl oz)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Dimet Charged fb. Flex + Select
Valor (2.5 oz) + Prowl H2O (2 pt)	Harmony SG (0.125 oz) + Cobra (8 fl oz) + SelectMax (12 fl oz) + NIS (0.25%)	Valor + Prowl fb. Harm + Cobra + Select
Fierce (3 oz)	Flexstar (12 fl oz) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Fierce fb. Flex + Select
Fierce MTZ (16 fl oz)	Cobra (8 fl oz) + SelectMax (12 fl oz) + COC (0.5%) + AMS (2.5 lb)	Fierce MTZ fb. Cobra + Select
Valor XLT (4 oz)	SelectMax (9 fl oz) + NIS (0.25%) + AMS (2.5 lb)	Valor XLT fb. Select (9)
Authority MTZ (14 oz)	Cobra (10 fl oz) + SelectMax (12 fl oz) + COC (0.5%) + AMS (2.5 lb)	Auth MTZ fb. Cobra + Select
Authority Edge (10 fl oz)	Cobra (8 fl oz) + COC (0.5%) + AMS (2.5 lb)	Auth Edge fb. Cobra
Trivence (8 oz)	Assure II (7 fl oz) + COC (1%)	Trivence fb. Assure II
Warrant Ultra (50 fl oz) + Metribuzin (6 oz)	SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb)	Warrant Ultra + Metri fb. Select (9)
Matador (3.9 pt)	Raptor (5 fl oz) + Flexstar (1 pt) + COC (1%) + AMS (2.5 lb)	Matador fb. Raptor + Flex
Moccasin MTZ (2.67 pt)	Ultra Blazer (1.5 pt) + Shadow (8 fl oz) + NIS (0.25%) + AMS (8.5 lb)	Moc MTZ fb. Blazer + Shad
Tripzin ZC (2 pt)	Ultra Blazer (1.5 pt) + Shadow (8 fl oz) + NIS (0.25%) + AMS (8.5 lb)	Tripzin ZC fb. Blazer + Shad
Upstage (21 fl oz) + Moccasin MTZ (2.67 pt)	Ultra Blazer (1.5 pt) + Shadow (8 fl oz) + NIS (0.25%) + AMS (8.5 lb)	Upstage + Moc MTZ fb. Blazer + Shad

Table 3. Soybean injury, weed control, program costs, soybean yield, and economic returns for non-GMO herbicide programs, 2020.

Herbicide Programs ³	Soybean Injury							All Weeds	Costs ¹	Yield	Economic Returns ²
	21 DAP	7 DAT	Prior to harvest (105 d after POST)								
	(%)	(%)	% control								
Sonic + Boundary (PRE only)	2	2	100	100	99	100	100	YES	\$56.50	49.9*	\$597.19*
Auth Edge + Metri (PRE only)	3	2	89	100	90	100	100	NO	\$39.58	50.0*	\$615.42*
Zidua PRO (PRE only)	1	1	95	100	98	100	100	YES	\$31.33	47.6	\$592.23*
Prefix + Metri (PRE only)	3	0	97	100	100	96	100	YES	\$29.79	47.1	\$587.22*
Boundary fb. Flexstar	3	14	93	100	100	100	100	YES	\$54.75	53.5*	\$646.10*
BroadAxe fb. Marvel	0	11	96	100	90	100	100	YES	\$62.04	50.4*	\$598.20*
Surveil + Metri fb. Select (9)	13*	3	100	100	100	100	100	YES	\$53.44	52.3*	\$631.69*
Dimet Charged fb. Flex + Select	4	14	100	100	100	100	100	YES	\$51.18	54.2*	\$658.84*
Valor + Prowl fb. Harm + Cobra + Select	7	25	97	96	100	100	100	YES	\$66.86	51.8*	\$611.72*
Fierce fb. Flex + Select	8*	11	100	100	100	100	100	YES	\$57.48	50.3*	\$601.45*
Fierce MTZ fb. Cobra + Select	13*	26*	100	100	100	100	100	YES	\$66.63	53.7*	\$636.84*
Valor XLT fb. Select (9)	6	1	99	100	91	93	100	YES	\$46.41	55.6*	\$681.95**
Auth MTZ fb. Cobra + Select	4	28*	100	100	100	100	100	YES	\$75.33	57.0**	\$671.37*
Authority Edge fb. Cobra	0	25*	94	100	100	100	100	YES	\$53.41	50.0*	\$601.59*
Trivence fb. Assure II	11*	6	99	100	95	100	100	YES	\$45.11	47.3	\$574.52*
Warrant Ultra + Metri fb. Select	2	0	100	100	100	93	100	YES	\$54.47	49.8*	\$597.91*
Matador fb. Raptor + Flex	0	15	99	95	98	100	100	YES	\$75.53	48.7	\$562.44
Moc MTZ fb. Blazer + Shad	1	18	100	99	100	100	98	YES	\$50.62	51.1*	\$618.79*
Tripzin ZC fb. Blazer + Shad	2	21	97	100	96	100	87	NO	\$46.10	47.8	\$580.08*
Upstage + Moc MTZ fb. Blazer + Shad	2	20	100	100	100	100	100	YES	\$63.25	50.9*	\$603.54*
Untreated	0	0	0	0	0	0	0	NO	---	30.6	\$400.86

Abbreviations: ANGR = giant foxtail, CHEAL = c. lambsquarters, AMAPO = Powell amaranth, AMBEL = c. ragweed, ABUTH = velvetleaf, SOLPT = eastern black nightshade fb. = followed by. Control of AMAPO with all herbicide programs was 100%.

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 = \$11.60/bu + non-GMO premium \$1.50/bu (December 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 sensitive crops. Consult the Table 12 in the MSU Weed Control Guide for Field Crops (E0434) 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. Substantial rainfall during the 2nd and 3rd weeks of May resulted in soybean not being planted until May 26. Low to moderate weed densities of giant foxtail, common lambsquarters, Powell amaranth, common ragweed, velvetleaf, and eastern black nightshade were present in this trial. Rainfall within the first two weeks of planting and application of the PRE herbicides was 1.25 inches. This rainfall thoroughly incorporated the PRE herbicides for excellent weed control. Due to warmer temperatures that lead to actively growing soybean, soybean injury was limited. Soybean injury from the PRE herbicides ranged from 3 to 13% ~21 DAP. The higher levels of injury were from treatments that contained the active ingredient flumioxazin (Valor) in some combinations with metribuzin, Surveil + metribuzin, Fierce MTZ, and Trivence. However, by the time of the POST application (~35 DAP) soybean injury was 4% or less except for Trivence where injury was 8%, illustrating soybean's ability to recover from PRE herbicide applications. Weeds that escaped control from the PRE treatments was predominately common ragweed, and some annual grasses, and on occasion common lambsquarters and velvetleaf. Out of the 20 PRE herbicide treatments, four treatments provided excellent control at the time of the POST, so no POST was applied. These treatments were Sonic (6 oz) + Boundary (1.5 pt), Authority Edge (10 fl oz) + metribuzin (6 oz), Zidua PRO (6 fl oz) and Prefix (2 pt) + metribuzin (6 oz). By July 27, these treatments all still provided >90% weed control. The POST herbicides following PRE treatments provided varying levels of soybean injury and weed control. Soybean injury from POST treatments ranged from 2-28%, 7 DAT. Cobra applied from 8 to 10 fl oz caused the greatest injury. By 28 DAT soybean injury was less than 2%. By 28 days after the POST treatments, all PRE followed by POST treatments provided greater than 90% control of all weed species. Common ragweed control was the species that was the least consistently controlled >90% with the PRE treatments. The fact that the common ragweed population was Group 2 (ALS)-resistant was the most challenging issue with some of the POST treatments. Additionally, Flexstar, Cobra, Marvel, and Ultra Blazer were used to clean up common ragweed escapes. All treatments with the exception of the PRE only treatment of Authority Edge + Metribuzin and Tripzin ZC (PRE) followed by Ultra Blazer + Shadow (POST) resulted in >90% control of all weeds at harvest. These two treatments controlled all weeds, except annual grass (89%) and eastern black nightshade (87%), >90%, respectively. There was a significant range in costs of the herbicide programs. Overall soybean yield was variable in this trial and 15 of the 20 herbicide programs evaluated ranked amongst the highest yielding. However, all programs ranked amongst the highest economic return, with the exception of one of the lower yielding programs that was also amongst the most expensive programs. The additional expense was due to the POST herbicides needed to control the lower overall weed control observed with the PRE treatment of Matador. This year with good rainfall for incorporation four of the PRE programs held throughout the season and two of which ranked amongst the highest yielding and all four ranked amongst the highest 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.