

Economics of Weed Control Programs for non-GMO Soybean, 2024

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A field trial sponsored by the Michigan Soybean Promotion Committee (MSPC) was conducted in 2024 at the MSU Plant Pathology Farm in 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. Eighteen different soil-applied (PRE) herbicide programs were applied immediately after soybean planting and were evaluated ~21 and 28 days after planting (DAP). At the 28 DAP evaluation, the PRE herbicide programs were scouted for weed escapes and POST herbicide treatments were selected based on weeds that escaped control. For example, if common ragweed was the escaped weed a herbicide like Flexstar or Cobra was applied. Herbicide rates were adjusted to weed size. In some cases, when both broadleaf and grass weeds needed to be controlled separate POST applications were made for the broadleaf and grass herbicides 7 d apart (+7d), to alleviate the chances for POST grass antagonisms. Three additional POST only treatments were applied when weeds were 2-inches tall and were designated as an early POST (EPOS) application. All treatments were evaluated one week after the POST application for soybean injury. There was one PRE treatment where a POST herbicide was not applied to show the importance of a PRE followed by POST herbicide program. Site characteristics and herbicide application timings are described in Table 1. Table 2 describes the herbicide programs evaluated. The maximum soybean yield was 67.4 bu/A and yield loss due to weeds was high. The weedy (untreated) yield was 28 bu/A, resulting in a yield loss of 39.4 bu/A (58%). Tables 3 & 4 contain 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	Clay loam
Soil pH	7.1
Soil Organic Matter	1.9
Dominant Weeds	ANGR, CHEAL, AMBEL ¹ , LAMAM, ABUTH
Planting Date	May 10
Application Timings:	
PRE	May 10
EPOS	June 3
POST	June 10
+ 7 d after POST	June 19
Evaluation Times	28 d after planting 7 and 28 d after POST

Abbreviations: ANGR = giant foxtail, CHEAL = c. lambsquarters, AMBEL¹ = c. ragweed, LAMAM = henbit, ABUTH = velvetleaf.

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

Table 2. non-GMO soybean herbicide programs evaluated in 2024.

PRE TREATMENT	POST TREATMENT	ABBREVIATED FORM
Boundary (2.4 pt)	Flexstar (1 pt) + Harmony (0.125 oz) + COC (1%) + AMS (2.5 lb) fb. SelectMax (9 fl oz) + NIS (0.25%) + AMS (2.5 lb) (+7d)	Boundary fb. Flex + Harm fb. Select (9) (+7d)
BroadAxe XC (32 fl oz)	Flexstar (1 pt) + Perpetuo (6 fl oz) + COC (1%) + AMS (2.5 lb) fb. SelectMax (9 fl oz) + NIS (0.25%) + AMS (2.5 lb) (+7d)	Broadaxe fb. Flex + Perp fb. Select (9) (+7d)
Sonic (6 oz) + Boundary (1.5 pt)	Flexstar (1 pt) + SelectMax (12 fl oz) + NIS (0.25%) + AMS (2.5 lb) (12 fl oz)	Sonic + Boundary fb. Flex + Select (12)
Surveil (3.5 oz) + Metribuzin (6 oz)	Raptor (5 fl oz) + Flexstar (1 pt) + COC (1%) + AMS (2.5 lb)	Surveil + Metri (6) fb. Raptor + Flex
Dimetric Charged (12 fl oz)	Harmony (0.125 oz) + SelectMax (9 fl oz) + NIS (0.25%) + AMS (2.5 lb) fb. Flexstar (1 pt) + COC (1%) + AMS (2.5 lb) (+7d)	Dimet Charged fb. Harm + Select (9) fb. Flex (+7d)
Valor EZ (2.5 fl oz) + Prowl H ₂ O (2 pt)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Valor EZ + Prowl fb. Flex + Select (12)
Fierce EZ (7.5 fl oz)	Raptor (5 fl oz) + COC (1%) + AMS (2.5 lb) fb. Cobra (10 fl oz) + COC (1.5 pt) + AMS (2 lb) (+7d)	Fierce EZ fb. Raptor fb. Cobra (10) (+7d)
Fierce MTZ (16 fl oz)	Cobra (10 fl oz) + SelectMax (12 fl oz) + COC (1.5 pt) + AMS (2 lb)	Fierce MTZ fb. Cobra (10) + Select (12)
Fierce XLT (4 oz)	Cobra (10 fl oz) + Perpetuo (6 fl oz) + COC (1.5 pt) + AMS (2 lb) fb. SelectMax (9 fl oz) + NIS (0.25%) + AMS (2.5 lb) (+7d)	Fierce XLT fb. Cobra (10) + Perpetuo fb. Select (9) (+7d)
Tendovo (2.35 qt)	Flexstar (1 pt) + COC (1%) + AMS (2.5 lb) fb. SelectMax (9 fl oz) + NIS (0.25%) + AMS (2.5 lb) (+7d)	Tendovo fb. Flex fb. Select (9) (+7d)
Authority Edge (9 fl oz)	Flexstar (1 pt) + SelectMax (12 fl oz) + COC (1%) + AMS (2.5 lb)	Auth Edge (9) fb. Flex + Select (12)
Authority Edge (7 fl oz) + Metribuzin (6 oz)	Cobra (12 fl oz) + SelectMax (12 fl oz) + COC (1.5 pt) + AMS (2 lb)	Auth Edge (7) + Metri (6) fb. Cobra (12) + Select (12)
Zidua PRO (6 fl oz)	Varisto (21 fl oz) + Flexstar (1 pt) + COC (1%) + AMS (2.5 lb)	Zidua PRO fb. Varisto + Flex
Zidua PRO (6 fl oz) + Metribuzin (6 oz)	SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb) fb. Flexstar (1 pt) + Harmony (0.125 oz) + COC (1%) + AMS (2.5 lb) (+7d)	Zidua PRO + Metri fb. Select fb. Flex + Harm (+7d)
Valor XLT (2.5 oz) + Valor EZ (1.5 fl oz) + Metribuzin (8 oz)	NO POST	Valor XLT + Valor EZ + Metri (8)
Prefix (2 pt) + Metribuzin (6 oz)	Synchrony XP (0.375 oz) + Cobra (10 fl oz) + NIS (0.25%) + AMS (2 lb) fb. SelectMax (9 fl oz) + NIS (0.25%) + AMS (2.5 lb) (+7d)	Prefix + Metri (6) fb. Synch + Cobra (10) fb. Select (9) (+7d)
Warrant Ultra (50 fl oz) + Metribuzin (6 oz)	Synchrony XP (0.375 oz) + Cobra (10 fl oz) + SelectMax (12 fl oz) + NIS (0.25%) + AMS (2.5 lb)	Warr Ultra + Metri (6) fb. Synch + Cobra (10) fb. Select (12)
Matador-S (3 pt)	Basagran (1.6 pt) + Ultra Blazer (1 pt) + COC (1%) fb. SelectMax (9 fl oz) + COC (1%) + AMS (2.5 lb) (+7d)	Matador fb. Basagran + UBlazer fb. Select (9) (+7d)
NO PRE	Varisto (27 fl oz) + Flexstar (1 pt) + COC (1%) + AMS (2.5 lb) (EPOS)	Varisto + Flex (EPOS)
NO PRE	Flexstar (1 pt) + Harmony SG (0.125 oz) + SelectMax (12 fl oz) + NIS (0.25%) + AMS (2.5 lb) (EPOS)	Flex + Harm + Select (12) (EPOS)
NO PRE	Synchrony XP (0.375 oz) + Cobra (10 fl oz) + Assure II (9 fl oz) + NIS (0.25%) + AMS (2.5 lb) (EPOS)	Synchrony + Cobra (10) + Assure (EPOS)

Table 3. Weed control at the time of POST (28 DAP) herbicide application¹.

Herbicide Programs	Weed control (at POST – 28 DAP) ⁴			
	ANGR	CHEAL	AMBEL	LAMAM
	% control			
Boundary (2.4 pt)	96 ³	91	79	98
BroadAxe XC (32 fl oz)	93	96	73	98
Sonic (6 oz) + Boundary (1.5 pt)	89	94	70	99
Surveil (3.5 oz) + Metribuzin (6 oz)	84	90	82	99
Dimetric Charged (12 fl oz)	84	83	90	99
Valor EZ (2.5 fl oz) + Prowl H ₂ O (2 pt)	85	100	80	100
Fierce EZ (7.5 fl oz)	85	85	88	98
Fierce MTZ (16 fl oz)	88	94	90	100
Fierce XLT (4 oz)	87	87	90	100
Tendovo (2.35 qt)	94	93	81	100
Authority Edge (9 fl oz)	81	94	76	86
Authority Edge (7 fl oz) + Metribuzin (6 oz)	79	91	74	98
Zidua PRO (6 fl oz)	82	82	75	96
Zidua PRO (6 fl oz) + Metribuzin (6 oz)	82	86	82	100
Valor XLT (2.5 oz) + Valor EZ (1.5 fl oz) + Metribuzin (8 oz)	86	99	86	100
Prefix (2 pt) + Metribuzin (6 oz)	85	80	73	93
Warrant Ultra (50 fl oz) + Metribuzin (6 oz)	85	86	78	95
Matador-S (3 pt)	90	86	88	98
Varisto + Flex (EPOS)	83	100	100	100
Flex + Harm + Select (12) (EPOS)	86	98	100	95
Synchrony + Cobra (10) + Assure (EPOS)	87	90	100	97

Abbreviations: ANGR = giant foxtail, CHEAL = c. lambsquarters, AMBEL² = c. ragweed, LAMAM = henbit, EPOS = Early POST, +7d = 7 d after POST.

¹POST herbicide selection was based on weed control that was less than 90% for the different weed species.

²The common ragweed population at this location is resistant to the Group 2 (ALS-inhibiting) herbicides.

³Control ratings in bold are not different from the highest value within that column.

⁴Control of EPOS treatments was 5 days after treatment.

Table 4. Soybean injury, weed control, program costs, soybean yield, and economic returns for non-GMO herbicide programs, 2024.

Herbicide Programs ¹	Soybean Injury		Prior to harvest (28 d after POST)				All Weeds (>90%)	Costs ² (\$/A)	Yield (bu/A)	Economic Returns ³ (\$/A)
	28 DAP	7 DAT	ANGR	CHEAL	AMBEL	ABUTH				
	(%)	(%)	————— % control —————							
Boundary fb. Flex + Harm fb. Select (9) (+7d)	2	18	99	100	100	100	YES	\$93.98	60.6*	\$603*
Broadaxe fb. Flex + Perp fb. Select (9) (+7d)	4	20	100	98	100	100	YES	\$107.28	64.1*	\$630*
Sonic + Boundary fb. Flex + Select (12)	0	16	98	95	95	100	YES	\$91.32	63.1*	\$634*
Surveil + Metri (6) fb. Raptor + Flex	9	25	98	97	100	100	YES	\$86.77	58.4*	\$585*
Dimet Charged fb. Harm + Select (9) fb. Flex (+7d)	5	20	100	98	100	100	YES	\$82.81	62.7*	\$638*
Valor EZ + Prowl fb. Flex + Select (12)	11	22	100	100	100	100	YES	\$73.98	61.5*	\$633*
Fierce EZ fb. Raptor fb. Cobra (10) (+7d)	10	14	97	97	98	100	YES	\$114.49	66.3*	\$648*
Fierce MTZ fb. Cobra (10) + Select (12)	14	31	100	94	100	100	YES	\$129.69**	59.5*	\$555*
Fierce XLT fb. Cobra (10) + Perpetuo fb. Select (9) (+7d)	6	29	99	85	99	100	NO	\$119.96	59.7*	\$567*
Tendovo fb. Flex fb. Select (9) (+7d)	3	16	100	95	100	100	YES	\$104.45	61.3*	\$601*
Auth Edge (9) fb. Flex + Select (12)	2	17	96	92	98	100	YES	\$91.41	65.6*	\$663*
Auth Edge (7) + Metri (6) fb. Cobra (12) + Select (12)	0	22	98	87	96	95	NO	\$99.71	62.9*	\$624*
Zidua PRO fb. Varisto + Flex	0	23	89	99	91	100	NO	\$95.48	60.0*	\$595*
Zidua PRO + Metri fb. Select fb. Flex + Harm (+7d)	1	2	100	97	98	100	YES	\$102.40	61.1*	\$600*
Valor XLT + Valor EZ + Metri (8)	7	7	79	88	87	100	NO	\$37.47	47.1	\$504
Prefix + Metri (6) fb. Synch + Cobra (10) fb. Select (9) (+7d)	2	40	98	100	99	100	YES	\$92.60	58.1*	\$576*
Warr Ultra + Metri (6) fb. Synch + Cobra (10) + Select (12)	2	44	91	100	98	98	YES	\$90.01	52.9	\$518
Matador fb. Basagran + UBlazer fb. Select (9) (+7d)	2	14	100	90	100	100	YES	\$104.96	67.4**	\$670**
Varisto + Flex (EPOS)	29	12	80	100	100	100	NO	\$44.63	59.8*	\$643*
Flex + Harm + Select (12) (EPOS)	28	16	90	88	100	100	NO	\$65.07	63.6*	\$666*
Synchrony + Cobra (10) + Assure (EPOS)	29	26	91	100	100	100	YES	\$68.93	59.6*	\$616*
Untreated	0	0	0	0	0	0	NO	---	28.0	\$322

Abbreviations: ANGR = giant foxtail, CHEAL = c. lambsquarters, AMBEL = c. ragweed, ABUTH = velvetleaf, fb. = followed by, +7d = 7 d after POST.

¹Many 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.

²Herbicide costs = avg. of price lists; App. cost = \$12.00/A; seeding rate = 150,000 seeds/A. Weed control costs = Herbicide \$ + Additive \$ + Application \$.

³Crop selling price = \$9.50/bu + non-GMO premium \$2.00/bu (December 2024). 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. Injury ratings in bold are significant; control ratings in bold are not different from the highest value within that column.

General Observations and Interpretation:

Each year precipitation 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 soybeans were planted, and PRE herbicides were applied on May 10. Rainfall this season was low after planting. In fact, within 10 days of planting there was only 0.38-inches of precipitation. The low rainfall led to reduced incorporation of the PRE herbicides that resulted in more variability in annual grass and common ragweed control from the PRE herbicides. Additionally, it led to overall low soybean injury from the PRE herbicides, with the most injury being around 10% with treatments that contained the active ingredient flumioxazin (Valor). All PRE herbicide treatments needed the first POST herbicide application. However, we left one of the PRE treatments to use as a yield comparison to see the benefits of the PRE treatment on early-season weed control. Both EPOS and POST herbicide applications resulted in soybean injury (2-44%). The highest injury was from the combination of Synchrony and Cobra with or without a POST grass herbicide. Soybean outgrew most of the injury caused by the EPOS and POST herbicide applications, with the exception of soybean still being set back with Synchrony + Cobra with 10-15% reduced growth, 28 d after the POST herbicide application. After POST herbicide applications, annual grass control was 90% or greater with all PRE followed by POST herbicide applications, with the exception where imazamox (Raptor or Varisto) was used for POST grass control (80% or higher), 28 DAT. The PRE only treatment resulted in only 79% control. Common lambsquarters and common ragweed control were also 85% or higher with PRE followed by POST applications, 28 DAT and velvetleaf control was 90% or higher. There were 15 of the 21 herbicide programs that provided 90% or greater control across all weed species. Of these programs, only one was a POST only treatment, the remainder were PRE followed by POST applications. More consistent rainfall in June (3.38-inches), July (4.96-inches), and August (4.01-inches) likely helped with the incorporation of the PRE residual herbicides for later season weed control after POST applications controlled weed escapes. The PRE followed by POST herbicide program costs including application costs of \$12 per acre, ranged from \$37.47 to \$129.69 per acre. Soybean yield from the different PRE followed by POST treatments ranged from 52.9-67.4 bu/A, of these 16 of the 17 herbicide programs evaluated ranked amongst the highest yielding. The PRE only treatment yielded 47.1 bu/A, yielding 41% more soybean than the weedy control showing the importance of a PRE for early-season weed control. All of the highest yielding programs, including the most expensive program and the EPOS only programs, were ranked amongst the highest economic returns. Even though the one-pass EPOS programs ranked amongst the highest yield and economic return they did not always provide the greatest weed control. 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 added herbicide and application cost.