MSU Weed Science

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Economics of Weed Control Programs in non-GMO Soybean, 2010

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A field trial sponsored by the Michigan Soybean Promotion Committee (MSPC) was conducted in 2010 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. Each soil-applied herbicide program was applied to two different sets of treatments. 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 one set of the treatments to control escaped weeds. 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 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. Due to extremely dry conditions during pod fill (August) soybean yields were quite variable and lower than what we normally observe. The maximum soybean yield was 47.1 bu/A and yield loss due to weeds was extremely high. The weedy (untreated) yield was 10 bu/A, resulting in a yield loss of 37.1 bu/A (79%).

Within 14 days after planting and application of the preemergence herbicides the site received 2.6-inches of rain. Additionally, this study was conducted on higher pH soils, as a result all of the soil-applied herbicide programs caused significant soybean injury, 20 days after planting (20 DAP). However, soybean outgrew most of this injury and it appeared that early soybean injury did not result in significant yield losses. Table 3 contains the data for soybean injury, weed control, herbicide program costs, soybean yield, and economic returns.

Table1. Site description.

Crop	Soybean
Variety	ZFS 725 Low Sat
Soil Texture	Loam
Soil pH	7.2
Soil Organic Matter	2.7
Dominant Weeds	SETFA, CHEAL, AMBEL, AMASS, ABUTH
Planting Date	May 28
Application Timings:	
PRE	May 28
POST	July 1
Late-POST (LPOS)	July 12
Evaluation Times	Soybean injury – 20 & 30 d after planting Weed control prior to harvest (86 d after LPOS)

Abbreviations: SETFA = giant foxtail, CHEAL = c. lambsquarters, AMBEL = c. ragweed, AMASS = pigweed species (Powell amaranth and redroot pigweed), ABUTH = velvetleaf.

Table 2. Non-GMO soybean herbicide programs evaluated in 2010.

	Treatments (Rate/A) – Timing	***Abbreviated Form***
1	Valor (2.5 oz) + Prowl H_2O (2 pt) – PRE	Valor + Prowl
2	Valor (2.5 oz) + Prowl H_2O (2 pt) – PRE fb. Flexstar (12 fl oz) + SelectMax (9 fl oz) + COC (1% v/v) - POST	Valor + Prowl fb. Flexstar + Select (P)
3*	Boundary (2.4 pt) – PRE	Boundary
4*	Boundary (2.4 pt) – PRE fb. Flexstar (1 pt) + COC (1% v/v) - POST	Boundary fb. Flexstar (P)
5*	Canopy (4 oz) + Prefix (1 pt) – PRE	Canopy + Prefix
6*	Canopy (4 oz) + Prefix (1 pt) – PRE fb. Flexstar (12 fl oz) + SelectMax (9 fl oz) + COC (1% v/v) - POST	Canopy + Prefix fb. Flexstar + Select (P)
7*	Authority MTZ (10 oz) + Valor XLT (3 oz) - PRE	Auth. MTZ + Valor XLT
8*	Authority MTZ (10 oz) + Valor XLT (3 oz) – PRE fb. Flexstar (12 fl oz) + SelectMax (9 fl oz) + COC (1% v/v) - LPOS	Auth. MTZ + Valor XLT fb. Flexstar + Select (LP)
9*	Valor XLT (4 oz) + Metribuzin (4 oz) - PRE	Valor XLT + Metribuzin
10*	Valor XLT (4 oz) + Metribuzin (4 oz) – PRE fb. SelectMax (9 fl oz) + COC (1% v/v) - LPOS	Valor XLT + Metribuzin fb. Select (LP)
11*	Canopy (5.5 oz) + IntRRo (2 qt) - PRE	Canopy + IntRRo
12*	Canopy (5.5 oz) + IntRRo (2 qt) - PRE fb. Flexstar (12 oz) + COC (1% v/v) - POST	Canopy + IntRRo fb. Flexstar (P)
13	Python (0.8 oz) + Metribuzin (8 oz) + Outlook (18 fl oz) - PRE	Python + Metr. + Outlook
14	Python (0.8 oz) + Metribuzin (8 oz) + Outlook (18 fl oz) - PRE fb. Flexstar (12 oz) + COC (1% v/v) - LPOS	Python + Metr. + Outlook fb. Flexstar (LP)
15*	Authority XL (3.8 oz) + Boundary (2 pt) – PRE	Auth. XL + Boundary
16*	Authority XL (3.8 oz) + Boundary (2 pt) – PRE fb. Flexstar (12 oz) + COC (1% v/v) - LPOS	Auth. XL + Boundary fb. Flexstar (LP)
17	Optill (2 oz) + Dual II Magnum (1.33 pt) – PRE	Optill + Dual
18	Optill (2 oz) + Dual II Magnum (1.33 pt) – PRE fb. Flexstar (1 pt) + COC (1% v/v) - LPOS	Optill + Dual fb. Flexstar (LP)
19*	Envive (3.5 oz) + Prowl H_2O (2 pt) – PRE	Envive + Prowl
20*	Envive (3.5 oz) + Prowl H_2O (2 pt) – PRE fb. Flexstar (12 fl oz) + SelectMax (9 fl oz) + COC (1% v/v) - LPOS	Envive + Prowl fb. Flexstar + Select (LP)

[a] 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.

* Soil pH is important in the breakdown and availability of some of these herbicides. Rates evaluated above are too high for soils with pH's around 7.0. Consult the MSU Weed Control Guide for Field Crops (E-434) or the herbicide label for soil pH restrictions.

Table 3. Soybean injury, weed control, program costs, soybean yield, and economic returns for non-GMO herbicide programs, 2010.

Herbicide Programs	Soybean Injury (PRE) 20 DAP	Soybean Injury (PRE) 30 DAP	SETFA	CHEAL	AMBEL[1]	AMASS	ABUTH	All Weeds	Costs[2]	Yield	Economic Returns[3]
			Prior to harvest (86 d after LPOS)								
	(%)	(%)	% control					(≥90%)	($/A)	(bu/A)	($/A)
Valor + Prowl	**34**†	**11**†	70	**99**	75	**93**	**99**	NO	$28.25	**38.1***	**$476.58***
Valor + Prowl fb. Flexstar + Select (P)			**99**	**99**	**99**	**99**	**99**	**YES**	$57.47	**42.8***	**$510.96***
Boundary	**16**†	1	**99**	**99**	76	**97**	**99**	NO	$29.27	**41.5***	**$520.61***
Boundary fb. Flexstar (P)			**99**	**99**	**99**	**99**	**99**	**YES**	$52.95	**44.0***	**$530.05***
Canopy + Prefix	**10**†	**11**†	85	**99**	**90**	**99**	**99**	NO	$25.34	**47.1****	**$598.74****
Canopy + Prefix fb. Flexstar + Select (P)			**99**	**99**	**99**	**99**	**98**	**YES**	$54.55	**44.6***	**$536.40***
Auth. MTZ + Valor XLT	**22**†	**8**†	83	**99**	**90**	**99**	**99**	NO	$28.28	**41.8***	**$525.57***
Auth. MTZ + Valor XLT fb. Flexstar + Select (LP)			**99**	**99**	**99**	**99**	**99**	**YES**	$57.49	**41.8***	**$496.36***
Valor XLT + Metribuzin	**32**†	**19**†	66	**99**	**95**	**99**	**99**	NO	$24.95	**38.5***	**$485.18***
Valor XLT + Metribuzin fb. Select (LP)			**99**	**99**	**96**	**99**	**99**	**YES**	$42.90	**38.5***	**$467.23***
Canopy + IntRRo	**16**†	**16**†	86	**99**	86	**99**	**99**	NO	$35.82	**40.9***	**$506.11***
Canopy + IntRRo fb. Flexstar (P)			**93**	**99**	**98**	**99**	**99**	**YES**	$55.74	**44.5***	**$533.89***
Python + Metr. + Outlook	**14**†	4	86	**99**	**94**	**99**	**99**	NO	$47.85	**42.7***	**$517.93***
Python + Metr. + Outlook fb. Flexstar (LP)			**92**	**99**	**99**	**99**	**99**	**YES**	$67.77	**44.5***	**$521.86***
Auth. XL + Boundary	**13**†	6	**99**	**99**	86	**99**	**99**	NO	$37.48	**42.3***	**$523.00***
Auth. XL + Boundary fb. Flexstar (LP)			**99**	**99**	**99**	**99**	**99**	**YES**	$57.40	**39.4***	**$464.65***
Optill + Dual	**13**†	1	**99**	**96**	87	**99**	**99**	NO	$35.21	**40.4***	**$500.09***
Optill + Dual fb. Flexstar (LP)			**99**	**99**	**99**	**99**	**99**	**YES**	$58.88	**43.4***	**$516.17***
Envive + Prowl	**32**†	**18**†	74	**99**	**92**	**99**	**99**	NO	$29.53	**41.3***	**$517.70***
Envive + Prowl fb. Flexstar + Select (LP)			**99**	**99**	**99**	**99**	**99**	**YES**	$58.75	**40.6***	**$479.20***
Untreated	0	0	0	0	0	0	0	NO	—	10.0	$132.50

Abbreviations: SETFA = giant foxtail, CHEAL = c. lambsquarters, AMBEL = c. ragweed, ABUTH = velvetleaf, AMASS = pigweed sp., fb. = followed by, P = POST, LP = late POST.

[1] A portion of the common ragweed population may have been resistant to ALS-herbicides.

[2]Herbicide and additive costs = avg. of price lists (May 2010); Application cost = $7.00/A; seeding rate = 157,000 seeds/A. Weed control costs = Herbicide $ + Additive $ + Application $.

[3] Crop selling price = $12.25/bu (December 2010) and $1.00 non-GMO premium. Economic return = (Yield x Price + Premium) – Weed Control Costs.

***** Values are not significantly different from the highest value within that column. ** Highest yielding and highest economic returns.

† Indicates significant soybean injury for the soil-applied herbicide, soybean injury was negligible 60 day after planting.

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 ample rain (2.6-inches) within two weeks of the soil-applied (PRE) herbicide applications. This allowed for good incorporation of the herbicides for excellent weed control, but it also caused significant soybean injury. Soybean injury may also have been exacerbated by the higher soil pH in which this study was conducted. On higher pH soils, rates of chlorimuron containing products (Canopy, Envive, Valor XLT, and Authority XL) and metribuzin (Boundary) should be reduced. Even though there was significant soybean injury early in the season, by 60 days after planting there was not much difference in soybean growth between the different treatments. All the total PRE herbicide programs provided excellent control of common lambsquarters, pigweed species, and velvetleaf. The cost of these programs ranged from $24.95 to $47.85 (herbicide + application costs). Due to the high populations of giant foxtail and common ragweed, none of the PRE herbicide programs provided excellent control of all weeds and POST herbicide programs were applied based on the weed escapes. The POST herbicide programs provided excellent control of the remainder of the weeds and all of the PRE followed by POST programs provided excellent season-long weed control. The extra application added to the cost of the treatment and this additional cost added anywhere from $18 to $29 per treatment (herbicide + application costs). In August, during soybean pod-fill this location received less than half of its normal rainfall leading to variable and lower than normal soybean yields. Soybean yield ranged from 38.1 to 47.1 bu/A. Variability due to low precipitation showed that there were no differences in soybean yield for any of the treatments, even though there was a range in yields. This variability also carried over into the economic returns, even though there were major differences in the cost of the herbicide programs, especially between the one-pass and 2-pass systems, there were no differences in the economic returns for any of the herbicide programs. Overall, it may be possible with some of these soil-applied programs to provide season-long control under moderate or lower populations of giant foxtail and common lambsquarters.