

Long-term tillage by herbicide study in a transgenic corn and soybean rotation. Krausz, Ronald F. and Bryan G. Young. This study was designed to evaluate weed control and weed population shifts over a long period of time in transgenic crops. The study was conducted on a Ebbert silt loam with 1.5% organic matter and pH 6.7 at the Belleville Research Center. Fertilizer applied in 2003 was 50 and 150 lb/A P₂O₅ and K₂O, respectively, to an area that had been cropped to field corn in 2002. Asgrow brand 'AG 4403' glyphosate-resistant soybean was planted 1.0 inch deep at 75 lb/A into either a reduced-till or no-till seedbed on June 21. Plots consisted of four rows with 30 inch row spacing, 27 ft long arranged in a split-block design with four replications. Main plots were either no-till or tilled and sub-plots were herbicide treatment. Application timings were; preemergence (PRE), postemergence, based on weed height in inches ("W), and sequential postemergence based on days or weeks after initial postemergence application (10DA) or (2WA) and are listed below. The herbicides were broadcast applied with a CO₂ pressurized sprayer using 8003 flat fan tips at 40 PSI in 20 GPA water. Monthly rainfall in inches was 2.8, 4.8, 8.3, 1.9 and 4.2 April, May, June, July and August, respectively. Weed population per 0.25 m² in the no-till nontreated plots, at no-till burndown in 2003, was 2 giant ragweed, 2 Pennsylvania smartweed, 17 common ragweed, and 22 giant foxtail. Weed population per 0.25 m² in the tilled nontreated plots, mid-season, was 21 giant foxtail, <1 giant ragweed, 2 ivyleaf morningglory, 3 common cocklebur, <1 common ragweed, 21 velvetleaf and <1 Pennsylvania smartweed. Application information is listed below.

Date	6-23-03	7-9-03	7-19-03	7-19-03	7-23-03	7-16-03	7-16-03	7-25-03	7-30-03
Treatment	PRE	2-4"W-1	4-6"W	10DA2-4"1	2WA2-4"1	2-4"W-2	2-4"W-3	10DA2-4"2	2WA2-4"2
Air temperature (F)	82	84	74	74	78	64	64	83	84
Relative humidity (%)	32	62	96	96	46	98	98	40	44
Soil moisture	normal	normal	wet	wet	normal	normal	normal	normal	normal
soybean									
leaf no.		V1	V3	V3	V4	V3	V3	V3	V4
height (inch)		3	6-8	6-8	6-10	6	6	6-8	8-10
giant foxtail									
leaf no.	2-4	2-3	5-6	3-4	3-4	1-4	1-4		
height (inch)	4-8	2-4	4-6	2-4	1-2	2-4	2-4		
giant ragweed									
leaf no.	8-16		5-8			8-12	8-12		
height (inch)	6-12		4-6			10-16	10-16		
ivyleaf morningglory									
leaf no.		1-3	5-6		2-6			3-4	
height (inch)		1-3	2-4		1-3			2-4	
common cocklebur									
leaf no.		1-3	5-6						
height (inch)		2-4	4-6						
common ragweed									
leaf no.	6-12		5-6						
height (inch)	4-10		3-4						
velvetleaf									
leaf no.		1-3	3-5		5-6				
height (inch)		1-3	4-6		2-4				
Pennsylvania smartweed									
leaf no.	6-16					6-10	6-10		
height (inch)	6-12					6-10	6-10		

There was no difference in the control of weeds among the glyphosate formulations applied at planting. Tillage had an effect on weed control and weed species establishment. In the no-till nontreated plots, ivyleaf morningglory, common cocklebur, and velvetleaf control was 98%, whereas giant foxtail, giant ragweed and common ragweed control was zero. In the tilled nontreated plots, ivyleaf morningglory, common cocklebur, velvetleaf, and giant foxtail control was zero and the giant ragweed and common ragweed control was 98%. In no-till, sequential herbicide applications provided 85 to 100% weed control regardless of herbicides. In till, herbicide treatments that included glyphosate provided 94 to 100% weed control. Bentazon plus acifluorfen plus clethodim provided 75 to 100% weed control. Bentazon plus acifluorfen caused 10 to 16% soybean injury. Injury was characterized as height reduction 14 days after treatment. However, injury did not delay soybean maturation. Soybean height tended to be greater in no-till compared with till, but grain yield tended to be greater in till compared with no-till. (Dept. of Plant, Soil and General Agriculture, Southern Illinois University, Carbondale).

Table 1. Long-term tillage by herbicide study in a transgenic corn and soybean rotation. (Krausz and Young)

Treatment ^a	Application		Contol, 10 days after PRE ^b			
	Rate (lb/A)	Time	AMBTR %	POLPY %	AMBEL %	SETFA %
No-till						
Nontreated			0	0	0	0
Glyphosate(UM)+handweed	0.75	PRE	50	50	50	100
Glyphosate(UM)+pendimethalin +sulfentrazone+cloransulam	0.75+1.0 +0.25+0.031	PRE	80	80	80	100
Glyphosate(UM)+sulfentrazone +cloransulam /glyphosate(UM)	0.75+0.25 +0.031 /0.56	PRE /2-4"W-3	80	80	80	100
Glyphosate(UM)+sulfentrazone +cloransulam /clethodim+COC	0.75+0.25 +0.031 /0.094	PRE /2-4"W-3	80	80	80	100
Glyphosate(UM)+pendimethalin /glyphosate(UM)	0.75+1.0 /0.75	PRE /4-6"W	50	50	50	100
Glyphosate(UM) /glyphosate(UM) /glyphosate(UM)	0.75 /0.56 /0.56	PRE /2-4"W-2 /2WA2-4"2	50	50	50	100
Glyphosate(TD) /glyphosate(UM)	0.75 /0.75	PRE /4-6"W	50	50	50	100
Glyphosate(UM) /bentazon&acifluorfen+clethodim +COC+28%N	0.75 /0.5&0.25+0.125	PRE /2-4"W-2	50	50	50	100
Glyphosate(UM) /bentazon&acifluorfen+COC+28%N /clethodim+COC	0.75 /0.5&0.25 /0.094	PRE /2-4"W-2 /10DA2-4"2	50	50	63	100
Tillage						
Nontreated						
Handweed						
Pendimethalin+sulfentrazone +cloransulam	1.0+0.25 +0.031	PRE				
Sulfentrazone+cloransulam /glyphosate(UM)	0.25+0.031 /0.56	PRE /2-4"W-3				
Sulfentrazone+cloransulam /clethodim+COC	0.25+0.031 /0.094	PRE /2-4"W-3				
Pendimethalin /glyphosate(UM)	1.0 /0.75	PRE /4-6"W				
Glyphosate(UM) /glyphosate(UM)	0.56 /0.56	2-4"W-1 /2WA2-4"1				
Glyphosate(UM)	0.75	4-6"W				
Bentazon&acifluorfen+clethodim +COC+28%N	0.5&0.25+0.125	2-4"W-1				
Bentazon&acifluorfen +COC+28%N /clethodim+COC	0.5&0.25 /0.094	2-4"W-1 /10DA2-4"1				
LSD			0	0	12	0
P			1.0	1.0	0.01	1.0

^aGlyphosate(UM) was Roundup UltraMax from Monsanto Co.

All COC at 1.0% v/v. COC = Prime Oil crop oil concentrate, a petroleum based additive with 17% emulsifier from Agrilience, LLC.

Glyphosate(TD) was Touchdown from Syngenta Crop Protection, Inc.

All 28%N at 4.0 qt/A. 28%N = 28% urea ammonium nitrate.

Study conducted since 1998 on same area.

^bRating date:

10 days after PRE was on Jul-3-03.

Table 2. Long-term tillage by herbicide study in a transgenic corn and soybean rotation. (Krausz and Young)

Treatment ^a	Application		Soybean injury days after treatment ^b			Soybean		
	Rate (lb/A)	Time	14	28	56	Yield bu/A	Height EOS ^c inch	Maturity DAP ^d
			%	%	%			
No-till								
Nontreated			0	0	0	0		
Glyphosate(UM)+handweed	0.75	PRE	0	0	0	39	35	114
Glyphosate(UM)+pendimethalin +sulfentrazone+cloransulam	0.75+1.0 +0.25+0.031	PRE	0	0	0	32	33	114
Glyphosate(UM)+sulfentrazone +cloransulam /glyphosate(UM)	0.75+0.25 +0.031 /0.56	PRE /2-4"W-3	0	0	0	42	34	114
Glyphosate(UM)+sulfentrazone +cloransulam /clethodim+COC	0.75+0.25 +0.031 /0.094	PRE /2-4"W-3	0	0	0	35	34	114
Glyphosate(UM)+pendimethalin /glyphosate(UM)	0.75+1.0 /0.75	PRE /4-6"W	0	0	0	40	32	114
Glyphosate(UM) /glyphosate(UM) /glyphosate(UM)	0.75 /0.56 /0.56	PRE /2-4"W-2 /2WA2-4"2	0	0	0	43	34	114
Glyphosate(TD) /glyphosate(UM)	0.75 /0.75	PRE /4-6"W	0	0	0	42	33	114
Glyphosate(UM) /bentazon&acifluorfen+clethodim +COC+28%N	0.75 /0.5&0.25+0.125	PRE /2-4"W-2	13	0	0	32	32	114
Glyphosate(UM) /bentazon&acifluorfen+COC+28%N /clethodim+COC	0.75 /0.5&0.25 /0.094	PRE /2-4"W-2 /10DA2-4"2	16	0	0	30	30	114
Tillage								
Nontreated			0	0	0	15	30	121
Handweed			0	0	0	43	31	114
Pendimethalin+sulfentrazone +cloransulam	1.0+0.25 +0.031	PRE	0	0	0	40	31	114
Sulfentrazone+cloransulam /glyphosate(UM)	0.25+0.031 /0.56	PRE /2-4"W-3	0	0	0	46	31	114
Sulfentrazone+cloransulam /clethodim+COC	0.25+0.031 /0.094	PRE /2-4"W-3	0	0	0	44	32	114
Pendimethalin /glyphosate(UM)	1.0 /0.75	PRE /4-6"W	0	0	0	45	30	114
Glyphosate(UM) /glyphosate(UM)	0.56 /0.56	2-4"W-1 /2WA2-4"1	0	0	0	47	29	114
Glyphosate(UM)	0.75	4-6"W	0	0	0	47	29	114
Bentazon&acifluorfen+clethodim +COC+28%N	0.5&0.25+0.125	2-4"W-1	10	0	0	37	30	114
Bentazon&acifluorfen +COC+28%N /clethodim+COC	0.5&0.25 /0.094	2-4"W-1 /10DA2-4"1	10	0	0	37	30	114
LSD			3	0	0	7	2	0
P			0.01	1.0	1.0	0.01	0.01	1.0

^aGlyphosate(UM) was Roundup UltraMax from Monsanto Co.

All COC at 1.0% v/v. COC = Prime Oil crop oil concentrate, a petroleum based additive with 17% emulsifier from Agrilience, LLC.

Glyphosate(TD) was Touchdown from Syngenta Crop Protection, Inc.

All 28%N at 4.0 qt/A. 28%N = 28% urea ammonium nitrate.

Study conducted since 1998 on same area.

^bRating dates:

14 days after PRE, 2-4"W-1, 2-4"W-2, 2-4"W-3 and 4-6"W-1 was on Jul-7-03, Jul-23-03, Jul-30-03, Jul-30-03 and Aug-2-03, respectively.

28 days after PRE, 2-4"W-1, 2-4"W-2, 2-4"W-3 and 4-6"W-1 was on Jul-21-03, Aug-6-03, Aug-13-03, Aug-13-03 and Aug-16-03, respectively.

56 days after PRE, 2-4"W-1, 2-4"W-2, 2-4"W-3 and 4-6"W-1 was on Aug-18-03, Sep-3-03, Sep-8-03, Sep-8-03 and Sep-13-03, respectively.

^cEOS = end of season.

^dDAP = days after planting.

Table 3. Long-term tillage by herbicide study in a transgenic corn and soybean rotation. (Krausz and Young)

Treatment ^a	Application		Control, days after treatment ^b								
			SETFA			AMBTR ^c			IPOHE		
			Rate (lb/A)	Time	14 %	28 %	56 %	14 %	28 %	56 %	14 %
No-till											
Nontreated			0	0	0	0	0	0	98	98	98
Glyphosate(UM)+handweed	0.75	PRE	100	100	100	100	100	100	100	100	100
Glyphosate(UM)+pendimethalin +sulfentrazone+cloransulam	0.75+1.0 +0.25+0.031	PRE	100	80	78	95	98	95	100	100	100
Glyphosate(UM)+sulfentrazone +cloransulam /glyphosate(UM)	0.75+0.25 +0.031 /0.56	PRE /2-4"W-3	100	100	100	100	100	100	100	100	100
Glyphosate(UM)+sulfentrazone +cloransulam /clethodim+COC	0.75+0.25 +0.031 /0.094	PRE /2-4"W-3	100	100	100	99	98	98	100	100	100
Glyphosate(UM)+pendimethalin /glyphosate(UM)	0.75+1.0 /0.75	PRE /4-6"W	100	100	100	100	100	100	100	100	100
Glyphosate(UM) /glyphosate(UM) /glyphosate(UM)	0.75 /0.56 /0.56	PRE /2-4"W-2 /2WA2-4"2	100	100	100	98	100	100	100	100	100
Glyphosate(TD) /glyphosate(UM)	0.75 /0.75	PRE /4-6"W	100	100	100	98	100	100	100	100	100
Glyphosate(UM) /bentazon&acifluorfen+clethodim +COC+28%N	0.75 /0.5&0.25+0.125	PRE /2-4"W-2	100	100	100	96	90	90	100	100	100
Glyphosate(UM) /bentazon&acifluorfen+COC+28%N /clethodim+COC	0.75 /0.5&0.25 /0.094	PRE /2-4"W-2 /10DA2-4"2	100	100	100	95	85	85	100	100	100
Tillage											
Nontreated			0	0	0	98	98	98	0	0	0
Handweed			100	100	100	100	100	100	100	100	100
Pendimethalin+sulfentrazone +cloransulam	1.0+0.25 +0.031	PRE	98	85	85	100	100	100	100	100	100
Sulfentrazone+cloransulam /glyphosate(UM)	0.25+0.031 /0.56	PRE /2-4"W-3	100	100	100	100	100	100	100	100	100
Sulfentrazone+cloransulam /clethodim+COC	0.25+0.031 /0.094	PRE /2-4"W-3	100	100	100	100	100	100	100	99	99
Pendimethalin /glyphosate(UM)	1.0 /0.75	PRE /4-6"W	100	100	100	100	100	100	90	91	99
Glyphosate(UM) /glyphosate(UM)	0.56 /0.56	2-4"W-1 /2WA2-4"1	100	100	100	100	100	100	50	80	95
Glyphosate(UM)	0.75	4-6"W	100	100	100	100	100	100	94	93	98
Bentazon&acifluorfen+clethodim +COC+28%N	0.5&0.25+0.125	2-4"W-1	100	100	100	100	100	100	79	75	75
Bentazon&acifluorfen +COC+28%N /clethodim+COC	0.5&0.25 /0.094	2-4"W-1 /10DA2-4"1	100	100	100	100	100	100	84	81	81
LSD			0.30	7	7	5	8	8	4	3	3
P			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

^aGlyphosate(UM) was Roundup UltraMax from Monsanto Co.

All COC at 1.0% v/v. COC = Prime Oil crop oil concentrate, a petroleum based additive with 17% emulsifier from Agrilience, LLC.

Glyphosate(TD) was Touchdown from Syngenta Crop Protection, Inc.

All 28%N at 4.0 qt/A. 28%N = 28% urea ammonium nitrate.

Study conducted since 1998 on same area.

^bRating dates:

14 days after PRE, 2-4"W-1, 2-4"W-2, 2-4"W-3 and 4-6"W-1 was on Jul-7-03, Jul-23-03, Jul-30-03, Jul-30-03 and Aug-2-03, respectively.

28 days after PRE, 2-4"W-1, 2-4"W-2, 2-4"W-3 and 4-6"W-1 was on Jul-21-03, Aug-6-03, Aug-13-03, Aug-13-03 and Aug-16-03, respectively.

56 days after PRE, 2-4"W-1, 2-4"W-2, 2-4"W-3 and 4-6"W-1 was on Aug-18-03, Sep-3-03, Sep-8-03, Sep-8-03 and Sep-13-03, respectively.

^cAt 28 days after 2-4"W-2 application, control of AMBTR and AMBEL is less than complete due to less than complete burndown at planting.

Table 4. Long-term tillage by herbicide study in a transgenic corn and soybean rotation. (Krausz and Young)

Treatment ^a	Application		Control, days after treatment ^b								
			XANST			AMBEL ^c			ABUTH		
			14	28	56	14	28	56	14	28	56
Rate (lb/A)	Time	%	%	%	%	%	%	%	%	%	
No-till											
Nontreated			98	98	98	0	0	0	98	98	98
Glyphosate(UM)+handweed	0.75	PRE	100	100	100	100	100	100	100	100	100
Glyphosate(UM)+pendimethalin +sulfentrazone+cloransulam	0.75+1.0 +0.25+0.031	PRE	100	100	100	100	100	100	100	100	100
Glyphosate(UM)+sulfentrazone +cloransulam /glyphosate(UM)	0.75+0.25 +0.031 /0.56	PRE /2-4"W-3	100	100	100	100	100	100	100	100	100
Glyphosate(UM)+sulfentrazone +cloransulam /clethodim+COC	0.75+0.25 +0.031 /0.094	PRE /2-4"W-3	98	98	98	100	100	100	100	100	100
Glyphosate(UM)+pendimethalin /glyphosate(UM)	0.75+1.0 /0.75	PRE /4-6"W	100	100	100	100	100	100	100	100	100
Glyphosate(UM) /glyphosate(UM) /glyphosate(UM)	0.75 /0.56 /0.56	PRE /2-4"W-2 /2WA2-4"2	100	100	100	100	100	100	100	100	100
Glyphosate(TD) /glyphosate(UM)	0.75 /0.75	PRE /4-6"W	100	100	100	100	100	100	100	100	100
Glyphosate(UM) /bentazon&acifluorfen+clethodim +COC+28%N	0.75 /0.5&0.25+0.125	PRE /2-4"W-2	100	100	100	100	96	96	100	100	100
Glyphosate(UM) /bentazon&acifluorfen+COC+28%N /clethodim+COC	0.75 /0.5&0.25 /0.094	PRE /2-4"W-2 /10DA2-4"2	100	100	100	100	100	100	100	100	100
Tillage											
Nontreated			0	0	0	98	98	98	0	0	0
Handweed			100	100	100	100	100	100	100	100	100
Pendimethalin+sulfentrazone +cloransulam	1.0+0.25 +0.031	PRE	95	86	86	100	100	100	100	100	100
Sulfentrazone+cloransulam /glyphosate(UM)	0.25+0.031 /0.56	PRE /2-4"W-3	100	98	98	100	100	100	100	100	100
Sulfentrazone+cloransulam /clethodim+COC	0.25+0.031 /0.094	PRE /2-4"W-3	99	94	94	100	100	100	100	100	100
Pendimethalin /glyphosate(UM)	1.0 /0.75	PRE /4-6"W	99	99	100	100	100	100	90	93	99
Glyphosate(UM) /glyphosate(UM)	0.56 /0.56	2-4"W-1 /2WA2-4"1	95	100	100	100	100	100	65	80	95
Glyphosate(UM)	0.75	4-6"W	100	96	99	100	100	100	94	93	98
Bentazon&acifluorfen+clethodim +COC+28%N	0.5&0.25+0.125	2-4"W-1	95	88	88	100	100	100	100	94	94
Bentazon&acifluorfen +COC+28%N /clethodim+COC	0.5&0.25 /0.094	2-4"W-1 /10DA2-4"1	95	88	85	100	100	100	100	95	95
LSD			5	5	5	0	2	2	6	3	3
P			0.01	0.01	0.01	1.0	0.01	0.01	0.01	0.01	0.01

^aGlyphosate(UM) was Roundup UltraMax from Monsanto Co.

All COC at 1.0% v/v. COC = Prime Oil crop oil concentrate, a petroleum based additive with 17% emulsifier from Agrilience, LLC.

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^cAt 28 days after 2-4"W-2 application, control of AMBTR and AMBEL is less than complete due to less than complete burndown at planting.