

Economics of Commercial Weed Control Programs in Corn 3-Year Summary

**David Hillger, Kathrin Schirmacher and Jim Kells
Department of Crop and Soil Sciences
Michigan State University**

Field trials were conducted in corn in 2004-2006 on the MSU Research Farm to compare weed control, corn injury, corn yield, and economic return of the dominant herbicide programs marketed in Michigan. Major herbicide companies were asked to submit weed control programs for the study based on soil type and weed infestation history. Site characteristics and herbicide application timings are described in Table 1. Table 2-4 list the treatment details, sorted by application method and need for Roundup Ready hybrids. Weed competition was very high at the research site in all years. In 2004, the maximum corn yield was 229 bu/A and the weedy (untreated) was 87 bu/A, resulting in a yield loss of 131 bu/A (60%). In 2005, the maximum corn yield was 223 bu/A and the weedy (untreated) was 85 bu/A, resulting in a yield loss of 138 bu/A (62%). In 2006, the maximum corn yield was 230 bu/A and the weedy (untreated) was 83 bu/A, resulting in a yield loss of 147 bu/A (64%).

In 2004, the site received excessive rainfall shortly after planting. A total of 6.1 inches of rainfall occurred within 2 weeks of preemergence herbicide application in 2004. The 2005 and 2006 seasons were more typical of Michigan growing conditions.

Table 1. Site description.

	2004	2005	2006
Crop	Corn	Corn	Corn
Hybrid	P37R70	DKC42-95	P37R70
Soil Texture	Clay Loam	Loam	Clay Loam
Soil pH	6.8	6.7	6.6
Soil OM	3.8	2.6	3.4
Dominant Weeds	ANGR, CHEAL, AMARE, AMBEL, ABUTH	ANGR, CHEAL, AMARE, ABUTH	ANGR, CHEAL, AMARE, AMBEL, ABUTH
Planting	May 17	May 5	May 4
Application Timings			
<i>PRE</i>	May 17	May 5	May 5
<i>Mid-POST (MP)</i>	June 16	June 2	June 1
<i>Late-POST (LP)</i>	June 28	June 17	June 12
Evaluation Time	27 days after MP	26 days after MP	26 days after MP

Abbreviations: ANGR= annual grass (primarily giant foxtail), CHEAL= common lambsquarters, AMARE= redroot pigweed, AMBEL= common ragweed, ABUTH= velvetleaf, OM= organic matter.

Table 2. Commercial corn herbicide programs selected by companies in 2004.

<i>Conventional</i>	<i>Treatments (Rate/A)</i>	<i>Abbreviated Form</i>
PRE	Guardsman Max (3.5 pt) + Prowl H2O (2.5 pt)	GuardsMax + Prowl
	Guardsman Max (3.5 pt) + Python (1 oz)	GuardsMax + Python
	Axiom (15 oz) + Atrazine (1 qt) + Prowl H2O (2 pt)	Axiom + Atz + Prowl
	Keystone (2.2 qt) + Python (0.8 oz)	Key + Python
	Keystone (2.2 qt) + Hornet WDG (3 oz)	Key + Hornet
	Keystone LA (1.9 qt) + Hornet WDG (3 oz)	KeyLA + Hornet
	Cinch ATZ (2.1 qt) + Basis (0.5 oz)	CinchATZ + Basis
	Lumax (2.5 qt)	Lumax
PRE/POST	Guardsman Max (3.5 pt) fb. Clarity (6 fl oz) + Aim (0.33 fl oz) + Activator 90 (0.25%) + 28% N (3 qt)	GuardsMax fb. Clarity + Aim
	Outlook (3 pt) fb. Distinct (4 oz) + Activator 90 (0.25%) + AMS (2.5 lb)	Outlk fb. Distinct
	Define SC (15 fl oz) fb. Buctril/Atrazine (2 pt)	Define fb. Buct/Atz
	Atrazine (1 qt) fb. Option (1.5 oz) + Distinct (2 oz) + MSO (1.5 pt) + 28% N (1.5 qt)	Atz fb. Option + Distinct
	Cinch (0.66 pt) fb. Steadfast ATZ (14 oz) + Distinct (2 oz) + COC (1%) + AMS (2 lb)	Cinch fb. SteadATZ + Distinct
	Bicep II Magnum (2.1 qt) fb. Callisto (3 fl oz) + Atrazine (0.25 qt) + COC (1%) + 28% N (2.5 %)	BicepIIMag fb. Callisto + Atz
Total POST	Atrazine (1 qt) + Callisto (1.5 fl oz) + Option (1.5 oz) + MSO (1.5 pt) + 28% N (1.5 qt)	Atz + Callisto + Option
	Steadfast ATZ (14 oz) + Distinct (2 oz) + COC (1%) + AMS (2 lb)	SteadATZ + Distinct
Roundup Ready		
PRE/POST	Keystone (1.1 qt) fb. GlyphomaxPlus (32 fl oz) + AMS (2 lb)	Key + GlyphoPlus
	Cinch ATZ (2 pt) fb. Roundup WeatherMax (22 fl oz) + AMS (17lb/100 gal)	CinchATZ fb. RoundWM
	Harness Xtra 5.6L (1.2 qt) fb. Roundup WeatherMax (22 fl oz) + AMS (2%)	HarnessXtra fb. RoundWM
	Bicep II Magnum (2.1 qt) fb. Touchdown Total (24 fl oz) + AMS (17 lb/100 gal)	BicepIIMag fb. Touchdown
POST (1-Pass)	Roundup OriginalMax (22 fl oz) + Atrazine (1 qt) + AMS (2 %)	RoundOM + Atz
	Degree Xtra (1.5 qt) + RoundupWeatherMax (22 fl oz) + AMS (2 %)	DegreeXtra + RoundWM
POST (2-Pass)	RoundupWeatherMax (22 fl oz) + AMS (2 %) fb. Roundup WeatherMax (22 fl oz) + AMS (2 %)	RoundWM fb. RoundWM
	Touchdown Total (24 fl oz) + AMS (17 lb/100 gal) fb. Touchdown Total (24 fl oz) + AMS (17 lb/100 gal)	Touchdown fb. Touchdown

Abbreviations: fb.= followed by, PRE= preemergence, POST=postemergence, PRE/POST= preemergence followed by postemergence.

Table 3. Commercial corn herbicide programs selected by companies in 2005.

<i>Conventional</i>	<i>Treatments (Rate/A)</i>	<i>Abbreviated Form</i>
PRE	Guardsman Max (3.5 pt) + Hornet WDG (3 oz) Define (19 fl oz) + Hornet WDG (3 oz) + Atrazine (1.5 qt) Keystone LA (1.9 qt) + Hornet WDG (3 oz) Keystone LA (1.9 qt) + Python (0.8 oz) Cinch ATZ (2.1 qt) + Basis (0.5 oz) Lexar (3.5 qt) Lumax (2.5 qt) + Atrazine (1 qt) Stalwart C (1.67 pt) + Atrazine (1 qt) + Callisto (5.33 fl oz) Micro-Tech (2 qt) + Hornet WDG (3 oz)	GuardsMax + Hornet Define + Hornet + Atz KeyLA + Hornet KeyLA + Python CinchATZ + Basis Lexar Lumax + Atz StalC + Atz + Callisto MicroTech + Hornet
PRE/POST	Guardsman Max (3.5 pt) fb. Distinct (4 oz) + NIS (0.25%) + AMS (2.5 lbs) Define (14 fl oz) fb. Equip (1.5 oz) + MSO (1.5 pt) + 28% N (1.5 qt) Bicep II Magnum (2.1 qt) fb. Callisto (3 fl oz) + Atrazine (0.25qt) + COC (1%) + 28% N (2.5%) Micro-Tech (2 qt) + Atrazine (1.3 lbs) fb. Distinct (6 oz) + NIS (0.25%) + 28% N (2 qt)	GuardsMax fb. Distinct Define fb. Equip BicepIIMag fb. Callisto + Atz MicroTech + Atz fb. Distinct
Total POST	Atrazine (1 qt) + Option (1.5 oz) + Define (12 fl oz) + MSO (1.5 pt) + 28% N (1.5 qt) Atrazine (0.75 qt) + Option (1.5 oz) + Callisto (1.5 fl oz) + MSO (1.5 pt) + 28% N (1.5 qt) Steadfast ATZ (14 oz) + Distinct (2 oz) + COC (1 %) + AMS (2 lbs) Steadfast (0.75 oz) + Distinct (4 oz) + COC (0.25%) + 28% N (2 qt)	Atz + Option + Define Atz + Option + Callisto SteadATZ + Distinct Steadfast + Distinct
Roundup Ready		
PRE/POST	Outlook (12 fl oz) fb. Roundup OriginalMax (22 fl oz) + Distinct (3 oz) + NIS (1 qt) + AMS (17 lb/100 gal) Guardsman Max (12 fl oz) fb. Roundup OriginalMax (24 fl oz) + AMS (17 lb/100 gal) Keystone (1.3 qt) fb. Durango (1.5 pt) + AMS (1.5 %) Basis (0.5 oz) + Atrazine (0.75 qt) fb. Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal) Basis (0.33 oz) fb. Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal) Harness Xtra (1.5 qt) fb. Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal) Atrazine (1.5 qt) fb. Roundup OriginalMax (22 fl oz) + AMS (17 lb/100 gal) Lumax (2 qt) fb. Touchdown Total (24 fl oz) + AMS (17.5 lb/100 gal) Stalwart Xtra (3 oz) fb. Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal)	Outlk fb. RoundOM + Distinct GuardsMax fb. RoundOM Key fb. Durango Basis + Atz fb. RoundWM Basis fb. RoundWM HarnessXtra fb. RoundWM Atz fb. RoundOM Lumax fb. Touchdown StalXtra fb. RoundWM
POST (1-Pass)	Degree Xtra (2 qt) + Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal)	DegreeXtra + RoundWM
POST (2-Pass)	Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal) fb. Roundup WeatherMax (22 fl oz) + AMS (17lb/100gal)	RoundWM fb. RoundWM

Abbreviations: fb.= followed by, PRE= preemergence, POST=postemergence, PRE/POST= preemergence followed by postemergence.

Table 4. Commercial corn herbicide programs selected by companies in 2006.

<i>Conventional</i>	<i>Treatments (Rate/A)</i>	<i>Abbreviated Form</i>
PRE	Guardsman Max (3.5 pt) + Hornet WDG (3 oz)	GuardsMax + Hornet
	Define (18 fl oz) + Hornet WDG (3 oz) + Atrazine (1.5 qt)	Define + Hornet + Atz
	Keystone LA (1.9 qt) + Hornet WDG (3 oz)	KeyLA + Hornet
	Keystone LA (1.9 qt) + Python (0.8 oz)	KeyLA + Python
	Guardsman Max (1.25 qt) fb. Impact (0.5 fl oz) + Atrazine (1 pt) + MSO (1%) + 28% N (2.5%)	GuardsMax fb. Impact + Atz
	Lexar (3.5 qt)	Lexar
	Lumax (3 qt) + Atrazine (1 qt)	Lumax + Atz
	Parallel Plus (2.8 qt)	Parallel Plus
PRE/POST	Guardsman Max (3.5 pt) fb. Distinct (4 oz) + NIS (0.25%) + AMS (2.5 lbs)	GuardsMax fb. Distinct
	Define (18 fl oz) fb. Buctril + Atrazine (2 pt)	Define fb. Buct/Atz
	Bicep II Magnum (2.4 qt) fb. Callisto (3 fl oz) + Atrazine (0.25qt)	BicepIIMag fb. Callisto + Atz
Total POST	Atrazine (1 qt) + Option (1.5 oz) + Define (12 fl oz) + MSO (1.5 pt) + 28% N (1.5 qt)	Atz + Option + Define
	Define (12 fl oz) fb. Equip (1.5 oz) + Atrazine (1 pt)	Define + Equip + Atz
	Steadfast ATZ (14 oz) + Distinct (2 oz) + COC (1 %) + AMS (2 lbs)	SteadATZ + Distinct
<i>Roundup Ready</i>		
PRE/POST	Outlook (12 fl oz) fb. Roundup OriginalMax (16 fl oz) + Distinct (3 oz) + AMS (17 lb/100 gal)	Outlk fb. RoundOM + Distinct
	Guardsman Max (2 pt) fb. Roundup OriginalMax (16 fl oz) + Distinct (3 oz) + AMS (17 lb/100 gal)	GuardsMax fb. RoundOM + Distinct
	Keystone (1.3 qt) fb. Durango (1.5 pt) + AMS (1.5 %)	Key fb. Durango
	Resolve (1 oz) + Atrazine (1.5 pt) fb. Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal)	Resolve + Atz fb. RoundWM
	Harness Xtra (1.5 qt) fb. Roundup OriginalMax (22 fl oz) + AMS (17 lb/100 gal)	HarnessXtra fb. RoundOM
	Harness Xtra (1.5 qt) fb. Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal)	HarnessXtra fb. RoundWM
	Lumax (2.25 qt) fb. Touchdown Total (24 fl oz) + AMS (8.5 lb/100 gal)	Lumax fb. Touchdown
	Parallel (2 pt) fb. Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal)	Parallel fb. RoundWM
POST (1-Pass)	Degree Xtra (2 qt) + Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal)	DegreeXtra + RoundWM
	Keystone LA (1.9 qt) fb. Durango (1.5 pt) + AMS (1.5 %)	Key + Durango
	Resolve (1 oz) + Atrazine (1.5 pt) + Roundup WeatherMax (22 fl oz) + AMS (17 lb/100 gal)	Resolve + Atz + RoundWM
	Stalwart Xtra (2.6 qt) fb. Roundup OriginalMax (22 fl oz) + AMS (17 lb/100 gal)	StalXtra + RoundWM
POST (2-Pass)	Roundup OriginalMax (22 fl oz) + AMS (17 lb/100 gal) fb. Roundup OriginalMax (22 fl oz) + AMS (17lb/100gal)	RoundOM fb. RoundOM

Abbreviations: fb.= followed by, PRE= preemergence, POST=postemergence, PRE/POST= preemergence followed by postemergence.

Table 5. Weed control effectiveness, weed control costs, corn yields, and gross margins for herbicide programs in 2004.

<i>Conventional</i>	<i>Treatments</i>	<i>ANGR</i>	<i>CHEAL</i>	<i>AMARE</i>	<i>AMBEL</i>	<i>ABUTH</i>	<i>All Weeds (≥ 90%)</i>	<i>Cost¹ (\$/A)</i>	<i>Yield (bu/A)</i>	<i>Gross Margin² (\$/A)</i>
PRE	GuardsMax + Prowl	81	85	96	55	65	No	31.89	208	332.11
	GuardsMax + Python	78	91	94	67	96	No	32.03	212	338.97*
	Axiom + Atz + Prowl ³	87	90	94	60	67	No	31.33	170	266.17
	Key + Python	79	98	99	64	99	No	30.53	212	340.47*
	Key + Hornet	72	93	94	60	97	No	32.62	214*	341.88*
	KeyLA + Hornet	74	98	98	65	98	No	33.48	212	337.52*
	CinchATZ + Basis	90	88	99	74	85	No	33.61	215*	342.64*
	Lumax	85	78	93	61	88	No	32.05	219*	351.20*
PRE/POST	GuardsMax fb. Clarity + Aim ³	90	93	99	98	98	Yes	36.37	202	317.13
	Outlk fb. Distinct	96	67	93	65	83	No	39.70	206	320.80
	Define fb. Buct/Atz	84	100	100	90	100	No	34.95	204	322.05
	Atz fb. Option + Distinct	91	89	99	86	93	No	36.59	221*	350.16*
	Cinch fb. SteadATZ + Distinct	99	100	100	100	100	Yes	43.53	221*	343.22*
	BicepIIMag fb. Callisto + Atz	96	100	100	99	100	Yes	45.24	216*	332.76
Total POST	Atz + Callisto + Option	96	100	100	100	99	Yes	31.48	220*	353.52*
	SteadATZ + Distinct	95	100	100	97	100	Yes	29.35	221*	357.40*
<i>Roundup Ready</i>										
PRE/POST	Key fb. GlyphoPlus	86	79	94	76	94	No	37.28	215*	338.97*
	CinchATZ fb. RoundWM	93	82	91	74	99	No	39.21	222*	349.29*
	HarnessXtra fb. RoundWM	86	75	93	75	98	No	41.50	221*	345.25*
	BicepIIMag fb. Touchdown	95	78	96	77	99	No	49.40	224*	342.60*
POST (1-Pass)	RoundOM + Atr	91	100	100	98	98	Yes	24.14	217*	355.61*
	DegreeXtra + RoundWM	99	100	100	100	99	Yes	33.91	222*	354.59*
POST (2-Pass)	RoundWM fb. RoundWM	99	100	99	100	100	Yes	39.83	229*	360.92*
	Touchdown fb. Touchdown	100	100	100	100	100	Yes	39.77	218*	341.73*
Untreated	Weedy	0	0	0	0	0	na	0	87	152.25

Abbreviations: ANGR= annual grass, CHEAL= common lambsquarters, AMARE= redroot pigweed, AMBEL= common ragweed, ABUTH= velvetleaf, fb.= followed by.

¹Herbicide and additive costs = avg. of price lists (April 2004); Application cost = \$6.00/A; Roundup Ready seed premium = \$20.50/bag; seeding rate = 30,000 seeds/A. Weed control costs = Herbicide \$ + Additive \$ + Application \$ + seed premium \$ (where applicable).

²Crop selling price = \$1.75/bu (December 2004). Gross Margin = (Yield x Price) – Weed Control Costs.

³Corn injury was 15% and 10% for Axiom + Atrazine + Prowl and Guardsman Max fb. Clarity + Aim, respectively. All other treatments showed no corn injury.

*Values are not significantly different from the highest value within that column.

Table 6. Weed control effectiveness, weed control costs, corn yields, and gross margins for herbicide programs in 2005.

<i>Conventional Treatments</i>	<i>ANGR</i>	<i>CHEAL</i>	<i>AMARE</i>	<i>ABUTH</i>	<i>All Weeds (≥ 90%)</i>	<i>Cost¹ (\$/A)</i>	<i>Yield (bu/A)</i>	<i>Gross Margin² (\$/A)</i>	
PRE	GuardsMax + Hornet	83	90	100	73	No	32.96	215*	289.54
	Define + Hornet + Atz	84	98	100	78	No	37.01	210*	277.99
	KeyLA + Hornet	92	99	100	75	No	34.38	215*	288.12
	KeyLA + Python	87	96	100	77	No	32.34	211*	284.16
	CinchATZ + Basis	77	77	100	57	No	33.61	205*	273.89
	Lexar	79	98	100	94	No	34.88	212*	283.12
	Lumax + Atz	82	99	100	98	No	35.03	208*	276.97
	StalC + Atz + Callisto	75	97	100	97	No	45.79	207*	264.71
	MicroTech + Hornet	68	66	100	67	No	26.51	202	276.49
PRE/POST	GuardsMax fb. Distinct	90	93	100	72	No	40.54	204*	265.46
	Define fb. Equip	97	99	100	86	No	43.55	216*	280.45
	BicepII Mag fb. Callisto + Atz	90	100	100	93	Yes	46.49	216*	277.51
	MicroTech + Atz fb. Distinct	88	98	100	86	No	42.36	212*	275.64
Total POST	Atz + Option + Define	88	85	100	64	No	37.63	208*	274.37
	Atz + Option + Callisto	89	100	100	96	No	31.77	212*	286.23
	SteadATZ + Distinct	91	98	100	93	Yes	30.04	214*	290.96
	Steadfast + Distinct	84	76	100	80	No	32.05	209*	281.45
Roundup Ready									
PRE/POST	Outlk fb. RoundOM + Distinct	96	91	100	80	No	45.12	218*	281.88
	GuardsMax fb. RoundOM	96	91	100	78	No	33.99	215*	288.51
	Key fb. Durango	97	87	100	76	No	33.71	222*	299.29
	Basis + Atz fb. RoundWM	86	95	100	82	No	37.95	212*	280.05
	Basis fb. RoundWM	83	71	99	79	No	33.42	219*	295.08
	HarnessXtra fb. RoundWM	97	99	100	81	No	41.14	223*	293.36
	Atz fb. RoundOM	82	89	100	83	No	27.58	216*	296.42
	Lumax fb. Touchdown	99	100	100	100	Yes	46.16	219*	282.34
	StalXtra fb. RoundWM	95	93	100	80	No	38.16	214*	282.84
POST (1-Pass)	DegreeXtra + RoundWM	99	96	100	87	No	36.51	219*	291.99
POST (2-Pass)	RoundWM fb. RoundWM	98	97	100	97	Yes	38.53	214*	282.47
Untreated	Weedy	0	0	0	0	na	0	85	127.50

Abbreviations: ANGR= annual grass, CHEAL= common lambsquarters, AMARE= redroot pigweed, ABUTH= velvetleaf, fb.= followed by.

¹Herbicide and additive costs = avg. of price lists (April 2005); Application cost = \$6.00/A; Roundup Ready seed premium = \$6.19/A; seeding rate = 30,000 seeds/A. Weed control costs = Herbicide \$ + Additive \$ + Application \$ + seed premium \$ (where applicable).

²Crop selling price = \$1.50/bu (December 2005). Gross Margin = (Yield x Price) – Weed Control Costs.

*Values are not significantly different from the highest value within that column.

Weed

Table 7. Weed control effectiveness, weed control costs, corn yields, and gross margins for herbicide programs in 2006.

<i>Conventional Treatments</i>		<i>ANGR</i>	<i>CHEAL</i>	<i>AMARE</i>	<i>AMBEL</i>	<i>ABUTH</i>	<i>All Weeds (≥ 90%)</i>	<i>Cost¹ (\$/A)</i>	<i>Yield (bu/A)</i>	<i>Gross Margin² (\$/A)</i>
PRE	GuardsMax + Hornet ³	88	99	99	76	76	No	33.38	216	\$615.86
	Define + Hornet + Atz	96	100	99	84	80	No	36.75	218	\$616.33
	KeyLA + Hornet ³	94	99	99	75	89	No	34.67	217	\$616.17
	KeyLA + Python ³	93	99	99	73	87	No	32.55	216	\$613.95
	Lexar	96	100	99	85	83	No	35.24	225*	\$638.36*
	Lumax + Atz	98	100	100	87	88	No	40.61	220	\$620.07
	Parallel Plus	96	99	100	77	67	No	27.35	227*	\$653.89*
PRE/POST	GuardsMax fb. Distinct ³	95	100	100	99	92	Yes	41.48	215	\$603.54
	GuardsMax fb. Impact + Atz	91	100	100	98	98	Yes	37.98	222*	\$627.91*
	Define fb. Buct/Atz	96	100	100	99	97	Yes	39.93	227*	\$639.76*
	BicepIIMag fb. Callisto + Atz	98	100	100	99	99	Yes	47.78	230*	\$641.15*
Total POST	Atz + Option + Define	91	100	100	100	98	Yes	23.85	222*	\$642.42*
	Define + Equip + Atz	84	99	100	92	80	No	34.77	224*	\$638.53*
	SteadATZ + Distinct	90	100	100	100	98	Yes	30.98	223*	\$636.64*
Roundup Ready										
PRE/POST	Outlk fb. RoundOM + Distinct ³	91	95	100	96	81	No	45.57	219	\$611.39
	GuardsMax fb. RoundOM + Distinct	84	99	98	99	86	No	42.95	224*	\$629.53*
	Key fb. Durango	89	98	99	93	79	No	36.93	222*	\$630.56*
	Resolve + Atz fb. RoundWM	81	86	98	94	85	No	34.43	220	\$625.70
	HarnessXtra fb. RoundOM	87	97	100	91	81	No	39.40	226*	\$638.59*
	HarnessXtra fb. RoundWM	92	98	100	91	85	No	41.18	217	\$610.41
	Lumax fb. Touchdown	98	100	100	90	86	No	51.34	228*	\$633.37*
	Parallel fb. RoundWM	97	90	100	91	82	No	43.23	222*	\$622.50
POST (1-Pass)	DegreeXtra + RoundWM	97	100	100	100	100	Yes	34.65	223*	\$633.52*
	Key + Durango	99	100	100	100	78	No	30.93	225*	\$644.23*
	Resolve + Atz + RoundWM	79	96	100	95	79	No	28.56	224*	\$643.31*
	StalXtra + RoundWM	98	100	100	99	95	Yes	36.50	226*	\$642.33*
POST(2-Pass)	RoundOM fb. RoundOM	99	100	100	100	100	Yes	32.08	227*	\$648.79*
Untreated	Weedy	0	0	0	0	0	n.a.	0	83	\$248.98

Abbreviations: ANGR= annual grass, CHEAL= common lambsquarters, AMARE= redroot pigweed, AMBEL= common ragweed, ABUTH= velvetleaf, fb.= followed by.

¹Herbicide and additive costs = avg. of price lists (April 2006); Application cost = \$6.00/A; Roundup Ready seed premium = \$8.80/A; seeding rate = 30,000 seeds/A. Weed control costs = Herbicide \$ + Additive \$ + Application \$ + seed premium \$ (where applicable).

²Crop selling price = \$3.00/bu (December 2006). Gross Margin = (Yield x Price) – Weed Control Costs.

³Corn injury was 9%, 8%, 10%, 6% and 4% at 26 days after last postemergence application for Guardsman Max + Hornet, Keystone LA + Hornet, Keystone LA + Python, Guardsman Max fb. Distinct and Outlook fb. Distinct, respectively. All other treatments showed ≤3% corn injury.

*Values are not significantly different from the highest value within that column.

Table 8. Summary of the 2004 commercial weed control program comparisons.

	Treatments providing ≥ 90% control of ALL weeds	5 Most Expensive	5 Least Expensive	Yields not differing significantly from the highest	Gross margins not differing significantly from the highest
Conventional					
PRE	0/8	0/8	2/8	3/8	6/8
PRE/POST	3/6	2/6	0/6	3/6	2/6
Total POST	2/2	0/2	2/2	2/2	2/2
Roundup Ready					
PRE/POST	0/4	2/4	0/4	4/4	4/4
POST (1-Pass)	2/2	0/2	1/2	2/2	2/2
POST (2-Pass)	2/2	1/2	0/2	2/2	2/2

Abbreviations: PRE= preemergence, POST=postemergence, PRE/POST= preemergence followed by postemergence.
Information in Table 8 is based on results presented in Table 5.

Table 9. Summary of the 2005 commercial weed control program comparisons.

	Treatments providing ≥ 90% control of ALL weeds	5 Most Expensive	5 Least Expensive	Yields not differing significantly from the highest	Gross margins not differing significantly from the highest
Conventional					
PRE	0/9	1/9	1/9	8/9	8/9
PRE/POST	1/4	2/4	0/4	4/4	3/4
Total POST	1/4	0/4	3/4	4/4	4/4
Roundup Ready					
PRE/POST	1/9	2/9	1/9	9/9	9/9
POST (1-Pass)	0/1	0/1	0/1	1/1	1/1
POST (2-Pass)	1/1	0/1	0/1	1/1	1/1

Abbreviations: PRE= preemergence, POST=postemergence, PRE/POST= preemergence followed by postemergence.
Information in Table 9 is based on results presented in Table 6.

Table 10. Summary of the 2006 commercial weed control program comparisons.

	Treatments providing ≥ 90% control of ALL weeds	5 Most Expensive	5 Least Expensive	Yields not differing significantly from the highest	Gross margins not differing significantly from the highest
Conventional					
PRE	0/7	0/7	1/7	2/7	2/7
PRE/POST	4/4	2/4	0/4	3/4	3/4
Total POST	2/3	0/3	2/3	3/3	3/3
Roundup Ready					
PRE/POST	0/8	3/8	0/8	5/8	4/8
POST (1-Pass)	2/4	0/3	2/3	4/4	4/4
POST (2-Pass)	1/1	0/1	0/1	1/1	1/1

Abbreviations: PRE= preemergence, POST=postemergence, PRE/POST= preemergence followed by postemergence.
Information in Table 10 is based on results presented in Table 7.

Table 11. A three-year summary of all weed control programs for corn yield (% of maximum yield) and gross margin (% of maximum gross margin).

<i>Conventional Treatments</i>		2004	2005	2006	2004	2005	2006
		-----% of max. yield-----			---% of max. gross margin---		
PRE	GuardsMax + Prowl	91	--	--	92	--	--
	GuardsMax + Python	92	--	--	94*	--	--
	GuardsMax + Hornet	--	96*	94	--	97*	94
	Axiom + Atz + Prowl	74	--	--	74	--	--
	Key + Python	92	--	--	94*	--	--
	Key + Hornet	93*	--	--	95*	--	--
	KeyLA + Hornet	92	96*	94	94*	96*	94
	KeyLA + Python	--	95*	94	--	95*	94
	CinchATZ + Basis	94*	92*	--	95*	92*	--
	Define + Hornet + Atz	--	94*	95	--	93*	94
	Lexar	--	95*	98*	--	95*	98*
	Lumax	96*	--	--	97*	--	--
	Lumax + Atz	--	93*	96*	--	93*	95
	StalC + Atz + Callisto	--	93*	--	--	88	--
	MicroTech + Hornet	--	91	--	--	92*	--
	Parallel Plus	--	--	99*	--	--	100*
	PRE/POST	GuardsMax fb. Clarity + Aim	88	--	--	88	--
GuardsMax fb. Distinct		--	92*	94	--	89	92
GuardsMax fb. Impact + Atz		--	--	97*	--	--	96*
Define fb. Buct/Atz		89	--	99*	89	--	98*
Define fb. Equip		--	97*	--	--	94*	--
Outlk fb. Distinct		90	--	--	89	--	--
Atz fb. Option + Distinct		97*	--	--	97*	--	--
Cinch fb. SteadATZ + Distinct		97*	--	--	95*	--	--
MicroTech + Atz fb. Distinct		--	95*	--	--	92*	--
BicepII Mag fb. Callisto + Atz		94*	97*	100*	92	93*	98*
Total POST	Atz + Option + Callisto	96*	95*	--	98*	96*	--
	Atz + Option + Define	--	93*	97*	--	92*	98*
	SteadATZ + Distinct	97*	96*	97*	99*	97*	97*
	Steadfast + Distinct	--	94*	--	--	94*	--
	Define + Equip + Atz	--	--	98*	--	--	98*
Roundup Ready							
PRE/POST	Key fb. GlyphoPlus	94*	--	--	94*	--	--
	Key fb. Durango	--	100*	97*	--	100*	96*
	CinchATZ fb. RoundWM	97*	--	--	97*	--	--
	HarnessXtra fb. RoundWM	97*	100*	95	96*	98*	93
	HarnessXtra fb. RoundOM	--	--	98*	--	--	98*
	BicepII Mag fb. Touchdown	98*	--	--	95*	--	--
	Outlk fb. RoundOM + Distinct	--	98*	95*	--	94*	94
	GuardsMax fb. RoundOM	--	96*	--	--	96*	--
	GuardsMax fb. RoundOM + Distinct	--	--	98*	--	--	96*
	Basis + Atz fb. RoundWM	--	95*	--	--	94*	--
	Basis fb. RoundWM	--	98*	--	--	99*	--
	Resolve + Atz fb. RoundWM	--	--	96*	--	--	96

	Atz fb. RoundOM	--	97*	--	--	99*	--
	Lumax fb. Touchdown	--	98*	99*	--	94*	97*
	StalXtra fb. RoundWM	--	96*	--	--	95*	--
	Parallel fb. RoundWM	--	--	97*	--	--	95
	RoundOM + Atz	95*	--	--	99*	--	--
POST (1-Pass)	DegreeXtra + RoundWM	97*	98*	97*	98*	98*	97*
	Resolve + Atz + RoundWM	--	--	98*	--	--	98*
	StalXtra + RoundWM	--	--	99*	--	--	98*
	Key + Durango	--	--	98*	--	--	99*
	RoundWM fb. RoundWM	100*	96*	99*	100*	94*	99*
POST (2-Pass)	Touchdown fb. Touchdown	95*	--	--	95*	--	--

* Values are not significantly different from the highest value within that column.

Observations

2004:

Excessive rainfall after herbicide application reduced weed control with preemergence programs, which often resulted in lower yields. The most expensive programs involved two applications. The least expensive programs involved one application. Three of the five most expensive programs were Roundup Ready programs. One of the five least expensive programs was a Roundup Ready program. The programs with the highest occurrence of yield loss were conventional treatments involving a preemergence application. Those treatments that caused significant corn injury had the lowest corn yields and gross margins. Four of the five most costly programs had high gross margins. Similarly, four of the five least costly programs had high gross margins. The major factor affecting gross margins was corn yield.

2005:

Four of the five most expensive programs involved two applications. Four of the five least expensive programs involved one application and were conventional. None of the treatments caused significant corn injury in 2005. Only 4 of the 28 treatments provided $\geq 90\%$ control of all weed species. Annual grasses and velvetleaf were the most difficult to control. Four of the five programs with the highest yields and gross margins involved two applications. All of the Roundup Ready treatments, regardless of application timing, had yields not differing significantly from the highest. Only one of the conventional treatments differed significantly from the highest. Overall, the programs submitted for comparison in corn were very good with 93% of those providing high gross margins.

2006:

All five of the most expensive programs involved two applications and the five least expensive programs involved one application. Measurable crop injury was observed soon after mid-postemergence application with five of the treatments in 2006; however by 69 days after the mid-post application, only one treatment (*Guardsman Max fb. Distinct*) still had significant injury (brace root malformation). Nine of the 27 treatments provided $\geq 90\%$ control of all weed species. Velvetleaf, followed by annual grasses and common ragweed were the most difficult to control. Four of the top five programs with the highest yields and two of the top five programs with the highest gross margins involved two applications. Ten of

the 13 treatments in the Roundup Ready system had yields that were not significantly different than the highest yielding treatment. Eight of the 14 conventional treatments had yields that were not significantly different than the highest yielding treatment. Nine of the Roundup Ready system treatments and eight of the conventional treatments had gross margins not significantly different from highest gross margin. Overall, the programs submitted for comparison in corn were very good with all providing $\geq 92\%$ of the highest gross margin.

Interpretation

In 2004, the excessive rainfall following planting and preemergence herbicide application disfavored the preemergence programs and favored the postemergence programs. It is important to remember that these results came from an atypical season and that these results must be interpreted in that context. We know from experience that the opposite can occur under different growing conditions and this is what happened in 2005 and 2006. In 2005, the preemergence only and the preemergence fb. postemergence weed control programs were more consistent in obtaining high yields and high gross margins relative to 2004. The unusually wet, growing conditions in 2004 created notable differences between weed control treatments, whereas in a more typical growing season (2005 and 2006) differences between treatments were minimal. With only one exception, the designed two-pass and single postemergence application systems were effective at preserving yield and maximizing gross margin in 2006. In most cases, the treatments with the highest corn yield had the highest gross margins.