Chapter VI

Mesotrione and Nicosulfuron plus Rimsulfuron plus Atrazine in Corn (*Zea mays*)

Abstract: Field experiments were conducted in 2002 and 2003 to evaluate total postemergence (POST) weed control in corn with mixtures of mesotrione, atrazine, and the commercial mixture of nicosulfuron plus rimsulfuron plus atrazine at full and reduced rates. Treatments were compared to nicosulfuron plus rimsulfuron plus atrazine POST, and *S*-metolachlor plus atrazine preemergence (PRE) alone and followed by (fb) nicosulfuron plus rimsulfuron plus atrazine POST. All treatments controlled common lambsquarters 99%. Common ragweed control with POST mesotrione plus nicosulfuron plus rimsulfuron plus atrazine combinations was greater than 89%. Addition of atrazine to mesotrione improved common ragweed control by at least 38 percent over mesotrione alone. Nicosulfuron plus rimsulfuron plus atrazine at the full rate and in mixtures with mesotrione controlled morningglory species (pitted morningglory and ivyleaf morningglory) 89 to 91%. Large crabgrass control varied between 2002 and 2003. In 2002, large crabgrass control was 58 to 76% with all POST treatments, but in 2003, nicosulfuron plus rimsulfuron plus atrazine POST alone controlled large crabgrass greater than 86%. Giant foxtail was controlled at least 97% with nicosulfuron plus rimsulfuron plus atrazine treatments. *S*-Metolachlor plus atrazine PRE fb nicosulfuron plus rimsulfuron plus atrazine POST controlled all weed species greater than 92%, except morningglory species, where control was 85%. Corn yields by total POST treatment combinations of mesotrione plus either rate of nicosulfuron plus rimsulfuron plus atrazine were comparable to metolachlor plus atrazine PRE alone or fb nicosulfuron plus rimsulfuron plus atrazine POST.

Nomenclature: Atrazine; mesotrione; nicosulfuron; rimsulfuron; *S*-metolachlor; common lambsquarters, *Chenopodium album* L. #[1] CHEAL; common ragweed, *Ambrosia artemisiifolia* L. # AMBEL; giant foxtail, *Setaria faberi* Herrm. # SETFA;

[1] Letters following this symbol are a WSSA-approved computer code from *Composite List of Weeds*, Revised 1989. Available only on computer disk from WSSA, 810 East 10th Street, Lawrence, KS 66044-8897.

ivyleaf morningglory, *Ipomoea hederacea* (L.) Jacq. # IPOHE; large crabgrass, *Digitaria sanguinalis* (L.) Scop. # DIGSA; morningglory species, Ipomoea spp. # IPOSS; pitted morningglory, *Ipomoea lacunosa* L. Roth # IPOLA; corn, *Zea mays* L. 'Dekalb DKC60-09 (RR2)', 'Pioneer 33B51', 'Pioneer 33G56'.

Additional index words: Sulfonylurea herbicides, reduced herbicide rates, total postemergence, triketone herbicides.

Abbreviations: DAP, days after planting; fb, followed by; POST, postemergence; PRE, preemergence; WATP, weeks after treatment with POST herbicides.

INTRODUCTION

PRE grass and broadleaf herbicides have provided season-long weed control in corn for several decades (Krausz and Kapusta 1998). However, adequate rainfall following a PRE herbicide application is required for herbicide activation and optimal weed control (Tapia et al. 1997). POST herbicides are frequently applied to control weeds which have escaped control by PRE herbicides. In the past decade, interest in total POST programs for weed control in corn has increased (Kapusta et al. 1994). The risk of inadequate rainfall for PRE herbicide activation, the introduction of effective POST grass and broadleaf herbicides, the development of herbicide resistant crops, and the need for corn growers to reduce work loads have promoted utilization of total POST programs in field corn. Total POST programs are effective alternatives to PRE residual herbicides, and allow growers to select herbicides and rates based on weed spectrums and densities present in each field (Foy and Witt 1990; Swanton and Weise 1991; Tapia et al. 1997). POST herbicides are currently available to control annual grass and broadleaf weeds in a single application, but complete and consistent broad-spectrum control may require tank-mixtures of grass and broadleaf herbicides (Carey and Kells 1995; Dobbels and Kapusta 1993; Rabaey and Harvey 1997).

Mesotrione is a PRE or POST triketone herbicide that controls several annual broadleaf weeds, but has limited grass activity (Armel et al. 2003; Beckett et al. 1999; Johnson et al. 1999). Use of mesotrione in a total POST weed management program will require a tank-mix partner for more complete annual grass control. Research indicates that combining mesotrione with atrazine POST increased control of emerged and later-emerging weeds (Bradley et al. 2000; Johnson et al. 1999).

Nicosulfuron plus rimsulfuron plus atrazine[2] is a commercial sulfonylurea plus triazine mixture that controls certain annual grass and broadleaf weeds POST in corn (Anonymous 2003). At the registered use rate, this mixture contains nicosulfuron at 13 g/ha plus rimsulfuron at 13 g/ha plus atrazine at 840 g/ha. Tank mixtures of mesotrione, nicosulfuron plus rimsulfuron plus atrazine, and additional atrazine POST may enhance control of several broadleaf weed and annual grass species in a single application. However, tank-mixtures of POST grass and broadleaf herbicides, particularly at reduced rates, have reduced weed control efficacy (Chow 1983; Hartzler and Foy 1983; Isaacs et al. 2002).

Reducing herbicide rates can increase grower profits and limit pesticide input into the environment (Alm et al. 2000; Prostko and Meade 1993). Application rates of some POST herbicides can be substantially reduced below registered rates depending on weed species, application timing, environmental conditions, and application accuracy (Putnam 1990). Research in soybean [*Glycine max* (L.) Merr.] indicated that certain POST herbicide rates could be reduced to as low as one-fourth of the registered rate (Baldwin and Oliver 1985).

An objective of these studies was to evaluate control of several broadleaf weeds, large crabgrass, and giant foxtail in a total POST weed management program with tank mixtures of mesotrione, the commercial mixture of nicosulfuron plus rimsulfuron plus atrazine at full and reduced rates, and additional atrazine. Another objective was to compare weed control by these total POST tank mixtures to standard PRE and PRE fb POST weed management programs.

MATERIALS AND METHODS

Experiments were conducted at the Eastern Shore Agricultural Research and Extension Center near Painter, VA in 2002 and at two locations in 2003, which are

[2] Basis Gold herbicide, E.I. DuPont de Nemours & Co., Crop Protection, Walkers Mill, Barley Mill Plaza, Wilmington, DE 19880-0038.

designated as 2003a and 2003b. The soil type was a Bojac sandy loam (Typic Hapludults) with approximately 1% organic matter and a pH of 6.1. Seedbeds were prepared by chisel plowing followed by tandem disking and tillage with an S-tine field cultivator with double rolling baskets. Fertilizer was applied broadcast before planting according to current recommendations from the Virginia Polytechnic Institute and State University (Donohue and Heckendorn 1994) and additional nitrogen was applied at the V5 corn growth stage. Corn hybrids planted were 'Pioneer 33G56'[3] in 2002, 'Dekalb DKC60-09 (RR2)'[4] in 2003a, and 'Pioneer 33B51' in 2003b. Corn was planted 4.0 cm deep at a rate of 57,000 seed/ha (Table 6.1).

Plots were four rows wide in 0.76 m spacing with an herbicide-treated area of 2.5 by 6.1 m, leaving a 0.9-m nontreated area between plots. Herbicides were applied with a tractor-mounted sprayer delivering 235 L/ha at 210 kPa through flat fan spray nozzles.[5] Herbicide application data for each location are presented in Table 6.1. Weed densities and heights were recorded at time of POST applications (Table 6.2). The experimental design was randomized complete block with three replications. Treatments included POST applications of mesotrione at 105 g ai/ha alone and in combination with atrazine at 280 g/ha, the commercial mixture of nicosulfuron plus rimsulfuron plus atrazine at 6.5 plus 6.5 plus 420 g/ha and 13 plus 13 plus 840 g/ha, respectively. Additional POST treatments were mesotrione at 105 g/ha plus nicosulfuron plus rimsulfuron plus atrazine at 6.5 plus 6.5 plus 700 g/ha and 13 plus 13 plus 1120 g/ha, respectively, and nicosulfuron plus rimsulfuron plus atrazine alone at 13 plus 13 plus 840 g/ha, respectively. Other treatments included for comparison were *S*-metolachlor at 870 g ai/ha plus atrazine at 1100 g/ha PRE alone and fb nicosulfuron plus rimsulfuron plus

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[3] Pioneer Hi-Bred International, Inc., 400 Locust Street, Suite 800, Des Moines, IA 50306-3453.

[4] Monsanto Co., 800 North Lindbergh Boulevard, St. Louis, MO 63167.

[5] TeeJet 8003VS flat-fan spray nozzles, Spraying Systems Co., P. O. Box 7900, Wheaton, IL 60189.

atrazine POST at 13 plus 13 plus 840 g/ha, respectively, and a nontreated check. All POST treatments included 1% v/v crop oil concentrate.[6]

Corn injury and weed control were evaluated visually on a 0 to 100% scale, with 0 equal to no plant response and 100 equal to complete plant death. Corn injury was evaluated at 2 and 4 weeks after treatment with POST herbicides (WATP) and visual weed control was evaluated 8 WATP. Individual weed species evaluations are presented, with the exception of morningglory species. In 2003a, pitted and ivyleaf morningglory densities were generally uniform throughout the experimental area compared to 2003b, where pitted morningglory was predominant and ivyleaf morningglory was scattered. Corn yields were determined by harvesting grain from the center two rows of each plot with a commercial combine modified for small plots. Yields were adjusted to 15.5% moisture before analysis.

All data were subjected to analysis of variance, and means were separated using Fisher's protected LSD test at P = 0.05 (Steel et al. 1997). When the analysis of variance revealed no significant treatment by location interaction, data were pooled over location. The nontreated check was not included with percentage data analyses, but was included with the corn yield analyses. Visual estimates of percent weed control were arcsine transformed before analysis, but nontransformed percentages are presented with mean separations based on transformed data.

RESULTS AND DISCUSSION

Corn Response. No significant treatment by location interaction occurred with corn response so data were combined at both 2 and 4 WATP. At 2 WATP, corn was injured less than 8% by all treatments (data not shown). Others have also reported slight injury from mesotrione (Armel et al. 2003; Johnson et al. 2002) and nicosulfuron plus rimsulfuron plus atrazine POST at 2 WAT (Nolte and Young 2002). By 4 WATP, no response was evident with any treatment.

[6] Agridex, a mixture of 83% paraffinic mineral oil and 17% polyoxyethylene sorbitan fatty acid ester, Helena Chemical Co., 5100 Poplar Avenue, Memphis, TN 38137.

Weed Control. *Common lambsquarters*. All treatments controlled common lambsquarters 99% at all locations (data not shown). Others have reported effective common lambsquarters control with POST applications of mesotrione or nicosulfuron plus atrazine (Armel et al. 2003; Beckett and Taylor 2000; Lackey et al. 1999; Menbere and Ritter 2001).

Common ragweed. There was a significant treatment by location interaction for common ragweed control so data are presented separately by location. Common ragweed control with mesotrione was 37 to 49% throughout all locations, but control with the addition of atrazine at 280 g/ha to mesotrione was 83 to 94% (Table 6.3). In other research, common ragweed was controlled at least 98% when atrazine at 560 g/ha was applied in combination with mesotrione at 105 g/ha, which suggests consistent common ragweed control with the mesotrione and atrazine mixture may require atrazine at rates above 280 g/ha (Whaley 2005). Similar increases in control of other broadleaf weeds were observed with the addition of atrazine to mesotrione POST (Bradley et al. 2000; Johnson et al. 2002). At all three locations, *S*-metolachlor plus atrazine PRE controlled common ragweed 62 to 85%. When fb nicosulfuron plus rimsulfuron plus atrazine, control was generally consistent at 93 to 98%.

Common ragweed control with nicosulfuron plus rimsulfuron plus atrazine POST was variable between locations at 44% in 2002, 86% in 2003a and 99% in 2003b (Table 6.3). Common ragweed height was 1 to 13 cm in 2002, 5 to 8 cm in 2003a, and 1 to 5 cm in 2003b, which may explain variability in control between years. In 2002, common ragweed control was improved to at least 90% with combinations of mesotrione with nicosulfuron plus rimsulfuron plus atrazine compared to mesotrione or nicosulfuron plus rimsulfuron plus atrazine treatments alone. In 2003a and 2003b, mesotrione combined with nicosulfuron plus rimsulfuron plus atrazine controlled common ragweed 89% or greater. Common ragweed control was improved 6 to 7 percent when additional atrazine was included in the mixture of mesotrione and nicosulfuron plus rimsulfuron plus atrazine at the reduced rate in 2002 and 2003a, but control was not improved by additional atrazine when the full rate of nicosulfuron plus rimsulfuron plus atrazine was included in the treatment.

Morningglory species. Morningglory species were not present in 2002. No significant treatment by location interactions were observed so data were pooled over 2003a and 2003b. Mesotrione alone and with atrazine controlled morningglory species 78 and 81%, respectively (Table 6.3). Armel et al. (2003) reported 76 to 86% control of a mixture of tall morningglory [*Ipomoea purpurea* (L.) Roth], ivyleaf morningglory, and pitted morningglory with mesotrione. However, other research reported variable control from 33 to 86% with mesotrione alone (Johnson et al. 1999). Nicosulfuron plus rimsulfuron plus atrazine POST controlled morningglory species 89% and control was not improved with the addition of mesotrione or additional atrazine. Morningglory species were controlled 84 to 85% with the mixture of mesotrione and the reduced rate of nicosulfuron plus rimsulfuron plus atrazine with or without additional atrazine. In other research, effective control of ivyleaf morningglory has been obtained with nicosulfuron plus rimsulfuron plus atrazine (Nolte and Young 2002; Young B. and Young J. 2000). *S*-Metolachlor plus atrazine PRE alone controlled morningglory species 70%, but was 85% when fb nicosulfuron plus rimsulfuron plus atrazine POST.

Large crabgrass. Data are presented separately by location due to a significant treatment by location interaction for large crabgrass control (Table 6.4). Control was generally lower in 2002 than in 2003a or 2003b. The height of large crabgrass at the time of POST applications may explain differences observed in control between locations. Large crabgrass in 2002 was 1 to 13 cm tall compared to 1 to 4 cm in 2003a and 3 to 5 cm in 2003b (Table 6.2). Mesotrione alone or with atrazine did not control large crabgrass more than 79% at any location.

At all three locations, *S*-metolachlor plus atrazine PRE controlled large crabgrass 81 to 95%, and when fb nicosulfuron plus rimsulfuron plus atrazine control was 93 to 99% (Table 6.4). Nicosulfuron plus rimsulfuron plus atrazine POST alone controlled large crabgrass 76% in 2002, 87% in 2003a, and 88% in 2003b. In 2002, all POST treatments controlled large crabgrass similarly at 58 to 76%. Large crabgrass control in 2003a was 80% with the mixture of mesotrione, the reduced rate of nicosulfuron plus rimsulfuron plus atrazine, and additional atrazine, but control was at least 88% when the mixture included the full rate of nicosulfuron plus rimsulfuron plus atrazine with or without additional atrazine. All POST treatments controlled large crabgrass 77 to 88% in 2003b.

Giant foxtail. Giant foxtail was not present in 2002 and control data were pooled over 2003a and 2003b since there was no significant treatment by location interaction. Giant foxtail control with mesotrione alone or with mesotrione plus atrazine was 14 and 28%, respectively (Table 6.4). Others also have reported insufficient control with mesotrione alone (Armel et al. 2003; Ohmes et al. 2000). *S*-Metolachlor plus atrazine PRE controlled giant foxtail 92% but was improved to 99% when fb nicosulfuron plus rimsulfuron plus atrazine POST.

Giant foxtail was controlled 97 to 99% by all POST treatments that included either rate of nicosulfuron plus rimsulfuron plus atrazine with or without additional atrazine (Table 6.4). Mekki and Leroux (1994) reported that giant foxtail was very susceptible to nicosulfuron, rimsulfuron, and the combination. At the time of application, giant foxtail was 3 to 8 cm and 1 to 10 cm in 2003a and 2003b, respectively. Other research has found effective control when POST applications are made to 5 to 10 cm-tall giant foxtail (Carey and Kells 1995; Tapia et al. 1997). Dobbels and Kapusta (1993) reported a reduction in giant foxtail control from the combination of nicosulfuron at less than the registered rate with atrazine, but that did not occur in our experiments.

Corn Yield. In general, corn yields were higher in 2003a and 2003b than in 2002, likely because rainfall was more consistent throughout the 2003 growing season than in 2002 (Table 6.5). No significant interaction was observed between 2003a and 2003b corn yields so data were pooled over locations. Inadequate common ragweed control in 2002 by mesotrione or nicosulfuron plus rimsulfuron plus atrazine POST likely reduced corn yields in these plots. Corn treated by all other POST treatments that contained atrazine except mesotrione plus atrazine, pooled over 2003a and 2003b, produced yields comparable to those treated by *S*-metolachlor plus atrazine PRE alone or fb nicosulfuron plus rimsulfuron plus atrazine POST. In this study, corn yields were not improved by the additional atrazine included with mesotrione plus nicosulfuron plus rimsulfuron plus atrazine combinations.

Common lambsquarters was the only weed species that was effectively controlled by mesotrione POST alone. Nicosulfuron plus rimsulfuron plus atrazine POST alone controlled morningglory species, large crabgrass, and giant foxtail, but consistent common ragweed control required tank mixtures with mesotrione. At all three locations, total POST combinations of mesotrione plus nicosulfuron plus rimsulfuron plus atrazine controlled weed species comparable to *S*-metolachlor plus atrazine PRE fb nicosulfuron plus rimsulfuron plus atrazine POST. In other research, mixtures of mesotrione with other POST herbicides in a total POST program also controlled weeds effectively (Whaley 2005).

These experiments were conducted under favorable conditions with good soil moisture and generally small weeds; however, our results may have been different under conditions of lower rainfall and larger weeds. Under adverse conditions, registered rates of all herbicides may be needed to minimize the risk of inadequate control (Rabaey and Harvey 1997). Our research has shown that combinations of mesotrione and nicosulfuron plus rimsulfuron plus atrazine applied at the V2 to V3 corn growth stage in a total POST weed management program can provide similar levels of weed control and corn yields as a standard PRE fb POST herbicide program.

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Table 6.1. Planting date, herbicide application dates, and corn height and stage at time of applications.[a]

	Location[b]		
	2002	2003a	2003b
Planting date	April 30	April 23	April 23
PRE application date	April 30	April 24	May 1
Corn height (cm) at PRE	—	—	1
V-stage	—	—	Spike
POST application date	May 28	May 21	May 16
DAP	29	28	23
Corn height (cm) at POST	28	18	13
V-stage	3	3	2-3

[a] Abbreviations: PRE, preemergence; POST, postemergence; DAP, days after planting.
[b] The two locations in 2003 and are designated as 2003a and 2003b.

Table 6.2. Weed height and density at the time of postemergence applications.

Location[a]	Common lambsquarters		Common ragweed		Morningglory species		Large crabgrass		Giant foxtail	
	Height	Density	Height	Density	Height	Density	Height	Density	Height	Density
	– cm –	no./m^2	– cm –	no./m^2	– cm –	no./m^2	– cm –	no./m^2	– cm –	no./m^2
2002	1-13	4	1-10	13	—	—	1-13	5	—	—
2003a	1-8	365	5-8	60	5	9	1-4	4	3-8	3
2003b	1-5	12	1-5	83	5-10	5	3-5	12	1-10	92

[a] The two locations in 2003 and are designated as 2003a and 2003b.

Table 6.3. Common ragweed and morningglory species control 8 WATP from POST mesotrione, nicosulfuron plus rimsulfuron plus atrazine, and atrazine combinations and from PRE *S*-metolachlor plus atrazine alone and fb nicosulfuron plus rimsulfuron plus atrazine POST.[a,b]

		Control			
		Common ragweed			Morningglory species[d]
Herbicide treatment[c]	Rate	2002	2003a	2003b	2003a + 2003b
	g ai/ha	%			
Mesotrione	105	49 c[e]	40 h	37 c	78 ef
+ atrazine	280	87 b	83 f	94 a	81 de
+ nicosulfuron + rimsulfuron + atrazine	6.5 + 6.5 + 420	90 b	89 de	98 a	84 de
+ nicosulfuron + rimsulfuron + atrazine	6.5 + 6.5 + 700	97 a	95 bc	99 a	85 bcd
+ nicosulfuron + rimsulfuron + atrazine	13 + 13 + 840	96 a	98 ab	99 a	91 a
+ nicosulfuron + rimsulfuron + atrazine	13 + 13 + 1120	99 a	99 a	98 a	90 ab
Nicosulfuron + rimsulfuron + atrazine	13 + 13 + 840	44 c	86 ef	99 a	89 abc
S-metolachlor + atrazine PRE	870 + 1100	88 b	62 g	85 b	70 f
S-metolachlor + atrazine PRE fb nicosulfuron + rimsulfuron + atrazine	870 + 1100 fb 13 + 13 + 840	98 a	93 cd	96 a	85 cd
Nontreated[f]		0	0	0	0

[a] Abbreviations: WATP, weeks after treatment with POST herbicides; POST, postemergence; PRE, preemergence; fb, followed by.
[b] The two locations in 2003 and are designated as 2003a and 2003b.
[c] All POST treatments included 1% v/v crop oil concentrate.
[d] Morningglory species control averaged over 2003a and 2003b. Morningglory species were not present in 2002. Morningglory species evaluated were pitted morningglory and ivyleaf morningglory.
[e] Means within a column followed by the same letter are not significantly different, according to Fisher's protected LSD at P = 0.05.
[f] The nontreated check was not included in the statistical analysis.

Table 6.4. Large crabgrass and giant foxtail control 8 WATP from POST mesotrione, nicosulfuron plus rimsulfuron plus atrazine, and atrazine combinations and from PRE *S*-metolachlor plus atrazine alone and fb nicosulfuron plus rimsulfuron plus atrazine POST.[a,b]

		Control			
		Large crabgrass			Giant foxtail
Herbicide treatment[c]	Rate	2002	2003a	2003b	2003a + 2003b[d]
	g ai/ha	%			
Mesotrione	105	67 b[e]	76 de	77 c	14 d
+ atrazine	280	70 b	71 e	79 bc	28 c
+ nicosulfuron + rimsulfuron + atrazine	6.5 + 6.5 + 420	72 b	70 e	84 bc	97 a
+ nicosulfuron + rimsulfuron + atrazine	6.5 + 6.5 + 700	58 b	80 cd	83 bc	98 a
+ nicosulfuron + rimsulfuron + atrazine	13 + 13 + 840	65 b	89 ab	85 bc	99 a
+ nicosulfuron + rimsulfuron + atrazine	13 + 13 + 1120	70 b	88 ab	87 abc	99 a
Nicosulfuron + rimsulfuron + atrazine	13 + 13 + 840	76 b	87 bc	88 ab	99 a
S-metolachlor + atrazine PRE	870 + 1100	95 a	90 ab	81 bc	92 b
S-metolachlor + atrazine PRE fb nicosulfuron + rimsulfuron + atrazine	870 + 1100 fb 13 + 13 + 840	99 a	93 a	94 a	99 a
Nontreated[f]		0	0	0	0

[a] Abbreviations: WATP, weeks after treatment with POST herbicides; POST, postemergence; PRE, preemergence; fb, followed by.
[b] The two locations in 2003 and are designated as 2003a and 2003b.
[c] All POST treatments included 1% v/v crop oil concentrate.
[d] Giant foxtail control averaged over 2003a and 2003b. Giant foxtail was not present in 2002.
[e] Means within a column followed by the same letter are not significantly different, according to Fisher's protected LSD at P = 0.05.
[f] The nontreated check was not included in the statistical analysis.

Table 6.5. Corn yield from POST mesotrione, nicosulfuron plus rimsulfuron plus atrazine, and atrazine combinations and from PRE *S*-metolachlor plus atrazine alone and fb nicosulfuron plus rimsulfuron plus atrazine POST.[a,b]

		Corn yield	
Herbicide treatment[c]	Rate	2002	2003a + 2003b[d]
	g ai/ha	kg/ha	
Mesotrione	105	2030 bc[d]	7370 c
+ atrazine	280	4930 a	8860 b
+ nicosulfuron + rimsulfuron + atrazine	6.5 + 6.5 + 420	4520 a	10790 a
+ nicosulfuron + rimsulfuron + atrazine	6.5 + 6.5 + 700	4010 ab	10540 a
+ nicosulfuron + rimsulfuron + atrazine	13 + 13 + 840	4840 a	10800 a
+ nicosulfuron + rimsulfuron + atrazine	13 + 13 + 1120	5280 a	10810 a
Nicosulfuron + rimsulfuron + atrazine	13 + 13 + 840	760 c	10270 ab
S-metolachlor + atrazine PRE	870 + 1100	5010 a	10820 a
S-metolachlor + atrazine PRE fb nicosulfuron + rimsulfuron + atrazine	870 + 1100 fb 13 + 13 + 840	5500 a	11220 a
Nontreated		880 c	2530 d

[a] Abbreviations: POST, postemergence; PRE, preemergence; fb, followed by.
[b] The two locations in 2003 and are designated as 2003a and 2003b.
[c] All POST treatments included 1% v/v crop oil concentrate.
[d] Corn yield averaged over 2003a and 2003b.
[e] Means within a column followed by the same letter are not significantly different, according to Fisher's protected LSD at P = 0.05.