

Chapter VII

Mesotrione, Rimsulfuron plus Thifensulfuron, and Atrazine Mixtures 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 rimsulfuron plus thifensulfuron at full and reduced rates. Treatments were compared to rimsulfuron plus thifensulfuron POST, and *S*-metolachlor plus atrazine preemergence (PRE) alone and followed by (fb) rimsulfuron plus thifensulfuron POST. Corn injury 2 weeks after treatment with POST herbicides (WATP) was less than 15% by all treatments and no response was evident by 4 WATP. All treatments controlled common lambsquarters at 8 WATP greater than 90% except rimsulfuron plus thifensulfuron alone POST, where control was 82%. Common ragweed control was at least 93% when atrazine was included in the POST mixtures. Morningglory species (pitted morningglory and ivyleaf morningglory) control was 74 to 90% with mixtures that included atrazine and control with these mixtures was higher at 2 of 3 locations than by mesotrione or rimsulfuron plus thifensulfuron alone or combined. Rimsulfuron plus thifensulfuron treatments controlled giant foxtail 90 to 99% and the mixture of mesotrione, rimsulfuron plus thifensulfuron at the full rate, and atrazine was the only POST treatment to control large crabgrass 85% or more. *S*-Metolachlor plus atrazine PRE fb rimsulfuron plus thifensulfuron POST controlled common lambsquarters, giant foxtail, and large crabgrass greater than 95%, common ragweed 85 to 99% and morningglory species 75 to 86%. Corn yields were consistently high in all years from *S*-metolachlor plus atrazine PRE alone or fb rimsulfuron plus thifensulfuron POST, mesotrione plus the full rate of rimsulfuron plus thifensulfuron, and mesotrione plus the reduced rate of rimsulfuron plus thifensulfuron plus atrazine. The mixture of mesotrione, rimsulfuron plus thifensulfuron, and atrazine applied in a total POST program can be an effective alternative to a PRE fb POST weed management program.

Nomenclature: Atrazine; mesotrione; rimsulfuron; S-metolachlor; thifensulfuron; common lambsquarters, *Chenopodium album* L. #¹ CHEAL; common ragweed, *Ambrosia artemisiifolia* L. # AMBEL; giant foxtail, *Setaria faberi* Herrm. # SETFA; 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’, ‘Dekalb DKC64-10 (RR2)’.

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, inadequate rainfall following a PRE herbicide application can result in less than optimal weed control due to poor herbicide activation (Tapia et al. 1997). POST herbicides are frequently applied to control weeds which have escaped control by PRE herbicides. 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).

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.

Mesotrione is a PRE or POST triketone herbicide that controls several annual broadleaf weeds, but grass activity is limited (Armel et al. 2003; Beckett et al. 1999; Johnson et al. 1999). Rimsulfuron plus thifensulfuron² is a commercial sulfonylurea herbicide mixture in a 2:1 ratio that controls selected grass and broadleaf weeds POST in corn (Anonymous 2003). Rimsulfuron plus thifensulfuron at the commercial use rate of 12 plus 6 g ai/ha, respectively, controls foxtails (*Setaria* spp.), fall panicum (*Panicum dichotomiflorum* Michx.), barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.], common lambsquarters, pigweed (*Amaranthus* spp.), and velvetleaf (*Abutilon theophrasti* Medicus). Mesotrione and rimsulfuron plus thifensulfuron have not consistently controlled common ragweed (Armel et al 2003; Himmelstein and Durgy 1996; Whaley 2005). Isaacs et al. (2002) reported improved control of common ragweed with tank mixtures of rimsulfuron plus thifensulfuron and other POST herbicides, but giant foxtail control was reduced when applied in mixtures with atrazine. A mixture of mesotrione with atrazine has improved control of common ragweed, morningglory species, and common cocklebur (*Xanthium strumarium* L.) (Johnson et al. 2002; Whaley 2005).

Mixtures of mesotrione, rimsulfuron plus thifensulfuron, and atrazine may enhance control of several weeds including acetolactate synthase- and triazine-resistant species, and may be an economically effective total POST herbicide program. Using mixtures of herbicides with different sites of action and using reduced rates of herbicides in mixtures may prevent or delay the appearance of herbicide resistant weed populations (Duke et al. 1989; Gressel and Stegel 1990). 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 (DeFelice et al. 1989; Devlin et al. 1991; Putnam 1990), but herbicides should be applied when the weeds are young and actively growing (Hagood 1989).

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

An objective of these studies was to evaluate corn injury and control of common lambsquarters, common ragweed, morningglory species, large crabgrass, and giant foxtail in total POST weed management programs with tank-mixtures of mesotrione, the commercial mixture of rimsulfuron plus thifensulfuron, and 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 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 growth stage. Corn hybrids planted were ‘Dekalb DKC64-10 (RR2)’³ in 2002, ‘Dekalb DKC60-09 (RR2)’ in 2003a, and ‘Pioneer 33B51’⁴ in 2003b. Corn was planted 4.0 cm deep at a rate of 57,000 seed/ha (Table 7.1).

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 7.1. No weeds were emerged in 2003b at the time of PRE applications. Weed densities and heights were recorded at time of POST applications (Table 7.2). The experimental design was

³ Monsanto Co., 800 North Lindbergh Boulevard, St. Louis, MO 63167.

⁴ Pioneer Hi-Bred International, Inc., 400 Locust Street, Suite 800, Des Moines, IA 50306-3453.

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

randomized complete block with a three by two factorial treatment arrangement plus controls. Factors were rimsulfuron plus thifensulfuron and atrazine POST at various rates. Factorial treatments included mesotrione POST at 105 g ai/ha, the mixture of rimsulfuron plus thifensulfuron POST at 0 plus 0, 6 plus 3, or 12 plus 6 g/ha, respectively, and atrazine POST at 0 or 560 g ai/ha. Control treatments included rimsulfuron at 12 g/ha plus thifensulfuron at 6 g/ha POST, *S*-metolachlor at 870 g ai/ha plus atrazine at 1100 g ai/ha PRE alone and fb rimsulfuron at 12 g/ha plus thifensulfuron at 6 g/ha POST, 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 evaluations were made on several dates, but only the final evaluation at 8 WATP is presented. Individual weed species evaluations are presented, with the exception of morningglory species. In 2002, pitted and ivyleaf morningglory densities were more uniform throughout the experimental area compared to 2003a and 2003b when 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). Data were also subjected to a factorial analysis of variance to evaluate the significance of rimsulfuron plus thifensulfuron rate and atrazine rate effects. Control treatments were not included in the factorial analyses. These factorial analyses are not shown in the tables but will be discussed where significance occurred. 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

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.

the corn yield analyses. Visual estimates of percent weed control were arcsine transformed, but nontransformed percentages are presented with mean separations based on transformed data. Nontransformed data for corn injury are presented.

RESULTS AND DISCUSSION

Corn Response. No significant treatment by location interaction occurred with corn injury at 2 WATP so data were combined. Corn injury was less than 15% at 2 WATP and was variable among treatments (Table 7.3). Response from mesotrione alone or with atrazine was 7% or less. Others have also reported slight injury from mesotrione at 2 WAT (Armel et al. 2003; Johnson et al. 2002). Mesotrione in mixtures with rimsulfuron plus thifensulfuron with or without atrazine injured corn 9 to 13%. By 4 WATP, no corn injury was evident with any treatment (data not shown).

Weed Control. There was no significant treatment by location interaction for common lambsquarters control so data were combined over locations. There was a significant treatment by location interaction for common ragweed, morningglory species, large crabgrass, and giant foxtail so data are presented by location. Common lambsquarters, common ragweed, and morningglory species were present at all three locations, but large crabgrass and giant foxtail were present at only two locations.

Common lambsquarters. All treatments controlled common lambsquarters 91 to 99% except rimsulfuron plus thifensulfuron alone, where control was 82% (Table 7.3). Others have reported effective common lambsquarters control with POST applications of mesotrione (Armel et al. 2003; Lackey et al. 1999; Menbere and Ritter 2001) or rimsulfuron plus thifensulfuron (Isaacs et al. 2002). Common lambsquarters has been controlled with less than registered rates of thifensulfuron (Fielding and Stoller 1990).

Common ragweed. Common ragweed control with mesotrione at 105 g/ha alone was 29 to 64% at all locations (Table 7.4). Mixing mesotrione with rimsulfuron plus thifensulfuron improved common ragweed control in 2003a and 2003b over mesotrione alone, but control did not exceed 65%. Mixtures with atrazine at 560 g/ha controlled common ragweed at least 93%. Whaley (2005) also reported insufficient common ragweed control with mesotrione alone, but in mixtures with atrazine at 560 g/ha, control was improved to at least 98%. At all locations, the main effect of atrazine rate was

significant for common ragweed control (data not shown). Pooled over atrazine rate, control from treatments without atrazine averaged 68% in 2002, 44% in 2003a, and 47% in 2003b. With atrazine, control averaged greater than 95% at all locations. *S*-Metolachlor plus atrazine PRE controlled common ragweed 70 to 98%, but when fb rimsulfuron plus thifensulfuron control was improved at least 13 percent at two locations. *Morningglory species*. Morningglory species control with mesotrione alone was 68 to 74%, but in mixtures with atrazine, control was 74 to 89% and was improved over mesotrione alone in 2002 and 2003a (Table 7.4). 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).

Rimsulfuron plus thifensulfuron controlled morningglory species less than 55% at all locations and when applied in a mixture with mesotrione without atrazine, control was not improved over mesotrione alone (Table 7.4). Furthermore, the addition of rimsulfuron plus thifensulfuron to the mixture of mesotrione and atrazine improved morningglory species control from 83 to 93% at only one location. At all locations, the main effect of atrazine rate was significant for morningglory species control (data not shown). Averaged over atrazine rate, control was 7 to 23% higher when mixtures included atrazine. Morningglory species were larger at the time of application in 2003b compared to at the other two locations, and there was less of a response from the addition of atrazine. At this location, higher rates of atrazine may have further improved control. Rimsulfuron plus thifensulfuron POST following *S*-metolachlor plus atrazine PRE improved control from 74 to 85% in 2003a, but control was not improved over *S*-metolachlor plus atrazine alone in 2002 and 2003b.

Large crabgrass. Large crabgrass was present only in 2002 and 2003a. *S*-Metolachlor plus atrazine PRE alone or fb rimsulfuron plus thifensulfuron POST controlled large crabgrass 90 to 96% (Table 7.5). Control from POST mesotrione was improved from 66 to 74% in 2002 with the addition of atrazine, but was not improved in 2003. In other research, large crabgrass control was 51 to 76% by mesotrione alone and was not consistently improved when mesotrione was applied in a mixture with atrazine (Whaley 2005). At both locations, the mixture of mesotrione, the full rate of rimsulfuron plus

thifensulfuron, and atrazine was the only POST treatment that controlled large crabgrass at least 85%. Control by all other POST treatments was comparable to or less than mesotrione plus atrazine. At both locations, the main effect of atrazine rate was significant for large crabgrass control (data not shown). Averaged over atrazine rate, mixtures that included atrazine controlled large crabgrass 16 and 3% higher in 2002 and 2003a, respectively, than mixtures without atrazine.

Giant foxtail. Giant foxtail was present only in 2003a and 2003b. Mesotrione alone or with atrazine was not effective for giant foxtail control (Table 7.5). Other researchers have reported insufficient giant foxtail control with mesotrione (Armel et al. 2003; Ohmes et al. 2000; Whaley 2005). Rimsulfuron plus thifensulfuron alone at the full rate controlled giant foxtail 99% at both locations and in mixtures with mesotrione and atrazine control was 93 to 99%. At both locations, rimsulfuron plus thifensulfuron at the reduced rate with mesotrione controlled large crabgrass 98%, but control was 90% when atrazine was included in this mixture. Isaacs et al. (2002) observed reduced giant foxtail control from the registered rate of rimsulfuron plus thifensulfuron applied with atrazine. At both locations, the main effect of rimsulfuron plus thifensulfuron rate was significant for giant foxtail control (data not shown). Averaged over rimsulfuron plus thifensulfuron rate, control was at least 94% with treatments that included either rate of rimsulfuron plus thifensulfuron. *S*-Metolachlor plus atrazine PRE alone controlled giant foxtail 86 to 95%, but control was 99% when fb rimsulfuron plus thifensulfuron.

Corn Yield. At all locations, corn treated with *S*-metolachlor plus atrazine PRE alone or fb rimsulfuron plus thifensulfuron, mesotrione plus the full rate of rimsulfuron plus thifensulfuron, and mesotrione plus the reduced rate of rimsulfuron plus thifensulfuron plus atrazine consistently produced high yields (Table 7.6). Yields from mesotrione were improved at 2 of 3 locations when applied in a mixture with atrazine. In 2002, corn treated with any POST treatment produced similar yields from 3350 to 5720 kg/ha. In 2003a, the main effects of atrazine rate and rimsulfuron plus thifensulfuron rate were significant for corn yield (data not shown). Averaged over atrazine rate, yield was improved from 7870 to 10330 kg/ha when atrazine was included. Yield was also improved by the full rate of rimsulfuron plus thifensulfuron, when averaged over rimsulfuron plus thifensulfuron rate. In 2003b, herbicide mixtures that included either

rate of rimsulfuron plus thifensulfuron produced corn yields similar to *S*-metolachlor plus atrazine PRE alone or fb rimsulfuron plus thifensulfuron.

Corn yields did not reflect late season weed control. It is surprising that some treatments did not effectively control common ragweed or morningglory species but still resulted in high corn yields. This suggests that early season weed competition must have been reduced sufficiently to prevent interference with corn yields. POST applications were made at the V2 to V3 corn stage in our studies. Research has indicated that weed competition in corn should be reduced by the V4 to V5 stage of corn growth for improved yields (Kapusta et al. 1994).

In other research, weed control and yields from corn treated with a total POST program that included mesotrione in mixtures with nicosulfuron plus rimsulfuron and atrazine were comparable to weed control and yields from corn treated by a standard PRE fb POST program (Whaley 2005). In these studies, the greatest benefit of rimsulfuron plus thifensulfuron in mixtures with mesotrione and atrazine was for control of giant foxtail and improved control of large crabgrass compared to mesotrione plus atrazine. Otherwise, mesotrione plus atrazine controlled common ragweed and morningglory species comparable to the PRE fb POST program. More consistent large crabgrass control may require the full rate of rimsulfuron plus thifensulfuron, particularly at high weed densities or weed heights. Reduced herbicide rates may not adequately control annual grasses under high densities (Defelice et al. 1989; O'Sullivan and Bouw 1993). A mixture of mesotrione, rimsulfuron plus thifensulfuron, and atrazine utilized in a total POST program can provide single-pass broad-spectrum weed control and produce corn yields comparable to weed control and yields of corn treated by a PRE or PRE fb POST weed management program.

ACKNOWLEDGMENTS

The authors thank the graduate students and technical support personnel at the Eastern Shore Agricultural Research and Extension Center who assisted with this research.

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Table 7.1. Planting date, herbicide application dates, and corn height and stage at time of applications.^a

	Location ^b		
	2002	2003a	2003b
Planting date	April 24	April 23	April 23
PRE application date	April 26	April 24	May 1
Corn height (cm) at PRE	—	—	1
V-stage	—	—	Spike
POST application date	May 23	May 21	May 16
DAP	29	28	23
Corn height (cm) at POST	25	18	13
V-stage	2	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 7.2. 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	1-10	125	1-10	3	1-8	12	1-10	20	—	—
2003a	1-8	252	5-8	113	1-5	14	1-4	5	3-8	27
2003b	1-5	32	1-5	123	5-10	15	—	—	1-10	91

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

Table 7.3. Corn response 2 WATP and common lambsquarters control 8 WATP from POST mesotrione, rimsulfuron plus thifensulfuron, and atrazine combinations and from PRE *S*-metolachlor plus atrazine alone and fb rimsulfuron plus thifensulfuron POST.^a

Herbicide treatment ^b	Rate g ai/ha	Corn response		Weed control ^c
		2 WAT	%	Common lambsquarters
Mesotrione	105	5 cde ^d		91 b
+ atrazine	560	7 cd		99 a
+ rimsulfuron + thifensulfuron	6 + 3	11 ab		96 ab
+ rimsulfuron + thifensulfuron	12 + 6	13 ab		96 ab
+ rimsulfuron + thifensulfuron + atrazine	6 + 3 + 560	9 bc		99 a
+ rimsulfuron + thifensulfuron + atrazine	12 + 6 + 560	9 bc		99 a
Rimsulfuron + thifensulfuron	12 + 6	14 a		82 c
<i>S</i> -metolachlor + atrazine	870 + 1100	3 e		98 ab
<i>S</i> -metolachlor + atrazine fb rimsulfuron + thifensulfuron	870 + 1100 fb 12 + 6	5 de		99 a
Nontreated ^e		0		0

^a Abbreviations: WATP, weeks after treatment with POST herbicides; POST, postemergence; PRE, preemergence; fb, followed by.

^b All POST treatments included 1% v/v crop oil concentrate.

^c Common lambsquarters control averaged over 2002, 2003a, and 2003b.

^d Means within a column followed by the same letter are not significantly different, according to Fisher's protected LSD at P = 0.05.

^e The nontreated check was not included in the statistical analysis.

Table 7.4. Common ragweed and morningglory species control 8 WATP from POST mesotrione, rimsulfuron plus thifensulfuron, and atrazine combinations and from PRE *S*-metolachlor plus atrazine alone and fb rimsulfuron plus thifensulfuron POST.^{a,b}

Herbicide treatment ^c	Rate g ai/ha	Weed control					
		Common ragweed			Morningglory species ^d		
		2002	2003a	2003b	2002	2003a	2003b
		%					
Mesotrione	105	64 bc ^e	34 f	29 e	68 c	74 cd	72 ab
+ atrazine	560	99 a	96 a	98 a	83 b	89 a	74 ab
+ rimsulfuron + thifensulfuron	6 + 3	68 b	47 de	48 d	65 c	79 bc	69 b
+ rimsulfuron + thifensulfuron	12 + 6	71 b	52 d	65 c	62 c	69 d	68 b
+ rimsulfuron + thifensulfuron + atrazine	6 + 3 + 560	99 a	98 a	98 a	93 a	89 a	77 ab
+ rimsulfuron + thifensulfuron + atrazine	12 + 6 + 560	99 a	93 a	96 a	88 ab	90 a	81 a
Rimsulfuron + thifensulfuron	12 + 6	61 c	38 ef	39 de	35 d	54 e	54 c
<i>S</i> -metolachlor + atrazine	870 + 1100	98 a	70 c	80 b	82 b	74 cd	72 ab
<i>S</i> -metolachlor + atrazine fb rimsulfuron + thifensulfuron	870 + 1100 fb 12 + 6	99 a	85 b	93 a	86 ab	85 ab	75 ab
Nontreated ^f		0	0	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 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 7.5. Giant foxtail and large crabgrass control 8 WATP from POST mesotrione, rimsulfuron plus thifensulfuron, and atrazine combinations and from PRE *S*-metolachlor plus atrazine alone and fb rimsulfuron plus thifensulfuron POST.^{a,b}

Herbicide treatment ^c	Rate g ai/ha	Weed control ^d			
		Large crabgrass		Giant foxtail	
		2003a	2003b	2002	2003a
		%			
Mesotrione	105	66 e ^e	76 c	16 d	15 d
+ atrazine	560	74 d	78 c	41 c	28 c
+ rimsulfuron + thifensulfuron	6 + 3	65 ef	79 c	98 a	98 a
+ rimsulfuron + thifensulfuron	12 + 6	57 g	80 c	99 a	98 a
+ rimsulfuron + thifensulfuron + atrazine	6 + 3 + 560	78 d	82 bc	90 b	90 b
+ rimsulfuron + thifensulfuron + atrazine	12 + 6 + 560	85 c	87 b	97 a	93 ab
Rimsulfuron + thifensulfuron	12 + 6	59 fg	78 c	99 a	99 a
<i>S</i> -Metolachlor + atrazine	870 + 1100	90 b	95 a	86 b	95 ab
<i>S</i> -Metolachlor + atrazine fb rimsulfuron + thifensulfuron	870 + 1100 fb 12 + 6	96 a	96 a	99 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 was present only at 2003 and 2003b. Large crabgrass was present only at 2002 and 2003.

^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 7.6. Corn yield from POST mesotrione, rimsulfuron plus thifensulfuron, and atrazine combinations and from PRE *S*-metolachlor plus atrazine alone and fb rimsulfuron plus thifensulfuron POST.^{a,b}

Herbicide treatment ^c	Rate g ai/ha	Corn yield		
		2002	2003a	2003b
Mesotrione	105	3920 bc ^d	5990 d	8670 b
+ atrazine	560	5400 abc	9870 ab	8700 b
+ rimsulfuron + thifensulfuron	6 + 3	4600 abc	8150 bc	9820 ab
+ rimsulfuron + thifensulfuron	12 + 6	5620 abc	9480 abc	10390 ab
+ rimsulfuron + thifensulfuron + atrazine	6 + 3 + 560	5720 abc	10140 a	10520 ab
+ rimsulfuron + thifensulfuron + atrazine	12 + 6 + 560	4100 bc	10970 a	11230 a
Rimsulfuron + thifensulfuron	12 + 6	3350 cd	7860 cd	9130 ab
<i>S</i> -Metolachlor + atrazine	870 + 1100	6540 ab	9990 ab	10650 ab
<i>S</i> -Metolachlor + atrazine fb rimsulfuron + thifensulfuron	870 + 1100 fb 12 + 6	7400 a	10400 a	11320 a
Nontreated		630 d	1060 e	1620 c

^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 Means within a column followed by the same letter are not significantly different, according to Fisher's protected LSD at P = 0.05.