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Zest Efficacy and Crop Response in Two Acetolactase Synthase-Tolerant Grain Sorghum Hybrids

R.S. Currie and P.W. Geier

Summary

Two ALS-tolerant grain sorghum hybrids were evaluated for efficacy and crop tolerance to Zest (nicosulfuron). Weed control and crop response in two herbicide-tolerant sorghum hybrids were similar. All herbicides controlled kochia, common sunflower, velvetleaf, and quinoa well. Palmer amaranth control was inadequate when no preemergence (PRE) herbicide was applied. Puncturevine and green foxtail control was 90% or more with all Zest (nicosulfuron) treatments applied early postemergence (EPOST) or postemergence (POST). Sorghum injury from the Zest treatments was minor and transient. Relative to the untreated controls, grain yields were greater when a PRE or PRE followed by POST program was used. However, sorghum receiving an EPOST treatment alone yielded no better than the weedy checks.

Introduction

Following the discovery of a wild sorghum biotype with resistance to acetolactase synthase (ALS)-inhibiting herbicides, the development of commercial grain sorghum hybrids with ALS resistance began. Accent (nicosulfuron) is an ALS-inhibiting herbicide commonly used in corn to control grasses and small broadleaf weeds. Prior to the development of ALS-tolerant sorghum, nicosulfuron would have severely injured the crop. However, the use of ALS-inhibiting herbicides may potentially help sorghum producers manage grass weeds that could otherwise go uncontrolled. The objective of this study was to compare two ALS-tolerant grain sorghum hybrids for efficacy and crop tolerance to Zest (nicosulfuron).

Experimental Procedures

Two experiments were conducted at the Kansas State University Southwest Research-Extension Center near Garden City, KS, in 2018 to determine the efficacy of and tolerance to nicosulfuron application timings in two ALS-tolerant sorghum hybrids. One study was planted to sorghum hybrid XSA5527 (Hybrid 1) while the second study was planted to hybrid XSA4820 (Hybrid 2). All herbicide treatments were applied using a tractor-mounted, compressed CO₂ sprayer delivering 19.4 GPA at 4.1 mph and 30 psi. Application, environmental, crop, and weed information is given in Table 1. Natural weed populations were supplemented by overseeding the experimental area with quinoa (to simulate common lambsquarters) and domesticated sunflower (to simulate common sunflower). Soil was a Ulysses silt loam with 3.4% organic matter and pH of 7.9

for both experiments. Grain sorghum necrosis was evaluated visually on July 16, 2018, and stunting was visually estimated on August 16, 2018. These dates were 6 and 37 days after the final herbicide applications (DA-C), respectively. Visual weed control was determined on August 16, 2018 (37 DA-C) as well. Grain yields were measured on October 29, 2018, by mechanically harvesting the center two rows of each plot and adjusting weights to 14.0% moisture.

Results and Discussion

Trends for weed control and crop response were similar between experiments. Kochia, quinoa, and common sunflower control was 90–100% and did not differ between herbicides (data not shown), nor did velvetleaf control (88–99%). Palmer amaranth control was best when Cinch ATZ (*S*-metolachlor/atrazine) was applied PRE or when followed by Zest plus atrazine POST (Table 2). Zest plus atrazine applied EPOST controlled Palmer amaranth only 50%. Cinch ATZ applied alone PRE provided no more than 78% puncturevine and green foxtail control, whereas any Zest treatment applied EPOST or POST controlled these weeds 90–100%. Minor sorghum necrosis (6 DA-C) and stunting (37 DA-C) occurred on each hybrid with POST treatments of Zest plus atrazine (Table 3). Yields were best when Cinch ATZ was applied alone PRE or followed by Zest plus atrazine POST (Table 3). Sorghum receiving Zest plus atrazine EPOST yielded no more than nontreated sorghum, and this was likely due to the poor Palmer amaranth control with this treatment.

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Table 1. Application information

Application timing	Preemergence		Early postemergence		Postemergence	
Sorghum hybrid	XSA5527	XSA4820	XSA5527	XSA4820	XSA5527	XSA4820
Application date	June 5	June 5	July 3	July 3	July 10	July 10
Air temperature (°F)	67	67	80	80	80	80
Humidity (%)	68	68	47	47	52	52
Soil temperature (°F)	69	69	75	75	77	77
Wind speed (mph)	5 to 8	5 to 8	3 to 6	3 to 6	2 to 5	2 to 5
Wind direction	South	South	South	South	South	South
Soil moisture	Good	Good	Good	Good	Good	Good
Grain sorghum						
Height (inch)	---	---	3 to 6	1 to 4	5 to 9	5 to 9
Leaves (number)	0	0	2 to 4	2 to 4	4 to 6	4 to 6
Palmer amaranth						
Height (inch)	---	---	1 to 3	1 to 4	1 to 5	1 to 5
Density (plants/10 feet ²)	0	0	3	5	1	1
Puncturevine						
Height (inch)	---	---	1 to 5	2 to 6	1 to 3	1 to 3
Density (plants/10 feet ²)	0	0	1	1	0.3	0.3
Kochia						
Height (inch)	---	---	1 to 2	1 to 3	1 to 3	1 to 3
Density (plants/10 feet ²)	0	0	0.2	0.1	0.1	0.1
Green foxtail						
Height (inch)	---	---	1 to 3	1 to 4	1 to 3	1 to 2
Density (plants/10 feet ²)	0	0	3	0.1	0.3	0.1
Velvetleaf						
Height (inch)	---	N/A ^a	1 to 3	N/A	1 to 3	N/A
Density (plants/10 feet ²)	0	N/A	0.2	N/A	0.1	N/A
Common sunflower						
Height (inch)	N/A	---	N/A	1 to 3	N/A	1 to 3
Density (plants/10 feet ²)	N/A	0	N/A	0.1	N/A	0.1

^aN/A = weed species not present in that experiment.

Table 2. Efficacy of Zest in two acetolactase synthase-tolerant hybrids^a

Treatment	Rate	Timing ^b	Palmer amaranth		Puncturevine		Green foxtail	
			Hybrid 1 ^c	Hybrid 2 ^d	Hybrid 1	Hybrid 2	Hybrid 1	Hybrid 2
	per acre		----- % Visual -----					
Cinch ATZ	3.2 pt	PRE	80	83	78	65	78	73
Cinch ATZ	2.0 pt	PRE	79	79	98	100	100	93
Zest	0.67 oz	POST						
Atrazine	0.75 qt	POST						
Crop oil concentrate	2.0%	POST						
Ammonium sulfate	2.0 lb	POST						
Cinch ATZ	2.0 pt	PRE	79	78	99	98	100	94
Zest	1.33 oz	POST						
Atrazine	0.75 qt	POST						
Crop oil concentrate	2.0%	POST						
Ammonium sulfate	2.0 lb	POST						
Zest	0.67 oz	EPOST	50	50	100	100	100	90
Atrazine	0.75 qt	EPOST						
Crop oil concentrate	2.0%	EPOST						
Ammonium sulfate	2.0 lb	EPOST						
LSD (0.05)			11	12	6	6	8	11

^aWeed control ratings were taken on August 16, 2018, which was 37 days after postemergence applications.^bPRE = preemergence. EPOST = early postemergence. POST = postemergence.^cHybrid 1 was Pioneer XSA5527.^dHybrid 2 was Pioneer XSA4820.

Table 3. Crop response of two acetolactase synthase-tolerant hybrids receiving Zest treatments

Treatment	Rate	Timing ^c	Necrosis ^a		Stunting ^b		Grain yield	
			Hybrid 1 ^d	Hybrid 2 ^e	Hybrid 1	Hybrid 2	Hybrid 1	Hybrid 2
	per acre		----- % Visual -----				----- bu/a -----	
Cinch ATZ	3.2 pt	PRE	0	0	0	0	55.8	32.0
Cinch ATZ	2.0 pt	PRE	6	10	4	4	42.6	34.9
Zest	0.67 oz	POST						
Atrazine	0.75 qt	POST						
Crop oil concentrate	2.0%	POST						
Ammonium sulfate	2.0 lb	POST						
Cinch ATZ	2.0 pt	PRE	9	9	6	6	47.7	31.9
Zest	1.33 oz	POST						
Atrazine	0.75 qt	POST						
Crop oil concentrate	2.0%	POST						
Ammonium sulfate	2.0 lb	POST						
Zest	0.67 oz	EPOST	1	0	0	0	26.4	14.4
Atrazine	0.75 qt	EPOST						
Crop oil concentrate	2.0%	EPOST						
Ammonium sulfate	2.0 lb	EPOST						
Untreated	---	---	0	0	0	0	22.6	12.3
LSD (0.05)			5	2	NS	5	14.6	7.0

^aNecrosis was evaluated on July 16, 2018, which was 6 days after the postemergence treatments.

^bStunting was evaluated on August 16, 2018, which was 37 days after the postemergence treatments.

^cPRE = preemergence. EPOST = early postemergence. POST = postemergence.

^dHybrid 1 was Pioneer XSA5527.

^eHybrid 2 was Pioneer XSA4820.

Figure 1. Untreated control.

Figure 2. Cinch ATZ 3.2 pt/a applied preemergence, picture taken 59 days after the pre-emergence treatment.

Figure 3. Cinch ATZ 2.0 pt/a applied preemergence followed by Zest 0.67 oz/a plus atrazine 0.75 qt/a postemergence, picture taken 24 days after postemergence treatment.

Figure 4. Cinch ATZ 2.0 pt/a applied preemergence followed by Zest 1.33 oz/a plus atrazine 0.75 qt/a postemergence, picture taken 24 days after postemergence treatment.

Figure 5. Zest 0.67 oz/a plus atrazine 0.75 qt/a applied early postemergence, picture taken 31 days after early postemergence treatment.