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Abstract

Acetolactase synthase inhibiting (ALS) herbicides were evaluated for efficacy in ALS-resistant grain sorghum. Kochia and quinoa control were similar among all herbicides tested regardless of evaluation date. Cinch ATZ alone preemergence, and Cinch plus Resolve and Harmony GT PRE followed by Zest POST controlled puncturevine 73-78%. Late-season green foxtail control was best when Zest was included as an early postemergence or postemergence application. Cinch ATZ applied alone preemergence, Cinch ATZ preemergence followed by Zest POST, and Cinch plus Resolve and Harmony GT PRE followed by Zest POST controlled Palmer amaranth 81–84%, and resulted in the highest grain yields.

Keywords

herbicide-tolerant sorghum

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R.S. Currie and P.W. Geier

Summary

Acetolactase synthase inhibiting (ALS) herbicides were evaluated for efficacy in ALS-resistant grain sorghum. Kochia and quinoa control were similar among all herbicides tested regardless of evaluation date. Cinch ATZ alone preemergence, and Cinch plus Resolve and Harmony GT PRE followed by Zest POST controlled puncturevine 73-78%. Late-season green foxtail control was best when Zest was included as an early postemergence or postemergence application. Cinch ATZ applied alone preemergence, Cinch ATZ preemergence followed by Zest POST, and Cinch plus Resolve and Harmony GT PRE followed by Zest POST controlled Palmer amaranth 81–84%, and resulted in the highest grain yields.

Introduction

Nicosulfuron is an acetolactase synthase inhibiting (ALS) herbicide that has long been used to control grass weeds in corn under the brand name Accent. Many of the ALS herbicides severely injure or kill sorghum species, including shattercane, johnsongrass, and grain sorghum. The evolution of shattercane with resistance to ALS herbicides allowed for development of commercial sorghum hybrids with this same resistance and the potential to use ALS herbicides to control nonresistant weed species in sorghum. Therefore, the objective of this study was to evaluate the ALS herbicides Zest (nicosulfuron), Resolve (rimsulfuron), and Harmony GT (thifensulfuron) for efficacy in ALS-resistant grain sorghum.

Experimental Procedures

An experiment conducted at the Kansas State University Southwest Research-Extension Center near Garden City, KS, evaluated nicosulfuron-containing herbicide treatments for efficacy and crop tolerance in ALS-resistant grain sorghum. Herbicides were applied preemergence (PRE), PRE followed by postemergence (POST), or early postemergence (EPOST). A tractor-mounted, compressed-CO₂ sprayer delivering 19.4 GPA at 3.0 mph and 30 psi was used to apply all herbicides. Application, environmental, crop, and weed information are given in Table 1. Natural weed populations were supplemented by overseeding the experimental area with quinoa (to simulate common lambsquarters). Soil was a Ulysses silt loam containing 3.4% organic matter and pH 7.9. Plots were 10 × 32 feet and arranged in a randomized complete block with four replications. Weed control was visually determined on July 16 and August 16, 2018, which

were 6 and 37 days after the POST treatments (DA-C), respectively. Grain sorghum necrosis was determined on July 6 and July 16, 2018, which was 3 days after the EPOST treatments (DA-B) and 6 DA-C, respectively. Grain yields were determined on October 29, 2018, by mechanically harvesting the center two rows of each plot and adjusting weights to 14.0% moisture.

Results and Discussion

All herbicides controlled kochia 88–100% and quinoa 98–100% regardless of evaluation date, and did not differ between herbicides (data not shown). Palmer amaranth control was best when Cinch ATZ (*S*-metolachlor/atrazine) was applied PRE alone, Cinch ATZ PRE was followed by Zest POST, and when Cinch (*S*-metolachlor) plus Resolve and Harmony GT PRE was followed by Zest POST (Table 2). At 37 DA-C, puncturevine control exceeded 90% with all herbicides except Cinch ATZ alone PRE or Resolve plus Harmony GT and atrazine PRE followed by Zest and atrazine POST. All herbicide combinations that included Zest either EPOST or POST controlled green foxtail 93% or more at 37 DA-C. Grain sorghum necrosis at 3 DA-B was 18% with the EPOST treatment of Cinch ATZ, Zest, and atrazine, but decreased to 6% by 6 DA-C (Table 3). Necrosis was also less than 10% with the other Zest treatments at 6 DA-C. Grain yields increased by 22–43 bu/a with most herbicide treatments compared to the nontreated controls (Table 3). However, sorghum receiving Resolve plus Harmony GT and atrazine PRE followed by Zest and atrazine POST, yielded similarly to the nontreated controls.

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.

Table 1. Application information

Application timing	Preemergence	Early postemergence	Postemergence
Application date	June 6, 2018	July 3, 2018	July 10, 2018
Air temperature (°F)	67	80	80
Relative humidity (%)	68	47	52
Soil temperature (°F)	69	75	77
Wind speed (mph)	5 to 8	4 to 6	2 to 5
Wind direction	South	South	South
Soil moisture	Good	Good	Good
Grain sorghum			
Height (inch)	---	3 to 6	5 to 9
Leaves (number)	0	2 to 4	4 to 6
Palmer amaranth			
Height (inch)	---	1 to 4	1 to 5
Density (plants/10 feet ²)	0	2.5	1.0
Puncturevine			
Height (inch)	---	1 to 5	1 to 3
Density (plants/10 feet ²)	0	1.0	0.3
Quinoa			
Height (inch)	---	1 to 3	---
Density (plants/10 feet ²)	0	0.2	0
Kochia			
Height (inch)	---	1 to 3	---
Density (plants/10 feet ²)	0	0.2	0
Green foxtail			
Height (inch)	---	1 to 3	1 to 3
Density (plants/10 feet ²)	0	1.0	0.2

Table 2. Efficacy of Zest application timings in grain sorghum

Treatment ^a	Rate	Timing ^b	Palmer amaranth		Puncturevine		Green foxtail	
			6 DA-C ^c	37 DA-C	6 DA-C	37 DA-C	6 DA-C	37 DA-C
	per acre		----- % Visual -----					
Cinch ATZ	3.2 pt	PRE	79	84	78	73	91	78
Resolve	1.0 oz	PRE	50	50	100	78	91	93
Harmony GT	0.25 oz	PRE						
Atrazine	0.75 qt	PRE						
Zest	0.67 oz	POST						
Atrazine	0.75 qt	POST						
COC	2.0%	POST						
AMS	2.0 lb	POST						
Cinch	1.33 pt	PRE	78	81	83	97	93	100
Resolve	1.0 oz	PRE						
Harmony GT	0.25 oz	PRE						
Zest	0.67 oz	POST						
COC	2.0%	POST						
AMS	2.0 lb	POST						
Cinch ATZ	2.0 pt	PRE	78	83	100	94	91	100
Zest	0.67 oz	POST						
Atrazine	0.75 qt	POST						
COC	2.0%	POST						
AMS	2.0 lb	POST						
Cinch ATZ	3.2 pt	EPOST	60	53	83	94	91	98
Zest	0.67 oz	EPOST						
Atrazine	0.75 qt	EPOST						
COC	2.0%	EPOST						
AMS	2.0 lb	EPOST						
LSD (0.05)			9	7	7	12	NS	7

^aCOC = crop oil concentrate. AMS = ammonium sulfate.

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

^cDA-C = days after the postemergence treatments.

Table 3. Grain sorghum response to Zest application timings

Treatment ^a	Rate	Timing ^b	Necrosis		Grain yield
			3 DA-B ^c	6 DA-C ^d	
	per acre		----- % Visual -----		bu/a
Cinch ATZ	3.2 pt	PRE	0	0	55.1
Resolve	1.0 oz	PRE	0	5	23.7
Harmony GT	0.25 oz	PRE			
Atrazine	0.75 qt	PRE			
Zest	0.67 oz	POST			
Atrazine	0.75 qt	POST			
COC	2.0%	POST			
AMS	2.0 lb	POST			
Cinch	1.33 pt	PRE	0	1	57.4
Resolve	1.0 oz	PRE			
Harmony GT	0.25 oz	PRE			
Zest	0.67 oz	POST			
COC	2.0%	POST			
AMS	2.0 lb	POST			
Cinch ATZ	2.0 pt	PRE	0	9	55.1
Zest	0.67 oz	POST			
Atrazine	0.75 qt	POST			
COC	2.0%	POST			
AMS	2.0 lb	POST			
Cinch ATZ	3.2 pt	EPOST	18	6	36.2
Zest	0.67 oz	EPOST			
Atrazine	0.75 qt	EPOST			
COC	2.0%	EPOST			
AMS	2.0 lb	EPOST			
Untreated			0	0	14.0
LSD (0.05)			2	4	10.9

^aCOC = crop oil concentrate. AMS = ammonium sulfate.

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

^cDA-B = days after the early postemergence treatments.

^dDA-C = days after the postemergence treatments.



Figure 1. Untreated control.



Figure 2. Cinch ATZ 3.2 pt/a applied preemergence, picture taken 58 days after preemergence treatment.



Figure 3. Resolve 1.0 oz/a plus Harmony GT 0.25 oz/a applied preemergence followed by atrazine 0.75 qt/a plus Zest 0.67 oz/a applied postemergence, picture taken 24 days after postemergence treatment.



Figure 4. Cinch 1.33 pt/a plus Resolve 1.0 oz/a plus Harmony GT 0.25 oz/a applied pre-emergence followed by Zest 0.67 oz/a applied postemergence, picture taken 24 days after postemergence treatment.



Figure 5. Cinch ATZ 2.0 pt/a applied preemergence followed by Zest 0.67 oz/a plus atrazine 0.75 qt/a applied postemergence, picture taken 24 days after postemergence treatment.



Figure 6. Cinch ATZ 3.2 pt/a plus Zest 0.67 oz/a plus atrazine 0.75 qt/a applied early postemergence, picture taken 31 days after early postemergence treatment.