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Summary

Grass weed control in sorghum has been a serious challenge for sorghum growers. The newly developed herbicide-tolerant (HT) sorghum technologies such as igrowth, Inzen, and Double Team sorghum will allow growers to use IMIFLEX, Zest WDG, and FirstAct respectively, for in-season weed control. However, the adoption of these HT sorghum technologies may increase the use of these labeled herbicides and increase the likelihood of herbicide drift or tank contamination to conventional sorghum. Three separate field studies were conducted at Kansas State University Agricultural Research Center (KSU-ARCH) near Hays, KS, to understand the response of conventional sorghum to various rates of IMIFLEX, Zest WDG, and FirstAct applied at two different growth stages. Results indicated that field-use rates (1X) of IMIFLEX, Zest WDG, and FirstAct resulted in 90 to 100% injury and complete or near-complete grain yield loss of conventional sorghum. In addition, low rates of Zest WDG (as low as 1/50X) and FirstAct (as low as 1/10X) also caused significant injury and grain yield loss of conventional sorghum. In conclusion, these results suggested that either drift or tank-contamination of these herbicides (even at low rates) can cause significant injury or grain yield loss of conventional sorghum. Proper adherence to the stewardship guidelines are necessary to avoid the drift or tank-contamination from these herbicides to conventional sorghum.

Introduction

Sorghum ranks after wheat, corn, and soybean as the fourth most planted crop in Kansas. It is a C₄ plant with high tolerance to heat and drought conditions. Weed control, especially for grass species, has been a serious challenge to growers.

Three HT sorghum technologies, including igrowth, Inzen, and Double Team have recently been developed. The newly developed HT sorghum technologies offer producers postemergence (POST) herbicide options for in-season weed control. Advanta Seeds developed igrowth sorghum. It has tolerance to IMIFLEX herbicide (imazamox, an active ingredient). Inzen sorghum is developed by Pioneer and provides tolerance to Zest WDG herbicide (nicosulfuron, an active ingredient). Both herbicides belong to acetolactate synthase (ALS) inhibitors (Group 2). Double Team sorghum is developed by S&W Seed Co. and carries tolerance to FirstAct herbicide (quizalofop-p-ethyl, an active ingredient). FirstAct is an acetyl-CoA-carboxylase (ACCase) inhibitor (Group 1).

Adoption of these HT sorghum technologies will increase the use of these labeled herbicides and may potentially increase the physical drift and/or tank contamination to nearby conventional sorghum. The objective of this study was to understand the response of conventional sorghum to various rates of IMIFLEX, Zest WDG, and FirstAct at two different sorghum growth stages.

Procedures

Three separate field studies were conducted in the 2021 growing season at the KSU-ARCH near Hays, KS. Conventional sorghum hybrid 'DKS 38-16' was planted at 46,500 seeds/a on June 8, 2021. Randomized complete block design was used in each experiment. Six rates of IMIFLEX, Zest WDG, and FirstAct, including 1/200X, 1/100X, 1/50X, 1/25X, 1/2X, and 1X (field-use rates of IMIFLEX = 6 fl oz/a; Zest WDG = 1.33 oz/a, and FirstAct = 10 fl oz/a) were separately tested at early (3- to 5-leaf, EPOST) and late (flag leaf, LPOST) growth stage of sorghum. A nontreated check was also included in each experiment. All herbicide applications were carried out using a CO₂-operated backpack sprayer equipped with Turbo Teejet AIXR 110015 nozzles and calibrated to deliver 15 gallons of spray solution per acre. Appropriate adjuvants were used for each herbicide as dictated by the herbicide label. Experimental areas were maintained weed free throughout the season to ensure no weed competition. Data on sorghum visual injury (%) were collected at biweekly intervals and grain yields were recorded at harvest. All data were subjected to ANOVA using Proc GLM in SAS program. Means were separated using Fisher's LSD test ($\alpha = 0.05$).

Results

Response to IMIFLEX Herbicide

Results indicated that 3 to 6 fl oz/a rate of IMIFLEX applied across both growth stages resulted in 70 to 90% sorghum injury at the time of crop maturity. Consistent with percent visual injury, 64 to 98% grain yield loss of conventional sorghum was observed when exposed to 3 to 6 fl oz/a rates of IMIFLEX herbicide (Table 1). No significant crop injury was observed with low tested rates (1/200 to 1/25X) of IMIFLEX (Table 1).

Response to Zest WDG Herbicide

Results showed that conventional sorghum injury (%) ranged from 79 to 100% when exposed to Zest WDG at 1/50 X up to 1X rate (1X = 1.33 oz/a) regardless of application timing (Table 2). Zest WDG applied at field-use rate (1X) resulted in complete or near-complete grain yield loss regardless of application timing (Table 2).

Response to FirstAct Herbicide

Results showed that exposure of FirstAct herbicide applied at 1/10X to 1X field use rate (10 fl oz/a), resulted in 63 to 100% crop injury and 38 to 100% grain yield loss regardless of application timing (Table 3).

Conclusions

These results suggested that drift and/or tank-contamination of IMIFLEX, Zest WDG, and FirstAct even at low rates can cause significant injury and grain yield loss of conventional sorghum. Growers adopting the new sorghum technologies should be proactive

and follow the stewardship guidelines to avoid drift and/or tank-contamination from these herbicides to conventional sorghum.

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Table 1. Crop injury (%) at maturity and grain yield response of conventional sorghum to different rates of IMIFLEX applied at two timings

Dose (fl oz/a) ^a	Application timing ^b	Injury (%) ^c	Yield (bu/a) ^d
Nontreated	---	0 d	93 a
0.03	EPOST	1 d	79 a
0.06	EPOST	2 d	90 a
0.12	EPOST	4 d	91 a
0.24	EPOST	2 d	86 a
3.00	EPOST	70 c	33 b
6.00	EPOST	90 a	8 c
0.03	LPOST	1 d	90 a
0.06	LPOST	1 d	97 a
0.12	LPOST	3 d	87 a
0.24	LPOST	3 d	88 a
3.00	LPOST	80 b	16 bc
6.00	LPOST	85 ab	1 c

^aHerbicide treatments were applied with appropriate adjuvants as dictated by IMIFLEX label using a backpack sprayer equipped with AIXR 110015 nozzles.

^bEPOST = early (3- to 5-leaf). LPOST = late (flag leaf).

^{c,d}Means within each column having same letters were not significantly different according to Fisher's protected LSD test ($P < 0.05$).

Table 2. Crop injury (%) at maturity and grain yield response of conventional sorghum to different rates of Zest WDG applied at two timings.

Dose (oz/a) ^a	Application timing ^b	Injury (%) ^c	Yield (bu/a) ^d
Nontreated	---	0 e	78 a
0.007	EPOST	1 e	77 a
0.013	EPOST	3 e	74 a
0.027	EPOST	85 cd	16 b
0.133	EPOST	100 a	2 c
0.665	EPOST	91 bc	1 c
1.330	EPOST	98 ab	1 c
0.007	LPOST	2 e	77 a
0.013	LPOST	2 e	74 a
0.027	LPOST	82 d	2 c
0.133	LPOST	89 cd	0 c
0.665	LPOST	88 cd	0 c
1.330	LPOST	90 c	0 c

^aHerbicide treatments were applied with appropriate adjuvants as dictated by Zest WDG label using a backpack sprayer equipped with AIXR 110015 nozzles.

^bEPOST = early (3- to 5-leaf). LPOST = late (flag leaf).

^{c,d}Means within each column having same letters were not significantly different according to Fisher's protected LSD test ($P < 0.05$).

Table 3. Crop injury at maturity and grain yield response of conventional sorghum to different rates of FirstAct applied at two timings

Dose (fl oz/a) ^a	Application timing ^b	Injury (%) ^c	Yield (bu/a) ^d
Nontreated	---	0 d	86 a
0.05	EPOST	3 d	78 ab
0.1	EPOST	3 d	76 ab
0.2	EPOST	5 d	63 bc
1	EPOST	83 b	26 d
5	EPOST	100 a	1 e
10	EPOST	100 a	0 e
0.05	LPOST	3 d	82 a
0.1	LPOST	3 d	83 a
0.2	LPOST	4 d	79 ab
1	LPOST	63 c	53 c
5	LPOST	96 a	2 e
10	LPOST	100 a	0 e

^aHerbicide treatments were applied with appropriate adjuvants as dictated by FirstAct label using a backpack sprayer equipped with AIXR 110015 nozzles.

^bEPOST = early (3- to 5-leaf). LPOST = late (flag leaf).

^{c,d}Means within each column having same letters were not significantly different according to Fisher's protected LSD test ($P < 0.05$).