

Texas A&M AgriLife 2020-2021 Bushland Grain and Forage Sorghum Herbicide Trials



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Introduction

Over-the-top herbicide technologies will provide sorghum producers more weed control options. New herbicide tolerant sorghum hybrids and herbicides prevent weeds from using valuable crop water and nutrients that are necessary to optimize yields and maintain profit margins. Although three herbicides are available to sorghum producers on the Texas High Plains, not all technologies were readily available for the 2020 and 2021 Texas A&M AgriLife herbicide trials.

The three technologies are from Corteva, Alta Seed, and Sorghum Partners. Each of these companies have developed sorghum varieties that are resistant to over-the-top herbicide applications for broadleaf and grassy weed control. The herbicide Zest WDG from Corteva/Pioneer was approved by EPA in 2016 for use in sorghum with the Inzen® trait. Inzen sorghum is non-transgenic, ALS-tolerant, for post-emergent grass control in sorghum. Inzen sorghum is not commercially available. Although Inzen hybrids and the Zest herbicide were not evaluated in the 2020 or 2021 herbicide trials, experimental hybrids and Inzen were evaluated in 2015 and 2018 Texas A&M AgriLife trials. Igrowth grain sorghum was commercially launched in 2021 and is a non-transgenic imidazoline tolerant grain and forage sorghum from Alta Seeds. The igrowth® program allows for the post-emergent imidazoline herbicide (Imiflex) to be used to control broadleaf and grassy weeds in pre- or post-emergent sorghum. These three new herbicide technologies are not labeled for Johnsongrass (Sorghum halepense) or Shattercane (Sorghum bicolor) control in sorghum. Sorghum Partners developed an herbicide resistant sorghum that is tolerant to Quizalofop and branded as Double TeamTM sorghum. This sorghum is non-transgenic and resistant to Acetyl CoA Carboxylase (ACCase) inhibiting herbicides. Double Team Sorghum will be commercially available for the 2022 growing season.

Resistant and herbicide tolerant weed species have become a problem in the Texas High Plains. Hard to control weeds require critical evaluation of herbicide programs that include preplant burndown, use of residual herbicides, and the timing of in-season applications as well as using labeled application volumes. Commercially available herbicides are evaluated in the Texas A&M AgriLife herbicide trials at Bushland in order to evaluate herbicide efficacy under regional conditions. This publication includes herbicide tank-mixes evaluated in grain and forage sorghum trials at the Texas A&M AgriLife James Bush Research Farm and the USDA-ARS Conservation and Research Production Laboratory at Bushland, Texas. Herbicides used in these trials are marketed for Texas High Plains production and approved for use in the respective crops in Texas by the United States Environmental Protection Agency.

Section 1. 2020-2021 Grain and Forage Sorghum Herbicide Trials

Industry partners for the 2020 and 2021 sorghum herbicide trials included Bayer, Corteva, and UPL (Tables 1-7). Treatments were replicated in the Bayer and Corteva trials using a commercially available grain sorghum hybrid Dekalb DKS37-07. The UPL trials evaluated a new pre- and post-emergent herbicide in an igrowth[®] grain sorghum ADVXG390IG (an imidazoline tolerant grain sorghum hybrid) from Alta Seeds that was not commercially available in 2020 but was launched commercially in 2021. In the 2021 UPL trials, igrowth grain sorghum hybrid ADVG2193IG and forage sorghum ADV2450IG were used for the efficacy trials.

The igrowth[®] program allows for post-emergent imidazoline herbicide (Imiflex) to be used to control broadleaf and grassy weeds in imidazoline tolerant sorghum. The Imiflex herbicide can be used pre or post sorghum emergence and has good residual control of weeds. Imiflex can be applied at a rate of 9 oz/acre as a pre-emergent or 6 oz/acre as a post-emergent, but not both. There is an 18-month sorghum plant-back restriction when using igrowth grain or forage sorghums.

Herbicide efficacy plots were fertilized, irrigated at a deficit rate, and conventionally tilled. All plots were swept and bedded to ensure a clean field prior to planting. All herbicide applications were sprayed with an application volume of 15 gallons/acre with a Lee Agra Spider broadcast sprayer using flat-fan nozzles at 40 PSI on 15-inch spacings. All treatments were assessed against an untreated check, to evaluate herbicide efficacy and crop phytotoxicity. Reported weed control is an average of ratings for all plots within a treatment at a specified number of days post herbicide application. Sorghum hybrids were planted on June 5, 2020, and June 9, 2021. There were 6 irrigation events for the 2020 season totaling 11.9 inches of applied water with 3.9 inches of rainfall from June 6 to August 19 when the trial was terminated. There were 3 irrigation events for the 2021 season totaling 8 inches of applied water with 10 inches of rainfall from June 9 to August 18 when the trial was terminated. In 2020 preemergent applications were applied on June 10 and post-emergent applications, at the 2-4 inch weed stage, were applied on July 1, 2020. Three treatments in the igrowth grain sorghum (2020) had a 19-day preplant herbicide (S-metolachlor + Mesotrione) applied on May 21, 2020. In 2021 pre-emergent applications were applied on June 10 and post-emergent applications, at the 2-4 inch weed stage, were applied on July 1, 2021. In addition to the grain sorghums used in the 2021 trials, an Alta Seeds igrowth imidazoline tolerant forage sorghum was also evaluated Different tank mixes and herbicide application timings were evaluated across all trials. Plots were rated every 7-10 days during the growing season. Yield is not a component for these trials and is not reported. There was no observable phytotoxicity after 30 days in any trial, when herbicides were applied at the recommended rates, and most trials had no observable phytotoxicity from herbicide applications.

Weed Species Targeted

Weeds targeted in the Bushland herbicide trials include redroot pigweed (Amaranthus retroflexus), Palmer Amaranth (Amaranthus palmeri), tumble pigweed (Amaranthus albus), kochia (Kochia scoparia), Russian thistle (Salsola ibercia), barnyardgrass (Echinochloa crus-galli), windmill grass (Chloris verticillata), and witchgrass (Panicum capillare). Weed populations vary between years. Primary weeds targeted in the 2020-2021 herbicide plots established in May, and June, were the Amaranthus species, Kochia, and grass weeds across all plots.

Acknowledgements

We gratefully acknowledge the assistance of students Shelby Lain, and Garyn Bigham with herbicide applications and plot maintenance.

Table 1. igrowth 2020 Bushland Sorghum Herbicide Trial

Pr	Primary Company Protocol - igrowth - Sorghum ADVXG390IG planted on 6-5-20				% Co days a days a	ntrol after I fter P	Pre	77 36 (% Co days a days a	ntrol after F	Pre	% Control 90 days after Pre 49 days after Post				
	Treatment	Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
1	Untreated Check	NA	NA													
	ImiFlex	9 fl oz/a	Dra Onlantina	10	00	00	07									
2	Atrazine	1 qt/a	Pre @planting	10	98	99	97									
2	2,4-D	8 fl oz/a	Post 2-4" weeds					0	07	05	07	~	07	05	07	
			sorg at 4-5 leaf					0	87	85	97	0	87	85	97	
	ImiFlex	9 fl oz/a	Dro Onlanting	10	100	00	00									
2	Mocassin II Plus	1 pt/a	Pre @planting	10	100	98	99									
3	Atrazine	1 qt/a	Post 2-4" weeds				~~~~~	•				•			00	
	сос	1%v/v	sorg at 4-5 leaf					0	99	92	99	0	99	90	99	
	ImiFlex	9 fl oz/a	Pre @planting	10	98	81	94									
4	Atrazine	1 qt/a	Post 2-4" weeds					•	00	<i></i>	02	•	00	C1	02	
	сос	1%v/v	sorg at 4-5 leaf					0	90	66	93	0	90	61	93	
	Mocassin II Plus	1 pt/a	Dro Onlanting	10	100	00	100									
_	Atrazine	1 qt/a	Pre @planting	10	100	98	100									
5	ImiFlex	6 fl oz/a	Post 2-4" weeds					0	00	07	100	~	00	04	100	
	сос	1%v/v	sorg at 4-5 leaf					0	99	97	100	0	99	94	100	
	Mocassin II Plus	1 pt/a	Dro Onlanting	10	05	02	05									
	Atrazine	1 qt/a	Pre @planting	10	95	95	95									
6	ImiFlex	6 fl oz/a	Post 2-4" weeds					•	05	00	02	•	05	00	02	
	2,4-D	8 fl oz/a	sorg at 4-5 leaf					0	95	88	93	0	95	80	92	
	Coyote	2 qt/a	15 days pre-plant	10	99	99	100									
7	ImiFlex	6 fl oz/a	Post 2-4" weeds					0	00	05	100	0	00	05	100	
	СОС	1% v/v	sorg at 4-5 leaf					0	99	95	100	0	99	95	100	
	Coyote	2 qt/a	15 days pre-plant	10	100	100	100									
0	ImiFlex	6 fl oz/a	Doct 2 4" woods													
0	Atrazine	1 qt/a	Post 2-4 weeus					0	100	100	100	0	100	100	100	
	СОС	1%v/v	solg at 4-5 leal													
	Coyote	2 qt/a	15 days pre-plant	10	100	100	99									
9	ImiFlex	6 fl oz/a	Post 2-4" weeds					0	100	100	100	0	100	00	100	
	2,4-D	8 fl oz/a	sorg at 4-5 leaf					0	100	100	100	0	100	99	100	
	Mocassin II Plus	1 pt/a	Pre Onlanting	10	100	98	98									
10	Atrazine	1 qt/a	The explanting	10	100											
10	2,4-D	8 fl 07/2	Post 2-4" weeds					0	100	05	96	0	100	05	96	
		8 H 02/a	sorg at 4-5 leaf					0	100	55	50	0	100	95	90	
	Bicep Lite 2 Mag.	1.5 qt/a	Pre @planting	10	100	100	100									
11	Huskie	13 fl oz/a	Post 2-4" weeds													
	NIS	0.25 % v/v	sorg at 4-5 leaf					0	100	100	100	0	100	100	100	
	AMS	4.75 lb/a	Joing at 4-5 ledi													

Table 2. igrowth 2021 Bushland Sorghum Herbicide Trial

Р	Primary Company Protocol - igrowth - Sorghum ADVG2193IG planted on 6-9-21					ntrol Ifter I	Pre ost	41 (20 c	% Cor days a lays at	ntrol fter F fter P	Pre ost	% Control 61 days after Pre 40 days after Post				
	Treatment	Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
1	Untreated Check	NA	NA													
	ImiFlex	9 fl oz/a	Pro Onlanting	0	100	96	100									
2	Atrazine	1 qt/a	Fie @planting	0	100	50	100									
2	2,4-D	0.5 pt/a	Post 2-4" weeds sorg at 4-5 leaf					0	100	77	100	0	100	67	100	
	ImiFlex	9 fl oz/a	Dra Qulantina	0	100	00	100									
2	Motif	6 fl oz/a	Pre @planting	0	100	98	100									
3	Atrazine	1 qt/a	Post 2-4" weeds					0	100	01	100	0	100	OE	100	
	сос	1 % v/v	sorg at 4-5 leaf					0	100	91	100	0	100	85	100	
	ImiFlex	9 fl oz/a	Pro Onlanting	0	100	96	100									
4	Sharpen	1 fl oz/a	Pre @planting 0	0	100	30	100									
4	Atrazine	1 qt/a	Post 2-4" weeds					0	90	72	100	0	90	53	100	
	COC	1%v/v	sorg at 4-5 leaf					0	99	72	100	0	99	55	100	
	ImiFlex	9 fl oz/a	Pre Onlanting	0	100	98	100									
5	Moccasin II Plus	1.3 pt/a			100		100									
	Atrazine	1 qt/a	Post 2-4" weeds					0	100	92	100	0	100	82	100	
	COC	1%v/v	sorg at 4-5 leaf					Ŭ	100	52	100	U	100	02	100	
	ImiFlex	9 fl oz/a	Pre @planting	0	100	92	100									
6	Atrazine	1 qt/a	Post 2-4" weeds													
	COC	1 % v/v	sorghum at V4					0	100	30	100	0	100	7	100	
	UAN	2.5 % v/v	Joighum ut V4													
	ImiFlex	9 fl oz/a	_													
	Moccasin II Plus	1.3 pt/a	Pre @planting	0	100	98	100									
7	Motif	6 fl oz/a														
	Atrazine	1 qt/a	Post 2-4" weeds					0	100	91	100	0	100	84	100	
	COC	1%v/v	sorg at 4-5 leaf						100	51	100	5	100		100	

Table 2 (cont). igrowth 2021 Bushland Sorghum Herbicide Trial

P	Primary Company Protocol - igrowth - Sorghum ADVG2193IG planted on 6-9-21					ntrol Ifter Ter P	Pre ost	41 20 (% Co days a days a	ntrol after fter F	Pre Post	% Control 61 days after Pre 40 days after Post				
	Treatment	Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
	Moccasin II Plus	1.3 pt/a	15 days pre-plant	0	100	98	100									
	Motif	6 fl oz/a	15 days pre plane		100		100									
8	ImiFlex	6 fl oz/a	Post 2-4" weeds													
	СОС	1 % v/v	sorghum at V4					0	100	94	100	0	100	91	100	
	UAN	2.5 % v/v	Solghum at V4													
	Moccasin II Plus	1.3 pt/a	15 days pre-plant	0	100	94	100									
	Sharpen	1 fl oz/a	15 days pre plant		100		100									
9	ImiFlex	6 fl oz/a														
	Atrazine	1 qt/a	Post 2-4" weeds					0	100	02	100	0	100	07	100	
	сос	1 % v/v	sorg at 4-5 leaf					0	100	92	100	0	100	02	100	
	UAN	2.5 % v/v														
	Moccasin II Plus	1.3 pt/a	Pre Onlanting	0	100	96	100									
	Motif	6 fl oz/a	Fie @planting	0	100	90	100									
10	ImiFlex	6 fl oz/a														
10	Atrazine	1 qt/a	Post 2-4" weeds					0	100	00	100	0	100	06	100	
	сос	1 % v/v	sorg at 4-5 leaf					0	100	90	100	0	100	90	100	
	UAN	2.5 % v/v														
	Moccasin II Plus	1.3 pt/a	Dra Oplanting	0	100	07	100									
11	Atrazine	1 qt/a	Pre @planting	0	100	97	100									
11	Huskie	14 fl oz/a	Post 2-4" weeds					0	100	00	100	0	100	05	100	
	AMS	1lb/a	sorg at 4-5 leaf					0	100	98	100	0	100	95	100	
	Moccasin II Plus	1.3 pt/a	Dra Oplanting	0	100	07	100									
	Atrazine	1 qt/a	Pre @planting	0	100	97	100									
12	ImiFlex	6 fl oz/a	Deet 2 All													
	Huskie	14 fl oz/a	Post 2-4" weeds					0	100	99	100	0	100	99	100	
	AMS	1lb/a	sorg at 4-5 leaf													

Table 3. igrowth 2021 Bushland Forage Sorghum Herbicide Trial

1	Primary Company Protocol - igrowth - Forage Sorghum ADV2450IG planted on 6-9-21					ntrol ofter I ter P	Pre ost	41 20 (% Co days a days a	ntrol after I fter P	Pre	% Control 61 days after Pre 40 days after Post				
	Treatment	Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
1	Untreated Check	NA	NA													
2	ImiFlex Atrazine	9 fl oz/a 1 qt/a	Pre @planting	0	100	99	100									
	Huskie AMS	14 fl oz/a 1 lb/a	Post 2-4" weeds forage at 4-5 leaf	orage at 4-5 leaf				0	100	100	100	0	100	100	100	
	ImiFlex Moccasin II Plus	9 fl oz/a 1.3 pt/a	Pre @planting	0	100	96	100									
3	Atrazine COC UAN	1 qt/a 1 % v/v 2.5 % v/v	Post 2-4" weeds forage at 4-5 leaf					0	100	75	100	0	100	48	100	
	ImiFlex Moccasin II Plus	9 fl oz/a 1.3 pt/a	Pre @planting	0	100	98	100									
4	Atrazine Huskie AMS	1 qt/a 14 fl oz/a 1 lb/a	Post 2-4" weeds forage at 4-5 leaf				*****	0	100	100	100	0	100	100	100	
	Moccasin II Plus Atrazine	1.3 pt/a 1 qt/a	Pre @planting	0	100	98	100									
5	ImiFlex 2,4-D NIS	6 fl oz/a 0.5 pt/a 0.25 % v/v	Post 2-4" weeds forage at 4-5 leaf					0	100	100	100	0	99	100	100	
	Moccasin II Plus Atrazine	1.3 pt/a 1 qt/a	Pre @planting	0	100	98	100									
6	ImiFlex Atrazine COC UAN	6 fl oz/a 1 qt/a 1 % v/v 2.5 % v/v	Post 2-4" weeds forage at 4-5 leaf					0	100	99	100	0	100	99	100	

Table 4. Bayer 2020 Bushland Sorghum Herbicide Trial

Pr	imary Company	ayer-Sorghum		% Co	ntrol			% Co	ntrol		% Control					
	DKS37-0	7 planted on	6-5-20	13	Days a	fter P	Post	28	Days a	fter F	Post	49 Days after Post				
Treatment		Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
1	Check	NA	NA													
	Huskie FX	1.1 pt/a	Post 2-4" weeds Sorghum 5-leaf													
2	AMS	1 lb/a		10	100	99	96	0	100	98	99	0	100	98	96	
	Atrazine	1 pt/a														
3	Huskie FX	1 pt/a	Post 2-1" weeds													
	AMS	1lb/a	Post 2-4 Weeds	10	100	99	97	0	100	99	97	0	100	99	97	
	Atrazine	1 pt/a	Sorghuill S-leal													

Table 5. Bayer 2021 Bushland Sorghum Herbicide Trial

Pr	imary Company	Protocol -B	ayer-Sorghum		% Co	ntrol			% Co	ntrol		% Control																							
	DKS37-0	7 planted on	6-9-21	15	Days a	after l	Pre	34	Days a	after	Pre	61 Days after Pre																							
Treatment		Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds																				
1	Check	NA	NA																																
	Huskie FX	1.1 pt/a	Pre @ planting																																
2	Atrazine	1pt/a		Pre @ planting	Pre @ planting	Pre @ planting	Pre @ planting	Pre @ planting	Pre @ planting	Pre @ planting	Pre @ planting	Pre @ planting	Pre @ planting	Pre @ planting	Pre @ planting	0	100	100	100	0	100	77	99	0	100	43	99								
	AMS	1lb/a																																	
	Huskie	1 pt/a																																	
3	Atrazine	1 pt/a	Pre @ planting	0	100	100	100	0	67	92	99	0	67	63	99																				
	AMS	1 lb/a		5		0 100 100																													

Table 6. Corteva 2021 Bushland Sorghum Herbicide Trial

Dri	Primary Company Protocol - Corteva-Sorghum				% Co	ntrol			% Co	ntrol		% Control				
FII	ווומוץ כטוווףמווץ ס בכאים	Piolocol-Co		20	Days a	after	Pre	53	Days a	after	Pre	61	Days a	after	Pre	
	DK337-C	n planteu on	10-9-21	00	Days at	fter P	ost	32	Days a	fter I	Post	40 Days after Post				
	Treatment	Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
1	Check	NA	NA													
	Cinch ATZ	3.2 pt/a														
	Roundup		Pre @planting	0	100	98	100									
2	Powermax	1 qt/a														
	Starane NXT	1.3 pt/a	Post 2-4" weeds					0	100	00	00	0	100	00	00	
	Atrazine	1 Lb/a	sorg at 4-5 leaf					0	100	00	99	0	100	00	99	
	FulTimeNXT	2 qt/a														
	Roundup		Pre @planting	0	100	98	100									
3	Powermax	1 qt/a														
	FultimeNXT	2 qt/a	Post 2-4" weeds					0	100	07	00	0	100	05	00	
	Starane Ultra	6.4 Fl oz/a	sorg at 4-5 leaf					0	100	97	99	0	100	93	99	
	Fultime NXT	3.2 pt/a														
	Roundup		Pre @planting	0	100	98	100									
4	Powermax	1 qt/a														
	Starane Ultra		Post 2-4" weeds					0	100	67	00	0	100	62	00	
		6.4 Fl oz/a	sorg at 4-5 leaf					0	100	67	99	0	100	05	99	
-	Dual 2 Mag	1.33 pt/a	Dra Onlanting	0	100	00	100	0	100	60	0	0	100	C۲.	0	
5	Atrazine	1 qt/a	Pre @planting	0	100	90	100	0	100	00	99	0	100	05	99	
6	Dual 2 Mag	1.3 pt/a	Post 2-4" weeds	0	100	83	100	0	100	0	100	0	100	0	100	
	Atrazine	1 qt/a	sorg at 4-5 leaf	0	100	65	100	0	100	0	100	0	100	0	100	



Figure 1. 2020 Sorghum Herbicide Efficacy Trial Weather



Figure 2. 2021 Sorghum Herbicide Efficacy Trial Weather