

Herbicide Activity on Old World Bluestems

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Introduction

Two main species of old world bluestems (OWB), yellow bluestem (*Bothriochloa ischaemum*) and Caucasian bluestem (*Bothriochloa bladhii*), have encroached on rangelands, pastures, and road right-of-ways in Kansas. Patches of these OWB have been shown to reduce species diversity and abundance at multiple trophic levels, and pose a long-term threat to native plant, insect, rodent, and grassland bird populations. These OWB species are utilized by cattle early in the growing season, directly following prescribed burns, and during droughts when other forages lack water uptake and may go dormant. However, these OWB species mature more quickly than native grass species and quickly form stem tissue, thus losing palatability to grazing animals rather rapidly compared to native grass species. In native pastures where OWB has invaded, native species may become overutilized because animals avoid the OWB. This weakens the native grasses and allows OWB to have a competitive advantage for moisture and nutrient resources. Over time, patches of OWB have expanded from 2.5 to 3.5 times their original patch size in 9 years, or a 15% annually compounded patch growth rate, when left uncontrolled. Several herbicides have been analyzed for OWB control, but glyphosate and imazapyr are the two herbicides that in the past have been shown to reduce OWB abundance most effectively in pastures. However, other herbicides with new label information for use in different forms of grassland or recreation areas may also have some activity on OWB and provide control. This study was performed to test several alternative herbicides with no known prior history of evaluation for control of OWB.

Experimental procedures

Herbicide test plots were evaluated in nearly solid stands of yellow bluestem and Caucasian bluestem. Plots were evaluated for OWB frequency, or the presence of OWB rooted within 100 small squares, each 4 × 4 inches in size within a square 40 × 40 inch frame, prior to herbicide application, and were also evaluated for OWB control 60 days following herbicide treatment. Control ratings were based on the amount of injury and the reduced production compared to untreated OWB plants. One year after herbicide treatment, OWB control and frequency were evaluated again to see if control observed during the year of treatment carried over into the next year. Herbicides were applied to plots arranged in a randomized complete block design with four replications. New locations of separate yellow and Caucasian bluestem stands were used in 2019 and 2020, for a total of four distinct and complete experiment locations. Herbicide treatments included the following rates of active ingredient: 1) fluazifop-P 6.0 oz/acre, 2) glyphosate 2.0 lb/acre, 3) halosulfuron 0.9975 oz/acre, 4) imazapyr

0.5 lb/acre, 5) mesotrione 3.0 oz/acre, 6) rimsulfuron 0.75 oz/acre, 7) sulfosulfuron 0.9975 oz/acre, and 8) untreated control. All herbicides were sprayed at 30 psi with an equivalent of 17 gallons/acre water carrier, and included a non-ionic surfactant at 0.5% v/v.

Results and Discussion

The frequency of OWB plants prior to herbicide application was not different between any of the herbicides. Combined across years, yellow bluestem frequency within the large frame was 93% and Caucasian bluestem frequency was 80% prior to herbicides being applied. Sixty days following application, glyphosate tended to display the greatest control of both yellow and Caucasian bluestem, followed by fluazifop-P and rimsulfuron (Table 1). Control of OWB 60 days after treatment with imazapyr was highly variable, with poor control in 2019 but much improved control, more closely resembling glyphosate control in 2020. Imazapyr variability was unexpected as it is one of the two primary herbicide recommendations for OWB spot control in pasture. During the year of treatment, fluazifop-P and rimsulfuron showed as much potential for OWB control as imazapyr. However, that control was short-lived and did not extend to the next growing season. One year after herbicide application, glyphosate provided much better control of both yellow and Caucasian bluestem than all other herbicides applied in the trial (Table 2). Glyphosate control 1 year after treatment was significantly greater in plots treated in 2019 than 2020; however, in both years of treatment, control with glyphosate was much greater than with any other herbicide. Greater control of both OWB species 1 year after treatment with glyphosate also translated into lower frequency of both OWB species 1 year after treatment. Frequency of both OWB species was below 26% when treating with glyphosate (Table 3). All other herbicides had an OWB frequency of near 90% or greater 1 year after treatment. Imazapyr has provided adequate control of OWB during the year after treatment in multiple prior experiments and in actual production pastures. The lack of control and the high OWB frequency with imazapyr during the year after treatment was unexpected in the current experiment.

Implications

Glyphosate continues to be the most reliable herbicide for control of OWB. However, glyphosate is non-selective and will also kill all other desirable pasture vegetation if treated. Imazapyr was variable in this trial, but has also provided adequate OWB control in prior experiments and in general production pastures. Most native tall and mid-grasses show tolerance and survival to low rates of imazapyr that are able to provide some control of OWB. Fluazifop-P and rimsulfuron showed initial OWB injury and control that was as good as imazapyr, although control did not extend into the next season in this trial. These two herbicides may have potential for further experimentation to control OWB.

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Table 1. Control of yellow and Caucasian old world bluestems 60 days after herbicide treatment in 2019 and 2020

Herbicide	Yellow bluestem			Caucasian bluestem		
	2019	2020	Avg. †	2019	2020	Avg.
	Control %					
Fluazifop-P	76	76	76 b	75	83	79 a
Glyphosate	99	97	98 a	99	*75	87 a
Halosulfuron	1	28	14 de	0	3	1 d
Imazapyr	8	*81	44 c	4	*78	41 c
Mesotrione	3	*23	13 de	0	*21	11 d
Rimisulfuron	82	75	78 b	61	66	64 b
Sulfosulfuron	31	18	24 d	41	41	41 c
Untreated	4	13	8 e	3	0	1 d

* Indicates control values for the herbicide are statistically different at $P \leq 0.05$ than the same herbicide in the prior year.

† Averages with different letters indicate control values are statistically different at $P \leq 0.05$.

Table 2. Control of yellow and Caucasian old world bluestems 1 year after herbicide treatment in 2019 and 2020

Herbicide	Yellow bluestem			Caucasian bluestem		
	2019	2020	Avg. †	2019	2020	Avg.
	Control %					
Fluazifop-P	0	3	1 b	0	8	4 b
Glyphosate	100	*82	91 a	99	*70	84 a
Halosulfuron	1	0	0 b	0	0	0 c
Imazapyr	0	*16	8 b	0	*13	6 b
Mesotrione	1	0	0 b	0	0	0 c
Rimisulfuron	3	0	1 b	0	0	0 c
Sulfosulfuron	1	0	1 b	0	0	0 c
Untreated	0	0	0 b	0	0	0 c

* Indicates control values for the herbicide are statistically different at $P \leq 0.05$ than the same herbicide in the prior year.

† Averages with different letters indicate control values are statistically different at $P \leq 0.05$.

Table 3. Frequency of yellow and Caucasian old world bluestems 1 year after herbicide treatment in 2019 and 2020

Herbicide	Yellow bluestem			Caucasian bluestem		
	2019	2020	Avg. †	2019	2020	Avg.
	Frequency %					
Fluazifop-P	99	94	96 b	92	86	89 b
Glyphosate	0	*32	16 a	3	*48	26 a
Halosulfuron	99	100	99 b	100	*89	95 b
Imazapyr	98	100	99 b	100	*85	93 b
Mesotrione	99	99	99 b	100	90	95 b
Rimisulfuron	100	97	98 b	99	88	93 b
Sulfosulfuron	99	99	99 b	99	90	95 b
Untreated	99	87	93 b	100	91	95 b

* Indicates frequency values for the herbicide are statistically different at $P \leq 0.05$ than the same herbicide in the prior year.

† Averages with different letters indicate frequency values are statistically different at $P \leq 0.05$.