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Reclaiming Old World Bluestem Pasture with Imazapyr Application and Native Grass Overseeding

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Abstract

Old world bluestems (OWB), mainly Caucasian bluestem (*Bothriochloa bladhii*) and yellow bluestem *(Bothriochloa ischaemum)* introduced from parts of eastern Europe, Asia, Africa, and Australia, have been shown to reduce abundance and diversity of some insect and wildlife species compared to native grasses when these OWB grasses form dense stands. These OWBs have been invading native pastures in the southern Great Plains and are rapidly increasing in the amount of area occupied in Kansas. Two landowners purchased pasture property in Ellsworth County, KS, and observed that Caucasian old world bluestem had increased in the pasture significantly over the course of several years. They developed a plan with local partners to reclaim the pasture back to native grass and forb dominance in an effort to improve wildlife habitat and cattle grazing on the property.

Keywords

broadcast spray, dicamba, no-till drill, plant frequency, prescribed burn, seed bank, vegetative cover, old world bluestem, imazapyr

Cover Page Footnote

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Introduction

Old world bluestems (OWB), mainly Caucasian bluestem (*Bothriochloa bladhii*) and yellow bluestem (*Bothriochloa ischaemum*) introduced from parts of eastern Europe, Asia, Africa, and Australia, have been shown to reduce abundance and diversity of some insect and wildlife species compared to native grasses when these OWB grasses form dense stands. These OWBs have been invading native pastures in the southern Great Plains and are rapidly increasing in the amount of area occupied in Kansas. Two landowners purchased pasture property in Ellsworth County, KS, and observed that Caucasian old world bluestem had increased in the pasture significantly over the course of several years. They developed a plan with local partners to reclaim the pasture back to native grass and forb dominance in an effort to improve wildlife habitat and cattle grazing on the property.

Procedures

The pasture reclamation project took place on a 240-acre tract in east-central Ellsworth County, KS. The pasture consisted of nearly equal halves of native, untilled pasture and cropland seeded back to native grasses in the 1950s. Twelve sample transects were established in both the native pasture and the converted cropland portion of the pasture (six in each portion). In 2016, these transects were sampled for Daubenmire cover classes of all vegetative species to show the extent of Caucasian OWB invasion within the two land areas (Figure 1). The two pasture areas were treated with imazapyr for three consecutive years to reduce the OWB population and to reclaim the pasture areas to native warm-season grass species. In 2017 and 2018, the entire pasture area was prescribe burned in late spring to remove old dead standing vegetation, and then imazapyr was broadcast sprayed at 0.5 lb/acre in early to mid-June. In 2019, imazapyr was applied at the same time period but the pasture was not burned prior to herbicide application. In 2020, dicamba at 0.25 lb/acre was applied to control marestail rosettes in early March, and then the pasture was overseeded in mid-April with a native grass mix consisting of big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), sideoats grama (*Bouteloua curtipendula*), and switchgrass (*Panicum virgatum*) at a combined grass seeding rate of 7.9 lb pure live seed/acre. In 2019–2021, seedling density, Daubenmire cover, modified step point basal cover, OWB plant frequency from a 100-grid frame, Robel visual obstruction, and falling plate meter biomass estimates were also collected along the transects.

Results and Discussion

In 2016, OWB cover along transects within the native portion of the pasture ranged from 0–53%, while OWB cover within the revegetated cropland portion of the pasture ranged from 7–94%. Combined, OWB provided 51% of the vegetative cover (Table 1) and formed many large patches with near monoculture stands within the two sample areas.

In 2017 and 2018, OWB seedlings had opportunity to emerge, but imazapyr treatment after seedling emergence likely controlled those seedlings. The OWB seedling emergence along transects in 2019 was very low prior to imazapyr application, and new seedlings were rarely found in 2019 or 2021 (Table 1). The percentage of squares occupied by OWB in a 100-grid frame, or the frequency, also gives an indication of the density of OWB because of the known large frame sample area. In the case of May 2019, the frequency of OWB was 1.1%, or stated another way, 1.1% of the transect area sampled contained an OWB plant. Following the imazapyr treatment in June 2019, the frequency of OWB in May 2020 and 2021 remained rather similar at 0.8% and 1.2% frequency. Daubenmire vegetative cover of OWB in 2019, following 3 years of imazapyr treatment, was significantly lower than in 2016 at less than 1% cover (Table 2). Shortgrass cover [blue grama (*Bouteloua gracilis*) and buffalograss (*Bouteloua dactyloides*)] also significantly declined with annual imazapyr application, while cover of native tallgrasses was similar or slightly increased through 2019 (Table 2). After 3 years of imazapyr treatment, marestail (*Conyza canadensis*) and western ragweed (*Ambrosia psilostachya*) cover greatly increased where OWB used to be prevalent, accounting for 42.9% of the canopy cover of the treated pasture in 2019. Western ragweed and marestail dominated the plant canopy in areas of bare soil once occupied by the OWB (Table 2). Most native grasses were not able to expand into these bare areas as quickly as the herbicide was able to decrease the OWB from 2017 to 2019.

The significant loss of total grass cover and the surge of western ragweed and marestail cover by the end of 2019 prompted the need to re-establish native grasses on the area once occupied by OWB. Native grass seeding was highly successful, with 0.4–3.1 native seedlings/ft^2 establishing along the sampled transects. Native seedling establishment tended to be greater along transects that had greater OWB cover in 2016 and was eventually controlled by imazapyr (Figure 2). Most native grasses increased in cover percentage and basal composition from 2019 to 2021 following the overseeding (Table 2). Successful native grass seedling establishment was somewhat surprising because native grass seedling growth has been severely depressed by an allelopathic effect in soils where OWB were currently or once growing. In 2020 and 2021, cover of OWB increased to near 5%, despite relatively little or no increase in OWB plant frequency (0.8% and 1.2% frequency in 2020 and 2021, respectively). This is likely the result of no herbicide treatment in 2020 to suppress growth of OWB plants that had survived imazapyr treatments from 2017–2019. These surviving OWB plants were suppressed from previous imazapyr treatments when cover estimates were collected in 2019, and thus lacked the vigorous foliage cover observed in 2020. Some new native grass seedlings nearly reached maturity by the end of the 2020 season. Cover increased for most native grass species in 2020 and 2021 compared to 2019, likely a result of both successful overseeding and the lack of significant OWB competition with native grasses that were already established and present before overseeding (Table 2). This result indicates new

native grass establishment can be successful within 3 years of OWB reduction, and that allelopathic effects of OWB on native grass seedling growth likely diminish within a 3-year time period.

Implications

Old world bluestem dominated pastures can be greatly transformed back into pasture that more closely reflects native grasslands. Although OWB was significantly reduced by 3 years of imazapyr application, OWB did not completely disappear and still poses a long-term risk if efforts to reduce or contain OWB are not continued. Continued herbicide treatment of smaller mapped patches or the combination of herbicides and growing season summer prescribed burns may help to reduce OWB further, or may at least help to significantly slow the rate of OWB spread within the pasture.

Acknowledgments

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Table 1. Caucasian old world bluestems (OWB) cover by transect in 2016 prior to imazapyr treatment, and in 2019, 2020, and 2021 after treatment. Also shown is seedling recruitment of OWB prior to and after native grass seeding, and of native grasses the year of reseeding.

	OWB Daubenmire cover %				OWB seedlings/ft²		Native seedlings/ft²
Transect	2016	2019	2020	2021	2019	2021	2020
1	46.5	1.2	13.3	0.3	0.1	0.1	1.4
2	41.5	0.3	7.5	0.0	0.0	0.0	1.3
3	93.5	0.0	2.5	8.5	0.0	0.2	2.5
4	72.8	0.0	0.0	0.0	0.1	0.3	1.4
5	14.7	0.0	11.0	4.2	0.0	0.0	0.9
6	71.3	0.0	0.0	0.0	0.0	0.4	1.8
7	6.8	0.2	0.0	0.0	0.0	0.1	0.4
8	92.8	0.0	8.2	6.8	0.0	0.1	3.1
9	89.5	1.0	19.5	17.2	0.0	0.4	1.6
10	0.0	0.0	0.0	0.0	0.0	0.0	0.8
11	30.2	0.2	0.0	16.3	0.0	0.0	2.0
12	52.8	0.0	4.7	6.5	0.0	0.0	1.5
Avg.	51.1	0.2 *	5.6 *	5.0	<0.1	0.1	1.5

* Indicates values in a column are statistically different at $P \leq 0.05$ than the same attribute in the prior year.

Table 2. Daubenmire species cover in 2016 before imazapyr treatment, in 2019 following the third year of imazapyr application, and in 2020 and 2021 following reseeding. Species basal composition in 2019 and 2021 of the combined pasture areas is also included.

	Daubenmire cover %				Step-point composition %	
Species	2016	2019	2020	2021	2019	2021
OWB	51.1	0.2*	5.6*	5.0	0.2	3.3
Indiangrass	1.9	5.0	13.5*	13.3	5.9	11.5*
Big bluestem	0.4	4.9*	18.0*	16.6	4.9	16.6*
Little bluestem	7.0	16.1*	27.2*	17.0*	19.7	17.1
Sideoats grama	0.1	0.4	5.7*	4.2	1.8	5.9*
Blue grama + buffalograss	14.1	1.1*	3.5	5.1*	3.7	6.1*
Western ragweed	0.1	17.5*	8.9*	7.5	21.2	7.5*
Marestail	0.0	25.5*	5.1*	0.0*	35.8	0.0*

* Indicates values in a column are statistically different at $P \leq 0.05$ than the same attribute in the prior year.

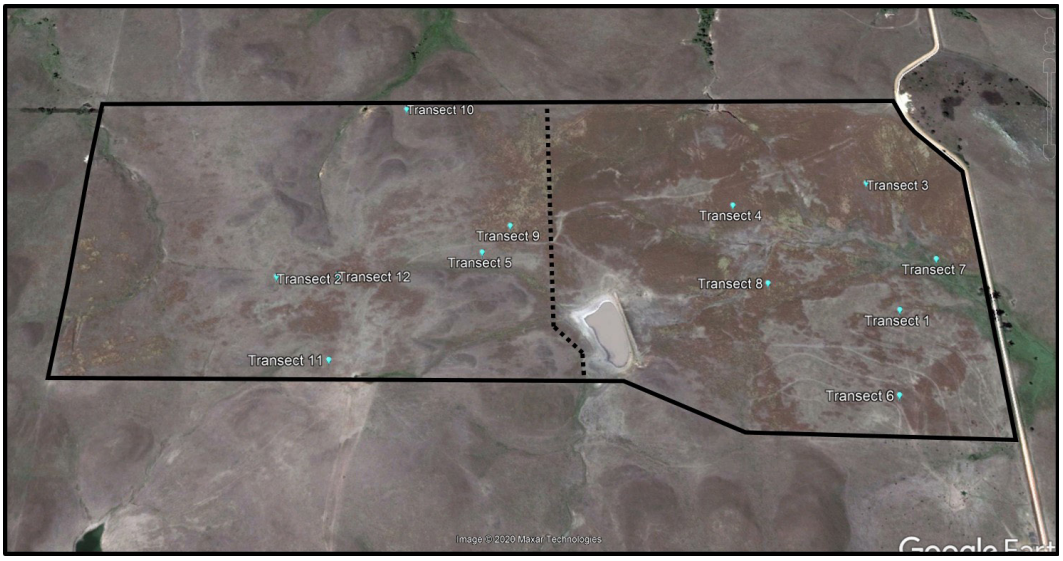

Figure 1. Study pasture in Ellsworth County, KS, approximately 230 acres in size. Land area to the right of the dashed line was cropland converted to pasture in the 1950s or 1960s. Brighter red and tan patches indicate areas of high density Caucasian OWB invasion in this northern pasture region. Diamonds mark locations of permanent transects established for collecting data.

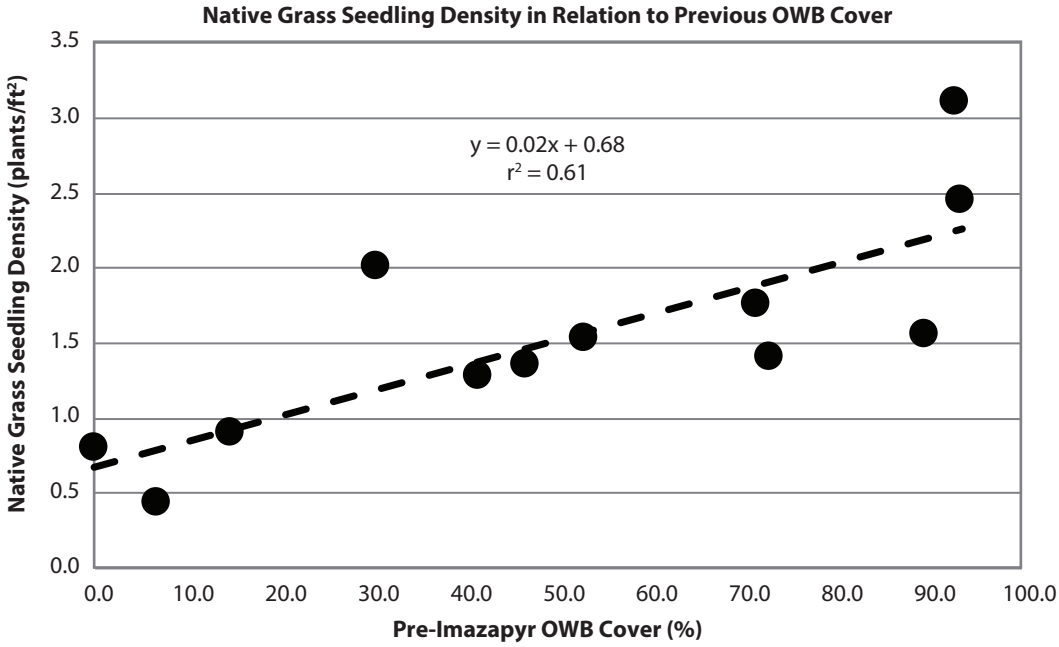

Figure 2. The relationship of OWB in 2016 prior to imazapyr control treatments and the native warm-season grass seedling density after reseeding. Seedlings tended to establish better in areas that had the greatest OWB cover prior to imazapyr treatment.