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Sericea Lespedeza Control from Growing-Season Prescribed Burning Causes No Collateral Damage to Non-Target Species

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Abstract

Objective: The objective of this study was to evaluate the effects of 4 consecutive years of prescribed fire applied to native tallgrass range in either April, August, or September on forage biomass production, soil cover, and basal plant cover.

Study Description: Nine fire-management units (14 ± 6 acres) were burned at 1 of 3 prescribed times: early spring (April 1), mid-summer (August 1), or late summer (September 1). Plant species composition and soil cover were assessed annually each July using a modified step-point technique.

The Bottom Line: Burning during the summer for 4 consecutive years resulted in excellent control of sericea lespedeza, Baldwin's ironweed, western ragweed, and invasive woody-stemmed plants, compared to traditional spring, dormant-season prescribed burning. In addition, major wildflower species prevalence increased in areas treated with prescribed fires during the summer compared with adjacent areas treated with prescribed fire during the spring.

Keywords

sericea lespedeza, prescribed burning, non-target species

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Sericea Lespedeza Control from Growing-Season Prescribed Burning Causes No Collateral Damage to Non-Target Species

J.A. Alexander, W.H. Fick, J. Lemmon, G.A. Gatson, and KC Olson

Introduction

Fire has been a key to sustaining the ecological integrity of the Kansas Flint Hills. While naturally occurring throughout history, aboriginal peoples used prescribed fire as means to attract wild game animals, manipulate growth of food plants, and to condition wood or stone to make implements. Early European settlers to the Great Plains adopted the use of fire to manage woody-plant encroachment and to enhance growth performance of domesticated herbivores. Fire has since played a pivotal role in sustaining the Kansas Flint Hills. Currently, fire is used as a treatment for the control of invasive species such as eastern red cedar (*Juniperus virginiana*) and roughleaf dogwood (*Cornus drummondii*). The most common grazing management practice in the Kansas Flint Hills involves annual spring burning in April followed by intensive grazing with yearling beef cattle from April to August.

Using this current management practice of annual fire and seasonal grazing there has been a steady increase of the invasive plant sericea lespedeza (*Lespedeza cuneata*). Introduced in the late 19th century for its soil conservation properties, sericea lespedeza has been an aggressive invader in Flint Hills plant communities. Individual plants can produce more than 700 seeds per stem annually; seed can be transported in contaminated hay, via machinery, and via the digestive tract of animals. Up to this time, control of sericea lespedeza has been limited to repeated, costly applications of herbicide, which have met with limited success and resulted in collateral damage to non-target plant species. We reported previously that prescribed burning conducted during either early August or early September had strong suppressive effects on sericea lespedeza. The objective of this report is to document the effects of prescribed burning during April, August, or September on grasses, forbs, and shrubs that are native to the tallgrass prairie region.

Experimental Procedures

Our experiment was conducted on a 125-acre native tallgrass pasture located in Geary County, KS. The site was historically grazed during the winter and spring by beef cattle; moreover, the infestation of sericea lespedeza on the site was problematic for the 20-year period preceding our study. Escort XP (metsulfuron methyl; Bayer Crop Science LP, Research Triangle Park, NC) was broadcast-applied via aircraft onto the site in the fall of 2013 at a rate of 1 oz/acre. Despite herbicide treatment, basal frequency of sericea lespedeza was 2 ± 1.3% and aerial frequency, the percentage of 1 ft × 1 ft plots in which sericea lespedeza was detected, was 36 ± 3.4% the following spring.

The study site was divided along watershed boundaries into 9 fire-management units (14 ± 6 acres). Unit boundaries were delineated by mowing firebreaks (≈ 20 ft wide) around each perimeter. Units were assigned randomly to 1 of 3 prescribed-burning times (n = 3/treatment): early spring (April 1), mid-summer (August 1), or late summer (September 1). Prescribed burns were carried out on or near target dates when appropriate environmental conditions prevailed: surface wind speed < 15 mph; surface wind direction = steady and away from urban areas; mixing height > 1800 ft; transport wind speed > 8 mph; relative humidity = 40 to 70%; ambient temperature = 50 to 100°F; and Haines index ≤ 4. All prescribed burning activities were carried out with the permission of Geary County Emergency Services, Junction City, KS (permit no. 348).

Forage biomass was measured along a single permanent 100-yd transect in each fire-management unit. Transects were read on July 19 and October 10 annually. At 3-ft intervals along each transect, biomass was estimated using a visual obstruction technique. Plant species composition and soil cover were assessed along each permanent transect in mid-July using a modified step-point technique. One hundred transect points were evaluated for bare soil, litter cover, or basal plant area (% of total area). Plants were identified by species; basal cover of individual species was expressed as a percentage of total basal plant area.

Results and Discussion

Total forage biomass was influenced by treatment and measurement date (treatment × time, $P<0.01$; Table 1). Forage biomass was not different ($P=0.78$) between treatments on July 19 over the 4-year course of our study. We concluded that repeated burning during the growing season did not impair forage production compared to conventional spring burning.

As expected, forage biomass was greater ($P<0.01$) in early spring than in mid- or late summer burn units on October 10, after growing-season fire treatments had been applied (Table 1). Prescribed fire treatments on August 1 and September 1 resulted in nearly complete removal of above-ground plant material; however, forage regrowth following fires resulted in significant accumulations of biomass prior to seasonal plant dormancy. Near the end of the growing season (October 10), mid-summer burn units recovered to 39% of pre-fire biomass levels during the 10-week period between treatment application and measurement. Similarly, late summer burn units recovered to 23% of pre-fire levels over the 6-week period between treatment application and measurement. We concluded that post-fire regrowth was likely sufficient to prevent erosion and soil-moisture loss during the subsequent dormant season and would have allowed light to moderate grazing during the ensuing fall and winter.

Frequency of bare soil, litter cover, and total basal plant cover were not different ($P≥0.21$) between early spring, mid-summer, and late summer burn units (Table 2). Soil cover values were generally indicative of healthy, normal tallgrass prairie ecosystems. Total basal cover attributable to grasses was not different ($P=0.24$) between prescribed-burn treatments. In addition, combined basal cover of major warm-season grasses (i.e., big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), indiangrass (*Sorghastrum nutans*), and sideoats grama (*Bouteloua curtipendula*)) were also not influenced (P=0.62) by the timing of prescribed burning.

Total basal cover attributable to forbs was not affected (P=0.38) by prescribed burning treatments (Table 2). Basal cover of sericea lespedeza was 4.3-fold greater (P=0.02) in early spring burn units compared with late summer burn units, indicating that growing-season prescribed burning effectively controlled vegetative reproduction by sericea lespedeza. In addition, combined basal cover of western ragweed (*Ambrosia psilostachya*) and Baldwin's ironweed (*Vernonia baldwinii*) decreased (P<0.01) in mid- and late summer burn units compared with early spring burn units. These benefits were accompanied by a tendency for combined basal cover of major wildflowers to increase (P=0.09) in late summer burn units compared with early spring burn units. We speculated that control of sericea lespedeza, western ragweed, and Baldwin's ironweed was the result of selective pressure applied to these species with growing-season prescribed burning, whereas major wildflower species appeared to have been stimulated by growing-season prescribed burning.

Total basal cover attributable to all woody-stemmed plants was not different (P=0.45) between early spring, mid-summer, and late summer burn units (Table 2). Combined basal cover of leadplant (*Amorpha canescens*) and New Jersey tea (*Ceanothus americanus*), woody-stemmed plants that are important components of grazing beef cattle diets in the Flint Hills, was also not different (P=0.39) between early spring, mid-summer, and late summer burn units. Interestingly, combined basal cover of invasive woody-stemmed plants (i.e., roughleaf dogwood, smooth sumac (*Rhus glabra*), buckbrush (*Symphoricarpos orbiculatus*), and honey locust (*Gleditsia triacanthos*)) tended to be less (P=0.09) in mid-summer burn units than in early spring and late summer burn units. We concluded that early spring, mid-summer, and late summer burn units were equally capable of controlling woody-stemmed plants.

Implications

Compared to traditional spring, dormant-season prescribed burning, burning during the summer for 4 consecutive years resulted in excellent control of sericea lespedeza, Baldwin's ironweed, western ragweed, and invasive woody-stemmed plants. In addition, major wildflower species prevalence increased in areas treated with prescribed fires during the summer compared with adjacent areas treated with prescribed fire during the spring. Growing-season prescribed burning may be an inexpensive and fairly comprehensive means to control sericea lespedeza propagation. At the time of this writing, prescribed burning in the Kansas Flint Hills had a cash cost of less than $1 USD/acre, whereas fall application of herbicide, which can negatively affect non-target species, was estimated to cost between $18 and $36 USD/acre.

Table 1. Effects of the timing of prescribed burning on overall forage biomass and canopy frequency and stem height of sericea lespedeza (*Lespedeza cuneata*) in native tallgrass rangeland

Evaluation date	Prescribed-burn timing	Total forage biomass, lb dry matter/acre
July 19	Early spring (April 1)	4,256[a]
	Mid-summer (August 1)	4,220[a]
	Late summer (September 1)	3,960[a]
October 10	Early spring (April 1)	3,692[a]
	Mid-summer (August 1)	1,661[b]
	Late summer (September 1)	928[b]
	Standard error[1]	430.0
	P – treatment × time	< 0.01

[1]Mixed-model standard error associated with comparison of treatment × time means.
[a,b]Means within a column with unlike superscripts are different (P≤0.05).

Table 2. Effects of the timing of prescribed burning on graminoid basal cover, forb basal cover, occurrence of bare soil, and litter cover during mid-summer on native tallgrass rangeland

Item	Early spring burn (April 1)	Mid-summer burn (August 1)	Late-summer burn (September 1)	Standard error[1]	P-value[2]
Bare soil, % total area	44.4	35.7	34.6	9.29	0.52
Litter cover, % total area	45.5	55.5	54.3	9.50	0.52
Basal vegetation cover, % total area	10.2	8.8	11.1	1.26	0.21
Total grass cover, % total basal cover	82.9	85.9	87.0	2.46	0.24
Major C4 tall grasses,[3] % total basal cover	54.8	52.3	56.9	4.74	0.62
Total forb cover, % total basal cover	15.7	12.8	11.9	2.86	0.38
Sericea lespedeza, % total basal cover	6.56[a]	3.22[ab]	1.52[b]	1.714	0.02
Western ragweed + Baldwin's ironweed, % total basal cover	4.19[a]	1.24[b]	1.39[b]	0.608	<0.01
Major wildflowers,[4] % total basal cover	0.51[d]	0.91[de]	1.27[e]	0.377	0.09
Total shrub cover, % total basal cover	1.88	1.82	2.41	0.516	0.45
New Jersey tea + leadplant, % total basal cover	0.84	1.32	1.38	0.429	0.39
Invasive woody plants,[5] % total basal cover	1.01[d]	0.49[e]	0.93[d]	0.245	0.09

[1]Mixed-model standard error associated with comparison of treatment main effect means.
[2]Treatment main effect.
[3]Combined basal cover of big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), indiangrass (*Sorghastrum nutans*), and sideoats grama (*Bouteloua curtipendula*).
[4]Combined basal cover of catclaw sensitivebriar (*Mimosa nuttallii*), dotted gayfeather (*Liatris punctata*), heath aster (*Symphyotrichum ericoides*), prairie coneflower (*Ratibida columnifera*), purple poppymallow (*Callirhoe involucrata*), purple prairieclover (*Dalea purpurea*), roundhead prairieclover (*Dalea multiflora*), and white prairie clover (*Dalea candida*).
[5]Combined basal cover of roughleaf dogwood (*Cornus drummondii*), smooth sumac (*Rhus glabra*), buckbrush (*Symphoricarpos orbiculatus*), and honey locust (*Gleditsia triacanthos*).
[a,b]Within row, means with unlike superscripts differ (P≤0.02).
[d,e]Within row, means with unlike superscripts tend to differ (P≤0.09).