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Effects of Growing-Season Prescribed Burning on Vigor of Sericea Lespedeza in the Kansas Flint Hills: I. Suppression of Seed Production and Canopy Dominance

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Abstract

Sericea lespedeza (*Lespedeza cuneata*) is a highly fecund noxious weed in Kansas and surrounding states. Individual plants are capable of producing greater than 1,000 seeds annually. Vigorous seed production allows sericea lespedeza to rapidly infiltrate native and cultivated grasslands; seed can be transported great distances via farm machinery and the alimentary canal of wild and domestic herbivores. In Kansas alone, sericea lespedeza infests more than 700 square miles of pasture, primarily in the Flint Hills region. The resulting damage to native habitats for wildlife and pasture quality for domestic herbivores has been devastating.

The predominant grazing management practice in the Kansas Flint Hills involves annual spring burning in April followed by intensive grazing with yearling beef cattle for a relatively short period from late April to August. During seasonal grazing, 40 to 60% of annual graminoid production is removed and grazing lands then remain idle for the remainder of the year. Under this prevailing management practice, invasion by sericea lespedeza into the tallgrass prairie biome has steadily increased. Oklahoma State University researchers speculated that dormant-season, spring fires may stimulate sericea lespedeza seed germination by scarifying seeds cast the previous fall. Previous research reported that application of growing season fire at 3 year intervals decreased the rate of sericea lespedeza invasion. Therefore, the objective of our study was to evaluate the effects of annual prescribed burning applied during the growing season on vigor of sericea lespedeza infesting native tallgrass range.

Keywords

sericea lespedeza, prescribed burning, growing season

Authors

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KANSAS STATE UNIVERSITY CATTLEMEN'S DAY

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Introduction

Sericea lespedeza (*Lespedeza cuneata*) is a highly fecund noxious weed in Kansas and surrounding states. Individual plants are capable of producing greater than 1,000 seeds annually. Vigorous seed production allows sericea lespedeza to rapidly infiltrate native and cultivated grasslands; seed can be transported great distances via farm machinery and the alimentary canal of wild and domestic herbivores. In Kansas alone, sericea lespedeza infests more than 700 square miles of pasture, primarily in the Flint Hills region. The resulting damage to native habitats for wildlife and pasture quality for domestic herbivores has been devastating.

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Key words: sericea lespedeza, prescribed burning, growing season

Experimental Procedures

A 125-acre native tallgrass pasture located in Geary Co., KS was used for our study. 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. The study site was divided along watershed boundaries into 9 fire-man-

agement units (12 ± 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 = 10 to 15 mph; surface wind direction = steady and away from urban areas; mixing height greater than 1800 feet; transport wind speed = 8 to 20 mph; relative humidity = 40 to 70%; ambient temperature = 75 to 100°F; and Haines index 4 or less. All prescribed burning activities were carried out with the permission of Geary Co. Emergency Services, Junction City, KS (permit no. 348).

Forage biomass, sericea lespedeza frequency, sericea lespedeza crown maturity, and sericea lespedeza stem height were measured along a single, permanent 100-yd transect in each fire-management unit (100 × 12-in^2 plot points/transect). Transects were laid out on a southwest-to-northeast gradient; transect ends were marked using steel fence posts. Transects were read on average dates July 19 and October 10. A 100-yd measuring tape was stretched from the southwestern end to the northeastern end of each transect. At 3-ft intervals along each transect, biomass was measured using a visual obstruction technique. In addition, a 12 × 12-in plot was projected on the eastern side of transects at each point of measurement. Within the plot, presence of sericea lespedeza was noted (e.g., yes or no). If sericea lespedeza was present, stem height and crown maturity of the sericea lespedeza plant closest to the 3-ft interval on the measuring tape was recorded. Stem height was measured in inches from the surface of the soil to its maximum length by manually holding the sericea lespedeza stem erect. Crown maturity was evaluated visually; sericea lespedeza plant crowns containing any senescent material or multiple stems were judged to be old growth (> 1 year old), whereas sericea lespedeza plant crowns without evidence of senescence or with single-stem crowns were judged to be new growth (< 1 year old).

A total of 100 mature sericea lespedeza plants were collected adjacent to permanent transects in each burn-management unit immediately after the first killing frost (approximately November 1). Plants were clipped at ground level and placed into a labeled paper bag. Bagged samples were dried using a forced-air oven. Individual plants in each sample were defoliated by hand. Resulting seeds, chaff, and stems were also separated by hand. The total amount of seed recovered from each sample was weighed to the nearest milligram. Seed weight was converted to seed count, assuming a density of 770 seeds/gram. Average seed production was calculated by dividing the number of seeds by the number of sericea lespedeza plants in each sample (n = 100).

Results and Discussion

Forage biomass, sericea lespedeza maximum stem height, and crown maturity were influenced by treatment and measurement date (treatment × time, $P \leq 0.01$; Table 1). Forage biomass was not different ($P \geq 0.81$) between treatments on July 19, indicating that burning during the latter half of the growing season did not harm forage productivity in subsequent years. As expected, forage biomass on spring-burn treatments was greatest ($P \leq 0.01$) on October 10; however, forage regrowth on mid-summer and late summer burn treatments was significant. All burn management units had greater than 3,600 lb of forage dry matter/acre before seasonal plant dormancy occurred. We concluded that

post-fire regrowth was sufficient to prevent erosion and soil-moisture loss during the dormant season.
Maximum stem height of sericea lespedeza and the proportion of mature sericea lespedeza crowns were not different ($P \geq 0.78$) between treatments on July 19 (Table 1). On October 10, stem height and proportion of mature crown did not change ($P \geq 0.22$) on spring burn treatments from the initial measurement on July 19. In contrast, burning in mid-summer or late summer reduced ($P \leq 0.04$) sericea lespedeza stem height and the proportion of mature sericea lespedeza crowns on October 10 compared to spring burning.

Canopy frequency of sericea lespedeza was greatest ($P < 0.01$) on spring-burn treatments (49.9% of plots) and least on mid-summer (31.4%) and late summer burn treatments (20.3%; Table 1). Incidence of plant canopies with multiple sericea lespedeza crowns was not different ($P = 0.13$) between treatments.

Whole-plant dry matter weight of sericea lespedeza at dormancy, total seed weight per sericea lespedeza plant, and seed production per sericea lespedeza plant were greatly diminished ($P < 0.01$) on mid-summer and late summer burn treatments compared to spring-burn treatments (Table 2). Whole-plant dry matter weight of individual sericea lespedeza plants on the spring-burn treatment was 8.6-fold and 24.3-fold heavier than sericea lespedeza plants on the mid-summer and late summer burn treatments, respectively. Seed production in areas treated with mid-summer fire was less than 5% of that in areas treated with spring fire. In areas treated with late-summer fire, seed production was 0.07% that of areas treated with spring fire.

We interpreted these data to indicate that prescribed burning during the growing season had strong suppressive influences on vigor and reproductive capabilities of individual sericea lespedeza plants.

Implications

Compared to traditional spring, dormant-season burning, burning during the summer months resulted in significant decreases in canopy dominance and seed production by sericea lespedeza. Growing-season prescribed burning is an inexpensive and comprehensive means to control sericea lespedeza propagation and invasion. 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 was estimated to cost between > $18 USD/acre. This manuscript presents the results of 3 years of a 4-year experiment.

Table 1. Effects of prescribed-burn timing of native tallgrass rangeland on forage biomass and canopy frequency, crown maturity, and stem height of sericea lespedeza (SL; *Lespedeza cuneata*)

Evaluation date	Prescribed-burn timing	Forage biomass, dry matter lb/a	Plant canopies containing SL, % of total	SL maximum stem height, in.	Incidence of multiple SL stems, % of SL-containing plant canopies	Mature SL crowns, % of SL-containing plant canopies
July 19	Early spring (April 01)	4,436[c]	47.9[a]	21.4[a]	72.3	92.8[a]
	Mid-summer (August 01)	4,401[c]	33.9[a, b]	21.5[a]	70.3	92.3[a]
	Late summer (September 1)	4,228[c]	27.1[b, c]	21.7[a]	62.4	94.6[a]
October 10	Early spring (April 01)	14,488[a]	52.0[a]	23.5[a]	84.1	91.4[a]
	Mid-summer (August 01)	6,490[b]	29.0[b, c]	9.2[b]	63.9	29.4[b]
	Late summer (September 1)	3,603[c]	13.6[c]	6.9[b]	63.5	12.3[c]
	Standard error*	865.3	9.16	1.72	10.82	8.23
	P–treatment	< 0.01	< 0.01	< 0.01	0.13	< 0.01
	P–time	< 0.01	0.37	< 0.01	0.72	< 0.01
	P–treatment × time	< 0.01	0.40	< 0.01	0.49	< 0.01

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

Table 2. Effects of prescribed-burn timing of native tallgrass rangeland on whole-plant dry matter weight and seed production by sericea lespedeza (SL; *Lespedeza cuneata*) as measured at plant dormancy

Item	Early spring burn (April 1)	Mid-summer burn (August 1)	Late-summer burn (September 1)	Standard error*	P-value†
Whole-plant dry matter weight, mg/plant	3,954[a]	460[b]	163[b]	561.1	< 0.01
Total seed weight, mg/plant	924[a]	42[b]	1[b]	153.1	< 0.01
Seeds, number/plant	710.8[a]	32.6[b]	0.5[b]	117.82	< 0.01

* Mixed-model standard error associated with comparison of treatment main effect means.
† Treatment main effect.
[a,b] Means within a row with unlike superscripts are different (P≤0.05).