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Effects of Prescribed-Fire Timing on Stocker Cattle Performance, Forage Biomass Accumulation, and Native Plant Species Composition

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KANSAS STATE UNIVERSITY CATTLEMEN'S DAY

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Z.M. Duncan, A.J. Tajchman, J. Lemmon, W.R. Hollenbeck, D.A. Blasi, and K.C. Olson

Abstract

Shifting the timing of prescribed fire application from spring (i.e., April) to late summer (i.e., August) or early fall (September) can reduce sericea lespedeza (*Lespedeza cuneata*) infestation and improve native forb diversity. Currently, information evaluating effects of late-summer or early-fall prescribed fire on yearling stocker cattle growth performance is limited. Eighteen pastures were grouped by watershed and each watershed was assigned to one of three prescribed-fire treatments (n = 6 pastures per treatment): spring (April 9 ± 5.1 days), summer (August 23 ± 4.9 days), or fall (September 29 ± 8.7 days). Burn treatments were applied in years 1, 2, and 3 but were not applied in year 4 due to unfavorable burn conditions. A total of 1,416 yearling stocker calves were grazed from May to August at a stocking density of 250 lb of live weight per acre over four consecutive grazing seasons. A permanent 328-ft transect was established in each pasture and was used to determine plant species composition and soil cover using a modified step-point method. Total body weight (BW) gains tended to be greater ($P = 0.06$) for spring-burned pastures compared with fall-burned pastures, whereas total BW gains for summer-burned pastures were intermediate. Spring-season prescribed fire resulted in greater ($P < 0.01$) proportions of bare soil compared with summer- and fall-season prescribed fire. Proportions of litter on the soil surface were greatest ($P \leq 0.05$) in the summer, intermediate ($P \leq 0.05$) in the fall, and least ($P < 0.01$) in the spring. Total grass, native grass, total forb, and native forb basal cover did not differ ($P \geq 0.13$) among treatments; however, basal cover of nectar-producing forbs was greater ($P \leq 0.05$) in fall-burned pastures compared with spring- and summer-burned pastures. Overall, shifting prescribed-fire timing from spring to summer resulted in similar stocker cattle growth performance and native rangeland plant composition.

Introduction

Annual spring-season prescribed fires are traditionally applied in the Kansas Flint Hills to improve yearling stocker cattle growth performance and promote native warm-season plant growth. Although spring-season prescribed fire has become a standard management tool for Flint Hills ranchers, shifting the timing of fire from spring to late summer (i.e., August) or early fall (i.e., September/October) may be beneficial.

Our research group has demonstrated late-summer (i.e., August) or early-fall (i.e., September) prescribed fires can be employed to manage sericea lespedeza (*Lespedeza cuneata*) infestations while subsequently improving native forb diversity. Sericea lespedeza is a noxious weed that has degraded more than 600,000 acres of native tallgrass prairie. In addition, shifting the timing of prescribed fire from spring to late summer or early fall may improve air quality by distributing smoke produced from burning the Flint Hills throughout the year. Despite optimistic reports, the effects of late-summer or early-fall prescribed fire on yearling stocker growth performance has not been documented. The objective of this experiment was to evaluate the effects of prescribed-fire timing on stocker cattle growth performance, soil cover, forage biomass accumulation, and plant species composition in the Kansas Flint Hills.

Experimental Procedures

This experiment was conducted at the Kansas State University Beef Stocker Unit from June 2018 to August 2022. Eighteen pastures were grouped by watershed, and each watershed was assigned to one of three prescribed-fire treatments (n = 6 pastures per treatment): spring (April 9 ± 5.1 days), summer (August 23 ± 4.9 days), or fall (September 29 ± 8.7 days). Burn treatments were applied in years 1, 2, and 3 of the experiment. Due to unfavorable burn conditions, burn treatments were not applied in year 4. Within each pasture, a permanent 328-ft transect was established. In June 2018, pre-treatment soil cover and plant species composition were measured using a modified step-point method and measured annually in June thereafter. Standing forage biomass was determined in 2018, 2020, and 2022 by clipping vegetation within ten 0.82^2-ft frames randomly placed at 33-ft intervals along each transect. Plant material was clipped at a height of 0.39-in above the soil and dried in a forced-air oven (122°F, 96 hours).

A total of 1,416 yearling cattle were grazed over four consecutive growing seasons beginning in 2019. Calves were grazed for 90 days at a targeted density of 250 lb of live weight per acre. Three-hundred-sixty heifers [initial body weight (BW) = 621 ± 86 lb] were grazed from May 2 to July 31 in year 1; 315 steers (initial BW = 738 ± 123 lb) were grazed from May 11 to August 10 in year 2; 385 steers (initial BW = 616 ± 74 lb) were grazed from May 5 to August 3 in year 3; and 356 steers (initial BW = 722 ± 85 lb) were grazed from May 5 to August 3 in year 4. In years 1, 2, and 3 calves were purchased in Texas, whereas calves were from Texas and Nebraska in year 4. Following purchase, calves were transported to the Kansas State University Beef Stocker Unit. Upon arrival, calves were held in earth-floor pens and limit-fed a growing diet until the start of the grazing season. Prior to grazing, calves were individually weighed and randomly assigned to one of 18 pastures. On the day grazing began, calves were individually weighed, vaccinated for viral respiratory and clostridial pathogens, treated for internal and external parasites, and allocated to their assigned pasture. In addition, a growth-promoting implant was given to steers in years 2, 3, and 4. Following the 90-day grazing period, calves were gathered, and individual BW were immediately measured.

Results and Discussion

Total BW gains and average daily gains (ADG) following the fourth consecutive grazing season tended to be greater ($P \leq 0.07$; Table 1) for calves grazing spring-burned pastures compared with calves grazing fall-burned pastures, whereas total BW gains and ADG for calves grazing summer-burned pastures were intermediate and not different from spring- and fall-burned pastures. Average daily gains were 2.38, 2.27, and 2.24 lb

per day for spring, summer, and fall prescribed-fire treatments, respectively. Overall, spring and summer prescribed-fire treatments resulted in similar growth performance, whereas fall prescribed fire slightly reduced BW gains when compared to spring burning. When considering fall prescribed fire for sericea lespedeza control, ranchers are encouraged to compare the costs associated with herbicide application versus the costs of reduced performance.

Forage biomass accumulation was not affected ($P = 0.58$; Table 2) by prescribed-fire treatments. Conversely, proportions of bare soil were greater ($P < 0.01$) in spring-burned pastures compared with summer- and fall-burned pastures. In addition, proportions of litter on the soil surface were greatest ($P \leq 0.05$) in the summer prescribed-fire treatment, intermediate ($P \leq 0.05$) in the fall prescribed-fire treatment, and least ($P < 0.01$) in the spring prescribed-fire treatment. Differences in proportions of bare soil and litter on the soil surface may be related to the length of time between fire application and soil cover measurements. Soil cover was determined in June of each year; therefore, as the length of time between fire application and sampling increased, proportions of bare soil decreased and proportions of litter on the soil surface increased. Conversely, basal vegetation cover did not differ ($P = 0.25$) among treatments.

Prescribed-fire timing did not affect ($P \geq 0.13$) basal cover of total grass species, native grass species, total forb species, or native forb species. In contrast, fall-burned pastures contained greater ($P \leq 0.01$) proportions of nectar-producing forbs compared with spring- and summer-burned pastures. Increased basal cover of nectar-producing forbs was interpreted to suggest prescribed fire applied later in the year (i.e., October) may benefit native birds or grassland-obligate invertebrates. In addition, fall-burned pastures tended to contain greater ($P \leq 0.08$) proportions total shrubs and increaser shrubs compared with spring-burned pastures, whereas proportions of total shrubs and increaser shrubs in summer-burned pastures were intermediate and not different ($P \geq 0.11$) from spring- and fall-burned pastures.

Implications

Data following four consecutive grazing seasons were interpreted to suggest that Flint Hills ranchers can employ summer-season prescribed fires to manage sericea lespedeza infestations without negatively impacting grazing yearling stocker growth performance, forage biomass accumulation, or native rangeland plant species composition.

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Table 1. Effects of prescribed-fire timing on stocker cattle performance in the Kansas Flint Hills

	Prescribed fire season				
Item	Spring	Summer	Fall	SEM[1]	*P*-value
Initial BW,[2] lb	672	680	667	7.7	0.26
Final BW, lb	887[a]	886[a]	868[b]	6.8	0.03
Total BW gain, lb	214[y]	204[yz]	201[z]	5.4	0.06
ADG,[3] lb/day	2.38[y]	2.27[yz]	2.24[z]	0.060	0.07

[a,b] Within rows, means with unlike superscripts differ ($P \leq 0.05$).
[y,z] Within rows, means with unlike superscripts tend to differ ($P \leq 0.10$).
[1]Standard error of the mean.
[2]Body weight.
[3]Average daily gain.

Table 2. Effects of prescribed-fire timing on forage biomass accumulation, soil cover, and plant species composition in the Kansas Flint Hills

	Prescribed fire season				
Item,	Spring	Summer	Fall	SEM[1]	*P*-value
Forage biomass, lb/acre	1756	1919	1972	221	0.58
Soil cover, % of total area					
Bare soil	64.2[a]	50.4[b]	54.0[b]	2.60	< 0.01
Litter cover	22.1[c]	37.0[a]	31.5[b]	2.55	< 0.01
Total basal vegetation cover	13.8	12.6	14.1	0.90	0.25
Basal cover, % of total basal vegetation cover					
Total grass cover	89.6	89.4	85.5	2.60	0.24
Native grass species	85.1	85.7	79.3	3.32	0.13
Total forb cover	9.9	9.4	13.0	2.57	0.34
Native forb species	9.8	9.3	13.0	2.44	0.29
Nectar-producing forbs	1.5[b]	1.7[b]	2.9[a]	0.44	0.01
Total shrub cover	0.5[z]	1.2[yz]	1.5[y]	0.44	0.07
Increaser shrubs[2]	0.02[z]	0.11[yz]	0.24[y]	0.093	0.08

[a,b,c] Within rows, means with unlike superscripts differ ($P \leq 0.05$).
[y,z] Within rows, means with unlike superscripts tend to differ ($P \leq 0.10$).
[1]Standard error of the mean.
[2]Shrubs that tend to proliferate in response to grazing.