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Abstract

Aboveground biomass production was measured on upland and lowland prairie in replicated, ungrazed watersheds at the Konza Prairie Biological Station (Manhattan, KS) that were burned annually for seven years in either autumn (November), winter (February), or spring (April). Average grass and forb biomass did not significantly differ among burn seasons on either topographic site, although production fluctuated considerably over years. Results of this study contrast with many of the conventional views of how tallgrass prairie vegetation responds to seasonal fire.

Keywords

Cattlemen's Day, 2003; Kansas Agricultural Experiment Station contribution; no. 03-272-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 908; Beef; Forage production; Biomass production; Tallgrass prairie; Burning

FORAGE PRODUCTION FROM TALLGRASS PRAIRIE BURNED ANNUALLY IN AUTUMN, WINTER, OR SPRING

E. G. Towne [1]

Summary

Aboveground biomass production was measured on upland and lowland prairie in replicated, ungrazed watersheds at the Konza Prairie Biological Station (Manhattan, KS) that were burned annually for seven years in either autumn (November), winter (February), or spring (April). Average grass and forb biomass did not significantly differ among burn seasons on either topographic site, although production fluctuated considerably over years. Results of this study contrast with many of the conventional views of how tallgrass prairie vegetation responds to seasonal fire.

Introduction

Fire is an integral component of tallgrass prairie. For more than 7,000 years vegetation has been influenced by anthropogenic burning practices. Intentional burning in autumn and late winter was a frequent ritual of most indigenous Indian tribes. After the influx of transient cattle to the Kansas Flint Hills in the late 1800s, pastures were burned annually in February or March to improve livestock gains. Traditional burn season shifted gradually to mid- or late-April, because fire at that time favored the warm-season perennial grasses that are the mainstay of livestock grazing. In addition, burning tallgrass prairie at times other than late spring has been discouraged because of reputed adverse effects on vegetation productivity. Current perceptions of how tallgrass prairie responds to fire at times other than late spring are based either on small-plot studies or from single-burn events. Because topographic location, soil texture, and climatic factors can affect forage production, long-term large-scale studies are needed to test conventional generalizations on how prairie vegetation responds to season of fire. In addition, fire season is often mistakenly blamed for the adverse effects from concentrated livestock grazing in pastures that have been partially burned by wildfires. Therefore, the objectives of this study were to assess biomass changes from annual burning in different seasons in large, ungrazed, replicated watersheds.

Experimental Procedures

The study was conducted on Konza Prairie Biological Station on six ungrazed watersheds that were burned annually in either autumn (late-November), winter (mid-February), or spring (late-April). Burning began in autumn 1993, with the same two watersheds being burned in the same season throughout the study. At the end of each growing season, aboveground biomass production was measured by clipping twenty, 20 × 50 cm quadrats on both upland and lowland sites in each watershed. Vegetation in the plots was clipped at ground level, separated into graminoid, forb, and woody components, oven-dried at 60°C,

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and weighed. Biomass production was analyzed as a repeated measures split-split plot, with burn season as the whole plot factor, topographic position as the subplot, and year as the sub-subplot.

Results and Discussion

Average grass biomass for the 7-year period was not different among burn seasons on either upland (P=0.96) or lowland (P=0.41) sites, although production fluctuated considerably over time (Figure 1). On upland sites, autumn burning did not significantly reduce grass production in any year compared to spring burning, and winter burning reduced (P=0.001) grass production only once (24% in 1999). In contrast, both autumn and winter burning increased (P<0.01) grass production 22% and 28%, respectively, above spring burning in 1995. In all other years, grass production was similar among burn seasons on the upland sites. Precipitation during the growing season was above normal in both 1995 and 1999, but timing of rainfall events likely was responsible for the different response patterns to season of burn. Precipitation in May was 2.8 times above normal in 1995, and April precipitation was 2.9 times above normal in 1999.

On lowland sites, interannual fluctuations of grass production were more erratic among burn seasons than on the upland sites. Winter burning produced higher (P<0.05) grass biomass than spring burning in three of the seven years (1994, 1995, and 1996), and autumn burning produced higher grass biomass than spring burning in two years (1995 and 1996). In contrast, spring burning increased (P=0.01) grass production above autumn burning only once (1998), and produced more (P<0.05) biomass than winter burning twice (1998 and 1999).

Average forb production did not significantly differ among burn seasons, although production was almost always lowest in response to spring burning on both topographic sites (Figure 2). Fluctuations in forb production apparently responded to precipitation patterns, but there was no significant trend towards increased forb biomass through time with repeated autumn or winter burning. Woody biomass (including leadplant) averaged 15 lbs/acre on uplands and 56 lbs/acre on lowlands, and it did not change through time from burning in any season. Although burning suppresses woody species by removing accumulated top growth, seven years of annual fire in autumn, winter, or spring did not eliminate any shrub species.

Interactions between burn seasons and years suggest that biomass production was likely mediated by climatic factors (e.g., temperature, precipitation amounts, or precipitation distribution patterns) that affected soil moisture availability. Burning tallgrass prairie during winter or early spring has been discouraged because bare ground that is exposed for extended periods potentially could increase surface runoff and evaporation losses, thereby lowering soil moisture and subsequent grass production. However, we saw no evidence of this in the production data collected, even though precipitation during the growing season was below normal in five of seven years of this study (which would, presumably, exacerbate these effects).

The results of this long-term study contrast with many of the conventional views of how tallgrass prairie vegetation responds to seasonal fire, and they challenged traditional recommendations that burning should only occur in late spring. Opposition to autumn, winter, or early spring burning may trace back to anti-burn campaigns in earlier decades and inferences extrapolated from other ecosystems. Annual burning of tallgrass prairie at times other than late spring is apparently a sustainable option that does not sacrifice forage production.

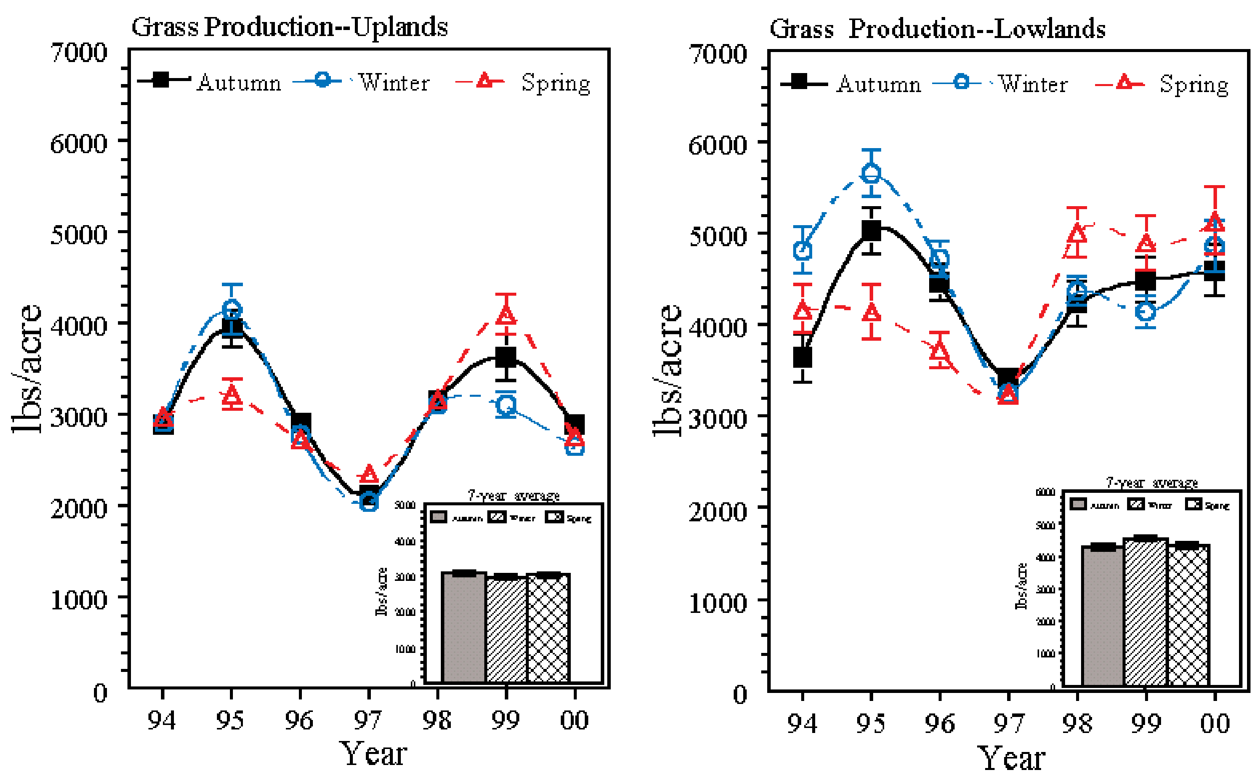

Figure 1. Grass Production from Autumn, Winter, or Spring Burning on Upland and Lowland Sites from 1994 to 2000.

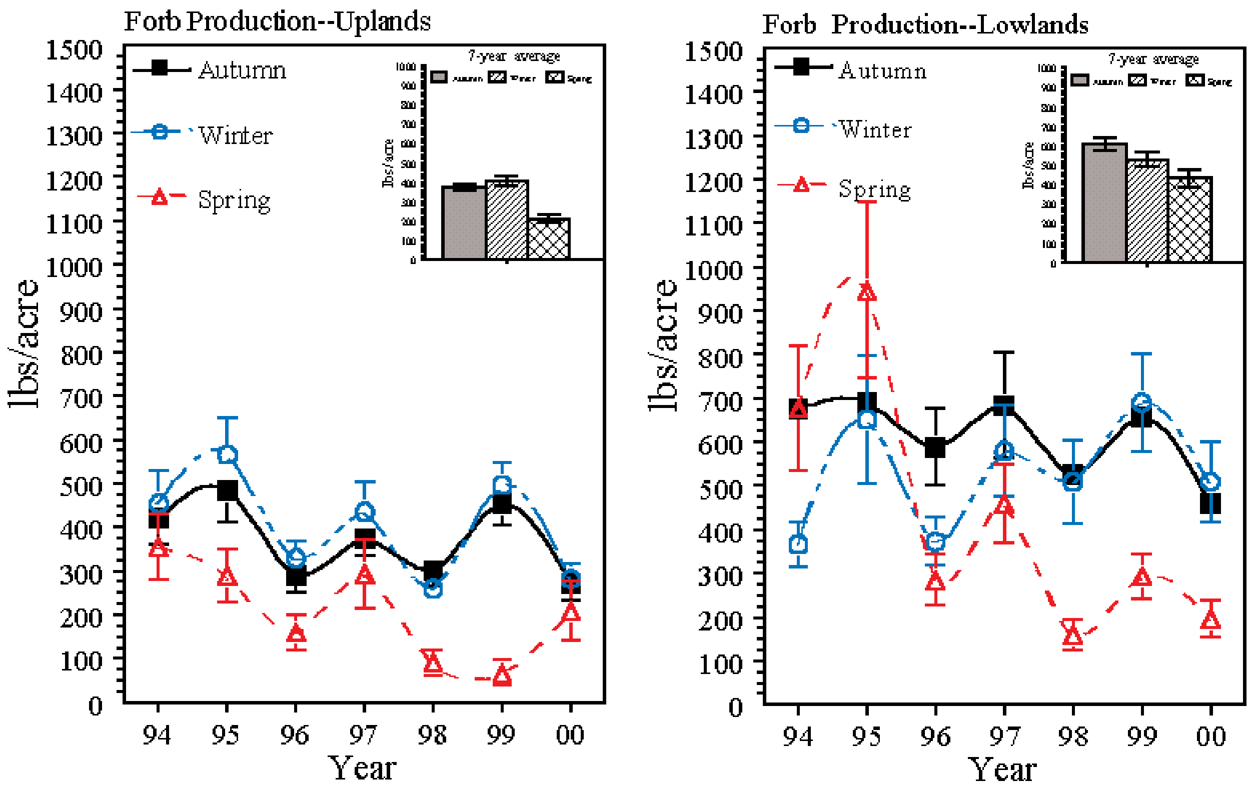

Figure 2. Forb Production from Autumn, Winter, or Spring Burning on Upland and Lowland Sites from 1994 to 2000.