EFFECT OF ANNUAL FIRE ON TALLGRASS PRAIRIE LEGUMES

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Summary

Total legume density was significantly higher in annually burned prairie (8.0 stems/ m^2) than in unburned prairie (3.0 stems/ m^2). Densities of six species were higher ($P<.05$) in burned than in unburned prairie, whereas only one legume species decreased from annual fire. Total legume biomass did not differ between burned (11.3 g/m^2) and unburned prairie (10.5 g/m^2). Most legume species either are favored by fire or are fire tolerant, and their persistence in annually burned grassland suggests that they may play an important role in the nitrogen budget of tallgrass prairie.

(Key Words: Fire, Forage, Legumes, Tallgrass Prairie.)

Introduction

Fire plays a dominant role in manipulating plant composition of tallgrass prairie. Annual burning favors warm-season perennial grasses and reduces most forb species. Legumes are common forbs in tallgrass prairie, but their response to fire, or to the absence of fire, is unknown.

In the Kansas Flint Hills, annual burning reduces available soil nitrogen. Plants that have the potential to fix atmospheric nitrogen may have a competitive advantage in this nitrogen-stressed environment. Thus, we hypothesized that legumes would be more abundant in annually burned tallgrass prairie than in unburned prairie.

Experimental Procedures

The study was conducted at Konza Prairie Research Natural Area on two ungrazed pastures burned annually in April and two adjacent long-term unburned pastures. In mid-July 1993 and 1994, 1 25 m belt transects (n=16) were placed at random locations in the four pastures (128 total transects). All legume stems rooted within the plot were counted, clipped at ground level, sorted by species, oven-dried, and weighed.

Tests for normality indicated that distributions of all legume species were highly skewed. Therefore, the data were analyzed nonparametrically using exponential scores computed from the ranks. Treatment means that were associated with a significant F statistic ($P<.05$) were separated by Fisher's least significant difference.

Results and Discussion

Total legume density was higher ($P<.05$) in annually burned sites (8.0 stems/ m^2) than in unburned sites (3.0 stems/m^2). Except for one species, all either tolerated or were favored by annual burning (Table 1). Six species responded positively to fire or alternatively were significantly inhibited by the environmental conditions created in the absence of fire. Stem density of leadplant (*Amorpha canescens*), the most common legume in tallgrass prairie, was 2.5 times greater in burned prairie than in unburned prairie, because fire stimulated vigorous

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resprouting. Other species that had a higher density in burned than in unburned prairie included white prairieclover (*Dalea candida*), purple prairieclover (*Dalea purpurea*), prairie lespedeza (*Lespedeza violacea*), manyflower scurfpea (*Psoralea tenuiflora*), and catclaw sensitive brier (*Schrankia nuttallii*). In contrast, Illinois tickclover (*Desmodium illinoense*) was the only legume that decreased from annual fire.

Annual burning did not affect total legume biomass (11.3 g/m^2 in burned prairie and 10.5 g/m^2 in unburned prairie). Manyflower scurfpea and white prairieclover both produced significantly greater biomass in burned than in unburned areas, but biomass of other legumes did not differ between burn treatments. Based on average biomass production for Konza Prairie, legumes comprised approximately 25% of the forb biomass in annually burned prairie and approximately 11% of the forb biomass in unburned prairie.

The nitrogen-deficient soils of annually burned prairie may provide ideal conditions for legumes, if they symbiotically fix nitrogen. The ability to nodulate and fix atmospheric nitrogen varies widely among prairie legume species. Consequently, the overall contribution of legumes to the nitrogen budget of tallgrass prairie has been estimated to be small. However, those nitrogen inputs may be far greater in annually burned sites where legume populations are dense.

Plants that persist in annually burned prairie must be able to tolerate chronic soil nitrogen deficiency and the direct effects of fire. Native legumes are among the few forb species that have adapted to these conditions. Despite this advantage, however, legumes are not the most abundant forbs in tallgrass prairie. Periodic droughts and competitive interactions with the warm-season grasses likely prevent legume species from dominating.

In summary, fire is an important factor influencing the density of legume species in tallgrass prairie. The persistence of legumes in both burned and unburned prairie reflects their adaptability to a pyrogenic habitat. Higher legume density in annually burned areas than in unburned sites suggests that these plants may play an important role in the nitrogen budget of tallgrass prairie.

Table 1. Density and Biomass of Tallgrass Prairie Legumes in Burned and Unburned Prairie

	Density (stems/m^2)		Biomass (g/m^2)	
Species	Burned	Unburned	Burned	Unburned
Leadplant	4.26[a]	1.64	5.72	7.04
Plains wildindigo	.17	.17	.92	1.16
Blue wildindigo	.01	.01	.16	.16
White prairieclover	.76[a]	.07	.55[a]	.09
Purple prairieclover	.31[a]	.15	.37	.24
Illinois tickclover	.01[a]	.06	.07	.10
Roundhead lespedeza	.84	.51	.79	.87
Prairie lespedeza	.66[a]	.12	.11	.07
Manyflower scurfpea	.56[a]	.11	2.06[a]	.55
Catclaw sensitivebrier	.27[a]	.06	.45	.17
Total legumes	7.97[a]	3.00	11.29	10.54

[a]Different from unburned prairie (P<.05).