

Summer burning decreases density of *L. cuneata* but does not effect species diversity

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Abstract

Efforts to restore the tallgrass prairie frequently employ the use of prescribed burning, and burning is conducted in different seasons to help control invasive species and promote high species diversity. Our study examined how season of burn affects *Lespedeza cuneata*, an invasive non-native species, and species diversity in experimental reconstructed prairie. We also studied the soil composition of the experimental plots to determine the effects of soil on our species density and diversity data. Our results suggest that summer burning is most effective in controlling the population of *L. cuneata*, and with continued application summer burning could significantly decrease the population.

Introduction

Grasslands once dominated central North America, but today, less than one percent of those grasslands remain (Howe 1995). In the past twenty-eight years, scientists have been involved in efforts to help restore prairies to their natural state. One major hurdle to restoring the prairies is controlling non-native species and maintaining species diversity (Smith & Knapp 2001).

Of the non-native species that plague restored prairies, *Lespedeza cuneata* is one of the most destructive. *L. cuneata* is an asian invasive plant species introduced to the United States in 1896 (Bidwell 2002). It is a late-flowering, C4 legume with little positive effect on the soil nitrogen (Smith 2002). *L. cuneata* has higher seed production rates than most native plants; consequently, it has a strong negative effect on native species diversity (Hobbs 1992). This plant has proved particularly resistant to many common herbicides, and is a major worry in most prairie restoration projects (Smith 2002).

For the purposes of our experiment, we measured the density of *L. cuneata* in relation to a similar native legume, *L. capitata* in plots burned in the spring, summer, and fall. In addition, we measured the overall species diversity within the plots to determine if there is a correlation between the two. We predict that the *L. cuneata* will have a lower relative density in the summer burned plots. This is because *L. cuneata* blooms later than *L. capitata*, so the burning will occur during its growth phase (Smith 2002). Those plots should have higher diversity than the spring and fall plots, due to the negative effect that *L. cuneata* has on diversity. This data will be helpful in determining whether

plots should be burned in a particular season to best control *L. cuneata*, and promote species diversity.

Methods

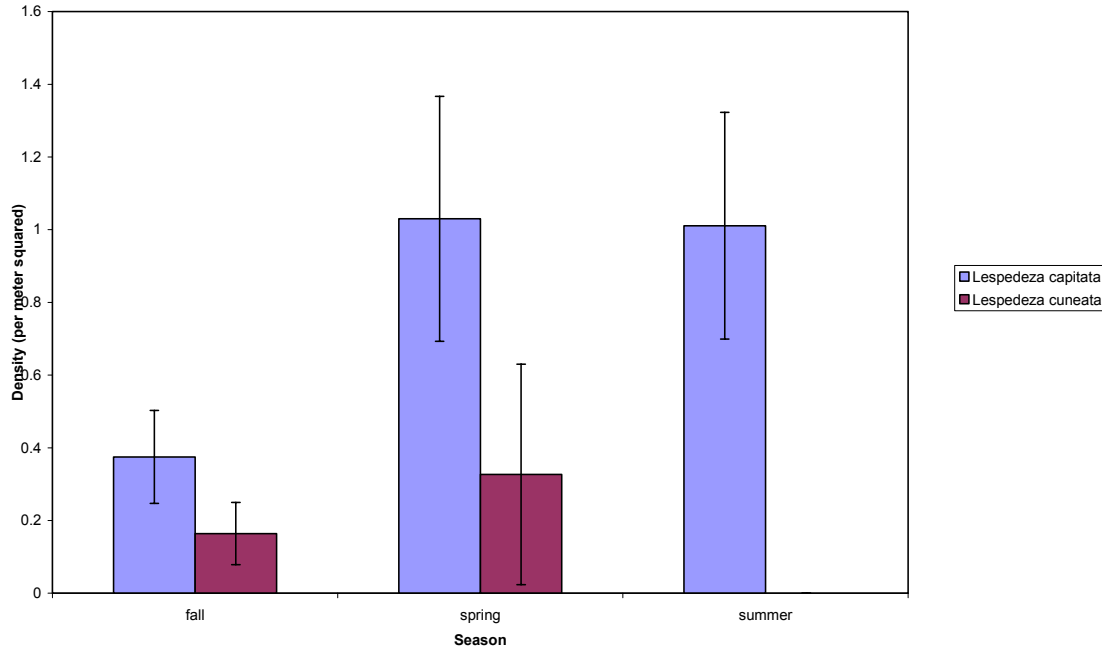
Data Collection

We studied the population of *L. cuneata* and *L. capitata* as well as species diversity at Conard Environmental Research Area in central Iowa. We collected our data from the field between October 8, 2003 and November 3, 2003. First, we measured the density of *L. cuneata* and *L. capitata* by counting the total population in each of the eighteen 10x20m season burned plots which were arranged in a randomized block pattern; six of them were burned in the spring, six in summer, and six in fall, all attempted to be burned every year in their respective season, since 1999. The summer burned plots were only successfully burned every other year because of a lack of dry fuel. There were eighteen seasonal burned plots divided into 6 blocks; we divided each plot into three sections by laying two tape measures lengthwise across the plot. We used three random coordinate pairs as datapoints, at which we measured species diversity by counting the number of species inside a quarter-meter quatrat, and then estimating the percent coverage of each species. Using the same random datapoints, we took three soil core samples in each plot.

Soil Analysis

We combined the three core samples from each plot into one sample, weighed each sample wet, dried them in a drying oven at 60°C for forty-eight hours, and found the difference

Figure1
Density on season burn plots



n=18

Figure 1. Comparison between mean densities (\pm SE) of *L. cuneata* and *L. capitata* in fall, spring, and summer burned plots.

between the wet and dry weights to determine percent soil moisture. We used a pH meter to analyze the pH of 5 g of soil mixed with 5 ml of deionized water. In order to determine the percent carbon and nitrogen of our samples, we ran 50 micrograms of ground soil from each sample through a ThermoFinnegan C/N analyzer.

Statistical Analysis

Our variables of interest were *Lespedeza capitata* population, *Lespedeza cuneata* population, species diversity, soil pH, and carbon-nitrogen content of the soil. We used ANOVA to test for significant effects of burn season and block. Due to zeros in our *L. cuneata* density data, we used the Kruskal-Wallis non-parametric test to determine the significance of

the difference of *L. cuneata*'s density among the different seasons of burn.

Results

ANOVA indicated that there was a significantly larger density of *L. capitata* than *L. cuneata* in the summer burned plots which had no *L. cuneata* at all ($p = .009$) (Fig. 1). The Kruskal-Wallis test showed a near significant difference in the density of *L. cuneata* populations between the different seasons ($p = .078$). However, there was not significant variation among density of the two species in any other season of burning (Fig. 1). There was also no significant variation in the species diversity the seasons of burning. ANOVA indicated a significant effect of block for both

Table 1. p- and f- values for soil composition according to block and according to season.

	block		season	
	f value	p value	f value	p value
soil pH	3.33	.05*	1.68	.235
percent soil carbon	4.00	.034*	.21	.813
percent soil nitrogen	2.4	.112	.07	.935

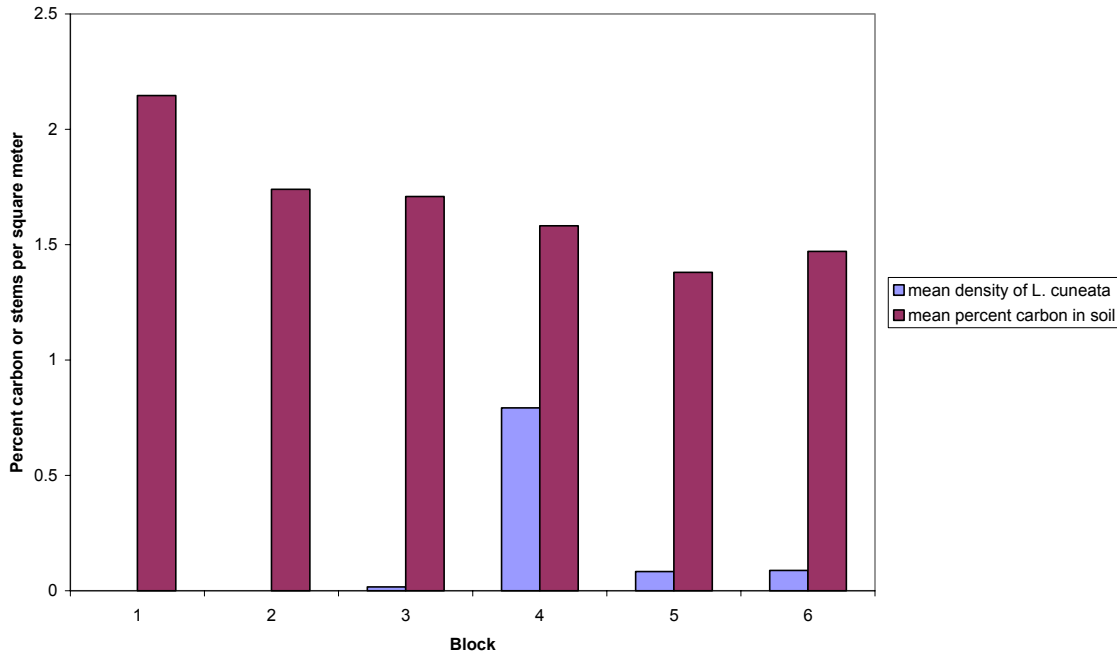


Figure 2. Mean *L. cuneata* density compared with mean percent carbon in soil, demonstrating block effect.

carbon content and soil pH (Table 1). The block effects can be seen in carbon content and *L. cuneata* density in Figure 2. On the other hand, there was no significant effect of season of burn for carbon, pH, and nitrogen (Table 1).

Discussion

The ANOVA test indicated that there was a significant difference between the density of *L. capitata* and *L. cuneata* for summer burned plots. There was also a near significant difference in the density of *L. cuneata* on the different season of burn plots. Both of these results suggest that our hypothesis that summer burning would be the most successful at decreasing the density of *L. cuneata* may be correct. These results can be attributed to the fact that *L. cuneata* flowers in the summer, and therefore, burning in the summer eliminates the *L. cuneata* that has already grown, as well as the seeds that would increase the population density (Smith 2002). Since the summer burned plots have only been burned twice, it is possible that the *L. cuneata* population in the summer burned plots will decrease more and more significantly over time.

Even after taking into account the block effect, our soil composition data was nonsignificant. Since the composition of soil largely affects a plant's livelihood, this soil gradient affected the plants' responses. The soil composition gradient created other factors besides burn season that could have influenced density and species diversity (Turner et al 1997).

In order to produce more significant results in future experiments, we would suggest using an area that is fairly flat and has even soil composition throughout the various plots. To ensure this we propose testing soil composition of the area to be studied before beginning the experiment. The effect of *Lespedeza cuneata* on species diversity could be more thoroughly observed by using two sets of plots; one with all the *L. cuneata* removed before burning and one in which the *L. cuneata* is left alone. This would separate the effect of *L. cuneata* on species diversity from the effect of seasonal burning.

Another interesting area of research would be to examine the differences in the effects of burning, mowing, clipping, and grazing on the *L. cuneata* population, as well as species diversity. By including these other treatments a more efficient way of eliminating *L. cuneata* may be

discovered, possibly in a combination of the treatments.

Since *Lespedeza cuneata* is a non-native species, threatening the diversity of native species, our results have shown that summer burning may be a good tool in eliminating this invasive species. While *Lespedeza cuneata* is just one non-native species threatening the tallgrass prairie, its removal would be a great step towards returning the prairie to its native state.

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