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Native Cover Crops: Effects on Weed Invasion and Prairie Establishment

Abstract
There are several native species that have potential as cover crops. During the 2004 growing season, we established five native species as cover crops at two separate sites, the Horticulture Research Station and the Western Research Farm, and we have been measuring cover crop and prairie species establishment, biomass production, and weed suppression annually since then. The objective of our study was to develop a better understanding of how cover plants are affecting weed and prairie species establishment.

Keywords
Ecology Evolution and Organismal Biology

Disciplines
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Native Cover Crops: Effects on Weed Invasion and Prairie Establishment

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Introduction

There are several native species that have potential as cover crops. During the 2004 growing season, we established five native species as cover crops at two separate sites, the Horticulture Research Station and the Western Research Farm, and we have been measuring cover crop and prairie species establishment, biomass production, and weed suppression annually since then. The objective of our study was to develop a better understanding of how cover plants are affecting weed and prairie species establishment.

Materials and Methods

Experimental plots were set up on slopes. Seed mixes containing 29 prairie species were added to the plots that contained one of six cover crop treatments. Cover crop treatments included the following:

1. Canada wildrye (*Elymus canadensis*)
2. Partridge pea (*Chamaecrista fasciculata*)
3. Illinois bundleflower (*Desmanthus illinoensis*)
4. Black-eyed Susan (*Rudbeckia hirta*)
5. Side-oats grama (*Bouteloua curtipendula*)
6. No cover crop (control)

These are all early-emerging species that have the potential to facilitate establishment of later emerging prairie species. Six replicate plots were established for each treatment. Plots are 5 m × 5 m and were established in tilled areas that were formerly in brome (*Bromus inermis*). The cover crops were seeded during early April 2004 at a rate of 10 lb/acre and were allowed to become established for the rest of the growing season before the prairie mix was added during the late fall of 2004, 2005, and 2006.

Previously, we reported that the amount of weed biomass varied across cover crop treatments ($P<0.05$) during 2005 (year 2). Weed biomass was highest in partridge pea plots, lowest in black-eyed Susan plots, and intermediate in other plots.

In 2006, we continued to sample species composition in each plot. Species composition remained different among plots at the Horticulture Station (Multi-response permutation procedure, $P<0.05$) but not at the less productive Western Research Farm. This suggests that the presence of different species of cover crops can be an important determinant of species composition in early stages of prairie development in productive but not less productive sites.

Fire temperatures. Fire is important in the ecology of tallgrass prairies. Prairie fires are started naturally due to lightning strikes and are often intentionally set to manage *for* prairie species and *against* non-prairie species. Thus, it is important to determine how early emerging cover-crop species affect fire intensity. If fire intensity is affected, then this could have important, indirect effects on community (e.g. species composition) and ecosystem processes. We burned each plot during spring 2006 to test whether cover crop species affected fire temperatures and the spatial extent of each fire. Fire temperatures and the proportion of each plot that was burned was highest in plots dominated by side-oats grama, second highest in plots dominated by Canada wildrye, and lowest in plots dominated by the other species (Figure 1). The more intense fires in side-oats grama plots knocked-back weedy species and favored its own persistence. This suggests that

these early emerging species have fundamentally altered an important process (fire intensity) in these prairie plots.

A second experiment involved planting cover crop species during spring or late summer/early fall, with prairie seed mix either added 1) with the cover crop seed or 2) during the year following. We found better prairie establishment when prairie mix was added with the cover crop in this second experiment. Further details will be discussed in future reports.

Results and Discussion

The length of time that a cover crop species will suppress weeds is a function of its lifespan. The annual (partridge pea) and biennial (black-eyed Susan) that we used greatly suppressed weeds in year 1 (partridge pea) and year 1 and early in year 2 (black-eyed Susan). Both species failed to reseed themselves, and both species senesced at a time period that weedy perennials like smooth brome and crown vetch tend to establish in the fall. Partridge pea was more weedy than any other treatment by 2005 (year 2). Given that prairie plants take several years to establish, we suggest that perennial cover crops (e.g. Canada wildrye) will provide the better overall long-term weed suppression. Not using a cover crop and merely treating the weeds before seeding remains a viable alternative.

The cover crops side-oats grama and Canada wildrye produced abundant fuel that led to plots being burned more thoroughly and at much higher temperatures than control plots or plots seeded with other putative cover crop species. Higher fire temperatures appear to have knocked back smooth brome and crown vetch, which should help to establish prairie in the long run.

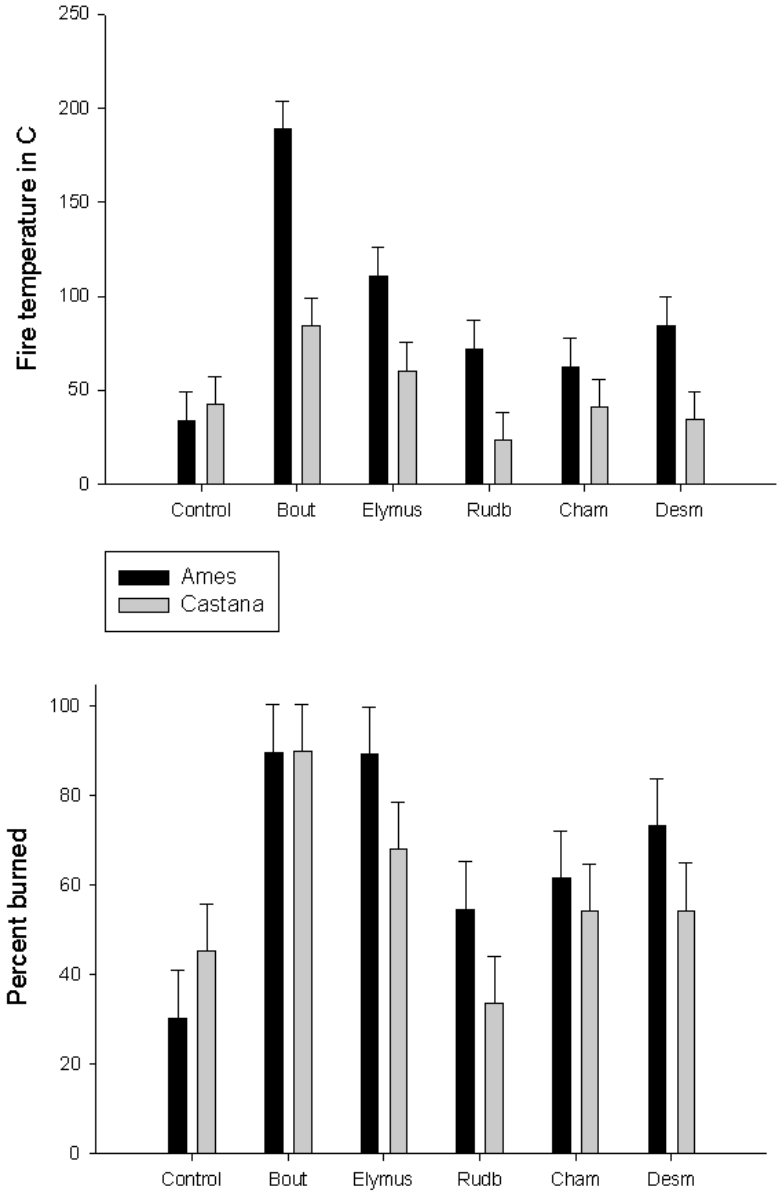

Figure 1. Fire temperatures (top panel) and proportion of the plot burned in plots dominated by no cover crop (Control) or the cover crops side-oats grama (Bout), Canada wildrye (Elymus), black-eyed Susan (Rudb), partridge pea (Cham) and Illinois bundleflower (Desm) at the Horticulture Station (Ames) and Western Research Farm (Castana).