

EFFECT OF FIRE ON MIXED-GRASS PLANT COMMUNITIES
IN BADLANDS NATIONAL PARK

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Objectives

This research has two principle objectives. The first of these is to determine the influence of fire on the density and peak standing crop of the major grass species of the Badlands National Park mixed-grass prairie. The second major objective is to develop burning prescriptions that would favor native plant species over exotics. Preemergent herbicide treatments have been added to provide an alternative method of controlling exotic annual plants.

Methods

Thirty 5-by-5-m plots were established in Badlands National Park. The experimental design used for this study was a randomized complete block with 3 replications of 10 treatments. Treatments are:

Untreated
Burn, April 1983
Burn, May 1983
Burn, April 1983 & April 1984
Burn, May 1983 & May 1984
Clip, April 1983
Clip, May 1983
Preemergent herbicide, September 1983
Burn, April 1983, and preemergent herbicide
Burn, April 1984

Tiller density was determined in April 1983 and July 1984 using five placements of a 0.10m² quadrat placed on a permanently marked diagonal across each plot. Differences in tiller density among treatments were determined with analysis of covariance using the April tiller density as the covariate. Standing crops were determined in August using five placements of a 0.10m² quadrat in each plot. Differences in standing crops among treatments were determined with analysis of variance. Orthogonal comparisons were conducted on nine different contrasts (Tables 1 and 2). Comparisons of tiller density were made on the adjusted means

Table 1. Tiller density (per m²) of Japanese brome and western wheatgrass in July 1984, after treating in 1983 and/or 1984, Badlands National Park, South Dakota.¹

Contrast	Japanese brome	Western wheatgrass
No treatment vs. 1983 burning treatments	2,617 2,028 ^{NS}	375 264 ^{NS}
No treatment vs. 1984 burning treatment	2,617 23 ^{**}	375 507 ^{**}
No treatment vs. double burning (1983 and 1984) treatments	2,617 580 ^{**}	375 333 ^{NS}
1984 burning treatment vs. double burning (1983 and 1984) treatments	23 580 [*]	507 333 [*]
No treatment vs. Atrazine treatment (Sept. 1983)	2,617 19 ^{**}	375 95 ^{**}
1983 clipping treatments vs. 1983 burning treatments	3,250 [*] 2,028	297 264 ^{NS}
1983 burning treatments vs. 1984 burning treatment	2,028 ^{**} 23	264 507 ^{**}
April 1983 burning followed by Atrazine treatment vs. Atrazine treatment	77 19 ^{NS}	302 95 [*]
Atrazine treatment vs. 1984 burning treatment	19 23 ^{NS}	95 507 ^{**}

¹NS means the contrast is not significant, * means significant at the 5% error level, and ** means significant at the 1% error level. All analyses of contrasts are within a species.

Table 2. Standing crops (g/m^2) of Japanese brome and western wheatgrass in July 1984, after treating in 1983 and/or 1984, Badlands National Park, South Dakota.¹

Contrast	Japanese brome	Western wheatgrass
No treatment vs. 1983 burning treatments	14.8 19.9 ^{NS}	21.2 6.6 ^{NS}
No treatment vs. 1984 burning treatment	14.8 0.7*	21.2 22.4 ^{NS}
No treatment vs. double burning (1983 and 1984) treatments	14.8 4.7 ^{NS}	21.2 18.4 ^{NS}
1984 burning treatment vs. double burning (1983 and 1984) treatments	0.7 4.7 ^{NS}	22.4 18.4 ^{NS}
No treatment vs. Atrazine treatment (Sept. 1983)	14.8 0.0*	21.2 7.7 ^{NS}
1983 clipping treatments vs. 1983 burning treatments	24.7 19.9 ^{NS}	13.0 6.6 ^{NS}
1983 burning treatments vs. 1984 burning treatment	19.9 0.7**	6.6 22.4 ^{NS}
April 1983 burning followed by Atrazine treatment vs. Atrazine treatment	1.5 0.0 ^{NS}	17.4 7.7 ^{NS}
Atrazine treatment vs. 1984 burning treatment	0.0 0.7 ^{NS}	7.7 22.4 ^{NS}

¹ NS means the contrast is not significant, * means significant at the 5% error level, and ** means significant at the 1% error level. All analyses of contrasts are within a species.

obtained from analysis of covariance.

Results

Japanese brome (*Bromus japonicus*) tiller density and standing crop was significantly ($P < 0.05$) reduced during the first year following burning (Tables 1 and 2). However, during the second year following burning, both tiller density and standing crop increased to approximately preburn levels. Burning resulted in fewer Japanese brome tillers than did clipping for 2 years after treatment. This indicates that mortality resulted from the effects of heat and not simply from removal of foliage. Atrazine (1.1 kg/ha) applied as a preemergent herbicide significantly reduced Japanese brome tiller density and standing crop compared to the untreated plots (Tables 1 and 2).

Burning significantly increased western wheatgrass (*Agropyron smithii*) tiller density during the first growing season (Table 1). However, during the second growing season, western wheatgrass tiller density was again reduced. Atrazine treatment significantly reduced western wheatgrass tiller density, at least for the first year after treatment. Standing crops of western wheatgrass were not significantly affected by any of the treatments (Table 2).

Conclusions

Burning in the spring significantly reduces the annual Japanese brome and somewhat benefits the perennial, rhizomatous western wheatgrass at least during the first growing season. However, during the second year following burning, Japanese brome density returns to preburn levels and the apparent first-year benefits to western wheatgrass are lost. Preemergent applications of Atrazine significantly reduced Japanese brome density and standing crop but reduced western wheatgrass tiller density the first year.

The important consequences of these treatments are not determined during the first year. The long-term reduction of the exotic, invader Japanese brome is the real goal. At this point, it appears that Atrazine may offer the greatest possibility of success. The result of these treatments will be monitored for 2 more years before a final evaluation will be made. In addition, a study of the population dynamics of Japanese brome has been initiated, with emphasis on the seed reserve in the soil. An understanding of this process, and how it is influenced by the treatments, is essential to an understanding of the long-range problem.