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 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

Twenty one 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 9 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 & preemergent herbicide, September 1983

Tiller density was determined in April and August 1983 using five placements of a $0.10m^2$ quadrat placed on a permanently marked diagonal across each plot. Differenced 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 $0.10m^2$ quadrat in each plot. Differences in standing crops among treatments were determined with analysis of variance. Orthogonal comparisons were made of untreated vs. treated plots (clipped and burned), untreated vs. all burned plots, burned vs. clipped plots, and April 1983 vs. May 1983 burned plots. Comparisons of tiller density were made on the adjusted means obtained from analysis of covariance. In August

1983, the September 1983 herbicide plots were analyzed as untreated plots. Plots scheduled to be burned in April (or May) 1983 and 1984 as well as the April burn and September herbicide plots were analyzed as additional replications of the April (or May) 1983 burn treatment. This resulted in six replications of untreated plots, nine replication of April 1983 burned plots, and six replications of the May 1983 burned plots. All other treatments have three replications. Subsequent evaluations will have three replications for each treatment.

Results

Japenese brome (Bromus japonicus) tiller density was significantly reduced on the treated plots (burned or clipped) when compared to the untreated plots (Table 1). Significant differences in Japenese brome tiller densities were found between the plots burned in April or May. This indicates that burning in May was more detrimental to Japanese brome plants than burning in April, even though both burning dates resulted in significantly fewer tillers than the unburned plots. Burning resulted in fewer Japanese brome tillers than did clipping, which indicated that mortality resulted from the effects of heat and not simply from top removal.

Standing crops of Japanese brome were significantly reduced on the treated plots compared to the untreated plots (Table 2). The burned plots had significantly lower Japanese brome standing crops than either the untreated or the clipped plots. No significant differences in standing crops were found between the plots burned in April or May.

Tiller density of western wheatgrass (Agropyron smithii) was significantly increased by burning or clipping (Table 1). No significant differences were detected between burning and clipping or between burning in April or May. This indicates that top removal and/or reduced interspecific competition (from Japanese brome) stimulated western wheatgrass tillering. However, no significant differences in western wheatgrass standing crop was detected between any of the preselected contrasts.

Conclusions

Burning in the spring, damages the annual Japanese brome and somewhat benefits the perennial, rhizomatous western wheatgrass at least during the first growing season. However, in many instances annual grasses have increased during the second growing season following fire (Daubenmire 1968, Whisenant et al. 1984). This experiment also includes treatments in which the plots will be burned 2 years in a row and plots in which burning is used in conjunction with preemergent herbicides.

Literature Cited

Daubenmire, R. 1968. Ecology of fire in grasslands. Advan. Ecol. Res. 5:209-266.

Table 1. Tiller density[1] (per m^2) of Japanese brome and western wheatgrass in August 1983, after burning or clipping in April or May 1983, Badlands National Park, South Dakota.[2]

Contrast	Japanese brome	western wheatgrass
No Treatment	2,740 *	295 *
vs. All Treated Plots	1,501	446
No Treatment	2,740 **	295 *
vs. Burn Treatments	908	427
Burn Treatments	908 *	427 NS
vs. Clip Treatments	2,095	465
April Burn	1,136 *	473 NS
vs. May Burn	681	381

[1] Means are adjusted means from analysis of covariance using pretreatment density as covariate.

[2] 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.

Table 2. Standing crops (g/m^2) of Japanese brome and western wheatgrass in August 1983, after burning or clipping April or May 1983, Badlands National Park, South Dakota.[1]

Contrast	Japanese brome	western wheatgrass
No Treatment	75	88
vs. All Treated Plots	37 *	85 NS
No Treatment	75	88
vs. Burn Treatments	28 **	90 NS
Burn Treatments	28	90
vs. Clip Treatments	47 *	80 NS
April Burn	35	91
vs. May Burn	20 NS	88 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.

Whisenant, S. G., D. N. Ueckert, and C. J. Scifres. 1984. Effects of fire on Texas wintergrass communities. J. Range Manage. (In Press).