Effect of Fire on Mixed-Grass Plant Communities in Badlands National Park

Steven G. Whisenant
Brigham Young University

Dan W. Uresk
Rocky Mountain Forest and Range Experiment Station

Follow this and additional works at: http://repository.uwyo.edu/uwnpsrc_reports

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

Steven G. Whisenant
Botany and Range Science
Brigham Young University
Provo, UT

Dan W. Uresk
Rocky Mountain Forest and Range Experiment Station
Rapid City, SD

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 0.10m² 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 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

Japanese 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 Japanese 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

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.\(^2\)

<table>
<thead>
<tr>
<th>Contrast</th>
<th>Japanese brome</th>
<th>Western wheatgrass</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Treatment vs. All Treated Plots</td>
<td>2,740*</td>
<td>295*</td>
</tr>
<tr>
<td></td>
<td>1,501</td>
<td>446</td>
</tr>
<tr>
<td>No Treatment vs. Burn Treatments</td>
<td>2,740**</td>
<td>295*</td>
</tr>
<tr>
<td></td>
<td>908</td>
<td>427</td>
</tr>
<tr>
<td>Burn Treatments vs. Clip Treatments</td>
<td>908*</td>
<td>427(^{\text{NS}})</td>
</tr>
<tr>
<td></td>
<td>2,095</td>
<td>465(^{\text{NS}})</td>
</tr>
<tr>
<td>April Burn vs. May Burn</td>
<td>1,136*</td>
<td>473(^{\text{NS}})</td>
</tr>
<tr>
<td></td>
<td>681</td>
<td>381(^{\text{NS}})</td>
</tr>
</tbody>
</table>

\(^1\) 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/m²) of Japanese brome and western wheatgrass in August 1983, after burning or clipping April or May 1983, Badlands National Park, South Dakota.

<table>
<thead>
<tr>
<th>Contrast</th>
<th>Japanese brome</th>
<th>western wheatgrass</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Treatment vs. All Treated Plots</td>
<td>75*</td>
<td>88 NS</td>
</tr>
<tr>
<td>No Treatment vs. Burn Treatments</td>
<td>75**</td>
<td>88 NS</td>
</tr>
<tr>
<td>Burn Treatments vs. Clip Treatments</td>
<td>28*</td>
<td>90 NS</td>
</tr>
<tr>
<td>April Burn vs. May Burn</td>
<td>35 NS</td>
<td>91 NS</td>
</tr>
</tbody>
</table>

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.