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EFFECT OF BURNING ON GERMINATION OF TALLGRASS PRAIRIE PLANT SPECIES

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Abstract. Seeds from 10 prairie plant species of burned and unburned portions of three tallgrass prairies were collected and tested for germinability. Germination of big bluestem (*Andropogon gerardii* Vitman) consistently averaged higher with burning. Indiangrass (*Sorghastrum nutans* L.) and sideoats grama [*Bouteloua curtipendula* (Michx.) Torr.] averaged 5% higher with burning on two of the three sites, although for indiangrass average germination for all three sites was 7% lower. Species for which germination declined with burning were false sunflower [*Heliopsis helianthoides* (L.) Sweet var. *scabra* (Dun.) Fern.], -13%; wholeleaf rosinweed (*Silphium integrifolium* Michx.), -10%; and white prairieclover (*Dalea candida* Michx. *ex* Willd.), -4%. For all species combined, burning also delayed peak germination and extended the length of time of germination.

Key Words. fire, germination, tallgrass prairie, Nebraska

INTRODUCTION

Fire, a natural component of the tallgrass prairie ecosystem, has been found both to increase seed production in some species, such as big bluestem (*Andropogon gerardii* Vitman), little bluestem (*Andropogon scoparius* Michx.), and indiangrass (*Sorghastrum nutans* L.) (Risser *et al.* 1981), and to decrease it in others, such as western ironweed (*Vernonia baldwinii* Torr. var. *baldwinii*) (Knapp 1984). In addition, percent germination has been found to be higher for seeds produced from burned areas for big bluestem, little bluestem, and Canada wild rye (*Elymus canadensis* L.) (Ehrenreich and Aikman 1957). Went *et al.* (1952) indicate that increased *in situ* germination in burned areas was due largely to better conditions created by the fire, but Daubenmire (1970) suggests that increased germination reflects the greater vigor and vitality of the burned plant itself. Other than these studies, little has been done to evaluate the effects of burning on seed germination of prairie species. The purpose of this study, therefore, was to expand this information with the specific focus being to evaluate the effect of burning on germination of several prairie species. This study was intended only as a limited, single-year, study to provide preliminary information for further, more detailed research. The study was not designed as a full, statistical evaluation of all aspects of fire effects on germination.

METHODS AND MATERIALS

Seeds of ten prairie plant species (Table 1) were collected in September 1985 from burned and unburned areas of three grass-

Table 1. Germination (%) of ten prairie species in burned and unburned sites. Species ordered from most positive to most negative response to burning based on averages for all sites. n = 30/treatment area/site. Emergence data are for combined sites. BU = Unburned; B = Burned; — = no data available. Species nomenclature is from the Great Plains Flora Association (1986).

	Hover Prairie		*Stolley Prairie*		*Allwine Prairie*		*Days to First Emergence*	
	UB	*B*	*UB*	*B*	*UB*	*B*	*UB*	*B*
	%						days	
Big bluestem (*Andropogon gerardii* Vitman)	—	—	3	13	7	20	32	16
Leadplant (*Amorpha canescens* Pursh)	20	33	3	3	—	—	40	14
Side-oats grama [*Bouteloua curtipendula* (Michx.) Torr.]	30	13	10	20	20	43	22	10
Canada wild rye (*Elymus canadensis* L.)	100	100	100	100	—	—	10	8
Finger coreopsis (*Coreopsis palmata* Nutt.)	20	23	20	17	—	—	9	10
Switchgrass (*Panicum virgatum* L.)	10	0	0	10	13	13	17	24
White prairie clover (*Dalea candida* Michx. *ex* Willd.)	13	13	17	10	—	—	14	14
Indiangrass (*Sorghastrum nutans* L.)	50	3	0	17	7	17	18	37
Wholeleaf rosinweed (*Silphium integrifolium* Michx.)	37	17	47	47	—	—	10	14
False sunflower [*Heliopsis helianthoides* (L.) Sweet var. *scabra* (Dun.) Fern.]	37	13	33	30	—	—	14	11

lands: Hover Prairie and Stolley Prairie, two native grasslands, and Allwine Prairie Preserve, a reestablished grassland. All sites were situated in east central Nebraska within 15 km of Omaha. Selection of different study areas was designed to allow the results to be more generally applicable to the tallgrass prairie region. Prescribed burns were conducted during late April 1985; unburned areas were last burned in Spring 1982. The species selected were determined by seed availability and by the intent to consider a variety of grasses and forbs. Due to low species diversity at Allwine Prairie, only indiangrass, big bluestem, switchgrass (*Panicum virgatum* L.), and sideoats grama [*Bouteloua curtipendula* (Michx.) Torr.] were collected. Plants at this site were from seed provided by the Soil Conservation Service and were probably of Kansas origin.

Seeds were collected from at least ten individuals of each species at each site and for each treatment (burned or unburned). All seeds from a single species/site/treatment were combined in a single paper sack. Samples at each site were not replicated. All awns, hairs, and glumes were left on seeds. The seeds were stored at room temperature for six weeks. During this time, filled seeds, presumably viable, were visually separated from chaff and from unfilled seeds using a dissecting microscope. The principal means used to separate filled from unfilled seeds was to use gentle pressure of a finger nail against the caryopsis. This procedure was especially important for those species with loose lemmae and paleae such as indiangrass, big bluestem, and sideoats grama. For species with hard lemmae and paleae, such as switchgrass, selection of viable seeds was slightly more subjective being based on general fullness of appearance of seeds. In addition to these criteria, seeds with apparent damage by herbivores were also excluded.

From each species/site/treatment sample, 30 seeds were randomly selected and stratified by placing them on moist filter paper in petri dishes and storing them at 0 C for four weeks. During this time, the filter paper was regularly checked and moistened with distilled water when found dry. After stratification, the seeds were planted in flats in a greenhouse. The flats contained a sterile mixture of 1:1:1 sand, peat, and clay loam soil. Burned and unburned samples were planted side by side in rows that were separated by dividers. Planting depth was approximately 0.1 cm. Flats were kept moist and rotated weekly to reduce any effects of location. No attempt was made to adjust photoperiod. Maximum greenhouse temperatures during this time varied from 16-19 C.

Seedling emergence was used as the indicator of seed germination success. The flats were checked daily for the first two weeks after planting, every other day during the third week, and only weekly for the fourth and subsequent weeks. The study was terminated after 13 weeks. At each observation, the occurrence of new seedlings was recorded and each individual marked with a toothpick.

RESULTS AND DISCUSSION

Total germination averaged 25% for combined seeds from the burned area and 23% for the unburned area. Canada wild rye germination was 100% for both treatments. The second highest total germination was for wholeleaf rosinweed (*Silphium integrifolium* Michx.) which averaged 47% in both the burned and unburned portions of one site (Table 1). The lowest average germination was 7% for switchgrass, although no germination occurred in two samples of this species as well as in one sample of indiangrass.

Big bluestem was the only species for which germination consistently increased with burning. Despite a spring burn, flowering of this species at one site was unexplainably low during 1985 suggesting between-site differences which could explain some of the variability of results obtained. The 10% average increase in germination of big bluestem with burning was similar to the 7% increase reported by Ehrenreich and Aikman (1957). While the response of germination to burning varied by site for other species, average germination for combined sites showed slight increases with burning for leadplant (*Amorpha canescens* Pursh) and sideoats grama. Germination of sideoats grama increased with burning in two sites but declined in the third. Germination of indiangrass is

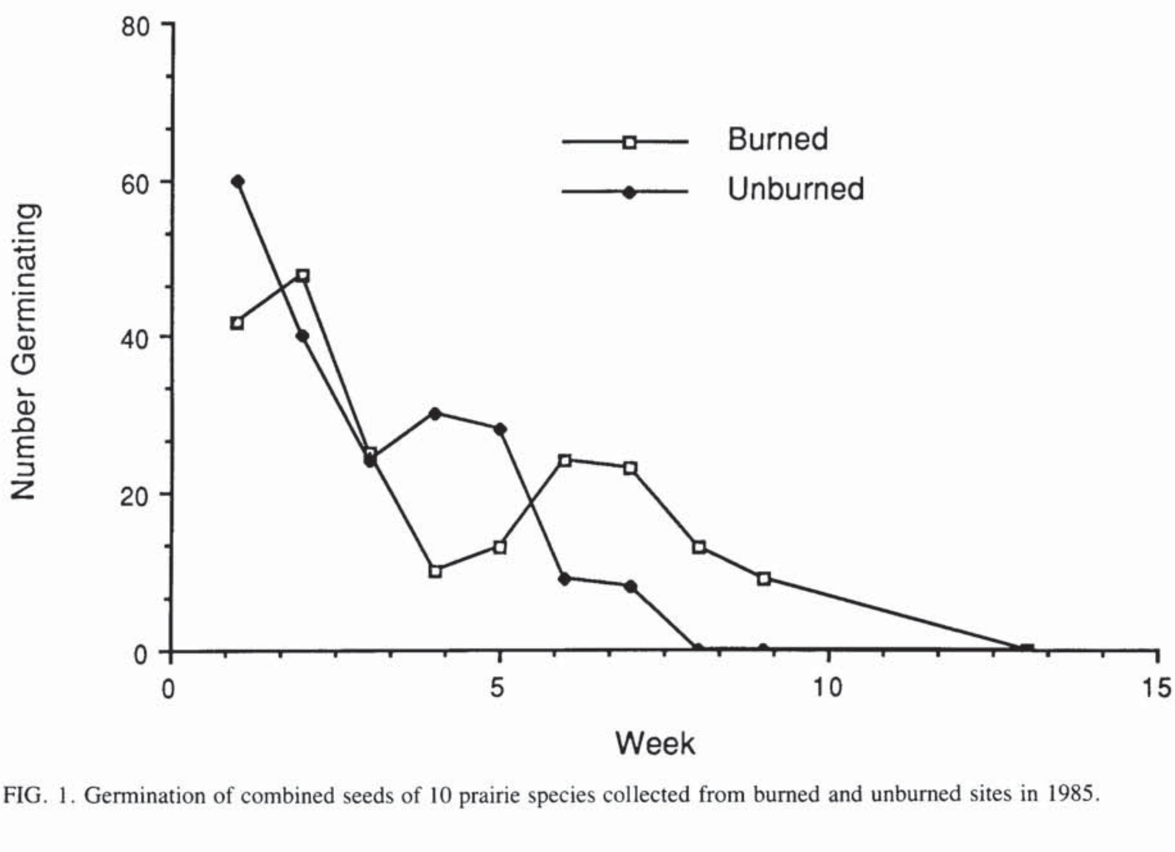

FIG. 1. Germination of combined seeds of 10 prairie species collected from burned and unburned sites in 1985.

also likely to increase with burning. While the average value for combined sites showed a 7% decline in germination of indiangrass, two sites showed increases (+14%) and only one decreased (-47%). Decreases in sideoats grama and indiangrass were both recorded for the same prairie (Hover Prairie) although no explanation for this difference in response is apparent. An increase in germination of indiangrass with burning is consistent with the results reported by Ehrenreich and Aikman (1957) although the increase they noted was only 2%.

Of species for which germination declined with burning, only false sunflower [*Heliopsis helianthoides* (L.) Sweet var. *scabra* (Dun.) Fern.] showed this response at all sites. For combined sites, however, average germination decline for wholeleaf rosin weed (-7%). Ehrenreich and Aikman (1957) indicated a substantial (36%) decline in germination of Canada wild rye with burning but, in this study, germination of this species was unaffected with all seeds germinating regardless of treatment.

The number of days before germination of the first seedling of a species was also quite variable (Table 1). For burned areas, these dates varied from as early as 8 days for Canada wild rye to as late as 37 days for indiangrass. Unburned areas varied from 9 days for finger coreopsis (*Coreopsis palmata* Nutt.) to 40 days for leadplant.

Germination over time for all species combined provides a general perspective of post-burn germination in grasslands. The results of this study indicated first, that two peaks occurred in germination; and second, that these peaks differed somewhat for burned and unburned areas. The highest germination, for both burned and unburned areas, occurred within the first 1-2 weeks of planting (Fig. 1). For seeds from the unburned area, this initial flush of germination occurred within the first week. For burned area seeds, the peak occurred during the second week. The subsequent peak occurred from weeks 4-5 for the unburned areas and weeks 6-7 for burned areas. Germination of seed continued for at least a week longer in the burned area than in the unburned area. Burning, thus, appears to both delay and extend germination.

The combined results of this study suggest that burning has the potential to affect the germination of seeds of prairie plants in various ways including increasing germination in some species and decreasing it in others and also altering the time and duration of overall germination. The variability of the results between sites, however, suggests that burning alone may not explain the germination responses observed. It is likely, for example, that different burning conditions occurred at each site or at each plant within a site and that these differently affected individuals. Moreover, it seems clear that there is some physiological response of prairie plants to burning that yet needs to be identified. Studies on physiological effects of fire on prairie plants, therefore, will be necessary to further explain the observed responses. From the results obtained, it is clear that a larger and more detailed sampling is needed to further refine our understanding of this aspect of prairie fire ecology.

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LITERATURE CITED

Daubenmire R. 1968. Ecology of fire in grasslands. Pages 209-266. *In* J. B. Cragg (ed.) Advances in Ecological Research, Volume 5. Academic Press, New York.

Ehrenreich, J.H., and J.M. Aikman. 1957. Effect of burning on seedstalk production of native prairie grasses. Proceedings of the Iowa Academy of Science 64:205-212.

Great Plains Flora Association. 1986. Flora of the Great Plains. University Press of Kansas, Lawrence.

Knapp, A. 1984. Effect of fire in tallgrass prairie on seed production of *Vernonia baldwinii* Torr. (Compositae). Southwestern Naturalist 29:242-243.

Risser, P.G., E.C. Birney, H.D. Blocker, S.W. May, W.S. Parton, and J.A. Weins. 1981. The True Prairie ecosystem. Hutchinson Ross Publishers, Stroudsburg, Pennsylvania.

Went, F.W., G. Juhren, and M.C. Juhren. 1952. Fire and biotic factors affecting germination. Ecology 33:351-364.