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Dan J. Stipe

Department of Biology, University of Nebraska at Omaha, Omaha, Nebraska

Thomas B. Bragg

Department of Biology, University of Nebraska at Omaha, Omaha, Nebraska

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EFFECT OF EASTERN RED CEDAR ON SEEDLING ESTABLISHMENT OF PRAIRIE PLANTS

Dan J. Stipe and Thomas B. Bragg
 Department of Biology, University of Nebraska at Omaha,
 Omaha, Nebraska 68182-0040

Abstract. To test the hypothesis that eastern red cedar (*Juniperus virginiana* L.) is allelopathic, seedling establishment of five herbaceous prairie species was evaluated by growing seeds in soil collected beneath and adjacent to a stand of this tree species. While four species showed no significant effect, the germination of one species, finger coreopsis (*Coreopsis palmata* Nutt.), was significantly reduced. Since eastern red cedar is an early invader of unburned prairie, such an allelopathic effect, even on only a few species, is of particular concern in that it has the potential to hasten degradation of invaded prairie sites.

Key Words. eastern red cedar, *Juniperus virginiana*, finger coreopsis, *Coreopsis palmata*, allelopathy, Nebraska

INTRODUCTION

Eastern red cedar (*Juniperus virginiana* L.) is purported to produce plant phytotoxins that adversely affect other plant species (Rice 1974, Gehring 1983), although evidence for this allelopathic effect does not appear to have been reported in the literature. As one of the early successional species of unburned tallgrass prairie (Bragg 1974), any allelopathic effect of eastern red cedar is of particular concern since it would have the potential to hasten the decline of prairie species that marginally persist under the canopy of invading trees. The purpose of this study, therefore, was to document whether such an effect occurs and, if so, to identify native prairie species that may be affected.

METHODS

In April 1986, two soil samples were collected at Allwine Prairie Preserve, a research site located 20 km northwest of Omaha, Nebraska. One sample was collected from beneath a grove of eastern red cedar trees (Tree Sample) and another was collected from a nearby grass-dominated area (Grassland Sample). The Grassland Sample was within 10 m of the edge of the trees but neither beneath nor down slope from them; the dominant grass species in this sample was smooth brome (*Bromus inermis* L. ssp. *inermis*). No herbaceous vegetation was present under the cedar canopy. After removal of litter, soil samples were collected to a depth of 5 cm, thoroughly mixed, and each of the two samples placed in three flats (55 x 35 cm) to a depth of 4 cm. The six flats, three per sample, were placed side-by-side in a well-lighted portion of a greenhouse with Tree Sample and Grassland Sample flats alternated to reduce any effect of location. All flats were perforated at the bottom to provide drainage.

Seeds from five species of tallgrass prairie plants (Table 1) were collected in the Fall of 1985 and stored over winter at 4 C. Seeds were collected from Hover Prairie, a native grassland within 15 km of Omaha, Nebraska. Prior to planting, seed samples were visually inspected under a dissecting microscope, and those appearing unlikely to be viable were removed. On 6 April 1986, 25 seeds of each species were planted in separate rows in each of the replicate flats. The seeds were barely covered with soil. Flats were kept well watered throughout the study using the same tapwater source. Seedling establishment was the parameter measured to assess any potential allelopathic effect of eastern red cedar. Growth of the seedling to a height of at least 5 mm was considered to

represent successful establishment. Establishment was recorded on 12 and 21 May and on 4 June 1986; mortality was also recorded on the latter of these dates.

Table 1. Establishment of five prairie species in soil collected beneath and adjacent to eastern red cedar trees. Species ordered from most to least negative response. Values represent mean percent germination \pm Standard Error from each of three, 25-seed samples. Species nomenclature is from the Great Plains Flora Association (1986).

Species	Seedling establishment	
	Grassland sample	Tree sample
	----- % (\pm S.E.) -----	
Finger coreopsis (<i>Coreopsis palmata</i> Nutt.)	84 + 2.8 ¹	0
Indiangrass [<i>Sorghastrum nutans</i> (L.) Nash]	21 + 2.4	13 + 0.9
Canada wild rye (<i>Elymus canadensis</i> L.)	35 + 1.7	28 + 1.6
Sideoats grama [<i>Bouteloua curtipendula</i> (Michx.) Torr.]	17 + 1.2	13 + 1.2
Leadplant (<i>Amorpha canescens</i> Pursh)	1 + 0.5	1 + 0.5

¹Significant difference at the 95% confidence limit.

RESULTS AND DISCUSSION

Of the five species evaluated, only finger coreopsis (*Coreopsis palmata* Nutt.) showed a significant difference between treatments (Table 1), as determined by t-tests at the 95% Confidence Interval. The response was even more noteworthy since total germination of this species was nearly 50% greater than any of the other species evaluated. While differences between treatments for other species were not significant, there was a consistently higher germination in the Grassland Samples for all other species except leadplant (*Amorpha canescens* Pursh) for which germination in both treatments was equally low. Mortality of germinated seeds generally was minimal and was not consistently related to any treatment; with one exception, all mortality occurred during the latter portion of the 2-month study.

This study supports the theory that eastern red cedar produces allelochemicals that affect establishment of at least some prairie species, although it is not clear whether the effect prevents germination or simply delays it. The implication from this conclusion is that eastern red cedar should be of particular concern in prairie management since it has the potential to increase the rate of degradation of prairie beyond the effects of shading of invading trees alone.

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