Maintaining Grassland Biodiversity While Controlling the Shrub *Rhus glabra*

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Introduction In the United States of America, the tallgrass prairie is a fragmented, threatened ecosystem. Few areas remain intact and many of those are degraded by increasing densities of woody plants. Historically, the resprouting shrub smooth sumac (*Rhus glabra* L.) was a minor species (Weaver and Clements, 1938) kept at low densities and restricted to ravines by a disturbance regime of fire and grazing. These and other processes are limited and some occur no longer (Steinauer and Collins 1996). Therefore, these plants increase rapidly and form dense thickets threatening productivity and biodiversity of the prairies (Tunnell et al. 2006). We tested the use of herbicides and fire to control smooth sumac with the goal of maintaining native forb biodiversity.

Materials and methods The experiment was conducted at Nine Mile Prairie (40°51′N, 96°51′W; 97 ha), a tallgrass prairie remnant 14 km west of Lincoln, Nebraska USA. Annual precipitation averages 718 mm, with a majority occurring from April to October. The dominant soil was Pawnee clay loam (fine, montmorillonitic, mesic Aquic Argiudoll). The study was a randomized complete block with 13 herbicide treatments and one control per block. Three blocks were located in both the burned and non-burned areas. Prescribed burns were conducted in May and herbicide treatments in June. Broadcast spray-applied herbicide treatments per ha were 1.06 and 2.13 kg ae 2,4-D LV Ester; 0.15 kg ae Picloram + 0.56 kg ae 2,4-D LV Ester; 0.20 kg ae Picloram + 0.84 kg ae 2,4-D LV Ester; 1.12 and 2.24 kg ae Triclopyr; 1.26 kg ae Triclopyr + 0.42 kg ae Clopyralid; and 0.56 kg ae Picloram. Wick-applied herbicide treatments per ha were 1.40 kg ae 2,4-D Amine; 0.2 kg ae Picloram + 0.74 kg ae 2,4-D Amine; 1.48 kg ae Triclopyr; 1.11 kg ae Glyphosate; and 0.74 kg ae Picloram. For two years following treatment, live smooth sumac stem densities were counted within a 3 x 7 m quadrat in each plot in mid-September, and forb frequencies were determined in late August using multiple placements of a 0.5 by 0.5 m quadrat. A mixed model analysis of variance was used to assess treatment differences. We focused on the most abundant forbs and the shrub leadplant (*Amorpha canescens* Pursh) because it is an important indicator species of a high quality tallgrass prairie plant community (Stubbendieck and Conard 1989).

Results and discussion Pretreatment stem densities of smooth sumac were not significantly different across all treatments ($P = 0.9170$). No interactions between herbicide and burning were detected, but the main effects of herbicide treatment and burning were significant. Smooth sumac stem density in burned plots (0.27 stems/$m^2 \pm 0.06$) was greater than stem densities on non-burned plots (0.14 stems/$m^2 \pm 0.04$). Stem densities were significantly reduced compared to the control ($P = 0.0001$), regardless of the herbicides used or the application method. Forb frequencies varied by treatment. Where 2,4-D, Picloram + 2,4-D, and glyphosate were applied with a wick, forb frequencies two growing seasons after treatment were not different from the control. Forb species richness for the wick treatments was consistently greater than for the spray treatments. Frequencies of leadplant where herbicides were applied with a wick were four times greater than when herbicides were applied as a broadcast spray.

Conclusions Prescribed burning is not an effective control measure for smooth sumac. While most herbicide treatments greatly reduced smooth sumac, the broadcast spray application resulted in decreases in forbs and leadplant. Wick application effectively controlled smooth sumac and prevented decreases in forb frequencies.

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