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Response of leafy spurge to date of burning

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Abstract:

The research was conducted on remnant tallgrass prairie located in Lancaster County, Nebraska in 1990. Plots (5 by 10-m) were not burned or burned on either April 23, May 2, May 14, or May 26, 1990. Leafy spurge stem density and yield and yield of associated herbaceous vegetation were determined in July 1990 to assess response of the grassland community to prescribed burning treatments. Burning in late April through mid-May stimulated leafy spurge stem production. Density of leafy spurge stems in plots burned by mid-May significantly exceeded ($P<0.04$) the stem density in plots burned at the end of May. Leafy spurge stem density in plots burned the first week in May averaged 84 stems m^{-2} as compared to only 27 stems m^{-2} in plots burned at the end of May. Stem density on unburned plots was not different from burned plots, regardless of time of burning. Leafy spurge yield from plots burned the first week in May and unburned plots were greater ($P<0.05$) than plots burned the end of May. Yield of other vegetation components was not affected by time of burning.

Overview of fire in the Great Plains

Climate, fire, and grazing animals were the principal interacting forces responsible for formation and maintenance of grasslands throughout the Great Plains of North America. In pristine time, before European man settled in the Great Plains, fires were initiated by lightning or Indians. The probability that a lightning strike would ignite a fire was dependent on the amount of fuel and weather conditions. Dry lightning storms occurring

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over heavy and continuous stands of dormant grass were capable of causing large fires if winds and temperatures were high and relative humidity was low. Indians used fire principally for hunting. Wildlife was attracted to freshly burned areas because of the abundance of highly palatable new grass and forb growth. Indians also used fire for warfare, rituals, signaling, and to reduce bothersome insect populations.

As European settlers arrived on the Great Plains, wildfires became feared. Wildfires destroyed the settlers' possessions, bared the soil from which they drew their livelihood, and occasionally killed friends and loved ones. Obviously with such an overwhelming impact, fire was avoided and deliberately setting a fire to manage the land became unthinkable. With the notable exception of the Kansas Flint Hills where fires have been deliberately set since the 1880's, fire was not considered a viable land management practice. Burning in the Flint Hills was used as a means to increase steer weight gains because it improved grass palatability, quality, and yield.

The constructive role of fire in improving and maintaining plant communities was not critically examined until the 1960's. Initially, fire was reintroduced in the southeastern and northwestern United States to enhance forest regeneration and wildlife habitat. Since that time interest in burning as a land management practice has flourished because alternative management practices such as chemical or mechanical treatments were either environmentally unsound, ineffective, or too expensive. Furthermore, much of the loss in productivity of North American grasslands can be attributed to increased density of undesirable plants caused by a history of overgrazing by domestic livestock and exclusion of fire.

Introduction

Leafy spurge is a competitive and widespread perennial weed on rangeland in the northern Great Plains (Watson 1985). It is rapidly becoming a major pest on grasslands in Nebraska and other central Great Plains states (Masters 1991). Ranchers view this weed as a significant threat because it reduces the quality and productivity of the grassland resource upon which livestock enterprises rely. Leafy spurge reduces rangeland carrying capacity by competing with desirable forages and rendering infested areas undesirable to cattle (Lym and Kirby 1987). Leafy spurge threatens native grassland communities by displacing native species (Belcher and Wilson 1985), thereby reducing native plant and animal diversity.

Leafy spurge is a successful adventive species because of the absence of natural enemies and its ability to reproduce by seed and from adventitious buds on the roots and crowns (Raju 1985). Seed dispersal mechanisms, high seed viability and longevity, and rapid seedling development enable new infestations to become easily established. Prolific vegetative reproduction and abundant energy reserves in the extensive root system maintain long-lived, dense leafy spurge infestations (Raju 1985). The capacity to produce new shoots from buds on the crowns and roots contributes to the resistance of this species to chemical and mechanical treatments (Messersmith *et al*. 1985).

Picloram (4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid) and 2,4-D [(2,4-dichlorophenoxy) acetic acid] have traditionally been used to control leafy spurge on rangeland (Lym and Messersmith 1985). Annual fall and spring treatments of 2,4-D are recommended to reduce leafy spurge seed production, but do not kill established plants (Lym and Messersmith 1987). Picloram at 2.2 kg/ha controls leafy spurge for 24 to 36 months when applied in the fall (Alley and Messersmith 1985), but the high cost of this treatment limits its use to small infestations.

Cost effective and environmentally sound treatment alternatives are needed to control or manage leafy spurge. One alternative that has not been evaluated is the use of prescribed fire. The overall objective of the research was to determine if burning could be used to improve control of leafy spurge on rangeland in the Central Great Plains. This research was stimulated by the possibility that leafy spurge competitiveness could be reduced, by burning in the late spring. In the late spring leafy spurge is in the late vegetative to early flowering phenological stages, while native perennial warm-season grasses are just initiating growth. Exploiting this difference in phenology may provide a means of improving control of leafy spurge on rangeland dominated by warm-season grasses.

Materials and methods

The research was conducted on remnant tallgrass prairie located in Lancaster County, Nebraska in 1990. Plots (5 by 10-m) were not burned or burned on either April 23, May 2, May 14, or May 26, 1990. Leafy spurge stem density and yield and yield of associated herbaceous vegetation were determined in July 1990 to assess response of the grassland community to the prescribed burning treatments. Leafy spurge density was determined by counting number of stems within 2, $1m^2$ quadrants randomly located within each plot. Yields were determined by clipping all vegetation within 2, 0.25-m^2 quadrants located in each plot. The vegetation was separated into leafy spurge and grass components, oven-dried, and weighed. The experiment was designed as a randomized complete block with 3 replications per burn treatment. Measured parameters were analyzed using standard analysis of variance procedures. Treatment means were compared using Fisher's-protected least significant difference at the $P \leq 0.05$ level of probability.

Results

Burning in late April through mid-May stimulated leafy spurge stem production. Density of leafy spurge stems in plots burned by mid-May significantly exceeded ($P<0.04$) the stem density in plots burned at the end of May. Leafy spurge stem density in plots burned the first week in May averaged 84 stems m^{-2} as compared to only 27 stems m^{-2} in plots burned at the end of May. Stem density of unburned plots was not different from burned plots, regardless of time of burning. Leafy spurge yield from plots burned the first week in May and unburned plots were greater ($P<0.05$) than plots burned the end of May. Yield of other vegetation components was not affected by time of burning.

Management implications

Leafy spurge stem density was generally stimulated by burning in the spring. Fire applied alone does not appear to have an adverse affect on leafy spurge. The stimulatory effect of fire may heighten the susceptibility to management with herbicides. Additional research is needed to determine if fire coupled with other management tools, i.e., biocontrol agents, or herbicides, could enhance leafy spurge control efforts.

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