



University of Kentucky  
UKnowledge

---

International Grassland Congress Proceedings

21st International Grassland Congress / 8th  
International Rangeland Congress

---

## Spatial Distribution, Biomass, and Soil Seed Bank of a Naturalized Population of Alfalfa in Native Mixed-Grass Prairie

Lan Xu

*South Dakota State University*

A. Boe

*South Dakota State University*

R. N. Gates

*South Dakota State University*

P. S. Johnson

*South Dakota State University*

Y. Zhang

*China Agricultural University, China*

Follow this and additional works at: <https://uknowledge.uky.edu/igc>



Part of the [Plant Sciences Commons](#), and the [Soil Science Commons](#)

This document is available at <https://uknowledge.uky.edu/igc/21/1-5/12>

The 21st International Grassland Congress / 8th International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

---

This Event is brought to you for free and open access by the Plant and Soil Sciences at UKnowledge. It has been accepted for inclusion in International Grassland Congress Proceedings by an authorized administrator of UKnowledge. For more information, please contact [UKnowledge@lsv.uky.edu](mailto:UKnowledge@lsv.uky.edu).

## Spatial distribution , biomass , and soil seed bank of a naturalized population of alfalfa in native mixed-grass prairie

L . Xu<sup>1</sup> , A . Boe<sup>2</sup> , R . N . Gates<sup>3</sup> , P . S . Johnson<sup>3</sup> , Y . Zhang<sup>4</sup>

<sup>1</sup> Department of Biology and Microbiology , <sup>2</sup> Department of Plant Sciences , <sup>3</sup> Department of Animal and Range Sciences , South Dakota State University , Brookings , SD 57007 , USA , <sup>4</sup> Department of Grassland Science , China Agricultural University , No 2 Yuanmingyuan West Rd . Haidian District , Beijing 100094 , P . R . China , E-mail : lan . xu@sdstate . edu

**Key words :** alfalfa , biomass , seed bank , mixed-grass prairie

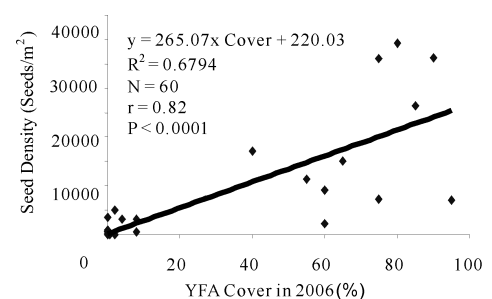
**Introduction** The occurrence of naturalized yellow-flowered alfalfa (YFA) (*Medicago sativa* subsp. *falcata*) on private and adjacent public rangeland in northwestern South Dakota , USA presents a dilemma . The capacity for natural reseeding demonstrates value for rehabilitating depleted rangelands by increasing soil organic C and N and forage production (Smith 1997) . However , spread of YFA in native rangeland potentially threatens native biological diversity and may result in changes in ecological processes and stability . Study objectives were : 1) to describe spatial distribution patterns of YFA , 2) to determine associations between YFA occurrence and species richness and biomass production of native plant communities , and 3) to examine density and viability of seed bank of YFA .

**Materials and methods** The study was conducted on the Grand River National Grasslands (GRNG) in northwestern South Dakota , USA (45°49'N , 102°33'W) . The climate is semiarid with high inter-annual variation in precipitation and frequent drought . Mean annual precipitation is 386mm and mean annual temperature is 6°C . Vegetation is dominated by mixed-grass prairie with a variety of native species such as *Pascopyrum smithii* , *Nassella viridula* , *Carex filifolia* , and *Bouteloua gracilis* . Soil types range from sandy loam on slopes and uplands to clay loam in swales . Two sites where YFA distribution has been concentrated were selected and sampled . Two permanent transects were established on each site along environmental gradients . Along each transect , cover by species was recorded in 2m × 1m quadrats placed at a 2-m intervals and distinctive plant communities were identified . Three biomass quadrats (1.45m × 0.3m) were randomly chosen within each plant community . Aboveground vegetation was clipped and sorted into alfalfa and other species . Three soil cores were randomly collected within each quadrat . Soil moisture and texture were determined . Three soil seed bank samples were extracted using a bulb planter (5cm dia . × 7.5cm depth) . YFA seeds were removed from soil using a series of soil sieves and counted . Germination and viability were determined using AOSA procedures for alfalfa . Canonical Discriminant Analysis , Principle Component Analysis and Analysis of Variance were used as appropriate for each data set .

**Results** High density of YFA was highly associated with swale areas and fine-textured soil . As YFA cover increased total biomass significantly increased and native species richness decreased (Table1) . This suggests YFA is a strong competitor with native species on rangelands . Spatial distribution of YFA seed bank was associated with plant communities , which varies with topography , soil texture , and YFA cover . The highest YFA seed density was more than 39 ,000 seeds m<sup>-2</sup> (Figure 1) . Greater than 99% of YFA seeds was viable but less than 4% germinated under standard laboratory conditions .

**Table 1** Native species richness and total biomass (g m<sup>-2</sup>) associated with YFA cover . Different letters on the same row show significantly difference ( $P < 0.05$ ) .

Variables	YFA Absent	YFA cover (<50%)	YFA cover (≥50%)
Native species richness	8a	6b	3c
Total biomass	194a	312b	571c



**Figure 1** YFA seed density associated with YFA cover .

**Conclusions** Naturalized YFA was not uniformly distributed across the landscape . Densest YFA populations were found in swales . Naturalized YFA increased total biomass production on mixed-grass prairie . However , high density of YFA was associated with reduced species richness and production from native species . Swales that were dominated by YFA contained a large reservoir of viable YFA seeds . Through periodic seed production and high level of hard seed , this population has capacity for maintenance and for expansion onto favorable landscape positions .

### Reference

Smith , N . G . (1997) . Yellow-blossomed alfalfa on rangeland in South Dakota . *Rangelands* 19 , 24-25 .