Weevils and Wheatgrass: Nine Years of Sustainable Spotted Knapweed Management

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Introduction

Spotted knapweed (*Centaurea stoebe* L.) is a short-lived perennial forb invading range and forest lands in the United States. Infestations are detrimental to soil and water resources, livestock forage, wildlife habitat, and plant species richness. Spotted knapweed often grows in association with cheatgrass (*Bromus tectorum* L.), and, where it does, introducing and establishing competitive plants is essential for the sustainable management of infestations and the restoration of desired plant communities. The knapweed root weevil (*Cyphocleonus achates*) is considered an effective control agent against spotted knapweed. Our hypothesis is the combination of seeding perennial grasses and weevil herbivory on spotted knapweed will shift the plant community to favor perennial grasses. This poster reports 9-year results of a revegetation study combining weevils with wheatgrass for sustainable management of spotted knapweed.

Objective:

To quantify the spotted knapweed density and biomass on 9-year-old revegetation plots where weevils were released in the Bitterroot Valley, Montana.

Study Site

The study was established in 1995 on the Calf Creek Game Range about 11 km northeast of Hamilton, Montana (460 17' N, 1140 1' W), at an elevation of 1,341 m. The plant community was a rough fescue/bluebunch wheatgrass (*Festuca scabrella/Pseudoroegneria spicata)* habitat type codominated by spotted knapweed and cheatgrass. Soils were Stecum stony loamy coarse sand (mixed Typic Cryorthents) and were moderately deep. Annual precipitation ranged from 406 to 457 mm with a bimodal distribution with peaks in the winter and spring.

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The plant community at the time of seeding in 1995

Intermediate wheatgrass plots in August 2004, 9 years after seeding

Bluebunch wheatgrass plots in August 2004, 9 years after seeding

Methods

In 1995, 432 adult knapweed root weevils (36 per grass seeding plot) were released on the site. A fall dormant seeding was applied in November 1995 using a no-till rangeland drill to establish three grass species in monoculture plots at a rate of 18 kg pure live seeds per hectare. 'Oahe' intermediate wheatgrass (*Thinopyrum intermedium*) and 'Goldar' bluebunch wheatgrass (*Pseudoroegneria spicata*) established, and 'Bozoyski' Russian wildrye (*Psathyrostachys juncea*) failed to establish.

Sampling

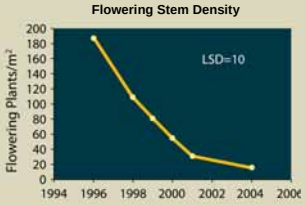
Density and biomass were sampled by species within a 1.0 by 1.0 m frame randomly placed in each seeding plot in August 2004. In addition, flowers on each adult knapweed plant were counted, and adult knapweed plants were dug up to determine if a root weevil was present or absent in the root. Analysis of variance was used to determine the effects of seeded grass treatment, weevil infection and their interaction on the density and biomass of spotted knapweed, and the proportion of the total biomass that was perennial grass or spotted knapweed. The difference between the biomass and number of flowers of spotted knapweed plants with and without weevils was also tested.

A spotted knapweed root gall with two weevil larvae and one emerging adult

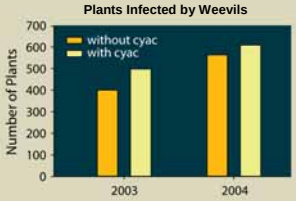
The spotted knapweed plant on the right has a root gall with one or more root weevils. The plant on the left is free of weevils.

Results

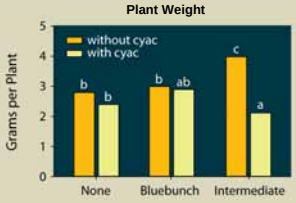
Spotted knapweed flowering stem density declined from 190 stems per square meter in 1996, 1 year after seeding, to 18 stems per square meter in 2004, 9 years after seeding, averaged over all plots. The decline in the spotted knapweed population may have been caused by the weevil, competition with seeded grasses, climate, or a combination of factors.



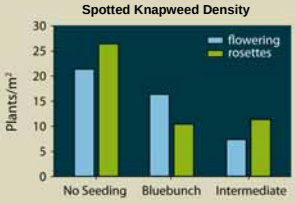
The proportion of spotted knapweed flowering plants infected by weevils was not affected by the grass seeding treatment (p>0.1). Of all flowering spotted knapweed plants sampled in 2003 and 2004, over half were infected with the knapweed root weevil (cyac = *Cyphocleonus achates*). Plants infected with weevils were smaller, weighed less, and produced fewer flowers than uninfected plants. In addition, infected plants had fewer root rings, a measure of the plants' ages, than plants sampled before weevil release. Weevils did not infect rosette plants; however, adult weevils feed on rosette leaves and may affect their ability to transition to flowering plants.



The spotted knapweed flowering plant weight per plant was affected by the interaction of grass competition and weevil infection. In the intermediate wheatgrass plots, weevil-infected plants weighed significantly less than infected or uninfected plants in all other plots except infected plants in the bluebunch wheatgrass plots. Uninfected plants in the intermediate wheatgrass plots weighed more than plants in all other plots. Rosette weight was affected by grass competition (data not shown). Rosettes weighed less in both the bluebunch and intermediate wheatgrass plots than the control plots.



Spotted knapweed density in 2004 was reduced by grass competition. The density of flowering plants was significantly lower in the intermediate wheatgrass plots compared to the nonseeded control plots but not lower compared to the bluebunch wheatgrass plots. Rosette density was significantly lower in both the bluebunch and intermediate wheatgrass plots compared to the control plots. Seedling knapweed density was not affected by grass seeding treatment (data not shown).



Conclusions

On a spotted knapweed/cheatgrass-infested site where weevils were released and grasses seeded in 1995, the spotted knapweed population declined significantly over 9 years. The decline can be partially attributed to grass competition and weevil herbivory. Where grasses were not seeded, cheatgrass was observed to increase. Weevils infected over half of the flowering knapweed plants, reducing their size, reproductive capacity, and longevity. Knapweed flowering plant density was reduced by intermediate wheatgrass, and knapweed rosette density was reduced by both bluebunch and intermediate wheatgrasses. Knapweed demographic data suggest that in the plots where no grass was seeded and where intermediate wheatgrass was seeded the populations are stable. Where bluebunch wheatgrass was seeded, we expect further declines in knapweed densities. Prescribed grazing management is important to maintain the competitiveness of the perennial grasses with spotted knapweed.