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Introduction

Introduced in the 1880s for improving forage production and controlling soil erosion, smooth bromegrass (*Bromus inermis* Leyss) has invaded and is threating numerous native prairie ecosystems and wildlife habitats in the Northern Great Plains. Land managers of the mixed-grass prairie ecosystems currently spend significant resources attempting to control invasive species and restore native grasslands with various management strategies including grazing, prescribed burning, herbicide application and seeding native species. Unfortunately, many studies have showed that such management efforts have minimal short-term effects. Without sustained effort, persistence and resurgence of smooth bromegrass is inevitable.

Such invasiveness and persistence may come from two primary sources: seed bank and bud bank. Since few grass seeds persist in the soil more than five years, the persistence of the aboveground component of perennial grasses population persistence is strongly driven by tiller recruitment from the belowground bud bank. Growing evidence demonstrates that the belowground bud banks play a fundamental role in local plant population persistence, structure, and dynamics (Benson and Hartnett 2006). Studying the dynamics of bud banks provides insight into plant community assembly and composition (Rusch et al. 2011), resistance to and resiliency following drought, fire, and or grazing (Vanderweide and Hartnett 2015, Russell et al, 2015). Since bud banks serve as reservoirs for recruitment of future aboveground tillers, understanding the role of the belowground bud bank in regulating the persistence of invasive species in the response to management strategies will lead to adaptive management strategies that sustain long-term control effectiveness. Our objective was to examine smooth brome belowground axillary bud and rhizome production for smooth bromegrass in response to different mowing frequency treatments.

Materials and Methods

This study was conducted at the Oak Lake Field Station in eastern South Dakota, USA (44° 30' N, 96° 31' W). Mean annual precipitation is 583mm and mean annual temperature is 5.9°C. Remnant tallgrass prairie vegetation is dominated by a variety of species such as big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), sideoats grama (*Boutelua curtipendula*), and purple coneflower (*Echinacea angustifolia*). Our experiment was composed of 4 mowing treatments (no-mowing control, mowing once, twice, or three times per growing season) in a randomized complete block design with four replications in 2013 and 2014 on a stand of smooth bromegrass that was at least 25 years old. Each of four 6m x 6m blocks dominated by smooth bromegrass were divided into 4 plots (3m x 3m), each of which was randomly assigned a treatment. Mowings were conducted when the uppermost node of elongated tillers reached mowing height at 6 cm. For all three mowing treatments the first mowing was done in early June of each year. The second and third mowing treatments were performed again in mid-August. The 3-mowing treatment was mowed for a final time in late October. Developmental stage and tiller density within two 0.1-m^2 sub-plots were recorded before each treatment. Three tillers were randomly selected from each treatment plot and excavated before treatment. For each tiller, the total number of proaxis nodes and total number of buds and their viability were determined. In 2015, three soil cores (10-cm dia. x 10-cm depth) were taken from each plot to evaluate the rhizome production in terms of rhizome length and mass separately in June and October.

Results and Discussion

Mowing treatments significantly reduced the number of proaxis nodes per tiller (Fig. 1A), the number of outgrowth tillers per tiller (Fig. 1C), and viable rhizome biomass (Fig. 1D). The number of total buds per tiller (Fig. 1B) significantly declined only under mowing once at the boot stage. Increasing the frequency of mowing treatments had little impact on bud bank reduction after two consecutive two years. However, viable rhizome biomass decreased as frequency of mowing increased during the growing season (Fig.1D).

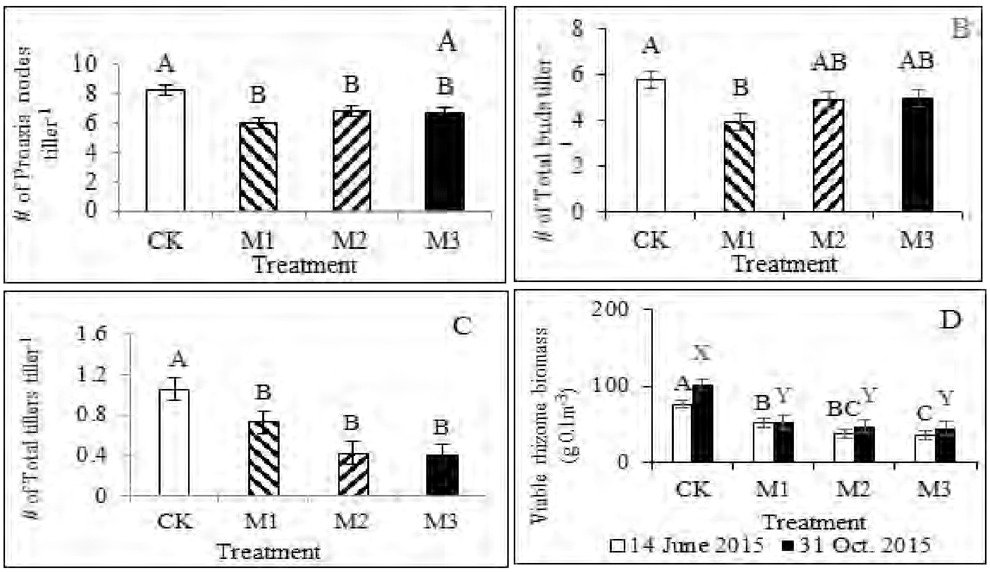

Figure 1. Number of proaxis nodes per tiller (A), number of total buds per tiller (B), total outgrowth tillers per tiller (C), and total viable rhizome biomass (D) in response to mowing treatments. CK=no-mowing control, M1= mowing once, M2=mowing Twice, M3=mowing three times. Different letters indicate difference among treatment means at p<0.05. Bars indicate the standard error.

Conclusions and Implications

Defoliation at the most vulnerable growth stage can effectively hinder axillary bud formation on the proaxis, tiller recruitment, and reduce food reserve in the rhizome of perennial grasses. Our results from this study clearly demonstrated that repeated mowing treatments reduced axillary bud populations and rhizome biomass, suggesting they could form the basis for a long-term management plan.

References

Benson, E. J. and Hartnett, D. C. 2006. The role of seed and vegetative reproduction in plant community and demography in tallgrass prairie. *Plant Ecology*, 187: 163-177.

Rusch, G. M., Wilmann, B., Klimešová, J., and Marianne, E. 2011. Do clonal and bud bank traits vary in correspondence with soil properties and resource acquisition strategies? Patterns in alpine communities in the Scandian Mountains. *Folia Geobot*, 46: 237-254.

Russell, M. L., Vermeire, L. T., Ganguli, A, C. and Hendrickson, J. R. 2015. Season of fire manipulates bud bank dynamics in northern mixed-grass prairie. *Plant Ecology*, 216: 835-846.

VanderWeide, D. L. and Hartnett, D. C. 2015. Belowground bud bank response to grazing under severe, short-term drought. *Oecologia*, 178: 795-806.