Modifying Seeding Date for Successful Establishment of Bluebunch Wheatgrass (*Pseudoroegneria spicata*)

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IMPACT STATEMENT

Land managers can modify seeding date of native perennial plant species during the revegetation of disturbed sites to increase establishment success. Modifying seeding date may be used to influence competitive interactions between native perennial grasses and invasive annual grasses. After one growing season, seeding bluebunch wheatgrass (Pseudoroegneria spicata) in fall (early November) or early spring (early April) produced larger individuals and more dense stands than seeding later in the spring.

SUMMARY

The objective of this project was to determine how modifying seeding date affected the size and abundance of bluebunch wheatgrass (*Pseudoroegneria spicata*). Seeding occurred in fall 2015 to late spring 2016 in a controlled field setting at two locations near Bozeman, MT. After one growing season, fall-seeded cohorts were larger in size and less dense than spring-seeded cohorts, which were smaller in size but more dense.

INTRODUCTION

Re-establishing native perennial grasses on degraded range and wildlands is important to achieving various land management objectives. However, revegetation efforts are often unsuccessful (Schantz et al., 2016). In habitats dominated by invasive plants, seedlings of weedy species can outcompete seedlings of native periennial grasses due to faster emergence and higher relative growth rates of weedy species (Mangla et al., 2011). In addition, abiotic environmental stressors, like seasonal drought, can limit native grass seedling recruitment (Mangla et al., 2011).

Revegetation of weed-infested rangeland typically involves applying herbicide to control weeds in the summer or fall; herbicide application is followed by seeding of native species, most often grasses, in fall of the same year. Seeded native perennial grasses remain dormant throughout winter and emerge the following spring. Even though fall dormant seedings are common practice, some research investigating the role of timing of seeding on perennial grass establishment in degraded rangeland has shown that spring seeding results in higher density and biomass of seeded species than seeding in the fall (Schantz, 2015; Schantz et al., 2016). Furthermore, seeding date may be used to manipulate competitive interactions between native perennial grasses and invasive annual grasses. In a greenhouse study, the order of emergence of seedlings of bluebunch wheatgrass and cheatgrass (*Bromus tectorum*) were manipulated by altering seeding date (Orloff et al., 2013). The native grass species was able to suppress cheatgrass when seeded four weeks prior due to its larger size and increased competitive abilities (Orloff et al., 2013).

Modifying seeding date as an ecologically-based management tool could facilitate desired species attaining a size-advantage over invasive plants, thus avoiding suppression by invasive plants. In addition, stressful abiotic environmental conditions may be overcome due to earlier seeded species having better access to limited resources (Schantz et al., 2016). The objective of this project was to examine whether fall or spring seeding results in the best establishment of the native perennial grass bluebunch wheatgrass. Furthermore, our project examined how late seeding could occur in the spring and still result in acceptable bluebunch wheatgrass establishment.

PROCEDURES

Our study was conducted at two sites near Bozeman, MT. Both sites were fallow crop fields at Montana State University's Arthur H. Post and Fort Ellis Research Farms. Fields were tilled and any existing vegetation removed prior to fall 2015. Eight seeding dates of bluebunch wheatgrass treatments included: Fall = 8 November 2015; S1 = 1 April 2016; S2 = 7 April 2016; S3 = 13 April 2016; S4 = 21 April 2016; S5 = 29 April 2016; S6 = 5 May 2016; and S7 = 12 May 2016. Seeds for bluebunch wheatgrass were sourced from the Goldar variety provided by Bruce Seed Farm (Townsend, MT) and originated from Washington. Seeds were hand-broadcasted at 667 seeds per m^2, following the high seeding rate used by Orloff et al. (2013). Each treatment was replicated eight times at Post Farm and 12 times at Fort Ellis in a completely randomized design consisting of 1 x 1 m plots. Hand-weeding was used to control weeds within plots; broadleaf herbicide and tilling were used to control weeds along buffer strips between plots.

In September 2016, we sampled bluebunch wheatgrass tillers per individual plant, density, seed heads produced per m^2, and plant height averaged across each plot. Average height was estimated to the nearest 5 cm across each plot. We determined survival by comparing density measurements between June and September. Each site was analyzed separately using log-linear regression models and Tukey's HSD, where appropriate, to determine differences among seeding groups ($\alpha = 0.05$).

RESULTS AND DISCUSSION

Over 15,000 individual seedlings were counted over a 12-week tracking period. Across all seeding groups, percent emergence ranged from 2 – 30%, with an average of 12%. Across both sites, percent survival was relatively high; ranging from 50 – 75% (Figure 1). There were no differences in survival among seeding dates at Post Farm and minimal differences at Fort Ellis (Figure 1).

In September 2016, we found that fall-seeded cohorts were larger in size but had fewer individuals than spring-seeded cohorts. Across both sites, a size comparison between seeding dates showed that fall-seeded cohorts averaged 32 – 43 tillers per plant compared to spring-seeded cohorts with an average 15 – 25 tillers per plant (Figure 2). At Fort Ellis, S1 seeding date resulted in the second highest average number of bluebunch wheatgrass tillers per plant. Across sites we found the cohorts seeded earlier in spring

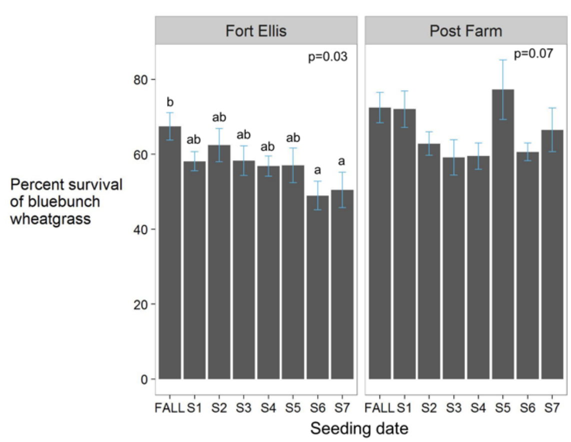

Figure 1. Survival (%) of bluebunch wheatgrass individuals from emergence to September 2016. Differences between seeding groups are indicated by letters and p-values. Seeding dates: Fall = 8 November 2015; S1 = 1 April 2016; S2 = 7 April 2016; S3 = 13 April 2016; S4 = 21 April 2016; S5 = 29 April 2016; S6 = 5 May 2016; and S7 = 12 May 2016.

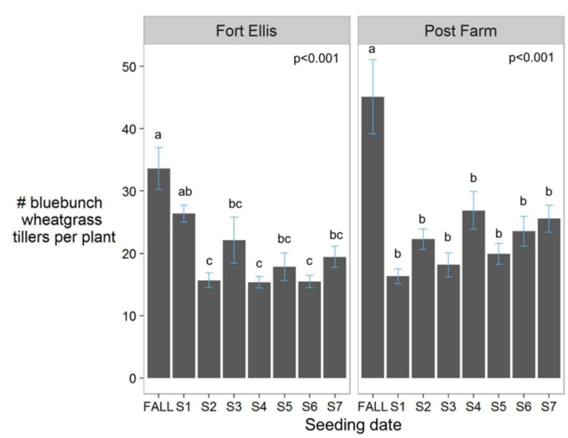

Figure 2. Size of bluebunch wheatgrass (tillers per plant) in September 2016, one growing season after seeding. Differences between seeding groups are indicated by letters and p-values. Seeding dates: Fall = 8 November 2015; S1 = 1 April 2016; S2 = 7 April 2016; S3 = 13 April 2016; S4 = 21 April 2016; S5 = 29 April 2016; S6 = 5 May 2016; and S7 = 12 May 2016.

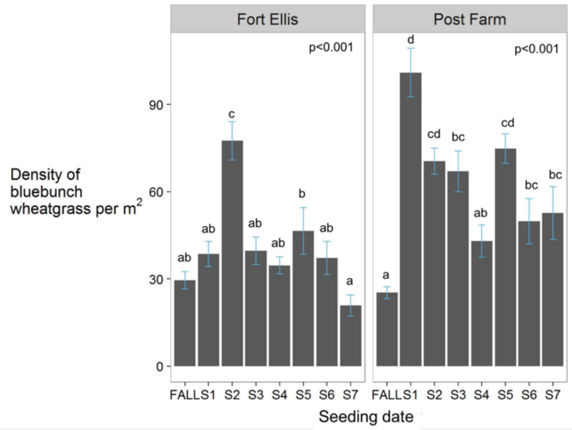

Figure 3. Density of bluebunch wheatgrass per m^2 in September 2016. Differences between seeding groups are indicated by letters and p-values. Seeding dates: Fall = 8 November 2015; S1 = 1 April 2016; S2 = 7 April 2016; S3 = 13 April 2016; S4 = 21 April 2016; S5 = 29 April 2016; S6 = 5 May 2016; and S7 = 12 May 2016.

had higher September density than fall-seeded or late spring-seeded cohorts. S2 at Fort Ellis had the highest average density at 80 individuals per m^2 (Figure 3). At Post Farm, S1, S2 and S5 had the highest average density of 95, 77, and 80 individuals per m^2, respectively (Figure 3). Plants seeded in the fall were taller and had more reproductive stems than late spring-seeded plants at both sites (data not shown).

Overall, our study indicates that fall or early spring seeding results in acceptable establishment of bluebunch wheatgrass. It should be noted, however, that our results are limited to bluebunch wheatgrass, and other native grasses may differ in optimal timing of seeding. Furthermore, our study took place in fallow fields, and establishment of seeded native perennial grasses may be more challenging in more natural settings, including degraded rangeland, where seeded grasses may have to compete with weedy species. In spite of these limitations, our study shows that land managers can continue to implement fall seeding or delay seeding to early spring for effective grass establishment during revegetation.

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