The Fitness Costs of Delayed Germination and Diminutive Growth Response of Cheatgrass

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The competitive ability of cheatgrass (*Bromus tectorum*) is often attributed to rapid early season germination. Our previous research has observed germination occurring from October through June near the Reno Nevada ARS research location. While the benefits of earlier germination have been well researched such as site occupation and resource allocation, the costs of delayed germination are less understood.

To examine the costs of delayed germination and diminutive growth response we designed multiple tests.

Test 1

In a controlled experiment using replicated field soil beds (7ft3) we observed the effect of cheatgrass delayed germination with minimal competition. Germination occurred naturally (October) and then by adding seeds later in March. Fifteen different soils and populations were used to avoid site specific differences .

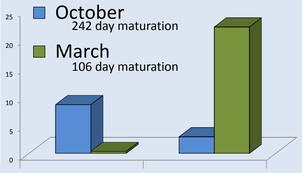
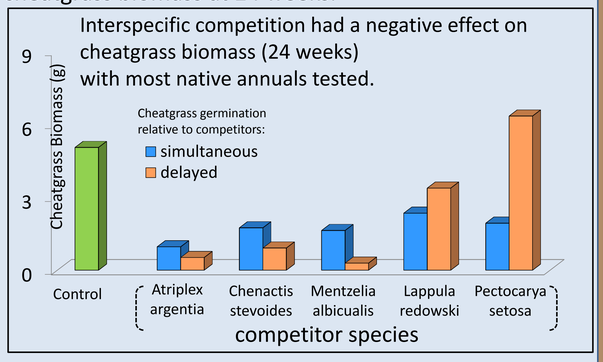


Photo April 1st (A) later germinating plants (March) and
(B) early geminating plants (October).

Earlier germinating cheatgrass had a significantly larger biomass ($p<0.05$) and lesser occurrence of smut. We believe the shorter stature of later germinating plants contributed to increased smut. In the field, we often observe increased smut during years of short stature plants.

Test 2

We observed interspecific competition and delayed germination with native annual species. Multiple Great Basin native annual species were grown with a target cheatgrass plant under greenhouse conditions. Treatments were (A) simultaneous germination between cheatgrass and competitors and (B) delayed germination with cheatgrass being delayed 4 weeks after native competitor germination. The response was target cheatgrass biomass at 24 weeks.



Delaying germination had varying effects. Spring germinating species with slower maturation further decreased cheatgrass biomass when cheatgrass was delayed (*Atriplex, Chenactis, Mentzelia*). However, fall germinating species with shorter maturation lead to increased cheatgrass biomass when cheatgrass was delayed (*Lappula, Pectocarya*). We believe this was due to the rapidly maturing annuals (*Lappula, Pectocarya*) senescing (<10 weeks) while cheatgrass continued to grow (24 weeks) in the absence of competition.

Test 3

Inter and Intraspecific cheatgrass competition were compared in regards to delayed germination and soil nitrogen depletion. Using a replicated randomized pot design we observed the effect of competition when competitors germinated 3 and 6 weeks earlier than cheatgrass. The response variable was biomass of a single target cheatgrass per pot (2.5gal) at 9 weeks (**Figure1**).

Treatments:

A. Control
1. Empty pot
2. Target cheatgrass (no competitors)

B. Competition
1. Intraspecific *(30 cheatgrass)*
2. Interspecific *(30 crested wheatgrass)*

C. Germination Delay
1. 3 weeks delay 'target' cheatgrass germination
2. 6 weeks delay 'target' cheatgrass germination

D. Competitor removal
1. No competitor removal
2. Remove competitors at 'target' cheatgrass delayed germination start

E. Soil Nitrogen
1. Nitrogen fertilized soil (N)
2. Natural field soil (Lo N)

* Response = biomass 1 target cheatgrass

At 9 weeks growth the percent of soil nitrogen depletion was similar between cheatgrass and crested wheatgrass (Figure 2). However at 3 weeks growth cheatgrass seedlings depleted soil nitrogen more, indicating a more vigorous young cheatgrass seedling than crested wheatgrass. This would be expected of an annual vs. a perennial in regards to seedling vigor. Even a single cheatgrass plant depleted soil nitrogen at 3 weeks growth (Figure 3).

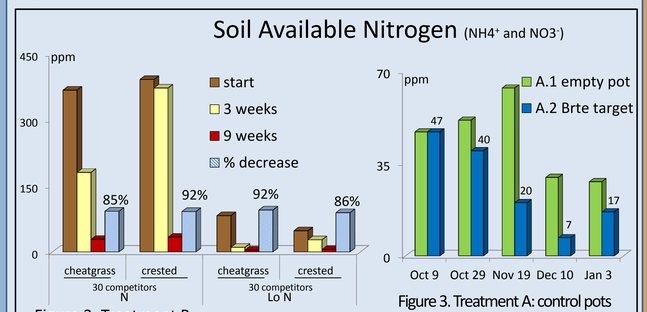
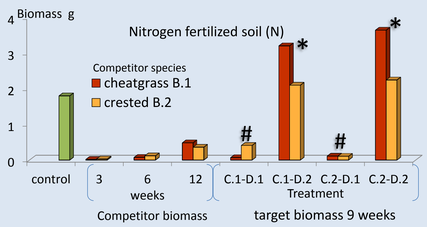
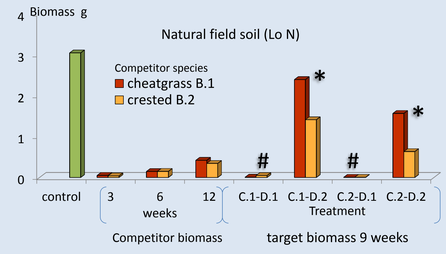


Figure 2. Treatment B:
30 cheatgrass or crested wheatgrass plants/pot
N (nitrogen fertilized soil),
Lo N (natural field soil)

Figure 3. Treatment A: control pots (empty) vs. 1 single cheatgrass (*Brte*)/ pot. Natural field soil (Lo N)

Competition and delayed germination lead to a drastic diminutive growth response of cheatgrass # (Treatment D.1) . Removing competitors prior to target germination, after initial nitrogen soil depletion resulted in a "normal" cheatgrass biomass* (Treatment D.2) .





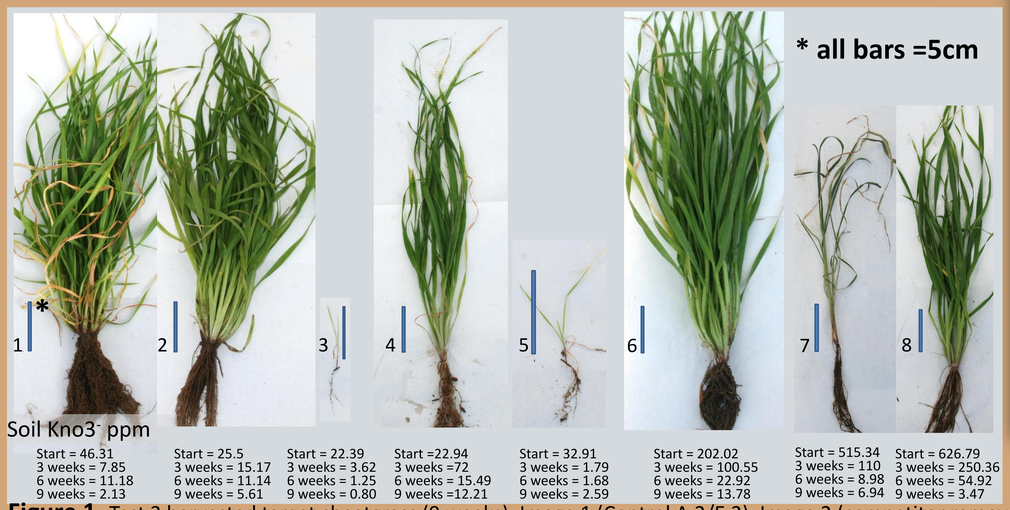


Figure 1. Test 3 harvested target cheatgrass (9 weeks). Image 1 (Control A.2/E.2), Image 2 (competitor removal B.1/D.2/E.2), Image 3 (with competition B.1/D.1/E.2), Image 4 (competitor removal B.2/D.2/E.2), Image 5 (with competition B.2/D.1/E.2), Image 6 (fertilized soil-competitor removal B.1/D.2/E.1), Image 7 (fertilized soil-w/ competition B.1/ D.1/ E.1) Image 8 (fertilized soil-w/competition B.2/D.1/E.1)