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Title:
Elymus elymoides population root and shoot trait responses to drought

Abstract:

Understanding how root traits vary within a species and how traits respond to heterogeneous environments, can provide important insight into functional plant attributes that influence plant survival in competitive environments. Selecting plant material with root traits that will support its survival in heterogenous environments may help improve the outcomes of ecological restoration, yet root traits are rarely incorporated into restoration sourcing decisions. Specifically, the impacts of population-level variation in root traits of restoration material are often overlooked. For these reasons, root traits of seedlings from two populations of *Elymus elymoides* spp. *elymoides* were quantified. *Elymus elymoides* is a native perennial bunchgrass frequently used in restoration in the Colorado Plateau that has been shown to exhibit significant among-population variation in many above- and below-ground traits. Plant were grown in a greenhouse study imposing a water stress gradient. The water stress gradient revealed differing allocation strategies and plastic responses to water stress in each population: the Ashley population had higher root mass fraction (RMF) and greater root allocation under water stress than the Fishlake population, which allocated more biomass to aboveground growth (including seed production). These results suggest that populations that allocate more growth to belowground traits (as in the Ashley population) will perform better in restorations where water stress is prevalent. However, this presents a practical challenge when trying to produce seeds for restoration because plants that invest more in root growth tend to have lower seed production, as only the Fishlake population produced seeds during the study period.

Key words:

Water stress, native grass, intraspecific trait variation, sand, gravel

File descriptions & Metadata:
The file "Foxx_and_Kramer_data" contains the data collected in this study. The tab "Metadata" contains the description of the data including explanations for the variables and the factor levels used.

Methods:

Seed Collection

The Ashley *Elymus elymoides* (Raf.) Sweezy seeds were collected from Ashley National Forest, UT and the Fishlake accession was collected from Fishlake National Forest, UT by the US Forest Service for common garden studies as part of the Colorado Plateau Native Plant Program.

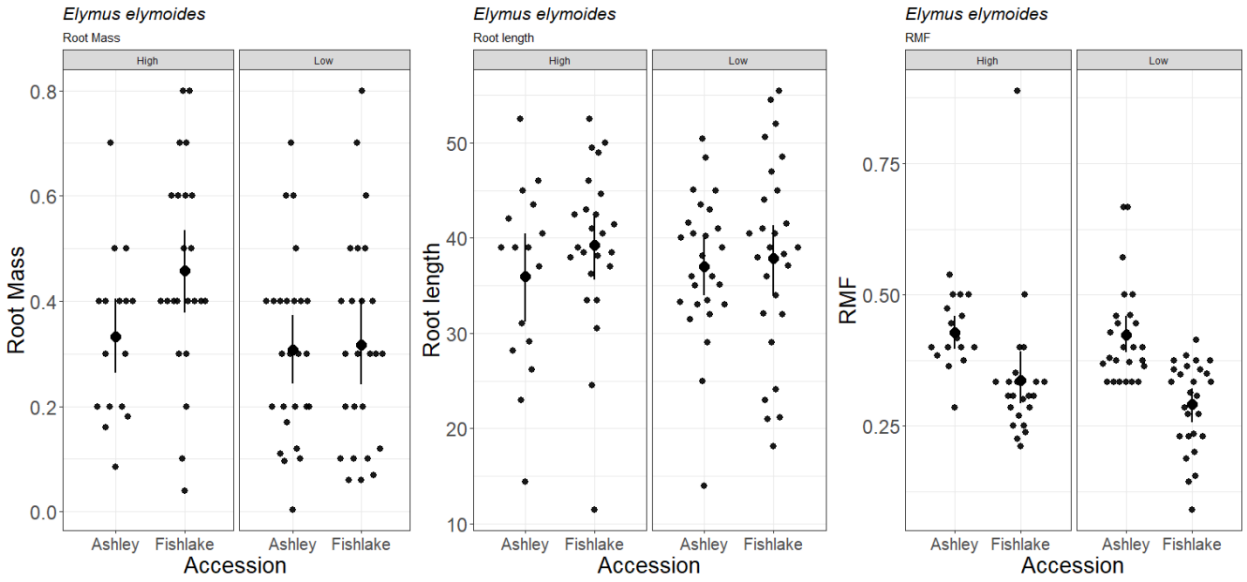
Seed propagation

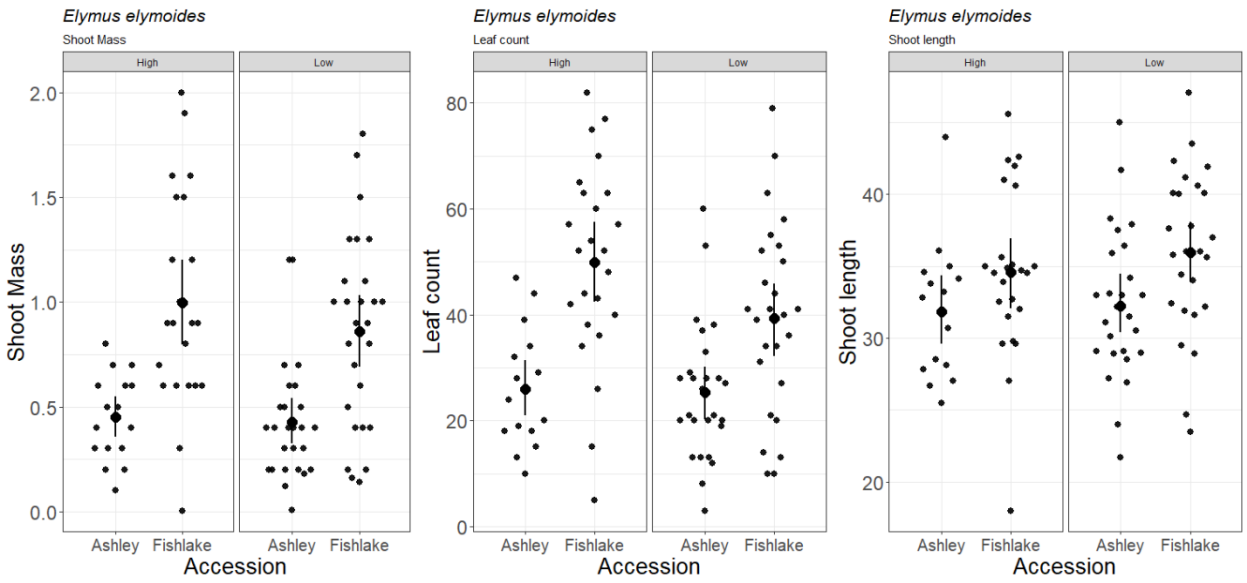
In October 2013, we surface sterilized seeds of both accessions with 8% bleach solution for 30 seconds followed by a DI water rinse for one minute. Next, we placed seeds of each accession on 90 mm diameter petri dishes filled with 1.5% solidified agar for cold moist stratification at 3°C in a refrigerator at the Chicago Botanic Garden (Glencoe, IL, USA) until we observed radicle emergence (1mm). We performed the experiment in a greenhouse, with a photoperiod of 9.5h light/14.5h dark, and day/night temperatures of 19Cº/17ºC. We used two substrate compositions to impose two levels of water stress, replicated in fifteen 24 cm tall x 21 cm wide round pots. One set of pots contained a 1:3 sand:gravel mixture (high water stress) and the other had a 3:1 sand:gravel mixture (low water stress). The presence of root-impenetrable gravel reduces the water available to roots relative to sand (Martre et al. 2002). To confirm that the different substrates had different water contents, we weighed 10g of ten soil samples for each substrate type, then placed samples in an oven at 105˚C for 24 hours prior to re-weighing the samples. Treatments with 1:3 sand:gravel composition held 60% less water (Foxx & Kramer, *in review*).

We placed the seedlings on the substrate surface, gently burying the small radicle so it incurred minimal disturbance. We watered pots every four days and applied 237 ppm NPK fertilizer weekly. We randomized pots into blocks, and each block was rotated on the bench tops every two weeks to lessen position effects. We checked each plant for survival weekly until experiment ended at 14 weeks.

E. elymoides plants were harvested and roots were gently separated and washed away of sand. The aboveground mass (crown, leaves, culms and inflorescences), belowground mass, final shoot height and root length were recorded. The root mass fraction (RMF) was calculated as the root mass divided by the total mass.

Figures:





References

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