Northwestern Arch Information

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Title
Root and shoot traits of wild and cultivar native grass populations

Hidden variation: cultivars and wild plants differ in trait variation with surprising root trait impacts

Abstract

Restoration practitioners have many seed material choices when restoring plant communities, and for some species, cultivars may be the most affordable and accessible material available. However, the process of plant selection and commercial seed production can limit trait variability critical to survival and persistence in heterogeneous environments. Several studies have shown impacts of plant selection and commercial production on trait values and variation, particularly in aboveground traits. Yet researchers rarely assess impacts on root traits in wild-collected material relative to cultivars. This is a critical gap, especially in arid environments where root traits play a key role in plant survival. To compare root and shoot trait values and variability between wild and cultivar accessions, we grew seedlings of three wild-collected accessions and three cultivars of *Pseudoroegneria spicata* (the cultivars 'Whitmar' and 'Goldar', and "selected germplasm" 'P-7'- selected from progeny resulting from crossing among 25 populations in a nursery. We grew the plants in stressful conditions in sand in growth chamber for four weeks. We harvested the plants and compared trait variation and average trait values between collection types of wild-collected versus cultivar for four shoot and four root traits. We found that wild-collected accessions had greater variation in two root traits and one shoot trait, whereby trait values differed marginally significantly by collection type for three root traits and one shoot trait. Specifically, wild-collected plants had 51% more root tips on average, and higher survival compared to cultivars. These results show the importance of understanding differences in root trait values and variation among accessions when selecting material for restoration use.

Key words

intraspecific variation; seed source; Pseudoroegneria spicata; lateral roots; allocation; survival

Methods

Seed germination

We used six *Pseudoroegneria spicata*, or bluebunch wheatgrass accessions in this study – three wild and three cultivar accessions. In February 2018 we surface sterilized 200 seeds per accession with 8% bleach solution for 30 seconds followed by a DI water rinse for one minute. Next, we placed fifty seeds per accession on four - 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 germination (emergence of the radicle) was observed. We checked germination three times weekly and moved germinants to watered, randomized cone-tainers in a growth chamber at 25°C/20°C day/night with a 14hr/10hr photoperiod.

Plant growth conditions

We grew the plants in 6.4 cm diameter x 30.5 cm height Ray Leach cone-tainers (Stuewe and Sons, Tangent, OR, USA) containing commercial sand with a 5 mm layer of loam topsoil on the surface to support initial establishment. We randomized accessions into 13 cone-tainer racks (blocks) and rotated three times weekly to reduce position effects. The initial sample size for each accession was 30 plants. We watered germinants every other day for seven days to encourage establishment, then three times weekly thereafter. We watered each cone-tainer with the same amount of water - 10 mL. We applied 10 mL of half-strength Murashige-Skoog (4.43 g/1L of DI water) (Sigma-Aldrich, St. Louis, MO) immediately following watering at week three. We harvested plants in random order between 23 to 28 days after being planted, with an equal subsample of all accessions harvested on each harvest day. This plant age coincided with the time at which most roots reached the bottom of the cone-tainer in a pilot study under the same conditions and planting materials (Foxx, *unpublished data*).

Sample processing and data collection

We washed plants gently of sand at harvest and imaged plants with a five-megapixel camera. WE placed plants in a 30.5 cm x 25.4 cm x 10.2 cm rectangular container with a black sheet of paper at the bottom and filled with water to spread the roots for more accurate assessments and provide greater contrast to the roots. We took photos from 30 cm above the plant, and we used these images to visually count the number of root tips. We counted the number of leaves and used a ruler to measure length of the longest root and the longest leaf to the nearest millimeter. We then stored the plants in coin envelopes and dried them in an herbarium drier for one week, then placed the plants at room temperature at constant laboratory conditions for three months prior to weighing. Following weighing with a laboratory balance, we used mass data (mg) to calculate root mass fraction (RMF: root mass/total mass) and shoot mass fraction (SMF: shoot mass/total mass). Root mass was square root transformed and shoot mass was log transformed to meet assumptions of normality. We also assessed plant survival based on the initial sample size and number of plants that survived to the end of the experiment.