2007-16-357

Project Title: Genetic Improvement of Prairie Junegrass

Project leader: Eric Watkins

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Objective:

1. Determine the genetic potential of native prairie junegrass germplasm for use as low-input turfgrass.

Start Date: 2007
Duration: ten years
Total Funding: $100,000

Prairie junegrass (*Koeleria macrantha*) is a native, perennial, prairie grass that has demonstrated characteristics that are desirable in low-input turfgrass situations. Several of the accessions we have evaluated maintain adequate turfgrass quality under non-irrigated and unfertilized conditions, though the species does have several deficiencies when grown as a turf (Figure 1). The species also exhibits a slow vertical growth habit which would lead to a reduced mowing requirement. In the last year, we examined a subset of our prairie junegrass collection based on our previous research on ploidy, turfgrass quality and seed production characteristics.

Seed production remains one of the principle limitations of prairie junegrass as a viable turfgrass species in the United States. We have found vast differences in seed production between accessions (Figure 2); in fact, top performing lines can produce ten times as much seed as lower performing lines. These poor performing accessions do not produce enough seed to be economically viable, but because of the variability we have seen in our breeding program, we should be able to improve this trait. Additionally, turfgrass quality is highly variable within the species, with the European collections demonstrating the best mowing quality and lateral spread and the collections from North America exhibiting poor quality. Ideally, we would utilize positive traits from both European (turf quality) and North American (seed production) types. We have so far been unsuccessful in making deliberate crosses resulting in viable seed between European collections and the North American collections; one reason for this is differences in the ploidy. Higher quality prairie junegrass from Europe is often tetraploid and the plants from North America in our collection are diploid. In order to address this problem, we have decided to manipulate prairie junegrass ploidy using chemical mutagenesis. The technique has been widely used in other turfgrass species such as zoysiagrass and perennial ryegrass to increase the total number of chromosomes.

Although colchicine (a chemical commonly used for this type of project) treatment has been used often in other species, the specific protocol must be adapted for each species with an

experiment to determine the recovery rate of plants with the desired ploidy. Early in 2017, we treated seedlings from a diploid ecotype originally collected in Minnesota with colchicine for three durations: 24, 48 and 72 hours. Colchicine prevents the formation of microtubules during cell division resulting in unreduced daughter cells. In our case, this means that the colchicine-treated plants should have the same number of chromosomes as the tetraploid plants from Europe. Tetraploid plants often have enlarged morphological characteristics such as flowers, leaves, and stomata and an increased number of chloroplasts compared to their diploid counterparts. Our initial results show slight differences in the length of stomata on the leaf surface between the plants treated for 72 hours and the untreated plants (Figure 3). We will examine the number of chromosomes in the root tips of the plants so that we can verify the actual ploidy in the treated plants and using flow cytometry as a higher throughput screening for ploidy.

We will use any tetraploid plants that we recover from this population to make deliberate reciprocal crosses between plants from North American and Europe collection. We hope to recover viable seed from those crosses so that we can introduce the turfgrass quality traits from European germplasm into the Minnesota ecotypes while maintaining economically viable levels of seed production. If successful, this project will move us much closer to a high quality, low-input prairie junegrass cultivar that could drastically reduce inputs in sustainable landscapes such as golf course roughs.

Summary Points:

- Seed production remains an important target for genetic improvement efforts in prairie junegrass.
- Ploidy differences between European and North American collections prevent combining useful traits from these populations.
- We used colchicine to overcome the ploidy barrier between the two collections, and future research will focus on verification of ploidy.

Figure 1: Prairie junegrass is often slow to establish and some accessions suffer from leaf rust disease.

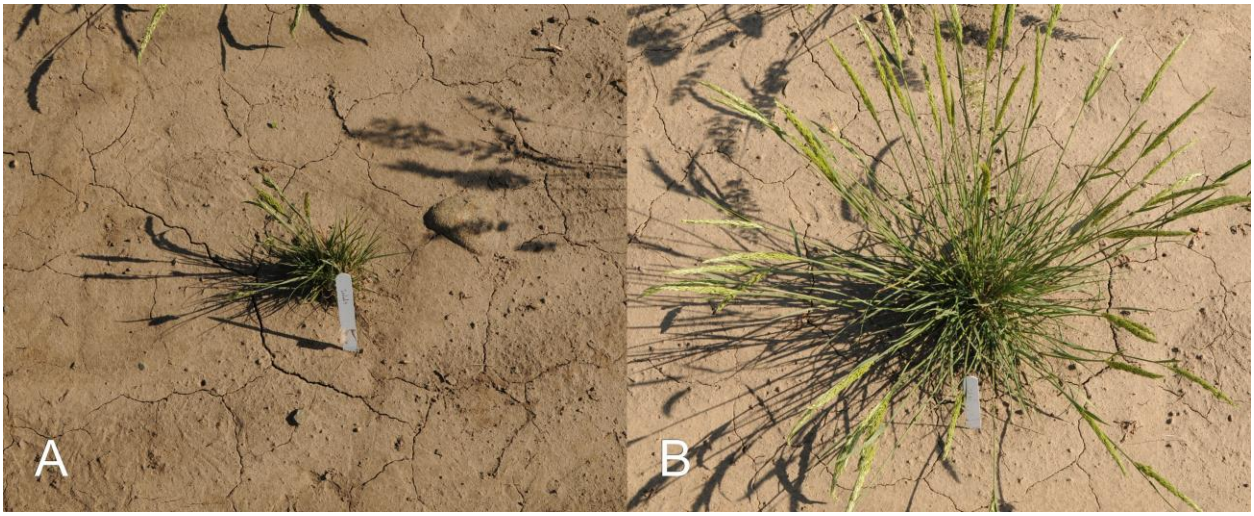

Figure 2. Seed production representative differences between an accession from Ireland (left, A) and an accession from Iowa (right, B). Images were taken on the same day during late spring in the first growing season after establishment.

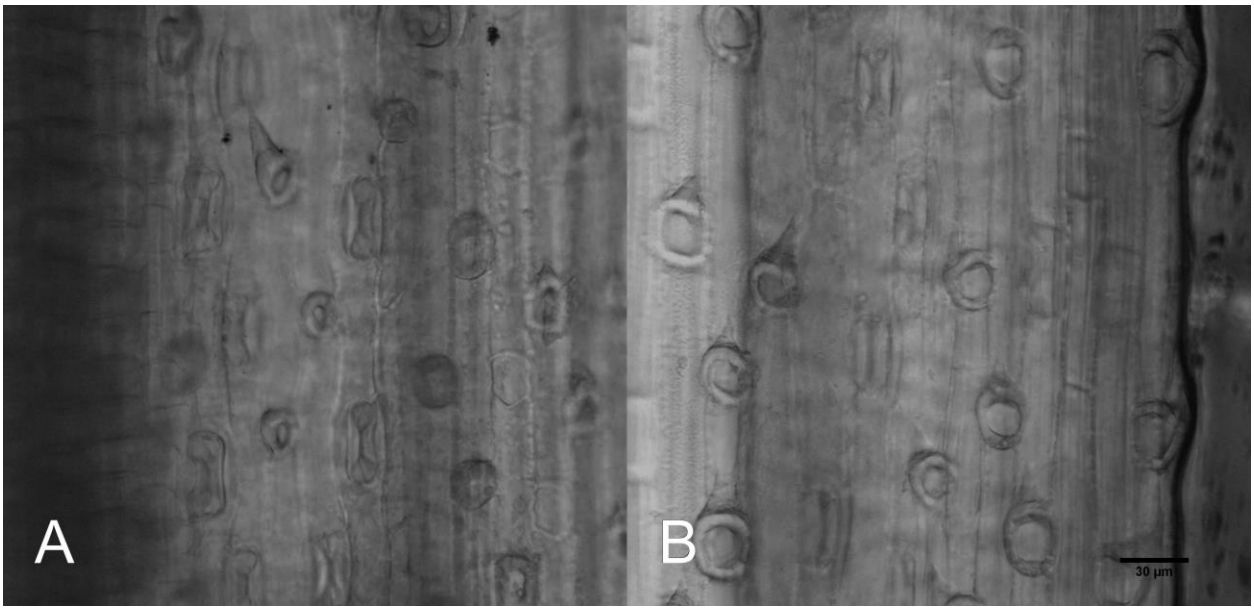

Figure 3. Stomatal length is an indicator of ploidy levels within a plant species. Left (A): potential tetraploid plant with an average stomatal length of 33μm. Right (B): diploid plant with an average stomatal length of 30μm. Images were taken of the abaxial leaf surface near the midpoint of the leaf with magnification of 400x.