2016-09-559

Title: Breaking Seed Dormancy in Buffalograss

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Objectives:

The primary goals of this research are to identify the mechanisms of buffalograss seed dormancy and develop/test alternative methods for breaking dormancy.

Start Date: 2016

Project duration: 3 years

Total funding: $60,710

Summary:

Buffalograss [*Buchloë dactyloides* (Nutt.) Engelm. syn. *Bouteloua dactyloides* (Nutt.) Columbus] has a strong seed dormancy response, common among many native grasses with potential for turf use (Figure 1). In the 1940's, the use of potassium nitrate as a seed treatment to overcome buffalograss seed dormancy was proposed. Treating buffalograss seeds with potassium nitrate followed by storing the seed wet at low temperature is the preferred treatment to overcome seed dormancy by buffalograss seed producers. The seed treatment generally increases germination from <20% in untreated seeds to >85% once treated. The mechanism by which potassium nitrate breaks buffalograss seed dormancy is not understood. The December, 2016 cover story of HortScience describes how potassium nitrate increases seed hydration and initiates germination, and was our lab's first investigation into understanding the role of potassium nitrate in breaking seed dormancy. This research project is taking a multifaceted approach to explore alternate seed treatments that may be more cost effective for seed producers, molecularly understand the mechanisms of seed dormancy in buffalograss, and apply traditional breeding methods to overcome seed dormancy mechanisms.

We are currently testing different seed treatments to break dormancy, which consist of soaking 100 burs in potassium chloride, potassium nitrate, or sodium chloride solution for 48 hours, or acetone for 24 hours. Following the seed treatment, the seed is dried for one day before either storing the seed for a five week chill period at 5°C prior to transferring them to a germination chamber or directly transferring them to a germination chamber without the cold treatment. Once transferred to the chamber, percent germination was collected weekly over four weeks. Percent dormancy was calculated by subtracting the total germinating seeds for each treatment from 100 (Figure 2). Seed viability was not tested, so dormant seed in this study includes dormant and non-viable seed. All treatments tested so far significantly reduce seed dormancy, suggesting the chemical may not be as important as the soaking process. Once seed treatments and seed lots are identified giving consistent results, samples will be collected for transcriptomics and hormone profiling to determine the role and timing of expression of important genes conferring either dormancy or germination.

In addition to seed treatments, recurrent phenotypic selection breeding strategies are being used to remove seed dormancy. Two approaches are currently being used. One approach is designed to select seeds that germinate within 14 days in the absence of any seed treatment, allow those to grow to maturity and intermate, and collect seed, repeating this process for several generations. Early generations from this approach had reduced seed dormancy suggesting the mechanism is under genetic control. Dormancy returned to a higher percentage in subsequent generations. Buffalograss burs, sold as seed, typically contain 3 to 5 caryopses. It is possible that even if one caryopsis germinates early, the others may retain dormancy making it difficult to overcome dormancy through breeding. We are continuing this approach to see if we can increase germination/decrease dormancy within a buffalograss population. Alternatively, a modified approach is being applied whereby once early germinating seedlings are identified, seeds are dissected to remove the other caryopses, accelerating the selection process for early germinating types with reduced dormancy.

Research was also started to understand maternal effects on seed dormancy. Buffalograss seed producers report variable success with the potassium nitrate treatment for breaking seed dormancy, occasionally requiring multiple treatments to break dormancy. The stronger dormancy response in a given year may be caused by environmental factors during seed development. Buffalograss flowers throughout the growing season and it is possible that the length of time on the mother plant may impact the dormancy response. We harvested seed on July 17th, August 2nd and 16th, and September 5th, 2017. Over the winter, germination tests will be done on treated and untreated seed from each harvest date to better understand if harvest timing date influences seed dormancy. Other factors like pest pressure, available moisture, temperature during seed maturation may also influence dormancy.

Together this data will help resolve buffalograss seed dormancy mechanisms and best management practices (seed treatments or field production management) to reduce the impact of seed dormancy.

Summary points:

1. Commercially, buffalograss seed dormancy mechanisms are overcome by a potassium nitrate seed treatment.
2. Soaking burs is more important than the solution used to break buffalograss seed dormancy.
3. Field-based breeding methods have potential for overcoming seed dormancy issues in future seeded buffalograss cultivars.

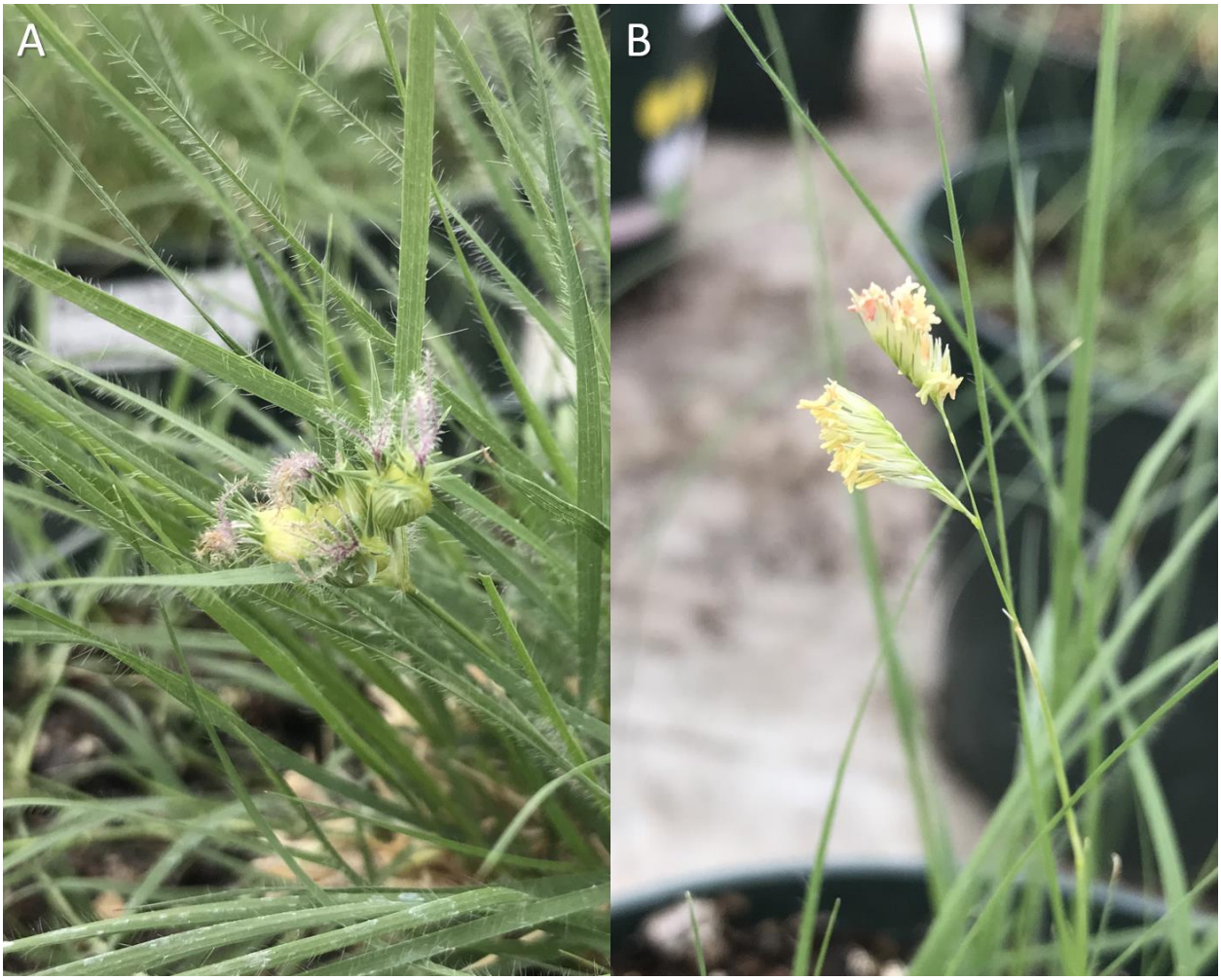

Figure 1. Female (A) and male (B) inflorescence of buffalograss, an important dioecious U.S. native turfgrass species.

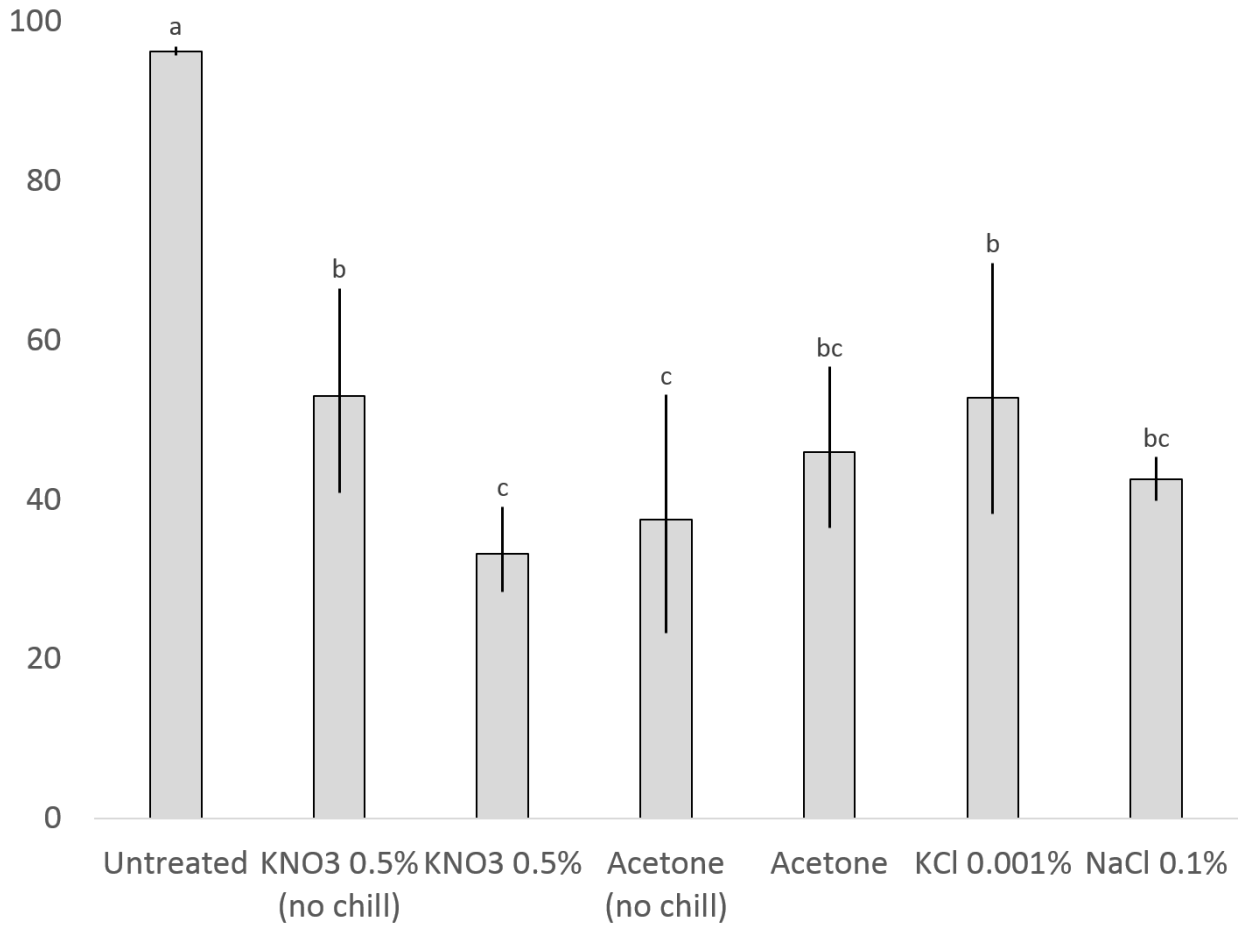

Figure 2. Dormancy of buffalograss following chemical treatments applied to break dormancy (based on 100 seeds). Error bars show standard deviation among four replications and letters indicate statistical groupings based on Fisher's LSD.