Multiple Stress Tolerance, Seed Dormancy Breaking, and Establishment of Seeded Saltgrass

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Objectives:

1. Quantify cold hardiness of potential varietal releases and advanced seeded lines.
2. Continue to determine the level of salinity tolerance during germination (seeded type only) and as mature turf for potential new cultivars.
3. Evaluate different seed treatments to break seed dormancy.
4. Evaluate saltgrass seeding establishment in the field with high and moderate levels of soil salinity.
5. Determine saltgrass rooting characteristics and soil moisture extraction patterns under two irrigation regimes.

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Project Duration: three years
Total Funding: $72,036

Saltgrass field plots at Horticulture Research Center, Fort Collins, Colorado. Northern types showed earlier dormancy than southern types. Southern types remained green in October.

Inland saltgrass (*Distichlis spicata*) is found in many climatic zones within the western United States and western Canada. Multiple-year lab and field experiments were conducted to compare cold hardiness and winter survival of saltgrass accessions. Northern accessions, COAZ-01, COAZ-02, and CO-01 were collected from the Front Range of Colorado. Southern accessions, COAZ-03, COAZ-04 and COAZ-05, were collected from San Joaquin Valley, California.

Plugs of these accessions were planted in the field in the summer of 2003. Rhizomes of each accession were sampled during mid-winters for 4 consecutive years and subjected to laboratory freezing tests. Ranking of accessions for the subfreezing temperature resulting in 50% mortality (LT_{50}) in Colorado was CO-01 (-18 to -20^{o}C) = COAZ-01 (-16 to -25^{o}C) = COAZ-02 (-15 to -23^{o}C) > COAZ-03 (-10 to -16^{o}C) = COAZ-04 (-9 to -14^{o}C) = COAZ-05 (-8 to -15^{o}C).

These data suggested that the northern accessions were 5 to 10 degrees more cold hardy than the southern accessions. Winter dormancy in the field among southern accessions was delayed 3-4 weeks in comparison with the northern accessions. Significant winterkills were not observed during the 4 years study period, except for the first winter season when a sharp decline in soil temperature to -10^{o} C in January/February 2004 caused a substantial winter injury for the Southern accessions only. Winter injury in the field is related more to soil temperature than air temperature.

Although saltgrass is classified as a halophyte, it is less salt-tolerant during germination than as established turf stands. The effects of germination regulating chemicals in enhancing seed germination under salinity conditions has been reported in several plant species. Experiments were conducted to test the effect of the application of concentrations of ethephon, fusicoccin, kinetin, thiourea, and Proxy on saltgrass seed germination under three salinity levels.

Saltgrass germination percentage was 56% under non-saline condition, which was reduced to 46% and 26% at 15 and 30 dS m^{-1} salinity levels, respectively. Ethephon application (5 mM) increased saltgrass germination percentage under the highest salinity treatment (30 dS m^{-1}) only. However, Proxy (at 5 mM a.i.) increased saltgrass germination under all salinity treatments, reaching 97%, 76% and 40% under control, 15 dS m^{-1}, and 30 dS m^{-1} salinity levels, respectively. Kinetin at 0.5-1.0 mM did not increase saltgrass germination under non-saline conditions but increased germination percentage at 15 and 30 dS m^{-1} salinity levels.

Fusicoccin (at 10 micromolar) and thiourea (at 30.0 mM) also increased germination percentage under all salinity treatments. Our investigation showed that 5.0 mM ethephon, 10 µM fusicoccin, 0.5-1.0 mM kinetin, 30 mM thiourea, and Proxy (at 5 mM a.i.) increased saltgrass seed germination under saline conditions.

A study was conducted in 2006-2007 to determine the effect of different seeding rates, seeding dates, and two different seed pre-treatments (scarification and stratification) on establishment of saltgrass on sites where soil salinity is approximately 5.0 dS/m. Seeding dates selected were May 15, June 15 , and July 15.

Saltgrass seeded in May could establish adequate coverage in September even using the lowest seeding rate (74 kg/ha). For plots seeded in July a high seeding rate (170 kg/ha) is required to establish adequate coverage by the end of September. In agreement with our previous findings, we found both machine scarification and stratification improve saltgrass seed germination and establishment.

Summary Points

- Northern saltgrass accessions started dormancy 3-4 weeks earlier in the fall and were 5 to 10^{o}C more cold hardy than the southern accessions.
- In laboratory experiments, ethephon (5.0 mM), fusicoccin (10 µM), kinetin (0.5-1.0 mM), thiourea (30 mM), or Proxy (at 5 mM a.i.) increased saltgrass's ability to germinate under high salinity conditions.
- Saltgrass seeded in May established adequate coverage by the end of September even using the lowest seeding rate (74 kg/ha). For plots seeded in July, however, a high seeding rate (170 kg/ha) was required to establish adequate coverage by the end of September.