

Breeding Turf-type Annual Ryegrass for Salinity Tolerance

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Objectives:

1. Identify improved salt- and sodium-tolerant genotypes and introgress the tolerance into adapted turf-type genotypes of annual ryegrass and increase seed of these populations for experimental testing.
2. Test new experimental lines of annual ryegrass under greenhouse and field conditions of highly saline and sodic soil and water, and release the line as a salt-tolerant variety.

Start Date: 2008

Project Duration: 3 years

Total Funding: \$88,276

Annual and perennial ryegrass are considered to be susceptible to high salinity. Genetic selection for tolerance to high salinity was carried out by two methods. First, a salt-tank greenhouse screening method was utilized to select salt-tolerant plants at Overton, Texas. Secondly, a screening procedure was utilized under high salt field conditions at Pecos, Texas.

The methods for selection of genotypes with improved salt tolerance were planting seed in the field in a high salinity soil and irrigating with highly saline water. Seed (300 g) was broadcast over a 30- x 30-ft area. Sprinkler irrigation was used to germinate and establish a stand. During the 2008-09 season, almost no rainfall occurred at Pecos. Irrigation was the only source of moisture for the growing season. Selection of seedheads of the best plants took place in May 2009.

In 2009-10, a second cycle of selection was conducted at Pecos using germplasm from the earlier selection. In the greenhouse procedure in 2009-10, two genotypes were selected. One was from Pecos, the second from the previous year's greenhouse selection. When plants were in the two to three-leaf stage, entire flats were immersed in water with a salt concentration of 3,100 ppm (4.9 dS/m).

Thereafter, flats were immersed every 3 to 4 days. Salt concentration was increased gradually over 60 days until a water salt concentration of 19,500 ppm (31.2 dS/m) was reached at selection period. At that time, 75% of plants were dead. Remaining plants (250 plants) cross-pollinated and produce seed in the spring of 2010. This seed, as well as the seed from Pecos, will be tested for salt tolerance in 2010-11 in both greenhouse and field studies.



Ryegrass plant at Pecos started in high-salt soil.

In addition to the above trials, 20 genotypes were tested in a field trial at Pecos and in a greenhouse study at Overton. At Pecos, ratings were made at two dates. On the first date, February 2, all genotypes were evaluated in an overseeded turf environment. The three lines that had highest salinity tolerance ratings were Pecos Salt Blk, Pecos Blk. 07-08, and TXR2009-SS-Blk. Each of these lines had been selected at either Pecos or Overton. These results indicate the ryegrass selected at Pecos is either more adapted to the Pecos environment and/or more tolerant to the high-salinity conditions at Pecos. Two intermediate entries, LH-08 and 66B-08, also showed above-average tolerance to salinity at Pecos.

In the greenhouse trial, plants were grown in flats in an organic mix and later immersed in high salt concentrations in a tank. Significant differences were measured between entries. However, results were not positively correlated with all the Pecos salt-tolerant selections. SS3 (07-08), a greenhouse salinity selection, and 'Intercross' (an intermediate ryegrass not selected for salt tolerance) appeared to have slightly more salt tolerance than other entries.

Seed from the most salt tolerant breeding lines as described from the Pecos screening trial will be increased in Oregon during the 2010-11 growing season. This increase is made up of 50% TXR2010-SS3G, 33.3% TXR2009-SSBlk, 8.3% Salt S-10, and 8.3% Pecos Blk 2010. Three pounds of seed will be planted on approximately 1 acre and should produce approximately 1,500 lb of seed in the summer of 2011.

This seed will then be returned to Texas for evaluation under field studies on high salt problem areas on golf courses in Texas. It will be compared to control varieties such as 'Panterra', 'Axcella 2', and 'Intercross' to determine if it is improved for salinity tolerance.

Summary Points

- Differences for salt tolerance between genotypes were obtained in both greenhouse and field experiments.
- Elite salt-tolerant germplasm selected at Pecos, Texas, was rated as most tolerant in a Pecos salinity trial in 2010.
- Seed of the elite salt-tolerant germplasm will be increased in Oregon in 2010-11 for further testing in 2011-12.