Genetic Enhancement of Turfgrass Germplasm for Reduced-input Sustainability

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Objectives:

1. The objective of this research, conducted at the USDA, ARS' Beltsville Agricultural Research Center in Beltsville, MD, is to use genetic and biotechnology approaches to identify and develop turfgrass germplasm with improved biotic and abiotic stress resistance. Efforts will be made to identify molecular markers associated with desirable traits and to combine useful traits into germplasm able to grow with reduced inputs.

Start Date: 2007
Project Duration: three years
Total Funding: $50,000

There is a tremendous need to improve the stress tolerance of turfgrass. To address this broad objective, we have undertaken the following five projects:

1. Development of *Danthonia spicata* as a Low Maintenance, Native Turfgrass Species

A key aspect to the development of *Danthonia spicata* (Poverty grass) as a low-maintenance turfgrass species is obtaining a better understanding of the biology of the species. Initial observations indicate that there is variation present in the species, and there may be more than one species present in natural stands.

A seeding rate trial was established at the University of Maryland turfgrass center using three different seeding rates. The results of the first year indicate no significant difference in turf quality between the three seeding rates.

Genetic diversity of selected *Danthonia spicata* germplasm was established using 347 AFLP markers. The results indicate that the species is primarily self-fertile, however, low levels of outcrossing are likely to occur. Genetic markers will be used to establish estimates of outcrossing rates in natural populations and controlled crosses will be attempted.

2. Field Screening of Bentgrass Germplasm for Resistance to Important Turfgrass Diseases

A field trial containing clonally-propagated plants from a bentgrass mapping population, developed by Dr. Geunhwa Jung at the University of Massachusetts, was established at the University of Maryland turfgrass center. The study involves approximately 300 entries replicated three times, plugged into a ryegrass turf.

The first rating of this material for disease resistance was conducted in the summer of 2008. The artificial inoculation with *Sclerotinia homoeocarpa* was not as effective as we would have liked. Slow fungal growth during inoculum development resulted in a late inoculation of the field trial. Disease development did occur and our first rating of the material was conducted with differences clearly present. Dollar spot disease severity was very high during the summer of 2009, and a second year of rating is being analyzed.

3. Development of *Koeleria macrantha* as a Low-input Turfgrass

The goal of this research is to increase the genetic potential of prairie junegrass (*Koleria macrantha* Ledeb.) for use as a low-input turfgrass. Research on *Koeleria* is all being conducted by the University of Minnesota and has initially been focused on germplasm collection. Future research may involve the establishment of research plots in Maryland to determine the tolerance of *Koeleria* germplasm to the stressful growing conditions present during Maryland summers.

4. Identification of Brown Patch Resistant Tall Fescue

The objective of this study was to use digital image analysis (DIA) to evaluate tall fescue plant introductions (PIs) for resistance to both *Rhizoctonia solani* and *R. zeae*. This study included 15 PIs selected from the USDA germplasm database and three commercial cultivars with varying brown patch resistance. The commercial cultivars had the lowest mean disease severity in each experiment. Mean disease severity ranged from 59-93% for *R. solani* and from 32-64% for *R. zeae*. Current work involves evaluating the diversity of resistance to both *R. solani* and *R. zeae* that may be present in each PI.

5. Bentgrass Breeding Consortium: Molecular Breeding for Dollar Spot and Snow Mold Resistances

The objective of this study was to identify candidate Miniature Inverted-repeat Transposable Elements (MITEs), a class of transposable elements that has not been previously described in turfgrasses, from *Agrostis* and assess their value as a molecular marker tool. 7,529 *Agrostis capillaris* L. and 8,535 *Agrostis stolonifera* L. DNA sequences, were screened using the FindMITE program to identify candidate MITE sequences. FindMITE identified 202 MITE-like sequences, or 1.26% of the 16,064 sequences. The MITE display markers had a significantly higher polymorphism rate (0.42) between the mapping population parents than Amplified Fragment Length Polymorphism (AFLP) markers at 0.28. An *Agrostis* diversity analysis has been completed utilizing 1,300 MITE display markers, and the results establish the relationship of ancestral diploid material to the cultivated varieties and show a reduction of genetic diversity in newly-developed cultivars.

Summary Points

- AFLP marker results indicate that *Danthonia spicata* (Poverty grass) is primarily a self-fertile species, however, a small percentage of outcrossing does occur.
- A high level of dollar spot (*Sclerotinia homoeocarpa*) infection in 2009 caused differing responses among bentgrass germplasm, planted in Maryland field trial.
- Tall fescue plant introductions (PIs), inoculated with *Rhizoctonia solani* and *R. zeae*, showed varying degrees of tolerance to both diseases.
- 1,300 Miniature Inverted-repeat Transposable Elements (MITEs) display markers were used in a diversity analysis of *Agrostis* species. The markers established the relationship between ancestral diploid material and cultivated varieties, and showed reduction in genetic diversity in new cultivars.