Cultivar Development and Extreme Temperature Tolerance of Greens-type *Poa annua*

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Objectives:

1. Collect, select, breed, and develop genetically-stable and phenotypically-uniform cultivars of greens-type *Poa annua* for commercial production.

2. Develop techniques to screen large numbers of progenies and germplasm accessions for tolerance to extreme temperature.

3. Identify molecular markers associated with genetic loci (genes) controlling agronomically-important traits and specific stress tolerances in order to aid in the breeding and development of improved cultivars of greens-type *Poa annua*.

Summary:

Poa annua L. has been part of the game of golf for over 130 years, however despite repeated attempts to breed improved strains, currently there are no commercial sources available of high quality greens-type *Poa annua*. The purpose of this research is not to replace creeping bentgrass as a putting surface but rather to offer an alternative grass to those golf courses where *Poa annua* L. is simply a better choice. One of the main problems with *Poa annua* greens is that it normally takes a long period of time to evolve strains of high quality, defined here as those strains with high shoot density and a range of stress tolerances. In addition, a patch-work of different strains normal results in a non-uniform putting surface due to differences among the strains in texture, seed head production, and vertical leaf extension rates after mowing. Differences in pest and environmental stress tolerance among the various strains also complicate the management of such a diverse population of plants. The main focus of this project is to develop commercial seed sources of uniform and stable cultivars of greens-type *Poa annua*. Such products would allow superintendents and architects an opportunity to utilize *Poa annua* putting surfaces rather than having to wait out the natural evolution of greens-types from the wild and weedy invasive annuals. Major progress in 2005 included initiating genetic analysis of mapping populations, discovery of salinity tolerance in *Poa annua*, improved genetic purity of seed production, and establishing several collaborative greens-type *Poa annua* research projects.

2005 REPORT

Greens-type *Poa annua* evaluation trials: In 2005, we began the process of renovating and constructing new research putting greens at the Joseph Valentine Research Facility. These plots are expected to be completed and established with plots for quality and stress tolerance evaluation by Summer 2006. Currently, we have the 2002 Landscape Management Research Center (LMRC) putting green trial that remains ongoing, as well as, we transplanted the 2001 trial into our newly acquired greenhouse at the LMRC. This greenhouse-sodded Poa is being grown on a sand-based root zone and maintained at an 1/8 inch (3.2mm) mowing height. The greenhouse-sod has will provide us with fresh

plant material, maintained at a greens height of cut, throughout the winter months for testing and evaluation purposes; including, salinity tolerance testing (NaCl), various disease inoculations, and tolerance to winter damage (Hardened vs. non-hardened comparisons).

Collaborative studies:
Collaborative studies continue with:

- Dr. Sowmya-Mitra, Cal-Poly – Ponoma, on management of Poa greens.
- Dr. Yves Castonguay, AG-Canada, Laval University on winter damage of Poa greens.
- Dr. David Aldous, University of Melbourne, Australia and Mr. John Neylan, Australian Golf Course Superintendent's Association, salinity tolerance and management of Poa greens.

In 2005, the breeding program began supplying necessary germplasm required for the following new collaborative studies:

- Dr. Trygve Aamlid, The Norwegian Crop Research Institute, in the areas of Pink Snow Mold (*Microdocium nivale*) tolerance and winter hardiness.
- The "new" NE Regional Project. This new multi-year, multi-state, multi-university Northeast Regional project is being focused on the influence on management practices on 1.) the development of Anthracnose disease on *Poa annua* and 2.) feeding of Annual Bluegrass Weevil, *Listronotus maculicollis* (formerly known as 'Hyperodes weevil') on *Poa annua*.
- Dr. Scott Warnke, USDA-ARS, Beltsville, MD. Together we are performing genetic analysis of the *Poa annua* genome in relation to potential fitness differences among between genotypes on the putting green.

Collaborative trials and On-site testing:

Continuing collaborations for turf quality evaluations include Dr. David Green, Cal Poly-San Luis Obispo; Dr. Gwen Stahnke, Washington State Univ.; Dr. David Aldous, University of Melbourne, Australia; Mr. John Neylan, Australian Golf Course Superintendent's Association; Dr. Frank Rossi, Cornell Univ.; and, Dr. Jim Murphy, Rutgers University.

Demand for seed of our greens-type Poa cultuivars, for on-site testing at golf courses and evaluation plots at Universities, continues to exceed our capacity to produce. Every year we continue to miss opportunities for establishing plots, across the USA and abroad, due to a lack of seed.

2005 Seed Harvest:

We are continuing our efforts to ensure the genetic purity of the greens-type *Poa annua* lines that are cultivated in the project. This effort, initiated in 2004, will begin to pay dividends for the 2005 seed harvest by providing genetically pure seed.

The 2005 seed harvest is still in the process of being cleaned. However, we predict that enough seed was produced this year to supply the ongoing collaborative research projects and the three new collaborative projects with seed for testing and evaluation purposes. This year we also shipped small samples of 2004 seed, we believed to be genetically pure, to the seed company DLF International in Oregon for evaluating commercial production potential of our best experimental cultivars. In the future, we will begin to rely more heavily on our collaborative seed-producing partner, DLF, to produce

the quantity and quality of seed necessary to satisfy the demand of research and evaluator interests.

Space-plant Nurseries:

In 2005, we began the process of moving our space-plant nursery from its former location to the Landscape Management Research Center at University Park campus where we currently have nine acres of irrigated space-plant nursery. We expect to increase this area to a total of 12 acres over the next several years.

Germplasm collections:

We currently maintain a world's collection of greens-type *Poa annua* which forms the basis of the breeding program as germplam for performing crosses and other associated genetic analyses. Even so, we are constantly collecting additional germplasms on a continual basis. A proposal was submitted in 2005 to the National Forage and Turfgrass Crop Germplasm Committee for a European Poa germplasm collection trip. By all accounts, the funding of this 2006 collection trip seems likely. This proposal is in collaboration with Dr. R.C. Johnson, USDA-ARS, Washington State University, for the purpose of collecting species of Poa closely related to *Poa annua*. Such germplasm simply does not exist within the nation's Plant Germplasm Introduction System and will be a valuable source of material for genetic analyses of the *Poa annua* genome.

Genetic research:

Studying *Poa annua*'s evolutionary history as a species and it's evolution of greens-types will greatly enhance our knowledge and ability to manipulate the species through traditional breeding efforts. With a world's collection in place, we have begun to study its genetic variability, higher and lower states of polyploidy, and gene function and regulation of biotic and abiotic stress tolerance. Mr. Jonathan LaMantia (PhD, Ecol.& Mol. Plant Phys. program) is the graduate student who has been brought on board to investigate and perform in this genetic research arena. Jon is using a combination of molecular techniques (genetic markers and flow cytometry) to further our understanding of the genetics underlying greens-type *P. annua* evolution.

Mapping populations, a necessary tool for our genetic analyses, have been constructed for the traits of annual and perennial life histories and for two diseases, Anthracnose and Dollarspot. Analysis of the mapping populations created in 2004 has commenced and has become part of the collaborative research work with Dr. Scott Warnke.

Environmental Stress Tolerance: Mr. Jon LaMantia and Ms. Jing Dai (MS, Agronomy), are currently evaluating our germplasm and mapping populations for salt tolerance and disease resistance (Anthracnose and Dollar Spot).