Genetic Enhancement of Turfgrass Germplasm for Reduced-input Sustainability

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Objectives:

1. Use genetic and biotechnology approaches to identify and develop turfgrass germplasm with improved biotic and abiotic stress resistance.
2. Identify molecular markers associated with desirable traits and to combine useful traits into germplasm able to grow with reduced inputs.

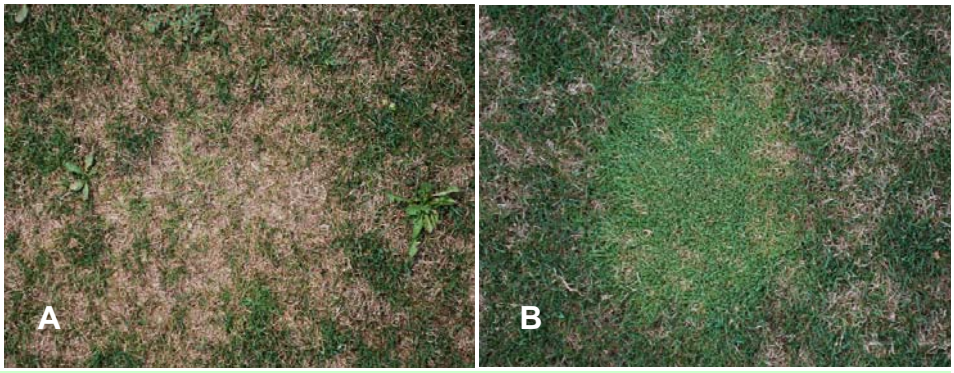
Start Date: 2007
Project Duration: three years
Total Funding: $50,000

There is a tremendous need to improve the stress tolerance of turfgrass. In the past year, our focus has been on identifying and improving disease and heat tolerance in bentgrass (*Agrostis* spp).

A major effort of ours is to improve dollar spot (*Sclerotinia homoeocarpa*) and brown patch (*Rhizoctonia solani*) disease resistance. Dollar spot and brown patch are the most widespread fungal diseases of highly managed turfgrass species such as creeping bentgrass (*A. stolonifera*). More money is spent to manage these diseases than all other turfgrass diseases combined. Dollar spot and brown patch are widespread throughout the summer months in warm humid areas of the United States, and spray programs are generally scheduled at regular intervals to safeguard against disease establishment. However, these spray strategies can lead to the fungi developing fungicide resistance, and this has become a major issue in certain regions of the country.

ARS researchers at Beltsville, MD are using new high-throughput DNA sequencing technologies to determine the genes that are important in the interaction of these important fungal pathogens with turfgrass plants. The identification of the genes involved in this interaction has the potential to significantly reduce the amount of fungicides needed to maintain disease-free turfgrasses.

A new type of bentgrass genetic marker was developed using sequence data obtained as part of a bentgrass DNA sequencing collaboration with Rutgers University. The new markers are based on Miniature Inverted Transposable Elements (MITEs). MITEs appear to be common in *Agrostis* and the markers were used to evaluate the genetic diversity of germplasm.



Susceptible creeping bentgrass clone showing low levels of dollar spot resistance (A) and creeping bentgrass clone showing resistance to dollar spot infection (B) in Maryland.

Critical to the development of improved cultivars is an understanding of the underlying genetic structure. Important to this understanding is knowledge of chromosome numbers and their arrangement. However, very little research on bentgrass chromosome identification is reported in the scientific literature. Therefore, 25 accessions of *Agrostis* from the USDA National Plant Germplasm System were selected for analysis. Previously exhibited DNA content values based on flow cytometry indicated that the accessions were diploids.

Plants from an experimental creeping bentgrass mapping population were established and inoculated with the dollar spot fungus at the University of Maryland turfgrass research center, College Park. Extensive disease development occurred for the second year, and clones with the highest levels of resistance were selected for further evaluation. The most resistant and some selected susceptible clones are being inoculated with *S. homoeocarpa* and *Rhizoctonia zeae*. Infected tissue is being harvested to evaluate gene expression that takes place during infection by these two important turfgrass fungal pathogens. The goal is to determine the genes that control resistance and make this information available to breeders for development of improved, disease-resistant cultivars.

Besides improving disease resistance, we are investigating genes for heat tolerance. Field data from 2008 and 2009, as well as growth chamber data from 2008, was used to search for regions of the bentgrass chromosomes that contribute to heat and drought tolerance in experimental populations. Recent analysis identified seven linkage groups that provide some level of tolerance to these important stresses. Future work will further refine these chromosome locations and the level of importance each plays in heat and drought tolerance. The goal is to improve the speed and accuracy of selection for these important traits.

Summary Points

- A new type of bentgrass genetic marker was developed using sequence data based on Miniature Inverted Transposable Elements (MITEs). MITEs appear to be common in *Agrostis* and the markers are useful in evaluating the genetic diversity of germplasm.
- Dollar spot resistant and susceptible plants are now being investigated to identify which genes are expressed, and potentially confer resistance in bentgrass.
- Analysis of bentgrass chromosomes identified seven linkage groups that contribute some level of heat and drought tolerance. These chromosome locations will more intensively studied to better understand the role each plays in conferring stress tolerance.