Genetic Enhancement of Turfgrass Germplasm for Reduced-Input Sustainability

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Objectives:

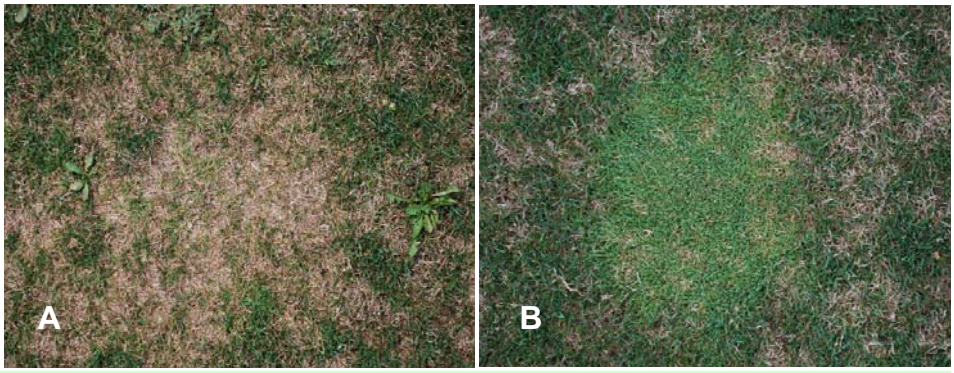
1. Use genetic and biotechnology approaches to identify and develop turfgrass germplasm with improved biotic and abiotic stress resistance.
2. Identify molecular markers associated with desirable traits and to combine useful traits into germplasm able to grow with reduced inputs.

Start Date: 2010
Project Duration: 3 years
Total Funding: $60,000

Bentgrasses (*Agrostis* spp.) are an important group of turfgrasses widely used on golf courses throughout the world. Although bentgrasses are highly diverse, much of the genetic diversity present in the species can be lost during the process of cultivar development. ARS researchers in Beltsville, MD are using new DNA marker technologies to understand the relationships between bentgrass species and develop new strategies for transferring important stress and disease tolerance genes between species.

A major effort is being done to improve dollar spot (*Sclerotinia homoeocarpa*) and brown patch (*Rhizoctonia solani*) disease resistance, as well as drought and heat tolerance. Dollar spot and brown patch are the most widespread fungal diseases of highly managed turfgrass species such as creeping bentgrass (*A. stolonifera*). In addition, irrigation of golf courses is under intense scrutiny, as potable water availability is increasingly restricted or limited. The identification of the genes providing disease and stress tolerance has the potential to significantly reduce the amount of fungicides and/or water needed to maintain healthy golf course turf.

Field and greenhouse data from 2008 and 2009 was used to search for chromosome locations influencing drought and heat tolerance in bentgrass. The analysis identified several important chromosomal regions governing stress tolerance traits in bentgrass species. The importance of these chromosomes in tolerance to multiple stresses may be most useful in future studies for the development of marker-assisted selection for both heat- and drought-tolerant creeping bentgrass cultivars.



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.

Plant tissue of creeping bentgrass inoculated with both dollar spot and brown patch was collected and is being prepared for study using high-throughput DNA sequencing. Gene expression differences that occur during infection may provide clues to the methods of resistance to these two important turfgrass pathogens. The goal of this work is to develop more efficient methods of selecting disease resistant grass that will lead to a reduction in fungicide applications to turfgrasses.

Newly developed genetic markers were used to study the genetic diversity of both diploid and tetraploid creeping bentgrass germplasm. The analysis with these markers identified important relationships between bentgrass species and will allow us to develop strategies to transfer important traits such as heat and drought resistance and disease resistance from closely related bentgrass germplasm.

The analysis also indicates that during the process of creeping bentgrass cultivar development, significant reductions in genetic diversity have occurred. Reduced genetic diversity can lead to critical crop vulnerabilities to disease and stress that could result in sudden crop losses. Knowledge gained from this research will be used to enhance the genetic diversity of creeping bentgrass.

*A major effort is to improve dollar spot (*Sclerotinia homoeocarpa*, shown above) and brown patch (*Rhizoctonia solani*) disease resistance, as well as drought and heat tolerance.*

Summary Points

- Several important chromosomal regions were identified that are believed to govern stress tolerance traits in bentgrass species
- High-throughput DNA sequencing is being utilized to develop more efficient methods of selecting disease-resistant bentgrasses.
- Newly developed genetic markers indicate that during the process of creeping bentgrass cultivar development, significant reductions in genetic diversity have occurred .