Seashore Paspalum: Breeding a Turfgrass for the Future

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USGA agronomists have noted a rapid increase in golf course developments placed on coastal venues. In addition, problems associated with salinity have become increasingly more prevalent in managed turfgrass over the past 10 years. Emphasis on water conversation strategies that use non-potable, alternative irrigation sources has been a primary contributor (9). Alternative irrigation water sources include recycled water, storm water, saline ground water, and seawater blends. Many of these alternative water sources contain much higher salt levels than traditional irrigation waters. The trend for use of more salt-laden irrigation waters on turfgrass sites is expected to continue to rise at a rapid rate and to further increase interest in developing more salt tolerant grasses, especially halophytes (1, 7, 8, 11). These trends have created the need for a high quality turfgrass that can tolerate stresses associated with salt-affected sites and even irrigation with brackish water.

Why Seashore Paspalum?

Seashore paspalum, *Paspalum vaginatum* (Swartz) is a warm-season perennial grass that is particularly well-adapted to moist and salt-affected areas common in coastal regions (3). It tolerates sandy and infertile soils, high concentrations of salt, and occasional inundation by sea water as well as water-logged conditions. It also has many morphological characteristics that make it desirable as a turfgrass. It produces both stolons and rhizomes, has an intermediate to fine leaf texture, an attractive dark green color, good density, and good tolerance to low mowing. Seashore paspalum is considered to be the most salt tolerant warm-season turfgrass species and also holds great promise for reclamation and soil stabilization of unmanaged salt-affected sites (4).

The first seashore paspalum breeding program was initiated by Dr. R. R. Duncan in 1993 at the University of Georgia Griffin Campus. USGA agronomists quickly recognized the potential of seashore paspalum as a species that could potentially meet the future needs of the golf course industry as a high-quality salt-tolerant turfgrass. During the mid 1990s, the USGA and the University of Georgia entered into a joint project to develop seashore paspalum as a turfgrass species suitable for course-wide use on golf courses with salt-related problems.

Dr. Duncan led the paspalum breeding program until his retirement in 1993 when Dr. Paul Raymer assumed leadership of the program. During his ten-year tenure with this program, Dr. Duncan assembled a collection of ecotypes from around the world and began an intensive program to assess the turf traits and genetic potential of this species as a turfgrass. Working closely with Dr. Bob Carrow and other turf scientists, a series of management studies were also undertaken to determine proper management protocols for this new turf species.

The University of Georgia seashore paspalum breeding program is now recognized as a major contributor to the recent success of seashore paspalum as a turfgrass species. Thus far, this program has focused on development of cultivars suitable of use by the golf course industry and has released three cultivars. Dr. Duncan released two cultivars before his

retirement in 2003. 'SeaIsle 1' and 'SeaIsle 2000' were developed as companion grasses, with SeaIsle 1 for use on fairways and tees, and SeaIsle 2000 for use on greens.

The most recent UGA release, 'SeaIsle Supreme', was licensed to sod producers in 2005 and is touted as a cultivar suitable for course-wide use (Table 1). Sea Isle Supreme has even better salt tolerance than our previous releases and should be well-suited for use as a fine turf in environments where salt is a problem for other turfgrasses. Supreme is a vigorous ecotype that is suitable for use on golf courses, athletic fields, and other recreational venues as a fine turf. It is a low-growing and rapidly spreading semi-dwarf type that tolerates a wide range of mowing heights and still maintains good turf density and quality. This property makes SI Supreme attractive as a grass that can be used on all parts of the golf course, from roughs to fairways to tees and greens. SI Supreme also has an extremely vigorous spreading growth habit that aids rapid establishment, grow-in, and recovery from any maintenance challenges. Thus far, SeaIsle Supreme licenses have been granted to five domestic growers and it is being marketed aggressively internationally.

Current Breeding Efforts

The current breeding program is an interdisciplinary effort with strong collaboration from a host of turf scientists including Dr. Kris Braman, entomologist, Dr. Lee Burpee, plant pathologist, Dr. Bob Carrow, stress physiologist, Dr. Zhenbang Chen, molecular biologist, and Dr. Tim Murphy, weed scientist. Our primary objectives are to further improve salt tolerance, insect resistance, and disease resistance as well as to improve weed management strategies and develop molecular tools to support breeding.

Previous research has demonstrated that seashore paspalum ecotypes vary greatly in their level of tolerance to salt (5, 6) and range from no better than the best bermudagrass hybrids to highly salt tolerant. Therefore, it is necessary to screen potential seashore paspalum cultivars prior to their release to document and ensure that they have high levels of salt tolerance. The existence of salt-tolerant plants (halophytes) and differences in salt tolerance among genotypes within plant species indicates that there is a genetic basis to salt response. Furthermore, genetically controlled variability for salt tolerance among genotypes infers that it may be possible to further improve salt tolerance of this species through breeding and selection. A pre-requisite for the development of new cultivars with improved salt tolerance is an efficient and effective salt tolerance screening method suitable for evaluation of large numbers of breeding lines. Such a screening method has been developed at the University of Georgia (10). This screening technique is now being used as part of the breeding program to attain even higher levels of salt tolerance in future releases.

The germplasm base for the University of Georgia paspalum breeding program is the largest and most diverse collection of seashore paspalum ecotypes in the world. Recent research findings now allow us to better utilize this germplasm base in our cultivar development program. A traditional breeding approach based on hybridization is now being used to generate new genetic variation through recombination. This approach allows us to generate thousands of unique individuals each year. Individual plants are hand trimmed in the greenhouse and undesirable plants eliminated. Each year more than 6,000 individuals are also screened for salt tolerance in the greenhouse. Salt tolerant individuals are transplanted to field plots for further evaluation of turf quality and resistance to dollar spot. This approach allows our breeding program to efficiently evaluate large numbers of individuals

for important traits and should insure continued improvement in turf quality, disease resistance, and salt tolerance in our future cultivar releases.

Differentiating seashore paspalum cultivars has been a challenge since most cultivars used commercially are morphologically very similar. The ability to accurately identify cultivars is useful in protecting intellectual property and provides an extremely useful tool for verifying the identity of cultivars and confirming off-types during the certification process. Amplified fragment length polymorphism (AFLP) is currently the most commonly used method for DNA fingerprinting. Simple sequence repeats (SSR) are growing in popularity and can be used in conjunction with AFLP for genotype identifications. We have used AFLP and SSRs to fingerprint the most commercially available seashore paspalum cultivars as well as all accessions in the USDA germplasm collection (2). The use of AFLP banding patterns has already proven to be useful as a new tool in resolving a number of industry issues related to cultivar identity and to quality control (identification of off-types) within our commercially released cultivars (Figure 1).

Currently, the disease susceptibility of seashore paspalum cultivars is largely unknown. This relatively new turfgrass is best adapted to coastal areas of the tropics and sub-tropics but is now being commonly used in more inland areas were fungal diseases may be a significant problem. Dollar spot caused by *Sclerotinia homoecarpa* and large patch (brown patch) caused by *Rhizotonia solani* are likely to be major fungal diseases impacting turf quality of seashore paspalum cultivars. A preliminary disease screening conducted at Griffin during the fall of 2004 indicated considerable genotypic variability for dollar spot resistance among eight standard cultivars evaluated (figure). This finding provides encouragement for screening efforts to identify plant germplasm with superior host plant resistance that can be used by the breeding program to develop cultivars with improved resistance.

Screening for resistance to dollar spot has become part of the routine evaluation protocol for our breeding program. Each year approximately 2000 individuals in the single plant evaluation nursery are artificially inoculated in mid September with the dollar spot fungus by Dr. Lee Burpee, UGA turfgrass research plant pathologist. At approximately 1-month after inoculation, all plots are rated for dollar spot symptoms using a modified Horsfall-Barratt disease rating scale with 0 = no disease and 9 = to 100% disease. These data are used as one of the major criteria for selection of individuals for advancement in the breeding evaluation scheme. Disease resistance of all selected individuals is also later confirmed in replicated field plots (Figure 2). All UGA breeding lines in entered in advanced, regional and NTEP turf field trials are compared to standard commercially available cultivars in replicated field disease evaluations.

Summary

UGA patented cultivars have been well-accepted by the turf industry both domestically and internationally. Certainly, the recent success of seashore paspalum has surprised many in the turf industry. The grass that was originally billed as "only a niche grass" for use on salt-affected sites or where irrigation with brackish water was necessary has suddenly become the turfgrass of choice on many new course installations where salt and irrigation water quality are not even an issue.

Marketers of paspalum cultivars boast a host of superior traits including multiple stress resistance and reduced requirements for water, fertilizers, and pesticides. These claims could be influencing turfgrass selection by golf course developers. However, the traits of paspalum that seem to be the most critical to course owners and superintendents are the ability to retain color during the winter months, better ball support, and the overwhelming beauty of a well-maintained paspalum golf course. Without a doubt, some course owners are using paspalum as a way to distinguish their course from their competitor's.

In summary, the rapid growth in global popularity of the latest generation of seashore paspalum cultivars far exceeds early expectations. In fact, it is now safe to state that seashore paspalum has finally earned a spot on the list of recognized turfgrass species. Breeders of this species still face many challenges such as improving disease and insect resistance, and developing better weed management options. This seashore paspalum breeding program is now well-positioned to meet many of the future challenges of the golf course industry.

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Summary Points:

The University of Georgia seashore paspalum breeding program began in 1993 with goals to develop new turf-type cultivars to meet the increasing demands of the golf industry for a high-quality turf that could perform on salt-affected sites and withstand irrigation with salt-laden irrigation water. This program is now well-positioned to further improve and expand the utility of this important turfgrass species.

This USGA supported program has:

- Amassed an impressive collection of seashore paspalum ecotypes from around the world.

- Conducted extensive research and developed research-based management protocols to support the adoption of this new turf species.

- Developed a breeding system that allows for efficient use of this germplasm to generate new and useful genetic variation.

- Developed an effective screening protocol that allows for further improvements in salt tolerance.

- Developed a system to further confirm and improve disease resistance.

- Developed DNA fingerprinting methods to aid in identifying cultivars.

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