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Initially billed as a 'niche grass' for use on salt-affected sites, seashore paspalum is now gaining popularity and becoming the turfgrass of choice on many new golf course developments even where salt and irrigation water quality are not an issue

Seashore paspalum: Breeding a turfgrass for the future

The University of Georgia's seashore paspalum breeding programme 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. The programme is now well-positioned to further improve and expand the utility of this important turfgrass species.

In recent times 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 decade and the 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, stormwater, 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.

Promising experimental lines in the UGA programme are grown in small replicated plots where they are mowed and managed similar to golf course fairways

Seashore paspalum produces both stolons and rhizomes, has an intermediate to fine leaf texture, an attractive dark green colour, good density, and good tolerance to low mowing heights. It is considered to be the most salt-tolerant warm-season turfgrass species and also holds great promise for reclamation and soil stabilisation of unmanaged salt-affected sites (4).

The first seashore paspalum breeding programme was initiated by Dr R. R. Duncan in 1993 at the University of Georgia (UGA) Griffin Campus. USGA agronomists quickly recognised the potential of seashore paspalum as a species that could meet the future needs of the golf course industry as a high-quality salt-tolerant turfgrass.

During the mid 1990s, the USGA and UGA 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 programme until his retirement in 2003 when Dr Paul Raymer assumed leadership. During his 10-year tenure with this programme, Dr Duncan assembled a collection of ecotypes from around the world and began an intensive programme 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.

The UGA seashore paspalum breeding programme is now recognised as a major contributor to the recent success of seashore paspalum as a turfgrass species. Thus far, this programme has focused on development of cultivars suitable for use by the golf course industry and has released three cultivars.

Dr Duncan released two cultivars before his retirement in 2003. Sealsle 1 and Sealsle 2000 were developed as companion grasses, with Sealsle 1 for use on fairways and tees, and Sealsle 2000 for use on greens.

The most recent UGA release, Sealsle Supreme, was licensed to sod producers in 2005 and is touted as a cultivar suitable for course-wide use. Sealsle Supreme has even better salt tolerance than the 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 Supreme attractive as a grass that can be used on all parts of the golf course, from roughs to fairways to tees and greens.

Supreme also has an extremely vigorous spreading growth habit that aids rapid establishment, grow-in, and recovery from any maintenance challenges. Thus far, Sealsle Supreme licenses have been granted to five US domestic growers and it is being marketed aggressively internationally.

CURRENT BREEDING EFFORTS

The current breeding programme is an interdisciplinary effort with strong collaboration from a host of turf scientists including entomologist Dr Kris Braman, plant pathologist Dr Lee Burpee, stress physiologist Dr Bob Carrow, molecular biologist Dr Zhenbang Chen and weed scientist Dr Tim Murphy. 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 couchgrass 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 UGA (10). This screening technique is now being used as part of the breeding programme to attain even higher levels of salt tolerance in future releases.

The germplasm base for the UGA paspalum breeding programme is the largest and most diverse collection of seashore paspalum ecotypes in the world. Recent research findings now allow us to better utilise this germplasm base in our cultivar development programme.

A traditional breeding approach based on hybridisation 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 6000 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 programme to efficiently evaluate large numbers of individuals for important traits and should ensure continued improvement in turf quality, disease resistance, and salt tolerance in our future cultivar releases.

UGA seashore paspalum breeding programme director Dr Paul Raymer

IDENTIFYING PASPALUM CULTIVARS

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 quality control (identification of off-types) within our commercially released cultivars.

SCREENING FOR DISEASE

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 where fungal diseases may be a significant problem.

Dollar spot, caused by *Sclerotinia homoecarpa*, and brown patch, caused by *Rhizoctonia solani*, are likely to be major fungal diseases impacting turf quality of seashore paspalum cultivars.

A preliminary disease screening conducted at Griffin campus during autumn of 2004 indicated considerable genotypic variability for dollar spot resistance among eight standard cultivars evaluated. This finding provides encouragement for screening efforts to identify plant germplasm with superior host plant resistance that can be used by the breeding programme to develop cultivars with improved resistance.

Screening for resistance to dollar spot has become part of the routine evaluation protocol for our breeding programme. Each year about 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 about one month after inoculation, all plots are rated for dollar spot symptoms using a modified Horsfall-Barratt disease rating scale (0 = no disease and 9 = to 100 per cent 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. All UGA breeding lines 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, fertilisers, 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 colour 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 others.

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 recognised 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 programme is now well-positioned to meet many of the future challenges of the golf course industry.

Each year thousands of unique individual plants are grown in the UGA greenhouse. Plants are hand-trimmed and undesirable plants eliminated prior to screening for salt tolerance

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