

Research You Can Use

Seashore Paspalum: Breeding a Turfgrass for the Future

Work continues at the University of Georgia on the development of this salt-tolerant species.

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Seashore paspalum, the grass originally billed as "only a niche grass" for use on salt-affected sites, is now gaining popularity and becoming the turfgrass of choice on many new golf course installations where salt and irrigation water quality are not primary issues. The University of Georgia Breeding Program is now recognized as a major contributor to the recent success of seashore paspalum as a turfgrass species.

Challenges associated with salinity have become increasingly more prevalent in managed turfgrass over the past 10 years. Water conservation strategies that include non-potable, alternative irrigation sources such as recycled water, storm water, saline groundwater, and seawater blends have been a primary contributor. Many of these alternative water sources contain higher

salt levels than traditional irrigation waters.

The trend for use of more salt-laden irrigation waters on turfgrass sites is expected to continue and to further increase interest in developing more salt-tolerant grasses. 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*) is a warm-season perennial grass that is particularly well adapted to moist and salt-affected areas common in coastal regions. It tolerates sandy and infertile soils, high salt concentrations, and occasional inundation by seawater, as well as waterlogged conditions. It also has many morphological characteristics that make it desirable as a turfgrass. It



Promising experimental lines are grown in small replicated field plots where they are mowed and managed similarly to golf course fairways. In this preliminary trial, 37 seashore paspalum experimental lines are compared to commercial varieties for turf quality, density, texture, color, seed head production, and other important traits.

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.

UNIVERSITY OF GEORGIA BREEDING PROGRAM

The first seashore paspalum breeding program was initiated by Dr. R. R. Duncan in 1993 at the University of Georgia Griffin Campus. 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 was quickly recognized. During the mid-1990s, the USGA and the University of Georgia (UGA) entered into a joint project to develop seashore paspalum as a turfgrass species suitable for use on golf courses with salt-related problems.

Dr. Duncan led the paspalum breeding program until his retirement in 2003, when Dr. Paul Raymer assumed leadership of the program. During his 10-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 also were 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 for use by the golf course industry and has released three cultivars. Dr. Duncan released two cultivars, SeaIsle 1 for use on fairways and tees and SeaIsle 2000 for use on greens prior to 2003.

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). SeaIsle Supreme has 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.

SeaIsle Supreme 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 SeaIsle Supreme attractive as a grass that can be used on all parts of the golf course, from roughs to fairways to tees and greens. SeaIsle Supreme also has an extremely vigorous spreading growth habit that aids in rapid establishment, grow-in, and recovery from 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 Drs. Kris Braman, entomologist; Lee Burpee, plant pathologist; Bob Carrow, stress physiologist;

Table 1
UGA-Developed Seashore Paspalum Cultivars

Cultivar	Propagation Method	Year Released	Marketer	Applications
Sealsle 1	Vegetative	2000	Sealsle Growers	Tee to green and sports turf
Sealsle 2000	Vegetative	2000	Sealsle Growers	Tee to green
Sealsle Supreme	Vegetative	2005	SI Supreme Growers	Tee to green and sports turf



(Above left) Each year thousands of unique individual plants are grown in the University of Georgia greenhouse. Plants are hand-trimmed, and undesirable plants are eliminated prior to screening for salt tolerance. (Above right) Seashore paspalum individuals can vary greatly in salt tolerance. Each year thousands of individual plants are screened for salt tolerance in the greenhouse. Individuals in the plant tray in the foreground appear less salt tolerant than those in the tray in the background. Note the salt accumulation on the edges of the tray.

Zhenbang Chen, molecular biologist; and 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.

SALT-TOLERANCE SCREENING

Previous research has demonstrated that seashore paspalum ecotypes vary greatly in their salt tolerance, ranging 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 prerequisite 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. This screening technique is now being used as part of the breeding program to attain even higher levels of salt tolerance in future releases.

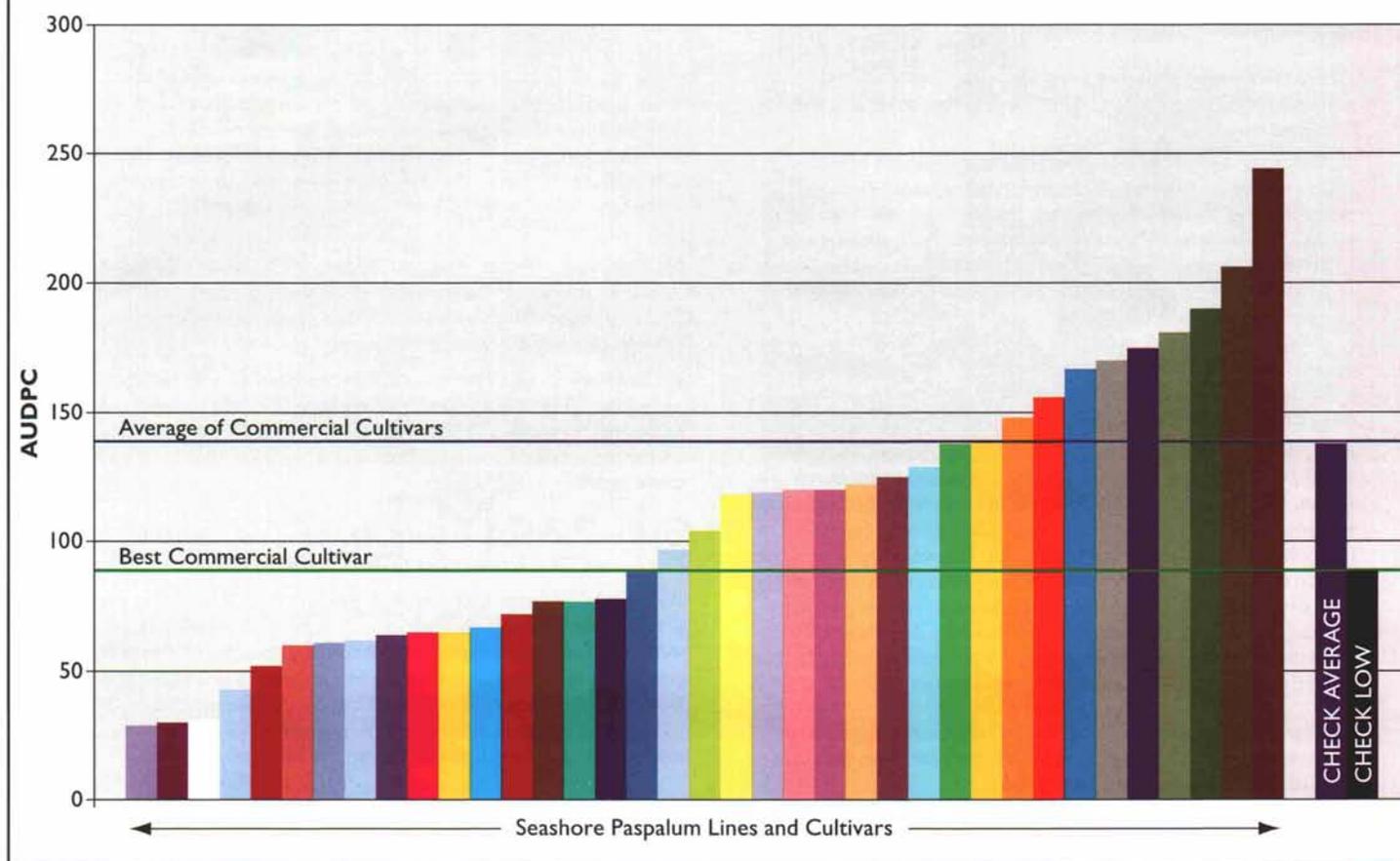
The germplasm base for the University of Georgia paspalum breeding program is the largest and most diverse collection of seashore paspalum ecotypes in the world. A traditional breeding approach based on hybridization is now being used to generate new genetic variation through recombination. Each year more than 6,000 individuals also are screened for salt tolerance in the greenhouse. Salt-tolerant individuals are transplanted to field plots for further evaluation of turf quality and dollar spot resistance. This approach allows efficient evaluation of large numbers of individuals for important traits and should insure continued improvement in turf quality, disease resistance, and salt tolerance in future cultivar releases.

CULTIVAR IDENTIFICATION

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. 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
Seashore paspalum lines and commercial cultivars compared for disease progress when artificially inoculated with dollar spot fungus



Thirty-seven experimental seashore paspalum lines and five commercial cultivars were compared for disease progress when artificially inoculated with the dollar-spot fungus. Disease severity ratings were taken weekly for seven weeks after inoculation and used to compute the area under the disease progress curve (AUDPC). Higher values indicate higher disease levels. Of the 37 experimental lines tested, 17 lines had dollar-spot ratings below the best commercial cultivar, indicating good potential to improve the disease resistance levels of future releases.

DISEASE RESISTANCE

Currently, the disease susceptibility of seashore paspalum cultivars is largely unknown. Although this new turfgrass is best adapted to coastal areas of the tropics and sub-tropics, it is now being commonly used in more inland areas where fungal diseases may be a significant problem. Dollar spot caused by *Sclerotinia homoeocarpa* and large patch (brown patch) caused by *Rhizoctonia solani* are likely to be major fungal diseases impacting seashore paspalum turf quality. 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.

Screening for dollar spot resistance has become part of the routine evaluation protocol for our breeding program. Each year, approximately 2,000 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 one month after inoculation, all plots are rated for dollar spot symptoms. 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. The grass that was originally billed as 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 issues.

Marketers of paspalum cultivars boast a host of superior traits, including multiple stress resistance and reduced requirements for water, fertilizers, and pesticides. The paspalum traits that seem to be the most critical to course owners and superintendents are the

CONNECTING THE DOTS

A Q&A with DR. PAUL RAYMER regarding the University of Georgia's seashore paspalum breeding program.

Q: Do you know of many instances where golf courses have been renovated using seashore paspalum following conversion to the use of reclaimed water?

A: Yes, I am sure there are several instances where conversion to reclaimed water has led to renovation using seashore paspalum. Perhaps a more common situation, however, is where seashore paspalum is prescribed for use on a new course development, either because reclaimed or some other salt-laden water source is to be used or it is projected that conversion to alternative water sources may occur in the future.

Q: Where did seashore paspalum come from? Are you planning collection trips to those areas in an effort to increase the genetic diversity of your breeding stock?

A: *Paspalum vaginatum* is considered indigenous to Africa, Asia, and Europe, and it is believed to have originated in southern Africa. It is now distributed throughout tropical and sub-tropical regions of six of the seven continents. Our current collection of germplasm was largely assembled by Dr. Duncan over a ten-year period and contains ecotypes from many areas of the world. My breeding program's focus thus far has been to recombine our existing germplasm to generate new diversity. Since the UGA collection contains very little material from Asia, adding ecotypes from the Pacific Rim would be my top collection priority.

Q: Our Green Section agronomists often mention the "wow factor" when referring to seashore paspalum. What is your response to this term as it describes seashore paspalum?

A: As I understand it, the "wow factor" is related to the overwhelming beauty of a well-maintained paspalum golf course. I do believe that the terminology does accurately describe the emotion you feel the first time you step onto a well-maintained seashore paspalum course. WOW. Major contributors to the "wow factor" are brilliant green color, desirable soft texture, and to some extent the pure novelty of paspalum turf. Without a doubt, some course owners are using paspalum and its ability to create the "wow factor" as a way to distinguish their courses from their competitors'.

Q: Although mature seashore paspalum is very salt tolerant, are there special precautions that superintendents need to be aware of during establishment?

A: This is an excellent point. Even though mature seashore paspalum turf is very salt tolerant, we recommend that the

cleanest water possible be used during establishment because salts can greatly reduce root growth and slow establishment. Both the soil and irrigation water should be tested prior to establishment. Saline or sodic soils may require aggressive tillage and amendment prior to planting. Irrigation water thresholds during establishment are not well defined, but several research programs are working to better define limits during establishment. We currently recommend that irrigation water should contain no more than 2,000 ppm TDS for optimum establishment.

Q: Your paper describes *Sealsle 1*, *Sealsle 2000*, and *Sealsle Supreme* as cultivar releases of the University of Georgia's seashore paspalum breeding program. Do you have additional about-to-be-released cultivars that golf course superintendents can expect?

A: We have three experimental lines entered into the seashore paspalum NTEP trials established during 2007. We have an additional three lines in advanced evaluations in Georgia. I expect that at least one of these six lines will be released within the next three years.

Q: All three of the University of Georgia cultivars are vegetatively propagated. Do you have plans to develop seeded types?

A: I would estimate that about 20 percent of our breeding effort is now directed towards the development of new seeded cultivars. We still have a lot to learn related to the production of seeded cultivars and have research underway to learn more about the factors that control flowering and the best environments for seed production. I expect that several new seeded cultivars will be released by the seed industry within the next year or two.

Q: How much of an impact do you think improved seashore paspalums will have on the golf course industry, and will they expand beyond the niche grass description?

A: I believe that seashore paspalum has already had a significant impact on the golf industry. The availability of this grass has made it possible to build new golf courses on some of the most striking coastal venues around the world where it was not possible before because of salt-related issues. Somewhat surprisingly, the use of seashore paspalum has already expanded beyond that of a niche grass as evidenced by its frequent use on many new courses where salt and irrigation water quality are not issues. Decisions to use seashore paspalum on these venues are most likely driven by its uniqueness and exceptional quality and beauty. Although I expect the use of seashore paspalum to continue to increase, I do not expect it to displace bermudagrass as the dominant warm-season turfgrass species anytime soon.

ability to retain color during the winter months, better ball support, and the overwhelming beauty of a well-maintained paspalum golf course.

The rapid growth in global popularity of the latest generation of seashore paspalum cultivars far exceeds early expectations. It is now safe to state that seashore paspalum has finally earned a spot on the list of recognized

turfgrass species. This seashore paspalum breeding program is well positioned to meet many of the future challenges of the golf course industry.

EDITOR'S NOTE: An expanded version of this paper can be found at *USGA Turfgrass and Environmental Research Online* (<http://usgatero.msu.edu/v06/n21.pdf>).

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