Seashore Paspalum Offers Alternative for the Future

By Ronny R. Duncan and R.N. Carrow

Beginning with funding from the USGA in 1993, a dedicated effort was initiated to genetically enhance seashore paspalum for golf course use.

The grass has been around for centuries, actually evolving on sand dunes exposed only to ocean water in South Africa. It's somewhat ironic that this grass evolved in the same country as the African bermudagrass, but was never recognized for anything other than its ability to grow in salt-affected environments. Seashore paspalum was duly noted as surviving the saline and moist habitats that dooms most bermudgrasses.

Legendary turf professor O.J. Noer was instrumental during the 1950s for moving the grass around the southeastern United States and Hawaii. A renewed effort occurred during the 1970s and 1980s with the import of cultivars from Australia. Worldwide movement of this grass has been documented (Duncan and Carrow, 2000).

Beginning in 1993, a systematic breeding and management research program was started at the University of Georgia-Griffin to fully exploit the potential recreational use of this species for golf courses on salt-affected sites where other warm-season grasses have failed. It can also be used in places with alternative non-potable water resources, including effluent and brackish sources. Because of these stress challenges and increasing need for water conservation and environmental stewardship, simply releasing new cultivars was not sufficient. A parallel management protocol program was instituted.

Promising ecotypes were sent to golf courses for the "final exam" to determine performance in a real-world situation.

Fairbanks Ranch CC in Rancho Santa Fe, Calif., is helping to pioneer seashore paspalum research.

The research

Initial breeding efforts at the University of Georgia started at the same point at which most breeding programs involving a "new" grass do — assembling a collection of ecotypes from around the world, followed by implementation of an evaluation program to assess the turf traits and the true genetic potential of the species.

At the same time, mother nurseries were established in Griffin, Ga., to start looking at the ecotypes in turf-plot situations. We exposed the plots to rotary mowers and eventually reel mowers when the plot sizes increased to simulate green, tee, fairway, landscape or sports field conditions to determine mowing tolerance and to eliminate ecotypes that produced unsightly seedheads. Drought-, acid-soil-, and salinity-tolerance studies were initiated, as well as wear and traffic studies to assess the individual ecotype levels of multiple-stress resistances.

DNA analysis studies were implemented to build a true genetic databank on the new ecotypes as compared to the old cultivars. Insect studies were initiated in concert with entomologists to determine the level of resistance to fall armyworms, spittlebugs, mole crickets and white grubs.

A parallel management-oriented program

was instigated at the same time as the breeding and evaluation program. The initial mowing height studies included taking the heights down to one-eighth inch to find green types and to identify ecotypes that should only be mowed at fairway or rough heights. Derivatives of the old cultivars were noted for their inability to be mowed cleanly during the hottest times of the growing season and were subsequently eliminated from the program.

Establishment studies identified those types that could root and grow rapidly. Herbicide efficacy studies were instrumental in identifying the tolerance or sensitivity of each ecotype to various herbicides. Encroachment studies looked at bermudagrass movement into paspalum and paspalum movement into bermudagrass.

New experimental herbicides were tried against the cultivars. Cold-hardiness studies were used to determine the northernmost region of survivability for the specific ecotypes.

Kapolei GC in Oahu, Hawaii, benefited from greens-grade seashore paspalum.

All of these preliminary trial results were used to find the one or two ecotypes with the best combination of turf traits that could be increased in volume vegetatively, since this species is planted by sprigs or sod. The promising ecotypes were sent to golf courses for the "final exam" to determine their performance in end-use, real-world situations. The result from all of this testing was the emergence of SeaIsle 1 (for fairways, roughs, tees, landscapes, sports turf) and SeaIsle 2000 (for greens and tees), with formal release by the University of Georgia in 1999.

Attributes

Great diversity exists among seashore paspalum ecotypes for all turf characteristics. Choice of cultivars with university-researched attributes is essential. SeaIsle 1 and SeaIsle 2000 exhibit the following attributes when compared with other grasses:

- Highest salinity tolerance of all warm-season grasses — the best cultivars are true halophytes.
- Can withstand most alternative water resources with varying levels of salinity, including effluent, brackish and, in extreme cases, short-term use of ocean water with proper management.
- Superior low-light intensity tolerance involving prolonged cloudy, rainy, foggy or smoggy conditions.
- Forms both rhizomes and stolons, and readily responds to verticutting, grooming or slicing.
- Wide soil pH range of 3.6 to 10.2, but the optimum range for maximum performance is 5.5 to 8.
- Excellent drought tolerance when managed properly. The root system must be trained deep into the profile with judicious irrigation scheduling.
- Wear and traffic tolerance similar to the bermudagrasses.
- Low-mowing height tolerance, with optimum ranges of one-eighth inch for SeaIsle 2000 and .25 inches to .75-inches for SeaIsle 1. Roughs mowed above 2 inches are definite penalty roughs. Landscapes can be managed in the 1-inch to 2-inch range.
- Can be overseeded with most cool-season grasses, but the dense canopy warrants use of a verticutter to ensure good seed-soil contact for the cool-season grass.
- Capability to root and persist equally well in pure sands, heavy clays and mucks or bogs.
- Can effectively and efficiently take up heavy metals or other contaminants.
- Excellent waterlogging or low oxygen tolerance. Can be inundated for short intervals with minimal detrimental effects.
- Capable of providing an effective buffer zone between environmentally sensitive areas and less sensitive areas (fairways or roughs transitioning into wetland areas and sand-dune stabilization).

• Chilling tolerance that provides prolonged color retention into the fall or winter months. Normally the last warm-season grass to go off color. SeaIsle 2000 actually has the best winter-hardiness.

• Seedheads for monostands of a cultivar do not readily produce viable seed. SeaIsle 2000 produces minimal seedheads during the growing season.

• Does not form a grain; holds the striping pattern exceptionally well.

• Looks like Kentucky bluegrass or perennial ryegrass — shiny, glassy dark green hue.

• Has a nutrient uptake and use system that is quite efficient.

Limitations

Every turfgrass has pluses and minuses, and seashore paspalum is no different. Some of the limitations include:

• Minimal shade tolerance, with similar responses to bermudagrass under tree canopies. It needs about six to eight hours of sunlight daily for good performance.

• Cold-hardiness similar to most of the hybrid bermudagrasses and actual adaptation to the southern transition zone in the United States.

• Cannot be effectively and rapidly established with irrigation water high in salinity (more than 5,000 parts per million of total salts) due to suppression of growth. Juvenile roots of all turfgrasses are sensitive to salt levels in the irrigation water, and paspalum is no different. Salinity tolerance of mature turf is substantially higher than immature turf.

• Few pesticides are specifically labeled for seashore paspalum.

• Seedheads may persist with some other cultivars that are on the market during certain months of the growing season.

• Lack of understanding the interactions among paspalum cultivars, salinity in the irrigation water, soil buildup of salts and the microenvironments on the golf course or on other sites, which necessitates specific changes in paspalum management to maximize long-term performance.

• Doesn't like to be scalped. Excess nitrogen can lead to succulence and enhanced scalping, thereby predisposing the grass to pathogen attack.

Future research and educational activities

A refinement of the management practices for greens is receiving top priority. Additional greens-type cultivars have been identified and are being increasingly produced for on-course evaluations.

A seeded hybrid cultivar is in preliminary production and evaluation and may be on the market in three to five years. The breeding is always focused on the development of new and improved cultivars, with promising experimentals having ocean-level salinity tolerance and improved multiple insect resistance.

A lawn/landscape cultivar has been identified and is being evaluated in Florida. A nematode assessment is being collaboratively investigated in South Carolina and Florida. The potential for enhancement of low-light intensity tolerance and subsequent management are under investigation, along with studies on irrigation scheduling and water uptake/use efficiency for paspalum.

Seashore paspalum will normally be grown in environments where salinity or poor water quality is an issue.

This grass is an environmentally friendly grass with multiple uses and multiple stress tolerances. As the grass increases in acreage in end-use situations and is exposed to the challenges of Mother Nature, more information will be gleaned and translated into a refinement of management protocols for specific stress environments.

Ronny R. Duncan and R.N. Carrow are professors in turfgrass breeding and stress physiology in the University of Georgia's department of crop and soil sciences at the University's Griffin campus. Duncan has been working with developing grasses for multiple stress environments, including drought, acid soils, high and low temperatures, high-bulk density soils and salinity stresses. Carrow has spent his entire career in turfgrass research, with expertise in environmental and traffic stresses. They can be reached at rduncan@gaes.griffin.peachnet.edu and at rcarrow@gaes.griffin.peachnet.edu, respectively.

REFERENCES

Liu, Z.W., R.L. Jarret, R.R. Duncan, and S. Kresovich. 1994. "Genetic relationships and variation among ecotypes of seashore paspalum (*Paspalum vaginatum*) determined by random amplified polymorphic DNA markers." *Genome* 37:1011-1017.

Liu, Z.W., R.L. Jarret, S. Kresovich, and R.R. Duncan. 1995. "Characterization and analysis of simple sequence repeat (SSR) loci in seashore paspalum (*Paspalum vaginatum* Swartz)." *Theoretical Applied Genetics* 91:47-52.

Cardona, C.A., R.R. Duncan, and O. Lindstrom. 1997. "Low temperature tolerance assessment of paspalum." *Crop Science* 37:1283-1291.

Johnson, B. Jack and R.R. Duncan. 1997. "Tolerance of four seashore paspalum (Paspalum vaginatum) cultivars to postemergence herbicides." *Weed Technology* 11:689-692.

Davis, S.D., R.R. Duncan, and B.J. Johnson. 1997. "Suppression of seashore paspalum in bermudagrass with herbicides." *J. Environmental Horticulture* 15(4):187-190.

Huang, B., R.R. Duncan, and R.N. Carrow. 1997. "Drought resistance of seven warm-season turfgrasses under surface soil drying. I. Shoot response." Crop Science 37:1858-1863.

Huang, B., R.R. Duncan, and R.N. Carrow. 1997. "Drought resistance of seven warm season turfgrasses under surface soil drying. II. Root aspects." *Crop Science* 37:1863-1869.

Johnson, B. Jack and R.R. Duncan. 1998. "Tolerance of seashore paspalum cultivars to pre-emergent herbicides." *J. Environmental Horticulture* 16(2):76-78.

Johnson, B. Jack and R.R. Duncan. 1998. "Influence of herbicides on establishment of eight seashore paspalum cultivars." *J. Environmental Horticulture* 16(2):79-81.

Carrow, R.N. and R.R. Duncan. 1998. *Salt-Affected Turfgrass Sites: Assessment and Management.* Ann Arbor Press. Chelsea, Mich. 185 p.

Trenholm, L.E., R.R. Duncan, and R.N. Carrow. 1999. "Wear tolerance, shoot performance, and spectral reflectance of seashore paspalum and bermudagrass." *Crop Science* 39:1147-1153.

Braman, S.K., R.R. Duncan, W.W. Hanna, and W.G. Hudson. 2000. "Evaluation of turfgrass for resistance to mole crickets (Orthoptera: Gryllotalpidae)." *HortScience* 35(4):665-668.

Trenholm, L.E., R.N. Carrow, and R.R. Duncan. 2000. "Mechanisms of wear tolerance in seashore paspalum and bermudagrass." *Crop Science* 40:1350-1357.

Duncan, R.R. and R.N. Carrow. 2000. *Seashore Paspalum — The Environmental Turfgrass.* Ann Arbor Press. Chelsea, Mich. 281 p.

Johnson, B. Jack and R.R. Duncan. 2001. "Effects of herbicide treatments on suppression of seashore paspalum (Paspalum vaginatum) in bermudagrass (Cynodon spp.)." *Weed Technology* 15:163-169.

Trenholm, L.E., R.N. Carrow, and R.R. Duncan. 2001. "Wear tolerance, growth, and quality of seashore paspalum in response to nitrogen and potassium." *HortScience* 36(4):780-783.

POPULAR MAGAZINE ARTICLES

Duncan, R.R. 1998. "Seashore paspalum herbicide management." *USGA Green Section Record* 36(2):17-19.

Carrow, R.N., R.R. Duncan, and M. Huck. 1999. "Treating the cause, not the symptoms: Irrigation water treatment for better infiltration." *USGA Green Section Record* 37(6):11-15.

Duncan, R.R., R.N. Carrow, and M. Huck. 2000. "Effective use of seawater irrigation on turfgrass." *USGA Green Section Record* 38(1):11-17.

Huck, M., R.N. Carrow, and R.R. Duncan. 2000. "Effluent water: Nightmare or dream come true." *USGA Green Section Record* 38(2):15-29.

Duncan, R.R., R.N. Carrow, and M. Huck. 2000. "Understanding water quality and guidelines to management." *USGA Green Section Record* 38(5):14-24.

Carrow, R.N., M. Huck, and R.R. Duncan. 2000. "Leaching for salinity management on turfgrass sites." *USGA Green Section Record* 38(6):15-24.