

1996 EXECUTIVE SUMMARY

DEVELOPMENT OF MULTIPLE STRESS TOLERANT SEASHORE PASPALUMS FOR GOLF COURSE USAGE

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A new green, a new tee, and two new fairways were built during 1996 to streamline initial evaluation of paspalum ecotypes and provide larger sites for additional evaluation of greens- and tee/fairway-types. Initial evaluation is on a green with mowing height 3/16-1/8 inch, which identifies fast-growing tee/fairway types and slow-growing greens types. Variations in slow-release/fast-release nitrogen fertilizers, irrigation, and verticutting were used to establish the new tee and new green from stolons. Two greens types (AP 10, AP 14) and one fairway type (PI 509018-1 from Argentina) are currently being evaluated on golf courses. Three courses in Atlanta—The Standard Club, Berkeley Hills CC, and Atlanta National CC—are evaluating the paspalums; two in Texas—Kings Crossing G&CC in Corpus Christi and The Cliffs near Graford; one in California—Tony Lema GC in San Leandro. Studies are continuing using simple sequence repeats or microsatellites to genetically profile paspalum ecotypes; PRE, POST, and establishment herbicide strategies are being investigated in cooperation with B. J. Johnson; field mole cricket evaluations are being conducted at Tifton, GA, in collaboration with Kris Braman and Wayne Hanna; Bob Carrow has refocused his research program to assess stress tolerance mechanisms in paspalums; the 3 ecotypes being evaluated on golf courses have been planted in Lincoln, NE, Manhattan, KS, Stillwater, OK, and Dallas, TX, to determine their cold thermal threshold/winter hardiness. They have survived -8° F at Blairsville in North Georgia. Somaclonal variation resulting from tissue culture regeneration has resulted in over 100 new selections from among 5500 regenerated plants, with improvements in genetic color (darker green), spread (growth rate), density (short internode length, finer leaf texture) and winter hardiness (6° C lower cold thermal threshold).

1996 Annual Progress Report

**DEVELOPMENT OF MULTIPLE STRESS TOLERANT SEASHORE
PASPALUMS FOR GOLF COURSE USAGE**

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Overall Assessment

The breeding program is set up to systematically evaluate ecotypes; first on greens; then on a larger scale. Slow, but deliberate increases in on-site collaboration is helping to build the paspalum database.

Infrastructure Improvements

A new 40' X 60' green was built and two greens-type paspalums (AP 10 and AP 14) were established during May-June using stolons. Mowing heights $< \frac{1}{2}$ " (13 mm), verticutting on a monthly schedule, and "spoon-feeding" with small increments ($\frac{1}{2}$ lb/1000ft²/per application) of slow- and fast-release nitrogen fertilizers escalated establishment and grow-in.

A new 25' X 30' tee was built and the best fairway-type paspalum (PI 509018-1) was established during May. The same low mowing heights, verticutting, and fertilization strategy was used for grow-in, with full coverage in 10 weeks using this faster-growing paspalum.

Two large areas were modified with 90:10 sand:peat applications to create large fairway evaluation areas. Tissue-culture-regenerated plants and hybrids were established for evaluation. Approximately 20 10' X 10' blocks were used for increase of potentially promising paspalums designated for evaluation on the 10' X 10' paddock green. Undesirable ecotypes will be removed from the paddock green during early November and new sod will be immediately planted. Plastic will be placed over the green to allow grow-in over the winter.

Evaluations

AP 10, AP 14, and PI 509018-1 have been established at Lincoln, NE (Terry Riordan); Manhattan, KS (Jack Fry); Stillwater, OK (Charles Taliaferro); and Dallas, TX (James Read) to assess the cold thermal threshold for these new fine-textured ecotypes that are being evaluated on golf courses. These ecotypes have survived -8° F at the Blairsville, GA, mountain location (1530 feet elevation). The placement from Nebraska to Texas should provide valuable data regarding overall winter hardiness.

GCSAA Chapter Affiliation Collaboration Project (Georgia)

Paspalums were established at Berkeley Hills Country Club, The Standard Club, and Atlanta National Country Club during June. The grasses were established in "mother nurseries" and eventually moved onto specific problem areas on each course.

Other Golf Course Evaluations

Jim Latham helped to set up collaboration with The Cliffs (Graford, TX—west of Ft. Worth) on Possum Kingdom Lake. I visited the site in October and helped establish the protocol for movement of paspalum next summer from their nursery site to their fairways. Initially, they will use the greens type paspalum on the collar of the bentgrass/hybrid bermuda greens as a physical barrier to common bermuda encroachment onto the green. Poor water quality makes this an ideal site for paspalum evaluation.

Kings Crossing in Corpus Christi, TX, is currently planted in Adalayd. They did not get the nursery site established because of budgeting priorities this year, but have prioritized it for 1997. They are maintaining the fairway type and one greens type in large wooden tree holders at the present time. I sent them additional vegetative material for fairway renovation and demonstration after my site visit in October. They will stolonize and use the protocol that we refined in establishment of our new green and tee. They will also verticut on a regular basis to thicken up their current Adalayd stand. The superintendent tried one fairway on my recommendation and was very pleased with the results. This is an excellent high saline-heavy Houston clay soil site with very poor water quality for paspalum evaluation.

Tony Lema Golf Course in San Leandro, CA (Ken Schwark) is another excellent site for paspalum evaluation. They are using recycled water and the fairway-type paspalum is growing vigorously. I sent extra vegetative material during mid-summer. M. A. Harivandi will work closely with K. Schwark at this site.

Paspalums sent for demonstration or turf-student training. Coarse, intermediate, and fine-textured clonal material has been sent to:

Mark Prinster	Chemlawn, Douglasville, GA
Henry D. Edwards	Lockerly Arboretum Foundation, Milledgeville, GA
Eddie Seagle	Abraham Baldwin College, Tifton, GA
Beth Guertal	Auburn University, Auburn, AL

International Evaluations

Guam—Greg Wiecko has established all 3 ecotypes. The fairway type (PI 509018-1) has been particularly impressive. He is investigating fertility, mowing height, paspalum encroachment into bermuda, use of salt water for weed control in paspalum. He hopes to eventually move some of the paspalums directly to the golf courses on the island. I plan to visit and give seminars either preceding or after the ITS meetings in Australia next summer.

Safe Haven, Grand Cayman, Cayman Islands. They have been evaluating '328' bermuda encroachment into paspalum stands, which was not the original objective. They are maintaining their bermuda management protocol and are trying to do this at peak bermuda growing times. I will be sending updated paspalum management protocols to them during November.

Vale do Lobo Golf Resort in Southern Portugal. I have not heard from the new superintendent yet, but they were to move the material from their greenhouse to nursery plots and problem areas on the course this summer.

Vance Baird at Clemson was sent 3 paspalums (Adalayd, PI 509018-1, PI 299042) for rhizosphere evaluations during late August.

Graduate Students

Cesar A. Cardona finished his Ph.D. on "Development of a Tissue Culture Protocol and Low Temperature Tolerance Assessment in *Paspalum vaginatum* Swartz" during late summer. A copy of the dissertation is included in the publications.

Two new students have started:

Laurie Trenholm (M.S. at Florida with Al Dudeck) will be working with Bob Carrow and me on fertility X traffic (compaction) X cool season grass overseeding interactions on paspalum. She will have plots on the new green plus on Bob Carrow's plots with 8 different paspalums. The Potash and Phosphate Institute is partially funding her research.

Geungjoo Lee from South Korea will be working with Bob Carrow and me on assessment of salt tolerance diversity among the 300 ecotypes in the paspalum collection and determination of mechanisms governing tolerance. Initial research will use controlled conditions in the greenhouse. We hope that this research will lead to a standardized protocol for assessing salt tolerance in turfgrasses.

Post-doc Bingru Huang (now on the turf staff at Kansas State)

Research was concentrated on drought resistance mechanisms of turfgrasses. The superior drought resistance of PI 509018 paspalum and Tifblair centipedegrass was associated with enhanced root growth at deeper soil layers, rapid water uptake from the deeper soil layer, maintenance of root viability at the soil surface when drought occurs in the upper soil profile, and rapid root regeneration after rewetting.

Additional Collaboration

Steve Kresovich, USDA Plant Genetic Resources Lab, Griffin.

Simple sequence repeats (SSRs or microsatellites) are being used to differentiate ecotypes and build a DNA profile for seashore paspalum. A current study involves 46 paspalum ecotypes from diverse backgrounds and their genetic diversity. We hope to learn more about

where these ecotypes have been moved throughout the world in response to saline ecosystem adaptation. We are currently trying to recruit a Brazilian Ph.D. candidate—Alexandra Casa—who has previous experience with *Paspalum* species.

Robert N. Carrow.

Bob has refocused his research program to include stress tolerance mechanism assessment of paspalum in relation to other turfs. This effort will include fertility and traffic interaction studies.

B. J. Johnson

Jack has emphasized PRE and POST herbicide applications as well as the effect of herbicides at sprigging (establishment). POST applications of quinchlorac, dicamba, and halosulfuron were safe to use for weed control in paspalum. Diclofop and imazaquin were marginal and 2,4-D plus mecoprop plus dicamba was unacceptable. Only preliminary data are available on the PRE and establishment studies.

Kris Braman—mole cricket field study.

A 42-entry (35 paspalums, 7 bermudas) test was planted during May at Tifton in collaboration with Wayne Hanna. The 3-year study includes monthly mole cricket and turf quality trait assessments.

Breeding

Over 5500 tissue-culture-regenerated plants and 180 hybrids are planted in turf evaluation plots in Griffin. Somaclonal variation for genetic color (darker green), spread (growth rate), density (short internode length, finer leaf texture) and winter hardiness (6° C lower cold thermal threshold, 10° C soil temperature emergence from winter dormancy) has resulted in over 100 selections for improved turf traits. Initial attempts to develop a transformation protocol using *Agrobacterium tumefaciens* strain pGE 203 has resulted in one regenerated, possibly transformed plant with the *bar* gene. Gene expression studies have not been performed to verify the transformation.

Additional seed will be collected during November from outcrossing blocks in an effort to identify new hybrids. Seed viability is expected to remain at less than 5%.

Ecotype Collection

Five new paspalums from Israel are in quarantine, with a probable release date of late 1997 or early 1998. I have been trying to acquire the few Chinese ecotypes that Milt Engelke brought back from his China bermuda collection trip. The seed have not been located yet at the Dallas experiment station.

Either immediately before or after the July 1997 ITS meetings in Australia, I plan to visit several sites in Australia to collect paspalums.

Conference Presentations on Paspalum

USGA Western Region Green Section Conference
NCGA Regional Conference, Castlewood Country, Pleasanton, CA, March 23, 1996

USGA Hawaii Regional Green Section Conference
Waialae Country Club, Honolulu, HI, April 8, 1996

1996 Research Support on Paspalum

USGA - \$40,000
Georgia Seed Development Commission - \$12,000
Georgia Turf Foundation Trust - \$5,000
(Includes GA Turf Assoc., GA GCSA, GA State Golf Assoc., GA Section PGA, Metro Atlanta Landscape and Turf Assoc.)
GCSAA - \$4,000
PPI - \$4,000 (graduate student support)
Lesco Inc. - fertilizer donation
Rhône-Poulenc Inc. - 'Ronstar' donation

Future Activity

I hope to be successful in recruiting the Brazilian student for fingerprinting (DNA profiling) of paspalum cultivars. When sufficient funds become available, I hope to recruit a Ph.D. or post-doc student to work on the self-incompatibility problem that is blocking seed production in seashore paspalum. A proposal has been submitted to Turfgrass Producers International to collaborate with sod companies in Georgia on sod/stolon production, maintenance, harvest, and reestablishment strategies with vegetatively propagated paspalum ecotypes. Another proposal has been submitted to the Georgia Seed Development Commission to develop the DNA fingerprinting protocol for seashore paspalum.

Publications

1. Cesar A. Cardona. 1996. Development of a tissue culture protocol and low temperature assessment in *Paspalum vaginatum* Sw. Ph.D. Dissertation. University of Georgia. 91p.
2. Wiseman, B.R. and R.R. Duncan. 1996. An evaluation of *Paspalum* spp. leaf samples for antibiotic resistance against *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae). J. Turf Management 4: accepted-in press.
3. Duncan, R.R. 1996. The environmentally sound turfgrass of the future—seashore paspalum can withstand the test. USGA Green Section Record 34 (1): 9-11.
4. Duncan, R.R. 1996. Seashore paspalum: the next generation turf for golf courses. Golf Course Management (April): 49-51.

5. Duncan, R.R. 1996. Paspalum for turf—the choice for the environment. Golf Course Management (accepted-in press).

New Manuscripts

1. Huang, Bingru, R.R. Duncan, and R.N. Carrow. 1997. Drought-resistance mechanism of seven warm-season turfgrasses under surface soil drying: shoot responses. Crop Science 37: submitted-in review.
2. Huang, B., R.R. Duncan, and R.N. Carrow. 1997. Drought-resistance mechanism of seven warm-season turfgrasses under surface soil drying: root aspects. Crop Science 37: submitted-in review.
3. Johnson, B. Jack and R.R. Duncan. 1997. Tolerance of four seashore paspalum (*Paspalum vaginatum*) cultivars to POST herbicides. Weed Technology: submitted-in review.
4. Cardona, C.A., R.R. Duncan and O. Lindstrom. 1997. Low temperature tolerance assessment in seashore paspalum turf. Crop Science 37: submitted-in review.
5. Duncan, R.R. 1997. Environmental compatibility of seashore paspalum for golf courses and other recreational uses. ITS Research Journal, Vol. 8, submitted-in review.
6. Cardona, C.A. and R.R. Duncan. 1997. In vitro culture, somaclonal variation, and transformation with paspalum turf ecotypes. —In: Recent Cellular and Molecular Genetic Approaches to Turfgrass Improvement. Ann Arbor Press, Chelsea, MI. (in press).
7. Brown, S.M., S.E. Mitchell, C.A. Jester, Z.W. Liu, S. Kresovich, and R.R. Duncan. 1997. DNA typing (profiling) of seashore paspalum (*Paspalum vaginatum* Swartz) ecotypes and cultivars. —In: Recent Cellular and Molecular Genetic Approaches to Turfgrass Improvement. Ann Arbor Press, Chelsea, MI. (in press).
8. Cardona, C.A. and R.R. Duncan. 1997. Callus induction and high efficiency plant regeneration in seashore paspalum turf. Crop Science. (submitted-in review).