evaluated for resistance to dollar spot throughout the summer and into the fall of 1998. Initial results indicate that only 8 out of 500 clones show high levels of resistance to dollar spot disease.

Nearly 11,000 new turfgrass evaluation plots were seeded in field trials at Adelphia, North Brunswick, and Pittstown New Jersey. They included 4,500 plots of Kentucky bluegrass; 1,890 plots of fine fescues; 1,750 plots of tall fescue; 1,700 plots of perennial ryegrass; and 1,040 plots of bentgrass. These tests will be evaluated for a number of years for establishment vigor, turf quality, pest resistance, stress tolerance, texture, density, vertical growth rate, and persistence.

Approximately 100,000 plants were added to our spaced-plant nurseries for selection of promising clones, evaluation of seed yield, disease resistance, growth characteristics, stress tolerance, and breeding behavior. An additional 25,000 seedlings were established in mowed, clonal evaluation trials. These came from promising breeding lines of perennial ryegrasses, fine fescues, *Deschampsia spp.* and *Koelaria spp.*

Research is currently underway to identify and characterize microsatellites in perennial ryegrass. These molecular markers are short DNA sequences that contain short di- or tri-nucleotide repeats that are randomly dispersed throughout the genome in most organisms. Their abundance makes them particularly useful for DNA fingerprinting which can aid in cultivar identification and ultimately cultivar protection. Microsatellites can also be useful for population genetics studies and for marker assisted breeding. Twelve polymorphic or variable microsatellite loci have been identified and used to study ryegrass cultivars, clones and other species within the genus *Lolium*. We find these markers provide reasonable insights into genetic relationships and are excellent for cultivar identification in perennial ryegrass. Seventy-five more potentially useful microsatellite loci that have been identified but need to be investigated further to determine if they are polymorphic. Since 20 to 30 polymorphic or variable loci are ideal for precise cultivar identification and chromosome mapping, future studies will concentrate on identifying more of these loci in perennial ryegrass.

We participated in the development of a number of new turfgrass cultivars. These included Jefferson, *CHAMPAGNE, CACHE, MOONLIGHT, DRAGON, BLACKSTONE, H94-301, SR-2100* and *SR-2109* Kentucky bluegrasses; *BRIGHTSTAR II, CALYPSO II, MONTEREY, PANTHER, PRELUDE III, PRIZIN, CATALINA, WINDSTAR, EXACTA, CHURCHILL*, and *PARAGON* perennial ryegrasses; *SHADOW II, AMBASSADOR, VICTORY II*, and *TIFFANY* Chewings fescues; *OXFORD* and *NORDIC* hard fescues; *FLYER II, TRAPEZE, PATHFINDER, FENWAY* and *AUDUBON* strong creeping red fescues; and *REMBRANDT, RENEGADE, PICASSO, MASTERPIECE, WOLFPACK, PLANTATION, MILLENNIUM*, and *SHENANDOAH II* tall fescues.

Field trials of transgenic creeping bentgrass have been established to evaluate promising transformed genes for herbicide resistance, stress tolerance, and pest resistance. Crosses have been made to initiate population backcrossing and recurrent selection programs to incorporate these genes into elite varieties and breeding synthetics. Work is progressing on the transformation of other turfgrass species.

We continue to make crosses of elite Kentucky bluegrass parents and screen large numbers of seedlings for promising hybrids under greenhouse conditions and in spaced-plant field nurseries. I

Seashore Paspalum Ecotype Tolerance to Root Limiting Soil Stresses and Traffic Stresses

University of Georgia

Robert N. Carrow

Start Date: 1998
Number of Years: 3
Total Funding: $75,000

Objectives:

1. *Develop and implement a salinity tolerance screening procedure that a) provides salinity tolerance of seashore paspalum ecotypes under well-watered and drought stress, b) allows 3 salinity tolerance screening protocols to be assessed for efficiency in separating seashore paspalum ecotypes and for establishing a "standard" protocol, and c) provides detailed data on seashore paspalum ecotype root tolerance data on the edaphic (soil) stresses of salinity, drought, and drought+salinty.*
2. *Determine seashore paspalum ecotype tolerance to the multiple root stresses in the acid soil complex (soil strength, drought, nutrient deficiencies, element toxicities, high soil/air temperatures) that strongly influence drought resistance via drought avoidance from deep rooting.*
3. *For nine seashore paspalum ecotypes with the greatest potential for release, to determine relative to TIFWAY bermudagrass overall drought resistance, rooting, shoot performance, and water use (ET)/soil extraction patterns under close-cut fairway conditions.*

The breeding/genetics paradigm of Dr. R. R. Duncan's program for seashore paspalum (*Paspalum vaginatum*) is to systematically determine ecotype tolerance to important stresses. Of particular interest is genetic-based resistance to soil chemical and physical factors that limit root development and longevity. For grasses, these are: 1) high soil strength, 2) soil drought where soil drying causes death of roots that varies considerably with ecotype, 3) high soil salinity limiting root growth through physiological drought and specific ion toxicity, 4) acid soil complex which is common on kaolinitic and Fe/Al oxide soils, 5) low soil oxygen, and 6) high air and soil temperatures, especially for cool-season species.

In this project, seashore paspalum ecotypes are screened for root responses to 4 of the 6 edaphic factors that limit rooting. This *multiple stress approach* provides important information for seashore paspalum resistance to individual and multiple soil stresses. This approach also is highly effective in identifying seashore paspalum ecotypes with *high nutrient uptake efficiency* and *drought resistance* via possessing a deep, extensive, viable root system. Root tolerance assessment to the major edaphic stresses has been a *missing ingredient* in most breeding programs targeted to improve drought resistance, water-use efficiency, or nutrient-use efficiency.

Study 1. Eighty-four seashore paspalum ecotypes and three control grasses (Common bermudagrass, TIFWAY bermudagrass, and Meyer zoysiagrass) were plugged (3.5 in. diameter x 3.0 in. deep) on 30 June 1998 into two adjacent sites at 4.5 feet centers. Both sites were a Cecil kaolinitic clay soil with 23 percent clay (A-horizon) and 45 percent (B-horizon). Site A was at pH 4.2 to create the acid soil complex stress which consists of aluminum/magnesium toxicities and potential deficiencies of manganese, potassium, calcium, and phosphorous. Site B was at pH 6.5. Both sites imposed the root stresses of high soil strength in a non-cracking soil, drought stress, and high soil temperatures.

At 24 days after plugging, irrigation was stopped and all grasses experienced periods of 8, 15, and 12 days without water from 24 July to 15 September. Mowing was at 1.25 inches and fertilization was at 1.0 lb N per 1000 ft^2 as 10-10-10 on 8 July.

Multiple soil stress response was evaluated based on a *Stress Index* that was a combination of two factors, a) the rank of the grass according to the degree of spread over 77 days after establishment at pH 4.2, and b) the ratio of growth (area covered) at pH 4.2 divided by growth at pH 6.5. Grasses that exhibited high growth under the severe soil stress of pH 4.2 situation should be able to grow and persist under a variety of irrigated and non-irrigated field conditions. The ratio of growth (area covered) at pH 4.2 divided by growth at pH 6.5 allows for identification of grasses with the highest tolerance to the acid soil complex stress. This stress is common in the Piedmont Region of the United States and very prevalent in tropical climates. Grasses with the highest ratio (1.0, equal growth at both pH's; < 1.0, less growth at pH 4.2 than pH 6.5) were ranked highest. Performances of selected grasses are in Table 8.

Study 2. Nine fairway type seashore paspalums and TIFWAY bermudagrass were stolonized on 16 July 1998 at a normal rate (0.75 bushels per 1000 ft^2). These will be evaluated in 1999 through 2000 under fairway conditions for shoot/root performance, evapotranspiration (ET) or water use, and overall drought resistance.

Table 8. Performance of selected grasses to multiple soil stresses (high soil strength, drought, acid soil complex, high soil temperature) that limit root development, viability, and persistence.

Grass	Stress Index Value	Stress Index Rank	Tolerance to Multiple Root-Limiting Soil Stresses
Hi 32 SP	15 (best)	1	Superior
HYB 7 SP	16	2	
HI 34 SP	17	3	
AP 4 SP	27	4	Very High
COMMON Bermuda	29	5	
PI 28960 SP	29	5	
TCR 6 SP	30	6	
96 HI 10 SP	31	7	
TIFWAY Bermuda	34	8	
AP 15 SP	34	8	
PI 509023	36	9	
Taliaferro SP	36	9	
TCR 3 SP	37	10	
AP 10 SP	38	11	
K 1 SP	38	11	
K 2 SP	39	12	
HI 101 SP	39	12	
Fwy 1 (PI 509019-1) SP	48	20	High
ADALAYD SP	67	32	Moderate
MEYER zoysiagrass	75	38	Low
Mauna Key SP	113 (worst)	54	Very Low

[a] Greens type, projected release 2000; very high salinity tolerance.
[b] Fairway type, projected release 2000; high salinity tolerance; high drought tolerance.

Selection of Turf Type and Seed Production in Inland Saltgrass (*Distichlis spicata)*

Colorado State University
Harrison G. Hughes

Start Date: 1998
Number of Years: 5
Total Funding: $125,000

Objectives:

1. *Determine turf performance of 7 elite CSU-USGA lines, 7 elite University of Arizona lines, 7 Great Basin lines (check lines from the University of Arizona).*
2. *Determining the range of stress tolerance (drought, salinity) present in inland saltgrass.*
3. *Determining seed production of 7 elite CSU-USGA lines.*
4. *Evaluate Kopec collection and Northern Great Plains collection.*
5. *Evaluation of seed germination and seedling vigor of all crosses.*
6. *Evaluate RAPD as a means of identifying unique genotypes of saltgrass.*
7. *Determine the relative chromosome number of elite clones.*
8. *Study the viability and germination requirements of inland saltgrass seed.*
9. *Evaluate seed priming as a possible method by which germination can be improved.*