1985
ANNUAL TURFGRASS RESEARCH REPORT

SUBMITTED JOINTLY BY:

United States Golf Association
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Far Hills, New Jersey 07931

Golf Course Superintendents Association of America
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January 10, 1986

Dr. Richard E. Chapin
Director of Libraries
Michigan State University
East Lansing, MI 48824

Dear Richard:

In March, 1982 the USGA Turfgrass Research Committee was formed to guide the USGA's long range multi-million dollar turfgrass research plans for the coming decade. The purpose is to develop Minimal Maintenance Turfgrasses for Golf with particular emphasis on a 50 percent reduction in water use requirements and 50 percent lower maintenance costs overall. In 1983, representatives of the Golf Course Superintendents Association of America were invited and became active, valued members of the Committee.

It is nearly four years now that the Committee has planned, coordinated and served as watchdog over the project. How have we done in efforts to insure proper progress, expenditures and direction toward the stated goals?

The attached annual Executive Reports from the researchers will surely give some clue as to direction and individual progress. A full, detailed annual report on any of the specific projects, including itemization of all expenses, is available on request to USGA Capital Campaign donors. But how does the Committee itself view the progress to date? What are the successes and failures? The questions are fair enough.

There is agreement that the breeding and plant stress mechanism phase is going very well. Perhaps some projects deserve more support and others less, but it is too early in the game to decide this point. We must constantly remind ourselves that new, improved turfgrass cultivars take a long time to develop -- usually from 8 to 20 years -- and we must not grow impatient.

The Research Reference Library is on track and progressing well. Over 6,000 entries are now in the computer. It is open for business to all; simply call the Michigan State University Library at (517) 353-7209 and ask for Peter Cookingham, or write him in care of the Turfgrass Information Center, W-212 Library, Michigan State University, East Lansing, Michigan 48824. We want this valuable facility to be used while the librarians continue to add to the data base and formulate plans for electronic access.

In the cultural practices area, it is agreed that greater time must be devoted to evaluating each project and grant request. The Committee plans to establish specific goals and tighten expectations for research in this area in the future.

The Committee unanimously agreed that monitoring each project by direct personal visits, at least annually, by Committee members is essential to success. There is also a general sentiment for acceptance of fewer total research projects but funding them at a higher level.

Overall, the Committee feels it has accomplished basically what it set out and was charged to do. As the following pages in this report will attest, a great deal of turfgrass research activity is now underway because of the USGA/GCSAA program. What is more important, however, is your reaction and your input. The Committee invites and welcomes your evaluation, your suggestions and your guidance. The development of improved Minimal Maintenance Turfgrasses is a worthy goal for everyone -- not just for golf, but for all who labor and are concerned with conservation and the environment. It is important for all who enjoy the beauty and recreation of the outdoors and what it has to offer our modern world. After the first four years, we believe the research program is on course.

Sincerely,

William H. Bengeyfield
Chairman, Turfgrass Research Committee
and National Director, USGA Green Section

WHB:csc

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USGA Executive Committee

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Administration

Dr. James R. Watson
The Toro Company

USGA/GCSAA - TURFGRASS RESEARCH

Restricted -- Not for Publication

PROJECT	UNIVERSITY/INVESTIGATOR	PRIOR YEARS ACTUALS 1983	1984	1985	1986	TOTAL FOUR YEARS
STRESS MECHANISMS	Texas A&M-College Sta./Dr. J. B. Beard	$ 84,500	$ 87,000	$ 91,000	$ 73,000	$ 335,500
TURFGRASS RESEARCH LIBRARY	MI State/Dr. R. E. Chapin	5,000	96,326	68,000	55,000	224,326
TURFGRASS BREEDING - I						
a. Zoysiagrass	Texas A&M-Dallas/Dr. M. C. Engelke	2,500	42,585	42,000	40,000	127,085
b. Native Grass	Univ. of NE/Dr. T. P. Riordan		4,100	20,000	18,000	42,100
	CO State/Dr. J. D. Butler			10,000	20,000	30,000
c. Poa Annua	Univ. of MN/Dr. D. B. White		11,600	15,000	15,000	41,600
d. Bluegrass/Ryegrass	Rutgers/Dr. C. R. Funk	5,000	5,000	5,000	5,000	20,000
Subtotal:		7,500	63,285	92,000	98,000	260,785
CULTURAL PRACTICES						
a. Soil Compaction	MI State/Dr. P. E. Rieke	3,000	3,000	3,000	5,000	14,000
b. Management	WA State/Dr. J. L. Nus		1,243	1,000		2,243
	MI State/Dr. B. Branham			10,000	15,000	25,000
	OH State/Dr. K. Danneberger				15,000	15,000
	Univ. of CA/Dr. R. H. Carrow				15,000	15,000
c. Water	Texas A&M-El Paso/Dr. G. L. Horst		3,480	15,000	15,000	33,480
d. Rooting	Univ. of NE/Dr. R. C. Shearman		4,000	23,000	20,000	47,000
e. Pathology	MI State/Dr. J. Vargas		1,500			1,500
	Cornell/Dr. A. M. Petrovic		1,500			1,500
	NC State/Dr. L. T. Lucas			10,000	10,000	20,000
	Cornell/Dr. R. W. Smiley			7,000		7,000
Subtotal:		3,000	14,723	69,000	95,000	181,723
TURFGRASS BREEDING - II						
a. Bermudagrass	Univ. of GA/Dr. G. W. Burton	5,000	5,000	5,000	5,000	20,000
	NM State/Dr. A. A. Baltensperger		4,500	20,000	20,000	44,500
	OK State/Dr. A. D. Brede				20,000	20,000
b. Bentgrass	Penn State/Dr. J. M. Duich	4,000	4,000	4,000	4,000	16,000
	Univ. of RI/Dr. C. R. Skogley	1,500	1,500	1,500	1,500	6,000
	MS State/Dr. J. V. Krans	2,500	2,500			5,000
	Texas A&M-Dallas/Dr. M. C. Engelke			40,000	40,000	80,000
	New Zealand DSIR/Dr. W. Rumball				10,000	10,000
Subtotal:		13,000	17,500	70,500	100,500	201,500
ADMINISTRATION	Cte Mtgs & Inspections	13,500	13,766	17,500	18,500	63,266
TOTALS		$126,500	$292,600	$408,000	$440,000	$1,267,100

Restricted-Not For Publication December 1, 1985

USGA/GCSAA TURFGRASS RESEARCH PROGRAM

1985 SUMMARY OF RESEARCH

A PPP

COLORADO STATE UNIVERSITY - Dr. Jack D. Butler, Principal Investigator

Development of Dryland Western Turfgrass Cultivars

1985 Grant - $10,000 (first year of support)

Western grasses grow successfully in arid regions on poor soil without the addition of water and fertilizer. Some of these grasses are adaptable to turf use. Changing economic conditions and water shortages have made it desirable to improve promising species to produce low maintenance turfgrasses for golf courses, parks, and lawns. The species which are receiving research attention at Colorado State University are alkaligrass (Puccinellia spp.), inland saltgrass (Distichlis stricta), blue grama (Bouteloua gracilis), and fairway wheatgrass (Agropyron cristatum).

Field evaluation of these species is being conducted in spaced-plant nurseries composed of individuals representing the genetic diversity of up to eight western states and five foreign countries. Individual plants are being evaluated on their important characteristics in a selective breeding program for improved turf performance. In all, 198 accessions are now being evaluated for performance in turf plots under low maintenance conditions. Elite individual plants will be selected, cloned and moved to replicated isolated cross pollination plots to produce the next generation of improved progenies. This cycle of field evaluation of individuals followed by production of an advanced generation from selected parents will be continued until significant improvement is achieved. At that time, improved varieties will be released for turf use.

CORNELL UNIVERSITY - Dr. Richard W. Smiley, Principal Investigator

Resistance of Bentgrass to Phialophora and Leptosphaeria Diseases

1985 Grant - $7,000 (First year of support. Dr. Smiley moved to Oregon State University as of November 1, 1985. This project is now on "hold".)

Seedlots of 42 bentgrasses are being screened for resistance to two isolates for each of two newly recognized root-infecting fungi; Phialophora graminicola and Leptosphaeria korrae. These fungi cause summer patch and necrotic ring spot diseases, respectively. The resistance studies are conducted for an 8-week period in controlled-environment chambers. Percentages of plants which survive the test will be reported in early winter. Surviving plants from selected seedlots will be returned to the plant breeder from whom the seed was supplied; this may assist in development of selections with high levels of resistance. Methodology was also developed to conduct similar screening studies on vegetatively propagated bentgrasses. This research revealed the potential for further complexities to exist in the etiology of take-all patch of bentgrasses, which have been thought to be caused only by Gaeumannomyces graminis var. avenae. In New York, it is now also known that P. graminicola causes a hot weather form of take-all patch on bentgrasses, and this possibility was confirmed during the development of methods for this project, sponsored by the USGA Green Section. These new finds have relevance to the likelihood that certain disease management strategies will or will not be effective during summer. The project was terminated prematurely because the principal investigator moved to another position.

THE UNIVERSITY OF GEORGIA - Dr. Glenn W. Burton, Principal Investigator

Bermudagrass Breeding - Vegetative

1985 Grant - $5000 (ongoing since 1956)

Dr. Burton is one of the preeminent plant breeders in the world. He reports that Tifgreen II bermudagrass, released by him in 1983, has had good reception throughout the Southeast. One golf course in South Florida reported that Tifgreen II developed many more seed heads than Tifgreen and this is not desirable. However, there have been no similar reports from other southern golf courses to-date. During the severe winter of 1984/1985, Tifgreen II greens survived temperatures as low as 0° F. and 6° F. although some winter kill did occur where low temperatures persisted. Additional reports are sought.

Work is under way in developing a bermudagrass resistant to the fall armyworm. Dr. Burton is working cooperatively with a USDA entomologist in screening for resistance with the intention of developing a bermudagrass which will not require insecticide protection from this pest.

Important breeding for greater winter hardiness of bermudagrass continues. Contacts in South Africa, developed by Dr. James R. Watson, a member of the USGA Turfgrass

Research Committee, have sent, during the past year, specimens of Cynodon transvaalensis to Dr. Burton. One came from an elevation of 7000 feet above sea level and should carry an unusual amount of winter hardiness. These grasses may be the ones Dr. Burton has been so anxious to find in South Africa.

Cross pollinations between the winter hardy bermudagrass discovered by Dr. Burton in Berlin, Germany with the most winter hardy hybrid tested for several years in New Jersey were made. It is a hoped a number of improved hybrids will develop from this cross. Seeds will be greenhouse planted this December for evaluation tests in the spring of 1986.

Irradiated dormant sprigs of Midiron bermudagrass (in 1984) have produced 67 promising mutants. These will now be field tested for winter hardiness on a golf course in Blairsville, Georgia where winter temperatures below 0° F. are common.

MICHIGAN STATE UNIVERSITY - Dr. Richard E. Chapin, Principal Investigator

Turfgrass Information File

1985 Grant - $68,000 (Third year of ongoing support)

In the spring of 1984, the USGA and Michigan State University signed an agreement whereby the MSU Library would design and develop a bibliographic computer database to provide access to published materials reporting the results of research that affects turfgrass and its maintenance.

The original statement of purpose of the USGA Turfgrass Information File was to provide efficient and effective access to all published and processed materials reporting the results of research affecting turfgrass and its maintenance. Three goals were identified as necessary for the successful completion of the Project.

1. Michigan State University will continue to acquire, maintain, and preserve all appropriate printed and processed materials reporting on research related to turfgrass growth, development, and maintenance.

2. Bibliographic access to the turfgrass collection is provided by on-line access to the Project's retrieval system, supplemented by appropriate printed reports. The Turfgrass Information File is housed in an ALPHA MICRO computer, using STAR software. Both the hardware and software work well. By June 30, 1985, 6000 records were in the database.

3. Michigan State University Library will provide loans and/or appropriate photocopies to all users who have reason to need access to the turfgrass collections. MSU Library is in the process of preparing a descriptive brochure that explains the project and services available. The brochure will explain how to acquire and use software to access the file with an IBM compatible personal computer. Also, the Library will continue to search telephone requests on demand.

MICHIGAN STATE UNIVERSITY - Dr. Paul E. Rieke, Principal Investigator

Comparing Core Cultivation with Hollow and Solid Tines

1985 Grant - $3,000 (Third year of support)

Core Cultivation (or aerification) of a creeping bentgrass putting green with traditional hollow tines was compared with the use of solid tines. Solid tine coring (also called "Shattercoring") removes no soil, reducing interference with play. But there is concern about compactive effects when no soil is removed from the rootzone. Both hollow and solid tine coring caused some loosening of the surface 2-inches of soil, but a zone of greater compaction tended to develop just below the bottom of the coring hole. There was also some indication that this compactive influence was enhanced if the soil was cored while wet compared to treatment when the soil was more dry, although differences were small. Data taken during the fall of 1985 should enhance our understanding of solid tine coring.

Based on evidence to-date, coring with hollow tines is still considered the standard practice to be used in the industry, particularly when there is need to fill the coring holes with topdressing, when larger coring holes are needed to alleviate surface compaction or when the topsoil from the cores is considered an important part of the thatch control program. But there may be a place for the use of solid tine coring during the summer when relief from surface compaction is needed, especially when runoff of irrigation water occurs. The use of small diameter solid tines will leave small openings which will heal over quickly and do not leave the turf as open to rapid desiccation. This practice could result in more efficient water use on sloping greens. Additional research is needed to determine the long term effects of regular use of solid tine coring on soil properties.

MICHIGAN STATE UNIVERSITY - Dr. Bruce Branham, Principal Investigator

The Effect of Seven Management Factors and their Interaction on the Competitive Ability of Annual Bluegrass and Creeping Bentgrass

1985 Grant - $10,000 (First year of support)

Annual bluegrass is the predominant turfgrass found on golf courses in the Northeastern region of the United States. Annual bluegrass is not planted intentionally, but is a weed that is very competitive under golf course management. The preferred species for golf course greens and fairways is creeping bentgrass. These studies were designed to measure the influence of seven management factors and their interactions on the competitive balance between the two species.

Two main field studies are being conducted to examine these seven factors. One study contains five factors of irrigation (daily, three times per week, or irrigation at wilt); fertility (2 lbs N/M/YR or 6 lbs N/M/YR); clipping removal or return; plant growth regulator (flurprimidol at 1 lb AI/A, mefluidide at 0.125 lb AI/A, or a check); and overseeding with bentgrass or no overseeding. This five factor study has been conduted for two years at the Hancock Turfgrass Research Center in East Lansing, Michigan.

The results indicate that removing clippings causes the greatest reduction in annual bluegrass population with a 14.2 percent decrease. The only other factor that caused a significant decrease in annual bluegrass populations was low nitrogen fertility, 2 lbs N/M/YR, which caused a 12.2 percent decrease in annual bluegrass.

There was however, a significant three-way interaction between clipping removal, irrigation, and fertility. Plots where clippings were removed, fertility was at 2 lbs N/M/YR and irrigation occurred at wilt had a significantly lower amount of annual bluegrass with a 22.8 percent decline. The other interesting aspect of this three-way interaction was that where irrigation was applied daily and fertility was low, the clipping treatment was not significant. Whether clippings are removed or returned, significant reductions in the annual bluegrass population can be achieved with low fertility and daily irrigation.

A second study examining the same irrigation and clipping treatments along with compaction and coring treatments found only compaction to be significant. Compacted plots had a 9.6 percent increase in annual bluegrass while noncompacted plots had a 5.4 percent decrease.

A final field study was designed to determine the effects of flurprimidol, a plant growth regulator which is claimed to give a competitive advantage to creeping bentgrass, on the rate of spread of creeping bentgrass. Results are preliminary but seem to indicate that flurprimidol does not encourage the spread of creeping bentgrass in an annual bluegrass turf.

UNIVERSITY OF MINNESOTA - Dr. Donald B. White, Principal Investigator

Breeding of Poa annua for Improved Cultivars

1985 Grant - $15,000 (Second year of support)

During 1985 new accessions were added to the germplasm collection from Arizona, California, Illinois, Michigan, Missouri, New Jersey, Minnesota and several European locations.

Evaluation of first and second generation selections continued and included a spaced planting in the field of representatives of 145 selections.

Several investigations into stolon propagation and storage resulted in the development for inducing flowering, storage of stolons, and evaluation of rooting habit. Investigations were also initiated regarding the modification of tissue culture for somaclonal variation.

The first field planting from stolons of superior selections was established and the first selections from the F1 generation of a 16B clone parent has been identified.

Crossing, selfing, evaluations, selection, seed harvest and data collection continue.

In 1986 we plan to continue research in the following areas:

1. Selfing, crossing and selection programs;
2. Self-incompatibility;
3. Tissue culture including efforts investigating possibilities for somaclonal variation;
4. Flower suppression and improved methods of emasculation;
5. As activities permit, increase the 16B selection for testing and evaluations at the University of Minnesota and other sites.

UNIVERSITY OF NEBRASKA - Dr. Terrance P. Riordan, Principal Investigator

Breeding, Evaluation and Culture of Buffalograss

1985 Grant - $20,000 (Second year of support)

Buffalograss Collection

Since the initiation of the Buffalograss Development project at UN-L, 708 buffalograss plants have been collected throughout the Great Plains region. During the summer of 1985, 519 plants were collected and either have been planted in an evaluation area at the Agricultural Research and Development Center near Mead or are being held in the greenhouse to be planted next spring. Forty-eight plants have been selected from the collection area for having qualities acceptable for turfgrass. Criteria for selection were density, horizontal growth, color, leaf height, seed production, inflorescence height (tall females, short males), breeding ability, extended fall color and overall aesthetic quality.

Buffalograss Plant Breeding

Three sources of commercial buffalograss seed, Texoka (Nebraska source), Texoka (Texas source) and Sharp's improved (Kansas source) were transplanted into the field for evaluation. Plants were rated for color, turf quality, leaf height and rate of cover. Sex was also determined when possible. The most outstanding plants are being vegetatively increased in the greenhouse and will be used as parents in the breeding program.

A breeding plan or strategy has been developed which will allow for both vegetative and seed production, hybridization and inbreeding, and development of either male and/or female plants. Experience will be necessary to select the best system.

The male and female plants selected for the breeding program have a superior color, turf quality, and better rate of cover than that of the base population. These plants also have a higher initial leaf height (better agronomic vigor) and a lower final unmowed leaf height. The percentage of female plants selected suggest that turf-type characteristics are sex linked. However, both good males and good females are required in the breeding program.

A test planting using three males and eight females was made during September. This planting was carried out to evaluate procedures and also to generate seed from the better female

parents. In this planting eight outstanding female clones are surrounded by three outstanding male clones. This plan allows for random pollination by the males and seed collection from each female.

Buffalograss Seed Treatment Evaluation

Buffalograss seed is relatively expensive and is slow to germinate and establish. The major reason for this is that multiple seeds are enclosed by a very hard burr. The main objective of this evaluation was to determine if scarification in a Waring blender would enhance germination and establishment. Laboratory results showed the 2-second treatment germinating more rapidly and with higher numbers than the other five treatments. In the field study the 2-second treatment was superior to all treatments including the check, decreasing the initial germination time and producing more seedlings, providing an earlier developing and denser stand compared to the no treatment stand. This lends itself to greater ease in establishing a buffalograss turf. Plans are to work with Ag. Engineering to develop a method for similarly treating buffalograss seed in large quantities.

Buffalograss Establishment Study

The data collected from this study was used to determine whether there was a significant difference between plugs with an established root system (pre-rooted plugs, PRP) and regular plugs (non-pre-rooted plugs, NPRP). In general, the PRP treatment produced more stolons much sooner, established much more quickly, and had a better initial adaptation to transplanting (color measurement) than the NPRP treatment. These results could be very significant in a vegetatively propagated grass and open up a new way of marketing buffalograss.

Buffalograss Culture

Herbicide evaluation studies on buffalograss since 1983 have given the following results: (1) Buffalograss shows a decrease in tolerance to increased rates of 2,4-D and combinations of 2,4-D, MCPP and dicamba, and (2) Combination treatments had a synergistic effect when compared to 2,4-D, MCPP and dicamba treated individually.

UNIVERSITY OF NEBRASKA - Dr. Robert C. Shearman,
Principal Investigator

Turfgrass Cultural Practices and their Interactive Effects on Rooting

1985 Grant - $23,000 (Second year of support)

UN-L Contributions

During the 1985 project period, the University of Nebraska made the following contributions to the joint research project by developing the following facilities:

1. An additional 18,000 sq. ft. of golf green research area, bringing the total research green area to approximately 46,000 sq. ft.

2. Completion of the Turfgrass Rhizotron Research facility with 40 root cells for rooting observations.

3. Irrigation scheduling research site with 20,000 sq. ft. of area divided into 24 individually controlled irrigation plots with tensiometers.

4. Addition of 3,500 sq. ft. to the Turfgrass Research Field Lab and Maintenance Facility.

Research Accomplishments

The following are accomplishments relating to the United States Golf Association support of this joint research project:

1. Developed a technique using neutron scattering to assess turfgrass depth and distribution of rooting, and to determine rootzone soil moisture extraction.

2. Developed a hydroponic method to screen differences in turfgrass rooting based on species, cultivar, and cultural practices. Verified responses of hydroponic system to those observed under field conditions.

3. Evaluated a nondestructive method for determining leaf area index (LAI) in turfs. Confirmed this technique on seven cool season turfgrass species.

4. Evaluated nitrogen and potassium effects on creeping bentgrass and Kentucky bluegrass turfs. The golf green evaluation with creeping bentgrass was further interacted with irrigation frequency. Potassium enhanced turfgrass rooting and drought avoidance in both species. Turfgrass wear tolerance was enhanced by potassium treatments and recuperative rate was enhanced by nitrogen in the creeping bentgrass evaluation which was conducted on a high sand content growing media.

NEW MEXICO STATE UNIVERSITY - Dr. Arden A. Baltensperger, Principal Investigator

Breeding Improved Seeded Bermudagrass for Turf

1985 Grant - $20,000 (Second year of support)

Presently, only three seeded, turftype bermudagrass varieties are available for turf use. "Common" bermudagrass seed is commercially available in quantity and used as a general purpose turfgrass in the southern half of the U.S. Improved seeded varieties are needed that are more attractive, especially in color and density and that are less sensitive to stress conditions of low moisture, iron, nitrogen, and cold than "common."

Plant breeding and genetic information now available indicates that improvement in the tetraploid or common type bermudagrass can be achieved by conventional selection and breeding.

This research project is designed to develop new seeded strains by polycrossing and single crossing desirable clones and evaluating progeny in several generations for turf quality and seed production. Several progeny from these crosses have been made and are currently being evaluated. Additional cycles of selection will be made, if necessary, to develop suitable strains.

NORTH CAROLINA STATE UNIVERSITY - Dr. Leon T. Lucas, Principal Investigator

Spring Dead Spot Disease

1985 Grant - $10,000 (First year of three year study solely supported by contributions from Mr. Hall Thompson)

Experiments were conducted to isolate fungi that have been reported to cause spring dead spot in Australia and California. Similar fungi were not isolated from samples collected in Alabama and North Carolina. Fungicide evaluation trials have been established on bermudagrass fairways that had spring dead spot in the spring of 1985. Disease control evaluations will be made in the spring of 1986. A graduate student has not accepted the assistantship at North Carolina State University yet. Efforts are continuing to have a graduate student on the project soon.

PENNSYLVANIA STATE UNIVERSITY - Dr. Joseph M. Duich, Principal Investigator

Bentgrass Breeding

1985 Grant - $4,000 (Ongoing support since 1958)

Considerable progress was achieved in all aspects of our bentgrass program in 1985, and compared to the previous year excessive rains were not detrimental to field work at planting or harvest time.

Penneagle Creeping Bent

Breeder Seed was produced in 1985 and a new one acre Breeders Nursery was established in July 1985. Commercial seed production is projected to increase 35-40% in each of the next three years.

PSU-126 Creeping Bent

Test seed has been distributed to 140 golf courses in 32 states and several countries to date. Formal requests for performance information will be issued this winter with anticipation of Experiment Station release in the spring of 1986. PSU test plots show no deficiencies following eight years of testing. Cool weather brown patch, Rhizoctonia cerealis, was encountered in the test in 1984-1985 and the PSU-126 showed a high level of resistance.

Oregon seed yield trails in 1985 showed an accepted level of seed yield, between Penncross and Penneagle. Breeder Seed nursery was doubled in size following another stage of reselection in 1984-1985.

A space-planted Referee Test was established in 1985 along with five creeping bent varieties for Plant Variety Protection data. Data was obtained from a similar Oregon test established in 1984 for the necessary two location test data. Preliminary electrophoresis laboratory results show a good differential identifying pattern utilizing three enzyme systems to date.

Experimental Creeping Bents

Eleven salt tolerant bents were nursery established for 2nd generation seed production in 1986 along with clonal plantings of 21 new salt tolerant selections from greens and fairways.

Clonal nursery plantings were made of 22 selections from Penncross and Penneagle segregates following five years mowing at 3/32-inch height of cut. Following the advent of the Stimpmeter and unprecedented demands on superintendents for ultra close-cut greens it appears paramount that bents be developed for closer mowing tolerance.

Colonial Bent Rhizome Development Project

1. SB 1-56 Series - Open pollinated progeny

Seven 2nd generation progeny plants each of 378 second generation half-sib families were selected for individual plant seed harvest in 1984. These plants were selected in the field based on plant spread and yield. The top 156 of 378 families were chosen for continuing into third generation progeny testing based on second generation half-sib family progeny performance in 1984. Particular emphasis was placed on deep rhizomes (those emerging thru holes in bottom of flat sections) and date marking their emergence.

Based on date of emergence, 20 progeny plants with deep rhizomes of 134 3rd generation half-sib families were field planted in 1985 to produce 4th generation seed in 1986.

2. SB 60-135 - Open pollinated progeny

Seven 1st generation progeny sibs each of 67 parents were also selected and individually harvested in 1984 for continued progeny tests. Approximately 18,000 plants [67 families x (7 1st gen progeny x 39 plants each)] were greenhouse planted for screening. Following date marking for deep rhizome development 20 progeny each of 63 second generation sib families were field planted in 1985 for third generation seed production in 1986.

3. Inbreeding

Selfing as a breeding technique to select for rhizomatous reproduction was continued on all colonial bent populations. Amount of selfing was dictated by the number of plants four individuals could bag during the pre-anthesis period; approximately 500 plants in 1985.

In 1984 107 2nd generation inbreds representing 16 parents and 31 1st generation inbreds in the SB 1-56 series set seed for progeny testing. Third generation half-sib families produced 1 to 54 progeny plants each. Approximately 1100 of 3000 plants screened for rhizomes were field planted in 1985 for further selfing.

In the SB 60-135 Series 137 1st generation inbred progeny from 33 parents that were poorly represented in previous work were progeny tested. Over 1100 plants of 3400 screened progeny were field planted in 1985. In both of these series uniformity within lines in contrast to interline variability is becoming apparent in the field. Inbreeding depression, as expressed by plant vigor is obvious as well. It is not known how well the weaker inbred types will survive winters in the field. The degree of restored vigor and rhizome growth as well shall be eagerly anticipated pending survival.

Self-pollination of 25 SB-1 and 28 SB-90 plants derived from cobalt 60 irradiated rhizome sections yielded 600 and 1200 progeny, respectively. Family size ranged from 1 to 72 plants. These first generation inbred families were screened for rhizomes and gross mutations. Following date marking for rhizome emergence, 470 plants were field planted for further selfing.

4. Other Colonial Bents

Eight rhizomatous bents were selected from bermuda fairways in Australia following treatment with atrizine to control Poa annua in 1984. Plants were greenhouse crossed in all possible combination and 1200 progeny field planted in September 1985. Future work will include selection, inbreeding and selection for triazine herbicide tolerance.

Auburn University supplied us with 14 selections which were field planted for seed production and further evaluation.

UNIVERSITY OF RHODE ISLAND - Dr. C. Richard Skogley, Principal Investigator

Selection and Breeding of Superior Bentgrasses

1985 Grant - $1,500 (Ongoing support since 1960)

Continued financial support from USGA/GCSAA has assisted Rhode Island Turfgrass Researchers in their efforts to select or develop improved grasses for the golf course industry. We are currently evaluating nearly 400 of our own experimentals, including about 130 bentgrasses. Vegetative materials and seed of several promising selections are being evaluated for seed production potential in Oregon.

RUTGERS UNIVERSITY - Dr. C. Reed Funk,
Principal Investigator

Breeding and Evaluation of Kentucky Bluegrass, Tall Fescue, Fine Fescues, and Perennial Ryegrass for Golf-Turf Use

1985 Grant - $5,000 (Ongoing support since 1961)

The initial certified seed was harvested from Spartan hard fescue, Victory Chewings fescue, Classic Kentucky bluegrass and Jazz perennial ryegrass. Seed increase fields have been planted to produce future crops of Cimmaron tall fescue, Arid tall fescue, Dawn Kentucky bluegrass, Rebel II tall fescue, and Freedom Kentucky bluegrass. Germplasm obtained from the New Jersey Agricultural Experiment Station was used in the development of these cultivars.

Kentucky bluegrasses with improved genetic resistance to billbugs were identified in old, low-maintenance turf trials.

Four plants containing non-choke-inducing endophytic fungi were discovered in our germplasm collection of blue sheeps fescue.

Breeding programs to incorporate endophytic fungi into leading cultivars and elite populations of hard fescue and Chewings fescue have been initiated.

Observations of an old, low-maintenance turf trial indicate that billbug resistance in tall fescue can be enhanced by the presence of a fungal endophyte.

Turfgrass germplasm was collected from old turfs in New York and New Jersey.

Over 4200 new turf evaluation plots and over seven acres of spaced-plant nurseries were established at the Adelphia research farm. This is part of our program to improve turfgrass performance by increasing stress tolerance, improving pest resistance, and reducing maintenance requirements.

TEXAS A&M UNIVERSITY - Dr. James B. Beard,
Principal Investigator
Department Soil/Crop Sciences,
College Station, TX

Plant Stress Mechanisms

1985 Grant - $91,000 (Third year of support)

From research conducted over the first three years, significant progress has been made. We have the potential to revolutionize our concepts of turfgrass water conservation.

Minimal Water Use Rates

1. The major warm and cool season turfgrass species vary substantially in water use rates. Initial data suggest that there may be as much variation among cultivars within a species as there is at the interspecies level.

2. The primary plant parameters affecting the evapotranspiration rate are a high canopy resistance and a low leaf blade area. These parameters are valid in interpreting the differentials in water use rates among eleven major warm season perennial turfgrasses. The morphological parameters can be easily assessed for use in screening thousands of clonal plantings for low water use rates in a breeding program. They are subject to modification by a number of cultural practices; thus, the turf manager can significantly affect the water use rate of a given turfgrass species.

3. Both warm and cool season turfgrass species possess significant differences in stomatal density and vary significantly in stomatal distribution over the leaf. In the case of warm season turfgrasses, there is a distinct relationship between the stomatal arrangement. A significantly higher stomatal density was found on the adaxial side of the leaf in comparison to the density found on the abaxial side, with the exception of Kentucky 31 tall fescue. There was no relationship between an increase in the evapotranspiration rate and a higher stomatal density.

4. It was found that potential evapotranspiration rate assessments across a range of warm season species can be reproduced in a water-heat stress simulation chamber. Growth inhibitors do possess a valid potential for use in reducing evapotranspiration rates of turfgrasses. The evapotranspiration rate increases as the cutting height is raised and as the nitrogen nutritional level is increased. The relative significance of an increased cutting height or nitrogen nutritional level on the evapotranspitation rate varies with the particular turfgrass species. In high nitrogen requiring turfgrasses, the evapotranspiration is most affected by changes in the nitrogen level, whereas, in low nitrogen requiring turfgrasses, evapotranspiration is affected by changes in mowing height.

5. There is genetic diversity within the bermudagrass species that contributes to a variance in potential evapotranspiration. This diversity can be measured and statistically analyzed.

Enhanced Rooting/Water Absorption

1. Initial experiments suggest that the root hair dimension of turfgrass root characterization has been overlooked and that over the past three decades, far too much emphasis has been placed on total root mass and depth. The rooting depths and total root weights of the major warm season turfgrasses vary substantially in terms of interspecies rooting potentials.

2. Spring root decline is a separate phenomenon rather than a result of other external stresses. There are two distinctly different dormancy phases for the root and shoot systems of warm season perennial grasses. The spring root decline response has occurred in all ten warm season grasses investigated, which indicates that it is common to most warm season perennial grasses used for turfgrass purposes.

3. Significant differences in rooting depth and root mass were found among the major cool season turfgrass species when grown under near optimum conditions. Certain cool season species, such as crested wheatgrass and the tall fescues, exhibited a stronger capability to sustain root growth under severe heat stress conditions.

Improved Drought Resistance

The major warm season turfgrass species vary greatly in drought avoidance and in drought resistance with comparative rankings being much different than had been previously assumed. Variations in drought avoidance and recovery is as great within most of the turfgrass species as the variation at the interspecies level.

Physiological Basis of Minimal Maintenance Turfgrasses

Genetic diversity in terms of minimal maintenance turfgrasses can be statistically evaluated.

TEXAS A&M UNIVERSITY - Dr. M. C. Engelke
Principal Investigator
Research & Extension Center,
Dallas, TX

Breeding and Development of Zoysiagrass

1985 Grant - $42,000 (Third year of support)

The USGA/TAES Zoysiagrass Breeding and Development Program is a diverse, multifacited approach to expand and improve existing cultivars of the Zoysia species. Constant observation of the plant collection reveals both the strengths and weaknesses of this turfgrass.

A taxonomic study of the Zoysia spp. germplasm was initiated to gain a better understanding of their breeding behavior. The genetic variability within the Oriental germplasm, collected four years ago in Southeast Asia with support from the USGA, continues to be evaluated in the field, greenhouse, and laboratory. Field notes were taken during the last year for fall color, growth rate, leaf type, spring greenup, flowering habit, percent cover, dormancy, and canopy temperature. Significant variation exists with the germplasm for all of these characters, and the probability of creating genotypes which possess favorable gene combinations are excellent. A test of the compatibility of the germplasm accessions was initiated during Spring 1985 in both the greenhouse and the field.

A commercially available Korean zoysiagrass seed stock was screened for tolerance to high soil temperatures and low soil moisture. Plants selected for superior performance during prolonged temperature and moisture stress, and those selected for their ability to recover from stress conditions differed significantly from an unselected base population. A field study using the selected and unselected populations was initiated to further examine the tolerance of this plant material to heat and moisture stress in the natural environment.

Attempts to produce single cross hybrids between individual zoysiagrass accessions were unsuccessful thus far. Several crossing techniques will be evaluated during the next year. A growth chamber constructed during the last year was useful in initiating plants to flower. Open-pollinated seedlings from 1983 and 1984 were planted to the field in Summer 1985. Eighty six families (i.e., the maternal parent and its open-pollinated offspring) were established in a replicated field trial to study the level of genetic variation for major agronomic characters, and provide accurate estimates of heritability. Such information is essential in determining the most effective breeding method to employ in cultivar development.

Forty cultivars were evaluated for sod strength and rate of regrowth after sod harvest. Three accessions have outstanding rhizome regrowth potential. These accessions and other cultivars will be planted into a new variety trial in Spring, 1986. A seed production trial was also initiated in August 1985 to help determine the potential for a seeded zoysiagrass variety.

TEXAS A&M UNIVERSITY - Dr. M. C. Engelke
Principal Investigator
Research & Extension Center,
Dallas, TX

Breeding and Development of Bentgrass

1985 Grant - $40,000 (First year of support; $20,000 contributed by Bentgrass Research Inc. of Fort Worth, Texas)

Susceptibility to heat stress limits use of bentgrass for high quality playing surfaces in the Southern and Central United States. In the fall of 1981, a group of individuals in the north Texas area interested in bentgrass established a fund-raising organization named Bentgrass Research, Inc., to support bentgrass research at TAES-Dallas. In October 1982, a 3600 square foot sand green was constructed by this group for research purposes. In April, 1984, the United States Golf Association, Bentgrass Research, Inc., and the Texas Agricultural Experiment Station joined in a concerted effort for the "Breeding and Development of Bentgrass". A limited collection of bentgrass germplasm had been assembled at TAES-Dallas over the previous four years. Most notably were individual plants which had survived naturally under Southern climatic extremes, often in direct competition with other species such as bermudagrass. In total as of November 1985, over 200 vegetative accessions from two countries and five states, 129 seeded accessions from nine countries, and five commercial varieties were included in the collection.

In the spring of 1985, a specialized greenhouse heat bench was utilized to select 196 clones with heat tolerance from a population of approximately 20,000 plants of 'Seaside' bentgrass. A root growth characterization study was initiated in mid-summer 1985 to examine the inherent genetic variation within the germplasm pool and to identify unique rooting characters which may be associated with plants selected for heat tolerance from the heat bench. Twenty clones were randomly selected from the elite vegetative material and Seaside selections are included in this study.

TEXAS A&M UNIVERSITY - Dr. Garald L. Horst,
Principal Investigator
Agricultural Experiment Station,
El Paso, TX

Developing Salt, Drought, and Heat Resistant Turfgrasses for Minimal Maintenance

1985 Grant - $15,000 (Second year of support)

Research Accomplished

1. Development of a new technique for growth and development evaluation of multiple germ plasm entries grown under salt stress conditions.

2. Reception and increase of 75 Buffalograsses, 40 St. Augustinegrasses, 3 Paspalums, and 65 Zoysiagrasses.

Current Research

1. Vegetative material of 29 Buffalograss and 37 St. Augustinegrass germ plasm are being evaluated for salt resistance.

2. Methods for evaluating zoysiagrass vegetative material are currently being investigated.

Research Planned 1985/1986

1. Complete evaluation of St. Augustinegrass germ plasm. (Feb. 1986)

2. Complete initial evaluation of buffalograss germ plasm. (May, 1986)

3. Continue accumulation of buffalograss germ plasm and expand cooperation with the University of Nebraska program.

4. Initiate zoysiagrass evaluation. (January, 1986)

5. Begin accumulation of bentgrass and bermudagrass germ plasm and expand cooperation with New Mexico State University and Oklahoma State University programs.

6. Investigate methods for further greenhouse and field evaluations on germ plasm which exhibited reasonable salt resistance.

WASHINGTON STATE UNIVERSITY - Dr. J. L. Nus,
Principal Investigator
Research & Extension Center,
Puyallup, WA

Evaluating Turfgrass Response to Water Stress - Osmotic Adjustment in Kentucky Bluegrass

1985 Grant - $1,000 (Second and last year of support)

A temperature controlled hydroponic system has been developed for culture of turfgrass for physiological studies. The rate of water stress development is controlled using polyethylene glycol in nutrient solutions. A technique using a combination of pressure-volume and moisture release curves is used to evaluate turfgrass response to water stress.

This study is concerned with the fundamental issue of identifying plant factors at the tissue or single plant level rather than those at a turfgrass populate or sward level. For example, it is concerned with stomatal control, cuticular resistance to water loss, and turgor maintenance by osmotic adjustment in response to drought; while shoot density, canopy resistance to water loss and rooting behavior represent plant factors at the sward level.

Water use requirement of plants depends on transpiration rates. Although transpiration is the sum total of stomatal and non-stomatal water loss, stomatal closure is generally recognized as the main cause of transpiration decline as water stress develops. Control of stomatal aperture, therefore, is a very important factor in a plant's ability to survive periods of limited moisture.

In August, 1985, the principle investigator transferred his work from Washington State to Kansas State University.

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Waynesborough Country Club	Paoli, PA
* Wayzata Country Club	Wayzata, MN
Westmoreland Country Club	Export, PA
* Weston Golf Club	Weston, MA
* Westwood Country Club	Rocky River, OH
* Wheatley Hills Golf Club	East Williston, NY
Wianno Club, Inc.	Osterville, MA

DONOR CLUBS (con't)

	Wigwam Country Club	Litchfield Park, AZ
	Wild Dunes Golf Club	Isle of Palms, SC
*	Wilderness Country Club	Naples, FL
*	Wildwood Golf & Country Club	Cape May Court House, NJ
	Williamette Valley Country Club	Canby, OR
*	Willow Oaks Country Club	Richmond, VA
	Winchester Country Club	Winchester, MA
*	Winged Foot Golf Club, Inc.	Mamaroneck, NY
*	Wolferts Roost Country Club	Albany, NY
*	Woodland Country Club	Carmel, IN
	Woodway Country Club	Darien, CT
	Wykagyl Country Club	New Rochelle, NY
*	Wyndemere Golf & Country Club	Naples, FL
	Yakima Country Club	Yakima, WA