1987
ANNUAL TURFGRASS RESEARCH REPORT

GOLF KEEPS AMERICA BEAUTIFUL

USGA GREEN SECTION

1987
ANNUAL TURFGRASS RESEARCH REPORT

SUBMITTED JOINTLY BY:

United States Golf Association
Golf House
Far Hills, New Jersey 07931

Golf Course Superintendents Association of America
1617 St. Andrews Drive
Lawrence, Kansas 66046

United States
Golf Association® Green Section

National Director
WILLIAM H. BENGEYFIELD

USGA®

FRANK HANNIGAN
Senior Executive Director

Box 3375
Tustin, CA 92681
(714) 544-4411

December 1, 1987

TO: THE READERS OF THE 1987 ANNUAL TURFGRASS RESEARCH REPORT

Research Committees, and the donors from whom all monies flow, are not known to lack expectations. The pure scientist may deal in the realm of disinterested inquiry, but there are others who live in anticipation of scientific progress and finding solutions to problems. The following pages contain the USGA/GCSAA 1987 Annual Turfgrass Research Report. It tells of the accomplishments and status of every research project now being funded by the USGA Turfgrass Research Committee.

The original goal remains the same; to achieve a 50% reduction in golf course maintenance costs and a 50% reduction in water use (based on 1983 figures) by 1993. The program, we believe, is on track. The Turfgrass Research Committee is especially pleased to call attention to the release of two brand-new turfgrasses in the past year. One is a seeded bermudagrass superior to common bermuda and is the work of Dr. Arden Baltensperger of New Mexico State University. The other, in fact several "others," are improved buffalograsses from the labors of Dr. Terrance Riordan of the University of Nebraska. There is a potential market demand for these seeded grasses in the millions of pounds. They are now under commercial foundation planting increases in Arizona and limited quantities of seed may be on the market as early as 1989. If this seems agonizingly slow, please remember, Mother Nature only works on one seed harvest a year.

There are dozens of other new and promising grasses now finding their way into the long pipeline of test and development. At least seven exciting Poa annua selections are to be distributed nationwide and evaluated in 1988. Creeping bentgrasses that withstand high temperatures, wear, resistance to pythium, thatch development, and having good commercial seed productivity are in the "breeding hopper." Zoysiagrass with unbelievable ability to rapidly recover from divoting, scarring and injury have been developed and represent a major breakthrough. There is even the possibility of having a zoysia variety someday comparable to bentgrass for putting greens. And can you imagine a zoysiagrass successfully growing in salt levels half of that found in seawater? It is true!

By 1991, expectations are to have several native grasses also ready for commercial release. The breeding of cold tolerance into seeded bermudagrasses now seems assured, but genetically combining cold tolerance with fine leaf texture in bermuda will take another three or four years, we are told. In New Zealand, over 1200 promising drought tolerant colonial bentgrasses are being evaluated and the best ones will be shipped to the USA for turf quality and seed trials in 1988. From 14 foreign countries (Canada, China, England, Germany, Iran, Japan, Korea, New Zealand, Nova Scotia/Canada, Philippines, South Africa, Sweden, Taiwan, Turkey) and the USA itself, huge quantities of new turfgrass germplasm has been collected and is in use in these breeding efforts. There has never been anything like it.

With so many new, improved grasses on the horizon, how does one go about protecting the effort and investment that has gone into their development? The Turfgrass Research Committee has a concern with this question and is taking steps to protect against pirating. Genetic "fingerprinting" is now possible and will provide a means of positive identification of new cultivars. The Plant Variety Protection Act is the law of the land and will be enforced. Biotechnology will play a major role in this development.

In the pages that follow, nine additional reports will be found on cultural practice studies, stress mechanisms, and the Turfgrass Research Library. I encourage you to their reading for you will find a wealth of new information and progress here.

Last July, ten university researchers receiving "major" USGA/GCSAA grants gathered in Salt Lake City to "show and tell" their individual projects. The two day meeting was a huge success. Three USGA Executive Committeemen were also in attendance. At its conclusion, the researchers were unanimous in their belief that the exchange was of inestimable value. The money spent on this meeting, they said, will be far more valuable than if placed in an entirely new research project. Another exchange is planned for 1988, probably in the grass seed producing State of Oregon. The scientists were equally supportive of the "monitoring visits" made annually by members of the Turfgrass Research Committee to each project. In fact, they requested the "on-site visits" be longer and more frequent for they directly helped move the projects along.

There is so much more to be told about this unique research program. But if you will read the pages that follow, I'm sure you will find genuine, solid, substantial research progress that you will be proud to be supporting. And would you please note the names of those USGA volunteers who serve, without compensation, on the Turfgrass Research Committee? If you should see any one of them any time in the future, ask about the program and plans for the future. Of course, please write to me any time with your suggestions or queries. They will always be welcomed.

You do have the right to hold certain expectations for this research program. We all do. The Turfgrass Research Committee believes such expectations are being met. We are grateful to you and to the researchers involved in this undertaking. And we thank you all for helping Golf Keep America Beautiful.

Sincerely,

Bill

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

WHB:hv

United States
Golf Association

USGA

FRANK HANNIGAN
Senior Executive Director

Golf House
Far Hills
New Jersey 07931
(201) 234-2300
Telex: 7109862521

To try to give proper recognition by naming here the many thousands of individuals, corporations, clubs, golf organizations and others who supported the USGA Capital Campaign to raise funds for turfgrass research would be too long a list for this report and would surely result in omissions of some who sacrificed time and money for the good of the cause. So excuse us for not even trying here, but just as soon as the final list is complete, all the names of donors will be recorded permanently at Golf House.

To all of you true friends of golf and the USGA we say: "Thank you, sincerely" -- for being there when you are really needed.

B. P. Russell

B. P. Russell
President, USGA Foundation and
Chairman of the Development Committee

INDEX

Page

Statement of Intent. 1
USGA Turfgrass Research Committee. 2
Chart — Turfgrass Research Grants 3
COLORADO STATE UNIVERSITY — Development of Dryland Western Turfgrass Cultivars 4
DSIR-NEW ZEALAND — Colonial Bentgrass Breeding. 5
UNIVERSITY OF GEORGIA — Bermudagrass Breeding-Vegetative. 6
UNIVERSITY OF GEORGIA — Influence of Soil Moisture Level on Turfgrass Water Use and Growth 8
UNIVERSITY OF GEORGIA — Cultivation Methods on Turfgrass Water Relationships and Growth Under Soil Compaction. 9
MICHIGAN STATE UNIVERSITY — The Effect of Seven Management Factors and Their Interaction on the Competitive Ability of Annual Bluegrass and Bentgrass 10
MICHIGAN STATE UNIVERSITY — Turfgrass Research Library. 12
UNIVERSITY OF MINNESOTA — Improvement of Poa Annua and Poa Supina for Golf Turf. 13
UNIVERSITY OF NEBRASKA — Breeding, Evaluation and Culture of Buffalograss 14
UNIVERSITY OF NEBRASKA — Turfgrass Cultural Practices and Their Interactive Effects on Rooting. 16
NEW MEXICO STATE UNIVERSITY — Breeding Improved Seeded Bermudagrass for Turf. 18
NORTH CAROLINA STATE UNIVERSITY — Spring Dead Spot Disease. . . . 19
OHIO STATE UNIVERSITY — Monoclonal Antibodies for Rapid Diagnosis of Summer Patch and Necrotic Ring Spot Diseases of Turfgrasses 20
OHIO STATE UNIVERSITY — Mechanisms for Heat Tolerance in Annual Bluegrass 21
OKLAHOMA STATE UNIVERSITY — Breeding and Evaluation of Seeded Cold Tolerant Bermudagrass. 22
PENNSYLVANIA STATE UNIVERSITY — Bentgrass Breeding. 23
UNIVERSITY OF RHODE ISLAND — Selection and Breeding of Superior Bentgrasses 24
RUTGERS UNIVERSITY — Breeding and Evaluation of Kentucky Bluegrass, Tall Fescue, and Perennial Ryegrass for Golf 25
TEXAS A&M UNIVERSITY — Plant Stress Mechanisms. 26
TEXAS A&M UNIVERSITY — Brown Patch and Pythium Disease Resistance in Bentgrass and Zoysiagrass. 28
TEXAS A&M UNIVERSITY — Breeding and Development of Zoysiagrass 29
TEXAS A&M UNIVERSITY — Breeding and Development of Bentgrass 30
TEXAS A&M UNIVERSITY — Developing Salt, Drought and Heat Resistant Turfgrasses for Minimal Maintenance 31

STATEMENT OF INTENT

It is the intent of the United States Golf Association (USGA) and the Golf Course Superintendents Association of America (GCSAA), through the USGA Foundation, to collect and disseminate substantial amounts of money for support of research to improve turfgrasses; specifically, to substantially reduce water use and maintenance costs and, further, to encourage young turf scientists to become leaders in research.

It is anticipated that funds for this purpose will be derived in major part from contributions to the USGA Foundation. Additional funds may be derived in the future from royalties attributed to marketable discoveries. The USGA presently intends to return any income received from royalties to the support of turfgrass research. Institutions which accept its research grants will be asked to engage in a free exchange of information with other investigators.

Historically, the sport of golf has maintained a leadership role in the development of improved turfgrasses through the activities of the USGA Green Section. While those developments have helped to provide better playing areas for golf, they have had a far-reaching impact on turfgrass improvement for other uses. Home lawns, parks, school grounds, highway rights of way and all other turfgrass uses have been improved by developments which were pioneered by the USGA.

The USGA expects to support research at numerous institutions. In some cases, several will be involved with the development of grasses and maintenance practices where the research may interact and overlap.

In view of this Statement of Intent, it is expected that recipients of grants will embrace the spirit of cooperation which the USGA and GCSAA is attempting to promote and that they will engage in a free exchange of information with other investigators.

USGA Turfgrass Research Committee

1988 USGA TURFGRASS RESEARCH COMMITTEE

William H. Bengeyfield, Chairman,
P. O. Box 3375,
Tustin, California 92681

Thomas Burton,
102 Major Wright Road,
St. Simons Island, Georgia 31522

Gerald F. Faubel, GCSAA Executive Committee
4465 Gratiot,
Saginaw, Michigan 48603

Dr. Victor A. Gibeault, University of California - Riverside
Batchelor Hall Extension, UC Riverside,
Riverside, California 92521

Frank Hannigan, Senior Executive Director, USGA
Golf House,
Far Hills, New Jersey 07931

Howard E. Kaerwar
12800 Gerard Drive
Eden Prairie, Minnesota 55344

Dr. Michael P. Kenna, Oklahoma State University
360 Ag Hall, Oklahoma State University,
Stillwater, Oklahoma 74074

Dr. Paul E. Rieke, Michigan State University
Dept. Crops & Soils, Michigan State University,
East Lansing, Michigan 48824

Charles W. Smith, Director, Administration & Support
Services, USGA
Golf House,
Far Hills, New Jersey 07931

F. Morgan Taylor, Jr., USGA Executive Committee
P. O. Box 758,
Hobe Sound, Florida 33455

Dr. James R. Watson, The Toro Company
8111 Lyndale Avenue South,
Minneapolis, Minnesota 55420

TURFGRASS RESEARCH GRANTS

PROJECT	SUBPROJECT	UNIVERSITY/INVESTIGATOR	YEARS FUNDED 1983	1984	1985	1986	1987 GRANTS	TOTAL GRANTS 83-87	AVERAGE GRANT PER YEAR	1988 GRANTS	PROJECT TOTALS 83 - 88
STRESS MECHANISMS		Texas A&M-Coll.Sta/Beard	XX	XX	XX	XX	70,000	405,500	81,100	55,000	460,500
		SUBTOTALS:					70,000	405,500		55,000	460,500
TURFGRASS RESEARCH LIBRARY		MI State/Chapin	XX	XX	XX	XX	65,000	289,326	57,865	65,000	354,326
		SUBTOTALS:					65,000	289,326		65,000	354,326
TURFGRASS BREEDING	Breeding General	Rutgers/Funk	XX	XX	XX	XX	5,000	25,000	5,000	5,000	30,000
	Bentgrass	Penn State/Duich	XX	XX	XX	XX	4,000	20,000	4,000	4,000	24,000
	* Bentgrass	Texas A&M-Dallas/Engelke			XX	XX	40,000	127,000	42,333	40,000	167,000
	Bentgrass	New Zealand DSIR/Rumball				XX	10,000	20,000	10,000	10,000	30,000
	Bentgrass	Univ of RI/Skogley	XX	XX	XX	XX	5,000	11,000	2,200	5,000	16,000
	Bentgrass	MS State/Krans	XX	XX				5,000	2,500		5,000
	Bermudagrass	Univ of GA/Burton	XX	XX	XX	XX	5,000	25,000	5,000	5,000	30,000
	Bermudagrass	NM State/Baltensperger		XX	XX	XX	20,000	64,500	16,125	3,000	67,500
	Bermudagrass	OK State/Taliaferro				XX	20,000	40,000	20,000	20,000	60,000
	Native Grass	CO State/Cuany			XX	XX	20,000	50,000	16,666	25,000	75,000
	Native Grass	Univ of AZ/Mancino								5,000	5,000
	Native Grass	Univ of NE/Riordan		XX	XX	XX	19,000	61,100	15,275	25,000	86,100
	Poa Annua	Univ of MN/White		XX	XX	XX	20,000	61,600	15,400	30,000	91,600
	Zoysiagrass	Texas A&M-Dallas/Engelke	XX	XX	XX	XX	40,000	167,085	33,417	40,000	207,085
		SUBTOTALS:					208,000	677,285		217,000	894,285
CULTURAL PRACTICES	Management	MI State/Branham			XX	XX	15,000	40,000	13,333		40,000
	Management	OH State/Danneberger				XX	15,000	30,000	15,000		30,000
	Management	Univ of GA/Carrow				XX	15,000	30,000	15,000	15,000	45,000
	Management	WA State/Brauen		XX	XX			2,243	1,121		2,243
	Pathology	Texas A&M-Dallas/Colbaugh					10,000	10,000	10,000	10,000	20,000
	Pathology	OH State/Shane & Nameth					10,000	10,000	10,000		10,000
	Pathology	MI State/Vargas		XX				1,500	1,500		1,500
	Pathology	Cornell/Petrovic		XX				1,500	1,500		1,500
	Pathology	Cornell/Smiley			XX			7,000	7,000		7,000
	** Pathology	NC State/Lucas			XX	XX	10,000	30,000	10,000		30,000
	Interactions	Univ of NE/Shearman		XX	XX	XX	20,000	67,000	16,750	25,000	92,000
	Soil Compaction	MI State/Rieke	XX	XX	XX	XX		14,000	3,500		14,000
	Salt	Texas A&M-El Paso/Horst		XX	XX	XX	15,000	48,480	12,120	15,000	63,480
		SUBTOTALS:					110,000	291,723		65,000	356,723
BIOTECH	Methodology	Univ of IL/Smith								8,400	8,400
		SUBTOTALS:								8,400	8,400
ADMINISTRATION	Mtgs & Inspections		XX	XX	XX	XX	27,000	84,685	16,937	39,600	124,285
		SUBTOTALS:					27,000	84,685		39,600	124,285
		TOTALS:	XX	XX	XX	XX	480,000	1,748,519	349,704	450,000	2,198,519

* Includes matching grant by Bentgrass Research, Inc. of Fort Worth, TX: 1985 - $27,000; 1986 - $20,000; 1987 - $20,000; 1988 - $20,000.
** Total grant funded by Mr. Hall Thompson for studies on Spring Dead Spot.

DEVELOPMENT OF DRYLAND WESTERN TURFGRASS CULTIVARS

COLORADO STATE UNIVERSITY
Fort Collins, Colorado

Dr. Robin Cuany
Principal Investigator

1987 Research Grant: $20,000
(third year of support)

Breeding research has continued on four western grass species which would be extremely useful in minimum maintenance turf plantings and for areas with special soil or moisture problems. The species in this turf performance improvement program are alkaligrass (*Puccinellia spp*.), blue grama (*Bouteloua gracilis*), fairway wheatgrass (*Agropyron cristatum*) and inland saltgrass (*Distichlis spicata*).

Alkaligrass is highly tolerant of saline, sodic and waterlogged soils and can therefore provide cover in such problem areas which are usually found in low areas of a turf. Its appearance and performance is approximately equal to Kentucky bluegrass in our turf test plantings which are progeny tests of accessions from six western states and five foreign countries. An advanced generation will be produced next year from the best performance disease resistant parents we have selected.

Blue grama, the dominant native grass in many western grasslands, produces a dense stand with a minimum amount of water and is tolerant of alkaline soils. Accessions from three western states have been screened and 27 elite selections produced seed this year in an isolated polycross nursery. The seedlings will be evaluated and serve as the basis of the second cycle of selection.

Fairway wheatgrass tolerates drought by going dormant and recovers rapidly after receiving moisture. We produced seed from 78 selected parent plants this year in an isolated crossing block and will field test their seedlings in Cycle 2 next year as well as testing the turf performance of those selected parents.

Inland saltgrass forms a dense system of robust rhizomes which allow it to rapidly spread and create a serviceable turf. It is highly tolerant of salt and waterlogged soils, and deep roots and rhizomes help to withstand droughts. Many accessions being tested grow less than six inches high under irrigation so require only infrequent mowing. Selected elite parents will produce advanced generation seed next year.

Plans are being made to evaluate superior strains of these grasses at three different experiment stations having different climate conditions in 1988.

COLONIAL BENTGRASS BREEDING

DEPARTMENT OF SCIENTIFIC & INDUSTRIAL RESEARCH -- NEW ZEALAND

Dr. William Rumball
Principal Investigator

1987 Research Grant: $10,000
(second year of support)

The goal of this project is to breed a Colonial bent cultivar for U.S. golf courses using New Zealand breeding materials, and doing the breeding work within New Zealand. Because of unfamiliarity with the golf scene in the United States, Dr. Rumball spent much time during a recent sabbatical in California visiting golf courses to better understand the concerns about high water usage and high maintenance costs. Although some promising bentgrass plants were collected in the U.S., most of the breeding material has been obtained from golf courses located in dry regions of New Zealand; courses that received no irrigation and low maintenance.

Over 1200 promising plants have been collected from over 70 golf courses. Each plant has been split into four pieces, two of which have been planted into a close-mown sward for observations on agronomic value. The other two pieces are growing without defoliation in a separate block to allow studies of flowering and seed production. We hope to identify plants that are dense and attractive under close mowing (especially in dry periods) and also flower at about the same time, and produce much seed. We should know with some certainty by February 1989 if this pragmatic approach is likely to succeed, but may have indications well before then.

BERMUDAGRASS BREEDING — VEGETATIVE

UNIVERSITY OF GEORGIA
Tifton, Georgia

Dr. Glenn W. Burton
Principal Investigator

1987 Research Grant: $5,000
(ongoing since 1956)

Dr. Glenn Burton's work in the development of greater winterhardiness in the 'Tif' type bermudagrass hybrids continues. The release of Tifgreen II in 1983 was an important step in this direction and continuing reports verify that this grass is definitely more winterhardy than Tifgreen (328). In 'side-by-side' plots with both grasses receiving minimal maintenance (one application of two pounds Atrazine per acre in the spring to eliminate some winter weeds and a March fertilization including adequate amounts of phosphorous and potassium and 100 pounds of nitrogen per acre -- for the entire year), Tifgreen II produced an excellent weed-free sod and showed greater ability to recover from severe cold than Tifgreen (328).

Dr. Bob Lynch, USDA entomologist, is exploring the possibility of producing army worm resistance in bermudagrass turf. Out of 500 bermudagrass introductions at Tifton, Georgia, mostly from Africa, at least one has been found with resistance. Army worms restricted to the foliage of this grass usually starve to death before they are able to reproduce.

In February and March 1987, Dr. Burton was in South Africa and found an opportunity to obtain Cynodon transvaalensis (bermudagrass) germplasm which had been growing primarily on golf courses at higher elevations. For years, he has been trying unsuccessfully to obtain just this type of winterhardy germplasm. Apparently it occurs only rarely under natural conditions. Dr. David Knox, University of Witwatersrand, gave some stolons of his best material to Dr. Burton and these were mailed to his laboratory at Tifton, Georgia. All but one survived the journey and were planted immediately under quarantine conditions. Unfortunately, the screen cage used to exclude insects in quarantine limited light conditions so severely that the new introductions could not and did not grow. In fact, they have almost died. They are now being carefully nursed back to life and only time will tell if they will make it for future breeding purposes.

Pollinations have been made using the most winterhardy selections from the Berlin, Germany bermudagrass cross with Cynodon transvaalensis in 1984. These selections were field-space planted during the summer of 1986 and out of that planting 64 of the best hybrids were selected. These were increased in a greenhouse last winter and field planted in June, 1987. They are now being grown with eight other known bermudagrasses for comparative purposes. One of these, Tifton 10 (selected by Dr. Burton in China in 1974) will probably be released next year as a superior common bermudagrass type with rapid rate of establishment and good winterhardiness.

Winterhardiness studies at the Blairsville (Georgia) Golf Course are continuing. Very low winter temperatures are possible here and in May 1987 4" plugs of various hybrid bermudagrasses were planted in a 25 x 50 foot plot of Penncross bentgrass. Included in the planting were the best crosses of Berlin X Cynodon transvaalensis, the Tif bermudas, Midiron and Vamont as well as mutants that Dr. Burton's associate, Dr. Hanna, has developed by irradiating dormant sprigs of Midiron bermudagrass. A similar trial area was also established on a golf course at Highlands, North Carolina. It is hoped these trial plots will prove to be a practical, effective method of screening for winterhardiness.

INFLUENCE OF SOIL MOISTURE LEVEL ON TURFGRASS WATER USE AND GROWTH

UNIVERSITY OF GEORGIA
Experiment, Georgia

Dr. Robert N. Carrow
Principal Investigator

1987 Research Grant: $10,000
(second year of support)

Reducing irrigation frequency is one means of conserving water. Of concern to the turfgrass manager would be the quantity of water conserved and any adverse effects on turf quality.

Three warm-season grasses (Tifway bermudagrass, Meyer zoysiagrass, common centipedegrass) were each irrigated under three irrigation regimes (well irrigated, moderate stress, severe stress). Results were: a) For the well watered irrigation regime, which would be common for golf course tees or very high quality fairways, bermudagrass used the least water in summer and fall. Relative to Tifway bermudagrass, Meyer zoysiagrass used 10%, 30%, and 5% more water for July, August, and October, respectively. Common centipedegrass used 4%, 23% and 13% more water than bermudagrass in July, August and October, respectively; b) At the moderate stress irrigation program, that would be typical of many fairways, water use rates were 39% and 11% greater in August for zoysiagrass and centipedegrass, respectively, than bermudagrass. Just prior to an irrigation, zoysiagrass showed slight wilt, while the other grasses did not; c) Under severe moisture stress, such as for rough areas, water use rates in August were 4% lower and 43% higher for zoysiagrass and centipedegrass, respectively, than bermudagrass. The zoysiagrass exhibited severe wilt and bermudagrass no symptoms. The semidormant state for zoysiagrass would account for its lower water use. Zoysiagrass did not appear to develop many roots into the heavy B horizon soil layer and could not effectively use subsoil moisture.

A second means of reducing water use is to use atmospheric, soil or plant based criteria to schedule irrigation in contrast to guessing when to water. We have gathered comparative data from this study on several irrigation scheduling techniques: measuring soil water content by time-domain reflectrometry; crop water stress index and stress degreee data which are plant based; and weather pan and Penman equation which are atmospheric based. Comparative data on these will allow growers to select the best means of scheduling irrigation.

CULTIVATION METHODS ON TURFGRASS WATER RELATIONSHIPS AND GROWTH UNDER SOIL COMPACTION

UNIVERSITY OF GEORGIA
Experiment, Georgia

Dr. Robert N. Carrow
Principal Investigator

1987 Research grant: $5,000
(second year of support)

On recreational turfgrass sites, soil compaction can increase water use while reducing growth. A primary means of alleviating soil compaction is by cultivation. A number of turfgrass cultivation methods are available but very limited data exists on their relative effectiveness for reducing soil compaction; thereby, improving water use efficiency and growth. In this study, five cultivation methods were compared under compacted soil conditions on Tifway bermudagrass -- deep drill aerifier, hollow-tine coring, solid-tine coring, Aerway slicer, Ryan slicer.

In the surface four inches, the Ryan slicer, deep drill, and Aerway slicer improved rooting compared to the compacted control (no cultivation) by 53%, 23% and 23%, respectively. Deep rooting is especially important and the Aerway slicer and deep drill methods enhanced rooting by 120% and 55%, respectively, relative to the control, while solid-tine coring reduced deep rooting by 15%. All cultivation methods improved water use in August compared to the check ranging from 2% to 14% higher. In this case, greater water use would be considered as beneficial since better growth should occur. One measure of growth is clipping yield. The deep drill aerifier and Aerway slicer were most effective and increasing clipping yields by 44% and 37%, respectively, over the control.

These plots will be severely compacted in Fall 1987. Cultivation treatments will be repeated in Spring 1988 and followed by periodic growth and water use measurements.

THE EFFECT OF SEVEN MANAGEMENT FACTORS AND THEIR INTERACTION ON THE COMPETITIVE ABILITY OF ANNUAL BLUEGRASS AND BENTGRASS

MICHIGAN STATE UNIVERSITY
East Lansing, Michigan

Dr. Bruce Branham
Principal Investigator

1987 Research Grant: $15,000
(last year of support)

Research was conducted for a three year period on the competition between annual bluegrass and creeping bentgrass under fairway conditions. Previous progress reports have detailed conclusions from only one or two years' data. This represents a final summary of the results of this field study.

Five management factors were investigated and included irrigation (110% of open pan evaporation (OPE) three times per week, 75% of OPE applied daily, and irrigation at severe wilt); clippings removed or returned; nitrogen fertility (Two pounds nitrogen per 1000 square feet per year or six pounds nitrogen per 1000 square feet per year; plant growth regulator (PGR) treatment (Embark at 1/8 pounds per acre, Cutless at 1.0 pounds per acre and a control); and overseeding with "Penncross" creeping bentgrass or no overseeding.

Results showed that only clipping treatments, plant growth regulators, and the initial annual bluegrass population had a significant effect over all three years. Nitrogen fertility was significant in only one out of the three years. Plant growth regulator treatment was not significant in any one year but was significant when data was analyzed over all three years. Over three years, clipping-removed plots had 12 percent more creeping bentgrass than clipping-returned plots when averaged over all treatments. Plots treated with mefluidide had significantly more annual bluegrass than plots treated with Cutless or receiving no treatment. Lowered nitrogen fertility caused a decrease in annual bluegrass in only one out of the three years of testing and was not a significant factor when data were combined over all three years. The decrease from low nitrogen fertility occurred in 1985, a year characterized by low natural precipitation. We concluded that low nitrogen fertility is effective when rainfall is low implying that heavier rains may minimize the difference between high and low nitrogen fertility.

A very interesting interaction between nitrogen fertility and plant growth regulator treatment was significant when the data was combined over three years. At low nitrogen fertility (Two pounds nitrogen per 1000 square feet per year), there was no difference in annual bluegrass populations whether treated with Embark, Cutless, or no plant growth regulator. However, under high nitrogen fertility (six pounds nitrogen per 1000 square feet per year), plots treated with Embark had significatly more annual bluegrass than plots treated with Cutless or not treated. Thus, Embark actually favors annual bluegrass when under high nitrogen conditions, while under no conditions was Cutless found to favor either annual bluegrass or creeping bentgrass when compared to plots receiving no plant growth regulator.

Clipping-removed plots were found to contain 60% less viable annual bluegrass seed than clipping-returned plots. We concluded that this difference was the primary reason why clipping removal favors creeping bentgrass. Returning clippings is a passive form of annual bluegreas overseeding.

Clipping removal significantly lowered soil potassium levels when compared to clippings-returned plots.

TURFGRASS RESEARCH LIBRARY

MICHIGAN STATE UNIVERSITY
East Lansing, Michigan

Dr. Richard E. Chapin
Principal Investigator

1987 Research Grant: $65,000
(fifth year of support)

The USGA Turfgrass Information File (TGIF) is housed in an Alpha Micro multiuser microcomputer, using STAR DEMS software. Both the hardware and software continue to work well. By October 1987 11,000 records were in the database. During the past year, service requests were received from 26 states. Requests may be made by contacting Peter O. Cookingham, Project Manager, at Michigan State University Libraries, East Lansing, MI 48824 (517-353-7209).

As the use of the Research Library increases, file users have become acquainted with the database objectives and usefulness and materials have been contributed for processing and addition to the file. Such contributions are particularly important for annual progress reports, theses and dissertations, and unpublished manuscripts. Current published literature is added to the file after processing by the TGIF staff; older materials are being added to the file on a systematic basis. Current emphasis is on the completion of the 1980-1987 conference proceedings.

On a quarterly basis the files and bibliographies of the National Agricultural Library, Commonwealth Agricultural Bureau, FAO, Biological Abstracts, and others are being reviewed and/or computer searched for omissions and for other titles that do not usually report turfgrass research. In addition, citation tracing of currently published refereed material adds to the comprehensiveness of the file. These file building techniques have resulted in TGIF citations originating from more than 1,270 different serial sources.

Recent monographs in the O. J. Noer Collection have also been added to the database, but have not been analyzed in detail for subject access. A proposed separate database, an interfiled index of "standard turf reference works," could provide intellectual access to the limited number of turf books.

A comprehensive brochure will soon be available to provide potential users with information on how to access the TGIF online, via telephone, or via mails. In addition, development and fine tuning of the software to distribute for use by remote PC's will enable direct searching of TGIF. Unfortunately, preparation of the software has taken longer than anticipated, but is now available for final testing by USGA Green Section staff. After final enhancements, the package will be ready for distribution on a broad scale. A formal announcement of availability and actual "sale" of this service will be made at the earliest possible date.

IMPROVEMENT OF POA ANNUA AND POA SUPINA FOR GOLF TURF

UNIVERSITY OF MINNESOTA
St. Paul, Minnesota

Dr. Donald B. White
Principal Investigator

1987 Research Grants: $20,000
(fourth year of support)

The *Poa annua* breeding project is about to enter a two-year critical phase. Dr. White and his superb research team have laid a solid foundation for understanding the variability, reproductive biology, improvement potential, increase and identification of this unique grass. This project has always been classified as 'high risk' and now the critical field evaluation (on golf courses and at other experiment stations) of the best *Poa annuas* produced to date is about to begin in 1988. There is every hope of success.

The severe winter of 1986-1987 resulted in a powerful hardiness evaluation of space planted materials and identifying superior selections. Advanced generations of some selections showed highly improved hardiness characteristics.

Collections of superior material were received from California, Ohio, Wisconsin, Texas (via Oregon) and Sweden (via Canada). Materials collected in Turkey were forwarded through the USDA but have yet to be received in Minnesota.

Poa supina was generally more cold hardy than *Poa annua.* Perennial *Poa annua* materials were consistently hardier than the annual types. Stolons of some selections survived more than seven months in dark cold storage. Sibbing resulted in more seed than selfing or crossing in some genotypes. This has potentially strong implications on seed production strategies. Experiments with electrophoresis indicate there is a good possibility of identifying (fingerprinting) differences in genotype. This will be extremely important to the introduction and protection of any new variety in the future.

Potted material is already available and stolon material should be available in early 1988 for planting on golf courses and at other experiment stations. Papers dealing with stolon storage and self incompatibility were presented at the ASHS and ASA meetings in 1987.

BREEDING, EVALUATION AND CULTURE OF BUFFALOGRASS

UNIVERSITY OF NEBRASKA
Lincoln, Nebraska

Dr. Terrance P. Riordan
Principal Investigator

1987 Research Grant: $19,000
(fourth year of support)

The following items are important to the long-term success of the buffalograss development project. This summary updates status on a new cultivar for release in 1989 and methods for propagating or marketing a new cultivar.

A. 1987 Synthetic for 1989 Turf-Type Buffalograss Cultivar.

A synthetic planting was made in June, 1987, using plant material selected for turf-type characteristics. This synthetic will be allowed to grow during 1987-1988 and seed will be harvested from all female clones. This seed will be available for testing either in late 1988 or early 1989.

B. Buffalograss Evaluation and Demonstration Plots.

Replicated tests have been initiated in Nelson, Nebraska and Stillwater, Oklahoma. Additional tests will be conducted in cooperation with the NCR-10 Regional Turfgrass Committee at regional sites and also at Cornell, Rutgers, Michigan State, Texas A&M-Dallas, and Colorado State. Demonstration plantings (non-replicated) have been made in Yuma, Arizona; Madras, Oregon; Marysville, Ohio and Bettendorf, Iowa.

C. Evaluation of Caryopses Time and Storage Conditions.

The caryopses in cold storage had a slightly lower germination than those stored at room temperature at 15 months. The high germination of the caryopses stored at room temperature will encourage further study into removal of the caryopses from the burr. (Caryopses: A small, dry, one-seeded fruit that remains joined with the seed in a single grain.)

D. Plug Prerooting Requirements.

The 1986-87 data shows that prerooting, as little as two weeks, will increase establishment rates for buffalograss allowing establishment during a single growing season.

E. Plug Fall Planting Study.

Plugs were planted September 4 and 16, and October 6 and 28, 1986. Observations from this study showed more rapid cover and better overall establishment with plots planted in September.

F. Collections.

Buffalograss was collected in seven south-central counties of Nebraska on July 7-8, 1987, in the counties of Iowa bordering on the Missouri River and in Missouri. Additional collections will be made in 1988 throughout the area of buffalograss adaptation.

TURFGRASS CULTURAL PRACTICES AND THEIR INTERACTIVE EFFECTS ON ROOTING

UNIVERSITY OF NEBRASKA
Lincoln, Nebraska

Dr. Robert C. Shearman
Principal Investigator

1987 Research grant: $20,000
(fourth year of support)

I. Accomplishments Pertinent to USGA Goals:

A. Cool-season turfgrass water use rates were identified for nine species. Water use varied by as much as 60%.

B. Cultivar differences in water use varied by 64%, 31% and 30% for Kentucky bluegrass, perennial ryegrass and creeping bentgrass, respectively.

C. Selection of appropriate species and cultivars could play a significant role toward meeting the 50% water conservation goal of the USGA.

D. Species and cultivars varied in turfgrass rooting responses in percentages similar to the magnitude observed for water use.

1. Species varied in total root production, root distribution and percent of roots supporting topgrowth.

2. Variation among cultivars of Kentucky bluegrass, perennial ryegrass, and tall fescue was similar to that observed in species rooting characteristics.

3. The combination of reduced water use, and increased rooting depth, distribution and percentage supporting topgrowth are important criteria in drought avoidance and potential water conservation.

E. Interaction of potassium nutrition and irrigation frequency resulted in a 38% reduction in total water use of Seaside creeping bentgrass.

1. Water use rate of daily irrigated turfs was higher than those receiving irrigation twice weekly.

2. Turfgrass quality was higher for turfs receiving light frequent irrigations, except for those turfs receiving more than 6.0 pounds potassium (K) per 1000 sq. ft./ season.

3. The interaction of infrequent irrigation and high potassium nutrition (i.e., $\geq$ 6.0 lbs. K/1000 sq. ft./ season) resulted in a water use reduction of 38% with no loss in turfgrass quality.

II. Other Research Contributions:

A. This project identified criteria for selection of water conserving cultivars of Kentucky bluegrass, perennial ryegrass, creeping bentgrass, and tall fescue, using vertical extension rate, verdure and shoot density.

B. This project devloped field, and greenhouse procedures for screening turfgrass species and cultivar rooting responses.

C. This project identified Kentucky bluegrass and tall fescue cultivars that were superior for reduced water use and enhanced drought avoidance. These cultivars could be used in blends and mixtures to enhance water conservation or in breeding programs to develop water conserving cultivars.

BREEDING IMPROVED SEEDED BERMUDAGRASS FOR TURF

NEW MEXICO STATE UNIVERSITY
Las Cruces, New Mexico

Dr. Arden Baltensperger
Principal Investigator

1987 Research Grant: $20,000
(fourth year of support)

NuMex S-1 (temporary designation) was released in the spring of 1987. The NMSU Variety Release Committee approved an exclusive release and the New Mexico Crop Improvement Association selected Farmers Marketing Corporation, Phoenix, Arizona, for seed increase and marketing of this variety. A 'Breeder Field' of NuMex S-1 was established near Roll, Arizona for seed production in 1987 and future years. This seed will be used by the company to establish Foundation Seed Fields in 1988.

NuMex S-1 is a seed-propagated cultivar with medium texture, density and plant height developed for general purpose use such as golf course fairways. NuMex S-1 was developed by intercrossing eight clones selected on the basis of polycross progeny performance for turf quality. Subsequently, progeny plants were subjected to several cycles of phenotypic recurrent selection for shorter internodes and increased color and density.

As a part of the overall bermudagrass breeding program, the third heritability study was completed and published as a thesis in December 1986. An additional study of seed fertility and seed set was completed in May 1987. These studies have been helpful and should be helpful in the future in determining the most effective breeding procedure for tetraploid bermudagrass populations.

SPRING DEAD SPOT DISEASE

NORTH CAROLINA STATE UNIVERSITY
Raleigh, North Carolina

Dr. Leon T. Lucas
Principal Investigator

1987 Research Grant: $10,000
(last year of support; $30,000 over three years was contributed by Mr. Hall Thompson of Shoal Creek, Alabama.)

The project on spring dead spot (SDS) of bermudagrass was completed in the fall of 1987. Fungi were isolated from bermudagrass with spring dead spot symptoms throughout this study. Selected isolates of the fungi were used to inoculate bermudagrass in the greenhouse in the fall of 1986. The inoculated pots were exposed to outside winter conditions during January to May of 1987. Spring dead spot symptioms developed with two of the isolates used. The symptoms produced were typical of spring dead spot symptoms on golf course fairways. The fungus that caused the disease was identified as *Gaeumannomyces graminis*, which is the first report of this fungus being associated with spring dead spot of bermudagrass. The fungus was identified from the inoculated plants and from spring dead spot samples collected in May from North Carolina and Alabama.

Fungicides and fertilizer treatments were evaluated at four locations in the southeastern United States for the control of SDS. Rubigan applied in September (1 oz./1000 square feet) and Tersan 1991 (8 oz./1000 square feet) applied in November were fungicides that gave the best control. Cold hardiness of bermuda grass following treatments with fungicides were evaluated in a study at Raleigh, North Carolina. Plugs of turf that were treated with Tersan 1991 in the fall survived cold temperatures better than other treatments. The fungicides and cold hardiness evaluations are continuing through the spring of 1988 to obtain two years of data for these experiments.

MONOCLONAL ANTIBODIES FOR RAPID DIAGNOSIS OF SUMMER PATCH AND NECROTIC RING SPOT DISEASES OF TURFGRASSES

OHIO STATE UNIVERSITY
Columbus, Ohio

Drs. William W. Shane &
Stephen T. Nameth,
Principal Investigators

1987 Research Grant: -- $10,000
(One year project)

The diagnosis of summer patch and necrotic ring spot diseases of Kentucky bluegrass, caused by Magnoporthe poae and Leptoshaeria korrae, respectively, is very difficult with current techniques due to non-distinctive disease symptoms and culture characteristics. New technologies are available that allow the rapid identification of micro-organisms through the use of antibodies derived from animal serum. The impact of this new approach is already being felt in the area of turfgrass management. Antibody-based kits are in use or being developed by private companies for detection of pythium blight, brown patch and dollar spot of turfgrass.

Development of antibody-based detection kits for necrotic ring spot and summer patch by private companies in the near future will be less likely because 1) these two newly discovered disease complexes are not well understood, and 2) the two pathogens attack crowns and roots rather than foliage, making sampling and assaying more difficult.

The immediate benefit of antibody-based assay systems for summer patch and necrotic ring spot will be for investigating the characteristics of the two pathogens. A second benefit will likely be a straightforward diagnostic test suitable for use by clinics and turf managers.

MECHANISMS FOR HEAT TOLERANCE IN ANNUAL BLUEGRASS

OHIO STATE UNIVERSITY
Columbus, Ohio

Dr. Karl Danneberger
Principal Investigator

1987 Research grant: $15,000
(last year of support)

Initial screening of numerous annual bluegrass biotypes revealed a 12 °C difference between the most sensitive and the least sensitive biotypes. Preliminary results show that the difference observed at the whole plant level is also present at the cell level. A number of factors govern heat tolerance in turfgrass plants. Our research is specifically looking at what role heat shock proteins play in high temperature tolerance of annual bluegrass and other turfgrass species.

Heat shock proteins (HSP) are proteins that form during periods of high temperature stress. Normal protein synthesis shuts down at high temperatures while HSP are beginning to synthesize. Their occurrence is ubiquitous in nature but their role in heat tolerance is not fully known.

The purpose of this research is to determine if HSP synthesis varies in annual bluegrass and other grasses regarding temperature and the rate of synthesis. In addition, we are trying to determine the location of the HSP genes on genomic DNA from turfgrasses.

Considerable progress has been made in investigating mechanisms of heat tolerance and stress in *Poa annua* L. over the past two years. This report does not represent the final version as we are currently finishing up a number of experiments and a more complete and formal report will be forthcoming.

BREEDING AND EVALUATION OF SEEDED COLD TOLERANT BERMUDAGRASS

OKLAHOMA STATE UNIVERSITY
Stillwater, Oklahoma

Drs. Charles Taliaferro,
J.A. Anderson, M.P. Kenna
Principal Investigators

1987 Research Grant: $20,000
(Second year of support)

The work at Oklahoma State University in developing a cold tolerant, fine leaf, seeded turf-type bermudagrass has gone exceedingly well in 1987. Neither nature nor mankind has ever produced such a grass plant before but certain scientific break-throughs have been accomplished by Dr. Taliaferro in 1987 and the outlook is exciting. Oklahoma State research with pasture type bermudagrasses has been going on for more than 20 years. Now, due largely to USGA financial support, turf type bermudas are receiving major attention and chances of successfully breeding superior, cold tolerant types have never been greater.

In the past year, this research team has accomplished a three-fold increase in basic plant fertility; i.e., a three-fold increase in the florets setting seed while, at the same time, making improvements in leaf texture. A total of 2500 new F_1 progeny were established in field nurseries for evaluation in 1987. Approximately 100 of these have been selected for further turf trials in the spring of 1988.

A new, creative technique has been developed for the rapid screening of cold tolerance in new cultivars. This will enable a turnaround time of two days by one technique, three to four weeks by another vs. an entire winter of field testing by older methods.

Successful tissue culture regeneration of plants from immature inflorescences was also achieved. This is an important break-through in developing haploid plants and subsequent homozygous lines for production of uniform F_1 hybrid progeny.

Several genotypes are currently being screened in replicated turfgrass variety trials. Texture and turf quality are approaching that of 'Midiron' and U-3 bermuda. Rate of coverage from vegetative material for these genotypes was superior to 'Tifgreen,' 'Tifway' and 'Midiron.' Several plants from the breeding populations were identified as potential parents for use in synthesizing new seeded varieties. Seed from these crosses will be evaluated this year in Stillwater, Oklahoma, and increased for evaluation next year by outside cooperators.

BENTGRASS BREEDING

PENNSYLVANIA STATE UNIVERSITY
University Park, Pennsylvania

Dr. Joseph M. Duich
Principal Investigator

1987 Research Grant: $4,000
(ongoing support since 1958)

1. Colonial Bentgrass

In order to more fully explore breeding possibilities, different types of nutrient systems (media) are being evaluated for their ability to induce callusing of microspores in the culture of haploids. Although success has been limited to date, the tests continue with different media. A morphological study is also in progress to better understand another development using techniques established for fixing a microtome sectioning of paraffin embedded materials.

In the past year, there have been 13,000 selfed and 18,000 open pollinated colonial bentgrasses (1st to 4th generation) screened for rhizome development. Selections have been made and planted in the nursery for further selfing and crossing in 1988. Seed was harvested from 87 early rhizome forming types, 24 new selections (1st generation), 600 selfed and open pollinated plants and 460 other colonials which survived disease screening for <u>Phialophora</u> and <u>Leptophaeria.</u>

2. Creeping Bentgrass

Approximately 500 creeping bentgrasses which survived Patch Disease organisms were individually harvested and will be planted for further screening. Also harvested were 13 early maturing types in the hope of spreading harvest dates in production fields to avoid weather disasters such as occurred in 1984. Turf quality screening will be done from several generations of reselected material as well as over 100 European creeping bentgrasses.

In the Fall of 1987, plots were established to evaluate non-certified Penncross bentgrass seed and significant differences are already evident. Laboratory electrophoresis analysis is being conducted to distinguish genetic variations.

SELECTION AND BREEDING OF SUPERIOR BENTGRASSES

UNIVERSITY OF RHODE ISLAND
Kingston, Rhode Island

Dr. Richard Skogley
Principal Investigator

1987 Research Grant: $5,000
(ongoing support since 1960)

During 1987 nearly 1000 grass selections were made from old turf stands in Northeastern and North Central United States. Among this group were about 325 bentgrasses -- the majority being colonials. Many of these selections were from old cemeteries, some over 200 years old.

Trial evaluations continue with 32 advanced generation creeping and velvet bentgrasses for putting green use. Two creeping bentgrasses are being increased in Oregon for potential release. "Providence" is the designated name for one of them and is already in trial at a few national locations. An improved, dark green velvet bentgrass is also being evaluated and increased.

There are nearly 100 colonial bentgrass trials under observation with several of these showing promise as 'improved' selections.

A study of grass mixtures for fairway purposes is continuing. These are being maintained with and without fungicide treatment. The automatic rain shelter constructed in 1986 was utilized during the 1987 season. Cup cutter plugs have been taken from field plots and established within the shelter. There are now 150 selections under drought stress evaluation.

BREEDING AND EVALUATION OF KENTUCKY BLUEGRASS, TALL FESCUE, AND PERENNIAL RYEGRASS FOR GOLF

RUTGERS UNIVERSITY
New Brunswick, New Jersey

Dr. C. Reed Funk
Principal Investigator

1987 Research Grant: $5,000
(ongoing support since 1961)

Turfgrass germplasm collections have continued in 1987 from a number of non-irrigated turfs throughout the northeastern states. Certified seed of a number of improved cultivars is being developed in tall fescues, perennial ryegrasses and Kentucky bluegrass. Plant resistance to disease and insect pests is being assessed and the search for endophytic fungi in certain grass species also continues.

PLANT STRESS MECHANISMS

TEXAS A&M UNIVERSITY
College Station, Texas

Dr. James B. Beard
Principal Investigator

1987 Research Grant: $70,000
(fifth year of support)

Accomplishments to date:

A. Scientific Contributions:

1. Based on the development of a sophisticated set of physical experiments, it was proven that canopy resistance is the major factor controlling evapotranspiration rates from turfgrasses rather than stomatal resistance.

2. A high shoot density and more horizontal leaf orientation plus a low leaf area based on a slow leaf extension rate and narrow leaf width are the plant morphological factors that are most significant in controlling evapotranspiration from turfgrasses.

3. Stomatal density and size has little influence on evapotranspiration rates.

4. The first comprehensive understanding of root hair morphology and viability among the major warm-season turfgrass species has been developed. Based on this work, it is evident that a lack of root hair number, length and/or viability can contribute significantly to reduction in drought resistance.

5. The environmental factors inducing spring root decline has shown that carbohydrate partitioning away from the roots is strongly associated with the root dieback phenomenon.

6. The specific plant morphological and/or physiological characteristics most important in contributing to drought resistance of individual warm-season turfgrass species have been identified.

B. Breeding Contributions:

1. From a breeding strategy standpoint, it has been demonstrated that at the interspecies and intraspecies levels those with the deepest and most extensive root systems are characterized by a high verdure and shoot growth rate.

2. A great range in diversity has been found at the intraspecies level for the canopy resistance and leaf

area components controlling evapotranspiration. This indicates that the generic material is available to the breeder to develop low water use rate cultivars.

3. Among warm-season species, the key limiting factors affecting drought resistance have been delineated. These vary greatly among the major warm-season turfgrasses including shallow rooting, high evapotranspiration rates, slow stomatal closure, minimal wax covering of the leaf/stomatal surface under water stress, and inferior internal tissue water stress tolerance.

C. Cultural Contributions:

1. For the first time, the comparative rooting potentials of the major warm- and cool-season turfgrass species have been characterized and published. Under mowing, the rooting depths range from 12 inches to 8 feet.

2. The comparative drought resistance of the major warm-season turfgrass species and cultivars have been investigated and published.

3. The concepts with respect to high canopy resistance and low leaf area have shown specific cultural practices that can be used in lowering the evapotranspiration rate. For the most part these are based on a low leaf area and slow leaf extension rate. Included are a low cutting height, moderate to low nitrogen fertility level, judicious irrigation and the use of shoot growth inhibitors.

4. The lack of effectiveness of stomatal antitranspirants for use in reducing evapotranspiration from turfgrasses has been demonstrated.

BROWN PATCH AND PYTHIUM DISEASE RESISTANCE IN BENTGRASS AND ZOYSIAGRASS

TEXAS A&M UNIVERSITY
Dallas, Texas

Dr. Phillip F. Colbaugh
Principal Investigator

1987 Research Grant: $10,000
(first year of support)

This project was initiated on April 1, 1987. The period from April 1 to November 1 has been spent assembling isolates of *Rhizoctonia* spp. and *Pythium* spp. for pathogenicity studies on the Bentgrass and Zoysiagrass Breeding and Genetics Project germplasm lines.

The efforts in this area have yielded some 40 isolates of *Rhizoctonia* spp. and 28 isolates of *Pythium* spp. from various grasses and environmental regimens throughout the U.S. A few isolates of *Rhizoctonia* and several isolates of *Pythium* spp. are due to arrive from other turfgrass pathology laboratories for a full representation of fungal species in each group. With the exception of a few fungal isolates from other University Laboratories, the pathogenic potential of isolates within the collection largely remains to be determined. Pathogenic isolates of *Pythium* spp. and *Rhizoctonia* spp. will be identified in laboratory and green house inoculation studies during the upcoming winter months (November - February).

Modified greenhouse benches with bentgrass and zoysiagrass and some incubation dishes containing plugs of field-grown turf will be used to assess pathogenicity of all isolates we have collected. Construction of special greenhouse benches is in progress for support of the pathology project with bentgrass and zoysiagrass. Some preliminary greenhouse inoculation studies we conducted with *Rhizoctonia* spp. isolates collected during the spring varied considerably in pathogenicity on Raleigh St. Augustinegrass.

Other diseases noted on bentgrass and zoysiagrass during the past spring, summer and fall seasons included an unidentified soil-borne fungal disease of zoysiagrass on the TAMU-Dallas field plots and on samples from St. Louis, Missouri. The disease appears to be very damaging during the spring and early summer and is presumed to be a *Leptosphaeria* type of soil-borne disease. Dollarspot disease was also noted to be very severe on the fine-leaved "Emerald" Zoysiagrass but not on the thicker leaved variety "Meyer" during the spring and fall growing seasons. Fungicide tests we conducted in the spring indicated the disease could be easily controlled with one or two applications of iprodione or chlorothalonil and recommmended use rates.

The first set of notes were taken during October on the experimental varieties of zoysiagrass. These observations, although preliminary, suggest that most of the elite collection of 25 Zoysiagrass selections were apparently not dollar spot susceptible. More detailed data will be collected on these experimental lines during the 1988 growing season.

BREEDING AND DEVELOPMENT OF ZOYSIAGRASS

TEXAS A&M UNIVERSITY
Dallas, Texas

Dr. M. C. Engelke
Principal Investigator

1987 Research Grant: $40,000
(fifth year of support)

Major regional field trials were initiated with cooperators for several states providing comparative evaluation of four experimental DALZ zoysia varieties with four commercially available zoysiagrass cultivars, including 'Meyer,' 'Emerald,' 'Belair,' and 'El Toro.'

Additional trials have been established to evaluate sod production potential (Ferris, Texas), and under the Linear Gradient Irrigation System (LGIS) at Texas Agricultural Experiment Station (TAES) -- Dallas to determine water use requirements. A replicated management study will be planted in the Spring of 1988 to evaluate the optimum nutritional requirements and influence of mowing height/frequency on turf quality and persistence. The establishment rate of the experimentals show considerable promise, however, the primary reason for their selection is related to the high rhizome production, and their inherent ability to recover following sod harvest, or divot injury.

Numerous agronomic and biological characteristics are presently being assessed on the DALZ lines selected during 1985, including shade tolerance (Dallas), salinity tolerance (El Paso), water use requirements (Dallas and College Station), disease (Dallas and Carbondale, Illinois), sod traits (Dallas), nutritional requirements (Missouri), putting quality (Dallas), and general turf adaptation (Arizona, Oklahoma, Illinois, Missouri, California and Dallas). The database developed through cooperation with scientists at each of these locations will provide the basis for releasing and recommending the use and distribution of new varieties. Two of the DALZ lines may be increased under foundation field conditions (~0.40 ha during 1988) to provide sufficient planting stock for potential release in the early 1990's.

Selections have been made from open-cross progeny which were field planted in 1985 without the benefit of irrigation or fertilization. These plants will be advanced into replicated field management/ varietal evaluation trials to determine their agronomic strengths.

Twenty-seven plants from the Oriental collection have been selected for their seed production potential. Progeny from each of the clones will be evaluated for agronomic traits and seed production to identify superior parental clones for turf quality and seed production potential.

BREEDING AND DEVELOPMENT OF BENTGRASS

TEXAS A&M UNIVERSITY
Dallas, Texas

Dr. M. C. Engelke
Principal Investigator

1987 Research Grant: $40,000
(Third year of support; $20,000 of the 1987 total was contributed by Bentgrass Research, Inc. of Fort Worth, Texas)

The Bentgrass Breeding Program at Texas A&M - Dallas was initiated in April 1985 as a joint effort between the United States Golf Association, Bentgrass Research, Inc., and the Texas Agricultural Experiment Station.

The Germplasm Introduction Nursery presently contains over 375 unique vegetative accessions from around the world, an additional 270 advanced generation selections identified for superior heat tolerance and rooting characteristics, and 70 seeded accessions.

Four limited clone Synthetic populations were generated in Oregon during the 1987 pollination season. An additional 77 polycross populations involving the very best of the bent germplasm collection produced sufficient seed for selection within the next generation. Significant differences existed between clones for root extension and root areas, which were used in a specific RHT crossing block in Oregon in 1987, from which seed will be used to conduct parent-progeny regression for root characters. Specific clones have been selected from 'Seaside' bentgrass for improved turf quality, density, and color and have been placed in isolation for development of the first generation of a 'Seaside II' cultivar.

Additional crosses and polycross populations will be created in 1988 based on laboratory, greenhouse, and field data collected in Oregon and at the Texas Agricultural Experiment Station (TAES)-Dallas.

Laboratory and Greenhouse research screening procedures continues at TAES-Dallas with specific emphasis on rooting characteristics and membrane stability (tissue tolerance to high temperatures). New facilities are being constructed in the fall of 1987 to create a Turfgrass Root Investigation Facility (TRIF) for examining root characteristics under field conditions.

Field evaluation trials have been conducted on the putting green and on native soil (simulated Fairway conditions) since 1985. These field trials have provided necessary information concerning thatching tendency, mowing quality, color retention, density of stand etc., to assist in selecting plant materials for the Oregon Crossing Blocks.

The excellent cooperation between the United States Golf Association, and Bentgrass Research, Inc. has been instrumental in implementing the procedures necessary for timely development of a new heat tolerant bentgrass for the golf industry.

DEVELOPING SALT, DROUGHT AND HEAT RESISTANT TURFGRASSES FOR MINIMAL MAINTENANCE

TEXAS A&M UNIVERSITY
El Paso, Texas

Dr. Garold L. Horst
Principal Investigator

1987 Research Grant: $15,000
(fourth year of support)

I. Research Accomplished:

1. Late in 1986, Texas A&M University completed a major research facilities expansion program at the El Paso Research Center. The turfgrass salt resistance program moved into a new controlled environment glass greenhouse with high intensity lighting. This new facility has reduced the time necessary for each salt resistance evaluation run by 10 to 15 percent.

2. Unexpected results of buffalograss salt resistance research is differences in germ plasm susceptibility to Pythium spp. in the vegetative establishment phase of development. About 15 percent of the entries evaluated appear to be susceptible.

3. Additinal evaluation runs on the current buffalograss germ plasm base indicate a low potential of rapidly obtaining salt resistant cultivars.

4. Initial salt resistance evaluation of 29 zoysiagrass selections from a diverse germ plasm base indicate high potential of obtaining salt resistant cultivars. Seventeen percent of the selections were able to maintain significant growth at salt levels half of that found in sea water.

5. Selections from the buffalograss improvement program under the direction of Dr. Terrance P. Riordan, University of Nebraska, recently arrived. This is the germ plasm base which will make up the synthetic scheduled for future release.

6. Salt resistance evaluation of three current turfgrass types have now been completed or are well under way. Salt resistance ranking of these turfgrasses is of the following order from least to most salt resistant. Buffalograss, St. Augustinegrass, and Zoysiagrass.

II. Current Research:

Vegetative material of 29 buffalograss and zoysiagrass germ plasm entries are being evaluated for salt resistance.

III. Research Planned:

1. Complete evaluation of current buffalograss germ plasm. Begin evaluation of the Nebraska buffalograss synthetic germ plasm in summer 1988.

2. Complete evaluation of Zoysiagrass germ plasm (1988 to 1989).

3. Receive and increase bentgrass and bermudagrass germ plasm. Thirty-two advanced bentgrass selections are scheduled from the Texas improvement program, under the direction of Dr. M. C. Engleke. Evaluation for salt resistance may begin by late spring to summer 1988.