SECOND
ANNUAL PROGRESS REPORT

concerning

BREEDING AND DEVELOPMENT OF BENTGRASS

submitted by

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EXECUTIVE SUMMARY
SECOND ANNUAL PROGRESS REPORT
BREEDING AND DEVELOPMENT OF BENTGRASS

Principle Investigator: Dr. M. C. Engelke

Research Associate: Ms. Virginia G. Lehman

RESEARCH PERIOD OF THIS REPORT: 2 November 1985 to 1 November 1986
Reference semi-annual report filed: May 1, 1986.

In April 1984, the Texas Agricultural Experiment Station, Bentgrass Research, Inc., and the United States Golf Association embarked upon a joint endeavor to develop bentgrasses which are genetically adapted to environmental conditions in the Southern United States. The germplasm collection currently includes over 530 vegetative accessions, 168 seeded accessions, 300 'Seaside' selections, and ten commercial or experimental varieties. Facility development to accomodate testing of this material has continued, with Bentgrass Research, Inc. constructing a new 1610 sq. meters (17,000 sq. ft.) sand base research green, with completion expected by 1 November, 1986. Field, laboratory, and greenhouse experiments are progressing toward identification of superior genotypes.

Testing is currently in progress in a greenhouse heat bench to determine sensitivity of seven cultivars and two experimental varieties to heat stress. Initial results indicate differences do exist between genotypes. Characterizaton of root systems to identify plants which will avoid heat-induced drought stress continues. Forty-seven Seaside and Seaside-RHT plants have been screened, with fifty additional clones under current evaluation. Completed evaluations indicate differences exist between genotypes. A manuscript summarizing the results from the first evaluation was submitted to the Texas Turfgrass Research Report - 1986. Preliminary laboratory evaluations to determine if selection for root heat tolerance has influenced shoot heat tolerance indicate significnt differences in shoot hydration exists between genotypes when grown under stress.

Field testing under both native blackland soils and root zone modified 'USGA sand based greens' conditions continue. Two-hundred thirty elite vegetative accessions were planted on blackland soil during May 1986, with turf quality ratings indicating approximately 25 % of these express superior adaptive characters. In addition, approximately 25% of the ELITE genotypes planted on the sand base green performed in a superior manner during 1986. Two-hundred ninety-four plants of Seaside and Seaside-RHT were planted during April 1986. Periodic evaluations indicated tremendous genotypic differences in spread, texture, density, color, and overall quality, with 46 clones ranking in the top quality group. Selection for root heat tolerance has not adversely affected the quality characters evaluated.

A project contract was established in 1985/86 with Dr. Jerry Pepin, and Pickseed West, Inc. Tangent, Oregon, to assist the breeding program in seed production of elite and synthetic germplasm resources. Floral initiation and development did not occur in the field plantings at Dallas during 1986, but was successful in Oregon. The plantings of elite germplasm in Oregon determined cross-compatability dates for the genotypes, and generated sufficient seed quantities for advanced generation testing. Three synthetics have been composed and have been transferred to Oregon for 1986-87 production.

Research for 1987 includes planting of newly acquired germplasm on the newly constructed research green. Selection for heat tolerance utilizing the greenhouse heat bench will continue with the seeded accessions. Laboratory procedures to test shoot and root heat tolerance are planned. Evaluation of root systems will continue in the greenhouse, with field plantings on the new green to correlate with the greenhouse information. Selected single crosses will be made in the greenhouse and soon to be constructed crossing chambers for progeny production. Selected genotypes which possess genetic tolerance to heat stress will be evaluated in Oregon for floral characters and seed production potential.

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ANNUAL REPORT NOVEMBER 1986

BREEDING AND DEVELOPMENT OF BENTGRASS

I. INTRODUCTION

This annual report, as required in the contract, is for the period of 1 November 1985 to 1 November 1986. Ms. Jo Ann Treat, President, Texas Research Foundation, and Mr. Charles W. Smith, Director of Administration and Services for the United States Golf Association, signed the original contract agreement effective 8 April 1985. The first annual report was submitted 1 November 1985, and the semi-annual report was filed in May 1986.

II. PERSONNEL

The Bentgrass breeding project includes a full time Research Associate (RA) position with additional funding available in the budget to provide approximately a 1/4 time technical assistant. Ms. Virginia Lehman continues in the position of Research Associate while simultaneously pursuing her graduate work toward completing the Ph. D. degree in Turfgrass Breeding. Additional funds have been provided through the Texas Agricultural Experiment Station to enable hiring a 1/2 technical assistant (TA) to support this program. The TA position is presently vacant however, several contacts have been made and candidates identified to refill this support position.

III. IMPLEMENTATION

A. GERMPLASM ACQUISITION

INTRODUCTION: Collection of plant materials which possess genetic variability in the desirable characters of the species is essential to the conduct of every plant breeding program. With the ultimate goal of creating new plant types which possess multiple desirable traits, the first and limiting step to improvement is the assemblage of plants possessing desirable characteristics.

OBJECTIVE: Assemble a germplasm pool of unique bentgrasses possessing genetic characteristics which reduce or eliminate the biological limitations of the species under natural environmental conditions

PROGRESS: As reported in the semi-annual report filed May 1986, 39 seeded accessions from U.S. academic and industrial cooperators and 'Duchess', a commercial cultvar from Ireland, had been added to the germplasm pool. Since then an additional 200 European vegetative accessions have been added to bentgrass collection. This material was collected in Europe by Mr. H. Kauerer, formerly of Northrup King, from at least six locations. Approximately 100 clones originated from the Rome, Italy Acquasanta Golf Course. Sixty or more clones were collected from the Nimes, France Campagne Golf Course. The remainder of the material came from Beaucaire Park, Avignon, France; Perugia, Cannes and Firenze Golf Clubs. Mr. Kauerer collected from fairways, greens, heavy shade, and park areas.

This addition to the collection should prove to be a valuable source of germplasm. The new additions to the collection have been propagated in the greenhouse, in preparation for field planting.

FUTURE WORK: The evaluation phase of new germplasm continues. The material added to the collection from Mr. Kauerer will be planted during November 1986 in the germplasm introduction nursery. The nursery will be planted on a new 17,000 square foot sand based research green currently under construction. This green is being constructed through major support from Bentgrass Research, Inc., and is scheduled for completion by 1 November 1986.

B. GERMPLASM ASSESSMENT

INTRODUCTION: The amount of heritable diversity available in plant populations define the limits of improvement possible for a given character. It is necessary to evaluate each plant for its potential value as a parent in the breeding program. This characterization is reviewed with regard to greenhouse, field, and laboratory techniques.

1A. GREENHOUSE - RESPONSE TO HIGH SOIL TEMPERATURES

OBJECTIVES: Determine the response of seeded experimental and commercial varieties to high soil temperatures.

JUSTIFICATION: Bentgrass is being utilized more frequently in the Southern United States than in past years. Several cultivars of diverse genetic origin, are commercialy available. Little information is available on their relative tolerance to high soil temperatures. Evaluation of the relative heat tolerance of these cultivars should aid in proper selection for use in specific environments.

PROGRESS: Seven cultivars ('Penncross', 'Penneagle', 'Prominent', 'Emerald', 'Kingston', 'Duchess', and 'Seaside') and two experimentals (ISI HK and PSU 126) were seeded during July 1986. Seeding rate was 0.1 g per 15 x 15 cm plot. The plant material was maintained at 2.5 cm height, and sprayed periodically with pesticides as needed to prevent damping off and mite damage. The material was allowed to grow to a mature turf, with soil heating initiated on 23 September 1986. Temperatures were monitored at 10 cm below soil surface. Turf performance is being evaluated as percent green tissue in each plot area. The study will be completed by 15 November 1986. Preliminary results indicate that Kingston velvet bent has the least tolerance to the heat treatment. As the study nears completion, individual planta will be selected from each of the cultivars, and will be further evaluated as genotypes with potential tolerance to high soil temperatures. In addition, 51 seeded genotypes of diverse orgin were seeded in single plantings. Individual plants will be selected from these plots as well. Germplasm used in this study was provided by Dr. Richard Skogley, and several independent and commercial plant breeders.

1B. GREENHOUSE - CHARACTERIZATION OF ROOTS

1. OBJECTIVE: Comparison of root characters of Seaside and Seaside-RHT bentgrass populations.

JUSTIFICATION: Numerous morphological and physiological characters of a plant contribute to its biological performance. A short root system may contribute to a situation that Levitt (1980) terms secondary heat-induced drought injury. Krans and Johnson (1974) found such a situation when creeping bentgrass was irrigated by three different methods. Bentgrass which was sub-irrigated developed a longer root system which aided in avoiding desiccation, which sprinkler-irrigated plants with short root systems incurred.

PROGRESS: Two phases of the study have been completed, with characterization of a total of 47 Seaside and 47 Seaside-RHT(A) plants for root length. The mean root length of plants in each of the populations was not significantly different, however, highly significant differences existed between plants within and between each population. Seaside-RHT averaged 489 mm in root length (averaged across both studies) with roots ranging in length from 309 to 620 mm. By comparison, 'Seaside' averaged 473 mm in length with a range from 237 to 617 mm (Table 1). This data suggests that the individuals with the shortest roots were was eliminated from the RHT population through selection under high soil temperatures. This is further supported by the distribution of roots through the soil profile (Table 2). The Seaside population have 36.6% of its total root mass in the upper 10 cm and 60% in the top 20 cm in contrast to 33.8% and 55%, respectively for the RHT population. Individual plants with the longest root systems, regardless of their source have been selected and will be utilized in future studies. A number of these same plants have been included in hybridization programs to further define mechanisms of inheritance of rooting characteristics in turf.

TABLE 1. The range and mean root lengths of Seaside and Seaside-RHT grown in greenhouse root tubes.

	POPULATION	
	RHT	SEASIDE
	root length (mm)	
STUDY 1	439	402
STUDY 2	529	545
avg root length	489	473
range in root length	309 - 620	237 - 617

Table 2. Distribution of roots throughout the soil profile for Seaside and Seaside-RHT expressed as % of total root mass., averaged over two studies.

	POPULATION	
	RHT	SEASIDE
depth (mm)	% total root mass	
0-100	33.8	36.6
100-200	55.0	60.0
200-300	72.6	75.4
300-400	84.0	85.6
400-500	93.0	93.2
500-600	100.0	100.0

FUTURE WORK: Fifty additional clones selected from Seaside and Seaside-RHT are currently, under evaluation for similar characteristics. Individual clones will be selected for inclusion into a synthetic nursery for seed production and subsequent progeny evaluation. Data analysis regarding root number and tiller number for the second study is in progress.

2. OBJECTIVES: Characterize the rooting systems of the elite bentgrass germplasm.

JUSTIFICATION: The elite bentgrass germplasm collection at TAES-DALLAS was assembled from plants obtained from Japan, Europe, and from throughout the Southern United States. Many of these plants represent local 'ecotypes' and are products of natural selection. Biological characters inherent to these plants have given them an evolutionary advantage. If these traits can be identified, and if they are under strong genetic control, they will be useful in cultivar development.

PROGRESS: Twenty elite clones were evaluated in sand during the fall of 1985. A second study was initiated in the fall of 1985, using black grit (a granular material used in sandblasting) as a root support media. These studies were completed, but plant growth was not ideal, and improved techniques have been implemented in later studies. The root screening procedure is designed to evaluate approximately 300 plants simultaneously. The agreement in performance between the Seaside and Seaside-RHT studies indicates the effectiveness of the tests.

FUTURE WORK: The root screening procedure is currently being used at its maximum to screen Seaside and Seaside-RHT(A) clones for differences in root characters. When these studies are complete (projected date, June 1987), the characterization of the elite clones will commence.

2A. LABORATORY - TISSUE TOLERANCE TO HIGH TEMPERATURES

INTRODUCTION: The ability of a plant to survive high temperature extremes may be attributed to several mechanisms including both avoidance and tolerance. Wallner et al. (1982) was effective in distinguishing between the shoot heat tolerance of some grasses by measuring the electrolyte leakage in solution before and after the tissue was subjected to heat stress.

1. OBJECTIVE: Determine if selection for heat tolerance in root systems has altered heat tolerance in leaf tissue of the plant.

JUSTIFICATION: Selection of plant materials for increased heat tolerance in root systems may indirectly select for increased shoot tissue heat tolerance.

PROGRESS: Twenty clones from Seaside and Seaside-RHT were vegetatively propagated in the greenhouse, replicated 8 times.

Four replications were grown in a heated soil bench, which averaged 5 C higher than the remaining four replications which were maintained at ambient greenhouse conditions. Ten leaf sections, 2.5 cm in length, were harvested from each plant, rinsed in distilled water,and suspended in 10 ml of distilled water. Electrolyte concentrations were measured after they were placed in a water bath at 54 C for 30 minutes. The temperature in the water bath was elevated to 70 C, and the tissue placed in the bath for 30 minutes to kill the tissue. Solute concentration was measured again. The data analyzed consisted of electrolyte leakage after 30 minutes of stress divided by total electrolyte concentration after death. The data was analyzed with a square root-arc sine transformation. A total of 320 samples were analyzed. The results were inconclusive, with no differences detectable between populations or individual clones.

FUTURE WORK: This study will be repeated, with additional refinments in technique and instrumentation. Specific empahsis will be directed to improve control and monitoring of temperature in the water bath. Additionally, the critical exposure temperature for cell injury will be reassessed and altered where needed. The temperature may not have been high enough to impose stress upon the tissue to distinguish between clones.

2. OBJECTIVE: Examination of Seaside-RHT and Seaside for various morphological characters which may identify traits critical to heat tolerance.

JUSTIFICATION: Resistance or tolerance to specific adverse environmental conditions may be the result of a qualitative (presence or absence of wax) or a quantitative character (moisture content). By examination of the Seaside-RHT and Seaside clones for constituent morphological characters, possible characters contributing to heat tolerance may be identified.

PROGRESS: Clones of Seaside-RHT and Seaside were placed under two soil temperature treatments (see Section 2.A.1.). Ten grams of shoot tissue were harvested from each clone, replicated four times, from each of two treatments. Only 19 of the 20 clones produced enough tissue to conduct this test. Fresh tissue weights were recorded, the tissue was dried at 80 C for 24 hours, and dry weights were recorded. There were no significant differences between populations or clones when the plants were held at ambient greenhouse temperatures. There were significant differences between clones within populations of plants which were preconditioned at higher temperatures, but not between populations (Table 3). Of significance is the importance of pretreatment under stress to distinguish morphological differences that may contribute to heat tolerance or resistance.

Table 4. Mean quality ratings of elite creeping bentgrass germplasm for 1985-86, established at Dallas, TX on a sand base green.

Genotype	Mean Quality	Leaf Width	Collection/ Source
A72	8.1a*	0.94j-o	Kneebone/Ariz.
Peagl2897	8.0ab	1.10e-o	Penneagle/MSU
ShadyOK8	8.0ab	1.27b-o	ShadyOak/ TX
MCC-3Con	7.9abc	.	MCC-3/ OK. State
A762	7.7a-d	1.44b-g	Kneebone/Ariz.
BH2754	7.6a-e	0.92l-o	TX
A85	7.6a-e	1.03f-o	Kneebone/Ariz.
BH2764	7.5a-f	1.01f-o	TX
ShadyOK2	7.4a-f	1.21b-o	ShadyOak/TX
A761	7.4a-g	1.18c-o	Kneebone/Ariz.
Twinhill1	7.4a-g	1.25b-o	Twinhill/OK
A72?	7.4a-g	1.13e-o	Kneebone/Ariz.
ShadyOK1	7.4a-h	1.32b-o	ShadyOak/TX
BH2766	7.3a-i	0.96h-o	TX
BH2758	7.3a-i	0.95i-o	TX
GoldAcre2	7.3a-i	1.47b-f	GoldAcre/TX
BH2763	7.2a-i	1.17c-o	TX
Pcross2994	7.2a-i	.	Penncross Std./TX
Pittmann	7.2a-i	1.20b-o	Ariz.
ShadyOK6	7.2a-i	1.12e-o	ShadyOak/TX
ShadyOK5	7.1a-j	1.23b-o	ShadyOak/TX
A69	7.1a-j	1.35b-n	Kneebone/Ariz.
BH2756	7.1a-j	.	TX
ShadyOK4	7.1a-j	1.30b-o	ShadyOak/TX
ShadyOK7	7.0a-k	1.16e-o	ShadyOak/TX
BH2767	7.0a-k	1.07e-o	TX
BH2769	7.0b-k	1.21b-o	TX
GoldAcre4	6.9c-k	.	GoldAcre/TX
BH2755	6.9c-k	1.10e-o	TX
BH2771	6.9c-k	0.92l-o	TX
ShadyOK3	6.9c-m	1.03f-o	
A77	6.8d-n	1.23b-o	Kneebone/Ariz.
Jacksbo3	6.8d-n	1.20b-o	Jacksboro/TX
BH2745	6.8d-o	0.92mno	TX
V858WWK	6.7d-o	1.06e-o	MSU
U1418	6.6e-q	1.40b-k	TX
Peagl2900	6.6e-q	1.07e-o	Penneagle/MSU
HCC-7-2	6.6e-r	1.29b-o	OK State/OK
MCC-3	6.6e-r	1.16e-o	OK State/MCC-3 sel
BH2761	6.6e-r	1.09e-o	TX
Dummy2	6.5f-s	1.38b-m	MSU
BH2751	6.5f-s	1.15e-o	TX
A18	6.5f-s	2.00a	Kneebone/Ariz.
V852WWK	6.5f-s	1.18c-o	MSU
BH2762	6.4g-t	0.93k-o	TX
A69?	6.4g-t	1.65abc	Kneebone/Ariz.
A39	6.4g-t	1.42b-j	Kneebone/Ariz.
Decatur4	6.4g-t	1.52a-e	Decatur/TX
BH2752	6.4h-u	1.31b-o	TX
BH2759	6.4h-u	0.90no	TX
BH2760	6.4h-u	1.11e-o	TX
MSU18	6.3i-v	1.08e-o	MSU
V851WWK	6.3i-v	1.17d-o	MSU
BH2749	6.3i-v	0.98h-o	TX
Toronto	6.3i-v	1.10e-o	MSU
Emer2899	6.3i-v	1.14e-o	Emerald/MSU
BH2765	6.1j-v	1.12e-o	TX
BH2758	6.1j-v	0.95i-o	TX
TwinHill2	6.1k-x	1.19b-o	Ok.City/OK
PSU126	6.0l-y	.	Tee To Green
BH2747	6.0l-y	1.18c-o	TX
Dummy1	6.0l-y	0.90no	MSU
Rivcrest1	5.9m-z	1.14e-o	RiverCrest/TX
Rivcrest3	5.9n-z	0.98g-o	RiverCrest/TX
Pcross3001	5.9n-z	.	Penncross/Int. Seeds
A89	5.8o-z	1.06e-o	Kneebone/Ariz.
A23	5.8o-z	1.42b-i	Kneebone/Ariz.
Rivcrest5	5.7p-a	1.64a-d	RiverCrest/TX
BH2753	5.7p-a	0.98g-o	TX
A742	5.7p-a	0.85o	Kneebone/Ariz.
A90	5.7q-a	0.91mno	Kneebone/Ariz.
BH2757	5.6q-a	1.03f-o	TX
MSU38	5.6r-a	1.07e-o	MSU
Pcross2886	5.6r-a	1.27b-o	Penncross/MSU
Peagl3003	5.6s-a	.	Penneagle/Int. Seeds
BH2750	5.6s-a	1.16e-o	TX
A741	5.4t-b	1.06e-o	Kneebone/Ariz.
BH2772	5.4t-b	1.01f-o	TX
Dummy3	5.3u-b	1.36o-n	MSU
B853WWK	5.3v-b	1.1e-o	MSU
Rivcrest4	5.3v-b	1.47b-f	Rivercrest/TX
U2380	5.3v-b	1.31b-o	TX
A61	5.2w-b	1.42b-i	Kneebone/Ariz.
MSU28	5.1w-c	1.24b-o	MSU
A21	5.0x-d	1.41b-i	A21
Carmen	5.0z-d	1.36b-n	MSU
Rivcrest2	4.9a-d	1.23b-o	Rivercrest/TX
Decatur1	4.7a-e	1.44b-h	Decatur/TX
Decatur3	4.7a-e	1.32b-o	Decatur/TX
Decatur2	4.5b-e	0.99f-o	Decatur/TX
Cohansey	4.5b-e	1.03f-o	OK. State/OK
Emer3002	4.4b-e	.	Emerald/Int. Seeds
Jacksbo2	4.1c-e	1.53a-e	Jacksboro/TX
Sea2896	4.0d-f	1.3b-o	Seaside/MSU
Prom2891	3.8e-f	1.37b-n	Prominent/MSU
ISI1985HK	3.8e-f	.	Private source
Jacksbo1	3.7e-f	1.47b-e	Jacksboro/TX
J083-6	3.3f-g	1.66ab	Japan
Sea3000	2.5g	.	Int. Seeds
Prom2960	2.4g	.	Prominent/Robinson

*Means listed in this table with the same letter are not significantly different at the k=100 level using the Waller-Duncan k ratio test.

3. OBJECTIVES: Determine differences in agronomic performance between Seaside and Seaside-RHT(A) and(B) under greens conditions.

JUSTIFICATION: On heavy, native soils, bentgrass tends to thatch heavily. To avoid the problems associated with thatching, modified soil sites, consisting primarily of sand, are utilized to improve drainage. Use of sandy soils may contribute to heat stress in bentgrass due to interference with the transpirational cooling mechanism. Field testing of bentgrasses selected for heat tolerance in the laboratory and greenhouse is necessary to determine the effectiveness of such selection. Seaside-RHT (A) and (B)were selected under greenhouse conditions specifically for their ability to survive high soil temperatures.

PROGRESS: Vegetative propagules of 294 plants of Seaside, Seaside-RHT (A), and Seaside-RHT (B) creeping bentgrass were established to the sand based green in April 1986. The RHT (B) population consists of additional plant material selected from the heat bench which was exposed to additonal heat and drought stress beyond that received by the RHT (A) group. Plot size is 30 x 45 cm. The material has been fertilized with 3.3 lbs. of N since planting. Quality evaluations, which include the components of color, spread, denisty, texture, and growth type have been taken oven the summer (Table 8). Significant differences are indicated in performance between clones, but no shift in the selected populations occurred in the criteria evaluated (Tables 6 and 7). This information indicates that selection for heat tolerance has not adversely affected the quality performance of the RHT populations.

3B. FIELD - AGRONOMIC ASSESSMENT

INTRODUCTION: The development of new turfgrasses requires careful consideration be given to the mechanisms of reproduction. The availability of the product determines feasible use, so that it must be produced efficiently and economically. Seed production is also essential to the plant breeder so that new hybrids may be produced to manipulate the genetic resources.

1. OBJECTIVE: Induce flowering in selected bentgrass clones and make selfed and hybrid crosses for progeny evaluation.

JUSTIFICATION: Flowering of bentgrass is necessary for genetic recombination. Creeping bentgrass requires a long-day photoperiod to induce flowering.

PROGRESS: Fifty clones of the elite germplasm collection were established in two replicates in the field at Dallas, Tx during November 1985. The plants were transplanted from 15 cm

Table 6. Number of individual plants in a rating category by population, taken from plants on a sand base green, 30 May 1986.

Population	Color			Texture			Spread			Density		
	-number of plants-											
	0	1	2	0	1	2	0	1	2	1	2	3
Seaside	20	124	4	50	77	21	16	62	70	85	36	27
RHT (A)	25	114	9	42	76	30	16	72	60	89	33	26
RHT(B)	38	105	5	56	70	22	12	53	83	88	38	22

Class

*No significant differences occurred between populations for classes using a chi-square analysis.

Table 7. Number of individual plants in a rating category by population, taken from plants on a sand base green, 9 Sept. 1986.

Population	Color			Texture			Spread			Density		
	-number of plants-											
	0	1	2	0	1	2	0	1	2	1	2	3
Seaside	50	117	23	46	105	39	24	95	71	45	84	61
RHT(A)	35	134	25*	44	109	41	19	85	90*	38	95	61
RHT(B)	48	123	24	50	99	46	25	95	75	53	83	59

*Significant differences did occurr between this population and Seaside for at the p=0.05 level, using chi-square test.

Table 8. Highest ranking clones of Seaside, Seaside-RHT(A), and Seaside-RHT(B) on a sand base green at Dallas, TX for the summer of 1986.

Clone	Source	Quality
105.3	RHT(B)	8.3a
1006.3	RHT(B)	7.8ab
902.1	RHT(A)	7.7ab
801.1	RHT(A)	7.7ab
205.3	RHT(B)	7.7ab
106.3	RHT(B)	7.3abc
406.2	Seaside	7.3abc
1002.1	RHT(A)	7.3abc
201.3	RHT(B)	7.3abc
1003.1	RHT(A)	7.3abc
607.2	Seaside	7.3a-d
1305.1	RHT(A)	7.0a-e
1401.3	RHT(B)	7.0a-e
1201.3	RHT(B)	7.0a-e
1007.1	RHT(A)	7.0a-e
907.2	Seaside	7.0a-e
604.1	RHT(A)	7.0a-e
507.1	RHT(A)	7.0a-e
1004.1	RHT(A)	7.0a-e
1407.2	Seaside	6.8a-f
1404.1	RHT(A)	6.8a-f
406.1	RHT(A)	6.8a-f
301.23	RHT(B)	6.7a-f
101.2	Seaside	6.7a-f
306.3	RHT(B	6.7a-f
203.1	RHT(A)	6.7a-f
206.1	RHT(A)	6.5a-g
1306.2	Seaside	6.5a-g
1201.2	Seaside	6.5a-g
1402.2	Seaside	6.5a-g
1006.1	RHT(A)	6.5a-g
402.2	Seaside	6.5a-g
1407.1	RHT(A)	6.5a-g
901.3	RHT(B)	6.5a-g
206.3	RHT(B)	6.3a-g
407.2	Seaside	6.3a-g
502.3	RHT(B)	6.3a-g
102.1	RHT(A)	6.3a-g
1404.2	Seaside	6.2a-h
1404.3	RHT(B)	6.2a-h
1103.1	RHT(A)	6.2a-h
802.2	Seaside	6.2a-h
1406.3	RHT(B)	6.2a-h
1401.1	RHT(A)	6.2a-h
605.3	RHT(B)	6.2a-h
401.3	RHT(B)	6.2a-h

*Means followed by the same letter are not significantly different at the k=100 level using the Waller-Duncan k ratio test.

pots, and had formed large, healthy plants by February 1986. The plants were artifically illuminated with incandescent lamps high in the red and far-red light spectrum beginning 8 April 1986. This illumination was added to the evening hours to extend the daylength to approximately 16 hours. No floral production was noted on any of the clones at any time during the study. It was felt that the heavy clay soil stayed too moist and kept the plants in a vegetative state rather than allowing transition into the floral mode. It was also felt that total thermal load may have resulted in a de-induction of flowering.

FUTURE WORK: Failure to initiate floral production in the field was a significant disappointment to the program. Some floral production was noted on clones in the germplasm repository in the greenhouse. Consequently, a small area in the greenhouse will be illuminated with incandescent lamps to make single and self crosses.

2. OBJECTIVE: Determine the floral production characteristics and associated seed production of the elite clones of bentgrass in a commercial seed production area.

JUSTIFICATION: Commercial bentgrass seed production is in the Pacific Northwest, with flowering occurring in mid-late June, with seed harvest in August. Previous attempts in Texas to develop functional crossing blocks and seed production trials were unsuccessful.

PROGRESS: Fifty clones of elite bentgrasses were sent to Pickseed West, Tangent, OR, in cooperation with Dr. Jerry Pepin. The plant material was planted in a crossing block with three replications during the spring of 1986. Dates of flowering were recorded and seed harvested from each maternal plant. The rate of spread and amount of resistance to summer dormancy were also recorded. From this information, groups of clones with desirable quality characteristics (Section 3.A.1) and niched flowering dates were selected for inclusion into small synthetic crossing blocks.

FUTURE WORK: Plant materials to be used in genetic recombination have been identified since initiation of the bentgrass breeding program. Seven individual plant groupings have been made based on several different criteria, as listed:

SYNTHETIC 1-86. This synthetic has a broad genetic base, with seven clones selected for inclusion. The plants have been tested as elite germplasm on the green and have high quality ratings, inclusive of low thatch build-up, and good spread. They did not show severe heat stress as some clones, and all flowered in Oregon during late May to early June. Four of the clones show a blue color, with origin of material including Texas, Arizona, and Michigan. This material has been propagated to include 3 replications, and will be moved to Oregon during fall, 1986.

SYNTHETIC 2-86. This synthetic represents a single-cross with selection of two parents based on high quality ratings when tested on the green in Texas. The two parents flowered later than the clones in Synthetic 1-86. Single crosses will be made in the greenhouse in Texas during the winter of 1986.

SYNTHETIC 3-86. The two plants in this synthetic showed late flowering dates, from mid- to late June in Oregon. The plants had good quality ratings when tested as the elite material on the green, and good seed production. Single crosses will be made in the greenhouse in Texas during the winter of 1986.

SYNTHETIC 4-86. This synthetic is composed of two clones with coarse leaf texture, rapid and aggressive spread, and a more erect growth habit that would be suited to use as a fairway type grass. The material was evaluated on both the sand green and native blackland soil. These indivduals were originally collected in Texas. Single crosses will be made in the greenhouse in Texas during the winter of 1986.

SYNTHETIC 5-86. Ten clones, having the highest quality,from Seaside, Seaside-RHT(A), and Seaside-RHT(B), irrespective of origin, have been selected to move to Oregon for evaluation of floral and seed production characteristics. This synthetic will then give us flowering dates and seed production characteristics to refine the combination into smaller synthetics. Three replications of the material will be propagated.

SYNTHETIC 6-86. Six clones of Seaside-RHT(A) with the greatest root length and six clones of Seaside with the shortest root length (selected from root studies in the greenhouse) will be moved to Oregon for seed production evaluation. The progeny evaluations from this material will indicate the heritabilities of the characters evaluated thus far. Three replications of the material have been propagated.

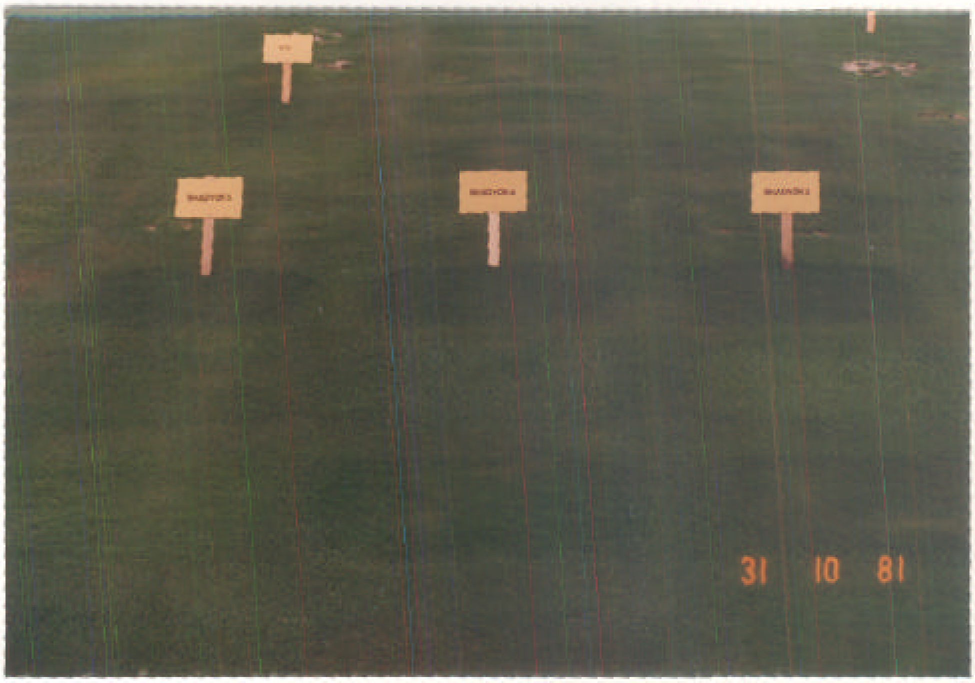

Figure 1. Superior performing genotypes of elite bentgrass established on a sand base green at TAES-Dallas, TX.

Figure 2. Individual clones of Seaside and Seaside-RHT showing genetic variability in spread, color, texture, and density.

Figure 3. Individual elite TAES-Dallas germplasm lines in seed production research plots, Tangent, OR.

SYNTHETIC 7-86. Twenty clones of Seaside-RHT(A) and twenty clones of Seaside that were evaluated in the first root study have been propagated to bring to flower in the greenhouse during the winter of 1986. With progeny from this broad-based synthetic, greater evaluation of characters such as leaf blade width, and response to heat stress may be evaluated. The material has been propagated.

Synthetic Summary: A total of 87 plants will be sent to Oregon under contract for seed production evaluation and to obtain sufficient seed from the selected crosses to continue the selection and developmental phases of the hybridization program. This will be in addition to the existing synthetic (Synthetic 1-85) which will be evaluated for its second year.

C. FACILITY DEVELOPMENT

The Bentgrass Research, Inc. hosted its Third Annual Golf Tournament in support of the breeding program on 1 April 1986. This group had projected construction of an additional research green, and construction was initiated on 1 October 1986. This facility is a 17,000 sq. ft. sand base green, complete with drainage and irrigation system. Projected completion date is 1 November 1986. This research facility will be a tremendous asset to the breeding program at Dallas. The green will be planted to ryegrass prior to planting to bentgrass. As mentioned in section A., plant materials for the germplasm introduction nursery have been readied to plant in the green.

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