ANNUAL PROGRESS REPORT

BREEDING SEED- AND VEGETATIVELY-PROPAGATED TURF BERMUDAGRASSES FOR GOLF COURSES

For the Period

1 November 1997 – 31 October 1998

Submitted By

C. M. Taliaferro
Plant Breeding and Genetics

D. L. Martin
Turfgrass Science

G. E. Bell
Turfgrass Science

J. A. Anderson
Stress Physiology

M. P. Anderson
Plant Molecular Biology

A. C. Guenzi
Cell Biology & Genetics

JOINTLY SPONSORED BY
UNITED STATES GOLF ASSOCIATION
AND
OKLAHOMA AGRICULTURAL EXPERIMENT STATION
OKLAHOMA STATE UNIVERSITY

Executive Summary

The principal objective of the turf bermudagrass breeding program at Oklahoma State University is to develop improved seed- and vegetatively-propagated cultivars for the transition zone. Specific goals of the project are to: 1) assemble and evaluate *Cynodon* germplasm accessions for important descriptors, 2) improve bermudagrass breeding populations for seed production potential and traits conditioning turf performance, 3) identify bermudagrass parental plants with superior combining ability for use in producing inter-and intra-specific F_1 hybrids, and 4) develop, evaluate, and release seed-and vegetatively-propagated turf bermudagrass varieties.

The development of seeded turf bermudagrass cultivars for the transition zone requires combining into breeding populations cold hardiness, economic seed yield potential and acceptable turf quality. Recurrent selection (RS) for these traits in broad genetic base *C. dactylon* populations has resulted in incremental improvement with each cycle of selection. The cold tolerant, seeded, synthetic variety OKS 91-11, was released in January 1997. Current synthetic varieties under evaluation as candidates for commercial release are OKS 91-3 and OKS 95-1. Additional plants were selected from recurrent breeding nurseries over the past year to generate new populations. The most elite of the selected plants will also serve as parents in narrow genetic base synthetic varieties. Breeding improvement in the broad base populations has now reached threshold levels that will allow more rapid progress in seeded turf bermudagrass cultivar development.

Intra- and inter-specific crosses were made to generate F_1 progeny populations for evaluation as potential vegetatively-propagated hybrid turf bermudagrass cultivars. One thousand F_1 hybrid progeny from crosses made in 1997 were trandplanted into field nurseries in spring 1998 for initial screening Approximately 50 hybrid plants selected over the past 3 years are now in various stages of evaluation in replicated mowing studies. Potentially valuable fertile hybrid plants from $2n=6x=54$ chromosome *C. dactylon* x $2n=2x=18$ chromosome *C. transvaalensis* crosses have been obtained. These tetraploid ($2n=4x=36$ chromosome) plants have one full genome (9 chromosomes) from *C. transvaalensis* and 3 full genomes (27 chromosomes) from *C. dactylon*. Open-pollinated and hybrid progeny from these plants have shown desirable turf characteristics.

Introduction

The turf bermudagrass-breeding program at Oklahoma State University was initiated in 1986 under the joint sponsorship of the United States Golf Association and the Oklahoma Agricultural Experiment Station. The initial broad objective was to develop fine-textured, cold-tolerant, seed-propagated varieties for the transition zone. The program was expanded in 1990 to include the development of superior vegetatively propagated varieties. Specific goals of the project are to: 1) assemble and evaluate *Cynodon* germplasm accessions for important descriptors, 2) improve bermudagrass breeding populations for seed production potential and traits conditioning turf performance, 3) identify bermudagrass parental plants with superior combining ability for use in producing inter-and intra-specific F_1 hybrids, and 4) develop, evaluate, and release seed-and vegetatively-propagated turf bermudagrass varieties.

BREEDING AND EVALUATION

Breeding Seed-Propagated Varieties

Recurrent selection (RS) for finer texture and increased seed yield has been practiced in two broad-genetic base *Cynodon dactylon* populations. One population was developed from cold-hardy germplasm subjected to RS for increased fertility (% of florets setting seed) and finer texture. The second population was developed from cold sensitive germplasm with high seed production potential. This population was developed by initially selecting for seed yield and turf quality among spaced plants growing at Yuma, Arizona. A new breeding population was developed in 1994 from *C. dactylon* germplasm collected from the Peoples Republic of China in 1993. Experimental varieties have been synthesized from these populations at various stages of cyclic development and evaluated for turf performance and adaptation characteristics. The cold-hardy, seed-propagated, experimental strain OKS 91-11, evaluated in the 1992-96 NTEP trial, was officially released in January 1997. OKS (BERPC) 91-3, the best of eight seed-propagated bermudas tested by Bob Carrow at Griffin, Georgia, is a candidate for commercial release. Selections were made in summer 1998 from 500 spaced plants of OKS 91-3 for the purpose of enhancing turf quality and uniformity. OKS 95-1, a three-clone synthetic, was entered into the 1997 NTEP bermuda trial. These parental clonal plants were selected from germplasm collected in the Peoples Republic of China in 1993. This synthetic potentially offers higher seed yields, better adaptation to the southeastern US, and higher turf quality than other cold hardy seeded bermudagrasses.

Preliminary results indicate it to be slightly less cold-hardy than OKS 91-11, but substantially more cold hardy than Arizona Common and similar types. Its performance in the 97 NTEP bermudagrass trial at Stillwater is discussed on following pages.

Recurrent selection nurseries were grown in 1998 in which putative superior plants were identified on the basis on seed set, turf quality, and adaptation. The plants are evaluated for up 3 years. Each year the breeding nurseries containing the plants are allowed to set seed, then for the duration of the growing season they are mowed at three-fourth inch height in order to assess turf quality. This management and duration of time facilitates selection of plants that develop and maintain the best turf quality while allowing simultaneous selection for seed production characteristics. Assessment of plants for a minimum of 2 years following the year of establishment is necessary to identify plants with performance stability. Differences among plants in performance characteristics, particularly stand retention, are often not expressed for 2-3 years following establishment.

Overall, recurrent selection within broad genetic-base, seeded bermudagrass populations has, over the past 10 years, refined them to the point of acceptable turf quality. Attainment of this threshold level of performance in turf quality and adaptation in these populations will permit new varieties to be developed at an accelerated rate. Continued PRS will incrementally improve the populations and the varieties developed from them.

Breeding Vegetatively-Propagated Varieties

African bermudagrasses, *C. transvaalensis*, selected for adaptation and turf quality features, have been used extensively in crosses with *C. dactylon* tetraploid plants over the past 5 years. Several hundred hybrid progeny plants are produced each year. Slightly over 1,000 progeny plants were established in spring 1998 for preliminary evaluation. In 1997, 32 hybrid plants were selected from screening nurseries established in 1995. These hybrid plants were established in a replicated fairway height mowing test on the Turf Research Center. An additional 18 plants were selected in fall 1997 prior to destroying the nurseries. The 18 selected plants were increased during the winter and planted in a replicated fairway height mowing evaluation test in spring 1998 on the Agronomy Research Station.

As previously mentioned, many of the selected plants from the 1995 hybrid populations had common parents. One of the common parents was a plant designated as '3200W 41-8'. The 3200W 41-8 plant is an F_1 hybrid from the cross of an African (*C. transvaalensis,* $2n = 2x = 18$ chromosomes) plant with 'Tifton 10' (*C. dactylon*, $2n = 6x = 54$ chromosomes). The 3200W 41-8 plant has $2n = 4x = 36$ chromosomes, presumably comprised of one genome (9 chromosomes) from the African parent and 3 genomes (27 chromosomes) from the Tifton 10 parent. Several F_1 progeny were produced from the African x Tifton 10

cross, but only two of the hybrids were fertile. The 14 selected plants from the 3200W 41-8 plant resulted from OP seed, or from backcrossing 3200W 41-8 to African or a *C. dactylon* parent. *C. dactylon* plants producing superior F_1 hybrids when crossed with the African parents were Q27774 from Australia, PRC-7 from China, and open-pollinated offspring of Texturf 10. These results are noteworthy because they point to the importance of the parents in producing good F_1 progeny plants. Parents having high genetic combining ability for turf quality and adaptation features are essential in breeding good vegetatively-propagated hybrid plants. The breeding value of the fertile interspecific hybrids like 3200W 41-8 was further pursued in 1998 by using them in crosses with both *C. transvaalensis* and *C. dactylon*. Crossing and/or backcrossing them with *C. dactylon* plants provides a means of incorporating into hybrid derivatives less than the full genomic measure of *C. transvaalensis* chromosomes.

EVALUATION OF BREEDING MATERIALS – TURF RESEARCH CENTER

NTEP Bermudagrass Trial in 1998

The 1997 NTEP bermudagrass test was established at Stillwater on August 15-25, 1997. The study is mowed 3 times per week at a 0.5 inch cutting height, irrigated as needed to prevent wilting, and fertilized with 5 lb of N 1,000 $ft^{-2}yr^{-1}$ simulating golf course fairway conditions. Oklahoma State University entries present in this test are vegetatively propagated entries OKC 18-4 and OKC 19-9 as well as seeded entry OKS 95-1. The trial was inoculated with the 3 known casual agents of Spring dead spot disease (*Ophiosphaerella herpotricha, O. korrae, and Leptosphaeria narmari*) on September 25, 1997.

Results

OSU seeded entry OKS 95-1 had greater turf density than Mirage and Jackpot (seeded industry standards for Oklahoma) on 20 Aug 98 (Table 1) and color ratings equal to these cultivars on 16 June 98. Visual quality ratings of OKS 95-1 exceeded those of Mirage and Jackpot on 2 of 4 rating dates (Table 1) and was equal in quality on the remaining 2 rating dates. Density and quality of OKS 95-1 was equal to that of Princess seeded bermudagrass on all dates, however, Princess provided darker green color on the 16 June 1998 rating date (Table 1).

Because of the late summer establishment date, the bermudagrasses failed to mature prior to the winter of 1997-98 and we did not use winter weed control or spring pre-emergent herbicide applications. Heavy weed pressure from a lack of herbicide treatments prevented us from being able to evaluate for Spring dead spot disease this first year.

In 1998 OKC 18-4 provided density and quality not significantly different than Tifway or Midlawn, which are considered proven industry standards at our testing site. OKC 18-4 provided statistically darker color (Table 1) than Midlawn and Tifway on the 16 June 1998 rating date. While density and color ratings of OKC 19-9 were equal to that of OKC 18-4, it provided statistically lower visual quality than OKC 18-4 on 2 of 4 rating dates.

Ratings taken in 1998 were from the first year of this NTEP bermudagrass study. Ratings and rankings of these grasses relative to industry standards may change over time. We expect to collect our first Spring dead spot ratings from these trials in 1999. We intend to investigate divot recovery of all bermudagrasses in 1999.

Evaluation of Seeded Bermudagrasses in 1998

A seeded bermudagrass study was established on 5 July 1995 containing the then experimental bermudagrass OKS 91-11 and seeded industry standards of performance Jackpot and Mirage. The trial is fertilized with 5 lbs. of N 1,000 $ft^{-2}yr^{-1}$, watered as needed to prevent wilting and mowed at 0.5 inches (representing a golf course fairway) and 1.5 inches (representing a moderate maintenance lawn or high maintenance rough). All plots were inoculated with *O. herpotricha*, the major casual agent of Spring dead spot disease in Oklahoma in fall of 1996.

Results

The area of turf afflicted with Spring dead spot disease at the 0.5 inch cut was less in the cultivars Jackpot and Mirage than in OKS 91-11 (Table 2). No differences were present at the 1.5 inch height of cut. Shoot survival within infected areas was greater with Jackpot than the other 2 bermudagrasses at the 1.5 inch height of cut, but no differences were present at the low height of cut. Earlier work with Mirage and Jackpot between 1994-1996 suggested that Mirage had better resistance/tolerance to Spring dead spot (SDS) disease than Jackpot. Results of this year's data are not consistent with our earlier work. No statistical differences were present among cultivars in this study with respect to area of infection in 1997. At least one additional year's research is needed to help clarify SDS resistance/tolerance differences. Shoot density in the seeded bermudagrass plots declined with increasing cutting height; no differences were present among cultivars within the 0.5 or 1.5 inch heights of cut (Table 2).

Visual quality among the 3 seeded bermudagrasses was not significantly different in 1998 except on 31 June when OKS 91-11 provided higher quality at the 0.5 inch cut (Table 3). OKS 91-11 provided equal or greater density and color ratings relative to Jackpot and Mirage on all dates in 1998 (Table 4).

This evaluation of field performance of seeded bermudagrasses will be continued in 1999.

1995 OSU Vegetative Bermudagrass Evaluation

A trial of experimental OSU bermudagrass selections was planted at Stillwater, Oklahoma on 21 July 1995. Midlawn and Tifway hybrid bermudagrasses were included as standards. The cutting heights of the study are 0.375 and 0.75 inches. Turf is irrigated to prevent stress and fertilized with 5 lbs. N 1,000 $ft^{-2}yr^{-1}$. The soil type present at the site is a silty clay loam.

Results

Previous work at OSU and Kansas State University has revealed that Midlawn has excellent resistance to Spring dead spot caused by *O. herpotricha*. Midlawn demonstrated superior SDS resistance/tolerance relative to Tifway (Table 5). OSU experimentals 46-8, 47-3 and 3-3 demonstrated very good SDS resistance/tolerance. Unfortunately, OKC 19-9 appeared fairly susceptible to this disease, approximately equal to Tifway.

Most OSU selections in this trial had suitable shoot density for use on tee boxes or fairways when Tifway was considered as a standard (Table 5). Visual quality of all entries in the trial varied throughout the summer (Table 6). In general, most selections provided suitable overall visual quality, visual color (Table 7) and visual density (Table 7) for use under tee box/fairway conditions relative to Tifway.

This 1995 vegetative trial of OSU experimental bermudagrasses and industry standards will be continued through 1999.

1995 African Bermudagrass Tee Box Trial in 1998

On 28 July 1995 a trial was established at Stillwater, OK that would compare the promising OSU experimental African bermudagrasses Ct 2567 and Ct 2747 with Tifway bermudagrass under 0.25 inch (tournament tee box height) and 0.375 inch (regular tee box height) conditions. The study is irrigated to prevent wilting and fertilized with 5 lbs. N 1,000 $ft^{-2}yr^{-1}$. Plots were inoculated with *O. herpotricha* in fall 1996.

Results

Both African bermudagrasses had less area afflicted with SDS than did Tifway bermudagrass (Table 8). There were no differences in shoot survival within affected disease areas.

Both Ct 2567 and Ct 2747 had numerically larger numbers (but not statistically greater) of shoots per unit area than Tifway bermudagrass (Table 8). Visual color ratings of the African bermudagrasses were similar to those of Tifway (Table 9) except on 28 May at the 0.25 inch cutting height when Tifway appeared darker green in appearance. No significant differences were present among entries in the trial with respect to visual density ratings. Tifway bermudagrass provided superior visual quality to Ct 2567 on 27 May at the 0.25 inch height of cut and on 24 August at the 0.375 inch height of cut (Table 10). Tifway provided superior quality over that of Ct 2747 only on 24 August at the 0.25 and 0.375 inch heights of cut. Visual quality of the African bermudagrasses were otherwise equal to that of Tifway except on 25 September when Ct 2567 provided quality superior to that of Tifway.

The African bermudagrass trial will be continued through 1999. Emphasis in our breeding and development program has changed from the examination of African bermudagrasses to that of interspecific hybrids between African and Common bermudagrasses. Both Ct 2747 and Ct 2567 appear to have some beneficial characteristics for use in low mowed tee boxes, however, based on our experiences with field trials in Texas and Florida we feel that the region of adaptation of African bermudagrass may be so narrow that prospects for successful commercialization of these grasses is limited.

1997 OSU Bermudagrass Fairway Trial

Promising OSU experimental bermudagrass selections were made from field space plantings in 1997 and established by vegetative means in a fairway trial at Stillwater on 13-15 August 1997. The trial is mowed at 0.5 inches, watered to prevent wilting and fertilized with 5 lbs. N 1,000 $ft^{-2}yr^{-1}$. Tifway, Midlawn and Tifsport were included as industry standards. This trial was also inoculated with *O. herpotricha*, in hopes of screening for resistance to SDS disease.

Results

Essentially all entries provided suitable visual density, color and visual quality (Table 11) during this first year of the trial. Some statistical differences were present among entries. It would be premature to speculate on the most promising entries at this early date. Due to a late summer establishment, severe winter weed invasion occurred and we did not apply fall pre-emergent herbicide applications or winter glyphosate applications. As a result, heavy winter annual weed pressure prevented us from assessing SDS resistance/tolerance this first season.

We will continue to evaluate the bermudagrasses in this trial in 1999. We expect to collect the first ratings on SDS disease in April 1999.

1997 Oklahoma City Golf and Country Club bermudagrass trial in 1998.

A field trial of vegetative bermudagrasses was established on a former bentgrass putting green nursery at Oklahoma City Country Club in Oklahoma City, OK. Midlawn and Tifway were included as local industry standards. The trial is maintained by Mr.Craig Elms, CGCS. Promising OSU experimental bermudagrasses were selected from space planting and from first stage replicated field trials for inclusion in this study. The trial is cut at 0.25 and 0.5 inches representing tournament tee box and fairway height conditions. The soil type is a sand. The area was maintained under 5 lbs. N 1,000 ft-2 yr-1 and irrigation to prevent wilting.

Results

All experimental entries demonstrated a rapid spring greenup equivalent to or better than Tifway except for OKC 39-3 at the 0.25 inch cut (Table 12). Based on our observations, both OKC 39-3 and Tifway experienced some winter-kill at the 0.25 inch cut in each replication, which lead to delayed greenup. The winter of 1997-1998 in Oklahoma City was considered mild.

During June through late September, entries OKC 18-4, OKC 19-9 and OKC 41-8 provided color ratings equal to or greater than Tifway. Ratings from late October revealed many selections to have color retention ratings numerically less than Tifway. Of the OSU selections, OKC 41-8 had color retention closest to that of Tifway.

All entries provided visual density ratings equal to or greater than Tifway except for Midlawn (Table 13). Dollarspot disease occurred only during late October at the test site. Only entry OKC 47-3 was affected by dollarspot disease (Table 13). At the 0.25 inch cut, Midlawn and entry 47-3 occasionally experienced scalping problems (Table 13).

Several OSU selection experienced late season flowering in late Sept-Oct (Table 14) when Midlawn and Tifway did not flower. Quality of OKC 41-8, OKC 18-4 and OKC 19-9 was usually equal to that of Tifway through most of the growing season, however, late season discoloration and seedhead formation reduced the overall quality of these selections on the 23 October rating date.

Very light stunt mite injury occurred on OKC 41-8 on all rating dates from 2 June through 3 September. Damage was so slight that it could not be quantified on a regular visual quality rating scale. No other bermudagrasses had any stunt mite injury during 1998.

Of all the OSU Experimentals in this trial, OKC 41-8 appears to be most promising for use on tee boxes and fairways. It has suitable color, quality, texture, dollarspot resistance and density. Some questions remain considering its susceptibility to stunt mites and if a slight tendency for late season flowering are significant enough to exclude it form more intense evaluation for potential commercialization.

Table 1. Density, color and visual quality. NTEP bermudagrass study. Turfgrass Research Center, Stillwater, OK.

	Density	Color	Visual Quality			
Genotype	20Aug98	16Jun98	16Jun98	16Jul98	20Aug98	25Sep98
OKC 18-4	8.0	8.0	7.0	5.3	6.0	8.0
OKS 95-1	8.0	7.0	6.3	6.7	7.0	7.0
Shanghai	7.0	8.0	6.3	6.3	6.0	8.0
Majestic	7.0	6.7	6.3	5.0	5.7	7.0
Mirage	7.0	6.7	6.0	5.0	5.0	6.3
Tifgreen	8.7	7.3	6.0	5.7	7.0	7.0
Blue-Muda	7.0	6.7	5.7	4.7	5.0	6.3
Princess	8.0	7.7	5.7	6.3	7.0	7.0
Jackpot	7.0	7.0	5.7	4.7	5.3	6.3
NuMex Sahara	7.0	6.7	5.7	4.3	5.3	6.3
Midlawn	8.3	7.0	5.7	4.7	5.3	7.0
Cardinal	9.0	6.0	5.7	3.3	5.7	7.0
Pyramid	7.3	7.0	5.7	4.7	5.3	6.3
Savannah	7.7	7.0	5.3	5.0	5.7	6.3
GN-1	7.7	8.0	5.3	4.3	5.7	7.0
Blackjack	7.3	6.3	5.3	4.7	5.7	6.7
SW1-7	7.7	6.7	5.3	4.7	5.0	5.7
Az. Common	6.7	6.7	5.3	4.7	5.0	6.0
J-540	7.0	7.0	5.0	4.7	5.7	6.3
Mini-Verdi	9.0	7.3	5.0	7.0	6.7	7.0
PST-R69C	7.7	7.0	5.0	5.7	6.0	6.3
Shangri La	7.3	7.0	5.0	4.3	5.3	6.0
Sundevil	8.0	7.0	5.0	4.7	4.7	6.0
Tifway	8.3	7.3	4.7	4.3	5.7	7.3
Tift94	8.3	7.3	4.7	4.7	6.0	7.3
OKC 19-9	8.0	8.0	4.3	4.3	5.0	6.3
J-1224	7.3	7.0	4.3	4.0	4.3	5.7
SW 1-11	8.0	7.0	4.3	4.0	5.0	5.7
CN 2-9	8.3	7.7	4.0	4.7	5.3	7.0
LSD (0.05)	**0.7**	**0.7**	**1.6**	**1.4**	**1.4**	**1.1**

Ratings were on a scale of 1-9, with 9 being best.
Cutting height 1/2 inch; fertility rate 5 lbs. N 1,000 ft^2yr^{-1}

Table 2. Evaluation of bermudagrass resistance to spring dead spot disease in the OKS 91-11 evaluation. Turfgrass Research Center, Stillwater, OK.

	Area (dm^2) of spot		Shoots dm^{-2} in infected area		Shoots dm^{-2} in noninfected area	
	Low	High	Low	High	Low	High
Genotype	22Apr98		22Apr98		22Apr98	
OKS 91-11	1.9	0.1	7.0	10.7	250.1	162.1
Jackpot	0.03	0.03	9.8	17.3	202.4	179.4
Mirage	0.05	0.1	9.1	10.7	153.0	149.7
LSD (0.05)	**0.6**	**NS**	**NS**	**3.5**	**NS**	**NS**

Low mowing height = 0.5 inches
High mowing height = 1.5 inches

Table 3. Visual quality ratings of seeded bermudagrass varieties in the OKS 91-11 evaluation. Turfgrass Research Center, Stillwater, OK.

	Visual Quality									
	Low	High	Low	High	Low	High	Low	High	Low	High
Genotype	27May98		31Jun98		15Jul98		24Aug98		25Sep98	
OKS 91-11	6.7	6.0	7.0	4.7	7.0	7.0	7.0	6.7	6.0	7.0
Jackpot	6.0	6.0	6.7	5.0	7.0	7.0	6.7	6.7	6.0	7.0
Mirage	5.7	5.7	6.0	4.7	7.0	6.0	6.7	6.7	6.0	7.0
LSD (0.05)	**NS**	**NS**	**0.8**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Ratings were on a scale of 1-9, with 9 being best.
Low mowing height = 0.5 inches
High mowing height = 1.5 inches

Table 4. Density and color ratings of seeded bermudagrass varieties in the OKS 91-11 evaluation. Turfgrass Research Center, Stillwater, OK.

	Density				Color			
	Low	High	Low	High	Low	High	Low	High
Genotype	28May98		24Aug98		28May98		24Aug98	
OKS 91-11	8.0	6.7	7.7	7.3	7.3	5.0	7.0	7.0
Jackpot	7.0	6.7	7.3	7.0	7.3	5.0	7.0	6.7
Mirage	7.0	6.7	7.0	7.0	7.0	5.0	7.0	6.0
LSD (0.05)	**0.0**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**0.8**

Ratings were on a scale of 1-9, with 9 being best.
Low mowing height = 0.5 inches
High mowing height = 1.5 inches

Table 5. Spring dead spot of vegetatively-propagated bermudagrasses planted on July 21, 1995. Turfgrass Research Center, Stillwater, OK.

	Area (dm^2) of spot	Shoots dm^{-2} in infected area	Shoots dm^{-2} in noninfected area
Genotype	22April98	22April98	22April98
46-8	5.3	6.4	755.2
47-3	4.7	6.1	682.9
47-10	11.9	0.8	1503.9
19-9	14.9	0.2	534.8
3-3	2.8	2.9	450.8
Midlawn	5.7	8.0	786.5
Tifway	12.8	0.4	469.1
39-3	11.3	0.2	735.5
7-2	13.2	0.1	516.7
3-1	7.8	1.3	368.6
LSD (0.05)	**3.3**	**NS**	**303.9**

Mowing height = 0.375 inches.

Table 6. Visual quality of vegetatively-propagated bermudagrasses planted on July 21, 1995. Turfgrass Research Center, Stillwater, OK.

	Visual Quality									
	Low	High	Low	High	Low	High	Low	High	Low	High
Genotype	27May98		22Jun98		15Jul98		24Aug98		25Sep98	
46-8	7.0	7.0	6.7	7.3	7.0	7.0	7.7	8.0	7.0	6.0
47-3	7.0	6.7	7.0	7.0	7.7	7.0	8.0	8.3	8.0	7.3
47-10	7.0	6.7	7.0	6.3	7.7	7.0	7.0	7.0	7.3	6.0
19-9	7.0	7.7	7.3	7.0	7.7	7.7	8.3	8.3	7.7	7.0
3-3	6.7	7.0	7.7	7.7	6.7	6.0	7.0	8.0	7.0	6.0
Midlawn	6.7	7.0	6.7	6.7	7.0	7.0	7.3	7.7	7.0	7.0
Tifway	6.7	7.0	7.7	7.3	8.0	8.0	5.3	8.0	8.0	7.0
39-3	7.0	7.0	7.3	7.0	7.3	7.0	7.7	7.3	7.0	6.3
7-2	7.0	6.7	7.0	6.3	7.3	7.0	7.3	8.0	6.7	6.0
3-1	5.3	5.7	6.3	7.0	6.7	7.3	7.3	8.0	7.0	6.0
LSD (0.05)	**0.7**	**0.7**	**NS**	**0.7**	**0.8**	**0.7**	**0.7**	**0.6**	**0.5**	**0.7**

Ratings were on a scale of 1-9, with 9 being best.
Low mowing height = 0.375 inches.
High mowing height = 0.75 inches.

Table 7. Color and density of vegetatively-propagated bermudagrasses planted on July 21, 1995. Turfgrass Research Center, Stillwater, OK.

	Color				Density			
	Low	High	Low	High	Low	High	Low	High
Genotype	26May98		10Jun98		26May98		10Jun98	
46-8	7.0	7.0	7.0	7.0	9.0	9.0	8.3	8.3
47-3	7.0	7.0	6.3	6.7	9.0	9.0	9.0	9.0
47-10	7.0	6.0	6.7	6.7	9.0	9.0	9.0	9.0
19-9	8.0	8.0	7.7	8.0	8.0	8.3	8.0	7.3
3-3	7.0	7.0	7.0	7.0	9.0	8.7	8.0	8.0
Midlawn	6.7	7.0	6.7	7.0	7.3	8.0	8.0	8.0
Tifway	7.7	7.7	7.3	7.7	8.3	9.0	8.0	8.0
39-3	7.0	7.0	6.3	7.0	8.7	8.0	8.3	8.3
7-2	7.0	6.7	7.0	7.0	8.0	7.7	7.7	7.3
3-1	6.7	6.7	7.3	7.3	7.0	7.3	8.0	8.0
LSD (0.05)	**0.5**	**0.6**	**NS**	**0.5**	**0.5**	**0.6**	**0.5**	**0.7**

Ratings were on a scale of 1-9, with 9 being best.
Low mowing height = 0.375 inches.
High mowing height = 0.75 inches.

Table 8. Spring dead spot of African and Tifway bermudagrasses in the African bermudagra: tee/fairway study. Turfgrass Research Center, Stillwater, OK.

	Area (dm^2) of spot	Shoots dm^{-2} in infected area	Shoots dm^{-2} in noninfected area
Genotype	22 April98	22 April98	22 April98
2567	1.2	83.8	1252.2
2747	2.4	19.1	1148.2
Tifway	5.0	21.2	724.0
LSD (0.05)	**2.3**	**NS**	**NS**

Cutting height = 0.375 inches.

Table 9. Color and density of African and Tifway bermudagrasses in the African bermudagrass tee/fairway study. Turfgrass Research Center, Stillwater, OK.

	Color				Density			
	Low	High	Low	High	Low	High	Low	High
Genotype	28May98		10June98		28May98		22August97	
2567	7.0	7.3	7.0	7.0	5.7	7.3	9.0	9.0
2747	7.7	7.0	7.0	7.0	6.7	7.3	9.0	9.0
Tifway	8.0	7.7	7.0	7.0	8.0	7.7	9.0	9.0
LSD (0.05)	**0.8**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Ratings were on a scale of 1-9, with 9 being best.
Low cutting height = 0.25 inches.
High cutting height = 0.375 inches.

Table 10. Visual quality of African and Tifway bermudagrasses in the African bermudagrass tee/fairway study. Turfgrass Research Center, Stillwater, OK.

	Visual Quality									
	Low	High	Low	High	Low	High	Low	High	Low	High
Genotype	27May98		22June98		16July98		24Aug98		25Sep98	
2567	4.3	5.7	6.3	6.7	7.7	7.7	7.7	7.0	8.0	8.0
2747	5.7	5.7	6.3	6.3	7.7	7.3	7.0	7.0	7.0	7.0
Tifway	6.3	6.7	7.7	7.0	8.0	8.0	8.0	8.0	6.7	6.7
LSD (0.05)	**1.3**	**NS**	**NS**	**NS**	**NS**	**NS**	**0.8**	**0.0**	**0.8**	**0.8**

Ratings were on a scale of 1-9, with 9 being best.
Low cutting height = 0.25 inches.
High cutting height = 0.375 inches.

Table 11. Density, color and visual quality of turf in the bermudagrass fairway study. Turfgrass Research Center, Stillwater, OK.

	Density		Color		Visual Quality				
Genotype	23Jun98	24Aug98	23Jun98	24Aug98	27May98	23Jun98	15Jul98	24Aug98	25Sep98
25-7	8.0	8.0	8.0	9.0	6.5	8.0	8.5	9.0	7.0
47-1	8.5	9.0	8.5	8.5	5.0	7.0	7.0	8.5	7.0
51-14	8.0	9.0	8.5	9.0	5.5	7.0	8.0	8.5	8.0
94-2	8.0	9.0	7.5	8.5	6.0	7.0	8.0	8.5	7.0
Tifway	6.5	8.0	7.5	7.5	5.0	5.0	7.5	8.5	7.5
10-9	6.5	8.0	7.0	8.0	4.5	5.5	7.0	8.0	7.0
1-20	8.0	8.0	7.5	8.0	6.5	8.0	6.5	8.0	6.5
18-11	8.0	8.0	7.0	7.0	6.0	7.0	7.0	8.0	7.0
19-18	8.0	9.0	7.0	8.0	6.5	7.5	7.0	8.0	5.5
24-4	6.5	8.0	7.0	7.5	6.5	6.0	6.5	8.0	7.0
25-15	8.0	9.0	8.0	7.5	6.0	7.0	7.0	8.0	6.5
25-6	8.5	9.0	7.0	7.5	6.5	7.0	7.0	8.0	5.0
26-13	8.5	8.5	7.5	8.5	6.5	8.0	7.5	8.0	6.0
30-20	8.5	9.0	7.0	7.5	5.5	7.0	6.5	8.0	6.5
38-2	8.5	9.0	6.0	7.5	6.5	7.0	7.0	8.0	6.5
46-4	8.0	9.0	7.5	8.0	7.0	8.0	7.0	8.0	6.5
49-17	9.0	8.5	7.0	9.0	6.0	7.5	7.0	8.0	6.5
52-15	8.5	9.0	7.0	8.0	7.0	8.0	7.0	8.0	6.0
53-1	7.5	9.0	7.0	8.0	6.0	8.0	6.5	8.0	5.5
6-12	7.5	8.0	7.0	7.5	7.0	7.0	7.0	8.0	6.5
68-9	6.5	8.5	6.5	6.5	4.5	5.5	6.0	8.0	6.0
70-18	7.5	8.5	8.0	7.5	6.0	7.5	7.0	8.0	7.5
74-3	7.5	8.0	7.0	7.0	6.0	7.0	7.0	8.0	6.5
78-10	7.5	8.5	8.0	7.5	5.0	7.5	6.5	8.0	6.0
9-4	7.5	8.0	7.0	8.0	6.0	6.5	7.0	8.0	6.5
GN-1	7.5	8.0	8.5	9.0	7.0	7.0	7.5	8.0	6.5
Midlawn	6.5	8.0	6.0	6.0	5.0	5.5	6.0	8.0	5.5
Tifsport	6.0	8.0	7.0	7.5	4.5	5.0	6.5	8.0	7.5
20-6	9.0	8.5	7.0	8.0	7.0	8.5	7.0	7.5	6.5
22-10	8.0	9.0	7.5	8.5	5.5	7.0	7.0	7.5	7.0
22-13	9.0	8.5	7.5	7.0	7.0	7.5	7.0	7.5	5.0
25-1	9.0	8.5	7.0	7.5	6.5	7.0	7.0	7.5	6.5
47-7	9.0	8.5	8.0	9.0	7.5	8.0	8.5	7.5	6.0
55-5	9.0	8.5	8.0	8.0	6.5	6.5	7.5	7.5	6.5
56-14	8.0	8.5	7.5	8.5	5.5	6.0	7.5	7.5	6.0
ERSTurf	6.5	8.0	6.0	6.0	6.0	6.0	6.0	7.0	7.0
LSD (0.05)	**1.2**	**0.9**	**0.9**	**1.0**	**1.1**	**1.2**	**1.0**	**NS**	**1.2**

Ratings were on a scale of 1-9, with 9 being best.

Table 12. Greenup and color ratings of bermudagrasses in 1998 at the Oklahoma City Golf and Country Club bermudagrass trial.

			Color Ratings							
	Greenup		23 June		2 Jul		3 Sept		30 Sept	
Entry	Low	High	Low	High	Low	High	Low	High	Low	High
18-4	6.0	7.0	9.0	8.0	8.3	9.0	8.0	8.0	7.3	7.7
19-9	7.7	8.0	8.7	7.7	8.0	8.3	8.0	8.0	8.0	8.0
41-8	7.3	7.3	8.7	8.3	8.3	9.0	8.0	8.0	8.7	8.3
47-3	7.7	9.0	7.0	6.3	3.7	6.3	5.3	6.0	7.0	7.3
39-3	4.7	5.7	7.0	6.7	6.0	7.0	7.0	7.0	6.7	7.0
Midlawn	7.3	9.0	7.3	6.7	4.7	6.0	7.0	7.0	7.0	6.7
Tifway	5.6	6.7	7.3	7.3	7.0	7.7	7.3	7.3	8.0	8.7
LSD (0.05)	**1.4**	**0.9**	**1.3**	**0.9**	**1.1**	**1.1**	**1.0**	**0.7**	**1.8**	**1.3**

Greenup rated on a 1-9 scale where 9 = complete greenup.
Color rated on a 1-9 scale where 9 = dark green.
Low cut turf is mowed at 0.25 inches, high cut turf is mowed at 0.5 inches.

Table 13. Color retention, visual density, dollarspot disease and scalping ratings of bermudagrasses in 1998 at the Oklahoma City Golf and Country Club bermudagrass trial.

	Color Retention		Density		Dollarspot Disease	Scalping Ratings 20 Aug		3 Sept	
Entry	Low	High	Low	High	High	Low	High	Low	High
18-4	6.3	6.3	7.0	8.0	9.0	8.3	9.0	8.0	9.0
19-9	6.7	6.7	7.0	8.0	9.0	8.0	9.0	7.7	8.7
41-8	7.0	7.0	7.3	8.0	9.0	9.0	9.0	8.0	8.7
47-3	6.7	6.7	7.7	9.0	7.0	6.0	8.3	4.7	6.7
39-3	5.0	5.0	7.7	8.7	9.0	7.7	8.7	7.7	8.7
Midlawn	6.7	6.7	6.0	7.3	9.0	5.7	8.7	6.0	8.7
Tifway	7.7	7.7	7.3	8.0	9.0	7.3	9.0	7.0	8.0
LSD (0.05)	**1.1**	**1.1**	**0.8**	**0.5**	**0.7**	**1.3**	**0.6**	**1.7**	**1.2**

Color retention was rated on a 1-9 scale where 9 = complete color retention.
Density was rated on a 1-9 scale where 9 = most dense.
Dollarspot disease was rated on a 1-9 scale where 9 = no dollarspot disease.
Scalping was rated on a 1-9 scale where 9 = no scalping.
Low cut turf is mowed at 0.25 inches, high cut turf is mowed at 0.5 inches.

Table 14. Flowering and visual quality ratings of bermudagrasses in 1998 at the Oklahoma City Golf and Country Club bermudagrass trial.

	Flowering				Quality Ratings					
	30 Sept		23 Oct		23 Jun		2 Jul		20 Aug	
Entry	Low	High	Low	High	Low	High	Low	High	Low	High
18-4	67	67	17	17	8.3	8.0	8.3	8.7	8.7	9.0
19-9	32	32	8	8	8.3	7.7	8.7	9.0	8.3	8.3
41-8	8	10	5	10	7.7	8.7	9.0	9.0	9.0	9.0
47-3	1	1	0	2	7.3	7.7	7.3	8.0	7.0	8.0
39-3	20	20	5	5	7.7	8.3	8.7	8.7	8.7	8.0
Midlawn	0	1	0	0	7.0	7.3	7.0	8.0	6.3	7.7
Tifway	0	0	0	0	8.0	8.3	8.0	9.0	8.0	9.0
LSD (0.05)	**9**	**9**	**6**	**6**	**0.9**	**1.0**	**1.2**	**0.8**	**1.4**	**0.8**

Flowering is a visual estimate of the percentage of the plot in flower.
Quality was rated on a 1-9 scale where 9 = best quality.
Low cut turf is mowed at 0.25 inches, high cut turf is mowed at 0.5 inches.

Table 14. (Continued) Visual quality ratings of bermudagrasses in 1998 at the Oklahoma City Golf and Country Club bermudagrass trial.

	Quality Ratings					
	3 Sept		30 Sept		23 Oct	
Entry	Low	High	Low	High	Low	High
18-4	7.3	8.0	7.7	8.3	5.7	6.0
19-9	7.3	8.0	7.7	8.3	5.7	6.0
41-8	7.3	8.0	8.7	8.3	6.7	7.3
47-3	5.3	7.0	7.3	7.7	5.7	6.3
39-3	7.0	7.7	7.0	7.3	5.3	6.0
Midlawn	6.0	7.3	5.3	7.0	5.7	6.3
Tifway	6.7	7.7	7.3	8.7	7.3	8.0
LSD (0.05)	**1.4**	**1.1**	**1.0**	**0.6**	**1.2**	**1.5**

Quality was rated on a 1-9 scale where 9 = best quality.
Low cut turf is mowed at 0.25 inches, high cut turf is mowed at 0.5 inches.