GE 9510-118

ANNUAL PROGRESS REPORT

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

For the Period

1 November 1999 - 31 October 2000

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 turf bermudagrass breeding program at Oklahoma State University seeks 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, and 3) identify bermudagrass parental plants with superior combining ability for use in producing inter- and intra-specific F, hybrids.

Recurrent selection (RS) for turf performance traits was continued in broad genetic base *C. dactylon* populations in 1999-2000. RS in these populations has increased turf quality, transition zone adaptation, and seed production potential. Two new cultivars, OKS 91-11 and OKS 95-1, have resulted from the cumulative breeding effort. The breeding effort has reached the threshold point where new incrementally improved varieties can be systematically developed. Testing of six new experimental synthetic varieties will begin in 2001. Additional elite plants were selected in 1999-2000 from RS breeding nurseries to generate new experimental varieties.

Intra- and inter-specific crosses were made to generate F_1 progeny populations for evaluation as potential vegetatively-propagated hybrid turf bermudagrass cultivars. Initial screening of approximately 2,000 F_1 C. dactylon x C. transvaalensis hybrids transplanted into field nurseries in spring 1999 produced 112 plants for continued testing. About 1200 new F_1 interspecific hybrid plants were established in screening nurseries in spring 2000. The interspecific hybrid OKC 18-4, with good performance to date in the 1997 NTEP bermudagrass trial, is a candidate for release as a commercial variety.

INTRODUCTION

The turf bermudagrass breeding program at Oklahoma State University is jointly sponsored by the United States Golf Association and the Oklahoma Agricultural Experiment Station. The broad goal of the program is to develop fine-textured, cold-tolerant, seed- and vegetatively-propagated varieties for the transition zone. Supporting objectives 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, and 3) identify bermudagrass parental plants with superior combining ability for use in producing inter- and intra-specific F_1, hybrids.

BREEDING AND EVALUATION

Breeding Seed-Propagated Varieties

We continued recurrent selection (RS) for finer texture and increased seed yield in three 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. Recurrent selection nurseries were grown in 1999 in which putative superior plants were identified on the basis on seed set, turf quality, and adaptation. The plants are evaluated for up to 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.

Experimental varieties have been synthesized from the broad base breeding populations at various stages of cyclic development and evaluated for turf performance and adaptation characteristics. Seed of six new experimental synthetic varieties was produced in 2000 from polycross blocks established in 1999. New parent plant selections were made in 2000 and will be established in isolated polycross blocks in spring 2001.

A small amount of seed of OKS 91-11 was produced by the licensee companies in 1999 and 2000. Seed was harvested from only a few acres, with additional acreage used to provide sprigs for planting of additional acreage. Some plantings made in 1999 failed due to poor growing

conditions. Over 100 acres planted in spring 2000 was successful. Seed yields from the limited acreage harvested in 1999 and 2000 averaged close to 300 lbs/acre. OKS 95-1, a leading variety in the current NTEP bermudagrass trial, was released in 2000 and will be licensed during winter of 2000-2001. The mean 2-year (1998-99) turf quality rating of OKS 95-1 was 6.65 as compared to 6.55 for both TifSport and Tifway. It was significantly greater than all seeded varieties except Princess (6.45) in turf quality. 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. We have scale up plantings of the parental clones of OKS 95-1 available for commercial planting in 2001

We affirm previous statements that 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 RS will incrementally improve the populations and the varieties developed from them. Six field polycross nurseries were established in spring 1999 to generate seed of new synthetic varieties. We feel that the program is now at the stage where new varieties can be developed and entered into commercial channels following the Rutgers model.

Breeding Vegetatively-Propagated Varieties

We continued to use African bermudagrasses, *C. transvaalensis*, selected for adaptation and turf quality features, extensively in crosses with *C. dactylon* tetraploid plants. Approximately 2,000 F_1 progeny plants were transplanted to a preliminary screening nursery in spring 1999. We have produced from 1,000 to 2,000 such hybrids during each of the past 6 years. 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. Performance data are given later in this report. Performance notes were taken in 1999 on hybrids in screening nurseries established in 1997 and 1998. Final selections will be made in early spring 2,000 for inclusion in a replicated fairway performance test at the Turf Research Center.

The F_1 hybrid 'OKC 18-4' had a 2-yr (1998-99) top rating of 6.60 in the 1997 NTEP bermudagrass test, but did not differ statistically from Tifway and TifSport (both 6.55), Tifgreen (6.50) and Midlawn (6.4). This variety continues as a candidate for release pending additional information on adaptation (mainly cold tolerance) and sod strength. Our results indicate that OKC 18-4 has a turf quality advantage over Tifway in spring and summer, but not during the fall. Its decline in turf quality in fall relative to Tifway is due to seedhead formation and somewhat lower retention of fall color.

As mentioned in previous reports, we feel that advances in producing superior F_1 hybrids are due to the development and identification of superior parents, both *C. transvaalensis* and *C. dactylon*. African bermudagrasses like '2352', '2567', '2570', and '3048' were the best of some

500 plants screened in tests on golf courses in the early 1990's. They have been used extensively as parents in crosses to selected *C. dactylon* parents. Elite *C. dactylon* parents from the recurrent selection breeding populations and from germplasm procurement have added to the overall quality of triploid hybrids produced. *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. Plants developed though interspecific hybridization and subsequent breeding are also now paying dividends. Many of the F_1 plants selected over the past 3 years for advancement to replicated performance trials trace to a parent designated as '320OW 41-8'. The 320OW 41-8 plant is an F, hybrid from the cross of an African (*C. transvaalensis*, 2n = 2x = 18 chromosomes) plant with 'Tifton 10' (*C. dactylon*, 2n = 6x = 54 chromosomes). The 320OW 41-8 plant has 2n = 4x = 36 chromosomes, presumably comprises of one genome (9 chromosomes) from the African parent and 3 genomes (27 chromosomes) from the 'Tifton 10' parent.

We selected 112 F_1 hybrid plants in fall 2000 from initial screening nurseries established in 1998-99. The 112 hybrids will be advanced to replicated screening nurseries to narrow the field.

Some 1200 new F_1 hybrid plants were planted in 2000 for initial screening.

PERFORMANCE EVALUATION

Seeded Bermudagrass Herbicide Tolerance Trial

In summer/fall of 1999 and 2000, M.S. Candidate Brian Scroggins screened Oklahoma State University seeded selections OKS 91-11 and OKS 95-1 at Stillwater, OK for tolerance to 1 and 2 X label rates of commonly used post-emergent herbicides. The purpose of this work was to determine tolerance of these grasses to the normal label rate as well as to an over application of several mainstream post-emergent herbicides. Herbicides included 2,4-D, Trimec Classic, Confront, MSMA, Sencor, Image, and Manage. The experiment was conducted 2 times in 1999 and 2 times in 2000 on a simulated golf course fairway at 1.3 cm (0.5 in) height. Turf response variables monitored included weekly clipping yield, as well as phytotoxicity and quality response. Analysis of data is not complete as yet.

Response of OKS 91-11 to Application of Primo L (Trinexapac-ethyl)

Master of Science Candidate Brian Scroggins screened the response of OKS 91-11 seeded bermudagrass at Stillwater, OK to applications of 0.25, 0.5, 0.75, 1.0, 1.5 and 2.0X label rates of Primo Liquid (Trinexapac-ethyl) growth regular in summer of 1999 and summer of 2000. The purpose of this work was to determine OKS 91-11 response to normal use rates as well as over applications of Primo growth regulator. Two studies were conducted in 1999 and each repeated in 2000, on OKS 91-11 grown at a 1.3 cm (0.5 in) and the other at a 3.8 cm (1.5 in) height of cut. These studies simulated fairway and rough/lawn type conditions. Phytotoxic response as well as turf quality and clipping yield were monitored on a weekly basis with shoot density sampled every 2 weeks. Analysis of data is not complete as yet.

1997 NTEP Bermudagrass Trial

The Oklahoma State University Turfgrass Research Center is one of several test sites for the 1997 NTEP bermudagrass trial. We included GN-1 and OKS 91-11 at our site as local standards in additional to official entries. The trial is maintained at 1.3 cm (0.5 in), fertilized with 240 kg N ha^{-1} yr^{-1} (5 lbs N 1,000 sq. ft.) and irrigated to simulate a golf course fairway within the region. Standard response parameters of visual color, visual quality, visual density, greenup, visual texture, and winter kill are measured as well as recovery from divoting. Additionally, the study was inoculated with *O. herpotricha, O. korrae, and Leptosphaeria narmari* in fall of 1997.

In the following discussion, Oklahoma State University entries will be compared with industry standard vegetative or seeded types in use within the region.

Greenup

The African bermudagrass Cardinal had earlier greenup than all other grasses, followed by Midlawn, which had significantly earlier greenup than all remaining grasses. OKC 18-4 demonstrated a greenup rate not significantly different from OKC 19-9, Tifway, and Tifsport (Table 1). OKS 91-11 and OKS 95-1 had a similar greenup rate and greened up significantly earlier than Princess but not significantly faster than Jackpot.

Winter Kill

Despite a mild winter, some winter kill was present in the trial (Table 1). Among seeded bermudagrasses, Princess suffered substantially greater winter kill than Arizona Common, NuMex Sahara, Mirage, Jackpot and OKS series bermudagrasses. OKS 91-11 and OKS 95-1 had the smallest amount of winter kill present on seeded grasses. Cardinal African bermudagrass had significantly less winter kill than all other vegetatively propagated bermudagrasses except for Midlawn and OKC 19-9. Winter kill ratings on OKC 18-4 and OKC 19-9 did not significantly differ. GN-1 had the greatest amount of winter kill on any vegetatively propagated bermudagrass.

Genetic Color Ratings

OKC 18-4, OKC 19-9, GN-1, Mini-verde, Tifway and Tifsport demonstrated the darkest green color among vegetatively propagated bermudagrasses (Table 1). OKS 91-11, OKS 95-1 and Princess were among the darkest green seeded bermudagrasses when genetic color ratings were compared.

Texture Ratings

Cardinal African bermudagrass had the finest texture of any bermudagrass, followed closely by Mini-verde (Table 1). Tifgreen, Tifway, Tifsport and OKC 19-9 had equal textural ratings with OKC 18-4 ranging 1 rating unit (statistically significant) more coarse in texture. Shanghai was the coarsest textured vegetatively propagated grass in the trial. Princess and OKS 91-11 had the finest texture of any seeded bermudagrass present in the trial, but not significantly different from OKS 95-1.

Density

Among vegetatively propagate bermudagrasses, Cardinal and Mini-verde were the densest grasses in the trial (Table 2). Tifgreen, Tifsport, Tifway and OKC 19-9 had similar density on 2 of 2 rating dates in 2000, with OKC 18-4 being slightly less dense than these varieties on the 2nd rating date. Princess and OKS 95-1 were the most dense of the seeded bermudagrasses and slightly denser than OKS 91-11 on 1 of 2 sampling dates.

Spring Dead Spot Resistance

Spring dead spot symptoms from causal agents other than *O. herpotricha* failed to develop. A higher level of resistance to spring dead spot (SDS) disease is indicated by smaller SDS necrotic patch area (Table 2). In previous research conducted in Oklahoma, Midlawn and African bermudagrasses have been found to be the most resistant to SDS. In 2000, Cardinal African bermudagrass, Midlawn and OKC 19-9 had the smallest SDS patches of any bermudagrasses. OKC 18-4 did not statistically differ from these grasses in SDS resistance. The SDS patch area on Tifway and Tifgreen was greater than the cultivars previously discussed, but not significantly so. The cultivar GN-1 was the most susceptible to spring dead spot when vegetative cultivars were considered.

The cultivar OKS 91-11 was more resistant to spring dead spot than several other seeded bermudagrasses, including OKS 95-1 and Princess. The cultivar OKS 95-1 was less affected by SDS than Princess.

Visual Quality

Due to its light yellow green color, Cardinal African bermudagrass usually had the lowest quality rankings in 2000 of any bermudagrass. Tifsport, Tifway and OKC 19-9 did not statistically differ in quality on any of 5 rating dates in 2000. Tifway, Tifsport and Midlawn had statistically greater quality than OKC 18-4 on 2 sampling dates late in the 2000 growing season. The trend of OKC 18-4 having slightly lower visual quality than Tifway and Tifsport late in the growing season has been seen in previous years. OKS 91-11 and OKS 95-1 did not statistically differ in quality on any of the 5 rating dates. Both grasses had higher visual quality in May-July than did Princess, with no differences among grasses present on later dates. This quality difference was likely due to more winter kill and spring dead spot disease present on Princess.

Divot Recovery

As in 1999, GN-1 recovered more quickly from divoting than did most other bermudagrasses (Table 3). OKC 18-4, OKC19-9, Tifway and Tifsport did not differ in their divot recovery rating at 2 weeks after divoting, except during June when Tifsport recovered more slowly than the OKC bermudagrasses.

OKS 95-1 and Princess were among the fastest seeded bermudagrasses to recover from divoting, and both recovered faster than OKS 91-11

USGA Fairway Bermudagrass Trial

Thirty-one F1 hybrids between *C. dactylon* and *C. transvaalensis* selected from field space planting were established at the OSU Turfgrass Research Center at Stillwater, OK in summer of 1997. The trial is maintained under simulated golf course fairway conditions with mowing at 1.3 cm (0.5 in), fertilization at 240 kg N ha^{-1} yr^{-1} (5 lbs N 1,000 sq. ft.) and regular irrigation. Tifway, Midlawn, and Tifsport were included as standards for the region. GN-1 was also included because of superintendents' growing interest in this grass. Standard performance parameters of greenup, color, texture, density, visual quality, and winter kill are being monitored. Additionally, divot recovery ratings are being made. The trial was inoculated in Sept. 1997 with a blend of three *O. herpotricha* isolates from Oklahoma.

Winter Kill Rating

GN-1 bermudagrass had significantly more winter kill than many other bermudagrasses in this trial (Table 4). A substantial amount of variation was present with respect to winter kill among the population of OKC selections present in the trial. No significant difference was present between Tifway and Tifsport with respect to winter kill.

As in previous years, Midlawn provided the earliest greenup in the trial (Table 4). Tifsport provided slightly earlier greenup than did Tifway, but not substantially so. Substantial variation was present among OKC selections with respect to spring greenup.

Tifway and Tifsport were the darkest green of the commercial available varieties in the trial; however, OKC 51-14, OKC 47-7, OKC 47-1, OKC 25-7, and OKC 25-15 had the same genetic color ratings as Tifway and Tifsport.

Spring Dead Spot

GN-1 bermudagrass was the most susceptible commercially available variety to SDS (Table 5). Unlike the findings in the NTEP bermudagrass trial, Tifsport had substantially smaller SDS patches present than did Tifway. Midlawn was the most SDS resistant commercially available cultivar. OKC 22-10, OKC 25-1, OKC 47-1, OKC 70-18, OKC 78-10 and ERSTurf necrotic SDS patches were numerically smaller than those on Midlawn.

Divot Recovery

GN-1 generally recovered more quickly than any other commercially available variety (Table 6). Tifway and Tifsport did not differ in their recovery rate. Several OKC selections had divot recovery rates similar to GN-1, including OKC 9-4, OKC 47-7 and OKC 19-18. As in 1999, OKC 70-18 was intermediate in its divot recovery rate and OKC 78-10 was one of the slowest OKC selections to recover. Midlawn was consistently the slowest commercially available bermudagrass to recover from divoting, as in 1999.

Visual Quality

Of the OSU selections that were both very winter hardy and more resistant to spring dead spot, OKC 70-18 and OKC 78-10 had the highest visual quality, with OKC 70-18 often providing

slightly better quality. Tifsport provided the highest visual quality of any bermudagrass throughout the year.

Peer Review Publications From USGA Sponsored Research

Martin, D.L., G.E. Bell, J.H. Baird, C.M. Taliaferro, N.A. Tisserat, R.M. Kuzmic, D.D. Dobson, and J.A. Anderson. 2001. Spring dead spot resistance and quality of seeded bermudagrasses under different mowing heights. Crop Sci. 41(1): *In press*.

Martin, D.L., G.E. Bell, C.M. Taliaferro, N.A. Tisserat, J.H. Baird, D.D. Dobson, R.M. Kuzmic, and J.A. Anderson. 2001. Spring dead spot resistance of inter-specific hybrid bermudagrasses. J. Int. Turf. Soc. 9:(accepted for publication).

Assefa, S., C. M. Taliaferro, M. P. Anderson, B. G. de los Reyes and R. M. Edwards. Diversity among *Cynodon* accessions and taxa based on DNA amplification fingerprinting. Genome 42:465-474.

Table 1. Winter kill, spring greenup, genetic color, and texture ratings for the 1997 NTEP Bermudagrass Trial at Stillwater, Oklahoma in 2000.

Entry	Winter Kill Ratings[1] 5 April	Spring Greenup Ratings[2] 24 March	Genetic Color Ratings[3] 15 May	Texture Ratings[4] 16 Aug
AZ Common	43.3	2.6	5.0	5.6
Blackjack	28.3	2.6	5.6	6.0
Blue Muda	35.0	2.6	5.0	6.6
Cardinal	3.3	6.6	4.0	9.0
CN2-9	23.3	2.6	8.0	8.0
GN-1	46.6	2.3	8.0	6.3
J-1224	38.3	2.3	6.3	6.0
J-540	35.0	2.3	5.6	6.3
Jackpot	30.0	3.0	5.0	6.6
Majestic	41.6	2.3	5.3	6.0
Midlawn	5.0	5.3	7.0	8.0
Mini-verde	38.3	2.0	8.0	8.6
Mirage	30.0	3.0	5.3	6.0
Numex Sahara	33.3	3.6	5.6	5.6
OKC 18-4	18.3	2.3	8.0	7.0
OKC 19-9	13.3	2.6	8.0	8.0
OKS 91-11	18.3	3.6	7.0	7.3
OKS 95-1	15.0	3.6	7.3	7.0
Princess	60.0	1.3	7.0	7.3
PST-R69C	30.0	2.6	6.6	7.0
Pyramid	48.3	1.6	5.0	6.3
Savannah	33.3	2.6	5.3	6.3
Shanghai	43.3	2.0	7.0	5.3
Shangri-La	36.6	3.0	5.6	6.3
Sundevil II	28.3	3.3	5.6	6.3
SW1-11	56.6	1.6	6.0	6.6
SW1-7	38.3	3.0	5.0	6.3
Tifgreen	16.6	4.3	6.6	8.0
Tifsport	23.3	2.6	8.0	8.0
Tifway	20.0	2.0	8.0	8.0
LSD(p=0.05)[5]	12.2	1.1	0.7	0.7

[1]Winter kill was rated on a 0-99 scale (0=no winter kill, 99=loss of 99 percent of turf area).
[2]Spring greenup was rated on a 1-9 scale (1=completely dormant, 9=completely green).
[3]Genetic color was rated on a 1-9 scale (1=light green, 9=dark green).
[4]Texture was rated on a 1-9 scale (1=coarse texture, 9=fine texture).
[5]If the difference between any two means in a column is equal to or greater than the LSD value, the means are statistically different.

Table 2. Density, percent cover and spring dead spot area for entries in 1997 NTEP Bermudagrass Trial at Stillwater, Oklahoma during 2000.

Cultivar	Density Ratings[1]		Percent Cover Ratings[2]		Spring Dead Spot Patch Area[3]
	15 May	16 August	15 May	16 August	18 April
AZ Common	5.0	5.0	85.0	99.0	622.3
Blackjack	5.0	6.3	87.3	98.6	750.9
Blue Muda	5.3	6.3	84.3	97.6	805.8
Cardinal	8.0	8.0	99.0	99.0	25.2
CN2-9	8.0	7.6	94.3	99.0	383.1
GN-1	7.3	8.3	83.3	99.0	1366.6
J-1224	6.0	6.6	79.3	97.3	808.4
J-540	5.3	7.0	82.6	98.3	875.9
Jackpot	5.3	6.0	87.3	99.0	681.9
Majestic	5.3	5.6	80.0	99.0	1080.8
Midlawn	7.3	7.3	98.3	99.0	20.2
Mini-verde	9.0	9.0	76.6	95.6	1194.9
Mirage	5.0	6.0	86.6	99.0	746.7
Numex Sahara	5.0	5.3	85.0	87.3	617.4
OKC 18-4	8.0	7.3	94.6	99.0	377.1
OKC 19-9	8.0	8.0	98.3	99.0	67.8
OKS 91-11	7.0	6.6	96.6	99.0	166.9
OKS 95-1	7.0	7.3	87.6	99.0	795.2
Princess	7.0	7.3	71.6	99.0	1947.5
PST-R69C	6.3	7.3	85.6	99.0	805.6
Pyramid	5.3	6.6	75.0	98.3	1105.5
Savannah	5.3	6.3	78.3	98.6	716.8
Shanghai	6.6	6.6	89.3	96.0	778.8
Shangri-La	5.6	6.3	87.3	99.0	741.6
Sundevil II	5.0	6.3	83.3	99.0	637.3
SW1-11	5.6	7.0	87.3	99.0	536.7
SW1-7	5.0	6.6	80.0	98.6	834.4
Tifgreen	8.0	8.3	91.6	99.0	486.4
Tifsport	8.0	8.0	93.6	99.0	472.8
Tifway	8.0	8.0	94.3	99.0	469.6
LSD(p=0.05)[4]	0.6	0.8	8.6	NS	606.3

[1]Density was rated on a 1-9 scale (1=bare, 9=maximum density).
[2]Percent cover was rated on a 0-99 scale (0=0 percent cover, 99=99 percent cover).
[3]Area of spring dead spot patches in cm.[2]
[4]If the difference between any two means in a column is equal to or greater than the LSD value, the means are statistically different.

Table 3. Visual quality, and percent divot recovery ratings for the 1997 NTEP Bermudagrass Trial at Stillwater, Oklahoma in 2000.

	Visual Quality Ratings[1]					Percent Divot Recovery Ratings at Two Weeks After Cutting for Three Separate Divot Cutting Dates[2]		
Entry	15 May	15 June	17 July	16 Aug	18 Sept	June Divots	July Divots	August Divots
AZ Common	4.6	5.6	5.6	6.0	6.3	73.3	80.5	76.1
Blackjack	5.3	5.6	6.0	6.0	6.6	75.0	81.6	79.9
Blue Muda	4.6	6.0	5.6	6.0	6.6	73.8	78.8	80.0
Cardinal	5.0	5.6	4.6	5.3	4.0	65.5	63.8	72.7
CN2-9	7.3	8.0	7.6	7.3	8.0	83.3	85.5	66.1
GN-1	6.0	6.6	7.0	7.3	7.3	92.2	98.3	91.1
J-1224	4.6	5.6	5.6	6.0	6.6	80.0	88.8	83.9
J-540	5.0	5.6	5.3	6.0	6.6	78.8	83.9	77.7
Jackpot	4.6	5.3	5.6	6.0	6.3	74.4	79.4	80.5
Majestic	4.6	5.6	6.0	6.0	6.6	76.6	82.2	73.8
Midlawn	7.3	7.6	7.3	7.6	8.0	69.4	67.7	69.4
Mini-verde	5.0	6.0	4.6	5.0	5.3	90.0	86.6	75.5
Mirage	5.3	6.0	5.6	6.3	6.6	74.4	81.6	82.2
Numex Sahara	5.0	5.6	6.0	6.0	6.6	74.4	77.2	76.1
OKC 18-4	7.6	8.3	7.3	6.6	7.3	86.6	78.9	73.3
OKC 19-9	7.3	8.3	7.6	7.3	8.0	83.9	83.3	78.3
OKS 91-11	7.0	7.3	7.3	6.6	7.6	80.5	82.2	62.7
OKS 95-1	6.6	7.3	7.6	7.3	7.6	96.1	93.8	85.5
Princess	4.6	6.0	6.3	7.3	7.6	91.6	94.9	87.7
PST-R69C	5.3	6.6	6.3	7.0	7.0	89.4	89.4	78.8
Pyramid	4.0	5.3	5.6	6.0	6.6	76.6	86.1	84.4
Savannah	4.6	5.6	6.0	6.6	6.6	82.2	85.5	85.0
Shanghai	5.0	6.3	6.3	5.6	6.3	91.1	91.6	80.0
Shangri-La	5.0	6.0	5.6	6.3	6.3	80.5	75.0	76.6
Sundevil II	5.0	5.6	5.6	6.3	6.6	80.0	90.0	77.2
SW1-11	5.0	6.0	6.0	6.6	6.3	86.6	90.0	83.8
SW1-7	4.6	5.6	6.0	6.6	6.6	76.1	86.1	76.6
Tifgreen	7.3	8.0	7.3	8.0	8.0	82.2	81.1	84.4
Tifsport	7.6	8.0	7.6	8.0	8.0	76.6	77.2	69.4
Tifway	7.6	8.3	7.6	8.0	8.0	81.6	76.6	66.6
LSD(p=0.05)[3]	0.8	0.8	0.9	0.8	0.6	6.9	8.3	13.0

[1]Visual quality was rated on a 1-9 scale (1=poor quality, 9=high quality).
[2]Percent divot recovery was rated on a 0-100 scale (0=0 percent recovery, 100=100 percent recovery).
[3]If the difference between any two means in a column is equal to or greater than the LSD value, the means are statistically different.

Table 4. Winter kill, spring greenup, genetic color, and texture ratings for the 1997 Fairway Bermudagrass Trial at Stillwater, Oklahoma in 2000.

Entry	Winter Kill Ratings[1] 5 April	Spring Greenup Ratings[2] 24 March	Genetic Color Ratings[3] 15 May	Texture Ratings[4] 16 Aug
10-9	32.5	3.0	8.0	7.5
1-20	12.5	3.0	8.0	8.0
18-11	25.0	3.5	6.5	8.0
19-18	5.0	3.5	8.0	8.5
20-6	5.0	3.5	6.5	8.0
22-10	10.0	3.5	8.0	8.5
22-13	10.0	2.5	7.5	9.0
24-4	17.5	3.0	7.5	7.5
25-1	7.5	3.0	7.0	8.5
25-15	17.5	2.0	8.5	8.0
25-6	22.5	2.0	7.0	8.5
25-7	70.0	1.5	8.5	7.0
26-13	27.5	2.5	7.5	8.0
30-20	12.5	3.0	7.0	8.0
38-2	22.5	3.0	7.0	8.0
46-4	57.5	1.0	8.0	8.0
47-1	20.0	2.5	8.5	9.0
47-7	35.0	1.5	8.5	8.0
49-17	25.0	2.5	8.0	8.0
51-14	10.0	4.0	8.5	8.5
52-15	7.5	4.0	7.0	8.0
53-1	15.0	1.0	8.0	8.0
55-5	15.0	2.5	8.0	8.0
56-14	22.5	3.0	8.0	8.0
6-12	7.5	4.0	6.5	8.0
68-9	20.0	4.5	8.0	8.0
70-18	7.5	3.0	7.0	8.0
74-3	7.5	4.5	6.5	8.0
78-10	7.5	4.0	6.5	8.0
9-4	12.5	3.5	8.0	8.0
94-2	20.0	1.5	8.0	8.0
ERSTurf	7.5	5.0	7.0	8.0
Tifway	27.5	2.0	8.5	8.0
GN-1	40.0	2.5	8.0	7.5
Midlawn	5.0	5.5	6.5	7.0
Tifsport	20.0	3.0	8.5	8.0
LSD(p=0.05)[5]	20.6	1.6	0.9	0.6

[1]Winter kill was rated on a 0-99 scale (0=no winter kill, 99=loss of 99 percent of turf area).
[2]Spring greenup was rated on a 1-9 scale (1=completely dormant, 9=completely green).
[3]Genetic color was rated on a 1-9 scale (1=light green, 9=dark green).
[4]Texture was rated on a 1-9 scale (1=coarse texture, 9=fine texture)
[5]If the difference between any two means in a column is equal to or greater than the LSD value, the means are statistically different.

Table 5. Density, percent cover and spring dead spot ratings for the 1997 Fairway Bermudagrass Trial at Stillwater, Oklahoma in 2000.

Entry	Density Ratings[1]		Percent Cover Ratings[2]		Spring Dead Spot Patch Area[3]
	15 May	16 Aug	15 May	16 Aug	20 April
10-9	7.0	7.5	86.5	94.5	1241.7
1-20	7.5	7.0	91.0	99.0	774.5
18-11	7.5	7.0	97.0	99.0	186.5
19-18	7.5	7.0	97.5	99.0	131.2
20-6	8.0	7.0	99.0	99.0	13.9
22-10	8.0	7.0	99.0	99.0	0.0
22-13	8.0	7.5	98.0	99.0	161.1
24-4	8.0	8.0	80.0	98.0	1054.6
25-1	8.0	7.0	99.0	99.0	30.1
25-15	8.0	7.5	97.0	99.0	191.2
25-6	8.0	7.0	97.5	99.0	166.1
25-7	7.0	8.0	80.0	99.0	573.6
26-13	8.0	7.0	96.0	99.0	319.2
30-20	8.0	7.0	93.5	99.0	547.5
38-2	8.0	7.5	92.5	99.0	479.5
46-4	8.0	7.5	93.5	99.0	296.6
47-1	8.0	8.0	99.0	99.0	9.4
47-7	8.0	8.0	94.5	99.0	416.6
49-17	7.5	7.5	96.5	99.0	233.2
51-14	9.0	8.0	97.5	99.0	122.6
52-15	8.0	7.0	96.5	99.0	314.8
53-1	7.5	7.0	95.0	99.0	584.1
55-5	8.0	7.0	96.0	99.0	282.8
56-14	8.0	7.0	97.0	99.0	161.5
6-12	7.0	7.5	91.5	99.0	640.0
68-9	8.5	8.5	91.0	98.0	679.4
70-18	8.0	7.0	98.5	99.0	17.1
74-3	7.0	7.0	94.5	99.0	251.5
78-10	7.0	6.5	99.0	99.0	0.0
9-4	7.0	7.0	95.0	99.0	305.4
94-2	7.5	8.0	97.5	99.0	181.7
ERSTurf	8.0	7.0	98.5	99.0	37.4
Tifway	8.0	7.5	92.5	99.0	466.6
GN-1	7.5	7.5	91.0	99.0	865.5
Midlawn	6.5	6.0	98.5	93.5	57.3
Tifsport	8.0	7.5	97.5	99.0	147.3
LSD(p=0.05)[4]	0.8	0.8	6.1	NS	392.6

[1]Density was rated on a 1-9 scale (1=bare, 9=maximum density).
[2]Percent cover was rated on a 0-99 scale (0=0 percent cover, 99=99 percent cover).
[3]Area of spring dead spot patches in cm.^{2}
[4]If the difference between any two means in a column is equal to or greater than the LSD value, the means are statistically different.

Table 6. Visual quality, and percent divot recovery ratings for the 1997 Fairway Bermudagrass Trial at Stillwater, Oklahoma in 2000.

	Visual Quality Ratings[1]					Percent Recovery at 2 Weeks After Divot Cutting[2]		
Cultivar	15 May	15 June	17 July	16 Aug	18 Sept	June Divots	July Divots	August Divots
10-9	5.0	7.0	6.5	7.0	7.5	94.1	92.5	87.5
1-20	6.0	7.5	7.5	7.0	7.0	88.3	77.5	85.8
18-11	7.0	7.0	7.0	7.0	7.0	94.1	92.5	88.3
19-18	6.5	8.0	7.0	7.5	7.0	92.5	91.6	90.8
20-6	7.0	7.0	6.5	7.0	7.5	89.1	80.0	89.1
22-10	8.0	7.0	8.0	8.0	7.0	90.8	84.1	84.1
22-13	5.5	6.5	6.0	7.0	6.5	86.6	81.6	85.0
24-4	4.5	6.0	5.5	7.5	7.5	91.6	93.3	87.5
25-1	8.0	7.5	8.0	7.0	7.0	91.6	93.3	88.3
25-15	6.5	8.0	7.5	8.0	7.5	93.3	94.1	85.8
25-6	7.0	7.0	7.0	7.0	7.5	85.8	81.6	82.5
25-7	4.5	7.0	8.5	7.0	8.0	98.3	95.0	87.5
26-13	8.0	7.0	7.5	7.5	7.5	89.1	79.1	88.3
30-20	6.5	7.0	6.5	7.0	7.0	80.8	84.1	88.3
38-2	6.5	7.5	7.0	7.0	7.0	90.8	91.6	86.6
46-4	6.5	7.0	7.0	7.5	7.0	90.0	85.0	81.6
47-1	7.5	7.5	7.5	8.0	7.5	93.3	85.8	86.6
47-7	7.5	7.5	8.0	8.0	7.5	95.8	94.1	92.5
49-17	7.0	7.5	8.0	8.0	7.0	83.3	75.8	81.6
51-14	7.0	7.5	7.5	7.5	7.0	97.5	95.8	90.8
52-15	7.0	8.0	8.0	7.5	7.5	87.5	91.6	85.8
53-1	6.5	8.0	8.0	8.0	7.0	90.8	84.1	85.8
55-5	6.5	7.5	7.0	7.0	7.0	82.5	85.0	86.6
56-14	6.5	7.5	7.0	7.0	7.0	88.3	83.3	83.3
6-12	6.5	7.0	7.0	8.0	7.0	95.0	94.1	90.0
68-9	5.5	7.5	7.0	7.5	7.5	94.1	93.3	87.5
70-18	8.0	7.5	7.5	8.0	8.0	90.8	85.8	85.8
74-3	6.5	7.0	7.5	7.0	7.0	85.0	78.3	72.5
78-10	7.5	7.0	7.0	7.0	8.0	79.1	77.5	81.6
9-4	6.5	7.5	7.5	8.0	7.0	95.8	90.0	91.6
94-2	7.5	8.0	8.0	8.0	7.0	88.3	81.6	87.5
ERSTurf	7.0	6.5	7.0	7.0	7.5	85.0	79.1	87.5
Tifway	7.0	7.5	8.0	8.0	8.0	87.5	85.0	79.1
GN-1	6.0	6.5	7.5	7.0	7.0	94.1	93.3	90.8
Midlawn	7.0	6.5	7.0	7.0	7.5	80.0	68.3	70.0
Tifsport	8.0	8.0	8.0	8.0	8.0	87.5	85.8	81.6
LSD(p=0.05)[3]	1.1	NS	1.0	0.6	0.8	8.8	7.0	9.2

[1]Visual quality was rated on a 1-9 scale (1=poor quality, 9=high quality).
[2]Percent divot recovery was rated on a 0-100 scale (0=0 percent recovery, 100=100 percent recovery).
[3]If the difference between any two means in a column is equal to or greater than the LSD value, the means are statistically different.