EXECUTIVE SUMMARY

Objectives of the Oklahoma State University bermudagrass breeding program are to develop: (1) seed-propagated, cold-tolerant, fine-textured varieties for the U.S. transition zone; and (2) improved varieties for golf course putting greens, with emphasis on adaptation to southern coastal states.

Two bermudagrass broad-base genetic populations ($C_{3fer-2tex}$ and C_{1ct}) and several narrow-base synthetic polycrosses were field grown in 1992 to provide seed for performance testing and further cyclic selection. Seed of the respective broad-base breeding populations was submitted for inclusion in the 1992 National Bermudagrass Evaluation Test. The second selection cycle (C_{2ct}) for increased cold tolerance was completed. A total of 1584 C_{1ct} plants were screened for cold tolerance. Only 1% survived the exposure temperature of -8.7 °C. Field tests were planted in late 1991 or early 1992 in Oklahoma and Arizona to measure seed yield of the broad genetic base breeding populations, narrow genetic base polycrosses, and selected clonal plants.

C. transvaalensis plants in Florida and Oklahoma screening nurseries began to show large differences in stand retention and turf quality in late 1991. Twenty-nine Florida grown plants maintaining good turf quality under rigorous putting green management were selected for inclusion in more intensive evaluation tests. Evaluation of six *C. transvaalensis* selections and Tifgreen and Uganda controls in a replicated putting green performance trial at Stillwater, OK demonstrated significant performance differences. *C. transvaalensis* selection 2747 had overall best performance in both 1991 and 1992.

Improved protocol for regeneration of bermudagrass plants from cultured tissues were developed. One protocol allows for use of mature caryopses from responsive genotypes. Previously, bermudagrass plants had been regenerated only from cultures derived from young inflorescence explants. Somaclonal variant regenerate bermudagrass plants have been identified and are now being morphologically, cytologically, and biochemically characterized.

Alterations in protein synthesis associated with cold acclimation were found in crown tissues of Midiron and Tifgreen bermudagrasses. Crowns of both cultivars after cold acclimation synthesized low molecular weight (17-31 kD, basic pI's of 7-9) proteins, though crowns from acclimated Tifgreen did so to a lesser extent. Both cultivars produced some unique cold regulated (*cor*) proteins in response to cold acclimation, while other *cor* proteins were produced in different concentrations by the cultivars. Research into the correlation between the synthesis of *cor* proteins and freezing tolerance in bermudagrass is continuing.

I. INTRODUCTION

The turf bermudagrass breeding program 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, winter hardy, seed-propagated varieties for the U.S. transition zone. The program was expanded in 1990 to include the development of superior vegetatively-propagated varieties for use on putting greens in the southern U.S. where bentgrass is poorly adapted.

Important ongoing activities supporting the breeding effort include the development/improvement/use of techniques to measure physiological and morphological parameters related to environmental stresses; the procurement, evaluation, and use of new turf bermudagrass germplasm in the breeding effort; use of tissue culture in generating genetic variation and screening for desirable traits at the cellular level; and evaluation of bermudagrass varieties and breeding lines for turf performance.

This report summarizes activities and progress for the period 1 November 1991 through 31 October 1992.

II. RESEARCH PROGRESS

Seed-Propagated Varieties. Seed was harvested in fall 1991 from the cold hardy breeding population ($C_{3fer-2tex}$) previously subjected to 3 and 2 cycles of recurrent selection for increased basic fertility (% of florets setting seed) and fine texture, respectively. The plants were selected for turf quality and seed set. Average percent seed set of the 329 plants was 62, measured on florets collected in August. Percentage seed set and germination of the 29 selected plants averaged 68 and 73, respectively (Table 1). Both basic fertility and textural fineness has been significantly enhanced in the $C_{3fer-2tex}$ population relative to the initial C_0 population. A portion of the seed harvested from the $C_{3fer-2tex}$ population in 1991 was designated as OKS91-11 and entered in the 1992 National Bermudagrass Evaluation Test conducted by the National Turf Evaluation Program.

Twenty-nine of the 329 plants comprising the $C_{3fer-2tex}$ population were selected, vegetatively propagated, and planted in September 1991 in an isolated polycross block and in a replicated experiment to measure seed yield. Seed was harvested from the polycross block in September 1992. Yield from the block was equivalent to 250 lbs. pure unhulled seed/acre. The seed yield test containing the 29 selections was harvested in late September and processing is now underway. We will further select among these 29 clonal plants on the basis of seed yield and combining ability for turf performance characteristics.

Seed was also harvested in 1991 from the Cycle 1-cold tolerance (C_{1ct}) common bermudagrass plant population in which recurrent selection is being practiced for increased cold tolerance using the mass screening procedure previously described. A portion of the seed from the C_{1ct} population was designated as OKS91-1 and entered in the 1992 National Bermudagrass Test.

A second cycle of cold-hardiness screening was completed in summer 1992. A total of 1584 plants was screened for superior cold hardiness. Plants were cold acclimated in a controlled environment chamber for 4 wks, then exposed to -8.7C, and evaluated for regrowth. Only 1% of the plants survived the low temperature treatment, and 0.4% (about one-half of the survivors) were noted to exhibit strong regrowth (Fig 1). Those plants exhibiting strong regrowth will be intercrossed to provide the next cyclic selection population.

Ten polycross blocks comprised of selected plants from the $C_{3fer-2tex}$ and C_{1ct} populations were established during the 1991 growing season. The purpose of these polycrosses is to test the combining ability of different parental combinations of plants. The number of parental plants in the respective polycrosses ranges from 5 to 10 and, thus, represent relatively narrow genetic base synthetic varieties. Seed was recently harvested from each of the polycrosses.

Selection of plants from the above mentioned populations for adaptation to the bermudagrass seed producing region of the southwestern U.S. continues. In October 1991, the 29 selected plants from the $C_{3fer-2tex}$ population were planted on the Yuma Valley Research Center (YVRC) at Yuma, AZ. However, we were required to move them to a different site (YVRC Mesa Farm) in June 1992 because the Research Center discontinued use of a large area including the planting. This effectively negated data collection in 1992. In April 1992, the $C_{3fer-2tex}$ and C_{1ct} populations plus six of the narrow genetic base synthetic populations were planted in a replicated seed production test on the YVRC mesa farm. First seed yield data from the 29 selected clones and the six entries in the replicated seed yield test will be in summer 1993.

<u>Vegetatively Propagated Varieties</u>: A total of 29 plants were selected from the *C. transvaalensis* screening nurseries in Oklahoma and Florida in October 1991 (Table 2). Fifteen of 3,300 plants were selected from the original screening blocks established on the Turf Research Center, Stillwater in 1990. Fourteen selections were made from screening nurseries on the Palm Beach, High Ridge, and Fiddlesticks Golf Clubs in Florida. Fig. 2 shows the screening nursery on the High Ridge Country Club. Many of the 100 plants at this site died in response to the imposed putting green maintenance regime, others were performing poorly, but a few maintained high turf quality. This magnitude of "sorting out" among genotypes is precisely what we hoped for. The 29 selected plants were increased in the greenhouse during the 1991-92 winter. New plantings in larger plots were made on four Florida Golf Courses in 1992. The number of selections planted in respective tests depended on available area. All 29 selections plus seeded *C. transvaalensis* were planted in single 75 ft^2 plots on the Palm Beach CC; 14 selections plus seeded *C. transvaalensis* and Tifdwarf were planted in 180 ft^2 single plots on the Emerald Dunes Golf Club in West Palm Beach; the same 16 entries were planted in 140 ft^2 single plots on the Imperial Golf Course in Naples; 15 of the selections plus 'Tifdwarf' were planted in duplicate 90 ft^2 plots (2 reps) on the Champions Golf Club in Houston, TX; the additional 14 selections plus seeded *C. transvaalensis* were planted in single 90 ft^2 plots on the Champions Golf Course. Additional *C. transvaalensis* progeny plants were planted in screening nurseries on the Emerald Dunes, Imperial, and Champions courses.

David Gerken, M.S. candidate in Horticulture, began a field evaluation of six experimental *C. transvaalensis* plants plus Uganda and Tifgreen bermudagrass under putting green conditions in spring of 1991 (Figs. 3 and 4). The six plants were selected in fall 1990 from 3300 *C. transvaalensis* plants planted on the OSU Turf Research Center in spring of that year. Thus, selection was based on visual appearance at the time of inspection, rather than on accumulated data. In 1992, all African bermudagrasses ranked higher than Tifgreen for overall visual quality (Table 3). Three of the six experimental *C. transvaalensis* plants ranked higher than Uganda. Relative ranking of the entries in the test was similar in 1991 and 1992. All entries in the test had increased shoot density in 1992 compared to 1991 (Tables 4 and 5). All *C. transvaalensis* entries in the test had greater ($P<0.05$) visual density and shoot counts in 1992 than Tifgreen. Some experimental *C. transvaalensis* entries had numerically greater visual density ratings and shoot counts than Uganda in 1992. Visual color ratings were higher ($P<0.05$) for Tifgreen compared to all *C. transvaalensis* entries in both 1991 and 1992 (Table 6). However, all experimental *C. transvaalensis* entries had higher ($P<0.05$) color ratings than Uganda in both 1991 and 1992. Data on 1992 green speed, clipping yield, root mass distribution, and leaf blade angles have not been statistically analyzed at this time. Mean 2-yr data from this test indicates experimental *C. transvaalensis* selection 2747 to have best overall performance and potential for commercialization. The strain is being increased for additional testing and potential release.

The differences in turf performance characteristics among the six experimental *C. transvaalensis* selections in Mr. Gerken's test attests to the amount of variation within the species. The tremendous phenotypic variation found among the thousands of *C. transvaalensis* progeny plants which we have grown over the past 5 yrs suggests ample potential for breeding within the species. A current priority objective is to generate a genetic population permitting estimation of genetic parameters. To that end, crossing of selected *C. transvaalensis* parental plants was initiated in spring 1992. Thirty-two randomly selected parent plants were assigned to four groups of eight plants each. In each group, four plants were randomly chosen as males, with each male to be crossed to each of the four females. The mating design produces full and half-sib progeny plants. Crossing is being done in the greenhouse by artificial emasculation and pollination. About 50% of the required crossing was completed in 1992, with the remainder scheduled for spring 1993. There is only about a 6 wk window of time in the spring in which crosses can be made.

<u>Cold Tolerance Research</u>: Seven bermudagrass genotypes were cold-acclimated in growth chambers, then exposed to a series of subfreezing temperatures to determine relative hardiness levels. The temperature resulting in 50% mortality (T_{50}), based on regrowth potential, was calculated from four clonally-propagated plants per genotype-temperature treatment combination on each of three dates in both 1991 and 1992. Tifton-10 was similar in freeze tolerance to Tifgreen. Vamont, Midlawn, Midiron, and Tifway were hardiest, exhibiting the lowest killing temperatures. Freeze tolerance is one of several important factors that contribute to winter survival. The following values represent hardiness levels after 4 wks of controlled

acclimation. The rate and stability of acclimation under natural conditions may also be important winter hardiness characteristics.

Genotype	T_{50}(°C)
Tifgreen	-7.7 a
Tifton 10	-7.9 ab
Midfield	-8.7 bc
Vamont	-9.5 cd
Midlawn	-9.5 cd
Midiron	-9.6 cd
Tifway	-10.1 d

A preliminary study was carried out to determine whether it was likely that freeze avoidance was a significant factor in winter survival of bermudagrass. Variability in vertical meristem distribution could result in a range of exposure temperatures under field conditions due to thermal buffering of the soil. Initially, cores were cut from six-yr-old plots of Midiron and Tifgreen sod. Cylindrical cores were cut into 2 cm sections parallel with the soil surface. Each section was potted in commercial mix and the number of shoots from each was counted following growth in a greenhouse. Virtually all shoots originated from the top 2 cm of soil. In a follow-up experiment, plants were started in cylindrical tubes filled with native soil or soil:sand (20:80% by volume). After one month in a greenhouse, each soil cylinder was sectioned into 1 cm disks as described above, and potted for subsequent shoot counts. Midiron and Tifgreen plants in native soil had 76 and 78% of shoots arising from the top 2 cm and no shoots emerging from below 4 cm. Midiron had 91% of shoots in the top 2 cm of the soil:sand mixture and 59% of Tifgreen shoots arose from the top 2 cm. No shoots originated from below 4 cm in either genotype. Although results are preliminary, differences if freeze avoidance between Midiron and Tifgreen in native soils are not supported by the data. Other genotypes or soil types may yield different results in more comprehensive evaluations.

Mr. Mark Gatschet, Ph.D. student in Crop Science, is nearing the completion of thesis research of protein synthetic response of bermudagrass to low temperatures. His results to date provide valuable new information on bermudagrass cold hardiness. The study characterizes the potential of Midiron and Tifgreen bermudagrasses for cold acclimation (CA) in a controlled environment, and demonstrates alterations in protein synthesis associated with CA. Freezing temperatures were applied to plants after 4 wks in growth chambers under acclimating (8/2°C : light/dark : 10/14 h periods) or nonacclimating (28/24 °C) conditions. Proteins synthesized by crowns were *in vivo* radiolabeled for 20 h with ^{35}S-Met and ^{35}S-Cys. After CA, LT_{50} (lethal temperature for 50% of plants) values for Midiron plants decreased from -6.5 to -11.3 °C, and for Tifgreen plants, decreased from -3.6 to -8.5 °C. Two dimensional polyacrylamide gel electrophoresis (2D-PAGE) and fluorography revealed many changes in protein synthesis by crowns after CA. Notably, crowns of both varieties after CA synthesized low molecular weight (17-31 kD), basic pi's of 7-9) proteins, though crowns from CA Tifgreen plants did so to a lesser extent. One dimensional polyacrylamide gel electrophoresis (1D-PAGE) and silver staining revealed several changes in crown protein composition associated with CA. Concentrations of proteins from approximately 80 to 10 kD or less decreased by 25% or more in crowns from acclimated Midiron and/or Tifgreen plants. 1D-PAGE and fluorography of radiolabeled proteins revealed major alterations in protein synthesis associated with CA (Fig 5). Crowns from acclimated Midiron plants synthesized cold-regulated (*cor*) proteins of 108, 60, 49, 40, 37, 36, 34, 27, 23, 21, and 15 kD, while crowns from acclimated Tifgreen plants synthesized *cor* proteins of 108, 48, 40, 36, 33, 27, 23, 21, and 15 kD. The unique synthesis of *cor* proteins having approximate molecular weights of 60, 49, 37, and 34 kD, and the greater level of synthesis of corresponding *cor* proteins having approximate molecular weights of 27, 23, and 21 kD, by acclimated Midiron crowns compared to Tifgreen, corresponds directly with the greater of cold hardiness of Midiron acclimated crowns compared to Tifgreen. However, crowns from acclimated Tifgreen plants uniquely synthesized *cor* proteins of approximate MW of 48 and 33 kD, and synthesized *cor* proteins of approximate molecular weights of 108, 40, 36, and 15 kD to greater levels than crowns from acclimated Midiron plants. The *cor* proteins of 60, 49, 37, 34, 27, 23, and 21 kD synthesized by acclimated Midiron crowns uniquely, or to a greater extent, than crowns from acclimated Tifgreen opens the possibility that these proteins may contribute to the greater absolute freezing tolerance of Midiron as compared to Tifgreen.

Of interest, however, is the fact that while Midiron plants, both without and after acclimation, are tolerant to lower freezing temperatures than comparably treated Tifgreen plants, both Midiron and Tifgreen plants apparently have the same net potentials for adjusting to lower freezing temperatures after CA, i.e. to freezing temperatures approximately 5 °C lower under conditions of CA in this study. Identification of *cor* proteins from either Midiron or Tifgreen plants then may lead to more accurate models of the role of these proteins in the CA of bermudagrasses, and contribute to the development of bermudagrasses having greater potential for CA and winter hardiness.

<u>Tissue Culture Research</u>: Research is continuing on improvement of tissue culture protocol for turf bermudagrasses. The basic objective is to developed more efficient and effective procedures for plant regeneration. Dr. Mohamed Chakroun, as part of his dissertation, developed a protocol for using mature bermudagrass caryopses as explants and also studied the effects of basal media and auxins on embryogenic induction and regeneration from bermudagrasses. Additionally, we have found somaclonal variant plants among populations of regenerated plants of Tifdwarf, Tifgreen and other bermudagrass plants. Work is now underway to morphologically, cytologically, and biochemically characterize these variant plants.

<u>Other Research</u>: Mr. John Lamle recently completed an M.S. thesis study on "Cytological Analysis of Self-Incompatibility in Bermudagrass, *Cynodon dactylon (L.) Pers*. John found that self-incompatibility in bermudagrass results from inhibition of pollen tube growth in both the stigmatic and styler tissues and that it is controlled gametophytically.

III. RESEARCH PLANNED

Seed Propagated Bermudagrasses: Evaluation of experimental synthetic varieties will be broadened and intensified to determine their potential for release as quickly as possible. A field study was planted on July 20, 1992 to compare the performance of 6 OSU experimental seeded bermudagrasses to 12 seeded bermudagrasses that are commercially available or will soon be commercially available (Table 7). Treatments to be imposed on the entries beginning in 1993 include cutting heights of 12.7, 25.4, and 38.1 mm (0.50, 0.75 and 1.5 ins.) and fertilizer rates of 147 and 245 kg N/ha/yr. (3 and 5 lbs N/1000 ft^2).

A cooperative effort between OSU and Kansas State University will begin in early 1993 to screen seeded bermudagrass for tolerance to Spring Dead Spot caused by the fungal pathogen *Ophiosphaerella herpotricha*. Field plots of bermudagrasses listed in Table 7, as well as additional OSU experimentals will be established in spring 1993 at the OSU Turfgrass Research Center. Plots will first be inoculated in fall 1993 by Dr. Ned Tisserat, KSU Turf Plant Pathologist. Evaluation for tolerance to Spring Dead Spot Disease will begin in Spring 94. Field inoculation and evaluation remain the most reliable means of evaluation of tolerance to the organism according to Dr. Tisserat.

Seed yield data will first be obtained in 1993 on the breeding populations ($C_{3fer\text{-}2tex}$ and C_{1ct}), several narrow genetic base experimental synthetic populations, and selected individual plants included in replicated tests in Oklahoma and Arizona.

We will continue the following breeding activities: (1) greenhouse phenotypic recurrent selection for refinement of texture, (2) selection for earlier and more prolific seed head production in cold tolerant populations, and (3) selection for increased cold-tolerance in populations derived from common bermudagrass.

Vegetatively Propagated Bermudagrasses: *C. transvaalensis* plants selected from current field test plantings will be advanced to more intensive and extensive testing in 1993. New spring 1993 tests are planned for golf courses in New Orleans, Las Vegas, and Los Angeles. Dr. Joel Barber, Director of Agronomy, Golf Course Enterprises, and former Co-Principle Investigator on this project has cooperated in arranging these sites. The tests will be under putting green management and will have treatments replicated.

A 7500 ft^2 sand green was prepared in October 1992 for planting of ca 35 bermudagrasses in 1993. Entries will include *C. transvaalensis* selections with Tifgreen and Tifdwarf as controls. The available area will permit two replications. Plots will be split to accommodate nitrogen fertilization rates.

Dr. Monica Elliott, Plant Pathologist at the University of Florida Research & Demonstration Center at Ft. Lauderdale will cooperate in evaluating some (number to be determined) of our *C. transvaalensis* selections under putting green management.

Evaluation of ca 200 F_1 plants from *C. transvaalensis* x *C. transvaalensis* and *C. transvaalensis* x *C. dactylon* crosses transplanted to the field in summer 1992 will continue. Several hundred additional F_1 plants from spring 1992 crosses will be transplanted to field nurseries. We will complete controlled crossing of the 32 *C. transvaalensis* plants used as parents to generate full and half sib progeny populations for estimating genetic parameters within the species.

Other Research: Cold tolerance research conducted by Dr. Anderson and Mr. Gatschet will continue. Future research objectives are to evaluate the effectiveness of the cold hardiness screening procedure perfected by Dr. Anderson and to continue to fine-tune and improve the procedure. Mr. Gatschet's research provides a basis for research to characterize the cold-regulated proteins of bermudagrass and ultimately to perhaps identify and manipulate the genes that produce them. We will also continue tissue culture research and look specifically at the potential of using callus to investigate protein synthesis in response to cold shock.

Table 1. Percentage of florets setting seed[1] and seed germination[2] for 29 selected plants from bermudagrass population $C_{3fer\text{-}2tex}$. Fall 1991.

Plant	Seed Set	Germination
	-------------%	-------------
1-1-5	69	83
1-3-7	73	77
1-5-10	59	83
1-9-4	60	81
1-12-8	78	83
1-12-9	72	62
1-18-7	75	85
1-18-10	53	74
1-19-10	60	51
1-22-10	63	77
1-23-3	42	73
1-23-7	75	77
2-1-8	62	56
2-3-11	93	90
2-4-5	74	56
2-4-8	79	83
2-5-9	79	73
2-5-11	73	81
2-6-5	59	79
2-10-8	70	86
2-10-10	64	85
2-11-7	76	59
2-11-11	94	59
2-12-6	66	84
2-13-10	54	42
2-14-5	56	73
2-17-2	64	87
2-24-5	71	26
2-24-6	51	86
$\bar{x}$	68	73

[1] Mean of 10 inflorescences
[2] Mean of 4 replicates @ 50 seed/plate

Table 2. *C. transvaalensis* plants selected from screening nurseries in Oklahoma and Florida in fall 1991.

No.	Accession #	Origin
01	80	Stillwater TRC
02	223	do
03	783	do
04	798	do
05	983	do
06	1220	do
07	1475	do
08	2288	do
09	2336	do
10	2420	do
11	2462	do
12	2554	do
13	2567	do
14	2583	do
15	2718	do
16	1111	Palm Beach CC
17	1394	do
18	1397	do
19	1556	do
20	1767	do
21	1898	do
22	1943	do
23	1946	do
24	1959	do
25	2352	High Ridge CC
26	2570	do
27	3048	do
28	2567	Fiddlesticks CC
29	Unknown	do

Table 3. Mean seasonal visual quality ratings for eight putting green turfgrasses during the 1991-1992 growing season at Stillwater, Oklahoma[1,2]

Genotype	Mean for 1991	Mean for 1992
2747	7.6A	7.6A
2864	7.5BA	6.8B
1415	7.0BC	6.6CB
UG	6.9DC	5.9D
1397	6.8DC	6.5CBD
696	6.7DC	5.9D
2387	6.5DC	6.0CD
TG	6.5D	5.0E
LSD	0.5	0.6

[1]Visual quality was rated on a 1-9 scale, where 1=lowest quality and 9=highest quality. Visual quality ratings were conducted on seven sampling dates in 1991 and 25 sampling dates in 1992.

[2]Means followed by the same letter are not significant at the 5% level using the Least Significant Difference test. Means were rounded to the tenths place after comparison with the LSD test.

Table 4. Mean seasonal visual density ratings for eight putting green turfgrasses during the 1991-1992 growing season at Stillwater, Oklahoma[1,2]

Genotype	Mean for 1991	Mean for 1992
2747	7.7A	7.9A
2864	7.4BA	7.3B
1415	7.1BAC	6.9CB
UG	7.2BAC	6.4D
1397	6.9BC	6.6CD
696	6.9BC	6.5CD
2387	6.7C	6.4CD
TG	7.0BC	5.1E
LSD	0.6	0.5

[1]Visual density was rated on a 1-9 scale, where 1=lowest density and 9=highest density. Visual density ratings were conducted on seven sampling dates in 1991 and 25 sampling dates in 1992.

[2]Means followed by the same letter are not significant at the 5% level using the Least Significant Difference test. Means were rounded to the tenths place after comparison with the LSD test.

Table 5. Mean seasonal shoot counts for eight putting green turfgrasses during the 1991-1992 growing season at Stillwater, Oklahoma[1,2]

Genotype	Mean for 1991	Mean for 1992
696	130.0A	170.1BA
2747	115.9BA	172.4BA
1415	112.6BC	164.3BA
2864	111.6BC	177.4A
1397	110.6BC	155.0AB
2387	101.5BC	173.8BA
UG	99.3C	151.9B
TG	46.5D	91.3C
LSD	14.4	23.8

[1]Shoot counts are the mean number of shoots per $283mm^2$ ($0.44\ in^2$) area of turf sampled. Shoot counts were made on 1 sampling date in 1991 and 2 dates in 1992.

[2]Means followed by the same letter are not significant at the 5% level using the Least Significant Difference test. Means were rounded to the tenths place after comparison with the LSD test.

Table 6. Mean seasonal visual color ratings for eight putting green turfgrasses during the 1991-1992 growing season at Stillwater, Oklahoma[1,2]

Genotype	Mean for 1991	Mean for 1992
TG	7.7A	8.0A
1415	7.0B	7.4B
1397	7.0B	7.5B
696	6.8CB	7.0C
2747	6.8CB	6.9C
2387	6.6C	6.8C
2864	6.6C	6.7C
UG	5.1D	5.4D
LSD	0.3	0.3

[1]Visual color ratings were made on a 1-9 scale, where 1=straw brown and 9=dark green. Visual color ratings were conducted on seven sampling dates in 1991 and 25 sampling dates in 1992.

[2]Means followed by the same letter are not significant at the 5% level using the Least Significant Difference test. Means were rounded to the tenths place after comparison with the LSD test.

Table 7. Seeded bermudagrasses established in a field trial at Stillwater in 1992.

Genotype	Source	Genotype	Source
African bermudagrass	OSU	Ft. Reno	OSU
Arizona Common	Many	Guymon	Johnston Seed Co.
BERPC 91-2	OSU	J-912	Jacklin Seed
BERPC 91-6	OSU	Poco Verde	Farmer's Marketing
BERPC 89-3	OSU	Primavera	Farmer's Marketing
BERPC 91-1	OSU	Sonesta	O.M. Scott & Sons
C2	Finelawn Research	Sundevil	Medalist America
Cheyenne	Pennington Seed	Tropica	Turf Merchants
DSM 250	Dessert Sun Marketing	"Seed from U-3"	Many

Fig. 1. Plants of C_{1ct} bermudagrass breeding population following cold acclimation and exposure to -8.7 °C. A total of 1584 plants were screened, with only 1% surviving. About half of these had strong regrowth.

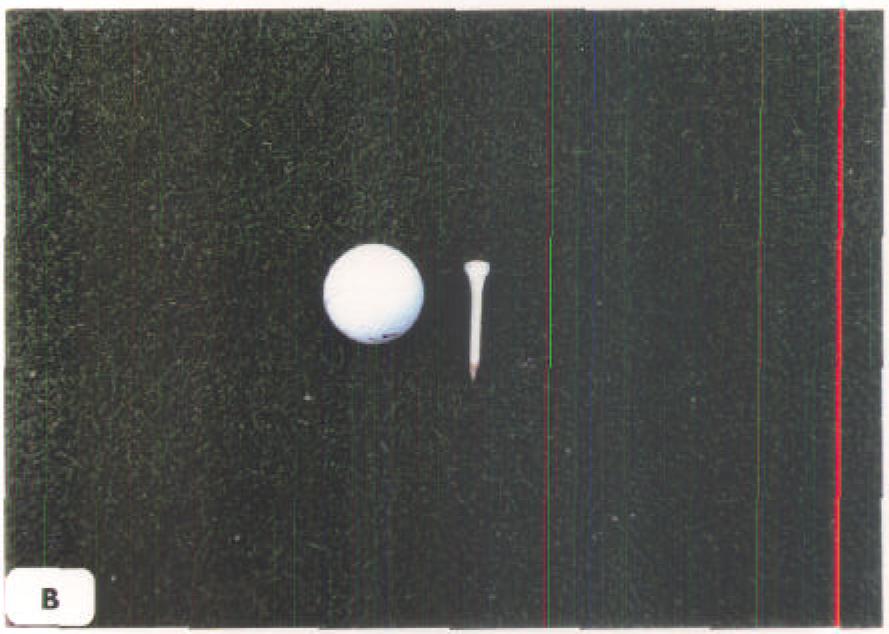

Fig. 2. *Cynodon transvaalensis* screening nursery at the High Ridge Country Club, Lantana, FL, October 1991. The nursery was planted 30 October 1990 with 100 plants spaced on 3′ centers. (a) Overview of nursery demonstrating differential survival and performance of plants. some died, others were performing poorly, but a few had excellent turf quality. (b) Closeup of one of the best plants.

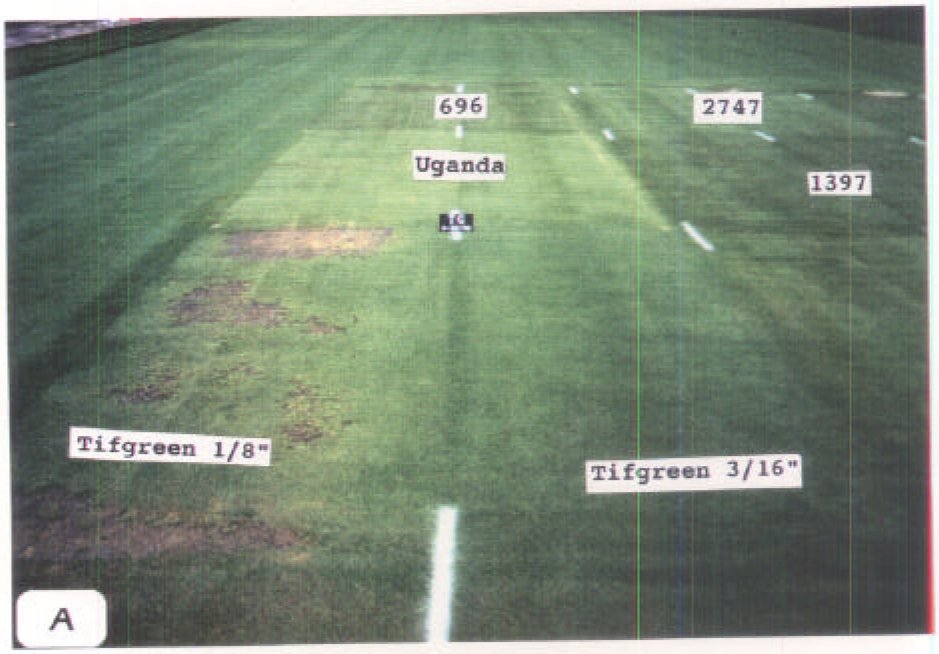

Fig 3. *C. transvaalensis* putting green evaluation trial, Turf Research Center, Stillwater, OK. David Gerken M.S. Thesis Research Project. (a) Tifgreen mowed at 1/8" in 1991 suffered severe winter injury. *C. transvaalensis* plants including 'Uganda' were not injured. Photo taken 6/25/92. (b) Core sampling *C. transvaalensis* selection 2747, the best performing experimental in the test. Photo taken Aug. 92.

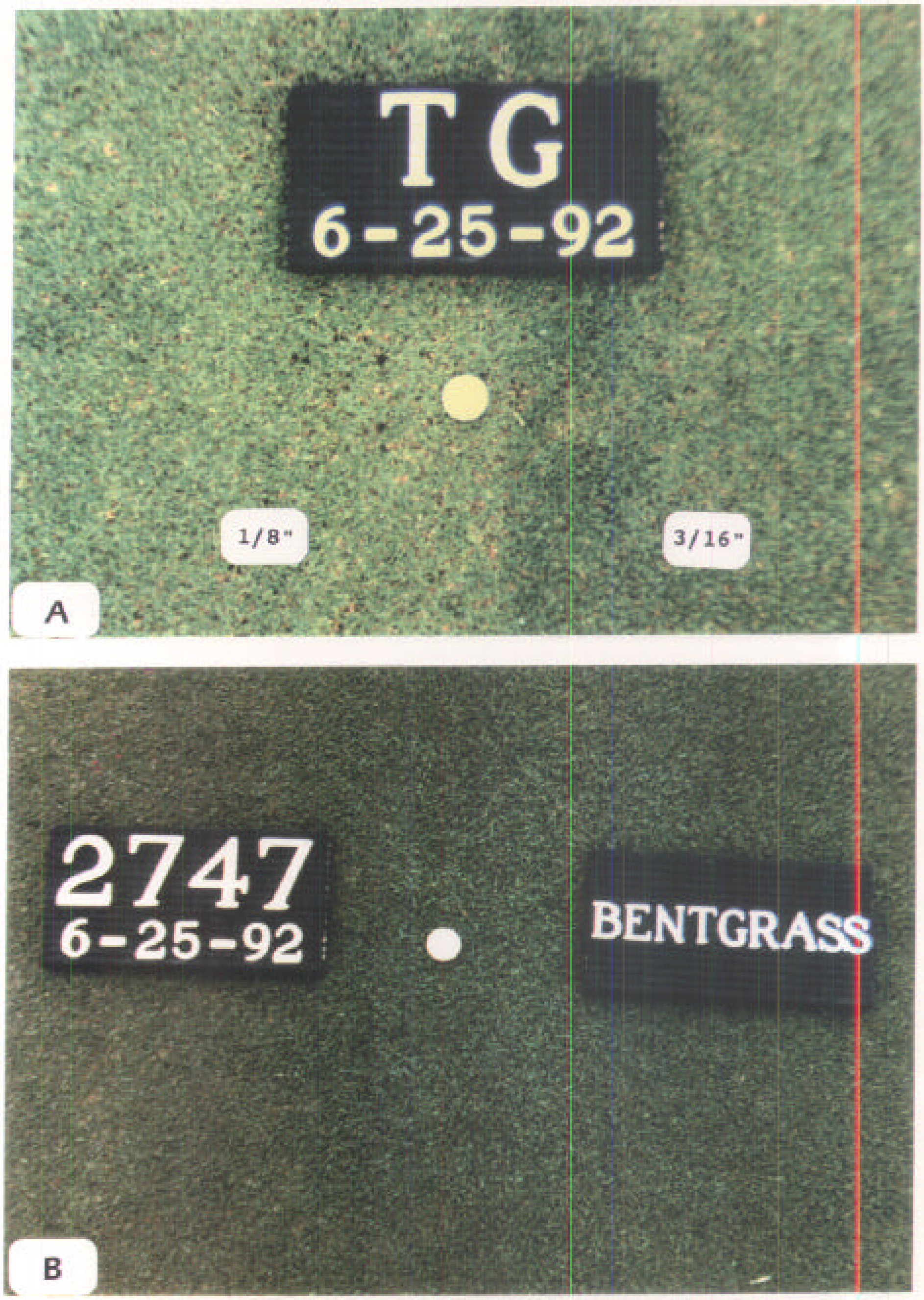

Fig. 4. *C. transvaalensis* putting green evaluation trial, Turf Research Center, Stillwater, OK. David Gerken M.S. Thesis Research Project. (a) Comparative appearance of Tifgreen maintained at 1/8 and 3/16". (b) Comparative appearance of *C. transvaalensis* selection 2747 and bentgrass.