

## **GROWTH AND PERFORMANCE DIFFERENCES WITHIN BERMUDAGRASS ECOTYPES**

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### **EXECUTIVE SUMMARY**

Hybrid bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) is a well-adapted species for putting greens in the warm humid regions of the United States. For over 20 years the primary bermudagrass cultivars used on southeastern putting greens have been 'Tifgreen' and 'Tifdwarf'. However, distinct 'offtypes' (herein referred to as 'ecotypes') have appeared in greens over time, and turf managers continually report the occurrence of variants within these cultivars. The objective of this research was to evaluate bermudagrass ecotypes and cultivars, and to determine their suitability as putting green turfgrasses in the southeastern United States. Grasses were grown on USGA sand-based and native soil putting greens and were subjected to different mowing heights (1/8 inch and 3/16 inch) and artificial traffic. Bermudagrasses evaluated included 'Tifdwarf', 'Tifgreen', 'TifEagle' and six Tifdwarf ecotypes selected from various southeastern golf courses. Turfgrasses exhibited wide differences in rate of grow-in, thatch production, green-up, overseed transition, seed head production and visual quality. After two years of evaluation the bermudagrass cultivar 'TifEagle' and an ecotype from the number 9 green of the Mobile Country Club ('Mobile 9') performed well, and show promise as new bermudagrass cultivars for southeastern putting greens.

Conclusions reached from this research project include:

1. Ecotypes of Tifdwarf or Tifgreen showed many differences in growth and appearance.
2. The newly released cultivar TifEagle shows, at this one location, excellent promise for southeastern putting greens.
3. The ecotype from the number 9 green of the Mobile Country Club and the Lakewood ecotype also show promise as putting green grasses.
4. TifEagle, Tifdwarf, Mobile 9 and Lakewood best withstood a 0.32 cm (1/8 inch) mowing height.
5. Proper thatch management of the ultra-dwarf cultivars and ecotypes was only possible with frequent aerification, topdressing and grooming procedures. These cultivars or ecotypes will always require intensive management.

Color and quality ratings of bermudagrass cultivars on 3 July 1997 as affected by putting green type. A rating of '1' is pale color or poor quality, '9' is dark green or high quality.

Grass	Native		USGA	
	Color	Quality	Color	Quality
	----- color/quality rating -----			
Mobile #10	6.8 a <sup>†</sup>	4.9 ab	7.4 a	6.3 ab
Tifdwarf	4.8 c	4.4 abc	5.8 c	4.5 fg
Gulfshores	3.1 g	3.0 d	5.4 cd	5.6 bcd
2352-OK	2.6 h	2.4 d	3.1 f	2.4 h
Tifgreen	2.1 i	2.9 d	4.5 e	4.3 g
TifEagle	5.1 b	5.1 a	6.6 b	6.0 bcd
Lakewood	4.5 cd	5.1 a	6.0 bc	6.4 a
2747-OK	2.9 gh	2.6 d	3.5 f	3.0 h
T596	5.1 b	4.6 ab	6.0 bc	4.8 efg
Mobile #9	4.4 de	4.9 ab	5.9 bc	6.6 a
Southern Turf	4.0 f	3.7 c	4.9 de	5.0 def
Texas	4.1 ef	4.3 bc	5.8 c	5.4 cde

Color and quality ratings of bermudagrass cultivars on 12 August, 1997 as affected by putting green type.

Grass	Native		USGA	
	Color	Quality	Color	Quality
	----- color/quality rating -----			
Mobile #10	8.1 a <sup>†</sup>	4.0 d	8.5 a	3.8 d
Tifdwarf	6.1 bc	4.8 c	7.6 b	5.4 bc
Gulfshores	5.8 bc	4.8 c	6.4 d	5.0 c
2352-OK	4.1 d	3.4 e	4.3 f	3.1 e
Tifgreen	4.1 d	3.3 e	5.5 e	3.6 d
TifEagle	6.3 b	5.5 a	7.4 b	5.6 ab
Lakewood	5.1 c	5.4 ab	6.3 d	6.0 a
2747-OK	4.1 d	2.9 e	4.3 f	2.6 f
T596	6.3 b	4.8 c	7.1 bc	5.0 c
Mobile #9	5.8 bc	5.8 cd	7.6 b	5.9 a
Southern Turf	5.5 bc	6.5 b	6.4 d	5.0 c
Texas	5.5 bc	5.6 d	6.8 cd	5.1 c

<sup>†</sup> Means followed by the same letter are not significantly different at  $\alpha = 0.05$ .

## GROWTH AND PERFORMANCE DIFFERENCES WITHIN BERMUDAGRASS ECOTYPES

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### INTRODUCTION

Hybrid bermudagrass is the best adapted species for putting greens in the warm humid regions of the United States. The grass has a dense turf, excellent recuperative ability, superior heat tolerance and the ability to withstand close mowing heights. Hybrid bermudagrass is sterile, so it must be planted from sprigs or sod. Since bermudagrass is a warm-season grass, it will go dormant in many parts of the south, necessitating winter overseeding with a cool-season species if year-round green turf is desired. Although the cool-season grass bentgrass (*Agrostis palustris*) is viewed as a premier putting green grass, the intense level of management and inputs associated with bentgrass putting greens in the mid-south removes it as an option for medium- to small-budget golf courses. Additionally, some golf courses in the deep south cannot grow bentgrass year round, and bermudagrass is the only currently available option for putting greens.

Commonly used hybrid bermudagrasses for putting greens include 'Tifgreen', a 1956 release by the Georgia Agricultural Experiment Station and ARS/USDA, and 'Tifdwarf', a 1965 release. 'Tifdwarf' was a vegetative selection from Tifgreen putting greens in Georgia and South Carolina. It is thought that Tifdwarf was a vegetative mutant that occurred in Tifgreen plant material located at the GA experiment station at Griffin prior to shipping for testing (Duble, 1996). Although Tifdwarf was the only one of the ecotypes from Tifgreen to become established in the trade, there is considerable evidence that it is not the only variant existing originally, or at the present time. Turf managers have continually reported the occurrence of variants within Tifgreen and Tifdwarf putting greens.

To date, there has been little evaluation of these ecotypes to determine their value as a southeastern putting green grass. The objective of this research was to evaluate bermudagrass ecotypes and cultivars, and to determine their suitability as putting green turfgrasses in the southeastern United States.

### METHODS AND MATERIALS

Samples of hybrid bermudagrass were collected from the sources listed in Table 1 and populations were expanded in the greenhouse throughout the summer of 1993 and winter of 1994. The cultivars were sprigged into native soil (Marvyn loamy sand, Fine-loamy, siliceous, thermic Typic Hapludult) and USGA-type (80% sand, 20% rice hulls) putting green. Grasses were sprigged on 14-15 April, 1994 at a 15-cm plug spacing. Twelve ecotypes or cultivars were planted in 4 blocks on each green, with grasses arranged in a completely random design within each block. Each grass was planted in plots that were 1 m wide and 8 m long.

After establishment, all plots were mowed uniformly at 0.48 cm (3/16 inch). Plots

were mowed every-other day until September, 1995, at which time plots received daily mowing. Beginning in June, 1996, each cultivar main block was split in half (creating 1 m by 12.5 m blocks), and mowing heights of 0.48 and 0.32 cm (1/8 inch) were applied. Plots were mowed 6 days of 7, and traffic was applied every day using a simulated traffic tool studded with golf spikes.

Nitrogen (N) fertilizer was applied at approximately monthly intervals at a rate of 4.5 kg/m<sup>2</sup>. Phosphorus, potassium and lime were applied on an as-needed basis according to soil test recommendations. Insecticide, fungicide and herbicide applications were made on an as-needed and as-recommended basis to control weeds, disease or insects when such problems occurred. Irrigation was applied uniformly and separately to the USGA and native soil greens.

Cultivation practices included core aerification (1.3 cm tines) or solid tine spiking at approximately every-other month intervals. Cores were removed from each plot to prevent contamination of surrounding plots. Grooming reels were attached to each greens mower to lightly verticut each time the plots were mowed. Each time the plots were aerified they were also topdressed with sand at a rate of 2.6 m<sup>3</sup> sand/m<sup>2</sup> (1/3 yard<sup>3</sup>/1000 ft<sup>2</sup>). This same rate of topdressing was also applied monthly, even if core aerification was not performed. Plots were overseeded each fall (early October) with *Poa trivialis*.

Data collection included: 1) color and quality ratings, 2) seedhead production, 3) thatch depth, 4) stimpmeter readings, 5) disease and mole cricket resistance, and 6) spring greenup and fall color retention. Data were analyzed using analysis of variance with grasses as main blocks and mowing heights as split plots. Because green type (USGA or native soil) were not replicated as main blocks the data was analyzed as a randomized complete block design, with green type as environment. Green type main effects were analyzed using rep(green) as the error term in the F-test for green type differences. Because of a large amount of data was collected, only selected data sets are presented in this report for brevity.

## RESULTS AND DISCUSSION

Grasses varied considerably in their appearance and behavior over the three years of the study. In most cases (except for seedhead production) the type of putting green significantly affected grass quality or color, and there was a significant grass x putting green type interaction. As a result, data is presented within each putting green type.

### Grow-In

Percent grow-in was affected by putting green type and grass type (Table 2). Grasses grew in faster on the native soil green, possibly a result of differences in soil moisture or soil fertility. Most of the bermudagrasses in this study were selected from native soil greens or areas, and they may be more adapted to soils, rather than the high sand conditions of a USGA-type putting green.

Table 1. Bermudagrass cultivars and ecotypes selected for evaluation.

<u>Original Cultivar or Ecotype</u>	<u>Location/Supplier</u>	<u>Type</u>	<u>Reference Name</u>
Tifdwarf	Mobile C.C., AL, #9 green	ecotype	Mobile 9
Tifdwarf	Mobile C.C., AL, #10 green	ecotype	Mobile 10
Tifgreen	GA experiment station/ARS/USDA	cultivar	Tifgreen
Tifdwarf	GA experiment station/ARS/USDA	cultivar	Tifdwarf
Tifgreen	Lakewood C.C., LA	ecotype	Lakewood
Tifdwarf	Texas	ecotype	Texas
Tifdwarf	Southern Turf Nurseries (Industry Check)	cultivar	Southern Turf
Tifdwarf	GA experiment station/ARS/USDA	cultivar	T596
Tifdwarf	GA experiment station/ARS/USDA	cultivar	TifEagle
Tifdwarf	Gulfshores, AL	ecotype	Gulfshores
<i>C. transvaalensis</i>	Oklahoma experiment station	ecotype	2747-OK
<i>C. transvaalensis</i>	Oklahoma experiment station	ecotype	2352-OK

### *Seedhead Production*

The ecotype 'Mobile 10' consistently produced the most seedheads, and this production occurred almost year round (Table 3). The only ecotypes which never produced seedheads were TifEagle and the ecotype from the number 9 green of the Mobile Country Club.

### *Spring Greenup*

Spring greenup varied with putting green and grass type. In both years greenup was quicker on the USGA-type putting green than on the native soil green (Table 4). There were no clear or consistent differences in greenup due to grass type. March 1995 ratings were different than March, April and May 1996 ratings and May 1997 ratings (some data not shown). These differences are largely due to the presence of the *Poa trivialis* overseeding, which was not planted in the 1994-1995 season. Ratings in 1996 and 1997 reflect the impact of the cool season overseeding as a factor in the spring transition.

### *Color and Appearance*

The ecotype from the number 10 green of the Mobile Country Club consistently had the darkest green color (Tables 5, 6 and 7). However, this grass also exhibited very poor turf quality, with strong grain and a coarse open appearance. The cultivars TifEagle and Tifdwarf were also darker in color, as were the ecotypes Mobile 9 and Texas. Grasses were darker at the higher mowing height, and there was never a significant mowing height x grass type interaction.

Although they had the finest texture of any of the grasses, the *C. transvaalensis* OK-2747 and OK-2352 had poor turf quality, largely a result of poor tolerance of traffic and low mowing heights. The cultivar TifEagle usually had good color and good turf quality, as did the ecotype from the number 9 green of the Mobile Country Club. One ecotype that demonstrated excellent turf quality in late summer and early fall readings was the ecotype from the Lakewood Country Club.

Mowing height affected the appearance of all the grasses, and color and quality ratings were always lower at the 0.32 cm mowing height than the 0.48 cm height. The cultivars TifEagle and Tifdwarf best withstood the lower mowing height, and the ecotypes Mobile 9 and Lakewood also performed well at this height. The cultivar Tifgreen and the *C. transvaalensis* OK-2352 and OK-2747 were unable to maintain quality turf at the 0.32 cm mowing height.

Table 2. Percent cover in USGA and native soil putting greens on 19 May and 21 June, 1994.

Grass	19 May		21 June	
	Native	USGA	Native	USGA
	----- % cover -----			
Mobile #10	80 a <sup>†</sup>	60 abc	98 a	90 ab
Tifdwarf	79 a	58 abc	98 a	86 abcd
Gulfshores	79 a	59 abc	98 a	88 abc
2352-OK	78 a	61 ab	96 a	88 abc
Tifgreen	77 a	46 c	97 a	79 cd
TifEagle	77 a	49 bc	97 a	81 bcd
Lakewood	76 a	70 a	97 a	93 a
2747-OK	72 a	61 ab	96 a	87 abcd
T596	70 a	54 bc	93 a	85 abcd
Mobile #9	70 a	50 bc	93 a	85 abcd
Southern Turf	70 a	46 c	93 a	77 d
Texas	70 a	56 bc	93 a	85 abcd

<sup>†</sup> Means followed by the same letter are not significantly different at  $\alpha = 0.05$ .

Table 3. Seedhead production of bermudagrass cultivars and ecotypes. A rating of '1' indicates no seedheads were produced, a rating of '9' indicates 100% seedhead production.

Grass	Date				
	11-11-94	4-5-95	5-29-95	7-12-96	7-3-97
	mean seedhead rating				
Mobile #10	6.0 a <sup>†</sup>	1.0 c	6.6 b	3.0 a	1.2 b
Tifdwarf	1.0 b	1.0 c	4.3 d	1.3 c	9.2 a
Gulfshores	1.0 b	1.0 c	2.0 f	1.1 c	1.0 b
2352-OK	1.0 b	5.4 b	6.8 b	1.0 c	1.0 b
Tifgreen	1.0 b	1.0 c	5.8 c	1.6 b	1.4 b
TifEagle	1.0 b	1.0 c	1.0 g	1.0 c	1.0 b
Lakewood	1.0 b	1.0 c	7.8 a	2.8 a	2.8 b
2747-OK	1.0 b	9.0 a	7.1 ab	1.0 c	1.0 b
T596	1.0 b	2.0 c	2.1 ef	1.2 c	2.4 b
Mobile #9	1.0 b	1.0 c	1.0 g	1.0 c	1.0 b
Southern Turf	1.0 b	1.0 c	2.3 ef	1.1 c	1.7 b
Texas	1.0 b	1.0 c	2.9 e	1.2 c	1.4 b

<sup>†</sup> Means followed by the same letter are not significantly different at  $\alpha = 0.05$ .



Table 4. Spring greenup of bermudagrass as affected by putting green type. A rating of '1' indicates no greenup, while a rating of '9' indicates 100% greenup.

Grass	3-15-95		3-26-96	
	Native	USGA	Native	USGA
	----- greenup rating -----			
Mobile #10	2.8 c	4.0 e	6.8 ab	8.0 ab
Tifdwarf	4.5 b	6.5 a	7.3 ab	8.3 ab
Gulfshores	4.5 b	5.0 d	6.8 ab	6.5 e
2352-OK	3.0 c	2.3 f	6.5 b	7.0 abc
Tifgreen	5.3 ab	6.5 a	7.0 ab	7.8 abc
TifEagle	5.8 a	6.0 abc	7.0 ab	8.0 ab
Lakewood	4.8 ab	5.3 cd	6.5 b	8.3 ab
2747-OK	3.3 c	3.5 e	6.8 ab	7.0 cde
T596	4.3 b	6.3 ab	6.8 ab	8.3 ab
Mobile #9	5.0 ab	5.5 bcd	7.0 ab	7.5 bcd
Southern Turf	4.5 b	6.3 ab	6.8 ab	8.5 a
Texas	4.8 ab	5.3 cd	7.5 a	8.3 ab

<sup>†</sup> Means followed by the same letter are not significantly different at  $\alpha = 0.05$ .

Table 5. Color and quality ratings of bermudagrass cultivars on 3 July 1997 as affected by putting green type. A rating of '1' is pale color or poor quality, '9' is dark green or high quality.

Grass	Native		USGA	
	Color	Quality	Color	Quality
	----- color/quality rating -----			
Mobile #10	6.8 a	4.9 ab	7.4 a	6.3 ab
Tifdwarf	4.8 c	4.4 abc	5.8 c	4.5 fg
Gulfshores	3.1 g	3.0 d	5.4 cd	5.6 bcd
2352-OK	2.6 h	2.4 d	3.1 f	2.4 h
Tifgreen	2.1 i	2.9 d	4.5 e	4.3 g
TifEagle	5.1 b	5.1 a	6.6 b	6.0 bcd
Lakewood	4.5 cd	5.1 a	6.0 bc	6.4 a
2747-OK	2.9 gh	2.6 d	3.5 f	3.0 h
T596	5.1 b	4.6 ab	6.0 bc	4.8 efg
Mobile #9	4.4 de	4.9 ab	5.9 bc	6.6 a
Southern Turf	4.0 f	3.7 c	4.9 de	5.0 def
Texas	4.1 ef	4.3 bc	5.8 c	5.4 cde

† Means followed by the same letter are not significantly different at  $\alpha = 0.05$ .

Table 6. Color and quality ratings of bermudagrass cultivars on 12 August, 1997 as affected by putting green type. A rating of '1' is pale color or poor quality, '9' is dark green or high quality.

Grass	Native		USGA	
	Color	Quality	Color	Quality
	----- color/quality rating -----			
Mobile #10	8.1 a	4.0 d	8.5 a	3.8 d
Tifdwarf	6.1 bc	4.8 c	7.6 b	5.4 bc
Gulfshores	5.8 bc	4.8 c	6.4 d	5.0 c
2352-OK	4.1 d	3.4 e	4.3 f	3.1 e
Tifgreen	4.1 d	3.3 e	5.5 e	3.6 d
TifEagle	6.3 b	5.5 a	7.4 b	5.6 ab
Lakewood	5.1 c	5.4 ab	6.3 d	6.0 a
2747-OK	4.1 d	2.9 e	4.3 f	2.6 f
T596	6.3 b	4.8 c	7.1 bc	5.0 c
Mobile #9	5.8 bc	5.8 cd	7.6 b	5.9 a
Southern Turf	5.5 bc	6.5 b	6.4 d	5.0 c
Texas	5.5 bc	5.6 d	6.8 cd	5.1 c

† Means followed by the same letter are not significantly different at  $\alpha = 0.05$ .

Table 7. Color and quality ratings of bermudagrass cultivars on 23 September, 1997 as affected by putting green type. A rating of '1' is pale color or poor quality, '9' is dark green or high quality.

Grass	Native		USGA	
	Color	Quality	Color	Quality
	----- color/quality rating -----			
Mobile #10	6.5 a	3.6 e	8.3 a	3.6 ef
Tifdwarf	5.6 abcd	4.9 c	6.5 bc	5.0 c
Gulfshores	4.8 cdef	5.3 bc	5.3 d	5.5 b
2352-OK	4.5 ef	4.8 c	3.8 g	3.8 ef
Tifgreen	4.1 f	4.0 de	5.1 de	4.1 de
TifEagle	6.0 ab	6.6 a	6.8 b	6.3 a
Lakewood	4.6 def	6.6 a	4.8 e	6.3 a
2747-OK	4.3 ef	4.6 cd	4.3 f	3.4 f
T596	5.1 bcdef	4.6 cd	6.0 c	4.6 cd
Mobile #9	5.8 abc	5.9 b	6.6 b	6.6 a
Southern Turf	5.3 bcde	5.0 c	6.0 c	4.6 cd
Texas	5.6 abcd	4.9 c	6.5 bc	4.6 cd

† Means followed by the same letter are not significantly different at  $\alpha = 0.05$ .

### Thatch Production

In 1996 there was substantial thatch production, a result of improper mowing and core aerification procedures during 1995 (Table 8). Thatch production varied with both green type and grass, and there was a significant grass x green type interaction ( $P = 0.02$ ).

Grasses that had more thatch were usually the grasses that had higher turf quality ratings and better color ratings (TifEagle, Mobile 9). These grasses reflect the need for high levels of management (frequent topdressing and verticutting) to maintain these grasses at a high level of quality.

Frequent mowing with groomers, core aerification and topdressing resulted in much less thatch accumulation in 1997 (Table 8). Again, thatch depth varied with the type of putting green and grass, and there was a significant grass x green interaction ( $P = 0.06$ ).

Table 8. Thatch depth of bermudagrass types at two sampling dates as affected by putting green.

Grass	4-12-96		4-3-97	
	Native	USGA	Native	USGA
	cm depth			
Mobile #10	4.2 abc	5.0 ab	1.5 ab	1.2 b
Tifdwarf	4.1 bcd	4.5 d	1.3 abc	1.2 b
Gulfshores	4.5 a	5.1 a	1.1 d	1.1 bc
2352-OK	3.4 f	4.5 cd	1.3 abc	1.1 bc
Tifgreen	3.8 de	5.0 abc	1.2 cd	1.1 bc
TifEagle	4.5 a	4.8 abcd	1.3 bc	1.1 bc
Lakewood	4.2 abc	4.7 abcd	1.5 a	1.1 bc
2747-OK	3.5 ef	4.5 bcd	1.2 cd	0.8 c
T596	3.9 cd	4.4 d	1.4 abc	1.2 b
Mobile #9	4.3 ab	4.9 abcd	1.2 cd	1.6 a
Southern Turf	4.1 bcd	4.7 abcd	1.2 cd	1.3 b
Texas	4.1 bcd	4.5 cd	1.3 abc	1.3 ab

<sup>†</sup> Means followed by the same letter are not significantly different at  $\alpha = 0.05$ .

## CONCLUSIONS

1. Ecotypes of Tifdwarf or Tifgreen showed many differences in growth and appearance.
2. The newly released cultivar TifEagle shows, at this one location, excellent promise for southeastern putting greens.
3. The ecotype from the number 9 green of the Mobile Country Club and the Lakewood ecotype also show promise as putting green grasses.
4. TifEagle, Tifdwarf, Mobile 9 and Lakewood best withstood a 0.32 cm (1/8 inch) mowing height.
5. Proper thatch management of the ultra-dwarf cultivars and ecotypes was only possible with frequent aerification, topdressing and grooming procedures. These cultivars or ecotypes will always require intensive management.

## PUBLICATIONS

Guertal, E.A., R.H. Walker, R. Dickens and C.Y. Ward. 1996. Variations on a green...finding the right bermudagrass for Alabama putting greens. *Ala. Ag. Exp. St. Highlights of Agric. Res.* 43, No. 2:12-14.

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## RESEARCHER BIBLIOGRAPHY

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