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Three ultradwarfs ('Tifeagle', 'Champion', and 'Floradwarf') were compared for turfgrass quality over a four-year period (2000-2003) in subtropical south Florida at different nitrogen rates and N:K ratios. 'Tifeagle' had the highest annual average turfgrass quality ratings and in three of the four years was significantly higher than the other two grasses evaluated in the experiment.

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PURPOSE

The purpose of *USGA Turfgrass and Environmental Research Online* is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 290 projects at a cost of $25 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of ***using science to benefit golf***.

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The Effect of Nitrogen Rates on Ultradwarf Bermudagrass Quality

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SUMMARY

New ultradwarf bermudagrasses have the promise of providing improved putting performance for golf courses in warm climates. Comparative documentation of ultradwarf performance under an array of management conditions and environments is needed to identify optimum strategies for these grasses. Three ultradwarfs ('Tifeagle', 'Champion', and 'Floradwarf') were compared for turfgrass quality over a four-year period (2000-2003) in subtropical south Florida. The effect of nitrogen rate was also evaluated. Research findings include:

- All turfgrasses provided annual average turfgrass quality ratings above that judged to be minimally acceptable.
- There were significant differences in the annual average turfgrass quality of the three bermudagrasses.
- 'Tifeagle' had the highest annual average turfgrass quality ratings and in three of the four years, was significantly higher than the other two grasses evaluated in the experiment.
- 'Champion' had an annual average turfgrass quality rating equal to 'Tifeagle' in year 1. Thereafter, it was lower than 'Tifeagle' in annual average turfgrass quality.
- 'Floradwarf' annual average turfgrass quality was lowest in year 1. In year 2 and 4, 'Floradwarf' annual average turfgrass quality was equal to 'Champion' and in year 3 was better than 'Champion'.
- Turfgrass quality was generally increased with increasing rate of nitrogen to 18 lbs N per 1000 sq. ft. per year. No additional increases in annual turfgrass quality were observed with higher N rates and in year 2, annual average turfgrass quality was reduced at the 24 lb N per 1000 sq. ft. rate of application.
- Turfgrasses in subtropical south Florida have a year-round growth cycle and intense rains which reflects higher annualized N rates.
- Ultradwarfs can provide acceptable quality turf for warm season putting greens in subtropical conditions.

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With Florida leading the USA in numbers of golf courses and with over 60 million rounds of golf played annually, there is great interest in improved putting surfaces. Since the 1990's, new ultradwarf bermudagrasses [*Cynodon dactylon* (L.) Pers. X *C. transvaalensis* (Burtt-Davy)] have been developed for better putting performance and have been planted in new and reconstructed greens. 'Tifeagle', 'Champion', 'Floradwarf', 'Miniverdi', and 'MS Supreme' are examples of commercially available ultradwarf-type putting green bermudagrasses (2, 3). According to White et. al (6), factors that have improved putting performance for these grasses include increased shoot density, tolerance to close mowing, high wear tolerance, and fast recovery.

One concern about ultradwarf cultural management is thatch accumulation (1, 6). Research on cultural management of ultradwarf bermudagrasses is beginning to emerge in the literature. For example, Hanna (1) investigated the effect of vertical mowing blade width, nitrogen

Figure 1. An overview of the experimental area after the weekly topdress treatment was applied.

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level, and application of Primo growth regulator (trinexapac-ethyl) on turfgrass quality in 'Tifeagle' bermudagrass. Hanna (1) reported that increasing nitrogen rate (0.25 vs. 0.5 lbs N per 1000 sq. ft. per application) resulted in better 'Tifeagle' turf color, yet was coupled with an increase in thatch accumulation.

Other research has focused on determining appropriate N rates on a regional scale (4, 6). An experiment that investigated several cultural management practices on selected ultradwarf bermudagrasses was conducted over a multi-year period in Texas (6). In that study, comparisons were not assessed between ultradwarfs, however the authors concluded that an annual nitrogen rate of 10 lbs. N per 1000 sq. ft. would provide for good quality ultradwarf turf regardless of variety (6). O'Brien and Hartwiger (4) suggested annual nitrogen rates of 6-12 lbs. N per 1000 sq. ft. for ultradwarf bermudagrasses in the southeast USA.

The National Turfgrass Evaluation Program (NTEP) in cooperation with the United States Golf Association and Golf Course Superintendent's Association of America (GCSAA) initiated the first on-site golf course ultradwarf cultivar trial in the late 1990's (3). The on-site cultivar trial was limited in scope and did not include cultural management factors such as fertilization, topdressing, or verticutting as study objectives. Moreover, at the initiation of our study, there was little comparative research information on ultradwarfs from which to base sound cultural management recommendations for golf course superintendents in subtropical south Florida. South Florida's climate provides favorable growing conditions for bermudagrass year-round.

Grass	YR 1	YR 2	YR 3	YR 4
	Quality (1-9)			
Champion	7.0a	6.6b	6.4c	6.5b
Floradwarf	6.5b	6.7b	6.6b	6.6b
Tifeagle	7.0a	7.0a	7.1a	6.9a
Significance	**	**	**	**

** = P<0.001; Means within the same column followed by the same letter are not significantly different.

Table 1. Comparison of annual average quality scores for the ultradwarf bermudagrass cultivars

To address select questions on cultural management and with great thanks to the support of the USGA and the Florida turfgrass industry, we initiated in late September 1999, an ultradwarf putting green research trial in south Florida at the Ft. Lauderdale Research and Education Center. This project was designed to identify the optimal cultural practices for best performance of three popular ultradwarf bermudagrasses and form the basis for management recommendations of these grasses under south Florida conditions.

Methods

The grasses were selected based upon their usage at the time of experiment initiation in Florida. The grasses chosen were 'Champion', 'Tifeagle', and 'Floradwarf'. Evaluations were based upon cumulative annual average visual turfgrass quality ratings of the turfgrasses. The effect of grass type and fertilizer nitrogen rate is discussed in this article.

The experiment was conducted at the University of Florida Research and Education Center. The grasses were sprigged into an existing USGA greens specification mixture. The field site was approximately 930 m^2 (10,000 sq. ft.). Mowing, irrigation management, supplemental fertilization in addition to nitrogen and potassium fertilization treatments discussed below, and overall management were provided by the Florida Golf Course Superintendent's Association Research Committee. The Research Committee also provided guidance on the experimental parameters for the study.

The three ultradwarf bermudagrasses ('Champion', 'Tifeagle', and 'Floradwarf') were mowed daily at 3.1 mm - 3.4 mm (0.125 - 135 inches) with a walk-behind greens mower. Cultural management practices evaluated in the first year included fertilizer at two N rates (6 and 12 lb. N/1000 sq. ft.) and potassium applied at either a 1:1, 2:1, or 1:2 N:K ratio. The low nitrogen rate was judged to be insufficient for growing ultradwarf bermudagrass in subtropical Florida. Thus, in years 2 through 4, three N rates (12, 18, and 24 lbs. N/1000 sq. ft.) was applied and potassium was applied at either a 1:1 or 2:1 ratio .

The changes to plots for N rate and N:K ratio were as follows:

2000 N:K	changed to	2001 N:K
--------*(lb. N:lb. K/1000 sq. ft. / year)*---------		
6:3		12:6
6:6		18:9
6:12		18:18
12:6		24:12
12:12		12:12
12:24		24:24

Nitrogen fertilizer was applied weekly as a liquid formulation of ammonium nitrate or urea to each plot. Potassium chloride (0-0-60) was the K source and was applied as a liquid. The daily mowing height ranged from 3.0 mm to 3.4 mm (0.13 to 0.14 inches) during periods of high disease stress. The experiment included two verticut frequency treatments (main plots), three grass cultivars, two topdressing frequency treatments, and six N:K fertilizer ratios designed as a factorial with four replications of each treatment for a total of 288 plots. Verticutting frequency was either weekly or biweekly. Verticutting was accomplished using a walk behind grooming mower set at the shallowest cutting depth. Topdressing frequency was either weekly or biweekly, which resulted in an annual 8 mm or 4 mm depth of topdressing, respectively for the two topdressing frequency treatments (Figure 1).

Visual observations of turfgrass quality were made using a 1-10 scale with 10 = dark green turf, 6 = minimally acceptable turf, and 1 = dead or brown turf. Average annual turfgrass quality ratings for the three ultradwarfs are provided for the entire four-year period. Average annual turfgrass quality ratings are provided for years 2-4 representing the change in nitrogen and potassium fertilizer applications after year 1. Statistical analysis was conducted on the summed data over each year for all treatments using ANOVA procedures and significant means were identified (5). The Duncan's Procedure for multiple comparisons was used to identify differences in grass cultivars and N rates.

Results

Annual Turfgrass Quality

Each of the three ultradwarf bermudagrasses had annual average turfgrass judged to

Figure 2. Although during the first year 'Tifeagle' and 'Champion' had similar turf quality, 'Tifeagle' had greater turf quality than 'Champion' for the remaining three years.

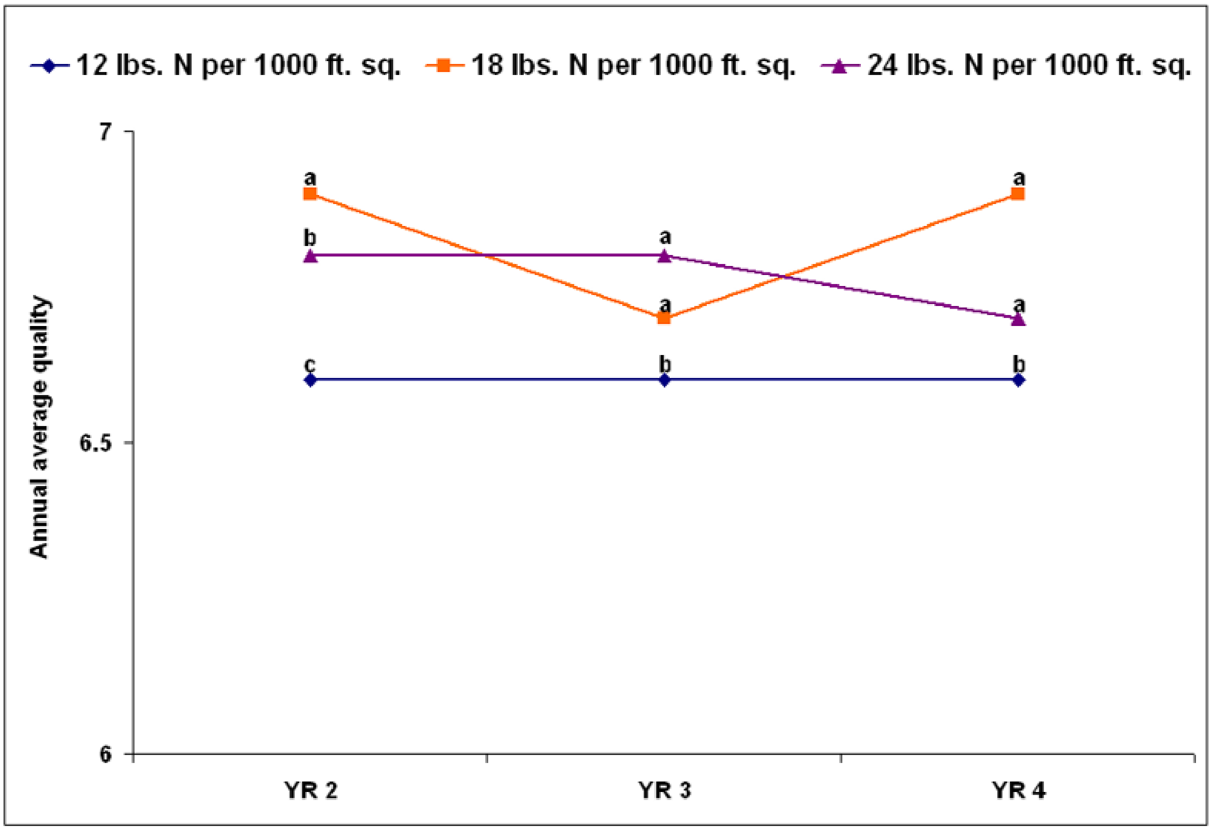

Figure 3. Annual average turf quality (1-9) of ultradwarf bermudagrass cultivars in response to increasing rates of nitrogen (lb N/1000 sq. ft./year.

exceed minimally acceptable standards in each of the four years of the study (Table 1). However, annual average turfgrass quality was significantly affected by grass type for all years (Table 1). 'Tifeagle' generally provided consistently high quality ratings over the four year rating period (Table 1). 'Floradwarf' was statistically equal to 'Tifeagle' on select dates during each year (data not presented), but annual average turfgrass quality was lower each year than 'Tifeagle '(Table 1).

With the exception of year 1, annual average turf quality for 'Floradwarf' was statistically equal to 'Champion' (Table 1). Although 'Champion' provided annual average turfgrass quality that was equal to 'Tifeagle' in year 1, thereafter 'Champion' had lower annual average turfgrass quality ratings than 'Tifeagle' (Table 1, Figure 2). 'Champion's annual average turfgrass quality decreased 0.4 points from year one to year two representing the greatest decline in quality over the four-year period (Table 1).

Each of the annual nitrogen rate treatments provided annual average turfgrass quality ratings above what is judged minimally acceptable for putting green turf, 6 (Figure 3). Nevertheless, increasing N did increase annual average turfgrass quality (Figure 2). In year 1, the annual average turfgrass quality score of 6.5 from grass receiving the 6 lb. N/1000 sq. ft. was significantly lower than the turfgrass quality from grass receiving the 12 lb N/1000 sq. ft. rate (7.2, $P<0.001$). Annual average turfgrass quality remained at 6.6 for the remainder of the study (Figure 3 and 4). After year 1, the 6 lb. N/1000 sq. ft. rate was replaced by the 18 and 24 lb. N/1000 sq. ft. rates. Increasing the annual nitrogen rate from 12 to 18 lb. N/1000 sq. ft. improved annual turf quality on most rating dates (Figure 3).

Increasing the annual nitrogen rate beyond 18 lb. N/1000 sq. ft. did not improve turf quality

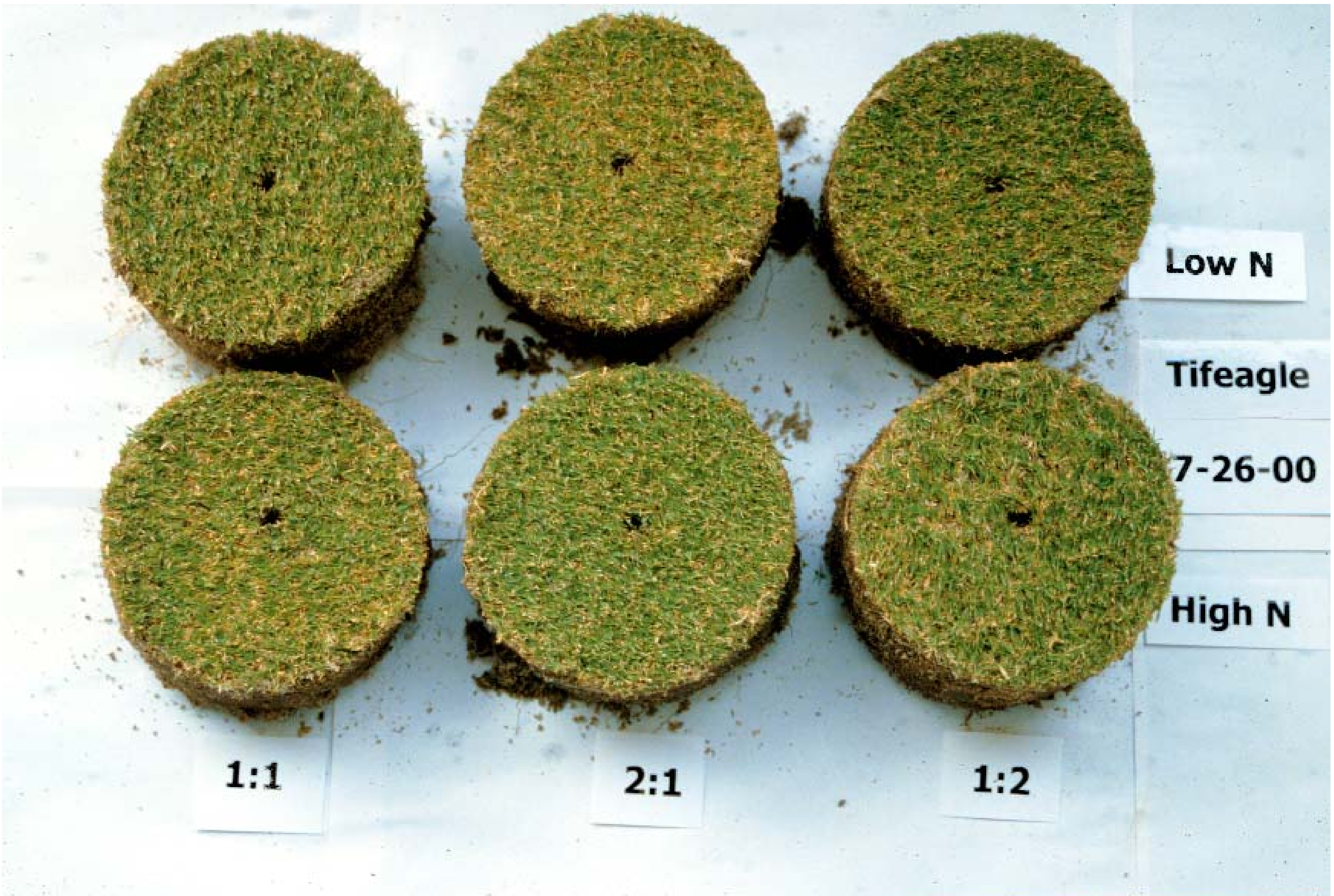

Figure 4. During the first year of the experiment, similar quality was observed for all N:K ratios. However, ratios at the higher rates of nitrogen had greater quality.

in any year (Figure 3). Moreover, the 24 lb. N/1000 sq. ft. rate led to a significant decline in turfgrass quality for the first year it was implemented (year 2, Figure 3).

Based on these results, acceptable annual average turfgrass quality can be achieved with any of the three ultradwarf bermudagrasses in subtropical Florida. The average annual application rates of N appear to be greater than those reported in other regions of the USA (6). However, this result was not unexpected as south Florida's climate permits year-round growth of bermudagrass. Efficient utilization of nitrogen fertilizer is problematic in regions such as south Florida where shallow rooted ultradwarfs are grown on highly permeable sand soils that have little ability to retain nutrients or water and receive intense periodic and appreciable seasonal rainfall. South Florida's subtropical climate consists of a wet season from May through October and a dry season from November through April.

During the wet season, high temperatures persist with frequent, intense rain events. While average daily temperatures are not as high during the dry season, high ET-demand weather is optimal with occasional rainfall. Perhaps it is during the wet season when frequent N fertilization at lower rates is needed for grass to benefit and to prevent loss of fertilizer to leaching. During the dry season, it is possible that higher N rates may be applied with less frequency. Future research should examine how N rates and other cultural management practices can be optimized to improve nutrient resource efficiency and reduce potential adverse environmental impacts during varying seasonal temperature and moisture conditions in South Florida.

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