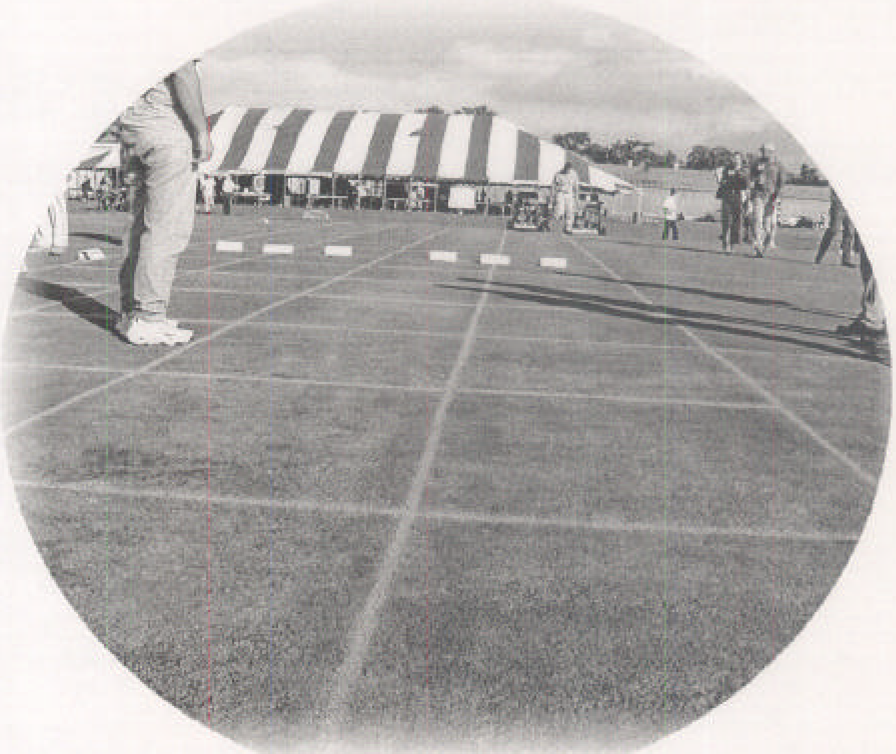
2000 Annual Research Progress Report

Performance and Management of New Dwarf Bermudagrasses

Richard H. White



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United States Golf Association-Green Section
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1 November 2000

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2000 Progress Report

On

PERFORMANCE AND MANAGEMENT OF NEW DWARF BERMUDAGRASSES

Submitted by:

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Texas Agricultural Experiment Station
Texas A&M University System

Jointly Sponsored by:

United States Golf Association
Houston Golf Association
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2000 ANNUAL RESEARCH PROGRESS REPORT

Performance and Management of New Dwarf Bermudagrasses

Executive Summary

Principle Investigator:	Dr. Richard H. White
Research Associate:	Mr. Mark Hall
Ag. Research Technician:	Mr. Trent Hale
Research Period:	1 April 1997 through 1 November 2000

Golf courses in the southern United States continue to explore and use new dwarf bermudagrasses on golf greens. Initial performance of many of the new dwarf bermudagrasses has been excellent. The golfing public has eagerly welcomed the new dwarfs and the quality putting surfaces created by these fine-textured, stoloniferous, high-shoot density bermudagrasses. Management of the new bermudagrasses continues to be a challenge for many golf course superintendents, particularly as golf greens planted to newer bermudagrass cultivars mature. Thatch and disease management appear to be the major challenges in the culture of the new dwarf bermudagrasses. A study planted at the Texas A&M University in April 1997 has documented the performance of five dwarf bermudagrasses under a range of cultural practices.

Five bermudagrasses including Champion, Floradwarf, MiniVerde, Tifeagle, and Tifdwarf were established on 15 April 1997 in 20 feet by 50 feet plots from sprigs at the rate of 12 bushels per thousand square feet. Uniform fertilization, mowing, topdressing, grooming, and irrigation were applied to all cultivars until August 1997. Mowing heights were gradually lowered to 0.125 inch during late June and early July. Main plots are bermudagrass cultivars. Sub-plots are annual nitrogen treatments of 6, 10, 14, and 18 lb of nitrogen per 1000 square feet. Nitrogen treatments were applied as bi-weekly treatments throughout the year. Sub-sub plots were vertical mowing treatments of *1)* light, bi-weekly treatments May through September, and *2)* severe vertical mowing once during spring transition and once immediately prior to overseeding in October. Sub-sub-sub plots were topdressing treatments of *1)* 0.02 inches applied bi-weekly May through September followed by a 0.20 inch application at overseeding to total 0.35 inches, and *2)* 0.15 inches in June and 0.20 inches in October totaling 0.35 inches. All treatments were replicated three times and occured in all possible combinations. Nitrogen, vertical mowing, and topdressing treatments were initiated in August 1997 after all grasses were fully established.

The initial results of these studies indicated that several of the new dwarf bermudagrasses appear to be well adapted to mowing heights of 0.125 inch. The new dwarf bermudagrasses offer potential for improved putting quality on golf greens in the southern United States where bermudagrass is adapted. This study demonstrated that many new bermudagrasses will require intensive culture to control thatch and to provide a true putting surface. Closer mowing and the growth characteristics of the new dwarf bermudagrasses will likely require increased turfgrass maintenace budgets. Golf course officials selecting a bermudagrass for

planting on greens should consider not only the agronomic strengths of each cultivar but also the budgetary requirements needed for an increased intensity of culture.

Although initial performance was excellent for all cultivars, bermudagrass decline became a serious problem for Floradwarf, then Champion, then Tifeagle. Miniverde demonstrated slight sensitivity to bermudagrass decline in late-2000. Tifdwarf exhibited only slight symptoms of bermudagrass decline during this study. Soil pH management and use of ammonium sulfate to supply half the annual nitrogen resulted in a dramatic recovery of Floradwarf from Bermudagrass decline during the summer of 2000. Champion had modest recovery and Tifeagle had marked recovery from Bermudagrass decline by late-summer 2000.

Thatch accumualation is a major consideration in the culture of all bermudagrass golf greens and the new dwarf bermudagrasses demonstrated aggressive thatch production in this study. Best performance of the new dwarf bermudagrasses, overall, occurred at low to moderate nitrogen fertilzation. Increasing nitrogen increased thatch accumulation, reduced shoot density in several cultivars, and resulted in lower summer turf quality in 2000. Frequent, light topdressing, in general, improved quality of all cultivars over the long-term although infrequent, heavy topdressing was equally effective in controlling thatch. Frequent, light vertical mowing caused substantial reductions in turf quality for all cultivars except Tifdwarf during late-summer 2000 compared to infrequent vertical mowing. No consistent difference in thatch depth was observed among vertical mowing treatments.

Recommendations for culture of the new dwarf bermudagrasses are being elucidated through by this study. However, dramatic changes in performance of the cultivars in this study during the summer of 2000, offer the opportunity to discern the long-term effects of specific cultural programs but limit delineation of specific cultural program recommendations. Continued monitoring of shifts in performance as they occur will be required in order to recommend the most efficient practices for controlling thatch, producing high shoot density, and developing quality putting surfaces. Golf course professionals should incorporate aggressive thatch control practices, frequent monitoring, and the flexibility to change as growth and environmental conditions dictate when developing cultural programs for the new dwarf cultivars.

2000 ANNUAL RESEARCH PROGRESS REPORT

Performance and Management of New Dwarf Bermudagrasses

I. INTRODUCTION

Several new dwarf bermudagrasses are currently receiving wide-spread use. Few studies have been conducted to determine the management requirements and relative performance of these grasses in replicated trials. The growth habits of these new grasses may create distinctly different management requirements from Tifdwarf and Tifgreen. The objectives of this study are to determine the effects of vertical mowing, topdressing, and nitrogen fertility on performance, thatch development, fall and spring overseeding transition, and turf quality of five dwarf bermudagrasses. This program is a cooperative research project funded jointly by the Texas Agricultural Experiment Station (TAES) and the United States Golf Association (USGA). This project was initiated in April 1997. Annual progress reports are submitted 1 November each year and semi-annual progress reports are submitted in 1 May. This report constitutes the 2000 annual progress report for the project and highlights activities between 1 January 1998 and 1 November 2000.

II. PROFESSIONAL AND TECHNICAL SUPPORT

Mr. Mark Hall, Research Associate, provides day-to-day oversight for the experimental protocol associated with this project. Mr. Hall holds a Master of Science Degree in Agronomy from Texas A&M University. He has been employed by the Soil and Crop Science Department about 12 years.

Mr. Trent Hale, Agricultural Research Technician and Ph. D. candidate joined the project in March 2000. Mr. Hale holds a B.S. in Biology and Master of Science in Entomology from Auburn University.

III. METHODS

Five bermudagrasses, including Mini-Verde, Champion, Floradwarf, TifEagle, and Tifdwarf were planted at the rate of 12 bushels of sprigs per 1000 square feet to 50 feet by 20 feet main plots in a strip-split plot experimental design on April 15, 1997. Sub-plots are annual nitrogen treatments of 6, 10, 14, and 18 lb of nitrogen per 1000 square feet. Nitrogen treatments were applied as bi-weekly treatments throughout the year. Sub-sub plots were vertical mowing treatments of *1)* light, bi-weekly treatments May through September, and *2)* severe vertical mowing once during spring transition and once immediately prior to overseeding in October. Sub-sub-sub plots were topdressing treatments of *1)* 0.02 inches applied bi-weekly May through September followed by a 0.20 inch application at overseeding to total 0.35 inches, and *2)* 0.15 inches in June and 0.20 inches in October totaling 0.35 inches. All treatments were replicated three times and occured in all possible combinations. Nitrogen, vertical mowing, and topdressing treatments were initiated in August 1997 after all grasses were fully established. During grow-in the experimental area was topdressed and groomed to smooth the surface.

Irrigation and mowing were uniformly applied. The experimental area was maintained at 0.125 inch during the summer and 0.156 inch during winter and early-spring by daily mowing. Pesticides were applied during the study on a curative basis for army worms, sod webworms, and mole crickets. No differences in insect pest activity were observed among treatments. Herbicides and fungicides were not applied.

The entire experiment was overseeded with *Poa trivialis* each fall. Monthly visual assessments of turfgrass quality and color were made. Bermudagrass quality was evaluated at least monthly on a 1 to 9 scale where 1 equals brown, seemingly dead turf and 9 equals darkest green, most dense, uniform, smooth and of finest texture. In June and September of each year, 2.5-cm diameter by 5-cm deep cores were collected from each plot. Shoots were counted and thatch and mat determined by measuring uncompressed depth of each. All data were subjected to an analysis of variance to determine differences among treatment means. When a significant f-ratio ($P \leq 0.05$) occurred for a treatment effect, Tukey's Studentized Range Test was used for mean comparison.

IV. RESULTS

This report is intended as an overview of results obtained since the initiation of the project in 1997. The response of cultivars and cultivars to cultural treatments has been intriguing. An aggressive effort to manage soil pH was initiated in July 1999 and continued through 2000. Soil pH management has been accomplished through application of gypsum and sulfur and through leaching of the soil profile. Additionally, ammonium sulfate has been used to supply half the total annual nitrogen. During 2000, soil pH was maintained at between 7.2 to 7.8, whereas in the past, pH increased to 8.5 to 9.4 because of the concentration of sodium and sodium bicarbonates in the irrigation water supply.

The cultivars in this study have been presented separately in this report. Although some responded similarly to cultural treatments, each cultivar has demonstrated considerable unique performance characteristics and the cultivar responses have become more dramatic as the study matures. This report includes brief cultural program recommendations for each cultivar. However, during 2000, it became apparent that the performance of these cultivars can change dramatically as they mature and that cultural treatments will need continuous monitoring and modification as growth and environmental conditions change.

Overview of experimental site at the Texas A&M University Turfgrass Field Laboratory in College Station, Texas during application of infrequent, heavy topdressing treatment in early-summer 2000. Inset illustrates frequent, light topdressing prior to hand brushing topdressing into canopy.

Tifdwarf bermudagrass quality during summer increased as applied nitrogen increased in 1998 and 1999 (Figure 1). However, overall quality of Tifdwarf during the summer of 2000 was less responsive to increasing N. Thatch depth increased from 14 to 42 months after planting (MAP) and thatch accumulation may have contributed to decreased quality, particularly at higher N application amounts (Figure 2). Shoot density generally increased with increasing N in 1998 and 1999 and in early summer 2000 (38 months) but no difference in shoot density was observed among N treatments in late-summer 2000 (42 MAP). Shoot density of Tifdwarf in good condition appears to range from about 15 to 20 shoots cm^{-2}. Densities of 10 shoots cm^{-2} or less, as observed at 38 months after planting reflect spring transition problems that may have been associated with increased thatch depth. Values presented in Figure 2 represent turf quality at the time thatch and shoot density determinations were taken. Turf quality at 14, 18, 30, and 38 MAP increased with increasing N but not at 26 and 42 MAP. Turf quality of Tifdwarf was not as good during summer 2000 compared to previous years particularly at the upper N application amounts, although turf quality for Tifdwarf overall has been relatively consistent (Photograghs 1 and 2).

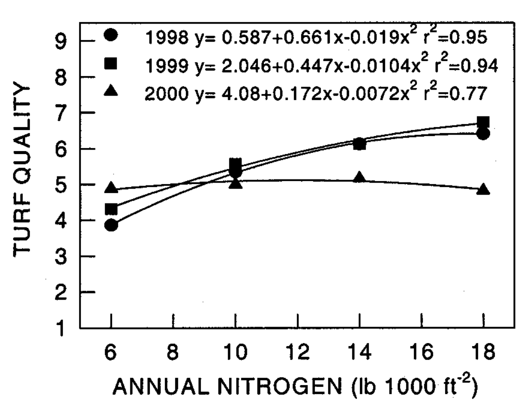


Figure 1. Turf quality of Tifdwarf bermudagrass across topdressing and vertical mowing treatments during June through October for 3 years as influenced by annual applied nitrogen.

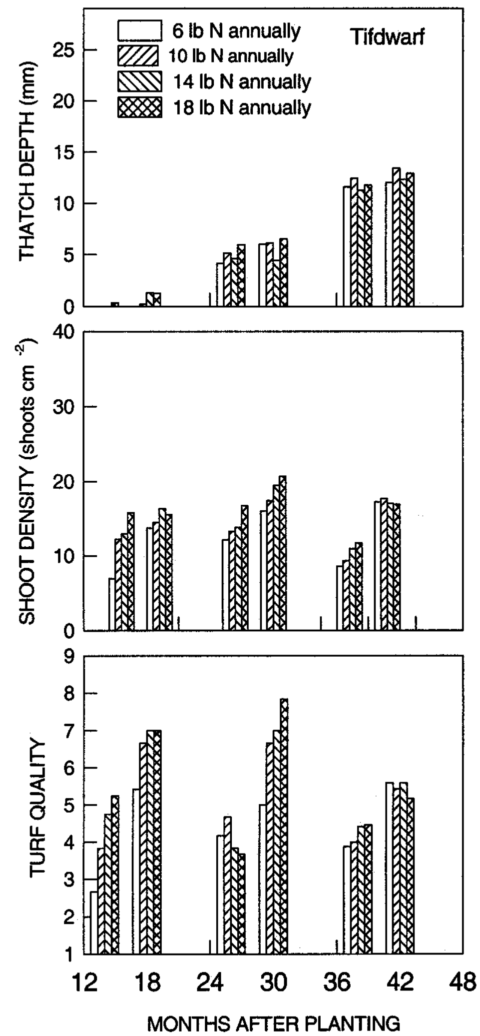


Figure 2. Thatch depth, shoot density, and turf quality of Tifdwarf bermudagrass at 14, 18, 26, 30, 38, and 42 months after planting as influenced by nitrogen fertilization.

Thatch accumulation and shoot density were similar among topdressing regimes for all observation dates (Fig. 3) but turf quality was superior for the frequent that the infrequent topdressing treatment at 42 MAP. During 2000, Tifdwarf turf quality was superior for frequent than infrequent topdressing in August through October when averaged across the two lowest N treatments (Fig. 4). Turf quality data pooled across the two lowest N treatments are presented because the best turf quality overall during summer 2000 occurred at low, rather than at high N fertility. Frequent topdressing improved uniformity compared to infrequent topdressing with a subsequent improvement in turf quality.

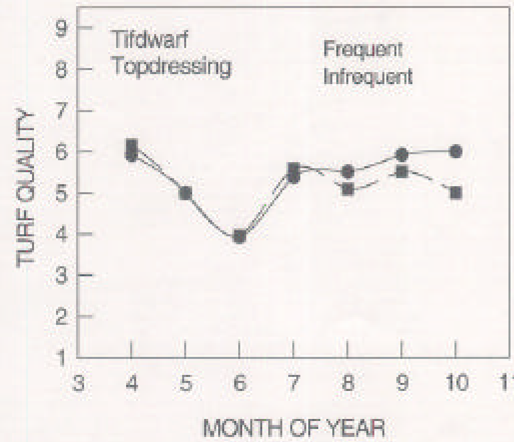
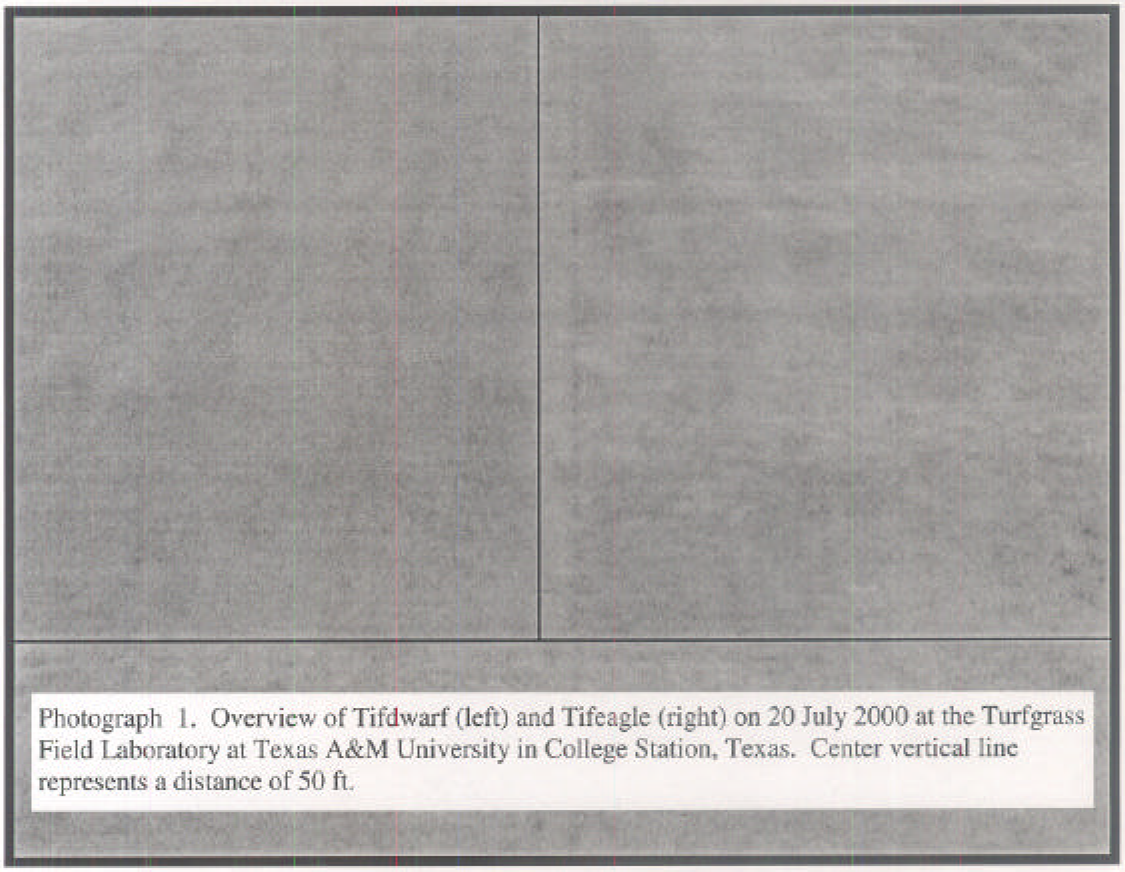


Figure 4. Turf quality of Tifdwarf bermudagrass during 2000 as influenced by topdressing treatments. Data were pooled across N treatments of 6 and 10 lb 1000 ft^{-2} $year^{-1}$ and across topdressing treatments.



Photograph 1. Overview of Tifdwarf (left) and Tifeagle (right) on 20 July 2000 at the Turfgrass Field Laboratory at Texas A&M University in College Station, Texas. Center vertical line represents a distance of 50 ft.

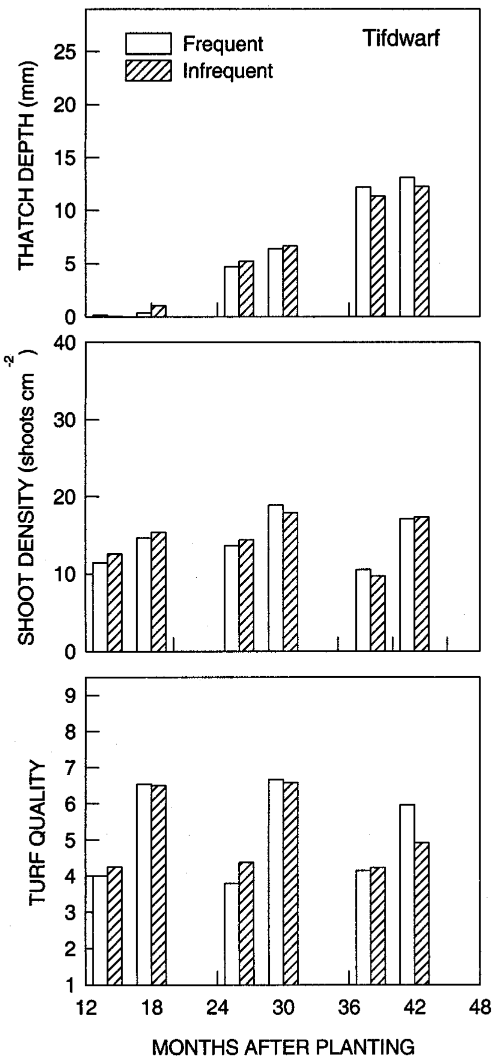


Figure 3. Thatch depth, shoot density, and turf quality of Tifdwarf bermudagrass at 14, 18, 26, 30, 38, and 42 months after planting as influenced by topdressing lightly every 2 wk (frequent) during June through October or heavy twice a year (infrequent) in June and October.

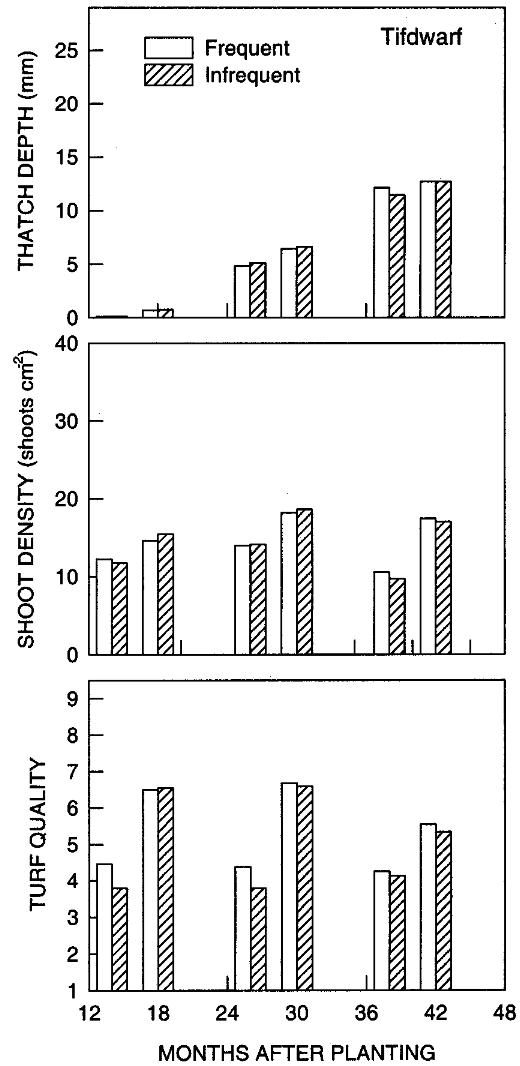


Figure 5. Thatch depth, shoot density, and turf quality of Tifdwarf bermudagrass at 14, 18, 26, 30, 38, and 42 months after planting as influenced by vertical mowing every 2 wk (frequent) during June through October or twice a year (infrequent) in June and October.

Thatch accumulation and shoot density were similar among vertical mowing treatments (Figure 5). Generally, turf quality was superior in early summer (14, 26, and 38 MAP) in all years for frequent than for infrequent vertical mowing. More severe defoliation and mechanical disruption in the fall caused by the more vigorous infrequent vertical mowing treatment resulted in less uniformity in overseeding stand, even though bermudagrass shoot density was not affected during spring and early summer. Infrequent vertical mowing, in general, reduced turf quality through spring transition in 2000 (Fig. 6). However, consistent differences among vertical mowing regimes were not evident in June through October 2000, although periodically, frequent vertical mowing reduced quality of Tifdwarf compared to infrequent vertical mowing (Photograph 2).

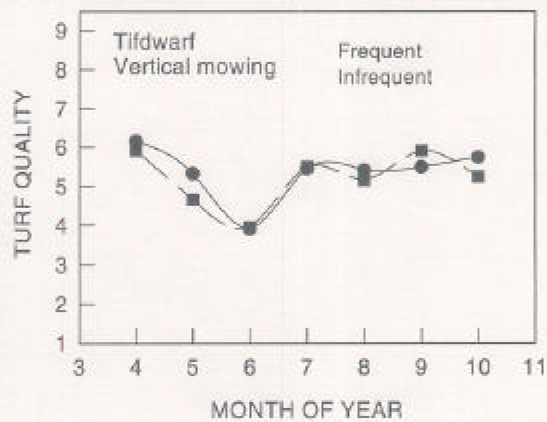


Figure 6. Turf quality of Tifdwarf bermudagrass during 2000 as influenced by vertical mowing treatments. Data were pooled across N treatments of 6 and 10 lb 1000 ft^{-2} $year^{-1}$ and across topdressing treatments.

Tifdwarf has performed reasonably well throughout this study, although performance during 2000 was less than in previous years. Thatch accumulation for all treatments is currently near 0.5 inch and may dramatically affect Tifdwarf performance in coming months.

Photograph 2. Overview of Tifdwarf bermudagrass illustrating effects of light, frequent vertical mowing (left) and infrequent, heavy vertical mowing (right) on 27 September 2000 at the Turfgrass Field Laboratory at Texas A&M University in College Station, Texas.

Champion bermudagrass turf quality increased with increasing N in summer 1998 (Fig. 7). Thatch accumulation also increased with increasing N through 18 MAP (Fig. 8). Across N treatments, shoot density was greatest at 18 MAP with densities of about 28 to 34 shoots cm^{-2}. Although the greatest shoot density for Champion was observed at 18 MAP, a decline in turf quality with increasing N was associated with similar trends in thatch accumulation and shoot density (Fig. 8). An overall decrease in shoot density and an increase in thatch was associated with a decline in summer 1999 turf quality as N increased (Fig. 7). Overall, turf quality substantially decreased in 1999 as N increased.

At 38 MAP, less thatch was observed at high than at lower N application rates (Fig. 8). An overall decline in growth, indicated by decreases in shoot density and turf quality as N increased, most likely limited production of tissue that could contribute to thatch. Bermudagrass decline symptoms were evident in Champion during 1999 and became more pronounced during 2000. Although shoot density increased from about 8 shoots cm^{-2} at 38 MAP to about 20 shoots cm^{-2} at 42 MAP, turf quality was below acceptable levels for Champion during 2000. Much of the loss in shoot density and associated poor quality can be attributed to bermudagrass decline {Photographs 3 and 4).

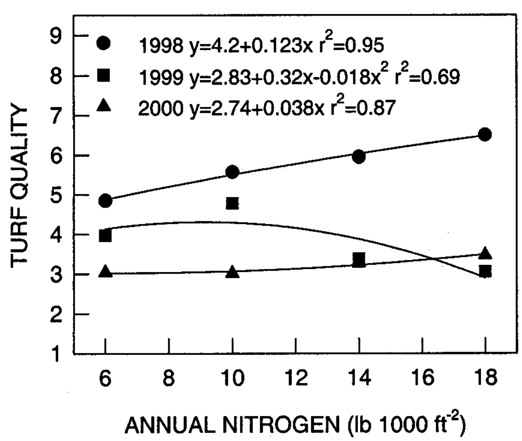


Figure 7. Turf quality of Champion bermudagrass across topdressing and vertical mowing treatments during June through October for 3 years as influenced by annual applied nitrogen.

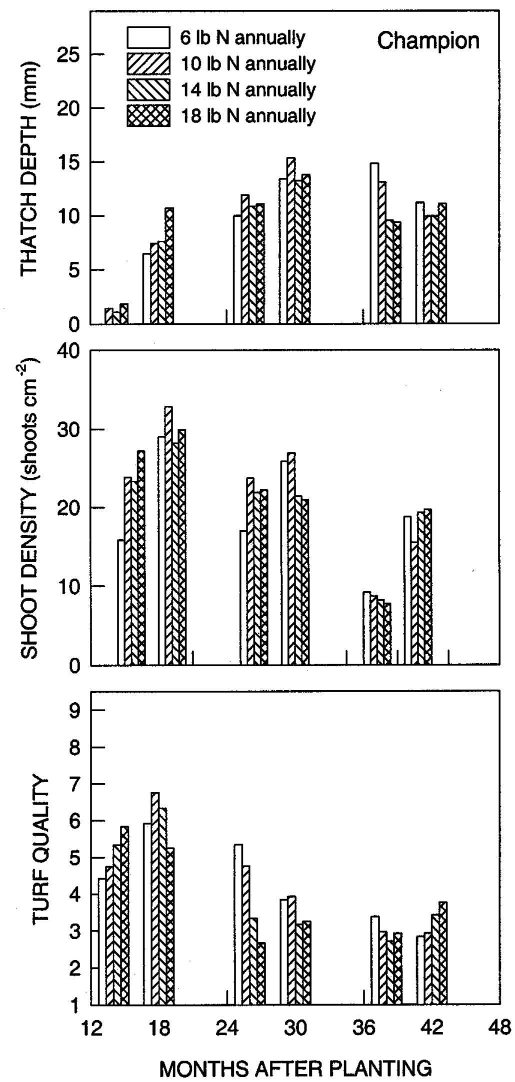


Figure 8. Thatch depth, shoot density, and turf quality of Champion bermudagrass at 14, 19, 26, 30, 38, and 42 months after planting as influenced by nitrogen fertilization.

Topdressing regimes had a similar effect on thatch accumulation except at 18 and 42 MAP (Fig. 9). Frequent topdressing more effectively controlled thatch accumulation than infrequent topdressing at 18 and 42 MAP. Frequent topdressing also increased shoot density at 30, 38, and 42 MAP compared to infrequent topdressing. However, topdressing regimes had a similar effect on turf quality at the time thatch and shoot density were determined and, generally, had a similar effect on summer turf quality during 2000 (Fig. 10).

Vertical mowing regimes had similar effects on thatch accumulation in Champion (Fig. 11) but frequent vertical mowing decreased shoot density on three out of six observation dates and dramatically reduced shoot density at 42 MAP compared to infrequent vertical mowing. At both 30 and 42 MAP,

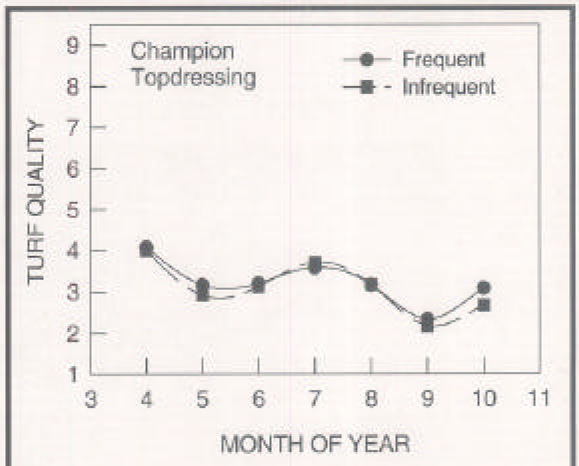
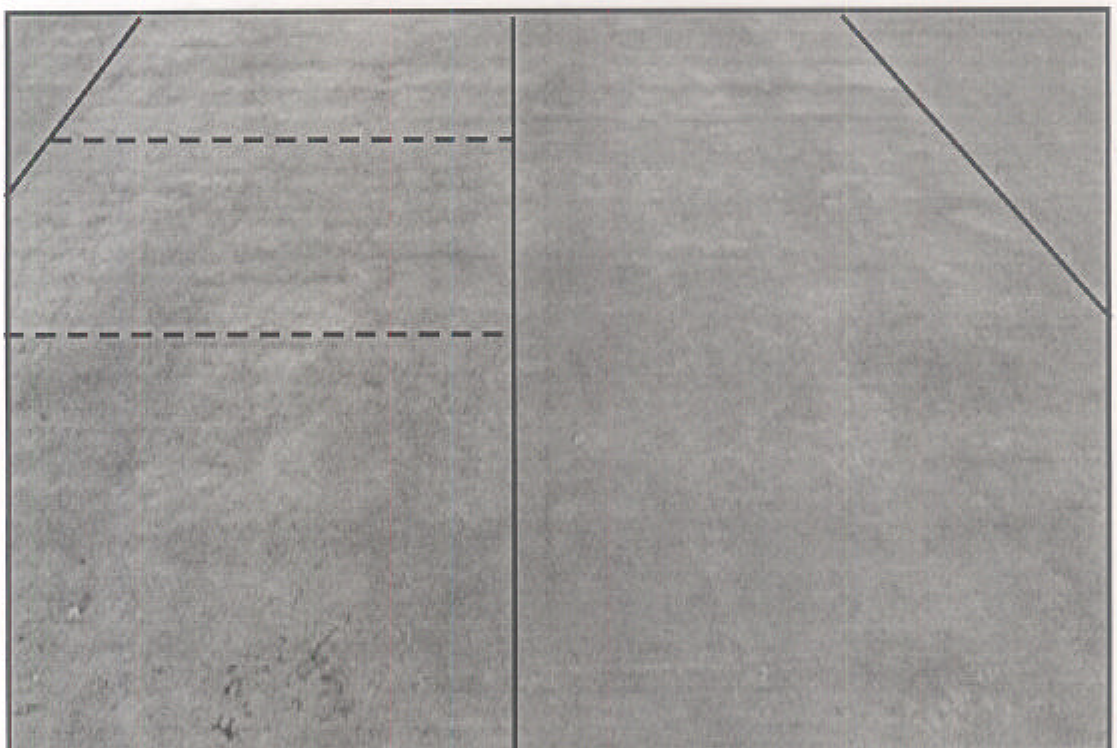


Figure 10. Turf quality of Champion bermudagrass during 2000 as influenced by vertical mowing treatments. Data were pooled across N treatments of 6 and 10 lb 1000 ft^{-2} $year^{-1}$ and across topdressing treatments.



Photograph 3. Overview of Champion (left) and Floradwarf (right) on 20 July 2000 at the Turfgrass Field Laboratory at Texas A&M University in College Station, Texas. Center vertical line represents a distance of 50 feet. Area within dashed lines is illustrated in Photograph 5.

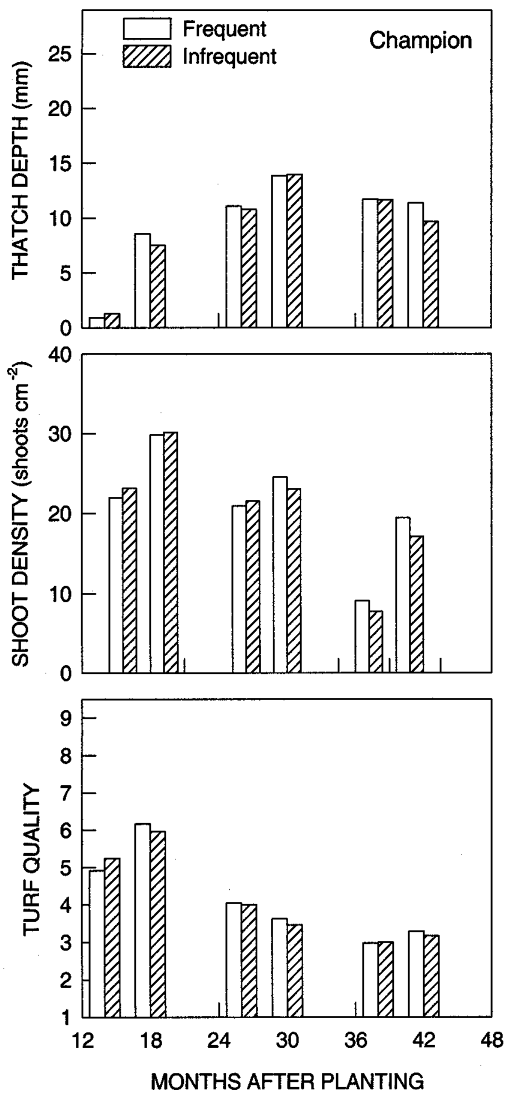


Figure 9. Thatch depth, shoot density, and turf quality of Champion bermudagrass at 14, 19, 26, 30, 38, and 42 months after planting as influenced by topdressing lightly every 2 wk (frequent) during June through October or heavy twice a year (infrequent) in June and October.

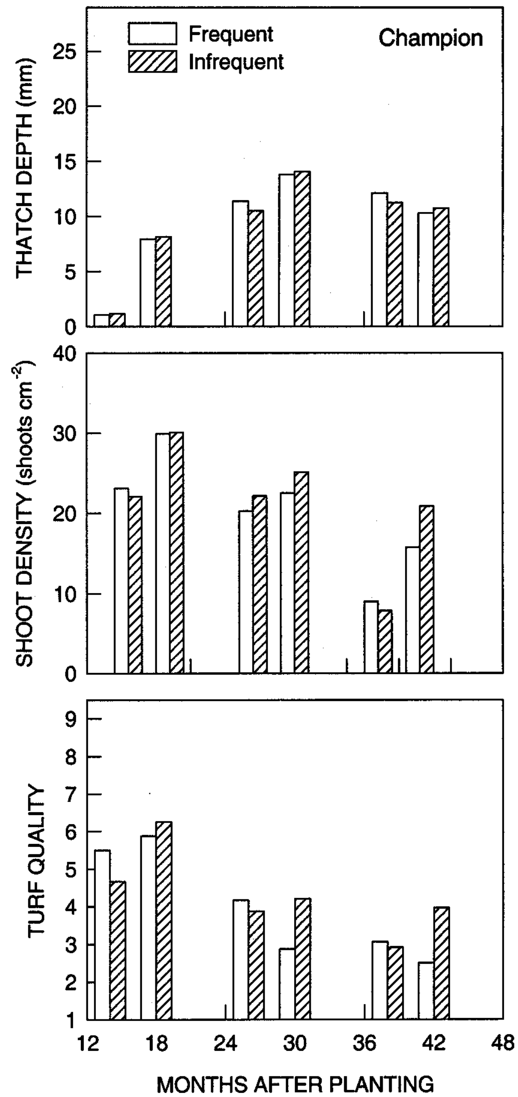


Figure 11. Thatch depth, shoot density, and turf quality of Champion bermudagrass at 14, 19, 26, 30, 38, and 42 months after planting as influenced by vertical mowing every 2 wk (frequent) during June through October or twice a year (infrequent) in June and October.

frequent vertical mowing caused a substantial reduction in turf quality (Fig. 11) The decline in turf quality caused by frequent vertical mowing was associated with an increase in bermudagrass decline symptoms (Photographs 4 and 5). Symptoms of bermudagrass decline were first evident in Champion during 1999 but became more pronounced during transition back to bermudagrass during 2000. Bermudagrass decline in Champion (Photograph C2) is characterized by thin, bare areas and chlorosis. Frequent, light defoliation of Champion during late-summer by vertical mowing caused an increase in bermudagrass decline symptoms and substantial loss of stand (Photograph 5). During August through October 2000, frequent, light vertical mowing reduced turf quality compared to infrequent, heavy vertical mowing.

Frequent, light vertical mowing appears to be advantageous in young stands of Champion but should be used cautiously as greens mature. Use of frequent, light vertical mowing during late-summer to early fall should be avoided if the canopy starts to thin and bermudagrass decline symptoms develop.

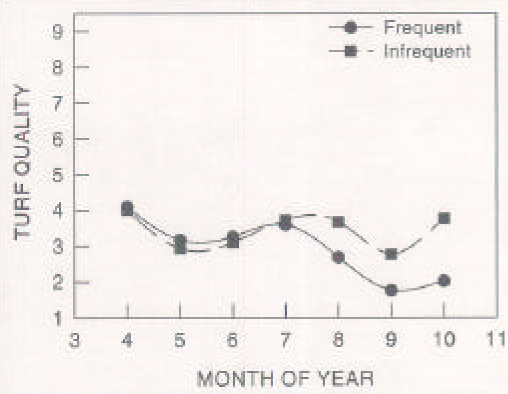
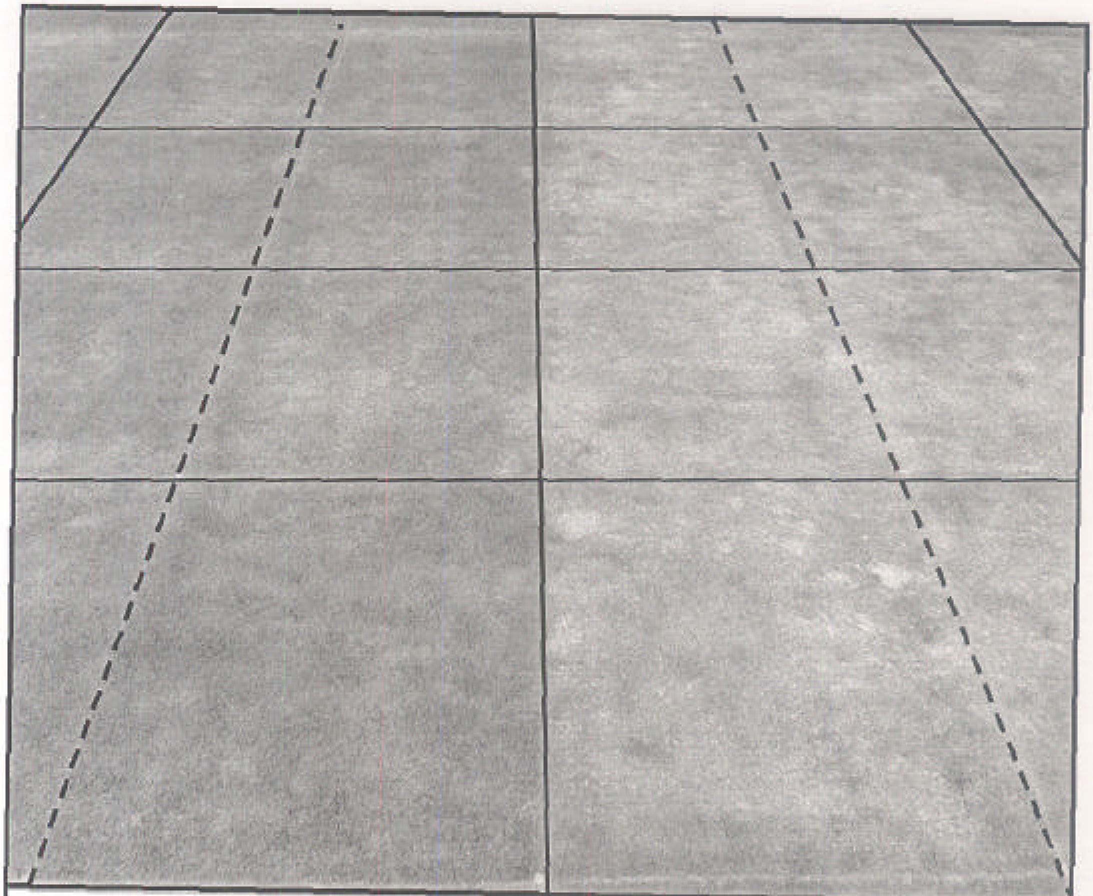


Figure 12. Turf quality of Champion bermudagrass during 2000 as influenced by vertical mowing treatments. Data were pooled across N treatments of 6 and 10 lb 1000 ft^{-2} $year^{-1}$ and across topdressing treatments.

In Champion, bermudagrass decline was promoted by specific cultural treatments particularly light, frequent vertical mowing in late-summer. Also, Bermudagrass decline increased with increasing N probably because of rapid thatch accumulation and subsequent mechanical damage caused by vertical mowing and scalping from mowing.

. Nitrogen applied at 6 to 10 lb N 1000 ft^{-2} appeared to be optimum for Champion bermudagrass in this study. Some golf course superintendents are using less annual N or foliar applications of nutrients to successfully maintain Champion golf greens. Topdressing will likely be required more frequently than used in this study to successfully control thatch. Light, frequent vertical mowing or grooming should be used in conjunction with light frequent topdressing to reduce thatch accumulation. Aerification should also be used routinely to aid in rooting and to control thatch. Champion bermudagrass greens and cultural programs should be evaluated routinely and refined as growth and environmental conditions change.

Photograph 4. Bermudagrass decline symptoms including characteristic thinning and chlorosis in Champion observed in June 2000.



Photograph 5. Overview of *one replication of Champion bermudagrass illustrating* treatment effects and bermudagrass decline symptoms on 27 September 2000 at the Turfgrass Field Laboratory at Texas A&M University in College Station, Texas. *Center vertical line represents a distance of 20 feet* and divides infrequent, heavy (left) and frequent, light (right) vertical mowing treatments. Vertical dashed lines divide frequent, light treatments (outside columns) and heavy, *infrequent (inside columns)* topdressing treatments. Nitrogen treatments from frong to back rows are 6, 10, 14, and 18 lb N 1000 ft^{-2} annually.

Floradwarf has been a particularly interesting cultivar to observe during this study because of changes in overall performance. Grow in and initial turf quality was excellent but Floradwarf developed bermudagrass decline symptoms earlier than other cultivars and subsequently turf quality suffered during 1998 and 1999. In 1998 turf quality increased with increasing N (Fig. 13) and there appeared to be a relationship between bermudagrass decline severity and N rate. Generally, decline symptoms decreased as N increased (Photograph 6). Overall summer quality of Floradwarf was poor in 1999. Since July 1999, aggressive soil pH management approaches were taken and ammonium sulfate was used routinely to supply half the total annual N. Soil pH management was continued through 2000 and soil pH was maintained near 7.5. Turf quality of Floradwarf was superior during summer of 2000 than in previous years, and increasing N up to 14 lb 1000 $ft^{-2} year^{-1}$ increased turf quality. During 2000, a dramatic recovery of turf quality was observed and at 42 MAP, excellent turf quality occurred for Floradwarf at 10 to 18 lb 1000 ft^{-2} $year^{-1}$ (Fig. 14).

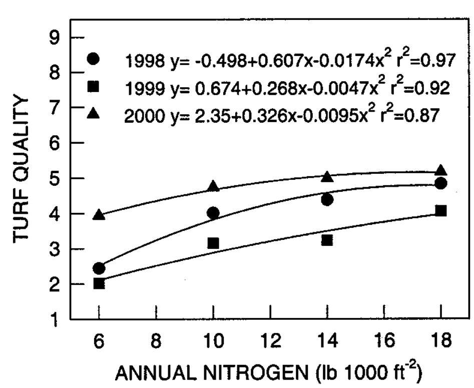


Figure 13. Turf quality of Floradwarf bermudagrass across topdressing and vertical mowing treatments during June through October for 3 years as influenced by annual applied nitrogen.

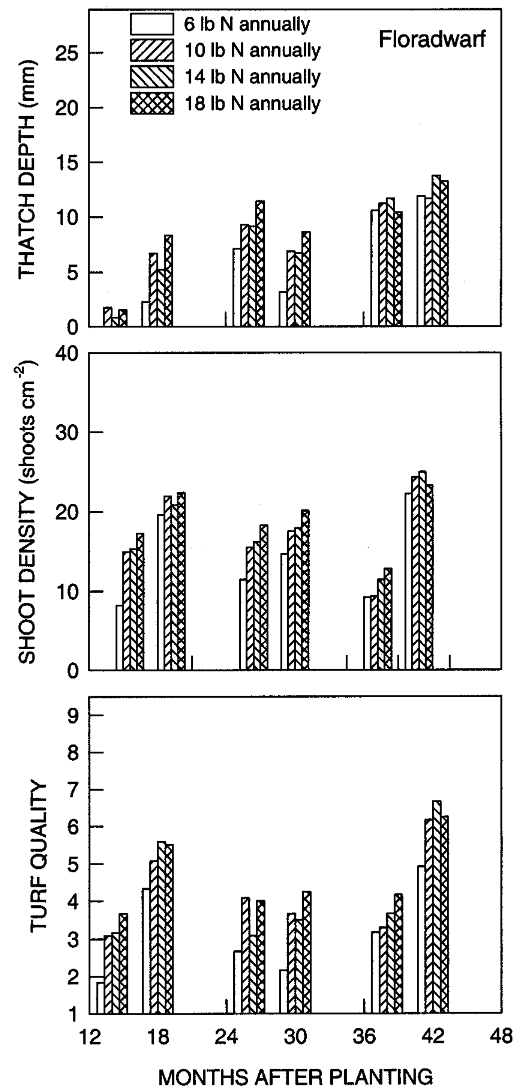


Figure 14. Thatch depth, shoot density, and turf quality of Floradwarf bermudagrass at 14, 19, 26, 30, 38, and 42 months after planting as influenced by nitrogen fertilization.

In general, thatch increased as N increased at all sampling dates, although at 38 and 42 MAP, thatch depth among N treatments was similar (Fig. 14).

Shoot density increased as N increased and, at 42 MAP, shoot density reached the greatest level during the study for Floradwarf (Fig. 14). At 38 MAP, overall shoot density was about 11 shoots cm^{-2} but increased to about 24 shoots cm^{-2} at 42 MAP. The dramatic increase in shoot density for Floradwarf can be attributed to suppression of bermudagrass decline due to soil pH management.(Photograph 6). Although present in 2000, bermudagrass decline symptoms were primarily associated with the lowest N rate and with frequent, light vertical mowing during late-August and September.

Topdressing regimes had a similar effect on thatch accumulation through 38 MAP (Fig 15). At 42 MAP, however, frequent, light topdressing increased thatch compared to infrequent, heavy topdressing. Topdressing regimes had a similar effect on shoot density but frequent, light topdressing improved turf quality on dates that thatch and shoot density were determined. Frequent, light topdressing improved turf quality during 2000 compared to infrequent, heavy topdressing (Fig. 16). Frequent, light topdressing improved uniformity and shoot density.

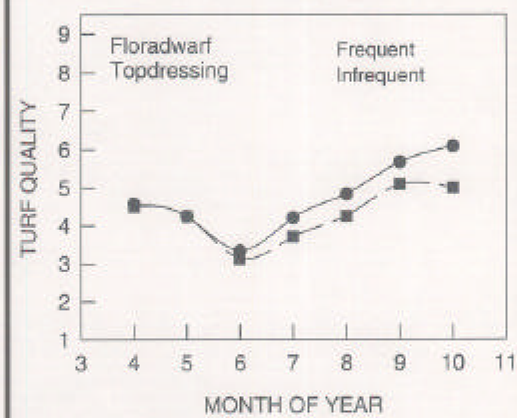
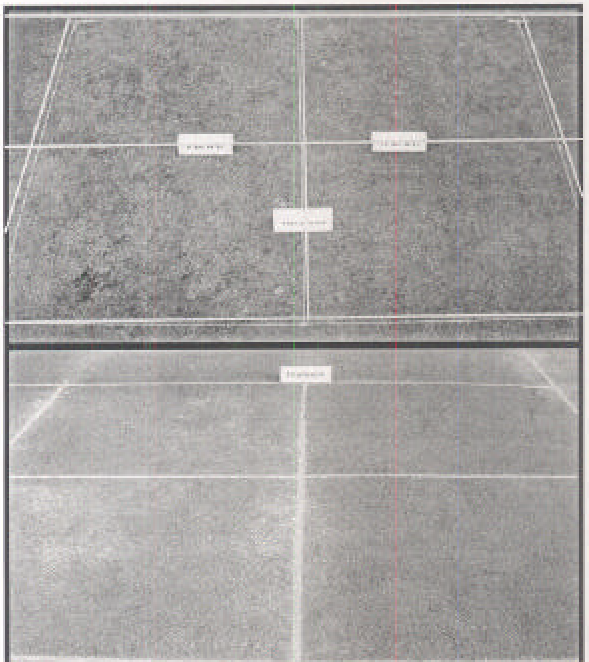


Figure 16. Turf quality of Floradwarf bermudagrass during 2000 as influenced by topdressing treatments. Data were pooled across N treatments of 6 and 10 lb 1000 ft^{-2} $year^{-1}$ and across topdressing treatments.



Photograph 6. Floradwarf in July 1999 (upper) and in September 2000 (lower) at the Texas A&M University Turfgrass Field Laboratory in College Station, TX. Left column receives 6 and right column receives 14 lb N 1000 ft^{-2} $year^{-2}$. All area in photographs received infrequent vertical mowing. Upper row receives frequent, light topdressing and lower row receives infrequent, heavy topdressing.

Vertical mowing regimes had a similar effect on thatch depth (Fig. 17) and shoot density was similar among vertical mowing regimes except at 42 MAP. Frequent, light vertical mowing reduced shoot density compared to infrequent, heavy vertical mowing with a marked decrease in turf quality at 42 MAP (Fig 17). During September through October 2000, frequent, light vertical mowing dramatically reduced turf quality of Floradwarf compared to infrequent, heavy vertical mowing (Fig. 18 and Photograph 7). Thin, bare areas became more prevalent under frequent vertical mowing and low N.

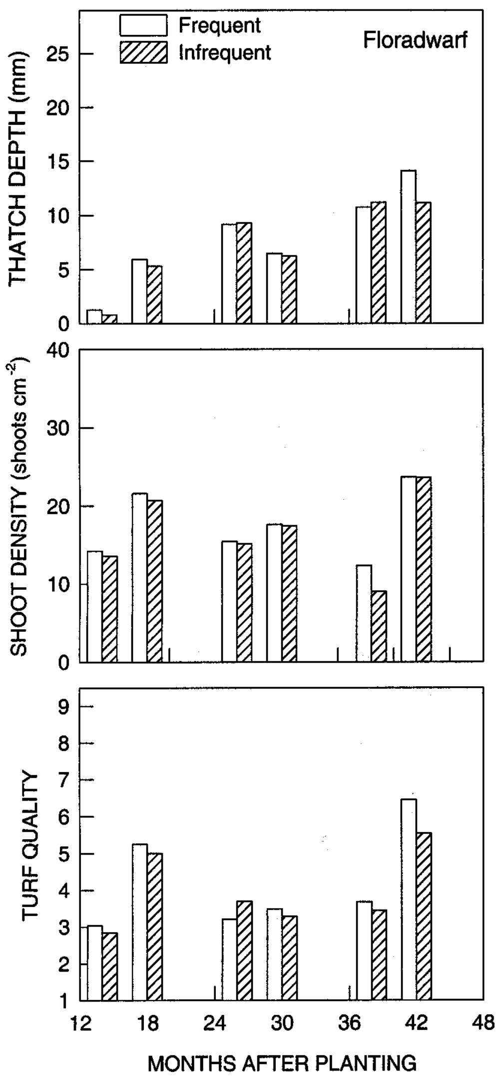


Figure 15. Thatch depth, shoot density, and turf quality of Floradwarf bermudagrass at 14, 18, 26, 30, 38, and 42 months after planting as influenced by topdressing lightly every 2 wk (frequent) during June through October or heavy twice a year (infrequent) in June and October.

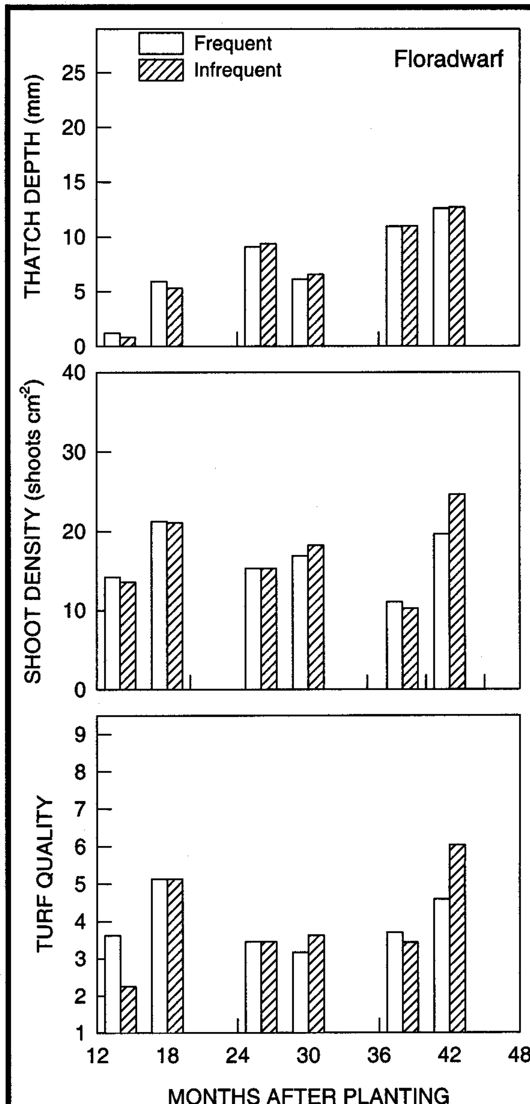


Figure 17. Thatch depth, shoot density, and turf quality of Floradwarf bermudagrass at 14, 18, 26, 30, 38, and 42 months after planting as influenced by vertical mowing every 2 wk (frequent) during June through October or twice a year (infrequent) in June and October.

Floradwarf appears to be sensitive to alkaline soil pH and apprears to be very susceptible to bermudagrass decline as pH increases above neutral. Floradwarf was responsive to increases in N and decreases in soil pH from about 9.0 to 7.5. Frequent, light topdressing should be used to control thatch because of less disruption of the playing surface, although heavy topdressing was just as effective in controlling thatch in this study. Frequent, light vertical mowing or grooming should be a component of cultural program for Floradwarf but should be monitored closely in late-summer to avoid mechanical injury. Floradwarf has performed adequately in this study at about 10 lb N 1000 ft^{-2} $year^{-1}$.

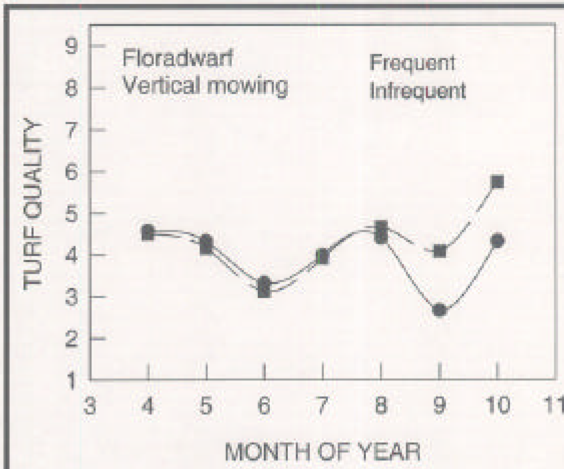


Figure 18. Turf quality of Floradwarf bermudagrass during 2000 as influenced by vertical mowing treatments. Data were pooled across N treatments of 6 and 10 lb 1000 ft^{-2} $year^{-1}$ and across topdressing treatments.

Photgraph 7. Floradwarf in September 2000 illustrating the effects of frequent, light vertical mowing (right) and infrequent, heavy vertical mowing (left) in late-summer and early-fall. Nitrogen treatments in rows from front 10, 6, 14, and 18 lb N 1000 ft^{-2} $year^{-2}$.

Miniverde had excellent turf quality during 1998 and 1999 and turf quality increased as N increased (Fig. 19). Summer turf quality, in 2000 however, decreased as N increased. Thatch accumulation was rapid for Miniverde and increased with increasing N (Fig. 20). Almost 1 inch of thatch was observed at 38 and 42 MAP. Shoot density of Miniverde increased with N through 30 MAP but at 42 MAP shoot density decreased with increasing N. The decrease in shoot density, as N increased, resulted in a subsequent decrease in turf quality at 42 MAP even though turf quality was good in early-summer (38 MAP) 2000 (Fig. 20 and Photograph 8).

Thatch accumulation was similar among topdressing regimes through 38 MAP. At 42 MAP, more thatch occurred for frequent, light topdressing than for infrequent, heavy topdressing (Fig. 21). Shoot density was greatest for frequent, light than for infrequent, heavy topdressing at 38 MAP only, although a similar trend was observed at 42 MAP. Greater shoot density in the frequent topdressing treatment was associated with greater turf quality than for infrequent topdressing. Although differences in quality among topdressing regimes were noted at 42 MAP, summer quality in 2000 was, in general, similar among topdressing regimes (Fig. 22).

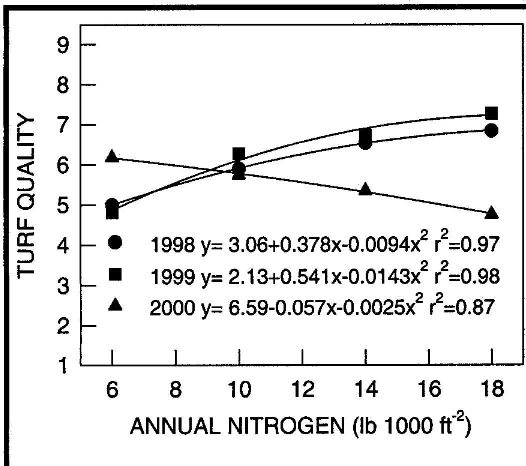


Figure 19. Turf quality of Miniverde bermudagrass across topdressing and vertical mowing treatments during June through October for 3 years as influenced by annual applied nitrogen.

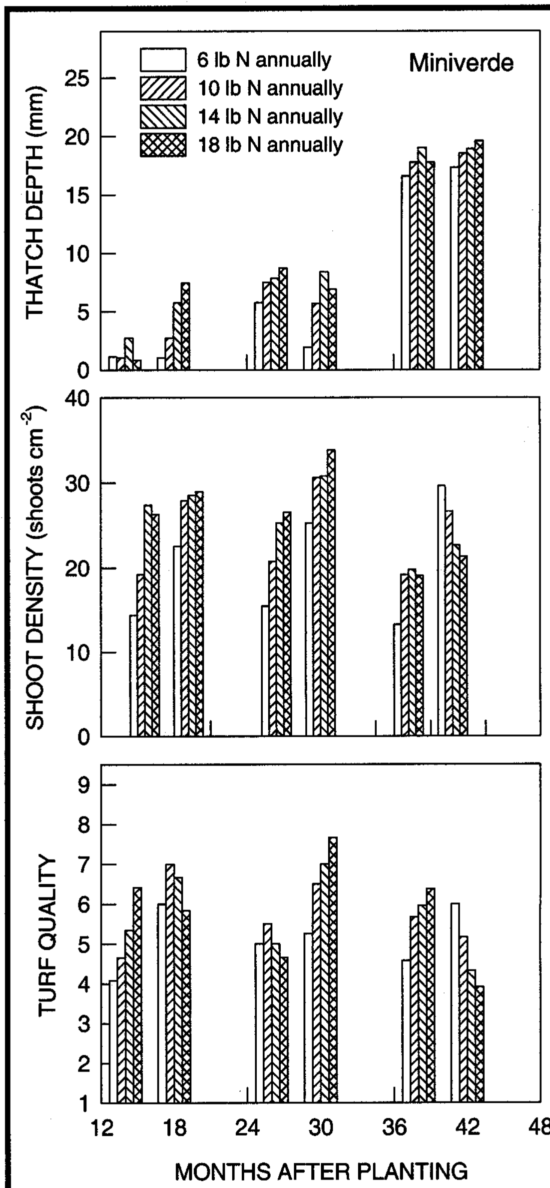


Figure 20. Thatch depth, shoot density, and turf quality of Miniverde bermudagrass at 14, 19, 26, 30, 38, and 42 months after planting as influenced by nitrogen fertilization.

Vertical mowing regimes had a similar effect on thatch depth (Fig. 23). Shoot density was also similar among vertical mowing regimes except at 42 MAP. Shoot density was less for the frequent, light than for the infrequent heavy vertical mowing treatment at 42 MAP. In early summer of 1998 and 1999 (14 and 24 MAP) frequent, vertical mowing treatments produced better turf quality than infrequent, heavy vertical mowing because heavy vertical mowing prior to overseeding in fall produced a non-uniform overseeding stand. At 42 MAP, poorer quality was observed for frequent than for infrequent vertical mowing (Fig. 23). During September through October 2000, frequent vertical mowing produced lower turf quality than infrequent vertical mowing (Fig. 24 and Photograph 9).

Based on response to treatments in this study, Miniverde should be maintained at about 6 lb N 1000 ft^{-2} $year^{-1}$. Topdressing should be applied frequently and in small amounts. At least two applications of topdressing per month should be used, and topdressing more frequently may be required to control thatch accumulation in this cultivar.

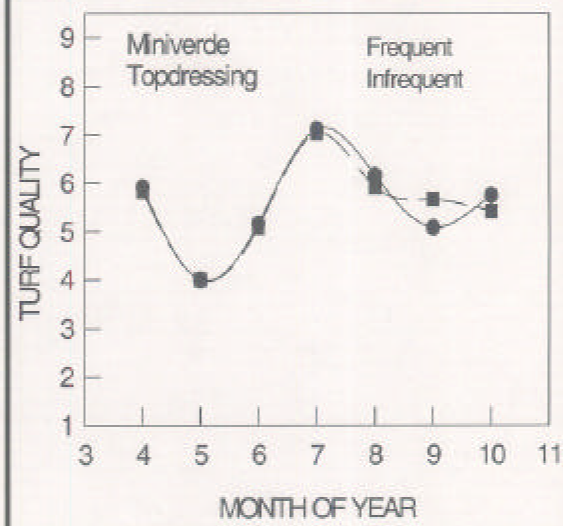
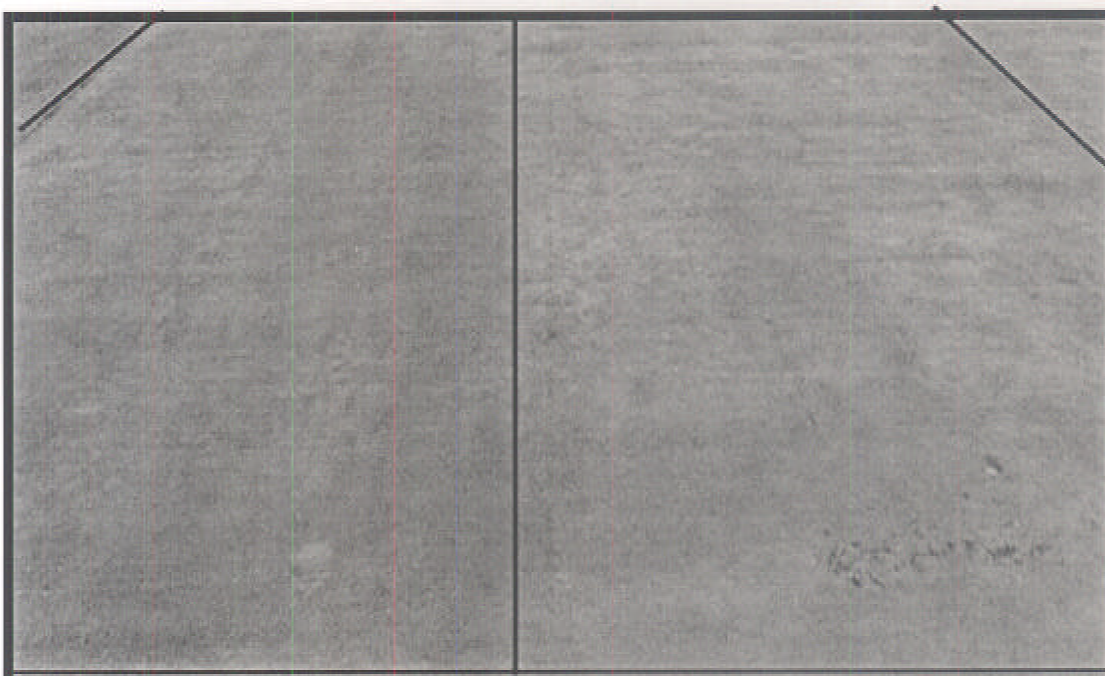


Figure 22. Turf quality of Miniverde bermudagrass during 2000 as influenced by topdressing treatments. Data were pooled across N treatments of 6 and 10 lb 1000 ft^{-2} $year^{-1}$ and across topdressing treatments



Photograph 8. Overview of Miniverde (left) and Champion (right) on 20 July 2000 at the Turfgrass Field Laboratory at Texas A&M University in College Station, Texas. Center vertical line represents a distance of 50 feet.

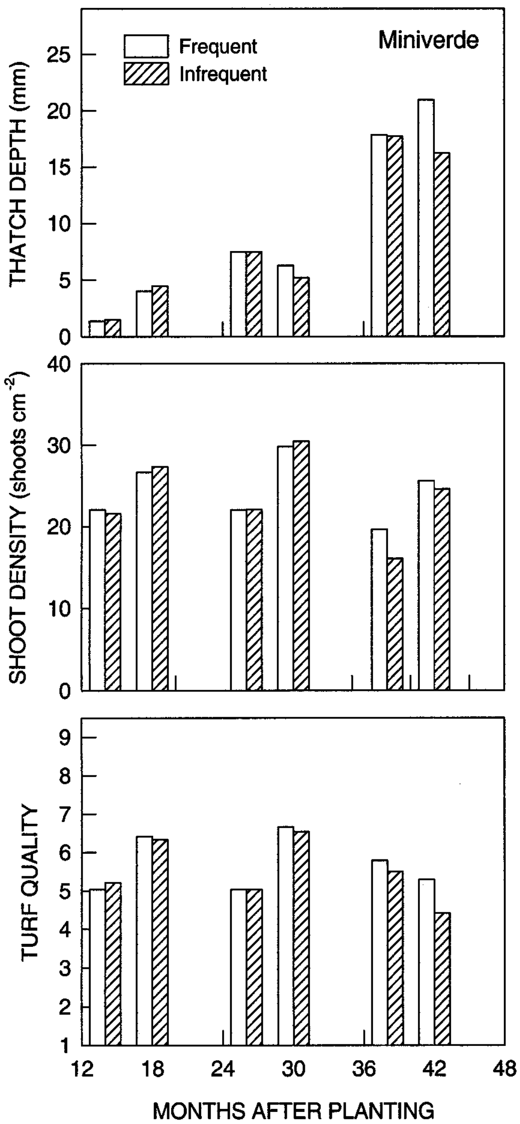


Figure 21. Thatch depth, shoot density, and turf quality of Miniverde bermudagrass at 14, 18, 26, 30, 38, and 42 months after planting as influenced by topdressing lightly every 2 wk (frequent) during June through October or heavy twice a year (infrequent) in June and October.

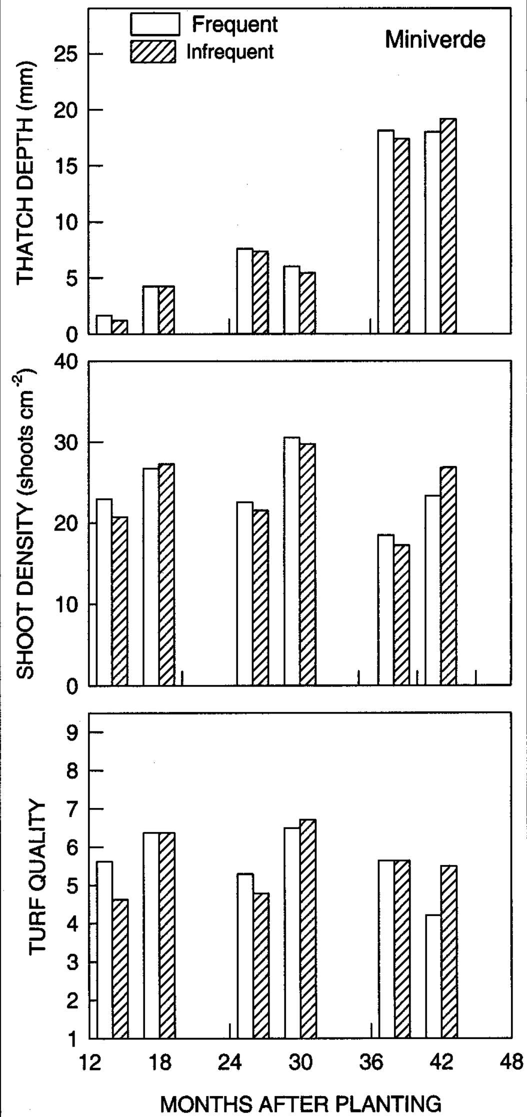


Figure 23. Thatch depth, shoot density, and turf quality of Miniverde bermudagrass at 14, 18, 26, 30, 38, and 42 months after planting as influenced by vertical mowing every 2 wk (frequent) during June through October or twice a year (infrequent) in June and October.

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Frequent, light vertical mowing should be used in cultural programs for Miniverde in early- to mid-summer to hasten transition and control grain. As Miniverde matured, vertical mowing in late-summer to early-fall decreased turf quality. Miniverde golf greens should be monitored closely and vertical mowing should be discontinued if turf quality declines. Vertical mowing could be continued after the canopy heals. Frequent, light topdressing and vertical mowing during the growing season has provided acceptable overseeding establishment in the fall without causing poor spring transition. Core aerification was not evaluated in this study but should be used routinely to help disrupt thatch and improve rooting. Miniverde is a high shoot density cultivar with a stoloniferous growth habit. Aggressive thatch production is the primary negative attribute of this cultivar. Intensive cultural programs designed to control thatch will be necessary to produce Miniverde putting surfaces that are of high quality.

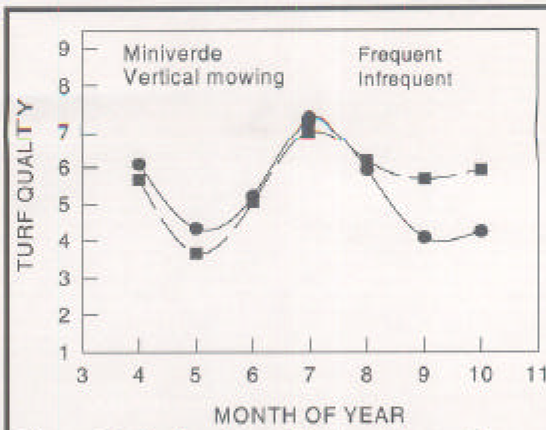
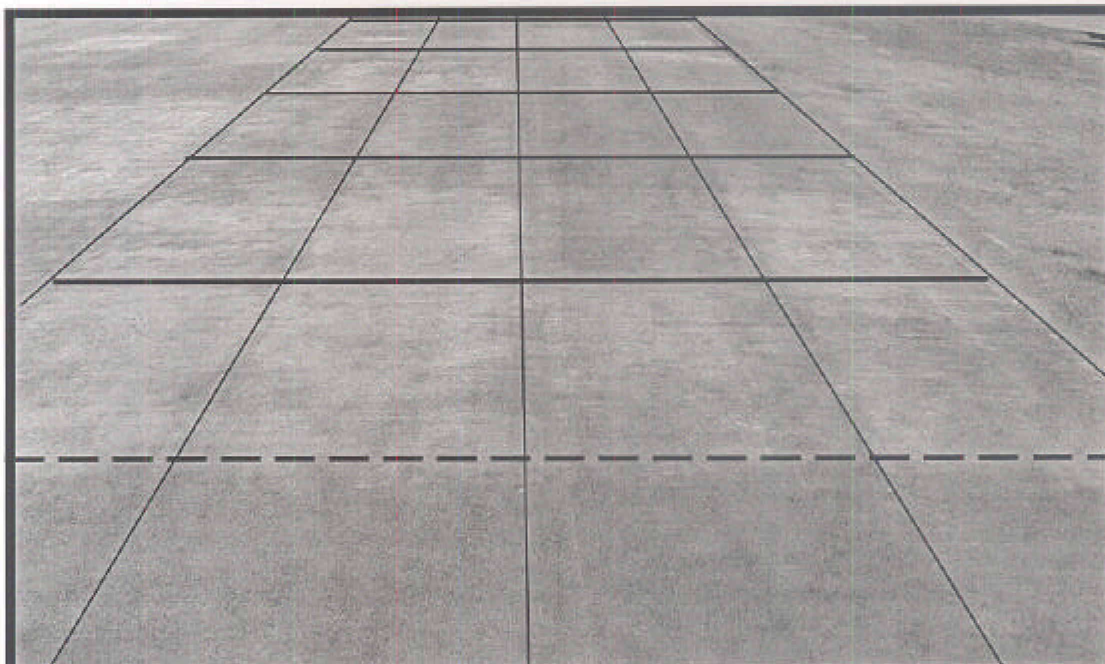


Figure 24. Turf quality of Miniverde bermudagrass during 2000 as influenced by vertical mowing. Data were pooled across N treatments of 6 and 10 lb 1000 ft^{-2} $year^{-1}$ and across topdressing treatments



Photograph 9. Overview of Miniverde on 27 September 2000 at the Turfgrass Field Laboratory at Texas A&M University in College Station, Texas. Area to rear of dashed line illustrates the effects of frequent vertical mowing compared to infrequent vertical mowing in foreground.

Turf quality of **Tifeagle** bermudagrass increased with increasing N up to 14 lb 1000 ft^{-2} annually in 1998 and 1999 (Fig. 25). In 2000, however, turf quality of Tifeagle declined with increasing N. Shoot density also increased with increasing N at 14, 18, 26, and 30 MAP, but decreased with increasing N at 38 MAP (Fig. 26). Shoot density was generally least for Tifeagle at 38 MAP but recovered to relatively high levels at 42 MAP. Although turf quality at 42 MAP had recovered to relatively moderate levels, turf quality during 2000 was less at high than at lower N because of poor uniformity and a mottled appearance (Photograph 10).

Thatch accumulation increased through 38 MAP and generally increased with increasing N (Fig. 26). Topdressing regimes had a similar effect on thatch accumulation except at 42 MAP, when frequent, light had greater thatch than infrequent, heavy topdressing (Fig. 27). Shoot density was not substantially affected by topdressing regimes, although turf quality at 38 and 42 MAP was superior under light, frequent than heavy, infrequent topdressing. Superior turf quality was observed during August Through October 2000 for frequent than for infrequent topdressing (Fig. 28).

Vertical mowing regimes had a similar effect on thatch accumulation and shoot density. However, at 14 and 26 MAP frequent, light vertical mowing had superior quality than infrequent, heavy vertical mowing (Fig. 29).

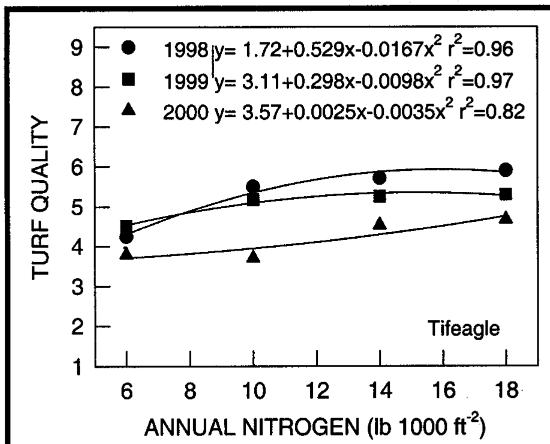


Figure 25. Turf quality of Tifeagle bermudagrass across topdressing and vertical mowing treatments during June through October for 3 years as influenced by annual applied nitrogen.

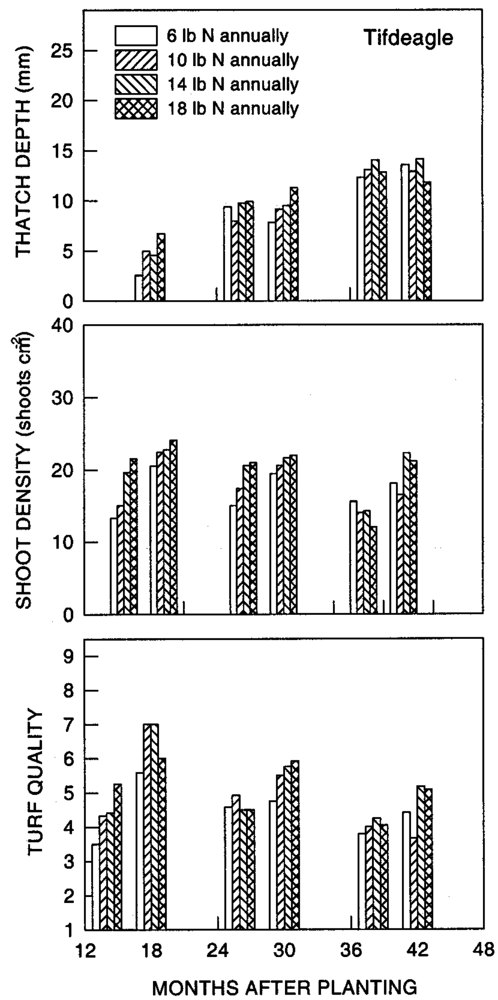


Figure 26. Thatch depth, shoot density, and turf quality of Tifeagle bermudagrass at 14, 18, 26, 30, 38, and 42 months after planting as influenced by nitrogen fertilization.

Turf quality observations at 14 and 26 MAP reflect treatment effects on spring transition and heavy vertical mowing in fall produced a non-uniform appearance that negatively affected turf quality the following spring. At 38 and 42 MAP, frequent, light vertical mowing decreased turf quality compared to frequent, heavy vertical mowing. Particularly at 42 MAP, frequent vertical mowing decreased shoot density with a subsequent decrease in quality. Frequent vertical mowing, in general, reduced turf quality in June through October 2000 compared to infrequent vertical mowing (Fig. 30 and Photograph 11.)

Bermudagrass decline symptoms were more prevalent under light, frequent than for heavy infrequent vertical mowing during late-summer. Decline symptoms during late summer were characteristic of symptoms in Champion bermudagrass (Photographs 10 and 11), although more patch like symptoms were also evident in Tifeagle during early-summer 2000.

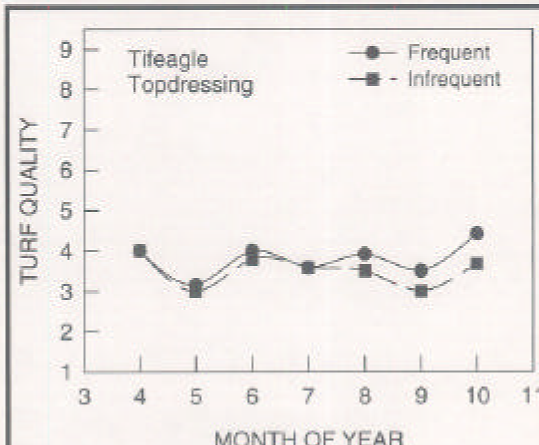


Figure 28. Turf quality of Tifeagle bermudagrass during 2000 as influenced by topdressing treatments. Data were pooled across N treatments of 6 and 10 lb 1000 ft^{-2} $year^{-1}$ and across topdressing treatments.

Photograph 10. Bermudagrass decline symptoms including characteristic thinning and chlorosis in Champion (upper) versus more irregular and patch-like symptoms in Tifeagle (lower) as observed in July 2000.

Tifeagle is a moderate shoot density, stoloniferous bermudagrass cultivar that will likely perform best with about 10 lb N 1000 ft^{-2} $year^{-1}$. High rates of N contributed to thatch accumulation and reduced overall turf quality. In summer 2000, application of N at more than 10 lb 1000 ft^{-2} $year^{-1}$ were beneficial for recovery of Tifeagle from a poor spring transition (Photograph 11) but constant, previous high N application rates contributed to transition problems in early-summer 2000. Substantial recovery of turf quality in Tifeagle due to N application greater than 10 lb 1000 ft^{-2} $year^{-1}$ was not evident until late-summer 2000.

Light, frequent topdressing in conjunction with grooming or light, frequent vertical mowing in the first one to two years

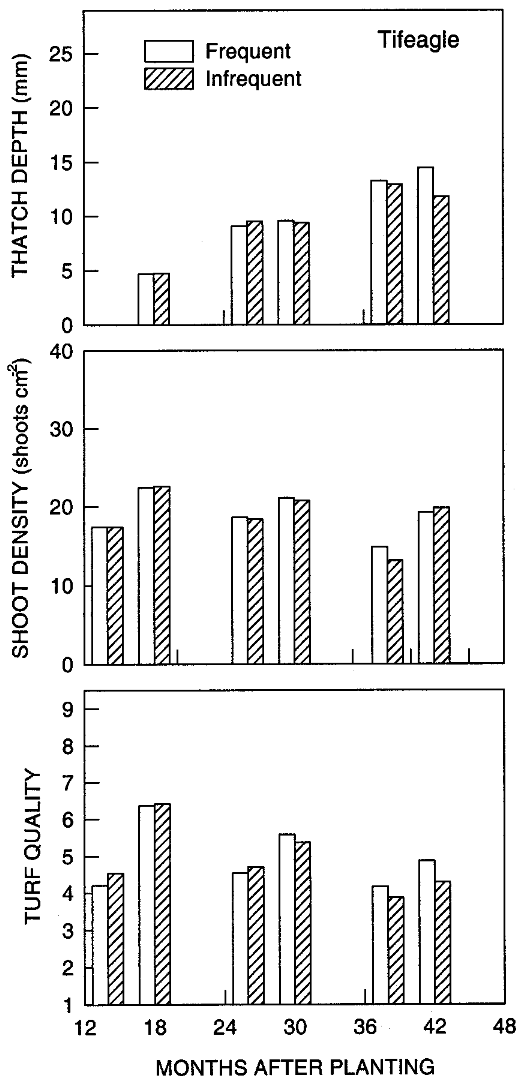


Figure 27. Thatch depth, shoot density, and turf quality of Tifeagle bermudagrass at 14, 18, 26, 30, 38, and 42 months after planting as influenced by topdressing lightly every 2 wk (frequent) during June through October or heavy twice a year (infrequent) in June and October.

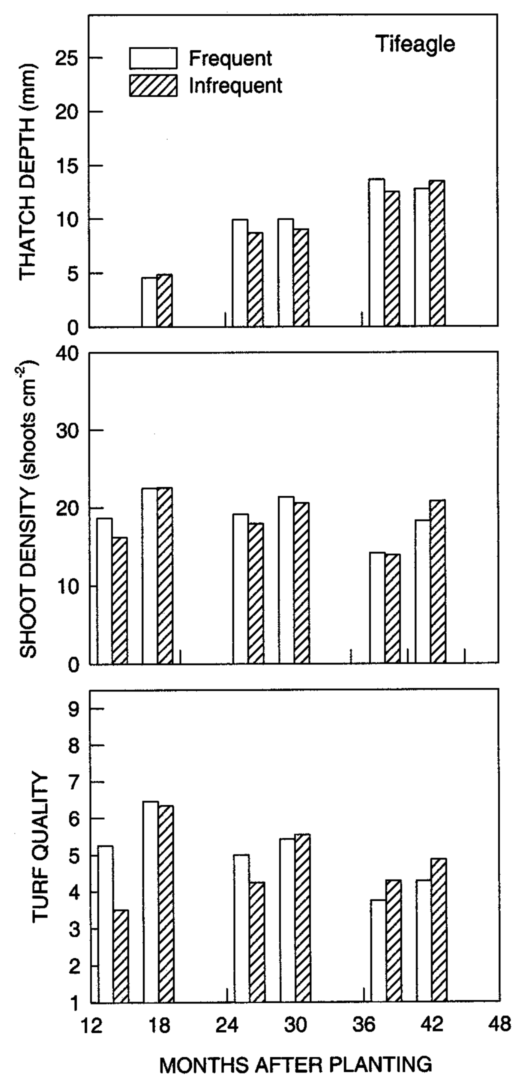


Figure 29. Thatch depth, shoot density, and turf quality of Tifeagle bermudagrass at 14, 19, 26, 30, 38, and 42 months after planting as influenced by vertical mowing every 2 wk (frequent) during June through October or twice a year (infrequent) in June and October.

V. FUTURE WORK

The study will continue to focus on thatch accumulation and performance during 2001. Bermudagrass decline became a problem on the research area during 1999 for Champion and Floradwarf and for Tifeagle in 2000. The response of the other cultivars to bermudagrass decline will be monitored closely during 2001. The development of bermudagrass decline will provide insight into the future management of this disease.

This USGA funded research has provided a wealth of information on the management of new dwarf bermudagrasses and has identified several potential problems that should be considered when making cultivar selection. Cultivar specific management requirements, such as nitrogen fertility, topdressing, and vertical mowing have been identified. We will continue to provide updates to the scientific community and to professional turf managers through presentations at turf conferences, regional seminars, and popular articles about this ongoing research. We will be preparing a referred publication concerning this research in 2001.