Environment and Culture Affect Bermudagrass Growth and Decline

The roles temperature and shade play in ultradwarf bermudagrass health are not totally understood.

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Bermudagrass decline is a devastating root disease of highly managed bermudagrass turf, especially on golf greens in the southern United States (Elliott, 1991). It is caused by an interaction of host-predisposing abiotic stresses and the soil-borne, ectotrophic, root-infecting fungus *Gaeumannomyces graminis* var. *graminis* (*Ggg*). Bermudagrass decline results in large areas of turf with weakened, short, brown-to-black root systems and an absence of feeder roots and root hairs. Symptoms include foliar chlorosis, a thinning stand, poor response to fertilizer and irrigation, and premature plant death. The pathogen causes root, rhizome, and stolon rotting. Nutrient and irrigation management is difficult because of diminished root systems. Above-ground symptoms of infection often become evident anywhere from spring green-up through the spring and summer months, when heat and moisture stress challenge the weakened root systems of affected plants. Symptoms also are common during cloudy, wet periods of late summer and early fall.

Drs. Joseph Krausz, Philip Colbaugh, Roy Stanford, and Richard White were part of the turfgrass research team at Texas A&M University that explored the effects of cultural, environmental, and plant growth factors on the recovery of bermudagrass from damage caused by *Ggg*. A strong component of the research was to gain a better understanding of how temperature and light levels influence dwarf bermudagrass growth and development. The influence of light and temperature on dwarf bermudagrass growth was of interest because bermudagrass decline often becomes more severe during persistent cloudy and overcast conditions (Waltz, 2003). Texas A&M University research also focused on cultural practices to enhance recovery of turf exhibiting bermudagrass decline symptoms. Although bermudagrass decline is not inevitable, when the disease does occur, strategies are needed to hasten turf recovery.


Tifeagle bermudagrass green at the time of treatment initiation in July.

CULTURAL STRATEGIES TO ENHANCE RECOVERY FROM BERMUDAGRASS DECLINE

Recommendations for hastening turf recovery from bermudagrass decline often include raising the mowing height and applying acidifying fertilizers and/or foliar feeding (Fermanian et al., 2003). A four-year-old Tifeagle bermudagrass putting green with severe symptoms of bermudagrass decline was used to explore cultural approaches for alleviating the disease symptoms. The green was maintained at 0.125 inch, had a soil pH of 9.1, and was previously fertilized with a coated urea nitrogen fertilizer.

Table 1
Turf quality in August and October for Tifeagle bermudagrass as influenced by monthly aerification with hollow or solid tines and biweekly fertilizer applications to provide 6, 12, and 24 pounds of N per 1,000 sq. ft. annually[1]

	Hollow Tine		Solid Tine	
Nitrogen	**August**	**October**	**August**	**October**
6	1.5a[2]	2.5a	2.8a	4.0c
12	2.0a	2.9a	3.2a	5.3b
24	2.2a	3.2a	3.0a	6.4a

[1]Plots were rated on a 1-to-9 scale, with 9 as the highest quality. A 5 was considered the minimal accepted quality level for putting greens.

[2]Means within months followed by the same lower-case letter are statistically similar.

Previous applications of several fungicides in a replicated trial conducted on the green the previous year were not effective in controlling the disease. A series of treatments was established in early July, including nitrogen (N) regimes, aerification, and topdressing arranged in a split-plot design. Nitrogen regimes included bimonthly applications of ammonium sulfate at 0.25, 0.5, and 1.0 lb. N per 1,000 sq. ft. to supply total annual N of 6, 12, and 24 lb. per 1,000 sq. ft. Ammonium sulfate was used in this study because of its acidifying effect on soils. Nitrogen regimes were supplemented with potassium, phosphorus, and micronutrients based on soil tests. Aerification treatments included monthly application of 0.5-inch solid tines and 0.5-inch hollow tines with cores removed. Topdressing treatments included none, 0.125-inch monthly, and 0.02-inch bimonthly. Treatments were initiated in early July and ended in early September. Visual evaluations of turfgrass quality were taken every two weeks. Microscopy was used to assess presence of *Ggg*.

Aerification is an important management tool that is used to remove and control thatch, reduce compaction, and improve root development. In this study, hollow-tine aerification disrupted the surface more than solid-tine aerification (Table 1). Aerification of any type had not been applied to the green for several years, resulting in heavy thatch, increased disease severity, and poor rooting. The poor rooting prevented the initial hollow-tine aerification from producing quality cores and uniform coring holes, resulting in greater surface disruption and a longer healing time than when solid tines were used.

Turfgrass quality improved and evidence of bermudagrass decline symptoms decreased with increasing N, especially for the solid-tine aerification treatments. Although 24 lb. N per 1,000 sq. ft. is considered excessive, this treatment, in conjunction with solid-tine aerification, resulted in rapid turf quality recovery and diminished bermudagrass decline symptoms. Also, turf quality increased and bermudagrass decline symptoms decreased to a greater extent for increasing N in conjunction with heavy topdressing than when compared to no and light, frequent topdressing (Table 2).

The most advantageous treatment combination for recovery from bermudagrass decline symptoms and improvement of turfgrass quality was solid-tine aerification, heavy topdressing, and 24 lb. N per 1,000 sq. ft. This improvement in quality was accomplished without raising the mowing height above 0.125 inch. Excessive N can cause rapid thatch accumulation, and the combination of the greatest amount of N and no topdressing became excessively soft by early October. However, plots that received the greatest amount of N in conjunction with heavy or light topdressing remained firm. Surprisingly, the large amounts of N used did not contribute to an excessive vertical growth rate.

The marked recovery of Tifeagle from bermudagrass decline symptoms for specific treatment combinations occurred even though *Ggg* was still present. Large amounts of N, as used in this study, should not be applied to bermudagrass for long periods of time due to the potential to negatively impact the environment and because of the potential to cause excessive thatch accumulation and contribute to reduced stress tolerance. Increasing N for short periods to enhance recovery followed by lower amounts of N to sustain turf density is, however, a more reasonable approach. Careful rootzone pH management combined with a sound nutrient management plan may reduce severity of bermudagrass decline (Waltz, 2003).

Table 2
Turf quality of Tifeagle bermudagrass in October as influenced by none, biweekly dusting, and monthly heavy topdressing[1]

	Topdressing Treatments		
Nitrogen	**None**	**Dusting**	**Heavy**
6	3.1b[2]	3.0b	3.2c
12	3.5b	3.6b	5.0b
24	4.1a	4.4a	6.1a

[1]Plots were rated on a 1-to-9 scale, with 9 as the highest quality. A 5 was considered the minimal accepted quality level for putting greens.

[2]Means within months followed by the same lower-case letter are statistically similar.

DWARF BERMUDAGRASS GROWTH AND DEVELOPMENT IN RESPONSE TO ENVIRONMENT

The optimum temperature for growth of bermudagrass is 80 to 95°F (Beard, 1973) and for *Ggg* the optimum growth temperature in culture is 86°F (Fermanian et al., 2003). Thus, both the bermudagrass and pathogen should grow and develop well at a range of 80 to 90°F. Controlled environment chambers were used to explore the effect of temperature on bermudagrass and *Ggg* and on subsequent disease development.

A single sprig of Tifdwarf bermudagrass was surface sterilized and then grown in a greenhouse for several months to create planting stock for use in the experiment. Sprigs were obtained from the single stock plant and established in individual containers to receive the following treatment combinations. Treatment combinations included inoculated and uninoculated plants, nitrogen treatments of 4, 8, and 12 pounds of N per 1,000 sq. ft., and temperature regimes of 95/80, 80/66, and 66/51°F day/night temperatures. Artificial lighting provided about one-third of full sunlight.

Tifdwarf bermudagrass growth response to temperature regimes of 95/80°F (left) and 80/66°F day/night (right). Plants were grown in growth chambers with 14 hours artificial light at about one-third of full sunlight.

Nitrogen nutrition influenced growth but was not as influential as the temperature regime. The effects of temperature regimes were robust. Internode length was 0.23, 0.51, and 0.83 inch, and leaf length was 0.29, 0.45, and 0.49 inch for the 95/80, 80/66, 66/51°F (day/night) temperature regimes, respectively. While the growth responses exhibited by Tifdwarf in these growth chamber studies were consistent with growth under low light (shade), temperature was a controlling factor in the degree of response. Additional studies were conducted with light levels of about 10, 25, and 50% of full sun within temperature regimes of 95/80 and 80/66°F (day/night). Decreasing light caused increases in leaf and internode length, but the degree of increase was regulated by temperature. The results of this study indicate that temperature as well as light levels regulate expression of dwarfness in Tifdwarf bermudagrass. Although Tifeagle was not a main focus of the growth chamber study, Tifeagle bermudagrass was exposed to the same temperature regimes to determine if growth responses were similar in Tifdwarf and Tifeagle. Similar responses to temperature regimes were observed for Tifdwarf and Tifeagle.

SUMMARY

The results of this study explain why raising the mowing height is often recommended as a cultural practice to reduce bermudagrass decline symptoms. In coastal and other areas affected by long periods of overcast, rainy weather, growth habit of dwarf bermudagrasses may change dramatically in response to low light and lower temperatures. The altered growth form of Tifdwarf that may occur during overcast and rainy weather would not likely tolerate close mowing heights. Thus, mowing stress would result in increased sensitivity to pathogenic organisms such as *Ggg* and may result in more substantial expression of disease symptoms. Weather data from Texas A&M University indicate that the high and intermediate temperature regimes and light levels used in this study can occur in southern climates in late summer and early fall during periods of heavy rain and week-long periods of overcast skies. Evidence of the altered growth form was observed within three to four days of exposure to the moderate temperature regime and light levels used in this study.

In addition to the potential implications that the changes in growth habit in response to environment may have for disease tolerance in dwarf bermudagrass, the effect of temperature on dwarf bermudagrass growth habit has tremendous implications for dwarf bermudagrass golf green management. The effects of temperature on growth habit of dwarf bermudagrass may explain why excessively large amounts of N applied during summer did not cause more robust vertical growth of Tifeagle in the field study described earlier in this text. Temperature should also be a major consideration in the timing and severity of cultivation practices such as core aerification. Healing of surface disruption caused by core aerification and vertical mowing may occur extremely slowly during July and August, periods previously perceived to support maximum bermudagrass growth. During exposure to the high temperatures of July and August, for example, the growth habit of many dwarf bermudagrasses may be extremely compact and not conducive to recovery from injury caused by aerification and vertical mowing. Tolerance to pests and wear also may be less during high-temperature periods. Establishment rates of dwarf bermudagrasses may be dramatically affected by seasonal changes in temperature, with slow establishment occurring at temperatures greater than 90°F. This notable discovery about the effects of temperature on dwarf bermudagass growth and development provides strong rationale for additional research on numerous aspects of bermudagrass culture, establishment, and pest and abiotic stress tolerance.

Effect of monthly solid (front three rows) and hollow-tine (back three rows) aerification, nitrogen at 6, 12, 24 and 6, 12, 24 lb. N per 1,000 sq. ft. (front to back), and heavy, light, and no topdressing (left to right) on the appearance of Tifeagle bermudagrass.

RESEARCH SUMMARY POINTS

- Tifeagle bermudagrass recovery from bermudagrass decline symptoms was enhanced by aerification, heavy topdressing, and aggressive fertilization with ammonium sulfate.
- Low light caused increased leaf and internode length in dwarf bermudagrasses, but temperature regulated expression of the dwarf growth habit.
- The alterations in growth form in Tifdwarf bermudagrass caused by low light and cooler temperatures that often occur during overcast rainy periods justifies raising the mowing height to reduce mowing stress that may contribute to bermudagrass decline severity.
- High temperatures cause a compact growth habit in dwarf bermudagrasses and may slow healing of surface damage caused by cultivation or pests.

REFERENCES

Beard, J. B. 1973. Turfgrass: Science and Culture. Prentice Hall, Inc., Englewood Cliffs, N.J.

Elliott, M. L. 1991. Determination of an etiological agent of bermudagrass decline. Phytopathology 81:1380-1384.

Fermanian, T. W., M. C. Shurtleff, R. Randell, H. T. Wilkinson, and P. L. Nixon. 2003. Controlling Turfgrass Pests. pp. 401-410. Prentice Hall, Upper Saddle River, N.J.

Waltz, Clint. 2003. Fungus Family Provides Fodder for Several Diseases. Turfgrass Trends. http://www.turfgrasstrends.com/turfgrasstrends/article/articleDetail.jsp?id=51998.

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