Light Intensity and Duration Influence Growth of Ultradwarf Bermudagrasses

Life in the shade may be less stressful for some ultradwarf bermudagrasses than for others.

By Grady L. Miller and Jeffry T. Edenfield

Golf course superintendents are often faced with major challenges caused by tree shade on turfgrass, particularly on putting greens. An increase in available sunlight or an increase in leaf area enables the turfgrass to increase carbohydrate synthesis and storage processes critical for withstanding the many stresses inherent to putting green turf.

Therefore, to relieve shade stress, superintendents usually raise mowing heights, or thin or remove trees. However, these remedies are often met with resistance by those who wish to maintain the natural setting, increase speed and maximize playability on the greens .

Ultradwarf bermudagrasses

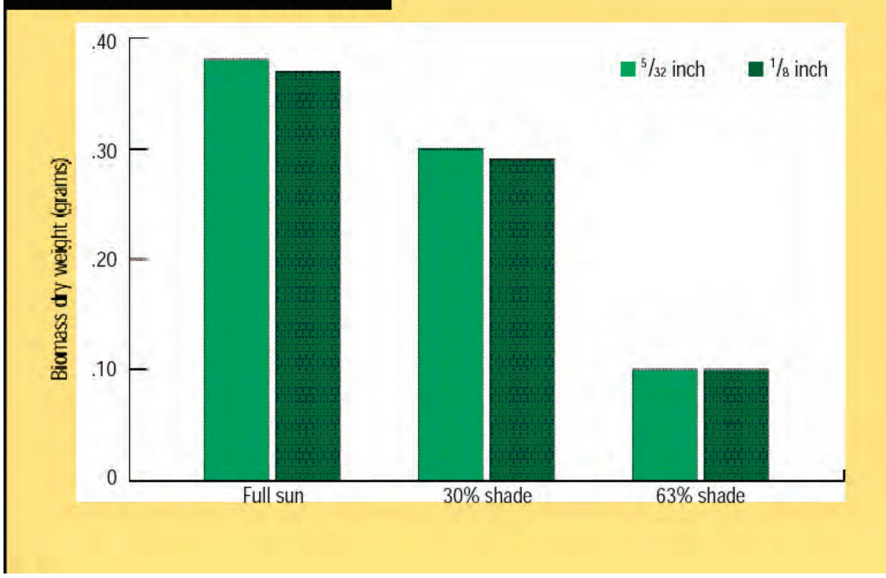
Responding to demand over the past decade for increased speed on putting greens , researchers have developed ultradwarf bermudagrasses, a new generation of bermudagrass cultivars that show improved tolerance of lower mowing heights. The term ultradwarf derives from the morphological characteristics of these cultivars: shortened internodes, reduced leaf size (compared to earlier “dwarf” grasses such as Tifdwarf) and more prostrate leaf habit. Champion, FloraDwarf, TifEagle and Reesegrass are the new hybrid bermudagrasses [Cynodon dactylon (L.) Pers. ´C. trans vaalensis Burtt-Davy] that we chose for testing.

Champion is a dwarf hybrid bermudagrass selected by Morris Brown in Texas in 1987 from a Tifdwarf hybrid bermudagrass golf green planted in the late 1960s. Coastal Turf Inc. of Bay City, Tex. subsequently developed this selection and conducted independent research. In 1995, the Florida Agricultural Experiment Station released FloraDwarf. Thought to be a mutant of Tifgreen, FloraDwarf was discovered on a practice green on the island of Kauai, Hawaii, by turfgrass researcher A.E. Dudeck, Ph.D., in the summer of 1988. TifEagle was cooperatively released by the USDA ARS and the University of Georgia Coastal Plain Experiment Station in August, 1997. It was developed as an induced mutant by cobalt radiation from Tifway II bermudagrass. Reesegrass is a hybrid that was discovered serendipitously on a golf green in New Orleans. This ecotype is the newest member of the ultradwarf family and has shown great potential in early research conducted in Alabama and Florida.

Objectives

This study addresses the dilemma golf course superintendents have when managing putting greens subjected to light stress from excessive tree shade. We evaluated physiological and growth responses of the ultradwarf bermudagrass cultivars to various levels of shade. Knowing the light requirements of these cultivars will allow superintendents to make better decisions about which cultivar to use in potentially shaded conditions. We also evaluated the potential advantages of slight increases in mowing height. It was hypothesized that a slight increase in mowing height would result in an exponential increase in carbohydrate synthesis, potentially facilitating a more stress-resistant turf.

MOWING HEIGHT VS. BIOMASS



Materials and methods

Studies were conducted during 2000 to evaluate physiological and growth parameters of five dwarf-type bermudagrass cultivars, maintained under three-shade regimes and two mowing heights. The cultivars evaluated were Tifdwarf, Champion, FloraDwarf, TifEagle and Reesegrass. The turf was grown in containers using a mixture of 85 percent sand and 15 percent organic-matter rootzone in an effort to comply with USGA putting green recommendations. At least 3⁄10 inch irrigation was applied daily to maintain proper plant turgor for high-quality turf. Nitrogen fertility was applied once a week at 1⁄4-pound nitrogen per 1,000 square feet per week for the duration of the study. The three light regimes were full sun, 63 percent shade and 30 percent shade. Covered structures of black polypropylene cloth were used to produce shade. The small containers were used to facilitate the number and diversity of treatments and allow whole-plant photosynthesis measurements. In the second treatment, the grasses were clipped six times a week at 1⁄8- or 5⁄32-inch with the clippings removed.

We collected data for photosynthetic rates, biomass, visual ratings of percent cover, and determinations of chlorophyll a and b. All measurements were taken three, six, nine and 12 weeks after initiation of the experiment, except chlorophyll determinations, which were taken at 12 weeks after initiation. Photosynthetic measurements were taken at irradiances of 0, 210, 1,540 and 1,950 µmols per square meter per second. From these measurements, we determined additional photosynthetic measurements: dark respiration, net photosynthesis and light compensation points. In dark respiration, the plant is using energy. Net photosynthesis is the balance of what is lost (dark respiration) plus the energy that is being produced. The light compensation point is the least amount of light needed for the plant to sustain life.

Results

Light intensity

Biomass measurements were taken after three days of growth. After collection, clippings were oven-dried to determine dry weights. Chlorophyll a and b analysis was also completed. Previous research had suggested that plants with higher ratios of chlorophyll b:a have greater light-harvesting efficiencies and, therefore, better shade tolerance. Visual ratings evaluated percent turf cover. All dependent variables were statistically analyzed.

As demonstrated by values of net photosynthesis, biomass accumulation, percent turf cover and total chlorophyll, TifEagle and Champion were superior to the other cultivars tested. For example, averages of net photosynthesis in full sun for TifEagle and Champion were 8 percent greater than for FloraDwarf, 15 percent greater than for Tifdwarf and 87 percent greater than for Reesegrass. In 30 percent shade, averages of net photosynthesis for TifEagle and Champion were 11 percent greater than for FloraDwarf, 20 percent greater than for Tifdwarf and 120 percent greater than for Reesegrass. These results indicate that TifEagle and Champion were more efficient at using available sunlight, even at reduced light intensity.

Averages of biomass accumulation of turf grown in full sun for TifEagle and Champion were 27 percent greater than Tifdwarf, 44 percent greater than FloraDwarf and 18 percent greater than Reesegrass. In 30 percent shade, biomass averages for TifEagle and Champion were 63 percent greater than those for Tifdwarf, but were similar to those for FloraDwarf and Reesegrass. For percent turf cover at 63 percent shade, averages for TifEagle and Champion were 28 percent greater than Tifdwarf and 94 percent greater than Reesegrass. These grasses used their enhanced photosynthetic capacity to produce more biomass than the other cultivars. In each shade treatment, TifEagle and Champion also had the highest levels of total chlorophyll, which would increase their capacity to absorb light.

Increased mowing height

Another objective for this study was to determine whether increased mowing height resulted in increased growth. The data suggest few advantages. For example, results for biomass accumulation were similar for the two mowing heights, even though the greatest differences would be expected for that parameter. In addition, few differences were determined in values for percent of turf cover.

Increasing mowing height in the 30-percent-shade treatment did result in a significant increase in percent of turf cover for all the cultivars tested. Increased mowing height was most advantageous in the full-sun and 30-percent-shade treatments as demonstrated by net photosynthetic rates. Increasing mowing heights by 0.04 inch increased net photosynthetic rates by 13 percent for the full-sun treatment and 10 percent for the 30-percent-shade treatment. Although some figures are statistically insignificant, the margin of benefit to the golf-course putting green may be much greater than indicated. The added value may be the ability to thin and/or remove fewer trees, which are important to the aesthetics of the course, while maintaining turf vigor.

The results suggest that TifEagle and Champion displayed physiological and growth characteristics more tolerant of shaded environments and that Reesegrass was least tolerant of shaded environments. In all cases, even slight increases in mowing height somewhat improved turfgrass performance.

Light intensity and duration in FloraDwarf and Tifdwarf

A second series of evaluations used growth chambers to evaluate FloraDwarf and Tifdwarf under varying light intensity and duration. Because of space constraints, only two cultivars could be used for these evaluations. Light treatments incorporated six light regimes, and each photoperiod was based on 12-hour days and 12-hour nights. The maximum available light was 1,540 µmols per square meter per second, denoted as full sun FS). Shade was either 570 µmols per square meter per second, denoted as 63 percent shade, or 1,078 µmols per square meter per second, denoted as 30 percent shade. Light treatments were (1) 12 hours full sun + 0 hours 63 percent shade; (2) 8 hours full sun + 4 hours 63 percent shade; (3) 6 hours full sun + 6 hours 63 percent shade; (4) 4 hours full sun + 8 hours 63 percent shade; 5) 0 hours full sun + 12 hours 30 percent shade; and (6) 0 hours full sun + 12 hours 63 percent shade.

Responses of the two cultivars were not significantly different, supporting earlier data obtained from the glasshouse studies. However, as limited as the evidence is, some results suggest FloraDwarf did respond to shaded conditions better than Tifdwarf. Results suggest that FloraDwarf has a greater ability to assimilate carbon reserves at lower levels of light, indicating greater shade tolerance. A year of weekly observations of a tree-shaded FloraDwarf green at the University of Florida Golf Course in Gainesville also indicated that FloraDwarf could endure 25 weeks at partial shade without a loss in quality. The data suggest that a combination of light intensity and duration affected overall turf quality.

Conclusions

Golf course superintendents are often faced with major challenges caused by tree shade on turfgrasses, particularly on putting greens. These studies looked at the effects of light and shade on turf health. Results indicate that TifEagle and Champion bermudagrasses are capable of sustaining quality better than other dwarf bermudagrass cultivars when grown under reduced-light conditions. FloraDwarf also responded slightly better to shaded conditions than Tifdwarf. None of the tested grasses performed well under dense shade or long periods of shade.

Acknowledgments

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Some Species Tolerate Shade With Proper Management

By L.E. Trenholm

Turfgrass requires a minimum amount of light for growth. Both intensity (brightness) and duration of light are important factors affecting turfgrass growth. In many landscape settings, grass will receive a minimum amount of light during enough of the day for adequate growth, even if the area is shaded for other portions of the day. However, in some situations, a grassed area may be shaded for most or all of the day, making it difficult for the grass to obtain either adequate intensity or duration of light for growth. Under shaded conditions, grasses will have elongated leaf blades and stems as they attempt to obtain sunlight by outgrowing their neighbors.

This tissue elongation depletes carbohydrates, causes shoot tissue to be weakened, and reduces the overall health and vigor of the turfgrass plant. Turf groundcover is also reduced and the bare ground resulting from this is conducive to weed growth. It is not advisable to grow turfgrass under conditions of heavy shade. Other groundcover sources or mulch should be used on these sites. For areas receiving moderate amounts of shade, however, there are certain species and cultivars that are able to maintain suitable growth. There are also specific management practices that will encourage better turfgrass health under shaded conditions.

Species Suitable for Use in Shade

Some species are particularly well-suited for use in shaded areas. Within these species, certain cultivars sometimes maintain considerable advantages when grown in a shaded environment. Included in these species:

St. Augustinegrass: This species is among the best overall for growth in shade, although it will also perform well in full sunlight. St. Augustinegrass cultivars that exhibit best shade tolerance include cultivars Seville and Delmar. Floratam, Floratine, and Floralawn exhibit moderate shade tolerance.

Zoysiagrass: This is another good choice for shaded areas. Like St. Augustinegrass, it will also do well in full sunlight. Generally, any cultivar of zoysiagrass will perform well in shade.

Bahiagrass is not recommended for use in shaded conditions, but **centipedegrass** will tolerate moderate shade.

Seashore paspalum and **bermudagrass** do not do well in shaded conditions.

Management Practices for Growing Turfgrass in the Shade

Because the turfgrass is already suffering from effects of a stress (lack of sufficient light), it is important to follow specific management practices for turf growth in the shade. Included in these practices are the following:

1. Increase the mowing height for grasses growing in the shade. For instance, if you normally cut St. Augustinegrass at a 3-inch height, increase the cutting height to 4 inches. The increased mowing height allows for more leaf area, thus intercepting as much available light as possible. In addition, leaf blades will be longer and narrower in the shade, and a lower cutting height will cause an excessive reduction in leaf length, which is not good for the grass. Higher mowing heights will also promote deeper rooting, which is one of the key mechanisms of stress tolerance for turfgrasses.

2. Reduce fertilizer applications to turf growing in shade. The grass grows more slowly in a shaded environment, which reduces fertility needs. Too much nitrogen fertilizer depletes carbohydrates and produces a weaker turf system. If you normally apply 4 pounds of nitrogen per 1000 square feet yearly, apply 2.5 to 3 pounds to turf growing in the shade. Limit any single fertility application to no more than 1/2 pound of nitrogen per 1000 square feet at any one time.

3. Irrigation. Water usage is reduced under shaded conditions, so irrigate only on an “as-needed” basis. This would be when the leaves begin to roll up lengthwise, take on a blue-gray color, or when impressions from foot or vehicular traffic remain on the grass. If the irrigation system covers an area that is partially shaded and partially in sun, consider removing the sprinkler heads from the shaded areas and irrigating by hand instead.

4. Avoid effects of traffic. The grass will be more easily injured by traffic if growing in shade and may not be able to recover adequately. Also, if trees cause shade, traffic may damage tree roots, resulting in decline or death of the tree.

5. Monitor for weed pressure. Weeds are able to outcompete turf in certain situations, and will seek out those opportunities. In a shaded environment, lateral turfgrass growth and groundcover may be sparse, leaving bare ground suitable for certain weeds. Treatment with a pre- or postemergence herbicide may be necessary. Use caution, however, when applying any chemical treatment to a shaded lawn, as there is a greater chance of phytotoxicity when a grass is under stress. Additionally, many herbicides are potentially damaging to landscape trees and shrubs.

6. Monitor for disease pressure. In many shaded environments, there will be less air movement and more humidity, which may increase the possibility of disease. Again, use caution if applying pesticides to a turf that is already under environmental stress.

Watch for Competition from Trees

Grasses growing under trees are subjected to further stresses in addition to reduced light. These include competition with tree roots for soil space, water, oxygen, and nutrients. Tree roots may extend far from the canopy line, so these competitive effects may occur at some distance from the tree.

Consider Alternatives to Grass

Attempting to grow grass in shaded environments may be time-consuming, frustrating, costly, and damaging to the environment. In areas that receive shade all day or for much of the day, an alternative ground cover or mulch may be the best choice. Consult your County Extension office for information on alternative groundcovers for shaded environments.