with high clay soils and poor surface drainage can cause problems, such as decline due to standing water. All of these problems can be avoided with better construction and renovation building techniques.

Water Quality

Do not neglect water quality. If turfgrass performance is marginal with an older bermudagrass variety, do not expect anything better with the ultradwarfs. Take the time to address water quality.

Overseeding

Like it or not, overseeding competes with and shades a bermudagrass surface. If overseeding is a must, consider using a lighter rate or join the growing number of courses that paint instead of overseed. Also, there are numerous products that can assist early removal of overseeding. Keep in mind that overseeding does contribute to organic matter levels in the upper portion of the rootzone. Extra aeration and topdressing are required.

Take Home Message

Ultradwarfs have the potential to provide the highest quality putting surfaces possible at sites where bermudagrass is the preferred turf species. Hopefully, this article has given the reader some ideas about maintaining the new ultradwarfs. More importantly, we hope the reader will study up on these new varieties and seek as much information as possible before problems arise.

Is Your Turf-Care Facility The Site of an Accident Waiting to Happen?

By Jim Baird

These were the words of the prosecutor in a recent court case in Australia that convicted the Warringah Golf Club and their former superintendent of criminal negligence. A pesticide used on the golf course was discharged from a spray tank onto an uncontained concrete wash pad that drained into a nearby creek. Contamination of the waterway resulted in the deaths of an estimated 10,000 fish and numerous waterfowl.

Could this happen on your golf course? Do you have a dilapidated turf-care facility and pesticide storage and containment areas that do not conform to environmental regulations? According to the legal brief in the these aforementioned case: "The evidence shows that a draft environmental policy and a master plan for the golf course were essentially not acted upon.

Furthermore, the President has given evidence that the board had in recent years focused on other matters in the belief that they had no responsibility in respect of environmental matters and that it was entitled to delegate such responsibilities to management employees."

So ultimately who was responsible? The Club was ordered to pay approximately $600,000 in fines, court fees, and costs of cleanup as well as installation of proper pesticide storage and handling facilities. The superintendent was sentenced to community service, had to pay substantial legal fees, and lost his job.

If your facility needs improvement, now is the time to take the necessary measures to protect our environment and the game of golf. Consult your state or local environmental regulatory agencies for information on standards and specifications regarding the safe storage and handling of chemicals on the golf course.

This regional update and others written by the Green Section staff may be found on the USGA Web site at: www.usga.org/green.

Editor's Note: With recent studies showing high levels of arsenic (regardless of the source) in golf-course soil and groundwater samples, regulators are taking harder looks at golf course operations and record-keeping. Expect more in-depth inspections in the future. Mix/load areas, pesticide storage facilities and wash-down pads are areas that need to be brought up to modern standards of containment and safety. Is your maintenance area an "accident waiting to happen?"

Florida Rosemary - An Endemic Native

By Elizabeth Gilmour

This is an environmental case study submitted as one of the requirements for becoming certified in the Audubon Cooperative Sanctuary Program.

Project description: Give an overview of the project. Why did you choose it? What were conditions like before and after implementing the project?

Unlike most case studies submitted to the Audubon Cooperative Sanctuary Program, this project was significantly based on research, observation, and conservation. The property at Frenchman's Reserve is graced by well over 50 acres of native Florida pine flatwoods, including sand pine scrub and oak-saw palmetto scrub. Intermixed among this treasured ecosystem is an endemic native plant, *Ceratiola ericoides*, also known as Florida rosemary, wild rosemary, and/or sandhill rosemary. The purpose of this project was to educate ourselves, our members, and our residents about this curious plant and to discover the existence of an extraordinary population here at Frenchman's Reserve. Being an endemic plant, we thought it appropriate to learn as much as possible about Florida rosemary in order to maintain its natural population while allowing golfers to enjoy their game.

Before realizing that we had a treasure trove of Florida rosemary in our upland preserve between Holes 1 and 9, golfers were allowed to retrieve their balls without limitation and spray technicians applied herbicides to anything that looked out of the ordinary. The former and the latter had the same result: Florida rosemary seedlings were growing by the inch and dying by the golfer's foot or by RoundUp toxicity.

Frenchman's Reserve no longer allows golfers to enter upland preserve areas along Holes 1 and 9. Additionally the Frenchman's Reserve staff now has been trained to recognize Florida rosemary seedlings and thereby adheres to the "NO SPRAY ZONE" requirements. Rosemary is coming back in full force and seedlings are breaking ground everywhere.

Mature Florida rosemary shrubs had been showing signs of decline. They simply did not look as vivacious as they once had. After much research, it was determined that several irrigation heads must be removed or adjusted in order to ensure the survival of mature groupings. Elimination of overhead irrigation is of utmost importance to the continued existence of Florida rosemary.

Success! Since the project's inception, Florida rosemary is growing like wildfire. Seedlings are no longer being stepped on or sprayed. Likewise, older clumps of the evergreen appear much healthier

Mature stand of Florida Rosemary in the upland preserve area between the first and ninth holes. Photo by Elizabeth Gilmour.

A young Florida or "sandhill" Rosemary plant. Photo by Elizabeth Gilmour.

since most of the overhead irrigation has been eliminated.

Goals: Please list your goals for the project:

- Educate staff, members, and residents about Florida rosemary, i.e. where it can be found, what it looks like, how it grows, etc.
- Enable the survival of Florida rosemary seedlings through proper training, identification, education, and conservation.
- Ensure the survival of mature groupings of Florida rosemary by reducing and/or eliminating overhead irrigation.

Implementation and Maintenance: What specific steps did you take to implement it? What kind of on-going maintenance will it require? Please give sufficient detail so that someone interested in duplicating this project could do so.

The first step in implementing this project was simple - identifying the problem.

After proper identification, research was our main goal. Through observation it was apparent that there were certain areas where Florida rosemary seedlings were being hardest hit. This end result had two root causes. The first was that golfers did not know about Florida rosemary. On top of this, golfers were not being properly informed that retrieving golf balls in preserve areas was not permitted. Thus, proper signage was installed along hole No. 1 and hole No. 9 clearly stating, "Environmentally Sensitive Area - Entering This Area Is Prohibited." In addition, we requested that the golf pro shop staff orally reinforce this rule with all golfers and members.

Secondly, it was observed that while spraying for weeds along preserve perimeters and landscaped beds along the golf course, spray technicians were dousing Florida rosemary seedlings with herbicide. The herbicidal injury was evident. Proper training, education, and identification solved this problem immediately. Frenchman's Reserve spray technicians no longer apply herbicides near any preserve areas.

The golf course maintenance staff then noticed something else that proved to be worrisome. Several mature Florida rosemary groupings that once thrived along the outside perimeter of the preserve were showing noticeable signs of decline. Through our research we determined that the cause was too much irrigation. Florida rosemary typically grows in well-drained, dry, sandy soils. It simply cannot grow in wet areas. We then looked at the design and layout of our irrigation system. After eliminating several heads and limiting the rotation of several others, the plants that had been in decline appear to be recovering nicely.

The only on-going maintenance that will be required is follow-up. We need to continue talking with our members and their guests in order to let them know about rules, signage, and upland preserve areas. We must ensure that our signage is legible, functional, and placed in appropriate, visible areas. We must also perform periodic irrigation maintenance checks to verify that no overhead irrigation is entering the preserve.

Results: Describe the results you achieved. What were the environmental benefits? Please be as specific as possible about any tangible results, e.g., number of acres naturalized, new species observed, increase in habitat acreage, number of birds fledged from nest boxes, number of gallons of water saved, acres taken out of intensive management, increase or decrease in man-hours needed to maintain, increase or decrease in equipment wear and tear.

As previously mentioned our results have been most successful. According to our head golf professional, Craig Voudren, members and their guests frequent the Audubon information table located in the golf pro shop where educational material on Florida rosemary is located. In part due to these educational materials and in part due to the signage placed along preserve areas, we are seeing much less foot traffic in these sensitive areas. Additionally, all herbicidal spraying has ceased. Ultimately our current population of young rosemary is well into the thousands. We are certainly proud of this conservation effort.

We have been able to salvage our mature groupings of Florida rosemary by eliminating or reducing overhead irrigation (and conserving water). Approximately a dozen groups had been showing signs of decline, i.e. leaf drop, little new growth, low seed production, etc. Now, three months after the project's inception, the Florida rosemary bushes appear remarkably healthier. These particular specimens are no longer showing signs of leaf drop, their overall color appears healthier, and they are growing much better.

Golfer/Employee response: How did golfers respond to the project? How did you communicate about your actions?

Most of Frenchman's Reserve members and golfers responded positively to the changes along holes No. 1 and No. 9. Some are concerned about losing their balls and not being able to retrieve them, but generally they understand the rule is in place for the better good of the environment. Since the Florida rosemary educational materials have been placed in a conspicuous area in the golf pro shop, many members have expressed an interest in better understanding Florida's unique ecosystems and the native plants within them. We plan on providing more educational materials in the future.

Our employees have responded just as well, if not better. Proper training and education only improve employee morale. Our employees now have a better understanding of the environment and how precious and fragile the Florida ecosystem really is.

Perspective and Recommendations: What, if anything, would you do differently if you were to do the project again? What would you recommend to others implementing this project?

The only thing we would have done differently would have been to implement this project sooner. Since the golf course is relatively new and young, we firmly believe that we nipped this problem in the bud. Keen observation was the key to saving our population of Florida rosemary.

Economic Costs and Benefits:

Cost to implement this project: $1,678.15
Anticipated or actual financial savings: $3,830.00

TIFSPORT

12 Reasons Why It's the New Certified Bermudagrass Standard For Golf Course Fairways, Roughs and Tees

If you're involved with the installation or day-to-day care and maintenance of golf course fairways, tees, roughs and practice ranges, you'll really appreciate how certified TifSport compares to Tifway and the other popular bermudagrass varieties in use today. Be sure to ask for TifSport by name. It makes a dense, luxurious dark green turf.

Closer Mowing Heights

After three-times-per-week mowings at 1/4", research conducted in Tifton GA shows that TifSport can tolerate closer mowing heights than Tifway and Midiron. Sod density was excellent.

Upright Leaf Blade Orientation

TifSport's leaf blade orientation and stiffness is being touted by many golf course superintendents. They feel Tifsport gives a better ball lie in cut fairways and roughs.

Impressive Leaf Texture

TifSport has a similar leaf texture to Tifway, and a finer leaf texture than most other grasses used on fairways and tees. This also helps promote good footing on athletic fields.

Superior Turf Density

TifSport has a greater density than Tifway-about a 1 point difference on a 10 point scale. And it's about 3 points better than common bermudagrass.

Good Lateral Growth

TifSport is more aggressive than genetically pure Tifway, especially during the cool weather months. This may account for TifSport's rapid grow-in and repair time.

Superior Sod Strength

TifSport has superior sod strength. This translates into improved playing conditions and resistance to divot injury in football, golf and baseball.

Excellent Traffic Tolerance

TifSport's density, sod strength and good lateral growth rate give it a high ranking for traffic tolerance. Athletic field managers and golf course superintendents are reporting outstanding re-growth from normal wear and tear.

Dark Green Color

TifSport has a dark emerald green color versus the somewhat lighter green of Tifway and Quickstand.

Drought Tough

TifSport developer Wayne Hanna has data from a 2-year study showing that TifSport has good drought tolerance. It not only stays green longer but it also recovers faster.

Cold Tolerant

TifSport has expanded the northern limits for warm season bermudagrasses, and has remained very consistent over multiple winters in Oklahoma.

Varietal Purity

In many cases common bermuda is being sold as Tifway 419, but Tifsport's on-going purity is carefully controlled by a rigorous set of rules and guidelines.

Vigorous Root System

This inside view of a typical TifSport plug shows TifSport's impressive root system, stolons and rhizomes.

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Alligators - The Ultimate Lizards

By Craig Weyandt

Alligator is derived from the Spanish word "el lagarto," which means, "the lizard." The Florida alligator's primary habitat is freshwater swamps and marshes, but can also be found in rivers, lakes and smaller bodies of water. They can tolerate a reasonable degree of salinity for short periods of time, being occasionally found in brackish water around mangrove swamps, although they lack the buccal salt-secreting glands present in crocodiles. Little alligators eat small invertebrates such as insects, small fish and frogs. As they grow larger, their dietary range increases to include larger prey, which consist of fish, turtles, small mammals, birds and reptiles including small alligators. When left alone, alligators will stay away from humans and pose little threat. If humans feed alligators, this will encourage the alligators to approach humans aggressively expecting food, which in turn can be extremely dangerous.

So please do not feed the alligators!

After all, for the last 65 million years alligators have done a pretty good job of feeding themselves. Also, alligators do not feed during the cooler months. Studies have shown that alligators generally begin to lose their appetite below 27C (80F), and stop feeding altogether below 23C (73F). They can easily last the winter on their energy reserves.

Cool facts:

- Alligators are really lizards
- Alligators now occupy almost every body of water in Florida
- The sex of an alligator is determined in the egg by the temperature of the nest
- Alligators hibernate during the winter months
- Alligators have between 74 and 80 teeth

Stewardship Notes

Goal for 2004: Bring Every Course Into the Fold

By Shelly Foy

My New Year resolutions have not changed much over the past few years. I would like to spend more time with my children, start exercising regularly, be a better listener, etc. I do feel like I am making some progress each year, but always could do more.

I'm running out of time to spend more time with my children because Hunter and Elizabeth are both seniors in high school and hopefully will be off to college in 2004. Of course, since Thomas is five, we still have many years of T-ball, soccer and school plays. John and I have already determined that there will never be a day when we are alone because once Thomas is ready to go off to college we will more than likely be grandparents.

My 2004 goals for the ACSP are to reach out to each and every golf course in Florida that is not a member of the program and encourage them to join. The FGCSA and the USGA are working together to promote Audubon International's 50 in 5 Initiative, which is to have 50% of golf courses enrolled in the program in five years. Florida is leading this push and we can't afford to slack off now. We are planning a series of ACSP Workshops in Florida in 2004 and we encourage every golf course to make plans to attend one close by.

While you are in San Diego, don't forget to take advantage of the many educational opportunities with the ACSP. Audubon International staff will be available at Booth S7609, directly across from the USGA. A special session titled, "The Business Value of Environmental Stewardship: An Environmental MBA for Superintendents," will be presented from 5-6 p.m. on Wednesday, Feb. 11. Audubon staff also will be teaching two seminars, "Wildlife Management and Habitat Conservation" Tuesday, Feb. 10, all day, and "Integrated Environmental Management" all day Wednesday Feb. 11.

We are planning a series of ACSP Workshops in Florida in 2004 and we encourage every golf course to make plans to attend one close by.

The winter season is a very good time to work on your Education and Outreach for ACSP certification. Over the years we have listed many ideas in the *Florida Green*, and I would encourage you to look through some past issues if you are searching for ways to promote environmental education.

We are always looking for tips and ideas to help you. Here's another very successful one: Craig Weyandt, golf course superintendent the Moorings Club in Vero Beach, has a regular column in the club newsletter that he calls "Wild at Heart." Craig always includes pictures, and he has had members tell him that since he has started writing "Wild at Heart," his article is the first thing they look for in the newsletter. They are so interesting; we will reprint them from time to time for possible use at your club.

I encourage you to make membership in the ACSP one of your New Year resolutions. All the best for a happy and prosperous 2004!

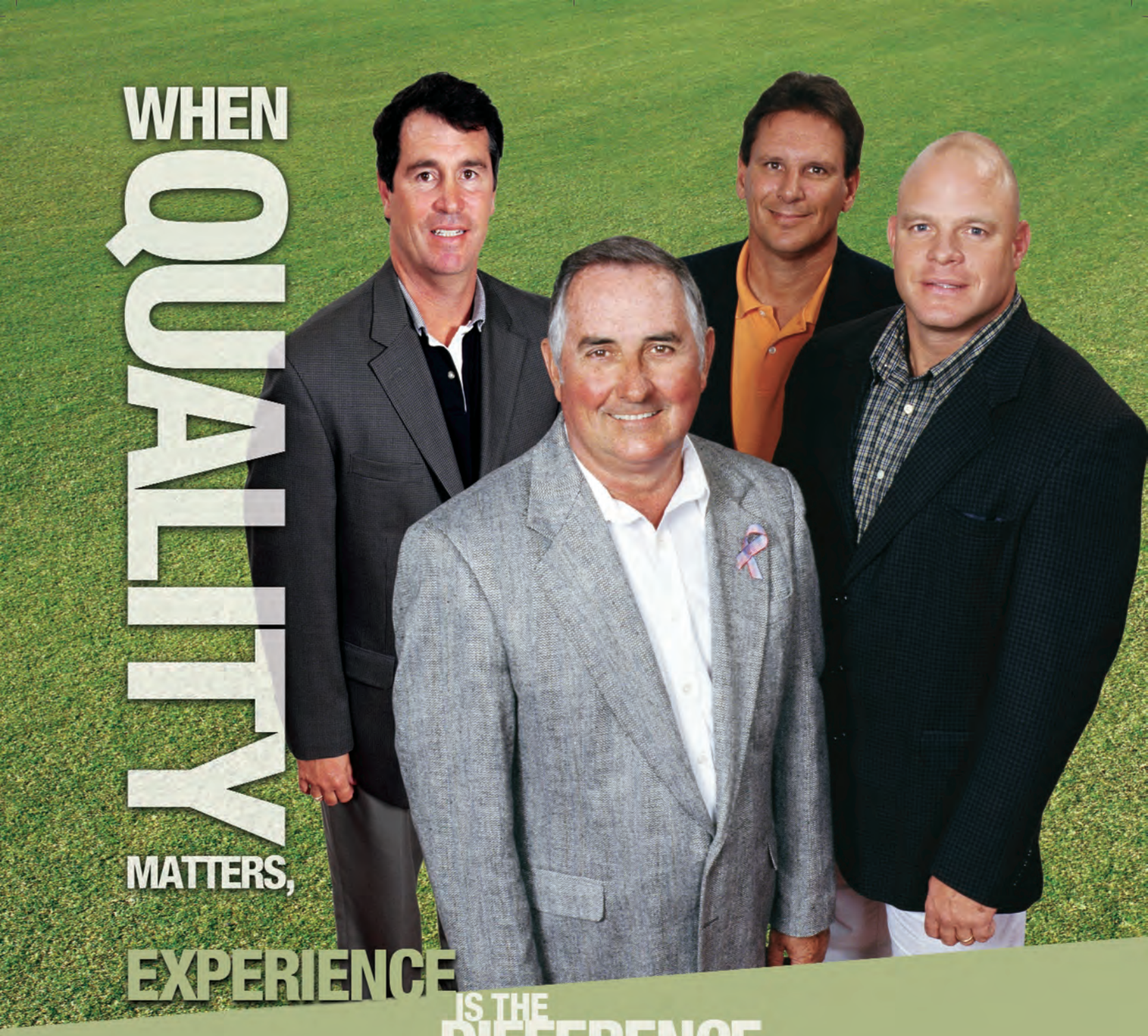
ACSP Year in Review

Florida Courses Joining in 2003

Abacoa GC
Banyan GC
Boca Greens CC
Card Sound GC
Crown Colony G&CC
Fiddlesticks CC
Forest CC
Ft. Lauderdale CC
Ft. Walton Beach GC
Gator Creek GC
Glades CC
Gleneagles CC
Grey Oaks CC
Kelly Plantation GC
LPGA International GC
Longboat Key Club - Harbourside
Longboat Key Club - Islandside
Maple Leaf G&CC
Misty Creek CC
Outdoor Resort GC
Palencia GC
Red Stick GC
Riomar CC
Ritz Carlton GC, Grande Lakes
Ritz Carlton Golf Club & Spa, Jupiter
Seminole GC
Shadow Wood Preserve
Six Lakes CC
Sugar Mill CC
Vasari CC
WCI Renaissance GC

ACSP Certified in 2003

Frenchman's Reserve
Hawk's Nest GC
Long Marsh GC
Pelican Sound GC
Sanctuary GC



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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.

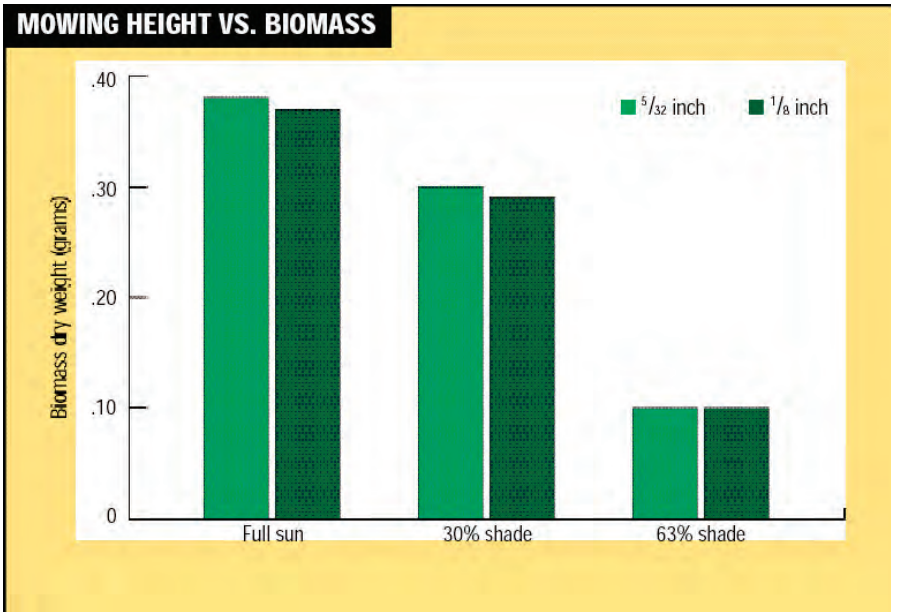
Objectives

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.

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 photosynthestic 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

Acknowledgments

This research was supported by a grant from the Florida Turfgrass Association and Florida GCSA, Seven Rivers Chapter.

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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.

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.