USGA GREEN SECTION
RECORD
A publication on Turfgrass Management January-February 2003

MAKING A CHANGE

The Annual Bluegrass Weevil • Raising the Bar: How High Can You Go?

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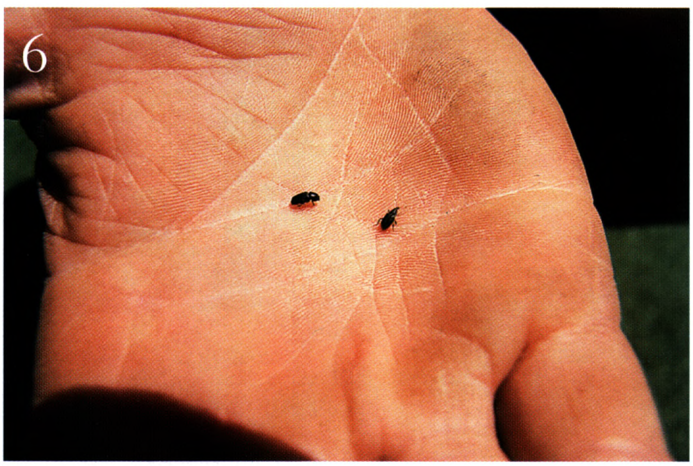
January-February 2003 Volume 41, Number 1



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Cover Photo
Sprigging with the desired new cultivar in the process of regrassing a bermudagrass putting green.

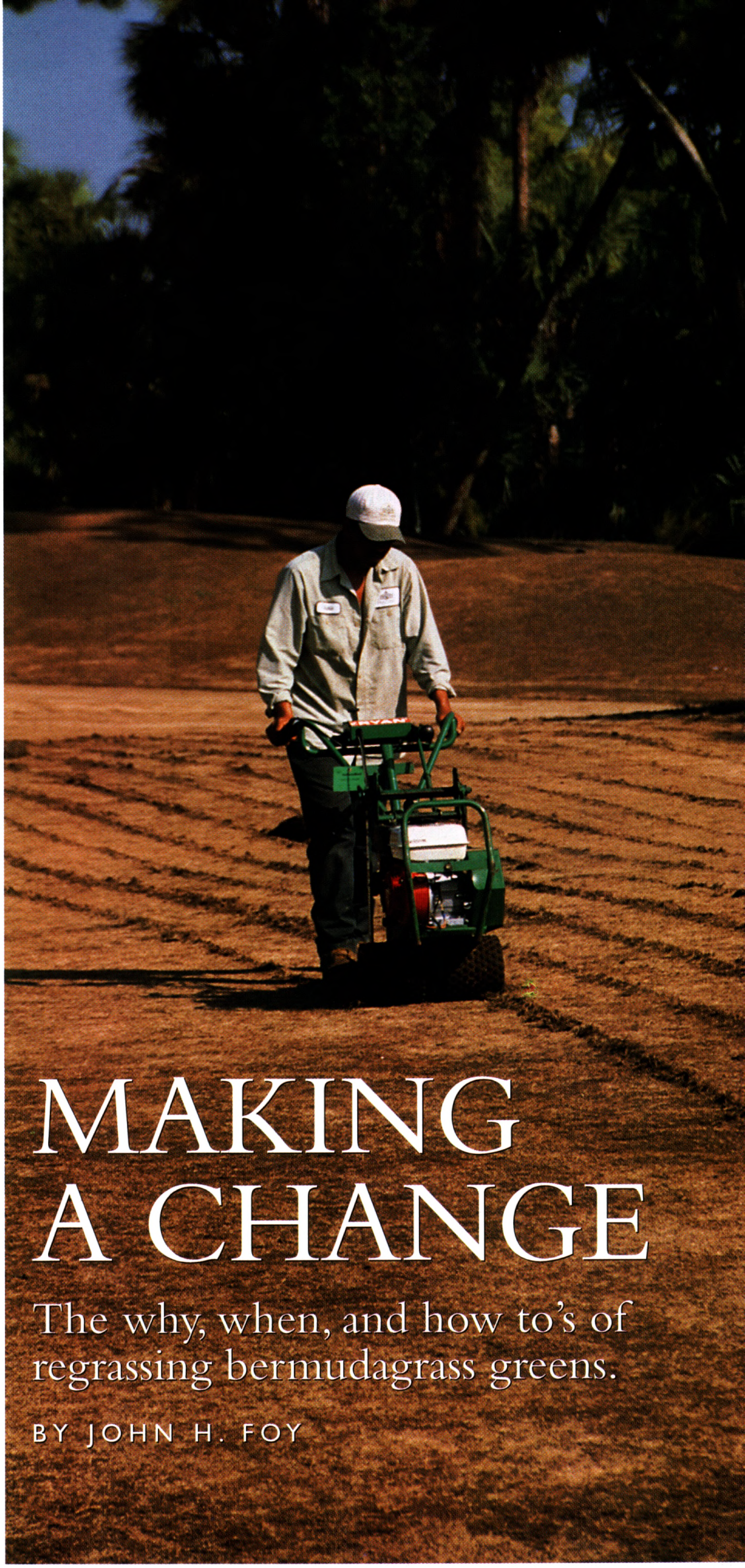
Regrassing/replanting/renovation of putting surfaces is a hot topic of discussion at golf courses anywhere bermudagrass is the base turf. Along with surface contamination problems that impact the type of conditioning that can be provided, the availability of new and better-adapted cultivars is the primary reason this work is being conducted or contemplated. Regrassing putting greens is not a popular proposition because of the disruptions and cost. Yet, this is a capital improvement project that will have to be faced at a number of courses over the next few years. Various aspects of this renovation work will be reviewed in this article, along with guidelines to help in determining when regrassing should be performed.

WHY REGRASS?

Tifgreen, the first improved hybrid bermudagrass cultivar for putting greens, was released in 1956. In 1965, Tifdwarf bermuda was introduced, and for the past 35 years it has set the standard for bermudagrass putting greens. With the management tools and knowledge available today, good quality conditioning for general play can be provided with Tifdwarf greens. Championship putting green conditioning can also be produced and maintained for short periods of time. Golfer expectations and demands, however, are pushing Tifdwarf to its limit.

Although Tifdwarf has long been the standard, new *ultradwarf* cultivars such as Champion, Floradwarf, Mini Verde, and Tif Eagle became available in the late 1990s and are challenging Tifdwarf's dominance. When compared to Tifdwarf, these cultivars have finer leaf texture, increased density, and are able to tolerate lower heights of cut. These characteristics make it possible to provide a smoother, truer ball roll, and fast to very fast putting speeds, if desired. While there's no such thing as a perfect low-maintenance putting green turfgrass, and probably never will be, the ultradwarfs have raised quality standards in hot, humid regions. Many regrassing projects have been inspired solely by the opportunity to convert to one of these new cultivars.

The development of areas or patches of turf that exhibit different morphological characteristics is a phenomenon noted early on with both Tifgreen and Tifdwarf bermudagrass. The cause or source of these "off-type" areas has been studied



MAKING A CHANGE

The why, when, and how to's of regrassing bermudagrass greens.

BY JOHN H. FOY

Removal of existing turf cover is the first step in the strip-and-till portion of the regrassing process.

If encroachment control efforts are not utilized on an annual basis, encroachment quickly gains the upper hand.

and debated, but not totally resolved. There is a general consensus that they are the result of either contaminants in the planting stock or genetic mutations. Within five to seven years after establishment of Tifdwarf putting surfaces, small off-type areas typically begin to appear in the base turf. Initially, this is primarily an aesthetic issue, but over time these off-type areas often develop differences in texture, growth habit, and tolerance of both mechanical and environmental stresses. Selective control of these off-type grasses is not feasible, and with each passing season there is a progression in both the size and number of off-type areas.

During the summer rainy season, particularly in Florida, some of the off-types show susceptibility to environmental stresses such as high temperature, humidity, and reduced sunlight intensity. When an additional stress factor such as a low height of cut or verticutting is added to the equation, the off-types rapidly decline and may take from a few weeks to a couple of months to recover. As the off-type areas increase in size and numbers, adjustments in programs and practices have to be made, and more often than not, management decisions are based on their impact on the off-type areas. As a result, it becomes progressively more difficult to provide consistently acceptable playing surfaces.

Another common surface contamination problem is encroachment of the fairway/rough bermudagrass into the perimeters of the greens. During the summertime, the aggressive growth habit of both the hybrid and common bermudas allows them to encroach into and dominate Tifdwarf. Although these bermudas can survive at putting green height, they cannot be managed to provide a good quality putting surface. The rate of encroachment corresponds to the length of the growing season, and in South Florida can be as much as two feet per year.

At one course where encroachment went unchecked for more than ten years, it was found that a third of the original putting green surface area had been lost. The large reduction in useable area caused a severe decline in both the playing quality and aesthetic characteristics. The head golf professional at this course described the greens as "bland circles that have only front, middle, and back hole locations."

Encroachment control measures such as sub-surface barriers, mechanical edging, or resodding of perimeters do help and are recommended. Yet, if control efforts are not utilized on an annual basis, encroachment quickly gains the upper hand.

As encroachment occurs, mowers typically adjust their mowing pattern inward, resulting in a progressive loss of useable putting surface. Often it is not recognized as a problem for several years, and then it is too late. And, unfortunately, it is not simply a matter of mowing back out to the original perimeter of the green. After severe encroachment has occurred, renovation and replanting are the only effective solution.

WHEN IS REGRASSING NEEDED?

Bermudagrass is a hardy species, and rarely does total putting green failure occur due to off-type and encroachment contamination. With adequate fertilization and irrigation, increased cutting heights, and other management adjustments, it usually is possible to maintain full turf coverage on even a severely contaminated green. For courses that cannot afford renovation or feel it is too disruptive, there is the option of simply lowering their expectations. Slower greens and lack of uniformity may not be too large a price to pay. In today's highly competitive golfing environment, though, most courses find it necessary to provide nothing less than top quality putting greens to attract and keep golfers.

Since environmental conditions play a major role in turf health and green performance, it is difficult to predict accurately when regrassing should be performed. Ideally, regrassing is done before there is a pronounced deterioration in conditioning and quality. Based on experience, when 30% to 40% of the total putting surface area has become contaminated, providing consistent and acceptable conditions becomes a real challenge. This is especially true during periods of adverse weather. When surface contamination exceeds 50%, it is almost impossible to provide a top quality putting surface.

Because of surface contamination problems, many courses regrass their putting surfaces on a 10- to 15-year cycle. At courses where fast to very fast putting speeds are demanded, the cycle can be even shorter. On the other side of the coin, if simply having a green turf cover is acceptable to the majority of golfers, greens can be nursed along for 20 years or more. Annual overseeding can mask contamination and extend the serviceable life of bermudagrass greens if the winter months are the primary focus. Additional spread of surface contamination occurs, however, with

While simply regrassing is the most common process, in some cases total green reconstruction is necessary.

routine changing of hole locations. Also, a point can be reached where consistent and acceptable overseeding results no longer can be produced.

Without question, the ultradwarf bermudagrass cultivars have raised the bar as far as the level of conditioning that can be provided. Along with being used almost exclusively on new courses, the ultradwarfs are the primary choice when older courses choose to regrass. And, the decision to regrass is often based on more than just agronomics. Most golfers (and all golf course superintendents) want very much to have the best greens they can. Like it or not, this promotes a great deal of competition among neighboring courses. As Americans, we tend to look to technology to give us an "edge," whether it is an oversized titanium driver or a new grass.

Whether a course uses one of the latest and greatest ultradwarfs or one of the old standbys, the primary focus and justification for regrassing is usually to reestablish a uniform monostand of turf on the green. Addressing other agronomic problems or limiting situations is advisable for achieving truly successful results over the short and long term. For a further and more detailed review of the various factors that affect putting green performance, refer to the article "Helping Your Greens Make the Grade" (*Green Section Record*, March/April 1998, and on the USGA website at www.usga.org/green). If a sound foundation is not present, regrassing putting surfaces is analogous to putting new carpet over a rotted sub-floor.

REGRASSING VERSUS REBUILDING: WHAT IS THE BEST OPTION?

Until the mid-1980s, fill soil generated from lake excavation was used to construct "push-up" greens at most courses in Florida. Often this fill soil was primarily sand, and given the hardy nature of Tifgreen and Tifdwarf bermudagrass, it was possible to maintain turf coverage and acceptable conditioning. With escalating demands and expectations, however, heights of cut have been pushed lower and lower. It was not so long ago that the standard height of cut was 0.186 inches. Only for tournaments or special events was the height brought down to 0.155 inches, and then for just a few days. Today, the standard is about 0.125 inches, and at some courses with ultradwarf greens, a height of cut of 0.100 inches or less is being maintained for extended periods of time. Although these new cultivars can tolerate extremely low cutting heights, close mowing still exerts significant stress on the turf and weakens the root system. To ensure that healthy turf can be produced over the long term, it is very important that rootzone physical characteristics not be a limiting factor.

When visiting courses that are considering renovation and currently have old push-up greens, the Green Section agronomist's first suggestion usually is to completely rebuild them in accordance to the USGA's guidelines. Yet, it is understood that this may not be an option or absolutely necessary in all cases. Based on experience, the basic criteria for having good bermudagrass performance over the long term are a homogenous high-sand-content rootzone mix and adequate or unrestricted subsurface drainage. At courses where drainage is not a problem, complete reconstruction of push-up greens may not be absolutely necessary. A regrassing process known as the "strip-and-till" method has been utilized successfully and is an option for both push-up greens and those built in accordance with USGA recommendations.

Following are the basic steps in a strip-and-till regrassing process:

- Remove the existing turf cover by cutting it as deeply as possible with sod cutters and then removing it by hand or scraping it off with a small front end loader.

• On older greens, excavate and remove an additional 2-4 inches of rootzone material to eliminate excessive thatch and organic matter.
• Add a layer of sand or rootzone mix approximately equal in depth to the amount of material removed into the green wells. Laboratory testing should be conducted to determine the best suited materials for installation.

A common problem with bermudagrass greens is the development of *off-type* surface contamination. Once 30% to 40% contamination exists, providing consistent and acceptable conditioning can be a major challenge. Regrassing is the only solution.

• Use a heavy-duty tractor-mounted rototiller to thoroughly incorporate the added materials as deeply as possible into the underlying rootzone. Rototill the entire surface multiple times in various directions at a slow ground speed and with a high operation RPM to mix the materials as uniformly as possible.
• The new rootzone mix is compacted and roughly shaped, making sure to provide surface drainage and adequate hole locations.
• Fumigation of the rootzone mix is strongly recommended when regrassing bermudagrass greens, killing any of the old bermuda that may be present and eliminating soil-borne pest organisms such as nematodes and diseases.
• After re-compacting the rootzone mix and final shaping, sprig with the desired bermudagrass cultivar to establish the new turf cover.

As with construction of new putting greens, laboratory testing of materials is an extremely important step with a regrassing project. Core samples of existing greens should be submitted to an accredited physical soil testing laboratory for complete evaluation. Assessment of physical and performance characteristics is needed to determine the best suited sand and/or amendments to incorporate into the existing profiles. The goal is to create a homogenous rootzone mix with characteristics (porosity, particle size range, moisture retention, and saturated hydraulic conductivity) that meet USGA guidelines.

When evaluating rootzone characteristics, care must be taken not to overemphasize the saturated hydraulic conductivity value (also referred to as SHC, infiltration rate, perc rate, and Ksat). The current USGA green construction recommendations detail two ranges of Ksat. The "normal" range is 6 to 12 inches per hour. The "accelerated" range is 12 to 24 inches per hour. Generally it is recommended that rootzones with Ksat values in the accelerated range be used in situations where irrigation water quality is poor or cool-season turfgrasses are being grown out of their range of adaptation. The accelerated range is often recommended in areas with high annual rainfalls. Yet, when rootzones have perc rates of 16 inches or more per hour, the greens are more difficult to manage and often require a much longer period of time to achieve full maturity. Until some natural organic matter accumulation occurs, high infiltration-rate greens are often droughty and require more frequent fertilization. This is a case where faster is not always better.

Since bermudagrass is a warm-season species, warm daytime and nighttime temperatures are desired for maximum growth and establishment. Thus, the ideal time for planting and grow-in of bermudagrass putting surfaces is June to July. When unavoidable weather delays make it impossible to complete the planting process until August or even September, there is a risk of missing the re-opening date and experiencing damage during the winter months. Also, since late summer is the peak of the hurricane season in Florida and the Gulf Coast area, it is desirable to have renovation projects completed as early as possible. A good construction contractor usually can take care of the soil work portion of a regrassing job in four to eight weeks. Thus, to plant the greens in early to mid-summer, regrassing projects should begin in April or in early May at the very latest.

OTHER CONSIDERATIONS AND EXPECTATIONS

Use of one of the new ultradwarf cultivars is one of the big reasons for a surge in regrassing projects with bermudagrass greens. As expected, it has been necessary to go through a learning curve with regard to determining the best or optimum management programs. Although the ultradwarfs are bermudagrasses, some adjustments in programs and practices are necessary relative to what is routinely performed with Tifdwarf greens. At facilities where premium quality conditioning and fast to very fast putting speeds are expected, ultradwarf greens are the best option. If the necessary equipment, budget, and time are limited or not available, though, difficulties can be experienced in maintaining a healthy turf cover and reaching the full potential of these new cultivars. While Tifdwarf is gradually being replaced as the standard for bermuda greens, it still has a place and is a viable option.

Test plots for the On-Site Evaluation of Bermudagrass for Putting Greens program were established in 1998 at eight golf courses across the southern portion of the U.S. This program was sponsored by the National Turfgrass Evaluation Program (NTEP), the United States Golf Association (USGA), and the Golf Course Superintendents Association of America (GCSAA) to help provide information and guidance in turf selection. Thus far none of the new ultradwarf cultivars has been found to be significantly superior to the others, though slight regional and time-of-year differences have been noted. Surveying other courses in the area and evaluating a couple of cultivars under site-specific conditions is recommended to assist in determining the best cultivar for use in a regrassing project.

The ultradwarf cultivars can tolerate and actually need to be maintained at lower heights of cut compared to Tifdwarf. However, cutting height alone cannot provide the dramatic increases in putting speeds possible with the ultradwarfs. The greatly increased shoot density of the ultradwarfs (compared to Tifdwarf) provides a smoother and truer ball roll, but this same density results in increased resistance to ball roll. Thus, to produce fast putting speeds, practices such as double cutting and/or rolling of the greens must also be employed.

The lower heights of cut do require that additional care be exercised with surface slopes or contours. Sharp contours or ridge lines are easily scalped or gouged by the mowers when a height of cut is 0.125 inches or less. Also, when fast putting speeds are maintained, surface slopes in excess of 3% result in reduced useable hole location area and more penal play characteristics. According to Tom Marzolf, Senior Design Associate with Fazio Golf Course Designers, it is now their policy to have hole location areas with slopes ranging from 0.5% to a maximum of 2.5% when speeds of 9.5 feet or faster will be maintained.

Finally, full turf coverage and smooth surface conditions can be developed fairly quickly following regrassing of bermuda greens. With Tifdwarf, 90 to 120 days typically is required to complete the grow-in and develop an acceptable playing surface. With the ultradwarfs, higher sprigging rates in the range of 35 bushels per 1,000 sq. ft. can be used, and full turf coverage can be established in as little as 60 to 80 days. Greens then can be reopened to play, but additional time must be allowed to develop a fully mature surface. Along with smoothing surface imperfections, a primary aspect of the maturing process is development of a slight amount of organic matter or "pad" in the upper rootzone. This helps provide some nutrient and moisture retention and is needed for surface resiliency. A common complaint with both renovated and new greens is that they are hard and don't hold well-played approach shots. With bermudgrass greens, one to two full growing seasons typically is required to develop a mature condition. A proactive education program for golfers on what can be expected following regrassing is advisable to help minimize complaints.

While the surface may appear to be clean, viable bermudagrass and pests such as nematodes can survive the regrassing process. Therefore, soil sterilization is strongly recommended.

As with all other assets, periodic renovation or upgrading of golf courses is a necessary proposition. Regrassing bermudagrass greens falls into this category and is likened to replacing a roof or a carpet in a house. An understanding of why and how regrassing is being undertaken can help ease the pain.

JOHN FOY *is director of the Green Section's Florida Region, where he stays busy with all of the golf courses looking to "make a change."*

The Annual Bluegrass Weevil

A little weevil causing big problems in the Northeast.

BY NIKKI ROTHWELL and DR. PATRICIA J. VITTUM

Listronotus maculicollis (Dietz), annual bluegrass weevil (ABW), is a pest of highly maintained turfgrass in the northeastern United States. The earliest report of this insect damaging golf course turf appeared in Connecticut in 1931. The insect then spread to Long Island and Westchester County, N.Y., where it has thrived for the past 70 years. However, recently, damage from this pest has been observed in many other states in the region: Massachusetts, New Hampshire, Maine, Vermont, northern New Jersey, and western and central Pennsylvania. ABW has also been reported in Montreal and areas surrounding Toronto, Canada.

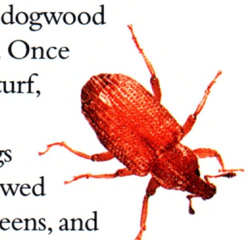
BIOLOGY

Adult ABW are small, compact beetles, approximately 3-4mm long (half the size of Kentucky bluegrass billbug) and with the characteristic weevil snout. Most adults are black, but when adults emerge from the pupal stage, they appear reddish in color and are called callow adults. As their outer shell (exoskeleton) hardens, the weevil takes on a speckled grayish color. This spotted appearance is due to patches of scales on the wing covers (elytra). As the weevil matures, the scales are sloughed away, leaving the adult weevil clothed in its predominate black coloration.

Eggs of the ABW are small (<1mm) and oblong. When eggs are first laid, they are whitish in color, but after a few days the eggs take on a smoky gray appearance. The eggs are located between the leaf sheaths of the grass plant. Typical of weevils, larvae of the ABW are legless. They are white, stout larvae with a dark brown head capsule. Older larvae take on a slightly curved form, but they do not appear as C-shaped as the typical turf-damaging white grub. Pupae resemble adult weevils with the snout, legs, and wings clearly recognizable, but they remain a creamy white color for most of the stage. As the pupae approach emergence, many body parts darken until they surface as callow adults.

SEASONAL PATTERNS

Adult weevils over-winter in areas adjacent to golf course turf. In the early spring, weevils emerge from over-wintering habitats and move onto the turf to feed. Adults begin migrating during *Forsythia* full bloom, and most weevils are on the golf course by the time flowering dogwood is in full bloom. Once on golf course turf, female weevils begin to lay eggs in the short mowed regions (tees, greens, and fairways). The eggs hatch within a week, and the larvae feed on the grass for two months before they enter the pupal stage in mid- to late June. Adults emerge in late June to early July to repeat the life cycle. The second generation larvae ABW complete their cycles at increased speed, and callow adults will be present on the golf course during mid-August. There has also been evidence of a third generation occurring in the southernmost areas of New York in recent summers. However, development of individuals is not closely synchronized, so a turf manager can find all stages of ABW on the golf course on any given date from late June through early September.



FEEDING INJURY

Most damage is caused by the larval stage of the ABW. Adult females emerge from over-wintering sites and move onto golf course turf, where they lay eggs in short mowed (0.6-2.0cm) grass. Females chew holes in the outer sheaths of the grass blade and insert the eggs between sheaths of the plants of fairways, greens, tees, and collars. Eggs hatch, and first instar larvae feed within the grass stem, but eventually older instars move from within the plant and progress down to the crown of the plant, where they cause the most severe damage. Fifth-instar larvae (the largest stage) cause significant damage that appears as large dead areas of turf on the golf course. Often the damage first appears in collars or the perimeter of greens, tees, and fairways. Cameron (1970) estimated that one larva could kill approximately 20 stems of grass during its development. Adults are known to feed on the grass blades and weaken the grass, but adult feeding causes no severe damage.

The fifth instar larvae are the biggest threat to golf course turf, but smaller instars often go unnoticed in the late spring. Damaged areas first appear as small yellow to brown marks on manicured turfgrass. The chlorotic plants are easily dislodged from the soil. Ulimately, these small areas coalesce to form large regions of dying grass. Eventually, high populations result in substantial areas of dead turf. Since ABW damage overlaps with anthracnose infection periods and symptoms closely resemble those of anthracnose, weevil damage can easily be misdiagnosed as disease. Although many golf course superintendents have observed ABW larvae to feed primarily on *Poa annua*, annual bluegrass, we have detected considerable larval damage on many varieties of creeping bentgrass. Field experiments also have demonstrated ABW larvae to be present in equal numbers in annual bluegrass and bentgrass plots.

MANAGEMENT

Annual bluegrass weevil larvae can be detected easily by cutting a wedge of turf with a knife and searching the turf/thatch interface for the creamy colored larvae. Cup-cutter plugs also can be removed from potentially infested areas; by gently pulling the plug apart, larvae can be distinguished against the dark colored soil. For first generation larvae, the threshold for damage is between 30 and 80 weevils per square foot, while summer thresholds are generally lower. Heat- and drought-stressed turf in July and August can only tolerate 20-40 weevils per square foot.

Adult monitoring can be performed with a soapy flush. Combine 1 to 2 tablespoons of a lemon-scented dish detergent with 2 gallons of water and pour over a 2- to 4-foot area. The soap irritates adult weevils lying deep in the turf layer, and they rise to the surface within five minutes. Adult weevils can be counted as they ascend. However, adult numbers are not directly correlated with resultant larval populations; the adult monitoring technique is designed to alert the superintendent if weevils are indeed present on the golf course.

Control of ABW populations most often has involved traditional insecticide applications. Applications targeted at emerging adult populations have yielded the most consistent control for golf course superintendents. The chemical treatment should target adults after they emerge from over-wintering, but before the females lay their eggs. Phenological indicators provide a reliable target date for spring application; sprays applied between *Forsythia* full bloom and dogwood (*Cornus florida*) full bloom, around the middle of April through early May, have provided significant control of ABW populations consistently.

Annual bluegrass weevil larva damage on annual bluegrass is often first noticed around the collar and perimeter of the greens. Damage is usually most severe in these areas.

When pursuing adult weevils, chemical treatments should be watered in lightly. Since larval populations were once thought to be concentrated on edges of fairways and greens, perimeter sprays were believed to provide adequate control. However, recent data from our laboratory have shown ABW larvae to be equally present across the entire width of the fairway, so perimeter applications may not ensure a larvae-free fairway. Because ABW development exhibits extreme overlaps in weevil life stage in July and August, we have a more difficult time predicting timing for control of second generation adult emergence. However, the general rule of thumb for treatment for second generation adult weevils in the metropolitan New York area is July 4th. We are working on a degree-day model that should help refine this date.

The most effective and economical method of control for ABW is to scout for adult weevils early in the season (April to early May) to verify their presence. Knowledge of the history of ABW infestations on the golf course also is valuable information; if adults indeed are present, a chemical application can be made to infested areas. Spot treating is also successful in controlling damaging ABW populations. Most often, ABW damage is correlated with other turf stresses such as water, fertility, and mowing. Healthy turf can be the best defense against ABW damage.

THE FUTURE OF ABW

The potential for ABW to spread to the midwestern regions of the U.S. is likely, but infestations are not expected in the near future. ABW have remained in the northeastern states for more than 75 years with little spread even from the Westchester County and southern Connecticut epicenters. However, because climate and varieties of grass are similar between midwestern and northeastern golf courses, there is potential for ABW migration west.

Currently, we are investigating potential stress factors that may affect ABW larvae and their damage. We are exploring the possible effects of mowing height and fertilization on the location of ABW larvae, and we are examining the numbers of larvae found in five commonly planted golf course grasses. In addition, we have measured turf quality for the different grass types as well as the turf response to mowing height and fertilization and their relationships with ABW infestation. Results from our field data will be available in the next year.

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Bentgrasses and Bermudagrasses for Today's Putting Greens

On-site testing yields important performance data.

BY KEVIN MORRIS

As the popularity of golf continues to increase worldwide, golf course owners, managers, and superintendents are asking for grasses that produce superior quality and fast putting surfaces, especially during periods of intense use. And with environmental concerns at an all-time high, new grasses need to produce this high quality with less water, fertilizer, and pesticides. This is a daunting challenge for plant breeders, with more than 17,000 U.S. golf courses located in highly varied climatic zones and receiving different levels of management expertise and available resources.

Improvement of grasses for use on putting greens is an ongoing process. Plant breeders are constantly searching for that "perfect" cultivar that encompasses dark green color, fine leaf texture, high density, and excellent disease, insect, drought, heat, and cold resistance. New cultivars also need to have high traffic tolerance, quick establishment, and good seed or vegetative production to keep them affordable. Although no single cultivar has been developed that has all of these desired qualities, consumers look to purchase those cultivars that contain what they consider the most desirable traits for their areas.

The on-site cultivar trials were established on participating golf courses where golfers could practice putting, chipping, and pitching. It was decided that cultivars exposed to golf course traffic stresses would produce the most applicable information.

EARLY ON

As golf gained popularity in the U.S. in the early 1900s, the grasses available for putting greens were very limited. Many greens consisted of closely mowed grasses that already existed in pastures or other grassy areas, or they consisted of South German bentgrass (*Agrostis* spp.) mixtures or locally adapted bermudagrass (*Cynodon* spp.) strains. Improved cultivars of vegetatively propagated creeping bentgrass (*Agrostis stolonifera L.*) such as Arlington, Cohansey, Toronto, and Congressional were selected and released in the 1930s and 1940s (2,4).

Penncross creeping bentgrass, released in 1954, quickly became popular for putting greens because its quality matched or exceeded the existing vegetatively propagated cultivars, yet it was seed propagated, which significantly reduced establishment costs (1). These traits made Penncross the most popular putting green cultivar in the U.S. for more than 30 years.

For putting greens in the warmer, southern U.S., Tifgreen bermudagrass was released in 1956 and produced superior quality compared to other bermudagrass cultivars (1). In 1965, Tifdwarf bermudagrass, a dwarf mutant selection from Tifgreen, was released (1). Tifdwarf produced better quality at lower mowing heights than Tifgreen and quickly became the standard cultivar for putting surfaces in tropical, subtropical, and low desert areas.

As faster, higher quality putting surfaces were demanded in the late 1970s, cutting heights continued to be lowered on putting greens. This led to a gradual reduction of heights of cut to where the majority of U.S. courses had settled on ⅛" to 5⁄32" as their preferred greens height. At these cutting heights, however, the standard cultivars Penncross, Tifgreen, and Tifdwarf began to exhibit more disease, heat, drought, and scalping. The need was increasing for improved cultivars with better disease, heat, and drought resistance, as well as the ability to produce high quality putting at the new, lower cutting heights.

Along with this need for improved putting green cultivars came the need to test these cultivars on a national scale. The National Turfgrass Evaluation Program (NTEP) initiated its first national trials of bentgrass for putting greens in 1989. Data from 29 university locations averaged over four years beginning in 1990 showed that only two entries, Providence and PRO/CUP, out of a total of 22, performed statistically better than Penncross (5,6). However, in a subsequent national bentgrass putting green trial initiated in 1993 at 27 university locations, 21 entries performed statistically better than Penncross in data averaged over four years and all locations (7).

BACK TO THE FUTURE

As many new cultivars and experimental selections were developed in the mid-to-late 1990s, the need was increasing for a new bentgrass trial. At about the same time, several improved ultradwarf bermudagrass cultivars were being developed for southern golf courses to address the same problem of high putting quality at low mowing heights. These new ultradwarfs also needed to be compared in national performance trials.

However, many golf course superintendents and some researchers questioned the usefulness of NTEP data collected at universities that may not be managed as intensively as actual, in-play putting greens. To address this issue, NTEP, the United States Golf Association Green Section (USGA), and the Golf Course Superintendents Association of America (GCSAA) agreed in 1997 to jointly fund and cooperate in an on-site testing program. Instead of comparing newly released cultivars at university field stations, bentgrasses and bermudagrasses intended for putting green use were to be planted on participating golf courses, much as they were in the 1920s and 1930s. This was to ensure that the trials would receive the level of maintenance commonly practiced on high-level golf courses and face the traffic stresses from golfers.

With significant funding from the USGA, new putting greens were built on 16 golf courses across the United States according to USGA recommended construction methods (Table 1). These greens were intended to be used as practice putting, chipping, or target greens, and thus receive the same real-life stresses that golf course turfs must endure.

Eighteen creeping bentgrass cultivars were seeded at eight sites in fall 1997 or spring 1998. Seven bermudagrass cultivars were established at three sites in the summer of 1998. Five of the sites established both bentgrass and bermudagrass on-site trials. A cooperating university turfgrass scientist was assigned to each trial site for the establishment and data collection of each trial (Table 1).

ON-SITE CREEPING BENTGRASS TRIAL

The on-site trials were limited to commercially available cultivars or those selections close to commercialization. Seventeen creeping bentgrasses were

Table 1

Test locations used in evaluating creeping bentgrass and bermudagrass cultivars in NTEP's on-site testing program.

Golf Course	Location	Superintendent	Research Cooperator
Bentgrass only			
Crystal Springs Golf Course	Burlingame, CA	Ray Davies	Dr. Ali Harivandi, California Cooperative Extension
Fox Hollow at Lakewood	Lakewood, CO	Bruce Nelson	Dr. Tony Koski, Colorado State University
Lassing Pointe Golf Course	Florence, KY	Jerry Coldiron	Dr. A. J. Powell, University of Kentucky
North Shore Country Club	Glenview, IL	Dan Dinelli	Dr. Tom Voigt, University of Illinois
Purdue Univ. Kampen Course	West Lafayette, IN	Jim Scott	Dr. Zac Reicher, Purdue University
TPC at Snoqualmie Ridge	Snoqualmie, WA	Tom Wolff	Dr. Gwen Stahnke, Washington State University
Westchester Country Club	Rye, NY	Joe Alonzi	Dr. James Murphy, Rutgers University
Westwood Golf Course	Vienna, VA	Walter Montross	Dr. David Chalmers, Virginia Tech University
Bentgrass and Bermudagrass			
Bent Tree Country Club	Dallas, TX	Keith Ihms	Dr. Milt Engelke, Texas A&M University
C.C. of Birmingham	Birmingham, AL	Lee McLemore	Dr. Elizabeth Guertal, Auburn University
C.C. of Green Valley	Green Valley, AZ	Mike Bates	Dr. David Kopec, University of Arizona
The Missouri Bluffs	St. Charles, MO	Alan Zelko	Dr. Barb Corwin, University of Missouri
SCGA Members Club	Murrieta, CA	John Martinez	Dr. Robert Green, University of California-Riverside
Bermudagrass only			
Country Club of Mobile	Mobile, AL	Ron Wright	Dr. Bryan Unruh, University of Florida
Jupiter Island Club	Hobe Sound, FL	Rob Kloska	Dr. John Cisar, University of Florida
Lakeside Country Club	Houston, TX	Mike Sandburg	Dr. Richard White, Texas A&M University

Table 2
Mean turfgrass quality, genetic color, and density ratings of creeping bentgrass cultivars grown on golf course practice greens.[1,2]

Entry	Turf Quality	Genetic Color	Spring Density	Summer Density	Fall Density
BACKSPIN	6.6	5.9	7.6	7.3	7.5
CATO	6.2	6.6	6.9	6.9	7.0
CENTURY	6.8	5.8	7.8	7.7	7.9
CRENSHAW	6.4	6.9	7.2	6.9	7.0
GRAND PRIX	6.7	6.0	7.4	7.6	7.5
IMPERIAL	6.7	6.1	7.8	7.7	7.3
L-93	6.8	6.9	7.5	7.2	7.5
PENN A-1	7.1	6.6	8.0	7.8	7.7
PENN A-4	7.3	6.8	8.4	8.2	8.1
PENNCROSS	5.3	5.4	5.9	5.6	5.4
PENN G-1	6.9	6.7	7.8	7.8	7.7
PENN G-6	6.7	6.6	7.6	7.5	7.5
PROVIDENCE	6.3	6.5	7.0	6.4	6.7
PUTTER	5.9	5.9	6.0	6.2	6.3
SR1020	6.4	6.3	7.1	6.9	7.0
SR1119	6.6	7.0	7.6	7.3	7.1
TRUELINE	6.1	6.4	6.8	6.7	6.5
VIPER	6.1	6.9	6.8	6.6	6.8
LSD[3]	0.1	0.2	0.4	0.4	0.4

[1]On-site Bentgrass Test, data collected from 1998 to 2001 at 13 sites.
[2]Rating scale used is 1-9; 9 = ideal turf, dark green color, maximum density.
[3]LSD (Least Significant Difference) statistic at the 5% (0.05) confidence level rating. Cultivar means must be more than this value apart to be deemed statistically significant.

entered by sponsoring companies, with one standard entry, Penncross, being included by NTEP. Entries were seeded in 50 sq. ft. plots and replicated three times. Seeding rate was 25 grams per plot or 1.1 lbs. per 1,000 sq. ft.

Pre-plant soil preparation and post-plant care varied from site to site but followed generally accepted practices of fertilization, pH adjustment, irrigation, and mowing. These greens were used for practice by golfers. Since cutting, moving, and replacing cups would compromise the integrity of plots, target flags were used instead of cutting actual cups.

Monthly turfgrass quality ratings were collected. Quality ratings include all the factors that are important to turfgrass managers, including color, density, texture, uniformity, disease or insect damage, drought, and heat and cold injury. Other required data included genetic color, spring green-up, leaf texture, and putting speed as measured by a modified Stimpmeter (3). Other information, such as disease and insect damage, winter injury, percent living ground cover, frost tolerance, and thatch accumulation was recorded if the cooperator found it reasonable and feasible to collect.

ON-SITE BERMUDAGRASS TEST

This trial was established at eight locations (Table 1) in spring and summer of 1998. All entries were vegetatively propagated cultivars. Planting rate was 24 3 in. × 3 in. plugs (live plant material and soil) of each entry per plot. Each plug was broken into many small pieces (sprigs) and hand planted. Plots were then rolled and irrigated carefully so that sprigs were not washed from their planting site. Some sites also used a lightweight planting cover to protect the sprigs from erosion.

Five new cultivars were submitted for inclusion in the trial, and Tifgreen and Tifdwarf were included as comparative standards. As with the bentgrass trial, each green was used for practice by golfers. Maintenance was performed by the golf course superintendent in a manner similar to the other greens on the course or other bermudagrass greens in the area. Data collection methods and Stimpmeter measurements were identical to those used in the bentgrass trial.

CREEPING BENTGRASS PERFORMANCE

After four years of data collection, Penn A-4 has been the outstanding entry in this trial. Turfgrass quality ratings (see Table 2) averaged over the four years and 13 sites show Penn A-4 alone in the top statistical grouping (mean turf quality = 7.3, LSD = 0.1), followed by Penn A-1 (7.1) and Penn G-1 (6.9). Surprisingly, Century, a cultivar that has turf quality ratings in the middle statistical grouping of the 1998 Official Bentgrass Test, is next with a turf quality rating of 6.8, making it statistically equal to Penn G-1 and L-93 (turf quality rating = 6.8). This may have been due to Century's susceptibility to dollar spot (*Sclerotinia homoeocarpa*). The superintendents managing the on-site trials effectively controlled dollar spot through the use of preventative fungicide applications. In contrast, the official trial sites at university field stations are encouraged to allow disease development before treating, lowering overall quality ratings.

Penn A-4 also was very consistent across locations. At ten of 13 locations, turf quality ratings of Penn A-4 from 1998 to 2001 placed it as the highest-scoring entry. Penn A-4 was the only entry to finish in the top statistical group for turf quality at each location averaged over the entire four-year period.

Improvement of grasses for use on putting greens is an ongoing process.

The highest genetic color ratings in the on-site trial belonged to SR1119 (genetic color = 7.0, LSD = 0.2), with L-93, Crenshaw, and Viper just below (6.9), but statistically equal to SR1119. Highest genetic color ratings did not belong to the cultivars with the highest overall turfgrass quality. However, top-performing entries, such as Penn A-4, Penn G-1, and Penn A-1 rated high for genetic color. The exception is Century, which rated almost at the bottom of all the entries.

Density ratings in each of spring, summer, and fall were very consistent over the three-year period. Penn A-4 had the highest density rating in each season. In spring, Penn A-1 had the next highest density rating (8.0), statistically equal to Penn A-4 (8.4, LSD = 0.4). Summer density of Penn A-4 (8.2, LSD = 0.4) placed it in the same statistical group as Penn G-1 (7.8) and Penn A-1 (7.8). Fall density ratings had Century (7.9), Penn A-1 (7.7), and Penn G-1 (7.7) in the same statistical group as Penn A-4 (8.1, LSD = 0.4).

Annual bluegrass (*Poa annua*) invasion is a major problem in many areas of the U.S. for those golf courses wishing to limit its presence on putting greens. Density ratings also seem to impact the percentage of annual bluegrass in the turf stand. Data collected from the Murrieta, Calif., site in December 2001 showed that Penn A-4, Penn G-6, Penn A-1, and Penn G-1 had the least amount of annual bluegrass after four years. Other new cultivars such as Century, L-93, Imperial, Providence, Putter, and Viper had significantly more *Poa annua*. Cato, SR1020, and Penncross had the greatest invasion of annual bluegrass after four years.

For golf course superintendents, any cultivar difference in ball roll or putting speed is important. Stimpmeter ratings were collected at the different sites on 46 total dates over the four-year period. Data collected on 32 of those rating dates yielded Stimpmeter ratings with no statistical differences among any entries. Stimpmeter ratings on six dates had statistically significant differences between only the top and bottom entries.

Table 3

Mean turfgrass quality, genetic color, and density ratings of bermudagrass cultivars grown on golf course practice greens.[1,2]

Entry	Turf Quality	Genetic Color	Spring Density	Summer Density	Fall Density
CHAMPION	6.1	6.6	6.5	6.4	7.7
FLORADWARF	5.8	6.6	6.1	5.7	6.9
MINI-VERDE	6.4	7.1	6.9	7.0	8.0
MS-SUPREME	6.0	6.3	6.3	6.4	6.8
TIFDWARF	5.9	6.6	6.5	6.2	7.3
TIFEAGLE	6.3	6.7	6.8	6.9	7.8
TIFGREEN	5.0	5.3	5.1	5.4	5.8
LSD[3]	0.2	0.3	1.0	0.8	0.5

[1]On-site Bermudagrass Test, data collected from 1998 to 2001 at 8 sites.

[2]Rating scale used is 1-9; 9 = ideal turf, dark green color, maximum density.

[3]LSD (Least Significant Difference) statistic at the 5% (0.05) confidence level rating. Cultivar means must be more than this value apart to be deemed statistically significant.

BERMUDAGRASS PERFORMANCE

Bermudagrasses that can tolerate ⅛ in. mowing heights with the density of some of the best bentgrasses are new to the turfgrass industry. Five entries, Mini-Verde, TifEagle, Champion, MS-Supreme, and Floradwarf, were included in this trial along with two standard entries, Tifdwarf and Tifgreen. Data were collected in summer and fall of 1998, which mainly reflected the rate of establishment, and then during the growing seasons of 1999-2001. One site, The Missouri Bluffs Golf Course in St. Charles, Missouri, suffered complete kill during the winter of 1998-99. Therefore, data were collected only in 1998.

Turfgrass quality ratings from the four years and eight sites (Table 3) show Mini-Verde (turf quality = 6.4, LSD = 0.2) and TifEagle (6.3) at the top, with Champion (6.1) slightly below, statistically equal to TifEagle but statistically below Mini-Verde. MS-Supreme at 6.0 was statistically equal to Champion but did not perform statistically as well as Mini-Verde or TifEagle in data averaged over all locations. Floradwarf (5.8) was statistically below Mini-Verde, TifEagle and Champion as well as being statistically equal to the standard entry Tifdwarf (5.9). Tifgreen was clearly at the bottom with a turf quality rating of 5.0. A closer examination of the data revealed that some entries performed better or equal to Mini-Verde or TifEagle at individual sites, but not averaged over all sites.

Mini-Verde had the highest average genetic color ratings at 7.1 (LSD = 0.3), statistically higher than all other entries. Density ratings in spring showed little statistical difference among all the entries. Mini-Verde finished with the highest average density rating in

An important part of putting green performance is disease resistance. Here, Dr. Peter Landschoot (left), turfgrass pathologist, discusses that aspect of cultivar performance with golf course superintendent Tom Wolff at the TPC at Snoqualimie Ridge site in Washington state.

summer (7.0, LSD = 0.8), however, statistically better than only Floradwarf and Tifgreen. Fall density ratings showed more statistical differences, with Mini-Verde, Champion, and TifEagle in the top statistical group.

The high color and density ratings most likely have resulted in the excellent turf quality ratings for these grasses. In addition, as with the bentgrasses, Stimpmeter ratings produced very little statistical difference among the entries. Out of 19 Stimpmeter rating dates, ten showed no statistical differences among any of the entries, while five ratings produced statistical differences between only the top and bottom entries.

ACKNOWLEDGMENTS

The author would like to thank the USGA and GCSAA for their significant financial support, as well as technical support for this research. In addition, we wish to acknowledge those seed companies and breeders that submitted their entries for inclusion into these trials and their financial support. Finally, many thanks go to the golf course superintendents, golf courses, and research cooperators involved in this project. Without their excellent cooperation and efforts, a research project of this magnitude and scope would not have been possible.

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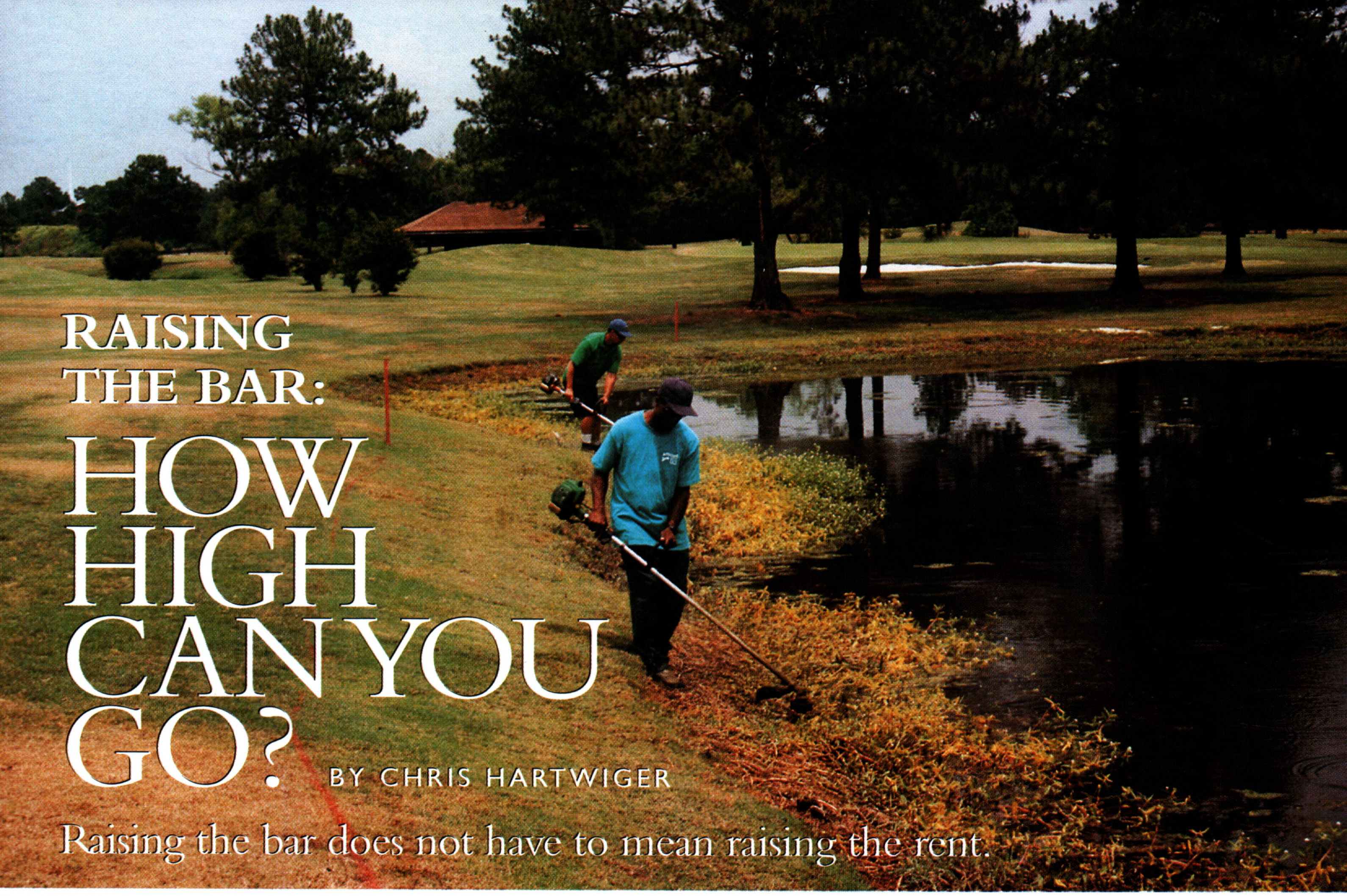
The Southern California Golf Association's golf course at Murietta, Calif., tested the new cultivars' abilities to resist invasion by annual bluegrass. Newer cultivars like Penn A-4, Penn A-6, Penn A-1, and Penn G-1 had the least amount of *Poa annua* after four years of testing.



RAISING THE BAR: HOW HIGH CAN YOU GO?

BY CHRIS HARTWIGER

Raising the bar does not have to mean raising the rent.

"Raising the bar" or "taking it to the next level" are phrases long on expectations and short on explanations. The enthusiasm generated by these phrases can spread like wildfire. Unfortunately, these phrases mean different things to different people, and this spells bad news for a golf course and its members who are searching for "the next level." A grass roots effort to "raise the bar" can create a lack of respect for current conditions and an insatiable demand for perceived golf course improvements.

Turfgrass conditions on golf courses across the country have never been better. However, golfers often are not any happier today than they were 10, 20, or 50 years ago. This article will attempt to boldly go where no man has gone before. The phrases "raising the bar" and "taking it to the next level" will be reviewed and a method will be offered to show golf courses where to focus if they are seeking "the next level."

DEFINITIONS

The phrases "raising the bar" and "taking it to the next level" will be used interchangeably in this article. A review of the most sophisticated, up-to-date turfgrass management textbooks offers no help in seeking a definition for either phrase. A little detective work is needed to get to the heart of this matter. Hundreds of interviews with course officials revealed some important answers. In response to the question, "What does 'raising the bar' mean to you?" most course officials offered some spin on the following themes. "I played at Top Dog C.C. across town and the course is always in perfect condition" or "we want a course that is in great condition all the time." These desires do not reflect tangible results that can be achieved, but dreams that may never be met. More times than not, a desire to "raise the bar" ends up being translated into some type of change that improves the appearance or presentation of the golf course.

The definition for "raising the bar" in this article is any improvement to the playability of the tees, fairways, or putting greens. The game of golf is played up the middle of the golf course, and this is where the emphasis of maintenance should remain. Today, golf courses are spending more money than ever before, but often there is little value for the extra money being spent. The

Reducing hand work in hazards does not alter the role of the hazard, but it does free up resources to be used on other portions of the golf course.

Unmanaged tree growth has rendered three quarters of this tee useless. This is not what the architect intended.

zone of intensive maintenance has spread from the middle of the course to the rough and even into the woods. Courses are spending tens of thousands of dollars on mulch, pine straw, and labor to maintain the woods!

WHY FOCUS ON THE MIDDLE OF THE GOLF COURSE?

There are several reasons why golf courses seeking "the next level" should focus on the middle of the golf course. First, there are many mid-level courses that try to compete with bigger-budget courses. These courses simply can't compete at the highest level, and instead of making a few areas on the golf course excellent, they end up with many areas that are average.

Pursuing excellence on a few areas is a much better strategy for most golf courses. A man-hour study conducted at a golf course in middle Tennessee revealed that 13% of the maintenance budget was spent on the putting greens. More than 60% of all shots in the average round of golf involve the putting greens. Every extra dollar invested in the putting greens impacts 60% of all shots in a round of golf.

Natural beauty is a key part of the golf experience. However, not many people would pay a green fee or club dues to "look" at a golf course once a week; people pay to play the game. A golf course that focuses on the middle provides improved value to its players.

A few courses are blessed with great natural terrain, a spectacular routing, or challenging architecture that have attracted golfers for many years. Other golf courses may not be as fortunate and must actively compete for play. In many cases, the condition of the putting greens establishes the reputation of a course, and this is yet another reason to focus on the middle of the course. A course with a smaller budget may not be able to match conditions with higher-budgeted courses, but they should be able to provide putting greens that are comparable.

SHOW ME THE MONEY

There are two ways to provide the funds necessary for any improvement on a golf course: raising the budget or reallocating resources. Increasing the budget is an easy way to accomplish improvements, but it may not be practical or realistic. For courses serious about getting "to the next level" with reallocated budget dollars, the first step is to identify areas where money is spent inefficiently or where money is being spent on areas with little or no impact on play.

On-course landscaping is marketed by course officials as a way to add color and enhance the golfer's experience. This may be true, but not many golf courses commit enough money for

Unnecessary landscaping at tee complexes is an example of resources that could be spent more effectively on tees, greens, and fairways.

installation *and* maintenance of appropriate plant materials. Too often, the wrong species are planted, they are not planted in scale with the area they are designed to complement, or the resources to properly maintain on-course landscaping are not available. The result is a product that looks inappropriate or unkempt. Time spent on these areas takes away from time spent on the primary golf course areas.

Maintaining turfgrass or vegetation inside lateral and water hazard boundaries is a classic poor use of money. Maintenance should be minimal inside hazards. A ball that lands in tall grass in a lateral hazard is treated no differently under the Rules of Golf from a ball that lands in the water in the same hazard. Officials at many golf courses would be amazed at the number of labor hours spent maintaining hazards each year. Wouldn't money be better spent on putting greens, where more than 60% of all shots are impacted?

Cart path edging, clearing and cleaning the woods, and unnecessary tree plantings are more areas where resources could be reduced. Money spent on dubious, expensive specialty products has skyrocketed over the past ten years and could be reduced or eliminated.

The search for the perfect bunker continues to ring the cash register. Thousands of dollars are spent on expensive sands and labor-intensive maintenance techniques to maintain a hazard. Wouldn't a better choice be to spend this money on areas where the golfer wants to be?

For courses serious about improving playability, there are funds to be found if consideration is given to shifting resources from hazards and peripheral areas. The biggest challenge is getting course officials to agree on what areas they want to be excellent. The improvements are the easy and fun part.

RAISING THE BAR

Entire articles could be written about how to improve playability up the middle of the course. The sections below are designed to offer suggestions and to stimulate thoughts about ways to improve the middle. Keep in mind that every course is different and not all ideas may be practical for a given situation.

ARCHITECTURAL INTEGRITY

Every golf course should ask this question: "Does the golf course play the way the architect intended?" If the answer is no, a golden opportunity exists to make a substantial improvement in playability.

Trees are the number-one cause of changes to architectural integrity, and they impact course architecture in a number of ways. Inappropriate tree plantings can wreak havoc on playability. For example, a tree planted between a fairway bunker and the putting green creates a double hazard. The golfer's only option is to chip back to the fairway, and the opportunity to hit a heroic recovery shot is lost.

Trees grow with time and can change architectural integrity. If golfers are using just one side of the tee to avoid tree interference, something is wrong. The infamous par-3 dogleg is a scenario that should set off warning signals, too.

Mowing patterns are altered over the years through regular maintenance. Fairway perimeters can become long and straight, while putting green perimeters tend to become round. On courses with the same fairway and rough grass, fairway perimeters can be restored with little expense. Restoring putting green perimeters is possible, but it is more expensive and may require resodding.

It is advisable to maintain a relationship with the golf course architect who was responsible for the design. If that individual is no longer available, work with an architect familiar with the original style of design. Every five or ten years, it is well worth the expense to have the architect provide recommendations for maintaining the design integrity.

Instead of spending time string-trimming a hazard, this staff member is able to roll the greens. This practice will impact 60% of all golf shots on this day.

PUTTING GREENS

Putting quality has improved dramatically over the years. Today, golf course superintendents have more tools and resources available. Because putting greens account for such a small percentage of acreage on the course, it is possible to have outstanding putting greens on a modest budget.

Outlined below are a few common shortfalls in putting green management programs. Addressing deficiencies in these areas will produce positive results immediately.

- Outdated mowing equipment. Keeping mowing equipment up to date improves the quality of cut.
- Lack of support staff. A well-trained mechanic must have time to keep bedknives and reels finely tuned.
- Infrequent topdressing. Light, frequent applications of sand topdressing improve green speed and smoothness and provide numerous agronomic benefits.
- Lack of organic matter management. An appropriate cultivation program enhances stress tolerance.
- Poor growing conditions. Shade is the enemy of every turfgrass species.

TEES

The requirements for high quality tees are straightforward. Tees should be level with complete turfgrass coverage. Size should be adequate to handle anticipated play. Trees should not be an obstacle that pushes play to one side of a tee. Improving tees is a great investment because every golfer plays from a tee on every hole.

FAIRWAYS AND APPROACHES

Top quality fairways and approaches are characterized by firm, dry conditions whenever possible. Turf coverage should be complete and golfers should be able to play the ball down during the golf season. Generally, the greater the mowing frequency, the higher the turfgrass quality. Mowing height should be a local decision, and it should be based upon the average player at the course. Higher handicappers prefer taller heights of cut, while low handicappers prefer lower heights of cut.

Fairway improvements can involve investments in drainage and equipment. Other fairway improvements can be inexpensive and quick to implement. For example, keeping fairways firm and dry does not have to be more expensive, but it does require membership education. Patches of brown are acceptable. Most golfers will enjoy the extra roll and shot-making options associated with firm, dry fairways.

CONCLUSION

The "next level" may be closer than you think. By taking an approach that focuses on the middle of the golf course, it is possible to enhance playing conditions with as much or as little as a course is willing to spend or reallocate. More importantly, a renewed focus on the middle offers an avenue to channel the enthusiasm of those wanting to take their golf course to the next level. Implementing these suggestions will improve your golf course, and no one will be dissatisfied with better tees, fairways, and putting greens.

CHRIS HARTWIGER *hurdles plenty of bars regularly in traveling to golf courses throughout the Southeast and Florida Regions.*

Good visibility and quietness make this maintenance shop office a pleasure to work in.

A Guided Tour

The Evolving Maintenance Facility

BY GARY BOGDANSKI

The maintenance barn of yesteryear can be an obstacle to operating a modern-day golf course.

The expectations of today's golfers require more labor and equipment, and with the added workforce and equipment it's easy to outgrow the golf course maintenance facility. At Sharon Golf Club (Sharon Center, Ohio) it became clear we needed to update our facility, not only from the maintenance standpoint, but also to provide better working conditions for our employees.

When faced with the need for a new facility, a golf course superintendent has several options: continue struggling with the existing facility, which is not a good option if there are health and safety issues; build a new facility from the ground up if the existing complex is in extreme disrepair, a very expensive proposition; or update the existing facility. We opted to update and add on to the existing complex, as the buildings were in good physical shape but needed maintenance.

THE PLANNING STAGE

Prioritizing the facility's needs allowed the process to proceed one step at a time. As a result, very thorough planning was accomplished for each addition. Over the span of 11 years, the facility's space was doubled to more than 16,000 sq. ft., not including the outside washpad and topdressing storage area. Each project was designed to meet the functionality of our operation and anticipate future needs. The primary goal was very simple: provide a professional work environment and eliminate health and safety concerns.

The safety factor was proactively investigated in every aspect of the project. Several agencies advised us: the local fire department, the building department, and the state bureau of workers' compensation. Our insurance carrier also was a good source of information.

One of the best ways to gather input is to tour other complexes to see how they function. Compiling ideas and advice from others helps develop a clear plan. As with all major construction, general contractors were utilized, but we stayed involved. Communication between all parties must be very clear. Mistakes during construction can be very costly. Our intent was to do it right the first time.

A GUIDED TOUR

The fuel dispensing area ranked the highest priority for improvement. Regulations required that the underground fuel tanks be removed. The local fire department allowed us to replace them with two 1,000-gallon above-ground tanks having their own secondary containment. In addition to minimizing the potential for pollution from spills or leaks, a considerable cost savings was realized using above-ground versus underground tanks. A roof was added to protect the tanks from the elements.

WORKSHOP

The second priority was an update to the existing workshop and larger working area. A 10 ft. × 10 ft. area in the shop was reconfigured to serve as an equipment manager's office. To reduce noise transmission, the walls were heavily insulated and the windows constructed with double-paned tempered glass with a 4-in. air gap. The result is a very quiet office in which to conduct business. Hot water heat and an air conditioner provide year-round comfort.

Other improvements to the shop area included an above-ground lift, natural gas infrared overhead heaters, and expanded parts storage. The actual building size increased to allow specialized maintenance procedures, such as washing equipment during cold weather and spray painting equipment. After much consideration an architect was hired to distill our ideas onto a blueprint. The final version consisted of a washroom, paint booth, flammable storage area, and a mechanical room.

The washroom is equipped with a steam cleaner and a floor drain that flows into an oil separator to catch any oily residue from equipment washing. During warmer weather an outside washpad is used; the washroom and paint booth serve a dual purpose and are used for mower parking during the golf season.

The Binks paint booth has a fire suppression system and a complete filter to catch paint overspray. Since a paint booth requires large volumes of air movement, an outside heater operating at 1 million BTUs supplies air for wintertime painting.

The flammables storage room where all paints and oils are stored is located at the far end of the building next to the paint booth. The room has explosion-proof lighting, heating, and fire suppression. The room also has a sunken floor to provide secondary containment. Because oil drums with hand pumps are extremely messy, the room has a loft with bulk oil storage cubes mounted overhead. Oil from drums is pumped to one of six steel tanks, each capable of holding 65 gallons. The product is then dispensed via gravity to a spigot below, with a drip trough that catches any spillage. This makes for a clean, space-saving method for dispensing oil.

The last room (which we call the boiler room) contains the fire suppression tanks for the paint booth and oil storage rooms. To eliminate noise, the air compressor was relocated from the main shop to this room. Hot water heats the flammable storage room as well as the paint booth when it is not being used.

PESTICIDE AND FERTILIZER STORAGE

A safe, secure facility to mix, load, and store pesticides and fertilizers is a must (See "Pesticide Storage: One Step Ahead," USGA *Green Section Record*, March/April 1997, Vol. 35(2):5-7). The design evolved as we discussed our plans with the governing bodies for this type of storage. In our case the local fire department and the Ohio Department of Agriculture had the highest jurisdiction. The project was designed in-house. Some of the main features in this all-block building are: secondary containment in the storage areas and in the mix/load room, epoxy-coated floors, ventilation for each room, and block walls that divide each room and extend to the roof deck to minimize the spread of fire. The mix/load room has a floor that slopes to a stainless-steel trough and flows to a custom-designed double-walled stainless-steel sump. The rinsate captured in this sump can be pumped up to one of three 55-gallon plastic overhead storage tanks and dispensed via gravity to a spray tank, an idea similar to the oil storage room. Having

The fuel-dispensing area was the number-one priority. The result was a clean, well-labeled refueling station.

three tanks allows the rinsate to be segregated by material type. Fertilizers are stored in an adjoining room on pallet racks. A used forklift was purchased to facilitate storage, and we can now store 18 tons on just one wall.

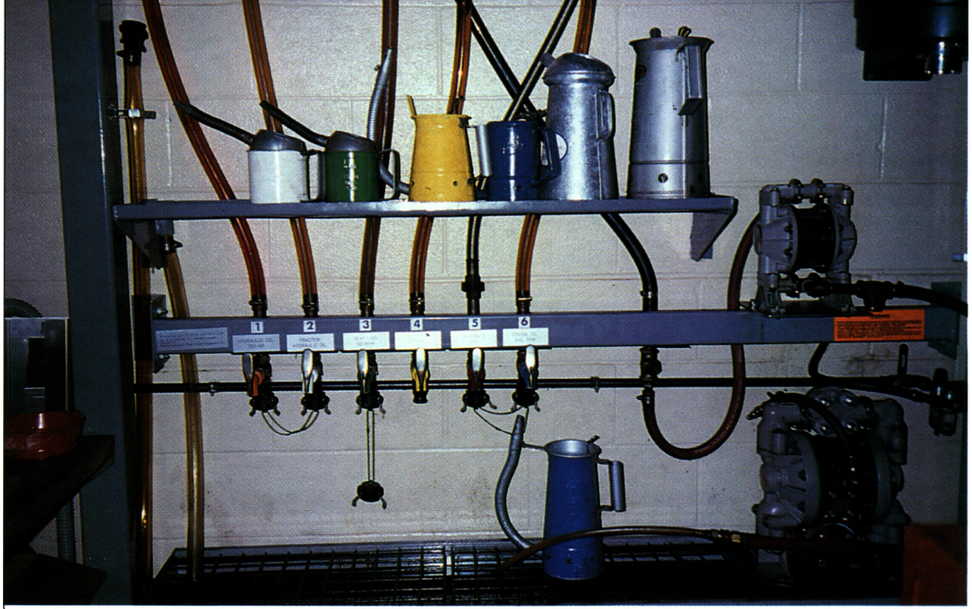
COLD STORAGE

During the last ten years our equipment inventory has doubled, and we faced the issue of how to house this extra equipment. We decided that a pole-type building would be the most cost-effective solution. The additional 2,600 sq. ft. helped eliminate the congestion in other buildings. Although the main purpose of this building was to store equipment, we included the capability to store PVC pipe and fittings. A "home improvement" type store approach was taken, using racking and labeling to ease locating parts and help us control inventory. As a result of the success of this storage method, it has been expanded throughout our older buildings with great success.

MAINTENANCE STAFF OFFICES

The last phase of the project involved the center of the entire maintenance operation: the construction of new maintenance offices. The goal was to provide an office environment not typically seen at a golf course. The previous office was inadequately sized, with three staff working out of a 12 ft. × 15 ft. room. The previous restroom accommodated only one person at a time. With 30 people on the crew, this configuration was inconvenient. The addition provided an additional 2,000 sq. ft. of space consisting of one private office, an open office area to accommodate three people, space for an administrative assistant, and restrooms. The open office provides for direct communication between staff members, as opposed to an individual office concept. The administrative assistant takes care of the cumbersome day-to-day paperwork and required record keeping, and having someone to answer the phone saves the mechanics from being distracted. The new office design is professional, with oak trim throughout, high ceilings, and specialty lighting.

With all of the improvements, we took the necessary time to assess our needs. Even before an architect was hired, we worked up a complete plan via CAD. As with past projects, there were many revisions. I even went so far as to lay out the proposed plan with paint lines on the ground to get an idea of actual spacing. When the redrawing was done, the plan was then given to an architect to draw it up.



Bulk oil dispensing can be clean and efficient. Oil is dispensed from six steel drums. A drip trough catches any spillage.

Fertilizers are stored on pallet racks. A lift truck increases fertilizer storage capacity.

CONCLUSION

If a working environment is created to be as professional as possible, there is an expectation that will carry through to the whole staff and be reflected on the golf course. In updating a current facility, the most important piece of advice is to ***take your time and plan it out***. The better it is on paper, the easier the project will proceed.

GARY BOGDANSKI *is the equipment manager at Sharon Golf Club in Sharon Center, Ohio. He's responsible for the maintenance of all equipment and buildings at this northern Ohio club.*

Understanding Bentgrass Dead Spot

Important new information helps manage this recently discovered putting green disease.

BY JOHN E. KAMINSKI and PETER H. DERNOEDEN

Bentgrass dead spot (BDS) is a relatively new disease of creeping bentgrass (*Agrostis stolonifera*) that is incited by the fungal pathogen *Ophiosphaerella agrostis* (1). In creeping bentgrass grown on golf course putting greens, BDS appears initially as small, dime-sized spots that may increase up to three to four inches in diameter (2).

DISEASE DESCRIPTION

During early stages of disease development, the spots are reddish-brown or copper-colored and mimic ball-mark injury. As the disease progresses, grass in the center of the spots becomes tan, while leaves on the outer edge appear reddish-brown. Frog-eye patches occur, but they are uncommon. Patches may be distributed throughout the putting green or they may be localized. Except

Table 1

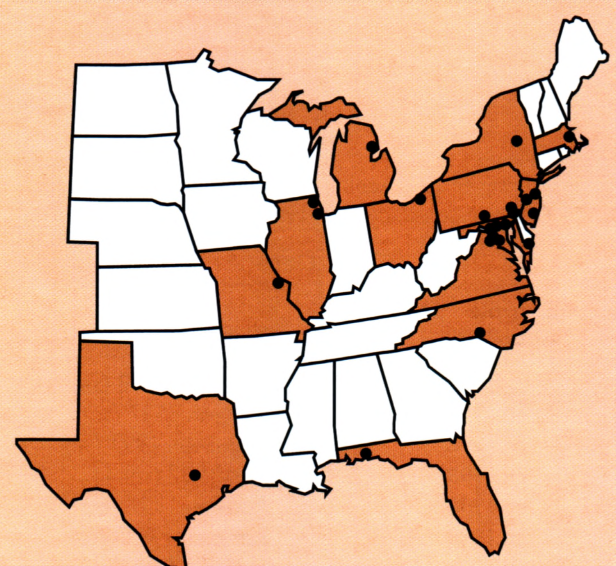
Bentgrass dead spot infection centers for 20 field-grown *Agrostis* spp. selections, College Park, Maryland, between 2000 and 2002.

		Infection centers per plot[X]					
		2000		2001		2002[Y]	
Cultivar	Bentgrass Species	6 Sept.	29 Nov.	15 May	16 Aug.	18 July	16 Aug.
ABT-CRB-1	creeping	27 a-d[Z]	11 b-e	9 bcd	3 ab	6 abc	22 abc
Backspin	creeping	18 cde	6 fgh	6 cde	2 bcd	2 ef	12 c-f
BAR AS 8US3	creeping	21 b-e	7 d-h	7 bcd	2 bcd	5 a-f	18 a-d
BAR CB 8FUS2	creeping	22 b-e	10 b-e	11 ab	2 bcd	3 c-f	12 c-f
Bardot	colonial	32 ab	6 e-h	4 ef	1 cd	2 def	9 def
Bavaria	velvet	8 f	4 h	2 f	0 d	2 def	4 f
Century	creeping	27 a-d	14 bc	11 ab	3 ab	6 abc	22 abc
Crenshaw	creeping	17 def	5 gh	6 de	1 bcd	2 ef	6 ef
Imperial	creeping	33 ab	9 c-g	8 bcd	1 cd	4 b-f	15 b-e
L-93	creeping	37 a	11 bcd	10 abc	2 abc	8 ab	26 a
Penn A-1	creeping	33 ab	15 bc	11 ab	3 ab	9 a	25 ab
Penn A-2	creeping	23 b-e	8 d-h	8 bcd	2 bcd	5 a-f	17 a-d
Penn A-4	creeping	29 a-d	15 b	12 ab	3 abc	5 a-e	15 b-e
Penn G-1	creeping	25 a-e	10 b-f	8 bcd	2 abc	3 c-f	10 def
Penn G-6	creeping	29 abc	8 d-h	9 bcd	1 bcd	4 b-f	23 ab
Penncross	creeping	14 ef	6 e-h	7 bcd	1 cd	2 ef	7 ef
Pennlinks	creeping	17 def	7 d-h	5 de	2 bcd	1 f	5 ef
Providence	creeping	24 a-e	11 b-e	11 ab	3 abc	4 c-f	9 def
SR1119	creeping	22 b-e	10 b-f	11 ab	2 bcd	3 c-f	18 a-d
SR7200	velvet	32 ab	24 a	14 a	5 a	6 a-d	12 c-f

[X]Data were transformed $(y + 0.5)^{1/2}$, but pre-transformed means are shown.

[Y]Bentgrass dead spot fully recovered in the autumn of 2001 and data from 2002 represent new infection centers.

[Z]Means in a column followed by the same letter are not significantly different ($P \leq 0.05$) based on the protected least significant difference multiple mean comparison test.



Locations of creeping bentgrass and bermudagrass confirmed to be infected by *Ophiosphaerella agrostis* between 1998 and 2002.

in severe cases, the patches generally do not coalesce. Sometimes the spots form depressions or pits in the putting surface.

Disease recovery is slow, and in severe cases BDS spots will not fully recover prior to winter. Foliar mycelium (i.e., microscopic strands of the fungus) is not observed in the field, but when diseased plants are incubated under high humidity for three to five days, a white to pale pink foliar mycelium may develop. Unlike other species of *Ophiosphaerella* that are turf pathogens, pseudothecia (i.e., sexual fruiting bodies of the fungus) often are found in the field on dying leaf, sheath, and stolon tissues.

NEED FOR RESEARCH

There is little information regarding the biology of *O. agrostis* or the relative susceptibility of bentgrass cultivars to the pathogen, geographic distribution of the disease, or cultural factors associated with BDS outbreaks. Hence, the primary objectives of this research were: 1) to determine the susceptibility of various field-grown bentgrass cultivars to *O. agrostis*; 2) elucidate cultural factors associated with BDS outbreaks; 3) determine the distribution of the disease in the U.S.; and 4) investigate pseudothecia production, ascospore release and germination, and other more basic biological properties of the fungal pathogen.

Bentgrass cultivar susceptibility to *O. agrostis* was assessed on a USGA-specified research green between 2000 and 2002 at the University of Maryland Paint Branch Turfgrass Research Facility in College Park, Maryland. Seventeen cultivars and experimental selections of creeping bentgrass, two cultivars of velvet bentgrass, and Bardot colonial bentgrass (Table 1) were seeded on September 20, 1999. The area was subjected to routine cultural practices throughout the study (i.e., fertilization, vertical mowing, aeration, and topdressing). On June 12, 2000, all plots were inoculated with an isolate of *O. agrostis*.

Disease progress at numerous golf courses also was monitored between 1999 and 2001 (map above and Table 2). In addition, a mail survey intended to collect information regarding the soil characteristics, cultivar(s) used, and any chemical or fertilizer applications that may have influenced BDS incidence and severity was sent to 21 golf courses. A timeline of BDS incidence and severity was developed based on the initial outbreak of BDS and the severity of the disease in consecutive years.

BIOLOGY OF THE PATHOGEN

Winter-dormant creeping bentgrass field samples showing symptoms of BDS were incubated at temperatures ranging from 59°F to 86°F (15°C to 30°C). Between 12 and 28 days of incubation, reactivation of BDS symptoms occurred at temperatures ≥ 68°F (20°C), but the greatest expansion in BDS patch diameter occurred at 77°F (25°C) and 86°F (30°C). The optimum temperatures for growth of hyphae among ten *O. agrostis* isolates ranged from 77°F to 86°F (25°C to 30°C), and growth was suppressed at 95°F (35°C).

Pseudothecia of *O. agrostis* was produced in the lab on a mixture of sterilized tall fescue seed and wheat bran. Pseudothecia developed under constant fluorescent light at 55°F to 82°F (13°C to 28°C), but no pseudothecia developed in darkness at any temperature. Pseudothecia developed in as few as four days, and mature ascospores were forcefully discharged or exuded en masse in the presence of water after a week of incubation.

Ascospores (fungal spores produced in pseudothecia) germination was rapid. Ascospores incubated at 86°F (30°C) germinated in as little as two hours. Germination during the first four hours of incubation was enhanced by both light and the presence of bentgrass leaves or roots. After 18 hours of incubation, however, there were few differences in the percentage of ascospores germinated, regardless of light treatment or presence of plant tissue. Ascospores were observed to either directly penetrate leaves and stems, or to enter leaves through open stomates (i.e., pores in the leaves of all higher plants used for gas exchange and evaporative cooling). Hence, *O. agrostis* can rapidly produce enormous numbers of spores that are capable of infecting new plants within a few hours.

CULTIVAR EVALUATION

Data from this study revealed that *O. agrostis* attacks all of the common *Agrostis* species and cultivars grown on golf courses. Individual cultivars within a species showed varying levels of susceptibility. The velvet bentgrass

Table 2

Location, cultivar, date samples were received, and date of planting of 19 creeping bentgrass and hybrid bermudagrass greens confirmed to be infected by *Ophiosphaerella agrostis*, 1998-2001.

Golf Course/State	Cultivar(s)/Blend	Date: Sample Received	Date: Planted
P. B. Dye G.C., MD	Penn G-2	Aug. 1998	Apr.-June 1998 (se)[Z]
Lowe's Island Club, VA[V]	Pennlinks	Sept. 1998	Autumn 1997 (se)
Beechtree G.C., MD	L-93+Crenshaw	Oct. 1998	Aug.-Sept. 1997 (se)
Ocean City G. & Y.C., MD	Penncross	Oct. 1998	June 1997 (se)
Hayfields C.C., MD	L-93+Crenshaw	Oct. 1998	Autumn 1997 (se)
Sand Ridge C.C., OH	L-93	Oct. 1998	Summer 1997 (se)
Marlton G.C., MD	L-93+Crenshaw	Oct. 1998	Oct. 1997 (se)
Hampshire Greens G.C., MD	Providence	Nov. 1998	Oct. 1996 (se)
Skokie G.C., IL[W,X]	SR1119	Dec. 1998	Sept. 1996 (se)
Hartefeld National G.C., PA	Crenshaw+Southshore	Dec. 1998	Sept.-Nov. 1994 (se)
Texas A&M University, TX	Champion	June 1999	Summer 1997 (sp)
Trenton C.C., NJ	L-93	June 1999	Nov. 1998 (sd)
Scotch Meadows G.C., NC[W,Y]	Penncross	June 1999	Aug. 1998 (se)
Persimmon Woods G.C., MO	Penn G-2	July 1999	Sept. 1997 (se)
Rutgers University, NJ	L-93	July 1999	Nov. 1998 (se)
River Bend G.C., MA	L-93	July 1999	June 1997 (se)
Bulle Rock G.C., MD	L-93	Aug. 1999	June 1997 (se)
The Bridges G.C., PA	Penncross	Aug. 1999	Summer 1994 (se)
Honeybrook G.C., PA	L-93	Nov. 1999	Apr.-June 1999 (se)
Inniscrone C.C., PA	L-93+SR1020+Providence	Mar. 2000	Autumn 1997 (se)
Orchard Creek G.C., NY	L-93	Aug. 2000	Sept. 1998 (se)
Red Hawk G.C., MI	Providence	Sept. 2000	Autumn 1998 (se)
Atlantic City C.C., NJ	Penn A-4	Sept. 2000	Sept. 1999 (se)
Glen View Club, IL[W,X]	SR1119+L-93+Providence	Dec. 2000	Sept. 1999 (se)
Olympia Fields C.C., IL[W,X]	L-93	Dec. 2000	Sept. 1999 (se)
Kelly Plantation G.C., FL	TifDwarf	Apr. 2001	July-Sept. 1998 (sp)
Mountain Branch G.C., MD	L-93	July 2001	Sept. 2000 (se)
Blue Mash G.C., MD	Penn A-4	Aug. 2001	Sept. 2000 (se)

[V] Disease also found on Penncross tees seeded in 1997 and 1998.
[W] Area fumigated with methyl bromide prior to seeding.
[X] Isolated by Dr. Randy Kane, University of Illinois.
[Y] Isolated by Dr. Henry Wetzel, North Carolina State University.
[Z] Seeded (se), sodded (sd), sprigged (sp).

cultivars SR7200 and Bavaria generally were the most and least susceptible cultivars, respectively. Bardot colonial bentgrass was highly susceptible to BDS, but it exhibited the greatest amount of recovery prior to winter.

The creeping bentgrass cultivars exhibited varying levels of susceptibility and recovery. Among the creeping bentgrass cultivars, L-93 had the greatest number of infection centers during the period of highest disease pressure (September 6, 2000), but the number of infection centers was not significantly different from many other creeping bentgrass cultivars, including Penn A-1, A-4, G-1, G-6, Imperial, ABT-CRB-1, and Providence. Pennlinks, Penncross, and Crenshaw had BDS levels that were not significantly different from the least susceptible cultivar (Bavaria) on September 6, 2000, and generally were the least susceptible creeping bentgrass cultivars over the course of the study.

Recovery of BDS patches was slow and did not begin to occur until after September 6, 2000. Once bentgrass growth decreased in late autumn, little recovery occurred and spots remained evident until growth resumed in late spring. Recovery was most apparent during late spring and early summer. Recovery of all cultivars from BDS probably was enhanced by fertilizer applications in September and November. In 2001, BDS levels were considerably less and new infections were minimal. Most infection centers from 2000 continued to recover, but new disease activity was observed in several previously infected spots between June and September, 2001. All bentgrass cultivars fully recovered by November, 2001.

In 2002, the disease reappeared in July following a prolonged period of heat stress. Disease levels were moderately severe and BDS infection centers were greatest in ABT-CRB-1, BAR AS 8US3, Century, L-93, Penn A-1, Penn G-6, and SR1119. The reason for decreased BDS activity by 2001 is unknown. A similar decline occurs with take-all patch (*Gaeumannomyces graminis* var. *avenae*) in *Agrostis* turf in response to a buildup of bacterial antagonists (6,7). Decline in BDS activity may be attributed to the buildup of antagonistic soil microorganisms, maturation of the turf, variable environmental conditions, or the cultural practices and the chemicals employed. Data collection in 2002, however, revealed that the disease can reactivate in older turf under conditions of high temperature stress.

During early stages of disease development, the spots are reddish brown or copper colored and mimic ball-mark injury. Except in severe cases, the patches generally do not coalesce, but recovery of bentgrass dead spot patches is slow and spots may not fully recover prior to winter.

FIELD OBSERVATIONS AND SURVEY RESULTS

Bentgrass dead spot was found only on newly constructed greens or where older greens were fumigated with methyl bromide. The disease generally developed between one and two years following bentgrass establishment. However, outbreaks also were observed in creeping bentgrass greens that were less than one year old and as old as six years. With few exceptions, BDS was most severe during the first or second year of symptom expression and declined as the greens aged. The decline phase generally lasted anywhere from one to three years after the first year of disease expression, with the number of infection centers per green normally decreasing in subsequent years.

All newly constructed greens affected by BDS consisted of at least 80% sand as the primary soil medium. In addition, two older golf courses were renovated using methyl bromide but had a sand-based medium from several years of topdressing. Although BDS was observed primarily on the putting surfaces, occasionally it was found on sand-based bentgrass collars and tees, indicating that *O. agrostis* can attack creeping bentgrass maintained at higher mowing heights. Bentgrass dead spot was not found in fairways or other sites where bentgrass turf was grown on native soil.

Active BDS infection centers generally appeared in areas with full sun and good air circulation, and disease severity varied from a few spots to several hundred per green. In addition, *O. agrostis* infection centers occurred predominantly along ridges and on mounds and south-facing slopes of greens. These areas are particularly prone to higher soil temperatures and often are the first to exhibit drought symptoms. These conditions generally result in higher levels of plant stress and may reduce the defense capabilities of bentgrass plants.

Bentgrass dead spot activity was observed as early as May but generally was most active during the summer and early autumn months. Recovery of BDS patches was slow, and active spots often remained evident until the first hard frost. Soil pH at construction and during periods of disease activity ranged from 4.9 to 7.8. Various nitrogen (N) sources were applied at different golf courses throughout the year. Although no association between any single N source and disease outbreak could be made, applying small amounts of water-soluble N (0.1 to 0.125 lb. N per 1,000 sq. ft.) with each fungicide application may help to reduce BDS severity and speed bentgrass recovery.

During the early stage of bentgrass dead spot development, new spots appear reddish brown or bronze. As diseased spots increase in diameter, the periphery of active spots maintains a reddish-brown appearance, while dead tissue in the center appears tan.

According to Wetzel (9), weekly applications of urea in conjunction with an effective fungicide reduced BDS severity. When applied weekly, however, urea alone did not significantly reduce BDS severity when compared to the untreated control (9). Field fungicide evaluation trials reported by Wetzel (9) and Towers (8) showed that propiconazole (Banner), chlorothalonil (Daconil), thiophanate methyl (Cleary's 3336), fludioxonil (Medallion), and iprodione (Chipco 26GT) effectively controlled BDS.

BDS. Of the 28 different golf courses from which *O. agrostis* was isolated, however, 14 had grown L-93 in monostands or in blends. It is worth noting that only a single isolate was used in this study, and that varying races of the pathogen may exist in nature. Variation among *O. agrostis* isolates could result in varying levels of disease severity among bentgrass cultivars.

The fungus rapidly produces fruiting bodies in the absence of fungicide use, and the pathogen is rapidly dispersed by ascospores. Under suitable conditions, ascospores can germinate in as little as two hours. The disease was most commonly found on greens within two years following the seeding of new greens or on older greens that had been fumigated with methyl bromide.

Unlike other turfgrass pathogens within the genus *Ophiosphaerella*, *O. agrostis* commonly produces flask-shaped fruiting bodies known as pseudothecia on necrotic leaf, sheath, and stolon tissue.

Bentgrass dead spot can be found in creeping bentgrass as far north as Michigan, as far west as Missouri, and along the eastern seaboard of the United States from Massachusetts to North Carolina. In addition, *O. agrostis* was found in Texas and Florida, causing dead spots in hybrid bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) greens that had been overseeded with roughstalk bluegrass (*Poa trivialis*). The occurrence of *O. agrostis* infection of bermudagrass in Texas subsequently was reported by Krausz et al. (5). The role of *Poa trivialis* in the introduction of the pathogen and spread of the disease is unknown.

Field observations confirm that the disease normally declines dramatically within one to three years. The oldest greens where BDS was found were six years old. However, disease may reappear during periods of prolonged heat stress. Thus far, BDS appears to be restricted to sand-based greens, collars, and tees, and it has not been found in bentgrass or bermudagrass grown on native soil.

Results of the survey and other observations confirmed that the disease is most prevalent in July and August, but it may appear in May and can remain active in bentgrass as late as December. In a bermudagrass green in Florida, however, the disease appeared as early as March.

IN SUMMARY

Survey reports and cultivar evaluation trials revealed that creeping, colonial, and velvet bentgrasses are susceptible to

ACKNOWLEDGMENTS

We thank the United States Golf Association for providing financial support for this study, R. Kane and H. Wetzel for providing isolates, and all of the golf course superintendents who contributed information.

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Preserving Wetlands the Right Way

There's more to it than meets the eye.

BY JEAN MACKAY

Preserving wetlands sometimes involves more than just protecting the land that's wet. For wetlands to be most beneficial, they have to be connected to other habitats so that a variety of creatures can creep, slither, walk, and fly safely from wetlands to neighboring habitats.

Wetlands not only are relied upon by wildlife that live in the water, but also are vital to species that use them to carry out part of their needs, such as feeding, drinking, or breeding. Thus, for most animals, wetlands and uplands must be connected for both habitats to serve the year-round needs of wildlife.

Yet government regulations rarely stipulate that these connections be preserved when permitting a new development. They merely require that the wetland itself be protected.

"That cuts off the ability of many creatures to get to the wetland," states Larry Woolbright, Ph.D., Director of Research for Audubon International. "For instance, many species of frogs and salamanders move between wooded uplands, where they spend much of the year, and wetlands, where they breed. Protecting only the wetland and developing all around it reduces or eliminates the ability of frogs and salamanders to reproduce — and that can spell the end to once-thriving populations."

GOING BEYOND MINIMUM REQUIREMENTS

Architects and developers can create more environmentally sensitive designs by taking these upland-wetland connections into account in new golf course construction. In some cases this involves going beyond what the government requires in regard to the "lines" it draws around wetlands. Golf course routing plans should leave upland woods next to wetlands or establish corridors of upland preserves that are linked to wetlands. In addition, golf course designers can delineate core habitat areas and small habitat patches throughout a property to minimize habitat fragmentation and maximize the wildlife value of protected natural areas.

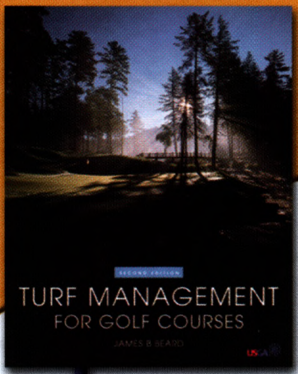
Lost Key Golf Club in Perdido Key, Florida, was designed to take advantage of the natural features of the property. Golf holes are nestled among wetlands, lakes, and upland areas to reduce fragmentation of vegetative communities. The course is a certified Silver Audubon Signature Sanctuary. MIKE KLEMME/GOLFOTO.COM

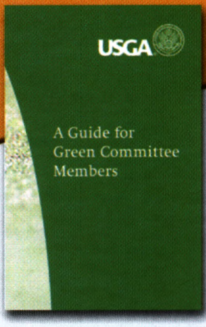
On-the-ground site surveys and careful analysis of design plans reveal whether the *primary functions* of a wetland — not just the basin with water in it — will be preserved. Wetland connections, proper drainage, and the final contours of the golf course landscape enable the wetland to continue absorbing and storing storm water, filtering nutrients, and recharging groundwater.

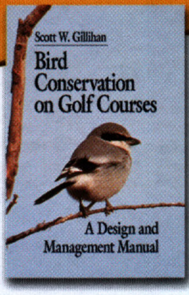
"It's critical to protect wetlands the right way, so that they continue to be an essential part of wildlife habitat and watershed integrity," says Woolbright. "When we work with Audubon Signature Program members, we visit the site and designate key wetlands and their upland habitats. Then we work with the architects and developers to make sure these areas are protected."

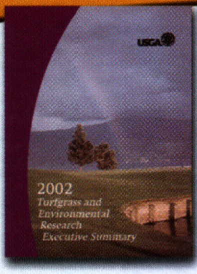
With thoughtful design considerations and a commitment to conservation, developers can integrate fully functioning wetlands into new golf courses in a way that is good for golf and good for the environment. "We know this can be done," concludes Woolbright. And he's right. Preserving wetlands as well as their functions benefits developers, golfers, wildlife, and the communities in which they live.

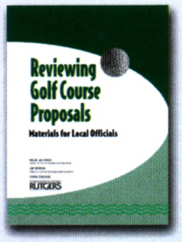
JEAN MACKAY *is the director of educational services for Audubon International. To find out more about the Audubon Signature Program or the Audubon Cooperative Sanctuary Program for Golf Courses, visit www.audubonintl.org or call (518) 767-9051.*











Publications

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2003 USGA Green Section Education Conference

Friday, February 14, 2003 • Atlanta, Georgia

50 YEARS OF LESSONS LEARNED

10:00 - 10:05 a.m.
Welcome
Moderator: Bob Brame
Director, North-Central Region

10:05 - 10:25 a.m.
The Turf Advisory Service: 50 Years on the Road
Jim Snow, *National Director, USGA Green Section*
Millions of miles and tens of thousands of reports have been logged since the first Turf Advisory Service visit 50 years ago. Join us for a brief glimpse of how things have changed and how they've stayed the same.

10:25 - 10:40 a.m.
Making the Right Spending Decisions When Tackling Water/Soil Quality Problems
Pat Gross
Director, Southwest Region
High-cost hardware and treatment programs aren't always the best choices.

10:40 - 10:50 a.m.
Presentation of the 2003 Green Section Award

10:50 - 11:05 a.m.
Strategies from the Field to Minimize Fungal Resistance
Stanley Zontek
Director, Mid-Atlantic Region
New pathogen strains can make our best fungicides ineffective. Find out the latest strategies for dealing with fungal resistance.

11:05 - 11:20 a.m.
An Important New Role in Green Construction for the Golf Course Superintendent
Jim Moore
Director, Construction Education Program
Rootzone mixes are only as good as the materials tested. There's more to taking samples than grabbing the first handful of sand off the pile!

11:20 - 11:35 a.m.
Dollars and "Sense" to Improve Soil Properties
Matt Nelson
Agronomist, Northwest Region
Want to save a few nickels? Make cost comparisons of rootzone amendments *before* the final purchase order is signed.

11:35 - 11:50 a.m.
How Statistics Can Lie
Jim Baird, Ph.D.
Agronomist, Northeast Region
Are you impressed by those remarkable claims in product ads? Here's why you might want to be a skeptic.

11:50 a.m.
Closing Comments

2003 USGA NATIONAL & REGIONAL CONFERENCES

National Conference
February 14 — Georgia World Congress Center, Atlanta, Georgia

Florida Region
To Be Announced — *To Be Announced*

Mid-Atlantic Region
February 24 — Radisson Hotel, Monroeville, Pennsylvania
March 20 — Woodholme Country Club, Baltimore, Maryland

Mid-Continent Region
March 26 — Bent Tree Country Club, Dallas, Texas
March 28 — Des Moines Golf & Country Club, Des Moines, Iowa

North-Central Region
March 24 — *To Be Announced*, Louisville, Kentucky

Northeast Region
March 13 — Hackensack Golf Club, Oradell, New Jersey
March 18 — Rhode Island Convention Center, Providence, Rhode Island
March 27 — Monroe Golf Club, Rochester, New York

Southeast Region
March 18 — Grandover Resort, Greensboro, North Carolina

Northwest Region
March 5 — Holiday Inn, Cody, Wyoming
March 12 — Hillcrest Country Club (*Tentative*), Boise, Idaho
March 17 — Sahalee Country Club, Sammamish, Washington
April 28 — Waialae Country Club (*Tentative*), Honolulu, Hawaii

Southwest Region
January 14 — Tustin Ranch Golf Club, Tustin, California
March 17 — Castlewood Country Club, Pleasanton, California
March 25 — *To Be Announced*, Denver, Colorado
April 1 — Spanish Trail Country Club, Las Vegas, Nevada
April 3 — Phoenix Country Club, Phoenix, Arizona

It's All About The Water

Less irrigation is better for golf, the turf, and the environment.

BY MATT NELSON

As an agronomist in the golf industry, it often amazes me how obsessed American golfers are with the color green. Preparing good golf conditions sometimes seems secondary to prepping the course for a beauty pageant. Players commonly react with worry, disdain, and disapproval at the first signs of any off-color turf. Panic develops when the dreaded *brown spot* occurs. What gives within the ranks of our great game?

National drought surveys indicate that nearly half of the U.S. is currently experiencing drought, and water restrictions have been mandated at golf courses across the United States. The fairways may get a little firm and lose some color, but with traffic control and prudent cultural programs, much of the turf can survive without water for extended periods. Every lie might not be perfect, but isn't this part of what makes golf such a great game? When the course gets dry during the summer months, then use those conditions for more roll and to play different types of golf shots. More bounce and roll presents risk and reward at some holes, different shots into greens throughout the year, and a greater premium on accuracy.

The golf industry has invested millions of dollars over the past two decades investigating the environmental impacts of golf course management. Our greatest challenge, however, will likely rest with irrigation. Water availability and quality will become the greatest issue facing golf courses throughout much of the country, if it isn't already. Players may have no choice but to tolerate changing golf course conditions throughout the year, and they may even learn to appreciate the many wonderful shades of brown.

But will it have to take water use mandates to change current golfer attitudes? Sadly, this is probably true. In drought-stricken states this season, where both voluntary and mandatory water restrictions were in force, I observed golf shop staff manually turning on sprinkler heads after the maintenance department had left for the day, resort managers demanding that golf course superintendents increase the watering, and an adamant group of golfers complaining directly to the mayor about the lack of watering at their municipal golf course. The golf shop staff killed most of a green, play at the resort was up even though several greens had been badly vandalized and closed, and late summer rains allowed the turf at the municipal course to resume normal growth and appearance. Oh ye of little faith. The turf doesn't have to be green and soft to survive or provide a playable surface.

Those doing the most complaining typically are at golf courses with circa-1970 irrigation technology while expecting Y2K conditioning. Forget about it. The margin for error with respect to turfgrass water management has become increasingly thin with ever-faster greens and lower heights of cut. Drought conditions quickly highlight the deficiencies in the watering system, and simply cranking up the run times to make up for poor distribution uniformity invariably results in soft, muddy spots where embedded lies, mud on the ball, and no roll are the norm — all in the midst of a drought. This inefficient use of water results in a blatant waste of our most precious resource.

If course operators and players truly are concerned about uniformity and consistency on the golf course, then the irrigation system is the place to start. Modern irrigation control capability, components, and design have greatly improved the ability of golf course superintendents to accurately meet the variable turf water demands. Improved control and coverage also will result in significantly reduced water use over the year. Oh, can't afford to replace your 29-year-old irrigation system? Buck up and find a way to finance replacement of the golf course's most valuable infrastructure item or quit whining and hit the ball. Golf was invented prior to irrigation and has survived most of its life without it. Many would argue it was a better game without it, too.

The USGA is committed to funding research that investigates turfgrass breeding and selection, and management practices that enable reduced water use. We will continue to seek out every alternative to reduce water use and be better stewards, but it will be much easier if golfers come to support this endeavor. So, this is a plea to the American golfer. Firm and dry conditions promote better and more exciting golf. Brown is beautiful, too! Listen closely — it's all about the water.

MATT NELSON *is an agronomist in the Green Section's Northwest Region.*

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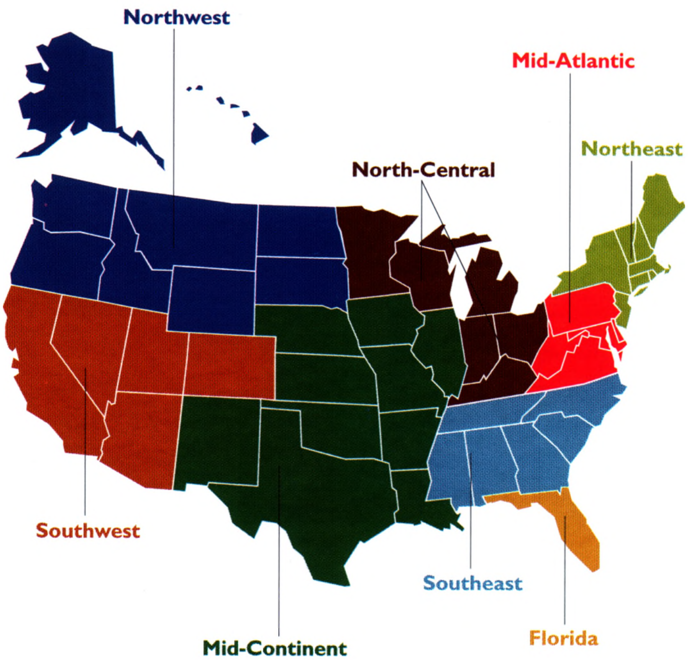

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Subscriptions $18 a year, Canada/Mexico $21 a year, and international $33 a year (air mail).

Subscriptions, articles, photographs, and correspondence relevant to published material should be addressed to: United States Golf Association, Green Section, Golf House, P.O. Box 708, Far Hills, NJ 07931.

Green Section Record (ISSN 0041-5502) is published six times a year in January, March, May, July, September, and November by the United States Golf Association®, Golf House, Far Hills, NJ 07931.

Postmaster: Address service requested — USGA Green Section Record, P.O. Box 708, Golf House, Far Hills, NJ 07931-0708.

Periodicals postage paid at Far Hills, NJ, and other locations. Office of Publication, Golf House, Far Hills, NJ 07931.

Printed on recycled paper

Turf *Twisters*

Q: Last spring our roughs were devastated by snow mold because of the unusually lengthy period of snow cover. The matted-down areas seemed to take forever to recover. Any helpful hints to accelerate this process in case it happens this year? (Michigan)

A: Gray snow mold or *Typhula* blight may affect either the leaf tissue or the leaves and the growing points of turf, depending on the severity of the infection. In areas of intermittent snow cover where the damage is limited to leaf tissue, the lesions will recover faster if the affected sites are raked or scarified with a vertical mower. This process will break up the matted, diseased tissue and stimulate the growth of the underlying grass plants.

Q: Does seashore paspalum require salty water (sodium)? (Florida)

A: A misconception is that seashore paspalum needs large amounts of sodium to survive. Although seashore paspalum grows in areas that contain elevated salts better than most turfgrasses, it thrives in *clean* water. Even though research shows that seashore paspalum can take up sodium, it acts like a plant growth regulator and reduces its growth. If high concentrations of salts are continually applied without periodic flushing, injury can occur.

Q: When is the best time to evaluate shade problems on troubled areas of the course? (West Virginia)

A: By far the best time to evaluate sunlight penetration is early in the morning. The drying effect offered by the light and warmth of the rising sun helps dry the turf early in the morning. This can be a critical component of an integrated pest management program. Also, evaluate sunlight exposure in all seasons. Spring is critical because the sun is moving higher in the sky. In the fall, the sun is actually dropping in the southern sky. Sunlight intensity varies and, as such, the effect on the turf will vary. For additional information, refer to the May/June 1997 issue of the *Green Section Record*, "Using New Technology to Solve an Old Problem: Trees," by David Oatis.

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