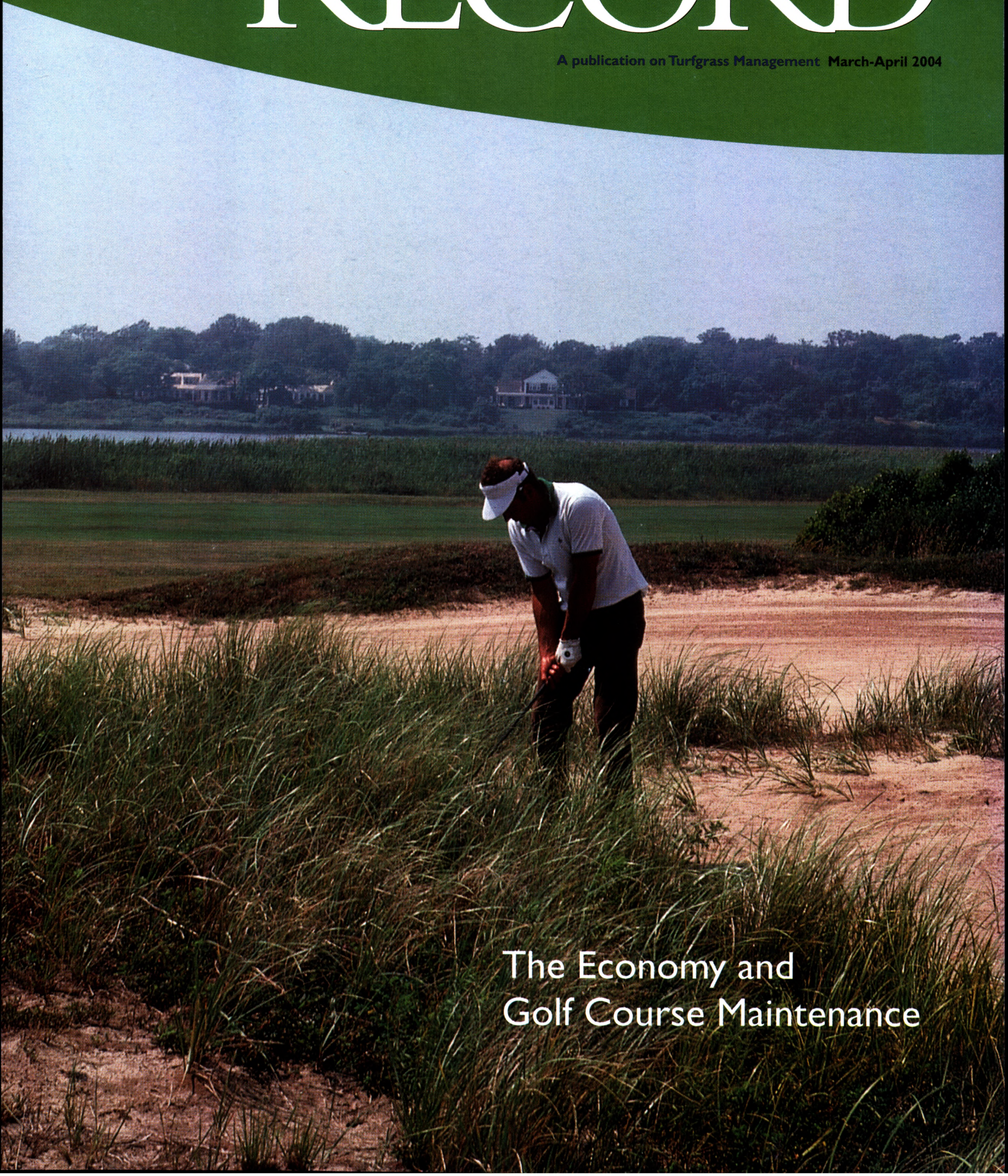
USGA GREEN SECTION

RECORD

A publication on Turfgrass Management March-April 2004



The Economy and Golf Course Maintenance

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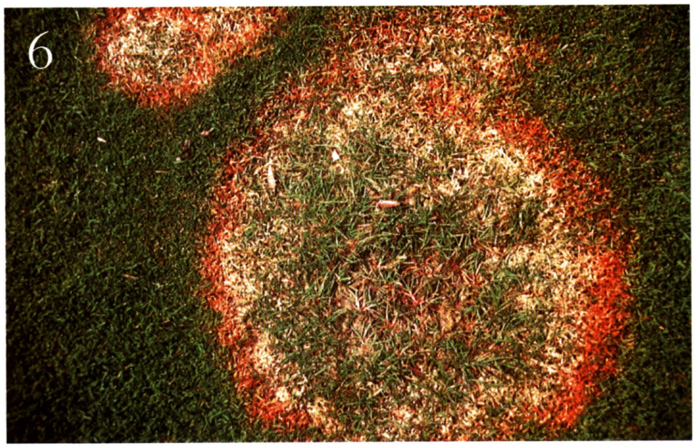
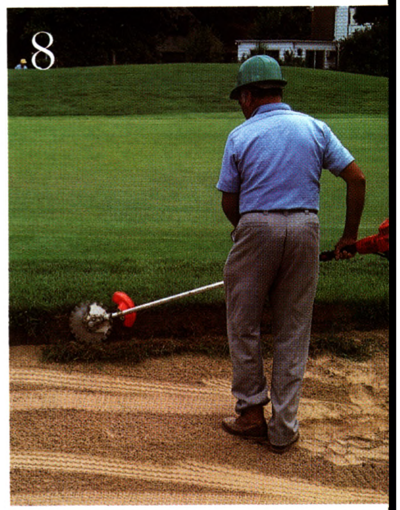
March-April 2004 Volume 42, Number 2





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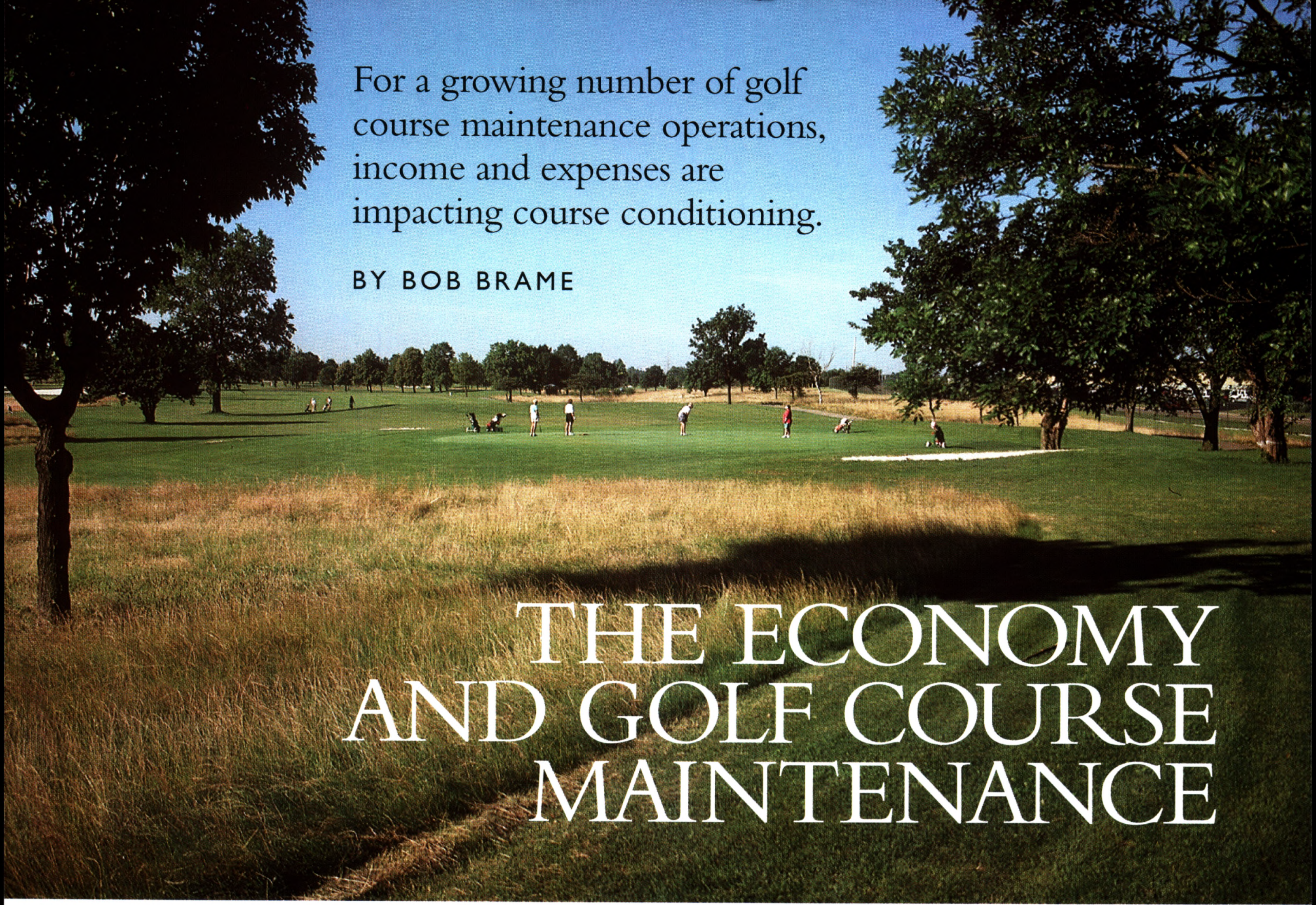
Agronomics, economics, and politics must be considered when determining what is right for the long-term conditioning of a golf course.



For a growing number of golf course maintenance operations, income and expenses are impacting course conditioning.

BY BOB BRAME

THE ECONOMY AND GOLF COURSE MAINTENANCE

Predominately out-of-play tall rough can enhance environmental friendliness while improving definition, and it helps keep maintenance dollars focused on more in-play acreage (Kitty Hawk Golf Complex, Dayton, Ohio).

Over the last couple of years the sluggish economy and the increasing cost of golf course conditioning have become frequently discussed concerns. Play volume vs. income, course conditioning, the maintenance infrastructure, and how to properly consider each have always been agenda items on course visits, but recently the intensity has elevated. Unfortunately, too many courses are approaching economic constraints with poor or no prioritization such that intermediate and long-term operational sustainability is suspect. This article will discuss a realistic and practical approach to managing quality golf turf relative to available funding. When budget cuts are needed, the following sequence will allow adjustments to be made without compromising the product or value ratio (what golfers are getting for their dollar).

PRIORITIZE ALL COMPONENTS OF COURSE MAINTENANCE

The decision makers should start with a prioritization of what's important. This cannot be done properly by the superintendent alone. The owner, board, committee, advisory group, or to whomever the superintendent answers, should be directly involved in determining the pecking order of course maintenance priorities. Putting surfaces are clearly first, but from there on down there is no right or wrong order, other than not having an agreed-upon order is wrong. While every course should have a custom-fitted prioritized listing, it's all about offering a course upon which the game of golf can be played. Carefully consider what's important to the game during the process of prioritizing components of the maintenance program. For example, it makes no sense to place trees (tree management) above what is needed for healthy grass growth, unless tree removal is needed to improve the grass-growing environment. Maintain candid objectivity when compiling the listing, relative to what the grass needs and the intended line of play. This process is discussed in detail in the July-August 2003 *Green Section Record* article "Stay Focused." Review the article (available on the USGA Web site) and complete the exercise before continuing this article.

Gravel, brick chips, bark, or other similar materials often erode or move with traffic, which increases maintenance costs as compared to a paved cart path.

storage space. More inclusively, the maintenance complex directly impacts staff morale, work ethics, and safety, along with equipment servicing and storage, which means this component of the maintenance infrastructure should not be taken lightly even though it is seldom visited by golfers.

Equipment Inventory. In the final analysis, it is the staff and equipment that get the work done. The equipment inventory should be replaced regularly to control repair and maintenance costs and to ensure efficiency. Conditioning objectives must be anchored by the equipment inventory to achieve sustainability. Generally speaking, an investment of 10% of the total equipment inventory replacement value, each year, will keep the inventory in good condition. However, the addition of extra items that may be needed to properly cover your objectives should be considered prior to, and over and above, the 10% replacement guideline. Trying to walk-mow 18 or more greens with only one mower is an example of needing to purchase extra units.

Operating Budget — Staffing. It is common for the salaries and wage line item(s) in the operating budget (all of what is being spent to staff the maintenance operation) to be 60% or more of the total budget. A higher percentage typically reflects more detailed manicuring and walk mowing of various sites, while a low percentage (55 or below) often suggests that conditioning expectations/objectives are out of line with staff to do the work. Recognizing that labor is such a large percentage of the total operating budget, it is a common target when reductions are deemed necessary. However, it should first be determined what will be reduced (the prioritized list should be adjusted) and then the staffing altered to accommodate the adjustment. The compiling of an agreed-upon prioritized list will be made more efficient with specific accounting of how funds have been spent in the past. Budgeting can then capitalize on past actuals and the level of conditioning that was offered.

Irrigation System. A key, if not *the* key, objective of golf turf conditioning is to maintain the surface and upper profile as dry as applicable variables allow. The intent is environmental friendliness, consistent/dependable playability, and healthy turf, which is always more economical than unhealthy turf. The irrigation system and how it is used directly impact the pursuit of dry conditioning or water management. More sprinklers and more efficient coverage control do

Without a prioritized list, there is no foundation for the following discussion, and the current cycle of income and expenses will not improve — there will be a continuing decline of course value or, at best, a wandering in the wilderness (no defined direction that guides the operation). However, the downward trend is often very subtle and, as such, it may require open-mindedness to detect and correct. An agreed-upon prioritization of all surfaces or components of the maintenance program, with specific subcomponents, is the first step towards properly managing agronomics, economics, and politics.

CORRECT INFRASTRUCTURE LIMITATIONS

The maintenance infrastructure includes, in no specific order and equally weighted, the irrigation system, drainage network, equipment inventory, maintenance complex, architecture, operating budget, and staffing. The prioritized listing of course components should help identify infrastructure needs and limitations. Conversely, the infrastructure will impact prioritizing components — there is a two-way street between components of the infrastructure and the pecking-order list.

Maintenance Complex. Every golf course should have a safe, efficient, and environmentally friendly maintenance complex. This would include two restroom and shower facilities, along with a nice lunch room. However, the prioritized listing will directly impact staff size and, as such, the needed employee and equipment accommodations. For instance, the walk mowing of greens or the triplex mowing of fairways, depending upon the listing and sub-objectives, will impact both staff accommodations and equipment not equate to wetter playing surfaces; in fact, quite the opposite is true. The prioritized listing should guide the assembly of specific features of the system. For instance, will the primary rough be watered? Where is it placed on the listing, and what subcomponent objectives have been agreed upon?

Drainage Network. Tying directly to the irrigation system in pursuing dry conditioning is efficient drainage. The drainage network is the combination of surface contours that allow runoff and tiling that provides subsurface movement. Like the other components of the infrastructure, drainage is vital to quality golf turf. Yet the level of drainage should be fitted to agreed-upon priorities and subcomponent objectives, along with architecture. As an example, predominately out-of-play natural rough will not need the same level of drainage efficiency as that of primary rough.

Architecture. If decision makers identify double-digit speed as an objective for greens on the prioritized listing, the surface contours should be subtle enough to accommodate the objective relative to play volume and the need to spread wear across the green via usable hole locations. Architecture must accommodate desired conditioning or else course playability will not be economically sustainable. Bunkers are another good example; if they're low on the listing, as hazards should be, it's important for the architecture to be such that constant erosion and/or washouts are avoided.

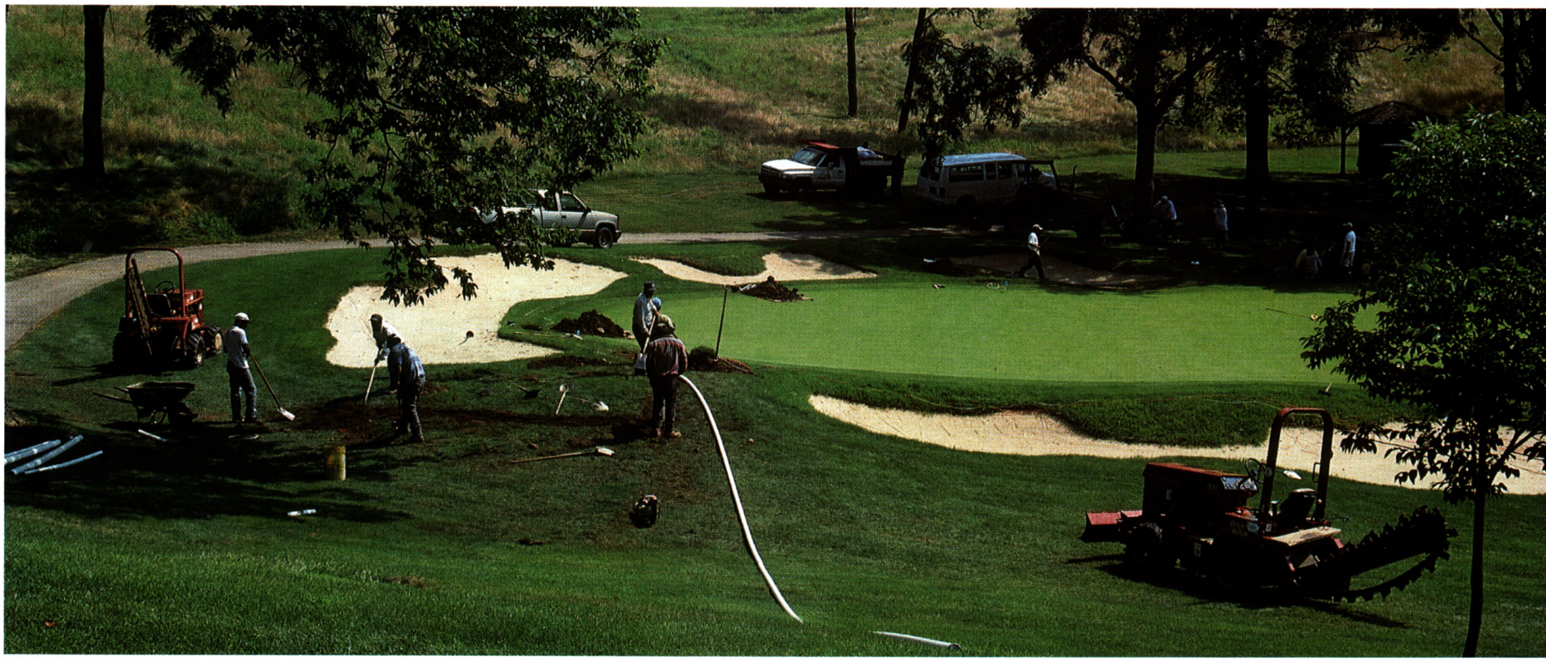
GUARD AGRONOMIC BUILDING BLOCKS

The four equally weighted building blocks of agronomically sound golf turf are:

- Fertilization
- Mowing (type of mower, bench setting, and sharpness
- Growing Environment (sunlight and air movement)
- Water Management (drainage/aeration and irrigation/rainfall)

Limitations in one or more of these equally weighted foundation building blocks cannot be corrected by any combination of secondary (other than what directly facilitates the four building blocks) strategies imaginable. As an example, fungicides will not control disease activity that is brought on by overwatering or a poor micro-environment. Guarding and properly implementing these building blocks, in pursuing quality golf turf that is economically sustainable, is not negotiable. An expanded discussion of these agronomic building blocks can be found in the July-August 1997 *Green Section Record* article "The Building Blocks of a Solid Maintenance Program."

Consider the progression: (1) develop a prioritized list of what makes up the maintenance focus, with desired and agreed-upon subcomponents, (2) make sure the infrastructure is in good order and that it properly supports the listed objectives, and then (3) invest to guard foundational agronomics. With this combination employed, it would

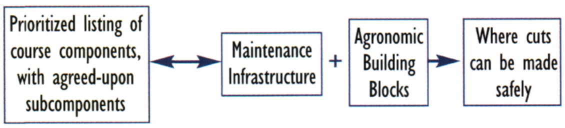


An efficient irrigation system is a vital component of the maintenance infrastructure, and it pays dividends over the intermediate and long haul.

be impossible to skip putting surface aeration in an effort to reduce labor costs or increase play. The skip could do both over the short term, but it would also open the door to far greater concerns. The logic is simple and straightforward; the greens should be first on the prioritized listing, while other components and surfaces can vary — not greens. Aeration directly impacts rootzone porosity via drainage, which ties to both the infrastructure and the water management building block. The same logic and progression can be applied to any agronomic, economic, or political question that may arise.

WHERE CUTS CAN BE MADE SAFELY

The specific places where cuts can be made safely will vary depending upon the specifics at a course. Applying the outlined template (as discussed and illustrated below) will ensure agronomic and economic sustainability.



The following are examples, which apply to most courses, of where cuts can be made without compromising the product or value ratio.

Add or Expand "No Mow" Predominately Out-of-Play Rough. Most courses have areas where little or no golf is played. Mark such areas and stop regular mowing. Ideally, identify the acreage as "natural." A natural area does not have weeds, as a weed is a plant out of place. No weeds means there is no need for herbicides. If, however, the desire is for tall grass blowing in the wind, then spot usage of herbicides occasionally may be needed to eliminate growth other than grass. One mowing a year typically will work with either approach. The end result will be improved definition and a more environmentally friendly operation, and budget dollars will be kept focused on more in-play acreage.

Planting wildflowers in predominately out-of-play rough is not as economical as going natural. Seeding will occasionally be needed to maintain a good stand of wildflowers, and weed control often becomes necessary.

The guiding concern with "no mow" rough is pace of play. An occasional ball in the tall rough is acceptable as long as the pace of play is not consistently slowed. The slope rating should reflect the presence of tall rough that is not marked as a hazard unless a hazard is present; tall rough does not meet the definition of a hazard in *The Rules of Golf.*

Add or Expand Buffer Strips. Hand mowing or trimming around lakes and creeks is not environmentally friendly, and there is a significant labor cost. A buffer strip of at least several feet, depending upon terrain features and/or architecture, will eliminate expensive hand labor, and it greatly reduces the chances of a chemical application moving into the body of water. Canada goose activity may also be reduced with buffer strips. With the hazard marking placed outside the buffer strip, there will be no negative impact on playability, although the different look may require some time to be fully accepted. As with the predominately out-of-play "no mow" rough, one mowing a year is normally sufficient to control tree sucker growth.

Participating in the Audubon Cooperative Sanctuary Program (ACSP), through Audubon International, is an excellent means of guiding the establishment or expansion of tall rough and/or buffer strips. Efficiency is improved and credibility will be elevated when the ACSP is guiding the process.

Eliminate Flower/Ornamental Beds. Clearly, when funding is tight, flowers and ornamental plantings should be reduced or eliminated. While everyone enjoys the color and texture that ornamentals and flowers offer, they are not needed for the play of the game. In a tough economy, anything that has no direct impact on playability, yet draws resources away from those areas that do, is excess baggage. The initial prioritized listing of surfaces and components should reveal, for most operations, a low placement for flowers and ornamentals.

Occasionally, trees and tree management needs are aligned with flowers and ornamental plantings, although they should be separate items on the initial listing. When the turfgrass growing micro-environment is compromised by any type of plant growth, it should be eliminated — remember the building blocks. On the golf course, trees, flowers, and ornamentals are all optional — grass is not. If the sequence in this article is followed, most tree work/removal will be done under the heading of "Guard Agronomic Building Blocks — Growing Environment."

Reduce Bunker Maintenance. It is important for bunkers to have well-defined margins so that *The Rules of Golf* can be applied. However, conceding the need for clearly defined margins, bunkers are hazards. Where did we get the idea that hazards should play consistently? Many times a year on course visits the request will be made, "We just want the bunkers to play consistently from hole to hole." True consistency will never happen, and the pursuit thereof is very expensive. No doubt we can thank televised golf for this predicament.

Considering the basics, bunkers are hazards that are to be avoided and as such do not need to play consistently. In addition, design (infrastructure — architecture) that does not allow constant erosion and minimizes bunker maintenance costs is what you're looking for. They should have good internal drainage and, again, be designed to prevent erosion. Daily raking is not necessary, however, and for most courses this component of maintenance could be lowered on the list, resulting in a saving.

Eliminate Bunkers. Even with reduced maintenance, bunkers typically are more expensive to maintain than the regular mowing of primary rough. This would suggest that if bunkers don't offer directional or playability value, they could be converted into grassy swales. This is a good topic to discuss with an architect, as it could offer significant savings while still presenting an enjoyable and challenging course to play.

Pave Cart Paths. No one particularly likes asphalt or concrete on a golf course, but golf carts are here to stay and a paved surface is the best means of controlling cart traffic wear. The use of gravel, brick chips, bark, or various other similar materials may sound good, as balls will not bounce as far if they are hit, but maintenance costs normally will be higher over the intermediate and long haul. The initial cost of paving should result in savings down the road.

Bunkers that frequently experience erosion should be renovated or have steps taken to correct the problem. In this case, an intercept drain was installed above the bunker to minimize water flowing over the bunker lip and washing out the bunker face.

CONCLUSION

Agronomics, economics, and politics are part of every golf course maintenance decision. All three must be considered, and at times it can be difficult to properly sort through the issues and do what is right for the long-term conditioning of the course. The solution to this dilemma, which is often intensified during tough economic times, begins with an agreed-upon prioritization of all components. The prioritized listing with agreed-upon subcomponents sets the stage for the precise evaluation and adjustment of the infrastructure. Needed upgrades or corrections to the infrastructure will then support the agronomic building blocks, to which secondary or fine-tuning strategies can be added. Individual sprinkler control around greens will complement the pursuit of dry conditioning, whereupon fungicide applications will achieve the desired control. Cuts or reductions should start with the prioritized listing and applicable subcomponents and process through the outlined template. Indiscriminate cuts often open the door to product decline that forces even more reductions. If adjustments are needed, measure twice (or more) and cut once.

BOB BRAME *is the director of the Green Section's North-Central Region. He visits courses in Indiana, Kentucky, and Ohio, where the economy has been a common topic over the last few years.*

Carving an Edge in Snow Mold

Researchers continue to improve our understanding of these cool-season turf diseases.

BY MATT NELSON

Snow mold diseases are among the most serious problems of cool-season turf in northern locations of the United States and throughout Canada. Where disease development is extensive, recovery can be delayed well into the growing season and seriously affect playability and revenue generation. At many golf courses, snow mold scars in the spring are often colonized by *Poa annua* before recovery of more desirable grasses occurs, and snow mold disease can be a significant factor influencing the rate of *Poa annua* colonization into the preferred stand of turf.[8] Because of the potential for widespread turfgrass damage and prolonged recovery in the spring, turf managers most commonly attempt to control snow mold diseases with preventative applications of fungicides in mid to late fall.

At locations where snow cover is persistent, preventative fungicide treatments are timed according to historical performance and weather conditions, in hopes that the last application can be made just prior to permanent winter snow cover. More than a few golf course superintendents and their staffs have removed snow from putting greens to apply fungicide for the prevention of snow mold diseases. Pink snow mold, caused by *Microdochium nivale*, can be active in wet or maritime climates throughout the year and require more extensive control programs. Cultural control recommendations include selecting or promoting more disease-resistant turfgrass, improving drainage, correcting thatch problems, allowing for sunlight penetration to critical play areas during winter, removing snow in late winter, proper mowing, and developing an appropriate fertility program.

Dark brown and black sclerotia of *Typhula ishikariensis*. Accurate identification of the gray snow mold causal agent will influence proper fungicide selection.

FUNGICIDE RESEARCH

Preventative applications of fungicides for the control of the various snow mold diseases remain the cornerstone of an effective disease control program. At sites where snow mold disease pressure is fierce, the lack of suitable alternatives will present a serious stumbling block to pesticide-free golf course maintenance. Currently, research is underway to evaluate the efficacy of many newer fungicide products and combinations, as well as biological control products, compared to conventional control materials.

PCNB (pentachloronitrobenzene) has long been an industry standard for snow mold control throughout much of North America. Good disease control efficacy, affordability, and formulation choices have attracted its widespread use. Documented cases of PCNB resistance are rare, but at least one study has shown a loss of effectiveness at a site with extended snow cover and extreme disease pressure when PCNB is used alone.[4] This isn't terribly surprising, considering that most modern fungicide trials have shown that various product combinations with or without PCNB generally provide the best control where disease pressure is high.[4,7] Repeated use of the same active ingredient for the same disease organism can lead to selection of resistant genotypes.

Researchers at Washington State University have identified different classes of fungicides that provide control of one organism responsible for gray snow mold (*Typhula ishikariensis*) but not another (*Typhula incarnata*), and vice versa.[4] This information suggests that golf course superintendents should know conclusively the exact organisms responsible for gray snow mold at their golf course. Diagnostic laboratory testing or identification of sclerotia in the spring of the year are tools available to differentiate between the organisms responsible for gray snow mold. Sclerotia of *Typhula incarnata* are larger (up to 5mm in diameter) and red or brown in color. Sclerotia of *Typhula ishikariensis* are smaller (<2mm in diameter) and are dark brown or black, are located in the dead leaf tissue or mycelia crust, and appear as though pepper were sprinkled over the disease patch, giving rise to the common name speckled snow mold for this type of gray snow mold. Both organisms are commonly active at sites with severe winters and extended snow cover.

Selecting the most appropriate fungicide program for use at a specific golf course involves an assessment of disease pressure, historical performance of various products, cost, and application method. Contact your regional Green Section office or university extension specialist to discuss disease control programs specific to the climate.

BIOLOGICAL CONTROL

Researchers have been investigating the potential of various biological control agents for the management of snow mold diseases for at least 20 years.[1] Investigators have been working with different fungal and bacterial organisms to offer a possible non-chemical control option for snow molds. Researchers in Canada have been working with isolates of *Typhula phacorrhiza* to suppress both pink and gray snow mold.[3,5] This organism is closely related to the *Typhula* species that cause gray snow mold, and it is suspected that competition for nutrients and space is the possible mode of action for suppression of disease-causing organisms. Trials across Canada have shown distinct promise, and the next steps will be more widespread testing in the U.S. and product registration for eventual trial in the marketplace.

Research conducted at Michigan State University has investigated the potential of *Pseudomonas aureofaciens* (Tx-1) to control pink snow mold. Initial studies have found that this organism can reduce disease incidence by reducing the amount of fungus in the fall prior to subsequent infection of turf.[2] The requirement of daily application of the organism for a prolonged period could preclude effective use at many locations.

In Alaska, research has indicated that the fungal organism *Trichoderma atroviride* can reduce disease pressure by parasitizing sclerotia of snow mold fungi.[6] Spring applications of this organism to snow mold patches may reduce subsequent disease the following winter. Preventative applications of this bio-control organism in the fall have demonstrated some disease control in Alaska, but trials in Washington and Montana did not show this organism to provide any suppression of snow mold diseases.[4] Perhaps the organism is adapted regionally to Alaskan conditions and could not compete or establish at lower-latitude sites.

Cultivars of creeping bentgrass exhibit varied susceptibility to both pink and gray snow mold.

The development of effective biological snow mold controls will be a real benefit to golf courses where snow mold disease pressure is significant, environmental sensitivity is high, pesticide use is contentious, and/or pesticide use is restricted. Before bio-control of snow mold is a reality, however, much more research and testing will be necessary to identify effective disease control agents that warrant the costs involved in product development and registration. Selecting pesticides with favorable environmental attributes, including low toxicity, low amounts of active ingredient required, low solubility, and short half lives, is another responsible management decision to safeguard the environment.

CONCLUSION

Recent snow mold research trials have indicated that a wide variety of fungicides and combinations, both old and new, can provide excellent control of snow mold diseases, depending upon the severity of snow mold pressure. Accurate identification of gray snow mold organisms can help develop a more refined disease control program. The development of effective biological snow mold controls is being investigated and is showing promise, yet it may still be some time before dependable products are available for use by the golf course superintendent. Realistically, incorporating biological control into the overall disease control program will likely provide the best results while reducing our dependence on fungicides.

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BUNKERS: HAZARDS OR HAVENS?

Have golfers become too spoiled by excessive bunker maintenance?

BY ROBERT VAVREK

The unnecessary quest for perfect playing conditions in bunkers will always require a considerable amount of time and labor. The cost of excessive maintenance in hazards ultimately is passed on to golfers.

Hazard — the very word suggests danger, risk, and a place to avoid. In the Rules of Golf, a "bunker" is a hazard consisting of a prepared area of ground, often a hollow, from which turf or soil has been removed and replaced with sand or the like. Nowhere in the Rules does it state or even suggest that playing conditions within bunkers must be firm, uniform, and consistent from hazard to hazard.

The design, location, and number of bunkers on any particular golf hole factor significantly into the course rating, but the playing conditions within bunkers have minimal influence on the slope or rating. However, a provision is available to adjust a course rating for any extraordinary concerns found in bunkers, such as exceedingly soft sand.

The perception among an increasing number of golfers, regardless of their level of skill, is that sand conditions within bunkers must be firm, uniform, and as near perfection as possible. Firm playing conditions in one bunker and somewhat softer sand in another is deemed unfair. If most golfers had their way, they would be granted relief when an errant 9-iron approach shot results in a partially embedded, fried-egg lie. As a result, some courses are putting nearly as much time and labor into conditioning sand in bunkers every day as they spend grooming the putting surfaces. The quest for bunker perfection occurs at private and public facilities, and the costs are ultimately passed on to the golfer.

Perhaps the golfers' perceptions of what sort of penalty to expect in a bunker are influenced by what they see on TV every weekend. Highly skilled professionals can often be heard whispering "get in the bunker" as an errant shot misses the target. These athletes, who play golf for a living and routinely practice recovery shots from a variety of lies in bunkers, find little difficulty getting up and down from the sand in intensively maintained hazards. Needless to say, they spend a great deal of time honing their bunker skills. In contrast, the average golfer spends plenty of time with a driver on a practice tee, but rarely practices bunker shots.

From the USGA's point of view, what are considered unacceptable or unfair playing conditions within a bunker? First, the margin of the bunker must be clearly defined to determine whether or not the ball lies in the hazard. Bunker margins that are obscured by overzealous bunker raking, which displaces sand out of the hazard, or

Left: Poor construction or design can lead to serious drainage problems after wet weather and results in more of a penalty than necessary.

Below: Bunker margins must be clearly defined so that the Rules of Golf can be applied to determine whether the ball is in or out of the hazard. However, they are hazards and do not need to play consistently.

weed encroachment are a Rules dilemma just waiting to happen. The ability to ground a club, to remove a loose impediment, and other Rules options available to a player depend on whether the ball lies inside or outside of the hazard.

Second, common sense dictates that there should be enough sand in the bunker to prevent golfers from injuring themselves when they attempt a recovery shot. As a general rule of thumb, the Green Section recommends approximately 4 to 6 inches of sand at the base of a bunker and 2 to 4 inches of sand across sloped bunker faces. Keep in mind that these are guidelines, not Rules, to provide a reasonable balance of drainage and stability for most bunker sands.

Third, bunkers should be maintained in a manner that minimizes the potential for a ball to completely bury in the sand. The pace of play can't help but slow when balls disappear into the face of a hazard.

You will find that the Rules of Golf are fair, but not overly sympathetic to golfers' misfortunes when they hit errant shots into a bunker. Etiquette dictates that *before leaving a bunker, a player should carefully fill up and smooth over all holes and footprints made by him*. However, should you have to drop in a bunker to, for example, obtain relief from casual water, and the ball happens to plug into the sand, you have no option to drop again without penalty (Decision 33-8/28). If your ball becomes completely embedded into the sand to the point where it cannot be seen, you are permitted to probe, rake, or use other means to find the ball. However, if the ball is uncovered or moved, it must be replaced and covered so that

only a part of the ball is visible (Rule 12-1). In essence, you are required to play the ball as it lies in the hazard, with fewer options for relief without penalty compared to the options available when the ball lies *through the green*.

Perhaps our *grip it and rip it* attitude toward golf in the United States is partly to blame for unreasonable expectations for perfect playing conditions within a bunker. Hit the ball as hard as you can and forget about strategy. Visit a classic links course in Scotland and you will find the locals have no problem playing sideways or backwards from a bunker. Similarly, they don't even consider declaring a ball unplayable in a bunker and taking a penalty stroke just to obtain an opportunity to exit the hazard and perhaps advance the ball. You won't find too many Scots grousing about soft sand or hard sand from Hell Bunker at the Old Course at St. Andrews. They seem to understand that luck, good and bad, is an integral part of the game.

In his famous book *The Spirit of St. Andrews,* Alister Mackenzie stated, "Many poor golf courses are made in an endeavor to eliminate the element of luck." Uniform, ultra-firm conditions in every hazard, in effect, remove an element of luck from the game. This is not meant to imply that bunkers should never be raked or that every stray shot into a bunker should result in the same penalty as a shot into a water hazard. However, the delicate equilibrium between a penalty and the ability to recover from an errant shot has been upset when anything but a perfect lie in the sand is deemed unacceptable. It is better to accept a good lie in a bunker as good luck and a difficult lie as bad luck than to debate what is fair and unfair on an area of the course that was designed to be avoided in the first place.

The bottom line is that bunkers are indeed hazards, not havens. A considerable amount of time and effort is wasted at many courses in the futile endeavor to provide the same conditions in every bunker. Shade, drainage, irrigation coverage, bunker design, and a myriad of other factors vary throughout the course and influence the playability of bunkers. Instead of complaining about bad luck in the sand, take a lesson or two and practice. After all, it was Gary Player who said, "The more I practice, the luckier I get."

BOB VAVREK, *senior agronomist for the North-Central Region, has the good luck to work with golf course owners, superintendents, and course officials in Wisconsin, Michigan, and Minnesota.*

Who says that bunkers have to be perfect?

Agronomic and Engineering Properties of USGA Putting Greens

Recent research demonstrates the importance of choosing the right sand for producing stable putting surfaces.

BY JAMES R. CRUM, THOMAS F. WOLFF, AND JOHN N. ROGERS III

Through practical field experiences and research, the USGA putting green recommendations have been revised a number of times, but at no time were they drastically changed. They remain the standard by which most golf course architects design and golf course construction companies build their highest-quality golf course putting greens.

Rootzone specifications for USGA putting greens require greater than 92% sand, not more than than 5% silt (0.05-0.002 mm), and not more than 3% clay (<0.002 mm) in the soil. Additionally, there must be a minimum of 60% coarse and medium sand, not more than 10% fine gravel and very coarse sand, not more than 20% fine sand, and not more than 5% very fine sand. The resultant rootzone is dominated by macropores (large pores that are air-filled at field capacity) that drain rapidly and maintain large amounts of aeration porosity important for turfgrass growth.

Within the engineering literature, high-sand-content soils are considered cohesionless materials, or materials that do not stick together. High-sand-content soils must rely on particle-to-particle touching and the friction produced to create a stable surface required for the game of golf. As we traveled the United States and visited many golf courses, it became apparent that all USGA specification putting greens do not behave alike. Some have strong, stable surfaces and others have surfaces that are difficult to manage because when a load was applied (i.e., foot or equipment traffic), deformation occurred. With these observations in mind, we initiated research to apply the principles of soils engineering to the issue of ensuring stability of sands used in golf course putting greens.

The specific objectives of the research were to: (1) develop six experimental sands that varied in particle size and gradation to represent a range of USGA specifications, (2) determine bearing capacity of the six experimental sands and relate their strength to size and gradation characteristics of the sands, and (3) determine bearing capacity of established putting greens and relate their strength to sand characteristics.

MATERIALS AND METHODS

LABORATORY TESTING

Laboratory testing focused on the effect of particle size, expressed as median grain size (D50) and gradation, expressed as coefficient of uniformity (CU) on bearing capacity.

Sieve analysis of coarse-grained material (sand, in this case) is generally expressed in two ways: percent retained and percent passing (or percent finer). The United States Department of Agriculture (USDA) has defined five classes of sands based on their particle size: very coarse sand (VCoS, 1.0-2.0 mm diameter), coarse sand (CoS, 0.5-1.0 mm diameter), medium sand (MS, 0.25-0.5 mm diameter), fine sand (FS, 0.10-0.25 mm diameter), and very fine sand (VFS, 0.05-0.10 mm diameter). The USGA has modified these classes slightly in the FS class range (0.15-0.25 mm diameter) and the VFS class range (0.05-0.15 mm diameter).

The percent retained in each class is calculated as the proportion of the total weight of the sample that is of the given size class. The percent passing is calculated as the proportion of the total sample weight that is finer, or passes a particular size (e.g., the percent passing a 2 mm sieve). Often, both ways of expression are presented as tables and as graphical representation of the data. The graphical representation of the percent retained data appear as histograms and of the percent passing as semi-log line graphs. The usefulness of the semi-log graphical presentations comes in the quantification and calculation of coefficients. For example, to determine the median grain size we would determine the D50, or the diameter (D) at

Michigan State University researchers adapted a California Bearing Ratio (CBR) testing device to measure in the field a putting green's soil strength against failure under compression. The CBR device was mounted to a tractor, and a plunger was pushed into the ground with a jack. A load cell with digital readout measured the force on the plunger or the pressure required to deform the putting green surface for each 0.01-inch displacement.

which 50% is larger and 50% is smaller. The coefficient of uniformity, Cu, is calculated as D60/D10, or a way to express the shape of the finest 60% of the percent passing curve. The larger the Cu, the greater the range in particle size and the more well-graded the sand.

Six gradations of sand were prepared for each of three different D50 sizes termed fine (FG), medium (MG), and coarse (CG). For each of these sands, two gradations were prepared: a very uniform gradation with a low Cu (LCU) and a more well-graded one with a higher Cu (HCU). In order to ensure consistency, these six sands were produced in the laboratory. These sands were made from a commonly available construction sand (MDOT 2NS) that had a wide range of particle sizes. To prepare the laboratory gradations, the 2NS sand was divided into a number of very narrow gradations by sieving. These were then recombined to achieve the desired gradations for testing. All six of these test sands were designed to meet the USGA guidelines for golf putting greens.

A soil's strength against failure under surface compressive load is termed its bearing capacity. This was directly tested in the lab by developing a modified California Bearing Ratio (CBR) testing device. This device has a circular plunger with a cross-sectional area of three square inches, which is forced into a sample volume of sand placed in a mold using a load frame. A load cell above the plunger displays the force pushing down on the soil sample. The depth the plunger has penetrated into the soil is measured with a dial gauge. Dividing the force by the piston area gives the applied pressure. The bearing capacity, or ultimate pressure that the soil can withstand before it fails corresponds to the peak of the curve and the soil's bearing capacity.

FIELD TESTING

A field CBR device was adapted from the original California Bearing Ratio testing device. The CBR device can be pinned to the three-point hitch or clamped to the loading bucket of most tractors. The device has a plunger that is pushed into the ground with a jack. A load cell with digital readout measures the force on the plunger. This force is recorded for a set of corresponding vertical displacements of the plunger into the ground, measured by a dial gauge clipped to the plunger arm and measuring movement relative to a reference beam.

The force measured by the load cell is divided by the area of the load piston to obtain the pressure on the surface of the putting green. This calculation is performed for every increment of vertical displacement. Force is recorded at every 0.01 inch of displacement for consistency. The pressure at each 0.01-inch displacement is plotted versus the vertical displacement (Figure 1). The initial part of the curve, labeled A, represents the pressure causing initial deformation of the surface layer. It is obvious from the graph that the surface offers little resistance to deformation. The portion of the graph labeled B shows that increasing stresses are developed as the underlying sand-based rootzone deforms under the surface layer. The underlying sand requires significantly greater stresses to produce additional deformation. At point C the sand fails and further displacement occurs with less stress (area D).

STUDY RESULTS

For the six sands used in this experiment, each falls within USGA specification guidelines but represents the extremes allowable for median size and distribution. Our expectation was that the sands with poor gradation (low Cu) would have lower ultimate bearing capacities than the sands with more well-graded distributions of sand sizes. Sands with poor gradation do not have the internal frictional forces required to make them strong. Sands that are well graded have frictional forces produced by smaller particles fitting within the voids of larger particles.

The bearing capacity tests show the benefits of sands with a high Cu. The laboratory bearing results show the well-graded sands (FGHCU, IGHCU, and CGHCU) were capable of withstanding an ultimate pressure greater than those sustained by the uniform sands. For example, the fine-grained high-Cu sand has an ultimate bearing capacity of approximately 44 pounds per square inch (psi), as compared to an ultimate bearing capacity of approximately 23 psi for the coarse-graded low-Cu sand. The higher-Cu sands have nearly double the bearing capacity as the low-Cu sands. It should be reiterated that although these sands display such a wide variety between their ultimate bearing capacities, they all fall within USGA gradation specifications and would be considered acceptable sands for golf putting green construction.

COMPARISON OF FIELD BEARING TESTS AND LABORATORY BEARING TESTS

The testing conditions in the lab were somewhat different from those in the field. In the lab, there was no layer of turf, organic matter, and roots incorporated in the surface of the soil. Also, in the lab, the sand is contained in a rigid mold that will not allow lateral deformation or strain of the sand. This leads to a well-defined peak stress at failure and a non-ambiguous bearing capacity. In the field, the surface layer applies a tensile confinement that allows significant deformation to occur at increasingly greater pressures on the sand without producing a well-defined peak stress at failure. Also, in the field, the sand-based rootzone can strain or deform somewhat laterally, similarly reducing the tendency to exhibit a peak.

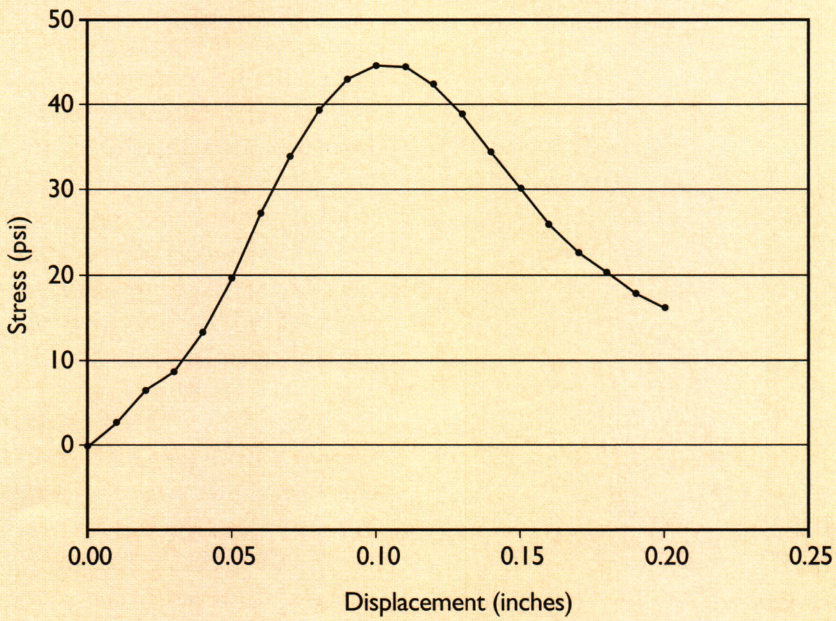
The sand-based rootzone does not reach a distinct failure point because of the tensile confinement applied by the surface layer filled with organic matter and roots. Also, the rootzone material has the freedom to deform laterally and redistribute the pressure to the adjacent soil. Although the field and lab tests are not exactly equivalent, it is noted that the lab results tend to act as upper and lower limits, bracketing the field results.

It is also shown that the slope of the pressure-displacement curves, or rate at which the pressure increases with increasing displacement, is highest for the confined lab bearing test and lowest for the field bearing test. The high rate of increase in pressure due to increasing displacement for the confined lab test occurs because the sand is confined from both lateral deformation (due to the rigid mold) and vertical deformation (due to the applied surcharge). The rootzone material is allowed to deform laterally, thus leading to its lower rate of increase in pressure due to increasing displacement.

Figures 2 and 3 display bearing capacity curves for newly (two- to four-months-old) established golf putting greens constructed of 100% sand (IGHCU) and of a mixture of IGHCU sand and 10% sandy loam textured topsoil. Within each figure the bearing capacity curves of the six experimental sands are also displayed for comparison.

Figure 1

Example Bearing Capacity Curve



In general, the 100% sand bearing capacity curves in the field and in the laboratory compare well, but in the field there is no lateral confinement and no distinct maximum bearing capacity as under laboratory conditions. With the addition of soil, a rootzone mixture with a higher Cu is produced. In fact, our results show a much higher bearing capacity than was seen from the six experimental sands. Qualitatively, it is easy to see and feel that the sand:soil rootzone is firmer and stronger than the 100% sand rootzone. Our data suggest the latter has a bearing capacity on the order of twice as high as the 100% sand rootzone.

To date we have not done enough field testing on a wide enough range of rootzones to develop bearing capacity criteria for what might be "too soft" or "too hard" for golf putting greens. We plan to continue this work and collect field bearing capacities from a wider variety of soils and putting greens to begin characterizing the strength properties of sandy rootzones.

Figure 2

Laboratory Bearing Capacity of Six Experimental Sands

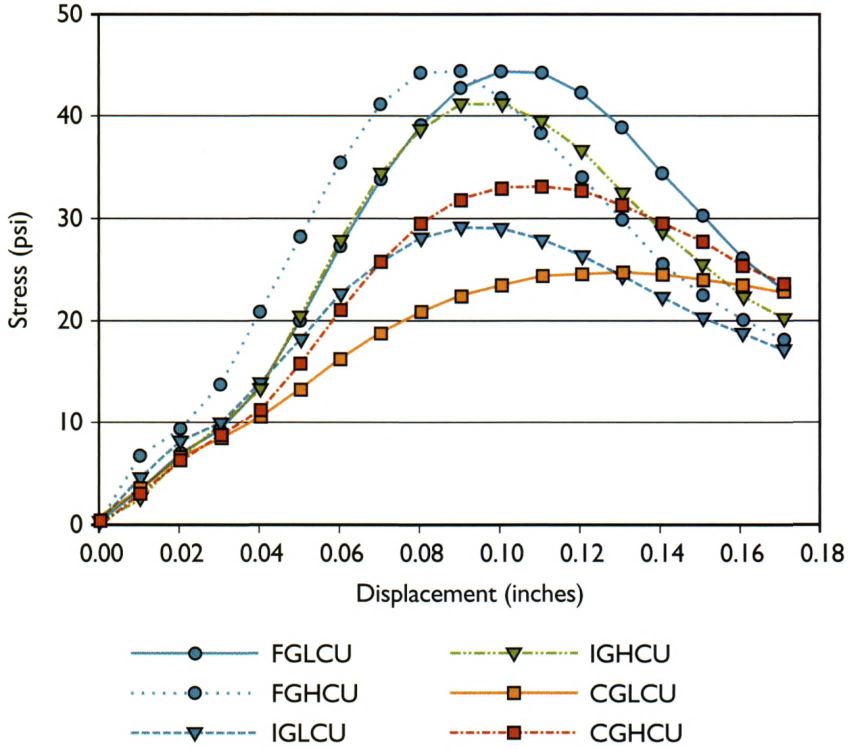
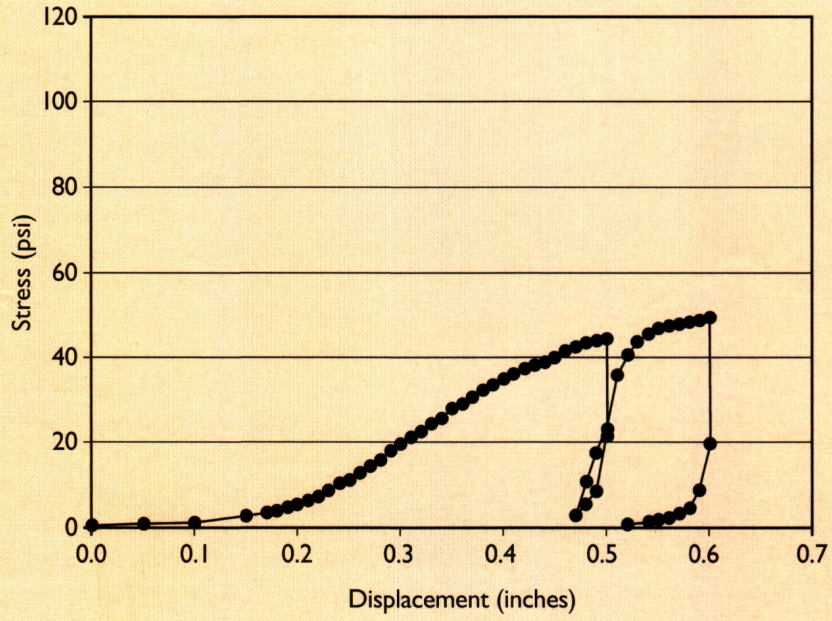


Figure 3

Field Bearing Capacity of 100% Sand Putting Green



SUMMARY

Particle gradation greatly influences the engineering properties of high-sand-content soils. In our studies, increasing the Cu of intermediate grade sands from 1.8 to 3.0 approximately doubled (from 22 to 42 psi) the laboratory bearing capacity. Increasing the Cu in the fine and coarse grain sizes of sands also dramatically increased the bearing capacity of the sands.

ACKNOWLEDGEMENTS

Appreciation is expressed to the United States Golf Association and the Michigan Turfgrass Foundation for their generous support of this research.

Note: This article first appeared in the USGA's *Turfgrass and Environmental Research Online* (http://usgatero.msu.edu). The specific URL for the article is http://usgatero.msu.edu/v02/n15.pdf.

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Identification, Distribution, and Aggressiveness of Spring Dead Spot Pathogens of Bermudagrass

Understanding what organisms cause the disease and their geographic distribution.

BY NED TISSERAT, FANNY IRIARTE, HENRY WETZEL III, JACK FRY, AND DENNIS MARTIN

Spring dead spot (SDS) is a destructive disease of common bermudagrass (*Cynodon dactylon*) and bermudagrass hybrids (*C. dactylon X C. transvaalensis*) throughout the northern range of its adaptation in the United States. It may occur on bermudagrass fairways and putting surfaces of all ages, although it typically appears 3-4 years after the turf has been established. The disease results in the formation of circular or arc-shaped patches of dead turf in early spring as bermudagrass breaks winter dormancy.

The dead patches, which are slightly depressed and straw-colored, may range in size from several inches to several feet in diameter. Roots and stolons of affected plants are dark brown to black and are severely rotted. In some regions, such as Australia and California, patches may be visible on slowly growing, but not dormant bermudagrass following wet, cold weather. Bermudagrass slowly fills in the bare areas during the growing season, and by late summer there may be little or no evidence of the disease. Dead patches reappear the following spring in the same locations.

IDENTIFICATION OF SDS PATHOGENS

Identifying the cause(s) of SDS has been an elusive and frustrating process. We now know that three closely related root-rotting fungi called *Ophiosphaerella korrae* (also called *Leptosphaeria korrae*), *O. herpotricha*, and *O. narmari* cause SDS. It is important to determine which *Ophiosphaerella* species is the cause of SDS at a specific location because these pathogens may differ in seasonal development, sensitivity to fungicides, and aggressiveness to individual bermudagrass cultivars.

Ophiosphaerella korrae ascospores are initially grouped together in a sac-like structure called an ascus. Individual ascospores are light brown, long, and cylindrical with multiple septations. The three *Ophiosphaerella* species that cause spring dead spot can be differentiated by spore length.

Unfortunately, these fungi are not easily distinguished in the field because they cause identical symptoms. They can be differentiated in the laboratory by spore (ascospore) length, with those of *O. herpotricha* being the longest, *O. korrae* intermediate, and *O. narmari* the shortest. However, these fungi seldom produce fruiting structures (called pseudothecia) containing ascospores on diseased bermudagrass stolons and crowns in the field, and only certain isolates can be induced to produce them in culture. Therefore, spore morphology cannot routinely be used to distinguish these fungi.

To facilitate rapid identification, we employed a polymerase chain reaction technique (PCR) to selectively amplify small segments of DNA from the three

Ninety days after inoculation with *Ophiosphaerella korrae* (middle) and *O. herpotricha* (right), the Arizona common bermudagrass roots showed discoloration and rotting. Roots on the left were not inoculated.

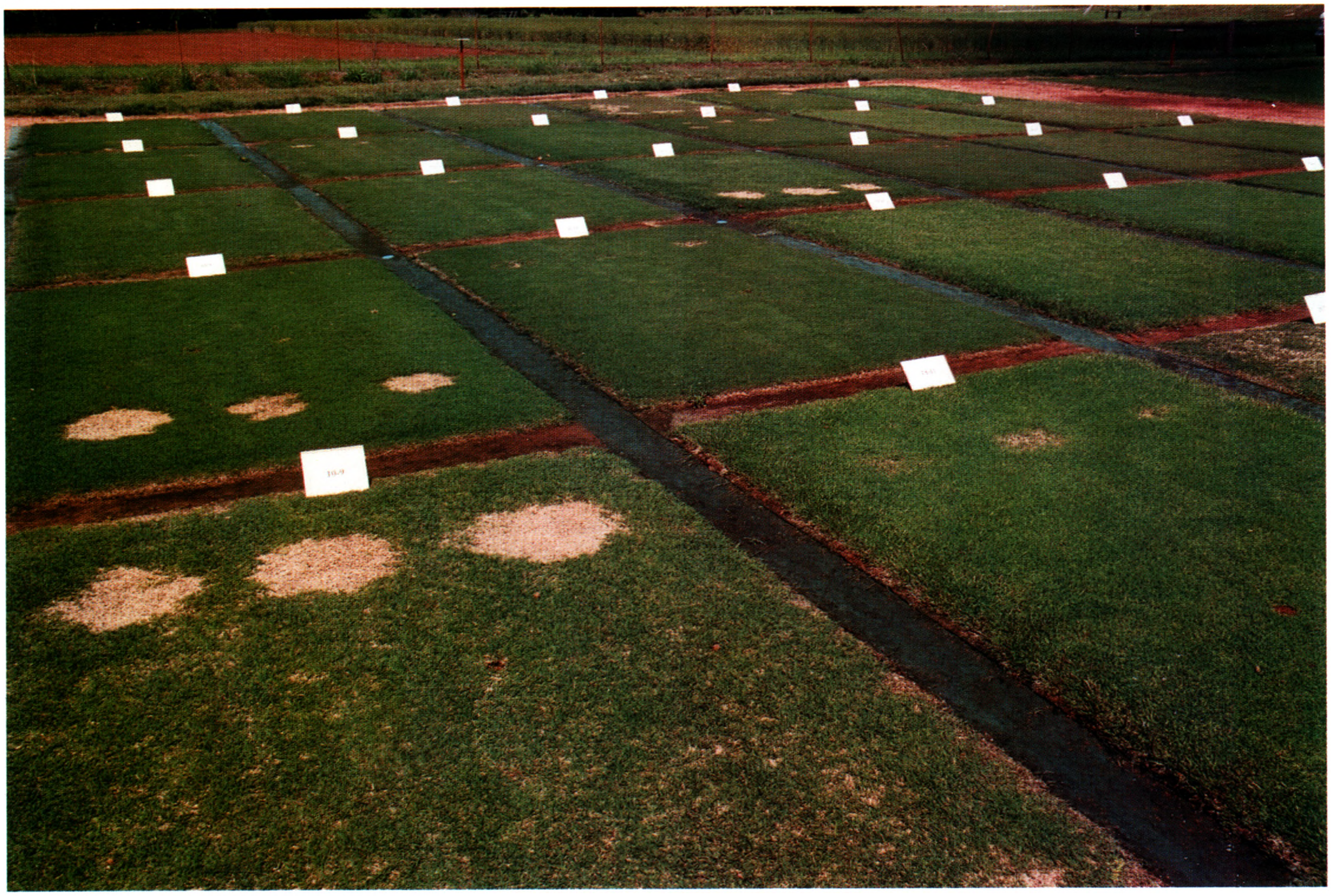
Ophiosphaerella species. By using species-specific oligonucleotide primers, DNA can be differentially amplified following DNA extraction from fungal cultures or diseased tissue. For example, if a PCR reaction is run using primers specific for *O. narmari*, only DNA of this fungus and not others, including other *Ophiosphaerella* species, will be amplified. Thus, the use of PCR primers specific to the three SDS pathogens can be used to determine which fungus is present in a diseased root. Amplified DNA can be detected in several ways, but commonly it is stained, loaded into an agarose gel placed in a buffer solution, and then subjected to an electrical current. As the amplified DNA migrates through the gel, it can be visualized using ultraviolet light.

DISTRIBUTION OF SDS PATHOGENS IN THE U.S.

One of our objectives was to determine the geographic distribution of SDS pathogens. The fungus *O. narmari* had previously been reported to be the primary cause of SDS in Australia, but it had not been found in North America. *Ophiosphaerella korrae* also was reported to be widespread in Australia and was documented as the cause of SDS in Maryland and California, whereas *O. herpotricha* was recovered from SDS patches in Kansas and Oklahoma. However, these early studies provided an incomplete picture of the geographic distribution of SDS pathogens in the United States because they were based on a limited number of samples collected from just a few geographic locations.

Since 1994 we have intensively sampled golf course fairways in several states and also collected a small number of isolates from widely dispersed geographic locations throughout much of the range of where SDS occurs in the United States. Our survey indicates that there are regional differences in the distribution of SDS pathogens. The majority of isolates we collected in Kansas and Oklahoma were *O. herpotricha*. This confirms that this fungus is the primary cause of SDS in the southern Great Plains. The fungus *O. korrae* was isolated less frequently in this region, with almost all of these isolates collected from a single golf course fairway near Afton, Oklahoma. Although only a few *O. narmari* isolates were recovered, they represented the first report of this fungus in North America. *Ophiosphaerella narmari* has since been found in other regions of the United States.

Bermudagrass selections are screened for spring dead spot resistance in replicated field trials in Stillwater, Oklahoma. Each plot was inoculated with *Ophiosphaerella herpotricha, O. korrae,* and *O. narmari*. Several selections showed good resistance to the disease.



In contrast, *O. korrae* was the only SDS pathogen in samples collected at sites in Mississippi, Alabama, South Carolina, Tennessee, and Virginia, and it was dominant in North Carolina. Although the number of locations sampled in each state was small, these results suggest that *O. korrae* is the most widely distributed SDS pathogen in the southern United States. Both *O. herpotricha* and *O. korrae* were collected in Kentucky, with their isolation frequency dependent on the location that was sampled.

The distribution of SDS pathogens in the western United States is less clear, although both *O. korrae* and *O. narmari* have been isolated from samples collected near Los Angeles, California. Further sampling in Arizona, Nevada, California, New Mexico, and western Texas is needed.

The uneven distribution of SDS pathogens in the United States may reflect regional differences in native ranges of these fungi. While *O. herpotricha* has been isolated from buffalograss lawns exhibiting SDS symptoms, it has not been isolated from this or other native grasses in natural prairie stands. Therefore, we are still uncertain whether this fungus is native to the Great Plains.

It seems unlikely that *O. korrae* is native to North America since bermudagrass and Kentucky bluegrass (the fungus causes necrotic ringspot on this host), the primary hosts for this fungus, are exotic grasses. An alternative explanation is that *O. korrae* was introduced and dispersed on infected bermudagrass roots and stolons. Thus, *O. korrae* might have initially infected an improved bermudagrass cultivar adapted to a specific geographic region and then was dispersed via contaminated sod/sprigs across a wide geographic area.

A study by Wetzel et al. supports this hypothesis. They found that *O. korrae* isolates collected from several southern states were genetically similar based on DNA fingerprinting techniques. These isolates differed substantially from *O. korrae* isolates collected from Kentucky bluegrass and bermudagrass in more northern regions of the United States. These northern isolates also were genetically similar. We believe that *O. korrae* may have been introduced into North America, with one or a few initial introductions occurring on bermudagrass in the southern United States and another introduction in more northern regions on Kentucky bluegrass. Further genetic studies are needed to confirm this hypothesis. Nevertheless, these results are strong evidence that this pathogen has been moved from one location to another on infected stolons or roots.

AGGRESSIVENESS OF SDS PATHOGENS

We were also interested to see if there were differences in SDS severity following inoculations with *O. herpotricha, O. korrae*, and *O. narmari*. A two-year-old stand of Midlawn bermudagrass at the Kansas State University John Pair Research Center, Wichita, Kansas, with no previous history of SDS, was inoculated in September 1997 with the three SDS pathogens. All 14 sites inoculated with *O. herpotricha* developed symptoms in 1999. The patches reappeared and had expanded in diameter in May 2000.

In contrast, only 10 of 14 sites inoculated with *O. korrae* developed symptoms in 1999, and of those only 7 appeared the following year. Patch diameters associated with *O. korrae* were significantly smaller than those caused by *O. herpotricha*. Unfortunately, this study did not include any *O. korrae* isolates from the southern region. Only one of the sites inoculated with *O. narmari* developed SDS, and the patch diameter of this spot was small.

These preliminary results indicate there are differences in aggressiveness of SDS pathogens to the bermudagrass

Table 1
Identification of *Ophiosphaerella* species isolated from bermudagrass cores collected in various states.

Location	Collection Date	Number of Isolates: *O. herpotricha*	*O. korrae*	*O. narmari*
Alabama, Vestavia Hills	1999	0	20	0
Arkansas, sites unknown	1994	0	6	0
California, Los Angeles	1983, 1999	0	2	4
Georgia, sites unknown	1994-1996	0	3	0
Kansas, 20 sites	1984-2000	55	0	1
Kansas, Independence	1994	71	9	0
Kentucky, Mayfield	1998	2	13	0
Kentucky, Henderson	1998	14	5	1
Kentucky, Paducah	1998	0	17	0
Mississippi, Starkville	1999	0	18	2
Missouri, Dunklin County	1996	2	0	0
North Carolina, 12 sites	1999-2000	0	63	1
North Carolina, Raleigh	1999-2000	12	5	0
Oklahoma, Afton	1994-1996	201	38	22
Oklahoma, Jenks	1994	173	0	0
South Carolina, 8 sites	1999-2000	0	16	0
Tennessee, Knoxville	1999	0	15	0
Texas, Dallas	1996	3	0	0
Virginia, Virginia Beach	1999	0	20	0
Virginia, Charlottesville	1999	0	5	0
Virginia, site unknown	1999	0	4	0
West Virginia	1999-2000	0	11	0

Table 2

Development of spring dead spot on Midlawn bermudagrass following inoculation with *Ophiosphaerella herpotricha, O. korrae*, and *O. narmari* in Wichita, Kansas.

	1999		2000	
Fungal Species	**Number of inoculation sites with dead spots**[X]	**Patch area (cm^2)**[Y]	**Number of inoculation sites with dead spots**	**Patch area (cm^2)**
Ophiosphaerella herpotricha	14	374a	14	1120a
Ophiosphaerella korrae	10	78b	7	264b
Ophiosphaerella narmari	1	46c	1	79c
Sterile oats	0	—	0	—

[X]Number of 14 inoculation sites for each species in which spring dead spot symptoms developed. Plots were inoculated in September 1997 with three isolates of each species and were rated in May of 1999 and 2000.

[Y]Average patch area for those inoculation sites in which spring dead spot symptoms developed. Patch diameters not followed by the same letter are significantly different (P<0.05) by Fisher's LSD test.

hybrid Midlawn grown under Kansas conditions. Further studies are needed to determine if this pattern holds true for other cultivars and in other locations. If so, it indicates that the pathogen needs to be considered when screening bermudagrass cultivars for regional differences in resistance to SDS.

SCREENING BERMUDAGRASS FOR RESISTANCE TO SPRING DEAD SPOT

Only a limited amount of success has been achieved in controlling SDS by cultural means. Control by fungicide applications has proved to be expensive and inconsistent. A promising approach to SDS control is development and deployment of resistant bermudagrass cultivars. Oklahoma State University has an active bermudagrass breeding program to develop vegetatively and seed-propagated bermudagrasses with increased resistance to SDS. Currently the screening process involves inoculating established bermudagrass in replicated field plots.

SDS symptoms do not develop with consistency until two years after inoculation, and measurements need to be continued for several growing seasons to insure consistent ratings. Thus, screening is an expensive and slow process. Nevertheless, this method has been used successfully to identify several bermudagrass selections with increased resistance to SDS. They include the vegetative selections Midlawn and Patriot and the seeded varieties Yukon and Riviera. These varieties, while not immune to SDS, consistently exhibit smaller dead spots and recover more quickly from the disease than susceptible varieties.

We are attempting to develop a more rapid greenhouse and laboratory method for screening large numbers of bermudagrass selections for SDS resistance. Previous attempts to correlate root discoloration and rotting observed in the laboratory to resistance ratings in the field were unsuccessful. In these studies, bermudagrass was not subjected to a freezing treatment, as would occur in the field, and no shoot mortality transpired. Hence, exposure to cold temperatures appears necessary for complete expression of SDS symptoms. Nus and Shashikumar found that inoculation with *O. herpotricha* and *O. korrae* reduced the ability of bermudagrass to withstand freezing temperatures. We are in the process of refining procedures for exposing inoculated bermudagrass to freezing temperatures to optimize symptom development in the laboratory.

SUMMARY

We now know that at least three closely related root-rotting fungi are responsible for SDS, they have regional distributions in the United States, and they vary in their aggressiveness to bermudagrass. We have also identified bermudagrass selections with increased disease resistance to *O. herpotricha*. Nevertheless, SDS remains a serious and largely uncontrolled disease of bermudagrass on many golf courses throughout the United States. Control of this disease will require a more comprehensive understanding of pathogen biology, disease epidemiology, and host resistance.

ACKNOWLEDGEMENTS

This research was supported by the United States Golf Association and the Kansas Golf Course Superintendents Association.

Note: Further information on this topic may be found at: http://usgatero.msu.edu/v02/n20.pdf.

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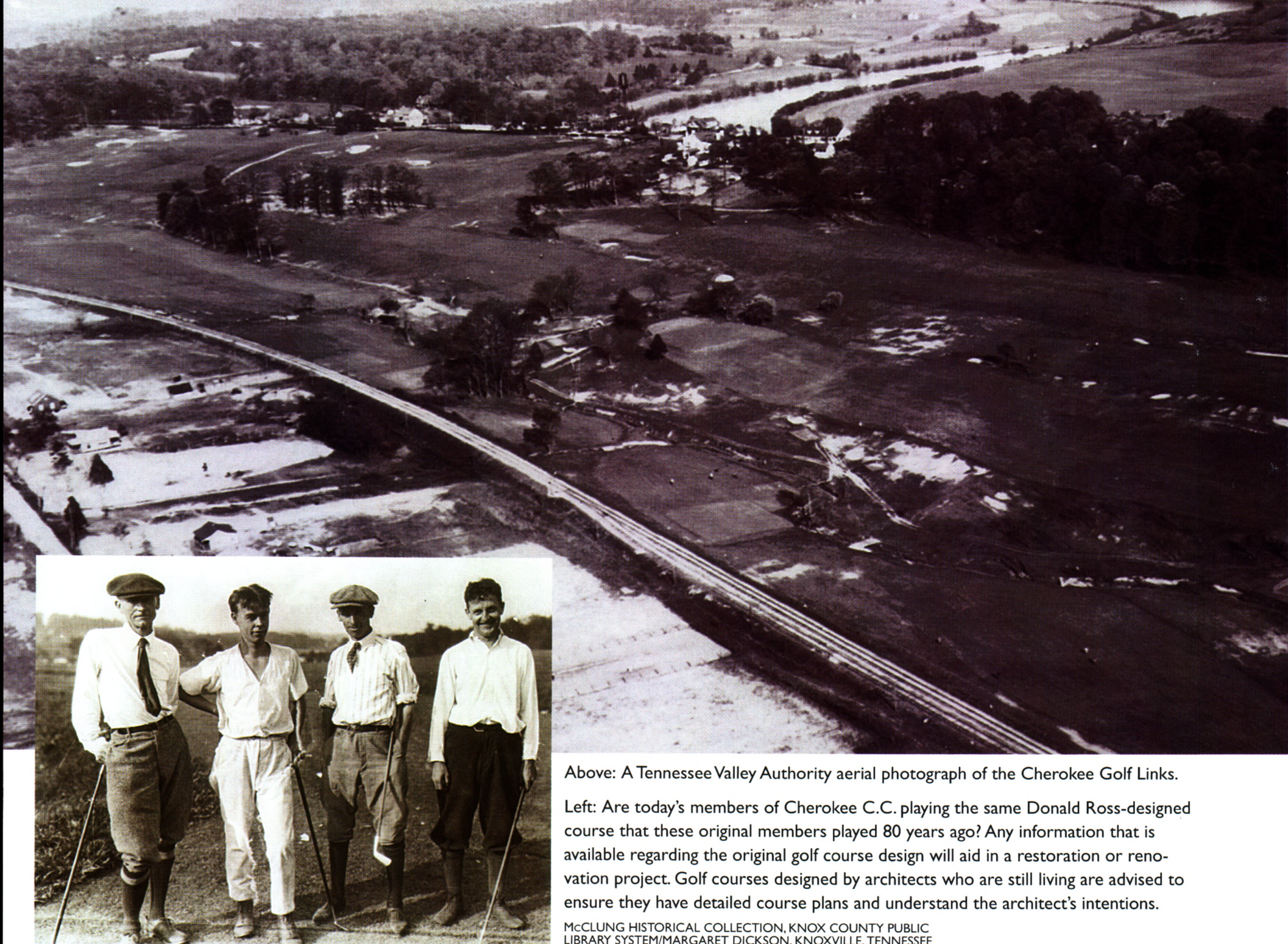


Above: A Tennessee Valley Authority aerial photograph of the Cherokee Golf Links.

Left: Are today's members of Cherokee C.C. playing the same Donald Ross-designed course that these original members played 80 years ago? Any information that is available regarding the original golf course design will aid in a restoration or renovation project. Golf courses designed by architects who are still living are advised to ensure they have detailed course plans and understand the architect's intentions.

McCLUNG HISTORICAL COLLECTION, KNOX COUNTY PUBLIC LIBRARY SYSTEM/MARGARET DICKSON, KNOXVILLE, TENNESSEE

Taking Your Course Back to the Future

Preserving important architectural documents can serve as future building blocks.

BY CHRISTOPHER C. SYKES

Sometimes you have to look to the past to see the future, which should always be the case when it comes to the classics. Cherokee Country Club (Knoxville, Tennessee) was founded in 1907, and the existing course was designed by Donald Ross in 1920. When I accepted the golf course superintendent position in 1997, the course had no plan, no vision, and no mission.

Due to this lack of planning, changes were made to the golf course with no regard to their long-term impact. Well-intentioned members implemented their own ideas for the golf course, which generally included some type of landscape planting. Architects were employed with little regard for preserving Ross's work. This classic, links-style golf course was slowly but surely evaporating, and everything that Ross had envisioned was being erased. The club desperately needed a plan and it made sense to look to the past, since, arguably, the greatest architect of all time had already developed a plan for the golf course. This proved to be no easy task.

The club had no information about Ross's involvement, and it was rumored

Restoring a golf course to the original architect's design is much easier if the plans have been saved.

that Cherokee Country Club may not be a Ross course. Our club historian had opinions, but no facts to back them up. Every nook and cranny throughout the clubhouse was searched with no success. Although we kept striking out, with each effort we learned a little more or uncovered clues as to where else to search. Knoxville's local historical society had a file on Cherokee Country Club that contained a series of low-level aerial photographs. The photographs showed the same routing, but with bunkers everywhere and no trees. This was our first big find.

We read through old newspaper articles hoping to find a clue as to Ross's role at Cherokee. Although this question wasn't answered, we did discover a lot of history about the golf course that had been lost through the years. I started writing a monthly excerpt in the club newsletter highlighting what we had found about the course history.

The Ross Society and the Tufts archives at the Given Memorial Library in Pinehurst had no additional information, but they considered Cherokee Country Club a Ross course. Khristine Januzik, curator at the Tufts archives, made numerous worthwhile suggestions about other places to search.

Another important find, located in the club's safe, were the minutes from past board of directors meetings that documented Ross's involvement with the club. The following are quotes from the minutes:

July 15th, 1919 — "On motion the Green Committee was authorized to employ Donald Ross to inspect and suggest improvements to the Greens."

March 3rd, 1920 — "The bill of Mr. Donald Ross amounting to $560 for drawing new plans for the golf links was submitted and ordered paid."

This important find validated that Cherokee Country Club was indeed a Ross course. Plans existed, but where were they? Also in the safe was a safety deposit box ticket. The ticket listed the contents of the box, including a notation "golf course plans." Unfortunately, the ticket dated back to the 1950s and the bank had long since closed. We have yet to find the actual plans, but maybe someday they will turn up.

So where do you go without the actual plans? The next best alternative is photographs, especially aerial photographs. The low-level aerial photographs were helpful, but they didn't accurately show the entire course. Later it was determined that the photographs must have been taken in the early 1920s.

The Tufts archives curator suggested contacting other Ross courses in the area because he sometimes made mention of area courses on some plans. Holston Hills is a 1927 Ross course just a few miles from Cherokee. Holston Hills historian John Stiles found many of Holston's original drawings and came across some fantastic aerial photographs. He mentioned that the Tennessee Valley Authority (TVA) made a practice of taking aerial photographs along waterways. Cherokee Country Club overlooks the Tennessee River, and the TVA had taken an aerial photograph of our area about once every decade. We were able to obtain photographs from the 1950s and '60s, but anything older had been sent to the National Archives in Washington, D.C. It took some work, but once we got our hands on the 1939 TVA aerial photograph of the Cherokee Golf Links, we had a good idea of what Ross had intended. This aerial photograph later became the backbone for our long-range master restoration plan.

Throughout this research process we conducted interviews for a restoration architect. Ron Prichard was chosen for his interest in staying with the integrity of the original architect's design. The majority of his master restoration plan for Cherokee came from the 1939 TVA aerial photograph and from his vast knowledge of Ross's architectural style.

We also interviewed long-standing members, past members, long-term employees, past employees, and anyone else who might have some knowledge as to what had existed. The most interesting and revealing interview was with Mrs. Margaret Dickson, whose father was Jimmy Dickson, Cherokee's first golf professional and greenkeeper. Mrs. Dickson still lives just off the second hole in the same house where she grew up. This house used to sit on what is now the first fairway, but she remembers one winter she and her mother went home to Scotland. When they came back, the house had been moved to where it sits today. She also remembers Vardon and Ray having dinner at their house when they were in town, and her father going to Pinehurst to visit Mr. Ross on numerous occasions.

You can see in the low-level aerial photographs that the course was undergoing a transition from the original 18 holes laid out by members in 1910 to the Ross routing that still exists today. Interestingly, there are no similarities between the two courses, and every hole was changed. Through the minutes it is clear that the club was implementing Ross's plan during the 1920s until the Great Depression hit. Shortly thereafter, Mr. Dickson died and as a result Ross's plans were never completed.

The 1939 TVA aerial photograph showed that some of the holes were complete, with numerous bunkers, and other holes still had no bunkers. Ironically, the holes closest to Mr. Dickson's home were the most complete. Today we still are trying to finish Ross's vision for Cherokee Country Club that he laid out more than 80 years ago. We are restoring what we know existed, and we are relying on Ron Prichard's expert knowledge for the rest. We have an excellent long-range master restoration plan in place and are well on our way to restoring the golf course.

The following were some other sources of information:

- Talked to other golf course architects who have worked on the course.
- Contacted former contractors who worked at Cherokee Country Club.
- Talked to the University of Tennessee athletic department because the University of Tennessee used to play matches at Cherokee.
- Contacted former board and committee members to see if their families knew any historical information.
- Went to the county courthouse and talked to the metro planning commission and city engineering department because course plans may have been submitted to acquire permits.

There are still a number of leads to follow up on and we continue to do research. Maybe someday Ross's plans will surface.

CONCLUSIONS

Having the desire to make a golf course better is easy. Making a change that improves the course in a meaningful way is much more difficult. I have discussed several ways to learn about your golf course's past in order to make sure that future changes are in line with the original architect's intentions. If the architect who designed your course is still alive, you are much further along the road to making improvements.

The Honors Course in Ooltewah, Tennessee, has subscribed to this very theory. When the course was built just 20 years ago, it was regarded as one of the most difficult courses in the country. Things have changed, however, with increased ball flight being the largest contributing factor. The winning score in the 1999 Tennessee State Amateur was 13 shots lower than what was recorded ten years prior.

David Stone, golf course superintendent at The Honors Course since its inception, suggested they bring back Pete Dye to make recommendations on how to combat the changes that were taking place. Mr. Dye stated the best way to recapture the course's integrity was to lengthen the long holes or most difficult holes versus lengthening the easier holes. In 2003 they added 160 yards to recapture some of the integrity of Dye's original design. The course now measures 7,230 yards from the back tees.

Periodic alterations by the original architect are not without precedent, and it doesn't mean the original plan was flawed. Donald Ross made changes to Pinehurst No. 2 more than a dozen times, so if you can, keep your architect on retainer. Schedule an annual visit to talk about the different things that can be done to continue making your course better. Learn from our experience and document everything. Golf courses are living entities that constantly evolve. Greens or bunkers may change shape over the years without you even noticing. Save architectural drawings and take numerous pictures to compare them to later versions. Whether it's a brand-new course or one built at the turn of the 20th century, protect and save your past because you will need it for the future.

It is unlikely the original architect intended for trees to block the left side of this cape hole, but tree encroachment over the years now interferes with the playability of the hole.

CHRISTOPHER C. SYKES *is golf course superintendent at the Cherokee Country Club.*

The Beer is Colder When the Grass is Greener

Course conditions can affect golfer perceptions of other club facilities.

BY JEFF HEILBRUN, CCM

Teton Pines Resort and Country Club (Jackson Hole, Wyoming) has undergone many changes in golf course management over the last few years. As general manager, I have had the mixed fortune of seeing our golf course go through some difficult times and then come out on the other side.

In the spring of 2001, we woke up from winter in shock. More than 70% of our greens were in bad shape from both pink and gray snow mold. Five of the greens had 25% healthy grass at best, and two of them were closer to 10%. Almost all of our tees were given last rites. The weather that spring was terrible, so recovery was excruciatingly slow.

Luckily, I had hired Mike Kitchen as our new golf course superintendent during the winter, so I could discuss our operation with a clear conscience, not knowing what lay beneath the snow. Our first phone call was to Matt Nelson, our USGA regional agronomist. The short-term forecast was pretty grim and, as it turned out, it was August 1st before some of our greens had any semblance of recovery.

The interesting thing to me as a general manager was that we also didn't have the best year in other parts of the operation. There were complaints about our snack bar, lounge, and food and beverage operations, and golf shop sales were down even though we didn't change the way we operated those departments. I witnessed what I now realize was evidence that our golfers were looking at the club through a lens clouded by a golf course they could not be proud of. An end-of-the-season member survey acknowledged the poor course conditions, and asked for other comments not related to course conditions, but we still received a very high number of comments about the greens and tees.

Following new agronomic practices put into place by Mike and making diligent efforts with winter preparation, including earlier-than-normal aerification, the next spring was much better. At the same time, we still had remnants of disease. As both Matt and Mike reminded this turf-simple mind of mine, patience is a virtue and we were headed down the right path.

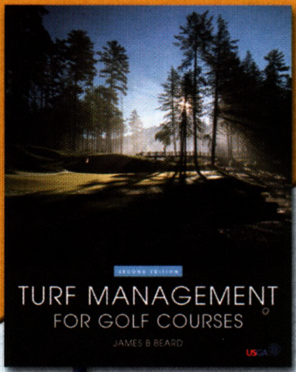
Enter spring 2003. Our superintendent has risen to saint status and "the grass is greener and the beer is suddenly colder." While most of this article is anecdotal, in reality the beer temperature hasn't changed. Our menus haven't changed much and the snack bar is about the same, but the golf course is dramatically different. Our members are proud of our course again, and we set records for the number of lunches served last year. Food and beverage service complaints were minimal, and our member golf events were well subscribed.

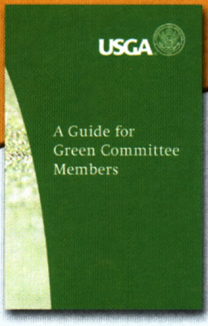
The moral of this story is that golf course conditions affect the entire club — financially, psychologically, and in many other ways. Past decisions to delay aerification until as late as possible so that our players didn't suffer putting on bumpy greens put us at great risk if early fall weather conditions turned sour as they did in the fall of 2000. By waiting so late to aerify, we couldn't properly drag in the topdressing sand, which resulted in damaged grass leaves and aerification holes that weren't completely filled. We neglected sound agronomic practices in favor of overconcern for upsetting the golfers. The irony is that we ended up with course conditions that upset members and guests for a full season.

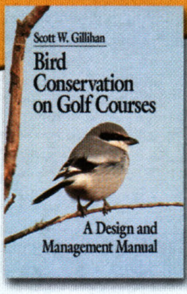
Now we aerify more often and agronomics come ahead of just about everything, while striking a balance with golf course access. We have a superintendent who understands the importance of the revenue side of our golf operation and instills an understanding of proper golf course care to the golf professional staff.

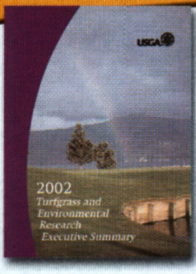
In this time of economic uncertainty, keeping the jewel of your operation in extraordinary condition ensures loyalty from your existing customer base and makes the rest of your golf operation look that much better to your players. By the way, you may notice a difference in your bottom line as well. Thanks to an understanding ownership, an experienced superintendent, and the services of the USGA Green Section, we're back on top of our game.

JEFF HEILBRUN, CCM, *is general manager, Teton Pines Resort and Country Club, Jackson Hole, Wyoming.*









Publications

Turf Management for Golf Courses: 2nd Edition

by James B. Beard and the USGA Green Section staff

This comprehensive volume is an invaluable guide to turf cultivation and management. It is designed for golf course supertintendents and Green Committee members, and contains hundreds of step-by-step instructions, techniques, and methods that cover every important aspect of a successful turf management program. 793 pages. **PG1100 $125.00**

Building the USGA Green: Tips for Success

by USGA Green Section staff

This 34-page booklet will guide you through the process of building a USGA Green. **PG1112 $4.50**

Golf Course Management & Construction: Environmental Issues

edited by Dr. J. C. Balogh and Dr. W. J. Walker

A comprehensive summary and assessment of scientific research on the environmental effects of construction and management of golf courses. An excellent reference book for golf course architects, developers, superintendents, and Green Committee members. 937 pages. **PG5275 $104.95**

A Guide for Green Committee Members

This booklet is designed to help guide Green Committees past the common pitfalls, show the opportunities of participation in the Green Committee, and assist in making the Committee work as an asset to the golf course. It highlights the features of the Green Section, defines common agronomic terminology, and provides a list of references and resources for additional information. **PG1715 $2.00**

Making Room for Native Pollinators

by Xerces Society

These guidelines help golf course superintendents plan and manage out-of-play areas for beneficial pollinating insects. **PG5002 $5.00**

Bird Conservation on Golf Courses

by Scott Gillihan

Funded through a grant from the USGA's Wildlife Links Program, this practical, hands-on manual is an excellent reference for golf course superintendents, golf course architects, and land managers. The book discusses managing habitat areas on golf courses and similar settings to benefit birds. 335 pages. **PG5250 $34.95**

2003 Turfgrass and Environmental Research Summary & 2003 Executive Summary

The accomplishments of the current research projects funded through the USGA Turfgrass and Environmental Research Program are summarized. Also included in the document is a list of the ten research projects to be conducted on the construction and maintenance of greens. **NS1640 and NS1651 No charge**

Wastewater Reuse for Golf Course Irrigation

edited by James T. Snow, et al

The first book to address issues of wastewater reuse, it features practical case studies, reviews regulations, and explains how to design a system. Perfect for golf course superintendents, irrigation consultants, architects, and builders. 294 pages. **PG5265 $99.95**

Reviewing Golf Course Proposals: Materials for Local Officials

by Billie Jo Hance and Jim Morris

An informational packet oriented to community land-use planners to assist communities in the crucial planning phase of golf course development. Includes basic environmental questions communities should ask when reviewing golf course proposals. **PG1718 $5.00**

Golf and the Environment

A 20-page technical summary describing the environmental benefits of turfgrasses. **PG1644 $3.00 each; 20+ copies, $2.00 each**

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On Course *With Nature*

Showcasing Florida's Unique Wetlands

Removing exotic plant material to restore native plant communities.

BY MATT TAYLOR

At Royal Poinciana Golf Club (Naples, Florida), there once was wetland infested with Brazilian pepper. No more. Now, the golf course showcases a large, thriving cypress stand to the east side of fairway 13 on our Pines Course. Big cypress fox squirrel and wood ducks make their home here, as do numerous other wildlife species. Golfers enjoy a new horizon as they play the hole. But that's how my story ends. Let me take you back to the beginning.

Brazilian pepper is one of the most aggressive and widespread of the non-indigenous plants thriving in wetland and upland habitats in Florida. This hearty tree, introduced from South America in the 1800s, spreads easily when fruit-eating birds, such as migrating robins and catbirds, eat the fruit and drop the seeds in their travels. Brazilian pepper covers hundreds of thousands of acres in south and central Florida, growing so densely that it physically and chemically prevents the growth of our native plants. It's made the state's Top Ten List of most unwanted plants for years now because of the damage it causes our native plant communities.

A Brazilian pepper hedge infested a 40,000-square-foot pine upland on the northern edge of Royal Poinciana's wetland. In addition, a 25-foot Java plum hedge planted along the property line some years ago also obscured the view of the wetland (Java plum is another exotic that invades and disrupts native plant communities). My thought was to open up a more aesthetically pleasing view from the fairway and create a corridor for more mammals and birds by getting rid of the exotic vegetation.

Brazilian pepper and java plum are aggressive non-indigenous plants that thrive in Florida wetland and upland habitats. At Royal Poinciana Golf Club they blocked views of a mature cypress wetland that represents native Southwest Florida.

Realistically, I knew this was going to be a huge project. Change does not come easily to a club that has been around for 35 years, and the result of removing the exotics would be dramatic. This area had always been a large hedge of massive outcropped Brazilian pepper, and, once finished, it would be an open void for a few years until the new plant material grew in.

Over a period of two years, I showed the green committee chair and several club members what lay beyond the hedge. I literally walked through the woods with them to explain what I had in mind. Their responses were encouraging, so I wrote articles about the project in our club newsletters to plant the seeds for change. I asked the opinions of other superintendents and colleagues within the industry. More positive responses gave me confidence that this was the right thing to do. I called an exotic removal company, obtained an estimate, and went to the board during the budget process. The project was approved.

Even up to the time when we began cutting trees, I continued to bring people out and let them know what was going to be done. This included the

A thorough communications campaign was followed by an extensive removal project of the exotics. The results were dramatic, and in a few short years this open void will showcase one of Southwest Florida's unique and valuable natural habitats.

golf professional, club manager, tennis professional, the green committee chairman, golf chairman, club president, landscape architects, golf course architects, and fellow superintendents. Communicating what was to be done, what it would look like, when it would be completed, what it would cost, and, equally important, *what was in it for the membership* was key.

GETTING THE JOB DONE

Because of the scope of the project, we selected a contractor to remove the exotic plant material. We waited to start until after our busiest golfing months due to the disruption we knew that the chainsaws and chippers would cause. The contractors began by removing the Java plum hedge and working their way down the edge of the wetland from the wettest area into an area that would stay dryer longer.

My goal during the removal process was not to have the area look as if a bomb had gone off when we finished. We removed as much of the chippings as possible, even bringing in additional labor to rake up chippings when rain prevented us from getting dump trucks to the area. Once all the material was out, we started to re-vegetate some of the large areas. On the north side of the wetland, we planted live oak, cypress, and cord grass. We laid pine straw as natural-looking mulch to help control weeds. This area will not require much ongoing maintenance, just some occasional weed control, touch-up pine straw, and monitoring to ensure that the pepper hedge does not come back.

In all, we removed two acres of exotic plant material. Though the horizon line of the hole has been dramatically altered, I have not heard any complaints. Golfers have gained a view of a mature cypress wetland that is representative of what Southwest Florida used to look like. The golf course now showcases, rather than obscures, one of Southwest Florida's most unique and valuable natural habitats.

MATT TAYLOR *is golf course superintendent at Royal Poinciana Golf Club, a 36-hole private club in Naples, Florida. The course achieved designation as a Certified Audubon Cooperative Sanctuary in 1996. Taylor received the 1999 GCSAA Private Course Environmental Steward Award for his work at Bonita Bay East, a 36-hole Audubon Signature Sanctuary.*

All Things *Considered*

GET REAL!

When maintenance programs are altered by weather, turf quality expectations need to be adjusted as well.

BY KEITH A. HAPP

"What will it hurt if one or two of us play the golf course?" In this case, the response to this commonly asked question was that it took only one person walking on an early morning, frost-covered surface to find out what it will hurt! This damage will take a long time to heal, and all of the golfers will have to wait for the green to recover from the damage caused by one golfer.

Weather patterns over the last two golf seasons have fluctuated wildly in the Mid-Atlantic Region. This offers confirmation that the business of managing golf course turf is dynamic; we are trying to manage turf during periods of extremes. Yet, when the weather changes, golfer expectations often do not. When the sidewalks are dry, regardless of all other conditions, golfers expect the course to be ready for play. During periods of bad weather, tolerance of disruption and course closure is low. Often, the passion for the game focuses on the present and not on long-term damage that can result from playing on turf that is under extreme stress. Turf managers plan and try to be as proactive as possible, but one thing is for sure — Mother Nature is in charge. Weather dictates what can be accomplished and, of course, what can be presented to the golfers.

Early in the spring the mantra begins, "What will it hurt?" There are always small groups of golfers who have to play when there is frost on the greens and the soils are still frozen. How much damage can one person do? How about two, three, or five? Where do you draw the line, and who has the best interest of the course in mind? The golf course superintendent is not trying to close the course so he or she doesn't have to come to work — they are protecting the golf course, the primary asset of most facilities. "What will it hurt?" Much more than you think.

With the emergence of spring comes the need for golf course preparation. For turf, this usually centers on aeration. Core cultivation is performed, debris is collected, and topdressing is applied. It sounds simple and, in fact, this procedure is one of the basic agronomic programs used at practically every course. The logistics of aeration, particularly putting green aeration, are challenging primarily because of the efforts made to minimize golfer inconvenience. However, logistical planning really becomes burdensome when rain occurs. When aeration is performed under wet conditions, the potential for damage increases dramatically. The flexibility to alter the maintenance schedule for inclement weather is not always provided. Golfer protest against completing aeration on an alternate day can delay or eliminate the procedure altogether, potentially setting the stage for disaster later in the season. Again the mantra, "What will it hurt?" Insisting that aeration be conducted at the wrong time of year increases the time needed for healing and negatively impacts playability. Delaying aeration by a week or a month, or omitting it until late in the fall so as to not inconvenience golf, costs more than you think!

As the season progresses, a desire for faster green speed dominates conversations. "What can it hurt? Just drop the height of cut so the greens will play the way we want to have them for a successful event." The ability to provide the desired playability level begins with the completion of essential treatment strategies to prepare for worst-case weather scenarios. When weather disrupts play, it may also mean that the completion of maintenance has been hampered. No one likes a rain delay,

especially if it interrupts golf course maintenance activities during the heart of the season. It takes time to catch up on maintenance, especially mowing, and the last thing that needs to be done is to create an unnecessary stress on the turf by mowing when it can and should be avoided. When soils are saturated, turf decline begins well before visual signs are evident on the playing surface. Mowing too low and at the wrong time can result in catastrophe. "What can it hurt?" More than you think!

A certain tolerance of necessary maintenance should be afforded, and this should be accompanied by establishing an acceptable range of playing conditions. Height of cut changes should be proactive, not as a result of damage that could have been avoided. When soils become saturated, other forms of relief may be needed. Poking a hole (aeration) will make a difference, and there are relatively non-disruptive procedures that can be used to accomplish the desired effect. Tools and practices can be used to stay one step ahead of turf decline.

The mantra can be reversed. Ask golfers, "What can it hurt . . . to allow a maintenance practice to be completed?" The turf manager has to be flexible and willing to adapt to the conditions presented. Golfers should participate in course maintenance by accepting some level of minor disruption when it is necessary to sustain the playing surfaces. It's about compromise and doing what is right. While a facility may have all of the tools that money can buy, it means little if they are not used when benefits will be provided for the turf. Weather is a variable that cannot be controlled. Maintenance programs that allow for preparation in advance of the worst possible scenario can help avoid turf decline during the heart of the season. Every turf manager wants to be as proactive as possible, and being able to adjust, adapt, and act is part of the business of managing turf. Let it happen and get real about expectations.

KEITH A. HAPP *is a senior agronomist in the Mid-Atlantic Region and has a sub-regional office located in the Pittsburgh, Pa., area, bringing him closer to the courses in the western portion of the Mid-Atlantic Region.*

News *Notes*

GREEN SECTION STAFF MEMBERS RECEIVE INDUSTRY RECOGNITION

Bob Brame, director of the North-Central Region, was honored on December 10, 2003, with the Ohio Turfgrass Foundation (OTF) 2003 Professional of the Year Award.

Bob Brame (left) accepts the Ohio Turfgrass Foundation 2003 Professional of the Year Award from Dennis Warner (Kenwood C.C., Cincinnati, Ohio).

Recipients are nominated by the OTF membership, and the final selection is made by the OTF Awards, Grants, and Scholarships Committee. Nominees are judged on fellowship, leadership in developing new ideas and trends in turfgrass management, activity in turf-related and other civic organizations, and length of dedicated service to the turfgrass industry.

After attaining an Agriculture B.S. degree from Purdue University, Bob worked as a superintendent at golf courses in Mexico, Illinois, and Indiana from 1972 to 1990. He joined the Green Section staff in 1990 as an agronomist in the Mid-Atlantic Region. In 1994 he accepted his current position as director of the North-Central Region, residing in Covington, Kentucky.

Jim Snow was honored with the New Jersey Turfgrass Association 2003 Hall of Fame Award and the 2003 John Reid Lifetime Achievement Award given by the Metropolitan Golf Course Superintendents Association.

Jim Snow, national director of the USGA Green Section, was recognized by the New Jersey Turfgrass Association with the 2003 Hall of Fame Award. This honor is presented annually to a person in recognition of continuing lifetime commitment of dedication, service, and achievements contributing to the advancement of the turfgrass industry of New Jersey. The Hall of Fame Award was presented at the New Jersey Turfgrass Conference in Atlantic City on December 10, 2003.

A second award was bestowed upon Jim Snow when he was selected by the Metropolitan Golf Course Superintendents Association to receive its prestigious 2003 John Reid Lifetime Achievement Award. The award was presented by John Carlone, CGCS, president of the Met GCSA, at their meeting on January 15, 2004.

Jim began his career with the USGA Green Section in 1976. He served as an agronomist in the Northeast Region from 1976 to 1982, and then as director of the Northeast Region from 1982 to 1990. In 1990 he assumed his current role as national director of the Green Section. Jim's numerous responsibilities include overseeing the Turf Advisory Service and a staff of 18 agronomists, the Construction Education Program, the Turfgrass and Environmental Research Program, and the Wildlife Links research program; he also serves as editor of the *Green Section Record* magazine. Other programs Jim has vigorously supported are Audubon International's Cooperative Sanctuary Program for Golf Courses and the Turfgrass Information File at Michigan State University.

PHYSICAL SOIL TESTING LABORATORIES

The following laboratories are accredited by the American Association for Laboratory Accreditation (A2LA), having demonstrated ongoing competency in testing materials specified in the USGA's Recommendations for Putting Green Construction. The USGA recommends that only A2LA-accredited laboratories be used for testing and analyzing materials for building greens according to our guidelines.

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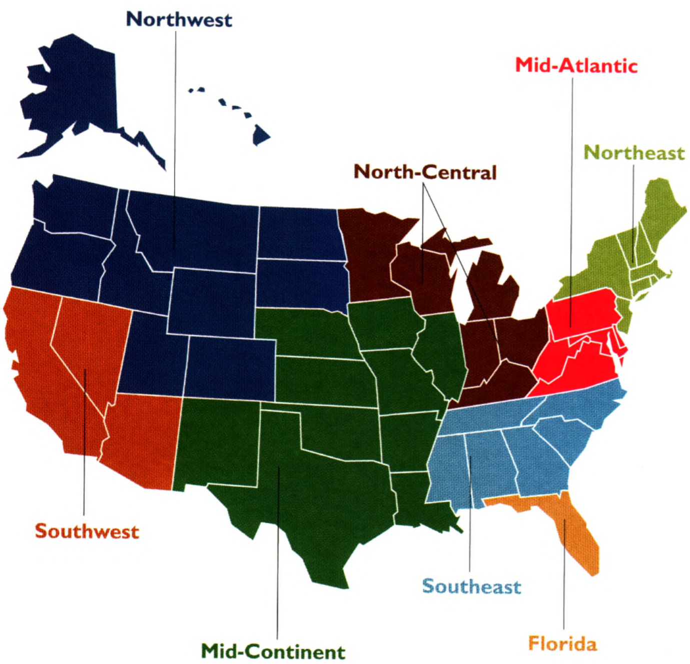

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Subscriptions $18 a year, Canada/Mexico $21 a year, and international $33 a year (air mail).

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: One of our golf course ponds has been completely overrun with cattails. Can the cattails be controlled with other means besides herbicides? (Connecticut)

A: Cattails quickly spread vegetatively with large rhizomes in shallow ponds and wetland areas. The plants can be controlled culturally through cutting and manipulating water levels. Selectively cutting the cattails in late spring when carbohydrate reserves are at their lowest will weaken the plants. Cutting the plants below the waterline or raising water levels at that time will also disrupt oxygen transport via the stems to the roots and rhizomes to eventually kill the plants. Always contact your state and local conservation departments before proceeding with any work in ponds or wetland areas! Additional information regarding wetland management can be obtained through the EPA Wetlands Web site: www.epa.gov/owow/wetlands/.

Q: Does the USGA Green Section have a recommendation on the type of spray nozzle to use on a golf course? Help settle an argument between two assistant superintendents. (Delaware)

A: Different spray nozzles should be used for different purposes. Thus, the nozzle you use to spray fungicides on your greens may not necessarily be the best nozzle to use for weed control. Check the label recommendations for every product you apply. We do have two recommendations. First, be sure to calibrate all of your sprayers at least annually, or if you switch nozzles, calibrate the sprayer for that usage. Second, replace all of your nozzles each year. It is money well spent to ensure the products you use are applied properly.

Q: Developing maintenance standards, time studies, and a set of long-range plans requires a fair amount of time and energy to produce. Are they really worth the trouble? (Washington, D.C.)

A: Golf course superintendents are business managers and should have a set of formal maintenance standards as to how the golf course will be maintained on a daily basis. When adhered to properly, maintenance standards provide protection from spur-of-the-moment changes to the maintenance program, and this provides continuity in golf course conditioning from year to year. Time studies help justify labor and machinery needs to provide the level of conditioning specified in the maintenance standards. Long-range plans provide a time frame as to when certain items should be replaced or when important projects should take place. This allows the membership time to plan for renovations and raise the funds necessary to complete those tasks. Obviously, it is important to have membership involvement with and adherence to the maintenance standards from year to year, and involving members should be one of the first tasks of each newly elected Green Committee.

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