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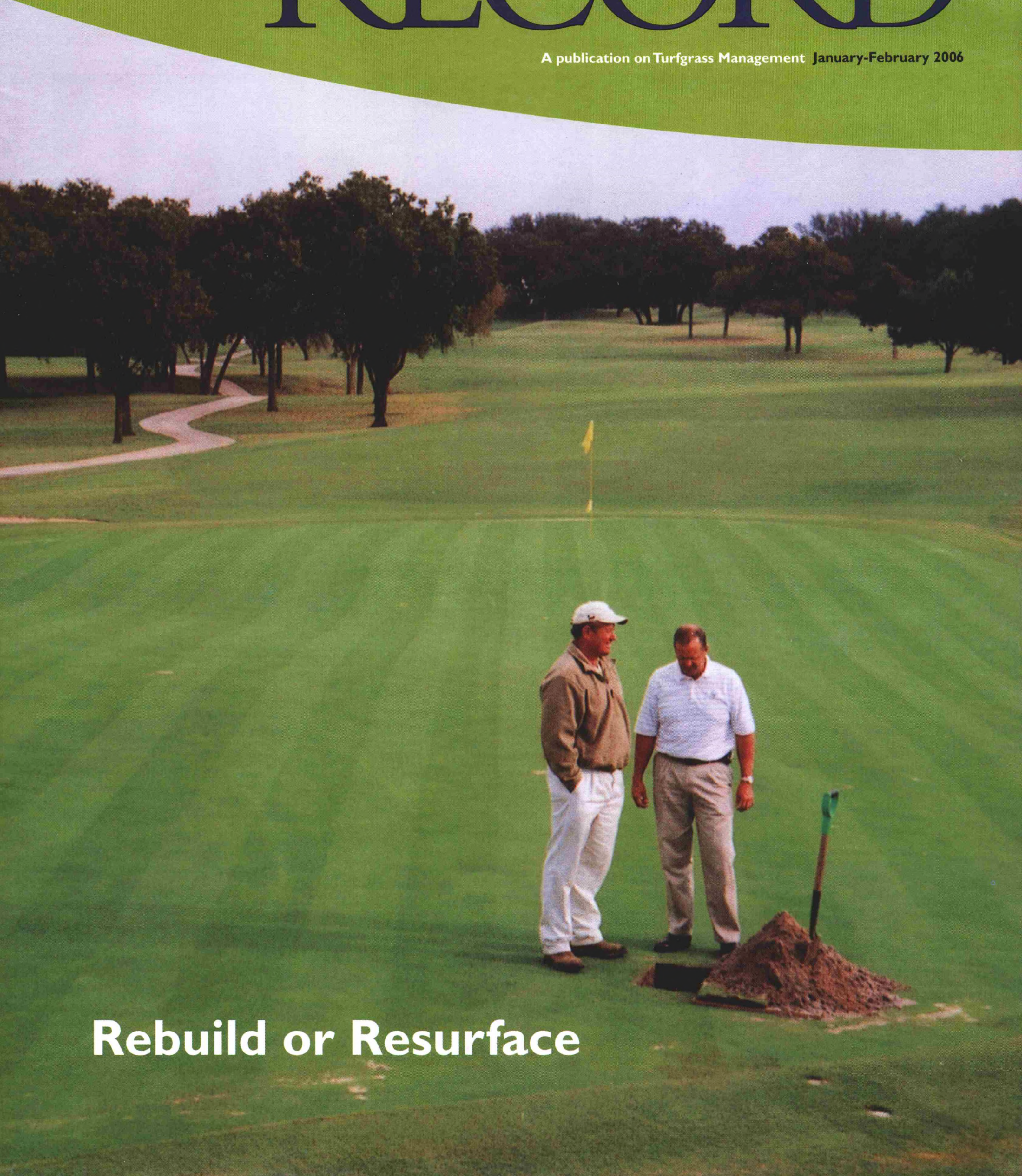

Rebuild or Resurface

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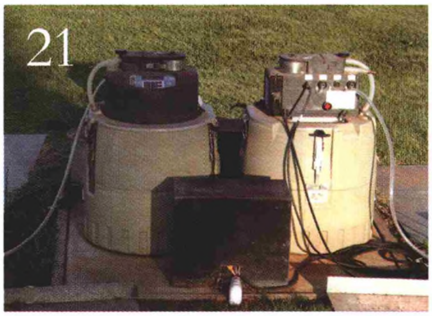
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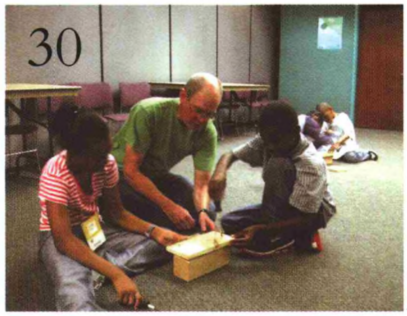
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Cover Photo
Golf courses facing the decision to renovate their greens should also consider the option of resurfacing versus rebuilding.

Rebuild or Resurface

Greens must be rebuilt every 15 to 20 years, even those of USGA method construction – or do they?

BY BUD WHITE

The architect has completed the green complex reconstruction plans, including the long-range plan for the entire golf course. The grass variety has been chosen for the putting surfaces. A high-quality sand has been identified and the rootzone mix has been evaluated by an accredited lab. Bids have been put out and returned, and a contractor has been selected. Rebuilding the greens will cost $655,000, and they will be closed for about nine to ten months.

Many courses have undergone this process, but in this case, did the course officials consider resurfacing instead of rebuilding? This is a fair question, and resurfacing may be a feasible alternative.

Nearly all golf courses eventually face the decision of renovating greens to improve playability and agronomic performance. Many courses today are confronted with this dilemma, even with 10- to 20-year-old greens built to USGA guidelines. A resurfacing option may be available for these courses, costing as little as 20% of the cost of total rebuilding. Although total reconstruction is often the mindset, it is not always necessary.

Research has shown that greens built to the USGA method maintain their original integrity below about the 4-inch depth many years after construction. It is the upper 3- to 4-inch zone that undergoes a drastic change in composition in the field with age. An increase in silt and clay from topdressing, wind movement, or sometimes through dissolved solids in irrigation water, creates this change in the upper zone. Organic matter (OM) buildup, however, is the primary effect that leads to poor infiltration, a tendency for black layer, increased algae on the surface,

Careful observation and testing are needed to determine whether a green must be rebuilt or only resurfaced.

poor rooting, an affinity for localized dry spot (LDS), and soft playing surfaces. This zone also can remain quite wet because organic matter increases water-holding capacity. This problem is located in the top 4 inches of the green and is not a profile/drainage system problem. If the greens were originally built to USGA specifications and were properly managed over the years, the surface layer can be replaced or modified to put the putting green system back into as-good-as-new working order.

How is the "rebuild vs. resurface" decision made? This step-by-step decision-making process includes:

- Digging test holes in greens to evaluate the integrity of the drainage system and profile.
- Correctly taking undisturbed soil cores.
- Sending sand samples from several sources to the lab along with the cores.
- Utilizing lab services to evaluate undisturbed soil cores.
- Deciding on a surface renovation procedure.

WHERE TO START

Resurfacing is a very effective option for courses that have older greens built to either USGA or California specifications. A scientific and systematic testing process is essential to ensure that your greens are candidates for successful resurfacing with long-term benefits. For poorly built greens, resurfacing alone is a temporary or *Band-Aid* approach, but it can improve performance for three to five years. Some courses have utilized this approach to improve the greens temporarily and optimize time to raise money and develop a long-range plan before spending reconstruction dollars.

As mentioned earlier, many golf courses with well-built older greens find that the rootzone mix below the 3- to 4-inch upper zone still functions the same as when it was installed, but that upper 3 to 4 inches becomes unacceptable over time. When the lower portion of the rootzone is tested by an accredited lab and found to be within specifications and when the drainage system is

Deciding whether to rebuild or resurface a green should be based on several steps. One is to evaluate the integrity of the drainage system. Here, a test hole was dug on the high side of the putting green and water was added directly to the gravel blanket.

intact, the club can choose the option of green resurfacing instead of full renovation to restore the greens back to their original condition.

This explains why rigorous aerification and topdressing is so vital to the health and life of turf and greens. Properly done, aerification can lengthen the *useful* life and performance of a green. The newer bentgrass and bermudagrass putting green grasses produce substantially more thatch and require more aeration. When organic matter accumulation becomes unmanageable, resurfacing or reconstruction is necessary.

During the renovation decision process, it is important that greens be evaluated for external growing conditions, because reconstruction alone will not solve a problem such as poor air circulation or excessive shade. The *Green Section Record* article "Helping Your Greens Make the Grade," by Jim Moore, March/April 1998, which can be accessed online at http://www.usga.org/turf/-articles/construction/greens/make the grade.html, is an excellent scorecard that should be utilized on difficult green sites to make sure all external factors are addressed. An important factor is the adequacy of the greens' irrigation system, which often is lacking.

Detailed testing is an essential investment in time and lab costs to ensure successful renovation. This procedure monitors the aging process of the roootzone and evaluates the effectiveness of the aerification and topdressing program. Test holes dug in existing greens can measure the function of the gravel blanket and check water flow through the drainage system. This also helps locate the exhaust end of the drainage system if all outlets have not been found.

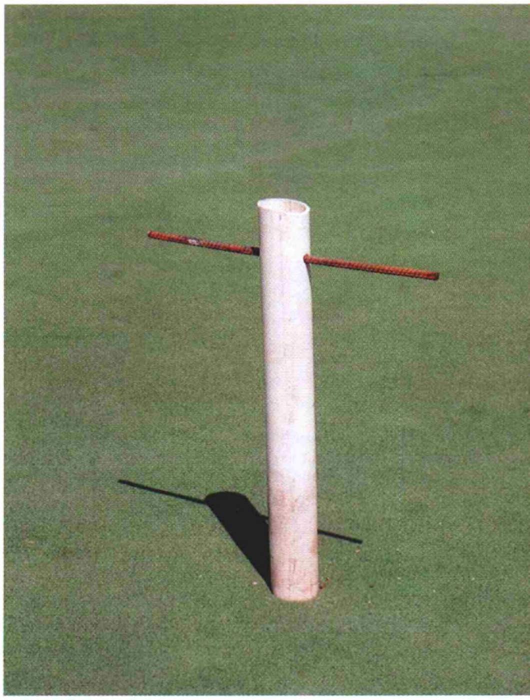
It is best to dig this test pit in the high side of a green so the cleanliness of the gravel blanket can be checked as water works its way through the gravel blanket, into the drain system, and eventually out of the drain outfall pipe.

LAB WORKS

Undisturbed soil core samples are taken by driving a 3-inch PVC pipe through the green profile and gravel blanket and into the subgrade. To remove the core, drill holes in the top of the pipe, put a piece of rebar through the holes, and pull the pipe out of the green. The pipe is then sealed on both ends and sent to an accredited lab for an undisturbed core evaluation. The lab will test the profile as it exists in the field, as well as the upper 3 to 4 inches and the lower 4 to 12 inches. The results help determine if the green profile is functioning properly and if it still meets guidelines below a certain depth. This is an excellent test for tracking the aging process of greens.

Along with the undisturbed core samples, the superintendent must send a sample of the sand expected to be used for the resurfacing. Ideally, the sand source will be the same one used when the greens were constructed, but this is often not the case. If there are questions about sand quality, or if a course is shopping for different sand sources for price, then multiple samples can be sent to the lab for evaluation. A gallon of each sand should be sent, along with a letter of explanation regarding your resurfacing plan. Contact the lab director prior to sending the samples so he/she is aware of your project, and provide some history and background to assist with the evaluation process. The lab will also provide sampling recommendations and shipping details.

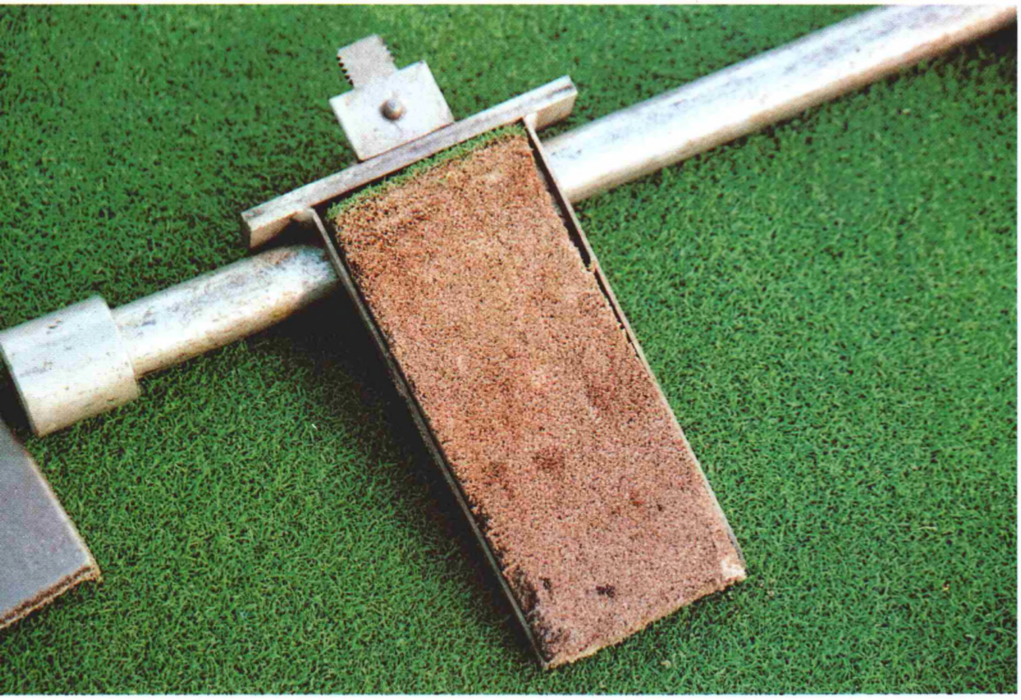
The proper procedure for sampling sand, as for any rootzone or topdressing material, is detailed in the "Quality Control Sampling" brochure, available through your USGA Green Section office. Good quality control is essential for establishing the initial sand quality, and regular monitoring must be carried out as loads are delivered throughout the renovation process.

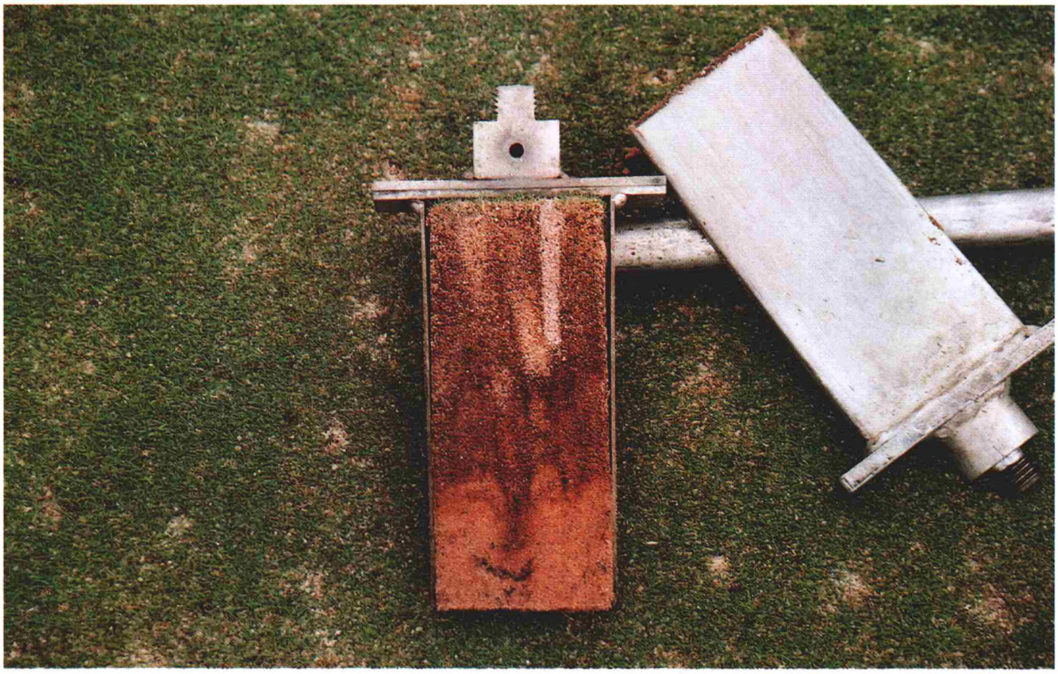


Undisturbed soil core samples help determine 1) if the green profile is functioning properly, 2) if it still meets guidelines below a certain depth, and 3) effects of the aging process. Cores are taken by driving a 3" PVC pipe through the green profile and gravel blanket and into the subgrade. The undisturbed core is sent to a lab for analysis.

GREEN REDESIGN

In the past, it was common for architects to utilize the rootzone mix instead of the sub-base for surface contour design. This practice does not adhere to the USGA method for construction, which requires that the sub-base mirror the finish grade contour and the rootzone be a consistent 12" ± 1" in depth. Therefore, rootzone depth validation should be conducted with probes to ensure a uniform rootzone depth. Only very minor modifications, if any, can be made to soften contours when resurfacing. If the golfers are happy with the existing contouring, then the upper 3 to 4 inches of the rootzone mix can be removed and a sand or mixture should be applied, making sure it is compatible with the existing rootzone mix. Rototilling may or may not be utilized (discussed





Over time, golf course greens change composition in the upper profile. The new profile (above) is from an eight-month-old green that was rototilled and resurfaced. The aged profile (right) shows the aeration history in the profile of a 12-year-old green.

later). The surface is then firmed, floated (smoothed), sterilized, and replanted.

The recommended standard today is a maximum of 3% slope on putting surfaces that will be maintained at a green speed approaching 10 feet as measured by the Stimpmeter.® A high percentage of older greens are too severe in slope and contouring for the increased speed demands of today's golfers. Existing slopes must be carefully evaluated and measured to stay within this guideline if at all possible. Severe slopes and faster greens are a recipe for disaster.

DECIDING ON A PROCEDURE

There are several ways to proceed with a resurfacing project.

- Thoroughly core aerate prior to sod removal and fill the holes with the replacement sand. Many superintendents double or triple aerate. Then, remove the sod to the 2- to 2½-inch depth, fill the void with the replacement sand, and float the green. Sterilization, final smoothing, and replanting complete the resurfacing. Deep-tine aeration or drill-and-fill can be utilized to penetrate the entire zone to more thoroughly eliminate deep layering. Sand is introduced 8 to 10 inches into the profile, versus 3 to 4 inches by conventional aeration only.

- The above procedure has also been utilized when resodding greens. Ideally, the sod is cut as thick as possible to remove more of the organic mat layer. Coordination with the sod producer is essential to ensure that the new sod is cut at the same depth as the sod being removed. After sod removal, the surface is lightly raked for smoothness, sterilized, and the new sod is installed.
- Remove the organic layer 2 to 4 inches deep, depending on the depth of the OM accumulation, and fill the created void with the replacement sand. The profile is tilled 6 inches deep to eliminate any layering that may still exist. This can be done quite effectively and uniformly by removing the upper 4 inches, followed by installing the replacement sand, rototilling the green in multiple directions approximately 6 inches deep, refloating, and firming. The new surface can then be inspected by the architect before planting to insure that the original contours are maintained.

Special Note: The turf on the collar should also be removed as part of the renovation. Sterilizing the collar provides a buffer for keeping *Poa annua*, bermudagrass, or other offensive grasses out of the green. The collar is also used as a transition, or tie-in, to the green surrounds and should be as seamless as possible. This cannot be done at the green edge.

As noted earlier, not all greens need to be rototilled. Many green renovation projects have been successful with thorough aeration prior to sod removal, topdressing to fill the holes, removing the sod, and reinstalling the replacement sand or sod without any disturbance to the profile below the sod layer. Light hand raking prior to new sod installation is needed, of course. Aeration must be deep enough, however, to completely

The collar should be included with putting green resurfacing to maintain green purity and a seamless tie-in to the surrounds.

reach through the layer of OM buildup. The OM depth depends on the age of the green, cultural management practices, and the growing environment, all of which can affect the rate of accumulation.

When an area is rototilled, firming and floating procedures must be implemented to prepare the seedbed for planting. Green contours can be lost without careful rototilling procedures, and new surfaces should be inspected and approved by the architect prior to planting.

Consequently, the best method for preserving contours will have to be considered on an individual basis. Both of these methods, rototilling or not rototilling, can be successful. The lab can assist with recommendations about which method might be better for your greens based on the test performance of the undisturbed soil cores.

Green contours can be lost without careful rototilling procedures. One method is to leave sod strips during rototilling and sand replacement to help maintain the contour details.

Firming and floating the finished product is a critical part of the renovation process, just as it is with new construction. Thorough applications of water are needed to maintain good soil moisture while firming and floating. Many courses contract this work out, as a quality golf course contractor is knowledgeable about the best procedures for firming and floating greens. If this work is done in-house, it is important for the superintendent to pay careful attention to preparing a firm and smooth seedbed.

A good rule of thumb is to firm and float the seedbed until the average-size person can walk across the green without leaving a footprint greater than ¼-inch deep. Again, watering must be included in the process to achieve appropriate firmness. To reiterate, collars must be included in the sterilization process. This also allows *Poa annua* and/or bermudagrass to be cleared from the collar to prolong a weed-free putting surface.

Total renovation is not the only alternative for improving green quality. Scientific and dependable methods are available to evaluate older, yet well built, greens to determine the quality of existing construction. Resurfacing has not been used frequently in the past, but many courses save 70% to 80% of what it would cost for complete reconstruction.

Moreover, the anticipated nine- to ten-month downtime is substantially reduced to four or five months, on average, due to the greatly reduced scope of work. This can significantly reduce revenue loss and golfer inconvenience. Your regional USGA Green Section staff agronomist can help any golf course work through this evaluation process and assist with quality control procedures during testing and renovation. Knowing the construction quality of your greens and researching renovation alternatives with an accredited lab could save your course money and downtime, and create much improved putting surfaces.

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Research *You Can Use*

Resistant Turfgrasses for Improved Chinch Bug Management

University of Nebraska researchers document multiple chinch bug resistance in cool- and warm-season turfgrasses.

BY TIFFANY M. HENG-MOSS, F. P. BAXENDALE, R. C. SHEARMAN, AND T. E. EICKHOFF

Numerous arthropods are important pests of the cool- and warm-season turfgrasses commonly found on golf courses. Turfgrasses are subject to injury by insect and mite pests, and several are known to have increased susceptibility to certain sap-feeding insects, including chinch bugs.

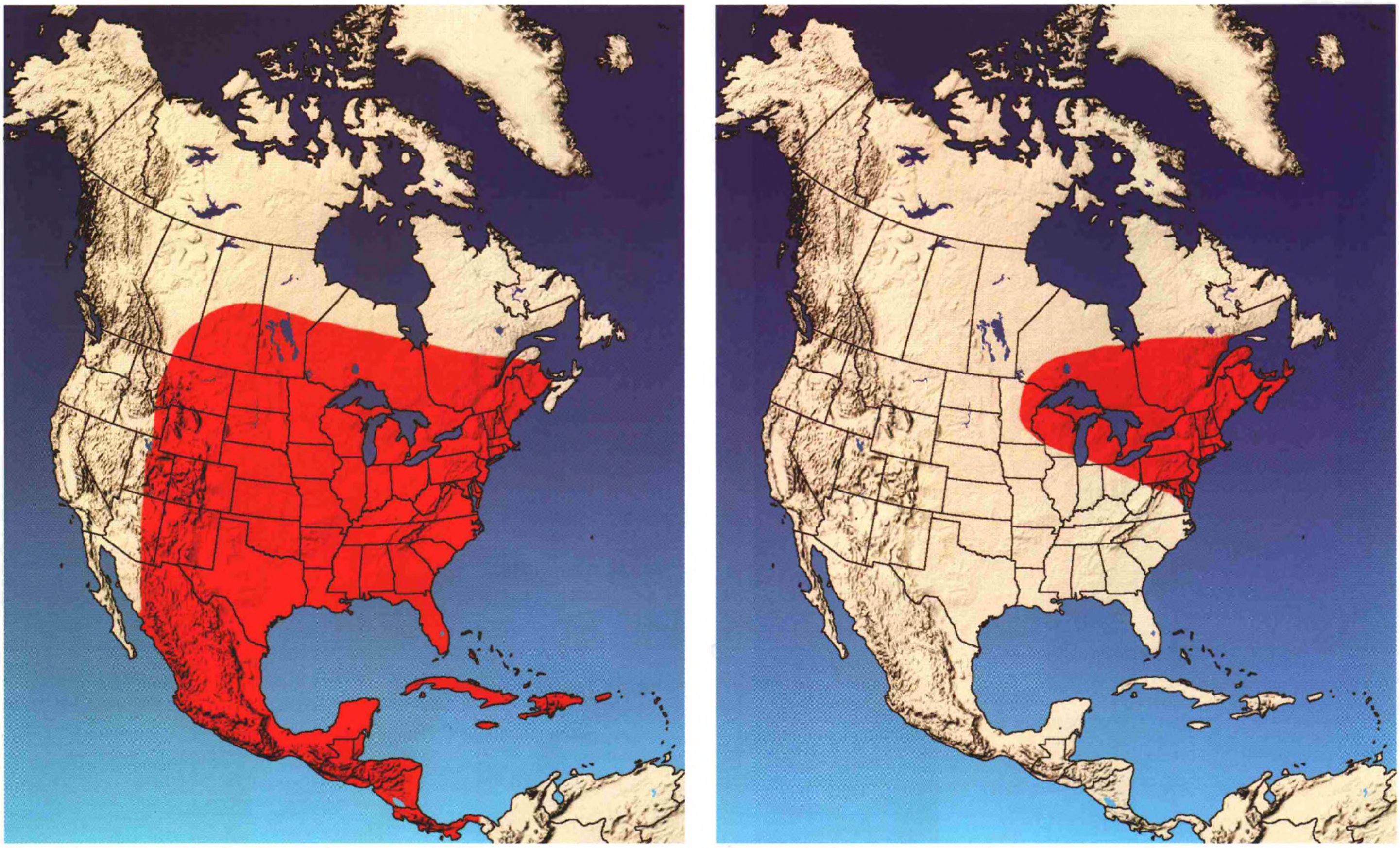
In the United States there are four chinch bug species that are of major economic importance: common chinch bug (*Blissus leucopterus leucopterus*), southern chinch bug (*Blissus insularis*), hairy chinch bug (*Blissus leucopterus*), and western chinch bug (*Blissus occiduus*).[8] Chinch bugs are widely distributed throughout the United States, primarily east of the Rocky Mountains. Individual species often have overlapping geographic distributions. In particular, the geographic distribution of the western chinch bug, and its preferred host, buffalograss, are such that any of the other chinch bug species could be present in adjacent turfgrasses. Furthermore, all four chinch bug species have extensive documented host ranges.

The common chinch bug is widely distributed across the east coast and western plains of the United States and south in Mexico. The most common hosts of this chinch bug include wheat, sorghum, corn, and several turfgrasses (bermudagrass, Kentucky bluegrass, tall fescue, and zoysiagrass).

Researchers at the University of Nebraska evaluated selected cool- and warm-season turfgrasses for resistance to chinch bugs in the *Blissus* complex, and documented the presence of multiple chinch bug resistance in these turfgrasses.

The hairy chinch bug is distributed throughout the northeastern United States. Its range includes southern regions of the eastern Canadian provinces, parts of the Midwest to Minnesota, and into the Mid-Atlantic States as far south as Virginia. It is an important pest of most cool-season turfgrasses, including creeping bentgrass, Kentucky bluegrass, perennial ryegrass, and fine-leaf fescues. The hairy chinch bug is also an occasional pest of zoysiagrass and St. Augustinegrass, and it has been reported feeding on timothy grass.

The southern chinch bug ranges from southern North Carolina southward to the Florida Keys and into eastern and southeastern portions of Texas. This chinch bug is considered the most destructive pest of St. Augustinegrass. It also occasionally infests bahiagrass, bermudagrass, centipedegrass, and zoysiagrass, and it has been reported feeding on crabgrass, guineagrass, pangolagrass, torpedograss, and tropical carpetgrass.



Chinch bugs are widely distributed throughout the United States, primarily east of the Rocky Mountains. Individual species often have overlapping geographic distributions. Shown, left to right, are the distribution of common chinch bugs, hairy chinch bugs, southern chinch bugs, and western chinch bugs.

The distribution of the western chinch bug includes much of the central United States, north into Canada, and south into Mexico. First detected infesting a heavily damaged buffalograss lawn in Lincoln, Nebraska, in 1989, these chinch bugs have subsequently been found associated with buffalograss throughout Nebraska and surrounding areas.[3] More recently, the western chinch bug has become a pest of zoysiagrass.

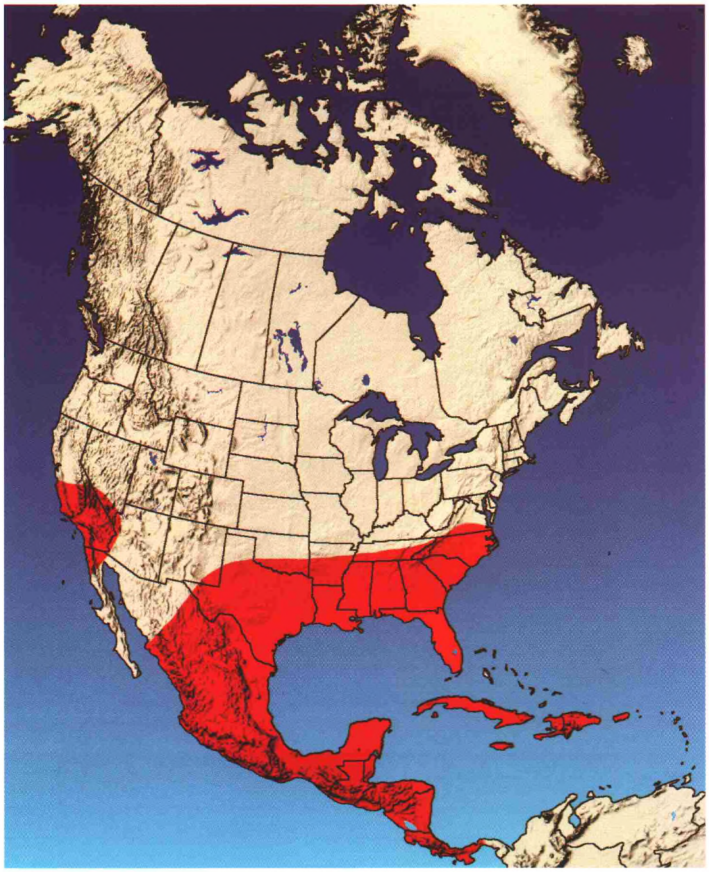
Recent studies at the University of Nebraska have shown that this chinch bug has an extensive host range, including buffalograss, zoysiagrass, Kentucky bluegrass, tall fescue, bermudagrass, and perennial ryegrass.[4] Among the turfgrasses tested, offspring were produced on buffalograss, fine fescue, perennial ryegrass, bentgrass, zoysiagrass, Kentucky bluegrass, and tall fescue, demonstrating that the western chinch bug can reproduce on a wide variety of hosts. These results have profound implications and provide new information that will facilitate improved monitoring and detection of chinch bug infestations before they build to damaging levels. Increased knowledge of the biology and host range of this chinch bug will aid in the development of more efficient management approaches.

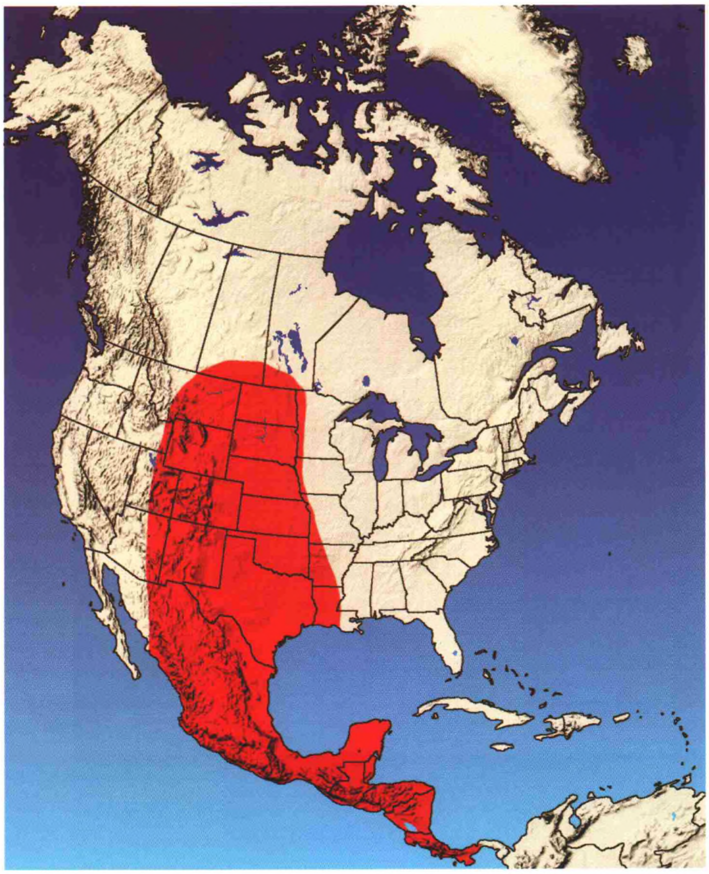
BASIC CHINCH BUG BIOLOGY

The immature stages of all chinch bug species are similar in appearance. Chinch bug eggs are elongate, whitish, and average < 1/25 inch (1.0 mm) in length when first laid. As the embryo develops, the egg takes on an orange-red color, with the nymphal chinch bug visible within the egg before hatching. First instars are tiny (< 1/25 inch), long, bright-red insects with a distinctive white band across the abdomen. As nymphs mature through five nymphal stages, their color gradually changes to orange-brown and finally to dark brown. Adults are black with reddish-yellow legs and are about 1/10 to 3/16 inch, depending on the sex and species. Females are typically larger and more robust than males.

Most chinch bug adults have shiny white wings that extend back over the abdomen, but wing dimorphism is common, with both macropterous (long-winged) and brachypterous (short-winged) forms present in certain species. Chinch bugs tend to feed in aggregations and often produce a characteristic odor from scent glands when disturbed or crushed. Most chinch bug species have two generations per year and overwinter as adults.

Chinch bugs injure grasses by withdrawing sap from plant tissues in the crown area. While feeding, they also may inject a salivary toxin that damages plant tissues and inhibits the translocation of water and nutrients. Initially, this feeding results in reddish-purple discoloration of the leaves. In the turf stand, damage appears as patchy areas





that turn yellow and dry to a straw-brown color as feeding progresses. At higher infestation levels, chinch bug feeding can result in severe thinning or death of the turfgrass stand.

Damage is usually the heaviest in sunny locations during hot, dry periods and is often mistaken for drought stress. Chinch bug infestations are less likely to develop in years when spring and summer rainfall and temperature are near or below normal. This occurs in part because fungal diseases keep chinch bugs under control. These diseases are much less likely to develop during periods of drought, and following several dry seasons chinch bug numbers can build to damaging levels.

PLANT RESISTANCE

Historically, insecticides have been employed as the principal method to control chinch bugs. However, concern for reducing pesticide inputs has underscored the need for developing alternative approaches for controlling insect pests affecting turfgrasses. One such approach involves the use of integrated pest management (IPM). This strategy employs all suitable techniques in as complementary and environmentally compatible a manner as possible to maintain pest populations below damaging levels. IPM tactics include cultural, mechanical, biological, and chemical controls, and the use of plant resistance to insects. The development of turfgrasses with resistance to chinch bugs offers an attractive approach for managing insect pests associated with turfgrasses because it is sustainable and environmentally responsible.

The idea behind plant resistance is to exploit natural plant defense systems. Turfgrasses possess a variety of natural defense mechanisms to overcome biotic stresses such as insect feeding. These defense mechanisms can be based on physical or chemical characteristics of the turfgrass. In some cases, the turfgrass is able to tolerate insect feeding through physiological and biochemical modifications.

Turfgrasses with resistance to the chinch bug species have been identified in both cool- and warm-season turfgrasses. However, few of the recently released cultivars have been evaluated for chinch bug resistance, and it remains unclear if turfgrasses with resistance to one chinch species may also be resistant to one or more of the other species. The USGA helped to fund a project that focused on evaluating selected cool- and warm-season turfgrasses for resistance to chinch bugs in the *Blissus* complex, and documenting any incidence of multiple resistance. This information is fundamentally important for developing chinch bug-resistant turfgrasses through conventional breeding and biotechnological techniques.

RESISTANCE TO THE WESTERN CHINCH BUG

Greenhouse and field screening studies were initiated to search for buffalograsses, bermudagrasses, and zoysiagrasses with resistance to the western chinch bug. Forty-eight buffalograss genotypes from diverse geographical locations were evaluated in replicated studies under greenhouse conditions. Based on turfgrass damage ratings, 4 were categorized as highly resistant, 22 were moderately resistant, 19 were moderately susceptible, and 3 were highly susceptible to chinch bug feeding.[5,6]

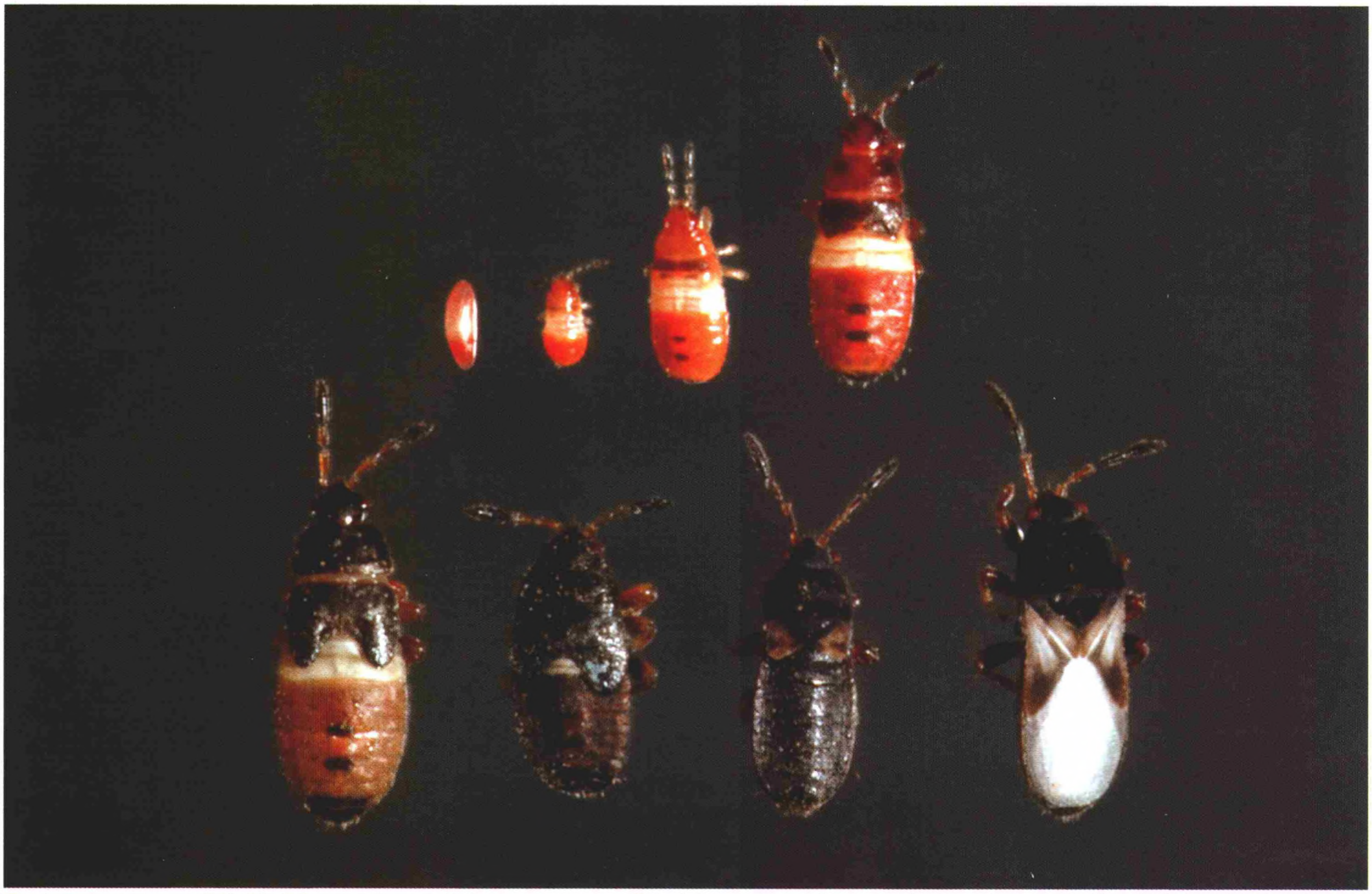
Of the buffalograsses studied, "Prestige" exhibited minimal chinch bug damage, although it became heavily infested with chinch bugs. This suggests that tolerance may be responsible for the resistance.[7] Plant tolerance has several advantages as a pest management tool from an ecological viewpoint: it raises economic/aesthetic injury levels, preventing early pest management action, and does not place selection pressure on pest populations, unlike other management approaches. In spite of its advantages, the use of tolerance for pest management is limited primarily because the mechanisms and genetics of plant tolerance remain unknown.

Studies are currently underway to investigate the biochemical and physiological mechanisms imparting resistance in buffalograss. This information is fundamentally important for formulating plant breeding strategies and subsequently developing chinch bug-resistant turfgrasses through conventional breeding and biotechnological techniques. In addition, knowledge of specific resistance mechanisms would be valuable for identifying biochemical and physiological markers for use in germplasm enhancement programs and for characterizing plant defense strategies to insect feeding.

Several zoysiagrasses and bermudagrasses were also evaluated for resistance to the western chinch bug. The zoysiagrass "Emerald" and bermudagrass "Mini Verde" displayed the highest level of resistance, while the zoysiagrasses "Myer," "Zenith," "DeAnza," and the bermudagrasses "Jackpot" and "Tifway 419" were moderately to highly susceptible to chinch bug injury.

MULTIPLE CHINCH BUG RESISTANCE

Another component of this research was to document the presence of multiple chinch bug resistance among selected cool- and warm-season turfgrasses. Because of the extensive geographical overlap of the four economically important chinch bug species and their host plants, the potential exists for the



The immature stages of all chinch bug species are similar in appearance. Chinch bug eggs are elongate, whitish, and average < 1/25 inch (1.0 mm) in length when first laid. As the embryo develops, the egg takes on an orange-red color, with the nymphal chinch bug visible within the egg before hatching. First instars are tiny, < 1/25 inch (1.0 mm) long, bright-red insects with a destinctive white band across the abdomen. As nymphs mature (there are five nymphal stages), their color gradually changes to orange-brown and finally to dark brown. Adults are black with reddish-yellow legs and are about 1/10 to 3/16 inch (2.5 to 5 mm), depending on the sex and species. Females are typically larger and more robust than males.

western chinch bug and other chinch bug species to become associated with and damage non-traditional turfgrasses. The presence of turfgrasses with resistance to multiple chinch bug species would be highly desirable in these interfacing situations.

A series of studies was conducted under greenhouse conditions to evaluate selected buffalograsses, fine fescues, and St. Augustinegrasses for resistance to multiple chinch bug species. These studies established that buffalograsses resistant to the western chinch bug were susceptible to southern and hairy chinch bugs. All St. Augustinegrasses (southern chinch bug-resistant "Floratam" and -susceptible "Raleigh" and "Amerishade") were highly resistant to the western chinch bug. Furthermore, all endophyte-free and -enhanced fine fescues were moderately to highly susceptible to the hairy chinch bug, but moderately to highly resistant to the western chinch bug. This research clearly demonstrates multiple resistance among turfgrasses to chinch bugs and suggests different feeding mechanisms among the chinch bug complex.[1]

The varying degrees of susceptibility and resistance exhibited by the grasses underscores the importance of identifying turfgrasses that are not only resistant to one particular chinch bug species, but also resistant to other chinch bug species inhabiting nearby turf areas. For example, as buffalograss is adapted to various regions throughout the United States, it is likely to be planted near areas of southern and hairy chinch bug infestations. Therefore, identifying turfgrasses that exhibit resistance to multiple chinch bug species will decrease the chances of an opportunistic infestation by southern and hairy chinch bugs.

The reasons for the different responses of the grasses to the three chinch bugs remain unclear. Studies investigating chinch bug probing behaviors, feeding locations, and mouthpart morphology have documented differences in probing frequencies among the chinch bug species and identified the vascular tissues, bulliform cells, and bundle sheaths as primary chinch bug feeding sites.[1] Scanning electron micrographs revealed no obvious differences in the mouthpart morphology among *Blissus* species and subspecies.[2] Studies are currently underway to identify and characterize chinch bug salivary secretions, and document differences among the chinch bug species.

Researchers at the University of Nebraska are investigating chinch bug damage. Recent studies have shown that the western chinch bug has an extensive host range, including buffalograss, zoysiagrass, Kentucky bluegrass, tall fescue, bermudagrass, and perennial ryegrass.

This research provides essential information for the development of chinch bug-resistant buffalograsses for use on golf courses and other turfgrass areas, and for the implementation of chinch bug management decisions. Commercial production of warm-season turfgrasses with resistance to chinch bugs will offer turfgrass professionals and homeowners with a high-quality turfgrass with enhanced resistance to chinch bugs.

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Over the past 25 years, a large number of real estate development golf courses have been constructed in Florida and other regions. With no separation between the golf course rough and the home lawns running parallel down both sides of almost every hole, a wall-to-wall maintenance philosophy must be practiced.

Roughing It With Bermudagrass

A review of basic management practices for the dominant warm-season turfgrass used in roughs.

BY JOHN FOY

The Scottish links courses typically have very wide fairways bordered by heather, gorse, and areas of tall but somewhat sparse grass. Since the game of golf was brought across the Atlantic Ocean, a characteristic of American golf courses that has evolved over time is maintaining acres of higher-cut turfgrass roughs.

With the shift to lightweight mowing of fairways in the 1980s, simple economics begged reductions in the acres of intensively maintained fairway turf by as much as 50% at some courses. The setup of courses hosting championships or professional tournaments has also resulted in increased rough turf acreage. The widths of fairway landing zones are being narrowed to as little as 25-30 yards to place a higher premium on accuracy. This type of setup is not necessarily appropriate for daily play, but there is a mindset at some courses that par must be defended to maintain rankings and status.

Furthermore, and coinciding with escalating golfer expectations for perfect turf through all areas, the boom in construction of real estate development courses over the past two to three decades has increased demands for lush, green, weed-free, and regularly mowed roughs. At many facilities, a wall-to-wall maintenance philosophy must be practiced because there is no separation between the roughs of the golf course and the home lawns running parallel down both sides of every hole.

Along with being a hazard or penalty for off-line shots, roughs are a design feature utilized to provide fairway definition. On northern cool-season grass courses, mixtures of Kentucky bluegrass, perennial ryegrass, and fine fescues provide both color and texture contrast to bentgrass fairways. Over the years there have been attempts to use different warm-season turfgrass species or cultivars in fairway and rough areas in an effort to

create a northern look on southern golf courses. However, in most cases, long-term successful results have not been achieved with mixing and matching different turfgrasses. Bermudagrass (*Cynodon sp.*) is by far the dominant turfgrass species used throughout the warm climatic regions of the United States, and the standard setup is a monostand of bermudagrass through both the roughs and fairways.

The hybrid bermudagrass cultivar Tifway (419) produces a very dense, fine-textured turf cover and has been used predominantly on courses throughout much of the South. In the middle to upper portion of the transition zone, where periodic winterkill can be a problem, more cold-hardy bermudagrasses such as Vamont and several new cultivars can be found; in the desert south-west, common bermudagrass roughs and fairways are frequently encountered.

HEIGHTS OF CUT AND ROUTINE MOWING

With any degree of fertilization and supplemental irrigation, the hybrid bermudagrasses produce a very dense turf cover. The shoot density of the common type bermudagrasses is less, but this is somewhat relative. The stoloniferous or "stemmy" growth habit creates additional resistance to being able to make good contact with the ball and swing the clubhead through bermudagrass roughs. Thus, if the goal is to have the roughs result in a half-shot penalty, care and discretion must be exercised with heights of cut. This is especially true with average- to high-handicap golfers who lack hand and arm strength and cannot aggressively attack golf balls sitting down in bermudagrass roughs. During the summertime and when hosting general play, a height of cut in the range of 1.25 to 1.50 inches does not produce an overly penal play character with hybrid bermuda roughs. Slightly higher heights of cut are sometimes practiced with common bermuda, but only for the play of professional tournaments or national championships is it ever recommended to maintain bermudagrass roughs at a height of cut of 2.50 inches or higher.

When bermudagrass is actively growing, a minimum mowing frequency of once per week is

A standard setup at northern golf courses hosting championships or professional events is to have a 6 to 10 ft. wide intermediate rough between the primary rough and fairways. However, due to height of cut limitations with bermudagrasses, maintaining this type of course setup when hosting daily play is not practical.

Dormant bermudagrass roughs can provide a striking contrast to overseeded fairways during the fall, winter, and spring months. At facilities that host moderate to heavy play, cart traffic management must be an integral and ongoing part of course management to prevent excessive wear and damage to the bermudagrass when it is not actively growing and able to recover.

needed. With bermudagrass roughs that receive regular irrigation, or during times of frequent rainfall, the height of bermudagrass roughs can easily double in a week's time. At many top facilities, a rough mowing frequency of two to three times per week is being practiced so that an excessively penal play character does not develop and to provide consistent conditioning in keeping with golfer demands and expectations. Naturally, with an increased mowing frequency, additional manpower hours and equipment must be made available. For budgeting purposes, a good rule of thumb is to allow one manpower hour per acre for routine mowing of roughs. In an effort to control costs, some facilities are maintaining a perimeter fine-cut rough that is mowed two or three times a week, while the deep roughs are still mowed only once per week.

An intermediate rough 6 to 10 feet wide beween the primary rough and fairways is maintained on courses hosting championships, and it has become a common feature on northern cool-season turfgrass courses. The goal with intermediate roughs is to provide a less severe penalty for shots that just miss the fairways. However, given the height of cut limitations of bermudagrass roughs, it is certainly debatable as to whether or not the additional cost of maintaining an intermediate rough is justified. An intermediate rough height of cut of 0.75 to 1.00 inch really does not provide any degree of visual definition between fairways being maintained at 0.50 inch and a primary rough at 1.25 to 1.50 inches.

With regard to mowing equipment, it has long been thought that reel units are needed to produce a clean, sharp, and good quality cut with bermuda roughs. Large multi-gang, ground-driven, pull-behind mowers were used at all facilities up until the mid-1980s. Then, coinciding with the movement to smaller and lighter-weight mowing units for fairways, the top facilities began to change over to medium-weight five-gang riding mowers with hydraulically driven reels.

In the past five years or so, there has been a major shift underway to the use of rotary mowers for routine cutting of bermudagrass roughs. Although rotary mowers have long been the standard in the north, it took innovations such as high rpm and multi-blade mulching decks to cut, rather than tear, bermudagrass. Providing an acceptable quality of cut, it is possible to take advantage of the other benefits of rotary mowers, such as still being able to mow wet and high grass, and more effectively cut tough seed stalks of grasses and broadleaf weeds. Furthermore, rotary mowers have a lifting or vacuuming effect that helps maintain a more upright shoot growth character, which in turn produces a more uniform cut and smoother surface condition. With a more upright shoot growth character, however, golf balls are able to settle deeper into the turf. Thus, setting up rotary mowers at a slightly lower height of cut is a needed adjustment when an equipment change is made. It is stressed that regular sharpening or replacement of the blades is needed to maintain a good quality of cut. Yet, compared to the maintenance of reel cutting units, there are savings in both time and money.

GROWING GRASS

As with all plants, bermudagrass needs the basic ingredients of sunlight, water, and food to produce a dense and healthy turf cover. Without a doubt, the most common growth-limiting factor encountered with bermuda roughs is shade. The bermudagrasses are the least shade-tolerant turf species used, and six to eight hours of direct sun needs to be provided. It is simply not possible to have heavily treed roughs and a good quality bermuda turf cover. The negative impact of trees has been extensively documented and will not be rehashed here. It should, however, be reiterated that tree feeder root competition for nutrients and moisture is often an overlooked turf problem, and root-pruning operations can produce a marked improvement in both rough and fairway turf quality.

With regard to irrigation and fertilization of bermudagrass roughs, both are needed to maintain a uniform, dense, and good quality turf cover. To accommodate demands for a lush, green aesthetic character, however, some courses use more fertilizer than required. In consideration of current environmental and economic course management issues, employment of a spartan rough management philosophy and irrigating and fertilizing only to maintain turf coverage is encouraged. Unfortunately, at most courses the standards of quality have been set, and the golfers are unwilling to accept anything less.

WINTERTIME CONSIDERATIONS

Daytime and nighttime temperatures in the mid-80- and 60-degree range, respectively, are needed for sustained active bermudagrass growth. In the fall, the growth rate of bermuda begins to slow in response to cooler temperatures and a shorter day length. With the onset of freezing temperatures or frost, warm-season turfgrasses such as bermudagrass enter into and remain in a semi- to fully dormant stage through the rest of the winter. A loss of green color coincides with this period of dormancy, and this is the driving force behind large acreage winter overseeding programs being conducted at resort and high-end private courses across the sunbelt region. The pros and cons of overseeding have been debated over the years, but this practice will no doubt continue to be necessary at many facilities. It should be pointed out, however, that the negative aspects of overseeding are exacerbated in rough areas. Even with the use of reduced seeding rates, the higher height of cut on roughs significantly increases the amount of stress and competition exerted on the base bermuda. With the existence of any other growth-limiting factors such as shade, poor drainage, or concentrated cart traffic, transition problems in the early summer are almost guaranteed. If resodding is not performed, reestablishment of the base bermuda can take the entire summer. Quite simply, the Green Section staff strongly discourages winter overseeding of bermudagrass roughs.

When overseeding is not performed, it is suggested to raise the height of cut of the roughs by 0.25 to 0.50 inch to increase wear tolerance and help maintain a degree of definition. At facilities that receive moderate to heavy winter play, aggressive and ongoing cart traffic management must be practiced to prevent the roughs from becoming totally beaten down and worn out. In the spring, once the bermudagrass breaks dormancy and shoot growth begins to occur, dropping the height of cut to 1.00 inch is advisable to remove damaged, older leaf material and reestablish a dense and smooth surface condition. In regions where bermudagrass never goes fully dormant, such as Central and South Florida, scalping the roughs to a height of cut of 1.00 inch or slightly less in the late spring to early summer is suggested. The golfers do need to be made aware that this will cause extensive discoloration, yet within a couple of weeks the green color will redevelop along with a dense and smooth surface condition.

At a cutting height of two inches or more, golf balls settle into bermudagrass roughs. The result is penal play for average to high-handicap golfers. A summertime rough height of cut of 1.25 to 1.50 inches is suggested, and while not as pronounced, there is still definition between the fairways and roughs.

CONCLUSION

Along with having desirable play characteristics, the very good wear, drought, heat, and salt tolerance of bermudagrass makes it one of the best adapted turfgrasses for roughs in warm climatic regions. However, and as is the case with bunkers, golfer expectations and demands are requiring that more effort and time be invested in the maintenance of roughs. If it is not possible to lower expectations as far as rough turf quality is concerned, for the future of the game, reducing acreage is encouraged as a compromise. When was the last time a golfer talked about how much fun he or she had playing out of the rough?

JOHN FOY *is director of the Florida Region of the Green Section and has spent 20 years trying to stay out of bermuda rough.*

The Annual Bluegrass Weevil Rears Its Ugly Head

New control options worth considering in the fight against the annual bluegrass weevil.

BY PAT VITTUM

Typical late spring feeding damage from annual bluegrass weevil larvae is often heaviest in the perimeter region of a green and becomes more diffuse toward the center of the green.

The annual bluegrass weevil (*Listronotus maculicollis*), often called the *Hyperodes* weevil, has become a major pest for golf course superintendents throughout the Northeast and Mid-Atlantic states and shows signs of increasing its range further.

LIFE CYCLE

Annual bluegrass weevils (ABW) spend the winter as adults in protected sites near fairways, greens, or tees. In the spring, adults migrate to shorter cut turf, where females lay eggs inside the leaf sheath of individual grass plants. Tiny larvae hatch out after about a week and spend five larval stages feeding and growing. Small larvae feed inside the stem, while larger larvae migrate downward and feed in the crown. By late May or early June, feeding damage from the larger larvae becomes very apparent. The insects pupate in the soil for about a week before emerging as new young adults in late June or early July. These adults mate and lay eggs for a second generation. Each larval stage in July or August develops more quickly than in the spring, normally resulting in three generations in a season. It is difficult to track the development of the weevil populations in the summer months because of the overlap between insect stages. It is not uncommon to find small larvae, medium larvae, large larvae, pupae, and adults all in the same summer sample.

MANAGEMENT PROGRAMS

Historically, superintendents in the New York metropolitan area have scheduled insecticide applications to control adult ABW between *Forsythia* full bloom and dogwood full bloom, using insecticides such as chlorpyrifos (Dursban™) or one of the pyrethroids. These chemicals kill many of the adults before they have a chance to lay eggs, significantly reducing spring larva populations. More recently, however, it has been increasingly difficult to figure out how to manage weevil populations in the summer because of the overlap in development. In 2004 there were limited options and most of the insecticides that were available (i.e., chlorpyrifos and the pyrethroids) were not particularly effective against larvae.

In 2004 we tested trichlorfon (Dylox™) on ABW larvae on a golf course in Westchester County. We applied the material on June 2 and came back just six days later to collect samples.

Treatment	lb. AI/A	Larvae per sq. ft.	% control
Control	—	66.1 b*	—
Dylox 80SP	4	12.7 a	81
Dylox 80SP	6	14.2 a	79
Dylox 80SP	8	14.2 a	79

*Numbers followed by the same letter are not significantly different from each other, Fisher's Protected LSD, $P < 0.05$.

These results (which were similar to results in 2003) were very encouraging, especially because the insecticide had been applied only six days before we sampled. Field observations in 2005 and in previous years also confirmed that Dylox can work well against larvae, sometimes providing better levels of control than we observed in the 2004 study.

We also tested spinosad (Conserve™) in 2005, again targeting the larvae. In this case we applied on May 10 or June 2 and sampled on June 20. The results from the early May applications were mediocre, but the early June applications (shown here) were much more effective:

Treatment	fl. oz./ 1,000	Larvae per sq. ft.	% control
Control	—	72.2 b*	—
Conserve	0.8	5.1 a	93.0
Conserve	1.0	4.1 a	94.4
Conserve	1.2	2.0 a	97.2

*Numbers followed by the same letter are not significantly different from each other, Fisher's Protected LSD, $P < 0.05$.

We considered these results to be very encouraging and conducted a follow-up study on the second generation of weevils at a second location. Unfortunately, the populations crashed during the study so we do not know

The annual bluegrass weevil adult pictured above is similar in size to black turfgrass ataenius, but it varies in its mottled color and characteristic beak.

how effective Conserve™ will be in summer conditions. Overall, however, the product looks very promising.

During the winter of 2005, the labels on Dylox™ and Conserve™ were expanded to include ABW larvae. But targeting larvae will necessitate a change in a manager's mindset — it is not easy to wait until larvae are present! We will all be learning as we go with this new approach. And we may have to be more aggressive with cultural strategies, such as minimizing the amount of annual bluegrass on greens, tees, and fairways.

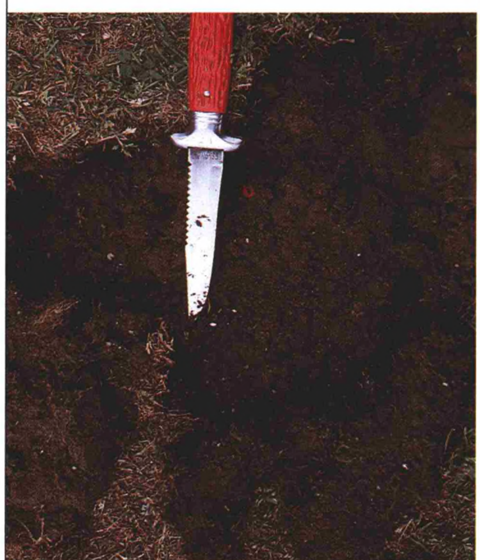
MONITORING FOR ANNUAL BLUEGRASS WEEVIL

Monitoring for ABW is fairly straightforward and critical for making proper management decisions. You can observe adults moving on the surface of the greens, tees, collars, or fairways on sunny days throughout the summer. You can also drive them to the surface using a soapy flush (one or two tablespoons of a lemon-scented dish detergent in one or two gallons of water spread over an area one or two feet on a side). Be sure to rinse the test area with irrigation water if it is a hot, sunny day. You can find larvae and pupae by cutting a wedge in the turf or pulling a core out of the turf and inspecting it by hand. The larvae look like grains of rice with a brown head, while the pupae are all white with a diamond shape. Our field observations suggest that the tolerance level for ABW larvae is between 30 and 80 larvae per square foot in the spring (through mid-June) and 10 to 40 larvae per square foot in the summer.

So for now, the "recipe" for control of ABW includes a spring application of a product targeting adults, after *Forsythia* full bloom and before dogwood full bloom. The alternative is to wait until larvae are active in late May or early June and apply trichlorfon or spinosad to areas where larvae are present in high enough numbers to cause damage. Summer management must be based on monitoring and determining which stages are present. When most insects are larvae, apply trichlorfon or spinosad. When most insects are pupae, wait at least a week and then use a material that is effective against adults. And when most insects are adults, apply chlorpyrifos or a pyrethroid. Until we resolve the matter of resistance in the pyrethroid group, it is wise to minimize the number of applications of those products.

Editor's Note: While trade names have been mentioned in this article, no endorsement is intended or implied by the author or the University of Massachusetts.

DR. PAT VITTUM *is an entomologist at the University of Massachusetts, where she has been researching annual bluegrass weevils and other insect pests on golf courses throughout the Northeast.*



Hyperodes weevils spend five larval stages feeding and growing. It is difficult to track the development of weevil populations during the summer months because of the overlap among insect stages.

Bonne Etiquette!

Golf course superintendents and the Green Committee can lead the way.

BY MATT NELSON

A topic common at USGA Green Section Turf Advisory Service visits is the perceived erosion of golf course etiquette. Often, this topic receives nothing more than lip service, such as, "Yes, it would be nice if golfers would fix their ball marks and replace divots." Over the years there have been some excellent articles that showcase the efforts of golf course superintendents teaching golfers the proper way to repair ball marks on greens; however, a comprehensive golf course etiquette policy is infrequently discussed. Etiquette is an aspect of the game whereby golf course superintendents and the Green Committee can take the lead. Given the various aspects of golf course etiquette, including safety, course care, pace of play, and consideration of other players, the Green Committee may be the perfect entity to develop a golf course etiquette policy to be ratified by the board of directors or owner.

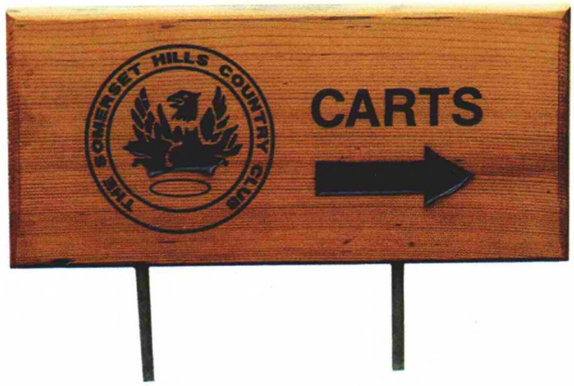
A golf course etiquette policy document should include specific criteria with respect to each facet of etiquette. These would include expected pace of play for 18 holes, perhaps with clocks at select locations on the golf course to inform players of their position. Details on searching for a lost ball, parking of golf carts, advancing to the next hole, flagstick removal and replacement, and ball retrieval from the hole (no putters!) should be included.

Player and maintenance staff safety should be featured prominently. Starting times in the morning and maintenance gaps in the schedule must be abided to protect employees and safeguard maintenance efficiency and quality.

Care of the golf course will include procedures for repairing ball marks and divots. Divot repair should address divot replacement and filling with a soil and seed mixture, whichever is the preferred policy at the golf course. Bunker raking, entering and exiting bunkers, and position of the bunker rakes can also be set in the etiquette policy. Golf cart policy, including path restrictions, should be explained and detailed. Trash disposal and electronic device use are items to include in the etiquette policy.

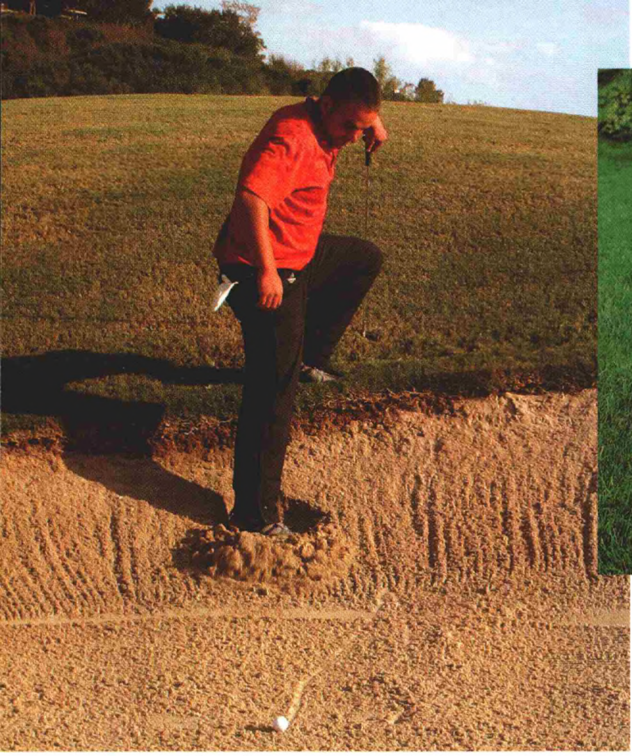
The golf course superintendent has an important role in the process of developing an etiquette policy. The superintendent should instruct the Green Committee on proper ball mark repair; the best way to deal with divots based upon grass species, growing conditions, and maintenance availability; how to rake bunkers; and where the rakes should be placed. The superintendent can provide digital images or pictures for the document to illustrate divot filling, ball mark repair, exiting bunkers, controlling carts, retrieving a

The pro shop staff and starter can provide reminders about specific etiquette items and how to carry them through correctly on the golf course.



Tasteful signage and creative educational reminders encourage golfers to contribute to the overall quality of the golf course.

The Green Committee and the golf course staff are perfectly suited to help golfers take ownership of their golf course and respect the game.



Occasionally, golfers need a reminder about the basic principles of etiquette on the golf course. Bunker raking, entering and exiting bunkers, and the position of bunker rakes should be described in the golf course etiquette policy.

Etiquette is an aspect of the game in which golf course superintendents and the Green Committee can take the lead. Developing a golf course etiquette policy document should include specific criteria, such as the expected pace of play for 18 holes. Placing clocks at select locations on the course helps keep golfers on track.

In developing a golf course etiquette policy, the golf course superintendent should provide pictures that demonstrate proper repair techniques and how to deal with conditions specific to the golf course property.

ball from the hole, and other tips. Pictures that demonstrate proper technique will add significantly to the value of the document.

After an etiquette policy document is developed and ratified by the board of directors or other appropriate authority, disciplinary action for breaching etiquette rules should be determined. This would include a written warning for a first offense, a formal admonition from the club/committee for a second offense, and perhaps a suspension of privileges for repeat offenders. The USGA website features guidelines on golf course etiquette at http://www.usga.org/playing/etiquette/etiquette.html. The end of these etiquette guidelines includes the following statement on enforcement: "If a player consistently disregards these guidelines during a round or over a period of time to the detriment of others, it is recommended that the Committee consider taking appropriate disciplinary action against the offending player. Such action may, for example, include prohibiting play for a limited time on the course or in a certain number of competitions. This is considered justifiable in terms of protecting the interest of the majority of golfers who wish to play in accordance with these guidelines. In the case of a serious breach of etiquette, the Committee may disqualify a player under Rule 33-7."

At a private club, the etiquette policy can be included in the member handbook, and new members should be expected to read and sign the policy as a condition of playing the course. The Green Committee should make a presentation at the annual meeting, educate all golf course staff, and serve as ambassadors of etiquette.

Public golf courses usually consist of a core group of regular golfers, and etiquette should be discussed at the annual meeting. In addition to the Green Committee serving as etiquette ambassadors and educating staff, it may prove helpful to include etiquette tips on the club's or Parks and Recreation Department's website or in a weekly newspaper column or newsletter. Etiquette also should be instilled regularly in high school and junior golf programs.

At resort courses, information dissemination and enforcement will present a greater challenge, but etiquette tips can be shared. The pro shop staff, starter, and player assistants can make weekly points of emphasis out of specific etiquette items. Creative educational reminders can be used on video displays, scorecards, or tasteful signage. Golf lessons also are an avenue for sharing the importance of etiquette and the spirit of the game.

The Green Committee is perfectly suited to helping golfers take ownership in their golf course and respect the game. Many new golfers simply have not had the exposure to golf etiquette and tradition that players growing up with the game have. Longtime players also can use a reminder periodically to further embolden the traditions of the game that many hold dear.

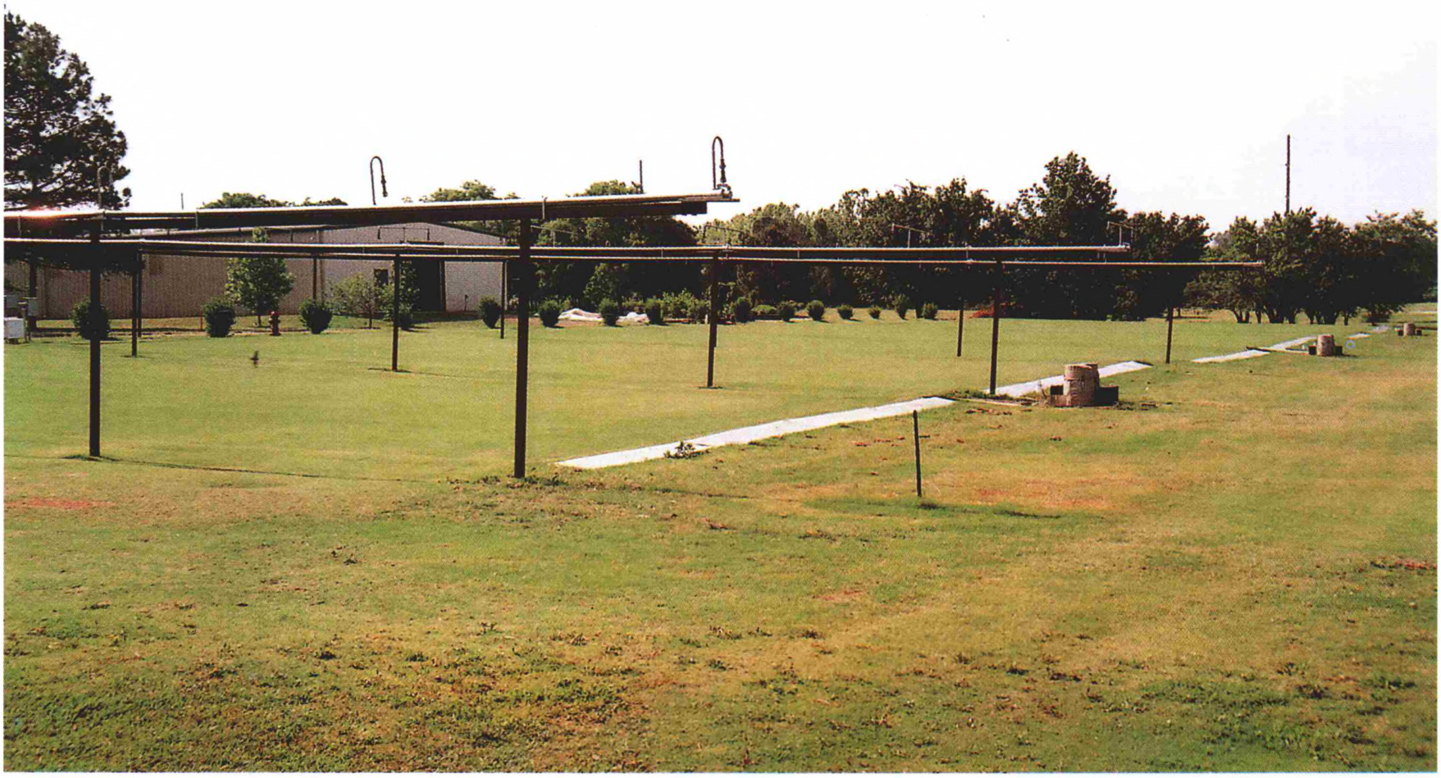
The golf course superintendent can encourage the Green Committee to lead the development of an etiquette policy document by setting up an initial meeting, offering a sample list of items to be addressed, and providing pictures for a handbook, website, or other form of communicating with golfers.

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

Mowing Roughs to Minimize Runoff

Scientists at Oklahoma State University demonstrate the environmental protection value of multiple-height roughs.

BY GREG BELL AND JUSTIN MOSS



Golf course fairways are fertilized to promote good turf cover, high turf density, and minimal weed encroachment. The higher-cut golf course rough acts as a vegetative filter strip or buffer that reduces runoff. Oklahoma State University researchers compared the use of multiple barriers with a single-buffer barrier in reducing nutrient runoff.

Golf course fairways tend to receive more fertilizer than most turfgrass areas to promote good turf cover, high turf density, and minimal weed encroachment. There is a slight but nonetheless possible likelihood that a small portion of the fertilizers applied to golf course fairways can dissolve in surface water runoff and contaminate lakes, streams, and other water features. Given this possibility, it is important that turf scientists pursue and investigate management methods that help superintendents develop environmentally sound practices that reduce the potential for nutrient runoff.

The higher-cut golf course rough that commonly surrounds fairways acts as a vegetative filter strip or buffer that reduces runoff.[2] Research suggests that the higher the buffer, the longer the period between rainfall initiation and runoff, and the more likely that runoff will be eliminated or reduced following a particular rainfall event.[1] The density of the turf on the fairway or in the rough also has an impact on runoff.[3,4] Golf course superintendents strive to maintain full turf cover and maximum turf density, thereby reducing the likelihood that runoff will occur.

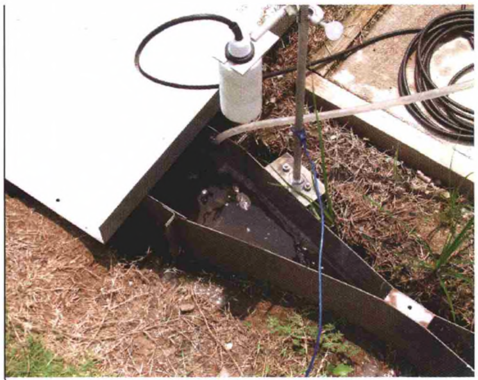
Even under worst-case conditions where fertilizer was applied to turf but not watered in and a major storm event occurred within a few hours of application, the amount of fertilizer nitrogen (N) and phosphorus (P) lost to runoff was generally less than 10% of applied and, more often, only 2-4% of applied.[9] The levels of P that were found during studies of nutrient runoff from turf were often less than those found in natural rainfall.[6]

Based on previous research, we reasoned that it is difficult for water to flow through the dense system of shoots formed by closely mowed turf.[3,4] Consequently, because turf density tends to increase with decreasing mowing height, it may be reasoned that a low mowing height should be more effective than a higher one for providing resistance to flow. That may be the case for turfgrass stands of a single mowing height, but it did not prove correct for turfgrass stands that include vegetative buffers.[1] When runoff flows from a low-cut turf to a higher-cut turf, its passage is further restricted.[2] Based on the density principle, water flowing from a short mowing height to a taller mowing height should pass easily through the relatively low density of the higher height of cut. Research indicates, however, that this does not occur. Buffers of 1.5 inches did not restrict flow as effectively as buffers of 3.0 inches.[1]

When surface runoff from a golf course fairway encounters golf course rough, it tends to slow and puddle until sufficient energy builds to allow the water to flow through or over the higher height of cut. The higher-cut turf forms a barrier to gravitational flow that must be overcome before the surface runoff continues down the slope, providing more time for the runoff to infiltrate into the thatch and soil. Therefore, a graduated system of rough such as apron to first cut to primary rough would provide three heights of cut, resulting in three barriers. Since wider buffers do not seem to deter runoff with greater effectiveness than shorter ones[2] and since exceptionally high mowing heights could negatively affect playability, this multiple-barrier strategy could provide the best alternative for reducing nutrient runoff from fairways. The objective of this research was to effectively compare this multiple-barrier strategy with the single-buffer strategy that is already known to be effective.

THE RESEARCH SITE

The water runoff research site at Oklahoma State University consisted of three irrigation blocks with two 40 ft. × 80 ft. plots per block, for a total of six plots on 0.44 acre. The site was mature common bermudagrass (*Cynodon dactylon*) on compacted silt loam soil with a surface infiltration rate of less than 0.5 inch per hour. The turf irrigation system delivers a precipitation rate of 2 inches per hour. A series of 18 time domain reflectometer probes served to monitor soil moisture so that the site could be consistently maintained at field capacity. The turf was mowed at 0.5 inch across the upper sections of each plot three times per week to simulate golf course fairways.



Ultrasonic modules (ISCO 710) mounted over each Parshall flume used ultrasonic reflection to measure water levels and flow rates every five minutes for 60 minutes.

The fairway sections were 40 ft. wide by 62 ft. long and were bordered by rough that was 40 ft. wide by 18 ft. long at the bottom of the slope. The single-barrier rough was mowed at 2 inches for the full 18 ft. length from fairway to collection trough, and the multiple-barrier rough was mowed at increasingly higher heights every 6 ft. down the slope. The mowing heights for the multiple-barrier rough increased from 1.0 inch at the highest surface elevation to 1.5 inches at the intermediate location to 2.0 inches at the lowest elevation. The buffers were mowed once per week.

Researchers at Oklahoma State University found that using vegetative buffers maintained at multiple mowing heights improved the ability to limit both nitrogen and phosphorus runoff compared to buffers maintained at a single height of cut.

FERTILIZER, PRECIPITATION, AND SAMPLE COLLECTION

To test nutrient runoff, urea and triple super phosphate fertilizer were applied at 1 lb. nitrogen (N) per 1,000 sq. ft. and 0.5 lb. phosphorus (P) per 1,000 sq. ft. four hours before irrigating and again following irrigation events to await natural rainfall. The fertilizers were applied as granules and were not watered-in so that the study represented worst-case conditions. Fertilizers were

Table 1

The mean runoff flow rate, amount of N and P, and N and P concentrations (conc.) during 5-minute intervals in runoff produced by six irrigation events and four natural rainfall events.

Time	Flow Rate		N Lost to Runoff		P Lost to Runoff		N Conc.		P Conc.	
	Multiple	Single	Multiple	Single	Multiple	Single	Multiple	Single	Multiple	Single
min	gal/ac/min		lb/ac/min				ppm			
Irrigation Runoff										
5	62	73	0.0005	0.0005	0.0015	0.0010	1.0	0.7	2.9	*1.7
10	151	182	0.0018	0.0015	0.0050	0.0043	1.4	*1.0	4.0	*2.8
15	234	*286	0.0046	0.0042	0.0120	0.0122	2.3	*1.7	6.2	5.1
20	285	*345	0.0075	0.0081	0.0185	0.0204	3.2	2.8	7.8	7.1
25	313	*381	0.0093	0.0112	0.0215	0.0254	3.5	3.5	8.2	8.0
30	334	*398	0.0102	*0.0126	0.0221	*0.0260	3.6	3.8	7.9	7.8
35	347	*412	0.0102	*0.0128	0.0207	*0.0243	3.5	3.7	7.1	7.1
40	348	*422	0.0097	*0.0126	0.0180	*0.0220	3.4	3.6	6.2	6.3
45	363	*423	0.0096	*0.0122	0.0164	*0.0197	3.2	3.5	5.4	5.6
50	365	*412	0.0090	*0.0113	0.0144	*0.0172	3.0	3.3	4.7	5.0
55	354	*406	0.0082	*0.0105	0.0125	*0.0150	2.8	3.1	4.2	4.4
60	341	*406	0.0074	*0.0102	0.0104	*0.0135	2.6	*3.0	3.6	4.0
Natural Rainfall Runoff										
5	284	277	0.0037	0.0034	0.0090	0.0061	1.6	1.5	3.8	*2.6
10	512	508	0.0073	0.0066	0.0205	0.0145	1.7	1.6	4.8	*3.4
15	349	409	0.0057	0.0057	0.0188	0.0183	2.0	1.7	6.5	5.3
20	191	*266	0.0034	0.0041	0.0124	0.0160	2.1	1.8	7.8	7.2
25	153	*195	0.0027	0.0033	0.0104	0.0127	2.1	2.0	8.1	7.8
30	170	*198	0.0029	0.0035	0.0107	0.0127	2.0	2.1	7.6	7.7
35	157	*218	0.0026	*0.0039	0.0091	*0.0130	2.0	2.1	6.9	7.1
40	126	*194	0.0019	*0.0033	0.0064	*0.0102	1.8	2.1	6.2	6.3
45	82	*143	0.0012	*0.0023	0.0037	*0.0066	1.7	2.0	5.3	5.5
50	45	* 93	0.0006	*0.0015	0.0017	*0.0038	1.6	1.9	4.6	4.9
55	18	* 55	0.0002	*0.0008	0.0006	*0.0020	1.5	1.8	4.0	4.4
60	11	* 33	0.0001	*0.0005	0.0003	*0.0011	1.4	1.8	3.4	3.9

*Indicates a significant difference between the multiple-barrier and single-barrier rough ($P < 0.05$)

applied to the simulated golf course fairway area six times in 2001 and six times in 2002. Fertilizer was not applied to the rough.

Covered troughs collected runoff water from each plot and channeled it through calibrated Parshall flumes by gravity flow. Ultrasonic modules (Isco 710) mounted over each Parshall flume used ultrasonic reflection to measure water level. Isco 6700 portable samplers (Isco, Lincoln, Nebraska) were secured to concrete platforms located between each experimental block. The samplers were programmed to determine water flow rate and collect runoff samples every five minutes for 60 minutes. Samples were tested to determine the amount of N and P in the runoff. The time from the beginning of precipitation to the beginning of runoff also was measured for each plot during each event.

Runoff caused by irrigation was collected three times in 2001 and three times in 2002. Natural rainfall runoff was collected once in 2001 and three times in 2002. Each time precipitation occurred, multiple samples of the irrigation or rainfall were collected and the concentrations of N and P in the samples were determined. Background concentrations were subtracted from the nutrient concentrations in the runoff to determine the actual amount of N and P removed from the turf.

RESULTS — RUNOFF RATE AND TIMING

During irrigation, the multiple-barrier rough reduced the peak runoff rate by 14% compared with the single-barrier rough and reduced the total runoff at 60 minutes by 16%. In contrast, peak runoff occurred more rapidly during the natural rainfall events, producing an average of 510 gallons per acre per minute at 10 minutes after runoff began (Table 1). The multiple-barrier rough did not significantly affect the peak natural rainfall runoff rate, but it did significantly reduce the cumulative runoff volume by 19% during 60 minutes of runoff.

The multiple-barrier rough significantly delayed the time from the beginning of precipitation to the beginning of runoff compared with the single-barrier rough during both irrigation and natural rainfall. The multiple-barrier rough delayed runoff initiation by approximately four minutes during irrigation and by two minutes during natural rainfall. The average time to initiation of runoff during irrigation events was 20 minutes for the multiple-barrier rough and 16 minutes for the single-barrier rough. Time to runoff for natural rainfall events was 39 minutes for the multiple-barrier rough and 37 minutes for the single-barrier rough.

NUTRIENT LOSSES

The fertilizer application methods that were applied to the irrigation experiments in this study were established to provide worst-case conditions. Golf course superintendents generally do not apply fertilizer within 48 hours prior to predicted rainfall and nearly always water-in the fertilizer immediately following application to minimize possible runoff losses. The nutrient losses in this study are representative of a worst-case scenario and are likely to be more severe than what typically occurs.

Fertilizer losses in runoff were small compared with fertilizer applied. On average, 1.5% of the N applied was lost to irrigation runoff and 0.5% to natural rainfall runoff during 60 minutes of runoff. Irrigation runoff caused a 5.5% loss of applied P and natural rainfall runoff caused a 3.3% loss of applied P during 60 minutes of runoff. These results are comparable with the results of other researchers and further support the contention that turf has a positive influence on the reduction of nutrient losses from runoff.[3,7]

The reduced runoff volume resulting from the use of the multiple-barrier rough compared to the single-barrier rough caused a significant reduction in the amount of N and P lost to both irrigation and natural runoff (Table 1). The multiple-barrier rough reduced the amount of N lost with 60 minutes of irrigation runoff by 18% and the amount of N lost with 60 minutes of natural rainfall runoff by 17%. The multiple-barrier rough reduced the amount of P lost to irrigation runoff by 14% and the amount of P lost to natural rainfall runoff by 11% during 60 minutes of runoff.

The concentration of NO_3-N never exceeded the recommended EPA limit for drinking water of 10 ppm,[8] but both dissolved N (NO_3-N + NH_4-N) and dissolved P consistently exceeded 1 ppm and 25 ppb, respectively, the commonly recommended allowances for reducing the likelihood of eutrophication.[9] The N concentrations in both irrigation and natural rainfall accelerated rapidly from 5 to 25 minutes and were highest between approximately 25 to 35 minutes (Table 1). The P concentrations also accelerated rapidly and were highest in both forms of precipitation at approximately 20 to 35 minutes (Table 1).

The rapidly accelerating nutrient losses during the beginning of runoff offset the delay in time to runoff between treatments and effectively neutralized the beneficial effects of the multiple-barrier rough during the initial stages of runoff. After 20 to 25 minutes of runoff, nutrient losses were nearly equal among treatments in spite of the average four- or two-minute delay in time to runoff caused by the multiple-barrier rough and the greater volume of irrigation runoff from the single-barrier rough (Table 1). Consequently, the multiple-barrier rough did not affect nutrient runoff significantly for the first 30 to 35 minutes of runoff, but maintained an advantage following 35 minutes until at least 60 minutes of runoff during both irrigation and natural rainfall.

RUNOFF REDUCTION

Based on 55 years of precipitation data collected at Stillwater, Oklahoma, an average of 81 rainfall events occurred each year.[5] Most of those events did not produce adequate precipitation to force runoff, but seven events per year produced at least 0.5 inch of rainfall (the amount required to produce runoff at the research site) at an average precipitation rate greater than 0.5 inch (the surface infiltration rate) for at least one hour, and lasted longer than 72 minutes (the average time of precipitation required to produce significant differences in nutrient losses between buffer treatments). Consequently, the use of multiple-barrier roughs could make a meaningful difference in the amount of nutrients lost in runoff during those seven runoff-producing rainfall events that are likely to occur each year in Stillwater, Oklahoma. The average annual rainfall in Stillwater is 37 inches, a relatively dry climate compared with many regions of the world. The multiple-barrier rough may well make a greater difference in regions where rainfall is more plentiful.

A simple observation of turf following a severe rainstorm indicates that runoff not only occurs through the shoots but also occurs over the leaves. Areas of severe runoff are identified by the prostrate appearance of the turf. When runoff water from bare soil encounters a grass barrier, the runoff slows due to shoot resistance until sufficient volume accumulates to provide the force necessary to bend the shoots and the lower leaves, allowing the runoff to flow over or around the plants. We hypothesize that when water encounters a second mowing height, a similar resistance occurs and sufficient volume must be accumulated to overcome this second barrier.

During this study, a puddle of water formed each time the runoff encountered a buffer. The puddling was most noticeable at the interface of the fairway and initial buffer but also occurred at the interface of each height increase in the multiple-height buffers. Although turf density can be expected to increase with lower mowing height and have an inhibitory effect on runoff,[3,4] the work of Baird et al.[1] indicated that when a buffer strategy is employed, the shoot height of the buffer vegetation had a greater effect on runoff than turf density. Baird et al.[1] reported that a 3.0-inch buffer height was more effective for reducing water runoff than a 1.5-inch buffer. Accordingly, multiple mowing heights result in multiple barriers that slow runoff and reduce runoff volume.

Editor's Note: A more detailed research report originally appeared in *USGA Turfgrass and Environmental Research Online* (http://usgatero.msu.edu). Readers may visit this Web site for this and many other articles reporting the results of USGA's Turfgrass and Environmental Research Program.

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GREG BELL, PH.D., *Associate Professor, and* JUSTIN MOSS, *Graduate Student, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, Oklahoma.*

Covered troughs collected runoff water from each plot and channeled it through calibrated Parshall flumes by gravity flow.

Paying the Price for Success

An open letter to aspiring turfgrass professionals.

BY JIM SIMMONS

Today's students have access to more information, but the competitive nature of the business may mean more years of experience are needed before becoming a golf course superintendent.

Dear Aspiring Turfgrass Professionals,

My name is Jim Simmons and I have been working on golf courses for almost 40 years. I have been the golf course superintendent at the Shoal Creek Club, in Birmingham, Alabama, since 1977. When I made up my mind to become a golf course superintendent, I had a goal to become the best superintendent in the business at the best course in the country. Throughout my career I have been fortunate to be in the right place at the right time to advance my career, but any success I have achieved has not come without hard work, long hours, and working for demanding employers. I have seen all sides of the business during my career, and I would like to share with you the traits that I believe are necessary to be successful in this business.

A CAREER IS LAUNCHED

I began working on my hometown course in 1966. Two of my friends and I were hired for what would turn out to be the job of a lifetime, at least for a hometown boy. I enjoyed the work and being on a golf course. My father, who was not known for the art of conversation, made a single comment to me, "Why don't you consider going to turf school?" From that point on, my career began.

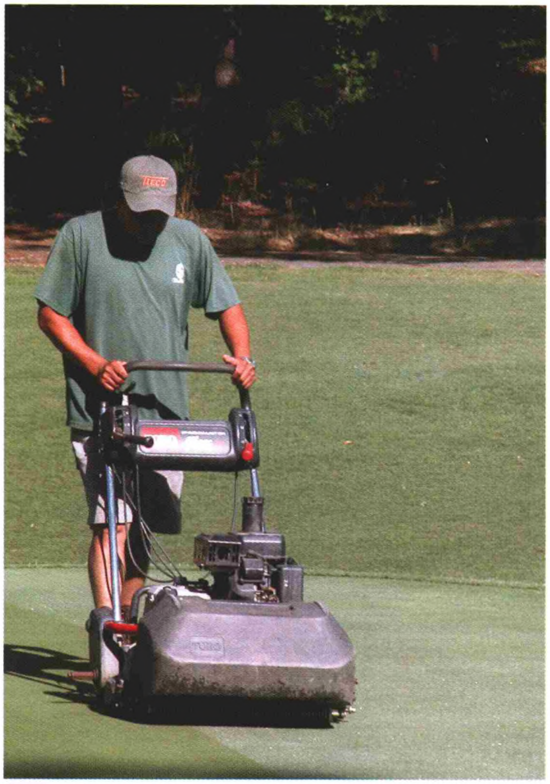
I enrolled at Michigan State University in their new two-year turfgrass management program. I was fortunate to be taught by professors such as James Beard, John King, Al Turgeon, Ken Payne, Paul Rieke, and Joe Vargas. Their interest and enthusiasm really motivated many of us in the class, and some of us needed motivating at that age.

My placement training or internship was done under Jack Hart at the NCR Country Club in Kettering, Ohio. The year was 1969 and the club would host the PGA Championship that same year. Student interns were unheard of at that time. Although Jack Hart was forthcoming with helpful information, many of his assistant superintendents and foremen were skeptical of college students. Most assistants and foremen were not turf educated and in many cases did not finish any formal education. Needless to say, it was difficult to gain the confidence of the assistant superintendents and foremen.

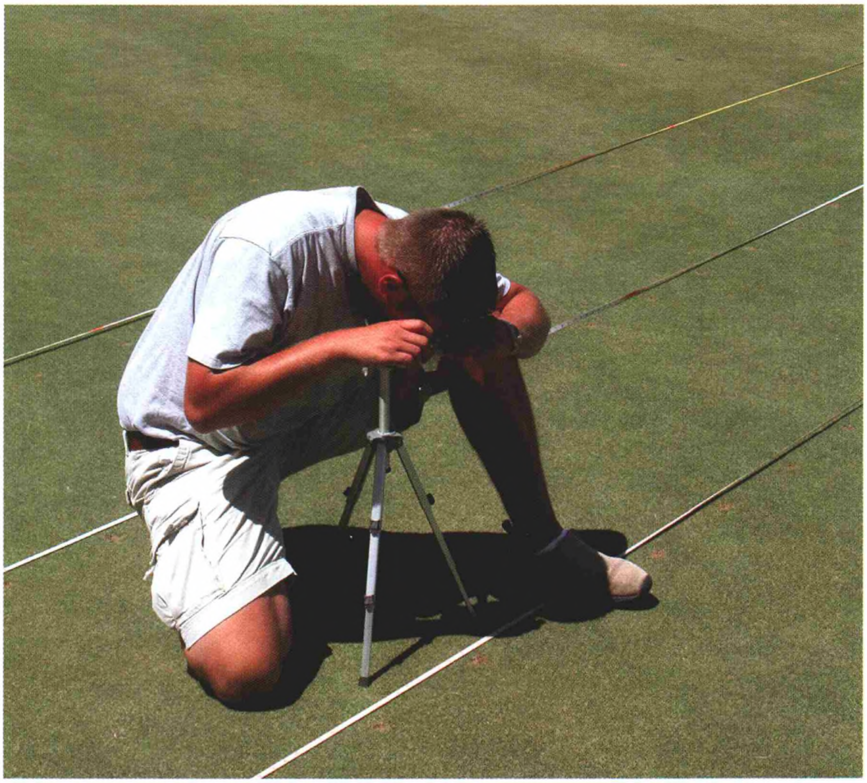
During my internship at NCR, I worked hard and gained valuable insight into the career of a golf course superintendent. Jack Hart told me something as I was leaving that has stayed with me my whole career: "Once you feel you do not have to get down on your hands and knees to evaluate your golf course, you will be thrown out of this business." To this day, this statement is the truth.

CLIMBING THE LADDER

Upon graduating, I went back to my hometown and worked a year as a so-called superintendent. My two friends and I made up the entire maintenance crew. It was hard work, the budget was low, and I earned $2.25 per hour. I thought I was doing well. The course owners were businessmen who built



Student interns who demonstrate hard work, self-discipline, dedication, and patience are developing the skills necessary to be a successful golf course superintendent.



A mentor once told me, "Once you feel you don't have to get down on your hands and knees to evaluate our golf course, you will be thrown out in this business." To this day, this statement is true.

the course out of love for the game. They gambled most of their wealth on this course, and they wanted every cent spent to be productive, to say the least.

A good friend of my family, Jack Welch, became the self-appointed guardian angel over my career. He brought information back from national meetings to me. He even piqued my interest in joining the Central Ohio Superintendents Association. At one meeting I got up the nerve to speak with Walter Fuchs, superintendent at Scioto C.C., one of the premier golf courses in the country. He invited me to Scioto to show me his operation. During the tour, I was so impressed that I asked if he knew of anyone looking for an assistant. He mentioned a young guy who had just become the superintendent at Brookside C.C. in Worthington, Ohio. I sent this superintendent, Ed Etchells, my resume, was asked to interview, and was soon hired. This move really jump-started my career.

Ed Etchells was demanding not only of himself, but of his employees as well. When I arrived at Brookside, it was considered the third-best course in the Columbus area. After renovating fairways and tees and generally improving the grooming of the course, it was considered right up there with Scioto C.C. All this work was done in a short period of time. I learned in a hurry to be self-disciplined, efficient, and organized when going about my jobs. Ed Etchells lived his life this way, and if one paid attention and wanted to progress, he would be wise to do the same.

BECOMING A SUPERINTENDENT

My father, an employee of Scotts, had a meeting with Jack Nicklaus years before my start in the business. Jack was interested in building a golf course in Dublin, Ohio, and he wanted Scotts to use the course as a proving ground for their products. Though the relationship never developed, I never forgot the message of that meeting — Jack Nicklaus wanted to build a golf course.

Eventually Nicklaus's course, Muirfield Village Golf Club, was built and Ed Etchells became the superintendent. I was hired as the assistant superintendent. Now I had two demanding individuals to answer to. Many of the skills I learned from my two previous courses paid off as I worked to prove my worth. Over the four years I worked at Muirfield, I continued to learn many valuable lessons and, although I did not know it at the time, I was laying the foundation for the next challenge in my life. The harder I worked and the more responsibility I was willing to shoulder, the more trust both Ed and Jack put in me. I did not sit around talking about what I could or could not do. Instead, I patiently showed them I was able to handle any situation on the golf course.

After Muirfield Village was completed, Jack started designing his own courses and Ed Etchells began providing agronomic consulting on all of Nicklaus's courses. Shoal Creek was Jack Nicklaus's first course he designed

FREQUENTLY ASKED QUESTIONS

Jim Simmons has more than 30 years of experience as a golf course superintendent. Over that time, he estimates that he has provided internships for more than 150 individuals, many of whom are still in the business. Although the faces of interns, crew members, and assistants change, Jim is asked the same questions over and over again. Below are a few of these questions along with Jim's responses.

What type of experience can I gain from an internship under you? Your internship will begin with learning to master the shovel and rake. As I observe your attitude and your ability to do excellent work, you will move up and learn additional jobs. If all goes well, you will have learned how work is done at Shoal Creek and you will be skilled at many different tasks.

Why am I initially assigned the lowest jobs as an intern? Interns start at the bottom for two reasons. First, I am able to get comfortable with you, your attitude, and your work. Second, if your training follows a progression and I am in a pinch for a crew member, I have a good feel for whether you are up to the task or not.

What traits do you look for when hiring an assistant superintendent? At Shoal Creek, traditionally assistant superintendents are hired from within the staff. Over time, I am able to observe the work ethic, attitude, and skills of individuals who will be considered for assistant superintendent positions.

How long can I expect to be an assistant superintendent? At Shoal Creek, an assistant superintendent is expected to remain on staff for approximately three years before seeking a superintendent's position. This time frame seems to work well for both sides. The club has invested a substantial amount training the assistant and reaps the reward of an experienced assistant for three years. The assistant has the benefit of three years as an assistant superintendent.

I have interviewed at several courses and I do not seem to ever get to the final interview. I always end up second or third. What is happening? You might be looking at the wrong type of course. Take a good look at yourself, your work ethic, and desires and seek a course that fits your profile.

When asked in an interview, "What kind of money are you looking for?" the interview seems to lose its intensity. How should I handle this question in an interview? You may be asking for too much money for your first position. Very few assistants leave their present position and land that "gold mine" salary. There are too many people applying for the same position. While some may have the experience to justify a high salary, others will have to prove themselves.

New challenges provide anyone from course worker to assistant to superintendent with an opportunity to develop new skills and show their employer that they can handle the job.

Perfecting all the jobs on the golf course helps lay the foundation for future success as a superintendent.

by himself in the United States. The story goes that the owner of the course, Hall Thompson, asked Jack during one of his site visits, "What type of grass are we planning for on the putting greens?" Without flinching, Jack said, "Bentgrass." In the next breath he mentioned he had this young man at Muirfield Village who was knowledgeable and ready to grow bentgrass. This is the reason I was hired at Shoal Creek.

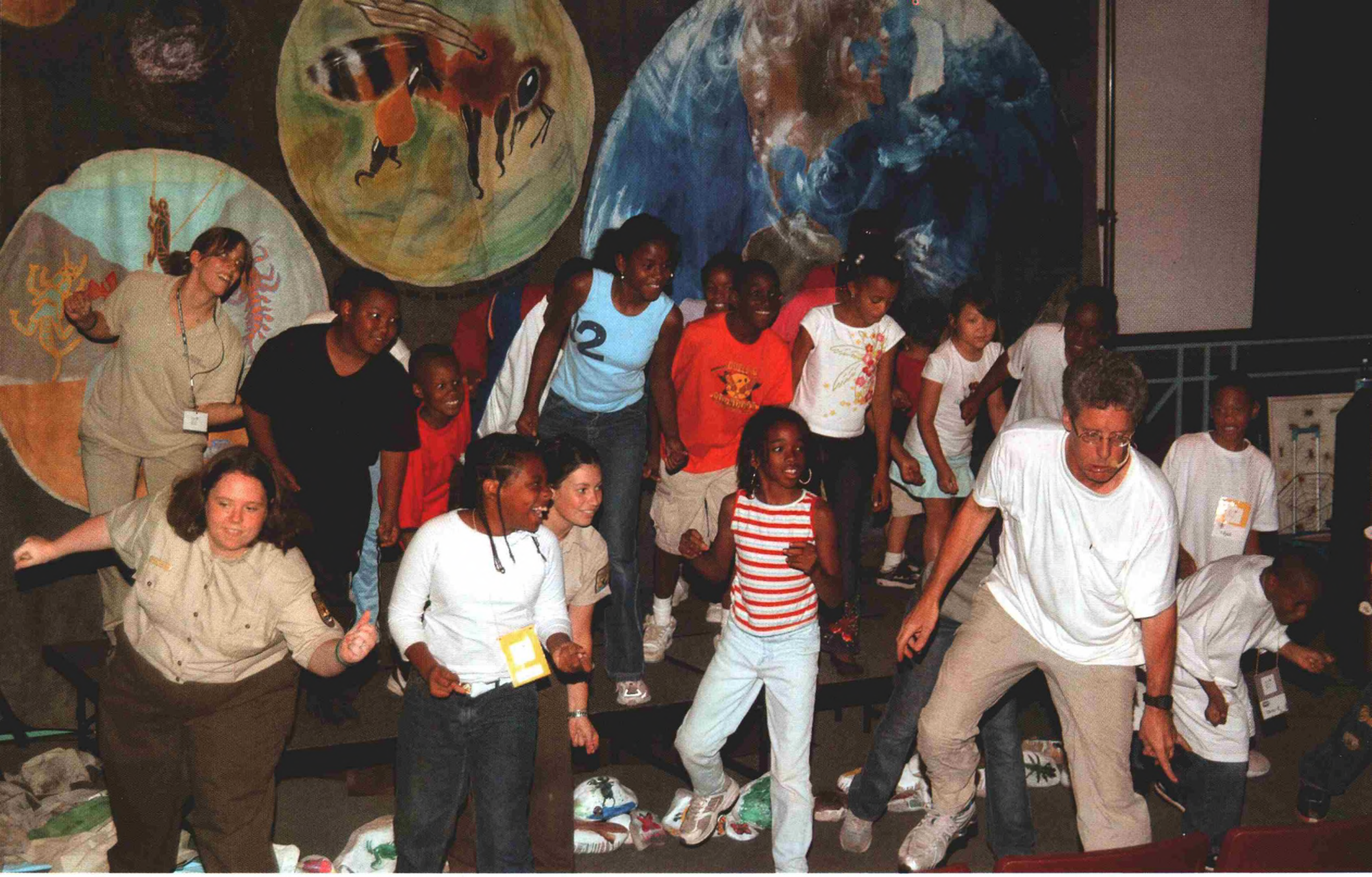
BECOMING A SUCCESSFUL SUPERINTENDENT

To be hired as a superintendent, I had proven that I was capable of working long hours, organizing and planning schedules, and managing employees. I had to deliver the results my employers desired, and I earned the respect of my employers not by telling them what I was capable of, but by working and providing a result they could relate to.

I can say that the careers of the students who work for me are enhanced tremendously when they work for an entire year on the golf course. They see everything from the early season pre-emergence herbicide applications to the end-of-the-season overseeding. Many students have not even worked an entire year on the golf course, but they believe they are ready for an assistant position or higher. Taking the time to learn all the on-course jobs and the changes that occur on the course throughout the year builds a foundation necessary for success.

It took me nearly ten years to reach my goals. I progressed from worker to assistant superintendent to superintendent. Today, there are many more graduates from turf schools and the job market has never been more competitive. It may take a person going from worker to intern to spray tech to assistant in training to assistant before being hired as a superintendent. No matter what the timeline is, however, there is a common thread I see in successful individuals — hard work, sacrifice, self-discipline, patience, and a positive attitude. Maybe more important than all these other traits is setting a goal to work toward. Do you have a goal?

JIM SIMMONS *is the only superintendent in the history of Shoal Creek. He has prepared Shoal Creek for two PGA Championships and the U.S. Amateur, and he has been a mentor to many interns and assistant superintendents.*



Each year the Patuxent Research Refuge hosts a week-long GeoCamp to immerse fifth-grade students in environmental education. The 2005 theme was insects, with a specific focus on pollinators. Billy B. led students in a song describing the importance of pollinators in their everyday lives.

GeoCamp Is Here Again!

Golf courses participate in a program to help young students become "Habitat Heroes."

BY JENNIFER HILL

GeoCamp 2005 (July 11-15) has come and gone for another year. The purpose of this week-long camp is to immerse rising fifth-grade students from two District of Columbia schools (Thomas Nevel and Smothers Elementary) into various environments and guide them in becoming "Habitat Heroes." GeoCamp is conducted in partnership with National Geographic, and the goal is to incorporate history, culture, and geography into the week via environmental education. Every year's session proves to be a new and exciting experience.

This year's theme was INSECTS! — focusing specifically on pollinators. Students were exposed to the world of honey bees, where they tasted honey, saw products bees help produce for humans, and listened to a song by Billy B. entitled "Bee Barf" — describing just what honey is. The students then discovered the importance of pollinators in their everyday lives.

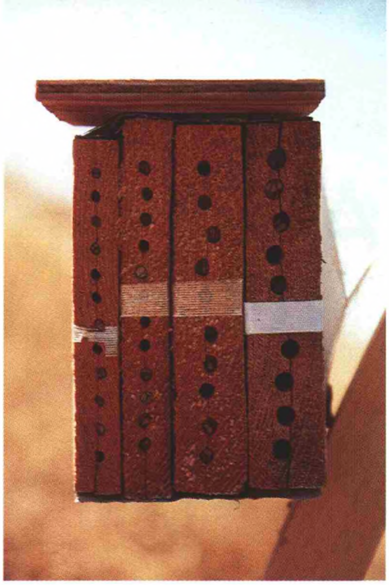
As Habitat Heroes, students participate in an action project to aid wildlife conservation. This year students built bee boxes for solitary nesting bees in an effort to conserve pollinators. Several local golf courses received the bee boxes to provide habitat for pollinators.

WHY BEE BOXES? WHY GOLF COURSES?

Golf courses can be relatively good places to see wildlife; however, they are often divided into "chunks" of habitat not suitable for many wildlife species. Often, you find beautiful landscaping and blooming flowers on a golf course, but you will not find fallen trees or patches of ground that are suitable for bees and other pollinators to nest in. By distributing bee boxes to neighboring golf courses, it is our hope that the bee boxes will help establish more nesting space for pollinators and raise awareness about their important function. With the boxes up, bees have both flowers for food and suitable habitat for nesting, egg laying, and protection.

Golf courses were selected for bee box distribution because the schools participating in the camp are very close to Langston Golf Course. By distributing bee boxes to Langston, the students learned a little about the history of the D.C. area and how Langston was historically an all-African-American golf course. Other nearby golf courses tie in geography (as did several other activities on bees/pollinators) and habitat enhancement. Our hope is that the students will be able to take a field trip to the golf course, learn a bit more history, observe a bee box made by a student, and observe other wildlife utilizing patches of habitat on the golf course.

Bats also play a role in pollination and are another example of an animal that may have suitable feeding areas, but not proper resting/protection areas, on the golf course. Bees pollinate flowers that we love to see, but, more importantly, they pollinate much of the food we eat, and bats eat many mosquitoes. The ponds or areas of water on a golf course draw insects and provide drinking water for bats. Flowers, pole-lights, and open fields attract insects, but snags (standing dead trees) are needed to provide resting habitat and protection for bats. To remedy this, a bat box can be placed on the side of a building, lamp, or telephone pole. Bees and bats are species that tend to have a negative "rap." Our hope is that by establishing suitable areas for them, the general public will learn about their significance in our daily lives.



Golf course out-of-play areas can provide excellent habitat for pollinators when combined with nesting sites and foraging areas. Bee nesting blocks can be made from pieces of water-resistant lumber at least 4" by 4" and 8" long. In one side of the block, drill holes between 3/32" and 3/8" in diameter, at approximately 3/4" centers. The holes need to be closed at one end.

A valid question about establishing bee boxes on the golf course is the possibility of bees stinging people. The bees housed in these boxes are non-aggressive, and several species do not even have the capability to sting.

GOLF COURSE'S ROLE IN THE ENVIRONMENT

Today, more golf courses are working toward habitat restoration for wildlife and plants. In creating more wildlife-friendly habitat on golf courses, biodiversity of plant and animal species will be aided. Langston Golf Course in Northeast D.C. accepted a few bee boxes and will coordinate student field trips. Opportunities such as these are key in reinforcing concepts taught during the camp, as well as providing a sense of accomplishment for the students in seeing their bee boxes mounted at a golf course.

In addition to discovering habitats in the environment during GeoCamp, students celebrated what they learned through music. Environmental singer and songwriter Billy B. (of "Bee Barf" fame) performed a one-hour concert in honor of GeoCamp and spent the afternoon singing about INSECTS!

GeoCamp is made possible with a grant from the National Geographic Society in partnership with the U.S. Fish and Wildlife Service, D.C. Geographic Alliance, and Friends of Patuxent. We thank all of these groups, as well as the volunteers and staff who helped make this event a success. We want to also thank USGS Patuxent Wildlife Research Center researcher Sam Droege, who provided advice and supplies to help with student education; Kimberly Erusha and Darin Bevard from the United States Golf Association; and Lloyd Luna, Bart Smith, Carolyn Grant, Jill Stevenson, and Joe Brotherton from the Bowie-Upper Marlboro Beekeepers Association, who provided beekeeping demonstrations. We also would like to thank the following participating golf courses that supported the Habitat Heroes of GeoCamp 2005: Baltimore Country Club, Timonium, Md; Baltimore Country Revenue Authority, Towson, Md.; Chevy Chase Club, Chevy Chase, Md.; Enterprise Golf Course, Bowie, Md.; Langston Golf Course, Washington, D.C.; Red Gate Golf Course, Rockville, Md.; Talbot Country Club, Easton, Md.; Queenstown Harbor, Queenstown, Md.

JENNIFER HILL *is a Park Ranger with the U.S. Fish and Wildlife Service stationed at Patuxent Research Refuge in Laurel, Maryland.*

A Blueprint for Management

Shaping the Audubon program to address golf's environmental concerns.

BY JEAN MACKAY AND JOELLEN ZEH

The Audubon Cooperative Sanctuary Program for Golf Courses (ACSP) was born in 1991 when a few hundred golf courses stepped forward to participate in the fledgling environmental education and certification program. With generous funding provided by the USGA, Audubon International crafted a program to address golf's environmental concerns and take advantage of its environmental opportunities.

As it turned out, *cooperative* was an apt part of the program's title. Audubon's biologists had a crash course in core aeration and green speed. Superintendents got smart about wildlife corridors and ecological systems. Together, they shaped a program that now serves as a blueprint for environmental management on golf courses around the world.

Today, more than 2,100 golf courses in 26 countries participate in the ACSP, while an additional 129 golf course development projects are enrolled in the Audubon Signature Program, a spin-off of the ACSP begun in 1993 that addresses the environmental aspects of development. More than half of those enrolled have developed an environmental plan to guide management of the golf course, and 504 have achieved certification for their outstanding best practices. Altogether, that represents well over 700,000 acres of golf course land, water, and wildlife habitats that are managed for the benefit of golfers and the environment.

With the aid of Audubon International programs, this progressive group of superintendents and golf course managers is setting the standard for the golf industry. Their successes and expertise have raised the bar for how golf courses can and should be managed. Equally important, they are helping golf to achieve its goal of educating the public about its commitment to good stewardship. Consider these achievements:

- More than 500 conservation organizations are directly involved with golf courses as a result of participation in the ACSP.
- Birdwatching teams from 63 ACSP and Audubon Signature golf courses identified 304 different bird species on golf courses during the 2005 North American Birdwatching Open, a yearly tally of birds on golf courses during spring migration. Fifty-seven percent of participants saw more than 50 bird species during the 24-hour event, providing credible data about the diversity of birds that use golf course habitats.
- Case studies and published articles highlighting Audubon golf program members appear regularly in a variety of international, national, and local media, including (in 2005): *The New York Times, Wisconsin Trails Magazine, Builder Magazine, Golfdom, TGM, The Gainesville Times, Charlotte Daily Progress, Platinum Coast Golf, Gold Coast Sun, The Sydney Morning Herald* (Australia), and this publication, the *USGA Green Section Record*, to name a few.
- In 2004, 86 golf courses participated in Audubon International's annual Nest Box Survey, reporting a total of 5,069 birds fledged from nest boxes on golf courses.
- More than 50% of classic and modern golf courses on *Golf Digest*'s Top 100 List are Audubon program members, which provides good evidence that excellence in golf and excellence in environmental management go hand in hand.

Fifteen years of working cooperatively has resulted in exceptional environmental management on individual golf courses, as well as improved awareness, education, and best practices industry-wide. Still, there's more to do. More superintendents need to join the cream of the crop and implement comprehensive environmental management practices. More need to document their environmental outcomes to build a body of regional and national data. And, as always, more needs to be done to bring golfers to the table.

Audubon International is in for the long run. We look forward to the next 15 years of continued progress, on-the-ground results, and industry-wide successes to improve the quality of our environment for the benefit of the game of golf and, more importantly, for our future.

GET INVOLVED!

Taking part in the ACSP may be easier than you think. Here's a quick look at what's involved:

- **Join the program!** Submit a simple registration form and membership fee of $150 (U.S.) to enroll. Register online or call Audubon International to request a brochure.
- **Complete a *Site Assessment and Environmental Plan*.** This benchmarking tool helps you evaluate your current management practices and develop a comprehensive environmental plan to guide improvements. Inherent flexibility in the ACSP is designed to help any golf course take stock of its environ-

Collier's Reserve in Naples, Florida, became the first certified Audubon Signature Sanctuary in 1995. Like so many members of the Audubon Signature and Cooperative Sanctuary Programs, its innovative practices and commitment to environmental quality serve as a model for others in the golf industry.

mental resources and potential concerns, and then develop a plan that fits its unique setting, goals, staff, budget, and available time.

• **Implement your action plan.** Delegate and work with others to implement new best practices and achieve your goals. The program includes these key areas:

- ◆ Wildlife and Habitat Management
- ◆ Chemical Use Reduction and Safety
- ◆ Water Conservation
- ◆ Water Quality Management
- ◆ Outreach and Education

• **Become certified.** ACSP members are often surprised to find that many of their day-to-day activities already meet certification requirements. Documentation and reporting for certification have been streamlined significantly since the early days of the program (thanks to feedback from ACSP members). So, if you're lingering under the impression that you *just don't have time to participate* or *can't possibly achieve certification*, think again.

To find out more, visit www.auduboninternational.org, e-mail acss@auduboninternational.org, or call Audubon International Membership Coordinator Jen Batza at (518) 767-9051, extension 12.

Also check out www.golfandenvironment.org, a new Web site dedicated to the game of golf and the protection of our natural environment.

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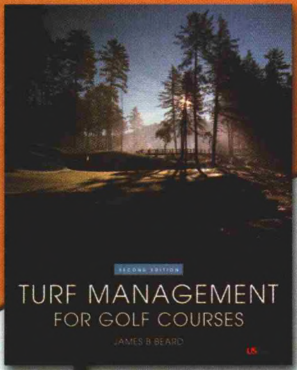
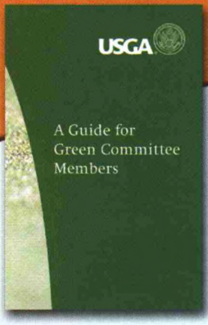
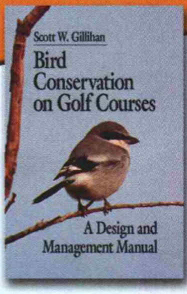
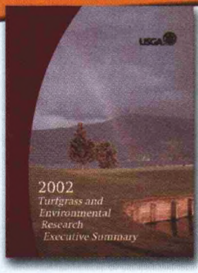
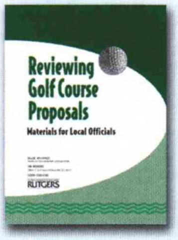










Publications

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**

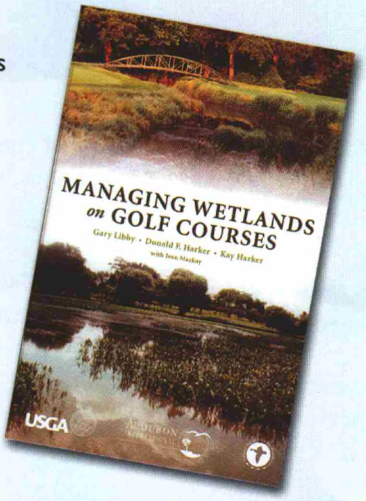
Bird Conservation on Golf Courses

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**

2004 Turfgrass and Environmental Research Summary & 2004 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. **NS1643 and NS1649 No charge**



Managing Wetlands on Golf Courses

by Gary Libby, Donald F. Harker, Kay Harker, with Jean Mackay

A comprehensive guide to managing wetlands on the golf course. *Managing Wetlands on Golf Courses* provides the most effective techniques for managing wetlands to maintain or enhance water quality, wildlife habitat, and the natural hydrology of the golf course landscape. A cooperative publication of the USGA, Audubon International, and the National Fish & Wildlife Foundation. 224 pages. **PG5000 $60.00**

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**

To order publications and for further information, contact the USGA Order Department:

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Shipping charges not included

2006 USGA Green Section Education Conference Golf Industry Show

Friday, February 10, 2006
Atlanta, Georgia

IT'S MORE THAN JUST TURF MAINTENANCE

10:00 a.m.
Welcome
KIMBERLY S. ERUSHA,
Director of Education

10:05 - 10:20 a.m.
Natural Areas: Wild or Wonderful?
JIM SKORULSKI, *Agronomist,*
USGA Northeast Region
Successful natural areas on golf courses must walk a fine line between being an asset to the property and a burden to those who play and maintain the golf course.

10:20 - 10:35 a.m.
GMOs — A Crossroads for the Turfgrass Industry
MIKE KENNA, PH.D., *Director of Research*
Genetically modified grasses have arrived. Are they here to stay? A historical perspective on the development of genetically modified grasses and the issues that will shape the future of this topic.

10:35 - 10:50 a.m.
Presentation of the USGA Green Section Award

10:50 - 11:10 a.m.
Golf Course Management — It's About The People
BILL GRIFFITH,
Walla Walla Community College
Lessons are shared about successfully managing and motivating employees.

11:10 - 11:25 a.m.
The Truth About Trees
DAVID OATIS, *Director,*
USGA Northeast Region
The economic realities of golf course trees are revealed.

11:25 - 11:45 a.m.
USGA Turf Tips
The USGA agronomists see many creative ideas in their extensive travels across the United States. The best and brightest ideas are presented as inspiration.

11:45 a.m. - 12:00 p.m.
More Than Just a Practice Green
JIM MOORE, *Director of*
Construction Education
New products and ideas are introduced to the market on a regular basis. A newly constructed test green study at Ridgewood Country Club in Waco, Texas, evaluates some of the new technologies and the economics involved in their use.

12:00 p.m.
Adjourn

2006 USGA NATIONAL & REGIONAL CONFERENCES

National Conference
February 10 — Georgia World Congress Center, Atlanta, Georgia

Florida Region
TBA

Mid-Atlantic Region
February 27 — Greater Pittsburgh Expo Mart, Monroeville, Pennsylvania
March 16 — DuPont Country Club, Wilmington, Delaware

Mid-Continent Region
January 12 — Overland Park Convention Center, Overland Park, Kansas
January 30 — Polk County Convention Complex, Des Moines, Iowa
March 30 — Houston Country Club, Houston, Texas
September 25 — Embassy Suites, Hot Springs, Arkansas

Northeast Region
March 7 — Rhode Island Convention Center, Providence, Rhode Island
March 16 — Hackensack Country Club, Oradell, New Jersey
March TBA — TBA, Albany, New York

Southeast Region
March 14 — Grandover Resort, Greensboro, North Carolina

Northwest Region
March 7 — Holiday Inn, Sheridan, Wyoming
March 20 — Waverley Country Club, Portland, Oregon
March 21 — Lakewood Country Club, Lakewood, Colorado
March 22 — The Country Club, Salt Lake City, Utah
April 11 — Honolulu Country Club, Honolulu, Hawaii

Southwest Region
January 9 — Valencia Country Club, Valencia, California
March 20 — Castlewood Country Club, Pleasanton, California
TBA — TBA, Arizona

All Things *Considered*

Speed Demons

Who's to blame in the need for speed?

BY MATT NELSON

Whether or not faster greens are good for the game of golf is a question that has and will continue to be debated. Those who oppose ever-faster putting surfaces cite agronomic problems, increased maintenance costs, environmental issues, slow play, architecture that has become unsuitable or obsolete, and flat participation in the game of golf. On the flip side, some golfers continue to demand fast greens and, in many cases, gauge putting green quality on pace alone. Championships, televised golf, and a majority of local golf events regularly showcase smooth and slick surfaces that no doubt were achieved through weeks or more of special preparation. Golfers have become accustomed to this level of conditioning and now expect it on a daily basis. The turf management industry has responded with better equipment and products, improved management techniques, and very skilled golf course superintendents. If we are to identify the demons in the need for speed, we need not look any further than ourselves.

Many in our industry may be quick to identify the Stimpmeter as speed demon no. 1. While the device was introduced to the industry as a means of maintaining consistency and to keep green speed reasonable throughout an event or during the season, it is commonly used today as a speed stick for some glorified notion of excellence. Bragging rights, ridiculous comparisons between golf courses, discussion fodder for 19th-hole agronomists, and a means of gauging superintendent performance have become dangerous uses of the Stimpmeter. But blaming the Stimpmeter for excessive green speed is taking the easy way out. The Stimpmeter can be, has been, and continues to be used to keep speeds reasonable. If the USGA had not introduced it to the game, someone else would have. Golfers and superintendents asked for a way to measure green speed and they got it, for better or worse.

Often, the most difficult demons to confront are those within. The Stimpmeter instruction manual doesn't come with directions to triple cut at 0.085, double roll, groom, and starve the turf to increase green speeds. Competitive superintendents and course officials led the way in increasing green speeds and dug themselves and their colleagues into a black hole from which they can't escape. The turf industry has responded with better mowers, improved cultivation tools and techniques, better products to regulate growth and keep turf alive with barely any leaf tissue, and advanced irrigation engineering.

Televised coverage of professional golf tournaments (the glamour demon) has been the vector for bringing speed to the masses. Somehow we've all arrived at the conclusion that faster is better. Speed has become ingrained in our collective golf psyche in a very short period of time.

Whether or not it's good for golf's long-term future, the game has evolved considerably in the last few decades and rolling back the clock isn't likely. Turf managers may think that ever-increasing green speed is plotting a course of inevitable agronomic failure, but we've said that before. It does seem to me, however, that we will reach a point where a majority of golf courses will be forced to present stale setups or "goofy golf" unless they absolutely flatten the contours and interest in their greens, whether designed by Tillinghast or Tinkerbell.

Confronting the demons of green speed will require nothing more than common sense. Additional measurement tools for putting green quality probably won't solve our problems. As Bobby Jones once said, "There is little room for entertaining the hope that putting may be reduced to a science. Good putting is at best a fleeting blessing. Here today, gone tomorrow."

Green speed has caused unnecessary agronomic problems. Faster speeds have created extremely difficult playing conditions for all but the most accomplished golfers. Slow play, higher maintenance costs and increased pesticide use can be attributed to excessive green speed. So can lost hole locations and putting green renovation.

Whether fast greens are good or bad for golf is debatable. The game is plenty difficult and time consuming to play and doesn't need to become harder or more expensive. Conquering the demons of speed will require self-examination by the industry, arguably for the good of the game and its future. Whether you blame the abilities of competitive superintendents, misguided course officials, a speed stick, or televised golf, we should be focusing on a fun, affordable game for the majority of golfers.

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

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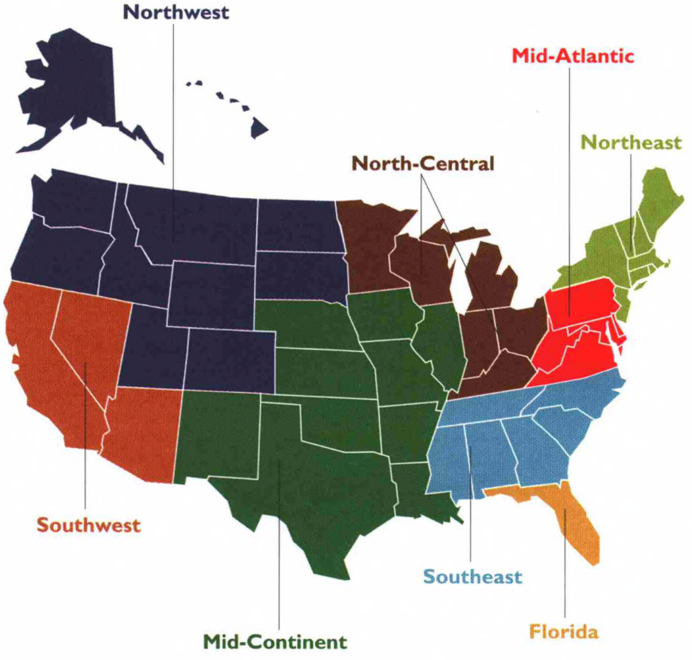

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Turf *Twisters*

Q: We heard that a recent IRS ruling allows a course to depreciate the cost of building greens. Is this true? (Oklahoma)

A: Actually, it is now possible for some courses to depreciate the cost of building greens, tees, and bunkers over a 15-year period. This ruling can be found on the Internal Revenue Service website by searching for Revenue Ruling 2001-60 (www.irs.gov/pub/irs-drop/rr-01-60.pdf). You also might want to view the "February 7, 2002, Industry Directive to Examiners" document and the "February 25, 2002, Industry Directive."

Q: Our zoysia fairways often become soggier as the winter wears on. Carts are restricted to paths more often, and as we play from less-desirable lies, handicaps rise steadily. Would overseeding with perennial ryegrass in the winter be a good idea for us? (North Carolina)

A: Organic matter development with zoysia causes these sites to retain water. This grass can act almost like a sponge, especially at sites with clay soils that don't drain well. Overseeding with perennial ryegrass does not relieve these symptoms, and it could make the problem worse. The best solution is to add drainage to the fairways, which addresses both surface water runoff and water soil seepage issues. Drainage experts are available to outline the planning, materials, time line, and costs of these projects. This planning stage is critical for success.

Q: Several greens on our course are susceptible to winter injury where water from melting ice and snow collects after a midwinter thaw. We have chipped away the ice and taken samples to document injury, but the process of removing turf from a frozen green often causes considerable damage to the sample. Any hints on ways to remove turf without damage? (Minnesota)

A: Try using a battery-powered hand drill equipped with a 2" to 3" hole cutter. Chip away most of the ice with a chisel or ax and use the bit to drill through the ice and into the first inch or so of putting surface. Gently tap a flat-head screwdriver or chisel into the space around the plug until the frozen bottom breaks free from the green. Remove the sample and place it in a Styrofoam cup filled with topdressing or divot repair mix. A healthy sample will begin to grow after four or five days on a warm sunny windowsill.