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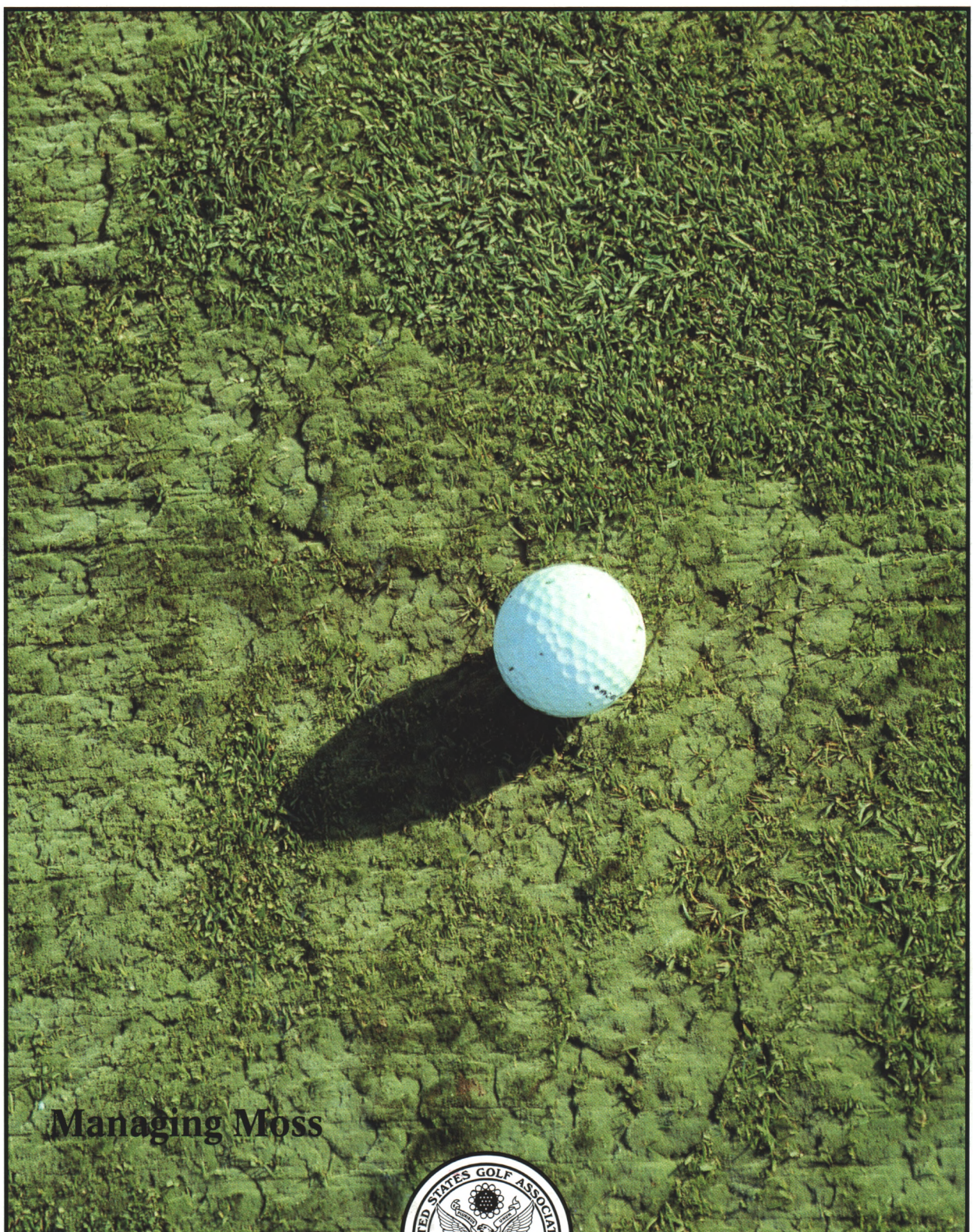

Managing Moss

A PUBLICATION ON TURFGRASS MANAGEMENT BY THE UNITED STATES GOLF ASSOCIATION®

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Cover Photo:
Silvery thread moss is a common contaminant of putting green turf.

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Employees should be trained to identify potential hazards on the golf course, and to immediately report those hazards to management. *See page 6.*

The fall overseeding establishment process takes understanding from both the golf course superintendent and the golfer. *See page 10.*

Spore production perpetuates the existence of moss. Great quantities of spores are produced during the life cycle of the plant.

Moss Eradication In Putting Green Turf

With persistence it can be selectively removed.

by KEITH A. HAPP

WITH ever-increasing demands placed on putting green turf, fueled primarily by the need for speed, is it any wonder that surface management problems develop? Today's golf course superintendent is faced with many turf management decisions, most of which are centered on providing the best possible playing conditions. At times during this quest, plant health is compromised in order to deliver the desired playing effect. While pursuing the ultimate ball roll and surface performance, bentgrass vigor can decline and the potential for weed development increases. One weed that can easily invade and fill available voids is moss. A small moss colony can proliferate and turn into a bigger problem that is more difficult to overcome. If conditions remain favorable, moss can spread across a putting surface.

It has been reported that thousands of species of moss exist. This is no surprise, since moss has been around for some 350 million years. Moss can develop and thrive in many different environments. Four mosses that often inhabit putting green turf are *Byrum argentum, Byrum lisae, Amblystegium trichopodium*, and *Brachythecium spp.* Each has its own characteristics. For example, *Byrum argentum* (silvery thread moss) is found in open sites. Its silvery appearance allows it to be distinguished easily from other mosses, and it is one of the most common contaminants of putting green turf.

Byrum lisae also is found in open sites but favors rocky or sandy soils. *Byrum lisae* is distinguishable from other mosses by its green to yellow-green appearance, and its colonies form tufts or clumps. Both species of *Byrum* mosses can tolerate a wide range of soil moisture conditions. A common misperception of *Byrum* moss is that it only competes well in shady, damp sites where turf has little or no chance of competing for space. Although it remains true that the best defense against weed encroachment is a dense stand of turf, *Byrum* moss can rapidly fill a void if the opportunity is presented. Once established, and if the conditions remain favorable, *Byrum* moss will proliferate in full sunlight.

Amblystegium trichopodium, on the other hand, is more difficult to identify and thrives in saturated soils. As such, this moss may be a problem on heavy clay soils or areas of poor drainage. *Brachythecium spp.*, which also thrives in wet soil conditions, is a common variety of moss referred to as "yard moss." *Amblystegium* and *Brachythecium* moss usually are found in higher cut turf, but they can be tracked easily into putting green surfaces. These mosses can become established in the rough or perimeter areas of the course and spores can be spread via air or foot traffic.

What is Moss?

Moss is a photosythesizing terrestrial plant. However, mosses are non-vascular plants and need to be in contact with water to avoid drying out. Many mosses absorb water over their whole surface, while others take in water through their rhizoids in a manner similar to that of vascular plants. Mosses that can survive in a state of desiccation have fine, hairlike leaves that can reflect the sun's heat. Cuticle development is rare, and this results in mosses being adapted to shady, moist locations. Mosses can, however, survive long periods of desiccation, in some cases several years, and can withstand high temperatures in a dormant state. Laboratory studies have found that mosses can tolerate dehydration levels equal to 80% of original biomass. When mosses are rehydrated, an immediate respiratory burst is manifested, but recovery is slow. Additionally, research has provided evidence that mosses can survive extended periods of dormancy by living symbiotically with blue-green algae. This relationship is important. Algae can be viewed as a precursor to moss encroachment. Hence, addressing the factors that encourage algae growth can preventatively discourage moss colonization. It is much easier to eradicate algae than it is to selectively remove moss from putting green turf.

How Does Moss Reproduce?

Although water is essential for their sexual reproduction, mosses are mainly land plants, and only a few species are adapted to aquatic environments. It is possible for moss to reproduce both sexually and asexually.

The sexual reproductive organs of bryophytes (mosses) are very characteristic in form, but they have little resemblance to those of flowering plants. Male and female organs may be on separate plants or on the same plant. In mosses the sex organs are usually interspersed with sterile hairs and are enclosed in leaves. This defense mechanism allows the moss to survive prolonged states of desiccation.

Asexual reproduction can be facilitated by water, wind, foot traffic, and even by maintenance equipment. For example, a moss plant can be severed by a golf spike and then transported to another area. When male and female gamete cells come in contact, fertilization is possible and a zygote is formed. Additionally, moss bryophytes can grow from small pieces of shoot or even leaves. Once a zygote is formed it is protected in specialized (gametophyte) tissue. The zygote then develops into the sporophyte, which eventually releases spores. The reproductive cycle is complete when these spores develop into the gametophyte structures that are identified as moss. Again, the primary requirements for completion of this cycle are voids in the turf and spores that easily generate a new colony.

Mosses develop in response to photosynthesis and also by nitrogen fixation in the absence of a light source. In the case of fixation, nitrate fertilizers applied to stimulate growth of the desired turf can be a catalyst for moss development. Thus, fertilization alone may not adequately correct a moss problem. To a certain degree, it could exacerbate the undesirable condition.

How Can Moss Be Identified?

Moss and slime/algae are different types of lower plants. It is relevant to consider them together because their occurrence and control measures overlap. When moss first colonizes an area it produces a black, slimy mat across the area before the green vegetative structures form. The green structures grow into branch-like filaments called protonema. These are the threadlike structures that bud out and develop into the gametophyte. The protonema of mosses are extensive, resembling green algae, and may persist for months. In the life cycle of moss, it is possible to wrongly diagnose and confuse this with algae. This is important and reinforces the need to have a basic understanding of the life cycle of moss. Accurate diagnosis leads to accurate and precise treatment of the problem at hand.

Mosses can take many shapes and forms. Stems and leaves of moss are complex, most having conducting strands, midribs, and a great diversity of cell form. Shoots develop from tetrahedral cells, and this results in three leaf arrangements. Leaves may be grouped in pairs, threes, and even sets of five. In the majority of mosses, leaves are not arranged in regular rows. Except for the midribs, leaves are one cell thick, with most or all of the cells containing chloroplasts. This particular feature can be exploited when eradication is attempted. Disrupting photosynthesis of moss via selective desiccation methods provides a competitive edge for turf, provided the desiccating effect is maintained.

Mistakenly treating for algae may interrupt photosynthesis, but in the case of mosses it has been shown that they will reproduce in the absence of light. Furthermore, not even soil sterilization can guarantee that an area will be free of dormant moss spores. The dried-out vegetative state does not utilize water or nutrients but will allow reproduction when conditions are again favorable. This further indicates the need to be persistent with control measures. Control requires constant vigilance and an understanding of when infestation takes place. Basically, if moss has colonized an area, an ongoing eradication program is needed to assure that it will not continue to be a problem.

The First Step in Correcting the Problem

First, ask why moss has developed on the green. Take a step back and review the management practices currently in use.

- Are surface and subsurface drainage systems sufficient to handle moisture conditions?
- Are cutting heights too low?
- Are fertilizer levels so low that they are preventing turf growth?
- Are the nutrients within the soil in balance so as to provide an optimal environment for sustained turf growth?
- Has a topdressing change been made that could affect the manner in which water moves through the soil profile?
- Finally, has irrigation frequency changed and inadvertently become a causal factor of moss development?

Answering these questions could provide a solution to moss encroachment problems and insight as to why colonization occurred.

To many, the solution may sound simple: raise cutting heights and increase fertility to promote healthy turf. But will contemporary golfers accept slower putting green speeds? From my experience, the answer is "no." A holistic approach, combining cultural and chemical means, may provide a more acceptable answer.

Cultural Strategies

A strong cultural management program can help to reduce the potential for moss encroachment. For example, aeration is the cornerstone of many maintenance programs. Aeration in any form helps to improve infiltration rates, which in turn helps to dry the soil surface and provides a competitive

edge to the desired turf. Physically removing thatch may also provide assistance in defeating moss populations. The fact is, small-tine shallow aerification has gained wider acceptance by both turf managers and golfers. Small-tine aeration, such as with quadratines, provides agronomic benefit without creating a great deal of surface disruption, and it is an excellent proactive management strategy whether moss is present or not.

In combination with small-tine aeration, light and frequent topdressing applications are a common practice. On heavy soil greens, the main benefit realized from this maintenance strategy is increased water infiltration. Basically, a green with better surface characteristics is being established on top of a native soil material. On new USGA greens or other high-sand-content greens, the benefit realized is good thatch management. To maintain a balance of water and air in the profile, and particularly near the soil surface, the thatch must be constantly diluted. As soil porosity increases, so does the likelihood that moss encroachment can be brought under control. Allowing the moisture to move freely into the soil rather than remaining on the surface reduces the potential for moss development. Also, as topdressing is applied, moss spores that may be present near the surface will be buried.

Examining changes in topdressing materials may offer clues as to why moss encroachment has occurred. Changes in the particle size of the topdressing sand or the use of a different organic matter in the mix could produce long-term problems. Periodic sampling and testing by a qualified physical testing laboratory can add both a check and a great deal of peace of mind. Problems can be avoided when a strong quality control program is in place.

A balance between cutting heights and fertility levels must be established. The overall goal of any maintenance plan is to provide healthy, vigorous turf. If this maintenance plan is compromised for the sake of ultra-fast green speeds, then weed invasion should be expected. It has been observed that moss growing on a putting surface will not encroach into the surrounding collar area. Quite simply, turf cut at a greater height resists invasion. Raising the mowing height as little as 1/32" has shown positive effects in reducing moss populations. Even raising the height of cut from 1/8" to 9/64" provides 13% more leaf blade. Greater leaf blade surface area enables the turf to become more vigorous by increasing photosynthesis. There are many other tools available to manage putting green speeds. Growth regulators, for example, can be applied in combination with other grooming tactics to enhance surface performance.

Fertility

A Scottish greenkeeper once said, "Moss is a sign of poverty in the soil." This is an amazingly accurate statement that has been verified by university research. There are some distinct nutrient deficiencies and relationships that favor moss encroachment. Research indicates that calcium-rich soil may exacerbate *Byrum* moss development. Areas of moss colonization tend to have higher calcium-to-magnesium ratios and a higher percentage of silt and clay in the surface. This soil texture accounts for the increased water retention due to reduced percolation. Examining the nutrient status and the physical properties of the soil therefore may provide a great deal of information not only to defeat moss, but also to promote the healthiest stand of turf possible. If calcium levels are high, $MgSO_4$ (Epsom salt) treatments may be warranted. Magnesium is a component of chlorophyll production, and its addition into the soil could enhance turf vigor.

There is a correlation between moss populations and potassium (K) levels in the soil. Moss pressure seems to increase as K levels decrease. As such, monitoring K levels in the soil is important. If deficiencies exist, corrective applications can be made in the spring or fall. Sulfate-of-potash treatments provide a safe means to achieve adequate K levels.

Various fertilizer treatments have been applied to selectively retard moss growth while the desired turf is promoted. Ammonium sulfate, for example, has performed well in many studies. This fertilizer is thought to produce a selective desiccating effect on moss when applications are made frequently and at low dosage rates. Treating with 1/12 to 1/8 lb. of N/1000 sq. ft. per week can produce positive results. This treatment regime also provides an acidifying effect that can produce desirable side effects. Patch diseases may be less likely to develop when the pH of the soil is managed in this manner.

Ferrous sufate applications have also been closely examined for their effect on moss. In fact, in 1933 calcined iron sulfate was a common treatment for moss problems. Iron treatments, in the form of iron sulfate, can be applied at a rate of 2 ozs./1000 sq. ft. every other week during the summer or at higher rates during the fall and winter. Up to 3 lbs. of iron sulfate/1000 sq. ft. has been applied to moss-infested putting greens, and this treatment strategy remains common in the British Isles. The effect of the treatment is dramatic. The turf takes on a dark green or even black

If conditions are favorable, moss can spread across a putting green and be carried from surface to surface. A small moss colony can proliferate and turn into a bigger problem over time.

appearance due to the chlorophyll surge. Moss colonies may experience a selective desiccating effect and the turf recovers. Positive signs of the desiccating effect on moss are exhibited by an orange-brown or golden-brown coloration. This is the initial sign of moss decline, but it is by no means an indication that treatment strategies should stop. As previously stated, persistence is the key.

Hydrated lime and copper sulfate have been suggested as treatments for moss contamination problems. However, the effect on the pH of the soil is of greater concern regarding the use of lime, and copper sulfate applications do not offer a wide margin for error. In many instances, the results of the treatment may be worse than the original problem.

Potassium of fatty acid (DeMoss) is a labeled product for moss control. The treatment procedure is similar to that of ammonium sulfate applications. The material must be applied frequently over an extended period of time to achieve the desired effect. Applying 2 to 3 ozs. of material/1000 sq. ft. every week can produce a significant reduction in moss populations, and the consistency with which the material is applied is an important ingredient for success.

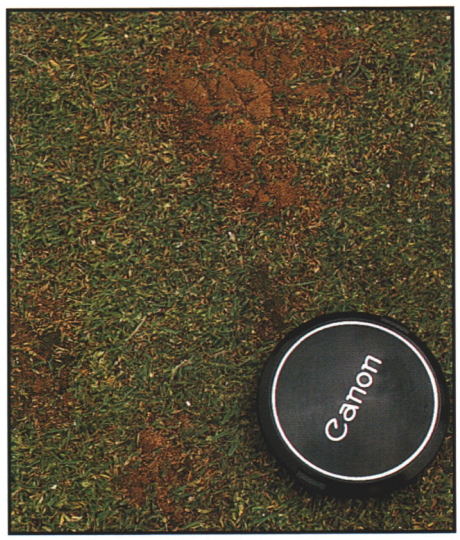
Chemical Treatments

Timing of chemical applications appears to be crucial to their success. Studies have tested control measures during maximum sporophyte development in the spring and found that selective eradication can be achieved.

Maneb- or Zineb-based fungicides applied to moss during its early stages are phytotoxic to young/immature moss plants and algae. Also, there are indications that Maneb treatment may inhibit N-fixation with respect to the symbiotic relationship of moss and algae. Treatments render populations unable to produce carbohydrate reserves and thus unable to compete for space. Maneb is a broad-spectrum fungicide, but it produces herbicidal action favorable to moss control.

Case Studies in Moss Control: Case Study #1

Spot treatment procedures have also provided satisfactory control of moss. DeMoss (Mycogen Corporation) has been applied in combination with wetting agents and a surfactant. Todd Voss, of the Double Eagle Golf Club, experimented with a combination of materials, which included DeMoss, on his sod nursery. The initial goal was to find a mixture that would apply selective pressure to moss without harming the desired stand of bentgrass. Once satisfactory results were achieved, the spray combination (1 oz. DeMoss, 1 oz. Lesco Wet, 1 oz. spreader sticker in 32 ozs. of water) was applied to moss populations on the course. Treatments were performed in the afternoon during the summer and continued throughout the fall. The treatments were performed with a hand-held squirt bottle calibrated to deliver repeatable applications.



Moss also responds to fertilization. A blackening of the moss often does not sufficiently desiccate the moss colony. Fertilization must be persistently employed to achieve the desired result.

Three to four squirts from the spray bottle adequately soaked the moss colonies. Within 24 to 48 hours, moss populations exhibited the orange to orange-brown color, signifying that a positive desiccating effect had occurred. Repeat treatments were performed depending on the density of the moss colonies and the spore populations in the soil. Minor phytotoxic effects were exhibited on the turf. But, via fertilization, the turf grew out of the herbicidal effect caused by the moss control mixture.

In combination with this eradication technique, spiking and overseeding were performed. As bentgrass populations increased, interspecific competition increased, and moss colonization was minimized.

Case Study #2

Another treatment strategy that has shown promising results is the use of Dawn dishwashing detergent. The detergent provides an excellent selective desiccating effect on moss populations and due to the ingredients of the product may also provide cryptocidal effects on the moss spore populations in the soil. Although Dawn has been tested at universities (Danneberger 1998, Landschoot 1998) and used successfully on golf courses, it is not currently labeled for use for moss control on turf and thus is not legal for this use at the present time.

John Keeler, of Hershey's Mill Golf Club, experimented with a number of control techniques on a designated test site. Applications of iron sulfate were tested at various rates, in addition to Dawn treatments. A check plot was also established to better evaluate treatment performance. Dawn treatments ranged from 2 ozs. to 8 ozs. of material/1000 sq. ft. The product was delivered to the moss colonies with a minimum of 1 gal. of water/1000 sq. ft.

An immediate response was observed following the application of Dawn. First, a water-soaked appearance was observed in the treated areas. Within 48 hours the moss colonies exhibited the classic orange or orange-brown discoloration while the surrounding turf showed no signs of phytotoxicity. After testing was formed, the material was applied to moss-infested sites throughout the course, and within a four- to six-week period acceptable moss control was achieved.

Although the treatment strategy centered on Dawn applications, a holistic program was put in place. Topdressing was applied periodically and nitrogen treatments were made on a routine interval. Putting green speeds were maintained in the sufficient range with the use of walk-behind mowers and infrequent rolling. Irrigation was applied to support turf growth, but not to the point of overly saturating the soil profile. Basically, every effort was put forth to strengthen the basic agronomic programs in order to allow moss control techniques to be as effective and long-lasting as possible. Surface performance was improved, and this led to heightened golfer enjoyment.

Case Study #3

John Klosiewicz, of the Vic Meade Hunt Club, utilized a combination of methods to overcome a serious moss infestation problem. The problem was so bad that reconstruction was thought to be the only corrective procedure available.

The road to recovery began with height-of-cut adjustments. The mowers

were raised to 5/32". Fertility levels were also increased, with ammonium sulfate and urea being the main sources of nitrogen. Chemical analysis of the soil provided evidence that high soluble salt problems existed, and this was addressed by treating with magnesium sulfate and gypsum.

The chemical analysis led to questions about how the salt problems developed. To find answers, the topdressing material was submitted for both chemical and physical analysis. The results indicated that the topdressing was a contributing factor due to its moisture retention capacity. A program of aggressive aeration was implemented to help remove thatch and soil. Following aeration, a carefully selected straight sand topdressing was applied to fill newly created columns to the surface. This was supplemented by weekly treatments of between 50 and 100 lbs. of material/1000 sq. ft. throughout the season. Soil porosity improved dramatically and this allowed the surfaces to be maintained in a much drier state.

After the physical properties of the soil were addressed, the next step was to selectively attack the moss colonies on the greens. During the months of December and February, iron sulfate was applied at a minimum rate of 2 lbs. of material/1000 sq. ft. This began the selective desiccation process. As the spring weather arrived and soil temperatures increased, urea and ammonium sulfate products were rotated into the treatment regime. Each was applied at a rate of 1/8 lb. N/1000 sq. ft. per week. The bentgrass responded to the increased N level and the moss became much less prevalent. Still, another method of eradication was needed.

In combination with fertility adjustments, DeMoss was applied every other week at a rate of 1 to 2 ozs. of material/1000 sq. ft. Only severely infested greens were treated in this manner, while spot treatments were performed on greens that exhibited only minor infestation. Bentgrass seed was introduced regularly during the entire eradication process. This integrated approach to moss control paid off; non-target damage was minimized and bentgrass populations increased dramatically.

Using a combination of techniques, the moss problems were brought under control in seven months. During this time, the playability of the surfaces did not suffer. Multiple mowings, light and frequent topdressing, growth regulation treatments, and rolling were used to maintain acceptable conditions.

Conclusion

The control of moss should be approached as a long-term project. It takes time for moss to develop into colonies that both visually and physically affect the playability of greens. Therefore, it is reasonable to expect that it will take time, often a long time, to reverse the undesirable condition.

The immature stage of moss colonization (the protonema) is highly susceptible to desiccation. If properly diagnosed during this early stage of development, site-specific treatment performed in a carefully thought-out manner could provide excellent results. Cultural practices such as spiking, aerification, topdressing, overseeding, and proper fertilization should accompany the use of a selective eradication product.

All aspects of management should be considered when battling moss. Is the sunlight sufficient to allow the turf to compete and fend off invasions? Is the air movement around the problem area adequate to permit soils to be purged of excessive moisture? Drainage should be corrected or installed where it is inadequate or nonexistent. Deep-tine aerification can provide relief when compacted soil conditions exist. Thatch management will enable good rooting and thus increase the vigor of the turf. Any preventative measure should be done with the overall goal being to promote healthy, vigorous turf. After all is said and done, healthy turf is the only way to cure and prevent moss invasion.

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Risk Management For Golf Facilities: Are You At Risk?

Some ideas for minimizing your exposure.

by JOHN M. FOTIADES

BEWARE has become the byword when it comes to injuries, illnesses, and liabilities at a golf facility. In this litigious society, settlements and verdicts from lawsuits are soaring, as are workers' compensation claims and insurance premiums. The cost to defend a suit, pay a claim, contest a citation, or pay a fine, can be devastating. So what can you do to minimize your liability exposure?

Risk Management Plan

Begin by initiating a risk management plan. Risk management is the process of identifying, evaluating, and managing existing or potential hazards or conditions that may lead to injury, illness, damage, or liability. For our purposes, a hazard or risk is a potential source of danger. Any successful risk management plan should have the following minimum criteria:

Management Commitment: Management should be committed to, and provide authority, personnel, resources, and full support for the successful implementation of any risk management plan. Everyone should understand that safety is of paramount importance.

Employee Involvement: Employee involvement and feedback in decisions affecting safety and health practices is also essential to the success of any risk management plan. It is the employee who may often know best what can be done to make a job practice, work area, or an existing condition safer.

Inspection: Identifying and evaluating hazards is the most important step of any successful risk management program. This inspection process is especially important because an unrecognized hazard cannot be managed. All areas of the golf course, clubhouse,

Children, because of their ages and inexperience, are owed a special duty of care for their protection and safety. Measures should be taken to keep them from potentially dangerous situations.

maintenance facility, outbuildings, work practices, and conditions should be reviewed and examined during the inspection.

Routine daily inspections are intended to detect substandard conditions that may change from day to day. Maintenance personnel often can correct problems detected during routine inspections. Periodic inspections, conducted at least semiannually, should be handled by a professional experienced in identifying and evaluating hazards and safety requirements. This more specific inspection is intended to detect permanent substandard conditions, such as design concerns or noncompliance with regulations.

Hazard Prevention and Control: Preventative measures must be implemented when an inspection reveals a hazardous condition that could cause illness, injury, damage, or pose a liability. Some common corrective measures involve training and educating employees, implementing administrative and workplace controls (e.g., equipment design, job rotation, new techniques), personal protective equipment, improving security, upgrading or replacing equipment, and formulating emergency plans.

Training and Communication: Establish a training program to ensure that employees receive required and necessary training. Outside workers and golfers also should be informed of what is expected of them for their own protection and safety.

Record Keeping: All employment and medical records, training logs, Occupational Safety Health Administration (OSHA) logs, inspection forms, checklists, inventories, corrective measures, accident reports, meeting notes, hazard communication, emergency evacuation plans, and other record-keeping areas must be documented. These records must be made available for current and future reference, inspection purposes, and to show a good-faith effort for safety concerns should a legal dispute arise.

Risk Management Includes . . .

Risk management at golf facilities covers numerous subjects, including OSHA standards, the Americans with Disabilities Act (ADA), the employment process, maintenance practices, equipment operation, pesticide usage, golf course design, practice areas, shelters, rules of play, security, food and beverage service, nuisances, and emergency medical treatment. Liability concerns also exist with wetlands and other environmental issues, buildings and structures, renovation work, and non-golf recreational activities (e.g., jogging, swimming). A risk management plan designed to manage hazards should address and prioritize each of these concerns in order to limit liability and to control insurance premiums and other costs. Effective risk management looks beyond compliance with specific legal requirements to address all hazards that could lead to injury, illness, damage, or liability.

OSHA standards govern workplace and equipment safety to protect employees. A written training program also should be established to ensure that all employees are properly trained.

OSHA

The Occupational Safety and Health Act and Administration (OSHA) were created to save lives, prevent injuries, and protect the health of workers. OSHA standards, which apply to all golf facilities in the United States, cover hazardous and toxic materials (e.g., pesticides, gasoline), egress and walking/working surfaces, personal protective equipment (PPE), sanitation, fire protection, medical and first aid, equipment, machine guarding, tools, emergency plans, and evacuations.

Even where OSHA standards do not address a specific situation, employers are responsible for complying with the Act's *general duty* clause, which states that each employer "shall furnish to each employee a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm to the employees." In addition, employers also are responsible for conducting inspections, responding to hazards, posting OSHA and other employee information posters, and providing safe tools and equipment and a right-to-know station. Employers must also maintain injury and illness logs and provide training, including emergency and fire prevention plans, first aid, and the use of personal protective equipment.

A hazard communication plan also must be developed. Most frequently cited violations of OSHA standards involve the hazard communication standard. The purpose of this standard is to ensure that information concerning the hazards of all chemicals in the workplace and appropriate protective measures is transmitted to employers and employees. This plan includes having employees learn how to read container labels and Material Safety Data Sheets (MSDS) and how to select and use the proper PPE.

Although OSHA does not cite employees for violations, it does require that they comply with health and safety standards, including reading the OSHA poster, using personal protective equipment and reporting hazardous conditions. Employees also must report any injury or illness and promptly seek needed medical attention. Employees' rights under OSHA include the right to request information regarding hazards or toxic exposure and to receive appropriate training.

OSHA provides a consultation service and otherwise conducts workplace inspections that may lead to citations and fines to ensure that employers provide a safe and healthful workplace.

Duty of Owner and Negligence

An owner or operator of a golf facility has a duty to exercise reasonable care for the safety and protection of others and to make reasonable and timely inspections, correct defects (e.g., defective cart brakes) and disclose any dangers (e.g., signage — wet slopes, work area) that others may not be aware of. Although an owner must anticipate the normal actions of the game, he cannot be required to foresee every possible accident. If these duties are breached, liability may attach where that conduct injures another. General examples of duties include supervising orderly play and maintaining the premises in a safe condition. The highest degree of care owed is to participants in recreational activities, such as golf; the lowest is due to trespassers —

A golf course owner or operator has a duty to exercise reasonable care for the safety and protection of others. Daily inspections of the golf course help to identify potential hazards. This inspection is a critical component of a risk management plan.

except for children, to whom a special duty of care is owed.

A breach of this duty, to exercise reasonable care for the protection and safety of others, may result in a claim of negligence. In order for a claim to be successful, there must be a legal, enforceable duty of care owed (e.g., duty to provide safe premises), and a breach of that duty which results in injury and damages.

Duty of Golfers and Others

Participants and others have a duty to exercise reasonable care for their own protection and safety. They may assume the risk of injury from ordinary hazards inherent in the game, such as being struck by an errant ball. Golfers have a duty to warn those within a foreseeable danger zone of errant shots. *Fore!*, the universal cry of golfers, may not by itself relieve one of liability. Such might be the case where an errantly struck ball injures a fellow golfer who is playing the same hole and is within reach. Golfers and others do not assume liability for extraordinary risks caused by another's negligence, such as where golfers have to cross a public way.

Defenses

The best defense is a risk management plan consisting of sound safety practices and policies. There are legal defenses that can be used should there be a claim of negligence. Assumption of the risk, and contributory or comparative negligence, may be valid defenses if an injured person knew, or should have known, of the risk or danger (e.g., errantly struck ball, entering a prohibited area) as one that was open and obvious, but proceeded anyway. Additionally, dangerous conditions or conduct often are considered an integral part of the game, such as the errantly struck ball. Unless there is an improper, intervening cause (e.g., design flaw), there is no duty. Assumption of the risk or comparative negligence will apply.

Waivers, such as those that appear on the back of a ticket or rental agreement, are an attempt to limit liability. To be valid, it must be shown that an injured party knew or should have known of the waiver and intended to relinquish the right to claim damages for an injury. Not all states recognize waivers, and in some, they are unenforceable against minors and where injuries result from intentional or reckless misconduct.

Workers' compensation provides that employers assume the costs of most work-related injuries and illnesses to employees, regardless of fault. However, negligence may be alleged, at least where an employer is without workers' compensation insurance, or where an injury is caused by someone other than the employer.

Training and Communication

A written training program should be established to ensure that all employees are properly trained. The plan should detail what is to be covered and expected of each employee. Educating golfers also is an essential component of any safety program. The program

Properly designed fuel storage tanks demonstrate the facility's commitment to safe and environmentally sound operations. These tanks are in the initial stages of installation.

should communicate what is expected of them while they are at the facility (e.g., safety rules for play, cart operation).

Employee training may be required, such as by OSHA or state regulation (e.g., pesticide applicator's license), or otherwise should be part of any risk management plan. Training is especially crucial for new or reassigned workers and must include safety practices, identifying hazards or potential hazards that could cause injury, and the corrective actions that can be taken to protect themselves and others.

Training should be conducted by qualified personnel or others. Have regularly scheduled meetings regarding all aspects of workplace safety. Set ground rules and appoint a facilitator to conduct and oversee the meetings. Keep accurate meeting notes and try to reach decisions whenever possible. Follow up to ensure that decisions and corrective measures are implemented. Communicate the message *Safety First* on a daily basis.

Safety Committee

A risk management plan should start with the appointment of a safety committee that consists of members from the management team, employees, and others who may have expertise in this area. If you cannot have a safety committee, then either appoint a safety director or seek the assistance of a risk management professional. Goals of the safety committee should include: assisting management in establishing and maintaining a safe facility and environment; establishing procedures for safety inspections, accident investigations, and first aid; evaluating corrective measures; and developing and prescribing training guidelines. The safety committee should meet regularly and maintain accurate and detailed notes from those meetings.

Summary

Liability can affect anyone associated with a golf facility. However, exposure to liability and damages can be greatly reduced by the use of an effective risk management plan. Although no golf facility can be free from all hazards, conditions, or practices that may create injury or liability, management should work to uniformly protect the health and safety of all employees, members, golfers, guests, and others.

Establishing and maintaining a risk management plan can result in lower injury rates, and a reduction in injury rates can lead to reduced costs (e.g., workers' compensation). Additionally, a successful risk management plan often will lead to an improvement in employee morale, reduced absenteeism, and increased productivity and work quality.

Preventative risk management — think of it as installing a traffic light before, not after, an accident has occurred. Remember, one successful lawsuit or fine can buy an awful lot of safety.

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A containment device is used to protect wetland areas from siltation caused by nearby construction work.

THE PROS AND CONS OF FAIRWAY OVERSEEDING

Winter overseeding of bermudagrass fairways has both benefits and some negative consequences.

by JOHN H. FOY

FOR THE VAST MAJORITY of American golfers, the presence of a lush green turf cover is one of the main criteria used to evaluate golf course quality. Even with their increased environmental awareness and agreement that course management programs should be geared to minimize impacts and conserve resources, golfers want to play on green grass. Television, no doubt, has greatly contributed to and heightened everyone's aesthetic consciousness.

Each fall, warm-season turf species such as bermudagrass begin to enter into a semi- to fully-dormant stage, depending on where in the South the course is located. This is a natural response to cooler temperatures and a shorter day length. Along with a progressive decline in growth rate, there is a loss of green color. Once soil temperatures reach 50 degrees Fahrenheit or lower, the bermudagrasses develop a straw-brown off-color character that persists until the spring. To compensate for this color change and to provide a lush green, actively growing turf for the winter, establishing a cool-season turf cover in the fall, on top of the dormant bermudagrass, has been a standard management procedure. For many years, winter overseeding of fairway and rough areas was practiced primarily at resorts and professional tour stops. However, over the past few years, fairway overseeding has been a rapidly growing trend at private clubs as well as daily fee courses.

A period of winter dormancy is a natural response of warm-season turfgrasses, such as bermudagrass, to cold temperatures and a shorter day length. Yet, American golfers want to play on green grass.

Pros

The obvious benefit of fairway overseeding is an actively growing green turf cover that appeals to many golfers. In the early to mid 1970s, colorants (dyes or paints) were tried as alternatives to fairway overseeding to control cost, reduce golfer inconvenience and minimize spring transition problems. This strategy never became very popular, however, because it was not possible to achieve a truly natural color that was similar to an overseeding cover. Also, with medium to heavy play, wear problems developed.

Another aesthetic issue is providing striped fairway mowing patterns, in keeping with current-day golfer expectations. With the use of light- to medium-weight fairway mowing equipment, improvements in both turf quality and conditioning have been achieved. With northern cool-season turfgrass fairways, rather dramatic mowing patterns can be produced and maintained. Yet, with bermudagrass fairways, these attractive mowing patterns cannot be established unless the stripes are burned into the turf by repetitively mowing the exact same pattern each time. This strategy eventually results in a significant grain problem on the fairways. Thus, winter overseeding makes it possible to have that northern look, even in Arizona and Florida.

There is no denying that winter overseeding of fairways is conducted to a large degree for cosmetic reasons. However, improved playability is another benefit of this practice. Every winter during Green Section Turf Advisory Service visits to courses throughout Florida, common complaints about dormant bermudagrass fairways are that the fairways are being mowed too low or that there is no grass on the fairways. The reality of the situation is that the height of cut was raised up in the fall, and more often than not the mowing units are only being sent out to break up divots and clean off debris rather than actually cut the dormant grass. These complaints result because the base bermuda is not actively growing and has become beaten down by golf cart traffic. It needs to be remembered that the average course handicap in America is 31 for female golfers and 16-17 for male golfers. These golfers typically try to sweep the ball off of the turf for their approach shots, and tight bermudagrass fairway lies make this

difficult. An actively growing perennial ryegrass overseeding cover provides additional ball support, and in turn there is the perception among a large number of golfers of better course conditioning.

Another common wintertime complaint is a loss of definition between the fairway and rough cuts. Here, too, cart traffic is the main cause of the problem, and regardless of whether just the fairways or both the fairways and roughs are overseeded, course presentation is dramatically improved with overseeding. In countries where golf carts are a rarity, wintertime course deterioration is not a big issue, even though the majority of play occurs during this time. In some respects, fairway overseeding can be viewed as a traffic management tool, given the fact that golf carts have become an integral part of the American game.

In addition to providing the desired aesthetic character, overseeding of bermudagrass fairways improves their wear tolerance as well as the playability for the average-to-high-handicap golfers.

Cons

While there are definite benefits to winter overseeding of bermudagrass fairways, there also are tradeoffs. First of all, there is no way around causing some course disruption and golfer inconvenience during the fall establishment process. To achieve successful seed germination and turf establishment, good seed-to-soil contact must be provided. However, today, with more emphasis being placed on thatch control throughout the summer growing season and the availability of effective growth regulator materials, severe verticutting and scalping procedures are not being conducted at most Florida golf courses for seed-bed preparation.

Yet, along with some degree of prep work and uniform seed application, daytime irrigation applications are needed for at least three to four weeks during the initial establishment phase. The establishment process typically is initiated sometime between October and early December, depending on the location of the course, and four to six weeks needs to be allowed for development of good coverage and appropriate conditioning. Furthermore, while not an option at some facilities, prohibiting cart traffic on juvenile overseeding is strongly encouraged to ensure optimum results. For a large number of facilities, the establishment process coincides with the return of golfers from the North, typically during prime golfing weather. This can result in a negative first impression and a difficult political situation for the golf course superintendent and course management.

Next, there is concern about the cost of winter overseeding. In south Florida, a seeding rate of approximately 300 pounds of perennial ryegrass per acre provides adequate stand density and the desired aesthetic and play characteristics. This process is better described as an interseeding, and works satisfactorily because the base bermudagrass does not go fully dormant and off-color. However, for most other areas of the country, higher seeding rates of 400-600 pounds of ryegrass per acre are necessary, and in a few locations 800-1000 pounds per acre are being used. Although there are several variables, an initial expenditure of $7,000 to more than $25,000 can be required for the seed alone. To control costs, annual ryegrass is sometimes added to perennial ryegrass blends. Over the past two or three years, ryegrass and *Poa trivialis* combinations have been used, allowing lower seeding rates to be used. Other costs that need to be factored in are the additional time and labor required for preparation and establishment, irrigation, fertilization, and pest control treatments.

Another substantial cost of fairway overseeding is regular mowing during the late fall, winter, and spring months. Once established, overseeded fairways need to be mowed at least three times per week and preferably on a daily basis in order to maintain consistent good quality conditioning. This consumes a significant number of labor hours and exerts additional wear and tear on the mowing units, which in turn shortens their life expectancy. The use of light- to medium-weight mowing equipment also is necessary to achieve top-quality results. For budgeting purposes, doubling the cost of the seed is often used as one means of estimating the total annual cost of fairway overseeding, but many courses estimate that it costs them $100,000 or more to overseed fairways.

From an agronomic standpoint, winter overseeding can be thought of as trying to grow two plants with different management requirements in the same spot. When management practices are geared to favor one, the health and

quality of the other can be compromised. With the establishment of an overseeding cover, significant competition and stress is exerted on the base bermudagrass. Thus, in the spring to early summer, there is the potential for deterioration in fairway conditioning and quality during the transition back to the base bermuda turf cover.

Even with management programs designed to gradually thin out the overseeding cover at the same rate the base bermuda is reestablishing coverage, problems are common. This is because environmental conditions are a major controlling factor in the results of the transition process. The worst-case scenario is a cool and wet spring followed by a rapid buildup of high humidity and hot temperatures. This allows the overseeded species to develop a mature character and at the same time retards the growth of the base bermudagrass. Then, with a quick decline in the overseeding species, a weak and thin bermudagrass turf cover is exposed. A few weeks to a couple of months then can be required to reestablish good quality fairway conditions. At some high-end resort and private golf courses in Florida, a budget contingency for sod is maintained, just in case a difficult overseeding spring transition occurs.

Winter overseeding has other impacts on course management, too. Although the overseeding cover is present for only four to six months, for successful results this practice needs to be considered in the scheduling of other programs. This is particularly true in regard to weed control programs. In overseeding of fairways year after year, a progressive increase in both winter and summer annual weeds can be expected. During the winter and spring months, establishment of *Poa annua* and other volunteer weeds is a common problem that can affect course appearance. It is also difficult to prevent invasion of goosegrass and crabgrass during the spring to early summer when the transition process is under way.

What's The Right Answer?

In consideration of the cost involved and negative impacts on course management, it is difficult to justify winter overseeding of bermudagrass fairways from the agronomic standpoint. Yet, most American golfers have been brainwashed to believe that green is good. Also, as noted earlier, a fluffy fairway lie is preferable to a tight semi- to fully-dormant bermudagrass lie by the vast majority of golfers. Thus, this practice no doubt will continue to be implemented at more courses from the Carolinas across to California. The best option at this point is to try to educate golfers that there is much more involved with successful winter overseeding than meets the eye, and keep our fingers crossed that the perfect year-round grass will be developed. But then would there be any need for Green Section Agronomists and highly skilled golf course superintendents? (Answer: Yes!)

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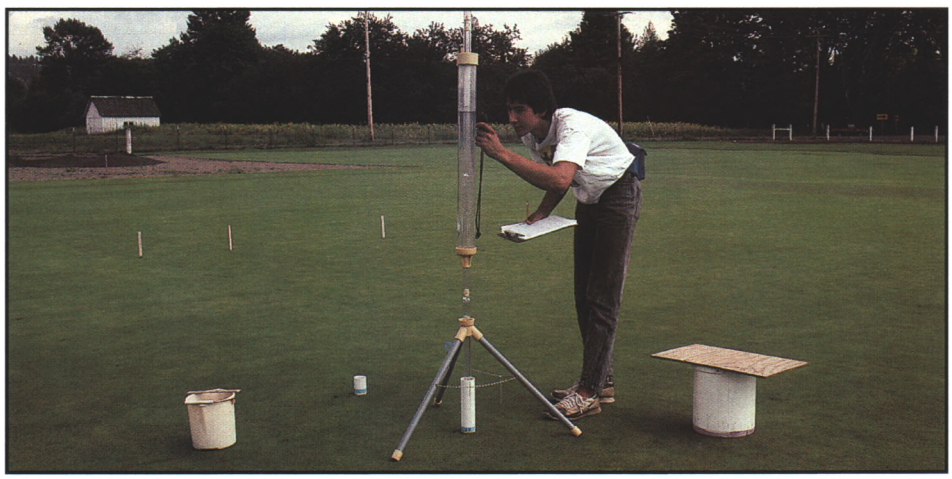
(Left) It is virtually impossible to prevent movement of some seed into non-target areas. If appropriate control measures are not used, volunteer establishment can create a significant weed problem. (Right) The Transition Blues. As temperatures and humidity increase in the late spring and early summer, a transition back to the base bermudagrass must be accomplished. Sometimes a rapid burnout of the overseeding cover occurs and this exposes a thin and weak bermuda base. Transition problems tend to be more pronounced in locations where other growth-limiting factors occur, such as shade or concentrated traffic.

Long-Term Aerification

A bentgrass fairway study compares hollow- and solid-tine core aerification.

by DRS. STANTON E. BRAUEN, WILLIAM J. JOHNSTON, and ROY L. GOSS



Saturated hydraulic conductivity in field plots was estimated using a Guelph permeameter. In general, saturated hydraulic conductivity was inversely related to the intensity of aerification.

TURF CULTIVATION by core aerification has many beneficial effects on turf. Better thatch control, less soil surface compaction, more uniform water infiltration, and improved surface aeration and rooting are often observed (Carrow et al., 1987; Erusha et al., 1989; Dunn et al., 1995; Lederboer and Skogley, 1967; Shildrick, 1985; White and Dickens, 1984). However, since thatch substantially increases pesticide sorption, reduction in thatch by coring may increase the potential for pesticides to move off the site (Dell et al., 1994).

Soil compaction in heavily trafficked areas of golf course fairways is often a problem, especially on heavy, wet soils, as frequently occur in the Pacific Northwest. Aerification with hollow tines, generally followed by sand topdressing, is commonly used to relieve this stress, but the aerification frequency needed, the turf disturbance caused, and the time and labor required are not always desirable. Aerification with solid tines rather than hollow tines has been used to some degree to reduce surface disturbance and labor requirements. However, core aerification may enhance turfgrass injury due to stress, increase weed establishment, decrease turf quality through disruption of the turf surface, and possibly slow water percolation through creation of a compacted zone of soil below the depth of coring tines (Erusha et al., 1989; Murphy, 1993; Shildrick, 1985).

A compaction zone, if present, may be different between hollow-tine coring (HTC) and solid-tine coring (STC) due to the differences in downward forces imposed by tine structure on soils. This study was designed to measure the effects of HTC and STC over several years on thatch development, soil bulk density, and hydraulic conductivity in a bentgrass fairway-type turf.

Experimental Methods

A five-year study was conducted on a fine sandy loam soil at the Turfgrass Field Laboratory at the Washington State University Puyallup Research and Extension Center, Puyallup, Wash. Core aerification was performed by HTC or STC on a well-established bentgrass fairway turf. At the beginning of aerification treatments in 1983, there were 1.6 to 1.9 inches of thatch. The turf was routinely clipped at 0.75 inches, fertilized at 131 lb./A (3 lb./1000 sq. ft.) annually with 21-7-14, and irrigated to prevent stress. A Greensaire II aerifier (Ryan/Ransomes America Corp., Lincoln, Neb.) was used in aerification and was equipped with 0.5-inch diameter hollow or solid tines. Treatments consisted of 0, 2, 4, or 6 aerifications annually between March and October via HTC, STC, or alternate hollow- and solid-tine coring (H/STC). Aerifications were made at the following times: two times annually during March and October; four times annually during March, May, August, and October; and six times annually during March, May, June, August, September, and October. Aerification was done when soil moisture was below field capacity and never when the soil was considered to be wet. Soil cores following HTC were removed, and the turf, including non-aerified treatments, was topdressed with approximately 8 cu. ft./1000 sq. ft. of sand (1 to 2 mm, 3.6%; 0.5 to 1.0 mm, 32.2%; 0.25 to 0.5 mm, 52.9%; 0.1 to 0.25 mm, 8.4%; and < 0.1 mm, 1.3%) following each treatment.

Thatch depth, dry weight, and density were determined in July 1983 and again in November 1988. Field-saturated hydraulic conductivity estimates were made during July and August 1989 using a Guelph permeameter (Soil Moisture Equipment Corp., Santa Barbara, Calif.). Soil bulk density values were taken in September 1989.

Results

After five years of core aerification, the net increase in dry weight of thatch was different between coring methods. HTC was more effective than STC in reducing net thatch buildup. Two to four aerifications annually were highly effective in controlling the change in thatch depth and dry weight (Table 1). White and Dickens (1984) previously found four to six core aerifications annually were required to have a major effect on thatch or related soil properties. However, in this study, six corings annually did not completely maintain thatch depth or dry weight at pre-study levels.

Thatch density increased markedly with increasing intensity of aerification over the five-year period. High-density thatch provides a more tortuous path for water, which increases resistance and allows for greater infiltration and reduced surface runoff from bentgrass fairways (Linde et al., 1995). The re-

sponse in thatch to aerification intensity was the same for all aerification methods.

Since HTC, to some extent H/STC, and increasing the number of annual core aerifications were all effective in reducing net thatch development, it seemed that physical removal of cores was an important factor controlling thatch development in bentgrass fairway turf. Improved soil biological activity due to frequent aerification plus sand topdressing following aerification may have been important in reducing thatch in these treatments.

Soil bulk density, following five years of coring at the 4- to 5-inch soil depth, was not affected by aerification method or by increasing the intensity of aerification (Fig. 2). However, there was a trend toward soil bulk density steadily increasing as the number of annual aerifications increased, which may indicate the development of a compaction zone below the depth of tine penetration over a period of time. Field-saturated hydraulic conductivity below the aerification zone (4 inches below the turf surface) was slightly greater with STC than HTC or H/STC. However, Murphy et al. (1993) reported that when aerifying a moist or wet loamy sand putting green soil profile, saturated water conductivity was 49% greater with HTC than STC. They also reported that STC provided short-term benefits, required repeated applications, and exhibited the potential for development of a cultivation pan. Field-saturated hydraulic conductivity was, in general, inversely related to the intensity of aerification annually. Two corings annually had a marked reduction in hydraulic conductivity with little additional decrease caused by additional coring annually.

Conclusions

HTC was more effective than STC in controlling change of thatch dry weight over a 5-year period. H/STC tended to be intermediate in performance. Two aerifications annually had a positive impact on change in thatch; however, six aerifications annually were required to have a major effect on thatch or soil properties. Soil bulk density below the depth of tine penetration was not changed by method of coring. However, soil bulk density below the aerification zone consistently increased as the number of annual corings increased, which suggests that long-term use of core aerification, especially in heavy soils, may result in development

Table 1
Net change in bentgrass thatch depth, dry weight, and density after five years due to 0 to 6 core aerifications per year.

Number of annual core aerifications	Net change in thatch		
	Depth (cm)	Ashed dry weight (kg m^{-2})	Density (kg m^{-3})
0	3.0 a	1.6 a	-2.7 d
2	2.7 ab	1.0 b	2.5 c
4	2.2 bc	0.6 c	6.4 b
6	2.0 c	0.2 d	11.0 a

Mean of 36 10cm cores averaged over coring methods. Means within columns not followed by the same letter are different by Fisher's protected LSD ($P = 0.05$).

Figure 1. Net change during 5 years in ashed dry weight of thatch as affected by coring method. Bar = 1 SD.

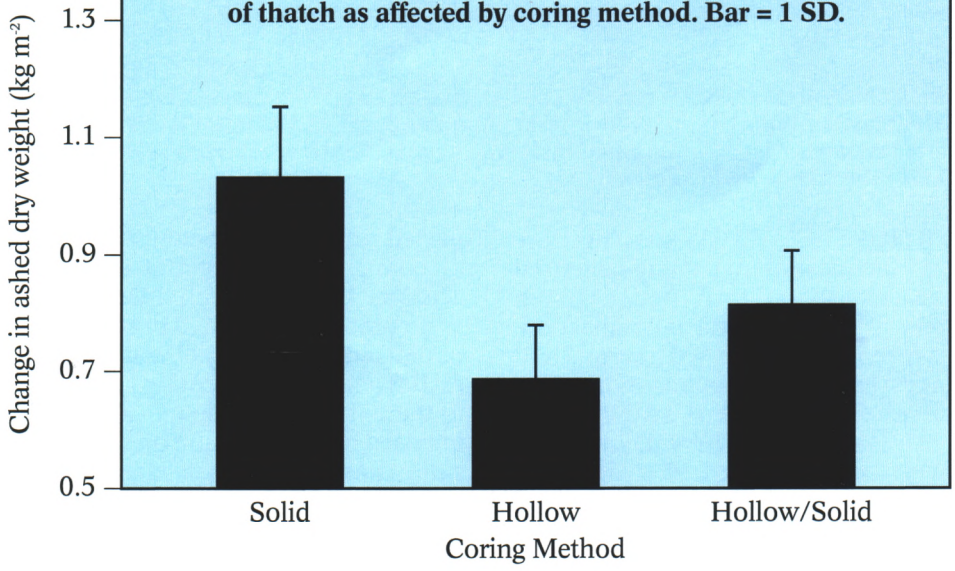
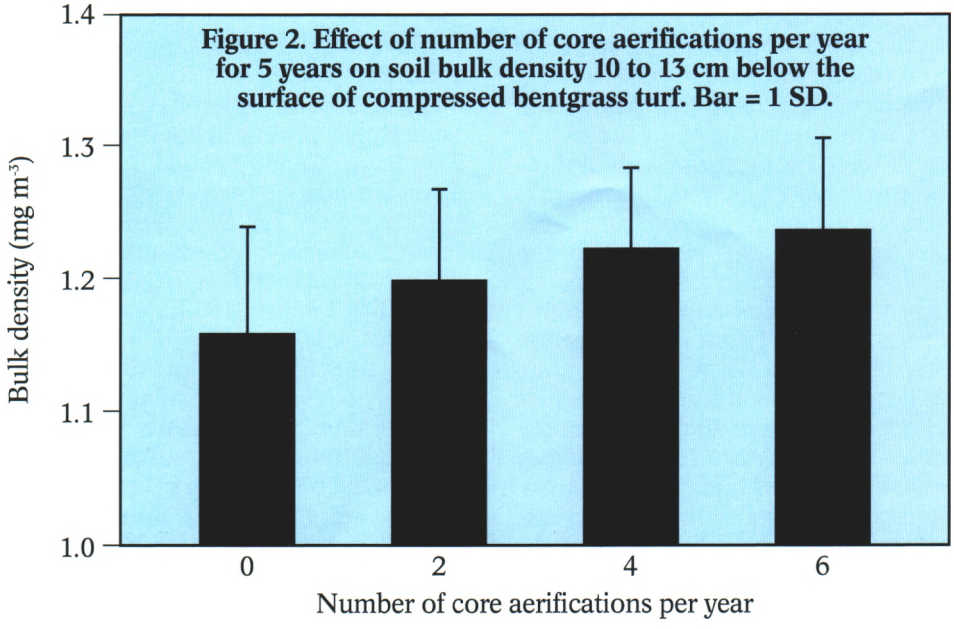


Figure 2. Effect of number of core aerifications per year for 5 years on soil bulk density 10 to 13 cm below the surface of compressed bentgrass turf. Bar = 1 SD.



Core aerification was conducted on the bentgrass fairway research plots at the Washington State University Research and Extension Center, Puyallup, Washington, during the five-year study of long-term aerification techniques.

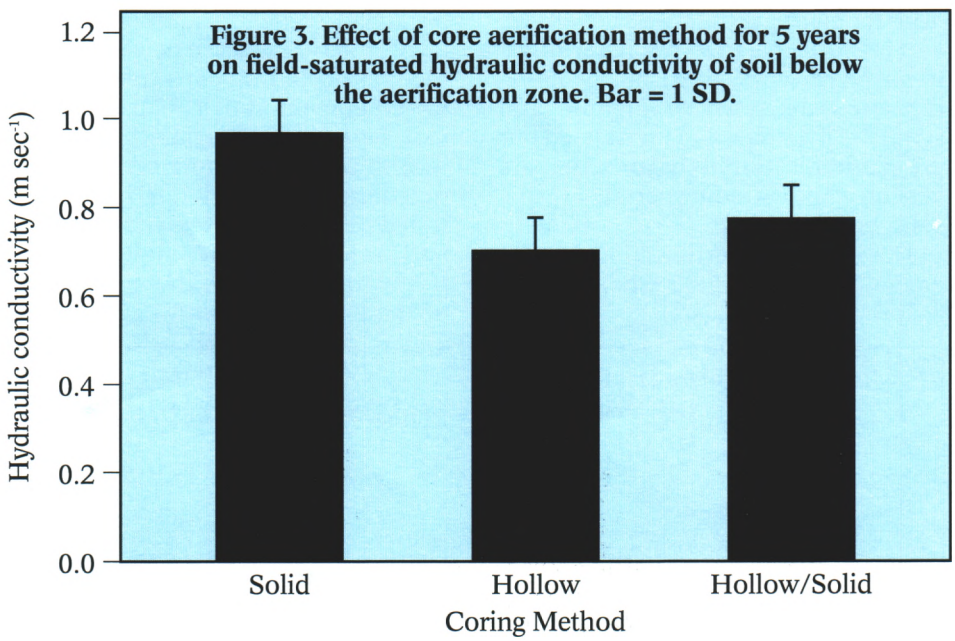


Figure 3. Effect of core aerification method for 5 years on field-saturated hydraulic conductivity of soil below the aerification zone. Bar = 1 SD.

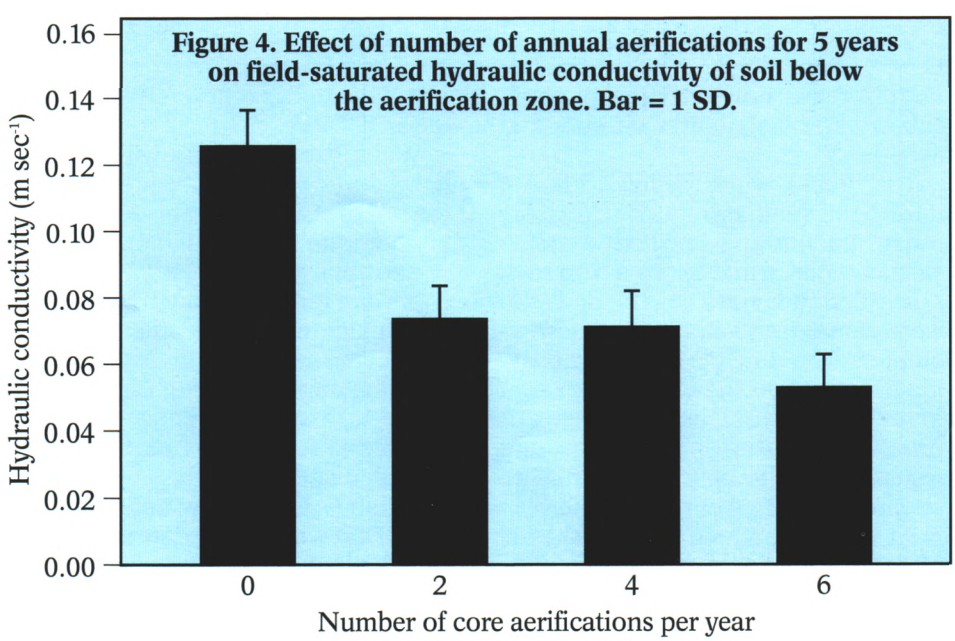


Figure 4. Effect of number of annual aerifications for 5 years on field-saturated hydraulic conductivity of soil below the aerification zone. Bar = 1 SD.

of a compacted zone. Field-saturated hydraulic conductivity 4 inches below the turf surface was reduced by increasing the number of annual corings, but soil receiving STC retained the ability to conduct water to a greater extent than that receiving HTC. Hydraulic conductivity values suggest that a compacted zone below the depth of tine penetration may be formed earlier with HTC than with STC, particularly when STC is conducted on soils that are dry and easily fracture in the compaction zone.

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A-4, Not Your Parents' Bentgrass

New management techniques for a new bentgrass variety.

by CUTLER ROBINSON, CGCS

BAYVILLE GOLF CLUB began as a vision to build a world-class golf course in Virginia Beach, Virginia. Every aspect of this project focused on having a great golfing facility; all other amenities were secondary. The selection of Tom Fazio as the golf course architect heightened the anticipation for a great golf course. When I was selected as superintendent in January of 1995, the honor, impending challenge, and responsibility were daunting.

The plans for the project as prepared by Fazio Golf Course Designers were very detailed and thorough. The selection of grasses and plant materials was consistent with what would be considered standard for the area. The owners and architect maintained a keen sensitivity to the surrounding environment and mandated that only native grasses, shrubs, and trees be used in the out-of-play areas. The fairways, tees, and primary rough turf were to be planted to 419 bermudagrass, with Crenshaw bentgrass specified for the greens. However, during the winter of 1995, I was introduced to the new Penn series of bentgrasses.

Keith Hall, Dave Donovan, and Bud Brown showed me the new Penn A-1 at their project, the Pointe Golf Course in Powell's Point, North Carolina. My interest in these new bentgrass varieties was piqued further when Dr. Melodee Fraser showed me slides of Penn A-4. After viewing the slides, it was clear that these new grasses offered a surface density similar to high quality perennial *Poa annua* (*Poa annua var. reptans*). The density of the stand of turf was truly amazing. Continued fact-finding provided evidence that the new bentgrass varieties would survive and even thrive under management regimens generally associated with championship preparation. With research in hand, I proposed to Bob Stanton (the club's development chairman) and Tom Marzolf (Senior Design Associate) that we seed our greens to A-4 creeping bentgrass. With the guidance and assistance of USGA agronomists Keith Happ and Stanley Zontek, it was agreed that A-4 would be used on the greens at Bayville Golf Club.

The greens were built in strict compliance with the USGA recommendations for putting green construction. We attempted to balance pre-plant nutritional levels in the greensmix by utilizing a combination of organic and synthetic materials. We formulated our pre-plant nutrition to balance our soil fertility while including natural organic sources of nitrogen.

The pre-plant fertilization for the greens at Bayville Golf Club were as follows:

Product	Analysis	Description	Rate
Harmony-greens fertilizer	14-3-6	natural organic/bridge product	5 lbs./1000 sq. ft.
Harmony-HI K fertilizer	6-2-12	natural organic/bridge product	5 lbs./1000 sq. ft.
Lebanon-starter fertilizer	10-18-18	greens starter fertilizer	5 lbs./1000 sq. ft.
Scott's STEP		granular micronutrient package	2 lbs./1000 sq. ft.
Dolomitic lime		magnesium & calcium source	10 lbs./1000 sq. ft.
Calcitic lime		pH adjustment & calcium source	5 lbs./1000 sq. ft.
Aqua root		humate source	2.5 lbs./1000 sq. ft.

Fertilizer selection and rates of application were based upon soil testing and experience.

The greens were seeded with A-4 during the summer of 1995. After the rough grading and finished contours were completed and approved on each hole, bermudagrass sprigs and sod were planted, and sand was placed in bunkers. This timeline meant establishing bentgrass during the extreme heat of June through August. However, this proved to be the right decision and resulted in a more mature turf when we opened in November of the same year.

As the turf matured through the fall of 1995, we found that lower mowing heights improved playing quality and general turf health. The crowns and shoots of the plants were bunched so tightly that the mowers had a tough time removing the previous day's growth. Even after mowing, the surfaces appeared puffy. Lowering the height of cut and mowing more frequently improved the appearance and playability of the turf. During the spring of 1996 we learned the height at which the grass could be cut was limited by the equipment, rather than the turf. It may be hard to imagine, but for this turf, lowering the mowing height did not negatively affect turf health. We tested various mowers and setups to find the lowest effective mowing height. If scalping occurred, the crowns sent up new shoots quickly. The bruised areas healed completely in a few days.

While experimenting with mowing procedures, we also were fine tuning our topdressing program. As with any good topdressing program, our goal was to apply the topdressing material at a rate that matched growth. We wanted to manage thatch and the mat layer. However, we quickly learned that working the sand through such a tight, dense turf was a challenge. Any particles over 0.50mm sat on the surface and damaged mowers and affected playability. Eventually, and with persistence, a weekly schedule of light topdressing provided the consistent blend of thatch, air, and soil desired. The topdressing also provided a degree of

resiliency that allowed frequent use of rollers to improve ball roll and the firmness of the putting surface.

The propensity of A-4 to form such a dense mat creates a potential threat of excessive thatch accumulation. Maintaining the lowest height of cut possible, along with weekly topdressings, helps us keep thatch under control. These practices also provide a firm, smooth putting surface. Our mowing/player preparation practices for 1997 were as follows:

Procedure	Number of times in 1997
Double cut (.100")	169
Double roll (Salsco)	32
Single cut (.100")	93
Single roll (Salsco)	157

It may seem extreme or excessive to mow and roll so frequently, but we consider these procedures essential to control thatch and satisfy our players. The costs of these procedures are offset by the turf's tolerance of environmental extremes and disease pressure. Pesticides and hand watering were not needed as much as we thought.

Over time, we also learned to streamline our procedures to maximize our results and minimize labor. During normal conditions, two people can topdress and brush the greens. We use the Grains Keeper Brush to work the topdressing into the surface. This tool allows us to complete this much-needed task ahead of the play while not affecting surface quality or damaging the turf. The Grains Keeper Brush has proven to be an excellent investment.

The use of an extremely clean and uniform topdressing material keeps mower damage to a minimum. During our experimental period, our equipment manager, Mike Flint, kept the mowers in tip-top condition. His efforts have been integral to our success, along with carefully selecting a topdressing material.

Our topdressing program continues to be fine-tuned. We now attempt to apply 30 to 35 topdressings per year. Environmental conditions guide us as to the rate of sand applied and the method by which it is worked into the turf. On most occasions, we topdress behind the mowers with a pendulum-type spreader and then broom the greens with the mechanical brush. The mechanical brush is not overly abrasive to the turf canopy. The upright growth pattern of the A-4 turf seems to allow the brushes to glide over the canopy. Under environmentally stressful conditions (extreme heat and high humidity), the sand is hand watered in, rather than brushed.

A-4 has a propensity to form a dense organic mat. By maintaining the lowest height of cut possible, in addition to applying weekly topdressings, thatch accumulation is kept under control.

No matter the conditions, a wetting agent is applied once a month on top of the topdressing sand and watered in. We proactively attack hydrophobic soil conditions. Offering the players a high-quality product immediately following each maintenance procedure is paramount.

The greens are aerified four times a year with ¼" quadratines. We treat in March, June, September, and November. The use of these smaller tines offers agronomic benefit while not adversely affecting playability. The small holes also heal quickly. Coring procedures are supplemented by four to six Hydro-Ject treatments per season.

We have experienced few disease or insect problems. During environmentally stressful periods the A-4 has performed beautifully. It has demonstrated excellent recuperative potential following drought stress, much better than other bentgrasses I have managed.

The occurrence of *Poa annua* has been so minimal that a little hand picking and plugging in April eradicates this scourge. Maintaining a healthy stand of turf through the stressful summer is the best method of annual bluegrass prevention.

A general misconception of guests to Bayville is that the new type of grass on our greens is the reason our surfaces are so enjoyable to play. The reality is

Equipment maintenance is as important as ever when dealing with the new bentgrass varieties. During our learning and experimental period our equipment manager, Mike Flint, kept the mowers in top condition. His efforts have been integral to our success.

that the grass can be managed to its full potential because the factors affecting its growth have been carefully skewed in its favor. The following factors have influenced the results achieved at Bayville:

- Use of golf spikes that do not pierce the leaves of the grass (non-metal).
- Meticulously constructed USGA-spec greens on sites that offer good light and air flow.
- Sound management via equipment availability and labor resources (through the support of the club's board approving equipment and labor resources).
- Establishing a variety of grass that has been genetically predisposed for specific playing characteristics.

Bert Crawford, green chairman at Bayville Golf Club, and I have worked closely to maximize player satisfaction at the club. His advice and guidance have had a positive impact on the product we offer. One bit of advice he gave regarding the management of our A-4 greens has held true. He said, "Life is an adaptation." I believe much of the success we have experienced with this grass is due to our willingness to be flexible and our ability to adapt specific procedures that provide the desired results. The staff is extremely flexible and understanding of the dynamics of environmental influences on turfgrass growth. Textbook or outlined procedures could never supplant in-the-field, on-the-spot decision making.

We have found that players of all skill levels adapt very well to Stimpmeter readings above 11 feet when this playing condition is offered on a consistent basis. The greatest challenge to the average player is stopping the ball on the putting surface, especially when the hole is playing downwind. For us, it is clear that healthy, firm, and fast putting surfaces heighten the enjoyment of golf. As turfgrasses and maintenance practices continue to improve, more and more people will be able to experience the exhilaration of playing championship conditions.

CUTLER ROBINSON *has been a golf course superintendent since 1982. Cutler was the superintendent at Elizabeth Manor Golf and Country Club in Portsmouth, Virginia, from 1986 until he assumed the duties at Bayville in 1995. He became a Certified Golf Course Superintendent in 1990 and has continued his postgraduate work in plant physiology, pathology, and weed science at VPI, working toward his master's degree.*

The following table is based on the management of Elizabeth Manor Golf and Country Club during 1994 as compared to the management of Bayville Golf Club in 1997.

A-4 Greens Management Cost Comparison to Penncross

Bayville Golf Club (A-4) with USGA green construction (1997) vs. Elizabeth Manor Golf and Country Club (Penncross with 25% *Poa annua*) with push-up/soil-based green construction (1994 management procedures)

- All dollars at 1997 cost (i.e., supplies and labor)
- Bayville has 150,000 sq. ft. of bentgrass, Elizabeth Manor has 100,000 sq. ft.

Procedure	Bayville 1997	Cost	Cost/ 1000 sq. ft.	Elizabeth Manor 1994 Total	1997 Cost	Cost/ 1000 sq. ft.
Mowing	5524 man-hours*	38,668	257.79	3200 man-hours	22,400	224.00
Rolling	785 man-hours	5,495	36.63	200 man-hours	1,400	14.00
Topdressing	594 man-hours 176 tons of sand at $42/ton	4,158 7,392	27.72 49.28	150 man-hours 120 tons of sand at $22/ton	1,050 2,640	10.50 26.40
IPM	labor and management			no significant difference		
Plant Protectants	disease, insect, and weed control	12,280	81.87	disease, insect, and weed control	10,500	105.00
Fertilizer and Soil Treatments	NPK, micros, Primer, misc., etc.	7,750	51.67	NPK, micros, agents, misc., etc.	7,500	75.00
Equipment Maintenance	parts: bedknives, reels; fuel, etc. labor/technician, 900 man-hours*	12,500	83.33	parts: bedknives, reels; fuel, etc. labor, 400 man-hours	5,500	55.00
Aeration	Quadratine and HydroJect 360 man-hours	2,520	16.80	Verti-Drain, coring, and HydroJect 240 man-hours	1,680	16.80
Hand Watering	400 man-hours	2,800	18.66	400 man-hours	2,800	28.00
TOTAL			**$714**			**$615**

Equates to $0.10 (ten cents) per square foot in additional maintenance costs per year
(for a course with 150,000 sq. ft. of bentgrass = $15,000/year additional cost)

Not included: cost of management, equipment depreciation, storage, and insurance

*All hourly rates based on $7.00/hour average wage, except equipment maintenance, which is based on $15.00/hour

Introducing A New Creeping Bentgrass Cultivar Through Interseeding: Does It Work?

It sounds like a good idea, but there are drawbacks.

by PATRICIA SWEENEY, Ph.D., and KARL DANNEBERGER, Ph.D., Department of Horticulture and Crop Science, The Ohio State University

THE RELEASE of several new creeping bentgrass cultivars with higher shoot density, finer texture, and greater tolerance to environmental stresses has led many golf course superintendents to think how best to introduce these new cultivars into their existing creeping bentgrass greens. The most effective means is through total renovation. This consists of killing or removing the existing turfgrass and then reestablishing with a new cultivar. The downside to this approach is the requirement to close the greens until the turf is established. This process could last as long as several months, during which time significant loss of play would occur.

An alternative method to total renovation of greens is a practice that is known as interseeding. In interseeding, the new, desired cultivar is introduced into an established stand of creeping bentgrass over a period of time. The desired result is a gradual conversion of the existing putting green surface of an older cultivar to one containing the new cultivar without serious disruption to the green.

Many of the practices used in interseeding are similar to or adapted from practices used to overseed bermudagrass greens with a cool-season turfgrass during the autumn. Generally, interseeding practices consist of trying to provide the best seed-soil contact possible without totally destroying the existing turf surface. Verticutting, coring, and topdressing are used in various combinations in interseeding programs. The intensity of these practices is generally not severe enough to disrupt or limit play. Practices that attempt to limit the competitiveness of the existing turf, such as using plant growth regulators or mowing at a shorter height of cut also may be used.

Following the mechanical preparation, the new cultivar is broadcast or slit-seeded into the stand. The seeding rate, in many cases, is higher than the normally recommended rates for establishment. Within a few weeks of seeding, superintendents often observe small seedlings germinating. However, after the turf fills in, how do we know how much of the new cultivar is present?

Assessing the Effectiveness of Interseeding

We looked at the effectiveness of one method of interseeding for incorporating new bentgrass cultivars over a four-year period. The putting greens used in this study were located on a golf course and established to Penncross creeping bentgrass. The greens had little if any thatch at the time of interseeding and had full canopy cover. Over the four-year period from 1994 to 1997, the greens were interseeded once with Providence and ProCup, and four times with G2. The procedure for interseeding the greens was similar all four years.

Prior to seeding, greens were aerified with ½-inch or ¼-inch tines and the plugs were removed. Greens were then topdressed and dragged. Seed was applied between 0.25 and 0.37 pounds per 1,000 square feet. The greens were then verticut or dragged to work the seed into the coring holes and turf. A second seeding at 0.25 to 0.37 pounds per 1,000 square feet was applied. Verticutting or dragging was again used to incorporate the seed. The greens were immediately watered, fertilized, and maintained to promote seedling establishment. The greens were initially cut at 5/32" with no baskets. After interseeding G2, mowing heights were gradually reduced to ⅛" over the next six to eight weeks.

In November 1997, we took 28 individual plant samples from a green. We used RAPD (Random Amplified Polymorphic DNA) markers, a molecular

Aerification was used to disrupt the soil surface and prepare the putting green for interseeding a new cultivar.

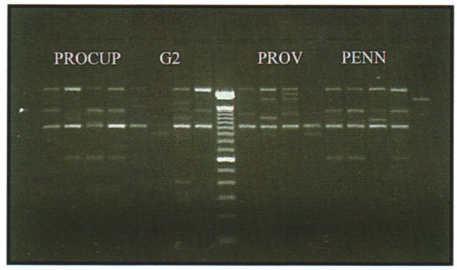
marker technique useful in fingerprinting genotypes, to determine the proportion of each cultivar on the green. We recognized there would be difficulties in determining the amount of newly introduced creeping bentgrass cultivars in the greens. Creeping bentgrass cultivars are synthetics, and thus are a mix of genotypes rather than a single genotype. Some of the genotypes present in the introduced cultivars are likely to be present in Penncross. It was unlikely that we could find a RAPD marker that could specifically identify a cultivar by being present in that one cultivar alone.

To make this study even more challenging, the green in question had been interseeded with three different cultivars over a four-year period. Ideally, we would have sampled the green to get a base reading before interseeding. This would have given us a before and after picture of the population on the green.

Regardless of these obstacles, we still thought we could get some idea of how successfully the newly introduced cultivars had become established on the green if we could identify a RAPD marker that was prevalent in Penncross but rare in the interseeded cultivars. We germinated seedlings of Penncross, Providence, ProCup, and G2, and extracted DNA from the seedlings. After four months of screening primers, we identified one that produced a RAPD marker in 75% of the Penncross and ProCup seedlings, but not in Providence or G2 seedlings.

We amplified DNA from 28 individual plant samples from the green in question using the primer that identified Penncross. Eighteen of 25 (several samples had poor amplification and were not used in the calculations) or 73% of the samples had the distinguishing RAPD marker for Penncross. Based on probabilities, the remaining seven plants were also likely to be Penncross. Since the identifying marker was not prevalent in Providence or G2, we concluded that these cultivars were not present. Although we can't rule out the possibility that a portion of the plants on the green might be ProCup, there is no evidence that ProCup would be any better at establishing than G2 or Providence. We feel confident in the conclusion that there are few, if any, of the newly introduced creeping bentgrass cultivars. Based on our work on this golf course, the greens are probably still Penncross.

Our study assessed the results of one method of interseeding new bentgrass cultivars into existing stands of bentgrass and may not be applicable when other methods are used to enhance establishment. Also, a more comprehensive sampling of various greens from other golf courses undergoing interseeding would be justified. However, in the context of plant competition, our data are very compelling. Actually, it would be more difficult to explain a shift from Penncross to one of the interseeded creeping bentgrass cultivars.



Random Amplified Polymorphic DNA (RAPD) markers were used to fingerprint or identify the proportion of each cultivar in the sample. Markers were determined for ProCup, G2, Providence, and Penncross creeping bentgrass.

The introduction of a cultivar into an existing stand of the same species would result in an extremely competitive situation. This competition is driven by the fact that individuals of the same species share the same requirements for resources. In other words, individuals of the two cultivars are so closely related and differentiation for a niche is so small that exploiting niche differences is difficult. Given that the individuals of the existing cultivar are more mature and already established, they have a distinct advantage in capturing resources such as light, water, and nutrients over the seedlings of the new cultivar. Almost all, if not all the advantages lie with the existing creeping bentgrass cultivar.

What about the new seedlings observed initially after seeding? Germination of seedlings does not depend on a competitive edge. Seedlings, given minimal space and moisture (soil contact), germinate, then live off the nutrients available in the seed. They don't compete with established plants for nutrients, space, light, and water. The question of whether the new seedlings compete once they have used up the energy from the seed has not been addressed. Our results imply that once the seedlings are on their own they do not compete well with existing plants.

Practices that slow the growth of the existing turf prior to and after seeding have been suggested as ways to favor the new seedlings. This philosophy works when you're attempting to favor one species over another, especially in the case of overseeding a warm-season turfgrass with a cool-season turfgrass in the autumn when the warm-season turfgrass is entering dormancy. The dormant warm-season turfgrass won't compete much during the winter. But how do you favor one cultivar of bentgrass over another? How can germinating bentgrass seedlings compete with an established stand of bentgrass? Mowing at a lower height of cut should tend to favor the newer creeping bentgrasses, but does this provide enough advantage for a seedling to out-compete an established plant of the same species? Our results suggest that it doesn't.

We would suggest that for interseeding to be successful, the existing creeping bentgrass would have to be severely stressed and a significant amount of the turfgrass canopy removed. Practices such as a severe scalping of the turf may reduce the competitiveness of the existing bentgrass to a level that the new cultivar would have a chance. Practices that destroy the turf canopy and create open spaces could reduce competition from the existing creeping bentgrass plants and allow the new seedlings to develop. Further studies need to be conducted to develop effective procedures for interseeding, but given our results and current interseeding procedures, introducing a new cultivar is best accomplished through total renovation.

If interseeding was successful, the dispersal of the new cultivar within the existing stand needs to be addressed. In other ecological systems, the introduction of a new species results in a patchy appearance indicating non-uniform introduction of the species. Will the same quilt-like transition occur when one cultivar is introduced into another? We suggest that greens with patches of various bentgrasses would not be desirable and that management of such a green would be difficult.

DR. PATRICIA SWEENEY *and* DR. KARL DANNEBERGER *are turfgrass professors in the Department of Horticulture and Crop Science at The Ohio State University. Their research work focuses on using molecular markers to evaluate shifts in turfgrass populations and to identify turfgrass cultivars.*

Crooked Oaks Golf Course has century-old live oaks and maritime forest on the property. Wildlife and habitat enhancement, in conjunction with naturalization areas, is a key component of our efforts in the Audubon program.

CERTIFICATION: A GRATIFYING EXPERIENCE

Seabrook Island and the Audubon Program become a natural fit.

by ALLAN H. PULASKI

I FIRST LEARNED of the Audubon Cooperative Sanctuary Program in late 1993. After learning more about this program, it became obvious to me that this was what golf needed — an organization that not only provided golf course superintendents with ideas and principles that could be implemented at almost any golf course to protect and enhance their unique environment, but also had the support of the USGA and many of the proactive environmental groups.

The Club at Seabrook Island is a private club located on a barrier island (Seabrook Island) about 30 miles southeast of Charleston, S.C., and is comprised of two golf courses. The golf courses offer many different challenges both from a golfer's viewpoint as well as from a maintenance standpoint because of their natural settings and completely different designs. The Ocean Winds golf course is bordered by sand dunes and salt marshes, while the Crooked Oaks golf course is routed through century-old live oaks and maritime forest.

As I learned more about the ACSP, it was apparent that this program could be a valuable addition to our management of both courses. The ACSP would allow us to accomplish three major goals: 1) protect and enhance the environment that is an integral part of these golf courses, while simultaneously providing quality playing conditions; 2) educate the membership and citizens of Seabrook Island that the environment and golf can co-exist with prosperity; and 3) compile the necessary documentation to achieve certification status with the program and to have our management practices documented properly.

One of the main concerns with implementing such a program was how the membership, especially the golfing membership, would accept these principles. The first person I asked to volunteer some time was a tennis member. Ann Kent is a very knowledgeable person who provides a very non-partisan view. She also is involved

with many other organizations in the community. After two meetings we formally assembled our Resource Committee for the program. The remainder of the group are five golf members, staff, and one town official, who is also a member. For us, the *Outreach and Education* category for certification was the easiest category to obtain certification and is the most important category that allows this program to thrive with positive results here at Seabrook Island.

The Club at Seabrook Island became a fully certified member of the ACSP in July 1996. We were all very proud as it was the first golf facility to achieve this designation in South Carolina.

Wildlife and habitat enhancement, in conjunction with naturalizing areas of turfgrass and providing aquatic buffers, is a key component of our program. We are able to incorporate these projects into other categories of the ACSP such as *Water Conservation and Water Quality Management*. As part of our continuing efforts to enhance wildlife, an emphasis has been focused on birds. Seabrook Island is located along the eastern flyway for migratory birds. Inventories of birdfeeders (78) and birdhouses (27) throughout the golf courses have been recorded, bluebird houses erected and monitored on the golf courses, an osprey nest erected, and wood duck boxes are planned. Projects like these have really helped influence participation in and the popularity of the Audubon Program here at Seabrook. Other events such as the Birdwatching Ryder Cup Championship conducted in May of 1997 and the North American Golf Course Birdwatching Open in May 1998 provided great opportunities for people in the community to see how golf courses can fill an ecological role while serving as a recreational facility.

Our Integrated Pest Management (IPM) program is very detailed. This intense IPM program is a credit to the assistant superintendents and staff. Our goal is to protect and enhance habitat each year for this fragile environment we enjoy each day. At the same time, we must manage these two golf courses, making sound agronomical decisions that will allow for quality playing conditions and an enjoyable round of golf for our clientele. With the IPM program, my staff records golf course conditions daily. With this recorded information, we are able to compare and reflect upon past conditions and their impact on the decisions involved with managing these two golf courses. As we compile more data, our management practices become more consistent each year, with pest control becoming more site specific.

When I evaluate the value of the ACSP personally and professionally, it is a *win-win* situation. Personally, it is an education process that is invaluable and allows me to experience nature firsthand. Professionally, the ACSP provides environmental guidelines and practices that golf course superintendents can use not only to enhance and protect the environment, but to enhance their value as knowledgeable stewards of the environment at local, regional, and national levels.

Mother Nature provides the settings, wildlife, and panoramic views we all enjoy at Seabrook Island. The ACSP has provided Seabrook with many ideas and practices to protect and enhance this unique environment. It has been the support of the club's membership and the efforts of the Resource Committee that have allowed the golf maintenance staff to implement these sound management practices. The experience has been very fulfilling for the Resource Committee at Seabrook. I guess that is why we work so hard to make it better every day.

ALLAN H. PULASKI *is a second-generation golf course superintendent. He is the Director of Golf Course Maintenance at The Club at Seabrook Island, Seabrook Island, South Carolina. Allan is on the Board of Directors of the Carolinas' Golf Course Superintendents Association and is a Public Relations Committee member for GCSAA.*

The Ocean Winds Golf Course is integrally intertwined with the sand dunes and salt marshes. Our maintenance is carefully managed to successfully protect and enhance these environmentally sensitive areas.

Peter Leuzinger

Correction

OUR APOLOGIES to Mr. Peter Leuzinger, CGCS, for misidentifying his golf course affiliation in the article "Environmental Commitment" in the July/August 1998 *Green Section Record*. Currently, Pete is golf course superintendent at The Ivanhoe Club, located in Ivanhoe, Illinois. Pete is a model in the environmental commitment arena as he is the only superintendent to have taken two golf courses to full certification status in the Audubon Cooperative Sanctuary Program: The Ivanhoe Club and St. Charles Country Club (St. Charles, Illinois).

Green Section Internships Awarded

FOR THE SECOND YEAR, the USGA Green Section awarded internships to outstanding turf management students. During 1998, the Green Section provided the opportunity for 14 students to travel with members of the Green Section staff on Turf Advisory Service visits for one week between the months of May and August. The goal of the internship program was to provide students with a broader view of the golf course industry and the opportunity to learn about golf course maintenance through the perspective of the Green Section agronomists. The students selected for travel during the 1998 season included:

Name	University	Year in School	Advisor
Jeffrey Borger	Penn State University	Junior	Dr. Tom Watschke
D. Cort Centanni	University of Georgia	Senior	Dr. Keith Karnok
Roger D. Cole	Purdue University	Senior	Dr. Clark Throssell
Charles R. Ford	University of Nebraska	Senior	Dr. Garald Horst
Travis W. Gannon	North Carolina State University	Senior	Dr. Rich Cooper
John E. Jordan	Texas A&M University	Graduate Student — M.S.	Dr. Richard White
Mark G. Kann	University of Florida	Junior	Dr. Grady Miller
Douglas P. McCullen	Oregon State University	Senior	Prof. Tom Cook
Art Schaub	Cornell University	Graduate Student — M.S.	Dr. Frank Rossi
Brian C. Smith	Virginia Tech University	Senior	Dr. Dave Chalmers
Michael A. Souza	California Polytechnic State University	Senior	Dr. Dave Wehner
Eric J. Sowatsky	Michigan State University	Senior	Dr. Jim Crum
Sean Tully	Colorado State University	Senior	Dr. Tony Koski
Matthew Wasserloos	University of Massachusetts	Graduate Student — M.S.	Dr. Nancy Garrabrants

Physical Soil Testing Laboratories*

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

BROOKSIDE LABORATORIES, INC.
308 S. Main Street
New Knoxville, OH 45871
Attn: Mark Flock
(419) 753-2448
(419) 753-2949 FAX

EUROPEAN TURFGRASS LABORATORIES LIMITED
3 Cunningham Road
Springkerse Industrial East
Stirling FK7 7SL Scotland
Attn: John Souter
(44) 1786-449195
(44) 1786-449688 FAX

N. W. HUMMEL & CO.
35 King Street, P.O. Box 606
Trumansburg, NY 14886
Attn: Norm Hummel
(607) 387-5694
(607) 387-9499 FAX

THOMAS TURF SERVICES, INC.
1501 FM 2818, Suite 302
College Station, TX 77840-5247
Attn: Bob Yzaguirre / Jim Thomas
(409) 764-2050
(409) 764-2152 FAX

TIFTON PHYSICAL SOIL TESTING LABORATORY, INC.
1412 Murray Avenue
Tifton, GA 31794
Attn: Powell Gaines
(912) 382-7292
(912) 382-7992 FAX

TURF DIAGNOSTICS AND DESIGN, INC.
310-A North Winchester Street
Olathe, KS 66062
Attn: Chuck Dixon
(913) 780-6725
(913) 780-6759 FAX

*Revised January 1998. Please contact the USGA Green Section (908-234-2300) for an updated list of accredited laboratories.

Chasing Color

Many of today's golfers think that if the turfgrass isn't green, it is dead.

by PATRICK M. O'BRIEN

OVER THE YEARS, I have spoken at hundreds of Golf Association meetings on topics ranging from *Poa annua* control to putting green reconstruction. No topic stirs up the pot more than the debate over whether or not to overseed dormant bermudagrass fairways for winter play. The desire to play on green fairway turf all year round is a popular notion, but few golfers understand that they are giving up long-range course improvements to have green fairway turf during the winter.

Today, fairways are being overseeded more than ever for various reasons. Historically, resorts throughout the South overseeded to attract golfers during the winter months. Resort courses have always placed a premium on the winter golf season since most of their play occurs at that time of the year. Over the past 10 to 15 years, new housing developments associated with golf courses in the South have overseeded to help sell real estate. Municipal and daily-fee courses have also been overseeding to entice golfers to play during the winter months. Even private clubs today are being lured into this practice. The primary reason most private courses overseed is for aesthetics. Television tournaments have encouraged demands for Augusta-like perfection and wall-to-wall green grass. But, even if your budget can afford fairway overseeding and the required maintenance that accompanies it, you need to ask if it is worth implementing. I find many courses can't afford this luxury maintenance practice and I hate seeing maintenance dollars being wasted on overseeding when there are so many other needs.

At most board meetings when overseeding is discussed, a cost estimate is assumed. Unfortunately, course officials and sometimes golf course superintendents assume that the major expense associated with overseeding is the seed itself. I've witnessed many course officials approve overseeding based on seed cost, when the additional equipment and labor expenses required can significantly exceed the cost of the seed. An overseeding cost worksheet (Table 1) developed by Bill Anderson, golf course superintendent at the Carmel Country Club, Charlotte, N.C., provides a line item expense report that can be used to estimate fairway overseeding costs. These items include the additional seed, fertilizers, herbicides, growth regulators, water, labor, and equipment costs that may be associated with fairway overseeding.

This fairway overseeding cost worksheet is invaluable to assist course officials with the development of a new budget that would include fairway overseeding. By filling out this expense report, many courses will realize that this strategy may not be cost-effective.

Many courses may decide that other course improvements merit approval in place of fairway overseeding. Whether fairway overseeding costs are $25,000 or $300,000 today, these expenses may be better allocated to other long-term improvements, such as cart paths, irrigation systems, turf equipment, maintenance buildings, drainage, new putting greens, etc. These improvements will last much longer than the six to eight months of temporary fairway aesthetics.

The aesthetic and playability benefits associated with fairway overseeding are not always achieved. A poor spring transition and the resulting slow recovery back to the base bermudagrass can cause poor summer playing conditions. As soon as the bermudagrass recovers in the late summer, overseeding occurs again and the cycle just repeats itself. Some years, even the overseeding is poor, and neither the winter nor the summer fairway surface is very good. Other intangibles include the fairway disturbance and wetter conditions for three weeks in the fall during seeding establishment, and the potential for more weeds with the limited herbicide options.

The decision to overseed fairways is a decision that must be made by each individual course. Avoid the common pitfall of copying what neighboring courses may be doing, as it may not be the best for your site. While fairway overseeding is inherently neither right nor wrong, it is vital that the course considers the required costs and agronomic practices before making the decision. By considering these factors, the course can make a decision on overseeding that is appropriate for their situation.

If a golf course's budget can allow for fairway overseeding as well as long-term goals, I have no problem with the private courses allocating funds for this expenditure. Otherwise, I'd vote for a good long-range plan, not lush, green fairway turf from October to May.

PATRICK O'BRIEN *is the director of the Green Section's Southeast Region.*

TABLE 1
Overseeding Cost Worksheet at Carmel Country Club, Charlotte, N.C.

Item	Unit Cost	Units Required	Total Cost
Seed		@ 400 lbs. per acre	
18 holes (30 acres)	$1.10 per lb.	12,000 lbs.	$13,200
Additional Fertilizers			
18 holes (30 acres)	$50 per acre	30	$1,500
Additional Herbicides			
18 holes (30 acres)	$60 per acre	30	$1,800
Additional Growth Regulators			
18 holes (30 acres)	$215 per acre	30	$6,450
Additional Water			
18 holes (30 acres)	L/S		$4,500
Additional Labor			
18 holes	$2,500 per hole	18	$45,000
Additional Equipment			
Drop spreader	$2,000		$2,000
Verticut reels	$8,700		$8,700
Vacuum	$23,500		$23,500
Fairway mower	$30,400		$30,400
TOTAL			**$137,050**

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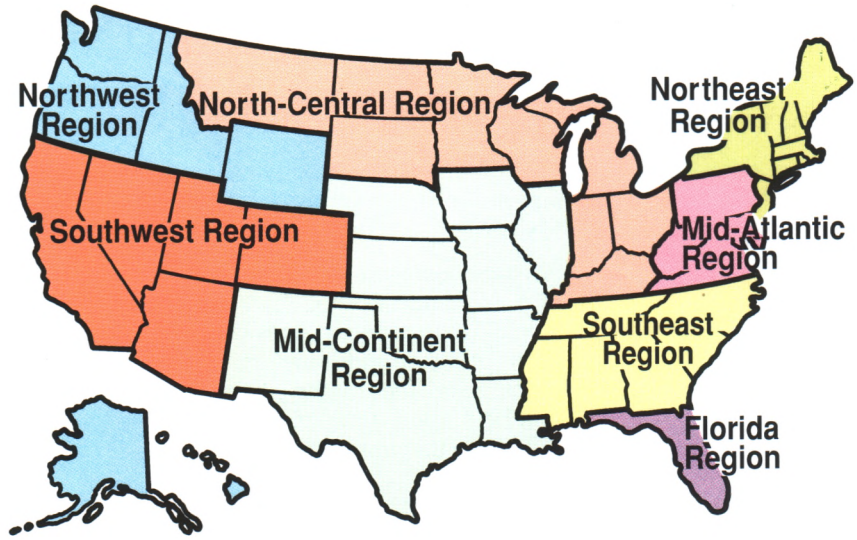

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TURF TWISTERS

DON'T CAST ASIDE

Question: Our membership complains each spring and fall about earthworm castings. I know the value of earthworms in turfgrass systems, but I cannot appease the membership. What can be done? (Maine)

Answer: Earthworms play a very valuable role in nutrient cycling, thatch reduction, and soil conditioning. There are no pesticides labeled for earthworm control, and using pesticides to combat earthworms is illegal. The British have contended for many years that the use of acidifying fertilizers, such as ammonium sulfate, provides very favorable results for discouraging earthworms. Sand topdressing the worst areas of fairways also will be helpful. Finally, continue to inform the membership about the value of earthworms in turfgrass management.

LONG-RANGE OPPORTUNITIES

Question: We are in the process of evaluating our operating budget. In particular, we're looking at salaries and wages in comparison with the total budget, and our equipment replacement program. At an average course, what percentage of the total operating budget is the salaries and wages line item, and what type of guidelines are available for long-range equipment replacement? (Nevada)

Answer: On average, 60% of an operating budget is usually allotted for salaries and wages. If there is a variance of 10% or more above or below the average, take a close look at conditioning expectations compared to available staff to do the work.

With regards to equipment replacement, most courses find it necessary to spend an amount equal to 10% of their annual golf course maintenance budget for new equipment purchases. Replacement intervals will vary throughout the country depending on the equipment type, intensity of use, and how you care for the equipment. As a general guideline, most fairway mowers and triplex units last five to seven years, utility carts and bunker rakes three to five years, walk-behind greens mowers three to five years, and string trimmers and smaller equipment two to three years.

TO EDUCATE GOLFERS

Question: During the spring and fall we experience a mottling effect and patchiness on our greens. I keep telling golfers that the effect is related to temperature. Is there an easy way to demonstrate this effect? (Maryland)

Answer: There's not much that is ever easy! If a purpling or reddening effect is experienced, examine both the upper and lower side of the grass leaf blades. If it is cold temperature stress, most likely the exposed surface will exhibit discoloration (normally purple or red) and the underside of the leaf will still exhibit the normal green color. If the purpling or reddening effect is experienced on both sides of the leaf, then it may be a disease or nutrient problem. This technique doesn't rule out other possibilities, but it does provide a starting point in your investigation.