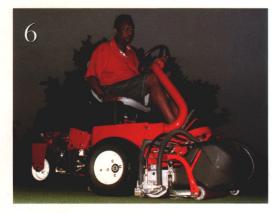


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November-December 2008 Volume 46, Number 6





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Cover Photo

Seashore paspalum: Moving the grass beyond niche status.

PHOTO BY NEIL A. CLEVERLY

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Coastal Conversions Part II

Lessons learned as seashore paspalum gains ground in a bermudagrass region. It's no longer a niche grass.

BY TODD LOWE



Seashore paspalum has shown to be much more tolerant of shade and low light conditions than bermudagrass. The healthy grass on the right is seashore paspalum on a shady practice tee, and the brown, thin grass on the left is bermudagrass.

eashore paspalum (*Paspalum vaginatum*) is a grass that has been around on golf courses for many years. It excels in salt tolerance, but early varieties, like Adelade, were coarse textured and produced mediocre playing conditions. This limited its use to golf courses that had salinity problems and labeled it a niche grass for areas with high salts.

Dramatic improvements in turf quality occurred with seashore paspalum over the past decade, due mostly to the collection and breeding efforts of the University of Georgia. In addition to improved salt tolerance, newer varieties produce aesthetic and playability characteristics that rival the dominant bermudagrasses, regardless of salinity issues. Several golf courses in the Florida Region soon recognized these improved characteristics and converted from bermudagrass to seashore paspalum.

The conversion to SeaIsle 1 and SeaIsle Supreme seashore paspalum that took place at The Sanctuary Golf Club in Sanibel, Florida, in 2005 was documented in the article "Converting Bermudagrass to Seashore Paspalum." Hammock Bay Golf & Country Club, located in Naples, Florida, regrassed to SeaDwarf in 2002, and The Wilderness Golf Club, also in Naples, Florida, regrassed to SeaIsle 1 in 2003. The Oaks Golf Club, in Sarasota, Florida, converted to SeaIsle Supreme in 2007.

Golf course superintendents from each club — Kyle Sweet (The Sanctuary), Rodney Whisman (Hammock Bay), Jim Torba (The Wilderness), and Earl McMinn (The Oaks) — were contacted to discuss the attributes and concerns of converting bermudagrass to seashore paspalum. Each course is unique in regard to expectations, budgets, and environmental concerns, and an



Seashore paspalum produces a tight lie, where the ball sits up high in the turfgrass canopy.

exhaustive review of each club's maintenance programs is beyond the scope of this article. Instead, this article offers insights into common differences in playability and management between bermudagrass and seashore paspalum and other important issues that golf courses should consider before converting.

PLAYABILITY AND AESTHETICS

A phrase that has become common with seashore paspalum is the "WOW factor." Seashore paspalum is a robust turfgrass that produces a tight canopy and prominent stripes following mowing. It also exhibits a more vibrant green color than bermudagrass, and even hardened skeptics note that it is a prettier grass. The WOW factor can be achieved on most turfgrasses by manipulating cultural practices like increased fertility and low mowing, but it is a quality that is easily achieved with seashore paspalum. Aside from improved salt tolerance, most clubs choose seashore paspalum due to its enhanced visual qualities compared to bermudagrass.

Putting green playability was initially thought to be a substantial concern with seashore paspalum as compared to bermudagrass. Although ultradwarf bermudagrass putting greens provide some of the finest putting surfaces in the

Florida Region, each of the superintendents interviewed for this article remarked that seashore paspalum putting greens play very well and that they receive few complaints about greens. A small percentage of golfers occasionally remark about slow putting greens, but this also occurred with the previous bermudagrass greens at each course and will most likely occur at every golf course, regardless of turf type. Unlike bermudagrass, achieving championship conditions does not seem to place great stress on seashore paspalum, requiring merely an increase of double mowing, rolling, and plant growth regulator treatments.

Seashore paspalum has a waxy cuticle on the leaf surface, and this often causes chip shots to release less than on bermudagrass. Golfers generally do not complain about this, but it is important to make note of this difference and play chip shots more at the hole. In fact, The

Oaks Club in Sarasota, Florida, has hosted several clinics with golfers to address slight differences in playability.

Almost all commercial seashore paspalum varieties can be mowed at any height on golf courses. There is a limitation in penal roughs, as the turf becomes open or puffy at heights above 1.75 inches. However, most courses maintain bermudagrass at or below 1.5 inches, so this is generally not an issue. A remarkable attribute of seashore paspalum is that the same cultivar can be utilized on every playing surface, and this eliminates encroachment of different grasses onto putting greens, a significant issue on bermudagrass.

Outstanding teeing grounds and fairways can be achieved with seashore paspalum, and golfers provide rave reviews about these playing surfaces. The golf ball sits much higher on seashore paspalum turf than on bermudgrass, thereby offering better ball control for good golfers. Although average golfers prefer a more cushioned lie, improved aesthetics on tees and fairways outweigh negative comments that might occur over tighter lies.

BERMUDAGRASS CONTROL

Common bermudagrass is ranked as the world's worst weed in crops, and completely eradicating established bermudagrass is an impossible task. Bermudagrass re-emergence occurs to some extent on all renovations, no matter which turfgrass is grown, and it has been a major issue when converting to newer bermudagrass varieties as well. Controlling common bermudagrass or bermudagrass off-types within commercial hybrid bermudagrass turf is as difficult as controlling them within seashore paspalum turf, as there are no effective selective herbicides at this time.

Golf courses in the Florida Region have taken many precautions during renovations to reduce bermudagrass re-emergence, ^{2,3} and these practices also are utilized when converting to seashore paspalum. They include:

- Multiple Roundup (glyphosate) and Fusilade (fluazifop) applications at long intervals. Bermudagrass is a perennial plant and requires at least three treatments and at least 21 days between treatments.
- Methyl bromide fumigation. It is rather costly and soon it will be unavailable, but fumigation is one of the best quality-control measures for

killing existing bermudagrass and enhancing genetic purity.

• Purchasing clean sprigs and sod. Turfgrass producers vary in maintaining genetic purity, and it is important to personally inspect the fields to review customer satisfaction. Do not just assume that all certified plant material is the same!

Each of the courses initiated an exhaustive chemical control program, including three or more applications of Roundup and Fusilade. Two courses even applied a fall herbicide treatment and then overseeded wall-to-wall with perennial ryegrass so that the base bermudagrass was weak going into spring herbicide treatments. Each course also fumigated all or most of the golf course with methyl bromide to kill the existing bermudagrass prior to sprigging.

Regardless of the precautions taken, it is important to plan for bermudagrass re-emergence following the renovation. If you take fewer precautions before renovation, you will probably have more bermudagrass issues following the renovation. The superintendents interviewed for this article remarked that some bermudagrass re-emergence has occurred, but most patches are inconspicuous and do not affect playability. In fact, most comments occur from curious golfers. who play in the morning and notice dew on some areas and not others (seashore paspalum has a waxy cuticle that repels dew). Common bermudagrass and coarse-textured off-types, however, are noticeable and decrease seashore paspalum turf quality.

A common practice for removing bermudagrass in seashore paspalum turf is to spray Roundup and Fusilade once or twice (follow-up treatment at three weeks) and to physically replace the dead grass with seashore paspalum sod. Such practices are recommended during the summer months, when golf rounds decrease and optimum turf recovery occurs. Managing bermudagrass requires a prioritized approach of removing the most conspicuous patches first, often within or adjacent to primary playing areas, and then focusing on secondary areas like roughs in subsequent years.

CULTIVATION AND MANAGEMENT

Most courses implement seashore paspalum management programs that are very similar to those for bermudagrass. Timings and frequencies of vertical mowing, core aeration, sand topdressing, and other cultivation practices vary depending upon course expectations for turf quality, but programs are quite similar to those at bermudagrass golf courses throughout the region.

As with bermudagrass, thatch management is necessary to maintain healthy turf and good playing conditions. Regular core aeration, vertical mowing, and sand topdressing are important for maintaining proper thatch dilution. Areas like bunker faces can become thatchy if not maintained appropriately and can easily scalp and look ugly for several weeks. Scalped seashore paspalum turf heals more slowly than bermudagrass and can appear as though it is diseased.

Mowers should be kept sharp to provide good turf quality and to decrease scalping as well. Seashore paspalum has thicker leaves and stems than bermudagrass, and many superintendents comment that sharpening mowers is a continual practice.

Although there are many similarities in management programs between the two grasses, differences exist and each superintendent remarked that:

- Higher rates of plant growth regulators are utilized. Primo (trinexapacethyl) is used commonly on most golf courses in the Florida Region. Superintendents remarked that two to four times the average rate for bermudagrass golf courses is applied to seashore paspalum. Trimmit (paclobutrazol) also is being used increasingly by seashore paspalum growers in conjunction with Primo.
- Less nitrogen is required by seashore paspalum. In fact, most superintendents only apply 25% to 50% of the nitrogen used on an average bermudagrass golf course. However, it is important to supply other necessary nutrients and micronutrients on a regular basis. Micronutrient deficiency can cause a mottled yellow appearance in seashore paspalum. New seashore paspalum turf with an insufficient organic mat layer or turf grown on sandy soil or soil with a high pH requires more frequent applications of micronutrients to maintain healthy turf.
- Seashore paspalum may require less water. This factor could not be quantified, but most superintendents feel that areas like putting greens



Managing bermudagrass in seashore paspalum requires a prioritized, long-term program of physical removal and sod replacement. The brown bermudagrass patches have been recently treated and will soon be replaced with seashore paspalum.

could go an extra day or two without needing water. All superintendents recognize that seashore paspalum has a root system that is two to three times longer and more robust than bermudagrass, and this factor most likely improves water use efficiency. Even so, seashore paspalum should not be allowed to suffer severe drought stress, as turf recovery following drought is often much slower than with bermudagrass.

In addition to greater salt tolerance, seashore paspalum grows much better in low light than bermudagrass. Bermudagrass becomes quite stressed from shade or increased cloudy weather and becomes thin and unsightly in low light situations. Seashore paspalum, conversely, is more adapted to growing in shaded or cloudy conditions and remains dense and green under most low light conditions.

The seashore paspalum root system (left) is much more robust when compared to two popular ultradwarf bermudagrass varieties (middle, right). Each grass was maintained under similar maintenance conditions on a golf course nursery green.



A WORD ABOUT PESTS

Increased disease occurrence has been well documented with seashore paspalum over the years. Most notably, large patch (*Rhizoctonia solani*) and dollar spot (*Sclerotinia homoeocarpa*) or a dollar spot-like disease have occurred on golf courses. Oftentimes, dollar spot has been diagnosed but occasionally fungicides for dollar spot control have been ineffective. Research at the University of Florida has shown that, in addition to large patch and dollar spot, other pathogens can be common on seashore paspalum, including *Rhizoctonia zeae*, *Fusarium* spp., and even a newer pest (*Poculum henningsianum*). Correct diagnosis is necessary for effective disease control, so always send samples to a reputable diagnostic laboratory.

It is important to note disease incidence, since bermudagrass experiences fewer pathogens than seashore paspalum, but it is also important to recognize the comments from most superintendents about diseases. Basically, superintendents note that diseases like large patch and dollar spot are more common, but they rarely receive complaints and very rarely lose turf. Most turfgrass pathogens are nuisances that cause temporary turf discoloration. Fungicide programs for most golf courses include preventative treatments on putting greens every three to four weeks (depending upon weather conditions) and spot treatments on tees and fairways as needed.

Weed management programs for seashore paspalum differ from those for bermudagrass, as there are fewer herbicides labeled for its use. But superintendents also believe that seashore paspalum is more competitive against weed invasion, and they generally do not complain about weeds. Many pre-emergent herbicides are safe on seashore paspalum and can be safely applied for annual weed control. Research has also shown that sedge control chemicals are safe on seashore paspalum, and several three-way 2,4-D combinations can be applied to control broadleaf weeds. Several golf courses still apply salt to control weeds early in the morning, when dew is still apparent on the weeds and not the seashore paspalum. It is important to note that salt is not a labeled herbicide and will also temporarily burn seashore paspalum leaves

Other pests commonly found in seashore paspalum are lepidoptera worms. In particular, sod webworms seem to harbor quite well in seashore paspalum turf and cause decline of turf quality. Insecticides applied to bermudagrass turf can also be safely applied to seashore paspalum.

LOOKING AHEAD

Water quantity and quality is the greatest concern for golf courses, as real estate developments place a greater strain on potable water. Golf courses are increasingly forced to utilize alternative water sources, and this was one of the principal factors for investigating the use of seashore paspalum as a turfgrass for golf courses. Water resources will most likely worsen in the future, and the need for improved salt tolerance will not abate. The USGA continues to fund this important program to develop improved turfgrasses that require fewer inputs for sustainable turf management.

Dr. Ronny Duncan, previously at the University of Georgia (with USGA-funded research grants), was the principal investigator



for developing improved seashore paspalum varieties for golf courses and is responsible for SeaIsle 1, SeaIsle 2000, and SeaIsle Supreme. Dr. Duncan retired several years ago and Dr. Paul Raymer continues this valuable research. In addition to improved salt tolerance and disease tolerance, Dr. Raymer has initiated a multi-departmental program for researching stress physiology, weed management programs, improved insect management, and overall turf quality.

The University of Florida is investigating seashore paspalum susceptibility to plant-parasitic nematodes and plant pathogens. Field observations suggest that some seashore paspalum varieties may be more tolerant of plant-parasitic nematodes than bermudagrass. Research projects include investigating the impacts of nematodes on seashore paspalum and bermudagrass varieties and developing effective disease management strategies for common pathogens that occur on seashore paspalum.

IN CONCLUSION

There is no perfect grass, and it is important to understand your particular goals and determine whether seashore paspalum is the right choice for your course. Many superintendents believe there is give-and-take when comparing seashore paspalum to bermudagrass in that there may be more funds spent on fungicides, sharper mowers, bermudagrass control, and maintaining comparable putting greens, but it also requires less nitrogen, less water (perhaps), and less winter overseed. Its greater tolerance of salt and shade offer better turf quality under stressful conditions.

Also, many courses view the conversion as an increase in standards as the WOW factor would have caused an increase in funds, regardless of the turf chosen.

Another consideration that should be addressed is the fear factor. It is only human to fear the unknown, and with seashore paspalum still a relatively new grass compared to other turfgrasses, fewer superintendents have experience growing it. One must keep an open mind, review as much literature as possible, and visit other seashore paspalum growers to be successful with this grass. Of all the superintendents who have converted to seashore paspalum, the author has not found any who have regretted the change. In fact, they all preferred growing seashore paspalum and providing excellent conditions for their golfers.

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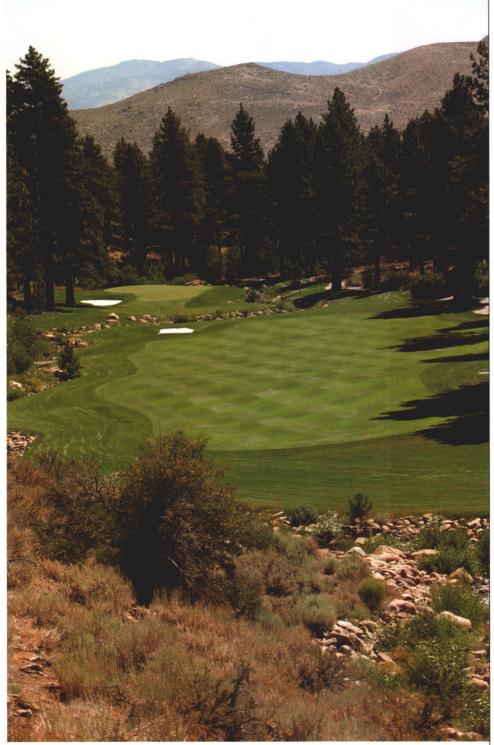
TODD LOWE is an agronomist in the Green Section's Florida Region.

Large patch and dollar spot are more common diseases on seashore paspalum than bermudagrass and can cause unsightly conditions.

Achieving Personnel Success

Paying close attention to the human side of golf course management is a vital part of producing exceptional playing conditions.

BY PAUL H. VERMEULEN



Veteran superintendents all recognize that a vigorous training program that promotes teamwork and attention to detail is the key to producing exceptional playing conditions.

hen it comes to finetuning the condition of any golf course, it goes without saying that one person, the golf course superintendent, can make the difference between excellence and mediocrity. Although the validity of this statement is beyond reproach, it is equally important to appreciate the deeper meaning of one human being can make all the difference in the world. More specifically, superintendents deserve recognition for great course conditions, but such recognition should largely be for their personnel management skills and not simply their hands-on activities. To emphasize key elements of personnel management, this article casts a light on some of the trade secrets that experienced superintendents believe have been important to their success.

Getting a course ready for play each day requires a staff of anywhere from 15 to 50 people, but more important than the actual number is the fact that they must all rely on each other to uphold a high standard. For instance, if the 50th member of the crew neglects to syringe the greens on a hot afternoon, does it really matter if the other 49 crew members did everything else perfectly?

Based on their actions, successful superintendents are in agreement that one of the first steps toward achieving high employee performance is to provide ample training. Without extensive training, even a relatively straightforward assignment like fairway mowing can produce disappointing, if not potentially costly, results. For example, the immediate signs of an improperly trained equipment operator on fairways are banana-shaped mow lines, wheel ruts in soft ground, and scalped turf



In the short time span of an afternoon, an employee without adequate training can unwittingly cause extensive damage across large areas of a golf course.

along the fairway perimeters. Further, given that the price of today's technically sophisticated fairway mowers can exceed \$50,000, an untrained operator who unwittingly drives with an air filter clogged with grass clippings can cause extensive mechanical damage in one afternoon.

Training new employees to take proper care of a golf course also involves far more than instructing them on how a particular piece of equipment turns on and off and turns left and right. For example, before someone can mow greens numbers 5, 7, 12, 14, and 18, they need to become familiar with the course's layout in order to find them. Then, once they find them, they need to know what to do if golfers are approaching, how to tell if the irrigation system ran as programmed by the superintendent, and how to be able to identify disease symptoms that are only visible before a green is mowed.

The foundation of a good training program for new employees typically includes the review of instructional videos and/or booklets, one-on-one instruction from the turf equipment technician, and one-on-one instruction from a senior supervisor or superintendent. From beginning to end, any training program must further stress

operator safety and proper technique for producing high-quality results. Although expensive and time consuming, good training is essential to producing exceptional playing conditions, and under no circumstances should someone be allowed to start work without it.

Given the extensive time and effort required to train new employees, it is

easy to appreciate the importance of minimizing turnover. Maintaining a competitive wage scale is an essential part of keeping employee turnover to a minimum, but superintendents who also focus their attention on employee welfare ultimately have the lowest turnover rates. Starting with the maintenance facility, a clean, well-organized working environment is a must for retaining valuable workers. In an earlier Green Section Record article titled "Getting It Right" by Bo Links (Nov./ Dec. 2005), the author details how constructing a modern 12,000- to 14,000-square-foot maintenance facility as a replacement for an undersized, corrugated metal building with dirt floors immediately uplifted staff morale. The connection to employee retention is that providing good working conditions or, more specifically in Bo's case, building a modern facility, demonstrates the importance of everyone's efforts.

In addition to addressing appropriate work surroundings, providing simple creature comforts can demonstrate how important an employee's role is



To produce the highest level of course conditioning, new employees require many hours of one-on-one training with the superintendent and other senior staff members.

to achieving success. Such comforts might include an oversized locker for storing personal hand tools, rain gear, etc.; catered meals from the clubhouse; a dryer for wet work clothes during the rainy season; low-cost vending machines; personalized parking spaces; and comfortable furniture in the break room. The vital message is to show appreciation to those who literally get the job done each day no matter the temperature or weather conditions.

Another familiar component of successful personnel management is taking a genuine interest in each employee. On a professional level, this effort amounts to identifying a task or tasks that best suit(s) an individual's talents and then amplifying them with additional training. It may seem odd, but astute superintendents have discovered that some employees have an interest in perfecting uncomplicated tasks, such as trimming bunker edges with a weedeater, while others require expansive job descriptions to retain interest in their positions. By the same token, it also is important that employees have some means of gauging their performance, whether their responsibilities are simple or complicated.

To help assess a worker's interests, some superintendents elect to use questionnaires. For example, student interns can be asked to spell out three to five activities they would like to include in their summer work schedule. Some might leave the questionnaire all but blank, which can indicate that they are either as green as the grass or have little interest in challenging themselves. Others may continue writing on the back of the page, which can indicate that they are either overeager or have a sincere interest in forwarding their careers as quickly as possible by learning all that they can. In both cases, the



Finding the right job for each employee is essential to making the most of everyone's individual strengths and interests. While some employees enjoy demanding job responsibilities, others with a keen eye for detail enjoy the challenge of straightforward tasks.

key is that the superintendent takes an interest in them as individuals and, in turn, tries to work on a strategy that best suits their unique qualifications and interests.

On a personal level, perceptive superintendents make an effort to learn what interests an employee off the clock. In some cases, learning about an employee's activities away from the golf course can help tailor the daily routine in a manner that improves job performance or in some way benefits the condition of the course. An example would be that some employees have a knack for masonry or carpentry work, and if presented with the opportunity

would enjoy completing special projects like retention wall construction or remodeling the break room. In most cases, however, learning about afterhours activities is simply a sincere way of building working relationships that foster high morale and lasting employee loyalty.

Also part of building productive employee relationships is giving feedback on a regular basis. While this topic may conjure up images of delivering harsh words to an uncooperative employee, experienced superintendents realize that giving feedback, both negative and positive, is a critical part of their success. Furthermore, they realize that there is actually more to be gained from giving positive feedback to each and every member of the crew. In so doing, employees are eager to take their work to the next level, because they know that their extra efforts make a difference. Then, when employees improve

their performance, they become role models for others around them to do good work.

In closing, any discussion about the essential elements of sustainable turf-grass management would be incomplete without including the most important one — the human element. To achieve personnel success in the field of golf course management, a winning strategy is to simply pay close attention to experienced superintendents who support those who support them.

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Water Issues Facing the Turfgrass Industry

Leading turfgrass scientists meet to exchange ideas regarding issues facing turfgrass water use.

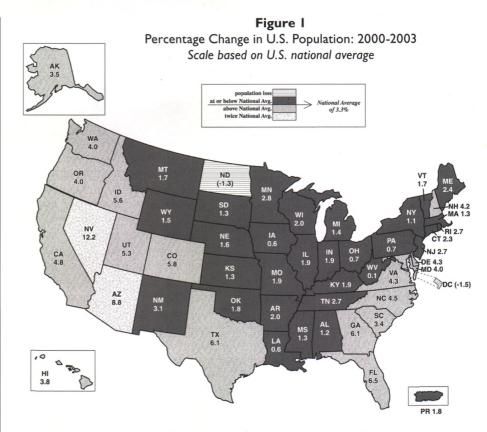
BY JAMES B. BEARD AND MICHAEL P. KENNA

urfgrasses used in urban areas impact Americans daily in many ways. There are an estimated 50 million acres of maintained turfgrass in the United States on home lawns, golf courses, sports fields, parks, playgrounds, cemeteries, and highway rights-of-way. The annual economic value of this turfgrass is estimated to be \$40 billion.²

Scientists have documented an array of benefits to the environment and humans resulting from turfgrasses, but critics point out the excessive water requirements and pesticide use for turfgrass versus other landscape materials. It is important, however, to point out that plants do not conserve water; people do. Turfgrasses belong to the grass family, which evolved over millions of years without pesticides and irrigation systems. There are grasses adapted to the wettest and driest climates in the world. Academic and industry research on turfgrass can and will continue to provide quality turfgrass while reducing pesticide use and conserving water.

WATER CRISIS

There is no longer a significant relationship between population distribution and water availability. The desert Southwest of the United States (Arizona, Nevada, and California) is among the fastest-growing areas,⁷ yet this is an area with undeniable water supply and distribution problems (Figure 1). According to the U.S. Geological Survey (USGS), total fresh water withdrawals during the last 45



years have declined as population has grown. The USGS concluded that more efficient industrial and agricultural water use accounted for the decrease in water withdrawals while population increased.

Urban water use can be divided into indoor and outdoor uses. Indoor water use remains fairly constant throughout the year; the peak demand for water during the summer, however, is the result of outdoor water use. Even in areas where water supplies are ample, an economic or investment concern exists whenever the peak demand becomes a driving force for water agencies' decision-making process.

Flattening the peak demand is an objective of water agencies. Because the demand curve typically is highest during times of increased outdoor water use, conservation efforts target landscapes generally and turfgrasses specifically.

Clearly, water conservation can have positive benefits, such as extending the availability of water to more people or other uses and reducing the costs associated with developing new water resources. Outdoor water use estimations are complicated, however, and have many shortcomings. There is a need for more research and analysis to refine outdoor water use. There also

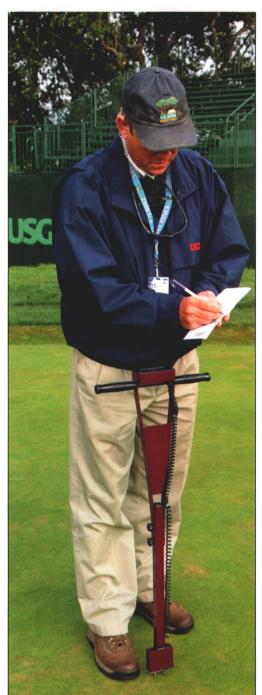
is a need to clarify how much water is consumed by various landscape materials and how much is returned either through evaporation, runoff, or groundwater recharge.

LOW-PRECIPITATION LANDSCAPES

Several problems can result from the loss of a turfgrass cover by not allowing appropriate irrigation in low-precipitation regions. The seven categories of problems include diseases and airborne dust, heat stress islands, wildfires, soil erosion and flooding, urban pollutants, criminal activity, and human disharmony. There is a tendency to use a simplistic approach for eliminating certain water uses by enacting public laws. A single-issue approach of not permitting irrigation on all or a portion of the land area, such as grassed lawns, can lead to other potentially serious problems.

Officials need to take these consequences into consideration when proposing legislation to exclude irrigation from all or part of the urban landscape. There are many other functional benefits attributed to the use of the turfgrass/soil ecosystem in urban landscapes that are summarized briefly. Certainly, the social and economic values of these benefits are substantial, but studies quantifying the economic aspects are needed.

Rather than eliminating certain water uses in low-precipitation landscapes, there are other substantial savings to be accomplished in furthering water conservation. These actions range from sustainable best management practices (BMPs) for irrigating turfgrass to repairing leaks in municipal water distribution systems. Incongruities in laws and "money-for-grass" approaches, which eliminate grassy areas but allow the use of ornamental shrubs and trees with higher water use rates, are not sound approaches. An integrated, holistic approach to water use in populated areas is essential. The elimination of turfgrasses from open



Accurately managing moisture levels in the rootzone is essential to provide top playing conditions, especially on putting greens. USGA Green Section agronomist Pat Gross checks putting green moisture levels at this year's U.S. Open at Torrey Pines.

areas in urban landscapes should be implemented only as a last resort in arid climates. Turfgrasses not only use water, but also collect, hold, and clean it while enhancing subsequent groundwater recharge and contributing to transpiration cooling.

REGULATORY CONSIDERATIONS

The Environmental Protection Agency (EPA) is responsible for implementing the Clean Water Act and Safe Drinking Water Act, portions of the Coastal Zone Act, and several international agreements protecting our oceans and shores. The EPA's activities are targeted to prevent pollution wherever possible and to reduce risk for people and ecosystems in cost-effective ways. In recent years, water security also has become a more critical part of the EPA's mission. Hall discusses the legislative history and context of the Safe Drinking Water Act and Clean Water Act, along with how the goals of these two acts are integrated through federal, state, and local implementation.9

MUNICIPAL POLICIES

There are two fundamentally different legal systems that govern the allocation of water throughout the United States. Under the riparian system, which applies to 29 eastern states that were historically considered wet states, ownership of land along a waterway determines the right to use of the water. In times of shortage, all owners along a stream must reduce the use of water. Because of water scarcity in the West, it was impractical for water rights to depend on ownership of land along streams. This resulted in the prior appropriation system of water rights, which was originally developed by miners in California and adopted by nine arid western states.

Under prior appropriation, a water right is obtained by diverting water and putting it to beneficial use. An entity whose appropriation is "first in time" has a right "senior" to one who later obtains a water right. In times of water shortages, senior rights must be fully satisfied before junior rights are met, sometimes resulting in juniors receiving no water at all. Richardson further explains these systems and various other existing water policies.¹⁶

In the United States, most water policy is at the state and local (municipal) level; the drinking water system is extremely decentralized and is structured in four basic ways: (1) owned by local governments, (2) independent government authorities, (3) privately owned companies, and (4) publicprivate partnerships. There are 53,000 community water systems in the United States, and they provide 90% of Americans with their tap water. Only 424 community water systems serve more than 100,000 people. In total, 80% of community water systems serve 82% of the U.S. population. Local governments or an independent government authority own 86% of the community water systems.

Historically, pricing qualifies the costs of capture, treatment, and conveyance. Consequently, this method often obscures the larger, but less quantifiable, societal interest in preserving

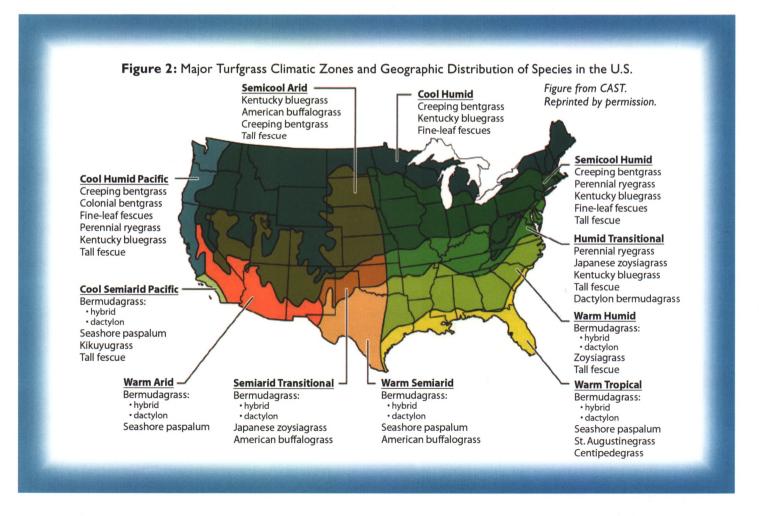
our water resources. In regard to water rates, there are well-established policies, primarily due to the efforts of the American Water Works Association (AWWA), whose members provide approximately 85% of the drinking water across the United States.

TURFGRASS AND THE ENVIRONMENT

The first step toward water conservation is selecting the correct turfgrass for the climate in which it will be grown. Kenna presents a breakdown of climate zones in the United States and the differences between cool-season and warm-season turfgrasses (Figure 2). During the last 30 years, turfgrass scientists have determined the water use rates for major turfgrass species. Turfgrasses can survive on much lower amounts of water than most people realize; several turfgrass species have good drought resistance. A great deal

of this information is available on the Internet through sources such as the Turfgrass Information File at Michigan State University (http://tic.msu.edu).

Agricultural chemicals registered with the EPA are applied to turfgrass, and through several processes, these chemicals break down into biologically inactive byproducts. Two concerns are whether pesticides and nutrients leach or run off from turfgrass areas. The downward movement of pesticides or nutrients through the soil system by water is called leaching. Runoff is the portion of precipitation or rainfall that leaves the area over the soil surface. There are several interacting processes that influence the fate of pesticides and fertilizers applied to turfgrass. Seven processes that influence the fate of pesticides and nutrients include volatilization, water solubility, disruption, plant uptake, degradation, runoff, and leaching.¹³ Branham³ and King



and Balogh¹⁴ further examine these processes and the likelihood that the pesticides will reach ground or surface water.

SOIL WATER

Water flow through soil is influenced partly by local weather conditions. Rainfall places water at the soil surface, and its intensity and duration dictate

show greater retention capabilities. Antecedent soil water content also affects the rate of water infiltration and flow through soil.

GROUNDWATER

Turfgrasses and associated management practices reduce the potential for leaching of pesticides and nutrients to groundwater. Branham reviews the



An important issue for the golf course industry is how golf course management affects water quality of the surrounding water resources. The USGA has funded several studies to analyze the movement of nutrients and pesticides from turfgrass in both plot- and watershed-scale study areas.

which portion will infiltrate or run off. Solar radiation, relative humidity, and wind control the rate of water evapotranspiration. Water flow through soil also is influenced by the characteristics and current growth stage of the turfgrass plant. The atmosphere's evaporative demand is tempered by the plant that draws water for transpiration from the soil. Consequently, intra- and inter-species differences in canopy resistance and variations in turfgrass cultural practices affect soil water uptake.

Water flow through soil is controlled by retention and transmission capabilities of the soil pore space.¹⁵ Coarsertextured soils show greater transmission capabilities, and finer-textured soils manner in which a healthy turfgrass protects groundwater.³ Turfgrass can provide considerable protection against leaching because of the high levels of organic matter and associated microbial activity that serve to immobilize and degrade applied pesticides and nitrates. Excessive irrigation or large rain events, which lead to preferential or macropore flow, can mitigate these advantages and push solutes below this zone of microbial activity.

It is unwise to generalize when discussing pesticides because each pesticide has different characteristics that affect its distribution and fate; most pesticides currently used in turfgrass, however, present fairly low risks of producing significant groundwater

contamination. Healthy turfgrass has a great capacity to use applied nutrients. Nitrate leaching may present problems, however, in some segments of the turfgrass industry where nitrogen fertilization rates have not been reduced to account for turfgrass age and clippings return

SURFACE WATER

Available knowledge about surface runoff quantity and chemistry from urban landscapes has increased over the last two decades; more information is required, however, before any overarching, widespread conclusions can be made. King and Balogh discuss factors that affect surface runoff, such as climate, site and soil conditions, and management.14 The most significant climate factors are precipitation, evapotranspiration, and temperature. Site and soil conditions also affect potential off-site movement of sediment, nutrients, and pesticides. The most significant site and soil conditions are soil texture and organic matter content, bulk density, hydraulic conductivity, thatch layer, landscape slope, and proximity to water resources.

The most critical factor affecting surface runoff is management, which includes irrigation, drainage, fertilizer and pesticide application, and cultural practices. A reasonable case could be made that runoff volume generally is small, and losses of pesticides and nutrients are less than those from agriculture. More geographically diverse, long-term data sets on both cool- and warm-season grasses and on well-defined catchments under natural conditions would further document this aspect.

PESTICIDE AND NUTRIENT MODELING

Researchers who develop various approaches to turfgrass management, regulators and the regulated community concerned about off-site transport of pesticides and nutrients, and various scientists and engineers who designed



Aquatic plants are being established in this small lake to filter nutrients and provide habitat for aquatic species.

the best management practices (BMPs) for managed turfgrass rely on mathematical models to predict the fate of turfgrass chemicals. Most of these models have not been designed for turfgrass, and the unique aspects of turfgrass relative to row crops should be incorporated into model algorithms and input guides. In addition, there can be fundamental questions about the overall model application scenarios regarding their ability to offer reliable predictions. Although models are useful tools, their content and application must be continually scrutinized and improved.

Cohen et al. summarize the key practices and research regarding techniques and applications of mathematical models that predict the offsite transport of turfgrass chemicals to water resources.⁵ These models are important tools for risk assessment and risk management

of turfgrass chemicals, but they have potential to produce results that deviate significantly from reality. There are fundamental conceptual model and algorithm issues when evaluating chemical fate in turfgrass compared with row crop agricultural systems.

PLANT SELECTION

Water use declines as the leaf area/leaf elongation rate decreases and the turf-grass density increases. Also, turfgrasses with deep, extensive root systems, coupled with decreased water use, are more drought resistant and have greater water conservation potential. Water usage rates vary with species and cultivars, as documented by extensive research, and are affected by external factors, especially environmental conditions. Selecting low-water-use and/or drought-resistant turfgrass species and cultivars is a primary means of

decreasing water needs. Also, selection of turfgrass species and cultivars that are adapted to local climatic conditions can result in significant water savings. For example, in arid and semiarid climatic conditions, warm-season turfgrasses use less water than cool-season turfgrasses. Devitt and Morris address these plant selection factors as they relate to water conservation.⁶

Currently, there is a lack of scientific data on the water use of trees, shrubs, and ground covers, as well as on how this water use is influenced by growing conditions and irrigation. Note that grassland-dominant plant communities occur in drier climates compared with forest lands. Emphasis should be placed on choosing functional landscapes and avoiding banning entire plant categories without justification. Turfgrasses that have lower water requirements should be used when possible.

TURFGRASS WATER USE

As water availability becomes increasingly limited and more costly, water conservation in turfgrass culture becomes extremely important. Without adequate water, turfgrass becomes brown and desiccated, and it may die in severe instances. Turfgrass growth characteristics that affect water use include differences in canopy configuration or leaf orientation, tiller or shoot density, growth habit, rooting depth, and root density. Water usage rates vary with species and cultivar and are affected by many external factors, especially environmental conditions. Huang discusses the water use characteristics of different turfgrasses and how environmental factors affect turfgrass water use.11

Water use of turfgrasses is evaluated based on the total amount of water required for growth and transpiration (water lost from leaves), plus the amount of water lost from the soil surface (evaporation). Transpiration water consumption accounts for more than 90% of the total amount of water transported into the plants, with 1% to 3% actually used for metabolic processes.

Dormant turfgrass plants have limited or no transpiration water loss, and thus have low water usage. The leaves of dormant turfgrass turn brown in response to a water deficit, but the growing points in the stem are not dead. In general, turfgrasses, especially those with rhizomes (underground stems), can survive without water for several weeks or months with limited damage, depending on the air temperature. Allowing certain turfgrasses to go dormant in low-maintenance areas can result in significant water savings without loss of turfgrass.

Water use of turfgrasses is influenced by environmental factors such as temperature, wind, solar radiation, relative humidity, soil texture, and soil moisture. These factors affect both plant transpiration and soil evaporation. Understanding the environmental factors influencing water use is important for



developing efficient cultural strategies for turfgrass, especially in areas with limited water supply. Knowledge of critical plant physiological status and soil moisture content of different soil types is important for scheduling when to irrigate, how much water to apply by irrigation to replenish water loss through evapotranspiration, and how deep to irrigate the soil.

CULTURAL PRACTICES

There is adequate research to substantiate specific cultural practices, or systems approaches, to decrease turfgrass water use, conserve water, and enhance drought resistance. Mowing height and frequency, nutrition, and irrigation are primary cultural practices that directly impact vertical elongation rate, leaf surface area, canopy resistance,

rooting characteristics, and resultant water use. These practices, as explained by Shearman, can be used immediately to conserve water and maintain turfgrass quality and functional benefits.¹⁷ Secondary cultural practices, such as turfgrass cultivation, topdressing, wetting agents, plant growth regulators, and pest management, also influence turfgrass top and root growth and subsequently influence potential water conservation.

ACHIEVING EFFICIENT IRRIGATION

Huck and Zoldoske discuss many elements of high water use efficiency in irrigation, beginning with proper system design and including installation, management, and maintenance of the irrigation system.¹² One critical element



funded several research projects to understand the hydrology, surface flow, runoff, and leaching of water from golf course turf. This project at Oklahoma State University is designed to understand how to minimize runoff by the use of vegetative filter strips along the edges of fairways.

The USGA has

is to apply the proper amount of water when the landscape needs the water to avoid both deep percolation and runoff. This practice may include cycling of control valves to minimize the surface movement of applied water.

A second important element to high water use efficiency is to apply water as uniformly as possible. Innovative sprinkler designs for turfgrass and drip/micro irrigation for landscape plants have improved irrigation uniformity significantly in recent years, when properly designed and installed. Tools now exist for designers to model sprinkler application uniformity before the system is purchased and installed. Thus, it is reasonable to specify the irrigation application uniformity in a contract before purchasing an irrigation system.

Auditing can be used to verify system performance after installation. Improved controllers for residential irrigation systems, combined with highly uniform sprinkler and/or drip irrigation systems, will produce high water use efficiency, leading to significant water savings over conventional practices. This approach has been validated on extensive turfgrass areas and needs to be emphasized for home landscapes.

RECYCLED WATER

In dry regions of the country, and in highly populated metropolitan areas where water is a limited natural resource, irrigation of landscapes with municipal recycled water, untreated household gray water, or other lowquality (saline) water is a viable means of coping with potable water shortages. Harivandi et al. explain these methods and the associated benefits and concerns of their use. 10 Many years of practice and field observation on extensive turfgrass areas confirm that recycled or brackish water can be used successfully to irrigate turfgrasses. Water conservation resulting from this practice far outweighs the potential negative impacts. Nonetheless, recycled or brackish water quality must be evaluated thoroughly before developing appropriate plant cultural strategies for its use.

Irrigation water quality, which is a function of the volume and type of dissolved salts present in the water, affects the chemical and physical properties of soil, and therefore plant-soilwater relations. The interrelationships can be monitored by regular chemical analysis, and in many situations can be managed. Currently, the use of household gray water for irrigating home landscapes is not widely practiced. More research is needed to determine the most effective, least expensive, and safest (vis-à-vis human health) methods for using such water.

PUBLIC POLICY APPROACH

A water conservation program can be very effective. It can be based on

science, and it can be embraced by the citizens of a community. The water conservation program in San Antonio, Texas, fits that description. San Antonio is a community in a semiarid climate that has decreased per-capita water use by more than 40% since the early 1980s and has avoided conflict over landscape watering. Success has been achieved because the San Antonio Water System recognized the value of lawns to its citizens and worked with them to develop a comprehensive water conservation program that addressed infrastructure improvements, inefficient plumbing, industrial technology, and other water-saving opportunities, along with savings in landscape watering. The landscape watering savings were based on opportunities identified in outside research and local studies, resulting in changes in turfgrass management, variety or cultivar selection, and irrigation technology, without attempting to eliminate lawns.

Every community's situation is different, and the formulas for decreasing water use may be different. The example provided by San Antonio shows that water use can be decreased in a manner that takes advantage of turfgrass benefits and is consistent with local positive attitudes toward turfgrass use.⁸

COMPREHENSIVE ASSESSMENT

Carrow and Duncan review various approaches for comprehensive water quality and environmental management.4 The BMP approach developed over the past 35 years by the EPA for protection of surface and subsurface waters from sediment, nutrients, and pesticides has a long track record for being successfully implemented because of certain critical characteristics. It is science-based; incorporates all strategies in the ecosystem (holistic); embodies all stakeholders and their social, economic, and environmental concerns; values education and communication outreach; allows integration of new



Providing great playing conditions while conserving water is a top priority of all superintendents. This requires careful hand-watering of putting greens so that firm, but fair conditions are maintained and the stress on the putting green turf is minimized.

technologies; has been applied at the regulatory, watershed, community, and site-specific levels, as well as in educational realms; and maintains flexibility to adjust to new situations. Thus, this BMP model is the template for dealing with other complex environmental issues, such as water conservation.

An Environmental Management System (EMS) approach brings under one umbrella all environmental issues and consequences at a site. When a single issue (e.g., water conservation) is targeted by a group toward the turfgrass industry or a single facility, it is not uncommon for the only determination of success to be the decrease in water use, without any consideration for economic/job or unintended environmental consequences. Within an EMS, all environmental issues are addressed, including potential adverse effects.

SUMMARY

There is a pending water crisis due to population growth in areas with inadequate water supplies. Even in areas where water supplies are ample, an economic or investment concern exists whenever peak demand becomes a driving force in decisions about providing water to the public. There is a tendency to use a simplistic approach

for eliminating certain water uses by enacting public laws. A single-issue approach of not permitting irrigation on all or a portion of the land area, such as grassed lawns, can lead to other potentially serious problems. Officials need to take these consequences into consideration when proposing legislation to exclude irrigation from all or part of the urban landscape.

In the United States, there is currently no national water policy, partly because of the history of the country and partly because most water issues have been treated as local issues, resulting in an extremely decentralized water delivery system. The nation's water issues need to be addressed in an integrated manner, focusing on programs at the watershed and basin levels. There is a need to reconcile the myriad laws, executive orders, and congressional guidance that have created a disjointed, ad hoc national water policy. The fiscal realities facing the nation need to be recognized to effectively coordinate the actions of federal, state, tribal, and local governments dealing with water.

For grassed landscapes, the first step toward water conservation is selecting the correct turfgrass for the climate in which it will be grown. There is adequate research to substantiate the use of specific cultural practices, or systems approaches, to decrease turfgrass water use, conserve water, and enhance drought resistance. These practices could be used immediately to conserve water and maintain turfgrass quality and functional benefits.

Recycled or brackish water can be used successfully to irrigate turfgrasses. Water conservation resulting from this practice far outweighs the potential negative impacts. Nonetheless, recycled or brackish water quality must be evaluated thoroughly before developing appropriate plant cultural strategies for its use. If irrigation systems are employed, proper design, installation, management, and maintenance are very important. One critical element is to apply the proper amount of water when the landscape needs the water to avoid both deep percolation and runoff.

Other concerns include potential pesticide and nutrient leaching and runoff from turfgrass areas. The legislative history and context of the Safe Drinking Water Act and the Clean Water Act demonstrate that federal, state, and local governments provide a clean and safe drinking water supply. It is important to understand that healthy turfgrass has a great capacity to use applied nutrients, break down pesticides, help recharge groundwater, and reduce surface runoff. The critical aspect is management, which includes irrigation, drainage, fertilizer and pesticide application, and cultural practices. Based on turfgrass landscape research, runoff volume generally is small and losses of pesticides and nutrients are less than those from agriculture. This information is being used to develop models for risk assessment and risk management of turfgrass chemicals.

The BMP approach developed by the EPA has a long track record of being implemented successfully. A water conservation program using a similar approach could be very effective. It can be based on science, and it can be embraced by the citizens of a community. The ultimate goal is to provide quality urban areas for daily

activities and recreation while conserving and protecting the water supply.

ACKNOWLEDGEMENTS

The authors wish to thank USGA's Turfgrass and Environmental Research Program, USDA-ARS, International Turf Producers Foundation, Responsible Industry for a Sound Environment (RISE), and the Irrigation Association for providing funding for a three-day workshop held January 23–25, 2006, in Las Vegas, Nevada.

The workshop, hosted by the Council for Agricultural Science and Technology (CAST), provided an opportunity for researchers, scientists, environmentalists, and water specialists to join together to discuss the issues facing the turfgrass and water industries. This resulted in CAST Special Publication 27 entitled Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes, which is available from the Council for Agricultural Science and Technology (CAST), Ames, Iowa. Access http://www.cast-science.org/ for information on ordering this important publication.

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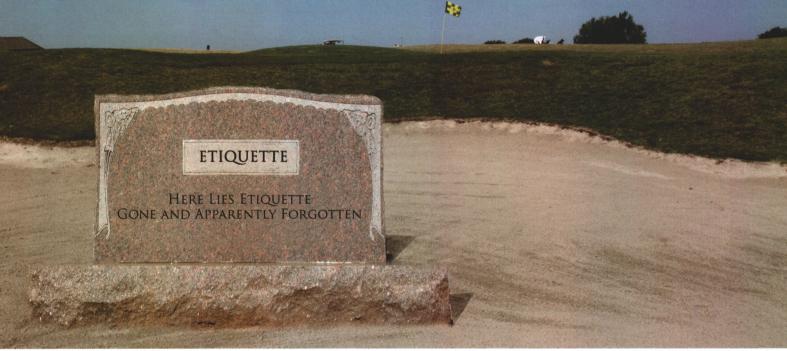
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An Appeal for the Return of Golf Course Etiquette

Being a good player does not make you a good golfer.

BY JAMES FRANCIS MOORE



Too many players have become poor golfers as a result of forgetting the basic courtesies of the game.

or the purpose of this article, consider the following definitions of good players and good golfers. Good players have low handicaps, usually hit the ball a mile, and occasionally post very low scores. Good golfers fill divots, repair ball marks, and practice good etiquette each and every time they are on the course. Anyone who has ever worked in golf course maintenance will verify that, unfortunately, the two terms are not mutually inclusive. In fact, good players often are the least likely to be considerate of the games of lesser mortals.

This is not to say that all good players are bad golfers. In fact, practicing good etiquette on the course seems to be slipping across the board, regardless of handicap. And the timing could not be worse. All but the wealthiest courses are finding it harder to make a profit these days, with large cost increases in fuel, fertilizer, and labor. Since labor almost always represents the largest budget item, it typically is the first to be targeted when budget reductions are necessary.

When forced to choose, most courses with reduced available labor place a higher priority on agronomic necessities than the niceties of completing tasks that good golfers normally do for themselves. Unless we can somehow encourage players to become better golfers, the overall quality of many courses will decline rapidly during tough economic times.

For those who wish to become better golfers, here are the ways you can help your course the most.

FILLING DIVOTS

Golfers often ask if they should replace their divots, fill them with whatever has been provided in the divot buckets, or just leave them for the crew. The best option is to fill the divot with the material provided by the maintenance staff. Typically, this is straight sand, although occasionally a sand/seed mixture is used by courses using cool-season turfgrasses. Replacing a divot is the second-best option, assuming the divot is

deep enough to include a significant amount of soil. Without the soil, the divot quickly dries out and is pulled back out of the ground during the next mowing.

Do — Fill divot holes with the material provided by the maintenance staff.

Don't — Overfill the hole, which results in a sand mound that can dull or damage the mowing units.

BALL MARKS

Few aspects of etiquette generate more discussion than the fixing of ball marks (at least now that most courses no longer allow spiked shoes), and even superintendents disagree on the best method of ball mark repair. The inability to agree on a single best method stems from the fact that ball marks are not all the same. On soft greens, a shot that descends from a very steep angle produces a deep, almost circular ball mark. On the same green, a shot that comes in low and hard will produce an elongated tearing of the green, and it often removes a plug of grass and soil. Ball marks on soft greens take time to repair properly. Compacted soil needs to be lifted gently, and the raised sides of the ball mark need to be gently pushed back toward the center. The elongated mark needs to be kneaded back together by pushing in from the sides, stretching the turf rather than tearing it. Replacing removed turf seldom accomplishes much, so it is best to leave it out.

In contrast, very firm greens can resist ball marks so well that they can be hard to find at all. On such greens the marks will be slight indentations that require a minimum of effort to repair. These marks can be repaired with a very slight lifting to restore smoothness.

Do — Restore surface smoothness by gently pushing from the sides and, in some cases, gently lifting the compressed area.

Don't — Aggressively twist (as is so often done by pros on national television), which does more harm than good.

BUNKERS

Among the first rules of etiquette taught to young players are to rake the bunker smooth of footprints and repair divots after a shot. Unfortunately, either through laziness or disdain, many players refuse to extend this courtesy to their fellow golfers. Shoving sand around with your foot or a clubhead is no substitute for raking.

However, for those who are willing to rake, it is important to do the job correctly. Avoid pulling sand down the bunker face when raking. Doing so results in very shallow sand on the face, leading to exposed soil, which is easily eroded. Also, many bunkers are constructed with liners or lining material installed on the slopes to reduce the problems of sand erosion. These liners should always be covered with at least 2 to 3 inches of sand.

It is equally important to avoid pulling sand out of the bunker and onto the adjacent turf. Piles of sand around the bunker edges can cause serious damage to mowing equipment. Sand raked out of the bunker will also result in a poorly defined bunker edge, making it difficult to determine whether the ball is in or out of the hazard.

Although most players are concerned only with how the ball got into the bunker and how they are going to get it out, good golfers know that it is important to consider how to get themselves in and out of the bunker as well. Climbing in and out of the steep side of a bunker can cause significant damage to liners and the sod on the bunker face. Entry and exit should always be from the low side.

Do — Push sand up the bunker face and enter and exit from the low side of the bunker.

Don't — Climb out of the high side of the bunker, which causes damage to liners and grass faces.



Your mother probably taught you to clean up after yourself. The same lessons apply to the golf course.

CARTS

Nothing causes more damage to golf courses than the improper use of golf carts. Superintendents expend many labor hours repairing this damage and trying to prevent it in the first place. The problems are many, and most could easily be prevented with common sense. One of the most common is players driving their carts on the banks of tees and the banks and approaches of greens. Driving too close to the greens is particularly troublesome, since the wear and tear on the turf in this area directly affects playing quality. These areas are frequently irrigated and therefore more susceptible to damage. Ropes, signs, and painted lines are all too frequently ignored by players who are too lazy to walk from the path to the green.



Overfilling a divot can cause damage to mowing equipment. Be sure to smooth the divot mix with your foot.



Standing in the exact same spot for extended putting practice can cause real damage to a putting green on a hot day.



Climbing into a bunker from the high side can cause severe damage to bunker liners and the grass face.

Unthinking cart drivers frequently pull two wheels off the path, presumably to make room for other carts to pass. Since they invariably do this next to greens and tees, it is no coincidence that ruts are commonplace in these areas immediately adjacent to the path. Although this is a great practice if you have a flat on the highway, it is unnecessary on the golf course. Seldom will someone need to pass a parked cart. Should a marshal, drink cart, or maintenance vehicle need to get by, they can easily pull off the path and around the parked cart.

Do — Avoid wet areas, stay off green and tee banks, and follow all directional signs, ropes, and lines.

Don't — Pull half off the path, as it is unnecessary and causes damage to high-visibility areas.

ROPES

Ropes are a necessary evil on every course that receives heavy play. No superintendent enjoys putting ropes up. They are constant maintenance headaches. Unfortunately, they are the most effective means of directing cart traffic and protecting areas of the course that are prone to damage.

Many golfers step on the ropes rather than over them presumably in an effort not to trip. Unfortunately, this practice pulls out the stakes that the ropes are attached to, leaving the rope lying on the ground. Someone on the maintenance staff then needs to fix the stakes and retighten the rope. Superintendents can help avoid this problem by installing ropes closer to the ground, making them easier for golfers to step over. Installing rope approximately 6 inches high deters most carts and reduces the

likelihood of tripping. Ropes also should be installed with gaps for walkers pulling carts.

Do — Pay attention to ropes and the areas they are intended to protect.

Don't — Step on a rope — step over it.

SMALL THINGS MAKE A BIG DIFFERENCE

There are many other small things golfers can do to help their course play and look better, and in the process free up the maintenance staff for more essential work.

- Picking up broken tees helps prevent damage to costly mower reels.
- Not overfilling trash containers prevents trash from blowing across the course.
- Replacing a sign or rope stake that has been knocked down keeps the course looking neat and helps prevent damage.
- If an irrigation system leak is spotted, let a maintenance staff worker know about it so it can be fixed before turf damage occurs from traffic through the area.
- Lose the herd mentality when driving your cart avoid following the same path of the carts before you.
- Avoid taking divots on your practice swings.
- Chip to the chipping green not the practice putting green.
- When practicing putting, avoid standing in one place for extended periods doing so can cause damage to the green.
- Put bunker rakes where the superintendent has directed them to be placed.

CONCLUSION

Part of the inspiration for this article stems from a group of men with whom I am fortunate enough to play golf regularly. Not only are these men good players, they are outstanding golfers. It is a real pleasure to watch them work their way around the course during a round. They don't just avoid damaging the course; they improve it in the process of enjoying their round! They leave the course better than they found it. And contrary to what you might think, none of this results in slow play. Imagine your course receiving 30,000 rounds per year from golfers like these fellows.

JIM MOORE is director of the USGA Green Section's Construction Education Program.

Research You Can Use

Heat and Drought Performance of Texas Bluegrass Hybrid Turf

Does this new turfgrass live up to the hype?

BY STEVE KEELEY, DALE BREMER, AND KEMIN SU



Figure I The visual appearance of Kentucky bluegrass (KBG, Apollo), Thermal Blue (TB, a hybrid bluegrass), and tall fescue (TF, Dynasty) varies after 36 days of temperature and irrigation deficit treatments. Front row is high temperature and back row is optimal temperature treatment. From left to right in both front and back rows: KBG (60% evapotranspiration [ET]), KBG (100% ET), TB (60% ET), TB (100% ET), TF (60% ET), and TF (100% ET).

exas bluegrass hybrid turf, or "hybrid bluegrass" for short, is the latest turfgrass to enter the scene in the ongoing quest for more heat-tolerant, drought-resistant coolseason turfgrass. Hybrid bluegrass is a genetic cross between native Texas bluegrass (Poa arachnifera Torr.) and Kentucky bluegrass (Poa pratensis L.). It looks a lot like Kentucky bluegrass and could potentially be used for golf course tees, fairways, and roughs in areas where cool-season grasses are grown. Early reports claimed that hybrid bluegrass had greater heat tolerance and drought resistance than other cool-season grasses (Read et al., 1999), but because it is a relatively new turfgrass, research has been limited. Our research, consisting of both growth chamber and field studies,

investigated the heat and drought performance of hybrid bluegrass in comparison to turf-type tall fescue and Kentucky bluegrass.

GROWTH CHAMBER STUDY

In the growth chamber study, which included Thermal Blue hybrid bluegrass, Dynasty tall fescue (*Festuca arundinacea* Schreb.), and Apollo Kentucky bluegrass, we established the grasses in lysimeters (Figure 1), split them into four groups, and subjected them to 48 days of one of the following treatments:

1) high temperature (95°F day/77°F night) and well watered (100% evapotranspiration [ET] replacement; 2) optimal temperature (72°F day/60°F night) and well watered; 3) high temperature and drought (60% ET replacement); 4) optimal temperature and

drought. Irrigation treatments were applied every 3 days. The turfgrasses were mowed every 3 days at 2.5 in., and a nutrient solution was applied weekly in concert with the irrigation to prevent nutrient deficiencies.

We collected data on visual quality, photosynthesis rate, leaf electrolyte leakage (an indication of membrane integrity, which was of interest because heat/drought can cause membranes to rupture, possibly killing the plant), shoot growth, canopy temperature, and soil-surface temperature.

The hybrid bluegrass did indeed prove to be more heat tolerant than the tall fescue and Kentucky bluegrass (Figure 1). Under the high-temperature, well-watered treatment, hybrid bluegrass had higher visual quality, photosynthesis, and shoot growth, and

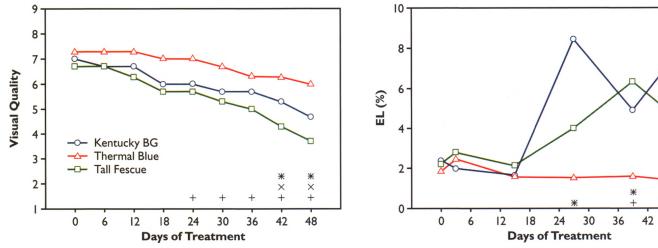


Figure 2. Effects of high temperature on: 1) visual quality, rated on a scale of 1 to 9 (1 = poorest and 9 = highest) (left), and 2) electrolyte leakage (right), in Kentucky bluegrass (Kentucky BG, Apollo), Thermal Blue (a hybrid bluegrass), and tall fescue (Dynasty). Symbols along the abscissa of each graph indicate significant differences (P = 0.05) between: Thermal Blue and Kentucky BG (*), Thermal Blue and tall fescue (+), and Kentucky BG and tall fescue (×), on a given day after initiation of the heat treatment (Days of Treatment).

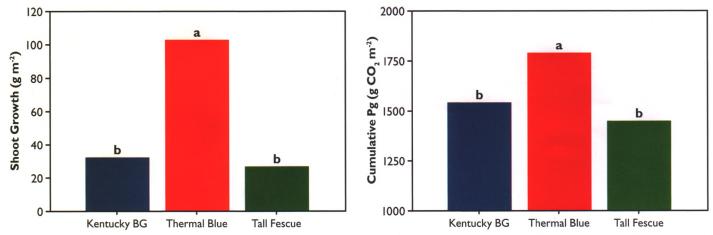


Figure 3. Effects of high temperature on: shoot growth (left) and cumulative photosynthesis (Pg) (right) in Kentucky bluegrass (Kentucky BG), Thermal Blue (a hybrid bluegrass), and tall fescue (Dynasty). Means with the same letters were not significantly different (P = 0.05).

lower electrolyte leakage (Figures 2 and 3) and soil surface temperatures. The superior heat tolerance of the hybrid bluegrass was probably due to more stable membranes and photosynthetic "machinery," which allowed it to continue growth under the high temperatures.

Under the high-temperature/ drought combination treatment, the differences among grasses were not as great, but hybrid bluegrass did have higher visual quality and photosynthesis than tall fescue (Figure 4). Tall fescue's performance was poorer than we expected based on previous field observations. Undoubtedly, the restricted rooting volume in the lysimeters prevented it from taking advantage of its genetic capacity to form deeper roots than other cool-season grasses.

FIELD STUDY

Based on our growth chamber results, we were cautiously optimistic about how hybrid bluegrass would perform under the combined effects of heat and drought in the field. We designed a field study to evaluate the drought performance of the same grasses we used in the growth chamber study, plus Reveille hybrid bluegrass. The plots were established under a large rain-out shelter (40 ft. \times 40 ft.), which allowed us to control the amount of water the plots received. Mounted on steel tracks, the rain-out shelter automatically covered the plots whenever it rained.

All grasses were mowed at 3 in. and fertilized with 3 lb. N per 1,000 sq. ft. per year. Other nutrients, such as P and K, were supplied according to soil test results.

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Irrigation level was the main treatment and consisted of either 60% (drought) or 100% (well watered) ET replacement. The treatments were applied to individual plots (4.5 ft. × 6 ft.) by hand twice weekly using a metered hose-end nozzle. Plots were bordered by metal edging to prevent lateral water flow. Performance of the grasses was evaluated by taking visual quality ratings and measuring canopy photosynthesis. In addition, soil moisture in the 0 in. to 20 in. profile was measured weekly using time-domain

reflectometry, and root samples were collected to a depth of 32 inches in order to investigate rooting characteristics of the grasses.

Our field results diverged from the growth chamber results, to say the least. In the field, the turf-type tall fescue dramatically outperformed the hybrid and Kentucky bluegrasses. The tall fescue had higher visual quality and photosynthesis rates than all other grasses under both drought and wellwatered conditions (Figures 5 and 6). Furthermore, root samples revealed that the hybrid bluegrasses were similar to the Kentucky bluegrass in their rooting patterns, with greater than 90% of their root mass in the top 12 in. of soil. Tall fescue, by contrast, had 3 to 12 times greater root length in the lower profile (24 to 32 in.) than the other grasses.

It should be noted that high performance in this study was defined as grass that stayed green and turgid longer when water was limiting. Clearly, when that kind of performance is the goal, tall fescue is still the cool-season turfgrass of choice for golf course roughs in areas where summers are hot, such as the mid-continental U.S. The caveat is that soils must be conducive to deep root growth. In shallow



To control water inputs and ensure drought-like conditions, an automated rainout shelter mounted on steel tracks (background) moves to cover plots (foreground) when it rains.

or compacted soils, hybrid or Kentucky bluegrass may outperform the tall fescue, based on our growth chamber research. Another option for rough areas during summer would be to allow the turfgrass to go dormant. In that scenario, hybrid or Kentucky bluegrass may be the better choice, but

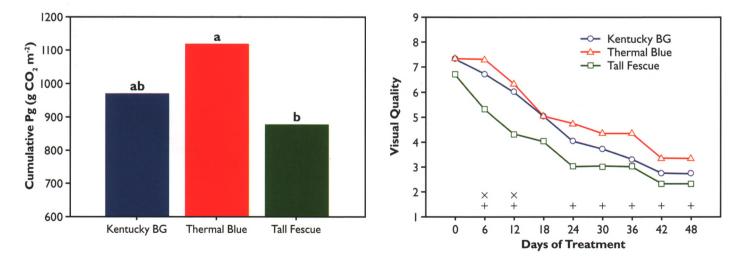


Figure 4. Effects of high temperature and drought combination on: I) cumulative photosynthesis (Pg) (left), and 2) visual quality (right), in Kentucky bluegrass (Kentucky BG), Thermal Blue (a hybrid bluegrass), and tall fescue (Dynasty). Means with the same letters in the left graph were not significantly different (P = 0.05). Symbols along the abscissa of the right graph indicate significant differences (P = 0.05) between: Thermal Blue and tall fescue (+), and Kentucky BG and tall fescue (×), on a given day after initiation of high-temperature/drought combination treatment (Days of Treatment).

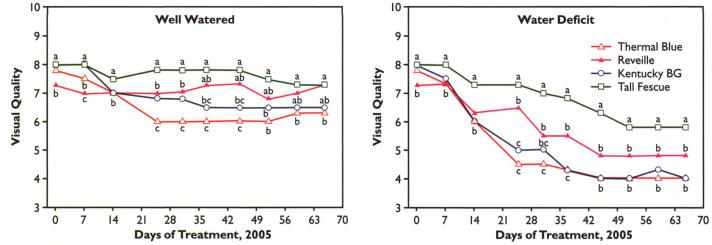


Figure 5. Visual quality (scale of 1 to 9, 9 = best) among turfgrasses under well-watered (left) and water-deficit (right) field conditions. Thermal Blue and Reveille are hybrid bluegrasses; Kentucky BG is Apollo, a Kentucky bluegrass cultivar; and Tall Fescue is the cultivar Dynasty. Means followed with the same letter on a given day after initiation of the water-deficit treatment (Days of Treatment) are not significantly different (P = 0.05).

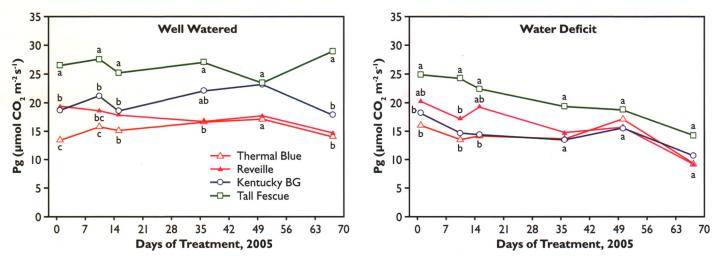


Figure 6. Gross photosynthesis (Pg) among turfgrasses under well-watered (left) and water-deficit (right) field conditions. Thermal Blue and Reveille are hybrid bluegrasses; Kentucky BG is Apollo, a Kentucky bluegrass cultivar; and Tall Fescue is the cultivar Dynasty. Means followed with the same letter on a given day after initiation of the water-deficit treatment (Days of Treatment) are not significantly different (P = 0.05).

that was not a subject of investigation in this study.

Between the hybrid bluegrasses, Reveille performed slightly better than Thermal Blue under the drought treatment, although the difference was usually not significant. Reveille's roots appeared to be more active, as it extracted more water from the 0–50 cm profile (data not shown). We also noticed that both hybrid bluegrasses recovered from the drought treatment slightly faster than the Kentucky bluegrass.

If you are interested in more detail on the research described herein, see Su et al., 2007 and 2008.

CONCLUSIONS

In summary, the performance of hybrid bluegrass was impressive under 95°F temperatures and 100% ET replacement in the growth chamber, but not so impressive under field conditions. In the field, the turf-type tall fescue provided the best drought resistance and overall performance. In the mid-continental U.S. and locations with a similar climate, where soils are reasonably deep, turf-type tall fescue will deliver green grass longer during a drought than the new hybrid bluegrasses we tested. Breeders have more hybrid bluegrasses on the way. Will they live up to the hype? Stay tuned.

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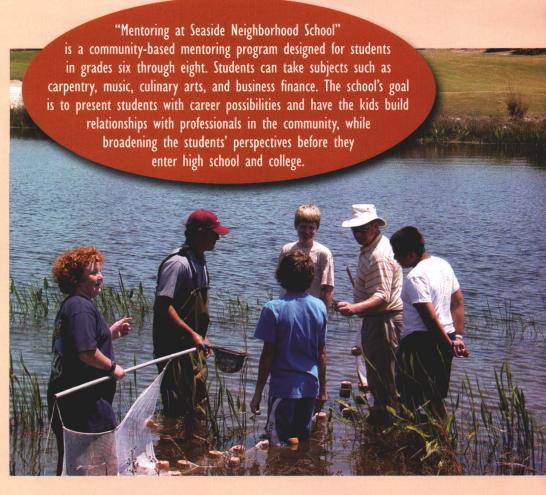
Inspiring Stewardship Throughout a Community

Extending environmental stewardship beyond the golf course and into the schools.

BY JULIE RIGG

ocated just off northwest Florida's scenic highway 30A in WaterSound, Florida, Camp Creek Golf Course is a 36-hole facility featuring a dunescape appearance, accentuated by magnificent wetlands, woodlands, lakes, sand dunes, and rolling contours. Under the leadership of Larry Livingston, golf course superintendent at Camp Creek, the course has been designated as a Certified Audubon Cooperative Sanctuary. That in itself is an outstanding accomplishment, but Larry's dedication to environmental stewardship extends beyond the golf course. Larry is recognized by his peers as a leader in the industry because he uses his knowledge and experience to assist others in becoming better environmental stewards, including the youth of his community. For the last several years he has participated in a mentoring program with Seaside Neighborhood School in nearby Santa Rosa Beach.

It's not surprising that Larry takes this kind of initiative. He is one of the



few Audubon International Stewards in northwest Florida, which puts him in the unique position of generating environmental awareness across multiple generations within his community. Although Larry's focus for the program is golf course maintenance, he admits, "I wanted to do more, and I think it's a good opportunity to show post-development impact on the environment. The students bring home handouts about the natural environment and share their experiences with their parents." Larry hopes that students will then start conversations with their families about what they learn, and thus expand the reach of his efforts.

"I enjoy promoting environmental stewardship. The mentoring program is a great way to do this. I think it's easier for the kids to develop good environmental habits because of their age," says Larry. The mentorship has allowed him to "understand the environmental mindset of the students," which helps him to tailor the programs

to address areas of misconception or lack of understanding.

Cathy Brubaker, principal at Seaside Neighborhood School, is proud to say that there have been up to 14 different categories in the program, and a mentorship at Camp Creek is "one of the favorites." She also says, "We give eighth graders first choice, but usually we have to bump a few students from the Camp Creek list because we have so many students who sign up for it." Larry is pleased with so much interest in the program, but he says, "We limit the program to six students for safety reasons. With that number we can safely get the students around the course in golf carts to the areas that we'll be studying."

Larry's spirited lessons provide basic information as well as hands-on experiences. One week it's "soaping for worms," another it's tying bricks to former Christmas trees and sinking them in a pond to create fish habitat. Other lesson topics include wetland study, effluent water management, and composting. One of the most exciting activities at Camp Creek allows the students to help by releasing carp into some of the lakes on the course. Larry explains, "Because the carp eat undesirable aquatic vegetation, we have not used any aquatic herbicides in the water for weed control except for emergent weeds like cattails."

Larry also offers a "mini-course" in fertilizer application and instructs students about how to take soil samples and send them to a lab for analysis. "From there, we take the soil sample results to the fertilizer room and look at the different numbers on the bags and talk about what the blends and

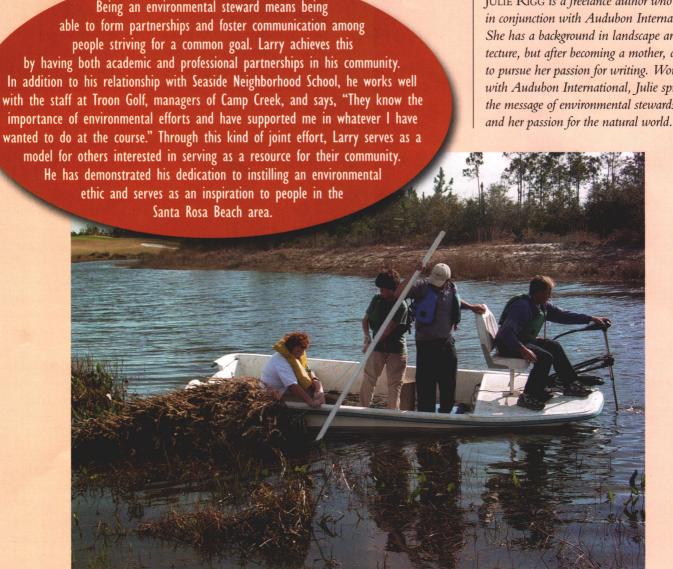
numbers on the bags mean and make a final determination as to what fertilizers need to be ordered." Larry underscores the importance of proper handling, label instructions, and how to measure and apply fertilizers. He says that "when fertilizers are applied properly, there is no harm to others. It's a simple but good point to follow."

In addition to his roles as a golf course superintendent, environmental steward, and mentor to young people, Larry has taken two of the three modules of the Florida Master Naturalist Program (Freshwater Wetlands and Coastal Systems) and is scheduled to take the Upland Habitats module this

fall. He also gives a short presentation each year at the Walton County Environmental Forum about Camp Creek's environmental efforts. This past May, he gave a presentation about participation in the Audubon Cooperative Sanctuary Program for Golf Courses to the Choctawhatchee Audubon Society. With the mentoring program and his own continued environmental education, Larry has found ways to both practice his stewardship and inspire a community.

For more information on the Audubon Cooperative Sanctuary Program for Golf Courses or about Audubon International, please visit: AudubonInternational.org.

JULIE RIGG is a freelance author who works in conjunction with Audubon International. She has a background in landscape architecture, but after becoming a mother, decided to pursue her passion for writing. Working with Audubon International, Julie spreads the message of environmental stewardship



News Notes



IIM LATHAM

Latham passed away in Deltona, Florida, on July 16, 2008. Jim worked for the United States Golf Association on two different occasions, from 1956 to 1960 as an agronomist in the Northeast and Southeast Regions, and then again from 1984 to 1994 as director of the Great Lakes Region. The intervening 25 years were spent with the Milwaukee Metropolitan Sewerage District, promoting one of the nation's first businesses designed to recycle waste products into landscape fertilizers.

Following his retirement from the USGA, he actively volunteered as a member of the USGA Turfgrass and Environmental Research Committee for eight years. In 2003, Jim was named a recipient of the USGA Piper & Oakley Award, which recognizes meritorious service to the USGA Green Section and the game of golf by a volunteer.

Jim Latham was admired for his practical insight and straight-shooting assessments of turfgrass management problems and solutions that resulted from his long involvement in the turfgrass industry.

WHEN THE FROST IS ON THE PENNCROSS

hen the frost is on the Penncross and the water line is drained, And ever southward go the golfers, Cads and Jags so aimed; Hear the rustle of the leaves as they cover rough and green . . . And traps and tees and fairways . . . and most everywhere between; Oh, it's then the time a feller is a-feelin' at his best With the risin' sun to greet him from a night of peaceful rest, As he wears a sweater mornin's and the clocks have all been changed, When the frost is on the Penncross and the water line is drained.

When the heat of summer's over and the coolin' fall is here . . . Of course we miss the foursomes and the markers on the tees And the rumble of the mowers and the buzzin' of the bees; But the air's so appetizin' and the landscape through the haze Is the crisp and sunny wonderland of early autumn days And you can count up on your fingers all the times it's rained When the frost is on the Penncross and the water line is drained.

The husky, rusty rustle of seed heads on the *Poa*,
The clank and bang of units as in the shed they go,
The flags in greens . . . kinda lonesome like, but still
There's a few diehard golfers whose needs we have to fill;
The ball washers are in the workshop, the sprayers in the shed,
The hose is coiled up neatly on the rafters overhead!
Oh, it sets my heart a-beating . . . with a fury never tamed
When the frost is on the Penncross and the water line is drained.

— William "Bill" Smart, Head Greenkeeper, 1970s The Powelton Club, Newburgh, N.Y.

STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION

1. Title of Publication — USGA GREEN SECTION RECORD. 3. Date of Filing — September 1, 2008. 4. Frequency of issue — Bimonthly: January/February, March/April, May/June, July/August, September/ October, and November/December. 5. Number of issues published annually - 6. 6. Annual Subscription Price - \$18.00. 7. Complete mailing address of known office of publication — United States Golf Association (USGA), Golf House, 77 Liberty Corner Road, P.O. Box 708, Far Hills, NJ 07931-0708, Contact Person: James T. Snow, Telephone: 908-234-2300. 8. Complete mailing address of the headquarters or general business office of the publisher — USGA, Golf House, 77 Liberty Corner Road, P.O. Box 708, Far Hills, NJ 07931-0708. 9. Names and addresses of Publisher, Editor, and Managing Editor: Publisher — USGA, Golf House, 77 Liberty Corner Road, P.O. Box 708, Far Hills, NJ Or931-0708. Editor — James T. Snow, USGA, Golf House, 77 Liberty Corner Road, P.O. Box 708, Far Hills, NJ 07931-0708. Managing Editor — James T. Snow, USGA, Golf House, 77 Liberty Corner Road, P.O. Box 708, Far Hills, NJ 07931-0708. 10. Owner (If the publication is owned by a corporation, give the name and address of the corporation immediately followed by the names and addresses of all stockholders owning or holding 1 percent or more of the total amount of stock. If not owned by a corporation, give the names and addresses of the individual owners. If owned by a partnership or other unincorporated firm, give its name and address, as well as those of each individual owner. If the publication is published by a nonprofit organization, give its name and address.) — United States Golf Association (USGA), Golf House, 77 Liberty Corner Road, P.O. Box 708, Far Hills, NJ 07931-0708. 12. For completion by nonprofit organizations authorized to mail at nonprofit rates — The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes has not changed during preceding 12 months. 13. Publication title — USGA Green Section Record. 14. Issue Date for Circulation Data Below - Sept./Oct. 2008. 15. Extent

and nature of circulation —		
ind nature of circulation —	Average No. Copies Each Issue During Preceding I2 Months	No. Copies of Single Issue Published Nearest to Filing Date
a. Total Number of Copies (Net press run)	16,761	16,500
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b.2. Mailed In-County Paid Subscriptions Stated on PS Form 3541	0	0
b.3. Sales Through Dealers a Carriers, Street Vendor Counter Sales, and Oth Paid Distribution Outsie	s, er	0
b.4. Paid Distribution by Otl Classes of Mail through		0
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f. Total Free or Nominal Rat Distribution	te 830	723
g. Total Distribution	16,576	16,408
h. Copies Not Distributed	185	92
i. Total	17,761	16,500
j. Percent Paid and/or Requested Circulation	95%	95.6%

I certify that all information furnished by me above is true and complete. — JAMES T. SNOW, Editor

All Things Considered

Nothing Comes For Free

Any maintenance practice that provides long-term improvement will require money and short-term acceptance of reduced playability, inconvenience, or both.

BY DARIN S. BEVARD

t is amazing how the rumor mill suggests that some other golf course has made some great improvement with no real cost or inconvenience to the golfers: Fairways were converted to creeping bentgrass in one season with no reduction in playability; greens were never closed during the winter and everything is still perfect; they overseeded their fairways and never had a problem with early summer transition! What do all of these claims have in common? Not unlike the legend of Big Foot or the Loch Ness monster, with a little investigation, these myths can usually be explained. In most instances, a misunderstanding of facts at the other golf course coupled with a desire for improvement at our golf course leads to a false hope of what can be accomplished for nothing.

Any time a significant change is made in a turf playing surface or additional stress is placed on the grass, there are consequences and costs. Sometimes the tradeoff is financial. There may be an increased cost in fertilizer or pesticides to overcome additional stress placed on the turf. Other times the cost is in reduced playability, inconvenience for golfers, or other intangible factors that cannot always be quantified.

Let's look at bermudagrass overseeding as an example. When bermudagrass fairways are overseeded during the early fall in the Mid-Atlantic Region, the bermudagrass is ripped to shreds and the fairways are overseeded with perennial ryegrass. For the next 2 to 3 weeks after overseeding, irrigation is applied regularly to the point of satu-

ration and carts are restricted to paths. Playability is greatly reduced and most golfers consider the cart restrictions a major inconvenience. In the early summer, the previously applied perennial ryegrass declines and the underlying bermudagrass begins to take over. Generally, there is a period of time during this transition when the fairways have thin and bare spots after ryegrass declines and bermudagrass has not completely filled in the voids, but the playability of the fairways in April and May is often superior to non-overseeded surfaces. A golfer who usually plays on non-overseeded fairways during the spring is wowed by the appearance and playability of overseeded fairways in the spring, but this person never had the chance to see the reduction in playability and inconvenience of cart restrictions during overseeding and transition. The first question: Why don't we do this at our course? The answer: Because there are costs that often remain unseen if you do not have all of the facts.

When looking to make any agronomic improvement, all costs must be considered, including the advantages provided with a given practice. Can bermudagrass overseeding increase spring rounds or outings to justify the inconvenience and cost? If the answer is yes, then the negatives associated with overseeding may be tolerable. Will long-term reliability and playability of fairways be improved through conversion to a different grass? If yes, then perhaps the cost of aggressive interseeding and the reduction in fall playability are worthwhile, but there will

be financial costs and a reduction in playability during each fall for each fall inter-seeding procedure. Nothing is free.

And the course that converted to creeping bentgrass in the fall? Their fairways had been devastated by gray leaf spot disease the previous summer, creating an excellent opportunity to establish bentgrass without competition from the ryegrass that was killed by the disease, but playability was poor for two months. The club that never restricted winter play? The superintendent made the decision of whether or not to close the course on a daily basis. The golfer simply played on a day that the course was declared suitable for play. The overseeded bermudagrass fairways with no transition problems? The golfer who raised the question played the course in early June, before transition problems were evident. Reasonable explanations accompanied each of these happenings.

Every golf course is looking for the Holy Grail: Improvement without cost. Do not get sucked in. Virtually everything involving improvement comes with some cost, financial or otherwise. Keep in mind that if controversial agronomic practices or course improvements had no cost or downside associated with them, they would not be controversial. Everyone would be happy. We know that this is not the case!

DARIN S. BEVARD is a senior agronomist in the Mid-Atlantic Region.



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

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

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

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

Printed on recycled paper

Turf Twisters

Q: What is the best way to water greens during the winter frost season? I tried to hold off as long as possible and stick to a deep and infrequent irrigation schedule, but this caused even more frost and a lengthy delay in tee times the next morning. Is light and frequent watering a better way to go in the winter? (Nevada)

A: Heavy watering at night can cause significant frost delays when freezing temperatures are expected. Since the turf tends to use less water during the cooler temperatures and shorter days of winter, hand water the greens as necessary in midafternoon when temperatures are warmer. This provides

enough time for the water to move away from the surface and penetrate into the soil so there is less residual moisture at night when temperatures drop to below freezing. You can resume the deep and infrequent watering schedule once the danger of frost is past.



Q: Our bunker sand gets very firm if it is not loosened with cultivation techniques. Is there a way we can address this condition without incurring added expense by using laborintensive preparation procedures? We cannot and do not want to spend more to



prepare our bunkers! (Virginia)

A: Some superintendents use cultivator bars on their mechanical bunker rakes. Bolts can be attached to the cultivator bar and they can be set to achieve a specific depth. One adjustment you might want to make is to turn the head of the bolt to

the sand. When the head wears off, it is time to change the bolts. The bolts can be set to a depth that loosens the sand, but does not dig too deep and come in contact with the floor of the bunker.

Q: Our golf course produces clumps of grass that become quite showy in the winter. Is this normal, and can we do anything about it? (Florida)

A: The phenomenon of "tufted" roughs is very common on Florida golf courses during the winter months. Bermudagrass produces a significant amount of above-ground stems that create a dense turf canopy when the grass is actively



growing. Bermudagrass growth decreases substantially during the winter months and some clumps of

grass stand out more as the temperature drops, especially when golf carts repeatedly run over the turf. Decreasing

cart traffic makes the clumps less conspicuous, so it is important to continually disperse cart traffic over the peak play season. Scalping roughs at 0.75" to 1" for a two- to three-week period in the summer improves overall turf density and uniformity. Although scalping is an excellent practice to perform each summer, it cannot completely reduce the phenomenon of tufted roughs during the winter play season.

