

USGA GREEN
SECTION

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FLEETING MOMENTS

A New Approach
to Managing
Maintenance
Equipment

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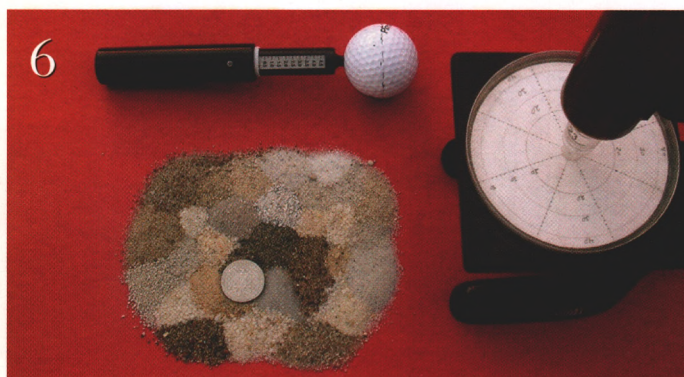
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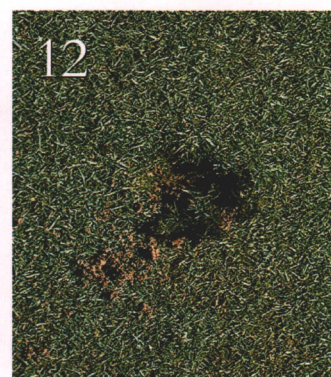
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CORRECTION:

The July/August issue the *Record* included an article entitled "The Money Pit," pertaining to the cost of building and maintaining bunkers. Unfortunately, the article contained an error regarding the amount of drainage pipe used in a typical bunker construction project of 100,000 square feet. On page 4 there is a line item for the installation of 1,000 linear feet of drainage pipe at a cost of \$5.50 per foot, for a total cost of \$5,500. Although the math is correct, a bunker project of 100,00 square feet would require approximately 10,000 linear feet of pipe rather than the 1,000 feet used in the calculation. Thus, the cost of installing the drain pipe would be \$55,000. This brings the total cost of the project to \$477,440, or about \$4.77 per square foot.



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Cover Photo

This shop filled with equipment provides an adequate sized fleet — but is it modern and efficient?



Another dog heading to the bone yard. Regular equipment replacement can prevent this type of situation.

Fleeting Moments

Managing an entire fleet of golf course maintenance equipment requires a new approach for golf courses at all levels.

BY TODD GRAY AND LARRY GILHULY

How many times have you read an article that makes you stop and think, "That is exactly what we are facing!"? If you answer the following five questions with affirmative responses, you should continue to read on, as golf courses across the United States are facing new challenges in how they manage their golf course maintenance equipment fleets.

1. Do you need more equipment than you request in your annual equipment replacement program?

2. Do you believe your golf course is falling behind in its equipment replacement program?

3. Is your maintenance and repair budget increasing?

4. Are your mechanic and/or staff displeased with the condition, reliability, and efficiency of your regularly used maintenance equipment?

5. Are you in competition with more golf courses than you were a decade ago?

The challenges faced by modern golf course superintendents have not changed significantly when compared to earlier generations in regard to growing grass and creating playing conditions for the game of golf. What *have* changed are 1) the expectation level of players on golf courses at every level, 2) ever-increasing costs to achieve these expectation levels (budget), 3) training and keeping quality labor (mechanics and operators), and 4) competition for players with other golf courses that were built during the boom times of the 1990s.

The equipment fleets on golf courses of every type have not been replaced on a regular schedule based on hours of use. The result is spiraling higher costs for maintenance and



Keeping equipment in your inventory twice its recommended normal life only leads to an increased maintenance and repair line item.

repairs, while equipment costs for new units are certainly not going down. The purpose of this article is to take a critical look at what caused the current situation at most golf courses and what can be done to help golf courses get a grip on their course equipment fleet management.

HOW DID WE GET WHERE WE ARE?

Today, more than at any time in our industry's history, more "business conditions" are affecting golf course conditions than ever before. A recently received email displays both the need for addressing this situation and some introductory comments on how to begin the process of addressing this issue:

I attended your presentation at the USGA regional conference and I must say it was the best time I have ever spent at a conference, hands down. Your presentation did not apply to anyone in that room more than myself or our

course superintendent. I operate two municipal golf courses and I would dare say that our current equipment program is a huge drain on our operation. We currently lease all of our equipment directly from our city fleet department. It is a bad system, and I have been given permission by our mayor to explore options outside of our system that could benefit our operation. I have attached an inventory of the equipment that we have at each golf course. The list does not have as much detail as you probably need, but I thought I would start with that and see where it goes. I would also like to seek input on a program for golf cars if your company is involved with that. Please let me know what additional information I can provide so that you and your team can provide us the options that are currently available.

Response:

From our work with several golf courses, municipal fleet reconfiguration is a growing need for many operations. I am somewhat certain that traditional "bid" and "balance sheet" ownership type practices remain in place with your city. These practices are no longer consistent with the competitive nature of the golf business or the increasing level of a municipal golf course's responsibility inside a city parks and recreation business to become an independent profit and business center. The practices simply must change. Successful city operations are recognizing the need to convert to a consistent replacement and properly run golf industry relevant program. Simply stated, municipal operations that remain in the transaction-based "bid/quote/own" system are tripping on nickels and spilling dollars, all while losing competitiveness.

Bell Nob, an outstanding operation managed in Wyoming as part of Campbell County's municipal system, is a recent significant converted operation. They have utilized municipal leasing for years, but have recently converted all turf, cars, and a GPS system to a new management system in order to consolidate, become more efficient, and coordinate a plan. I look forward to furthering this initiative and encourage you to forward this message to your mayor to keep him abreast of our combined efforts and to pave the path of support in weeks ahead. It will be a very easy decision once you see the numbers and the rationale, but a decision that will involve a paradigm shift in your golf course management system. You are losing and wasting money each day, and you should convert as soon as we can do our analysis.

There are several factors that have occurred in the past decade that have led this golf course operator, and many more, to the current situation. Let's look at a few of these factors as they relate to your operation:

● **Significant prosperity and overall growth during the late 1990s and early 2000s.** It seems like only yesterday when there was a widely held recommendation that hundreds of golf courses needed to be built annually to keep up with the demand of existing and new golfers. Times were good, with exceptional amounts of discretionary income available, thus the game of golf became very popular.

● **Significant increase in the amount of product, choices, and expectations.** High-end private and public golf courses were at the forefront of construction, with green fee models that have proven to be far beyond what golfers today wish to pay. However, when all the new construction was occurring, the economy was going full steam, and \$20-30 green fee golf courses were not even considered. The resulting high costs to maintain these high-end courses, combined with the following factor, have resulted in many golf courses having difficulty with their expensive golf course equipment inventory.

● **The golf industry is a lagging economic trailer of the overall national economy.** With the disaster in September 2001 and an overall downturn in our national economy during the mid-2000s, golf followed as a lagging industry. In a nutshell, the extra money of the dot.com times was gone, and with it the discretionary income used for pleasure and leisure activities, such as golf. With less money available in the overall population and a larger number of golf courses to choose from, many golf courses felt the pinch. This resulted in reduced green fees and ever-tightening budgets, with far less capital available for expensive golf course maintenance equipment. This was followed by a prolonged period (four years plus) of economic uncertainty and revenue contraction.

● **Additional economic challenges (gas prices, fertilizer costs, electric costs, water costs, etc.).** As the cost for fuel continues to climb, there are many aspects of the golf course maintenance operation that severely impact cash flow and the bottom line. Dramatically increased costs for gasoline/diesel, fertilizer, water, and the electricity required for the operation of the irrigation system have had a major impact.

● **Competition for golfers — it has changed significantly.** First, there is more competition than ever, in all sectors. The industry experienced significant growth in the late 1990s,

creating many more golfing alternatives for prospective golfers. Second, overall economic contraction in recent years, combined with more available golf courses, has caused revenue contraction in all sectors. Third, all sectors now compete with each other for golfers' discretionary dollars, resulting in competition that has not existed in the past. Private golf clubs now compete with daily-fee courses that offer a very high level golfing experience. All daily-fee golf courses compete with each other. Municipal courses must have higher standards than ever, as they, too, are facing a more discerning golfing public with more available alternatives.

In 2008, the simple fact is that if a golf course does not compete favorably on course conditions, that course will lose the revenue to another course. One of the single biggest factors affecting course conditions is the golf course maintenance equipment that is used on the golf course. The golf course equipment fleet is the single largest recurring expense relative to the overall golf operation, and regardless of the equipment manufacturer, this equipment expense never goes away.

WHAT CAN BE DONE? THERE IS A LIGHT AT THE END OF THE TUNNEL

Because of the economic conditions that govern the industry, the importance of cash flow management has become the critical issue at golf courses in all sectors. Private clubs, in general, do not have the influx of new members to provide the financial offset to all of the capital needs that their facilities require on an ongoing basis. Daily-fee, resort, and municipal operations are already cash-flow-driven businesses. Golf course operators must realize these economic realities, as they impact every course's ability to invest in the golf course maintenance equipment that is required to deliver a quality product. Since these economic conditions are not likely to change in the foreseeable future, there is a bridge between golf course maintenance and the business of running the course that needs to be understood and strengthened.

The first step is to realize that the equipment fleet is just that — a fleet, composed of 20-40 or maybe even more individual component parts, all of which do a specific maintenance job. It is not 30 or 40 individual pieces of equipment. The golf course superintendent is called upon to manage the fleet. Part of that job includes a

Fleet management includes every unit used for the maintenance of your golf course, with each piece requiring a proper replacement schedule.



replacement schedule, control of the golf course maintenance budget, the creation of a year-over-year plan, and a responsibility to stay within a budget. That means that a plan must be in place for all 30 or 40 pieces at all times — not the more typical 1-3 or 5 pieces of turf equipment that are in greatest need of replacement.

Once you have made the jump to fleet vs. individual piece equipment management, it will be easier to look at the plan for each individual piece. In this step, in most cases, golf course operators will easily identify the differences in

useful life between the different pieces in their fleet. A tractor, for example, has a much longer useful life than a utility vehicle, even though both pieces are part of their fleet. Attaching a useful life to each piece is important.

Next, use your own records to prove the useful life of the equipment. Some pieces last for a long time without requiring much maintenance, yet still deliver quality results. Others wear out sooner, causing course conditions to deteriorate, draining staff resources, and requiring expensive repairs. In most cases there will be

a clear optimal rotation that emerges, which is consistent with the intuition that course managers *feel* would be the optimal replacement cycle.

The next step is to bridge the gap between the optimal replacement schedule and the business reality of limited financial resources. This is more complicated because it involves more levels of club management than just the golf course superintendent. If golf courses accept that 1) the economic landscape of our industry has changed, 2) cash flow is more important than ever, and 3) every aspect of a golf course operation must be examined, then this step may be easier to take. This step will challenge a golf course's practices. Importantly, it will address what a course's true goals are relative to equipment. In virtually all cases, it is not a golf course's goal to own equipment. The truth is that the goal of virtually every golf course in the industry is to *operate each piece of equipment as inexpensively as possible over its useful life and then dispose of it.*

If a golf course can establish a comprehensive plan for its entire course maintenance fleet, with a specific replacement schedule for each component piece, and where that replacement is sensitive to the growing importance of business cash flow, it is likely that most, if not all, golf course equipment will end up being managed under one big plan. Equipment fleets are a large operating expense that is ongoing. They are no longer a mix of some owned (tractors) and some

financed (higher use) individual pieces. If golf course managers and operators realize that the goal is to manage this overall expense as one, there is a high likelihood that they will be able to transition to a better overall solution.

SUMMARY

The outlined observations and recommendations are very important because they apply universally to this industry. Literally no golf course or club is exempt from the need to improve in some area of golf course fleet management. If golf course conditions can improve, it is likely that economic efficiency and staff efficiencies can be recognized. If golf courses fall behind on equipment replacement, a look at the overall plan is warranted. The choice is yours. Look at your overall golf course equipment inventory as a long-range and critical portion of the golf course operation, or just give it a review once a year for a fleeting moment.

TODD GRAY, VP, Golf & Turf Division, Wells Fargo Financial, has provided more than two decades of financial assistance to golf courses in North America regarding their management of equipment. LARRY GILHULY, director, Northwest Region, USGA Green Section, has observed golf courses in the Western U.S. and British Columbia struggle to keep up with the rising costs of equipment. The perspective of the authors comes from two different directions, yet both agree that this subject is the key to effective golf course management.



Fairway topdressing is just one example of equipment needs brought on by greater golfer expectations.

Research You Can Use

Physical Analysis of Sands for Golf Course Bunker Use

Are current laboratory tests good predictors for bunker sand performance in the field?

BY JIM SKORULSKI

Bunker sand can be a frustrating topic as more emphasis is placed on the playability and consistency of sand bunkers. Many problems with bunkers can be traced back to poor sand selection. More golf courses are realizing the value of using an accredited physical soil testing laboratory to help analyze prospective sands and help predict their playing qualities in the field. Dr. Cale Bigelow, assistant professor of agronomy, Purdue University, and Dr. Douglas Smith, associate professor, USDA-ARS, National Soil Erosion Research Laboratory (West Lafayette, Ind.), recently completed a study that evaluated the physical characteristics of more than 20 commercially available bunker sands to determine if any single physical test currently used by accredited soil testing laboratories is a good predictor of bunker sand firmness in the field. I recently had an opportunity to discuss the project with Dr. Bigelow, and the following article is based on our interview.

1. This research project was timely considering the increasing scrutiny that is being given to sand bunker maintenance and playability. What specific concerns caused you to initiate this project?

Golf course superintendents face increasing demands to provide consistently firm, smooth bunker surfaces. We felt it was important to try to understand the similarities and differences among a wide variety of commercially available bunker sands.



Proper sand selection is crucial in the quest for near-perfect conditioning and consistency demanded by golfers today.

Additionally, I was interested in trying to determine if a simple measurement could be related to surface firmness.

2. What tests are currently used in laboratories to analyze the physical characteristics and

predict the playing qualities of bunker sands?

Generally, bunker sands are evaluated by using measurements typically used for rootzone sands, including particle size distribution analysis, particle shape/angularity, and testing for calcium carbonates. The only test currently being widely employed for sand firmness is the modified pocket penetrometer test. The modified penetrometer method was developed and introduced by James Thomas and Dr. Kirk Brown of Texas A&M University. It is the best method currently available for measuring firmness, but it does not account for some factors that affect firmness in a field situation. The test is conducted in a wooden box with static sidewalls and a relatively small quantity of oven-dried sand. Normally the penetrometer is pushed into the sand surface by hand, which may result in uneven pressures and variable measurement values. Most labs replicate this process at least five times and arrive at an average value. I have been told that some labs attach the penetrometer to a drill press-like assembly to minimize pressure variations. Regardless, the process is not ideal, but it is the best procedure currently available.

3. So, is it your feeling, based on this project, that the penetrometer test remains the best means to predict the firmness of bunker sand in the field?

As a relative laboratory measurement, yes, it is the best means to measure



This laboratory study at Purdue University evaluated the physical properties and visual characteristics of more than 20 bunker sand materials. No single sand physical property or combination of properties was able to accurately predict sand firmness or resistance to golf ball penetration.

surface firmness. One situation that I can see being a mistake, however, is if someone were to try to replicate the laboratory data under field conditions, where lower penetrometer values would likely be observed. This is related to several factors. First, due to the large quantity of sand in a real bunker, the static sidewall forces are reduced. Even if you measured adjacent to a bunker edge, the surrounding soil would likely have some degree of "give." Additionally, there are natural variations in moisture content, which functions as a lubricant, promoting particle slippage. This will certainly vary with individual sand particle size distributions and sand depth.

EDITOR'S NOTE: *An extensive effort is underway to replace the penetrometer with equipment that is more reliable and less subject to user-induced variables. A test procedure using the USGA TruFirm™ device is being developed by Sam Ferro of Turf Diagnostic & Design (Linwood, Kansas) to measure depth of penetration and coefficient of restitution of bunker sands. The laboratory testing procedures are being reviewed by the accredited laboratories and will soon be submitted to ASTM for adoption as a standardized test.*

4. From your limited testing, did you find any single physical sand characteristic that can be used with confidence to predict the performance of bunker sand?

No single measurement was a good indicator for firmness. However, particle size distribution, as expressed as coefficient of uniformity (Cu), and angularity are important data. For example, I would be very hesitant to recommend a rather fine, round, uniform sand, particularly for bunkers with steep erosion-prone slopes where moderate to heavy rainfall events are likely. Sands with these characteristics would also likely produce soft conditions and a greater chance for buried lies when used at greater depths. The penetrometer data are helpful, but as I mentioned, the laboratory data are not going to be identical to field performance. There would, however, be some relativity between sands, meaning firmer sands in the lab will likely produce firmer field conditions. I would caution a golf course manager or construction project manager from trying to exactly replicate the laboratory's measurements. There are simply too

many variables and factors in field conditions.

5. In your opinion, are the laboratory tests alone a good predictor of how bunker sand will perform in the field?

Just like choosing an appropriate grass cultivar for greens, tees, and fairways, the laboratory research data are merely a starting point in the selection process. The end user needs to carefully consider utility (the importance of the playing characteristics), long-term maintenance, bunker architecture (size, severe slopes, etc.), and appearance before making a sand selection. The lab data simply provide information for comparing sands. The sand particle size distribution and information regarding uniformity and angularity are the most useful data provided by the test. Let's not forget the value of developing a test bunker that will allow golfers an opportunity to play and see several prospective sands before a final decision is made.

6. Do you have a single take-home message or recommendation based on this limited study that you would like to pass on to superintendents and course officials



The penetrometer device pictured above is currently the best means to quantify the firmness of bunker sand in the laboratory. The penetrometer device and laboratory test may soon be replaced by a new procedure that will reduce the variability of the current measurement.



One additional measurement that may help laboratories predict sand firmness is the angle of repose. This measurement is a calculation expressed as degrees, derived from measuring the mean diameter of the base and apex height of a dry sand cone. Coarser textured, more angular sands with wider particle size distribution are more likely to stack higher, resulting in a narrower base and taller cone apex and ultimately a greater angle of repose.

who are dissatisfied with their current bunker sands or are in the process of selecting a new sand?

Many agronomists have been saying this for years, and philosophically I agree. Overall, the industry is spending way too much time and money on bunkers and bunker maintenance. There is no reason that bunker maintenance dollars should be equivalent to putting green maintenance. Bunkers are hazards and golfers should pay a price for being in them. That having been said, however, many golfers have expectations for the finest, most pristine conditions possible (e.g., firm, smooth, aesthetically pleasing sand bunkers that complement the well-manicured turf). Proper sand selection is crucial to achieve this goal on a consistent basis. In some cases, it makes sense to spend a premium price to ship in a coarser textured, angular material rather than settling for a lower-priced locally available sand that is more likely to wash or create conditions that are softer than desired.

During our study, we were impressed by the crushed or manufactured products, including the limestone materials. Instinctively, the limestone products are potentially unsuitable due to their soft mineralogical nature compared to silica materials. In my observations under field conditions, however, these products seem to perform very satisfactorily. The long-term questions regarding issues related to any plugging of drainage tile still remain. The other concern with the crushed products is mower pickup of large particles. Our research is continuing and moving on to the next phase, erosion potential using various sands, but that discussion will have to be the subject of another article.

A more in-depth version of this research project can be found at Turfgrass and Environmental Research Online (TERO), <http://usgatero.msu.edu/v07/n03.pdf>.

JIM SKORULSKI is a senior agronomist in the USGA Green Section's Northeast Region.

Infection and Colonization of Bermudagrass by a Spring Dead Spot Pathogen

Work continues at Oklahoma State University to understand the infection process of spring dead spot.

BY NATHAN R. WALKER, OLIVER C. CAASI, THOMAS K. MITCHELL, STEPHEN M. MAREK, AND YANQI WU

OBJECTIVES

- To incorporate fluorescent protein genes into *Ophiosphaerella herpotricha*, one of the pathogens causing spring dead spot of bermudagrass.
- Evaluate infection and colonization of bermudagrass cultivars by fluorescent *O. herpotricha* at different temperatures.
- Evaluate differences in infection and colonization among bermudagrass cultivars that vary in disease susceptibility.

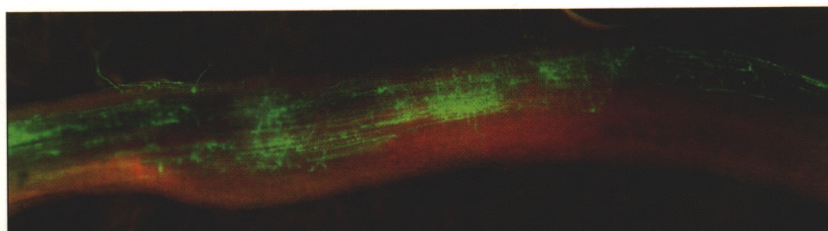
Start Date: 2006

Project Duration: Three Years

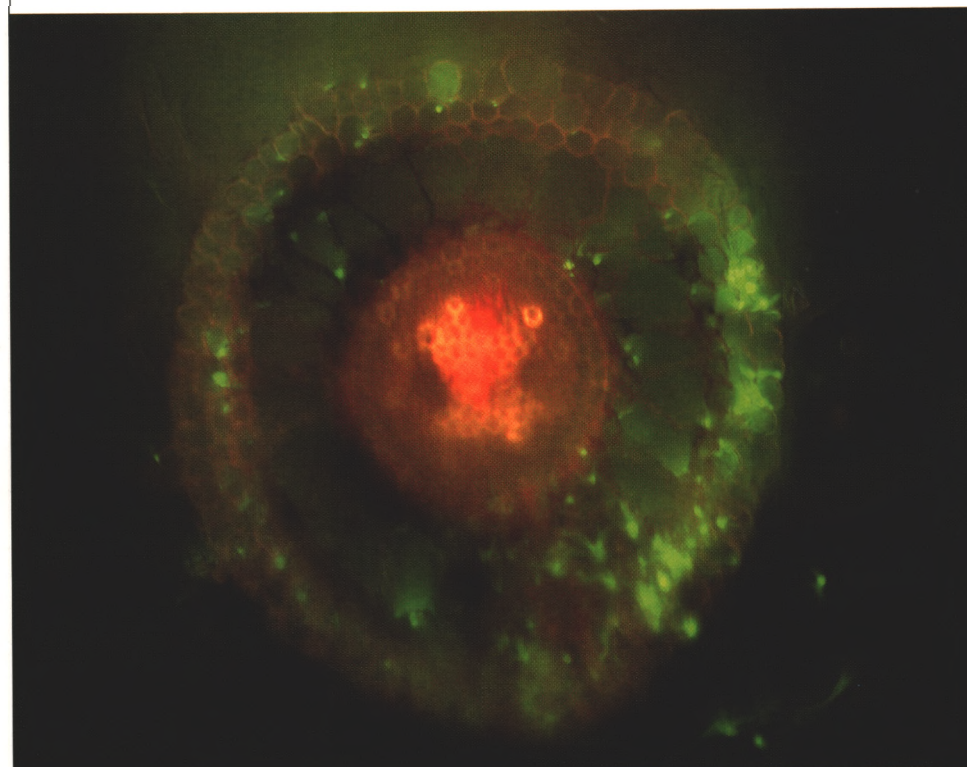
Total Funding: \$59,684

Spring dead spot (SDS) is the most devastating and important disease of bermudagrass that undergoes winter dormancy. The disease is caused by one or more of three fungal species in the genus *Ophiosphaerella* (*O. herpotricha*, *O. korrae*, or *O. narmari*). The disease causes unsightly dead patches on fairways, tee boxes, and bermudagrass greens, resulting in increased management inputs to eliminate weeds and encourage regrowth of bermudagrass into the dead areas.

Despite the identification of the causal agents of the disease in the 1980s, the underlying factors that ultimately lead to death of the plants remain poorly understood. A critical



O. herpotricha transformant expressing green fluorescent protein (GFP, a visualization gene) is currently being used to follow root infection and colonization of various bermudagrass cultivars at different temperatures. The transformed fungus fluoresces green (40x).



Transverse section of infected Tifway root reveals extensive internal necrosis and cell wall breakdown of cortical cells corresponding with colonization by *O. herpotricha* expressing GFP. The transformed fungus fluoresces green and the vascular bundle autofluoresces red (200x).



Spring dead spot is caused by one or more of three fungal species (*O. herpotricha*, *O. korrae*, or *O. narmari*) and is the most devastating disease of bermudagrass.

limitation to the study of turfgrass root diseases is the inability of researchers to rapidly and easily study the plant-fungus interactions because they occur below ground and often inside of roots. The overall goal of this study is to enhance our understanding of the interaction between *O. herpotricha* and its bermudagrass host and how environmental factors influence this interaction for the development of strategies for more effective disease control.

Through the insertion of genes into the fungus, transgenic isolates of *O. herpotricha* expressing fluorescent protein genes (visualization genes) have been generated and are currently being used to follow root infection and colonization of various bermudagrass cultivars at different temperatures (conductive and non-conductive). Root necrosis surrounding fungal hyphae was observed for the susceptible cultivars Tifway and Jackpot 10 days after

inoculation. Only minor root discoloration was observed around hyphae of the more resistant Midlawn cultivar. Transverse sections revealed extensive internal necrosis and infection of Jackpot and Tifway root cortices. In contrast, infection of Midlawn appeared limited to the outermost cortical cells, and these cells did not appear necrotic. No vascular infection by *O. herpotricha* was observed in any of the cultivars examined.

Future studies will utilize a confocal scanning laser microscope that can optically "section" infected roots, producing three-dimensional images of the fungus as it moves on and into bermudagrass roots. We expect to further observe cellular differences in the infection and colonization of bermudagrass cultivars that differ in susceptibility to *O. herpotricha*. This basic information on how the cultivars react to the causal fungus will improve

our ability to enhance and deploy host-plant resistance through traditional breeding efforts at Oklahoma State University.

SUMMARY POINTS

- Fluorescent transgenic fungi have been generated.
- These fluorescent fungi are being used to study the progression of disease in bermudagrass varieties that differ in susceptibility to the disease. Susceptible varieties display more extensive root cortical cell necrosis associated with fungal invasion than that observed in a resistant variety.
- These fluorescent fungi also are being used to study the progression of disease under conducive and non-conductive temperatures regimes.
- This information will be used to enhance host-plant resistance through traditional breeding efforts at Oklahoma State University.

CONNECTING THE DOTS

An interview with the authors regarding their investigations into the infection and colonization of bermudagrass by a spring dead spot pathogen.

Q: Using fluorescent protein genes expressed in the pathogen to visualize infection seems like a very ingenious way to track the infection and colonization process. Where did you learn about this approach and has it been used in other pathogen/host systems?

A: This approach has been used to study fungi, bacteria, and viruses that cause diseases of many important crop plants such as rice, wheat, and vegetables. Early on, this approach was not widely used, but now it has become very common and is being applied to a large range of plant pathogens.

Q: Where did these fluorescent protein genes come from and how difficult was it for you to transform *O. herpotricha* with them?

A: The green fluorescent protein was originally obtained from a jellyfish and the red proteins from a sea coral. Now these genes can be purchased from commercial sources, obtained from colleagues, or directly synthesized, which is how we produced the red protein gene, tdTomato. To express these genes in fungi, they must be engineered with a fungal gene promoter and then introduced into the fungus's genome by transformation. The transformation of *O. herpotricha* was very difficult at first. We tried several different approaches that were successful for other fungi, but not for *O. herpotricha*. In time, we overcame the difficulties, and now we can do the transformation on a fairly regular basis and have expanded our efforts to other similar fungi.

Q: Spring dead spot is a devastating disease of bermudagrass and one that still holds mysteries regarding its management. How do you envision that your work in establishing the infection and colonization process of the pathogen(s) will help in the overall understanding of this disease with regard to managing and controlling it?

A: Our efforts are aimed at shedding light on the disease system. So far, we have learned how the fungus penetrates root cells and how the fungus moves through the root, causing cortical cell death as it progresses. We have seen how the plant reacts directly and indirectly to the pathogen. If we better understand how the fungus is interacting with the plant, this may give us greater insight into mechanisms of plant resistance or tolerance to the pathogen.

Q: From previous work to date, it appears that more cold-tolerant bermudagrass cultivars are more resistant to infection and colonization by the spring dead spot pathogen. Is this your view, and what does that

tell us about the interaction of infection by these pathogens and cold hardiness of bermudagrass?

A: We knew very little about the direct infection and colonization of bermudagrasses in the past. Often we were limited to seeing dead patches and the necrotic roots, crowns, and rhizomes. Now we can directly visualize infection and colonization of cultivars, including the more cold-tolerant cultivars. Yes, based on our studies, the more cold-tolerant cultivar Midlawn is colonized to a lesser extent than Tifway 419, which is less cold tolerant. So it appears that there is a correlation between reduced colonization and greater cold tolerance.

Q: You mention that this work will help Oklahoma State University's traditional breeding efforts to produce greater host-plant resistance in future bermudagrass releases. Please explain how that will work. Does that mean each potential new bermudagrass release will be screened for SDS host-plant resistance using this visualization-gene method?

A: Previously, to evaluate a new prospective bermudagrass, it was established in the field, inoculated with the fungus, and, after several years, disease symptoms could be evaluated. In addition to the time required to conduct the assay, much has been invested in the prospective line only to find out late in the selection process that it may not be very resistant. With some of the new approaches we are attempting to develop, we may be able to screen germplasm many years in advance of field release, and we can pre-screen accessions for resistance and incorporate those lines into the breeding program for selection of the resistance trait. These new approaches take weeks, not years.

Q: How important is this technique in understanding host-pathogen interactions, and do you feel other turfgrass diseases can be studied this way? If so, what other turfgrass disease complexes do you feel would benefit from this approach?

A: The use of transgenic pathogens that express fluorescent proteins or visualization genes has been extremely important in the study of many different disease systems. Many investigators have been able to document the infection of plants by pathogens, movement of pathogens in the host, and reproduction of the pathogens using this technique. There are many other turf diseases that could be studied using this technique and not just the soil-borne diseases. I expect that there would be new information gained about other important diseases of turfgrass such as dollar spot and those caused by *Rhizoctonia* pathogens if transgenic isolates of those pathogens were produced.

JEFF NUS, PH.D., manager, USGA Green Section Research.

RELATED INFORMATION

<http://turf.lib.msu.edu/ressum/2007/14.pdf>
<http://turf.lib.msu.edu/ressum/2006/18.pdf>
<http://turf.lib.msu.edu/ressum/2007/20.pdf>
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<http://turf.lib.msu.edu/ressum/2003/32.pdf>
<http://turf.lib.msu.edu/ressum/2002/30.pdf>
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<http://usgatero.msu.edu/v02/n20.pdf>
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The Anatomy of a Pitch Mark

Your greens are talking to you. Are you listening?

BY STANLEY J. ZONTEK



A Type I pitch mark — The Bruise. This type of ball mark is most common on firm greens. It is hard to find but easy to repair.



A Type II pitch mark — The Dent. This type of ball mark is found on relatively firm greens, after a “soft” landing golf shot. This type is easier to find and relatively easy to repair.

Most *USGA Green Section Record* articles tell a story while informing readers about new and oftentimes better ways to maintain and manage golf course turfgrass. This article is an exception. It asks more questions than it answers. Its purpose is to make the point that, perhaps, your putting greens are “talking to you” via the pitch marks sadly left unrepaired by golfers. In some small way, an unrepaired ball mark tells a story.

The USGA Green Section is bringing to the field a device to measure putting green firmness. The use of this device will no doubt spark a debate and interest in measuring the firmness of greens and, to a lesser extent, bunker sands. History will determine if the USGA TruFirm™ device will be as misunderstood or as controversial as the Stimpmeter.® Hopefully not. Nonetheless, to the turf manager who walks on greens every day and to the golfer who plays shots to a green, putting green firmness is an important issue.

This article will be an attempt to assist the golf course superintendent and the golf community in determining a quick, simple, and inexpensive way to determine the firmness of greens. This tool already exists in the ball mark repair tool.

Many years ago I began to realize that grass talks to you in many different ways. Clearly, there is a huge difference between yellow, chlorotic turfgrass and lush, dark green grass. Classically, this is the difference between under-fertilized hungry grass and over-fertilized, lush turf. Equally, when moss exists on a green, it could be an indicator of mowing too close, too much thatch, too much irrigation, and maybe too little nitrogen fertilizer. The list goes on.

Consider the common everyday ball mark. Although not as precise as the TruFirm or various moisture meters, a simple look at ball marks can help determine how soft, firm, wet, or dry a green may be.

DIFFERENT TYPES OF BALL MARKS

In my opinion, there are basically four different types of pitch marks. Obviously, there are varia-

tions between and within the different types. It could be argued that no two ball marks are the same, however, for the purposes of this article, the discussion focuses on four basic categories of pitch marks.

• **Type I — The Bruise.** Type I pitch marks leave only a bruise on the surface of the green. This type of ball mark is difficult to locate, and when found it is a cinch to fix. Firm greens tend to have Type I ball marks whether they are sand-based greens or older greens modified by years of core aeration and sand topdressing. This type of pitch mark also is common on the classic links style of management for golf courses in England, Ireland, and Scotland (and elsewhere around the world). Better golfers tend to want this type of firmness, but it could be the most difficult type to achieve and maintain for long periods of time. Type I firmness is best for major championship preparation and play.

• **Type II — The Dent.** Pitch marks of this style are your average ball mark. It is a dent or shallow depression left on the surface of the green. Type II ball marks are easy to locate if you go looking for them, as indeed you should look for *all ball marks*. It's a bit more challenging to repair and, if improperly repaired, or worse yet, left unrepaired, can be a slow-to-heal blemish on the putting green that takes weeks to heal.

• **Type III — The Pit.** Pitch marks of this type are deep impacts that leave an easy-to-see crater on the green. The pit type must be more carefully repaired. It takes some expertise and time to push the grass back into the crater. You never want to lift from the bottom; while this may smooth the surface of the green, it leaves an area of bare soil that is even slower to heal than a Type II ball mark.

With this type of ball mark the turf manager should begin to ask questions. Are my greens too wet due to rainfall or irrigation? Do I need to better control my thatch? When golf shots begin to leave this type of ball mark, a red flag should wave.

• **Type IV — The Skid Mark.** This type of pitch mark is the worst type of ball mark. The term for this type of pitch mark was picked up during Green Section TAS visits with turf managers who were concerned with this type of ball mark on their greens. Instead of a golf ball leaving a bruise, dent, or pit, this ball mark can have a chunk of grass torn from it. It is the largest ball

mark. It is the one most difficult to repair and it takes the longest time to recover.

As with the Type III pitch mark mentioned above, when this ball mark is seen on a green, the green is definitely talking to you. Finding the answer on what to do will be discussed next.

WHAT DOES ALL THIS MEAN?

In simple terms, the type of ball mark left after play could be your best indicator of how the greens are being managed or even how they are designed. Are they too wet? Are they too thatchy? Are they being aerated and topdressed enough? Are the greens too contoured? Is turfgrass density being maintained with a good fertilizer program or are they not fertilized enough? Obviously, all these factors and more can have a huge impact on turf density and the type of ball mark that results and the speed at which it recovers.



Nonetheless, the simple ball mark can also be an important indicator for the turf manager to consider these points:

• Are your greens too wet? Are you in an irrigation rut of regularly scheduled 10-15 minutes of irrigation each night to replace water used and lost during the day? Is it raining too much? Are the greens pocketed with poor air circulation that slows evaporation? Do trees need to be removed or underbrush cleared? Do you need to install a fan? Do older greens need supplemental

A Type III pitch mark — The Pit. This is one of the easiest ball marks to find, one of the slowest to heal due to its size, and the first ball mark type that begins to suggest that a green is soft.

internal drainage? Do older greens need to be rebuilt because they lack drainage, stay too wet, and have unreliable turfgrass?

- Are you hand watering enough? Are you relying on perimeter overhead irrigation systems as the primary way to water greens? Remember, perimeter full-circle or part-circle irrigation heads, by the very nature of their placement, tend to over-water the centers of greens.
- How is the thatch zone in the greens? Is it a mat or is it intermixed with topdressing? Is it



A Type IV pitch mark — The Skid Mark. This is perhaps the worst type to see on a green. It is the largest and most difficult to repair and thus the ball mark of most concern.

holding water? Can you squeeze water from the thatch zone? Organic matter acts like a sponge, holding excess water on the surface of the green, where it is needed the least. When *was* the last time the greens were dethatched?

- Are the greens well aerated? Are they being aerated enough? Are you using the best tine size or are you compromising putting green aeration due to golfer, management, or golf shop pressures? Under-aerated greens tend to have more thatch and surface compaction, which restricts drainage. The roots of the grass can also be shallower, requiring more frequent irrigation. These are all bad situations if you're trying to achieve firm putting greens.
- Are you topdressing the greens enough? Are you using enough sand per green per year? Are you compromising the amount of topdressing applied to save time and money on both materials and mower maintenance, and in order to keep your mechanic from finding another job?

- Are there other factors influencing the greens? How is your water quality? Is it time to flush your greens? What is your wetting agent program (if any)? Are you using the proper wetting agent chemistry, or are you overusing wetting agents? Some wetting agent chemistries, by their very nature, tend to hold water in the thatch zone. While this makes them excellent materials for wetting the soil, their improper use can complicate the situation.
- How are your greens designed? Sand-based greens having abrupt contour changes can inherently have bad water movement and water retention characteristics. That is, a low swale can stay wet, regardless of how a green is irrigated, whereas a ridge or a mound only a few yards away stays dry. *Sand-based greens do not necessarily drain uniformly.* The design and contour of a green can affect the type of ball mark, independent of the best efforts of a golf course superintendent.
- How are your greens doing . . . really? What type of complaints or compliments are you receiving from golfers? Are the greens holding? Are they not holding? The type of complaints can be telling. A better golfer tends to like a firmer green, whereas higher-handicapped golfers tend to like greens that hold any shot hit into them, with any club, at any trajectory, and with any spin. There are many factors that determine the type of ball mark on a green.

BE PROACTIVE

Use the type of pitch mark you have on your greens to your advantage. If you formerly had Type I ball marks and the greens are now showing more Type II or, worse yet, Type IIIs and IVs, show the pro, the green chairman, the owner; show anyone who will listen. "Look, the greens are getting too soft. We need to topdress more, core more, install internal drainage in the greens, etc., etc., etc." I submit that golfers understand ball marks better than we might expect. After all, they walk on each green every day they play. They lament non-repaired or poorly repaired ball marks and the blemishes to the putting surface that result.

They also know the difference between firm greens, where it is difficult to even find where a ball hit the green, and severely ball-marked greens that just look bad and play badly. Golfers know when something is wrong. Use this to your advantage.



DISCLAIMER

This article is a huge oversimplification of a very complex topic. Obviously, the weather has a huge impact on putting green softness and firmness. The type of golf shot hit into a green also has a huge impact on the resulting ball mark. After all, there are tremendous differences with the spin of the ball, its trajectory to the green, and even the slope and contour of a green when the ball impact occurs. Obviously, a green sloped towards the fairway and a green sloped away from the incoming shot can have different types of ball marks. How the greens are maintained, the budget, and *how golfers want their course maintained* are all important factors that can affect the type of ball mark that results from play.

IN CONCLUSION

This article asks more questions than it answers. The simple ball mark can be an important maintenance and management tool in determining short-term as well as long-term care of the greens, along with the weather. Perhaps there could be no more simple education tool than to understand what the greens are saying. Quite literally, they are *talking* to you, and it would be best to listen.

STAN ZONTEK is director of the Green Section's Mid-Atlantic Region.

A non-repaired ball mark. Note the wilted grass. Regardless of the ball mark type, a non-repaired pitch mark is bad for the grass and bad etiquette. Always repair your ball marks, regardless of their type.

Controlling Spring Dead Spot of Bermudagrass

Scientists at Mississippi State University conduct research to unravel this mysterious turfgrass disease.

BY MARIA TOMASO-PETERSON

OBJECTIVES

- Determine the effectiveness of spring and fall fungicide applications for reduction of spring dead spot incidence and severity.
- Determine the effect of organic fertilizer for the reduction of spring dead spot incidence and severity and overall improvement of turf quality.

Start Date: 2007

Project Duration: Three Years

Total Funding: \$30,000 Per Year

Spring dead spot is a serious root-rot disease of bermudagrass and is the most important disease of hybrid bermudagrasses managed as putting green and fairway turf. Aesthetically undesirable necrotic patches ranging from a few inches to several feet in diameter are evident in the spring and early summer in bermudagrass swards that experience a dormant period.

Three fungal species in the genus *Ophiostoma* (*O. korrae*, *O. herpotricha*, and *O. narmari*) are identified as the causal organisms throughout the United States and Australia. In Mississippi, *O. korrae* has been identified as the causal organism of spring dead spot and has been consistently isolated from Tifway bermudagrass roots managed as a fairway on a monthly basis for two years.

Based on fungal isolation results, it has been determined that the frequency of occurrence of *O. korrae* was greatest



Fungicide applications are watered into the rootzone of Tifway bermudagrass at Old Waverly Golf Club, West Point, Mississippi.

Table I
Fungicide treatments, application rates, and timing for controlling spring dead spot in a Tifway bermudagrass fairway.

Fungicide Treatment	Application Rate (oz. product/1,000 sq. ft.)	Application Timing
Fenarimol (Rubigan)	4.0	March, April, Sept., Oct.
Fenarimol	4.0	Sept., Oct.
Fenarimol	4.0	March, April, May
Fenarimol	4.0	April, Sept., Oct.
Fenarimol + thiophanate-methyl	6.0 + 6.0	Sept.
Propaconazole (Banner)	4.0	Oct.
Myclobutanil	1.2	Nov.
Azoxystrobin	2.0	Oct.
Control (water)	—	—



Spring dead spot is a serious root-rot disease of bermudagrass and is the most important disease of hybrid bermudagrasses managed as putting green and fairway turf.

during spring transition (9.4%) compared to summer (4.6%) and fall (3.1%) transition growth periods. As a result of the observed fungal activity in bermudagrass roots during spring transition, fenarimol (Rubigan) and other standard fungicides labeled for spring dead spot control are being applied to the symptomatic bermudagrass fairway in the spring and fall (Table 1). An organic or inorganic nitrogen source is being applied concurrently with fungicides to identify a fungicide/nitrogen source combination that may result in reduced spring dead spot incidence and severity while promoting high turf quality.

The study was initiated in the spring of 2007 in the Tifway bermudagrass

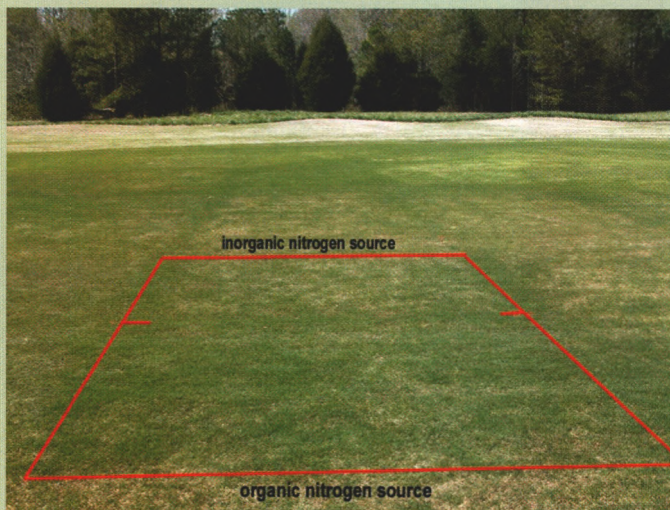
fairway located at Old Waverly Golf Club, West Point, Miss. Spring dead spot symptoms were observed throughout the study area in the spring of 2007. The treatment plots (15 × 10 ft.) are arranged in a randomized complete block design with a split-plot arrangement of treatments and replicated four times.

Fungicide treatments are the whole-plot factor, and nitrogen source is the sub-plot factor (7.5 × 10 ft. sub-plots). Fungicide treatments are applied during the spring and fall transitions. The nitrogen sources include Roots® 12-2-12 organic fertilizer and a 12-2-12 blend of inorganic fertilizer including ammonium sulfate (21-0-0), triple super phosphate (0-46-0), and muriate

of potash (0-0-60) applied at 1.0 lb. of N per 1,000 sq. ft. per month (May-October).

Turfgrass quality is recorded monthly throughout the growing season. Spring dead spot incidence and severity are evaluated in the spring of each year by determining the number of patches and quantifying the area of symptomatic bermudagrass per plot using digital image analysis. Recovery of symptomatic patches also will be monitored throughout spring transition. The soil pH was 6.1, with phosphorus, potassium, magnesium, zinc, and calcium at high to very high levels, according to soil analyses conducted at the Mississippi State University Soil Testing Lab. Soil pH is being analyzed

Control plot in March 2008. Half the plot was treated with an organic nitrogen source (foreground) and the other with an inorganic nitrogen source (background) throughout the 2007 growing season.



Healthy turf (above) quantified as no disease. Spring dead spot symptomatic turf (below) determined to be 7% diseased. These results are based on digital imaging analysis.



in the spring and fall of each year to monitor the effects of the nitrogen sources.

The results of this three-year study will identify a fungicide/fertility disease management program that is effective for controlling spring dead spot of bermudagrass managed as fairway turf. These results also will allow us to determine whether there is an added benefit of using an organic nitrogen source that includes bio-stimulants and microbes compared to an inorganic, acidifying fertilizer in reducing spring dead spot incidence and severity.

SUMMARY POINTS

- The occurrence of *O. korrae* was greatest in Tifway bermudagrass roots in spring transition (9.4%) compared to summer (4.6%) and fall (3.1%) transition growth periods in 2005 and 2006.
- Fenarimol and other standard fungicides labeled for spring dead spot control are applied to a symptomatic Tifway bermudagrass fairway in the spring and fall.
- An organic or inorganic nitrogen source is applied concurrently with fungicides to identify a fungicide/nitrogen source combination that results in reduced spring dead spot incidence and severity.

RELATED INFORMATION

<http://www.ipmcenters.org/pmsp/pdf/SouthernTurfgrass.pdf>
<http://turf.lib.msu.edu/ressum/2007/20.pdf>
<http://a-c-s.confex.com/crops/2007am/techprogram/P36305.HTM>
<http://www.apsnet.org/meetings/2007/abstracts/a07ma561.htm>
<http://www.apsnet.org/meetings/2006/abstracts/a06ma587.htm>
<http://a-c-s.confex.com/crops/2006am/techprogram/P23425.HTM>

MARIA TOMASO-PETERSON, PH.D.,
assistant professor, Department of Plant Pathology, Mississippi State University, Mississippi State, Miss.

CONNECTING THE DOTS

An interview with DR. MARIA TOMASO-PETERSON regarding Mississippi State University's efforts to manage this important disease of bermudagrass.

Q: Developing effective management strategies for spring dead spot (SDS) of bermudagrass would certainly be welcome news for superintendents of southern golf courses. Your data indicate that the frequency of occurrence of *O. korrae* was greatest in spring compared to summer and fall. Depending on the eventual outcome of this study, could this mean that fungicide programs to control SDS may be focused on applying fungicides in the spring to prevent necrotic symptoms that would otherwise appear a year later?

A: Bermudagrass root production occurs on an annual basis, with the sloughing of old roots in early spring, while simultaneously initiating new roots. The greatest root production occurs in the summer growing season and declines in the fall. Spring fungicide applications may protect the new roots from *O. korrae* infection. In this study, we may find that spring and fall applications are necessary to reduce *O. korrae* activity, allowing a window for establishing and sustaining a healthy, vigorous root system that can support stored carbohydrates that are necessary for spring green-up. Keep in mind that fungicides alone will not control this disease as past reports have stated. Cultivation practices such as core aeration and vertical mowing must be implemented during the growing season to promote vigorous bermudagrass root production.

Q: What is the purpose of the nitrogen treatments? Are they largely to quantify regrowth rate from necrotic patches, or do you think nitrogen inhibits the infection and spread of SDS pathogens similar to the way nitrogen inhibits dollar spot?

A: This project was designed to have nitrogen available to the bermudagrass fairway throughout the growing season and more specifically into the fall. It has been reported in the literature that late-season nitrogen (N) applications on bermudagrass improved fall and spring color and did not reduce total nonstructural carbohydrates in the rhizomes. Winter survival was not compromised and late-season N fertilization did not influence cold tolerance parameters such as lipid unsaturation or proline concentration. Reports also suggest no differences in freeze tolerances between N-treated and untreated samples, indicating late-season N applications do not predispose bermudagrass to winterkill, and therefore should not influence enhanced SDS severity of bermudagrass. Nitrogen most likely will not have a direct effect on *O. korrae*. The whole premise is to grow the healthiest bermudagrass plant such that if and when *O. korrae* infection occurs in the root system, the plant can out-compete the disease pressure.

Q: What leads you to believe that an organic source of nitrogen would have any different effects on spring dead spot incidence than the inorganic ammonium sulfate source?

A: It is not only the organic source of nitrogen that is slowly released and made available to the plant, but how the organic fertilizer also enhances the beneficial microbial populations in the rhizosphere. The organic fertilizer also has a biostimulant and a potentially beneficial microbial package that reduces stress and facilitates the release of nutrients for uptake. In our first spring observations for this study, a large number of plots showed improved spring green-up following a season of organic fertilizer applications as compared to ammonium sulfate plots.

Q: Some previous research focused on the effects of temperature on the infection and spread of the SDS pathogen. From a previous conversation, you indicated that this spring's lack of severe SDS symptoms followed last year's exceptionally dry growing season. How might moisture affect SDS development in bermudagrass?

A: Soil moisture is essential not only for healthy root and shoot production, but for fungal growth as well. With a rainfall deficit of more than 25 inches in 2007 where this study is located in Mississippi, we still recovered *O. korrae* isolates every month from bermudagrass roots. But the fungus may have been in a dormant state, not parasitizing and colonizing as actively as if soil moisture was adequate, and less root damage would occur, which could translate into reduced spring dead spot incidence and severity.

Q: Previous growth chamber studies at Kansas State University have shown that once infected by the SDS pathogen, the host bermudagrass

experiences a significant loss in the ability to acclimate to cold. Is this consistent with your observations of field-grown bermudagrass in your area?

A: In previous spring dead spot studies in Mississippi, we determined there was no direct association between the occurrence of *O. korrae* and soil temperature. Over the three-year study, winter soil temperatures averaged 46°F, with spring and fall transitions averaging 61°F and 63°F, respectively. Spring dead spot incidence and severity were inconsistent from year to year and could not be correlated with soil temperatures. This is just one factor that leads to the bewilderment of this pathosystem!

Q: What are your current recommendations on how to manage spring dead spot, and how are the results of your study likely to reaffirm or change those recommendations?

A: When a golf course superintendent discusses spring dead spot management with me, we discuss the conventional fungicides that are currently labeled for spring dead spot, with the most successful being fenarimol (Rubigan). Split or single applications in the fall should be made when soil temperatures are between 60°F and 80°F.

Manage healthy turf throughout the growing season. The fundamentals of proper plant nutrition should be followed for greens, tees, and fairways. Maintain soil pH in the 5.5 range. Schedule cultivation practices that include core aeration and deep vertical mowing. The management of the turf will dictate the frequency. All debris generated from cultivation practices should be removed from the site. In most fairways and some greens, the cores are backfilled into the aeration holes. The spring dead spot fungus colonizes roots, rhizomes, stolons, and crowns. If the infected plant parts are moved to non-infested or healthy turf, new infection courts can become established through the introduction of this infested material. This is the most common way the spring dead spot fungus is disseminated. Water management is critical for healthy plants. Deep, infrequent irrigation cycles are the best approach.

No spring dead spot management recommendations can be made until definitive conclusions are drawn based on the results of this three-year study.

Q: Explain the process of digital image analysis as you are using it to quantify disease symptoms. Is it a superior technique compared to simply rating the plots for disease patches?

A: Digital image analysis is fast becoming an accepted means for evaluating plant diseases, and turf is no exception. Several software programs are available to interpret the data and provide quantitative results instead of relying solely on subjective rating schemes. With regard to spring dead spot, an overhead view of the plot is captured with a digital camera and downloaded into the digital image analysis software. Parameters are established for the image and the percent area green is calculated. To confirm the accuracy of the software, I took pictures of healthy bermudagrass turf and compared them to turf symptomatic for spring dead spot. The software calculates the area of disease based on the amount of green color present in the image. Digital image analysis is another tool for quantitatively interpreting data that can be used in addition to qualitative disease ratings.

Q: It is fairly early in the project, but are there indications of how both fungicide timing and nitrogen treatments affect SDS development?

A: The first spring into this project did not result in high disease pressure as compared to spring 2007. This is one of the challenges when investigating spring dead spot — unexplained inconsistencies from year to year. I did, however, observe differences in spring green-up when comparing organic and inorganic nitrogen sources as previously discussed. I might interpret this as healthier plants going into winter dormancy, perhaps due to increased carbohydrate storage, but that would be another project altogether. I did observe that the control plots had poorer turfgrass quality and did have spring dead spot symptoms. At this point it is really too early to make any preliminary conclusions on fungicide timing, nitrogen treatments, and their effect on SDS development. We do know that spring applications of the demethylation inhibitor (DMI) fungicide fenarimol, applied at 4 oz. per 1,000 sq. ft., does not cause delayed green-up or phytotoxic effects on the bermudagrass fairway.

JEFF NUS, PH.D., manager, USGA Green Section Research.

Restoring a Gem

Communication and careful planning and organization pay off.

BY DAVID KUYPERS



Corroded old pipes were no longer capable of providing adequate hydraulic flow, so coverage and turf performance suffered.

In 1929 construction began on Cutten Fields in Guelph, Ontario. Arthur Cutten was a Guelph native who had amassed a sizable fortune through various enterprises in Chicago, Illinois. Cutten envisioned creating a world-class recreational resort for his hometown, and he planned to donate it to the city once it was built.

He enlisted his friend, Chick Evans, a very accomplished amateur player, to design the golf course. Evans was the first player to hold the U.S. Amateur and U.S. Open titles in the same year, 1916. Unfortunately, like many, Cutten's fortune vanished in the stock market crash of 1929, and by the time Cutten Fields opened in 1931, there were serious financial difficulties. The club had a series of different stewards through the years, including golf course architect Stanley Thompson, who assisted in the design. Eventually the club, now known as the Cutten Club, became wholly owned by the University of Guelph, whose property is adjacent to the club. In 2005 the

membership leased the land and all the assets back from the University to operate independently as a member-owned and operated private club. The membership had a strong desire to make significant capital improvements to the golf course and the facilities, an investment that the University had no interest in funding.

In 2005 the club hired David Kuypers to be the golf course superintendent and charged him with developing a plan to move forward with the capital improvements and to improve the overall conditioning level of the golf course.

THE PROBLEMS

Most of the challenges stemmed from years of under-funding the maintenance of the golf course. This left an aging infrastructure, dated design styles, and extremely poor growing environments. The irrigation system was a steel, center-row system, with block systems around the greens dating to the 1950s. The pipe was undersized,

terribly corroded, and in poor repair. It was simply incapable of delivering water with the necessary control, consistency, or volume to sustain turf effectively. The golf course had been renovated in the early 1990s in an effort to reduce maintenance costs, and some of its best and most dramatic features, a signature of Thompson designs, were eliminated. Worse yet, an extensive tree planting program was implemented through the 1980s and 1990s. Coupled with strong golfer resistance to removal, the trees were literally choking the golf course and hiding its best asset, the topography. The tree plantings also had created growing environments that were incapable of supporting reasonable quality and reliable playing surfaces.

Clearly, the course needed a tremendous amount of work, and a plan was needed to deal with the fundamental infrastructure flaws and the growing environments. These problems had to be corrected before any restoration work could be undertaken. The dete-



Too many sprinklers on one line spell insufficient pressure and poor coverage.

rioration of the course was so severe that very aggressive solutions were necessary, and nothing short of a major project would have the desired effect. However, membership approval was required before anything major could be undertaken.

On the plus side, all but one of the original greens were intact, and while they had shrunk to a fraction of their original size, their original shapes were obvious and the green complexes had great character. Clearly, the original design was classic and interesting, but it took some imagination to see it. The design was well worth restoring, so the idea of “preserving and enhancing” was adopted as a theme.

THE TEAM

With such varied problems, a team of experts from different disciplines was needed to provide the input needed to develop the plan. A second team was needed to present the project to the membership for approval. The agro-



With a zone or block system, the low sprinkler heads in each zone can weep, creating obvious problems.

nomic side of the team consisted of Golf Course Architect Ian Andrew, Dave Smith of DCS Agronomics, Tim Fredericks of Fredericks McGuire Irrigation Consulting, Dave Oatis of the USGA was brought in for a Turf Advisory Service consultation with a follow-up visit by Dr. Jim Baird to review tree plantings with the club's arborist. This team was coordinated through David Kuypers, golf course superintendent. A plan was eventually

THE PLAN

The operational plan called for a comprehensive tree management program in year 1, followed by the installation of a new irrigation system in years 2 and 3. The irrigation system installation was complicated since the system had to be designed around features that were not yet constructed. Finally, the golf course renovations, including tee and bunker construction, would be undertaken in the latter half of year 3.

The plan could be delayed or accelerated depending on the financial performance of the operation. The strategic plan was intended to be both broad in its vision for the club and its future; however, it also detailed the steps needed to fulfill this vision along with the dues increases and capital assessments needed to fund the projects. This full disclosure allowed the membership to understand what they were being asked to approve and how much it would cost them.

THE COMMUNICATION STRATEGY

The first approval hurdle was the irrigation system. A decision was made to start communicating the rationale and protocol of the tree management plan at the same time. There often is a strong emotional side to tree management programs, and the plan was to start the communication process slowly to allow members to come to grips with it. The initial communication was done as a presentation to the entire membership and to specific groups of the membership. The problems resulting from the awful growing environments and the antiquated irrigation system were clearly enumerated along with the proposed solutions. In addition to these membership presentations, there were numerous articles written for the club newsletter. The USGA Turf Advisory Service Report, which also clearly identified the issues on the golf course, was made available through the club Web site, and there were even some demonstrations on the golf course. Once the strategic plan was finalized, it was presented in conjunction with the operational plan to illustrate the financial implications of the project. Grant Robinson, architect of the strategic plan, presented it to the membership while Superintendent Kuypers presented the operational plans. As the vote drew near, the need for these initiatives was boiled down to five simple talking points that were then communicated to the various com-



Years of sand being blasted out of bunkers created a droughty, infertile soil that was not capable of supporting healthy turf.

developed that addressed all of the key problems, but it then had to be approved by the Golf Course and Grounds Committee, the Finance Committee, the Board of Directors, and ultimately the membership. The golf course superintendent acted as the principal information agent as the plan worked its way through these committees. Once the plan had been approved at the board level, another team was required for the purposes of gaining membership approval.

In order to put the operational plan in the proper context to be communicated to the membership, a strategic plan was developed for the club as a whole. The strategic plan examined the business environment that the club competes in and the club's relative strengths, weaknesses, and opportunities. It also considered threats that the club faced in the marketplace. The plan was projected out over five years and would be reviewed each year as the economic environment changed.

mittees and key members for the purpose of spreading accurate information in membership circles. The efforts proved successful, and phase 1 of the project passed with no opposition.

The communication strategy for phase 2 of the project was different in tone than in phase 1. There were fewer agronomic reasons to renovate bunkers, tees, and cart paths because the decision hinged more on what type of golf course the members wanted. Since most members liked the course to start with, the idea of restoring and enhancing the original, classic design was very appealing. There were three parts to the communication strategy of phase 2:

1. The strategic plan, which had been updated after year 1, was presented by the treasurer to communicate the vision of the club.

2. The methodology behind the renovation work was presented by the golf course architect. The goals were to restore the original design intentions and shot values of the golf course, increase the amount of teeing area (particularly forward teeing grounds), and improve a dilapidated cart path system.

3. The progress of phase 1 also was a key component of the communication of phase 2. Initially, weather issues in fall 2006 had slowed progress, but the spring of 2007 allowed much of that lost time to be made up. More importantly, phase 1 was on budget through the duration of the project.

Again, the efforts at communication proved successful. Phase 2 passed by a wide margin and was undertaken in the fall of 2007.

While the projects were underway, there were many avenues through which members could be updated on the progress of the project. The Web site was updated daily with progress reports, pictures, and the area of the golf course that was being worked on that day, especially if it involved the closing of all or part of a hole. There was also a large project board in the

main lobby of the club that noted which holes were finished, which were next, and the estimated date of completion. Finally, the golf shop was given daily updates on the work in progress. The golf shop staff is the first and sometimes only contact for the players, and it was important for them to be able to give accurate information.

THE EPILOGUE

The communication efforts certainly added to the overall workload of the senior management team and the members who volunteer to sit on various committees. The investment of time and talent by these individuals made for a smooth approval process

and generated significant goodwill from the membership toward a well-executed plan. Most important, the extensive planning and organization efforts that took so much time and energy paid off in the end. The course was improved immeasurably, and seemingly insurmountable problems were overcome in the process of the step-by-step solution. Not surprisingly, the golfers at Cutten are happy to see the end of the projects and are looking forward to enjoying the golf course in 2008.

DAVID KUYPERS is golf course superintendent at Cutten Club in Guelph, Ontario, Canada.



A topnotch new automatic irrigation system with good control and hydraulic flow is an essential tool for effective water management.

INTERPRETIVE SUMMARY

Special Publication 27 March 2008

Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes

This publication is the culmination of discussions and presentations from 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.

Proponents of maintained turfgrass argue its environmental and human benefits, including decreased runoff from storm events, erosion and air pollution control, heat dissipation, recreational and business opportunities, and enhanced property values. Critics, however, point out that turfgrasses in landscapes use excessive water, require excessive or unnecessary fertilizers and pesticides, disturb existing land use patterns, and waste time, money, and resources.

Pending Water Crisis

Several factors will have an impact on the magnitude of any potential water crisis: (1) the rapidly expanding population, specifically in areas of limited or unreliable water resources, (2) a growing economy with new home construction and business development, (3) a potential shift of environmental conditions for plants and animals that rely on water used by humans, (4) landscape plant water requirements, and (5) social and cultural aspects associated with the availability of clean, fresh water.

Indoor water use remains fairly constant throughout the year, but the peak demand for outdoor water use occurs during the summer. Therefore, conservation efforts target landscapes generally and turfgrasses specifically. Flattening the peak demand is an objective of water agencies.

Water Policy

The United States currently does not have a national water policy. Most policies are established at the state and local level, resulting in a drinking water system that is extremely decentralized. It is structured in four basic ways: (1) local government ownership, (2) independent government authority ownership, (3) privately owned companies, and (4) public-private partnerships.

Through the national government, however, the Environmental Protection Agency is responsible for implementing the Clean Water Act and Safe Drinking Water Act and targets its activities to prevent pollution and decrease the risk for people and ecosystems in the most cost-effective ways possible. Through integrated federal, state, and local

implementation, these Acts have had a positive impact on water protection and conservation.

Water Use and Conservation

Water availability and conservation are a priority for the turfgrass industry. The first step is to select the correct turfgrass for the climate in which it will be grown. Though the available scientific data are incomplete, plant selection and landscape design also are key factors in urban landscape water conservation. In addition, communities must develop and implement sustainable water management plans for this purpose. The water program in San Antonio, Texas, is one example of citizen and government cooperation, resulting in decreased water use and economic savings.

Specific cultural practices can be used to decrease water use and enhance drought resistance in urban landscapes, including mowing height and frequency, turfgrass nutrition, and turfgrass irrigation. Secondary practices — soil cultivation, topdressing, wetting agents, plant growth regulators, and pest management — also influence potential water conservation.

The elimination of turfgrasses from open 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.

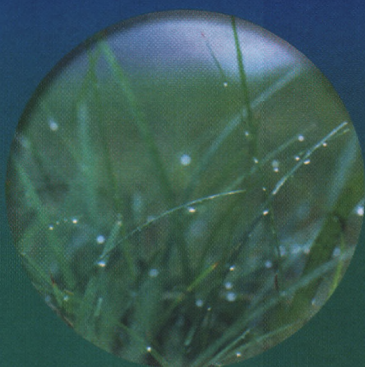
Efficient Irrigation and Alternative Water Sources

The use of alternative water for irrigation is another means of conserving potable water, in both high-rainfall areas and regions of recurring drought. In dry regions of the country, and in highly populated metropolitan areas where water is limited, irrigation with municipal recycled water, untreated household gray water, or other low-quality (saline) water is a viable means of coping with potable water shortages. Much recycled water and all brackish water used for irrigation, however, contain elevated concentrations of dissolved salts that are potentially toxic to turfgrasses. Consequently, periodic monitoring with chemical water analysis is necessary for sound irrigation management. Very few water sources, however, are absolutely unsuitable for turfgrass irrigation.

Important aspects of any irrigation system design include efficient and uniform water application, regardless of the type of water applied, and filtration of suspended matter content in recycled and brackish waters. Additionally, groundwater quality monitoring programs may be required, and, depending on local regulations, sites irrigated with recycled water

Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes

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may be required to protect adjacent properties or bodies of water from irrigation runoff or overspray.

Leaching and Runoff

Beyond water conservation, extensive turfgrass use requires attention to pesticides and fertilizers and their potential for leaching and runoff. Turfgrass managers must adopt practices that decrease the potential for pesticide and nutrient leaching that can harm groundwater and, to some extent, surface water supplies. Most pesticides currently used in turfgrass, however, present fairly low risks of significant groundwater contamination. A healthy turfgrass provides considerable protection against leaching because of high levels of organic matter and associated microbial activity, serving to immobilize and degrade applied pesticides and nitrates. Nitrate leaching may, however, present problems in some segments of the turfgrass industry where nitrogen fertilization rates have not been lowered to account for turfgrass age and clippings return.

Runoff is affected primarily by

- Climate — temperature, evapotranspiration, and volume, intensity, and duration of precipitation;
- Site and soil conditions — soil texture and organic matter content, bulk density, hydraulic conductivity, thatch layer presence, landscape slope, and proximity to water resources; and
- Management — irrigation, drainage, fertilizer and pesticide application, and cultural practices.

Researchers, regulators, scientists, and engineers rely on mathematical models to predict the off-site transport of turfgrass chemicals to water resources. These models are important tools for risk assessment and risk management of turfgrass chemicals, but there are fundamental concerns about the reliability of the model applications.

Comprehensive Approaches

The 1977 amendment to the Clean Water Act established Best Management Practices (BMPs) focused on a holistic, systems approach that addressed concerns for pesticides, nutrients, and sediments related to water quality protection. The Best Management Practices approach has a long track record for being successfully implemented because it

- Is science-based;
- Incorporates all strategies in the ecosystem;
- Embodies all stakeholders and their social, economic, and environmental concerns;

- Values education and communication outreach;
- Allows integration of new technologies and concepts;
- 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.

Adoption of the BMPs model would be beneficial for the turfgrass and landscape industries, allowing them to go forward in a positive and unified manner, be an excellent environmental model, and demonstrate a high degree of environmental stewardship. It would also provide a model for research, education, and extension needs to serve the turfgrass industry and society.

Additionally, an Environmental Management System (EMS) approach brings under one umbrella all environmental issues and consequences on a site. Within an EMS, all environmental issues are addressed, including economic consequences and potential adverse effects.

Assessment

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. The tendency is to use a simplistic approach for eliminating certain water uses by enacting public laws. A single-issue approach, however, can lead to other potentially serious problems.

The nation's water issues need to be addressed in an integrated manner. The fiscal realities facing the nation need to be recognized in order to effectively coordinate the actions of federal, state, tribal, and local governments dealing with water.

Perceived environmental problems must not be addressed in isolation, but in terms of all the interrelationships and stakeholders associated with these landscapes. The ultimate goal is to provide quality urban areas for activities and recreation while conserving and protecting our water supply.

Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes was written by a task force of 25 scientists, co-chaired by Dr. James Beard, Texas A&M University, and Dr. Mike Kenna, U.S. Golf Association. All current members of CAST may request one free copy; please include shipping amount indicated on the order form below. Linda M. Chimenti, Managing Scientific Editor. <http://www.cast-science.org>.

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On Course *With Nature*

Save Water While Increasing Appeal

The Tournament Players Club at Summerlin, Las Vegas, Nevada, goes natural.

BY JOSHUA CONWAY



The Tournament Players Club at Summerlin lowered its water consumption, reduced its maintenance, and increased visual appeal by converting a sizable area to a desert garden.

Water is perhaps our most valuable natural resource, and careful steps must be taken to ensure its continued availability. Golf courses are often criticized for the large amounts of water they use as part of their turf care operations, and, as a result, water conservation projects are often given priority. The Tournament Players Club at Summerlin, a private 18-hole club located in Las Vegas, Nevada, is no exception. Its

location in a desert ecosystem makes it especially scrutinized in the local community.

To reduce water consumption, a 7,500-square-foot area of sheep's fescue adjacent to the 6th hole was chosen for naturalization. Golf course superintendent Dale Hahn selected this project to reduce water consumption and convert an unsightly grass area into a more aesthetically pleasing garden. To achieve these goals, he converted the area into

a low-water-use desert garden that serves as an educational resource for members, informing them about the variety of native plants that could be found on and around the course.

The first step in implementing this project was to cap the existing irrigation lines in the section chosen for naturalization, which would cause the grass to dry out and die. The dead grass and associated organic matter were then removed, and the area was



Using some plants from other sections of the property, this project was completed for under \$3,000 and will result in a labor and water usage saving of over \$2,000 per year.

cleaned down to bare soil. Three hundred plants were transplanted into the area, representing 18 species of desert plants present in the surrounding ecosystem. Once the plants were in place, desert rock and soil were hauled in from other parts of the property and spread over the entire garden area. Labels were placed near the plants, allowing members and their guests to learn about the different plants that were selected for the garden. The labels were professionally made and included the common names and Latin names of the plants in the garden.

The resulting desert garden requires some occasional hand-watering and weeding, but it is considerably less expensive to manage than the sheep's fescue, both in terms of man-hours and associated materials such as fertilizer, chemicals, and fuel. Since the plants chosen for the garden are native desert

plants, they are better suited to the dry desert climate and require much less water. The low-maintenance garden requires only 10 percent of the man-hours that were needed to maintain the fescue, and it will also result in a saving of approximately half a million gallons of water per year.

Many of the plants selected will flower in the spring, adding aesthetic appeal to the golf course while at the same time providing nectar for hummingbirds. The total cost of the project, including labor, was under \$3,000, and it will result in a saving of more than \$2,000 per year, including reduced labor and water use. Many of the plants used in the project were transplanted from other portions of the property, which helped to keep the cost of the project low.

According to Hahn, response to the project has been very favorable, and,

considering all of the environmental factors, the project has been a home run. Plans are underway to expand the project in the future.

Members and guests were kept apprised of the project through photos and information placed on the bulletin boards in the men's and women's locker rooms, as well as in the display that the TPC at Summerlin uses to inform members about the projects undertaken as part of the club's membership in the Audubon Cooperative Sanctuary Program for Golf Courses.

JOSHUA CONWAY is the education and communications manager for Audubon International. He can be contacted at jconway@auduboninternational.org. For more information about the Audubon Cooperative Sanctuary Program for Golf Courses, call (518) 767-9051, extension 12.

Think Outside the Frame!

Golf's bad word — it's time to stop saying and thinking it.

BY DAVID A. OATIS

On nearly every Turf Advisory Service visit, I hear someone utter golf's bad word, and it is beginning to make my blood boil! It is high time we put an end to it. The word I refer to is *framing*. This word has crept into the American golfer vernacular to the point where it now shapes our views and limits our thinking. For many, it has quietly become a virtual tenet of golf course design, and golfers everywhere now assume that every green, landing zone, and even every golf hole must be framed by something. Usually it is mounding or bunkering or trees that do the framing, but it could be some other feature such as naturalized roughs. The discussion of framing now is so pervasive that one might assume that a framing requirement has been written in the Rules of Golf or in the rules of golf course architecture.

The truth is, greens, landing zones, fairways, and golf holes do not always require a frame of trees or mounding, bunkers, or naturalized roughs. The preoccupation with framing may be a product of television, where we usually get a view of individual golf holes and where the view is unnaturally narrowed. Perhaps it also comes from photographs of golf holes, where we see the fairway and green, but only a little rough and even less of the surrounding landscape. We certainly hear the term a lot on television — so often that it seems to be an accepted fact that every golf hole and every part of every golf hole should be framed by something. Nothing could be farther from the truth.

Early golf courses were built on links because the land was so ideally suited to the game. Nature was the architect of these courses, and little was framed in these natural landscapes. If you have ever played a traditional links course, you might remember that, when standing on a tee or in a fairway, it sometimes is difficult to determine in which direction to hit the ball. In these wide-open landscapes, even the largest green will look small, and that can make the hole seem more difficult than it really is. The clear, striking definition we so often find in North America isn't found on a traditional links course. Our current rigid thinking suggests that earth should be moved, berms erected, bunkering created, or trees planted to block views, separate golf holes, define landing zones, funnel our vision, and FRAME! What a crime that would be on a wide-open, windswept landscape.

So, please, think outside the frame for a minute, and ask yourself what is wrong with seeing more of the landscape from one vantage point. Why should our eyesight be limited to seeing one claustrophobic golf hole at a time? Playing golf at many courses now is like looking at a series of tiny pictures or pieces of a puzzle. You can see each hole, but not the entire course. It is much like looking through a keyhole.

Framing closes in landscapes and hides great topography. When trees are used to frame a green and they are too close, they can block a view of the bunkers and/or the topography to the outside of the bunkers. So, is framing a

required element of design? Absolutely not! Can it be a useful tool? Yes, particularly where there are unique designs or unwanted views that are better off hidden. However, another option is to maintain perimeter plantings around the property so that interior views can be opened up. This allows golfers to see more of the landscape and the topography, and golfers are able to see it from multiple vantage points. Opening up older courses and not overplanting new ones allow golfers a rare treat: an uncluttered panoramic view of the landscape and its topography. After all, golf was originally a ground game, and it is the topography that makes great golf courses great.

Framing is not a required element for every design. It is not a rule that must be followed for every course and every hole. In fact, loads of golf holes would be better off without their frames. It is not necessary to turn every golf hole into an individual portrait. Doing so is like giving an artist a palette that is too small for the picture he is trying to paint. So, the next time you hear people talk about how the tree or bunker or whatever "frames" the golf hole or green complex, tell them to open their eyes and look at the entire landscape, not just a snapshot of one small part of it. Tell them to *think outside the frame!*

DAVID OATIS is director of the USGA Green Section Northeast Region.

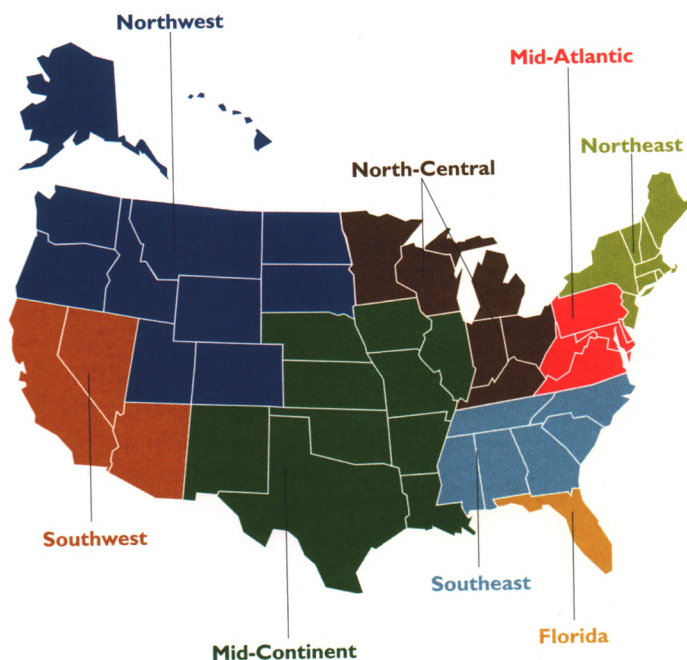


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Turf Twisters

Q: A consultant has told us that shade is the primary reason that a couple of our greens are not performing well. I am confused, though, because the trees that have been recommended for removal only cause shading

during the fall and winter months. How can these trees be responsible? (Connecticut)

A: Shade during the fall months can reduce the turf's ability to harden off thoroughly, and winter shade fre-

quently leads to an increased incidence of winter injury. This can be a result of prolonged snow and ice cover and/or slower thawing in the spring with an increased number of freeze/thaw cycles. Full sunlight penetration all

year is a simple way to increase turf health and vigor, and maximizing light penetration all year can significantly reduce the potential for stress and disease problems.

Q: Our putting greens were sprigged this past summer and are currently in excellent condition. What are any common concerns that we should be aware of for the first winter play season? (Louisiana)



greens is perimeter thinning from continual mowing.

Young greens lack an appropriate pad of thatch and organic matter, necessary for stress recovery. To maintain good turf density during the winter play season, perimeter mowers (preferably walk-behind mowers) should be affixed with solid rollers. It is also important to disperse play properly over the winter

during the first season of growth. Limited entry/exit areas can become quite thin from increased traffic. These issues become tolerable following the first season of growth, when a proper pad has developed, but they are quite stressful during the initial year after sprigging.

A: One of the most common issues of new putting

Q: During extended periods without rain, the edges of our course, particularly areas underneath trees, tend to turn brown first. We have an irrigation system. Why does this happen? (Virginia)



A: Your situation is common. Sprinkler systems are set up on an overlapping pattern, and the quantity of water delivered to the outer edges of the course is lower on traditional double-row irrigation systems. Additionally, surface roots from the trees can extend a distance that is equal to roughly half the height of the tree, and trees and turf compete for what limited water is available.