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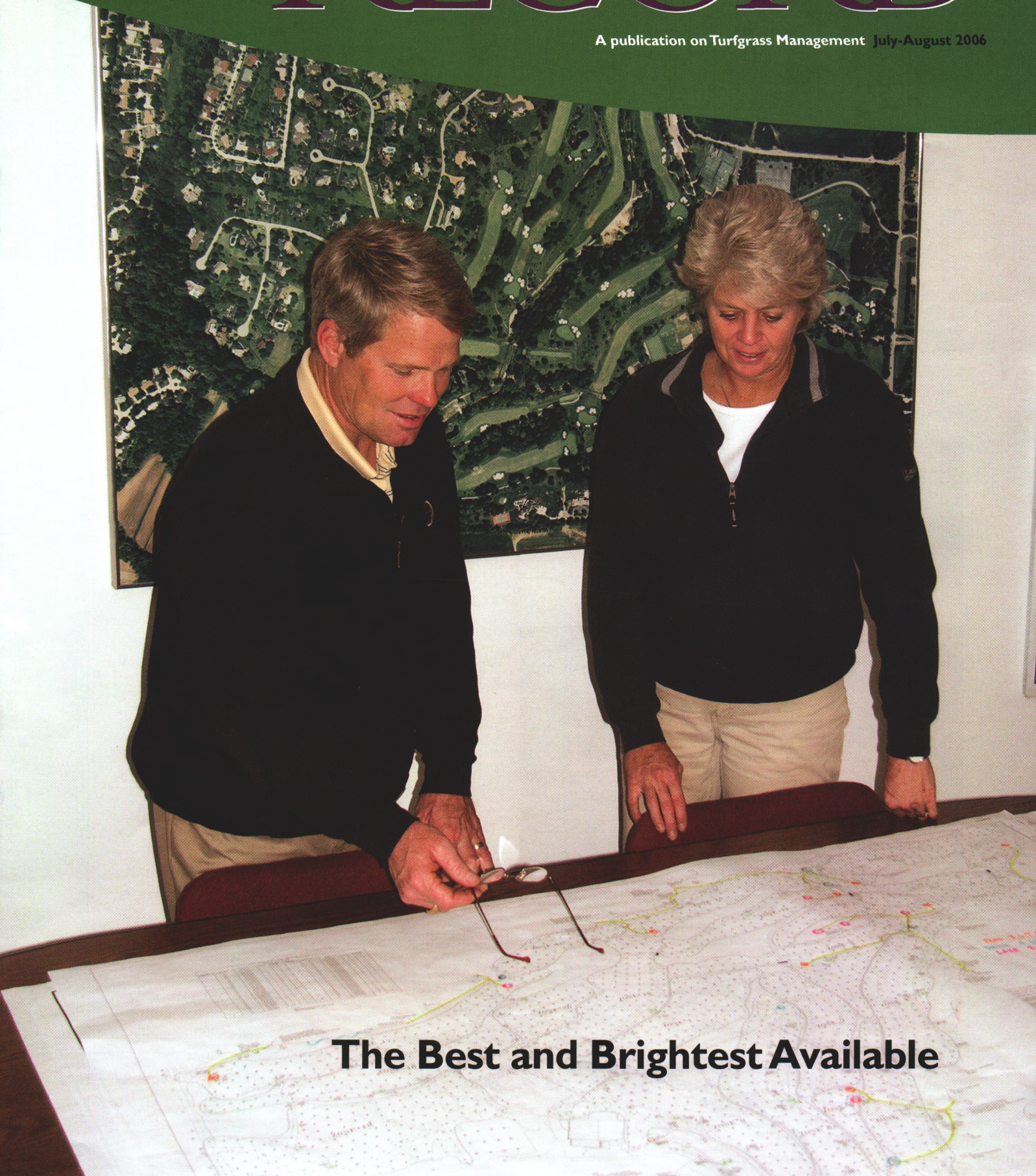

The Best and Brightest Available

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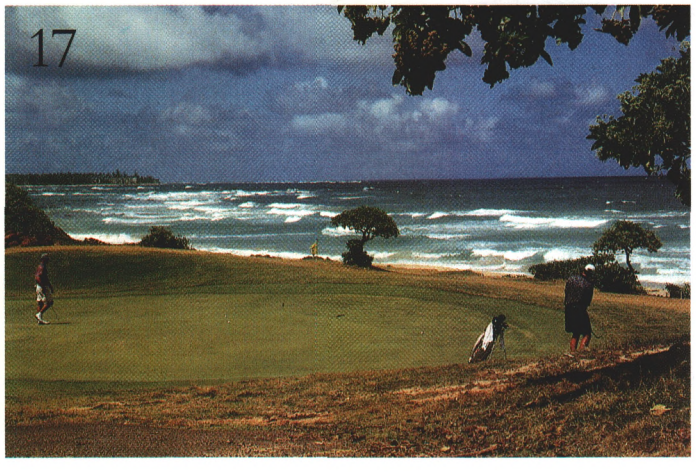


Cover Photo
Assembling a unified team of well-qualified individuals is the most important step towards maintaining a high-quality golf course.

The Best and Brightest Available

Hiring the right superintendent to fill an open position takes time and effort.

BY PAUL VERMEULEN

One should never take the duties and responsibilities of a golf course superintendent lightly. To put things in perspective, putting green maintenance is the most sophisticated form of agriculture and requires equal parts of art and science to produce the high quality playing surface so often demanded by today's golfers. Thus, when a superintendent vacancy arises due to retirement or other circumstance, a selection committee should focus on hiring the best and brightest available.

Make no mistake. Finding good candidates with the kind of well-rounded credentials needed to be a golf course superintendent is a true challenge. To be successful, the right candidates must possess an in-depth knowledge of agronomy and the game of golf, have expert managerial and communication skills, and be keenly aware of environmental issues that challenge our modern society.

To date, the subject of hiring a golf course superintendent has received little attention in the glossy pages of most professional magazines. The reason could be that writing about job turnover is a delicate topic that makes authors uncomfortable, or simply that superintendents are largely taken for granted and most course officials assume that eager candidates will be just outside the door waiting to step in. Whether apprehension or apathy, the truth is that nothing gets done on a

Candidates for a superintendent position must have proficient administrative abilities in addition to a wide range of skills to keep the maintenance department running smoothly and within budget.

golf course without people, and nothing gets done well without capable leadership from the superintendent.

Hiring a new golf course superintendent essentially involves attracting, identifying, and evaluating qualified candidates. The problems faced by ad hoc selection committees, however, are that they have (1) little technical knowledge regarding course management, (2) limited experience administrating a rigorous hiring procedure, and (3) limited free time to spend sitting in long meetings deciding whom to hire. It should not be surprising, then, that many course officials find sidestepping the process too tempting to ignore.

Probably the most common maneuver around a comprehensive process for hiring a new superintendent is to call well-known individuals in the turfgrass industry for a so-called "short list" of top candidates. Realistically, however, no one individual can know all of the best candidates, nor can anyone know who may step forward if the opening is widely publicized. Thus, avoiding the responsibility of conducting an all-inclusive search limits access to a larger pool of candidates, which subsequently can fail to bring forward many good candidates for an open position. Furthermore, discussions about unofficial candidates from a short list can spark false rumors of a superintendent's job dissatisfaction and unnecessarily endanger his/her current position.

Superintendent candidates with extensive construction experience may merit special consideration in the interview process when the golf course requires major improvements in the foreseeable future.

Executive search firms can provide administrative assistance with part of the hiring process, such as writing a job description/posting, preliminary candidate screening, candidate recruiting, and conducting background checks. Keep in mind, however, that the role of such firms should be to aid the open hiring process for the convenience of a selection committee and not to act as an exclusive porthole through which a short list of candidates can be obtained. A directory of search firms that have established a credible track record is available from the GCSAA.

Given the pitfalls of seeking an easy resolution for employers and potential candidates alike, the best course of action for selection committees is to use a hiring strategy that can maximize the likelihood of success, keep people out of harm's way, and convey the importance of the superintendent's role in the game of golf. The approach presented in this article is one that has worked well for selection committees in the Mid-Continent Region. It's not intended to suggest that it is an industry standard, because there is none. Rather, it's an example of an objective process that can be used by selection committees to identify good candidates. And, while this article is directed at selection committees, it can also be used as a guide for developing a succession plan by forward-thinking superintendents.

GETTING STARTED

Every successful formula for hiring a professional staff member begins with an understanding of how that person contributes to the overall operations of a facility. Few selection committee members have a clear understanding of a superintendent's entire range of responsibilities, so the best place to start the hiring process is to develop a detailed job description for the position. To help expand the language of this document, a sample job description is available in the Career & Employment Services section of the Golf Course Superintendents Association of America's (GCSAA) Web site (www.gcsaa.org/career).

Developing a general understanding of a superintendent's normal duties, members of a selection committee will also be better prepared to write a detailed job posting, respond to questions about the opening from interested candidates once it is published, and ask meaningful questions when interviewing final candidates. If a job description is already being used for conducting annual performance reviews, then it should be carefully

reviewed during the first meeting of the selection committee and updated, if necessary.

After penning a job description, the next step is to put together a salary and benefits package. This information is also needed to write a job posting, although exact details are not required for an advertisement (see Figure 1), and to answer phone calls from would-be candidates who want to learn more about the opportunity. Of special importance here is that the course's top officials must be in full agreement with the details of the package and, in particular, the maximum salary figure. If not, an awkward situation could develop should someone on the selection committee talk to a candidate about a higher salary figure than can be offered. Basic information on salaries and benefits is available in the *Compensation and Benefits Report* published by the GCSAA in Lawrence, Kansas. At a cost of $400, this report summarizes local, state, and regional statistics based on a biennial survey of association members.

When assembling a salary and benefits package, the committee should decide whether or not to use an employment contract. Typically, such a document defines the terms and conditions of employment, compensation, and benefits; causes for termination; and annual bonus criteria. The advantage of such a document is that it can be used in final negotiations as a show of good faith with a top candidate concerned about employment stability. A sample employment contract is also available for public view in the Career & Employment Services section of the GCSAA's Web site. If using an employment contract is not preferred, then a straightforward offer letter covering the terms of employment should be drafted for later use in the hiring process.

ATTRACTING CANDIDATES

After finalizing the preliminary documents, the next big task is to create an invitation that will attract interested candidates. This effort starts with writing a detailed job posting that describes the position, the course, employment compensation, preferred qualifications, application deadline, and contact information. The goal is to write an advertisement that will interest candidates with credentials that match the position's responsibilities. This is accomplished by providing details about the facility and stating the preferred qualifications. For example, if the course has a high profile in the community and requires a rigorous daily routine to maintain it in top condition, then stating a preference for candidates with ten or more years of experience may be entirely appropriate. Absent details, the selection committee may be inundated with résumés submitted by everyone taking a blind shot at a once-in-a-lifetime opportunity.

Once the job posting has been suitably crafted, it is time to cast a wide net by getting it in front of as many eyes as possible. This is done by running an ad with the local and national superintendent associations, both of which charge a small fee to cover expenses. Also, it is a good idea to circulate the information among individuals who can share it with interested parties. While it is inappropriate to contact people for a short list of names simply to avoid the responsibility of conducting an objective candidate search, it is not inappropriate to request assistance with gaining the attention of a superintendent who might have an interest in moving should the right

Golf Course Superintendent
Prairie Fire Golf Club
Tallgrass, Illinois

Course Description: Prairie Fire Golf Club is a planned, 18-hole facility that will indulge golf enthusiasts from all over the United States. Designed with ol' world links in mind, the course will be sited on 450 undisturbed acres of naturally occurring dunes in central Illinois. Sustainable maintenance standards will be supported by a state-of-the-art infrastructure and an estimated $1.5 million annual budget. Pending superintendent selection, turf species establishment and construction details are yet to be determined.

Employment Compensation: A regionally competitive salary and benefits package will be negotiated with the final candidate. The terms and conditions of employment shall be specified in a written agreement.

Preferred Qualifications:

1. Twenty years of related experience, with ten years of experience as a golf course superintendent.
2. Bachelor of Science degree in environmental and/or turfgrass related studies.
3. Direct experience with native landscapes, course construction, major tournament preparations, and cool-season turfgrass management.
4. Accredited participation in GCSAA career development programs.
5. Proficient oral and written communication skills.

Application Deadline: November 1st; position available immediately.

Contact Information: S'even Underpaar, President & CEO
The Turning Point Development Co.
29 Halfway Circle
Golf, Illinois 81855
E-mail address: 7under@TheTurn.net

Note: All inquiries will be handled with strict confidentiality.

Figure 1.
When posting an ad for an open position, specific details should be provided so as to create interest among candidates with credentials matching the job's responsibilities.

opportunity arise. Lastly, selection committee members who believe they know a good candidate should contact that person directly, as opposed to involving the employer, to find out if he or she might have an interest in pursuing the opening.

As a matter of procedure, upholding a firm policy of confidentiality is very important during all stages of the hiring process. Without it, the selection committee can easily construct a barrier between themselves and many candidates whose first priority is to protect their current position and avoid rumors of discontent. Understandably, when the time comes to check references over the phone, maintaining absolute confidentiality is virtually impossible; nonetheless, it is valuable for the committee members to continue their trek along high ground by using discretion regarding private conversations.

NARROWING THE FIELD

Every effort to publicize an available position will be rewarded with a significant number of résumés, especially if the position carries with it some degree of professional prestige. Thus, it will be necessary to reduce the candidate pool to ten or so applicants for potential interviews. Initially, the only logical method of narrowing the field of candidates is a careful review of the submitted résumés.

To ensure an objective résumé review, a list of selection criteria must be established. The major criteria that pertain to the superintendent's profession include: level of formal education, years of experience, participation in continuing education or certification programs, and regional expertise. Other criteria that may be helpful in sorting a large group of résumés can include: environmental leadership, service to professional organizations, golf knowledge, and unique experience(s), e.g. course construction, major tournament preparations, etc. Whatever the circumstances, the goal is to tailor a list of criteria that is fair and balanced and to apply those criteria uniformly.

It is important to keep the applicant abreast of his/her status throughout the hiring process. This

is more than a simple matter of etiquette, as the superintendents' community can be exceptionally tight knit and the impolite handling of any one individual can spawn legitimate concern among a larger group. To keep an applicant current, a short letter should be mailed stating that the selection committee has received the résumé and that the candidate will be contacted as each phase of the hiring process unfolds.

Once the selection committee has identified ten or so leading candidates, the time has come to pick up the phone and start making calls to whittle the list down to three or four for interviews. The first calls should be made to the remaining candidates themselves. The threefold aim of these conversations is to clarify information stated on the résumé, gauge the candidate's true level of interest in the position, and evaluate general competency. As a word of caution, try to avoid reading too much between the lines. It may be difficult for some top candidates to fully express themselves over the phone. The second round of calls should be to references provided by each candidate and to individuals who are known to have working relationships with the candidates.

Whether the golf course is located in a densely populated urban area or in a less populated location of the country, greater emphasis is placed on environmental issues and associated maintenance practices. Golf course superintendents with the skill sets to address these issues have an added advantage when competing for available job openings.

CONDUCTING INTERVIEWS

With the candidate pool whittled down to a manageable number to interview, the remaining challenge is to identify who among them is best suited for the position. The key is to create a stage on which the final candidates will have an equal opportunity to showcase their abilities. To help set the stage, a packet containing confidential information about the facility should be sent to each finalist. Such a packet should include the previous year's maintenance budget with a line item breakdown, the green committee's maintenance standards, a master plan summary (if applicable), past USGA Turf Advisory Service reports (if available), soil and water test reports, and an employee organizational chart that includes position descriptions. Being provided with in-depth information about the facility, candidates will have the opportunity to talk specifics during the interview, as opposed to talking about what-if scenarios or other courses that have nothing to do with the subject at hand.

After the information packets are mailed out, each final candidate should be invited to tour the property before meeting with the selection committee. To give the impression that there is indeed sincere interest in meeting with each of the final candidates, it is always best to schedule visits to the course independently. If that is not feasible, then every effort should be made to keep the candidates separated at all times. Remember, interviewing is a two-way proposition. There is

no point in trying to attract the best and brightest available only to drive them away with carelessness or neglect before they can be hired.

We all like to feel appreciated. As every candidate deserves individual attention, it is good to have a prominent individual, such as the club president, on hand for an official welcoming. Simply telling someone to pick up a cart key at the golf shop when they arrive and drive themselves around the course sends good candidates running for home. If an employer cannot find the time to meet a candidate when he/she first arrives, why would a newly hired superintendent believe that he/she would get any attention whatsoever when coming to work seven days a week?

Tours of the property should include an opportunity to see every hole, the maintenance facility, and clubhouse. Further, as the intent of the tour is to give final candidates ample opportunity to gather information about golf operations, a knowledgeable host should be provided for each leg of the tour. For example, during the visit to the maintenance facility the outgoing superintendent or the assistant should be in attendance. Likewise, golf professionals make good hosts during the ride around the course, as they can provide valuable insight regarding playability issues. By including other staff members in the interview process, the selection committee can include their input when conducting the evaluation of the finalists.

When a golf course hosts a golf championship, the ability to handle a large staff, both paid and volunteer, is an essential skill. Leadership and managerial skills of a potential golf course superintendent should be an important part of the selection criteria in any hiring situation, but special consideration should be given if a golf course has plans to host a large event.

The time has now come for the selection committee to meet each candidate behind closed doors. By this point, everyone in the room should be able to have an informed and intelligent conversation about what lies ahead. The onus, however, is squarely on the shoulders of the candidate, whose task it is to establish confidence in his/her abilities and to give a vision for upholding the maintenance standards, if not lifting them to a higher level. The members of the selection committee must now integrate all that they have learned through the selection process to discern fact from fiction and rate each candidate's capabilities.

At the conclusion of each interview, the selection committee should request a written summary of the candidate's recommendations for the course with a prescribed due date, typically seven days. This report not only keeps the interview fresh in the minds of the selection committee's members, but it also offers an opportunity to evaluate written communication skills. It may also be desirable for the selection committee to seek an invitation from two or more finalists to visit their current places of employment. No committee member should ever show up unannounced, as it may create an awkward situation and jeopardize the confidentiality of the process.

Having covered all of the bases, the selection committee can now rank the final candidates in order of interest. This ranking should be based primarily on the quality of the interview, input

To produce a high-quality golf course commensurate with triple-digit green fees, golf course owners must place special emphasis on hiring a superintendent with the ability to properly train, coordinate, and motivate the daily activities of a large maintenance staff.

from staff members who interacted with the candidates, the quality of the summary report, overall management style (communication skills, professionalism, leadership qualities, and organizational skills), and the credentials of the candidate. Rankings completed, an offer can then be made to the top candidate, pending a background check. Background checks should be conducted by a third party to separate course ownership from future litigation stemming from clerical errors in the acquired information.

Interestingly enough, there is a strong probability that the top candidate will decline a reasonable offer. Leading reasons often stated for such a decision include counteroffers from current employers and family circumstances arising from the proposed change in employment or a long-distance move. (Recall the comments about discerning a candidate's true interest in taking the position?) Given the significant odds against the top candidate accepting an offer, care should be taken to avoid letting the second- and possibly third-ranked candidates from becoming discouraged before all of the i's are dotted and the t's are crossed.

CONCLUSION

By this point, it probably has become obvious that using a well-conceived hiring process takes considerable time and effort. Hiring the right person to take on the responsibilities of superintendent is truly the first and, more accurately, the most important step towards maintaining a golf course in optimum condition. To find the best and brightest available, develop a sound strategy that openly invites all eligible candidates to the table and objectively evaluates each set of credentials. Then, follow the process through to the end without succumbing to the temptation of simply hiring someone who someone else thinks is the *right choice*. In the end, your effort will be rewarded each time you walk up to the first tee.

Acknowledgement: I would like to thank the Selection Committee at Olympia Fields Country Club in Olympia Fields, Illinois, for test driving the hiring procedure discussed in this article in the recruiting of the new Director of Grounds Maintenance.

PAUL VERMEULEN *joined the USGA Green Section in 1987 as an agronomist in the Western Region and has been the Director of the Mid-Continent Region since 1996.*

Research *You Can Use*

Non-Target Effects of Fungicide Applications on Microbial Populations of Putting Greens

Surprisingly, research at Cornell University demonstrates that fungicides have little effect on long-term populations of putting green microbes.

BY G. E. HARMAN, E. B. NELSON, AND K. L. ONDIK

Currently there are between 20 and 30 million acres of turfgrass in the United States, consisting of lawns, parks, golf courses, athletic fields, sod farms, industrial and institutional grounds, rights-of-way, and other recreation areas. The turfgrass industry continues to grow rapidly.

The management of turfgrasses, especially on golf course greens, represents perhaps the highest level of plant management practiced on any agricultural or horticultural commodity known today. Proper turfgrass management involves a number of rather complicated mechanical, physical, chemical, and biological manipulations that result in the desired product of a blemish-free carpet of green grass.

Highly maintained turfgrass sites characteristically use high inputs in the form of fuel, fertilizers, pesticides, and water for irrigation. Pesticide use, in particular, can be substantial. The use of fungicides is a major tactic for controlling diseases on high-quality turfgrasses. This is particularly true on putting greens. Short cutting heights, the ever-increasing amount of traffic on putting greens, and low nutrient inputs have placed unprecedented stresses on turfgrass plants, making them highly susceptible to damage from many different diseases, some of which were previously considered relatively unimportant.

The majority of fungicide applications are made to putting greens and tees, making the amount of fungicide applied per unit area quite high. Since many high-maintenance turfgrass sites are found in close proximity to surface waters and within groundwater recharge areas, and primarily in and around urban areas, questions have been raised as to the impact of such a land use on water quality, wildlife, and human health, particularly as it relates to pesticide exposure.

Further, there have been a number of non-target effects of fungicides in turfgrass management systems. These have included selection of fungicide-resistant biotypes of pathogens, promotion of non-target diseases, enhanced thatch buildup, decreased root or stem biomass, and rapid disease resurgence following fungicide applications.[5]

Given the high levels of fungicides applied to turfgrass, we considered it likely that high levels of applications of frequently applied fungicides would alter soil and foliar microbial communities. This perturbation would be expected to have significant consequences, including the promotion of non-target diseases and rapid disease resurgence, because of the destruction of natural antagonists of turf pathogens. This article summarizes three years of extensive sampling of turf microbial communities in the presence and absence of fungicide applications.

HOW THE RESEARCH WAS CONDUCTED

In 1996, five eight-foot diameter "swimming pool" greens constructed in 1995 at the Cornell University Turf Research Farm in Ithaca, N.Y., were used as the experimental microplots. The pools contained the standard USGA sand/peat rootzone profile.

Subplots consisted of an untreated plot and the seven fungicide treatments. Each subplot was three square feet and each treatment was represented on each pool. The fungicides selected represent different classes with different modes of action. For example, Daconil Ultrex (chlorothalonil) is a contact fungicide with a relatively non-specific mode of action against most classes of fungi.

Table 1

Cornell University scientists tested various turfgrass fungicides shown below to see whether their repeated use would have significant effects on either foliar or soil-borne microbial populations of putting greens.

Treatment	Active Ingredient	Rate	Application Interval
Untreated	— —	— —	— —
Daconil Ultrex	chlorothalonil	3.6 oz./1,000 sq. ft.	14 days
Chipco 26019 Flo	iprodione	8 oz./1,000 sq. ft.	21 days
Subdue Maxx	mefenoxam	1 oz./1,000 sq. ft.	21 days
Banner Maxx	propiconazole	4 oz./1,000 sq. ft.	21 days
Bayleton 25W	triadimefon	4 oz./1,000 sq. ft.	21 days
Prostar 50WP	flutolanil	3 oz./1,000 sq. ft.	14 days
Sentinel	cyproconazole	0.167 oz./1,000 sq. ft.	21 days

Chipco 26019 Flo (iprodione) selectively damages energy-producing organelles in select fungi. Banner Maxx (propiconazole) and Bayleton (triadimefon) are systemic in plants and have a very specific mode of action, inhibiting a specific enzyme necessary for fungal cell integrity.[3] In all cases, if alternative rates are registered, we always used the maximum legal rate of the fungicide. The treatments, active ingredients, rates, and application schedules are shown in Table 1.

Two hundred milliliters of the appropriate rate was applied to each plot using a hydraulic CO_2 sprayer. Samples were taken from the plots starting in May, before any fungicide application, and monthly thereafter through September. Nine to 12 1.0cm-diameter cores were taken from each subplot at a depth of 3cm and transported to the laboratory for microbial assays.

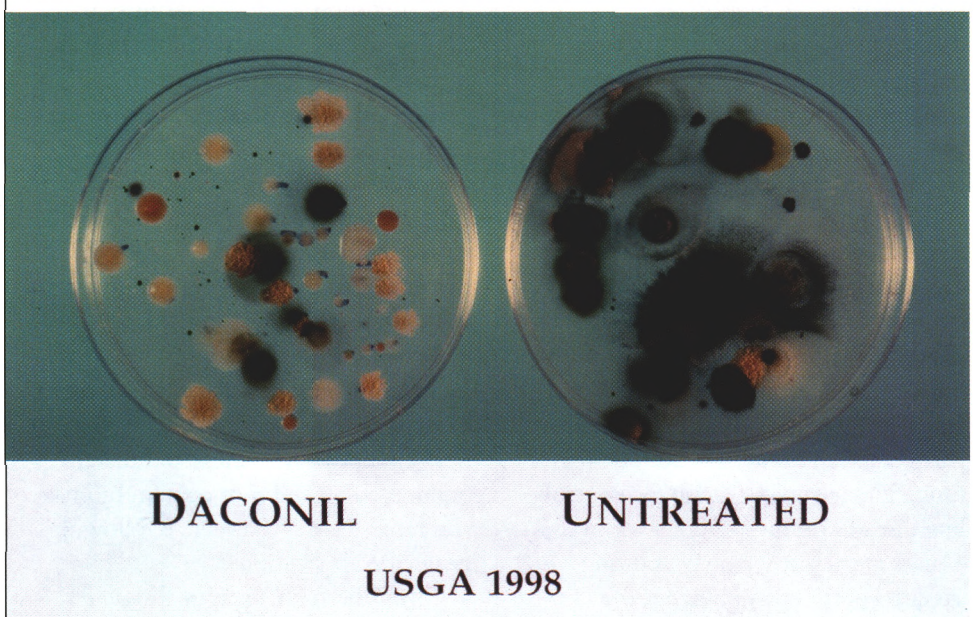
Microbial plate counts were determined by performing a serial dilution in phosphate-buffered saline (PBS) and plating appropriate dilutions on solid media. Acidified potato dextrose agar plus a microbial colony restrictor[4] was used to enumerate total culturable fungi. This medium eliminates growth of bacteria and permits characterization of colonies based on colony morphology. Some of the most common fungi encountered on this medium were *Trichoderma* and *Penicillium spp.* and yeasts. These fungi are very common in soil and on roots and usually have either few effects on plant growth or else have beneficial ones, including biocontrol abilities. Total culturable bacterial population numbers were estimated by plating on tryptic soy agar (10% strength). This is a differential medium favored by bacteria, and fungi grow poorly on it.

We also examined specific microbial groups. For Actinomycetes, which are filamentous bacteria, we used 0.02% tripticase soy agar plus the antibiotic polymixin B sulfate. This nutrient-poor medium is favorable for Actinobacterias, with minimal growth of fungi or other bacteria. *Pseudomonas spp.*, which are common plant-associated bacteria and frequently have biocontrol ability, were enumerated on a selective medium that we have used earlier.[4] Finally, we enumerated Oomycetes in the genus *Pythium* using a *Pythium*-selective medium.[4] These organisms may be plant pathogens or biocontrol organisms, depending on the particular species and strain that may be present.

In addition, BIOLOG GN plates were used to assess functional diversity by means of metabolic profiles. General levels of microbial activity were determined by the rate of hydrolysis of fluorescein diacetate. Finally, phospholipid fatty acid profiles were used to assess taxonomic diversity of microbial communities.

WHAT WE FOUND

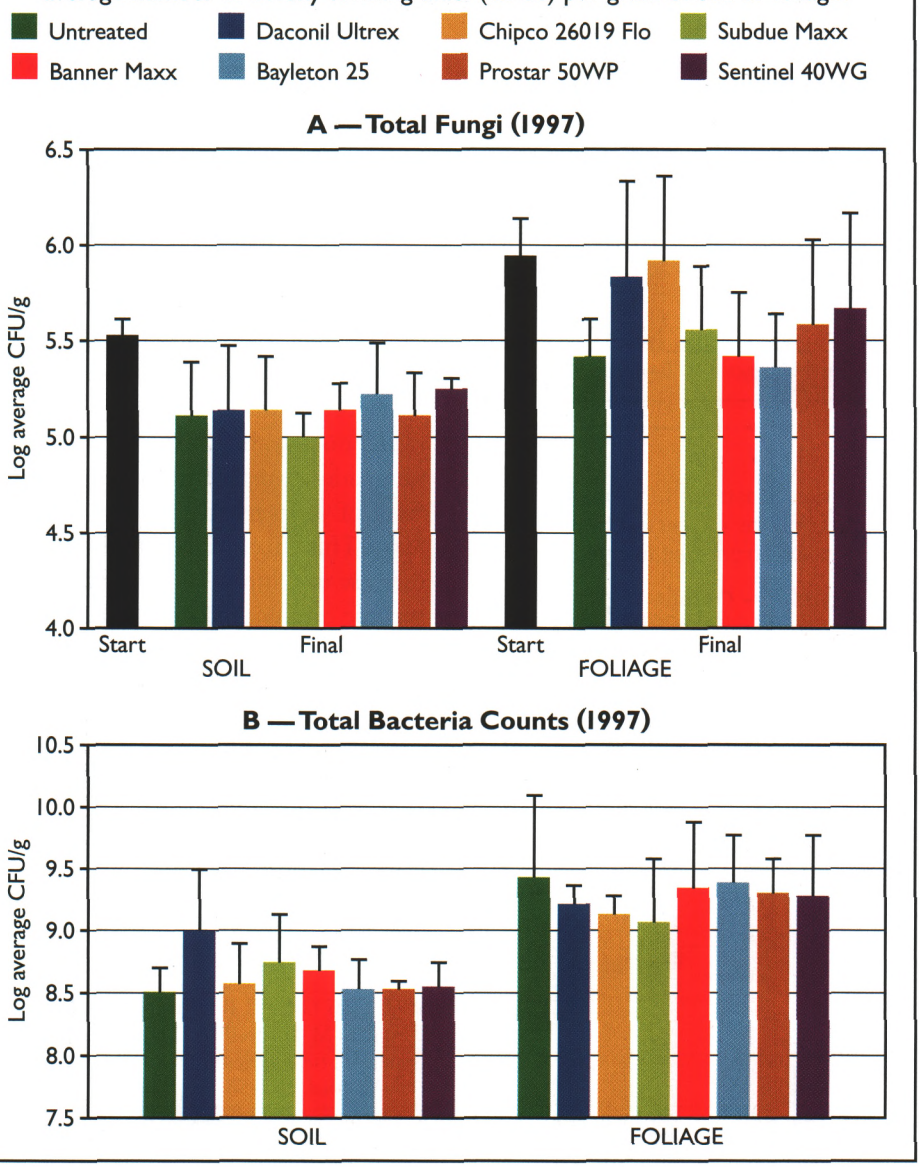
In 1996, we sampled roots from the plots every month and evaluated changes in the microbial profiles using the various media. We detected no significant differences and the results were similar to those in 1997, so we will present only the 1997 data. Similarly, we found no significant differences in BIOLOG microbial metabolic profiling, based on principal component analyses.



These dilution plates represent the appearance of cultures from untreated plants and Daconil Ultrex-treated leaves. The dark colonies are filamentous fungi and the white to tan mucoid cultures are yeasts. Fungicides have been found to have little effect on long-term populations of putting green microbes.

Figure 1

Enumeration of total fungi (A) at the start of the 1997 season (May) and after a full season of fungicide applications (September). Total bacteria (B) are represented only at the end of the season. Populations are represented by the log of the average number of colony-forming units (CFUs) per gram of soil or foliage.



We also found no differences in general microbial activity or following phospholipid activity tests.

In 1997, we sampled both roots and leaves. The total number of fungal propagules detected was greater in soil at the start of the season than later, but there were no significant effects even after the season-long application of fungicides, regardless of the fungicide applied (Figure 1). On leaves, there were no significant effects of fungicide applications on total numbers of fungi, regardless of time or fungicide application. Most of the fungi detected were in the genus *Trichoderma*. We were able to distinguish between species similar to *T. virens* and those similar to *T. harzianum*, since the latter has a tan pigmentation on the reverse side of the acidified potato dextrose agar plates while those of *T. virens* are white.

There was no significant effect of time or treatment on either *Trichoderma spp.* in soil, but on foliage, there were initially higher levels of *T. harzianum* at the start of the season. By the end of the season, there were no differences between the two, and fungicide applications made no difference. Likewise, the fungicide applications had no effect on total numbers of *Pythium spp.*, total bacterial, Pseudomonad or Actinobacteria numbers.

In contrast, nearly all of the fungi on leaves were similar to *T. harzianum*, but by the end of the season, other fungi had largely displaced *T. harzianum*, and were predominately yeasts, *Penicillia*, and others. This was particularly true with plants that had been treated with Daconil Ultrex. On plants treated with Bayleton 25, *T. harzianum* remained the predominant culturable fungus (Figure 2).

In 1998, we performed a mini-experiment on a soil green at the Cornell University Turf Research Farm. In September and again in October, we focused on the timing of sampling after application of fungicides. We sampled the plots before we made the scheduled application (day 0), one day after the application (day 1), and again seven days after the application (day 7). FDA hydrolysis analyses and fungal enumerations were performed at each sampling time (i.e., days 0, 1, and 7) for four different treatments: untreated, Daconil Ultrex, Chipco 26019 Flo, and Banner Maxx. Three repetitions of each treatment were sampled. For the final sample set, all treatments were sampled one day after the final fungicide application.

The relative numbers of filamentous fungi versus yeasts changed substantially on turf leaves as evidenced by both the numbers and plate appearances (Figure 3). However, there was no significant difference in total microbial metabolic activity among fungicide treatments as measured with the FDA test. Most of the fungi isolated from leaves of untreated plants were filamentous fungi, while after the season-long application of Daconil, most of the fungi isolated were yeasts. With Chipco or Banner, the change in populations of filamentous fungi versus yeasts was more transitory, dropping immediately after application and then increasing within a week.

Figure 2

Changes in leaf fungal compositions over time (start = May 1997) and at the end of the season as affected by different fungicide applications.

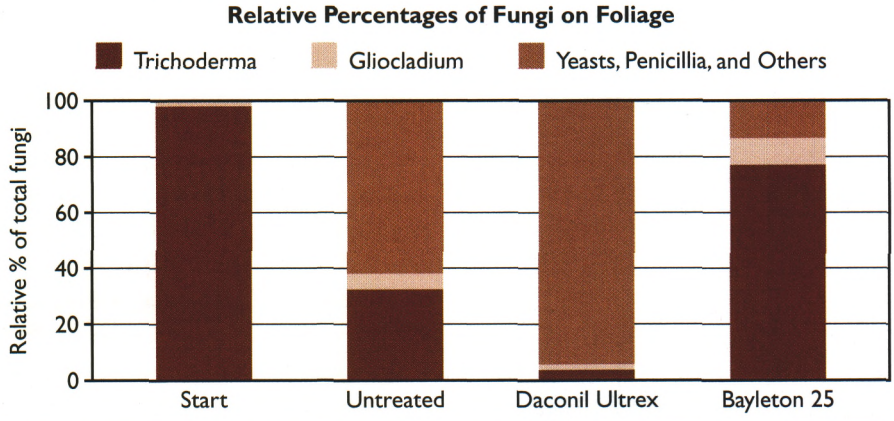
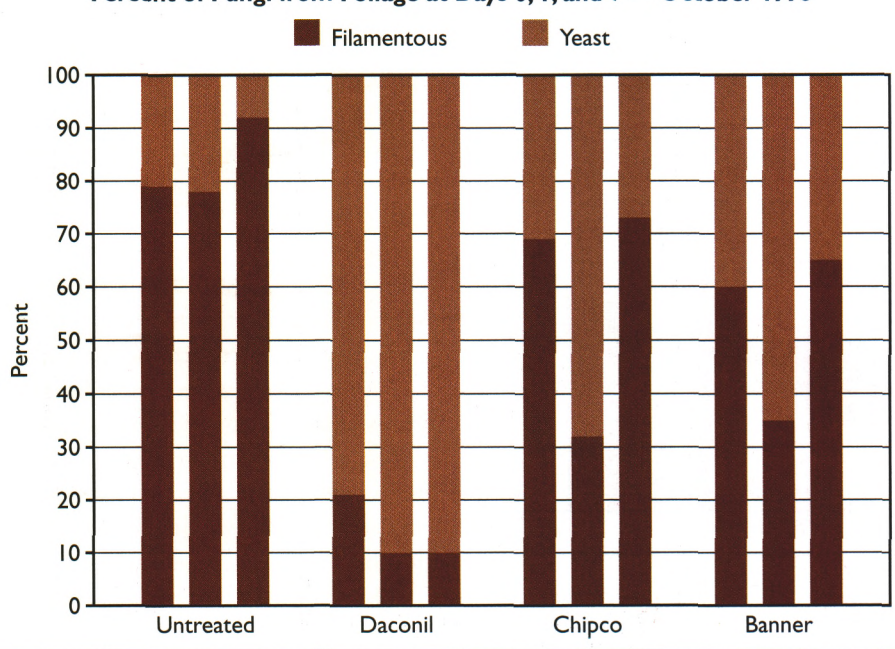


Figure 3

Changes in populations of filamentous fungi versus yeasts on turf foliage just before and shortly after fungicide applications as expressed by percentages of filamentous fungi or yeasts isolated from turf foliage.



ORIGINAL HYPOTHESIS WAS WRONG

Our hypothesis at the start of the work was that repeated applications of fungicides would dramatically change the microbial composition around roots and on leaf blades. This clearly was not the case with any of the fungicides tested. On roots, we could see no changes whatsoever with plating tests, BIOLOG tests for metabolic profiles, fatty acid microbial profiles, or tests for total microbial metabolic activity. Thus, while different results might be obtained with other assays, such as ribosomal DNA assays, it does not appear that repeated applications of fungicides have major impacts on soil microbial communities.

This may be because (a) the fungicides are mostly water insoluble and therefore do not penetrate deeply into the soil, or (b) the soil microbial community is highly competitive and resilient and able to rebound very quickly after fungicidal applications. The fact that *Trichoderma spp.* are so prevalent in the fungal community may also be significant since many members of this genus are highly resistant to a variety of fungicides[2] and their populations could be selectively favored over the years that greens are established.

We were particularly surprised at the leaf plating data, which at first glance gave little indication of change based on numbers counted on the various media. However, it now is clear that while total numbers of fungi on leaf blades do not change, the application of fungicides changes the composition in favor of yeasts relative to filamentous fungi. This effect may be transitory, as in the case of Chipco, or longer lasting, as was the case with Daconil. The fungal community on leaf blades appears highly dynamic and changing in response to fungicide applications. It is important to note that the natural dollar-spot epiphytotic that occurred each year was controlled by fungicides as expected.

LITERATURE CITED

1. Anonymous. 2005. Fungicides hit growth spurt in turf and ornamental markets. *Grounds Maintenance* 40(8):6.

2. Harman, G. E., C. R. Howell, A. Viterbo, I. Chet, and M. Lorito. 2004. *Trichoderma* species — opportunistic, avirulent plant symbionts. *Nature Rev. Microbiol.* 2:43-56.

3. Köller, W. 1992. Target sites of fungicide action. CRC Press, Boca Raton, Fla.

4. Norton, J. M., and G. E. Harman. 1985. Responses of soil microbes to volatile exudates from germinating pea seeds. *Can. J. Bot.* 65:1040-1045.

5. Smiley, R. W., P. H. Dernoeden, and B. B. Clarke. 1992. Compendium of turfgrass diseases. 2nd edition. APS Press, St. Paul, Minn.

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An Organic Approach to Golf Course Management

An island mandate becomes reality.

BY JEFFREY W. CARLSON

A blend of Tiger colonial and L-93 creeping bentgrasses, with Jamestown II chewings fescue, has produced quality fairway playing surfaces that tolerate the most prevalent disease on the golf course, dollar spot.

In November 1998, I joined a team of developers to build a golf course on the island of Martha's Vineyard, situated just off the coast of Massachusetts. A year and a half and a mountain of paperwork later, this abandoned 148-acre lot subdivision gained approval for a private 18-hole golf course. One of the 36 conditions of approval was that the golf course be managed with natural organic fertilizers and without traditional pesticides. With faith in some of the recent advances in turfgrass research, a concern for the future of pesticide use in the United States, and a history of not always thinking through the long-term ramifications of my actions, I accepted the position as construction and grow-in superintendent for the new, organically managed golf course, The Vineyard Golf Club.

PLANNING AND CONSTRUCTION

Realizing the challenges that lay ahead, we invested a great deal of time working with the architects Donald Steel and Tom Mackenzie, the USGA Green Section, and various local universities to determine the most effective construction techniques, help identify potential pest problems we were likely to face, and select grasses and materials that would provide the greatest chance for success. We cleared more than 30,000 trees from the site, disked forest litter into existing topsoil to improve its structure and organic content, and seeded with grasses deemed to be most resistant to the diseases common to the area. All of the greens were lined with plastic, and lysimeters were installed at

Managing dollar spot disease without fungicides can be a trying experience, as illustrated on the experimental practice chipping green. A combination of sound cultural practices and the use of several bio-products have reduced the disease pressure and damage on the regular greens to an acceptable level.

the exit points. Ground wells also were installed along the perimeter of the property to measure nitrate nitrogen leaching on the site.

Evaluating these techniques five years later, I am glad we modified the sandy topsoil, but I wish we had cleared even more trees and had not been forced to install the liners that have since impacted drainage in the USGA greens. Conversely, we were fortunate to be able to choose from varieties of newer and more disease-resistant grasses, and we have unexpectedly benefited from the requirement to install the monitoring wells.

The benefit was realized when abutting homeowners reported nitrate levels in excess of the state drinking water standard in their wells. Immediately, all fingers pointed to the golf course as the source of the contamination. Armed with well records that verified that groundwater exiting the property never exceeded the state threshold, the local board of health agent and county water resource planner were able to demonstrate to the homeowners that their individual septic systems were the probable source of contamination. Had we not installed those wells prior to grassing and had we not routinely disclosed our results to the local authorities, the golf course may have been liable for the installation of a municipal water and sewer system at an estimated cost of $1 million.

THE EARLY YEARS: BATTLING DISEASE

The grow-in period proceeded rather smoothly and the golf course opened with a great sense of accomplishment. A combination of aggressive nitrogen fertility, timely applications of *Pseudomonas* tx-1 (Bioject), and traditional cultural practices typical for a new course made this superintendent feel pretty confident. There was some light dollar spot and scattered take-all patch active by early summer, but it did not seriously impact the turf or playing conditions. Disease pressure intensified as the weather became more severe in the summer. The bottom fell out as dollar-spot disease severely damaged the greens and tees. *Pythium* blight and brown patch, which are rarely problems on Martha's Vineyard, also became active with the unusually high temperatures and humidity occurring that summer.

So, it was back to the drawing board. We re-evaluated our existing programs and modified the organic management plan by reducing nitrogen and water inputs, altering the *Pseudomonas* delivery

Above: During the golf course planning stage, we did not fully comprehend the extent of damage associated with crows and skunks in search of white grubs on an organically managed golf course. Right: An innovative approach is often required when managing a golf course without traditional pesticides. Because no curative means of controlling oriental beetle grubs was available, we instead targeted management efforts against crows, skunks, and raccoons that were damaging the surfaces while in search for the grubs.

system, and supplementing the program with the bio-pesticide Ecoguard. We diligently continued to remove dew every morning and to topdress and aerate the greens both conventionally and with the Toro Hydroject machine. The disease activity eventually waned and the turf recovered everywhere except on the sixth and ninth greens, which were located in more shaded and stagnant growing environments. Forty pitch pines were subsequently removed, and one year later the sixth and the ninth are two of the healthiest greens on the course.

YEAR 3: THE YEAR OF THE GRUB

With disease pressure somewhat under control, our confidence once again began to grow, at least until the oriental beetle, *Exomala orientalis*, decided to call the tees, fairways, roughs, and bunker banks home. The real fun began that fall when a sizeable number of Martha's Vineyard's skunk and crow populations discovered a new food source. At the height of the feeding activity, I measured the damaged surface areas and found that as awful as things looked, we still had in excess of 99% healthy turf on the course. Needless to say, we had to meet this new challenge and are doing so with the help of Dr. Pat Vittum from the University of Massachusetts, who is using the site to investigate several biological control options. We also realized we had to deal with the here and now, so we turned to our own "Carl Spackler," Walter Walodyka, the island's only skunk and crow removal expert. Walter's aromatic pickup truck has become a common site roving over the golf course in spring and fall, trapping the skunks and crows and removing them from the property. We have learned that organic insect management is much more "in your face" than the timely application of an insecticide . . . just ask our members.

YEAR 4: WHAT LIES AHEAD?

So then what is our next challenge, our new frontier? Our battles with disease and insect pests will continue. We anticipate weeds to emerge as a major challenge in our organic management program. Annual bluegrass and broadleaf weeds are beginning to encroach into playing areas and roughs. Our current approach is to keep the weeds under control through a hand-weeding program. However, we realize that without a selective chemical means of control, this weed problem will evolve into our next major challenge.

The Vineyard Golf Club

- This is predominately a walking golf course.
- Traffic is relatively low at less than 10,000 rounds annually.
- Less than 1% of the grass on the property is annual bluegrass.
- There are few trees impacting any playing areas, and there are no plans for future tree planting programs.
- The island climate is temperate. The temperature is rarely above 90 degrees, and the wind almost always blows.
- Our members are very aware of the unique restrictions that have been placed on the course and have been steadfast in their support and enthusiasm for their course.

WHAT HAVE WE LEARNED?

- This effort is a work in progress. We anticipate that new challenges will arise, and programs and practices will evolve to meet those challenges.
- The organic limitations force us to be creative and flexible and think outside traditional management parameters.
- A proactive management style is critical for success in an organic turf management program.
- More information about non-traditional pest management is needed if we are going to remain successful in combating pest problems without traditional pesticides.
- Perception of pest damage often varies widely between those who manage the turf and the golfers. We receive very few complaints from the golfers as long as green speed, surface smoothness, and good tight lies are provided.
- The turf manager and golfers alike must adopt a different attitude when working in this new frontier.
- Open communication with the membership and local community is critical to success!

Before any evaluation of the organic management program can be made, qualifiers that have made our programs a success must be acknowledged. The unique location of the golf course provides a temperate climate with frequent wind and moderate temperatures. The facts that the golf course is new, provides good grass-growing environments, is well drained, and has minimal populations of annual bluegrass are helpful. We also are very fortunate to have informed members who remain supportive of the programs and who understand the unique challenges we face.

Looking back to 2001, I was not sure I would be here in five years to write a story about the organic management program at The Vineyard Golf Club, or that there would even be a course to write about. By combining the latest products and research with an understanding and informed membership, along with an extraordinarily dedicated staff, we have a golf course that everyone is proud of. Last summer our staff received its greatest compliment when one of our members told me he had a guest play 18 holes with him for the first time. Only after they had finished the round and were having lunch did the member have to "remind" the guest that he had just played an "all organic" golf course.

JEFF CARLSON, CGCS, *a two-time national winner of the GCSAA's Environmental Leader in Golf Award, supervised the construction and grow-in and is the superintendent of The Vineyard Golf Club.*

We anticipate that weeds will become our next major challenge as the golf course continues to mature. We have implemented often labor-intensive, non-chemical means of weed control and continue to search for new alternative management options.

Green Speed: Trick or Treat?

A combination of research and common sense can provide exactly what is needed for golfers and your greens — healthy surfaces with smoothness and a desirable speed.

BY LARRY GILHULY

Put your books down, class, it is time for a pop quiz. There are only five questions, and I am sure you will get them all correct. Please answer the following five statements true or false based on your knowledge of turf management and the game:

Question 1. Raising green mowing heights makes greens healthier. (True)

Question 2. Mowing heights can be raised while retaining desired green speed. (True)

Question 3. Green rolling increases green speed, but rolling should not exceed three times weekly to avoid wear. (True)

Question 4. Golfers gauge green speed near the hole and are poor judges of green speed. (True)

Question 5. Target green rolling may be the answer to your green speed woes. (True)

Now, let's look at the research and reasoning behind these five answers. Or, as they say, here is the rest of the story that you may be able to use to address green speed issues.

RAISING MOWING HEIGHTS MAKES GREENS HEALTHIER

Since the introduction of the Stimpmeter in the late '70s, the quest for ever-increasing green speed has resulted in a three- to four-foot increase that can be traced primarily to lowering mowing heights from 3/16" (0.188) to well under 1/8" (.125) to achieve regular green speeds in excess of 11 feet. The negative effect of this "need for speed" has resulted in the following:

- Needless green reconstruction of interesting, older, contoured greens.
- Fewer useable hole locations.
- Slower rounds due to more putts.
- Excessive difficulty not suited for most players.
- Slower recovery of ball marks and old hole plugs.

No golfer facing an uphill, sidehill 40-foot putt similar to the one shown can tell if the lower two decks of the green are not rolled.

- Increased turf stress caused by heat, summer moisture stress, disease, moss, insects, weeds, etc.

The first four negatives relate to the play of the game, while the final two points are of greatest concern to golf course superintendents. Research has shown numerous times that greater root mass and depth is achieved as mowing heights are raised, resulting in healthier turf that can withstand various stresses. However, the reluctance to raise mowing heights is understandable, as research (and common sense) suggests that greens are slower as mowing heights rise. What to do? Research provides part of the answer to the green speed issue.

MOWING HEIGHTS CAN BE RAISED WHILE RETAINING GREEN SPEED

Some very interesting research conducted during 2004 and 2005 by Dr. Bruce Clarke and col-

Research at Rutgers University has shown that mowing heights can be raised approximately 0.030" in conjunction with rolling and will produce a green speed similar to that of a lower mowing height.

leagues at Rutgers University will be published later this year. Although the details of this project will be available soon, their research shows that mowing heights can be raised approximately 0.030" and, with double mowing or single mowing in conjunction with rolling, will produce a green speed similar to that of a lower mowing height. This simple study clearly shows that lowering mowing heights is not the only way to obtain green speeds desired by some players, duplicating results found at Michigan State University.[1] So there it is — the simple answer. Other rolling research, however, shows that too much of a good thing can cause problems.

GREEN ROLLING INCREASES GREEN SPEED, BUT ROLLING SHOULD NOT EXCEED THREE TIMES WEEKLY

Research conducted by Chris Hartwiger[2] and Dr. Thomas Nikolai[1] indicates that rolling greens definitely will increase green speed when conducted more than once weekly, but turfgrass wear is a concern when rolling frequency is increased to more than three times weekly. The Rutgers study and other research conducted at Michigan State show that rolling is a perfectly acceptable alternative to lowering mowing heights, but simply alternating mowing and rolling throughout the week has not been accepted by players who want "lightning fast" greens. For those golfers who think they can judge green speeds easily, research again leads us to another very interesting portion of the green speed equation.

GOLFERS ARE VERY POOR AT GAUGING GREEN SPEED

Two very interesting research projects were completed in 2002 at Michigan State[3] and 2004 at the University of Connecticut[4] that came to the same conclusion — golfers are not very good at determining green speed, and they become even more challenged as green speed increases. At Michigan State, researchers found that players of all skill levels could not distinguish differences in green speed of 6" or less. Also, as green speed increased, differences of as much as 12" became less distinguishable. At Connecticut, a survey approach was used for a two-month period with more than 300 samples taken to determine if players (all skill levels) knew the green speed of the hole they just finished. They did not. Also, 87% of the golfers surveyed rated the green just played as satisfactory, regardless of the actual speed. Finally, consider this very important question: "Where on the green do players judge the speed?" There is little question that green speed is judged at or near the hole. This last part of the survey provides the final piece to the green speed puzzle and leads to the entire premise of this article.

TARGET GREEN ROLLING MAY BE THE ANSWER TO YOUR GREEN SPEED WOES

To review, research has shown the following:

1. Putting green rolling is a very important tool in smoothing greens while increasing green speed.

2. Putting green rolling should not be conducted more than three times weekly.

3. Double mowing or mowing plus rolling allows mowing heights to be raised approximately 0.03 inch with the same green speed.

4. Golfers are poor judges of green speed, especially as greens increase in speed. And finally and most importantly . . .

5. Higher mowing heights allow greens to survive better during the summer and tolerate many common stresses.

When these five research results are added together, it becomes apparent that one answer to the green speed issue consists of more rolling and raising the height of cut. However, rolling more than three times weekly causes problems with turf wear. It is the fourth point where the different concept of "target" rolling comes into play to provide a common-sense approach to this entire issue. Since golfers generally are poor judges of green speed, yet they do desire smooth greens and they judge green speed around the hole, why not simply roll 20-30 feet around the hole, rather than the entire green? For example, if holes are changed six times weekly and the greens are of adequate size, green rolling in a target manner could be completed six times weekly, which would be equivalent to rolling two or three times since the entire green is not being rolled every time. Also, putting green rollers generally increase speed from 6 to 10 inches, depending on the type of roller used. Since players have a difficult time determining this magnitude of difference, and rollers make greens smoother, the golfers benefit without placing the turf under more stress.

DOES THIS REALLY WORK?

During USGA TAS visits to nearly 100 golf courses last year in the Northwest Region, the following question was asked, "Have you ever used 'target' or 'site specific' or 'tournament' rolling techniques for your greens?" More than 50% of surveyed golf course superintendents had used this technique when they were short of manpower or when a shotgun did not allow for full green rolling. At least two cases (one *Poa annua* and the other hybrid bermudagrass noted in Figure 1) had followed this program on a regular basis with excellent results — no excess turf wear was noted when greens were target rolled 20-30 feet around the holes from four to six times weekly. Mowing heights were raised 0.03 inch with the same speed achieved and much healthier greens.

Figure 1

Can this work at your golf course?

- It has worked well for more than two years at Ironwood C.C., Palm Springs, Calif., for Mark Cupit, CGCS.
- 2004 — rolled 6 times weekly, 4 target, 2 complete
- 2005 — rolled 4 times weekly, 3 target, 1 complete
- Cutting height changed from 0.95" to .125"
- Green speed remains 10'6" on Tifdwarf
- Deep slice — every 2 weeks
- Regular aeration — 2 times yearly, ⅜"-½" tines
- Roller used — lightweight, includes spiker on unit
- Root depth/turf health — greatly improved
- No complaints about green inconsistency!

The final critical question was, "When using this type of rolling technique, did any players notice or complain about inconsistency?" The answer was unanimous — not one player has ever noticed when this technique was used, but they truly noticed how smooth the greens were when they were rolled only around the holes on a daily basis. This provides the same type of "anecdotal" observation as indicated in the previously noted research — golfers are poor judges of speed and gauge their speed near the hole when the ball loses its speed.

The idea of "target" rolling offers the perfect combination of rolling without causing excess stress, creating smooth surfaces at whatever speed your membership desires (stay in the 9'6" to 10'6" range, if possible), and, most important, the opportunity for mowing heights to be raised to a more practical level. Are you trying to "trick" the golfers using this technique? Not at all, as it is a "treat" to play smooth greens that consist of healthy turf.

REFERENCES

Nikolai, Thomas. More Light on Lightweight Rolling. Green Section Record, January/February 2002.

Hartwiger, Christopher. The Ups and Downs of Rolling Putting Greens. Green Section Record, July/August 1996.

Karcher, Douglas, Thom Nikolai, Tom Calhoun. Golfers' Perceptions of Green Speeds Vary. Golf Course Management, March 2001.

Dest, William M., Karl Guillard. Putting Green Speed: A Reality Check. NCGA Quarterly Bulletin, Vol. 4, No. 1.

LARRY GILHULY *provides agronomic tricks of the trade to USGA TAS subscribing golf courses in the Northwest Region of the Green Section.*

Research *You Can Use*

Nutrient Loss from a Golf Course Watershed

Research on a Texas golf course underscores the importance of careful nutrient management.

BY K. W. KING AND J. C. BALOGH

Scientists from the USDA Agricultural Research Service and Spectrum Research, Inc., installed monitoring devices at the Morris Williams Municipal Golf Course in Austin, Texas, to investigate the nutrient concentrations that might be expected from typical management of municipal golf courses in a semi-arid climate.

Turf may be defined as the managed surface layer of soil, grass plants, and the plants' fibrous roots. In the U.S., there are an estimated 50 million acres of turf. The largest percentage of turf is found in home lawns, while approximately 10 million acres are located on roadside right-of-ways. Only 3% of the turf in the U.S. is managed as the nation's 17,000 golf courses.[6,19]

Environmentally sound management of golf course turf provides both public and private facilities with environmental, cultural, and economic benefits. Public demand is increasing for golf course managers to maintain high-quality turf on golf courses, but also to protect water and soil resources in the vicinity of these facilities. High-quality golf course watershed-scale data are needed to adequately address the issue of nutrient fate and transport on managed turf. The objective of this research effort was to quantify nutrient transport in surface and subsurface drainage waters from a golf course watershed.

NUTRIENT LOSSES FROM TURF

Periodic nutrient applications are an integral and essential part of establishing and maintaining high-quality turf. However, these applications increase the potential for nutrients to be transported off site in surface runoff or through subsurface drainage features. Runoff and nutrient loss research from turf has been conducted at the field and, to a lesser extent, the watershed scale. Research on subsurface losses of nutrients generally has focused on leachate rather than the amounts moving laterally and returning to surface flow.

The general conclusions of the small-scale studies indicate that with well-maintained turf, the amount of runoff is small, and the concentrations of nutrients in the surface runoff are often below levels of major concern. However, while studies on small scales are

valuable, they may not represent the diversity and connectivity associated with a watershed-scale system.

Watershed-scale golf course assessments indicate that concentrations of nutrients from water features on golf courses are generally consistent with those reported in plot-scale studies. Cohen et al.[3] reported that a survey of runoff on 17 golf courses in the United States did not contain any cases of NO_3-N (nitrate nitrogen) exceeding the drinking water standard of 10 mg L^{-1}. The median NO_3-N value recorded in that survey was 0.38 mg L^{-1}. Nutrient loading, however, is greater from the watershed-scale systems when compared to plot studies.

EXPERIMENTAL SITE

A section of Morris Williams Municipal Golf Course (MWMGC) in Austin, Texas, managed by the City of Austin Parks and Recreation Department (PARD), served as the study site for this project. The study area on MWMGC is characterized by a series of grassed waterways, culverts, and casual water detention areas that cross the center of the course. The topography is such that the contributing area (72 acres) contains 10 greens (1.8 acres), 7 fairways (20.3 acres), and 7 tees (0.74 acre). The managed areas (greens, fairways, and tees) represent 32% of the total area. The contributing area also contains approximately 16 acres of reduced-managed rough, with the remainder comprised of unmanaged trees and shrubs. Surface runoff was measured at the inlet and outlet of the study area. Subsurface drainage was measured from the 15th fairway, tee, and green.

Surface and subsurface discharge and associated nutrient concentrations were recorded during a five-year period (April 1, 1998 - March 31, 2003) on MWMGC. Four sites within the study area were instrumented with automated samplers to collect periodic water samples. The four sites were identified as: Site 1 (surface water entrance to the study area), Site 2 (surface water exit from the study area), Site 3 (subsurface drainage for the fairway south of the stream and green of hole number 15), and Site 4 (the fairway north of the stream and tee area of hole number 15).

Each culvert was equipped with an area-velocity flow meter. Inflow to the course was measured by relating the stream depth collected every 15 minutes to area-velocity flow measurements for two entrance culverts. Likewise, Site 2 was characterized by a box culvert that drains water from the course. An area-velocity meter and crest stage gauges were installed to measure the discharge leaving the course.

Subsurface drainage was measured from French drains located on the 15th hole. Nutrient concentrations in the drainage water from the two sites were measured daily from April 1999 to March 2003 using automated samplers programmed to collect one sample every 24 hours. Subsurface flow from the French drains at the sampling sites also was recorded. All samples were analyzed colorimetrically for No_3+No_2-N, NH_4-N (ammoniacal nitrogen), and PO_4-P (hereafter referred to as dissolved reactive phosphorus or DRP) concentrations.

INPUTS

Annual precipitation during the five-year period ranged from 22.1 inches to 37.1 inches. The golf course was irrigated with a mixture of potable water from the city and water pumped from an onsite reservoir. Irrigation was applied on an as-needed basis, determined by course personnel, to replace evapotranspiration losses. The roughs and unmanaged areas were not irrigated.

During the study period, management practices were typical of municipal courses in the southern United States. Fairways and greens were established with a hybrid bermudagrass cultivar. Greens were overseeded in late fall with perennial ryegrass (*Lolium perenne* L.). Fertilizer was applied by both dry broadcast and spray techniques throughout the year as a combination of organic, bio-stimulant, slow-release, and fast-release formulations. Average annual N application mass for the study area (71.7 acres) was 40.8 lb. $acre^{-1}$, while P applications totaled 7.2 lb. $acre.^{-1}$

Table 1

Statistical analysis* of nutrient concentrations (mg L^{-1}) in storm flow and baseflow for 5-year period of record (April 1, 1998, to March 31, 2003).

	Storm Flow Concentrations (mg L^{-1}) (n = 1050 for Site 1, inflow; n = 1063 for Site 2, outflow)					
	NO_3+NO_2-N		NH_4-N		PO_4-P	
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Mean	0.30	0.44	0.10	0.09	0.12	0.15
Median	0.23a	0.35b	0.05a	0.04b	0.10a	0.13b
Maximum	2.25	3.52	4.04	3.23	0.90	0.99
	Baseflow Concentrations (mg L^{-1}) (n = 239)					
	NO_3+NO_2-N		NH_4-N		PO_4-P	
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Mean	0.30	0.79	0.10	0.03	0.11	0.10
Median	0.27a	0.73b	0.08a	0.02b	0.10a	0.10a
Maximum	1.84	2.35	0.69	0.17	0.37	0.27

*Medians for each constituent followed by the same letter are not significantly different ($p < 0.05$) using Mann-Whitney nonparametric test.

NUTRIENT LOSSES IN RUNOFF

Based on the collected runoff event data (Table 1), the system contributed statistically significant increases in median No_3+No_2-N concentrations (+0.12mg L^{-1}) and PO_4-P concentrations (+0.03mg L^{-1}), and decreases in NH_4-N concentrations (-0.01mg L^{-1}). For the period of record, the estimated storm flow contributions for the study period due to course runoff were 1.2kg ha^{-1} yr^{-1} No_3+No_2-N, 0.23kg ha^{-1} yr^{-1} of NH_4-N, and 0.51kg ha^{-1} yr^{-1} PO_4-P. These storm flow amounts represent approximately 3.3% of applied N and 6.3% of applied P over the contributing area for the same period.

The relatively high percentage of applied-P losses in storm flow is surprising, considering the relative immobility of P in turfgrass soils. Current background levels of extractable P in the soil (0-6 inches) ranged from 9mg kg^{-1} in the roughs to 44.5mg kg^{-1} in the greens. Although the current management strategy is to use a low-level phosphorus fertilizer, the residual phosphorus in soil from previous heavy applications during course establishment is still available for low-level losses in storm flow.

Similar findings have been reported from agricultural land use areas.[8,24,25] This may account for the higher percentage of phosphorus losses compared to current application levels. The movement of residual soil phosphorus may be a result of both elevated surface runoff and subsurface lateral flow losses of phosphorus during and after storm flow events. The results of this study suggest that soils with relatively high background levels of phosphorus may have the potential for low, but significant, contributions of phosphorus to surface water.

NUTRIENT LOSSES IN STREAM BASEFLOW

Based on grab sample data, the golf course contributed a significant increase in median concentration of No_3+No_2-N (+0.46mg L^{-1}) to baseflow exiting the course (Table 1). NH_4-N concentrations were reduced in baseflow (-0.06mg L^{-1}), and the course had no significant effect on PO_4-P concentrations in baseflow (Table 1). These results were similar and consistent with storm-flow concentration contributions.

Seasonal trends of No_3+No_2-N in the baseflow were observed. No_3+No_2-N levels in baseflow at the downstream site were consistently higher than at the upstream site, with differences being greater from fall to spring, which is the period of overseeding establishment and bermudagrass dormancy. In contrast, NH_4-N levels were consistently higher at the upstream site, and no seasonal patterns were observed. PO_4-P concentrations were similar at both sites and steady throughout the year.

Table 2

Statistical distribution of measured daily nutrient concentrations (mg L^{-1}) in subsurface drainage water.

	Site 3 Lateral Flow Concentrations (mg L^{-1}) (n = 1339)	
	NO_3-N	DRP
25th percentile	0.69	0.09
Median	1.27	0.11
75th percentile	1.58	0.15
Maximum	3.94	0.99
Mean	1.15	0.13
	Site 4 Lateral Flow Concentrations (mg L^{-1}) (n = 1461)	
	NO_3-N	DRP
25th percentile	0.20	0.07
Median	0.32	0.09
75th percentile	0.64	0.11
Maximum	3.07	0.62
Mean	0.47	0.09

NUTRIENT LOSS IN SUBSURFACE FLOW

For the four-year period of subsurface sample data collection, measured median NO_3-N concentration at Site 3 was 1.27mg L^{-1}, while median DRP concentration was 0.11mg L^{-1} (Table 2). Measured median concentrations at Site 4 were 0.32mg L^{-1} NO_3-N and 0.09mg L^{-1} DRP (Table 2). NO_3-N and DRP concentrations from Site 3 were significantly greater than concentrations detected at Site 4. Greater NO_3-N and DRP concentrations measured at Site 3 are indicative of greater and more frequent fertilizer applications to greens compared to fairways.

There was a weak relationship between daily discharge and NO_3-N concentration at Site 4; however, no relationship was detected for DRP and discharge at Site 4. A similar analysis conducted for Site 3 showed no relationship between drainage discharge and NO_3-N or DRP.

The estimated average annual combined load of NO_3-N in the drainage water associated with Site 3 (0.77kg ha^{-1}) and Site 4 (1.92kg ha^{-1}) was 2.7kg ha^{-1} (approximately 2.5% of the amount of nitrogen applied on the study area). This amount is comparable to, but less than, the value of 3.8kg ha^{-1} yr^{-1} reported by Mitchell et al.[18] on a grass system in Illinois and the value of 10.7kg ha^{-1} yr^{-1} documented by Ruz-Jerez et al.[22] for intensively managed ryegrass in New Zealand. In contrast,

Table 3

Selected studies identifying nutrient and sediment concentrations (mg L^{-1}) in surface waters from grassed and wooded catchments.

Reference	Land Use	Area	NH_4	NO_3+NO_2	TN	DRP	TP	Duration	Study Location
Gaudreau et al., 2002[7]	Common bermudagrass	6 m^2	—	1.30	—	4.20	—	8 events	College Station, Texas
Morton et al., 1988[20]	90% Kentucky bluegrass, 10% red fescue	32 m^2	—	0.87	—	—	—	2 years	Kingston, R.I.
Easton and Petrovic, 2005[5]	80% Kentucky bluegrass, 20% perennial ryegrass	37.2 m^2	1.44	10.1	—	0.50	—	18 months	Ithaca, N.Y.
Linde and Watschke, 1997[16]	bentgrass and ryegrass plots	123.5 m^2	—	1.47	—	4.06	—	2 years	State College, Pa.
Winter and Dillon, 2005[27]	13 sites on 5 golf courses	—	—	0.30	0.94	—	0.03	2 years	Ontario, Calif.
Starrett and Bhandari, 2004[26]	Native prairie	—	—	—	1.18	—	0.39	3 months	Manhattan, Kan.
	Golf course construction	—	—	—	3.94	—	0.93	20 months	
	Golf course	—	—	—	1.91	—	0.51	4 years	
King et al., 2001[14]	Golf course storm events	29 ha	—	0.30	—	0.00	—	22 events	Austin, Texas
	Golf course baseflow		—	0.86	—	0.01	—	13 months	
This study	**Golf course storm events**	**29 ha**	**0.00**	**0.12**		**0.03**		**5 years**	**Austin, Texas**
	Golf course baseflow		**0.06**	**0.46**		**0.00**			
Kunimatsu et al., 1999[15]	Golf course	53 ha	0.30	0.29	1.30	0.05	0.10	2 years	Japan
Malin and Wheeler, 2000[17]	Golf course	54 ha	0.04	0.32	—	0.019	—	1 year	New Hanover Cty., N.C.
	Golf course	53.7 ha	0.03	0.32	—	0.008	—	1 year	New Hanover Cty., N.C.
	Golf course	NA	0.23	1.46	—	0.005	—	9 months	Brunswick Cty., N.C.
	Golf course	46.4 ha	0.03	0.06	—	0.056	—	1 year	New Hanover Cty., N.C.
	Golf course	111.7 ha	—	0.11	—	0.004	—	1 year	New Hanover Cty., N.C.

the average NO_3-N loading from corn and corn/soybean crop production systems is reported to be in the range of 5-100kg ha^{-1} yr^{-1}.[9,13,21]

The estimated average annual combined DRP load transported through the French drains at Site 3 (0.08kg ha^{-1}) and Site 4 (0.38kg ha^{-1}) was 0.46kg ha^{-1} (an amount equivalent to 2.0% of the applied P). This amount is considerably greater than loadings recorded from drainage water on a corn production system (0.04kg ha^{-1} yr^{-1}).[9]

DRP losses in subsurface drainage water can be substantial when conditions for leaching are favorable or promoted or when preferential flow is present.[4,10,12] The soil present in this study area is susceptible to preferential flow[1] and may explain the greater transport of DRP. In addition, leaching can be substantial in sandy soils like those found in the green.

While only a few studies have been conducted on watershed-scale turf systems, it is important to understand how this study's data compare with other studies. The NO_3-N and DRP concentrations measured in this study are on the low end of the range of concentrations reported from other plot- and watershed-scale turf studies (Table 3). Measured nitrate-NO_3-N concentrations on this golf course never exceeded or even approached the EPA 10 ppm standard for drinking water. However, measured DRP concentrations often exceeded 25 ppb, a level associated with eutrophication and biology disruption (Walker and Branham, 1982; Keeney, 1982; and Koehler et al., 1982). Nutrient loadings measured in this study are also comparable to those reported from both plot- and watershed-scale turf studies (Table 4). DRP loads were on the high end of the range of reported loads.

Turf managers are often faced with multiple options for managing turf. They are asked to balance turf quality and growth with climate, soil, vegetative conditions, and management practices. Their choice of management practices is critical for controlling and/or reducing surface runoff and potential for nutrient transport.

Editor's Note: A complete version of this paper can be found at *USGA Turfgrass and Environmental Research Online* (http://usgatero.msu.edu). The specific URL for this paper is http://usgatero.msu.edu/v05/n06.pdf.

LITERATURE CITED

1. Allen, P. M., R. D. Harmel, J. G. Arnold, B. Plant, J. Yelderman, and K. W. King. 2005. Field data and flow system response in clay (Vertisol) shale terrain, north central Texas. *Hydrological Processes* DOI 10.1002/hyp.5782.

2. Birdwell, B. 1995. Nitrogen and chlorpyrifos in surface water runoff from a golf course. M.S. Thesis, Texas A&M University. College Station, Texas.

3. Cohen, S., A. Svrjcek, T. Durborow, and N. L. Barnes. 1999. Water quality impacts by golf courses. *J. Environ. Qual.* 28(3):798-809.

Table 4

Selected studies identifying nutrient loads (kg/ha/yr) in surface waters from grass plots and golf courses.

Reference	Land Use	Area	NH_4	NO_3+NO_2	TN	DRP	TP	Duration	Study Location
Gross et al., 1990[11]	60% tall fescue, 40% Kentucky bluegrass: fertilized	10 m^2	0.09	0.06	0.17	0.05	0.02	18 events	Upper Marlboro, Md.
	60% tall fescue, 40% Kentucky bluegrass: non-fertilized		0.05	0.04	0.08	0.02	0.01		
Schwartz and Shuman, 2005[23]	Tifway bermudagrass	25.2 m^2	—	3.05	—	—	—	4 years	Griffin, Ga.
Easton and Petrovic, 2005[5]	80% Kentucky bluegrass, 20% perennial ryegrass	37.2 m^2	0.35	0.90	—	0.12	—	18 months	Ithaca, N.Y.
Birdwell, 1995[2]	Golf green (bermudagrass)	0.025 ha	—	0.52	—	—	—	3 months	College Station, Texas
	Golf fairway (bermudagrass)	1.57 ha	—	0.96	—	—	—		
King et al., 2001[14]	Golf course: storm events	29 ha	—	2.10	—	0.30	—	22 events	Austin, Texas
	Golf course: baseflow		—	4.30	—	0.05	—	13 months	
This Study	**Golf course: storm events**	**29 ha**	**0.23**	**1.20**	**—**	**0.51**	**—**	**5 years**	**Austin, Texas**
Kunimatsu et al., 1999[15]	Golf course	53 ha	1.70	3.70	13.5	1.60	3.04	2 years	Japan

4. Duxbury, J. M., and J. H. Perverly. 1978. Nitrogen and phosphorus losses from organic soils. *J. Environ. Qual.* 7:566-570.

5. Easton, Z. M., and A. M. Petrovic. 2005. Effect of hill slope on nutrient runoff from turf. *Golf Course Management* 73(2):109-113.

6. Federal Highway Administration. 2004. Successes in stewardship. April 2004 Monthly Newsletter. Federal Highway Administration, U.S. Dept. of Transportation, Washington, D.C.

7. Gaudreau, J. E., D. M. Veitor, R. H. White, T. L. Provin, and C. L. Munster. 2002. Response of turf and quality of water runoff to manure and fertilizer. *J. Environ. Qual.* 31:1316-1322.

8. Gburek, W. J., and A. N. Sharpley. 1998. Hydrologic controls on phosphorus loss from upland agricultural watersheds. *J. Environ. Qual.* 27(2):267-277.

9. Gentry, L. E., M. B. David, K. M. Smith-Starks, and D. A. Kovacic. 2000. Nitrogen fertilizer and herbicide transport from tile-drained fields. *J. Environ. Qual.* 29(1):232-240.

10. Geohring, L. D., O. V. McHugh, M. T. Walter, T. S. Steenhuis, M. S. Akhtar, and M. F. Walter. 2001. Phosphorus transport into subsurface drains by macropores after manure applications: implications for best manure management practices. *Soil Science* 166(12):896-909.

11. Gross, C. M., J. S. Angle, and M. S. Welterlen. 1990. Nutrient and sediment losses from turfgrass. *J. Environ. Qual.* 19:663-668.

12. Jamieson, A., C. A. Madramootoo, and P. Enright. 2003. Phosphorus losses in surface and subsurface runoff from a snowmelt event on an agricultural field in Quebec. *Canadian Biosystems Engineering* 45:1.1-1.7.

13. Kladivko, E. J., G. E. Van Scoyoc, E. J. Monke, K. M. Oates, and W. Pask. 1991. Pesticide and nutrient movement into subsurface tile drains on a silt loam soil in Indiana. *J. Environ. Qual.* 20:264-270.

14. King, K. W., R. D. Harmel, H. A. Torbert, and J. C. Balogh. 2001. Impact of a turfgrass system on nutrient loadings to surface water. *Journal of the American Water Resources Association* 37(3):629-640.

15. Kunimatsu, T., M. Sudo, and T. Kawachi. 1999. Loading rates of nutrients discharging from a golf course and a neighboring forested basin. *Water Sci. Tech.* 39:99-107.

16. Linde, D. T., and T. L. Watschke. 1997. Nutrients and sediment in runoff from creeping bentgrass and perennial ryegrass turfs. *J. Environ. Qual.* 26:1248-1254.

17. Mallin, M. A., and T. L. Wheeler. 2000. Nutrient and fecal coliform discharge from coastal North Carolina golf courses. *J. Environ. Qual.* 29:979-986.

18. Mitchell, J. K., G. F. McIsaac, S. E. Walker, and M. C. Hirschi. 2000. Nitrate in river and subsurface drainage flows from an east central Illinois watershed. *Trans. of the Amer. Soc. of Agric. Engineers* 43:337-342.

19. Morris, K. 2003. The national turfgrass research initiative. National Turfgrass Federation, Inc., and National Turfgrass Evaluation Program. Beltsville, Md.

20. Morton, T. G., A. J. Gold, and W. M. Sullivan. 1988. Influence of overwatering and fertilization on nitrogen losses from home lawns. *J. Environ. Qual.* 17:124-130.

21. Randall, G. W., J. A. Vetsch, and J. R. Huffman. 2003. Nitrate losses in subsurface drainage from a corn-soybean rotation as affected by time of nitrogen application and use of nitrapyrin. *J. Environ. Qual.* 32:1764-1772.

22. Ruz-Jerez, B. E., R. E. White, and P. R. Ball. 1995. A comparison of nitrate leaching under clover-based pastures and nitrogen-fertilized grass grazed by sheep. *J. Agric. Sci.* 125:361-369.

23. Schwartz, L., and L. M. Shuman. 2005. Predicting runoff and associated nitrogen losses from turfgrass using the rootzone water quality model (RZWQM). *J. Environ. Qual.* 34:355-358.

24. Sims, J. T., R. R. Simard, and B. C. Joern. 1998. Phosphorus loss in agricultural drainage: Historical perspective and current research. *J. Environ. Qual.* 27(2):277-293.

25. Stamm, C., H. Flühler, R. Gächter, J. Leuenberger, and H. Wunderli. 1998. Preferential transport of phosphorus in drained grassland soils. *J. Environ. Qual.* 27(3):515-522.

26. Starrett, S., and A. Bhandari. 2004. Measuring nutrient losses via runoff from an established golf course. p. 38 *In* J. L. Nus (ed.) 2004 USGA Turfgrass and Environmental Research Summary. Far Hills, N.J.

27. Winter, J. G., and P. J. Dillon. 2004. Effects of golf course construction and operation on water chemistry of headwater streams on the Precambrian Shield. *Environmental Pollution* 133:243-253.

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Scientists from the USDA Agricultural Research Service in Columbus, Ohio, and Spectrum Research, Inc., monitored the Morris Williams Municipal Golf Course in Austin, Texas, to study the nutrient concentrations in water. Findings included:

- Approximately 3.3% of the nitrogen and 6.3% of the phosphorus applied to the study area contributed to the nutrients found in the storm flow water.
- The golf course contributed a significant increase in the median concentration of NO_3+NO_2-N in the water exiting the course, reduced levels of ammoniacal nitrogen (NH_4-N), and had no effect on dissolved reactive phosphorus concentrations.
- Nitrate nitrogen (NO_3-N) concentrations moving through the subsurface drainage water were approximately 1/10th of the concentrations typically reported for tile drainage from row crop agriculture.
- Time of the year influenced the data. Nitrate nitrogen was present in greater concentrations in the surface and subsurface drainage water during the winter months when there were periods of greater rainfall, the turfgrass was dormant, and microbial activity was reduced than when compared to spring and summer.
- Dissolved reactive phosphorus (DPR) concentrations in the subsurface drainage water from the golf course were greater than concentrations reported measured in agricultural tile drains. These values could pose a potential threat of providing excessive nutrients to surface waters, such as ponds, resulting in excessive plant growth.
- The timing and magnitude of nitrate nitrogen and DPR moving through subsurface drainage from the golf course turf were dependent on temperature, precipitation, and turf management factors such as the magnitude and timing of applied fertilizer. At the more intensively managed site, higher levels of nitrate nitrogen and DPR were measured when compared to the less intensively managed site.

Surface water samples (storm flow and baseflow) were collected throughout the study period using automatic collection systems installed on the course.

Master Plans: The Do's and Don'ts for Membership Approval

Communication is everything.

BY TODD RAISCH

What is it they say about real estate? The keys to success are location, location, and location. Similarly, there are three keys to any successful membership vote. They are *good communication, good communication*, and *good communication*.

Just in the last few years I've been a part of three such votes: a successful golf course master plan, a successful facility master plan, and a painful failure, a new irrigation proposal that was shot down by an overwhelming majority of the membership. Communication played a huge role in the approvals and defeat. This article will share with you some of the lessons I learned the hard way so that your future plans are successful the first time around.

I'm going to relate my experiences in chronological order, so let's start with the failed irrigation system.

I was somewhat surprised one evening in the summer of 1999 when a casual conversation I had with my chairman turned into his strong support for a new irrigation system. Just prior to a Board meeting he told me the Board would be discussing long-term capital requirements that night, and he asked me what one capital item would be the most necessary over the next three to five years. My immediate response was that we needed a new irrigation system. He asked why, so I explained the basics of our single-row system and how the distribution efficiency would be greatly enhanced by a three- or five-row

Watching sprinklers function does not tell the complete story. More evaluation, such as using catchment tests, is necessary to accurately characterize performance.

A new maintenance building represents a significant expense and can be difficult to justify. The golfers need to understand the deficiencies of the existing facilities and the potential repercussions if nothing is done to resolve the situation.

system. By the time I had arrived at the office the next morning, an email had arrived saying that the Board had given its approval for the design of a new system, and that we now had to sell the need to the membership for a February 2000 vote and a fall 2000 installation.

I quickly researched designers and then asked Jim Barrett to join our team. He recommended a comparison letter from him describing the inadequacies of the current system and how a new system would better suit our needs. This turned out to be the first of several mistakes. We all assumed that since the membership had never voted down any major assessment, we were assured of membership approval and only a minimum of information filtered down to the members. The letter from Mr. Barrett was used only as a tool to further convince the Board of the need for a new system. The membership never saw any outside consultants' recommendations.

We did, however, draft a two-page letter that detailed all of the reasons why a new system was necessary. It carefully explained all the reasons for our proposal and included several color photos to give it a professional look. At this point we felt confident of the vote. Unfortunately, most members were unable to get past the first sentence of our letter. It read:

"Based on the recommendation of the Greens and Grounds Committee, the Board of Directors has approved the installation of a new state-of-the-art irrigation system." Due to our poor choice of words, the proposal was dead the day this letter arrived in the mailboxes of our members. The backlash from our membership was incredible! "Who do they think they are? They can't approve a project with such large financial implications. Only the members can approve such a request." Despite several letters to clarify the Board's position, we were slaughtered at the polls. We received just 41% of the vote. If only we had taken the time to communicate correctly at the outset . . . .

Nonetheless, I wasn't ready to give up the fight. The year 2000 brought with it a new chairman for me, and he believed strongly in the need for the new system. Recognizing the previous problems with respect to communicating with the membership, we set up four focus group meetings in 2000 to do three things: explain the inherent need for the system, discuss the financial implications, and allow the membership to ask questions and comment on the proposal. This last part was clearly the most important. The membership made it clear that the inherent need for the system was not nearly as big an issue to them as was how the proposal was presented to them, especially since they were never provided the opportunity to give any feedback. After much positive feedback from the focus groups, we

thought we were ready to go forward, but some other events at the club forced us to put the irrigation system on the back burner.

At the same time as the irrigation debacle, the Board had begun looking at other issues on the course and approved the development of a master plan for the entire golf course.

We hired noted golf course architect Gil Hanse, and he began his work immediately. At the same time we sat down with four groups of 25 members each to discuss what they would like to see done on the golf course. We took down every comment and then asked Gil to incorporate the ideas he thought necessary. Obviously, we were confident that Gil would only include what he felt was appropriate, but involving the membership in the process went a long way toward the eventual approval of the program. Following Gil's final recommendations, every member was given a color copy of Gil's plan.

The next step was the town hall meeting. The president provided the background, the treasurer talked about finances, and Gil discussed the plan. Finally, and most importantly, we gave the members the time to have their say. One recurring comment was that the cost of the project was more than they wanted to pay for. Based on this and other comments, the Board then came out with its "Board Recommended Projects." A few items were taken out of the plan, most notably the bunker restoration, which would now be financed over time from the operating budget instead of all at once by an assessment. The original $2.1 million price tag was down to $1 million, and the vote passed by a huge majority.

Shortly after the approval of the golf course master plan, my chairman, who had orchestrated the golf course vote, became president and was now evaluating other needs for the club. Obviously, we needed to close the deal on the irrigation system, but we also had several infrastructure problems. Two of the five grounds buildings were on the verge of falling down, the clubhouse was neither functional nor up-to-date in décor, technology, or storage. The entrance road also needed a major upgrade. Knowing that good communication was the key to our previous success, the president quickly mobilized his troops and began a PR blitz that included a deluge of information for the membership.

First was the hiring of a clubhouse consultant firm. They put together a detailed survey, requesting preferences on everything imaginable concerning the clubhouse, greens and grounds complex, irrigation system, and financing.

While we were tabulating the results of the survey, the report on existing conditions came out. This was a stroke of genius. The firm put together a report that described all of the infrastructure problems. They described how the kitchen floor was about to fall into the basement, how the maintenance facility was unable to support our needs, etc., etc.

Following that, the consulting firm and the Board started cranking. What they came up with was nothing short of spectacular. Although the Board never expected to do all of the projects, letting out that the proposed plan would cost in excess of $23 million actually worked to the Board's advantage. When the Board came in with a more reasonable proposal, they were everyone's heroes.

The next step was a series of focus group meetings. Again, four groups of 25 were invited to attend specific meetings divided up by age. The president served as MC of the event and introduced several speakers, the first of whom was the president of the consulting company. He covered the results of the survey, the existing conditions report, their vision for our future, and finally a list of the Board-recommended projects. Those projects totaled $7 million out of the original $23 million.

Next came the chairman of the Greens and Grounds Committee. Something he said during those meetings will always stick with me. He very

What may be an obvious need to the professional turf manager may require a great deal of explanation to the average golfer. In times of drought, increased water storage capacity can make a big difference.

forcefully stated that no one in the room outside of the superintendent and David Oatis of the USGA has the technical knowledge to determine whether we need another system or not, and whether it would be three or five rows, Rain Bird or Toro, etc. I had been expecting plenty of questions with regard to these types of things, but they never came up, and I believe that his opening statements diffused a lot of that. My chairman then introduced David Oatis, who gave a 20-minute tutorial titled "Irrigation 101." Now I could have easily given this presentation, and we actually talked about my doing it. However, having an impartial outsider recommend it, especially with the initials USGA on his lapel, lent a level of comfort to the membership that a superintendent cannot provide.

Finally, David Oatis, the president of the consulting firm, the treasurer, and I sat up front for a Q&A session. I quickly became very confident when there seemed to be more comments than questions. It appeared that our message had gotten through, because many of the comments were about why we were not doing more.

Following the Q&A session, another survey was passed out to the focus group participants. Although the results looked good, we were not taking any chances with the irrigation system.

Between the focus group meetings in July of 2003 and the final vote in September of 2003, my chairman and I hosted an irrigation night on the golf course. I turned on the sprinklers and showed the limitations of the current system. This won over several more skeptics. Seeing something firsthand versus taking someone's word for it can be very convincing.

At this point the Board had a decision to make: how to structure the vote. Prior to the focus groups, the plan had been to have one up-or-down vote on all of the projects. This now seemed risky, since we could potentially lose everything, including the irrigation system, which polling told us had overwhelming support. Ultimately, projects were packaged. The irrigation system was put together with the three new grounds buildings. The clubhouse renovation was put together with the entrance road renovation and a club generator.

There was also one final question on the ballot. Without tying the hands of future Boards, members were asked if there was a sense of resolution with regard to whether or not future Boards should continue with the implementation of the remaining elements of the overall master plan.

In the end, it really was a long process — a lot of meetings, letters, and presentations. However, it paid off. The clubhouse projects passed at 82 percent approval, while the irrigation and grounds buildings obtained 87% approval. Even the continuation of the master plan by future Boards passed by a 79 percent approval rate.

What made the difference between this overwhelming success and the previous failure? In a word, communication. The process starts with an idea that is developed into a sound, well-grounded plan to solve a problem or improve the facility. The formulation of the plan can be aided considerably through the use of consultants and impartial third parties. The same consultants who help formulate the plan can then help explain the need for and the intricacies of it to the membership. The steps we took to educate and inform the membership helped them through the initial shock and aggravation at the expense required for the projects, and it allowed the sound logic of the plan to sell itself. The best plan in the world is of little value if it never gets implemented. Education can allay many fears, so take the time to thoroughly communicate your message to the golfers.

TODD RAISCH, CGCS, *is superintendent at The Ridgewood Country Club in Paramus, New Jersey.*

Golfers who don't see bunker washouts because they are repaired quickly may not fully understand the need for a bunker renovation project.

Research *You Can Use*

The Driving Force!

Nitrogen — still an essential building block for sustaining healthy grass.

BY MAX SCHLOSSBERG, PH.D.

Striving for perfection begins with promoting healthy grass. Meeting nutritional requirements of the turf is essential and should be the number-one priority of the maintenance program.

Of all the managed turfgrass areas comprising a golf course, none is more valued or intensively maintained than the putting greens. Putting green square footage may represent less than 2% of the total managed golf course turf, yet putting green quality can make or break golfers' perception of playing conditions and, quite possibly, their entire golfing experience.

Nitrogen (N) fertilization is an important component of putting green management. Under optimal growth conditions and intermediate nutrient sufficiency, no other plant essential nutrient has as powerful an influence on turfgrass canopy color and vigor, root-to-shoot growth relations, and disease susceptibility. Likewise, when applied at rates commensurate with turfgrass requirements, traditional fertilizer sources that provide any/all plant essential nutrient(s) besides N (excepting acids or liming agents) do not have the profound effect on soil biochemical activity as do N fertilizers.

Nitrogen fertilizers include numerous quick-release (QR; e.g. salts, urea) and slow-release forms (SR; e.g. natural organics, synthetic organics, coated prills), each having its pros and cons. The advent of SR technologies may be the most notable advance in recorded fertilizer history. However, because the most effective SR fertilizers are water-insoluble, coated, or both, most are only available in granular or sprayable-powder forms. Low-SGN (size guide number) SR granulars are effective putting green fertilizers that minimize nutrient leaching loss and osmotic tissue desiccation, while steadily supplying available nutrients to turfgrass. Nevertheless, the persistent nature of granular SR fertilizers requires them to either be watered through the canopy, stabilized in the upper soil profile (i.e., applied following aeration or verticutting procedures) or free to persist on the putting surface, potentially redirecting golfers' putts before being carried away in the mower clippings. This is one of several justifications for liquid spray fertilizer application to putting greens during periods of peak golfing activity. Other reasons in support of this application method are:

- Frequent, light fertilizer applications optimize plant health and nutrient recovery (Bowman, 2003).
- Regular spray applications are already being made to putting greens during the peak season.

RESEARCH INVESTIGATIONS

These things considered, independent field studies were initiated on two putting greens, purposefully cohabited by creeping bentgrass (*Agrostis palustris* L. Pennn A4) and annual bluegrass (*Poa annua* L.). These experiments were

facilitated in 2003 and 2004 at the Penn State University Valentine Turfgrass Research Center (University Park, Pa.) for the purpose of identifying:

- Annual N fertilization rate effect on color and health of putting greens cohabited by creeping bentgrass and *Poa annua*, and
- The potential interactive effects of QR-N form and/or systematic growth regulation on the first objective parameters.

METHODS

Though creeping bentgrass/annual bluegrass mixtures covered both experimental putting greens, their underlying rootzones possessed dramatically different physical and chemical properties (Table 1). Likewise, the topdressed pushup green (TDPU) was more than 20 years old at experiment initiation, while the sand-based green (SB) was constructed only two years prior. In both studies, fertilizer treatments (each comprising ⅓ of the annual rate) were applied April to October with a CO_2-powered hand sprayer in a volume of 2.2 gal./1,000 sq. ft. (95 GPA), every 15 ± 4 days. The 2-year experiment on the TDPU green evaluated a wide array of annual N rates (1.5-8 lbs. N/1,000 sq. ft./year) and ammonium to nitrate ratios (NH_4^+ as ammonium sulfate vs. NO_3^- as calcium nitrate) to determine their influence on color, health, and nutrient content of the putting surface.

In 2004, the SB green experiment evaluated a narrow range of treatments that showed most positive responses on the TDPU green the previous year. These treatments were: 3 or 5 lbs. N/1,000 sq. ft./year in one of four QR-N forms: ammonium nitrate, ammonium sulfate, 9 parts NH_4-N:1 part NO_3-N, or 9 parts NH_4-N:1 part dicyandiamide-N (DCD, an organic nitrification-inhibitor containing 67% N by mass), with or without bimonthly Primo MAXX (trinexapac-ethyl, 0.125 oz./1,000 sq. ft.) growth regulator applications, for the same TDPU-green study purposes listed above.

As mentioned, these sites were maintained as golf course putting greens throughout the experimental periods. Corrective P_2O_5 and K_2O fertilizer applications were made prior to each experimental season. All plots were equally mowed (0.125" height, 6-7 days a week), irrigated, and treated with plant protectants when necessary. Outside of the described treatments, no systemic fungicides, growth regulators, fertilizers, or wetting agents were applied to either study. Measurements collected for evaluative purposes were:

- Nitrogen (N) — no other plant essential nutrient has as powerful an influence on turfgrass canopy color and vigor, root-to-shoot growth relations, and disease susceptibility. The research is clear; basic fertility needs must be met before the full benefit of fine-tuning fertility strategies can be realized.
- Ammonium-based nitrogen is a catalyst that stimulates the uptake of phosphorus (P) and manganese (Mn), two essential plant nutrients. Therefore, before corrective P or Mn applications are performed, consider including this nitrogen source in your fertility program, especially if phosphorus or manganese is reported as deficient based on plant tissue analysis.
- Rootzone soil organic matter and percolation rate are traits that should be factored into decisions regarding N fertilizer type, rate, and frequency of application. Perform soil analysis at least annually (physical and chemical) to assist in developing a fertility program that meets the needs of the turf.
- Limiting N inputs to achieve green speed is counter productive. Increase N fertility and frequency to satisfy N requirements of healthy turfgrass. This action, coupled with growth regulator application can further enhance plant health while still attaining the desired level of ball roll distance. First and foremost, strive to maximize the natural defense mechanisms of the turf.

Table 1

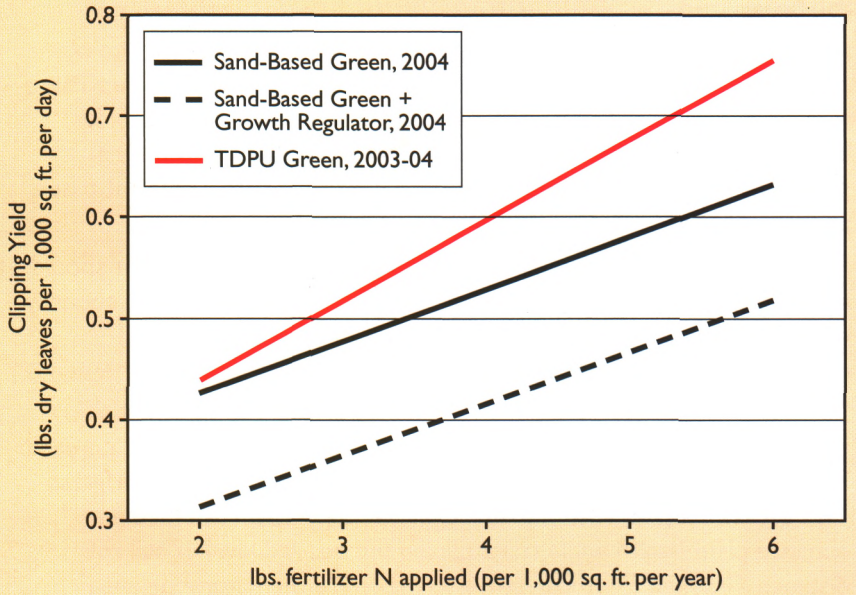
Preliminary soil fertility/chemical properties of experimental putting green rootzones (composite samples of upper 3", thatch removed).

Soil Properties	Experimental Green[1] TDPU	SB
Soil pH (1:1 H_2O)	7.0	7.5
CEC (meq/100 g soil)[2]	8.1	4.7
Soil Organic Matter (% mass)[3]	4.0	1.3
$CaCO_3$ equivalency (% mass)	2.0	3.3
	— lbs. nutrient/acre[2] —	
P_2O_5	293	67
K	141	31
Mg	365	134
Ca	2,512	1,624

[1]Topdressed pushup green (TDPU) and sand-based green (SB)
[2]Determined using Mehlich 3 extractant
[3]Determined by loss on ignition (LOI)

Figure 1

Average daily clipping yield (shoot biomass production) by experimental putting green, annual nitrogen fertilizer rate, and trinexapac-ethyl (GR) application (sand-based green [SB] only).



turfgrass shoot growth/vigor (clipping yield, in lbs. dry clippings/1,000 sq. ft./day), canopy dark green color index (DGCI, Karcher and Richardson, 2003), and tissue nutritional status (nutrient concentration in dry clippings). These data were collected 2-5 times per study/year, within 4 to 12 days of treatment application, and analyzed by regression and/or analysis of variance statistical procedures.

RESULTS

Statistically, shoot growth/vigor response was better correlated to rate of N fertilizer application than to form of the QR N (data not shown). Expectedly, growth response to N was direct. However, clipping yield measured on the SB green lagged behind yields measured on the identically N-fertilized TDPU green (Figure 1). Further, Primo MAXX (GR) application to the SB green depressed growth rate to 74% of the control plot growth rate independent of N rate or form.

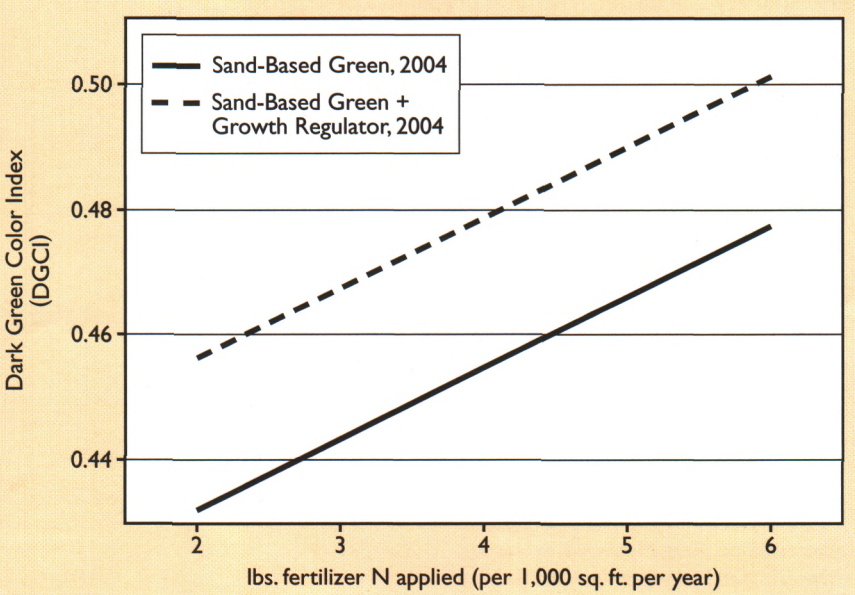
Canopy color, measured by dark green color index (DGCI), was significantly affected by both N rate and form on the TDPU green. Though not shown here, a significant effect of fertilizer ammonium content on DGCI was observed over 2 years on the TDPU green. At annual N rates exceeding 5 lbs. N/1,000 sq. ft., canopy DGCI levels significantly increased when ammonium comprised half (4% increase) or >80% (6% increase) of the fertilizer N. Conversely, canopy color on the SB green was affected most by N rate or GR (Figure 2), with GR treatment increasing DGCI values 5%, regardless of N rate or form.

Shoot tissue nutrient concentration data, an integral requirement in the comprehensive evaluation of turfgrass health, provided valuable information. In both greens, N fertilization rate directly affected N, K, Cu, and Zn levels in tissue. However, the more interesting nutrient level responses to N-fertilizer applications were observed on the TDPU green, particularly the direct relation of tissue P and Mn levels to increasing ammonium content at every N rate (Figure 3).

Of the treatments applied to the SB green, GR application decreased K and Mn concentration in shoots by 5% and 15%, respectively. As with the TDPU green, N rate and N form interacted to affect shoot Mn levels significantly (Figure 4).

Figure 2

Average dark green coloration (by DGCI) of sand-based putting green (SB), by annual nitrogen fertilizer rate and trinexapac-ethyl application.



SUMMARY

These data support previous research results and provide new insight into putting green turfgrass nutritional response to N. The difference observed in shoot growth between the two greens was not expected, considering similar conditions of light, temperature, and N fertilizer reapplication frequency. The lesser growth rate of the SB green, when compared to the TDPU green, illustrates the limited nutrient sequestering capacity and nutrient mineralization activity associated with young, low-OM, sand-based root media. Moreover, University Park received 29" of rain between May and October in 2004, and the relatively limited nutrient uptake in the SB green may have resulted from nutrient leaching. Thus, rootzone soil OM and percolation rate are traits that should be factored into decisions regarding N fertilizer type, rate, and frequency of reapplication.

Nitrogen form played a significant role in canopy color and tissue P on the TDPU green, and it affected Mn tissue levels of both greens. The N form associated with these enhancements was ammonium. Exclusive use of ammonium sulfate for N fertilization is a well-recognized soil-acidifying strategy. In both greens, ammonium sulfate fertilization resulted in significant tissue Mn increases, regardless of soil chemical properties (Table 1) or historical micronutrient fertilizer applications.

The observed effects of Primo MAXX GR on putting green growth and color are in agreement with recent research (McCullough et al., 2005). Use of the GR did not interact with N rate or form, but consistently increased canopy color (5%) while suppressing shoot growth (26%), tissue K (5%), and tissue Mn (15%) in the 4- to 12-day period following GR application. Ideally, these results will be considered by golf course superintendents who have not adopted GR use as a maintenance practice, yet fervently withhold nitrogen fertilizer from their bentgrass/*Poa* cohabited putting greens for the

Figure 3

Average leaf tissue P or Mn concentration from topdressed-pushup (TDPU) green, by ammonium content of quick-release N fertilizer and annual nitrogen fertilizer rate.

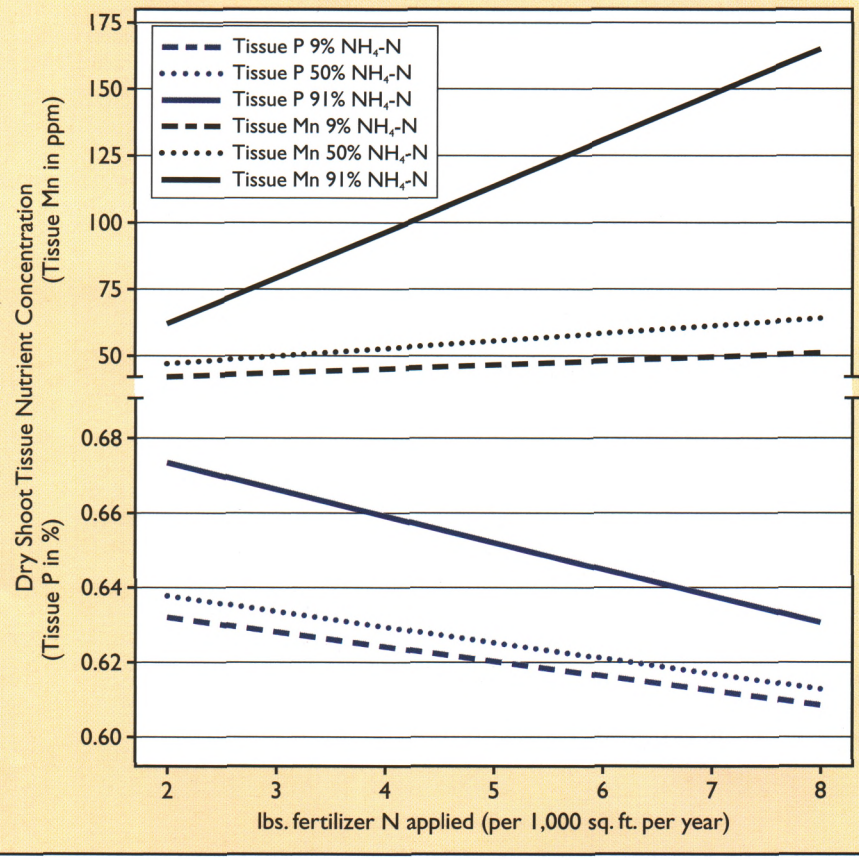
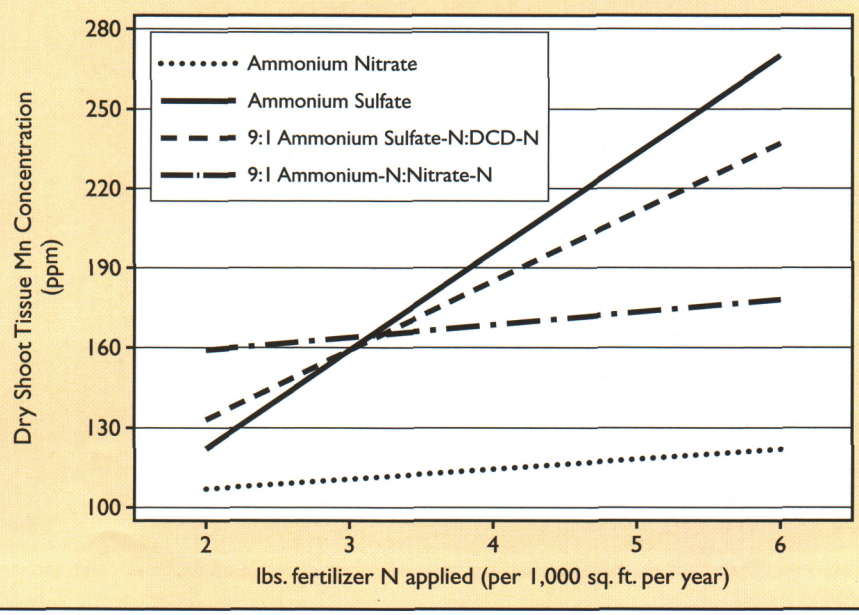


Figure 4

Average leaf tissue Mn concentration from sand-based (SB) green, by quick-release N fertilizer formulation and annual nitrogen fertilizer rate.



purpose of enhancing ball roll distance. An important message that can be derived from these results is this: Suitable green speed can be mutually excluded from suboptimal leaf N and disease susceptibility. Increase your N fertilization frequency and rate to satisfy the N requirements of healthy turfgrass (>4% tissue N). This action, coupled with initiation of GR applications, is an effective and widely used method to significantly enhance plant health and canopy color (Figure 2) without an undesired concomitant increase in shoot growth (Figure 1).

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REFERENCES

Bowman, D. C. 2003. Daily vs. periodic nitrogen addition affects growth and tissue nitrogen in perennial ryegrass turf. Crop Sci. 43:631-638.

Karcher, D. E., and M. D. Richardson. 2003. Quantifying turfgrass color using digital image analysis. Crop Sci. 43:943-951.

McCullough, P. E., H. Liu, and L. B. McCarty. 2005. Trinexapac-ethyl application regimens influence creeping bentgrass putting green performance. HortScience 40:2167-2169.

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Nitrogen — no other plant-essential nutrient has as powerful an influence on turfgrass color and vigor, root-to-shoot growth relations, and disease susceptibility.

Searchable Native Plant Database Now Available

The Internet can now be used to find plants naturally suited to a particular region or habitat.

BY JEAN MACKAY

Choosing the correct native plants for golf course landscaping just got easier, thanks to a new Web-based search tool from Audubon International. "Surf Your Region and Surf for Native Plants" educates people about native plants specific to their region. Based on the *Landscape Restoration Handbook*, by Don Harker, the tool allows anyone to search for a plant list to guide tree or shrub selection on properties throughout the United States.

Using "Surf Your Region and Surf for Native Plants" is simple: type in your zip code and get a map, watershed information, and a plant list. The list can then serve as a reference when choosing trees and shrubs that are best suited for your golf course. "Surf Your Region and Surf for Native Plants" is accessible via the "Resources" section of Audubon International's Web site (www.audubon-international.org) and can also be found on a recently created Web site called Audubon Sustainable Communities (www.audubooncommunities.org).

WHY NATIVE PLANTS?

Native plants *originated* and *grow naturally* in a particular region or habitat. When you landscape with plants that are native to your region, you help to preserve not only the unique local character of your area, but also the overall biological diversity of North America.

Think of it this way: How many Bradford pears do we really want? Though lovely in spring, these natives of Korea and China do nothing to promote our own unique natural heritage. How many times can we appreciate flowering cabbage and kale in golf course landscape beds? Descended from Mediterranean vegetables, these plants can't compare with the beauty or wildlife value of our own fall flowering natives, like asters, coneflowers, or desert marigolds.

If we continue to make courses in Dallas look like courses in D.C., San Francisco, and Detroit, then we're missing the boat. Among the best things golf courses can offer to golfers and our environment alike is a round played amidst the spectacular beauty of each unique region. Using primarily native plants in the golf course landscape achieves that worthy goal.

Landscaping with native plants has a number of well-recognized benefits:

- Maximizes habitat management efforts
- Provides food and cover for wildlife
- Provides a full complement of species in the plant communities on the course
- Reduces water, fertilizer, and chemical inputs
- Preserves the unique biological diversity of your region
- Reduces the need for high-intensity maintenance
- Helps the golf course become a valued part of local green space networks

SURF YOUR REGION AND SURF FOR NATIVE PLANTS:

http://www.audubooncommunities.org/regional/search/.

JEAN MACKAY *is the director of educational services for Audubon International, a nonprofit environmental organization that focuses on environmental stewardship and sustainability. The Audubon Cooperative Sanctuary Program and Audubon Signature Programs, sponsored by the USGA, have been helping golf courses implement environmental management practices since 1991. To find out more, visit www.audubooninternational.org.*

I Want It Perfect — NOW!

High-quality golf course conditions take time.

BY PATRICK J. GROSS

Golfers have always appreciated perfect golf course conditions. The problem is they want it ***NOW!*** Superintendents are feeling the pressure to produce perfect conditions at all times, regardless of the season and without regard to the capriciousness of Mother Nature. The following are three perfect examples of the frustrations that golfers and superintendents experience in the quest for the eternally perfect golf course:

A NEW IRRIGATION SYSTEM

Countless times I have heard golfers complain, "Why do I still see wet spots and dry spots and a bunch of guys hand watering after $1.6 million was just spent on a new irrigation system?" The assumption is that if enough money is spent, then any problem can be resolved immediately. It is important to note that a new irrigation system is simply a tool (albeit an expensive tool) to keep your turf alive when there is not enough rainfall to get the job done. It is not a magic wand to make your course perfect. It takes at least one to two years for the superintendent and his staff to adjust and fine tune the system. Nozzles are changed, a few sprinklers may need to be moved, and water schedules are manipulated throughout the season to account for wind or changing shade patterns. Often sprinklers are placed in new locations, and it takes the surrounding turf several months to adapt to the new irrigation patterns.

OVERSEEDING AND TRANSITION

For decades, golfers have flocked to southern resort areas during the winter to enjoy the beautiful golfing conditions created by winter overseeding. Golfers would typically arrive in early November and head back home at the end of May. Winter conditions would be perfect, with no concern about what the course looked like during the summer because they weren't there.

Now, a steady trend of people are living year 'round in the desert resort areas of Palm Springs, Phoenix, and Las Vegas, and there is shock and dismay when they discover that golfing conditions are not always perfect in the summer. There is no appreciation that the superintendents in these areas are attempting to grow a winter crop (perennial ryegrass) and a summer crop (bermudagrass) with a seamless transition between the two despite the huge differences in plant growth requirements. If it were agriculture, they would plow the field and start over, but golf courses don't have that luxury. It takes several weeks in the fall to establish the perennial ryegrass and several more weeks in the summer to reestablish the bermudagrass. Obviously, there are some awkward moments during these transition periods when conditions are not ideal. As one friend aptly put it, "I can give you nine months of perfect. Which nine months do you want?"

BUNKER CONDITIONING

An annoying trend has developed with the expectations for bunker conditioning. Although they were once considered hazards, bunkers are now looked upon as playing surfaces similar to tees, fairways, and greens. Meticulous grooming is expected, if not demanded, because if a golfer fails to make a good shot from a bunker, it must be the conditions — it couldn't possibly be their lack of skill, type of sand wedge, or failure to occasionally practice the shot.

HOW MUCH MONEY IS IT GOING TO TAKE . . . ?

Expectations are often directly tied to the amount of money spent to play a particular course or fees paid to join a golf club. How would your expectations change if you played a golf course where the green fees were $15, or $50, or $150, or even $350? Right or wrong, there is a value demanded for the amount of money spent. Unfortunately, there is a limit to what superintendents and nature can provide at any given time of the year, regardless of green fees or maintenance budget. While many courses can achieve perfect conditions for a few months, I have yet to see the course that doesn't take its lumps at some point during the year. While some things can be manipulated, turf growth generally follows its own time schedule based on the season and a number of factors that are out of the control of the superintendent.

So, please be patient and appreciate quality golf course conditions, because as a wise agronomist once said, "The only thing that happens fast in agriculture is crop failure — everything else takes time."

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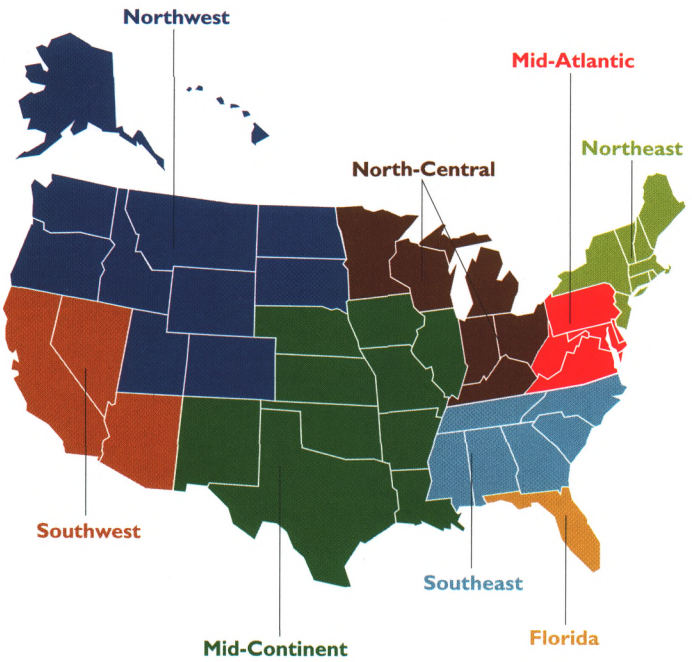

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Turf *Twisters*

Q: Our course is constructing a new 11,000 sq. ft. practice putting green. Unfortunately, the money earmarked for this new construction is less than the lowest bid we received from building contractors. Our manager suggested that we build the green in-house to keep costs down, but we do not have a large enough staff or enough construction experience to build this large green. Any thoughts on this situation? (Maryland)

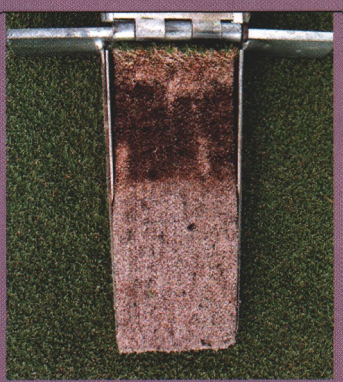
A: Frankly, it sounds as if you have answered your own question. If you have concerns about your ability to successfully complete this project, they are probably valid. Golf course builders generally have better equipment and more experienced employees to complete these projects. Additionally, undertaking a project of this magnitude will put extra strain on your maintenance staff to perform normal course maintenance. Thus, daily course conditions may suffer as your staff is forced to focus on construction. This is not to say you cannot complete this project in-house. Unfortunately, short-term savings are often considered ahead of long-term costs if you cannot complete the new green properly.

Q: Is it better to leach our greens before or after aeration? (California)

A: If your greens suffer chronic problems with soluble salt accumulation, you would be better off leaching one week before you plan to aerate and topdress. This will give you a clean slate going into the process and will likely allow the holes to heal faster. When leaching is performed after aeration, the water tends to travel down the holes more rapidly and does not do a very effective job of reducing salts between the holes. This results in green dots above the aeration holes and yellow turf in between.

Q: Many of my members come from other regions where they aerate greens only once or twice yearly, and they are convinced that I punch holes in greens for the sole purpose of aggravating them and their guests. How do I convey the difference between Florida conditions and what they are accustomed to in other regions?

A: Bermudagrass produces more organic matter than can be degraded by soil microbes in Florida. As a result, organic matter accumulates in the upper rootzone at an accelerated pace. This organic matter clogs up soil pores and creates saturated conditions within the rootzone. During periods of increased play, organic soils also become more easily compacted from traffic. As a result, roots become stressed during rainy conditions or during periods of



increased play. It is for this reason that putting greens are cultivated more rigorously than other regions to keep the soil matrix diluted with sand.

It is impossible to compare different types of grasses (cool season vs. warm season) and different climates. Soil cultivation programs that are effective in one region may not necessarily work well in another region. Be patient with your membership and try to educate them on the conditions that occur in your region and how they differ from other regions.

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