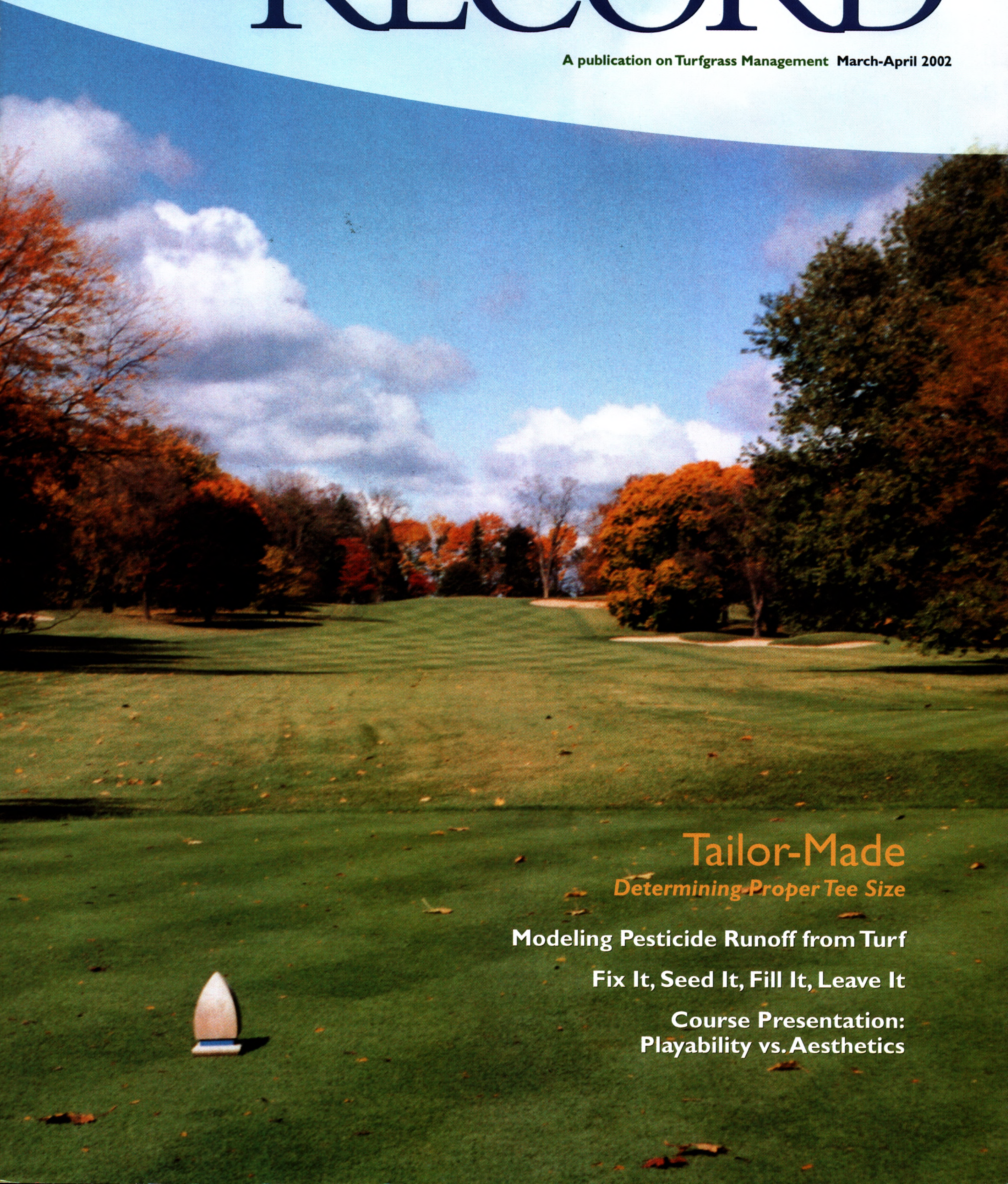
USGA GREEN SECTION

RECORD

A publication on Turfgrass Management March-April 2002



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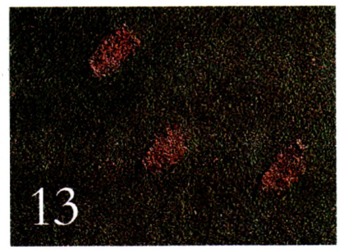

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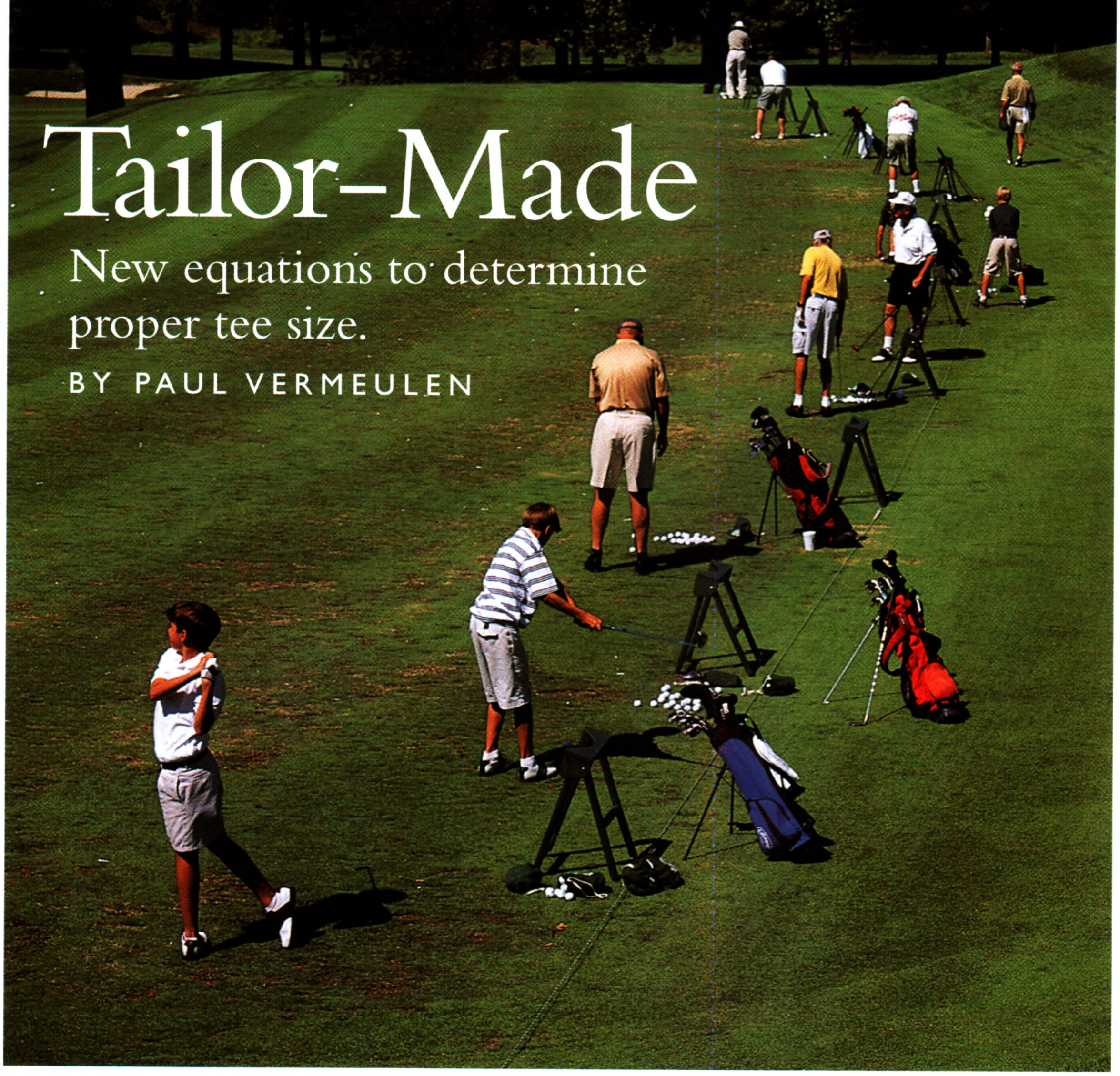
Cover Photo
Maintaining good turf on tees is possible when the usable square footage is adequate.

Tailor-Made

New equations to determine proper tee size.

BY PAUL VERMEULEN



The correct size of a driving range tee can be calculated using the stall dimensions, ratio of stall area damaged over total stall area, weekly rotation frequency, divot recovery rate, and needed number of stalls during the peak golfing season.

Standing on the first tee of your favorite course without grass underfoot would be a disappointment, to say the least. There was a time, however, when that was exactly how the game commonly was played. Before the development of improved turfgrasses, golfers used to step onto a bare teeing area, reach into a large box (appropriately called a teebox), and grab a handful of sand to build a small mound on which to tee up their ball.

With the care of these old tees being relatively straightforward (i.e., the only routine maintenance was to refill the teeboxes every few days), why is it then that green committees all over the globe chose to switch to turf? Although the exact reason may never be known, it is probably safe to assume that golfers complained about the bare tees being unplayable after a heavy rain because the ground turned to mud. (Or perhaps it was that superintendents got tired of golfers complaining about their tee shots going off-line because the sand in the tee boxes was inconsistent!) In any event, today's golfer is much more sophisticated, or pampered, depending on how you look at the situation, than those of yesteryear.

As a result of watching endless hours of made-for-TV golf, most golfers would feel cheated if they had to swing their $500 metal drivers on a turfless tee. The lopsided educational experience of TV golf typically shows well-dressed touring professionals playing on large, perfectly groomed teeing surfaces surrounded by cheering fans from all walks of life. After exposure to such idyllic scenery, who among us would not lose their sense of reality?

In defense of golfers, however, one must concede that the opportunity to play on 18 well-manicured tees is not an unreasonable expectation. Given the right circumstances, a superintendent should have little difficulty maintaining a good stand of turf throughout the golfing season. The problem is that most golfers cannot tell the difference between the right circumstances and circumstances beyond the superintendent's control when it comes to bare ground showing up in the middle of the tees.

The cold truth is that the circumstances involving televised golf are rarely identical to the circumstances of golf at the local course. Here, one can find superintendents having difficulty maintaining turf on the tees because they are too small to support the number of rounds being played. More specifically, the usable square footage of the tees is inadequate, thus dictating the reuse of a teeing area battered by concentrated divot removal before it has had time to fully recover. As the golfing season progresses, the turf gets thinner and thinner from continual reuse and, at some point, golfers suddenly start complaining about poor maintenance.

When faced with the problem of tattered tees resulting from limited area, the real question at hand is not what is wrong with the maintenance program, but rather how much larger does each tee need to be so that it can be maintained successfully. A search of articles written on the topic of proper tee sizing reveals a general rule of thumb in *Golf Course Design and Construction*, available from the National Golf Foundation (NGF). This rule states that tees should have 100 to 200 square feet of usable space for every 1,000 rounds of golf played annually. Applying this rule to a course that hosts an average of 40,000 rounds per year suggests that the tees should range in size from 4,000 to 8,000 square feet.

While at first glance this rule of thumb seems both straightforward and practical, close examination exposes several serious flaws. First, the rule of thumb does not specifically take into consideration the par value and number of each hole.

The difference in par value is very significant, as golfers commonly use an iron on a par-3 hole and a driver or fairway wood on both par-4 and 5 holes. When golfers swing irons, they tend to remove a divot that grows in size as the loft of the club increases. Thus, more area is required to maintain a par-3 tee in good condition than a par-4 or 5 tee. The number of the hole is also significant, as golfers tend to take numerous practice swings and/or the occasional mulligan on the first and tenth holes, dictating the need for more square footage.

Second, the rule of thumb underestimates the square footage for golf courses that host a moderate number of rounds during a three- to four-month season and overestimates the square

The installation of an artificial surface is necessary when the lack of real estate prevents tee expansion.

footage for those that host a large number of rounds throughout the entire year. For example, the rule simply suggests that a course hosting 14,000 rounds per year should have tees that range in size from 1,400 to 2,800 square feet. If this same course were to divide the square footage into three multiple tees on each hole and host the majority of its annual rounds during the summer, i.e., 100 rounds per day, then many of the small

needed because the teeing surfaces would heal relatively quickly.

Lastly, the rule of thumb offers no guidance for the proper sizing of driving range tees. In the absence of such information, most courses across the United States have grossly undersized driving range tees that are a constant source of aggravation for golfers, the golf course superintendent, and governing course officials. In most cases, the

individual tees would end up being severely worn halfway through the golfing season. To make matters worse, many of the individual tees would be too small to maintain with a riding mower.

In another example, the rule suggests that a course hosting 90,000 rounds per year should have tees that range in size from 9,000 to 18,000 square feet, a very broad range indeed. Dividing the large square footage into three or even five multiple tees would not be a problem, but maintaining somewhere in the neighborhood of six acres of teeing ground on a heavily played course would certainly be time consuming. Furthermore, since the only regions where 90,000-plus rounds can be played in a 12-month period are where warm-season species grow vigorously most of the time, the excessive square footage would not be

greatest source of aggravation is the fact that the size of a small range tee cannot be increased due to an absence of available real estate.

After identifying the weaknesses of the rule of thumb published by NGF, the task at hand is to develop a set of equations that accurately accounts for the many different circumstances across the United States. To do this, the best place to start is to establish a minimum size requirement for golf courses that host a very small number of rounds, either seasonally or annually. This minimum size requirement must take into consideration two basic design criteria to be applicable across a broad range of circumstances.

First, nearly all courses are now designed with three or more multiple tees on each hole to accommodate golfers of all skill levels by varying

As a result of watching endless hours of made-for-TV golf, most golfers would feel cheated if they had to swing their $500 metal drivers on a teeing surface composed of bare soil and weeds. Without adequate square footage, however, such unpleasant circumstances cannot be avoided.

the total length of the course. Second, to maintain courses in an efficient manner, each individual tee should be at least 800 square feet so that they can be easily mowed with a riding mower. Based on these basic design criteria and the fact that par-3 tees and the first and tenth tees require additional square footage, minimum tee sizes can be intuitively set as follows:

Hole	Forward Tee	Middle Tee	Back Tee	Total
Par 3	800 ft^2	2,000 ft^2	800 ft^2	3,600 ft^2
Par 4 & 5	800 ft^2	1,400 ft^2	800 ft^2	3,000 ft^2
Nos. 1 & 10	800 ft^2	1,800 ft^2	800 ft^2	3,400 ft^2

Next, a multiplier must be established that determines the necessary increase in square footage based on play volume. This multiplier must take into account several factors. First, the total size of the tees must increase in proportion to the volume of daily play during the peak golfing season. By using daily play figures during the peak golfing season rather than annual play figures, as is done in the NGF publication, the multiplier will yield more accurate results by taking into account the specific time frame when problems on the tees are most likely to occur. Second, the area of turf damaged by both divot removal and the scuffing of golfers' feet during the normal act of swinging a club conservatively equals 0.6 square feet for par-3 holes and 0.4 square feet for par-4 and 5 holes and tees Nos. 1 and 10.

By taking into consideration basic design criteria and the need for a multiplier that increases square footage based on daily play, the following equation for determining tee size can be written:

$$y = (z)(m)(x) + (b)$$

Variable	Definition	Units
y	needed square footage for a tee	ft^2
z	area damaged per round	ft^2/round
m	days to full divot recovery	days
x	average number of rounds per day	rounds
b	minimum square footage value	ft^2

As an example, this equation can be used to determine the needed square footage for a typical course that hosts 200 rounds per day during the peak golfing season and promotes full divot recovery in 30 days using standard maintenance procedures. These values are calculated as follows:

Par-3 Tees

$$7{,}200\ ft^2 = \frac{0.6\ ft^2}{1\ round} \times 30\ days \times \frac{200\ rounds}{1\ day} + 3{,}600\ ft^2$$

Par-4 & 5 Tees

$$5{,}400\ ft^2 = \frac{0.4\ ft^2}{1\ round} \times 30\ days \times \frac{200\ rounds}{1\ day} + 3{,}000\ ft^2$$

Tees Nos. 1 & 10

$$5{,}800\ ft^2 = \frac{0.4\ ft^2}{1\ round} \times 30\ days \times \frac{200\ rounds}{1\ day} + 3{,}400\ ft^2$$

As a quick reference, a summary of tee sizes based on an area of damaged turf per round of 0.6 ft^2 for par-3 holes and 0.4 ft^2 for par-4 and 5 holes and tees Nos. 1 and 10, a 30-day divot recovery period, and minimum square footage values is presented in Table 1.

Once the square footage needed to successfully maintain the tees is determined, the final step is to subdivide and determine the value for each

Maintaining good turf on tees is impossible when the usable square footage is inadequate. The real question at hand is not what's wrong with the maintenance program, but rather how much larger does the tee need to be so that it can be maintained successfully.

individual multiple tee on each hole. As a guideline, the percentage of golfers playing from each set of tee markers should be used. Using the previous example, if 13% of the golfers play from the back tees, 69% play from the middle tees, and 18% play from the forward tees, then the square footage for each tee on a given hole should be divided as follows:

Hole	Total Square Footage	Back Tee	Middle Tee	Forward Tee
Par 3	7,200	936 (7,200 × 13%)	4,968 (7,200 × 69%)	1,296 (7,200 × 18%)
Par 4 & 5	5,400	702* (5,400 × 13%)	3,726 (5,400 × 69%)	972 (5,400 × 18%)
Nos. 1 & 10	5,800	754* (5,800 × 13%)	4,002 (5,800 × 69%)	1,044 (5,800 × 18%)

**For ease of maintenance, the square footage of an individual tee should be increased to a minimum of 800 ft² without reducing the needed square footage of other tees on the same hole.*

DRIVING RANGE TEES

Having established a set of equations for determining the proper size of the tees on the course, the only remaining task is to do the same for the driving range tee. The circumstances are a little bit different, but the basic approach to the problem should be the same. In short, the equation should take into account the area of turf damaged on a daily basis during the peak golfing season and the general rate of divot recovery.

The dimensions of the area of turf damaged on a daily basis can be determined given that golfers typically concentrate their use in the forward three-quarters of each stall to avoid hitting other golfers practicing in neighboring stalls. For example, if the dimensions of a driving range stall are 10 feet wide by 8 feet deep and golfers typically concentrate their use in the forward three-quarters, then the area of damaged turf is equal to 60 ft² (10 ft × 8 ft × ¾ = 60 ft²).

The rate of divot recovery on a driving range tee is appreciably slower than for the tees located on the course. The difference between the two is due to the severity of turf damage on driving range tees. When golfers practice within the confines of a stall, they remove divots from an area until the turf has been all but completely harvested. With so little vegetation left behind, recovery from underground portions of the remaining plant material or from seed takes much longer.

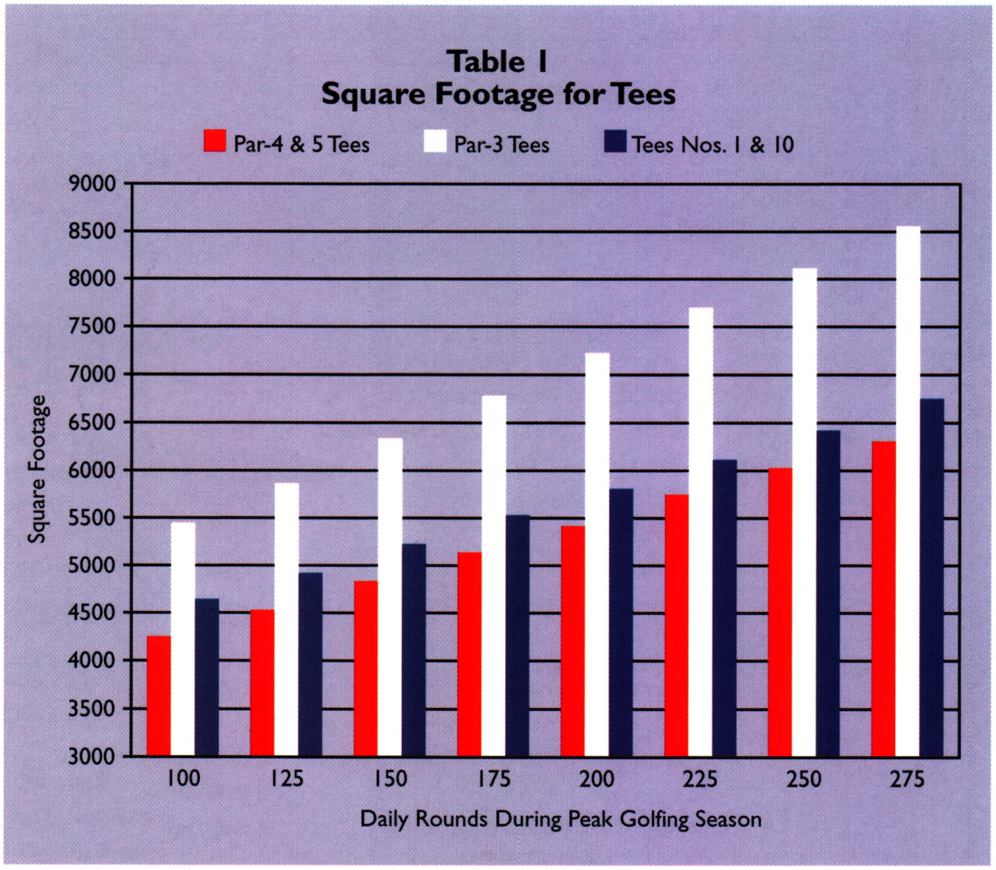
By knowing the area of turf damaged on a daily basis during the peak golfing season and the general rate of divot recovery, the following equation for determining the size of a driving range tee can be written:

$$y = (z)(d)(q)(m)(x)$$

Variable	Definition	Units
y	square footage of driving range tee	ft²
z	square footage of individual driving range stalls	ft²
d	ratio of stall area damaged over total stall area	ft²/ft²
q	weekly rotation frequency	days/7 days
m	days to full divot recovery	days
x	number of stalls needed per day during peak golfing season	stalls/day

As an example, the above equation can be used to determine the needed square footage for a typical driving range tee where 14 stalls measuring 10 ft by 8 ft are needed, the ratio of stall area

A summary of tee sizes based on the area of damaged turf per round, a 30-day divot recovery period, and minimum square footage values.



damaged over total stall area is 3 ft² over 4 ft², the stalls are rotated daily, and full divot recovery is promoted in 40 days. This value is calculated as follows:

Driving Range Tee

$$33{,}600 \text{ ft}^2 = \frac{(10 \text{ ft} \times 8 \text{ ft})}{1 \text{ stall}} \times \frac{3 \text{ ft}^2}{4 \text{ ft}^2} \times \frac{7 \text{ days}}{7 \text{ days}} \times 40 \text{ days} \times \frac{14 \text{ stalls}}{1 \text{ day}}$$

As a quick reference, a summary of driving range tee sizes based on a standard 10 ft by 8 ft stall size, a ratio of 3 ft² of damaged area per 4 ft² of available space, daily stall rotation, and a 40-day recovery period is presented in Table 2.

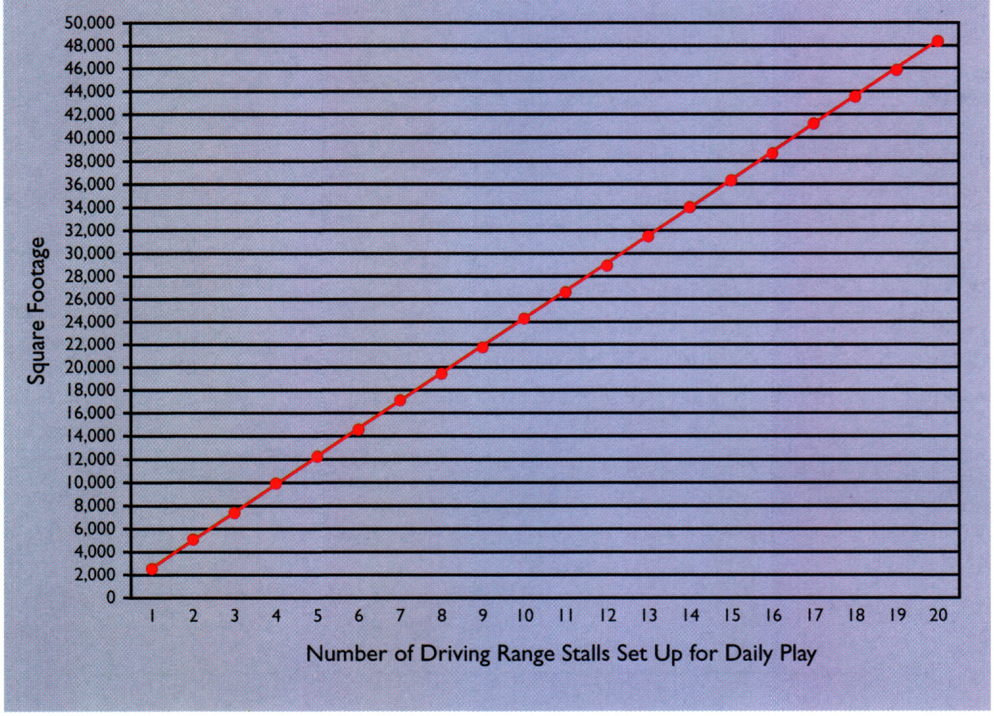


Table 2
Square Footage for Driving Range Tee

A summary of driving range tee sizes based on a standard 10 ft by 8 ft stall size, a ratio of 3 ft² of damaged area per 4 ft² of available space, daily stall rotation, and a 40-day divot recovery period.

In addition to calculating driving range tee size, the equation can also be used to document the need for an artificial surface by solving for days available for full divot recovery and then subtracting this value from the actual number of days needed for full divot recovery as determined by on-site testing. For example, a course with the following circumstances:

Area of driving range tee	15,000 ft²
Dimensions of individual driving range stall	12 ft × 8 ft
Ratio of stall area damaged by divot removal	3 ft² / 4 ft²
Weekly rotation frequency	4 days / 7 days
Number of stalls needed per day during peak golfing season	14 stalls/day

The value for days available for full divot recovery is calculated as follows:

$$\frac{15{,}000 \text{ ft}^2}{\frac{(12 \text{ ft} \times 8 \text{ ft})}{1 \text{ stall}} \times \frac{3 \text{ ft}^2}{4 \text{ ft}^2} \times \frac{4 \text{ days}}{7 \text{ days}} \times \frac{14 \text{ stalls}}{1 \text{ day}}} = \text{approx. } 26 \text{ days}$$

Taking this value and subtracting it from the actual number of days needed for full divot recovery as determined by on-site testing, e.g. 40 days, equals a shortfall of 14 days. In other words, the turf on the driving range tee will be harvested 14 days before full divot recovery can be promoted by routine maintenance procedures. This being the case, it can be documented that an artificial surface must be used 14 days out of every 40 days during the peak golfing season to successfully maintain the driving range tee.

If the equation is not used to document the need for an artificial surface, then, at a minimum, it can be used to calculate the maximum number of stalls that can be set up during the peak golfing season without causing the premature harvest of turf. This can be done by using the actual divot recovery period determined by on-site testing and solving for the number of driving range stalls needed on a daily basis. Using the same information as in the last example, the number of driving range stalls needed on a daily basis is calculated as follows:

$$\frac{15{,}000 \text{ ft}^2}{\frac{(12 \text{ ft} \times 8 \text{ ft})}{1 \text{ stall}} \times \frac{3 \text{ ft}^2}{4 \text{ ft}^2} \times \frac{4 \text{ days}}{7 \text{ days}} \times 40 \text{ days}} = \text{approx. } 9 \text{ stalls}$$

In conclusion, since the very first day golf was played on grass tees, many superintendents have had to explain repeatedly why the centers tend to go bald during the peak golfing season. When faced with such unpleasant duties, try using new math to solve an old problem.

REFERENCE

Georgiady, P. 1997. In the Beginning. *Golf Journal*. L(8):20-23.

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Research *You Can Use*

Modeling Pesticide Runoff from Turf

Can computer modeling help protect the environment?

BY DOUGLAS A. HAITH

PHOTO BY DR. KEVIN ARMBRUST, UNIV. OF GA.

Modeling pesticide runoff can be useful in evaluating the potential for applied chemicals to migrate to surrounding surface waters.

Turf professionals recognize that improperly applied chemicals used to control turfgrass pests can be harmful to the plants and animals that live in and around the ponds, streams, and lakes surrounding golf courses and other grassed areas. Indeed, care is taken to prevent contamination of these waterways from spills, rinse water, or inadvertent applications. However, it may be difficult to control pollution from another route: the runoff of pesticides caused by rainstorms and melting snow. When water from these natural events flows off the turf, it may carry the pesticides with it to surface water.

UNDERSTANDING RUNOFF

The considerable water-holding capacities of the components of turf systems (i.e., verdure, thatch, and soil) limit water runoff from all but the most severe weather events, unless the system is already saturated. Also, the extensive adsorption by turf organic matter tends to bind pesticides to the turf even when water runoff does occur. Nevertheless, the threat of pollution cannot be discounted. Sampling of waters near golf courses has detected many turf pesticides, and it is likely that at least some, if not most, of those chemicals were transported in runoff.

Whether the pollution is large or small, the ultimate concern must be prevention, or at least management to control it. But such management requires information. Which chemicals are most likely to run off? What practices reduce or eliminate runoff? If chemicals do move from turf to waterways, what will their impacts be?

Surface water pollution from pesticide runoff can be a result of significant rainfall occurring soon (e.g., less than 24 hours) after the chemical application. Successful turf managers are always cognizant of current and forecasted weather conditions, so in well-managed turf, this may rarely occur. This limits our ability to draw conclusions regarding the extent of runoff from field experiments. Although it is possible to experimentally create the extreme precipitation conditions that produce significant pesticide runoff, the effort required cannot account for all turf chemicals or the broad range of weather and site conditions encountered in the field.

COMPUTER MODELING

Environmental engineers rely on mathematical models, or equations, to predict water pollution. The models are usually referred to as *fate and transport* models because they predict the movement and ultimate deposition of water contaminants.

Until recently, no fate and transport models were available specifically for turf. Rather, researchers and consultants resorted to models that were developed for agricultural crops. It was reasoned that the interaction of chemicals, plants, and soils is similar for turf and field crops. However, when pesticide runoff values were calculated from these models for turf areas and compared with actual measurements taken in the field, large discrepancies became apparent. These discrepancies arose because of fundamental differences in the ways that plants and soil influence pesticide behavior in crops and turf.

Agricultural models typically view chemical runoff losses as originating in the surface layer of soil. Chemicals are washed off crop foliage and added to the soil surface, where they subsequently contribute to runoff. However, given the dense vegetation of turfgrass foliage and thatch, most surface losses from turf occur directly from vegetation. Runoff losses from turf soils play a relatively minor role. From the point of view of pesticide behavior, field crops are *soil* systems and turf is a *plant* system.

DEVELOPMENT OF A PESTICIDE RUNOFF MODEL FOR TURF

The United States Golf Association has sponsored research on runoff modeling for several years at Cornell University. Early on, we thought that agricultural models could be adapted for turfgrass

Using computer modeling to evaluate the potential for pesticide runoff can aid in protecting golf course water features.

systems, but this approach was eventually abandoned for the development of a new model based on the unique characteristics of turf. This model is called TurfPQ and is available (including the user's manual) by request (dah13@cornell.edu).

As the model was developed, it was important that it be practical and that it function as a credible tool for turf professionals and consultants. This meant that the input data required for the model be readily available, and software should be easy to run on desktop computers. It also meant that the model would be subjected to extensive field testing to determine if its predictions were accurate.

Field testing is a critical aspect of model development. A fate and transport model is nothing more than a set of mathematical equations translated into computer code. The equations may or may not accurately reflect reality. Until a model is tested, it is just an elaborate hypothesis. To test the model, field experiments are designed to measure pesticide runoff from turf systems subject to controlled applications of water and chemicals. The fate and transport model is then run with appropriate input parameters corresponding to the experiments. The runoff values predicted by the model are compared with the observed or measured pesticide runoff. If the measured values and the predicted values are relatively close, the model can be accepted as a reasonable tool for predicting pesticide runoff.

TESTING THE MODEL

TurfPQ was tested using published plot runoff data for 52 runoff events in four states, involving three soil groups, four turfgrass species (bermudagrass, creeping bentgrass, tall fescue, and perennial ryegrass), and six pesticides. The outcome of this testing is shown in the accompanying graph, which compares observations and model predictions. Each data point in the figure corresponds to the model prediction and observed pesticide runoff for a single runoff event. Points, or events, lying on the line y' = y represent perfect model performance (i.e., model values are exactly equal to observations). Points above the line indicate over-prediction by the model (i.e., predicted pesticide runoff is higher than the measured value). Events lying under the line are under-predicted.

Most of the events are relatively close to the line, indicating that TurfPQ predictions are fairly close to the actual measured pesticide runoff. There are exceptions, however. For two of the events, the model predicts pesticide runoff of approximately 20% of that applied, but the actual values were closer to 10%. On average, model results are about 50% larger than the measured values, which, by model prediction standards, can be considered very good.

USE OF TurfPQ FOR RISK ANALYSIS

The value of a model such as TurfPQ is that it can rapidly evaluate or simulate the effects of widely differing chemicals, weather, management, and site conditions. When run with extensive multi-year weather records, simulations can provide long-term estimates of pesticide runoff.

As an example, we used TurfPQ to simulate runoff of two common turf fungicides, chlorothalonil (Daconil) and iprodione (Chipco 26019) from bentgrass fairways in Boston, Mass; Philadelphia, Pa.; and Rochester, N.Y. One-hundred-year records of daily precipitation and temperature were produced for each of these locations. The simulations produced 100-year daily records of three variables: water runoff, pesticide runoff, and pesticide concentration in runoff.

These simulations allowed us to estimate quantities of pesticide that could reach nearby surface waters. Comparing those predicted runoff values with the LC_{50} for *Daphnia magna* (water flea) and rainbow trout gives an indication of the environmental risk posed to surrounding surface waters. LC_{50} is the chemical concentration which kills 50% of the test species over a 48- or 96-hour period.

Even allowing for the fact that TurfPQ predictions tend to be 50% larger than actual values, it is hard to escape the conclusions that the current use of chlorothalonil and iprodione may pose significant water quality risks. However, it may be possible to mitigate these risks by modifying application schedules and amounts. One of the virtues of models such as TurfPQ is that such modifications can be easily evaluated.

A NEW ERA IN ENVIRONMENTAL ASSESSMENT

Concerns for the environmental impacts of turf chemicals seem to have gone through three phases: problem awareness, understanding, and solution. During the first phase, which largely overlapped the 1980s, we became aware of the potential for water pollution from the extensive use of turf chemicals. Reactions from environmental groups and turf managers were sometimes extreme, and it is probably safe to say that many of the concerns were based more on emotion than fact.

During the 1990s, a great deal of scientific research on the issue was published, and the results of experiments and monitoring brought us to a much better understanding of the problem. We are now in the third, or problem-solving phase. With mathematical models such as TurfPQ to evaluate potential for pesticide runoff, we now have the tools to evaluate alternative chemicals and management strategies to help safeguard the environment.

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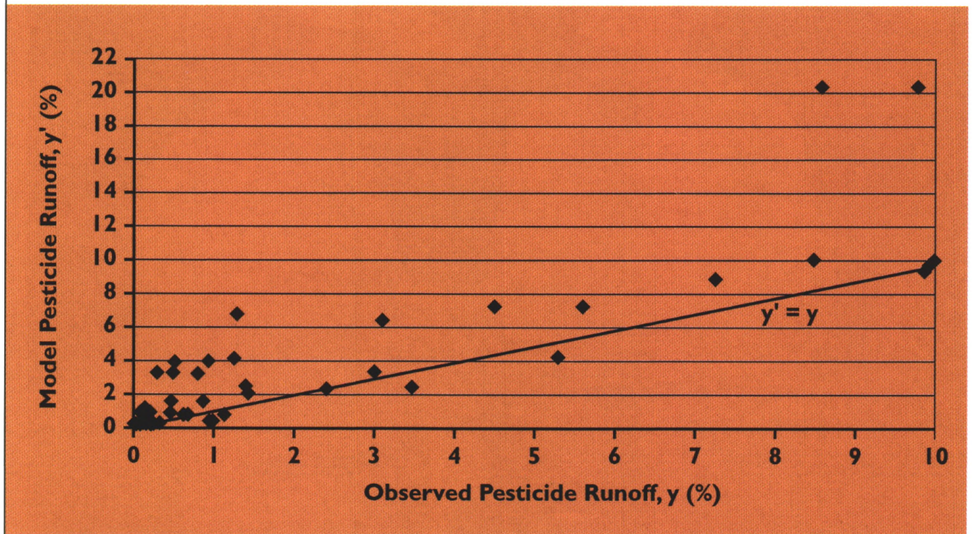

Comparison of TurfPQ model pesticide runoff estimates with observed values. Points on the line represent perfect prediction by the model of the observed runoff. Points above the line indicate over-prediction (model overestimated actual runoff), and those below the line indicate under-prediction (model underestimated actual runoff).

Mean Pesticide Runoff (%)

Pesticide	Number of Events	TurfPQ Model Prediction	Observed
2,4-D	7	8.3	4.3
Chlorpyrifos	3	2.9	0.5
Diazinon	6	0.3	0.7
Dicamba	7	4.0	3.6
Dithiopyr	18	1.2	0.3
Mecoprop	11	4.2	3.7
Overall Mean	52	3.2	2.1

Comparison of observed and TurfPQ modeled pesticide runoff for six pesticides.

Dealing with Boards, Committees, and the Management Team

Take a proactive effort with those who affect your professional life.

BY ROBERT P. SEXTON

Let the committee know you are working with outside consultants on renovation projects.

One activity in my professional life is to conduct a workshop to help golf course superintendents recognize the importance of and personal benefits to be gained from learning the skills of dealing with boards, committees, and managers in the very emotional world of member-owned country clubs. Whether or not a course is in "good" condition is based as much on opinion as it is on fact. Such opinions are subjective, temporary, emotional, and subject to interpretation. This article considers this gray area and some of the realities and strategies that superintendents should consider to improve their ability to influence these opinions.

To begin, let's look at why clubs are such different creatures compared to other recreational facilities.

- In other facilities, the management team is empowered to act with the authority of owners' representatives in dealing with visiting guests who have zero emotional or financial interest in the property. In clubs, it is the exact opposite. Club staffs have limited and fluctuating authority when dealing with long-tenure, repeat customers who, as owner-members, have a substantial emotional and financial interest. To illustrate this point, imagine a ranger asking a member to leave the course for repeatedly parking too close to the green. It is unlikely to happen. However, such a possibility is accepted by the guest as a condition of playing that course.
- Clubs are governed by owners volunteering to serve temporarily on boards and committees. These governing bodies must make the policies and rules concerning the conduct of their fellow owner-members. This task (particularly the role of enforcement) is difficult, sensitive, and often avoided in favor of the more familiar role of involvement with operations.

The job of serving as one of these board and committee (B&C) volunteers, if they execute the responsibility outlined above, is anything but easy. Let's look at why.

A bunker with poor drainage is a good example of a photo to include with the superintendent's monthly written report. It lets the committee know you want to take action to solve this problem.

- B&C members are constantly being second-guessed by a body of owner-member customers very much used to exerting influence and receiving special treatment. These corporate stockholders aren't just names on a list or a stack of mailing labels. Instead, they ride in your cart and eat at your table. This permanent audience includes non-members (spouses, etc.) who have strong opinions as well.
- Cultural considerations are a powerful, yet subjective, motivation behind making decisions — or avoiding them. An example is whether to have a tough course or one set up for speedier play. The culture factors can include the club's traditions, a chairman's agenda, or, in the area of renovating clubhouses, not wanting to change the décor because of the familiarity it provides. While this also may be true in the corporate world, it is rarely as strong a presence as in clubs because of their emotional foundation (e.g., clubs are an extension of the home).

To summarize, this combination of committees, boards, management staff, and members creates an amazingly fluid organizational structure. The ability of a superintendent (or pro, manager, etc.) to productively navigate whese waters is a matter of understanding responsibilities not traditionally taught in the recreation industry. This article will look at three areas: being an educator, getting policies on the record, and the role as a historian. Space permits a full description of only one. I have chosen educator, since it is the foundation upon which the remaining two skills are built.

EDUCATOR

This is, in its simplest form, keeping everyone informed. But in a management environment where the B&C leadership often changes every year, such a traditional task is much more complicated. The main topic is the superintendent's monthly written report. It may sound boring, but it is an extremely effective means of getting your message out to your target audience. Although formal writing is a chore for many, the monthly report need not be long or extremely detailed.

- Concentrate on the facts and get to the point quickly.
- Include pictures to reduce the need for long narratives.
- Make the report something that can be read in two or three minutes and it is much more likely to be read.

IMMEDIATE BENEFITS

- The story is told your way, emphasizing certain points and providing background. It gets read before the meeting. You can give credit or thank whoever has made significant contributions over the past month, educate people about your staff, warn of potential problems, report on the status of projects, discuss the trend of financial information, remind what was done before, present pros and cons of alternatives, etc.
- It has the best chance of being effective, which can be described as giving reasonable people appropriate information in a timely manner. These reasonable people will often be of assistance at the meeting by addressing the unreasonable comments ("Wait a minute, Harry. Didn't you see what the superintendent said in his report . . . .").

Get the word out to the course officials about areas of the golf course experiencing problems. This green lacked sites for hole locations due to surface contours. The usable cupping areas were flagged and the green was photographed to help visually illustrate the problem.

The monthly report is not the only written communications vehicle. The annual orientation is another. But the orientation comes from the monthly report, not the reverse. Understanding some of the immediate and long-term benefits may act as an incentive for you to take this proactive step in managing those to whom you report.

LONG-TERM BENEFITS

- First and most important, you increase your credibility. Increased credibility inevitably leads to an increase in your influence. People will listen to what you say, seek your opinion in advance, and give you more flexibility in doing your job. While you are still likely to be second-guessed periodically, it will happen less frequently, and other people on the committee will assist you more often.

- You will make your supervisor or committee chair more effective. Over time, they will depend on you more, and everyone will know who did the work no matter who takes the credit. Never forget that the money comes from being skilled at handling the tough relationships, not the easy ones. You will be more skilled in communication by being more comfortable in discussing the subjects covered.

The following list is a brief outline of some of the subjects you might include. Note that it is unlikely that any single monthly report will include all of these subjects.

- Course condition: prior month, coming month, problems experienced and how they are being corrected, etc.
- Staff: promotions/terminations, training programs, achievements, marriages, babies. Your goal here is to make your staff come alive to the managers and committees.
- Plant and equipment condition: irrigation, equipment, lakes, etc.
- Other issues and items of interest: member relations, legal/regulatory issues, USGA visits.
- Projects/capital equipment: progress, status of delivery, future needs, etc.
- Attachments: GCSAA articles, industry reports, etc.

The role of educator, via a monthly report, is an essential part of a golf course superintendent's responsibility. What's more important, it is a great skill to acquire.

GETTING IT ON THE RECORD

As with the educator role, this is an essential skill in the transient nature of a club's changing boards and committees. Invariably there is a need to get the owners to go on the record (OTR) with a written policy. In all the superintendents' groups I have spoken to, this example brings the most universal nodding of heads in agreement. Less agreement is observed when emphasizing that it is the club management staff's job to bring the owners to the point of seeing the need for such documentation, understanding the alternatives, and utilizing your professional recommendations to prepare the documents. Dangerous water has just been entered. But it also prompts the question, "If not you, then who?" In executing this role, a club's management staff must employ any number of strategies, including the use of outside expertise, policies at other courses, etc.


Show off new equipment and technologies used in the golf course maintenance program.

HISTORIAN

In every organization, written documentation is the key to effective organization. In this role, the superintendent should volunteer to draft any number of documents, including the monthly minutes, the newsletter articles from the Green Committee Chairman, and announcements to the members about things affecting the course (temporary greens, etc.). Perhaps the most important task of a historian is to moderate future swings in the actions of the committee, board, or executive management. A well-documented, historical record of past actions and decisions is the best means of preventing the constant "reinvention of the wheel" that results in lost time, revenue, and effectiveness. The history I am referring to is not the club history, which is a social document, but rather a recording of business-related decisions for new decision-makers to easily absorb and reference as part of their duties.

As an example, consider a tree policy. A history of this policy's ups and downs over the years is a remarkable read. Without knowing this history, committees cannot make informed decisions, withstand the emotional nature of the crisis of the moment, and gain an appreciation for the difficulty of being a member of the management team in a private club. A history of the policy on memorial trees would include expense tracking, species, location, maintenance, signage, approval to plant, etc., and — the most important decision — how to get an exception to the policy when an owner-member wants to do something different.

In closing, the main purpose of this article is to encourage superintendents to realize the benefits of becoming more skilled in the arena of interaction with members, their committees and boards, and other members of the management team. As with all skills, this will go with you wherever you work. What's more important, their use will increase the likelihood that your opinion that the course is in good condition will be accepted, as well as your recommendations on what is required if it isn't.

ROBERT P. SEXTON *founded the firm Managing Expectations, and he gives programs to club management staff, boards, and committees on management/member relations.*

Fix It, Seed It, Fill It, Leave It

Proper repair of fairway divots depends upon turfgrass species, time of year, and whom you talk to.

BY DARIN BEVARD

Through the green, a player should ensure that any turf cut or displaced by him is replaced at once and pressed down . . . .

With this statement regarding etiquette in the *Rules of Golf*, the debate begins on fairway divot repair. The passage clearly indicates that golfers are responsible for the repair of divots resulting from their golf shots. However, this is not always as simple as it sounds. Although golfers may replace divots, is this really what is best for fairway conditions? What is the best method for handling divots? If golfers do not fix or replace divots, who does? The confusion surrounding these questions is the result of several factors. These include grass type (warm-season versus cool-season grasses), weather conditions, and maintenance resources. The intent of this article is to provide guidelines for fairway divot repair for warm- and cool-season fairway turf.

Should a divot be replaced, or should the turf be thrown away and the scar filled with divot mix? From an agronomic perspective, opinions vary dramatically. However, an unrepaired divot provides a void that often is filled by weeds such as crabgrass and goosegrass if left unattended. The ugly appearance of an unrepaired divot is also undesirable.

From a playability and etiquette perspective, I believe a divot that is large enough to be replaced should be replaced, unless the scar can be filled immediately using divot mix. The lie of the ball may not be perfect, but divot repair will prevent a ball from finding the scar from a large divot. The maintenance crew may eventually remove the divot if additional repair is necessary, but during a round of golf, large divots should be replaced.

COOL-SEASON GRASSES

In areas where cool-season grasses are maintained, fairways are composed mainly of perennial ryegrass or creeping bentgrass. Varying amounts of *Poa annua* or other grasses such as Kentucky bluegrass also may be present, but maintenance is usually targeted for creeping bentgrass or perennial ryegrass. Divot-scar repair for each of these grasses can be quite different.

Perennial ryegrass has a basal-tillering growth habit. This often results in a divot that falls to pieces because it is not held together by stolons or rhizomes. Many times there is little left to replace. Thus, the best option is to fill the divot scar with a seed/soil mixture. This will level the divot scar

Plastic bottles or buckets attached to golf carts and filled with divot mix have proven to be a popular method that allows golfers to aid in the process of repairing fairway divots.

(Above) Filling divot scars with a seed and soil mix provides leveling of the hole as well as the opportunity for reestablishment from seedling turfgrass.

(Opposite page) Green-colored divot mix is becoming increasingly popular. Although there is an added expense, the aesthetic benefits are appreciated.

and allow reestablishment of the turf from seed. Perennial ryegrass seed will germinate and grow rapidly to heal the scar, especially during the spring and fall when weather conditions are favorable.

Creeping bentgrass maintains a stoloniferous growth habit. A divot taken from creeping bentgrass often results in the infamous "beaver pelt," a rather large divot that should be replaced for playability reasons. In fact, during the spring and fall, these large divots often will survive and re-root. During the hotter summer months, the chances of survival are reduced, and the scars will likely fare better when filled with a divot mixture containing creeping bentgrass seed, soil, and sand.

Fairways composed of Kentucky bluegrass pose a dilemma for divot repair. A combination of divot replacement and divot-scar filling will be needed. The slow germination of Kentucky bluegrass seed makes this grass slow to heal divot scars when filled with soil and seed. Filling the scars with a divot helps level the surface and allows the grass to heal the blemishes via rhizome growth. Adding Kentucky bluegrass seed can only help with healing, but again, its slow germination reduces the benefit of seed in the divot mix.

Realize that fairway divot scars in cool-season grasses will heal more rapidly during the cooler spring and fall months. During the summer months when hotter, drier weather is the rule, the growth rate of cool-season grasses can drop significantly. Often, germinating seedlings cannot survive the environmental stresses present during the summer. The overall result is more visible divot scars during July and August and the perception that divot repair is being neglected, which is usually not the case!

WARM-SEASON GRASSES

The divot issue is less complex with warm-season grasses. Zoysiagrass and kikuyugrass rarely yield deep divots in the first place. Any divot that is taken usually breaks into small pieces. Thus, filling the divot scar with sand is the best option. With bermudagrass, larger divots are taken more frequently. However, filling the divot scar with sand, even in instances where the fairways have been overseeded with perennial ryegrass, is still the best option for divot repair. When growing conditions are favorable, these aggressive warm-season grasses will fill any blemishes. If larger divots are taken and the scars cannot be filled with sand, the divot should be replaced for playability reasons.

THE DIVOT MIX

Divot mixes for cool-season grasses generally contain a combination of sand, seed, and soil. Some superintendents even add starter fertilizer to aid in germination and growth. The divot mix should contain enough soil and/or organic matter to maintain adequate moisture to aid germination. A combination of straight sand and seed requires more frequent watering for germination, which is undesirable. The soil content of the divot mix should be low enough that it still flows freely for easy use and does not smear under wet conditions. Do not skimp on seed. Too much seed is better than too little.

In warm-season turf, straight sand is usually used to fill divot scars. Seed is rarely included. In the case of bermudagrass, many of the fairway grasses are vegetatively established and the addition of seed in the divot mix will produce undesirable bermudagrass contamination.

Any divot mix can be dyed green for aesthetics. This comes at an additional cost, but provides a more uniform appearance for the fairways.

Ultimately, the condition of the golf course falls on the shoulders of the golf course superintendent. Whoever repairs divots should make sure it is done neatly to eliminate concerns about playability and potential inadvertent Rules infractions.

WHO IS RESPONSIBLE?

Who is responsible for repairing divot scars? In short, everyone has some responsibility in the matter. The etiquette of golf calls for golfers to replace divots and repair any damage to the course. Thus, whenever possible, golfers should participate in the process during their round of golf. The golf course superintendent or the golf professional staff must provide the players with the necessary tools to help with divot filling.

The most popular method to date has been the use of bottles or buckets attached to golf carts and filled with divot mix. For this to be successful, the bottles must be filled frequently. A station that allows golfers the opportunity to refill bottles during their round of golf should be provided. Without a reliable supply of divot mix, golfers can become frustrated and lose interest in the process. The use of divot bottles by walking golfers is not as easy. Walkers should make the effort to replace divots to the best of their ability to maintain good playability.

Ultimately, the condition of the golf course falls on the shoulders of the golf course superintendent. Some maintenance efforts may be needed to help with the effort to fill divot scars, which is a simple but labor-intensive activity. Fairways are comprised of 20 to 30 acres or more at most 18-hole golf courses. Thus, proper budgetary resources for labor and materials are needed to carry out this activity. If these resources are provided, the maintenance staff can help to repair fairway divot scars.

Outside groups such as high school golf teams can contribute to fairway divot repair efforts in return for the use of a golf course for practice and matches. Members at some courses have also helped with this task. Whoever repairs divots should make sure it is done neatly to eliminate concerns about playability and potential inadvertent Rules infractions.

CONCLUSION

The debate among golfers over divot repair will always be with us because of the confusion about grass types, weather factors, and labor resources. Agronomy is not always compatible with playability regarding the repair of divot scars. All golf courses should implement a plan to address fairway divot repair based upon their individual needs and resources. When divot scars are neglected, weeds can encroach, unfortunate golfers can face difficult shots, and the general appearance of the course can suffer.

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Astron® Can Reduce the Level of Growth Suppression Provided by Primo MAXX® in Creeping Bentgrass

A study indicates a possible useful interaction between two turf products.

BY P. H. DERNOEDEN AND J. E. KAMINSKI

In the Mid-Atlantic Region and elsewhere, golf course superintendents routinely apply Primo MAXX® (trinexapac-ethyl, Syngenta Crop Protection, Greensboro, N.C.) to greens to suppress clippings and improve green speed. Astron® (Floratine Products Group, Inc., Collierville, Tenn.) also is used on greens, presumably for the purpose of improving turf vigor in the summer. Astron contains some micronutrients and an unspecified amount and source of gibberellic acid (i.e., there is no mention of gibberellic acid on the label). Primo MAXX inhibits growth by suppressing gibberellic acid synthesis in plants. As previously noted, Astron may contain a source of gibberellic acid, which technically could reverse the effects of Primo MAXX. There are different types of gibberellic acid and biostimulants, and it was unknown if Astron would interfere with the growth-regulating effects of Primo MAXX. Since many golf course superintendents use both products on greens during the summer, it seemed prudent to assess any potential interactions between Primo MAXX and Astron.

University of Maryland researchers investigated the question, "Can the effects of a growth regulator be reversed by applying a biostimulant?"

Primo MAXX and Astron were applied to Providence creeping bentgrass. The bentgrass was seeded in September 1999 and grown on a USGA-specified greens mix and mowed to a height of 0.20 inch. Clipping weights were monitored as a measure of growth suppression and/or enhancement.

RESULTS

Seven days following the first application, bentgrass foliar growth in plots treated with Primo MAXX alone was suppressed more (47%) than turf growth in plots treated with Primo MAXX tank-mixed with Astron (29-31%) (Table 1). Except on June 30, Astron reduced the effectiveness of Primo MAXX in the Primo MAXX + Astron tank mix between June 21 and July 28. On July 6, there was no growth suppression (i.e., +4%) in plots treated with Primo MAXX tank mixed with Astron. All 14-day treatments were applied last on July 13. The bentgrass in plots treated with Primo MAXX alone or Primo MAXX + Astron on a 14-day interval incurred post-inhibition growth stimulation (i.e., turf was growing more rapidly in Primo MAXX-treated plots versus the untreated control) by August 11 and 25, respectively. Post-inhibition growth stimulation is a phenomenon associated with most plant growth regulators.

Bentgrass treated with Primo MAXX weekly + Astron on a 14-day interval exhibited less foliar growth inhibition when compared to plots treated with Primo MAXX alone on June 21 and July 13 and 20. However, on August 4 and 11, growth suppression was improved with Primo MAXX weekly + Astron on a 14-day interval, when compared to Primo MAXX alone. Improved growth suppression on the aforementioned dates was likely due to applying Primo MAXX six times on a weekly schedule (last applied July 20) and Astron four times, whereas Primo MAXX alone was applied only three times (last applied July 13).

Between June 21 and August 4, the average reduction of clippings as a percent of the control was 43%, 23%, and 41% for plots treated with Primo MAXX alone (3 applications), Primo MAXX + Astron on the 14-day interval (3 applications), and Primo MAXX weekly (6 applications) + Astron (4 applications) on a 14-day interval, respectively. Astron applied alone resulted in increased clipping weights on two dates (i.e., July 6 and 20). In summary, tank mixing Primo MAXX with Astron on the 14-day interval reduced the ability of Primo MAXX to suppress foliar growth by about 47% (i.e., 23% versus 43%), when data were averaged (i.e., June 21 to August 4). Furthermore, the growth suppression effectiveness accorded by applying Primo MAXX weekly and Astron on a 14-day interval was partially offset by Astron on three dates, when compared to Primo MAXX alone. It appears that the nutrients or possibly unspecified amounts of gibberellic acid in Astron reduced the effectiveness of Primo MAXX. In any case, these data should help to answer the question, "Can the effects of a growth regulator be reversed or partially reversed by applying a biostimulant that apparently contains gibberellic acid?" The results of this test appear to say yes.

CONCLUSIONS

Before any definitive conclusions are drawn, this study should be repeated to corroborate the results. The data, however, strongly indicated that Astron can reduce the ability of Primo MAXX to suppress the foliar growth of creeping bentgrass. There are many products claiming to be biostimulants or having some attribute(s) (i.e., thatch or disease control) that will benefit turf. The fact is that most of these types of products have not been field tested on turf. Several of the companies selling these products are unwilling to provide financial support to test their compounds, but they seem to have plenty of money for advertisements.

For this study, we were grateful for the funding provided by Syngenta on behalf of Primo MAXX. The Astron was donated by a local superintendent. Universities do not provide budgets to support product testing. Funds must come from industry, and those companies willing to support research will get first priority. Golf course superintendents can help their cause by insisting that manufacturers provide field test data on their products. Test results should be supported by studies conducted in two or more states by different turfgrass scientists.

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Table 1.
Creeping Bentgrass Clipping Weight as a Percent of the Untreated Control as Influenced by Primo MAXX (Primo) and Astron

Treatment	Rate (oz. product/ 1,000 sq. ft.)	Spray Interval (Days)	Clipping Weight									
			June 21	June 30	July 6	July 13	July 20	July 28	Aug. 4	Aug. 11	Aug. 21	Aug. 25
			(% of the control)									
[x]Primo	0.10	14	-47c[z]	-36bc	-36c	-39c	-64e	-53c	-23b	16a	16a	16a
[x]Astron	0.75	14	-2a	2a	23a	7a	9a	1a	-6a	-1bc	-4c	-5c
[x]Primo + Astron	0.10 + 0.75	14	-29b	-20b	4b	-23b	-19c	-39b	-35c	-1bc	9ab	14a
[y]Primo + Astron	0.10 + 0.75	7 + 14	-31b	-45c	-46c	-16b	-45d	-52c	-50d	-16c	6abc	10ab
Untreated	—	—	0a	0a	0b	0a	0b	0a	0a	0b	0bc	0bc

[x]Treatments were applied June 14 and 30 and July 13, 2000.
[y]Primo MAXX was applied weekly on June 14, 21, and 30, and July 6, 13, and 20, whereas Astron was applied June 14 and 21 and July 6 and 20, 2000.
[z]Means in a column followed by the same letter are not significantly different at P = 0.05 according to the least significant difference test.

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Research *You Can Use*

How Does Turf Influence Pesticide Dissipation?

Active thatch microbe populations can help reduce the risks of some pesticides.

BY B. E. BRANHAM AND D. S. GARDNER

(Opposite page) In turf, the pesticide application is made to a continuous layer of organic matter. The highly active microbe populations in thatch break down many pesticides much more quickly when applied to turf compared to applications to bare soil.

(Below) Turfgrass management is considered a close cousin of production agriculture. Research at the University of Illinois documents pesticide dissipation in turf versus bare soil.

It is no secret that production agriculture is receiving more and closer scrutiny because of concerns about pesticide and nutrient leaching that may be threatening some our nation's water resources. Like it or not, turfgrass management is considered a close cousin of production agriculture. Problems identified in production agriculture are assumed to apply to turf as well. So, it may be logical for government regulators, environmental activists, and concerned citizens to assume that highly maintained turfgrass sites also represent risks to the environment since turf, in many respects, is similar to production agriculture.

To gain a better understanding of this, the United States Golf Association funded research at the University of Illinois for three years to document pesticide dissipation in turf versus bare soil. These side-by-side studies were designed to determine the role of turf-

grass and associated thatch on the fate of pesticides applied to turf.

WHY STUDY PESTICIDE DISSIPATION?

There were several reasons for undertaking these studies. First, many of the computer models used to predict pesticide leaching and movement have been developed for use in row crop agriculture, where the application is usually made to bare soil. In turf, the pesticide application is made to a continuous layer of organic matter, the turf, which may play a dominant role in the ultimate fate of these pesticides. Second, it may be possible to adjust these models to account for the effect of turf on pesticide fate.

Third, previous research indicated that some pesticides dissipate much faster when applied to turf than when applied to bare soil[1,2,3]. In most cases, however, these were not side-by-side comparisons, but separate studies conducted by different investigators at different locations. This leaves open the possibility that the increases in pesticide dissipation rates were not due totally to the presence of turf, but to some other factors.

At the University of Illinois, dissipation rates and leaching of five pesticides used in turf were examined. The focus was on newer pesticides, where little previous information on dissipation rates and leaching existed. Even for older pesticides, however, the amount of published information regarding their fate in turf is often quite limited or non-existent. The five pesticides chosen consisted of three fungicides, one insecticide, and one herbicide. These pesticides were selected to have a wide range of solubilities and half-lives that result in different leaching potentials.

IMMOBILE OR MODERATELY MOBILE PESTICIDES

After completing these experiments with five different pesticides, some trends began to emerge. The most illuminating finding is that pesticides classified as immobile or moderately mobile tend to have shorter half-lives in turf than in bare soil. The more rapid dissipation is due to the high microbial activity found in thatch.

For immobile pesticides, the faster rate of dissipation has few benefits from an environmental perspective, since these products tend not to leach anyway. However, decreasing soil or turf residence times could reduce the likelihood of pesticide runoff, since they will be present in the environment for shorter periods of time.

Preemergence herbicides, which need to remain present for several months to provide effective control, are often applied at higher rates in turf than in row crop agriculture. For example,

the rate for pendimethalin in soybean weed control is 0.75 lbs. a.i./acre, whereas in turf, rates of between 1.5 and 2.25 lbs. a.i./acre are used. For this group of pesticides, field experience has already shown that pesticides break down faster in turf than in bare soil.

The real value of turf appears in the case of pesticides that are moderately mobile. These products may leach to groundwater when conditions are favorable for leaching. These conditions include sandy soils, high rainfall or irrigation following pesticide application, or low soil organic matter content. In other cropping systems, the leaching potential of these pesticides does exist. In turf, it appears unlikely that these products would leach to a significant extent because of the capacity of turf to retain and degrade these compounds.

One example of a moderately mobile pesticide studied is ethofumesate (Prograss). The distribution of ethofumesate with soil depth in turf versus bare soil was dramatically different. Ethofumesate leached to a deeper extent and persisted much longer in bare soil than in turf. Of all the pesticides studied, the effect of turf on pesticide dissipation was most pronounced for ethofumesate, where the half-life went from 56 days in bare soil to only three days in turf. The reduced half-life effectively eliminates most of the leaching risk of ethofumesate applied to turf.

MOBILE PESTICIDES

On a less positive note, pesticides classified as mobile tend to behave the same regardless of whether they are applied to turf or bare soil. We believe this is because the thatch does not retain these mobile pesticides, and so they bypass the pesticide-degrading thatch layer of turf. Both mefanoxam (Subdue Maxx) and halofenozide (Mach II) behaved about the same in turf as in bare soil. Both products quickly reached the lowest layer we sampled, six to 12 inches, by the fourth day after application.

These products may dissipate more rapidly in thatch than in soil, but they tend to move through the thatch layer quickly and are not there long enough to derive the benefit of thatch on pesticide dissipation. While small percentages of the total pesticide application rate leached to the lower soil depths, these are important amounts because once they reach these depths there is much less likelihood they will be degraded before reaching groundwater.

One very practical result of this research is the recommendation that irrigation following the application of a mobile pesticide should be as light and infrequent as practical. In other words, try to keep the pesticide in the thatch layer where it can be degraded. While

Solubility and Reported Half-Lives of Pesticides Used in the University of Illinois Dissipation Studies

Pesticide	Trade Name	Water Solubility (PPM) 20-25 C	Previously Estimated Half-Life (Days)
Propiconazole	Banner	110	110
Halofenozide	Mach II	510	?
Ethofumesate	Prograss	50	30
Cyproconazole	Sentinel	140	90
Mefanoxam	Subdue Maxx	26000	70

rainfall cannot be controlled, irrigation should be light enough that it does not move these products through the thatch for the first four to seven days after application.

However, it is important to recognize where the target zone is for a particular pesticide. Many of these products are mobile by necessity. For instance, halofenozide will not be very effective against grubs if it is tightly bound by thatch, since grubs typically inhabit the soil layer below the thatch. In fact, irrigation is often suggested as a means to move grub-control pesticides through the thatch layer.

Choose grub-control products with care. The newer products such as Merit or Mach II have more specificity (i.e., kill the pests, but cause less harm to other insects) and are less toxic than many of their predecessors. The challenge with these two products is that it is more difficult to use them curatively, and much easier to use them preventatively, which may result in overuse.

As mentioned previously, the difference in pesticide half-life between applications to turf versus bare soil was most striking for ethofumesate. Ethofumesate is a preemergence herbicide that is used as a postemergence control of annual bluegrass in turf. Clearly, it is good that ethofumesate does have postemergence activity because with a half-life of only three days, it is not going to persist long as a preemergence herbicide in turf. This result explains many of the field responses observed with ethofumesate. In our field trials, the level of preemergence control from ethofumesate was never as good as from other preemergence herbicides used in turf. We now understand why.

TURF AS A MICROBIALLY ACTIVE ORGANIC LAYER

The original goal was to develop a better and more quantitative understanding of the role of turf in pesticide dissipation and leaching. While this research certainly provides a better understanding of how turf affects pesticide dissipation rates, not as much progress has been made in quantifying the role of turf in pesticide fate. However, an initial study with cyproconazole (Sentinel) showed that the presence of turf was much more important than the amount of turf present in affecting the rate of pesticide dissipation.

Perhaps the best way to view turf is not as a wonderful filtration system that degrades everything applied to it, but rather as a highly sorptive layer of organic matter teeming with microbial activity that will reduce the potential problems caused by the introduction of pesticides into this environment. It will not eliminate these problems, but it will dampen their impact on water resources.

Exercise special care when using pesticides that are considered mobile in soil. These products are most likely mobile in turf, as well. Modify irrigation practices to retain these pesticides within the thatch layer as long as possible. When a choice exists, choose pesticides that are classified as moderately mobile or immobile over those classified as mobile.

It is the responsibility of the golf course superintendent to make wise choices regarding pesticide use and selection that minimize the risk of ground or surface water contamination. You have a good system to manage, but it still must be managed well.

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Half-Lives (Days) Determined in Turf or Bare Soil from Experiments Conducted in Urbana, Illinois, 1996-1999

Pesticide	Trade Name	Half-Lives (Days) Bare Soil	Half-Lives (Days) Turf
Propiconazole	Banner	29	12-15
Halofenozide	Mach II	>64	>64
Ethofumesate	Prograss	51	3
Cyproconazole	Sentinel	128	8-12
Mefanoxam	Subdue Maxx	7-8	5-6

On Course *With Nature*

Looking Back, Looking Forward

How far we've come and where we're going.

BY JEAN MACKAY AND PETER BRONSKI

Outreach and Education: After joining the Audubon Cooperative Sanctuary Program for Golf Courses, Aldeen Golf Club in Illinois adopted Christian Life Schools, offering the golf course property and greenhouse for use as a satellite learning center. Glenn Bereiter, superintendent, pioneered the partnership. During the spring of 2001 the children monitored the growth and development of annual flowers, maintained nature journals, and planted an area of native prairie species.

In 2001, Audubon International celebrated the tenth anniversary of the Audubon Cooperative Sanctuary Program (ACSP) for Golf Courses, an environmental education program designed to help golf courses play a significant role in enhancing and protecting wildlife habitats and natural resources, while reducing environmental risks. Looking back over the last ten years, there is much to be proud of since the first golf courses joined the program. Today, 2,125 courses throughout the United States are enrolled, and 307 have achieved designation as Certified Audubon Cooperative Sanctuaries by implementing and documenting a full complement of conservation activities (membership figures as of November 1, 2001).

Although many courses already have a number of environmental management practices in place, the ACSP provides a framework for organizing, expanding, and documenting these activities. And the positive publicity garnered by those who serve as case studies and demonstration sites has led to an improved public perception of golf courses as a whole.

Indeed, through the dedication, collaboration, and hard work of thousands of golf course superintendents, USGA Green Section staff, golf associations, and local conservation organizations, we are achieving the original aims of the program:

- Enhancing wildlife habitats on existing golf courses;
- Encouraging active participation in conservation programs;
- Recognizing golf courses as important open spaces;
- Crediting the people actively participating in environmentally responsible projects;
- Educating the public and the golf community about the benefits of golf courses and the role they play relative to the environment and wildlife.

DOCUMENTING RESULTS

In 2000 and 2001, Audubon International's research department conducted a survey to assess the environmental outcomes of participation in the Audubon Cooperative Sanctuary Program for Golf Courses in a number of key environmental priority areas. These included: wildlife habitat conservation, chemical use reduction, and water quality. In addition, the survey included a brief assessment of participant attitudes related to the impact of ACSP participation on golf playing quality, job satisfaction, and golfer satisfaction.

The survey was mailed to all golf course members; 23% responded, and data from these 470 golf courses were compiled and analyzed. Results indicate a high level of environmental quality improvement among participants in the program.

WILDLIFE AND HABITAT MANAGEMENT

The ACSP provides significant educational information and resources to help golf courses enhance and protect habitat for native wildlife species. Results of the survey show that the majority of participants have expanded wildlife habitats significantly. Since joining the Audubon Cooperative Sanctuary Program:

- 80% of respondents decreased managed turfgrass to increase wildlife habitat.
- 89% conscientiously chose native plants when landscaping, compared with 49% before joining the program.
- 77% added gardens for birds and butterflies.
- 65% now maintain a wildlife inventory, compared with just 16% before joining.

• The average number of acres per golf course devoted to providing wildlife habitat increased from 45 acres to 67 acres, an increase of 22 acres per golf course.

• Combined, the golf courses that responded to the survey provided 40,214 acres of wildlife habitat, an increase of nearly 10,000 acres due to program participation.

CHEMICAL USE REDUCTION AND SAFETY

Helping golf courses to reduce the use of pesticides and fertilizers, as well as safely use, store, and handle chemicals is a key environmental priority of the ACSP. Results of the research survey indicate that golf courses have been able to achieve these objectives without sacrificing golf course playing quality or member satisfaction. Since joining the ACSP:

• 75% of respondents reduced pesticide costs.

• 82% reduced pesticide use.

• 92% used pesticides with a lower toxicity level.

• 89% improved cultural control methods to decrease the need for chemical use.

• 64% improved spill containment for pesticide mixing and loading areas, compared with 33% before joining.

• 85% increased the percentage of slow-release fertilizers used.

• 74% increased the use of natural organic fertilizers.

WATER CONSERVATION AND QUALITY

Limiting water consumption and preventing water pollution have long been critical environmental issues. The ACSP aims to help golf courses protect water quality for irrigation, drinking water supplies, and aquatic habitats and wildlife species. Responses to the survey suggest that golf courses are taking increasing steps to decrease water use and protect water resources from potential pollutants. Since joining the Audubon Cooperative Sanctuary Program:

• 60% reduced water costs.

• 89% improved their irrigation system or the way that water is applied.

• 69% decreased water usage.

• Golf courses saved an estimated 1.9 million gallons of water per year per course since joining.

• 86% increased efforts to monitor water quality.

• 55% increased emergent vegetation in golf course ponds.

• 45% instituted a contained equipment wash-off area, compared with just 23% prior to joining.

Water Conservation and Quality: Over the years, a small half-acre pond near the 18th hole at Colorado Springs Country Club (Colorado Springs, Colorado) had lost much of its plant and animal life. With some help from Audubon International, Terry Bolin, superintendent, decided to undertake a pond restoration project. He introduced trout, bass, and bluegill, and added aquatic plants such as cattails, sedges, reeds, and water lilies. The project successfully transformed a sterile pond into a beautiful habitat for fish, birds, and other wildlife.

PARTICIPANT ATTITUDES

In order for environmentally sound management practices to be implemented and accepted, they must not jeopardize the superintendent's or club's ability to maintain high quality playing conditions or satisfy golfers. In addition, golf course superintendents must perceive environmentally sound maintenance as a positive aspect of their jobs if they are to make a long-term commitment to maintaining environmental quality. The ACSP assists golf courses in educating golfers and local community members about the benefits of maintaining an environmentally sensitive golf course. Program participants have been able to effectively integrate environmentally sound maintenance practices without sacrificing golfing priorities. Since joining the ACSP:

• 50% reported improved playing quality and 49% reported similar playing quality.

• 99% reported that golfer satisfaction has improved or remained the same.

• 66% of superintendents reported improved job satisfaction.

CONCLUSION

Environmentally sound golf course management is essential for maintaining the quality of the environment and continuing the natural heritage of the game of golf. The Audubon Cooperative Sanctuary Program for Golf Courses provides educational resources, a structured framework, and a set of environmental standards that help golf courses respond effectively to the challenges of maintaining an environmentally sound golf course. Audubon International looks forward to continuing its work with the golf industry to further improve environmental performance, measure results, and make the program an industry standard.

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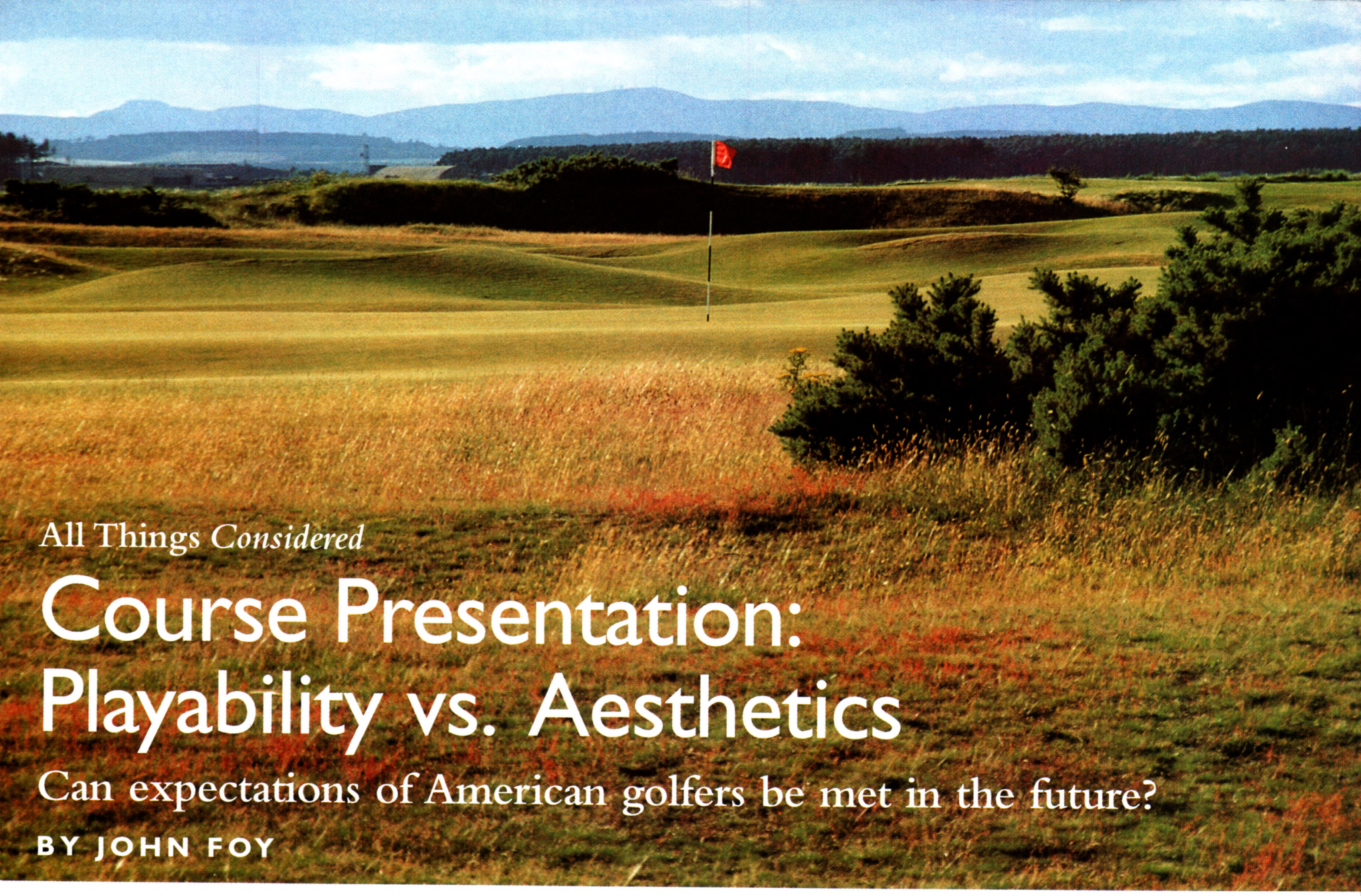

All Things *Considered*

Course Presentation: Playability vs. Aesthetics

Can expectations of American golfers be met in the future?

BY JOHN FOY

Golf course conditioning has steadily improved. Around Florida and across the lower South, the introduction of the ultra-dwarf bermudagrasses has raised the bar with respect to putting green quality. These new cultivars can be mowed routinely at 1/8 inch or less, which was unheard of just a few years ago. Golfer expectations have risen, and in some cases the standards for daily conditioning are equal to or better than what was expected of tournament courses just a few years ago. However, environmental extremes and increasing governmental regulations result in limitations on the use of basic resources such as water, pesticides, and fertilizers. Thus, the question arises as to whether or not golfer demands and expectations can be met in the future.

Successfully managing golf courses in Florida in 2001 meant dealing with environmental extremes. During the winter and into the early summer, a severe drought occurred. This is the normal dry season in Florida, but with below-average rainfall for two to three years, lake and aquifer levels reached record lows, and in a large portion of the state, the alarming reduction in potable water supplies created a crisis situation. Water management districts around the state were forced to impose or further expand landscape irrigation restrictions. For the first time at many courses, it was necessary to manage with significantly less water. While this presented challenges to course managers, they found that it was possible to survive.

By midsummer, it began to rain with a vengeance, and the opposite extreme developed. Though much needed, periods of prolonged and/or extremely heavy rainfall during the late summer and fall resulted in a new set of course management challenges. By year-end, total rainfall amounts for most of the state had reached at least average levels, and in some locations were as much as 10 to 12 inches above normal. Naturally, this brought an end to the drought, and irrigation restrictions were either completely lifted or reduced by the water management districts. With a rapidly growing population in Florida, however, it is a fact that water has become a limited resource, and less will be available for course irrigation in the future.

The drought and irrigation restrictions of 2001 were a wake-up call for golfers at facilities throughout Florida. Due to demands for a lush

Golfers' expectations vary as to what is the ultimate in course conditioning. Some golf courses in the United States focus on the aesthetics of a highly manicured look in contrast to a more natural presentation of European golf courses, with the primary focus on course conditioning (St. Andrews).

green color, over-irrigation of golf courses has been one of the most common mismanagement practices encountered. The base bermudagrass turf of Florida golf courses does have good drought tolerance, and we found that it was indeed possible to maintain turf coverage and good playing conditions when irrigation restrictions were in full effect. Although adjustments in management programs were necessary, the golfers found better playing surfaces and in particular a lot more roll on their tee shots. Some golfers finally began to realize and accept that green color is not a factor that impacts course quality or playability.

In addition to less water for course irrigation, increased regulation of fertilizers and pesticides has and will continue to occur. In response to environmental concerns, the golf course maintenance industry has made excellent progress in reducing its reliance on these materials. Nevertheless, pesticides must be applied to control heavy pest (insect, weed, and nematode) pressures, and fertilizers have to be used to produce a dense, healthy turf cover. The loss of some compounds is to be expected, and this will make it even more difficult to maintain an acceptable level of pest control. Research continues to develop alternative management practices, treatments, and better-adapted turfgrass varieties or cultivars, but how many facilities will be able to use materials that cost $300-$500 or more per acre on a large-scale basis?

Labor is yet another resource issue that has been a major concern. Nearly every golf course I visited this past year was dealing with a labor shortage. Not only was it hard to find and retain adequate staff to keep up with routine maintenance, but there has been a shortage of qualified individuals for assistant and technician positions. There is simply no way around the fact that modern-day course management is labor intensive and time consuming. This is especially true of course grooming and manicuring, which has a big impact on the average golfer's perception of quality. We can talk about prioritizing and reallocating resources, but at a growing number of facilities, essential maintenance practices have been curtailed or have become very expensive due to labor shortages and shrinking budgets.

Over the years I have enjoyed the *Greenkeeper International* magazine, published by the British and International Golf Greenkeepers Association. Something that has always stood out has been the use of the word *presentation*, with the primary focus being course conditioning. Unlike American trade magazines, every picture is not a shot of a green, perfectly manicured golf hole. I find this refreshing but troubling at the same time, because it highlights the fact that the aesthetic side of course presentation is often overemphasized in the United States.

It has been my contention for many years that unrealistic golfer expectations and demands will not be changed until regulations restrict or remove various management tools. I am confident, however, that American ingenuity will prevail and that the golfers of this country will continue to be provided with good to excellent quality facilities. Nonetheless, with ever-increasing limitations on resources, we remain confronted with the big job of educating golfers about the differences between aesthetics and playability.

JOHN FOY *is Director of the USGA Green Section's Florida Region, where he visits golf courses throughout the state of Florida.*

Modern-day course management is labor intensive, but some golfers believe that the highly manicured standards can be taken too far.

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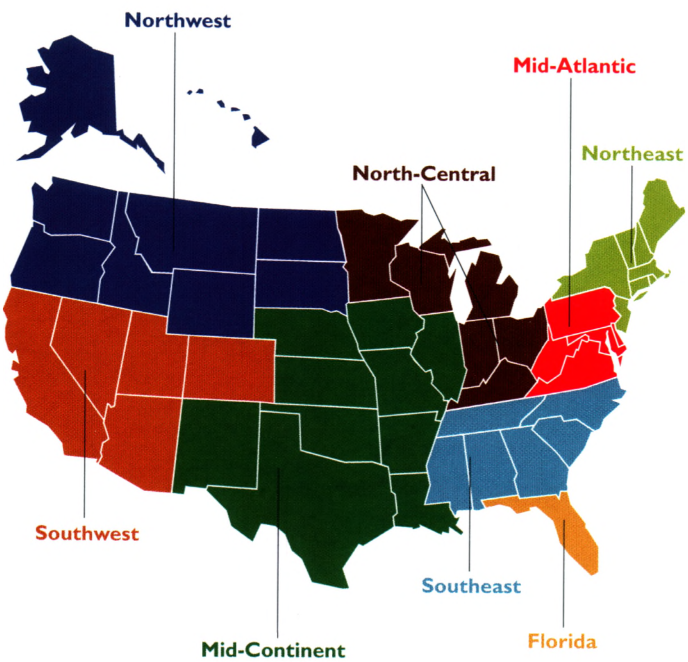

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Subscriptions $18 a year, Canada/Mexico $21 a year, and international $33 a year (air mail).

Subscriptions, articles, photographs, and correspondence relevant to published material should be addressed to: United States Golf Association, Green Section, Golf House, P.O. Box 708, Far Hills, NJ 07931.

GREEN SECTION RECORD (ISSN 0041-5502) is published six times a year in January, March, May, July, September, and November by the UNITED STATES GOLF ASSOCIATION®, Golf House, Far Hills, NJ 07931.

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

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

Printed on recycled paper

Turf *Twisters*

Q: Our course has just hooked up to a recycled water source. How often should we be testing water quality? (Nevada)

A: Initially, for the first two to three years it would be wise to test quarterly to monitor any fluctuations of quality that may result due to seasonal flow and water use variations in your municipality's reclamation plant. Once you feel confident that the quality is remaining relatively stable throughout your irrigation season, you can consider reducing the frequency of testing to annually, during the month of peak irrigation demand.

Q: I am a new member of our Green Committee with little experience in golf course maintenance, but a keen interest in understanding the operation. Can you give one or two good sources of information for a Green Committee neophyte? (Idaho)

A: Although there are many different publications available, two specific sources are recommended. *A Guide for Green Committee Members* is an outstanding source to understand your responsibilities as a member of the Green Committee. If you wish to get a more in-depth view of golf course maintenance, try the newly revised *Turf Management for Golf Courses* by Dr. James Beard and the Green Section staff. This all-inclusive book will answer almost every question you may have concerning golf course maintenance. Both publications are available by contacting the USGA Order Department at 1-800-336-4446.

Q: Our superintendent always places the tee markers in the rough, outside of the tee box. He claims that it is more efficient for the person mowing tees in order to stay ahead of play in the morning. Is this a violation of the Rules of Golf? (Hawaii)

A: No. The Rules of Golf state that "the *'teeing ground'* is the starting place for the hole to be played. It is a rectangular area two club-lengths in depth, the front and the sides of which are defined by the outside limits of two tee markers. A ball is outside the *teeing ground* when all of it lies outside the *teeing ground*." However, it is recommended that tee markers be placed on the shorter cut tee surface. It is preferable that tee markers be placed about 4-6 yards apart. This helps improve wear distribution on the tee by providing more teeing ground locations, and players will be less likely to inadvertently tee up in front of the tee markers. Finally, your course should consider reviewing its policy of early morning play if there is not enough time allowed to move tee markers.

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