USGA GREEN SECTION

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Fairway Grass Options for the Transition Zone

Lightweight Rolling

What Are Golfers Thinking?

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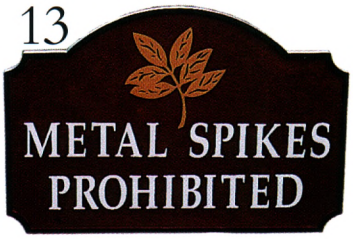
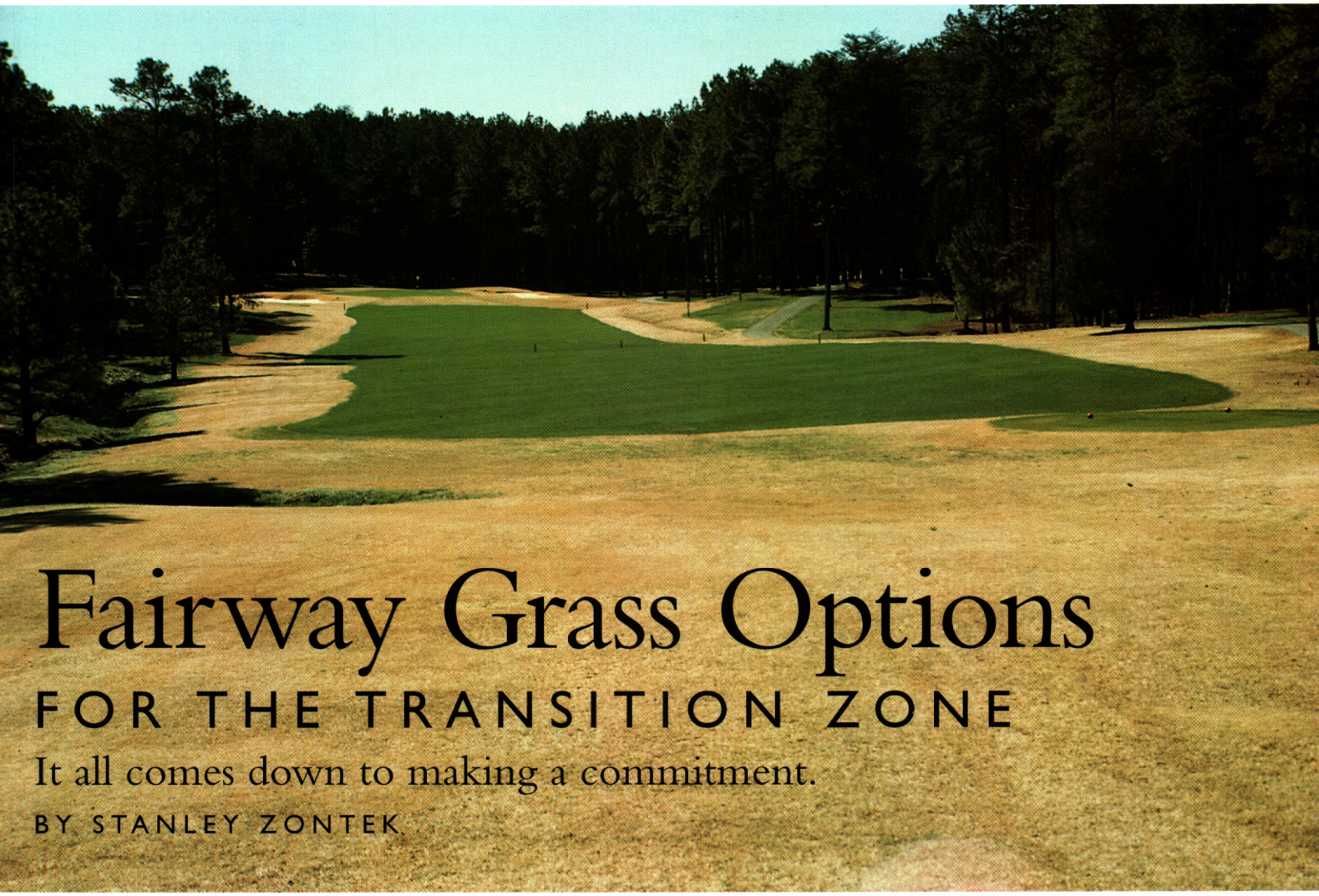


Cover Photo
Fieldstone Golf Club (Greenville, Del.) preserved colonial homestead remains and integrated them on the golf course fairway.



Fairway Grass Options

FOR THE TRANSITION ZONE

It all comes down to making a commitment.

BY STANLEY ZONTEK

The Mid-Atlantic region of the USGA Green Section is located in the eastern Transition Zone of the United States. One of the most frequently asked questions for both new and older golf courses in this region is, "What's the best grass for fairways?" Since there isn't a simple response to this question, perhaps it is best to respond with the following questions.

- How do you want your fairways to look and play in the summer? In the winter? In the spring and fall?
- Are your golfers comparing the grass on your fairways to neighboring courses with another type of grass, and is there pressure from your golfers to conform to their standard?
- How much play does your course receive?
- Do your players expect to drive up to their golf ball, jump out of the cart, hit a shot, and drive away playing "cart ball" at all times of the year? In other words, will they respect cart restriction rules some months of the year, or do they want complete access to the fairways at any time of the year?
- Does green color of the turf mean anything on a year-round basis? Will your golfers tolerate and enjoy golf on fairway turf that isn't green in the winter?
- Are chemical usage and the cost of fairway maintenance concerns on your golf course?
- Do you want the most "bang for the buck" in terms of fairway playability? Do you want the best possible fairway turf for the least amount of money?
- Are your fairways heavily tree lined? This may limit your ability to grow warm-season grasses like bermudagrass and zoysiagrass.
- If the fairways are tree lined, are they oriented north/south or east/west? Or is this even a concern?
- How good or bad is your fairway drainage?
- How good or bad are your fairway soils?

Overseeding a bermudagrass fairway with perennial ryegrass is another option for fairways located in the Transition Zone region of the United States.

As you can plainly see, answering the question "What's the best grass for fairways in the Transition Zone?" is not easy or straightforward.

Another question for someone not familiar with the Transition Zone may be, "What is a Transition Zone anyway?"

Historically, the Transition Zone region has been defined as the northern extreme for the adaptation of warm-season grasses like bermudagrass and zoysiagrass, and the southern extreme for the adaptation of cool-season grasses like the bentgrasses, Kentucky bluegrass, perennial ryegrass, and the fescues. The Transition Zone is also where the distinction between the annual and perennial biotypes of *Poa annua* becomes blurred. In this Zone, *Poa annua* can be a true winter annual. Equally, there are always some perennial biotypes of *Poa annua* that tend to survive the weather extremes in this region of the country just fine. However, for the purposes of this article on fairway grasses, creeping bentgrass, perennial ryegrass, and *possibly* Kentucky bluegrass are the cool-season grasses for fairways in the Transition Zone. Simply defined, the Transition Zone is an overlap area for plants. It is neither a southern area where warm-season grasses are best adapted nor a northern climate where cool-season grasses thrive. For turf managers who maintain golf courses in Transition Zones worldwide, such areas are simply tough spots to grow grass.

As a footnote, old-timers called this area the "goosegrass zone." They used a weed to define a climatic zone and, interestingly, this observation is amazingly accurate. If you can see goosegrass (silver crabgrass, *Eleusine indica*) growing naturally, you are in a Transition Zone!

It should be noted that modern plant breeding has blurred these lines. Cold-tolerant bermudagrasses are being developed and thus can be grown further north. Equally, now bentgrasses are more heat tolerant and disease resistant and thus can be grown further south. What to do? This

In some instances, bermudagrass will not survive winter stresses. In this situation, the zoysiagrass prevailed. The winter injury potential and the brown versus green winter color are major reasons for the reluctance to use warm-season grasses in the transition zone.

article will be an attempt to update and review these grass options. A better decision can be made on which type of grass to grow through a combination of factors — like better irrigation and drainage systems, a realization that too many trees and too much shade are bad for all grasses, better mowing equipment, higher operating budgets such that comprehensive fungicide and growth regulator programs are now commonplace, plant breeding that has yielded stronger and better adapted varieties, and perhaps most important of all, golfers who expect better fairway turf more days of the year regardless of the weather.

The next section will discuss the strengths and weaknesses of each grass type.

CREEPING BENTGRASS
(Agrostis stolonifera palustris)

For the purpose of this article, only creeping bentgrass will be discussed for Transition Zone fairways, even though plant breeders may someday yield other adapted bentgrass species for fairway usage, most notably colonial bentgrass (*Agrostis tenuis*).

Strengths

- Considered the "Cadillac" of fairway grasses. It is perceived that more of the *better* courses have bentgrass fairways than other grass options.
- Does not require extensive yearly interseeding in comparison to perennial ryegrass.
- Excellent winter hardiness.
- Good to excellent summer heat tolerance.
- Depending upon the variety, bentgrass has reasonably good disease tolerance, especially when properly managed in terms of irrigation, fertility, and thatch control.
- Stays green through most winters, losing color only during the coldest and most desiccating winters.
- Responds well to growth regulator programs for *Poa annua* suppression and control, and for clipping reduction.
- Tolerates some shade.
- Tolerates moderate to low levels of fertility once established.
- Can be closely cut.
- Spreads by stolons, making divot recovery reasonably good in the spring and fall.
- Plant breeders have provided any number of good grass choices, which can be used as single varieties or in compatible blends. Also, bentgrasses as a group are being genetically engineered as another means to improve the species.

Weaknesses

- Slow divot recovery during hot summers, requiring a divot-filling program.
- When under wilt stress in the summer, cart restrictions may be needed.
- Thatch must be controlled. Unless properly managed, thatch can be the Achilles' heel of bentgrasses.
- Bent fairways are at their best with lightweight mowing and clipping removal programs. This can increase the cost of golf course maintenance in comparison to other grass options.
- Requires a good irrigation system for establishment and maintenance.
- Can require handwork, especially hand watering and attention to isolated dry spots, to avoid overirrigation.
- Requires a moderate fungicide spray program.
- Bentgrass can creep into intermediate roughs and primary rough. The turf manager needs to be mindful of this or else fairway contours can slowly change, or the character of the rough definitely will change!
- Requires careful selection of individual varieties and seed lots to avoid seed contamination concerns with *Poa annua* and *Poa trivialis*.
- Some golfers do not like the tight lies associated with properly maintained bentgrass fairways.

PERENNIAL RYEGRASS
(Lolium perenne L.)

Even with today's concerns about chemical usage in the environment, a significant number of golf courses maintain perennial ryegrass as their principal fairway turf. Perennial ryegrass has evolved as the replacement for Kentucky bluegrass fairways, which were common in the Transition Zone a few decades ago. Ryegrass shares many of the same color and growth habit characteristics of Kentucky bluegrass but is far easier to establish and maintain than Kentucky bluegrass, especially under the close mowing heights common on today's fairways.

Strengths

- Good playability. When properly maintained, the ball sits up well on perennial ryegrass, and a wide spectrum of golfers like the playability offered by ryegrass fairways.
- Toughness. Except in extreme circumstances, golf courses seldom restrict cart traffic from rye-

grass fairways. This grass is compatible with the concept of "cart ball." The fact is, perennial ryegrass is physically one of the toughest and most wear-resistant cool-season grasses available to the turf manager.

- Tolerance to a wide range of plant-protectant chemicals, including those for pre- and post-emerge herbicides, which eases controlling weeds and weed grasses of the Transition Zone like crabgrass, goosegrass, *Poa annua*, broadleaf and narrow-leaf weeds.
- A nice dark green color that stripes well.
- Inexpensive seed.
- Rapid seed germination.

Spring dead spot on bermudagrass is the only significant disease to impact this species in the Transition Zone.

- Excellent seedling vigor.
- New varieties are always being developed with better density and better mowing characteristics.
- Excellent winter color and spring green-up.
- Responds well to growth regulators.
- Rapid recovery via interseeding and growth of existing plants when turf loss problems do occur.
- Very drought tolerant.
- Moderately tolerant to summer heat stress, depending upon the variety.
- Most varieties are endophyte-enhanced for natural insect suppression.

Weaknesses

- Disease susceptibility. Perennial ryegrass requires a comprehensive and preventative fungicide spray program that can be expensive and extend for nearly the entire grass-growing season. Pythium, brown patch, and gray leaf spot can be devastating.
- Slow to spread. Perennial ryegrass is a bunch grass that spreads by basal tillers, though there are some short rhizomes on some varieties.
- Normally requires a fall interseeding program to maintain density and introduce new varieties.
- Did I say, "Extremely susceptible to summer diseases"?
- Susceptible to ice damage during the winter in shaded and low-lying areas that hold water.
- Perennial ryegrass fairways are at their best with a moderate fertility program.
- Many choices. Can be confusing when choosing which varieties to use.
- Did I say, "Extremely disease susceptible"? You get the point. The Achilles' heel of perennial ryegrass is its susceptibility to a long list of fungal diseases that can be devastating and expensive to control.

ZOYSIAGRASS
(Zoysia japonica Steud.)

Zoysiagrass continues to be an option for fairways in the Transition Zone. Recently, the use of this grass has declined, rightly or wrongly. Apparently, concerns about the winter color of zoysiagrass and its intolerance of overseeding are limiting its use in the northern part of the Transition Zone. Nonetheless, zoysiagrass remains an excellent turf for fairways in the Transition Zone.

Strengths

- Outstanding playability when actively growing, when semi-dormant, and even when dormant.
- Requires low inputs of fertilizer, fungicides, herbicides, and insecticides.
- Only susceptible to one major disease — zoysia patch.
- When dormant, like bermudagrass, winter weeds are easy to control. (I bet I'll get a few letters on this comment.) Pre-emerge and post-emerge herbicides normally work well.
- Moderate irrigation requirements. Though drought tolerant, zoysiagrass is at its best when irrigated. This is both a strength and a weakness.
- Of the warm-season grasses available, zoysiagrass is extremely winter hardy. The most-used variety continues to be Meyer.

• Tolerant of a wide range of soil conditions.
• Tolerates traffic, except when dormant.
• Tough to take a divot from zoysiagrass.

Weaknesses

• Cost of establishment. Zoysiagrass may be the costliest of the grasses to establish initially.
• Slow to establish. Sodding fairways is now the most-used establishment technique.
• Tan/brown winter color. Under normal circumstances, overseeding for winter color is not recommended.
• Though drought tolerant, zoysiagrass is at its best when irrigation is provided.
• Traffic needs to be restricted when dormant.
• Divots are slow to heal when dormant or semi-dormant (if you can even take a divot!).
• Requires a thatch-control program in the summer when the grass is actively growing.
• Can experience winter ice damage in low areas that hold water.
• Only marginally shade tolerant.

BERMUDAGRASS
(Cynodon L. spp.)

Bermudagrass still has a strong presence on golf course fairways, especially in the lower half of the Transition Zone. Research in breeding continues to yield new bermudagrasses that offer improved winter hardiness along with finer leaf blades and better turf density, even approaching that of the hybrid bermudagrasses from southern regions. The following list assumes reasonable winter hardiness.

Strengths

• Outstanding summer appearance and playability. The hotter it is, the better bermudagrasses grow.
• Moderate fertilizer and water needs.
• In comparison to other grass options, bermudagrass performs well using inexpensive agricultural-grade fertilizers.
• Outstanding wear tolerance when actively growing.
• Tolerance to a long list of chemicals for insect and weed control.
• Only one major disease to manage — spring dead spot.
• Cost effective and rapid to establish.
• Tolerates growth regulators to enhance turf density, especially the common types of bermudagrass.
• Greatest "bang for the buck." Bermudagrass is the low-cost grass option for fairways.
• Can be overseeded for winter color with the realization that some damage to bermudagrass can occur, especially in shaded and wet areas during cool springs common to a Transition Zone area.

Weaknesses

• Winter color. Some golfers do not like the tan/brown color of dormant bermudagrass. For this reason, we are seeing more and more golf courses overseed bermudagrass with perennial ryegrass in the Transition Zone. This overseeding negates some of the cost advantages to bermudagrass fairways and negatively impacts the health of the bermudagrass, especially in shaded and wet, low-lying areas.
• Poor spring playability. Non-overseeded bermudagrass fairways lose much of their canopy over the winter. In the spring, golfers say they are "playing on dirt" until the bermudagrass breaks dormancy and begins to grow. In some springs, this can be agonizingly slow.
• Low tolerance to shade.

Take-all patch sometimes occurs on new bentgrass fairways. Over time, dollar spot becomes the most commonly observed disease.

• Susceptible to winter damage in shade and low areas that hold water and ice.
• Intolerant of overseeding in shade and poor drainage areas. May require tree removal and/or replanting or resodding following the transition of the overseeded ryegrass.

OTHER GRASS OPTIONS

The final choice on the grass to use comes down to the individual decision by individual clubs, courses, architects, and golf course superintendents. After all, isn't that the beauty (or the frustration) of the game of golf?

While creeping bentgrass, perennial ryegrass, bermudagrass, and zoysiagrass comprise the majority of fairways on golf courses in the Transition Zone, there are other grasses being grown. Most of these grasses have simply adapted to a particular golf course. For example, there are fairways composed of various combinations of bentgrass and *Poa annua*; fairways of combinations of perennial ryegrass and *Poa annua*; and fairways of perennial ryegrass and *Poa annua*, along with various amounts of common and improved bermudagrasses and even patches of zoysiagrass, many of unknown or long-lost origins. Some golf courses where a final decision on grass types has not been made contain a hodgepodge of grasses of widely varying grass types. If there is an advantage to this approach, it is that there will always be some grass somewhere on fairways. The disadvantage of this approach is that fairway quality never is good or, if it is, it can change quickly with the weather. Having fairways containing a combination of warm- and cool-season grasses without a commitment to either grass option makes the already difficult job of maintaining fairways even worse.

There is even some Kentucky bluegrass surviving in fairways. In fact, improved varieties of Kentucky bluegrass are once again being tried on fairways in the upper Transition Zone. It has been our experience that interseeding Kentucky bluegrass into an existing stand of grass may not work and may be a waste of time and money. It is with new golf courses where the option of using Kentucky bluegrass may have some hope of success. Time will tell. The final verdict will be based on how well these grasses perform in the long term.

The same situation exists for seeded, winter-hardy varieties of bermudagrass. Plant breeding is yielding new varieties that, at the time this article is being written, seem to have potential for use on fairways in the Transition Zone. However, these new varieties of seeded bermudagrass also remain unproven in the field under actual playing conditions. The agronomic verdict is just not in for these two grasses.

Still confused? In some respects, that's the point of this article. Regardless of what grass choice is made for fairways in the Transition Zone, in some years, due to the weather, any choice may seem wrong. In the Transition Zone, there are significantly different choices on which type of grass is to be grown on fairways.

Agronomically, there may not be a best choice for all golf courses in all situations like those that may exist for other golf courses even a few hundred miles north or south of the Transition Zone. To help make that final decision on which grass to use, consulting with the agronomists of the USGA Green Section, state university and extension specialists, and simply visiting neighboring golf courses that have these grasses growing on them are good ideas. In this grass-growing zone of adversity, everyone seems to help everyone else.

SUMMARY

What's the bottom line? In the final analysis, your choice of fairway grasses comes down to this one word — COMMITMENT.

Any and all of these grasses can be grown with reasonable success in the Transition Zone. The final choice on the grass to use comes down to the individual decision by individual clubs, courses, architects, and golf course superintendents. After all, isn't that the beauty (or the frustration) of the game of golf? No two courses are alike. This is so very true in the Transition Zone areas where, for example, in the Washington, D.C., metropolitan area, you can play golf on courses having essentially pure bentgrass, ryegrass, bermudagrass, zoysiagrass, and/or blends of them all, within a few miles of each other! In fact, at Woodmont Country Club in Rockville, Maryland, arguably one of the finest 36-hole facilities in the area, they have zoysiagrass on one of their 18-hole courses and ryegrass on their other course! It all comes down to the type of playability you want during the time of year your play is the greatest, your budget, and, again, your commitment to that type of fairway grass.

STANLEY ZONTEK, *Director of the USGA Green Section Mid-Atlantic Region, has visited courses in the Transition Zone for 30 years.*

Research *You Can Use*

Ball Mark Recovery as Influenced by Growth Regulators and Bio-Stimulants

Combinations of growth regulators and bio-stimulants may enhance turfgrass recovery.

BY THOMAS L. WATSCHKE, JEFFERY BORGER, AND JAMES BROSNAN

Ball marks on putting greens have long been the bane of golf course superintendents and golfers alike. Ball marks have a negative impact on ball roll, creating erratic putting conditions. They also serve as encroachment hot spots for annual bluegrass and other weeds, such as goosegrass. Golfers often are unaware that a ball mark has been produced by the shot they launched at the green and are not always diligent about checking for them. If they do discover that a mark has been made, the repair is not necessarily accomplished properly.

Many putting greens are now maintained with low nitrogen fertility, which slows the turf growth rate and helps provide faster putting conditions that are associated with high-quality putting greens. Unfortunately, with less fertilization, damage to greens, including ball marks, does not heal as rapidly as most superintendents desire. This has become more of a problem in recent years as putting green quality has greatly improved; ball marks are even more noticeable. Any maintenance program that enhances recovery from any damage without negatively affecting playing conditions is beneficial.

An experiment supported by a grant from the USGA Green Section and Nutramax Laboratories was conducted during the 2001 season at the Valentine Turfgrass Research Center at The Pennsylvania State University. The project assessed whether a growth regulator (Primo), urea, a bio-stimulant (Macrosorb Foliar), and/or combinations thereof could enhance ball mark recovery under very low nitrogen fertility conditions.

The treatments included:

- Primo Maxx alone at the labeled rate for greens.

Ball marks distract from the smoothness of the putting green surface. Research at Penn State University investigated the impact of growth regulators and fertilizer rates on ball mark recovery.

Table 1

Percent reduction of ball marks in creeping bentgrass/*Poa annua* putting greens in 2001

Treatment	Form	Rate (oz./ 1,000 sq. ft.)	Percent Reduction 8-21	8-22	8-23	8-24	8-25	8-26	8-27	8-28	8-30	9-04	9-07	9-11	9-14	9-18	9-21	9-25	9-27	10-02
Primo Maxx Macrosorb Foliar	1MEC L	0.125 2	3.1a[1]	7.9a	12.6a	6.1a	6.8a	8.2b	13.2ab	14.3ab	12.6b	11.9c	23.9b	24.0d	29.4bc	45.8b	44.7b	53.9bc	57.2b	54.4b
Primo Maxx Urea	1MEC 46G	0.125 0.15 lb. ai/A	2.9a	12.1a	10.4a	7.4a	8.9a	13.6a	15.6ab	18.6ab	20.4ab	19.6b	30.0b	32.2bc	30.4bc	49.2ab	57.8ab	63.2abc	67.2ab	69.4ab
Check Primo Maxx	1 MEC	0.125	1.1a	11.5a	10.7a	10.1a	10.8a	11.5ab	17.6ab	20.0a	27.1a	30.1a	36.3a	40.7a	48.8a	54.4ab	66.9a	76.0a	81.8a	78.5a
Check Macrosorb Foliar	L	2	4.2a	9.9a	13.8a	9.2a	7.2a	11.7ab	14.2ab	16.1ab	19.9ab	19.4b	29.2b	28.3cd	40.6abc	63.8a	62.5ab	71.1ab	73.5ab	69.7ab
Check Urea	46G	0.15 lb. ai/A	1.5a	8.9a	10.3a	7.1a	3.9a	6.9b	11.4b	12.2b	18.6ab	17.4b	25.3b	28.6cd	27.5c	41.1b	46.9ab	53.2c	58.1b	58.1b
Check			1.4a	13.9a	10.4a	10.0a	8.9a	14.2a	18.2a	20.3a	26.9a	27.9a	37.9a	38.9ab	45.6ab	48.9ab	58.2ab	64.6abc	71.7ab	69.7ab

[1]Means followed by same letter do not significantly differ (P = .05 Duncan's New MRT)

- Primo in combination with Macrosorb Foliar (at 2 ounces per 1,000 square feet).
- Primo in combination with urea (at 0.15 pound of actual nitrogen per 1,000 square feet).
- Macrosorb Foliar alone (2 ounces per 1,000 square feet).
- Urea alone (0.15 pound of actual nitrogen per 1,000 square feet).
- Untreated check plot.

Six ball marks were produced on each plot using a golf ball (cut in half) mounted on the base of a 2-by-4, which was then placed on the surface of the turf and pounded with a mallet until the golf ball half was buried into the surface. The vegetative material was removed from within the ball marks. The simulated ball marks were filled with topdressing to mimic a reasonably repaired ball mark. The resulting ball mark was initially 1.6 inches (40 millimeters) in diameter. Recovery rate was measured on several dates following the production of the hole. The site was maintained like a putting green throughout the experiment.

The results of this experiment were somewhat inconsistent with past research. Previous research has shown that Primo can improve the rate of divot recovery in creeping bentgrass fairways. This recovery is the result of an increased rate of lateral spread by the creeping bentgrass stolons. This enhanced recovery was accomplished without additional nitrogen application. Macrosorb Foliar has provided improved recovery from mechanical damage.

In this experiment, turf treated with Primo and Macrosorb Foliar, separately, tended to recover from ball marks faster than untreated turf. However, when turf was treated with a combination of Primo and Macrosorb Foliar, the rate of recovery from the ball mark damage was slightly slower (although not statistically so) than untreated turf. Since Macrosorb Foliar is known to facilitate the absorption of a number of chemicals, it is suspected that enhanced uptake and movement of the applied Primo may have occurred with this combination, thereby reducing the turf growth rate. Urea, alone, did not increase the rate of healing compared to untreated turf.

It is possible that the recovery rate from ball mark damage can be enhanced by the application of growth regulators or bio-stimulants without providing increases in nitrogen fertility that may reduce green speed. While the data in this experiment were not statistically different, trends were apparent. Further research needs to be conducted to assess whether reduced rates of Primo in combination with Macrosorb Foliar can bring about the positive response seen from Primo applications alone. The results achieved with the same applications on a site with higher nitrogen fertility also need to be examined.

DR. THOMAS WATSCHKE, *professor of turfgrass science at Pennsylvania State University, has recently begun researching bio-stimulants and their effects on turfgrass management. He acknowledges that there is still a great deal more to learn about these products.* JEFFERY BORGER *is a research staff assistant, and* JAMES BROSNAN *is a graduate assistant.*

Table 2

Quality ratings taken on August 15, 2001, of creeping bentgrass where 0 = Worst, 7 = Acceptable, and 10 = Best

Treatment	Form	Rate (oz./ 1,000 sq. ft.)	Quality
Primo Maxx Macrosorb Foliar	1MEC L	0.125 2	5.7
Primo Maxx Urea	1MEC 46G	0.125 0.15 lb. ai/A	7.3
Check Primo Maxx	1MEC	0.125	7.3
Check Macrosorb Foliar	L	2	7.7
Check Urea	46G	0.15 lb. ai/A	5.7
Check			8.0

The residual effect of rolling on green speed is not always clear cut. Several research studies report a measurable residual effect up to 48 hours after rolling, while others report the increase lasts not more than one day.

Research *You Can Use*

More Light on Lightweight Rolling

Research is shedding light on rolling as a season-long maintenance practice.

BY THOMAS A. NIKOLAI

In 1901 Walter Travis wrote, "From May until October each green should be rolled daily with a light roller, rather than once or twice a week with a heavy one."[1] For the next quarter century the debate over roller frequency and weight was waged in numerous publications. Before the issue was resolved, however, most turfgrass managers lost interest in rolling putting greens as the effects of soil compaction on turfgrass rooting became clearer.[2]

In the early 1990s, the practice of rolling greens was reinitiated due to the

demand for faster green speeds.[4] With its resurrection came articles praising it for tournament preparation while warning of negative effects if overused for regular play. Golf course superintendents searched for advice about roller use, but found little research regarding rolling. Specifically, information was needed concerning the use of rollers in a season-long program.[1] Recognizing this need, a handful of turfgrass researchers initiated studies of lightweight green rolling.

FREQUENCY AND COMPACTION

Over the past decade three studies considered the impact of season-long green rolling on soil compaction. Penn State University researchers compared plots having both USGA-recommended sand or native soil rootzones. Plots were rolled once or twice per week, but no changes in turfgrass quality, soil bulk density, or water infiltration were found in rolled plots versus plots that were not rolled.[3]

Researchers at Michigan State University (MSU) rolled USGA and native soil bentgrass greens three times per week. However, those treatments resulted in no significant change in turf quality, soil compaction, or water infiltration from unrolled putting green plots.[7] At North Carolina State University, bentgrass greens were rolled zero, one four, and seven times per week. Once again, plots rolled once per week resulted in no reduction in turfgrass quality.

One side observation was that rolling impacted dollar spot symptoms on the turf plots. The plot on the right was rolled three times per week and showed few dollar spot lesions, while the left plot was not rolled and was heavily impacted by the disease.

Rolling four and seven times per week decreased turfgrass quality on plots growing on both USGA-recommended sand rootzones and plots having native soil rootzones.[4] Furthermore, compaction increased on the native soil greens rolled four and seven times per week during the first year of the study. It is noteworthy that the loss in quality attributed to lightweight rolling four and seven times per week were not immediate. The reduction in turfgrass quality at those frequencies took three to four weeks to become apparent.

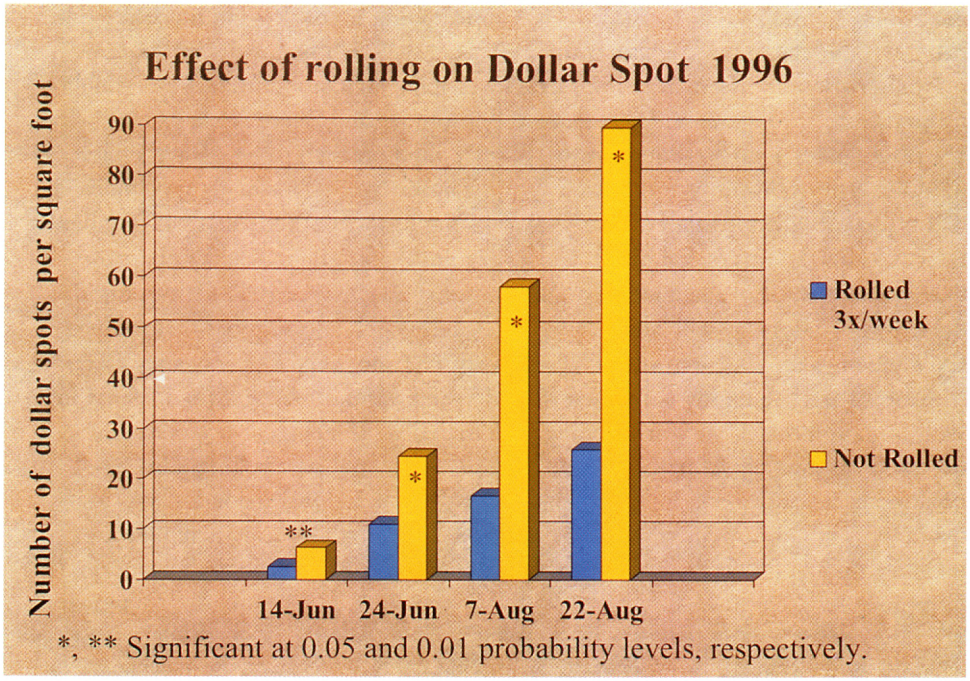
GREEN SPEED AND GOLFER PERCEPTION

Most rolling studies have considered the immediate and residual effects that rolling has on green speed. All studies concluded that rolling noticeably increases green speed on the day rolling is applied. The amount of increase varied from day to day, but rolled plots were generally one foot faster than non-rolled plots on the day they were rolled.

The residual effect that rolling has on green speed is not as clear-cut. Several studies report a measurable residual effect up to 48 hours after rolling, while other studies report the increase lasts not more than one day. Some of the apparent discrepancy may be due to the

way the data are reported. Although studies reported a statistically significant increase in green speed up to 48 hours after rolling, the residual increases are usually three inches or less.[9] Golfer surveys indicate that most golfers cannot detect differences in green speed of six inches or less.[5] Thus, the three-inch difference is valid scientific reporting, but from a real-world aspect the greens would not be noticeably faster to the golfer two days after rolling.

The fact that most golfers cannot detect differences in green speed of six inches or less adds credence to the argument that posting green speeds may be more bother than it's worth. Often, golfers argue over half-foot differences in green speeds, while surveys show that even low handicappers cannot detect differences in green speeds that accurately.



Research plots at Michigan State University were rolled over a five-year period to study the effects of this maintenance practice when used in a season-long program.

ROLLER WEIGHT AND TYPE

Roller weight and type appear to be linked together. It would seem logical that heavier rolling machines would result in greater increases in green speed for a longer period of time. However, results from a Michigan State University study indicate roller type must be considered in an evaluation of the effect of roller weight.

In the MSU study, a triplex attachment roller (single roller per attachment) weighing approximately 1,300 pounds and a sidewinder roller (three rollers traversing the same area) weighing about 950 pounds were included in the study. Both increased green speed approximately one foot on the day they were applied compared to non-rolled plots. The day after rolling, however, the triplex-rolled plots averaged three inches faster than the non-rolled check plot, while the sidewinder-rolled plots averaged six inches faster than the check.[7]

ROLLING VERSUS MOWING

Rolling frequency and duration (length of time using the same roller schedule) have an effect on residual green speed, too. This is most apparent when comparing mowing height green speed studies performed at the University of Arizona and again at Michigan State University. Both universities investigated whether it may be possible to raise mowing height and still retain putting speeds by incorporating rolling as a routine maintenance practice.

The two studies differed slightly in that the roller frequencies differed, but the difference in mowing heights was identical (0.03 inch). The University of Arizona study rolled two times per week, while the MSU study rolled three times per week. In the University of Arizona study, rolling was not as effective in increasing green speed as lower mowing. In other words, the non-rolled, low-cut turf was still faster than the rolled, higher-cut bentgrass.[6] In the Michigan State study, the non-rolled, low-cut turf plots also were initially faster than the rolled high-cut plots. However, after two weeks of rolling, the higher-cut plots retained the same green speed as the non-rolled, low-cut turf on the day the greens were rolled and the day after rolling treatments were applied.[7]

ROLLING AND PEST OUTBREAKS

Golf course superintendents have been justifiably concerned that rolling may lead to diseased turf. Dollar spot is a turfgrass disease that can be spread by maintenance equipment that carries fungal mycelium and infected plant tissue from green to green.[10] Because of this, it may be reasonable to assume that rolling would increase the severity of this disease. However, dollar spot severity *decreased* on research greens at Michigan State University that were rolled three times per week for five straight years.

These positive results were obtained because of the timing of the mowing and rolling. Similarly to most golf courses, the research greens were mowed at dawn and rolled within an hour after mowing. This timing is believed to be important because early morning mowing may exacerbate the release of guttation droplets forming at the tips of the cut leaf blades. These guttation droplets are used as a nutrient supply by fungal pathogens. Rolling within an hour after an early morning mowing may disperse concentrated

guttation water, thus reducing the pathogen's ability to infect other plants.

Rolling also may affect the ability of turfgrass insects to infect and populate an area. In 1998, Dr. Dan Potter from the University of Kentucky reported that black cutworm moths lay nearly all their eggs on the tips of leaf blades and that many eggs survive passage through the mower blades and will later hatch.[8] On a green rolling research site at MSU, bird activity highly coincided with numerous black cutworms being observed on the site. While no attempt was made to quantify the number of cutworms on the site, significantly less bird activity was observed on greens that were rolled.[7] Considering debris adheres to green rollers and is transported to the wash pad, it is conceivable that rolling could have decreased the amount of cutworms per green by removing eggs with the excess debris.

CONCLUSIONS

Although the effect of roller weight is dependent on the type of roller used, results indicate it is safe to operate a sidewinder roller (with three rollers) weighing up to 960 pounds three times per week in a season-long program. Triplex attachment rollers can weigh more because there is less weight being applied on each roller. However, it is important that when a specific rolling program is adopted, the total number of rounds and other factors imparting stress on the greens be kept in mind.

Research also suggests that rolling three times per week increases green speed significantly, and the increase in speed is still apparent up to six days after rolling. This frequency may also allow the superintendent the flexibility of raising the cutting height up to 0.03 inch during the heat of summer and retain the same green speeds as the non-rolled shorter height of cut.

Although the MSU studies suggest that rolling after an early morning mowing decreases dollar spot severity and may pick up excess turfgrass leaf litter, resulting in fewer black cutworms, further research is needed. If additional research can corroborate these observations, rolling greens may prove to be more important than just being a means to increase green speed.

ACKNOWLEDGMENTS

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What Are Golfers Thinking?

The top ten questions frequently asked of the USGA Green Section.

BY BRIAN MALOY

Communicating with golfers is probably the most important part of a superintendent's job description. Unfortunately, when the daily responsibilities of maintaining the golf course get in the way, there is often precious little time left to effectively communicate with those who have questions regarding maintenance activities. As a former superintendent, I remember the strange looks when, one day, I was working with my crew to reopen our flood-damaged course. It was evident that the golfers did not understand why the greens were being watered after the course had just received three inches of rain. What they did not realize was that we were not watering the greens, but rather attempting to remove a layer of silt that had been deposited on them. In hindsight, I realize that taking the time to discuss my agronomic strategy with the golfers would have answered their questions and prevented their imaginations from running wild.

After visiting many courses on behalf of the USGA Green Section, I have come to the realization that many golfers have the same questions regarding course maintenance. The purpose of this article is to address ten of the most frequently asked questions we receive during Turf Advisory Service visits.

QUESTION #1

Why is it necessary to aerify the greens when they are at their best?

It is no coincidence that greens are usually in their best condition right before aerifying. The reason is that the turf needs to be in good condition to endure the physical trauma of core removal. When the date for aeration is postponed to accommodate the golfing calendar, it is likely that it will take longer for the aeration holes to fill in. For more information, refer to the article entitled "Orange Barrels and Putting Green Aerification" by Bob Brame in the January/February 1999 issue of the *Green Section Record*.

QUESTION #2

Why is it necessary to aerify greens built according to USGA specifications?

Many golfers are under the impression that USGA greens should not require routine maintenance practices, such as core aeration, for several years. Their belief is that new greens should be comparable to new cars that do not require a

Aerification is an essential agronomic practice that is necessary to help control organic matter accumulation.

tune-up until they have reached 100,000 miles. As living turfgrass plants do not perform like machinery, new greens often require the same maintenance practices as older greens.

According to research conducted at the University of Georgia, USGA green profiles constructed with 1-3% organic matter can quickly accumulate 8-10% organic matter as a result of normal turfgrass root and stolon growth. When organic matter accumulates to such a high percentage, the water infiltration rate can decline 40% or more. To sustain a high infiltration rate, core aeration is employed to harvest organic matter and introduce fresh sand into the soil profile. For more information, refer to the article entitled "Core Aeration by the Numbers" by Chris Hartwiger and Patrick O'Brien in the July/August 2001 issue of the *Green Section Record*.

QUESTION #3

Is it possible to substitute water injection aeration for core aeration if the greens are built in accordance with USGA specifications?

As previously discussed under Question #2, turfgrass plants continually add organic matter to the rootzone by virtue of their normal growth cycle. Water injection aeration cannot remove this accumulating organic matter in the process of relieving soil compaction, as it does not remove a core. As such, it cannot serve as a substitute for core aeration. For more information, refer to the article entitled "Organic Matter Dynamics in the Surface Zone of a USGA Green: Practices to Alleviate Problems" by Dr. Robert Carrow, published in the USGA's *2000 Turfgrass and Environmental Research Summary,* available on the USGA website at www.usga.org/green.

Tees of insufficient size will not recover quickly enough to support day-to-day play.

QUESTION #4

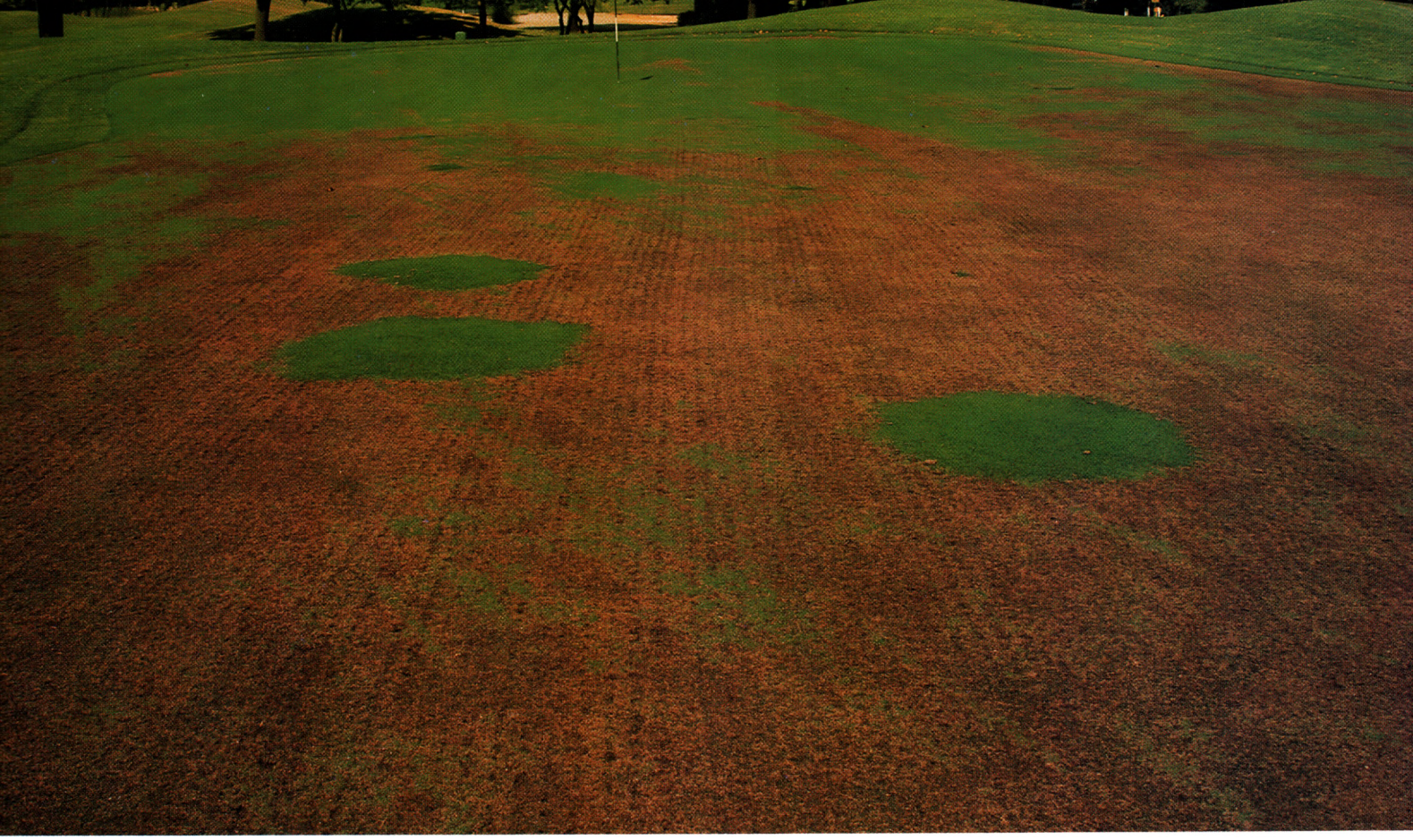
Agronomists talk so much about the importance of aeration. So, why don't they support wearing metal-spiked shoes?

Research conducted by Green Section Director Dr. Marvin Ferguson in 1958 showed that those wearing metal spikes caused severe damage to the turf, compacted the soil, and delayed turf recovery around the hole locations. Since the mid-1990s when spikeless shoes became popular, golfers have enjoyed smoother, healthier putting surfaces across the country. For more information, refer to the article entitled "The Metallic Mashers of Monocots — Golf Spikes!" by Larry Gilhuly in the September/October 1996 issue of the *Green Section Record*.

QUESTION #5

Why are the greens much faster at my friend's course, where we recently played in a member-guest tournament?

Superintendents coordinate a number of agronomic practices so that the condition of a golf course will be at its best for special events. Unfortunately, greens cannot endure the intense cultural practices that are required to provide fast green speeds for extended periods of time. Research conducted at Kansas State University confirmed that, regardless of bentgrass cultivar, turfgrass quality declined as the height of cut was lowered for extended periods. The pursuit of perpetually fast greens can result in dead turf by the end of the season and unemployment for the superintendent. For more information, refer to the article entitled "S.P.E.E.D. — Consider What's Right for Your Course" by Paul Vermeulen in the November/December 1995 issue of the *Green Section Record*.



QUESTION #6

Are there new products that can allow the turf to be cut short throughout the entire season?

Superintendents at the best-conditioned courses are always happy to report that their success is the result of hard work, the employment of basic agronomic practices, and the use of common sense. This is not to say that there are not products that promise equal results and at the same time allow the staff to punch out early. The bottom line is, if it sounds too good to be true, then it probably is. For more information, refer to the article entitled "It Just Has to Be Cheaper or Better" by Bob Vavrek in the September/October 2001 issue of the *Green Section Record*.

QUESTION #7

Is it possible to improve our divot-riddled tees by applying more water and fertilizer?

Unfortunately, many players falsely believe that applying more water and fertilizer will hasten divot recovery regardless of the overriding circumstances. There is a point of diminishing return, however, when too much water and fertilizer can actually erode turf quality and deteriorate playing conditions. This happens when the turf becomes too succulent and disease prone and thus is no longer tolerant of normal use. When the quality of the tees deteriorates because of concentrated divot removal, the most likely causes are heavy shade that retards the growth of the turf or a lack of space to rotate the markers. For more information, please see the article entitled "How Large Is Large Enough?" by Paul Vermeulen in the Midwest Association of Golf Course Superintendents' January 2001 issue of *On Course*.

QUESTION #8

What is the quickest way to get damaged greens back into playable condition?

If the damaged areas of a green are too large to repair using nursery sod, then the best course of action is to restrict daily play by establishing a temporary green. If daily play is not restricted, damaged greens can further deteriorate because of golfer traffic and the inability to employ special maintenance practices, such as overseeding. Rather than delay the recovery process, temporary greens are the answer to a speedy recovery. To reduce the likelihood of turf loss in the future, it is important to analyze all the factors that impact the situation. For more information, please see the article entitled "Helping Your Greens Make the Grade" by James F. Moore in the March/April 1998 issue of the *Green Section Record*.

Once a green has suffered stress, the quickest way to encourage a speedy recovery is to restrict the traffic to a temporary green.

QUESTION #9

Is closing the golf course one day per week a cost-effective method for improving its overall condition?

Closing a golf course on a regular schedule is, in fact, a good way to improve course conditioning and help keep the maintenance budget in line. The reason is that the productivity of the staff improves dramatically when they do not have to repeatedly suspend their activities due to approaching golfers. For more information, please see the article entitled "Closing for Maintenance" by Mike Huck in the January/February 2001 issue of the *Green Section Record*.

QUESTION #10

As part of a master plan, the golf course architect has recommended removing more than 250 trees around the greens and tees. Is this kind of suggestion a normal component of a master plan?

Good turf needs good growing conditions, and tree removal is an essential part of master plans on many older courses. Oftentimes, well-intentioned individuals implement tree-planting programs that, in the long run, result in dense forestation. As trees mature, they dramatically affect the way a course plays as compared to the architect's original intention. Also, they cast long shadows over the turf and reduce air movement to the extent that greens and tees develop a poor performance record. Rather than earmarking funds for planting additional trees on the property, consider using the money to take better care of the trees that are already established. For more information, refer to the article entitled "Trees Versus Turf" by Jack Swayze in the November/December 2000 issue of the *Green Section Record*.

CONCLUSION

Since Green Committees change from year to year, one should not make the mistake of assuming that new members automatically understand the importance of routine maintenance procedures. It is the responsibility of the superintendent to explain the importance of what is being done on a daily basis and how it keeps the course in good condition. Discussing common agronomic questions with golfers will help them understand why they are important.

EDITOR'S NOTE

Articles published in the *Green Section Record* since 1997 can be viewed and downloaded from the USGA's website at www.usga.org/green. Select the *Green Section Record* tab.

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Overplanting trees on the golf course is a national epidemic. As the trees mature, they dramatically affect the way the course plays as compared to the architect's original design.

Is Your Course Certified?

Tips for success in the Audubon Cooperative Sanctuary Program.

BY PAUL DOTTI

The Audubon Cooperative Sanctuary Program (ACSP) for golf courses was launched in 1991 by Audubon International and the United States Golf Association to promote environmental stewardship by protecting wildlife habitat and natural resources. Of the nearly 16,000 golf courses in the United States today, 13.5% are members of the ACSP and only 1.9% are Certified Sanctuaries.

When Edgewood Country Club set out to become certified in the Audubon Cooperative Sanctuary Program (ACSP), it was intimidating to think of what lay ahead. I was overwhelmed by what seemed like countless hours of paperwork associated with this program. My initial reaction was to put the certification packet on the shelf and forget about it altogether. We were already practicing several elements of the program and I felt that the membership was not going to think any differently of the golf course or myself if Edgewood C.C. became a Certified Audubon Cooperative Sanctuary. After further consideration, I decided to jump right in and start from the beginning. This article describes the certification process and provides helpful hints toward achieving certification.

GETTING STARTED

The first step is to become a member of the ACSP. New golf courses in the design or development phase join the Audubon Signature Program. To become a member golf course, contact:

Audubon Cooperative Sanctuary Program
Audubon International
46 Rarick Road
Selkirk, NY 12158
Telephone: 518-767-9051, ext. 12
E-Mail: acss@audubonintl.org
Website: www.audubonintl.org

Successful environmental projects on the golf course begin with good planning and implementation in the early stages.

With the ACSP program, we are able to demonstrate to the public and our profession that we are doing the right thing for our environment and our future.

Wildflowers can provide a nice contrast to the golf course turf, and they served as a good selling point for the naturalization concept at Edgewood Country Club (New Jersey).

The annual $150.00 membership fee ($200.00 for international golf courses) covers the cost of educational materials and attaining and maintaining certification. New members receive an information packet that contains a step-by-step handbook for certification and a "how to" guide for completing various components of the program. Some topics include generating environmental plans, constructing nest boxes, creating a wildlife inventory, and developing outreach and education activities.

KEY INGREDIENTS FOR CERTIFICATION

You will soon discover that your golf course is already implementing many of the practices required for certification. Regardless, the following tips are very helpful for achieving certification.

Delegate Responsibility

Although you may be the person primarily responsible for coordinating the certification program, don't attempt to do everything alone. Assembling a Resource Advisory Group (RAG) helps spread out the workload by tapping the expertise of several individuals.

Forming a RAG is also one of the requirements for certification in the Outreach/Education component. Wildlife identification and management are important areas of expertise to have represented in the group. Consider an avid bird watcher or someone from a local nature center who is willing to help develop a wildlife inventory of the golf course. I recruited a friend of mine who is knowledgeable in the identification of wildlife and plant materials. Examples of other individuals to include on the team are your assistants or other interested crew members, Green Committee members, local school teachers or administrators, and Boy/Girl Scout troop leaders. The more resources available, the easier the process.

Record Keeping

Record keeping is absolutely essential for achieving certification. A 35mm camera can provide "before" and "after" photos. Written documentation of turf management and Integrated Pest Management (IPM) practices is required throughout the process. A detailed map of the golf course helps depict various landscape features and environmental management practices.

Training and Communication

Employee training is a component of certification, and both written and verbal communication with staff, customers, stakeholders, and the community is needed to relay information throughout the program.

THE CERTIFICATION PROGRAM

The certification program consists of six component areas:

- Environmental Planning (must be completed first).
- Wildlife and Habitat Management.
- Chemical Use Reduction and Safety.
- Water Conservation.
- Water Quality and Management.
- Outreach and Education.

Environmental Planning

The Environmental Planning component consists of the site assessment and environmental plan for the six component areas. The site assessment is a six-page questionnaire to provide Audubon International with general information about your golf course, including the number of rounds per year and area of turf surfaces, gardens, natural plant communities, and water features. The Environmental Plan is divided into six sections, one for each component of the program. Each section consists of a series of goals and management practices that are required to achieve certification. In each section, you need to indicate whether a practice is *implemented, partially implemented*, or *not implemented*. For each management practice

marked *partially* or *not implemented*, you fill out the last column titled *Planned Efforts*. Write down start and expected completion dates, or why the practice may not be applicable to your golf course. Don't worry if you have marked *no* or *partially implemented* to many of the management practices. The Environmental Plan simply serves as a checklist of goals to work toward in obtaining certification.

Wildlife and Habitat Management

The purpose of this component is to identify wildlife and enhance or protect existing habitats or create new ones if none exist. While naturalizing the golf course is an integral part of wildlife and habitat management, it is not going to be readily accepted at every golf course. Many golfers who are used to manicured turf may not like the look of naturalized areas, or they may be concerned about slow play, unwanted wildlife, or deer ticks. I was faced with all of these concerns at Edgewood Country Club, and educating the membership through newsletters and the course bulletin board led to general acceptance of naturalization. The use of wildflowers also helped to garner support by adding color and contrast to the golf course.

If naturalization is not feasible, wildlife enhancement can still be achieved by several other practices, including installation of nesting boxes or bird feeders on the course, planting native plant species that will attract butterflies or hummingbirds, or by leaving understory vegetation growing in woodland areas.

Certification in the Wildlife and Habitat Management component requires developing a wildlife inventory and submitting photos showing examples of naturalized areas, nest boxes, water features, and signage for habitats or Environmentally Sensitive Zones. Be sure to include "before" and "after" photos of restored habitats, if applicable.

Chemical Use Reduction and Safety

Integrated Pest Management (IPM) is already an integral part of many superintendents' management programs. With this component, however, the key is to document everything regarding pest populations, and chemical and cultural control practices. For example, I keep records of past occurrences of localized dry spots, crabgrass, *Hyperodes*, and white grubs. Prior to my involvement in the ACSP, I used to apply nearly all pesticides on a preventative basis. Now, pests are controlled on a curative or as-needed basis, except for some of the more potentially devastating diseases on greens.

Scouting and monitoring pest activity are important elements in IPM. Pest or damage thresholds should be established before making a pesticide application. For example, we do not spray for *Hyperodes* unless we find at least 5 to 10 adults per square foot. Choosing pesticides that have low use rates, low toxicity, and minimal potential for runoff or leaching is another part of environmental stewardship. We include biological control products when applicable.

Cultural practices are a big part of IPM. Controlling thatch is one way to grow healthier turf and reduce the potential for pest invasion. Core aeration, verticutting, and topdressing are all beneficial practices for managing thatch and ultimately reducing pesticide usage.

Certification in Chemical Use Reduction and Safety requires photos of chemical storage/ mixing and loading areas as well as equipment storage and wash areas. Also required is documentation of your IPM practices, including pest scouting, threshold levels, cultural practices, and choice of pesticides and fertilizer.

Signage is one way to demonstrate your involvement in environmental stewardship and the Audubon Cooperative Sanctuary Program.

Water Conservation

Water conservation begins with making sure your irrigation system runs as efficiently as possible. Repair all leaks as soon as they are detected and make sure irrigation heads apply proper coverage. Replace full-circle heads with part circles along hard-surface areas, woodland edges, naturalized areas, and water features. Make every effort not to irrigate during the peak times for evapotranspiration (ET), and install or rely upon quick-coupler valves to hand water chronic dry spots instead of operating irrigation heads. Last, but not least, mulch all flower beds and new plantings to retain soil moisture and improve plant health. This also will reduce weed growth and pesticide applications.

Certification in Water Conservation requires documentation of a properly

functioning irrigation system, use of ET or weather data to schedule irrigation, and quantification of daily, monthly, and annual water use, preferably before and after your participation in the ACSP.

Water Quality Management

This is perhaps the most intimidating component of the certification process because water quality testing is required. Although some golf courses may be sensitive to disclosing test results, testing is necessary to determine water quality before and after implementation of environmental management practices. Water quality testing is required for representative water features throughout the golf course. Testing parameters include pH, temperature, and concentrations of nitrogen and phosphorus.

Another phase of this component is the implementation of Best Management Practices (BMPs) to protect water quality, such as establishing vegetative buffer areas adjacent to water features. Vegetative buffers can be created by planting aquatic plants around pond edges or letting the existing vegetation grow naturally. Mowing equipment and application of pesticides and fertilizer should be kept away from these buffer areas to reduce the risk of surface water contamination.

Certification in Water Quality Management requires photos showing areas where chemicals or fuel are stored or used, and documentation of water quality test results and management of water features, including aquatic weed/pest control records.

Outreach and Education

This is probably the most rewarding component in the whole program. Here we have the opportunity to get people involved in the program and provide education about the environmental benefits of golf courses. I started spreading the news by writing a monthly newsletter and established a bulletin board in the clubhouse. Also, we have adopted two local schools, hosted two class field trips to the golf course, and installed a butterfly and hummingbird garden, bird boxes, and feeders for the children to maintain.

Certification in Outreach and Education requires photos of your environmental sanctuary display and people involved in stewardship projects. Also, you will need to provide samples of written materials such as a newsletter, newspaper article, signs, or letters that document your education and outreach efforts.

ENVIRONMENTAL CASE STUDY

Another requirement of the certification program is that you must complete an Environmental Case Study form to provide more detailed information about any one of the projects that you've implemented. Our case study on Wildlife and Habitat Management was featured in Audubon International's *Stewardship News*, and we received numerous phone calls from across the country. It is rewarding to know that other people can benefit from your work in this program.

ACHIEVING CERTIFICATION

Once the goals of each program component are met and documented, you are ready to apply for certification. You will receive a Certificate of Achievement for each component completed in the program. Upon completion of all six components, your golf course will be designated as a Certified Audubon Cooperative Sanctuary, and you will receive an art print for display at your facility, a camera-ready logo, and a press release.

Certification lasts for two years. After that time the golf course completes a re-certification packet to update the progress of each component. Obviously, you have worked very hard to become a certified sanctuary in the program. Don't let all that hard work go by the wayside by not renewing your annual membership or not maintaining up-to-date records of program components.

SUMMARY

Hopefully this article will serve as a catalyst for those of you who have not yet joined the ACSP or are new members who are a bit overwhelmed by what lies ahead. Initially, I felt intimidated by the amount of work I thought might be involved in this program, but I managed to live to tell about it through hard work and surrounding myself with dedicated resources.

Maybe you're skeptical about the whole idea of certification. Does having a certificate on the wall make you any more of a steward to the environment than golf courses without one? Like most certification programs of its kind, becoming a certified sanctuary can mean as little or as much as the time and effort you put into it.

With the ACSP, we have the opportunity to demonstrate to the public our commitment to the environment. Take full advantage of making your certificates or press releases available to the public, or spread the word by hosting tours of the golf course. I know that students and teachers alike were amazed at how different the golf course looks from "inside the fence." Not only do I feel satisfied seeing the results at our golf course, but also at other certified golf courses as well. In some regions of the country, golf courses represent some of the last remaining open spaces. With the ACSP program, we are able to demonstrate to the public and our profession that we are doing the right thing for our environment and our future.

PAUL DOTTI *is the golf course superintendent at Edgewood Country Club in River Vale, New Jersey. His course was designated as a Certified Audubon Cooperative Sanctuary in August 2000. He also is a member of the Audubon Steward Network, a group of dedicated Audubon Cooperative Sanctuary members who use their knowledge and experience within the ACSP to provide information and assistance to others who are interested in the ACSP.*

Research *You Can Use*

Spring Dead Spot: A Major Bermudagrass Disease

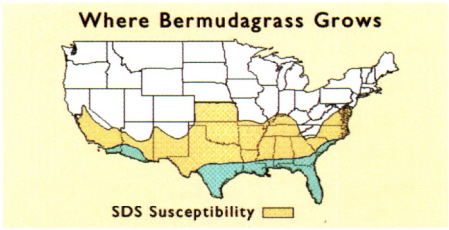
New research is helping against this serious bermudagrass disease.

BY MICHAEL ANDERSON, ARRON GUENZI, DENNIS MARTIN, CHARLES TALIAFERRO, AND NED TISSERAT

Spring dead spot (SDS) is a major disease that affects bermudagrass in the United States and worldwide. Within the United States, the disease is most prevalent in the northern range of bermudagrass adaptation.[5,7] Researchers at Oklahoma State University and Kansas State University are focusing their efforts on gaining a better understanding of how bermudagrass is infected, with the ultimate goal of developing improved control options.

THE PATHOGENS

The disease was first noticed as early as 1936 and was fully described by 1960.[14] Today we know three root-rotting fungi cause the disease: *Ophiosphaerella herpotricha, Ophiosphaerella korrae*, and *Ophiosphaerella narmari*.[2,4,12,15] All three fungi species are found in the United States.[16] *O. herpotricha* is the most abundant causal agent in the Midwest. *O. Korrae* has been identified throughout the United States and Australia. *O. narmari* has been isolated in California, Oklahoma, and Kansas, and is a major pathogen in New Zealand and Australia.[16] Furthermore, *O. korrae* infects several other plants, including Kentucky bluegrass, annual bluegrass, and red fescue, where it causes the disease known as necrotic ring spot.[3,6,17]



This map notes the range of bermudagrass growth (yellow and green) and spring dead spot disease (yellow) across the United States. Spring dead spot is predominant in the northern range of bermudagrass adaptation (adapted from A. Gould, editor, Turfgrass Patch Diseases Caused by Ectotrophic Root Infecting Fungi. APS Press, St. Paul, Minn.)

SYMPTOMS AND RESISTANCE

SDS symptoms include circular, bleached, and depressed thatch areas from six inches to three feet in diameter. The fungus usually takes from two to three years to become fully established. Once established, the below-ground roots and rhizomes typically are covered with dark brown to black fungal hyphae. Like many root-rotting fungi, this fungus is most active in the early fall and spring, when temperatures and moisture favor fungal growth and when bermudagrass growth slows down. In the fall, infection weakens the bermudagrass root system and predisposes it to winter injury. For this reason, the disease is more common in northern, colder climatic areas[10] and during years of severe winter.

Resistance to the disease has been identified in many bermudagrass varieties. Researchers have shown there is a close association between resistance to SDS and resistance to cold temperatures. In other words, bermudagrass varieties that resist the cold also resist SDS infection.[1] Since freezing temperatures tend to increase damage, it stands to reason that cold-resistant varities would show less damage than non-resistant varieties. Nus and Shashikumar[11] showed that infection with *O. herpotricha* and *O. korrae* reduced the ability of a single bermudagrass line to adapt to cold temperatures.

With the coming of spring and warmer temperatures, bermudagrass breaks dormancy and spring growth continues. In the diseased areas, damaged tissue often fails to regrow, leaving the characteristic circular patches that contain dead and dying tissues. Regrowth can occur from the margins of the infection zone and from surviving plants within the patch, resulting in a recolonization of the dead areas. Often, recolonization by aggressive varieties may cause the patches to completely disappear. This seasonal cycle of infection and recolonization results in a variation in patch size from year to year. For some unknown reason, after five to six years, the symptoms usually subside and can even disappear.

CONTROL MEASURES

What can be done to reduce the damage caused by SDS? Unsightly patches of infected bermudagrass often require expensive remedies. Disease symptom severity increases with a number of environmental conditions and cultural practices. Generally speaking, factors that delay fall dormancy or reduce winter hardiness tend to promote the

disease. Excessive fall fertilization and thatch accumulation will increase SDS infection. Bermudagrass growing on soils that are poorly drained or have been compacted also show greater symptoms. Dr. Ned Tisserat recommends dethatching and core aerification to reduce damage caused by SDS.[12]

What about fungicides? Unfortunately, chemical fungicides have been erratic with respect to disease control. Control varies from year to year and usually requires more than one application. One of the best approaches for reducing SDS where *O. herpotricha* is the causal agent is the use of resistant bermudagrass varieties. The program of Dr. Dennis Martin has been very active in evaluating SDS response in commercial varieties and elite breeding lines.[8,9] Resistant varieties typically show less damage due to SDS. However, none of these varieties is immune to the disease, and some do not offer the quality demanded by golfers.

BERMUDAGRASS VARIETY SUSCEPTIBILITY TO SPRING DEAD SPOT DISEASE

Resistant	**Susceptible**
Guymon	Arizona Common
Midlawn	Cheyenne
Midfield	Jackpot
Midiron	NuMex Sahara
Yukon	Oasis
Mirage	Poco Verde
Sundevil	Primavera
	Princess
	Sonesta
	Shanghai
	Tifton 10
	Tifway
	Tifgreen
	Tropica
	Vamont
	Sunturf

BIOCONTROL

Researchers also are investigating other potential means of controlling SDS.

When infected with spring dead spot, bermudagrass roots can become covered with black fungal hyphae. Like many root-rotting fungi, this fungus is most active in early fall and spring.

One possibility is through the application of a biocontrol agent. Biocontrol agents usually consist of microorganisms that kill or inhibit the growth of specific plant pathogens. Several biocontrol agents have been successful in controlling specific plant diseases. Recently, a bacterium was found by the laboratory of Dr. Michael Anderson that dramatically suppressed the growth of *O. herpotricha* in the lab. Perhaps incorporation of an aggressive bacterium into the soil may suppress the infection process enough to tip the balance in favor of the bermudagrass plant. The bacterium could be applied as a soil drench during the fall when the fungus is most active, or in the spring to improve the rate of recovery during spring green-up. Plots have been established for the testing of this biocontrol agent in the field, and results should be forthcoming in a couple of years.

BASIC BIOLOGY

Research to better understand the basic biology behind the infection process is also continuing. There are many constraints in studying SDS and in breeding for resistant varieties. One of the major constraints is that it takes two to three years to establish the disease in the field, and an additional three years to collect and analyze the data. All in all, at least three to five years of work are required before field trials can provide meaningful data. Breeders, especially commercial breeders, are reluctant to tackle this problem directly if it takes five years to evaluate the material after each round of genetic selection. There has to be a better way.

Conceivably, controlled environmental studies could take less time. However, results from controlled studies often fail to correlate with those from the field. In other words, varieties showing resistance in the field often fail to do so under controlled conditions. This indicates that certain factors that contribute to resistance may be missing in the controlled studies. At Kansas State University, Dr. Ned Tisserat is studying the infection process under controlled environmental conditions in order to identify these missing factors. Dr. Tisserat is primarily focusing on low temperature applications and inoculum levels in order to simulate field conditions. Other factors, such as differences between the microbial composition of field soils or in the thatch layer, may also be associated with resistance manifestation. Successful identification of the missing factors will provide valuable information concerning the infection process and allow the construction of a more rapid screening system.

UNDERSTANDING GENETIC RESISTANCE

Finally, a better understanding of the infection mechanism at the molecular level could lead to novel and improved control methods. In the laboratory of Dr. Arron Guenzi, research is being conducted to identify genes that are activated and deactivated during the infection process. Genes direct the biological activity of all living organisms. The pattern of activation or deactivation of specific genes drives all biological processes. Research has shown that many plant defense genes are activated in response to fungal infection. The idea behind this research is that if one could identify the pattern of gene expression, one could better understand how the plant defends itself against pathogen attack and ultimately engineer a better defense response. By analyzing patterns of gene expression, Dr. Guenzi hopes to uncover important genetic relationships that are associated

The field evaluation plots for spring dead spot resistance demonstrate the range of variety resistance. The variety on the right shows more resistance to spring dead spot in comparison to the research plot on the left.

with the SDS infection process and resistance mechanisms.

In addition to the work on gene expression, the laboratory of Dr. Genzi has also been active in developing techniques to incorporate new genes into bermudagrass through genetic transformation. There are great barriers when working with a plant species such as bermudagrass that has never been effectively transformed. Although many attempts have been made in the past with little success, the successful and efficient transformation of bermudagrass will allow for the incorporation of new and important genes into current cultivars.

This team approach by researchers from Oklahoma State and Kansas State Universities should yield greater knowledge of the infection mechanisms and provide new tools to combat this costly disease. As we advance into the future, it is our hope that research supported by the USGA will ultimately bring to producers and users improved turfgrasses, management procedures, and biotechnological and microbiological tools to make SDS a subject of history.

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Getting Golfers in the Swing of Things

Educating golfers about realistic and environmentally sound golf course management practices.

BY JEAN MACKAY

It seems so obvious, so simple: golf is a game that's played on plants. Yet, how many golfers remember that fact when they're out there smacking the ball off a tee?

For ten years now, working with the Audubon Cooperative Sanctuary Program, I've listened to superintendents relate story after story about golfer demands for spotless perfection on the golf course, flawless playing quality, and smooth, fast greens. I've watched superintendents take cutting heights lower and lower, knowing that they risk greater insect and disease outbreaks due to stressed plant health. If that's not enough, they roll their greens, plant ultra-dwarf turf varities, and apply the necessary chemicals to keep plants alive and their jobs intact. And still, golfers smack their balls off the tee, leave divots unearthed, and complain about the greens.

So what's to be done?

The USGA Green Section and Audubon Cooperative Sanctuary Program, as well as the coalition of organizations involved in the Golf and the Environment forum, have undertaken a variety of initiatives to educate golfers, not only about proper etiquette, but also about environmental issues related to golf. Among the most successful strategies, however, are the on-the-ground efforts of superintendents reaching out to their own golfers and encouraging an attitude of environmental stewardship.

Why is this approach so effective? Superintendents know their course, they know the game, they know their golfers, and they can be persistent in targeting specific environmental issues and promoting good stewardship.

Superintendents involved in the Audubon Cooperative Sanctuary Program have pioneered many strategies to educate golfers about realistic and environmentally sound golf course maintenance. They have involved golfers in a variety of projects to raise awareness of the vital link between overall environmental quality and the natural heritage and enjoyment of the game of golf.

If you would like your golfers to be a bit more on the ball when it comes to supporting environmentally sensitive golf course maintenance, try one or more of these ideas. The greater the number of superintendents involved, the more successful all our efforts will be to get golfers in the swing of things.

THE BENEFITS OF REACHING OUT

Communicating with golfers about your environmental efforts can help you:

- Gain recognition and support for your management efforts.
- Increase golfer understanding of wildlife and environmental quality on the golf course.
- Counter negative stereotypes about golf courses as polluters of the environment.
- Communicate your commitment to good stewardship.

OUTREACH AND EDUCATION STRATEGIES

- **Join the Audubon Cooperative Sanctuary Program (ACSP).** The ACSP provides a framework for integrating environmental management strategies into your day-to-day routine. Equally important, it lends legitimacy to your environmental stewardship efforts and rewards you and your course for your positive efforts.
- **Invite golfers to get involved.** Contact golfers at your course, inform them of your involvement in conservation projects, and invite their participation. A newsletter article or announcement on the bulletin board requesting help from individuals to assist with projects, such as wildlife surveys or nest box construction and monitoring, may result in more positive responses than you think.
- **Teach good stewardship.** If your course offers golf lessons or has a junior golf program, include lessons on how golfers can support good environmental stewardship while they play. Repairing ball marks and divots is just the beginning of what golfers can do. Discuss how golfer demands for fast play and perfect conditions can stress turf and pose risks to turf health and the environment. Encourage people to view natural areas as integral to the nature of the game and to respect wildlife and natural habitats on the property.

Post the Environmental Code of Ethics for Golfers in a visible location

ENVIRONMENTAL CODE OF ETHICS FOR GOLFERS

The American golf community is dedicated to preserving golf's treasured links to nature. We recognize our historic tradition of integrating the game with the natural heritage, character, and challenges of the landscape on which it is played. As golfers, we accept our responsibility to ensure that golf courses are managed in harmony with the environment.

We commit to . . .

- Use and protect natural resources on the golf course in an environmentally responsible way.
- Foster wildlife and natural habitats in non-play areas of the golf course.
- Respect designated environmentally sensitive areas within the course.
- Support golf course management decisions that protect and enhance the environment.
- Encourage maintenance practices that promote healthy turf.
- Plan long-range conservation efforts on the golf course.
- Educate others about the benefits of environmentally responsible golf course management for the future of the game and the environment.

Adapted from "Environmental Principles for Golf Courses in the United States," March 1996, Golf and the Environment Summit, Pinehurst, N.C.

• **Use tournaments to showcase environmental aspects of the golf course.** If you are hosting a tournament, use the opportunity to educate people about the environmental quality of your golf course. For example, highlight your ACSP involvement through the media or put up a simple display to show some of the environmental projects you've undertaken. Create a simple media fact sheet that highlights stewardship accomplishments and key natural features of the golf course.

• **Lead a golf course tour.** Consider hosting an outing once per year for members, regular golfers, or specific golfing groups (*e.g.*, seniors, ladies). Such a tour can showcase various aspects of your stewardship efforts and convey information about what golfers can do to support you.

• **Create a display.** Create a display in your clubhouse to educate members about wildlife species, habitat conservation, and golf course maintenance. It also can promote the positive efforts you have undertaken to maintain a high degree of environmental quality at your golf course.

• **Write newsletter articles.** Newsletter articles about your stewardship activities are an easy way to reach your audience. Include a variety of topics, such as: wildlife or habitat management, best management practices, water quality testing, dealing with problem wildlife, water conservation measures, and what golfers can do to support environmental quality.

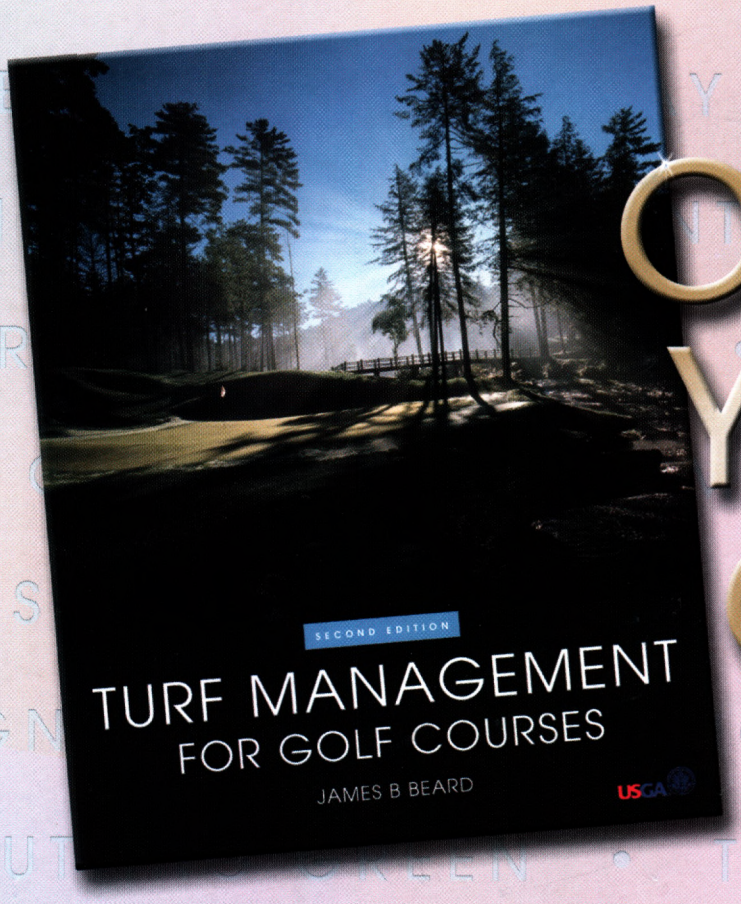
Signs and displays, such as this one at Glendoveer Golf Course (Portland, Oregon) can effectively showcase a golf course's commitment to environmental quality. Glendoveer G.C. received certification in the Audubon Cooperative Sanctuary Program in 2001.

• **Mount signs.** Mounting signs can be an effective education strategy, as well as a way to protect areas of special concern. The primary objective of any sign is to concisely communicate your message to all who will see it.

• **Request help with nest boxes.** Nest boxes are a good starter project that raise awareness about birds on the golf course and often serve as a catalyst for greater involvement in conservation activities. Invite golfers to "adopt a box" by donating money for one or more boxes and agreeing to check and maintain them throughout the spring and summer.

• **Host projects for kids.** Get kids involved by making bird feeders or nest boxes for the course or their own backyards, hosting a fishing derby, or leading a school tour. Getting kids involved in environmental activities pulls parents into the golf course for non-golf activities and helps people begin to see the property not just as a golf course, but as a community asset.

JEAN MACKAY *is the Director of Educational Services for Audubon International, where she has worked closely with members of the Audubon Cooperative Sanctuary Program for 10 years. She can be contacted at jmackay@audubonintl.org. For information on the Audubon Cooperative Sanctuary Program for Golf Courses, call (518) 767-9051, extension 12, or visit www.audubonintl.org.*



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The long-awaited second edition of *Turf Management for Golf Courses*, written by Dr. James B. Beard in conjunction with the USGA Green Section staff, is available through the USGA Order Department.

This book is the most comprehensive, practical, golf turf book ever published. Dr. Beard's 40-plus years of research experience and the combined field experience of the USGA Green Section staff have produced a detailed book covering the practical and technical aspects of golf turfgrass management, maintenance, and operation. The first edition has been used as a standard reference for golf course superintendents, architects, and turfgrass scientists since 1982, and the second edition includes the countless changes that have occurred in golf course maintenance over the past 20 years.

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USGA Green Section Education Program

Saturday, February 9, 2002 • Orlando, Florida

MAKING ACCOMMODATIONS FOR GOLFERS AND THE ENVIRONMENT

12:30 p.m.
Welcome
Moderator: JAMES T. SNOW
National Director, USGA Green Section

12:35 p.m.
Accommodating Golfers with Disabilities
MARK FRACE, *Project Director, USGA Resource Center for Individuals with Disabilities*
Opportunities are available within the game of golf for individuals with disabilities. Information about the new USGA Resource Center for Golfers with Disabilities and superintendents' concerns about adaptive equipment devices for disabled golfers will be addressed.

1:05 p.m.
The Best Turf Tips from the Green Section Staff
MATT NELSON
Agronomist, Northwest Region
JIM BAIRD
Agronomist, Northeast Region
BRIAN MALOY
Agronomist, Mid-Continent Region
STAN ZONTEK
Director, Mid-Atlantic Region
BOB VAVREK
Agronomist, North-Central Region
PAT O'BRIEN
Director, Southeast Region

1:30 p.m.
Presentation of the USGA Green Section Award

1:40 p.m.
More of the Best Turf Tips
CHRIS HARTWIGER
Agronomist, Southeast Region
KEITH HAPP
Agronomist, Mid-Atlantic Region
JIM SKORULSKI
Agronomist, Northeast Region
JOHN FOY
Director, Florida Region
PAUL VERMEULEN
Director, Mid-Continent Region
PAT GROSS
Director, Southwest Region

2:05 p.m.
There's Room Enough for Both of Us — Building a Golf Course on an Environmentally Sensitive Site
TIM HIERS, CGCS,
The Old Collier Golf Club, Naples, Florida
Tim Hiers encountered more than a few ups and downs with the construction of the new Old Collier Golf Club. He will share his practical experiences that have made this a win-win situation for golf and the environment.

2:35 p.m.
The Best Turf Tips Keep on Coming
BOB BRAME
Director, North-Central Region
DARIN BEVARD
Agronomist, Mid-Atlantic Region
JIM MOORE
Director, Construction Education Program
DAVE OATIS
Director, Northeast Region
LARRY GILHULY
Director, Northwest Region

2:55 p.m.
Closing Remarks

2002 USGA NATIONAL & REGIONAL CONFERENCES

National Conference

February 9	Orange County Convention Center Orlando, Florida

Florida Region

November 12	Jacksonville Marriott Jacksonville, Florida
November 14	Palm Beach Gardens Marriott Palm Beach Gardens, Florida

Mid-Atlantic Region

February 25	Radisson Hotel Monroeville, Pennsylvania
March 29	Dupont Country Club Wilmington, Delaware

Mid-Continent Region

March 6	Lakewood Country Club Dallas, Texas
March 7	Lakeside Country Club Houston, Texas
March 19	Norwood Hills Country Club St. Louis, Missouri
April 4	Pleasant Valley Country Club Little Rock, Arkansas

North-Central Region

March 25	Airport Marriott Minneapolis, Minnesota
March 27	Marriott North Indianapolis, Indiana

Northeast Region

March 14	Beth Page State Park Farmingdale, New York
March 21	The International Club Bolton, Massachusetts

Southeast Region

March 12	Pinehurst Country Club Pinehurst, North Carolina
March 21	Marriott Hotel Chattanooga, Tennessee

Northwest Region

March 6	The Heritage Inn Great Falls, Montana
March 11	Waverley Country Club Portland, Oregon
March 13	Owyhee Plaza Boise, Idaho
April 22	Waialae Country Club Honolulu, Hawaii

Southwest Region

March 14	Country Club of Salt Lake Salt Lake City, Utah
March 18	Castlewood Country Club Pleasanton, California
March 19	Sheraton Universal Hotel North Hollywood, California
March 22	Arizona Country Club Phoenix, Arizona
March 26	*To Be Announced* Denver, Colorado

All Things *Considered*

An Ill-Fated Concept?

Integrated pest management: Is it viable in today's game?

BY JIM SKORULSKI

Integrated pest management (IPM) is practiced, at least to some degree, at just about every golf course, but seldom, if ever, is a complete IPM program practiced for the entire golf course. Heavy play, busy event schedules, earlier tee times, staffing shortages, fear, complacency, golfer apathy, and ever-increasing demands for perfection are all legitimate roadblocks to implementing IPM programs. Does that mean that IPM is an ill-fated concept?

As an industry, we advocate the use of IPM principles and are quick to defend our management programs as being environmentally sound, and most are. But (be truthful, now) how many IPM principles are you really employing in your pest management decisions, and can you do more? The following are some good questions you can use to evaluate whether your IPM program is up to par.

- Are you following a formal IPM protocol or management plan?
- Have key pest problems been identified and an up-to-date, organized database developed for each pest?
- Is a formalized monitoring program in place and a daily journal or record of all pest activity and abiotic stresses being maintained?
- Have you been able to modify cultural programs to reduce environmental and pest pressures?
- Are specific treatment thresholds being used for even a few pests?
- Are any biological agents being used?

Is there any hope? I think there is, as most of you are probably incorporating some of these very basic IPM principles in the field. If you are not, then it's time to reevaluate your programs. The next step is to piece those concepts together to develop a more complete and meaningful IPM program. With a little coaxing and a few ideas you can do just that.

So how might this be done? First, you have to determine what concepts can be integrated into your management programs based on the available resources, time, traffic, and membership attitudes. Not all the concepts may be workable or practical for an operation at a given time, and a complete IPM program may not be feasible for the entire golf course. If that is the case, then think small. Consider implementing a more thorough IPM program for fairways alone, where management programs are generally less intensive. The potential to reduce pesticide usage over the larger fairway acreage arguably would have a greater benefit than a similar program for greens. A reduction in the chemical budget may also be realized. If not fairways, then consider a more thorough IPM protocol for primary rough areas or sand bunker banks and green surrounds. Even non-turf areas such as ponds or ornamentals and tree plantings are excellent candidates for IPM. Starting small will require fewer resources, help build confidence, and develop a template that can be used to expand the programs further.

Another option for implementing an IPM approach is to do so for an individual pest or pest complex over the entire golf course. Such an approach should be possible and effective against specific weeds, insects, or diseases. Concentrating on a single primary pest may be less daunting and more practical, and the successes provide the impetus for more extensive IPM programs.

The possibilities and options for using IPM on golf courses are many. The traditional IPM approach we were taught in school and used in agricultural and forestry systems probably will not be practical or effective for golf courses. However, be progressive and creative to mold an IPM strategy that has the potential to work under your conditions. To be successful, you will have to remain open to new technologies and find innovative ways to solve difficult problems. Turfgrass researchers and agronomists will also have to remain open-minded and bring to market new tools and ideas that are both practical to implement and effective for managing pests. Perhaps the biggest challenge will be to modify a mind-set that demands absolute perfection and consistency that are unattainable and contrary to responsible pest management. That is the responsibility of the entire industry.

So is IPM an ill-fated concept in today's game? It does not have to be. Sure, there are difficult issues that must be addressed, but implementing a more comprehensive IPM management approach may not be as hard as you think. Plant the seed for the IPM concept in course officials, supervisors or owners, as well as your staff. Reevaluate your current management programs and develop a pest management plan for the upcoming season. Obtain a copy of the IPM Protocols developed by the University of Massachusetts. Try to hire a pest management specialist who can take the time to develop and implement more formalized IPM on the golf course. Be alert for and open to all the new and promising technologies that will increase your management capabilities.

This is not the time to have a business-as-usual attitude. Yes, our industry tries very hard to protect the environment while producing the best playing conditions possible. But more can and should be done. Make a conscious effort to learn more about your pest management options and give IPM a second chance. The fate of our industry just may depend on it.

JIM SKORULSKI *is a Green Section agronomist who visits golf courses throughout the New England states and eastern Canada.*

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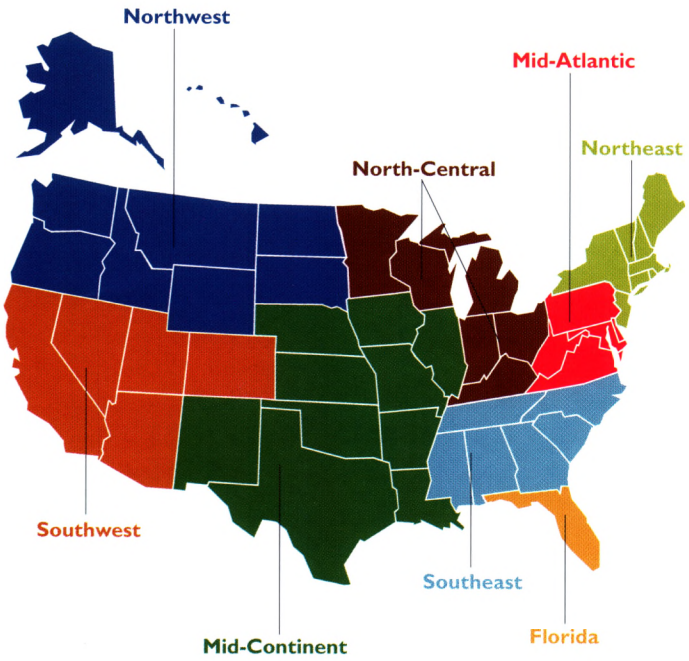

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Turf *Twisters*

Q: I've been a golf course superintendent for several years, and while I love to play golf, my work schedule makes regular participation in the game difficult. I've often heard the importance of regular play emphasized as being a good public relations/credibility tool. Any suggestions on how I can improve the frequency and regularity of playing the course I'm responsible for maintaining? (Kentucky)

A: First, approach the playing of the course your are responsible for maintaining as part of your job. In other words, it should be done during a regular business day and not pushed to evenings or weekends. Pick a weekday that accommodates your schedule and the club's calendar of activities. Once selected, block a tee time

that you will use each week. Interested members can be encouraged to fill out your group and, in so doing, combine the regular play of the course you maintain with an opportunity to discuss concerns of interested players. Be sure to discuss this strategy with the Green Committee or your boss, but with a little planning a regular tee time can be a good policy.

Q: I recently received a soil nutrient test in which the results varied significantly from a test completed last year. Should I be concerned? (New York)

A: Soil nutrient test results can vary depending on the test protocol and extractants used by a laboratory. Therefore, it is always a good idea to request this information when a different laboratory is used to complete the analysis. Soil pH and available nutrients can also be influenced by fertilizer applications made immediately prior to the soil tests. This is especially true on sandy soils with a low CEC and low buffering capacity, where nutrient concentrations fluctuate more widely. Have new soil nutrient tests completed if you are concerned with the inconsistencies, and contact your local Green Section agronomist or university specialist to review the test results and its recommendations further. Remember that the soil test results provide only a snapshot of current nutrient status in the soil and that these levels will change over time. Use the test results to monitor the progress of your fertilizer programs and to serve as a basis for future applications.

Q: Is there a big difference between maintenance costs for ultradwarf and Tifdwarf putting greens? (Florida)

A: Ultradwarf bermudagrass greens require more aggressive thatch management than Tifdwarf; however, the difference in maintenance costs is dependent on several factors. Ultradwarf bermudagrass greens must be routinely verticut, aerified, and topdressed during the growing season to provide acceptable putting surfaces. We have noticed that the optimum timing for light verticutting and topdressing is every 7 to 14 days during the growing season. Also, greens should be core aerified at least 3 to 4 times each year. Many upper-end golf courses and golf courses with longer growing seasons (like those found in South Florida) are already providing similar maintenance practices for Tifdwarf, so the difference in maintenance costs is not as large as you might think.

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