USGA GREEN SECTION

RECORD

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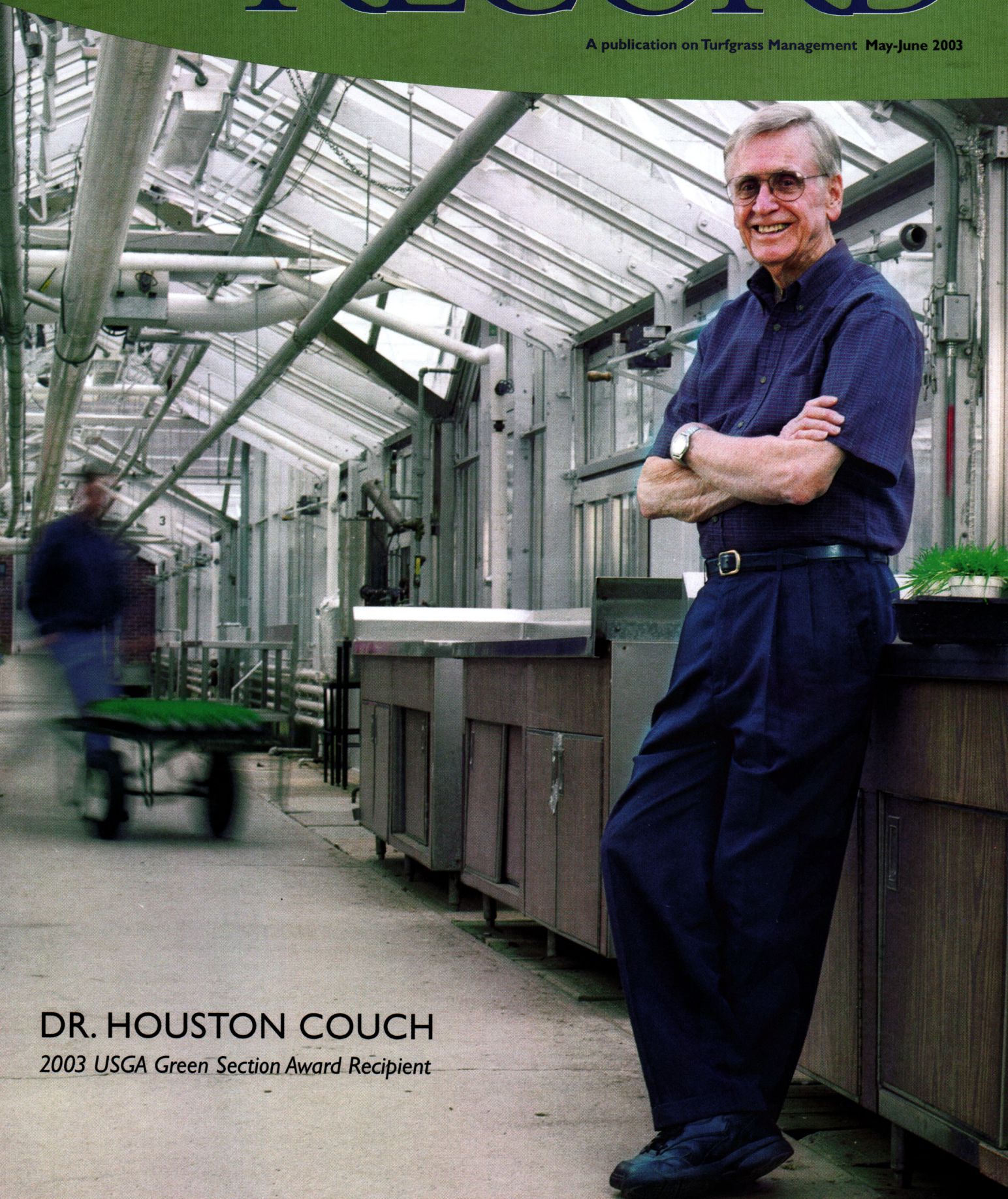

DR. HOUSTON COUCH

2003 USGA Green Section Award Recipient

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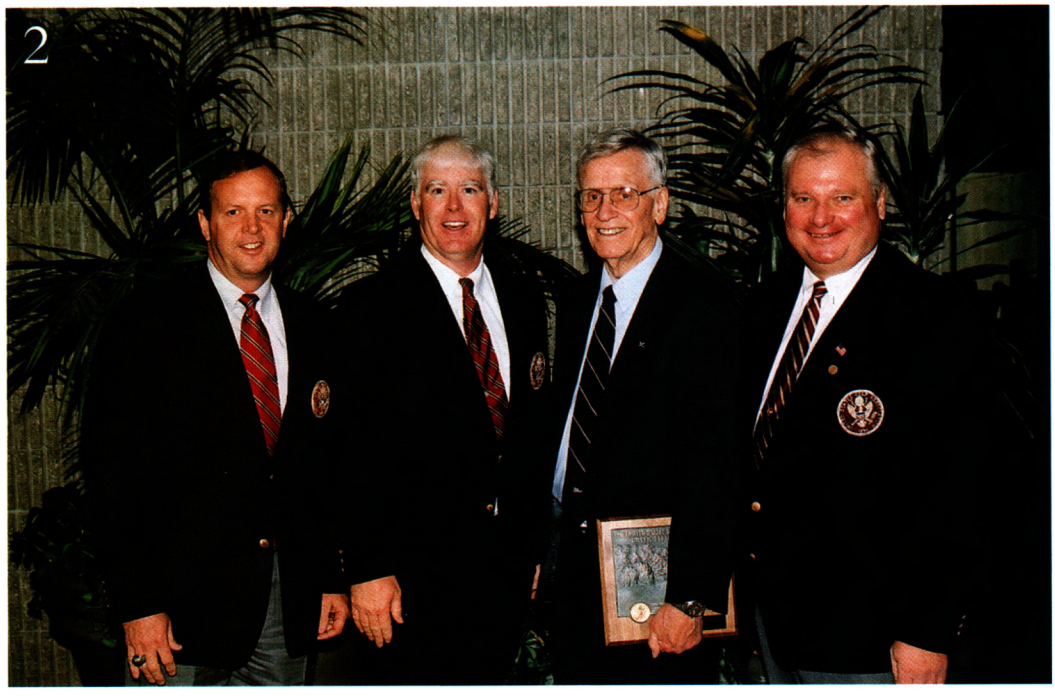


Cover Photo
Dr. Houston Couch's dedication to turfgrass pathology earns him the 2003 USGA Green Section Award.

2003 GREEN SECTION EDUCATION CONFERENCE

50 Years of Lessons Learned

February 14, 2003 • Atlanta, Georgia

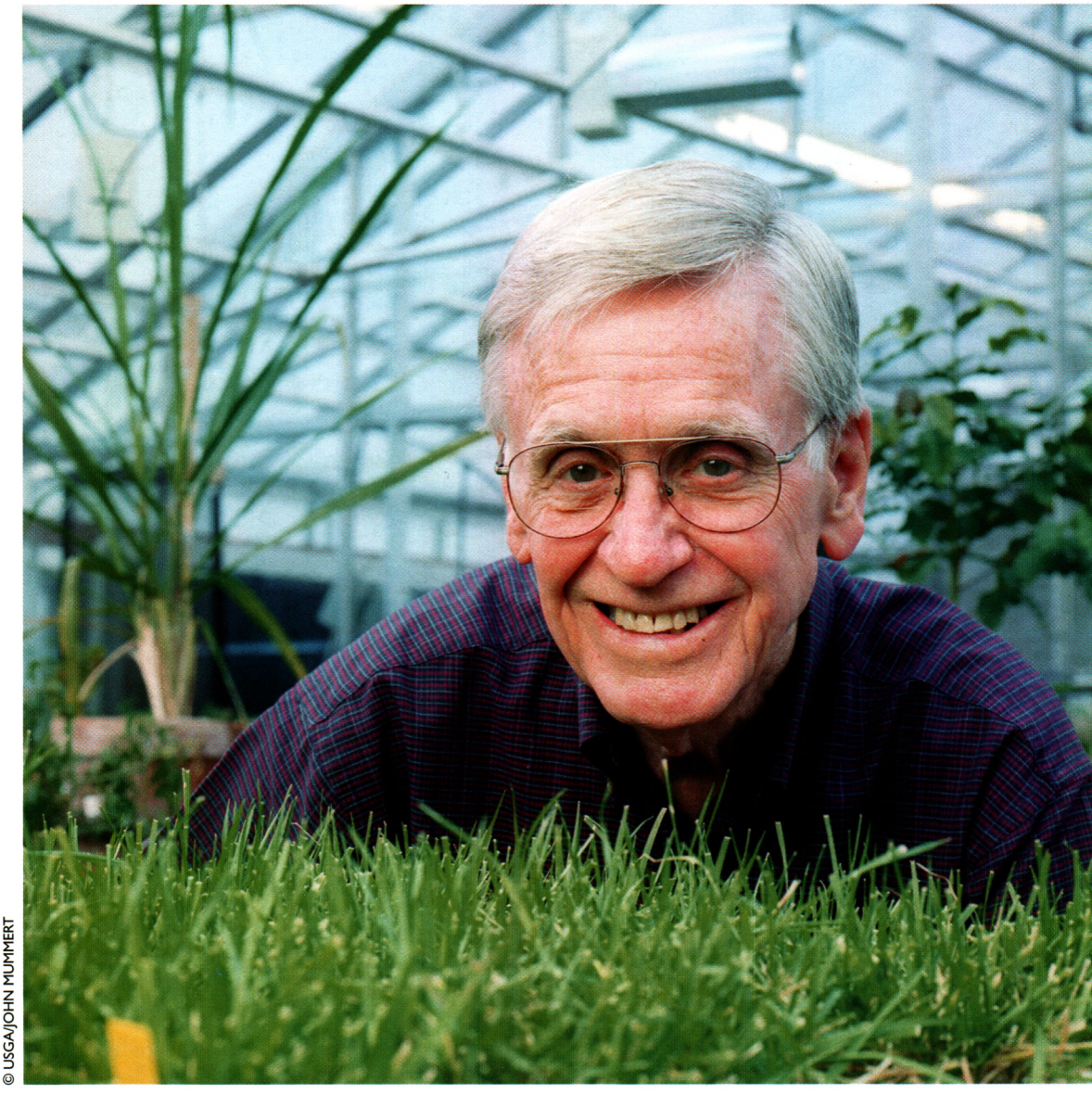
For the 22nd consecutive year the annual Green Section Education Conference was held in conjunction with the Golf Course Superintendents Association of America Conference and Show. This year, more than 900 people attended the Green Section's program on Friday, February 14, at the Georgia World Congress Center. Bob Brame, of the USGA Green Section's North-Central Region, served as moderator for the morning's program of six speakers who addressed this year's theme, "50 Years of Lessons Learned."

NO COUCH POTATO

Dr. Houston Couch receives the 2003 USGA Green Section Award.

Dr. Houston Couch, plant pathologist at Virginia Polytechnic Institute, was selected as the recipient of the 2003 Green Section Award. Granted by a distinguished panel of experts in the turfgrass field, this annual award recognizes persons for distinguished contributions to golf through work with turfgrass. The award was presented to Dr. Couch by Bruce Richards, a member of the USGA Executive Committee, at the Golf Course Superintendents Association of American Conference and Show in Atlanta, Georgia, on February 14, 2003.

Dr. Couch has proven to be a leader in many aspects of his life. A professor at VPI since 1965, he has taught plant pathology on the college level for nearly 50 years, impacting a countless number of students who have gone on in the turfgrass industry. He authored the first comprehensive turfgrass pathology textbook, *Diseases of Turfgrasses*, first published in 1965 and reprinted in three



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USGA Green Section National Director Jim Snow congratulates Dr. Couch.

subsequent editions. His publication efforts continued with the release of *The Turfgrass Disease Handbook* in 2000.

During his career, he published more than 150 scientific papers and lectured at more than 500 industry conferences in the United States and internationally. His research focus established him as a recognized expert on root disease ecology and disease control.

In addition to his research and teaching, he has developed excellent educational tools, including a seasonal computer bulletin board and disease forecasting and control service for turfgrass managers and the general public.

His style is legendary. "As a much sought-after public speaker at turf conferences and seminars, he is in his element — always articulate and informative, frequently dogmatic and controversial, often the amusing raconteur, and seldom dull," writes Dr. Noel Jackson, professor emeritus, University of Rhode Island. "He has the experience and enthusiasm to stimulate an audience, and many in the turf industry, particularly those in golf course management, have benefited greatly from his unstinting endeavors."

A native of Estill Springs, Tennessee, as a young man Houston had aspirations of becoming a civil engineer and building bridges. In 1943, just 18 years old, he was drafted into the U.S. Army parachute infantry as part of the 517th Regimental Parachute Combat Team during World War II. Following the Battle of the Bulge, he was wounded in action in Belgium and awarded the Purple Heart. He was honorably discharged in 1945.

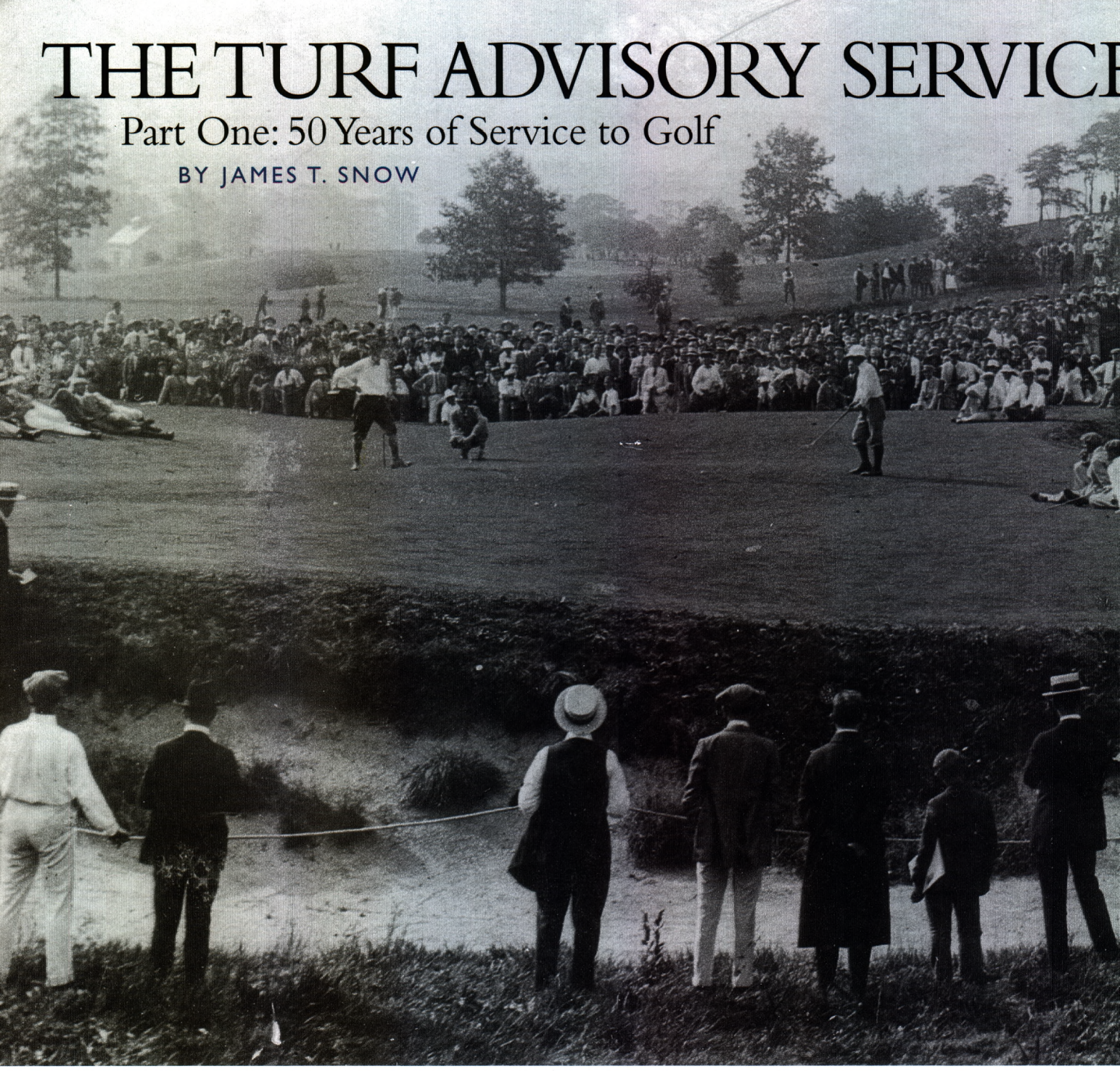
Couch returned home and entered Tennessee Technological University. After watching the engineers during the war, he decided that engineering wasn't his calling. He graduated from Tennessee Tech with a Bachelor of Science degree in agronomy. While taking a plant pathology course, the professor so impressed him with the importance of the material that upon graduation he decided to further his studies, earning a Ph.D. in plant pathology from the University of California – Davis.

From 1954 to 1965, he taught botany and plant pathology at Penn State University. In 1965, he began his odyssey at VPI, teaching plant pathology and plant physiology. His students remember him well and think well of him. Dick Fisher, golf course superintendent at Farmington Country Club (Va.), writes, "I first met Dr. Couch as a freshman at Virginia Tech in 1965. He was teaching plant pathology then, and he is still teaching me plant pathology. The students feared his class because you were expected to learn the subject without any hand-holding on his part. At least that's what he told us. In reality, he has been holding our hands for the last 35 years to good effect."

THE TURF ADVISORY SERVICE

Part One: 50 Years of Service to Golf

BY JAMES T. SNOW



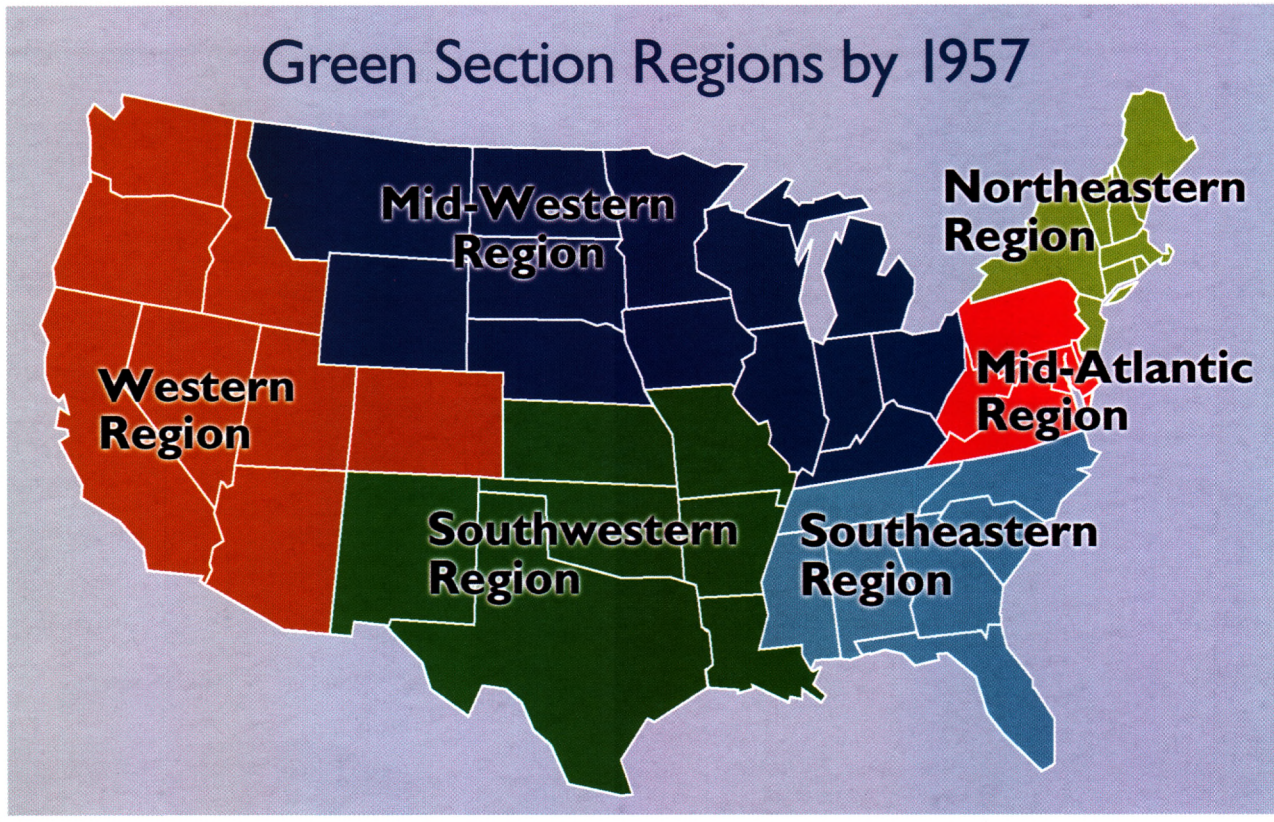
Play during the 1920 U.S. Open Championship at the Inverness Club (Inverness, Ohio). E. J. Marshall, then chairman of the Green Committee, could not find impartial, authoritative agronomic information to help in their preparation efforts. His search led him to the USGA and the United States Department of Agriculture, who agreed to collaborate in the development of scientific information relating to golf course turf. The result was the formation of the USGA Green Section on November 30, 1920.

When the USGA Green Section's new Turf Advisory Service got off the ground in 1953, could the founders ever have imagined that it would celebrate its golden anniversary in much the same form and with much the same purpose? After all, for the previous 32 years, since its inception in 1921, the Green Section had been primarily a research organization, founded on a need to conduct research and distribute research findings that would help golf courses provide better turf for better golf. Could this new program succeed, or

would the need for the Green Section fade slowly away?

THE TURF ADVISORY SERVICE — WHAT IT IS AND HOW IT WORKS

The Green Section's Turf Advisory Service (TAS) is a service to the game of golf provided by the United States Golf Association. The cornerstone of the program is the on-site visit to participating courses by an experienced agronomist, followed by a complete written report of his findings and recommendations. The visit usually includes a tour of the golf course with the course superintendent and course officials, and many topics are discussed. Today there are 18 regional agronomists located in 13 offices throughout the country. Each agronomist is thoroughly familiar with golf course management problems and solutions in his local territory, and is able to share that information with participating courses. We often are asked about what a golf course can expect by participating in the program. The short answer is that each course has its own special needs and stands to benefit in its own unique



	Year Established	First Regional Director
Western Region	1953	Charlie Wilson
Southwestern Region	1953	Marvin Ferguson
Northeastern Region	1954	Al Radko
Southeastern Region	1954	B. P. Robinson
Mid-Atlantic Region	1955	Charlie Hallowell
Mid-Western Region	1957	Jim Holmes

way. Nevertheless, the benefits generally fall into one or more of the following categories. With the help of the agronomist, the course can:

- Establish long-range plans and preventative maintenance programs to avoid future problems.
- Obtain objective, unbiased advice with no commercial ties.
- Benefit from a second set of eyes that sees the good and bad of more than 100 courses each year.
- Receive feedback from the agronomist, who serves as a sounding board for ideas from the golf course superintendent and the course officials alike.
- Receive help in solving problems at hand.
- Save money! Countless times a simple suggestion from the Green Section has saved many times the cost of the visit.
- Document problems and progress from year to year via the agronomist's written reports.

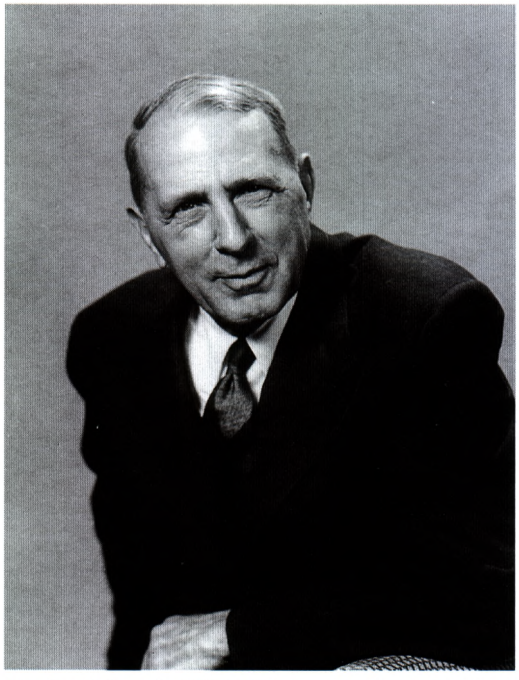
To obtain a visit from a Green Section agronomist, a fee is paid to the USGA and the visit is scheduled. The fee has increased over time, but it covers less than 50% of the cost of maintaining a staff to provide the service. The remainder is subsidized by the USGA. In 2002, more than 1,600 golf courses availed themselves of the service, and nearly 2,000 visits were made by our 18 regional agronomists. USGA agronomists also speak at hundreds of meetings and conferences each year and write countless articles for various industry publications, thereby spreading the word about good turf management to thousands of others responsible for providing the best possible playing conditions for their golfers. The TAS is truly a service to the game, helping golf courses everywhere provide *better turf for better golf.*

HOW THE TURF ADVISORY SERVICE EVOLVED

As it so happens, the concept of direct service to USGA member clubs by visiting agronomists had its roots in the 1920s and perhaps even earlier. Drs. Charles V. Piper and Russell A. Oakley, two USDA grass experts, became the first chairman and co-chairman, respectively, of the Green Section when it was established in November of 1920. Both were accomplished scientists and golfers, and both had consulted with golf courses

Marvin H. Ferguson, 1940-1951, 1953-1968*

Note: Dates in picture captions indicate years with the USGA. *Asterisk indicates years as Turf Advisory Service agronomist.



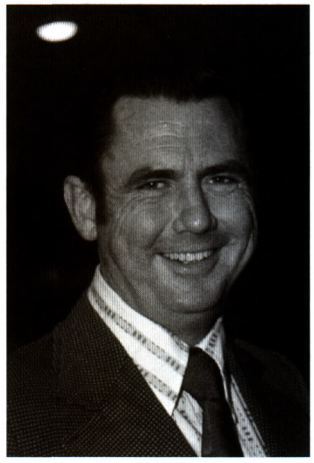
Charles Hallowell, 1955-1961*

many times before 1920. Dr. Piper assisted renowned golf course architect C. B. McDonald in 1908 when McDonald was trying to grow-in his new masterpiece, The National Golf Links of America, in eastern Long Island. Piper's fertilization recommendations were instrumental in getting grass to grow on the very sandy soil at this site.

Although the focus of their work was golf turf research during the 1920s, both Piper and Oakley and other USGA scientists of the era consulted with golf courses as time allowed, usually in conjunction with travel to meetings and conferences across the country. It was called the "Advisory Service" at that time, and the only charge connected with the service was the payment of expenses. Because of time constraints, the Green Section staff would visit only a few dozen courses each year, although the annual report of 1938 indicated that more than 150 visits were made in 24 states. When the United States entered WWII in 1942, the Pentagon was built on the site of the Green Section's turf plot area in Arlington, Va., and the office was moved to the new USDA headquarters in Beltsville, Md. Golf activity in general came to a slow crawl, and Green Section scientists joined the war effort as specialists in establishing grass landing strips for airplanes on the European front.

Dr. Fred Grau became the Green Section's director after the war ended in 1945, and his first step was to decentralize the research program. This involved conducting less research work at the turf plot area in Beltsville and instead distributing research dollars to turf experiment

James Holmes, 1957-1969*



James Latham,
1956-1960,*
1984-1994*

With more than 20 colleges and universities conducting turfgrass research, it became clear that putting this research information in the hands of practitioners was an important next step. In 1950 the USGA Executive Committee approved advisory visits for $50 per day ($100 for non-member clubs) plus expenses. However, the staff was small and busy, and had limited time to carry out many visits. Written reports were included in the service for the first time.

Dr. Grau had envisioned the Green Section coordinating turfgrass research throughout the country — not just golf turf research, but *all* turf research. In 1952, Charlie Wilson, a research assistant at the Green Section's office in Beltsville, was sent to Davis, Ca., to set up a regional office to help coordinate research and education efforts in the West.

From left: James "Monty" Moncrief, 1957-1982*; William Bengeyfield, 1954-1978,* 1982-1990; Alexander Radko, 1947-1981,* 1976-1981.

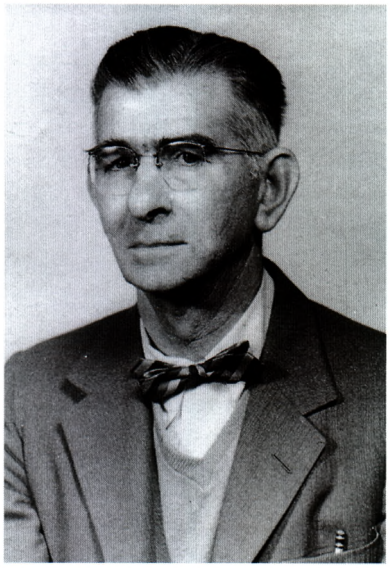
In the meantime, USGA Executive Director Joe Dey and Green Section Committee Chairman Richard S. Tufts were envisioning something quite different. They saw the need for a broad outreach program whereby Green Section agronomists would dedicate their time to on-site consultations with USGA member clubs and courses, taking research results directly from the experiment stations and applying them to practical problems on a golf course level.

stations across the country. This made sense, since research results would be more pertinent when done on a local level, rather than trying to extrapolate results obtained thousands of miles away in a completely different climatic area. The program was very successful in helping to build good turfgrass management programs at land-grant institutions across the country, as witnessed by the following statistics: In 1945 there were fewer than 10 turf workers at 5 experiment stations; by 1951 there were more than 100 workers at more than 20 experiment stations.

In announcing the new USGA Green Section Regional Turf Service in the February 1953 issue of the *USGA Journal and Turf Management*, Richard Tufts stated: "The emphasis heretofore has been on research, and a large body of knowledge has thus been discovered. Now the emphasis is being changed. Now, stress will be placed upon direct service to USGA member clubs and courses —

B. P. Robinson, 1954-1956*

Charles Wilson, 1950-1955*



T.T. (Tate) Taylor, 1956-1961*

in helping clubs, at the local level, with their own particular problems."

The first step in getting the new program off the ground was to establish regional offices across the country. Because the reaction of golf courses to the program was uncertain, it was decided to start with a single region and then expand to other areas if demand for the service was strong enough. The Western Region was the first to become established, and Charlie Wilson became the first regional director, covering the states of Arizona, California, Colorado, Idaho, Nevada, Oregon, Utah, and Washington. A total of 96 courses subscribed to the service in the Western Region in 1953. This success spawned the establishment of an additional five offices throughout the country over the next several years.

So began a program that for 50 years has made untold contributions to the enjoyment of the game of golf through its work with individual golf courses, golf course superintendents, and course officials. Could the founding fathers of the Turf Advisory Service have foreseen the relevance and longevity of the program when they took that bold step in 1953? Perhaps not, but they saw a great need and placed their money on a program that continues to pay big dividends for the game of golf to this day. Not a bad investment!

JAMES T. SNOW *is national director of the USGA Green Section.*

Dollars and "Sense" to Improve Soil Properties

Make rootzone amendment cost comparisons before the final purchase order is signed.

BY MATT NELSON

For the past 40 or 50 years, golf course putting greens have been constructed with predominately sand rootzones. Sand resists compaction, provides rapid drainage, and maintains good aeration porosity. Limiting factors of sand as a growth medium include low nutrient and water retention. To overcome these limitations, sands are commonly amended with organic material. Laboratory testing of the sand and various amendment choices identifies the proper ratio of each component for optimal performance and reduces the potential risk for problems. Over the past few decades, inorganic soil amendments have piqued the interest of turfgrass managers and scientists. Performance criteria and cost are important factors when choosing the proper soil amendment.

The most commonly marketed inorganic soil amendments are porous ceramics, diatomaceous earth, and zeolites. These materials have high water-holding capacity due to internal pore space, and some have a high cation exchange capacity (CEC) for nutrient retention. These are attractive attributes, but a research review is prudent to determine if these qualities actually result in improved turfgrass performance as compared to organic amendments. The next step is to determine if the benefits are cost-effective.

PERFORMANCE CRITERIA: WATER-HOLDING CAPACITY

Inorganic soil amendments are characterized by having a large volume of internal pore space that confers a high water-holding capacity. Evidence suggests that much of this water is held too tightly and thus remains unavailable for plant use,[1,4,24] although McCoy showed that water held by calcined clay and diatomaceous earth might be more available than previously thought.[12] This could be important during periods of extreme moisture stress, but would be less apparent under normal maintenance conditions. Studies by Bigelow et al. indicate that sand particle size and architecture play a more important role in water availability than the internal pore space of soil amendments.[1] Bowman showed that peat retained more water than any inorganic amendment tested and, comparatively, released water more gradually at all tensions.[1,4]

Anecdotal evidence from the field suggests that inorganic amendments are useful to alleviate localized dry spot when incorporated into the upper soil profile via core aeration and topdressing. This has yet to be substantiated with replicated, independent research at multiple sites. A topdressing study conducted at Iowa State University showed that none of the inorganic amendments tested had a significant effect on the amount of dry patch compared to the sand/peat control,[13] while researchers at Missouri found that topdressing with porous ceramic clay reduced dry spot incidence and facilitated turf recovery.[14] An Auburn University study demonstrated a negative effect on rooting when a calcined clay product was added to a creeping bentgrass rootzone via aeration and topdressing.[8]

NUTRIENT RETENTION

Another important aspect of amendments to sand is nutrient retention. Sands have low cation exchange capacity (CEC), and amendments are used to hold more nutrients in the rootzone. This is especially important during turfgrass establishment when nutrient leaching potential is greatest. Several studies have shown that none of the inorganic amendments available today are any more effective at reducing nitrate leaching than peat moss.[1,4,19,21] Zeolites have very high CEC and have been shown to improve potassium retention in the rootzone,[10,16,22] yet research also has shown that peat was more effective at improving nitrogen and potassium recovery in the plant compared to zeolite.[19] Sodium retention may present a problem in sites where salinity and sodicity are issues.[20] With respect to preventing leaching losses and retaining nutrients for plant growth, it appears that organic matter amendments remain superior or equal to inorganic products.

TURFGRASS ESTABLISHMENT

As mentioned previously, sands are most prone to nutrient loss from leaching during turfgrass establishment. As the turfgrass stand matures, plant productivity results in an increase of soil organic matter and a corresponding increase in both nutrient retention and water-holding capacity. Unamended sands typically present challenges for turfgrass establishment, requiring more water and fertilizer than amended sand. Several studies have indicated that peat moss as an amendment is superior to inorganic materials with respect to establishment rate.[2,3,4,26] Conflicting reports exist regarding the influence of zeolites on the rate of turfgrass establishment.[17,21] Zeolite and sphagnum peat

Building putting greens is a costly endeavor, involving specified materials and several construction steps. Soil amendment selection can significantly affect the bottom line.

were found to have similar microbial community structure, thus refuting the claim that zeolite will promote early microbial activity in a sand rootzone compared to traditional organic matter amendments.[6]

LONG-TERM QUALITY

The long-term effects of using an inorganic amendment in putting green construction remain largely unknown, and additional studies are needed. The mechanical and chemical stability of inorganic soil amendments is a concern, as breakdown of these materials could conceivably result in reduced porosity and performance. More long-term study is needed to evaluate the effects of amendment breakdown and physical performance of the rootzones and turf. However, a five-year rootzone study at Rutgers University indicates that turfgrass quality differences between amendment treatments are becoming less apparent with time.[16] A likely explanation is that as the turf matures, the developing thatch/mat layer becomes the limiting factor with respect to water infiltration, gas exchange in the rootzone, and correlating turfgrass vigor.[16,21] Proponents of inorganic amendments argue that the benefits of an inorganic amendment will last over time as compared to peat, which decomposes rapidly. There is no research evidence that demonstrates rapid degradation of peat in the rootzone, but rather evidence that suggests peat will last much longer than other organic matter sources.[24] Organic matter also accumulates in the rootzone as the turf matures. Look around the maintenance facility and take note of how many tools are designed for organic matter removal! Water-holding capacity and nutrient retention are rarely problems for established greens; thus, soil amendments appear to be less important after the first few years of establishment. Gibbs et al. did not demonstrate that zeolites encouraged deeper rooting over the long term.[7]

DOLLARS AND SENSE

The soil amendment debate essentially can be reduced to cost-effectiveness. Recent university research shows quite clearly that none of the inorganic soil amendments evaluated provide any significant agronomic benefit as compared to peat.[1,2,4,16,21,26] There seems to be an inherent desire for *bigger, better, faster, or more sophisticated* products in almost every facet of our industry. While inorganic amendments may appear attractive based upon certain attributes and production methods, research has yet to validate any major performance

advantage over traditionally used organic amendments. And when it comes time to put pencil to paper for a construction project, the type of amendment selected can significantly influence the bottom line.

The following example of a golf course construction project is based upon average costs for sand, inorganic amendments, peat, and blending. Obviously, trucking costs significantly alter these figures, depending on where the inorganic amendment must be shipped. The cost of peat varies less (range of approximately $80 to $110 per 4 cu. yd. bale of sphagnum peat) than most inorganic soil amendments throughout the country; thus, transportation costs are not as significant. This example project requires 6,000 cu. yd. of rootzone mixture, which assumes approximately 140,000 sq. ft. of putting greens with a 12 in. deep rootzone, plus a waste factor of 10-20%.

Assuming a 90:10 rootzone construction blend of sand:peat by volume, 600 cu. yd. of peat is needed since peat does not displace any significant amount of sand when mixed (you still need 6,000 cu. yd. of sand). We assume the cost of sphagnum peat is $105 for a 4 cu. yd. bale. If 150 bales are required for this project, the total cost of peat is $15,750. Sand weighs approximately 1.35 tons per cu. yd; thus, 8,100 tons of sand are needed. Dividing $15,750 by 8,100 tons of sand equals a cost of $1.95 of sphagnum peat per ton of mix. Using reed sedge peat could increase the cost of peat to as high as $4.50 per ton of mix. Laboratory testing is a critical component of the construction process to identify the most suitable organic matter amendment for the sand used in construction.

An average blending cost of materials ranges from $2.50 to $3.50 per ton. The cost is the same, regardless of the amendment type. Blending costs approximately $24,300 in this example, using an average blending cost of $3 per ton.

A long-term rootzone study at Rutgers University is addressing the role of various organic and inorganic soil amendments in turfgrass quality and performance.

Sales tax is another important consideration, and for this example we will assume a sales tax of 5%. If the delivered cost of the sand is $25 per ton at 8,100 tons, peat is $105 per bale at 150 bales, and blending cost is $3 per ton for 8,100 tons, the tax would be $10,125, $788, and $1,215, respectively ($12,128 total tax). Thus, the *total cost* of materials for this putting green construction project utilizing a 90:10 blend of sand to sphagnum peat moss is $254,678 ($212,625 for sand + $16,538 for peat + $25,515 for blending).

If, instead of peat moss, an inorganic soil amendment is selected for this project, the calculation to determine the cost of the materials is as follows. We assume again that this putting green construction project will encompass 140,000 sq. ft. of putting surface with a 12 in. deep rootzone. The cost of sand and blending remains the same.

A recent phone survey of the major inorganic soil amendment suppliers revealed an average cost of approximately $200 per cu. yd. (the range was $180 to $225 per cu. yd.). This is an average cost of commonly marketed porous ceramic, diatomaceous earth, and zeolite products before delivery. This number is subject to variation due to trucking costs, and the delivered cost could be higher than reported in this example. For the sake of this example, we will use a 90:10 ratio of sand to inorganic amendment by volume.

Unlike peat moss, inorganic soil amendments displace sand on a 1:1 ratio. Thus, only 5,400 cu. yd. of sand and 600 cu. yd. of inorganic amendment are necessary to achieve 6,000 cu. yd. of rootzone mix. If 5,400 cu. yd. of sand is equal to 7,290 tons, then the cost of sand at $25 per ton is $182,250. The cost for the inorganic soil amendment at $200 per cu. yd. for 600 cu. yd. is $120,000.

The weight per cu. yd. of the inorganic soil amendments ranges from 675 to 1,350 lbs. For the sake of this example, we will use an average weight of 1,000 lbs. per cu. yd. to estimate

blending cost. Therefore, 600 cu. yd. of inorganic soil amendment weighs 300 tons. The blender will therefore blend 7,290 tons of sand with 300 tons of inorganic amendment for a cost of $22,770 (7,590 tons × $3).

Assuming the same 5% sales tax, the tax on the sand at $25 per ton for 7,290 tons, inorganic amendment at $200 per cu. yd. for 600 cu. yd., and blending cost of $22,770 is $9,113, $6,000, and $1,139, respectively ($16,252 total tax). Thus, the *total cost* for the materials in this putting green construction project utilizing a 90:10 blend sand to inorganic amendment is $341,272 ($191,363 for sand + $126,000 for inorganic amendment + $23, 909 for blending). Remember, this total could increase significantly, depending on location and trucking costs.

CONCLUSION

In this fictitious 18-hole putting green construction example, the cost of materials increased by $86,594 when an average inorganic soil amendment was used at a 90:10 sand-to-amendment ratio by volume as compared to using sphagnum peat moss at the same ratio. Based upon independent research conducted at several leading universities across the nation, it would be difficult to justify the added expense agronomically. Organic matter consistently is documented as the best amendment for sand-based rootzones for performance criteria and cost.

Currently, the USGA guidelines for putting green construction do not recommend the use of inorganic soil amendments.[23] The upcoming revisions (2003) to the guidelines will likely state that with proper laboratory testing it is safe to use certain inorganic soil amendments and still comply with specifications; however, each course should look at cost effectiveness as an important criterion. In any case, put pencil to paper at the outset of any planned construction project and compare dollars and *sense*.

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Superintendents' New and Critical Role in Putting Green Construction

Step by step to a successful green.

BY JAMES FRANCIS MOORE

The last few years have been great for golfers, with new courses springing up in virtually every community. Many of these new courses come equipped with state-of-the-art irrigation systems, dramatic and exciting designs, and the best grasses turfgrass scientists can develop. Not surprisingly, these new courses often offer some of the very best playing conditions found in a community. Such conditions draw players away from the older courses — unless the older courses make steady improvements to remain competitive. This need to stay competitive has led to a significant rise in renovations, particularly on the putting greens.

While there are many questions that must be addressed prior to beginning a green reconstruction or renovation project, perhaps the most critical is, "How much will this cost?" Until this question is addressed accurately, the feasibility and scope of the project cannot be determined. The second question often is, "How can we be sure the job is done right?"

The total cost of the project involves a variety of issues ranging from how much revenue will be lost in the restaurant to the cost of repairing roads damaged by heavy equipment. But by far the most variable cost (and thus the most difficult to accurately determine) will be for construction materials. No one is in a better position to locate suitable construction materials, and thus determine their cost, than the golf course superintendent.

When the green reconstruction project begins, quality control is paramount to protect the owner's investment. This is particularly true for the production of the rootzone material. Again, no one is in a better position to ensure the work is being done properly than the golf course superintendent.

The bottom line is that today's superintendents are often finding themselves charged with responsibilities critical to the success of one of the most important improvement projects a course can undertake. To meet these responsibilities, the superintendent must play a very active role in materials selection and quality control testing. It is the superintendent's task to accomplish the following major goals:

- Identify materials that meet the project specifications and are the most reasonably priced. This will allow a close estimation of total project cost.
- Establish a positive relationship with the materials supplier, which will prove invaluable throughout the project.
- Ensure an accurate bidding process by making certain all bids are based on the same construction materials. Variances in the bid amounts then will reflect differences in contractor methods and will eliminate materials substitutions.
- Institute a methodical and scientifically based sampling program that protects both the owner and the contractors (suppliers, blenders, and builders).

To accomplish these goals, the superintendent should follow the steps listed below:

STEP 1 — PRE-QUALIFY CONSTRUCTION MATERIALS

Most communities will have numerous suppliers of sand and gravel within a reasonable distance to the course. The superintendent and the assistant superintendent should visit these suppliers and learn about their products and their overall operations. The superintendent can help the supplier better understand the project needs by giving them a packet of information regarding putting

Three 50-ton piles are mixed with varying percentages of organic matter. The piles are "lean," "medium," and "rich." By sampling each pile, the ideal mix can be identified by the laboratory.

green construction and quality control. These packets are available free of charge from the Green Section Construction Education Program office.

From each supplier, the superintendent should collect samples of sand and gravel that are likely to fall within the project specifications. Be sure to follow the sample collection procedure outlined in the Green Section publication entitled *Quality Control Sampling of Rootzone Mixture Stockpiles.*

These samples should be submitted to an accredited physical soil testing laboratory. A list of the accredited laboratories can be found at the web site referenced at the end of this article. Please note: It is important to select one laboratory and utilize only that laboratory for all testing activity throughout the entire project. The laboratory will produce various mixtures of the submitted sand and the most commonly used peat moss products. If an inorganic amendment or compost product is preferred, it will be necessary to provide these materials to the lab. Be sure to talk to the lab directly to determine how much of the amendments they will need. The lab will also compare the sand to the gravel to determine whether or not they are compatible.

The lab will send a report back to the superintendent, detailing the physical and performance characteristics of various mixtures of the supplied materials. It is now the superintendent's job to select which combination of sand, amendments, and gravel will be best for the project. This decision should be based on numerous factors, including cost, availability, and performance. Every superintendent should seek qualified help in this decision-making process.

When this step is completed, the superintendent will have identified exactly which materials will be used, who will supply them, and the price of those materials. This information is then provided to those who wish to bid on the project. Although each bidder should negotiate the cost of the materials with the supplier, everyone must base their bids on the same materials.

STEP 2 — DEVELOP A STANDARD OR TARGET MIXTURE

The next step is to actually begin producing the rootzone materials for the greens. It is likely that months will have passed since the first testing process took place in Step 1. By now, the project has been approved, contractors have been selected, and construction is underway. The sand supplier is ready to provide the sand, the organic matter has been delivered, and the blending contractor is ready to begin producing the mixture to go into the green cavity. The goal now is to produce a mixture that is acceptable to all concerned parties.

The blender should be instructed to blend approximately 150 tons of mix, using the materials and mixing ratio identified in Step 1. It is a good idea to blend three 50-ton piles, slightly changing the percent organic matter for each pile. Piles should be blended "lean," "middle," and "rich."

The superintendent should collect a sample from each 50-ton pile using the standardized sampling procedure. The same laboratory that did the preliminary testing should test the samples. When the lab returns the test results, they should be compared against the results of the preliminary testing. It is unlikely (and unnecessary) that these test results will be identical. However, the makeup of

the sand should be similar to the original sampling. If the numbers have changed radically, steps should be taken to determine why such a change has occurred.

The goal now is to select the best mixture of the three blending ratios. This mixture will then become the *standard* or *target value* for all future blending.

Should the test results of all three of the 50-ton piles prove unacceptable, the testing laboratory should be consulted regarding the best choice of remedial action. If the particle size distribution of the sand and organic matter have remained fairly consistent since the preliminary testing, it may simply be a matter of adjusting the blending ratio to make the mix acceptable. However, if adjusting the blending equipment does not correct the problem, the sand may need to be processed further (through additional washing and/or screening) to achieve a more favorable particle size distribution. It is also possible that the organic material has changed in its composition. Either way, the entire testing process will need to be repeated until a satisfactory 50-ton pile can be achieved. This is critical to establish the *standard* for the remainder of the blending process.

STEP 3 — BLEND STOCKPILES AND COMPARE THEM TO THE STANDARD

After the physical properties of the *standard* have been identified, mass production of the rootzone mixture can begin. The rootzone mix should be blended in 1,000-ton increments, which is acceptable for most jobs. However, if the sand and/or organic amendments tend to vary in their makeup, 500-ton lots will provide a greater degree of quality control. The smaller 500-ton lots are also a good idea when the laboratory test results indicate the materials are borderline in terms of meeting the construction guidelines chosen for the project.

Each 1,000- or 500-ton pile should be sampled using the standardized procedure, and the test results should be compared against the *standard*. Again, it is highly unlikely that the *standard* and the sample removed from each pile will match up exactly. The USGA Green Section document *Guidelines for Establishing Quality Control Tolerances* outlines the plus or minus values that should be utilized when comparing the two samples.

If all of the test results are within acceptable tolerances, the 1,000- or 500-ton pile should be marked ready for delivery to the project. However, if any aspect of the testing indicates that the pile has deviated from the target sample by more than the tolerances identified in the document, and the new properties are unacceptable, the pile should be reblended.

After the pile has been approved, it can be hauled to the project or stored for later delivery. As each pile is tested and approved, it can be combined with previously approved piles for the sake of storage.

Rootzone materials production should be a team effort, including the golf course superintendent, his assistant(s), a representative of the materials supplier, and the blender.

CONCLUSION

Although this article outlines three important steps a superintendent should take to help ensure a successful green construction project, there is a fourth step that is probably the most important of all. Given the tremendous responsibility today's superintendent needs to shoulder during such a project, he or she should strive to learn everything possible about green construction and rootzone testing issues. A visit to the USGA Green Section's web site (www.usga.org/green/coned) will provide a wealth of information. For additional assistance, e-mail or phone the Green Section Construction Education Program office.

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Making the Right Spending Decisions When Tackling Soil and Water Quality Problems

Issues to consider before investing the dollars.

BY PATRICK J. GROSS

Do you want to be on the cutting edge of golf course maintenance technology? A few golf courses are using an exciting new product, and they have never looked better! Here is what this product will do for you:

- It will make water wetter.
- Reduce irrigation by 10% to 40%.
- Save fertilizer.
- Reduce the need for chemical applications.
- Reduce the need to aerify.
- Control algae in your lakes.
- Control fungus, mildew, and root rot.
- Eliminate black layer.
- Improve drainage.

Does the above scenario sound too good to be true? Most definitely, but superintendents fall prey to such outrageous sales tactics and spend thousands of dollars of their employers' money in search of the magic product that solves all their soil and water quality problems with little or no effort.

Soil and water are the two biggest resources that superintendents manage in the production of high quality turfgrass. It makes sense that any efforts to improve soil and water quality will have a corresponding positive effect on turf growth. Concerns are more prevalent today, given the fact that several newer courses are built on sites with adverse soil conditions and the increased use of recycled water or poor quality well water. It is only natural that superintendents are looking at ways to improve soil and water quality. With so many options, the question becomes which product to choose.

Salt- and sodium-affected soil is a major obstacle to producing top-quality turfgrass conditions. The white powder on the surface of the soil in the above photograph is not snow — it is salt!

IS THERE A PROBLEM?

Before jumping on the bandwagon with the latest treatment device or product, it is important to analyze your situation to see if there is an actual problem. Questions you may want to ask include:

- Are there signs of poor soil permeability or water ponding throughout the course?
- Does your turf show salt stress symptoms and decline?
- Does your water or soil have a high pH that limits nutrient availability?
- Is the entire course affected or are problems restricted to certain areas?

If you are convinced there may be a problem, the next step is to have an independent laboratory test the chemistry of the soil and water to see if amendments or treatment devices are warranted. The laboratory you choose should be experienced in evaluating saline and sodic conditions for soil and water. While many of the same companies that manufacture products or equipment will offer to test your soil and water free of charge, it is best to use an independent laboratory that does not have a stake in selling you anything. Using such a laboratory insures that you

are receiving unbiased information to form the basis for any future spending decisions. A few hundred dollars spent for unbiased laboratory testing can save a golf course thousands of dollars in unnecessary equipment or ineffective products.

TREATMENT OPTIONS

The chemical evaluation of your soil and water quality will guide you toward the best treatment options for your situation. The following sections provide a brief overview of some options to improve soil and water quality at your course.

BASIC AGRONOMIC PROGRAMS

Sound cultural programs should be the basis for treating problems associated with high salinity, which are the most prevalent soil and water quality problems observed in the arid Southwest. Soil tests typically show a high ECe (>4.0 dSm) and a low sodium hazard (ESP<15%). Controlling soil salinity requires attention to the following agronomic programs:

- Aeration.
- Leaching.
- Drainage.
- Fertility.

The goal is to dilute the accumulated salt with extra water and move it down through the soil, away from sensitive turf roots. A good irrigation system with proper distribution uniformity is essential to manage high salinity situations. While it may seem easier to apply a promising new product to solve the problem, very few products perform as well as an aerifier in conjunction with good irrigation practices. Aeration and leaching also are critical programs that must be employed for the treatment of sodic or saline-sodic soils.

GYPSUM

Gypsum is most often recommended to treat the following conditions:

- Sodic or saline-sodic soil conditions (ESP>15%).

Gypsum injectors are typically used to treat sodic or saline-sodic soil conditions, water sources with high SAR, or very pure water sources.

- Water with a high SAR (>10) that contributes to poor water infiltration and surface sealing.
- Very pure water sources (ECw<0.5 dS/m).

Gypsum can be surface applied if there are only marginal problems with sodium-affected soil or water. For chronic problems, solution-grade gypsum can be mixed with water and injected into the irrigation system. The following is a general estimate of the cost to purchase and operate a gypsum injection system:

- Equipment cost: $7,000 to $15,000 or more.
- Solution-grade gypsum: $120 to $200 per ton.
- Annual cost for gypsum: approximately $10,000 to $20,000 per year or more, depending on the recommended application rate based on soil and water tests.

ACIDIFYING TREATMENTS

An acidifying amendment is typically recommended for the following situations:

- Sodium-affected soil with poor infiltration (ESP>15%) where there is adequate free lime present in the soil.
- Water with a high adjusted SAR and a residual sodium carbonate (RSC) level greater than 1.25.
- Reducing the pH of the soil and water.

There are several options for applying acidifying amendments, including surface-applied sulfur, acidifying fertilizers, the use of a sulfurous generator to treat water in the irrigation reservoir, or the direct injection of sulfuric acid into the irrigation mainline. The following is a general estimate of the cost to purchase and operate a sulfurous generator:

- Equipment cost: $12,000 to $16,000.
- Sulfur: $250 to $350 per ton.
- Annual cost for sulfur: $3,000 to $5,000 or more per year, depending on the volume of irrigation water used and the amount of sulfur recommended by soil and water tests.

The use of a sulfurous generator is generally considered simple and cost effective if it can be justified by soil and water testing. A few issues to consider are the uniformity of mixing the acidified water in the lake and the aesthetics of the generator, which produces smoke and is often placed in a visible location on the shore of the irrigation lake.

Another option for acid treatment is the direct injection of sulfuric acid into the irrigation mainline. The following is a general estimate of the cost to purchase and operate an acid injection system:

- Equipment cost: $15,000 to $18,000.
- Acid: $1.00 to $1.75 per gallon.
- Annual cost for acid: $8,000 to $25,000 per year, depending on the volume of irrigation water used and the amount of acid recommended by soil and water tests.

Direct injection of acid into the irrigation mainline improves the uniformity of mixing, but there are safety concerns with handling concentrated sulfuric acid. The safety issue is often addressed by using a sulfuric acid product that is mixed with urea, commonly referred to as N-phuric acid. The acidification properties are the same, although the cost of the material is generally higher. The results achieved with the use of N-phuric acid are often misleading because most people will notice the nitrogen response and assume it was the acid and not necessarily the urea. Other points to consider include providing adequate space at the irrigation pump station for acid storage tanks and injection equipment. The storage tanks also must be accessible to delivery trucks.

DO YOU NEED AN INJECTION SYSTEM?

Before you invest in an expensive injection system, it is important to test the chemical properties of the soil and water to see if such a system is necessary. Surface applications of gypsum or sulfur in test plots also can be made as preliminary treatments to evaluate the long-term effectiveness of an amendment program. Consider the following advantages and disadvantages regarding injection systems:

ADVANTAGES

- Injection of amendments into the irrigation system reduces the dust associated with granular applications.
- Reduced labor requirements for application.
- Acid injection reduces the burn potential on low-CEC soils.
- Acid injection equipment also can be used to inject liquid fertilizers.

DISADVANTAGES

- Liquid amendments are more expensive than dry products.
- The initial expense of the equipment and ongoing costs for repair and replacement of parts.
- Corrosion of irrigation equipment.
- The hazard involved with handling concentrated acid.
- The uniformity of the irrigation system is critical for accurate application.

OTHER OPTIONS FOR SOIL AND WATER TREATMENT

In addition to injection systems and the surface application of soil amendments, there are other avenues that can be explored to address soil and water quality problems, including:

- The use of surfactants and soil wetting agents to treat localized dry spots and to improve water infiltration where sodium levels are not a concern.
- Blending different water sources to improve chemical properties and reduce the percentage of sodium and soluble salts.
- Plumbing a separate irrigation line to the greens to supply potable water, assuming the potable water quality is better than the irrigation source.
- Planting salt-tolerant grasses.

Some golf courses have installed in-line pipe devices and other types of water treatment hardware in an effort to improve water quality and turf performance. The cost of such devices is often very high ($40,000 to $50,000 or more), and there is very little peer-reviewed scientific research to justify manufacturer claims. It also is difficult to obectively evaluate these products in the field since a large section of the course or the entire course is treated, leaving no opportunity for an untreated check area for comparison. In such a

The direct injection of sulfuric acid into the irrigation mainline from a nearby storage tank is another method to introduce acidifying amendments. The hazard of handling concentrated acid must be considered along with the need to provide adequate space at the pump station for the storage tank and access by delivery trucks.

The use of a sulfurous generator is one option to treat sodium-affected soil or irrigation water high in bicarbonates. A few issues to consider are the uniformity of mixing the acidified water in the lake and the aesthetics of the generator, which produces smoke and is often placed in a visible location on the shore of the lake.

situation, it is suggested for buyers to proceed with caution.

CONCLUSION

The marketplace is full of products aimed at improving soil and water quality, and it is difficult for superintendents to decide which products would aid their situation. If your golf course is experiencing difficult soil and water quality issues, do yourself and your employer a favor by taking the following actions:

- Obtain a thorough chemical analysis of your soil and water from an independent laboratory that has no stake in selling you any treatment products or equipment.
- Purchase and read the book *Salt-Affected Turfgrass Sites — Assessment and Management* by Dr. Bob Carrow and Dr. Ronny Duncan, which describes and explains the various soil and water interactions and provides a sound agronomic rationale for treatment options.
- Take the GCSAA class on "Managing Salt-Affected Turfgrass Sites" to enhance your knowledge of soil and water quality problems and their treatment.
- Seek the advice of soil and water quality experts to help evaluate your test results and offer unbiased recommendations.
- Protect the interest of your employer when considering soil and water treatment options and spend the money as if it were your own.

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How Statistics Can Lie

Are you impressed by remarkable claims in product ads? Here's why you might want to be skeptical.

BY JAMES H. BAIRD

"There are three kinds of lies: lies, damned lies, and statistics."
BENJAMIN DISRAELI (1804-1881)

If you start paying close attention to the use of statistics in everyday life, especially advertisements, then it becomes very easy to relate to the assertion made long ago by British Prime Minister Benjamin Disraeli. Valid or not, all of us use and rely upon statistics countless times each day — "Last night I slept about six hours. My office is approximately 2.5 miles from home. There's a 50% chance of rain today. My USGA Handicap Index is 6.2. On average, I run about four miles a day. The average golf course maintenance staff is comprised of 15 employees." In a nutshell, we need statistics to help us simplify and summarize our complex world.

Contrary to the implication of the title, statistics do not create themselves; people have to create them. There is no such thing as a perfect statistic, but some are less imperfect than others. Furthermore, we must realize that whether you're an activist, politician, salesperson, or a scientist, people use statistics to persuade. Confused? Must we all become statisticians to differentiate between good and bad or imperfect from less-than-perfect statistics? The purpose of this article is to identify some of the most common misuses of statistics and, in doing so, help you become a critical thinker, especially as it relates to those remarkable claims from salespeople and product advertisements.

"THE WELL-CHOSEN AVERAGE"

One of the most common statistics that you will encounter is the *average*. But what exactly is *average*? Most of the time the *average* represents the *mean*, which is defined as the arithmetic average of all samples from a population. However, the *average* also can represent the *median* — middle value in a ranked series, or *mode* — most frequent value in a series. If the distribution of a population or its sample is bell-shaped (i.e., normally distributed), then you need not be concerned about the source of the *average* because the *mean, median*, and *mode* will be approximately equal to one another. On the other hand, statistics such as average salary, maintenance budget, or green speed often skew from a normal distribution. In that case, if you want to be more compelling in your attempt to amaze or persuade, report the *mean*. Otherwise, reporting the *median* or *mode* would provide a more accurate assessment of the population.

THE NAKED STATISTIC

An average value without a measure of the variability in a distribution or the degree of significance is a naked statistic. Try comparing two or more of these statistics and you end up with totally useless information. Researchers collect data from an experiment or sampling study and subject it to statistical analysis in order to provide evaluation of treatment differences according to tests of significance that are based on measuring uncontrolled variability. One of the most widely used tests to determine significant differences between means is the Least Significant Difference (LSD), usually expressed at the 5% level of significance. Thus, if the difference between two treatment means is greater than the $LSD_{0.05}$, there is a 95% probability that the difference was due to treatment effects or a 5% probability that the difference was due to chance alone.

For example:

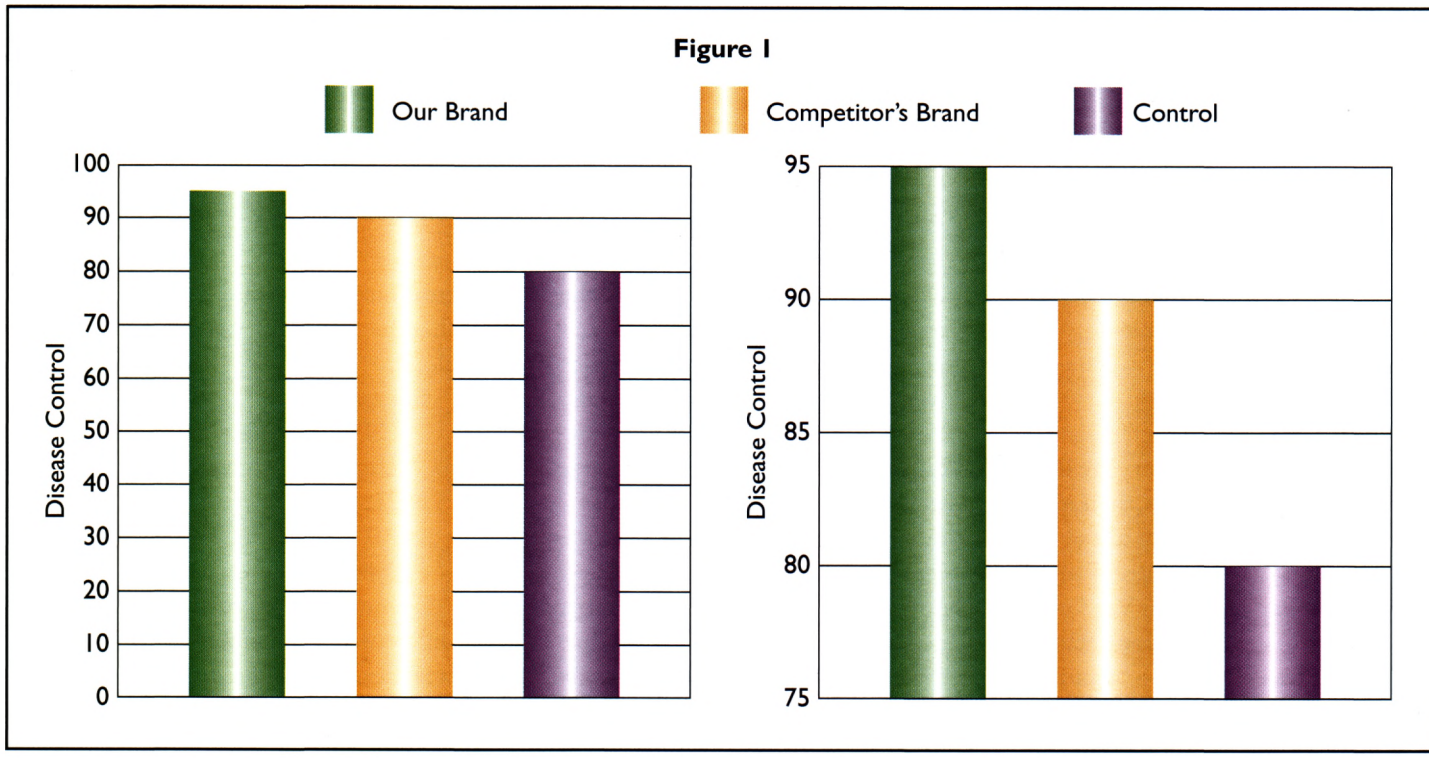
$LSD_{0.05} = 0.3$
Treatment A mean = 9.0
Treatment B mean = 8.6
$9.0 - 8.6 = 0.4$
$0.4 > 0.3$ ($LSD_{0.05}$)

There is a 95% probability that the difference between treatment A and treatment B was due to the treatments themselves.

Now, imagine that I have a product to sell that I believe will improve the turf on your golf course. I give you, the superintendent (representing a small sample size), some of my product to test on your golf course. Chances are you won't replicate the application of the product, nor will you leave an untreated area of turf for comparison. Thus, how can anyone really be certain that my product was responsible for your results? Well, *chances are* something will happen, and if it is positive, then I'll be sure to include your picture and testimonial in my product advertisement. If not, I'll move on to the next golf course. What is the moral of this story? The smaller the sample size, the greater the probability that the results will be produced by chance (and not my product).

"THE GEE-WHIZ GRAPH"

Who has time to read these days, so why not show a picture, table, or graph to represent statistics? In Figure 1, the "Our Brand" product is only slightly better than the competitor's brand and a little more so than the control. In order to create the perception of large, significant differences (never mind the naked statistics), just change the magnitude of the scale on the vertical axis



Can you differentiate between the original and mutant statistics? Simply changing the magnitude of the vertical axis can turn a graph with no obvious significant differences (left) into a "gee-whiz" graph (right) that gives the impression there are significant differences between products.

and — *voila!* — the "Our Brand" product is now the best thing since sliced bread. Be cautious of "Gee-Whiz" graphs, tables, or pictographs.

POST-HOC RATIONALIZATION

"I just put down a magical biostimulant (hereafter referred to as "A") and you won't believe the tremendous improvement in turf shoot density and rooting ("B")!

Question: Have you done anything else recently?

"Well, sure, but nothing out of the ordinary. I aerated, topdressed, and bumped up the height of cut and nitrogen fertility. But it has to be that product!"

Post-hoc rationalization is "the fallacy of arguing from temporal sequence to a causal relation." More simply put, you can't always assume that if B follows A, then A caused B.

"HOW TO STATISTICULATE"

Misleading people with the use of statistics has been referred to as "statisticulation." Some of the more common ways to statisticulate include: 1) the use of means when medians are more appropriate; 2) misuse of significant figures — e.g., on average, I sleep 6.35 hours per night (who keeps track of sleep beyond the precision of about the nearest half-hour?); 3) improper use of percentages — e.g., "there's a 50% chance of rain on Saturday and the same on Sunday, so don't make any plans for this weekend because there's a 100% chance of rain"; and 4) mangling or changing the meaning of a good statistic through space and time, otherwise known as a "mutant statistic."

THE "SEMI-ATTACHED" STATISTIC

The last, but certainly the most important method of abusing or misusing statistics is the *semi*-attached statistic. Use of semi-attached statistics or information is perhaps the principal reason why bad statistics and snake oils have thrived since the life and times of Disraeli and Piper & Oakley (pioneers of the Green Section), and why they will probably continue to exist beyond our lifetime. Subscribers to this philosophy believe that "if you can't prove what you want to prove, demonstrate something else and pretend they are the same thing." Somewhere buried in the semi-attached statistic is usually a trace of truth or fact, but the rest is a whole lot of fluff. Thus, it is very difficult to pin a "lie" on a semi-attached statistic.

Wondering how you can learn to see through all of this? Read on to learn how to become a critical thinker.

SUMMARY

In his book titled *Damned Lies and Statistics*, author Joel Best describes four personalities in regard to how people cope with statistics. The "Awestruck" understand very little about statistics, but that's of no real concern to them because statistics have magical powers, just like the products they use.

The "Naïve" have a little more understanding of statistics, but are basically accepting of what they are told. If Dr. Turfgrass Expert or the famous golf course superintendent says

it's true, then it must be true. Besides, applying that product can't hurt anything, right?

The "Cynical" are very suspicious of statistics, in general, except when it comes to those that support their own beliefs. Overall, they don't trust in numbers and feel that "you can prove anything with statistics."

Finally, the "Critical" take a more thoughtful approach to statistics that avoids the extremes of naïve acceptance and cynical rejection. The Critical ask important questions such as who is the source and how do they know? How were the statistics produced? Where is the measure of variability or degree of significance? Is the statistic being properly interpreted? Most of all, they ask, "Does it make sense?"

Hopefully, this article has provided you with the tools to work toward becoming a critical thinker about statistics and the multitude of turf care products that are at your disposal.

"It ain't so much the things we don't know that get us into trouble. It's the things we know that ain't so."
ARTEMIS WARD

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Replicating treatments and including an untreated control provide a more reliable estimate of whether observed differences are due to the treatment or simply to chance.

Strategies from the Field to Delay Fungal Resistance

Taking a holistic approach to disease control and managing fungal resistance.

BY STANLEY ZONTEK

FUNGAL RESISTANCE! The thought that your golf course may one day develop a disease that is resistant to the chemicals you know and rely upon causes most turf managers more than a passing concern. It is a real worry, especially in the Transition Zone areas of the country where the *normal* weather patterns each year include extended periods of oppressive heat and humidity and are punctuated by thunderstorms. These are perfect conditions for fungal diseases to develop and cause damage to turfgrasses. As a general rule, more disease problems occur in this region of the country than the more temperate northern regions or in the South, where the more disease-tolerant bermudagrasses are grown. Suggestions on ways to control turfgrass diseases without inducing fungal resistance are the subjects of this article.

Currently there is a debate among turfgrass pathologists about which fungicide use concept is the best. Fortunately, fungal resistance problems are not yet rampant in the Mid-Atlantic region of the country, where disease pressure is high and fungicide usage is heavier than in other regions. A few cases of fungal resistance have occurred, associated primarily with gray leaf spot resistance to strobilurin fungicides, such as Heritage, and with pythium blight resistance to Subdue. However, when you consider how many different diseases are a problem and how many fungicide sprays are made during the year, the superintendents in this region of the country generally are doing a very good job of controlling disease while managing, or at least delaying, fungal resistance problems.

The first line of defense for disease control is to grow a healthy stand of grass. Maintaining plant health and improving the growing environment are essential aspects of managing putting green turf.

Suggesting ways to manage disease problems in a tough grass-growing region of the country is the purpose of this article. Additionally, the practices outlined in this paper are not a theoretical approach to disease control. They are in routine use throughout the Mid-Atlantic region and other areas of the country. Several turfgrass pathologists were contacted in preparing this paper, and there was enthusiastic agreement that a holistic approach to disease control is the best method for managing or at least delaying fungal resistance to currently available fungicides.

THE HOLISTIC APPROACH

What is meant by a *holistic approach*? The definition of *holism* suggests a "functional relationship between parts that make a whole." In this case, it could include various management programs and techniques working together for disease control and managing resistance. Call it what you like: Best Management Practices (BMPs), Integrated Pest Management (IPM), or common sense and experience, etc. Effective disease control, as it is commonly practiced in many areas of the country, involves much more than simply spraying a fungicide every 7-14 days. This holistic approach includes:

PLANT HEALTH

Weak, stressed grass is more prone to disease, and if disease occurs, unhealthy grass is slower to recover. Fungicides, even the best ones, just do not seem to work as effectively when grass is unhealthy. In my opinion, the cause for many a fungicide failure is unhealthy grass, rather than fungicide failure or fungal resistance. Simply put, healthy grass on putting greens is:

- **Free of Undue Environmental Stress.** That is, a turf growing in a good grass-growing environment, free of shade problems and enjoying good air circulation and soil drainage.
- **Free of Undue Mechanical Stress.** The grass should not be too heavily topdressed, aggressively brushed, groomed, aerated, verticut, dethatched, or otherwise mechanically damaged during periods of hot weather in the summer. Spores of pathogens that cause anthracnose and other diseases enter the grass plant more easily through wounds caused by mechanical damage.
- **Free of Mower Stress.** Grass should not be cut too closely during periods of

Streaking *Pythium* on a perennial ryegrass fairway will put fear into a golf course superintendent. A holistic approach to disease control is the best method for managing, or at least delaying, fungal resistance to currently available fungicides.

weather stress. This includes increasing mowing heights and not mowing grass when conditions are too wet. If free water exists on the surface of a green, skip mowing that day, or mow later in the day when the green is drier. Also, switch from grooved to solid rollers to reduce wounding and mower stress in the summer.

- **Free of Chemical Stress.** Interactions among growth regulators and fungicides can be an element of plant stress, especially during a hot and humid summer. Heavy use of growth regulators also can slow recovery. Some preemergence herbicides have been linked to chemically stressing the turf, too. In many situations, superintendents in the Mid-Atlantic region avoid applying preemergence herbicides to greens (unless absolutely necessary) and rely upon postemergence control programs or the old standby, hand weeding. This is IPM using a BMP at its best!

These are some of the elements of stress management over which a turf manager has some control. Weakened, stressed grass ultimately can result in difficult-to-control disease problems, especially anthracnose and summer patch, even though a sound fungicide spray program is in place. In fact, when we visit a golf course with a good fungicide spray program and where disease problems are still occurring, we look beyond the chemicals being applied. We consider other stress factors that may be reducing the health of the turf and reducing the effectiveness of the chemical applications. Plant health is the key factor in complementing a fungicide spray program. Other health factors include:

FERTILITY

Putting greens need fertilizer. As practiced in the Mid-Atlantic region, most greens are fertilized on a light and frequent basis — not too much nitrogen, but not too little. This program involves weekly to biweekly applications of soluble fertilizers at rates ranging from 0.10 to 0.20 lb. of actual nitrogen per 1,000 sq. ft. per application. Micronutrients such as iron also are added. The goal is to keep the grass plant green, healthy, and growing during the summer. In using this program, always check compatibilities between fertilizers and fungicides. Most soluble fertilizers can be tankmixed with most fungicides, but *read the label*. In my opinion, these applications of soluble fertilizers improve turf health and make fungicides work better. Dr. Peter Landschoot, of Penn State University, makes the point that anthracnose is a low-nitrogen disease. Keep this in mind.

SPRAY VOLUMES

Re-read the labels on the fungicides you use. I'll wager that you may not be using enough water as a carrier when fungicides are applied. If too little water is used, fungicide sprays can become concentrated in the upper canopy of the turf. The fungicide can be more rapidly mowed off than if the entire

grass plant were to be thoroughly wetted with the spray solution. This lack of water as a carrier can diminish control and ultimately waste money. Also, penetrant fungicides enter the grass plant and are translocated from the point of contact upward, and they seem to need this extra water.

How much water? While a contact fungicide alone may require only 1-2 gallons of water per 1,000 sq. ft., most fungicide combinations seem to need 2-3 gallons per 1,000 sq. ft. as a minimum. For penetrants on fairways, 100 gallons/acre is a standard recommendation. Yes, this extra water may involve more time to spray greens (or fairways), but higher spray volumes may improve control, reduce the number of chemical applications, manage resistance, and save money.

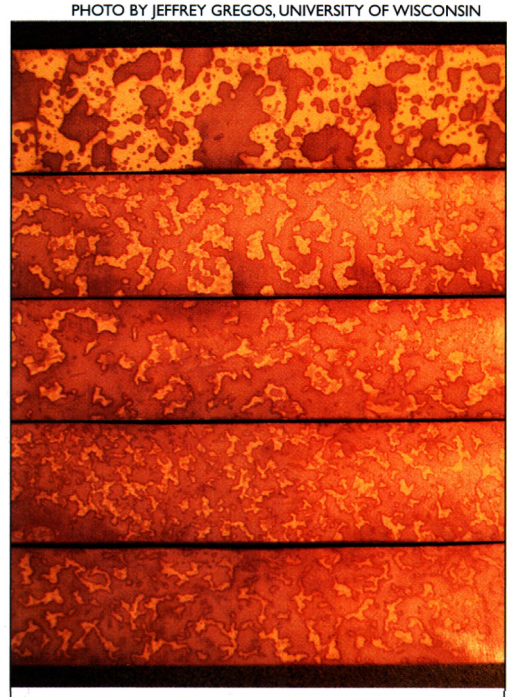
Note: Fosethyl aluminum (Signature and Prodigy) is the only true systemic fungicide — it can move upwards or downwards in plants. These products may be the one exception to the spray volume guidelines.

NOZZLE TYPE

The nozzle you use should be of a type that provides good coverage and the correct spray volume as per the fungicide label. All too often, one nozzle is used for fungicides and herbicides. This may not be the best procedure. Similarly, sprayers should be calibrated on a regular basis, and worn nozzles, regardless of their type, should be replaced on a regular basis, but at least once per season. Increasingly, there is a trend to use flat fan or similar type nozzles to *drive* the fungicide spray deeper into the grass canopy, using higher (but not too high) spray pressure. This seems to make good sense. Dr. Peter Dernoeden from the University of Maryland and Dr. Houston Couch of VPI, both state, "Flat fan type nozzles are preferred for disease control applications."

Here is the bottom line. All nozzle types can be used to provide good coverage and disease control, although

PHOTO BY JEFFREY GREGOS, UNIVERSITY OF WISCONSIN



This image compares nozzle spray patterns using water-sensitive paper. More yellow color represents less coverage. Good coverage helps ensure better disease control. From top: XR Tee Jet, Twin Jet, Turbo Tee Jet, Flood Jet, and RA Raindrop.

some engineering is involved to achieve the proper sprayer configuration, including boom height, partial to 100 percent overlap, proper nozzle angle, etc. There is an absolute need to have the proper nozzle, calibration, pressure, and water to provide the best coverage and the best disease control.

FUNGICIDE SELECTION

Why are fungicides finally mentioned near the end of this article? In reality, if you view disease control and the management of resistance using a holistic approach, fungicides are but one part of the disease control equation. Plant health is first, followed by managing those stress factors that can be controlled, followed by using the best spray techniques to complement the mode of action of the fungicides being applied.

All too often, superintendents seem to use fungicides as a crutch. That is, they rely upon chemicals as their primary means of disease control, and discount factors like maintaining plant health and reducing stress. This is an all too common mistake. When a fungicide spray does not seem to provide effective control, the common curse is that the fungicide is not working or that fungal resistance has occurred. *Could it be that the grass is so weak that even the best fungicides won't revive dying grass?*

Fungicides are an important part of an effective disease management program in the Mid-Atlantic region. Most putting greens in this region are sprayed on a preventive basis beginning in the spring and continuing into the fall. For a long list of reasons, most golf greens (except on new golf courses or those with rebuilt or regrassed greens) have a combination of bentgrass and *Poa annua*. This mix of grass species is one curse of older courses in the Transition Zone. There always seems to be some disease that needs to be preventively treated, like anthracnose and dollar spot, leaf spots, pythium blight, brown patch, and those pesky root diseases like summer patch and take-all patch. Then there are snow molds, yellow tuft, etc. See what I mean? There always is a disease problem to be managed. When fungicides are applied, the following guidelines are offered.

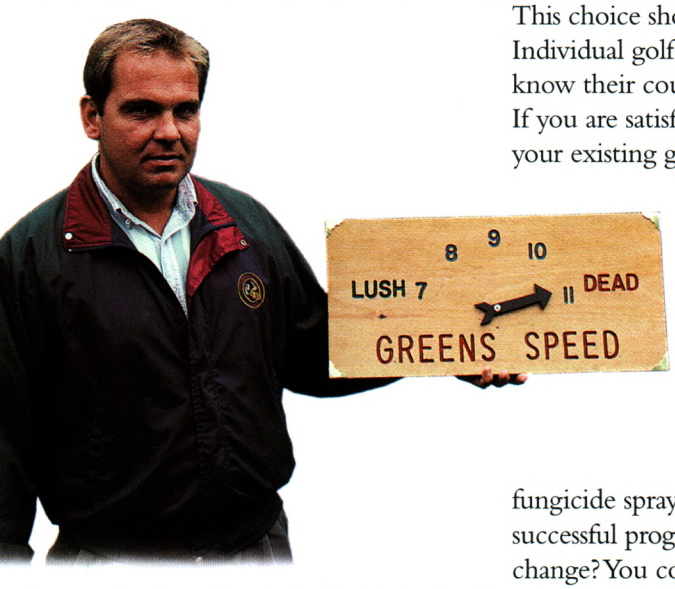
TANK-MIX AND ROTATE CHEMISTRIES

This technique is first choice for many superintendents in the Mid-Atlantic region. They tank-mix a contact fungicide with a penetrant fungicide. For the next spray, they again include a contact fungicide with another penetrant that has a different chemistry and mode of action. Part of this spray rotation includes our industry's only true systemic fungicide, fosethyl-aluminum (Signature or Prodigy), tank-mixed with a contact fungicide. This is a continual process throughout the spray season, i.e., always rotating between penetrant fungicides (acropetal or local), while normally including a contact fungicide in each spray mixture. There is now research support for this technique.

In a disease epidemiology model developed by Dr. Paul Vincellli of the

University of Kentucky, research suggests that "fungal resistance was delayed best with a tank-mix of contact and systemic fungicides or contact and penetrant fungicides."

Yes, this program is more expensive, but it seems to work best. This model also is supported by what superintendents and other plant pathologists in the Mid-Atlantic region have experienced. In an article of this type, it is difficult to recommend specific products for specific diseases. Contact your state cooperative extension specialists or your regional USGA agronomists for answers to disease control questions you may have. In the final analysis, tank-mixing of fungicides along with soluble nitrogen (when compatible) seems to make a wonderful fungicide spray blend to promote plant health, control disease, and manage (delay) fungal resistance.



Reductions in mowing height to achieve green speed have agronomic consequences. Superintendent Rhys Arthur from Indian Spring Country Club (Silver Springs, Md.) has a sign that says it all.

ALTERNATE CHEMISTRIES

This seems to be a second choice approach to disease control, but it still is an effective program. An individual fungicide chemistry is applied, then alternated to another chemistry for the next spray. This approach seems to work best in a preventive spray program. The addition of soluble fertilizers (when compatible) also works well using this program.

Note: If a curative fungicide application is needed with either approach, spray intervals should be compressed, rates increased from preventive to curative rates, and a tank-mix program using a contact with a penetrant fungicide should be scheduled until disease control has been achieved.

YOUR EXPERIENCE

This choice should never be discounted. Individual golf course superintendents know their courses better than anyone. If you are satisfied with the results from your existing green management and fungicide spray program, why change a successful program for the sake of change? You could be one of the fortunate courses that has yet to experience difficult-to-control disease problems on greens. In the long run, however, one of the previous choices most likely will be more effective in delaying fungal resistance.

LUCK

One last aspect of resistance management and disease control should be mentioned. It is luck, both good and bad. Yes, luck enters into this issue. Here's why. All fungi are not exactly the same. There are individual races or biotypes of each pathogen, each of which exhibits different levels of virulence. Golf courses don't necessarily share the same pathogen biotypes. That is, one golf course may have certain biotypes of the same disease while other golf courses may have different biotypes. There is no way of knowing for sure which race or biotypes you have on your golf course. Dr. Peter Landschoot of Penn State University, when referring to anthracnose, states, "There are benign races of anthracnose and there are weapons-grade types."

Dr. Paul Vincelli, from the University of Kentucky, in studying gray leaf spot resistance to strobilurin fungicides, seems convinced that the resistance gene in the fungus pre-existed on the course before the first fungicide was ever applied! Perhaps this fact helps to explain why one golf course may experience a disease problem and another golf course does not . . . why one superintendent's fungicide spray program works and a similar program on another course does not . . . why one fungicide may provide an excellent level of control on one golf course while on a neighboring course the same product does not work as well. The realization that not all of our pathogens are necessarily the same may help explain why one course may be luckier or less lucky in its disease control efforts than another course.

SUMMARY

To effectively control disease and delay fungal resistance, turf managers should take a holistic approach to disease control. Controlling disease while delaying fungal resistance involves much more than using chemicals alone. Maintaining plant health and improving the growing environment are essential aspects of managing putting green turf. Then, when chemicals are needed, they should be correctly applied. In the final analysis, which product to use and how to use it ultimately comes down to a decision that individual golf course superintendents must make.

Our industry is light years away from the old days when the most commonly used fungicide spray was a mix of PMA (phenyl mercuric acetate) and Thiram, sprayed weekly, beginning in the spring and continuing into the fall. Come to think of it, wasn't this a tank-mix?

STANLEY J. ZONTEK, *director of the Mid-Atlantic Region, has been with the USGA Green Section for 32 years.*

Jim Moore (right), director of the Construction Education Program, presents Jim Latham with the USGA Green Section Piper & Oakley Award during the Wisconsin Golf Superintendents Association get-together held at the GCSAA Conference in Atlanta, Georgia.

LATHAM NAMED USGA'S PIPER & OAKLEY AWARD RECIPIENT

Jim Latham of Deltona, Fl., was presented with the United States Golf Association Green Section's Piper & Oakley Award in February 2003 at the annual GCSAA Conference and Show. The award was established in 1998 to recognize meritorious service to the USGA Green Section and the game of golf by a volunteer.

Latham was actively involved on the USGA Turfgrass and Environmental Research Committee from 1995 to 2002. He attended numerous research monitoring visits and was able to shed some practical light on the research being considered by the committee.

"I'm thrilled to be named the winner of the Piper & Oakley Award," said Latham. "I was honored to be appointed to the Turfgrass and Environmental Research Committee in the first place, and those eight years of association with the committee were a real pleasure as well as a constant source of new information."

His practical insight came from his long-standing involvement in the turfgrass industry. Latham worked as a USGA Green Section agronomist from 1956 through 1960, and he returned for a second stint from 1984 to 1994. In between, he worked for 25 years with the Milwaukee Sewerage Commission, helping to promote one of the nation's first businesses designed to recycle waste products into landscape fertilizers.

Following their retirement from the USGA in 1994, the Lathams moved back to their home state, residing in White Bluff, Texas. Jim's wife, Lois, also had a long history with the Green Section, working alongside Jim as his secretary and operating the regional office during Jim's Green Section career. They recently moved to Florida to be near their family.

Dr. Charles V. Piper and Dr. Russell A. Oakley were among the earliest scientists to conduct studies in the fields of turfgrass science and golf course management, and they served as the first chairman and co-chairman of the USGA Green Section when it was formed in 1920. They were men of great character, keen vision, and remarkable achievement, whose contributions to the improvement in early greenkeeping methods were immeasurable. The Piper & Oakley Award periodically recognizes others who have so generously contributed to the programs and activities of the USGA Green Section.

2002 RESEARCH SUMMARIES AVAILABLE

The *2002 Turfgrass and Environmental Research Summaries* are now available free of charge through the USGA Order Department. The publications compile the results of 79 research project grants distributed in 2002, totaling $1.47 million.

The publication is available in two formats. The first booklet provides a one-page summary of each research project. This publication is appropriate for researchers, university extension personnel, and golf course superintendents who are interested in a bit more in-depth information on the research projects. Request publication #NSI 150.

The second document, the *2002 Turfgrass and Environmental Research Executive Summary,* provides a brief synopsis of each project supported by the USGA's Turfgrass and Environmental Research Program. The general public and course officials will be more interested in this format. The publication number to request is NS 1651.

Both documents are available free of charge by contacting the USGA Order Department at 888-336-4446 or by contacting Mary McConnell, USGA Green Section, at mmcconnell@usga.org.

ON-LINE RESEARCH INFORMATION RESOURCE AVAILABLE

Keeping up to date on current research taking place at universities across the country can be a daunting task. For many years, using the Turfgrass Information File (TGIF) has proven to be an excellent resource to easily research and access published turfgrass information found in journals and trade magazines.

Recently, the USGA has launched an on-line information resource to supplement TGIF with detailed results of USGA-funded research projects. The *Turfgrass and Environmental Research Online* (TERO) is designed to share results of completed and ongoing research projects. As the final project results are published in scientific research journals and trade magazines, these references will become available through TGIF and linked to the TERO article.

TERO is written with the golf course superintendent and other turfgrass professionals in mind. It is not necessary to be a subscribing member of TGIF to access the information published on TERO. Take a look at http://usgatero.msu.edu.

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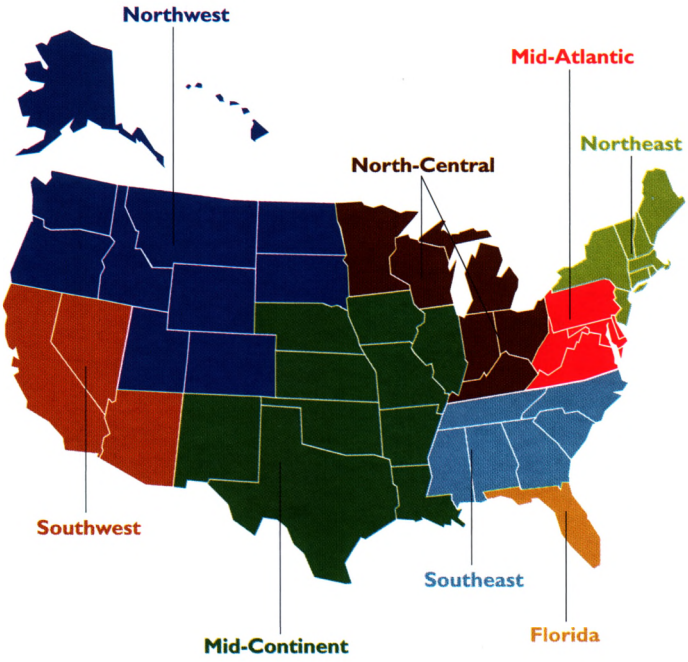

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Turf *Twisters*

Q: My maintenance budget was reduced significantly from last year. What practices should we reduce or cut to decrease our operating expenses and still provide acceptable playing conditions? (Florida)

A: The long-term health of the turfgrass should not be jeopardized by reducing necessary practices like core aeration or fertilization; however, other practices like raking bunkers or maintaining out-of-play areas can certainly be reduced. Maintaining primary playing surfaces (greens, tees, fairways) is of highest importance, and once these are taken care of, golfers can decide where the reduced maintenance should occur. Examples include decreasing bunker raking and edging, cart path edging, annual flower bed maintenance, or providing natural buffers in out-of-play roughs or lake banks by allowing the turf to grow taller. Time studies are valuable tools that golfers can use to see exactly how many man-hours can be saved by reducing these tasks. For additional ideas, read "Raising the Bar: How High Can You Go?" in the January/February 2003 *Green Section Record*.

Q: Many golf courses in our area will likely be faced with water restrictions this season in the face of an extended drought. How can our course best deal with communicating that golf can be more fun when the turf is dry? (Colorado)

A: Local golf associations and golf course superintendent associations can pool resources to effect a positive media campaign illustrating that golf course superintendents are professional, responsible water managers and that the game offers more excitement with bounce and roll. Positive communication will be critical during the current water crisis in the West. Spread the word!

Q: I like to get away from the busy driving ranges during the summer and hit some practice balls at a nearby park. When is a good time to seek shelter when I see lightning and hear thunder off in the distance? (Minnesota)

A: According to the Lightning Safety Institute, lightning is very unpredictable. You can be 6 to 8 miles away from a lightning strike and still be in immediate danger. Consequently, they recommend, "If you hear it, clear it." In other words, if you hear thunder or see lightning, it's time to pack up and seek shelter. For more information regarding lightning, visit www.lightningsafety.com.

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