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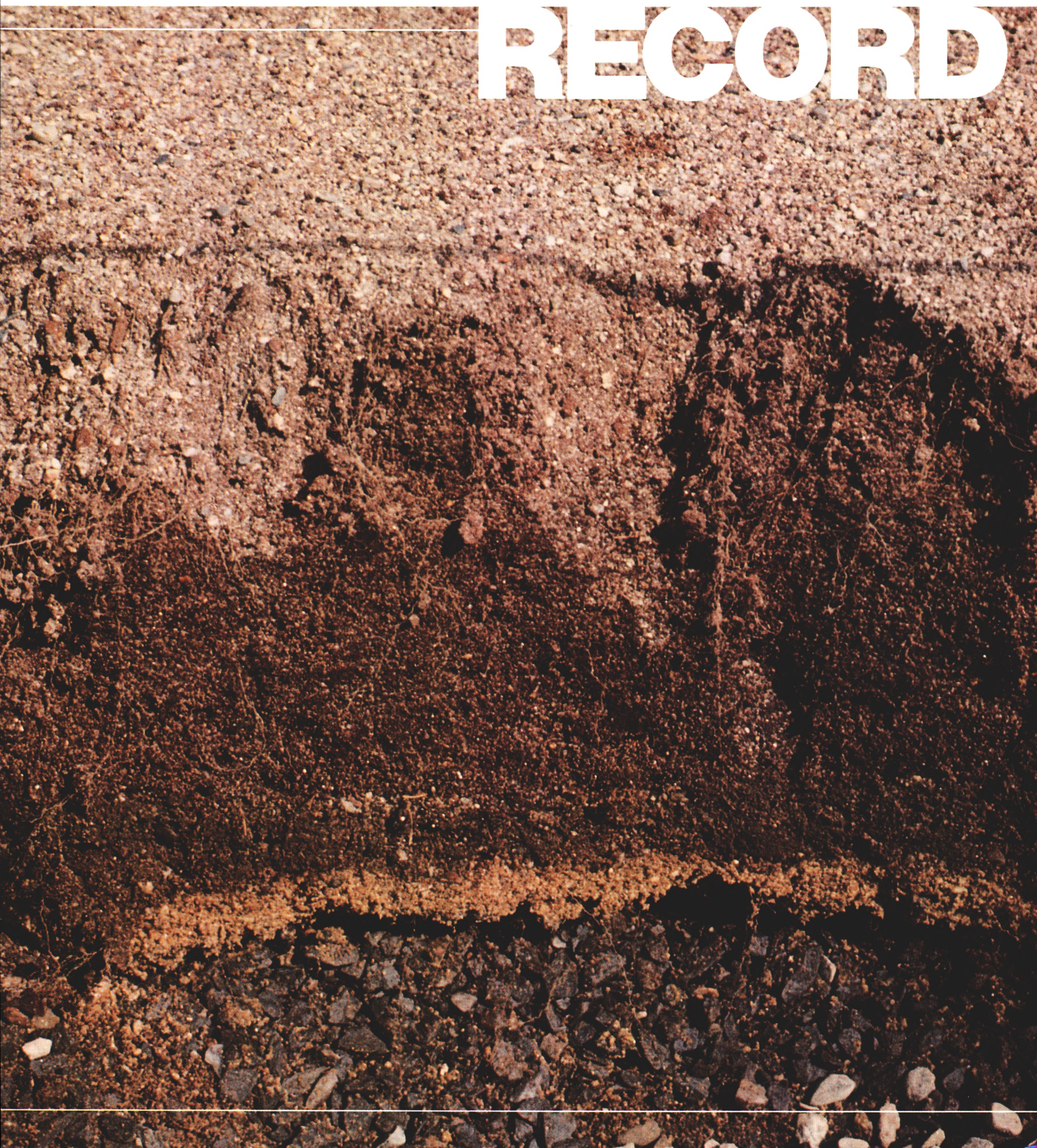
Green Section RECORD



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Green Section RECORD

Cover Photo:
Profile of a green built to USGA Specs.

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A properly built USGA green starts with good drainage.

Thirty Years of Green Section Greens

by JAMES M. LATHAM
Director, Great Lakes Region, USGA Green Section

THE PUBLICATION by the USGA Green Section in 1989 of *Specifications for a Method of Putting Green Construction* provided another step in the evolution of practices that enable golf course superintendents to cope with pressure for flawless turf on true, fast, putting surfaces which receive heavier play than ever before. The story of the USGA green actually began in the late 1940s and early 1950s, when studies began on the comparison of soils in "good" greens and "poor" greens. Observations on construction and topdressing mixtures published by the Green Section date from the early 1920s, but the soils were not subjected to scientific scrutiny in soils laboratories until after World War II.

Not all of the greens of that era were poor. Many are still in use and are maintained in the same manner as more recent greens, but it is practically impossible to duplicate them today. The early Green Section specifications closely followed the results of physical analyses of the soils in what were then considered good greens. Attempts to modify the poor greens were usually unscientific and often caused even worse conditions. Snake oils will always be with us to provide the desperate with what they hope will be miracle cures.

One of the early investigations on good versus poor soil conditions was made by R. R. Davis, at Purdue University. He measured water percolation and compared the capillary and non-capillary porosity of soils in putting greens under play. His investigation noted the effect of compaction on reducing the large pore space in the upper 3½ inches of soil, leading to a suggestion that 40% to 50% sand, with particles larger than 0.25 mm, be used in green construction mixes. One of his observations was particularly noteworthy: "In most instances air circulation is believed to be better around the best greens. More trees are found around the poorest greens, and tree roots are prevalent in these greens."

Almost a decade of investigation after this and other research, the USGA Green Section published *Specifications for a Method of Putting Green Construction* in the September 1960 issue of *USGA Journal and Turf Management*.

TABLE I
Changes in specified sand particle size distribution between 1960 and 1989.

— 1960 —
There was no preference indicated. The laboratory made the decision on the proportion of components from any materials submitted.

— 1973 —
The preferred sand had particles of which
100% were smaller than 1.00 mm,
35% were smaller than 0.50 mm,
not more than 15% were smaller than .25 mm,
not more than 5% were smaller than 0.06 mm.

— 1974 —
The statements were simplified to suggest that ideally 75% of the particles should be between 0.25 and 1.0 mm.

— 1989 —
100% should be below 1.00 mm in diameter, with a maximum of 10% below 0.25 mm and a preferred range between 0.25 and 0.75 mm.

It should be noted that laboratories have the capability to deal with almost any components submitted, but may have strong reservations about the playing quality of the finished greens.

TABLE II
Recommended porosities, by volume, of root zone mixtures after compaction.

Porosity	1960	1989
Capillary	15-21%	15-25%
Non-Capillary	12-18%	15-25%
Total	Minimum 33%	35-50%

Increased non-capillary pore space provides more available oxygen for root and microbiological respiration.

TABLE III
Variations in Peat Quality*
(Species of original vegetation was not determined)

Source	pH	% Organic Matter (Loss on Ignition)	Water Holding Capacity %
Canada	3.0	92	713
Minnesota	7.0	86**	832
Michigan	3.5	77	683
Iowa	6.4	61**	222

*Values are reported in percentage by weight.
**The ash in these samples contained significant amounts of silt.

It presented a construction technique that could be used anywhere in the world, including areas where ideal components were not easily or economically available. The strategy was based on developing a growing medium that provided resistance to compaction and drained readily, yet retained an adequate level of capillary moisture and nutrients to sustain turfgrass growth with normal maintenance.

The introductory remarks in the 1960 publication are applicable today:

> The pace of golf activity and the traffic on golf courses is presently at a peak, however, which has never been equaled in our country. Many of the construction methods that were satisfactory in an earlier day, will no longer produce greens which will withstand the wear which is now imposed upon them.

Research into construction procedures and soil mixtures was sponsored by the Green Section at its own research station, in Beltsville, MD, and at Oklahoma State University, UCLA, and Texas A&M. The projects proved that "problems of construction procedures and methods, and those of physical behavior of soils cannot be separated . . . and must be considered together if a desired result is to be produced."

Literature cited in the 1960 specifications provides a list of distinguished researchers who studied the problems and prescribed a means of solving them; R. B. Alderfer, M. E. Bloodworth, R. R. Davis, W. L. Garman, H. L. Howard, R. P. Humbert and F. V. Grau, J. R. Kunze, O. R. Lunt, and A. M. Radko. The key man on the project was Dr. Marvin Ferguson, the Green Section's Director of Research, who worked closely with the soil scientists at Texas A&M University to devise a reproducible means of testing the components of a growing medium for greens. The tests, still in use, are standard procedures in any soils laboratory and require only one special piece of equipment, the compactor, which can be easily assembled.

THE new construction method made use of a common principle of water movement in soil — a perched water table. This principle is graphically illustrated in the time-lapse movie *Water Movement in Soils*, produced by Dr. Walter Gardner, at Washington State University, in 1957. (It should be *must* viewing for any turf manager). This means that water resists flow from a fine-textured soil into a coarser

Sandy soil (Pine Valley)

A 1-1-1 mix (Des Moines)

Dense clay (Louisville)

Figure 1: Note that even though the profiles are uniform, there is a wide variation of components which affect the permeability and porosity of each. (Photos by O. J. Noer, 1952. Courtesy Milorganite Division MMSD.)

material below it until the upper profile has become saturated and gravity overcomes the adhesive nature of water for soil and the cohesive force of water molecules. Thus, even a sandy surface mixture need not be droughty if there is an abrupt change in particle size between the root zone mixture and the drainage layers below. In effect, it made use of stratification (often called layering) for beneficial results.

Prior to these investigations, the soils used in green construction were usually a mechanical mixture of available soil from the vicinity of the green site, some kind of organic matter, and easily accessible sand, in a 1:1:1 or 2:1:1 ratio. Whenever time and materials were available, manure was used and the mixture was composted prior to being put into place on the green site. During the post World War II boom, neither manure nor time was available, so the quality of new greens was suspect from the outset. The popularity of golf meant heavier traffic than originally anticipated on new and older courses, and the failure rate of greens grew, season after season. Various means of reducing soil compaction were devised, but it became apparent that a fundamental change in construction techniques was necessary.

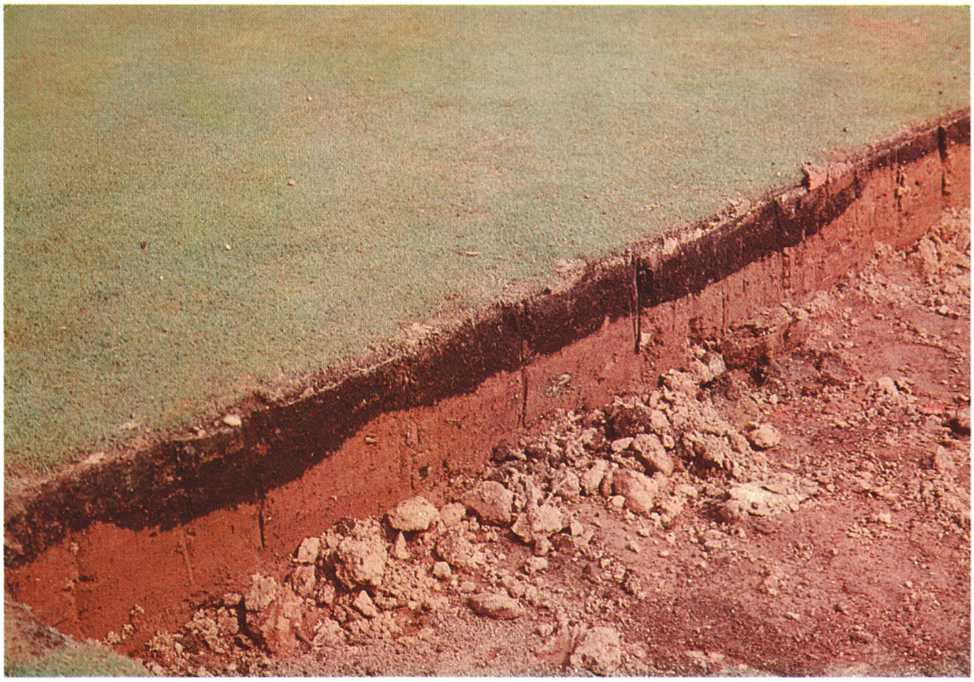
During the 30 years since the original "Green Section Specs" first appeared, there have been many changes in the criteria used to evaluate the playing quality of greens. In the 1950s and 1960s, most of the greens in this country were mown at ¼ inch. The mowing height was often raised on bentgrass greens during the summer and on bermudagrass greens after they were overseeded in the fall. Major USGA championships were played on greens cut at 3/16 inch until the late 1970s. It is unlikely that the turf grown on old soil mixes could withstand present mowing heights or the amount of traffic to which greens are now subjected. (Keep in mind that although many old greens are still in use, their upper profiles have been modified with sand or high sand content topdressing mixtures.)

THERE have been several refinements in the standards set for acceptable mixtures through the past 30 years. Less soil is being used now, since the adverse physical effects of silt and clay on internal drainage have been acknowledged. The particle size distribution of the sand used in the mixture is now a primary concern, as is the quality of organic matter. This evolution is a natural result of the transition from soil to a soilless growing medium, which serves as a means of coping with ever-increasing play and a demand for better putting trueness and speed, shot retention, and overall playing consistency.

Initially, an effort was made to take *any* available sand, soil, and organic source and combine them into an acceptable green. It was basically successful, but some of the creations were hard and required more time to mature than expected. The higher porosity and lower nutrient retention also demanded that these greens be managed differently from the other greens, and this became a problem in some instances. At that time color and the quantity of clippings removed were criteria of turf health. Nevertheless, these greens grew grass quite well where previous attempts were unsatisfactory.

The early acceptance of high-sand greens was hampered to some degree by the experience at courses that built only one or two of them. The new greens had probably replaced one or two of the worst greens on the course and, naturally, played much differently than the comfortably mature 30- or 40-year-old greens remaining, so player resentment ran high until a cushion of turf (thatch and topdressing) was developed. It was, and still is, difficult to run two entirely different management programs in an effort to produce green-to-green consistency.

The prevalence of finer sands in coastal regions and the Central Plains prompted investigations on their use in preference to coarse sand. Apparently, the silt and clay content of the soil used in mixtures with these finer sands presented a major problem in water infiltration and percolation with these mixtures, and a trend away from the use of soil began. The smaller non-capillary pores were more easily plugged by the plate-like silt particles.



On-site mixing failed (Georgia, 1958)

Off-site mixing succeeded (Wisconsin, 1988)

Figure 2: The profiles on the left and right are in greens "mixed" on-site by attempting to disk or roto-till peat into sand. Note varying thicknesses of components in green on left, at a course in Atlanta, Georgia, in 1958 which had been built two or three years earlier. On the right is another non-mixed profile from a new Colorado course in 1986. The profile views were made possible by excavation prior to rebuilding. In the center is the profile of a green in which the components were mixed off-site before placing on the green.

The fine sands found on some beaches and the blow sands of the plains have problems of their own, so the pendulum of change has come to rest in the medium range, where the particles are between 0.25 and 0.50 mm in diameter. This grade should be the predominant size in the sand component of mixtures, although a small percentage of slightly finer and coarser particles seems to lend stability to the final mix. Even so, a sand with a high percentage of round grains requires a period of time to settle down.

WHEN USGA specifications were first published in 1960, they differed significantly from those of 1989 because they were based on data extrapolated from the best soil-based greens in play at the time. For example, the acceptable water infiltration rate (in the laboratory) was in a range from ½ to 1½ inches per hour. This was raised to 4 to 6 inches per hour after a few years, and today the water infiltration rate in the laboratory is not considered to be as important a criterion for selection or rejection of a putting green soil mix, because it changes under field conditions.

Perhaps the most noticeable change in the specifications deals with the selection of sand (Table I). The general dissatisfaction with greens built with concrete or certain masonry sands and the ready acceptance of greens built with more uniform particles in the medium size range brought a major breakthrough in material selection. Medium sand is a technical term and was (and is) confusing to laymen, because it appears to be quite fine grained when subjected to a visual test. Once the terminology was understood, however, the high-sand/low-soil or no-soil mixtures became predominant. There is today a high degree of confidence in using this technique, but only if the components and the final mixture are subjected to testing by an experienced soils laboratory competent in running physical analyses for golf course use. Even small deviations from the specified parameters can be troublesome.

While not as apparent as the recommendations on sand or permeability, the revisions in porosity standards are very important. This change is shown in Table II.

Modifications to the USGA green-building method have been tried by architects and builders over the years. Many of these modifications have failed or have, at the very least, caused maintenance difficulties. Some pure sand greens, for instance, have turned out to be either hard or so physically soft and unstable that the weight of standard equipment leaves wheel marks for several years after play begins,

On-site mixing failed (Colorado, 1986)

depending upon the characteristics of the sand. Excessively deep layers of a topmix have resulted in very dry surfaces, while shallow profiles of topmix have remained very wet. The need for uniformly stratified profiles demands that the final surface contours must be designed into the subgrade.

The principal controversy in the Green Section Method of Construction is the intermediate layer of coarse sand between the drainage bed of ¼- to ⅜-inch-diameter stone and the sandy topmix of particles smaller than 1 mm. Builders do not like it because they say it is difficult to put into place. Some scientists believe the intermediate layer is unnecessary because untrafficked test plugs showed little infiltration of fine particles into the drainage bed.

Questions have also arisen on the use of a geotextile fabric as a substitute. At present, the Green Section's policy is to specify the intermediate sand layer until research and field experience prove otherwise. More than anything else, it ensures a sharp textural interface between the finer material in the topmix and the drainage bed. This is the key to maintaining a perched water table, the principle on which this method of construction is based.

ONE OF THE more difficult problems encountered is the selection of organic components. It can be washed out of sand during the screening operation, but cannot be removed from peats or other organic sources. Unfortunately, it cannot be quantified in the field, so laboratory analyses are mandatory. Table III shows the variations of some peat samples collected in the Midwest. Sometimes, samples from the same source show a lot of variation because peat deposits are not necessarily uniform. This is a good reason to begin the search for high-quality components well in advance of construction time.

Despite their high failure ratio, there are those who think components of greens can be mixed on site by some kind of tillage apparatus. But these builders do not have to manage these greens or pay the higher annual costs involved in maintaining turf quality and playing consistency. Physical laboratory tests of components mean nothing in these cases, since the surface profile cannot possibly be uniform. This is a throwback to the by-guess-and-by-gosh era when turf failure was not uncommon.

Granted, some of these till-in jobs produce acceptable turf until their promoters have been paid and are gone, but the added cost of future maintenance to make up for the fundamental shortcomings in these greens has only just begun. The differences in sand:peat ratios from one area of a green to another, perhaps only a few feet apart, mean the turf will react differently to heat or moisture stress. Fertility retention will also vary, as will the percolation of water through the profile. Figure 1 illustrates what slow learners we can be. Both of these greens, which had been on-site mixed, were being rebuilt in less than five years.

The initial cost of green construction according to Green Section Specifications can be greater than some other methods, but these costs are low when total operations or maintenance costs over the long term are considered. Pay now or pay later has never meant more, and when golfer inconvenience due to poor playing quality is considered, Green Section greens are downright cheap!

Further revisions or fine tuning of the 1989 Specifications may be made in future years, but they will be small. Greens built strictly according to these rules, and properly managed during establishment, are performing admirably. They do require different maintenance than old soil-based greens, but that should be expected. The sandy profiles retain adequate moisture yet provide the quantity of soil oxygen required for root and microbiological respiration. Nutrient retention is not as high as with soil, but the trend toward light and frequent fertilizer applications greatly reduces loss by leaching.

These Specifications encompass a method of green construction in which the Green Section has the utmost confidence. Greens built according to this plan have been widely accepted by golf course superintendents nationwide. More important, though, is the praise these greens are receiving from golfers. That is ample reward for the scientists and superintendents who have worked toward this goal during these 30 years.

The USGA agronomist can help the superintendent and club bypass the politics of an issue and get directly to the agronomic basis for a problem.

Make the Most of a Great Resource — USGA Green Section Visits

by RAY DAVIES
Golf Course Superintendent, Virginia Country Club, Long Beach, California

OUR PROFESSION could be described in the following manner: "Providing the best possible playing conditions for the game of golf by carefully managing the resources made available for this purpose." What resources? The irrigation system, equipment, supplies, and labor are some of the physical resources needed to produce good playing conditions. But perhaps the most important asset we have at our disposal is knowledge.

We might think of knowledge in terms of how much we know. For the sake of this discussion, though, let's define it as the information to which we have access before we make a decision. Why do I make this distinction? Well, let me explain. There may be plenty of information stored away in your brain, but if it can't be remembered, it is of no use in making a decision. On the other hand, if you have no experience in solving a particular problem but have access to someone who does, you can make use of information necessary to make the proper decision.

The point is, your informational resources are vitally important to your success in this profession. These resources include your peers, seminars, professional journals, educators, researchers, suppliers, and the USGA Green Section agronomists.

We all have had experiences in this business we would rather forget, like days when the grass wants to die and we can't for the life of us figure out why. We try everything that worked before, but without positive results. Whom do we call for help? We may call on our neighboring superintendents, who usually make themselves available on short notice to visit and share their knowledge concerning the problem.

If the problem is not resolved with their assistance, we may be in some pretty tough circumstances with our golfers. They want answers and improvements now! Often this is the time we call on the USGA Green Section agronomists.

How do you feel about the Green Section agronomists? Are they the guys you call only after you have serious problems? Do you feel comfortable knowing that they are there, or does their presence give you "willies"? Do you have annual visits so they can gain a better understanding of your course and its problems, or do you call on them only at the behest of the boss?

It has been my experience that superintendents have a black-and-white approach to the USGA Green Section services. They either look forward to the annual visit or they have no use for them. For some reason, many of us feel that we don't need someone poking a core sampler into our greens. "What do they know about my problems anyway?"

How do you get the most out of this source of information? Is it possible that by proper management of this resource, your job performance could improve?

To make the most of a Green Section visit, you have to look on it as an opportunity. You are the customer; they're there to help you. An "inspection" is the last thing you want. It is an inspection only if you abdicate your responsibility to manage the visit.

How do you do this?

First of all, know your needs. What are your problems — on the course, with your physical resources, with the management above you, or the membership? Be sure to take full advantage of the service.

Secondly, you must manage the time so that all areas you need addressed are given attention. You are abdicating your responsibility if you allow others to decide what is to be evaluated and discussed without leaving time for the subjects you feel are most important. Take control! A Green Section visit should not be simply a social call. The potential for accessing knowledge and information that can benefit you is too great.

Third, involve your supervisors, green chairman, or other interested members in most of the Green Section visits. These people have a vested interest in the success of the golf course maintenance program. They will be more sympathetic to your problems when they hear them discussed with the agronomist. The support you receive for your programs from the agronomist will add weight to them, helping you sell your supervisors on the need for physical resources such as equipment, labor, a new irrigation system or a larger budget. Plan some time alone with the agronomist to discuss technical matters or other concerns.

Fourth, have the necessary information available to answer questions about your current maintenance programs. How much fertilizer have you applied? What chemical applications have been made and at what rates? What size are your greens and tees? These are all questions you need to know for yourself. Recent soil test reports should also be available.

Finally, what should be your course of action after the visit? After receiving the Turf Advisory Service (TAS) report, use the information for club newsletters and green committee meetings. Make copies of the report for the entire green committee, the board of directors and, in some cases, the entire membership. Above all, carefully consider those portions of the report that may improve your program and fall within your budgetary guidelines. Review past reports to see how much progress you've made.

USGA Green Section visits can be one of your most important resources. If you take the initiative and use the service properly, you will be more successful in obtaining the resources you need from your club as well as receiving timely tips or problem diagnosis. The agronomist is best able to serve your needs if you take the time to manage the visit.

Remember: (1) Know what you want to accomplish with the visit, (2) Organize your time so that attention is paid to all problem areas, (3) Involve your supervisors, (4) Have the necessary technical information regarding your course and your maintenance program ready, and afterward follow up by using the TAS report to educate the entire membership.

Make the most of a wonderful resource.

Golf course maintenance today requires modern equipment. The USGA agronomist can be invaluable in securing effective new equipment.

Hoelon — A New Tool for Goosegrass Control

by DR. L. B. McCARTY
University of Florida, Gainesville, Florida

GOOSEGRASS (*Eleusine indica*) is probably the worst summer annual grass weed found in golf greens. It is adaptable, in part, due to its abundant seed production, its prostrate growth habit which allows it to thrive under low mowing heights, and its tolerance to compacted, high-soil-moisture areas. Heolon (common name: diclofop-methyl) is a new post-emergence herbicide that shows excellent potential for goosegrass control with little resulting phytotoxicity to bermudagrass. **Currently, Hoelon has a 24(c) label for turf use only in the state of Florida.** It is sold by the Hoechst-Roussel Agri-Vet Chemical Company, located in Somerville, N.J.

Diclofop Research

Diclofop-methyl is classified in the oxy-phenoxy-acid ester herbicide family. Two other members of this herbicide family used on turf include Acclaim and Poast. Initial applications of these herbicides were in row crops where they were shown to control many annual grass weeds with little injury to broadleaf crops. Annual ryegrass (*Lolium multiflorum*) and wild oat (*Avena fatua*) control in wheat, barley, and soybeans are currently the primary uses of Hoelon. Reports from Hawaii were the first to reveal potential for Hoelon use in turf. Additional research at the University of Florida and Clemson University indicates that Tifway, Tifgreen, Tifdwarf, Ormond, and common bermudagrasses have excellent tolerance to Hoelon, and possibly other bermudagrass cultivars also would display good tolerance. Use rates range from 0.75 to 1.5 fl. oz. per 1,000 sq. ft. Research indicates that at least two-fold safety is anticipated on healthy growing bermudagrass. This safety factor helps ensure that bermudagrass damage should be minimum in the event that excessive overlapping or miscalibration occurs. Two applications are allowed per year. Soil half-life for Hoelon ranges from 10 to 30 days, depending on soil type present.

Goosegrass is most susceptible to Hoelon when treated in the 2- to 4-leaf stage. Higher rates (1.5 fl. oz. per 1,000 sq. ft.) are necessary to control larger plants, and control diminishes when goosegrass begins to mature and produce seedheads. When small plants are treated, control is usually excellent (>95%). Experience indicates that goosegrass mowed one day prior to treatment is controlled better than those plants that are left unmowed. The treated areas should not be mowed within 48 hours after treatment to allow

Bermudagrass golf green that has unacceptable goosegrass infestation. Repeat application and/or excessive phytotoxicity would be expected with previously available herbicides.

Test areas showing bare ryegrass plots where Hoelon was applied within one month of overseeding (background) and when applied longer than one month prior to overseeding (foreground).

At this stage of growth (2- to 5-leaf stage), goosegrass is the most sensitive to Hoelon as well as to all other postemergence herbicides.

time for herbicide uptake and translocation.

Weaknesses and Precautions

Hoelon does have weaknesses as well as strengths. Excessive phytotoxicity to bermudagrass can occur if treatments are made when the grass is growing under environmental or physiological stresses. These stresses could include close mowing (scalping), cool temperatures, drought, nitrogen deficiency, excessive nematode pressure, and shade. As with most herbicides, only mature, actively growing turf should be treated. Although it is very active on goosegrass, control of other weeds with Hoelon appears to be limited. Crabgrass (*Digitaria spp.*) is only partially controlled (50 to 75%), while annual bluegrass (*Poa annua*) appears to be unaffected. Other annual grasses reported to be partially controlled include fall panicum (*Panicum dichotomiflorum*), foxtail (*Setaria spp.*), and itchgrass (*Rottobellia exaltata*). Perennial weeds, such as dallisgrass (*Paspalum dilatatum*) or torpedograss (*Panicum repens*), are not susceptible. An important characteristic of Hoelon is its slow rate of kill. Usually it takes two to three weeks for complete control to be achieved. Superintendents should account for this delay when planning for club events and other important tournaments. Good soil moisture is also necessary for maximum activity.

Another concern with the use of Hoelon is its effects on germinating overseeded ryegrass. Frequently, goosegrass is most noticeable and therefore most often treated in late summer just prior to overseeding. Our research work indicates that a minimum of six weeks should be allowed between the last application of Hoelon and the anticipated date of overseeding with perennial ryegrass. Applications less than six weeks before overseeding may delay germination. Hoelon's effects on other grasses used for overseeding are not fully known.

Tank Mixing

Questions are often asked about tank mixes with Hoelon to increase efficacy. As a general rule, tank additives such as crop oils or adjuvants are not necessary with Hoelon. Additives are recommended only when large, mature goosegrass is present, but an increased burn potential to treated bermudagrass can be expected. Normally this burn is temporary (one to two weeks), but may cause concern if noticeable prior to major golfing events. Research at the University of Florida indicates that tank-mixing with other goosegrass control materials such as the organic arsenicals (e.g., MSMA and DSMA) generally results in reduced control (approximately 10% to 25% less). This reduction in control possibly results from the contact mode of action of the organic arsenicals which may damage external plant cells that normally are ports of entry for Hoelon to be absorbed and translocated. Tank-mixing with metribuzin (Sencor) often causes unacceptable phytotoxicity to the bermudagrass, which requires one to three weeks to recover. Other research suggests that no currently labeled turf herbicides should be tank-mixed with Hoelon and that 2,4-D treatment should not follow Hoelon applications for at least one week.

Golf course superintendents in Florida are often amazed at the control of goosegrass following treatment. Hoelon can provide excellent control without repeat application, as required with other herbicides, and does not normally injure bermudagrass. This is especially encouraging for courses that have perpetual goosegrass problems. Hopefully, this material will become more widely available in other states in the near future.

THE AFTERMATH OF A HURRICANE

by **PATRICK M. O'BRIEN**
Director, Southeastern Region, USGA Green Section

Hurricane Hugo traveled over 2,300 miles, but the Carolinas felt the strongest forces.

HURRICANE HUGO HIT Charleston Harbor at midnight on September 22, 1989, leaving a path of destruction in both North and South Carolina. It is estimated that 40% of the golf courses in these states sustained damage caused by gusting winds of up to 175 mph, tidal surges, and plough mud deposits. It was unbelievable to see the brown turf, mud, and fallen trees on these formerly impeccable landscapes.

Hugo traveled more than 2,300 miles during its journey of destruction. The first areas to feel the impact of the hurricane's force were the islands of St. Croix and Puerto Rico. Hugo's next stop was historic Charleston, South Carolina, after which it took an inland path through Santee, South Carolina, and Charlotte, Hickory, and Roaring Gap, North Carolina, before heading into western Virginia.

Tree damage was the most widespread form of damage to most golf courses. Golf courses that stood in Hugo's path lost between 500 and 2,000 trees. The coastal courses at the Country Club of Charleston and The Debordieu Club, for example, each lost approximately 2,000 trees. The mountain course of the Old Beau Golf Club, at Roaring Gap, North Carolina, lost almost 5,000 trees.

Tree removal and debris cleanup were made much easier with the rental of accessory equipment such as chain saws, chippers, bucket trucks, dump trucks, and stump grinders.

For many golf courses, 50% or more of their tree losses were tall southern pines, trees with short root systems that can't withstand high winds. Partially uprooted and leaning pine trees can still be seen as evidence of the storm's passage along many Carolina highways. Some deeper-rooted live oaks had the tops of their canopies blown away.

Needless to say, it will take many years for landscapes on Carolina golf courses to fully recover. In the meantime, fairway contour mowing programs are helping to provide some additional strategy for golfers' games, and new trees are being planted in strategic locations. If there's any consolation to the loss of so many trees, it will be in the improved performance of bermudagrass turf without the negative impact of so much shade and tree root competition.

Another major destructive force of the storm was the tidal surge along the coastline, affecting many coastal golf courses from Charleston to Myrtle Beach. The highest storm surge was 19.8 feet, reported about 30 miles northeast of Charleston.

The tidal surge caused some significant concerns for golf course superintendents. Most coastal courses are at elevations less than 25 feet above sea level, and large areas of these courses were covered by water. Greens, tees, fairways, roughs, and bunkers became submerged. A 13-foot surge occurred at the famous Wild Dune Course, on the Isle of Palms, putting the entire island under water. Also, many irrigation ponds were inundated with a dose of seawater, and expensive pump stations and field satellite irrigation controllers became submerged.

Plough mud and silt deposits from nearby marshes covered the turf on some sites. The Country Club of Charleston was left with deposits of 3 inches to 3 feet of mud and silt throughout many areas of the golf course. The mud removal was one of the most difficult tasks of the recovery process, requiring the use of tractors with box blades. Hand shovels and hoses were used to remove lighter deposits and remaining mud from the turf.

The effects of submersion caused by the tidal surge are evident this spring in many groves of pine trees, which never survive well in wet soils. Extra rootzone moisture brought on by the storm has caused significant needle drop, and only time will tell just how many trees recover.

Another concern after the storm was the potential for saltwater damage to the turf, soil, and irrigation ponds. Intense sunshine on the day following the storm caused sunscald on many bermudagrass fairways, and anaerobic soil conditions created by the tidal surge caused additional browning in other turf areas. Initial irrigation water samples indicated total soluble salt levels between 15,000 and 22,000 ppm.

Turfgrasses grown on most coastal courses have excellent saltwater tolerance. Bermudagrass and zoysiagrass, both of which display good salt tolerance, are the most widely planted turfs on these courses. Many of the bentgrass greens at the Debordieu Club, however, were submerged by the tide and covered with mud. Fortunately, bentgrass also has a reasonably good salt tolerance rating. The centipede rough turf grown on a few courses was a concern, though, because it is characterized by poor salt tolerance.

The 8 to 10 inches of rain that followed the storm was difficult for local residents, but was fortunate for the turf and soil. Sodium loading of the soil profile could have caused turf problems later on, but was significantly reduced

(Top) Matt Sapochek, golf course superintendent at Debordieu Golf Club, inspects mud and debris in a bunker after the tidal surge.

(Above) Mud, saltwater, and fallen trees are evidence of the severity of this storm.

with the rains. The predominantly sandy soils are very suitable for this type of flushing and leaching. Later, soil tests indicated acceptable total soluble salt levels. In fact, many clubs never had to apply gypsum after soil tests were analyzed.

Some courses applied extra nitrogen, potassium, and iron to the bermudagrass fairways after debris removal, and many fairways had good color prior to the cold weather last winter. Mike Fabrizio, the golf course superintendent at Wild Dunes, applied a mixture of gypsum, diammonium phosphate, magnesium, and minor nutrients with very successful results. Indeed, many superintendents reported having to mow the bermudagrass turf by December.

By spring it looked like the warm-season turfgrasses were recuperating quite well. A few low areas where additional salt accumulated required resodding or sprigging this spring, and some extra aerification and slicing helped roots to penetrate through silt layers caused by the mud. It now appears that even many centipede rough areas survived the tidal surge.

The bentgrass greens at The Debordieu Club provided a mysterious agronomic story after the hurricane. Several greens were submerged and covered with mud and eventually died, while other submerged greens survived. The practice green, #1 and #9 greens are all located around the clubhouse and at practically the same elevation. All became submerged with the tidal surge, but only #9 green died. No one is sure why this happened, but perhaps the saltwater remained just a little longer on this green.

At the Wild Dunes Golf Course, the 17th and 18th oceanside holes were severely damaged by the tidal surge. On both areas the irrigation systems have been restored, the terrain has been reshaped, and new sod has been laid this spring. All greens are now being rebuilt and converted from Tifgreen to Tifdwarf bermudagrass to improve their drainage and putting quality. It is hoped that both courses at Wild Dunes will be fully operational by July 1990.

Hurricane Hugo was a costly storm for every golf course in its path. The cleanup costs for most coastal clubs ranged between $50,000 and $250,000, depending on their circumstances, and a few courses experienced much higher costs.

The ingenuity and organizational abilities of golf course superintendents were put to a real test after the storm. The cleanup work, securing extra labor, and dealing with insurance and government agencies became a critical part of the job. These golf course superintendents demonstrated creativity and poise during this disaster, and their hard work has paid off for their golfers, who are again enjoying the beauty and challenge of these golf courses this season.

NEWS NOTES FOR SPRING

James Moore accepts Texas A&M Award from Dr. James B. Beard.

Green Section Receives Texas A&M Award

The USGA Green Section has been honored with the Special Award from the Department of Soil and Crop Sciences at Texas A&M University. The award was made in recognition of the Green Section's support for research work within the department.

James Moore, a member of the Green Section staff who lives in and works from Waco, Texas, accepted the award, presented by Dr. James B. Beard, professor at Texas A&M.

In his statement, Dr. Beard noted the Green Section's support, remarking that it was "best exemplified by the more than $1 million the USGA has committed to support turfgrass research conducted by the Texas Agricultural Experiment Station over more than four decades." Six principal investigators have received support over that time, and many graduate students have been trained at the M.S. and Ph.D. levels in the area of turfgrass science.

Major funding thrusts have emphasized two major areas of research. The first involved the development of an optimum root zone system for heavily trafficked turf areas by Drs. Morris Bloodworth and Marvin Ferguson. This evolved into the Green Section specifications for putting green construction.

More recently, Green Section support has been devoted to the development of water-conserving, minimal-maintenance turfgrasses and cultural systems. Work by Dr. Beard has led to the characterization of drought resistance mechanisms of the warm-season grasses, and funding continues in support of Dr. Milt Engelke's breeding work to develop improved turfgrass cultivars for golf.

Dr. Beard concluded, "No other segment of the turfgrass industry has made even a modest monetary commitment compared to the contributions made by the USGA. This dedicated group's efforts to support turf research have contributed not only to improved golf turf, but also to the lawn and sports field segments of the turfgrass industry as a whole."

Chuck Gast Joins Green Section Staff

The Green Section is pleased to announce the appointment of David "Chuck" Gast to the position of agronomist in its Florida office. Chuck is an Illinois native, and received a Bachelor of Science degree in horticulture from Kansas State University.

For the past 13 years Chuck has been the golf course superintendent at the Tascosa Country Club in Amarillo, Texas. During that time he was involved in several major course renovation projects, including the changes associated with the construction of 115 homesites within the course itself. More recently, he supervised the construction of a 9-hole addition to the golf course.

Chuck has been very involved in professional organizations and activities, having served as director on the boards of several turfgrass and golf course superintendents associations. He has been a participant in many conferences, and in 1982 obtained Certified Golf Course Superintendent status.

Chuck Gast

In his new position on the Green Section's staff, Chuck will report to John Foy, Director of the Florida Region. He will also assist Pat O'Brien, Southeastern Region Director, in making Turf Advisory Service visits to golf courses in several southeastern states. He will soon be moving his family, including wife Linda and two children, to the Hobe Sound, Florida, area.

With more than 20 years of golf course management experience to his credit, Chuck Gast brings a wealth of experience to the golf courses participating in the Green Section's Turf Advisory Service in the Southeastern United States.

ALL THINGS CONSIDERED

Patience, Gentlemen, Patience

by DAVID A. OATIS
Director, Northeastern Region, USGA Green Section

WE ALL have heard the saying "patience is a virtue," but it is something I sometimes find absent in golf turf management. We live in a society that demands instant gratification, and I can give you hundreds of examples of this fact. Have you ever stopped to consider just how many fast-food establishments there are? Today eyeglasses can be made in an hour, telephone calls can be made from cars, and documents can be faxed across the country in seconds.

This feeling of impatience has definitely carried over to golf, where members and club officials are exerting more pressure on superintendents to produce superior playing surfaces without giving full consideration to the needs of the turf. Clubs with severe problems want them addressed instantly and at little cost. And yesterday is not soon enough for results.

A typical example of how impatience causes long-term problems occurs when a newly constructed green is rushed into play. The consequences usually include thinning, weedgrass invasion, and poor playability . . . all of which add up to membership dissatisfaction. Along those same lines, sodding a new green to get it into play more quickly often results in mismatched soil types and long-term soil layering problems.

Unfortunately, most agronomic programs do not achieve overnight results, and they should not be expected to since managing fine turf is not a short-term proposition.

Solid agronomic programs have to be developed and implemented, and they must then be given time to produce the desired results. Golfers sometimes forget that superintendents are working with fickle Mother Nature. Superintendents, too, are sometimes guilty of expecting too much too quickly. Keep in mind an old truism passed on to the Green Section staff by former National Director Bill Bengeyfield: "The only thing that happens fast in agriculture is crop failure." In short, have patience, gentlemen, have patience.

TURF TWISTERS

TO MINIMIZE DAMAGE

Question: When mowing a green with a triplex putting greensmower, is it better to make the first pass through the center of the green or near the edge? (Oregon)

Answer: Because of the potential for hydraulic leaks following a long transport from green to green, it is always better to make the first pass with a triplex mower near the edge of the green. If a leak occurs, resodding could then be done in non-cupping areas, rather than down the center of the green.

HAVE YOUR WATER TESTED

Question: During the past few years the quality of our irrigation water supply has gradually declined. The sodium absorption ratio (SAR) has been steadily increasing. In discussing this problem with other local superintendents, I find some are now injecting acid into their irrigation systems to improve water quality. How can I determine if acid injection can be of benefit in my situation? (Arizona)

Answer: To evaluate the potential benefits of acid injection, send a water sample to an irrigation water testing laboratory. They can measure the sodium absorption ratio and the adjusted sodium absorption ratio after acid injection. The difference between these two values is a result of neutralizing the bicarbonates that would otherwise react (precipitate) with calcium and magnesium, and raise the sodium absorption ratio. If the adjusted value is considerably lower, there might be some benefit to injecting acid into your irrigation system.

AND TOPDRESS WHEN THE GRASS GROWS

Question: We topdress our greens regularly between late spring and early fall, but we see dark layers develop like annual rings on trees when profiles of the greens are viewed. Why? (Wisconsin)

Answer: There is strong grass growth in the spring and in the fall, outside of your topdressing period. It will help to add light dressings during the mid-spring and fall growth periods. Topdressing should follow the pattern set by the rate of grass growth, keeping in mind the slowdown of growth during hot weather.