MAY 1976

# USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association

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**VOL. 14, No. 3** **MAY 1976**




COVER PHOTO—Installing drain lines in the sub grade of a putting green.


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# "MAIR SOUND-HONEYMAN"

**by Stanley J. Zontek** Green Section Director, Northeast Region

This cry rang out for years from the wise ole tongue of Old Tom Morris, Superintendent of the famous St. Andrew's golf course in Scotland from 1865 to 1904. He was urging Mr. Honeyman, his foreman, to add more sand top-dressing to the greens. Even then it was understood that the better soil aeration and drainage resulting from sandy soils was better for all-around good grass growth ... and golf.

It was true then and it is true now. All it took was several long decades for this information to filter down and be precisely identified and defined by soil scientists in terms of what is required for good putting green turf growth. These criteria are the amounts of sand, silt, clay, and organic matter needed to produce soil having good internal drainage, good aeration, water-holding capacity, bulk density, and proper particle sizes, all in proper balance.

These may well be part of the naturally occurring characteristics of the "links" and "green" land that make up the old course at St. Andrews. Remember, the natural soil there is greatly influenced by blowing sand and the natural sand dune accumulations, certainly not what makes up the native silt or clay-based topsoils in so many parts of this country. Loamy sand soils like this are seldom naturally occurring, especially over large areas, and if a soil like this cannot be found, then one must be made. Herein lies the basis of the USGA Green Section soil specifications for putting green construction.

It is interesting to note however, even today with our wealth of scientific and practical expertise on the subject, many people are still skeptical about rapidly draining very high (70 to 90 per cent) sand content soils. This is especially the case, it seems, in those areas of the country where the cool-season grasses are grown. This article will attempt to clarify this situation.

## Why High Sand Content Soils?

Two of the most basic soil characteristics desired on golf course greens are good water infiltration and soil aeration. *The ability of water to move through a soil is imperative for good grass growth.* Good soil drainage and good soil areation usually go hand-in-hand. A deep, fibrous root system is usually a result of good soil aeration. Agronomically, the deeper the grasses' rooting system is, the healthier the turf. Compare this to shallow-rooted turf commonly experienced on heavy-soiled greens during the summer in many areas of the country. One can see and understand why shallow-rooted greens are prone to disease and wet wilt and must be carefully syringed and pampered to help "get them through" the summer stress period. Greens with good drainage and aeration, however, are *much* less prone to this type of injury and can actually survive the rigors of the summer season much easier than their heavy-soiled, slow-draining counterparts.

## Other Benefits of Good Soil Drainage?

Simply stated, they are:

1—Less overall disease development.

2—Less frost heaving in the spring.

3—Less direct low temperature kill.

4—Less scald or wet wilt injury during heat stress.

5—Less soil salinity or salt accumulation problems in those more arid areas of the country where this is a problem.

On the other hand, poor soil drainage results in: a shallow root system; reduced turfgrass vigor and quality (more weeds?); poor soil aeration, increased disease activity; increased compaction; and greens slower to warm up in the spring. Some of these are interrelated, but the end result is usually the same—poor, expensive to maintain, hard putting greens with less than desirable putting surfaces during the peak summer playing season.

With golf turf management being what it is today, it is better to have more drainage in a green than not enough. You can always add more water to a green but you can't always get rid of it when you want to. Well-draining high sand soils do hold less water than their heavy-soiled counterparts, but this factor is no real management problem with modern irrigation systems in common use today. In reality, sandy greens may actually require less watering! With the grass' deeper and more fibrous root system, it has a greater reservoir area from which to draw water. Also, players are less likely to be disturbed by afternoon syringings.

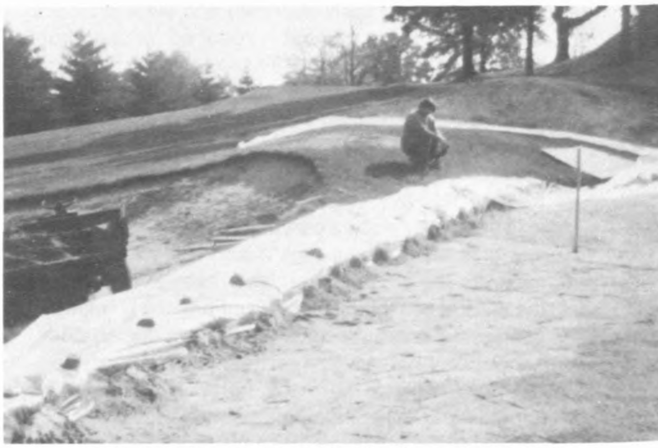
## What Are High Sand Content Soils?

Across the board recommendations on percentages of sand, soil, and organic matter in a putting green soil mixture is impossible. There simply is too much variation in the materials from one section of the country to another; indeed, from one sand pit to another. What is actually needed is a physical analysis of the materials on hand. It is essential if a predictable, well-performing putting green soil mix-

*Matured soil nursery, prepared in advance of actual green construction using the same soil to desired sub-grade.*

*Stripping old green and removing soil to desired sub-grade.*

*Coarse sand layer being installed over the stone base continues to be an integral part of the construction procedure.*



*Ringing the green with plastic as an interface between native soil and new greens soil.*

ture is expected. Such a soils laboratory supported by the Green Section, is located at Texas A&M University, Soil Physics Section, Soil & Crop Sciences Department, College Station, Texas 77843, under the supervision of Dr. Kirk W. Brown and Dr. Robert L. Duble.

It should be pointed out that the figures reported by the laboratory, especially those on infiltration rates, may be a little misleading. When a lab report says a particular putting green soil mixture will drain at a rate of four inches per hour, this is with no grass growing on it. With growing turf, this infiltration rate is effectively cut just about in half. Therefore, what initially may sound like a tremendous amount of water moving through a soil recommended by the lab report will, in the field, actually have a much lower infiltration rate in time.

One other point is interesting. As a Green Section spec soil mixture is prepared, extreme care must be exercised in the mixing. Every 10 per cent increase in the amount of silt and clay inaccurately added to the mix will again cut the infiltration rate in half. This is for every 10 per cent increase in silt or clay. It is therefore easy to understand why a soil mixture like the old standby 1-1-1 mix of soil, sand, and organic matter can cause summer problems. It simply contains far too much silt and clay for good internal drainage.

## Experience Is A Good Teacher

Good soil drainage has been known and recognized for years in the more southern regions where the summers are regularly hot and humid. Experience *is* a good teacher. Bermudagrass greens in this part of the country had better drain well, because if they do not, grass simply cannot be grown on them. Where high infiltration rates do occur, good bermudagrass growth is the rule.

As the use of bentgrass on putting greens moves farther south, there is renewed interest in soils with even better drainage. Bentgrasses require greater infiltration rates than the bermudagrasses. If a particular green's internal drainage is not up to par, one can expect bentgrass problems during the summer.

*Installing drain lines in the sub-grade.*

*Pea gravel over drain lines and sub-grade to form stone base.*

*Mixing tested Green Section specification soil for use on the new green.*

*Top soil spreading operation.*

*Final sodded green.*

The rebuilding of greens may be necessary.

In the Transition Zone, good soil drainage is also critical. Depending on the season, one can experience either good weather with few turf problems, or else tropical heat and humidity. When this occurs, the extra water infiltration capacity of high sand content soils is essential if good putting green turf is to be maintained. In reality then, greens in the Transition Zone should be built to the same high water infiltration standards as more southern greens so that all weather occurrences can be readily handled. Many of the putting green turf problems in the Transition Zone can be directly traced to inadequate infiltration rates, especially during hot and wet summers.

In the northern cool-season grass regions, good soil drainage is usually considered not as critical as in the South or Transition Zones. At least this has been the general feeling. The summers seldom get as hot and humid or stay that way for as long a period of time. When it does occur, however infrequently, it is still difficult to accept turf loss on greens due to inadequate infiltration rates. Players are demanding better and better golfing conditions through the season and, weather permitting, even longer and longer golfing seasons. Better soil drainage is therefore becoming much more important and recognized in the northern areas of the country. Besides better summer performance, we believe it is a fact that greens built to the USGA Green Section Specifications can be used earlier in the spring and perhpas even later in the fall than other type greens. When heavy-soiled greens are wet and soft in the spring, high sand greens are firm.

| Soil Mix Materials | Gravel >2 mm (>9 mesh) | Total Sand (9-300) mesh | Silt .002-.05 mm (<300 mesh) | Clay <.002 mm | Sand Fractions Very Coarse 1-2 mm (9-16 mesh) | Coarse 0.5-1 mm (16-32 mesh) | Medium 0.25-.5 mm (32-60 mesh) | Fine 0.1-.25 mm (60-140 mesh) | Very Fine 0.05-.1 mm (140-300 mesh) |
|---|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | % | % |
| Sand | 5.05 | 92.4 | 2.04 | .51 | 7.9 | 21.0 | 46.7 | 14.8 | 2.0 |
| Loam A | 18.4 | 40.1 | 33.49 | 8.01 | 5.1 | 6.8 | 1.7 | 10.0 | 6.5 |
| Loam B | 2.4 | 42.9 | 44.93 | 9.77 | 4.2 | 9.0 | 11.2 | 9.8 | 8.7 |

% Ash = 14.6

| Mixes examined (Parts in Ten) | | | Bulk | % Pore Space | | Infiltration | Percent Moisture retention At Pressure Indicated | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sand | Loam Soil | Humus Amendment | Density g/cm³ | Cap. | Non-Cap. | Rate-Inches of $H_2O$ | 40 cm atm | 1/3 atm | 2/3 atm | 1 atms | 3 atms | 6 atms | 15 pH | Mix. |
| | Loam A | | | | | | | | | | | | | |
| 10 | 0 | 0 | 1.44 | 21.0 | 24.5 | 8.5 | 14.5 | .49 | .69 | 1.2 | .54 | .52 | | 6.9 |
| 9 | 0 | 1 | 1.39 | 24.2 | 23.3 | 5.2 | 17.4 | 4.7 | 2.6 | 3.0 | 2.2 | 1.6 | | 6.5 |
| 8 | 0 | 2 | 1.24 | 29.3 | 23.7 | 3.4 | 23.7 | 4.7 | 3.8 | 4.3 | 2.9 | 2.4 | | 6.5 |
| 8 | 1 | 1 | 1.38 | 28.7 | 19.3 | 3.2 | 20.8 | 4.4 | 4.2 | 4.8 | 3.4 | 2.7 | | 6.5 |
| 7 | 1 | 2 | 1.32 | 34.7 | 15.3 | 1.2 | 26.4 | 5.3 | 4.2 | 4.5 | 3.1 | 2.5 | | 6.3 |
| | Loam B | | | | | | | | | | | | | |
| 8 | 1 | 1 | 1.42 | 29.5 | 16.5 | 2.9 | 20.8 | 8.0 | 8.6 | 4.3 | 3.2 | 2.4 | | 6.2 |
| 7 | 1 | 2 | 1.28 | 35.1 | 16.9 | .68 | 27.6 | 6.7 | 6.5 | 6.3 | 5.0 | 4.2 | | 6.3 |

[1]Lime values indicate rates of pure calcium carbonate (100% neutralizing value) uniformly incorporated to a six-inch soil deposit. Adjust rate of application according to neutralizing value of material used and depth of soil to which it is applied.

This can measurably extend the golfing season in many parts of the country. Where play is on a fee basis, this can be all-important for revenue. Furthermore, early play should not be overlooked by private clubs. Members always chafe at the bit in the early spring to begin playing their favorite sport. High sand content greens can be ready for them.

## A Success Story

In the spring of 1972 the Shorehaven Golf Club, of East Norwalk, Conn., decided on a long-range program of course renovation, including the reconstruction of some putting greens. The club wanted to replace the old, small, poorly constructed greens (high silt and clay content) with new and larger modern greens. Hopefully they would be easier to maintain, better for year-round play, and also able to handle the increased wear and tear. The size and soil problems of the older greens usually manifested themselves in terms of weed infestations, thin summer turf, and overly firm greens. There was a constant struggle every summer. After due consideration it was decided to construct the new greens to the USGA Green Section Specifications. To achieve this, samples of readily available sand, soil, and organic matter were sent to the then USGA-supported soils laboratory at Mississippi State University (now at Texas &AM University) for analysis. The results of the testing are shown in Figure 1.

From this testing, a mixture of eight parts sand and two parts humus was decided upon, although the 9-0-1 mixture also met requirements. The 8-0-2 mixture achieved the desired soil physical characteristics because, if you will note, the sand and peat had sufficient silt and clay in it so the addition of soil was not needed. Since sands, soils, and organic matters vary greatly from one area of the country to another, an analysis of this sort is a service certainly well worth the money.

Once the soil mixture was confirmed and accepted, the program actually got underway. There was a desire to make the Shorehaven green reconstruction as painless as possible. To shorten the time to reopening of the new greens, a sod nursery was constructed beforehand. The same soil mixture was used in the nursery as on the new green. Soil layering and different soil textures were avoided. The good turf on the new nursery set the stage for the actual remodeling and reconstruction of the green and surrounding bunker area. Where there is concern by the membership over inconvenience from a rebuilding program, consider the Shorehaven approach of using a sod nursery and the same soil mixture.

## In Summary

Today more than ever, consistently good putting green turf is the result of good soil drainage, aeration and good management. The USGA Green Section Specifications for Putting Green Construction provide the physical essentials.

This however, is not the end of the story. It is one thing to see and read about a green being constructed and quite another to learn how well it grew grass through the season. How will this type of construction and maintenance compare to the maintenance of the older, more heavily-soiled greens at Shorehaven? This question will be answered by the Golf Course Superintendent who is now living with this green—Robert Phipps. His comments will appear in the January, 1977, issue of the USGA Green Section Record after over two full years experience with observing and maintaining this green. Stay tuned! His comments should be interesting.

# MR. SUPERINTENDENT—

## Are You an "Endangered Species"?

by **STAN FREDERIKSEN,** Manager—Turf Products, Mallinckrodt, Inc., St. Louis, Mo.

Mr. Golf Course Superintendent—is your future as a career turf manager "clouded"? Perhaps much more than you think. Let's take a look at some very ominous considerations you will have to face in the very near future.

Back in the early '60s, Miss Rachel Carson's book SILENT SPRING was published. It had an everlasting impact upon the world of growing things, including your "thing," highly maintained fine turf. Undoubtedly its original purpose was a truly noble one—to focus public attention upon the indiscriminate use of chemical pesticides and the adverse effect this could have on man and his world, not to mention the Earth's millions of other living inhabitants.

However, the overreaction by federal, state and local government officials was startling. Federal agencies, armed with powers delegated to them by Congress, began removing from the marketplace pesticides they found had caused some kind of harm, either to people or the "environment." They also began removing pesticides they felt "might," even under the remotest possible circumstances cause some sort of problem, whether there had ever been such problem reported in connection with those pesticides or not. Further, the "possibility" of potential harm was not limited to that associated with people. The new phrases "balance of nature" and "endangered species" and others began to appear. One group or another began worrying whether in the next 15 or 20 years the "purple-crested-thing-a-ma-bob" would become extinct because of the impact in the "environment" of chemical pesticides. Strangely enough, some of these groups paid little attention to the very basic question—"Should the world be made safe and adaptable for people?—or for 'endangered species'?"

Let's make some observations as to what has happened since SILENT SPRING to bring us to where we are at present, with respect to pesticides and their use:

1. Gone from the market place are many of the important pesticides that helped farmers grow plentiful food crops that you could buy inexpensively. The same pesticides helped you grow beautiful fine turf. Few of these

*Putting green protected by mercurial fungicide in November, photo taken in April. No snow mold protection on collar area except in foreground where spreader was emptied. Experts have testified there are no substitutes for mercurial fungicides on turf. (Photo by Toro Mfg. Co.)*

ever caused problems, but (found some government agencies), they "just might" cause problems, and so they were banned.

2. Gone is the incentive on the part of chemical companies to develop new pesticides to help your career. Why should they? There's now only one chance in several thousand that any new compound could ever become commercially available as a pesticide.
3. Gone is the source of many of your turf pesticides—that source being pesticides originally researched and developed for food crops. Because turf is such a small segment of the agriculture market, very few, if any, companies would ever embark on a program of research to develop a pesticide just for turf when the chance for its commercial success is so slim. With pesticides for food crops in jeopardy, you can imagine how remote is the possibility of new pesticides for turf.
4. Just after SILENT SPRING appeared, the food pesticides people found their warehouses filled with pesticide compounds that the government had banned for food crop use. When a magazine writer said that, "A $14 million market has opened up for fungicides on golf course turf," you can bet the food pesticides manufacturers started moving their erstwhile unsaleable (for food crop use) fungicides over into the turf market, rightly reasoning that "very few people eat grass." It was at this time (mid 1960's) that you saw entry into the turf fungicides markets, firms which had never participated in such markets before.
5. Right after SILENT SPRING, Monsanto published a resounding rebuttal to the book. To discover what the world would be like without pesticides, read the October, 1962, issue of *Monsanto Magazine* article entitled "The Desolate Year." It depicts a world without pesticides, overrun with insects and other pests, and presents a frightening picture of how tenuous is the thread that holds civilization together. Without pesticides, the human race could literally be eliminated. The grim fact is that all the pesticides we've ever had could only hold antagonistic pests in check. In no way could all of them be eliminated. Witness even today in your continuing battle against turf pests how many insects and fungi have readily adapted to pesticides and/or have become entirely resistant to many of them. To reinforce yourself on this particular point, be sure to see the motion picture "The Helstrom Chronicle," which shows that practically all insects can adapt to just about any pesticide—and that it may not be too far in the future when insects, not humans, will rule the world! That is, unless mankind can continue its pressure on the pest world through much more pesticide research and a constant flow to the marketplace of more new pesticides.
6. Is pesticide research dead? Maybe not quite, but it's rapidly approaching that state. Dr. John Shred, the famous Connecticut entomologist, told me at a turf conference a couple of years ago that at that time of the year just 12 months before he had, in the first quarter of the year, screened hundreds of chemical compounds for insect control activity. During the current quarter, he told me, he'd received candidate insecticide compounds from only two companies.
7. Over-reaction has also shown up at the state and local levels. More and more states, because of pressure from environmentalist groups, are placing their own bans on many pesticides, whether there's any real basis for such action or not, and they are imposing almost intolerable regulations and conditions. An example is California where anyone who even recommends the use of a pesticide must have a permit or license. In the original legislation, a license was needed not only for the state itself, but also for every county of the state in which that pesticide was to be sold and/or recommendations for its use made! It's just about enough to turn off anyone and let the pests take over by default.
8. Another part of the untenable present pesticide situation is the practically impossible maze of registration procedures. Whereas formerly a good pesticide could attain registration in a few weeks, it may now require years—and lots of money. New obstacles have been thrown up, including such things as "feeding studies," "residue studies," "environmental impact studies" and the like. Some companies have received pesticide applications back from the EPA no less than five or six times for "more data," the "dotting of i's," the "crossing of T's," etc. Do you wonder about the increasing prices of pesticides? You shouldn't when you begin to realize the tremendous costs involved just in registration, including the horrendous work involved, the numerous trips to Washington, etc.
9. The crunching halt to pesticide research was mentioned earlier. The true extent of this literally jumps at you when you hear that many companies are completely abolishing their pesticide research facilities and terminating their people. Many experiment stations, formerly strong in agricultural and turf pesticide research, have either cut back or eliminated this from their programs.

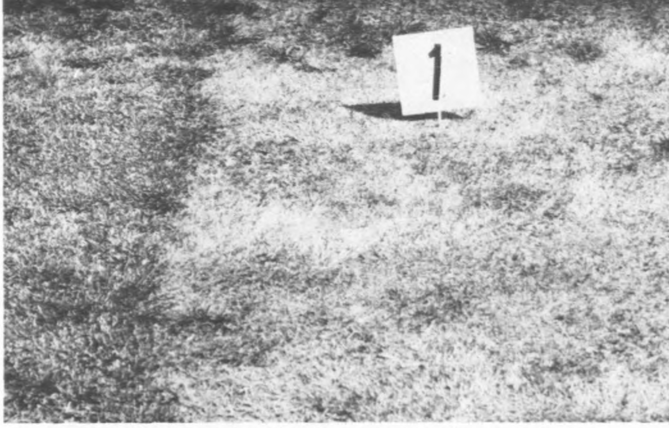
10. Again, a persistent reason given for removing long-standing, well-and-safely used pesticides from the market is that they "might" (not *"will"*) result in malignancies or "get into the food chain" (another favorite phrase of the environmentalists), or otherwise adversely affect the "ecological balance." It's likely true that indiscriminate airplane spraying of toxic substances over wide areas could pose health problems. But this is far different (for instance) from a qualified turf manager spraying a few ounces of a mercurial fungicide on a tiny (relatively, in area) putting green, where there's *proof* that it can only move *downward* (never laterally), and will tie up into insoluble and therefore innocuous soil compounds that can never contaminate or pollute.

So-o-o-o—Where does all this leave us? Some obvious conclusions:

1. Expect to see very few new pesticides in the foreseeable future.
2. Expect the *loss* of many pesticides that, until now, you've used routinely. In October, 1977, (this was originally scheduled for October, 1976, but the time was extended), all federal registrations of pesticides will expire and all new registration applications submitted. Bet that the EPA intends to eliminate all those that it feels aren't needed, or that a few pseudo-ecologists feel you don't need, simply by refusing to re-register those pesticides after October, 1977. What you need or what you deem necessary for managing your turf areas, appears to be of little or no significance.
3. Be ready to get by with far fewer pesticides than you've ever had before. You'll have to take what you can get, and be satisified. It won't matter that what's available to you just might not work.
4. Watch for alternate methods of pest control. Close at hand may be the era of biological controls—or even the control of pests with sophisticated electronic devices not yet even dreamed of.
5. Pests could increase their activity to where, perhaps, intolerable conditions for the public may force changes in government thinking to the point where the bureaucrats will really have to decide whether to control pests or choose the only other alternative and let the pests overwhelm the people.

If the average turf manager must choose between eliminating some of the management "tools" he now has to work with, it has been determined that the very last thing he'll give up is his store of good pesticides. He simply cannot maintain fine turf, especially putting greens, without good pesticides—at least as of now.

What's to be done? That's mostly up to you. You can either endure the restrictions and regulations, or you can do something about it! Write to your Congressman! Write to your Senator! Work through your association and its fine membership, and let the government know that its actions are jeopardizing **your** career. In order to manage fine turf properly you need good tools—**especially good pesticides!** Just because something "might," at a future time, cause a problem is no reason to ban it if it has never caused a problem before. Mercurial turf fungicides are a good example. For over 50 years—one-fourth the entire history of the United States—mercurial fungicides have served golf course superintendents well. They are without peer in performance and low in cost-in-use. In all those 50 years there has never been a documented case of injury with these materials when used as directed. And yet there is the threat of a denial of registration of these mercurials. Why? No one really knows. It happens that a number of routine items of commerce, readily available over-the-counter to anyone of any age appear to be far more dangerous than mercurial turf fungicides, used as per their labels. It has been said, for example, that **ordinary aspirin causes more deaths every year than all pesticides combined—of any type—and designed for whatever purpose!**



*A pre-emergent herbicide was used on dormant U-3 bermuda on the right side while Poa annua invasion has taken over on the untreated portion, left.*

What man can do to pollute the Earth is infinitesimal compared to what the Earth does to itself. A recent article claimed that when Mount Krakatoa, the volcano, exploded and sank into the Pacific back in the 1880s, that single explosion threw into the atmosphere more particulate pollutants than has all of Mankind since the world began! By the way, the title of the article is, "The Earth Is Its Own Worst Polluter."

Why is it that you are the key to the future of good pesticides? Because you are the only one government officials will listen to—because you are the one most adversely affected when important pesticides are no more. Thus it is imperative that you let your voice be heard—individually and through your associations. If you don't it might just be *you, The Golf Course Superintendent* who becomes the endangered species.

A GREEN SECTION SUPPORTED RESEARCH PROJECT

# Better Bermudagrasses for Golf[1]

by GLENN W. BURTON[2]

"Why keep on trying to breed better bermudagrasses for golf? The Tif-bermudas will do the job if properly managed."

This statement from a leading turf specialist in the South made me stop and think. Our best turf bermudas for golf—Tifgreen, Tifway, and Tifdwarf—do have a pretty good performance record. They are certainly an improvement over the common bermudagrass they replaced.

Several years ago, a superintendent of a Florida golf course that had Tifdwarf on the greens and Tifway on the fairways and tees told me that Ben Hogan said it was the finest turf he had ever played on. But it was well managed. Northern golfers playing Tifdwarf greens in Birmingham, Ala., thought they were playing on bentgrass greens. Again, the greens were properly managed.

The Tif-bermudas were bred to give good turf with less fertilizer, insecticides, and fungicides than many other grasses. Tifdwarf and Tifway are darker green than most other grasses and require less nitrogen fertilizer to give the desired dark green color. They also require less fertilizer than other bermudas to create the sod density necessary to crowd out weeds. Tifway is resistant to the bermudagrass mite, a pest that otherwise would have to be controlled with chemicals. Tifway, Tifgreen, and Tifdwarf are immune to rust and fairly resistant to several other diseases. Put very simply, it costs less to maintain good turf with the Tif-bermudas than with most other grasses. Springhill Country Club, Tifton, Ga., with Tifdwarf on the greens and Tifway on the fairways, tees, and rough, has demonstrated that these grasses can be kept in excellent playing condition on a limited budget.

"Too much thatch," a criticism of Tifway, is evidence of too much fertilizer and water and sometimes too little mowing. Cutting Tifdwarf daily at a height of 3/16 inch, fertilizing moderately and topdressing as needed could overcome most of the criticism we have heard of this grass. Yes, with proper management, the Tif-bermudas would do a pretty good job—a much better job than they are doing on some golf courses today. But they are not perfect.

None of the Tif-bermudas is resistant to nematodes. If we could increase their nematode resistance, golf courses could save many thousands of dollars spent for nematicides. If we could increase their winterhardiness and make them resistant to spring dead spot, they would be much more useful in the northern part of the bermudagrass belt. Tifdwarf turns purplish brown when temperatures approach 32 degrees Fahrenheit. To overcome this unsightly color, greens must be either overseeded with cool season grasses or sprayed with gibberellin. These expensive operations in the lower part of the bermudagrass belt could be eliminated with a golf green bermuda that would not turn purple and brown when it gets cold. These are but a few of the reasons why we keep on trying to breed better bermudagrasses for golf. We made progress with the development of the Tif-bermudas and we believe we can continue to do so.

## Hybridization

When plant breeders try to develop better varieties, they find parents that have the desired traits and hybridize them. If the desired combination of traits is not found in the $F_1$ (first generation)

*Rhizomes of Tifgreen bermudagrass prepared for irradiation.*

[1] Cooperative investigations of the Agricultural Research Service, U.S. Department of Agriculture, and the University of Georgia, College of Agriculture Experiment Stations, Coastal Plain Station, Tifton, Ga.

[2] Research Geneticist, Agricultural Research Service, U.S. Department of Agriculture, and the University of Georgia, College of Agriculture, Experiment Stations, Coastal Plain Station, Tifton, Ga.

*Bermudagrass mutants and new hybrids under evaluation at Beltsville, Md., for winter-hardiness.*

hybrids, it can usually be found in the $F_2$ (second generation) grown from these hybrids. It is often necessary to look at thousands of $F_2$ plants. We cannot use this procedure as we try to improve Tifgreen, Tifway, and Tifdwarf, because they are sterile triploids. They are hybrids between two species, the tetraploid *C. dactylon* and the diploid *C. transvaalensis*. Because they are sterile, we can have no seed for an $F_2$ generation. If we do not find the desired combination of traits in the $F_1$ hybrids, we must make more $F_1$ hybrids and hope to find them there. Because Tifgreen, Tifway, and Tifdwarf are sterile, they cannot be used as parents to add, for example, nematode resistance to them. We must make more species hybrids and hope to find in them all the desirable traits in the Tif-bermudas plus the new ones sought. Just how difficult this is will be apparent if we review the combination of traits the game of golf demands.

## Golf Course Demands

For top-quality golf greens, a grass must be able to withstand daily defoliation to a height of 3/16 inch and maintain a smooth, uniform surface that will keep the ball on a true course. Its leaves must be fine, soft, and closely spaced to meet this requirement. It must also have a uniform dark green color. For tees, a variety must be tough to stand the punishment doled out by the golfer and his clubs. It must have dense, stiff leaves to hold the ball well above the soil, and it must heal rapidly to fill in divot holes left by the players. For fairways, a variety must make an attractive, uniform carpet, dense enough to give a good lie to the ball. It must be able to heal divots rapidly and must tolerate considerable traffic. It must do all of this over a great variety of microenvironments with less water and care than greens and tees.

In addition to these specific demands, there are a number of general characteristics that we would like to incorporate into new golf course varieties for the South. First and most important is dependability. These varieties (except for overseeded winter grasses) should be perennial regardless of the weather. They should maintain a green color throughout their growing period (hopefully to be extended by increasing frost resistance). Low maintenance costs and, of lesser importance, low establishment costs should receive major attention in the development of every new variety. Adding resistance to drought, cold, disease, insects, nematodes, and weeds will lower maintenance costs. Wear resistance, shade tolerance and low weed potential are other important traits that should be added.

Tifdwarf, the last improved grass to come from our turf breeding project at Tifton, was released in 1965. From 1965 to 1970, we made and evaluated a number of new sterile triploid hybrids. Some were good but none was better than Tifway, Tifgreen, Tifdwarf already in use on golf courses. The best of these are being kept in our nursery as insurance against a possible disaster, such as the 1970 corn blight disease which greatly reduced corn yields.

In 1966, after the Grassland Congress in Finland, I spent three weeks in Europe looking for winter hardy bermudagrasses. I had the help of grass breeders and botanists in Germany, Switzerland, Italy, and France and mailed back rhizomes of a number of bermudagrasses I found there. Agronomists in several states helped evaluate their winter hardiness. Professor Milo Tesar at Michigan State University had to go to his northernmost planting near Lake City, Michigan to find the two most winter hardy plants. One of these came from a railroad siding in Berlin where Professor Soukoup had seen it growing for 15 years. The other plant I found in the Alps of north Italy. One of my Canadian friends recently reported that the Berlin bermuda was surviving in Canada.

We are using the Berlin bermudagrass as a parental source of winter hardiness and have made several hundred hybrids between it and our best *Cynodon transvaalensis* introduction from South Africa. Dr. Jerrel Powell, ARS, USDA, Beltsville, Md., is helping us evaluate these hybrids for winter hardiness. Because these $F_1$ hybrids are sterile and will not produce an $F_2$ generation, we cannot expect to develop hybrids as winter-hardy as their Berlin parent. We do expect some of them to be more winter-hardy than the Tif-bermudas.

Some of the progeny from the Berlin bermudagrass have set seed very well in small plots. In 1974 we isolated three of the best of these and used springs to plant large plots. When we harvested seed from these plots near the end of the season, we found lots of heads but a very poor seed set, due, we think, to self-incompatability. To solve this problem, we interplanted them in 1975 and expect to get a good seed harvest. Our objective is to develop a winter-hardy bermudagrass than can be propagated by seed.

## Mutation Breeding

The failure of the triploids made in the late 1960s to excel the Tif-bermudas caused us to turn to mutation breeding as a possible way to improve them. The occurrence of Tifdwarf as a natural mutant in Tifgreen suggested that speeding up this natural mutation process with mutagenic agents might be profitable.

Thus, in the winter of 1969-70, with the help of Dr. Jerrel Powell, we began mutation breeding research to produce mutants of Tifdwarf and Tifgreen. Dormant stolons, washed free of soil and cut into one or two node sections were selected because their buds contain few cells. Actively growing buds contain many cells and a one-celled mutant occurring in such buds will usually be obscured by the development of the normal cells around it. Thus the ideal bud for mutation breeding will have only one cell.

When we treated dormant buds of Tifdwarf and Tifgreen with the chemical mutagen EMS (ethyl methane sulfonate) at rates up to levels that killed many buds, noticeable variants failed to appear. When we exposed dormant sprigs to 7 to 12 kR of gamma irradiation from a cobalt 60 source, however, a number of distinctly different bud mutations occurred. Isolated from normal tissue and grown in two-inch pots in the greenhouse, these 60 mutants differed in leaf size, hairyness, stem diameter, internode length, and basic plant color. In a field planting they differed in herbicide sensitivity, frost tolerance and spreading rate.

In the winter of 1970-71, we exposed dormant stolons of Tifgreen and Tifway to gamma rays and planted them in flats of sterile soil in the greenhouse. In April we space-planted in the field the tiny plants that grew from the irradiated buds and isolated 62 mutants from Tifgreen and 36 from Tifway. These mutants were similar to those obtained earlier. Tifway, however, gave a lower mutation frequency and failed to produce as much variation in plant color.

From these studies we have learned that mutation breeding is a very effective method for creating variation in the sterile triploid bermudagrasses. Our experience indicates that dormant sprigs should be exposed to 7,000 to 9,000 r of gamma irradiation and then planted in sterile soil in the greenhouse. When well established, the plants from irradiated sprigs should be space-planted in the field. A regular daily search for mutant shoots should begin as soon as stolons appear. Color differences are easier to detect on cloudy days. Mutant shoots should be removed immediately and grown in the greenhouse, otherwise they will be overgrown with normal plant material and lost.

Up to 6 per cent of the sprigs of Tifgreen and Tifdwarf that we irradiated produced $M_1$ mutants. Approximately 70 per cent of these mutants did not sector and gave rise to uniform turf when increased vegetatively. Sectoring mutants were usually stabilized by isolating small sectors from them. Frequency of discernible mutants was lower in Tifway than in Tifgreen and Tifdwarf.

The mutants from our mutation breeding program were set out in plots along with normal material of Tifgreen, Tifway, and Tifdwarf to serve as checks at Tifton, Ga. and Beltsville, Md. For the past three years we have been carefully evaluating these mutants, searching for one or more that may be superior to the normal Tif-bermudas. We have about decided that the dwarfs smaller than Tifdwarf are too small and grow too slowly to be useful on most golf courses. Some mutants that looked good three years ago no longer compare favorably with their normal parent. We learned years ago that it takes at least three years to pick the good ones. Some of the mutant plots have very few nematodes in them; others are heavily infested. Dr. A.W. Johnson, ARS, USDA, nematologist at Tifton, is helping to evaluate these mutants for nematode resistance. Evaluation is difficult because it is hard to get a uniform infestation in the field, and nematodes cannot be cultured in the laboratory as can disease organisms. Dr. Johnson has some of the most promising mutants in the greenhouse and hopes to give us a resistance evaluation of them by next spring. By that time we hope we will have several mutants (at least one from each Tif-bermudagrass parent) to increase and release for evaluation on golf courses.

# Is Your Grass Bugged?

*When significant numbers of grubs are feeding underground by chewing of the roots of the turfgrass plant, the sod can be rolled back as shown here.*

**by CARL H. SCHWARTZKOPF,** Mid-Continent Director, USGA Green Section

The average insect population per square mile is estimated to be equal to the total population of people in the world. Fortunately, less than one per cent of the nearly one million insect species are pests to plants and animals. Of the 100,000 insect species that occur in the United States, about 600 species are considered serious pests. Of these, fewer than 60 are detrimental to the growth and development of fine turfgrass.

Insects that damage turfgrass areas may be classified into various groups. The first is comprised of those insects that feed underground, such as white grubs, billbugs, wireworms, mole crickets and ground pearls. The second group are those that feed above ground, including sod webworms, armyworms, cutworms and frit flies. The above and below ground feeding insects form the two largest groups that damage turf. Other insect groups that damage turf include chinch bugs, aphids, leafhoppers and spittlebugs. They suck necessary plant juices from the leaves and stems of grasses. A final group are not plant feeders at all, but those that damage turf indirectly by building mounds, digging holes and being a nuisance to man and other animals by stinging or biting. This last group includes ants, earwigs, crickets, fleas, ticks, mosquitos, bees and wasps.

**Soil Inhabitors**

The soil-inhabiting white grubs that feed on roots of grasses are the most difficult insect pests to control. They live in soil that is usually covered with a sod layer. Their presence often goes undetected until large, brown dead areas appear. Occasionally, these areas are misdiagnosed as an inadequacy in the irrigation system or as a turfgrass disease problem. At this time the grubs are usually almost full grown and large numbers can be found in the damaged areas. If an insecticide is applied to the infested turf, the material must be washed or soaked into the root zone where the grubs are located. Sufficient water must be applied to soak the insecticide into the soil, yet not so much water that the chemical is leached from the area where it is effective.

The name 'white grub' is given to many species of insects that are similar in appearance. Species are found in all regions of the United States. They are u- or c-shaped worms found in the soil just below the surface. Typically, white grubs are cream-colored or white with a brown head, a dark area at the posterior end of the body, with three pairs of legs.

A white grub could be the immature or larval stage of one of many beetles. Examples of the adult include the Japanese beetle, European chafer, Oriental beetle and the Asiatic garden beetle. These larvae forms can be identified by observing the rastrel pattern on the bottom side of the last body segment.

Life cycles vary with each species. For example, the Japanese beetle completes its life cycle from egg, larvae or grub and pupa or resting stage, emerging as an adult in one year. Similarly the green June beetle, European and masked chafer have one-year life cycles. On the other hand, grubs of the May beetle (*Phyllophaga sp.*) may remain in the soil for 2 or 3 years. The amount of time the larvae remain in the soil depends on the species. A white grub that has recently caused great damage to golf course turf in several Eastern and Midwestern states is the *Ataenius spretulus.* This beetle has a one-year life cycle, though the number of broods per year has not been established.

Typically, white grubs feed on grass roots during the late summer and fall. In late fall, they dig deeper into the soil, especially in regions where the ground freezes. After spending the winter deep in the soil, the grubs return to the grass root zone and resume feeding. Grubs with a one-year life cycle usually pupate in May. Grubs with a life cycle of more than two years continue to feed the following year.

**Leaf Chewers**

The second major group of insects are those that chew on the leaves and stems of the grass plant. Sod webworms or lawn moths, along with armyworms and cutworms, are usually the most damaging surface feeding insects that affect turfgrass. Lawn moths when present can be observed flying just above the turfgrass area in a zigzag pattern during the early evening hours and in the light rays of the night watering vehicle.

The female sod webworm lays the eggs while flying over the turf in the evening hours. These eggs will hatch in a week to ten days. The young webworm larvae will begin feeding on the grass, thereby causing damage to the area. Most regions of the United States have two or three generations per year. Usually, the first generation of sod webworms in early summer are not enough to cause damage. However, each succeeding generation, six to eight weeks later, can increase significantly the number of larvae. As these larvae grow larger, so does their appetite and the damage resulting to the turfgrass area.

Sod webworm feeding causes small, irregular areas of dead or dying turf. These small areas coalesce into a large damaged area within a few days. A badly damaged location has many uneven patches of dead turf with pencil-sized holes. These small holes result from birds feeding and digging the larvae from their burrows.

Armyworms are another damaging type insect larvae found on turfgrass areas. As do many insects, the armyworm commonly overwinters as a larva or pupa. Armyworms are 1 to 1½ inches long, with dark stripes down the center of the back and along each side. The remainder of the body may be varying shades of green. The armyworm feeds commonly at night, but does not hide completely during the day as does the sod webworm.

A group of insect larvae known as cutworms also damage turfgrass areas, especially putting greens after they have been cored. The vertical holes left by a coring machine (aerator) provide an ideal site for the larvae to rest during the day until they feed on the grass blades in the evening.

**Achieving Control**

To achieve adequate control of insects, it is important to know the life cycle and in what stages of development they are most susceptible to being reduced. To maintain an ecological balance in nature, it is not desirable to achieve total eradication of an organism. Insects may be controlled by either biological, chemical, physical or mechanical methods.

Examples of biological or natural controls include frogs, toads, lizards, moles and birds as well as other animals that feed mainly on insects. Some insects are predatory on other insects, such as the Tachinid fly that lays its eggs on the armyworm. As the fly larvae eat, the armyworm is soon killed. Viruses, fungi and bacterial diseases also help to hold insect populations in check. The use of bacteria, causing milky disease that kills grubs of the Japanese beetle, is another example of natural or biological control. Biological controls do not eliminate a past species completely; they only reduce the population, thereby keeping the damage minimal. However, biological controls are usually self-generating, so a control specie, once installed, continues to reproduce and remain effective.

Insecticides or chemical poisons used to destroy insect pests may be divided into two groups; stomach poisons and contact poisons. Stomach poisons are used mainly to control insects with chewing mouthparts. Contact insecticides are applied directly on the pest or are applied where the insects will pick them up. Contact poisons are especially useful in controlling insects with piercing-sucking mouthparts. If eaten, a contact insecticide acts as a stomach poison.

Physical and mechanical controls are the simplest, most obvious and at times most effective. The old-fashioned fly swatter is an example of a simple, inexpensive method of control. Unfortunately, physical and mechanical methods of insect control are limited in large turfgrass areas.

With the Environmental Protection Agency declaring the intent to cancel registrations of pesticides containing chlorinated hydrocarbons, it will become necessary now to correctly identify the damage-causing organism and treat accordingly. In the past, it was possible to treat with a broad-spectrum insecticide and achieve satisfactory control even if the damaging insect had not been properly identified.

# NEWS NOTES FOR MAY

## Personnel Changes in Green Section Regional Offices

F. Lee Record announced his resignation from the USGA Green Section on January 31, 1976. Record served 13 years with the Green Section as Mid-Continent Director and earlier as Agronomist in the Eastern Region.

Holman M. Griffin also announced his resignation from the Green Section, effective March 31, 1976. During his 13-years on the staff, Holman served USGA Member Clubs from Texas through the South and Northeastern states. For the past five years he was Mid-Atlantic Director. Griffin now joins the National Golf Foundation staff with offices in Texas.

William (Billy) Buchanan now becomes the Mid-Atlantic Director and returns to his native Virginia. Buchanan, a graduate of Virginia Polytechnic Institute, has been with the Green Section since 1972. He carries the lowest handicap on the Green Section staff.

Stanley J. Zontek has been appointed not only to a new role but to a new region as Green Section Director, Northeast Region. A graduate of Pennsylvania State University, he has been one of the Green Section's outstanding Eastern Agronomists for the past four years. His childhood was spent on a golf course in Pennsylvania where his father was the Superintendent.

Carl H. Schwartzkopf becomes the Mid-Continent Director after serving in that region as Agronomist for the past four years. A native of Michigan and graduate of Michigan State University, Carl is a most widely traveled Green Section Agronomist. He has visited USGA Member Clubs from coast to coast and border to border and brings this experience and talent to mid-western subscribers.

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I certify that the statements made by me above are correct and complete.
Robert Sommers, Managing Editor

# TURF TWISTERS

## SKUNKS

**Question:** Some skunk is divoting my fairways. How do I apprehend the critter? (New York)

**Answer:** If dressed in anything but black and white, be discreet. If black with white stripe, the critter is divoting for insects or grubs. Get rid of them and the "striped cat" will move to "grubier pastures."

## WON'T HOLD

**Question:** We built three new greens last year. They will not hold a shot very well. Golfers complained the greens are hard. What can be done so they will hold a shot this year? (Iowa)

**Answer:** It sounds like the new greens have not had sufficient time to develop the necessary amount of thatch and mat for cushion underfoot and the resiliency to hold a properly hit shot. Increasing the amount of nitrogen by ¼ to ½ pound per 1,000 square feet will help. Occasionally, after fertilization mow the greens without the catchers; this should be beneficial. Depending on varieties, it takes longer for some turf to produce thatch, so do not become impatient if the greens do not improve in their ability to hold a shot within the first year.

## MOLE CRICKETS

**Question:** I am rather isolated and have a problem with mole crickets. What do you suggest for control? (Puerto Rico)

**Answer:** There are several insecticides that control mole crickets, chlordane, Dursban, Diazinon, Sevin, etc. It is best to apply the insecticide in early May just before dark when the crickets begin to move about. Spray during the nymph stage for best control.