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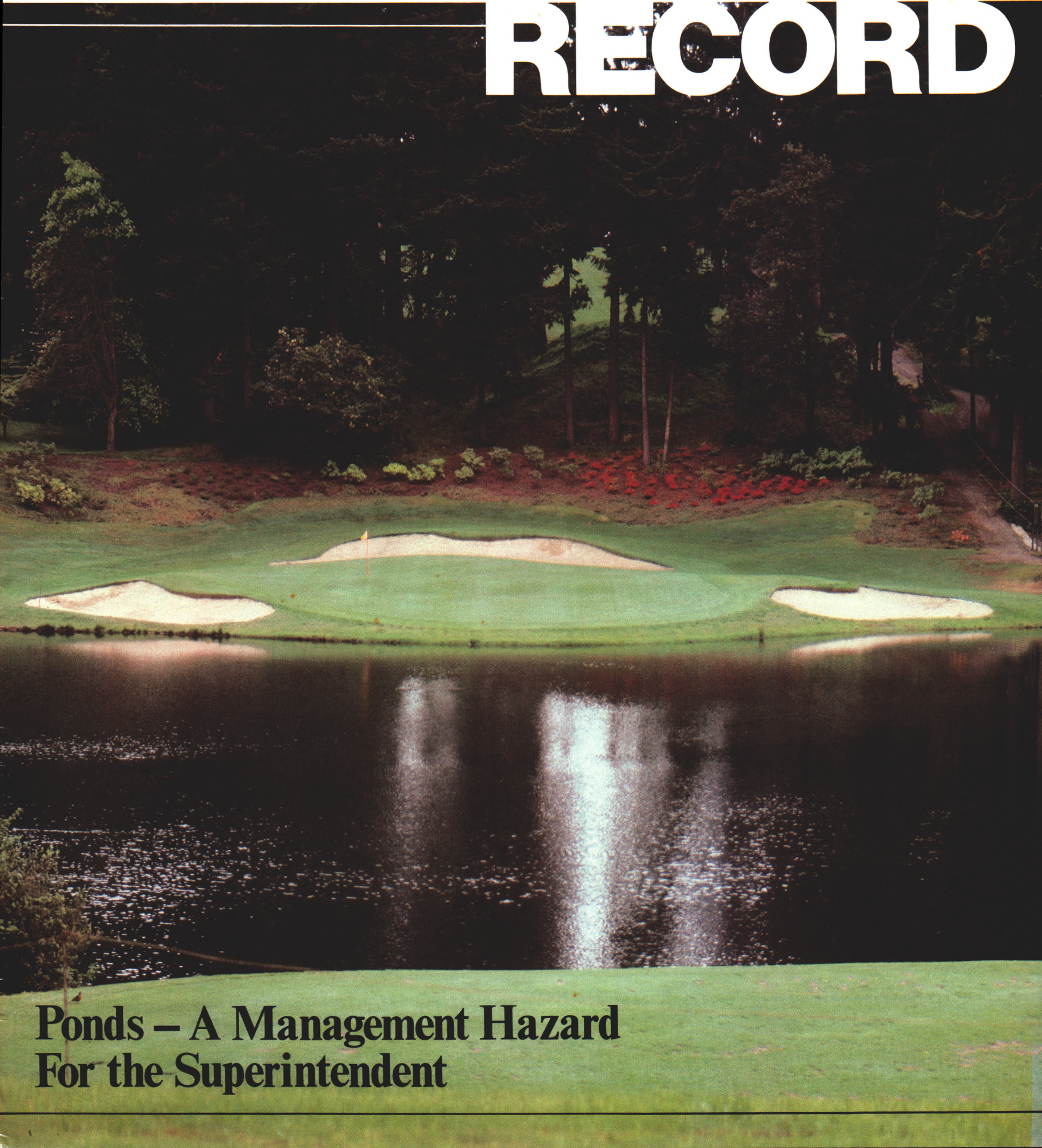

Ponds – A Management Hazard For the Superintendent

USGA

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The 11th hole, par-3 at Seattle Golf Club, Seattle, Washington.

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A flexible membrane can provide an effective seal.

Avoiding the Ugly Pond

by TIMOTHY G. ANSETT,
Agronomist, Western Region, USGA Green Section

PROBABLY the most exciting and remembered golf holes in the world are those involved with water. Any golfer who has played the 18th at Pebble Beach or the 16th at Cypress Point will always recall the dramatic role of the Pacific Ocean. Of course, not everyone has an ocean to fall back on for scenic beauty, but any body of water, whether a natural lake, artificial pond or irrigation reservoir, can greatly influence the appearance and playability of a golf course. And the memories should be positive ones, not those of a neglected pond slowly turning into an unsavory bog filled with trash. With proper construction and proper maintenance, the eyesore can be changed to an eyecatcher by the golf course superintendent and green committee.

This article will provide pond management information helpful in avoiding the presence of ugly ponds. It should particularly aid the reader in initial pond construction and provide insight into management problems associated with existing ponds and reservoirs.

Purpose

There are many purposes and uses for ponds and reservoirs on the golf course. They frequently serve as a hazard or design feature, provide water storage for irrigation, add visual beauty, or act as a collection point for surface or subsurface drainage. In some cases, a pond may be developed to provide fill material for elevations throughout the property or to provide water storage for fire protection. Establishing a refuge for fish and waterfowl is not unheard of, nor is the possibility of providing a revenue-producing source from lost golf balls.

It stands to reason that few ponds or reservoirs are built for a single purpose; some may actually be intended to serve all the above uses and additional ones as well. Since the purpose will strongly influence the design and construction requirements, those considering building a pond or reservoir should examine their purposes closely. The greater the number of intended purposes, the more difficult it will be to create a pond that will satisfy all of them, because some purposes may be in conflict with one another. For example, many courses could easily provide a pond in front of the 18th green to serve as a hazard, to add a view of water from the clubhouse, and for fire protection. Yet, if the 18th green is the highest point on the course, the new pond cannot also serve easily as a drainage collection point. If the pond is for irrigation water storage, then the pumphouse will need to be adequately screened from the clubhouse view. Number 18 may even be an extremely demanding golf hole before the addition of a pond.

Certainly a pond or reservoir can serve more than one purpose. But we should recognize that we shouldn't try to have it serve too many purposes, because if we do, it will serve none of them well. Having a pond serve its purpose well is critical to a construction or rebuilding project. Determine which purposes are most desirable, and concentrate on them.

Design & Construction

Already mentioned is the influence of purpose on the design and construction of a golf course pond. Another major influence is that of economics, and this should be of *both* construction *and* future maintenance. The cost of maintenance is too often overlooked in golf course construction projects. An initial savings in construction may often result in future maintenance costs far exceeding the original savings. Initially designing and building it right for efficient maintenance will save money in the long run.

Proper location of a pond is important and illustrates the potential conflict of purposes. As an irrigation reservoir, the ideal location would be centrally on the course at a high elevation, to minimize pumping costs. For use in drainage and water collection, a low elevation would be required for simplest operation. Housing lots with a view of water will bring a higher price, perhaps more than offsetting the construction costs. If a pond is to act as a hazard, proper placement is critical for the desired effect on a golf hole. Water hazard placement and locating a pond for aesthetic purposes are tasks best assigned to a qualified design expert, the golf course architect. Regardless of what location the purpose may dictate, construction costs can force a change in plans. Because the cost of excavation might range from 60¢ to $5 per cubic yard, depending on soil type and the presence of rocks, changing locations may be the only means of affording a pond.

With an almost infinite number of pond shapes to choose from, it is best to rely on the judgement of a golf course architect to assign the desired shape. As to size, the purpose again exerts its influence. If serving to collect excess surface and subsurface drainage, the pond and spillways must be able to accommodate runoff without the pond overflowing. An irrigation reservoir might hold just enough water for one irrigation cycle, being filled in the interval between irrigations, or can be used to increase pumping capacity by accumulating a limited flow source until an adequate supply is available. The largest capacity reservoir is desired if its purpose is to store water for later use during a drought.

One of the most frequent mistakes in building golf course ponds is the failure to provide adequate depth. Particularly in warmer climates, a shallow pond is prone to algae and aquatic weed problems. Even if a pond is only to serve as a hazard or design feature, eight to 10 feet should be the minimum depth considered. Failure to provide this depth will increase weed control costs, if not create a permanent eyesore. Evaporation losses are also reduced in deep ponds.

Bank maintenance makes up a large part of pond maintenance costs, and, therefore, bank characteristics must be adequately considered. Although reducing the safety factor, steeper slopes (but no less than 4 to 1) are preferred for several reasons: They minimize the amount of shallow water, reducing weed control problems, limit the time spent searching for golf balls during play, and they reduce the bank surface area exposed to erosion from wave agitation.

Above the water surface, many different bank materials have been successfully used. They include gabions, rocks of assorted shapes and sizes, concrete poured or applied as gunite, and crushed concrete or asphalt. Other types of banks include steep slopes of natural vegetation, which require limited maintenance, or more gradually sloped banks of turf mowed regularly along with roughs. Probably the best above-water bank design is that which requires minimal maintenance or one which can be maintained in the same manner as other parts of the course.

On most courses, the more natural look of turf, rock, or native vegetation would be considered more desirable than the manufactured look of a poured concrete ring. When constructing banks, remove fertile topsoil and you will minimize aquatic weed problems. Also, to avoid deposition of organic matter and debris into a pond, it will be desirable to prevent surface runoff from entering the pond through appropriate contouring around banks.

Actual pond construction methods will vary greatly, depending on location. To minimize excavation costs, a low area of a course might serve as a pond

simply by construction of one or more dams. On an extremely flat course, total excavation of the pond area may be the only means of providing a pond. Typically, pond construction involves both damming and excavating in a cut-and-fill process. As mentioned earlier, excavation is a major cost in pond building and may vary considerably, but saving excavation costs initially by building a shallow pond should be avoided.

The second major construction cost is that of sealing, and several methods deserve consideration. Perhaps the best and least expensive one is the use of two to three six-inch layers of impervious clay subsoil, alternately placed and compacted. Unfortunately, if such a clay material is not available near or on location, the costs of transport are likely prohibitive. The most expensive, although not necessarily the most effective method, is using a rigid material such as concrete, either poured or applied gunite. Other than cost, the chief disadvantage of a rigid lining is the possibility of cracking, thus reducing effectiveness. More commonly used sealing methods include the use of chemical or bentonite linings or a flexible membrane such as PVC.

A beautiful view from the clubhouse, Fort Wayne Country Club, Fort Wayne, Indiana.

Algae — a common weed problem.

Bentonite and chemical liners both rely on clogging soil pores to block seepage, bentonite being effective because of its extreme swelling characteristics when wetted. Although an effective seal can sometimes be gained using bentonite or a chemical sealant, and at up to 50 percent savings over a flexible membrane lining, there are serious limitations. Greater amounts are required for more permeable soils, reducing the cost advantage, and in very coarse or gravelly soils, an effective seal may not be possible.

It is probably due to past sealing failures that more pond builders today are using flexible membrane liners. When properly installed, a PVC liner can provide a 100 percent seal over a long period of time. Normal procedure calls for excavation of the pond basin to a depth of one foot below the desired final elevation. The surface must then be checked for any sharp rocks, etc., which could damage the liner. In some cases, a fill material might be utilized for protection between sharp objects and the liner. For a pond less than 30 feet deep, a 10mm PVC liner thickness will be adequate, and after installation it should be covered carefully with 12 inches of fill soil, preferably infertile, which is compacted for added protection. An "anchor" trench of about one foot in depth is dug approximately two feet above the intended water level, where the edge of the liner can be secured. The cost of a PVC liner and the installation procedures discussed above will vary with the size of the pond, the price of labor, and the availability of fill soil, and current estimates range from 30¢ to 50¢ per square foot. It must be emphasized that the best time to effectively seal a pond is during original construction. Failure to do this results in additional costs for later sealing, if possible, and a poorly performing pond in the interim.

Another desirable design feature is providing a means to control the pond water level through inlets and outlets. An important aspect of pond inlets is the avoidance of bank erosion from water flow. By directing inflowing water out away from the banks or providing an erosion-proof surface such as concrete at the inlet, erosion will be reduced. If water flows into the pond from surface runoff and subsurface drainage, outlets and spillways must be of sufficient size to avoid frequent pond overflow when it rains. Outlets can also provide the capability to totally drain a pond, which can aid in weed and fish control, bottom cleaning and repair of leakage.

Maintenance

Proper pond design and construction will minimize maintenance requirements and potential problems, but even the "perfect" pond will still need some types of regular care. They include marking, bank maintenance, and aquatic vegetation control.

Unless the ponds on a golf course are totally out of bounds, they should be marked in accordance with the Rules of Golf. Failure to properly mark water hazards results in incorrect drops, inappropriately grounded clubs by golfers, and potential arguments about casual water. From the Rules of Golf, a "water hazard" is defined as any sea, lake, pond, river, ditch, surface drainage ditch or other open water course (regardless of whether or not it contains water), and anything of a similar nature. All ground or water within the margin of a water hazard, whether or not it be covered with any growing substance, is part of the water hazard. The margin of a water hazard is deemed to extend vertically upwards and should be defined by yellow stakes or lines.

A "lateral water hazard" is defined by red stakes or lines. It is a water hazard or that part of a water hazard so situated that it is not possible or is deemed by the Committee to be impracticable to drop a ball behind the water hazard and keep the spot at which the ball last crossed the margin of the hazard between the player and the hole.

Either type of water hazard should include within its marked boundaries the water area, rough banks, and unkempt growth relating directly to it. A natural break or abrupt change in slope is often used as the hazard boundary. When stakes are used, since the line from stake to stake determines the limit of the hazard, care must be used to assure that no area which should be a part of the hazard lies outside the line. For that reason, the use of painted lines may be appropriate for some or all water hazards. A disadvantage of marking paint is the need to regularly repaint the margins, but use of a non-selective herbicide on the narrow line prior to painting will minimize the repainting requirements.

Maintenance costs will be minimized if banks are designed to be virtually maintenance-free, such as rock or stone, or if turf is maintained which can be mowed regularly with other areas of the course. Another low-maintenance possibility is the use of native or introduced plants which form a dense cover. Weed invasion will occur in many types of pond banks, and to keep weeds in check, regular herbicide applications may be required. Regular repair of bank erosion is also necessary, because eroded areas can quickly increase in size if they are neglected.

Probably the most frustrating aspect of pond maintenance is that of controlling aquatic vegetation. This topic alone is worthy of a series of articles; only a few key points will be addressed here. Already mentioned are the needs for adequate water depth and to minimize the amount of shallow water by utilizing steep banks. Deeper water is less subject to aquatic vegetation growth because of its lower temperature and the reduced sunlight it receives. Also affecting aquatic growth is the fertility level of water and soil on pond banks or bottoms. It is probably impossible to do anything but accept the fertility level of the water you obtain, and there are benefits to being able to irrigate with nutrient-rich water. However, to minimize pond nutrient content, any organic matter and nutrient deposition into ponds should be avoided. Beneficial practices include reducing fertilization of turf around ponds and preventing surface water from depositing grass clippings and other organic debris.

Other means of minimizing aquatic growth include the use of dyes and pond aerators. The effect of dyes is to restrict light penetration, reducing some aquatic growth by limiting photosynthesis. Aerators prevent excessive temperature buildup by circulating water throughout a pond. The increased oxygen levels generated encourage organic matter decomposition, limiting the buildup of dead vegetation, which reduces pond depth and water-holding capacity. By promoting decomposition, the unpleasant odor of stagnant ponds is also lessened through aeration. The reduced carbon dioxide level present in aerated ponds limits algae growth, and the improved water circulation enhances distribution of applied chemicals, increasing effectiveness. Despite all the other advantages, the attractive appearance of water streaming toward the sky may be reason enough for the installation of a pond aerator.

Even when design and management practices favor reduced aquatic weed populations, some control measures will usually be necessary. Options include physical removal, chemical treatment, control through changing the water level, or biological control using vegetation-eating fish. Control measures should begin early enough in the growing season (when the water temperature reaches 56 degrees F.) to insure staying ahead of the problem. As with any type of pest control, proper identification of the pest is the appropriate first step. Aquatic weeds are typically placed in one of four groups: emersed, submersed, floating or algae. Without correct identification, control may be unsuccessful. Use of chemicals for aquatic weed control requires special precautions because of the potential to contaminate fresh water supplies used for irrigation or human or animal consumption. Utilize local expert sources on the subject and always read, understand, and follow label directions.

Summary

Many existing golf course ponds are plagued with problems, do not perform their intended function, or their appearance detracts from, rather than enhances, the golf course. Much of the blame can be placed on a desire to save money during original construction. Through careful planning in the initial construction (or in later rebuilding) and regular maintenance, ugly ponds can be avoided. That eyesore can become an eyecatcher!

A YOUNG ASSISTANT GOLF COURSE SUPERINTENDENT PROVIDES SOME FACTS FOR AN AGE-OLD CONTROVERSY

Comparing Maintenance Costs: Bentgrass Versus Bermudagrass Greens

by **MIKE DAVIS**, Assistant Golf Course Superintendent, Callaway Gardens, Pine Mountain, Georgia

EVEN TODAY, the questions and discussions revolving around the subject of bentgrass vs. bermudagrass greens in southern regions seems endless. Which grass really does produce the highest putting quality and most practical putting surface for southern regions? Here, at Callaway Gardens, Georgia, we have an unusual opportunity for comparing one grass over the other, as well as comparing the costs for maintaining each type of green. Of course, our turf programs may vary quite widely from other golf courses, depending upon location, number of rounds, personnel, turf needs, budget, or maintenance practices. Whatever the case may be, we all strive to have the best possible playing surface within the budget given us.

I have taken actual cost figures from two of our courses at Callaway Gardens. Hopefully, some of this information will be of use in deciding if you want bent or bermuda for planting new greens or in consideration of converting older ones from bermudagrass to bentgrass. Both grasses have their own benefits and their own management requirements.

The two courses we are comparing in cost are the Lake View Golf Course and the Gardens View Golf Course. Lake View was constructed in 1949. It presently has Tifgreen (328) bermudagrass on its 100,000 square feet of total putting area. Good air circulation is a problem with trees on either two or three sides of 13 of the 18 greens. With 98 acres of maintained turf, dog-legged fairways and picturesque scenery, it is

Bermudagrass/Bentgrass Comparisons

1978	Bermudagrass		Bentgrass		Cost Difference
	Total	Cost/M	Total	Cost/M	Per 1,000 sq. ft.
Fungicides	$2,236	$22.36	$3,906	$37.20	Bent = $14.84 More/M
Insecticides	139	1.39	162	1.54	Bent = $.15 More/M
Pre-Emergent Herbicides	155	1.55	325	3.10	Bent = $1.55 More/M
Overseeding	4,000	40.00	00	00.00	Bermuda = $40 More/M
Fertilizer	2,450	24.50	992	9.59	Bermuda = $14.91 More/M
	A Cost Difference of $38.37/M "More" on the Bermuda Greens/M				
Estimated Number of Golf Rounds for 1978	Lake View (328) 37,000				Gardens View (Bent) 35,500

1979	Bermudagrass		Bentgrass		Cost Difference
	Total	Cost/M	Total	Cost/M	Per 1,000 sq. ft.
Fungicides	$5,149	$51.49	$3,400	$32.38	Bent = $19.11 More/M
Insecticides	343	3.43	501	4.77	Bent = $1.34 More/M
Pre-Emergent Herbicides	180	1.80	3.51	3.34	Bent = $1.54 More/M
Overseeding	2,500	25.00	0.00	0.00	Bermuda = $25 More/M
Fertilizer	2,407	24.07	1029	9.80	Bermuda = $14.27 More/M
	A Cost Difference of $55.50/M "More" on the Bermuda Greens/M				
Estimated Number of Golf Rounds for 1979	Lake View (328) 40,000				Gardens View (Bent) 32,500

1980	Bermudagrass		Bentgrass		Cost Difference
	Total	Cost/M	Total	Cost/M	Per 1,000 sq. ft.
Fungicides	$1,748	$17.48	$4,286	$40.81	Bent = $23.33 More/M
Insecticides	186	1.86	391	3.72	Bent = $1.86 More/M
Pre-Emergent Herbicides	310	3.10	370	3.52	Bent = $.42 More/M
Overseeding	1,800	18.00	0.00	0.00	Bermuda = $18.00 More/M
Fertilizer	2,786	27.86	1,056.50	10.06	Bermuda = $17.80 More/M
	A Cost Difference of $10.19/M "More" on the Bermuda Greens/M				
Estimated Number of Golf Rounds for 1980	Lake View (328) 42,500				Gardens View (Bent) 36,000

the golfer's favorite of the four courses. Percolation on the greens averages about an inch per hour.

The Gardens View Course was constructed and planted with Penncross bentgrass in 1969 on 105,000 square feet of putting surface. Air circulation is good on 15 of the 18 greens, but soil percolation is poor, averaging .09 inches per hour. With the high humidity in our area and the poor drainage of the greens, it is easy to understand the disease potential here. Although Gardens View is not as challenging as Lake View, bentgrass lovers come to this course to test their putting skills on these fast and slick greens.

The main pests in our area are armyworms, goosegrass, annual bluegrass, leaf spot diseases, curvularia, large brown patch and pythium. As you look over the above charts, these are the target pests that run up the cost for managing both grasses on our greens. They contain what we believe to be the highest-cost areas for managing bentgrass and bermudagrass during the past three years.

Fungicides

Turfgrass diseases never miss the opportunity to invade our greens when conditions are favorable on our poorly drained soil. The years 1978 and 1980 were normal for spraying, but 1979 was abnormal on the bermuda greens. Leaf spot was a constant problem throughout the growing season. When the greens were overseeded in the fall, pythium also tried its best to take hold and wipe out our overseeding program. With regular applications of fungicides for the leaf spot disease plus the cost of a good pythium fungicide at curative rates, it did not take long for the fungicide cost per 1,000 square feet to skyrocket.

Insecticides

The only turf-damaging insects that are presently chemically controlled on our greens are the armyworms. They are abundant on both grass varieties. They do favor the bentgrass, as the charts show, each year. Different insecticides are rotated with each application to discourage possible immunity buildup to any one insecticide. We keep three different insecticides in stock for armyworm control.

Pre-emergent Herbicides

These are applied for the control of goosegrass (*Elucine indica*) and annual bluegrass (*Poa annua*). The cost is higher per 1,000 square feet on the bentgrass greens for two reasons. Bentgrass is not overseeded on a yearly program, as is the bermuda green, and, therefore, we can apply pre-emergence materials more frequently without worry of later problems on overseeded greens.

Each year our overseeding target date is October 1. Therefore, the pre-emergent applications must be backed up at least 45 to 90 days, depending on the label instructions, in order to safely sow our seeds to the bermuda greens. We feel we lose a little less control on late germinating goosegrass seeds and early germinating annual bluegrass seeds on the bermuda greens. The application of activated charcoal, to erase the activity of the pre-emergent materials in the soil, is not yet a regular part of our program, even though it has brought on some heavy discussion.

The second reason for using more pre-emergent herbicides on bentgrass greens is to eliminate the need for later post-emergent applications. When bermudagrass really gets growing in June and July, goosegrass is also well underway. We can apply post-emergent herbicides to these greens and get fair to good control with only slight discoloration for a short period. On the other hand, availability of post-emergent materials for goosegrass control in bentgrass is quite limited. Bentgrass is not in its most vigorous stage during these hot months, but goosegrass is extremely active. With heat and humidity already a stress factor, we find it best not to apply a post-emergent material to bent. It would only create more problems and we do not want to look at off-color greens for a long time. The weed seedlings that do survive the pre-emergence treatment are removed by hand.

Overseeding

The charts show the annual costs for quality putting surfaces. The costs per 1,000 square feet vary considerably for several reasons. In 1978 we had tournaments booked in early November, including the PGA Club Professional Championship. It was decided that greens should be seeded at a maximum rate to give a quicker, more dense germination. This in turn would give better putting surfaces for the earlier tournaments on the newly seeded greens. Even though the same program was followed for 1979, the seed market prices made a considerable difference. The cost was much more for perennial ryegrass per pound in 1978 than in 1979, and this shows an enormous cost difference per 1,000 square feet. In 1980, the seed cost per pound was almost identical to 1979, but our seeding rate was cut considerably. Keep in mind that the cost of seed, type of seed you decide to use, and the rate you decide to sow all play a very important part in the annual cost. We normally sow a minimum of 30 pounds per 1,000 square feet and, at times, have gone up to 40 pounds per 1,000 square feet for our overseeded greens. Our type? Manhattan perennial ryegrass continues to be our choice.

Bentgrass greens normally do not receive yearly overseedings. Every so often you may make the decision to overseed some of the weaker greens to improve density or increase bentgrass populations. We find this a good practice from time to time, but the cost will hardly exceed the price of a couple cases of a good fungicide. Nevertheless, this type of seeding could be costly if you have pre-emergents still active in the soil. Check your spray records for the application date and be safe.

Fertilizer

Fertilizer application is the one area we have the most control over, and the cost of fertilizer has been the most stable in the past three years. The bermuda greens receive a normal feeding of 20 to 24 pounds of actual nitrogen per year. Fertilizer applications are based on our projected needs to withstand heavy wear and to maintain the best appearance and putting surface possible for our guests. The heaviest applications are applied from April through September and then foliage fed as needed on the overseeded ryegrass greens. Fertilizer analysis is determined from soil tests taken in October or November every year on all tees, greens and fairways.

Bentgrass greens show a favorable savings each year in fertilizer costs. Our normal fertilizer program consists of six to nine pounds of actual nitrogen per year. The time of applications is just the opposite of the bermuda greens. We feed heavier from October through March and foliage feed very little, if any at all, from April until September.

Summary

A number of turf maintenance practices are not listed on the charts. These practices include aerifying, spiking, verticutting and brushing. We have found that the same amount of attention is given to these matters regardless of the type of grass. We aerify all greens two times per year, both bentgrass and bermudagrass. During the growing season we lightly verticut both grasses weekly. The same goes for spiking and brushing. Since these areas are handled the same, no cost difference is involved.

There are two areas in which I found it difficult to place cost differences.

1. We believe it takes approximately 30 percent more man-hours to maintain our bent greens than it does our bermuda greens. Whether it is watching closely for disease, wilt or water management and the frequent syringing during the hotter months, I cannot give you an accurate time or cost figure. I hope the summer of 1980 was an exception to the 30 percent estimate. If all summers were like 1980, I feel an 80 percent estimate would be more correct to watch over the bentgrass greens.

2. A big factor concerning our bentgrass program is revenue. It is a written policy that, during July, August and September, the bent course is not open for afternoon play. This might be a major problem for a regular 18-hole golf course operation. We are fortunate in not having that consideration at Callaway Gardens. We check the bent greens regularly for wilt and syringe them so often to cool them down, that we feel the golfers would not enjoy their game with our frequent interference. Furthermore, bentgrass does not need high traffic wear and heat mixed together in the same afternoon.

I have no idea how much revenue we may lose through this policy. However, the decision is a sound one agronomically and managing summer bentgrass greens is much safer at The Gardens because of it.

I've Never Seen THAT Before!

Sclerotium rolfsii Blight On Golf Greens

by **TOM UNRUH**, Golf Course Superintendent,
Del Paso Country Club, Sacramento, California

and **DR. ZAMIR K. PUNJA**,
University of California, Davis, California

Figure 1

MOST GOLF course superintendents have at some time seen unusual spotting or discolorations on their greens, problems which may not always be easy to diagnose, even with the help of color photographs available in our literature. With luck and a little time, these unusual markings may develop into something recognizable; better yet, they could go away. But what if they get worse, much worse? At the Del Paso Country Club, in Sacramento, California, that is exactly what happened on the greens, starting in the summer of 1977.

A few small, irregular, yellowish rings appeared in June of that year (Figure 1). The rings neither expanded nor healed. Turf samples were taken to the plant pathology section of the State Department of Agriculture, where the disease was identified as being caused by the fungus *Sclerotium*. The description of this fungus indicated that it was not normally found on turf! Fortunately, like all happy turf disease stories, the problem faded away in 1977.

But the disease returned in 1978 with a vengeance not to be forgotten. By July 1, about 30 percent of the area of the 18th green, where the disease was first seen, was brown, and the problem was identified as being due to the fungus *Sclerotium rolfsii*, causing southern blight disease (Figure 2). There were no fungicides registered on turf for control of the disease at the time.

Because our plight was not seen on national television, we did not receive instant offers of assistance from across the nation. We thus began to seek help from knowledgeable persons in our area. As word of our problem spread, we received an offer of assistance from Zamir K. Punja, at the University of California at Davis, who was working at the time on *S. rolfsii* affecting vegetable crops. It also became apparent that this disease was occurring on golf courses in Southern California, and through cooperation, the trading of information began. Today, after three years of work and research, we feel we can control this disease on turf. All preliminary work was done at the Plant Pathology Department at U.C. Davis, while the field work was carried out on the practice putting green at Del Paso Country Club.

Because this disease has had little exposure or fame, it will benefit many to be familiar with it, the symptoms that it produces, and fungicides which should be considered for its control.

THE DISEASE on golf greens was first seen in 1975 in North Carolina, and it showed up on greens in California in 1977. The turf varieties primarily affected in Sacramento are *Poa annua*, bentgrass, and ryegrass. Common bermuda is the only resistant turf species noticed so far. Unfortunately, varietal studies have not yet been conducted, so it is not possible to determine whether tolerant varieties exist.

The fungus is soil-borne and affects over 500 species of plants, including tree fruits, vegetables, and ornamentals. It produces large numbers of resistant structures (sclerotia) which are round, brown in color and resemble mustard seeds. They germinate to produce mycelium (Figure 3) which starts the disease. Initially, the spots on greens appear as yellowish patches that progress into crescent-shaped and eventually circular spots with living turf in the center (Figures 1 and 2). The spots vary from eight to 36 inches in diameter. The disease progresses rapidly at temperatures above 75°F and flourishes with high moisture and thatchy conditions. By providing greater aerification and reducing the thatch, it may be possible to slow down development of the spots, because growth of the fungus is retarded. The fungus also grows best between pH 3.0 and 5.0, and growth is reduced above pH 7.0.

Again, it may be possible to reduce development of the spots by raising the soil pH to above 7.0 with repeated applications of lime. Also, by addition of excess nitrogen in the form of ammonium sulfate, for example, the progress of the disease can be reduced. Keep in mind, however, that these cultural methods of control only reduce development of the spots and do not control the disease or stop it completely. We have tested these methods and have found them to be much less effective and not as practical as, say, the use of effective fungicides.

We also explored the possibility of using biological control against *S. rolfsii*. The soil-inhabiting fungus *Trichoderma* that is present in most soils, attacks the sclerotia of *S. rolfsii*, causing them to rot. *Trichoderma* has been used to successfully control southern blight on blue lupine, tomatoes, and peanuts in other areas of the U.S. By applying *Trichoderma* to the greens, we hoped to destroy the sclerotia already present and so reduce the disease.

In 1979, *Trichoderma* was grown in the laboratory on diatomaceous-earth granules impregnated with molasses solution as a nutrient source, and

Figure 2

Figure 3

applied to two greens at three different times. By analyses of soil samples taken weekly from treated areas, we demonstrated that *Trichoderma* levels in treated plots were much higher than in untreated areas. Unfortunately, the amount of disease in most of the treated plots was not significantly reduced in 1979, although some treated plots showed reduction in disease. Usually, results from biological control attempts in which one fungus (*Trichoderma*) is used to reduce another (*S. rolfsii*) are not as dramatic, clear-cut, consistent, or rapid as we would like to see. However, it has potential for use in control of disease and deserves further investigation.

BY THE SUMMER of 1980, the southern blight disease was reported on 12 golf courses throughout California. Then, and even today, there were no fungicides specifically registered for the control of *S. rolfsii* on golf greens in California. Studies were conducted at Davis in 1979-80 to determine which of the available fungicides could prevent sclerotia from germinating, because

Sclerotium rolfsii *blight on golf greens. Figure 1: Initial spotting of the green as it appears in the early spring. Figure 2: Severely infected green showing disease spots as they appear in midsummer. Figure 3: Slerotium germinating to produce mycelium. Figure 4: Experimental plots on the practice green showing levels of control achieved with different materials. Most heavily diseased plot on lower left is the check plot. Figure 5: Comparison of PCNB-treated plot (left) with check plot (right).*

Figure 4

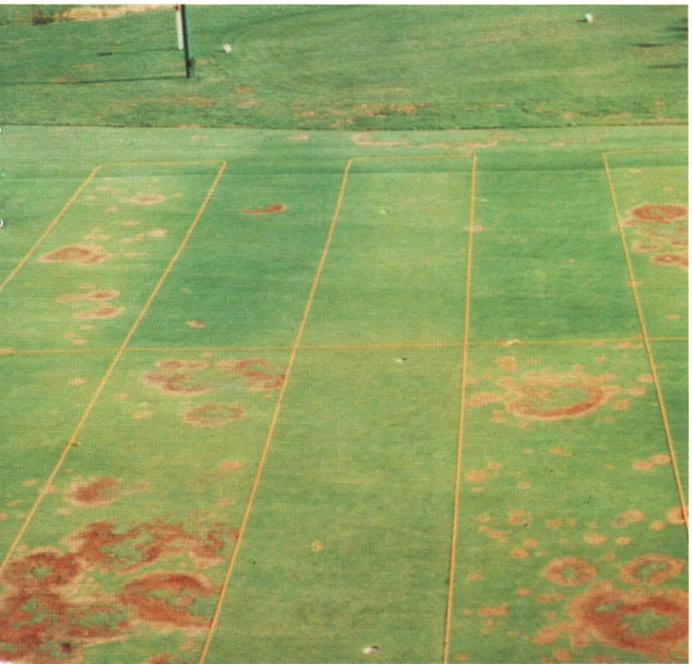


Figure 5

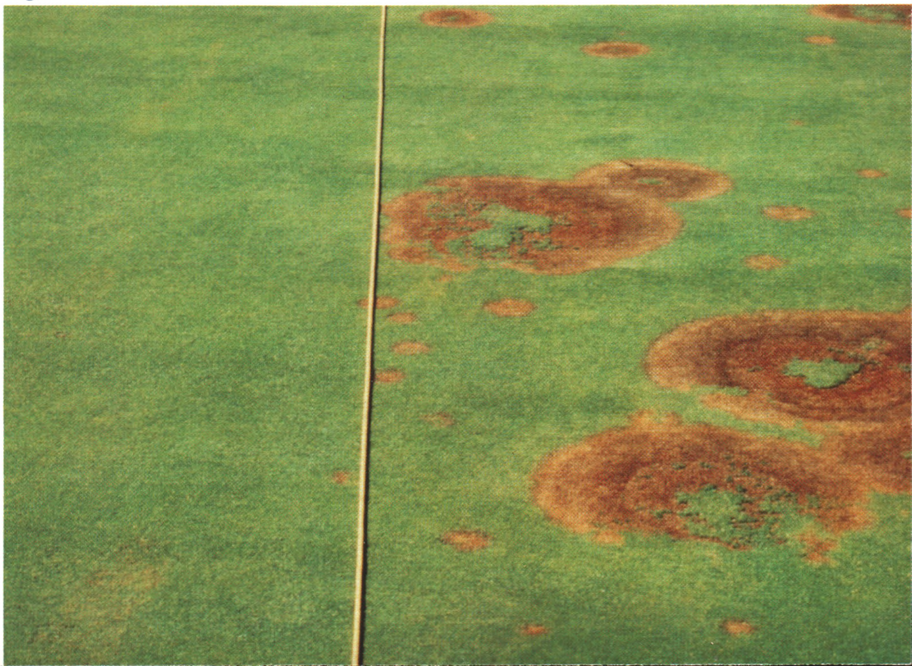


TABLE 1
Results from Chemical Control Trials against *Sclerotium rolfsii* Blight on Golf Greens carried out at Del Paso in 1980-81

Treatment	Rate (in ounces active material per 1,000 sq. ft.)	Average number of diseased spots in each plot	Percent of area of each plot that was diseased
1980			
Botran + Actidione	4.9 + 1.4	3	0.9
Captan	26	2	0.2
Dithane M-45	31	31	13.4
PCNB	7	0	0
Vitavax	7	3	0.2
Ammonium bicarbonate	6.4	2	0.8
Ammonium sulfate	8.1	2	2.3
Check	0	20	17.9
1981			
Vitavax + Captan	3.5 + 12.0	0	0
Vitavax + ammonium bicarbonate	3.5 + 3.0	0	0
OAG 3890	2.0	3	0.6
Check	0	15	15.4

these sclerotia spread the disease and occur in large numbers in the thatch. Subsequently, the best of these fungicides were tested in the field in 1980-81 on an experimental basis. Twenty-two different fungicides and 33 inorganic salts (some containing calcium, others with nitrogen, such as calcium nitrate, ammonium sulfate) were first tested in the laboratory against the sclerotia. Of these, eight fungicides and 17 salts showed promise.

In the spring of 1980, the experimental trials were initiated on the practice putting green, on which we observed uniform disease distribution in 1979. Five fungicides (Botran-Actidione, Captan, Dithane M-45, PCNB, and Vitavax) and two salts (ammonium sulfate and ammonium bicarbonate) selected from the previous screening processes were used. The fungicides were applied to the plots at rates two to three times higher than the label rates because previous attempts at control of *S. rolfsii* using label rates of some of these materials were unsuccessful. The materials were applied every 14 days, beginning on May 5. All materials were watered into the turf after application. In 1981, the trials were repeated on the putting green, and the same five fungicides used in 1980 were tested, but at lower rates. Also, we combined Vitavax with Captan, Vitavax with ammonium bicarbonate and also tested an experimental fungicide, OAG 3890. We also tested calcium nitrate and hydrated lime.

Disease severity was assessed by counting the total number of diseased spots of all sizes in each plot and then estimating the percent of the total area that was diseased in each plot. The significant results from the experimental trials in 1980 and 1981 can be seen in Table 1.

The method of applying the materials was very important in preventing burning of the turf. Some of the fungicides cause phytotoxicity when applied in midsummer when temperatures are high. Also, inorganic salts such as ammonium bicarbonate can cause burning, as would any fertilizer if it were not applied at the correct rate. In our trials, if the materials were applied to relatively dry greens and then heavily watered in within minutes of application, there was no phytotoxic reaction. The purpose of the heavy irrigation was to get the material off the foliage and into the area of the crown and into the thatch. This procedure prevents leaf burning and gets the material into the areas where the sclerotia are usually found.

THE RESULTS of the work done in 1980 and in 1981 indicated that PCNB (Terraclor) and Vitavax were very effective in controlling *S. rolfsii* blight (Figures 4 and 5). Botran-Actidione mixture and Captan also prevented serious outbreaks of the disease. Combining reduced rates of Vitavax with reduced rates of Captan or ammonium bicarbonate gave better control than each chemical applied alone at higher rates. Application of nitrogen-containing materials reduced the amount of disease, but it probably is not a practical means of control. Although all materials were applied routinely every 14 days, it may be possible to reduce the number of applications and the amount of fungicide used, or vice versa, depending on the severity of the problem and individual circumstances.

We should point out, however, that none of the materials tested kill the sclerotia; therefore, the fungus is still there and the disease will reappear unless efforts are made to prevent its reestablishment.

The Green Section and the Turfgrass Advisory Service

Since 1953, the Green Section has been offering a Turfgrass Advisory Service to USGA Member Clubs to assist in resolving turfgrass problems.

Effective January 1, 1982, the fee for the Turfgrass Advisory Service will be $350 for one visit. The fee for two or more visits, if payment is made **prior to March 1**, is as follows:

Two visits — $500
Subsequent visits (three or more) — $250 per visit

Although the fee has been increased, it is less than the price charged in 1977! The fee has been raised to meet the ever-increasing costs of operation. The USGA Green Section Turfgrass Advisory Service is a nonprofit effort designed to provide an important service to USGA member clubs.

We hope you will support the USGA through its Green Section and Turf Advisory Service. The Service will in turn provide you with the latest unbiased information regarding the proper conditioning and maintenance of golfing turf.

Original practice range designed by Donald Ross (1914), at Siwanoy Country Club, New York.

Practice Ranges - Are They Neglected?

by WILLIAM S. BREWER
Senior Agronomist, Eastern Region, USGA Green Section

ITEM — Some years ago a major golf magazine published a well-known amateur golfer's remarks deploring the condition of the practice range at his home course. This was followed shortly by a heated "letter to the editor" from the golf course superintendent to the effect that the distinguished gentleman did not adequately appreciate the situation. Did he realize the difficulties, costs, relatively low priority in the competition for funding and the general lack of golfer cooperation in the care of the range?

ITEM — For the September, 1981, issue of the *Green Section Record*, Herb Graffis wrote an article about lesson and practice areas under the title "Golf Neglects the Idea that Made It Big."

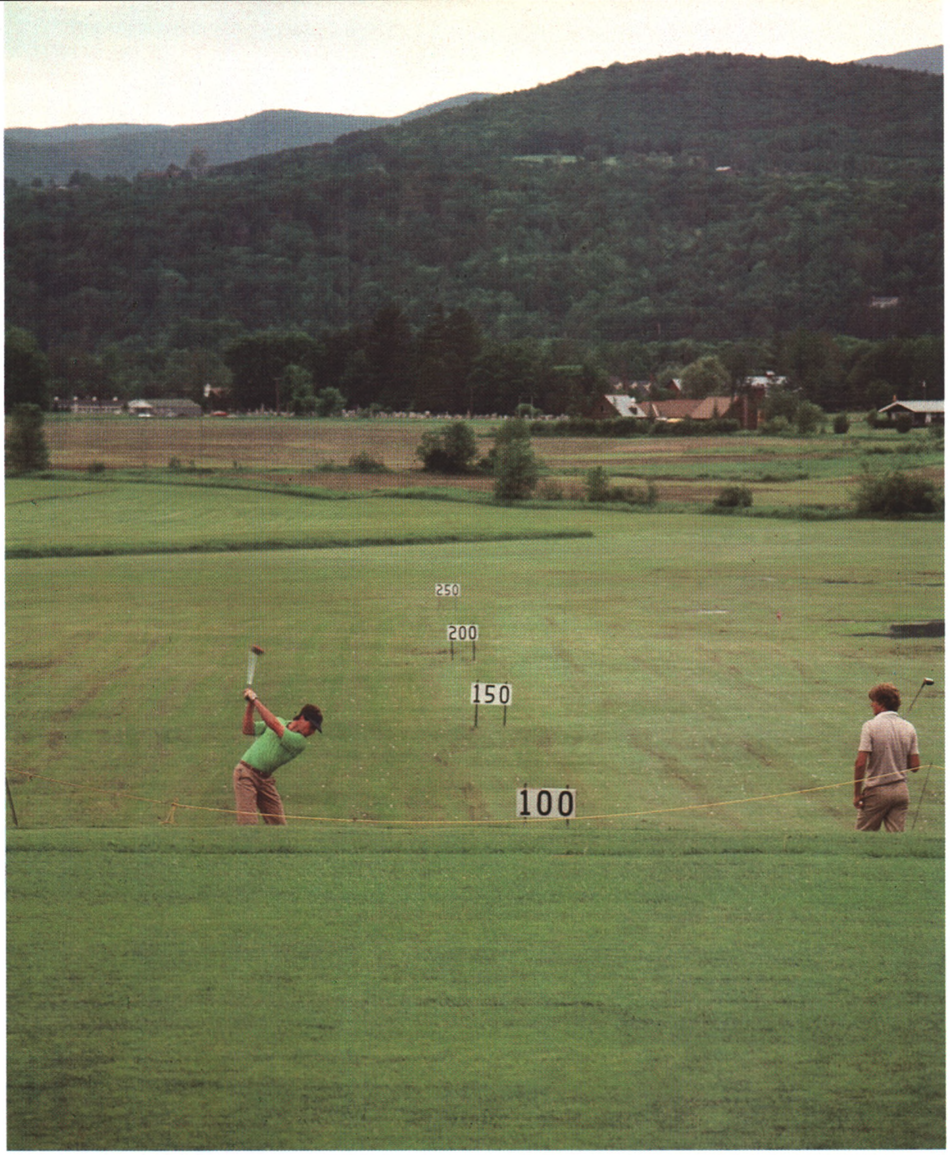
ITEM — As a keen observer of the golf course maintenance scene, retired Green Section National Director Al Radko summed up prevailing impressions this way: "Practice ranges at golf courses are often an eyesore in an otherwise plush setting. The range, a most desirable facility, is too frequently neglected in the budget and is given little incentive for improvement."

Given this background, I set out to survey the situation during my Turf Advisory Service consultations in 1981. The study was done in the Northeastern states mainly, but the results may well prove of general interest nationwide.

THE RESULTS

Number of courses surveyed	125	
Number with inadequate ranges	75	(60%)
Number with adequate ranges	25	(20%)
Number with good ranges	25	(20%)

To the statistician, the results of the survey should not be considered statistically valid even for this section of the country. Still, the findings indicate that the situation is not quite as bad as many might have thought. This is especially true when the surveyed courses are considered as a group.



Practice range at Stowe Country Club, Vermont. A good facility; upper tee roped off for turf recovery period.

Individually, however, far too many courses clearly provide inadequate facilities, and many have no practice range at all.

THE DEFICIENCIES*

No practice range	43
Practice teeing area too small	12
Range fairway too small (under 100 yards wide — 3; under 250 yards long — 25)	28
Agronomic limitations (For example, severe drainage problems or lack of irrigation for tee)	11
Teeing surface (not up to expectations for smoothness and turf density)	most

*These numbers do not add to 75 since some practice areas suffer from more than one deficiency. Teeing surface conditions were not considered for tabulation since few were considered to be satisfactory by the superintendents themselves.

Obviously there is an element of subjectivity involved in making the judgements about some of the noted deficiencies. Also to be considered are the relative needs of each individual course, i.e., a single 4,500-square-foot tee may be sufficient in one case, whereas another facility could require five times as much useable area. With these things in mind, an attempt was made to at least be consistent wherever situations were not clear-cut.

Another reason these findings are difficult to project overall is that there was probably a disproportionately high number of older courses sampled. In only five cases, for example, had the range been designed and built with the original course. Included in this group, interestingly enough, is the Siwanoy Country Club, in suburban New York City. It was perhaps here that architect Donald Ross first introduced the innovation of a practice range. The survey found that at some point seven courses had redesigned their course and converted one of their original golf holes into a practice range.

What is the future for practice areas on those golf courses sampled? Unfortunately, over 70 percent of those already without separate practice facilities appear not to have access to enough uncommitted land for future development. This even included — regrettably — courses designed and built without adequate practice facilities within the past decade or two, some of these being municipal operations. Two of the courses surveyed, however, have found a solution in leasing adjacent land for practicing. But one of these has also chosen to make no improvements on this area "because that might lead to an increase in the taxation rate." One course is even lucky enough to be located across the road from a commercial driving range. Surprisingly, only one of the 25 public facilities included in the survey has developed a commercial-type driving range facility of its own.

Contrary to the notion of complete neglect, a variety of projects were found to be in progress.

IMPROVEMENT ACTIVITIES (1981)

Teeing area rebuilding and/or enlarging	10
Teeing area sodding	2
Range fairway enlarging	3
Building a practice area	1
Other design improvements (drainage, irrigation, adding practice bunkers, etc.)	5
Planning to build (5) or rebuild (5) range	10

While these figures may not show a great flurry of improvement activity, they do indicate promise. Most encouraging is the finding that of the 12 surveyed courses now lacking a separate practice range but having enough extra land available, fully half of them are either in some stage of planning to build a range or have actually done so in 1981. (Two of these projects are being held up pending the approval of various state agencies.) Also notable are the five other courses making plans to rebuild ranges in different locations to overcome deficiencies in their existing situation, i.e., mostly the lack of sufficient length. The fact that several of these projects will also require some reworking of existing golf holes makes the practice area undertakings all the more impressive.

SOME MANAGEMENT IDEAS

Promising, but not revealed by the data, is the array of approaches being tried for solving some of the practice area maintenance problems more effectively and efficiently. Included are such things as:

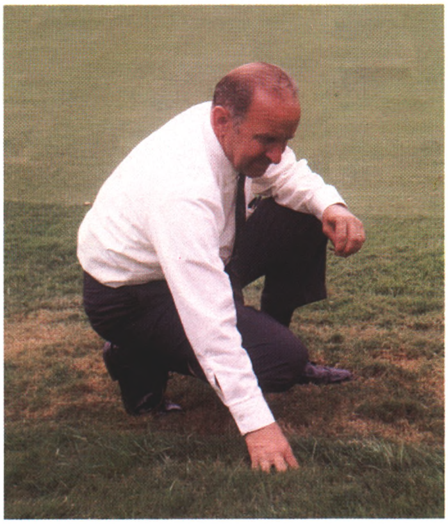
- Use of growth retardants on range fairway (to cut mowing requirements).
- Designation of "in-use" portion of teeing area with rope, pinned to the ground, and moved as needed for better control of wear patterns.
- Multiple use of range turf, including using it as fairway turf nurseries and as product testing areas.
- Use of artificial netting/screening and/or plantings as safety barriers or as backstops on short ranges (making small ranges more nearly ideal in size).
- Use of shallow (2″ depth) circles of sand as target areas.
- Restriction of one area for woods only (cutting size of teeing area in need of higher-intensity management).
- Use of compaction-limiting mesh material (Enkamat) on teaching tee area (combined with other management procedures to speed turf recovery).
- Regular teeing area topdressing and/or divot filling with soil/seed mix.
- Enlisting assistance of golf professional and golfers in maintaining surface smoothness by placing soil/seed containers on "in-use" teeing areas.

In summary, it is unfortunate that too many older courses find themselves with nowhere to go for adequate practice area development. Even some of the newer courses have been remiss in providing for this most desirable, if not absolutely essential facility. Nevertheless, golf is not neglecting this need altogether.

Of course, there remains much room for improvement. Very much to the credit of the golf course superintendent, they expressed, almost to a man, a desire to be able to upgrade practice facilities. One in particular summed up the most important aspect of the problem this way:

"The practice range is always the lowest-priority item in my budget. Every year I propose funding for improvements and a higher level of maintenance. Every year this is the first item to be eliminated. It looks like we'll just have to make do until the year comes when there is absolutely nothing else extra that needs doing anywhere at the club."

Al Radko Retires



EVERY NOW and then, if a profession is lucky enough, some special person comes along with exceptional talent, unmatched thoughtfulness and total dedication. Al Radko is such a man!

No one has worked for the good of golfing turf and the golf superintendent through the USGA Green Section longer than Al Radko's 35 years. He has traveled much of the world. He was responsible, to a large degree, for the rehabilitation of Japan's golf courses immediately after World War II. He was responsible also for the construction and care of the USGA's gift, "Ike's Green," to the White House in the early 1950s. Since graduating from the University of Maryland in 1948, he has held every possible position the Green Section has to offer: technician, agronomist, Northeast Director, National Director, Research Director, USGA Championship Course conditioning responsibilities, as well as editor of the *Green Section Record*. The USGA has been his sole employer and agronomics for golf his total avocation and occupation.

There is probably not a turf conference in the USA that Al Radko has not addressed at one time or another. There is probably not a publication in our field today that has not carried an article written by him.

For that young lad from Yonkers, New York, who has loved golf all his life — "teeing up time" is here. The good will and warm wishes of everyone who has known him or been touched by his untold contributions to better turf are extended to him in his retirement. May all his pars seem like birdies, and all the smiles in golf be as broad as his.

MAINTENANCE Aids

A TIP FROM

TIM HIERS
Former Golf Course Superintendent,
Suntree Country Club,
Melbourne, Florida

Traffic control "buttons" are excellent for control of carts and remind the driver to stay on the asphalt path. There was no turf to the left three months prior to gluing these "buttons" with expoxy glue at Suntree Country Club, Melbourne, Florida.

USGA GREEN SECTION RECORD
JANUARY/FEBRUARY 1982

TURF TWISTERS

A MILLIMHO OR TWO

Question: What in the world is a "millimho" and how is soil salinity measured? (California)

Answer: Soil salinity is usually determined by measuring the electrical conductivity of the soil solution. A soil sample is saturated with distilled water which mixes with the salt in the sample. The salt solution is then extracted and tested for its capacity to conduct an electric current. The saltier the soil, the greater its conductivity. In the past, conductivity has been expressed as "millimhos per centimeter." Now, if you think that's bad, try "deci-siemens per meter." That's the new metric unit for electrical conductivity! How much salt is represented by a conductivity of 1 deci-siemens (or 1 millimho)? It represents about two level teaspoons of table salt dissolved in five gallons of water.

ON THE GREENEST GREENS

Question: We have Seaside bentgrass greens that are 20 years old. They are really not the greenest greens our members have ever seen. In planning for the coming growing season, can we successfully overseed with another bent that might improve our color over the next few years? (New Mexico)

Answer: Although the Green Section has long preached that super "green" putting surfaces do not necessarily equal "good" putting surfaces, surely some degree of greenness is desirable. Dealing with the soils of New Mexico, you might first want to try two or three ounces of ferrous iron sulfate in five gallons of water per 1,000 square feet. Do not water in because this must be a leaf feeding. Weekly iron applications (or more often if conditions warrant) will frequently improve color during the growing season. Magnesium sulfate applications, applied in a similar manner, may also be worth investigation. In addition, check irrigation practices. Iron and magnesium deficiencies are often associated with overly wet soils. Overseeding with Penncross or Penneagle bentgrass should improve the quality of your Seaside greens. However, this writer would not expect a startling or even significant color improvement from overseeding. The problem seems more one of nutrition — iron, magnesium, or perhaps even nitrogen. Don't "overgreen" them!

MAY CAUSE A REACTION

Question: I have recently heard that a vigorous turf cover over the root system of a tree or shrub may affect the latter's growth. Is this true or false? (Idaho)

Answer: There seems to be some truth to it. Research indicates the suppression of woody plants by leachates of roots from perennial ryegrass, red fescue and Kentucky bluegrass do involve chemical inhibitors. Turfgrass competition for nitrogen may also be a factor in shrub or tree development. Competition for moisture, however, did not appear to be involved. These inter-reactions are called allelopathy.