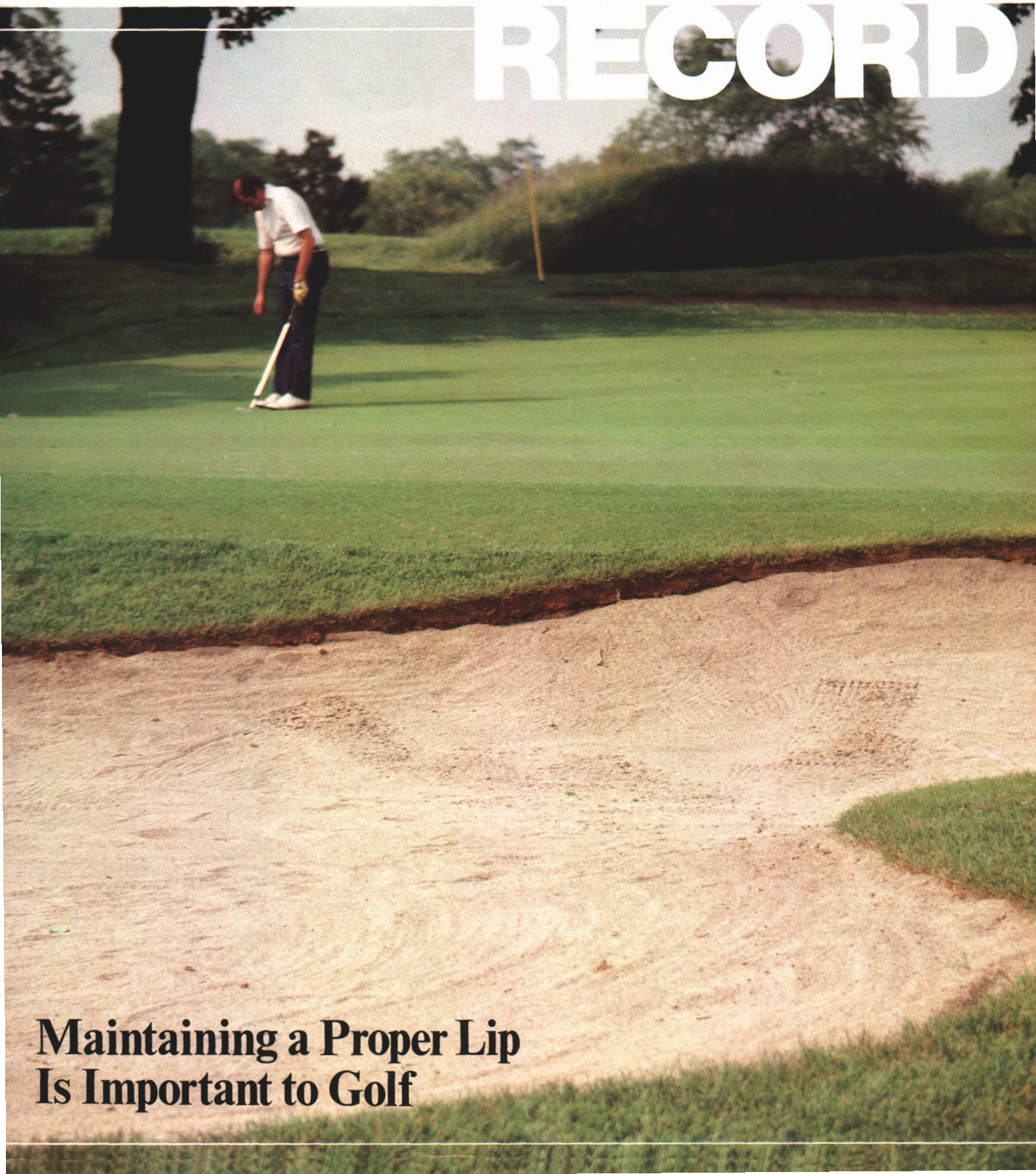
A Publication on
Turfgrass Management by the
United States Golf Association

September/October 1981

USGA Green Section RECORD



Maintaining a Proper Lip Is Important to Golf

USGA

Green Section RECORD

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Vol. 19, No. 5
SEPTEMBER/OCTOBER 1981

Cover Photo:
The eighth hole at Tedesco Country Club, Marblehead, Massachusetts.

GREEN SECTION RECORD (ISSN 0041-5502) is published six times a year in January, March, May, July, September and November by the UNITED STATES GOLF ASSOCIATION, Golf House, Far Hills, N.J. 07931. Subscriptions and address changes should be sent to the above address. Articles, photographs, and correspondence relevant to published material should be addressed to: United States Golf Association Green Section, Golf House, Far Hills, N.J. 07931. Second class postage paid at Far Hills, N.J., and other locations. Office of Publication, Golf House, Far Hills, N.J. 07931. **Subscriptions $3 a year.**

Correcting a problem area — turf above lip deteriorated and is in the process of being replaced. Baltusrol Golf Club, Springfield, New Jersey.

Sand Bunkers — Keeping That Edge

by JAMES T. SNOW
Agronomist, Northeastern Region, USGA Green Section

FEW PEOPLE INVOLVED in golf would deny the importance of the sand bunker on golf courses today, from both an appearance and playability standpoint. Yet few other features on a course are considered such a maintenance headache as the sand bunker. When everything is considered — including the need for edging, weeding, raking, trimming, adding sand, and occasional renovation or reconstruction, much of which must be done by hand — the claims that sand bunkers are high maintenance features probably have some merit. However, just like every other feature on a golf course, a well-designed, properly constructed, and well-maintained sand bunker need not be a heavy burden for the golf course superintendent.

If design and construction faults are evident, they can often be modified or corrected without major expense. In fact, it is less often design or construction problems that cause labor-intensive maintenance for sand bunkers than the extremely high standards demanded by much of the golfing public.

It is often said that overgrooming is overspending, and this is certainly the case with sand bunkers at many courses.

Changing the public attitude toward grooming standards for sand bunker maintenance is not the only thing that can be done to reduce costs. Maintenance practices that actually increase the cost of maintenance and contribute to bunker deterioration, some of which have been considered acceptable for many years, need to be reviewed and modified.

Establishing an Edge

Maintaining a well-defined edge along the border of the sand bunker is one indication of a properly kept golf course. Not only is this important from a playability standpoint, so that the golfer can determine if he is in the hazard, but the effectiveness of the bunker as a visual component in the landscape may be spoiled or enhanced by the manner the edge is kept.

Sand bunkers may have two types of edges, depending on the design and location of the bunker. A 2- to 4-inch vertical lip should be maintained *only* on a greenside bunker from which it is possible to escape and reach the green by putting and *only* on the edge facing the direction of play. A common mistake is to establish a lip around the entire perimeter of the greenside bunker or on bunkers located away from the green, a practice which serves no practical purpose. A golf ball nestled next to a sharp lip along the back side of a greenside or fairway bunker may not leave the golfer an opportunity to advance the ball toward the hole, a situation which is considered unnecessarily severe. Sand should be raked and kept at the soil line in these areas.

The importance of edging sand bunkers cannot be overstated, and yet it seems that the time and money spent on this annual or semi-annual effort could be reduced by adopting a different philosophy and changing some common practices. Is a sharply delineated, clean-shaven lip or edge really necessary, does it serve a purpose, or is it even really attractive? This type of lip is usually achieved by using a power edger several times each year or by removing several inches of the lip with square-edged shovels. There are many who believe that this look is too artificial and represents overgrooming, though this is really a matter of personal taste. Nevertheless, in these times of tight budgets, perhaps a move toward tidy but less-manicured bunker edges is warranted.

To create a lower-maintenance bunker lip, the establishment of a well-rooted turf along the edge is first necessary. Kentucky bluegrass, tall fescue, perennial ryegrass, and fine fescues all can be found to serve nicely in this role. Because it is deeply rooted, persistent and drought tolerant, yarrow makes a particularly good plant material for bunker lips in some instances. Bentgrass and *Poa annua* do not serve the purpose and should be replaced, usually by sodding, if they predominate along greenside bunkers.

After the turf has become established, leaf blades are allowed to hang down over the edge of the lip, requiring only a quick trimming if they become too long. Actual edging is done only to keep rhizomes and stolons from encroaching into the sand, a process which is sometimes done with a non-selective, short-residual herbicide. Maintaining a higher height of cut allows the grass along the bunker lip to remain stronger and helps to define the bunker visually. In fact, this style of sand bunker maintenance does not generally work well where the turf is cut at one inch or less.

Allowing turf on bunker edges to grow in this manner is not new; it has been practiced on many golf courses for years. It does not preclude the need to rake the sand regularly, eliminate weeds, provide good drainage and trim when necessary, but it can provide a well-defined, stable, attractive bunker edge which takes less time and costs less to maintain.

The Role of The Power Sand Rake

The introduction of the riding power sand rake during the 1970s has had a

(Opposite page) A typical bunker washout after a rainstorm. (Above and below) A way to correct the problem.

significant positive impact on bunker maintenance. One worker can now rake in a few hours what it used to take several men an entire day to do. Not only that, but the weed bar attached to most commercial units has eliminated most of the weeding work which had been such a time-consuming job in the past.

On some courses, this machine has saved many man-hours of labor that can now be put to better use. On others, especially municipal and public courses, it has meant that the bunkers are raked more often, contributing greatly to their appearance and playability. The sand rake is a versatile machine, and it is often used for spiking greens and dragging in topdressing material (with appropriate attachments). It certainly has an important place on many golf courses today, except for those with few sand hazards or with bunkers which are too small or inconveniently designed.

In many respects the increased use of the power sand rake has paralleled that of the triplex putting green mower, and like the triplex mower, the sand rake has produced some undesirable side effects. As a practical matter, the power rake is really not designed to rake the sand in every bunker from edge to edge, even

assuming that the bunker is relatively flat. However, with human nature dictating that a worker will want to spend as little time off the seat as possible, that is what often happens. The result is that sand gets pushed outward over the edges of the bunker due to the outward lateral push of the machine as it travels in a circular pattern around the bunker, and the edges become broad ridges of sand with a few meager tufts of grass. This symptom is most common on any edge where the machine is making a sharp turn.

Another common problem is the trail of sand left outside the bunker at the point where the machine makes its exit. This is caused by the worker who does not raise the rake arm quickly enough, hoping to avoid having to climb off the machine and touch up the exit tracks with a hand rake. Even when the sand is not dragged out over the edge, leaving the bunker at the same location each day may result in the deterioration of the lip or edge, a problem that can be minimized by leaving the bunker from a different location each day, if possible.

The problems inherent with this type of lip and edge deterioration are twofold. From a playability standpoint, the edge of the bunker may become so poorly defined that the golfer cannot determine whether he is in the hazard or not. As far as maintenance is concerned, the bunker lip may have to be partly rebuilt every two to four years in order to reestablish a well-defined edge. This may require digging the sand from the edge, perhaps adding topsoil to establish a lip, and placing sod around the perimeter of the bunker.

Basically, this is a laziness problem, and it need not occur. For best results with the power sand rake, use it to rake the center portion of the bunker, coming no closer than 12-18 inches from the edge. Then have the worker leave the bunker, preferably from one of several different locations, and touch up the sand along the edge of the bunker with a hand rake. Time will still have been saved by using the machine, and quality will not have been lost.

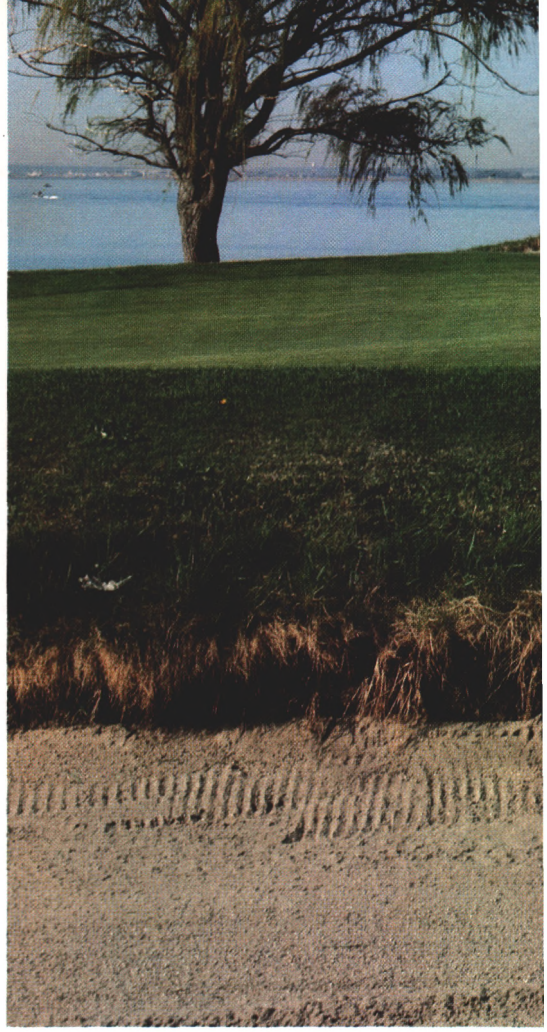
Dealing with Sand Buildup

A problem that every golf course faces through the decades is the buildup of sand in the lips and bank areas adjacent to sand bunkers caused by the blasting of sand as golfers play their shots. The result, over a period of many years, is the gradual deterioration of the established lip or edge and the thinning of turf in this area. Turf damage is caused by drought conditions created by the buildup of up to several feet of pure sand adjacent to frequently used bunkers.

Cutting the turf around the bunker at a higher height, as suggested above, will maintain better turf density as the sand builds up. This is often not possible with greenside bunkers where sand buildup may be occurring in the collar and the green itself. The use of wetting agents can reduce the wilting tendency of turf in these areas. Some have installed perimeter mist-type irrigation systems to supply extra moisture to droughty collars and sand bunker banks.

Inevitably, however, turf deterioration continues to such an extent that renovation becomes necessary. When this occurs, accumulated sand must be removed down to the original soil level, topsoil may be added where desired to achieve the final contour, and sod is most often used to resurface the lip edge and adjacent bank.

There is really no shortcut to this procedure. Trying to place new sod over many inches or feet of accumulated sand is usually not satisfactory. However, removing a significant layer of sand may give a very new look to an old area. A decision must be made as to



(Above) An example of a lower-maintenance lip — the natural look. Warwick Country Club, Warwick, Rhode Island.

(Below) Typical problem caused by improper use of the mechanical sand rake — sand raked over the bunker edge.

whether the new (original design) grade is kept or whether the more familiar grade is reestablished by adding topsoil. It provides some food for thought to consider how sand accumulation in greenside bunker banks has changed the playability and appearance of golf holes on the old courses over the years.

The problem of sand accumulation is especially noticeable on the frequently played greenside bunker, where it may take only a couple of years after renovation for turf deterioration to become apparent again. To maintain consistency, the maintenance programs at many clubs include resodding these turf areas approximately every five years, thereby avoiding the major reconstruction work needed when many inches of sand have accumulated.

Concerns With Washouts

Most golf courses experience sand bunker washouts at one time or another, where water entering from nearby areas carries sand off the bunker faces and deposits it in the nearest low spot. At the very least this occurrence demands that the sand be shoveled back onto the faces. But if washouts are allowed to continue, the lip becomes eroded or undermined and requires renovation on a regular basis.

Needless to say, sand bunker washouts are a real maintenance headache and should be prevented if at all possible. There are two good techniques available for dealing with this problem. The first involves the construction of a drainage ditch on the slope above the bunker which would channel surface water harmlessly around the sides during a heavy rainstorm. The required depth and width of the ditch depends upon the volume and surface velocity of the water as it approaches the bunker. Swales are often quite easily created by removing the sod in a 4- to 10-foot-wide strip along the area above the bunker, excavating the soil to establish a gentle, functional ditch, and replacing the sod. Be sure that the ditch directs the surface water toward an out-of-play area and that it is not shaped so severely that it becomes a maintenance headache itself!

Because there is sometimes not enough room to create a ditch, especially when the bunker is located close to a green, a good alternative for preventing washouts is the interceptor drain. This is simply an open stone drain which is installed in the same location where a ditch would be built, on the slope above and to the sides of the bunker. An interceptor drain can be easily installed by digging an 18- to 24-inch-deep, 6-inch-wide trench in the area above the bunker, placing 4-inch flexible plastic perforated pipe in the trench, and re-filling to the surface with crushed stone or pea gravel. The actual width of the trench may need to be increased if water volume and surface velocity so demand. The drainage pipe can be connected to an existing drainage system, directed to an out-of-play area, or ended at a dry well.

This type of drain is designed to intercept surface water during a rainstorm before it reaches the sand bunker and causes washout problems. It is effective because stone is added to the surface, providing surface water with immediate access to the trench. Sod, therefore, should never be placed over the trench. Instead, just allow the adjacent turf to cover over naturally.

If the washout problem is particularly severe, a combination of a shallow ditch and an interceptor drain might be more effective than either one alone.

Practice is essential to all levels of play. Open Championship contestants at Merion Golf Club, Ardmore, Pennsylvania.

Golf Neglects The Idea That Made It Big

by HERB GRAFFIS
USGA Green Section Committee, Florida

DONALD ROSS was a golf professional who came from Dornoch, Scotland, in 1899 to become a renowned and beloved American golf revolutionary. He has had an effect on the game as profound as any man. The genial gentleman achieved this wonder in a very simple way — he invented the lesson and practice tee.

Before this Ross innovation, lessons were playing lessons, and all golf practice, except putting, was done on the golf course. The first practice putting green was born by accident. It was built on the "Ladies Course" at St. Andrews, which was a short, primitive chip-and-putt course.

Nothing . . . absolutely nothing . . . was done in golf course architecture to develop the game from the few early "Ladies Courses" in Scotland until Donald Ross, as professional at the North Carolina golf and health resort of Pinehurst, observed the process of some pioneers endeavoring to be golf teachers. These men were teaching themselves during the North and South Open Championships at a place irreverently called Maniac Hill. American professionals who spread from the schoolyard at Maniac Hill carried their learning nationwide to their jobs. At their clubs they did not have the convenient and useful classroom that Maniac Hill provided. There wasn't time or teachers enough for the old-style playing lessons.

Golf teachers selected rough areas or momentarily vacated tees or fairways near the clubhouses or the sheds that

were called pro shops. There, the teachers and pupils were not too safe from the stray shots of those playing the course, nor were the players safe from wild practice shots. The tutoring was conducted with difficulty.

By the time American golf was to outgrow its infancy, Ross, the busiest golf course architect in the United States, recalled Maniac Hill and included his epochal first lesson and practice tee in his next golf course design. This innovation definitely gave golf a tremendous impetus in worldwide growth. To my embarrassment and sorrow, I long ago lost my notes of an informative visit with Ross at Pinehurst. My foggy recollection is that Ross said it was about 1914 and the course was in New York or Pennsylvania.

PRACTICE RANGES, despite all their potential for attractiveness and utility, too often remain golf ghettos where the underprivileged golfers are condemned to hack away, sunbaked in education for fun. Try, and I'm sure you'll find it difficult, to name just one golf course at which there has been a development of the Ross idea fitted to today's conditions.

The Ross practice tee brainchild has continued to grow and benefit golfers, even though it often came as an afterthought in the design of golf courses. The practice area is usually located on leftover ground, and the thought of coordinating it with the location, function, and service with revenue-producing potential for clubs seems to have escaped the attention of those to whom the pleasant game of golf is a business. In the meantime, the practice range showed its power in Tom Thumb or miniature golf courses, the par 3s, and the executive courses.

"Golf Training or Learning Centers" have been devised by at least two golf architectural firms for golf schools concerned with making learning a profitable business. Golf architects might include practice areas when real estate developers ask them to instill the charm of golf into acreage so that it won't be just another golf course.

It was that spirit and environment of the blessed out-of-doors that inspired and guided many through the difficult years of adjustment in this country. Intelligent Americans need and are subconsciously straining to regain the tranquil charm of the days when golf's heart was young in this land. There were no "monster" golf courses then, no moving of mountains of earth to imitate Scotland's dunes. Have we forgotten that golf is something to grow with, a happy free living? The genius of Donald Ross found a simple and sure way to sample this playful Eden. Then the trail seems to have been lost.

With all the imagination there is in the business of golf and the realism that must recognize the imperative necessity of modernizing golf again in every way, why is there such tardiness in making golf convenient in the midst of a tremendous real estate boom to get the city folks to the therapy of the countryside? Who is going to become rich and famous and be the benefactor of those who care and should be golfers? Doesn't anyone in golf recognize this potential?

A practice group at Stratton Mountain Country Club, Stratton Mountain, Vermont.

Photograph by H. SCHRIEBL

Bermudagrass and Bentgrass - Draw The Line!

by **CHARLES B. WHITE**
Agronomist, Southeastern Region, USGA Green Section

OVER THE LAST several years, bentgrass has slowly made its way onto the putting greens of golf courses deeper and deeper in the Southeast. Although the problems associated with maintaining bentgrass during the summer in the Southeast have caused superintendents many sleepless nights, there is also one problem adjacent to the bentgrass putting surfaces that continues to persist — the choice of bentgrass or bermudagrass for the collar adjoining bentgrass greens.

Each grass has its advantages; therefore, it is best to consider the advantages and disadvantages for each before deciding which would be the most feasible for your specific golf course. A collar ranging from 1 foot to 4 feet wide, depending on individual preference, greatly enhances the aesthetics and playing quality of the putting green area. An attractive collar not only sets off the putting surface itself, but also provides an intermediate, uniform step between fairway and putting green heights. It also serves as a buffer between the fairway and the putting green grasses and helps deter encroachment of the more aggressive fairway turf.

The upper South, sometimes referred to as the transition zone, is a region where warm-season and cool-season grasses can be grown. Unfortunately, neither does as well there as they do in their normal habitat. It also leads some to believe that a good bermudagrass collar cannot be maintained in conjunction with a bentgrass putting green in this zone. This is by no means true. The following will describe a way to establish and maintain a bentgrass putting green and a bermudagrass collar without significant encroachment in either direction.

The best bermudagrass varieties to use for collars in the Southeast are Tifgreen or Tifdwarf. These hybrids provide excellent collars because they are used for putting greens also. Their physical characteristics are similar to and very compatible with the bentgrasses. These two elite varieties are also more susceptible to the effects of the herbicide siduron and therefore can be easily controlled when grown adjacent to the bentgrass putting green surfaces.

A spring and fall application of siduron at the recommended rates in a band around the edge of the bentgrass putting green maintains a clear and definite line between the bermudagrass and bentgrass without injury to the bentgrass putting green. In addition, a thin-bladed edger, carefully guided around the outside perimeter of the putting surface, severs the bermudgrass stolons and rhizomes. The siduron is then banded around the green perimeter (about 18 inches wide) to aid in a more complete kill of the bermudagrass stolons and rhizomes in the putting

Edging machines are used to deter bermudagrass invasion into the bentgrass putting surface. Athens Country Club, Athens, Georgia.

surface. The edger should be set to penetrate one to two inches. This late spring and early fall control program maintains a precise line of demarcation between the bermudagrass collar and the bentgrass putting surface the year around.

BERMUDAGRASS collars provide their best playing conditions during a time when the bentgrass is under heat stress in summer. Maintaining a healthy collar can be helpful in reducing some of the headaches associated with bentgrass putting surfaces. A good program of summer aerification and topdressing helps produce excellent bermudagrass collars. Spring aerification of the bentgrass greens extends over the bermudagrass collars as well. If the bermudagrass and bentgrass are aerified at the same time, the cores should be removed in a manner that prevents some bermudagrass cores from accidentally contaminating the green by being plugged or raked into the aerifier holes. When removing the cores, extreme care should be exercised to rake the cores towards the outer perimeter of the collar so that the bermudagrass does not infest the bentgrass turf.

Vertical mowing on a three- to four-week basis through the summer followed up by a light topdressing further encourages a uniform surface. Bermudagrass collars in this region should receive between four and five pounds of nitrogen per 1,000 square feet per year.

Bermudagrass collars are normally overseeded in the fall to provide a uniform surface as well as an aesthetically pleasing green color in the fall and winter. Overseeding effectively complements the color of the thriving bentgrass putting green in appearance and playability. Overseeding rates should not exceed 18 pounds of perennial ryegrass per 1,000 square feet, or 1½ pounds of bentgrass per 1,000 square feet. These amounts of seed provide a dense stand of cool-season grass without retarding the bermudagrass regrowth in spring.

BENTGRASS collars, on the other hand, are advantageous in the northern extremities of the Southeast where extended periods of intense heat and humidity are not prevalent. Bentgrass collars maintained in the hotter humid areas of the Southeast can cause severe problems to the superintendent because the thatch and disease problems are multiplied by the higher height of cut. Insects also tend to thrive in the collar area. When the bentgrasses come under stress in summer, a bentgrass collar is usually a good indicator as to what is in store for the shorter cut putting surface. Localized dry spots and silt also tend to be more severe in the bentgrass collars when heat builds up and restricted air movement at the soil surface occurs.

Spraying siduron around the perimeter of bentgrass putting green. Athens Country Club, Athens, Georgia.

THE PROBLEMS associated with bentgrass collar management are further aggravated when collars are established on poor soil. Such is often the case when greens are rebuilt. The newly prepared soil mixture is usually spread within the boundary of the putting surface only while collars are expected to produce excellent playing surfaces on inadequate soil. Then during periods of summer stress, when collars cannot be watered separately, significant grass is lost. When the soil is heavier in the collars, it remains constantly wet and disease proliferates. When collar soils are sandier than the greens mix, then the collars tend to remain on the dry side. Remember that water must be applied according to the needs of the putting green, and not the collar.

Bentgrass collars in this region should never be fertilized heavier than 1½ to 1¾ pounds nitrogen per 1,000 square feet per year, due to their tendency to thatch. Bentgrass collars will provide the best playing conditions by receiving the same cultural programs as the bentgrass putting surfaces.

One final but important consideration in making the collar grass choice concerns the presence of the more aggressive fairway bermudagrasses, such as Tifway or common. These are not readily controlled by siduron. In such cases the strong growing bermudagrasses would quickly invade collars established to bentgrass. Therefore, a buffer of Tifgreen or Tifdwarf between the bentgrass putting surface and the aggressive Tifway and common bermudagrasses is essential. To co-exist, it is essential to draw the line between bentgrass and bermudagrass, in order to provide the best of both worlds — bentgrass putting greens and bermudagrass fairways!

Zoysiagrass Establishment From Seed

by **HERBERT L. PORTZ**
Southern Illinois University, Carbondale

THE RECENT development of a successful seed treatment assuring rapid zoysia establishment is certain to create greater interest in this turfgrass species. Generally, in the past, this excellent warm-season turfgrass has been established vegetatively, mainly because seed germination has been poor (less than 60 percent) and very slow (up to several weeks), even after mechanical scarification. Now, with base scarification and a follow-up light treatment, zoysia seed will germinate over 85 percent in seven days.

This new treatment technique was developed in Korea by Drs. T. Y. Yu, D. Y. Yeam, and co-workers. Dr. Yeam enjoyed sabbatical leave in 1978-79 and worked as a research associate at the United States Department of Agriculture's Beltsville research station and at Southern Illinois University at Carbondale. Because of limited import, he brought untreated Korean zoysiagrass (*Zoysia japonica* Steud.) seed to assure that he could display and further refine his treatment procedures while here.

Initial seed treatment consists of soaking seed in a potassium or sodium hydroxide (KOH or NaOH) solution. After testing various concentrations and soaking durations, it was determined that soaking the seed in a 30 percent solution for 25 minutes gave the best results, 95.3 percent germination in seven days under light conditions.

For rapid germination under conditions similar to those found in the field, a light treatment prior to seeding is needed. Imbibed seeds are treated for 36 to 48 hours with sunlight or fluorescent light. Test results using different lengths of fluorescent light treatment are shown in Figure 1. The seed subjected to the KOH seed scarification treatment resulted only in 30 percent germination in seven days, but when this seed was also subjected to a light treatment for 36 to 60 hours, germination increased to 70 percent, even in the dark.

FIGURE 1
Germination after KOH and Different Light Treatments
7 Days at 30-35° C, Dark Conditions, Petri Dishes

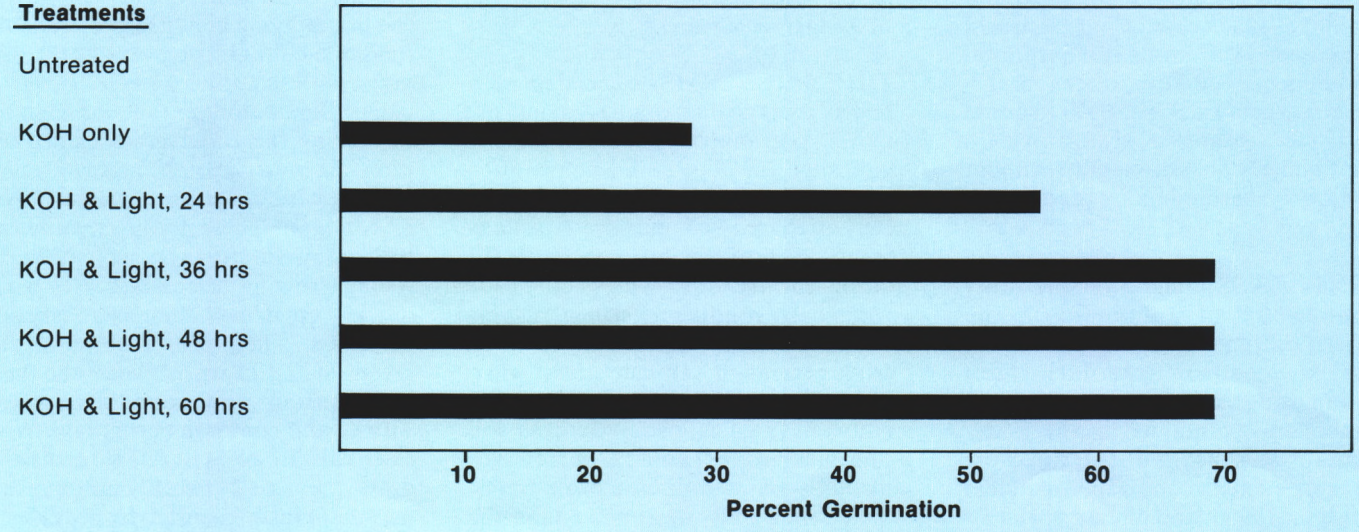


TABLE 1
Seed Treatments and Seeding Methods and Resulting Ground Cover of Zoysiagrass at Two Locations in 1980

Seed Treatment	Seeding Method	Ground Cover		
		USDA-B	SIU-C	
		3 Weeks	5 Weeks	12 Weeks
		%		
U	BR	3.0 b*	6.7 e	51.7 b
U	SR	2.0 b	5.0 e	48.3 b
U	RS	3.0 b	8.3 e	51.7 b
S	BR	51.7 a	48.3 b	88.3 a
S	SR	58.3 a	70.0 a	90.0 a
S	RS	7.0 b	25.0 cd	81.7 a
SL	BR	66.7 a	78.3 a	91.7 a
SL	SR	56.7 a	80.0 a	85.0 a
SL	RS	6.0 b	36.7 bc	81.7 a

U = untreated; S = scarified; SL = scarified and light.
BR = Brillion rolled; SR = smooth rolled; RS = Roger's seeder.

*Means within columns followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Immediately following the light treatment, it is important to dry the seed at relatively high temperatures (above 30° C), because any delay will cause seed subjected to these treatments to sprout. Rapid drying and storage at low temperatures (0 to 40°C) is necessary to retain seed viability.

It was also determined that temperatures of 30 to 36°C gave best germination, which indicates that the zoysiagrasses must be seeded in late spring or summer. Prior to seeding, an additional seed soak of 24 hours further enhanced the speed of germination. This procedure fits especially well when using a hydroseeder.

SEED CHARACTERISTICS of zoysia that are responsible for seed dormancy differ from those of most turfgrasses. A hard, waxy outer glume develops around the caryopsis (seed). This hard seed covering must be scarified or removed before normal germination occurs. A reduction in seed size from almost 3mm in length to less than 2mm is noted after KOH scarification and dehulling. Following scarification, light and perhaps water and oxygen can then penetrate and change the internal hormone balance which causes the embryo to begin its germination process. This light response is a phytochrome reaction triggered by red light, and is unique also to lettuce and some weed seeds. Sunlight or white light from a fluorescent bulb each contain sufficient red light to trigger this phytochrome reaction. Although as little as two minutes of light is probably adequate, the seed needs to continue the pregermination process until it is no longer reversible, hence a 36- to 48-hour time period is needed. Low or alternating temperatures can partially substitute for this light.

Perhaps most intriguing in the entire germination process are the internal hormonal changes required to bring about germination. It has been shown by Dr. Yeam and co-workers that there is a decrease in an abscisic acid-like substance and an increase in a gibberellic acid-like substance in zoysia seed after the KOH and light treatments. The actual effect of the base KOH or NaOH solution on the seed cover is still being investigated. Also, the quantity and quality of light needed, as well as the effect of temperature on breaking seed dormancy still need more research.

FIELD ESTABLISHMENT of Korean zoysiagrass seed was begun at several locations in 1980. At Carbondale and Beltsville, experiments were conducted on seeding methods and rates. Untreated (U), KOH-scarified (S), and scarified and light-treated (SL) seeds were used in a seed treatment/seeding method experiment. Percent ground cover from a uniform seeding rate of 1½ pounds per 1,000 square feet and three seeding methods are

TABLE 2
Seeding Rates for SL Seed and Resulting Ground Cover at Two Locations in 1980

Seeding Rate		Ground Cover		
		USDA-B	SIU-C	
m^2	1000 ft^2	3 Weeks	5 Weeks	12 Weeks
g	lb	%		
1.25	¼	40.0 b	68.3 b	86.7 a
2.50	½	58.3 b	70.0 ab	88.3 a
3.75	¾	68.3 ab	81.7 ab	88.3 a
5.00	1	71.7 ab	80.0 ab	90.0 a
7.25	1½	83.3 ab	83.3 ab	90.0 a
10.00	2	91.7 a	86.7 a	90.0 a

shown in Table 1. The SL treated seed gave the highest percent ground cover when rolled with the Brillion and a smooth roller after broadcast seeding. The non-light treated seed (S) was slower to emerge when Brillion rolled and especially when drilled as compared to being smooth rolled because of soil coverage and subsequent light exclusion. In 12 weeks, however, a ground cover of 80 to 90 percent was obtained from all but the untreated seed.

In the seeding rate experiment, the SL treated seed was broadcast at rates from ¼ to 2 pounds per 1,000 square feet. (See Table 2.) There was a significant difference between the ¼- and 2-pound rate at both locations at three and five weeks. At 12 weeks, however, there was no difference between seeding rates at Carbondale. The low rate of ¼ pound was slower to establish, and considering the problem of uniform seed distribution and possibly less than ideal weather or irrigation conditions, one should consider a seeding rate of ¾ pounds or higher for planting and weather insurance.

Weed control treatments in connection with seedling establishment were first tested in greenhouse trials, and siduron gave minimum zoysia toxicity and good weed control. Field trials subsequently have further confirmed the feasibility of using siduron for preemergence annual grassy weed control. The granular formulation of siduron was found to be slightly more phytotoxic to zoysia seedlings than the wettable powder water solution of equivalent strength. The previously described method and rate experiments also received a treatment with eight pounds active ingredient (a.i.) per acre of 50 WP siduron. Broadleaf weeds were controlled with postemerge applications of 2,4-D at ¾ pound a.i./acre and dicamba at ¼ pound a.i./acre.

Hydroseeding is being tested with excellent initial results. During the dry, hot summer of 1980, without follow-up irrigation, however, seedlings succumbed to the drought despite the turf fiber mulch. Hydroseeding is extensively practiced in Korea.

SEED PRODUCTION prospects for most zoysiagrass cultivars look promising. Seed is normally ready to harvest between June 15 and July 15 at Carbondale. The spike-like heads are easily hand harvested, the way it is done in Korea by older women and school children. Seed spikes can also be harvested with shears. Mechanical harvesting is now being researched in this country.

The major problem of adapting specific cultivars, such as *Meyer* zoysia, to seed production and use is that they do not breed true. Meyer notably segregates and seedlings display diverse growth habits from seed. There could also be problems of sterility and low seed yields. Midwest seedlings were phenotypically more uniform. Also, the Common zoysia seed presently imported from Korea displays considerable variation in seedling progeny.

A strong zoysiagrass breeding program is needed to develop new cultivars that can be propagated by seed. J. J. Murray, USDA-SEA, already has such a program underway. Midwest and Korean establish more rapidly, have a coarser leaf texture and longer internodes than Meyer or Emerald zoysia. With new germplasm and careful selection, cultivars may be developed for specific use and increased insect and disease tolerance. Presently chinch bugs and billbugs are the most serious insect pests, while rust, brown patch, and Fusarium blight are diseases that have been observed on zoysiagrasses.

MANAGEMENT practices applicable to Meyer may not suit Korean or other coarser types of zoysia. Preferably low-maintenance, labor-saving cultural practices can be employed with the ultimate prospect of no mowing, no fertilizing, no irrigating — a distinct possibility for roadsides, waste and other minimal-maintenance areas. Today, in Korea, most of the native zoysia which predominates over the countryside receives no maintenance whatever. Athletic fields, golf courses, and other high-use areas will require more intensive management. The nitrogen requirement ranges from ½ to 2 pounds nitrogen per year.

The use of treated seed opens new horizons for zoysiagrass. Zoysia seed can be planted efficiently with a hydroseeder, conventional drop, and rotary broadcast seeders. A complete cover in less than a year is usually assured when scarified and treated with light. Companion seeding of cool-season turfgrasses such as Kentucky bluegrass, perennial ryegrass, and tall fescue insures almost immediate use as well as erosion control during the first winter and spring. It is easy to convert to a complete zoysiagrass stand with appropriate cultural practices or a dormant spraying with glyphosate. The prospect of new cultivars promises more versatility on all areas from roadsides to fine lawns.

The climate and soil for seed production in the United States is excellent, but better seed harvesting techniques remain to be developed. When this is a reality, then zoysiagrass, a much-needed species for the transition zone, will undoubtedly be far more widely used.

Figure 2 summarizes techniques for treating and establishing zoysiagrass from seed.

FIGURE 2

SEED TREATMENT	SEED ESTABLISHMENT
KOH 30%	¾ to 1 lb./1000 sq. ft.
Duration 25 min.	Broadcast or Hydroseed
Light 36-48 hrs.	Lightly rake and/or roll
Presoak 24 hrs.	Siduron 8 lbs. a.i./acre
80-90% germination in 7 days	Irrigate as needed
	Post treatment 2,4-D/ dicamba if needed

Maintenance Aids

A TIP FROM

JAMES McNALLY, Golf Course Superintendent
Manasquan River Golf Club, Brielle, New Jersey

MECHANICAL SAND rakes have proven to be adaptable to multi-purpose use. Superintendent McNally made a one-step operation of overseeding weak areas by attaching the seeder box as shown. This equipment is convenient for all small overseeding tasks and because of the low-pressure feature of the tires, it can be safely used for overseeding putting greens.

USGA GREEN SECTION RECORD
SEPTEMBER/OCTOBER 1981

TURF TWISTER

QUESTION: What is the USGA policy with respect to hole locations on the putting greens, particularly during tournament play?

ANSWER: Many factors affect selection of hole locations. The first and most important is good judgment in deciding what will give fair results. Do not be tricky in locating holes.

Following are specific points:

1. Study the design of the hole as the architect intended it to be played. Know the length of the shot to the green and how it may be affected by the probable conditions for the day — that is, wind and other weather elements, condition of the turf from which the shot will be played, and holding quality of the green.
2. There must be enough putting green surface between the hole and the front and the sides of the green to accommodate the required shot. For example, for a long iron or wood shot to the green, the hole should be located deeper in the green and further from its sides than may be the case for a short pitch shot.

   In any case, the USGA recommends that the hole be located at least five paces from any edge of the green. If a bunker is close to the edge, or if the ground slopes away from the edge, the distance may well be greater, especially if the shot is more than a pitch.

   Consideration should be given to fair opportunity for recovery after a reasonably good shot that just misses the green.
3. An area two to three feet in radius around the hole should be in good condition without any steep slopes or, if possible, any changes in the degree of slope. In other words, the green in the holing-out area should be as nearly level as possible and of uniform grade, but it need not be exactly level. In no case should holes be located in tricky places, or on sharp slopes where a ball can gather speed. A player above the hole should be able to putt with a reasonable degree of boldness, and not purely defensively.
4. Consider the condition of nearby turf, especially taking care to avoid old hole plugs which have not completely healed.
5. Holes should be cut as nearly on the vertical as possible, not plumb with the contour of the green.
6. There should be a balanced selection of hole locations for the entire course with respect to left, right, central, front and back positions. For example, beware too many left positions with resulting premium on drawn or hooked shots.
7. For a competition played over several days, the course should be kept in balance daily as to degree of difficulty. In a stroke competition, the first hole of the first round is as important as the last hole of the last round, and so the course should not be set up appreciably more difficult for any round — balanced treatment is the aim. An old concept of making the course progressively harder round after round is fallacious.

   One form of balanced daily treatment is to select six quite difficult hole locations, six which are somewhat less difficult, and six which are of moderate difficulty.
8. In early rounds, anticipate players' traffic patterns and avoid locating many holes where walking across the green by many players could spoil good hole locations for later rounds.
9. In match play, a hole location may, if necessary, be changed during a round provided the opponents in each match play the same location.

   In stroke play, Rule 36-4a requires that all competitors in a single round play with each hole cut in the same position.

   When 36 holes are played in one day, it is not customary for hole locations to be changed between rounds, but there is no Rule to prohibit. If they are changed, all competitors should be informed.
10. The greenkeeper who cuts the holes should make sure that the Rules of Golf are observed, especially the requirements that the hole-liner not exceed 4¼ inches in outer diameter and that it be sunk at least one inch below the putting green surface (Definition 15).
11. During practice days before a competition, it is advisable to locate holes in areas not likely to be used during play, preferably at the fronts and the backs of greens, bearing in mind the areas which will be impaired by foot traffic patterns.