NOVEMBER 1975

USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association

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A well played shot from a properly maintained bunker.

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BUNKERS: MAJOR CONCERN FOR MAINTENANCE

By LEE RECORD

Mid-Continent Director, USGA Green Section

The self-propelled sand trap or bunker rake has eased to some extent the pain of keeping the bunker playing surface manicured; unfortunately, mechanization is not always the answer. Bunkers are still one of the most costly items on a per-square-foot basis in the golf course superintendent's maintenance budget. How can this expenditure be reduced? What steps can be taken to correct built-in maintenance problems for old, established bunkers as well as for proposed new ones?

Excerpts from the chapter on "Bunkers" in the booklet "Building Golf Holes for Good Turf Management" published by the United States Golf Association and edited by Dr. Marvin H. Ferguson contain many of the answers one would wish to seek out. Highlights of the "Bunker" chapter follow:

> The design of bunkers is governed principally by the requirements of play, topography of the area and aesthetic considerations. From the standpoint of maintenance, however, several other factors must be taken into account. The first thing to be considered is the effect of the design on mowing. Nearly all golf courses have bunkers which require hand mowing to some extent, and this probably cannot be avoided, but, if thoughtfully designed, bunkers can require a minimum of hand mowing.
>
> Fairway bunkers or those in the rough immediately adjacent to the fairway should be so designed that mowing can be accomplished with the standard gang units used for fairways or roughs. Bunkers located within the confines of the fairway should be surrounded by an apron of rough, for two reasons. First, if this is done, the area around the bunker will not require the intensive management necessary for fairways; however, these areas should be maintained neatly. Secondly, sand blasted out of the bunker onto the surrounding turf will not cause the rapid deterioration that would be inflicted on closely cut turf.
>
> For fairway or rough, the use of grass hollows should be given careful consideration. If properly designed, they afford the de-

Surface runoff causes erosion and shoveling problems.

sired test without the additional maintenance required by sand bunkers. Grass hollows should be nothing more than gradual depressions as far as the actual feature is concerned, but provision should be allowed for drainage.

By far the greatest mowing maintenance problem occurs around bunkers in the immediate vicinity of the green. Certainly they must be kept in a neatly manicured condition, and this requires increased mowing. Once again, turf areas bordering the bunker should be maintained at rough height, and design should allow for this.

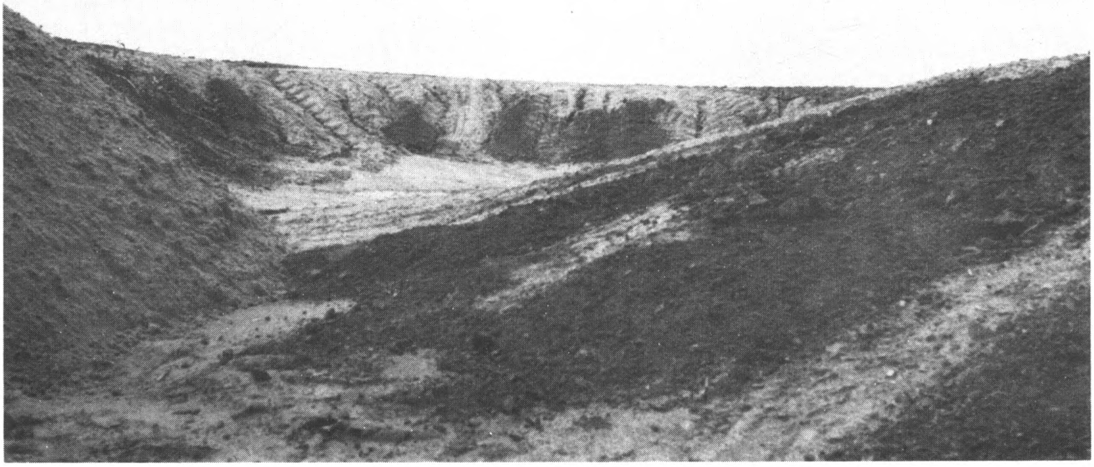
Sometimes architectural considerations necessitate the positioning of a bunker flush against the green or collar. This causes great difficulty in mowing of both the green proper and the narrow area between bunker and green. Sand blasted out of such bunkers damages mower reels and bedknives, and after a period of time sand build-up on the edges of such a green will cause a droughty condition, and thus weak turf.

Whenever shot requirements permit, bunkers should be positioned so that there is at least 6 feet between the near edge of the actual trap and the outer edge of the collar. This would facilitate cutting with a triplex or similar mechanized equipment; blasted sand would be less of a problem, and green mowing could be accomplished with greater ease and safety. In addition, the higher cut around the bunker would tend to accentuate both the sand and the green.

Steep-flashed banks within the bunker are frequently desirable because of the need for visibility, but they present a problem of sand stability, and many prefer to turf such banked areas down to sand level. This causes mowing difficulties if the banks are too steep, and it becomes necessarily a hand operation. It may also result in a hidden bunker. Whether hand mowing of steep banks or stabilizing sand on them is more of a problem is a matter of conjecture. However, if slopes are not severe and mechanized mowing can be accomplished, turf should be more desirable than sand.

Design of bunkers affects drainage not only within the bunker but the area surrounding. This is perhaps a question of location more than any other single factor. Bunkers are sometimes necessarily placed within surface drainage flow areas. If this must be done, care should be taken that drainage into the bunker does not occur. With proper grading and the use of swales, drainage water can be diverted around the bunker and away from areas in play. Don't forget the point that the surrounding area should be drained, too—the bunker build-up should not impede or restrict flow of water.

Drainage within the bunker is of prime importance from the standpoint of both play and maintenance. Poorly drained bunkers hold water for days after heavy rainfall or irrigation, and even after the water disappears the sand is heavy and difficult to play from. Poorly drained bunkers promote washing or move-



New bunker—very steep construction to hold sand or to mow grass.

ment of sand from higher to lower areas. Finally, poorly drained bunkers always appear dirty due to the seepage of soil particles up to the sand surface.

This is strictly a question of design and construction. No degree of maintenance will alleviate the problem. Wherever possible, sand surfaces should be level or very nearly so, to minimize water flow. Where large bunkers are required and proper grading cannot be done, terracing or stepping of sections should be utilized, the areas between the sections being tufted.

In many cases, the tile drainage must be used to eliminate water build-up in bunkers. If the bunker is large and cannot be tiled completely, tile should be placed in or about the lowest point. Slope of the bunker floor should be only enough to allow the water to move. Anything more will cause excessive sand movement.

All the points mentioned so far relate directly to maintenance and therefore the budget. Obviously, golf would suffer without sand, and golf courses would lose some of the beauty and contrast provided by bunkers. However, if poorly designed, bunkers require more maintenance than can be justified, and they become an unfair hazard as well as an eyesore. As a general rule, bunkers should be designed to allow for maximum mechanized maintenance, and this is especially pertinent to mowing and edging. They should be designed to afford minimum sand movement. It is far easier to rake footprints from sand than to move large quantities of sand by hand.

Proper drainage reduces "cementing" of sand particles and thus the need for more frequent raking. The location of greens bunkers can minimize the amount of sand blasted onto the green. This eliminates the damage to mowers and the time required to repair them. These are just some of the ways in which design affects maintenance costs, and it is rather obvious that bunker design has a substantial impact upon the budget.

Location of bunkers definitely affects traffic flow, especially in the vicinity of greens. One must remember that these are limited areas and traffic is extremely concentrated. Bunkers located near greens should take into consideration their effect on entrance areas and departure areas. Departure areas are generally governed by location of the next tee, usually somewhere to rear or to either side of the green.

Frequently, bunkers placed in these areas serve little function other than providing color and texture contrast. Much of the desired contrast could be accomplished by height of cut alone, or in conjunction with grass depressions.

Fairway bunkers most frequently are not really fairway bunkers at all. They are rough bunkers. Why have a bunker at the edge of a fairway or in the rough? This prevents the ball from entering the rough, which is itself a test if it is maintained as rough. The need for framing can be fulfilled by shaping or contouring fairways, placement of trees, and the use of gradual mounds or hummocks.

The role of sand in this great game is

clearly understood, and it is certainly desirable, but it should be used more discriminately. Sand can be used to enhance both play and course beauty without compounding maintenance problems."

The golf course superintendent of today must ask himself when preparing his budget, "Am I kidding myself about the constant shoveling of sand in the 16th green bunker after each rainstorm or should the bunker be rebuilt to correct the condition of improper construction and drainage?"

Frequency of weeding, edging and raking a bunker is easily determined by the demand of manicuring that is desired by the particular club. Mowing around a bunker with a triplex or rotary mower will take a certain amount of time and should be planned in the budget. Frequency will depend upon climate, irrigation and feeding practices within the bunker area.

Often it may not be too steep a bank but rather, the consistency of the sand being used that makes the sand come rolling down during a rainstorm.

Green Section Recommendations For Sand Particle Size Range for Bunker Use

ASTM Mesh 16 to 60

Millimeter 1.00 to .25

Sieve Opening—inches 0.0394 to 0.0098

Sand explosion out on the collar or into the green in time leaves a very droughty condition to sustain plant life. Hand watering may be required to correct this condition, but time and money may not be available. Sand that has built up should be removed and replaced with new soil and sod.

Each bunker has its priorities. Examine the bunker to determine what measures are needed to correct problems and ease your cost of maintenance. As one Superintendent described his bunker situation to me recently, "It is my opinion, we will always have second class bunkers unless we can completely rebuild them from the bottom up, by installing the proper drains and slopes. Perhaps reducing the overall size by increasing the shaping or scalloping of the present 'monsters' would make the bunkers more playable and give the course more eye appeal and depth. Only in this way will be have first class bunkers."

RAIN SHELTERS

By LOUIS F. OXNEVAD

The old rain shelters at Riviera Country Club in Coral Gables, Fla., were built in the 1940s and were sized to hold one golf cart plus riders. By 1974, they were in need of replacement. I presented pictures to the Green Committee of rain shelters I had built at other courses. They could accommodate more than one golf cart and were more attractive than our existing shelters. The Green Committee agreed to the addition; I drew several sketches and submitted them for bids. The lowest bid for three new shelters, which did not include the final roofing material was $9,800. This was more than the budget would allow, so I asked for $3,800 and began making plans and investigating materials and costs. By using the golf course crew, I could reduce labor costs.

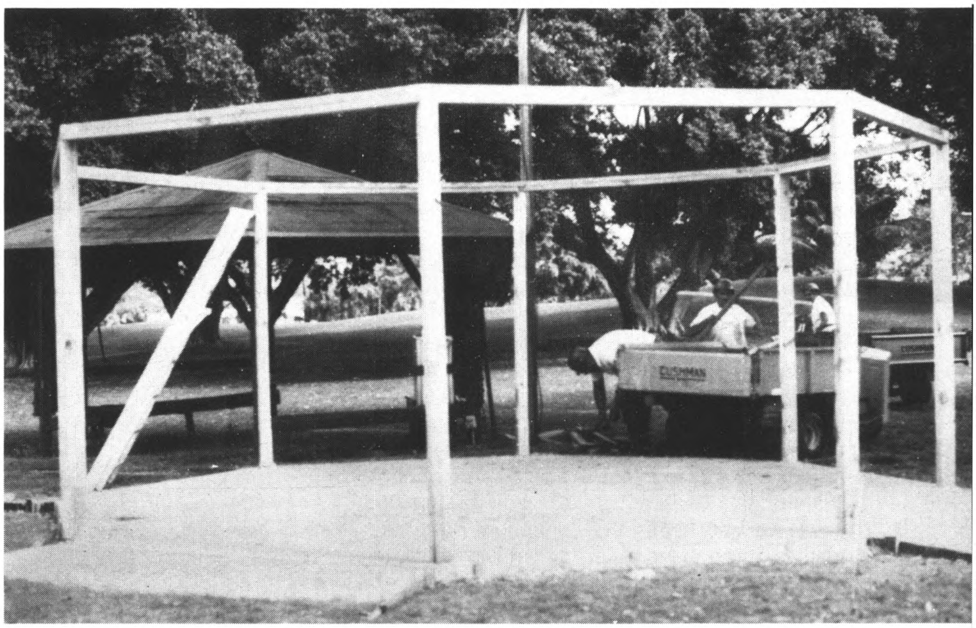
The first consideration was the size of golf carts and the number each shelter could accommodate in the smallest amount of space. An octangular shape seemed the most sensible. This would allow four carts to enter from four directions and also give protection from wind and rain on all four sides. Selection of the material was the second consideration. We chose pressure treated lumber that would withstand all types of weather. Galvanized nails were used throughout.

Steel wire was placed within the octangle to reinforce the concrete. We used four cubic yards of 2,800 pound strength and poured the concrete four inches thick, sloping it slightly from the center to the outer edge and filling the eight footing holes.

Before the concrete set we placed metal channels into the eight corner footing holes. These metal channels were made by a local metal shop to our specifications of 24-inches long and wide enough to hold a 4" x 4" stud. Three sets of holes were drilled into the metal channels at distances of four inches from the bottom, four inches from the top and eight inches from the top. An eight-inch bolt was placed through the bottom set of holes for an anchor in the concrete that filled the footing holes.

We let the concrete cure for 36 hours and then removed the 2 x 4's that formed the original shape from the outer edges. The 4 x 4 corner studs were then bolted to the eight metal channels using the

The old and beginning of the new.



Taking shape.

other two sets of predrilled holes.

At the top of each corner stud, 4 x 4 headers were bolted for the outer edge support of the roof. We framed in the four areas for walls, which were seven feet high and eight feet wide. Two ½-inch pieces of 4′ x 8′ rough sawn cedar plywood were used for each wall area.

The rafters were 12-foot long 2 x 4's which gave us an 18-inch overhang. We used a 4 to 1 pitch for the roof framing. The most difficult part of the construction was securing the first four roof rafters. These were cut on an angle for joining at the center of the roof. The peak of the roof measured 12 feet from the concrete floor slab. Galvanized metal rafter plates were used to secure all rafters to the headers. The other 12 rafters were cut on angles to fit in the center and secured to the headers. Two sets of braces were used between each rafter at distances of three feet and seven feet from the center. The braces nearest the center were cut to form a 16-sided star. We used ½-inch 4′ x 8′ plywood for the roof sheeting and topped it with two layers of 30-pound felt.

To finish the overhang, 1 x 8 redwood was used as a facer board. This extended ½-inch above the roof sheeting. At this point, a lightning rod was installed with copper cable attaching it to a copper pile driven 12 feet into the ground.

The final roofing material was red river gravel mixed with epoxy, the same mixture I had used for cart paths in the past. This mixture was spread ½-inch thick, beginning at the center roof and working

The rafters

toward the outer edge. The strength of this roof should support heavy snow as well as withstand any strong Florida winds. The mixture of red river gravel and epoxy makes the roof sparkle in the sunlight which is most attractive.

Even though we used durable type wood materials, we stained all wood areas with a mixture of 2 gallons wood preservative to 1 gallon of redwood stain. This gave a light reddish brown color that blended with the gravel roof and made the shelter blend more naturally with the surroundings.

The interior of the shelter contains two benches and an electric water cooler. Mounted near the top rafters are three of our automatic irrigation controllers. This does not detract from the inside appearance and keeps the controllers protected as well as giving the members something to talk about while using the shelter.

The total cost of all three shelters was less than the $3,800 allocated. Keep in mind though, this was for materials only and did not include labor. Knowing that it was something that didn't have to be mowed, raked, swept or picked up every day gave the golf course crew a sense of pleasure as well as pride in a task well done.

Around the outside of the four outer walls we planted fern and red flowering shrubs. The planting helped tie the new building into the landscaping scheme of the golf course.

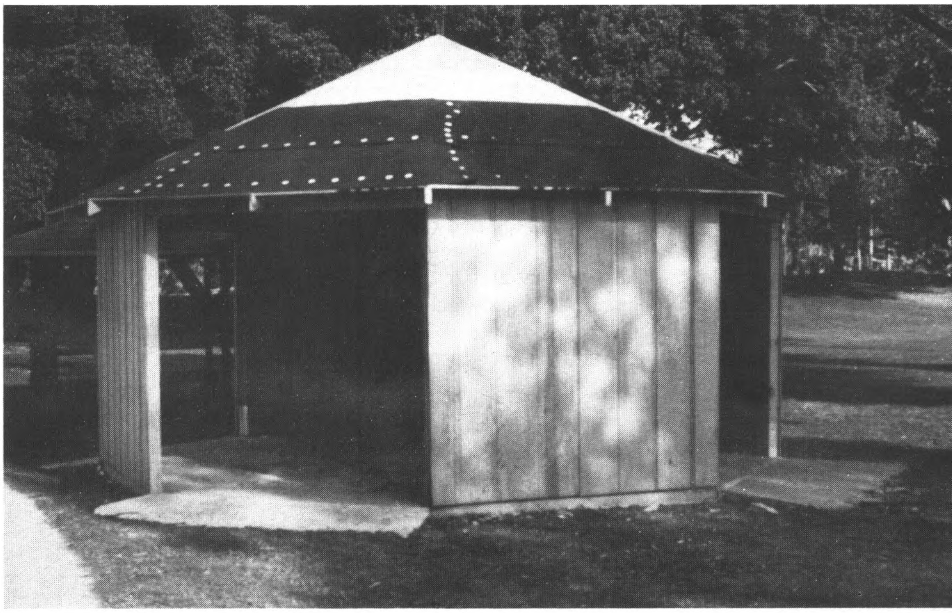
If we were doing it again, we would use 4.5 cubic feet of concrete and form and pour the cart ramps into the shelter at the same time as the floor slab. We had to tie the ramps in later.

We had so many compliments on this project that one of our members, Darrell McQueen, drew up a set of plans for our future use.

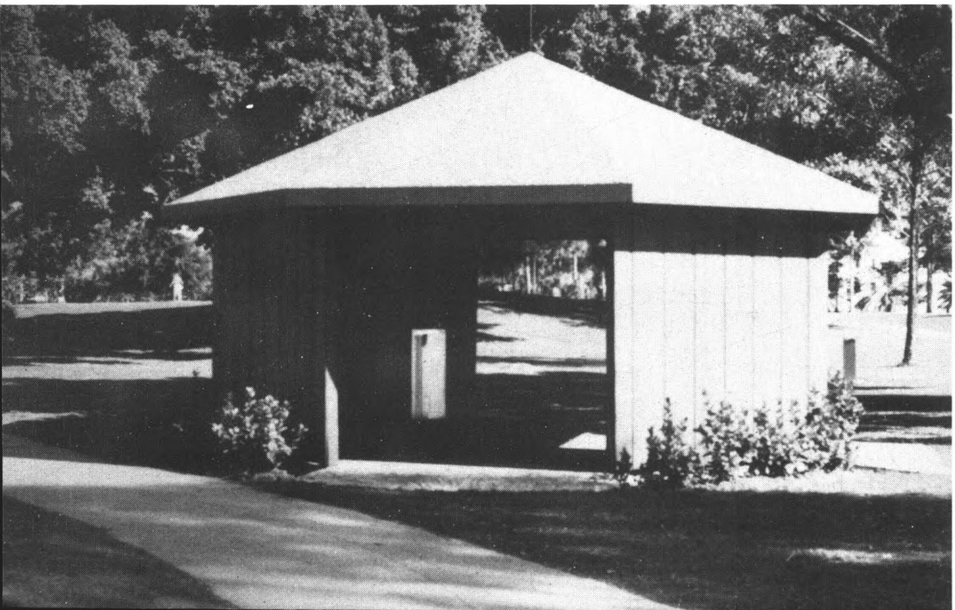
ABOUT THE AUTHOR

Louis F. Oxnevad majored in Horticulture at North Carolina State University and has served as golf course Superintendent at Riviera Country Club, Coral Gables, Florida and as a USGA Green Section Committeeman for many years. His contributions to his profession include President of the Florida Superintendents Association, Triangle Turfgrass Association and South Florida Superintendents Association. He currently is serving on the Board of the Florida Turfgrass Association.

The dome.



The roofing.



The finished product; landscaping, water cooler and all.

What is Happening to Our Bermudagrass?

A New Concern with the Hybrids

By JAMES B. MONCRIEF, Southern Director, USGA Green Section

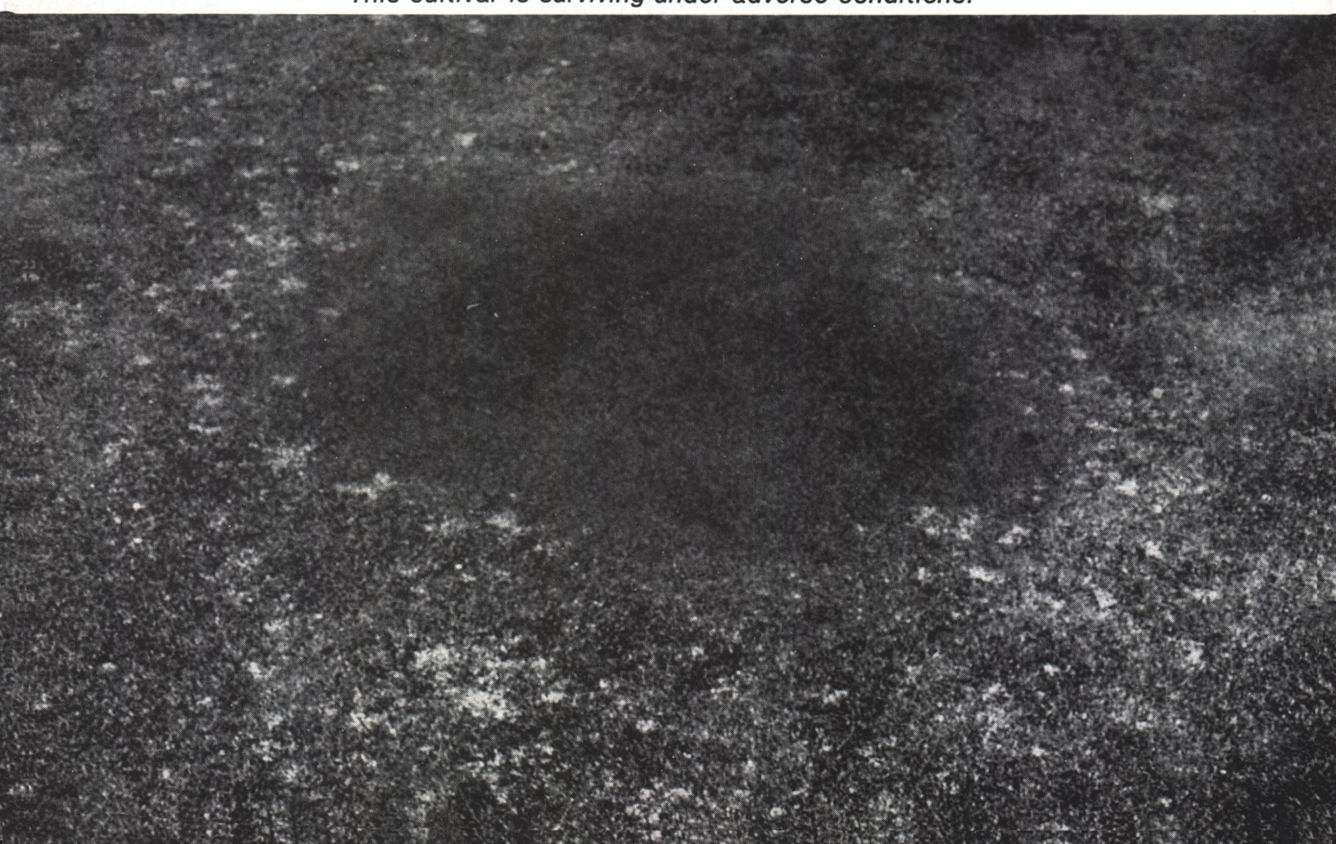
The past two or three years have brought more and more questions concerned with small patches of different grasses developing in hybrid bermudagrass greens. It is becoming difficult to maintain a pure bermudagrass stand. The "mixing" occurs in greens and larger areas as well. The golf course superintendent is concerned with greens while the sod nurseryman is concerned over the larger areas as he wants to sell an uncontaminated product.

A pure strain of bermudagrass is first the responsibility of the researcher, then the sod grower, and finally the turfgrass manager. The researcher has a long, tedious job in selecting strains of turfgrasses. He has to keep close surveillance while evaluating the merits of each grass for a particular use. There is constant roguing of cultivars and foreign bermudagrasses from research plots. Any strain of bermudagrass to be released has had several years of testing and has been cleared through State and Federal agencies before it is released.

Bermudagrass is heterogenous indicating an unstable tendency. We see this in the variation of grass under stress. Many common bermudagrass selections produce fertile seeds sometime during the year, and this makes it easy for golfers to carry seed onto the greens. On the other hand, hybrids have sterile seed, and there should be no mixing from seed produced by Tifway, Tifgreen, Tifdwarf, and other hybrids.

There are many ways common bermudagrass seed can be transported onto greens. It is quite difficult to keep a pure stand. A strong, healthy turf

This cultivar is surviving under adverse conditions.



on greens is the first and best defense against common bermudagrass invasion.

It is much easier to observe a mixture of grasses in small research plots and greens than it is in fairways, athletic fields, and other large turfgrass areas. Spectators at sporting events are not so concerned about the mixture of grasses as the turfgrass manager is on his greens. The best putting surfaces have pure strains of grass, or grasses that have very similar texture, especially with hybrid bermudagrasses.

In recent years, we have observed different cultivars or mutants of grasses in hybrid bermudas, especially where the grass is under stress. Stress in greens can develop from poor construction, partial shade, chemical treatment, traffic, being mowed closely, insects, and other environmental conditions.

Stress from the environment has created changes in the vegetative appearance, but this does not include grain. This statement is not readily accepted by many turfgrass managers, but in the next five years it will be very interesting to see the changes that have occurred in bermudagrass and what the cause is. It is quite obvious that changes in common bermudagrass could be entirely from seed, but in hybrids that have sterile seed, other causes have to be considered. When bermudagrass is thinning out but a small spot of grass continues to grow and spread, it is reasonable to conclude it is a different grass from some contamination or growth created by the dominant grass. For several years, selections have been made from areas where a superior grass was taking over the established grass. Several superintendents have made selections and are planting greens with their selections. Reese Coltrane, Superintendent of Lakewood Country Club, New Orleans, has made a selection from his ninth green and will eventually plant all 18 greens with it.

When there are mixtures of grasses in greens, it is advisable that the mixture be removed immediately. If this is not done, the cup changer will set the undesirable grass into key cup setting areas, especially when bermudagrass is overseeded and he cannot see where the undesirable grass is located. Some cup changers do not recognize the difference in grasses.

In some greens where the grain is obvious, the members invariably think there are different types of grasses growing in the same green. Bermudagrass grain gives a different appearance in the opposite direction. Grain in the grass has created many serious discussions for turfgrass managers, each thinking his problem is unique. Many are.

One of the best methods for removing foreign grasses is to gas it with methyl bromide. Sometimes one area is gassed then resodded, plugged, or stolonized. The soil mixture should be gassed before planting to eliminate any seed or live stolons in the seedbed. It would be advisable that the area is observed immediately after the grass begins to grow, and all foreign grass rogued as soon as there is a distinction. If too much is present, then the area should be gassed again and replanted with a pure strain of grass. A sod nursery is essential.

Light, chlorotic areas appearing in the greens have caused considerable concern across the South. Many soil samples have been taken from these areas and a complex problem exists causing the grass to have the chlorotic appearance. Usually diseases and nematodes cause the grass to be in a weak condition and off-color.

Most superintendents question the cause of chlorotic areas. Several solutions have been offered but none have proven to be the cause. Bermudagrass mites, nematodes, disease complex, and turfgrass management practices are some of the causes. Tom Brown, Superintendent at the Country Club of Austin, Texas, has used an acaricide over a period of several weeks. The number of patches in the greens were reduced by 50 per cent but many small areas still exist.

In the middle 1960s some chlorotic spots were treated with a nematacide and were finally eradicated by using a fungicide over a period of two years of repeated applications. Soil samples from

Tifdwarf under stress at Country Club of Austin, Texas.

A typical green showing variation in grasses. This can occur in Tifdwarf as well as Tifgreen.

these areas were checked for nematodes, diseases, and in some cases, bermudamites.

The diseases found were *Rhizoctonia, Helminthosporium, Curvularia,* dollarspot, *Fusarium,* and *Pythium.* In a recent soil sample where disease symptoms were noticed, there were 50 propagules of Pythium per one gram of soil.

The higher the nematode count, the more prevalent the chlorotic conditions. Nematode assays were made on 100 cc of soil. A recent period of sampling from these spots in Florida has not verified nematodes as the main cause.

Researchers at the Georgia Coastal Plain Experiment Station exposed vegetative parts of Tifway, Tifgreen, and Tifdwarf to radiation and have created many mutations. This would certainly indicate that bermudagrass under stress in greens could cause changes in vegetative characteristics on the golf course.

Every 18-hole golf course should have a turfgrass nursery and it should be kept free of all undesirable grasses. Constant surveillance is necessary to keep a pure stand and all employees should be able to distinguish the undesirable grasses, especially in greens, and bring it to the superintendent's attention immediately. When any undesirable grass is observed it should be removed immediately. The longer an undesirable grass is allowed to remain, the better established it becomes and the harder it is to eradicate.

We can summarize by stating the researcher must establish a pure strain for the certified grower and the sod nursery should pass it on to the turfgrass manager in the same condition. The turfgrass manager should keep a pure stand of grass for his operations at all times. If bermudagrasses mutate, then the researcher must develop a grass that is stable and retains its characteristics to compete with undesirable grasses. The turfgrass manager of the golf course should maintain a pure stand of grass by constant surveillance and from planting year after year. A pure stand of grass makes a much better putting surface and a much more attractive green.

Single Step Mechanical Thatch Removal

A GREEN SECTION SUPPORTED RESEARCH PROJECT

By BRAHM P. VERMA AND DENNY C. DAVIS*

Thatch build-up is a problem commonly encountered in lawns and golf courses. Usually there are two approaches for a solution to the thatch build-up problem: prevention and cure. Prevention of thatch build-up in the first place frequently can be accomplished by proper cultural practices. However, when providing a uniform playing surface in golf courses, preventive methods are seldom entirely successful. A second (cure) method where thatch already has accumulated is to mechanically loosen and remove the thatch.

Several machines are available for loosening thatch, but none satisfactorily picks up the loosened thatch under all conditions. These machines range in size from small push units to large tractor-mounted units and use blades mounted vertically on a rotating horizontal shaft to pull and cut the thatch. Depending upon the severity of thatch build-up, blades may be spaced from less than one inch to more than three inches apart. The thatch usually is loosened and left on the surface, thus requiring separate operations of raking, vacuuming and/or blowing to a side to remove the thatch. If it is left on the surface, it is unsightly and can work back into the turf and create the same build-up problem.

A research project at the University of Georgia, Georgia Station, funded in part by the USGA Green Section, is partially directed toward developing a principle of dethatching which loosens and picks up the loosened thatch in the same operation.

DESIGN CONSIDERATIONS

A dethatcher design that would achieve thatch removal and collection in a single operation would be superior to currently used methods in many respects:

1. It would not allow the loosened thatch to work back into the turf.
2. One operation would achieve both dethatching and picking, thereby reducing the labor, energy and cost of operation.
3. It would remove abrasive soil particles pulled with the thatch, thereby prolonging the life of mower blades.
4. It would achieve more efficient thatch collection.

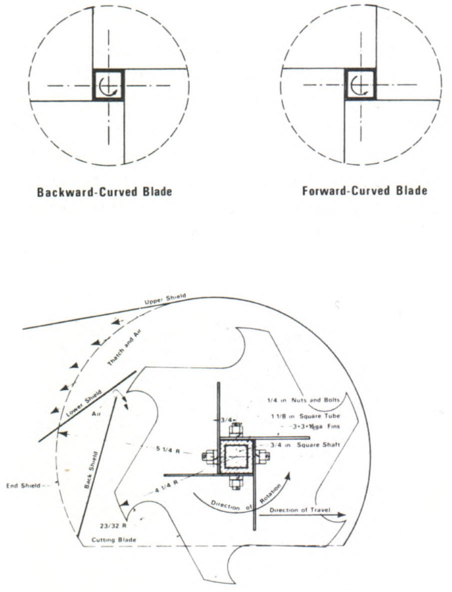
While studying mechanical dethatching it was envisioned that the following three alterations in the present mechanical dethatcher would permit one to loosen the thatch and simultaneously make the loosened thatch airborne for collection and transportation to a desired location:

1. Add impellers between the shaft-mounted blades to create a fan for making airborne the loosened thatch and soil particles.
2. Reverse the direction of shaft rotation to make the blades and impellers rotate opposite to the direction of travel.
3. Design a shield to channel the loosened material to a location from which conveyance by belts, auger or by some other device could be accomplished.

Reversal of the direction of rotation was proposed to:

1. Utilize the uncut turf in front as a shield to aid

Figure 1.



* Associate Professor and Assistant Professor, Agricultural Engineering Department, University of Georgia, Georgia Station, Experiment, Georgia 30212

in lifting the loosened material and making it airborne.
2. Prevent the material from floating into the previously cut slot (as happens with the forward-rotating blades).
3. Improve the cutting and loosening of thatch by utilizing pull forces and eliminating the initial compression that occurs with forward-rotating blades.

CONSTRUCTION OF AN EXPERIMENTAL UNIT

To incorporate the design considerations into a unit for testing, a 12 inch wide hand-push experimental dethatching unit was constructed. The blade assembly shown in Figure 1 included four 8½ inch diameter, commercially-available dethatching blades with six cutting points mounted three inches apart on a ¾ inch square shaft. Spacers between the blades were made from 1⅛ inch square tubing on which two ¼ inch bolts were brazed on each face. The bolts provided the means for fastening impellers between the cutting blades. The assembly was mounted in bearings on a suitable frame structure and was driven by a V-belt connection to a five horsepower gasoline engine. Four rubber wheels for moving the dethatcher were fastened to the frame in a manner which permitted adjustment for the depth of cut. Twelve straight impellers for each of two impeller sizes tested (3 x 3 inch and 3 x 3½ inch) were cut and drilled to match the bolts brazed to the spacers.

The shield assembly included two partial-circle end shields, a curved upper shield, a lower shield, and a back shield as seen in Figure 1. The upper shield forms the base of a discharge channel between the blade and the upper shield. The channel depth gradually increases and forms a discharge chute with the lower shield. One end of the lower shield barely clears the blade (⅛ inch clearance) to insure complete discharge. The back shield forms a ½ inch slot opening for air to enter at the low pressure area below the lower shield.

Figure 2 shows the blade, impeller and shield assembly viewed from the bottom.

EXPERIMENTAL DESIGN

An experiment was designed to test the performance of the dethatching unit for a selected range of design and operating conditions. The selected range of operational and design conditions were as follows:

(1) 2 positions of impellers (P): P_b=backward-curved and
P_f=forward-curved blades
(2) 2 lengths of impellers (L): L_1 = 3 in. (impeller clears the turf)
and L_2 = 3.5 in. (impeller touches the top of turf)
(3) 3 rotation speeds (RPM): 1100, 1800, and 2500.
(4) 2 ground speeds (S): S_1 = 0.75, and S_2 = 1.25 mph.

The two positions of impellers shown in Figure 1 represent the backward-curved and forward-curved blades in centrifugal fan theory. The two lengths of impellers were selected so that the shorter impellers cleared the surface of the grass and the longer impellers penetrated approximately a quarter inch into the grass. The tests were conducted in a uniform Tifgreen turf plot.

To determine the performance of the dethatching unit, a measure of both the thatch collected in the catch tray and the thatch left on the grass was required. Three different measurements for quantifying the grass and thatch were selected. They were (1) fresh weight, (2) fresh volume, and (3) dry weight. Weight measurements were accomplished by standard methods, but volume measurements required the development of a procedure by which the samples could be brought to a constant density condition. A simple correlation analysis yielded a high degree of correlation among the three measurements; therefore, fresh weight was used to quantify the performance of the unit.

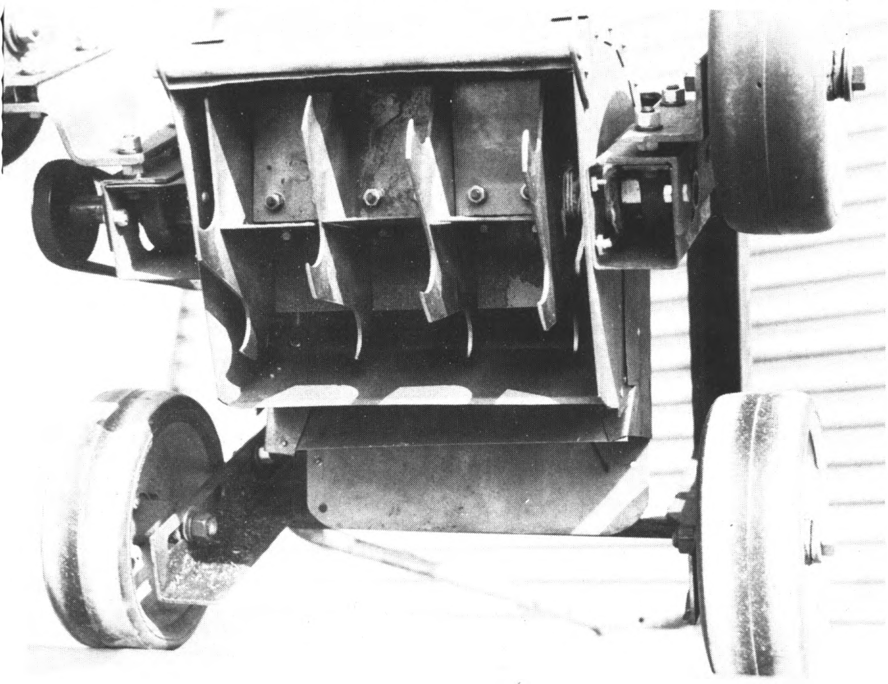


Figure 2. Cutting blade, impellers and shield assembly of the experimental dethatcher viewed from the bottom.

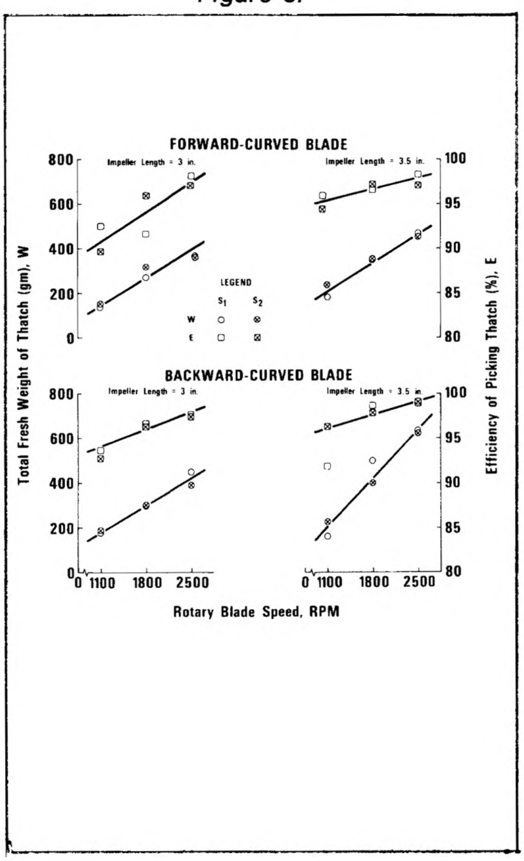
RESULTS AND DISCUSSION

To evaluate dethatching performance at various design and operating conditions, total fresh weight of loosened thatch from the turf, W, (fresh weight of thatch collected plus fresh weight of thatch left on the ground) was used in a factorial analysis of variance. The analysis shows that at 95 per cent probability level there was a significant effect due to position, length and rotational speed of the blade but no effect due to ground speed or replication. A further analysis indicated that all three levels of rpm were significantly different and that with an increase in rotational speed there was a significant increase in total fresh weight of thatch at all test conditions. (See Figure 3).

Picking performance of the dethatcher was measured by determining the ratio of the fresh weights of the thatch picked up by the machine to the total thatch loosened (efficiency of picking). At 95 per cent probability level there was a significant effect due to position, length and rotational speed of the blade but no effect due to ground speed or replication. Again all three levels of rpm were significantly different. Figure 3 shows a plot of rpm versus efficiency of picking at all test conditions.

The statistical analysis has shown the effects of rpm on both loosening thatch (W) and efficiency of picking (E). As the rotational speed was increased from 1,100 rpm to 2,500 rpm there was a nearly linear increase in W and a significant increase in E for all test conditions. This result is easily attributed to the more vigorous action of the cutting blade for loosening thatch at the higher rpm. The increase in rpm also caused greater air flow which helped to carry the loosened thatch around for deposit in the catch tray.

Figure 3.



The two positions of the impellers, forward-curved (P_f) and backward-curved (P_b) blades, have a significant effect on the efficiency of picking. The backward-curved blade condition was slightly more efficient than the forward-curved blade condition. The longer impellers were more efficient in picking up loosened thatch than were the shorter impellers. The gain in the efficiency of picking, however, resulted at the cost of severe bruising to the top of the turf. The gain in the total fresh weight of the loosened thatch is attributed to the additional grass tips cut by the longer impellers.

CONCLUSIONS

The test data and analysis show that any one of the reported test conditions would be satisfactory for the loosening and pickup of the loosened thatch. Rotational speeds of the blade and impellers in the range from 1,800 to 2,500 rpm, the backward-curved impeller position, and impeller lengths which clear the top of the turf gave best performance. Under these conditions the efficiency of picking thatch ranged between 96.5 and 98 per cent. Dethatching performance was not significantly affected by ground speeds from 0.75 to 1.25 mph.

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USGA GREEN SECTION
NOVEMBER, 1975

TURF TWISTERS

THE BUFFER

Question: Can I substitute extensive back-lapping for the tedious and time-consuming job of grinding reels and bedknives? (Vermont)

Answer: Actually all the back-lapping operation does is to buff or polish with liquid emery the cutting surfaces on a reel and bedknife. It is not a sharpening operation (which is the removal of metal by stone grinding) but rather one of honing the edges. If a ripple develops in these surfaces, all that can be done is to grind it out. This is not to discount the back-lapping operation. It remains as one of the most important maintenance procedures that can be performed to help keep the mowers clipping off the grass blades with a nice sharp, neat cut.

BETWEEN

Question: I have asphalt roads on my course and in low areas where water stands, there is constant repair of asphalt. What is my best solution? (Mississippi)

Answer: Excavate where the water stands or flows and construct a 4-inch reinforced concrete slab.

ASPHALT OR CONCRETE

Question: We will be installing asphalt cart paths next spring. Your suggestions will be appreciated. (Arizona)

Answer: Firstly, you might want to do some comparative shopping. Check the cost of asphalt versus concrete paths. With oil prices continuing up, clubs in certain areas have found concrete paths no more costly than asphalt (i.e., if the golf course crew furnishes the labor). Concrete will also require less maintenance in the future. Secondly, study each hole individually for the best path location. Traffic flow varies from one hole to another (tee location, terrain, yardage, trees, bunkers, etc.). There's more to it than meets the eye. Thirdly, cart paths must drain well, be at ground level and a width of six feet is generally accepted today.