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USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association

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COVER PHOTO—
Weeds interrupt the uniformity of a beautiful turf picture.

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Dandelion and clover, two well known weeds that spoil turf.

Weeds and Their Control

by **A. ROBERT MAZUR**, Agronomist, USGA Green Section

A weed is classically defined as a plant that is growing where it is not wanted, or a plant that is out of place. Weeds are plants that have more undesirable than desirable characteristics. At times even some of our fine turf species can be considered weeds; bentgrass in a Merion bluegrass tee is a weed. In turf, uniformity is the key to high quality. Any plant that causes a variation in leaf color, texture, or growth habits of the turf stand is classed as a weed.

History of Weed Control

Agriculture has advanced more in the past 100 years than in the previous 100 centuries. More striking is the fact that man's ability selectively to control weeds has been developed to the greatest degree only in the last 30 years. Presently we are in the era where specific chemicals are used for the control of specific weeds. The major historical achievements that have led to our present knowledge are approximated as follows:

1850-1900 **Julius Sachs** and **Charles Darwin** observed the significant fact that plants produce certain growth-regulating substances. These growth-regulating substances are translocated from the site of production to a site of activity and could be compared with the nervous system in animals.

1900 **Bonnett, Schultz** and **Bolley** working independently observed that copper salts would selectively kill broadleaf weeds in cereals.

1941 **Pokorny** reported the synthesis techniques for 2, 4-D.

1944 **Marth** and **Mitchell** showed that 2, 4-D selectively removed dandelions, plantain and other broadleaf weeds from bluegrass turf.

1945 **Templeman** established the principle of preemergence soil treatment for selective weed control.

Weed Classification

A plant's method of reproduction, the length of time it grows and the time of year that it grows are instrumental in determining control measures. The three principal groups of weeds are annual, biennial, and perennial.

Annual weeds complete their life cycle from seed in less than one year. Due to the prolific production of seed and their fast growth, annual weeds are very persistent. The summer annuals such as crabgrass, goosegrass and knotweed that germinate in the spring, make most of their growth during the summer, and they usually mature and die in the fall. The winter annuals such as wild garlic and henbit usually germinate in the fall or winter and mature and seed in the spring or early summer before dying. Another weed we can consider with this class is "our old friend" **Poa annua.**

Biennial weeds such as bull thistle and cinquefoil generally live for more than one year but less than two years.

Perennial weeds such as dandelion, plantain, mouse-ear chickweed and quackgrass live more than two years and may live almost indefinitely. Most perennial weeds reproduce by seed but many are able to spread vegetatively.

Weed Control

In turf management we have principally two methods of weed control available to us; mechanical and chemical control.

Mowing is an effective means of mechanically controlling tall-growing weeds in turfgrass. Repeated mowing not only prevents seed production of some species but it may also starve underground parts by drastically reducing the weed's photosynthetic surface. This type of control is only effective on tall-growing weeds when an area is mowed repeatedly. Vertical mowing is effective on the lower growing weeds only when properly timed to set back seed production and plant growth.

Weed-killing chemicals are referred to as herbicides. The use of chemicals for the selective control of weeds has developed rapidly since the work of Marth and Mitchell with 2, 4-D. The type of herbicide application is usually classified with reference to weed-seed germination or turf establishment. Preemergence treatments are applied prior to weed-seed germination. This is the most effective means of controlling some of our grassy weeds such as crabgrass and goosegrass. Post-emergence treatments are applied after the weeds have become established. This is the manner in which most broadleaf weeds are eliminated from mature turf. Seedbed sterilization is a nonselective treatment made prior to the seeding of the turfgrasses.

Herbicides fall into three classes: soil sterilants, contact herbicides and growth regulators.

Soil sterilants are chemicals that prevent the growth of green plants when present in soil. The length of time any chemical remains active in the soil depends on (1) the nature of the chemical, (2) the activity of soil microorganisms, (3) adsorption on soil colloids, (4) leaching, (5) volatility and (6) photodecomposition.

In order for a herbicide to give effective seedbed sterilization, it must not only remain active in the soil long enough to kill both the viable weed seeds and existing plant parts, but also the herbicide must dissipate prior to the seeding of the turfgrasses. If the herbicide has killed both the viable weed seeds and existing plant parts the soil will remain weed free for a long period of time after the chemical has disappeared.

A preemergence herbicide treatment depends on the ability of the herbicide to remain in the top 1/2 inch of the soil for a sufficient period of time and at a high enough concentration to control weed seedlings. This takes into consideration that most of the annual weed seeds germinate near the surface of the soil.

Contact herbicides are directly toxic to living cells and kill the plant parts covered by the chemical. There is little or no translocation of this type of herbicide through living cells. Contact herbicides such as sodium arsenite have been used effectively on golf courses in the past for the control of annual weeds such as knotweed. However, they do little more than "burn off" or chemically mow perennial weeds.

Growth regulators are organic compounds other than nutrients, which in small amounts promote, inhibit, or otherwise modify the physiological processes of plants. Growth regulators or hormone-type herbicides are generally applied as postemergence treatments. They can be absorbed by either the roots or above-ground parts of the weed and are translocated throughout its system. Essentially hormone-type herbicides upset the plant's growth and metabolic processes. The fact that certain chemicals will selectively kill certain plants without harming others make them a very effective tool in weed control. Rate of application is often the key to usefulness. The old axiom, "If a little is good,

more is even better," does not apply. Where small amounts give selective weed control, increased rates can often injure the turfgrasses.

Herbicide Selectivity

A selective herbicide is one that is more toxic to one plant than to another. When this herbicide is applied to a mixture of plants, some may be killed and others may be affected only slightly or not at all. Selectivity is based upon factors such as morphology, absorption, translocation, and physiology.

The morphological or structural differences such as protected meristematic regions, differences in leaf surface or orientation, and the presence of a waxy cuticle or hairs permit the selective application of herbicides. On broadleaf plants the new growth is located in the terminal portion of the stems which is exposed to the herbicide spray. The growing point of grasses, on the other hand, is usually protected by a leaf sheath. Grasses may also present far less leaf surface than broadleaf weeds and are generally oriented so that chemical sprays will quickly flow off the leaf surfaces.

To be effective herbicides must enter the plant. Absorption can take place either through the leaves or the roots. Depending upon the nature of the chemical it may be absorbed quickly or little if at all. The leaves of most plants are covered by a non-polar wax-like cuticle which prohoibits the penetration of polar materials such as water. While the roots on the other hand readily pick up and translocate polar materials like water. In order to get penetration of leaf tissues we must use an organic or non-polar herbicide such as the organic acids and esters. Any material that will bring the polar or water-soluble herbicides into more intimate contact with the leaf tissue will aid absorption. It is for this reason that wetting agents and spreader stickers added to polar herbicides increase their herbicidal toxicity. However, this can reduce the selectivity of the herbicides if it is dependent upon the difference in foliar absorption for its effects. Non-polar herbicides applied to the soil are generally converted to polar substances which can be absorbed through the roots of the weeds.

Translocation

Translocation or movement of herbicides in the plant takes place in the phloem with food materials, in the xylem with water or in the intercellular spaces.

The movement of herbicides in the phloem is generally from the leaves toward the roots. The phloem consists of living cells that translocate food materials from the leaves to the other plant parts. Extremely toxic chemicals such as contact herbicides quickly kill the cells and are therefore not translocated. Because the hormone-type herbicides are translocated along with food materials, we can expect the best results with these materials when the weeds are actively growing.

Translocation through the xylem is generally from the roots upward. Movement of herbicides is believed to be in conjunction with the upward movement of water in the plant. The xylem tissue is principally non-living. Therefore, all types of herbicides, even the toxic or poisonous chemicals, can be absorbed from the soil and quickly translocated to all parts of the plant. Actually, some of the toxic chemicals such as the arsenicals may even move downward through the xylem tissue under special conditions.

Translocation through the intercellular space is primarily by non-polar substances with low interfacial surface tensions. An example would be the absorption of kerosene or fuel oil through the cuticle, bark and stomates. Once these materials are inside the plant they can move in any direction. Water-soluble materials move little if at all through the intercellular spaces.

Physiological Differences

There are a great many factors that account for selective herbicidal toxicity. Differences in cell metabolism, enzyme systems, cell permeability, chemical constituents and polarity could be involved. Many of these factors interact and often the exact mechanism of action is not definite. The entire metabolic process of a plant can be thrown out of balance by either blocking or stimulating a certain biochemical process.

Photosynthesis and respiration are the two basic physiological processes that are taking place in plants. Photosynthesis is essentially a building process while respiration is a breakdown process. The substituted ureas, such as siduron, and the triazines, such as simazine, interfere with a basic reaction in photosynthesis known as the Hill Reaction. The Hill Reaction is essentially the splitting of water into hydrogen and oxygen, which is the primary step in the synthesis of plant foods. Therefore when the herbicide disrupts this reaction, the plant dies from starvation.

Weed Prevention

The most important requirement in the prevention of weeds is good turf management. This includes selection of the proper grass specie, fertility rate and regime, soil type and

reaction, cutting height and frequency of mowing, good moisture level and drainage along with the control of damaging insects and disease. Chemical control of weeds is not the long-term answer if the preceding factors are not recognized and practiced. Chemical weed control is no substitute for good turf management.

Weeds generally become a problem in turf when the grass loses its vigor and density. Many of the weeds thrive under conditions that are unfavorable for turfgrasses. Knotweed, for example, will flourish on dry and compacted areas that receive constant traffic. Therefore, we must start with a program to improve conditions so as to promote a stronger and more vigorous turfgrass stand.

Kentucky bluegrass and fescue fairway turf should be mowed at a height of 1-1/4 to 1-1/2 inches, watered deeply and infrequently, and receive the major portion of its fertility in the early fall. Closer cut, more water and early spring fertility will leave a weak, open, and diseased turf that is subject to invasion by weeds that will tolerate this management regime, i.e., **Poa annua,** crabgrass and knotweed.

Delaying fertilizer applications in the spring until the soil has warmed up and the bentgrasses are actively growing helps to hold down the early spring flush of growth by the annual bluegrass. The use of our more slowly available forms of nitrogen during the summer months, the peak period for weed-seed germination, gives a slow, steady feed to our permanent grasses and avoids the quick stimulation that encourages weed seedling development.

Water management is important in checking weed-seed germination and development. A mature turf will tolerate dry soil at the surface for a longer period than the germinating and developing weed seedlings. Withholding water until the permanent grasses show signs of stress is an effective means of minimizing weed-seedling development.

Grasses differ in their ability to resist weed invasion. We should select grasses according to the management they will receive. In the areas we intend to water and mow at 1/2 inch, or less, the situation dictates the use of bentgrasses or bermudagrasses. In areas that we will mow infrequently at 1-1/2 inches or higher without supplemental irrigation, the bluegrasses and fescues are more appropriate.

Contamination of weed-free areas should also be avoided. Topdressing materials should be sterilized to prevent the introduction of weed seed. The use of certified seed for turf establishment and overseeding will minimize the introduction of undesired species. Clean seed is particularly important as many of our weedy grasses cannot be selectively removed with herbicides from the desired turf species. Cleaning equipment will reduce the amounts of weed seed and vegetative parts that are carried from one area to another. Preventing adjacent weedy areas from going to seed by mowing or chemical treatment will also reduce this source of infestation.

Use of Chemical Herbicides

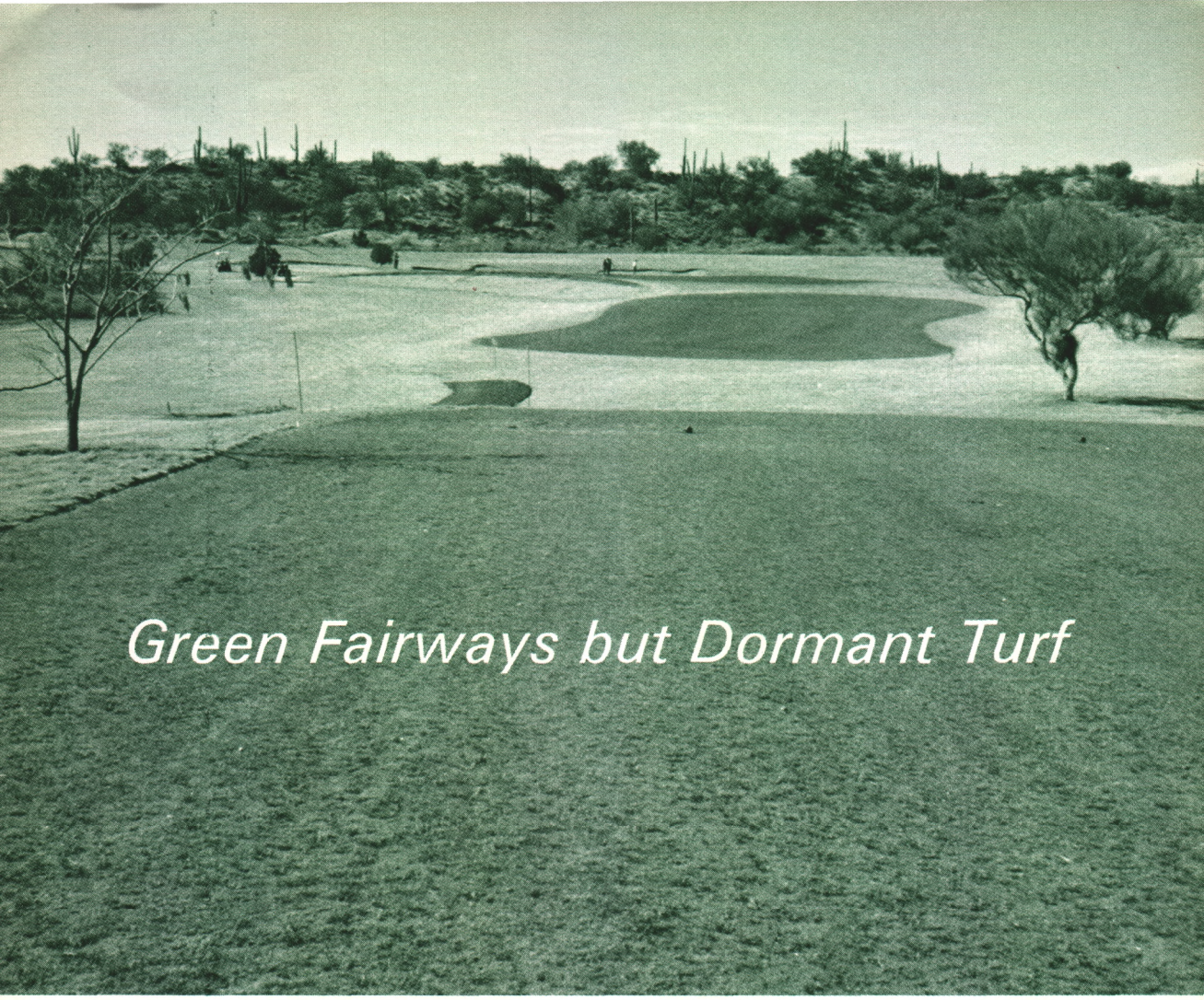
The application rates of herbicides as expressed in pounds per acre are usually very critical. When herbicides are applied at less than the optimum rates they seldom give effective control unless a second application is made. Applications at rates in excess of those prescribed on the label can result in the nonselective killing of all vegetation, including the turfgrasses. By reading the labels and thoroughly familiarizing yourself with all materials prior to use, you can greatly reduce the chances of injury to man and turf. Equipment should be properly calibrated at selected pressures and speed to insure uniform application at desired rates. Sufficient water should be used to facilitate even distribution of the material over the predetermined area. Applications are most favorably made in the late afternoon or early morning when air movement and traffic are at a minimum. Dew in the early morning often provides an excellent reference line for application of these materials.

Climate affects the results of a herbicide application indirectly through the growth rate of the weeds and turf. There should be adequate soil moisture and favorable temperatures so that the weeds and turf are actively growing. On the other hand, herbicide applications should be avoided during the heat of summer when herbicides tend to lose their selectivity and can injure the desired turf species.

In instances where a minimum number of weeds are present, it may be more advisable to remove them by hand rather than embark on a complete spray program.

Summary

It is important to evaluate your weed problems and eliminate the conditions that have brought them about. You can eliminate weeds through mechanical and chemical treatments but only good turf management practices will replace weeds with desirable turf coverage and keep the weed from reappearing. Let me reiterate by saying chemical weed control is not a substitute for good turf management.



Green Fairways but Dormant Turf

A winter scene on a par-3 hole at Tucson National Golf Club where dye has been applied.

by JIM TALLEY, Golf Course Superintendent, Tucson National Golf Club, Tucson, Arizona

Golf in the Southwest is a 12-month game, and maintaining a course for year-'round play presents a variety of problems to be solved by the golf course superintendent. If he were building a new course, one of the first questions to be answered would be "what is the best fairway turf I can use, since fairways make up the major acreage of my course?"

If he were located in the southern half of the United States his answer would probably be bermudagrass or one of its hybrids. More often the superintendent already has the planted fairways of an established golf course and they are in bermudagrass or one of the hybrids which are dominant in the area.

Tucson National Golf Club is a course of 7,200 yards, planted from tee to green, including roughs, in Tifway 419. Greens are Penncross bentgrass. The course is situated in a desert setting using natural vegetation, palo verde mesquite, sahuro, aleppo pine and olive trees.

Bermudagrass thrives in warm weather, generally April through October and goes dormant after the first frosts in the late fall, turning a very light brown, almost white. Golfers like green; green to cut the sun's glare, green to provide a target outlining the fairway and green to form a background so that he can follow the flight of the ball. So how do we get a green golf course during the winter season? Answer:

Either overplant with a grass that grows in the winter or dye it green.

At Tucson National Golf Club we dye it green. This decision was made after trying a winter rye overplant and after experimenting with dyed fairways and weighing the advantages and disadvantages of each method. We feel that with all factors considered, the dye application is superior. We have used it three seasons and plan to continue indefinitely. Acceptance by our golfing membership is excellent and our maintenance costs are significantly reduced.

Overplanting winter ryegrass involves (a) purchase of seed, (b) sowing of seed, (c) fertilization, (d) a continuous irrigation program with particularly heavy irrigation thru germination, (e) a continuous mowing program, (f) and finally a painfully slow transition to the Tifway turf in the spring. (Competition between rye and Tifway in the spring retards the Tifway significantly.) Clumps of ryegrass last until midsummer, contaminating the Tifway turf.

The dye operation is a simple one. The dye is applied after the grass blades have turned brown and are dry and capable of absorbing the pigment. After experimenting with a number of dyes, comparing color, light fastness, ease of application and finally cost, we chose a particular lawn concentrate which mixes at a ratio of 1 to 50 with water. Application is made with a regular fairway spray unit, 18 gallon-per-minute pump, and a 20-foot boom fitted with low volume nozzles on 11-inch centers.

The spray nozzles are set at 22 inches above the turf surface. Pump unit pressure should be at least 150 PSI. Tees and fairways are sprayed at about 1½ to 2 miles per hour, depending on the shade of green desired. By spraying we eliminate planting, fertilization, heavy irrigation, mowing and the slow transition mentioned above. Moreover, we have no ryegrass contamination at any time.

We do recommend weekly irrigation to retain soil moisture, which also moistens the grass blades giving them better resilience and washes away accumulation of dust. Water does not affect the dye once it has been allowed to set.

Overplanting winter rye has one important

Landing areas are easily designated for the winter golfer.

Superintendent Jim Talley reports excellent acceptance by the membership.

disadvantage. If you have experienced a *Poa annua* invasion of your bentgrass greens, you will certainly understand this emphasis. We find that most rye seed contains *Poa annua* seed contamination and that by planting winter rye we are introducing *Poa annua*. Eventually *Poa* will appear in the bentgrass greens. There is no *Poa annua* in the dye we use and by dying rather than overplanting we are eliminating a serious problem for the golf course superintendent.

At Tucson National we dye the tee surfaces and fairways. The fairways start ninety (90) yards in front of the women's tees. The rough between the tee and fairway is left a dormant brown. In this method we mark fairway areas in green contrasting the rough, which is left its natural brown. The fairways are sculptured up to the collar of the greens.

I have said that acceptance by the membership is excellent; acceptance by the pros in the Tucson Open was equally good. Their consensus was that dormant Tifway or bermuda is an excellent hitting surface with consistently good lies and that the dyed surface answered all the requirements of cutting glare, outlining the target area and providing a dark background.

Our original application of dye made in early December cost less than $5,000. Two months later a very light application was made to televised holes and to turf around the clubhouse area which was not part of the golf course. Total cost for the year was well under $7,000. Compared with previous overseeding of winter rye, we calculate a savings of over $8,000 when seed, mowing, fertilization and irrigation are considered.

If your course has an annual ryegrass overseeding requirement, you might well consider our program for 'greening up' the course. It is simple and relatively inexpensive. In addition, the "free" winter months allow you to take advantage of seasonal dormancy and finish those maintenance projects you never have time for otherwise.

ANTHRACNOSE — Serious Disease Problem

by **DR. PAUL M. ALEXANDER,** Agronomist, USGA Green Section

Anthracnose, a disease of cool-season grasses, was first found in South Carolina on a golf course in Spartanburg County in November, 1966. All 18 playing greens plus the practice green had been overseeded in mid-October with seaside bentgrass at three pounds per 1,000 square feet, following usual overseeding preparations.

No fungicide program was followed.

By mid-November, all 19 greens were in such bad condition that they were overseeded with seaside bentgrass a second time, using the same seeding rate. This second overseeding was lost before mid-December. Then help of a plant pathologist was requested. Needless to say, it was too late to overseed again to produce a good winter playing surface, but a lot was learned during the following weeks.

This disease is caused by the fungus *Colletotrichum graminicola* (Ces.) Wils. and is a well known pathogen of cereal crops and pasture grasses. It has been a problem on cool-season species of turfgrasses in several areas, especially the Pacific Northwest for many years. Since it is known to be seed-borne and since it had not been known to occur in South Carolina before 1966 it was presumed to have been introduced by means of contaminated seed. A high percentage of the seed used for overseeding purposes in the South is harvested in the Pacific Northwest, so various seed lots from this area were checked for anthracnose contamination. Results of these tests confirmed the postulation of seed-borne *A. graminicola*. Grass species tested included annual ryegrass, perennial ryegrass, highland bentgrass, seaside bentgrass, and common creeping red fescue.

In the fall and early winter of 1967, anthracnose was found in overseedings in several additional areas of South Carolina. There were also unconfirmed reports from four other locations in North Carolina. After checking greens in both states during late fall and early winter of 1968, it is believed that anthracnose is now widely distributed and will continue to present a threat to overseedings each year.

Symptoms

The symptoms of this disease deviate somewhat from those given in Couch's *Diseases of Turfgrasses* in that the spots on individual leaves do not exhibit a pronounced reddish-brown color. Generally speaking, very large areas are affected, and the entire green will begin to look "thin."

The use of annual ryegrass in the overseeding mixture presents a difficult diagnosis problem. It has been observed that annual ryegrass is more resistant than the bentgrasses, fescues, and/or *Poa trivialis*. Since the ryegrass germinates more quickly and develops more rapidly, the disease situation on the other grasses usually remains undetected because of this "masking" effect of the ryegrass. By the time symptoms are observed on the ryegrass, chances are that the bentgrasses are completely gone and that the fescue or *Poa trivialis* stand is reduced by 60 to 80 per cent.

Typical leaf symptoms of all grass species include:

1—General blotchiness, which is light tan to yellow;

2—As the disease progresses, individual leaves turn straw to dirty white;

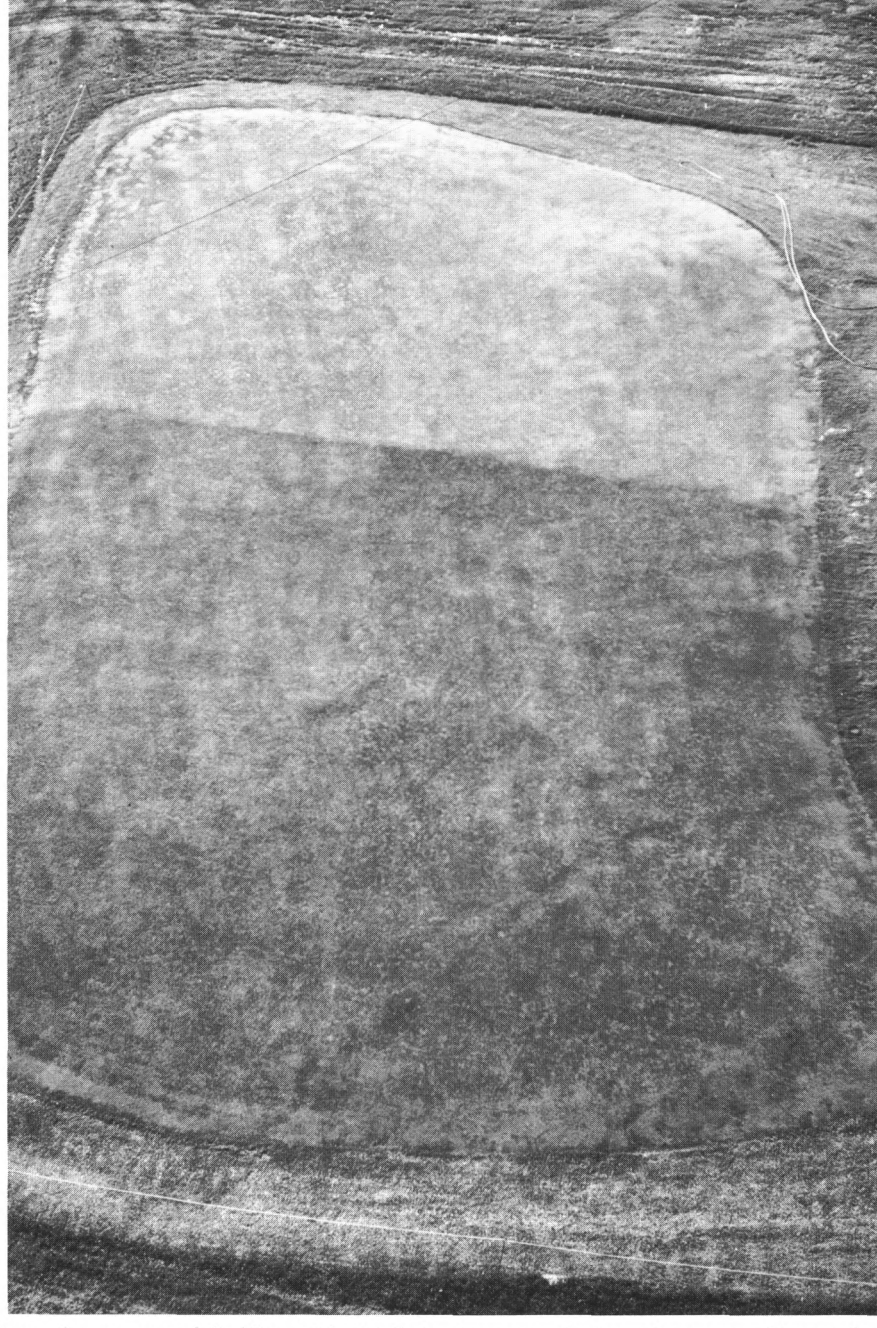
3—During this color change, the affected leaf begins to shrivel drastically from the tip toward the base—this closely resembles damage caused by a dull greensmower;

4—The final stage involves formation of tiny, black fruiting bodies *(acervuli)* of the fungus on the older diseased leaves.

Control Measures

The use of a sound fungicide program on golf greens throughout the year cannot be overstressed. However, during overseeding time, more care than usual must be exercised since seedlings are much more susceptible to chemical injury. It was learned that some of the more common turf fungicides when used at "normal" rates could severely injure the emerging seedlings. Control of anthracnose could not be achieved when rates were reduced to non-phytotoxic levels.

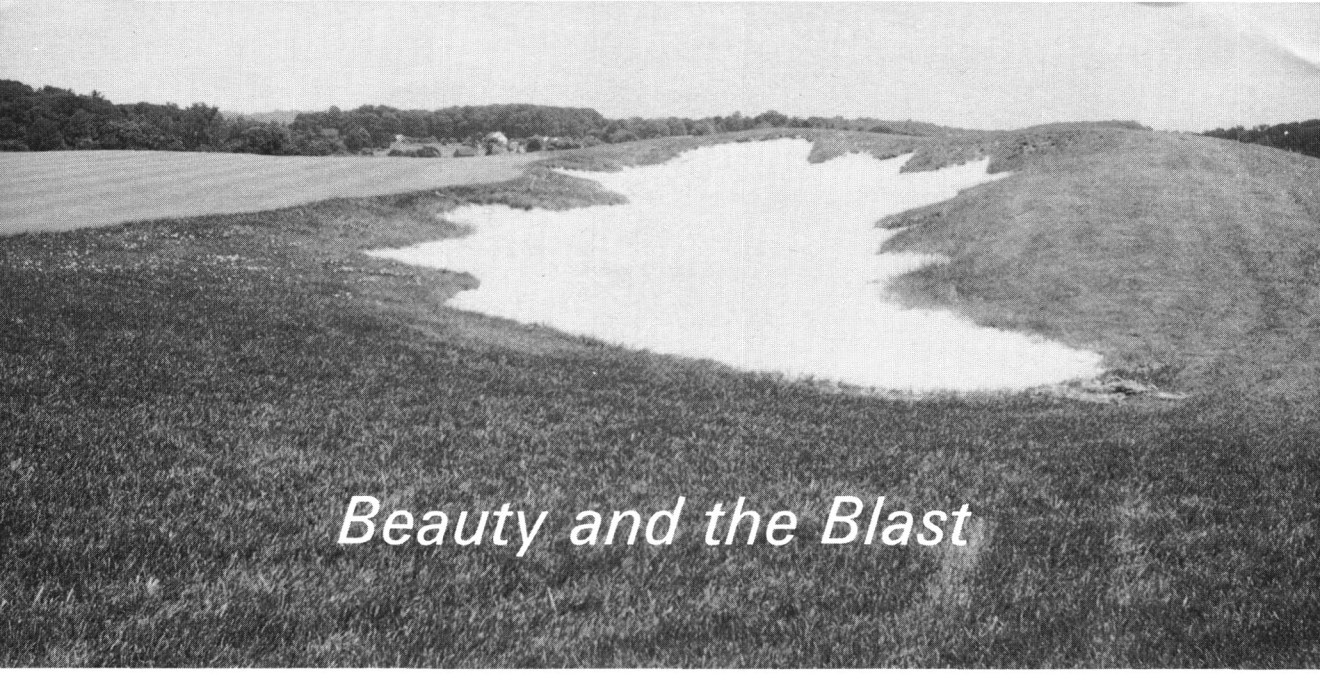
Because of these factors, some of the older, less phytotoxic agricultural fungicides were com-



Aerial view of green used for fungicide trials in the control of anthracnose. Diseased portion untreated and healthy portion treated at 10-day intervals with 6 ounces of Zineb (2-78) per 1,000 square feet giving good control.

pared with standard turf fungicides in 1967 and again in 1968. Results of these tests indicated that maneb, zineb, or ziram when used at 6 ounces per 1,000 square feet every two to four days would provide "curative" control of anthracnose. When any of these three chemicals were used immediately prior to or following overseeding, a high degree of "preventive" control was provided for from six to 10 days.

It is recommended that preventive fungicide treatment should start with the overseeding operation and then be continued at seven- to 10-day intervals throughout the winter season. Waiting for the disease to appear is inviting disaster and will usually result in re-overseeding or extremely poor winter greens.



Beauty and the Blast

Good surface drainage keeps sand clean.

by **ALEXANDER M. RADKO**, Eastern Director, USGA Green Section

A bunker is an integral part of a golf course, creating a hazard that is unique to the game. It is defined in **The Rules of Golf** as an area of bare ground, often a depression, which is usually covered with sand.

This sand is of special importance to all who are interested in the management and maintenance costs of golf courses.

Bunkers are important to golf; their beauty in contrast to the deep green color of turf is appealing as well as challenging. They can also be a costly maintenance item. How costly depends upon a number of factors.

SIZE

There is no regulation regarding size, the "pot bunker" well placed is as effective as any larger bunker—it's all part of the architect's plan. Large bunkers are eye catching, yes, even spectacular; few, in fact, will argue that the larger ones add to the general beauty of the golf course more so than smaller ones. One wonders, however, if beauty is sometimes considered over their value as a hazard. There is one thing for sure—the larger the bunker, the more costly it is to rake and restore it to its original smoothness after a day's play.

PITCH

Bunkers vary in facing; some are steep with little or no lip, others are level and there is every conceivable in-between variation. Most are faced-up to the front, that is in the direction of the putting green, and they taper gradually to the rear and finally even out to the turf level. No rule applies: the architect usually prevails. Some bunkers are sloped on two, three, or even four sides, and after rainstorms or heavy play, the more facings and the steeper its banks, the more man-hours are required to restore the sand to its original condition.

NUMBER

There is no set rule with regard to number. We have seen good courses that are almost devoid of bunkers, but the champion of our experience is a course in New Jersey that has 254 individual bunkers on 18 holes. Is there any question that this course will require a larger work force than any course with fewer bunkers? During a recent conversation with a superintendent and Green Committee member whose course has an average number of bunkers, the superintendent stated that his bunkers cost as much to maintain as his greens. The committeeman's startled reaction was a questioning and disbelieving W-H-A-T??? Labor is the major cost of the golf course operation, and a course with emphasis on sand is going to be costlier to maintain than the course that com-

Sand piled in Firestone Country Club parking area. It will be used in 66 bunkers on the new North Course. The 4,120 tons represent a lot of future manhours raking sand for pleasurable golf.

bines a fair share of tree and grass hazards with sand.

SIZE OF SAND PARTICLES

Size contributes to softness or compaction of sand and whether it will footprint excessively or not. Sand that contains a large percentage of gravel tends to compact more readily, allowing the ball to sit up, but when exploded onto the green, this type of sand creates problems in mowing and putting. Maintenance men always try to remove the gravel by poling before mowing, but this is sometimes difficult when greens are wet with dew. Those that escape poling are sometimes cleanly picked up in mowing; **sometimes they are not** and this means more grinding, more adjusting of mowers, more time lost or consumed **NEEDLESSLY.** Players always take time to remove these particles from their line for the obvious reason that they deflect the putt. Incidentally, have you ever noticed any golfer removing a pebble from his line, placing it in his pocket or discarding it **far off the putting green?** Most simply toss it a few feet away ON THE GREEN for the following players to move it again, and again, and again. Here and now we make a plea for golfers to pick up any obstruction on greens, pocket it, and toss it into a trash receptacle at the first opportunity. Player assistance is not only welcome, but CORDIALLY INVITED!!!

Preferably, sand in bunkers should contain no particle over 1-1/4 mm. and none less than 1/4 mm. The largest percentage should be in the 1/2 mm. to 1-1/4 mm. size. This is especially important for courses located where sand is subject to wind erosion. Sand in bunkers should be of similar texture as sand used for topdressing soil mixtures. For a fine article on sand particle size we refer you to the article by Charles Wilson of the Milwaukee Sewerage Commission that appeared in the September 1968 issue of the **USGA Green Section Record.**

DEPTH

Depth of sand is important to maintenance. Excessively deep sand causes unnecessary softness resulting in deeper footprinting. This also adds to costs. The rule of thumb of most superintendents is to introduce or keep sand to a settled depth of four to six inches. To compute the amount of sand required, it takes 37-1/2 cubic yards of sand to cover 2,000 square feet to a depth of six inches. The deeper the sand, the deeper the ball will bury, the more frequently will a "fried egg" result. Depth of sand on facings and slopes is critically important to maintenance. When a ball buries on an inclined plane, the golfer disturbs more sand, sets his feet deeper and the deeper he has to dig to

make the shot. It takes time and a strong arm to re-level the sand on the sloped faces. Most golfers don't have the time to give it anything but superficial attention, so these deep prints are left for the maintenance crew to repair properly. Some superintendents believe in minimizing depth on slopes to approximately two inches so that the ball hits and rolls to the bottom of the trap.

DRAINAGE

Surface and internal drainage are always of Paramount Importance, just as it is on any area of the golf course. Bunkers that have good drainage seldom get dirty with clay sifting up through the sand when they are flooded. As with greens, surface and internal drainage are important, but surface drainage will cure a lot of ills if properly done. Good surface drainage means that the pitch is so slight and so subtle that the sand doesn't move, but the water does. When deep bunkers are built they must have tile or gravel drains that effectively lead the water out. Special provision must be made that drains in deep bunkers remain functional. Too often they quickly clog with sand and become unwelcome, unplanned ponds.

In summary, sand maintenance is costly! There is a point at which the hazard ends and luxury maintenance begins. It really boils down to how much your club is willing to pay for aesthetics.

If budget is a critical factor, it would be well to study the bunker situation carefully and eliminate the superfluous traps (those out of play and those that handicap poorer players only), cut down on the size of excessively large ones, improve internal and surface drainage, check pitch of bunkers that require excessive man-hours to restore sand to its original condition, and carefully measure the depth of settled sand. Excessive use of sand wastes valuable budget dollars.

Rains cause sand erosion on slopes.

Highly frequented bunkers cause turf to deteriorate when an accumulation of sand results from endless explosion shots.

SUPER SAM by Paprocki

Solution to July Green Section Record Crossword Puzzle

ACROSS

2. A type of blade — *rotor*
4. Wet wilt — *scald*
6. Direction — *east*
7. Took apart — *undid*
9. Martini ingredient — *olive*
11. Place ball from unplayable lie — *drop*
13. What seed will do in a flood — *float*
15. Hole-in-one — *ace*
17. Accumulation of vegetable matter formed by partial decomposition under anaerobic conditions — *peat*
19. Greasy substance — *oil*
20. $CACO_3$ — *lime*
22. To sow — *seed*
23. Deciduous tree — *elm*
24. Characteristic carrier — *gene*
26. Arrid — *dry*
28. Green scum — *algae*
31. Soil — *dirt*
33. First — *prima*
34. Wear away — *erode*
35. Carry golfers uphill — *rail*
36. Too much hot fertilizer — *seres*
37. Does to green before seeding — *evens*

DOWN

1. Fill, pack firmly — *stuff*
2. Audio part of a tractor — *radio*
3. Biggest little city — *Reno*
4. Escape for moisture vapor — *stoma*
5. Difficult to keep during hot, humid weather — *alive*
8. Insecticide — *DDT*
10. Top country clubs — *elite*
12. Bluegrass — *Poa*
14. What the fourth man in a fourball usually is — *late*
16. Jointed stem of grass — *culm*
17. Small sod piece — *plug*
18. Woody perennial — *tree*
19. Occurs following spring or winter kill — *odor*
21. Powerful (comb. form) — *mega*
22. Results if mower is set too low — *scalp*
25. Finish — *end*
26. Less humid — *drier*
27. Time measures — *years*
28. What the golfer did in the halfway house — *ate*
29. Continues upward — *grows*
30. What the course needs to be in top shape for — *event*
32. It is completely surrounded — *isle*

USGA GREEN SECTION RECORD
SEPTEMBER, 1969

TURF TWISTERS

REALLY!

Question: Really, how close to the edge of a green may I place the cup? (Utah)

Answer: If you're looking for an exact answer, we do not have it. Many factors must be considered, but first and always, use good judgment in deciding what will give fair results. The USGA tries to start, if possible, at least 5 paces away from the edge of the green. If a bunker is close by, the distance should be greater, especially if the approach is over the bunker and more than a pitch shot. The holding quality of the green, the length of the shot to the green, the probable prevailing conditions for play for the day and the design of the hole are other factors that must be taken into consideration. But five paces seems minimum.

FESCUES FOR GREENS?

Question: I have recently obtained a copy of "Turf Management" which was brought to my attention by clients who queried the use of fescue in their greens.
Their doubts were raised by the implication at the top of page 100 that this grass will not support close cutting.
As many of the finest—hence close-cut—greens I know have a very large proportion of fescue, I am wondering if there is a mistake in publication or if the seed you have in the United States is not a pure strain. At least I feel an exception should be made in the case of S59 creeping red fescue.
Can you elucidate on the foregoing? (France)

Answer: Most fescues are morphologically adapted to take a rather close cut but have difficulty in standing up under the summer temperatures in most areas of the United States.
In the case of the variety S59, this is a sports turf variety developed at the Aberystwyth Plant Breeding Station in Wales and it as well as some other grasses such as ryegrass and timothy are used successfully for this purpose in European climates.
Many of the European grass strains are presently under test in the United States and some show promise; however, they are not commercially available in most cases. Also, as previously mentioned, the fescues do not grow well in hot weather and most European introductions seem to be affected more so than the American strains under test.
Musser's book is correct for the area of its adaptation; however, you will find some passages in direct conflict with accepted European turf culture because of ecological differences.

SEEDLINGS UP—THEN DOWN

Question: I had very poor results with overseeding my bermuda greens last year with *Poa trivialis*, bent and fescue. The seed seemed to come up in patches with the general cover very spotty and subsequent overseedings of the thin spots were also not very successful. What can you recommend? (Louisiana)

Answer: Questioning revealed that no fungicide was being used prior to or after overseeding and we suspect that many of your seedlings were lost to damping off diseases. You should use a curative rate of one of the fungicides normally recommended for damping off prior to overseeding and then follow up with preventative rates of the fungicide for 4 to 5 weeks after seeding. The trouble was not so much with the grasses planted or conditions of their planting as with subsequent seedling diseases. You might also read Dr. Paul Alexander's article in this issue.