JANUARY 1972

USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association

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Herb and Joe Graffis -12th Recipients of USGA Green Section Award

For the first time since it was begun in 1961, the Green Section Award of the United States Golf Association will be presented to dual recipients. The 1972 award will be received by Herb and Joe Graffis during the annual USGA Green Section Conference on Golf Course Management at the Biltmore Hotel in New York City on Friday, January 28, 1972. It will be presented by Philip H. Strubing, USGA President, and Henry H. Russell, Chairman of the USGA Green Section Committee.

The Graffis brothers are the 12th recipients of the award and the first in the publishing business. It is awarded in recognition of "distinguished service to golf through work with turfgrass."

In 1927 Herb and Joe Graffis founded the publication *Golfdom*, which they edited and published. Through their editorial policies they encouraged the trial of turf products in experimental plots throughout the country. They also campaigned for improved status and recognition of golf course superintendents, the use of proven turf chemicals, improved drainage, installation of fairway watering systems and automatic irrigation. They helped set guidelines for the use of pull carts, and later for automotive carts to avoid damage to turf.

While their publications were the most visible part of their work, they were active in other areas. The Graffises founded the National Golf Foundation and helped establish the Golf Course Superintendents Association of America Turfgrass Conference and Show. For many years Herb Graffis has been President of the National Golf Fund, the sponsor of National Golf Day. This promotion has served as a source of revenue for a number of worthy golf projects, among them turf research and scholarship grants.

Throughout their careers both have been strong supporters of the USGA Green Section. They have gathered material from leading golf course superintendents for a series of symposiums on the most successful procedures, and have encouraged superintendents to attend college agronomy courses to increase their knowledge of the field.

Previous recipients of the Green Section Award:

1961—Dr. John Monteith
1962—Prof. Lawrence S. Dickinson
1963—O. J. Noer
1964—Joseph Valentine
1965—Dr. Glenn W. Burton
1966—Prof. H. Burton Musser
1967—Elmer J. Michael
1968—James L. Haines
1969—Dr. Fred V. Grau
1970—E. R. Steiniger
1971—Tom Mascaro

FIGURE I

Winter Injury in the Cool Temperate Zone

by LEE RECORD, Mid-Continent Director, USGA Green Section

Desiccation and low temperature kill are the two major causes of winter injury to the turf plant in the cool temperate zone of the United States. A third type of injury caused by fungus organisms, *Typhula spp.* and *Fusarium spp.,* is prevalent from year to year, but is not as serious or as damaging as desiccation and low temperature kill. Mechanical damage, a fourth type of injury, is increasing.

Desiccation Injury

A grass plant must rely on an internal water supply for respiratory activity. When soil moisture is limited and the internal supply of water within the plant is diminishing to a point that water loss is greater than the amount that can be taken into the root zone, the plant desiccates. This is basically a wilting phenomenon but one that is more feared than any other form of physiological winter injury. Figure (I).

Desiccation can be held to a minimum by applying several hundred gallons of water to the area of concern before it comes under stress. Water tanks, spray equipment and the use of the watering system are tools used to obtain and disburse the water. Several applications are normally required. In the plains area of the mid-continent, it is common to have the watering system in operation during the open winter months to prevent excessive turf loss. The watering system is drained from day to day after the system has been in use. If desiccation has occurred, it is important to power spike the damaged area several times, overseed, topdress and syringe frequently to encourage germination and plant recovery. If at all possible, play should be restricted until the damaged area has recovered sufficiently to withstand traffic. However, if early play is permitted, turf re-

covery is normally slow, as a form of mechanical injury is then taking place. Soil moisture and temperature will have a direct bearing as to how early a damaged area can be played upon.

Low Temperature Kill

The conditions for low temperature kill to the turf plant are physiological. When the lower crown of the turf plant is in an extreme state of water content under low temperature stress, complete destruction of the plant can occur. Often the turf plant comes out of the winter looking good under these conditions. However, damage has occurred within the plant to the crown and root system which is not visible. When temperatures begin to rise in early spring to encourage growth, the plant begins to transpire and will soon die; there is no life support system functioning.

Low temperature kill has been associated with ice formation, which has been misleading. There is no question that excessive ice or snow will cause suffocation or winter scald. Suffocation will occur if an excessive amount of carbon dioxide accumulates, if oxygen is restricted, or when an interchange of soil gases is stopped. Under an anaerobic condition such as this, the solubility of excessive use of arsenicals, or heavy metals such as mercury and cadmium fungicides and perhaps other herbicides, may increase the total amount of damage. Winter scald, on the other hand, is when standing water or ice acts as a lens for the sun, which, in turn, scalds the leaf. To prevent suffocation and winter scald injury, surface and sub-surface drainage must be adequate. Breaking and removing the ice layer during the alternate freezing and thawing period during the late winter is imperative. Figure (II).

Snowmold

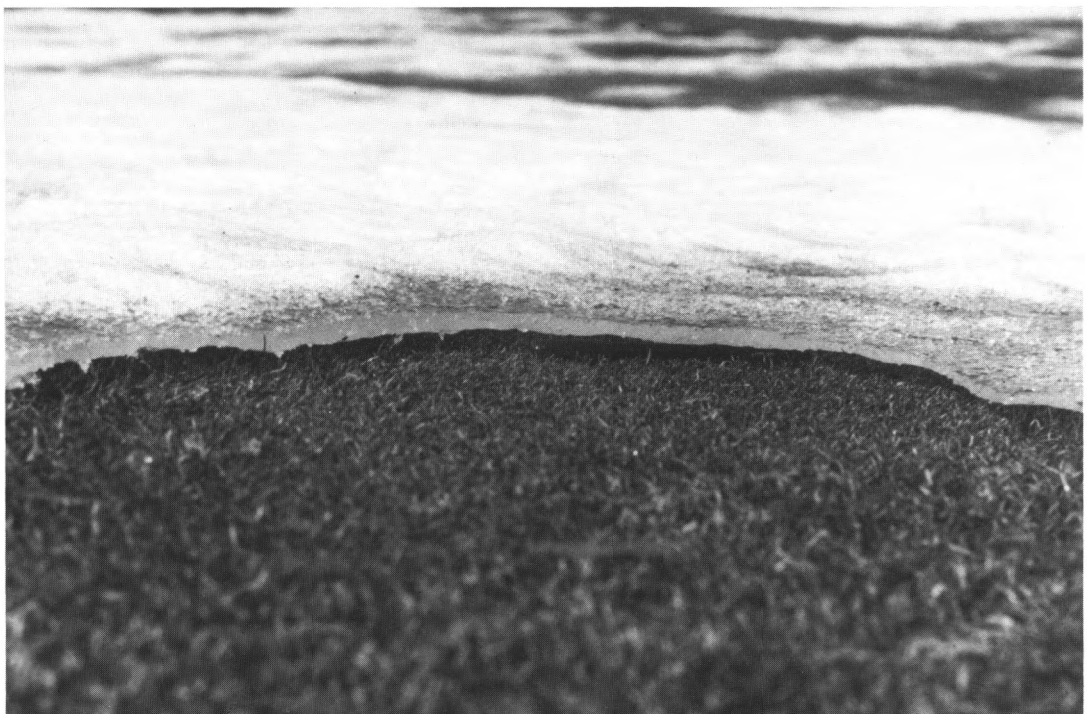
Typhula spp. and *Fusarium spp.* fungi cause minimal damage to turf if normal preventive fungicide applications have been carried out. There is one exception when snowmold is in abundance during the spring of the year regardless of the preventive fungicide program practiced; that is when the ground is not completely frozen before the winter snow sets in. Snow is a tremendous insulator against cold and protects turf from desiccation. However, it increases the use of fungicides rather than limits their use. Recovery from snowmold injury to the turf plant is rather rapid if optimum spring growing conditions are present. Turf is not completely destroyed, but merely set back in a mottled state.

Mechanical Injury

Mechanical injury to turf takes place in two different forms; foot and vehicular traffic. With a long, late fall and early spring playing season in many areas, serious injury to turf by foot printing on frosted playing areas has become standard at many golf courses. Ice crystals within the grass blades are distorted and rupture living cells, causing death. Syringing greens in early morning, for instance, before traffic is allowed on the course, will help solve the problem; water melts the ice crystals.

During the spring when the upper portion of the soil has begun to thaw, the soil is overly wet and slippery. Foot traffic at this time will cause severe compaction and tearing of the roots at the point where they penetrate the still

FIGURE II



frozen area. When soils are partially thawed, injury is serious and long lasting. Visual damage is not noticed at this time of the season, but is one of the primary reasons why troubled areas act up during periods of summer stress.

Snowmobile damage to turf is becoming more apparent each season. A snowmobile running in loose snow will create approximately a five- to six-inch-deep track. When this area is used over and over, a glazing or icing effect takes place. Toxic conditions will develop as previously pointed out, with the end result in turf loss.

One can easily see what a golf course superintendent has to face in the cool temperate zone of the United States. Turf injury will result in many forms, in many ways, under varying conditions. It is not an easy task to provide optimum playing conditions when the breaks are not going your way. The golfing membership plays in late fall or early spring and often refuses to remain off the frozen turf. Construction to improve drainage or rebuild a new green is not carried out because of the late playing season. The ground is not frozen solid going into the winter months, an early snow falls and preventive fungicides have not been applied for snowmold control. To top it off, the snowmobiles have an early start this winter. With spring around the corner, anaerobic conditions have been created with an abnormal amount of snow. Ice and snow removal has been taking place in order to correct existing conditions. And, as the remaining ice and snow melts, low temperature kill has occurred with a healthy looking plant on the playing surface. Snowmold is scattered hither and yon, and the northwesterly winds are just beginning to let you know that desiccation may still be a problem this early spring.

Yes, here comes the golfer, the snowmobile has been put away and he can't understand why the course is the way it is. Under these conditions one must expect turf loss.

Conclusion

What steps then should be taken by golf course superintendents to prevent winter injury? The first and most important rule is not to play on turf when it is not actively growing, especially greens. Temporary greens should be played from the time the ground begins to freeze in late fall until completion of heaving and thawing in early spring. Excerpts from "The Case For Temporary Greens," January, 1966, USGA Green Section Record, document the importance of remaining off turf during this stress period:

"So many more golfers play each course now in regular season that injury due to the increased traffic is mounting and off-season play can only add to the total traffic injury problems.

"In late fall or early winter when frost enters the ground, turf becomes frozen and the upper fraction of soil becomes moistened with frost. Traffic at these times will break or crack the stiff and frozen blades of grass, weaken them, and *Poa annua* or other weeds could subsequently encroach, and so the turf is generally weakened. Traffic imposed upon moistened soil results in a cementing of the soil due to the lubricating action of the moisture. This undoubtedly adds to compaction.

"In winter when the ground is frozen solid, turf blades would suffer only if play were allowed while the grass, too, was frozen. The danger here is that during the day while players are on the course, sufficient thawing could occur in the upper fraction of soil to cause footprints and a cementing action of the soil. This occurs when air temperatures are higher than normal and, of course, these are the very days when golfers prefer to play.

"The most difficult time for turf is in late winter and early spring, from mid-February through March when the top one inch of soil (or less) is thawing but the soil beneath is frozen. Traffic on greens at this time will result in severe compaction.

"Any time water stands on a green in winter, no play should be allowed. This results in extreme softness of the upper fraction of soil and turf.

"All told, any amount of play in winter generally means more rigid management during the growing season, especially more aeration and more topdressing to true and level greens. If play is allowed on regular greens, we cannot stress too vigorously that the days must be very carefully chosen; that someone must make these day-to-day decisions; and that your course must be treated as an individual problem. It should not be kept open or closed simply because a nearby course is open or closed.

"The only way to insure against possible trouble is to have temporary greens. It has often been suggested that the word 'alternate' be used in place of 'temporary,' because the latter bears a negative connotation."

Second, drainage conditions must be at an optimum if sound turf programs are to be carried out and followed to prevent winter injury. And, third, an adequate budget, good source of labor and communication between the golf course superintendent and his immediate superior must become a reality when facing the winter injury problem in the cool temperate zone of the United States.

Snowmobile Use on the Golf Course

by STANLEY J. ZONTEK, Agronomist, USGA Green Section

Snowmobiling is growing in popularity throughout the northern snow-covered areas of the country. The sport is full of thrills, spills and fun, but is the golf course the best place for the snowmobile? This article will attempt to show some of the effects of snowmobile use on golf courses in the northeastern United States, and offer some thoughts on how to avoid possible turf injury where they are used.

Snowmobile damage falls into two categories. Mechanical injury, which is visible and seen when it occurs. This is the broken limbs, rundown trees and gouged earth. Then there is the more subtle, yet more severe ice injury. It only shows itself in the spring after the packed ice and snow clears and the memory of winter snowmobiling fades.

Mechanial Damage

When the snowmobilers take off, the thought of intentionally causing damage is far from their minds. But the inherent nature of the sport is to strike out and "explore" areas of the course. It takes the riders to hills and dales previously seen only while searching for a badly hit shot during the summer. It also involves climbing and descending steep hills and mounds to prove the traction and power that the dealer assured us the vehicle possesses. However unintentional the action, some damage usually occurs. As seen in Figure 1, a snowmobile tipped over on its side, some gasoline spilled out, and apparently flowed down the groove made by the snowmobile's track. This elongated strip of dead turf appeared the next spring after the snow melted.

Figure 2 illustrates the scuffing of frozen grass and what can happen when an area void of snow is driven over with a snowmobile. The damage is similar to that of walking on frozen greens: the grass plant is crushed, the blade desiccates and turns brownish-white.

Another type of mechanical injury is that of vandalism by both riders and non-riders. It involves broken limbs, run-down shrubs, small trees and evergreens, etc. With snowmobiles and possibly sledding on the course, people other than members are on the property using it as a winter playground. It has been our experience that these people do not exercise prudent care of the course. For that matter, even the members are often careless when the course is used for purposes other than golf.

Ice Injury

As the snowmobiles travel over and over the same area, the snow is packed tight and ice is formed. Packed snow and ice is perhaps the

Figure 1. Spilled gasoline from a snowmobile caused this damage.

Figure 3. Dead fairway turf resulting from a snowmobile trail made during the winter.

most severe type of condition caused by the snowmobile. The insulated layer of oxygen that occurs with a normal snow cover is no longer present, and the turf is subjected to an environment void of oxygen. The grass under this ice cover is much more susceptible to snow mold and freezing and thawing damage. Figure 3 graphically shows dead turf resulting from a snowmobile trail down the center of the fairway. The damage was caused by a combination of ice injury and snow mold. The grass species that appears to be most susceptible is *Poa annua.* This does not mean that other varieties are immune. They are susceptible but to a lesser degree. One other consideration is that if the permanent grasses are thinned out over winter, *Poa annua* invasion is enhanced. This usually means a setback in the permanent grass population of the fairway and a maintenance headache to the superintendent for years to come.

Snowmobiles On The Course

There are several outstanding reasons for the use of snowmobiles on the golf course. Membership pressure is one. A club member's family has a snowmobile and what better place to ride it than at the course. Also, if there is a drive underway for new members in the club, what better incentive can be offered than year-around recreational facility. Golf in the spring, summer and fall supplemented by winter paddle tennis and snowmobiling.

The main reason for permitting their use appears to be monetary. Their use on the course can keep the food services at the clubhouse operating at an increased volume and tempo through the winter. Also, the rental of club-owned snowmobiles can be another revenue source. The capital investment for this purchase can be returned in several years with a profit, if there is a good, long-lasting snow cover and the vehicle is properly managed and maintained.

Precautions to Take

If snowmobiles are used on the course, here are some precautions to take in order to minimize possible turf damage:

1. With the possibility of physical injury to the riders, the question will arise, "does the

Figure 2. Tracks left by a snowmobile as it traveled over a frozen green.

club have proper insurance coverage?" If not, it should be obtained.

2. Carefully regulate and enforce areas where the snowmobiles may travel. Set up trails to keep the riders in the woods and rough as much as possible. Cross fairways only when absolutely necessary.

3. Stay away from greens, tees, approaches and landing areas of fairways.

4. Educate the riders in proper etiquette of snowmobile use in order to minimize damage to the course, the vehicle and the riders themselves.

5. Operate the vehicles only when there is a minimum of six inches of snow on the ground.

6. Do not operate the machine during the spring thaw when the snow is wet and melting. This increases the possibility of ice damage.

7. On areas of possible use, apply an extra application of snow mold preventive fungicide in the fall, and when the snow clears in the spring. This reduces the possibility of damage by snow mold.

Conclusion

This article has attempted to show some of the pros and cons of snowmobile use on the golf course. Enthusiasts will paint a rosy picture for their use, and in some cases little injury actually occurs. But, speaking from an agronomic point of view, we would say without reservation that the golf course is not the best place to operate snowmobiles. Winter revenue generated from their use can be lost in an increased maintenance budget for repair of damage done directly or indirectly by them. The course, if damaged, will also be slower to recover in the spring and will reach its top playing condition much later in the season. Unfortunately, some golfers may feel the poor turf is a reflection of the superintendent's turf management program. Rather, the real culprit is the heavy traffic and course use by snowmobiles during the winter.

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

Applying nutrients and other chemicals through an irrigation system has been a controversial subject for some time. The technique is not new. A number of magazine articles favorable to this method have appeared recently, including our own GREEN SECTION RECORD.

In the following two articles, Alexander M. Radko, Eastern Director, and William H. Bengeyfield, Western Director of the USGA Green Section present their differing views. Comments and experiences from our readers will be welcome. If there are enough of them, we will publish them in a later issue.

A Case for Fertigation

by ALEXANDER M. RADKO,
Eastern Director and National Research Director, USGA Green Section

There is an old cliché which says, "Never Argue With Success," and this has been one of the cardinal rules by which the Eastern office of the Green Section of the USGA operates. Management programs are intricate in that a change here may force a change or two in another direction; therefore, utmost care is taken in all program changes.

Several years ago Somerset Hills Country Club officials brought up a number of questions relative to the possibility of fertilizing through the watering system. They have a large reservoir

Counterpoints to Fertigation

by WILLIAM H. BENGEYFIELD
Western Director, USGA Green Section

It seems so logical. The pieces fit so easily together that one should be wary from the outset. On the one hand we have an operating irrigation system on our golf course, and on the other there are soluble fertilizers and other chemicals waiting to be applied to the turf. Our maintenance crew is shorthanded and labor costs are high. Efficiency in turf management is our goal and we want to do the best possible job for our club. Conclusion: fertigation is for us! Right? (maybe) — Wrong! (probably).

When up against today's demands for "progress," it is sometimes difficult to stand fast and defend the old, standard, successful ways of doing things. Progress must never be opposed just because it requires a change. At the same time, a change does not necessarily lead to progress. What is good for one golf course may very well not work for another. Any superintendent or club considering the possibilities of fertilizing through the irrigation system will want to consider carefully his individual situation and measure both pros and cons. After seeing numerous attempts at golf course fertigation, and after a long, analytical look, I must honestly conclude that fertigation is impractical for most golf courses. The passing years have shown the practice to have its share of hangups, problems and disappointments.

In any debate, we must first find a common point of departure. Therefore, it seems fair enough for us all to initially agree that the addition of plant food—no matter what the method of delivery—is a good and beneficial practice for turfgrass. Some agronomists feel that light and continued fertilizer applications are best. Others, equally competent, are not fully convinced the technique is necessary or even best for quality playing turf over a long period. But this point aside, all agronomists will

that serves as their irrigation supply adjacent to their 12th hole and they began by emptying a couple of bags of ammonium nitrate into the pond. We discouraged this because we felt that they weren't getting very much out of this method of handling fertilizer; we couldn't be sure of how much the plant, fish and animal life in the lake were using; we weren't sure of what was evaporating or going out over the dam after rainstorms; we couldn't be sure of what was left for the golf course, how much was being applied to the turfgrasses. Discussions led to changes and they devised the system outlined in detail in the September issue of this publication.

In essence, the technique revolves about applications of small amounts of nitrogen per 1,000 square feet per application and in their case it was decided to apply a total of 1-1/4 pounds of nitrogen per 1,000 square feet to fairways during the year. Things worked out well enough that this has been the steady annual program for the last seven years at Somerset Hills and my observation is that their fairways have improved steadily in permament grasses.

In this time a strange phenomenon occurred. The common Kentucky bluegrasses that were seeded years ago have more than held their own and now comprise a good portion of the total fairway turf, despite the fact that only bentgrasses have been overseeded for the last several years. Fairways now are a combination bentgrass, Kentucky bluegrass, with a minimum of *Poa annua.*

Over the seven years that we have closely observed these fairways the common Kentucky bluegrasses have been cut *below* an inch and *they have thrived*, in fact, they provide as good, or better, playing turf than many fairways established to the *improved* Kentucky bluegrass selections.

Common Kentucky bluegrass is not supposed to do this. We all know that it is supposed to weaken and gradually disappear at this mowing height. It hasn't! The bluegrasses at Somerset Hills are not soft and lush. The ball sits up on the bluegrass turf providing a lie that caused one of the better players at the club to remark that he prefers to play from the bluegrass portion of the fairway. This is one of the rare times that we've heard that a low handicap golfer prefers bluegrass to bentgrass in fairways.

During the difficult July-August periods, when summer problems arise at other clubs in

agree that fertilization is a good and important practice.

If you agree with the above, then the first point is made. Our discussion is *not* concerned with the merits of fertilization, but rather with the *best method* of *distributing* fertilizers over our golf course turf. This is the basic and essential point; *distribution.*

Let's look at the factors involved in fertilizer distribution through a) the irrigation system and b) through dry applications.

Fertigation

In any discussion of fertigation, the problem of accurately metering or injecting the exact amount of fertilizer material into irrigation lines is frequently raised. Science has solved this puzzle and very accurate devices are available today. Because of this advance, progressive nurserymen and greenhouse operators are practically home free when it comes to irrigation and proper fertilization of their crops. To their controlled growing conditions of temperature, light, soils, etc. (conditions not available on the golf course), they can now add effective control of irrigation and fertilization.

Then, if the problem is not one of accurate

Guess where the pop-up sprinkler head is located!

No. 10 fairway at Somerset Hills Country Club, Bernardsville, N.J. Note excellent stand of bentgrass in foreground and excellent common Kentucky bluegrass throughout center and background.

the region, we have observed no serious general thinning at the Somerset Hills course. Last summer was a case in point. After eight inches of rainfall in a three-day period in late July and a 10-inch rainfall in one day in late August, fairways at many courses thinned badly. Brooks and streams at Somerset Hills eroded badly, indicating that they, too, were deluged with rain, but their turf held up beautifully. It was one of the very few courses that I visited that

metering and if the grass plant cannot discern whether its plant food comes through the irrigation system or the fertilizer spreader, what are the objections to golf course fertigation?

My objection is that fertigation depends entirely on the irrigation system, and it is doubtful if there will ever be a perfect golf course irrigation system. This is true regardless of the cost involved. There are too many variables and they are beyond control. The trick of uniformly irrigating 100 acres or more of rolling, tree-lined and wind blown terrain—made up of differing soil types and drainage requirements—is far more difficult (if not impossible) than one may first suspect.

Consider the problem of prevailing winds. Irrigation equipment manufacturers concede that a wind over 10 m.p.h. distorts the sprinkler pattern beyond any reasonable prediction. Compensation for prevailing winds may be a good talking point, but is of questionable value under field conditions. For example, the prevailing wind does not mean the wind is always blowing out of one quarter. What happens to the sprinkler pattern when the wind shifts? Further, wind velocity itself varies and may be high during the early hours of irrigation and nil at later hours. "As unpredictable as the wind," someone once said. How is it possible to compensate for this factor in design? I recall one golf course designing their system for wind compensation only to end up with fairways dry and hard in the middle and overwatered on the perimeters! Even distribution and efficient use of fertilizers and chemicals under distorted irrigation wind patterns is simply not possible.

But regardless of the wind, most irrigation systems today are poorly designed and engineered. Uniform precipitation rates have not been considered in many cases. Rather, the primary concern has been with coverage; coverage of those areas deemed important to the play of the hole. This generally means the center of the fairway. One need only wait for adverse summer weather in order to see the inadequacies of most irrigation systems. Therefore, if irrigation design is faulty to begin with, how can one expect to apply fertilizers or chemicals accurately through such a system?

The irrigation engineer has problems other than wind, rolling terrain, variable pressures, trees, soils, etc. He must also work with certain

didn't exhibit a severe thinning of fairway turf. Could the carefully planned fertilization program have made this difference?

Over the years of observation of golf courses in the Eastern region, it has been a certainty that more serious problems arise with too much, not too little, fertilizer on mature, established turf. Too often turf growers become confused with the needs of a plant in process of establishment with its later needs as a mature turf. Mature cool-season turfgrasses can get by with far less than newly established turf.

Not only is the total annual amount an important consideration, but the amount per application is equally important. But old ideas die hard and once a practice is established it's hard to break away and change. Habit enters into the process of fertilization, too. If a man is brought up with the idea that his turf requires "X" pounds of nitrogen per acre per year, it is difficult for him to change, but come the summer stress period and you can bet that the heavy-handed are always first to lose turf.

It has been my observation that superintendents who apply very light applications of fertilizer over the year will apply it any time that they feel the turf needs it. For example, if you apply four treatments one month apart at the rate of 1/4 pound nitrogen per 1,000 square feet, it is far safer and far more beneficial to the mature turf than one pound applied at one time. Granted a dry formulation applied with a spreader saves labor when you make one application instead of four; however, the advantages of lighter treatments applied over a longer period far outweigh the labor considerations so far as the health and subsequent performance of the plant is concerned.

Dry formulations of any product are not as efficient as liquid applications. By this we mean that it takes a larger quantity of a dry formulation to get the job done. We see this in the use of most materials used on golf courses—if applied dry the amount required is usually double the liquid formulation. How much of this is lost through leaching, to the atmosphere, to heavy rains soon after application—nobody knows!

The advantages of metering light rates of nutrients through the irrigation system far outweigh the disadvantages, in my opinion. They are as follows:

(1) Problems of uniform coverage are minimized when fertilizers are applied more frequently, very lightly but often.

(2) Nutrients can be applied at any time of the day or night, rain or shine when frequent, light applications are made. It is not as impor-

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mechanical, physical and hydraulic limitations. And he must work within the client's financial limitations as well. Someone someday must find a way to convince the client that a properly designed, engineered and installed system is going to cost X number of dollars. There are no

Water does collect in low areas. Here, the late James L. Haines, Denver Country Club superintendent and past recipient of the Green Section Award shows the problem.

tant to select your days so carefully as when one or two applications are made per season.

(3) No serious overlapping occurs when very small amounts of fertilizer are used per application. One-sixteenth to one-eighth of a pound of nitrogen per application would generally be the preferred range on cool-season grasses.

(4) It is possible to formulate any specific ratio of major or minor elements desired. The golf course superintendent personally could manipulate the formula from application to application.

(5) There is no danger of "wheel burn" caused by tire marks of heavy equipment used during or after certain dry formulations are applied.

(6) It eliminates the use of another machine which reduces stress potential on turf and soils.

(7) It reduces changes for misapplication—applying too much at any one time—which causes stress problems on the grasses.

(8) It reduces the need for specialized training of one man to expertly calibrate and operate fertilizer spreaders. The responsibility with fertigation rests mostly with the golf course superintendent.

(9) It allows for maximum use of an

Golf ball resting on a common Kentucky bluegrass patch — note excellence of lie. Bentgrass comprises the lower half of the photograph.

bargain basement models. No short cuts. Until this is accomplished, the outlook is dim indeed for any irrigation system to even approach uniformity of coverage over 120 acres of golf course.

If distorted fertilizer distribution is not enough, the fertigation technique must face other problems that should be mentioned:

1. Low temperature "salt out" which may clog the irrigation line with fertilizer.
2. Corrosion of metal parts within the irrigation system due to fertilizer salts.
3. Possible concentration of phosphorous at the soil surface.
4. On uneven, bumpy fairways, the low, pocketed areas will continually receive more runoff and more fertilizer. Growth will be faster, more luxuriant. Uneven areas are also difficult to mow evenly; poor lies for the golfer result.
5. During a rainy season, overwatering may be necessary in order to fertilize.
6. Different areas of the golf course have different fertilizer requirements. Tees and approaches need more fertilizer (but not more water) than fairways and roughs.
7. Impracticality of applying herbicides, fungicides and insecticides through the irrigation system.

The Case For Dry Fertilizer Application

Over the years, we have seen both dry and liquid fertilizer programs in use. In only a few cases has the "wet application" technique persisted. Obviously it has merit under certain circumstances. But in the majority of cases, the use of dry pelletized fertilizer material is the most widely accepted and successful approach today. It is more than convenient. It affords the opportunity for *uniform distribution,* and this means better turfgrass management and more uniform playing conditions throughout the golf course. Indeed, a number of clubs trying fertigation have returned to dry fertilizer applications after a year or two. Their reasons varied, but obviously some requirement of the fertigation program could not be met.

Using one of today's modern cyclone-type spreaders and granular fertilizer materials, two men can fertilize 18 fairways, tees, approaches and rough areas in 12 hours (24 manhours) or less. By using dry, granular material, the men

A closer look at the permanent grass population of No. 10 fairway at Somerset Hills. Note the high percentage of common Kentucky bluegrass.

expensive system. It helps justify the cost of installing an up-to-date automatic system.

(10) It permits more controlled growth, a natural, not a forced growth of the intensively maintained turfgrasses.

(11) You get maximum use out of minimum quantities of nutrients applied. Tough turf is the result!

Fertigation is in its infancy. There are problems to work out but this technique, in my opinion, has great potential and will one day be in widespread use.

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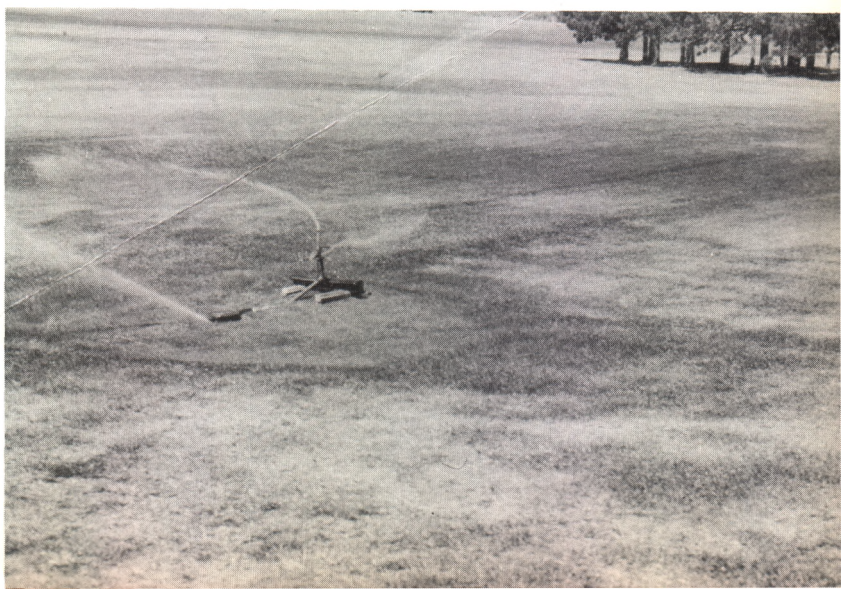
are able to place the fertilizer exactly where it is needed. Uniform distribution and accurate placement—even on slopes, hillsides and other difficult areas—is achieved. The "shadowing effect" caused by a fixed sprinkler head located behind a tree or shrub is largely overcome by a moving base fertilizer applicator. The labor cost is less than $75 per application if one assumes an hourly wage of $3. This seems a small price to pay for total and uniform coverage over 100 acres or more. Even this fertilizer expenditure may be overcome by using less expensive fertilizers for dry application when compared with the highly refined materials needed for soluble applications. The rate of application and timing is easily controlled by the superintendent.

If one is interested in the best method of distributing fertilizers uniformly over a golf course, the "dry look" seems very much alive.



Water distribution is only as good as the engineering, design and installation of the system.

TURF TWISTERS

CHARCOAL DUST

Question: Will the application of charcoal dust on ice help melt ice on greens? (New Jersey)

Answer: Any dark material applied to ice on greens will help attract the warmth of the sun's rays, penetrate and melt ice in winter; however, materials that create layers should be avoided. Therefore, top-dressing soil or organic fertilizers suit the purpose far better than charcoal.

PROVIDES THE GREEN

Question: Where does the USGA get its money for research? (Connecticut)

Answer: From several sources as follows:

1) Five dollars per USGA Member Club is allocated, which amounts to approximately $20,000 annually.
2) The National Golf Fund allocates an amount from its National Golf Day Tournament proceeds. This has been one of the most consistent sources of research revenue over the years. Funds in the area of $20,000 were made available to the USGA Green Section Research and Education Fund, Inc. for golf turfgrass research projects in 1971. ENCOURAGE ALL YOUR MEMBERS TO PARTICIPATE IN NATIONAL GOLF DAY'S TOURNAMENT and you will help solve golf related turfgrass problems sooner.
3) The New England Golf Association contributes annually. Funds from golf associations throughout the nation would be welcome.
4) Professional-Amateur events occasionally contribute to our Research and Education Fund.
5) Individuals and commercial firms who are interested in better playing conditions contribute also.

Write to any of our offices (see inside front cover of this publication) for our USGA Green Section Research and Education Fund, Inc. brochure. All contributions are tax deductible in accordance with Internal Revenue Code 501 C(3).

FOR BLUEGRASS SEED

Question: I have a strain of native bluegrass growing in various places on my course which seems very heat tolerant and is virtually disease free the year round. We have tried to produce seed from this grass but as yet have been unsuccessful. Can you explain why this grass bears no seed? (Georgia)

Answer: A possible explanation of the lack of seed production could be an insufficient period of cold induction at your location. Bluegrass varieties all require a period of cold temperatures and short days to induce seed production. The amount of cold required differs greatly between different bluegrass varieties.