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.*

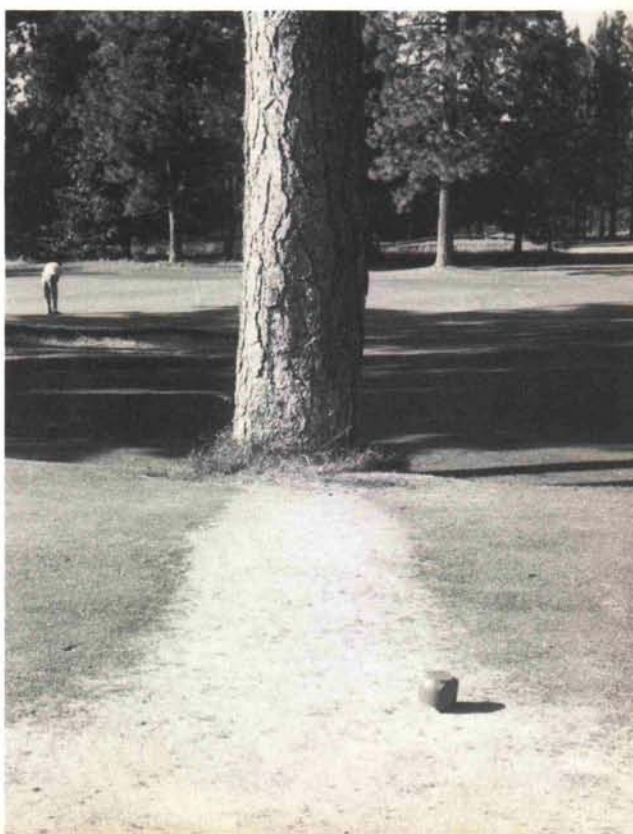
Let's look at the factors involved in fertilizer distribution through a) the irrigation system and b) through dry applications.

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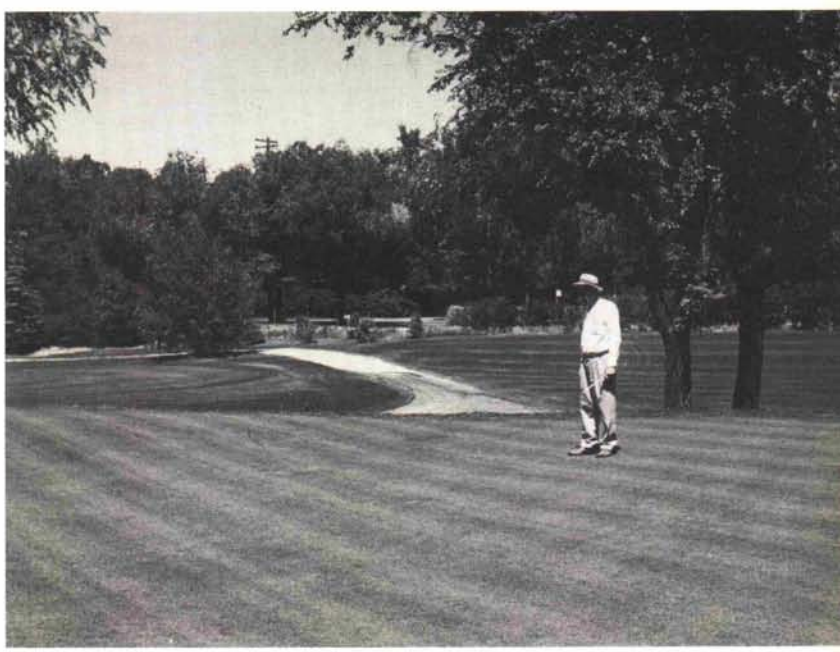
mechanical, physical and hydraulic limitations. And he must work within the client's financial limitations as well. Someone someday must find a way to convince the client that a properly designed, engineered and installed system is going to cost X number of dollars. There are no



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.

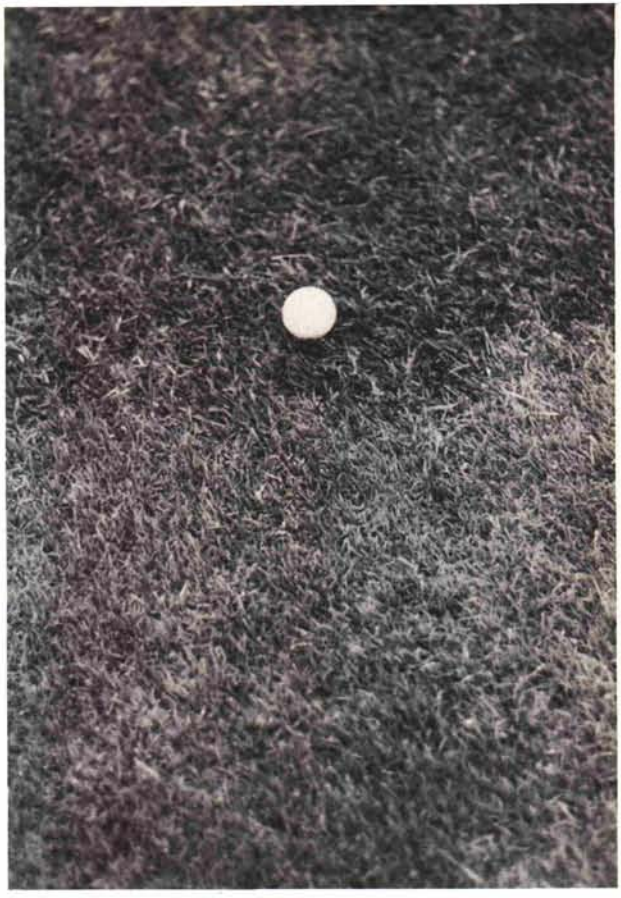
(5) There is no danger of "wheel burn" caused by tire marks of heavy equipment used during or after certain dry formulations are applied.

(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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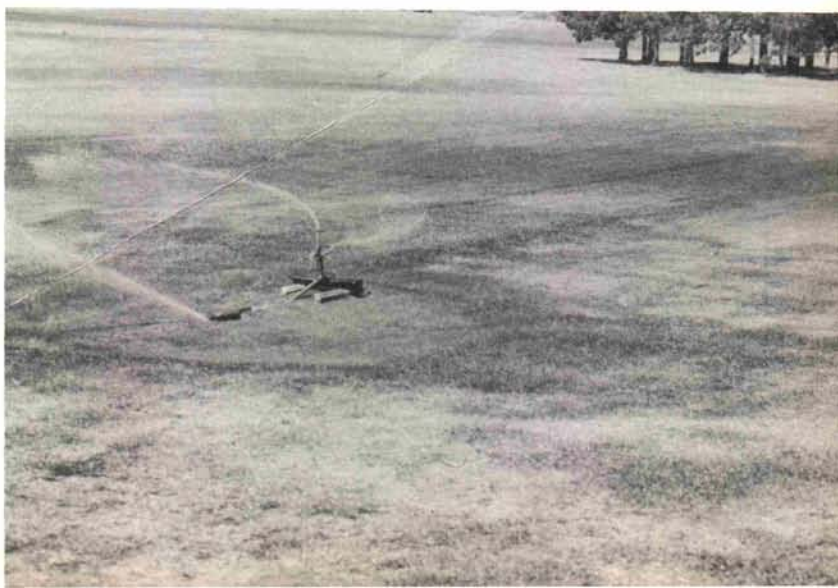
are able to place the fertilizer exactly where it is needed. Uniform distribution and accurate placement—even on slopes, hillsides and other difficult areas—is achieved. The "shadowing effect" caused by a fixed sprinkler head located behind a tree or shrub is largely overcome by a moving base fertilizer 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.