Controlled irrigation turfgrass plots at the AREC Ft. Lauderdale experiment station, University of Florida. Half the plots are irrigated daily and the other half are irrigated only when moisture sensing probes indicate the soil is dry. In the controlled irrigation plots, tensiometers or impedance electronic type systems are used. The plots are being expanded to include the interaction of irrigation practices and nitrogen sources on turfgrass quality and growth.

mends that you install two, one near the top of the rootzone and one near the bottom. If you get a light rain shower, the top layer may be effectively wetted, but perhaps not deep enough into the rootzone to do any good. The bottom tensiometer will turn the irrigation system on. If you haven't had rain for a number of days, the profile will typically dry from the top down, and the top tensiometer will turn the system on. Installation of two provides a safeguard to make sure that everything is adequate."

Resistance-type soil water monitoring systems

"Soil type definitely affects the resistance reading and you have to essentially calibrate the system for each different soil type that you're involved with. On a putting green, this would not be too much of a problem, but a fairway with several different soil types and several resistance-type devices, you have to be aware that they will trip at different points, different moisture levels.

"Applied salts from fertilizers, or other materials, will affect the ratings and influence when the system will turn on or off. There is also a replacement period of every three to five years, depending on soil conditions."

A tensiometer is shown, installed in St. Augustinegrass turf. The tip is located four inches below the turf surface. The tensiometer is wired in series to the solenoid.

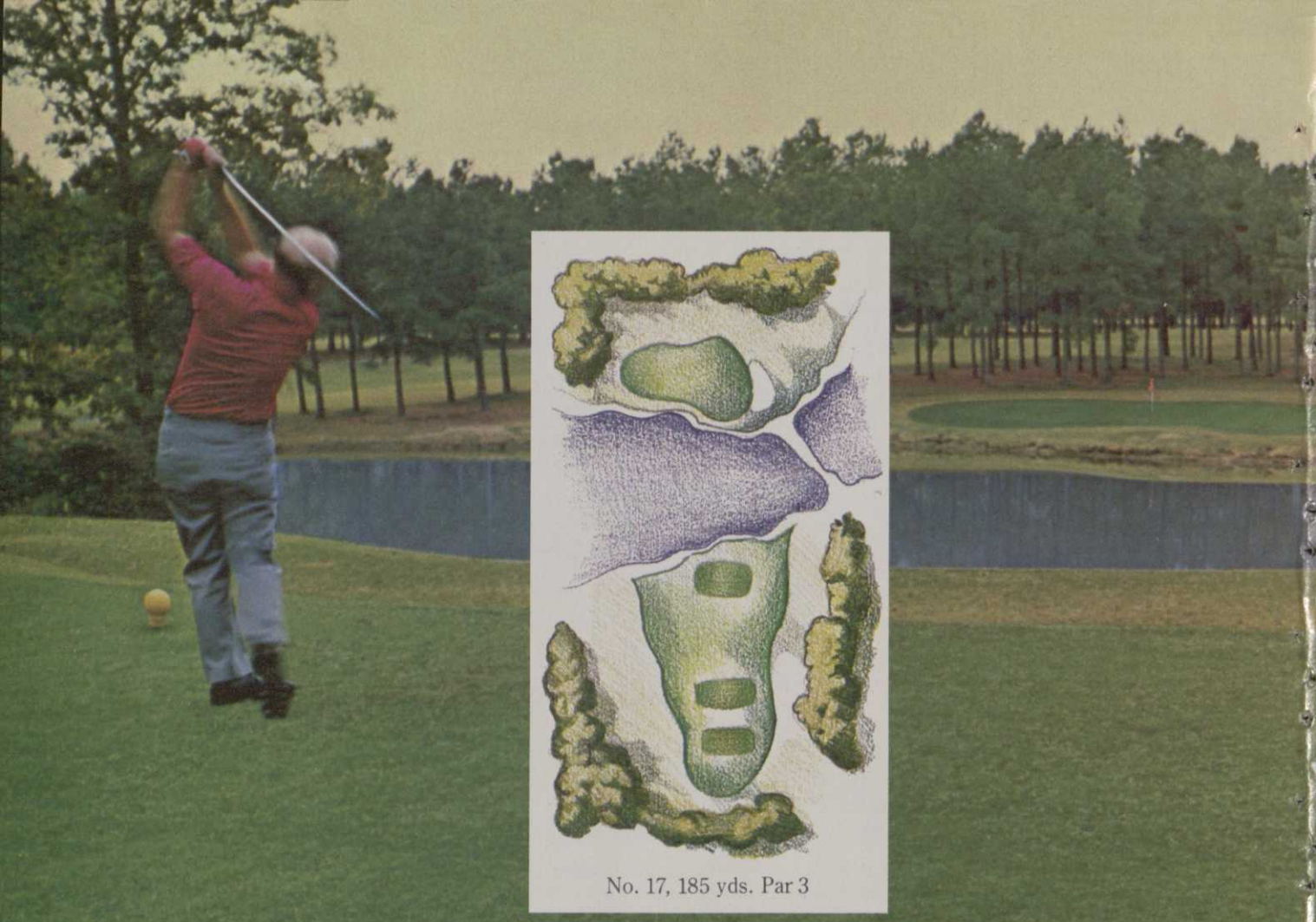
Electronic types

"There are several new, electronic-type soil water monitoring systems coming out on the market. Most are still in developmental stages, but I'm currently involved with one of them, the impedance system."

Impedance system

"The impedance system involves an electronic device which interfaces with an existing control clock. It has a pair of stainless steel probes that go into the ground. One probe is placed just underneath the thatch layer, surrounded by soil. The bottom probe is about three to four inches below the first. This type, very much like the resistance type,

Continues on page 14



No. 17, 185 yds. Par 3

Here's how to play the 17th hole at the Atlanta Athletic Club.

The Atlanta Athletic Club ranks as one of the south's great championship courses. The "Highlands", one of two 18-hole courses at the Atlanta Athletic Club, was the site of the 1976 U.S. Open and host to the 1981 P.G.A. Championship.

Number 17 at Highlands is a scenic, but dangerous par 3. An elevated tee looks down over an expanse of water to the green, 185 yards away. The terrain makes proper club selection essential.

To avoid the lake that runs all the way to the fringe, you'll need a long, high iron shot. Don't hit it too hard or you'll be in the pine trees at the back of the green.

With the right combination of power, finesse and a great putting game, you might even find yourself headed toward 18 with a birdie.

Here's how to get to the 18th.

Like most of the nation's top courses, the Atlanta Athletic Club uses E-Z-GO golf cars. The reason is one of economics. E-Z-GO cars have lower operating costs. And they're built to deliver the kind of trouble-free performance that returns the most profit from a golf car fleet. Considering their return-on-investment, it's no surprise that E-Z-GO is the world's most chosen golf car.

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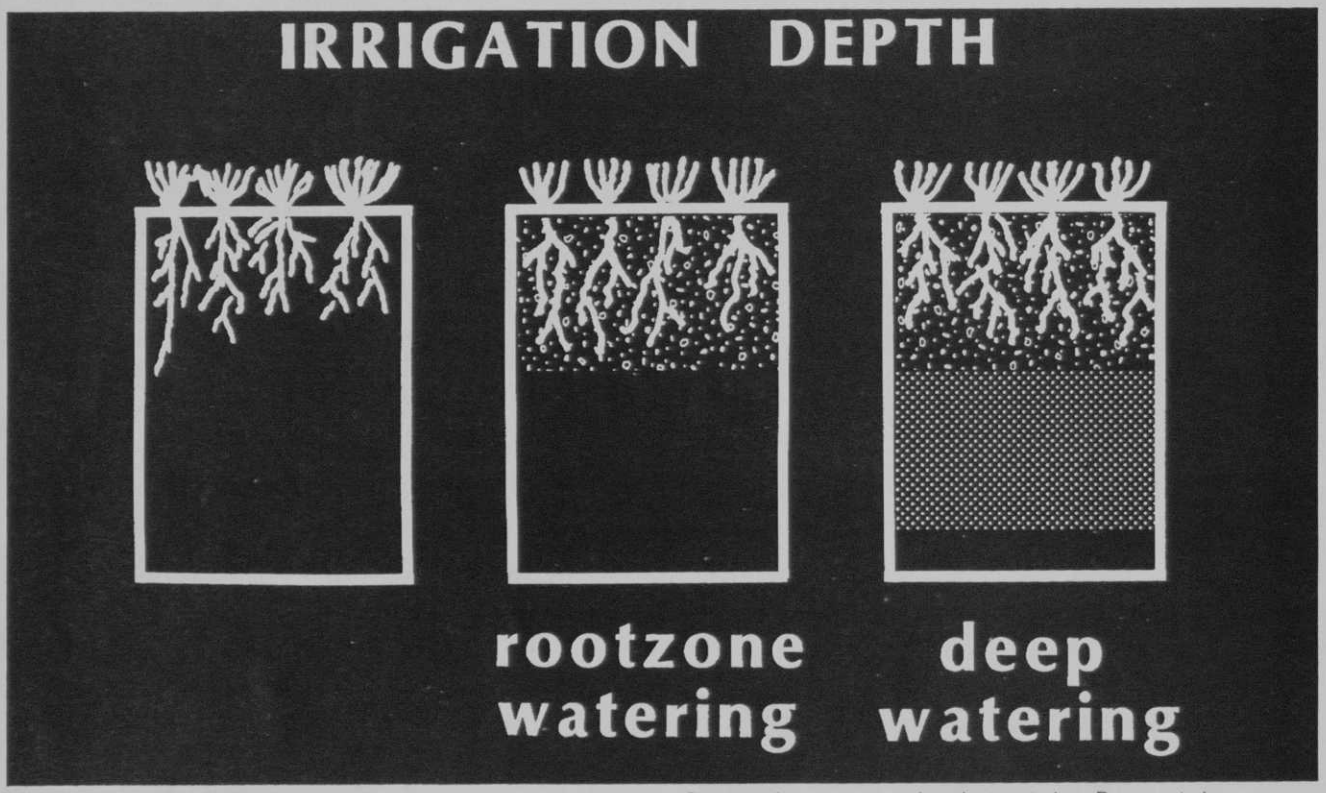
Sensors *from page 11*



Proper irrigation depth for humid parts of the United States is shown. Saturate the rootzone only, when watering. Deep watering wastes water and causes excessive leaching of fertilizers and pesticides.

relies on electric current to go from one probe to another. The amount of water that is in the soil will influence how both of the systems react.

"This system is less susceptible to salt concentration, which is a big advantage, and soil type seems to be of less importance in the way it reacts. Very careful probe placement is essential, however. If they are too close together, they won't trip properly and if they are too far apart, the system will stay closed for longer periods of time."

RF (radio frequency) Signal System

"This system can be interfaced with an existing time clock or on its own. It has a control box and a probe that goes into the soil. The probe consists of a plate, copper clad on either side. It generates a radio frequency that comes out of one side of the plate, sort of like a magnetic field, that goes around to the bottom side, or vice versa, of the plate. The system can be calibrated to soil type and set to go on or off at a given wetness in the soil."

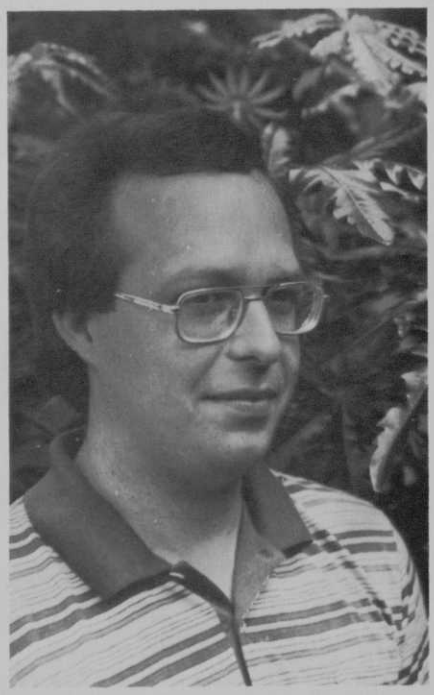
Background

Dr. Augustine works closely with George Snyder, Professor of Soil Science at the University of Florida, who has developed a computer simulation model of daily irrigation versus the soil budget irrigation (watering when needed, when the soil reaches a certain dryness). Data that Professor Snyder has run through the computer for typical Florida conditions show, conservatively, a 40 percent savings for the soil budget irrigation.

Preliminary data, a year ago last January (during fairly normal weather for Florida), showed an 89 percent savings for tensiometer controlled irrigation versus daily. "Of course," Dr. Augustine emphasizes, "This certainly will vary according to the season and amount of rainfall."

Conclusion

One of the things that Dr. Augustine deems exceedingly important is that if you do not have, or intend to use a moisture sensing system, you should take time to calibrate your sprinkler system and learn how much water is being applied any given time you irrigate. "You can save more water that way, without incurring any cost other than the labor to do it," he says. "Most people cannot tell you more than they turn the sprinklers on for 15 to 30 minutes per zone." **GB**



Dr. Bruce Augustine came to the University of Florida specifically to work on water-related problems. He received his Ph.D. in turfgrass physiology from the Ohio State University, his Masters of Science from the University of Idaho, and his B.S. from the University of Deleware.

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Turfgrass insect identification

By Dr. Harry D. Niemczyk, Professor of Turfgrass Entomology,
Ohio Agricultural Research & Development Center, Wooster, Ohio

Quiz yourself. Answers are on page 21.

A. _____

E. _____

F. _____

G. _____

Photo courtesy Dr. H. Tashiro

K. _____

Photo courtesy Dr. J.A. Reinert

L. _____

M. _____

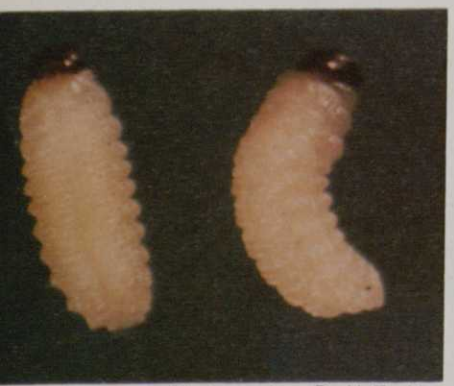


Photo courtesy Dr. H. Tashiro

_____

Photo courtesy Dr. J.A. Reinert

R. _____

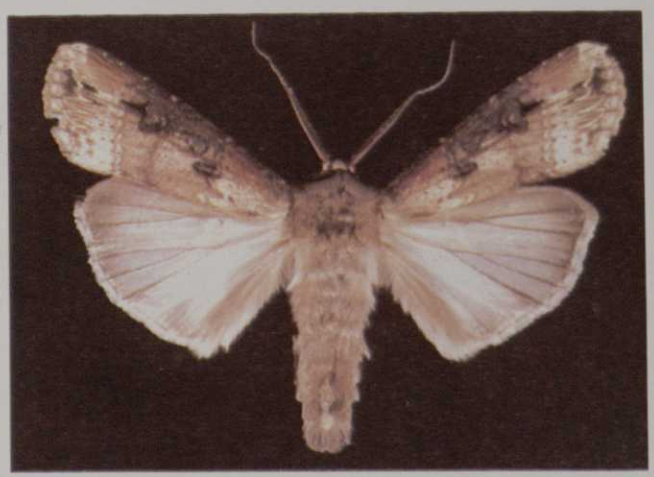
S. _____

B. _____

C. _____

D. _____

H. _____

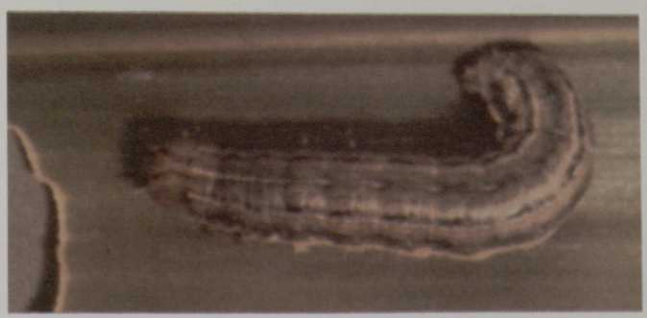


I. _____

J. _____

Photo courtesy Dr. J. Schread

N. _____



O. _____

P. _____

T. _____

U. _____

V. _____

Sand topdressing can be a short-term solution. Rebuilding is long-term.

Modifying greens—Topdressing and rebuilding

by Louis E. Miller, Golf Course Superintendent,
Louisville Country Club, Louisville, Kentucky

Remedy for problems—Old

Fourteen years ago I took the position of Superintendent at the Louisville Country Club, and one of the major problems that I noticed right from the start was the heavy thatch conditions that prevailed on all of the greens. The bad part of the problem was that the members liked the thatchy greens because the cushion made up for a poorly hit shot and the ball would hold on the green. The thatch was so bad that you could reach inside the cup and pick up the turf like it was a carpet. The roots wouldn't even penetrate the thatch into the soil layer. The thatch was a good one and one-half inches thick.

I informed the greens committee that the thatch was going to go. They couldn't have been more cooperative, and were prepared to take the flack from some of the membership, especially some of the older members who had grown accustomed to the spongy greens. Another important point to mention here is that only about two of the greens had any tile under them, and they were all composed of a very heavy clay mixture. The physical construction of the greens was a thatch layer over a clay base, and that was all. Not to detract from my predecessor, because he did what he could, but his hands were tied. They didn't even want a Greensaire on the greens. Consequently, he had to use an old Wespoint aerifier, and it wouldn't even penetrate the thatch.

For the first few years my program was that of aerification vertical thatching, using a mat-a-way with knives on two inch centers, removing both the cores and thatch and then topdressing. The program I used at that time was not readily accepted by most people; I had to make the choice after some serious deliberation and elimination. In coming up

with the topdressing mix, I eliminated any peat, mainly because of the already present heavy organic layer. That left sand and soil. It was difficult to get a good grade of soil that would not ball up, so to speak, when mixed with washed sand, and in view of the fact that Dr. Daniel was doing extensive work with calcined clay at the time, I felt that mixing the medium washed sand with the processed clay would give me a good consistent mix that would not only true up the putting surface but at the same time would drag into the aerifier holes and vertical slits easily.

We applied the material quite heavily, 1/4 to 5/16 inch, and worked it well into the green. Due to the shock not only to the green, but to the membership, we did this just two times a year—in the spring and fall. After a period of about two years, we could notice the thatch really starting to disappear, and after the third year, it had been completely decomposed. We had also pushed our roots down to the five or six inches and had a good, resilient putting surface.

I know that you hear a lot about "layering," using a different material on the topdressing program than the green is composed of. I disagree with that theory and have six

Continues on page 20

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	Texture	Fine	Medium to Coarse	Fine to Medium
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greens of the old construction to back up my theory. The thing that I do agree with is that once a sand topdressing program has been started, it is necessary to stay with it and not switch back and forth, because then you will get layering.

Twelve of our greens have been rebuilt since I started the sand topdressing program, but the topdressing program on the old six greens has not changed in fourteen years. I have had some people say that the calcined clay could be eliminated, but if I did so, then I would have to change the topdressing material, and, as a good friend with many years in the field of turf management and construction told me, "Boy, something that works for you and is doing a good job, don't mess it up."

That pretty well sums up my feeling also. It has been a good program and has worked well. These old greens will be replaced with new greens of U.S.G.A. type construction within the next year, but the sand topdressing program will continue until they have been rebuilt. The main reason—because it works.

Remedy for problems—New

Of the many various methods of construction used to build a putting green, the U.S.G.A. method is probably the most accepted as being the "successful" way to properly construct a green. The U.S.G.A. method of layering has been refined and tested for a number of years, and if all of the proper steps are followed in the right sequence, then a correctly built green with many years of service should be the result.

If you are considering rebuilding one green or your entire course, then the first step is to acquire the services of a competent golf course architect. I have seen too many greens that have been designed by the superintendent or a member of the greens committee that have been disasters. In our particular case, we secured the services of David Pfaff, whose work was quite reputable. His design kept the existing character of the course yet gave an innovative flare to the new greens to be built.

A committee was established consisting of the superintendent, golf pro, and two members of the greens committee. Once the board of directors had approved the construction of three of the greens, it was the job of the committee to work with and approve the design of the architect. This project was to be done over a period of six years, by doing three

greens each year. As soon as the board approved the project, we began mixing our topmix. In wanting to stay away from any soil at all, we sent samples of the sand and peat to Texas A & M University for analysis for the U.S.G.A. Soils Testing Laboratory. Their recommendation was to use eighty percent of the sand, which was classified as a medium wash, and twenty percent of the Millburn peat. This material had a percolation rate of 7.4 inches per hour. We mixed off-site starting in June, using two front end loaders and a Lindig soil shredder. Using two loaders and mixing the material before putting it through the shredder, we found that two men could mix about one hundred tons in a six-hour day. The high sand content made it necessary to clean and change the oil on the breathers and crankcases of all equipment used each day. We were able to mix two thousand tons in about one month's time.

The sod was removed from the green the morning that the construction was started and used to establish a temporary putting green. This lessens the shock to the membership and gives them a satisfactory surface to putt on during the construction. The architect's job is finished once he gives us the final draft of the blueprints. As far as the staking and grade work, this should be handled by the superintendent. Using a transit properly is part of his professional requirements. The two main stakes to be considered throughout the construction are the center stake and the backsight stake which is established in the center of the fairway. The backsight stake is absolutely essential in that it allows the green to be properly oriented with the fairway. If a cut or fill is required then the center stake and four others will suffice until a rough grade is reached. The green can then be staked on sixteen points with the proper grade marked on each stake. This just speeds things up for the operator.

The base grade of the new green should roughly conform to the finish grade, except that it will be eighteen inches deeper. Once the base grade is established, the next step is to in stall the tile lines. In our case, the design of the tile system varied with each green, with a minimum spacing of twelve feet and a maximum of twenty. The main thing to keep in mind is that they all have the proper fall. We used four inch ADS plastic perforated tile with a half-inch gravel to bed and cover the pipe.

The gravel bed can be spread by one operator using a tractor with a blade or grader box and a laborer to hand rake the tight spots next to the edge and around the stakes. The gravel can be tucked right to the green, and ten to twelve-ton loads on tandem trucks helps to reduce tracking on the course.

The coarse sand blanket can be spread in the same manner as the gravel blanket. A spot check from time to time by the superintendent helps insure the quality of this in-