tion, wind speed and evaporation rates to estimate how soil moisture levels are changing. Once fed into computerized irrigation controllers, these formulas adjust the amount of water applied.

One such system was established by Dr. Richard Snyder at the University of California, Davis. Called the California Irrigation Management System (CIMS), the project is now run by the state Department of Water Resources. Snyder always stresses that the estimated evapotranspiration (ET) rates generated by the CIMS need to be periodically adjusted and corrected based upon actual field measurements of soil moisture.

Pogue and others feel that moisture sensing devices are a more direct method of shutting down irrigation when plants have all the water they need. They feel these devices placed in the rootzone of key plants are bound to be more accurate than even highly sophisticated formulas designed to estimate what soil conditions are. They don't use the same methods to measure soil moisture levels, but they are all convinced these devices can detect a plant's water needs at any moment and can relay this message to a central location for adjustment of irrigation cycles.

Soil and plant scientists have been experimenting with soil moisture sensing devices for more than 60 years. Researchers at Cornell University and Iowa State University discovered that an enclosed tube of water with a porous ceramic tip on the bottom responded to different soil moisture levels like they theorized a plant's roots did. They knew that plant roots had to pull water away from soil particles. As the soil got drier, the roots had to pull harder to overcome the grip of the soil particles on the water.

When they added a vacuum gauge to measure the suction inside the tube, the researchers could assign a number to the wetness or dryness of the soil. The drier the soil was, the higher the gauge read. Since this was a measure of the tension of the water in the soil, they called the device a tensiometer.

Scientists in soil and plant laboratories were the first to use it. "With the tensiometer," Pogue points out, "researchers could compare plant performance under varying conditions knowing that soil moisture conditions were exactly the same for all plants being studied. In other words, they could eliminate water as a variable in their research."

It wasn't until 1951, when Irrometer began commercial production, that tensiometers became available to the landscape and agriculture industries. Citrus growers were the first to use them to a significant degree. Early tensiometers had to be checked individually by the irrigation manager before he would adjust the amount of water applied manually. If they were left unattended during extended dry periods, they could run dry. The water in the tensiometers had to be checked regularly.

Irrometer's tensiometer has been commercially available for more than 30 years, but its appeal is starting to broaden with rising water bills and a growing awareness of the problems caused by overwatering or underwatering turf and ornamentals. Irrometer has added a data collection unit to its tensiometer, making it more useful to turf and landscape managers.


Irrigation manager sets the switches on the moisture sensing devices for the desired moisture levels.

Water Conservation Systems, Inc., makes a solid-state tensiometer called a Hydrovisor. Like Irrometer's tensiometer, it measures the suction required to remove water from the grip of soil particles. WCS president Ed Bramlett says it's this force that matters, not the percentage of moisture in the soil. Rather than measuring the suction through a porous ceramic tip, the Hydrovisor uses soil temperature information to calculate the availability of water in the soil.

The Hydroturf System from Hydrodyne measures the amount of free water between soil particles in the rootzone. Griswold Controls' Scanex also measures soil moisture content. All companies have reported water savings of 50 percent in systems where their devices have been used.

When electromechanical controllers were developed in the late '50s and early '60s, they opened new doors for moisture sensors. Electric valves in the field, linked to the controller with wires, would open and close according to instructions at times set on the controller clock. No longer did the landscape manager have to manually open valves located in many different locations and then wait or return to shut them off again. The electromechanical controller was quickly accepted as a big labor saver for the landscape industry.

Sensing a great opportunity, in 1961 the engineers at Irrometer linked a switching unit to its tensiometer. When the tensiometer detected a preset level of moisture in the soil, the switching unit would break the circuit between the valve and the controller shutting the water off. As the soil became drier and fell below another preset moisture level, the switching unit would reconnect the circuit and the signal from the controller to irrigate would again activate the valve.

"The manager could set the controllers in the field to cycle more frequently and the tensiometers would stop any cycle after soil moisture levels were adequate," said Pogue. This eliminated the need for the irrigation manager to read the tensiometers before adjusting the irrigation cycles. Still, the units would run dry if left unchecked during dry periods, says Pogue. Part of the problem was irrigation managers didn't understand how these moisture sensors worked, so the company began to hold water management seminars.

The advent of solid state controllers and, most recently, computerized centralized controllers, greatly expanded the number of stations a central controller could operate. Today, satellite controllers in various locations in the field can both receive instructions from a centralized computer as well as send appropriate information back. Now, a person sitting at a computer in an office can know what heads out of thousands in a system are operating and at what pressure. He can see by feedback from gauges in the field if there are leaks, malfunctioning valves or

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Taking the Guesswork
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heads and if certain zones have all the water they need.

Soon, software for these computers will be able to take the feedback from the field and make adjustments to irrigation cycles automatically. In addition, satellite controllers in the field will be able to communicate with a central computer by radio or telephone lines. With so much new information and technology, it is easy to see a need for irrigation managers who understand these complex systems and can get the most out of them.

Moisture sensor manufacturers are taking advantage of this new capability. Utilizing computer software and two-way communication between field controllers and a central computer, Irrometer has solved two of its problems with tensiometers. Now, actual soil moisture readings from many tensiometers in the field can be seen on a control panel sitting next to the central computer. Without going into the field to check individual moisture sensors, the irrigation manager can adjust cycles without leaving his desk. It also allows him to carefully track his soil moisture trends and to spot problem areas long before they become serious.

The feedback capability also alerts a central computer when tensiometers have broken suction and are malfunctioning. "This eliminates the maintenance problem associated with tensiometers," says Pogue. "By using feedback from moisture sensors in the field, the long, dry periods that cause the units to break suction are eliminated. But, if they do malfunction, the irrigation manager will know right away without having to go into the field to find out."

The first major installation of a system combining tensiometers with a Motorola centralized computer is planned for the Sepulveda Basin Golf and Recreation Project in Los Angeles. Dave Megeath, the project manager for Motorola, says, "The whole key at this point is the software. Our software was compatible with Irrometer's so we didn't have to wait to develop programs to link the tensiometers with our MIR-3500 System."

The Sepulveda Basin complex includes two golf courses and a driving range, plus general landscaping. With long range plans to utilize reclaimed water, the moisture sensors will insure that control is maintained over the potential deep percolation of low quality water into the ground water supply.

"The park also wanted control of the irrigation system to be in one person's hands," Megeath adds. "Since there is such a variety of sites within the park, moisture sensors seemed like a good way to customize water needs for these areas. The two-way communication between the MIR-3500 and the tensiometers clinched the sale. The results in water and labor savings will be very interesting to see."

As manufacturers of other centralized computer irrigation systems develop the software to incorporate the tensiometers, their new capabilties can be realized in more systems. In the meantime, tensiometer systems can be installed in key problem areas for connection with computers at a future date. Pogue recommends two probes per site, one at a shallow depth and another at 3/4 of the depth of the root system. This will permit better control over deep penetration of water in various soil types.

A number of probes can be connected to a single switching unit. The switching units, when hooked to controllers set to cycle frequently, will maintain appropriate soil moisture levels and prevent the tensiometers from breaking suction. When the manager of a large irrigation system adds a centralized computer controller, or when the company who made an existing computer controller develops the necessary software, the tensiometers can be incorporated into an overall water management program.

Significant water and labor savings have been realized already by incorporating moisture sensing devices into large irrigation systems. As the value of water continues to rise and computer technology helps improve the reliability and accuracy of moisture sensors, they will become as important a part of an irrigation system as a source of water, satellite controller or valve.

CHALKBOARD

TIPS FROM THE PROS

Summer Disease Recovery

By Eliot Roberts

Most common turf diseases are far less active in the cooler weather of fall than during summer months. The fall is a good time to help turf recover from any patches, spots or thinning caused by recent disease activity. Basically, this is a matter of encouraging regrowth and spread of existing grasses. It should include overseeding with new disease-resistant varieties to prevent summer damage next year.

Fall is a good time to have the soil tested. Correcting soil deficiencies will greatly aid in turfgrass recovery. Adjust fertilizer applications and amend soil as indicated by the test results. After the fall playing season ends, aerify to relieve soil compaction. Often, thin diseased turf will respond to loosening of the soil in the fall. Root growth is stimulated and recovery from disease is speeded.

Thatch promotes diseases in turf. Any accumulation over 1/2-inch should be removed in the fall. A vertical mowing machine or powered rake will slice out this excess material above the soil surface. Rake and remove the thatch from the field.

Following the use of a vertical mower or power rake, the lawn should appear well-thinned with fewer plants per square foot. Overseed with certified seed of disease-resistant varieties. The new grasses will thicken the turf and make it easier to protect it from diseases next summer.

EDITOR'S NOTE: Eliot Roberts is executive secretary of The Lawn Institute.

Management Practices Cited For Increase in Pythium

Pythium is back in force on bentgrass surfaces in many parts of the country this year. Leon Lucas, turfgrass pathologist at North Carolina State University, thinks the problem is caused in part by common management practices.

Warm summer weather and poor drainage have combined to make this disease a great concern to many superintendents, says Lucas. Poor drainage and summer irrigation practices are robbing the bentgrass roots of valuable oxygen at a time when the roots need to be their healthiest.

Lucas blames a compacted layer of soil two to three inches below the surface. Roots find it difficult to penetrate this layer and water will not percolate through it to drainage systems below. Surprisingly, this layer is often linked to compaction caused by the tips of aerifier tines. Aerifying at the same depth every time packs the soil at the bottom of aerifier holes. As a result, root growth is hampered and damp conditions persist at the surface.

Lucas believes the poor surface drainage also robs fungicides of their effectiveness since conditions hamper the distribution of the chemicals in the rootzone. Pythium species were found on the roots of healthy bentgrass on trouble-free greens, so the weakened state of bentgrass roots caused by the subsurface layer reduces the bentgrass plant's resistance to the disease.

Poor drainage appears to trap fertilizer salts near the soil surface. High levels of soluble salts probably killed some of the short roots, Lucas theorizes, and encouraged top growth over root growth. Low potassium levels were also discovered in problem greens. Since this nutrient is important for root growth and stress tolerance, a deficiency may have hindered root development.

Roots of bentgrass weakened by pythium were very short in late summer and fall and remained shallow into the winter. Bentgrass root growth remained slow due to high soil temperatures through late November and December 1985 in North Carolina. Root regrowth is encouraged by cooler temperatures.

But don't stop aerifying, says Lucas. Greens with good drainage, aeration, fertilization and careful irrigation have fewer problems with pythium. Aerifying in midsummer, with small tines and leaving the holes open, helps the bentgrass overcome root rot. He also believes periodic use of deep aerfiers to break up the hardpan layer can help in some cases.

Lucas states, "A combination of factors contributed to the pythium root rot problem. Pythium was the straw that broke the camel's back. I don't anticipate the disease will be severe unless poor soil drainage exists, too much water is applied or improper fertilization practices are used."

On the same subject, Clinton Hodges, turfgrass pathologist at Iowa State University, reports pythium problems on old greens recently rebuilt with sand. The bentgrass grows well during the mild periods of spring and early summer the year following renovation. With the arrival of hot, humid weather, the turf begins to die in a pattern typical of pythium-induced cottony blight or foliar blight. Fungicides have not been effective so far.

Intense aerification followed by application of fungicides into the aerifier holes may slow the disease, says Hodges, but will not stop it. Wetting agents in conjunction with fungicides have proven useful in some cases. He has has also observed that decreasing irrigation to an absolute minimum may slow the development of the disease.

Hodges says the disease remains a serious problem for about three years after reconstruction and then diminishes in severity. He speculates that organic matter and wind blown silt amend the sand during this period, but no specific reasons are available at this time. The problem is confined primarily to old golf greens reconstructed with sand. The disease is rarely found on newly constructed sand greens.

Spring Transition Tips

Many sports turf managers begin to worry in the spring when the overseeded perennial ryegrass seems to keep the bermudagrass from coming out of dormancy. As the spring season starts, these managers tend to worry about the mixed stand of turfgrasses on their fields.

According to Dr. James Beard, their concern is often justified. Research at Texas A&M University has established two important facts about spring transition. First, bermudagrass has very poor shade tolerance. Ryegrass can actually shade out the bermudagrass if allowed to grow tall. To counteract this, Beard recommends relatively close mowing (3/16 inch) and modest weekly vertical cutting to open up the turf and let the sun and warmth reach the bermuda.

Secondly, Beard warns that holding back water in the spring to discourage the ryegrass can also harm the bermudagrass. The reason is that bermudagrass experiences root decline in the spring. The weakened root system is less capable of extracting limited moisture from the soil. To overcome this weakened state, maintain irrigation and fertilize with one pound of nitrogen per 1,000 sq. ft. per WEEK.

If you have a tip you would like to pass along to other sports turf managers, please send it to **sportsTURF** magazine, P.O. Box 156, Encino, CA 91426. Photos are encouraged to help illustrate your tip.

CHINA SIGNS AGREEMENT WITH INTERNATIONAL SEEDS

An Oregon turf seed producer has entered the drive to raise the standard of living in China. International Seeds, Inc., (ISI) of Halsey, OR, has signed an agreement to supply improved varieties of forage grass seed to the Chinese so they can develop millions of unused acres into productive pasture for beef and dairy cattle.

Harry Stalford will manage the two-year project for ISI and will work with Chinese scientists in pasture land development. The objective of the project, says ISI President J.L. Carnes, is to determine which grass seed varieties pose the greatest potential for turning these lands into productive pastures. The first seeds will go to China this fall.

LEBANON EXPANDS LIQUID FERTILIZER LINE

Lebanon Chemical Corp., a custom blender and manufacturer of fertilizers in Pennsylvania, has greatly expanded its liquid fertilizer business with the purchase of Tidewater Agricorp, Inc., of Chesapeake, VA. Tidewater's product line and 20 fertilizer outlets from Virginia to North Carolina will be operated by Lebanon's Total Turf Care Division, which handles sales to the professional golf and lawn care industries.

Mark Nazum, who was manager of Tidewater's Commercial Division, has been promoted to Manager/Agronomist of the liquid turf fertilizer line. Before his association with Tidewater, Nazum was manager of technical services for Rollins Care, a division of Rollins, Inc., Atlanta, GA.

Paul Mengle, Lebanon manager of marketing and sales, will be responsible for marketing the expanded line of liquid turf fertilizers.

WARREN'S APPOINTS TEEPLE NATIONAL SALES MANAGER

Warren's, headquartered in Crystal Lake, IL, has announced the recent appointment of Steve Teeple as national sales manager.

Teeple is a relative newcomer to the turfgrass business. His background is primarily in the materials-handling industry, where he has had extensive sales and sales-management experience. He will work at the corporate headquarters.

Mike Holmes, general manager of Warren's, commented, "This move is aimed at strengthening Warren's marketing effort as we grow in our current operations as well as expand into new markets."

He noted, "Steve has a strong sales and sales-management background. He should bring some fresh marketing perspective to our company as well as our industry."

Warren's is one of the nation's oldest sod-producing companies. It also produces and markets proprietary turfgrass seed and markets a specialty fertilizer line and a specialized lawn spreader. It is a national distributor for Warren's TerraBond, a geotextile or filter fabric.

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ROOKIES

PRODUCT UPDATE

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Each Multi-Core head contains from nine to 18 tines, from 3/16 to 5/8-inch. The machine can remove up to one cubic yard of thatch per 1,000 sq. ft. or none at all with the spiker head.

The standard 16-inch-wide model can aerate 4,500 sq. ft. per hour. A wider swath model and both steering and non-steering units are available. All are powered by either a seven or eight hp four-cycle engine. The Multi-Core is easily towed by a utility vehicle when not in use.

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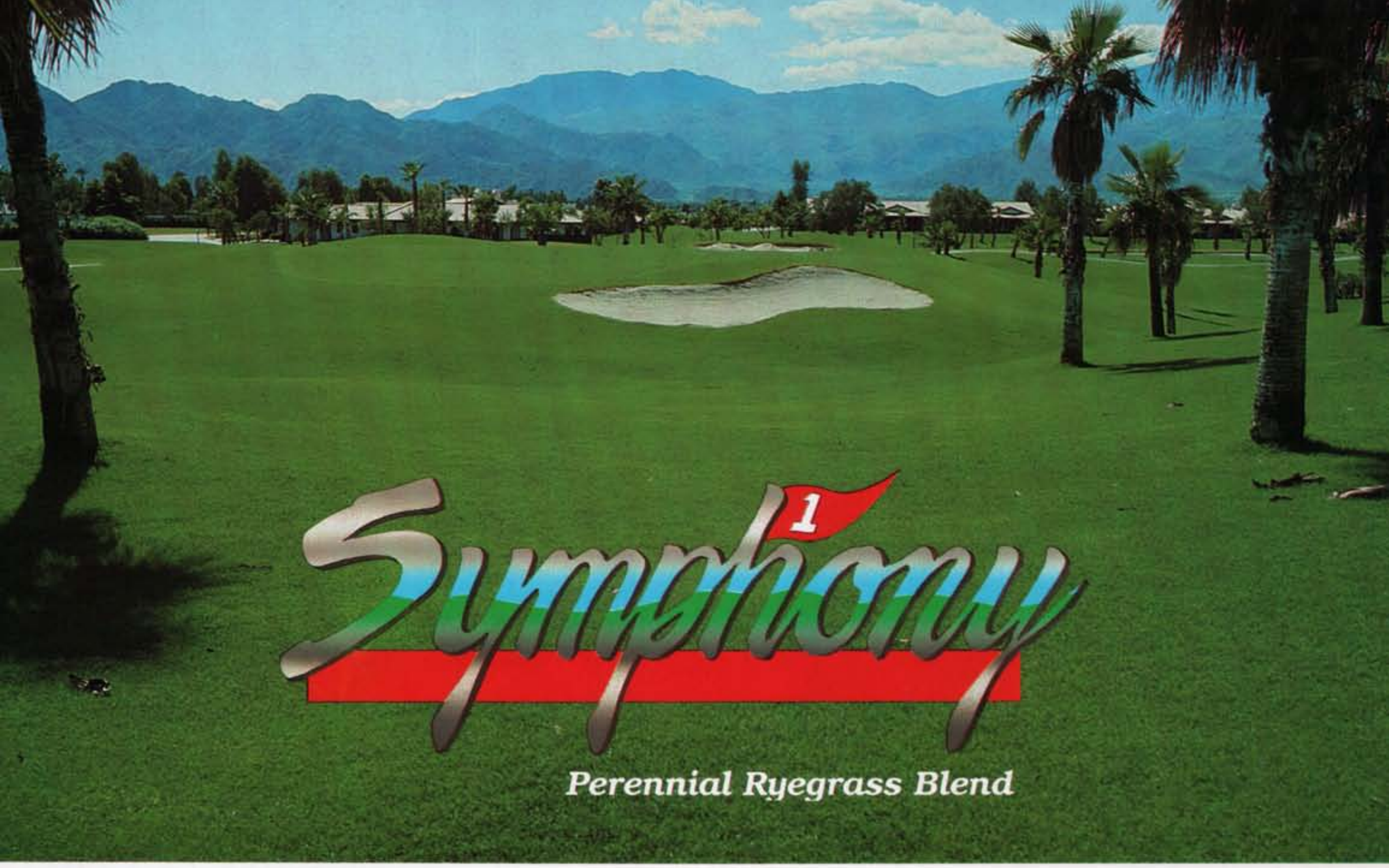

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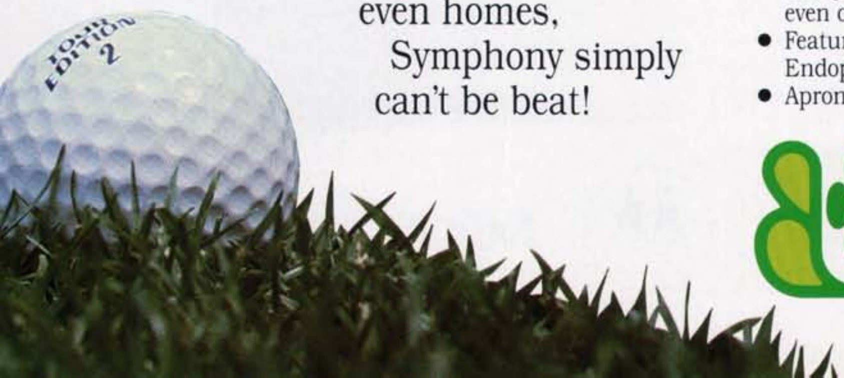

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