10,000 will go across my desk from turf sites all over the world. Many of these sites have been evaluated yearly for as many as 15 years. Soil testing data is powerful research information and it has allowed many turf grass managers to discover ways in which to renovate a tired field without going to costly extremes.

Today, more than ever, understanding what your soil needs is not only prudent but is becoming a necessity. Soil testing, however, is still a mystery to most of us as it was to me as a young County Extension Agent coming out of college. I would look at the hundreds of soil tests and feel nothing but frustration in my lack of understanding. I see that same frustration in the eyes of many turf grass managers because soil testing can be confusing, but it is our basic blood work and by understanding what is wrong we can make significant changes in the way the soil works and in the way the plant responds.

By getting the soil right we can help to open the soil physically, allowing more air and water to move through the soil profile, this improves drainage, creates checks and balances for pathogens, better mobilizes nutrients, improves recovery and reduces fertility inputs.

Amending a field must start with a complete soil test but unfortunately many of the tests available today are not very complete and simply add to the confusion. Many tests are given away for free and are free for a reason—because they are little more than pH readings. This lack of data makes it very difficult to amend a field appropriately.

A quality soil test will list the CEC showing how much nutrient the soil can hold, a clay soil being much bigger than sand based soils. It will also list all the basic anions (negatively charged elements) and cations (positively charged elements) and ideally show the desired levels of calcium, magnesium and potassium the three nutrients that make up 85% of the soils base saturation. A complete base saturation (the percentage of the cations on the soil colloid) should be listed that will include calcium, magnesium, potassium, sodium, trace elements and hydrogen.

Too many soil tests show a partial percentage list of these important cations but will average the shortened list and still come up with what appears to be a complete percentage. Remember percentage refers to 100%; base saturation numbers should always add up to 100%, if they are more or less you know you are not dealing with a complete base saturation. Or, if one of the six cations is not listed you are not dealing with a complete base saturation.

In this magazine's May 2005 issue, we chronicled the experiences of Bob Studholm, from the Fairfax County (VA) Parks Authority. When Bob started testing all 275 of his fields with Logan Labs from Ohio he focused on balancing his soils; subsequently he noticed his soils draining better, recovering better and his cost of fertility went down significantly. Bob worked at bringing his calcium levels between 60% and 70%, magnesium between 12% and 17% the level of potassium close to 5%, and he always tried to maintain hydrogen levels at 10% because on his complete soil test, 10% hydrogen would always give him a

pH of 6.3. That number is generally recognized as the "ideal" pH because it is the point at which there is maximum potential mobility of both the macro and micro nutrients.

Three-legged stool

The focus of any good soils program should always include a chemical, a physical and a biological approach. This is the old "three legged stool" diagram that can be found in any good soil science book, all three need to be equal or the stool falls over. Chemistry affects physics which in turn affects biology and it is ultimately soil biology that makes everything in the soil work.

With a better environment for biology, which can be established with good soil testing, we can build better levels of humus in the soil. Turfgrass managers are quickly realizing that as they build a carbon based program they are reducing inputs and saving their budgets. All of this starts with chemistry (the soil test) which is our first limiting factor. In fact a good soil test may actually be only 50% fertility the rest being physics and biology. So then why do we spend so much of time with only pH and the basic three nutrients?

On recent work done on a soccer field we found the soil to be very imbalanced. The calcium base saturation was 45% and the magnesium base saturation was also in the 40% range. This left very little room of other cations such as hydrogen and in fact the percentage of hydrogen was 0% which meant the pH was above 7.0.

Since the base saturation percentages always add up to 100% we knew that by adding calcium in the form of high calcium limestone (dolomitic lime would have added unwanted magnesium) we would knock the magnesium off the soil colloid and open the soil up just enough to get air and water through the soil profile. This also allowed some hydrogen (acidity) to take hold on the soil colloid lowering the soil pH a phenomenon that we

have documented hundreds of times on sports fields all across the country. This soil showed a high CEC so it took a few years but just as Bob Studholm reported on his fields, we again saw the field open up and drainage improve. The most important nutrient in turf has always been oxygen and the best way to get oxygen into the root-zone is to amend the soil appropriately based on good soil testing and following the advice of that blood work.

When amending a field or building next year's program the best investment that you can make is to be sure you know exactly what your soil is telling you and the only way to do that is to sample the soil with a quality soil testing laboratory. The soil report will tell you how to amend you soils for maximum performance, for maximum recovery and for a reduction of inputs.

There are numbers of good consultants in our industry who understand how to read a complete base saturation soil test and can be of great assistance in helping you discover what direction to take your program for maximum performance. When followed through with properly, I have never seen an investment in good soil testing not pay for itself many times over. ■

Joel Simmons is an agronomist in Easton, PA. He has worked as a Penn State County Extension Agent and a soils instructor at Rutgers University. Joel owns Soil First Consulting and can be reached at joel@soilfirst.com.

Prevent turf disease with manganese

Since the 1980s it has been known that applications of manganese can decrease the severity of diseases caused by the fungus *Gaeumannomyces*. Though the original research was done on diseases of wheat, PACE Turf has applied those findings to turfgrass diseases, such as take-all patch and decline, with good results.

Larry Stowell, Ph.D., PACE Turf's agronomist and plant pathologist, says that to achieve disease suppression of take-all patch, he recommends that soils contain a minimum of 30 ppm (parts per million) manganese (when analyzed using Melich III extraction). Iron should be present at three times the level of manganese. "At least 90 ppm iron is desired if you are targeting 30 ppm manganese," Stowell says. "Products that are effective in delivering manganese are Granusol Mn (a granular 31% manganese product) and manganese sulfate (which can be applied as a granular or as a spray, 30% manganese). To maintain soil manganese levels at a minimum of 30 ppm, apply either product at 100-200 lbs/acre watered in following application. The 100 lb/acre rate will increase soil manganese by about 15 ppm. Quarterly applications at this rate (equivalent to 2.3 lb/1000 sq ft) may be necessary in some locations to keep the manganese at 30 ppm in the soil, but be careful—too much manganese can also be a problem."

PACE Turf's other lead turf researcher, Wendy Gelernter, Ph.D., says, "Please keep in mind that manganese (Mn) is a whole different animal than magnesium (Mg), with which it is frequently confused."

How does manganese damage the disease-causing fungal organism? Gelernter says, "Ian Thompson and his colleagues at Purdue University are working with take-all of wheat (which is closely related to take-all patch and decline diseases). They've found that the fungus causes some of its damage by converting manganese, an essential plant nutrient, into a form that the plant cannot use. When extra manganese is applied to turf in the form of Granusol manganese or manganese sulfate, the plant gets another chance to grab some of this important mineral before the fungus gobbles it up."

The Purdue researchers also made a finding that has great potential in turf management: the fungus that causes gray leaf spot, *Magnaporthe grisea*, may disable manganese in the same way as the take-all fungus does. Stowell says, "If this proves to be correct, then it may be possible to prevent some gray leaf spot damage through preventive applications of manganese, as well."

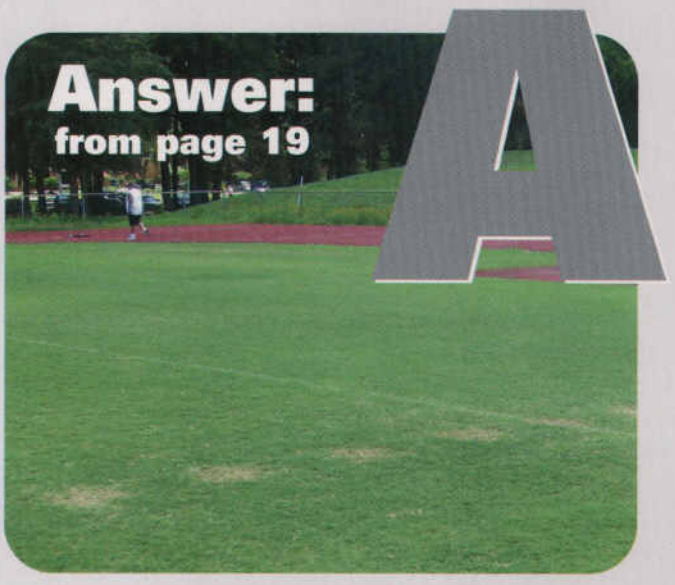
For more specific information on manganese requirements, see PACE Turf's soil management guidelines at www.paceturf.org. Additional turf management topics are available to members of PACE Turf. Free trial memberships are also available at the website.

PACE Turf is a membership organization that provides research, education and information services to the turf management community. Founded in 1993 by Wendy Gelernter, Ph.D. and Larry Stowell, Ph.D., the PACE Turf mission is to generate and share independent and objective agronomic information among turf professionals so they may develop management programs that are effective, practical and scientifically sound. ■

John Mascaro's Photo Quiz

This photo might be easy to guess for those of you with football practices on your fields, but I think it is worth printing the photo. The brown squares on this football stadium field are the result of the dreaded ladder drill. This fine training ritual involves putting a rope ladder on the turf and having players perform various footwork drills between the rungs of the ladder. The brown marks are a result of the wear and tear on the turf. This particular college held a summer football camp in which the entire camp of over 150 players performed the drill several times without moving the ladders. Since this drill was performed on the actual playing field instead of the practice fields, and the fact that they performed the drills near the center field also aggravated the sports turf manager. Often, strength and conditioning coaches fail to understand the importance of moving practice drills around from one area to another. During the playing season, it is hard if not impossible to get areas near the center of the field of play to recover due to the increased stress on the turf.

Photo submitted by Justin P. Newell, former director of facilities and operations at Jacksonville University, who is now at Tulane University. Andy Sorrow is sports turf manager at Jacksonville University.



If you would like to submit a photograph for John Mascaro's Photo Quiz please send it to John Mascaro, 1471 Capital Circle NW, Ste # 13, Tallahassee, FL 32303 or email to john@turf-tec.com. If your photograph is selected, you will receive full credit. All photos submitted will become property of *SportsTurf* magazine and the Sports Turf Managers Association.

Ochsner employs two-wire irrigation system in Dayton

Dan Ochsner, head groundskeeper for the Dayton (OH) Dragons of the Midwest League, was experiencing "phantom" electrical problems last spring at Fifth Third Field. He called in J.C. Wheaton, manager for Centerville Landscape and Irrigation, Inc., to help him troubleshoot the problem. "The field had a 'gremlin' problem," said Wheaton. "Zones would work one minute, but not function the next day. Then last spring they lost the ability to activate about half of the zones from the controller."

While doing patchwork, Wheaton and his crew discovered that the old system was a "rat's nest" of re-spliced wires and riddled with in-ground connections that weren't even close to the valve boxes. "Dan and I decided to finally fix it once and for all. That's when we started talking about two-wire.

Head groundskeeper Dan Ochsner (left) and JC Wheaton, manager, Centerville Landscape and Irrigation, Inc. at the Dayton Dragon's home field.

"After doing the math, we found that retrofitting the ballfield with two-wire would prove to be much more cost-effective than pouring money into the existing faulty electrical," he said.

Two-wire irrigation control systems use just a single pair of wires that extend from the controller to each valve sequentially in the irrigation network. The two-wire path can be branched in any direction that works best for the site.

"In a conventional, multi-wire installation, we'd dig trenches to accommodate wiring from the controller to each station, then extend the common and run a hot wire back to the controller," said Wheaton, "with costs adding up for labor, wire and materials.

"However, we found that systems with over 300 feet of mainline cost less when installed with two-wire and they are easily expandable."

The ability to add valves at any time and anywhere along the two-wire path is one of the system's best-known features—no retrenching.

"Installing two-wire also doesn't require any special equipment or tools, so we could use the same valves that we were familiar with and the same solenoids and waterproof connectors that were already on our trucks. Even the line is typical irrigation wire," said Wheaton.

Back at the ballfield, Wheaton and Ochsner decided to go with an Underhill 2Wire system. They brought in a new Hunter ICC Controller, but kept the Hunter I-25 and I-40 rotors, along with the 2" HBV (Hunter brass

Underhill decoders are attached to every valve and irrigation programming is relayed to each valve over the two-wire system.

Hunter ICC is set up for operation with two-wire decoder module, which directs all 13 stations.

valves). They also ran new wire and connected the valves to the two-wire system with Underhill's 2Wire Decoder Receivers. A Hunter rain sensor was added for improved efficiency.

Renovation started April 1, 2008 and was completed in 4 work days, with a little juggling around the Dragons spring schedule.

Since the entire system was going two-wire, when the new ICC was installed, the crew just snapped the Underhill ICC Decoder Module into the first module slot. To verify the ICC module was correctly inserted, the installer pressed and held the Push button until a green LED programming light flashed to indicate the Decoder Module had been correctly mounted. All 13 stations were then enabled.

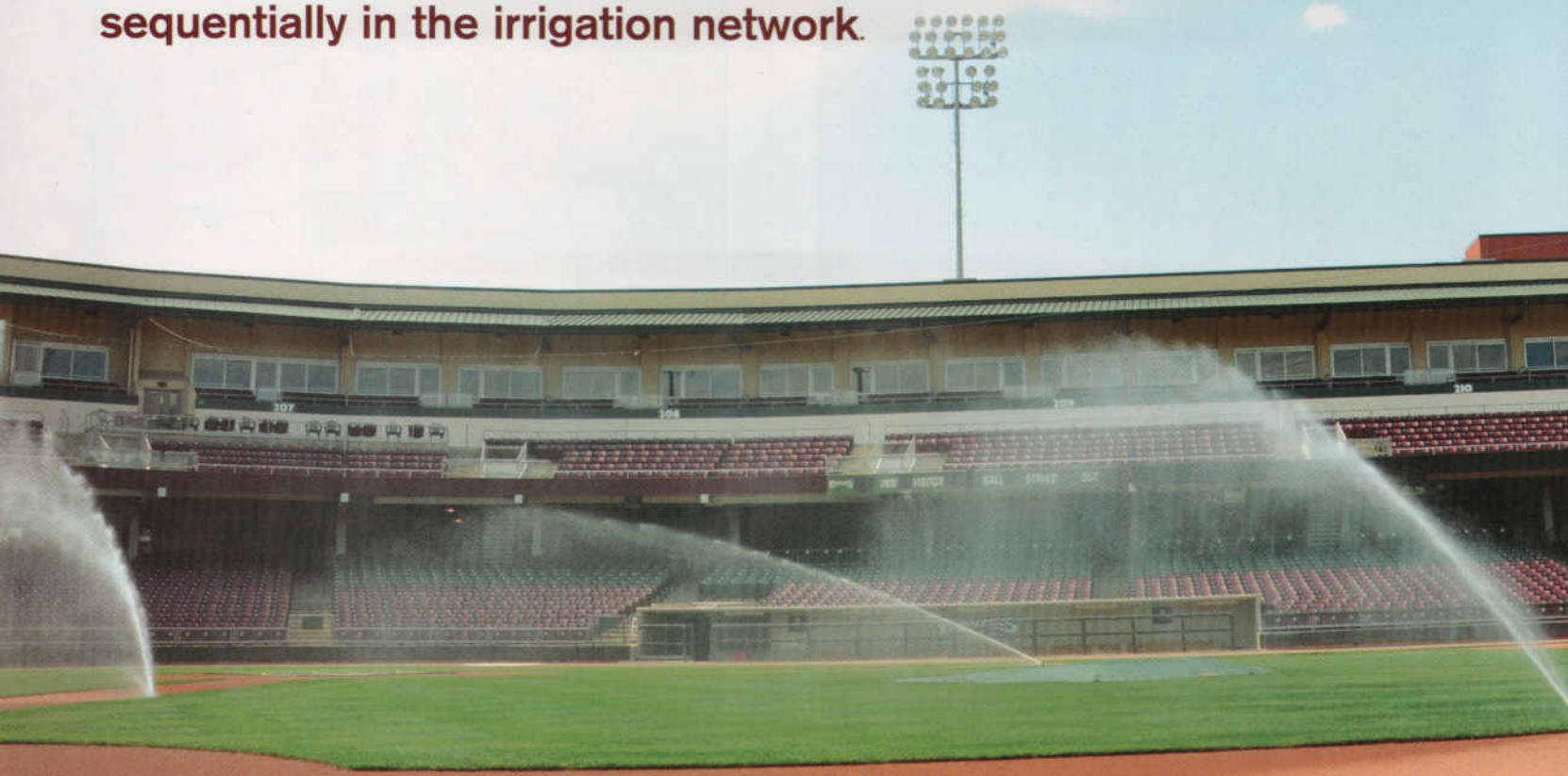
Each valve decoder/receiver was set with a unique station address before the decoders were installed. That way, when the controller turned on a decoder station, it sent power down the main two-wire cable along with a digital signal (the address) that was specific to each valve decoder. As the decoder/receiver heard its address, it applied voltage to the solenoid, completing communication from the controller to each station.

All Fifth Third Field valve decoder/receivers were programmed with Underhill's portable Programmer/Tester. There is also a built-in decoder programmer on the ICC Decoder Module, which allows the installer to program a valve decoder station number by inserting red and black decoder wires into the ICC Decoder Module.

Connecting Valves and Decoders

The Centerville crew routed the main two-wire cable between each control valve location and the ICC. At the valves, they cut the main cable

Two-wire irrigation control systems use just a single pair of wires that extend from the controller to each valve sequentially in the irrigation network.



Hunter I-25 and I-40 rotors at work with new control system.

and stripped back the outer insulation 4 inches on each cut end. They then stripped each conductor one-half inch and the four wires on the decoder one-half inch. After they spliced the decoder's red and black wire into the main cable, they connected the decoder's red wire to the main cable's LI conductor and the black to the L2, then attached each of the decoder's yellow wires to each solenoid wire valve. All wire splice connections were done using waterproof connectors.

Back at the ICC Controller, they routed the main two-wire cable through the conduit and attached the conduit to the controller at the large portal at the right side bottom of the cabinet. They then stripped one-half inch of insulation from ends of the main two-wire cables and secured each conductor into the bottom two terminals of the ICC Decoder Module. They finished by connecting the conductor with the decoder's red wires to LI and the conductor with the decoder's black wires to L2.

Ochsner reports they've had great luck with the system, which runs the irrigation every evening with water from an on-site well. He has five zones of 180-degree heads on the perimeter, running for 10 to 18 minutes, and eight zones of 360-degree rotors on the field, typically irrigating for 20 to 30 minutes.

Ready for all kinds of Midwest weather, the field is turfed with Kentucky bluegrass, overseeded with perennial ryegrass and has an efficient sand-based rootzone drainage system. Drain lines are set 18 inches below grade, running parallel at 25-foot intervals.

"My only two-wire recommendation is that the irrigation installer prepare a detailed system plan that identifies each valve and decoder and the overall number of zones. This will save hours of time during troubleshooting, such as locating bad solenoids or identifying non-working zones," said Wheaton. ■

This article supplied by Hardwick Creative Services, Encinitas, CA

Where to use two-wire

Two-wire is used on sites where the costs of installation and maintenance are a consideration, typically systems with more than 300 feet of mainline. Two-wire is also recommended for use on sites that might be installed in phases or unexpectedly expanded, such as a community sports facility or college sports complex.

Irrigation and drainage go hand and hand

As demand for water increases so does its cost. But of greater consequence to those who manage sports fields is the real possibility that irrigation water use in the foreseeable future is going to be seriously curtailed.

In managing sports turf it seems to be that we either have too much water around in which case we need to undertake drainage, or too little, in which case we need to irrigate. The two are interdependent on one another and can no longer be treated as separate entities.

It's unwise to compromise in the design of irrigation and drainage schemes to save a little money initially. You should be looking upon both as major capital investments, which can

Shelton System 25 installing secondary drainage in soccer stadium.