CORNELL UNIVERSITY TURFGRASS TIMES

CUTT

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New Strategies for Broadleaf Weed Management

There is an increasing array of herbicides on the market for postemergence broadleaf weed control. Enhancing the overall spectrum of broadleaf weed control, these new products feature new active ingredients and possibilities for combinations. To adequately manage weeds in commercial turf settings, the ability to selectively remove broadleaf weeds from turfgrasses is of critical importance. Although broadleaf herbicides have been available since the 1940's when 2,4-D first came on the market, and the phenoxy herbicides are still the most widely used for turfgrass weed management, new formulations and products will help provide the chemical tools for future weed control.

Formulations

Besides the active ingredients, product efficacy also depends on formulation and the environmental conditions at the time of application. Herbicides are available in a wide variety of formulations including liquids, powders, emulsifiable concentrates, dissolvable granules, and granular forms. Most commercial applicators and turfgrass managers prefer to use liquid applications as they are considered to be most effective and faster acting. However, granular formulations are now widely available for many herbicides and with new formulations, are faster acting and more available for uptake by foliage. In addition, for some operations, they can be easier to handle and apply; for example in landscape beds or large areas for application.

Certain formulations also differ in volatility and ability to be absorbed by foliage of broadleaf weeds. Ester formulations are more volatile than salt formulations of 2,4-D or phenoxy products and tend to penetrate foliage more quickly. Due to their volatility, especially under warm conditions, these esters often put nearby ornamentals at risk; therefore many companies have developed LV or lower volatility ester formulations. Granular products can also occasionally volatilize if not watered in shortly after application. In any case, if a large rainfall is predicted, it would be better to postpone application until the chance of imminent rainfall has passed. If droughty conditions are experienced, uptake and translocation of

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This Times

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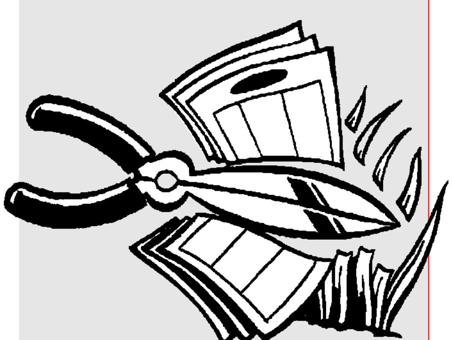
CUTT

Clippings

The goal is to document the amount of turfgrass acreage in New York and the economic value of turf, turf production, services, and expenditures. NASS expects to send out 15,000 questionnaires.

The survey will increase knowledge about this important industry and ultimately enable the public, industry and government to work together to ensure its continued growth and benefit to all New Yorkers.



New York Turfgrass Survey a Reality

The New York State Turfgrass Association (NYSTA), in cooperation with the New York Agricultural Statistics Service (NASS) and the New York State Department of Agriculture and Markets, will conduct the first New York Turfgrass Survey this fall. The goal is to document the amount of turfgrass acreage in New York and the economic value of turf, turf production, services, and expenditures. NASS expects to send out 15,000 questionnaires and to have about a 30-40% return rate.

According to Steve Ropel, NASS State Statistician, "The development of a quality mailing list is essential to making the survey a success." NYSTA, working closely with the agencies involved, is developing a targeted list of turf management professionals in a variety of related industries including landscape, sod farm, golf course, parks and recreation, highway rest areas, and cemeteries. Residential properties, corporate sites and schools also will be evaluated in order to obtain an accurate assessment of turfgrass acreage in New York State. The list of all known operations in each segment of the turfgrass industry will then be combined and a sample will be selected from the resulting list. Turf managers in this sample will be contacted to complete a questionnaire and data collected will be statistically expanded to represent all of New York.

Steve Griffen, NYSTA President and co-owner of Saratoga Sod Farm, Inc., said that the survey, which has been initiated by NYSTA and partially funded by members over the past several years, will increase knowledge about this important industry and ultimately enable the public, industry and government to work together to ensure its continued growth and benefit to all New Yorkers.

The target date for the first questionnaire is September and the final report is expected to be completed by the spring of 2004. Once the survey is tabulated, a publication will be prepared. Anyone receiving a questionnaire may request a copy of the publication by checking a box on the survey form. Others may contact the New York State Agricultural Statistics Service by mail at 1 Winners Circle, Albany, NY 12235; by phone at (518) 457-5570 or (800) 821-1276; by fax at (518) 453-6564; or by email at nass-ny@nass.usda.gov. The publication will also be available, when completed, on the NASS web site, www.nass.usda.gov/ny.

The New York State Turfgrass Association is made up of individuals in the green industry who have joined together to share technology, promote environmental stewardship, support education, advance research, and disseminate research findings. For more information, please contact the New York State Turfgrass Association, at (518) 783-1229, nysta@nysta.org, www.nysta.org.

Denise Lewis
NYSTA

Scanning the Journals

Results of the calcium study indicated that regardless of the source or scheduling of Ca applications, there were no effects on tissue Ca levels.

Carpet fibers and ground up sneakers reduced bulk density (less compacted) while Turfgrids and Netlon increased bulk density (more compacted). Generally, as turfgrass wear increased, treatments that lowered bulk density showed smaller increases in surface hardness.

Do You Need More Calcium?

Surveying the turf industry these days there appears to be a renewed interest in applying calcium. Many turf managers believe that supplemental calcium is required on sand-based rootzones with low cation exchange capacity (CEC) or because calcium might not be soluble. Others justify calcium applications from soil testing that utilizes the base cation saturation method of interpreting soil test results. In either case there is limited data to support widespread calcium use.

Iowa State University researchers conducted an experiment on creeping bentgrass (L-93) growing on a calcareous sand green (defined as having 1-40% free carbonates, pH 7.3 to 8.5). It has been suggested that while this green is calcareous, the calcium is not available and growing turf would benefit from calcium applications. To address this recommendation, four pounds of calcium per 1000 sq. ft. were applied at various frequencies and via $CaCO_3$, $CaSO_4$, $Ca(NO_3)$, and Nutri-Cal liquid calcium chelate. The turf and soil were sampled to determine the Ca and other nutrient levels.

Results of this study indicated that regardless of the source or scheduling of Ca applications, there were no effects on tissue Ca levels. In addition, the researchers observed no effect on the tissue content of any other nutrient, except for an 11% increase in Mg with $CaSO_4$ in one year. Finally, while there are well known Ca-P interactions associated with high pH the researchers observed no Ca-P interaction in this study.

One important aspect of this study was the issue of proper soil nutrient extractant for soil testing purposes. If your soils are highly calcareous then any use of the ammonium acetate method with result in errors in recommendations. Based on several recently published studies in turf and vegetables the increased use of Ca does not appear to be beneficial.

From: St. John, R.A., N.E. Christians and H.G. Taber. 2003. Supplemental calcium applications to creeping bentgrass established on calcareous sand. Crop Sci. 43:967-972.

Turf Reinforcement for Safety

Increased traffic on sports fields has increased the need for improved drainage. The immediate response to improving drainage has been the advent of sand-based athletic fields modeled after putting green construction. However, a significant and often overlooked distinction is the stability requirement for traction and safety on sports fields that is not required on putting greens. Still, little is known about what would enhance stability and what the increased stability would do to other soil properties, notably drainage and hardness.

Penn State University researchers Andy McNitt and Pete Landschoot investigated the use of several types of reinforcing materials on field hardness and soil physical properties. They tested DuPont shredded carpet, Netlon, Nike Reuse-a-shoe (lights and heavies), Turfgrids, and Sportgrass. Inclusion amounts in sand based systems were based on current industry standards.

Surface hardness and soil bulk density were found to be correlated in the 2 years of the study. The carpet fibers and the ground up sneakers reduced bulk density (less compacted) while the turfgrids and netlon consistently increased bulk density (more compacted). In general, as turfgrass wear increased, the treatments that lowered soil bulk density usually showed smaller increases in surface hardness.

The researchers concluded that Netlon, Turfgrids and Sportgrass under traffic resulted in higher surface hardness values than what would be considered unacceptable for safety. What this study did not investigate was the common practice of including small amounts of soil or fine particles into a sand rootzone. This would be a interesting complement to this current study.

From: McNitt, A.S. and P.J. Landschoot. 2003. Effects of soil reinforcing materials on the surface hardness, soil bulk density and water content of a sand root zone. Crop Sci. 43:957-966.

Broadleaf Weed Management

continued from page 1

Concern about the potential for cancer and lymphoma, which may be linked with repeated applications of 2, 4 D, has resulted in greater interest in new chemistries for broadleaf control.

However, the application of dicamba at high concentrations can be a real problem around well-established ornamentals in that penetration into the rooting zone of trees and shrubs can result in death and injury of expensive ornamental plantings.

postemergent products is often limited. Timely irrigation before application may be helpful to ensure adequate uptake.

Active Ingredients

Many postemergent broadleaf herbicide products contain two or more active ingredients to enhance the overall spectrum of weeds controlled by the product. Most of these products contain two or more of the following active ingredients: 2,4-D, dichlorprop, MCPA, MCPP, dicamba, triclopyr, and clopyralid. All of these herbicides are considered to have growth regulatory effects, meaning that they act as synthetic auxins or growth regulators when taken up by the plant, resulting in overstimulation of growth, and twisting or deformation of foliage. This 'epinasty' or deformation eventually results in the death of the plant as the vascular system is destroyed (see photo below).

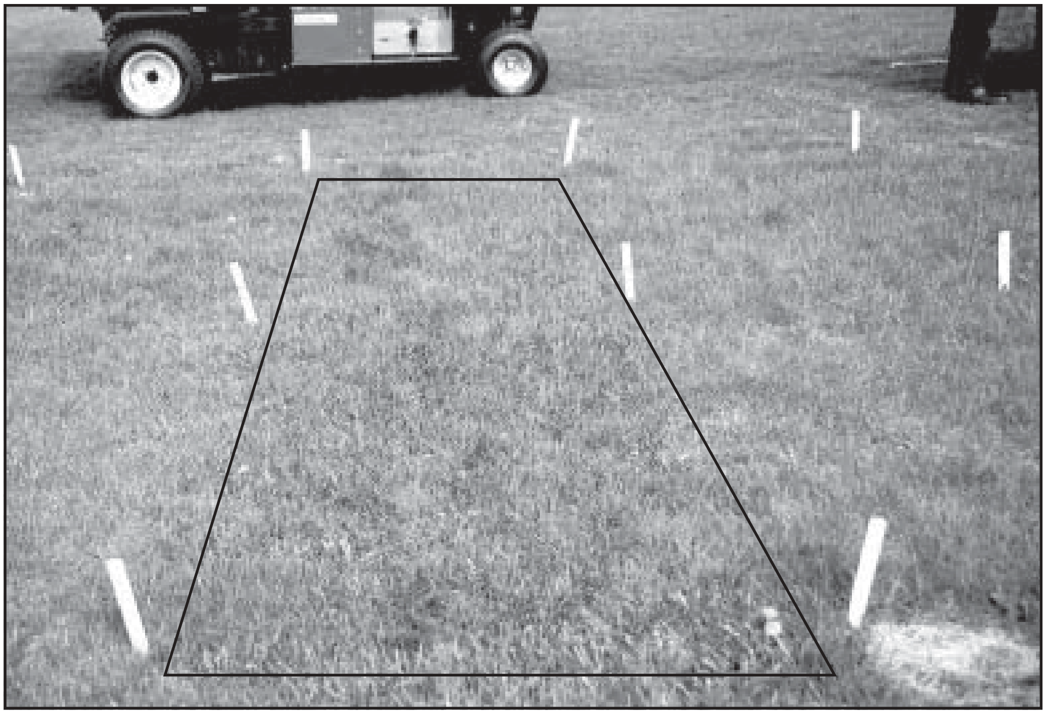
Although these phenoxy herbicides have a similar mode of action in the plant, their effectiveness on broadleaves varies depending on the ability of some weeds to metabolize the particular phenoxy herbicide before killing the plant. Many of you are familiar with this problem, when applying 2,4-D-containing products to turfgrasses infested with deeply rooted weeds such as broadleaf plantain, perennial buttercups or thistles, which can often effectively metabolize these herbicides. Concern about the potential for cancer and lymphoma, which may be linked with repeated applications of 2, 4 D, has resulted in greater interest in new chemistries for broadleaf control.

Within 2,4-D-product mixtures, one often finds MCPA and MCPP, both phenoxy acid herbicides. They are combined with 2, 4 D because they are active on clovers and chickweeds in particular, and enhance the weed control spectrum of 2, 4 D. Dicamba is a benzoic acid herbicide with a similar growth regulator type mode of action. It is active upon many broadleaf weeds, including summer annuals such as knotweed, spurge and purslane, and also certain perennials including plantains and ground ivy. Many of these 3-way product formulations have small percentages of dicamba and do not completely control ground ivy or other perennials which require higher concentrations of dicamba for complete management. However, the application of dicamba at high concentrations can be a real problem around well-established ornamentals in that penetration into the rooting zone of trees and shrubs can result in death and injury of expensive ornamental plantings.

Triclopyr and Clopyralid

Triclopyr and clopyralid—and combinations containing these products—have been labeled for use in turf in New York over the past few years. Both these herbicides are classified as pyridinoxy acids and control many weeds that 2, 4 D and other phenoxy herbicides do not ef-

Epinastic growth (curling) typical of injury by phenoxy-based herbicide.



2,4-D and triclopyr activity on ground ivy applied at full bloom.

fectively manage. Triclopyr is effective on oxalis, ground ivy and small-seeded legumes and is often sold in combination with 2, 4 D, MCPA or clopyralid. Triclopyr can be safely applied to both warm and cool season grasses at low rates, but should be carefully applied on bentgrass and warm season grasses at higher rates as injury will result.

Clopyralid will provide good control of such weeds as clover, thistle, pineapple weed, perennial buttercups, and dandelions. Clopyralid and products containing clopyralid, such as Confront and Millenium, can be a problem when considering residual activity of the herbicide in mulches and manures. Because of this problem, clopyralid is no longer available for use in residential lawns. After the herbicide is applied to lawns or pasture, it can wind up in clippings or in animal manure that may be further composted.

Due to the persistence of the herbicide, which does not break down as rapidly in the composting process as expected, the herbicide can remain active in the compost for up to 18 months, leading to unexpected toxicity when compost is applied to ornamentals or garden plants. This problem has been observed in Washington, California and a few other states in the US applying municipal compost to gardens. Due to these concerns, Dow has been working with our research team and others across the US to study the activity and development of fluroxapyr as a clopyralid replacement in turf and ornamentals. This product may well be labeled in NY in the near future.

Other Products

Other products that were recently labeled for turf use in NY include metsulfuron (Escort) and chlorsulfuron (Lesco TFC), both initially manufactured by DuPont but now reintroduced by Riverdale as Manor and Corsair. In NY, metsulfuron (Escort) can only be used on industrial turf for control of broadleaf weeds. Both metsulfuron and chlorsulfuron belong to the sulfonylurea family of herbicides, which have extremely low toxicity to animals but are highly toxic to susceptible weeds at very low rates.

These products control establishments of wild garlic, onions, ryegrass, tall fescue, and other undesirable grasses as well as numerous broadleaf weeds. They are often spot applied to remove these infestations and in the southern US metsulfuron tends to be widely used for weed management in warm season turfs due to the tolerance St. Augustine grass exhibits with this herbicide. Unfortunately, repeated applications of both metsulfuron and chlorsulfuron, when used in other cropping systems, have resulted in the appearance of sulfonyl urea resistant weeds.

Carfentrazone

Of great interest to NY turf managers has been the recent introduction and labeling of the

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Proper Management Prevents Compaction

Soil compaction is defined as the pressing together of soil particles, resulting in a more dense soil mass with less pore space. The size and organization of soil particles is a determining factor when considering the amount of compaction that might occur. Finer particle silt and clays are more easily pressed together, but improper sand based mixtures with an array of particle sizes and shapes can be equally susceptible when a heavy load is applied. Ultimately, it is vital to understand the consequences of compaction, as many of the cause are unavoidable.

Soil Under Foot

Researchers have investigated the difference in compaction associated with vehicular or foot traffic. Regarding foot traffic, the speed of the traffic event and the weight per unit of contact area are important factors in assessing the overall compaction. For example, a crew member running on a putting surface exerts 38 times more compaction than if they were walking. In addition, a street shoe with a larger surface area has 25 times less compacting force than a cleated shoe with a smaller surface area. What types of shoes are the crew members wearing on the putting greens when they are walk-mowing?

Vehicular traffic involves the vertical force of a moving tire, sheer stress from slippage and vibration. Studies have shown that large, wide tires increase the depth of soil compaction as compared to lighter vehicles with narrow tires. Starting and stopping that creates slippage increases the compaction, yet increasing speed from 1 to 3 miles per hour without slippage decreased compaction 50% in the top two inches of soil.

Squeezing the Plant

A turfgrass surface significantly absorbs and dissipates the force of compaction and yet the effect of compaction on turf growth is difficult to diagnose. Still, the compaction of the soil will ultimately influence the health of the turf by reducing soil aeration, altering plant and soil moisture relationships, or soil temperature. Obviously, there are significant effects on root growth, but shoot growth is also influenced as nutrient and water uptake is altered. Physiologically, there are several studies that reveal how compaction reduces energy reserves, increases canopy temperature and increases disease incidence.

The most critical of all consequences to compaction is the reduction in soil oxygen level. Interestingly, the distribution of rooting is one

Severely compacted areas are not able to sustain healthy turf.

Program Spotlight

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of the most critical factors. Under compacted soil conditions, roots appear to be confined to the surface. In fact, Bob Carrow at the University of Georgia reported 20% more surface rooting when soil was compacted and significantly fewer deeper roots. He speculated that reduced oxygen levels were a factor, but more important was the energy the plant must expend to “squeeze” through the tighter soil matrix. Consequently, when compaction persists in the summer, plant energy levels are reduced 25 to 50%! This information is vital when considered with the recent research conducted at Kansas State that reports severe declines in energy are the cause of bentgrass summer decline.

Poa Paradox

The lack of oxygen in compacted soils often translates to increased water holding. Several studies have seen increased root and shoot growth as a result of improved moisture relations. In addition, turfgrass water use, measured as evaporation from the soil and transpirational water loss from the plant (evapotranspiration) decreases as compaction increases. Still, it is common to see turfgrass managers apply additional water to compacted sites. This might be due to low infiltration rates, thin turf that leaves the soil exposed and increases evaporation, and a perceived lack of growth that is often met with additional water.

Creeping bentgrass tolerates extremely saturated soil conditions. In most wet areas on northern courses, it is the predominant species. In fact, many park systems that flood areas for skating rinks, seed creeping bentgrass because it is the only plant that will survive under water and ice. When the soil is saturated with water, the soil pores are filled and little air is available. This is also true when the soil is compacted and smaller pores hold water and in general the soil lacks oxygen. Yet, in these compacted situations, annual bluegrass is more competitive and survives where creeping bentgrass will not. How can this be?

Air pores in the plant that connect the root to the shoot might be crushed in bentgrass on compacted sites and not in annual bluegrass. This “crushing” prevents bentgrass from oxygenating their roots from the surface. This could be an important consideration with regard to the new air injection systems, should they be capable of forcing oxygen into the rootzone and favoring bentgrass growth.

The Fix

Once the soil becomes compacted, there are limited short-term solutions that will provide relief. If the sand content can be increased from 70 to 90%, water infiltration will increase 20-fold. Once the sand becomes the major component of the rootzone, bridging between particles occurs and theoretically the sand creates larger pores and a rigid matrix resistant to compaction. However, this will take a decade or more with less than aggressive procedures. Remember, a core cultivation unit setup with 0.5 in. tines on 4 in. spacing at normal speed only affects 5-8% of the soil surface. Therefore, golfers who see superintendents “burying” the green with sand must realize how little is accomplished at each event. This argues further for building right and managing it properly to avoid compaction problems.

There has been a considerable amount of sports turf research conducted on synthetic fiber—for example, plastic fibers, ground up Nike sneakers, carpet fibers, and crumb rubber—inclusion in sand to improve stability and reduce compaction, while maintaining infiltration. Most of the work has explored various percentages of the material incorporated into the sand. While stability is important for putting greens, there is a wide range of specifications that can provide what is needed. However, tee areas or heavily trafficked practice greens might consider some of this technology to enhance surface stability, compaction resistance and improve a turf’s conditions.

Taming the Tiger Effect

As with all challenges on the golf course, the first step is awareness and recognition of the problem. Compaction is often referred to as the hidden stress. Understanding the effects on rooting and overall turf health may explain why certain areas suffer more than others do. Short-term solutions such as core cultivation and soil amendment address only the symptoms of the problem: low soil aeration and poor infiltration. Long-term solutions are severely disruptive and might limit an already short golf season. Consequently, prevention is the best option.

Know your soils or sand, by having them physically analyzed in an attempt to understand their likelihood for compacting. Maintain a dense turf through proper management, rec-

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Broadleaf Weed Management

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carfentrazone-based products. Carfentrazone (also known as Quicksilver) has been produced and used for weed management in cereal crops in Europe and in combination with other herbicides for use along utility lines and rights of way. FMC is now marketing this product for use alone in warm and cool season turfgrasses for broadleaf weed management, and Riverdale is marketing it in combination with other products (including 2,4-D, MCPA, MCPP and dicamba).

Carfentrazone applications result in rapid weed control, with results often seen within hours after application. Complete control of certain perennials was noted in up to 7 days after application. Speed Zone and Power Zone are two new products which contain carfentrazone plus MCPA, MCPP, and dicamba or 2,4-D, MCPP and dicamba, respectively. Both of these products are marketed by Riverdale and enhance the spectrum of activity of carfentrazone for broadleaf weed management. These products excel in cool weather control so applications can be made in early spring and the products are rain-fast in as little as 3 hours after application.

Power Zone is particularly effective at controlling clover, dandelion, ground ivy, and spurge in turfgrass. Carfentrazone is remarkable in that it is particularly fast acting, non persistent in the soil, and apparently not associated with the development of any herbicide resistance to date. Upcoming formulations of carfentrazone may include combinations with newer chemistry such as clopyralid and fluroxapyr. We are currently working with both FMC and Dow to evaluate these product combinations for greatest efficacy. It has been reported that carfentrazone plus phenoxy-product combinations may exhibit additive or synergistic effects when combined in comparison to each product applied separately. We are currently evaluating these mixtures to determine if this is a possibility.

This fall I will be releasing a new website for weed management in turf and ornamentals which will contain articles, references, many photographs, and web-based publications which describe the latest in both chemical and alternative forms of weed management. Hopefully you will find this tool helpful to logically select an effective weed management program for your landscape setting.

Leslie A. Weston, Ph.D.

Table 1. Description of Broadleaf Postemergent Herbicides Now Available for Use in Turf in New York State.

Product	Mode of action	Soil persistence	Rapidity of control
2,4-D	growth regulator	limited	moderate
dicamba	growth regulator	moderate	moderate
triclopyr	growth regulator	moderate	rapid
clopyralid	growth regulator	long	rapid
metsulfuron	inhibitor of branched chain amino acids	long	moderate
chlorosulfuron	inhibitor of branched chain amino acids	long	moderate
carfentrazone	PPO inhibitor	none	very rapid

Preventing Compaction

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ognizing that a dense turf absorbs and dissipates much of the compactive forces. Most importantly, manage the traffic by regularly moving the cups and tee markers, and scatter golf cart traffic. Consider moving them more than once a day if heavy traffic is expected with non-tournament play. Communicate these issues with architects and golf professionals so that they understand the importance of dispersing traffic by providing large tee areas and copious amounts of cupping space. In the end, the Tiger Effect equals compaction that must be tamed!

Frank S. Rossi, Ph.D.

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Why not invent a sprinkler head that can adjust its geometry and flow? Doesn't the golf industry need a "smart-head"? Consider the idea that one head can be programmed and adjusted to deliver the amount of water at a desired flow rate to a specific area without irrigating the entire complex.

"Soil moisture monitoring is the final frontier in golf turf irrigation," proclaims Paul Roche, the irrigation manager for the S.V. Moffett Company in Rochester, NY and coauthor of the new book, Golf Course Irrigation: Environmental Design and Management Practices.

Efficient Irrigation

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to provide maximum flexibility for delivery. Tim O'Neil, CGCS, the current Secretary/Treasurer of the GCSAA and superintendent at the Country Club of Darien, CT, increased the number of heads from 240 to 1200 when the 40 year old system was replaced in 2002.

Increasing the number of sprinklers has been a growing trend in irrigation systems for the last 15 years beginning with a variety of heads around putting greens. Obviously, the putting green will need to be irrigated differently than the surrounds. Within the surrounds the bunker capes may require additional irrigation due to the proximity of the sand. Also, many courses that grow creeping bentgrass in the southern US have installed "mist" heads dedicated to frequent, cooling irrigation cycles.

Adding up the heads around the greens, one could find in excess of 30 heads. Each head requires some level of care and maintenance when considering its exposure to mowers, particles and poor water. Not only is this expensive to design and install, but to maximize efficiency it must be properly maintained.

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Sensing Water

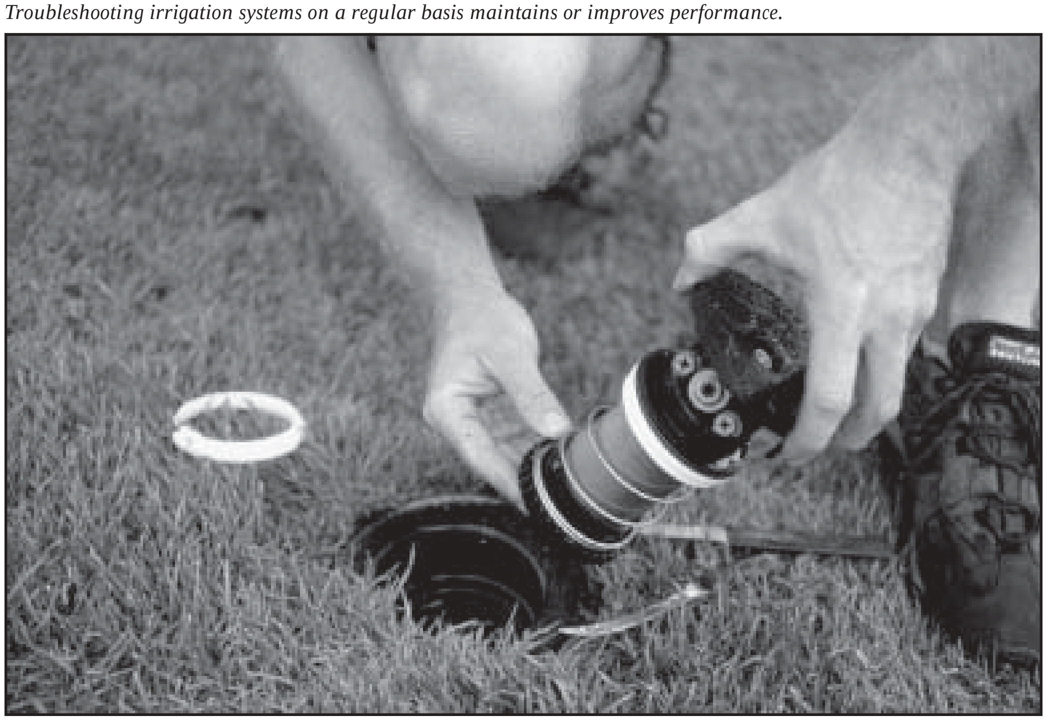
Will the sprinkler head or irrigation system of the future "sense" where the water is needed? "Soil moisture monitoring is the final frontier in golf turf irrigation," proclaims Paul Roche, the irrigation manager for the S.V. Moffett Company in Rochester, NY and coauthor of the new book, *Golf Course Irrigation: Environmental Design and Management Practices* (Wiley, 2003, 452pp).

Interestingly, in the new irrigation text the authors said, "Soil moisture sensors have not been used successfully in golf irrigation systems." The one paragraph devoted to this issue explains that the obstacles to proper monitoring are the soil differences on a course and at what depth to measure moisture that would represent an irrigated area.

Professor Carrow discussed his current research with colleagues in New Zealand who have developed a system for measuring soil moisture at several depths with a single device. Carrow presents this research at the website he developed, http://www.turfgrasswater.com. In addition, the site provides the latest research on irrigating turf and links to important information on irrigation design, maintenance and installation.

The goal of developing and using the soil moisture probes would be to have the capacity

Troubleshooting irrigation systems on a regular basis maintains or improves performance.



to measure at several depths in several different soils. This would permit modeling approaches to predict soil moisture gradients and, depending on your turf root system, determine the need for irrigation across soil types and locations. Ultimately, it would be useful to have as few moisture probes in the ground to minimize cost and care.

Delivery-Minded

When W.A. Buckner developed the first slow-rotating hoseless sprinkler system and installed it at Pebble Beach Golf Club in 1912, it would have been hard to imagine how far systems would come. Yet, as far as we have come with technology using poor quality water and design, there is still a human aspect to delivering water.

"I am always considering how much water the turf can do without," states Mike Saffel, golf course superintendent at the Powder Horn Golf Club, Sheridan, WY. Saffel continues, "I spend the bulk of my time on my course considering irrigation needs so I can use my water as efficiently as possible."

Erick Holm, CGCS, the former Superintendent of the Onondaga Golf and Country Club in Fayetteville, NY (now at Hop Hollow CC, CT) was able to integrate the latest technology (science) with his feel (art) for golf turf irrigation.

Erick went from limited flexibility with irrigation zones and heavy reliance on hand watering to maximum flexibility with less need for hand watering. The old irrigation system had six heads per zone while the new system provided individual head control. In two summers with similar weather conditions and different irrigation systems Onondaga reduced the amount of total man-hours for hand watering from 290 to 85.

Future

If we agree that golf courses should not be using potable water, then system design and operation are critical. "Improvements and upgrades are the first step," says Ali Harivandi, Environmental Horticulturist for the University of California Extension Service, quoted in the June 2003 *Golf Course Management* magazine. "Salts and other contaminants accentuate problems from poor system performance," he continues, "a complete system audit is required."

What will it take for all golf courses to embrace the approaches espoused by Saffel and Holm? KSU Professor Fry argues that it might be an economic motivation, some might say it will need to be regulated before widespread behavior changes and still others might become "delivery-minded" because of environmental concern.

Regardless of the motivation, the golf turf industry needs to get out in front on this issue. The demand should resonate from irrigation companies through regulators and down to the end-users. Simply having the latest technology is not a guarantee of efficiency, it is just one step toward a new behavior.

Frank S. Rossi, Ph.D.

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CUTT

A Healthy Ecosystem

Four of the five listed BMP's do not involve use of an irrigation system, but rather feature designs for uniform application of water, proper installation and maintenance for optimum performance.

Practicing Efficient Irrigation

"Water use will be the dominant issue for the next generation of golf turf managers," proclaimed Professor Bob Carrow, University of Georgia, at the 2003 New England Turfgrass Conference. Following this proclamation Carrow focused the remainder of his presentation not on agronomic aspects of water use, but rather on irrigation system performance.

The Irrigation Association agrees with Carrow and states the details of the attention to irrigation system design, installation and maintenance in their 2002 draft publication, "Irrigation Best Management Practices (BMP)," available at http://www.irrigation.org. In fact, four of the five listed BMP's do not involve use of an irrigation system, but rather feature designs for uniform application of water, proper installation and maintenance for optimum performance.

"Water providers have little empathy for superintendents," states Professor Jack Fry of Kansas State University, "who manage inefficient irrigation systems." In fact, Fry discusses the effect of poor water distribution in terms of dollars. He outlines the process used by the city of Wichita, KS where they charge golf courses that stay within the agreed upon water use goal about $520.00 per acre-foot of water. However, when courses exceed the use expected, the cost increases to almost $800.00 per acre-foot.

The mantra of many superintendents who work where rainfall is abundant, is "I'd rather have it dry so I can control the amount of water applied." Yet the best irrigation system under ideal conditions delivers only 80% uniformity values. In the real world, most golf courses do not have state of the art systems and, even if they do, it is not likely they are being used to their potential. What will it take to change behavior and practice efficient irrigation?

More Heads?

The first guideline of the Irrigation Association BMP's for designing an irrigation system states, "Obtain direct knowledge of site conditions and not rely solely on plot plans to generate a design." More specifically, this point is considered in guideline #17, that requires a thorough evaluation of the physical, environmental and hydraulic site conditions, including typical wind patterns before siting sprinkler heads.

It follows then that if site-specific irrigation is synonymous with improved efficiency, irrigation systems will need more sprinkler heads

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