CORNELL UNIVERSITY TURFGRASS TIMES

CUTT

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Good News, Bad News

There is a good news/bad news scenario playing out for golf course superintendents. A recent survey asked golfers who play at least twice per month what are the most important factors that contribute to their enjoyment during a round. It suggests that more than the score they shoot or who they are playing with, good greens, well maintained bunkers, tees and fairways make their experience worth coming back for.

We are no longer the "overalls and work-boot gopher chasers". It appears that golf superintendents are now recognized as key people in the game. Nevertheless, I am worried that we could become a victim of our own success and we are missing a chance to grow the game.

Who Says?

The "core golfers" who were surveyed for the Golf 20/20 Study represent less than five percent of the entire U.S. golfing community. Clearly these people are the economic drivers of the game. They are folks who buy expensive equipment, pay high-end greens fees and watch golf on television.

However, many of these folks are the golfers at our facility who complain endlessly about slow greens, bunker conditions, fairway roll, etc. These are the vocal minority who we invest a disproportionate amount of time catering to and whom we lament at every chance.

I argue while providing high quality course conditioning is our goal, we must be realistic. I am concerned that while we are "patted on the back" by one hand, the other hand pokes us for increasing (and unrealistic) course quality at a time when we are pushing the biological limit of our system.

The pursuit of fast greens and perfect bunkers is not sustainable. Now that we know what pleases our customers and they know we are the ones who provide it, shouldn't we start a dialogue with them? I believe there is a happy medium that will keep them satisfied and also be realistically achieved. By reaching this balance, we will not only maintain our support but expand it as well.

If the golf industry intends to be healthy and hopefully expanding by 2020, we need to attract more new golfers. Now that we know we are pleasing our core customer base, it is time to start asking why more people are not playing golf. It's time to see if there are aspects of golf course management, such as environmental stewardship and faster play, that will attract new golfers.

What?

Honestly, I am as confident as ever that the golf industry is improving its environmental stewardship every year. Just like the ubiquity of high quality conditioning previously reserved for high-end courses, environmental stewardship is everywhere as well.

One way to start marketing our environmental stewardship is by adopting an "organic" label. Yes I said it. I think we need to have organic standards at various levels and have courses labeled organic. Will this path be wrought with peril? No more so than production agriculture was and is now co-existing as traditional and organic.

In fact, I think golf can do it better than agriculture because, with Audubon

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This Times

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Editor: Frank S. Rossi, Ph.D.

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Clippings

Eshenaur, a former educator with Cornell Cooperative Extension in Monroe County, led a horticulture program with a long-standing reputation for excellence.

CORNELL Turfgrass

Distance Learning from Cornell

Cornell Golf Pest Management Course
January 24-26, 2007
Cornell University Campus

Brian Eshenaur Is New IPM Ornamental Educator in New York State

Brian Eshenaur, M.S., has been hired as the Western New York ornamental IPM educator with the New York State Integrated Pest Management (IPM) Program.

Eshenaur, a former educator with Cornell Cooperative Extension in Monroe County, led a horticulture program with a long-standing reputation for excellence. He built his reputation on accurate diagnoses—the lab processes about 30 a week—that identified not just run-of-the-mill disease pests but the oddball cases that stump most practitioners. But his outreach to dozens of nursery and landscape care professionals throughout Monroe County's heavily populated cities and suburbs sealed it.

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NYSTA Citation of Merit Winner, Sherwood Moore, CGCS, Receives Honorary Doctor of Science Degree

(NYSTA wishes to extend our condolences to the family of Sherwood Moore who passed away on July 29 at the age of 90.)

NYSTA member and Citation of Merit award winner, Sherwood Moore, CGCS, was honored on May 27, 2006, by the University of Massachusetts at their Stockbridge School commencement with an honorary Doctor of Science degree. Mr. Moore is the first person to receive an honorary degree from the Stockbridge School. According to the school's official announcement, he is considered to be the greatest golf course superintendent of our time. Moore was recognized for his lifelong commitment to promoting the golf course superintendent profession. He has served as an articulate spokesman, written numerous articles, and mentored many students who have gone on to become outstanding superintendents.

Sherwood Moore graduated in 1937 from the Stockbridge School of Agriculture at what was then Massachusetts Agricultural College and participated in the Winter School for Greenskeepers and Golf Course Foremen. This program was the first of its kind in the

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Cornell Golf Pest Management Course

January 24-26, 2007
Cornell University Campus

Instructors include specialists from Cornell University, Frank Rossi, Dan Peck, Dave Hicks, Jennifer Grant; the University of Massachusetts, Pat Vittum; Cook College, Rutgers, Bruce Clarke and Rich Buckley and the USGA, Dave Oatis.(**Credits:** Continuing education credits will be offered including NYS Pesticide Recertification Credits and GCSAA credits.(**Course Schedule:**(Day 1: Introduction and Managing Turf Insects(Day 2: Managing Turf Weeds, Dealing with Annual Bluegrass and Turf Pest Diagnostics(Day 3: Managing Turf Diseases and Special Pest Management Topics(**Questions?** Contact Joann Gruttadaurio, at 607-255-1792, or jg17@cornell.edu(

Improving Irrigation Efficiency

Turfgrass irrigation is often the most imprecise aspect of management systems. Not only are there inherent inadequacies in most irrigation systems but also there are a variety of biological variables, such as grass species and pest management.

Researchers at Rutgers University conducted a study to determine how "little" water you could apply and maintain acceptable turfgrass health and quality. Fairway maintained creeping, colonial and velvet bentgrass were irrigated at 100, 80, 60 and 40% of measured evapotranspiration (ET). The researchers collected data on the amount of soil water lost, the water use efficiency (amount of energy produced by the plant per unit of water consumed), and turfgrass quality.

Interestingly while all three species are bentgrass, there were significant differences in their water use. In fact, colonial bentgrass was the least drought tolerant and largest water user compared to creeping and velvet bentgrass. There was some evidence that the lower shoot density, rapid leaf extension and more upright leaves of colonial bentgrass contributed to its water use characteristics when compared to velvet bentgrass.

In addition to the species variability there was a significant seasonal effect on water use and irrigation needs. All species performed well during the summer months when irrigated to 60 to 80% of ET and in the fall the species performed well when irrigated to only 40% ET.

The researchers concluded that velvet and creeping bentgrass species are more efficient in water use compared to colonial bentgrass. This is important information as more turfgrass managers are seeking biological (grass type) and technological (irrigation systems) solutions to reducing overall water use while maintaining turfgrass quality. *From: DaCosta,M and B.Huang. 2006. Deficit irrigation effects on water use characteristics of bentgrass species. Crop Science 46:1779-1786.*

Preventing Turf Winterkill

A significant amount of turf dies each year from injury sustained during the winter months. Of all the managed turf, annual bluegrass seems to sustain the worst injury and coupled with its omnipresence on golf courses and sports fields, winter kill events can be catastrophic for an operation.

Over the last decade Canadian researchers have been investigating aspects of winter injury of annual bluegrass. Studies have focused on physiological aspects of dormancy and hardiness as well as understanding the role of winter protective covers. A recent study conducted in Quebec explored the role of soil organic matter as a contributory factor in winter injury.

The study focused on the difference in recurrent injury on native soil greens with high organic matter levels and sand-based greens constructed to USGA specifications. Oxygen levels were measured under a variety of protective covers that included felt, straw mulch, wood shaving mats, or clear polyethylene cover over wood shaving mat.

There were significant differences in oxygen consumption under the various covers and there was also recurrent damage to greens that could not be explained by ice encasement, disease, freezing temperatures or excess water. However there was a clear relationship between soil respiration rates (an indication of microbial activity on organic matter) and winter damage, i.e., the more organic matter the more winter injury.

The use of impermeable covers has been shown to be an important aspect of preventing winter injury to turf, especially regarding ice accumulation. Maintaining a dry surface during winter will enhance survival, however the oxygen consumption under these covers by soil organisms appears to be lethal and exacerbated on native soil greens. It is recommended that new sand based greens be constructed to reduce the incidence of winter injury or provide for ventilation under the protective covers to prevent anoxic conditions. From: *Rochette,P.,J.Dionne,Y.Castonguay and Y. Desjardins. 2006. Atmospheric composition under impermeable winter golf green protections. Crop Science 46:1644-1655.*

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Scanning the Journals

Turfgrass irrigation is often the most imprecise aspect of management systems. Not only are there inherent inadequacies in most irrigation systems but also there are a variety of biological variables, such as grass species and pest management.

The use of impermeable covers has been shown to be an important aspect of preventing winter injury to turf, especially regarding ice accumulation.

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Program Spotlight

Preliminary studies conducted at Cornell University have suggested certain microbial-based products have the potential to reduce overall nitrogen use.

Microbial inoculants have been shown to improve nitrogen use efficiency in agricultural crops however this has not been well documented for turf.

Preliminary Evaluation of Reduced Nitrogen Fertility with Microbial Inoculants

Introduction

Preserving water quality is a critical issue facing the golf turf industry. For many years, research has focused on the fate of pesticides and nutrients applied to turf to understand the potential risk to water quality. The majority of studies to date have concluded that when used properly, fertilizers and pesticides do not pose a significant risk to water quality.

A recent study has raised concerns regarding nitrogen leaching from a mature stand of fairway turf when high fertilizer rates are maintained. It could be inferred from this research that preservation of water quality on golf courses demands we investigate strategies to reduce nitrogen use rates while maintaining high turf quality.

Microbial inoculants have been shown to improve nitrogen use efficiency in agricultural crops however this has not been well documented for turf. Preliminary studies conducted at Cornell University have suggested certain microbial-based products have the potential to reduce overall nitrogen use. Therefore, the goal of this project is to evaluate the effect of Advanced Microbial Solutions SuperBio SoilLife in combination with reduced rates of fertilizer on turf growth and quality.

Methodology

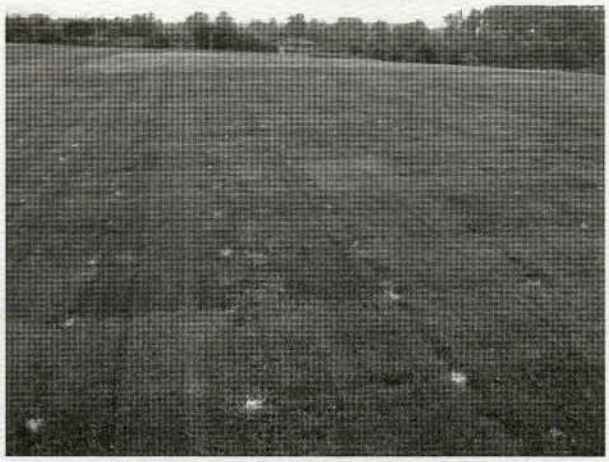
Two John Deere fertilizer products (8-0-8) with and without SuperBio SoilLife were applied at three rates in a completely randomized experiment with three replications (Table 1). Experimental plots (4' x 3') were established at the Cornell University Turfgrass Research Center in Ithaca, NY on a mixed stand of creeping bentgrass (*Agrostis palustris* "Putter") and annual bluegrass soil-based fairway turf (pH

Table 2. Effect of fertilizer with and without SuperBio Soil Life on turfgrass quality ratings.

Treatment	N rate	5-Aug 5DAT	18-Aug 18DAT	26-Aug 26DAT	9-Sep 40DAT	23-Sep 54DAT	4-Oct 8DAT2	7-Oct 11DAT22	21-Oct 5DAT2
8-0-8	1	7.7	7.0	7.4	6.6	7.5	7.2	7.6	8.1
8-0-8 + SL	1	7.8	6.9	7.6	6.7	7.5	6.9	7.4	7.7
8-0-8	0.8	7.2	6.9	6.7	6.7	6.0	6.6	7.3	6.5
8-0-8 + SL	0.8	7.3	6.9	7.3	6.8	6.8	6.8	7.3	6.9
8-0-8	0.4	6.6	6.7	6.2	6.7	5.6	5.9	7.2	6.6
8-0-8 + SL	0.4	7.3	7.2	6.8	6.8	6.4	6.4	7.2	7.2
LSD (p=0.05)		0.3	NS	0.4	NS	0.3	0.3	0.2	0.2

= 6.5). The plots were mowed three times per week at 0.5 inches.

Applications of the granular fertilizers were made on August 1 and September 26. Prior to the study, the plots had received 1.5 lbs N, 0.3 lbs P and 1.5 lbs K per 1000 ft^2 in three applications that ended on July 1. The plots were managed to championship turf conditions with bi-weekly topdressing, regular irrigation to prevent stress and curative pest management.



Average daily temperatures for August and September ranged from a high of 79.6° F (26.4° C) and a low of 54.7° F (12.6° C). Precipitation during this period was approximately 2.3 inches below normal. The four months of June through September were the warmest such period on record, averaging 4.2 degrees warmer than normal. Precipitation was below normal; 38% of normal for July, 83% for August and 55% for September.

Data was collected for turfgrass quality on a 1 to 9 scale (where 1=poor quality turf, 6=acceptable quality turf and 9= excellent turf), clipping production and tissue nutrient content. Data analysis was conducted using linear mixed models with compound symmetric covariance structure to assess overall treatment effects when repeated measurements were made on the same experimental unit over time. Treatment differences at individual measurement events were evaluated using analysis of variance and Fisher's protected least significant difference (LSD). The MIXED and GLM procedures in SAS/STAT software version 9.1 (SAS, Cary, NC) were used to perform the analyses.

Results

Turf Quality

In general turfgrass quality ratings remained above acceptable for the entire length of the study except for one treatment on two rating dates. The ability to maintain acceptable turf quality at 40% normal nitrogen rates when blended with Soil Life demonstrates an important response.

When averaged over the 12 weeks of the study, the 1 lb treatment with and without Soil Life had significantly higher turf quality ratings than the other two rates with and without Soil Life (see Addendum). However, the 40 and 80%

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Table 3. Effect of fertilizer with and without SuperBio Soil Life on clipping production.

		Clipping Wt (grams)	
Treatment	**N rate**	**21-Sep7WAT**	**31-Oct5WA2T**
8-0-8	1	4.8	19.6
8-0-8 + SL	1	3.4	18.5
8-0-8	0.8	3.4	19.2
8-0-8 + SL	0.8	4.8	15.9
8-0-8	0.4	3.7	18.3
8-0-8 + SL	0.4	3.3	17.5
LSD (p=0.05)		NS	NS

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Program Spotlight

The ability to maintain acceptable turf quality at 40% normal nitrogen rates when blended with Soil Life demonstrates an important response.

On almost every rating date for the lower N rate treatments, the Soil Life additions improved turf quality.

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N treatments demonstrated a significant benefit of using Soil Life where in each case the treatment with Soil Life had significantly higher turf quality when averaged over the 12 weeks of the study.

The 1 lb. rate had significantly higher turf quality ratings independent of Soil Life at 53 days after the first treatment. In addition, turfgrass quality ratings remained significantly different throughout the latter part of the study. There was a significant separation between the 1 lb. treatment and all other treatments, but very little difference among the lower N rate treatments except on the last rating date. Still, on almost every rating date for the lower N rate treatments, the Soil Life additions improved turf quality.

Clippings

Clippings were collected seven weeks after the initial treatment, and five weeks after the second treatment. There were no significant differences among treatments on either collection date (Table 3). In addition, while clipping production on October 31 was significantly higher for all treatments than on September 21, there were no differences among the treatments when averaged over both dates.

The lack of effect of nitrogen rates on clipping production is telling albeit not consistent with turf quality responses, i.e., higher N rates typically provided higher quality. First it suggests there is a uniform growth response to all fertilizer treatments that appears to persist for up to seven weeks. More importantly however is the lack of substantial growth difference when nitrogen rate was 40% compared to 80% and the full rate treatment independent of Soil Life treatment.

Tissue Nutrient Content

There were few meaningful differences among the treatments regarding tissue nutrient content on either dates. In fact, there are no significant macronutrient differences only small differences in minor elements such as iron and aluminum on 21-September. This was surprising as one would expect an increase in nutrient uptake at higher N rates due to growth demand.

In fact, in the case of iron and aluminum the higher N rates had the lowest concentration compared to the lower N rates. Iron and aluminum are typically taken up in greater amounts under lower soil pH, however, we did not measure soil pH differences during or after the study.

Summary

It is hard to draw strong conclusions after only one season's data. However, we are observing a significant effect not simply of the fertilizer but of the Soil Life additions especially at reduced nutrient rates. It appears the benefit of Soil Life is not as pronounced at the higher N rates but clearly demonstrating a benefit when used with lower nutrient rates.

Frank S. Rossi, Ph.D.

Mary Thurn

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Feature Story

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International, we already have a mechanism that looks at the entire environmental cost, not just the use of organic products. We can keep high quality conditions and tap a whole new sector or society.

The other factor stopping the growth of golf in my mind is time. Less people, especially guys like me raising a family and working too hard, spending four to five hours playing golf is the issue. Make the greens too fast as well as other conditions that cater to the core golfer and I'm outta here.

I want smooth, not fast greens. I want my ball to roll a long way after I drive it and I want short rough. As far as bunkers, I wouldn't know a bad bunker from a good bunker so superintendents should not waste time and energy killing themselves to make them perfect. Plus, I know this may be a secret, but shouldn't I be penalized for hitting into the bunker?

The news from Golf 20/20 is good for superintendents but I'm not sure it is good for the game. I think any activity where you can walk around a beautiful landscape for a couple of hours, hang out with friends and family and get exercise ought to be the most popular activity in the world. It's time for golf course superintendents to use our new found credibility to grow the game.

Frank S. Rossi, Ph.D.

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Clippings - Sherwood Moore

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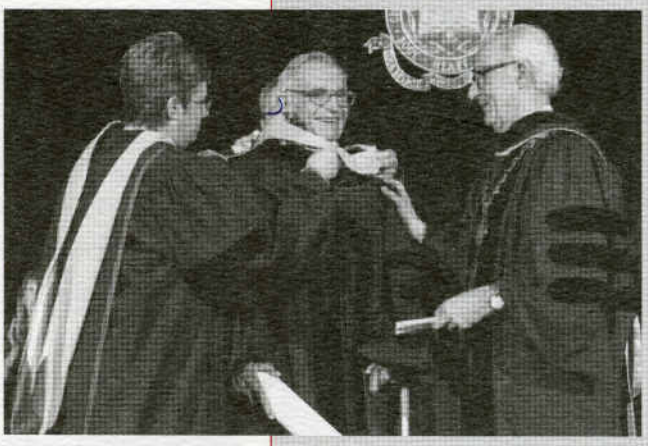
nation and is still offered at UMass Amherst. He has achieved numerous awards and honors throughout his life including GCSAA's Old Tom Morris Award which is named after Tom Morris, a greenskeeper, golf professional, four-time British Open winner, and topped ranked links designer of the 19th Century. This award, which has been given to such luminaries as Gerald Ford, Bob Hope and Jack Nicklaus, was presented for his continuing lifetime commitment to the game of golf conducted in a manner exemplified by Tom Morris.

In addition, Moore was honored in 1984 with NYSTA's most prestigious award, the Citation of Merit, because he has demonstrated all of the necessary criteria: dedication to turfgrass research and education; involvement in and support of association activities; interest in promoting careers in the turfgrass industry; community involvement; and admiration and respect of peers and colleagues. Two Citation of Merit award winners, NYSTA President, Michael Maffei, CGCS, and former NYSTA President, Mel Lucas, CGCS, attended the award ceremony at the Stockbridge School commencement. Past NYSTA board member, Ted Horton, CGCS, was also in attendance.



In his career, Moore was employed as a superintendent at several New Jersey golf clubs before moving on to Winged Foot Golf Club and then to Captains Golf Course in Brewster, Massachusetts. He served as president of both the New Jersey and Metropolitan Golf Course Superintendent Associations.

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NYSTA News

Turfgrass Environmental Stewardship Fund Receives Legislative Appropriation

Professional turfgrass managers are constantly challenged to meet consumer expectations and environmental safety, while complying with a myriad of government regulations. Scientific research to date tells us that achieving healthy turf while preserving and protecting the environment is possible. However, more research is needed to provide improved turf management solutions. For this reason, the New York State Turfgrass Association for several years has advocated for a state supported fund to provide professional turf managers with the skills they need to enhance turf quality, while protecting the environment.

The Turfgrass Environmental Stewardship Fund has been one of the priority issues at our annual Turfgrass Advocacy Day in Albany. NYSTA is pleased to report this initiative has been recently funded! The 2006-07 New York State budget includes $175,000 for the "services and expenses of the Turfgrass Environmental Stewardship Fund." Senator Catharine Young, who represents the 57th Senate District (Allegany, Cattaraugus, Chautauqua and Livingston Counties) and is Chair of the Senate Agriculture Committee, originally expressed her support for the Turfgrass Environmental Stewardship Fund at our 2006 Turfgrass Advocacy day in February and then proceeded to secure this appropriation in the state budget.

The Turfgrass Environmental Stewardship Fund will support environmental research that looks beyond the traditional agronomic aspects of turfgrass science and seeks to determine the influence of practices on the environment. Preference will be given to research that will have a positive impact on the environment such as water quality protection methods, Integrated Pest Management that strives to reduce reliance on pesticides, and the development of biological control practices that enhance the ecological compatibility of turf systems. The fund will also improve research and technology information dissemination and promote the value of turfgrass to the citizens of New York. NYSTA and its members wish to thank Senator Young for her support of the Fund and her recognition of the value of scientific research.

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Upcoming NYSTA Events in 2007

January 30-31	**Southeast Regional Conference & GCSAA Seminar,** Holiday Inn-Suffern, Suffern, NY
February 7	**2007 Turfgrass Advocacy** Empire State Plaza, Albany, NY
March 5	**Western Regional Conference,** Buffalo/Niagara Marriott, Amherst, NY
March 27	**Adirondack Regional Conference** Crowne Plaza Lake Placid Resort, Lake Placid, NY
November 13-15	**Empire State Green Industry Show** Rochester Riverside Convention Center, Rochester, NY

Clippings - Brian Eshenaur

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"Brian has provided us with a wealth of information," says Jody Mills, diagnostic horticulturist at Broccolo Tree and Lawn Care in Rochester, New York, noting that Cooperative Extension's services have been "absolutely essential" in keeping a solid IPM focus in all of Broccolo's 2,800 client properties. "I'm always amazed at the knowledge he has."

Eshenuar also started Cooperative Extension's "Great Lawns/Great Lakes" program. Highly-trained master gardeners teamed up with homeowners to apply Cornell University research information and IPM methods that keep lawns healthy and attractive while reducing the potential to pollute nearby Lake Ontario. Runoff from misapplied fertilizers and pesticides—as much as 67 million pounds of pesticides are applied to home lawns each year in the U.S.—can contribute to water pollution.

"Brian has been among our most esteemed collaborators," says Jennifer Grant, Ph.D., assistant director and community IPM coordinator for the New York State IPM Program. "We highly value his enthusiasm, innovativeness, and expertise, as well as the rich network of growers, educators, and pest management professionals he has cultivated."

Eshenaur joins the program, which also recently hired ornamentals coordinator Elizabeth Lamb, on May 16, 2006. "Our educators and the ornamental industry are excited for us to be back up to full IPM staffing," says Grant.

Integrated Pest Management promotes least-risk ways to manage pests, whether on the farm or in the community. Find out more about the New York State IPM Program at www.nysipm.cornell.edu

Healthy Ecosystem

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on water infiltration rate or turfgrass visual quality.

3. When considering only soil type differences, the sand had the lowest soil salt levels (even though it received twice the amount of salt) and slightly lower visual quality. Both soil salt levels and visual quality values were in the acceptable range.
4. As anticipated, soil salt levels on average were higher at the end of the year than before the study, but were at a low level.
5. When only considering grass species, grass type did not influence soil salt level, water infiltration rate or visual quality.

Summary to Date

When considering interaction between the main factors of waste water irrigation, soil type and grass species in time (before and after irrigation), there were a few statistically significant differences observed as follows:

1. Independent of soil type, Kentucky bluegrass was affected more (slightly lower visual quality) by waste water irrigation than creeping bentgrass. In fact, waste water slightly improved the visual quality compared to the control water. This may be due in part to the higher salt tolerance of creeping bentgrass.
2. Independent of soil and grass type, over the course of this study, the turfgrass visual quality was influenced by the source of irrigation water. The turfgrass grown with normal waste water source (1X) had slightly lower visual quality in August and September than the other months. The high salt waste water (2X) irrigation caused lower visual quality from August to November than at the start of the study in July. In contrast, the control irrigation treatment (source was Fall Creek), resulted in slightly higher turfgrass visual quality as the study progressed.
3. Independent of grass type, there was an interaction of soil type and waste water irrigation type on turfgrass visual quality. With the normal waste water irrigation (1X), the turfgrass quality was best on the sandy loam soil, but at the higher salt irrigation or the control water treatment, the quality of turfgrass grown on the sandy loam soil had lower or similar quality to the other soils. Turfgrass grown on sand generally had the lowest visual quality for all sources of irrigation.
4. The soil salt levels (EC) were higher after the irrigation season when waste water was used. When the typical water source was used (control from Fall Creek), irrigation had no affect on soil salt level.

A. Martin Petrovic, Ph.D.

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Healthy Ecosystem

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In the Northeast there has been very limited use of waste water for irrigation. For example, in New York there are just two golf courses of the over 850 golf courses in the state that use waste water for irrigation.

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serve as a bio-filter and reduce the amount of phosphorus and nitrogen reaching streams and lakes. The guidelines developed provided the necessary information on what testing should be done on waste water and how to interpret the results to use waste water safely.

Background

The availability of fresh water for irrigation in many parts of the United States is becoming critically limited. This is especially true for irrigation of non-food and fiber production sites including parks, commercial and residential lawns, athletic fields, golf courses, cemeteries, sod farms and other landscape plantings. This is true even for the Northeastern U.S. where many people perceive an abundance of fresh water. Major metropolitan water suppliers in the Northeastern U.S. are required to double the supply capacity of their systems for the three summer months that are dominated by landscape irrigation demands.

As urban and suburban sprawl continues, the demand for freshwater resources also increases. There is an obvious need to consider water conservation and/or the use of alternative water sources for landscape irrigation. Waste water has long been successfully used for irrigation in the Southwestern U.S. Waste water includes treated sewage effluent and non-human waste water, gray water. Most large-scale waste water irrigation comes from sewage treatment plant effluent.

The benefits of waste water as an irrigation source include: conservation of freshwater that would be used for irrigation, supply of small amounts of nutrients to enhance plant growth every time the site is watered, and a reduction of pollutant (phosphorus and nitrogen) discharge into surface water. The potential hazards from waste water irrigation involve salt injury to plants, long term affects on soil health (reducing in drainage and increase in runoff/erosion), other soluble compounds in the water and human pathogens in the waste water. Proper water treatment has all but eliminated the human pathogen issue. Long-term use of waste water irrigation of turfgrass sites in Arizona, a low rainfall area, has shown to increase salts levels in the soil which could harm plant growth and destroy the structure of soils.

In the Northeast there has been very limited use of waste water for irrigation. For example, in New York, there are just two golf courses of the over 850 golf courses in the state that use waste water for irrigation. One golf course (45 holes) in Lake Placid, NY gets all its irrigation water from the Village of Lake Placid. The Village of Lake Placid has reduced its phosphorus loading into Lake Champlain by 25 percent. To date, the Lake Placid golf courses, which have very sandy soil, have seen no turf damage from salt.

Study 1: Demonstrate that the waste water will not harm the turf and soil at the Newman Golf Course, City of Ithaca, NY.

The purpose of this study was to determine if watering a practice green at the Newman Golf Course with waste water similar to the one produced by the City of Ithaca Waste Water Treatment Plant would affect soil health and turfgrass quality in 2005.

Material and Methods

The practice green at the Newman Golf Course, Ithaca, NY, was used to demonstrate the safety of using waste water with the same properties generated by the Ithaca Area Waste Water Treatment Facility to irrigate the golf course. This demonstration involved comparing the waste water and the current irrigation water (Ithaca City Water). Half of the practice green received only simulated waste water supplied by a fertilizer proportioner (provided by EZ-FLO Inc., Fertigation Systems) and the other half with the current irrigation water (City of Ithaca). The irrigation started on July 20 and ended on October 31, 2005.

The simulated waste water contained the following chemical analysis:

	mg/L
Sodium (Na)	21.36
Magnesium (Mg)	15.17
Phosphorus (P)	0.32
Sulfur (S)	0.33
Potassium (K)	8.62
Calcium (Ca)	85.69
Ammonium (NH4-N)	12.07
Nitrate (NO3+NO2-N)	3.17
Chloride (Cl)	230.85 mg/kg
Electrical conductivity (EC)	0.82 dS/m

To determine the affect of waste water irrigation on the golf turf, monthly visual quality data were collected (July 18, August 15, September 20, October 18 and November 14, 2005) using a scale of 1-9, where 1 is dead turf, 6 acceptable turf and 9 ideal turf quality.

To determine the impact of waste water irrigation on soil health, soil samples at the beginning of the irrigation season (July 18, 2005) and at the end of the season (November 28, 2005), were tested for salt levels (electrical conductivity) and water infiltration rates of the soil were determined in the field.

Results and Discussion

In general, irrigation with simulated waste water for a three and a half month period had little or no effect on golf turf quality and soil health. Over time, the soil salt levels slightly increased with both sources of irrigation and both had low salt levels. Visual quality was in general good and unaffected by waste water irrigation. The water infiltrate rate was slightly lower on the half of the practice green receiving waste water irrigation but an infiltration rate of 3.5 inches per hour (8.9 cm/hr) is still considered high.

Study 2: Determine the impact of simulated waste water on turfgrass and soil health of several commonly used turfgrass species and on a wide range of soils.

The site for the second study was a rainout shelter facility at the Cornell University Turfgrass and Landscape Research Center, Ithaca, NY. The site was constructed in 1990 with three soils (sand, sandy loam and silt loam). During the irrigation season (July 20 - October 31, 2005) all rainfall was excluded from the site with a moveable greenhouse called a rainout shelter. This insured that all the water provided would be waste water, which will give the greatest chance of damage. Three types of irrigation water were used, the current irrigation water (Fall Creek), water with the same properties generated by the Ithaca Area Waste Water Treatment Facility (shown above) and water with twice as much salt and nutrients as that generated by the Ithaca Area Waste Water Treatment Facility.

Monthly visual quality data were collected on July 18, August 15, September 20, October 18 and November 14, 2005 using a scale of 1-9, where 1 is dead, 6 acceptable and 9 ideal quality. To determine the impact of waste water irrigation on soil health, soil samples at the beginning of the irrigation season (July 8, 2005) and at the end of the season (November 28, 2005) were tested for salt levels (electrical conductivity). Water infiltration rates of the soil were determined in the field on May 5, 2004 and again on February 14, 2006. Due to the extremely high infiltration rates, data for sand was not obtainable with the method we used.

Results and Discussion

In general, the use of waste water irrigation, including twice the salt level, had little or no effect on turfgrass quality and soil health as measured by soil salt level and water infiltration rate. Table 2 contains the results for each of the main three factors (irrigation source, soil texture and grass type) as well as before and after irrigation values. There were small differences observed as follows:

1. When considering only waste water irrigation, applying waste water slightly increased the soil salt level (EC), with higher salt irrigation water resulting in higher soil salt level at the end of the study. All soil salt levels were however considered low.
2. When considering only waste water irrigation, applying waste water had no effect

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The benefits of waste water as an irrigation source include: conservation of freshwater that would be used for irrigation, supply of small amounts of nutrients to enhance plant growth every time the site is watered, and a reduction of pollutant (phosphorus and nitrogen) discharge into surface water.

CUTT

Healthy Ecosystem

As urban and suburban sprawl continues, the demand for freshwater resources also increases. There is an obvious need to consider water conservation and/or the use of alternative water sources for landscape irrigation.

Demonstrating the Usefulness and Safety of Waste Water for Irrigation of Large Turfgrass Areas

The availability of fresh water for irrigation in many parts of the United States is becoming critically limited. This is especially true for irrigation of non-food and fiber production sites including parks, commercial and residential lawns, athletic fields, golf courses, cemeteries, sod farms and other landscape plantings. There is an obvious need to consider water conservation and/or the use of alternative water sources for landscape irrigation. Waste water has long been successfully used for irrigation in the Southwestern U.S. In the Northeast there has been very limited use of waste water for irrigation.

In two field studies we found in general, irrigation with simulated waste water for a three and a half month period in 2005 had little or no effect on turf quality and soil health. Applying waste water slightly increased the soil salt level (EC), with higher salt irrigation water resulting in higher soil salt level at the end of the study. All soil salt levels were, however, considered low. Kentucky bluegrass was effected more (slightly lower visual quality) by waste water irrigation than creeping bentgrass. The turfgrass grown with a normal waste water source had slightly lower visual quality in August and September than in other months. The high salt waste water irrigation caused lower visual quality from August to November than at the start of the study in July. Turfgrass quality improved from July to November when irrigated with normal irrigation water.

This initial survey of New York golf courses using or considering waste water for irrigation shows great promise. Managers found that the benefits of using the recycled waste water out weighed the costs. Especially when the waste water source was close to the golf courses, waste water offered less expensive water for irrigation. Extra management would be necessary to monitor the water and soil nutrient content through routine testing so timely adjustments could be made throughout the growing season. Managers found that having access to waste water would increase the areas irrigated and offered more play. Extra mowing and pest management may be necessary. The communities reap environmental benefits by having more water from the treatment plants diverted to golf courses where the soil would

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