CORNELL UNIVERSITY TURFGRASS TIMES

CUTT

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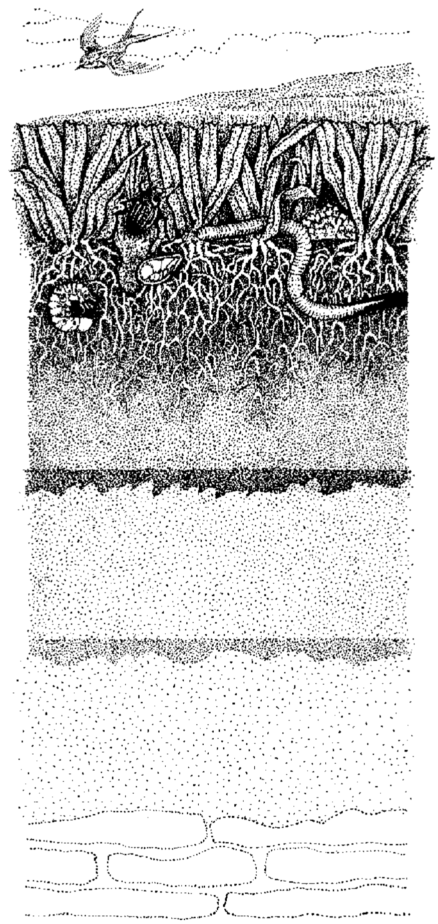

Water Conservation Techniques in Turfgrass

Turfgrass is considered by some as a major water consuming landscape feature. For example, Kentucky bluegrass is often singled out as a grass requiring high irrigation in arid and semi-arid regions of the U.S. In recent years there has been a shift towards less water demanding landscapes by utilizing such techniques as low water requiring turfgrass species and/or cultivars and alternative landscape features like xeriscapes. Although these techniques are useful in new landscape installations and some retrofitting of existing sites, it remains that many landscapes in cool-season turfgrass regions are mainly composed of traditional turfgrasses such as Kentucky bluegrass, perennial ryegrass, and fine and tall fescue. Thus, it is important to develop and use simple turfgrass management strategies that will conserve water on existing sites with traditional turfgrasses by reducing plant water use. ■

Two of the most common maintenance practices used in turfgrass management are mowing and fertilization. Mowing has a pronounced influence on the physiology and growth habit of the turfgrass plant. Mowing influences such properties as leaf area, root system depth and distribution, and shoot density which can influence plant water use. Fertilization, especially with nitrogen, can also influence plant water use by altering the physiology and morphology of the plant. The impact of variation in seasonal mowing heights and fertilization (nitrogen and potassium) on the water use, growth, visual quality, and water use efficiency of Kentucky bluegrass was studied in several experiments.

Mowing

One of the basics of mowing is selecting the height at which to mow. Conventional wisdom suggests mowing as high as possible in order to produce a more stress tolerant plant by encouraging a deeper root system. High cut turf will have a greater leaf area and lower resistance to water leaving the canopy (referred to as canopy

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This Times

Short Cutts

I have truly loved working in extension because it put me in contact with you, the turfgrass industry on a daily basis.

Hummel Leaves Cornell Post For Industry

It is with mixed emotion that I announce the departure of Dr. Norman Hummel from the Department of Floriculture and Ornamental Horticulture and Cornell's respected team of faculty and staff who serve the turfgrass industry in New York State. Dr. Hummel, who joined the faculty at Cornell in 1984, established one of the premier turfgrass extension programs in the country. Because of the breadth and depth of his knowledge, Dr. Hummel was greatly respected by turfgrass professionals throughout New York, the Northeast and the United States. He was constantly in demand as a speaker and was consulted frequently by industry.

During his tenure at Cornell, Dr. Hummel provided outstanding leadership to the interdepartmental turfgrass program team consisting of Dr. A. Martin Petrovic, Dr. Joseph Neal and Joann Gruttadaurio, Department of Floriculture and Ornamental Horticulture; Dr. Eric Nelson, Department of Plant Pathology; Dr. Michael Villani, Department of Entomology; and Gerard Ferrentino and Jennifer Grant, Integrated Pest Management Program. The collective wisdom of this group helped establish a coordinated vision that has effectively guided the development and implementation of the extension, research and teaching programs associated with the turfgrass program within the New York State College of Agriculture and Life Sciences (CALS). Dr. Hummel also served ably as CALS' official liaison with the New York State Turfgrass Association (NYSTA). With the support of this organization, Dr. Hummel was a key figure in the establishment and/or the development of the Cornell University Turfgrass Short Course, the New York Turf and Grounds Management Exposition, *Cornell University Turfgrass Times* (CUTT), and the matching grants program between CALS and NYSTA.

Dr. Hummel also proved to be an able researcher. His work relative to the management of nutrients applied to turfgrass serves as the basis of current nutrient management recommendations provided for industry. In addition Dr. Hummel contributed greatly to our knowledge of turfgrass management strategies that reduce the need for chemical control of turfgrass pests.

Dr. Hummel's enthusiasm, presence and friendship will be missed. But there is some good news to report. Dr. Hummel will be joining the turfgrass industry, thus, we will continue to see

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A Personal Message From the Editor

If you have ever wondered if men really do experience a mid-life crisis, let me tell you from my experience that it is true. I turned 40 years old this year, and while I can't say that this is a crisis of any sort, I have come to a crossroads in my life and career. For the past 13 years I have had the pleasure to have worked on the faculties at Iowa State University (2 years) and Cornell University (11 years) in an extension capacity. I have truly loved working in extension because it put me in contact with you, the turfgrass industry on a daily basis. I liked knowing what was going on out there all the time, and what was needed in terms of extension education. The time has come, however, to change course. I have recently submitted my resignation from Cornell, effective August 8.

For the past couple of years I have not enjoyed working in my position as much as one should. The demands on my time to do tasks that I felt were nonproductive and unrewarding grew. There was little opportunity within my position, and within Cooperative Extension and Cornell to obtain the help I needed or to change the direction my position was heading. The challenge was gone, and the prospect of doing the same thing in the same system for another 25 years was not encouraging. When you no longer look forward to going into work in the morning, its time for a change, and this change, I believe

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Editor-in-Chief: Norman W. Hummel, Jr.
Masthead Illustration: Benn Nadelman
Illustrations: Timothy Tryon, Patti Zimmerman
Kenn Marash
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Nitrogen and Chloride Applications to Control Summer Patch in Kentucky Bluegrass

It has been reported that at least two-thirds of the golf courses in the northeast have been damaged by patch diseases. Once established, patch diseases can reduce the overall appearance and quality of sport and recreational turf. Nitrogen (N) affects diseases in many crops. It has been established that N form (nitrate vs. ammonium) is more important than N rate in determining the severity of many plant diseases. Chloride (Cl) has been reported to reduce the severity of at least 16 different foliar and root diseases on 11 nonturf crops.

Researchers at Rutgers University assessed the influence of N form and rate of N and Cl application on turf quality and summer patch severity in Kentucky bluegrass cv. Fylking. In this two-year experiment, plots of Kentucky bluegrass cv. Fylking were artificially inoculated with *Magnaporthe poae* (the causal agent of summer patch). Two types of N were applied (ammonium sulfate and calcium nitrate) at three rates to provide 0, 2 or 4 lbs N/1,000 ft^2/yr. Combinations of potassium sulfate and potassium chloride also were applied to provide 0, 2.5 or 5 lbs Cl/1,000 ft^2/yr.

Plots were rated for disease intensity and turf quality. Summer patch symptoms were more severe when the turf was fertilized with nitrate N than with ammonium N. The greatest amount of disease occurred where the high rate of nitrate N was applied, followed by the low rate of nitrate N. The least amount of disease developed where the high rate of ammonium N was applied. The rate of Cl application did not significantly influence summer patch severity. Researchers found a significant reduction in the development of summer patch through the cumulative effect of lowering soil and rhizosphere pH over a period of two years by application of N as ammonium sulfate. Lower pH in the soil and rhizosphere may reduce the severity of summer patch by either direct or indirect means. The pH level at which disease is suppressed, the impact of different soil types on disease development, and the mode of action of pH in reducing disease need to be determined.

(From: D.C. Thompson, B.B. Clarke, and J.R. Heckman. 1995. Nitrogen Form and Rates of Nitrogen and Chloride Application for the Control of Summer Patch in Kentucky Bluegrass. Plant Disease 79:51-56.)

Efficacy and Fate of Herbicides Applied to Perennial Ryegrass Turf

Researchers at the University of Nebraska and Montana State University conducted a two-year study to evaluate the efficacy of dithiopyr, compared to pendimethalin, in reducing large crabgrass *(Digitaria sanguinalis)* infestation, and to monitor the fate of the herbicides after application to a closely-mowed perennial ryegrass *(Lolium perenne)* turf.

Main plot (perennial ryegrass blend of 'Blazer', 'Fiesta' and 'Jazz') treatments consisted of 2.5 or 5 cm per week irrigation. Subplot treatments included pre applications of dithiopyr or pendimethalin at rates of 0.6 and 1.7 kg ai ha^{-1}, respectively. Immediately prior to herbicide application, large crabgrass was seeded into the turf.

Herbicide efficacy was not different between the 2.5 and 5 cm weekly irrigation treatments. Dithiopyr reduced large crabgrass infestation more than pendimethalin at 86 days after treatment (DAT) and beyond the first year, and at 74 DAT and beyond in the second year. For pendimethalin, large crabgrass infestation was greater than 25% at 86 DAT in either year. For dithiopyr, infestation was less than 5% at the same time periods. The data supports the standard recommendation of a second pendimethalin application for season-long control.

In both years, more pendimethalin but less dithiopyr was found in thatch 7 DAT than 1 DAT. Neither herbicide was detected 10 to 20 cm deep, nor in samples collected 30 cm outside of the experimental plots in either year. At 126 DAT (the final sampling date), little herbicide was detected in verdure, but residues were found in most thatch and all mat samples. No difference in herbicide dissipation was observed between the 2.5 and 5 cm weekly irrigation treatments. The estimated DT_{50} (average time for 50% reduction in detectable residues) in the turf-soil profile was 35 days for dithiopyr and 23 days for pendimethalin.

(From: L.C. Schleicher, P.J. Shea, R.N. Stougaard, and D.R. Tupy. 1995. Efficacy and Dissipation of Dithiopyr and Pendimethalin in Perennial Ryegrass (Lolium perenne) Turf. Weed Science 43:140-148.)

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Scanning the Journals

A review of current journal articles

Researchers found a significant reduction in summer patch through the cumulative effect of lowering soil and rhizosphere pH over a two year period by application of N as ammonium sulfate.

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Water Conservation

continued from front cover

In recent years there has been a shift towards less water demanding landscapes by utilizing such techniques as low water requiring turfgrass species or cultivars and alternative landscape features like xeriscapes.

resistance), thus will use more water on a relative basis. Having a deeper root system allows the plant to obtain water deeper in the soil, thus becoming more drought tolerant and requiring less irrigation. Conversely, shorter cut turf will use less water but will be susceptible to greater stress due to a shallower root system.

One complicating factor in this discussion is the seasonal nature of both the root system development of cool season turfgrasses and plant water deficits that relate to the need for irrigation. The root system of most cool season turfgrasses are not perennial and follow a growth pattern of: extensive new root initiation and elongation in the spring; a summer decline period; and a slight resurgence of growth in the fall. Soil water deficits occur when precipitation is less than evapotranspiration (ET) for a long enough period of time to deplete the reserves of water stored in the soil, thus irrigation is needed. In cool season areas of the U.S. this most often occurs from late spring, through summer and into early fall.

Typically, turf is mowed at one cutting height during the year or in some situations allowed to grow higher in the summer months in order to reduce stress. The hypotheses tested in this study were: (1) Kentucky bluegrass will use more water if mowed at 3 inches than at 1 inch, (2) mowing higher in the spring will result in a deeper root system (more stress tolerant plant) and shorter in the summer will result in less water use, thus conserve water.

The following experiment was conducted to test these hypotheses: typical bucket weighing lysimeters (10" ID by 12" deep, PVC filled with a sandy loam soil for the Ithaca study or a silt loam for the Plainview study) were sodded with Kentucky bluegrass. Following a several months establishment period, the lysimeters were placed in field plots to simulate typical microclimatic conditions of a lawn. Two sites were used, one at the Cornell University Turfgrass Field Research Laboratory in Ithaca, NY and the other at the Cornell Cooperative Extension of Nassau County office complex in Plainview, NY. There were eight different mowing treatments (see Table 1) applied to the test area, each replicated three times. It should be noted that there was a four week transition period from one cutting height to another. During this time the turf was allowed to grow a half inch or was cut one half inch shorter so as to reduce the potential for stressing the turf (scalping especially). The field plots were 5' x 10' in size with one lysimeter placed in each of the plots. Mowing was done on a weekly basis. Each lysimeter was weighed three times per week to determine the water use rate. Root samples were periodically harvested and clipping yields collected from the lysimeters. On a biweekly basis a visual quality assessment was made. All other maintenance practices followed a typical lawn program.

Table 1. Seasonal mowing height variation effects on the average evapotranspiration rate (ET) and visual quality of Kentucky bluegrass, Ithaca, NY.

Mowing height (inches)			ET (mm/day)	Visual Quality[†]
Spring	Summer	Fall		
1	1	1	6.0	4.8
1	1	3	4.8	5.3
1	3	1	6.0	5.6
1	3	3	5.5	5.7
3	1	1	5.7	5.4
3	1	3	5.2	5.4
3	3	1	4.5	5.1
3	3	3	6.4	5.1

[†] Visual quality based on a scale of 1=dead grass and 9=ideal turf.

Table 2. Seasonal mowing height variation effects on the average clipping yield and root growth of Kentucky bluegrass, Ithaca, NY.

Mowing Height (inches)			Shoot Growth (g)	Root Growth (g/cm³)		
Spring	Summer	Fall		Spring	Summer	Fall
1	1	1	1.4	14.0	14.4	6.8
1	1	3	1.0	12.4	11.2	9.1
1	3	1	1.1	14.5	15.7	8.1
1	3	3	1.0	14.8	13.3	8.3
3	1	1	1.3	13.2	12.3	7.4
3	1	3	1.1	11.7	11.6	9.3
3	3	1	1.1	13.7	13.0	10.2
3	3	3	1.1	13.6	12.3	8.3

Due to the wet nature of the study years (1989, 1990 and 1991) only limited data was obtained for water use measurements. Thus, the only reliable data to be presented was from the Ithaca site in 1990. As seen in Table 1, turf mowed at a constant height (1" or 3") had significantly higher average ET rates, thus would have required more irrigation water, than any of the mowing treatments that varied the height up or down. This difference was as much as 30% which could be a significant water savings. As expected, the higher cut turf used on average slightly more water (6%) than the lower cut turf. In addition, the average visual quality was higher on plots where mowing height was varied during the year (Table 1). Clipping yields (important if clippings are disposed of in landfills) and root growth (Table 2) were not significantly affected by the various mowing treatments. It should be noted that these studies were conducted during wet years and it is uncertain as to the results under drier conditions.

Fertilization

Fertilizers can influence water use in many ways. It has been long contended that faster growing grass will use more water. Therefore, if nitrogen (N) stimulates shoot growth then N may also stimulate water use. However, nutrients like N also influence other properties that may affect water use. High N has been shown to reduce the root system as shoot growth increases. At some point the stunted root system may not be able to supply the necessary water needed by the plant. Increasing the amount of N applied to turf also increases the number of shoots which increases the canopy resistance, possibly lowering water use. Potassium (K) has less influence on plant growth but improves plant stress tolerance (especially drought tolerance). Nutrients are seldom applied individually, thus the interaction of nutrients on water use should be evaluated. The hypotheses tested were: (1) even though N stimulates shoot growth it has a minimal affect on turfgrass water use, and (2) K will reduce turfgrass water use while increasing drought resistance.

Several experiments were conducted to study the effect of N, K and phosphorus (P) on the growth, water use and water use efficiency of either Kentucky bluegrass, or in the case of N, creeping bentgrass. The studies were conduced in a similar manner as described earlier. The same soil and bucket lysimeter set was used for Kentucky bluegrass. The study with creeping bentgrass, a grass primarily used on golf courses, utilized a sand root zone 12" deep (30 cm) unlined with 4" (10 cm) of gravel to simulate a putting green. N, P and K were applied to Kentucky bluegrass as urea, 0-46-0 and potassium chloride at the rates shown in Table 3. Ammonium sulfate was applied to creeping bentgrass at rates shown in Table 4. The amounts of nutrient applied range from no fertilization to excessive levels.

As expected, when more N is applied the clipping yields of either Kentucky bluegrass (Table 3) or creeping bentgrass (Table 4) increased dramatically. However, the affect of N on water use (ET) is far less apparent. Clipping

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Table 3. Nitrogen effects on the shoot growth, water use (evapotranspiration (ET)) and the water use efficiency (WUE) of Kentucky bluegrass.

Nitrogen Rate lbs/1,000 ft^2	Clipping Yield	% Change ET	WUE
0	0	0	0
1	+138	-5	205
3	+152	+3	181
6	+132	+14	159
9	+152	+2	122
12	+285	+38	237

Table 4. Nitrogen effects on the shoot growth, water use (evapotranspiration (ET)) and the water use efficiency (WUE) of creeping bentgrass.

Nitrogen Rate lbs/1,000 ft^2	Clipping Yield	% Change ET	WUE
0	0	0	0
2	+138	+13	83
4	+666	+13	88
6	+866	+8	89

Water Conservation

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Common turf maintenance practices like mowing and fertilization can have a dramatic effect on the water use of common grasses like Kentucky bluegrass and creeping bentgrass. Altering the height of cut during the year resulted in as much as a 30% lower plant water use figure which could relate to a substantial saving in water used for irrigation.

Banning fertilization as a means of reducing the need for irrigation was found to be ineffective.

yields were increased by 150% with less than a 14% increase in water use (Kentucky bluegrass). This is most apparent in the normal range of N fertilization of 1 to 6 lbs N/1000 sq.ft. Unfertilized turf is very inefficient in utilizing water to produce growth (dry clippings) and that even the smallest amount of N substantially increased water use efficiency (WUE). In the study where K was also evaluated (Table 5), as before, when the amount of N applied increased, shoot growth increased with only a slight increase in water use. Potassium additions resulted in lower water use values, which appears to be related to less shoot growth. Evaluated alone, K applied at moderate rates (2 to 4 lbs K2O/1000 sq.ft.) resulted in lower water use.

Summary

Common turf maintenance practices like mowing and fertilization can have a dramatic effect on the water use of common grasses like Kentucky bluegrass and creeping bentgrass. Altering the height of cut during the year resulted in as much as a 30% lower plant water use figure which could relate to a substantial saving in water used for irrigation. Banning fertilization as a means of reducing the need for irrigation was found to be ineffective. In fact, unless extremely excessive levels of N are applied (9 to 12 lbs N/1000 sq.ft./yr.), water use is not affected. Potassium application accompanying N is a way to also help reduce water use.

A. Martin Petrovic and Beatrice Beth Baikan,
Dept. of Floriculture and Ornamental Horticulture

Table 5. Effects of nitrogen (N) and potassium (K) on the shoot growth, water use (evapotranspiration (ET)) and the water use efficiency (WUE) of Kentucky bluegrass.

Interaction Rate (lbs/1,000 ft2)			% Change	
N	K	Clipping Yield	ET	WUE
1	4	0	0	0
3	2	+6	-3	+8
3	6	-16	-3	-16
6	0	+43	+10	+22
6	4	+18	+3	+19
6	8	+14	+5	+9
9	2	+90	+5	+45
9	6	+63	+16	+28
12	4	+96	+6	+45
Simple Effects				
1		0	0	0
3		-6	-3	-5
6		+28	+6	+16
9		+77	+10	+36
12		+96	+6	+45
	0	0	0	0
	2	+3	-8	+11
	4	-2	-7	+5
	6	-14	-7	-9
	8	-20	-5	-19

Welcome to Scott Ebdon

Filling in for Norm Hummel will be Scott Ebdon. He will be joining the rest of the Turfgrass Work Group (Rod Ferrentino, Joann Gruttadaurio, Joe Neal, Eric Nelson and Marty Petrovic) and will be assuming some turfgrass extension responsibilities. Scott obtained his Masters degree from the University of Rhode Island where he concentrated on turfgrass management. He worked for 9 years in the turfgrass industry and came to Cornell in 1991 to work with Marty Petrovic. Scott received his doctorate in August this year. His research emphasized Kentucky bluegrass water use.

Scott is no stranger to turfgrass research and extension activities. He has been a speaker at the New York State Turfgrass Association Conference and an instructor at the Cornell Turfgrass Management Short Course. He will serve as the primary resource person for questions involving cultural aspects of turfgrass establishment and maintenance for professional turfgrass managers. Of course, your first line of defense is your local county Cooperative Extension agent (with turfgrass responsibilities). If they are not able to help you, you may contact Scott at (607) 255-1629. Joann Gruttadaurio will continue to coordinate the Cornell Turfgrass Management Short Course and the Field Diagnostic Summer Course. For questions regarding these educational programs, call her at (607) 255-1792.

Hummel Leaves

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him at many of the events which he was associated with while a faculty member at Cornell. Dr. Hummel has established a private laboratory that will be dedicated to the physical analysis of soil samples and a consulting firm that is associated with the laboratory. Thus, his expertise will still be sought by many. Do not be surprised if, in the future, you still see him speaking at meetings and conferences or find a need to call him for advice. We sincerely wish the very best to Dr. Hummel, his wife Terri and children Matthew, Adrienne and Natalie. May they all enjoy the fruits of his success.

As for those who may be wondering about the fate of the position vacated by Dr. Hummel, there is encouraging news. Thanks to the support of Dean David Call, the Associate Deans and Directors, we were given permission to begin a position search. To be able to do so is no small matter in view of the tight budget situation that we are now enduring. In fact, there are only two approved searches moving forward within CALS at this point in time, one of which is our turfgrass position. Normally, there are at least ten such searches underway. The position, which is being advertised throughout the United States, has already attracted several applications. Dr. A. Martin Petrovic has agreed to serve as chair of the Search Committee. If you have any questions about the position or the search process please feel free to contact Dr. Petrovic (607) 255-1796 or myself, Dr. George Good (607) 255-2048.

There will undoubtedly be a period of time after Dr. Hummel's departure and prior to the arrival of a new faculty member — anticipated to be January 1996 — during which we will be operating without an extension faculty person in turfgrass science. For those with questions about turfgrass management, call the Cornell Cooperative Extension Field Staff person in your area who has turfgrass management responsibilities. However, knowing that some inquiries will come to us at Cornell, we will shore up our ability to cover phone calls and correspondence associated with turfgrass management issues. We plan to keep Dr. Hummel's phone (607) 255-1629 and answering systems active during this time to allow calls to be handled by other turfgrass staff. Similarly, correspondence will be reviewed and answered. For information on turfgrass pests, contact the following faculty: weed management, Dr. Joseph Neal (607) 255-2170; turfgrass disease management, Dr. Eric Nelson (607) 255-7841; turfgrass insect management, Dr. Micheal Villani (315) 787-2342.

George L. Good, Chair
Dept. of Floriculture and Ornamental Horticulture

From the Editor

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will be in my best interest, as well as that of my family and the Turfgrass Science Program at Cornell.

Over the past couple of years I have developed a soil and turfgrass consulting business on the side, nearly all of it serving out-of-state clientele. In the past few months I have picked up some prominent clients, including Greensmix, Trans American Soil Blenders, and the clients of Nicklaus, Fazio, and Hurdzan design groups. I am very excited about devoting full time to the business, and to expand my services into areas where I see opportunities. While I will no longer be at Cornell, I still intend to be very a much a part of the turfgrass industry in New York.

Over the past several years, it has indeed been a pleasure for me to work with some of the fine people that I have. Marty Petrovic, for one, is really the foundation of the turf program. He was the first faculty member of the current team and played an important role pushing for the program which we have. I have always appreciated his wisdom. Eric Nelson, Mike Villani, and Joe Neal are the three best plant protection people in their respective areas in the world, bar none. What a pleasure it has been for me to work with them, always willing to cooperate in whatever way they could for the betterment of the program. They were committed to getting the information they generated in their research programs out to the industry. Joann Gruttadaurio has been a good friend and colleague. There would have been far fewer extension programs coming out of our department if it had not been for her efforts. I would also like to acknowledge our cooperative extension field staff. Talk about thankless jobs — nowhere will you find a more dedicated group of individuals. To all of you: your commitment to outreach education has been an inspiration.

Finally, I would like to thank all of you in the industry, especially the leadership in the many state and regional associations, for your support of the turf program. My departure does not mean that the program is any less deserving of your support, and I am sure you will continue to do so. Thank you all, for it has really been my pleasure. I will look forward to seeing you at some point in the future at conferences or in the field.

Norman W. Hummel Jr.
Associate Professor of Turfgrass Science
Dept. of Floriculture and Ornamental Horticulture

Update on the Search to Replace Hummel

The departure of Dr. Norm Hummel has created a major gap in Cornell's Turfgrass Science Program. We were fortunate to be given the approval to hire a replacement. The search committee is composed of Drs. Joe Neal, Mike Villani, Eric Nelson, and Marty Petrovic (chair); Ms. Joann Gruttadaurio and Mr. Joe Hahn.

There are seventeen applicants for the position and interviews will start in October. The quality of the applicants is outstanding and we are anticipating that the new person will start work sometime near the first of the year.

Screening For Low Water Use In Kentucky Bluegrass

The identification of selections that combine superior turfgrass quality with low consumptive water use becomes an overriding objective in turfgrass breeding programs.

It would appear that turfgrass breeding programs are developing Kentucky bluegrasses that combine both superior turf quality with lower consumptive water use.

In maintaining functional turfgrass during stressful summer periods, frequent applications of irrigation water are often needed. In a well irrigated turfgrass, as water resources become limited and competition for a finite water supply increases, the identification of selections that combine superior turfgrass quality with low consumptive water use (low evapotranspiration) becomes an overriding objective in turfgrass breeding programs.

The identification of turfgrasses with low evapotranspiration (ET) rates has been difficult because turfgrass ET is routinely assessed using weighing lysimeters which are relatively labor intensive and not well suited for mass screening. The emphasis of our research was to develop a technique to screen for Kentucky bluegrass (KBG) selections having a conservative water use pattern on the basis of plant measurements that are typically assessed by plant breeders.

Low ET rates under well watered conditions has been associated with turfgrass morphology that combine high canopy resistance components (high shoot density, horizontal leaf and shoot orientation, and high leaf densities) with low leaf area components (slow vertical leaf extension rate and a narrow leaf width). Much of this research has emphasized warm-season turfgrass and only a superficial treatment has been given to cool-season turfgrasses such as KBG.

We initiated a greenhouse study to determine the relationship between plant morphology and water use in 61 KBG cultivars with special emphasis on the relative importance of these morphological characteristics in predicting low- and high-water use types. We used a multivariate technique, discriminant analysis to predict or recognize low- or high-water-use types on the basis of several canopy resistance and leaf area measurements obtained from both unmown space plants and mowed turfgrass.

In developing cultivars for turf usage, plant breeders typically evaluate plant characteristics obtained from both space plant nurseries and dense-mowed swords. A multivariate technique was used because comparative water use is the sum total of each component which is operating simultaneously in combination, and therefore water use is a multivariate problem.

The 61 KBG cultivars were categorized based on ET rates conducted in the growth chamber across three temperature environments (77, 86 and 95˚F) as either low- or high-water use cases, with 28 cultivars categorized as low and 33 as high. Fourteen characteristics were evaluated, and all were included in the analysis. Compared to single plant morphology (space plant), turfgrass morphology was more efficient and required fewer predictors, and thus fewer measurements, in predicting the true or actual water use group.

Leaf angle from mowed turfgrass, a component of canopy resistance, was the most important predictor of water use group and predicted actual group membership in 72.1% of the cases. Correct classification was improved only slightly over leaf angle alone to 75.4% by incorporating a single leaf area component such as leaf width or leaf extension rate. A 75.4% correct classification rate was the best achieved and was as good as using all 14 variables in the analysis simultaneously. These results based on discriminant analysis indicate that identification of water conserving KBG is possible on the basis of a few simple plant measurements.

The 61 KBG cultivars evaluated in our study included 59 entries from the 1990 high-maintenance and 2 entries from the low-maintenance National Turfgrass Evaluation Program (NTEP) variety trial, sponsored by the USDA and the National Turfgrass Federation, Inc. NTEP evaluates turfgrass selections for overall turfgrass quality and other criteria conducted across a wide range of geographic environments. In this study a lower water use pattern in the 61 KBG cultivars was associated with higher shoot densities, a more horizontal leaf orientation, slower vertical leaf extension rates, and a narrower leaf width based on unmown space plant- and turfgrass-morphology. In addition, a lower water use pattern in 59 selections from the high-maintenance NTEP trial was associated with higher turf quality performance. We detected a significant negative correlation (r=-.50) between cultivar ET rate measured at 77˚F (a near optimum growth temperature for cool-season turfgrass) and the overall turf quality performance of a cultivar. In an effort to breed KBG for higher turfgrass quality performance under well irrigated and fertilized conditions, breeders have indirectly bred more conservative water use grasses. These results demonstrate an important relationship between characteristics that combine high canopy resistance with low leaf area components are also superior turf forming properties in KBG. It would appear that turfgrass breeding programs are developing KBG that combine both superior turf quality with lower consumptive water use. This will be important in reducing irrigation requirements in order to meet the challenges of a limited and finite water supply while maintaining high turfgrass quality standards.

J.S. Ebdon and A.M. Petrovic
Dept. of Floriculture and Ornamental Horticulture

Turfgrass Management Research Summary 1993-95

The research summarized here involves several turfgrass management topics like the use of municipal solid waste (MSW) compost as a soil amendment/factors important in water use to environmental fate of fertilizers/pesticides. Funding for such projects have come from many sources like the US Golf Association, New York State Turfgrass Association, Regional Golf Course Superintendents Associations in New York and from corporations. Without such support this research program would not be possible; thank you for your continued support.

Environmental Fate

Three years ago a team of researchers from Penn State University, University of Massachusetts and Cornell University set out to develop a more comprehensive knowledge base as to the fate of pesticides and fertilizers applied to experimental fairways under large scale field research facilities. Each university had a section of the research objectives with specialized facilities to conduct the research and applied the same materials on similar sites. Penn State University determined the extent of pesticide and nutrient runoff from fairway type-turf of either creeping bentgrass or perennial ryegrass. University of Massachusetts examined volatilization and foliar disslogability of pesticides applied to fairway type turf (creeping bentgrass). Cornell University studied the impact of soil type and precipitation on pesticide and nutrient leaching from fairway type-turf (creeping bentgrass).

The objectives of the Cornell University's portion of the is project were to determine pesticide and nutrient leaching from high maintenance fairway-type turf as influenced by:

- soil texture (sand, sandy loam and silt loam)
- pesticide properties (persistence and mobility)
- rainfall differences (moderate and very heavy rainfall patterns)
- turfgrass maturity (density and organic matter accumulation)

A second main objective of this project was to determine the impact of the addition of organic matter (peat) at the time of construction on pesticide leaching from experimental, sand based putting greens.

During the summer of 1993 we experienced major lightning storm damage to our main research facility (ARESTS), so parts of the project are still ongoing.

This study was design to examine a wide range of conditions that are known to impact pesticide leaching. As example, soils used ranged in texture from sand, with a high potential for pesticide leaching, to a silt loam soil with a nominal potential for pesticide leaching. Pesticides used also reflect a range in potential for leaching with mecoprop, trichlorfon and isazofos having a high potential for leaching and triadimefon an intermediate potential for leaching. Climatic factors like the amount of rainfall and/or irrigation, that also influence pesticide leaching, were also evaluated in this project.

Experimental Conditions

These experiments were conducted in the field to simulate actual golf course conditions, minus the golfer. The sites were mowed frequently, and fertilized/irrigated at rates typical of golf courses.

Fairways Studies

Fairways comprise the largest section of the more highly maintained portion of the golf course. Fairways are therefore where the most total pounds of pesticides and fertilizer are used on a high quality golf course. Fairways usually are build with on-site soils that can range from very sandy soils to very fine-textured clays. It is known that the extent of either pesticide or nutrient leaching is highly dependent on soil properties. Thus, it is important to study nutrient/pesticide leaching from fairways having several soil types.

This research was conducted at the ARESTS (Automated Rainfall Exclusion System for Turfgrass Studies) Facility at the Cornell University Turfgrass Field Research Laboratory in Ithaca, NY. This facility is designed to control all water going on to the turf (rainfall and/or irrigation) and collect all the water passing through the soil (leachate). During the months of May through October, a large greenhouse on wheels (called a rainout shelter) quickly covers the experimental site if rain occurs. This allows us to control the amount of rainfall and irrigation during the growing season. In this study we used historic weather data and applied irrigation to mimic a normal rainfall pattern and an above normal rainfall pattern. In this way we could determine if certain weather type years are likely to result in greater pesticide/nutrient leaching than others.

The ARESTS Facility is composed of 27 free draining lysimeters (plots) that are 12' x 12', containing nine plots of three soils (sand, sandy loam and silt loam) 15" deep, and are individually irrigated. The site was seeded with Penncross creeping bentgrass in May of 1991. All of the systems are linked with a data acquisition/con-

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Research Summary

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Highly sandy sites, such as putting greens, are often cited as the most susceptible to nutrient and pesticide leaching due to high permeability and both low organic carbon content and cation exchange capacity.

It was not surprising that pesticide leaching from experimental fairways was found to be influenced by soil type, specific pesticide and a climatic factor, such as precipitation or irrigation.

trol system via computer. The site was completed in 1987 but reseeded with Penncross creeping bentgrass in May of 1991. The site is mowed three times per week (clippings removed) and irrigated so that at least one inch of rainfall/irrigation is applied per week.

Pesticides and fertilizer were applied to all but one plot of each soil type which served as the untreated control treatment.

Greens Study

Highly sandy sites, such as putting greens, are often cited as the most susceptible to nutrient and pesticide leaching due to high permeability and both low organic carbon content and cation exchange capacity (CEC). During construction the opportunity exists to modify sand with amendments that will possibly reduce both nutrient and pesticide leaching, by increasing the amount of organic carbon and the CEC level. Thus, the objective of this section of the project is to determine the effect of an organic amendment (peat) on the leaching of pesticides from sand based experimental putting greens. The site for this study is the Cornell University Turfgrass Field Research Laboratory, Ithaca, NY. The site was constructed during 1992 and sodded with washed creeping bentgrass on 5-6 October, 1992. Plots consisted of 8' diameter USGA Greens Section style profiles containing 12 inches of root zone mix, and 2 inches of coarse sand with 4 inches of gravel at the bottom. Each plot is a small swimming pool that contains 1 outlet to collect the leachate. The amendment added to a slightly calcarious sand is a reed sedge peat at a ratio of 80:20 (v/v). The unamended sand was included for comparison. Triadimefon was applied during the week of October 25, 1992.

Research Findings

The nature of these studies is such that we were collecting leachate samples from a depth of 15" which is considered the most important zone for retaining and degrading pesticides/nutrients. Under real life conditions this water must move deeper through the soil until it reaching the water table. Therefore, the data presented here is not groundwater quality data, but is an estimate of the maximum concentration of pesticide/nutrient that could be in groundwater, assuming a water table depth of 15". On sites with deeper water tables concentrations would be less.

Pesticides

It was not surprising that pesticide leaching from experimental fairways was found to be influenced by soil type, specific pesticide and a climatic factor (precipitation/irrigation), as shown in Tables 1 and 2. This type of experiment is considered a 'worst case scenario' type by using highly mobile pesticides on some shallow-water table-highly leachable soil (sand) and having a rainfall/irrigation pattern likely to cause leaching. The extent of leaching, however, in some cases was quite surprising. As example, having 50 to 62 per cent of mecoprop leaching from the sand experimental fairways was extremely high. This suggests that newly seeded turf, or other sites with low shoot density, that have very sandy soils, are at some risk of being highly susceptible to pesticide leaching, assuming other factors important to pesticide leaching are present. Results form other studies and from monitoring studies of actual golf courses have found mecoprop not leach to any great extent. Mecoprop was reapplied in 1994 to three year old-dense turf and the extent of leaching was at least 10 times less than observed in 1991.

We also observed that in one case (trichlorfon) pesticide leaching was unaffected by soil type. This is highly unusual for studies of this nature. However, if one understands the nature of this study the results are explainable. First, an highly water soluble pesticide that does not easily bind to organic matter was applied and large amount of rainfall was receive within the first eight days after it was applied (4.4" and 9.6" for the normal and above normal precipitation treatments, respectively). Highly water soluble pesticides that do not easily bind on to organic matter can move through the soil via water if they are quickly degraded. The large amount of rainfall that occurred within the first eight days after application resulted in a large amount of pesticide leaching primarily do to a water flow process known as preferential flow. In this case water very rapidly moves through soil in either macropores (worm holes, cracks in soil, etc.) in non-sand soils (ie. sandy loam and silt loam) or fingers in sand. The data from this study strongly confirms that preferential water flow did occur on these soils causes by the heavy rainfall and that pesticide leaching was heavily influence by preferential water flow.

The label for the pesticide isazofos states not to apply this material on sandy areas due to a potential for leaching into groundwater. Our results confirm that isazofos does leach from sand, but the good news is that little leaching was observed in the finer textured soils (sandy loam and silt loam).

Pesticide properties are very important in understanding the potential for pesticide leaching. Triadimefon is considered to have the low-

Table 1. The percent of applied pesticide leached and maximum concentration of pesticide found in the drainage water (leachate) from experimental fairways.

Soil	Precipitation	Isazofos	MCPP	Trichlorfon	Triadimefon
		Pesticide			
		% of applied pesticide leached/maximum concentration			
Sand	Normal	10.4 767*	51.0 1900	1.18 140	1.0 190
	Above Normal	5.6 544	62.12 1400	3.44 467	2.44 118
Sandy Loam	Normal	0.04 15	0.79 21	1.13 118	0.06 8
	Above Normal	0.09 122	0.46 70	4.41 302	0.01 5
Silt Loam	Normal	0.68 77	0.44 130	0.63 71	0.24 43
	Above Normal	0.30 34	1.25 89	3.33 504	0.28 66

* Maximum concentration of pesticide detected in the drainage water (leachate), in mg/L (ppb).

Table 2. The maximum concentration of nitrate and phosphate detected in the drainage water (leachate) from experimental fairways.

Soil	Precipitation	Sept. 13 - Dec. 31, 1991 Nitrate	Sept. 13 - Dec. 31, 1991 Phosphate	Jan. 1 - Aug.10, 1992 Nitrate	Jan. 1 - Aug.10, 1992 Phosphate
		Sampling Period			
		---maximum concentration, mg/L---			
Sand	Normal	12.2 (1)*	0.17	4.3	0.19
	Above Normal	13.2 (1)*	0.15	4.8	0.17
	Untreated	<0.5	0.06	0.5	0.11
Sandy Loam	Normal	3.5	0.08	3.6	0.11
	Above Normal	3.1	0.11	3.5	0.09
	Untreated	1.7	0.54	0.5	0.11
Silt Loam	Normal	4.3	0.11	6.6	0.11
	Above Normal	5.9	0.11	5.8	0.12
	Untreated	<0.5	0.32	1.1	0.27

* Number in parentheses equals the number of samples above the 10 mg/L drinking water standard for nitrate nitrogen. Only 2 of the 1,385 samples analyzed thus far were above 10 mg/L.

est potential for leaching of the four pesticides used in these studies. For each soil by precipitation treatments, triadimefon leaching was the lowest of the four pesticides. Little or no leaching was observed on the two finer textured soils; some leaching occurred from the sand experimental fairways that were only four months old.

Though the data is not shown due to the fact that pesticide leaching was so small, pesticide (triadimefon) leaching from experimental greens was negligible. It is important to point out these greens were sodded with washed creeping bentgrass sod two weeks before the pesticide was applied. This dense turf effectively eliminated pesticide leaching (most of the leachate samples were below the detection limit of 5 ug/L), regardless of the root zone composition (sand v. sand/pest). This data supports the notion that dense turfed sites, even of straight sand, are not likely to be prone to pesticide leaching.

Nitrate and Phosphorus

Nitrate leaching into groundwater for golf courses treated with fertilizers is a concern since nitrate was found to be the major contaminate of groundwater in the US in a recent USEPA groundwater quality survey of private and public drinking wells.

Phosphorus leaching from golf courses could be a concern if the drainage water from the golf course ended up in surface waters like ponds, lake and streams where eutrophication threatens water quality.

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Pesticide properties are very important in understanding the potential for pesticide leaching. Triadimefon is considered to have the lowest potential for leaching of the four pesticides used in these studies.

Dense turfed sites, even of straight sand, are not likely to be prone to pesticide leaching.

Research Summary

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Pesticide leaching from experimental fairways was found to be predictable and only occurs under the worst case scenarios. Thus, whenever possible, avoid applying pesticides under worst case scenarios.

Dense, healthy, beautiful turf dramatically reduces the risk of pesticide leaching, even on sites with the greatest potential for leaching (sand based putting greens).

Turfed sites that are not dense are prone to substantial pesticide leaching.

The accepted drinking water standard for nitrate-nitrogen is 10 mg/L. Only 2 of the 1,385 leachate samples from the experimental fairways analyzed to date were above this standard. Most were way below the standard (< 1 mg nitrate-N/L). Therefore, nitrate leaching from well fertilized fairway turf, even from sand, is not significant.

Phosphorus levels in the leachate from the experimental fairways were seldom above the analytical detection limit of 0.05 mg/L. None of the fertilized sites had any leachate samples with concentrations greater than 0.3 mg/L, which is often considered the phosphorus concentration of eutrophic surface waters.

Cultivation-Conditions for Rapid Water Movement Through Soil

Conditions that lead to rapid water movement through soils include preferential pathways and rainfall/irrigation rates in excess of the water holding capacity of the soil. Preferential pathways include such things a holes (macropores) in the soil such as from earthworm holes, cracks and holes created from dead roots and by finger flow in sand (not macropores but act the same way). These macropores can quickly drain water past the surface soil before the pesticide can be tied up/degraded and thus be leached much more that expected. Conditions conducive for such action usually involves heavy rainfall or over irrigation that results in water flowing quickly through soil not in the normal way. Thus, water soluble pesticides should not be applied immediately in advance of anticipated heavy rainfall or this type of unusual leaching can occur.

Cultivation has been shown to increase pesticide leaching only from a finer textured soil (sandy loam) than sand when conditions are present for rapid water movement through large pores, heavy rain right after application.

Summary

As with any experiment that covers such a wide range of factors important in pesticide/nutrient leaching, there is good and bad news. First the good news:

- Pesticide leaching from experimental fairways was found to be predictable and only occurs under the worst case scenarios. Thus, whenever possible avoiding applying pesticides under worst case scenarios is highly encouraged.
- Dense, healthy, beautiful turf dramatically reduces the risk of pesticide leaching, even on sites with the greatest potential for leaching (sand based putting greens).
- Nitrate and phosphorus leaching from experimental fairways was found to be minimal.

Now for the bad news:

- Turfed sites that are not dense are prone to substantial pesticide leaching, assuming other conditions for leaching are present (mobile pesticide applied and water moving through soils).
- Preferential water flow greatly increases the potential for pesticide leaching.

These findings point to several things that turfgrass managers can do to reduce the potential for groundwater contamination via pesticide leaching.

1. Know the sites you manage that have a high probability for leaching (sandy-low organic matter soils, shallow water table, thin turf or newly seeded sites, are that are over irrigated due to a inadequate irrigation system).

2. Determine which pesticides are more likely to leach and therefore, use them with caution on sites (identified in 1) more prone to leaching. Information on pesticide properties of this type is readily available but not is listed on the pesticide label.

3. Understand the conditions that are important if preferential water flow (period of heavy rainfall and excessive irrigation) and avoid the use of highly water soluble-low organic matter binding pesticides during these periods.

MSW Compost

The problems related to solid waste management, namely the lack/cost of landfills, has caused municipalities to look at alternative sites for disposal of wastes. One type of waste, MSW or what's left after recycling, can be composted and possible be used as a soil amendment. MSW compost contains some nutrients, organic matter and other material. A major component of MSW is disposable dippers which contain water adsorbing polymers. Thus can MSW compost provide nutrient for plant and retain water in sandier soils? Thus the purpose of this project was to evaluate MSW compost (Pembroke Pines, Florida) as a soil amendment in sod production on Long Island, NY (sandy soil).

Compost was added to the site prior to plowing and worked into the surface 6" of soil. MSW was applied at a rate equivalent to 0.5, 1.0 and 1.5" thick or 9, 18 or 27 tons/acre. The site was seeded and maintained as a normal sod field (irrigated, fertilized and weed control used)

It was observed that the MSW compost additions initially delay establishment, but did not negatively affect sod production. Thus, in typical turfgrass uses (other than sod production) a delay in establishment would be undesirable. Therefore, it would be important to understand what factor(s) may be important in affecting establishment including MSW compost properties and moisture. In the field study it was observed that the turfgrass density (% cover) was less on the MSW compost treated plots, especially at higher application rates. The period after seeding was somewhat dry. The possible explanations of the field results are: MSW compost somehow suppressed germination or shoot growth that was reflected in lower turfgrass density; the composting process for the Florida MSW material was not complete, therefore, when added to the soil the composting process was again initiated possibly injuring the seed (lower germination) or suppressing shoot growth; and the suppression was enhanced by dry soil and may have been a function of ammonia release (direct injury to the seed or young seedlings, or a rapid pH increase), higher temperatures (more stress on the plants) or acetic acid (direst injury to the seed or young seedlings or a rapid pH drop) release during further composting in the soil.

A greenhouse study determined the affect of compost age/maturity and environmental conditions (moisture) on germination rate, shoot biomass production and soil pH change. Germination was not affected by compost. It was observed, however, that the maturity of compost affected shoot growth. The compost that was used initially reduced shoot growth, where the compost that was allowed to age did not. The amount of irrigation affected growth but did not affect the results on compost affects. Thus, it is important that any compost be fully complete before being used as a soil amendment unless it will be allow to lay fallow for some time before seeding.

A. Martin Petrovic
Dept. of Floriculture and Ornamental Horticulture

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Scanning the Journals

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Resistance of Kentucky Bluegrass Cultivars to Rust

One hundred and twenty-eight Kentucky bluegrass cultivars or selections were established in 1990 at the Turfgrass Research Area of Iowa State University's Horticulture Research Farm for evaluation of resistance to rust under a high-maintenance program. In 1993, the turf received 1 lb N per 1,000 ft^2 in mid-April. Plots were mowed at 2.5 inches until June 5 and at 3.5 inches during the remainder of the growing season. No fungicides, insecticides or herbicides were used in 1993. The plots were rated visually for disease severity on September 30, 1993.

Significant differences in disease resistance were found among the cultivars and selections in this test. The cultivars 'Conni', 'Alpine' and 'Cheri' showed the least amount of disease. The cultivar 'Opal' exhibited the most severe disease symptoms and signs.

In a similar field trial, 62 Kentucky bluegrass cultivars or selections were established in 1991 for evaluation of resistance to rust under a low-maintenance program. During 1993, the turf received no N fertilization prior to the rating date. It was mowed at 2.5 inches until June 5 and at 3.5 inches during the remainder of the growing season. No fungicides, insecticides or herbicides were used in 1993. The plots were rated visually for disease severity on September 30, 1993.

Again, Significant differences in disease resistance were found among the cultivars and selections in this test. The selections 'ISI 21' and 'MN 2405' showed the least amount of disease. The cultivar 'Cynthia' exhibited the most severe disease symptoms and signs.

(From: M.L. Gleason, N.C. Christians, and J.R. Dickson. 1994. Resistance of Kentucky Bluegrass Cultivars and Selections to Rust Under a High-Maintenance Program, 1993; and Resistance of Kentucky Bluegrass Cultivars and selections to Rust Under a Low-Maintenance Program, 1993. Biological and Cultural Tests 9:149-150.)

Significant differences in disease resistance were found among the cultivars and selections in this test. The cultivars 'Conni', 'Alpine' and 'Cheri' showed the least amount of disease. The cultivar 'Opal' exhibited the most severe disease symptoms and signs.

Pest Watch

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It is ideal to send a sample from both "healthy" turf as well as "declining" turf. Some diseases may be present in both healthy-appearing turf and declining turf. Having both types of samples present helps eliminate such diseases as the primary cause of the symptoms.

If you want to send samples to the IPDDL, send them to the following addresses:

Nematode and Disease Samples
IPDDL 321 Plant Science Building
Department of Plant Pathology
Cornell University
Ithaca, NY 14853

Phone: (607) 255-7850
Nematode phone: (607) 255-7862
Fax: (607) 255-4471

Insect Samples
IPDDL
4140 Comstock Hall
Department of Entomology
Cornell University
Ithaca, NY 14853

Phone: (607) 255-3144
Fax: (607) 255-0939

Your local county office of Cornell Cooperative Extension also may be able to help diagnose pest problems.

Guidelines for Collecting Turf Samples for Disease Diagnosis

It is ideal to send a sample from both "healthy" turf as well as "declining" turf. Some diseases may be present in both healthy-appearing turf and declining turf. Having both types of samples present helps eliminate such diseases as the primary cause of the symptoms.

Submit turf samples 4-6 inches square and at least 3 inches in depth. A cup cutter size sample works well. The sample should be taken from areas showing symptoms but not completely dead; half of the sample should show the injury, half the sample should be healthy. If the pattern is a general decline then this type of sampling may not be possible. Wrap the sample in newspaper or brown paper and pack securely in a sturdy box. Avoid using plastic or plastic bags. Samples should be mailed immediately after being taken. If this is not possible, store the sample in a refrigerator until it is mailed. Avoid exposure to heat or direct sunlight. Do not moisten the sample.

Guidelines for Collecting Turf Samples for Nematode Diagnosis

It is best to collect a sample from "healthy" turf as well as "declining" turf. In some cases the plant parasitic nematodes found are not the primary cause of the symptoms. A sample from healthy turf helps to determine this. The best time to sample for nematodes is a month after the grass greens up in the spring. Mid-autumn sampling also is acceptable.

Sampling patterns depend on the symptoms present and the size of the affected area. If a gradual decline is noticed, samples should be taken randomly throughout the area, in a zigzag pattern, for example. A minimum of 6 subsamples should be taken from an area that is 1/2 acre in size. If symptoms appear in patches, subsamples should be taken just inside the perimeter of the patches (at the edge of the symptoms). All samples should be taken from a depth equal to that of the root system (i.e. around 4 inches). Subsamples can be taken with a 1-inch soil sampling tube, with a cup cutter, or with a bladed trowel. Subsamples should be mixed together. Approximately a pint of soil then should be randomly sampled from the mixture. This sample then should be placed in a plastic bag and shipped immediately. If the sample cannot be shipped immediately, store it in a refrigerator. Avoid exposure to heat or direct sunlight. Do not moisten the sample.

Guidelines for Collecting Insect Samples

Collect ten or more insects in each sample, if possible. Soft-bodied insects such as grubs and caterpillars must be preserved properly. It is best to kill soft-bodied insects in boiling water, then preserve them in rubbing alcohol or 100 proof liquor. Package these samples in glass or plastic vials containing alcohol, then securely wrapped to avoid breakage during shipping. Please indicate the original color of the specimen. Hard-bodied insects such as beetles, wasps, moths, etc. should be packaged in layers of tissue and placed in a sturdy box. Cup cutter size turf samples containing insects may be submitted also. Wrap the sample in newspaper or brown paper, punch a few holes in a plastic bag, and insert the plant sample. Do not moisten the sample.

DIANE KARASEVICZ
DEPARTMENT OF PLANT PATHOLOGY

Cornell Cooperative Extension's Turfgrass Management Short Course

Since the first Cornell Turfgrass Management Short Course was held in January of 1986 more than 700 professional turfgrass managers from New York, New Jersey, Connecticut, Delaware, Pennsylvania, Maine, Massachusetts, Vermont, California, Wisconsin, Colorado, Canada and France have graduated. Forty instructors and assistants from Cornell University, SUNY Agricultural and Technical Colleges and the Turfgrass Industry are involved in teaching the lectures and laboratories. Class enrollment is limited so that laboratory sessions can maximize hands on experiences.

The 2-week long Short Course includes 75 teaching hours, covering the principles of turfgrass establishment and maintenance. Topics include grass morphology, identification and selection, soil science, drainage, irrigation, fertilization, cultivation, renovation; and pest management topics, (including identification and control strategies for insects, diseases and weeds). Other topics that help develop turfgrass professionals include: the selection, establishment and maintenance of ornamentals; developing budgets, communication skills, customer relations, motivation in management, and turfgrass management strategies. Daily student evaluations are collected and summarized to help improve subsequent Short Courses. A pass/fail final exam is given at the end of the course to assess achievement of the course's educational goals from both the instructor's perspective as well as from the student's perspective.

The Cornell Turfgrass Science Program promotes continuing education and maintains contact with past graduates throughout the year at regional and statewide Cooperative Extension and industry sponsored educational programs and conferences. According to our graduates:

"The Cornell Short Course experience has made a positive impact on their job performance and in their careers as turfgrass managers."

For more details contact Joann Gruttadaurio, Short Course Coordinator, at (607) 255-1792. **Mark your calendar today: the Eleventh Annual Turfgrass Management Short Course will be held January 8-12 and 15-19, 1996.**

The 2-week long Short Course includes 75 teaching hours, covering the principles of turfgrass establishment and maintenance.

Mark your calendar today: the Eleventh Annual Turfgrass Management Short Course will be held January 8-12 and 15-19, 1996.

Cut out or copy this form

REGISTRATION FORM

Eleventh Annual Cornell Cooperative Extension Turfgrass Short Course

Please complete and mail the form below to Kelly Woodhouse, 20 Plant Science Building, Cornell University, Ithaca, NY 14853.

Make your check of $600 payable to Cornell University. Class enrollment is limited. A cancellation fee of $50 will be charged to registrants who cancel after December 20, 1995.

Please submit one form for each individual and **please print clearly**.

Where would you like your student packet sent? ____ Home Address or ____ Business Address

Name: ______________________________ S.S.# ________________

Home Address: ____

______________________________ Home Phone: ________________

Business Address: ____

______________________________ Business Phone: ______________

Describe your **turfgrass experience** and **number of years** in the business: ____________

____

____

Education:

High School: ____________________

2 year degree in: ________________

4 year degree in: ________________

Masters in: _____________________

My work deals with:

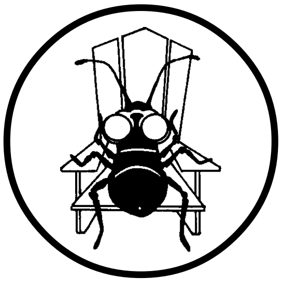
______Landscape maintenance

______Golf course maintenance

______Athletic fields and school grounds

______Lawn care

The Insect and Plant Disease Diagnostic Lab at Cornell University



Pest Watch

The Insect and Plant Disease Diagnostic Lab diagnoses insect problems and plant diseases; recommends insect and plant disease management practices; prepares and distributes fact sheets about insect pests and plant disorders; and keeps records of pest activity and new pest findings.

The Insect and Plant Disease Diagnostic Lab (IPDDL) at Cornell University has several functions. The most important is the diagnosis of insect problems and plant diseases. The lab also recommends insect and plant disease management practices, prepares and distributes fact sheets about insect pests and plant disorders, and keeps records of pest activity and new pest findings. The number of turf samples received for disease and nematode diagnosis from golf courses has been growing each year for the last several years. The relatively rapid turnaround time for disease diagnosis (often same day diagnosis) has been enthusiastically received.

The costs for diagnoses are as follows:

- insect and mite identifications $25
- fungal and bacterial disease identifications 25
- virus identifications 40
- nematode assays 40

In New York State, Diagnostic Checklist Forms are available for purchase through county offices of Cornell Cooperative Extension. Forms also may be purchased directly through the lab (contact Betty Lou Poole at (607) 255-3250). Completed forms should accompany each problem submitted. We suggest that you purchase forms ahead of time and send them in as needed. This saves the lab a lot of paperwork and allows for a speedier diagnosis.

Several samples believed to be affected by the same problem can be submitted on one form (the samples will be examined as a group). If, by chance, you can include a photograph of the symptoms, this can be very helpful. Try to send samples of the problem *before* pesticide treatments are made. Once pesticides have been applied, accurate identification of the insect or disease responsible for the symptoms may be impossible. If you have a fax number, please include it on the Checklist Form.

If you do not have access to a Checklist Form you can still send a sample to the lab. Please include a check, made payable to Cornell University, for the appropriate fee. Also include information about the problem: a general description, when it first appeared, is it getting worse, plant parts affected, distribution of the problem (small patches, large patches, general decline), and chemicals/fertilizers used over the past month. This information is requested on the Checklist Form. Again, it is best to send samples *before* pesticide treatments are made. If you have a fax number, please include it with the information sent.

It is best to avoid sending samples to the lab after Wednesday afternoon via traditional mail or UPS services. Samples sent should arrive at the lab before Friday afternoon or else they will spend the weekend in a post office. In the summer, samples delayed in route can severely overwarm during a weekend and be useless for diagnostic work when they do arrive. Samples sent via overnight or next day couriers arrive in the best condition.

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Cornell Cooperative Extension

Cornell University Turfgrass Times
20 Plant Science Building
Cornell University
Ithaca, NY 14853

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