1996 Illinois Turfgrass Research Report

A COOPERATIVE EFFORT OF THE
University of Illinois, Southern Illinois University,
Illinois Turfgrass Foundation, and the Chicago District Golf Foundation

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Introduction

Greetings from the turf faculty, staff, and advisors at the University of Illinois, Southern Illinois University, and the Chicago District Golf Association. We are pleased and proud to bring you the 1996 Illinois Turfgrass Research Report.

This report highlights a small portion of the 1996 research activities and also reports on other activities that took place that year. Within these pages, you will find information on such varied topics as turf pest control, turf growth management and culture, computers in turf management, and turf cultivar evaluations. Without doubt, 1996 was a productive year for our turf personnel.

A major change in the University of Illinois Turf Team occurred in May,1996, when Jean Haley left the program after nearly twenty years. Jean left the U. of I. to pursue a career working with animals at a veterinary clinic. We will miss Jean, and we wish her well in all endeavors.

We sincerely want to thank the Illinois Turfgrass Foundation (ITF) for financing the production of this Report. The ITF is a not-for-profit group dedicated to supporting turfgrass research and education in Illinois. ITF activities include an annual conference, the North Central Turfgrass Exposition, several golf days, and the Indiana-Illinois Turfgrass Short Course (cosponsored with the Midwest Regional Turf Foundation of Indiana). In addition, the ITF supports the production and distribution of the Illinois Turfgrass Update and Turfgrass Tips. Without the ITF, it would be impossible to maintain the high quality of turfgrass research findings and educational events turf mangers in Illinois currently enjoy.

Thanks for your support in 1996! We look forward to serving the Turf Industry in 1997.

Tom Voigt

Summary of PGR and Weed Control Research in Turf

Bruce Branham, Eric Kohler, Garry Grant, and Darin Lickfeldt

Program Overview

The 1996 growing season marked my first summer in Illinois. This was a critical year for development of my research program at the University of Illinois. Although we took several steps backwards and sideways, we made some forward progress. In 1996 the technician associated with the turfgrass program for nearly 20 years, Jean Haley, left the university to pursue a new career opportunity. Two graduate students also left my program. So, 1996 began with one technician and two graduate students and ended with one graduate student who began his M.S. degree in the fall of 1996. Despite these setbacks, I'm very excited about the program that we will develop at the University of Illinois. We have good support from the turf industry, excellent facilities, and a strong team of faculty. In addition, I believe that we initiated some very good research in 1996 and will strive to improve the quantity and quality of research related to turfgrass management.

The newest, and only, member of my program is Eric Kohler, a 1996 graduate of the University of Illinois with a B.S. degree in chemistry. His project will focus on the control of *Poa annua* on golf course turf. His initial research will examine the site of uptake of ethofumesate. During the winter of 1997, we will hire a replacement for Jean Haley. The search process began in October 1996 and should conclude sometime in February or early March. In addition, a new Ph.D. student, Dave Gardner, will join the program in January 1997. Dave is currently completing his M.S. degree at Iowa State University. Thus, despite the setbacks that occurred in 1996, the program should be well positioned to initiate new research in 1997.

Research Highlights in 1996

Over 30 research trials were conducted in 1996. A complete copy of all research is available and can be supplied to anyone interested by contacting a member of the turfgrass program at the University of Illinois.

Much of the research conducted in 1996 was supervised by Sang Wook Han, a postdoctoral research associate at the U. of I. Many of you may have interacted with Sang Wook during his Ph.D. program under Tom Fermanian. Dr. Han did a superb job taking over for Jean Haley on short notice and conducting most of the field research. This report highlights some of the research performed in 1996.

Mowing Reduction with Trinexepac-ethyl (PRIMO)

Most of the research conducted with Primo has focused on its use on golf course turf with little emphasis on applications in the home lawn market. This study was designed to examine the potential use of PRIMO, a new plant growth regulator (PGR), to reduce mowing and improve turf quality in Kentucky bluegrass turf. The application schedule was designed to be incorporated into a lawn-maintenance operation with three rates of Primo applied every 6 weeks during the growing season. A second set of applications was made monthly throughout the growing season to compare this application interval with the 6-week interval. Rates of Primo 1EC were 0.45, 0.6 and 0.75 fluid ounce product/M for the monthly application schedule and 0.6, 0.75, and 0.9 fluid ounce product/M for the every-6-week schedule. The first application for both application timings was made on 23 April 1996. Fertilizer was applied at two different rates to each Primo rate by application timing. Fertilizer rates were 3 pounds N/M/year and 6 pounds N/M/year applied as urea. Applications of sprayable urea were made weekly at the proper rate to give the yearly totals indicated. The weekly applications were made to reduce the growth surge seen with large applications of soluble nitrogen so we could better observe the action of the growth regulator on turf growth. Clippings were collected weekly throughout the study.

The data in Figure 1 show the seasonal growth pattern for Kentucky bluegrass at 3 and 6 pounds N/M/year. The fertilization was begun on 17 April, which might explain the variable clipping yields seen at the beginning of the study. After the flush of growth in early May, clipping production was between 20 and 25 gm clippings per week for the period 17 May through 21 June and 2 August through 13 September for the 6 pounds N/M nitrogen rate. The summer decline in growth occurred from 28 June through 26 July.

The data in Figure 2 show the effectiveness of Primo in reducing mowing quantity during a typical growing season. The initial

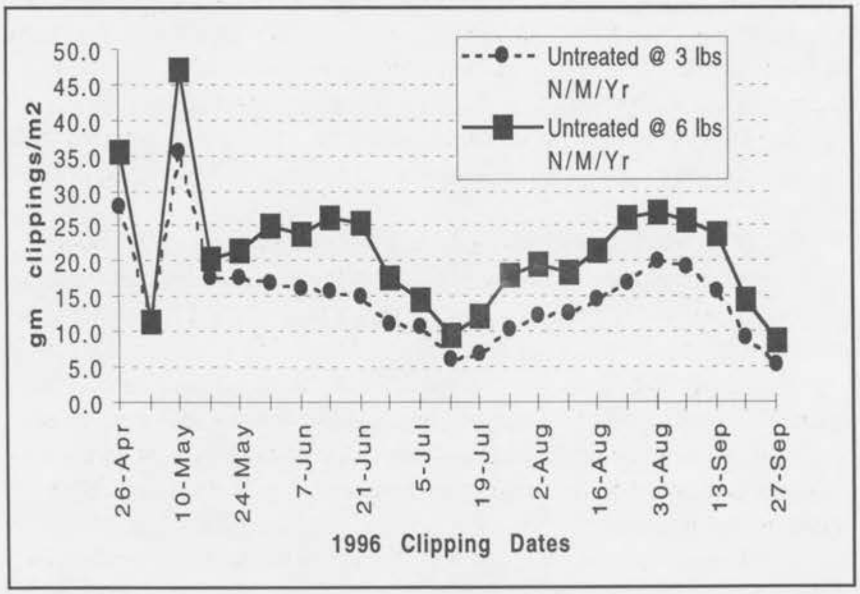
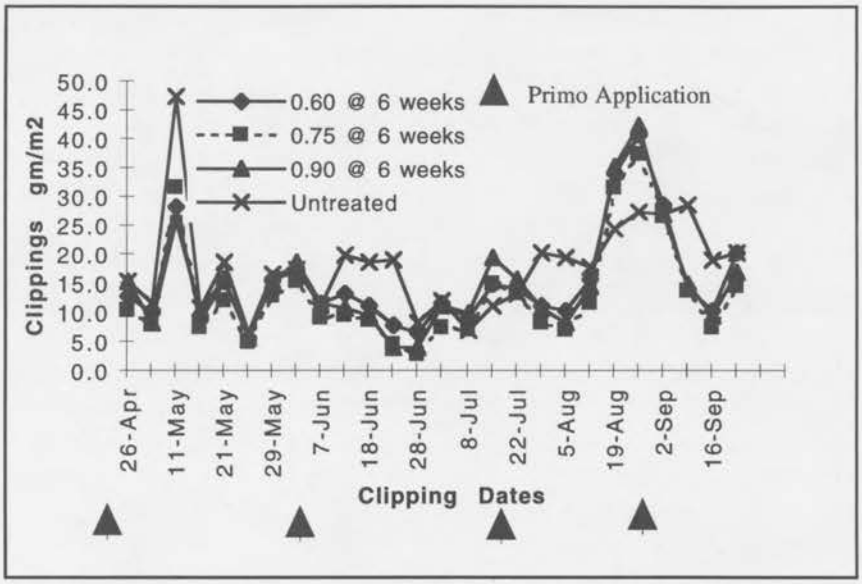


Figure 1. Kentucky bluegrass clippings at two N levels.

application reduced mowing to about 60 percent of normal at two weeks following treatment. Although there is a 50 percent difference in the Primo rate, from highest to lowest, the growth response to differing PGR rates is not that dramatic. These data clearly show a growth rebound following Primo applications, particularly after the second and third Primo applications, with the growth rate of Primo-treated turf approaching the level seen for the control plot during the spring growth

Figure 2. Clipping production with Primo application every six weeks at 6 lbs. N/M.



flush. Some of the spring growth is pushed into the summer months when growth naturally slows. This may be an advantage in terms of turf performance and quality and should not create a problem of excessive clippings.

The data in Figure 3 show that the more frequent applications smooth out the magnitude of growth swings seen with the 6-week applications. However, the more frequent applications seem to provide more growth suppression only at the lowest of the two rates in common at both application intervals. That is, the applications at 0.6 fluid ounce/M/month show significantly less growth suppression than the same rate applied every 6 weeks. However, at the higher rate of 0.75 fluid ounce/M, application frequency had little impact on overall growth suppression.

This study will be repeated in 1997 to gain a more thorough understanding of the response of Primo under home lawn conditions. However, several conclusions can be drawn from these PRELIMINARY results. The reduction in clippings during the spring growth surge can be significant and worth the cost of application. Some advantage may be gained by making the first two applications on 4-week spacings, particularly during an extended spring growth window. However, subsequent applications could be made on 6-week spacings without much difference in performance.

Other research conducted in 1996 focused on weed control in turf. One of the areas that proved most promising was the control of creeping bentgrass in Kentucky bluegrass turf. Creeping bentgrass can be a very aggressive weed outside of a golf course putting green, tee, or fairway where it is a very desirable species. However, many older home lawns and even golf course roughs have been invaded by this species where it can be considered a weed. Selective control of bentgrass with herbicides has proven very difficult. Many people in the industry recommend 2,4-D to kill creeping bentgrass; however, while 2,4-D can injure creeping bentgrass when the bentgrass is under stress, outright

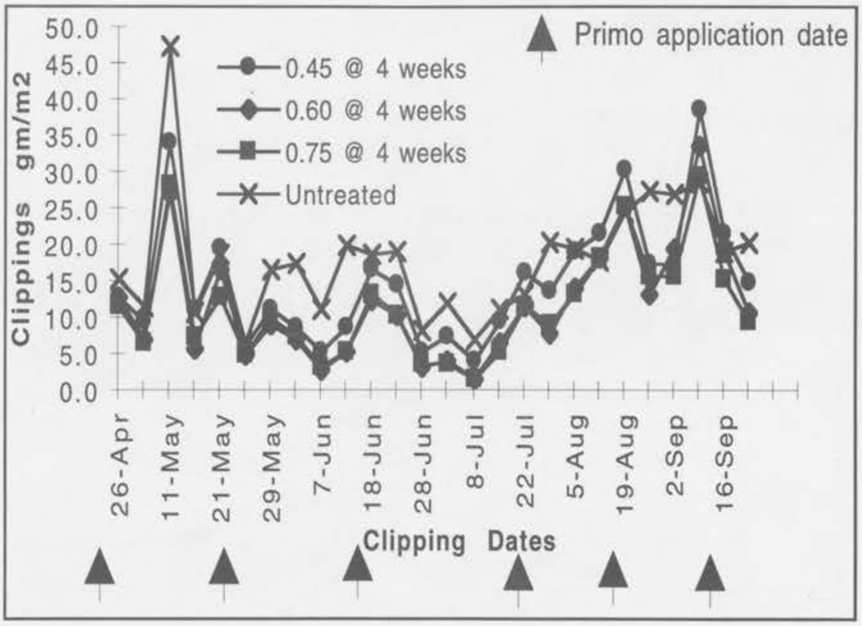


Figure 3. Clipping production with monthly Primo applications at 6 lbs. N/M.

kill is very rare. Creeping bentgrass is difficult to eradicate due to its stoloniferous growth habit. It is difficult for herbicides to kill the entire stolon. Often, injury or even kill of a portion of the stolon only results in cosmetic discoloration, and the plant soon regenerates from the living portion of the stolon.

In 1996, several experiments were conducted with a new herbicide from Rhone-Poulenc called isoxaflutole. When this product was applied to a mixed Kentucky bluegrass and creeping bentgrass turf, the creeping bentgrass was very susceptible to the action of the herbicide. The herbicide causes a bleaching of leaf tissue so that the creeping bentgrass turns white or a straw brown color. Some injury to the Kentucky bluegrass was observed; however, it was of short duration. Rates of 0.18 pounds ai/A applied twice on 4-week spacings resulted in the complete elimination of creeping bentgrass. This product could be used to control creeping bentgrass in Kentucky bluegrass, but creeping bentgrass is so aggressive it usually chokes out all of the desirable Kentucky bluegrass so that when the bentgrass dies, large patches of dead turf remain. Therefore, this product may best be used to keep bentgrass out of an area or to prevent its reinfestation once the majority of the bentgrass has been removed by other means. On golf course roughs, this product could be used once per year to prevent any bentgrass from creeping in and destroying the uniformity of the Kentucky bluegrass rough.

Map-Based Record-Keeping System For Golf Course Superintendents

Tom Fermanian, Sangwook Han, and Claudio Golombek

Introduction

The focus of our efforts in 1996 has been centered in three research projects. Two of the three projects are directed toward assisting with the management of golf course turf. One major effort is continuing through an investigation to measure the impact of plant growth regulators (PGR) on the stress tolerance of bentgrass fairways. This research is in its third year and is the main research supported through the Illinois Turfgrass Foundation (ITF).

A new project was initiated earlier this year that we hope will be the start to our long-term goal of developing a site-specific pesticide application system. The first requirement of reduced or site-specific applications is to map the specific areas that require or receive a pesticide. We are currently building a golf course record-keeping system that maps information to specific areas on a course.

A third project, also underway, expands on earlier research by Tom Voigt. We are building a computer tool to explore National Turfgrass Evaluation Program (NTEP) databases for new information. This tool will simplify our processing of new NTEP data. We will report on these efforts at a later date.

Using Primo™ on Creeping Bentgrass Fairways

Using plant growth regulators on golf course fairways is increasing in popularity. The reasons for using a PGR varies greatly. Some superintendents are seeking mowing or clipping reduction. Others want increased quality and consistency.

If your first objective is increased quality, any phytotoxic effects from a growth regulator limit its use. Some of these phytotoxic effects are the direct result of an application. More often they are the results of a long accumulation of indirect effects. One of these indirect effects might be accumulated stress from a variety of sources.

It would be very useful to have a mechanism for evaluating the current level of general plant stress. One mechanism might be to measure the current level of total nonstructural carbohydrates (TNC) found in the plant. Generally, as TNC levels increase, turf plants tolerate stress better.

A project was started two years ago to evaluate the impact of repeated use of PGRs on general plant health. This research was conducted both in the greenhouse (reported in the *1995 Illinois Turfgrass Research Report*) and on fairway turf at the Urbana research center. In these initial studies a pattern of TNC accumulation and dissipation was discovered. Generally, turf treated with a PGR showed an increase in TNC for the first several weeks. At approximately 4 weeks after treatment, TNC levels began to decrease for at least 8 more weeks, 12 weeks after the initial application.

This past summer we conducted another field study to evaluate the impact of applications of Primo, a gibberellic acid (GA) inhibiting turfgrass growth regulator (TGR). This study was similar to experiments

Primo Experiment Facts

Initial samples taken: May 30, 1996

Initial clippings collected: May 29, 1996

Clippings sampled weekly

Quality observed weekly

Mowing height: 3/4 inch

Compaction treatment: (Mon-Fri) (8 paths each day) in previous years, however, we tried to focus on refining the Primo rate and application intervals. As in previous years, the study was conducted on 'Pennlinks' creeping bentgrass at the Landscape Horticultural Field Research Facility in Urbana. This year we again add stress to one-half of the turf through compaction with a smooth weighted roller. Treatments for this experiment are shown in Table 1.

Table 1. Primo treatments applied to a creeping bentgrass fairway.

Application interval[1]	Application rate[2]	Time interval[3]	Total rate[2]
Single application	0.73	0	0.73
Every 4 week appl.	0.73	0 + 4 + 8	2.19
Every 2 week appl.	0.15	0 + 2 + 4 + 6 + 8	0.73
Every 3 week appl.	0.18	0 + 3 + 6 + 9	0.73
Every 4 week appl.	0.24	0 + 4 + 8	0.73
Control	—	—	—

[1] The initial application (week 0) of Primo was May 31, 1996.
[2] Primo was measured in oz. product/1000 sq. ft.
[3] The time interval was measured in weeks.

Mowing Reduction

The effect that a growth regulator has on clipping production is always of interest to golf course superintendents. We collected clippings once each week during the experiment. Unfortunately, not all of the data has been evaluated. The evaluation of weighed clippings is presented in Figure 1.

There was a measurable reduction in clipping production on many of the Primo-treated turfs from the second week after initial applications through the eleventh week of the study. For the remainder

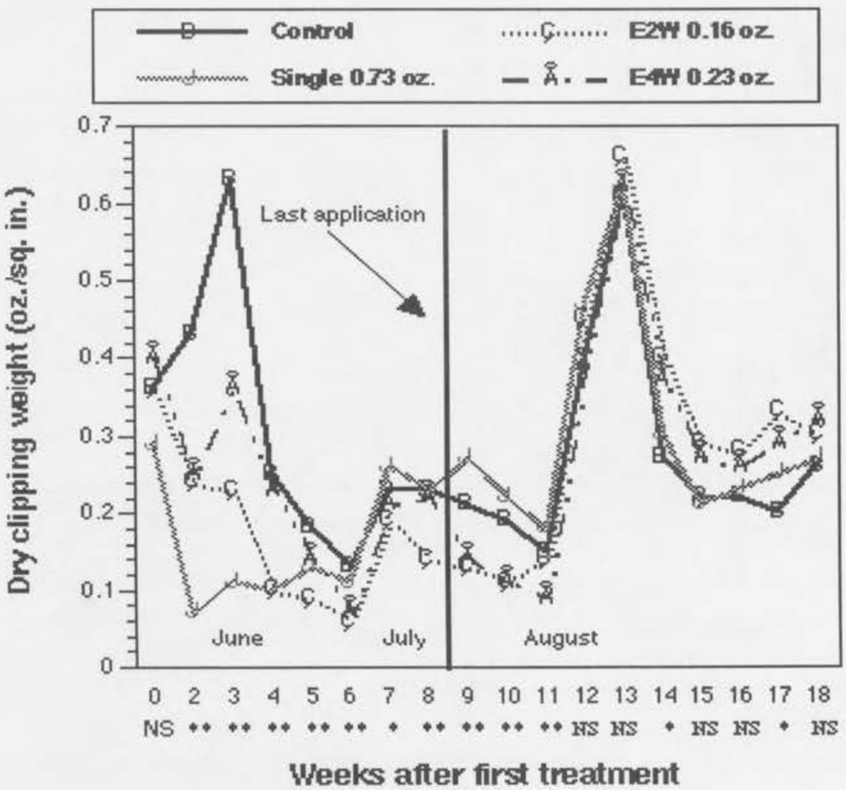


Figure 1. Clipping production from creeping bentgrass treated with Primo.

of the experiment, clipping production on treated turfs was very similar to the untreated control plots.

Turf Quality

While mowing reduction and general plant health are crucial, the overall turf quality is most important. Sometimes TGRs can cause a reduction in quality. An evaluation of overall turf quality was assessed each week of the study. Turf quality was not reduced by any treatment in the study. Any noticeable changes in turf quality were purely seasonal.

Effect of Primo on Carbohydrate Reserves

Samples of the bentgrass verdure were collected each week of the study. Unfortunately, we have only had time to analyze some of the samples. The results of our analysis of TNC levels is shown in Figure 2. A trend similar to ones observed in earlier experiments was found in the results of these analyses. Generally, either no difference or a slight elevation in TNC levels was observed in the first 4 weeks after initial application. This was often followed by a significant depression in TNC levels for up to 15 weeks. This year's results follow earlier observations; however, there were no practical differences in TNC levels during the first 4 weeks. It is noteworthy that a significant depression in TNC was still measured in the 12th week of the experiment.

What Does This Mean?

While we have observed a trend of reduced TNC levels in treated turf over several experiments, it probably is not of great concern. The depressed TNC levels are not very big. Also there have been no reported problems with lower stress tolerance in treated fairways. It might alert you to the possibility of multiple sources of stress contributing to lowered tolerances. Primo and other growth regulators are excellent tools for enhancing fairway quality and offer minimal risk to turf quality.

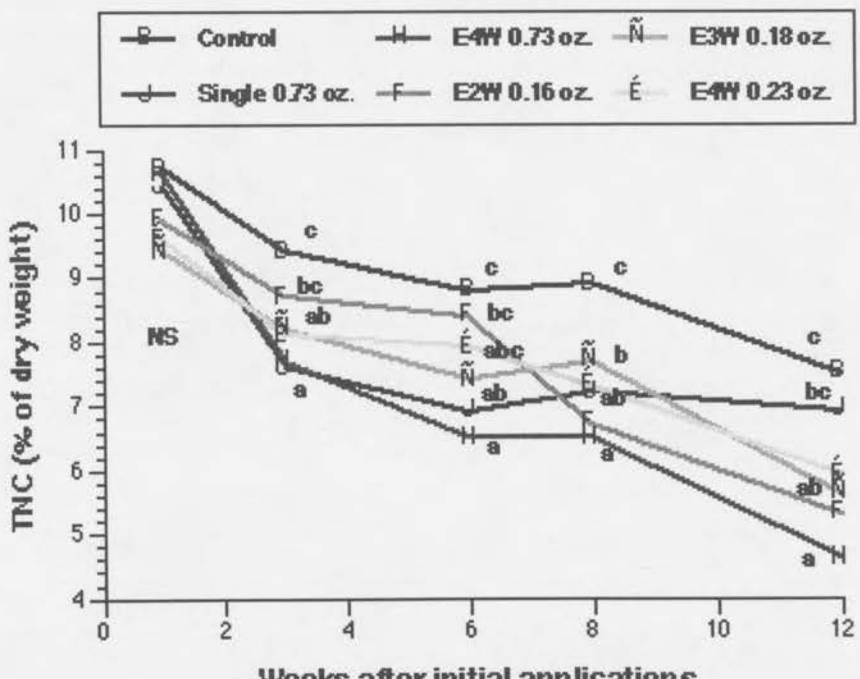


Figure 2. Total nonstructural carbohydrate reserves in creeping bentgrass verdure treated with Primo.

Site-Specific Pest Management

Reduced use of pesticides is a goal of many golf course superintendents. The desire for minimizing pesticide applications is generally twofold. First, public relations often dictate the need to reduce pesticide use even when risks are minimal. This environmental sensitivity is one motivating factor. Another is to reduce the cost of managing fairway turf. We feel this might be the greater driving force. Because of these perceived needs we would like to develop a high-quality, cost-effective system of pest management.

Overview of Research

The development of a functional, site-specific application system will require three distinct research and engineering phases. Initially, a mechanism must be developed that actively senses the need for a direct pest control activity, such as spraying. Secondly, a computer program is needed to map the sensed areas to a representation of the turf area. This program must also develop sprayer instructions that limit application only to specifically selected sites. Finally, a sprayer will have to be modified to interpret the spraying instructions to accurately apply materials to the previously chosen site.

Map-Based Record-Keeping System

Due to financial constraints we decided to begin the research with the development of the computer program. This programming effort, however, was greatly simplified. The main objective of our system was to provide a mechanism for keeping records of fairway pest management. The main difference between our record-keeping system and more traditional approaches is our system links data to specific areas. This link is called a spatial reference.

Current Work

Over the past year a map-based record-keeping system was developed within the geographical information system (GIS) software, ArcView. ArcView can be modified by using a programming language called Avenue. We have modified the standard ArcView program to enable it to search for correct pesticide use and to track pest problems. In addition to organizing and tracking pesticide use on the course, the system can also record local weather data. Weather data can be summarized and displayed graphically. A help system for the program is now being constructed. In the near future we will be seeking turfgrass managers to assist us in an evaluation of the system.

Help Evaluate the System

The real value of the system will only be determined by golf course superintendents. For the system to be useful, it must be understandable by superintendents and provide the functions they need. To achieve these goals, we have designed a two-step evaluation study. Initially, we will evaluate the system on campus with students and university staff. This evaluation will help us to refine the "ease of use"of the system. Then we plan to take the system on the road to have golf course superintendents conduct the final evaluation. If you are interested in participating in this effort, please contact either Claudio Golombek or Tom Fermanian at (217) 244-5147.

Turfgrass Extension and Research Activities

Tom Voigt

My program was involved in a number of extension and research activities during 1996. The program's major extension activities included outreach educational programs and turf information distribution, while turfgrass species and cultivar evaluations highlighted my 1996 research activities.

Outreach Educational Programs and Turf Information Distribution

Four major outreach education activities were emphasized by the turf program in 1996. These activities included working with the 1996 Indiana-Illinois Turfgrass Short Course, the Pesticide Applicator Training Program, the Master Gardener Program, and the 1996 University of Illinois Turfgrass, Nursery, Landscape, and Trial Garden Field Day. In these events, professional and avocational turf managers received up-to-date training in turf selection, management, and pest control. Overall, more than 3,500 individuals received turf training in these, and other, outreach education events in 1996.

The other major outreach function of the program is the distribution of turfgrass information. Timely circulation of turfgrass information appeared in publications such as *Turfgrass Tips* and *Illinois Turfgrass Update*, along with contributions to the *Home, Yard, and Garden Pest Newsletter*. These newsletters, along with articles in the trade publications *Grounds Maintenance*, *Golf Course Management*, and *On Course*, provided an opportunity to reach a wide turf audience.

New for 1997

Several new extension educational programs and turf information distribution services are planned for 1997. A site on the World Wide Web is presently under construction and will begin providing information before January 1, 1997. This site will not only provide access to turf extension advice and publications, but will also provide useful information about all aspects of the University of Illinois turf program, as well as the Illinois Turfgrass Foundation.

In the area of outreach education, the Indiana-Illinois Turfgrass Short Course is also undergoing some changes in 1997. Entering its fourth year, the location of our traditional five-day course has been shifted from Merrillville, Indiana, to the Pheasant Run Resort in St. Charles, Illinois. The move has occurred in an attempt to reach a larger commuter audience than was available in Merrillville. In addition, we have added an entirely new two-day advanced program entitled *Turfgrass Growth Responses to Environment and Management*. This new course will be held concurrently with the five-day program and will also be held at the Pheasant Run Resort. These programs will be held during the last week in February 1997 and will feature turfgrass specialists from the University of Illinois, Purdue University, and the Chicago District Golf Association.

Turfgrass Species and Cultivar Research

The majority of my research program involves University of Illinois activities related to the National Turfgrass Evaluation Program (NTEP). Bentgrasses, Kentucky bluegrasses, tall and fine-leaf fescues, and perennial ryegrasses were all studied in seven different evaluations. The objective of these studies is to determine the suitability of these turfgrasses for use in Illinois.

In two studies, 28 bentgrasses were evaluated in the NTEP Putting Green Trial and 22 bentgrasses were evaluated in the Fairway Trial. In 1996, mowing and fertilization on these trials were altered in an attempt to more closely mimic golf course playing conditions. The fairway-height bentgrass was mowed at 1/2 inch and received 3 pounds of nitrogen per 1,000 square feet per year, while the green-height bentgrass was mowed at 5/32 inch and received 3.75 pounds of nitrogen per 1,000 square feet per year. See Tables 1 and 2 for results of the 1996 evaluations.

Two Kentucky bluegrass trials were planted in September 1995 and evaluated throughout this past year. The high-maintenance trial features 103 Kentucky bluegrasses maintained under golf course fairway conditions (including a mowing height of 7/8 inch). Some very obvious differences, particularly regarding turf color, disease resistance, density, and leaf texture, began to emerge among these grasses during the 1996 growing season. No recommendations are available from this trial; we are not comfortable making recommendations following a single year of study. Several entries in this study performed very well, and it is easy to predict that several of these high-quality Kentucky bluegrasses will find their way onto golf course fairways.

Twenty-one Kentucky bluegrasses comprise the low-maintenance trial in which the entries are receiving very minimal management.

Table 1. Results of 1996 bentgrass fairway evaluation at Urbana.

Cultivar	Color	Density	Mean Quality
18th Green	7.0 d	5.0 a	5.67
BAR AS 492	5.3 ab	5.3 ab	5.39
BAR Ws 42102	6.0 a-d	6.3 b-d	6.44
Cato	6.7 c-d	6.3 b-d	6.38
Crenshaw	6.3 b-d	6.0 a-d	6.06
Exeter	6.3 b-d	5.3 ab	5.34
ISI-At-90162	5.0 a	6.7 cd	5.89
Lopez	5.7 a-c	6.0 a-d	5.84
OM-At-90163	6.0 a-d	5.3 ab	5.78
Penn G-2	6.0 a-d	6.0 a-d	5.99
Penn G-6	5.3 ab	7.0 d	6.96
Penncross	6.3 b-d	5.0 a	6.07
Penneagle	6.0 a-d	5.3 ab	6.57
PRO/CUP	7.0 d	5.7 a-c	5.89
Providence	6.7 c-d	6.0 a-d	5.65
Seaside	6.3 b-d	5.0 a	4.88
Seaside II (DF-1)	6.3 b-d	6.7 cd	6.84
Southshore	6.0 a-d	6.3 b-d	6.72
SR 7100	5.7 a-c	5.7 a-c	5.28
Tendenz	5.7 a-c	6.0 a-d	4.78
Trueline	7.0 d	6.3 b-d	6.34
LSD	1.2	1.1	

Mean quality is the average of the monthly ratings of three replications taken May through October. Quality, is rated on a 1 through 9 scale where 1 = dead turf, 5 = minimally acceptable turf, and 9 = highest-quality turf. For color and density ratings, 1 = light green turf or open turf; 5 = minimally acceptable turf characteristics; and 9 = dark green turf or very dense turf.

Table 2. Results of 1996 bentgrass putting green evaluation at Urbana.

Cultivar	Color	Density	Mean Quality
18th Green	4.3 ab	4.7 ab	5
BAR AS 493	4.0 a	5.7 b-e	4.1
BAR Ws 42102	5.7 c-e	7 ef	5.9
Cato	6.3 e	6.7 d-f	6.1
Century (Syn 92-1-93)	5.0 a-d	7.3 f	6.33
Crenshaw	5.0 a-d	6 b-f	6.33
DG-P	5.0 a-d	6 b-f	5.7
Imperial (Syn 92-5-93)	6.3 e	7.3 f	6.23
ISI-Ap-89150	5.3 b e	6.7 d-f	5.43
Loft's L-93	5.0 a-d	6.3 c-f	6.67
Lopez	5.7 c-e	6.3 c-f	6.43
Mariner (Syn-1-88)	6.0 de	5.7 b-e	5.67
MSUIEB	5.3 b-e	5.7 b-e	6.1
Penn A-1	5.3 b-e	6.7 d-f	6.9
Penn A-4	5.0 a-d	6.7 d-f	6.33
Penn G-2	5.7 c-e	6.7 d-f	6.8
Penn G-6	4.7 a-c	7 ef	6.57
Penncross	5.0 a-d	4 a	6
Pennlinks	5.7 c-e	6 b-f	6.2
PRO/CUP	6.0 d-e	5.3 a-d	6.8
Providence	6.0 d-e	6.3 c-f	6.9
Regent	5.3 b-e	5 a-c	5.3
Seaside	4.3 ab	4 a	4
Southshore	5.7 c-e	6 b-f	6.47
SR 1020	5.0 a-d	6.7 d-f	5.8
Syn 92-2-93	5.3 b-e	7.3 f	6.23
Tendenz	4.0 a	5.3 a-d	3.67
Trueline	4.7 a-c	5.3 a-d	6.2
LSD 0.05	1	1.4	

Mean quality is the average of the monthly ratings of three replications taken May through October. Quality is rated on a 1 through 9 scale where 1 = dead turf, 5 = minimally acceptable turf, and 9 = highest-quality turf. For color and density ratings, 1 = light green turf or open turf; 5 = minimally acceptable turf characteristics; and 9 = dark green turf or very dense turf.

1996 Turfgrass Cultivar Recommendations

The turfgrass cultivars listed below have performed acceptably in trials in Urbana over the past eight years.

The Kentucky bluegrasses and perennial ryegrasses were irrigated to prevent stress, were mowed at 1 and 3/4 to 2 inches, and received 2 to 4 pounds of nitrogen per 1,000 square feet per year. The tall fescue and fine fescue have not been irrigated, have been maintained at 1 and 3/4 to 3 inches, and have received 1 to 2 pounds of nitrogen per 1,000 square feet per year.

These lists should be used to guide turfgrass cultivar purchases and should not be considered all inclusive; cultivars not listed may not have been tested in Urbana trials or may perform well when grown under different management and/or environmental conditions. Seed of some cultivars may no longer be available nor be available in all areas.

Table 3. Recommended fine-leaf fescue cultivars.

Chewings Fescues	*Creeping Red Fescues*	*Hard Fescues*
Barfalla	Aruba	Aurora (endo)
Bridgeport	Dawson	Biljart (C-26)
Jamestown	Seabreeze	Discovery
Jamestown II	Shademaster II	Ecostar
Koket	Nordic	Shadow E
Reliant II	SR 5100	Scaldis
Tiffany		SR 3100
Victory		

Table 4. Recommended improved Kentucky bluegrass cultivars.

Adelphi	Baron	Coventry	Majestic	Rugby
Admiral	Barzan	Cynthia	Midnight	Shamrock
Allure	Bensun (A-34)	Eagleton	Mona	SR 2000
Alpine	Blacksburg	Eclipse	Monopoly	SR 2100
America	Broadway	Enmundi	Mystic	Summit
Ampella	Bono	Estate	Nugget	Sydsport
Argyle	Bristol	Glade	Parade	Trenton
Aspen	Challenger	Julia	Plush	Victa
Banff	Cheri	Limosine	Princeton 104	Washington
Barblue	Classic	Livingston	Ram I	Welcome
Barmax	Columbia			

Table 5. Recommended perennial ryegrass cultivars.

Advent	Caliente	Equal	Palmer	Rival
Allaire	Citation II	Express	Patriot	Runway
APM	Dandy	Gator	Pennant	Seville
Barage++	Dasher	Gettysburg	Pinnacle	SR 4200
Barry	Delray	Goalie	Prelude	Tara
Birdie II	Derby	Manhattan II	Ranger	Target
Blazer II	Diplomat	Omega II	Repell	Yorktown III
Brenda	Elka	Ovation	Repell II	

Table 6. Recommended tall fescue cultivars.

Adventure	Chieftan	Leprechaun	Rebel II	Tomahawk
Apache	Duke	Lexus	Rebel Junior	Trailblazer
Austin	Eldorado	Marathon	Rebel 3D	Trailblazer II
Aztec	Falcon	Mesa	Silverado	Trident
Bonanza	Finelawn	Monarch	SR 8200	Vegas
Bonanza II	Finelawn 88	Montauk	SR8210	Virtue
Bonzai Plus	Finelawn Petite	Mustang	SR 8300	Wrangler
Brookston	Jaguar II	Olympic	SR 8400	
Cafa 101	Jaguar	Pyraamid	Sundance	
Carefree	Legend	Rebel	Thoroughbred	

New Research Areas

During the latter parts of the 1996 growing season, my program was involved in two new research evaluations. First, a new NTEP tall fescue evaluation was planted in September. In this trial, 130 different tall fescues will be evaluated for their suitability under low-maintenance management in Illinois. This evaluation will be ongoing for 3- to 5- years.

In a second study, we have identified an individual plant of sand bluestem (*Andropogo hallii*) from our block of native grasses worthy of further evaluation as an ornamental grass. This plant appears to have a refined habit and reliable and outstanding autumn color worthy of further study and potential clonal release. Now it is being propagated asexually so that it may be evaluated in a variety of settings.

Summary

In closing, 1996 has been an exciting and active year in my turf extension and research programs. Much has been done to upgrade our outreach educational programs and information distribution services. Plans are underway for the continued development, growth, and improvement of these activities for 1997. The program's main research focus will continue to be in the area of evaluating and cataloging turfgrass species and cultivar data. The results of these trials provide useful and important information for Illinois turf managers. The addition of evaluations of unusual grass species and management techniques will expand these activities in 1997.

Take-All Patch Research at the University of Illinois

Hank Wilkinson, Randy Kane, Hanafy Fouly, Loretta Ortiz, Dianne Pedersen, and Fern Siew

Introduction: Take-All Patch (TAP) on Creeping Bentgrass

TAP is not a new disease, but it is more prevalent in the Midwest each year due, in part, to an increased use of sand root zones and greater areas of golf courses planted to creeping bentgrass. The disease was originally identified on golf courses in the Northwest United States. It generally was thought to be limited to the northern corners of the United States and Europe, but now we know that it can attack bentgrass anywhere if climatic conditions are right.

Point One: Take-All Patch Is Found Only On Creeping Bentgrass!

We don't know why this disease is limited to bentgrass turfs, but we hope to determine this in the future. The fungus that causes TAP is *Gaeumannomyces graminis* var. *avenae*, or GGA, which to most golfers means nothing, but to turf pathologists the Latin name tells us that it is a soil-borne fungus found in most soils. We have found this fungus all over Illinois, the northern half of the U.S., and Europe. We would like to search for it in Australia, but we have not bothered to ask the Illinois Turfgrass Foundation (ITF) for permission! As a soil fungus, it is very well adapted to survive the hard winters and summers of Illinois, and it will attack and kill the roots, crowns, and stolons of bentgrass. Further, we know that it can be moved in soil, turf, and cores but not by water, shoes, or mowers.

Point Two: The Disease Is Moved In Soil, Not In Clippings Or On Tires!

Our research has determined that soil temperature is the single most important climatic factor which controls the development of this disease. For example, we know that at a temperature of about 55°F (12°C) this fungus is colonizing the roots of bentgrass. First, it is important to know that the soil temperature we refer to should be measured at a depth in the soil where most of the new bentgrass roots will be found. In general, most of the new bentgrass roots are found in the upper 2 inches (5 cm) of the turf (not very deep). Roots originate from nodes on the crowns and stolons of the bentgrass, and it is the new roots that are attacked by the fungus when the soil temperature is 55°F. Temperatures will increase and decrease each day (diurnal fluctuations for you U. of I. grads!). It is best to measure the soil temperature when it is half way between the high and low temperature for a day, i.e., the average temperature, which occurs at about 11:00 A.M. (local time).

Point Three: When The Soil Temperature At A Depth Of 2 Inches Is 55°F, Take-All Patch Is Active.

Once the soil temperature reaches 55°F, the fungus will be warm enough to grow and infect grass roots, but there are some mitigating circumstances. First, the soil must be moist but not saturated. This condition is usually present in the spring or with irrigation. Second, the length of time that the soil is both warm and wet enough for disease development will determine how severely the grass roots will be infected.

Point Four: Long, Cool, Wet Springs Are Ideal For Take-All Patch!

However, simply having cool, wet conditions is not enough. There must be some stress on the turf after it is infected, but not much is needed. If a cool, wet spring is followed by a dry period, then the symptoms of the disease will appear. The severity of the disease is determined by a combination of how long the cool and wet conditions last and the extent of the subsequent stress. The take-all symptoms will continue to be seen for as long as both the fungus and the stress are present. The fungal growth slows down dramatically as the soil temperature reaches 75°F (22°C) or when the soil becomes quite dry. However, superintendents usually do not let a turf become moisture stressed before they turn on the irrigation. Once the fungus has stopped growing, the turf will recover from the symptoms by growing new roots, crowns, stolons, and leaves.

Point Five: The Red-Orange Leaves Often Used To Identify Take-All Patch Are Not Infected; They Are Just Showing Signs Of the root, Crown, And Stolon Infections.

In Illinois, you do not see take-all patch in the summer months! If someone tells you this, they are probably not a U. of I. alumnus! However, it is possible for a pathologist to find the take-all fungus on your roots during most of the year, so be careful when you send a sample to a laboratory and ask them if it has take-all!

Point Six: It Is Best To Call Us If You Have A Take-All Patch Problem. Through Your Support, Illinois Has Become The Best Laboratory In The World For The Diagnosis And Management Of Take-All!

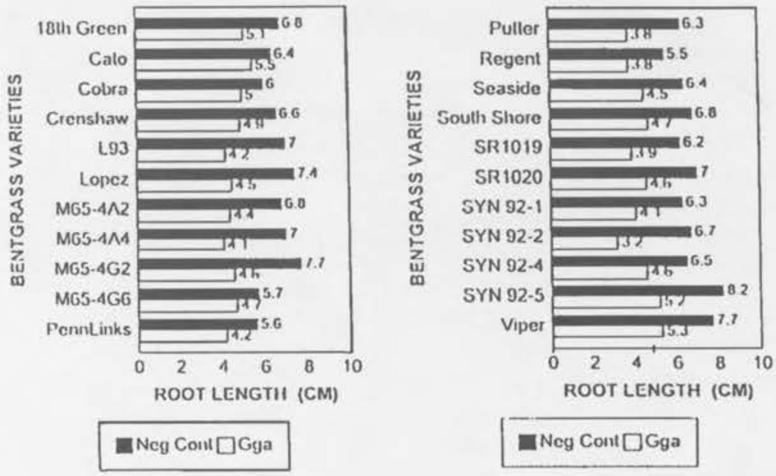
What happens in the fall when the soil temperatures cool from 75 to 55°F? It is quite simple: new turf roots are growing, and the temperature is correct for infection, but there must be sufficient moisture for infection to take place. Furthermore, you are unlikely to see the symptoms of take-all in the fall, because there is usually little stress on the turf once the soil temperatures have fallen between 55 and 75°F. However, just because you don't see take-all patch doesn't mean your grass roots are not being infected. The infections developing in the fall could predispose the turf to more severe winter kill, snow mold, and take-all next spring.

Point Seven: In The Fall, When The Soil Is Moist, New Roots Are Being Infected, But You Probably Won't See Symptoms!

Research on the Fungus that Causes Take-All Patch

Support from the ITF and "turfers like you" has allowed us to investigate the diversity of the fungus that causes take-all patch. WHO CARES ABOUT DIVERSITY? Diversity means difference, and just like people, fungi differ even within the same group. Recall that take-all patch is caused by GGA, but our research has found that not all GGAs are alike. We have collected hundreds of samples of turf from Illinois and the world. From each sample, we isolate GGA and study the DNA. We have learned that there may, in fact, be at least two different groups of GGA. Each group can be expected to behave differently. These differences are being studied for their sensitivity to fungicides, critical temperatures for development, and differences in ability to attack the

Figure 1. Resistance of 22 creeping bentgrass varieties to take-all patch: root length measurements.



numerous varieties of bentgrass. Further, our research has developed DNA probes that will allow rapid identification of GGA in a sample that you send us.

Point Eight: DNA Can Be Used To Rapidly Identify GGA From Infected Turf!

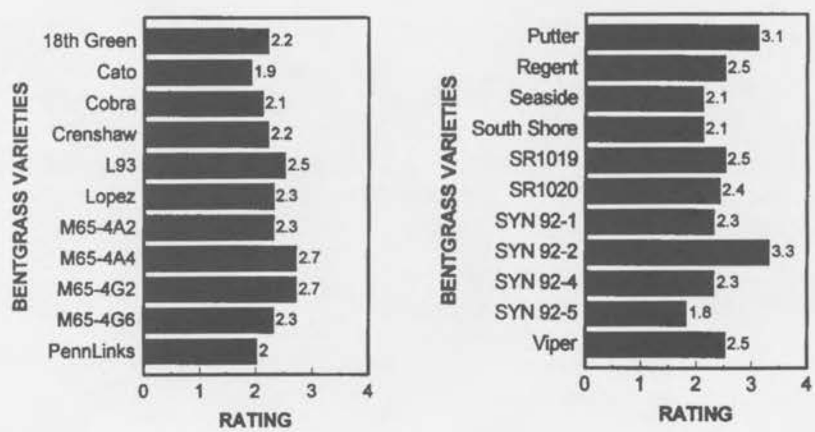
Knowing your turf is terminally ill from take-all is the first step, but knowing how to cure it is more critical. We have developed two fronts toward improving your ability to manage take-all patch: genetic-resistance evaluations and fungicide programs.

Genetic Resistance Among the Varieties of Creeping Bentgrass

We have examined 22 varieties of bentgrass for resistance to take-all (Figures 1 and 2). Resistance to root-rotting fungi, like GGA, is complicated. For a bentgrass to have really "good" resistance or resistance that you, the superintendent, can see, it must have resistance to infection, resistance to stress, and good recovery growth after infection. The data in Figures 1 and 2 show how GGA reduces the root length and increases the disease severity. GGA reduces the length of new bentgrass

Figure 2. Resistance of 22 creeping bentgrass varieties to take-all patch: quality ratings.

0 = no disease
4 = dead turf



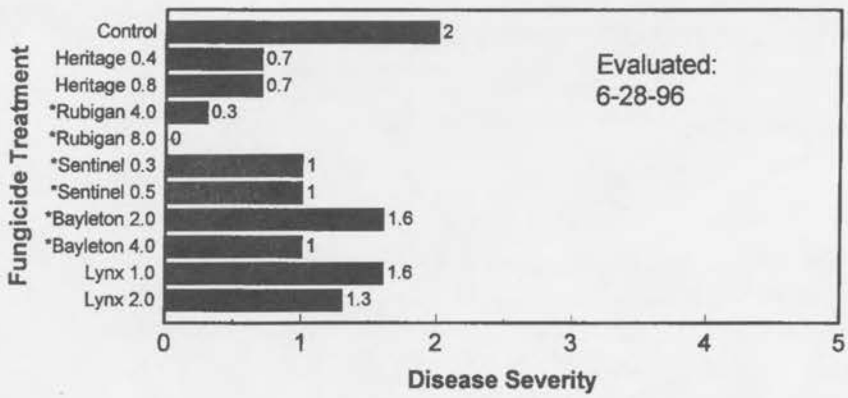


Figure 3. Fungicide control of take-all patch on a bent-grass fairway.

***Fungicides initially applied in Fall, 1995**
All fungicides applied in Spring, 1996
Disease severity: 0 = no disease, 5 = many patches and severe

roots, but not all bentgrasses produce the same amount of roots. Variety SYN 92-5 grows the longest roots and appears to resist the fungus well. SYN 92-2 produces long roots when GGA is not present, but when GGA attacks the roots they are reduced by more than half. Penn Links does not produce the longest roots, but it also does not suffer greatly from GGA. The ratings in Figure 4 show how the bentgrass varieties suffer stress from infection. The worst is SYN 92-2. When infected with GGA, it basically shuts down and the leaves turn brown. The best varieties were SYN 92-5 and Cato. It will take time to sort out which varieties are the best in the field, and it will take even more time to produce new and more resistant bentgrasses.

Fungicide Programs for Controlling Take-All

By using the correct timing of fungicide applications (spring and fall), knowing where the fungicides must be applied for effectiveness, and knowing which fungicides are effective against GGA, you can manage take-all. Consider the following for your fungicide program:

1. Correct timing: apply fungicides when the average 2-inch-deep soil temperature is 55°F in spring or 75°F in the fall.
2. Target for action: the fungicides must reach the crown-root zone; use a lot of water!
3. Fungicides are always being studied to determine the most effective ones available. The current fungicides that have been effective are listed in Figure 5. Only Rubigan and Bayleton are specifically labelled for action against take-all patch.

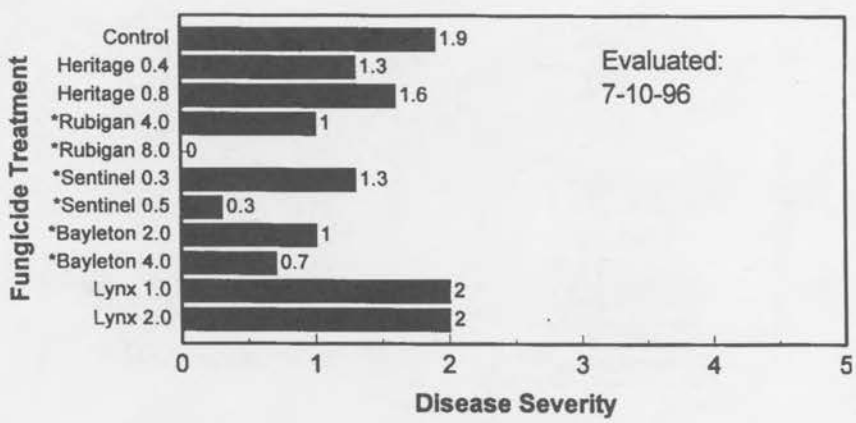


Figure 4. Fungicide control of take-all patch on a bent-grass fairway.

***Fungicides initially applied in Fall, 1995**
All fungicides applied in Spring, 1996
Disease severity: 0 = no disease, 5 = many patches and severe

Southern Illinois University Turf Expands Into Soils Research

Kenneth Diesburg and She-Kong Chong

Our Influence Overseas

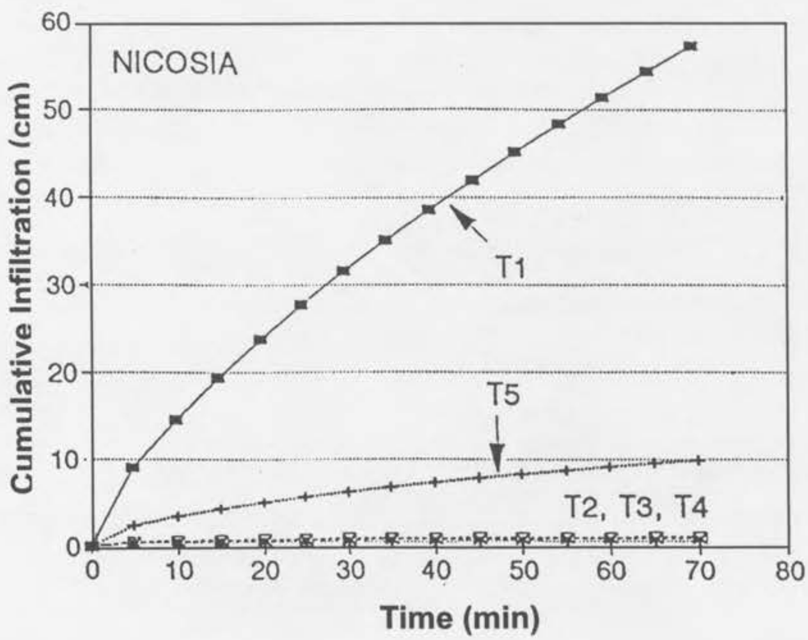
In 1993, a bright young student from Cyprus, Chrystalla Constantinou, attended my turfgrass class. She had come to Southern Illinois University-Carbondale because of a track scholarship. By the end of the term, she realized that working with turfgrass was a way she could merge the unlikely partners of athletics and plant science by exploring a way to improve the turf athletic fields of her country. The combination of Mediterranean climate and poor soils in Cyprus makes it difficult to maintain a vibrant turf throughout the year. It became obvious to Chrystalla that a constructed rootzone with irrigation was the way to go.

Chrystalla was accepted as a graduate student in turfgrass research at SIU-C. She proposed, as her thesis, to evaluate indigenous sources of organic matter and sand compared to soil, regarding their value in a constructed rootzone for athletic turf. Cyprus is an island country of limited resources in the northeast corner of the Mediterranean Sea. Its popularity as a winter practice area for the soccer teams of northern Europe is growing. The cost of importing rootzone components is prohibitive, so it is necessary to develop a viable turf construction and management program for athletic turf in Cyprus.

The upshot of our project, besides the opportunity of working in Cyprus, was that we discovered a valuable new source of organic amendment to sand-based rootzone for the turf: crushed olive pits. After the oil has been pressed out, an excellent combination of available nitrogen and potassium and coarse sand-sized particles of decomposi-

Figure 1. Water infiltration rates in constructed rootzones at Nicosia, Cyprus, 1994.

T1 = 100% soil (So), T2 = 95% So + 5% chicken manure (CM), T3 = 90% So + 10% CM, T4 = 75% sand (Sa) + 10% CM + 15% So, T5 = 75% Sa + 10% crushed olive pits + 15% So.



tion-resistant olive pits remains. The other source of organic matter, chicken manure, failed to be of value in soil and performed poorly in sand during the hotter part of the growing season. Apparently, it plugs the macropores in both soil and sand rootzones, thereby limiting water infiltration and rootzone air exchange. Figure 1 shows the superior water infiltration rate of sand amended with soil and crushed olives. Figure 2 shows the superior turf quality associated with that rootzone.

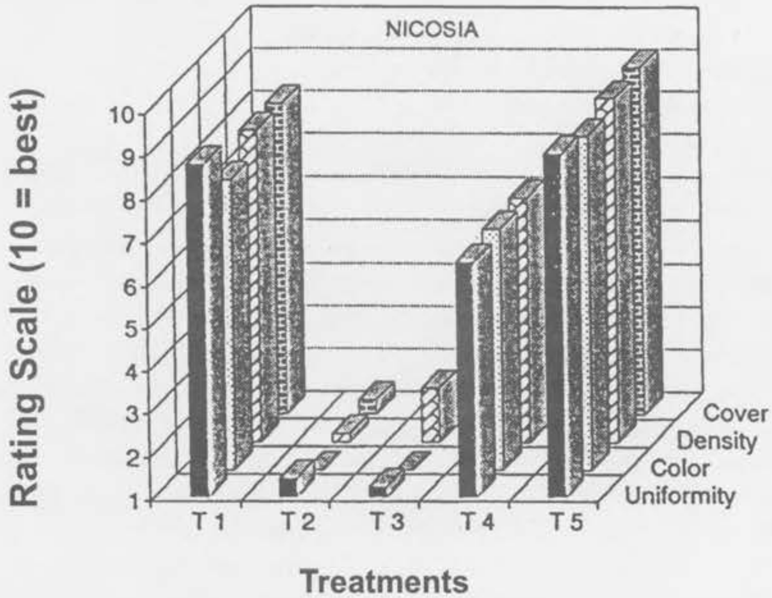


Figure 2. Averaged seasonal turf qualities in constructed rootzones at Nicosia, Cyprus, 1994.

T1 = 100% soil (So) T2 = 95% So + 5% chicken manure (CM), T3 = 90% So + 10% CM, T4 = 75% sand (Sa) + 10% CM + 15% So, T5 = 75% Sa + 10% crushed olive pits + 15% So.

All rootzones in the experiment were mowed, compacted, and irrigated equally and fertilized with 1 pound nitrogen per 1000 square feet per month through the growing season. Figures 1 and 2 were created from data gathered from two identical experiments at different sites in Cyprus. Soil by itself performed well, but it has proven to be inadequate for athletic turf. As a clay loam soil with low organic matter, it compacts and loses its structure under high-traffic sports conditions.

Four New Rootzone Projects

An important outcome from the Cyprus project was the stimulation of interest from our soil physicist, Dr. She-Kong Chong, in constructed and amended turf soils. He is now devoting 90 percent of his time to turfgrass soils research.

The 80:20 or 90:10 sand:peat rootzones that are used most commonly constructed rootzones are failing to provide the appropriate combination of adequate water retention in the shallow portion of the rootzone along with enough air space in the deep portion of the rootzone. There is a syndrome called 'summer bentgrass decline' that is common in the transition zone and was prevalent in northern Illinois during the summer of 1995. It appears to be the outcome of a combination of high soil temperature, high relative humidity, low air movement, water-logged sand-based rootzone, and activity from a variety of pathogens in bentgrass putting green. Fungicides, irrigation, and syringing are ineffective in totally preventing summer bentgrass decline. Dr. Chong and I theorize that a sand amendment better than peat is needed. This improved sand amendment should provide water retention inside its porous particles and less water retention on the outer surface of its particles. Its particles should also be hard and fracture resistant with size and density closer to that of sand. Peat retains too much water on its outer surfaces. Also, its particles are very light with a large percentage of them being small enough to move within the rootzone, between sand particles, and aggregate in layers, thus decreasing water infiltration. A properly amended sand-based rootzone would provide enough reserve moisture in its shallow portion and enough air in its deeper portion to give bentgrass roots the opportunity to grow more deeply during the summer.

In testing our theory, we have initiated the following soils projects:

Comparison of 'Profile' porous ceramic to Canadian and Dakota peats as amendments in a sand-based practice putting green.

The green is being constructed this fall at Rend Lake Golf Course. It will have three separate rootzones, each containing one of the above amendments. Each rootzone will have its own drainage field lined with plastic. This will allow us to measure water retention and movement of pesticides or nutrients out of the green. Across the three rootzones, three cultivars of bentgrass will be compared: Penncross, Crenshaw, and A-4. The cultivar, A-4, is one of the most recent generation of bentgrass cultivars having extra high shoot density plus heat tolerance. Golf course superintendents virtually never have an opportunity such as this green will provide; the ability to compare rootzones and cultivars, side-by-side, in an actively played and managed green. The green is large enough to allow us to remove one rootzone, once we are finished studying it, while leaving the other two for daily play.

Construction of a lysimiter area for evaluation of experimental rootzones for soil and water properties and fate of nutrients and pesticides.

The area is larger than a football field (over 80,000 square feet) at the Horticulture Research Center at SIU-C. When it is finished, it will have the capacity to hold over 100 lysimiters. We presently have 20 lysimiters constructed and waiting to be installed. The rough grade has been set, the fine grade and seed bed are being prepared, and turfgrasses will be established during fall, 1997.

Laboratory evaluations of the effects of organic materials compared to peat on sand-based rootzone properties.

Chang-Ho Ok joined us from Korea as a graduate student in August, 1996. He is presently working on the hydrologic characteristics of sand-based rooting mixtures amended with various amounts of earthworm casting and a biologic derivative from steer manure.

Testing crumb rubber as an amendment to native soil in athletic turf.

Discarded automobile and truck tires are a waste and pollution problem. Transforming them into shredded and crumbed rubber makes them a valuable resource. Dr. Trey Rogers of Michigan State University did some pioneering work with crumb rubber in sand-based rootzones. Several popular articles have been published of his work. We plan to perform similar tests in native soil. The goal is to improve the resiliency of turf under intense athletic play. Laboratory experiments will be conducted this winter to zero in on the proper grade and concentration needed to significantly improve soil properties after compaction. In 1997 we plan to begin testing the best combinations of grade and size in two new soccer and track-and-field facilities at SIU-Edwardsville. We are receiving a grant of $144,000 over two years from the Illinois Department of Commerce and Community Affairs to conduct this research.

Your investment in turfgrass research in Illinois over the years is paying off. It provides the basis from which we can solicit outside grants. From turfgrass research at Southern Illinois University:

1. You have gained a new tall fescue cultivar, 'Pyramid', that is tolerant to the summer stresses unique to the moist, continental, transition zone.

2. You have supported the identification of cultivars within all the turfgrass species that are best adapted to the transition zone climate.

3. You are gaining a new turfgrass growth regulator for cool-season turfgrasses, Ethrel. Rhone-Poulenc is considering labelling for cool-season turfgrasses.

4. You have received a method of early-season establishment of seeded zoysiagrass by using plastic cover.

5. You now have greater volumes of zoysiagrass seed available because of the use of chemical seed scarification methods adopted within the USA. The methods were pioneered by Dr. Portz with his Korean colleagues; Dr. Yeam, Dr. Ahn, and Dr. Choi.

We thank you for your support.

Acknowlegements

We wish to thank the following companies, and organizations for their support of our turfgrass research programs during 1996. Much of our success depends on the generous support of industry through contributions of time, materials, or funding. If your organization provided support in 1996 and was not listed, please contact Tom Voigt.

A-G Turf Farms
Abbot Labs
AgrEvo, USA
Aimcore
American Cyanamid, Inc.
Arkansas Valley Seed Co.
Authur Clesen, Inc.
BASF Corp.
Baker Seed Co.
Belleville Seed House
Benck's Turf Nursery
Beverly Country Club
Bladerunner Farms, Inc.
BioPlus Mfg., Inc.
Cannon Turf Supply, Inc.
Cantigny Golf Course
Cardinal Creek Country Club
Central Illinois Golf Course Superintendents Association
Central Illinois Power Service
Central Sod Farms, Inc.
Champaign Country Club
Chicago Botanic Gardens
Chicago District Golf Foundation
Chicago Manufacturing Center
Chicagoland Golf Course Superintendents Association
Ciba Corp.
Club Car
Coon Creek Sod Farms
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MPR Supply
Medalist America
Mid American Sod Producers Association
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Midwest Association of Golf Course Superintendents
Miles Incorporated
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Mueller Farms, Inc.
Munie Outdoor Services
National Turfgrass Evaluation Program
National Turfgrass Federation
Nature Safe
Neogen, Inc.
Northwest Illinois Golf Course Superintendents Association
NOVCO
O.M. Scott & Sons Co.
Ocean Organics
Olsen-Fennel Seed Co.
Olympia Fields Country Club
Outdoor Equipment, Inc.
PBI-Gordon
Pickseed West, Inc.
Possibility Place Nursery
Professional Turf Specialties, Inc.
Pure Seed Testing
Quality Turf Nurseries
Red Hen Turf Farm, Inc.
Rend Lake Golf Course
Rhone-Poulenc Ag. Co.
Riverside Golf Club
Rohm & Haas Company
Rolawn Turf Nursery of England
Ruth Lake Country Club
Sandoz Crop Protection
Schaafsma Sod Farm
Seed Research of Oregon, Inc.
Silver Lake Country Club
Southern Illinois Golf Course Superintendents Association
Southern Illinois Grounds Maintenance Association
Southern Illinois Nurseryman's Association
Southern Illinois University, College of Agriculture
Southern Illinois University, Physical Plant
Spraying Systems Co.
Summit Seed Company
Tee-2-Green Corp.
Terra/Androc, Inc.
Terra International
Toro Co.
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Turf-Seed Inc.
Tyler Enterprises, Inc.
University of Illinois, College of Agriculture Experiment Station
University of Illinois Extension Service
University of Illinois, Grounds Department
University of Missouri
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Warren's Turf Nursery
Zeneca Incorporated

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Southern Illinois University Department of Plant and Soil Science	Doug Bogard Dr. She-Kong Chong Todd Deitz Dr. Kenneth Diesburg Brett Hendren Chang Ho Ok Grant Holliman Steve Hughes Justin Kreid Tim Murray Matt Paulin Bob Paulson Jason Vogel Tim White	

Illinois Turfgrass Calendar of Events

Southern Illinois University Turfgrass .... August 19, 1997
Field Day

1997 University of Illinois Turfgrass,............................... August 20, 1997
Landscape, Nursery, and Trial Garden
Field Day

1997 North Central Turfgrass Exposition......................... December 1 - 4, 1997

Indiana-Illinois Turfgrass Short Course .... February 23 - 27, 1998

For information about these events, or to obtain additional copies of this report, contact:

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