2003
Illinois Turfgrass Research Report

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

Turfgrass Series # 11

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December 2003

Greetings!

The turf faculty, staff, and advisors at the University of Illinois, Southern Illinois University, and Chicago District Golf Association are happy to bring you the NCTE edition of the *2003 Illinois Turfgrass Research Report*. This report contains brief summaries of programs conducted across the state of Illinois. We hope the report provides you with an insight into the diverse activities that are ongoing to provide you with the latest in turf management techniques and technology.

We sincerely 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, and moreover, the **ITF** also sponsors many fund-raising activities that help make this research and education possible. In 2003, the support provided by the **ITF** is particularly important given shrinking state budgets and industry consolidations. Overall, without the **ITF**, it would be difficult to maintain the high-quality turfgrass research findings and educational events turf managers in Illinois currently enjoy.

We also sincerely thank the many supporters and contributors to all of our programs. They will be recognized individually in the final version of the report. These supporters and contributors are committed to advancing the science of turfgrass management in Illinois by supporting educational activities for the betterment of the industry. They have been loyal supporters to our programs and are critical for our success.

This publication gives us an opportunity to share information about the myriad of research activities we are involved in. Some of the information herein may only provide findings from a single growing season and be considered to be preliminary. Other information provides final research results. To provide this information in a meaningful fashion, we have developed a summary format. Each brief article provides the highlights and impacts of the author's activities. With this format, we hope it is easier to draw a "take home" message from the activities that can be more directly applied to your turf management activities.

In addition to this printed copy of the report, an electronic version was produced and is available for viewing on the University of Illinois Turfgrass Program Web Site (*www.turf.uiuc.edu*). Along with the *2003 Illinois Turfgrass Research Report*, research reports from previous years, back to 1989, are also available.

We hope you find this information useful and wish you the best in the upcoming season!

2003 ITF Advisors -
Bruce Branham, Ken Diesburg, She-Kong Chong,
Tom Fermanian, Andy Hamblin, Randy Kane, Tom Voigt, and Hank Wilkinson

2003 Turf, Un-Mowed Rough, Landscape, and Biofuel Grass Evaluations

Tom Voigt, Gary Eifert, Doug Pool, John Tallarico, Emily Heaton, and Rich Pyter

Turfgrass Studies

In 2003, Gary Eifert began a field study to determine the potential of colonial bentgrass (*Agrostis capillaris*) for Illinois golf course fairways and also a study in which he is monitoring the quality of mixed colonial bentgrass-creeping bentgrass (*A. palustris*) fairways. Glory and Tiger II colonial bentgrasses performed well in the recently completed 1998 National Turfgrass Evaluation Program Fairway Bentgrass Trial. Colonial bentgrasses are of interest for fairway planting because this species is generally considered to require less maintenance and is less troubled by dollar spot than creeping bentgrass. Colonial bentgrasses are, however, more susceptible to brown patch.

Plots of Glory and Tiger II colonial bentgrasses were planted in September 2002 using a strip plot design with four replications. Beginning in April 2003, three mowing and three fertility treatments were imposed. The plots were irrigated as needed and received no pesticide applications. The fertility treatments were one pound, two pounds, and four pounds of actual N per 1,000 ft.^{2} per year, and the mowing treatments were the 1/2", 11/16", and 7/8". The plots were rated every two weeks for fairway quality using a scale of 1 – 9 where 1 equals dead turf, 9 = perfect turf, and 5 equals minimally acceptable fairway turf quality. The percent of plots covered by brown patch was also recorded.

Following the first year of study, the quality of the Glory colonial bentgrass plots were superior to those of Tiger II colonial bentgrass, and the Glory plots that received four pounds of actual N per 1,000 ft.^{2} per year and were mowed at either 1/2" or 11/16" had the highest mean quality over the 2003 growing season, while, the lowest rated plots over the same time period were the Tiger II plots that received one pound of actual N per 1,000 ft.^{2} per year and mowed at either 7/8" or 11/16". In addition, the Glory plots generally had less severe invasions of brown patch. At the August 15 rating, the Glory plots that received two pounds of actual N per 1,000 ft.^{2} per year and mowed at 11/16" averaged 22.5% brown patch coverage, while at the other extreme, the Tiger II plots that received two pounds of actual N per 1,000 ft.^{2} per year and were mowed at 1/2" averaged 71.25% brown patch coverage.

The colonial/creeping bentgrass mixture studies were also planted in September 2002 and received two pounds of actual N per 1,000 ft.^{2} per year and mowed at 1/2". The mixes in this study were based on seed weight, and the six treatments in this study are Tiger II colonial bentgrass (100%, 95%, 90%, 75%, 50%, and 0%) mixed with Providence creeping bentgrass (0%, 5%, 10%, 25%, 50%, and 100%) respectively. Quality ratings were made monthly using a scale of 1 – 9 where 1 equals dead turf, 9 = perfect turf, and 5 equals minimally acceptable fairway turf quality. Following the 2003 growing season, the highest rated plots were those of 50% Tiger II colonial bentgrass and 50% Providence creeping bentgrass, while the lowest rated plots were the 100% Tiger II plots. Both of these studies will continue through the 2004-growing season. The final results for both of these studies will appear in next year's Illinois Turfgrass Research Summary.

Finally, three NTEP trials were planted in Urbana in 2003 and two were planted at Midwest Golf House in Lemont. In Urbana, Bentgrass Fairway, Bentgrass Putting Green, and Fine Fescue Trials were planted. In Lemont, Bentgrass Fairway and Fine Fescue Trials were planted.

Un-Mowed Rough Studies

A large amount of research has recently been devoted to studying the suitability of grasses and forbs for planting in un-mowed rough areas. In a recently completed study sponsored by the Central Illinois Golf Course Superintendents Association and Golf Course Superintendents Association of America conducted at the U. of I. orange golf course in Savoy, 9 grasses were evaluated in large (120 ft^2) plots. Redtop, orchardgrass, 'Kentucky 31' and 'Millennium' tall fescues, a fine fescue blend, and Timothy were seeded in Autumn 2000. We found that these grasses required nearly a year to completely cover the plots, but all were successfully established by seeding, flowering commenced in Spring 2002, and the fine fescue blend was the most attractive of any of the seeded cool season grasses each year through mid summer. By late summer, however, this foliage had been matted down and was in need of mowing. In addition, we learned that orchardgrass and Timothy are too tall for anything other than very far-roughs and all of these grasses tolerated an application of clopyralid (Lontrel) to control Canada thistle. Finally, these grasses should be mowed once a year in late summer/early autumn or twice a year in early/mid spring and late summer/early autumn. In the potted grasses (side-oats grama, switch grass, little bluestem) planted in this study, have not been able to compete with cool season weeds in spring and autumn because the grasses are dormant at that time, the, rust-red little bluestem foliage in autumn was the most ornamental aspect of the study during the late growing season, and switchgrass (4' - 6') and little bluestem (3' - 4') may be too tall for some un-mowed out-of-play areas. Also, there was no phytotoxicity caused by the application of clopyralid (Lontrel) and these grasses should be mowed or burned in spring prior to the onset of growth.

In 2003, several new studies were initiated with the goal of identifying plants and management methods for un-mowed *playable* roughs. At Midwest Golf House, Doug Pool is working with a tall and a fine fescue that have tolerance to applications of Round-up. Weed control can be achieved by periodical applications of glyphosate, and when planted at low densities, these grasses can be open enough to be playable. In another of Doug's playable un-mowed rough studies, warm season grasses, primarily blue grama and buffalograss, are being evaluated.

Landscape Grass Studies

John Tallarico is presently completing his M.S. thesis dealing with several ornamental grass studies. In the first study, we identified a big bluestem (*Andropogon gerardii*) suited to landscape planting. 'Prairie Chief' big bluestem was selected because of its upright, slightly open habit, and its autumn coloration of various combinations of red, purple, and orange can occur. Fall colors typically remain effective for three weeks or longer. In a second study, the tolerances of 15 ornamental grasses to the preemergence herbicides isoxaben (Gallery) and isoxaben + trifluralin (Snapshot) were evaluated. Overall, both herbicides appear to be safe for application on the ornamental grass species tested. Based on our research, we would not exclude any species in our tests from the isoxaben and isoxaben + trifluralin labels at the current label application rate. In a third study, John evaluated the timing and heights for cutting back dormant ornamental grasses. He found that grasses should be cut back, and this can be done in either autumn after they have gone dormant or in spring before the onset of growth. Moreover, the grasses seemed to perform better when cut back short, relative to the size of the grass, in the season following being cut back compared to cutting back at a taller height. This research was funded by the State of Illinois through the Illinois Council on Food and Agricultural Research (C-FAR).

Biofuel Grass Studies

Miscanthus x *giganteus* is a large (>12'), warm season hybrid grass originating in Asia. Ph. D. student Emily Heaton is evaluating this grass and its potential as a renewable energy source when combusted with coal to produce heat and/or electricity. In preliminary studies, this grass appears to produce more biomass than switch grass, the native standard for biomass production. Over the next 5 years, large-scale studies will be developed and planted at various Illinois sites to determine its suitability for commercial biofuel applications. Our primary role in these studies will be to develop mass propagation and eradication techniques. This research is funded by the State of Illinois through the Illinois Council on Food and Agricultural Research (C-FAR).

Our thanks to the ITF and its members for this research support - without your involvement, this work would be impossible!

2003 Turfgrass Weed Control and PGR Progress Report

B.E. Branham, W. Sharp, J.S. Beasley, J. Mueller, and F. Kandil

The past year has been a very interesting one in many ways. We have made considerable progress on a number of research topics including plant growth regulator physiology, metabolism, and turf response; pesticide runoff from turf; selective Poa annua control; selective creeping bentgrass control in Kentucky bluegrass: and new herbicides for broadleaf weed control. In this report I will only be able to highlight some of these research findings. Please consult our website for a complete report on these projects plus others.

Teaching an Old Dog New Tricks!

Selective control of *Poa annua* L. var. reptans Hausskn (Timm), the perennial form of annual bluegrass and the form that commonly infests high-quality golf and sports turf, has long been a goal of turf managers and turf researchers alike. We are as close as we have ever been to safely controlling this pest. For the last few years we have been experimenting with the use of pendimethalin (Pendulum®) for the **postemergence** control of annual bluegrass. Pendimethalin is a preemergence herbicide primarily applied in the spring to control summer annual grass weeds. However, we observed that fall-applied pendimethalin killed emerged annual bluegrass, i.e. this preemergence herbicide also has postemergence activity at this time of year. This approach has advantages and disadvantages; being a pessimist, we'll cover the downsides first. The biggest downside is that this is still a preemergence herbicide, as the annual bluegrass dies, you will not be able to overseed into the voids left by the annual bluegrass. Spring is a poor time to try to get grass to recover and fill-in, particularly if you can't overseed. Many turf managers have experienced the feeling of helplessness that occurs in the spring when trying to get injured or dead turf to recover, and a cold spring can push the recovery process past Memorial Day. Pendimethalin can also injure creeping bentgrass, so this approach may not work on many of the golf fairways, tees, and greens in the Northeast United States.

On the positive side, this procedure works, which is more than can be said about many of the annual bluegrass control options of the past. Second, our data from 2002-03 seems to indicate that you may be able to dial-in the amount of control you desire (Table 1). This may be perfect for turf managers who don't want the disruption that occurs when large voids are left in the turf. In other words, instead of shooting for 90-100% control, it might be best to get 20-30% for the first two to three years before attempting to get higher levels of control. This approach would permit a gradual reduction in annual bluegrass that is less noticeable to end-users, but still makes a significant reduction each year. We have initiated a number of trials in the fall of 2003 to better determine the rate, timing, and frequency of pendimethalin applications needed to achieve effective annual bluegrass control.

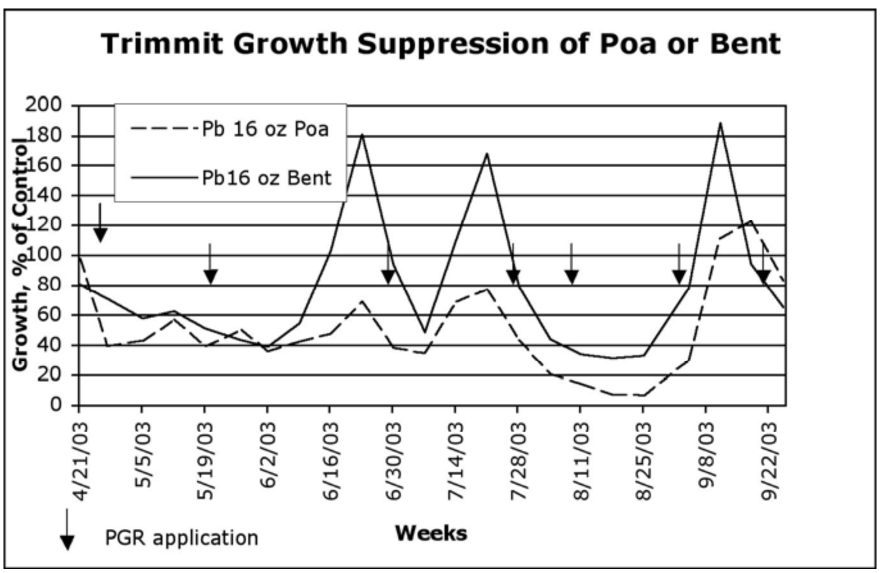
Table 1. Percent Poa annua control from single or sequential pendimethalin applications.

				% Poa annua Ctrl	
TRMT	FORM	RATE **(lbs ai/A)**	Frequency	5/23	6/30
Control				2	3
PreM	60 WDG	1.5	10/4	21	44
PreM	60 WDG	3.0	10/4	28	61
PreM	60 WDG	1.5 + 1.5	10/4 + 10/15	29	51
PreM	60 WDG	3.0 + 3.0	10/4 + 10/15	37	69
PreM	60 WDG	1.5 +1.5 +1.5	10/4 + 10/15 + 11/1	37	71
PreM	60 WDG	3.0 + 3.0+3.0	10/4 + 10/15+11/1	44	86
PreM	60 WDG	3.0 + 3.0 + 3.0 + 3.0	10/4+ 10/15 +11/1 +11/15	32	91
LSD=0.05				11	21

How Do Plant Growth Regulators Affect Turf Physiology and Growth?

Plant growth regulators have become a standard tool for managing golf course and athletic field turf over the last decade. PGRs can reduce turf growth, increase turf density and quality, and have other impacts on turfgrass growth and development. My 2002-03 ITF grant has been used to fund the studies of PhD student Jeff Beasley. Jeff's research is focused on the rebound effect that occurs as growth regulation wears off. Jeff's project is also focused on measuring photosynthetic rates of treated and untreated turf in the field, determining the effect of PGRs on root growth and total biomass production, and measuring the half-life of paclobutrazol (Trimmit®) and trinexapac-ethyl (Primo®) in field-grown turfgrass plants. Jeff will be presenting his data during the next year, but I wanted to highlight one of his findings.

Jeff has studied turfgrass root growth using a hydroponic system to allow more careful sampling of roots. Roots of field-grown turfgrass are very difficult to study for a variety of reasons. Jeff has found that root growth follows shoot growth, even when treated with a PGR. So, as shoot growth is inhibited, root growth is also decreased. A common theory that has floated around for some time suggests that as turf shoot growth is reduced by a PGR application; the "extra" growth is put into roots. We don't believe this is the case. As the turf growth begins to return to normal, and even above normal growth, root growth also recovers, but total rooting is reduced by PGR treatment. Jeff will be discussing his research in detail at a later date.



On a closely related topic, we have always been interested in the growth responses of turfgrasses to PGRs. Indeed, one of the first major uses of PGRs was for the selective growth suppression of Poa annua by paclobutrazol. During 2003, we investigated the growth responses of pure stands of annual bluegrass or creeping bentgrass to sequential applications of paclobutrazol or trinexapac-ethyl. As you can see in the figure above, the early-season growth differential is not that great between the two species, it is only during the summer months that we begin to see the growth differences really stand out, particularly during the rebound effect. Also, note that at the end of the growing season, an application on 8/25 didn't seem to show any PGR activity. This has been a problem that many superintendents have observed with repeated use of these PGRs.

We greatly appreciate the support of the ITF during 2003 and are excited to be able to report the research we have conducted on your behalf. Please consult our web site for additional information on these projects.

Automated Turfgrass Evaluation

Thomas Fermanian, Mark Schmidt, Siddhartha Narra, and Zachary Anderson

Many days as I am working I think this is just "business as usual" in my research, teaching, and outreach activities. With the sabbatical leave of Dr. Branham, this year has been anything but "business as usual." There has been a substantial shift in the time I spend on teaching activities. While this has added a time commitment, it has not impacted our research activities. There might have been some reduction in outreach activities, however.

Even with the slight reduction in outreach activities, service to the turfgrass industry, national societies, and the University have increased. I was elected as Chair-Elect of the C5 Division of the Crop Science Society of America. This is the national society for industry and academics interested in turfgrass science. My duties as division chair begin November 2004. Locally, I have temporarily been assigned leadership of our Landscape Horticulture Research Facility in Urbana.

Recognition for your continuing support

As in the past, my program is only as strong as the generous support I receive from the turfgrass industry. First, I thank John Deere Company for their continuing support of all our research projects. The use of their equipment and technical expertise is invaluable to our success. I also thank Florentine products Inc., Monsanto Co. and many others for their support of our research activities. I also wish to thank the support I receive from the other turfgrass faculty at the University of Illinois. We are truly a team!

Education activities

Undergraduate student enrollment changes over time in the Department of Natural Resources and Environmental Sciences. We are currently experiencing a downward trend in horticulture majors currently at approximately 60. The good news however, is that turf student enrollment is slightly up at approximately 17. Turf majors at the U. I. have the opportunity to take three turf specific courses, Controlling Turfgrass Pests, Introduction to Turfgrass Management, and an advanced turf management course. Normally, I co-teach the turfgrass pests course but, during Bruce Branham's absence I will be teaching part or all of the three courses. In addition to these course assignment changes, I am the sole adviser for turf majors and adviser to the turf club. Please contact me if you wish to post any summer internship or position announcements for our students.

Automating the evaluation of turf health

The major focus of all of the graduate student research projects is the development of an automated turfgrass health evaluation system. Mark Schmidt, a full-time John Deere employee and part-time graduate student, is finishing the analysis of a series of studies evaluating the potential of an imaging multispectral camera system, which we are using in all of our projects. Mark hopes to complete his thesis by next summer.

Sensing turf moisture and nitrogen status – Siddhartha Narra

As a part of developing automatic sensing tools for precision turf management, research is underway at the Landscape Horticultural Research Center (LHRC), Urbana. Over the past two seasons, field experiments were conducted at the LHRC to correlate tissue nitrogen (N) and water status with turfgrass reflectance characteristics measured using a multispectral image acquisition system. Data were collected from creeping bentgrass and perennial ryegrass plots on six dates this summer. Results from the data collected during the 2002 growing season are shown in Table 1. Although, no vegetation index is able to measure tissue moisture and N content with some degree of consistency, other vegetation indices will be investigated after data from 2003 are analyzed.

Table 1. Correlation coefficients between tissue moisture and N content and common vegetation indices.

	Ryegrass				Bentgrass			
	*Norm. G	*Norm. R	NDVIG	NDVIR	Norm. G	Norm. R	NDVIG	NDVIR
Moisture	0.26553 0.0146	0.22882 0.0363	-0.31271 0.0038	-0.27927 0.0101	-0.48779 <.0001	-0.50731 <.0001	0.49050 <.0001	0.51436 <.0001
Quality	0.51228 <.0001	0.53381 <.0001	-0.47652 <.0001	-0.49696 <.0001	0.72054 <.0001	0.72661 <.0001	-0.71119 <.0001	-0.71587 <.0001
	Ryegrass				Bentgrass			
	Norm. G	Norm. R	NDVIG	NDVIR	Norm. G	Norm. R	NDVIG	NDVIR
Quality	0.16311 0.0550	0.18426 0.0299	-0.15704 0.0649	-0.18976 0.0253	-0.09253 0.2445	-0.11772 0.1382	0.09625 0.2260	0.10565 0.1836
N %	-0.13100 0.1243	-0.16461 0.0528	0.14477 0.0891	0.16211 0.0566	-0.02981 0.7082	-0.03275 0.6810	0.03469 0.6632	0.02340 0.7689

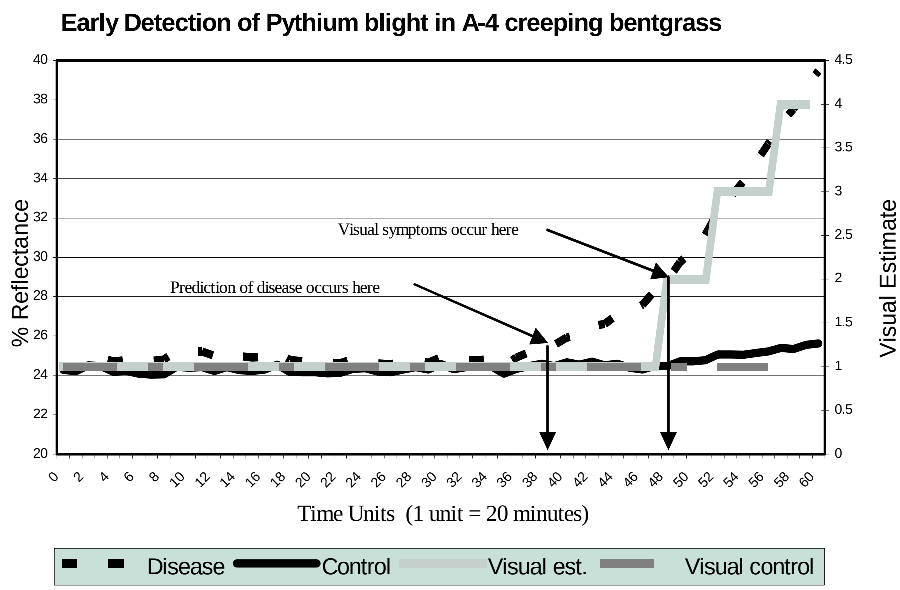
* Norm. G = Normalized Green; Norm. R = Normalized Red; Norm. G = (Reflectance Green/ Reflectance NIR); Norm. R = (Reflectance R/ Reflectance NIR)

Over the next two seasons, this project will encompass several greenhouse experiments, under hydroponics. The reflectance of turf canopy from different wavebands in the visible and near infrared region will be investigated for predicting short-term nitrogen and moisture stresses in turf.

Experiments will also be conducted to evaluate the use of different imaging and non-imaging sensors for automatic quality assessment of various Kentucky bluegrass cultivars from an existing NTEP trial. While past research has focused on evaluating density and color of different turfgrass systems, a comprehensive measurement of turfgrass texture has not been attempted, and this may be the biggest challenge.

Sensing turf disease development – Zach Anderson

Turfgrass Pathogens begin infecting grass tissues before visible disease symptoms occur. By the time symptoms of disease occur, the pathogen has established a relationship with its host and becomes harder to control. Our research is investigating canopy reflectance at known wavelengths as a means to pre-visually detect Pythium blight and Brown patch diseases in A-4 creeping bentgrass.



In this experiment, Pythium blight was detected 3 hours prior to visible disease symptoms.

Pre-visual detection could also lead to a number of research experiments that study the effects of cultural practices on disease development after initial pathogen activation but prior to symptom development. Additional studies will be conducted over the next year.

Turf Soil Research at Southern Illinois University

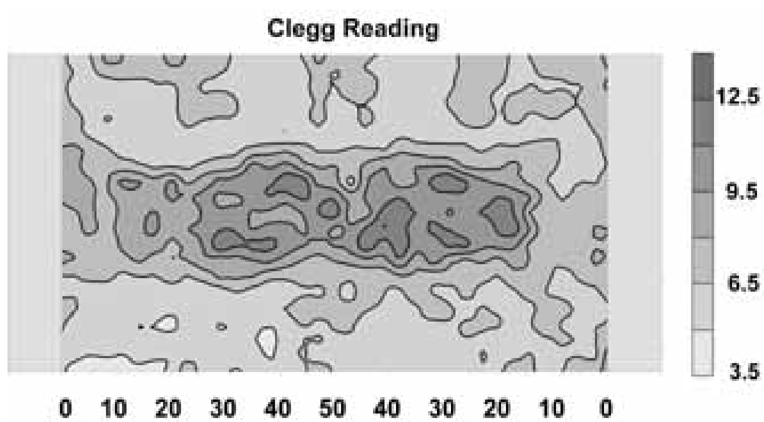
Turf Soil Research Team Members: She-Kong Chong, Professor and Team Leader; Sam Indorante, Adjunct Professor; Richard Boniak, Ph.D. Graduate Research Assistant; Tommy Boniak, Undergraduate Research Assistant; Anquan Zhang, M.S. Graduate Research Assistant; Yanhe Huang, Visiting Professor

Measuring Saturated Hydraulic Conductivity of Coarse-Textured Rootzone Mixes

This project is funded by the USGA. The objective of this study is to develop a permeameter for measuring K_{sat} of coarse-textured golf green rooting mixes. A technician with minimum knowledge in soil physics can operate and produce consistent laboratory results. Presently, a permeameter has been designed and constructed. The advantages of this newly developed permeameter are: 1) the saturation and measurement processes can be carried out within the same hydraulic system without the requirement of moving the soil sample in and out of water, 2) by keeping the soil column in water, air re-entry (entrapped-air) into the sample can be avoided, 3) the hydraulic gradient of the permeameter is adjustable to fit a wide range of hydraulic drops, 4) the permeameter can provide a very stable and accurate measurement of hydraulic gradient. The permeameter is presently tested by a group of students majored in turf and soil science programs to examine the accuracy and versatility of the apparatus. Preliminary results showed that the permeameter worked very well for sand. The test will be extended to measure various rooting mixes amended with different organic materials.

Fig. 1. The newly developed permeameter.

Fig. 2. Variability of surface hardness of the newly constructed football field.



Mapping Surface Hardness and Soil Compaction of a Football Field

The safety, quality and performance of a football field are dependent upon the smoothness, hardness, and uniformity of the field. In addition to the proper construction, minimization of turf wear and prevention of soil compaction are the keys to having a successful sport field. Both turf wear and soil compaction are important not only to the quality and performance of the field, they also affect soil drainage, surface stability, and safety of the players. The goal of this study is to map the field and to identify areas with high foot traffic. The project was started in July 2003 at the Carbondale Community High School football field. The football field was constructed in 2001. The first game played on the field was on August 29, 2003. The field was built on the indigenous soil classified as Hosmer silt loam. In the experiment, the field was divided into 735 grids. In each grid, rootzone penetrating resistance, surface hardness, and bulk density, and soil moisture content was measured simultaneously. In addition, turf vigor and color and percent of cover were also scored by visualization. Data will be collected before and after the football season. The 2003 season data has been collected. This project will be continued in 2004. This information collected in this study will be invaluable for sport field superintendents for their future management, and also it will provide a database for future football field design and construction.

Rooting Mixes for Athletic Field

Both athletic fields and golf tees are subjected to intense traffic. Therefore, most of the athletic fields and golf tees experience severe compaction resulting in poor drainage and unfavorable turf growth. One way to alleviate this problem is to select high-sand root mix similar to USGA green specifications. However, the high cost of construction and management has deterred superintendents. Therefore, most tees and football fields have been built with indigenous materials. The objective of this study is to search for the best sand to silt loam ratio for optimal turf growth. It is also important that the medium is compaction-resistant with good drainage ability. Medium-textured soil (silt loam) was used in the study mainly because most of the topsoil in Illinois is classified as silt loam, and it is assessable and economically feasible for most superintendents. In the experiment, the Camden silt loam was mixed with the USGA sand at the following proportions: 10:90, 20:80, 30:70, 40:60, 50:50. In addition, root medium with 100% silt loam and 100% sand were also included for comparison. The experiment is conducted in the green house with soil columns of 18 in (diameter) and 15 in (length). Each treatment was replicated four times. The Bermuda grass ‘Quickstand’ was used as a test turf. Effect of compaction will be considered in the experiment.

A Closer Look at Growth Regulation of Annual Bluegrass

Dr. Kenneth L. Diesburg

Introduction

In recent years research with turfgrass growth regulators has expanded from restriction of shoot growth in turfgrass species into suppression of annual bluegrass and its seed heading. While Primo, Cutless, and Turf Enhancer have proven effective in restricting shoot growth, Embark and Proxy are proving effective in restricting seed head growth. Embark effects are very consistent across environments while Proxy seems to be more effective in the west, north, and northeast United States and ineffective in the southeast. Proxy has occasionally been ineffective in the north and northeast when applied too early in the spring or followed too soon by fertilizer application. These apparent discrepancies warrant a closer look at what is happening with the morphogenesis of annual bluegrass in response to growth regulators and taking note of associated climate differences.

Materials and Methods

During 2003, an area with nearly 100% stand of annual bluegrass was subdivided into 2-m square plots per treatment, 16 treatments, three replications. Treatments were applied April 4 as the annual bluegrass was mostly in the late boot stage of heading (2 in a scale of 1 to 9, 1 = no heading and 9 = fully bolted. Heading and Turf Quality ratings were recorded April 22 (18 Days After Treatment: DAT) and May 7 (34 DAT). Pretreatment (Old) shoots and post-treatment (New) tillers were counted May 28 (55 DAT). The experiment was left non-mowed with no fertilizer or irrigation applied.

Results and Discussion

The results of this experiment (Table 1) show Turf Enhancer was superior in restricting Heading. But it did not enhance the Turf Quality of annual bluegrass. The restriction of heading by Cutless was effective early but reduced over time, while that of Turf Enhancer did not. The results also show the ability of Proxy to enhance the effectiveness of Prograss in restricting annual bluegrass heading. At the same time, Proxy enhanced the Turf Quality of Prograss-treated plots. By counting New tillers versus Old shoots we get a closer look at one reason why the Proxy/Prograss combinations enhanced Turf Quality. But Turf Enhancer caused an even higher ratio of New tillers to Old shoots without enhancing Turf Quality. This can be explained in that Proxy appears to delay the normal senescence and death of annual bluegrass from spring into summer, thus allowing it to continue tillering. Mefludide effects are different in that the complete and short-lived stoppage of growth is followed by a flush of growth, thus the enhanced tillering, later. But Turf Enhancer stimulates pronounced tillering over a long period of time in a compact tuft.

This is the first time Proxy alone has not been effective at this location and Turf Enhancer has been highly effective in restricting heading. This can be explained by associating air and soil temperatures surrounding the time of treatment (Table 2) and integrating information from discussions with Dr. Bert McCarty, Jim Merrick, and Kerry Anderson. The typical timing of application of growth regulators in South Carolina is starting in February, when diurnal temperatures range between the 30s and 60s with several repeat applications into spring. The typical timing of application in Southern Illinois has been in April, when diurnal temperatures range between the 50s and 80s. But in 2003, even though the date of application was the typical April 4, the diurnal temperatures were between the 30s and 60s. It was a cooler than normal spring. Soil temperatures were correspondingly lower. Connect this with what Bayer has found with use of Proxy in the North and Northeast United States, its ineffectiveness when applied too early in spring, and we can rationalize what might be happening. Proxy needs moderate, not cool, temperatures in order to be effective. Conversely, Turf Enhancer appears to do very well in the cooler temperatures.

Table 1. Response of annual bluegrass to mid-spring applications of turf growth regulators under low fertility, SIU, 2003.

	Rates	Tillers (cm^2)	Tiller Ratio[a]	Heading 18 DAT	Heading 34 DAT	Turf Quality 18 DAT	Turf Quality 34 DAT
Turf Enhancer	3.3	1.9 a	0.76 a	1.3 g	1.0 f	2.0 c-f	1.7 f
Proxy+Prograss	10+3	1.4 ab	0.45 b	3.3 d-f	2.7 e	2.0 c-f	7.3 a-c
Proxy+Prograss	5+2	1.1 a-c	0.40 bc	3.3 d-f	5.0 c	3.0 a-c	7.0 bc
Prograss	3	1.4 ab	0.40 b-d	3.3 d-f	5.0 c	2.3 b-e	4.7 d
Turf Restore+Bacteria	0.5+0.50	1.9 a	0.34 b-e	6.0 b	9.0 a	1.0 f	3.3 de
Proxy+Prograss	5+3	1.9 a	0.34 b-e	3.3 d-f	3.7 de	2.7 b-d	6.7 c
Proxy+Primo	5+0.50	0.9 a-c	0.26 b-f	4.3 cd	7.0 b	1.7 d-f	6.3 c
Cutless+Proxy	0.09+10	1.1 a-c	0.23 c-f	3.7 de	6.3 b	2.3 b-e	4.0 de
Cutless	0.18	1.2 a-c	0.21 c-f	2.7 e-g	6.3 b	1.3 ef	3.3 de
Cutless+Primo	0.09+0.13	0.7 bc	0.18 d-f	2.0 fg	7.0 b	2.0 c-f	4.0 de
Proxy	10	0.7 bc	0.17 ef	7.0 ab	8.3 a	1.0 f	4.0 de
Proxy+Prograss	5+1	0.7 bc	0.17 ef	5.7 bc	7.0 b	2.3 b-e	4.3 d
Primo	0.25	0.7 bc	0.17 ef	6.0 b	8.3 a	2.0 c-f	2.7 ef
Embark	0.90	0.5 c	0.16 ef	1.3 g	4.0 cd	3.3 ab	8.7 a
Proxy+Embark	5+0.90	0.5 c	0.14 ef	2.3 e-g	3.7 de	4.0 a	8.3 ab
UTC		0.5 c	0.12 f	7.7 a	8.7 a	1.3 ef	3.3 de
LSD 0.05			0.21	1.4	1.1	1.1	1.2

[a] Ratio of new tillers to old shoots.

Table 2. Air temperatures (°F) before and after growth regulator applications to suppress annual bluegrass heading, SIU, 2003.

Year	10-days before heading (ave. min./ave. max. in °F)	Application date	Application temperature (ave. min./ave. max. in °F)	10-days after heading (ave. min./ave. max. in °F)
1998	73/54	6-Apr	83/53	86/62
1999	76/55	14-May	65/56	77/53
2000	62/36	6-Apr	76/53	64/39
2001	59/38	6-Apr	77/68	76/59
2002	61/34	11-Apr	79/38	80/62
2003	65/41	4-Apr	72/47	62/39

Other Research - Zoysiagrass Breeding

The first synthetics were planted into turf plots for evaluation. Grow-in proceeded well and will be complete during 2004. Further plantings of winter hardy zoysias were completed in Illini Country Club at Springfield, Golf House at Cog Hill, and Turnberry Country Club at Crystal Lake. Thanks are extended to Jim VanRavensway, Randy Kane, Lee Miller, and Jim Evans for their able assistance. Over 600 new genotypes were established in spaced plantings at Carbondale. Selections for superior types continue. Research into management for maximum seed production continues.

NTEP Cultivar Trials

The new fine fescue trial was established in uniform shade this fall. The Kentucky bluegrass sun, Kentucky bluegrass shade, perennial ryegrass, zoysiagrass, bermudagrass, and tall fescue trials continue.

Dollar Spot Control Research – 2003 Summary

Lee Miller & Randy Kane, CDGA; and Hank Wilkinson, Univ of Illinois

Fungicide resistant (or "tolerant") dollar spot populations present significant challenges to turf managers who must find alternative avenues for control. In some cases, managers are dealing with dollar spot that is resistant to more than one class of fungicide, which compounds the problem by limiting control options. As in previous years, we continue to test contact and systemic fungicides for control of these dollar spot populations.

In 2003, we tested a variety of fungicide chemistries and combinations at three sites that have three different circumstances of dollar spot fungicide sensitivity:

1. Ridgemoor Country Club 12th Fairway – Potential multiple resistance / tolerance to several different systemic fungicide classes.

2. Cantigny Experimental Green – Known tolerance to demethylase inhibitor fungicides (DMI) and resistance to benzimidazoles.

3. Prairie Landing Practice Area Target Green – No intensive fungicide applications over the years, so potentially no fungicide resistance issues.

The products tested at each site included representatives of the benzimidazole (Cleary 3336), dicarboximide (Chipco GT, Curalan), and DMI (Banner, Bayleton,) classes, as well as newer fungicides such as the strobilurin products Compass and Insignia, and Emerald and Medallion, both of which fall into other chemical classes. Of these newer products, Emerald is reported to have excellent dollar spot activity, while Medallion, Compass, and Insignia have been reported to have 'suppressive' dollar spot activity. Emerald and Insignia are new products from BASF that have recently received EPA registration. Medallion is produced by Syngenta and Compass is a Bayer product.

Results. Throughout the region, disease onset was much later than in previous seasons, and disease pressure was markedly lower than past summers. This is evidenced by no dollar spot symptoms showing in our plots until the beginning of August, whereas in years past a dollar spot explosion would normally occur in late May to early June. The shorter dollar spot season and lower disease pressure was possibly due to a colder 2003 winter and an almost non-existent spring that still saw morning frosts occurring in late May and early June.

At the Prairie Landing and Cantigny test sites, overall dollar spot pressure was extremely low, with only 5-10% of untreated check areas affected on most rating dates (**data not presented**). Even with the low disease pressure, some differences in fungicide control were apparent. At Prairie Landing, only Cleary's 3336 failed to control dollar spot, which again shows that benzimidazole resistance may be a common characteristic of dollar spot populations in the Chicagoland area. Also, Medallion on a 14-day schedule suppressed dollar spot to an acceptable level (under a low pressure situation), which supports the reported 'suppressive' activity of this product. At the Cantigny site, the most notable difference in dollar spot suppression was between the two strobilurin fungicides - Compass and Insignia. Insignia (at 0.9 oz/1000 $ft^{2)}$ does seem to suppress dollar spot, holding it to under 1% severity. Compass (at 0.15 oz/1000 ft^2) worked marginally (3-5% severity), but did not provide an acceptable level of control.

At the Ridgemoor site, dollar spot pressure was more intense than at the other two sites, especially later in the season (**see Table below**). As suspected, this site has dollar spot populations with visible dicarboximide and DMI resistance. Indirect evidence based on lab screens indicates that dicarboximide resistance may also be occurring at other sites in our region, so this was not a big surprise. The DMI sensitivity at Ridgemoor was less obvious this year, as Bayleton did suppress dollar spot to below 5%. At this site 10 years ago dollar spot resistance to the DMIs was much more prevalent. Since fewer DMIs have been used at Ridgemoor in those intervening10 years, this observation might indicate that DMI resistance comes at a 'fitness' cost to the fungus. Without the continued application of a DMI, the dollar spot population may revert back to being DMI sensitive. Further study needs to be completed to verify this. The new fungicide Emerald (common name = boscalid) provided complete control of dollar spot at 0.13 oz/1000 ft^2 on a 14 day interval. Note also that we observed anthracnose activity in Emerald treated plots. At present Emerald is labeled only for dollar spot and bentgrass dead spot control, so careful fungicide programming will be needed to control other diseases when using this product for dollar spot.

In conclusion, dollar spot has been found in Illinois and throughout the Midwest that is resistant or tolerant to the benzimidazoles, dicarboximides, and DMIs. Newer fungicides such as Emerald seem to be an effective tool for controlling these populations and should be rotated in with effective contact (multi-site inhibitor) products where a resistance problem is known to exist. Other new fungicides such as Insignia or Medallion, although only offering suppression and not complete control of the disease, could be used during times of low disease pressure to manage the disease until application of a fungicide labeled for dollar spot control is necessary.

				% Dollar Spot (average of 3 reps)			
Fungicide	**Chem. class**	**App rate**	**Timing**	**Aug 1**	**Aug 8**	**Aug 15**	**Aug 22**
Untreated Check	--	--	--	7.3	7.3	8.3	26.7
Chipco 26 GT	dicarboximide	4 oz	21 d	4.0	2.0	2.0	4.3
Curalan	dicarboximide	2 oz	21 d	6.0	3.0	4.3	7.3
Daconil + 26GT	multi-site + dicarboximide	3.2 oz 4.0 oz	21 d	2.0	1.0	0.3	1.7
Daconil + Curalan	multi-site + dicarboximide	3.2 oz 1.0 oz	21 d	3.0	1.3	0.3	3.0
Bayleton	DMI	0.5 oz	14 d	0.3	0.7	0.3	2.0
Bayleton	DMI	1.0 oz	21 d	1.7	0.7	0.7	2.0
Emerald	anilide	0.13 oz	14 d	**0.0**	**0.0**	**0.0**	**0.0**
Emerald	anilide	0.18 oz	21 d	0.7	0.3	0.3	**0.0**
Insignia	strobilurin	0.9 oz	14 d	0.7	1.0	0.3	0.7
Emerald/Insignia (alternating)	anilide + strobilurin	0.13 + 0.9 oz	14 d	**0.0**	0.3	**0.0**	**0.0**
Daconil + Emerald	MSI + anilide	3.2 + 0.13 oz	21 d	1.0	0.3	**0.0**	**0.0**
Compass + Bayleton	strobilurin + DMI	0.15 + 1.0 oz	21 d	1.7	0.3	0.7	3.7

*rates are ounces per 1000 square feet; dollar spot rated as percent of plot area affected.

Genetics of Disease Resistance

Andy Hamblin

We have had several projects underway in 2003 that have revealed interesting results. It was a difficult year to produce high seed yields in our research plots due to ill timed rain and other constraints. However, much of our lab and greenhouse work has produced good results. I thank Karen Simmons and Joyce Jones, Master's degree students in my lab, for their hard work this past year. They have worked not only on their own projects, but many of mine as well.

Blending Study

Karen Simmons' thesis project was designed to identify the effect of disease on Kentucky bluegrass blends. Our hypothesis was with each incremental increase in the percentage of disease resistant plants in a blend, you get a corresponding level of protection from disease. Many propose that including a resistant variety in a blend, even in small percentages, provides substantial resistance to disease. This is termed the *barrier effect*, which supposes that the rate of disease spread is slowed or stopped due to the presence of disease resistant plants. Because of the dense growth of turfgrass, the proximity of adjacent susceptible plants does not allow for a barrier to be produced. Therefore, this research supported our hypothesis. It is clear that if you have 25% of a blend composed of a resistant variety, you will get roughly a 25% level of resistance. In some cases you get less than what you would expect. The diseases included in this study were Bipolaris leaf spot, Drechslera leaf spot, crown rust, powdery mildew, pink snow mold, Pythium blight, and Rhizoctonia brown patch. Due to the selection of high quality Kentucky bluegrass varieties by plant breeders, we recommend using a monoculture with high levels of resistance to diseases endemic to a grower's environment. Then, manage the variety for any deficiencies it may have, similar to what is done currently with creeping bentgrass management.

Dollar Spot

Joyce Jones is working on a project to identify if pathogenic races of the dollar spot pathogen exists across a number of creeping bentgrass varieties. Her research is still underway, but we do have some initial information. In other research, six different vegetative groupings of the fungus were identified. We are doing similar research to characterize our collection of 25 fungal isolates. We have inoculated 15 different varieties with each isolate to identify the level of resistance that is provided. In our initial analysis, it is not clear that pathogenic races exist. This is due to the fact that few varieties showed complete resistance. However, we expect that in future studies, the reactions will provide more substantial information. If pathogenic races exist, it is possible that the fungus is either genetically diverse, or it is mutating and able to overcome resistance. Also, it may be possible to use different resistant sources to pyramid or stack genes together to provide long-term resistance. If pathogenic races do not exist, then the resistant varieties we currently have could potentially provide resistance over many years.

Other Research

USGA Midwest Bentgrass Consortium—Illinois, Wisconsin, and Michigan State are sharing clones of creeping bentgrass varieties to study quality and disease resistance. This will be a resource provided to commercial growers as a source of varieties adapted to the Midwestern U.S.

USGA Gray Leaf Spot Research—We are providing on-site research plots for gray leaf spot research conducted by Joe Curley and Geunhwa Jung from the University of Wisconsin.

CFAR Miscanthus Genetics—We are doing DNA tests to identify the genetic diversity of Miscanthus spp. in a University of Illinois collection. This is one component of a large Illinois Council for Food and Agriculture consortium to investigate and enhance this grass for use as a biofuel.

USDA Brown Patch Genetics—This project funded by the USDA is designed to characterize disease resistance in a tall fescue population so that further genetic analyses can identify and isolate these genes.

Minimizing Water Requirements for Kentucky Bluegrass Sod Establishment and Related Water Studies

Professor H.T. Wilkinson, Dianne Pedersen and Shelby Henning

Introduction—Some thoughts on water issues facing the sod industry!
I would like to introduce you to the research that we are conducting by giving you my perspective on how it fits into the BIG WATER PICTURE! Water is essential to all life on earth. Water can exist in several different forms: crystals (ice), liquid, and gas (humidity). Water can be found in many different places on earth, depending on its form. The quality of water depends on the nature of the dissolved or suspended particles in it. Water is a superb solvent, and usually exists as a solution not as pure water. Humans use water in many ways and for many purposes. To make water available for human use, it must be harvested or collected from lakes, rivers, oceans, or wells. The amount of water available on earth today is the same amount that was available a billion years ago, and the same amount that will be available a billion years from now. However, water on earth is dynamic, constantly changing in form and location. So when it is said that there is a water shortage, it does not mean "on earth," but at a particular location on earth. A shortfall of water can be simply explained as follows: if you remove water from a location faster than it is replaced, then a shortage will result. This is the current situation that exists in certain areas of Colorado and which has affected the green industry. When a water shortage develops, there are two general reactions by a community: efforts are made to speed up water replacement; and efforts are made to reduce the speed at which water is used or removed. It is this latter effort that can directly affect the sod industry. Reducing water use is much more complicated than understanding the cycle of water on earth, because humans are "in control." To develop an effective plan to reduce the use of water, you have to accurately know: who is removing the water; how much water is being removed from a given location; and how fast water will be returned to that location for further use. I do not know of any community that has this type of information. So how do community governments make decisions on who should be allowed to use the water, what they are allowed to use it for, and how much water should be used. Measuring and recording who uses water, how much they use, and for what purpose the water is used are facts that can be collected. These facts have generally not been collected with great care, because water shortages are just becoming important issues in some locations within the United States, and it costs money to collect such information, i.e., it was not a high priority for local governments. But now it is important! However, it still takes time and money to collect this information, and that translates to mean that we now have shortages of both water and water use data. The water use research program that I have started for the sod industry, which is supported by both the sod industry, the Illinois Turfgrass Foundation, and the University of Illinois, is focused on two objectives:

1. Determining the minimal amount of water it takes to establish sod.
2. Determining how to efficiently use water to establish sod.

The results of these objectives will go a long way in terms of establishing facts that define how much water it takes to establish sod. They will also create practical information for landscapers on how they can improve water use efficiency.

While this research will be beneficial to the sod and landscape industries, it will not answer the question: "in a water shortage, where does water use for sod establishment rank among all the uses of water in a community?" However, it is very important for the sod industry to study and understand their need for water, both for sod production and for sod establishment. This type of knowledge can assist them and community legislators in understanding how and where to rank the use of water for sod, when water shortages exist. Lacking this information can only hurt the sod industry because the application of water to sod is highly visible to the public, which gives the impression that sod uses a lot of water. While those in the sod industry believe this is not the case, we must prove it through science, and we must aggressively educate the public that using water for sod deserves a fairly high priority in terms of urban management.

Description of the rain-exclusion shelters: The idea of a rain-exclusion shelter is to prevent natural rainfall from falling on the experimental turf. **In order to study water use for efficient establishment of sod, it is necessary to control both how much water is applied and when it is applied to the turf.** To achieve this, you need to exclude all natural water and use only irrigation water. For water use research to be meaningful, it must be conducted outdoors. The idea of a rain-exclusion shelter is not new. Scientists studying corn and soybeans have used them to determine the impact of acid rain on crops. Two such shelters were erected on the campus of the University of Illinois. However, the design of these now defunct shelters presented many problems for researchers. They were custom-made to accommodate corn (15 ft tall) and they were very long (100 ft). Needless to say, they were prone to wind damage and closure failures. In addition, their extreme height and their weak supports made structure maintenance and repair very difficult, costly, and dangerous. With no existing manufacturer of rain-exclusion shelters for turf, we designed our own.

Rain-exclusion shelters being covered (October, 2003) at the University of Illinois!

University of Illinois Rain-Exclusion Shelters: Our shelters are only 4 ft tall, 50 ft long and 21 ft wide. This gives us a very low profile shelter, which will cover 1,000 ft^2 of turf for research. In addition, the low profile reduces the wind-generated force on the structure, thus reducing the force needed to move the structure for closure. The inner struts of our structure are square steel stock, which are braced with steel cables. The structure is covered with tin sheeting to provide stability and longevity. We estimate each structure will be useable for 20 years. The genius of our design is in the controls and mechanism for moving the structure. First, all controls and drive mechanisms are contained within the shelter at all times, thus avoiding the elements. The shelter must move approximately 60 ft in 1 minute (1 ft per second), in order to effectively exclude natural precipitation. To meet these specified parameters, several designs using different materials were evaluated. Initially, it was hoped that the structure could be moved using a 12 volt DC system. This idea was scrapped upon realizing that the force required to drive the structure in a 75 mph wind exceeded all realistic designs and materials. This required the structure to be powered by either 110 volt AC or 220 volt AC. In addition, the inability to use a 12 volt DC system also meant that moving a shelter in two directions (open and closed) would require an intricate electrical design. The advanced design called for the use of 220 volt AC single phase power to operate a 110 volt AC motor in both the forward and reverse directions. The system works as follows: 110 volt AC power is converted to 220 volt AC single phase; this is fed into an electronic controller that electronically changes the polarity of the current delivered to the 110 volt AC motor. The motor is powered up in one direction by the rain-sensing switch, and powered up in the opposite direction when the rain-sensing switch dries off. The rolling distance (enough to cover or uncover the turf) is controlled by stop switches at the ends of the shelter track. All controls, except the rain-sensing switch, are contained within the shelter. The 110 volt AC power is supplied through a matched gauge, all-weather electrical cord that is automatically wound and unwound as the shelter moves.

The design and fabrication of the final shelter drive system also required several modifications from the original friction drive system. The resistive force generated by the structural mass of the shelter and wind resistance required the use of a 3/4 horsepower motor (turning at 1800 rpm) with a very substantial gear-reduction unit. The output of the gear reduction unit was 60 rpm. The final drive mechanism could only be fabricated by coordinating its design with that of the system used to support the shelter. The shelter is supported on 12 wheels. These wheels (double-flanged, flat wheels) are 4 inches in diameter and 1.75 inches wide. This specification is mandated by the track on which the shelter moves. Each side of the shelter rides on a unistrut, steel track: 110 ft long and supported every 6 ft. The unistrut design allows for roller chain (schedule 50) to be secured within it. A 4 inch diameter gear is attached to the end of the drive mechanism and moves along the roller chain, thus driving the shelter. This design transfers all of the rotational energy generated by the drive mechanism into shelter motion.

A larger challenge than the motion mechanism has been the rain sensing control unit. We tried several irrigation control switches, but none was sensitive enough for our purpose, and they required minutes to hours before they would call for the shelters to uncover the turf. The shelters are covered in sheet metal and, as such, absorb considerable heat. If the shelters cover the turf for more than 10 minutes in typical summer temperatures, the resulting heat buildup could kill the turf. Our solution was to use a custom-designed and fabricated, optical sensing unit, which allows rain to be quickly sensed (cover the turf), and quickly senses when the rain has stopped (uncover the turf).

What have we learned so far? In preliminary studies of sod establishment, we have learned that there are three phases of sod establishment: 1-6 weeks, 6-12 weeks, and 12 weeks to 18 months. By 18 months, the sod will have re-produced nearly all of the root mass that it lost when it was harvested. Realizing that sod establishes in phases will help us in directing our future studies. For example, during the first 6 weeks after sod is installed, the need for water will be mostly frequent, light applications to keep the sod and the top one-half inch of soil moist. However, if the soil beneath the sod is moistened to a depth of 3-6 inches prior to installing the sod, then considerably less water will be needed after installation. The research that we will conduct over the next three years will critically determine the amounts and timing of irrigation, and the location of water in the soil profile that is most supportive of sod establishment.

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University of Illinois Golf Courses
Weaver's Ridge Golf Club
White Premium Organics
Wilson's Nursery
Wisconsin Sod Producers Association
Yoder Brothers, Inc

Mark your calendar!

Indiana-Illinois Turfgrass Short Course -- Feb. 23-27, 2004
Willowbrook Holiday Inn
Intersection of Rte. 83 and I-55
Willowbrook, IL

For more information about this event, or to obtain additional copies of this report, contact:

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