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K-State Turfgrass Research 1998

Kansas State University. Agricultural Experiment Station and Cooperative Extension Service

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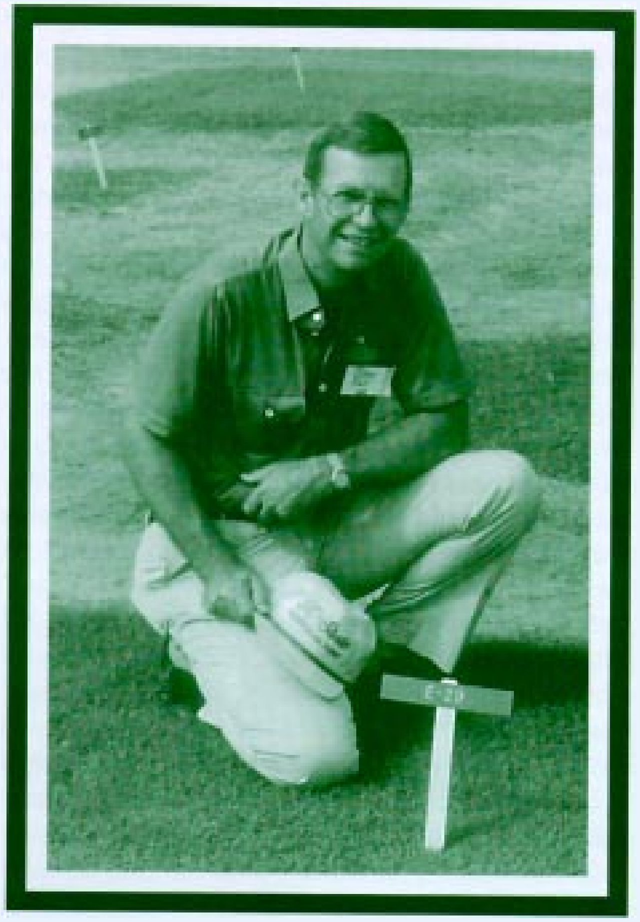
Abstract

1997 was a successful research year. Not only were numerous studies initiated and completed, as evidenced by the work reported herein, but we were also successful in obtaining funding for future work. K-State received four grants from the United States Golf Association in 1997. Dr. Bingru Huang got funding for at least 1 year to work on managing creeping bentgrass through our summer stress periods. Dr. Ned Tisserat received funding for a 3-year project on the biology and management of spring dead spot in bermudagrass. Two projects also were funded in Civil Engineering and Agronomy that involve environmental studies related to the construction of Colbert Hills Golf Course in Manhattan.

Keywords

Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 812; Kansas Agricultural Experiment Station contribution; no. 98-439-S; Turfgrass; Pest management; Environmental stress; Tall Fescue; Zoysiagrass; Bluegrass

KANSAS STATE UNIVERSITY AGRICULTURAL EXPERIMENT STATION AND COOPERATIVE EXTENSION SERVICE



1998 TURFGRASS RESEARCH

Report of Progress 812

FOREWORD

All years have their low points, and this was no exception. We were all saddened by the passing of Dr. John Pair on January 24, 1998. Dr. Pair had been an important member of our turfgrass team. His professional career at K-State spanned 32 years, plus 5 years as a graduate student. His research accomplishments in ornamentals and turfgrass were substantial. Dr. Pair worked tirelessly on the development of Midlawn and Midfield bermudagrasses. He contributed greatly to our knowledge of turfgrass adaptation in the Midwest through evaluation of cultivars best adapted to this region. In the ornamentals area, he was widely recognized as an expert in species adaptation and worked extensively on development of Osage orange and dogwood selections. Dr. Pair was a true plantsman, who was as comfortable in discussions with nurserymen as he was with golf course superintendents. Such individuals are few and far between. We will all miss John dearly!

On a more positive note, 1997 was a successful research year. Not only were numerous studies initiated and completed, as evidenced by the work reported herein, but we were also successful in obtaining funding for future work. K-State received four grants from the United States Golf Association in 1997. Dr. Bingru Huang got funding for at least 1 year to work on managing creeping bentgrass through our summer stress periods. Dr. Ned Tisserat received funding for a 3-year project on the biology and management of spring dead spot in bermudagrass. Two projects also were funded in Civil Engineering and Agronomy that involve environmental studies related to the construction of Colbert Hills Golf Course in Manhattan.

We are all looking forward to the development of Colbert Hills, a new, $10 million, 18-hole, championship golf course in the rolling Flint Hills about 5 miles west of the K-State campus. The PGA TOUR will oversee management of the facility. Scheduled for completion in 2000, Colbert Hills will serve the university, community, and state in a multitude of ways other than as a daily-fee golf course, including: 1) as a practice and tournament course for the K-State golf teams; 3) as host for a skills-based youth golf academy; 3) as a research facility to study the environmental impact of golf courses on natural resources and evaluate best management practices for turfgrass culture in the Midwest; and 4) as a resident course where K State students pursuing the golf course superintendent profession can gain hands-on classroom and internship experience. Tentative approval also has been granted for a classroom/laboratory/office facility adjacent to the maintenance building for use by researchers working on site.

Of significance to all golf course superintendents in the state is the development of a new Golf Course Management education program that will begin at K-State in Fall, 1998. This is the first program of its kind in the U.S. that places a strong emphasis on business and communication skills and also includes course work in hospitality management. Graduates of the new program that go to 18-hole facilities will be familiar with responsibilities and goals of managers involved in business, hospitality, and food service operations. Graduates also should be highly employable at 9-hole facilities, where retaining a specialist in all areas of course operation is not practical or affordable. Furthermore, superintendents trained in this program should have the credentials to compete for a position as general manager later in their careers.

Keep this research report in handy place--it can be useful all year long. This information, and more, is also available on our web page at **http://www.oznet.ksu.edu/dp_hfrr/turf/welcome.htm**

Please let us know if we can address your turf management concerns. We strive to make our research projects emphasize the problems we consider most important to Kansas turfgrass managers.

The K-State Turf Team

Personnel Associated with the K-State Turfgrass Program

Bob Bauernfeind	Extension Entomologist
Mike Daratt	Farmer II, Horticulture Research Center, Wichita
Jack Fry	Associate Professor of Horticulture, Turfgrass Research & Teaching
Bingru Huang	Assistant Professor of Horticulture, Turfgrass Research & Teaching
Steve Keeley	Extension Turfgrass Specialist
Larry Leuthold	Professor Emeritus
Xiaozhong Liu	Ph.D. Candidate, Horticulture
Christy Nagel	Extension Horticulture Secretary
Linda Parsons	Sedgwick County Master Gardener
Derek Settle	M.S. Student, Horticulture
Michael Shelton	Plant Research Technician II, Horticulture Research Center, Wichita
Steve Starrett	Assistant Professor, Civil Engineering
Ned Tisserat	Professor of Plant Pathology, Plant Pathology Extension and Research
Ward Upham	Extension Associate - Horticulture
Tom Warner	Professor and Head, Department of Horticulture, Forestry, and Recreation Resources
Henry Wetzel	Ph.D. Candidate, Plant Pathology
Steve Wiest	Associate Professor of Horticulture, Plant Stress Research
Alan Zuk	Research Assistant

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TITLE: 1996 National Tall Fescue Cultivar Evaluation Trial

OBJECTIVES: To evaluate tall fescue cultivars under Kansas conditions and submit data collected to the National Turfgrass Evaluation Program.

PERSONNEL: Linda Parsons, Ned Tisserat, and John Pair

SPONSOR: USDA National Turfgrass Evaluation Program

INTRODUCTION:

Tall fescue is the best adapted cool-season turfgrass for the transition zone. It is drought and heat tolerant and has few serious insect and disease problems. However, tall fescue possesses a rather coarse leaf texture, because it lacks stolons and has only very short rhizomes. Efforts to improve cultivar quality include selection for finer leaf texture, a rich green color, and better sward density, while still maintaining good stress tolerance and disease resistance.

MATERIALS AND METHODS:

After we incorporated 13-13-13 at a rate of 1 lb. NPK per 1000 sq ft into 390 5 ft ×5 ft study plots in Wichita, we seeded a trial including 130 cultivars and experimental numbers on September 11, 1996 at a rate of 4.4 lb seed/1000 sq ft. We maintained fertility of the plots at 0.25 to 0.5 lb N/1000 sq ft per growing month. We mowed the plots weekly during the growing season at 2.5 in. and remove clippings. We irrigated as necessary to prevent stress and control weeds, insects, and diseases only when they presented a threat to the trial.

At appropriate times during the course of the study, we collected information on seedling vigor; genetic color; spring green-up; leaf texture; quality; and, where applicable, disease resistance. Rating was done on a scale of 0=brown turf, 6=acceptable, and 9=optimum measure.

RESULTS:

Our initial observations (Table 1) showed that Arid, Kentucky-31 w/endo., Titan 2, Safari, Overtime mix, and Renegade had the greatest seedling vigor. Their short height indicated that Pick FA N-9, ZPS-5L, Gazelle, and Pick FA UT-9 were the most dwarf selections. OFI-931, LTP-4026 E+, MB 213, Millennium, Pennington-1901, and AA-A91 formed the most dense stands; BAR FA 6LV, MB 213, BAR Fa6 US1, J-5, J-98, MB 29, Pick FA 6-91, and ZPS-5LZ had the deepest green color; and MB 29, Gazelle, J-101, LTP-4026 E+, Pennington-1901, Pick FA N-93, and Pick RT-95 had the finest texture.

In 1997 (Table 2), we rated the fescue plots monthly throughout the growing season for turf quality. Those that performed best overall were Empress, PST-5E5, LTP-SD-TF, Southern Choice, BAR FA 6D, MB 210, OFI-931, PST-5M5, and Millennium. At the end of the summer, we found that MB 213, MB 216, MB 215, Pick FA N-93, and ZPS-5LZ had the darkest green color and that BAR Fa6 US1, Pick FA 20-92, ATF-196, BAR FA 6LV, Pick FA 6-91, and WRS2 had the finest texture. As a result of the extremely wet spring and early summer, most of the turf was affected by Pythium blight. Tomahawk-E2, Kentucky-31 w/endo., AV-1, ISI-TF10, JSC-1, Renegade, and SS45DW showed the least injury, and Pennington-1901, Gazelle, Pick GA-96, and AA-989 showed the most injury.

Table 1. Initial ratings (1996) of tall fescue cultivars at Wichita, KS[1].

Cultivar/ Experimental Number	Seedling Vigor	Height	Density	Color	Texture
Arid	9.0	9.0	7.7	3.7	3.3
Kentucky-31 w/endo.	9.0	9.0	6.7	3.0	2.3
Titan 2	8.7	8.3	8.0	6.3	4.0
Safari	8.3	8.0	7.7	5.3	4.0
Overtime mix	8.0	8.3	7.0	5.3	4.0
Renegade	8.0	8.0	8.0	5.7	3.7
Aztec II	7.7	7.3	7.3	6.0	5.3
Bonsai 2000	7.7	7.7	7.7	6.3	5.0
CU9501T	7.7	6.7	7.0	6.7	4.7
CU9502T	7.7	7.7	7.7	5.7	5.7
DP 7952	7.7	8.7	7.3	4.7	3.0
JTTFC-96	7.7	8.0	7.3	4.7	3.7
OFI-931	7.7	7.0	8.7	6.7	5.0
R5AU	7.7	7.3	7.7	7.0	4.7
SSDE31	7.7	8.0	7.3	6.7	3.7
Shenandoah	7.7	7.3	8.0	6.0	4.3
Southern Choice	7.7	7.0	8.0	7.3	5.3
AT-7	7.3	6.7	7.3	7.0	5.0
DLF-1	7.3	8.3	7.3	4.7	4.0
DP 50-9011	7.3	8.3	7.3	6.0	4.0
Equinox	7.3	7.7	7.7	5.7	4.3
Falcon II	7.3	8.3	7.7	6.3	5.3
ISI-TF9	7.3	7.3	7.3	6.0	4.0
JTTFA-96	7.3	7.0	6.3	4.7	3.3
Leprechaun	7.3	7.0	7.0	6.3	4.7
Pixie E+	7.3	7.3	7.7	6.3	4.3
Regiment	7.3	7.7	8.0	6.0	5.7
SR 8210	7.3	7.7	8.0	6.3	5.0
WFPB-1B	7.3	7.7	7.0	5.3	4.0
WVPB-1D	7.3	7.7	8.0	6.0	3.7
AA-A91	7.0	6.7	8.0	7.7	5.3
Apache II	7.0	6.3	7.3	6.3	5.3
Duster	7.0	7.0	7.3	7.0	5.0
Finelawn Petite	7.0	7.3	7.3	6.7	4.3
Genesis	7.0	6.3	7.7	7.0	5.3
ISI-TF11	7.0	7.7	8.0	6.3	4.3
LTP-4026 E+	7.0	6.7	8.3	7.7	6.3
MB 212	7.0	7.3	7.7	7.7	5.3
PSII-TF-9	7.0	7.0	7.7	6.7	4.0
RG-93	7.0	7.3	8.0	6.3	5.0
SS45DW	7.0	6.7	6.7	6.7	4.0
WX3-275	7.0	7.3	7.3	6.7	4.7
ATF-020	6.7	5.7	6.3	6.7	5.0
Anthem II	6.7	7.3	7.0	6.7	5.3

Cultivar/ Experimental Number	Seedling Vigor	Height	Density	Color	Texture
Empress	6.7	7.0	7.7	6.7	5.0
ISI-TF10	6.7	6.7	7.0	6.3	5.7
JSC-1	6.7	8.0	7.7	6.0	3.7
LTP-SD-TF	6.7	6.0	7.7	7.3	4.7
MB 215	6.7	6.3	7.7	8.0	5.7
MB 29	6.7	6.7	7.7	8.3	6.7
Marksman	6.7	7.7	8.0	6.0	5.0
Millennium	6.7	6.3	8.3	7.3	5.7
Mustang II	6.7	7.0	8.0	6.0	5.0
PST-523	6.7	6.3	7.7	6.7	4.7
Pennington-1901	6.7	6.7	8.3	8.0	6.3
SRX 8084	6.7	7.0	7.3	6.7	5.0
Tarheel	6.7	5.3	6.0	6.0	3.7
Tulsa	6.7	6.7	7.0	6.7	5.3
WVPB-1C	6.7	7.7	7.0	6.3	4.7
AA-989	6.3	6.0	7.7	7.3	5.3
ATF-038	6.3	6.3	7.3	6.3	4.7
ATF-182	6.3	5.7	7.3	6.0	5.0
ATF-257	6.3	7.7	7.0	6.3	3.7
AV-1	6.3	8.0	6.7	5.3	4.0
Alamo E+	6.3	7.0	7.7	6.7	5.0
BAR FA 6D	6.3	5.7	6.7	7.3	5.7
BAR FA 6LV	6.3	7.0	8.0	8.7	6.0
BAR Fa6D USA	6.3	5.3	7.3	7.7	5.3
Crosfire II	6.3	7.0	7.3	6.7	4.3
EA 41	6.3	6.3	7.0	7.7	5.7
J-101	6.3	6.0	7.7	7.7	6.3
MB 210	6.3	7.0	7.7	7.3	5.7
MB 211	6.3	6.7	7.0	7.7	5.7
MB 214	6.3	6.0	7.3	8.0	5.0
MB 216	6.3	6.7	7.0	8.0	4.3
OFI-96-31	6.3	6.7	7.7	7.3	5.0
OFI-96-32	6.3	7.0	7.3	7.0	5.3
PC-AO	6.3	7.3	6.7	6.7	4.0
PRO 8430	6.3	6.3	6.3	6.3	4.7
PST-5E5	6.3	6.3	7.0	7.0	4.7
PST-5M5	6.3	6.7	7.7	7.0	4.3
PST-R5AE	6.3	6.3	7.0	7.3	5.0
PST-R5TK	6.3	7.3	7.7	6.3	4.0
WRS2	6.3	6.0	7.7	7.3	4.3
EC-101	6.0	7.3	7.7	6.3	4.3
J-98	6.0	5.7	7.0	8.3	6.0
Jaguar 3	6.0	7.0	6.7	6.7	4.0
Koos 96-14	6.0	6.7	6.7	6.3	4.0
MB 213	6.0	7.0	8.3	8.7	5.3
MB 28	6.0	7.3	8.0	8.0	5.7

Cultivar/ Experimental Number	Seedling Vigor	Height	Density	Color	Texture
PSII-TF-10	6.0	6.7	7.0	7.0	4.0
Pick FA 6-91	6.0	5.3	6.3	8.3	6.0
Pick FA XK-95	6.0	5.7	7.0	7.7	5.0
SRX 8500	6.0	5.0	6.3	7.3	5.3
ZPS-2PTF	6.0	6.3	6.7	7.7	5.3
ATF-022	5.7	7.0	7.0	6.3	4.3
ATF-188	5.7	6.3	6.3	6.7	4.3
ATF-192	5.7	6.7	7.0	5.7	4.7
ATF-196	5.7	6.3	6.3	6.7	4.7
ATF-253	5.7	6.7	7.3	6.3	4.0
BAR FA6 US6F	5.7	5.7	7.7	7.3	5.7
BAR Fa6 US2U	5.7	5.0	6.7	8.0	5.7
Bonsai	5.7	6.3	6.0	6.3	4.0
Coyote	5.7	6.3	7.3	7.7	5.3
J-5	5.7	5.3	6.3	8.3	5.7
Lion	5.7	6.3	6.7	7.0	4.3
OFI-FWY	5.7	7.0	7.7	6.3	5.0
PST-5RT	5.7	6.7	7.3	7.3	4.7
PST-5TO	5.7	7.0	7.0	6.0	4.0
Pick FA 15-92	5.7	5.3	6.0	7.7	5.3
Pick FA 20-92	5.7	6.0	6.0	8.0	5.3
Shortstop II	5.7	5.0	5.3	7.3	6.0
Twilight II	5.7	6.3	6.3	7.0	4.7
AA-983	5.3	5.0	7.3	8.0	4.7
BAR Fa6 US3	5.3	5.3	6.7	8.0	6.0
Cochise II	5.3	5.7	5.7	6.7	4.3
Coronado	5.3	5.7	6.3	7.3	5.0
J-3	5.3	6.0	6.7	7.7	5.3
MB 26	5.3	5.3	6.0	7.7	5.7
OFI-951	5.3	5.3	6.3	7.3	5.3
Pick FA B-93	5.3	5.3	6.3	7.3	6.0
Pick FA UT-93	5.3	4.3	5.3	8.0	6.0
Pick GA-96	5.3	5.7	6.0	7.0	5.3
Pick RT-95	5.3	5.3	7.0	7.7	6.3
Sunpro	5.3	5.7	5.7	8.0	5.0
BAR Fa6 US1	5.0	5.3	6.7	8.3	6.0
Tomahawk-E	5.0	6.0	6.7	6.7	4.3
Gazelle	4.7	4.3	5.7	8.0	6.3
ZPS-5LZ	4.7	4.0	5.3	8.3	5.0
Pick FA N-93	4.0	3.3	5.0	7.7	6.3
LSD[2]	*1.0*	*1.2*	*1.6*	*0.9*	*1.2*

[1] Ratings based on a scale of 0-9 with 9=greatest vigor, height, density, etc.
[2]To determine statistical differences among entries, subtract one entry's mean from another's . A statistical difference occurs when the value is larger than the corresponding LSD value.

Table 2. 1997 performance of tall fescue cultivars at Wichita, KS[2].

Cultivar/ Experimental No.	Color	Texture	Pythium Resist.	Quality 3/31	4/30	5/29	6/25	7/23	8/28	9/30	10/31	Avg.
Empress	6.7	8.0	4.0	6.7	7.3	7.7	6.3	6.0	6.0	7.7	7.7	6.9
PST-5E5	7.3	7.3	5.7	6.0	7.0	6.7	6.7	6.7	6.3	8.0	7.3	6.8
LTP-SD-TF	7.3	7.7	5.7	6.7	7.3	6.3	6.7	5.7	6.0	7.7	8.0	6.8
Southern Choice	7.7	7.7	2.7	7.0	7.0	7.7	6.7	6.3	5.3	7.0	7.3	6.8
BAR FA 6D	8.0	8.0	5.3	6.3	8.0	7.0	6.7	5.0	5.3	7.7	8.0	6.8
MB 210	7.7	7.3	5.3	6.7	6.7	7.0	6.3	6.3	6.0	7.3	7.7	6.8
OFI-931	7.0	7.7	6.3	7.0	7.3	6.7	6.3	6.0	6.0	7.7	7.0	6.8
PST-5M5	6.7	7.3	5.0	6.7	7.0	5.7	7.0	6.7	6.0	7.0	8.0	6.8
Millennium	7.3	8.0	3.0	6.7	7.7	8.0	6.3	5.7	4.7	7.3	7.3	6.7
OFI-96-32	6.7	7.3	5.0	7.0	7.3	6.7	6.0	5.7	6.0	7.7	7.0	6.7
SSDE31	7.0	6.7	4.0	7.0	7.0	6.7	6.0	6.3	5.0	8.0	7.3	6.7
Falcon II	6.7	7.3	6.0	7.3	7.0	5.7	6.3	6.3	6.3	7.0	7.3	6.7
CU9501T	7.3	7.3	4.0	6.7	7.0	6.7	7.3	5.3	5.0	8.0	7.0	6.6
Finelawn Petite	7.0	7.0	6.0	6.7	6.7	5.0	6.3	6.3	7.0	8.0	7.0	6.6
ISI-TF11	6.7	7.0	4.0	7.0	7.3	6.0	6.0	6.3	5.7	7.7	7.0	6.6
Titan 2	6.3	6.7	4.3	6.7	6.7	6.0	6.0	7.0	5.7	7.7	7.0	6.6
Anthem II	7.0	8.0	4.3	7.0	7.0	6.7	6.0	5.3	6.0	7.3	7.3	6.6
BAR Fa6D USA	7.7	7.7	5.3	5.7	7.3	5.3	7.0	6.0	5.7	8.0	7.7	6.6
PST-R5AE	7.3	7.0	2.7	6.7	7.0	6.3	6.7	6.0	5.0	7.3	7.7	6.6
Tarheel	7.0	7.7	4.0	6.0	6.7	5.7	6.3	7.0	6.0	7.3	7.7	6.6
BAR Fa6 US1	7.7	8.7	5.0	5.7	6.7	5.3	7.0	6.7	6.0	7.3	7.7	6.5
Genesis	6.7	7.0	4.7	7.3	6.7	5.3	6.7	6.0	5.7	7.3	7.3	6.5
JSC-1	5.7	7.3	6.7	7.3	6.7	6.0	6.7	6.0	5.3	7.7	6.7	6.5
MB 28	8.0	7.0	4.0	6.3	7.0	6.7	6.3	6.0	6.0	7.0	7.0	6.5
PST-5RT	7.0	7.3	4.0	6.0	6.7	6.3	6.0	6.0	6.3	7.7	7.3	6.5
Shenandoah	5.7	6.7	4.3	7.3	7.0	5.0	6.0	6.7	5.3	7.7	7.3	6.5
OFI-96-31	7.3	7.3	5.0	7.0	7.3	7.3	6.3	5.7	4.7	6.7	7.0	6.5
OFI-FWY	7.0	7.7	5.0	6.3	6.7	6.0	6.7	6.0	6.3	7.3	6.7	6.5

Cultivar/ Experimental No.	Color	Texture	Pythium Resist.	Quality								
				3/31	4/30	5/29	6/25	7/23	8/28	9/30	10/31	Avg.
PST-523	6.7	7.3	3.3	6.7	7.0	7.0	6.0	6.0	5.7	6.7	7.0	6.5
Renegade	6.0	7.7	6.7	7.0	6.7	5.7	6.0	6.0	6.3	7.3	7.0	6.5
SS45DW	6.7	7.3	6.7	6.7	6.7	5.0	5.7	6.0	7.7	7.3	7.0	6.5
WFPB-1B	6.7	7.3	5.7	7.0	6.3	5.7	6.3	5.3	6.3	7.7	7.3	6.5
Pennington-1901	8.0	7.7	1.7	6.7	7.7	7.7	7.0	5.7	3.3	6.7	7.0	6.5
ISI-TF9	6.7	7.0	4.0	7.0	6.7	6.7	6.0	5.3	5.3	7.7	7.0	6.5
MB 29	8.0	7.7	5.3	6.0	7.0	5.3	6.3	6.7	5.3	7.3	7.7	6.5
PSII-TF-9	6.7	6.7	4.0	7.3	7.0	6.0	6.0	5.0	5.7	7.3	7.3	6.5
LTP-4026 E+	7.3	8.0	2.3	7.0	7.5	7.3	6.3	5.7	3.7	7.0	7.0	6.4
AT-7	7.7	7.3	3.3	7.0	6.0	6.0	6.3	6.0	5.3	7.7	7.0	6.4
ATF-182	7.0	7.7	4.0	6.3	6.7	7.0	6.0	6.0	5.3	7.0	7.0	6.4
ATF-253	6.0	7.0	4.7	5.7	6.3	6.0	6.0	6.3	6.0	7.7	7.3	6.4
Duster	7.3	7.7	3.0	6.7	7.0	6.3	6.0	5.0	5.3	7.7	7.3	6.4
Jaguar 3	7.3	7.3	4.0	6.3	7.0	5.7	6.7	6.3	5.0	7.0	7.3	6.4
MB 212	7.3	7.7	4.3	6.0	6.7	6.3	6.3	6.0	5.7	7.3	7.0	6.4
MB 213	8.7	7.7	4.7	6.0	7.0	7.3	6.3	6.0	4.7	7.0	7.0	6.4
MB 214	8.0	8.0	4.7	6.0	6.7	6.3	6.7	5.3	5.3	7.7	7.3	6.4
Marksman	6.3	7.3	5.0	7.0	7.0	6.3	6.3	5.0	5.7	7.3	6.7	6.4
Mustang II	6.7	8.0	2.0	7.0	7.0	6.0	6.3	6.3	4.7	7.3	6.7	6.4
PST-5TO	7.3	7.7	5.0	6.0	7.0	5.7	6.7	5.7	6.0	7.3	7.0	6.4
PST-R5TK	6.7	7.0	2.7	6.0	7.3	6.0	6.7	6.3	4.7	7.0	7.3	6.4
Pick FA 20-92	7.7	8.7	4.7	5.7	6.3	6.3	7.3	5.7	6.0	7.0	7.0	6.4
AA-A91	8.0	7.7	3.3	6.7	6.7	6.3	6.3	5.7	5.0	7.0	7.3	6.4
Aztec II	7.3	8.0	4.7	6.7	6.7	5.7	6.0	5.0	6.7	7.7	6.7	6.4
BAR Fa6 US2U	7.7	8.0	3.3	6.7	7.0	6.0	7.0	5.3	6.0	6.7	6.3	6.4
ISI-TF10	6.7	7.7	6.7	6.3	7.0	5.7	6.0	5.0	6.7	7.7	6.7	6.4
JTTFC-96	5.0	6.7	6.3	7.3	6.3	5.0	6.7	6.7	5.3	7.7	6.0	6.4
Leprechaun	7.0	7.3	5.7	6.7	6.3	5.3	6.7	6.0	6.3	7.0	6.7	6.4
PSII-TF-10	6.7	7.3	5.0	7.0	7.3	6.0	6.0	6.3	5.3	6.3	6.7	6.4

Cultivar/ Experimental No.	Color	Texture	Pythium Resist.	Quality 3/31	4/30	5/29	6/25	7/23	8/28	9/30	10/31	Avg.
Pick FA 6-91	7.7	8.3	5.7	5.7	6.3	5.7	7.0	5.0	6.0	7.3	8.0	6.4
R5AU	7.0	7.0	2.7	6.7	7.0	7.3	6.7	5.7	4.3	6.3	7.0	6.4
RG-93	7.0	7.7	4.0	6.7	6.3	6.0	6.3	6.3	4.7	7.7	7.0	6.4
Tomahawk-E	6.3	7.7	7.3	6.3	6.3	5.0	7.0	5.3	6.3	7.7	7.0	6.4
WRS2	8.0	8.3	4.7	6.0	6.3	5.3	6.3	6.3	5.7	7.3	7.7	6.4
Coronado	7.7	7.7	5.0	5.7	6.7	5.3	6.3	5.3	6.0	7.7	7.7	6.3
Overtime mix	6.0	7.0	6.3	7.3	6.3	4.0	5.7	5.7	7.0	7.3	7.3	6.3
ZPS-2PTF	7.7	7.7	4.3	6.0	6.0	5.0	7.0	6.0	5.7	7.3	7.7	6.3
Apache II	7.3	7.7	5.7	6.3	6.7	6.3	6.3	5.7	5.0	7.0	7.0	6.3
DP 50-9011	6.3	8.0	5.3	7.3	6.3	6.0	5.7	4.7	6.3	7.3	6.7	6.3
Twilight II	7.3	8.0	4.0	6.3	6.7	6.7	6.7	4.7	5.3	7.0	7.0	6.3
AA-983	7.7	7.3	2.7	6.0	7.0	6.0	7.0	6.3	4.3	6.3	7.3	6.3
Regiment	6.7	7.7	2.0	7.0	7.3	7.0	6.3	5.3	4.3	7.0	6.0	6.3
Safari	6.3	7.0	6.0	7.3	6.0	6.0	6.3	5.3	5.7	7.3	6.3	6.3
Tulsa	6.3	7.7	3.0	6.3	7.0	6.0	7.0	5.3	4.3	7.3	7.0	6.3
AA-989	7.3	7.0	1.0	6.3	7.3	6.7	6.3	6.0	3.7	6.7	7.0	6.3
ATF-192	6.3	7.3	2.7	6.7	7.0	7.0	6.0	5.3	4.3	7.0	6.7	6.3
BAR FA 6LV	8.0	8.3	4.7	6.3	7.0	5.3	6.3	5.7	5.3	6.7	7.3	6.3
Bonsai 2000	7.0	7.7	4.3	6.3	7.0	6.3	6.3	5.0	5.0	6.7	7.3	6.3
CU9502T	6.3	7.3	5.7	7.0	7.0	5.3	6.3	6.3	5.0	6.0	7.0	6.3
DLF-1	6.7	6.7	5.7	7.3	6.3	4.7	5.3	5.7	7.0	7.3	6.3	6.3
EC-101	6.3	7.7	3.3	7.0	6.7	6.0	6.0	5.7	5.0	6.7	7.0	6.3
MB 215	8.3	7.0	3.0	6.0	7.0	6.7	7.0	5.3	5.0	6.7	6.3	6.3
MB 216	8.7	7.3	5.3	6.0	7.0	5.7	6.0	5.3	6.3	7.0	6.7	6.3
Pick FA XK-95	7.7	7.7	3.7	6.0	7.0	6.7	7.0	5.3	4.7	6.7	6.7	6.3
SRX 8500	6.7	7.3	3.0	6.7	7.0	6.3	6.0	5.7	4.7	6.7	7.0	6.3
WVPB-1C	7.0	6.7	3.3	6.7	6.7	6.7	6.3	6.0	4.3	6.7	6.7	6.3
Equinox	7.0	7.7	4.3	6.7	6.7	5.3	6.0	4.7	5.7	8.0	6.7	6.2
ATF-020	7.3	7.3	3.3	6.0	6.3	5.7	6.0	5.7	5.3	7.7	7.0	6.2

Cultivar/ Experimental No.	Color	Texture	Pythium Resist.	Quality 3/31	4/30	5/29	6/25	7/23	8/28	9/30	10/31	Avg.
Lion	7.3	6.7	3.7	6.0	5.7	6.0	7.3	5.0	5.3	7.3	7.0	6.2
ATF-038	6.7	7.3	3.3	6.3	6.7	5.3	6.7	5.0	5.0	7.3	7.0	6.2
J-98	7.3	8.0	3.7	6.0	6.7	7.0	7.0	5.0	4.7	5.7	7.3	6.2
Koos 96-14	7.0	7.3	6.3	6.7	6.7	6.0	6.0	5.3	4.7	7.7	6.3	6.2
PC-AO	6.3	7.3	4.3	6.3	6.7	5.7	6.0	6.0	5.3	6.7	6.7	6.2
Crosfire II	7.0	7.3	3.3	6.3	7.0	5.3	6.7	6.0	4.7	6.7	6.5	6.1
ATF-257	6.3	6.7	2.7	6.3	6.3	5.0	6.0	6.0	5.3	7.0	7.0	6.1
BAR FA6 US6F	7.7	7.7	4.0	6.7	7.0	6.3	6.7	4.7	4.0	6.7	7.0	6.1
BAR Fa6 US3	7.7	7.7	4.3	6.0	6.0	6.3	6.7	5.3	5.3	6.3	7.0	6.1
Coyote	8.0	8.0	3.3	5.7	7.0	6.0	6.7	5.3	5.3	6.3	6.7	6.1
J-3	7.7	7.3	3.3	6.3	7.0	7.3	6.7	5.0	3.7	6.3	6.7	6.1
PRO 8430	6.7	7.0	6.0	6.0	7.0	5.7	6.0	5.7	5.0	6.7	7.0	6.1
Pixie E+	7.0	7.3	2.7	7.0	6.3	6.0	6.3	4.0	5.0	7.0	7.3	6.1
ATF-188	7.0	7.3	2.7	6.7	7.0	6.3	6.3	5.7	3.7	6.3	6.7	6.1
Cochise II	6.7	8.0	3.7	6.0	6.3	6.0	6.7	4.7	5.0	7.0	7.0	6.1
Bonsai	6.3	7.7	5.0	6.0	6.0	5.0	6.0	5.7	6.3	6.7	6.7	6.0
J-101	7.3	8.0	2.0	6.0	7.3	6.7	6.3	5.0	4.3	6.0	6.7	6.0
MB 211	7.7	7.0	3.3	6.0	7.0	7.3	6.7	5.0	3.3	6.3	6.7	6.0
OFI-951	7.7	8.0	2.7	6.0	7.0	6.7	7.0	5.0	4.0	6.0	6.7	6.0
WX3-275	7.0	7.3	5.3	5.7	6.3	5.3	6.3	6.0	5.0	7.0	6.7	6.0
Pick FA 15-92	7.3	7.7	3.3	6.0	7.3	6.0	6.3	4.3	5.3	6.3	6.7	6.0
SRX 8084	7.3	7.3	4.3	6.3	7.3	5.3	6.0	5.0	5.0	6.3	7.0	6.0
ATF-022	6.3	7.3	3.3	6.3	6.3	6.0	6.0	5.3	4.3	7.3	6.3	6.0
Pick GA-96	7.0	7.7	1.3	6.0	6.7	6.3	6.0	5.3	4.3	6.3	7.0	6.0
SR 8210	6.0	7.3	4.3	6.7	7.0	5.7	6.0	3.7	5.3	7.7	6.0	6.0
WVPB-1D	6.3	6.7	4.3	7.0	6.7	5.7	6.0	5.3	4.3	6.7	6.3	6.0
Arid	4.7	5.3	4.0	7.7	6.0	5.3	6.0	5.7	5.3	6.3	5.3	6.0
DP 7952	5.0	6.7	6.3	8.0	4.3	6.3	6.0	5.7	5.0	7.3	5.0	6.0
ZPS-5LZ	8.3	8.0	2.3	5.0	7.0	6.0	7.0	4.7	4.3	6.7	7.0	6.0

Cultivar/ Experimental No.	Color	Texture	Pythium Resist.	Quality 3/31	4/30	5/29	6/25	7/23	8/28	9/30	10/31	Avg.
Alamo E+	7.3	7.7	5.0	6.0	6.7	5.0	6.0	4.7	5.3	6.7	7.0	5.9
Gazelle	8.0	8.0	1.3	5.3	7.0	6.0	8.0	3.7	4.0	6.3	7.0	5.9
Pick FA B-93	7.0	7.0	2.0	6.7	7.0	5.7	6.3	4.7	4.0	5.7	7.0	5.9
AV-1	5.0	6.0	6.7	7.7	5.7	5.7	5.0	5.7	4.7	6.7	5.7	5.8
Pick RT-95	7.3	7.7	4.3	6.0	6.7	6.0	6.7	5.0	4.7	5.7	6.0	5.8
MB 26	8.0	8.0	4.7	5.3	6.7	4.7	6.0	4.3	5.7	6.7	7.3	5.8
Sunpro	7.7	7.7	3.0	5.7	6.0	6.3	6.7	5.0	4.3	6.3	6.3	5.8
J-5	8.0	8.0	4.7	5.3	6.3	6.3	5.7	5.3	4.7	6.0	6.7	5.8
ATF-196	7.0	8.3	3.3	6.0	6.3	5.7	6.0	4.7	4.7	5.7	7.0	5.8
JTTFA-96	4.7	6.0	2.3	8.0	6.3	5.7	5.7	5.3	4.0	6.3	4.7	5.8
EA 41	8.0	7.0	4.3	5.7	6.3	5.0	6.3	4.3	4.3	5.7	6.0	5.5
Shortstop II	7.3	7.7	2.0	5.3	5.7	6.0	5.7	4.3	3.7	6.0	7.0	5.5
Pick FA N-93	8.3	8.0	3.7	4.7	4.0	5.0	6.3	4.0	4.3	5.7	6.3	5.0
Pick FA UT-93	7.0	7.7	2.0	5.0	5.3	4.3	6.3	4.3	3.3	5.3	6.3	5.0
Kentucky-31 w/endo.	4.0	5.0	7.0	8.0	5.3	4.0	4.0	5.0	4.0	5.7	4.0	5.0
LSD[2]	0.9	1.1	5.2	1.0	1.3	2.3	1.1	1.8	3.9	2.8	1.2	0.7

[1] Ratings based on a scale of 0-9 with 9=color, texture, pythium resistance, and quality.
[2]To determine statistical differences among entries, subtract one entry's mean from another's . A statistical difference occurs when the value is larger than the corresponding LSD value.

TITLE: Zoysia Cultivar Trial

OBJECTIVE: To compare several vegetative and seeded zoysiagrasses for performance in Kansas.

PERSONNEL: Jack Fry

SPONSOR: National Turfgrass Evaluation Program

INTRODUCTION:

Meyer zoysiagrass is used throughout the transition zone for golf course fairways and home lawns. There is interest in identifying zoysiagrass cultivars that can be established more rapidly, and have better turf quality attributes than Meyer.

MATERIALS AND METHODS:

Twenty-five grasses were established from seed or plugs in July, 1996 at the Rocky Ford Turfgrass Research Center in Manhattan. Seeded selections were ZEN 500, ZEN 400, Zenith, J-36, J-37, Chinese Common, Z-18, and Korean Common. Plots measured 5 by 5 ft, and were arranged in a randomized complete block design. Seeding rate was approximately 2 lbs/1000 sq ft. Six 2-inch- diameter plugs of vegetative selections were planted in each plot. The area received frequent irrigation through the establishment period, with frequency decreasing as plants became established. Mowing was done at 1.5 nches with a rotary mower in 1996. In 1997, a reel mower was used 3 days weekly to maintain turf at a 0.75-inch height 3 days weekly. Nitrogen was applied to provide 1 lb N/1000 sq ft.

RESULTS:

<u>1996 (Data not shown)</u>: The seeded selections, with the exception of Korean Common, exhibited the best coverage when plots were rated in September. For example, coverage was between 68 and 77% for ZEN 400, Zenith, J-36, J-37, and Chinese Common. Coverage of vegetative selections generally ranged from 20 to 50% at the end of the first season.

<u>1997 (Table 1)</u>: Coverage: All seeded selections except ZEN 500, Z-19, and Korean Common had coverage > 95% by the August rating date. Of the vegetative selections, only El Toro had > 90% coverage by August. Meyer exhibited 78% coverage. Cultivars with > 80% coverage included J-14, Miyako, Jamur, Emerald, and Palisades.

Spring Green Up: Plots were rated in early May. Early spring green-up generally would be considered an asset. However, cultivars that green up too early also may be predisposed to late-spring freezing injury. Cultivars that exhibited relatively high spring green-up scores were Korean Common, ZEN 500, ZEN 400, Zenith, and Chinese Common. Conversely, cultivars that exhibited very low spring green-up were Z-18, Miyako, HT 2-10, DeAnza, Victorial El Toro, Jamur, Zeon, Cavalier, and Palisades. Several of these may have been damaged by winter temperatures.

Leaf Texture: Finest leaf texture was observed for Emerald and Cavalier. Cultivars with coarser leaves were DeAnza, Victoria, HT 2-10, and Korean Common.

Color: Cultivars that were among the highest for color scores were Zenith, Korean Common, HT 2-10, DeAnza, Victoria, Jamur, Meyer, Emerald, Crowne, and Palisades.

Turf Quality: Relatively low quality scores in June and July were due partly to the lack of complete cover in most of the plots. Cultivars that were slower to establish received lower scores because more bare ground was present. Highest quality scores at the end of the season (September) were observed for the seeded cultivars (that had higher coverage). Poorest quality was observed for DeAnza, Victoria, HT 210, and Z-18.

Table 1. Performance of zoysiagrass cultivars at Manhattan, KS in 1998.

Cultivar	Seeded (S) or Vegetative (V)	Coverage %		Spring	Leaf		Turf Quality			
		July	August	Green up	Texture	Color	June	July	August	Sept.
				0 to 9 scale[1]						
ZEN 500	S	63	70	6.7	5.0	7.7	3.7	3.7	4.0	5.0
ZEN 400	S	87	98	6.3	5.7	7.0	5.3	5.3	6.3	7.3
Zenith	S	88	97	6.3	5.3	8.3	5.3	5.0	6.0	8.0
J-36	S	63	97	5.7	5.0	7.7	4.7	4.7	5.3	7.0
J-37	S	91	98	5.7	4.3	7.7	5.3	5.3	6.7	7.0
Chinese Common	S		97	6.3	4.7	7.7	6.0	6.0	6.3	7.3
Z-18	S	36	45	0	4.3	7.5	1.0	2.7	2.7	3.3
Korean Common	S	60	63	7.3	4.0	8.0	2.0	3.3	3.7	4.0
DALZ 9601	V	76	65	1.0	6.7	7.0	1.7	4.7	5.0	4.3
J-14	V	78	87	5.7	5.3	7.7	3.3	4.0	4.7	6.3
Miyako	V	70	87	0	4.7	7.7	1.0	3.3	4.7	5.7
HT 2-10	V	66	23	0	3.3	8.0	0.0	1.0	5.0	2.0
DeAnza	V	22	28	0	2.3	8.0	0.3	3.0	2.0	2.3
Victoria	V		20	1.0	4.3	8.0	0.3	3.3	1.7	1.7
El Toro	V	88	92	3.0	5.3	7.7	2.3	4.0	6.0	7.0
Jamur	V	81	83	2.0	6.0	8.0	3.3	3.0	5.7	5.7
Zeon	V	53	63	1.3	6.3	7.3	1.7	3.0	3.7	4.3
Meyer	V	78	78	4.3	6.7	8.7	3.0	4.0	4.3	5.3
Emerald	V	75	85	3.3	8.0	8.0	3.0	3.7	4.7	5.7
Cavalier	V	57	62	0.7	8.0	7.7	1.7	2.3	3.7	4.3
Crowne	V	78	78	2.3	5.0	8.0	2.3	3.3	4.7	6.0
Palisades	V	78	88	1.7	5.0	8.0	2.7	3.7	5.3	6.3
LSD[2]		*56*	*49*	*2.7*	*4.8*	*1.5*	*2.4*	*4.6*	*4.2*	*3.5*

[1]Attributes rated visually on a 0 to 9 scale, 9 = best.

[2]To determine statistical differences among entries, subtract one entry's mean from another's. A statistical difference occurs when this value is larger than the corresponding LSD value.

TITLE: High-Maintenance Kentucky Bluegrass Trial

OBJECTIVE: To evaluate Kentucky bluegrass cultivars under golf course fairway conditions in the transition zone.

PERSONNEL: Steve Keeley

INTRODUCTION:

Turfgrass breeders have been recently directing efforts toward developing Kentucky bluegrass cultivars with improved tolerance to low mowing heights. Successful cultivars must form a dense playing surface at low mowing heights (5/8 inch or less), and they must have resistance to summer patch. If such cultivars can be identified, they would provide a viable alternative to perennial ryegrass for cool-season fairway turf in the transition zone.

MATERIALS AND METHODS:

One-hundred and five Kentucky bluegrass cultivars were seeded in September of 1995 at the Rocky Ford Turfgrass Research Center in Manhattan. Plots were mowed at 9/16 inch and were fertilized with 4 lb N/1000 sq ft/year. The turf was irrigated to prevent stress. No fungicides or insecticides were applied.

Turf quality was rated monthly from April to November on a visual scale of 0 to 9, where 0=dead turf and 9=optimum density and uniformity. In this particular trial, cultivars with an average quality rating of 5.5 or above would be acceptable fairway turfs. The cultivars also were rated for color and density. Billbug damage occurred on some plots in July, and rust infested some plots in September; accordinglym the cultivars were rated for susceptibility to these pests.

RESULTS:

Because summer performance is critical in Kansas, the cultivars are ranked in Table 1 according to their mean quality from June through August. Cultivars with an average rating of 5.5 or above included Apollo, Blacksburg, America, PST-B2-42, PST-BO-141, Wildwood, Unique, ZPS-2183, Odyssey, Midnight, Glade, and Bartitia. When selecting cultivars for fairway use, one also should consider their season-long quality rating (averaged from April through November). All the cultivars mentioned above except Wildwood, ZPS-2183, and Bartitia had average season-long quality ratings above 5.5. Out of the above group, Blacksburg was the most susceptible to rust. Rust is a fairly minor disease concern, but it can be very unsightly while it is active. Blacksburg should be blended with rust-resistant cultivars for use in fairways. All of these cultivars appeared to have decent billbug tolerance. We will continue to evaluate these cultivars over the next several years.

Table 1. Performance of Kentucky bluegrass at low mowing height in Manhattan, KS.

	Quality*												
Cultivar	Apr	May	Jun	Jul	Aug	Oct	Nov	Jun-Aug Mean	Apr-Nov Mean	Color	Density	Rust (Sept.)	Billbug Damage (July)
Apollo (PST-B 3-180)	6.0	6.8	7.3	5.7	6.7	5.7	5.0	6.7	6.2	6.3	6.7	8.3	8.7
Blacksburg	5.2	7.2	7.3	6.0	6.7	4.3	4.0	6.6	5.8	7.7	6.7	5.7	8.3
America	4.3	5.8	6.3	5.7	6.3	6.0	5.0	6.1	5.6	6.0	6.3	7.3	8.7
PST-B 2-42	5.2	6.2	6.3	5.0	6.0	5.3	4.3	6.1	5.6	6.7	6.3	8.0	8.5
PST-B O-141	5.2	6.5	6.0	4.0	6.3	6.0	5.7	6.1	5.9	6.7	6.3	7.7	8.8
Wildwood	5.0	6.7	7.0	5.5	5.3	3.7	3.3	5.9	5.2	6.7	6.0	7.3	8.0
Unique	5.0	5.5	6.5	4.3	5.8	5.5	5.0	5.9	5.5	6.3	6.0	6.7	8.3
ZPS-2183	5.0	5.5	6.3	5.3	5.5	4.0	4.0	5.9	5.2	7.3	6.0	7.7	8.5
Odyssey (J-1561)	5.0	6.8	6.7	5.3	5.5	5.0	4.7	5.8	5.6	7.0	6.7	9.0	8.0
Midnight	5.2	6.7	7.3	5.2	4.8	5.3	4.3	5.8	5.6	8.0	6.7	9.0	7.7
Glade	5.7	7.0	6.3	4.0	5.7	6.3	5.3	5.7	5.9	7.0	6.3	9.0	7.7
Bartitia	4.5	5.8	6.3	5.8	4.7	4.0	4.0	5.6	5.0	6.7	6.3	7.0	7.3
Abbey	5.0	5.7	6.0	5.8	5.5	5.7	4.0	5.4	5.2	6.0	5.7	9.0	8.2
Fortuna	5.0	5.3	5.3	4.5	5.3	4.3	3.7	5.3	4.9	6.7	5.7	8.7	8.0
NJ 1190	5.5	7.0	7.0	4.3	4.8	4.0	3.3	5.3	5.1	6.0	7.0	4.0	6.8
PST-638	4.5	6.7	6.0	4.5	5.0	3.7	3.0	5.3	4.8	7.0	6.0	6.0	7.7
Nimbus	4.5	5.2	5.5	4.0	5.0	4.0	3.0	5.3	4.6	6.0	5.7	6.3	7.2
SR2109	5.0	5.7	6.0	4.3	5.0	4.5	3.5	5.3	4.9	6.5.	6.7	7.7	7.2
Ba 75-173	5.0	6.2	7.0	4.2	4.5	4.0	3.5	5.3	4.9	6.7	5.7	6.3	6.5
NuStar	5.0	5.8	5.3	4.3	5.1	4.3	3.7	5.2	4.9	6.0	5.7	7.3	8.0
Ba 73-373	5.0	6.3	6.3	4.5	4.7	4.0	3.7	5.2	5.0	6.3	6.3	6.3	7.8
PST-P 46	4.2	5.8	6.0	4.3	5.2	4.0	3.3	5.2	4.7	7.3	6.0	6.7	6.8
SR2000	5.0	5.2	6.0	4.0	4.8	5.0	4.0	5.2	5.0	7.3	6.0	6.7	7.7
Jefferson	6.2	6.2	6.0	4.5	4.8	4.7	4.3	5.2	5.3	6.0	6.0	8.0	7.5
SRX2205	5.0	6.5	6.3	6.0	4.7	3.7	2.7	5.2	4.8	6.7	6.0	6.0	7.3
Total Eclipse (TCR-1738)	4.7	5.7	5.7	5.0	4.8	4.7	4.3	5.2	5.0	7.3	6.00	8.7	8.0
Ba 81-058	5.2	5.7	6.0	4.2	4.8	4.3	4.3	5.1	5.0	6.7	6.00	9.0	7.3

Table 1. Performance of Kentucky bluegrass at low mowing height in Manhattan, KS.

	Quality*												Billbug
Cultivar	Apr	May	Jun	Jul	Aug	Oct	Nov	Jun-Aug Mean	Apr-Nov Mean	Color	Density	Rust (Sept.)	Damage (July)
Lipoa	5.5	6.3	6.0	3.34	5.0	4.3	5.0	5.1	5.2	7.7	6.0	8.3	7.2
ZPS-309	5.2	6.0	6.0	4.7	4.8	5.0	4.0	5.1	5.1	7.0	6.0	7.3	7.7
Explorer (Pick-3561)	5.8	5.8	6.0	5.0	4.5	5.5	4.5	5.0	5.2	6.0	6.0	9.0	7.8
Eclipse	4.8	4.8	5.0	4.8	5.2	4.7	3.7	5.0	4.7	6.0	5.3	7.3	7.7
Marquis	4.7	5.8	5.3	4.2	4.8	4.0	3.7	5.0	4.7	6.7	6.3	8.3	7.2
PST-A 7-60	4.8	6.0	6.0	4.8	4.8	4.0	3.7	5.0	4.8	7.0	7.0	7.7	7.0
Rugby II (Med-18)	5.0	6.8	6.0	4.8	4.5	4.0	5.0	5.0	5.1	8.0	6.0	9.0	6.8
Goldrush (Ba 87-102)	5.0	5.5	6.5	5.5	4.3	5.0	4.5	5.0	5.0	6.7	6.0	8.7	7.2
Princet on 105	5.5	6.0	6.3	4.7	4.7	5.0	4.0	5.0	5.1	6.7	6.0	9.0	6.7
LTP-621	5.7	6.0	5.7	3.5	4.8	5.3	4.7	4.9	5.2	6.0	6.0	8.7	7.0
Award	5.3	6.8	6.0	4.5	4.5	5.0	4.0	4.9	5.1	7.3	6.7	9.0	7.2
Arcadi (J-1936)	5.3	6.3	5.5	3.0	4.8	4.5	4.5	4.9	5.0	6.7	5.3	9.0	6.5
Conni	6.0	7.0	6.5	4.0	4.3	5.0	4.5	4.9	5.3	6.0	7.0	9.0	7.0
Misty (Ba 76-372)	4.5	5.2	5.0	3.5	4.8	4.7	4.0	4.9	4.7	6.0	5.0	8.0	7.3
Allure	6.1	6.5	6.0	4.5	4.5	5.0	5.0	4.8	5.3	5.7	6.3	9.0	7.2
HV130	4.2	6.3	6.0	4.5	4.3	5.5	4.5	4.8	5.0	7.0	6.3	8.3	6.7
ZPS-2572	5.5	6.3	6.5	4.0	4.3	4.0	4.0	4.8	4.9	7.7	6.3	9.0	6.3
Coventry	6.5	6.3	6.5	3.8	4.0	4.5	4.5	4.8	5.2	5.3	6.3	8.7	7.5
H86-690	4.7	5.3	5.3	3.8	4.7	4.0	3.3	4.8	4.6	7.7	5.0	7.0	7.2
LKB-95	5.5	6.2	6.0	4.2	4.7	4.3	4.0	4.8	4.9	6.7	6.7	7.7	6.2
SR2100	5.2	5.2	5.7	4.2	4.7	5.7	3.3	4.8	4.8	6.3	5.3	9.0	6.7
Chicago (J-2582)	5.5	5.5	5.3	4.2	4.7	4.7	4.3	4.8	4.9	6.0	5.7	8.7	6.8
Ba 75-490	5.5	5.5	5.7	4.2	4.5	4.7	4.0	4.8	4.8	6.3	6.0	9.0	6.7
Limousine	5.2	6.0	5.3	3.8	5.2	4.0	3.7	4.8	4.7	6.3	6.7	7.0	6.3
HV 242	5.8	6.3	5.3	4.2	4.8	4.3	3.7	4.7	4.9	6.7	6.3	8.3	6.3
Rambo (J-2579)4.8	5.5	5.5	4.5	4.3	5.0	4.0	4.7	4.	6.3	6.0	8.7	6.7	
NuGlade	4.5	5.5	5.3	4.0	4.3	5.0	4.0	4.7	4.71	7.0	5.7	9.0	6.8
Ba 81-270	5.5	6.0	6.0	4.7	4.0	5.3	4.3	4.7	5.0	5.7	6.3	8.3	6.5

Table 1. Performance of Kentucky bluegrass at low mowing height in Manhattan, KS.

Cultivar	Quality*									Color	Density	Rust (Sept.)	Billbug Damage (July)
	Apr	May	Jun	Jul	Aug	Oct	Nov	Jun-Aug Mean	Apr-Nov Mean				
Ba 70-060	5.0	5.5	5.3	3.7	4.5	4.7	3.7	4.7	4.5	6.0	5.3	7.3	6.7
PST-BO-165	5.8	5.8	5.7	4.2	4.2	5.7	5.0	4.6	5.2	5.3	5.7	8.3	6.3
Seabring (BA 79-260)	4.3	5.0	5.7	4.3	3.8	3.7	3.7	4.6	4.3	7.3	5.7	9.0	6.5
BAR VG 3115B	5.2	6.0	5.7	3.7	4.2	3.7	3.3	4.6	4.6	5.0	5.7	4.0	6.5
Pick 8	5.0	5.3	5.0	2.8	4.7	5.3	4.0	4.6	4.8	8.0	5.7	8.7	7.0
Sidekick	4.8	4.6	5.3	4.2	4.2	4.3	3.7	4.6	4.5	6.0	5.3	8.0	6.7
Ascot	5.0	5.7	5.7	4.2	4.3	4.3	3.7	4.6	4.6	7.0	5.3	8.0	6.5
Ba 77-702	4.5	5.3	5.3	4.2	4.2	4.7	4.0	4.6	4.6	6.3	5.7	8.7	7.0
A88-744	4.5	5.5	5.5	4.3	4.0	5.0	5.0	4.5	4.8	6.7	6.0	8.7	6.8
Baron	5.2	6.0	5.0	4.0	4.5	4.7	4.3	4.5	4.8	6.0	5.3	8.3	6.5
Ba 81-113	4.2	4.5	5.3	5.2	4.0	4.3	3.7	4.5	4.3	6.3	5.3	7.7	6.8
Caliber	5.2	5.3	4.7	4.2	4.5	4.7	3.7	4.4	4.6	6.3	5.7	7.7	6.7
Cardiff	5.2	5.7	5.7	4.0	3.5	3.0	2.7	4.4	4.2	7.0	6.0	8.0	6.5
PST-A 418	4.0	4.8	5.0	3.8	4.2	4.0	3.0	4.4	4.2	8.0	5.3	7.0	7.7
OFI 94-25 KBG	5.3	5.0	5.0	4.0	4.8	4.5	4.0	4.4	4.6	5.7	5.3	6.7	6.0
Quantum Leap (J-1567)	4.0	4.8	4.5	3.8	4.3	4.5	4.0	4.4	4.4	6.7	6.0	8.3	7.3
Shamrock	5.7	5.8	5.3	3.8	3.7	3.7	3.3	4.4	4.5	6.3	5.3	8.0	6.7
Ba 76-197	4.8	4.5	5.3	4.0	3.8	4.7	3.3	4.4	4.4	6.3	5.3	7.3	6.7
Challenger	4.3	5.5	5.0	4.0	4.2	4.7	4.3	4.4	4.6	6.3	5.3	8.0	6.8
Ba 75-163	4.5	4.7	5.0	4.0	4.2	4.3	3.7	4.4	4.3	7.0	5.3	8.7	7.2
BAR VG 233	5.3	6.5	5.3	3.8	3.8	3.7	3.3	4.3	4.6	6.3	6.0	8.0	6.3
Haga	6.2	6.0	5.7	3.8	3.8	5.7	5.0	4.3	5.1	5.3	5.7	9.0	6.0
PST-A 7-245A	4.8	5.3	5.3	4.3	3.8	4.7	4.0	4.3	4.6	6.0	5.7	9.0	6.8
Raven	4.7	5.3	4.7	3.7	4.2	4.3	3.3	4.3	4.4	6.3	5.3	8.7	7.0
Chateau	5.7	6.3	5.0	3.5	4.2	4.7	4.3	4.3	4.8	5.7	6.3	8.7	6.2
VB 16015	4.7	4.3	4.7	3.5	4.2	3.3	2.7	4.3	4.0	7.3	5.0	8.3	6.8
Platini	4.7	6.0	5.3	4.8	3.7	4.7	3.7	4.3	4.6	6.7	5.7	7.7	6.7
NJ-54	4.3	5.0	5.0	4.8	3.6	3.0	2.4	4.2	4.0	6.9	5.7	7.8	6.6
Baronie	6.5	5.0	5.0	4.0	3.8	5.5	5.0	4.2	5.0	5.0	6.0	9.0	6.8

Table 1. Performance of Kentucky bluegrass at low mowing height in Manhattan, KS.

Cultivar	Quality*												Billbug
								Jun-Aug	Apr-Nov			Rust	Damage
	Apr	May	Jun	Jul	Aug	Oct	Nov	Mean	Mean	Color	Density	(Sept.)	(July)
BAR VG 5649	4.7	5.8	5.3	5.3	3.5	4.3	4.3	4.2	4.5	7.0	5.7	7.67	5.7
OFI 94-13 KBG	4.5	4.8	4.7	3.5	4.3	4.7	4.0	4.2	4.4	5.0	4.7	8.0	6.2
Dragon (ZPS-429)	3.8	4.5	4.7	4.0	3.8	3.7	3.7	4.2	4.0	7.0	5.0	8.0	6.7
BAR BG 6820	3.5	4.3	5.0	4.2	3.5	3.0	3.0	4.2	3.8	7.0	5.7	9.0	6.2
Ba 81-227	4.7	6.0	5.5	5.6	3.5	4.0	3.5	4.2	4.4	6.0	5.7	8.3	6.2
Pick-855	3.4	4.7	4.3	3.8	4.0	3.7	3.3	4.1	4.0	6.7	5.0	7.7	6.5
Compact	6.0	4.7	5.0	3.7	3.7	3.7	3.7	4.1	4.3	5.0	5.0	8.3	6.0
LTP-620	4.5	5.5	4.7	4.2	3.8	4.3	4.0	4.1	4.4	6.7	5.0	8.7	6.3
Classic	6.0	5.5	4.5	3.3	4.0	5.5	5.0	4.0	4.9	5.3	5.7	8.3	5.8
Ba 81-220	4.5	5.3	5.0	4.0	3.7	4.0	3.5	4.0	4.2	7.0	5.7	8.0	6.7
J-1555	4.2	5.2	4.7	4.0	3.7	3.7	3.7	3.9	4.1	6.7	4.7	8.3	5.8
NJ-GD	5.3	5.3	4.3	3.8	3.7	4.0	3.7	3.9	4.3	6.0	5.0	8.0	6.2
Bluechip (MED-1991)	4.0	4.5	4.3	3.8	3.5	3.3	3.0	3.9	3.8	7.0	4.7	9.0	6.0
Sodnet	4.0	4.8	4.7	3.5	3.5	2.3	2.3	3.9	3.6	7.7	4.3	7.7	5.8
Livingston	5.3	5.3	4.5	3.3	3.3	4.0	4.0	3.8	4.3	6.0	5.3	7.3	6.7
Pepaya (DP 37-192)	3.3	4.8	5.5	3.5	2.8	2.5	2.0	3.8	3.4	8.0	5.0	6.0	5.3
Kenblue	3.7	3.7	4.0	3.7	3.5	3.7	3.0	3.7	3.6	4.7	4.3	8.0	6.0
MED-1580	4.5	5.8	4.5	4.5	3.3	3.5	3.0	3.7	4.0	7.0	5.3	6.7	6.5
Absolute (MED-1497)	4.5	5.5	5.0	3.3	3.0	3.5	3.0	3.6	3.9	8.0	5.7	8.0	5.8
J-1576	3.0	4.3	4.5	3.5	2.8	4.0	2.5	3.5	3.5	8.0	5.7	6.0	6.5
*LSD** (p =0.05)*	*1.2*	*1.5*	*1.5*	*1.3*	*1.4*	*1.4*	*1.3*	*1.1*	*1.0*	*0.8*	*1.2*	*1.8*	*1.7*

*Rated on a scale of 0 = dead turf to 9 = optimum density and uniformity.
**To determine statistical differences among entries, subtract one entry's mean from another's . A statistical difference occurs when the value is larger than the corresponding LSD value.

TITLE: Flowering Ornamentals and Growing Degree Days as Indicators for Crabgrass Emergence in Midwestern Turf

OBJECTIVE: To correlate flowering times of ornamentals and growing degree days to crabgrass emergence

PERSONNEL: Jack Fry, Steve Wiest, Ward Upham, and Alan Zuk (Kansas State University)
Roch Gaussoin (University of Nebraska)

SPONSOR: Kansas Turfgrass Foundation

INTRODUCTION:

Efficacy of some preemergence herbicides is strongly dependent upon timing of application relative to crabgrass emergence. Herbicides that have a relatively short residual, such as pendimethalin, provide better crabgrass control if applied near the date of germination. Applications of preemergence herbicides after emergence is generally ineffective. In the past, turfgrass managers have employed various methods to determine optimum time for preemergence herbicide application, including calendar date, soil temperature, growing degree days (GDD), and flowering ornamentals. However, little research has been done to correlate ornamental bloom times with crabgrass emergence.

MATERIALS AND METHODS:

Crabgrass emergence. Areas at the Rocky Ford Turfgrass Research Center at Manhattan, KS and on the University of Nebraska campus at Lincoln, NE were surveyed for smooth crabgrass emergence during the springs of 1995 through 1997. Bare ground and thin turf areas were assessed separately, beginning in March and ending when emergence was observed.

Flowering ornamentals. During the springs of 1995 through 1997, 11 flowering ornamentals were surveyed in Manhattan, KS and Lincoln, NE. Cultivars of ornamentals were not known. At least one, and usually more more than one, specimen of each species was surveyed. When flower initiation or withering dates differed among specimens within a species, an average date was calculated. Ornamentals evaluated were bridal wreath spiraea (*Spiraea prunifolia* Sieb. and Zucc.), callery pear (*Pyrus calleryana* Decne.), daffodil (*Narcissus* spp. L.), flowering quince (*Chaenomeles* Lindl.), forsythia (*Forsythia* x. *intermedia* Zab.), iris (*Iris* spp. L.), lilac (*Syringa vulgaris* L.), redbud (*Cercis canadensis* L.), saucer magnolia (*Magnolia* x *soulangiana* Soul.-Bod.), tulip (*Tulipa* spp. L.), and Vanhoutte spiraea [*Spiraea* x. *vanhouttei* (Briot) Zab.].

Analysis. We determined the difference between bloom date or wither date of ornamentals and a date 2 weeks before crabgrass germination. Variance analysis then was conducted on this difference. This is because we didn't expect the date of bloom or wither to be close to the desired date but hoped to be able to predict the desired date by adding a certain number of days to the date of ornamental bloom or wither.

Analysis of the degree-day estimation was a bit more complicated. Seven base temperatures from 30 to 60 F were tested. Hourly temperatures were used to calculate the degree-days that occurred above the base temperature from 1 January until 2 weeks before crabgrass germination (the desired date). The base tempeatures were averaged across years. The average degree-day then was used to estimate the desired date for each year. Variance analysis was conducted on the difference between the estimated date and the desired date for each year.

RESULTS:

Crabgrass emergence. At Manhattan, the earliest date of crabgrass emergence in bare soil was 15 April 1995, whereas the latest date was 9 May 1996 (Fig. 1). In thin turf, the earliest date of emergence was 5 May, 1997, and the latest date was 22 May, 1995.

At Lincoln, the earliest date of crabgrass emergence in bare soil was 1 June, 1996 , and the latest date was 8 June, 1997 (Fig. 1). In thin turf, earliest emergence occurred on 10 June, 1996, and the latest observed date was 17 June, 1997. The variability in the emergence dates from year to year, particularly in Manhattan, clearly indicates that calendar date is not a reliable indicator for determining application times for preemergence herbicides.

Emergence in bare soil occurred 23 to 53 days earlier in Manhattan than in Lincoln. In thin turf, emergence at Manhattan was observed 25 to 43 days earlier than in Lincoln. This again emphasizes that the recommended 2-week differential between these locations (i.e., April 15 vs. May 1) for schedules of preemergence herbicide applications is not consistent with differences in emergence dates observed.

Flowering ornamentals. Candidate ornamentals were those that started and/or ended bloom prior to crabgrass emergence. A period of several days to 2 weeks between start or end of bloom and emergence would be preferred to allow application of the preemergence herbicide and activation by rainfall or irrigation. At Lincoln, all ornamentals started and ended bloom before crabgrass emergence in bare soil or thin turf (Fig. 1). However, several ornamentals ended bloom after crabgrass emergence in bare soil at Manhattan in all years and would not be reliable indicators for timing applications of preemergence herbicides.

Considering both locations and emergence in bare soil or thin turf, end of bloom was generally a more consistent indicator of crabgrass emergence than start of bloom (Fig. 2). Those ornamentals whose flower wither most consistently predicted crabgrass emergence in bare soil were daffodil, callery pear, and lilac. Those whose flower wither were most accurate in predicting emergence in thin turf were daffodil, lilac, and redbud.

Growing degree days. Lawn care and golf course personnel probably would find it much easier to observe, for instance, flower wither in daffodil than to calculate growing degree-days. However, occasions may arise when the necessary flowers are not available, such as after a particularly harsh winter. Thus, we examined the ability of hourly temperatures to estimate the timing of crabgrass emergence. Figure 3 demonstrates that using a base temperature of 50 or 55 results in the best prediction (i.e., lowest error). In fact, the error observed for these base temperatures for germination on bare soil was about 8.5 days, considerably lower than the lowest observed errors for ornamental bloom (Figure 2). Errors for germination in thin turf were about the same as those observed with ornamental bloom. These results indicate that crabgrass germination, and thus control measures, can be estimated by either observing bloom characteristics of selected ornamentals and/or by calculating growing degree-days.

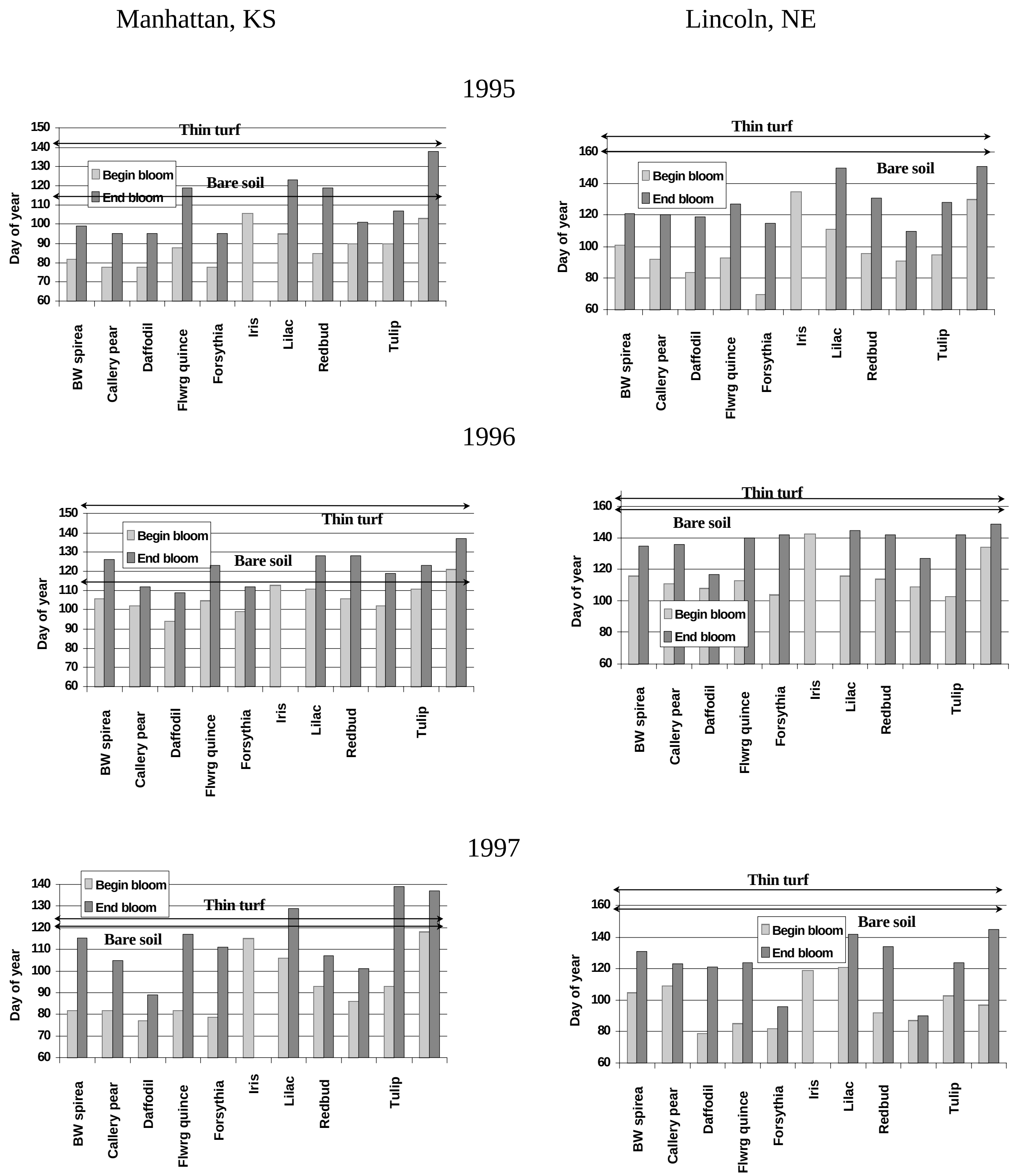


Figure 1. Correlation between a date 2 weeks prior to crabgrass emergence and the start and end of bloom of tested ornamental perennials.

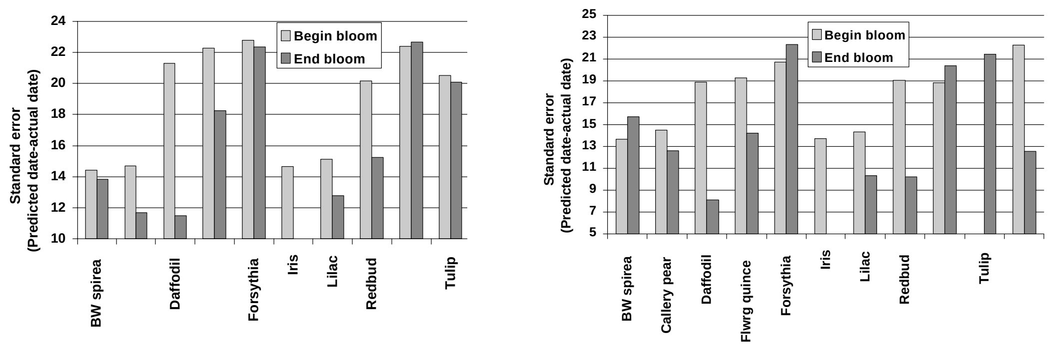


Figure 2. Error of date predicted for crabgrass germination control measure (2 weeks before crabgrass germination) for each ornamental tested. The larger the value, the worse the error and, thus, the less desirable the plant is as an indicator.

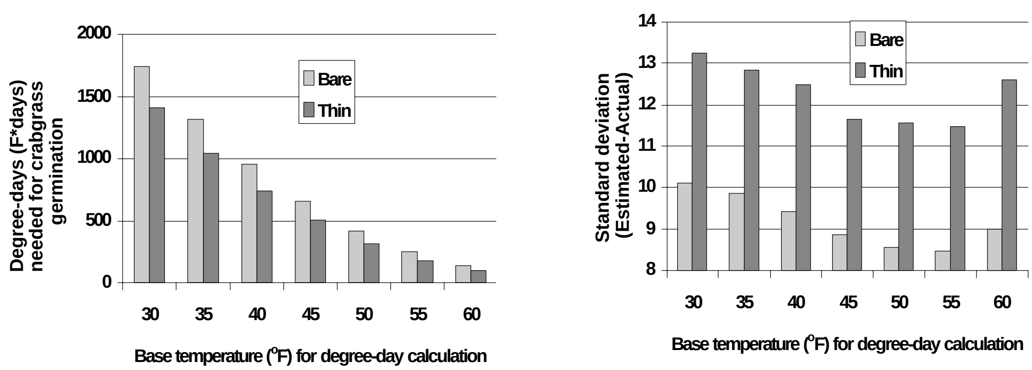


Figure 3. Estimating timing of crabgrass germination control measures by calculating degree-days. Actual degree-days are shown on the left, the error at each base temperature is shown on the right.

TITLE: *Cyclocephala* in Kansas: 1997 Flight Patterns and Species Distributions

OBJECTIVES: To identify the species of *Cyclocephala* in Kansas and to determine flight activities with special emphasis on peak flight activity as a tool to predict the timing of preventative grubacide applications.

PERSONNEL: Bob Bauernfeind

SPONSOR: Kansas Turfgrass Foundation

COOPERATORS:

Various people who operate blacklight traps: Gary Custis (KC area - PBI); Alan Zuk (Rocky Ford Superintendent); Cliff Dipman (Manhattan Country Club superintendent); Kenny Wetzel (Abilene School District); Bill Wood (Jewell County CEA, ret.); Byron Hale (Decatur County CEA); Craig Poe (Oakley - 4-H'er); Lawrent Buschman (Garden City, Southwest Research-Extension Center); Mark Olney and Darryl Kennedy (City of Liberal Parks Dept., and Willow Tree Golf Course Superintendent, respectively); Robert Pohl (Pohl's Garden and Nursery, Great Bend); Mike Daratt (Wichita HRC Field Tech.), and Joe Knickerbocker (Independence Nursery and Garden Center)

INTRODUCTION:

White grubs are the most serious insect pests of high-maintenance turfgrass in Kansas. They are the larval stages of beetles in the family Scarabaeidae. Perhaps the most commonly recognized scarab beetles are May and June beetles which, in late spring through summer, are attracted to lights during evening hours. Although white grub larvae of these June beetles are capable of causing damage to turf, the white grub larvae of "masked chafers" are considered (by turf entomologists throughout the United States) to be the primary pests of high maintenance turfgrass.

Cyclocephala species have a 1-year developmental cycle. Eggs deposited during June and July hatch in 1-2 weeks, and the larvae rapidly develop and become (for the most part) mature 3rd instar larvae prior to the onset of cooler/cold weather in the fall. During this developmental period, annual grubs will feed on grass root systems. Depending on grub population levels and the condition/vigor of the turfgrass, turf may be damaged and killed late when grubs have attained their most damaging stage/size in late August through September and into October.

Research has shown that the development of annual grubs can be traced back to the flight activities of the chafers responsible for egg production. Thirty to 40 days after peak flights of chafer occur, all grubs will have hatched from eggs, and 90% of the grubs will be in their 1st or 2nd developmental stages/instars. This is an ideal time to monitor for grubs (their presence and numbers) and apply preventative grubacide treatments if deemed necessary. Small grubs are extremely susceptible to insecticides, and will not have yet caused significant damage to the root systems of the turfgrass upon which they feed.

MATERIALS AND METHODS:

Two types of blacklight traps were used to monitor chafer flights: General Purpose Blacklight Traps (O.B. Enterprises, Inc.) and UL40 Bug Zappers (DeJay Corporation). The electric grids of the UL40 traps were deactivated, and the traps were fitted with funnels and collecting cans. The traps were run over a 3-month period (May 1 - Aug. 1) during which catches firest of the year could be recorded as well as flight peaks.

For the most part, collections were made on a daily basis. Specimens were placed in alcohol-filled specimen containers or in plastic sacks that were placed in freezers. Dated samples eventually were brought Kansas State University where chafer numbers were determined and species identified.

RESULTS:

The following tables summarize the 1997 work.

Table 1. 1997 *Cyclocephala* Flight Activities in Kansas.

Trapping Site	First Catch of Year	Flight Peak
Kansas City	-	7/10
Colbert Hills	6/19	7/10
Londondery	6/12	7/08
Rocky Ford	6/14	7/10
Manhattan CC	6/11	7/09
Abilene	6/15	7/13
Mankato	6/18	7/09
Oberlin	6/17	7/06
Oakley	6/15	7/08
Garden City	6/17	7/08
Liberal	6/17	6/30
Great Bend	-	7/06
Wichita HRC	6/08	7/12
Independence	6/09	7/10

Table 2. 1997 *Cyclocephala* Distribution in Kansas.

Trap Site	Total No. Chafers	Species *lurida*	*pasadenae*	*longula*	*borealis*
Kansas City	1,908	100.0	0.0	0.0	0.0
Colbert Hills	7,194	94.3	5.3	0.0	0.4
Londondery	8,575	91.6	8.4	0.0	0.01
Rocky Ford	16,116	87.2	12.6	0.0	0.2
Manhattan CC	6,003	96.0	3.9	0.0	0.1
Abilene	651	93.4	6.0	0.6	0.0
Mankato	2,610	66.1	33.9	0.0	0.0
Oberlin	593	1.7	98.3	0.0	0.0
Oakley	8,408	0.0	99.9	0.1	0.0
Garden City	12,147	0.8	99.2	0.0	0.0
Liberal	2,396	10.4	87.4	1.9	0.0

Although an 11-day spread occurred between the initiation of chafer flights, overall, most first catches of the year were fairly well clustered. Any differences between them were smoothed out, as evidenced by the dates of flight peaks. Thirteen of the 14 sites experienced their respective peaks within a 7-day time frame. Only at the Liberal site was the peak out of line. Although substantial peaks occurred on the evenings of July 2 and July 9, the total number of chafers collected on those nights were not as high as the number for June 30. The bottom line is that for 1997, chafer activities were very uniform throughout Kansas as determined by the extensive east to west and north to south network of blacklight traps.

As in past years, *Cyclocephala lurida* and *C. pasadenae* were the predominant species in Kansas. *C. lurida* can be seen to be a more eastern Kansas species, whereas *C. pasadenae* is more western in its distribution. However, either species can occur in either area. Numbers of *C. borealis* numbers were low in comparison to all other species; it was recorded only from the four traps in the Manhattan area and the lone trap at Independence.

Of interest was the appearance of *C. longula* in five trapping areas. Previously, this species had been recorded only from the Wichita HRC site and in numbers that never made up more than 5% of the total trap catch. This is in stark contrast to the 13.4% collected in 1997 Because 1997 was the first year of trapping in Abilene, Great Bend and Liberal, the frequency of appearance of *C. longula* at those sites is not known. But its presence (especially at Great Bend and Liberal) is an indicator of some western distribution. The appearance of *C. longula* at the Oakley site was very interesting, because the catch at that northwest site had been 100% *C. pasadenae* for two previous trapping seasons.

TITLE: Assessing Genetic Diversity in *Ophiosphaerella herpotricha*, *O. korrae*, and *Phaeosphaeria narmari*, Three Agents that Cause Spring Dead Spot of Bermudagrass

OBJECTIVE: To assess the genetic diversity of these fungi through the use of the molecular biology techniques.

PERSONNEL: Henry Wetzel and Ned Tisserat

INTRODUCTION:

Spring dead spot (SDS) of bermudagrass is caused by the fungi *Ophiosphaerella herpotricha*, *O. korrae*, and *Phaeosphaeria narmari*. *Ophiosphaerella herpotricha* is the agent that has been associated with SDS throughout the midwest region of the transition zone, whereas *O. korrae* has been associated with SDS throughout the east and west coast regions of the transition zone. *Phaeosphaeria narmari* is the primary cause of SDS in Australia. We reported the first detection of *P. narmari* from colonized bermudagrass obtained from the Shangri-La G.C. in Afton, Oklahoma at the 1996 American Phytopathological Meetings. Since then, we have detected this fungus on colonized bermudagrass obtained from the Salina C.C. in Salina, Kansas in May of 1997. Classical microbiological methods have failed to reveal the reproductive biology of these organisms. This study is using molecular biology techniques to determine whether or not populations of these fungi are clonal (i.e., identical) or variable on a spatial scale such as from fairway to fairway on the same golf course or from golf course to golf course within a region.

MATERIALS AND METHODS:

Numerous turfgrass samples were collected in May of 1994 from three golf courses including: Independence G.C. in southeast Kansas and South Lakes G.C. and Shangri-La G.C. in northeast Oklahoma. An additional 272 isolates were collected from Shangri-La G.C. in May of 1996 to confirm previous results on the possibility of all three SDS agents coinciding on the same fairway. Bermudagrass roots exhibiting the presence of darkly pigmented ectotrophic runner hyphae were washed, surface sterilized, and plated on selective medium. Cultures exhibiting *O. herpotricha* colony morphology then were transferred to liquid media in preparation for the isolation of deoxyribonucleic acid (DNA). The DNA then was extracted, and isolate identity was confirmed with specific polymerase chain reaction (PCR) primers for *O. herpotricha* and *O. korrae*. In July of 1997, we developed *P. narmari*-specific PCR primers so we now can identify this fungus from infected bermudagrass samples. Once isolates are identified through PCR, an additional set of PCR primers, developed from a DNA library of *O. herpotricha*, then is implemented to assess the similarities and differences among the *O. herpotricha* isolates. A technique known as random amplified polymorphic DNA (RAPD) PCR also will be used to assess and verify genetic diversity among *O. herpotricha*, *O. korrae*, and *P. narmari* isolates.

RESULTS:

Isolates collected in May 1994 from Independence G.C., South Lakes G.C. and Shangri-La G.C. have been identified to species. All isolates from the South Lakes G.C. appeared to be *O*. *herpotricha*. The majority of the isolates from the Independence G.C. were *O*. *herpotricha*; however, nine isolates of *O*. *korrae* were recovered from this course. This is the first golf course in Kansas where *O*. *korrae* has been detected on bermudgrass. The majority of the isolates from Shangri-La G.C. were *O*. *herpotricha*; however, four isolates each of *O*. *korrae* and *P. narmari* were recovered from this course. Results of the resampling of Shangri-La G.C. in May 1996 were as follows: 141 *O*. *herpotricha*, 71 *O*. *korrae*, 30 *P. narmari*, and 30 unidentified isolates. We now evidence to support identification of the *P. narmari* isolates based on comparisons of their internal transcribed ribosomal DNA sequences to that of *P. narmari* isolates from Australia. Five of the 30 Afton, Oklahoma *P. narmari* isolates are 98% identical to four of the 12 Australian *P. narmari* isolates for which we have DNA sequences.

Preliminary data have been assessed for genetic diversity among the Shangri-La G.C. *O*. *herpotricha* isolates collected in 1994. Results indicate that many genotypes coexist within an individual fairway. This suggests that sexual recombination is occurring frequently among the populations of *O*. *herpotricha*. These initial results need to be repeated, and genetic diversity of the remaining two golf course samples needs to be assessed. Because of the more frequent occurrence of *O*. *korrae* and *P. narmari* from the second sampling trip in May of 1996 to Shangri-La G.C., we will begin to assess the genetic diversity of these species with the RAPD PCR assay and also use this assay to verify genetic diversity in *O*. *herpotricha* isolates.

TITLE: Dollar Spot Susceptibility and Fungicide Programs for Four Creeping Bentgrass Cultivars

OBJECTIVES: To evaluate bentgrass cultivars for susceptibility to disease and to investigate the effectiveness of fungicide management regimes for influence on turf quality, applications required, and active ingredient applied.

PERSONNEL: Derek Settle, Jack Fry, and Ned Tisserat

SPONSORS: Kansas Turfgrass Foundation, Kansas Golf Course Superintendent's Association

INTRODUCTION:

More fungicide is applied to creeping bentgrass putting greens per unit area than any other area of the golf course. Superintendents often choose to use a preventive application schedule, following the “better safe than sorry” approach. In some cases, this preventive schedule results in application of more fungicide and higher associated labor costs, with little or no visual quality gain. Information is needed on how cultivar selection, pesticide selection, and application strategy (preventive vs. curative) influence turf quality and the total amount of active ingredient applied.

MATERIALS AND METHODS:

The study was conducted in the summer of 1997 on a USGA green at the Rocky Ford Turfgrass Research Center. The bentgrass was mowed daily at 5/32 inch, irrigated with 1 mm of water daily, and received a season total of 4.4 lbs N / 1000 sq ft. The experimental design was a split plot with three replications. Whole plots consisted of four creeping bentgrass cultivars: L-93, Crenshaw, Penncross, and Providence. Subplots were 3.3 ft X 7.2 ft and consisted of five fungicide treatments. Fungicides were applied at various intervals depending on treatment from 6 June to 30 September at the manufacturers' recommended rates (Table 1). The treatments and formulations included: 1) Non-treated; 2) Chipco 2F 26019 @ 4 fl oz/1000 sq ft every 14 days; 3)Chipco 2F 26019 @ 4 fl oz/1000 sq ft as needed when the number of dollar spots per plot increased from previous week's numbers in at least two of the three replicates; 4)Prostar 50WP @ 3 oz/1000 sq ft + Bayleton 25WG @ 0.5 oz/1000sq ft every 28 days; and 5)Chipco Aliette Signature 80WP @ 4 oz/1000 sq ft + Chipco 26019 2F @ 4 fl oz/1000 sq ft every 14 days. Fungicides were applied with a CO_2-powered backpack sprayer equipped with 8004 nozzles at 20 psi in water equivalent to 2 liters/144 sq ft. Weekly visual ratings were given to each fungicide subplot on a 0-9 scale, where 6=acceptable quality. Dollar spot numbers were counted and recorded for all plots weekly beginning at first appearance on 7 July and continuing until 9 October.

RESULTS:

The weather during the summer of 1997 was relatively cool and dry. The only disease observed was dollar spot. Therefore, turf quality in nonfungicide treated plots was primarily a function of damage caused by dollar spot. Crenshaw exhibited the greatest susceptibility to dollar spot in nontreated plots and had the lowest turf quality rating (Fig.1). L-93, Penncross and

Providence consistently had fewer spots and higher quality ratings (Fig.1). In fact, L-93 exhibited acceptable quality (rating >6) throughout the summer in nontreated plots. This suggests that certain bentgrass cultivars may maintain high quality in the absence of fungicides in some years.

Applications of fungicides to protect bentgrass from dollar spot increased turf quality ratings (data not shown). The Aliette + Chipco 26019 (14 day), Chipco 26019 (14 day), Chipco 26019 (curative), and Prostar + Bayleton (28 day) treatments all resulted in better quality ratings (6-8) by adequately controlling dollar spot all season. Crenshaw did not exhibit acceptable quality with the Prostar + Bayleton combination after 1 August. This illustrates that cultivars more prone to diseases, such as dollar spot, may require a more frequent spray interval during periods of high disease pressure. Application of Chipco 26019 on a curative schedule was as effective in suppressing dollar spot and maintaining turf quality as the preventive application of the same fungicide on a 14 day interval. The curative schedule resulted in six fewer applications and over three times less active ingredient applied when compared to the preventive program. The Chipco 26019 + Aliette Signature (14 day) resulted in >16 times more active ingredient applied than the Chipco 26019 curative program.

Table 1. Fungicide treatments, number of applications, and total active ingredient for creeping bentgrass study at Manhattan, KS in 1997.

Treatment	Rate	No. Applications	Total ai (oz/1000sq ft)
Chipco 26019 (14-days)	4 fl oz	9	9.0
Chipco 26019 (Curative)	4 fl oz	2 or 3*	2.0 or 3.0*
Prostar + Bayleton (28 days)	4 oz + 4 fl oz 8.8		5
Chipco 26019 + Aliette Signature (14-days)	4 oz + 4 fl oz 37.8		9

*Curative treatment number and the associated a.i. total varied according to bentgrass cultivar (Crenshaw required three fungicide applications, versus two for L-93, Penncross, Providence).

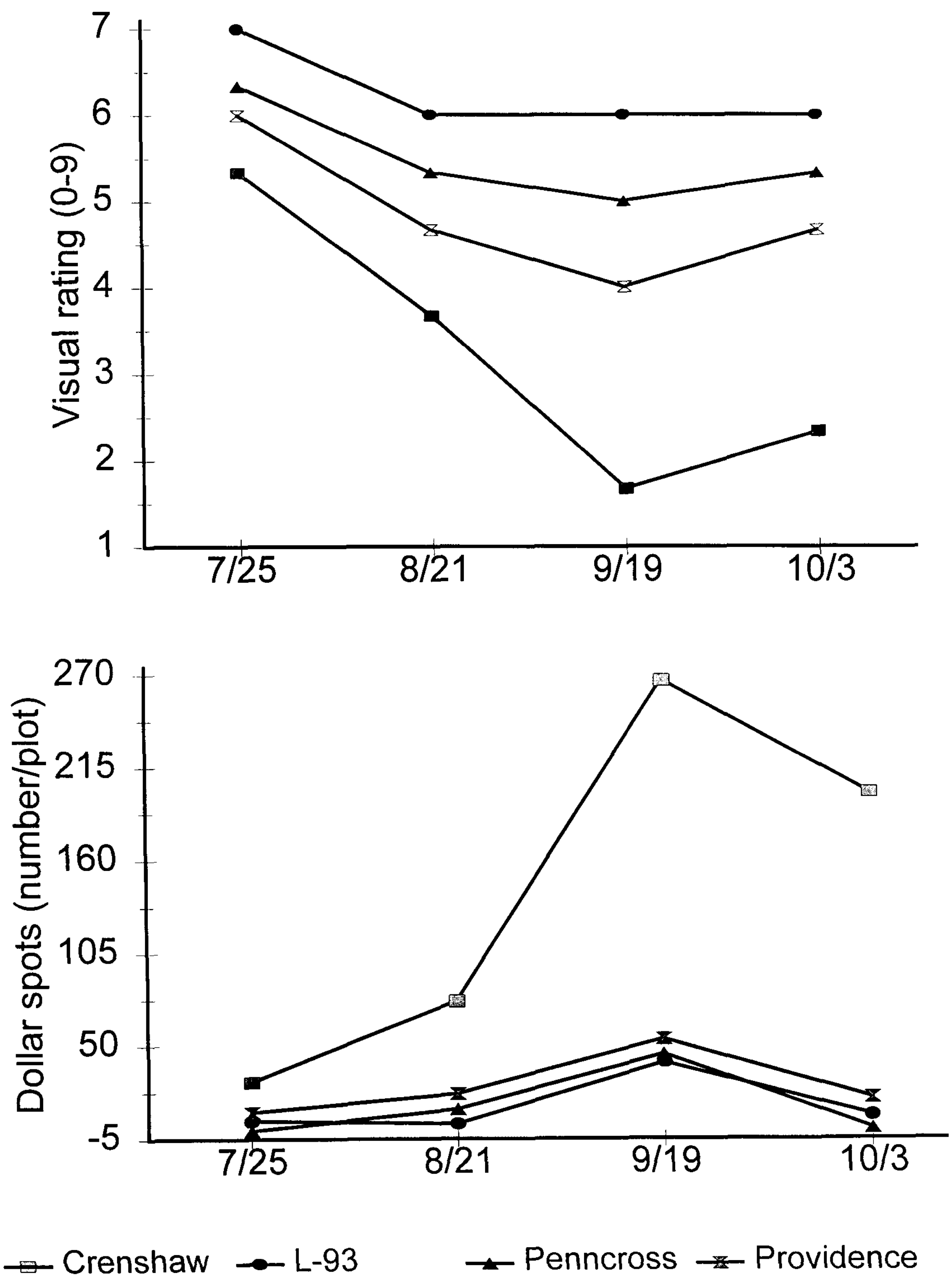


Fig. 1. Visual quality ratings and dollar spot disease susceptibility of four creeping bentgrass cultivars in nonfungicide treated plots at Manhattan, KS in 1997.

TITLE: Preventive Fungicide Applications for Control of Dollar Spot on Creeping Bentgrass

OBJECTIVES: To evaluate the effectiveness of various fungicides for control dollar spot on creeping bentgrass and to determine whether certain fungicide combinations enhance turf quality in the absence of disease.

PERSONNEL: Derek Settle, Jack Fry, and Ned Tisserat

SPONSORS: Rhone Poulenc, Terra, AgrEvo, Rohm & Haas, Kansas Turfgrass Foundation, Heart of America Golf Course Superintendent's Association, and the Kansas Golf Course Superintendent's Association

MATERIALS AND METHODS:

Fungicides were evaluated on an established stand of Cohansey bentgrass on a sand-based putting green at the Rocky Ford Turfgrass Research Center, Manhattan, KS. The turf was mowed at 0.16 in, irrigated as needed, and fertilized with 4 lb N/1000 sq ft annually. Treatments included 11 fungicide applications and a no-fungicide control. Applications were made at 2-wk intervals beginning on 13 June and continuing through 21 August. Fungicides were applied with a CO_2-powered backpack sprayer with 8003 TeeJet nozzles at 30 psi in water equivalent to 5.3 gal/1000 sq. feet. Plots were not irrigated after applications. Plots were 5 ft x 6 ft and arranged in a randomized complete-block design with three replications. Plots were rated every 2 weeks for the percent area damaged by dollar spot and for overall turfgrass quality.

RESULTS:

The summer was relatively warm and dry. The only disease that was continuously active on the putting surface was dollar spot. Only one minor outbreak of brown patch and no Pythium blight were observed. In general, all fungicides except Aliette, Prostar and Heritage reduced the incidence of dollar spot by the final rating date (Table 1). Applications of Aliette Signature plus either Chipco GT, EXP10702B, or Chipco 26019 Flo did not significantly improve turfgrass quality over application of Chipco 26019 Flo alone.

Table 1. Effects of fungicide treatments on control of dollar spot and quality of creeping bentgrass, Manhattan, KS, 1997.

	11 Jul		25 Jul		8 Aug		21 Aug	
Treatment and Rate/1000 ft^2	Quality*	Dollar Spot**	Quality	Dollar Spot	Quality	Dollar Spot	Quality	Spot
Aliette Signature 80 WDG 4 oz + Chipco GT 2SC 4 fl oz	8.3	0.0	7.7	0.0	8.0	0.0	6.7	1.7
Aliette Signature 80 WDG 4 oz + Chipco 10702B 2SC 4 fl oz	8.1	0.9	7.1	0.3	7.7	0.0	7.1	2.5
Chipco 26019 Flo 2SC 4 fl oz	8.0	1.7	7.3	5.7	7.3	1.0	7.0	0.3
Aliette Signature 80 WDG 4 oz + Chipco 26019 Flo 2 SC 4 fl oz	7.7	0.0	7.3	3.3	7.0	1.7	7.0	0.7
Aliette Signature 80 WDG 4 oz + Daconil Ultrex 82.5 SDG 3.8 oz	7.6	0.4	5.6	1.3	5.2	35.7	7.1	2.5
Aliette 80 WDG 4 oz + Fore 80 WP 8 oz	6.0	18.7	6.0	17.0	5.7	17.3	6.0	11.7
Thalonil 90 DF 3.5 oz	6.0	15.0	5.7	11.0	6.3	6.7	7.0	0.0
Fore 80 WP 8 oz	5.3	27.7	6.0	13.3	6.3	4.0	6.3	12.0
Heritage 50 WG 0.2 oz	5.1	36.3	5.7	4.7	4.0	21.7	4.3	44.7
Aliette Signature 80 WDG 4 oz	4.7	47.0	4.3	6.7	4.7	11.7	4.3	44.7
No fungicide	4.7	42.3	4.0	8.3	2.7	55.0	3.3	42.7
Prostar 50 WP 2 oz	4.3	41.2	4.3	12.3	2.7	56.7	4.7	19.7
*LSD*** (P=0.05)*	*1.5*	*17.3*	*1.5*	*NS*	*1.9*	*34.0*	*1.3*	*21.2*

*Quality ratings based on 0-9 scale where 0 = dead turf and 9 = healthy turf with no discoloration.
**Dollar spot ratings on 11 July represent the number of infection centers in 25% of the plot area. Ratings on all other dates represent the percentage plot area damaged by dollar spot.
***To determine statistical differences among entries, subtract one entry's mean from another's. A statistical difference occurs when this value is larger than the corresponding LSD value.

TITLE: Influence of Irrigation Management on Disease Development in Perennial Ryegrass

OBJECTIVE: To evaluate effects of irrigation management and fungicide regimes on perennial ryegrass quality and brown patch infection.

PERSONNEL: Derek Settle, Jack Fry, and Ned Tisserat

SPONSORS: Heart of America Golf Course Superintendent's Association, Kansas Golf Course Superintendent's Association, Golf Course Superintedent's Association of America

INTRODUCTION:

Daily irrigation is assumed to enhance disease severity when compared to irrigation schedules that supply the same amount of water, but less frequently. However, our results over the past 2 years indicate that more brown patch occurs in perennial ryegrass plots watered infrequently than those watered daily. This year we reduced the previous daily irrigation amount of 7.5 mm/day by 2.5 mm/day and applied 5 mm/day. Several fungicide application strategies also were compared for efficacy in disease control, and number of applications and total active ingredient required are reported.

MATERIALS AND METHODS:

The study was conducted in the summer of 1997 on an established perennial ryegrass blend maintained at ½ inch fairway mowing height at the Rocky Ford research site. The ryegrass was fertilized with urea (46-0-0) in September, November, and May to provide a total of 3 lb N/1000 sq ft. The experimental design was a split plot with three replicates. The whole plots were 30 ft X 100 ft and consisted of two irrigation schedules: 1) 5 mm daily and 2) irrigation every third day to replace 80% of atmometer-estimated evapotranspiration. Pop-up, gear-driven, Nelson 6000 irrigation heads were used to deliver water to plots. Subplots were 12 ft X 12 ft and consisted of the following fungicide treatments: 1) no fungicide application; 2) monthly preventive applications of Prostar at 3 oz/1000 sq ft; 3) curative applications of Daconil Ultrex at 3.8 oz/1000 sq ft immediately following any symptoms of brown patch; and 4) applications of Daconil Ultrex at 3.8 oz/1000 sq ft based on a brown patch disease warning model. Fungicides were applied to turf with CO_2-powered sprayer at 20 psi using 8003 flat fan nozzles in water equivalent to 2 liters per 144 sq ft. Visual quality ratings were made weekly for each fungicide plot on a 0-9 scale, where 0=dead turf and 9=optimum color density and uniformity. Disease incidence was quantified by estimating the visual % plot damage by brown patch and by counting the number of infection centers per plot for dollar spot. An infestation of rough bluegrass (*Poa trivialis*) was observed in August and rated visually for % cover. Soil microbial activity was determined by randomly coring the upper 5 cm from plots in each of the two irrigation regimes. The soil then was processed and sealed into air-tight serum bottles that could allow extraction of air samples using a needle syringe. The air was extracted five consecutive times during a 48-hour period and injected into a gas chromatograph that measured CO_2 concentration.

RESULTS:

Irrigation regimes began on June 10 and ended on September 4, 1997. Approximately twice as much water was applied to the daily blocks versus turf irrigated to replace 80% of estimated ET (Fig.1). Brown patch severity was light in 1997 with only one major infection period. Brown patch was greater in the ET plots versus daily irrigated plots (Fig 1) The second observed disease, dollar spot, exhibited greater activity in the daily irrigation regime (42 infection centers per plot) compared to the ET regime (10 infection centers per plot) on August 21 (Fig.1).

An undesirable grass species, *Poa trivialis*, was observed in midsummer. It was likely a seed contaminant. Coverage was 41% greater in the daily ET-irrigated plots on Sept. 9 (Fig. 1).

Almost 50% more fungicide (active ingredient) was required by following a preventive rather than curative program (Table 1). The preventative flutolanil fungicide treatment exacerbated dollar spot, and twice as many infection sites were counted than in untreated turf (data not shown). A weather model that relies on a location's daily relative humidity and minimum temperature accurately predicted the July 22 brown patch episode and suppressed disease effectively (1.2% plot damage). However, the model predicted an additional seven spray dates that were not associated with any brown patch occurrence at the site.

Carbon dioxide was measured on 27 August to investigate differences in microbial activity level between the two irrigation treatments. CO_2 evolution over a 48-hour period was 6.32 ug/g dry soil/hr in daily irrigated turf compared to 4.44 ug/g dry soil/hr from ET-irrigated turf. This indicates a greater population of microbes in the soil under daily irrigated turf, some of which could be suppressing brown patch. Continued research will focus on both micro-environment and plant physiological indicators that may be responsible for altering disease development under differing irrigation regimes.

Table 1. Fungicide treatments, number of applications, and total active ingredient applied to perennial ryegrass at Manhattan, KS in 1997.

Treatment Applied (oz.)	Application Regime	Rate of a.i. oz/1000 sq ft	Number of Applications	Total a.i.
No fungicide		0	0	0
Flutolanil	Preventive	1.5	4	6
Chlorothalonil	Curative	3.1	1	3.1
Chlorothalonil	Model*	3.1	4	12.4

*Model based on Rocky Ford weather station data, minimum daily temperature and average daily relative humidity, used to predict brown patch outbreaks. (Fidanza, M. A. et. al. 1995. Development and Field Validation of a Brown Patch Warning Model for Perennial Ryegrass Turf. Phytopathology 86:4).

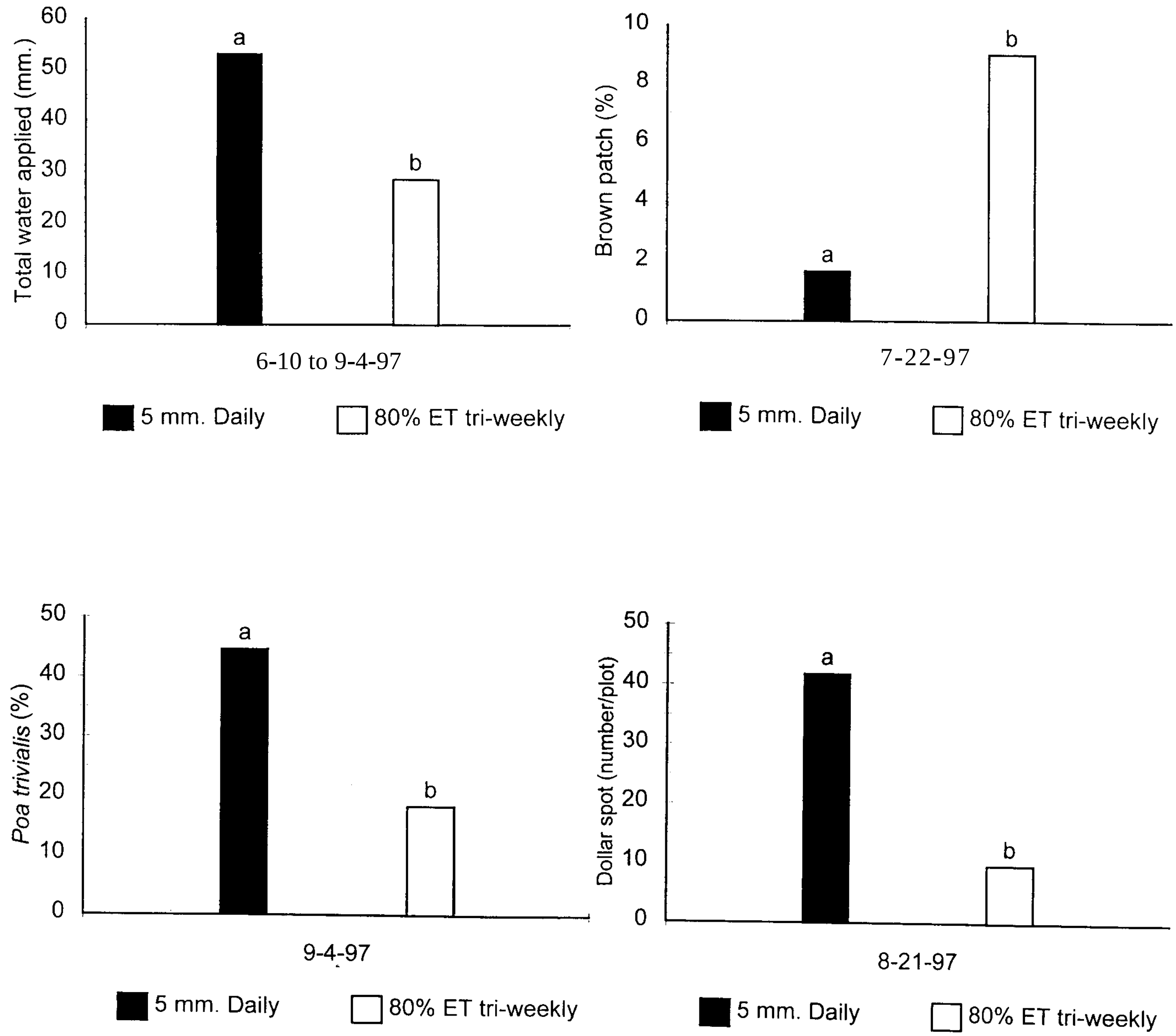


Figure 1. Irrigation treatment effects on total water applied, brown patch, dollar spot, and rough bluegrass on perennial ryegrass in 1997. Irrigation treatments were significantly different on all dates ($P \leq 0.05$).

TITLE: Effects of Aerification and Fungicide Application on the Development of Summer Patch Disease in Mystic Kentucky Bluegrass

OBJECTIVE: To evaluate the use of aerification with a fungicide application to suppress summer patch disease in Kentucky bluegrass maintained under golf course fairway conditions.

PERSONNEL: Henry Wetzel

SPONSORS: Bayer, ISK Biosciences, Novartis, Rohm & Haas, and Zeneca

MATERIALS AND METHODS:

An experiment to test the effects of fungicide application and aerification was established on a 4-year-old stand of Mystic Kentucky bluegrass at the Rocky Ford Turfgrass Research Center. The experimental design was a completely randomized block with four replications, and the treatment structure was a split plot with the whole plot (120 ft^2) receiving fungicide and the subplot (60 ft^2) receiving aerification. Aerification was done on 18 Oct 96 and 25 Mar 97 with a Ryan Greensair equipped with 0.37 in. hollow tines. The aerification cores were verticut to amend the soil back into the plots, and the remaining thatch was raked and discarded. Whole plots were inoculated on 31 Mar 97 at 10 random locations each with 0.18 oz of oat kernels infested with a single *M. poae* isolate collected from the experimental area in the previous year to a 2 in. depth with a 0.75 in. diam. soil probe. The turfgrass was reel mowed three times per week at 0.75 in. to mimic a golf course fairway situation and received 3.0 lb N/1000 sq ft/year. Irrigation was applied deeply and infrequently to maintain adequate soil moisture. Fungicides (Table 1) were applied on 28 Apr, 24 May, and 21 Jun 97 in 2.2 gal H_2O/1000 sq ft with a backpack CO_2 pressurized (36 psi) sprayer equipped with three flat-fan TeeJet 8010 nozzles. Fungicides were not watered in following treatment. Dimension and Trimec Classic each was applied at the rate of 1.5 fl oz/1000 sq ft on 6 May 97 for preemergence crabgrass and postemergence broadleaf weed control, respectively. Merit 0.5G was applied at the rate of 1.4 lb/1000 sq ft on 28 May 97 for the preventative control of subsurface-feeding white grubs.

Summer patch disease severity was assessed visually as a percent of plot area blighted by *M. poae* on a 0 to 100% scale where 0 = no blighting and 100 = entire plot area blighted. Turfgrass blight ratings exceeding 5.0% would be considered unacceptable control of *M. poae*. Turfgrass quality was assessed on a 0 to 10 scale, with 0 being completely brown or dead turf; 8 being minimal acceptable quality for golf course fairway turf; and 10 being optimum turf density and greenness. Data were analyzed using the SAS PROC MIXED procedure, and significantly different treatment means were separated using the least squares means or Fisher's protected LSD procedures at the P = 0.05 level.

RESULTS:

Summer patch symptoms were noted first on 28 Jul and reached their greatest expression on 15 Aug (Table 2), mainly because of natural infestations of *M. poae*. Generally, summer patch disease pressure was light, probably because of minimal rainfall and mild temperatures during the spring. Turfgrass quality ratings reflected disease severity in all treatments.

Bayleton-, Eagle- and Heritage-treated plots exhibited acceptable quality for golf course fairway turf regardless of aerification treatment. Turfgrass quality improved in the Fluazinam-treated plots that were not aerified but was not significantly different than that of the control plots. Heritage, Bayleton, and Eagle significantly reduced summer patch symptoms in the aerified plots. Sentinel reduced blighting under an aerified regime but was associated with an increase in blighting in nonaerified turf. Fluazinam was associated with increased blighting relative to other fungicides in aerified plots, but blight levels in nonaerified turf were similar to those for all other treatments except Sentinel.. Control plots that were not aerified had significantly less summer patch compared to aerified control plots, suggesting that disease severity was enhanced under an aerified regime in the absence of a fungicide treatment.

In addition, an epidemic of leaf rust, caused by *Puccinia* spp., was observed in late Sept into early Oct on the same Kentucky bluegrass plot area where the summer patch study was conducted. Turfgrass quality ratings of the whole plot area were collected on 10 Oct 97. Overall, 16 weeks after the final fungicide application on 21 June, Eagle-, Sentinel-, and Bayleton-treated plots were exhibiting control of leaf rust, whereas Fluazinam- and Hertiage-treated and control plots each exhibited a significant amount of rust pustules that detracted from their overall turfgrass quality (Table 3).

Table 1. Fungicide treatments applied to Mystic Kentucky bluegrass at the Rocky Ford Turfgrass Research Center in Manhattan, KS, 1997.

Treatment	Rate	Application Dates
	oz/1000 sq ft	
1. Eagle 40 WP	1.2	28 Apr, 24 May, 21 Jun
2. Fluazinam 500F	1.5	28 Apr, 24 May, 21 Jun
3. Sentinel 40WG	0.25	28 Apr, 24 May, 21 Jun
4. Heritage 50WG	0.4	28 Apr, 24 May, 21 Jun
5. Bayleton 25DF	4.0	28 Apr, 24 May, 21 Jun
6. Control	–	28 Apr, 24 May, 21 Jun

Table 2. Turfgrass quality and percent plot area blighted in a stand of Mystic Kentucky bluegrass as influenced by fungicide and aerification treatments in the presence of *M. poae*, the cause of summer patch disease in Manhattan, KS on 15 August 1997.

	Turfgrass Quality‡		Plot Area Blighted†	
Treatment	Aerified	Not Aerified	Aerified	Not Aerified
1. Eagle 40 WP	8.2 bcd*	8.1 cd	3.0 cd	2.8 cd
2. Fluazinam	6.4 ef	7.6 d	10.6 b	3.0 cd
3. Sentinel 40WG	7.5 de	6.4 ef	5.5 c	11.9 ab
4. Heritage 50WG	9.5 a	9.4 ab	0.0 d	0.2 d
5. Bayleton 25DF	9.0 abc	8.9 abc	1.1 cd	1.1 cd
6. Control	5.4 f	7.6 d	16.2 a	5.1 c

‡Turfgrass quality was assessed on a 0 to 10 scale, with 8 being minimal acceptable quality for a golf course fairway.

†Summer patch disease severity expressed as percent plot area of the turfgrass stand blighted.

*Means within a rated parameter followed by the same letter are not significantly different according to the least squares means procedure at P=0.05.

Table 3. Whole-plot turfgrass quality rating reflecting the severity of leaf rust (*Puccinia* spp.) in Mystic Kentucky bluegrass in Manhattan, KS on 10 October 1997.

Treatment	Turfgrass Quality ‡
1. Eagle 40WP	8.1 a*
2. Fluazinam 500F	6.9 b
3. Sentinel 40WG	8.4 a
4. Heritage 50WG	7.0 b
5. Bayleton 25DF	8.7 a
6. Control	7.0 b

‡Turfgrass quality was assessed on a 0 to 10 scale, with 8 being minimal acceptable quality for a golf course fairway.

*Means followed by the same letter are not significantly different according Fisher's protected LSD procedure at P=0.05.

TITLE: Effects of Cultivar, Fungicide Applications, and Clipping Removal on Development of Rhizoctonia Brown Patch on Tall Fescue.

OBJECTIVE: To evaluate management options for control of Rhizoctonia brown patch of tall fescue.

PERSONNEL: Ned Tisserat and John Pair

SPONSORS: Kansas Turfgrass Foundation

MATERIALS AND METHODS:

Tall fescue plots were established at the Horticulture Research Center, Wichita, in the spring of 1996. The experimental design was a split-split plot. The cultivars (main plots) AFA, Houndog V, Jaguar 3 and Kentucky 31 were seeded in early April at a rate of 6 lb/1000 sq ft. Cultivars were mowed (subplots)every 4-5 days at a height of 2 ½ inches with 1) a mulching mower in which the clippings were returned to the turf or 2)with a mower in which clippings were collected and removed from the plots. Each subplot received 1) no fungicide treatment; 2) preventive applications of Prostar at 3 oz/1000 sq ft on 5 Jun, 1 Jul, and 30 Jul; or 3) curative applications of Daconil Weather Stik at 6 oz/1000 sq ft on 18 and 30 Jul. Individual plots were 8 X 4 ft and were replicated three times. Fungicides were applied in water equivalent to 4 gal/1000 sq ft at 30 psi with 8004 flat-fan nozzles using a CO_2-powered backpack sprayer. Plots were rated for % plot area damaged.

RESULTS:

No significant interactions occurred among cultivars, mowing, or fungicide treatments. Therefore, only main treatment effects are presented. In general, KY-31 sustained the least amount of damage resulting from brown patch and Pythium blight (Fig. 1). Previous studies have shown that the open growth habit of KY-31 is less conducive to brown patch development. However, KY-31 did not have aesthetically high quality during periods when diseases were not active.

Returning clippings to the turf (mulching mower) did not significantly affect disease severity, except on 30 Jul (Fig. 2). These results suggest that returning grass clippings with a mulching mower does not influence the development of brown patch. However, mulching mowers may slightly increase the severity of Pythium blight.

Preventive monthly fungicide treatments with Prostar were effective in reducing brown patch in mid July (Fig. 3). These results suggest that one or two monthly applications may adequately suppress brown patch. Unfortunately, Prostar has no efficacy against Pythium blight. Plots treated with Prostar were not significantly different in the amount of disease at the last two sampling dates. Curative applications of Daconil were somewhat effective in reducing brown patch severity on 24 Jul (curative application on 18 Jul) but were only moderately effective in suppressing Pythium blight.

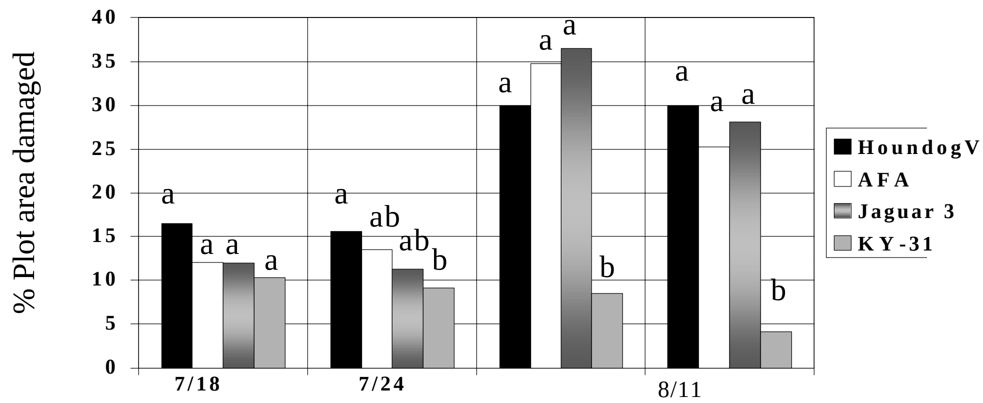


Figure1. Cultivar effects on disease severity. Ratings on 17 and 24 Jul represent Rhizoctonia brown patch, whereas ratings on 30 Jul and 11 Aug primarily represent Pythium blight.

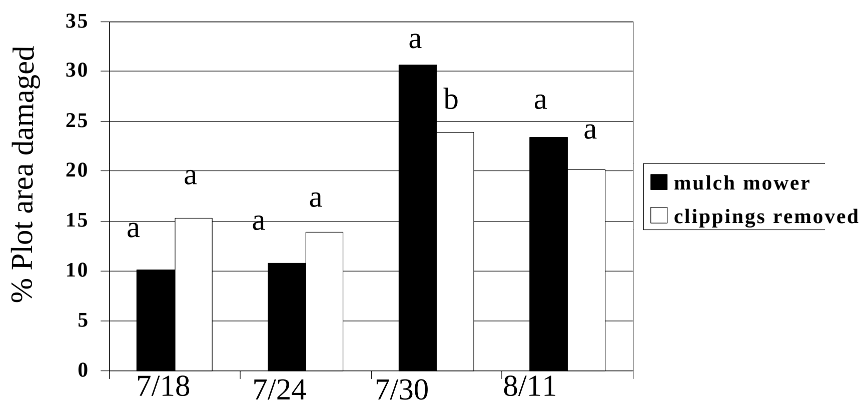


Figure 2. Effect of returning grass clippings to the turfgrass on the severity of disease on tall fescue.

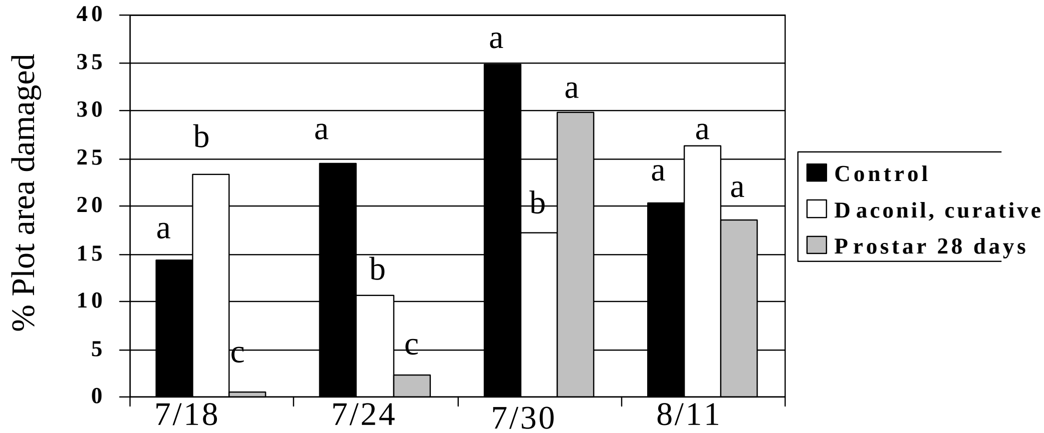


Figure 3. Effects of fungicides on reductions of brown patch (18 and 24 Jul) and Pythium blight (30 Jul and 11 Aug). Preventive applications of Prostar were made at approximate 1 month intervals beginning 5 Jun. Curative applications of Daconil were made on 18 and 30 Jul.

TITLE: Preventive Fungicide Applications for Control of Rhizoctonia Brown Patch of Tall Fescue.

OBJECTIVE: To evaluate the effectiveness of a preventive fungicide spray program to control brown patch disease.

PERSONNEL: Ned Tisserat and John Pair

SPONSORS: Novartis, Rhone Poulenc, Agrevo, Bayer, Zeneca, Terra, and the Kansas Turfgrass Foundation

MATERIALS AND METHODS:

Fungicides were evaluated on an established stand of tall fescue (blend of three unidentified cultivars) at the Horticulture Research Center, Wichita, KS. Fourteen fungicide treatments were applied on 5 Jun, 1 Jul, and 30 Jul with a CO_2-powered backpack sprayer with 8003 TeeJet nozzles at 30 psi in water equivalent to 2.9 gal/1000 sq ft. Plots were not irrigated after applications. Plots were 6 ft X 10 ft and arranged in a randomized complete-block design with three replications. Plots were rated every 2 weeks for the percent area damaged by Rhizoctonia brown patch.

RESULTS:

Brown patch was not present on tall fescue until late July. Symptoms were present in plots in late July but at relatively low levels. All fungicide treatments except CGA 245704 suppressed brown patch severity on 30 Jul (29 days after the last fungicide application). (Table 1).

Table 1. Control of Rhizoctonia brown patch of tall fescue by preventive fungicide applications at Wichita, KS in 1997.

Treatment and Rate/1000 sq ft	% Plot Area Damaged[1]	
	31 Jul	16 Aug
Banner Maxx 1.2MC 2 fl oz	0.0 a	0.0 a
Heritage 50WP 0.4 oz	0.0 a	0.0 a
Prostar 50WP 2 oz	0.0 a	0.0 a
Prostar 50WP 3 oz plus Bayleton 25 DF .75 oz	1.3 a	0.0 a
Heritage 50WP 0.2 oz	1.7 a	0.0 a
Thalonil 90W 3.5 oz	1.7 a	0.0 a
Chipco 26019 2SC 4 fl oz	1.7 a	0.0 a
Bayleton 25DF 2 oz	1.7a	0.0a
Eagle 40 WP .6 oz plus Daconil Ultrex 82WG 3.8	3.3 a	0.0 a
Sentinel 40WG 0.25 oz	3.3a	0.0a
Aliette Signature 80 WG 4 oz plus Chipco 26019	3.3 a	0.0 a
Daconil Ultrex 82WG 3.8 oz	5.0a	0.0a
Thalonil 4L 6 fl oz	15.7 b	0.0 a
CGA 245704 50WG 0.05oz	23.3c	11.7 b
No fungicide	26.7c	18.3 b

[1]Treatment means not followed by the same letter are significantly different (*P*= 0.05) by FLSD test.

TITLE: Preventive Fall Fungicide Applications for Control of Rhizoctonia Large Patch Disease of Zoysiagrass.

OBJECTIVE: To evaluate the effectiveness of preventive fungicide applications for the control of Rhizoctonia large patch of zoysiagrass.

PERSONNEL: Ned Tisserat

SPONSORS: Kansas Turfgrass Foundation, Heart of America Golf Course Superintendents Association, the Kansas Golf Course Superintendent's Association, Novartis, Rhone Poulenc, AgrEvo, Bayer, Zeneca, and Rohm & Haas

MATERIALS AND METHODS:

Fungicide plots were established on Meyer zoysiagrass fairways at the Highlands and Alvamar Golf Courses in Hutchinson and Lawrence, KS respectively. Turfgrass was mowed at 0.5 inches, irrigated as needed, and fertilized with approximately 1.5 lb N/1000 sq ft annually. Fourteen fungicide treatments were applied on 24 Sep in Lawrence and 4 Oct 1996 in Hutchinson with a CO_2 backpack sprayer with 8003 TeeJet flat fan nozzles at 30 psi in water equivalent to 2.2 gal (Lawrence) or 4.3 gal (Hutchinson) per 1000 sq ft. Treatment plots were 10 ft X 12 ft and replicated four (Lawrence) or three (Hutchinson) times in a randomized complete-block design. Plots were not irrigated after fungicide applications. The percentage plot area diseased was recorded on 23 and 24 Apr 1997 in Lawrence and Hutchinson, respectively, after zoysiagrass resumed spring growth,

RESULTS:

The fall of 1996 was relatively dry, and large patch was not evident at either location before the zoysiagrass went dormant. The winter was also very dry. No evidence of active colonization of the turfgrass by the fungus was observed at the time of the spring rating, suggesting that most turf damage occurred between fall dormancy and resumption of growth in spring. All fungicides reduced severity of large patch at Lawrence, but applications of Polyoxorim and Daconil Ultrex did not significantly reduce disease compared to nontreated plots at Hutchinson. Plots treated with Sentinel at both sites appeared to be slower to break winter dormancy and were slightly off-color (lighter green). Results for the past several years indicate that a preventive fungicide treatment in late September is effective in suppressing both fall and early spring symptoms of Rhizoctonia large patch.

Table 1. Control of Rhizoctonia large patch disease of zoysiagrass by preventive fungicide applications in Kansas, 1997.

	% Plot Area Damaged	
Treatment and Rate 1000 sq ft	Hutchinson	Lawrence
Prostar 50WP 3 oz	0.0 a*	0.0 a
Banner Maxx 1.2 MC 4 fl oz + Medallion 75WG 0.5 oz	0.0 a	7.5 abc
Eagle 40WP 1.2 oz	0.0 a	1.3 ab
Bayleton 25DF 2 oz	1.0 ab	3.7 abc
Heritage 50WP 0.4 oz	1.0 ab	1.8 ab
Lynx 25DF 1 oz	2.0 abc	2.5 abc
Sentinel 40WG 0.25 oz	3.3 abc	1.3 ab
Banner 1.2MC 2 fl oz + Medallion 75WG 0.25 oz	7.7 bcd	9.8 bc
Banner 1.2MC 3 fl oz	8.3 cd	11.3 cd
Chipco 2601950DG 4 oz	9.3 cd	7.5 abc
Eagle 40W 0.6 oz + Fore 80WP 6 oz	11.7 d	13.0 cd
Penstar 75WP 8 oz	12.0 d	0.0 a
Polyoxorim 2.2 WP 4 oz	19.3 de	8.7 abc
Daconil Ultrex 82 WG 3.8 oz	19.3 de	18.7 d
No fungicide	28.3 e	31.2 e

*Means not followed by the same letter are significantly different (P = 0.05) by FLSD.

Percentage data were arcsine/square root transformed for analysis and then backtransformed to presentation.

TITLE: Variations in Summer Performance of Bentgrass Cultivars

OBJECTIVE: To investigate genetic variations in quality of creeping bentgrass turf during summer.

PERSONNEL: Xiaozhong Liu and Bingru Huang

SPONSORS: Golf Course Superintendent's Association of America, Kansas Turfgrass Foundation, Alfred Sloan Foundation

INTRODUCTION:

Creeping bentgrass is the most widely used cool-season turfgrass on golf greens. Turf quality in transitional and warm climate regions often declines during summer months, when golf greens receive maximum use. Loss of bentgrass in midsummer is observed on many golf courses and research sites every year. Evaluation of variation among bentgrass cultivars in tolerance to summer stress might help superintendents to select high quality cultivars and prevent summer quality decline.

MATERIALS AND METHODS:

The experiment was conducted in a USGA green at the Rocky Ford Turfgrass Research Center, Kansas State University, Manhattan, Kansas from June to October, 1997. The green was maintained following typical management practices used on Kansas golf courses with a 5/32 inch mowing height and irrigation on alternate days to replace 100% daily water loss. Bentgrass quality was evaluated as visually and estimated using a multispectral radiometer (MSR 16).

RESULTS:

Among the four cultivars, L-93 ranked the highest in visual quality rating from June to October, followed by Providence and Crenshaw. Penncross ranked the lowest in turf quality (Fig. 1). The results from MSR measurements were consistent with visual quality ranking. Of the four cultivars, L-93 had the highest leaf area index (Fig. 2) and green leaf biomass (Fig. 3). Penncross had the lowest green leaf biomass and leaf area index. Crenshaw and Providence ranked intermediate. The reflectance at 661 nm indicates greenness of turf. L-93 had a darker green color than Penncross (Fig. 4).

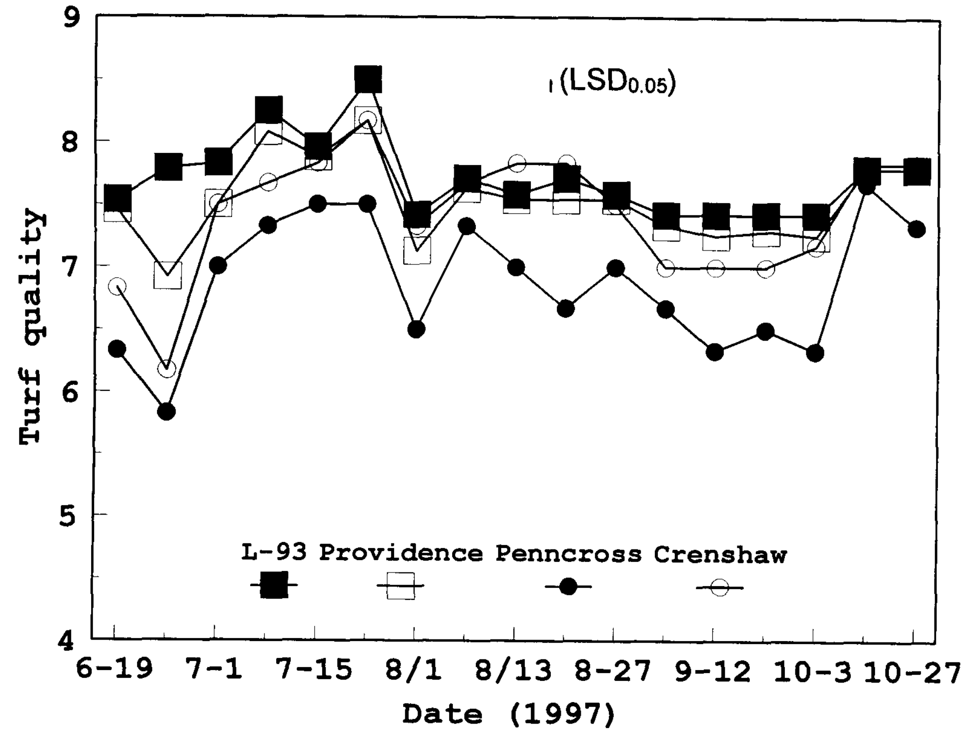


Figure 1. Bentgrass cultivar variations in turf quality.

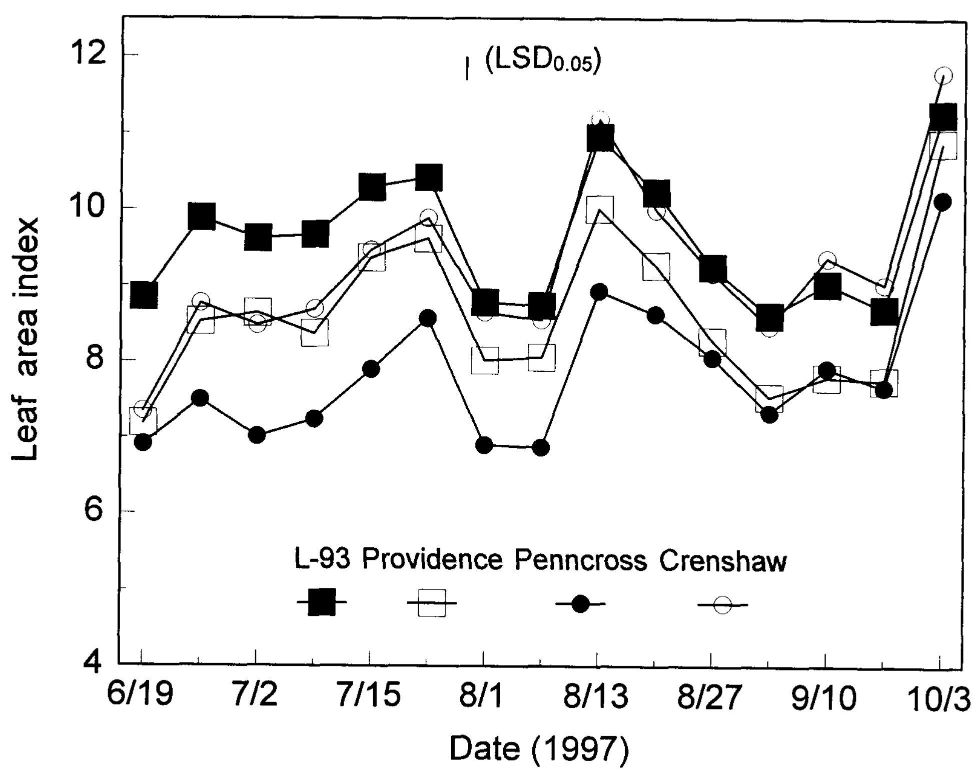


Figure 2. Bentgrass cultivar variations in leaf area index.

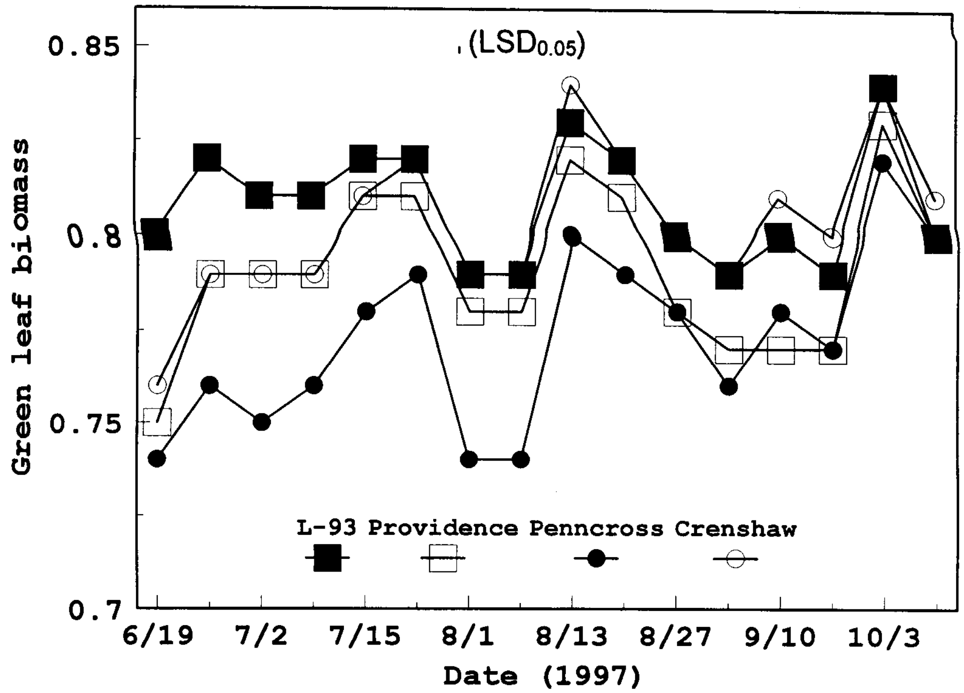


Figure 3. Bentgrass cultivar variations in green leaf biomass.

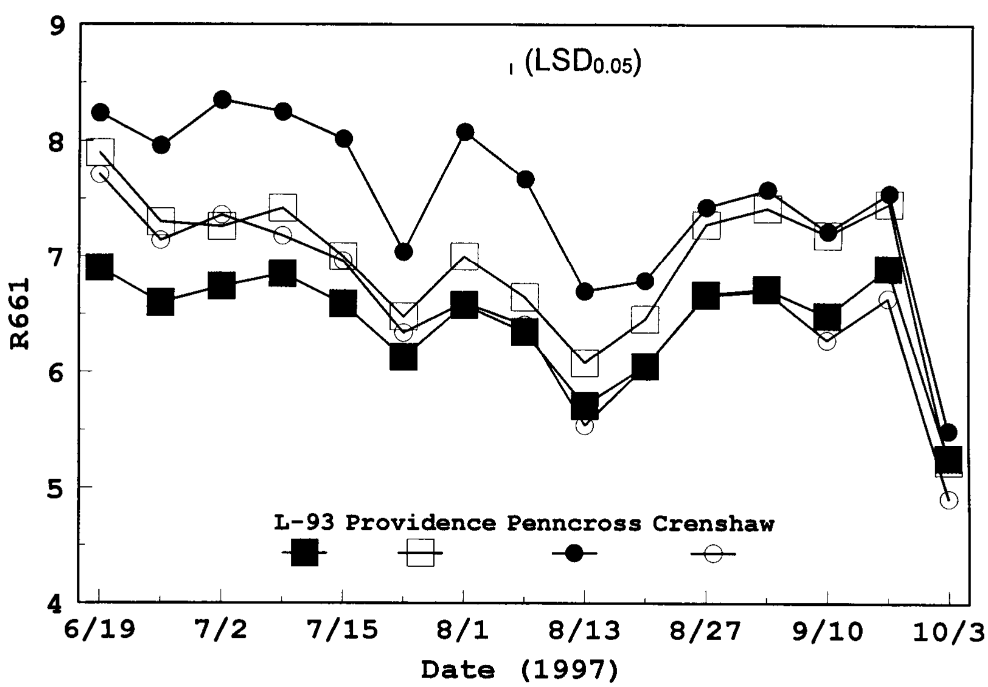


Figure 4. Bentgrass cultivar variations in turf color (reflectance at 661 nm)

TITLE: Influence of Cultural Factors on Bentgrass Summer Performance

OBJECTIVE: To study the effect of cultural practices on bentgrass quality and physiological factors that may control decline in turf quality during summer.

PERSONNEL: Xiaozhong Liu and Bingru Huang

SPONSORS: Golf Course Superintendent's Association of America, Kansas Turfgrass Foundation, Alfred Sloan Foundation.

INTRODUCTION:

Many factors could be associated with summer decline of growth and quality in creeping bentgrass, including high temperature, humidity and soil moisture, poor soil aeration, restricted air movement, localized dry spots, high soluble salts, and disease. Cultural practices including irrigation and mowing height could modify micro-environmental conditions and affect physiological processes and turf quality in bentgrass.

MATERIALS AND METHODS:

The experiment was conducted on a USGA green at the Rocky Ford Turfgrass Research Center, Kansas State university, Manhattan, Kansas from June to October, 1997. Two bentgrass cultivars, Penncross and Crenshaw, were used in this study. Two irrigation and two mowing height treatments were applied, beginning in mid-June. Mowing height treatments were 5/32 inch and 1/8 inch. Irrigation regimes included watering daily (to replace 100% daily ET) or every other day (to replace 50% daily ET). Bentgrass quality was evaluated visually and estimated using a multispectral radiometer (MSR 16). Photosynthesis and respiration were measured using a Li-Cor 6200 at various times. Chlorophyll fluorescence was measured using a plant efficiency analyzer (Hansatech).

RESULTS

Daily irrigation (100% ET) and alternate-day irrigation (50% ET) had no effects on turf quality and physiological factors for Penncross or Crenshaw (Figs. 1 to 5). However, mowing height had significant effects on bentgrass quality, leaf area index, green leaf biomass, photosynthesis and respiration rates, and photosynthetic efficiency, particularly for Penncross. Both Penncross and Crenshaw had higher visual quality rating at a 5/32 inch mowing height than at a 1/8 inch height (Fig. 1). Beginning in late September, bentgrass quality started to recover in the low mowing treatment. Leaf area index (Fig. 2) and green leaf biomass (Fig. 3) also were higher at a 5/32 inch mowing height than at a 1/8 inch height for both cultivars.

Photosynthesis rates decreased in both Penncross and Crenshaw when mowing height decreased from 5/32 inch to 1/8 inch. However, respiration rate increased at the 1/8 inch mowing height (Fig. 4). Photosynthetic efficiency, expressed as chlorophyll fluorescence, was higher at the 5/32 inch mowing height than at 1/8 inch for both cultivars (Fig. 5).

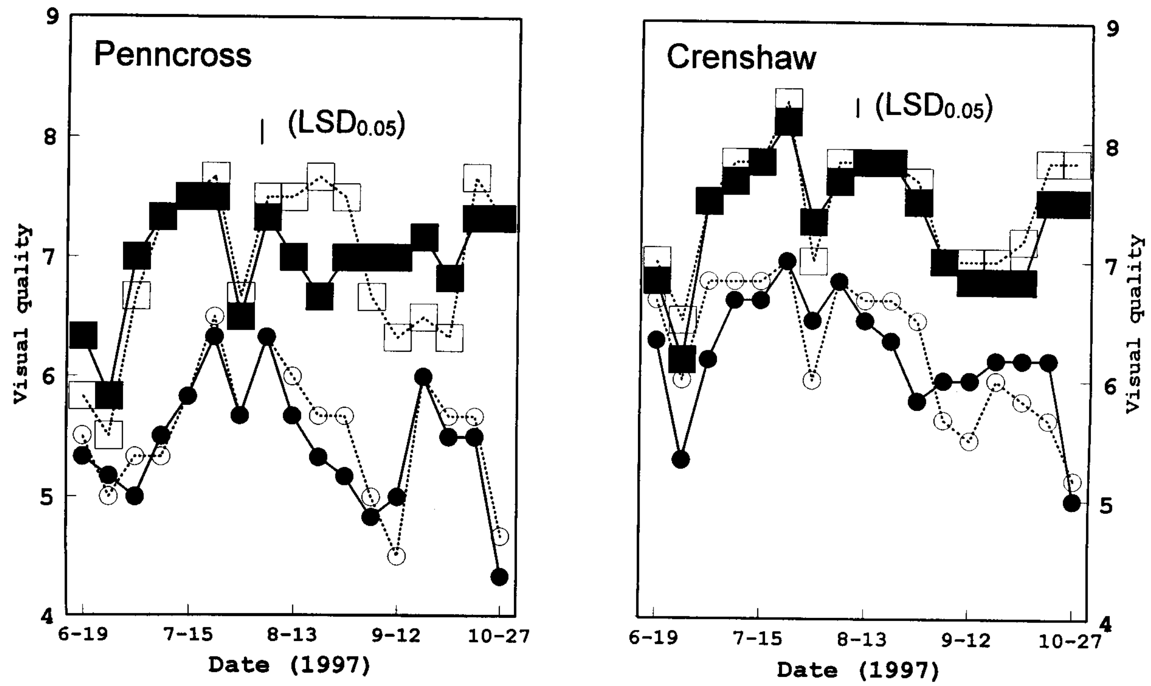


Figure 1. Effects of mowing height and irrigation on bentgrass turf quality.

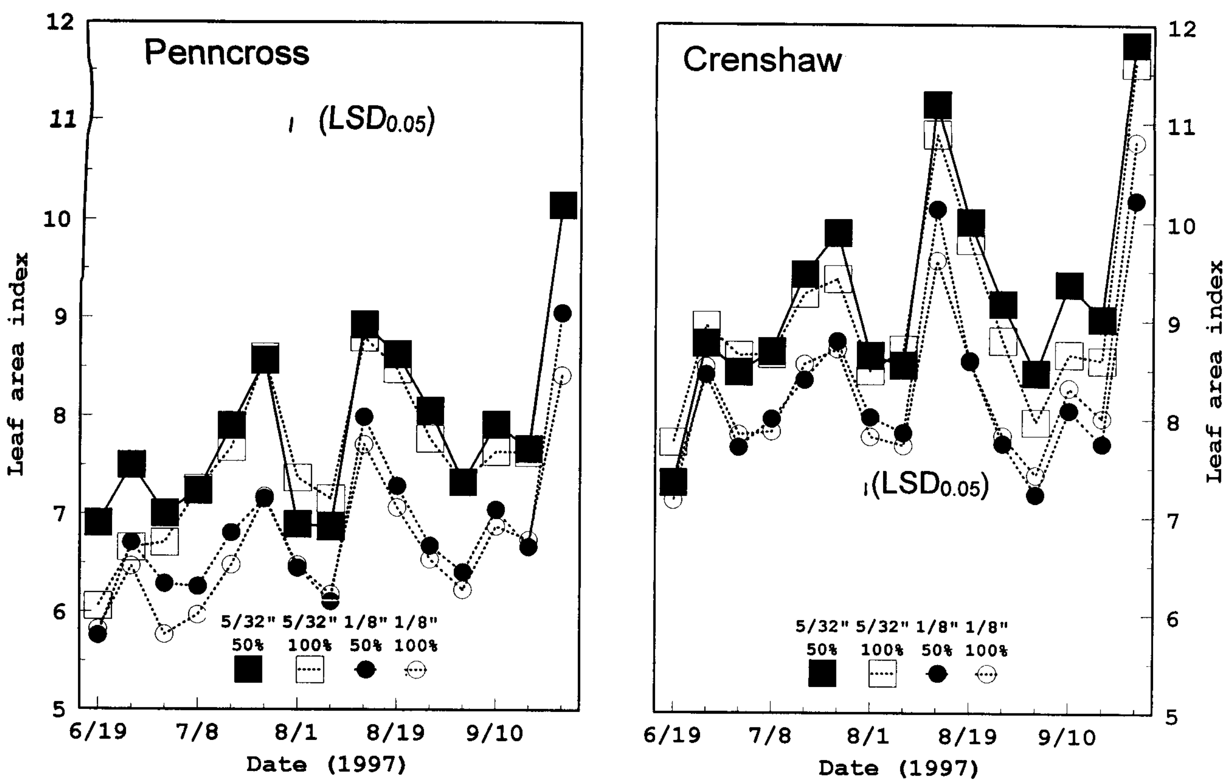


Figure 2. Effects of mowing height and irrigation on leaf area index of bentgrass.

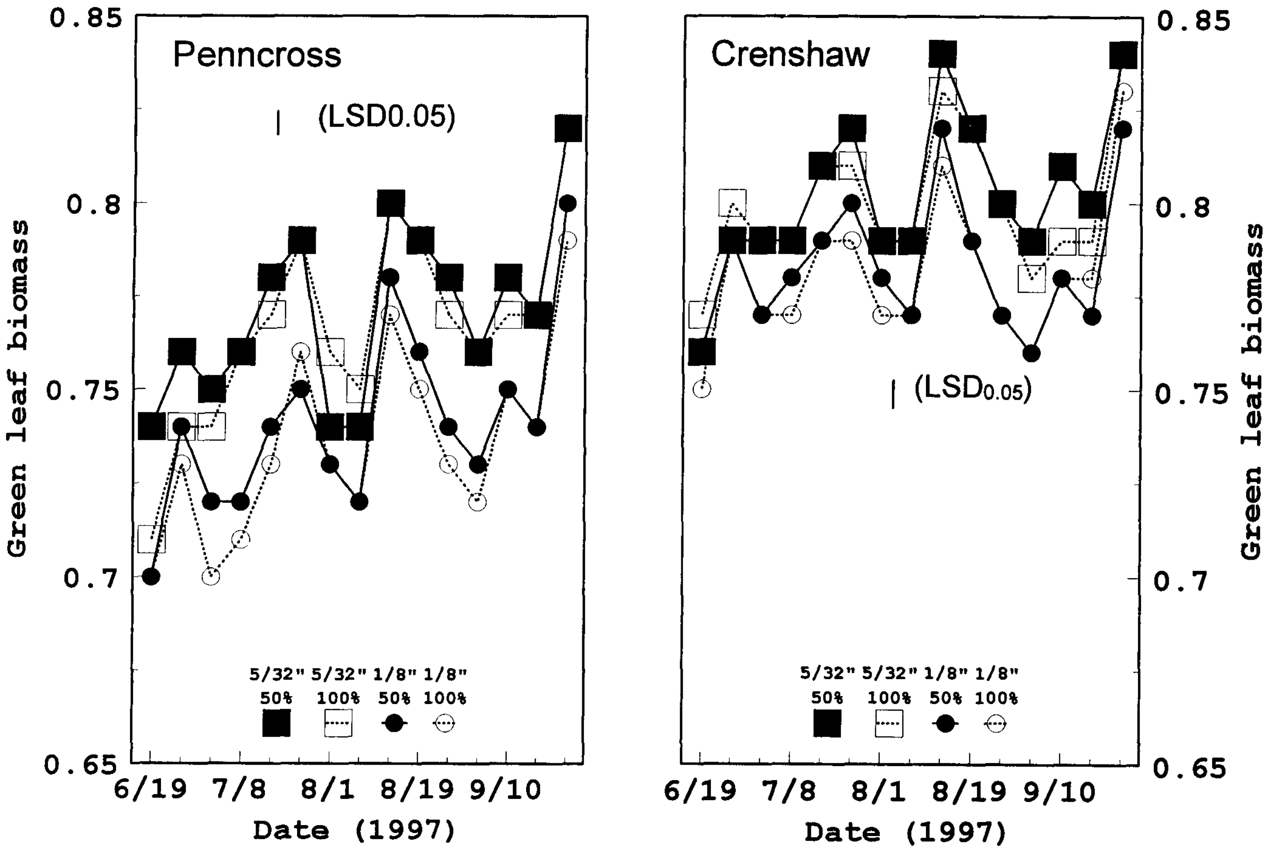


Figure 3. Effects of mowing height and irrigation on green leaf biomass of bentgrass.

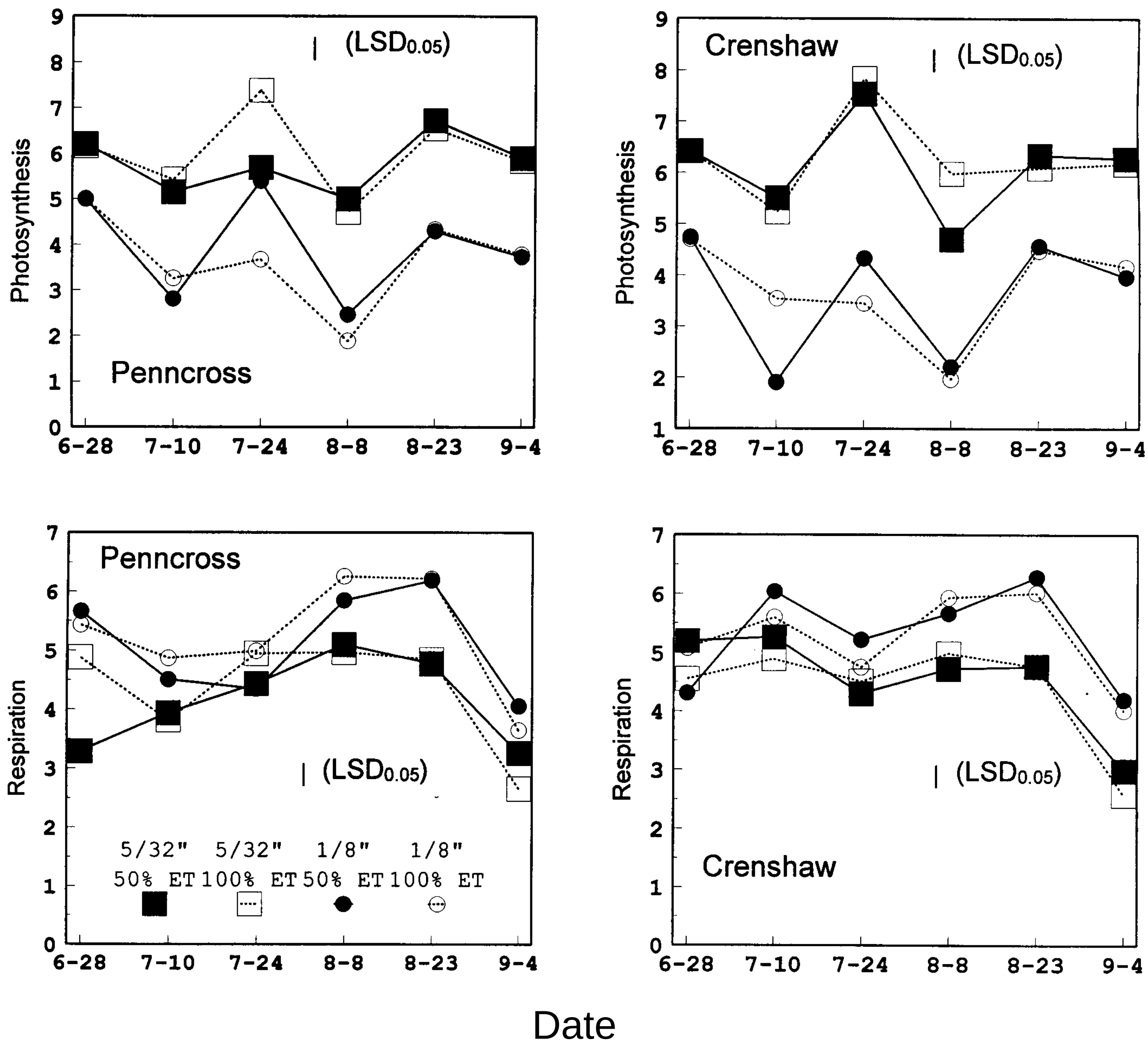


Figure 4. Effects of mowing height and irrigation on photosynthesis and respiration rate of bentgrass.

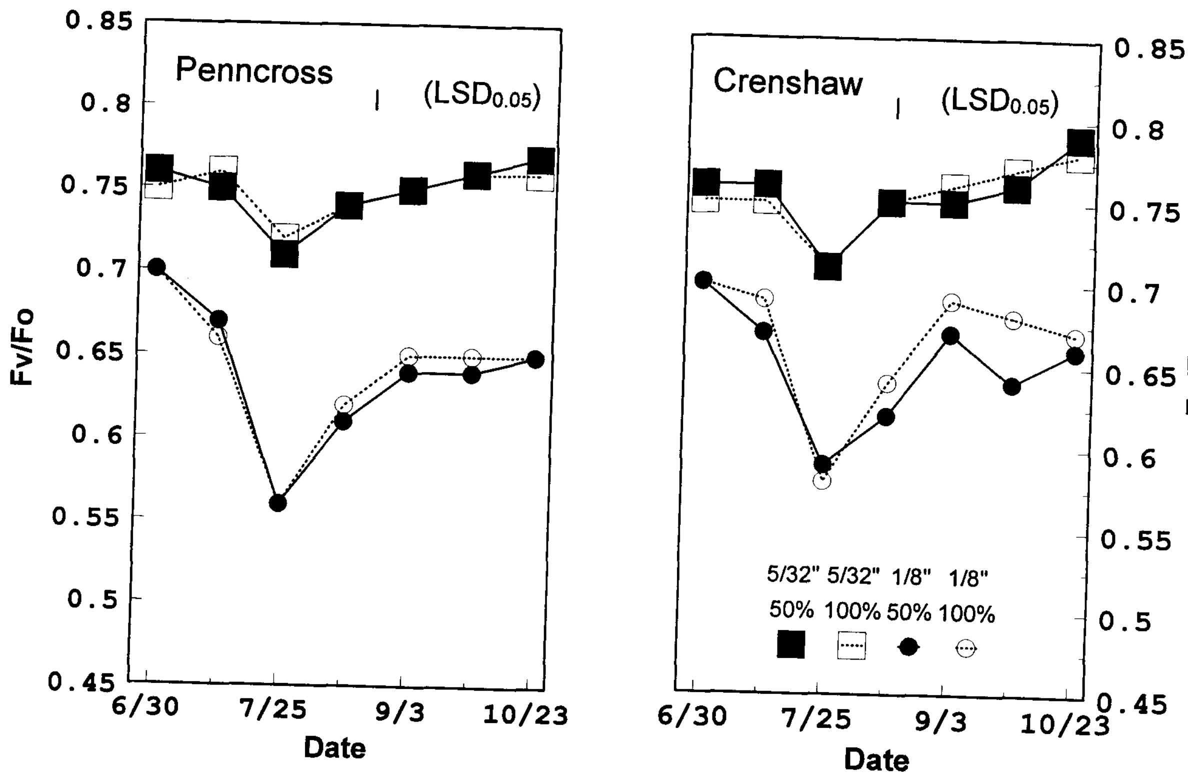


Figure 5. Effects of mowing height and irrigation on chlorophyll fluorescence of bentgrass.

TITLE: Responses of Buffalograss and Zoysiagrass to Surface Soil Drying

OBJECTIVE: To determine the responses of root growth, viability, and distribution to upper soil drying in relation to water uptake and drought resistance in buffalograss and zoysiagrass

PERSONNEL: Bingru Huang

SPONSORS: Kansas Turfgrass Foundation, Kansas Agricultural Experiment Station

INTRODUCTION:

Drought is one of the major stress factors limiting turfgrass growth in Kansas. The surface soil layer often becomes very dry, while soil moisture is available in deeper soil in the field in many areas. Drought-sensitive species may suffer severe damage even with only localized soil drought stress. Root growth, viability, and water and nutrient uptake capacities may have significant impacts on turfgrass tolerance to surface soil drying.

MATERIALS AND METHODS:

The study was conducted in a greenhouse from June to August in 1997. Sod pieces (30 x 25 cm) of Prairie buffalograss and Meyer zoysiagrass were collected from field plots at the Rocky Ford Turfgrass Research Center, Kansas State University and planted in 30 x 25 x 80 cm wood boxes filled with a mixture (2:1 v/v) of coarse river sand and top soil. The boxes consisted of three wood sides and a slanted plexiglass front. The front face was tilted about 35^{o} to allow monitoring of root elongation and proliferation.

The soil column in the boxes was partitioned into three sections which were separated from one another with coated waxed paper. Drip irrigation tubes were positioned about 2 cm beneath the soil surface in each layer to irrigate individual layers separately.

The experiment consisted of three soil moisture treatments: a) well-watered control -water was added daily to each soil layer to maintain the entire soil profile well-watered; b) drying of upper soil - the upper two soil layers (0-40 cm) were allowed to dry down by withholding irrigation, while the lower 40-cm segment was watered daily; c) drying of whole soil profile - soil was watered initially and then watering was withhold to allow the entire soil profile to dry down.

RESULTS:

Leaf water potential (R_{leaf}), a sensitive indicator of water deficit, declined 7 d after drying of the upper soil layers for Meyer zoysiagrass but declined only when the entire soil profile was dried for Prairie buffalogrfass (Table 1). The variations between Prairie buffalograss and Meyer zoysiagrass in responses of R_{leaf} to soil drying were associated with the differences in root elongation rate, distribution pattern, and the capacity of water uptake.

Under drying conditions, Prairie buffalograss roots elongated faster than Meyer zoysigrass roots (Fig. 1). Prairie buffalograss had a larger proportion of roots in the lower 40 cm of soil than

Meyer zoysigrass (Fig. 2). The water depletion rate of Prairie buffalograss was also higher than that of Meyer zoysiagrass in the deeper layer. However, Meyer zoysiagrass had a higher water depletion rate than Prairie buffalograss in the upper 20 cm soil (Fig. 3). Soil water content in the upper drying soil increased at night for both grasses but to a larger extent for Prairie buffalograss (Fig. 4), indicating a flux of water into the upper layer, which could have been due to water efflux from roots that penetrated into the deeper soil layers where water was available. Higher ^{15}N uptake in the upper drying soil layer also was demonstrated clearly when Prairie buffalograss was partially dried than when it was fully dried (Fig. 5). The results imply that the deep, extensive growth of roots in Prairie buffalograss not only facilitates water utilization in the deeper soil but also may improve surface soil water status, thereby maintaining viable roots in surface drying soil and enhancing turfgrass tolerance to localized soil drought stress.

Table 1. Leaf water potential as affected by soil moisture.

Grass		Leaf Water Potential (MPa)		
species	Treatment	7 d	17 d	28 d
Buffalo	Well-watered	-1.31 b	-1.09 b	-1.05 b
	Partially dried	-1.45 baA	-1.26 bB	-1.39 bB
	Fully dried	-1.70 aA	-2.45 aB	-3.78 aB
Zoysia	Well watered	-1.18 b	-1.28 b	-1.21 c
	Partially dried	-1.53 baA	-1.65 bA	-2.01 bA
	Fully dried	-1.81 aA	-2.88 aA	-4.12 aA

Means followed by the same letters within a column are not significantly different based on an LSD test (p = 0.05). The lowercase letters indicate comparisons between treatments within a grass species. The uppercase letters indicate comparisons between grass species within a treatment.

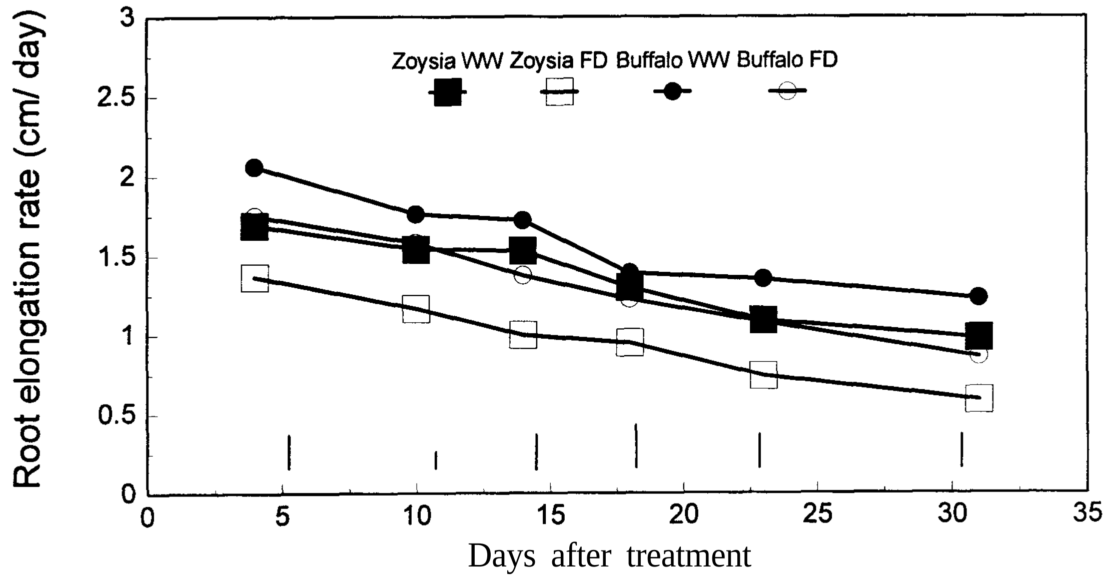


Figure 1. Root elongation rates of buffalograss and zoysiagrass under well-watered (WW) and fully dried (FD) conditions.

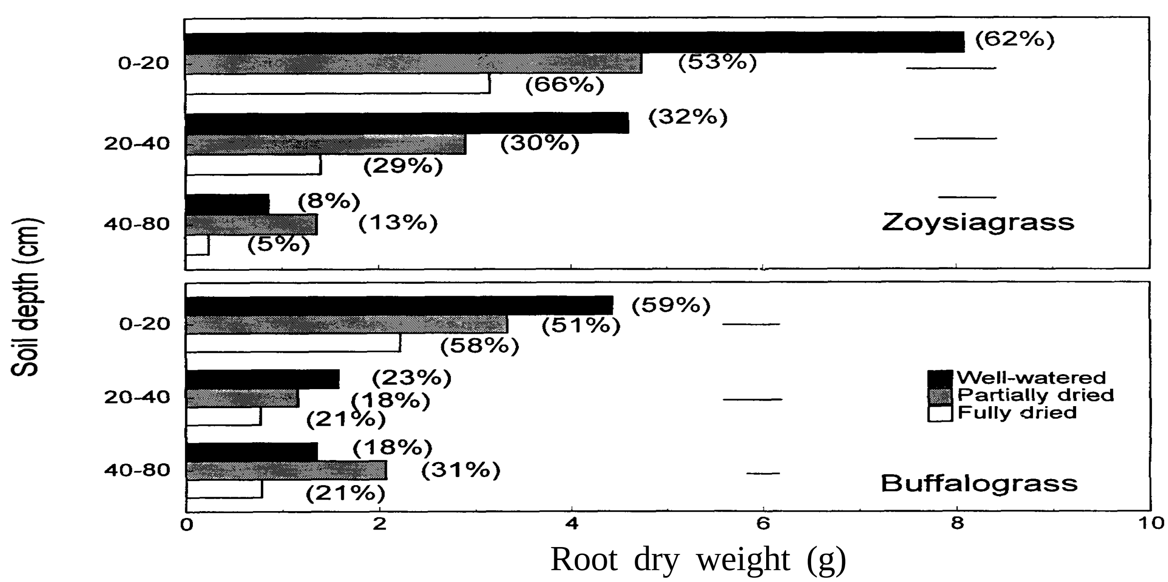


Figure 2. Root distribution patterns of buffalograss and zoysiagrass as affected by soil drying. Values in parentheses are proportions of roots in each layer.

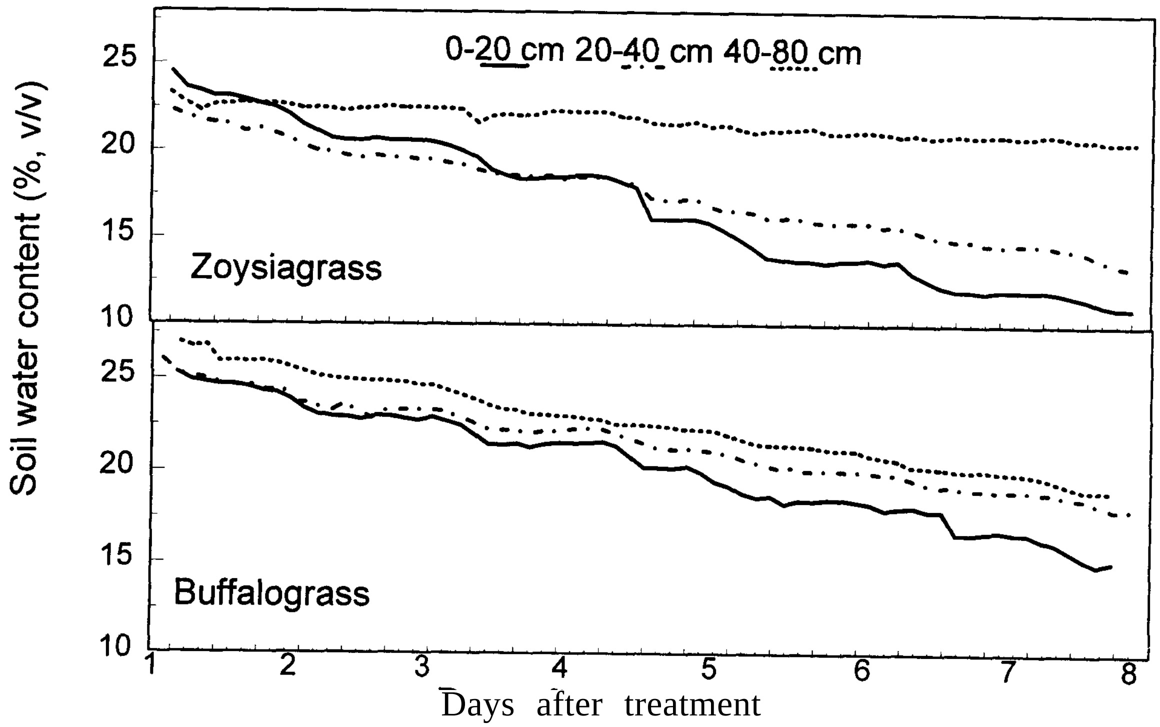


Figure 3. Water depletion by buffalograss and zoysiagrass in three soil depths when irrigation was withheld in the entire soil profile.

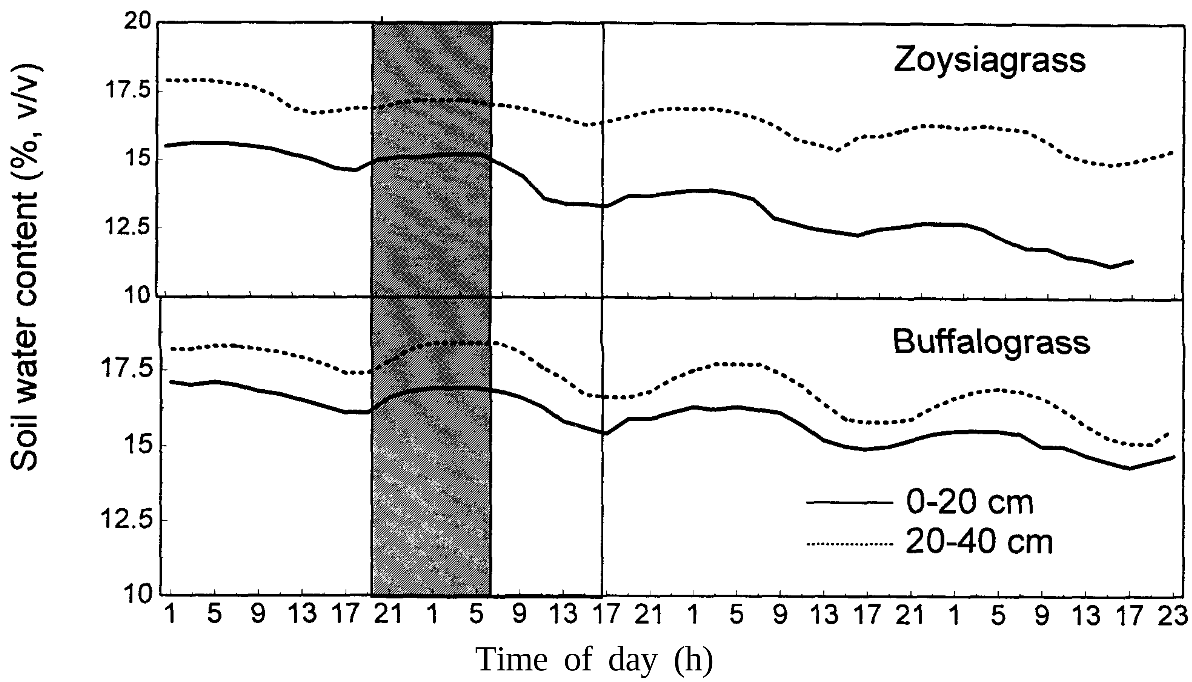
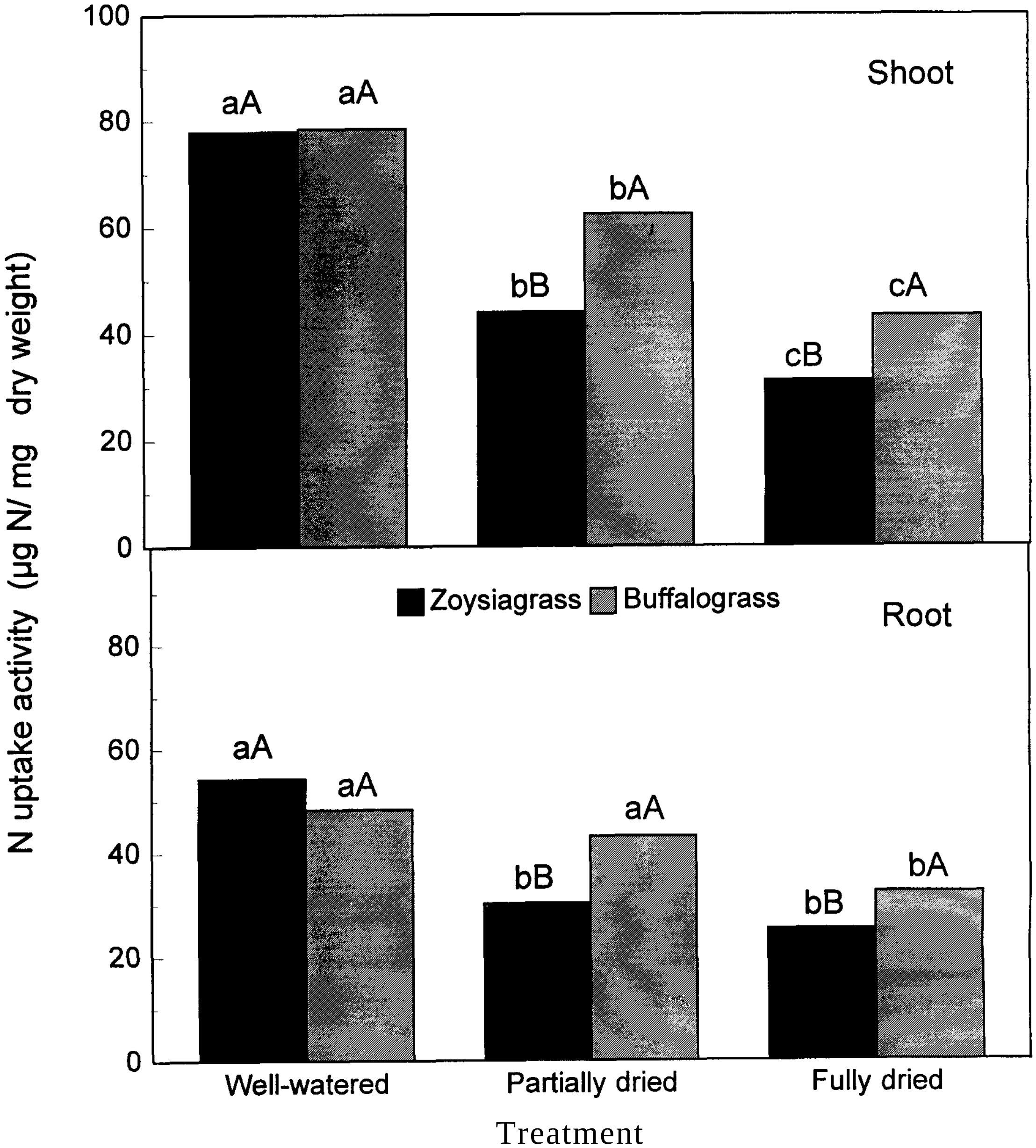


Figure 4. Diurnal changes in soil water content with buffalograss and zoysiagrass in 0-20 and 20-40 cm soil layers over a 4-d period when the upper 40-cm soil was dried and lower 40-cm soil was watered.



N-15 uptake of roots of buffalograss and zoysiagrass in the upper 20-cm as affected by soil drying. Columns marked with the same letters are not significantly different based on an LSD test ($p = 0.05$). The lowercase letters are for comparisons between treatments within a species, and the uppercase letters for comparisons between species within a treatment.

TITLE: Identifying a Characteristic Dimension in Four Turfgrass Species

OBJECTIVE: To identify an objective way to distinguish turfgrasses.

PERSONNEL: Steven Wiest

SPONSOR: Kansas Turfgrass Foundation

INTRODUCTION:

The analysis of turfgrass plots typically has been done by a subjective rating system. Results varied from observer to observer as well as from experimental location to location. To mitigate this problem, this project deals with quantifying turf plots in an objective manner. We are concentrating on the analysis of digitized photographic images of turf plots. This paper reports one way to distinguish coarse- vs. fine-textured turfgrasses.

MATERIALS AND METHODS:

Black and white photographs of plots were taken with a wide-angle lens (28 mm) at a height of 65 inches from the turf surface on 8 September 1998. Species examined were: zoysiagrass, buffalograss, bermudagrass and tall fescue, with three replications. The images were digitized from negatives with an Olympus ES-10 scanner (Olympus America, Inc., Melville, NY). Fourier transforms were performed on the digitized images, and a radial plot of the power spectrum was obtained from each image using NIH-Image v. 1.61 (National Institutes of Health, Washington DC). Hurst plots (log frequency vs. log intensity) were used to subtract "background" from the power spectra, so peaks would be more evident.

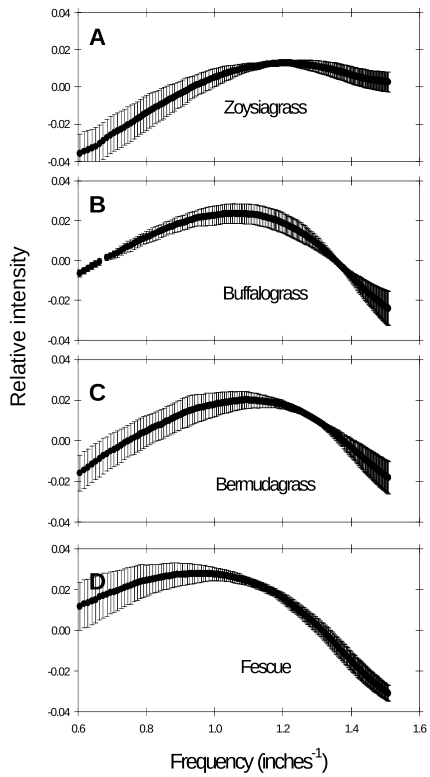
RESULTS:

The power spectra of each species were averaged, and the averages are presented along with vertical standard error bars in Figure 1. The peak of the power spectrum occurs at the average spacing between leaves (more precisely, between areas of the canopy that reflect significant amounts of light). Zoysiagrass had the lowest characteristic dimension, tall fescue had the highest, and buffalograss and bermudagrass had intermediate characteristic dimensions (Figure 2).

The width of the power spectrum peak (Figure 1) indicates the variability in the characteristic dimension within the canopy. Zero intensity was used as the cutoff for measuring peak width. The minimum characteristic dimension (occurring at the high frequency) was <0.66 inches for zoysiagrass whereas all the other species had about the same minimum characteristic dimension (ca. 0.75 inches). The maximum characteristic dimension was largest for fescue (2.7 inches), followed by buffalograss (1.5 inches), bermudagrass (1.3 inches), and zoysiagrass (1.1 inches).

These results demonstrate that this technique, using digitized photos as part of a rating system, can distinguish species on the basis of their power spectrum characteristics.

Figure 1. Portions of power spectra of



digitized photographs of turfgrass canopies.

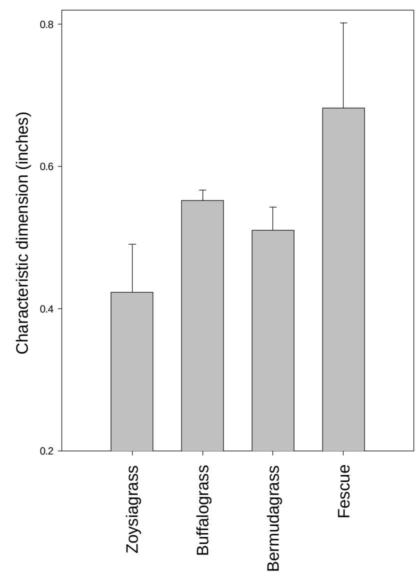


Figure 2. Average characteristic dimension of the four tested species.

Work in Progress

TITLE: How Urbanization Impacts Water Resources

OBJECTIVE: To determine changes in water quality when a golf course is developed on native prairie.

PERSONNEL: Steve Starrett

The building of Colbert Hills Golf Course in Manhattan, KS provides many excellent and unique research opportunities related to water resources. We have been collecting surface water samples for about 1.5 years from the site to determine background water quality. We plan to investigate how water quality changes when the land use changes from a native prairie condition to a golf course. The investigation and development of Best Management Practices is also planned. The United States Golf Association is providing funding for 5 years to investigate nutrient runoff from portions of Colbert Hills Golf Course. Researchers from many different departments at Kansas State University are actively pursuing funding to study the changes in the entire ecosystem (water, soil, flora, fauna).

THANKS!!

Many organizations and corporations provided a significant level of support to the KSU turfgrass research program in 1997. Aid was in the form of grants-in-aid, equipment, contributions, or research cooperation.

- AgrEvo
- Alfred Sloan Foundation
- Alvamar Country Club
- Bayer
- Daru
- Dow Elanco
- Excel Corporation
- Gard'N Wise
- Golf Course Supt. Assoc. of America
- Grass Pad
- Great American Turf (John Deere)
- Great Plains Industries
- Heart of America GC Supt. Assn.
- Highlands Country Club
- IMC Fertilizer, Inc.
- Industrial Sales
- Kansas Agricultural Experiment Stn.
- Kansas Golf Course Supt. Assn.
- Kansas Golf Association
- Kansas Turfgrass Foundation
- Manhattan Country Club
- Modern Distributing (Toro)
- Monsanto
- National Turfgrass Evaluation Program
- Novartis
- O.M. Scott & Sons, Inc.
- Outdoor Equipment (Cushman Mfg.)
- PBI Gordon
- Prairie Dunes Country Club
- Professional Lawn Care Assn. of Mid-America
- Rhom & Haas
- Rhone-Poulenc
- Royal Seeds
- Ryan Lawn & Tree
- United States Golf Association
- Valley Feed & Seed
- Williams Lawn Seed
- Zeneca

Numerous other companies provided grants for pesticide evaluation or donated seed, fertilizer, or chemicals. Several golf course superintendents in state were gracious enough to allow research to be done on their sites. Without the support of each of these individuals and organizations, turf research at KSU would be severely inhibited. Please forgive us if we have overlooked your contribution. Thanks to all for your support!

Note: Trade names are used to identify products. No endorsement is intended, nor is any criticism implied of similar products not mentioned.

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