KANSAS STATE UNIVERSITY AGRICULTURAL EXPERIMENT STATION AND COOPERATIVE EXTENSION SERVICE K-STATE Kansas State University

2000 TURFGRASS RESEARCH

Report of Progress 855

Fiftieth Anniversary

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FOREWORD

The year 1999 was an eventful one for the turfgrass team at K-State. Construction occurred throughout the year at Colbert Hills which was dedicated on May 1, 2000. We are fortunate to have a championship-calibur golf course right in our backyard. Colbert Hills will serve as an outstanding facility for beginning and experienced golfers of all ages, but also has sparked many positive projects of significance to the turfgrass industry, including its role as: a site for internships for students in the undergraduate program in golf course management; a facility for turfgrass evaluation and research (on the 9-hole teaching course); and a site for evaluating the environmental impact of construction from prairie to completed golf course.

In December, 1999, we said goodbye to Dr. Steve Keeley as he left his position as turfgrass Extension specialist. In July, 2000, we'll welcome him back, as he returns to K-State to assume a role in teaching and research in the new golf course management program. Also joining us in July will be Dr. Matthew Fagerness who will start his tenure as the new extension specialist. We now have five faculty in the Throckmorton Plant Sciences Center who have dedicated research time in turfgrass science. K-State has never before seen this level of faculty support for the turfgrass industry. University administrators should be commended for the insight in addressing the growing needs of the turfgrass industry and those of incoming undergraduates enrolling in the golf course management program.

This publication contains results of projects done throughout 1999 by K-State turfgrass researchers. You can see many of these projects in progress on August 3, 2000 at the Kansas Turfgrass Field Day. This will be held at the Rocky Ford Turfgrass Research Center in Manhattan.

What questions can we answer for you? Maybe you're curious about the best performing tall fescue cultivars for lawns, bermudagrasses for fairways, or bentgrasses for greens. If you need to know how to manage fungicide programs to control diseases on tall fescue lawns or bentgrass greens, that information is here. As a superintendent, maybe you're having trouble keeping your putting greens in playable condition all summer - some suggestions lie inside. Keep this research report handy - it can be useful all year long. We also make this information available on our web site at : http:www.oznet.ksu.edu/dp_hfrr/welcome.htm. As always, we're interested in hearing your ideas about future research projects.

This year marks the 50th anniversary of the Kansas Turfgrass Foundation. Plans are underway to help celebrate this milestone during the annual Turfgrass Conference in Topeka November 28-30.

Personnel Associated with K-State Turfgrass Program

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TITLE: Tall Fescue Cultivar Trial

OBJECTIVE: To evaluate tall fescue cultivars under Kansas conditions

PERSONNEL: Linda Parsons and Ned Tisserat

SPONSOR: USDA National Turfgrass Evaluation Program

INTRODUCTION:

Tall fescue is the cool-season turfgrass best adapted to Kansas' transition zone. It is drought and heat tolerant and has few serious insect and disease problems. Efforts to improve cultivar quality include selecting for finer leaf texture, a rich green color, and better sward density, while still maintaining good stress tolerance and disease resistance. Identification of improved varieties that perform well in Kansas is of great interest to local distributors and consumers.

MATERIALS AND METHODS:

We seeded 390 5 ft × 5 ft study plots at the John C. Pair Horticultural Center in Wichita, KS on 11 September 1996 with 130 tall fescue cultivars and experimental numbers. Seeding rate was 4.4 lb seed/1000 sq ft. Prior to seeding, we incorporated 13-13-13 into the study plots at a rate of 1 lb NPK/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 to 3.0 inches and returned clippings. We irrigated as necessary to prevent stress and controlled weeds, insects, and diseases only when they presented a threat to the trial.

In the months following seeding, we rated the fescue cultivars on seedling vigor; height, to help distinguish dwarf from standard cultivars; texture; genetic color; and density. During the ensuing years, we collected data on turf quality, spring green-up, color, texture, and resistance to pythium blight and brown patch. Rating was on a scale of 0=dead turf, 6=acceptable, and 9=optimum measure.

RESULTS:

The best overall performers for 1999 (Table 1) were Masterpiece, Millennium, and PST-5E5. As the result of an unusually mild winter and early spring, all cultivars had greened up by 6 April, although AV-1, ISI-TF10 , JTTFA-96, and Pick FA 6-91 did so the most rapidly. At summer's end, we looked at turf color and texture and found that BAR Fa6 US1 and MB 214 were the darkest green and that BAR FA 6D and SRX 8500 had the finest texture. Many of the turfgrass plots developed brown patch in mid-summer. We found that Kentucky-31 w/endo., Apache II, PST-5E5, Red Coat, Tar Heel, and Titan 2 were the most resistant and OFI-951, OFI-FWY, DP 50-9011, Coronado, Arid 2, and Alamo E were the least resistant to the disease.

In looking at early performance, we found that Arid and Kentucky-31 w/endo. demonstrated the greatest seed vigor, and Millennium, Plantation, and Rembrandt formed the most dense stands by the end of their first growing season. Their shorter height indicated that Pick FA N-93, ZPS-5LZ, Pick FA UT-93, and Gazelle were the most dwarf selections. In 1997 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., Kitty Hawk S.S.T., and Renegade proved among the most resistant and Plantation, Gazelle, and Rebel 2000 the least resistant to the blight.

Table 1. 1999 performance of tall fescue cultivars at Wichita, KS[1].

Cultivar/ Experimental Number	Spring Green-Up	Color	Texture	Brown Patch Resist.	Quality 4/27	5/24	6/21	7/19	8/16	9/14	10/18	11/15	Avg.
Masterpiece (LTP-SD-TF)	8.0	6.5	6.7	7.7	7.0	7.7	6.0	6.7	5.3	7.3	8.3	7.3	7.0
Millennium (TMI-RBR)	8.0	6.5	7.0	7.3	7.3	8.3	6.7	6.3	6.0	7.0	7.3	6.7	7.0
PST-5E5	8.0	7.0	7.0	8.7	6.7	7.7	7.3	7.3	6.0	7.3	7.0	6.0	6.9
MB 210	8.0	7.0	6.7	8.3	6.3	7.7	7.0	7.0	6.0	7.3	7.0	6.0	6.8
MB 213	8.3	8.3	6.0	7.3	7.3	8.7	5.7	6.3	5.7	7.0	7.3	6.3	6.8
Plantation (Pennington-1901)	8.3	7.3	6.7	7.7	7.0	7.7	6.7	6.3	6.0	7.3	7.0	6.3	6.8
Rembrandt (LTP-4026 E+)	8.0	7.0	7.0	7.7	6.7	8.0	6.7	6.0	6.0	7.0	7.3	6.7	6.8
Bonsai 2000 (Bullet)	8.0	6.5	7.0	7.3	6.7	7.3	6.7	6.3	6.0	7.0	7.0	7.0	6.8
Crossfire II	8.0	7.0	6.7	8.3	6.3	7.7	7.0	7.7	5.0	6.7	7.0	6.7	6.8
Jaguar 3	8.3	6.5	6.7	7.3	7.0	8.0	6.7	6.7	5.0	6.0	7.3	7.0	6.7
MB 212	7.7	7.5	6.7	7.3	6.7	7.3	7.0	6.0	5.7	7.0	7.7	6.3	6.7
Wolfpack (PST-R5TK)	8.0	6.3	6.7	8.3	6.7	7.3	6.7	6.7	5.7	6.7	7.7	6.3	6.7
BAR FA 6D	7.7	7.0	7.7	8.0	6.7	7.7	7.0	6.3	5.3	6.7	7.0	6.7	6.7
CU9501T	8.3	7.0	6.7	8.0	6.7	6.3	6.7	7.0	6.0	6.7	7.3	6.7	6.7
CU9502T	8.0	6.0	7.0	8.3	6.3	7.3	6.3	6.0	5.7	6.7	7.7	7.3	6.7
Aztec II (TMI-AZ)	8.3	6.0	7.0	7.0	6.7	7.3	6.3	6.0	6.0	6.7	7.0	7.0	6.6
BAR FA 6LV	7.7	7.0	7.3	7.7	6.7	7.7	7.0	6.3	5.3	6.3	7.0	6.7	6.6
ATF-253	8.3	6.5	6.3	8.3	7.0	6.7	6.3	6.7	5.7	6.3	7.3	6.7	6.6
Falcon II	8.0	6.0	6.3	7.7	7.0	7.3	6.3	6.3	6.0	6.7	7.0	6.0	6.6
PST-5M5	7.3	6.0	6.3	7.7	7.0	7.3	6.3	6.3	5.3	6.7	7.0	6.7	6.6
PST-5TO	7.3	7.0	7.0	8.3	6.3	7.0	7.0	6.3	5.0	7.0	7.3	6.7	6.6
Pick RT-95	8.0	7.0	7.3	7.0	6.3	8.0	5.7	5.7	5.3	7.0	7.7	7.0	6.6
R5AU	8.0	7.3	7.0	8.3	6.3	8.0	7.0	6.7	5.3	6.3	7.0	6.0	6.6
Bandana (PST-R5AE)	7.7	7.5	7.0	8.0	6.7	7.3	6.7	6.3	5.0	6.3	7.0	7.0	6.5
Watchdog (Pick FA B-93)	7.7	7.0	7.0	7.7	6.7	7.3	7.0	6.0	5.3	6.3	7.3	6.3	6.5
ATF-022	7.7	6.0	7.0	8.3	6.7	7.3	7.0	6.0	5.3	6.7	7.0	6.0	6.5
ATF-257	8.0	6.0	6.7	8.3	7.3	7.0	6.0	6.7	5.7	5.7	7.3	6.3	6.5
Apache II	7.7	6.0	6.3	8.7	6.7	7.0	6.7	6.3	5.3	6.7	7.3	6.0	6.5
Arid 2 (J-3)	8.3	8.0	6.0	6.3	7.3	8.3	5.0	6.0	5.3	6.7	7.0	6.3	6.5
Arid 3 (J-98)	7.7	7.5	7.0	7.0	7.3	8.0	5.7	5.7	5.3	6.0	7.3	6.7	6.5
Bravo (RG-93)	8.3	7.0	6.3	7.7	7.0	7.7	5.7	6.3	5.3	6.3	7.0	6.7	6.5
Coyote	7.7	8.0	7.0	7.7	6.7	7.7	6.7	6.0	4.7	7.0	7.0	6.3	6.5
EC-101	7.7	6.0	6.0	7.0	6.0	8.0	6.0	6.0	5.7	7.0	7.0	6.3	6.5
MB 214	7.7	8.5	6.7	7.7	6.7	7.7	6.7	6.3	5.3	6.3	7.0	6.0	6.5

Cultivar/ Experimental Number	Spring Green-Up	Color	Texture	Brown Patch Resist.	Quality 4/27	5/24	6/21	7/19	8/16	9/14	10/18	11/15	Avg.
MB 215	7.3	8.0	6.3	7.7	6.7	8.0	6.0	6.0	5.3	6.7	7.0	6.3	6.5
Mustang II	7.7	6.0	6.3	7.3	6.3	7.3	6.0	6.3	5.7	7.0	7.0	6.3	6.5
Pedestal (PC-AO)	8.0	6.7	6.0	7.7	6.3	8.0	6.7	5.3	5.3	6.7	7.0	6.7	6.5
Rebel 2000 (AA-989)	8.3	7.3	6.0	8.0	7.3	7.3	6.0	6.3	5.3	6.3	7.0	6.3	6.5
Shenandoah II (WRS2)	8.0	7.5	6.7	8.0	6.3	7.0	7.0	6.0	5.0	6.3	7.7	6.7	6.5
Velocity (AA-983)	8.0	7.0	6.3	7.7	7.0	7.7	6.7	6.7	5.0	6.0	7.0	6.0	6.5
Anthem II (TMI-FMN)	7.3	6.5	6.7	6.7	6.7	7.0	6.3	6.3	5.3	6.3	7.0	6.7	6.5
MB 211	8.3	8.0	6.7	7.3	7.0	7.3	6.3	6.0	5.3	6.3	7.0	6.3	6.5
Reserve (ATF-182)	8.0	6.5	6.3	7.7	6.7	7.3	6.0	6.3	5.0	6.3	7.0	7.0	6.5
Safari	8.0	6.5	6.7	8.3	6.3	7.3	6.0	6.3	6.0	6.7	7.0	6.0	6.5
Scorpio (ZPS-2PTF)	8.3	8.0	6.7	7.7	6.7	7.0	7.0	5.3	4.7	6.0	8.0	7.0	6.5
Tar Heel	7.3	6.5	6.3	8.7	6.0	7.0	7.0	6.3	6.0	6.3	7.0	6.0	6.5
BAR Fa6 US2U	7.3	7.0	7.0	7.7	6.3	7.7	6.3	6.3	5.7	6.0	7.0	6.0	6.4
Gazelle	7.7	7.0	6.7	7.3	7.3	7.7	6.7	5.3	4.7	6.3	7.3	6.0	6.4
Kitty Hawk S.S.T. (SS45DW)	7.3	6.0	6.3	7.3	6.0	7.3	7.0	5.7	5.7	6.3	7.0	6.3	6.4
MB 28	7.3	8.0	6.0	6.7	6.7	8.0	5.7	6.0	5.3	6.7	7.0	6.0	6.4
Overtime mix	8.3	6.0	6.0	8.3	6.7	7.0	6.3	6.0	5.3	6.3	7.3	6.3	6.4
Twilight II (TMI-TW)	8.3	7.0	6.3	7.3	6.7	8.0	5.0	7.0	5.7	6.0	7.0	6.0	6.4
BAR FA6 US6F	8.0	7.5	7.3	8.0	7.0	7.3	6.3	6.3	5.0	6.3	6.7	6.0	6.4
BAR Fa6 US1	7.7	8.5	7.3	7.7	6.3	7.7	7.0	5.7	4.7	5.7	7.0	7.0	6.4
BAR Fa6D USA	8.0	7.5	7.0	8.3	6.3	7.3	6.3	6.3	5.3	6.3	7.0	6.0	6.4
EA 41	7.7	8.0	7.0	8.0	6.0	7.7	6.3	6.0	5.7	6.3	6.7	6.3	6.4
Genesis	8.3	6.5	6.3	8.0	6.3	7.0	6.7	6.0	5.3	6.3	7.3	6.0	6.4
Lion	7.0	8.0	6.0	7.3	6.7	7.7	5.7	6.3	5.7	6.3	7.0	5.7	6.4
Rebel Sentry (AA-A91)	8.3	8.0	5.7	8.0	7.0	7.7	7.0	5.7	4.7	5.7	7.3	6.0	6.4
Tulsa	7.7	5.7	7.0	8.0	6.7	7.3	6.7	6.3	5.3	6.3	6.3	6.0	6.4
WPEZE (WVPB-1C)	7.7	6.5	6.0	7.7	6.3	7.3	6.0	6.3	5.7	6.7	7.0	5.7	6.4
WVPB-1B	7.7	6.0	6.0	7.7	6.3	7.3	6.3	6.3	5.3	6.0	7.0	6.3	6.4
WX3-275	7.7	6.7	6.7	7.3	6.0	7.7	6.3	6.0	5.3	6.3	7.3	6.0	6.4
ATF-020	8.3	6.5	6.3	7.7	7.0	7.0	5.7	6.3	5.7	6.3	6.7	6.0	6.3
Alamo E	8.0	6.7	6.7	6.3	7.0	7.7	5.7	5.7	5.3	6.0	7.0	6.3	6.3
Brandy (J-101)	8.3	7.0	6.3	7.0	7.3	7.7	5.0	6.0	5.0	6.7	7.0	6.0	6.3
Empress	7.3	7.0	6.3	7.0	6.3	7.3	6.3	5.7	5.0	7.0	7.0	6.0	6.3
ISI-TF9	7.3	6.0	6.3	8.0	6.0	7.0	6.7	6.3	5.7	6.0	7.0	6.0	6.3
MB 216	8.3	8.3	6.0	7.7	7.3	7.3	6.7	6.0	5.0	5.7	6.7	6.0	6.3

Cultivar/ Experimental Number	Spring Green-Up	Color	Texture	Brown Patch Resist.	Quality								
					4/27	5/24	6/21	7/19	8/16	9/14	10/18	11/15	Avg.
MB 29	7.7	8.0	7.0	8.0	6.3	7.7	6.3	6.0	5.3	6.3	6.3	6.3	6.3
OFI-96-31	8.3	7.0	6.0	7.0	7.0	8.0	5.3	6.0	5.3	6.0	6.7	6.3	6.3
PRO 8430	7.7	7.0	6.3	7.7	6.3	7.3	6.0	6.0	5.3	6.7	6.7	6.3	6.3
Pick FA 20-92	7.7	7.3	6.0	7.3	6.7	6.7	6.0	5.7	5.7	6.7	7.0	6.3	6.3
Pick FA 6-91	8.7	7.0	6.7	7.0	7.0	7.7	6.0	6.0	5.0	6.0	6.7	6.3	6.3
Pick FA XK-95	7.7	8.0	6.3	7.3	6.3	7.0	5.3	6.0	5.0	6.3	8.0	6.7	6.3
Red Coat (ATF-038)	8.0	6.5	6.7	8.7	6.3	7.3	6.0	6.3	5.0	6.3	7.0	6.3	6.3
SR 8210	7.7	6.0	6.7	7.0	6.7	6.7	5.7	6.3	5.7	6.7	7.0	6.0	6.3
Shortstop II	8.0	6.5	7.0	7.3	6.0	7.7	6.3	6.0	5.0	6.3	7.3	6.0	6.3
Chapel Hill (TA-7)	7.7	7.0	6.3	8.3	6.3	7.3	6.0	6.7	5.3	6.0	6.7	6.0	6.3
DP 50-9011	7.7	6.3	6.3	6.3	7.0	8.0	4.3	6.0	5.7	6.3	6.7	6.3	6.3
Good-EN (Koos 96-14)	7.7	6.0	6.0	7.3	6.3	7.3	6.0	6.7	5.7	6.0	6.3	6.0	6.3
ISI-TF11	7.0	5.0	6.3	7.3	6.0	7.0	6.7	6.3	5.3	6.0	7.0	6.0	6.3
Southern Choice	8.3	7.0	6.0	7.3	6.7	7.7	5.7	6.3	5.0	6.0	6.7	6.3	6.3
Axiom (TF-192)	7.7	6.0	6.0	7.3	6.3	7.3	5.7	6.0	5.3	5.7	7.3	6.3	6.3
BAR Fa6 US3	7.7	7.0	6.7	7.3	6.7	7.0	6.7	5.7	5.0	6.0	6.7	6.3	6.3
Bulldawg (Pick GA-96)	7.3	7.0	6.3	8.0	6.3	7.3	6.3	6.0	4.7	6.7	6.7	6.0	6.3
Coronado Gold (PST-5RT)	7.7	7.0	6.7	8.0	6.3	7.3	6.3	6.0	4.7	6.0	6.7	6.7	6.3
Coronado	7.7	7.5	6.7	6.3	6.7	7.0	6.0	5.7	5.0	6.7	7.0	6.0	6.3
DLF-1	8.0	6.0	6.3	7.7	6.0	6.7	6.0	6.0	5.7	6.3	7.0	6.3	6.3
Duster	7.3	7.5	7.0	7.3	6.3	7.0	6.3	6.0	5.3	6.0	7.0	6.0	6.3
OFI-96-32	8.0	7.0	6.0	7.3	6.3	7.3	5.7	6.0	5.7	6.3	7.0	5.7	6.3
Pick FA N-93	7.7	7.5	6.3	6.7	7.3	8.0	5.7	5.0	5.0	6.3	7.0	5.7	6.3
Pixie E+	7.7	6.0	6.3	7.3	6.3	7.0	6.3	6.3	4.7	6.3	7.0	6.0	6.3
SRX 8084	7.3	6.0	6.7	7.3	5.3	7.0	6.3	6.0	6.0	6.3	7.0	6.0	6.3
Tomahawk-E	7.7	6.5	7.3	7.3	6.0	7.0	6.3	6.0	5.0	6.0	7.0	6.7	6.3
WVPB-1D	8.0	6.5	6.0	7.3	6.3	7.7	5.7	6.3	5.3	6.0	6.7	6.0	6.3
ATF-196	7.7	6.5	6.3	7.3	7.0	7.3	6.0	5.3	4.3	6.0	7.0	6.7	6.2
Comstock (SSDE31)	7.7	6.5	6.3	7.7	6.3	7.0	6.0	5.7	5.0	6.7	7.0	6.0	6.2
Finelawn Petite	7.0	6.3	6.0	7.3	6.0	7.0	6.3	6.0	5.0	6.3	7.0	6.0	6.2
ISI-TF10	8.7	6.0	6.3	8.3	7.0	7.0	6.0	6.0	5.0	6.0	6.7	6.0	6.2
OFI-931	7.0	7.0	7.0	7.3	6.3	7.3	5.7	6.0	5.3	6.3	6.7	6.0	6.2
Regiment	7.7	6.0	7.0	7.3	6.0	7.0	6.7	5.7	5.3	6.0	6.3	6.7	6.2
Titan 2	8.0	6.0	6.0	8.7	6.0	7.0	6.3	6.0	5.7	5.7	7.0	6.0	6.2
Bonsai	8.3	6.5	6.3	6.7	6.3	7.0	6.3	5.0	5.3	6.0	7.0	6.3	6.2

Cultivar/ Experimental Number	Spring Green-Up	Color	Texture	Brown Patch Resist.	Quality								
					4/27	5/24	6/21	7/19	8/16	9/14	10/18	11/15	Avg.
Cochise II	7.3	7.0	6.3	7.0	6.0	7.0	5.7	5.7	5.3	6.7	7.0	6.0	6.2
OFI-951	7.0	7.0	7.0	5.3	6.0	7.0	6.0	5.3	5.3	6.0	7.0	6.7	6.2
PST-523	8.3	7.0	6.3	7.3	6.3	7.0	6.7	6.0	4.7	5.7	7.0	6.0	6.2
Pick FA UT-93	8.3	7.0	6.3	7.3	6.7	6.7	6.3	6.0	5.3	6.0	6.7	5.7	6.2
Renegade	7.7	6.0	6.0	7.7	6.7	7.3	6.0	5.7	4.7	6.3	7.0	5.7	6.2
Arabia (J-5)	7.7	7.7	6.3	7.0	6.3	7.0	5.7	6.0	5.0	6.0	7.0	6.0	6.1
Leprechaun	8.0	6.0	6.0	6.7	6.3	7.0	6.3	5.0	5.3	6.0	7.0	6.0	6.1
MB 26	7.7	7.5	6.7	7.7	6.7	7.3	6.0	5.3	4.3	5.7	6.7	7.0	6.1
Shenandoah	8.3	6.5	6.3	7.7	6.0	7.3	6.0	6.0	5.0	5.3	7.0	6.3	6.1
ZPS-5LZ	8.0	8.3	7.3	7.0	6.7	7.0	5.3	6.0	4.7	6.3	7.0	6.0	6.1
ATF-188	8.0	6.0	6.7	7.0	6.7	7.0	5.3	5.7	4.7	6.3	7.0	6.0	6.1
Equinox (TMI-N91)	7.7	6.0	6.3	7.3	6.0	7.0	5.7	5.7	5.3	6.0	7.0	6.0	6.1
JSC-1	7.7	6.0	5.7	8.0	6.0	7.0	5.7	6.0	5.7	6.0	6.3	6.0	6.1
OFI-FWY	7.7	6.7	7.0	6.3	6.3	7.3	5.3	5.7	5.0	6.0	7.0	6.0	6.1
PSII-TF-10	7.0	7.0	6.3	7.0	5.7	7.0	6.0	6.0	4.7	6.7	6.7	6.0	6.1
PSII-TF-9	7.3	6.3	6.0	7.0	6.0	6.7	5.3	6.0	5.3	6.3	7.0	6.0	6.1
Pick FA 15-92	7.3	7.0	6.3	7.0	6.7	7.7	5.3	5.0	4.7	6.0	7.0	6.0	6.0
SRX 8500	7.0	6.7	7.7	7.3	6.0	7.0	5.7	5.3	5.0	6.3	6.7	6.3	6.0
JTTFC-96	8.0	6.0	6.7	8.3	6.3	7.0	5.7	6.0	5.0	5.7	6.3	6.0	6.0
Marksman	8.0	6.5	6.3	6.7	6.3	7.0	5.3	5.7	5.0	6.3	6.7	5.7	6.0
Sunpro	8.0	8.0	6.7	7.3	6.0	7.0	5.3	5.7	4.7	5.7	7.0	6.0	5.9
DP 7952	8.3	5.5	6.3	7.0	5.3	6.3	5.7	5.3	5.0	5.7	6.3	5.3	5.6
Arid	8.3	4.3	5.3	8.3	5.0	6.0	5.3	5.3	5.3	5.0	5.7	6.3	5.5
AV-1	8.7	5.5	5.7	7.3	5.3	5.3	5.0	6.0	5.0	4.7	5.7	6.0	5.4
JTTFA-96	8.7	5.0	6.3	7.0	5.0	4.3	3.7	4.7	4.0	4.3	5.3	5.0	4.5
Kentucky-31 w/endo.	8.0	4.0	4.0	9.0	4.0	5.0	4.0	4.0	4.7	4.0	4.0	4.0	4.2
LSD[2]	*1.0*	*1.5*	*0.9*	*1.4*	*1.0*	*1.1*	*1.5*	*1.1*	*1.2*	*1.1*	*0.8*	*0.7*	*0.4*

[1] Ratings based on a scale of 0-9 with 9=earliest green-up, darkest color, finest texture, greatest resistance to brown patch, and best overall 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: Fine Leaf Fescue Cultivar Trial

OBJECTIVE: To evaluate fine leaf fescue under Kansas conditions

PERSONNEL: Alan Zuk

SPONSOR: USDA National Turfgrass Evaluation Program

INTRODUCTION:

Fineleaf fescue is a shade-tolerant, cool-season grass with a slow, nonaggressive growth habit but a high density upon establishment. Blade width is usually narrower than 2 mm. Leaf curling often occurs during dry periods which can cause a wiry texture. These grasses do not tolerate wet, poorly drained soils; are susceptible to summer heat stress and various diseases; have a fair wear tolerance, and have a fair to poor recuperative potential. Fineleaf fescues are better adapted to northern climates and often are thinned severely by our hot summers.

MATERIALS AND METHODS:

Seventy nine fineleaf fescue cultivars were seeded at the Rocky Ford Turfgrass Research Center in Manhattan, KS in September, 1998. The trial was mowed at 3 inches and fertilized with 3 lb. N/1000 sq ft/ year. Seedling vigor and spring, summer, and fall density and quality from April through October were rated visually using a 0 to 9 scale, 9 = best.

RESULTS:

Sixty eight cultivars had an average seedling vigor ratings of 8 or higher, including Salsa, DGSC 94, ACF 083, Seabreeze, and Shademark (Table 1).

Sixty seven cultivars had an average spring density ratings of 7 or higher, including Sandpiper, Pick FF A-97, Quatro, Salsa, and PST-4HM.

Forty cultivars had average summer density ratings of 7 or higher, including ISI FRR 5, BAR CF 8 FUS1, Treazure (E), and ABT-CHW - 3.

Fifty four cultivars had average fall density ratings of 7 or higher, including Shademaster II, Jasper II, ISI FRR 5, ABT-CHW-2, and ABT-CR-2.

Forty-one cultivars had average quality ratings of 7 or higher, including ISI FRR 5, ABT-CR-2, PST 4FR, MB-63, and ACF 092.

Table 1. Performance of fineleaf fescue cultivars under lawn conditions at Manhattan, KS in 1999.

Cultivar	Seedling Vigor	Spring Density	Summer Density	Fall Density	Quality[1] April	May	June	July	Aug	Sept	Oct	Mean
ISI FRR 5	9.0	8.3	8.7	8.7	8.7	8.7	8.0	8.0	8.0	9.0	8.0	8.3
ABT-CR-2	8.7	8.7	8.0	8.7	8.0	9.0	8.0	8.0	7.7	8.3	7.7	8.1
ACF 092	8.7	7.3	8.3	8.3	7.7	8.0	8.3	7.7	7.7	8.7	7.7	8.0
MB-63	9.0	8.0	8.7	8.3	8.3	8.7	7.7	7.7	8.0	8.3	7.3	8.0
PST-4FR	9.0	8.0	7.7	8.3	8.0	9.0	8.7	7.3	7.0	8.3	7.7	8.0
Jasper II	9.0	7.3	8.3	9.0	8.0	8.7	8.0	6.3	8.0	8.7	7.3	7.9
Longfellow II	8.3	8.0	8.3	8.0	8.3	8.7	8.3	7.0	7.3	8.7	7.0	7.9
PST-ELF	8.7	7.7	8.0	8.0	8.0	9.0	8.3	6.7	7.7	8.3	7.3	7.9
ABT-CHW-3	7.3	7.0	8.7	8.7	7.3	9.0	8.7	7.0	7.7	8.3	6.7	7.8
Florentine	8.7	7.3	8.3	8.7	7.7	8.3	7.7	6.3	8.0	8.7	7.7	7.8
ISI FRR 7	8.7	7.3	8.0	8.0	8.8	8.7	8.3	6.7	7.0	8.3	7.3	7.8
Treazure (E)	8.7	7.0	8.7	8.7	7.7	8.3	8.3	7.0	7.7	8.7	7.0	7.8
Ambassador	7.7	7.3	8.0	8.7	7.3	8.3	83.	7.7	7.3	8.0	7.0	7.7
Culombra	8.3	7.7	8.3	8.8	8.0	8.0	8.3	7.0	7.7	8.0	7.0	7.7
Intrigue	8.0	7.0	8.0	8.0	7.3	8.7	8.3	6.7	7.0	8.3	7.7	7.7
Pathfinder	9.0	7.7	8.0	8.3	7.7	8.3	8.0	6.7	7.7	8.3	7.3	7.7
PST-47TCR	8.8	7.7	8.0	8.3	8.0	8.7	8.7	7.7	7.0	7.0	7.0	7.3
SRX 52961	8.3	7.3	8.0	7.3	7.3	8.7	8.3	6.7	7.3	8.3	7.3	7.7
SRX 52LAV	9.0	8.0	7.7	8.7	8.0	8.7	6.7	7.0	7.7	8.7	7.3	7.7
Brittany	8.3	7.7	8.0	8.0	8.0	8.3	7.3	6.7	7.7	7.7	7.3	7.6
Salsa	9.0	8.3	6.7	7.0	9.0	8.7	8.7	5.7	6.3	7.7	7.0	7.6
Shademaster II	8.7	7.0	8.0	9.0	7.3	8.3	7.3	5.7	8.0	8.7	7.7	7.6
SR 5100	8.3	7.7	8.3	8.3	8.0	8.0	7.3	6.7	7.7	8.3	7.3	7.6
ABT-CHW-2	8.0	6.7	7.7	8.7	7.3	8.3	7.7	6.0	7.3	8.3	7.3	7.5
BAR CF 8 FUSI	8.7	7.3	8.7	8.3	7.0	8.0	7.7	6.7	7.3	8.7	7.3	7.5
BAR CHF 8 FUS2	8.7	6.7	7.0	7.0	7.0	8.3	8.0	6.7	6.7	8.0	7.7	7.5
Shademark	9.0	8.0	7.7	8.0	8.7	8.3	7.3	6.3	6.7	8.0	7.0	7.5
ABT-CHW-1	8.0	7.3	8.0	8.0	7.3	8.3	8.3	7.0	7.0	7.3	6.7	7.4
ASC 082	8.7	7.7	7.0	8.0	8.0	8.3	7.7	6.3	6.7	8.3	6.7	7.4
ASC 087	8.7	7.0	7.7	7.7	7.7	8.7	7.7	6.3	6.3	8.0	7.0	7.4

Table 1. Performance of fineleaf fescue cultivars under lawn conditions at Manhattan, KS in 1999.

Cultivar	Seedling Vigor	Spring Density	Summer Density	Fall Density	Quality[1] April	May	June	July	Aug	Sept	Oct	Mean
Jamestown II	8.7	8.0	7.7	7.3	8.7	7.7	8.3	6.0	6.7	7.3	7.0	7.4
Pick FRC A-93	7.3	7.7	8.0	8.3	7.0	8.3	8.0	7.3	6.7	7.7	7.0	7.4
Sandpiper	8.7	8.7	7.7	7.7	9.0	8.0	7.7	6.3	6.7	8.0	6.3	7.4
ABT-CR-3	8.3	6.7	8.0	8.0	7.0	8.3	7.7	6.7	7.3	8.0	6.3	7.3
Magic	8.0	8.0	8.0	8.0	7.7	8.0	8.0	6.3	6.7	8.0	6.7	7.3
DGSC 94	9.0	7.3	6.7	7.3	8.3	8.3	7.3	5.7	6.3	8.0	6.7	7.2
Tiffany	8.7	6.7	7.3	7.7	7.3	7.3	8.3	6.7	6.7	7.3	6.7	7.2
ACF 083	9.0	8.0	7.0	7.3	8.0	7.7	8.3	6.3	6.3	7.0	6.3	7.1
4001	8.3	8.0	6.7	7.3	8.7	8.3	8.0	5.0	5.3	7.3	6.3	7.0
Banner III	8.0	6.0	7.7	7.3	6.3	8.0	8.0	5.3	6.7	8.0	7.0	7.0
Bridgeport	8.7	7.3	7.7	7.7	7.7	7.7	7.3	5.7	6.7	7.7	6.3	7.0
PST-4MB	8.0	8.0	6.7	6.3	7.7	8.0	7.3	5.3	6.3	7.0	7.0	7.0
ABT-HF-4	8.0	7.7	6.7	7.3	7.3	8.0	8.3	4.7	6.0	7.0	6.7	6.9
BAR HF 8 FUS	9.0	8.3	6.3	7.7	8.3	8.0	7.7	5.0	5.7	7.0	6.3	6.9
Pick FRC 4-92	8.0	7.3	7.0	6.7	7.3	8.0	8.0	5.7	6.0	7.3	6.0	6.9
PST-4HM	8.3	8.3	6.7	7.0	8.3	7.0	8.0	5.0	6.3	7.0	6.3	6.9
BAR SCF 8 FUS3	8.0	6.7	6.0	6.3	7.3	8.7	8.3	5.0	6.0	7.0	5.3	6.8
Defiant	8.3	8.3	6.7	6.7	8.0	8.3	7.7	5.0	6.0	6.3	6.3	6.8
Attila E	9.0	8.0	6.0	6.7	8.3	7.3	8.0	4.3	6.0	7.3	5.7	6.7
ISI FL 11	8.7	7.7	6.7	7.0	7.3	7.7	7.3	5.3	5.7	7.0	6.3	6.7
Oxford	8.7	8.0	6.7	7.0	8.3	8.0	8.3	4.3	6.0	7.0	5.0	6.7
Shadow II	7.0	4.3	8.3	7.7	5.0	7.3	7.3	6.0	6.7	7.3	7.0	6.7
SR 3200	8.7	7.7	6.3	7.7	7.7	7.7	7.7	4.3	6.3	7.3	6.0	6.7
ASR 049	8.0	7.7	6.0	6.0	7.3	8.3	8.7	5.0	5.0	6.3	5.3	6.6
Heron	7.7	7.7	6.0	6.0	7.3	7.7	8.3	5.7	5.0	6.3	5.7	6.6
ISI FL 12	8.3	7.3	6.0	7.0	7.3	8.0	7.7	4.3	5.7	7.0	6.3	6.6
Pick FF A-97	8.7	8.7	6.3	7.0	8.3	7.0	7.7	4.0	6.0	7.3	6.0	6.6
ABT-HF1	8.3	8.3	6.3	6.0	8.3	8.3	7.7	4.7	5.0	6.0	5.7	6.5
AHF 009	8.3	8.0	6.0	7.0	8.3	7.3	7.3	4.0	5.3	6.7	6.0	6.4
Discovery	8.3	6.7	6.3	6.7	7.0	7.0	7.3	4.7	5.7	7.0	6.0	6.4
Ospery	8.3	7.0	6.0	6.3	7.3	7.7	8.7	4.3	5.0	6.3	5.7	6.4

Table 1. Performance of fineleaf fescue cultivars under lawn conditions at Manhattan, KS in 1999.

Cultivar	Seedling Vigor	Spring Density	Summer Density	Fall Density	Quality[1]							
					April	May	June	July	Aug	Sept	Oct	Mean
Rescue 911	7.3	7.3	6.3	7.0	7.0	7.3	7.7	5.0	5.7	6.7	5.7	6.4
SRX 3961	8.0	7.3	6.0	6.3	7.0	7.3	8.0	4.7	5.7	7.0	5.3	6.4
AHF 008	8.3	6.7	6.0	6.3	7.3	7.3	7.7	4.3	5.5	6.3	6.0	6.3
Nordic (E)	8.3	7.3	5.7	6.3	7.7	7.7	8.3	4.7	4.3	5.7	5.7	6.3
Seabreeze	9.0	8.0	5.7	5.7	8.0	8.0	8.3	4.3	4.3	6.0	5.3	6.3
ABT-HF-3	8.0	7.7	6.7	7.3	7.3	7.0	7.7	3.7	6.0	6.3	5.7	6.2
Bighorn	7.7	8.0	6.7	7.3	7.3	7.0	7.0	3.7	6.0	6.3	6.0	6.2
Scaldis	8.7	7.7	6.0	6.7	7.7	7.3	7.0	4.0	5.3	6.3	5.7	6.2
Minotaur	7.7	8.3	5.3	6.3	8.3	7.3	7.0	4.0	5.0	5.7	5.7	6.1
Quatro	8.7	8.7	5.3	5.7	8.3	7.7	7.7	4.3	4.3	5.3	5.0	6.1
MB-82	7.0	4.7	6.3	6.3	4.7	6.0	7.3	5.0	5.7	6.7	6.3	6.0
Reliant II	8.7	7.7	5.0	6.0	8.3	7.7	8.0	3.7	4.0	6.0	4.7	6.0
Dawson E+	8.7	7.7	4.3	5.7	8.0	8.0	7.7	3.3	3.3	6.0	4.7	5.9
ABT-HF-2	8.3	7.3	4.7	4.7	7.7	7.7	7.7	3.3	3.7	5.3	5.3	5.8
Common Creeping Red	9.0	7.0	5.0	5.3	8.0	7.3	6.7	3.3	4.3	5.7	4.7	5.7
Boreal	9.0	7.7	3.3	4.7	8.0	8.3	7.7	2.7	2.7	4.3	4.3	5.4
ASC 172	7.7	4.7	4.7	5.7	4.3	6.0	6.3	4.0	3.3	6.0	4.7	5.0
SR 6000	7.0	6.7	2.7	4.0	6.3	7.0	7.0	3.0	2.0	4.0	3.3	4.7
LSD Value[2]	*1.1*	*2.1*	*1.7*	*1.9*	*1.9*	*1.2*	*1.9*	*1.4*	*1.7*	*1.8*	*1.8*	*1.0*

[1]Quality rated on a scale of 0 - 9 with 9 = best.

[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: Bentgrass Cultivar Evaluation for Golf Course Fairways

OBJECTIVE: To evaluate the performance of bentgrass cultivars for golf course fairways in Kansas

PERSONNEL: Jack Fry

SPONSOR: USDA National Turfgrass Evaluation Program

INTRODUCTION:

Creeping bentgrass is used routinely for golf course fairways and tees in humid, northern climates and in the transition zone east of the Mississippi river. The Kansas climate creates a greater risk for bentgrass winter desiccation, which is one reason it has not been as used widely here. In addition, there are concerns regarding water and fungicide requirements and cultivation practices needed to maintain bentgrass quality.

MATERIALS AND METHODS:

Grasses were seeded on September 16, 1998 at a rate of 1.1 lbs/1,000 sq ft at the Rocky Ford Turfgrass Research Center, Manhattan, KS. The trial was mowed at 9/16 inch and was fertilized with 3 lb. N/1,000 sq ft/year. Pre- and postemergence herbicides were employed. No fungicides or insecticides were used. Turf was irrigated to prevent severe drought stress.

Data were collected on leaf texture, coverage in early 1999, dollar spot (no. of spots per plot), percentage plot area damaged by brown patch, and turf quality (monthly from April through September). Ratings were done on a 0 to 9 scale where 9 = best, unless otherwise stated.

RESULTS:

The 26 cultivars differed in genetic color, leaf texture, and spring coverage; however, I will focus on turf quality and disease resistance (Table 1).

Turf Quality. Best mean turf quality was observed in PST-OVN, SRX 1 BPAA, Grand Prix, L-93, Penncross, and Penn G-6. Quality was best in June, with a range of 3.7 (Golfstar) to 8.7 (SRX 1BPAA). Quality declined in September when dollar spot was most severe, with the best performers being PST-OVN, L-93, and Seaside II.

Dollar Spot. Cultivars most susceptible to dollar spot were Backspin, Century, Imperial, Princeville, and Providence. All colonial bentgrasses exhibited good dollar spot resistance.

Brown Patch. All colonial bentgrasses were very susceptible to brown patch, suggesting that their use in Kansas would require summer fungicide applications. Creeping bentgrass selections exhibited much less brown patch infection, and no differences occurred among them on either rating date.

Table 1. Mean turfgrass quality and other ratings of bentgrass cultivars in the National Bentgrass (Fairway) test at Manhattan, KS in 1999.

Cultivar	Genetic Color	Leaf Texture	Cover (%)	Dollar Spot Aug	Dollar Spot Sept	Brown Patch July 1	Brown Patch July 27	Turf Quality Apr	Turf Quality May	Turf Quality Jun	Turf Quality July	Turf Quality Aug	Turf Quality Sept	Turf Quality Mean
PST-OVN	8.7[1]	8.0	90.0[2]	8.0	7.0	2.3	2.3	6.0	7.0	8.0	7.7	7.3	6.3	7.1
SRX 1BPAA	9.0	8.7	83.3	8.0	6.3	3.3	0.0	6.0	6.3	8.7	7.3	7.0	5.3	6.8
Grand Prix	8.3	8.3	88.3	7.7	6.0	1.7	0.0	6.7	6.7	8.0	7.0	6.7	5.0	6.7
L-93	9.0	8.3	86.7	8.0	7.7	0.0	0.0	6.0	5.7	8.3	7.3	6.7	6.3	6.7
Penncross	8.7	7.7	91.7	6.0	5.7	0.0	3.0	7.7	6.0	7.7	7.3	6.7	4.7	6.7
Penn G-6	8.0	8.0	90.0	7.7	6.0	0.0	1.7	6.3	5.3	8.0	7.0	7.3	5.3	6.6
Seaside II	7.7	8.0	88.3	8.7	7.3	2.7	0.7	6.7	5.0	7.3	6.3	6.7	6.3	6.4
SRX 1120	8.3	8.3	86.7	6.7	5.0	0.7	0.0	6.3	6.3	8.3	6.7	6.3	4.7	6.4
Backspin	7.7	7.7	85.0	5.7	3.7	1.0	0.0	6.7	5.7	8.0	7.0	6.3	4.0	6.3
Trueline	8.0	8.0	83.3	7.7	6.7	0.0	0.0	5.7	5.3	7.7	7.0	6.3	5.7	6.3
Century	8.0	9.0	88.3	4.7	4.7	1.0	1.3	6.0	6.7	8.3	6.7	6.0	3.7	6.2
Imperial	8.3	8.7	86.7	5.3	4.0	1.7	0.0	6.3	6.7	8.7	6.0	5.7	4.0	6.2
Penneagle	7.3	6.7	85.0	7.7	5.7	0.0	1.0	6.0	4.7	7.0	7.0	7.3	5.0	6.2
Princeville	8.0	7.7	88.3	6.3	5.0	1.7	1.3	6.0	5.3	7.7	6.3	6.7	4.7	6.1
SR1119	8.3	8.3	80.0	6.7	5.0	0.7	0.7	4.7	6.3	8.0	7.0	6.0	4.7	6.1
Providence	8.0	8.0	86.7	6.7	4.0	6.7	0.7	5.7	5.0	7.7	6.7	6.3	4.3	5.9
ABT-COL-2[4]	7.3	7.0	75.0	8.7	5.7	21.7	28.3	4.7	6.3	6.3	5.3	6.3	5.0	5.7
ISI AT-5*	7.7	6.0	81.7	7.3	6.0	13.3	30.0	5.3	6.0	6.3	4.7	5.3	5.7	5.6
PST-9HG*	7.0	6.0	73.3	8.0	6.3	20.0	23.3	5.0	5.7	5.7	5.0	6.7	5.3	5.6
SRX 7MODD*	8.0	6.3	71.7	9.0	7.0	21.7	30.0	4.7	5.7	6.0	4.0	6.0	6.0	5.4
Tiger	6.7	6.3	78.3	7.7	6.7	16.7	31.7	5.3	5.3	6.0	4.3	6.0	5.3	5.4
Seaside	6.7	4.3	93.3	6.7	6.0	6.7	11.7	6.7	4.0	5.0	5.0	6.3	5.0	5.3
SRX 7MOBB*	7.0	6.3	83.3	7.7	6.7	21.7	35.0	5.0	6.0	6.7	4.0	5.3	5.0	5.3
PST-9PM*	7.0	5.3	70.0	7.7	6.3	16.7	12.7	4.0	4.7	5.3	4.3	6.0	5.7	5.0
SR 7100*	7.3	5.7	60.0	8.0	6.3	15.0	33.3	4.0	4.7	6.0	3.7	5.3	5.0	4.8
Golfstar*	7.0	4.7	58.3	8.0	7.3	10.0	28.3	3.7	3.7	3.7	3.7	5.0	6.0	4.3
LSD Value[3]	*1.0*	*1.3*	*20.9*	*1.6*	*3.2*	*6.2*	*11.1*	*1.7*	*1.4*	*1.0*	*0.8*	*NS*	*1.3*	*0.6*

[1]Ratings based on a scale of 0-9 with 9 = best green-up, color, texture, and quality.
[2]Cover rated in April, and brown patch ratings are on a 0 to 100% scale.
[3]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. NS = not statistically significant.
[4]Colonial bentgrasses designated by an *. All others are creeping bentgrasses, except Golfstar, which is an Idaho bentgrass.

TITLE: Bentgrass Cultivar Evaluation for Putting Greens

OBJECTIVE: To evaluate new and standard bentgrass cultivars for use on putting greens in Kansas

PERSONNEL: Jack Fry

SPONSOR: USDA National Turfgrass Evaluation Program

INTRODUCTION:

New bentgrasses for putting green use continue to be developed and released. Penncross has been the standard for years, but superintendents have come to accept the benefits that some newer cultivars offer, including better quality, disease resistance, and heat tolerance.

METHODS:

Twenty-six creeping bentgrass, and three velvet bentgrass cultivars were seeded on September 16, 1998 at 1.5 lb/1,000 sq ft at the Rocky Ford Turfgrass Research Center, Manhattan, KS. Plots received 0.5 lb N at planting and 1 lb in fall 1998. In 1999, 7 lb N/1,000 sq ft were applied. Mowing was done 5 or 6 days weekly at 5/32 inch. Bayleton was applied in May to suppress dollar spot, but no other fungicide applications were made. Dylox was applied in July to control black turfgrass ataenius. Plots were rated for leaf texture, dollar spot, brown patch, and turf quality. All ratings were done visually on a 0 to 9 scale, 9 = best. A rating of 7 was considered an acceptable turf quality score.

RESULTS:

Texture. Cultivars that had a coarser texture than those receiving the highest ratings (8.0) were SRX 1120, Penncross, Pick CB 13-94, Penn A-4, Pennlinks, and Bavaria (Table 1).

Dollar Spot. Cultivars that exhibited dollar spot resistance statistically equivalent to the highest rated selections (L-93 and Penncross) were Penn G-6, Penn A-1, Penn G-1, and Pennlinks.

Brown Patch. No differences were observed in brown patch ratings.

Turf Quality. Significant differences occurred among cultivars in July, August, and September. Cultivars that had a rating of 7.0 or higher on three of six rating dates were L-93 and Penn G-6. The best quality occurred in September, and quality of L-93 was superior to that of all other cultivars.

Table 1. Mean turfgrass quality and other ratings of bentgrass cultivars in the National Bentgrass (Greens) test at Manhattan, KS in 1999.

		Dollar	Brown	Turf Quality						
Cultivar	Texture	Spot	Patch	Apr	May	Jun	Jul	Aug	Sep	Mean
L-93	7.7[1]	8.7	8.0	5.0	4.7	7.0	5.7	7.3	8.0	6.3
Penn G-6	7.0	8.0	7.3	4.3	5.0	7.3	6l7	7.3	7.0	6.3
ISI Ap-5	7.3	7.0	8.0	4.3	4.5	7.0	6.3	7.0	6.7	6.1
Penn A-1	8.0	8.3	8.0	4.7	5.0	6.7	6.3	7.0	7.0	6.1
Penn A-2	7.7	8.0	7.3	4.3	5.0	6.3	7.0	6.7	6.7	6.0
SR 1119	7.3	6.7	6.7	4.7	4.7	7.0	6.7	7.0	6.0	6.0
SRX 1120	6.7	6.7	8.0	4.3	5.0	6.3	6.0	7.0	6.0	5.8
BAR AS 8FUS2	7.7	7.0	7.0	4.7	4.7	6.3	5.3	6.7	6.3	5.7
Penn G-1	7.3	8.3	7.7	4.3	4.3	6.3	5.7	6.7	7.0	5.7
Penncross	6.3	8.7	8.3	4.7	4.7	6.0	6.0	5.7	7.0	5.7
Pick CB 13-94	6.7	6.7	7.7	4.7	4.3	6.0	6.0	6.7	6.3	5.7
ABT-CRB-1	8.0	6.3	6.7	4.3	4.3	6.0	6.0	7.3	5.3	5.6
Imperial	7.7	5.3	5.7	5.0	4.7	6.3	6.3	6.3	5.0	5.6
Penn A-4	6.7	7.0	8.0	3.7	4.5	6.0	6.3	6.3	6.3	5.6
Syn 96-1	8.0	5.0	7.7	4.7	4.7	6.7	5.7	7.0	5.0	5.6
Syn 96-3	8.0	4.3	8.3	4.7	5.0	6.7	6.0	6.3	5.0	5.6
Backspin	7.0	5.7	8.0	4.3	4.3	6.3	6.0	6.7	5.3	5.3
Providence	7.3	5.7	8.0	4.3	4.3	6.3	5.3	7.0	5.7	5.5
SRX 1NJH	7.0	7.0	7.0	4.0	4.5	6.0	5.7	6.3	6.0	5.5
Syn 96-2	8.0	4.0	8.0	4.7	4.7	6.3	5.7	6.3	5.0	5.4
PST-A2E	7.7	7.0	8.0	4.3	4.7	5.3	5.7	5.3	6.3	5.3
Pick MVB	7.0	6.7	8.0	4.0	4.7	6.3	4.7	6.0	6.0	5.3
Crenshaw	7.3	4.7	7.7	3.3	4.0	6.0	6.0	6.0	5.0	5.1
SR 7200	7.0	6.7	8.7	4.3	4.5	5.3	4.7	5.7	6.0	5.1
Pennlinks	6.3	8.3	7.7	4.3	4.0	5.3	5.3	5.0	5.7	4.9
SRX 1BPAA	7.0	7.3	7.0	4.0	3.5	4.7	5.0	5.0	6.3	4.8
BAR CB 8US3	7.3	4.3	7.0	4.3	3.7	5.0	5.3	5.7	4.3	4.7
Century	7.3	5.0	7.3	3.0	4.0	5.3	5.3	5.0	4.7	4.7
Bavaria	6.7	7.7	7.3	4.3	3.7	4.3	4.7	4.3	6.0	4.6
LSD[2]	*1.1*	*0.8*	*NS*	*NS*	*NS*	*NS*	*1.8*	*1.2*	*0.8*	*1.0*

[1]Ratings based on a scale of 0-9 with 9 = best green-up, color, texture, and quality.

[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. NS = Not statistically different.

TITLE: High-Maintenance Kentucky Bluegrass Trial

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

PERSONNEL: Steve Keeley

SPONSOR: USDA National Turfgrass Evaluation Program

INTRODUCTION:

Turfgrass breeders recently have been 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 must have resistance to summer patch. If such cultivars can be identified, they would provide viable alternatives 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, KS. The trial was mowed at 9/16 inch and was fertilized with 4 lb N/1000 sq ft per year. Irrigation was applied as needed to prevent drought stress. Because of extremely heavy billbug damage in 1998, imidacloprid (Merit) was applied in late May of 1999 to prevent a reoccurrence. This decision was made because we had obtained good billbug susceptibility data in 1998 and wanted to look at other characteristics in 1999. No fungicides were applied.

Turf quality was rated monthly from May to November on a visual scale of 1 to 9, where 1=dead turf and 9=optimum density and uniformity. In this particular trial, most people would find cultivars with an average quality rating of 5.5 or above to be acceptable fairway turfs. The cultivars also were rated for spring green-up, genetic color, and density.

RESULTS:

Apollo, America, Unique, and Showcase were the only cultivars to attain mean quality ratings of 5.5 or higher for the season (Table 1). Brilliant was the only other cultivar to attain at least a 5.0 mean quality rating. Over the past 4 years, these five cultivars really have stood out from the rest of the field. Because Kansas conditions impose a severe test on any Kentucky bluegrass cultivar, careful selection is extremely important. However, these five cultivars would be expected to perform better as a fairway turf than the other cultivars in the trial. All have similar genetic color, so they could easily be blended together for fairway use.

Table 1. Mean turfgrass quality and other ratings of cultivars in the National Kentucky Bluegrass Test, Manhattan, KS in 1999.[1]

	Genetic	Spring	Summer		Turf Quality							
Cultivar	Color	Green-Up	Density	Wilting	May	Jun	Jul	Aug	Sept	Oct	Nov	Mean
Apollo	6.7	6.3	6.7	4.7	6.0	6.7	6.0	6.3	6.3	6.3	5.0	6.1
America	5.7	6.0	6.3	5.7	5.7	7.0	5.0	6.3	5.7	5.3	4.7	5.7
Unique	5.7	6.3	6.0	5.0	5.3	6.3	5.3	6.0	5.3	6.0	5.3	5.7
Showcase	6.0	6.7	6.3	5.3	4.7	5.7	5.0	6.0	6.7	6.0	5.0	5.6
Brilliant	6.7	6.7	6.3	5.3	5.0	6.0	4.0	5.7	4.7	5.0	5.0	5.0
Jefferson	6.7	6.0	6.0	3.3	3.7	6.0	4.7	4.7	4.7	4.7	5.3	4.8
OFI 94-13	6.3	5.0	4.7	5.0	4.3	5.7	4.7	5.7	3.7	4.7	5.0	4.8
Midnight	4.3	8.0	6.7	2.7	4.0	5.7	4.3	5.0	4.7	4.3	3.3	4.5
Baronie	6.0	5.0	6.0	3.0	4.7	4.0	3.7	4.0	4.7	4.7	4.7	4.3
OFI 94-25	5.7	5.7	5.3	4.7	4.0	5.0	4.3	5.0	3.7	4.0	4.0	4.3
ASP200	5.7	7.0	6.3	2.7	4.3	5.0	4.3	3.7	4.0	5.0	3.7	4.3
Ba 75-490	5.7	6.3	6.0	3.7	4.7	4.0	4.7	4.0	4.0	3.7	4.0	4.1
Livingston	6.0	6.0	5.3	3.0	4.0	5.7	4.0	3.7	4.0	4.7	3.0	4.1
Jewel	6.0	6.0	5.7	2.7	5.0	5.7	4.0	3.0	3.3	4.0	3.7	4.1
Wildwood	5.7	6.7	6.0	3.0	4.0	6.3	5.0	3.7	3.7	3.0	3.0	4.1
Pick 8	5.7	8.0	5.7	2.0	5.0	5.3	4.0	3.3	4.0	3.7	3.3	4.1
Haga	6.3	5.3	5.7	3.7	3.7	4.3	3.3	4.3	4.3	4.0	4.3	4.0
PST-BO-1	6.3	5.3	5.7	2.3	4.7	5.3	3.7	3.0	3.7	3.7	4.0	4.0
Rugby II	4.7	8.0	6.0	2.3	3.3	5.0	3.7	4.0	4.3	4.3	3.3	4.0
Chateau	6.3	5.7	6.3	2.0	5.0	5.3	4.0	3.0	3.3	3.7	3.3	4.0
Odyssey	5.7	7.0	6.7	3.0	3.0	5.0	3.7	3.7	4.0	4.0	3.7	3.9
Envicta	5.7	6.7	5.7	1.7	4.7	5.0	3.7	3.3	3.7	3.3	3.0	3.8
Classic	6.0	5.3	5.7	3.3	4.0	4.0	2.7	3.3	4.3	3.7	4.3	3.8
Explorer	5.7	6.0	6.0	2.3	3.7	5.0	3.7	3.0	3.7	4.0	3.3	3.8
Ba 81-220	4.3	7.0	5.7	1.7	4.3	5.3	3.7	3.0	3.3	3.7	2.7	3.7
Ba 81-270	6.0	5.7	6.3	2.7	4.3	4.7	4.0	3.0	3.3	3.3	3.3	3.7
Champagn	6.7	6.0	6.0	3.0	3.7	4.0	3.0	2.7	3.3	3.7	5.3	3.7
Goldrush	5.3	6.7	6.0	2.0	3.7	5.0	3.3	2.7	4.0	3.7	3.0	3.6
Serene	6.0	6.0	5.7	2.3	4.3	4.7	3.3	2.7	3.3	3.7	3.3	3.6

Table 1. Mean turfgrass quality and other ratings of cultivars in the National Kentucky Bluegrass Test, Manhattan, KS in 1999.[1]

	Genetic	Spring			Turf Quality							
Cultivar	Color	Green-Up	Density	Wilting	May	Jun	July	Aug	Sept	Oct	Mean	
BAR VG	6.3	7.0	5.7	2.0	4.0	5.0	4.0	2.3	3.3	3.3	3.3	3.6
Coventry	5.7	5.3	6.3	2.3	4.3	5.0	4.0	2.7	3.0	3.3	2.7	3.6
Blacksburg	6.3	7.7	6.7	1.3	3.3	5.3	4.0	3.0	3.3	3.0	3.0	3.6
Seabring	5.0	7.3	5.7	2.7	3.0	4.3	4.0	3.7	4.0	3.3	2.7	3.6
Arcadia	5.7	6.7	5.3	1.7	3.3	4.7	3.7	3.0	3.7	4.0	2.7	3.6
Caliber	6.0	6.3	5.7	3.3	3.0	3.7	4.7	3.0	3.7	3.0	3.7	3.5
SR2109	5.3	6.3	5.7	1.7	4.7	5.0	3.3	2.3	3.3	3.0	3.0	3.5
Challenger	6.0	6.3	5.3	2.7	3.3	3.7	3.0	3.3	3.7	3.3	4.3	3.5
Award	5.0	7.3	6.7	2.7	3.3	4.3	3.7	2.7	3.7	4.0	3.0	3.5
Impact	4.7	8.0	5.7	2.0	3.0	4.3	3.3	3.3	3.7	4.0	2.7	3.5
Total	5.0	7.3	6.0	2.7	3.0	4.0	3.3	3.7	3.7	4.3	2.3	3.5
Ba 81-058	6.3	6.7	6.0	3.3	3.0	3.7	4.0	3.3	3.7	3.3	3.3	3.5
Eclipse	6.3	6.0	5.3	2.7	2.7	4.0	3.3	3.0	4.0	3.7	3.3	3.4
Chicago	5.7	6.0	5.7	2.3	3.0	4.3	3.3	3.0	3.3	3.3	3.7	3.4
NuGlade	5.0	7.0	5.7	3.0	3.0	4.0	3.7	3.3	3.7	3.3	3.0	3.4
J-1555	5.7	6.7	4.7	3.3	3.0	4.3	3.7	3.0	3.3	3.3	3.3	3.4
Platini	6.0	6.7	5.7	1.7	4.3	4.3	3.7	2.0	3.0	3.3	3.0	3.4
Absolute	5.7	8.0	5.7	2.0	3.0	4.3	3.3	3.0	3.3	3.7	2.7	3.3
BAR VG	5.7	6.3	6.0	1.3	3.7	4.3	3.3	2.0	3.3	3.0	3.7	3.3
Ba 76-197	5.7	6.3	5.3	2.3	4.0	4.0	3.7	2.7	3.3	3.0	2.7	3.3
Compact	6.3	5.0	5.0	3.3	2.7	3.7	3.0	3.3	3.7	3.3	3.7	3.3
HV 242	7.0	6.7	6.3	1.3	4.3	5.0	3.7	1.7	2.7	2.7	3.0	3.3
Rambo	5.7	6.3	6.0	1.7	3.0	4.3	3.7	2.7	3.3	3.3	2.7	3.3
Ba 75-163	6.3	7.0	5.3	3.0	3.3	3.7	4.0	3.0	3.3	3.0	2.7	3.3
Princeton	6.3	6.7	6.0	2.3	3.0	4.0	4.0	2.3	3.3	3.0	3.3	3.3
SR2000	5.7	7.3	6.3	2.7	3.7	4.0	4.0	2.7	3.0	2.7	2.7	3.2
Quantum	5.0	6.7	6.0	2.0	3.0	4.3	3.3	2.7	3.3	3.0	3.0	3.2
Ba 73-373	5.3	6.3	6.3	3.0	3.3	4.7	3.3	3.0	3.0	2.3	2.7	3.2
Sidekick	5.7	6.0	5.3	2.7	2.7	3.7	3.0	3.0	3.7	3.3	3.0	3.2
ZPS-309	5.7	7.0	6.0	2.0	3.3	3.7	3.7	2.7	3.0	3.0	3.0	3.2
Lipoa	6.3	7.7	6.0	2.0	2.7	5.3	4.3	2.7	2.7	2.7	2.0	3.2

Table 1. Mean turfgrass quality and other ratings of cultivars in the National Kentucky Bluegrass Test, Manhattan, KS in 1999.[1]

Cultivar	Genetic Color	Spring Green-Up	Density	Wilting	May	Jun	July	Aug	Sept	Oct	Nov	Mean
NJ-GD	7.0	6.0	5.0	3.0	3.7	3.7	3.0	3.3	3.0	2.7	3.0	3.2
MED-1580	6.0	7.0	5.3	2.3	3.3	4.0	3.7	3.3	2.7	3.0	2.3	3.2
ZPS-2183	7.0	7.3	6.0	2.3	4.3	4.7	3.3	2.3	2.7	2.0	2.7	3.1
Allure	6.0	5.7	6.3	2.7	3.7	4.0	3.7	2.3	3.0	3.0	2.3	3.1
NJ 1190	6.0	6.0	7.0	2.3	3.0	5.0	3.7	2.7	3.0	2.3	2.3	3.1
Fortuna	6.0	6.7	5.7	2.3	3.7	4.0	3.3	2.7	3.0	3.0	2.3	3.1
NJ-54	6.0	6.3	6.0	2.0	3.3	5.0	3.0	2.3	2.7	2.7	2.7	3.1
A88-744	6.7	6.7	6.0	2.3	3.3	3.7	3.0	2.7	3.0	2.7	3.3	3.1
H86-690	5.7	7.7	5.0	2.7	3.0	3.3	2.7	2.7	3.7	3.3	3.0	3.1
BAR VG	6.0	5.0	5.7	2.7	3.0	3.7	3.0	3.0	3.0	2.7	3.0	3.0
Blackstone	6.0	7.0	6.0	2.3	3.0	3.3	3.3	2.7	3.3	2.7	2.7	3.0
Shamrock	6.3	6.3	5.3	3.0	3.7	3.7	3.0	2.3	2.7	2.7	3.0	3.0
NuStar	6.3	6.0	5.7	2.0	2.7	4.0	3.0	2.7	3.0	3.0	2.7	3.0
Ascot	5.3	7.0	5.3	2.7	3.0	3.7	3.0	3.0	3.3	2.3	2.7	3.0
Ba 70-060	5.3	6.0	5.3	1.7	4.0	4.3	3.0	2.0	2.7	2.7	2.3	3.0
Ba 81-113	6.0	6.3	5.3	1.3	4.3	4.3	3.3	2.0	2.7	2.0	2.0	3.0
Marquis	5.7	6.7	6.3	1.3	3.3	4.3	3.0	2.3	2.7	2.7	2.3	3.0
Baron	6.0	6.0	5.3	2.3	3.0	3.7	3.7	2.7	2.7	2.7	2.3	3.0
Limousine	6.3	6.3	6.7	1.7	3.0	4.7	3.7	2.0	2.3	2.3	2.3	2.9
PST-P46	5.3	7.3	6.0	2.7	3.0	3.7	2.7	2.3	3.3	2.7	2.3	2.9
Northstar	4.7	7.0	7.0	1.7	2.3	4.7	3.0	2.3	3.0	2.3	2.3	2.9
Moonlight	5.7	8.0	5.3	3.0	2.7	3.0	3.0	3.3	3.0	2.7	2.3	2.9
Sodnet	5.0	7.7	4.3	2.7	3.3	3.3	3.0	2.0	3.0	2.7	2.3	2.8
Nimbus	6.0	6.0	5.7	2.0	3.3	3.7	2.7	2.7	2.7	2.3	2.3	2.8
Conni	5.7	6.0	7.0	1.7	2.7	3.7	3.0	1.7	2.7	2.7	2.7	2.7
Abbey	5.3	6.0	5.7	1.7	3.0	4.0	2.7	2.0	2.3	2.3	2.3	2.7
Bluechip	5.7	7.0	4.7	2.0	2.7	3.7	3.0	2.3	2.7	2.3	2.0	2.7
Kenblue	5.3	4.7	4.3	2.7	2.7	3.0	2.3	2.7	2.7	2.7	2.7	2.7
SR2100	5.7	6.3	5.3	2.0	3.3	3.3	2.7	1.7	2.3	2.0	3.0	2.6
Raven	5.3	6.3	5.3	1.0	3.0	4.0	2.7	2.0	2.0	2.3	2.3	2.6
Ba 77-702	5.7	6.3	5.7	1.7	2.7	3.7	3.0	1.7	2.7	2.0	2.3	2.6

Table 1. Mean turfgrass quality and other ratings of cultivars in the National Kentucky Bluegrass Test, Manhattan, KS in 1999.[1]

Cultivar	Genetic Color	Spring Green-Up	Density	Wilting	May	Jun	Jul	Aug	Sept	Oct	Nov	Mean
SRX 2205	4.7	6.7	6.0	2.3	3.0	3.7	2.7	2.0	2.0	2.0	2.3	2.5
Misty	6.3	6.0	5.0	2.3	2.3	3.0	3.0	1.7	2.3	2.3	2.3	2.4
Dragon	6.3	7.0	5.0	2.0	2.7	2.7	2.3	2.0	2.7	2.0	2.3	2.4
Pick-855	6.3	6.7	5.0	2.3	2.3	2.7	2.3	2.0	2.3	2.3	2.3	2.3
Pepaya	5.0	8.0	5.0	1.0	2.7	3.0	3.0	1.3	2.0	2.0	2.0	2.3
BAR BG	4.7	7.0	5.7	1.3	2.7	3.3	2.7	1.0	2.3	2.0	2.0	2.3
Cardiff	7.0	7.0	6.0	2.3	2.0	2.7	2.7	2.0	2.7	2.0	2.0	2.3
Bartitia	5.0	6.7	6.3	1.0	3.0	3.0	2.3	1.3	2.3	1.7	2.0	2.2
VB 16015	6.3	7.3	5.0	1.7	2.0	2.0	2.0	1.0	2.0	2.0	2.0	1.9
NJ-54	4.7	7.3	5.3	2.0	2.0	1.7	1.7	1.7	1.7	1.7	2.0	1.8

[1]Ratings based on a scale of 0-9 with 9 = best green-up, color, texture, and quality.

[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: Bermudagrass Cultivar Trial

OBJECTIVE: To evaluate seeded and vegetative bermudagrass cultivars under Kansas conditions

PERSONNEL: Linda Parsons

SPONSOR: USDA National Turfgrass Evaluation Program

INTRODUCTION:

Bermudagrass is a popular warm-season turfgrass that is heat and drought tolerant and wear resistant. Recent introductions of interest are being selected for their improved hardiness and quality. Specifically, new seeded varieties show the potential for improved winter survival. Both seeded and vegetative types need further evaluation to determine their potential use by both sod growers and consumers.

MATERIALS AND METHODS:

During the summer of 1997, we established 18 seeded and 10 vegetative bermudagrass cultivars and experimental numbers at the John C. Pair Horticultural Center in Wichita, KS. Preparation for the study included incorporating 13-13-13 into 84 5 ft × 5 ft study plots at a rate of 1 lb NPK/1000 sq ft. We seeded or plugged the plots in a randomized complete block design. We maintained fertility of the plots at 0.5 to 0.75 lb N/1000 sq ft per growing month. We mowed the plots weekly during the growing season at 1.0 to 1.5 inches and returned clippings. We irrigated as necessary to prevent dormancy and controlled weeds, insects, and diseases only when they presented a threat to the trial. At appropriate times during the course of the study, we rated the turfgrass on a scale of 0=dead turf, 6=acceptable, and 9=optimum measure.

RESULTS:

We rated turfgrass quality monthly throughout the 1999 growing season (Table 1). Ratings were influenced by degree of coverage and weed infestation as well as turf density. The best overall performer was seeded type OKS 95-1. Good vegetative selections were Cardinal, Midlawn, and OKC 18-4. On 14 May, we found that vegetative types Cardinal and Midlawn and seeded type OKS 95-1 were the earliest to green-up. At summer’s end, we looked at turf color and texture and found that Shanghai, OKC 18-4, and CN 2-9 were the darkest green and that vegetative types Cardinal, Midlawn, Tifway, and Tifgreen had the finest texture. OKS 95-1 was the most finely textured seeded type.

Table 1. 1999 performance of bermudagrass cultivars at Wichita, KS[1].

Cultivar/ Experimental No.	Seeded / Vegetative	Spring Green-Up	Color	Texture	Quality						
					5/27	6/28	7/26	8/26	9/20	10/18	Avg.
OKS 95-1	S	8.0	6.3	6.7	7.3	7.3	8.0	8.0	6.3	6.0	7.2
Cardinal	V	8.0	4.0	9.0	7.7	6.0	8.0	6.0	6.0	4.0	6.3
Midlawn	V	8.0	5.7	8.0	7.0	6.0	7.3	6.3	5.7	4.7	6.2
OKC 18-4	V	7.0	8.0	6.7	6.7	6.3	7.3	7.0	5.7	4.0	6.2
Tifway	V	4.7	7.0	8.0	5.3	6.0	7.3	6.7	5.7	5.7	6.1
OKC 19-9	V	7.3	7.0	6.0	6.7	6.3	7.3	6.3	5.0	4.0	5.9
Shanghai	V	7.0	8.7	5.0	7.0	6.0	6.0	7.0	5.7	4.0	5.9
Tift 94 (Tifsport)	V	4.3	6.7	7.0	5.7	5.3	7.0	6.0	5.7	4.7	5.7
CN 2-9	V	5.0	7.7	7.0	5.7	6.0	6.3	5.7	5.3	4.7	5.6
Princess	S	3.3	7.0	6.0	4.3	4.7	6.7	7.0	6.0	4.0	5.4
Tifgreen	V	5.3	6.0	7.7	5.0	5.7	6.7	5.3	5.3	4.0	5.3
J-540	S	6.7	6.0	6.0	5.3	4.7	6.0	5.7	5.3	4.0	5.2
Majestic	S	4.3	5.7	5.7	4.7	4.0	5.0	6.3	6.0	4.3	5.1
PST-R69C	S	5.0	6.0	6.0	4.7	4.7	5.7	6.0	5.3	3.3	4.9
Blackjack	S	6.0	5.7	5.3	5.3	4.0	5.0	5.7	5.7	3.7	4.9
J-1224	S	5.3	6.3	6.0	5.7	4.0	5.0	5.3	5.0	4.3	4.9
Mirage	S	4.7	6.0	5.7	5.0	3.3	4.3	5.3	5.3	5.0	4.7
Pyramid	S	5.7	6.0	5.7	5.0	4.0	4.7	5.0	5.3	4.3	4.7
Shangri La	S	5.0	6.0	6.0	4.7	3.7	4.3	5.0	6.0	4.3	4.7
Blue-Muda	S	5.7	5.7	5.7	4.7	3.7	4.7	6.0	5.3	3.3	4.6
SW 1-11	S	1.7	6.7	6.0	3.0	3.3	4.7	6.3	6.0	3.7	4.5
SW 1-7	S	4.7	6.0	5.7	3.7	4.3	4.7	5.7	5.7	3.0	4.5
NuMex-Sahara	S	4.0	6.0	5.3	4.3	3.0	4.3	5.7	5.3	3.7	4.4
Savannah	S	5.3	6.0	6.0	4.7	4.0	4.7	4.7	4.7	3.3	4.3
Sundevil II	S	4.3	6.0	5.3	4.3	3.7	4.3	4.7	4.7	3.0	4.1
Mini-Verde	V	2.3	6.7	7.0	3.7	4.3	4.7	3.7	4.0	2.0	3.7
Jackpot	S	3.3	5.7	5.7	3.3	2.3	3.3	4.7	4.7	4.0	3.7
Arizona Common	S	2.0	6.0	5.3	2.0	1.7	3.3	5.0	4.7	5.0	3.6
LSD[2]		*1.7*	*0.6*	*0.7*	*1.5*	*1.3*	*1.3*	*1.3*	*1.1*	*1.4*	*0.8*

[1] Ratings based on a scale of 0-9 with 9=earliest green-up, darkest color, finest texture, and best 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: Zoysiagrass Cultivar Trial

OBJECTIVE: To evaluate performance of zoysiagrass cultivars in the Kansas climate

PERSONNEL: Jack Fry

SPONSORS: USDA National Turfgrass Evaluation Program

INTRODUCTION:

Meyer is the standard zoysiagrass cultivar used in Kansas. However, there is interest in identifying other cultivars that may be adapted to our climate. The greatest limiting factor to the use of a new zoysiagrass is freezing tolerance. Unfortunately, since this test was established in 1996, we have not had a severe winter to really test the cold hardiness of these selections. Meyer is also relatively slow to establish; therefore, a cold-hardy zoysiagrass with a relatively fast rate spread would be preferred.

MATERIALS AND METHODS:

Grasses were established from seed or plugs in July, 1996 at the Rocky Ford Turfgrass Research Center, Manhattan, KS. 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 with three replicates. Seeding rate was approximately 2 lb./1,000 sq ft. Six, 2-inch-diameter plugs of vegetative selections were planted in each plot. Mowing was done 3 days weekly at a 0.75-inch height. Nitrogen was applied in June to provide 1 lb N/1,000 sq ft. Irrigation was applied to prevent significant drought stress.

RESULTS:

Color. Highest genetic color ratings were received by Crowne, El Toro, Meyer, Emerald, DALZ 9601, Cavalier, Palisades, Jamur, and J-14. (Table 1)

Spring Green-Up. Fastest spring green-up occurred with J-37, ZEN-400, J-36, Chinese Common, Z-18, HT-210, ZEN-500, and Korean Common.

Leaf Texture. Finest leaf texture ratings were received by Emerald, DALZ 9601, Cavalier, and Zeon.

Turf Quality. Highest mean quality rankings were given to Emerald, DALZ 9601, Cavalier, Zeon, Palisades, El Toro, and Jamur. Meyer had an average overall quality rating partly because of billbug damage. Of the seeded selections, Zenith is a cultivar we are evaluating in larger plots. It is fast to establish, is cold hardy, and has leaf texture that is somewhat finer than that of other seeded types.

Peformance ratings of some of these cultivars do not adequately represent their adaptabilty for use in Kansas, because they have not been exposed to a “harsh” winter.

Table 1. Mean quality and other ratings of zoysiagrass cultivars in the national zoysiagrass test at Manhattan, KS in 1999.

Cultivar	Genetic Color	Spring Green-up	Leaf Texture	Turf Quality May	June	Jul	Aug	Sep	Mean
Emerald	7.7[1]	2.0	9.0	6.0	8.3	8.7	8.0	8.0	7.8
Dalz 9601	7.7	1.0	9.0	4.7	7.0	8.3	8.0	7.7	7.1
Cavalier	7.7	1.0	9.0	4.7	6.7	8.0	7.7	8.0	7.0
Dalz 9601	7.7	0.7	9.0	4.3	6.7	8.0	7.7	7.3	6.8
Zeon	7.3	1.0	7.7	4.7	6.0	7.3	7.7	7.7	6.7
Palisades	7.7	1.7	6.0	3.3	6.7	8.0	8.0	7.0	6.6
El Toro	8.0	1.0	5.0	4.0	6.0	7.7	8.0	7.0	6.5
Jamur	7.7	1.3	5.7	3.7	6.3	7.7	7.7	7.0	6.5
J-14	7.7	2.7	4.0	5.0	5.0	7.0	7.3	7.3	6.3
J-37	6.3	5.7	4.3	6.3	5.0	6.3	7.0	7.0	6.3
ZEN-400	6.0	5.0	4.3	6.7	5.3	6.3	6.7	6.7	6.3
J-36	7.0	5.0	4.3	6.0	5.0	6.0	7.0	7.0	6.2
Crowne	8.3	1.0	5.3	2.7	6.0	7.3	7.7	7.0	6.1
Chinese Common	6.3	5.0	4.0	6.0	5.0	6.0	7.0	6.0	6.0
Victoria	7.5	2.0	5.5	3.5	4.0	5.5	-	7.3	6.0
Meyer	8.0	2.7	6.7	4.3	5.3	6.0	5.7	6.3	5.5
Zenith	7.0	3.7	4.7	5.0	4.3	5.7	6.3	6.0	5.5
Miyako	6.7	0.0	4.7	2.0	4.3	7.0	7.0	6.3	5.3
Z-18	6.3	4.3	3.7	5.3	3.7	5.3	6.0	5.7	5.2
HT-210	6.3	4.0	3.7	4.7	4.0	4.7	6.3	6.0	5.1
ZEN-500	6.0	4.7	5.7	4.7	4.7	5.3	4.7	5.3	4.9
Korean Common	6.0	5.7	3.0	5.0	4.3	4.7	4.7	5.0	4.7
De Anza	7.5	1.0	5.0	4.0	2.0	4.5	5.0	6.0	4.3
LSD Value[2]	*1.6*	*1.9*	*1.8*	*1.9*	*1.9*	*1.8*	*1.2*	*1.5*	*1.4*

[1]Ratings based on a scale of 0-9 with 9 = best green-up, color, texture, and quality.

[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: Buffalograss Cultivar Trial

OBJECTIVE: To evaluate seeded and vegetative buffalograss cultivars under Kansas conditions

PERSONNEL: Linda Parsons

INTRODUCTION:

Buffalograss is the only native species used for turfgrass in Kansas. It requires little maintenance and is heat and drought tolerant. The introduction of many new selections, both seeded and vegetative, has aroused considerable interest in growing buffalograss. Further evaluation of these new releases is needed to determine their potential for use by Kansas consumers.

MATERIALS AND METHODS:

During the summer of 1997, we established 9 seeded and 11 vegetative buffalograss cultivars and experimental numbers in 60 8 ft × 8 ft study plots at the John C. Pair Horticultural Center in Wichita, KS. Prior to seeding and plugging the plots, we incorporated 13-13-13 into them at a rate of 1 lb NPK/1000 sq ft. We maintained fertility at 0 to 0.25 lb N/1000 sq ft per growing month. We mowed the plots weekly during the growing season at 2.5 to 3.0 inches and returned clippings. We irrigated as necessary to prevent dormancy and controlled weeds, insects, and diseases only when they presented a threat to the trial. At appropriate times during the course of the study, we rated the turfgrass on a scale of 0=dead turf, 6=acceptable, and 9=optimum measure.

RESULTS:

The 1999 growing season for buffalograss in Wichita started in May and was over by the middle of October. Turfgrass quality ratings during that period were influenced by degree of coverage and weed infestation as well as turf density. The best overall performers for the year were the two vegetative types 609 and UCR-95 and the two seeded types Cody and Sharp's Improved #2 (Table 1). On 14 May, we found that vegetative types 91-118, 378, 609, and Bonnie Brae and seeded types Cody and Sharp's Improved #2 showed the earliest spring green-up. Consumers seem most interested in dark green, finely textured turfgrass varieties. So at summer's end, we looked at turf texture and found that vegetative types Midget and 609 were the finest. The seeded types with the finest texture were Bison and Sharp's Improved. In 1998 we looked at turf color and found that vegetative types Prairie, 609, and UCR-95 and seeded types BAM-1000, Bison, and Cody were the darkest green.

Table 1. 1999 performance of buffalograss cultivars at Wichita, KS[1].

Cultivar/ Experimental Number	Seeded (S)/ Vegetative (V)	Spring Green-Up	Texture	Quality					
				5/27	6/28	7/26	8/26	9/21	Avg.
609	V	7.3	8.7	6.3	6.7	6.3	5.7	7.0	6.4
Cody	S	7.3	8.0	7.0	7.0	6.7	6.0	5.0	6.3
UCR-95	V	3.3	8.0	5.7	6.7	7.0	6.0	6.0	6.3
Sharp's Improved #2	S	7.3	8.0	7.0	6.0	6.7	5.7	5.7	6.2
Bison	S	7.0	8.3	6.3	6.7	6.3	6.0	5.0	6.1
91-118	V	8.0	7.0	6.7	6.7	6.0	5.3	5.3	6.0
Sharp's Improved	S	7.0	8.3	7.0	6.0	6.7	5.3	5.0	6.0
Tatanka	S	6.7	8.3	6.7	6.3	5.7	5.3	5.7	5.9
Texoka	S	7.0	8.0	6.3	6.3	6.0	5.3	4.7	5.7
Bonnie Brae	V	7.3	7.7	6.0	6.3	5.3	5.0	5.3	5.6
BAM-1000	S	6.0	8.0	6.0	6.0	6.0	5.0	4.3	5.5
Prairie	V	5.7	8.3	5.7	5.0	5.0	5.3	5.7	5.3
Sharpshooter	S	6.3	7.0	6.3	6.0	5.3	4.0	4.3	5.2
378	V	7.3	8.3	5.7	5.0	5.7	4.7	4.3	5.1
8907	S	6.0	7.3	5.7	6.0	5.3	4.0	4.3	5.1
Stampede	V	6.7	7.3	5.3	4.7	4.7	4.3	5.0	4.8
86-120	V	7.0	8.0	5.3	5.3	5.0	4.3	3.7	4.7
Midget	V	4.7	9.0	5.0	5.3	4.3	4.3	4.3	4.7
Legacy (86-61)	V	6.7	7.7	5.0	4.7	4.3	4.0	3.0	4.2
Mobuff	V	5.3	8.3	4.0	3.7	3.3	3.0	3.0	3.4
LSD[2]		*1.2*	*1.0*	*1.7*	*1.4*	*1.7*	*1.1*	*1.2*	*1.1*

[1] Ratings based on a scale of 0-9 with 9=earliest green-up and best texture 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: 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

PERSONNEL: Derek Settle, Jack Fry, and Ned Tisserat.

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

INTRODUCTION:

Recent improved varieties of creeping bentgrass are being introduced on golf greens in Kansas without a complete understanding of how our variable transition zone climate may affect their disease susceptibility. The standard bent varieties such as Penncross now are being displaced by newer popularized varieties such as Crenshaw. Significantly, no research has documented the specific fungicide requirements of a newer bentgrass cultivar, which could impact a golf course's annual expense and use of pesticides.

The objective of this study was to assess the susceptibility of four widely used creeping bentgrass cultivars to two common fungal diseases, dollar spot *(Sclerotinia homoeocarpa)* and brown patch (*Rhizoctonia solani*). Additionally, we wanted to look for application strategies that could reduce fungicide use without sacrificing the quality necessary for a bentgrass green.

MATERIALS AND METHODS:

The study was conducted for the third and final year during the summer of 1999 on a USGA green at Rocky Ford Turfgrass Research Center. Bentgrass was mowed daily at 5/32 inch, irrigated with 1 mm of water daily, and received a season total of 5 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 x 7.2 ft and consisted of seven fungicide treatments. Fungicides were applied at various intervals depending on treatment from 7 May to 17 September at the manufacturers' recommended rates (Table 1). The treatments and timing included: 1) nontreated; 2) Daconil Ultrex every 7 days 3) Chipco GT every 14 days; 4) Chipco GT + Aliette Signature every 14 days; 5) Bayleton + Prostar every 28 days; 6) Bayleton + Heritage every 28 days; 7) Daconil Ultrex as needed when the number of dollar spots per plot increased from previous week's numbers in at least two of the three replicates. Fungicides were applied with a CO_2-powered backpack sprayer equipped with 8004 nozzles at 20 psi in water equivalent to 2 liters/288 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 from14 May until 24 September. Brown patch data were taken as % plot damage beginning at the first appearance on 26 July and continuing until 18 August. The area under the disease progress curve (AUDPC + 1) was used to sum all weekly data within each cultivar over the entire season. Cultivars responded differently to fungicide treatments (interactions occurred). Therefore, dollar spot and brown patch AUDPC means for each cultivar were analyzed separately within each fungicide treatment (Fig. 1), and fungicide treatments were analyzed separately within each cultivar (Table 1).

RESULTS:

The weather during the summer of 1999 was initially cool in June, but hot, dry conditions prevailed by July. The majority of precipitation at Manhattan occurred the beginning of August, when a single, moderate outbreak of brown patch occurred. Although conditions were markedly less humid compared to the summer of 1998, dollar spot disease pressure was greatest in 1999. Also, dollar spot damage began earlier than in the previous 2 years. As early as 7 May, significant plot damage was observed in the Crenshaw plots. A moderate brown patch epidemic began on 26 July, maximum levels of blighting reached 60% in untreated plots by 12 August, and damage lasted until 18 August.

Dollar Spot. Without fungicides, cultivars differed in their susceptibility to dollar spot and could be ranked as follows; Crenshaw > Penncross > Providence > L-93 (Fig.1). Crenshaw was found to be highly susceptible to dollar spot, whereas L-93 displayed good resistance. Poor visual quality was associated with untreated plots regardless of cultivar (Fig. 2). Among cultivars, fungicides were found to be equally effective in suppressing dollar spot in L-93, Penncross, and Providence (Fig. 1). In contrast, Crenshaw consistently suffered greater dollar spot damage in all treatments except Chipco GT alone or in combination with Aliette Signature every 14 days (Fig. 1, Bayleton + Prostar not shown).

Within each cultivar, fungicides were found to have differing efficacies (Table 1). In general, spray strategies that reduced fungicide use were unable to control dollar spot under conditions of high disease pressure, as in Crenshaw plots. Two cultivars, L-93 and Penncross, were similar in that all fungicide treatments were able to provide similar dollar spot control. However, L-93 was the only cultivar that maintained acceptable visual quality (> 6) when a low rate of Daconil Ultrex was applied weekly as recommended (Fig. 2). This treatment reduced the needed active ingredient by 50% compared to the labeled rate every 14 days.

Similarly, curative applications of Daconil Ultrex at the recommended rate provided acceptable season-long visual quality for L-93 alone (Fig. 2). Five curative treatments were necessary for L-93, cutting the application number in half when compared to spraying preventively every 14 days. Providence also responded well to the curative dollar spot treatments, and unacceptable quality occurred on only two of the 16 dates rated (Fig. 2).

The curative approach requires scouting before spraying, and total number of sprays was found to vary depending on cultivar susceptibility to dollar spot. In 1999, L-93 required the fewest number of sprays, five, followed by seven for Penncross and Providence, and eight for Crenshaw. Total curative sprays required from 1997 to 1999 were as follows: L-93 = 12, Providence = 14, Penncross = 15, and Crenshaw = 18. This represents a significant reduction in the number of sprays required when compared to applications of Chipco GT every 14 days, which totaled 30 over the same 3-year period.

The 28-day Bayleton treatment combinations provided acceptable visual quality for all cultivars except Crenshaw and required a total of five applications for the season. Interestingly, the treatment combination of Bayleton + Azoxystrobin elevated dollar spot numbers compared to Bayleton + Prostar for Crenshaw (Table 1). A similar trend of elevated dollar spot appeared in L-93, Penncross, and Providence, although numbers were not significantly different.

Brown Patch. Without fungicides, slight differences in cultivar susceptibility to brown patch was apparent and could be ranked as follows; Crenshaw $ L-93 $ Penncross $

Providence. Crenshaw and Providence were most susceptible to brown patch in 1998, and Providence's resistance to the disease in 1999 is difficult to explain. Among all cultivars, the preventive treatments of Chipco GT and Chipco GT + Aliette Signature every 14 days or Bayleton + Prostar, and Bayleton + Heritage every 28 days were equally effective in suppressing brown patch blighting. Chipco GT applied every 14 days was the only 'single' fungicide that provided acceptable visual quality (> 6) all season for both brown patch and dollar spot among all cultivars. Prostar and Heritage were very effective in suppressing brown patch, but not dollar spot, and additional fungicides, such as Bayleton, were required to maintain acceptable visual quality. The 28-day preventive treatment combinations reduced the number of fungicide applications by 50% compared to use of Chipco GT alone every 14 days. Further, plots sprayed with Heritage at 0.2 oz /1000 sq ft every 28 days reduced fungicide use (half the labeled rate) and provided excellent brown patch control, with little to no blighting observed in either 1998 or 1999.

Within cultivars, the weekly low rate of Daconil Ultrex was effective in reducing brown patch blighting in L-93 only. Brown patch damage in L-93 was limited to 10% or less, whereas in all other cultivars, the treatment had no effect on brown patch development, which was similar to that in untreated plots. L-93 was unique in that a 'single' reduced-rate fungicide could provide acceptable control of both dollar spot and brown patch for the entire season.

The curative treatment was not as effective in reducing brown patch compared to the preventive treatments, but was better than no treatment. In general, the curative treatment reduced brown patch blighting by about half when compared to untreated plots. This meant that the curative treatment was unable to provide acceptable control of brown patch blighting (< 10%) for any cultivar in either 1998 or 1999 and would not be recommended for brown patch control on a bentgrass green.

In conclusion, bentgrass cultivar selection in this study was found to have a significant impact on levels of both dollar spot and brown patch diseases. A cultivar such as Crenshaw may actually increase fungicide use, whereas a cultivar such as L-93 is likely to decrease fungicide use and could provide a superintendent with greater flexibility in selecting an effective application strategy.

Table 1. Fungicide treatments and control of dollar spot among four creeping bentgrass cultivars at Manhattan, KS, 1999.

Fungicide	Interval (days)	Cultivar (AUDPC[x]) Crenshaw	L-93	Penncross	Providence
Daconil Ultrex 82.5 DG	7	3045 d[y]	82 a	414 a	720 a
Chipco GT 2F	14	256 a	11 a	36 a	48 a
Aliette Signature 80 WP + Chipco GT 2 F	14	382 a	8 a	88 a	29 a
Prostar 70 WP + Bayleton 50 DF	28	852 b	45 a	91 a	26 a
Heritage 50 WG + Bayleton 50 DF	28	1301 c	58 a	398 a	119 a
Daconil Ultrex 82.5 DG (Curative)[z]	as needed	1410 c	308 a	384 a	442 b
Untreated	N/A	6459 e	1609 b	3112 b	2299 c

[x]Area under disease progress curve (AUDPC) represents weekly dollar spot number/sq m from 21 May to 24 September, 1999.

[y]Column means not followed by the same letter are significantly different ($P \leq 0.05$)

[z]Applied as needed when the number of dollar spots per plot increased from previous week's numbers in at least two of the three replicates. Total curative applications required: Crenshaw = 8, L-93 = 5, Penncross = 7, and Providence = 7.

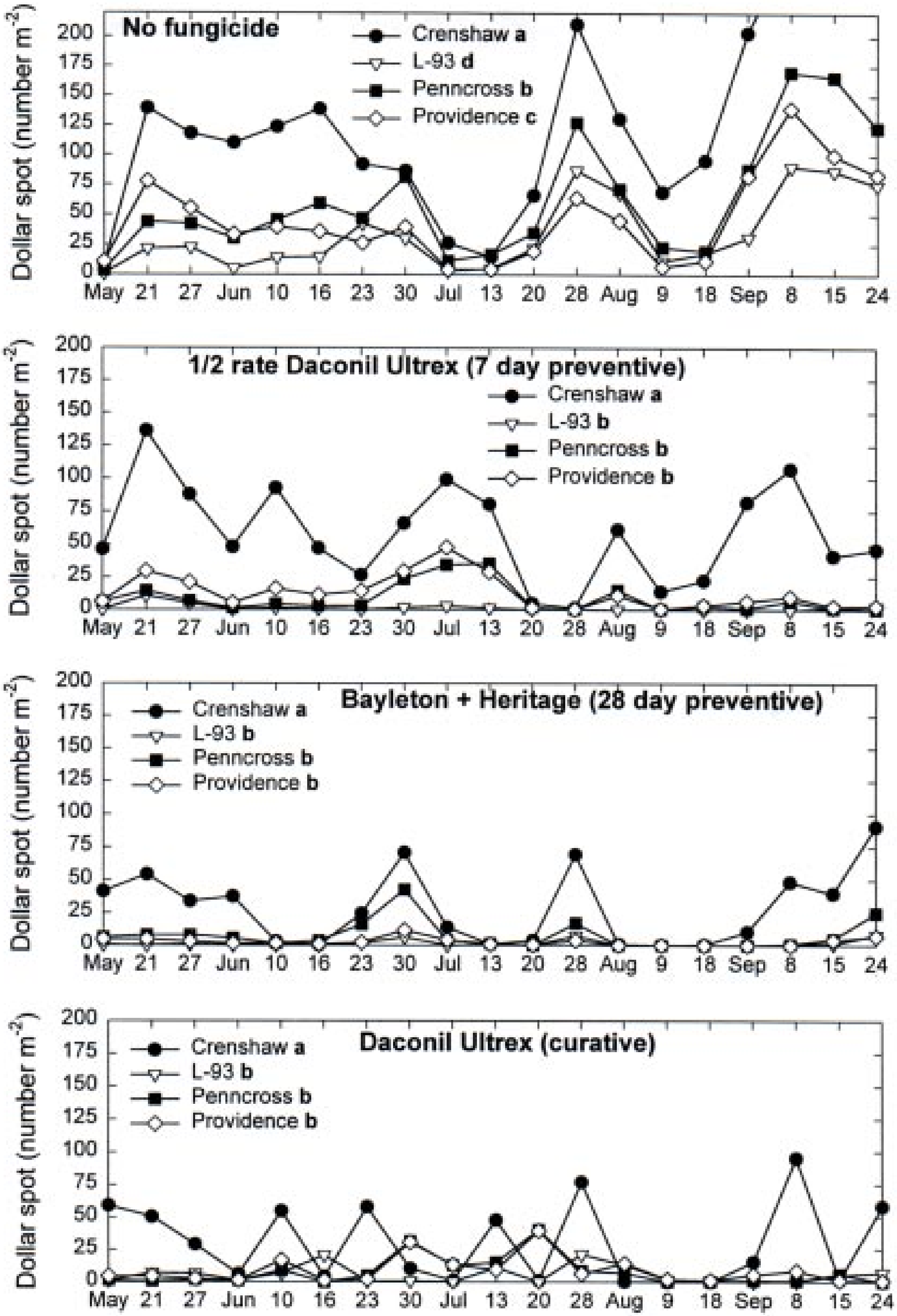

Figure 1. Creeping bentgrass cultivars, selected fungicides, and dollar spot at Manhattan in 1999. Cultivar names not followed by the same letter are signifcantly different (P = 0.05) using AUDPC.

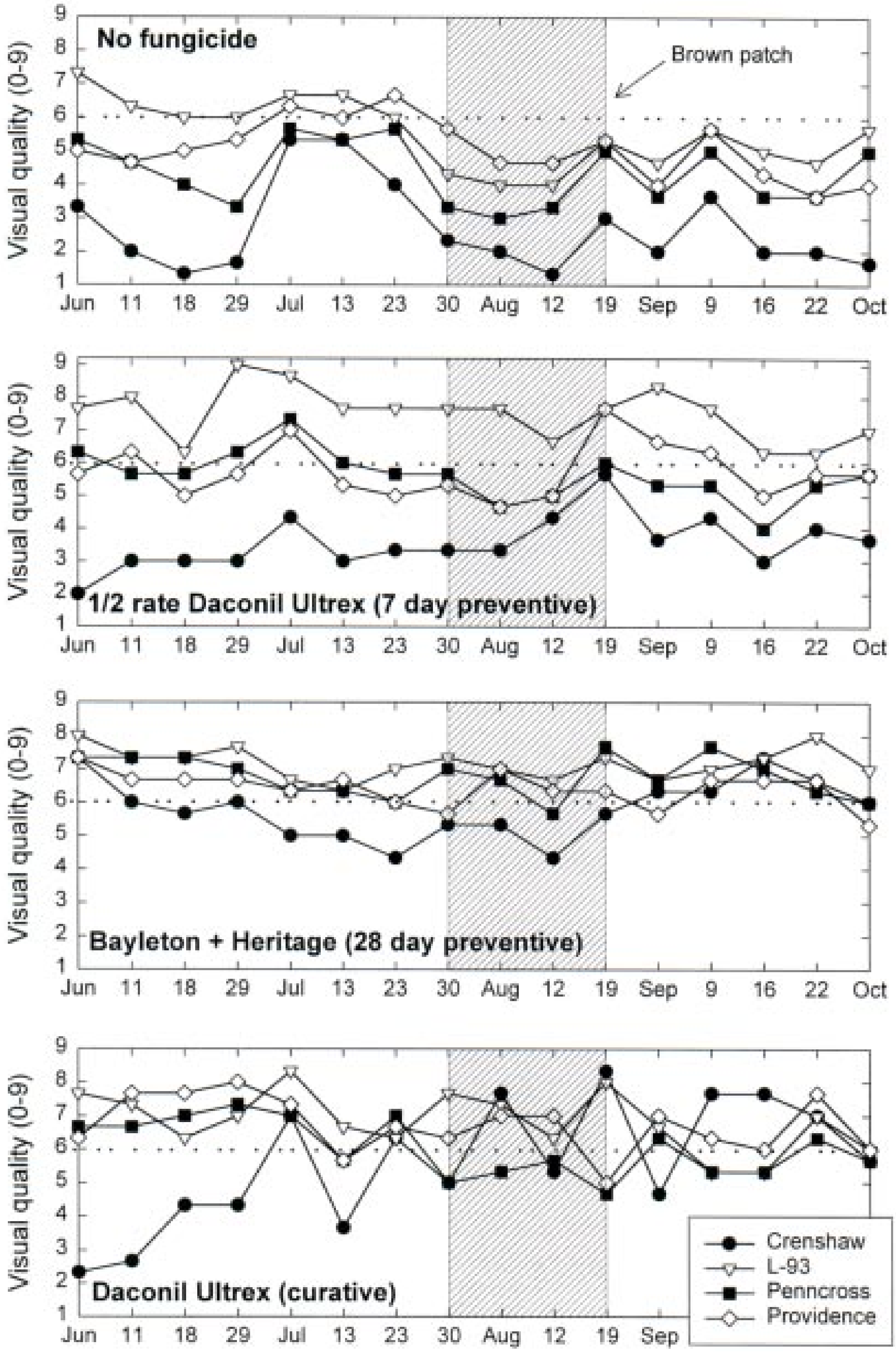

Figure 2. Visual quality (9=best, 6=acceptable) of creeping bentgrass cultivars with selected fungicide treatments during dollar spot and brown patch epidemics at Manhattan in 1999.

TITLE: Effects of Irrigation Frequency, Clipping Removal, and Fungicide Application Strategies on Development of Rhizoctonia Brown Patch in Tall Fescue

OBJECTIVE: To evaluate potential cultural and chemical management strategies for the most efficacious control of Rhizoctonia brown patch in a typical tall fescue home lawn

PERSONNEL: Derek Settle, Jack Fry, and Ned Tisserat

SPONSORS: Kansas Turfgrass Foundation, Ryan Lawn and Tree

INTRODUCTION:

Tall fescue is highly susceptible to brown patch, a common disease in the Great Plains region from late May through early September. Irrigation and clipping management practices are thought to influence brown patch. Commonly, cultural recommendations to limit brown patch development are given, but scientific study is lacking. Our purposes were to better understand how cultural practices may influence brown patch blighting and to look for an infrequent fungicide application schedule that could benefit tall fescue in areas where high quality is desired or necessary. New treatment subplots for 1999 included a low 1-inch mowing height and a preventive treatment with Prostar fungicide every 35 days.

MATERIALS AND METHODS:

Tall fescue plots were established at the Rocky Ford Turfgrass Research Center in Manhattan, KS in September 1997. An Olathe slit seeder was used to plant a turf type tall fescue blend at a rate of 7 lbs / 1000 sq ft. Prior to summer 1999, the tall fescue received a total of 5 lbs of nitrogen in the form of urea, applied at 1 lb/1000 sq ft each month: Sept, Oct, Apr, May, June. The experimental design was a split-split plot with three replications. The whole plots measured 28 ft x 50 ft and consisted of two irrigation schedules: 1) 0.2 inch of water daily and 2) 0.4 inch of water every other day. In June and July, daily irrigation was split into three, 6-minute intervals applied at 1:00, 3:00, and 5:00 a.m. These multiple, nightly irrigations resulted in an increase in Pythium blight. Therefore, on 3 August, the irrigation schedule was returned to a single, 18-min application at 4:00 a.m. Pop-up gear driven heads were used to deliver water to plots.

The split plots measured 14 ft x 50 ft. Cutting height was 3.5 inches, and clippings were either 1) returned or 2) removed with a 21-inch rotary lawn mower each week.

Subplots were 10 ft x 10 ft and consisted of the following fungicide treatments: 1) untreated; 2) untreated with cutting 1 inch height three times weekly; 3) Heritage 50 WG at 0.2 oz / 1000 sq ft every 35 days; 4) Prostar 50 WP at 2.2 oz / 1000 sq ft every 35 days; and 5) Daconil Ultrex 82.5 DG at 3.8 oz / 1000 sq ft as needed at first signs of blighting. Fungicides were applied to turf with a CO_2-powered sprayer at 20 psi using 8004 flat fan nozzles in water equivalent to 2 liters/200 sq ft.

Plots were rated weekly and separately for the percentage areas blighted by brown patch and Pythium blight. Blight percentages were used to calculate the area under the disease progress curve (AUDPC). AUDPC values were $\log_{10}X + 1$ transformed prior to analysis. Weekly visual quality ratings were made on a 0-9 scale, where 0 = dead turf; 6 = minimum rating for acceptable quality; and 9 = optimum color, density, and uniformity. Analysis of variance on all ratings was performed with the PROC MIXED procedure, and a Saterthwaite adjustment was used for split-split plot analysis of variance.

Four 12.5 sq in. turf cores were removed randomly on 14 May 1999 from untreated (3.5-inch height) and Heritage-treated sub-subplots. Numbers of grass tillers were measured for each of the four cores and averaged for each plot. Total tissue nitrogen was determined using a percent by weight result (g N / 100 g dry tissue weight) with a dry combustion analyzer. Tissue nitrogen testing was conducted only on Heritage fungicide sub-subplots during October 1999.

RESULTS:

In 1999, three moderate brown patch outbreaks (21 June, 23 July, and 27 August) resulted in blighted turf from mid-June through early September (Fig. 1). Pythium blight developed on 29 July and again on 16 August (Fig. 2).

Irrigation frequency did not influence brown patch AUDPC. However, Pythium blight AUDPC was higher in daily irrigation plots with clippings returned. For example on 16 August, daily irrigated tall fescue was 17% blighted where clippings were returned versus 10% where clippings were collected. In contrast, approximately 1% blighting occurred in tall fescue irrigated infrequently regardless of clipping management.

Clipping management had no effect on brown patch AUDPC. Returning clippings provided superior color in comparison to plots with clippings removed (8.6 versus 6.9 on 1 October). Similarly, returning clippings resulted in higher leaf tissue nitrogen levels 3.9% vs. 3.5% on 3 October.

Preventive and curative fungicide treatments suppressed brown patch. Preventive applications of Heritage at 35-day intervals resulted in > 95% brown patch control (Fig. 1). Although Prostar also controlled brown patch for 21 to 28 days, its effectiveness waned 4 weeks after application and resulted in a higher AUDPC than the Heritage treatment (Fig. 1).

Curative applications of Daconil Ultrex were less effective in reducing brown patch than preventive Heritage and Prostar treatments. Because of rapid blighting during the first 24 hours of a brown patch outbreak, plots sustained 5 to 25% damage before treatments could be applied. Furthermore, blight increased slightly for approximately 4 days after treatment as leaves with incipient infections at the time of fungicide application wilted and died. Nevertheless, three curative treatments suppressed blighting by 25 to 50% during individual brown patch outbreaks and reduced the AUDPC (Fig. 1).

Lowering the mowing height from 3.5 inches to 1 inch reduced AUDPC for brown patch. However, this was primarily a result of reduced blighting during the first brown patch epidemic in late June (Fig. 1). Initially, the 1-inch mowing height decreased tall fescue canopy density and likely provided a less favorable microenvironment for brown patch development in June. Blighting at both mowing heights was similar in July and August when canopy densities were similar.

Pythium blight occurred in both years but was restricted primarily to Heritage or the 1 inch-height, untreated plots. The untreated plots mowed at 3.5 inches were relatively free of Pythium blight (Fig. 2). Frequent mowing at 1 inch and Heritage's nearly complete suppression of brown patch appeared to increase tall fescue sward density. This may explain the Pythium blight results.

Tall fescue in all plots recovered from blighting by mid- to late-September and had acceptable visual quality ratings (> 6). Although plots treated with Heritage had a higher (P#0.05) shoot density than untreated plots on 17 Aug 1998 (4.8 vs 3.1 tillers/sq in.), densities were not significantly different by 14 May 1999 (4.8 vs 4.7 tillers/sq in.).

In conclusion, turfgrass cultural practices appear to be less significant in brown patch development than was previously thought. Our results suggest that brown patch in tall fescue is largely unaffected by irrigation frequency and clipping management, and that several fungicide strategies can be used to reduce disease severity. Surprisingly, we also found a regular occurrence of Pythium blight. Its development was exacerbated by daily irrigation, returned clippings, Heritage applications, and frequent mowing at 1 inch height.

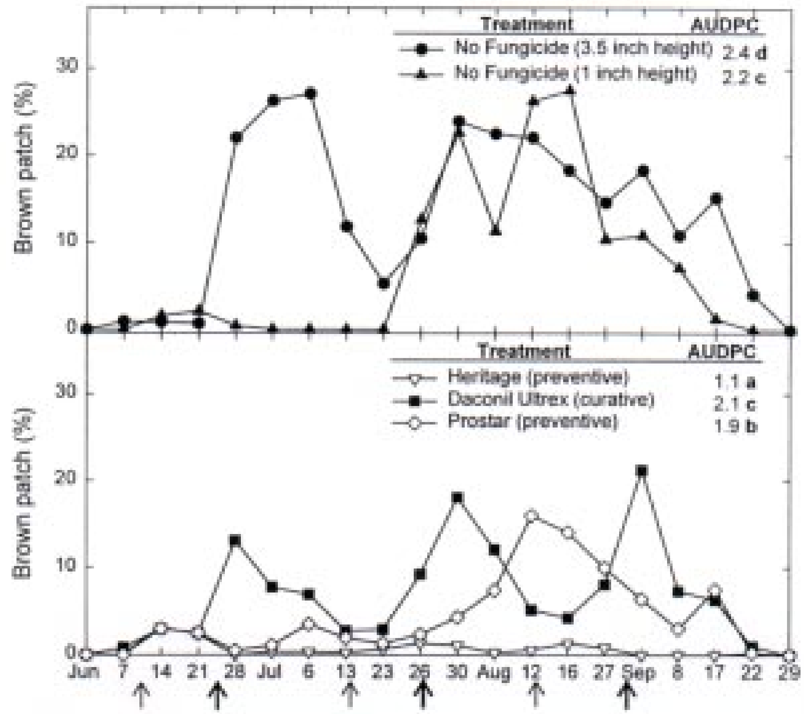

Figure 1. Effects of fungicide applications and mowing heights on brown patch development in tall fescue at Mahattan, KS in 1999. Symbols beneath the date represent days on which (↑) preventive or (↑) curative treatments were applied. AUDPC means followed by the same are not significantly different (P = 0.05).

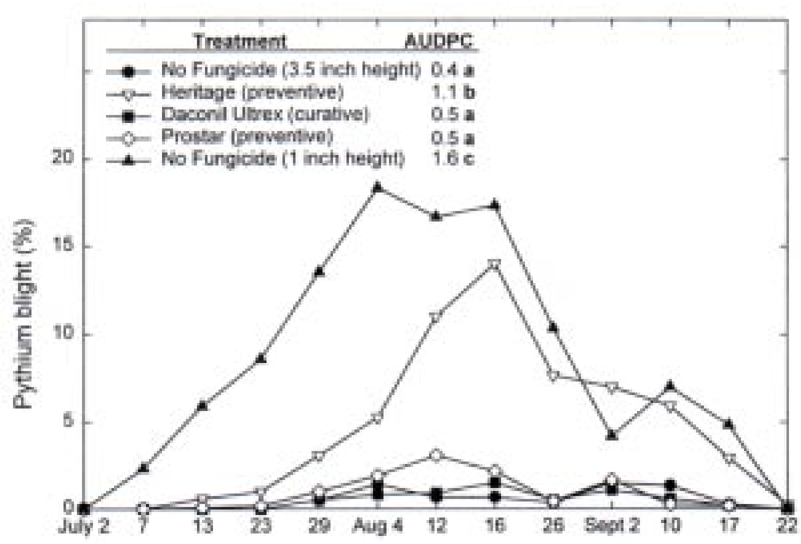

Figure 2. Effects of fungicide applications and mowing heights on pythium blight development in tall fescue at Manhattan, KS in 1999.
AUDPC means followed by the same letter are not significantly different (P = 0.05).

TITLE: Influences of Irrigation Frequency, Poling, and Nitrogen Rates on Brown Patch in Perennial Ryegrass

OBJECTIVE: To evaluate effects of irrigation frequency, poling, and nitrogen rates on brown patch development in perennial ryegrass

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 Superintendent's Association of America

INTRODUCTION:

Brown patch is a common disease on perennial ryegrass fairways in the transition zone. It often occurs in midsummer during extended periods of hot, humid weather and causes unsightly patches of blighted turf.

Previous research at K-State indicated that brown patch was reduced in ryegrass by irrigating daily (Jiang et al. 1998. Crop Sci. 38:440-445). We hypothesized that irrigation reduced disease by removing early morning dew, physically disturbing the fungal mycelium, or altering the nitrogen (N) status of the plant. Hence, the objective of this study was to evaluate the effects of irrigation frequency, dew removal, and N fertility on brown patch development in ryegrass in the field.

MATERIALS AND METHODS:

The study was conducted in the summer of 1999 on a perennial ryegrass blend established during the fall of 1997 at the Rocky Ford Turfgrass Research Center, Manhattan, KS. The ryegrass was maintained at a 1/2 inch fairway height by mowing three times weekly. No fungicide was applied to the study. The experimental design was a split-split plot with three replications. The whole plots measured 28 ft x 42 ft and consisted of two irrigation schedules: 1) 0.2 inch of water daily at 5:00 a.m. and *2*) 0.4 inch of water every other day at 10:00 a.m. Pop-up, gear-driven irrigation heads delivered water to plots. Subplots 14 x 42 ft split the whole plots in half lengthwise, and poling (yes vs. no) was applied daily at 7:00 a.m. with a 10 ft long, flexible, fiberglass pole. Sub-subplots were 10 x 10 ft and consisted of four increasing annual rates of N: 2, 4, 6, and 8 lbs/1000 sq ft (Table 1)

Plots were rated weekly for the percentage plot area blighted by brown patch. Blight percentages were used to calculate the area under the disease progress curve (AUDPC). AUDPC values were $\log_{10}X + 1$ transformed prior to analysis. Color was rated on 1 June, prior to brown patch activity, to describe visible chlorosis of the low N treatments, where 0 = brown and 9 = dark green. Analysis of variance on all ratings was performed with the PROC MIXED procedure, and a Saterthwaite adjustment was used for split-split plot analysis of variance.

RESULTS:

During 1999, warmer summer temperatures and few periods of >10 hrs of leaf wetness reduced brown patch activity compared to 1998. Nevertheless, two separate brown patch epidemics caused extended periods of moderate blighting from early June to early July and again from late July to early September (Fig. 1). Very hot, dry weather (maximum air temperatures exceeding 100°F) during mid-July suppressed brown patch between epidemics and allowed ryegrass recovery.

Irrigation. Irrigation frequency did not significantly alter brown patch development. Plots irrigated daily at 4:00 a.m. exhibited similar blighting levels compared to plots irrigated every other day at 10:00 a.m. Therefore, brown patch fungal development is neither enhanced nor reduced by irrigation in early morning, a time when periods of naturally occurring dew (leaf wetness) exist.

Poling. Early morning dew removal by poling did not influence brown patch development. Poling was of limited use in 1999, because few periods of extended leaf wetness occurred. For example, two periods of > 10 hour leaf wetness were measured during July, 1999. In comparison, 12 periods of > 10 hour leaf wetness were measured during July, 1998, and poling reduced brown patch by 10%.

Nitrogen. Nitrogen fertility did not affect brown patch blighting consistently in 1999. From 8 June to 20 July, brown patch blighting was greatest at 2 and 4 lbs N/1000 sq ft / yr (Fig. 1). This was surprising, because the low N rates had suppressed brown patch in 1998. A lack of vigor was associated with the low N rates at summer's start. For example, on 1 June, 1 week prior to initial brown patch activity, turf receiving 2 and 4 lbs N/1000 sq ft / yr exhibited poor visual color, 5.6 and 5.2, respectively (6 = acceptable). However, this condition did not persist and, with the low N rates, tended to display greater brown patch resistance during the second epidemic (20 July to 10 September) compared to plots with 6 and 8 lbs N /000 sq ft / yr. On 30 July, more blighting occurred (P#0.10) in plots receiving 8 lbs N/1000 sq ft^{-2} / yr. Nevertheless, AUDPC values were not different among N levels during the second epidemic (Fig. 1). The results for 1999 suggest that a chlorotic, slow growing turfgrass may have increased susceptibility to brown patch, and N below recommended rates should be avoided.

In conclusion, the impact of irrigation frequency on brown patch development in ryegrass fairways is still unclear. Daily, early morning irrigations did not reduce brown patch in either 1998 or 1999 field evaluations. It is possible that the amount of water applied was not sufficient to adequately remove the dew or interrupt mycelium growth on the leaf surface. For example, Jiang et al. reported a decrease in brown patch with daily irrigations of more water (0.3 inch/day). The extended period required to apply the additional water may have been sufficient to influence disease development.

Jiang et al. also suggested that increased brown patch severity in ryegrass in infrequently irrigated plots may have resulted from increased wilt-induced mortality of infected plants. Alternatively, brown patch-infected plants in infrequently irrigated plots may have been slower to recover from injury compared to those in plots that were watered each morning. This deserves further study.

Table 1. Application rates and dates for four annual N fertility regimes on perennial ryegrass at Manhattan, KS in 1999.

Annual Nitrogen Fertility[z] (lbs/1000 sq ft)	April	May	June	September	October	November
2	-	-	-	-	1	1
4	1	-	-	1	1	1
6	1	1	1	1	1	1
8	1.5	1	1	1.5	1.5	1.5

[z]Nitrogen applied as sulfur-coated urea.

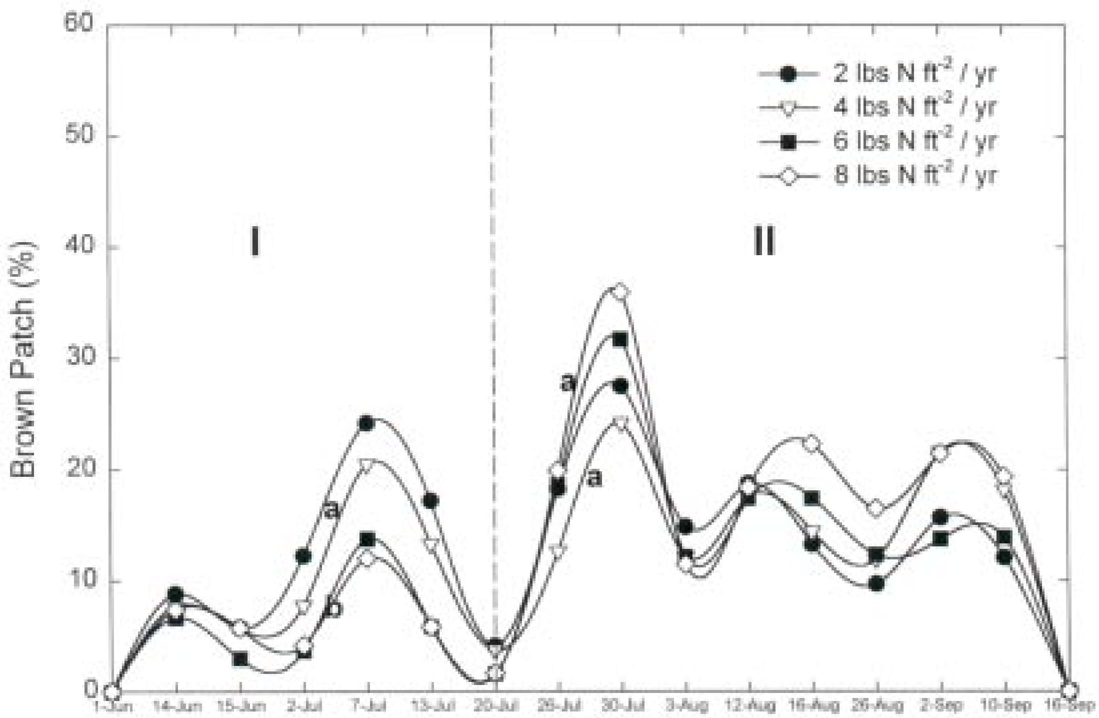

Figure 1. Effects of four N rates as sulfur-coated urea on two brown patch epidemics (**I** & **II**) in a perennial ryegrass study at Manhattan, KS in 1999. Area under the disease progress curves followed by the same letter are not significantly different (P = 0.05).

TITLE: Reactions of Tall Fescue Cultivars to Pythium Blight and Brown Patch

OBJECTIVE: To evaluate resistance of tall fescue cultivars to Pythium blight and brown patch

PERSONNEL: Derek Settle, Jack Fry, Linda Parsons, and Ned Tisserat

SPONSORS: Kansas Turfgrass Foundation, USDA National Turfgrass Evaluation Program

INTRODUCTION:

Rhizoctonia brown patch and Pythium blight can affect the aesthetic quality of tall fescue during the summer. Historically, these diseases have been controlled by a combination of cultural and chemical methods. There is renewed interest in the breeding of tall fescue cultivars with resistance to these diseases. Our purpose was to evaluate the disease susceptibility of tall fescue cultivars entered in the National Turfgrass Evaluation Program.

MATERIALS AND METHODS:

One hundred and thirty entries from the National Turfgrass Evaluation program at the John C. Pair Horticultural Center in Wichita, KS were seeded into 5 x 5 plots on 11 Sept 1996 at a rate of 4.4 lb seed/1000 sq ft. Prior to seeding, plots were fertilized with 13-13-13 at 1 lb NPK/1000 sq ft. Fertility in plots was maintained at 4 lb N/1000 sq ft per year. Plots were mowed weekly at a cutting height of 2.5 inches, and the clippings were returned. No fungicides were applied in any year. The experimental design was a randomized complete block with three replications. Plots were rated for the percentage plot area damaged by Pythium blight or Rhizoctonia brown patch.

RESULTS:

An epidemic of Pythium blight occurred in late July 1997 following a period of heavy rainfall, saturated soil, and high nighttime temperatures. None of the cultivars exhibited acceptable ($\leq$ 10%) levels of blighting, and most sustained damage to more than 40% of the plot area (Table 1). Although damage persisted for approximately 1 month after infection, all cultivars recovered completely by mid-September. This indicates that *P. aphanidermatum* was primarily damaging the leaves and not the shoots or roots of diseased plants. The summer of 1998 was hot and dry, and no disease was detected. A moderate outbreak of Rhizoctonia brown patch occurred in early July 1999. Blighting among cultivars ranged from 5-45% of the plot area. Several selections exhibited acceptable levels ($\leq$ 10%) of damage during the epidemic.

Table 1. Reactions of tall fescue cultivars to Pythium blight and brown patch.

Cultivar	% Plot Area Damaged Phythium Blight 1997	% Plot Area Damaged Brown Patch 1999
AA-983	73	16
ATF-020	67	14
ATF-038	67	6
ATF-188	73	23
ATF-192	73	23
ATF-196	67	23
ATF-253	53	10
ATF-257	73	9
AV-1	33	21
Alamo E	50	35
Anthem II	57	28
Apache II	43	8
Arabia	53	26
Arid 2	67	35
Aztec II	53	30
BAR FA 6D	47	6
BAR FA 6LV	53	15
BAR FA6 USF	60	11
BAR FA6 US1	50	14
BAR FA6 US2U	77	15
BAR FA6 US3	57	20
BAR FA6D USA	47	9
Bandana	73	13
Bonsai 2000	57	20
Bonsai	50	28
Bravo	60	16
CU9501T	60	12
CU9502T	43	10
Cochise II	63	23
Comstock	60	17
Coronado Gold	60	15
Coyote	67	17
Crossfire II	67	8
DLF-1	43	21
DP 50-9011	47	37
DP7952	57	25
Duster	70	18
EA 41	57	15
EC-101	60	23
Empress	60	27
Equinox	57	22
Falcon II	40	21
Finelawn Petite	40	22
Gazelle	97	21
Genesis	53	13

Table 1. Reactions of tall fescue cultivars to Pythium blight and brown patch.

Cultivar	% Plot Area Damaged Phythium Blight 1997	% Plot Area Damaged Brown Patch 1999
Good-EN	47	18
ISI-TF10	43	9
ISI-TF11	60	20
ISI-TF9	60	14
J-101	80	28
JSC-1	33	17
JTTFA-96	77	25
JTTFC-96	47	9
Jaguar 3	60	18
Kentucky 31	30	5
Kitty Hawk S.S.T.	33	20
Leprechaun	43	32
Lion	63	25
MB210	47	11
MB211	67	20
MB213	53	20
MB214	53	19
MB215	70	17
MB216	47	17
MB26	53	17
MB28	60	27
MB29	47	12
Marksman	50	30
Masterpiece	43	16
Millennium	70	20
Mustang II	80	23
OFI-931	37	20
OFI-951	73	45
OFI-96-31	50	30
OFI-96-32	50	23
OFI-FWY	50	31
Overtime Mix	37	8
PC-AO	57	18
PRO 8430	40	15
PSII-TF10	50	23
PSII-TF-9	60	20
PST-523	67	18
PST-5E5	43	5
PST-5M5	50	18
PST-5TO	50	8
Pick FA 15-92	67	30
Pick FA 20-92	53	20
Pick FA 6-91	43	23
Pick FA B-93	80	15

Table 1. Reactions of tall fescue cultivars to Pythium blight and brown patch.

Cultivar	% Plot Area Damaged Phythium Blight 1997	Brown Patch 1999
Pick FA N-93	63	28
Pick FA UT-93	80	18
Pick FA XK-985	63	22
Pick GA-96	87	12
Pick RT-95	57	23
Pixie E+	73	20
Plantation	87	17
R5AU	73	9
Rebel 2000	90	10
Rebel Sentry	67	12
Regiment	80	23
Rembrandt	77	17
Renegade	33	19
Reserve	60	14
SR 8210	57	23
SRX 8084	57	18
SRX 8500	70	23
Safari	40	-
Shenandoah	57	18
Shortstop II	20	20
Southern Choice	73	23
Sunpro	70	25
TA-7	67	11
Tar Heel	60	6
Titan 2	57	8
Tomahawk E	27	23
Tulsa	70	16
Twilight II	60	22
WPEZE	67	18
WRS2	53	10
WVPB-1B	43	19
WX3-275	47	17
Wolfpack	73	12
APS-2PTF	57	17
ZPS-5LZ	77	23
LSD 0.05	*32*	*17*

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 large patch of zoysiagrass.
PERSONNEL:	Ned Tisserat
SPONSORS:	Kansas Turfgrass Foundation, Heart of America Golf Course Superintendent's Association, Aventis, Zeneca, Bayer, Rohm & Haas

INTRODUCTION:

Rhizoctonia large patch of zoysiagrass is the most common disease on zoysiagrass fairways in Kansas. Symptoms develop in early to mid-September and continue until winter dormancy. The disease may reappear in spring as the zoysiagrass resumes growth. It can be suppressed by fungicide applications in early September. We report on the efficacy of various fungicides for control of this patch disease.

MATERIALS AND METHODS:

Fungicide plots were established on Meyer zoysiagrass fairways at the Highlands golf courses in Hutchinson, KS. Turfgrass was mowed at 0.5 inch, irrigated as needed, and fertilized with approximately 1.5 lb N/1000 sq ft annually. Thirteen fungicide treatments were applied on 29 September 1999 with a CO_2 backpack sprayer with 8003 TeeJet flat fan nozzles at 30 psi in water equivalent to 2.2 gal/1000 sq ft. Treatment plots were 10 X 12 ft and replicated four times in a randomized complete block design. Plots were not irrigated after fungicide applications. The percentage plot area diseased was recorded on April 24, 2000 after zoysiagrass resumed spring growth.

RESULTS:

No large patch was evident before or after fungicide application in the fall. However large patches were present in nontreated areas as zoysiagrass broke winter dormancy. This indicated that much of the infection occurred between fall dormancy and resumption of zoysiagrass growth in the spring. Applications of Heritage, Bayleton, RH 0753, Triton, and Prostar gave excellent control (< 5 % blighting) of large patch (Table 1). These results are consistent with previous experiments and indicate that a single fungicide application in fall is effective in suppressing large patch disease through the fall and winter dormancy. These fungicides also appeared to be suppressing further progression of the disease in mid- to late April. However, the development of small, active patches in these treatments indicated that an additional spring application may be required for disease suppression during late April and early May.

Table 1. Control of large patch disease of zoysiagrass by fall fungicide applications, Hutchinson, KS

Treatment and rate/1000 sq ft	% Plot Area Damaged
Heritage 50WP 0.4	0.0 a
RH 0753 2SC 0.5 fl oz	0.0 a
Bayleton 50DF 1 oz	0.5 a
Heritage 50WP 0.2 oz	0.5 a
RH 0753 2SC 0.25 fl oz	1.5 a
ProStar 70 WP 2.2 oz	1.5 a
Triton 1.67SC 0.5 fl oz	2.5 a
Triton 1.67SC 1.0 fl oz	3.3 ab
TADS 12529 70WG 8.5g	8.8 abc
TADS 12529 70WG 4.25g	14.5 bc
No fungicide	27.5 d

* Means not followed by the same letter are significantly different (*P*= 0.05) by FLSD.
Rated on April 24, 2000.

TITLE:	Preventive Fungicide Applications for Control of Brown Patch and Dollar Spot of Creeping Bentgrass
OBJECTIVE:	To evaluate the effectiveness of preventive fungicide applications for the control of dollar spot and brown patch on bentgrass
PERSONNEL:	Derek Settle, Jack Fry, and Ned Tisserat
SPONSORS:	Kansas Turfgrass Foundation, Heart of America Golf Course Superintendent's Association, Aventis, Zeneca, Novartis, Bayer, Rohm & Haas

INTRODUCTION:

Dollar spot, caused by the fungus *Sclerotinia homoeocarpa*, and brown patch, caused by *Rhizoctonia solani*, are the two most common diseases on creeping bentgrass putting greens in Kansas. These diseases usually are controlled by regularly scheduled preventive fungicide applications. In this study, we evaluated various fungicide combinations for their effectiveness in suppressing these diseases.

MATERIALS AND METHODS:

Fungicides were evaluated on an established stand of Cobra creeping bentgrass on a sand-based putting green at the Rocky Ford Turfgrass Research Center, Manhattan, KS. The turf was mowed to a height of 0.16 inch, irrigated as needed, and fertilized with 4 lb N/1000 sq ft annually. Applications were made at 2-wk or 4-wk intervals beginning on 7 May and continuing through August. Fungicides were applied with a CO_2-powered backpack sprayer with 8003 TeeJet nozzles at 20 psi in water equivalent to 2.7 gal/1000 sq ft. 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 week from 23 Jun through 12 August for the number of dollar spot infection centers and the percentage plot area damaged by brown patch

RESULTS:

Dollar spot developed in early June and continued throughout the summer. A single brown patch epidemic occurred in early August. All fungicide treatments except Daconil Ultrex at 14-day intervals reduced the area under the disease progress curve (AUDPC) for dollar spot compared to the nontreated control. All fungicides except Daconil Ultrex plus Bayleton reduced AUDPC for brown patch.

Table 1. Control of brown patch and dollar spot of creeping bentgrass by fungicides, Manhattan, KS, 1999.

	Spray Interval	Dollar Spot (number infection centers/plot)			Brown Patch (% plot area blighted)		
Treatment and Rate/1000 sq ft	days	23 Jun	6 Jul	AUDPC*	4 Aug	12 Aug	AUDPC
No fungicide	-	38.0 a	4.8 ab	1.97 a	30.0 a	60.0 a	1.76 a
Chipco 26 GT 2SC 4 fl oz	14	0.0 b	0.0 c	0.71 cde	1.3 c	8.3 c	0.56 cd
Daconil Ultrex 82.5DG 3.8 oz	14	3.0 b	7.5 a	1.47 ab	2.5 c	28.8 b	1.00 bc
Daconil Ultrex 82.5DG 1.6 oz plus Bayleton 50 DF 0.25 oz	14	0.0 b	0.0 c	0.19 e	2.0 c	50.0 a	1.40 ab
Compass 50WG 0.1 oz plus Banner MAXX 1.2MEC 0.5 fl oz	14	0.3 b	0.0 c	0.76 cde	3.8 c	0.0 c	0.45 cd
Compass 50WG 0.15 oz plus Banner MAXX 1.2MEC 0.5 fl oz	14	0.0 b	0.3 c	0.34 de	2.5 c	0.0 c	0.26 d
Eagle 40WP 0.6 oz plus RH 0753 2SC 0.12 fl oz	28	0.0 b	1.3 bc	0.32 de	0.8 c	8.0 c	0.63 cd
Eagle 40WP 0.6 oz plus RH0753 2SC 0.25 fl oz	28	8.3 b	1.0 c	1.00 bc	12.0 b	6.5 c	1.10 bc
Eagle 40WP 0.6 oz plus RH 0753 2SC 0.5 fl oz	28	2.0 b	1.3 bc	0.52 cde	3.8 c	0.0 c	0.46 cd
Bayleton 50DF 0.5 oz plus ProStar 70WP 2.2 oz	28	0.3 b	1.3 bc	0.66 cde	0.0 c	3.7 c	0.23 d
Bayleton 50DF 0.5 oz plus ProStar 70WP 1.5 oz	28	0.0 b	1.5 bc	0.83 cd	1.3 c	1.8 c	0.24 d
Bayleton 50DF 0.5 oz plus Heritage 50DG 0.3 oz	28	0.8 b	0.8 c	0.89 bcd	0.0 c	0.0 c	0.0 d

*Area under disease progress curves (AUPDC) from 23 June through 12 August. Values for both dollar spot and brown patch were log (X+ 1) transformed prior to analysis and back-transformed for presentation. Means not followed by the same letter are significantly different (*P* ˜0.05) by Fisher's LSD

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TITLE: Distribution of *Cylocephala* spp. in Kansas

OBJECTIVE: To determine the numbers and distribution of *Cyclocephala* species occurring in Kansas

PERSONNEL: Bob Bauernfeind

SPONSOR: Kansas Turfgrass Foundation

INTRODUCTION:

Annual white grubs (the larval stages of *Cyclocephala* spp. beetles) are the major pests of turfgrass in much of the Midwest. Grubs develop underground, primarily feeding on grass roots. Substantial root damage can result in decreased vigor and eventual death of grass plants. Whereas *Cyclocephala* species determinations have been cited for various states, records on *Cyclocephala* sp. for Kansas were lacking. A 4-year trapping project was undertaken for the purpose of defining the makeup of *Cyclocephala* populations in Kansas.

METHODS AND MATERIALS:

Blacklight trapping sites and numbers of years in the *Cyclocephala* spp. monitoring project were: Abilene (1); Ellinwood (1); Garden City (4); Great Bend (3); Hutchinson (1); Independence (4); Kansas City (2); Liberal (3); Manhattan - Rocky Ford Turf Research Center (4), Manhattan Country Club (4), Londondery Drive residence (4), Colbert Hills Golf Club (3); Mankato (3); Medicine Lodge (1); Oakley (4); Oberlin (4); and Wichita - John Pair Horticultural Research Center(4), and Koch Industries (2).

Gempler's™ 15 watt blacklight traps powered by a 110 volt AC system were used at the Garden City and the Manhattan Londondery sites, and a 15-watt blacklight trap equipped with a photocell and powered by a 12 volt DC system was used at the Manhattan Colbert Hills location. At all other sites, DeJay Corporation Stinger® Electronic Insect Control - Model UV40 units were modified to serve as blacklight traps. Wires providing energy to electrifying grids were detached and capped. Two 6.35 cm S-hooks were used to attach a #58 mechanic's funnel to the bottom of the housing units protecting the blacklight bulbs. Nine-tenth's kg coffee cans were attached to the bottoms of the collecting funnels.

Seasonal trapping activities began on May 1, well in advance of the appearance of *Cyclocephala* spp., and were terminated after the evening of July 31, a time well past the main flight period of the beetles. Trap catches (mostly collected on a daily basis) were emptied into sealable plastic sacks, which were labeled with dates and collection site designations. Samples were frozen until such time that they could be collected.

After samples had thawed, individual *Cyclocephala* were removed, washed and dried if necessary, and counted. Next, beetles were separated by sex and species. When beetle numbers exceeded 500 per trapping night, beetles in five subsets (each containing 100 randomly selected individuals) were sexed and identified. Final characterization of those large samples then was based on extrapolations utilizing the averages determined for the subset counts. *Cyclocephala* species identifications were based on various characters outlined in several sources.

RESULTS:

From 1996 - 1999, 232,016 *Cyclocephala* spp. were collected from 18 various trapping sites throughout Kansas. Of that total, 169,056 specimens were individually examined, sexed, and identified to species. Identifications of the remaining 62,990 were extrapolated from subsets of 100 each as described above.

Six species of *Cyclocephala* were identified as occurring in Kansas: *C. borealis* Arrow, *C. hirta* LeConte, *C. longula* LeConte, *C. lurida* Bland, *C. melanocephala* (Fabricius) and *C. pasadenae* (Casey). Numbers collected were: 584; 429; 2,219; 93,799; 1; and 132,915, respectively.

Distribution

C. pasadenae - Although essentially occurring throughout Kansas, *C. pasadenae* is a more western species given its prevalence at: Oberlin - 99.2% of 12,550; Oakley - 99.975% of 39,929: Garden City - 98.6% of 45,723; and Liberal - 91.4% of 8,357, as compared to the lowest percentages at the most eastern sites: Kansas City - 0% of 2,007; Independence - 6.6% of 5,855; Manhattan Colbert Hills - 8.0% of 11,463; Manhattan Rocky Ford - 18.3% of 32,074; Manhattan Country Club - 6.8% of 8,651; Manhattan Londondery Drive - 9.6% of 18,839; Abilene - 6.0 of 651; Wichita Koch Industries 8.2% of 1,467; and Wichita John Pair Horticultural Research Center - 25.3% of 8,735. *C. pasadenae* populations were intermediate at more centrally located sites: Hutchinson - 28.9% of 2,585; Mankato - 39.4% of 10,776; Great Bend - 48.4% of 5,522; Ellinwood - 52.4% of 6,664; and Medicine Lodge - 58.4% of 8,109.

C. lurida - *C. lurida* also occurred throughout Kansas but could be considered the eastern counterpart to *C. pasadenae* based upon its prevalence at Kansas City - 100% of 2,007; Independence - 85.8% of 5,855; Manhattan Country Club - 93.0% of 8,651; Colbert Hills - 91.5% of 11,463; Manhattan Londondery Drive - 90.3% of 18,839; Manhattan Rocky Ford - 81.5% of 32,074l; Wichita Koch Industries - 91.7% of 1,467; Wichita John Pair Horticultural Research Center - 65.2% of 8,735; and Mankato - 60.6% of 10,776, as compared to the lowest percentages at Oakley - 0% of 139,929; Oberlin - 0.8 % of 12,550; Garden City - 1.3% of 45,723; and Liberal - 6.4% of 8,357. As with *C. pasadenae*, *C. lurida* populations were more comparable at the more centrally located trapping sites at Great Bend - 50.0 % of 5,522; Ellinwood - 46.2 % of 6,664; Hutchinson - 41.1% of 2,585; and Medicine Lodge - 33.9% of 8,109.

C. longula - Although *C. longula* was recovered from 9 of the 18 trapping sites, it definitely was most highly concentrated in southcentral Kansas: Hutchinson - 15.1% of 2,585; Wichita John Pair Horticultural Research Center - 9.3% of 8,735; and Medicine Lodge - 7.6% of 8,109. Notable numbers also were recovered at Liberal - 2.3% of 8,357; Great Bend - 1.6% of 5,522; and Ellinwood - 1.4% of 6,664. *C. longula* recovered at Abilene, Oakley and Garden City were single year catches (4 in 1997, 8 in 1997, and 17 in 1999.

C. borealis - This was the fourth most abundant species and was collected from 7 of the 18 trapping sites. It was collected every year at the Independence and four Manhattan area trap sites. The highest populations of *C. borealis* were consistently at Independence (449 of the 584 specimens trapped over the course of the study). Of the 135 remaining specimens, 131 were recovered from the four Manhattan area trapping sites (57, 49, 14, and 11 from Colbert Hills, Rocky Ford, Londondery residence, and Manhattan Country Club, respectively). Two specimens each were trapped in 1998 and 1999 at Wichita Koch Industries and Garden City, respectively.

C. hirta - This species appeared in traps only in 1999. Of the 439 collected specimens, 418 were recorded from three south-central trapping sites: 386 at Hutchinson, 19 at Wichita John Pair Horticultural Center, and 13 at Wichita Koch Industries. The remaining 21 were captured at Garden City.

C. melanocephala - A single specimen was taken at Wichita John Pair Horticultural Center during the 1999 trapping season.

DISCUSSION:

Cyclocephala spp. were found to be diverse and abundant in Kansas. Four species were trapped on a yearly basis from 1996 to1999. Two species were recorded only in 1999. Based on numbers of individuals retrieved from blacklight traps, five species could be considered established in Kansas. The lone *C. melanocephala* (a species listed as being common in the southern United States and south to Argentina) may have been an errant specimen in Kansas.

Cyclocephala species have varied distribution patterns in Kansas. *C. pasadenae* is definitely a western species given its prevalence at the four most western trapping sites, whereas *C. lurida* is decidedly an eastern species given its dominance in eastern trap catches. With the exception of incidental catches at Garden City, Oakley, and Abilene and more substantial catches at Liberal, Great Bend, and Ellinwood, 82% of *C. longula* were concentrated most heavily in a pocket of south-central county trapping sites (Wichita John Pair Horticultural Research Center, Medicine Lodge, and Hutchinson). Given its prevalence at Hutchinson and appearances at both Wichita sites, as well as Garden City, *C. hirta* may have a range similar to *C. longula* . Although *C. borealis* was recovered at various sites, it was trapped consistently in higher numbers only at the Independence location.

Knowing the species distribution of *Cyclocephala* in Kansas may be of more academic interest then practical value at this time. The larvae of all species likely have similar development rates and feeding habits. However, further scrutinization of the data collected over the trapping project may provide more usable applications. Flight patterns for all species look to be similar. But flight patterns differ depending on the year and location in Kansas. Perhaps applying weather data from the various locations may help elucidate flight patterns as well as their intensities. Differences in sex ratios existed among the different trapped species. Perhaps this might have some bearing on widespread or narrow-range occurrences of grub problems. The data will be analyzed to provide additional useful information.

TITLE: Evaluation of Improved Kentucky Bluegrass Cultivars Maintained at Two Fairway Heights

OBJECTIVE: To identify acceptable Kentucky bluegrass cultivars for fairway use in the upper transition zone, with specific attention to quality, density, and summer patch resistance

PERSONNEL: Robb Kraft and Steve Keeley

SPONSOR: Kansas Turfgrass Foundation

INTRODUCTION:

Kentucky bluegrass once was used widely for upper transition zone fairways but has declined in popularity because of its inability to withstand the lower mowing heights preferred by today's golfers. Perennial ryegrass, with its tolerance to low mowing heights and fast establishment rates, largely has replaced Kentucky bluegrass for cool-season fairways in this region. However, perennial ryegrass must be overseeded annually and is susceptible to a number of diseases, including gray leaf spot, brown patch, and Pythium blight. Gray leaf spot, in particular, has caused widespread loss of perennial ryegrass fairways in recent years. However, bluegrass breeders recently have focused efforts on improving performance at low mowing heights. Many new cultivars have been released from these efforts. Besides overall quality and density at these low heights, susceptibility to summer patch disease is of great concern. If cultivars of Kentucky bluegrass can be found that exhibit both high performance at fairway heights and summer patch resistance, the species would once again become a viable option for upper transition zone fairways. Other attributes that favor Kentucky bluegrass include its superior cold tolerance, mowing quality, and recuperative capacity. This study is designed to evaluate performance (i.e, quality, density, and summer patch resistance) of promising Kentucky bluegrass cultivars at two low mowing heights in comparison with older "standards" and perennial ryegrass.

MATERIALS AND METHODS:

The study consists of three replicates of 16 treatments. The treatments include a perennial ryegrass check; 12 monostands of Kentucky bluegrass; and three Kentucky bluegrass blends (compact types: Midnight+Blacksburg+Unique, aggressive types: Limousine+ Touchdown, and compact plus aggressive types).

The Kentucky bluegrass cultivars were chosen based on performance in the NTEP Kentucky bluegrass trial located at the Rocky Ford Turfgrass Research Center, Manhattan, KS with mowing at 9/16 inch. Apollo, Arcadia, Award, Northstar, and Odyssey are all products of the recent low-mow breeding programs. Blacksburg, Midnight, and Unique are somewhat older, but performed well in the initial NTEP evaluations. Baron, Limousine, Touchdown, and Park were included as standards. Limousine and Touchdown are both aggressive-type cultivars that frequently are recommended for fairways. Baron is a widely used cultivar but would not be expected to do well at fairway heights. Park was included because it appears to be relatively susceptible to summer patch disease, and therefore, should give us an indication of the summer patch pressure present in the study.

The study was seeded in the fall of 1997, and plots were inoculated with the summer patch causal organism in April 1999. Each treatment consists of two 5 ft x 5 ft subplots: one maintained at 7/8 inch and one maintained at 9/16 inch. Traffic was simulated with the use of a smooth power roller. The study was rolled with 12 passes a week – this is equivalent to a 200-pound person walking over the same area 11 times a week. Data collection included periodic shoot counts to determine tiller density, disease ratings, and overall visual quality ratings.

RESULTS:

The results are best interpreted by comparison with the ryegrass check. The perennial ryegrass performance was typical of well-maintained ryegrass fairways in the region. The Kentucky bluegrass cultivars that showed the most promise were Unique and Apollo, followed by Award and the two blends containing the compact types. The treatment rankings were essentially the same under the two mowing heights (i.e., there was no significant interaction between cultivar and mowing height). Therefore, Table 1 shows the mean quality ratings for both different mowing heights. However, an inspection of the data did indicate that the older cultivars, Baron and Park, experienced a more drastic reduction in quality when the mowing height was reduced from 7/8 to 9/16 inch (data not shown).

Summer patch resistance could not be evaluated in 1999 because of the slow establishment of the inoculum. This was not unexpected, and we hope to see more summer patch occurring in 2000 as a result of the inoculations.

Additional projects related to this study include investigating ways to successfully introduce Kentucky bluegrass into an existing perennial ryegrass fairway and evaluating Prograss (ethofumesate) tolerance of Kentucky bluegrass cultivars.

Table 1. Mean quality ratings* for improved cultivars of Kentucky bluegrass maintained at fairway heights at Manhattan, KS, 1999.

Cultivar	6/11	6/18	7/2	7/9	7/23	7/30	8/13	8/20	8/27	9/3	9/15	Overall Mean
Unique	5.5	5.2	5.5	5.2	5.2	4.0	5.0	4.5	4.5	4.3	5.3	4.9
Appolo	5.5	5.3	4.8	5.0	5.3	4.5	4.2	4.2	4.2	3.8	4.2	4.6
Compact + Aggressive KB blend**	5.5	4.5	5.0	4.3	4.5	4.2	4.0	3.8	3.7	4.0	4.7	4.4
Compact KB blend	5.2	4.7	4.5	4.5	4.5	3.8	4.3	4.2	4.5	3.8	3.8	4.3
Award	4.8	4.7	4.5	4.5	4.2	3.7	4.0	4.2	4.2	4.2	4.2	4.3
Odyssey	4.5	3.8	4.3	3.8	4.0	3.8	4.2	4.0	4.2	3.7	4.3	4.1
Blacksburg	4.0	4.2	4.7	4.7	4.0	3.2	4.0	4.0	4.0	3.5	4.2	4.0
Perennial Ryegrass blend5.5	4.3	4.3	3.5	4.0	3.2	4.0	3.3	3.7	3.3	4.8	4.0	
Midnight	4.5	4.2	4.3	4.5	4.2	3.7	3.5	3.8	3.7	3.7	4.0	4.0
Arcadia	4.2	3.7	4.7	4.2	3.8	3.5	3.7	3.8	3.8	3.7	4.2	3.9
Limousine	4.7	4.5	4.0	4.2	3.8	3.3	3.8	3.5	3.7	3.3	4.0	3.9
Aggressive KB blend	4.3	4.3	4.5	4.3	4.0	3.3	4.0	3.0	3.5	3.2	3.8	3.8
Baron	4.0	3.7	4.3	3.5	3.0	2.7	3.3	3.3	3.5	3.5	4.0	3.5
Touchdown	3.8	3.5	3.8	3.5	3.2	2.8	3.2	3.0	3.0	3.3	3.8	3.4
Park	4.0	3.5	4.3	3.5	2.8	2.8	3.2	2.7	2.8	2.7	3.2	3.2
Northstar	3.5	2.8	3.0	3.0	3.0	2.7	3.0	3.0	3.0	3.0	3.3	3.0
LSD (0.05)												*0.2*

*Quality was rated on a scale of 1-9; 1 = dead, 9 = optimum quality and uniformity.

**Compact blend: Midnight + Blacksburg + Unique
Aggressive KB blend: Limousine + Touchdown

TITLE: Effects of Sulfur Applications on Creeping Bentgrass Quality and Soil pH

OBJECTIVE: To evaluate sulfur application rates and timing for influence on creeping bentgrass quality and soil pH

PERSONNEL: Joon Lee, Jack Fry, and Steve Keeley

SPONSOR: Kansas Turfgrass Foundation

INTRODUCTION:

Sulfur is an essential plant nutrient but is applied most commonly by golf course superintendents to reduce soil pH. Sulfur burn to bentgrass greens has been reported. Often, phytotoxicity is not evident until weeks or months after application. The sand used to construct putting greens is often calcareous (i.e., inherently high in lime content). On these calcareous greens, attempts to reduce soil pH may be futile, because an unrealistic amount of sulfur would be required to neutralize the buffering effects of the lime.

MATERIALS AND METHODS:

This study was initiated in September, 1998 on a sand-based golf green at the Rocky Ford Turfgrass Research Center in Manhattan, KS. Established Penncross creeping bentgrass was growing on a rootzone mix comprised of 84% sand, 14% silt, and 2% clay. Soil pH was 7.7, and Ca content was approximately 1.5% (1500 ppm). Turf was mowed at 5/32 inches and irrigated to prevent stress. The plot area received 12 passes with a flat roller weekly to apply 1.1 kg/sq cm static pressure to simulate foot traffic over the plots.

Sulfur was applied at 2.5, 5, 10, or 20 lbs/1,000 sq ft/yr applied once or split into two or five applications through the year. An ammonium sulfate treatment also was included and was applied in April, May, September, and October at 1.0 lbs N/1,000 sq ft and in June and July at 0.5 lbs N/1,000 sq ft. An nonsulfur-treated plot also was included that received methylene urea at the same rates as described for ammonium sulfate. All plots except ammonium sulfate-treated turf also received the same application of methylene urea. Data were collected on turf quality, phytotoxicity, and soil pH. Turf quality was rated on a 0 to 9 scale, where 9 = optimum quality, 7 = acceptable quality for a putting green, and 0 = dead turf. Phytotoxity was rated on a similar scale, where 9 = no signs of sulfur burn, and 0 = complete browning of plants. Three or four cores 1 inch in diameter by 4 inches deep were taken in July, 1999 to determine sulfur application effects on soil pH.

RESULTS:

Only sulfur applied at 20 lbs/1,000 sq ft/yr caused a reduction in quality or increase in phytotoxicity compared to all other treatments. Phytotoxicity was greater in June in turf that received a single 20-lb sulfur application in October. In July, quality was lower in turf that received a single 20-lb sulfur appplication in October. Phytotoxicity was greater in July in turf receiving a single 20-lb October application and that receiving 10 lbs in April and 10 lbs in October. Sulfur application had no effect on soil pH when samples were collected in September, 1999. Sampling of areas in the 20 lb October treatment that exhibited turf injury indicated that pH in these isolated areas was very low (<5). Reasons for irregularity in pH change within these plots are unknown.

Results after 1 year of study indicate that moderate sulfur application rates (2.5, 5, or 10 lbs/1,000 sq ft/yr) to this calcareous research green had no phytotoxic effects and also had no effect on turf quality or soil pH. This study will continue in 2000.

Table 1. Penncross creeping bentgrass quality, phytotoxicity, and soil pH as affected by sulfur application rates and dates.

Application Rate (lbs S/1,000 sq ft yr)	Rate Split Equally over:	Turf Quality* July	Phytotoxicity** June	Phytotoxicity** July	Soil pH***
2.5	October	7.0 a	9.0 a	9.0 a	7.9
	April, October	7.0 a	9.0 a	9.0 a	7.9
	April, May, Sept., Oct, Nov	6.7 a	9.0 a	9.0 a	7.9
5.0	October	7.0 a	9.0 a	9.0 a	7.8
	April, October	7.3 a	9.0 a	9.0 a	7.9
	April, May, Sept., Oct., Nov.	7.0 a	9.0 a	9.0 a	7.8
10.0	October	6.7 a	9.0 a	8.3 ab	7.8
	April, October	7.0 a	9.0 a	9.0 a	7.9
	April, May, Sept., Oct., Nov.	7.0 a	9.0 a	9.0 a	7.7
20.0	October	4.0 b	6.7 b	4.3 c	7.8
	April, October	6.0 a	8.0 a	7.7 b	7.8
	April, May, Sept., Oct., Nov.	6.7 a	8.7 a	8.7 ab	7.8
Ammonium sulfate****		7.3 a	9.0 a	9.0 a	7.9
Nutralene		6.0 a	9.0 a	9.0 a	7.9

*Turf quality was rated visually on a 0 to 9 scale, where 0 = dead turf, 7 = acceptable putting green quality, and 9 = optimum color and density. Means in columns followed by the same letter are significantly different (P<0.05).

**Phytotoxicity rated visually on a 0 to 9 scale, 9 = no phytotoxicity.

***Soil was sampled to a 4-inch depth in September, 1999. Values are not significantly different.

****Ammonium sulfate applied at 5 lbs N/1,000sq ft/yr - 1 lb in April, May, Sept., and Oct; 0.5 lbs each in June and July.

TITLE: Factors Affecting Establishment of Seeded Zoysiagrass in Perennial Ryegrass

OBJECTIVE: To evaluate practical cultural approaches for converting a ryegrass fairway to zoysiagrass

PERSONNEL: Alan Zuk and Jack Fry

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

INTRODUCTION:

Perennial ryegrass is used widely on golf courses throughout the transition zone of the United States. However, the cost of maintaining perennial ryegrass in the transition zone, in particular, has become uneconomical for many golf courses because of high water costs and multiple fungicide applications.

Seeded zoysiagrass would be of great use to transition zone superintendents, if ryegrass fairways and tees could be converted without closing the golf course. This would require that pre- and postplant management of the competing ryegrass allowed for successful germination, development, and spread of the maturing zoysiagrass stand.

Several factors, such as competition for water, nutrients, and sunlight, may impair the successful conversion of ryegrass to seeded zoysiagrass. If a cold-hardy, seeded zoysiagrass cultivar could withstand this competition during establishment, golf course superintendents could convert their cool-season fairways and tees with significantly less time, effort, and expense.

MATERIALS AND METHODS:

On June 18, 1999, Zenith zoysiagrass was seeded at 1 lb/1000 sq ft in 4 x 8 ft plots arranged in a split-plot, randomized, complete-block design. The following treatments were applied to individual plots with three replications: Roundup (3 qts/a); Primo (1.5 qts/a); Embark (2.5qts/a; scalping at 0.25 in (scalping continued until zoysia grew to a height of 0.25 inches); Primo + scalping; and untreated. Prior to seeding, the entire area was core-aerified and verticut to open up the ryegrass and encourage seed-to-soil contact. The seed was kept moist by watering for 15 minutes, two to three times per day. After germination, watering frequency was reduced to one time per day for 30 minutes.

A trafficking treatment was included to simulate the effects of wear and soil compaction over the treated areas during the establishment phase. Trafficked treatments were rolled 12 times per week with a smooth power roller that exerted 1.1 kg/sq cm of static pressure.

Seedlings were counted by randomly tossing a 10 x 10 cm grid on each plot three times, counting seedlings in the grid, and then averaging the three sums. The final seedling count was taken in November, when the dormant zoysiagrass seedlings were easier to count.

RESULTS:

Percent Coverage: The treatment with the highest percentage of zoysiagrass coverage by the end of the first season was Roundup/no traffic (75%), followed by Roundup/traffic with 23% coverage. Of the treatments where zoysiagrass was seeded into an existing ryegrass canopy, Primo and scalped/no traffic showed the highest percentage of coverage (11.6%). In each instance, the trafficked treatments yielded a lower percent coverage than the nontrafficked treatments.

Seedling Count: Without competition from an existing turf canopy, the Roundup/no traffic treatment yielded the highest results with 10 seedlings per 100 sq cm area. Of the treatments where zoysiagrass was seeded into an existing ryegrass canopy, the scalped/no traffic treatment had the highest average seedling count with 3.6 per 100 sq cm followed by Primo and scalped with 3.1 seedlings per 100 sq cm and Roundup/traffic with 2.8 seedlings per 100 sq cm.

Quality: Plots were rated from the perspective of what a golfer may see if the fairway was open during the establishment phase. Overall quality was rated on a 0-9 scale regardless of the species of grass growing in the plot. As expected, plots treated with Roundup exhibited the lowest quality ratings during June and July. The control, Primo, and Embark/no traffic treatments showed the highest quality ratings from July through September (not shown).

TITLE: Irrigation Management to Improve Heat Stress Tolerance of Kentucky Bluegrass.

OBJECTIVE: To investigate the effects of drought preconditioning on photosynthesis and water relations associated with subsequent heat tolerance in Kentucky bluegrass

PERSONNEL: Yiwei Jiang and Bingru Huang

SPONSORS: Kansas Turfgrass Foundation

INTRODUCTION:

Heat stress is a major factor limiting cool-season grass growth. It often is associated with water stress. Whether plant tolerance to high temperature during summer could be improved by prior exposure of plants to water stress (drought preconditioning) induced through infrequent irrigation when temperature is cool during spring is not well understood. Such information would help to improve summer performance of cool-season turfgrasses by developing efficient irrigation management practices and, in the meantime, reduce water use.

MATERIALS AND METHODS:

Sod pieces of Kentucky bluegrass (cv. Mystic) were grown in polyvinylchloride tubes in the greenhouse at Kansas State University. Plants were grown at 20/20 C (day/night temperatures) and allowed to dry down for about 14 d when leaf wilting occurred and then watered to allow turf quality to recover fully. Plants were exposed to two drying-rewatering cycles before being exposed to heat stress at 35°C/30°C (day/night) in growth chambers. Non-preconditioned plants were well watered.

Turf quality (TQ), canopy photosynthetic rate (Pn), leaf relative water content (RWC), root dry weight, and soluble carbohydrate content were measured.

RESULTS:

During heat stress, plants previously exposed to moderate water stress or irrigated infrequently (preconditioned) were able to maintain higher turf quality than those that were frequently and well watered (Fig.1). Higher Pn also was observed in preconditioned plants (Fig.2) starting at 9 d of heat stress.

Preconditioned plants developed deeper, more extensive root systems (Fig. 3), accumulated more soluble carbohydrates (Fig. 4), and thus, maintained higher relative water content than non-preconditioned plants (Fig. 5).

The results suggest that infrequent or deficit irrigation that induces mild drought stress would enhance plant tolerance to subsequent heat stress and reduce water use during summer.

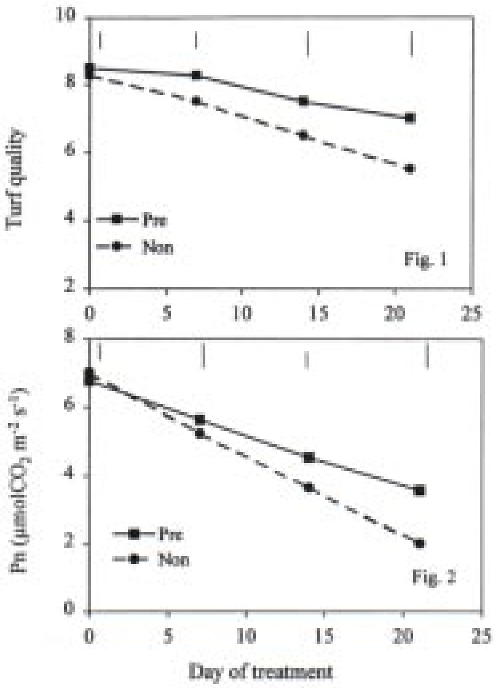

Fig.1.Turf quality and Fig.2. canopy photosynthetic rate (Pn) as affected by heat stress in drought-preconditioned (pre) and non-preconditioned (non) Kentucky bluegrass. Vertical bars indicate LSD values ($p=0.05$) for treatment comparison at a given day of treatment.

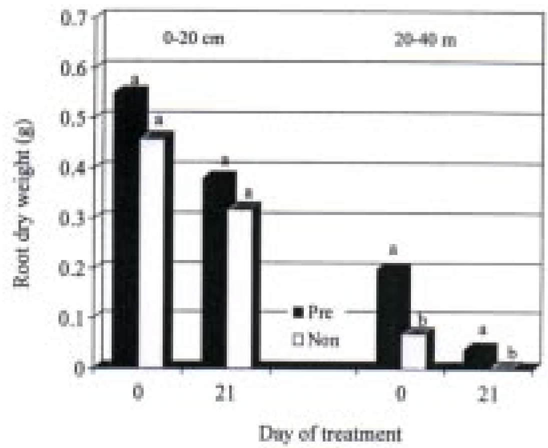

Fig. 3. Root dry weight at 0-20 and 20-40 cm soil depths as affected by heat stress in drought-preconditioned (pre) and non-preconditioned (non) Kentucky bluegrass. Columns at a given soil depth marked with the same letters are not significantly different based on LSD test ($p=0.05$).

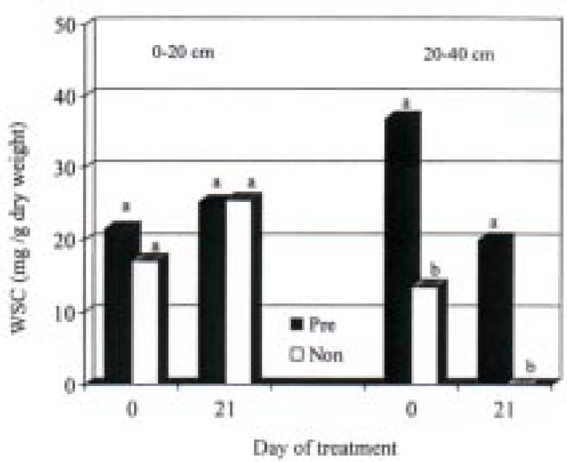

Fig. 4. Root water soluble carbohydrate (WSC) at 0-20 and 20-40 cm soil depths as affected by heat stress in drought-preconditioned (pre) and non-preconditioned (non) Kentucky bluegrass. Columns at a given soil depth marked with the same letters are not significantly different based on LSD test ($p=0.05$).

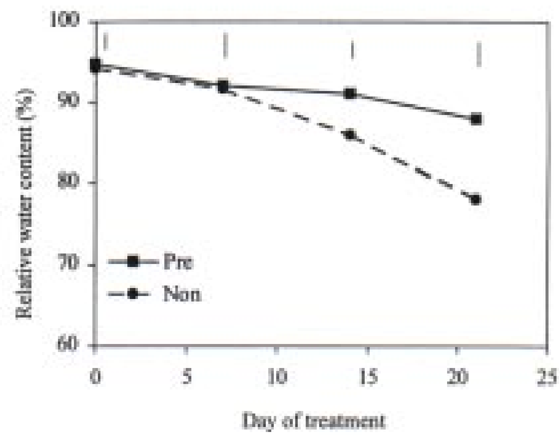

Fig. 5. Leaf relative water content as affected by heat stress in drought-preconditioned (pre) and non-preconditioned (non) Kentucky bluegrass. Vertical bars indicate LSD values ($p=0.05$) for treatment comparison at a given day of treatment.

TITLE: Seasonal Changes in Shoot and Root Growth and Carbohydrate Metabolism of Creeping Bentgrass

OBJECTIVE: To determine physiological factors associated with summer bentgrass decline

PERSONNEL: Qingzhang Xu, Bingru Huang, and Jack Fry

SPONSORS: United States Golf Association and Kansas Turfgrass Foundation

INTRODUCTION:

Growth chamber experiments have demonstrated that turf quality decline under high temperature conditions is related to inhibition of root growth, reduction of photosynthesis, and carbohydrate starvation in creeping bentgrass. However, seasonal changes of root growth and carbohydrate metabolism have not been studied under field conditions.

MATERIALS AND METHODS:

The experiment was carried out on a USGA-spec putting green at the Rocky Ford Turfgrass Research Center, Manhattan, KS, in 1999. Creeping bentgrass cultivars, L-93 and Penncross, were mowed at 5/32 and 1/8 inch.

Turf quality was rated visually based on color, uniformity, and density on a 0 to 9 scale. Shoot and root samples were dried in an oven at 75 C to analyze for content of total nonstructural carbohydrate (TNC). Root dehydrogenase activity was measured with the TTC reduction method. Carbon allocation to roots was determined using a ^{14}C labeling technique.

RESULTS:

Daily air maximum temperatures reached 30 C or higher on many days during July and August (Fig. 1), when turf quality for both L-93 and Penncross declined (Fig. 2). Turf quality recovered in October. L-93 had better turf quality than Penncross, particularly in midsummer.

Root dry weight for both cultivars decreased during summer (Fig. 3). L-93 maintained greater root dry weight than Penncross. Raising mowing height from 1/8 inch to 5/32 inch increased root dry weight for both cultivars, particularly in during summer months. Root activity also decreased in midsummer (Fig. 4). No significant difference in root dehydrogenase activity was found between the two cultivars or between the two mowing treatments.

Carbohydrate contents in shoots and roots decreased during summer for both cultivars and then increased in October (Figs. 5 and 6). L-93 had higher TNC content than Penncross. The highest TNC content was found just before the winter. Raising mowing from 1/8 to 5/32 inch increased TNC content for both cultivars.

Carbon allocation to roots was inhibited during summer for both cultivars (Fig. 7). L-93 had greater carbon allocation to roots than Penncross. Raising mowing height from 1/8 inch to 5/32 inch increased carbon allocation to roots.

In conclusion, summer bentgrass decline was related to the reduction of root growth, carbohydrate content in shoots and roots, and carbon allocation to roots. L-93 had better turf quality, a bigger root system, higher TNC content, and greater carbon allocation to roots than Penncross.

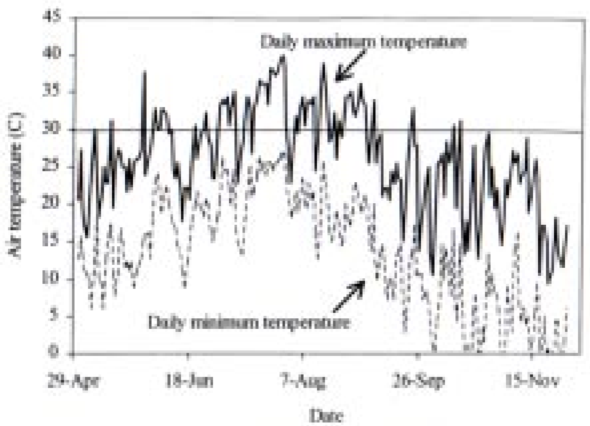

Fig. 1. Seasonal changes of daily maximum and minimum air temperatures.

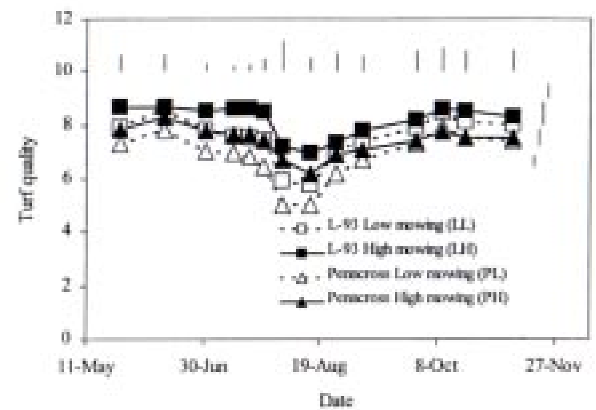

Fig. 2. Seasonal changes in turf quality of L-93 and Penncross under high (5/32 inch) and low (1/8 inch) mowing. Vertical bars on the top indicate LSDs (P=0.05) for cultivar and mowing comparison at a given day; vertical bars on the right indicate LSDs (P=0.05) for time comparison of a given mowing height for a given cultivar.

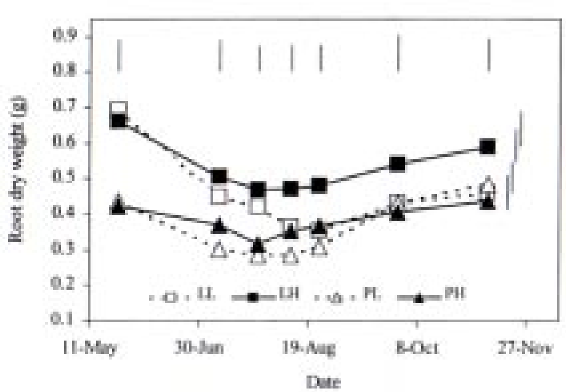

Fig. 3. Seasonal changes in root dry weight of L-93 and Penncross under high (5/32 inch) and low (1/8 inch) mowing. Vertical bars on the top indicate LSDs (P=0.05) for cultivar and mowing comparison at a given day; vertical bars on the right indicate LSDs (P=0.05) for time comparison for a given mowing height of a cultivar. Treatment symbols are the same as in Fig. 2.

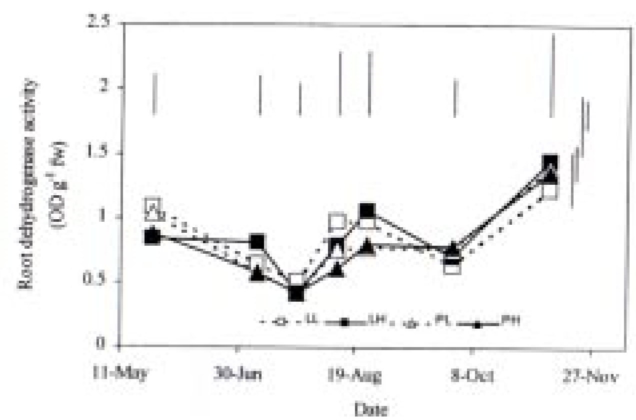

Fig. 4. Seasonal changes in root dehydrogenase activity of L-93 and Penncross under high (5/32 inch) and low (1/8 inch) mowing. Vertical bars on the top indicate LSDs (P=0.05) for cultivar and mowing comparison at a given day; vertical bars on the right indicate LSDs (P=0.05) for time comparison for a given mowing height of a cultivar. Treatment symbols are the same as in Fig. 2.

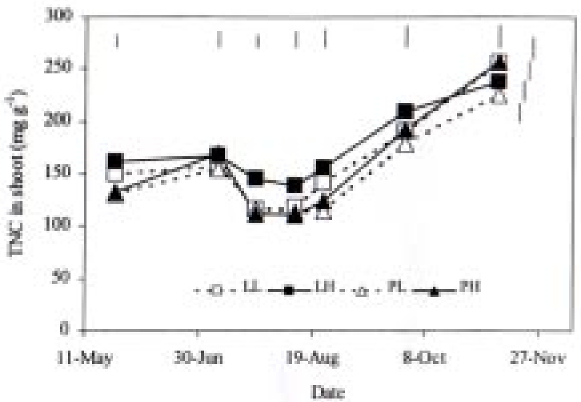

Fig. 5. Seasonal changes in total nonstructural carbohydrate (TNC) content in shoots of L-93 and Penncross under high (5/32 inch) and low (1/8 inch) mowing. Vertical bars on the top indicate LSDs (P=0.05) for cultivar and mowing comparison at a given day; vertical bars on the right indicate LSDs (P=0.05) for time comparison for a given mowing height of a cultivar. Treatment symbols are the same as in Fig. 2.

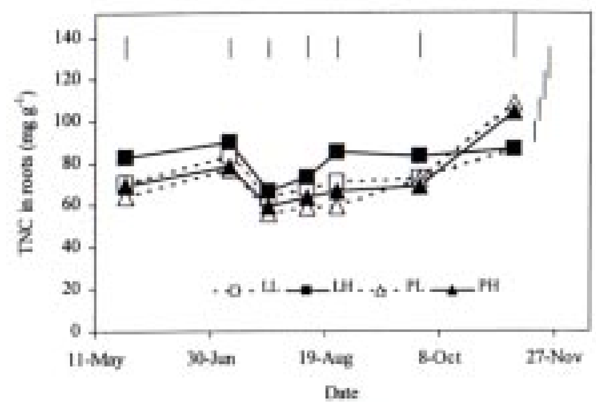

Fig. 6. Seasonal changes in total nonstructural carbohydrate (TNC) content in roots of L-93 and Penncross under high (5/32 inch) and low (1/8 inch) mowing. Vertical bars on the top indicate LSDs (P=0.05) for cultivar and mowing comparison at a given day; vertical bars on the right indicate LSDs (P=0.05) for time comparison for a given mowing height of a cultivar. Treatment symbols are the same as in Fig. 2.

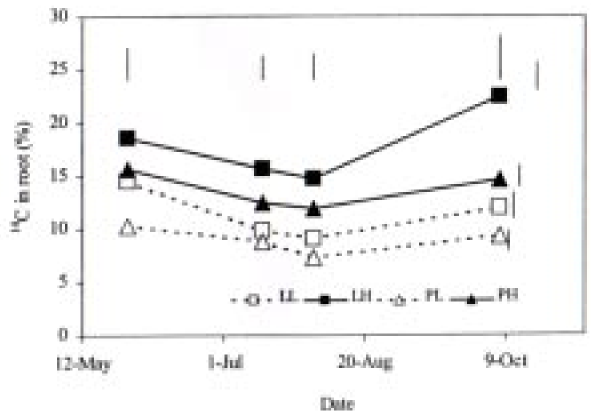

Fig. 7. Seasonal changes in ^{14}C allocation to roots of L-93 and Penncross under high (5/32 inch) and low (1/8 inch) mowing. Vertical bars on the top indicate LSDs (P=0.05) for cultivar and mowing comparison at a given day; vertical bars on the right indicte LSDs (P=0.05) for time comparison for a given mowing height of a cultivar. Treatment symbols are the same as in Fig. 2.

TITLE: Alleviation of Heat Injury in Creeping Bentgrass with a Biostimulant (CytoGro) and Mineral Nutrients.

OBJECTIVE: To identify biostimulants and nutrients that could alleviate heat injury in creeping bentgrass

PERSONNEL: Jinmin Fu and Bingru Huang

SPONSORS: Kansas Turfgrass Foundation and Kansas Agricultural Experiment Station

INTRODUCTION:

Heat stress is a major factor limiting growth of creeping bentgrass in the transitional zone. Heat damages plants by limiting water and nutrient uptakes and hormone synthesis in roots. Cultural practices that could supplement nutrient and hormone supplies to plants would improve turf growth under heat stress.

MATERIALS AND METHODS:

Sod pieces of Penncross were collected from 3-year-old plots at the Rocky Ford Turfgrass Research Center, Manhattan, KS. Grasses were transplanted into polyvinylchloride tubes with a mixture of 10% profile and 90% sand and placed in growth chambers. Turf was mowed daily at a 3-4 mm height.

Grass was exposed to high temperature (35/30 C, day/night) or an optimum temperature level of 20/20 C. Water only (control), CytoGro (a cytokinin-like compound, 0.8 oz /000 sq ft), $CaCl_2$ (10 mM), KH_2PO_4 (10 mM), and NH_4NO_3 (2 lbs/1000 sq ft) were sprayed uniformly on foliage at 0, 14, and 28 days of heat stress treatment. Turf quality, photosynthetic rate, and leaf photochemical efficiency were evaluated during heat stress.

RESULTS:

Turf quality (Fig. 1), photosynthetic rate (Fig. 2), and leaf photochemical efficiency (Fig. 3) of plants in all treatments declined with heat stress, but the decline was more severe for plants treated with water only (CK).

Plants sprayed with CytoGro, $CaCl_2$, and KH_2PO_4 once before heat stress was imposed had a higher photosynthetic rate and leaf photochemical efficiency than plants sprayed two or three times during heat stress. But plants sprayed three times with NH_4NO_3 had a higher photosynthetic rate than those treated only one time before heat stress.

High temperature decreased chlorophyll content (Fig. 4). Plants sprayed with $CaCl_2$, CytoGro, K_2HPO_4, and NH_4NO_3 had higher chlorophyll contents at 45 days of treatment than high temperature-treated plants sprayed with water.

In summary, applications of CytoGro, $CaCl_2$, K_2HPO_4, and NH_4NO_3 to leaves alleviated heat injury to creeping bentgrass to some extent. However, their effectiveness varied; three applications of NH_4NO_3 were most effective.

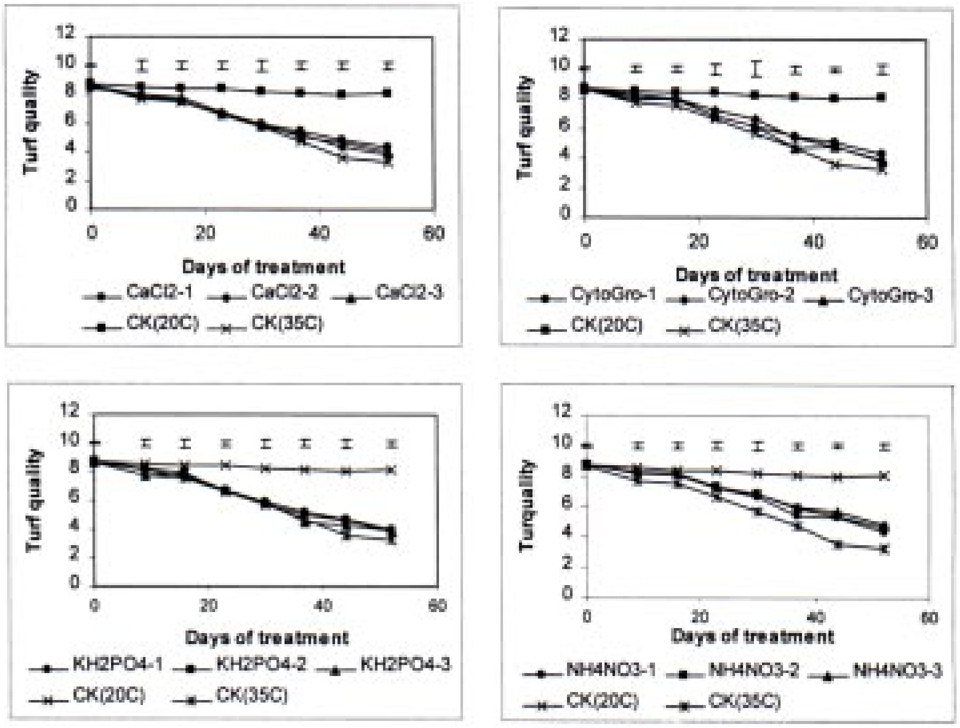

Figure 1. Effects of CytoGro and mineral nutrients on turf quality response of creeping bentgrass to heat stress. Bars indicate protected-LSDs (P=0.05) for treatment comparisons at a given day.

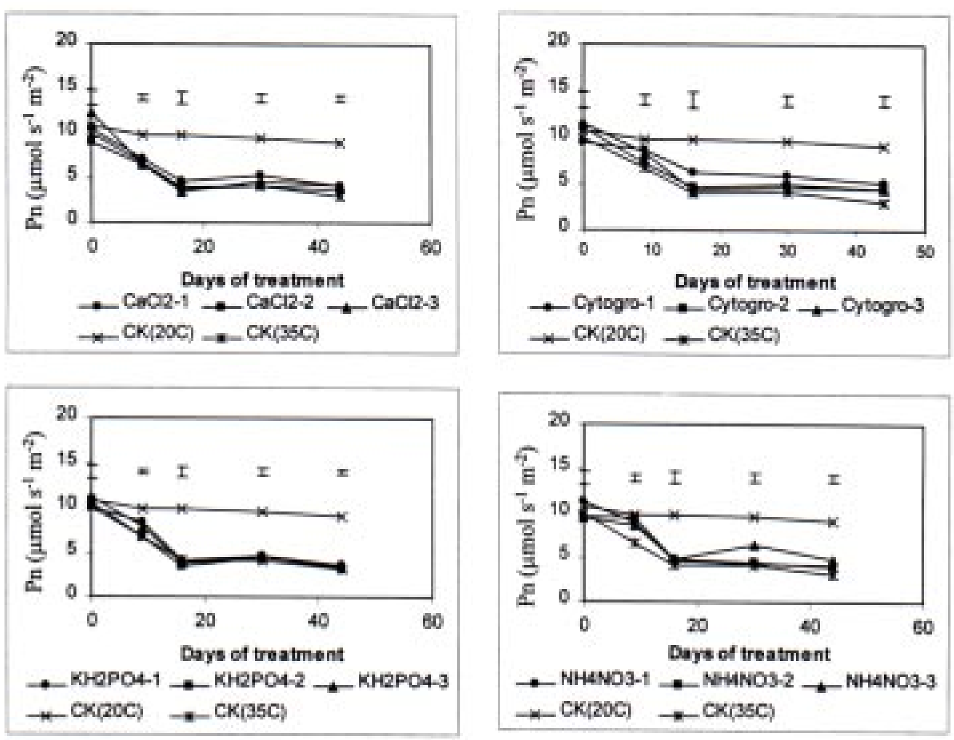

Figure 2. Effects of CytoGro and mineral nutrients on photosynthetic rate of creeping bentgrass exposed to heat stress. Bars indicate protected-LSDs (P=0.05) for treatment comparisons at a given day.

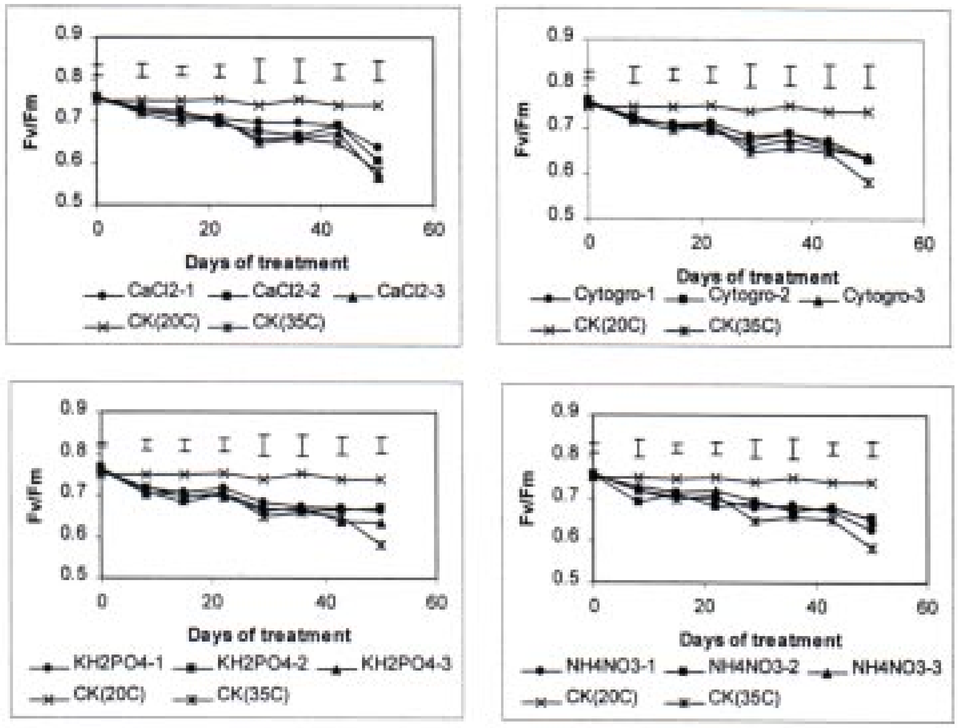

Figure 3. Effects of CytoGro and mineral nutrients on leaf photochemical efficiency of creeping bentgrass exposed to heat stress. Bars indicate protected-LSDs (*P*=0.05) for treatment comparisons at a given day

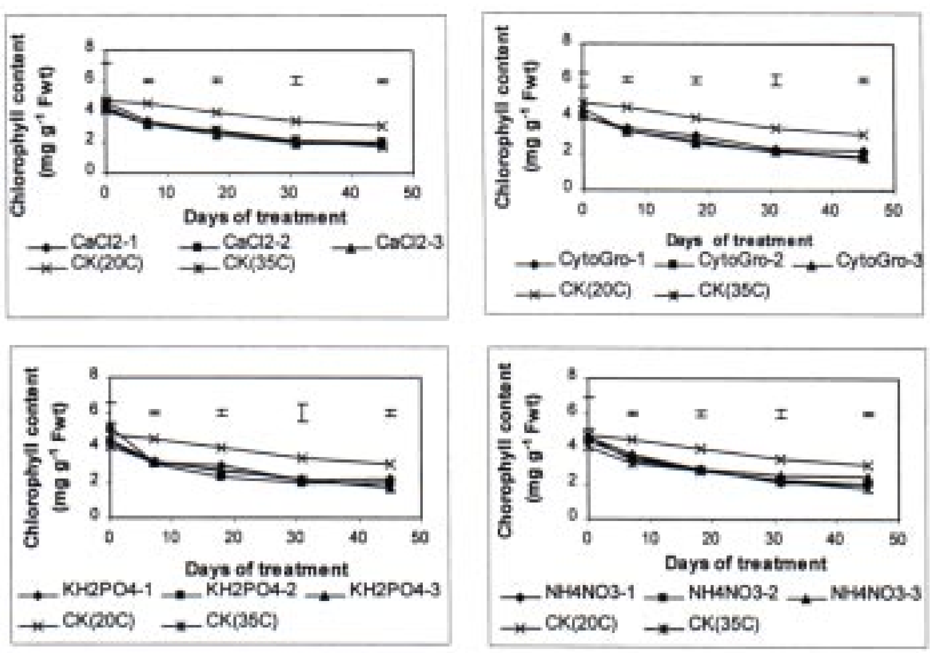

Figure 4. Effects of CytoGro and mineral nutrients on chlorophyll content response of creeping bentgrass to heat stress. Bars indicate protected-LSDs (*P*=0.05) for treatment comparisons at a given day.

TITLE: Effects of Calcium on Leaf Senescence Associated with Heat Stress in Two Cool-Season Grasses

OBJECTIVE: To examine whether Ca^{2+} treatment of foliage could improve heat tolerance in tall fescue and Kentucky bluegrass by alleviating leaf senescence

PERSONNEL: Yiwei Jiang and Bingru Haung

SPONSOR: Kansas Turfgrass Foundation

INTRODUCTION:

Growth suppression in cool-season grasses under heat stress involves water deficit and oxidative stress. Calcium (Ca^{2+}) is involved in the regulation of plant responses to heat stress. However, it is not clear whether external Ca^{2+} treatment could enhance heat tolerance in cool-season turfgrasses. More information about the role of Ca^{2+} in heat tolerance would be useful to turfgrass managers.

MATERIALS AND METHODS:

Sod pieces of tall fescue (cv. Rebel Jr.) and Kentucky bluegrass (cv. Kenblue) were grown in polyvinylchloride tubes in the greenhouse at Kansas State University. A 10 mM $CaCl_2$ solution was sprayed uniformly on foliage once daily during a 3-day period, and control plants were sprayed with deionized water. Heat stress was imposed in growth chambers at 35°C/30°C (day/night). Some of the Ca^{2+}-untreated plants were maintained at 20°C /15°C as the temperature control.

Turf quality, activities of the antioxidant enzymes catalase (CAT) and ascorbate peroxidase (AP) and lipid peroxidation (malondialdehyde content) were determined. These are indicators of leaf senescence.

RESULTS:

Heat stress reduced turf quality in both species (Fig. 1), but Ca^{2+} treatment increased turf quality and photosynthetic rate under heat stress.

The activities of CAT and AP decreased during heat stress (Figs. 2 and 3), but plants treated with Ca^{2+} had higher CAT and AP activities than untreated plants. Lesser amounts of malondialdehyde (MDA) accumulated in Ca^{2+}-treated plants than in untreated plants during extended periods of heat stress (Fig. 4).

In summary, external Ca^{2+} treatment enhanced heat tolerance in both tall fescue and Kentucky bluegrass. Its was related to the maintenance of antioxidant activities and a decrease in membrane lipid peroxidation.

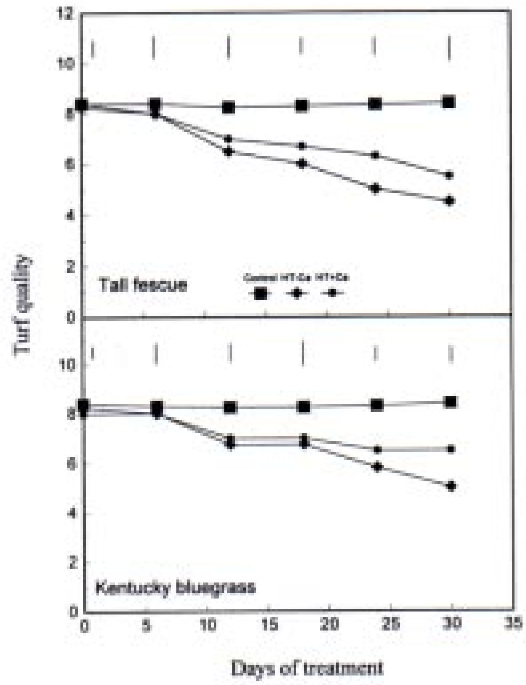

Fig.1. Turf quality as affected by heat stress (HT-Ca) and Ca^{2+} treatment (HT+Ca) in tall fescue and Kentucky bluegrass. Vertical bars indicate LSD values (p=0.05) for treatment comparison at a given day.

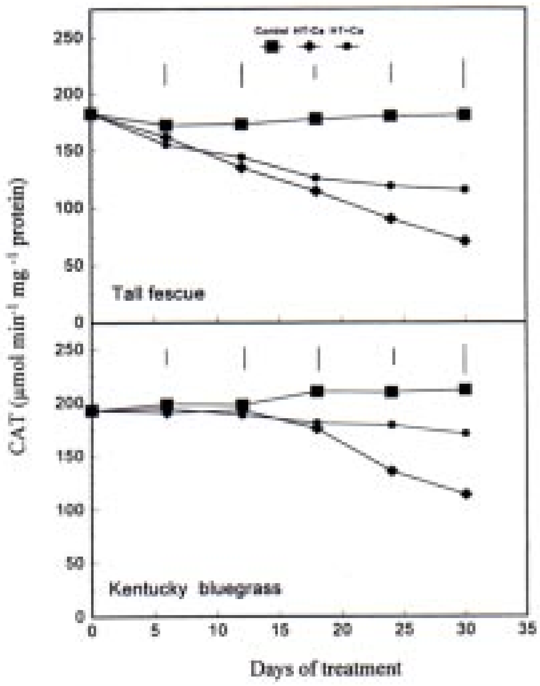

Fig.2. The activity of CAT as affected by heat stress (HT-Ca) and Ca^{2+} treatment (HT+Ca) in tall fescue and Kentucky bluegrass. Vertical bars indicate LSD values (p=0.05) for treatment comparison at a given day.

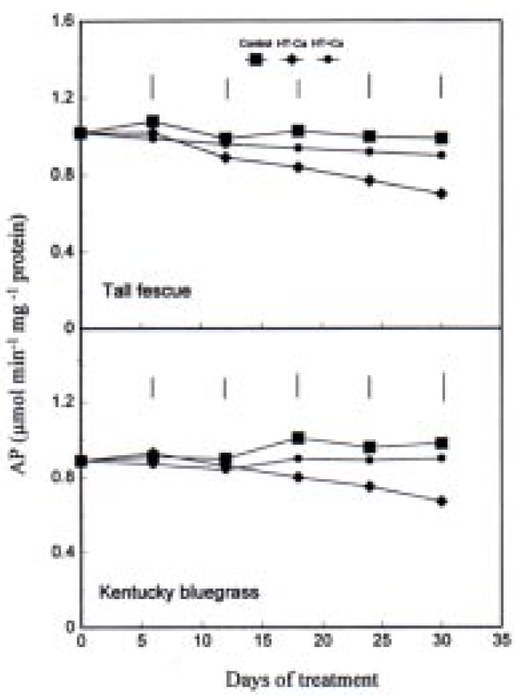

Fig.3. The activity of AP as affected by heat stress (HT-Ca) and Ca^{2+} treatment (HT+Ca) in tall fescue and Kentucky bluegrass. Vertical bars indicate LSD values (p=0.05) for treatment comparison at a given day.

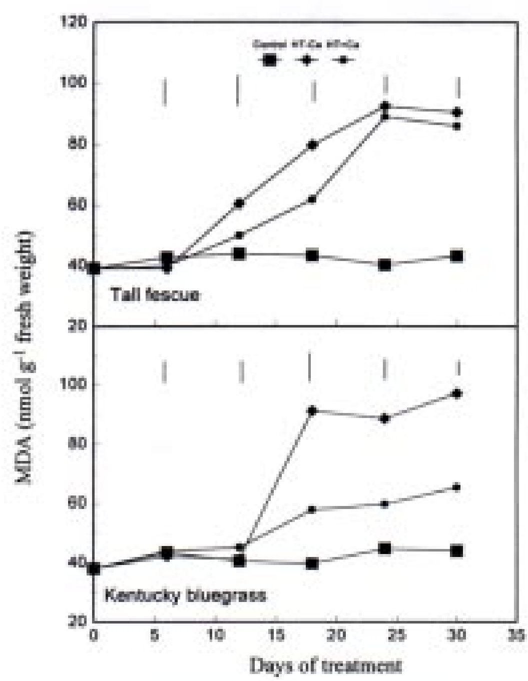

Fig.4. Lipid peroxidation (MDA content) as affected by heat stress (HT-Ca) and Ca^{2+} treatment (HT+Ca) in tall fescue and Kentucky bluegrass. Vertical bars indicate LSD values (p=0.05) for treatment comparison at a given day.

TITLE: Cytokinin Effects on Shoot and Root Growth of Creeping Bentgrass in Response to Heat Stress

OBJECTIVES: To examine whether external application of a cytokinin would enhance heat tolerance of creeping bentgrass and to determine the effective concentrations

PERSONNEL: Xiaozhong Liu and Bingru Huang

SPONSORS: Kansas Turfgrass Foundation and Kansas Agricultural Experiment Station

INTRODUCTION:

Heat stress is a major environmental factor limiting growth and quality of cool-season turfgrasses during summer in the transitional zone and warm climatic areas. Growth and quality of turfgrass, and metabolism of cytokinin decline in summer. Supplementation of cytokinins by external treatment might help to alleviate heat stress injury.

MATERIALS AND METHODS:

Sod pieces of Penncross creeping bentgrass collected from 3-year-old field plots were grown in growth chambers for 30 d and then subjected to high soil temperature (20/35 C air/soil) alone and high air and high soil temperatures (35/35 C) for 56 d. Four concentrations of the cytokinin, zeatin riboside (ZR): 0.01, 0.1, 1, and 10 :mol and 50 ml of water were applied to the root zone at the beginning (0 d) and 14 d of high temperature treatment. Turf quality and growth and photosynthetic capacity of roots and shoots were measured.

RESULTS:

Turf visual quality (Fig. 1), canopy net photosynthetic rate (P_n)(Fig. 2), leaf photochemical efficiency (Fv/Fm)(Fig. 3), and leaf growth rate (Fig. 4) decreased, whereas root mortality (Fig. 5) and root electrolyte leakage (Fig. 6) increased at both 20/35 and 35/35^{o}C, but to a greater extent at 35/35^{o}C. Applications of 1 and 10 :mol ZR mitigated heat stress injury to shoots and roots, with 10 :mol ZR being more effective when applied at either 0 or 14 d of heat stress. Application of 0.1 :mol ZR alleviated high temperature injury for a shorter period and was less effective than 1 and 10 :mol ZR. Application of 0.01 :mol ZR had no effects on shoot and root responses to high soil temperature alone or in combination with high air temperature.

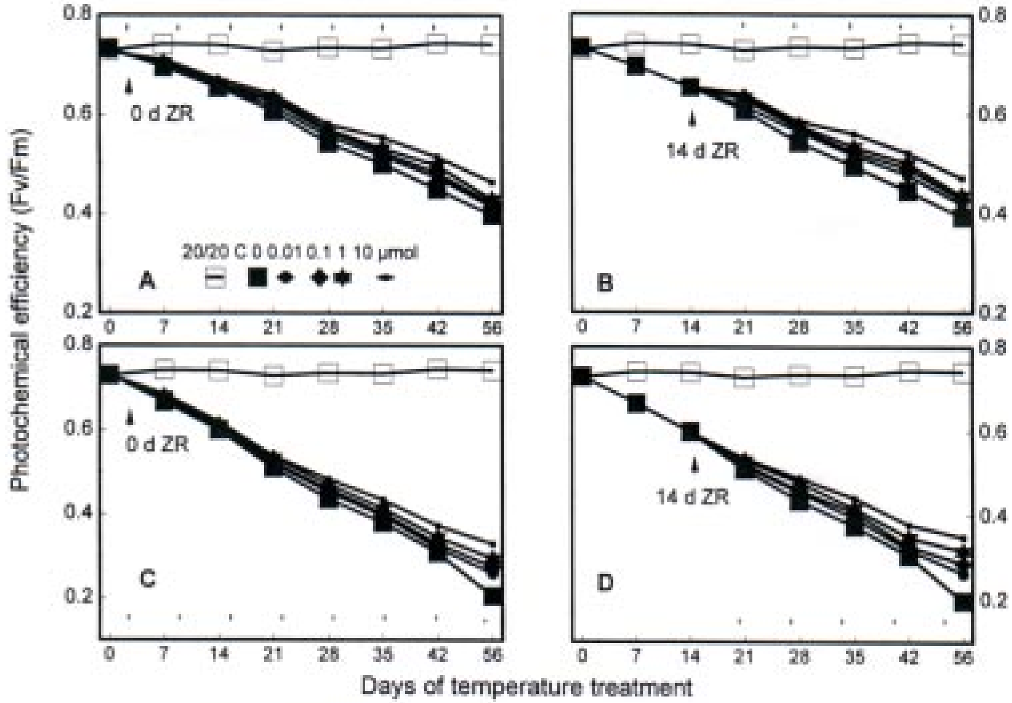

Fig. 3. Leaf photochemical efficiency of creeping bentgrass as affected by cytokinin application at 0 and 14 d of high soil temperature (A, B) and high air and soil temperatures (C, D). Vertical bars indicate LSDs (p = 0.05) for treatment comparisons.

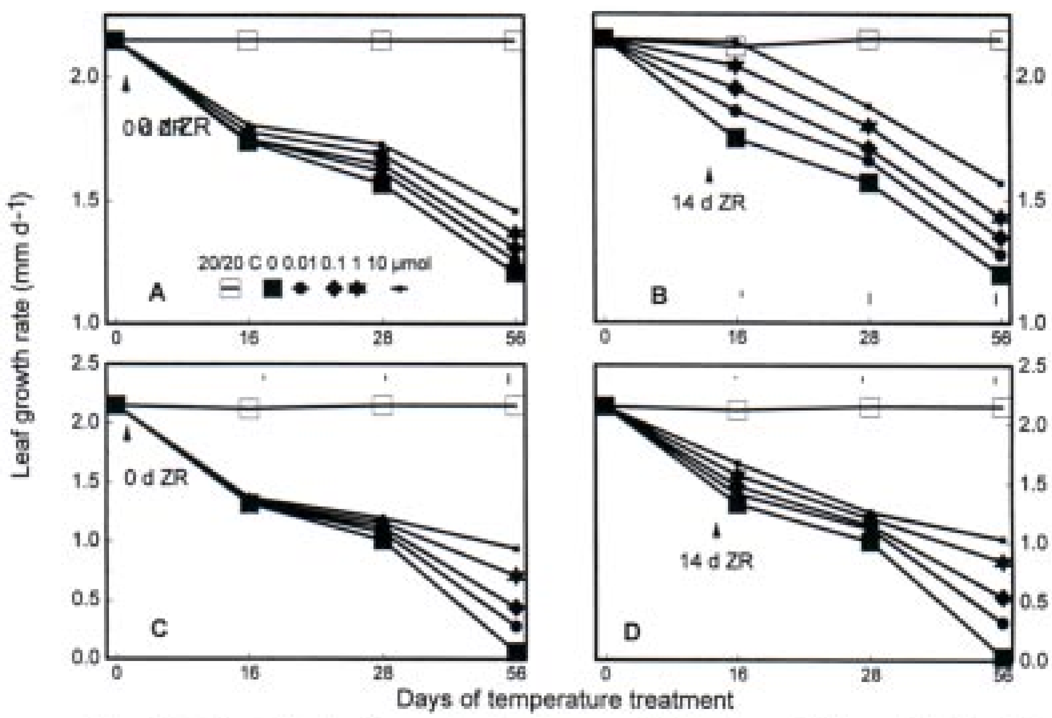

Fig. 4. Leaf growth rate of creeping bentgrass as affected by cytokinin application at 0 and 14 d of high soil temperature (A, B) and high air and soil temperatures (C, D). Vertical bars indicate LSDs (p = 0.05) for treatment comparisons.

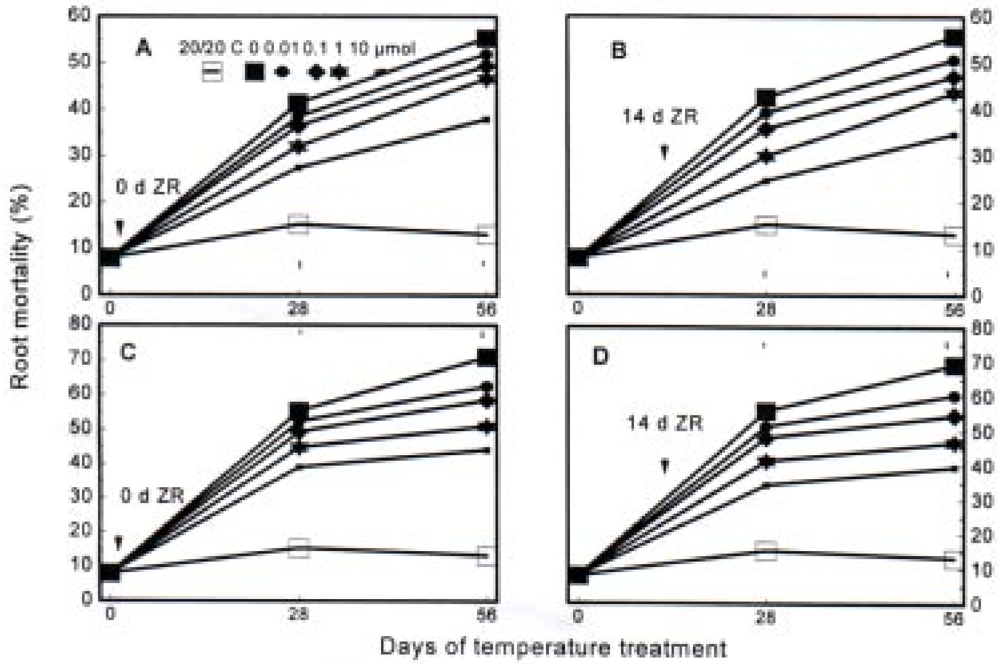

Fig. 5. Root mortality of creeping bentgrass as affected by cytokinin application at 0 and 14 d of high soil temperature (A, B) and high air and soil temperatures (C, D). Vertical bars indicate LSDs (p = 0.05) for treatment comparisons.

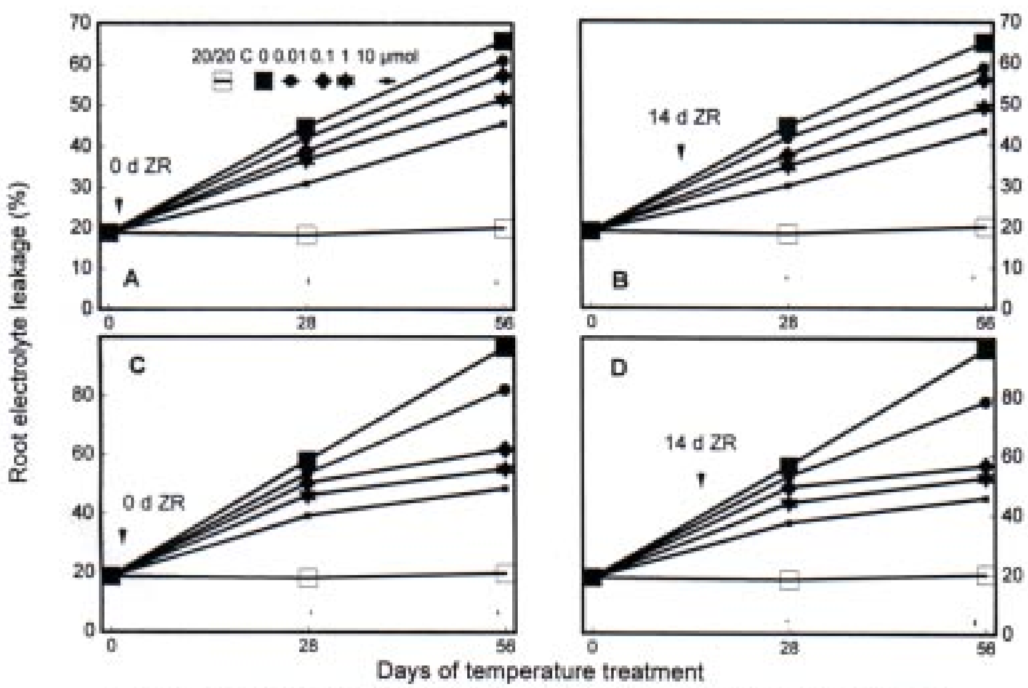

Fig. 6. Root electrolyte leakage of creeping bentgrass as affected by cytokinin application at 0 and 14 d of high soil temperature (A, B) and high air and soil temperatures (C, D). Vertical bars indicate LSDs (p = 0.05) for treatment comparisons.

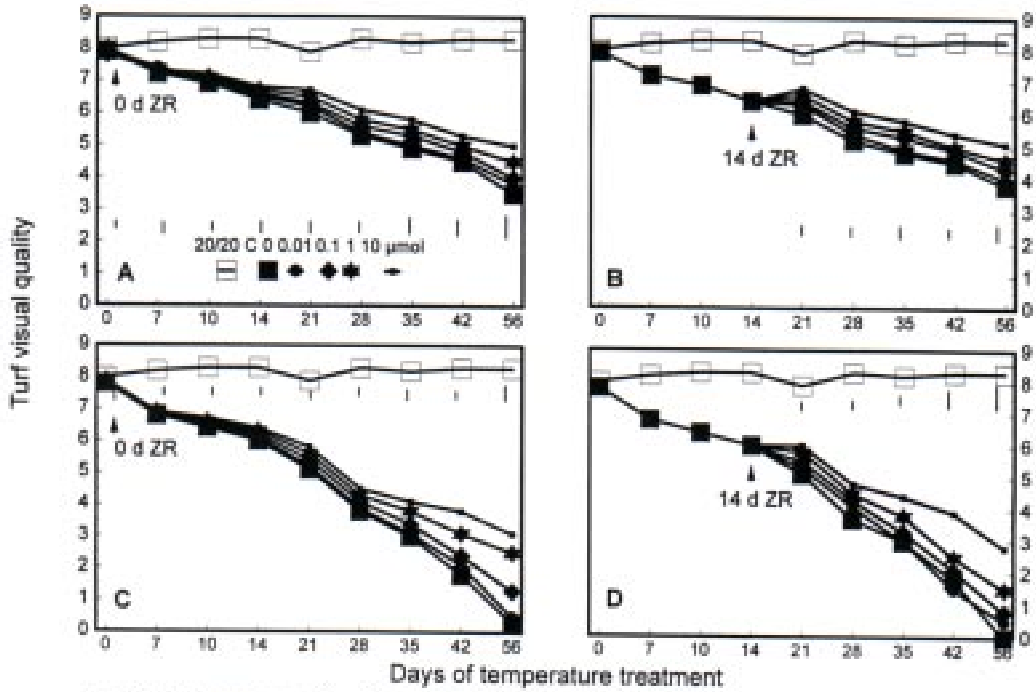

Fig. 1. Turfgrass quality of creeping bentgrass as affected by cytokinin application at 0 and 14 d of high soil temperature (A, B) and high air and soil temperatures (C, D). Vertical bars indicate LSDs (p = 0.05) for treatment comparisons.

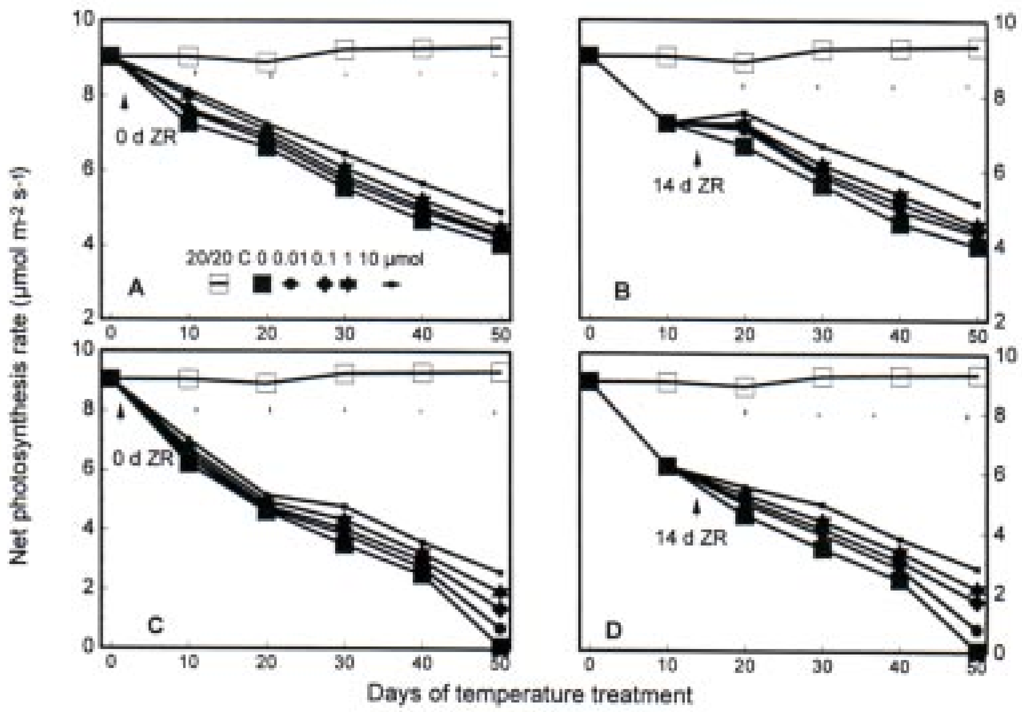

Fig. 2. Photosynthetic rate of creeping bentgrass as affected by cytokinin application at 0 and 14 d of high soil temperature (A, B) and high air and soil temperatures (C, D). Vertical bars indicate LSDs (p = 0.05) for treatment comparisons.

THANKS!!

Many organizations and corporations provided a significant level of support to the KSU turfgrass research program in 1999. Aid was in the form of grants-in-aid, equipment, contributions, or research cooperation.

- Aventis
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- BASF
- Bayer
- Colbert Hills Golf Club
- 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 Golf Course 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
- Mid-America Green Industry Council
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- National Turfgrass Evaluation Program
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- O.M. Scott & Sons, Inc.
- Patten Seed Co.
- Outdoor Equipment (Cushman Mfg.)
- PBI Gordon
- Prairie Dunes Country Club
- ProSource One
- Rohm & Haas
- Rhone-Poulenc
- Ryan Lawn & Tree
- The Cleary's Corporation
- Turf Professionals Equipment (Toro)
- 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 the 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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