Kansas State University Agricultural Experiment Station
and Cooperative Extension Service

K-STATE TURFGRASS RESEARCH

2008

Report of Progress 998

FOREWORD

Turfgrass Research 2008 contains results of projects conducted by K-State faculty and graduate students. Some of these results will be presented at the Kansas Turfgrass Field Day, August 7, 2008, at the Rocky Ford Turfgrass Research Center. Articles included in this Report of Progress present summaries of research projects that were completed recently or will be completed in the next year or two. Specifically, this year's report presents summaries of research on environmental stresses and the environment, disease control, and cultivar evaluations.

What questions can we answer for you? The K-State turfgrass research team strives to be responsive to the needs of the industry. If you have problems that you feel need to be addressed, please let one of us know. In addition to the CD format, you can access this report, reports from previous years, and all K-State Research and Extension publications relating to turfgrass online at:

www.ksuturf.com

and

www.oznet.ksu.edu/library/

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Note. Photos by K-State Turfgrass faculty, staff, and students unless otherwise noted.

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Irrigation Requirements of 28 Kentucky Bluegrass Cultivars and Two Texas Bluegrass Hybrids in the Transition Zone

Objectives:	1. Develop and implement a novel method for concurrently comparing irrigation requirements among 30 turfgrass cultivars using a large rainout facility at Kansas State University 2. Produce a database of relative irrigation requirements for 28 Kentucky bluegrass cultivars and Two Texas bluegrass hybrids 3. Partition Kentucky bluegrass cultivars into high, medium, and low irrigation requirement categories 4. Conduct drydown and genetic rooting potential experiments in a greenhouse to evaluate responses to drought and physiological characteristics among the same cultivars tested in the field
Investigators:	Dale Bremer, Steve Keeley, Jack Fry, and Jason Lewis
Sponsors:	U.S. Golf Association, Turfgrass Producers International, and Kansas Turfgrass Foundation

INTRODUCTION

One of the most important challenges facing the turfgrass industry is the increasingly limited supply of water for irrigation. Consequently, water conservation and improving turfgrasses' resistance to drought stresses have become increasingly important. Turf managers commonly face drought, which can occur anywhere in the United States. In 2004, a task group from the Environmental Institute for Golf concluded that future water availability is a serious issue in the western United States, there is a lack of data on water use in many states, and state and local drought restrictions may be imposed on turf managers with no regard for damage to turfgrasses. Nevertheless, clients and the public (e.g., golfers at private and public facilities, participants at outdoor sporting events, and lawn owners) express displeasure when turfgrass is not of expected quality when irrigation is restricted.

A 2005 NASA study determined that turfgrass already covered an area three times greater than any other irrigated crop in the United States., and urban expansion in the United States is projected to increase nearly 80% by 2025. Because turfgrass acreage is increasing with urban expansion, demand for water for turfgrass irrigation will also likely continue to increase. One strategy to mitigate irrigation demands for turfgrass may be identification of cultivars that use less water and tolerate drought better. Kentucky bluegrass is commonly used on golf course roughs and fairways, in sports fields, and in home and commercial lawns. Consequently, information is needed about Kentucky bluegrass cultivars that conserve water while maintaining acceptable quality.

A large, fully automated rainout shelter (40 ft × 40 ft) at Kansas State University near Manhattan, KS, offers a unique opportunity to compare irrigation requirements of multiple turfgrass cultivars in the stressful climate of the U.S. transition zone, which spans northern regions where cool-season grasses are adapted and southern regions where warm-season grasses are adapted. Because the shelter shields plots during rainfall, plots can be irrigated individually as needed to determine respective irrigation requirements among cultivars under identical field conditions. Turfgrasses with similar visual qualities but lower irrigation requirements may offer significant water savings to turfgrass managers. In this study, we are investigating water use and performance of 28 Kentucky bluegrasses cultivars and two Texas bluegrass hybrids using the rainout shelter (Fig. 1).

METHODS

Cultivars, Turfgrass Management, Experimental Design

Turfgrasses in the study include 28 Kentucky bluegrass cultivars and two Texas bluegrass hybrids (Table 1). Cultivars were selected to include representatives from major “groups,” based on similar phenotypic characteristics, of Kentucky bluegrasses; most cultivars were best-performers in National Turfgrass Evaluation Program (NTEP) trials. Four standard entries are included in the mix: Midnight, Baron, Eagleton, and Kenblue.

Preparation of the plot area included cultivation, fumigation, leveling, and insertion of 30-cm-deep metal edging around individual plots to prevent lateral water movement. Plots (3.7 ft × 4.0 ft) were seeded on September 19, 2006, at approximately 2 lb/1,000 ft^2 pure live seed in a randomized block design; cultivars were replicated three times each for a total of 90 plots. Starter fertilizer (18-46-0) was applied at 1 lb/1,000 ft^2 N. Plots were covered with a seed germination blanket (Futerra F4 Netless, Profile Products LLC, Buffalo Grove, IL) to prevent seed movement across plots from water or wind and irrigated several times daily to maintain a wet seedbed during germination. Plots were mowed once in the fall of 2006 at approximately 2 in. and weekly or as needed at the same height during 2007. In May, September, and November 2007, plots were fertilized with 1 lb/1,000 ft^2 N.

Irrigation Management and Data Collection

Plots were well-watered until June 1, 2007, after which turfgrasses were allowed to dry down without irrigation or precipitation until signs of wilt. Individual plots were evaluated daily for wilt and irrigated with approximately 1 in. of water when about 50% of the plot exhibited visual symptoms of wilt. Each plot was irrigated manually, and irrigation quantity and date were recorded for each plot. This experiment continued through the end of September 2007. Total irrigation requirements of each cultivar for the 4-month study period were summarized. This project will be repeated in 2008.

General turf performance was also evaluated daily by visually rating turf quality. Turfgrass quality was rated on a scale from 1 (dead, brown turf) to 9 (optimum uniformity, density, and color); 6 was considered minimal acceptable quality for a home lawn.

Greenhouse Component

The same cultivars used in the field study are being evaluated for rooting depth in the greenhouse using slanted root tubes (Fig. 2). Briefly, this involves seeding turfgrasses into clear polyethylene root tubes filled with fritted clay (Turface) then inserting polyethylene tubes into opaque PVC pipe (sleeves). Turfgrasses were established in the tubes in the fall of 2007, and root growth is being monitored periodically along the side of the clear root tubes. When roots in the first tube reach the bottom of the container, we will commence a dry down to evaluate relative drought resistance among cultivars. Plants will then be rewetted to evaluate recovery. Finally, roots will be harvested, dried in forced-convection ovens, and weighed to compare root biomass among cultivars. This research is underway, and final results will not be available until late in 2008.

RESULTS

Total amount of water applied to individual cultivars in the first year varied significantly and ranged from 8 to 22 in. during the 4-month period from June through September. Visual quality also varied substantially among cultivars (Figs. 3 and 4). In general, when considering visual quality and water requirements, cultivars in the Compact America and Mid-Atlantic groups performed better (higher quality, lesser water requirements) and “Common” types performed poorer (lower quality, greater water requirements) among phenotypic groups. However, there was significant variability even among cultivars within each group. These cultivars will be evaluated again in the summer of 2008, their second year of establishment, which will incorporate further climatic variability into results. After the second year, total irrigation requirements of each cultivar will be summarized over both years and reported.

We anticipate this research will result in a list of NTEPs best-performing Kentucky bluegrass cultivars separated into categories with high, medium, and low irrigation requirements. This list will provide guidance to turfgrass managers who are interested in Kentucky bluegrass cultivars that may conserve water without significantly compromising quality and those who may face irrigation restrictions that can affect their turfgrasses. The list will also provide information on rooting potential and relative drought resistance among cultivars.

Table 1. List of 28 Kentucky bluegrass cultivars and two Texas bluegrass hybrids selected for the 2-year study under the rainout shelter at Kansas State University

Group[a]	**Cultivar**
Aggressive	Limousine
	Touchdown
Common	Kenblue
	Park
	Wellington
Compact	Diva
	Moonlight
	Skye
Compact America	Apollo
	Bedazzled
	Kingfisher
	Langara
	Unique
Compact Midnight	Award
	Blue Velvet
	Midnight
	Midnight II
	Nu Destiny
European	Bartitia
	Blue Knight
Julia	Julia
Mid-Atlantic	Cabernet
	Eagleton
	Preakness
Shamrock	Abbey
BVMG	Baron
	Envicta
	Shamrock
Texas bluegrass hybrids	Longhorn
	Thermal Blue Blaze

Shaded boxes indicate the four standard entries

[a] Groups indicate cultivars with similar phenotypic characteristics.

Figure 1. Ninety plots of Kentucky bluegrasses cover an area of 1,550 ft^2 under a rainout shelter at the Rocky Ford Turfgrass Research Center near Manhattan, KS.

Figure 2. Slant tubes in greenhouse used to study drought resistance, recovery after drought, and genetic rooting depth potential among Kentucky bluegrass cultivars.

Figure 3. Well-watered plots at beginning of study (June 4, 2007) prior to initiating drydown experiments.

Figure 4. Plots at 2 months into the study (Aug. 4, 2007). Drought or heat stress is evident in some plots of Kentucky bluegrass.

Freezing Tolerance Evaluation of New Zoysiagrass Progeny

Objective:	Compare experimental zoysiagrass progeny and selected cultivars with Meyer for freezing tolerance
Investigators:	David Okeyo and Jack Fry
Cooperators:	Milt Engelke and Dennis Genovesi, Texas A&M University
Sponsors:	Heart of America Golf Course Superintendents Association, Kansas Golf Course Superintendents Association, Kansas Turfgrass Foundation

INTRODUCTION

Since 2004, we have been evaluating new zoysiagrass progeny for their adaptation in the Kansas climate. Meyer zoysiagrass is the standard for use in the transition zone. Like other *Zoysia japonica* cultivars, Meyer is hardy. High quality zoysiagrass species in the *Z. matrella* group are not hardy in the northern transition zone. Dr. Qi Zhang screened more than 600 zoysiagrass progeny for winter survival in the field from 2004 to 2007. This study will provide a more in-depth evaluation of freezing tolerance of 10 zoysiagrass progeny, most which resulted from crosses of *Z. matrella* × *Z. japonica*.

METHODS

Ten selected zoysiagrass progeny were sampled from the field in December 2007 and February 2008 to determine freezing tolerance. Meyer and Cavalier (a less hardy *Z. matrella*) were also included at both samplings, and DALZ 0102 (a *Z. japonica*) was included in the February sampling. Four replicates of 6-cm diameter × 5-cm-deep cores were sampled in December, and three replicates were sampled in February. Each replication was run through a controlled freezing chamber separately (Fig. 1).

A thermocouple was installed at a 2-cm soil depth in two randomly selected plugs per replication to monitor temperature. Plugs were placed in a freezer at -3°C and covered lightly with crushed ice to prevent supercooling. The next day, the freezer was set to drop in temperature by 2°C/hr. In December, one plug per progeny was removed at -6°C, -10°C,-14°C, -18°C, and -22°C. In February, temperature treatments were narrowed to -10°C, -12°C, -14°C, -16°C, and -18°C. At each sampling, one set of plugs was placed in a growth chamber at 4°C overnight and was not frozen (control). After freezing, plugs were returned to a growth chamber set at 4°C to thaw slowly overnight.

After thawing, grasses were planted in 8-cm-diameter containers and placed in a greenhouse maintained at a 30°C/25°C day/night temperature with a 14-hr photo period under supplemental lighting to provide 580 µmol/m^2 per second at canopy level. Recovery growth was evaluated after 6 weeks by counting the number of living tillers in each plug at each temperature. Number of surviving tillers for each plug at each temperature was converted to a percentage of surviving tillers and compared with the same progeny exposed only to the 4°C treatment. Percentage tiller survival data were subjected to analysis of variance. An LT_{50} (temperature killing 50% of grass tillers compared with the nonfrozen control) was determined using regression analysis.

RESULTS

Following sampling in December, no recovery growth occurred in any grasses except Meyer after exposure to -18°C (Table 1). Cavalier and 5324-53 exhibited no recovery growth after exposure to -14°C. At -14°C, all progeny had a lower percentage of tiller recovery than Meyer. LT_{50} ranged from -2.4 (Cavalier) to -17.1 (Meyer). All progeny had an intermediate LT_{50}; the highest was 5283-27 (-10.8°C) and lowest was 5321-3 (-15.9°C).

Grasses were hardier in February than in December, and all progeny except Cavalier and 5311-8 exhibited some recovery growth at -18°C (Table 2). LT_{50} ranged from -4.8°C for Cavalier to -16.7°C for 5324-53.

Freezing tolerance of all progeny and cultivars evaluated was superior to Cavalier at both sampling times (Fig. 2). Meyer demonstrated a greater ability to tolerate freezing early in the winter (December) than all other cultivars and progeny. By February, all progeny exhibited a level of hardiness equivalent to Meyer. Results indicate there is promise for release of an improved zoysiagrass cultivar that should have a level of freezing tolerance comparable to Meyer.

Figure 1. Grasses were sampled from the field and subjected to freezing temperatures in the laboratory. Then, recovery growth was evaluated in the greenhouse.

Figure 2. Zoysiagrasses that are hybrids of *Z. japonica* × *Z. matrella* (left) exhibit better hardiness than Cavalier zoysia (*Z. matrella*), on right.

Table 1. Effects of freezing on tiller recovery and LT_{50} of zoysiagrass cultivars and progeny in December 2007[a]

	Tiller recovery (%)						
Progeny	4°C	-6°C	-10°C	-14°C	-18°C	-22°C	LT_{50} (°C)
8507 × Meyer	100.0a	77.0b	68.1b	17.5bc	0	0.0	-10.8
Cavalier × Anderson #1							
5311-3	100.0a	142.7ab	98.8ab	46.4b	0	0	-15.8
5311-8	100.0a	104.7ab	76.5b	24.8bc	0	0	-13.2
5311-22	100.0a	135.3ab	121.4ab	16.9bc	0	0	-15.5
5311-26	100.0a	85.2b	82.8b	25.9bc	0	0.0	-12.7
5311-27	100.0a	104.2ab	106.7ab	33.8bc	0	0	-14.8
5311-32	100.0a	112.1ab	92.4ab	30.9bc	0	0	-14.4
Emerald × Meyer (5321-3)	100.0a	156.2a	111.2ab	30.6bc	0	0	-15.9
8501 × Meyer							
5324-18	100.0a	101.8ab	82.8b	1.9c	0	0	-12.4
5324-53	100.0a	122.2ab	83.1b	0.0c	0	0	-13.2
Meyer	100.0a	130.7ab	144.9a	73.6a	0.9a	0	-17.1
Cavalier	70.7b	92.5ab	37.4b	0.0c	0	0	-2.4

[a] Living tillers on each plug were counted, and percentage survival relative to the 4°C treatment was calculated.
Within columns, means followed by the same letter are not significantly different at $P \leq 0.05$.

Table 2. Effects of freezing on tiller recovery and LT_{50} of zoysiagrass cultivars and progeny in February 2008[a]

	Tiller recovery (%)						
Progeny	4°C	-10°C	-12°C	-14°C	-16°C	-18°C	LT_{50} (°C)
8507 × Meyer	100.0a	112.3b	65.0b	74.3ab	11.0ab	3.7a	-14.6
Cavalier × Anderson #1							
5311-3	100.0a	150.0ab	95.7ab	69.3ab	66.3a	4.7 a	-15.9
5311-8	100.0a	114.0a	72.3b	73.3ab	2.7b	0 a	-14.5
5311-22	100.0a	110.3ab	83.3ab	96.3ab	42.7ab	1.7a	-15.6
5311-26	100.0a	84.0ab	67.3b	76.7ab	36.0ab	7.0a	-14.8
5311-27	100.0a	142.7b	142.7a	95.3ab	21.3ab	19.0a	-16.1
5311-32	100.0a	107.3ab	114.3ab	61.7ab	14.7ab	12.3a	-15.2
Emerald × Meyer (5321-3)	100.0a	85.0ab	44.7bc	51.7b	19.0ab	12.7a	-13.3
8501 × Meyer							
5324-18	100.0a	92.3b	100.3ab	68.3ab	45.0ab	2.0a	-15.3
5324-53	100.0a	113.0ab	99.0ab	121.7a	65.0a	14.0a	-16.7
Meyer	100.0a	84.0ab	89.3ab	60.3ab	33.0ab	22.0a	-16.1
Cavalier	100.0a	32.7b	1.3c	56.0b	21.0ab	0a	-4.8
DALZ0102	100.0a	88.7b	95.0ab	89.3ab	43.0ab	2.3a	-15.5

[a] Living tillers on each plug were counted, and percentage survival relative to the 4°C treatment was calculated.

Within columns, means followed by the same letter are not significantly different at $P \leq 0.05$.

Nitrogen Source and Timing Effect on Carbohydrate Status of Bermudagrass and Tall Fescue

Objective:	Evaluate effects of coated nitrogen sources at various timings, compared with urea at traditional timings, on non-structural carbohydrate status of bermudagrass and tall fescue and low temperature tolerance of bermudagrass
Investigators:	Tony Goldsby and Steve Keeley

INTRODUCTION

Non-structural carbohydrates (NSC) are the energy source for turfgrass growth and recovery; therefore, NSC levels have often been used as indicators of physiological health and/or stress tolerance of a turfgrass. Several research studies have shown that higher NSC levels in winter improve low temperature survival of various turfgrass species. Similarly, cool-season turfgrass quality during summer has been related to higher NSC content in shoots and roots. Spring regrowth after winter dormancy and turfgrass recovery from excessive traffic and other stresses also depend on an adequate supply of NSC.

Turfgrass cultural practices can have a significant effect on plant health by altering NSC levels. For example, lower mowing heights reduce leaf area for photosynthesis, which ultimately results in a reduction in rooting. Turfgrass fertilizer regimes can also affect NSC levels.

Nitrogen fertilizer is essential for high quality turfgrass, but multiple studies have documented decreased NSC levels with higher N rates. This reduction likely occurs because nitrogen promotes vegetative growth, which has been shown to deplete NSC levels in turfgrass. Thus, turfgrass stands receiving high N may be less able to tolerate and/or recover from various stresses. Slow-release nitrogen fertilizers have potential to provide a solution to this problem by moderating turfgrass vegetative growth. Compared with fast-release sources, slow-release N sources may also require fewer applications, produce more uniformity, and have a lower burn hazard.

However, many slow-release N sources are dependent on microbial activity for N release, which makes timing and rate of release somewhat difficult to predict. Nitrogen release from natural organic N sources and urea formaldehyde is increased when conditions favor microbial decomposition. Consequently, most release occurs during periods of elevated temperatures and adequate moisture. Polymer-coated nitrogen fertilizers that are not dependent on microbial activity for N release have been developed. These should provide a more predictable and precise rate of N release. Because turfgrass NSC levels are known to fluctuate seasonally, it is important that NSC sampling be conducted throughout the year to provide a clear picture of a fertilizer regime’s effects on turfgrass NSC levels.

The objective of this study was to evaluate effects of spring vs. late summer applications of polymer-coated N sources, compared with traditional N sources, on NSC status, turf quality, color, and low temperature survival of Midlawn Bermudagrass (*Cynodon dactylon* L. Pers. × *C. transvaalensis* Burtt-Davy) and a blend of turf-type tall fescue (*Festuca arundinacea* Screb.).

MATERIALS AND METHODS

On August 1, 2005, we initiated N fertilizer treatments (Table 1) in a completely randomized design with four replications. This research was conducted at the Rocky Ford Turfgrass Research Center, Manhattan, KS. We measured NSC every two months by extracting two 10-cm-diameter plugs from each plot and measuring regrowth in darkness in a growth chamber at 24°C. The regrowth period lasted for 9 weeks. Plugs were completely defoliated before being placed in the growth chamber. Shoot growth was removed every two weeks, clippings were dried at 70°C for 48 hr, and dry weights were recorded. Data were analyzed using SAS for Windows and MSTAT.

Low temperature tolerance of Midlawn Bermudagrass, affected by N source and timing, was evaluated during the winter of 2006-2007. Nitrogen sources evaluated in this aspect of the study were limited to polymer-coated N sources and urea (as a check treatment) because of constraints on the number of plugs that could be handled in our freeze chamber. Initially, five (2-in. diameter) plugs were removed from each treatment plot during November 2006 and January and March 2007. Plugs were then placed in a growth chamber and allowed to acclimate at 3°C for 12 hr. Following the 12-hr acclimation period, plugs were moved to a thermo-controlled freezing chamber at -3°C.

Temperature was decreased at a rate of -3°C/hr, and five plugs were removed at each of the following temperatures: for the November and March sampling periods, -3°C, -6°C, -9°C, -12°C, and -15°C, and for the January sampling period -6°C, -9°C, -12°C, -15°C, and -18°C. Two thermocouples were inserted into the maximum freezing temperature group to ensure proper temperatures were attained. These temperatures were determined from previously available literature and the LT_{50} for Midlawn.

After the freezing regime, plugs were allowed to reacclimatize at 3°C for 12 hr. Plugs were then transferred into 4-in. pots using a standard potting mixture of loam, sand, and peat and kept in a greenhouse at 25°C for observation. Plugs were evaluated weekly for 6 weeks on two parameters: survival and percent recovery. This procedure was replicated three times in November 2006, January 2007, and March 2007.

RESULTS

Nitrogen source did not affect NSC levels in either Bermudagrass or tall fescue. Application timing had a significant effect on NSC levels in Bermudagrass but not tall fescue. For the polymer-coated N sources, we observed significantly higher overall NSC in the Bermudagrass with the August-applied treatment compared with the April applications (Figure 1). Bimonthly results are shown in Figures 2 and 3.

Midlawn Bermudagrass low temperature tolerance was affected by N source but not timing. For the November 2006 and March 2007 sampling periods, low temperature survival and recovery was greater with polymer-coated N sources than with the urea check. (Data not shown). There was no treatment effect in the January 2007 sampling. Less of a treatment effect is expected at this time because plants are naturally more cold hardy in January than during the acclimation/ deacclimation periods in November and March.

Table 1. Nitrogen treatment list

Midlawn Bermudagrass Treatments	**Tall Fescue Treatments**
1) Polyon 43-0-0 @ 4 lb N/M in early April	1) Polyon 43-0-0 @ 3 lb N/M in early September
2) Polyon 43-0-0 @ 4 lb N/M in early August	2) Polyon 43-0-0 @ 1.5 lb N/M in early September + 1.5 lb N/M in late March
3) Polyon 41-0-0 @ 4 lb N/M in early April	3) Polyon 41-0-0 @ 1.5 lb N/M in early September
4) Polyon 41-0-0 @ 4 lb N/M in early August	4) Polyon 41-0-0 @ 1.5 lb N/M in early September + 1.5 lb N/M in late March
5) Sulfur Coated Urea @ 4 lb N/M in early April	5) Sulfur Coated Urea @ 3 lb N/M in early September
6) Sulfur Coated Urea @ 4 lb N/M in early August	6) Sulfur Coated Urea @ 1.5 N/M in early September + 1.5 lb N/M in late March
7) Sulfur Coated Urea @ 2 lb N/M in early April+ 2 lb N/M in August	7) Urea Formaldehyde @ 3 lb N/M in early September
8) Urea Formaldehyde @ 4 lb N/M in early April	8) Urea Formaldehyde @ 1.5 N/M in early September + 1.5 lb N/M in late March
9) Urea Formaldehyde @ 4 lb N/M in August	9) Check: Urea @ 1 lb N/M in early September, November, and May
10) Check: Urea @ 1 lb N/M in May, June, July, and August	

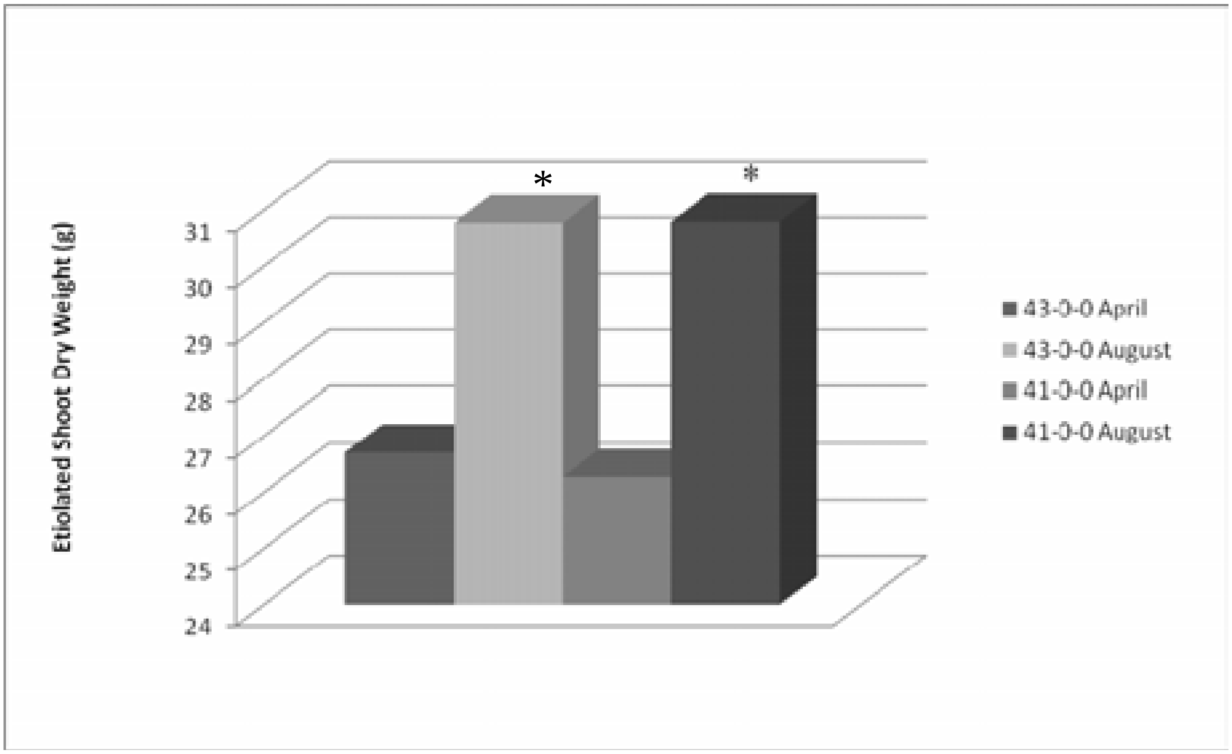


Figure 1. Effect of application timing of polymer-coated N sources on cumulative Midlawn Bermudagrass biomass.
*significant at $P \leq 0.05$

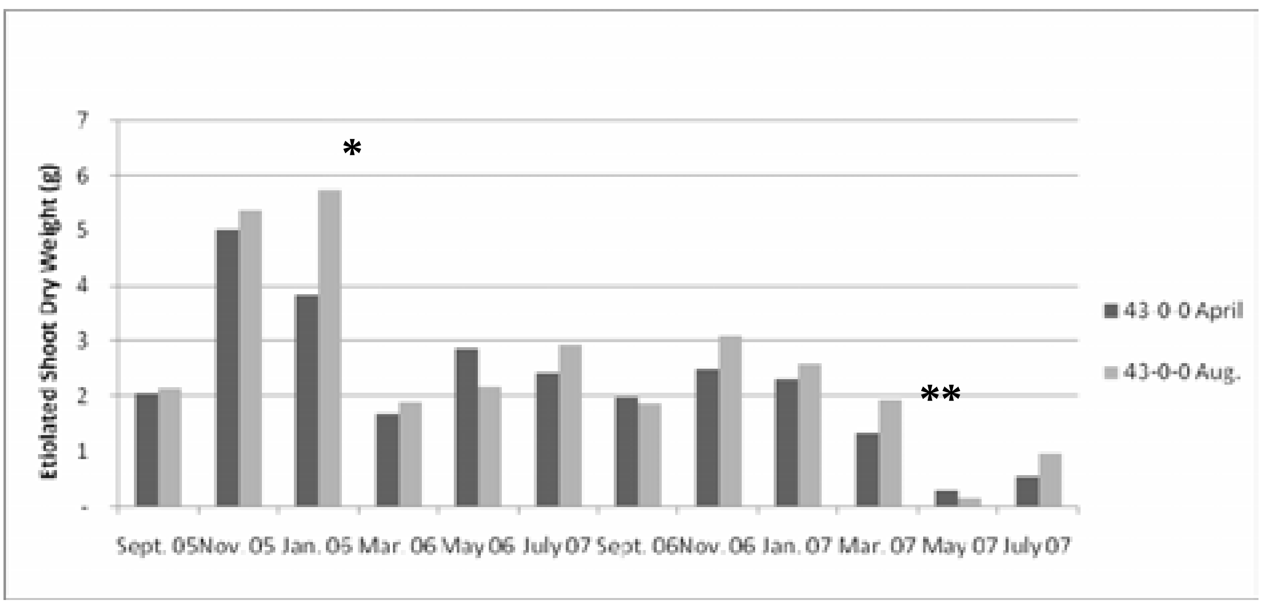


Figure 2. Effect of application timing of a polymer-coated N source (43-0-0) on bimonthly Midlawn Bermudagrass biomass.
*significant at $P \leq 0.05$
**significant at $P \leq 0.10$

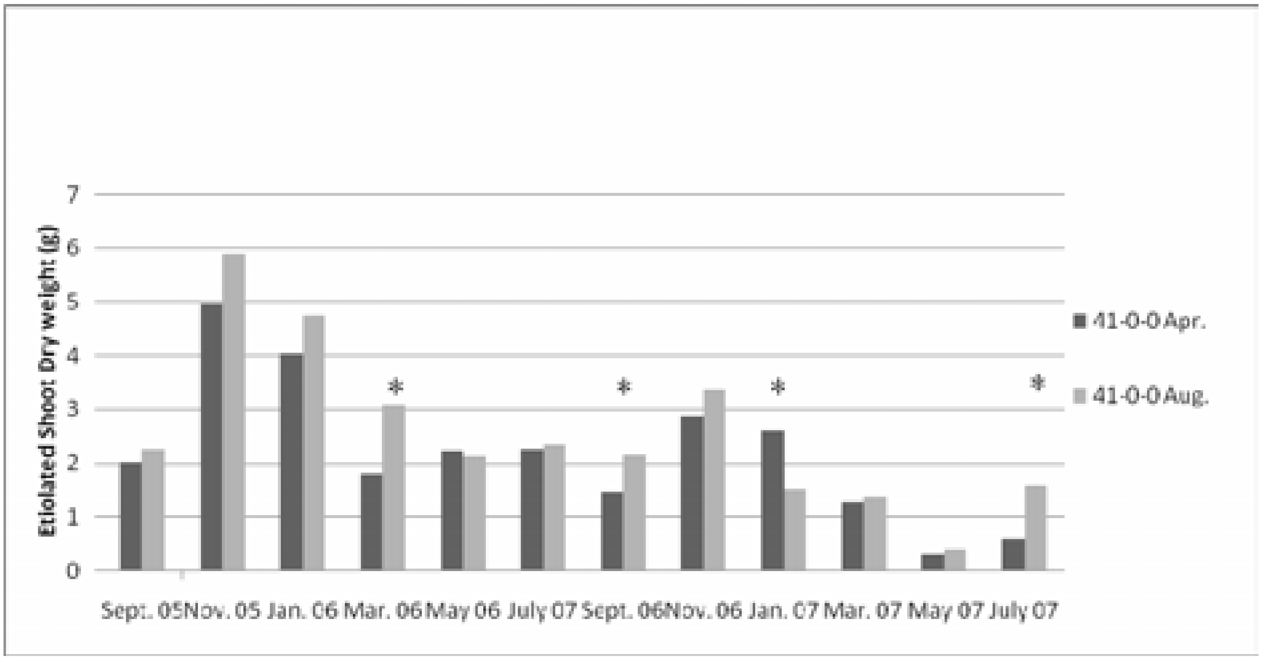


Figure 3. Effect of application timing of a polymer-coated N source (41-0-0) on bimonthly Midlawn Bermudagrass biomass.
*significant at $P \leq 0.05$

Low Input Sustainable Turfgrass Trial (LIST): A Regional Cooperative Research Project

Objective:	Identify species that can perform as acceptable turf under low-input conditions
Investigator:	Rodney St. John

INTRODUCTION

Because of decreasing water supplies and increasing pressure from the public to use fewer pesticides, turfgrass areas need to be maintained with fewer inputs. Many turfgrass breeders are focusing on enhancing current turfgrass species and developing new varieties that use less water and are resistant to more pests. The objective of this project is to identify alternative grass species that are adapted to this region and require minimal inputs. This is a joint North Central Region project being conducted at 11 different university locations throughout the Midwest. This study is a follow-up to previous low-input sustainable turfgrass (LIST) studies. Species, varieties, and maintenance practices used in this study were chosen based on results of previous studies.

MATERIALS AND METHODS

The trial was planted as a randomized complete block design with three replications (25 plots per replication, 75 plots total). Individual plot size was 3 ft × 5 ft. A border of at least 5 ft was planted around the perimeter of the trial. Plots were seeded at rates listed in Table 1 in September 2007 and covered with a Futerra Environet (Profile Products, LLC, Buffalo Grove, IL) seeding blanket. A starter fertilizer was applied at the time of seeding at 1.5 lb/1,000 ft^2 P_20_5. The trial was irrigated during establishment. No pesticides were used at any time.

The trial is mowed monthly at a height of 3 in. during the growing season, clippings returned. No irrigation, fertilizer, or pesticides will be applied.

Persistence and uniformity will be the two primary criteria used to determine quality for each plot. Turfgrass quality and stand density data will be taken monthly during the growing season (April-October) following the National Turfgrass Evaluation Program protocol (1-9 scale, 9 = greatest quality). Establishment vigor was evaluated on a 1-9 scale 8 weeks after seeding and will be evaluated during the first week of May 2008. When disease occurs, the disease will be identified and the percentage of the plot affected will be recorded. Data will be collected for two full growing seasons; the study will end in the fall of 2009.

RESULTS

The trial is in the first full year of data collection. Establishment vigor data is presented in Table 1. Research plots received a heavy downpour just a few days after seeding in the fall of 2007. The Futerra Environet seeding blanket held the seed in place and prevented erosion from within the plots. Other areas outside of the LIST study that were not covered by Futerra Environet had considerable erosion and seed loss.

Table 1. Cultivars included in the LIST trial[a]

Common name	Species	Cultivar	Seeding rate (g/plot)	Establishment (%)
Tall fescue	*Festuca arundinacea*	Barlexas II	40	98.3
Hard fescue	*Festuca trachyphylla*	SR 3150	25	96.7
Chewings fescue	*Festuca rubra* var. *commutata*	Intrigue	25	96.7
Chewings fescue	*Festuca rubra* var. *commutata*	Jamestown II	25	96.7
Colonial bentgrass	*Agrostis tenuis*	Barking	8	96.7
Tall fescue	*Festuca arundinacea*	Rebel Exeda	40	95
Tall fescue	*Festuca arundinacea*	Falcon IV	40	95
Hard fescue	*Festuca trachyphylla*	Reliant IV	25	95
Tufted hairgrass	*Deschampsia cespitosa*	SR 6000	15	95
Sheeps fescue	*Festuca ovina*	Barok	25	95
Chewings fescue	*Festuca rubra* var. *commutata*	Culumbra II	25	93.3
Colonial bentgrass	*Agrostis tenuis*	Revere	8	93.3
Idaho bentgrass	*Agrostis idahoensis*	Spike	8	90
Hard fescue	*Festuca trachyphylla*	Predator	25	88.3
Tufted hairgrass	*Deschampsia cespitosa*	Barcampsia	15	88.3
Sheeps fescue	*Festuca ovina*	Azay	25	88.3
Hard fescue	*Festuca trachyphylla*	Firefly	25	81.7
Texas bluegrass hybrid	*Poa pratensis ×arachnifera*	Thermal Blue	15	81.7
Kentucky bluegrass	*Poa pratensis*	Diva	15	80
Sheeps fescue	*Festuca ovina*	Azure	25	80
Prairie junegrass	*Koeleria macrantha*	SRK	15	76.7
Tufted hairgrass	*Deschampsia cespitosa*	ShadeChamp	15	75
Texas bluegrass hybrid	*Poa pratensis ×arachnifera*	Bandera	15	75
Prairie junegrass	*Koeleria macrantha*	Barleria	15	73.3
Texas bluegrass hybrid	*Poa pratensis ×arachnifera*	Dura Blue	15	70

[a] 25 different cultivars representing 10 different species were planted. Average percentage establishment was rated 8 weeks after seeding on November 10, 2007.

Measurement of Photosynthesis and Respiration in Turfgrass With Large and Small Surface Chambers

Objective:	1. Fabricate a large surface chamber for measuring canopy-level CO_2 fluxes in turfgrass 2. Compare measurements of photosynthesis and respiration among the new surface chamber, the large chamber of Murphy (2007), both closed-flow systems, and a smaller surface chamber attached to a Licor 6400, which uses an open-flow system 3. Measure and compare net photosynthesis and respiration and estimate gross photosynthesis of two cool-season turfgrasses with the three chambers
Investigators:	Dale Bremer, Jason Lewis, Jamey Deusterhaus, and Jay Ham
Sponsor:	Kansas Turfgrass Foundation

INTRODUCTION

Field measurements of photosynthesis in turfgrass are often conducted with surface chambers that cover a small area of the canopy. Measurements may not be representative of overall photosynthesis where spatial variability is high (e.g., in green leaf area index, soil moisture). Furthermore, measurements with many portable photosynthesis systems may take up to 4 min, during which time the conditions that affect photosynthesis (e.g., air temperature) may change significantly inside the chamber. We fabricated a large turfgrass chamber similar to the design of Murphy (2007) that measured photosynthesis more quickly than a typical small chamber used in turfgrass; the chamber covered 34 times more surface area than the smaller chamber (Figs. 1 and 2). Potential benefits of larger chambers include: 1) measurements that cover greater surface areas, which may reduce variability in photosynthesis measurements, and 2) faster measurements of photosynthesis, which may reduce undesirable temperature effects that can develop when chambers cover plots for longer measurement periods.

Theory of Operation

Instantaneous gross photosynthesis (Pg) can be calculated as:

Pg = Pnet + (Rc+Rs)

Where:

- Pnet (net photosynthesis) is measured with sunlit chambers: Pnet = Pg – (Rc + Rs);
- the sum of Rc (canopy respiration) and Rs (soil respiration) is measured with shaded chambers;
- the small chamber, which is an open-flow design, is partially pressurized and therefore blocks a portion of Rs from entering the chamber (Bremer and Ham, 2005);
- pressure inside the two large chambers is approximately equal to ambient atmospheric pressure and, therefore, chamber measurements include all soil respiration; and
- calculations of Pg cancel influence of Rc and Rs on photosynthesis measurements and thus also remove any bias of pressurization in the chamber on gross estimates of photosynthesis.

MATERIALS AND METHODS

- Chamber sides were constructed with clear Plexiglass; tops were covered with heat-stretched Propafilm-C.
- Chamber measurements were collected from tall fescue (*Festuca arundinacea* Schreb.) and Kentucky bluegrass (*Poa pratensis* L.) at the Rocky Ford Turfgrass Research Center, Manhattan, KS.
- Fluxes of CO_2 were measured with all three chambers on October 24, 2007.
- Measurements were collected with each chamber simultaneously under full sunlight and shaded conditions, respectively.
- Large chamber measurements were replicated four times each in tall fescue and Kentucky bluegrass.
- Measurements were collected from the same locations with both large chambers.
- Measurements with the small chamber were collected at three locations within the footprint of the large chambers for a total of 12 times in each turfgrass species
- An infrared thermometer mounted inside the midsized turf chamber allowed for estimates of canopy conductance.

RESULTS

- Net photosynthesis rates were calculated with data from sunlit chambers within 25 to 45 seconds during measurements according to models that best fit the data (linear or quadratic).
- Respiration (canopy + soil) rates were calculated with data from shaded chambers within 30 to 55 seconds according to models that best fit the data (linear or quadratic).
- Respiration was generally lower when measured with the small chamber than with the larger chambers, probably because the small, partially pressurized chamber blocked some Rs during measurements (Fig. 3).
- Canopy conductance was greater in tall fescue (1.41 cm/second) than in Kentucky bluegrass (1.23 cm/second).
- Air temperature inside the midsized chamber increased about 0.94^{o}C to 1.26^{o}C during measurements compared with increases of 1.03^{o}C to 1.48^{o}C in the smaller chamber; increases were generally similar among chambers (data not shown).
- Using estimates from among chambers, Pg was 6% to 18% greater in Kentucky bluegrass than tall fescue (Fig. 3).

CONCLUSIONS

- Equilibrium rates of CO_2 decrease (sunlit chambers) and increase (shaded chambers) were reached rapidly, so measurements of photosynthesis and respiration required only about 30 to 40 seconds after the system was placed on the plot.
- There was excellent agreement among the three chambers (± 12%) in determination of Pg despite measured differences in Pnet and Respiration. This suggests that errors caused by a chamber’s effect on soil respiration tended to cancel when Pg was calculated.
- In plot studies of turfgrass, evaluating treatment effects on Pg (using a combination of sunlit and shaded measurements) may have a distinct advantage over isolated measurements of Pnet or Respiration.

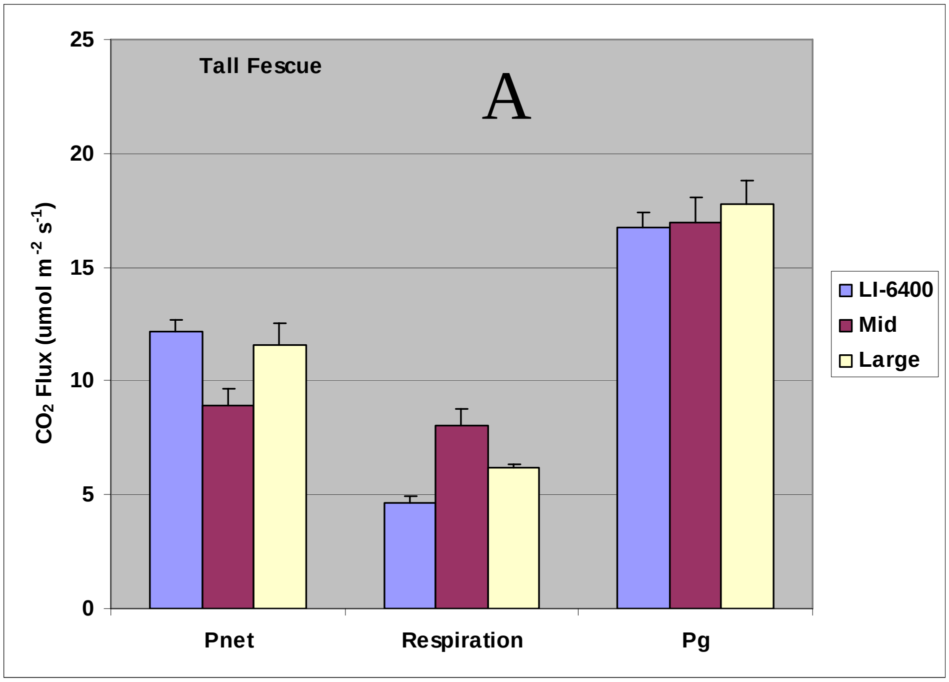
REFERENCES

Bremer, D.J., and J.M. Ham. 2005. Measurement and partitioning of in situ carbon dioxide fluxes in turfgrasses using a pressurized chamber. Agronomy Journal, 97:627-632 [errata: 98:1375].

Murphy, J.T. 2007. Patterns of carbon dioxide and water vapor flux following harvest of grass at different times during the growing season. Ph.D dissertation. Kansas State University, Manhattan.

Figure 1. Large chambers cover surface areas of 7.23×10^{-1} m^2 (large chamber at left, Murphy, 2007) and 2.4×10^{-1} m^2 (mid-sized chamber at right). The small chamber attached to a Licor 6400 (center) covers only 7.09×10^{-3} m^2.

Figure 2. Large chamber fabricated to measure CO_2 fluxes in turfgrass. The system was connected to and controlled by a datalogger in the red cooler.



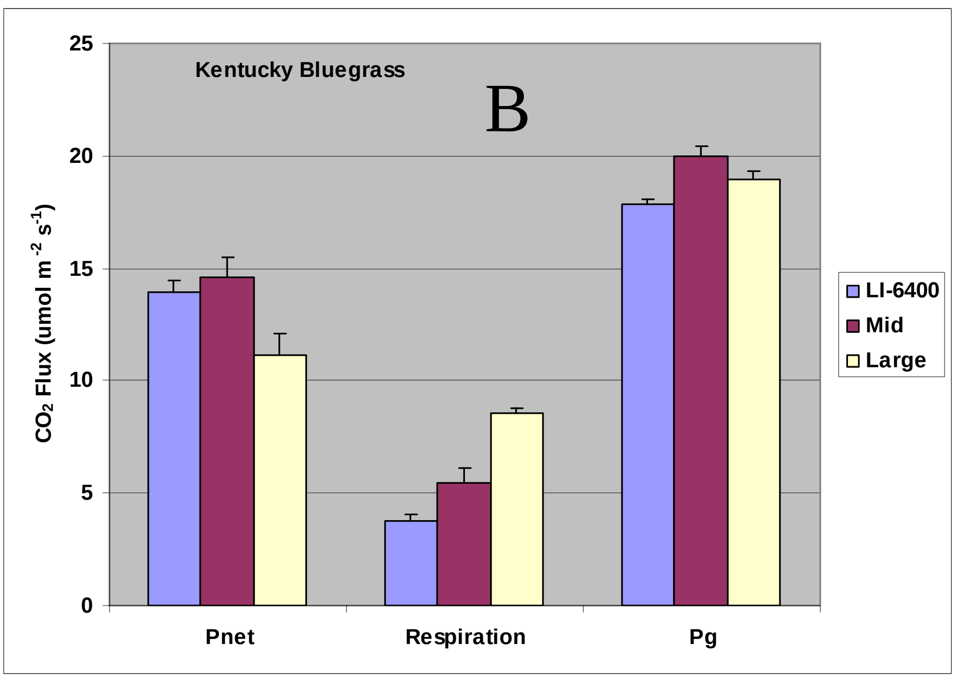


Figure 3. Estimates of net photosynthesis (Pnet), respiration (canopy and soil), and gross photosynthesis (Pg) in tall fescue (A) and Kentucky bluegrass (B). Small chamber is denoted by LI-6400.

Potential for Slow-Release Polymer-Coated and Organic Nitrogen Fertilizers to Mitigate Greenhouse Gas (Nitrous Oxide) Emissions in Turfgrass

Objective:	Investigate nitrous oxide (N_2O) emissions from turfgrass fertilized with urea and two controlled-release fertilizers: polymer-coated N and organic N
Investigators:	Dale Bremer and Jason Lewis
Sponsors:	International Plant Nutrition Institute, Kansas Turfgrass Foundation Agrium and Sustane contributed slow release polymer-coated and organic N fertilizers, respectively

INTRODUCTION

Recent attention on global warming and climate change has increased awareness of the public, industry, and government about the importance of mitigating greenhouse gas emissions from anthropogenic activities. Agriculture contributes more than 80% of emissions of nitrous oxide (N_2O), a major greenhouse gas, into the atmosphere. Typically, N_2O emissions are increased by nitrogen (N) fertilization of crops including turfgrass, which may be the most significant crop in urban agriculture in terms of land area coverage. In the United States, 16 to 20 million ha of urbanized land, up to 18% of the land area in some regions, are covered with turfgrasses (e.g., golf courses, sports fields, parks, home lawns); this represents an area three times larger than any irrigated crop. Because turfgrass is often fertilized with N, urban areas probably contribute increasingly to atmospheric N_2O. This indicates a need for research to identify best management practices that mitigate N_2O emissions in turfgrass. One such practice is use of N fertilizers that result in lower emissions of N_2O. Controlled-release N fertilizers may reduce greenhouse gas emissions in turfgrass because they can slow the processes of nitrification and denitrification, main sources for N_2O emissions in fertilized turfgrass. In this study, which is only halfway completed and will conclude in the fall of 2008, we are investigating N_2O emissions from turfgrass using two controlled-release fertilizers: polymer-coated N and organic N. Polymer-coated N is formulated for only one application per season and designed to release N slowly over the entire season. An increasing interest in eco-friendly organic products makes organic N fertilizer an attractive alternative to consumers, particularly if it is found to reduce greenhouse gas emissions compared with synthetic fertilizers.

MATERIALS AND METHODS

We investigated the effects of polymer-coated (Agrium, Calgary, Alberta, CA) and organic (Sustane, Cannon Falls, MN) N fertilizers on N_2O emissions from Bermudagrass turf during the summer of 2007 and will continue investigating during 2008. This study includes three treatments: urea, polymer-coated N, and organic N. Weekly measurements of N_2O emissions are collected using small surface chambers from May through September and more frequently (≈ two or three times) during the week following fertilizations. Gas samples collected from the chambers are transported to the laboratory and analyzed with gas chromatography. Bermudagrass is fertilized annually with 4.0 lb/1,000 ft^2 N during the study. Urea and organic N applications are 1.0 lb/1,000 ft^2 in May, June, July, and August. Fertilization with polymer-coated N is applied only once at the beginning of the study because of its slow-release design and is formulated according to the manufacturers' guidelines. This research is being conducted at the Rocky Ford Turfgrass Research Center in Manhattan, KS. In addition to N_2O emissions, soil moisture, temperature, and soil nitrate and ammonium concentrations are being measured concurrently; these ancillary factors have been shown to affect N_2O emissions. Climatic conditions are monitored with a weather station located at the site. Visual turf quality is also assessed in all plots at the beginning of the study and prior to each fertilization during the study.

RESULTS

Emissions of N_2O consistently increased among treatments after each fertilization including in polymer-coated N, which was not fertilized on the second, third, and fourth fertilizer treatment dates (Fig. 1). The increase in N_2O fluxes in polymer-coated N plots after fertilization dates likely was caused by irrigation that was applied after N fertilization to minimize ammonia volatilization of N fertilizers. Wetter soils generally increase denitrification rates, which typically results in greater N_2O emissions than from drier soils. Emissions from urea, however, were sometimes higher than from either slow-release fertilizer after fertilization. In general, N_2O emissions returned to pre-N fertilization levels among fertilizer treatments after 7 to 10 days. Emissions also increased among plots after irrigation or precipitation. The relationship between soil temperature (at 1 in. depth) and N_2O emissions was weaker than between soil moisture and emissions, although emissions were lower during winter when soils were cold (e.g., at or below freezing). There were no significant correlations between N_2O emissions and soil ammonium and nitrate levels. Emissions of N_2O from turfgrass are complex, however, and likely were affected partially by all factors including fertilizer type, soil moisture levels, soil temperatures, and soil N levels (i.e., ammonium and nitrate).

Cumulative N_2O emissions during the first year ranged from 2.0 to 2.3 kg N_2O-N/ha (1.8 to 2.1 lb/a) and were statistically similar among N fertilizer sources (Fig. 2); cumulative emissions during the summer were about 1% of the N fertilizer applied. Numerically, however, N_2O emissions were highest from urea and lowest from the organic slow-release fertilizer. Strict interpretation of the data indicates that fertilizer type, including controlled-release N, does not affect overall N_2O emissions from turfgrass. Variability is high in this type of data collection, which complicates statistical detection of differences among fertilizer treatments. We will measure N_2O emissions for another growing season (2008), and it will be interesting to observe whether the trend of higher N_2O emissions from urea-fertilized than from slow-release-fertilized turfgrass continues in 2008 and if so, whether differences will be statistically significant.

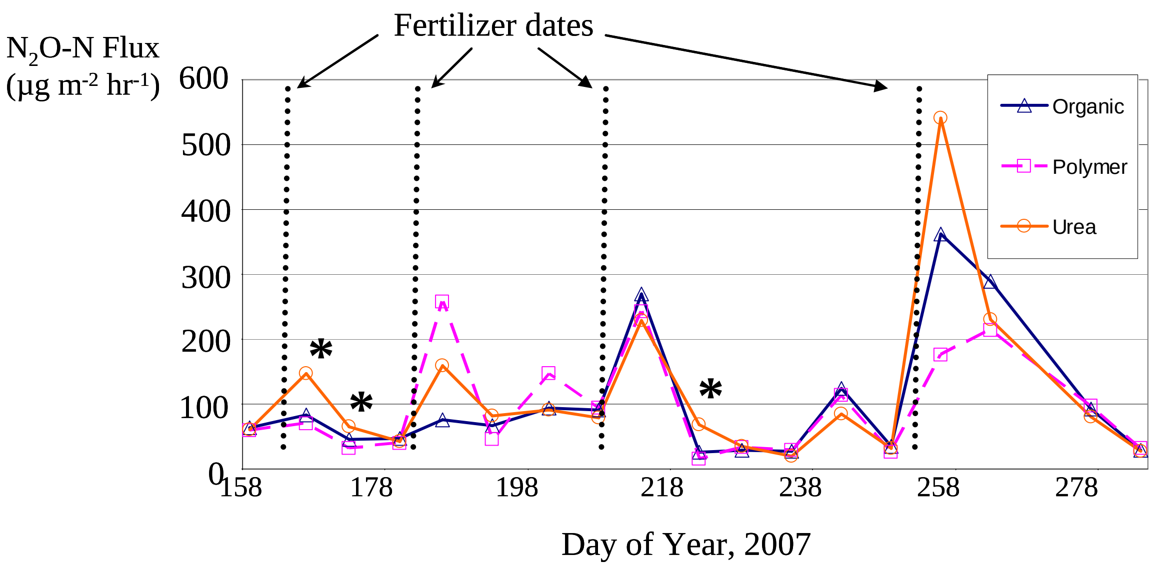


Figure 1. N_2O emissions from Bermudagrass during the summer of 2007. Asterisk indicates significant differences among treatments on a given day ($P < 0.05$).

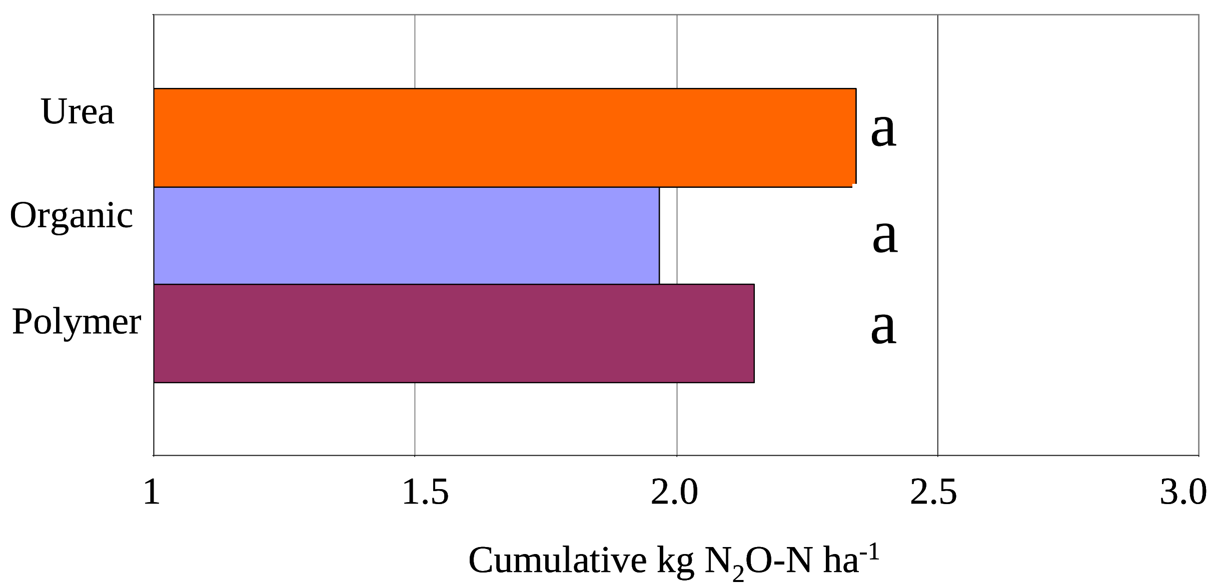


Figure 2. Cumulative N_2O emissions from Bermudagrass during the summer of 2007. Bars followed by the same letter indicate means are not significantly different ($P < 0.05$).

Emissions of Nitrous Oxide from Three Different Turfgrass Species

Objective:	Investigate the seasonal magnitude and patterns of nitrous oxide (N_2O) fluxes in one cool-season and two warm-season turfgrasses
Investigators:	Jason Lewis and Dale Bremer
Sponsor:	Kansas Turfgrass Foundation

INTRODUCTION

Fertilizing different turfgrass species (e.g., warm- and cool-season turfgrasses) with nitrogen (N) at different rates and frequencies may affect N_2O emissions. Therefore, selection of different turfgrass species may be a useful management tool for mitigating N_2O emissions from turfgrass ecosystems. In this study, we investigated N_2O emissions from three turfgrass species fertilized at typical N rates for each species.

MATERIALS AND METHODS

Eighteen plots, six plots per species, were arranged and established in a repeated Latin square design (Fig. 1). One cool-season (perennial ryegrass, *Lolium perenne* L.) and two warm-season (Bermudagrass [*Cynodon dactylon*] and zoysiagrass [*Zoysia japonica*]) turfgrass species were investigated. Urea N fertilizer was applied to turfgrasses according to the schedule presented in Table 1. Soil fluxes of N_2O were measured weekly to monthly from June 2006 to February 2008 using static surface chambers and analyzing N_2O by gas chromatography. Turfgrass irrigation requirements were determined with the Penman-Monteith equation (FAO-56), and all plots were irrigated as needed by hand to ensure uniformity. Plots were mown at 2.5 in. twice weekly with a rotary mower during the growing season. Ancillary measurements of soil moisture, soil temperature, and soil ammonium and nitrate were also collected to evaluate their effects on N_2O emissions.

RESULTS

Daily fluxes of N_2O ranged from -17.63 µg N_2O-N/m^2 per hour on September 25, 2007, to 1633.59 µg N_2O-N/m^2 per hour on July 11, 2006 (Figs. 2 and 3). Nitrogen fertilizer increased N_2O emissions up to 45-fold within 1 day, although the amount of increase differed after each fertilization. Soil water filled pore space and soil temperatures were positively correlated with fluxes of N_2O (i.e., N_2O emissions were generally greater when soils were wetter and warmer). During the 21-month study, cumulative emissions of N_2O-N from Bermudagrass were about 22% greater than from perennial ryegrass and 40% greater than from zoysiagrass. Cumulative fluxes were 5.97 kg/ha (5.3 lb/a) in Bermudagrass, 4.91 kg/ha (4.4 lb/a) in perennial ryegrass, and 4.27 kg/ha (3.8 lb/a) in zoysiagrass (Fig. 4). Percentages of total N fertilizer volatilized as N_2O were 1.5% in Bermudagrass, 1.3% in perennial ryegrass, and 2.3% in zoysiagrass. Although total N_2O-N emissions were lower in zoysiagrass than Bermudagrass, the percentage of N fertilizer lost as N_2O was higher in zoysiagrass. Greater emissions from Bermudagrass than zoysiagrass were likely caused by greater N inputs in Bermudagrass (i.e., 4 lb/1,000 ft^2 annually in Bermudagrass compared with 2 lb/1,000 ft^2 in zoysiagrass). Conversely, emissions were greater from Bermudagrass than from ryegrass despite receiving identical fertilizer N inputs on an annual basis. Therefore, greater emissions from Bermudagrass than from perennial ryegrass may have been related more to fertilization timing; soil was warmer during summer months when Bermudagrass was fertilized and cooler in the fall and spring when ryegrass was fertilized.

Table 1. Fertilization schedule for Bermudagrass, perennial ryegrass, and zoysiagrass

	Bermudagrass	Perennial ryegrass	Zoysiagrass
	--------------------------------lb/1,000 ft^2 N	------------------------------	
May	1.0	1.0	1.0
June	1.0	---	---
July	1.0	0.5	1.0
August	1.0	---	---
September	---	1.5	---
November	---	1.0	---

Figure 1. Plots of perennial ryegrass, zoysiagrass, and Bermudagrass. Measurements of N_2O were collected from each plot with static surface chambers as shown.

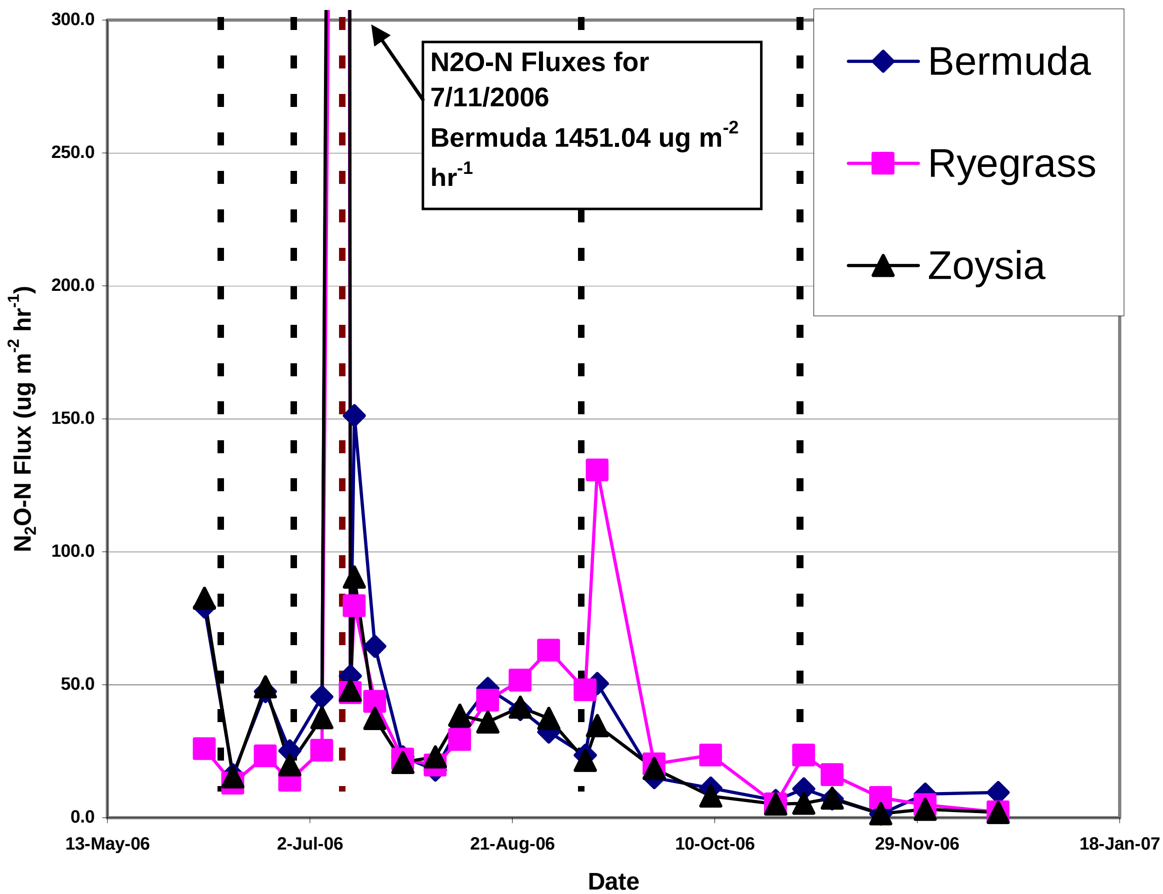


Figure 2. Patterns of N_2O nitrogen fluxes among turfgrass species from June 6, 2007, to December 12, 2007. Vertical dashed lines represent N fertilization dates.

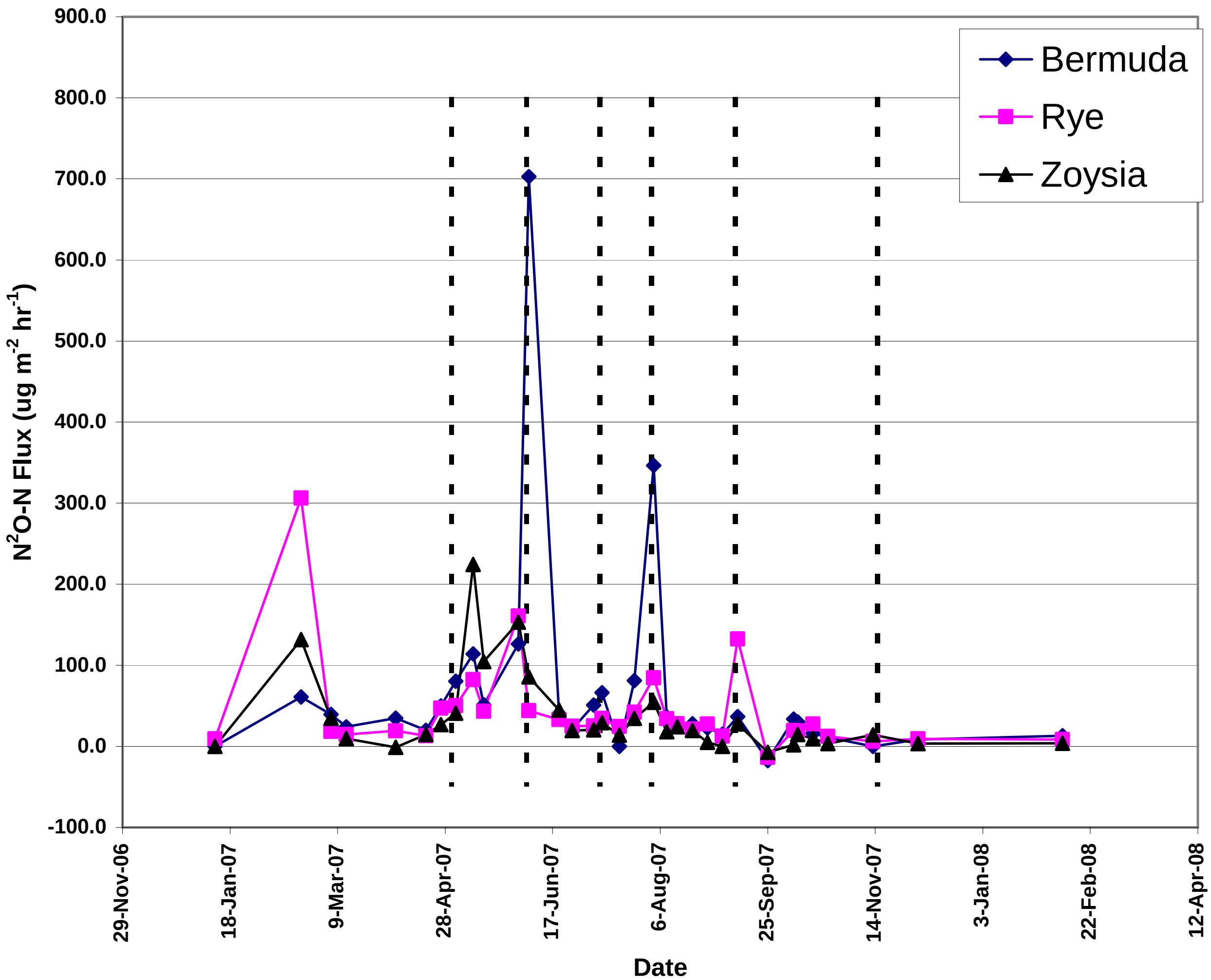


Figure 3. Patterns of N_2O nitrogen fluxes among turfgrass species from January 11, 2007, to February 9, 2008. Vertical dashed lines represent N fertilization dates.

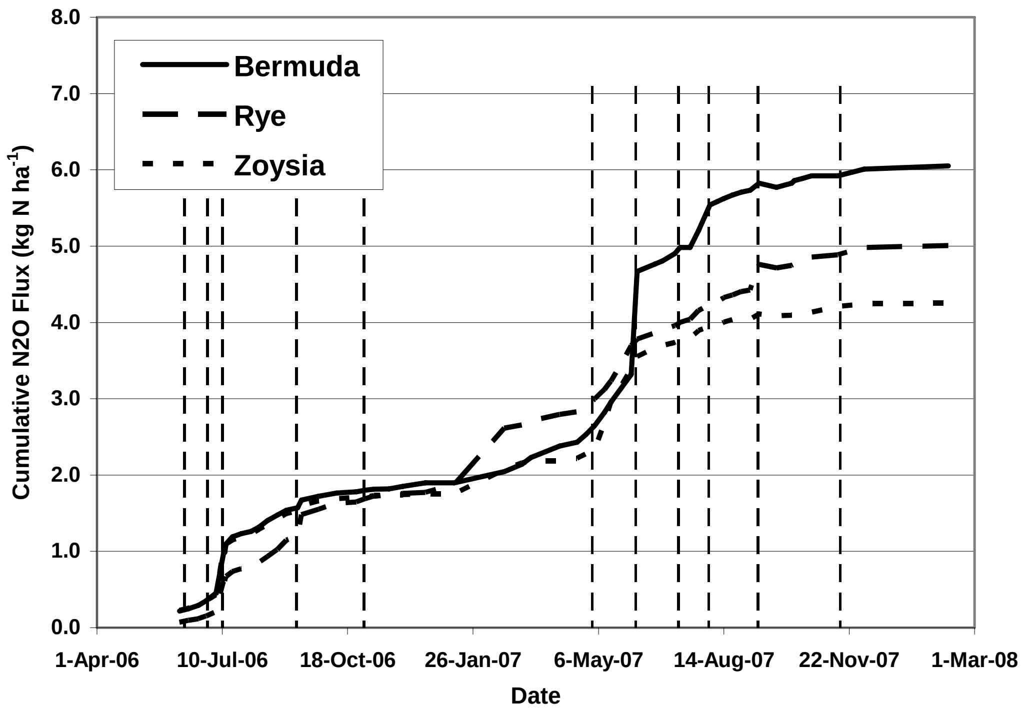


Figure 4. Cumulative fluxes of N_2O-N from turfgrass species over the entire study. Vertical lines represent N fertilization dates.

Evaluation of Preventative Fungicide Applications for Control of Fairy Ring on Creeping Bentgrass

Objective:	Evaluate preventative fungicide applications for control of fairy ring
Investigators:	Megan Kennelly and Brandon Gonzalez
Sponsor:	Bayer

INTRODUCTION

Fairy ring is caused by many different fungi. Symptoms include rings of dead turf (Type 1), rings of stimulated/dark green turf (Type 2), or rings of mushrooms (Type 3). This study was conducted to evaluate several fungicides for disease prevention.

MATERIALS AND METHODS

The study was conducted in 2007 on an established creeping bentgrass putting green with a sand-based soil at Alvamar Country Club, Lawrence, KS. Turf was mowed to a height of 0.115 in., irrigated as needed, and fertilized with 2.75 lb/1,000 ft^2 N during the growing season. As part of routine green maintenance, the entire study area was treated with Bayleton SC (1 oz/1,000 ft^2) on March 28, 2007. Fungicide applications were made beginning May 21 at intervals indicated in Table 1. Fungicides were applied with a CO_2-powered boom sprayer with XR Tee Jet 8003VS nozzles at 30 psi in water equivalent to 2.0 gal/1,000 ft^2 and irrigated immediately afterward with 0.1 to 0.2 in. water. Plots were 5 ft × 5 ft and arranged in a randomized complete block design with four replications. Plots were rated by visually estimating the percentage of each plot with Type 2 (green rings and arcs of stimulated turf, no dead turf, no mushrooms) or Type 1 (rings or arcs of dead turf) symptoms.

RESULTS

See Table 1 for details. Fairy ring developed in June with Type 2 symptoms on the first three rating dates, and symptoms progressed to Type 1 rings in July. Although as much as 25% of the plot area in some individual plots was affected by ring/arc symptoms, there were no treatment differences on any rating dates. No phytotoxic effects were observed.

Table 1. Fairy ring severity in experimental plots

	Spray	Disease severity[b]				
Treatment and rate/1,000 ft^2[a]	interval (days)	June 4	June 11	June 21	July 12	July 23
Unsprayed control	---	2.5	2.5	2.0	3.0	1.75
Bayleton 4SC 1.5 fl oz + Revolution L 6.0 fl oz	21	0.0	0.0	0.0	3.75	1.5
Bayleton 4SC 1.5 fl oz + Revolution L 6.0 fl oz	28	0.6	0.3	1.0	1.3	2.0
Lynx 240SC 1.5 fl oz + Revolution L 6.0 fl oz	21	2.5	1.3	0.0	0.0	0.0
Lynx 240SC 1.5 fl oz + Revolution L 6.0 fl oz	28	0.0	1.3	0.5	0.0	0.0
Tartan 2.4SC 2.0 fl oz + Revolution L 6.0 fl oz	21	0.0	0.0	1.0	0.0	0.0
Bayleton 4SC 2.0 fl oz + Revolution L 6.0 fl oz THEN Prostar 70WP 2.2 oz + Revolution L 6.0 fl oz	21	2.5	2.5	0.0	5.5	6.3
Prostar 70WP 2.2 oz + Revolution L 6.0 fl oz THEN Prostar 70WP 2.2 oz	21	0.5	0.0	1.3	2.5	1.4
Revolution L 6.0 fl oz	21	1.3	1.3	1.0	6.3	4.0

[a] 21-day products were applied on May 21 and June 11. 28-day products were applied on May 21 and June 21.

[b] Values are means of four replicates. Values on June 4, 11, and 21 represent Type III fairy rings (rings of dark turf), and values on July 12 and 21 are Type I fairy rings (dead turf). Values were log (x +1) transformed prior to analysis using Tukey's pairwise comparisons (family error rate *P* = 0.05).

Preventative Fungicide Applications for Management of Dollar Spot on Greens-Height Creeping Bentgrass

Objective:	Evaluate fungicides for management of dollar spot
Investigators:	Megan Kennelly and Brandon Gonzalez
Sponsors:	BASF, Cleary Chemical, Bayer

INTRODUCTION

Dollar spot, a common disease caused by the fungus *Sclerotinia homoeocarpa*, appears on greens nearly every year. It can develop throughout the growing season but is most common in spring through early summer and late summer through early fall. In low-cut (e.g., putting green) turf, the disease appears as sunken patches of tan/brown turf up to about 2 in. in diameter. In severe cases, infection spots coalesce to form larger blighted areas. Many fungicides are labeled for dollar spot suppression in golf courses. This study was conducted to evaluate efficacy of several standard and newer fungicides for dollar spot control.

MATERIALS AND METHODS

Fungicides were evaluated in 2007 on an established stand of Penncross creeping bentgrass grown on a sand-based putting green at the Rocky Ford Turfgrass Research Center, Manhattan, KS. Turf was mowed to a height of 0.156 in., irrigated daily for 15 min, and fertilized with 2.25 lb/1,000 ft^2 N during the season. Applications were made at 2-, 3-, or 4-week intervals beginning May 25. Fungicides were applied with a CO_2-powered boom sprayer with XR Tee Jet 8003VS nozzles at 30 psi in water equivalent to 2.0 gal/1,000 ft^2. Plots were 4 ft × 5 ft and arranged in a randomized complete block design with four replications. Plots were rated every 1 to 2 weeks from June 6 through September 21 by counting the number of dollar spot infection centers per plot.

RESULTS

See Table 1 for details. On May 25, prior to the first application, there was an average of 5.1 infection centers per plot across the entire area. During the trial, dollar spot had three peak periods of activity (mid-June, early August, and September) separated by periods of very low activity. On June 6, all products except Tartan (1.0 and 1.9 fl oz), Lynx (0.75 and 1.0 fl oz), Nativo, Headway, and Insignia significantly reduced disease compared with the untreated control, with less than three infection centers per plot. On all other rating dates, all materials except Insignia provided significant disease reductions compared with the untreated control, with less than five infection centers per plot. On August 3 and September 6, plots treated with Insignia had higher dollar spot severity and more than double the number of infection centers than the untreated control. No phytotoxic effects were observed.

Table 1. Dollar spot severity in experimental plots

Treatment[a]	Spray interval (days)	Disease severity[b] June 6	June 19	Aug. 3	Sept. 6	Sept. 21
Untreated control	---	15.3ab	39.0a	71.8b	44.5b	44.5a
Tartan II 238SC 1.0 fl oz	14	2.3abc	0.8b	0.0c	0.0c	0.0b
Tartan II 238SC 1.3 fl oz	14	0.0c	0.0b	0.0c	0.0c	0.0b
Tartan II 238SC 1.9 fl oz	14	2.5abc	0.0b	0.0c	0.0c	0.0b
Lynx 2SC 0.75 fl oz	14	1.8bc	0.5b	0.0c	0.0c	0.0b
Lynx 2SC 1.0 fl oz	14	4.8abc	0.5b	0.0c	0.0c	0.0b
Lynx 2SC 1.5 fl oz	14	1.0c	0.3b	0.0c	0.0c	0.0b
Nativo 300SC 0.6 fl oz	14	2.0bc	0.3b	0.3c	0.5c	0.0b
Nativo 300SC 1.2 fl oz	14	3.3abc	0.0b	0.0c	0.0c	0.0b
Headway SC 1.5 fl oz	14	1.3bc	0.0b	0.0c	0.0c	0.0b
26/36 3.8SC 3.0 fl oz	14	0.3c	0.0b	0.0c	0.0c	0.0b
3336 Plus 19.4%SC 2.0 fl oz	14	0.0c	0.0b	0.5c	0.0c	0.0b
3336 4F 2.0 fl oz	14	0.8c	0.0b	0.3c	0.0c	0.0b
3336 4F 2.0 fl oz + CLEXP13 1.3 fl oz	14	0.0c	0.0b	0.0c	0.0c	0.0b
3336 4F 2.0 fl oz + CLEXP 14 0.3 fl oz	14	0.3c	0.0b	0.0c	0.0c	0.0b
Trinity 1.69SC 2.0 fl oz	28	0.8c	0.0b	0.0c	0.5c	0.0b
Trinity 1.69SC 1.5 fl oz	21	1.0c	0.0b	0.0c	0.0c	0.0b
Emerald 70WG 0.18 oz	21	0.8c	0.0b	0.0c	0.0c	0.0b
Insignia 20WG 0.9 oz	28	12.0ab	57.0a	165.8a	113.5a	54.3a

[a] 14-day treatments were applied on May 25, June 6 and 20, July 2 and 19, August 6 and 23, and September 6 and 20. 21-day treatments were applied on May 25, June 13, July 2 and 25, August 15, and September 6. Insignia was applied May 11, June 6, July 2, August 6, and September 6. The Trinity 28-day treatment was applied on May 25, June 20, July 19, August 15, and September 20.

[b] Values represent the mean number of dollar spot infection centers per plot for four replicates. Values were log (x +1) transformed prior to analysis. Within columns, means followed by the same letter are not significantly different according to Tukey's pairwise comparisons (family error rate P = 0.05).

Fungicide Applications for Control of Large Patch on Zoysiagrass

Objective: Evaluate fungicides for suppression of large patch

Investigators: Megan Kennelly and Jack Fry
Sponsors: Bayer, Cleary Chemical, Syngenta

INTRODUCTION

Large patch of zoysiagrass is caused by the fungus *Rhizoctonia solani* AG 2-2. The disease causes large areas of blighted turf. Symptoms can appear in fall as turf enters dormancy or spring as turf emerges from dormancy. This study was conducted to test several products and different timings of one product for control of large patch.

MATERIALS AND METHODS

Fungicides were evaluated on an established stand of Meyer zoysiagrass at the Manhattan Country Club, Manhattan, KS. Turf was mowed to a height of 0.5 in. and fertilized with 3 lb/1,000 ft^2 N during the season. Treatments were applied twice at 4-week intervals beginning September 18 or 19, 2006, except Heritage (TL 0.8 MEC), which was applied once on four staggered dates. Fungicides were applied with a CO_2-powered boom sprayer with XR Tee Jet 8003VS nozzles at 30 psi in water equivalent to 2.0 gal/1,000 ft^2. Plots were 5 ft × 8 ft and arranged in a randomized complete block design with four replications. Plots were rated periodically through October 2006 until turf became dormant and again starting at green-up in April and May 2007 by visually estimating the percentage of infected area per plot.

RESULTS

See Table 1 for details. Large patch symptoms developed quickly and unexpectedly during September 16-17, 2006, immediately prior to the first fungicide applications. Disease severity increased over the next month, and on October 18, only Tartan II (both rates), TBZ + TFS at 2.0 oz, and Nativo had significantly lower disease severity compared with the untreated control, though Tartan II at 1.0 oz started with a lower disease pressure. In the spring, symptoms first developed in late April when turf became active. On May 14 and 21, there were no significant differences among treatments. On May 30, all treatments except Tartan II at the 2.0-oz rate and the late application of Heritage had significantly lower disease severity than the control. There were no significant differences among the different Heritage timing treatments on any rating dates, but the early treatment consistently led to the numerically lowest disease severity. All fungicides suppressed disease severity compared with levels observed in the fall. No phytotoxic effects were observed, and there were no differences in green-up in the spring.

Table 1. Large patch severity in experimental plots

Treatment[a]	Spray interval (days)	Disease severity[b] Sept. 18	Oct. 18	Apr. 30	May 14	May 21	May 30
Untreated control	---	10.0bc	47.5a	7.5ab	15.0	15.0	13.8a
Tartan 288SC 2.0 fl oz	28	46.3ab	42.5ab	0.0c	5.0	2.5	0.0c
Lynx 240SC 1.5 fl oz	28	1.3c	17.5abcd	0.0c	0.0	0.0	0.0c
TBZ[c] 240SC 1.5 fl oz	28	28.8b	35.0abc	0.0c	0.0	0.0	0.0c
Tartan II 240.6SC 1.0 fl oz	28	2.5c	12.5bcd	2.5bc	2.5	2.5	0.0c
Tartan II 240.6SC 2.0 fl oz	28	12.5b	8.8cd	0.0c	1.8	2.5	1.8abc
TBZ + TFS[d] 250SC 1.0 fl oz	28	20.0b	32.5abcd	0.0c	3.8	5.0	1.3bc
TBZ + TFS[w] 250SC 2.0 fl oz	28	21.3b	7.5cd	0.0c	1.3	1.3	0.0c
Prostar 70WG 2.2 oz	28	22.5b	23.8abcd	2.5bc	1.3	0.0	0.0c
Bayleton 480SC 2.0 fl oz	28	17.5b	40.0ab	0.0c	0.0	0.0	0.0c
Heritage TL 96SC 1.5 fl oz	28	15.0b	21.3abcd	0.0c	0.0	0.0	0.0c
Nativo 300SC 1.2 fl oz	28	12.5b	6.3d	0.0c	0.5	1.3	1.3bc
Endorse 2.5WP 4.0 oz	28	15.0b	20.0abcd	0.0c	5.0	5.0	1.3bc
26/36 SC 4.0 fl oz	28	31.3b	40.0ab	0.0c	0.0	0.0	0.0c
CL-EXP-09 45%DF 1.2 oz	28	10.0b	15.0abcd	0.0c	0.0	0.0	0.0c
Heritage 50WG 0.2 oz (week 1)	---	10.0b	22.5abcd	0.0c	1.3	1.3	1.3bc
Heritage 50WG 0.2 oz (week 2)	---	25.0b	28.8abcd	2.5bc	10.0	10.0	1.3bc
Heritage 50WG 0.2 oz (week 3)	---	15.0b	23.8abcd	0.0c	2.5	5.0	1.3bc
Heritage 50WG 0.2 oz (week 4)	---	28.8b	27.5abcd	0.0c	5.5	8.8	6.3ab

[a] Endorse, 26/36, and CL-EXP-09 were applied on September 19 and October 16, 2006. All other 28-day treatments were applied on September 18 and October 16, 2006. Heritage treatments labeled week 1, 2, 3, and 4 were applied on September 18 and 25 and October 1 and 8, respectively.

[b] Values are means of four replicates. Disease severity was assessed by visually estimating the percentage of infected area in each plot. Disease severity values on September 18 were prior to fungicide application. Values were changed from percentage to proportions (0-1) and subject to the arcsin($\sqrt{x}$) transformation prior to analysis. Within columns, means followed by the same letter are not significantly different (P = 0.05) by Fisher's Protected LSD.

[c] TBZ = trifloxystrobin.

[d] TBZ + TFS = tebuconazole 200 g/L + trifloxystrobin 50 g/L.

Lateral Spread of Tall Fescue Cultivars and Blends

Objective:	Compare lateral spread of tall fescue cultivars and blends with Kentucky bluegrass
Investigators:	Jack Fry, Rodney St. John, Dale Bremer, and Steve Keeley
Sponsors:	Kansas Turfgrass Foundation We are also grateful to Hummert International, Barenbrug USA, and seed Research of Oregon for providing seed for this research

INTRODUCTION

Some new tall fescue cultivars and blends have been advertised as being rhizomatous, which results in faster establishment and recovery time. More research is needed to determine the extent of this rhizomatous nature in tall fescue. Barenbrug USA researchers reported that Labarinth tall fescue produced more and longer rhizomes than several other tall fescue cultivars when evaluated 20 months after transplanting 2-month-old plants. Ohio State University researchers evaluated six tall fescue cultivars including some purported to be rhizomatous and found that the average number of plants producing a rhizome was 21% and all rhizomes were less than 3 cm long. More information is needed to evaluate the rhizomatous potential of tall fescue cultivars and its influence on lateral spread and recuperative ability.

MATERIALS AND METHODS

Six different cultivars or blends were seeded into a silt loam soil in 5-ft × 5-ft plots arranged in a randomized complete block design on September 14, 2005, at the Rocky Ford Turfgrass Research Center, Manhattan, KS. Each cultivar was replicated four times. Tall fescues evaluated were Grande II, Regiment II, Barlexus, Water Saver RTF tall fescue blend (39.84 Labarinth; 29.93 Barlexus II; 29.86 Barrington), and Kentucky-31. SR2284 Kentucky bluegrass was also included. Grande II, Regiment II, and the Water Saver RTF blend (particularly the Labarinth cultivar in the blend) are purported to be more prolific rhizome producers. Tall fescue was seeded at 7 lb/1,000 ft^2, and Kentucky bluegrass was seeded at 2 lb/1,000 ft^2. Seed was mixed with Milorganite to provide 1 lb/1,000 ft^2 N at the time of seeding. Nitrogen from urea was applied at 1 lb/1,000 ft^2 in November 2005 and May and September 2006. Turf was irrigated to prevent drought stress and mowed at least once weekly at 3 in.

During the fall of 2005, percentage of coverage during the establishment period was determined weekly through 9 weeks after seeding using a First Growth camera.

On July 28, 2006, four 4-in.-diameter × 4-in.-deep (10.2-cm diameter) plugs were removed from the center of each plot. On August 1, 2006, a uniform circle (1-ft diameter × 4-in. deep) was cut in the center of each plot around the area where plugs were removed, and voids were filled with the same field soil to return to the original level. Plugs were planted in an adjacent area for another study in which lateral spread will be evaluated (data not shown). Hand weeding within each circular void was done as needed. On August 31 and October 5, 2006, the number of emerging daughter plants arising from rhizomes within each void was counted. On August 31, the greatest distance from the circle's edge that a newly emerging daughter plant was observed was also recorded. On May 5 and October 7, a ruler was used to measure the diameters of the voids remaining in the center of the plots and the diameter to which plugs had spread in the adjacent study area. Data were subjected to analysis of variance, and means were separated using an F-LSD ($P < 0.05$).

RESULTS

Establishment Rate

Kentucky bluegrass was slowest to establish following seeding in the fall of 2005 (Fig. 1). Among tall fescues, Kentucky-31 exhibited greater coverage 3 weeks after seeding than other cultivars and was greater than at least one other tall fescue cultivar on all rating dates. Regiment II had lower levels of coverage than at least one cultivar other than Kentucky-31 at 2 to 5 weeks after seeding and 7 weeks after seeding. Coverage of other tall fescue cultivars and blends was intermediate between Regiment II and Kentucky-31.

Lateral Spread into Voids

Kentucky bluegrass had significantly more emerging daughter plants than any tall fescue cultivar or blend on each evaluation date (Fig. 2, Table 1). Kentucky bluegrass had produced more than 11 daughter plants per 1-ft-diameter void on August 31 and more than 18 on October 5. The average number of daughter plants emerging in voids in tall fescue plots was less than two on both evaluation dates. The greatest distance from the circle's edge that a Kentucky bluegrass daughter plant emerged was about 8 cm. Tall fescue daughter plants emerged no more than 1.5 cm from the circle's edge.

In May and October 2007, Kentucky bluegrass had a void diameter that was less than half that of all tall fescue cultivars and blends; no differences occurred among tall fescues (Table 2).

Spread of Plugs

In May and October 2007, Kentucky bluegrass plugs had spread to an area more than three times larger than all tall fescue cultivars and blends; no differences occurred among tall fescues (Table 2).

In summary, rhizomatous tall fescue cultivars and blends did not increase rate of coverage relative to non-rhizomatous types. By October 2007, plants were more than 48 months old. Research by Barenbrug USA indicated that plants needed to be at least 20 months old before rhizome production was substantial. We will continue to collect data on these cultivars and blends.

Table 1. Daughter plants emerging in 30.5-cm circular voids in the center of tall fescue and Kentucky bluegrass plots and the farthest distance away from the circle's edge that any one plant emerged[a]

Cultivar or blend	Reported to have improved recuperative potential?	Daughter plants (no.) Aug. 31	Daughter plants (no.) Oct. 5	Distance (cm) Aug. 31
Grande II tall fescue	Yes	0.50b	0.50b	1.25b
Regiment II tall fescue	Yes	2.00b	0.00b	2.25b
Water saver RTF tall fescue blend	Yes	0.25b	0.50b	0.25b
Barlexus tall fescue	No	1.50b	1.00b	1.50b
Kentucky 31	No	1.25b	2.00b	1.00b
SR2284 Kentucky bluegrass	---	11.50a	18.75a	8.25a

[a] Voids were created on July 28, 2006.
Within columns, means followed by the same letter are not significantly different ($P < 0.05$).

Table 2. Diameter of voids that were originally 30.5-cm wide on July 28, 2006, and of plugs that were originally 10.2-cm wide on the same date when measured in May and October 2007

Cultivar or blend	Reported to have improved recuperative potential?	Diameter of voids (cm) May 5	Diameter of voids (cm) Oct. 7	Diameter of plugs (cm)[a] May 5	Diameter of plugs (cm)[a] Oct. 7
Grande II tall fescue	Yes	29.6a	21.7a	17.0b	22.2b
Regiment II tall fescue	Yes	27.7a	21.8a	18.7b	20.3b
Water saver RTF tall fescue blend	Yes	29.5a	24.6a	16.2b	21.4b
Barlexus tall fescue	No	29.5a	24.1a	18.3b	21.0b
Kentucky 31	No	27.9a	26.1a	16.3b	18.8b
SR2284 Kentucky bluegrass	---	10.8b	10.5b	38.8a	73.7a

[a] Means of two plugs per plot and four replications.
Within columns, means followed by the same letter are not significantly different ($P < 0.05$).
Numbers represent means of four replications.

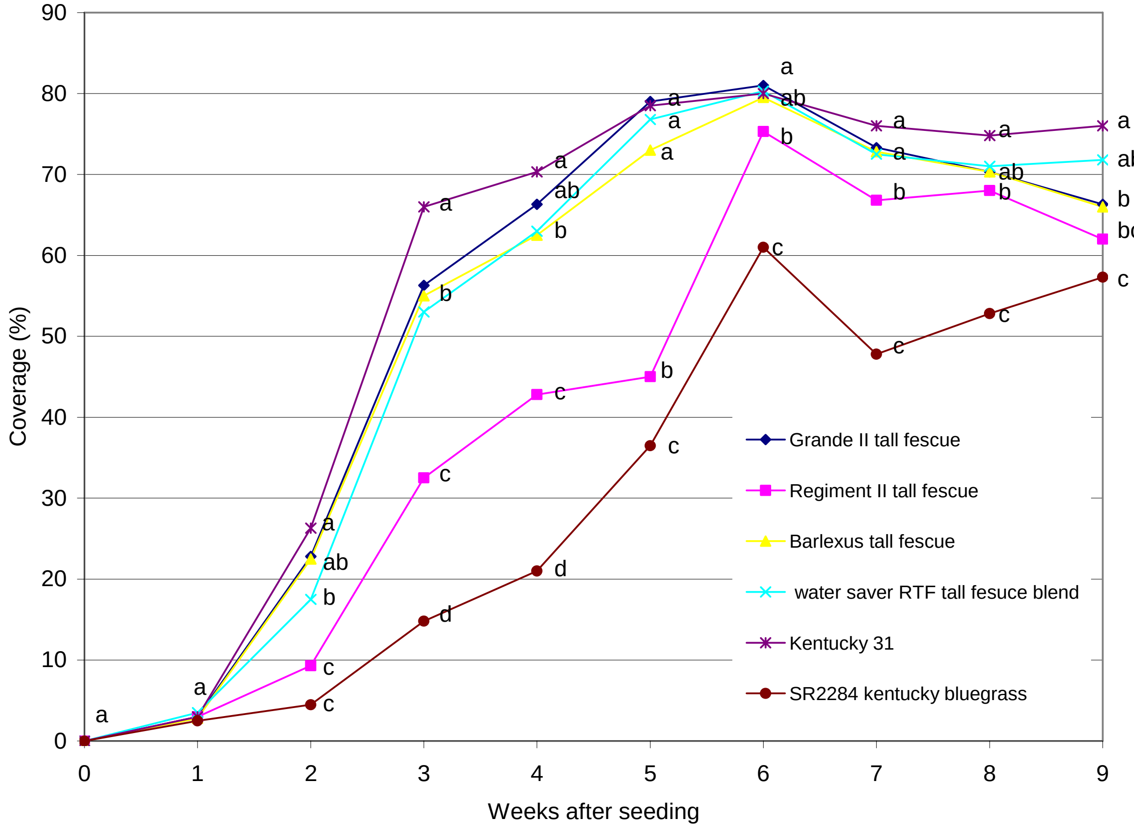


Figure 1. Rate of coverage of tall fescue cultivars and blends and Kentucky bluegrass after seeding on September 14, 2005. Points represent the mean of four replicates. Within weeks, points followed by the same letter are not statistically different ($P < 0.05$).

Figure 2. Kentucky bluegrass (left) shows significant rhizome development and fill of a void in April 2007 after the void was created in July 2006. All tall fescue cultivars and blends (one shown on right) had almost no lateral spread into voids on this date.

Growth Characteristics of New Zoysiagrass Progeny

Objective:	Evaluate growth characteristics of 18 new zoysiagrass progeny compared with Meyer zoysiagrass
Investigators:	David Okeyo, Jack Fry, Milt Engelke, Denis Genovesi, and Rodney St. John
Sponsors:	Heart of America Golf Course Superintendents Association, Kansas Golf Course Superintendents Association, and Kansas Turfgrass Foundation

INTRODUCTION

Meyer zoysiagrass (*Zoysia japonica* Steud.) has been the predominant cultivar used in the transition zone since its release in 1952 because of its excellent freezing tolerance and good turf quality. However, it is relatively slow to establish and coarser in texture than cultivars of *Z. matrella.* Researchers at Texas A&M University released several zoysiagrass cultivars including Crowne, Cavalier, Diamond, and Palisades that exhibited higher turf quality than Meyer in southern evaluations but lacked freezing tolerance necessary in the transition zone. In earlier evaluations, we screened more than 600 progeny for adaptability in the transition zone and leaf texture relative to Meyer. From these evaluations, we identified 31 progeny that had good winter tolerance and quality characteristics. This report summarizes the growth characteristics of 18 of these zoysiagrasses along with Meyer and another experimental cultivar, DALZ 0102.

MATERIALS AND METHODS

Zoysiagrasses were propagated in the greenhouse beginning in the fall of 2006. On June 5, 2007, 18 zoysiagrass progeny plus DALZ 0102 and Meyer were planted at the Rocky Ford Turfgrass Research Center, Manhattan, KS. A duplicate set of plots was planted at the Olathe Horticultural Research Center on June 13, 2007. The experimental design was a randomized complete block with three replications. Sixteen 4-in.-diameter plugs were planted on 1-ft centers in plots measuring 5 ft × 5 ft. This report summarizes results from Manhattan; data from Olathe has yet to be analyzed.

Just after planting, Ronstar at a rate of 3 lb/a (a.i.) was applied to prevent emergence of annual grasses. Irrigation was applied to provide water at 0.75 in./week, and urea was applied at 1 lb/1,000 ft^2 N on June 24 and July 21. Turf was mowed once weekly at a height of 2.5 in. beginning on August 3. On August 17, mowing height was reduced to 2.0 in., and mowing was done twice a week. From August 31, 2007, until the end of the season, mowing height was 1.5 in. and frequency was two to three times per week.

In Manhattan, data were collected on number of stolons, stolon elongation, stolon branching, leaf blade width, leaf texture, and percentage of plot coverage (Fig. 1). Number of stolons and stolon elongation were determined weekly beginning on June 18, 2007. Stolon branching was started on June 26, 2007, using three randomly selected plugs from each of the subplots. Stolon numbers were determined by counting the number of stolons originating from each plug. Stolon elongation and branching were evaluated on a single stolon that was labeled with a loose knot of thread tied around the stolon. Elongation was determined by inserting a colored plastic toothpick in the ground at the tip of the stolon. The next week, after elongation had occurred, the distance from the end of the stolon to the location of the toothpick was measured. Leaf width was measured using a caliper in the greenhouse prior to planting and again at 6 weeks after planting in the field. Leaf texture and turfgrass quality were rated visually on September 21, 2007, and October 5, 2007, by two researchers on a scale of 0 to 9 (0 = coarsest and 9 = finest texture), from which the mean of the two were taken for analysis. Percentage cover was rated visually on August 24, and September 24 using a 0% to 100% scale. Data were subjected to analysis of variance using SAS procedures, and mean significant differences among varieties were separated using least significant difference (LSD) at $P \leq 0.05$.

In Olathe, data were collected on percentage coverage, texture, and fall color. Data from Olathe have not yet been analyzed but will be incorporated into this report by January 1, 2008.

RESULTS

Stolon Number

Stolon numbers after 7 weeks ranged from about 13 (5321-48) to 39 (5311-22) per plug (Table 1). DALZ 0102 had more stolons than Meyer at Week 1. Progeny 5324-18 had a greater number of stolons from Weeks 2 to 7. All progeny from the Cavalier × Anderson #2 cross had more stolons than Meyer at Weeks 6 and 7.

Stolon Elongation

Weekly stolon elongation rates ranged from a low of 0.8 cm (5324-52, Week 1) to 10.4 cm (5324-53, Week 7) (Table 2). Progeny that exhibited a faster rate of stolon elongation than Meyer were 5312-49 at Week 5, 5312-36 at Week 6, and 5324-53 at Week 7.

Stolon Branching

Branching was minimal at Week 2 but increased steadily in all progeny through Week 7 (Table 3). Progeny 5324-53 had a greater number of stolon branches than Meyer at Week 6.

Leaf Blade Width

When evaluated in the greenhouse prior to planting in the field, all progeny except 5321-48 and DALZ 0102 had a narrower leaf blade width than Meyer (Table 4). When measured in the field at Week 6, there was no difference in leaf blade width among progeny. Grasses had not been mowed in the field at this point, and mowing height greatly influences leaf blade width.

Texture

On September 24, all progeny had a higher (finer) texture rating than Meyer except 5311-22, 5312-49, 5321-3, 5321-24, 5321-48, 5324-18, 5324-27, 5324-52, 5327-19, and DALZ 0102 (Table 4).

Coverage

On August 24, progeny 5311-22, 5311-26, 5321-3, and 5324-18 had higher levels of coverage than Meyer (Table 4).

CONCLUSIONS

Of the 18 zoysiagrass progeny evaluated, several had greater stolon production, elongation, and/or branching than Meyer. In addition, several progeny had a finer texture and faster establishment rate than Meyer.

In 2008, a select number of progeny are going to be evaluated for freezing tolerance, rhizome production (sod regrowth), rooting and drought resistance, and shade resistance. Progeny that exhibit the most promise for development as a commercial cultivar will be expanded and evaluated in larger plots in Texas and possibly other locations, including some Kansas City area golf courses. A second study evaluating an additional 13 progeny was planted in August 2007 in both Manhattan and Olathe; this study will also be evaluated through 2008.

Figure 1. David Okeyo, Ph.D. student, evaluates growth of zoysiagrass progeny in the field.

Table 1. Stolon number of zoysiagrass progeny at Manhattan, KS, 2007[a]

Progeny identification	Stolon number[b]						
	June 18	June 26	July 2	July 11	July 17	July 24	Aug. 1
8507 × Meyer (5283-27)	1.88ab	8.11bc	14.33bc	21.45ab	23.67ab	25.44b	30.67b
Cavalier × Anderson # 2							
5311-3	1.67abc	9.11b	16.78b	21.78ab	25.67ab	32.22a	35.67ab
5311-8	0.89abd	9.67ab	16.99b	22.55ab	23.89ab	26.89b	30.11b
5311-22	1.78ab	9.89ab	17.00b	22.56ab	29.11a	35.44a	39.11a
5311-26	1.44abcd	5.56bc	9.89c	16.34b	21.00bc	26.78b	29.89b
5311-27	1.11abd	7.67bc	12.22bc	19.78b	22.89ab	27.78b	30.44b
5311-32	1.22abcd	10.11ab	14.22bc	21.56ab	24.22ab	26.22b	30.55b
Zorro × Anderson #2							
5312-36	1.00abcd	9.44ab	14.89bc	17.67b	19.33bc	24.22bc	27.67bc
5312-49	0.44bcd	4.78bc	9.78c	14.11bc	13.55c	18.78c	22.45c
Emerald × Meyer							
5321-3	1.34bd	8.44bc	8.78c	16.11bc	23.78ab	27.22b	29.78b
5321-24	0.22dc	5.22bc	6.22c	12.11bc	14.00c	14.67cd	18.33cd
5321-45	0.45bcd	4.11bc	5.89c	7.88c	10.78c	12.45cd	15.78d
5321-48	0.11d	3.67c	5.33c	8.89c	10.11c	11.33d	13.89d
8501 × Meyer							
5324-18	1.72bac	14.03a	21.97a	26.44a	28.39a	33.33a	36.78ab
5324-27	0.89bdac	4.11bc	7.00c	18.00b	20.11bc	24.11bc	27.00bc
5324-52	0.78bdc	8.33bc	10.00c	13.22bc	12.33c	15.67cd	19.22cd
5324-53	0.44bcd	6.22bc	10.33c	18.00b	21.99b	21.22bc	24.99bc
Meyer × Diamond (5327-19)	0.45bcd	6.33bc	10.67c	16.22bc	17.67bc	16.55c	20.78cd
DALZ0102	2.33a	5.57bc	7.33c	11.78bc	13.44c	15.00cd	18.55cd
Meyer (control)	0.67bcd	5.44bc	10.00c	14.67bc	15.09bc	15.22cd	18.33cd

[a] Grasses were planted as 4-in.-diameter plugs on 1-ft centers into 5-ft × 5-ft plots on June 5, 2007.

[b] Stolon number per plug is the average of three replicates and three randomly selected plugs per plot.

Within columns, means followed by the same letter are not significantly different ($P < 0.05$).

Table 2. Stolon elongation of zoysiagrass progeny at Manhattan, KS, 2007[a]

	Stolon elongation (cm)[b]						
Progeny identification	June 18	June 26	July 2	July 11	July 17	July 24	Aug. 1
8507 × Meyer (5283-27)	2.86a	3.67ab	2.51b	4.22ab	3.16b	2.98bc	5.21c
Cavalier × Anderson # 2							
5311-3	2.33a	3.84ab	4.77ab	4.61ab	5.48ab	5.94ab	7.88bc
5311-8	2.28a	4.49ab	3.31ab	4.23ab	3.93b	5.73ab	7.25bc
5311-22	1.75a	3.82ab	3.67ab	5.69ab	4.89ab	7.01ab	9.21abc
5311-26	2.62a	2.97b	2.23b	3.51b	3.46b	3.22bc	5.83bc
5311-27	1.08a	3.30ab	2.99b	4.36b	4.74ab	4.61b	7.80bc
5311-32	2.99a	4.91ab	3.03ab	5.39ab	4.78ab	5.72ab	6.13bc
Zorro × Anderson #2							
5312-36	1.68a	5.25ab	3.48ab	5.64ab	5.22ab	7.43a	8.92abc
5312-49	0.98a	3.33ab	4.92a	6.28a	6.722a	6.59ab	9.28abc
Emerald × Meyer							
5321-3	3.37a	3.37ab	2.087b	4.24ab	3.64b	4.51b	6.82bc
5321-24	0.89a	3.01ab	1.59b	2.66b	1.71b	1.85c	2.65c
5321-45	1.22a	4.19ab	2.03b	3.97ab	3.30b	4.23bc	5.74bc
5321-48	0.24a	2.41b	1.48b	1.89b	2.05b	2.33bc	3.28c
8501 × Meyer							
5324-18	2.83a	5.87a	4.26ab	5.98a	4.94ab	5.49ab	6.85bc
5324-27	2.89a	2.38b	2.21b	3.14b	3.00b	3.91bc	4.98c
5324-52	0.80a	3.56ab	2.11b	2.62b	2.44b	3.83bc	6.77bc
5324-53	2.33a	4.97ab	4.17ab	5.82ab	4.95ab	6.17ab	10.4a
Meyer × Diamond (5327-19)	1.77a	5.02ab	3.91ab	4.53ab	4.27ab	4.62b	6.55bc
DALZ0102	3.34a	1.80b	1.47b	2.39b	2.55b	2.90bc	5.70bc
Meyer (control)	3.04a	3.32ab	2.87ab	4.06ab	3.62b	4.36b	4.73c

[a] Grasses were planted as 4-in.-diam. plugs on 1-ft centers into 5-ft × 5-ft plots on June 5, 2007.
[b] Stolon elongation is the average of three replicates and one stolon from three randomly selected plugs per plot.
Within columns, means followed by the same letter are not significantly different ($P < 0.05$).

Table 3. Stolon branching of zoysiagrass progeny at Manhattan, KS, 2007[a]

	Stolon branching[b]					
Progeny identification	June 18	June 26	July 2	July 11	July 17	July 24
8507 × Meyer (5283-27)	1.89a	5.33a	9.89ab	15.78a	23.44ab	26.78ab
Cavalier × Anderson # 2						
5311-3	1.44a	3.22a	7.44ab	12.00ab	23.00ab	25.99ab
5311-8	2.78a	3.44a	7.44ab	10.89ab	19.78b	22.56b
5311-22	3.89a	3.67a	7.22ab	11.33ab	25.22ab	29.22ab
5311-26	2.22a	3.56a	6.22ab	7.78b	18.11b	21.11b
5311-27	2.78a	1.67a	3.66ab	7.00b	17.65b	19.11b
5311-32	3.78a	5.11a	9.67ab	14.44ab	22.44b	25.56ab
Zorro × Anderson #2						
5312-36	2.56a	3.56a	6.67ab	12.44ab	26.56ab	30.00ab
5312-49	2.89a	2.56a	5.33ab	9.33b	18.45b	22.44b
Emerald × Meyer						
5321-3	3.33a	3.33a	7.22ab	11.78ab	17.89b	22.11ab
5321-24	1.00a	3.00a	5.78ab	9.33b	16.22b	20.22b
5321-45	1.22a	3.33a	7.00ab	10.89ab	23.00ab	26.55ab
5321-48	0.78a	1.89a	2.89b	6.33b	12.44b	15.00b
8501 × Meyer						
5324-18	2.72a	4.91a	9.55ab	15.39ab	30.11ab	35.11a
5324-27	0.67a	3.00a	4.22b	6.44b	11.00b	13.67ab
5324-52	0.56a	3.22a	6.11ab	10.00ab	18.45b	22.44b
5324-53	0.89a	5.44a	11.22ab	18.22a	35.78a	39.00a
Meyer × Diamond (5327-19)	1.11a	3.99a	8.00ab	12.67ab	26.00ab	28.78ab
DALZ0102	2.78a	4.55a	7.67ab	11.56ab	19.67b	25.11ab
Meyer (control)	2.67a	5.44a	11.44a	11.89ab	22.56b	37.78a

[a] Grasses were planted as 4-in.-diam. plugs on 1-ft centers into 5-ft × 5-ft plots on June 5, 2007.
[b] Stolon branching is number of branches and the average of three replicates and one stolon from three randomly selected plugs per plot.
Within columns, means followed by the same letter are not significantly different ($P < 0.05$).

Table 4. Leaf blade width, texture, and coverage ratings of zoysiagrass progeny at Manhattan, KS, 2007[a]

	Leaf width (mm)		Quality	Color	Texture[b]		Plot coverage	
Progeny identification	Greenhouse	July 13	Sept. 21	Oct. 10	Sept. 24	Oct. 5	Aug. 24	Sept. 24
8507 × Meyer (5283-27)	2.59de	2.59c	7.0ab	7.67ab	6.33ab	6.83a	53.33cd	85.00bc
Cavalier × Anderxon #2								
5311-3	2.58de	2.50c	6.5bc	7.67ab	6.00ab	6.67ab	54.17cd	90.00b
5311-8	2.18f	2.36c	8.0a	6.67b	6.67ab	7.17a	63.33bc	95.00ab
5311-22	2.85cd	3.22b	7.17ab	5.67b	3.67cd	5.33cd	78.33a	97.67ab
5311-26	2.86cd	3.12bc	7.67ab	6.33b	6.67ab	6.67ab	67.50b	96.00ab
5311-27	2.78d	2.80bc	7.41ab	7.32ab	6.0ab	6.17bc	65.37bc	96.36ab
5311-32	2.71de	2.75c	8.0a	7.67ab	6.00ab	6.00bc	64.17bc	94.67ab
Zorro × Anderson #2								
5312-36	2.59de	2.78c	7.12ab	7.67ab	6.00ab	6.67ab	60.00c	97.67ab
5312-49	2.79d	2.72c	6.0bc	6.33b	5.67b	5.00d	66.67bc	94.67ab
Emerald × Meyer								
5321-3	2.51e	2.44c	6.67b	6.67b	4.67bc	6.00bc	72.50ab	99.00a
5321-24	2.85cd	2.83bc	4.67c	7.67ab	5.33bc	6.17bc	42.50e	76.67cd
5321-45	2.41e	2.72c	5.67bc	7.67ab	6.67ab	6.17bc	51.67d	85.00bc
5321-48	3.37b	2.61c	5.33c	8.00a	4.67bc	6.33b	43.33e	73.00d
8501 × Meyer								
5324-18	2.66de	2.61c	7.33ab	6.00b	5.33bc	6.50b	74.17ab	97.67ab
5324-27	3.05c	2.94bc	4.67c	6.67b	5.00bc	5.67c	44.17e	81.67c
5324-52	2.55e	2.56c	5.5bc	8.00a	5.67b	6.83ab	55.83cd	86.67bc
5324-53	1.81g	2.67bc	7.67ab	7.67ab	7.00a	6.83ab	56.67cd	93.33ab
Meyer × Diamond (5327-19)	2.99cd	3.06a	6.67b	7.33ab	4.67bc	6.00bc	58.33cd	88.33bc
DALZ0102	3.77a	3.67a	5.67bc	7.67ab	3.00d	3.08e	66.67bc	94.67ab
Meyer (control)	3.40b	3.16bc	6.0bc	7.67ab	4.33c	4.50d	55.83cd	94.67ab

[a] Grasses were planted as 4-in.-diam. plugs on 1-ft centers into 5-ft × 5-ft plots on June 5, 2007.
[b] Texture was rated visually on a 0 to 9 scale, where 9 is the finest and 0 is the most coarse textured.
Within columns, means followed by the same letter are not significantly different ($P < 0.05$).

2002 Bermudagrass NTEP Evaluation

Objective:	Evaluate Bermudagrass cultivars under Kansas conditions and submit data collected to the National Turfgrass Evaluation Program (NTEP)
Investigators:	Linda R. Parsons and Rodney St. John
Sponsor:	USDA National Turfgrass Evaluation Program

INTRODUCTION

Bermudagrass is a popular, warm-season turfgrass that is heat and drought tolerant as well as wear resistant. It has a wide range of uses and is especially suited for athletic field turf. Kansas represents the northernmost region in the central United States where Bermudagrass can be successfully grown as a perennial turfgrass. Historically, few cultivars that have both acceptable quality and adequate cold tolerance have been available to local growers. New introductions of interest are continually being selected for improved hardiness and quality; seeded varieties, in particular, show potential for improved winter survival. Both seeded and vegetative types need regular evaluation to determine their long-range suitability for use in Kansas.

MATERIALS AND METHODS

In June 2002, three replications each of 42 Bermudagrass cultivars and experimental numbers were planted in a randomized complete block design at the John C. Pair Horticultural Center, Wichita, KS. Twenty-nine entries were seeded; 13 vegetative entries were plugged with 12-in. spacings. Starter fertilizer was incorporated into the study plots at planting time at a rate of 1.0 lb/ 1,000 ft^2 N. We maintained plot fertility at 0.5 to 0.75 lb/1,000 ft^2 N per growing month. We mowed plots once a week during the growing season at 0.75 to 1.0 in. We irrigated as necessary to prevent dormancy and controlled weeds, insects, and diseases only to prevent severe stand loss.

During the course of the study, we collected information on spring green-up, genetic color, leaf texture, seed head density, quality, and other measures when appropriate. Rating was done on a scale of 1 = poorest, 6 = acceptable, and 9 = optimum.

RESULTS

The 2002 National Bermudagrass Test was scheduled for completion at the end of 2006. Throughout the 5 years of the study, the best overall performers were vegetative cultivars Midlawn and Patriot and seeded cultivars Yukon, Riviera, and Contessa (Table 1).

About a month after trial plots were planted in 2002, seeded cultivars FMC-6, SR 9554, and Panama were the best established with the greatest percentage groundcover. Vegetative cultivars lagged far behind seeded cultivars in percentage cover, with MS-Choice, Midlawn, and Premier being the best. By August, seeded cultivars Sunstar, FMC-6, Panama, and SR 9554 showed the best cover. Vegetative cultivars still lagged behind, with Midlawn, Celebration, and Patriot doing best. This trend continued through September. Seeded cultivars FMC-6, Sunstar, SR 9554, Panama, B-14, and NuMex Sahara plots were the best with more than 90% coverage. By

September, the best vegetative cultivars, Patriot, Celebration, Midlawn, and Tift No. 3, had only attained between 70% to 75% coverage.

In addition to overall quality, we looked at a number of other turf characteristics throughout the course of the study (Table 2). Beginning with the spring of 2003, we started every new growing season by rating spring green-up and found that the best performers were vegetative cultivars Midlawn and Ashmore and seeded cultivar Yukon. We looked at genetic color and found that vegetative cultivars Celebration and Patriot and seeded cultivars Tift No. 2 and Yukon were the darkest green. Vegetative cultivars Ashmore and Midlawn and seeded cultivars Yukon and SWI-1012 had the finest leaf texture. Because seed heads in a lawn detract from its appearance, every spring, summer, and fall throughout the course of the study we looked for turf plots with the fewest seed heads. In May, cleanest plots included vegetative cultivars Midlawn, Aussie Green, and Celebration and seeded cultivars Yukon and Contessa. In July, vegetative plots with the fewest seed heads were MS-Choice, Patriot, and Premier, and in September, cultivars MS-Choice, Midlawn, and Tifway. In July, the seeded plot with the fewest seed heads was SWI-1046, and in September, Yukon. Every mid-summer we rated turf stands for density and found that vegetative cultivars OKC 70-18, Patriot, Tifway, and Premier and seeded cultivars SWI-1044, SWI-1012, and Yukon were densest. At the end of each year, we attempted to rate turf plots for color retention just before the night of the first freeze. We were successful twice and found that vegetative cultivars MS-Choice, Tifway, and Tifsport and seeded cultivars SWI-1046 and Tift No. 1 tended to retain color the best.

At first, the winter of 2006-2007 was unexceptional. Unseasonably warm temperatures occurred during the last week of February and continued through March. At the beginning of April, temperatures dropped dramatically; instead of highs in the 50s to 60s and lows above freezing, 4 days had highs in the mid-30s to low 40s and lows below freezing with temperatures on three nights reaching the low 20s. Curious to see what affects, if any, these abnormal temperature fluctuations had on Bermudagrass, we decided to continue rating the trial into the summer of 2007. Results are presented in Table 3. Spring green-up was unusually slow, and May quality was poor; only vegetative cultivars Ashmore and OKC 70-18 were somewhat acceptable performers. Percentage of living ground cover for May ranged from 70% for the vegetative cultivar Ashmore to less than 5% for seeded cultivars Mohawk, B-14, Arizona Common, and NuMex Sahara. By July 24, recovery was substantial in many plots. Quality had improved, with vegetative cultivars Premier, Patriot, OKC 70-18, Aussie Green, and Midlawn and seeded cultivars SWI-1044, Riviera, and Contessa doing best. Percentage of living ground cover improved to 90% or better for vegetative cultivars Patriot, OKC 70-18, Aussie Green, and Premier and to 85% or better for seeded cultivars SWI-1044, Riviera, SWI-1014, Contessa, and SWI-1046.

For more results of the nationwide 2002 National Bermudagrass Test, visit the NTEP Web site: http://www.ntep.org/

Table 1. Performance summary of Bermudagrass cultivars at Wichita, KS, 2002-2006[a]

Cultivar/ experimental number[b]	S or V[c]	July estab. (%)	Aug. estab. (%)	Sept. estab. (%)	Quality					
					May	June	July	Aug.	Sept.	Avg
Midlawn*	V	12	35	72	6.1	5.7	5.9	5.8	4.3	5.7
Yukon*	S	28	43	75	5.8	5.4	5.2	5.6	4.8	5.4
Patriot*	V	10	28	73	4.9	5.4	5.9	5.4	5.1	5.4
Riviera*	S	3	23	67	4.6	5.4	5.1	5.4	5.4	5.2
Contessa (SWI-1045)*	S	23	43	89	4.5	5.0	5.2	5.6	5.4	5.2
Premier (OR 2002)*	V	12	23	67	4.5	5.2	5.3	4.9	4.9	4.9
SWI-1012	S	10	27	78	4.3	4.8	4.9	5.0	5.1	4.8
OKC 70-18	V	5	10	53	4.6	4.6	5.0	5.3	4.9	4.8
SWI-1044	S	13	45	80	3.5	4.7	5.0	5.3	5.2	4.7
SWI-1014	S	2	18	60	4.3	4.6	4.8	4.9	4.3	4.6
Aussie Green*	V	11	27	70	4.3	4.7	4.6	4.5	4.1	4.4
Panama*	S	72	88	92	3.3	4.4	4.3	4.8	4.8	4.3
CIS-CD5	S	19	53	83	3.3	4.3	4.4	4.9	4.7	4.3
CIS-CD6	S	10	32	80	3.9	4.5	4.2	4.7	4.2	4.3
Celebration*	V	8	28	72	3.4	4.3	4.5	4.8	4.7	4.3
FMC-6*	S	80	92	95	3.3	4.5	4.3	4.6	4.6	4.3
SR 9554*	S	78	87	94	3.7	4.3	4.3	4.6	4.1	4.3
Tifsport*	V	11	22	63	3.8	4.3	4.5	4.7	4.1	4.2
SWI-1046	S	17	40	78	2.9	4.1	4.4	5.3	5.1	4.2
Tifway*	V	7	15	53	3.6	4.4	4.6	4.7	4.2	4.2
Sunstar*	S	65	94	95	3.8	4.2	4.3	4.3	4.2	4.2
LaPaloma (SRX 9500)*	S	32	68	89	3.5	4.1	4.3	4.4	4.3	4.1
Sunbird (PST-R68A)*	S	8	22	70	3.3	4.3	4.2	4.5	4.3	4.1
MS-Choice*	V	13	25	67	2.8	4.2	4.3	4.8	4.8	4.1
CIS-CD7	S	20	48	89	3.3	4.3	4.1	4.6	4.0	4.1
Transcontinental*	S	18	70	87	3.5	4.2	4.1	4.3	4.1	4.1
SWI-1041 (Veracruz)*	S	20	45	89	2.3	3.8	4.3	4.9	5.0	4.0
Ashmore*	V	7	13	50	5.2	4.3	3.1	3.5	3.4	3.9
Southern Star*	S	22	48	85	3.2	3.9	4.2	4.3	4.0	3.9
SWI-1001	S	60	75	90	2.9	4.1	3.8	4.5	4.1	3.9
Princess 77*	S	48	65	89	2.3	3.4	4.1	5.2	4.6	3.9
Tift No. 4	V	7	10	62	3.3	3.9	3.8	4.1	4.4	3.8
Mohawk*	S	63	78	88	3.0	3.8	3.8	4.3	3.9	3.8
NuMex Sahara*	S	58	84	91	2.8	3.8	4.0	4.2	4.0	3.8
Sundevil II*	S	14	42	85	3.3	3.6	3.8	4.0	3.8	3.7
B-14	S	52	78	91	2.9	3.5	3.6	4.3	4.0	3.7
Tift No. 3	V	9	25	71	2.3	3.6	3.8	4.3	4.4	3.6
GN-1*	V	7	22	67	2.7	3.6	3.4	3.7	3.8	3.4
Arizona Common*	S	23	55	84	2.6	3.3	3.3	3.8	4.0	3.4
SWI-1003	S	25	40	80	1.8	2.8	3.0	3.8	4.3	3.0
Tift No. 1	S	42	62	82	1.4	2.1	2.6	3.3	3.7	2.5
Tift No. 2	S	15	45	81	1.0	1.3	1.6	2.0	2.1	1.5
LSD[d]		*19*	*17*	*11*	*0.5*	*0.6*	*0.6*	*0.6*	*0.9*	*0.5*

[a] Ratings based on a scale of 1-9 with 9 = best measure.
[b] Cultivars marked with "*" became commercially available in 2007.
[c] S = seeded; V = vegetative.
[d] To determine statistical differences among entries, subtract one entry's mean from another's. If the result is larger than the corresponding LSD value, the two are statistically different.

Table 2. Performance summary of Bermudagrass cultivars at Wichita, KS, 2002-2006[a]

Cultivar/ experimental number[b]	S or V[c]	Spring green-up	Genetic color	Leaf texture	Summer density	Fall color	May seed-heads	July seed-heads	August seed-heads
Midlawn*	V	5.3	6.3	8.0	6.3	5.2	9.0	7.6	8.6
Yukon*	S	5.1	7.0	6.2	6.1	4.7	9.0	6.8	6.9
Patriot*	V	4.7	7.8	5.4	6.9	4.5	8.9	8.4	8.2
Riviera*	S	4.4	6.3	4.9	6.0	5.0	8.5	6.8	6.0
Contessa (SWI-1045)*	S	3.7	6.9	5.7	5.7	5.5	9.0	6.0	6.1
Premier (OR 2002)*	V	4.3	6.8	7.8	6.7	4.8	8.8	8.1	7.0
SWI-1012	S	3.9	6.7	5.9	6.1	5.3	8.9	6.4	6.2
OKC 70-18	V	4.8	6.1	7.3	7.6	5.7	8.9	7.6	6.5
SWI-1044	S	3.1	6.3	5.8	6.6	5.0	8.5	6.8	6.3
SWI-1014	S	4.4	6.4	4.6	5.2	5.0	9.0	6.5	6.0
Aussie Green*	V	3.7	7.1	5.8	5.9	4.7	9.0	7.4	7.3
Panama*	S	2.8	5.8	4.8	4.7	3.7	8.3	6.6	5.6
CIS-CD5	S	3.1	6.8	4.6	4.7	4.7	8.3	5.8	5.3
CIS-CD6	S	3.7	6.1	4.7	5.3	4.2	7.4	6.7	5.1
Celebration*	V	3.1	7.9	5.8	5.9	4.8	9.0	6.1	6.8
FMC-6*	S	2.8	6.0	4.6	4.6	4.3	8.8	6.8	5.6
SR 9554*	S	3.6	6.5	4.9	4.6	4.2	8.5	6.2	5.2
Tifsport*	V	3.4	7.2	7.2	6.4	6.0	9.0	7.6	8.0
SWI-1046	S	2.8	6.9	5.7	6.0	5.8	9.0	6.9	6.2
Tifway*	V	3.1	7.1	7.6	6.9	6.5	9.0	7.2	8.3
Sunstar*	S	3.2	6.3	4.4	4.1	4.2	8.5	6.8	5.7
LaPaloma (SRX 9500)*	S	2.9	6.2	4.6	4.9	4.2	8.3	6.5	5.5
Sunbird (PST-R68A)*	S	3.3	6.0	4.6	4.8	4.2	8.1	6.1	5.4
MS-Choice*	V	2.7	7.6	4.8	5.9	6.5	9.0	8.7	8.5
CIS-CD7	S	3.2	6.6	4.2	4.3	4.5	8.3	5.8	5.3
Transcontinental*	S	3.2	6.3	4.4	4.4	4.0	8.5	6.1	5.3
SWI-1041 (Veracruz)*	S	2.4	5.9	5.0	5.6	5.5	9.0	5.5	5.9
Ashmore*	V	5.0	4.8	8.4	4.9	5.3	8.5	7.8	8.2
Southern Star*	S	3.1	6.5	4.3	4.4	4.0	8.5	5.8	4.8
SWI-1001	S	2.4	6.4	4.7	4.6	4.5	8.5	6.7	5.6
Princess 77*	S	2.3	6.8	5.2	5.1	5.3	9.0	5.8	5.2
Tift No. 4	V	3.0	6.8	6.7	6.6	5.8	9.0	5.9	7.1
Mohawk*	S	2.7	6.1	4.3	4.0	4.0	8.4	6.8	5.9
NuMex Sahara*	S	2.8	5.9	4.4	3.9	4.3	8.5	6.6	6.1
Sundevil II*	S	3.0	5.8	4.3	4.2	3.8	8.3	5.8	4.8
B-14	S	2.9	5.9	4.3	3.7	4.0	8.2	6.1	5.3
Tift No. 3	V	2.2	6.6	5.2	5.6	5.0	9.0	7.3	7.4
GN-1*	V	2.8	7.3	4.4	5.2	4.7	9.0	7.3	6.9
Arizona Common*	S	2.2	6.3	4.3	3.6	4.3	8.3	6.6	5.4
SWI-1003	S	2.3	5.9	4.4	4.8	5.0	8.6	5.1	4.8
Tift No. 1	S	1.8	6.8	4.1	4.7	5.8	9.0	5.9	5.3
Tift No. 2	S	1.9	7.2	4.4	2.8	5.7	9.0	6.6	5.2
LSD[d]		*0.6*	*0.6*	*0.6*	*0.8*	*0.8*	*0.3*	*0.6*	*0.6*

[a] Ratings based on a scale of 1-9 with 9 = best measure.

[b] Cultivars marked with "*" became commercially available in 2007.

[c] S = seeded; V = vegetative.

[d] To determine statistical differences among entries, subtract one entry's mean from another's. If the result is larger than the corresponding LSD value, the two are statistically different.

Table 3. Performance of Bermudagrass cultivars at Wichita, KS, following April 2007[a]

Cultivar/ experimental number[b]	S or V[c]	Spring green-up	May Quality	May Cover (%)	June Quality	June Cover (%)	July Quality	July Cover (%)
Premier (OR 2002)*	V	4.3	4.7	67	5.0	90	6.3	90
Patriot*	V	4.0	4.7	68	5.0	96	6.0	94
OKC 70-18	V	5.3	5.0	67	5.3	95	5.3	93
Aussie Green*	V	3.0	4.0	43	5.3	83	5.3	92
Midlawn*	V	3.7	4.3	63	5.0	89	5.3	88
SWI-1044	S	2.3	3.7	40	4.3	85	5.0	90
Riviera*	S	3.7	3.7	57	5.0	87	5.0	90
Contessa (SWI-1045)*	S	2.3	3.3	30	4.0	72	4.7	85
Celebration*	V	2.3	2.7	18	2.7	52	4.7	82
Tift No. 4	V	2.7	3.3	40	3.7	75	4.7	82
GN-1*	V	2.3	2.7	23	4.0	67	4.7	78
SWI-1014	S	4.7	3.7	43	4.7	87	4.3	88
Ashmore*	V	5.3	4.7	70	5.0	92	4.0	88
SWI-1046	S	3.0	3.3	40	4.3	85	4.0	83
SWI-1012	S	2.3	3.0	35	3.7	80	4.0	80
Yukon*	S	3.7	4.0	50	4.0	82	4.0	77
Tifway*	V	2.0	2.3	25	3.0	65	4.0	68
CIS-CD7	S	2.3	2.3	28	3.0	67	3.7	67
CIS-CD6	S	2.0	3.0	23	3.0	80	3.3	68
Tifsport*	V	1.3	1.7	20	2.7	33	3.3	67
Tift No. 3	V	1.0	1.3	10	2.3	23	3.3	62
SWI-1003	S	1.3	1.7	13	2.7	45	3.0	65
Princess 77*	S	1.3	2.0	13	2.3	28	3.0	63
SWI-1041 (Veracruz)*	S	1.0	1.7	13	2.7	33	3.0	57
SR 9554*	S	1.7	1.7	13	2.7	28	3.0	55
Sunbird (PST-R68A)*	S	1.7	1.7	13	2.3	37	3.0	53
MS-Choice*	V	1.7	2.0	15	2.7	55	3.0	52
Tift No. 1	S	1.3	1.3	10	2.3	27	3.0	45
CIS-CD5	S	1.7	2.0	15	2.7	37	2.7	50
Southern Star*	S	1.7	2.0	13	2.7	30	2.7	38
Transcontinental*	S	1.3	2.0	13	2.3	40	2.3	52
FMC-6*	S	1.3	1.3	7	1.3	25	2.3	32
Panama*	S	1.3	1.3	6	3.3	22	2.3	23
LaPaloma (SRX 9500)*	S	1.3	1.3	7	2.0	13	2.0	27
Sunstar*	S	1.3	1.0	6	1.7	20	1.7	32
SWI-1001	S	1.0	1.0	7	1.7	13	1.7	27
Sundevil II*	S	1.3	1.3	12	2.0	17	1.7	24
Tift No. 2	S	1.3	1.3	5	1.7	16	1.7	18
B-14	S	1.0	1.0	2	2.0	7	1.7	13
Mohawk*	S	1.0	1.3	4	1.3	8	1.3	17
Arizona Common*	S	1.0	1.0	2	1.7	10	1.3	5
NuMex Sahara*	S	1.0	1.0	1	1.0	2	1.0	1
LSD[d]		*0.8*	*0.7*	*11*	*1.1*	*22*	*1.0*	*23*

[a] Ratings based on a scale of 1-9 with 9 = best measure.
[b] Cultivars marked with "*" became commercially available in 2007.
[c] S = seeded; V = vegetative.
[d] To determine statistical differences among entries, subtract one entry's mean from another's. If the result is larger than the corresponding LSD value, the two are statistically different.

2007 Bermudagrass NTEP Evaluation

Objective:	Evaluate Bermudagrass cultivars under Kansas conditions and submit data collected to the National Turfgrass Evaluation Program (NTEP)
Investigator:	Rodney St. John
Sponsor:	USDA National Turfgrass Evaluation Program

INTRODUCTION

Bermudagrass is a popular, warm-season turfgrass that is heat and drought tolerant as well as traffic tolerant. It has a wide range of uses and is especially suited for athletic field turf. Kansas represents the northernmost region in the central United States where Bermudagrass can be successfully grown as a perennial turfgrass. Historically, few cultivars that have both acceptable quality and adequate cold tolerance have been available to local growers. New introductions of interest are continually being selected for improved hardiness and quality; seeded varieties, in particular, show potential for improved winter survival. Both seeded and vegetative types need regular evaluation to determine their long-range suitability for use in Kansas.

MATERIALS AND METHODS

In June 2007, three replications each of 41 Bermudagrass cultivars were planted in a randomized complete block design at the Horticulture Research and Extension Center, Olathe, KS. Twenty-five entries were seeded; six vegetative entries were plugged with 12-in. spacing. Starter fertilizer was broadcast over study plots at planting time at a rate of 1.0 lb/1,000 ft^2 N. Plots were mowed once a week during the growing season at 1.5 in. Plots were irrigated as necessary to prevent dormancy.

During the course of the study, information will be collected on spring green-up, genetic color, leaf texture, seed head density, quality, and other measures when appropriate. Rating is done on a scale of 1 = poorest, 6 = acceptable, and 9 = optimum.

RESULTS

Because of the limited number of plugs per square foot compared with the number of seeds per square foot of the seeded varieties, most seeded varieties covered the plot area quicker than vegetative types (Table 1). By August, many seeded types had completely covered the plot area (Table 1).

More information on the National Turfgrass Evaluation Program and nationwide 2007 National Bermudagrass Test results are available on the NTEP Web site: http://www.ntep.org

Table 1. Percentage establishment data for Bermudagrass cultivars at Olathe, KS, 2007

Cultivar	Propagation type	July ground cover (%)	August ground cover (%)
SWI-1113	seeded	83.3	100.0
PSG 91215	seeded	80.0	100.0
Princess 77	seeded	76.7	100.0
SWI-1070	seeded	76.7	100.0
SWI-1122	seeded	76.7	100.0
IS-CD10	seeded	76.7	100.0
NuMex-Sahara	seeded	73.3	100.0
SWI-1117	seeded	73.3	100.0
Sunsport	seeded	73.3	100.0
PSG 94524	seeded	70.0	100.0
PSG PROK	seeded	70.0	100.0
SWI-1081	seeded	66.7	100.0
SWI-1083	seeded	66.7	100.0
OKS 2004-2	seeded	66.7	100.0
OKC 1134	vegetative	56.7	100.0
PST-R6FLT	seeded	73.3	98.3
PSG 9Y2OK	seeded	73.3	98.3
RAD-CD1	seeded	70.0	98.3
Yukon	seeded	66.7	98.3
PSG 9BAN	seeded	76.7	96.7
Veracruz	seeded	73.3	96.7
Riviera	seeded	70.0	96.7
J-720	seeded	70.0	96.7
SWI-1057	seeded	70.0	95.0
Patriot	vegetative	70.0	95.0
IS-01-201	seeded	66.7	95.0
Midlawn	vegetative	63.3	95.0
OKC 1119	vegetative	56.7	85.0
Premier	vegetative	53.3	83.3
BAR 7CD5	seeded	63.3	80.0
Tifway	vegetative	50.0	73.3

2006 Tall Fescue NTEP Evaluation

Objective:	Evaluate tall fescue cultivars under Kansas conditions and submit data collected to the National Turfgrass Evaluation Program (NTEP)
Investigators:	Linda R. Parsons and Rodney St. John
Sponsor:	USDA National Turfgrass Evaluation Program

INTRODUCTION

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

MATERIALS AND METHODS

On September 8, 2006, we seeded 348 study plots (5 ft × 5 ft) at the John C. Pair Horticultural Center, Wichita, KS, with 116 tall fescue cultivars and experimental numbers in a randomized complete block design. We are maintaining fertility of the plots at 0.25 to 0.5 lb/1,000 ft^2 N per growing month. We mow plots weekly during the growing season at 2.5 in. and remove clippings. We irrigate as necessary to prevent stress and control weeds, insects, and diseases only when they present a threat to the trial.

During this 6-year study, we will collect information on establishment, spring green-up, genetic color, leaf texture, quality, fall color retention, and other measures when appropriate. Rating is done on a scale of 0 = poorest, 6 = acceptable, and 9 = optimum.

RESULTS

About 6 weeks after seeding, we rated fescue cultivars on establishment as measured by percentage ground cover. During 2007, we collected data on turf quality, green-up, and brown patch resistance.

Initial observations (Table 1) showed that by early October 2006, RK 6, SR 8650, Tulsa III, and Z-2000 were the best established. In the spring of 2007, we started off by rating fescue for green-up and found that by the middle of March, Speedway, RAD-TF17, RK 6, RK-1, and Rhambler were the greenest. Throughout the growing season, we rated turf monthly for quality. Ratings were influenced by degree of coverage, weed infestation, and disease resistance as well as turf color, texture, and density. Those that performed best overall were SC-1, DP 50-9407, K06-WA, PST-5WMD, and SH 3. The relatively cool, rainy days of early spring lasted well into summer and were abruptly followed by a period of hot, dry weather. As a result, some fescue plots began showing signs of brown patch. We rated turf for resistance to the disease and found that Ky-31, Bullseye, Burl-TF8, DP 50-9407, Firenza, RP 2, RP 3, and Van Gogh fared the best.

Table 1. Performance of tall fescue cultivars at Wichita, KS, 2006-2007[a]

Cultivar/ experimental number	2006 estab. (%)	Green-up	Brown Patch	Quality Mar	Apr	May	June	July	Aug	Sept	Oct	Avg
SC 1	63	5.7	7.7	5.3	5.0	5.3	6.3	6.3	6.0	6.0	5.3	5.7
DP 50 9407	82	5.7	8.3	6.0	5.7	5.3	6.7	6.3	5.7	5.3	4.3	5.7
K06 WA	75	5.3	7.0	5.0	5.3	5.7	6.3	6.3	5.3	5.3	6.0	5.7
PST 5WMD	57	5.3	7.7	4.7	5.0	6.0	6.3	6.7	6.0	5.7	4.7	5.6
SH 3	73	6.0	7.7	5.3	5.3	5.0	5.3	6.0	6.0	5.3	5.7	5.5
Bullseye	53	5.7	8.3	4.7	5.3	6.0	6.0	6.0	5.3	5.0	5.3	5.5
RKCL	72	5.3	7.0	5.3	5.7	5.7	6.3	4.7	5.7	5.3	5.0	5.5
Turbo	53	5.0	8.0	5.0	5.7	6.0	5.3	5.3	5.3	6.0	5.0	5.5
ATM	73	5.3	7.7	5.3	5.0	5.3	5.3	5.3	6.0	6.0	5.0	5.4
IS TF 147	60	5.3	7.7	5.3	5.7	5.7	6.3	5.3	5.0	5.0	5.0	5.4
RK 6	62	6.7	7.3	5.3	5.3	6.0	6.0	5.7	5.3	5.3	4.3	5.4
Firenza	78	5.7	8.3	5.3	5.0	6.0	6.0	5.7	5.3	5.0	4.7	5.4
DP 50 9411	68	5.7	7.3	4.7	5.7	5.7	6.3	5.3	4.7	5.3	5.0	5.3
Monet (LTP 610 CL)	77	5.3	8.0	5.3	5.3	5.7	5.7	5.7	5.3	5.0	4.7	5.3
RP 3	48	5.3	8.3	4.0	5.7	5.3	6.0	6.0	5.3	5.3	5.0	5.3
Hemi	63	5.7	7.7	5.0	5.7	5.7	5.3	5.3	5.7	5.3	4.3	5.3
LS 11	52	6.3	5.7	5.0	6.3	6.0	6.3	5.3	4.7	5.0	3.7	5.3
M4	77	4.7	8.0	5.0	5.3	5.3	5.7	6.0	5.3	5.3	4.3	5.3
NA BT 1	70	5.7	7.3	5.3	5.0	5.0	5.7	5.7	5.7	5.3	4.7	5.3
TG 50 9460	73	4.7	7.7	5.0	5.0	5.3	6.7	5.7	5.0	5.0	4.7	5.3
Van Gogh (LTP RK2)	65	6.3	8.3	5.0	5.0	6.0	5.7	5.7	5.3	5.7	4.0	5.3
AST 3	58	5.0	7.3	5.0	6.0	6.0	6.3	5.7	4.7	4.0	4.3	5.3
Burl TF8	72	5.3	8.3	5.0	5.0	5.0	6.0	6.0	5.0	5.0	5.0	5.3
J 130	63	5.0	7.7	5.0	6.0	5.3	6.0	5.3	4.7	5.0	4.7	5.3
J 140	65	6.3	8.0	5.0	5.0	4.7	5.0	5.7	6.0	6.0	4.7	5.3
MVS MST	52	4.7	7.0	5.0	4.7	5.3	5.7	5.0	5.7	5.7	5.0	5.3
Millennium SRP	75	4.7	7.7	5.3	5.0	5.7	5.3	5.3	5.3	5.3	4.7	5.3
SR 8650 (STR 8LMM)	62	6.3	7.0	5.7	5.0	5.0	5.7	5.7	5.3	5.0	4.7	5.3
IS TF 154	65	5.3	7.7	4.0	5.3	5.7	5.7	5.7	5.7	5.0	4.7	5.2
PST 5HP	62	5.0	7.7	4.7	5.7	5.3	5.7	5.7	4.7	4.7	5.3	5.2
Falcon IV	72	6.0	7.7	5.7	5.0	5.7	5.3	5.3	5.0	5.0	4.3	5.2
IS TF 128	57	5.7	7.7	4.7	5.7	5.7	5.7	5.3	5.0	5.0	4.3	5.2
IS TF 138	50	6.0	8.0	4.3	5.3	6.0	6.3	5.7	5.0	4.7	4.0	5.2
IS TF 159	55	5.3	7.0	3.7	6.0	6.0	6.3	5.7	5.0	4.7	4.0	5.2
MVS 1107	57	5.7	7.3	5.7	5.3	5.0	5.3	5.3	5.0	5.3	4.3	5.2
RK 5	75	5.7	7.7	5.7	5.0	5.7	5.7	5.0	5.3	4.7	4.3	5.2
RNP	63	5.0	7.0	5.0	5.7	6.0	6.0	5.0	4.7	4.3	4.7	5.2
Cezanne Rz (LTP CRL)	52	5.3	7.7	5.7	5.3	5.7	5.3	5.7	5.3	4.0	4.0	5.1
PSG TTRH	68	5.7	6.0	5.0	5.7	5.3	5.7	4.7	5.0	5.0	4.7	5.1
Rhambler	70	6.7	7.3	5.7	4.7	4.7	5.0	5.3	5.3	5.7	4.7	5.1
Speedway (STR 8BPDX)	63	7.0	7.7	5.3	4.3	5.0	5.7	5.3	6.0	5.0	4.3	5.1
DKS	60	5.3	7.3	5.0	5.7	5.3	6.0	5.3	4.3	5.0	4.0	5.1
IS TF 153	62	6.0	8.0	5.0	4.7	5.7	6.0	4.7	5.3	5.0	4.3	5.1
Hunter	53	5.7	5.7	5.3	5.7	5.7	5.7	4.7	4.3	4.3	4.7	5.0

(continued)

Table 1, continued. Performance of tall fescue cultivars at Wichita, KS, 2006-2007[a]

Cultivar/ experimental number	2006 estab. (%)	Green-up	Brown Patch	Quality								
				Mar	Apr	May	June	July	Aug	Sept	Oct	Avg
IS TF 152	52	4.7	7.7	4.0	6.0	5.3	6.3	5.7	4.3	4.7	4.0	5.0
JT 33	63	4.7	7.3	5.0	5.0	5.3	6.3	4.7	4.7	5.0	4.3	5.0
KZ 2	57	5.7	6.0	5.0	5.3	5.0	6.3	5.0	5.0	4.3	4.3	5.0
PSG 85QR	65	5.3	7.7	6.0	5.0	5.0	5.3	5.3	4.7	5.0	4.0	5.0
RK 4	65	5.3	8.0	5.3	5.0	5.0	5.7	5.0	5.0	4.7	4.7	5.0
RP 2	52	5.0	8.3	4.0	4.3	5.3	5.0	6.0	5.7	5.7	4.3	5.0
Z 2000	62	4.7	7.3	4.7	5.3	5.3	6.0	5.3	4.3	5.3	4.0	5.0
ATF 1199	55	5.0	7.3	5.0	5.3	5.0	5.7	5.0	4.7	5.0	4.3	5.0
CE 1	70	6.3	7.7	5.7	5.0	5.3	5.0	5.0	5.0	4.3	4.7	5.0
RAD TF17	57	6.7	7.3	5.3	5.3	5.7	5.7	5.0	4.3	4.3	4.3	5.0
BAR Fa 6235	55	6.0	7.0	4.7	4.7	5.7	5.7	5.0	5.3	4.3	4.3	5.0
BGR TF2	60	5.0	7.3	5.0	5.3	5.3	5.7	5.3	4.7	4.0	4.3	5.0
DP 50 9440	65	5.7	7.7	4.7	5.7	4.7	5.7	5.7	5.0	4.3	4.0	5.0
Einstein	75	5.0	7.3	5.3	5.0	5.0	5.0	5.3	5.0	4.7	4.3	5.0
IS TF 161	62	5.0	7.3	4.3	5.3	5.7	6.0	4.3	4.3	4.7	5.0	5.0
JT 41	70	5.7	7.7	5.7	5.3	5.3	5.3	4.7	5.0	4.3	4.0	5.0
JT 45	72	4.7	7.0	5.3	5.7	5.3	5.0	4.7	4.7	4.7	4.3	5.0
RK 1	60	6.7	8.0	5.3	4.3	4.3	4.7	5.7	5.7	5.0	4.7	5.0
Rebel IV	60	6.3	7.0	5.7	5.0	4.7	5.7	4.7	5.0	4.7	4.3	5.0
Tulsa III	62	6.0	7.7	5.0	5.0	5.0	5.0	5.0	4.7	5.3	4.7	5.0
AST 1	58	5.7	6.7	5.0	5.3	5.7	6.0	4.7	3.7	4.3	4.7	4.9
GE 1	62	5.3	8.0	5.3	5.0	5.3	5.3	5.7	4.7	4.0	4.0	4.9
PSG 82BR	72	4.7	7.0	4.7	5.0	5.7	5.0	5.0	4.7	5.0	4.3	4.9
STR 8BB5	53	6.0	7.3	5.0	5.3	5.3	5.3	4.7	4.0	5.3	4.3	4.9
Skyline	57	5.7	7.7	4.7	5.3	5.3	6.0	5.0	4.3	4.7	4.0	4.9
Escalade	65	5.3	7.3	5.3	5.0	5.3	4.7	4.7	5.0	4.7	4.3	4.9
LS 06	57	5.3	7.0	5.3	5.3	5.3	5.3	5.0	4.7	4.3	3.7	4.9
BGR TF1	62	6.0	7.3	5.3	5.3	5.0	5.3	5.0	4.3	4.0	4.3	4.8
Col M	47	5.7	7.3	4.0	5.7	4.7	5.7	5.0	4.7	4.7	4.3	4.8
IS TF 135	57	5.3	6.0	4.7	5.7	5.3	6.0	4.0	3.7	5.0	4.3	4.8
LS 03	48	5.0	6.7	4.3	5.3	5.3	6.3	4.7	3.7	4.3	4.7	4.8
MVS BB 1	70	6.3	7.7	5.0	5.0	5.0	5.3	6.0	5.0	3.7	3.7	4.8
MVS TF 158	42	5.0	7.0	4.0	4.3	5.3	6.0	5.3	5.0	4.7	4.0	4.8
Col J	47	6.3	6.0	4.3	5.0	5.3	5.7	4.7	4.3	4.7	4.3	4.8
GWTF	60	6.0	8.0	4.7	5.0	5.0	5.7	5.3	4.3	4.3	4.0	4.8
JT 42	77	4.7	7.0	5.0	5.3	5.3	5.0	4.7	4.7	4.3	4.0	4.8
Rembrandt	58	5.3	6.0	5.7	5.0	5.0	5.0	4.3	4.0	4.3	5.0	4.8
STR 8GRQR	53	6.0	7.3	4.7	4.7	5.0	5.0	4.7	4.3	5.7	4.3	4.8
AST 7003	53	5.0	6.3	4.7	4.7	5.3	5.0	5.3	4.7	4.7	3.7	4.8
AST 2	47	6.0	6.7	4.7	5.3	5.3	5.0	4.3	4.3	4.3	4.7	4.8
BAR Fa 6363	58	5.7	7.0	5.3	5.0	5.3	5.3	4.0	4.3	4.0	4.7	4.8
Boltmore	70	5.3	7.0	5.3	5.0	5.3	5.3	4.7	4.0	4.7	3.7	4.8
CS TF1	65	5.0	6.3	5.0	6.3	5.3	5.7	4.7	3.7	3.7	3.7	4.8
IS TF 151	63	5.0	7.0	4.0	5.3	5.7	5.7	5.0	4.3	4.0	4.0	4.8
06 DUST	68	5.3	7.0	5.0	5.0	5.0	5.3	4.7	4.7	4.3	3.7	4.7
AST 7001	48	5.7	5.7	5.0	5.3	5.3	5.7	4.3	4.3	4.0	3.7	4.7
AST 4	60	6.0	6.7	5.0	5.0	5.3	5.3	5.0	4.3	3.7	4.0	4.7
Col 1	43	5.0	6.0	4.7	5.0	4.7	5.7	4.0	4.0	5.0	4.7	4.7
Padre	75	4.7	7.3	5.7	5.0	4.7	5.0	5.0	5.0	3.7	3.7	4.7
GO 1BFD	82	4.5	7.0	5.7	4.3	4.3	4.7	5.0	4.7	4.3	4.3	4.7

(continued)

Table 1, continued. Performance of tall fescue cultivars at Wichita, KS, 2006-2007[a]

Cultivar/ experimental number	2006 estab. (%)	Green-up	Brown Patch	Quality								
				Mar	Apr	May	June	July	Aug	Sept	Oct	Avg
JT 36	63	5.0	7.3	4.3	5.0	5.3	5.0	4.7	4.3	4.7	4.0	4.7
KZ 1	58	5.7	6.7	4.7	6.0	5.0	6.0	4.3	4.0	3.7	3.7	4.7
NA SS	50	6.3	6.7	4.0	5.3	6.0	5.7	4.7	3.7	4.0	3.7	4.6
ATF 1328	53	6.0	7.3	4.7	4.7	4.3	5.3	4.7	4.0	4.7	4.3	4.6
Aristotle	75	5.0	6.7	5.7	5.0	4.7	5.0	4.3	3.7	4.3	4.0	4.6
Justice	75	6.0	6.7	5.3	4.7	5.0	5.0	4.3	4.3	3.7	4.3	4.6
Magellan	78	5.3	7.7	6.0	4.7	4.7	4.7	4.3	4.7	4.3	3.3	4.6
PSG RNDR	50	5.0	7.0	3.7	4.7	5.0	5.0	5.0	4.3	4.3	4.7	4.6
MVS 341	55	4.3	6.7	4.3	5.0	5.0	5.7	4.3	4.0	4.0	4.0	4.5
Plato	87	4.7	6.7	5.7	4.7	4.7	4.7	4.3	4.7	4.3	3.3	4.5
0312	62	6.3	6.3	5.0	5.3	5.0	5.7	3.7	3.3	3.7	4.3	4.5
06 WALK	55	6.0	7.3	5.0	4.3	4.3	4.7	4.7	4.7	4.0	4.3	4.5
AST 7002	55	5.3	6.7	4.3	5.0	5.3	5.3	4.3	3.3	4.3	4.0	4.5
Lindbergh	78	5.7	6.7	5.3	5.0	4.3	4.7	5.0	4.0	3.7	3.7	4.5
ATF 1247	58	5.3	5.3	4.7	4.7	4.7	4.0	4.0	4.0	4.7	4.3	4.4
PSG TTST	67	5.3	7.0	5.3	5.0	4.3	4.3	4.0	4.0	4.0	3.7	4.3
Tahoe II	60	4.7	6.3	4.3	5.0	5.3	5.0	3.7	3.3	4.0	4.0	4.3
Solverado	75	4.7	7.3	5.7	4.0	4.0	3.7	4.0	4.3	3.3	3.3	4.0
Ky 31	83	6.3	8.7	4.0	3.3	3.0	2.7	3.0	3.0	2.7	2.7	3.0
LSD[b]	*18*	*3.8*	*2.1*	*2.5*	*1.1*	*1.4*	*1.0*	*1.4*	*1.1*	*1.3*	*3.0*	*0.5*

[a] Ratings based on a scale of 1-9 with 9 = best measure.

[b] To determine statistical differences among entries, subtract one entry's mean from another's. If the result is larger than the corresponding LSD value, the two are statistically different.

2003 Bentgrass Fairway NTEP Evaluation

Objective:	Evaluate performance of creeping bentgrass cultivars under golf course fairway management conditions
Investigator:	Jack Fry
Sponsor:	USDA National Turfgrass Evaluation Program

INTRODUCTION

Creeping bentgrass is used for putting greens in Kansas, but several courses are using it on fairways. Creeping bentgrass fairways are commonplace in the eastern half of the United States. Information is needed on which creeping bentgrass cultivars are best suited for golf course fairway conditions.

METHODS

Creeping bentgrass was seeded on September 24, 2004, in plots measuring 6 ft × 6 ft. In 2007, the study area received 3 lb/1,000 ft^2 N. Turf was mowed at 0.5 in.; no aerification or topdressing was used. Irrigation was applied to prevent drought stress. An insecticide was applied in July for white grub control, and a preemergence herbicide was applied in April.

Data were collected on turfgrass quality each month from April to August. Quality was evaluated visually with a rating scale of 0 to 9 scale, where 9 = best; a rating of 7 was considered acceptable for a golf course fairway.

RESULTS

In general, creeping bentgrass cultivars performed better than colonial bentgrasses. Cultivars and the months during which they received an average acceptable quality rating were: Crystal Blue Links, May and July; Declaration, May and June; LS-44, July; Mackenzie, May; Authority, May and July; Shark, May; Princeville, July; SR 1119, July, Penneagle II, May; Kingpin, May; L-93, July.

Quality of all cultivars declined significantly between July and August, primarily because of summer heat stress Results from this location and others throughout the United States are available on the NTEP Web site: www.ntep.org

Table 1. Quality of creeping and colonial bentgrass maintained under fairway conditions in the NTEP evaluation at Manhattan, KS, 2007

Name	Type	May	June	July	August	Mean
Crystal Bluelinks	Creeping	7.3	6.0	7.0	4.0	6.1
Declaration	Creeping	7.7	7.0	5.3	4.0	6.0
LS-44	Creeping	6.7	5.0	7.3	4.7	5.9
Mackenzie	Creeping	7.3	5.3	6.7	4.0	5.8
Penncross	Creeping	6.3	5.0	7.3	4.3	5.8
SR 1150	Creeping	6.7	5.7	6.7	4.3	5.8
Authority	Creeping	7.0	5.0	7.0	3.7	5.7
Shark	Creeping	7.3	5.3	6.7	3.3	5.7
13-M	Creeping	6.7	5.3	6.3	4.0	5.6
IS-AP 14	Creeping	6.3	5.7	6.7	3.7	5.6
Princeville	Creeping	5.7	4.7	7.3	4.7	5.6
SR 1119	Creeping	6.7	5.3	7.0	3.3	5.6
Independence	Creeping	6.7	4.7	6.3	4.3	5.5
Penneagle II	Creeping	7.0	5.7	6.0	3.3	5.5
Kingpin	Creeping	7.3	5.0	6.3	3.0	5.4
L-93	Creeping	6.3	4.3	7.3	3.7	5.4
Alpha	Creeping	6.7	4.0	6.7	3.7	5.3
Pennlinks II	Creeping	6.3	4.7	7.0	3.3	5.3
T-1	Creeping	7.3	5.7	5.7	2.0	5.2
EWTR	Colonial	6.7	5.0	5.3	3.3	5.1
Bengal	Creeping	6.7	4.0	6.0	3.3	5.0
IS-AT 7	Colonial	6.3	4.7	5.7	3.3	5.0
Tiger II	Colonial	6.0	5.0	5.7	3.0	4.9
Bardot	Colonial	6.0	5.0	5.0	3.0	4.8
PST-9VN	Colonial	6.0	4.3	5.7	3.0	4.8
Seaside	Creeping	5.0	3.7	6.0	4.3	4.8
PST-9NBC	Colonial	6.0	4.3	5.0	2.7	4.5
SR 7150	Colonial	5.7	4.0	5.0	3.0	4.4
LSD[a]		*1.2*	*1.7*	*1.0*	*1.6*	*0.7*

[a] To determine statistical differences among entries, subtract one entry's mean from another's. If the result is larger than the corresponding LSD value, the two are statistically different.

2007 Ornamental Grass Trial

Objective:	Evaluate different species and cultivars of ornamental grasses for their winter hardiness, appearance, and growth characteristics
Investigator:	Rodney St. John and Robin Dremsa

INTRODUCTION

Ornamental grasses, sedges, and rushes can be great additions to Midwest landscaping, but little research has been conducted to evaluate these plants in a Kansas climate. This project will evaluate many species and cultivars of ornamental grasses for many years. The study will record winter and summer survival rates, the rate at which grasses spread, average height, and appearance. The study will also include a picture record of each grass as it progresses throughout the season and trial.

Ornamental grasses come in a wide variety of sizes, shapes, colors, and textures; most used in the Midwest are clump forming and keep their round shape. However, some have rhizomatous growth habits and can be more active spreaders. Both growth habits can be desirable depending on location and intended use. One purpose of this study is to evaluate spreadability of ornamental grasses.

MATERIALS AND METHODS

Many available grasses are native to Midwestern prairies. They are adapted to this climate and can tolerate a wide variety of conditions, making them useful for low-maintenance and natural-looking gardens. Therefore, this study will be conducted with low-maintenance management practices. Grasses were irrigated and fertilized during establishment. They will not receive supplemental irrigation after establishment, and subsequent fertilizer will only be applied to correct any nutrient deficiencies.

Sixty-seven different grasses (Table 1) were planted in the summer of 2007 at the Horticulture Research and Extension Center, Olathe, KS. This trial will run for several years. Detailed information about each grass is available on the KSUTurf Web site: http://ksuturf.com/OrnamentalGrasses.html

Table 1. 67 different ornamental grasses were planted in the summer of 2007

Scientific name	Common name	Map #	Height[a]	Hardiness
Andropogon gerardii	Big Bluestem	1	5-8 ft	Zone 3
Arundo donax variegata	Variegated Giant Reed	2	14 ft	Zone 6
Bouteloua curtipendula	Sideoats grama	3	3 ft	Zone 4
Bouteloua gracilis	Blue Grama	4	8-15"	Zone 3
Buchloe dactyloides	Buffalo Grass	5	4-8"	Zone 4
Calamagrostis canadensis	Bluejoint Grass	6	3-5 ft	Zone 3
Calamagrostis ×acutiflora 'Karl Foerster'	Foerster's Feather Reed Grass	8	3-5 ft	Zone 5-9
Calamagrostis ×acutiflora 'Overdam'	Overdam Feather Reed Grass	9	3-5 ft	Zone 4
Carex sp. 'Grasshopper'	Grasshopper Sedge	10	12-16"	Zone 5
Carex buchananii	Fox Red Curly Sedge	11	2-3 ft	Zone 5
Carex cornica 'Snowline'	Snowline Sedge	12	6"	Zone 5
Carex elata 'Bowles Golden'	Bowles Golden Sedge	13	1-2 ft	Zone 5
Carex glauca	Blue Sedge	14	6-12"	Zone 5
Carex grayi	Gray's Sedge/Mace Sedge	15	3 ft	hardy
Carex muskingumensis 'Oehme'	Oehme Palm Sedge	16	2 ft	Zone 4
Carex muskingumensis	Palm Sedge	17	2 ft	Zone 4
Eragrostis elliotii 'Wind Dancer'	Lovegrass	18	2-3 ft	Zone 6
Eragrostis elliotii	Blue Lovegrass	19	18"	Zone 5-9
Erianthus ravennae/Saccharum ravennae	Hardy Pampas Grass/ Ravenna Grass	59	14 ft	Zone 6
Festuca cinerea 'Dwarf'	Fescue	20	10"	Zone 4
Festuca glauca 'Elija's Blue'	Fescue	21	6-10"	Zone 4
Festuca paradoxa	Clustered Fescue	22	2-4 ft	hardy
Hakonechloa macra 'Aureola'	Golden Variegated Hakone Grass	23	1-3 ft	Zone 4
Hystrix patula	Bottlebrush Grass	24	2-5 ft	Zone 3
Juncus inflexus	Juncus Blue Arrows	25	3 ft	Zone 5-9
Juncus pallidus	Juncus Javelin	26	5 ft	hardy
Koeleria cristata	Junegrass	27	2-6"	Zone 3-9
Leymus arenarius 'Blue Dune'	Blue Dune Lyme Grass	28	3-4 ft	hardy
Luzula 'Ruby Stiletto'	Wood Rush	29	8-12"	hardy
Luzula sylvatica	Greater Wood Rush	30	20"	Zone 4
Melinis nerviglumis 'Savannah'	Pink Crystals Ruby Grass (Annual)	31	12-24"	Zone 9
Miscanthus floridulus 'Giganteus'	Giant Chinese Silver Grass	32	8-15'	Zone 4-9
Miscanthus sinensis 'Little Dot'	Little Dot Maiden Grass	33	4-5'	Zone 6
Miscanthus sinensis 'Adagio'	Adagio Dwarf Maiden Grass	34	5 ft	Zone 6
Miscanthus sinensis 'Gracillimus'	Maiden Grass	35	7-10 ft	Zone 5
Miscanthus sinensis 'Little Kitten'	Little Kitten Dwarf Maiden Grass	36	4 ft	Zone 5
Miscanthus sinensis 'Little Zebra'	Dwarf Zebra Grass	37	4 ft	Zone 6
Miscanthus sinensis 'Morning Light'	Morning Light Maiden Grass	38	7 ft	Zone 5
Miscanthus 'Purpurescens'	Flame Grass	39	4-5 ft	Zone 4
Miscanthus sinensis 'Rotsilber'	Red Silver Maiden Grass	40	5-7 ft	hardy
Miscanthus sinensis 'Silberfeder'	Silver Feather Grass	41	7 ft	Zone 4
Miscanthus sinensis 'Silberfeil'	Silver Arrow Grass	42	7 ft	Zone 5

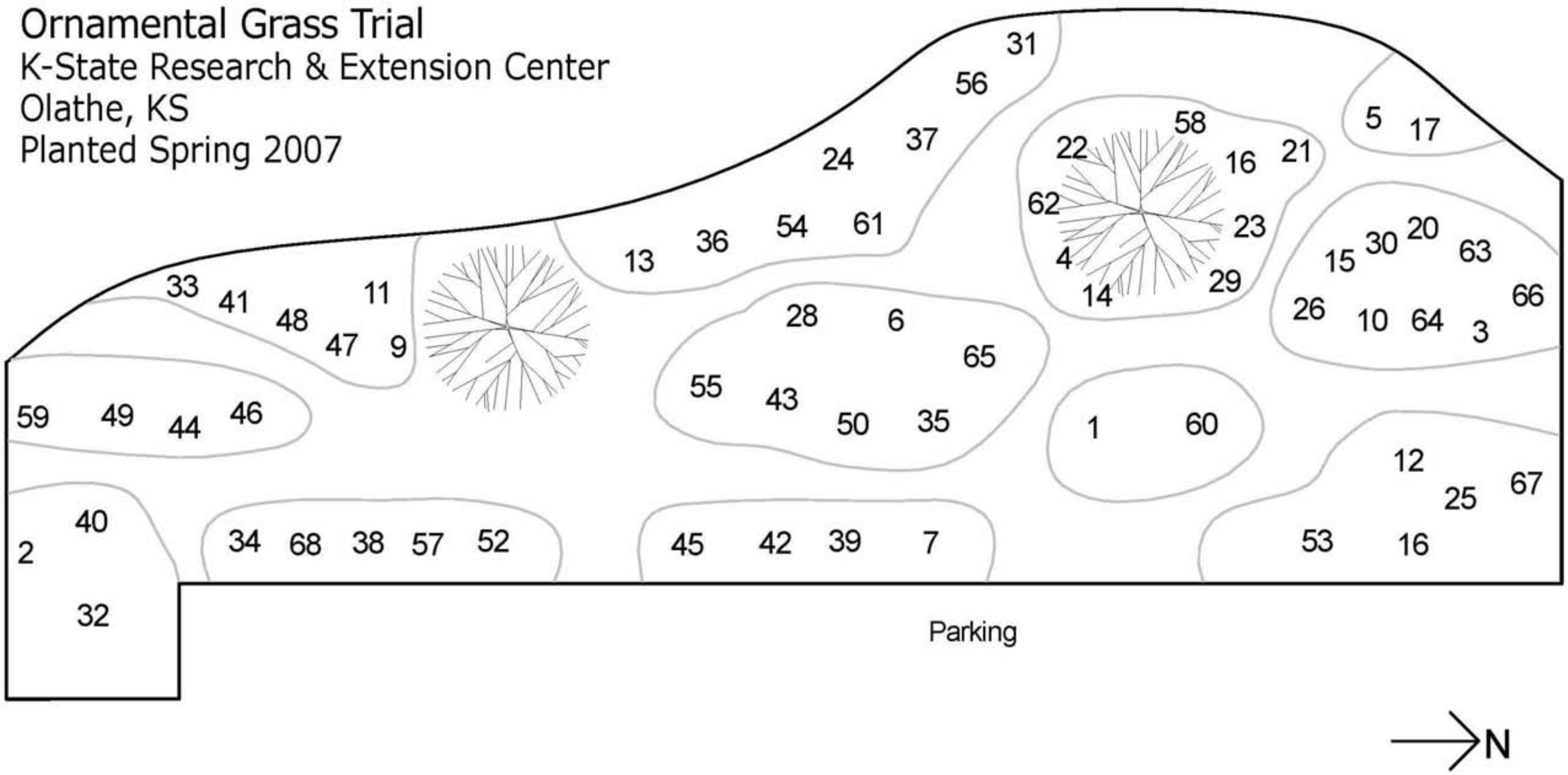
(continued)

Table 1, continued. 67 different ornamental grasses were planted in the summer of 2007

Scientific name	Common name	Map #	Height[a]	Hardiness
Miscanthus sinensis 'Strictus'	Porcupine Grass	43	4-9 ft	Zone 5-9
Miscanthus sinensis 'Variegatus'	Variegated Maiden Grass	44	7 ft	Zone 5
Miscanthus sinensis 'Yaku Jima'	Yaku Jima Dwarf Maiden Grass	45	3-4 ft	Zone 5
Molinia arundinacea 'Skyracer'	Moor Grass	46	7 ft	Zone 4
Panicum virgatum	Switch Grass	47	4-8 ft	Zone 4
Panicum virgatum 'Dallas Blues'	Dallas Blues Switch Grass	48	6 ft	Zone 4
Panicum virgatum 'Prairie Sky'	Prairie Sky Switch Grass	49	5 ft	Zone 5
Panicum virgatum 'Shenandoah'	Shenandoah Red Switch Grass	50	4 ft	Zone 5
Pennisetum alopercuroides	Fountain Grass	51	3-5 ft	Zone 8-11
Pennisetum alopecuroides 'Hameln'	Dwarf Fountain Grass	52	1.5-2.5 ft	Zone 5-9
Pennisetum alopecuroides 'Little Bunny'	Miniature Fountain Grass	53	10-12"	Zone 5-9
Pennisetum alopecuroides 'National Arboretum'	National Arboretum Fountain Grass	54	2 ft	Zone 6
Pennisetum orientale 'Karley Rose'	Oriental Fountain Grass	55	4 ft	Zone 6
Pennisetum purpureum 'Princess'	Princess Napiergrass	56	2-3 ft	Zone 7-11
Pennisetum setaceum 'Rubrum'	Purple Fountain Grass (Annual)	57	5 ft	Zone 9
Phalaris arundinacea 'Dwarf Garters'	Dwarf Ribbon Grass	58	12-15"	Zone 4
Schizachyrium scoparium	Little Bluestem	60	3 ft	Zone 3
Schizachyrium scoparium 'The Blues'	The Blues Little Bluestem	61	3 ft	Zone 3
Sesleria autumnalis	Autumn Moor Grass	62	12-15"	Zone 5
Sesleria caerulea	Blue Autumn Moor Grass	63	12"	Zone 4
Sorghastrum nutans	Indian Grass	64	5-8 ft	Zone 3
Sporobolus aspera	Rough Dropseed	65	3 ft	Zone 5
Sporobolus heterolepsis	Prairie Dropseed	66	12-36"	Zone 3
Stipa lessingiana	Capriccio Stipa	67	1-2 ft	Zone 6
Tripsacum dactyloides	Eastern Gamma Grass	68	8 ft	Zone 5

[a] Heights listed are reported heights that the grass can potentially grow, not actual heights at the Olathe, KS, Center.

Ornamental Grass Trial
K-State Research & Extension Center
Olathe, KS
Planted Spring 2007



Turfgrass Research 2008

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