TURFGRASS RESEARCH 2014

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Foreword

Turfgrass Research 2014 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 on August 7, 2014, at the Rocky Ford Turf Research Center in Manhattan. 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. Notice that each article is now presented as an individual file. This allows you to go directly to articles you have interest in and allows us to link the articles in other media outlets we use, such as Twitter and weekly blogs.

We could not conduct the research in these reports without the support of the Kansas turfgrass industry. This support comes in many forms: organizations such as the Kansas Golf Course Superintendents Association and Heart of America Golf Course Superintendents Association hold tournaments to raise funds; companies such as Ryan Lawn and Tree make donations or sponsor trials to help evaluate plant protectants and fertilizers; and you support education in turfgrass science by attending the annual turfgrass conference and field day.

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. You can access current turfgrass research reports, reports from previous years, and all K-State Research and Extension publications relating to turfgrass online at:

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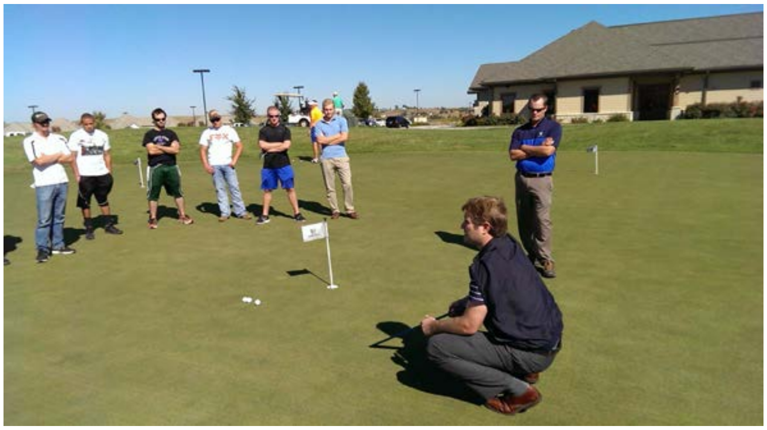

Industry involvement is critical for support of turfgrass research and education. Here, Ty McClellan, Education Director for the United States Golf Association (squatting in front) and Matt Gourlay, golf course superintendent at Colbert Hills Golf Course in Manhattan, visit with K-State students about green speed. Ty and Matt are graduates of the K-State golf course management program.

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'Cody' Buffalograss Tolerance to Combination Postemergent Broadleaf-Weed Herbicides[1]

Jared Hoyle[2] and Jake Reeves[2]

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Summary. Plots treated with all evaluated herbicides recovered to an acceptable level 28 days after application.

Rationale. Options for sedge, broadleaf, and grass weed control in buffalograss [*Buchloe dactyloides* (Nutt.) Engelm.] are limited, and applications of traditional herbicides previously have resulted in unacceptable buffalograss injury.

Objectives. Summarize herbicide tolerance of 'Cody' Buffalograss initiated in the summer of 2013.

Study Description. Experiments were conducted in 2013 at the John C. Pair Horticulture Center in Haysville, KS. 'Cody' buffalograss was maintained at 7.6 cm and irrigated as needed to prevent turfgrass decline throughout the experiment. Not all herbicides used in this study are labeled for use on buffalograss. Herbicide rates were either the maximum labeled rate or the maximum labeled rate for other warm-season turfgrasses. Herbicide treatments included the following.

- **Celsius**: thiencarbazone (0.03 kg/ha) + iodosulfuron (0.007 kg/ha) + dicamba (0.2 kg/ha);
- **Katana**: flazasulfuron (0.09 kg/ha);

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[1] This research was sponsored in part by a grant from the Kansas Turfgrass Foundation.
[2] Department of Horticulture, Forestry, and Recreation Resources.

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- **Q$_4$Plus**: quinclorac (0.87 kg/ha) + sulfentrazone (0.07 kg/ha) + 2,4-D (1.0 kg/ha) + dicamba (0.1 kg/ha);
- **SpeedZone**: carfentrazone (0.03 kg/ha) + 2,4-D (1.0 kg/ha) + Mecoprop (0.32 kg/ha) + dicamba (0.1 kg/ha);
- **Surge**: sulfentrazone (0.03 kg/ha) + 2,4-D (0.75 kg/ha) + Mecoprop (0.27 kg/ha) + dicamba (0.1 kg/ha);
- **Trimec Classic**: 2,4-D (1.0 kg/ha) + MCPA (0.3 kg/ha) + dicamba (0.1 kg/ha);
- **T-Zone**: triclopyr (0.17 kg/ha) + sulfentrazone (0.02 kg/ha) + 2,4-D (0.6 kg/ha) + dicamba (0.07 kg/ha);
- **EndRun**: quinclorac (0.8 kg/ha) [Drive XLR8], MCPA (1.1 kg/ha) + fluroxypyr (0.11 kg/ha) + triclopyr (0.11 kg/ha) [Battleship III], 2,4-D (0.9 kg/ha) + MCPA (0.25 kg/ha) + dicamba (0.08 kg/ha);
- **Dismiss**: sulfentrazone (0.4 kg/ha) + quinclorac (1.2 kg/ha) [Solitare], sulfentrazone (0.4 kg/ha);
- **Blindside**: carfentrazone (0.03 kg/ha) [QuickSilver], sulfentrazone (0.4 kg/ha) + metsulfuron (0.04 kg/ha); and
- **SquareOne**: carfentrazone (0.05 kg/ha)+ quinclorac (0.85 kg/ha).

Plots were treated with herbicides on July 1, 2013. Experimental design was a randomized complete block with four replications and individual plot size of 1.5 × 1.5 m. Herbicides were applied in 374 L/ha of water at 275 kPa with a CO$_2$-pressurized boom sprayer with XR8004VS flat-fan nozzles. Buffalograss phytotoxicity (0 to 100), turfgrass color (1 to 9), quality (1 to 9), and normalized digital vegetation index (NDVI) (0 to 1) were collected. All data were analyzed using SAS (SAS Institute, Inc., Cary, NC), and means were separated according to Fisher's Protected LSD at $\alpha \leq 0.05$ significance level.

Results. No buffalograss injury was observed 7 days after treatment (DAT) with Katana or QuickSilver (Table 1). Slight buffalograss phytotoxicity (0 to 10%) was observed 7 DAT on research plots treated with Celsius, Q$_4$Plus, Surge, Drive XLR8, Solitare, Dismiss, Blindside, and SquareOne. Applications of SpeedZone, Trimec Classic, T-Zone, Battleship, and EndRun resulted in >14% buffalograss phytotoxicity. By 28 DAT, all herbicide treatments excluding SpeedZone (3.8%), T-Zone (2.5%), and Katana (1.3%), resulted in no buffalograss phytotoxicity.

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Table 1. 'Cody' Buffalograss phytotoxicity from various postemergent combination herbicides in Haysville, KS[1]

	Percentage phytotoxicity[2]	
Herbicide treatment	July 8	August 8
Celsius	3.8 d[3]	0 c
Katana	0 d	1.3 bc
Q_4Plus	3.8 d	0 c
SpeedZone	15 ab	3.8 a
Surge	7.5 bcd	0 c
Trimec Classic	15 ab	0 c
T-Zone	13.8 abc	2.5 ab
Drive XLR8 + MSO[4]	3.8 d	0 c
Battleship	18.8 a	0 c
EndRun	15 ab	0 c
Solitare	6.3 cd	0 c
Dismiss	3.8 d	0 c
QuickSilver	0 d	0 c
Blindside	2.5 d	0 c
SquareOne	2.5 d	0 c

[1] Applications were applied on July 1, 2013.

[2] Percentage phytotoxicity was determined by visually estimating the amount of the total ground cover in each plot that had chlorotic vegetation on a 0 to100% scale, where 0% = no phytotoxicity.

[3] Within columns, means with followed by the same letter are not significantly different according to Fisher's Protected LSD ($P \leq 0.05$).

[4] Methylated seed oil (MSO) was added to treatment according to the label at 1.5 pt/a rate.

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Figure 1. 'Cody' Buffalograss research trial plot in Haysville, KS, on July 8, 2013.

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Prolonged Drought and Recovery Characteristics of Kentucky Bluegrass Cultivars[1]

Tony Goldsby[2], Dale Bremer[2], Jack Fry[2], and Steven J. Keeley[2]

Summary. Twenty-eight Kentucky bluegrass cultivars and two hybrid bluegrasses[3] (Table 1) recovered well from extended drydowns in two years with no irrigation and little precipitation. The recovery was slower in the year with a longer, more severe drydown.

Rationale. Kentucky bluegrass (*Poa pratensis* L.) (KBG) is the most widely used cool-season turfgrass for lawns, golf courses, athletic fields, and other areas where a dense grass cover is desired. Increasing water scarcities may result in irrigation restrictions to KBG, perhaps for lengthy periods, without regard for potentially damaging effects on KBG.

Objectives. Evaluate the performance of these bluegrasses during extended drydowns and their recuperative abilities after being re-watered.

Study Description. A field study was conducted in 2010–11 at the Rocky Ford Turfgrass Research Center in Manhattan, KS, under a fully automated rainout shelter that prevented precipitation from falling on plots. These bluegrasses were subjected to 81 days without irrigation in the first year and 61 days without irrigation in the second year. To measure their performance during the drydown and recovery periods, we took digital photos of the turf periodically

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[1] This research was sponsored in part by a grant from the Kansas Turfgrass Foundation.
[2] Department of Horticulture, Forestry, and Recreation Resources.
[3] Hybrid bluegrasses are genetic crosses between Kentucky bluegrass and native Texas bluegrass (*Poa arachnifera* Torr.).

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and analyzed them with software to determine the percentage green cover of each plot.

Results. All 30 of the bluegrasses went completely dormant in the first year and mostly dormant in the second year from prolonged drought stress (Figure 1). Remarkably, all 30 bluegrasses recovered in both years, although the recovery was slower (i.e., lasted well into the following spring) after the first drydown because of longer exposure to drought (Figure 2). There were no consistent differences in the performance of the 30 bluegrasses.

Table 1. Phenotypic types and cultivars of Kentucky bluegrasses and hybrid bluegrasses

Type[1]	Cultivar	Type	Cultivar
Compact America	Apollo	Common	Kenblue
	Bedazzled		Park
	Kingfisher		Wellington
	Langara		
	Unique	Compact	Diva
			Moonlight
Mid-Atlantic	Cabernet		Skye
	Eagleton		
	Preakness	BVMG[2]	Abbey
			Baron
Compact Midnight	Award		Envicta
	Blue Velvet		
	Midnight	Shamrock	Shamrock
	Midnight II		
	Nu Destiny	European[3]	Bartitia
			Blue Knight
Aggressive	Limousine		
	Touchdown	Hybrid bluegrasses	Longhorn
			Thermal Blue Blaze
Julia	Julia		

[1] Kentucky bluegrass classification types.
[2] BVMG, Baron, Victa, Merit, and Gnome.
[3] Blue Knight and Bartitia have since been reclassified as "Other Type."

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Figure 1. Conditions of bluegrass plots in Manhattan, KS, at the end of the drydowns in 2010 (left) and 2011 (right). The drydown in 2010 was longer than in 2011.

Figure 2. Conditions of bluegrass plots in Manhattan, KS, at the end of the recovery periods after the drydowns in 2010 (left) and 2011 (right). The recovery in 2010 lasted into the spring of 2011 (left, photo taken May 31, 2011), whereas in 2011 the recovery was faster (right, photo taken October 16, 2011). The 81-day drydown in 2010 ended on September 4, and the 61-day drydown in 2011 ended on August 1, 2011.

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Effects of Nitrogen Source and Spray Volume on the Establishment of Silvery-Thread Moss

Zane Raudenbush and Steven J. Keeley[1]

Summary. Applying soluble nitrogen increases silvery-thread moss (*Bryum argenteum* Hedw.) cover. Spray volume did not significantly affect moss growth throughout the experiment. Pots treated with ammonium sulfate (AMS) had more moss cover compared with urea and the control, regardless of spray volume. Similarly, *B. argentum* dry weight increased threefold when sprayed with AMS compared with all other treatments; the increased dry weight was the result of longer gametophyte filaments.

Rationale. The practice of spraying small quantities of soluble nitrogen (<8 lb/a N) at relatively high frequencies (e.g., biweekly) may promote *B. argenteum* growth because the moss lacks a vascular system capable of removing water and nutrients from the soil. Different water-soluble N sources such as AMS have not been evaluated for their effects on the spread of *B. argenteum*. Decreasing spray volume raises the concentration of a spray solution; therefore, it was hypothesized that reducing spray volume when applying soluble N would have a negative effect on *B. argenteum* growth.

Objectives. Determine the effect of spray volume and different soluble N sources on *B. argenteum* growth.

Study Description. A population of *B. argenteum* collected from a putting green at the Rocky Ford Research Center in Manhattan, KS, was increased via asexual propagation in the greenhouse. *Bryum argenteum* plugs were dried and processed with a coffee grinder, and 0.7 g of ground plant material was placed

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[1] Department of Horticulture, Forestry, and Recreation Resources.

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in 10 × 20-cm pots containing sand conforming to United States Golf Association specifications for putting green rootzones. A control and two N sources, urea and AMS, were applied weekly at 4.35 lb/a N at three spray volumes: 10, 44, and 108 gal/a of water. Dibasic potassium phosphate was used to supply all treatments with 0.37 lb/a phosphorus (P) and 0.94 lb/a potassium (K). Percentage moss coverage was determined weekly using a camera mounted on a custom-made light box, and digital images were analyzed using SigmaScan (hue: 45-75, saturation: 50-100). Treatments were evaluated in a completely randomized two-factor design (factor A = nutrient source; factor B = spray volume), and the study was repeated. At 7 weeks after initial treatment (WAIT), moss was harvested, placed in a drying oven for 72 hours at 75°C, and dry weight was recorded.

Results. Overall, spraying soluble N increased moss cover compared with the untreated control at several rating dates, and AMS had the highest moss cover at three rating dates in both experiments (Tables 1 and 2; Figure 1). Compared with urea, AMS caused more than a threefold increase in *B. argenteum* dry weight in both experiments; no differences in dry weight between urea and the water control were observed (Figure 2). Spray volume was not significant at $P = 0.05$ for percentage cover or dry weight at any rating in Experiments 1 and 2.

Table 1. Effect of urea and ammonium sulfate (AMS) on percentage *B. argenteum* cover in Experiment 1

	% cover[1]			
Treatment	1 WAIT[2]	3 WAIT	5 WAIT	7 WAIT
AMS	35 a	53 a	62 a	74 a
Urea	31 b	53 a	44 b	42 b
Control	26 c	35 b	33 c	40 b

[1] Means followed by the same letter in a column are not statistically different ($P \leq 0.05$) by Fisher's LSD.

[2] Weeks after initial treatment.

Table 2. Effect of urea and ammonium sulfate (AMS) on percentage *B. argenteum* cover in Experiment 2

	% cover[1]			
Treatment	1 WAIT[2]	3 WAIT	5 WAIT	7 WAIT
AMS	35 a	60 a	55 a	60 a
Urea	33 a	43 b	34 b	36 b
Control	29 b	33 c	28 b	34 b

[1] Means followed by the same letter in a column are not statistically different ($P \leq 0.05$) by Fisher's LSD.

[2] Weeks after initial treatment.

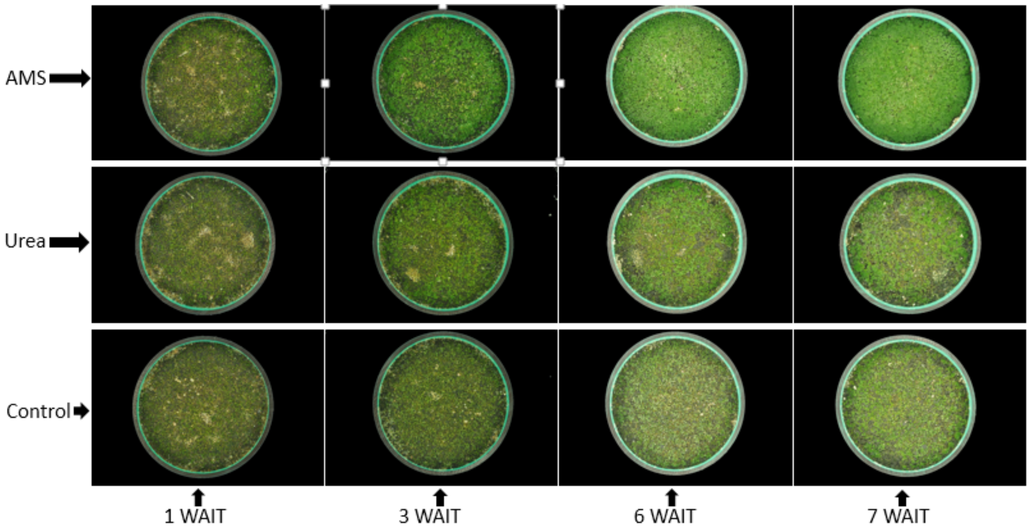

Figure 1. *B. argenteum* cover in Experiment 1 when fertility treatments were applied using a spray volume of 44 gal/a of water.
(AMS: ammonium sulfate.)

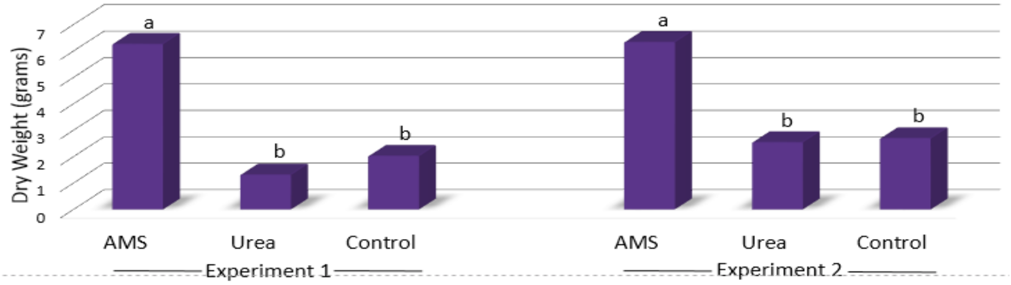

Figure 2. Effect of urea and ammonium sulfate (AMS) on *B. argenteum* dry weight harvest 7 weeks after initial treatment.

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Effects of Irrigation, Cutting Height, and Primo on Mowing Requirements of Tall Fescue[1]

Joshua Chabon[2], Dale Bremer[2], and Jack Fry[2]

Summary. Irrigation based on soil moisture sensors (SMS) saved water compared with frequency-based irrigation while providing acceptable turfgrass quality but did not affect mowing requirements of tall fescue. Increasing tall fescue mowing height, or applying Primo, resulted in mowing reductions.

Rationale. Mowing requirements can be affected by irrigation strategy, mowing height, and plant growth regulators, but information is limited on how they may interact.

Objectives. Evaluate irrigation strategy, mowing height, and Primo (trinexapac-ethyl) for their influence on irrigation and mowing requirements.

Study Description. Field studies were conducted in 2012–13 on a Chase silt loam soil at the Rocky Ford Turfgrass Research Center in Manhattan, KS, in tall fescue (*Festuca arundinacea*). Study periods were April 9 through November 30, 2012, and May 13 through October 22, 2013. Irrigation treatments included: (1) frequency-based irrigation, set to run automatically three times weekly to mimic the irrigation scheduling of a typical homeowner; and (2) SMS-based irrigation that was triggered when soils dried to a predetermined threshold. Mowing was done with a walk-behind rotary mower set at 2 or 3.5 in. based upon the one-third rule; one set of plots at these heights received a monthly

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Primo application, whereas the other set did not. The total number of mowings were counted, data were subjected to analysis of variance, and Fisher's protected LSD ($P \leq 0.05$) was used to detect treatment differences.

Results. Irrigation did not affect mowing requirements. In 2012, tall fescue mowed at 2 in. and treated with Primo required three fewer mowings than untreated turf mowed at 2 in.; at a 3.5-in. cutting height, only one fewer mowing resulted after Primo application (Table 1; Figure 1). In 2013, mowing at 3.5 vs. 2 in., or using Primo vs. not, resulted in a 9% reduction in total mowings required.

Table 1. Interaction between mowing height and Primo on total mowings for tall fescue from April 9 through November 30, 2012, in Manhattan, KS

Mowing height (inches)	Primo[1]	Total mowings[2]
2.0	No	9.0 a[3]
2.0	Yes	6.0 c
3.5	No	7.5 b
3.5	Yes	6.5 c

[1] Primo was applied at 0.3 lb a.i./a on April 16, May 19, June 18, July 12, August 10, September 5, and October 3, 2012.

[2] Mowing was done following the one-third rule: turf at 2 in. was mowed when it reached 3 in., and turf at 3.5 in. was mowed when it reached 5 in.

[3] Means followed by different letters within a column are significantly different ($P = 0.05$).

Figure 1. Raising mowing height or applying Primo resulted in a reduction in total number of mowing over the season, but irrigation application strategy had no effect on mowing (photo credit: torogov.com).

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Irrigation Management and Nitrogen Fertilization Effects on Water Application Amounts and Nitrate Leaching in Turfgrass[1]

Joshua Chabon[2], Dale Bremer[2], and Jack Fry[2]

Summary. Irrigation based on soil moisture sensors saved water compared with frequency-based irrigation while providing acceptable turfgrass quality, and nitrate leaching was negligible under the conditions of this study.

Rationale. Urbanization in the United States has increased the area covered with turf, causing greater concern about water amounts used for irrigation and the potential for leaching from nitrogen (N) fertilization in urban watersheds.

Objectives. Evaluate differences between frequency-based irrigation and soil moisture sensor (SMS)-based irrigation in: (1) total amount of water applied; (2) nitrate leaching levels among various N fertilizer rates and types; and (3) turfgrass quality.

Study Description. Field studies were conducted in 2012–13 on a Chase silt loam soil at the Rocky Ford Turfgrass Research Center in Manhattan, KS, in tall fescue (*Festuca arundinacea*). Irrigation treatments included: (1) frequency-based irrigation, set to run automatically three times weekly to mimic irrigation scheduling of a typical homeowner; and (2) SMS-based irrigation that was triggered when soils dried to a predetermined threshold. Nitrogen treatments consisted of no N fertilizer (control), urea, and polymer-coated urea, each at 2.5 and 5.0 lb/1,000 ft^2 per year; fertilizer was applied in five applications in

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each year. To measure leaching, soil solution was extracted from a depth of 30 in. using suction lysimeters every two months during the growing season. Data were subjected to analysis of variance, and Fisher's protected LSD ($P \leq 0.05$) was used to detect treatment differences.

Results. The SMS-based irrigation applied 32 to 70% less water than frequency-based irrigation (Table 1). Water savings were greater in the wet year of 2013 than the drier year of 2012. In the wet year (2013), precipitation maintained the soil moisture at higher levels, which allowed the SMS system to bypass irrigation cycles more often than in the dry year (2012). There were no differences in nitrate leaching between irrigation treatments or among N sources, and leaching did not exceed 0.6 mg/L. All fertilized turf had acceptable quality throughout the study.

Table 1. Yearly total irrigation values for frequency- and soil moisture sensor (SMS)-based irrigation treatments and total precipitation during the study periods

Irrigation/precipitation[1]	2012	2013
	------------------- in.	-------------------
Frequency-based	19.5 a[2]	15.8 a
SMS-based	13.2 b	4.8 b
Difference[3]	-32%	-70%
Total precipitation	12.1	23.7

[1] Values for the study period from May 28 through October 15 in 2012 and May 27 through October 14 in 2013.

[2] Means followed by different letters within a column were significantly different ($P = 0.05$).

[3] (SMS – frequency) / frequency.

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Winter Survival of 2013 National Turfgrass Evaluation Program Zoysiagrass and Bermudagrass Entries at Kansas Locations[1]

Cole Thompson[2], Jack Fry[2], Jared Hoyle[2], and Jason Griffin[2]

Summary. Only a few entries in the zoysiagrass and bermudagrass National Turfgrass Evaluation Program (NTEP) trials exhibited good survival following the 2013–2014 winter and will be suitable for use in Kansas.

Rationale. Low-temperature stress can limit the use of warm-season turfgrasses in Kansas. National Turfgrass Evaluation Program studies are located nationwide to evaluate characteristics of turfgrass species. Kansas currently provides a location for both zoysiagrass and bermudagrass NTEP studies.

Objective. Summarize winter injury of zoysiagrass and bermudagrass NTEP entries the spring after studies were initiated in the summer of 2013.

Study Description. The Kansas location of the zoysiagrass NTEP study is at the Rocky Ford Turfgrass Research Center in Manhattan, KS. The bermudagrass NTEP study is located at the John C. Pair Horticulture Center in Haysville, KS. In Manhattan, the temperature dropped to a low of -12°F on January 6, 2014, and below-zero temperatures were also recorded in December (-6°F); February (-9°F), and March (-3°F). The low temperature in Haysville was -6°F on January 7, 2014; below-zero temperatures also occurred in March (-1°F). Entries in each study were established in June 2013. All zoysiagrass entries were established vegetatively; some of the bermudagrass entries are seeded

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types. Percentage zoysiagrass survival was visually estimated on May 6 and 21, 2014. The bermudagrass study was evaluated on May 20, 2014. All data were subjected to analysis of variance, and Fisher's protected LSD ($P \leq 0.05$) was used to detect treatment differences.

Results. Eleven of 36 zoysiagrass entries did not survive the winter in Manhattan, and an additional 10 entries had ≤50% winter survival (Table 1 and Figure 1). 'Meyer' zoysiagrass had no injury emerging from winter, and KSUZ 1201 and KSUZ 0802, experimental progeny jointly developed by K-State and Texas A&M AgriLife Research – Dallas, were the only grasses with winter survival comparable to 'Meyer' (Table 1). In the bermudagrass NTEP study in Haysville (Figure 2), two of 35 entries did not survive winter, and an additional eight entries had ≤50% winter survival. 'Latitude 36,' 'Yukon,' and five experimental bermudagrass progeny had no injury emerging from winter, and 'Astro,' 'Patriot,' 'Riviera,' and five other experimental progeny were statistically equivalent to the aforementioned grasses in winter survival (Table 2).

Figure 1. Several National Turfgrass Evaluation Program zoysiagrass entries in Manhattan, KS, on May 22, 2014.

Figure 2. Several National Turfgrass Evaluation Program bermudagrass entries in Haysville, KS, on May 6, 2014.

Table 1. Survival of NTEP zoysiagrass entries in Manhattan, KS

Cultivar or progeny	Percentage survival[1] May 6		Percentage survival[1] May 21	
Meyer	100.0	a[2]	100.0	a
KSUZ 0802	98.3	a	99.3	a
KSUZ 1201	96.7	ab	98.3	a
FAES 1319	83.3	bcd	86.7	b
DALZ 1301	93.3	abc	82.0	b
Empire	83.3	cd	78.3	bc
11-TZ-4321	51.7	efg	75.0	bc
FAES 1305	70.0	cde	71.7	bc
Zeon	48.3	fg	71.7	bc
10-TZ-1254	86.7	bcd	65.0	cde
10-TZ-35	78.3	cde	65.0	cde
A-1	35.0	gh	65.0	cde
DALZ 1302	78.3	cdef	63.3	cde

Table 2. Survival of NTEP bermudagrass entries in Haysville, KS

Cultivar or progeny	Percentage survival[1] May 20	
Latitude 36	100.0	a[2]
JSC 2-21-1-v	100.0	a
JSC 2-21-18-v	100.0	a
JSC 2009-6-s[3]	100.0	a
Yukon[3]	100.0	a
OKC 1131	100.0	a
OKC 1163	100.0	a
OKC 1302	98.3	ab
Astro	97.3	ab
JSC 2007-8-s[3]	96.7	ab
JSC 2007-13-s[3]	96.7	ab
JSC 2009-2-s[3]	95.3	abc
Patriot	93.3	abc

Table 1. Survival of NTEP zoysiagrass entries in Manhattan, KS

Cultivar or progeny	Percentage survival[1]			
	May 6		May 21	
FAES 1304	68.3	def	55.0	def
FAES 1312	50.0	efg	50.0	ef
FAES 1318	5.0	h	31.7	fg
FAES 1317	13.3	h	19.3	gh
09-TZ-54-9	5.0	h	15.0	gh
FAES 1328	3.7	h	10.0	gh
FAES 1307	5.0	h	9.3	gh
GGZ 504	0.3	h	6.0	gh
FAES 1313	0.0	h	4.3	h
FAES 1329	0.7	h	2.7	h
CSZ 1105	0.0	h	2.7	h
FAES 1315	0.0	h	1.7	h
DALZ 1303	0.0	h	0.7	h
FAES 1316	0.3	h	0.0	h
09-TZ-53-20	0.0	h	0.0	h
CSZ 1109	0.0	h	0.0	h
FAES 1303	0.0	h	0.0	h
FAES 1306	0.0	h	0.0	h
FAES 1308	0.0	h	0.0	h
FAES 1309	0.0	h	0.0	h
FAES 1310	0.0	h	0.0	h
FAES 1314	0.0	h	0.0	h
FAES 1322	0.0	h	0.0	h

[1] Percentage survival was determined by visually estimating the amount of the total ground cover in each plot that had green leaf tissue.

[2] Within columns, means followed by the same letter are not significantly different according to Fisher's Protected LSD ($P \le 0.05$).

Table 2. Survival of NTEP bermudagrass entries in Haysville, KS

Cultivar or progeny	Percentage survival[1]	
	May 20	
DT-1	93.3	abc
Riviera[3]	91.7	abc
OKS 2011-1[3]	86.7	bcd
11-T-510	81.7	cde
OKS 2011-4[3]	76.7	def
PST-R6P0[3]	73.3	efg
11-T-251	71.7	efgh
BAR C291[3]	68.3	efghi
OKS 2009-3[3]	61.7	fghij
MBG 002[3]	60.0	fghij
MSB 281	60.0	fghij
FAES 1326	51.7	ghijk
North Shore SLT[3]	48.3	hijk
PST-R6CT[3]	48.3	hijk
PST-R6T9S[3]	46.7	ijk
Tifway	40.0	jkl
Celebration	25.0	klm
FAES 1327	25.0	klm
NuMex-Sahara[3]	11.7	lm
FAES 1325	10.0	m
Princess 77[3]	0.0	m
12-TSB-1[3]	0.0	m

[1] Percentage survival was determined by visually estimating the amount of the total ground cover in each plot that had green leaf tissue.

[2] Within columns, means with followed by the same letter are not significantly different according to Fisher's Protected LSD ($P \le 0.05$).

[3] Seeded entry.

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TURFGRASS RESEARCH 2014

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SRP1107
JULY 2014

Evaluation of Selective Herbicide Combinations and a Plant Growth Regulator on Rough Bluegrass Control[1]

Cole Thompson[2], Jack Fry[2], and Megan Kennelly[3]
Collaborators: Zac Reicher and Matthew Sousek, University of Nebraska-Lincoln

Summary. Three applications of Velocity 17.6 SG at 6 oz/a consistently reduced rough bluegrass cover and provided up to 92% control 16 weeks after initial treatment (WAIT).

Rationale. Rough bluegrass (*Poa trivialis* L.) is a problematic weed in cool-season turfgrasses in the transition zone and northern United States. Velocity (bispyribac-sodium) is the only product currently labeled for selective rough bluegrass control in cool-season turfgrasses, but it can be used only on sod farms and golf courses.

Objectives. Evaluate several herbicides, Xonerate 4 SC (amicarbazone), Tenacity 4 SC (mesotrione), combinations of Xonerate 4 SC + Tenacity 4 SC, Velocity 17.6 SG, and a plant growth regulator, Trimmit 2 SC (paclobutrazol), for rough bluegrass control.

Study Description. Field studies were conducted in 2013 at the Rocky Ford Turfgrass Research Center in Manhattan, KS, and the John Seaton Anderson Turf Research Center in Mead, NE, in rough bluegrass monostands and at a

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[1] This research was sponsored in part by a grant from the Kansas Turfgrass Foundation.
[2] Department of Horticulture, Forestry, and Recreation Resources.
[3] Department of Plant Pathology.

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View all turfgrass research reports online at: ***www.ksre.ksu.edu/bookstore*** commercial golf course in Hutchinson, KS, in a mixed stand of rough bluegrass and perennial ryegrass (*Lolium perenne* L.). Treatments were applied one to three times beginning in late June at approximately 10-day intervals in 87 gal/a of water. Rough bluegrass control was visually estimated at 2, 4, 8, 12, and 16 WAIT. Data were subjected to analysis of variance, and Fisher's protected LSD ($P \leq 0.05$) was used to detect treatment differences.

Results. Rough bluegrass was not effectively controlled by applications of Xonerate 4 SC, Tenacity 4 SC, combinations of Xonerate 4 SC + Tenacity 4 SC, or Trimmit 2 SC (Table 1). Velociy 17.6 SG was the only treatment that consistently reduced rough bluegrass coverage (Figures 1 and 2), but it was also injurious to perennial ryegrass at 8 WAIT (data not shown).

Table 1. Effect of treatments on rough bluegrass control

		Control (%)[1]		
		16 WAIT[2]	12 WAIT	16 WAIT
Treatment and rate/a	Applications[3]	Manhattan	Hutchinson	Mead
1. Untreated	0	17 d[4]	0 b	3 bc
2. Xonerate 4 SC (1.4 fl oz)	2	54 bc	0 b	3 bc
3. Xonerate 4 SC (2.8 fl oz)	1	45 bcd	0 b	0 c
4. Xonerate 4 SC (2.8 fl oz)	2	63 ab	0 b	2 bc
5. Tenacity 4 SC (4.0 fl oz)	1	46 bcd	0 b	4 bc
6. Tenacity 4 SC (4.0 fl oz)	2	56 bc	13 b	8 b
7. Tenacity 4 SC (4.0 fl oz)	3	50 bc	17 b	2 bc
8. Xonerate 4 SC (1.4 fl oz) + Tenacity 4 SC (4.0 fl oz)	2	42 bcd	7 b	1 c
9. Xonerate 4 SC (2.8 fl oz) + Tenacity 4 SC (4.0 fl oz)	1	48 bcd	0 b	0 c
10. Xonerate 4 SC (2.8 fl oz) + Tenacity 4 SC (4.0 fl oz)	2	49 bcd	0 b	3 bc
11. Trimmit 2 SC (16.0 fl oz)	3	27 cd	23 b	4 bc
12. Velocity 17.6 SG (6 oz)	3	92 a	58 a	16 a

[1] Percentage rough bluegrass control was determined by comparing cover on each rating date to initial cover in each plot [if % cover on rating date ≥ initial % cover, then % control = 0; otherwise, % control = (initial % cover – % cover on rating date) / initial % cover × 100].

[2] Weeks after initial treatment.

[3] Treatments were applied in Manhattan on June 27, July 8, and July 18; in Hutchinson on July 2, July 15, and July 29; and in Mead on June 27, July 10, and July 22.

[4] Within columns, means with followed by the same letter are not significantly different according to Fisher's Protected LSD ($P \leq 0.05$).

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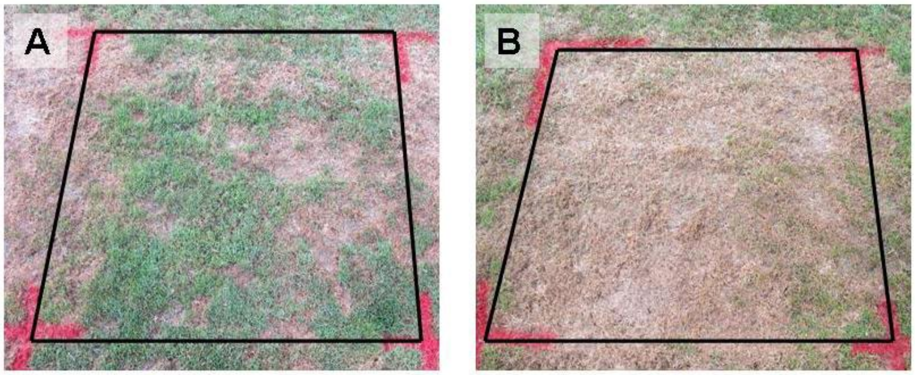

Figure 1. Effects of treatments in Manhattan, KS: A) untreated and B) Velocity 17.6 SG on July 26, 4 weeks after initial treatment. Decline in the untreated plot is due to abiotic stress.

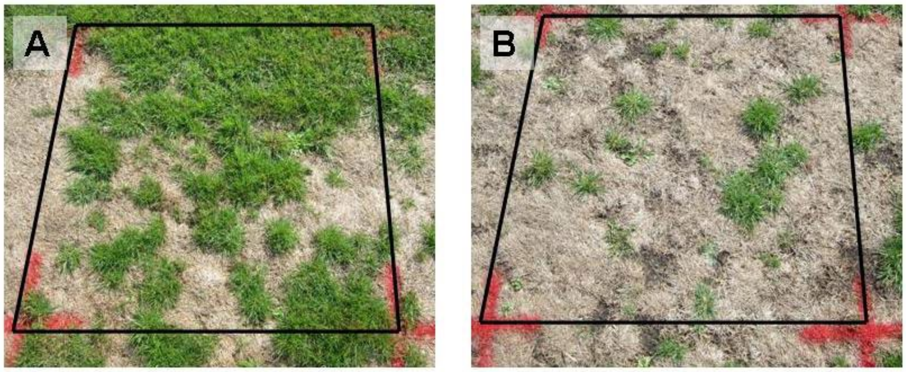

Figure 2. Effects of treatments in Manhattan, KS: A) untreated and B) Velocity 17.6 SG on October 17, 16 weeks after initial treatment. Note rough bluegrass recovery in B compared with Figure 1.

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TURFGRASS RESEARCH
2014

Evaluation of Colorants on 'Meyer' Zoysiagrass

Ross Braun[1], Jack Fry[1], and Megan Kennelly[2]

Summary. Turf colorants effectively enhanced green color of dormant zoysiagrass. Using a higher application rate or adding a midwinter application helped color persistence. Colorants increased canopy temperatures more than soil temperatures, which may encourage earlier spring greenup.

Rationale. In the transition zone, zoysiagrass provides a number of agronomic and economic benefits compared with cool-season turfgrass, including reduced water, pesticide, and fertilizer requirements and simplified weed control. However, brown zoysiagrass color during dormancy prevents its more widespread use among turf managers. Although colorants are used routinely in the South, more information is needed about the use of colorants on zoysiagrass in the transition zone where a longer winter dormancy period occurs.

Objectives. Determine the effects of colorants along with recommended number of applications and application volumes on 'Meyer' zoysiagrass in the transition zone.

Study Description. Field studies were conducted at the Rocky Ford Turfgrass Research Center and Colbert Hills Golf Course in Manhattan, KS, from October 2013 through May 2014 on 'Meyer' zoysiagrass maintained at fairway height (0.5 in.). Thirteen treatments, including an untreated control, consisted of the colorants Green Lawnger, Endurant, and Wintergreen Plus applied once in October at 100 or 160 gal/a or at the same rates in October and February (18

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[1] Department of Horticulture, Forestry, and Recreation Resources.

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weeks after the initial application). Turf color was visually rated on a biweekly schedule, and spring soil and canopy temperatures were monitored biweekly starting in March. Data were subjected to a threefold nested analysis of variance, and Fisher's protected LSD ($P \leq 0.05$) was used to detect differences.

Results. Results from the two locations were similar; data from Rocky Ford are presented in Table 1. A single application of each colorant at 100 gal/a on October 17 resulted in acceptable color for about 8 weeks (through December 11). Single applications at 160 gal/a resulted in acceptable color for at least 12 weeks (through January 10). Supplementing the autumn application with a sequential application on February 17 resulted in acceptable turf color throughout the remainder of dormancy with all colorants regardless of application volume. Green Lawnger and Endurant provided a dark-green turf color, whereas color after Wintergreen Plus application was more of a pine green (Figure 1). All three colorants at both application volumes and both application timings resulted in higher spring canopy temperatures on some spring evaluation dates, which may serve to speed spring greenup.

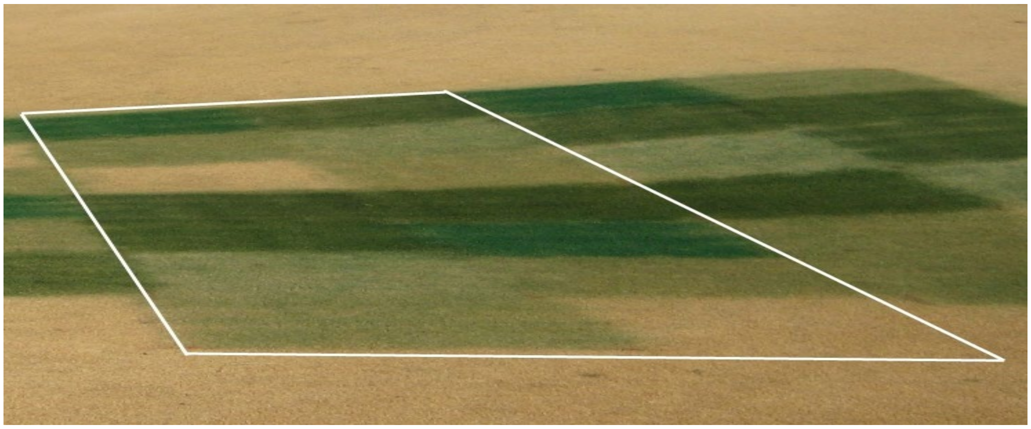

Figure 1. Study area after the second application timing treatments on 'Meyer' zoysiagrass at the Colbert Hills Golf Course on February 24, 2014 (18 weeks after treatment). White box: Top (furthest) row, from left to right in each row: Wintergreen Plus (100 gal/a, two applications), Green Lawnger (100 gal/a, two application), Endurant (160 gal/a, one application), Wintergreen Plus (100 gal/a, one application), Untreated, Green Lawnger (100 gal/a, one application), Green Lawnger (160 gal/a, two applications), Endurant (160 gal/a, two applications), Endurant (100 gal/a, two applications), Wintergreen Plus (160 gal/a, two applications), Wintergreen Plus (160 gal/a, one application), Green Lawnger (160 gal/a, one application), Endurant (100 gal/a, one application), Untreated.

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Table 1. Effect of colorant, application volume, and application timing on color of 'Meyer' zoysiagrass at the Rocky Ford Turfgrass Research Center, Manhattan, KS, 2013–2014

		Turf color[1]					
		Oct. 17[2]	Dec. 11	Jan. 10	Feb. 21	Mar. 17	May 1
Treatment	Application date[3]	0 WAT[4]	8 WAT	12 WAT	18 WAT	22 WAT	28 WAT
Green Lawnger							
100 gal/a	Oct. 17	9.0	7.1 b[5]	5.9 b	4.5 c[7]	3.0 fg	7.3 c
	Oct. 17 + Feb. 18	--[6]	--	--	9.0 a	8.5 ab	9.0 a
160 gal/a	Oct. 17	8.8	7.8 a	7.0 a	5.3 b	3.3 efg	6.8 c
	Oct. 17 + Feb. 18	--	--	--	9.0 a	8.5 ab	9.0 a
Endurant							
100 gal/a	Oct. 17	8.5	6.3 c	5.4 c	3.8 d	2.5 g	6.8 c
	Oct. 17 + Feb. 18	--	--	--	8.8 a	8.0 bc	8.8 a
160 gal/a	Oct. 17	8.9	7.5 ab	6.6 a	4.3 cd	3.5 def	7.5 bc
	Oct. 17 + Feb. 18	--	--	--	9.0 a	9.0 a	8.8 a
Wintergreen Plus							
100 gal/a	Oct. 17	8.9	7.5 ab	5.8 bc	5.5 b	4.0 de	7.0 c
	Oct. 17 + Feb. 18	--	--	--	8.5 a	7.3 c	8.5 ab
160 gal/a	Oct. 17	8.9	7.8 a	6.6 a	5.3 b	4.3 d	7.3 c
	Oct. 17 + Feb. 18	--	--	--	9.0 a	8.8 ab	9.0 a
Untreated		5.0	1.0 d	1.0 d	1.0 e	1.0 h	5.3 d

[1] Turf color was rated on a 1 to 9 scale, where 1 = straw brown; 6 = acceptable green color (light green); and 9 = dark green.

[2] No significant difference ($P \geq 0.05$) for date.

[3] Colorants at a dilution of 1:6 (colorant:water) were applied using a three-nozzle, CO_2-pressurized sprayer with 8002VS nozzles at 20 psi calibrated to deliver spray solution at half of the total gal/a application volume in two directions.

[4] Weeks after treatment (weeks after first colorant application).

[5] Means in a column followed by the same letter are not significantly different according Fisher's protected least significant difference test, $P \leq 0.05$.

[6] No significant difference ($P \geq 0.05$) for application timing for date. Therefore, application volume means are the average of 8 observations for the 100 and 160 gal/a treatments before February 21, regardless of application timing.

[7] Means for application timing effect on colorant and application volume beginning on February 21; based on $n = 4$.

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