Turfgrass Research 2020

Evaluation of Selected Large Patch-Tolerant *Zoysia* spp. for Performance in Kansas

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Summary

Turf quality characteristics and large patch incidence of ten selected experimental zoysiagrass genotypes were evaluated during the 2018–2019 growing season in Manhattan, KS, and establishment rate of the same ten was evaluated in Olathe, KS. Although plots were inoculated with *Rhizoctonia solani* (AG 2-2 LP) in September 2018 in Manhattan, no large patch occurred. However, the genotypes showed variability in turf performance measured by turf quality, spring greenup, fall color retention, and genetic color. In Olathe, KS, at Shadow Glen Golf Club, the ten genotypes were planted on June 17, 2019. The range in visual ground coverage on September 27, 2019, was 63.3 to 92.7%.

Objectives

- To evaluate performance of ten large patch-tolerant zoysiagrass genotypes compared to eight standard zoysiagrass cultivars.
- To identify the large patch-tolerant experimental genotypes with the best turf quality and compare rate of establishment from plugs.

Rationale

Zoysiagrass (*Zoysia* spp.), a warm-season turfgrass, is commonly used on golf course fairways and tees, and home lawns. In the United States transition zone, zoysiagrass is popular because it possesses excellent heat tolerance, drought tolerance, and requires less fertilizer and pesticides than other commonly used turf species. In addition, zoysiagrass can tolerate the cold winters better than many other warm-season species, such as bermudagrass (*Cynodon* spp.) (Beard, 1973).

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A persistent challenge with zoysiagrass is its susceptibility to large patch disease (Green et al., 1993). Meyer zoysiagrass has been used extensively in the U.S. transition zone since its release in 1952 mainly because of its excellent cold tolerance compared with the other zoysiagrass cultivars (Fry et al., 2017). However, Meyer is highly susceptible to large patch and isn't as fine in texture or as dense as other cultivars (Patton, 2009). The cost associated with the use of preventive fungicides in spring and fall to prevent large patch is a concern for zoysiagrass turf managers.

Development of large patch-tolerant zoysiagrass cultivars could be a promising alternative to fungicides. Researchers at Texas A&M AgriLife Research in Dallas, TX, crossed 22 cold-hardy zoysiagrasses with TAES 5645 (*Z. japonica*) or its derivatives that had demonstrated tolerance to large patch in breeding stock, resulting in 2,858 progeny. These progeny were evaluated for cold adaptation and turf performance in non-replicated field plots in three different locations: Manhattan, KS; West Lafayette, IN; and Dallas, TX, from 2012 to 2014 (Braun, 2014). From each location, 20 progeny that performed the best were selected and aggregated 60 progeny were advanced forward for further field testing. All 60 progeny were established in replicated field trials in 2015 in Manhattan, KS, and Fayetteville, AR, and evaluated for large patch tolerance from 2015 to 2018. Additionally, all 60 progeny were established in eight other locations including West Lafayette, IN, for turf performance evaluation. Based on the large patch tolerance and turf performance measured by percent green cover, turfgrass quality, spring greenup, and winter injury, the ten best performing progeny were selected (Xiang, 2018). This study assessed the performance of those ten best potential large patch-tolerant progeny along with eight standards.

Study Description
Field Management
The study plot was established using plugs in July 2015 at the Rocky Ford Turfgrass Research Center in Manhattan, KS, as described by Xiang (2018). Each plot measured 6- × 6-ft with 2-ft alleyways between the plots. A blend of perennial ryegrass (*Lolium perenne*) was seeded in the alleyways in September 2015 to prevent soil erosion. Plots were fertilized with urea (46-0-0) in June to provide a total of 44 lb N per acre per year in 2018 and 2019. Plots were maintained under golf course fairway/tee conditions and mowed at 0.5 inches with a reel mower and irrigated to avoid drought stress. Dimension 2EW (Dow AgroSciences, Indianapolis, IN) was applied at 1 lb a.i. per acre in April 2019 as pre-emergent herbicide to control weeds, and Speedzone (a.i. 2, 4-D, 2-ethylhexyl ester, mecoprop-p acid, dicamba acid, and carfentrazone-ethyl) at 43 gallons of product per acre in July 2019 and July 2020 each as post-emergent herbicide to kill broadleaf weeds.

We also established the ten best progeny for on-site evaluation in Shadow Glen Golf Club, Olathe, KS, on June 17, 2019. Plots were prepared by removing the existing Kentucky bluegrass using a sod cutter. Soil was added back to each plot and leveled

smooth. Each plot measured 6- × 6-ft with a 2-ft alley. The ten progeny were established by planting 24 two-inch diameter plugs in each plot, whereas commercial cultivars, 'Meyer' and 'Innovation' were established using 12 plugs per plot. Ronstar G (a.i. oxadiazon 2%, Bayer Environmental Science) was applied immediately after planting at 2 lb a.i. per acre. The plots were mowed at 3 inches and irrigated to prevent stress through the growing season.

Pathogen Inoculation

Plots in Manhattan were inoculated on September 16, 2019, with isolates of *Rhizoctonia solani* (AG 2-2 LP), which were obtained from a naturally infected zoysiagrass area in June 2016 and maintained since by regularly transferring onto new plates. The field inoculum was prepared and applied as described by Obasa et al. (2013). To prepare the inoculum, we took 150 g of oat kernels with 150 mL water in a 1 L jar and autoclaved for 30 minutes twice on two consecutive days. We segmented the ¼ PDA (Potato Dextrose Agar) plate containing *R. solani* samples into tiny pieces and added one half of the material to one jar. The jars were incubated at room temperature for two weeks with regular shaking every 2 days before applying in the field. We randomly divided each plot into two sub-plots, one half for inoculation of pathogen and the other half for a disease-free sub-plot. In each inoculated sub-plot, we sliced a slit below the thatch layer using a pocket knife, applied 8–10 g of oat inoculum in each slit, and finished tamping the turf back. The plots were kept wet for about two weeks by irrigating about 0.5 inch with sprinkler system to foster fungal growth. We applied a preventive fungicide, flutolanil (N-[3-(1-methylethoxy) phenyl]-2(trifluoromethyl) benzamide, ProStar 70 WG, Bayer Environmental Science, Research Triangle Park, NC) at 8.6 lb a.i. per acre on September 11, 2018, April 30, 2019, and September 16, 2019, in each plot to keep the healthy sub-plots clean. The fungicide was applied using a CO_2 compressed hand-sprayer equipped with a single 8004 EVS nozzle (TeeJet Technologies, Urbandale, IA) calibrated to deliver 86 gallons per acre.

Data Collection and Analysis

We collected data from the selected ten best progeny and eight standards (Table 1). All data were collected from every sub-plot independently. We visually rated overall turf quality, spring greenup, and fall color retention. Visual turf quality, defined as evaluation of color, density, leaf texture, and uniformity, was rated on a scale of 1–9 (where 1 = poorest quality, 9 = optimum quality, and 6 = minimally acceptable turf). More quality ratings were taken in spring and fall, as we had anticipated large patch. Spring greenup was rated on a scale of 1–9 (1 = brown, and 9 = fully green); and fall color retention was also rated on a scale of 1–9 (where 1 = brown, and 9 = dark green) following National Turf Evaluation Program (NTEP) guidelines (Shearman and Morris, 2000). Experimental design was a split-plot in which zoysiagrass entries were the whole plot (6 ft × 6 ft) and treatment (inoculated or fungicide-treated) was the sub-plot (6 ft × 3 ft).

The study at Shadow Glen Golf Club was set up as randomized complete block with four replications. We recorded percent living ground cover visually on a scale of 0–100% on September 27, 2019, following NTEP guidelines (Shearman and Morris, 2000). All data were subjected to analysis of variance (ANOVA) using Proc GLIMMIX procedure in SAS 9.4 (SAS Institute, Cary, NC). Means were separated using Fisher's protected least significant difference (LSD) test at $P = 0.05$.

Results

In this study, we didn't find the interaction effect of treatment × genotype on any of the responses measured. The simple main effect of the large patch inoculation treatment was also not significant. Results presented herein are thus only the main effects of genotypes, including turf quality, fall color, spring greenup, and genetic color.

We found some variability among the genotypes in turf performance. Innovation zoysiagrass was in the highest statistical group on each of the seven rating dates (Table 1). Experimental genotypes which were statistically equivalent to Innovation on at least four rating dates were DALZ 1701, DALZ 1702, and DALZ 1707. Fall color of these three genotypes was similar to Innovation in 2018 and 2019, with the exception of DALZ 1707, which was lower on November 2, 2018 (Table 2; Figure 1). Likewise, spring greenup of these three genotypes was similar to Innovation in 2019. Experimental genotypes that had genetic color comparable to Innovation on July 26, 2019, were DALZ 1701, DALZ 1808, and DALZ 1813.

At Shadow Glen Golf Club in Olathe, KS, ground cover ranged from 63.3% to 92.7% on September 27, 2019 (Table 3; Figure 2). Genotypes, such as DALZ 1703, DALZ 1812, and DALZ 1808 had significantly higher ground cover than DALZ 1707 and DALZ 1809.

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Table 1. Turf quality of experimental and commercial zoysiagrass genotypes evaluated in Manhattan, KS, in 2018 and 2019

	Turf quality[†]						
	2018			2019			
Entry ID	10/11	10/26	11/2	6/21	8/9	9/6	10/28
DALZ 1701	7.3ab[†]	5.8abcd	4.7abc	6.2abc	7.2bc	7.0c	4.8ab
DALZ 1702	6.8bcde	5.7bcde	4.8ab	6.0abcd	7.2bc	7.3abc	4.3abc
DALZ 1703	6.3ef	5.7bcde	4.7abc	6.0abcd	7.0c	7.0c	4.3abc
DALZ 1707	7.3ab	5.2de	4.2cd	6.3ab	7.7ab	7.5ab	4.5abc
DALZ 1808	7.0bcd	5.5bcde	4.3bcd	6.5a	7.0c	7.0c	4.7ab
DALZ 1809	6.5def	5.0e	4.0d	6.0abcd	7.0c	7.0c	3.8c
DALZ 1810	6.7cde	5.3cde	4.3bcd	5.5d	7.0c	7.0c	4.2bc
DALZ 1811	6.0f	5.3cde	4.2cd	5.7cd	7.0c	7.0c	4.2bc
DALZ 1812	6.3ef	5.2de	4.0d	5.7cd	7.0c	7.0c	3.8c
DALZ 1813	7.0bcd	5.2de	4.0d	6.5a	7.2bc	7.2bc	4.3abc
Chisholm	7.0bcd	6.0abc	4.8ab	6.2abc	7.3bc	7.0c	4.8ab
El Toro	7.0bcd	6.0abc	4.7abc	5.7cd	7.0c	7.0c	4.5abc
Innovation	7.7a	6.5a	5.0a	6.5a	8.0a	7.7a	5.0a
KSUZ 1201	7.0bcd	6.0abc	5.0a	5.8bcd	7.5abc	7.3abc	5.0a
Meyer	7.3ab	6.0abc	5.0a	6.2abc	7.2bc	7.0c	5.0a
TAES 5645	7.0bcd	6.0abc	5.0a	6.3ab	7.3bc	7.3abc	4.8ab
Zeon	7.2abc	6.2ab	5.0a	6.3ab	8.0a	7.7a	5.0a
Zorro	7.0bcd	6.0abc	5.0a	6.2abc	7.0c	7.0c	5.0a
LSD§$_{0.05}$	0.52	0.73	0.51	0.62	0.53	0.45	0.67

[†]Visual turf quality scores were rated on a scale of 1–9; where 1 = poorest quality; 6 = minimum acceptable quality; and 9 = optimum color, density, texture, and uniformity. Scores were recorded on the sub-plots (fungicide treated and nontreated) and means were pooled across sub-plots.

[†]Values within a column followed by the same letter are not statistically different at $P \le 0.05$ according to Fisher's protected least significant difference (LSD).

Table 2. Fall color, spring greenup, and genetic color of experimental genotypes and commercial zoysiagrass cultivars evaluated in Manhattan, KS, in 2018 and 2019

Entry ID	Fall color[†] 2018 10/19	11/2	Fall color[†] 2019 10/14	11/14	Spring greenup[‡] 2019 4/26	5/30	Genetic color[§] 7/26
DALZ 1701	6.3abc[¶]	4.7ab	6.3	4.5ab	2.3bcd	7.0ab	8.0ab
DALZ 1702	6.8a	4.7ab	6.7	4.3abc	2.3bcd	7.0ab	7.7bc
DALZ 1703	6.8a	4.7ab	6.3	3.8cd	2.3bcd	7.0ab	7.7bc
DALZ 1707	6.0c	4.2bc	6.8	4.2abcd	2.7abc	7.0ab	7.7bc
DALZ 1808	6.3abc	4.3abc	6.7	3.8cd	2.3bcd	7.2a	8.0ab
DALZ 1809	6.8a	4.8a	6.8	4.2abcd	2.8abc	7.0ab	7.3cd
DALZ 1810	6.2bc	4.3abc	6.5	4.2abcd	2.5bc	5.8bc	7.7bc
DALZ 1811	6.0c	4.0c	6.7	4.3abc	3.0abc	6.7ab	7.3cd
DALZ 1812	6.2bc	4.2bc	6.7	4.0bcd	2.8abc	6.8ab	7.3cd
DALZ 1813	6.0c	4.0c	6.2	4.2abcd	2.8abc	7.2a	8.0ab
Chisholm	6.8a	4.2bc	6.7	4.7a	2.2cd	6.7ab	7.7bc
El Toro	6.2bc	4.2bc	6.3	3.7d	1.0d	4.8c	7.0d
Innovation	6.7ab	4.8a	6.5	4.2abcd	2.7abc	7.3a	8.3a
KSUZ 1201	6.5abc	4.5abc	6.8	4.3abc	4.0a	6.7ab	7.7bc
Meyer	6.3abc	4.5abc	6.8	4.3abc	3.7ab	7.3a	7.7bc
TAES 5645	6.0c	4.3abc	6.3	4.2abcd	1.0d	6.7ab	7.7bc
Zeon	6.8a	4.8a	6.3	4.7a	1.7cd	6.3ab	8.0ab
Zorro	6.5abc	4.3abc	6.7	4.5ab	2.3bcd	6.3ab	7.7bc
LSD_{0.05}	0.51	0.50	NS	0.55	1.49	1.25	0.46

[†]Visual fall color ratings were recorded on a scale of 1–9, where 1 = straw brown and 9 = optimum green color. Scores were recorded on the sub-plots (fungicide treatment) and means were pooled across sub-plots.

[‡]Visual spring greenup ratings were recorded on a scale of 1–9; where 1 = straw brown and 9 = optimum green color. Scores were recorded on the sub-plots (fungicide treatment) and means were pooled across sub-plots.

[§]Visual genetic color ratings were recorded on a scale of 1–9; where 1 = light green and 9 = dark green. Scores were recorded on the sub-plots (fungicide treatment) when turf was actively growing and was not under stress and means were pooled across sub-plots.

[¶]Values within a column followed by the same letter are not statistically different at $P \le 0.05$ according to Fisher's protected least significant difference (LSD).

Table 3. Ground cover of ten experimental zoysiagrass progeny on September 27, 2019, after planting on June 17, 2019, at Shadow Glen Golf Club in Olathe, KS

Entries	Ground cover (%)[†]
DALZ 1703	92.7a[‡]
DALZ 1812	89.3ab
DALZ 1808	81.7abc
DALZ 1811	76.7bcd
DALZ 1701	75.0bcd
DALZ 1702	74.3bcd
DALZ 1813	71.7cd
DALZ 1810	70.0cd
DALZ 1707	65.0d
DALZ 1809	63.3d
LSD$_{0.05}$	15.3

[†] Twenty-four 2-inch diameter plugs were planted in each plot on June 17, 2019. Percent ground cover was rated visually on a scale of 0 to 100% on September 27, 2019. Two commercial cultivars were not included in the analysis because fewer plugs/plot were used during establishment.

[‡] Values within a column followed by the same letter are not statistically different at $P \leq 0.05$ by Fisher's protected least significant difference (LSD). Least significant difference was calculated using Fisher's protected LSD at $P = 0.05$.

Figure 1. Zoysiagrass genotypes showing variability in fall color retention in Manhattan, KS, on October 25, 2019.

Figure 2. Zoysiagrass plots at Shadow Glen Golf Club in Olathe, KS, on September 27, 2019, showing some variability in ground cover 102 days after planting.