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RESEARCH

Addressing Misperceptions Regarding Buffalograss Tolerance to Sandy Soils, Traffic, and Shade

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ABSTRACT

Buffalograss [*Buchloë dactyloides* (Nutt.) Engelm. syn. *Bouteloua dactyloides* (Nutt.) Columbus] is often reported as being intolerant of shade, traffic, and sandy soils. Historically, these observations were made on early turf-type cultivars or common types and may not reflect performance of modern cultivars and germplasm selections. As an example, the 1991, 1996, and 2002 buffalograss National Turfgrass Evaluation Program (NTEP) trials had evaluation sites consisting of sandy loam to sandy clay loam. One of the four sandy loam sites in the 1991 trial, and five of nine sandy loam–sandy clay loam sites in the 1996 and 2002 tests had buffalograss entries rating 6.0 or greater. We have since successfully established buffalograss on sandy sites with management changes typical of grasses considered adapted to sandy sites. In addition, multiyear shade and traffic studies were conducted at the University of Nebraska–Lincoln turfgrass research farm. A Brinkman traffic simulator was used to apply weekly traffic to 104 buffalograss genotypes from mid-June through October in 2013 and 2014. Following 2 yr of moderate traffic, 70 of the genotypes were minimally affected by the traffic treatment. Shade tolerance studies were started in 2009 and 2013. Three buffalograss genotypes rated in the top 6% of 54 genotypes evaluated when grown under 60% shade cloth in the 2009 study. In 2013, four buffalograss entries grown under 60% shade cloth rated in the top 12% of 34 evaluated genotypes. A comparison of relative performance of 16 genotypes in common among the 2009 and 2013 shade studies highlight significant variability in performance under different environmental conditions and the need for revisiting historical recommendations.

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Abbreviations: NTEP, National Turfgrass Evaluation Program; PAR, photosynthetically active radiation.

Buffalograss is an important native amenity grass species ideally suited for low-input turf environments because of its innate cold, heat, and drought tolerance. In addition to these desirable stress tolerance traits, buffalograss is highly stoloniferous, forms a dense sod, and requires less frequent mowing and less water to maintain an acceptable turf than most other conventional turfgrass species (Shearman et al., 2004). Reports suggest that buffalograss is not adapted to sandy soils (Wenger, 1943), should not be used in high-traffic areas (Morton and Engelke, 1992), and is intolerant of shade (Wu, 1990). These perceptions of buffalograss stem from early observations, experiments, and reports of common or early turf-type buffalograss cultivars and impede adoption and influence management of modern improved cultivars.

As an example, Wenger (1943) noted that buffalograss does not thrive on sandy soils, making this statement based on the observation that buffalograss is not common in the sand hills of the western Great Plains because of its preference for heavier soils. In the sand hills region, buffalograss could be found in flats and drainage ways with higher percentages of silts but not in areas dominated by sandy soils (Wenger, 1943). While this observation holds true, it is not clear if buffalograss is not adapted to sandy soils, does not outcompete other species adapted to sandy soils, or other factors. Since that time, others have reported buffalograss adaptation to a range of soil types but a preference for fine textured soils (Beard, 1973; Riordan and Browning, 2003;

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Shearman et al., 2004; Turgeon, 2012). The NTEP coordinates evaluation trials of turfgrasses across the United States, reporting on site characteristics and turfgrass performance. Buffalograss NTEP evaluation tests were initiated in 1991, 1996, and 2002 (http://www.ntep.org/) and 22 of the 49 tests reported soils with a significant sand component (loamy sand, sandy clay, sandy clay loam, and sandy loam). None of the test sites reported failure as a result of sandy soils.

Shade is an important part of the landscape, with 20 to 25% of all managed turf grown under some type of shade (Beard, 1969, 1973). Wu (1990) evaluated 'Highlight 24' and 'Texoka' buffalograss grown in full sun or under black shade cloths permitting 30 and 50% natural sunlight. Wu (1990) concluded that buffalograss does not tolerate shade, but stand persistence was not evaluated. Variability in rate of stolon elongation, dry weight, and percentage turf cover was observed in these two cultivars. Huff and Wu (1987) evaluated sex expression of monoecious and dioecious buffalograss in different environments and found that high light promoted female sex forms and low light favored male forms in monoecious types. While this latter report may have implications for production of seeded buffalograss, together these reports suggest variability in buffalograss response to contrasting light levels and opportunities for genetic improvement through breeding.

Traffic tolerance is another important characteristic for any turfgrass species, and one of the traits differentiating turf-type grasses from non-turf-type grasses. Recovery following traffic was noted as a desired characteristic of low-mowed buffalograss (Johnson et al., 2000). Johnson et al. (2000) observed good buffalograss recovery following traffic, but the purpose of their study was to evaluate the performance of buffalograss genotypes at a low mowing height. In Texas, a reduction in 'Prairie' buffalograss canopy density in response to medium and high traffic levels occurred, and there was some injury at low traffic levels (Morton and Engelke, 1992). Buffalograss subjected to low traffic levels maintained acceptable turf quality. A generally held belief is that buffalograss lacks traffic tolerance, but there is limited research supporting this view.

There has been an active buffalograss breeding effort at the University of Nebraska since the mid-1980s and conclusions drawn from prior observations of buffalograss may not apply to modern cultivars and germplasm selections. The purpose of the current study is to test the performance of buffalograss cultivars and germplasm selections in response to shade or traffic and revisit prior observations of buffalograss performance in different soil types.

MATERIALS AND METHODS

Buffalograss Soil Type Adaptation

Mean visual quality data and soil texture classifications were obtained from the NTEP website for the 1991, 1996, and 2002 NTEP buffalograss tests (http://www.ntep.org/bu.htm). Visual quality data were grouped based on reported soil texture (sandy: loamy sand, sandy clay, sandy clay loam, and sandy loam; nonsandy: silt loam, silt, silty clay, clay, silty clay loam, and loam). Welch's t-test implemented in R was used to determine if mean buffalograss quality across all sandy sites was the same as the mean quality across all nonsandy sites. Welch's t-test was also used for pairwise comparisons between all reported soil textural classes from the NTEP buffalograss tests.

Traffic Tolerance

An advanced buffalograss performance evaluation trial consisting of 104 buffalograss entries, including six named varieties and 98 experimental lines, was established on 11 June 2008. The study was established as a randomized complete block design with three replications at the John Seaton Anderson Turfgrass Research Farm near Mead, NE. The trial was maintained by providing 2.54 cm water mo^{-1} either by rainfall or supplemental irrigation and fertilized with 98.8 kg N ha^{-1} yr^{-1}. Sulfur-coated urea was applied at a rate of 49.4 kg N ha^{-1} in late June and mid-July of each year of the study (since 2008). The study was mowed to maintain a 7.6-cm height during each growing season. In 2013, the study was modified to a split-block design by applying traffic weekly to the 5-yr-old turf stand with a Brinkman Traffic Simulator. The traffic simulator was outfitted with 7.9-mm (5/16-inch) hex bolts to simulate tearing and shearing action along with the compaction and compression forces. Two passes were made with the simulator pulled behind a garden tractor weekly from June through October in 2013 and 2014.

Visual quality observations were made, following NTEP guidelines, of the trafficked and nontrafficked portions of each plot on 16 Aug., 17 Sept., and 17 Oct. 2013 and 3 Jul., 20 Aug., and 18 Sept. 2014. Analysis of variance (ANOVA) of the traffic treatment and genotypes was performed in SAS using PROC GLIMMIX (SAS Institute, 2009). Fisher's LSD ($P \leq 0.05$) was used to compare genotype $\times$ treatment interactions at each rating date to identify genotypes that best tolerate the traffic.

Shade Tolerance

On 20 May 2009, three parallel studies were established to evaluate the performance of 52 buffalograss genotypes. Each study was established as a randomized complete block design with three replications. One study was established in full sun, another under a 30% black shade cloth, and the third under a 60% black shade cloth. Each study was maintained as described above with the exception that a 5.1-cm mowing height was used. Visual quality observations were made on 13 July and 15 Sept. 2009, 1 July and 24 Sept. 2010, and 18 Sept. 2011. Analysis of variance (ANOVA) for each light treatment and genotype was performed in SAS using PROC GLM (SAS Institute, 2009). Fisher's LSD ($P \leq 0.05$) was used to compare genotypes at each rating date.

Sixteen buffalograss genotypes spanning different levels of shade tolerance were advanced along with 18 additional buffalograss genotypes to a second shade study established in 2013. Genotypes lacking shade tolerance were advanced to the 2013 trial as shade intolerant controls. The 2013 shade study was established as a split-plot design with three replications. Each block was split based on light treatment (full sun or 60% shade) and all genotypes were randomized under each light treatment. Visual

Table 1. Welch two-sample *t*-test comparisons of National Turfgrass Evaluation Program (NTEP) buffalograss visual quality means grown in different soil textural classes.

	Loamy sand		Sandy clay		Sandy clay loam		Sandy loam		Silt loam and silt		Silty clay and clay		Silty clay loam		Loam	
	df	*p*-value	df	*p*-value	df	*p*-value	df	*p*-value	df	*p*-value	df	*p*-value	df	*p*-value	df	*p*-value
Loamy sand (70–90% sand)	(4.63 ± 0.27)†															
Sandy clay (45–65% sand)	39	0.028	(3.96 ± 1.72)													
Sandy clay loam (45–80% sand)	84	<0.001	44	<0.001	(5.32 ± 1.19)											
Sandy loam (43–85% sand)	39	<0.001	38	<0.001	225	0.061	(5.09 ± 0.84)									
Silt loam and silt (0–50% sand)	121	0.025	48	0.002	316	0.023	280	0.321	(4.95 ± 1.67)							
Silty clay and clay (0–45% sand)	72	0.080	44	0.005	210	0.002	157	0.051	262	0.532	(4.85 ± 0.96)					
Silty clay loam (0–20% sand)	98	<0.001	48	<0.001	235	0.033	180	<0.001	286	<0.001	201	<0.001	(5.66 ± 1.30)			
Loam (23–52% sand)	49	<0.001	42	<0.001	143	0.314	89	0.002	188	0.001	121	<0.001	150	0.190	(5.46 ± 0.62)	

† Values in parentheses along the diagonal represent soil class means and standard deviations of the NTEP visual quality rating means from the 1991, 1996, and 2002 buffalograss trials.

quality observations were made on 17 Oct. 2013 and 9 Oct. 2014 at the end of each growing season. Ten random 12.7-cm (5.0-inch) depth soil temperature measurements were collected under each light treatment block using a digital thermometer (General Tools & Instruments LLC). Similarly, 10 photosynthetically active radiation measurements were collected under each light treatment block on 20 Aug. 2013 by a BQM Quantum Meter μmol m^{-2} s^{-1} (Apogee Instruments). Analysis of variance was conducted using PROC GLM and genotype × treatment comparisons were made using Fisher's LSD ($P \leq 0.05$).

RESULTS AND DISCUSSION

Soil Type Adaptation

Buffalograss NTEP tests were conducted in 1991, 1996, and 2002. The 1991, 1996, and 2002 tests consisted of 22, 14, and 10 buffalograss entries grown at 24, 12, and 9 sites, respectively. Site characteristics and mean buffalograss quality for each tested variety following the completion of each study was downloaded from the NTEP website (http://www.ntep.org/). Forty-five of 49 sites reported both buffalograss visual quality and soil texture and these data were used for subsequent analyses. Eight soil texture classes were represented by the 45 sites: loamy sand, sandy clay, sandy clay loam, sandy loam, silt loam and silt, silty clay and clay, silty clay loam, and loam. Based on soil textural classifications, loamy sand, sandy clay, sandy clay loam, and sandy loam consist of sand ranging from 70 to 90, 45 to 65, 45 to 80, and 43 to 85% respectively, while silt loam, silt, silty clay, clay, silty clay loam, and loam consist of sand ranging from 0 to 50, 0 to 20, 0 to 20, 0 to 45, 0 to 20, and 23 to 52%, respectively (Toogood, 1958). In our analysis, the former group represents sandy soils and the latter represents nonsandy soils. Of the 45 tests, 22 were conducted on sandy soils and 23 on nonsandy soils. In total, there were 785 mean visual quality observations. A Welch two-sample *t*-test (Welch, 1947) was performed comparing the sandy and nonsandy visual quality data and there was no significant difference in group means (*p*-value = 0.1516). Since no difference was observed between sandy and nonsandy soils, pairwise comparisons were made between each soil textural class (Table 1). The sandy clay and silt loam and silt classes have the highest variability in visual quality (standard deviation of 1.72 and 1.67, respectively), while the loamy sand class has the least (standard deviation 0.27). No clear trend in visual quality was observed between soil types relating to sand content. The silty clay loam class has the lowest amount of sand and the highest mean visual quality rating (5.66), but was not significantly different from any of the other soil textural classes except loam with visual quality grand mean of 5.46. Similarly, loamy sand has the highest amount of sand with a relatively high mean visual quality rating (4.63) and was not significantly different from the other soil textural classes except silty clay and clay with a slightly higher visual quality grand mean of 4.85 (Table 1). Based on these observations, buffalograss performance was not affected by soil texture. Compared with coarse-textured soils, fine-textured soils have more water-holding capacity, which might sustain buffalograss longer in a limited irrigation input management setting. This observation is true, however, for any managed turfgrass species and should not confine buffalograss use to silt and clay soils.

Table 2. Analysis of variance of buffalograss visual quality in response to moderate traffic.

Effect	16 Aug. 2013	17 Sept. 2013	17 Oct. 2013	3 July 2014	20 Aug. 2014	18 Sept. 2014
Traffic	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Genotype	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Genotype × traffic	<0.0001	0.0002	0.0097	0.0193	0.0053	0.0112

Traffic Tolerance

Traffic tolerance is an important characteristic of grass species used for turf, and buffalograss is considered to lack traffic tolerance. Significant improvements in canopy density and sod strength have been made through plant breeding, which should contribute to improved traffic tolerance of modern buffalograss cultivars and germplasm relative to unimproved common types or early cultivars. The traffic pressure was moderate, yet still severe enough to negatively impact several of the tested genotypes. The traffic treatment was meant to simulate moderate traffic in low-use recreation fields and high-traffic lawns such as those found surrounding university campus buildings. As expected, significant differences were observed for treatment, genotype, and genotype × treatment interactions at all rating dates (Table 2). The impact of traffic tolerance is best observed as stand persistence over time.

At the final rating date, 70 entries showed no visual quality difference in response to the traffic treatment, 34 entries showed a decline in response to traffic, and no entries improved in response to traffic. Among top performing entries, visual quality ranged from 6.0 to 6.7 on 17 Sept. 2013 and 5.3 to 5.7 on 18 Sept. 2014 (Fisher's LSD $P \leq 0.05$). Trafficked entries NE3283 and NE3284 consistently performed among the top performers at both rating dates, suggesting these experimental lines have both good quality and traffic tolerance. Conversely, NE2850 and NE2940 consistently performed among the worst at both rating dates, suggesting these lines have poor quality and little traffic tolerance (data not shown). The intensity of traffic used in this study was light to moderate and chosen because it was severe enough to enable observations of genotypic variability in response to the stress. These data do not support buffalograss use on high-traffic areas, as that was not tested, but they clearly demonstrate variability among tested entries, a good level of traffic tolerance among the entries, and opportunities for further improvement through plant breeding contrary to previous observations on early genotypes.

Shade Tolerance

Shade is a significant component of the landscape and Beard (1969, 1973) suggests that 20 to 25% of all managed turf is grown in some type of shade. Buffalograss is considered to be intolerant of shade (Beard, 1969; Wu, 1990). For buffalograss success in a broad range of landscapes, improvements in shade tolerance is important. In 2009, three parallel studies were established to evaluate performance of 54 buffalograss entries in full sun or shade from either a 30 or 60% black shade cloth permitting 70 or 40% natural light, respectively. Significant genotype differences were observed in each study at each rating date with the exception of the 30% light study on 24 Sept. 2010 (Table 3). The full-sun study visual quality grand means were 3.99 on 24 Sept. 2010 and 4.31 on 18 Sept. 2011. The 30% light study had an overall mean visual quality of 3.93 and 4.01 on the two September rating dates, respectively, while the 60% light study had 2.98 and 2.99 in the grand means, respectively. While these were designed as three separate studies, and visual qualities cannot be directly compared, visual qualities were lower in the shaded studies as expected. In the 2009 shade study, NE3489, NE3490, and Prestige performed among the best, and 38 entries performed among the worst under 60% shade cloth (Table 4).

Table 3. Analysis of variance of the impact of full sun, 30% shade, and 60% shade light treatments on 54 buffalograss entries at Mead, NE on 24 Sept. 2010 and 18 Sept. 2011.

Light treatment	24 Sept. 2010	18 Sept. 2011
Full sun	<0.0001	<0.0001
30% shade	0.3897	<0.0001
60% shade	<0.0001	0.0011

In addition to the shade-tolerant lines identified from the 2009 shade study, we discovered that certain entries could tolerate heavy shade (40% natural light) contrary to previous reports. As such, a second shade study was established in 2013 to directly compare performance of 34 buffalograss genotypes grown in either full sun or under 60% black shade cloth. On 20 Aug. 2013, grand mean photosynthetically active radiation (PAR) of the full sun treatment was 975.6 (SD 50.3) and 264.8 μmol m^{-2} s^{-1} (SD 47.3) for the 60% shade treatment. As expected, the 60% shade treatment significantly reduced PAR (Welch two-sample *t*-test *p*-value < 2.2×10^{-16}) with a 72.9% reduction in PAR. The shade treatment also caused a significant 1.8°C reduction in soil temperature (*p*-value < 2.2×10^{-16}). The full sun grand mean soil temperature at 12.7-cm depth was 22.9 and 21.1°C under the shade cloth. Visual quality was observed at the end of the 2013 and 2014 growing seasons. Light treatment effects were observed in both rating years, but genotype and genotype × treatment interactions were only observed in 2014 (Table 5). We anticipate performance in dense shade to decline over time, so detecting genotype and genotype × treatment interactions in the final study year was expected. Sixteen genotypes exhibiting poor, moderate, and good shade tolerance in the 2009 shade studies were advanced

Table 4. Analysis of variance of the impact of light treatments on the quality of 54 buffalograss entries on 18 Sept. 2011 at Mead, NE.

Type	Full sun†	30% shade	60% shade
Legacy	4.67bc‡	5.00ab	3.00c–e
NE3489	4.00d	4.67bc	3.67a–c
NE3490	5.00ab	4.00c–e	4.00ab
NE3496	4.00d	3.67d–f	2.33e
NE3497	4.00d	4.00c–e	2.67de
NE3498	4.00d	4.00c–e	3.00c–e
NE3499	4.67bc	4.00c–e	3.33b–d
NE3500	4.00d	3.33ef	2.33e
NE3501	4.67bc	4.00c–e	3.33b–d
NE3502	4.67bc	4.00c–e	3.00c–e
NE3503	4.67bc	4.33b–d	3.33b–d
NE3504	4.33cd	4.00c–e	3.33b–d
NE3505	4.00d	3.67d–f	3.33b–d
NE3506	4.33cd	4.00c–e	3.33b–d
NE3507	4.33cd	3.67d–f	3.00c–e
NE3509	4.33cd	4.33b–d	3.33b–d
NE3510	4.33cd	4.00c–e	2.33e
NE3511	4.67bc	3.67d–f	2.67de
NE3512	5.00ab	4.33b–d	3.00c–e
NE3513	4.67bc	3.67d–f	2.33e
NE3514	4.67bc	4.00c–e	2.67de
NE3515	4.67bc	3.67d–f	3.00c–e
NE3516	4.00d	3.33ef	2.33e
NE3517	4.00d	3.67d–f	3.00c–e
NE3518	4.33cd	4.00c–e	2.67de
NE3519	4.00d	3.67d–f	2.67de
NE3520	4.33cd	4.00c–e	3.00c–e
NE3521	4.00d	4.33b–d	3.33b–d
NE3522	4.00d	5.00ab	3.00c–e
NE3523	4.33cd	4.67bc	3.33b–d
NE3524	5.00ab	4.00c–e	3.00c–e
NE3525	4.00d	4.00c–e	2.67de
NE3526	4.33cd	3.67d–f	3.00c–e
NE3527	4.67bc	4.00c–e	3.33b–d
NE3528	4.00d	3.67d–f	2.67de
NE3529	4.00d	3.67d–f	2.33e
NE3530	4.00d	3.67d–f	2.33e
NE3531	4.00d	4.00c–e	3.00c–e
NE3532	4.33cd	3.67d–f	3.00c–e
NE3533	4.00d	3.67d–f	3.00c–e
NE3534	4.00d	3.00f	2.67de
NE3535	4.00d	3.67d–f	3.33b–d
NE3536	4.33cd	4.33b–d	3.33b–d
NE3537	4.00d	4.00c–e	3.00c–e
NE3538	4.00d	4.00c–e	3.00c–e
NE3539	4.67bc	4.67bc	3.00c–e
NE3540	4.00d	4.00c–e	3.00c–e
NE3541	5.00ab	4.33b–d	3.00c–e
NE3542	4.33cd	4.33b–d	3.00c–e
NE3543	4.33cd	3.33ef	3.00c–e
NE3544	4.00d	4.33b–d	3.00c–e
NE3545	4.00d	4.00c–e	3.33b–d
NE3546	4.00d	4.00c–e	2.67de
Prestige	5.33a	5.67a	4.33a

† Established in spring 2009, buffalograss entries were grown in full sun, or under 30% or 60% black shade cloths in 2009, 2010, and 2011.

‡ Letters following mean visual qualities within each column represent significance groups based on Fisher's LSD (0.05)

Table 5. Analysis of variance of the impact of full sun, 30% shade, and 60% shade light treatments on 34 buffalograss entries at Mead, NE, on 17 Oct. 2013 and 9 Oct. 2014.

	17 Oct. 2013	9 Oct. 2014
Genotype	0.0543	<0.0001
Light treatment	<0.0001	<0.0001
Genotype × light treatment	0.4148	<0.0001

Table 6. Visual quality of 16 buffalograss entries grown in full sun or under a 60% shade cloth (heavy shade) in two separate studies at Mead, NE.

	18 Sept. 2011†		9 Oct. 2014‡	
	Genotype	Quality	Genotype	Quality
Full sun	Prestige	5.33a§	NE-BFG-09-3490	6.00a
	NE-BFG-09-3490	5.00ab	NE-BFG-09-3524	5.67ab
	NE-BFG-09-3524	5.00ab	Legacy	5.33a–c
	Legacy	4.67bc	NE-BFG-09-3521	5.33a–c
	NE-BFG-09-3515	4.67bc	NE-BFG-09-3505	5.00b–d
	NE-BFG-09-3539	4.67bc	NE-BFG-09-3507	5.00b–d
	NE-BFG-09-3507	4.33cd	NE-BFG-09-3532	5.00c–d
	NE-BFG-09-3523	4.33cd	NE-BFG-09-3515	4.67c–e
	NE-BFG-09-3532	4.33cd	NE-BFG-09-3523	4.67c–e
	NE-BFG-09-3542	4.33cd	NE-BFG-09-3529	4.33d–f
	NE-BFG-09-3498	4.00d	NE-BFG-09-3542	4.33d–f
	NE-BFG-09-3500	4.00d	Prestige	4.33d–f
	NE-BFG-09-3505	4.00d	NE-BFG-09-3498	4.00e–g
	NE-BFG-09-3521	4.00d	NE-BFG-09-3500	4.00e–g
	NE-BFG-09-3529	4.00d	NE-BFG-09-3540	4.00e–g
	NE-BFG-09-3540	4.00d	NE-BFG-09-3539	3.00h–j
Heavy shade	Prestige	4.33a	NE-BFG-09-3490	4.67d–e
	NE-BFG-09-3490	4.00ab	NE-BFG-09-3542	4.67c–e
	NE-BFG-09-3505	3.33b–d	NE-BFG-09-3521	4.33d–f
	NE-BFG-09-3521	3.33b–d	NE-BFG-09-3523	4.33d–f
	NE-BFG-09-3523	3.33b–d	NE-BFG-09-3524	4.33d–f
	Legacy	3.00c–e	NE-BFG-09-3507	4.00e–g
	NE-BFG-09-3498	3.00c–e	NE-BFG-09-3515	3.67f–h
	NE-BFG-09-3507	3.00c–e	NE-BFG-09-3532	3.67f–h
	NE-BFG-09-3515	3.00c–e	NE-BFG-09-3540	3.67f–h
	NE-BFG-09-3524	3.00c–e	NE-BFG-09-3498	3.33g–i
	NE-BFG-09-3532	3.00c–e	NE-BFG-09-3505	3.00h–j
	NE-BFG-09-3539	3.00c–e	Prestige	2.33j–l
	NE-BFG-09-3540	3.00c–e	Legacy	2.00kl
	NE-BFG-09-3542	3.00c–e	NE-BFG-09-3500	2.00kl
	NE-BFG-09-3500	2.33e	NE-BFG-09-3539	1.67lm
	NE-BFG-09-3529	2.33e	NE-BFG-09-3529	1.00m

† The first shade study was established in 2009 and visual quality ratings collected 18 Sept. 2011 following 3 yr of light treatments.

‡ The second shade study was established in 2013 and visual quality ratings collected 9 Oct. 2014 following 2 yr of light treatments.

§ Letters following mean visual qualities within each column represent significance groups based on Fisher's LSD (0.05) for that evaluation date.

to the 2013 study. The 16 entries in common between the 2009 and 2013 studies are presented in Table 6. In Table 6, genotypes are identified that exhibited consistent performance in full sun and dense shade. For example, NE3490 and NE3524 performed among the top entries when grown in full sun and NE3490 also performed well in both studies when grown in 60% shade. The experimental line NE3529 consistently performed among the worst in dense shade, suggesting this line lacks shade tolerance. There were also several entries, such as 'Prestige', with variable performance in response to the light treatment in both studies. Results from these shade studies demonstrate that buffalograss can survive dense shade and significant variability in response to the tested light treatments among genotypes.

CONCLUSIONS

Buffalograss has long been considered to lack adaptation to coarse textured soils, be intolerant of shade, and have poor traffic tolerance. Early reports were typically based only on observations of common types of buffalograss or early cultivars and limited field trials. Even with little research supporting the observations, they became commonly accepted and have influenced adoption and site selection of buffalograss. As shown by the present analysis of buffalograss performance in different soils, soil texture alone has little impact on buffalograss performance. By imposing artificial traffic or shade, variability in buffalograss response was observed and genotypes were identified that tolerated the stress. The data presented here are contrary to previous reports and necessitates a re-examination of prior observations through research-based studies to fully understand the range and adaptation of buffalograss.

Conflict of Interest

The authors declare that there is no conflict of interest.

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