Evaluation of Two Seeded Bermudagrasses for Fine Turf Quality and Shade Tolerance

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Introduction

- Bermudagrass (*Cynodon* spp.) is the predominant warm-season turfgrass but shows poor or very poor shade tolerance.
- Bermudagrass turf would have greater utilization in shaded golf course fairways or home lawns if shade tolerance were improved.
- Bermudagrass shows considerable variability in adaptation to shade stress (Gaussoin et al., 1988; Baldwin et al., 2008).
- Some improvement has been made for clonal bermudagrass cultivars but not for seeded types.
- OSU turfgrass breeding program has developed two experimental synthetic cultivars from parents selected for superior shade tolerance in a prior experiment.

Objective

- Evaluate the turf quality of two experimental seeded bermudagrass genotypes under multiple years of moderate or heavy shade in comparison with commercially available clonal and seeded cultivars.

Materials & Methods

Field Management

- Grasses were planted in June, 2013 in Oklahoma Agriculture Experiment Station, Stillwater, OK. Each plot size was 0.9 x 1.5 m.
- Shade fabric was installed during growing season months from 2014 to 2016.
- Nitrogen applied monthly at 49 kg N ha^{-1} from May to Sept.
- Mowed weekly at 63mm.
- Irrigated as required to prevent drought stress.

Experimental Design

- The study was 3 x 10 factorial design: Three levels of shade (environments) were assigned using black neutral shade cloth plus vegetative shade (fig 1).
- Ten genotypes were arranged in a randomized complete block design with four replications within each shade environment.

Table 1. Genotypes used for this study.

	OKS 2011-1	OKS 2011-4	Riviera	Yukon	Princess 77	Latitude 36	North Bridge	TifGrand	Patriot	Celeb-ration
Type	S[1,2]	S[1,2]	S	S	S	V	V	V	V	V
Species	H[1]	H	H	H	H	H	H	H	H	C

[1]S= Seeded, V= Vegetative, C= Common type (*C. dactylon*), H= Hybrid (*C. dactylon x C. transvalensis*)
[2] Experimental cultivar

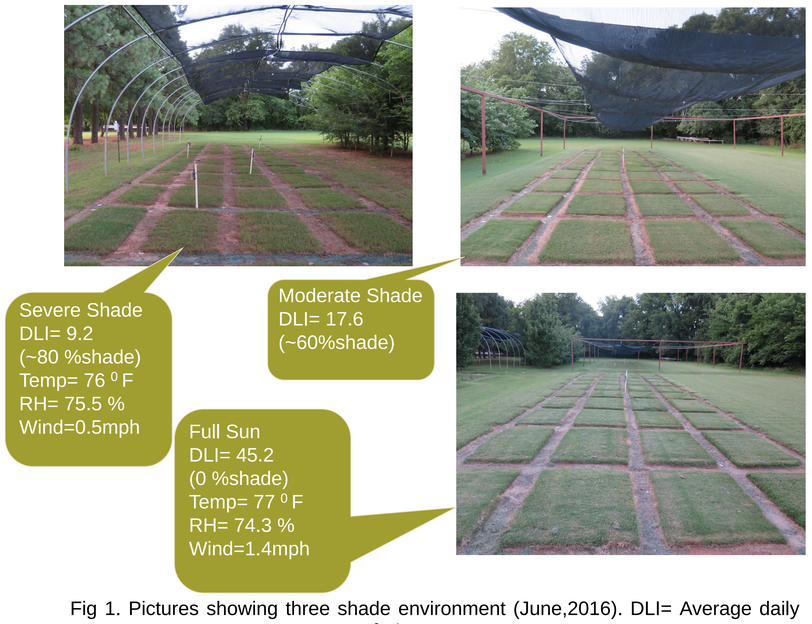

Fig 1. Pictures showing three shade environment (June,2016). DLI= Average daily light integral measured in µmol$m^{-2}s^{-1}$. DLI, air temperature, relative humidity and wind speed are averaged over May to June, 2016.

Materials & Methods

Data collection and Analysis

- Visual rating for turf quality (TQ) on a scale of 1-9 (9=best) were obtained in every two weeks from June to Sept in each year.
- Normalized difference vegetative index (NDVI) [0 to 1] were obtained using Greenseeker (Trimble Navigation, CA) from June to Sept in each year.
- Turf performance data were averaged across ratings for each year.
- Photosynthetically active radiation (PAR), air temperature, relative humidity, and wind speed were recorded using environmental sensors (Watchdog 2550 Weather Station and Watchdog 1000 series micro station, Spectrum Technologies Inc.) from May to Sept.
- Analysis of variance was performed using SAS 9.4 within each year. Means were separated using Fisher's protected least significant differences test at $p<0.05$
- Least square means were used to calculate percent decline over years.

Results

Table 2. ANOVA for NDVI and TQ for combined 2014, 2015, and 2016 year data.

Source	Shade (S)	Genotype (G)	Year (Y)	S x G	S x Y	G x Y	S x G x Y
NDVI (Pr>F)	<.001	<.001	<.001	<.001	<.001	0.8557	0.2548
TQ (Pr>F)	<.001	<.001	<.001	<.001	<.001	0.0007	0.2309

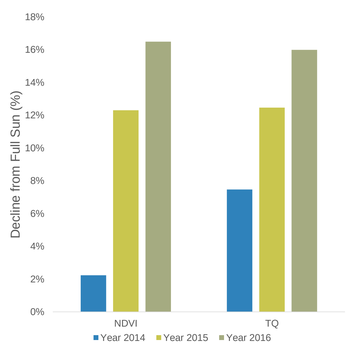

Fig 2. Effect of Year on decline in NDVI and TQ under moderate shade as compared to full sun.

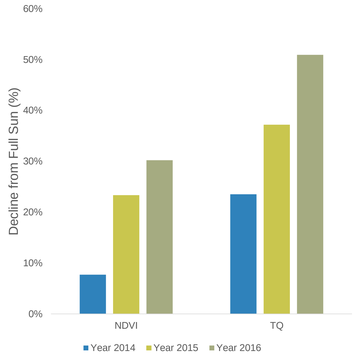

Fig 3. Effect of Year on decline in NDVI and TQ under severe shade as compared to full sun.

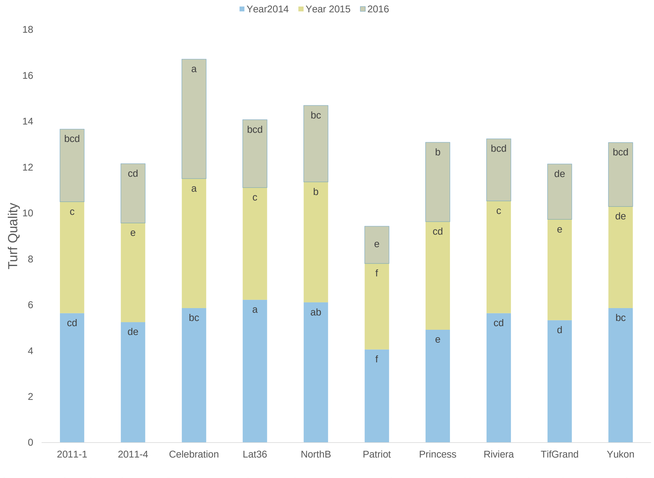

Fig 4. Distribution of mean of TQ for ten entries as affected by dense shade stacked in three experimental years. Letters indicate significant differences among the genotypes within the same year at $p<0.05$.

Results

- Turf quality and NDVI declined each year under both shade treatments with 50% reductions in TQ for severe shade and 16% reduction in TQ for moderate shade by year 2016 (Fig 2 and 3).
- After three years of severe shade, Celebration was the top-performing cultivar and Patriot was the worst performing cultivar.
- OKS 2011-1 was statistically better than OKS 2011-4 but was not different from other seeded cultivars (Riviera, Yukon, Princess 77).
- Linear regression of NDVI against Turf quality scores showed good agreement with an R^2 value of 0.74.

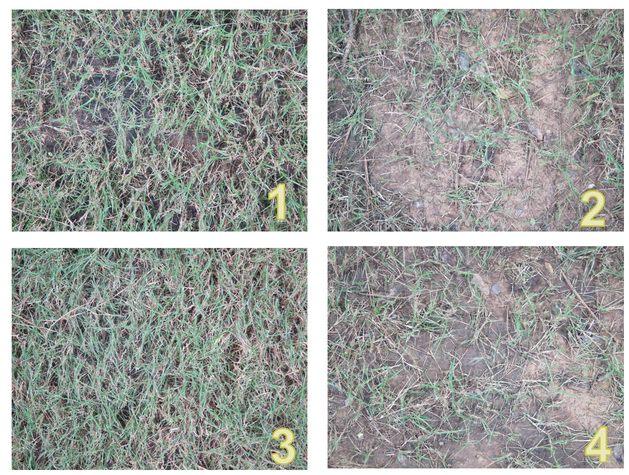

Fig 5. Digital images of 1) OKS 2011-1, [2]OKS 2011-4, [3]Celebration, and [4]Patriot in severe shade (Sept 16, 2016).

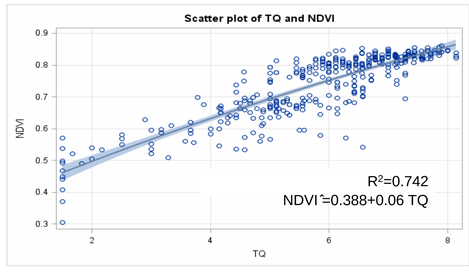

Fig 6. Scatter plot and linear regression showing relationship between NDVI and TQ. Data represent all measurement dates and experimental units (N=360).

Conclusion

- Severe shade treatment provided an adequate stress for effective screening of germplasm for shade tolerance.
- The superior shade tolerance of Celebration warrants further investigation.
- The lack of superior shade tolerance among experimental cultivars OKS 2011-1 and OKS 2011-4 suggests further screening and selection cycles are needed before reliable improvement in this trait can be achieved.
- NDVI was an effective tool for screening shade tolerance among bermudagrasses in this study.

Acknowledgments

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References

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- Baldwin, C.M., H. Liu and McCarty, L.B. (2008). Diversity of 42 bermudagrass cultivars in a reduced light environment. Acta Hortic. 783: 147-158.