Selection of Bermudagrass Germplasm that Exhibits Potential Shade Tolerance and Identification of Techniques for Rapid Selection of Potential Shade Tolerant Cultivars

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Objectives:

1. Screen bermudagrass germplasm collections and selections for their performance in shaded environments.
2. Determine turfgrass characteristics that may useful for screening future selections for potential shade tolerance.
3. Create 1 or 2 genetic populations by physiological and molecular selections of shade tolerant and susceptible parents for future research.

Start Date: 2008
Project Duration: three years
Total Funding: $90,000

A research site was assigned and planted using greenhouse-grown bermudagrass plugs on June 22, 2007 at the Oklahoma State University Turfgrass Research Center, Stillwater, OK. The site was specifically constructed to host this and future shade selection projects. Funds for development of the site were obtained from the Oklahoma Agricultural Experiment Station, Stillwater, OK. Additional research funding was secured for this project through the Oklahoma Turfgrass Research Foundation and from the Huffine Endowed Professorship. Additional sources of funding are under consideration.

The research site receives mid- to late afternoon shade, depending on season, from a dense, mature evergreen canopy on the west side of the site. The site meets the most important parameters for effective shade research. Late afternoon vegetative shade is provided by conifers on the west side of the plots. These conifers also provide root competition and reduce the predominately westerly airflow.

Maple trees have been planted along the south side of the site and redbud trees along the east side. We attempted to increase the duration of shade at the site by planting vines along a hoop structure in 2008, but we had limited success. Consequently, in the next few years, as the deciduous shade trees mature, we will design neutral shade canopies that limit photosynthetic efficiency and adjust to the duration that we desire. Using canopies, we can increase the shade duration to increase photosynthetic stress or decrease duration to limit the loss of potential selections.

Bermudagrass	Sun			Shade			Shade/sun
	VisualTQ	Visual Rank*	NDVI**	VisualTQ	Visual Rank	NDVI	Decline***
	1-9=best	---- LSD ----		1-9=best	---- LSD ----		---- % ----
Patriot	7.6	A	0.7646	7.1	A	0.7365	-3.7
C19	7.2	B	0.7681	6.7	BC	0.7479	-2.6
C23	7.0	BC	0.7772	6.3	EFGHIJKL	0.7333	-5.6
Tifton10	7.0	BCD	0.7300	6.5	BCDEFG	0.7261	-0.5
Tifton4	7.0	BCDE	0.7579	5.8	QRSTUV	0.6796	-10.3
C17	6.9	BCDEF	0.7515	6.6	BCD	0.7462	-0.7
C20	6.9	BCDEFG	0.7703	6.3	DEFGHIJK	0.7460	-3.2
C29	6.8	BCDEFGH	0.7463	6.4	CDEFGHI	0.7099	-4.5
C28	6.8	CDEFGHI	0.7443	6.7	B	0.7183	-3.5
C116	6.8	CDEFGHI	0.7532	6.1	JKLMNOP	0.7154	-5.0
C34	6.8	CDEFGHIJ	0.7329	6.0	KLMNOPQ	0.6775	-7.6
C35	6.7	CDEFGHIJK	0.7419	6.3	DEFGHIJ	0.7022	-5.4
C12	6.7	CDEFGHIJK	0.7338	5.8	PQRST	0.7168	-2.3
C13	6.7	DEFGHIJKL	0.7582	6.6	BCD	0.7464	-1.6
C27	6.7	DEFGHIJKL	0.7466	6.4	BCDEFGH	0.7295	-2.3
PRC-06-5	6.6	EFGHIJKLM	0.7394	6.4	CDEFGHI	0.7140	-3.4
Celebration	6.6	EFGHIJKLM	0.7537	6.3	DEFGHIJ	0.7387	-2.0
C72	6.6	EFGHIJKLM	0.7402	6.3	EFGHIJKL	0.7182	-3.0
C16	6.6	EFGHIJKLM	0.7401	6.2	HIJKLMNO	0.7114	-3.9
C4	6.6	FGHIJKLMN	0.7554	6.5	BCDE	0.7524	-0.4
C73	6.6	FGHIJKLMN	0.7270	6.0	KLMNOPQ	0.7055	-3.0

Top 24 bermudagrass selections determined by visual quality means collected on six rating dates from May 19 to August 15, 2008.

The study consists of 45 bermudagrass selections and four standards ('Celebration', 'Patriot', 'Tifton 4', and 'Tifton 10'), replicated five times on the shade site and on an adjacent site that is in full sun for about 90% of each day. Visual turf quality (TQ) and NDVI (Normalized Difference Vegetation Index) were assessed every two weeks in 2008 and results are reported for six rating dates from May 19 to August 15, 2008.

In 2008, shade stress occurred on the shade site for 12% longer each day than on the sun site. However, this short duration of shade stress was presumably sufficient to cause an average 4.9% decline in TQ and a 3.4% decline in NDVI when selections were individually compared between the shade site and the sun site.

The top performing selections ranked by LSD mean separation (P=0.05) of TQ ratings indicate that there is significant variation among selections in both sun and shade. Visual TQ ratings change with rating date. They are accurate for ranking selections on any given day but are not accurate for comparisons among rating dates. The NDVI is consistent and can be accurately compared among dates. Consequently, it is a good tool for accurately evaluating seasonal changes or for individual comparisons over multiple rating dates.

According to NDVI, the selections that had the best TQ in sun declined from 0.4% to 10.3% in shade suggesting that some of these selections tolerate shade better than others. As we increase shade stress, we are confident that we can determine selections with potential for shade tolerance.

Summary Points

- In 2008, the shade site received 88% of the solar irradiance received on the sun site.
- Turfgrass quality ratings and NDVI indicated significant diversity among selections.
- The mean visual turf quality decline between like selections in full sun to shade was 4.9% and the mean decline in NDVI quality was 3.4%.