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 effectiveness in shaded environments.
2. Determine turfgrass characteristics that may useful for screening future selections for potential shade tolerance.
3. Create one or two genetic populations by physiological and molecular selections of shade tolerant and susceptible parents for future research.

Start Date: 2008
Project Duration: 3 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. The site was specifically constructed to host this and future shade selection projects. 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. 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 to increase the duration of vegetative shade.

We attempted to increase the duration of shade at the site in 2008 by planting vines along a hoop structure, but we had limited success. We had more success with the vines in 2009 and also added a 75% black woven shade cloth above the plots to provide shade in the middle of the day. In April, 2010, additional 75% black woven shade cloth was added to provide extended shade.

The study consists of 45 bermudagrass selections and four standards, 'Celebration', 'Patriot', 'TifGrand', and 'Tifton 10'. 'Celebration', 'TifGrand', and 'Tifton 10' were chosen for their potential shade tolerance, and 'Patriot' was chosen for its likely poor shade tolerance. The bermudagrass selections were collected primarily from China, Africa, Australia, and other nations. Plot size was 61 x 61cm with a 23-cm border between plots. Each bermudagrass was replicated five times on the shade site that is in full sun for about 33% of each day and on an adjacent site that is in full sun for about 90% of each day. Visual turf quality (TQ) and normalized difference vegetative index (NDVI) were assessed every two weeks in 2010, and results are reported for five rating dates from June 1 to Sept. 30, 2010.

In 2008, shade stress occurred on the shade site for 12% longer each day than on the sun site. This short duration of shade stress caused an average 4.9% decline in TQ and a 3.4% decline in NDVI. On May 7, 2009, a black woven shade cloth with 75% light reduction (10 ft x 160 ft) was installed on a hoop structure overhead to provide longer and more uniform shade for the shade site. Consequently, the shade duration increased from 12% in 2008 to 52% in 2009. The additional shade caused an increased decline in TQ from 4.9% in 2008 to 7.5% in 2009 and a decline in NDVI of 3.4% in 2008 to 5.2% in 2009.

A second significant decline in TQ was observed by adding additional 75% black woven shade cloth in 2010. TQ decline increased from 7.5% in 2009 to 38.9% in 2010, and NDVI decline also deepened from 5.2% to 23.9% in 2010. The bermudagrass selections differed significantly in TQ and in NDVI both in full sun and in shade in both 2009 and 2010.

In 2010, photosynthesis rates were measured in spring, summer, and fall from five best, five worst, and the four standard bermudagrass selections. CO_2 gas exchange rate was the highest in summer and the lowest in spring for plants both in full sun and shade.

No changes in shade duration will be made to the shade block in 2011. However, a 75% black woven shade cloth (10 ft x 160 ft) will be added over the current full-sun block moderate shade. A third block established in June 2009 will become the full-sun block in 2011.

An additional black woven shade cloth (75% light reduction) has been added to the shade site in April, 2010.

Shade stress was severe in 2010 and provided adequate stress for selecting resistant grasses and measuring differences in photosynthesis rates. By adding a moderate shade block in 2011, we hope to develop a relationship between shade stress and CO_2 gas exchange. Photosynthesis will again be measured from the five best selections, five worst selections and four standards in May, July, and September. From this data, we may be able to roughly estimate the amount of shade that each selection can tolerate.

Summary Points

- In 2010, the shade site received 33% of the solar irradiance received on the sun site.
- Turfgrass visual quality ratings and NDVI indicated significant diversity among selections.
- The mean visual turf quality decline between like selections in full sun to shade was 39% and the mean decline in NDVI quality was 24%.