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Title: Determining Precise Light Requirements for Various Turfgrass Systems

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Objectives:

1) Estimate seasonal DLI requirements for various warm-season turf types present in a golf course fairway/tee setting.
2) Compare estimated DLI values from Objective 1 to estimated DLI requirements of comparable turfgrass systems (cultivar and mowing height) in a standardized field research setting.

Start Date: 2016
Project Duration: 2 years
Total Funding $15,080

Summary

Introduction

A decrease in photosynthetically active radiation (PAR) caused by tree shade is often detrimental to turfgrass quality. The cumulative amount of PAR photons delivered over one day is termed the daily light integral (DLI) with units of mol / m^2/ d. The DLI measurement is an effective method to determine the light requirements of warm-season turfgrass types in a standardized research setting, however this is a labor intensive process and typically requires multiple seasons to complete. No published research has attempted to evaluate DLI values *in situ* on the golf course, where existing tree shade is obviously limiting turfgrass growth. It may be possible develop methodology for quickly determining a minimum DLI requirement for various turfgrass types in existing turfgrass landscapes, where there is an obvious gradient of high to low turf quality caused by tree shade.

Methods

Four warm-season cultivars were selected for evaluation at area golf facilities (Table 1). For each cultivar, two independent shaded sites were identified for DLI measurement. Quantum light sensors were installed in four positions along a line transect in each shaded site (Fig. 1). Daily light integrals (mol / m^2/ d) were then determined over a 6 day period at each site in 2017, measuring PAR on 15 min intervals at each sensor position. Concurrently, visual turfgrass quality was evaluated at each sensor position. Multiple turfgrass plugs from each site were extracted and transplanted at to standardized shade research setting at the Arkansas Agricultural Research and Extension Center in Fayetteville. Plugs were established in full sun conditions for one month and then varying levels of shade stress were applied using moveable shade structures (Fig. 2). Quantum light sensors were mounted under each of the shade cloth treatments, and PAR was recorded for the duration of the study. The PAR light measurements were summed to calculate DLI values under each shade treatment for monthly and seasonal averages. The turf was evaluated using visual turfgrass quality ratings, which were recorded every two weeks during the study. Visual ratings were based on evaluation of turfgrass cover, color,

density, and uniformity using a 1 to 9 scale with 1 representing dead turf and 9 representing dark green, healthy turf. Any turfgrass quality rating below 6 was deemed unacceptable turfgrass quality. Critical DLI values necessary to attain acceptable quality were then estimated for each cultivar in using non-linear regression, both in the research setting and *in situ.*

Results

In the standardized research setting when evaluated over two growing seasons, 'Cavalier' zoysiagrass had the lowest critical DLI requirement at 18.5 mol / m^2 / d and 'Meyer' zoysiagrass had the highest at 27.8 mol / m^2 / d (Fig. 3) when maintained under golf course fairway conditions. However, in the golf course setting, the critical minimum DLI values estimated for 'Cavalier' and 'Meyer' were 24.6 and 22.6 mol / m^2 / d, respectively (Fig. 4), which did not agree well with the research setting values. In addition, the critical minimum DLI value estimated for common bermudagrass was surprisingly low at 11.5 mol / m^2 / d in the golf course setting, compared to 26.8 mol / m^2 / d in the research setting. It is likely that seasonal variable shade and tree root competition contributed to relatively poor critical minimum DLI estimates in the golf course setting.

Summary Points

- The following minimum DLI requirements (mol / m^2 / d) were determined from multiple seasons of season-long shade stress when maintained under fairway conditions:
    - **22.8 for 'Astro-DLM' bermudagrass**
    - **26.8 for common bermudagrass**
    - **18.5 for 'Cavalier' zoysiagrass**
    - **27.8 for 'Meyer' zoysiagrass**
- Minimum DLI values determined from observations in the golf course setting were not consistent to those obtained from the standardized research setting.
- Additional work is needed to develop an efficient method to determine DLI requirements in an established turfgrass landscape.

Table 1. Location sites of four turfgrass types under evaluation when estimating a minimum DLI requirement in an existing landscape.

Turfgrass	Golf Course	Location
'Astro-DLM' bermudagrass	Shadow Valley Golf Club	Rogers, AR
Common bermudagrass	Bella Vista Golf Club	Bella Vista, AR
'Cavalier' zoysiagrass	Blessings Golf Club	Johnson, AR
'Meyer' zoysiagrass	Shadow Valley Golf Club	Rogers, AR

Figure 1. Quantum light sensors placed along line transect in shaded areas on golf courses. Positon 1 = full turfgrass coverage, 2 = slight turfgrass decline, 3 = extensive turfgrass decline, 4 = complete turfgrass failure.

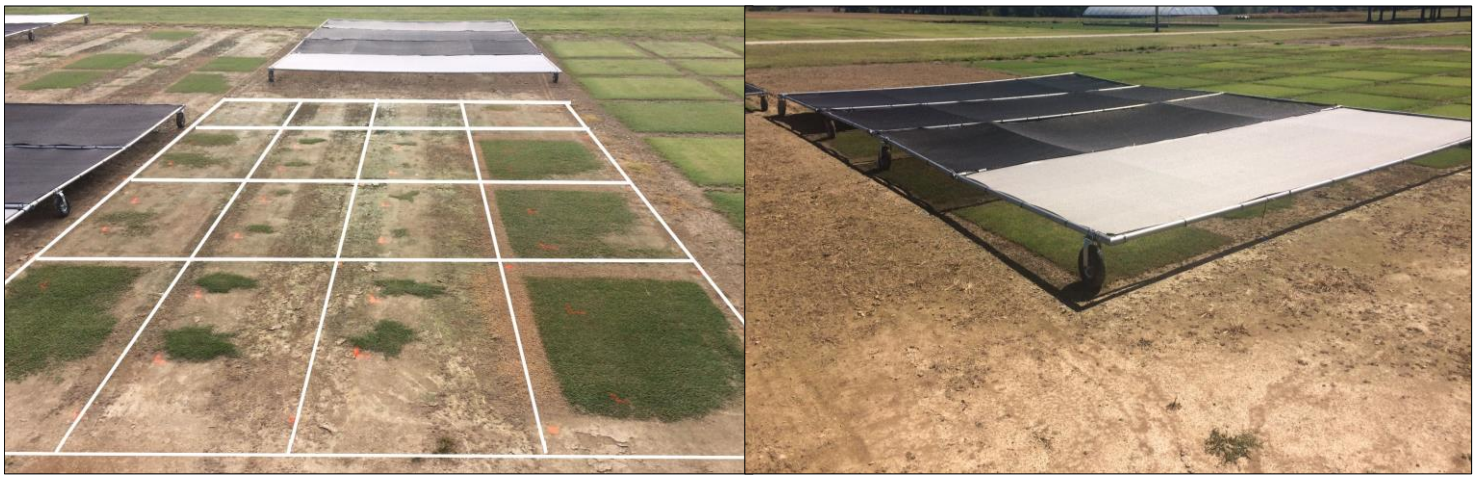

Figure 2. Turfgrasses from each golf course site transplanted to a standardized research setting under shade structures applying continual 22, 40, 60, or 90% shade.

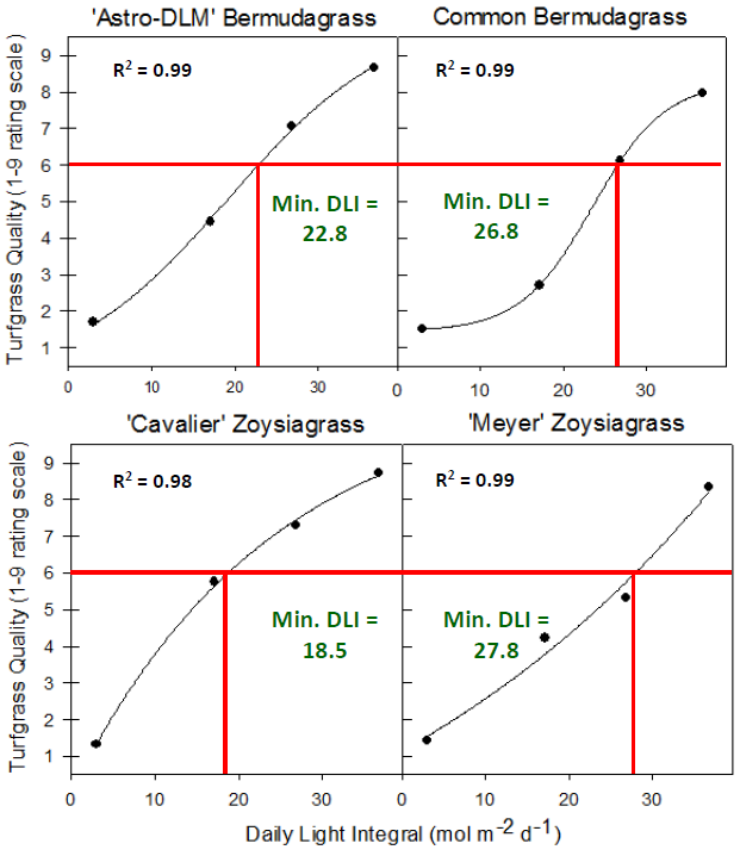

Figure 3. Visual turfgrass quality response of warm-season turfgrasses in standardized research setting under 22, 40, 60, and 90% continual shade from May-September 2017. Visual quality rated on 1-9 scale. Red lines indicate minimum acceptable quality and estimated minimum DLI requirement.

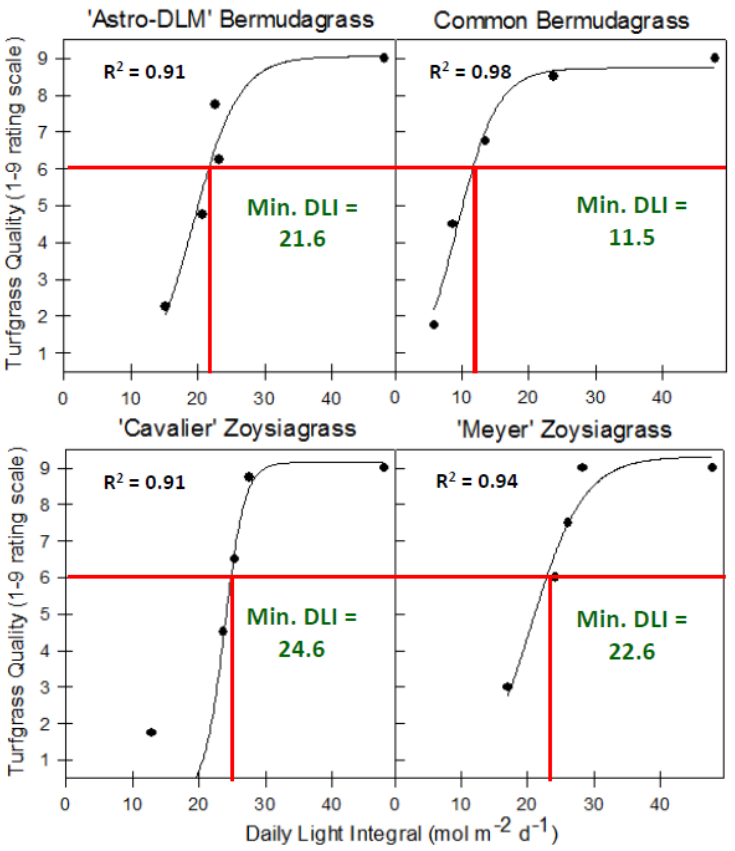

Figure 4. Turfgrass quality response of warm-season turfgrasses in golf course fairway/tee setting under estimated season long daily light integral (mol m^{-2} d^{-1}) regimes present at each site. Visual quality rated on 1-9 scale. Red lines indicate minimum acceptable quality and estimated minimum DLI requirement.