

2016-07-557

Minimum Daily Light Integral Requirements for Warm-Season Fairway/Tee and Rough Cultivars: Mowing Height and Growth Regulator Interactions

Benjamin Wherley, Zhaoxin Chen, and Russell Jessup
Texas A&M University Department of Soil & Crop Sciences

Maintaining turf in shade is a significant management challenge for golf course superintendents. Environmental differences with regard to month of the year, shade sources, intensity, duration of shade, or hours of direct sunlight make it difficult to specify a minimum light requirement in terms of hours/day that can extend across various situations. Rather than responding to a number of hours of direct sunlight or percent shade, plants respond to the cumulative daily total number of photons (measured in moles/sq. meter/day) received within the photosynthetically active wavelengths (400-700 nm), termed daily light integral (DLI). The limited amount of turfgrass DLI research that has been conducted in the past has primarily involved greenhouse experiments or has been focused on ultradwarf bermudagrass.

A two-year field study was conducted over the 2016/2017 growing seasons in College Station, TX, under replicated treatments offering 0 to 90% reductions in photosynthetic photon flux (PPF). Objectives of the study were to 1) determine minimal DLI requirements for 10 zoysiagrass and bermudagrass cultivars commonly used on golf courses, 2) determine how minimal DLI requirements change seasonally (spring, summer, and fall months), 3) determine effects of fairway & rough cutting height (0.75" vs. 2") on minimal DLI, and 4) determine impacts of Trinexapac-Ethyl (TE) on minimal DLI requirements.

A 15,000 sq. ft. irrigated shade research facility has been constructed in 2015 at the Texas A&M Turfgrass Field Laboratory. Turfgrasses utilized in this project are shown in Table 1. Two parallel studies are being conducted: A 'rough study' conducted at 2" mowing heights, and a fairway study managed at 0.75" mowing heights. Both studies are arranged in a completely randomized design with 4 replicate plots per treatment and 6 density-neutral shade levels (0, 30, 50, 70, 80, 90% photosynthetic photon flux reduction) as the whole plot factor. Shade structures cover plots throughout the year, including winter months, and are only removed for short periods for routine maintenance and data collection. Plots were established in July 2015, with grasses provided 6-weeks to establish under full sun conditions before shade structures were moved onto plots. Turf quality, digital image analysis of percent green cover, NDVI, and rooting data were measured monthly. Polynomial regression was used to determine minimal DLI thresholds for acceptable Turf Quality in each entry at the end of the project. Two-year average DLI for the summer month periods (June-Aug) are provided in Table 2. These DLI were also calculated for Spring (March-May) and Fall (Sept.-Nov.) periods with similar regression analysis performed. In this report, two-year average Summer DLI data have been provided for all cultivars at both fairway and rough mowing heights. The following are some of the key findings from this analysis:

- Summer DLIs were measured to be similar between the two years. In year 1 (2016), DLIs produced by the shade treatments were 5.8, 8.6, 11.7, 20.9, 27.9, and 47.6 mol m⁻² d⁻¹ for the 90, 80, 70, 50, 30, and 0% (Full Sun) shade treatments, respectively. For year 2 (2017), summer DLIs were 5.4, 8.7, 12, 21.1, 27.9, and 46.2 mol m⁻² d⁻¹ for the 90, 80, 70, 50, 30, and 0% (Full Sun) shade treatments, respectively (Table 2).
- During Summer months, DLIs for Fairway Height turf were highest for bermudagrass cultivars and lowest for zoysiagrass cultivars. Trinexapac-Ethyl reduced DLI requirements by ~0.5 to 2 mol m⁻² d⁻¹ in bermudagrasses and by ~3 to 7 mol m⁻² d⁻¹ in zoysiagrasses (Figure 1).
- Without TE, Fairway bermudagrass cultivars ranked as follows, from lowest to highest Summer DLI requirement: Latitude 36 < Celebration < TifGrand < Tifway. With TE, bermudagrass ranked as follows, from lowest to highest

Summer DLI requirement: Latitude 36 < TifGrand < Celebration < Tifway (Figure 1).

- Without TE, Fairway zoysiagrass cultivars ranked as follows, from lowest to highest Summer DLI requirement: Zorro < Zeon < Palisades < Geo < JaMur. With TE, zoysiagrass ranked as follows: Zorro < Zeon < JaMur < Palisades < Geo (Figure 1).
- At Rough Height, cultivars expressed a much wider range of Summer DLI requirements, from as low as 11.75 to 32 mol m⁻² d⁻¹. At Rough Height, Summer DLI ranked as follows for the bermudagrass cultivars: Celebration < Latitude 36 < Tifway < TifGrand. Zoysiagrass cultivars ranked as follows: Zorro < Zeon < Palisades < JaMur (Figure 2).
- At Rough Height, minimal DLI required for acceptable Turf Quality in Zorro and Zeon zoysiagrass (11.75 and 13.25 mol m⁻² d⁻¹, respectively) were lower than that required for Palmetto St. Augustinegrass (15.5 mol m⁻² d⁻¹) (Figure 2).
- Minimal DLI required for acceptable Turf Quality was noticeably lower for all cultivars for the Spring and Fall periods (Data not shown)

Table 1. Species, Cultivars, and Origin of entries included in the Texas A&M shade study. St. Augustinegrass was included only in the rough height study as a shade tolerant check.

Species	Cultivar	Origin
Bermudagrass	Tifway	University of Georgia
	TifGrand	University of Georgia
	Latitude 36	Oklahoma State University
	Celebration	Sod Solutions
Zoysiagrass	Zeon	BladeRunner Farms, Inc.
	Zorro	Texas AgriLIFE Research
	Palisades	Texas AgriLIFE Research
	JaMur	BladeRunner Farms, Inc.
	Geo	Sod Solutions
¹ St. Augustinegrass	Palmetto	Sod Solutions

¹ Palmetto St. Augustinegrass was included as a shade tolerant check at the rough mowing height only.

Table 2. Mean daily Light Integrals (DLI) within each of the shade treatments during the summer months (June, July, August) months for the 2016 and 2017 seasons.

	DLI (mol m⁻² d⁻¹)	
	2016	2017
Full Sun	47.6	46.2
30% Shade	27.9	27.9
50% Shade	20.9	21.1
70% Shade	11.7	12.0
80% Shade	8.6	8.7
90% Shade	5.8	5.4

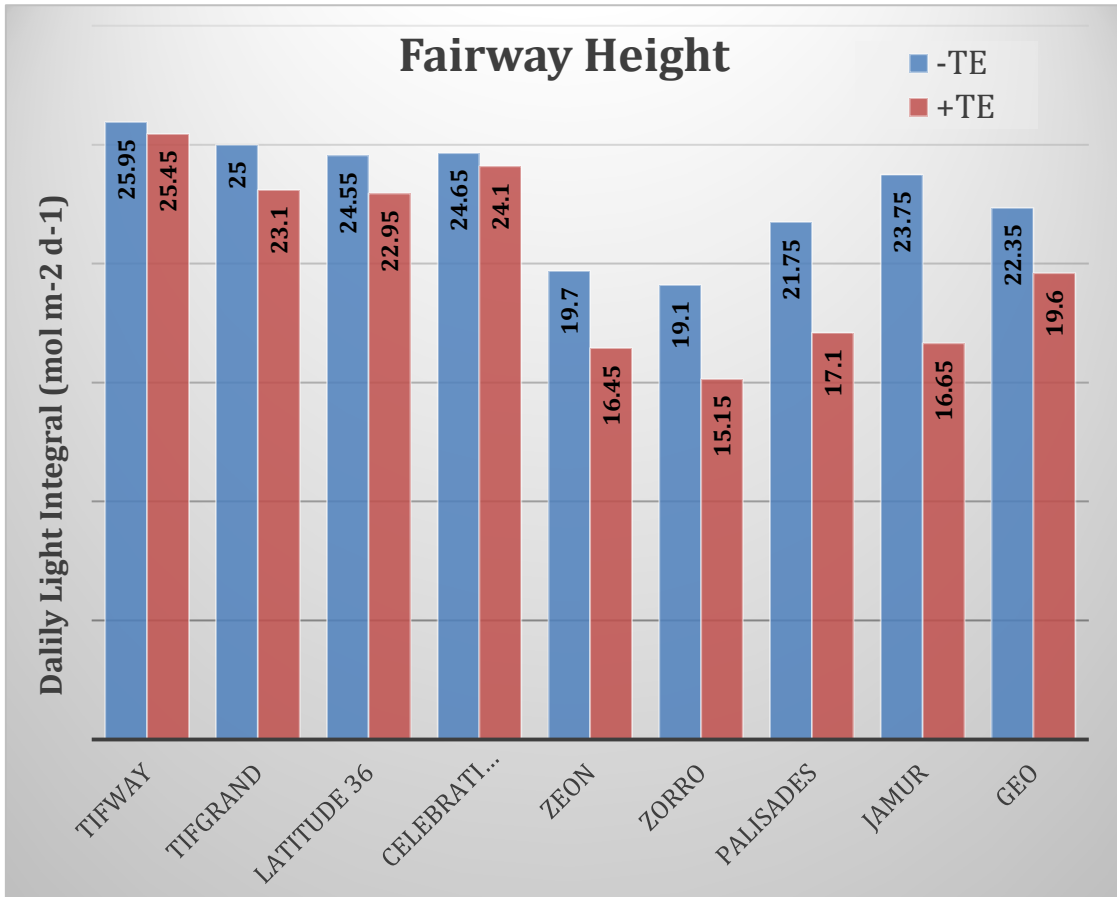


Figure 1. Two-year average minimal Daily Light Integrals required to maintain minimally acceptable Fairway Turf Quality during summer months with and without Trinexapac-Ethyl (TE). Data are averaged over the 2016 and 2017 summer months (June, July, and August).

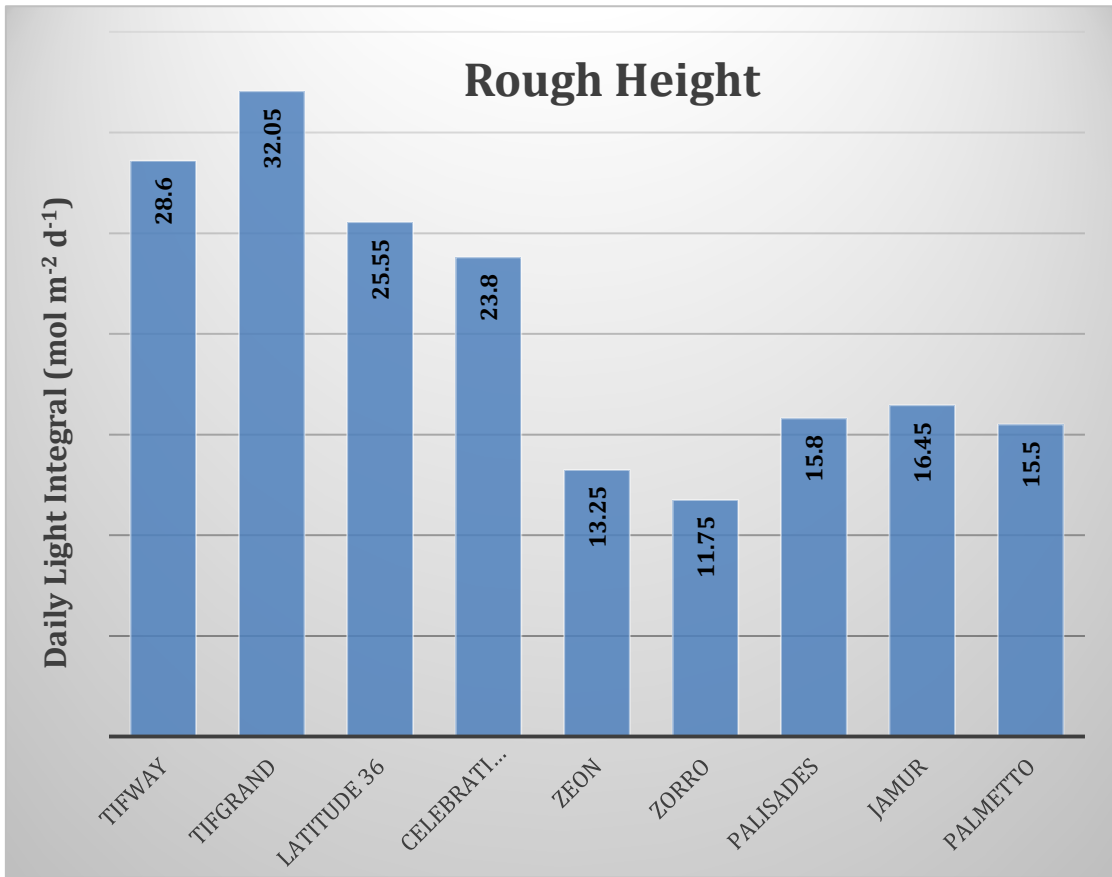


Figure 2. Two-year average minimal Daily Light Integrals required to maintain minimally acceptable Rough Height Turf Quality during summer months. Data are averaged over the 2016 and 2017 summer months (June, July, and August).



Figure 3. Image of the Texas A&M Research Field Laboratory shade study facility with shade structures in place.