Effect of Shade Timing and Intensity on Creeping Bentgrass Influenced By Trinexapac-Ethyl and Plant Protectant

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Introduction

- Putting greens are often partially surrounded by trees to enhance the aesthetics or influence the playability of the golf course[3].
- A decrease in available photosynthetically active radiation (PAR) caused by tree shade can be detrimental to turfgrass growth, development, and quality[1].
- Although it is thought that morning shade is more detrimental, morning or afternoon shade had no effect on turfgrass quality on a creeping bentgrass putting green in Ohio[1].
- Daily light integral measurement has been used to determine PAR light requirements as well as the effects of morning and afternoon shade on ultradwarf bermudagrass putting greens[2,3].
- The growth regulator trinexapac-ethyl has been demonstrated to increase shade tolerance of creeping bentgrass[4].
- Plant protectants such as Turf Screen are marketed to enhance turf quality of shaded turfgrasses, but no research has been performed to validate this claim.
- Research is needed to quantify the daily integral light requirements for creeping bentgrass in the transition zone and the effects of shade timing and intensity, growth regulator, and plant protectants on shaded turf.

Objectives

1. **Evaluate turf quality differences between morning and afternoon shade with varying levels of shade intensity**
2. **Evaluate the effect of trinexapac-ethyl and Turf Screen plant protectant on turfgrass quality in shaded conditions**
3. **Determine a daily light integral threshold to maintain acceptable quality creeping bentgrass putting greens in the transition zone**

Materials and Methods

Experimental Area

- Location: Arkansas Agricultural Research and Extension Center; Fayetteville, AR 72701
- Turfgrass: 'Tyee' creeping bentgrass (*Agrostis stolonifera* L.)
- Construction: USGA putting green specifications[5]
- Mowing: 6 times weekly at 3.6 mm
- Fertilization, pest management, irrigation, and cultural practices were followed according to putting green management typical to the region

Treatments

- **Shade timing:** Morning (sunrise to solar noon) and afternoon (solar noon to sunset) (Fig. 1)
- **Shade intensity:** 0%, 70%, 80%, or 90% reduction of full sun (Fig. 1)
- **Trinexapac-ethyl (Primo Maxx):** 3.2 kg ha^{-1} applied weekly
- **Turf Screen (titanium oxide + zinc oxide):** 0.028 kg ha^{-1} applied every two weeks
- **Trinexapac-ethyl + Turf Screen:** application rates and frequencies same as above

Data Collection

- Visual ratings for turfgrass quality recorded every two weeks
- Daily light integrals (mol m^{-2} d^{-1}) measured using quantum light sensors (Spectrum Technologies) (Fig. 2)
- Clipping collection, ambient temperature measurement, golf shoe traffic visual damage ratings, and digital image analysis (data not shown)

Data Analysis

- Experimental design was a randomized 2 x 4 x 2 x 2 split-strip plot design with three replications.
- Data were analyzed using SAS v. 9.3 PROC MIXED. Treatment means for significant main effects and interactions were separated using Fisher's protected LSD (α = 0.05).

Fig. 1. Moveable shade structures used to apply each shade intensity and shade timing.

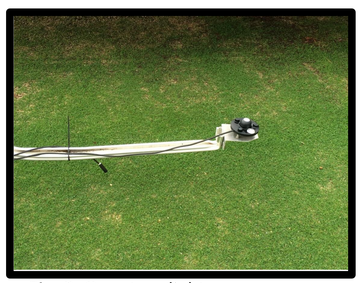

Fig. 2. Quantum light sensor mounted under each shade level to record daily PAR light integrals.

Results

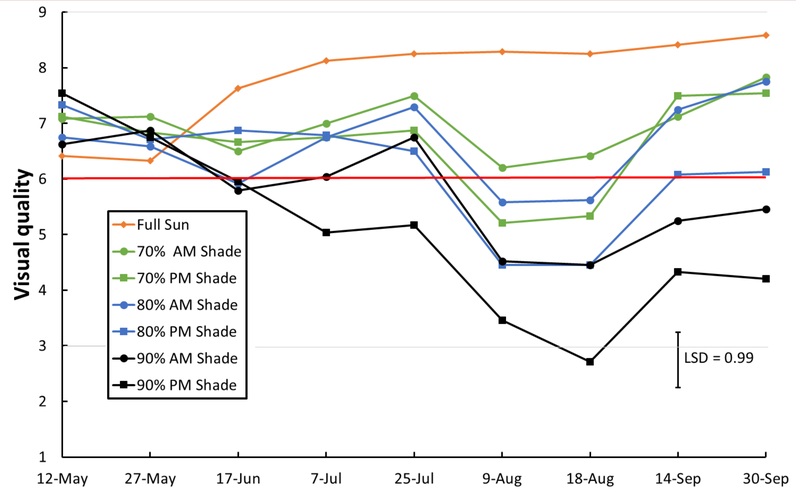

Fig. 3. The effects of shade timing and intensity on visual turfgrass quality from May to September 2016. Visual rating scale is 1-9; red line indicates minimum acceptable quality.

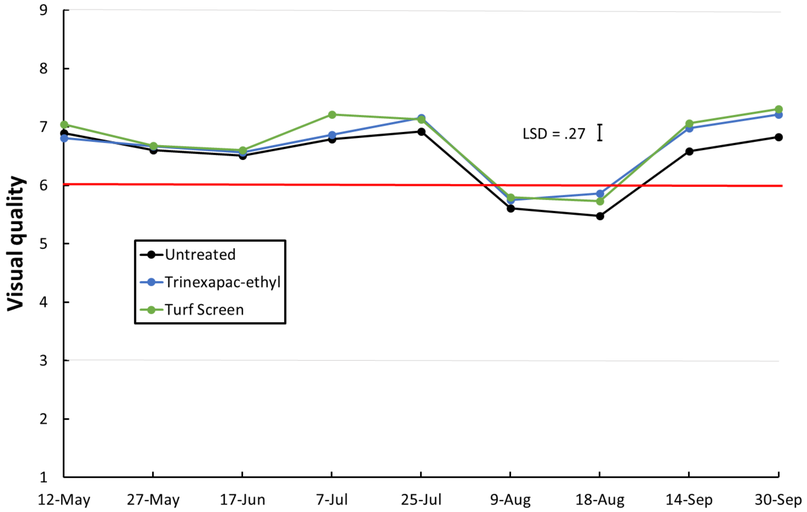

Fig. 4. The effects of applications of trinexapac-ethyl growth regulator and Turf Screen on total turfgrass quality compared to an untreated control. Visual rating scale is 1-9; red line indicates minimum acceptable quality.

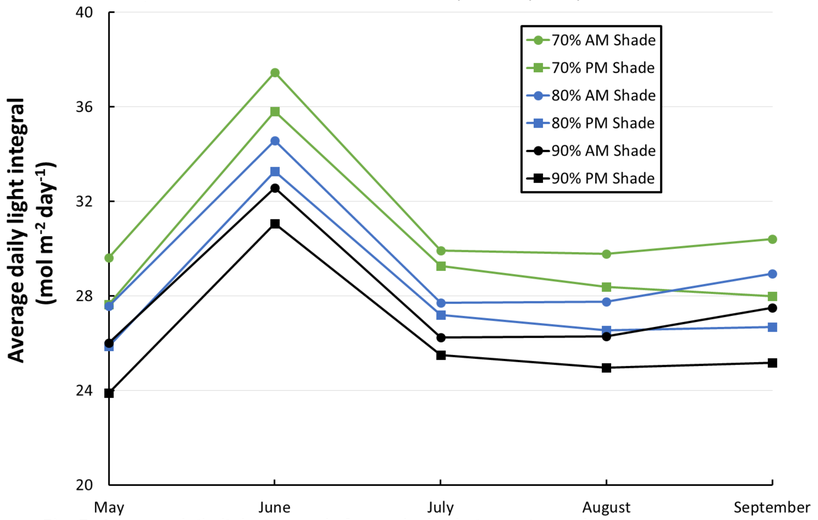

Fig. 5. Average daily light integrals for each shade intensity and timing treatment for each month. Average daily light integrals for full sun treatments were never lower than 44 mol m^{-2} day^{-1} during any month of the trial.

Results (cont.)

- Compared to AM shade, PM shade was more detrimental to overall turfgrass quality at intensities of 80% and 90% shade for the final four rating dates (Fig. 3).
- During the month of August, 70% PM shade and 80% shade ,at both timings, produced unacceptable turfgrass quality (Fig. 3).
- Regardless of timing, 90% shade produced unacceptable turfgrass quality in august and September (Fig. 3 and 6).
- Daily light integrals were higher for turfgrass receiving morning shade compared to turfgrasses receiving afternoon shade for every month of the trial (Fig. 5).
- Applications of trinexapac-ethyl maintained or improved overall turfgrass quality over the final three rating dates (Fig. 4).
- Applications of Turf Screen maintained or increased overall turfgrass quality on one rating date in July as well as the final two rating dates (Fig. 4).

Fig. 6. The visual effects of PM applied shade at various shade intensities on Aug. 12. From left to right; Full sun, 70% shade, 80% shade, and 90% shade.

Conclusions

- The accelerated decline in turfgrass quality of creeping bentgrass receiving afternoon shade compared to morning shade is opposite of accepted thought regarding shade timing on turfgrass.
- The early results of this trial indicate that golf course superintendents may amend their selective tree pruning or removal programs to focus on trees causing afternoon shade on creeping bentgrass turf before those trees causing morning shade.
- Based on our preliminary data, superintendents should aim to obtain daily light integrals higher than 30 mols m^2 d^{-1} to ensure acceptable creeping bentgrass putting greens.
- Applications of trinexapac-ethyl and Turf Screen plant protectant may be effective in reducing quality decline in shaded creeping bentgrass in late summer months during peak summer stress conditions.
- Further research needs to be conducted to determine a more precise daily light integral requirement for creeping bentgrass putting greens and to confirm the effects on turfgrass quality caused by shade timing.
- Additional research should also be performed to determine if trinexapac-ethyl and Turf Screen are effective in lowering the daily light integral requirement of creeping bentgrass putting greens.

Acknowledgements

Mr. Daniel O'Brien and Mr. John McCalla (University of Arkansas)
Mr. Scott May (Turf Max LLC)

Literature Cited

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[5]*USGA Recommendations for a Method of Putting Green Construction*. [Far Hills, NJ: United States Golf Association].