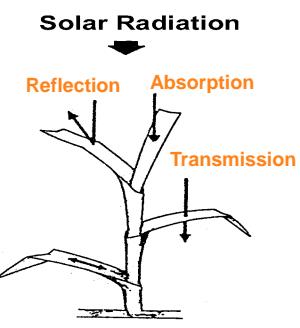


# Daily Light Requirements for Bermudagrass

J. Bryan Unruh, Ph.D.  
Extension Turf Specialist

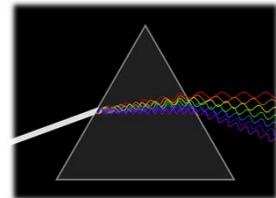


## Atmospheric Environment - Light



## Effects of Light on Turfgrass Growth

- Light intensity
- Light quality
- Light duration



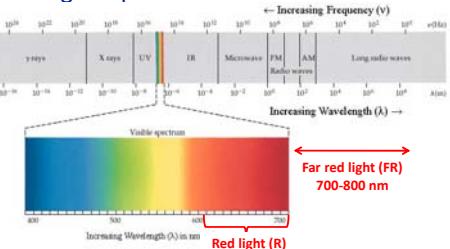
### Warm-season Turfgrass Physiology Questions

- How much light do the grasses need?
  - Filtered light?
  - Sun specks?
  - Sun angle?
  - Season of year (daylength)?
  - Influence on metabolism?
  - Influence on irrigation requirement?
  - Influence on nutrient uptake?



### Effect of Light Quality on Turfgrass Growth

- Light quality refers to the color or wavelength reaching the plant's surface.



Adapted from C. Foresman, 2009

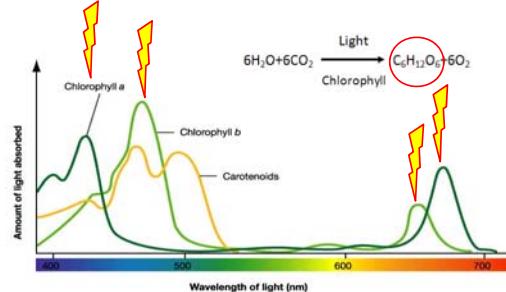


### Effects of Light Intensity on Plant Growth

- Time of day
  - Low at sunrise and sunset, high at midday.
- Atmospheric Screening -
  - High on clear days.
  - Cloud cover can screen up to 96%.
  - Smoke can screen out as much as 90% of the incoming radiation.
- Topography -
  - Causes localized variations in light intensity because it affects the angle at which radiation strikes the earth.



### Effect of Light Quality on Turfgrass Growth



**Shade from trees reduces light quality because the light is filtered. The tree leaves "remove" the red and blue light components, leaving mainly the green, which is not effective in photosynthesis.**

### Effect of Light Duration on Turfgrass Growth

- Light duration refers to the amount of time (hours) that the turf is exposed to sunlight.
  - Influences plant growth and development.
    - Physiological Responses
    - Development Responses



## Solar Radiation

- Energy (photons) delivered per unit of time over a specified area
  - Watts per meter square per day ( $w/m^2/day$ ) (Toro)
  - Langley/day (Ly/day =  $cal/cm^2/min$ ) (Rainbird)

$$w/m^2/day = 2.04 \text{ Ly/day}$$

$$\text{Ly/day} = 0.49 w/m^2/day$$

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## Optimum Solar Radiation

Dudeck and Peacock, 1992

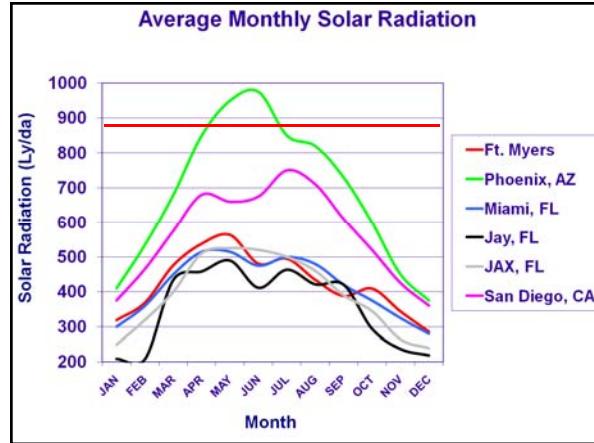
- Warm-Season Turf:
  - 812 - 969 Ly/day (AVG = 890 Ly/day)
  - 390 - 465  $w/m^2/day$  (AVG = 427  $w/m^2/day$ )
- Cool-Season Turf:
  - 242 - 485 Ly/day (AVG = 360 Ly/day)
  - 116 - 233  $w/m^2/day$  (AVG = 175  $w/m^2/day$ )

$$w/m^2/day = 0.48 \text{ Ly/day}$$

$$\text{Ly/day} = 2.07 w/m^2/day$$

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### PGRs and higher heights: Improving TifEagle greens in shade

Adjustments in cultural practices can give ultra-dwarf Bermudagrass a chance to survive in the shade.

B. Todd Burnell, Ph.D., and Bert McCarty, Ph.D.

**Shade grasses** in more recent turf grass species such as hybrid Bermudagrass (TifEagle®) have been developed to tolerate shade or semi-shade. While these grasses have improved shade tolerance, they still require more light than cool-season grasses, and lateral growth, lateral internodes, length (LIL), is still the southern United States shade tolerance standard. TifEagle® and Champion are commonly used for putting green surfaces because of their high heights and fast regrowth after cutting, and are often used for golf courses and residential lawns. However, shade from nearby buildings will reduce light availability.

**Cultural practices** (spraying, mowing height, fertilizer, irrigation, and soil management) can influence performance and appearance in shade. A recent study by Burnell et al. (2004) found that increasing mowing height by 0.5 inches (1.3 cm) increased quality of TifEagle® by 4.4% (measured by improved leaf phenology and reduced leaf senescence) and 4.8% (improved leaf phenology and reduced leaf senescence) in shade (Fig. 1). Raising mowing height may increase wear and tear for maintenance, but it may also reduce the need for irrigation, which may reduce water use and improve soil depth and improve surface density (Fig. 2).

**Gibberellic acid** (GA) has been effectively used to increase plant height and biomass, thereby increasing plant photosynthesis and growth. However, it is crucial to find additional sources of energy to support the extra energy. Gibberellins are a class of plant hormones that regulate cell division and differentiation. Applying PGRs (Type II) like gibberellins can also slow the synthesis of other plant hormones, like auxin.

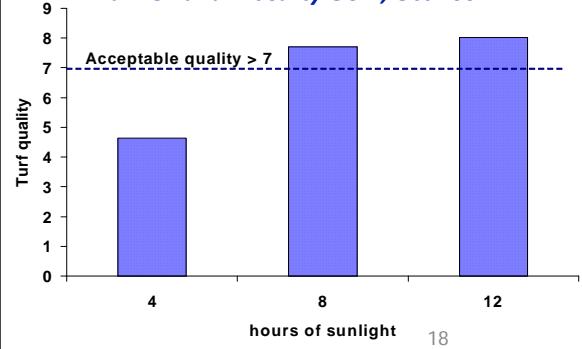


Figure 1. Ultra-dwarf (TifEagle®) are used to replace the area of a shaded putting green. Water consumption is reduced.

**Materials and methods** This study was conducted in the eastern United States at the University of Florida's green research garden in Oklawaha, FL. TifEagle® was grown on a sand-based putting green mixture (sand, 60%; peat moss, 20%; and perlite, 20%) and maintained at a minimum height of 0.25 inches (0.6 cm) in filtered sunlight.

Applying growth promoters or substances that increase height are limited.

### TifEagle Greens Bunnell and McCarty GCM, Oct 2004



SUNLIGHT QUANTITY		Daily light integral (moles of sunlight/square meter/day)		
Year	Quantity	Sunlight (hours)		
		12	8	4
2001	mean	1095	39.8	34.5
	maximum	1420	51.6*	44.1
	minimum	265	9.6	7.4
2002	mean	1165	42.3	36.5
	maximum	1435	52.1*	44.7
	minimum	406	14.7	12.5
Two-year Average		41.1	977	22.1

\*Maximum and minimum daily light integrals for 2001 occurred on July 22 and July 25, respectively. In 2002, maximum and minimum daily light integral occurred on July 19 and July 12, respectively.

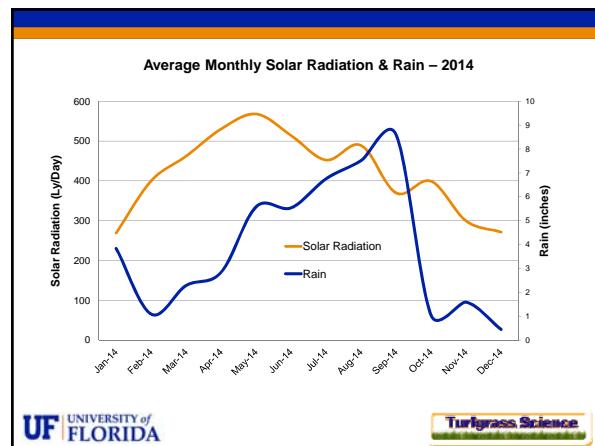
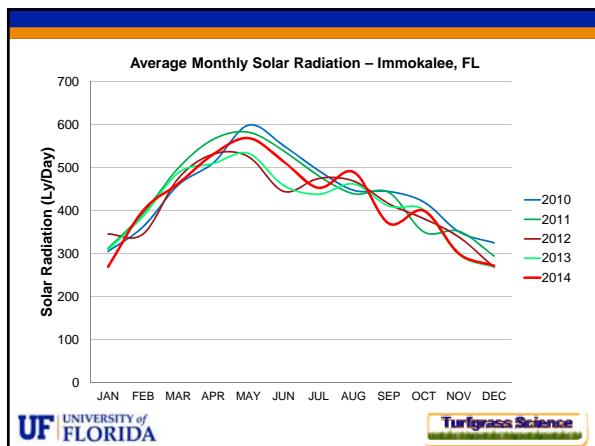
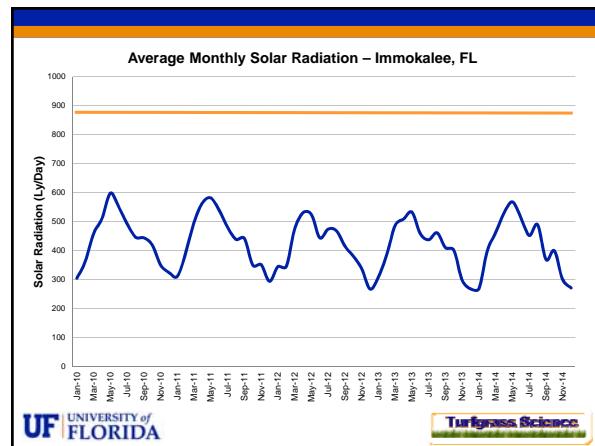
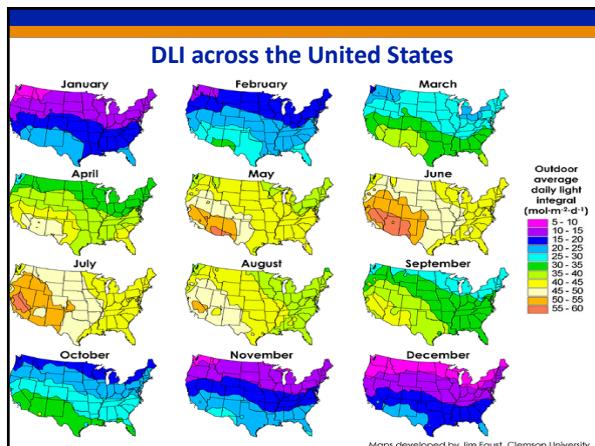
Table 1. Yearly, two-year combined, maximum and minimum daily light integrals (moles/square meter/day) of 12, eight and four hours of sunlight from June to August in Clemson, S.C., during 2001 and 2002.

## Solar Radiation

- Energy (photons) delivered per unit of time over a specified area
  - Photosynthetic photon flux density (PPFD)
  - Micromoles per meter square per second ( $\mu\text{mol m}^{-2} \text{s}^{-1}$ )
- Daily Light Integral (DLI)
  - Compilation of all PPFD measurements over 24 hour period (day)
  - Moles per meter square per day ( $\text{mol m}^{-2} \text{ d}^{-1}$ )

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## Stanford et al., 2005

- Tifdwarf bermudagrass grown in growth chambers with 14 hour daylength at 1/3 of full sunlight.



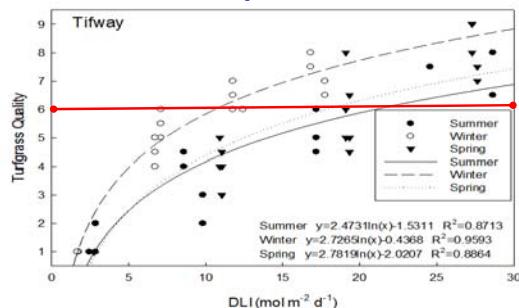
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Dr. Brian Glenn

- Establish baseline DLI requirements for common warm-season turfgrasses throughout various applications for use
- Determine plant changes that occur as an effect of changing low light environment based on aesthetic, physiological, and morphological indicators
- Identify means in which DLI research can be used by proprietors.

## DLI Requirements



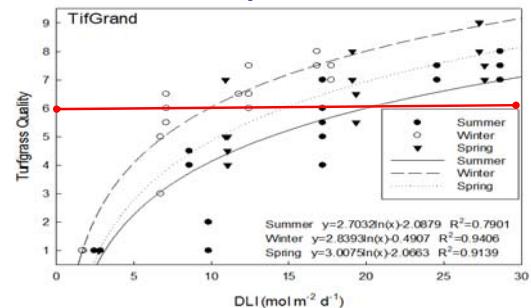
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## DLI Requirements



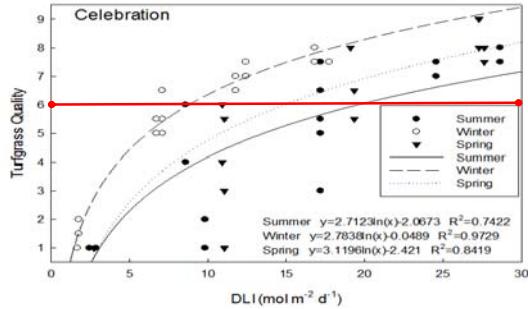
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## DLI Requirements



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## DLI Requirements

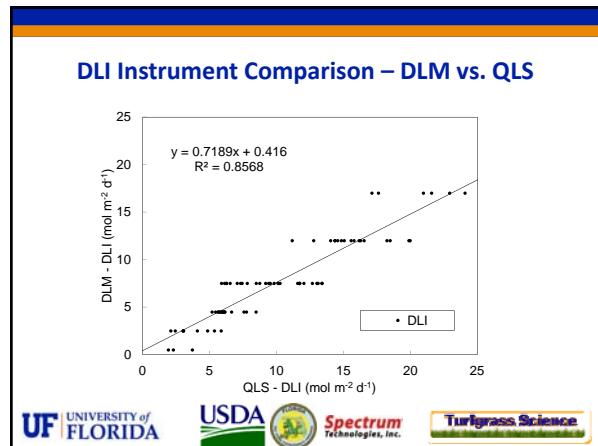
Turfgrass Cultivar	DLI requirements (mol m^-2 d^-1)		
	Summer	Winter	Spring
Tifway hybrid bermudagrass	<b>21.0</b>	<b>10.6</b>	<b>17.9</b>
TifGrand hybrid bermudagrass	<b>19.9</b>	<b>9.8</b>	<b>14.6</b>
Celebration common bermudagrass	<b>19.6</b>	<b>8.8</b>	<b>14.9</b>
SeaDwarf seashore paspalum	13.2	8.0	11.9
Diamond zoysiagrass (matrella)	11.3	7.4	10.9
Palisades zoysiagrass (japonica)	11.2	8.2	11.2
Pristine zoysiagrass (matrella)	10.8	7.3	10.6
JaMur zoysiagrass (japonica)	10.3	6.8	10.5

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## Experimental Design

- Isolation house at Turfgrass Envirotron
  - Gainesville, FL
- Two month duration
  - May-June 2014
- 27 - 21°C day-night temperature



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## Experimental Design

- Split-plot design
  - Main plot - shade
- Four shade regimes
  - 0, 30, 50, 70% shade



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## Experimental Design

- Supplemental lighting
  - HPS with 1000 W bulbs, 0.9 m above canopy
  - Photoperiod of 12 h d⁻¹
  - Temperature reduced by 13% under 70% shade



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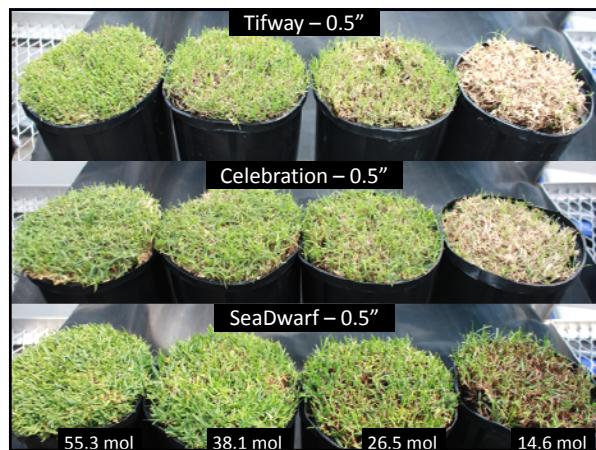
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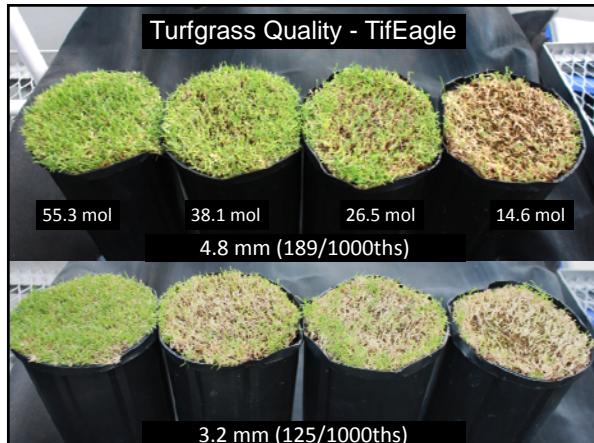
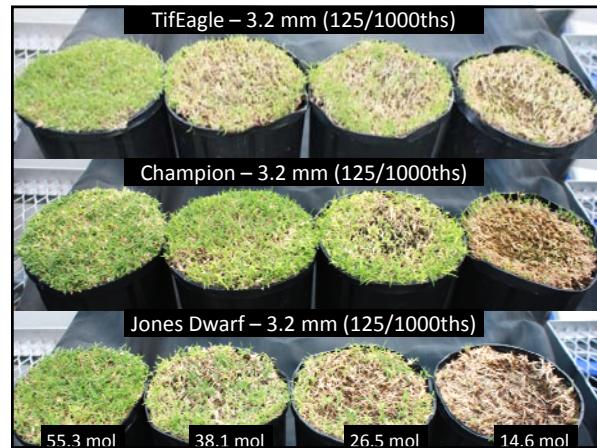
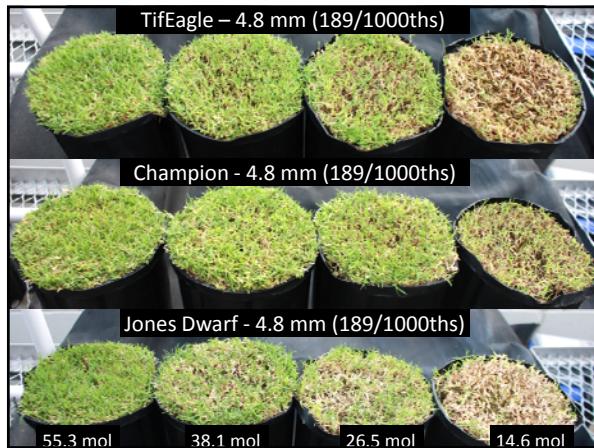


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Turfgrass Cultivar	DLI requirement ( $\text{mol m}^{-2} \text{d}^{-1}$ )*		
	High	Low	% Change
Jones Dwarf bermudagrass	39.8	47.3	+ 19
TifEagle bermudagrass	33.7	38.5	+ 14
Champion bermudagrass	30.6	31.9	+ 1
Tifway bermudagrass	23.3	32.6	+ 40
Celebration bermudagrass	18.5	26.4	+ 43
SeaDwarf seashore paspalum	15.6	27.0	+ 73

\*Reduced to 93% observed DLI

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