Daily Light Requirements for Bermudagrass

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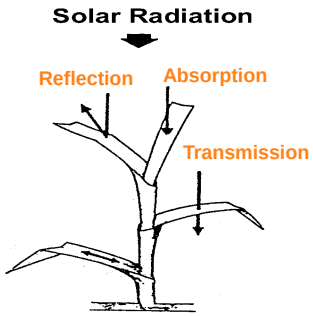
Turfgrass Science

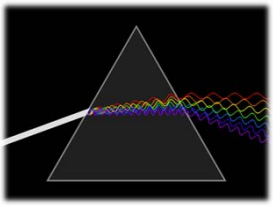
Atmospheric Environment - Light



Solar radiation on leaf blades.

Effects of Light on Turfgrass Growth

- Light intensity
- Light quality
- Light duration



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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?

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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.

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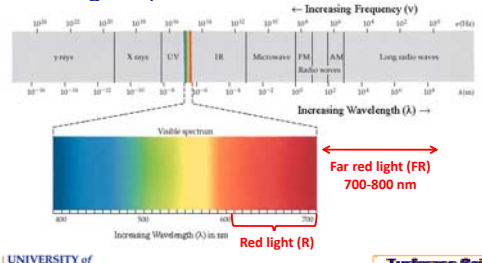
Effect of Light Quality on Turfgrass Growth

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



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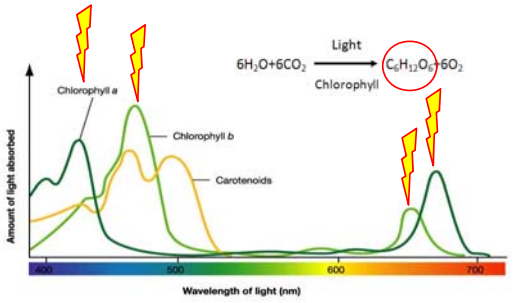
Effect of Light Quality on Turfgrass Growth



Absorbance peaks: **Chlorophyll a** = 430 nm, 662 nm
Chlorophyll b = 454 nm, 643 nm

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

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Solar Radiation

- Energy (photons) delivered per unit of time over a specified area
  - Watts per meter square per day (w/m²/day) (Toro)
  - Langley/day (Ly/day = cal/cm²/min) (Rainbird)

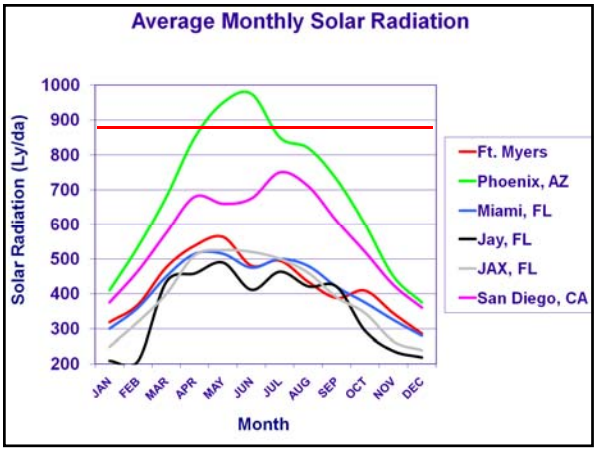
w/m²/day = 2.04 Ly/day
Ly/day = 0.49 w/m²/day

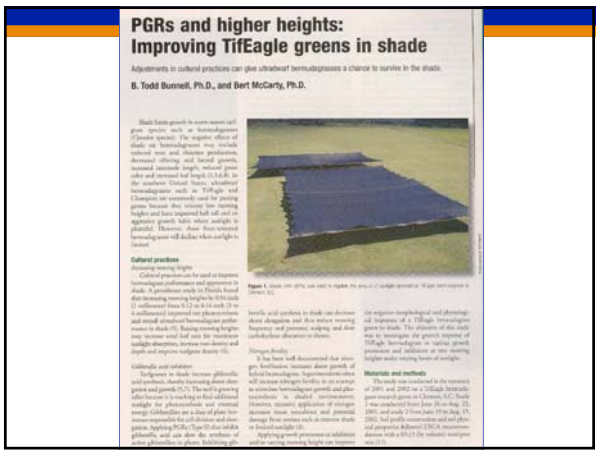
Optimum Solar Radiation

Dudeck and Peacock, 1992

- Warm-Season Turf:
  - 812 - 969 Ly/day (AVG = 890 Ly/day)
  - 390 - 465 w/m²/day (AVG = 427 w/m²/day)
- Cool-Season Turf:
  - 242 - 485 Ly/day (AVG = 360 Ly/day)
  - 116 - 233 w/m²/day (AVG = 175 w/m²/day)

w/m²/day = 0.48 Ly/day
Ly/day = 2.07 w/m²/day



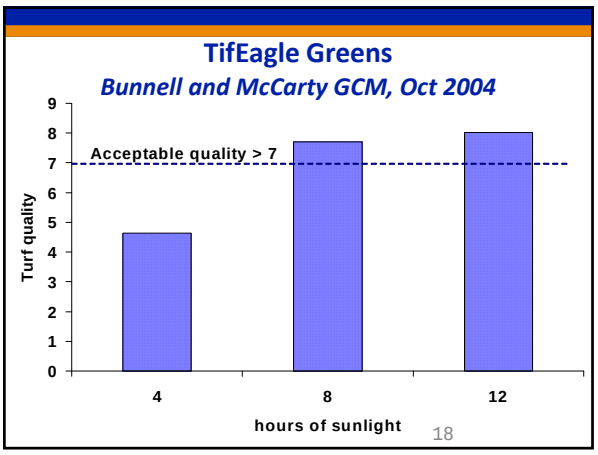

PGRs and higher heights:
Improving TifEagle greens in shade

Adjustments in cultural practices can give ultradwarf bermudagrasses a chance to survive in the shade.

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

TifEagle Greens

Bunnell and McCarty GCM, Oct 2004



SUNLIGHT QUANTITY

Warm-Season Turf:
812 - 969 Ly/day
390 - 465 w/m2/day

Year	Quantity	Daily light integral (moles of sunlight/square meter/day)	Sunlight (hours) 12	8	4
2001	mean	1095	39.8	34.5	21.3
	maximum	1420	51.6*	44.1	27.3
	minimum	265	9.6	7.4	3.3
2002	mean	1165	42.3	36.5	22.7
	maximum	1435	52.1*	44.7	27.3
	minimum	406	14.7	12.5	7.4
Two-year Average	41.1	977	35.5	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 ($\mu mol\ m^{-2}\ s^{-1}$)
- Daily Light Integral (DLI)
  - Compilation of all PPFD measurements over 24 hour period (day)
  - Moles per meter square per day ($mol\ m^{-2}\ d^{-1}$)

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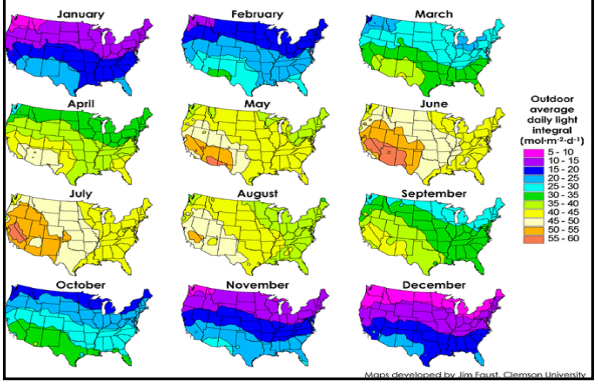
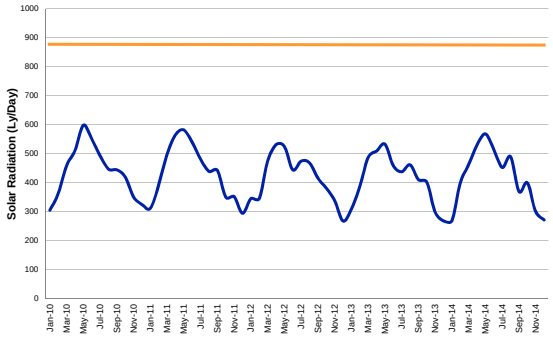
DLI across the United States



Average Monthly Solar Radiation – Immokalee, FL



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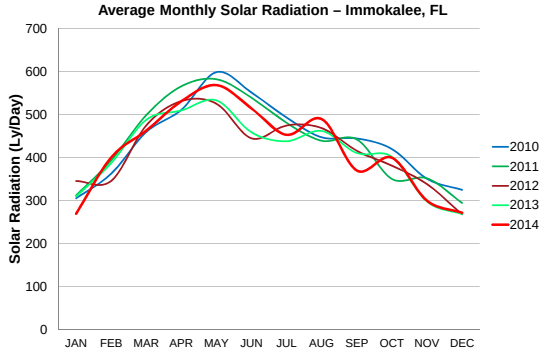
Average Monthly Solar Radiation – Immokalee, FL



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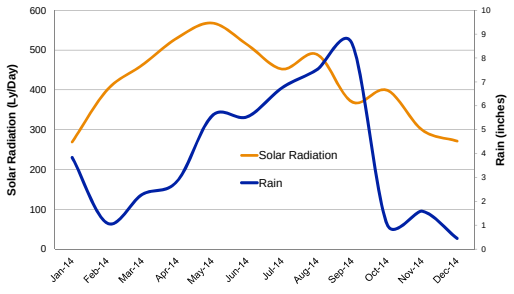
Average Monthly Solar Radiation & Rain – 2014



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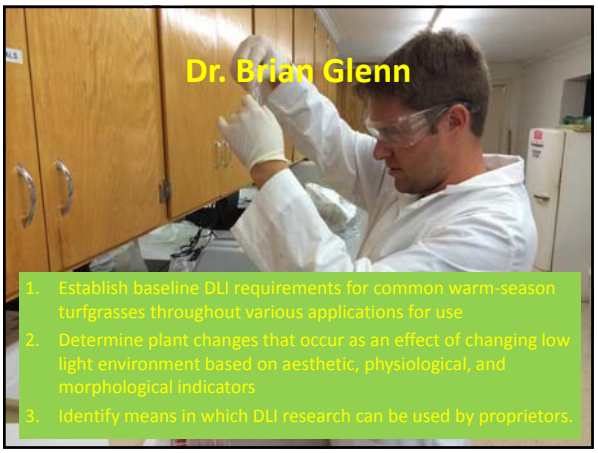
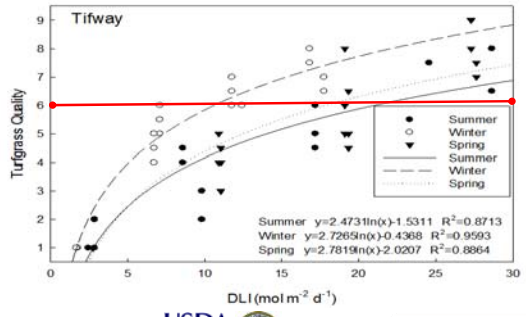
Stanford et al., 2005

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

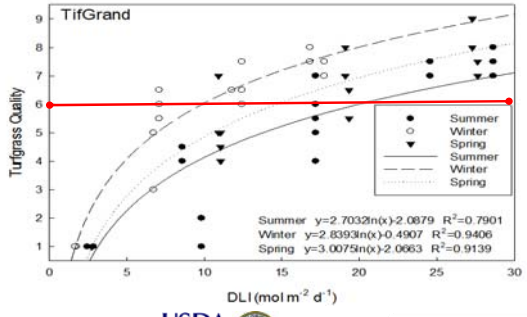


1. Establish baseline DLI requirements for common warm-season turfgrasses throughout various applications for use
2. Determine plant changes that occur as an effect of changing low light environment based on aesthetic, physiological, and morphological indicators
3. Identify means in which DLI research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

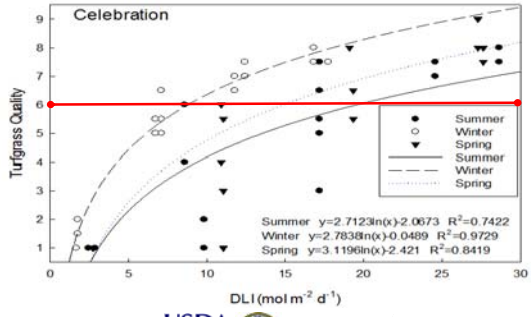
DLI Requirements



DLI Requirements



DLI Requirements



DLI Requirements

Turfgrass Cultivar	DLI requirements (mol m^{-2} d^{-1}) Summer	Winter	Spring
Tifway hybrid bermudagrass	**21.0**	**10.6**	**17.9**
TifGrand hybrid bermudagrass	**19.9**	**9.8**	**14.6**
Celebration common bermudagrass	**19.6**	**8.8**	**14.9**
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

Research @ UF

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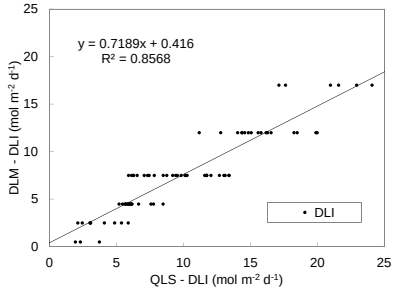
DLI Instrument Comparison – DLM vs. QLS



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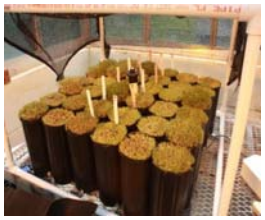
Experimental Design

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

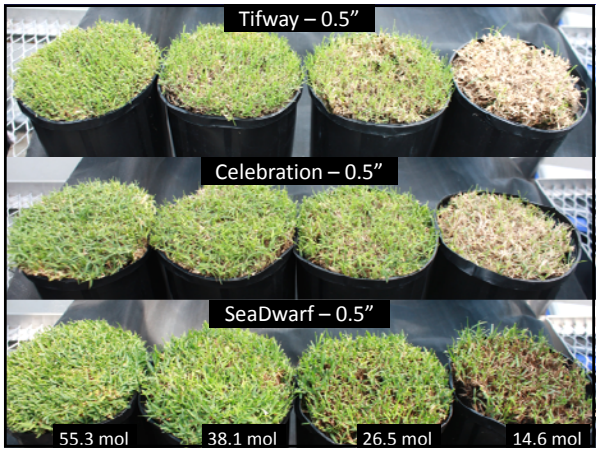
Experimental Design

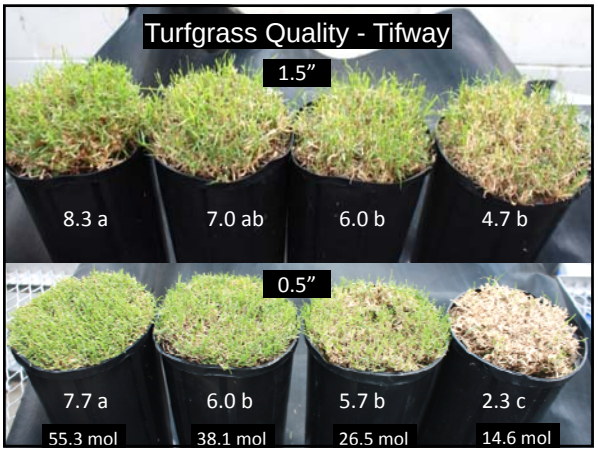
- Split-plot design
  - Main plot - shade
- Four shade regimes
  - 0, 30, 50, 70% shade

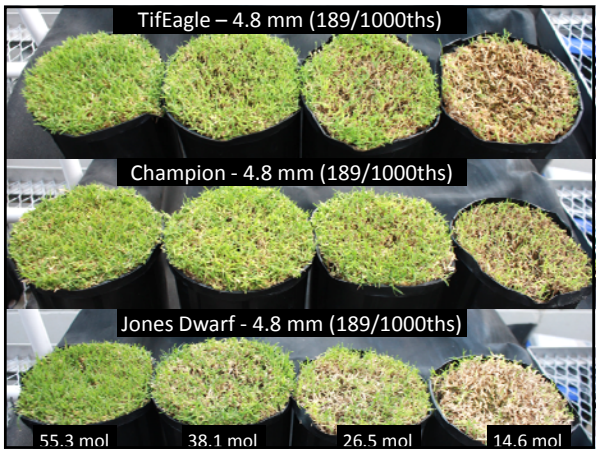


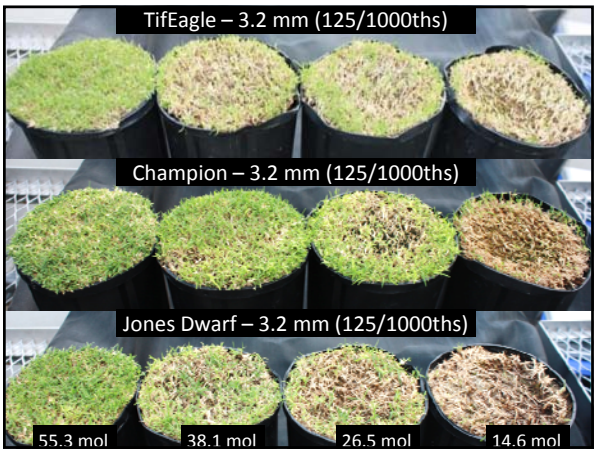
Experimental Design

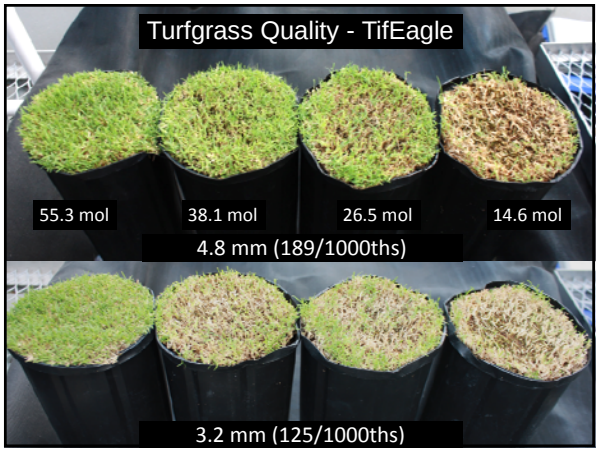
- Supplemental lighting
  - HPS with 1000 W bulbs, 0.9 m above canopy
  - Photoperiod of 12 h d^{-1}
  - Temperature reduced by 13% under 70% shade











DLI Requirements

	DLI requirement (mol m^{-2} d^{-1})* Mowing Height		
Turfgrass Cultivar	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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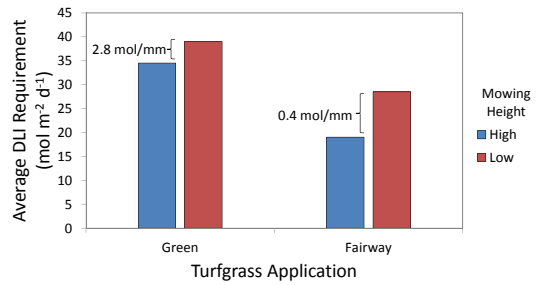
Summary



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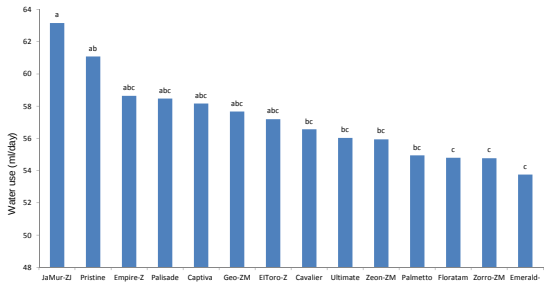
Zoysiagrass Water Use



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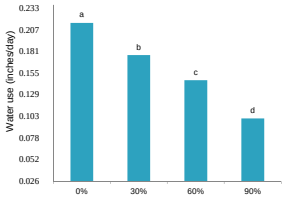

- 30% Shade → 19.8% reduction in water use
- 60% Shade → 35.8% reduction in water use
- 90% Shade → 60.5% reduction in water use

USDA

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