Daily Light Requirements for Grass Species

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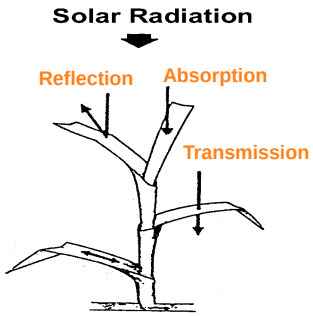
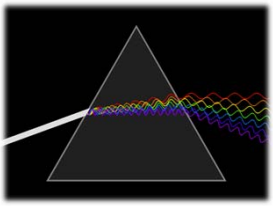
Atmospheric Environment - Light



Solar radiation on leaf blades.

Effects of Light on Turfgrass Growth

- Light intensity
- Light quality
- Light duration



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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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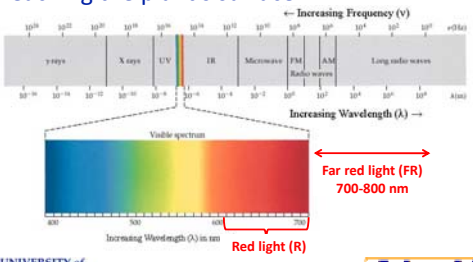
Effect of Light Quality on Turfgrass Growth

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



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Adapted from C. Foresman, 2009

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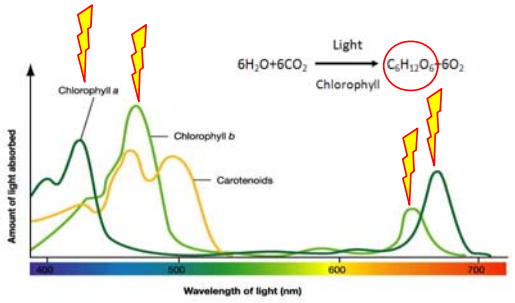
Effect of Light Quality on Turfgrass Growth



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 ($w/m^2/day$) (Toro)
  - Langley/day (Ly/day = $cal/cm^2/min$) (Rainbird)

$w/m^2/day = 2.04$ Ly/day
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/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

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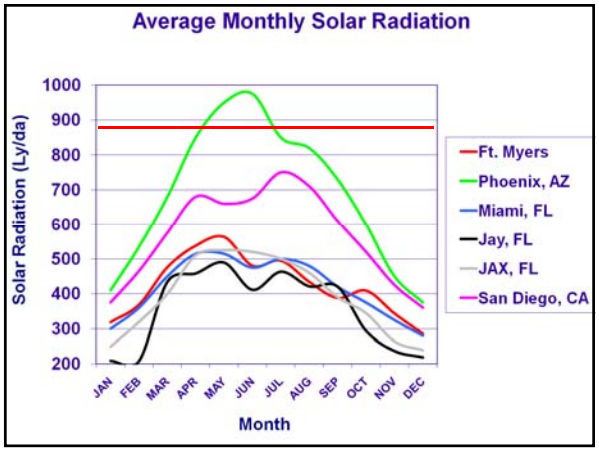

Light Meters

- Quantum sensors measure light energy at the specific wavelengths plants actually use for photosynthesis.
- All quantum meters here measure Photosynthetic Photon Flux (PPF) as µmol m^{-2} s^{-1} for Photosynthetically Active Radiation (PAR) in the range of 400 to 700 nm.

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- The 3 or 6 sensor handheld bar on this Quantum Light Meter provides a spatial averaged PAR reading.
  - $277 (3 sensor) or $329 (6 sensor)

Solar Radiation

- Energy (photons) delivered per unit of time over a specified area
  - Photosynthetic photon flux density (PPFD)
  - Micromoles per meter square per second (µmol 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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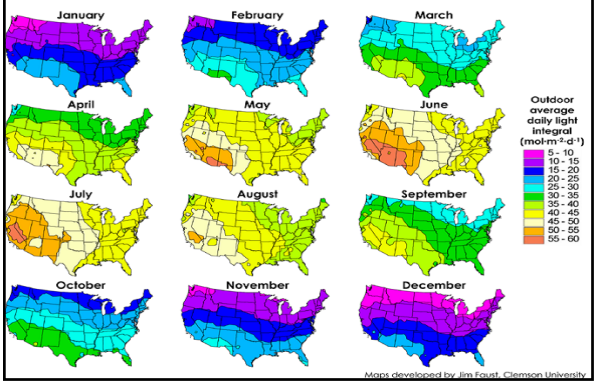
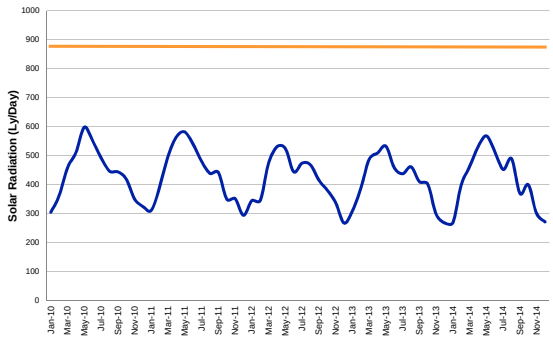
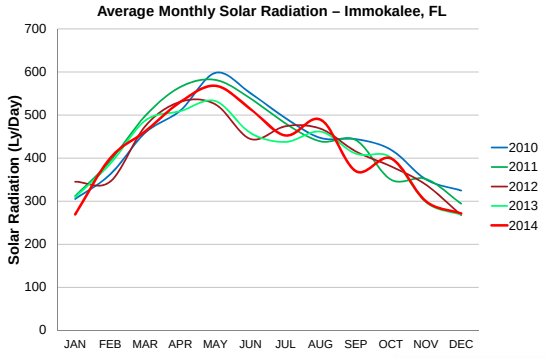
DLI across the United States



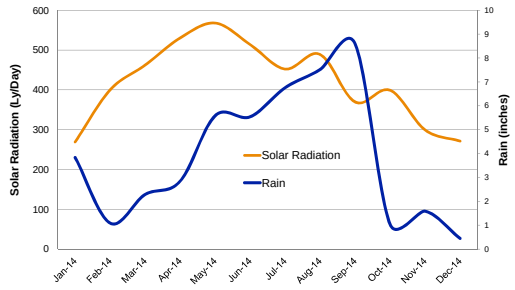
Average Monthly Solar Radiation – Immokalee, FL



Average Monthly Solar Radiation – Immokalee, FL

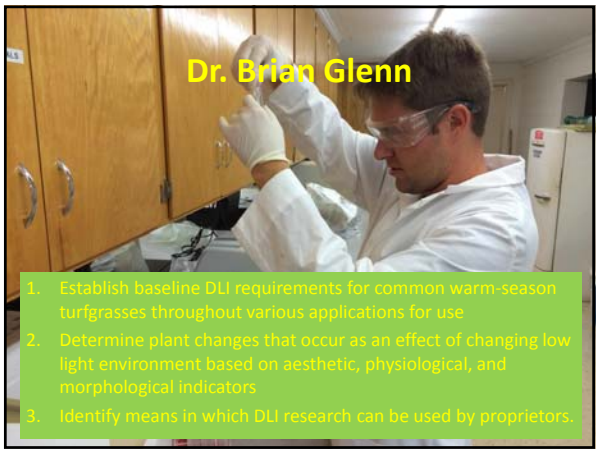


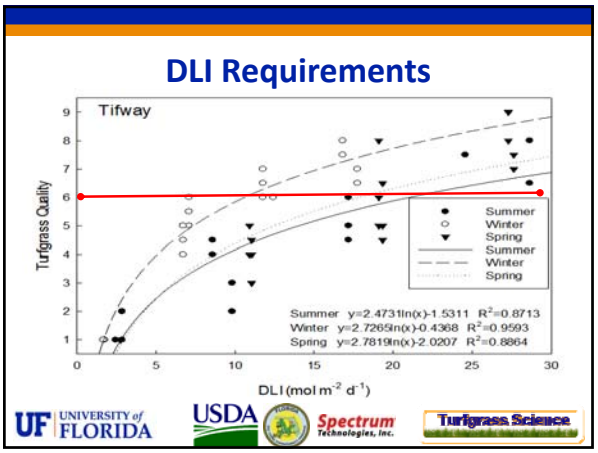
Average Monthly Solar Radiation & Rain – 2014



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?


Dr. Brian Glenn
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
Tifway
Turfgrass Quality
DLI (mol m-2 d-1)
Summer
Winter
Spring
Summer y=2.4731ln(x)-1.5311 R2=0.8713
Winter y=2.7265ln(x)-0.4368 R2=0.9593
Spring y=2.7819ln(x)-2.0207 R2=0.8864
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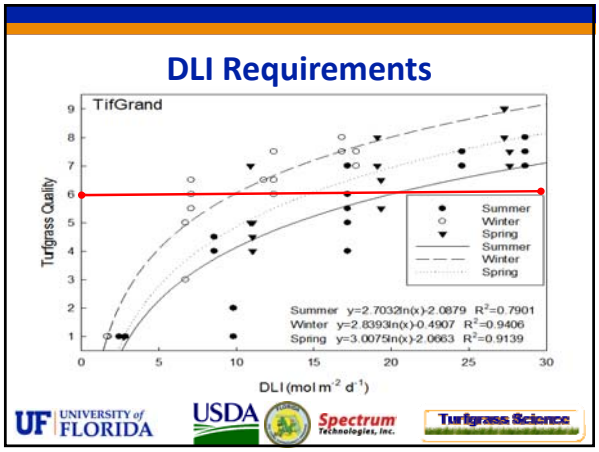
DLI Requirements
TifGrand
Turfgrass Quality
DLI (mol m-2 d-1)
Summer
Winter
Spring
Summer y=2.7032ln(x)-2.0879 R2=0.7901
Winter y=2.8393ln(x)-0.4907 R2=0.9406
Spring y=3.0075ln(x)-2.0663 R2=0.9139
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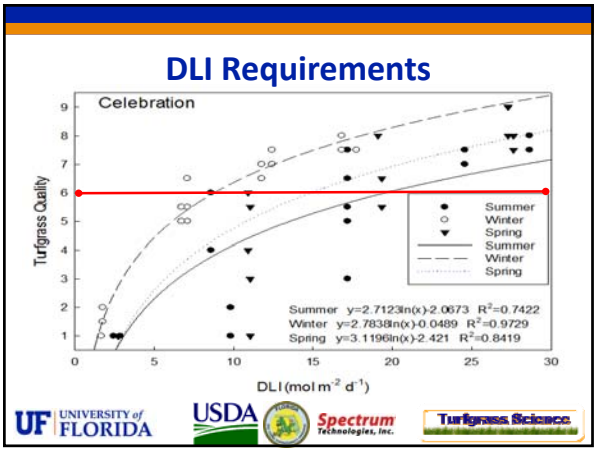
DLI Requirements
Celebration
Turfgrass Quality
DLI (mol m-2 d-1)
Summer
Winter
Spring
Summer y=2.7123ln(x)-2.0673 R2=0.7422
Winter y=2.7838ln(x)-0.0489 R2=0.9729
Spring y=3.1196ln(x)-2.421 R2=0.8419
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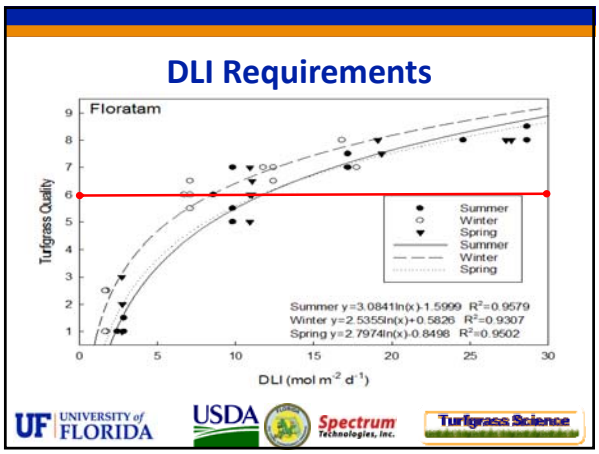
DLI Requirements
Floratam
Turfgrass Quality
DLI (mol m-2 d-1)
Summer
Winter
Spring
Summer y=3.0841ln(x)-1.5999 R2=0.9579
Winter y=2.5355ln(x)+0.5826 R2=0.9307
Spring y=2.7974ln(x)-0.8498 R2=0.9502
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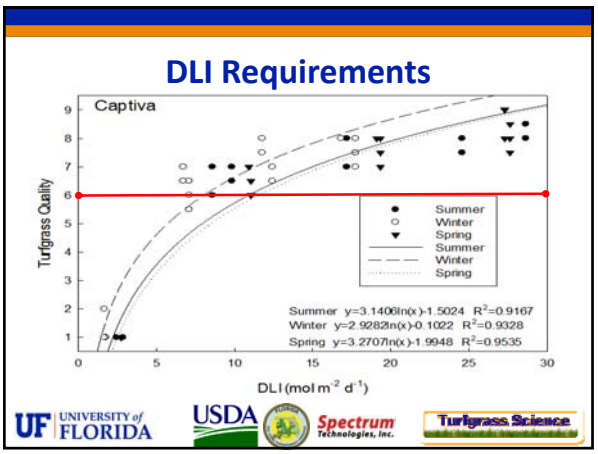
DLI Requirements
Captiva
Turfgrass Quality
DLI (mol m-2 d-1)
Summer
Winter
Spring
Summer y=3.1406ln(x)-1.5024 R2=0.9167
Winter y=2.9282ln(x)-0.1022 R2=0.9328
Spring y=3.2707ln(x)-1.9948 R2=0.9535
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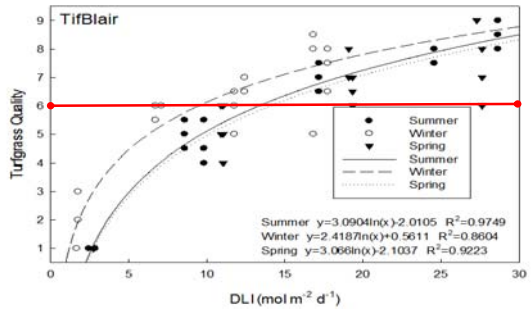
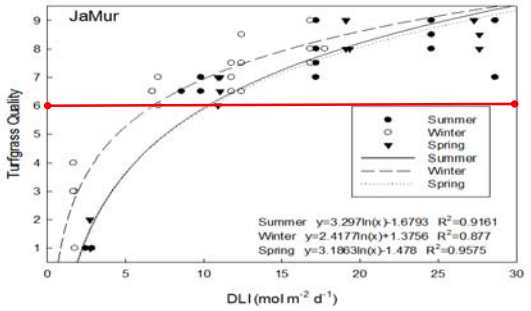
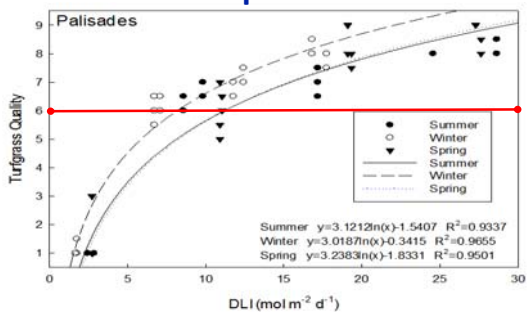
DLI Requirements



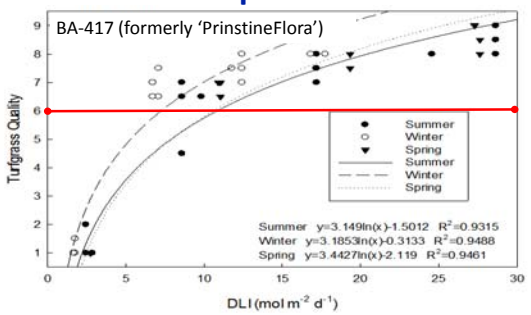
DLI Requirements



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
TifBlair centipedegrass	13.4	9.5	14.1
Floratam St. Augustinegrass	11.8	8.5	11.6
Palisades zoysiagrass (japonica)	11.2	8.2	11.2
Captiva St. Augustinegrass	10.9	8.0	11.5
BA-417 (formerly PristineFlora) zoysiagrass (matrella)	10.8	7.3	10.6
JaMur zoysiagrass (japonica)	10.3	6.8	10.5

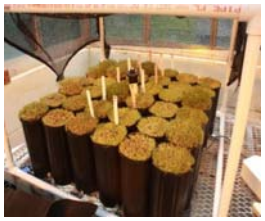
Research @ UF

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



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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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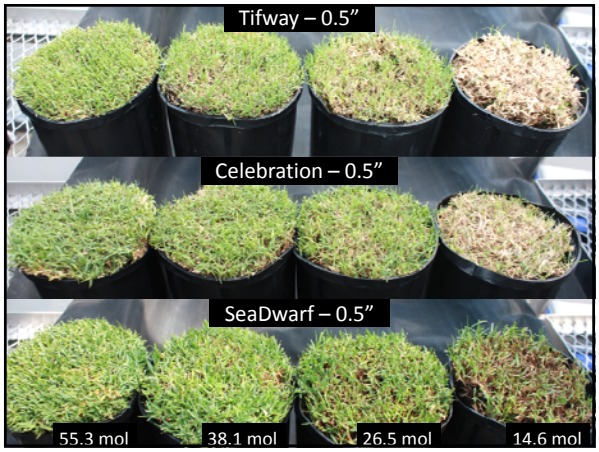
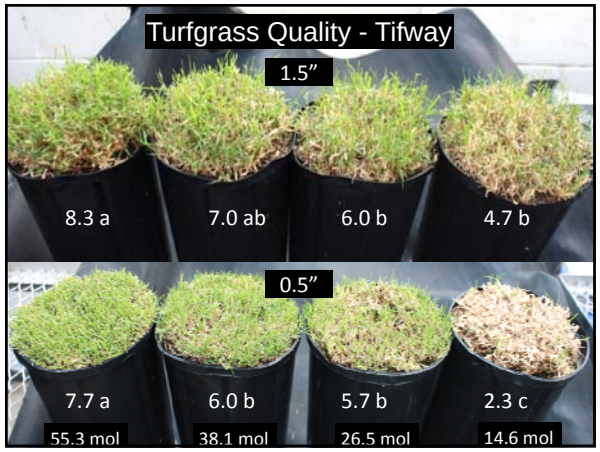
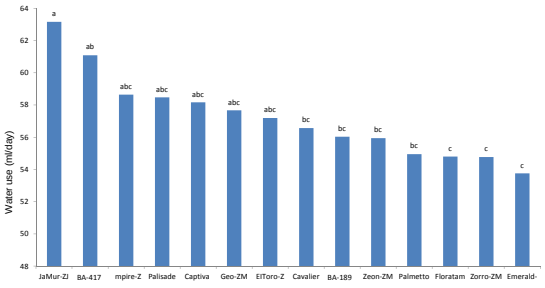




Zoysiagrass Water Use



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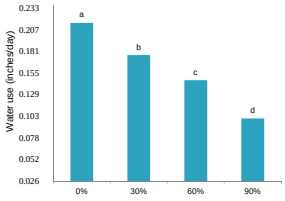

- 30% Shade → 19.8% reduction in water use
- 60% Shade → 35.8% reduction in water use
- 90% Shade → 60.5% reduction in water use

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Cultural Practices

- Remove shade (pruning branches).
- Reduce traffic.
- Increase mowing height.
- Reduce irrigation.
- Reduce N fertilization ¼ to ½ less than full sun conditions.
  - Increase frequency of application.

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