

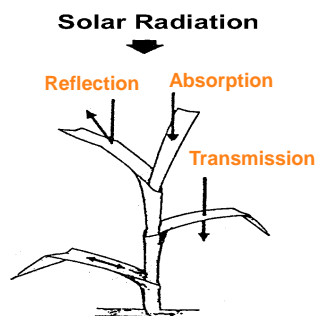
## Practical Tactics for Managing Turf in Shaded and Low-Light Conditions

J. Bryan Unruh, Ph.D.  
University of Florida, IFAS



Rainy, overcast weather???

## Atmospheric Environment - Light

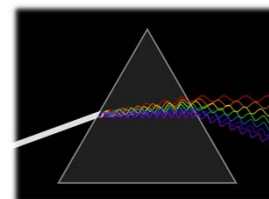


Solar radiation on leaf blades.

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## Effects of Light on Turfgrass Growth

- Light intensity
- Light quality
- Light duration

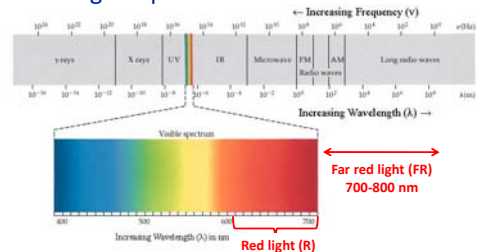


## Effects of Light Intensity on Plant Growth

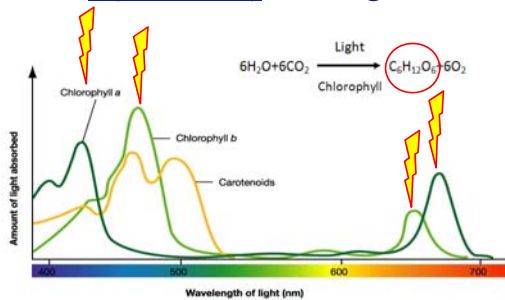
- Time of day
  - Low at sunrise and sunset, high at midday.
- Atmospheric Screening -
  - High on clear days.
  - Cloud cover can screen up to 96%.
  - Smoke can screen out as much as 90% of the incoming radiation.
- Topography -
  - Causes localized variations in light intensity because it affects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

## Effect of Light Quality on Turfgrass Growth

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



## Effect of Light Quality on Turfgrass Growth



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

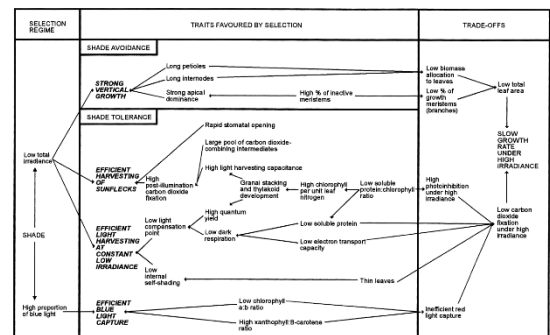
**Shade from trees reduces light quality because the light is filtered.**  
*The tree leaves "remove" the red and blue light components, leaving mainly the green, which is not effective in photosynthesis.*

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## 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

## Shade Avoidance vs. Shade Tolerance



## Solar Radiation

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

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

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

## Optimum Solar Radiation

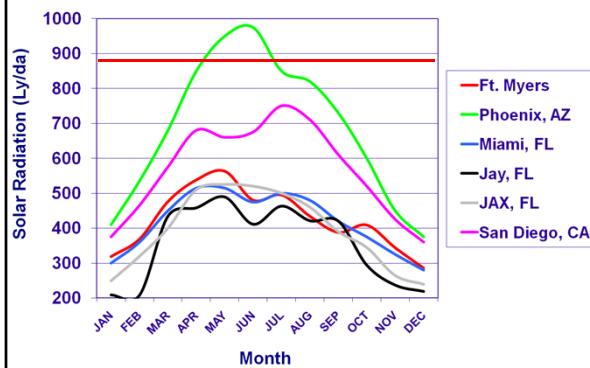
Dudeck and Peacock, 1992

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

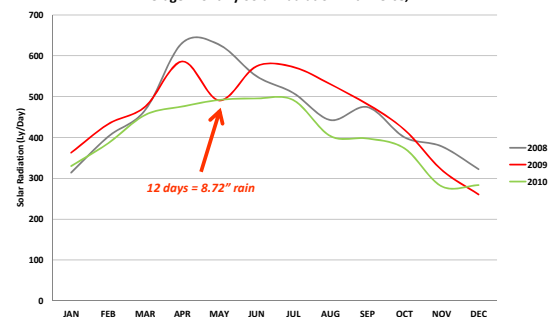
**$\text{w/m}^2/\text{day} = 0.48 \text{ Ly/day}$**

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

## Average Monthly Solar Radiation



## Average Monthly Solar Radiation - Ft. Pierce, FL



## 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  $\mu\text{mol m}^{-2} \text{ s}^{-1}$  for Photosynthetically Active Radiation (PAR) in the range of 400 to 700 nm.





### They see the light

Researchers are using daily light integral technology to help superintendents pick turfgrass cultivars for problem spots.

Mark Laidlaw

**UF UNIVERSITY of FLORIDA**

**Turfgrass Science**

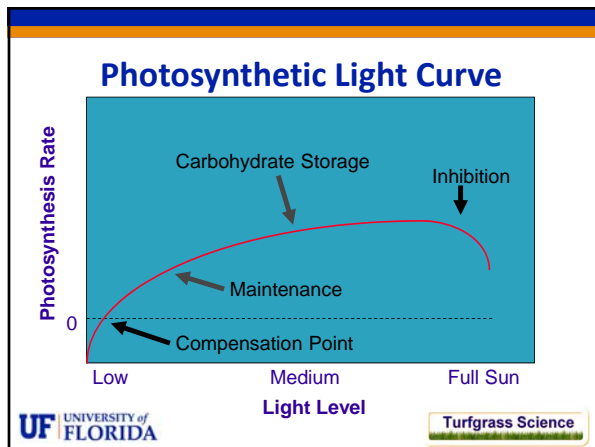
### Research @ UF





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### Physiological Responses to Low Light

- Higher chlorophyll content
- Lower respiration
- Lower compensation point
- Reduced carbohydrate reserves
- Lower demand for water, nutrients
- Reduced heat, cold, drought, wear tolerance

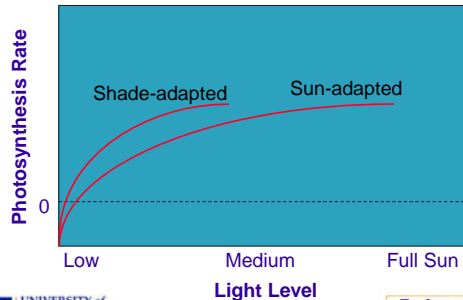
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## Photosynthetic Light Curve



## Morphological Responses to Low Light

- Reduced growth
- Thinner leaves
- Reduced shoot density
- Leaves are more succulent (less substance)
- Reduced tillering
- Longer, more erect leaves
- Longer internodes
- Slower establishment

## What Are the Growth Changes?



## Research at Texas A&M University

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



## Management in the Shade

- Changes in morphology and physiology dictate management practices.
  - Increase mowing height = longer leaves = more light interception = more photosynthesis.
  - Increasing mowing height can increase respiration;
    - Increased "self-shading"
    - Decreased leaf evaporation (increased disease)
    - Decreased traffic tolerance

## Shade Increases Disease Incidence

- Thinner leaves less resistant to disease penetration.
- Sun light inhibits spore germination.
- Higher humidity increases spore germination.
- Surfaces stay wet longer.
- Reduction in airflow.

## Research at Oklahoma State Univ.

**FIGURE 1**



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## Research at Oklahoma State Univ.

- The air restriction plots had the most severe disease and were the last to dry each morning in spite of their exposure to full sun.
- The turf density on the green was greatest in full sun, less under light reduction and least in airflow restriction.

## Research at Oklahoma State Univ.

- Airflow restriction and light reduction may cause different problems but are equally detrimental to turfgrass health.
- If both of these stresses are present and one is removed, an immediate improvement in turfgrass health can be expected.

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## Research at Oklahoma State Univ.

- Practical Considerations:
  - Increasing the air circulation in a shaded environment should lead to improved growing conditions.
    - Removing low-growing brush and trimming tree limbs to at least 10' off the ground.
    - Opening east to west corridors through existing vegetation or structures can help air circulation immensely.
    - Re-grading may be required.
    - Fans can also be effective.



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## Research at the University of Nebraska

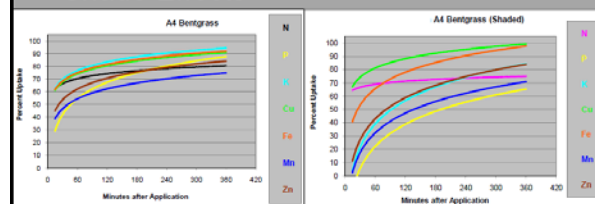
- Foliar-applied nutrients to creeping bentgrass putting greens.



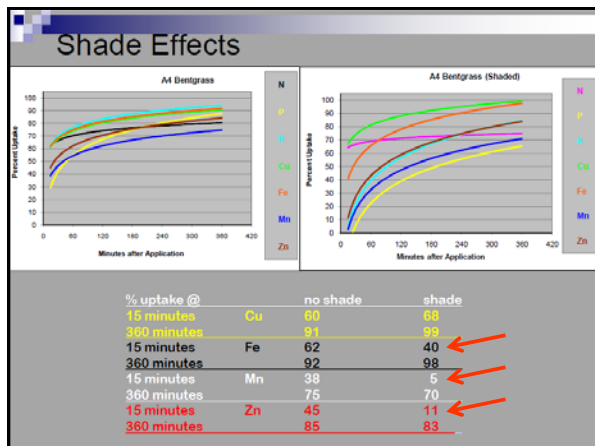
- Nutrients washed off surface at 15 and 360 minutes and analyzed for nutrients.

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## Shade Effects

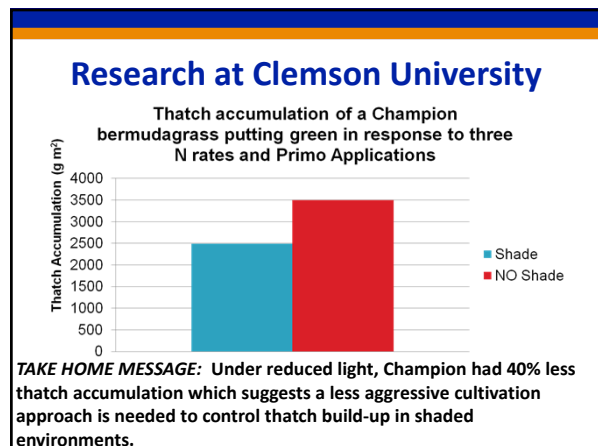
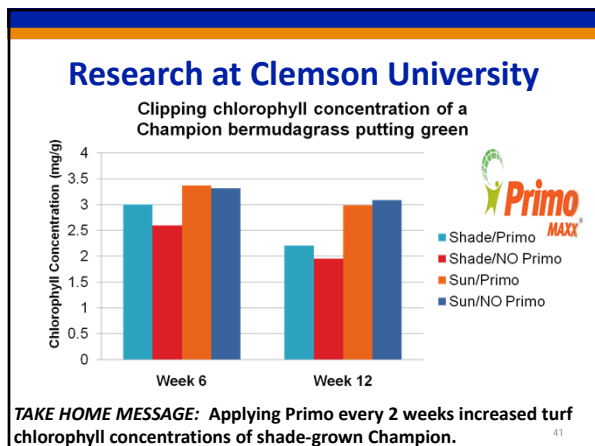
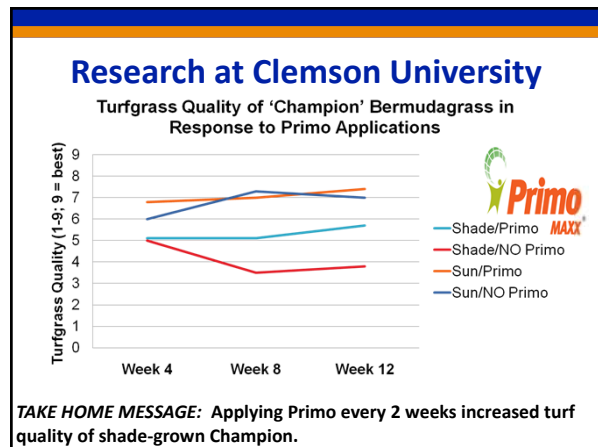
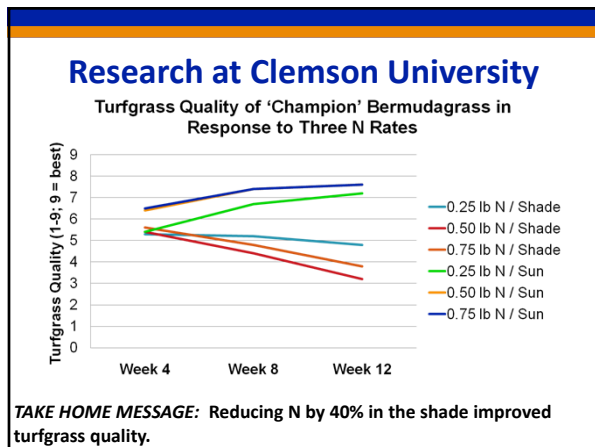


% uptake @		no shade	shade
15 minutes	N	65	65
360 minutes	N	81	77
15 minutes	P	30	0
360 minutes	P	88	65
15 minutes	K	65	5
360 minutes	K	92	85



### Shade Effects

- Initial uptake (i.e. first 15 minutes) is impeded by shade
- Shaded turf (@ 6 hrs) is at or near un-shaded
- Shaded turf should be mowed first, delay irrigation or mowing if possible



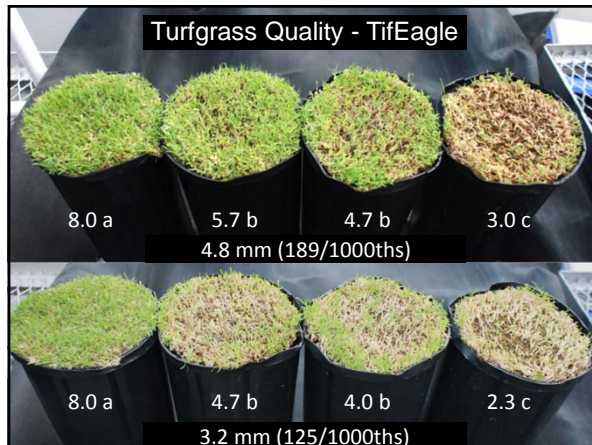
## Management in the Shade

- Putting green management
  - Walk mow instead of ride
  - Roll instead of mow
  - Growth regulators can mitigate etiolation
  - Spoon-feed and avoid higher N rates.
  - Increase height of cut.
    - Fractional changes can make a big difference
      - 0.125" to 0.156" creates a 25% increase in leaf area.
      - 0.141" to 0.156" creates a 11% increase in leaf area.

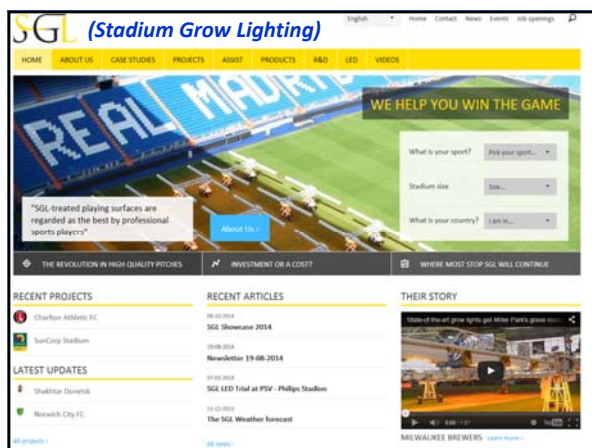
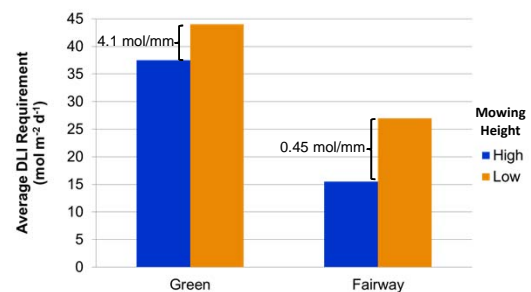
## DLI Requirements

	DLI requirement (mol m <sup>-2</sup> d <sup>-1</sup> )*		
	Mowing Height		
Turfgrass Cultivar	High	Low	% Change
Jones Dwarf bermudagrass	38.2	48.3	+ 26
TifEagle bermudagrass	35.2	43.9	+ 25
Champion bermudagrass	39.1	39.9	+ 2
Tifway bermudagrass	18.7	32.2	+ 72
Celebration bermudagrass	14.6	25.4	+ 75
SeaDwarf seashore paspalum	13.3	23.3	+ 75

<sup>\*</sup>Reduced to 93% observed DLI



## Mowing Height Summary



## Bottom Line. . .

- Remove shade (pruning branches)
- Increase airflow
- Reduce traffic
- Increase mowing height
- Reduce irrigation
- Reduce N fertilization  $\frac{1}{4}$  to  $\frac{1}{2}$  less than sunlight turf growing areas.
  - Increase frequency of application.
- Incorporate plant growth regulators



### Acknowledgements:

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