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

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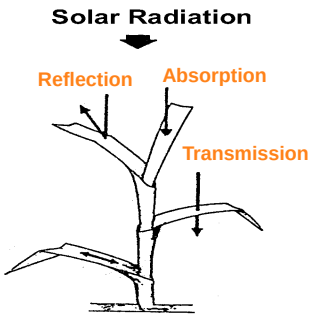
Atmospheric Environment - Light

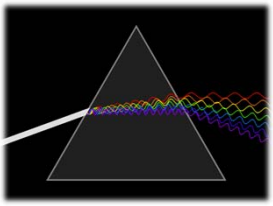


Solar radiation on leaf blades.

5

Effects of Light on Turfgrass Growth

- Light intensity
- Light quality
- Light duration



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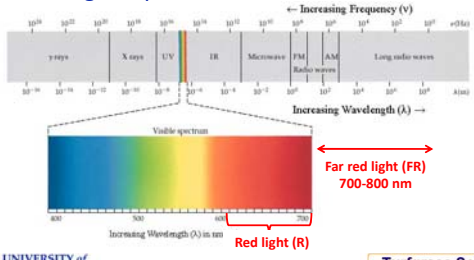
6

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.

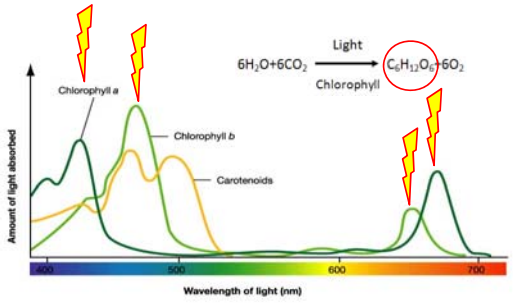


Adapted from C. Foresman, 2009

Effect of Light Duration on Turfgrass Growth

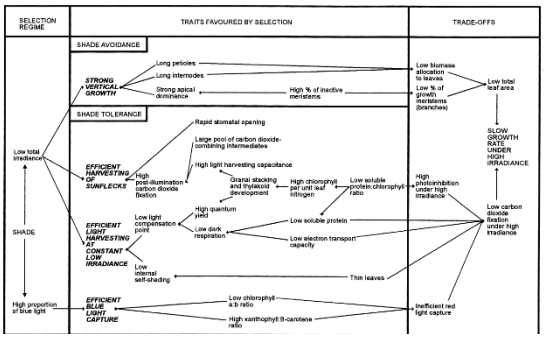
- Light duration refers to the amount of time (hours) that the turf is exposed to sunlight.
  - Influences plant growth and development.
    - Physiological Responses
    - Development Responses

Effect of Light Quality on Turfgrass Growth



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

Shade Avoidance vs. Shade Tolerance



Henry and Aarssen 1997

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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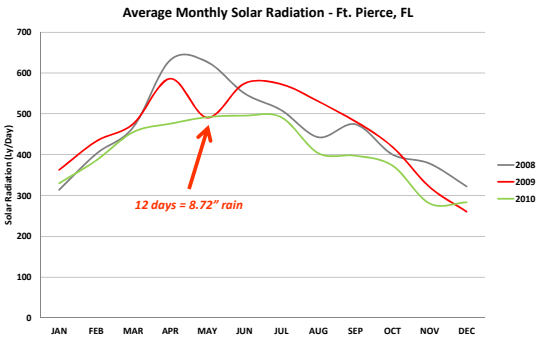

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Optimum Solar Radiation

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 Ly/day
Ly/day = 2.07 w/m^2/day

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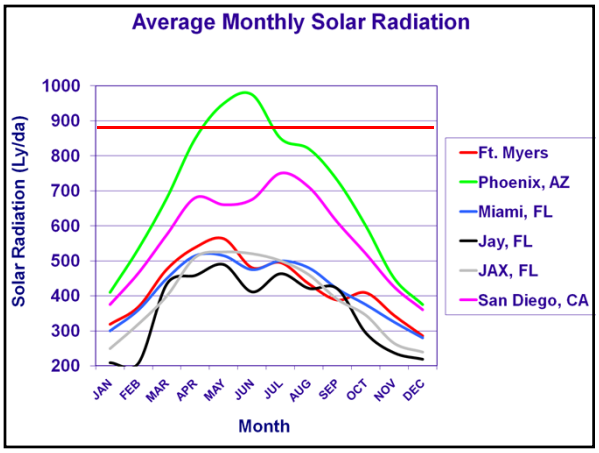

Light Meters

- 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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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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Research @ UF

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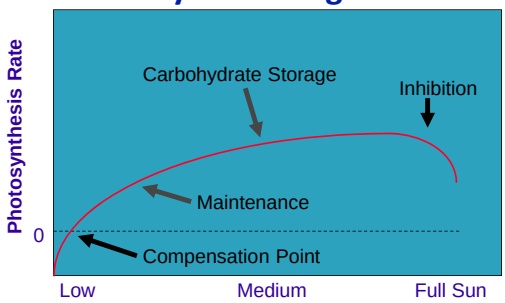
TifGrand Bermudagrass

Photosynthetic Light Curve



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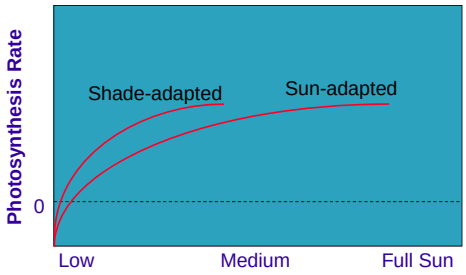
Celebration Bermudagrass

Photosynthetic Light Curve



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Research at Texas A&M University

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

28

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

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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

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What Are the Growth Changes?

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.

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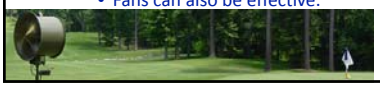
Research at Oklahoma State Univ.

31

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 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 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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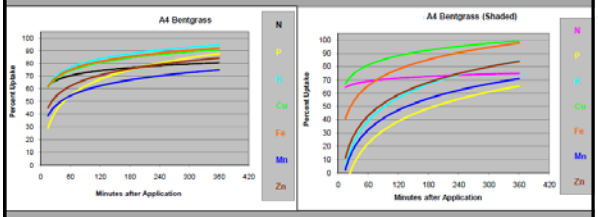
Research at Oklahoma State Univ.

- 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.

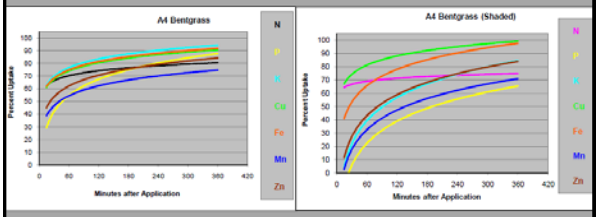
33

Shade Effects



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

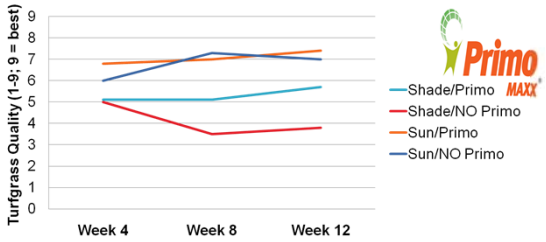
Shade Effects



% uptake @		no shade	shade
15 minutes	Cu	60	68
360 minutes		91	99
15 minutes	Fe	62	40
360 minutes		92	98
15 minutes	Mn	38	5
360 minutes		75	70
15 minutes	Zn	45	11
360 minutes		85	83

Research at Clemson University

Turfgrass Quality of 'Champion' Bermudagrass in Response to Primo Applications



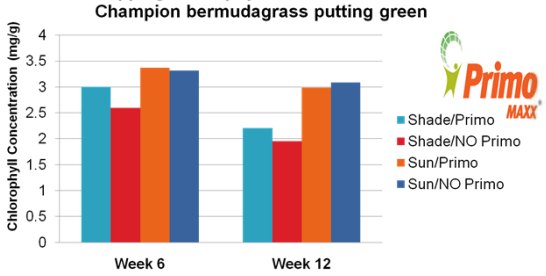
TAKE HOME MESSAGE: **Applying Primo every 2 weeks increased turf quality of shade-grown Champion.**

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

Research at Clemson University

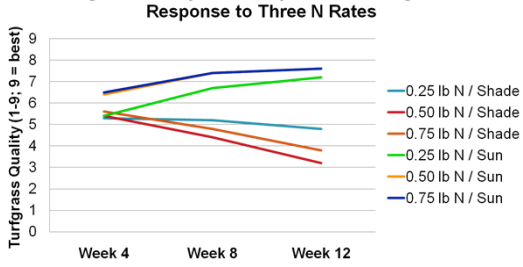
Clipping chlorophyll concentration of a Champion bermudagrass putting green



TAKE HOME MESSAGE: **Applying Primo every 2 weeks increased turf chlorophyll concentrations of shade-grown Champion.**

Research at Clemson University

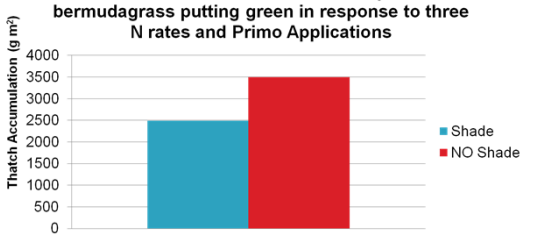
Turfgrass Quality of 'Champion' Bermudagrass in Response to Three N Rates



TAKE HOME MESSAGE: **Reducing N by 40% in the shade improved turfgrass quality.**

Research at Clemson University

Thatch accumulation of a Champion bermudagrass putting green in response to three N rates and Primo Applications



TAKE HOME MESSAGE: **Under reduced light, Champion had 40% less thatch accumulation which suggests a less aggressive cultivation approach is needed to control thatch build-up in shaded environments.**

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.

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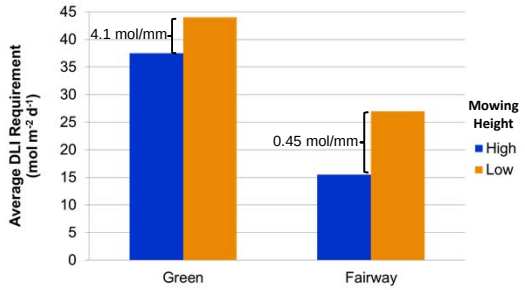
Mowing Height Summary



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DLI Requirements

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

*Reduced to 93% observed DLI

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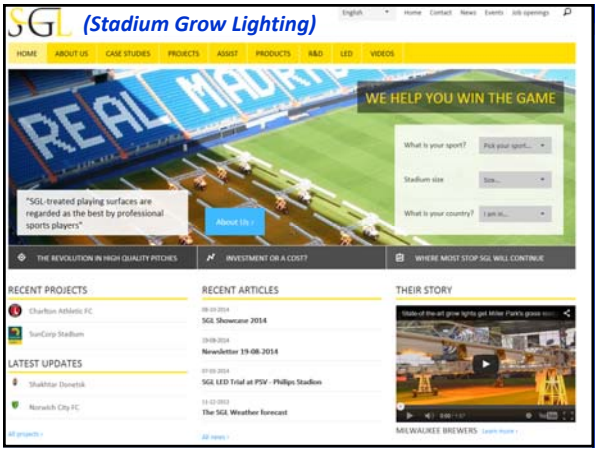

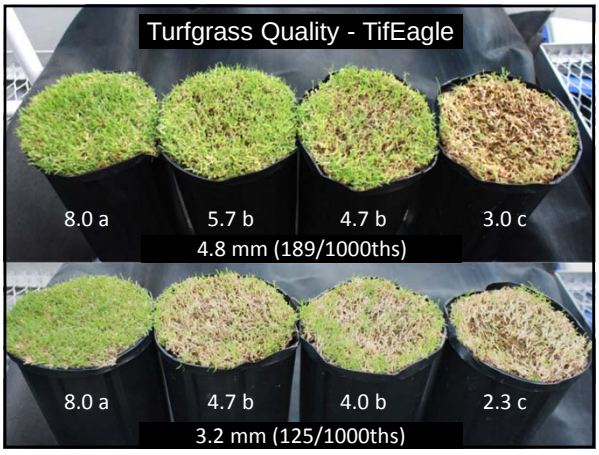

Bottom Line. . .

- Remove shade (pruning branches)
- Increase airflow
- Reduce traffic
- Increase mowing height
- Reduce irrigation
- Reduce N fertilization ¼ to ½ less than sunlight turf growing areas.
  - – Increase frequency of application.
- Incorporate plant growth regulators

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Acknowledgements:

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