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

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Atmospheric Environment - Light

Solar Radiation

Reflection  Absorption  Transmission

Solar radiation on leaf blades.

Effects of Light on Turfgrass Growth

- Light intensity
- Light quality
- Light duration

Rainy, overcast weather???
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%.
- 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.

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

Shade Avoidance vs. Shade Tolerance

Henry and Aarssen 1997

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.
**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)

\[
\text{w/m}^2/\text{day} = 2.04 \text{ Ly/day} \\
\text{Ly/day} = 0.49 \text{ w/m}^2/\text{day}
\]

**Optimum Solar Radiation**

*Dudeck and Peacock, 1992*

- **Warm-Season Turf:**
  - 812 - 969 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)

\[
\text{w/m}^2/\text{day} = 0.48 \text{ Ly/day} \\
\text{Ly/day} = 2.07 \text{ w/m}^2/\text{day}
\]

**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 µmol m⁻² s⁻¹ for Photosynthetically Active Radiation (PAR) in the range of 400 to 700 nm.
Research @ UF

Photosynthetic Light Curve

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

TifGrand Bermudagrass

Celebration Bermudagrass
**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.
- 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.

- 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.

- Foliar-applied nutrients to creeping bentgrass putting greens.
- Nutrients washed off surface at 15 and 360 minutes and analyzed for nutrients.
Research at Clemson University

**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

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

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

**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.

DLI Requirements

<table>
<thead>
<tr>
<th>Turfgrass Cultivar</th>
<th>Mowing Height</th>
<th>% Change</th>
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</thead>
<tbody>
<tr>
<td>Jones Dwarf bermudagrass</td>
<td>38.2</td>
<td>48.3</td>
</tr>
<tr>
<td>TifEagle bermudagrass</td>
<td>35.2</td>
<td>43.9</td>
</tr>
<tr>
<td>Champion bermudagrass</td>
<td>39.1</td>
<td>39.9</td>
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<td>Tifway bermudagrass</td>
<td>18.7</td>
<td>32.2</td>
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<tr>
<td>Celebration bermudagrass</td>
<td>14.6</td>
<td>25.4</td>
</tr>
<tr>
<td>SeaDwarf seashore paspalum</td>
<td>13.3</td>
<td>23.3</td>
</tr>
</tbody>
</table>

*M reduced to 93% observed DLI

Turfgrass Quality - TifEagle

<table>
<thead>
<tr>
<th></th>
<th>8.0 a</th>
<th>5.7 b</th>
<th>4.7 b</th>
<th>3.0 c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>4.8 mm (189/1000ths)</td>
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<th>4.0 b</th>
<th>2.3 c</th>
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<tbody>
<tr>
<td>Height</td>
<td>3.2 mm (125/1000ths)</td>
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Mowing Height Summary

4.1 mol/mm

0.45 mol/mm

Mowing Height Summary

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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