The PALLET

Newsletter of Turfgrass Producers of Texas *Spring 2018*

TURFGRASS **GROWTH IN SHADE**

Previously printed in TPI *Turf News* **January/February 2018**
By Casey Reynolds, PhD

Managing turfgrasses in shade can be one of the more challenging aspects encountered by turfgrass managers everywhere. Unlike weeds, insects or diseases, you can't simply spray something to correct it. Furthermore, who doesn't love a good shade tree on a hot summer day? Privacy fences, homes or other structures, trees, shrubs, etc. all have the capacity to block sunlight from reaching turfgrasses and thereby creating shade. In this edition of Rooted in Research, we'll explore the fundamentals behind shade, its impacts on turfgrass health, and recent research designed to determine exactly how much sunlight is needed to meet the needs of various turfgrass species.

In order to understand shade, it's important to first understand the sunlight that it's blocking. Sunlight has properties of both particles and waves. Particles of light called photons contain energy that is delivered in various wavelengths which are defined by the distance between successive crests. The electromagnetic spectrum (Figure 1) includes the entire range of wavelengths of electromagnetic radiation delivered to the Earth's surface by the sun. Unfortunately, not all of these wavelengths are useful for plant growth. In fact, photosynthetically active radiation (PAR), which is what drives growth in plants, makes up a very small amount of this spectrum. The entire 300 nanometer (nm) range of PAR from 400-700 nm, when compared to the entire electromagnetic spectrum, is equivalent to the width of a coin (a United States dime) when compared to driving from New York, NY, to Los Angeles, CA. This tiny portion of light is all that's useful to plants. As a result, one can imagine that it doesn't take much additional shade from cloud cover, trees, homes, etc. to limit turfgrass growth in shade.

Turfgrasses, like all plants, require sunlight in order to supply energy to support photosynthesis, which literally means "synthesis using light." As photosynthesis occurs, solar energy is used to drive the synthesis of carbohydrates and oxygen from carbon dioxide and water. In shaded environments, photosynthesis is reduced, which can result in decreased growth rates of turfgrasses, thinning, and even death. This is because plant survival dictates that net photosynthesis (carbon gains) exceed respiration (carbon losses) for the plant to continue to grow, produce new tissues, store carbon, etc. The point at which this pendulum swings in either direction is called the light compensation point, or the point at which photosynthetic CO_2 uptake exactly balances CO_2 release through respiration.

Generally speaking, cool-season turfgrasses reach light saturation, the point at which any additional sunlight cannot be effectively used for photosynthesis, at approximately 50% of full sunlight. By contrast, warm-

(Continued on Page 6)

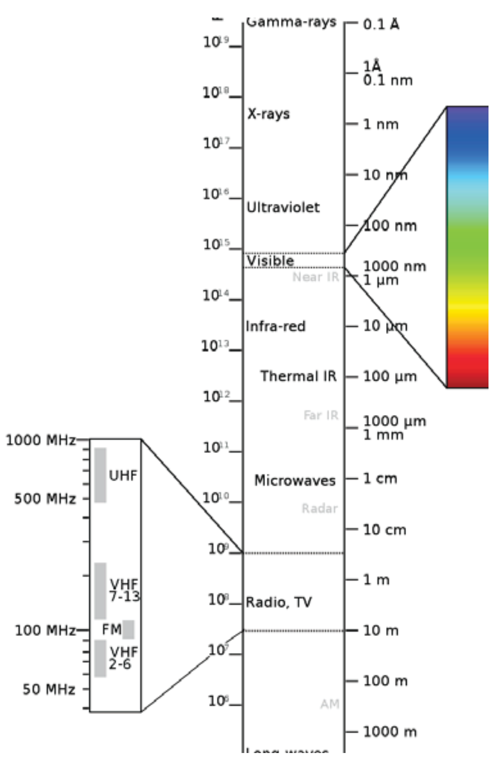
Shade For Turfgrass?

(Continued from Page 1

season turfgrasses typically require full sunlight to reach light saturation. This introduces a series of questions, such as: "How much full sunlight do various turfgrass species and varieties need to row?" "Is afternoon sun better than morning sun?" " Is four hours of shade/partial sun better or worse than two hours of full sun?" "how do we measure it?" and so on.

Light intensity varies by location, diurnal cycle, time of year, atmospheric conditions, cloud cover, shade, etc.

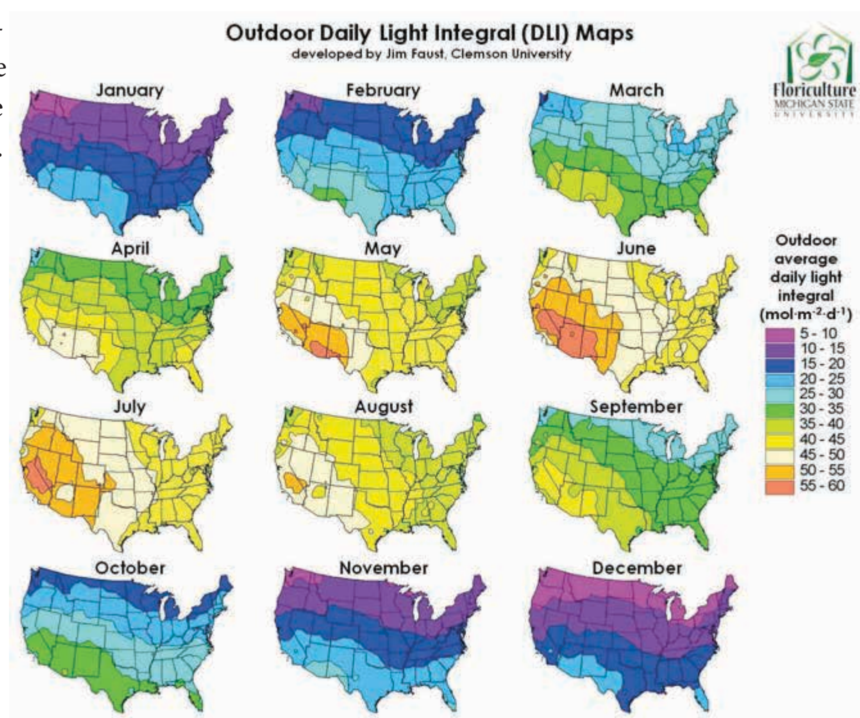
Sometimes this is measured as photosynthetic photon flux density (PPFD) in units of mol m -2 s -1, which provides an instantaneous value for how much PAR is reaching a leaf 's surface. However, the item of most interest to turfgrass researchers is how much photosynthetically active radiation (PAR) strikes a surface throughout the course of a day, season or year. This integrates PPFD into a term called the Daily Light Integral (DLI) and is much more useful for quantifying shade tolerance in plants. DLI also is useful because there are simple, inexpensive devices capable of measuring DLI that are commercially available to turfgrass managers.



Publicly available data on DLIs, such as the information in Figure 2, illustrate the amount of PAR striking the Earth's surface at various points in the United States at different times of year. One can see from this data the substantial differences that exist based on location and season. For example, during the spring months there can be 46 percent more PAR in the desert southwest than the northeast United States and from January to August in Houston, TX, the amount of PAR increases by 142 percent. These types of baseline data are important for calculating percent reductions using light meters under various shade levels.

Tips for growing turfgrass in shade

- Select the appropriate species and cultivar. Fine fescue and Tall fescue offer the highest shade tolerance for cool-season lawns while St. Augustinegrass and Zoysiagrass provide the highest shade-tolerance in warm-season turfgrasses.
- Shade source matters: Trees are more likely to alter light quality (red light, blue light, red/far red ratios) than buildings or other structures which primarily reduce light quantity.
- Tree species matters: Evergreen trees provide more shade than deciduous trees.
- Mowing height: Mow turfgrasses on the upper end of their recommended height range.
- Fertilization: Reduce nitrogen applications. Excessive leaf growth comes at the expense of roots and other stored carbon sources.
- Traffic: Limit traffic when possible; turfgrasses under shade grow less vigorously and therefore won't recover as rapidly as in full sun.
- Plant growth regulators: PGRs have been shown to increase turfgrass quality in closely mowed turf when grown under moderate shade.



(Continued on Page 7)

(Continued from Page 6)

Much of the current turfgrass shade research regarding determining minimum required DLIs is focused primarily on warm-season turfgrasses. Cool-season turfgrasses are typically more shade tolerant than warm-season turfgrass species so, generally speaking, DLIs for cool-season turfgrass are lower than those for many warm-season turfgrasses. Reported DLIs for several warm-season species and cultivars are reported in Table 2. Bermudagrass, as expected, has the highest DLIs ranging from 13.9 – 18.6 mol m^{-2} d^{-1} in the spring/fall and 18.6 – 22.4 mol m^{-2} d^{-1} in the summer. This was followed by Centipedegrass (13.4 – 14.7), Seashore paspalum (11.1 – 13.0), St. Augustinegrass (10.6 – 11.5), and Zoysiagrass (9.7 – 11.3). Therefore, for clients dealing with substantial shade in southern environments, zoysiagrass and St. Augustinegrass offer the highest shade tolerance (lowest DLI) and greatest likelihood for success. Within zoysiagrass varieties, additional research has shown that fine textured species that are often interspecific crosses of *Z. japonica* and *Z. matrella* or *Z. pacifica* typically have better shade tolerance than coarse textured varieties of *Z. japonica*.

Commercially Available Light Meter for determining DLI

It is important to remember that most, if not all, turfgrass species will perform best in full sun. Shade tolerance varie among species and cultivar and selecting the appropriate one for use is the first line of defense in managing healthy turfgrass in moderate to dense shade. Also, next time you see your shadow on the lawn, remember that the particles of sunlight hitting your back just traveled 93 million miles only to be obstructed from hitting your turfgrass in the last few feet thanks to you!

Casey Reynolds, PhD, is executive director of Turfgrass Producers International.

Citations

Bell, G.E., T.K. Danneberger, and M.J. McMahon. 2000. Spectral irradiance available for turfgrass growth in sun and shade. Crop Sci. 40:189–195.

Bunnell, B. T., L. B. McCarty, J. E. Faust, N. C. Rajapakse, and W. C. Bridges. 2005. Quantifying a daily light integral requirement of a 'TifEagle' bermudagrass golf green. Crop Sci. 45(2): p. 569-574.

Gardner, D. S. and R. M. Goss. 2013. Management of Turfgrass in Shade. P. 219-247. In. Stier et al. (ed.) Turfgrass: Biology, Use, and Management. Agron. Monogr. 56. ASA, CSSA, and SSSA. Madison, WI.

Glenn, B., J. Kruse, and J. B. Unruh. 2012. Daily light integral requirements for twelve warm-season turfgrasses. Int. Ann. Meet. p. 72111.

Korczynski, P.C., J. Logan, and J.E. Faust. Mapping Monthly Distribution of Daily Light Integrals across the Contiguous United States. HortTech. 12(1): 12-16.

Turgeon, A.J. 1995. Turfgrass Management. 4th ed. Prentice-Hall, Inc. Upper Saddle River, NJ.

Wherley, B.G., P. Skulkaew, A. Chandra, A.D. Genovesi, and M.C. Engelke. 2011. Low-input Performance of Zoysiagrass (Zoysia spp.) Cultivars Maintained under Dense Tree Shade. HortSci. 46(7):1033-1037.

Zhang, J., B. Gleen, J.B. Unruh, J. Kruse, K. Kenworthy, J. Erickson, D. Rowland, and L. Trenholm. 2017. Comparative performance and daily light integral requirements of warm-season turfgrasses in different seasons. Crop Sci. 57: 2273-2282.

Table 1. Relative shade tolerance of turfgrasses

Tolerance	Cool-season species	Warm-season species
Highly Shade Tolerant	Annual bluegrass Fine fescue Tall fescue	None
Shade Tolerant	Roughstalk bluegrass	Centipedegrass Seashore paspalum St. Augustinegrass Zoysiagrass
Shade Intolerant	Kentucky bluegrass	Bermudagrass
Highly Shade Intolerant	Creeping bentgrass Perennial ryegrass	Bahiagrass Buffalograss Carpetgrass

Gardner and Goss, 2013. Management of Turfgrass in Shade and Turgeon, 1995.

Table 2. Reported DLI values (mol m^{-2} d^{-1}) for various warm-season turfgrass species

Species/Cultivar	Spring/Fall	Summer
Tifeagle bermudagrass	n/a[1]	32.6
Tifway bermudagrass	17.4 – 18.6	21.4 – 22.4
Celebration bermudagrass	14.2 – 15.7	19.5 – 20.2
Tifgrand bermudagrass	13.9 – 15.4	18.6 – 20.9
Tifblair centipedegrass	13.4 – 14.7	13.3 – 14.7
Seadwarf seashore paspalum	11.1	13.0
Captiva St. Augustinegrass	10.8	10.6
Floratam St. Augustinegrass	10.8	11.5
Palisades zoysiagrass	10.5 – 11.3	10.9 – 11.3
Diamond zoysiagrass	10.1 – 11.1	11.0 – 11.1
Jamur zoysiagrass	9.7	9.9

[1] data not available
[2] Data compiled from Bunnell et al. (2005) Glenn et al. (2012) and Zhang et al. (2017)