

resistance. However, some turf managers object to the brown color of dormant Chisholm. The objective of this experiment was to determine if turfgrass colorants or overseeding could enhance winter color. Field studies were conducted in Manhattan and Haysville, KS from October 2012 to May 2013. Treatments included the colorants Green Lawngr and Ultradwarf Super, applied once (autumn) or twice (autumn plus mid-winter), annual ryegrass overseeding, a tall fescue control, and an untreated control. For the fall application, colorants were applied at a dilution rate of 1:6 (colorant:water) at 1225 L/ha on 21 October (turf 5-10% green) in Manhattan and 31 October in Haysville. Mid-winter applications were done on 23 January in Manhattan and 5 February in Haysville. Prior to overseeding, turf was vertically mowed, then seeded with annual ryegrass at 488 kg/ha on 28 September in Manhattan and on 11 October in Haysville. Visual color was rated weekly on a 1 to 9 scale in which 1 = straw brown; 6 = acceptable color, and 9 = dark green. A single application of Green Lawngr provided acceptable color for 14 weeks after treatment (WAT) at both sites. At 14 WAT, a second application resulted in acceptable turf color until spring green up in early May. Ultradwarf Super applied once provided acceptable color for 6 WAT in Manhattan and 10 WAT in Haysville, resulting in an 8 and 4 week period, respectively, of unacceptable color until the second application. Overseeding provided 4 weeks of acceptable color beginning 4 weeks after seeding in Manhattan, but color was not acceptable in Haysville. Chisholm color was enhanced with colorant application, which could make this cultivar more desirable. (Ross Braun, M.S. student, and Drs. Jack Fry, Megan Kennelly, Dale Bremer, and Jason Griffin).

Late-Season Bermudagrass Control with Glyphosate, Fluazifop and Mesotrione Combinations for Spring Renovation.

Common non-selective bermudagrass removal recommendations include multiple applications of glyphosate, while bermudagrass is actively growing. This application results in non-aesthetically pleasing and non-functional turfgrass throughout the summer. Turfgrass managers do not always have the opportunity for this application timing. Two research trials were initiated in Fall of 2013 in Manhattan, KS to determine non-selective bermudagrass control with glyphosate, fluazifop and mesotrione combinations prior to winter dormancy. Individual and all possible combinations of glyphosate, fluazifop and mesotrione applications were conducted October 9, 2014. Any treatment containing glyphosate resulted in <25% green cover 7 days after application. By October 31, 2013 all treatments including the non-treated resulted in <5% green cover. Final results could potentially provide new herbicide combinations for Fall bermudagrass control for Spring renovation. (Drs. Jared Hoyle and Cole Thompson)

‘Cody’ Buffalograss Tolerance to Combination Post-Emergence Herbicides. With the increase pressure to reduce irrigation on turfgrass systems, a low-input turfgrass species, buffalograss, has become more widely accepted in the Mid-West. Although, options for sedge, broadleaf, and grass weed control in buffalograss are limited and applications have previously resulted in unacceptable buffalograss injury. Experiments were conducted in 2013, in Haysville, KS to evaluate ‘Cody’ buffalograss tolerance to various broad-spectrum postemergent herbicides. ‘Cody’ buffalograss was maintained at 7.6 cm and irrigated as needed. Not all herbicides used in this study are labeled for use on

buffalograss. Rates of herbicides were either maximum labeled rate or maximum labeled rate for a labeled warm-season turfgrass. Herbicide treatments included Celsius, Katana, Q4Plus, Speed Zone, Surge, Trimec Classic, T-Zone, Drive XLR8, Battleship III, EndRun, Solitare, Dismiss, QuickSilver, Blindside, and SquareOne. Plots were treated with herbicides on July 1, 2013. No buffalograss injury was observed 7 DAT with Katana or QuickSilver. Slight buffalograss phytotoxicity (0 to 10%) was observed 7 days after treatment (DAT) on research plots treated with Celsius, Q4Plus, Surge, Drive XLR8, Solitare, Dismiss, Blindside, and SquareOne. Applications of Speed Zone, Trimec Classic, T-Zone, Battleship and EndRun resulted in > 14% buffalograss phytotoxicity. By 28 DAT all herbicide treatments excluding SpeedZone (< 10%) and T-Zone (< 5%), resulted in no buffalograss phytotoxicity. With the increasing use of buffalograss in low-input turfgrass systems, combination herbicides may cause slight injury but are a viable option for weed control. (Dr. Jared A. Hoyle)

Turf Paint and Glyphosate Application Timing Effects on Annual Bluegrass Control and Zoysiagrass Spring Green-up.

Turfgrass managers commonly apply glyphosate on dormant zoysiagrass to control winter annual weeds. More recently, turfgrass managers are using paints and pigments to color dormant zoysiagrass throughout the winter months. Glyphosate application on dormant zoysiagrass is well documented, but information about the interaction of glyphosate and paint applications is lacking. A field study was conducted to evaluate the effects of glyphosate and glyphosate + Endurant (Turfgrass Colorant) timing applications for annual bluegrass control and zoysiagrass spring green-up. Treatments included a non-treated, glyphosate and glyphosate + Endurant applications applied in November, December, January and February (9 total treatments). Initial results indicate that all glyphosate and glyphosate + Endurant applications, across all timings, reduced annual bluegrass populations. Previous research has shown that early applications of glyphosate on zoysiagrass when turf is not completely dormant can result in delayed spring green-up and injury. Initial zoysiagrass Spring green-up observations demonstrate that the addition of Endurant to glyphosate at early applications (November) may increase glyphosate safety on zoysiagrass. (Dr. Jared A. Hoyle and Mr. Jake Reeves)

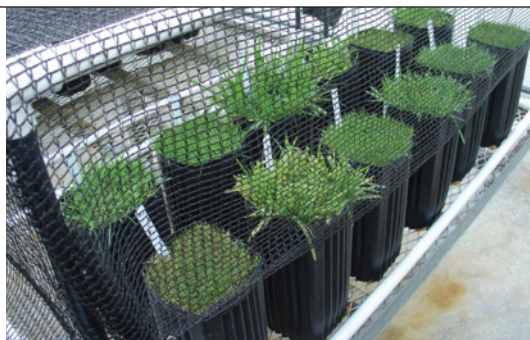
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Daily Light Integral Requirements for 12 Warm-Season Turfgrasses. This study was conducted by Brian Glenn and Jason Kruse, PhD, University of Florida, Gainesville; and J. Bryan Unruh, PhD, University of Florida, Jay, FL.

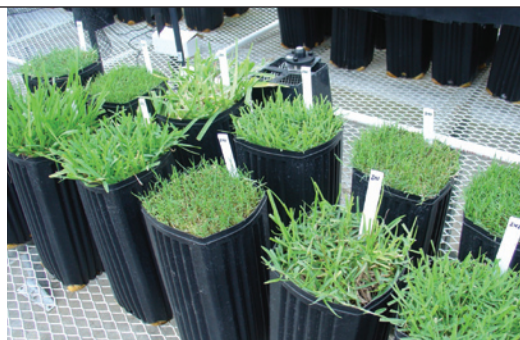
If you have it, shade can cause turfgrass maintenance challenges on athletic fields. After water, temperature, and nutrition requirements are met, light interception is the growth-limiting factor for turfgrass. In many cases, shade on athletic fields can be caused by stadium superstructure resulting in various microclimates on the field as the sun moves across the sky. Stadiums that may experience these areas are increasing, as many sports are trying to improve game-day comforts using air conditioning and retractable roofs. Shade can be even more detrimental when using warm-season turfgrass, which require more sun for optimal growth (Figure 1). As these turfgrasses sense cues



▲ **Figure 1.** Shade on bermudagrass



▲ **Figure 2.** Twelve warm-season turfgrass species under 30% shade



▲ **Figure 3.** Twelve warm-season turfgrass species

associate with lower light, they begin to react and try to “grow out” of shaded conditions. This is usually seen as elongated, thin leaves, and can lead to unsightly scalping. If light levels are not increased, turfgrass quality will eventually begin to decline.

Daily light integral, or DLI, is a method of measuring light that quantifies total light intensity accumulated during the course of a day. It is measured in moles of light per meter squared per day (mol/m²/day). In the past, light has been reported in hours of full sun or percent shade. These are often vague as incoming solar radiation changes periodically due to sun movement, cloud cover, and changing shadows caused by objects such as buildings and trees. DLI is a more precise method to evaluate available light in a given location on the field, as it takes into account the dynamic nature of shade.

To put DLI into perspective, the average summer ranges are 40-45 moles in the eastern U.S., and can get as high as 60 moles in parts of the southwestern US. These ranges can fall significantly during the winter months. In certain areas where warm-season turfgrass is grown year-round, ranges can drop to as low as 15 moles. If these levels are already marginal for growing a specific turfgrass in your area, reductions in light caused by shade can further impact turf quality and growth.

By using some light-monitoring equipment, turfgrass managers can easily determine exactly how much light is falling on a particular site. The question becomes, how can this information be used to make more informed decisions about turfgrass management from a species standpoint? We set out to determine threshold light levels using DLI to maintain quality turfgrass. We also wanted to see how much temperature impacted these DLI requirements, so that managers could determine if the amount of light measured was adequate for their turf, no matter the time of the year.

Greenhouse trials were conducted at the Turfgrass Envirotron at the University of Florida over 2 years to evaluate minimum DLI requirements to maintain acceptable turfgrass quality for twelve warm-season turfgrasses (Figure 2). Four treatments (0%, 30%, 60% and 90% shade) were used to develop a light gradient to determine the point at which turfgrass quality becomes unacceptable (Figure 3). These grasses were shaded for a period of two months. All treatments simulated either summer or winter average temperatures in south Florida (87 F and 74 F, respectively).

When DLI requirements were calculated after the trials were completed, there was a substantial difference between the summer and winter ranges (Table 1). The highest requirement from the grasses that were included was 22 moles, where that number dropped down to around 11 moles during lower temperatures. Turfgrasses in both

temperatures were actively growing, but the samples in the cooler environment seemed to tolerate shade better. The answer can most likely be attributed to lower energy demands on the turf with lower temperatures, allowing the plant to maintain quality without as much light.



▲ **Figure 4.** DLI100 Light Meter from Spectrum Technologies.

Many of the results when comparing grasses were expected based on past research and observations. Bermudagrass had the highest light requirements, while

the zoysiagrasses had the lowest. Some of the species that were selected for the studies are marketed for their “shade tolerance,” including Celebration and TifGrand bermudagrasses.

Now that we have an idea of the relative light requirements for different grasses, how can they be used? With the right tools, this information can help turfgrass managers establish a starting point when dealing with shade on their fields. One instrument that can be used is a small light sensor that measures DLI over a 24 hour period (Figure 4). After a few days of monitoring, the average DLI can be determined for the site. Multiple units can be used across a field if various microclimates exist. If the DLI is below the requirement for the given season and declines in turf quality have been observed, a different turfgrass species with a lower DLI requirement may be recommended.

These values are an approximation for each of the species tested, but different factors can potentially alter DLI requirements for a specific grass. Low mowing heights could lead to unacceptable turfgrass quality, even with an acceptable amount of light. Using a plant growth regulator (PGR) could lead to higher quality under lower light levels. Minimum acceptable quality may also not be acceptable on high profile sports turf, so these requirements may need to be adjusted according to expectations. When used for comparison purposes, these values can help managers determine if quality issues are a product of shade or if another possibility should be considered.

Research using DLI is ongoing, including determining the effect of different mowing heights on DLI requirements within the same species. New information using DLI could potentially help managers account for the effects of low light on turfgrass growth. Raising mowing heights, applying PGRs, and other cultural practices could be proactively altered to maximize turfgrass health and minimize negative effects due to shade and other reductions in light. ■