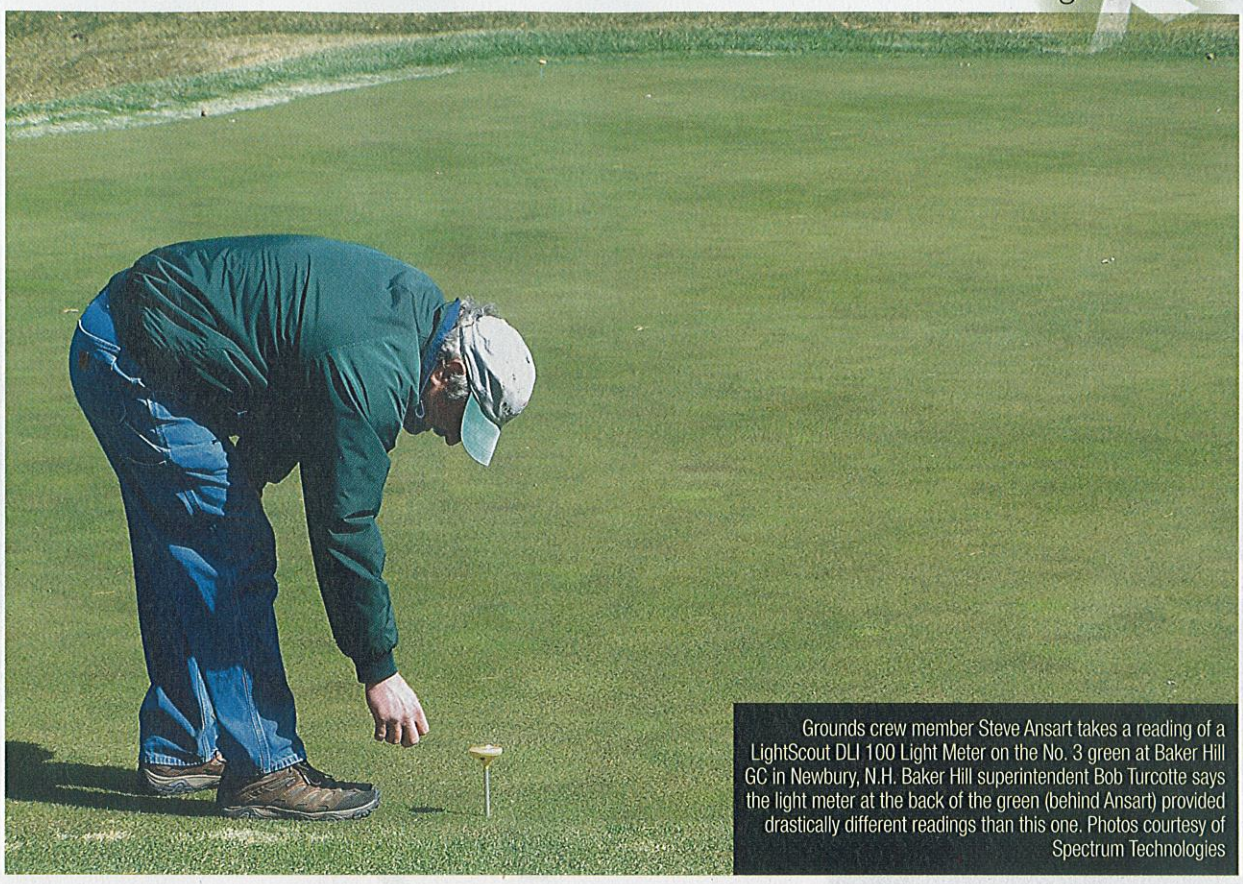


Grounds crew member Steve Ansart takes a reading of a LightScout DLI 100 Light Meter on the No. 3 green at Baker Hill GC in Newbury, N.H. Baker Hill superintendent Bob Turcotte says the light meter at the back of the green (behind Ansart) provided drastically different readings than this one. Photos courtesy of Spectrum Technologies

They see the light

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

Mark Leslie

Mankind has known that sunlight was a good thing for growing plants since before Noah built the ark, but just how much was good for which plants was open to unscientific interpretation.

Now researchers at the University of Florida are undertaking a study that will go well beyond giving superintendents vague turfgrass designations like "shade tolerant" and "full sun."

"I envision a chart that shows precisely the best DLI (daily light integral) value — not just for species of turfgrass, but for specific cultivars as well," says J. Bryan Unruh, Ph.D., whose team at UF is on the leading cusp of DLI research.

Such a chart would be a valuable tool for any superintendent overseeing construction of a new golf course or renovating greens, according to Todd Bunnell, Ph.D., whose research under Bert McCarty, Ph.D., at Clemson University in 2001-2002 broke new ground in this area.

"That's pure science," Bunnell — now the director of agronomy for ValleyCrest Golf Course Maintenance based in Carmel, Ind. — says of Unruh's current research. "The more you can quantify something and put a value on it, as far as sunlight requirements are concerned, the better off we will be. It will allow us to better plan and better build golf courses so we're not setting ourselves up for failure."

Speaking of Bunnell's and McCarty's research, which was a springboard for Unruh's, the USGA's Green Section director for the Southeast Region, Patrick O'Brien, says, "Bert and

LightScout DLI 100s — installed in full sun, partial sun and shade — simplify the process of monitoring greens over a 24-hour period.

Todd are rock stars for what they did. In my 35 years with the USGA, it is one of the best research projects providing valuable information."

DLI research and the resulting technology are finding support from superintendents as well.

"It's a wonderful idea," says Dan Dinelli, CGCS, superintendent at North Shore Country Club in Glenview, Ill., and a 30-year member of GCSAA. "Suppose you have a problem green. Usually it involves drainage, air movement or sunlight — one, two or all three of those elements. Imagine having the power to get DLI readings on that green, and discovering you're getting X but need Y."

Mark Hoban, GCSAA Class A superintendent at Rivermont Country Club in John's Creek, Ga., and a 35-year association member, agrees: "It's a great system, and for scientific work that's the way to go. For the general superintendent who wants to spot-check his light conditions, it's a great tool… That's what we need: a quantitative analysis. It's the next thing needed when people are cutting down trees right and left."

Hoban adds that he borrowed a more expensive weather station/data logger (WatchDog, Spectrum Technologies) from Earl Elsner, Ph.D., at the University of Georgia to provide "real proof" of the turfgrass problems he faced.

Bob Turcotte is using Spectrum Technologies' more affordable LightScout units as an "educational tool" at Baker Hill Golf Club in Newbury, N.H., where he is the GCSAA Class A superintendent.

"We put them on a green in the open, another on a shaded green, and the golfers can note the difference between the two in the course of a day," Turcotte says. "Then you can talk to members about playability of the golf holes: that shady greens don't dry out as fast, so they're slower and hold water more as opposed to greens that are high and dry."

Daily light integral (DLI): The number of moles of photosynthetically active radiation (PAR) per square meter per day.

Proving ground

Unruh, colleague Jason Kruse, Ph.D., and graduate student Brian Glenn are running three cycles of tests this year to account for varied photo periods and day lengths, in what Unruh calls "cutting-edge research, none of which has been done before on turf."

After the studies, Unruh and colleagues expect to produce precise DLI information for:

- Tifway, TifGrand and Celebration bermudagrasses
- Palisades, JaMur, PristineFlora and Diamond zoysiagrasses
- SeaDwarf seashore paspalum
- Floratam and Captiva St. Augustinegrasses
- TifBlair centipedegrass
- Argentine bahiagrass.

Using Spectrum Technologies' LightScout DLI 100 Light Meters and LightScout External Light Sensor Readers, Unruh is fully armed for his research.

While Bunnell, working without light meters, was able to dispel the myth that morning sunlight was more intense and thus more important than afternoon sunlight, Unruh is already establishing facts that superintendents can put to use.

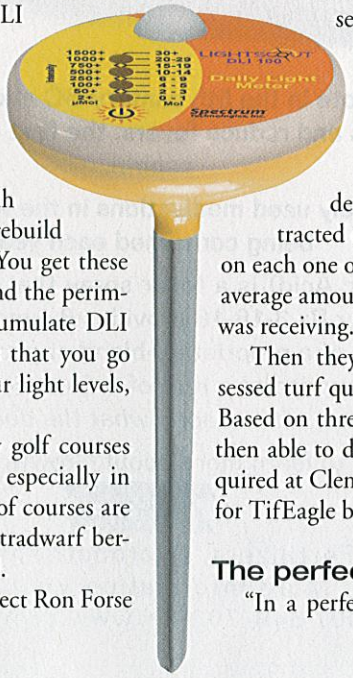
Such as, Unruh says, "Florida is called the Sunshine State, but we're not. Once we started charting solar radiation, we found (Florida) actually has low levels of solar radiation, especially in the fall. For instance, storm season has a lot of cloud cover and haze, causing Florida's light levels to plummet.

"People use the term 'shade.' But my real concern is low light," Unruh continues. "It's low light because there is less solar radiation impacting the earth because of cloud cover or water vapor."

For example, he says, "Celebration and TifGrand bermudagrasses are both marketed as 'shade-tolerant.' But there is something going on in these cultivars, which require less light or are more efficient at using the light that they receive. That's where I see this research going.

"We can open up a tree canopy by thinning or get rid of trees and do those kinds of things to keep from obstructing the light that's coming down. The other side of the equation is selecting grasses that are appropriate to the DLI levels of your particular situation."

Unruh and his colleagues are "ground-proofing" the DLI turfgrass chart that will show superintendents what grasses they should use. They are mounting DLI 100 meters and PAR pyranometer sensors inside putting-green cups, capping them with specially made acrylic lids and placing them in putting greens where they will accumulate light over time.



"You know your current conditions," Unruh says. "The trees are there. You're going to rebuild your green. What grass should you choose? You get these gizmos, which are cheap, and put them around the perimeter of your greens, then allow them to accumulate DLI readings. What I can ultimately envision is that you go to our table of DLI values and, based on your light levels, choose what cultivar should do best."

This research is perfect timing for many golf courses around the country facing renovations, and especially in the Southeast, where O'Brien says a number of courses are switching from bentgrass to some type of ultradwarf bermudagrass, which does not tolerate shade well.

"Thumbs-up, baby," says golf course architect Ron Forse of Forse Design in Hopwood, Pa., when hearing of Unruh's research. "That type of information is crucial. We're using the same species, but specifically knowing the best cultivar will be very helpful. If there is a distinct difference in the DLI, we can hone in on whether a tree has to go, or if we can use an attractive specimen."

Bunnell says that when he performed his research 10 years ago, many courses in the Carolinas were 10 to 20 years old.

"They were not originally designed for trees to be 50 feet tall next to the green. The golf courses had outgrown themselves," he explains. "The result is that a lot of shade is being cast down on these bermudagrass putting greens, and inherently bermudagrass has very, very little shade-tolerance. It requires a high-intensity sunlight throughout the day, especially during the growing season. And if it doesn't get that — when it is being mowed very low or getting a lot of traffic — it's going to decline. Basically the plant is going to use more carbohydrates than it will produce because it has a lower amount of sunlight than required to maintain its growth."

Bright enough

Bunnell and McCarty proved the importance of DLI data, opening the door for Unruh's research.

For instance, Bunnell recalls presenting his research at a field day where superintendent Gary Snyder of Harbour Town Golf Links on Hilton Head Island, S.C., was in attendance.

Snyder, a 34-year GCSAA member who is now retired, had been struggling with a few greens over a couple of years and recognized it was likely a shade issue. The prevailing wisdom at the time was that morning sun was more intense than afternoon sun, so he was ready to cut down the trees causing morning shade. But after hearing Bunnell's talk, Snyder cut down the afternoon shade trees, and within months the problem green began to turn around.

"That was the first validating data point that our research could help golf course superintendents," Bunnell says.

Bunnell and McCarty's second objective was to determine how much sunlight a green needs.

"We took that same study and through determination of a daily light integral that subtracted out the amount of shade that was being cast on each one of those greens, we were able to determine the average amount of moles of sunlight per day that each plot was receiving."

Then they correlated carbohydrates and visually assessed turf quality versus the amount of sunlight received. Based on threshold levels and mean separation, they were then able to determine that 32.6 moles of sunlight are required at Clemson to maintain acceptable turfgrass quality for TifEagle bermudagrass.

The perfect world

"In a perfect world," Bunnell said, "we could do Tif-

dwarf, Champion and other cultivars, but due to research restraints, we were only able to do TifEagle."

Now, it appears, that "perfect world" has arrived. At least that is Unruh's objective at the University of Florida.

Unruh's impetus for such a study began 16 years ago when he joined the faculty at UF.

"You think of Florida and heat and sunlight and it being perfect for growing bermudagrass," he says. "Every year in the dog days of summer our greens (in Florida) plummet. Turf health goes down. When I got here we'd get letters saying, 'Don't fire your superintendent. Bermudagrass decline season is upon us.' So we delved into different things that plague grasses, and low light started to be implicated in some of these diseases. I started to talk with experts in California and then with (Spectrum Technologies President) Mike Thurow.

"In the back of my mind it was not the shade, but low light conditions that stood out," Unruh continues. "It's long been a nagging interest of mine."

Unruh finally reached a tipping point and has assembled the team to tackle the challenge of understanding DLI requirements of warm-season turfgrasses.

Whereas Spectrum Technologies displays a chart in its catalog showing "Generalized Plant Responses to Different Light Levels" — 2-5 DLI being "very low," 5-10 DLI "low," 10-20 DLI "medium," 20-30 DLI "high" and 30-60 DLI "very high" — Unruh is excited about getting scientifically precise.

"Most of the time in the landscape and golf industries, we say we basically need eight hours of sunlight," he says. "But what is eight hours of sunlight? That's not a quantifiable number. If the sun comes up at 6 a.m. and goes down at 7 p.m., that's 13 hours of sunlight so everything should be great. But it's not as intense in the morning and it's not as intense in the evening. Between 10 and 2 it's much more intense. As the plant sees the light, it starts to accumulate the photons to convert into energy, and more and more as the day grows long there is less and less light.

"DLI is basically quantifying that entire period of time where light is being accumulated by the plant."

Besides producing his turfgrass DLI chart, Unruh's team is also assessing the LightScout DLI 100 meters — "because they're cheap ($59 apiece, or three for $169) and superintendents could afford to use them" — and exploring the influence of shade duration on turfgrass morphology, that is, how the grass is growing.

"For example," he says, "Dr. Richard White at Texas A&M had a graduate student doing a project in a growth chamber. They used plugs of bermudagrass, the same cultivar, two different temperature regimes under one-third sunlight. If I were to show you the pictures, one of the plugs looks like you just pulled it out of the green; the other looks like a bad hair day. What happened is, as plants reach for the light, their morphological structure changes; they adapt. The main implications are basically the grasses get spindly. So if you have a green with the back in shade and the front in full sunlight and you get into the cooler time of the year, the morphology gets altered. The mower traverses the green at the same cutting height.