Putting the pixels together in turfgrass management

Editor's note: *This article was written by an employee of TurfScout*


Photo courtesy of TurfScout®

Wilbur Wright pioneered the art of aerial photography shortly after the first airplane flight. What began as a fascination with capturing events, landscapes and architecture paved the way for the science of satellite imaging and remote sensing. Simply put, remote sensing is the act of measuring characteristics of an object without coming into contact with that object. In turfgrass, characteristics measured with remote sensing can be a tremendous asset for: stress detection, monitoring recovery, precision turf management, and irrigation efficiency, to name just a few.

The old adage, "A picture is worth a thousand words," falls short here; remote sensing on turfgrass "Speaks volumes."

How can a camera or sensor measure turf quality and more importantly, how can it "see" what turfgrass managers can't? The amount of light reflected from a surface tells us something about that surface. As different environmental conditions affect a turfgrass (water stress, nutrient deficiency or disease, for example), rapid and predictable changes occur at the cellular level that impact how the plant tissue reflects light. In turf, (and most plants), red and blue light are absorbed for photosynthesis. Healthy turf will absorb more red and blue light than unhealthy turf. In near-infrared wavelengths, healthy turf is highly reflective and would appear very "bright" to the human eye, if we could see in that region of the light spectrum. In other words, a *decrease* in near-infrared reflectance signals stress while an *increase* signals recovery or improvement in turf quality. This technology has recently garnered the attention of the turfgrass community, but the science behind the sensor dates back to 1950s and has been extensively researched in the agricultural community since the early 1970s.

Over the last decade, the research community has investigated the role of remote sensing in turfgrass. A driving force behind the research has been the ever present demand for a more efficient, conservation-conscious and resource-savvy approach to managing turfgrass. Research shows visible and near-infrared reflectance is sensitive to water stress, nutrient deficiency, disease pressure, and mowing height, for example. As mobile sensors that are easily mounted on mowers or carts are coming to market, the transition from cutting edge technological developments to practical turfgrass solutions has become a reality.

TurfScout is already delivering remote sensing to the turfgrass industry. The company processes raw light reflectance and GPS data to create maps and charts of turf quality designed to help turf managers improve quality, prevent problems and save money. The set-up is nearly

How refueling propane-powered equipment works

MORE THAN TWO DOZEN MODELS of propane-fueled commercial lawn mowers are available from brands well known to sports turf managers. Propane-fueled mowers reduce greenhouse gas emissions by almost 50% and carbon monoxide emissions by more than 80% compared with gasoline mowers.

Refueling is easy thanks to a proven model adopted from another market: the forklift industry. This mature business model applies the exact same methodology to the propane-fueled commercial mower market. Propane providers replace empty cylinders with full counterparts through a just-in-time inventory schedule that meets a sports turf manager's needs, ensuring that a propane mower fleet will never have too much or not enough fuel on hand.

Cylinder exchange programs usually include installation of a storage cage in a centrally located spot that is easily accessible to personnel. When a mower cylinder is empty, appropriately trained personnel can access the cage and refuel their mower in a matter of minutes by removing the empty cylinder and installing a full replacement from the cage, using all relevant safety measures and personal protective equipment.

In addition to on-site refueling, there are currently thousands of propane refueling stations across the country with locations in every state.

For fleets that require a large propane volume, a propane provider can install a no-spill dispenser on-site that turf managers can use to refuel empty mower cylinders, as well as tanks for vehicles fueled by propane autogas. Depending on storage necessity, longevity, and available space, this on-site refueling infrastructure includes underground or above ground storage tanks for longer-term use. After installing the dispenser, propane providers facilitate training on how to safely refill both propane cylinders and propane autogas vehicles.

In addition to on-site refueling, there are currently thousands of propane refueling stations across the country with locations in every state. To learn more about propane-fueled commercial lawn mowers, vehicles fueled by propane autogas, and available refueling options, visit www.poweredbypropane.org. *-Brian Feehan, VP, Propane Education & Research Council* ■


>> PROPANE CYLINDERS are typically installed horizontally on a mower, and are either located in the mower's rear, or on the sides, as shown here.

turnkey, and making maps is as easy as downloading photos from your digital camera. Our team has automated the science of making "Smart Maps and Charts." Smart Maps and Charts of turf quality are available almost immediately from our website. Without being an expert in mapping or remote sensing technology, the turfgrass manager or consultant can now use objective measurements of turf quality, and the "big picture" view of Smart Maps, to refine inputs, such as water, nutrients and pesticides, evaluate turfgrass response and recovery, streamline resources and labor, and take action before a problem has taken the turf.

Ongoing turf breeding research at the University of Georgia's Tifton campus has been geared toward the identification of more stress tolerant grasses for the future. "Preliminary results of a 48-day drought study during 2010 indicate that spectral reflectance data collected by TurfScout correlate very well with traditional visual ratings of turfgrass quality, as well as with newer methods of estimated % green cover using digital image analysis," says Brian Schwartz, PhD. Schwartz says the only difference between these techniques to date has been that spectral reflectance data is predicting the visual assessments by about 3 days. For Schwartz's turfgrass breeding program, this means that he can effectively identify drought tolerant genotypes in the field using quantitative data taken by workers without years of training and experience with visual ratings. For the turfgrass manager, it could allow the detection of stressed areas well in advance of visual symptoms, thereby giving them a chance to apply treatments before anyone else ever knew there was a problem.

You also can track and manage disease control and nutrient management with Smart Maps. How effective is your program? Did a particular product prevent otherwise inevitable stress? Or did the product speed recovery time? Dave Spak, PhD, with Bayer Environmental Science is currently using reflectance data as a component of their Plant Health Initiative. Spak says, "Measuring plant health through radiometry has become a routine evaluation in many of our product programs, particularly our fungicide program. Although we still rely on human element and visual evaluations, this technology takes the subjectivity out of quality evaluations. Also, the technology has the ability to detect plant stresses that may not be visible to the naked eye.

Lastly, use of GPS and TurfScout allows us to rapidly process and manage the huge volumes of data which was a major hurdle in the adoption process. As we are still learning how to use this tool, we expect the innovation in the area of remote sensing in plant research will continue to evolve."

In another example, Harsco Minerals, manufacturer of specialty micronutrient fertilizer Excellerator, decided to look at this technology in conjunction with TurfScout as a way to capture reflectance as an indirect indicator of turf quality following Excellerator applications to three golf course greens. "We were happy to find that the reflectance data revealed clear areas of turf response to Excellerator-treated areas compared to areas on the same green not receiving treatment. We were able to see the hidden beneficial effects on turfgrass such as significant improvement in root growth. We also saw enhanced turf health from Excellerator applications that may go unnoticed by the naked eye," says Marty Campfield, global product manager. "Having been involved with GPS and GIS for many years, it seems clear that the marriage of these technologies has created an innovative approach to capturing on-the-go reflectance data."

Because sensors can be mounted on a mower or cart, mapping may be integrated into routine operations and Smart Maps available in minutes. The application of this kind of approach spans both research and golf course management. Bruce Martin, Ph.D. at Clemson University is currently using Smart Maps and Charts to support his research program and evaluate turfgrass management strategies. "TurfScout has created a very convenient way to couple objective reflectance data, such as NDVI and RVI measurements [both are near-infrared and red reflectance indices], with precision GPS to create maps, manage data and provide a near real-time evaluation of experiments in progress. I think the data and their programs for data management enhance and help to validate our more subjective ratings. Both are needed, along with 'ground-truth' measurements and examinations of stressed turf to provide a good evaluation of turf management strategies," says Martin. ■

Dana Sullivan, Ph.D. has more than 10 years experience in precision agriculture and remotely sensed data analysis.