plants. Topdressing also gives an opportunity to level the surface of a playing field. The material used during topdressing should be chemically and physically very similar to the existing soil unless the intent is to modify the soil texture.

6. Overseeding

Overseeding into thin turf or small patches of bare soil can be done in late winter, spring or early fall. When overseeding, it is especially important that the seed comes in contact with the soil and has space to germinate. Perennial ryegrass overseeded at the rate of 4 - 6 kg/100 m^2 serves very well. Perennial rye is a quick germinating variety that can tolerate enough wear to be effective on an athletic field.

7. Playing Surface

I have been asked many times at different athletic field maintenance seminars if I would do a quick demonstration on "puddle repair." My answer has always been the same, "NO." We cannot fix puddles; we fix low spots in our playing surface by constantly working the skinned portion of a softball or baseball field. Working with our favorite leveling drag we need to constantly be working the skin in all directions to maintain a playing surface that will not form low spots.

8. Transition Areas

The appearance of the transition areas can make your field look like a million bucks or a million ducks, depending on the care. These areas, where the grass and skin areas on a baseball or softball field meet, where players run on and off of the field, or athletes always walk to and from the practice field, can really make or break the appearance, safety and playability of a field. We need to continually work to keep these areas from forming lips, dips and safety hazards on our playing fields.

9. Communications

Wait, the title of this article is "Eight Steps to an Easy Field Facelift" not nine steps. Well, like Garth Brooks sings in his song "Friends in Low Places", I was going home one night and thought to myself, Jeff, is that really the way that article should end? No, so I wrote another step, just as Garth wrote another verse.

Even if we know everything there is to know about the first eight steps of a field facelift, no one will understand them if we do not follow step nine. We have to let people around us, our bosses, supervisors, coaches, players, volunteer parents and school administrators know what we know. Not only what we need for a safer and more playable field, but also why we need it. Our job as sports turf managers is to maintain fields; their job is to do something else. We need to communicate our needs and our reasons for our needs so that they better understand the importance of the first eight steps.

If we adopt these nine steps, and formulate a game plan for our fields, these steps will have spectators saying, "How did they do that?" •

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[1] Turfgrass Fertilization; A Basic Guide for Professional Turfgrass Managers, Peter Landschoot, Assoc. Professor of Turfgrass Science, the Pennsylvania State University, 2003.

Using Canopy Reflectance Tools in Turfgrass Management

Dr. Ken Carey, *Department of Plant Agriculture, University of Guelph*

Background

Turfgrass managers can tell a lot about turf just by looking at it – and the more experienced they are, the better their judgement. Nutrient status, pest damage, abiotic stresses (drought, traffic, etc.) are all visible to the trained eye. Sometimes, however, it's good to have some tools to help – the highly trained manager may not be available to see everything, or the problem may produce very subtle effects. This article discusses some recent innovations in assessing turfgrass, developed and widely used in turf research, which might be useful to the turfgrass manager.

What we see when we look at a turfgrass sward could be termed "canopy reflectance" – it's just the ambient sunlight reflected off the leaves in the full visible light spectrum. A trained researcher or turfgrass manager learns to record and interpret the details of what they see, whether it's the off colour of nutrient deficiency or spray damage, or the darkening of drought stress. However, both in research and in practical management situations, we work with less well-trained helpers, and will benefit from techniques that remove the subjectivity and observer bias, and reduce the need for training.

One very familiar tool is a camera, and with improved digital cameras this is a very useful adjunct to assessing problems. However, even though they can form an important permanent record, the digital photos still need to be interpreted. Researchers are working on improving software to analyze digital images to document and quantify turf characteristics (weed and disease infestation, drought and nutrient stress), but these full spectrum techniques are still relatively early in development for widespread turf use.

A more mature, and somewhat simpler, technology for assessing turf involves restricting the wavelengths observed to ones that we have learned through experience are indicative of turfgrass problems. Photosynthesis in plants involves chlorophyll absorbing light to power the plant, and the wavelengths that chlorophyll absorbs are a subset of the sunlight hitting the plant (Figure 1). Light that chlorophyll absorbs is not reflected, and the light hitting the plant looks different from that reflected. Of the visible wavelengths, chlorophyll absorbs red light, generally, so the light reflected is white minus red = green. The wavelengths that chlorophyll absorbs are often termed photosynthetically active radiation or PAR.

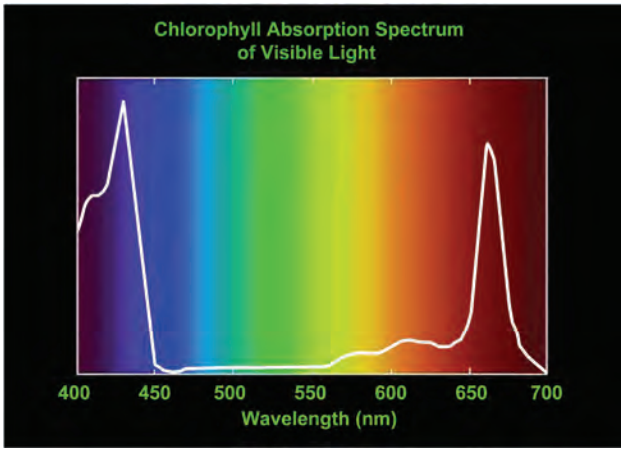

Figure 1. The peaks show the wavelengths of visible light that are absorbed by chlorophyll (Photosynthetically active radiation).

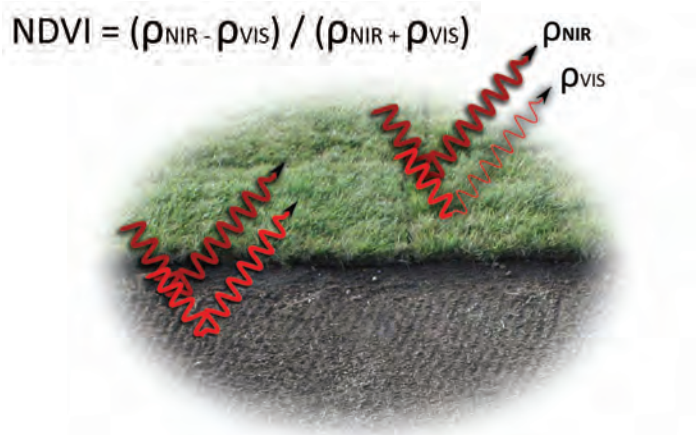

Figure 2. Measurement (pVIS) and reference (pNIR) waves of light reflecting off bare soil and turf.

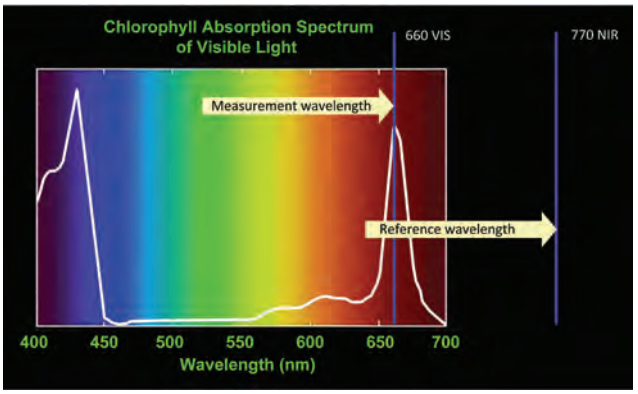

Figure 3. Measurement (660 nm) and reference (770 nm) wavelengths used by the Greenseeker to calculate NDVI.

Various sensors have been developed which all function in a similar fashion, comparing the reflectance off a surface (e.g. turf) of a wavelength that chlorophyll absorbs (measurement wavelength), with one that chlorophyll does not absorb (reference wavelength). Figure 2 shows light reflecting from turf and bare soil. The longer (reference) wavelength is not absorbed by chlorophyll and is reflected equally from both surfaces; the shorter (measurement) wavelength is partly absorbed by the plant, and the reflected amount is reduced. Usually the measurement wavelength used is in the red (visible) part of the spectrum and the reference in the near-infrared (Figure 3). Canopy reflectance sensors like this will report/record an index which is usually of the form (ρNIR - ρVIS) / (ρNIR + ρVIS). Rho (ρ) is the reflectance, and you can see from the formula that when there is no absorbance by chlorophyll (ρNIR = ρVIS) the top of the ratio is zero, and the index is zero. When all of the measurement wavelength is absorbed (ρVIS = 0), the ratio becomes ρNIR / ρNIR or 1. Some sensor systems, like the Greenseeker (Figure 4), will report an index between 0 and 1 (sometimes called the normalized-difference vegetation index, or NDVI), others like the Spectrum FieldScout (Figure 5) multiply the index and report a value between 0 and 1000 (chlorophyll index).

Canopy reflectance in turf management

The key feature of canopy reflectance indices like NDVI and the chlorophyll index is that the values observed in turfgrass are very sensitive to a multitude of things of interest to a turf manager. Changes in nutrient status, moisture status, traffic, insects, disease, rootzone problems, and other biotic and abiotic stresses can all produce subtle shifts in canopy reflectance, some of which are even undetectable by a trained human eye.

Canopy reflectance, especially as it is affected by nutrient status, has become an important tool in precision agriculture, where maximizing yields and optimizing fertilizer inputs is tied to systems that measure reflectance. The uses in turfgrass

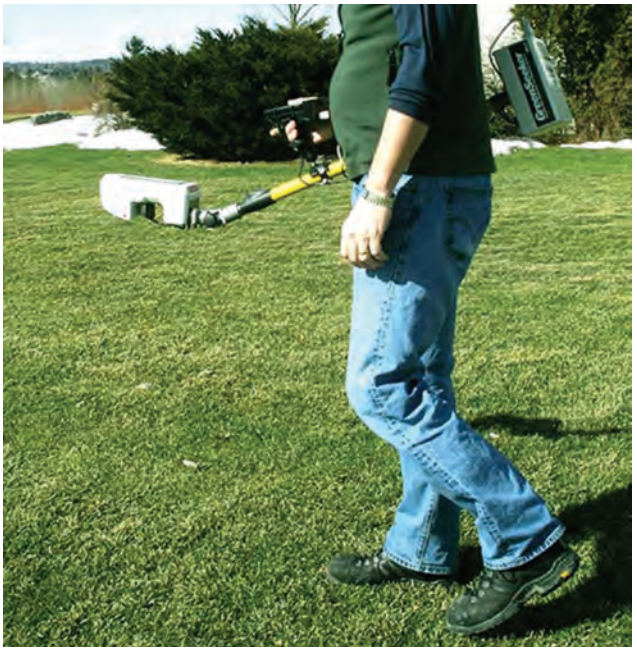

Figure 4. Greenseeker canopy reflectance sensor system.

Figure 5. Spectrum FieldScout chlorophyll meter.

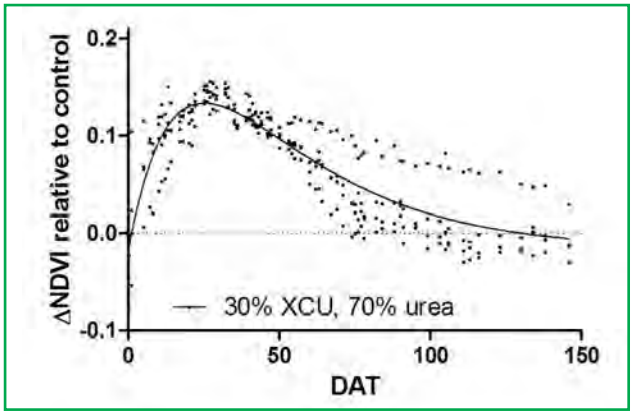

Figure 6. Change in canopy reflectance following a single application of slow-release nitrogen fertilizer (points represent data from four replicate plots; the line is the best fit release curve; DAT = days after treatment).

Figure 7. Cover development in turf trial.

management will likely be more complex as they develop, since yield and nutrient stress are only a small part of the stresses that turf experiences. For example, research is currently being done to examine the potential in water management [Crum et al. 2010. Crop Science 50:301-315.], but most of the current use is in turf research.

A few examples of the power and sensitivity of the system will, we hope, convince you that it is a technique to watch. The more the system is used in research, the faster the applications to the real world will be developed.

Fertilizer performance and release characteristics

Figure 6 shows a sample of data collected from recent fertilizer performance trials at the Guelph Turfgrass Institute (GTI). The points show the change in NDVI as a fertilizer application at day 0 gradually releases and increases the absorption of PAR to the maximum at ~25 days after treatment, then gradually declines as the fertilizer runs out at ~100 days. Using these techniques we can help fine tune release characteristics of fertilizers, but the same data could help a turf manager track nutrient status.

Germination, establishment and cover development in turf

Canopy reflectance can be used to track the establishment of newly seeded turf. In research trials, we can use this to assess different cultivars, blends and mixtures, or different management techniques in establishment. Figure 7 shows cover development in a recent trial at the GTI, and Figure 8 shows the change in canopy reflectance in one of the entries over the first 26 days after seeding. Figure 9 shows data from an earlier trial, in this case using the chlorophyll index rather than NDVI. Sixteen Kentucky bluegrass cultivars show clear differences in speed of establishment as measured by canopy reflectance.

Drought stress, water use and localized dry spot

Figure 10 shows localized dry spot and treatment effects of wetting agents in a recent trial. If we look at the canopy reflectance and independent assessments of soil moisture (Figure 11) and localized dry spot (Figure 12), the potential of canopy reflectance to detect and help manage water problems is clear. We have also used the technique in assessing the

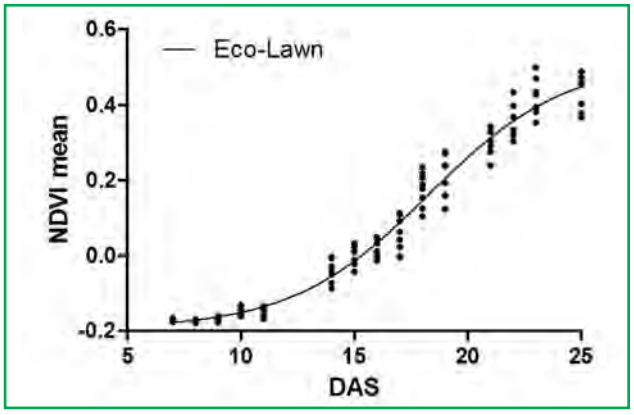

Figure 8. Increase in canopy reflectance with germination and cover development in seeded turf.

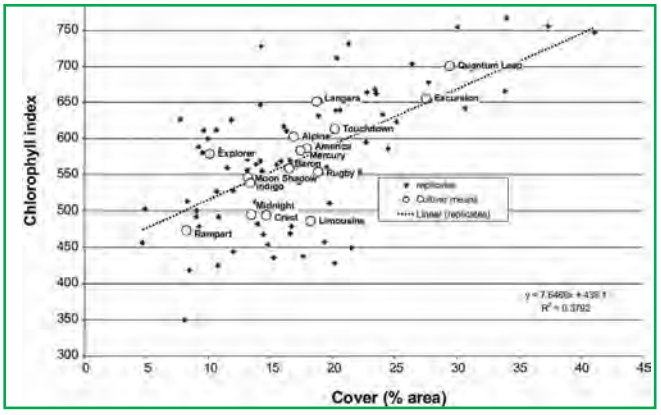

Figure 9. Association between grass cover and canopy reflectance (chlorophyll index) in Kentucky bluegrass cultivars.

Figure 10. Localized dry spot in bentgrass turf; some plots are treated with wetting agents.

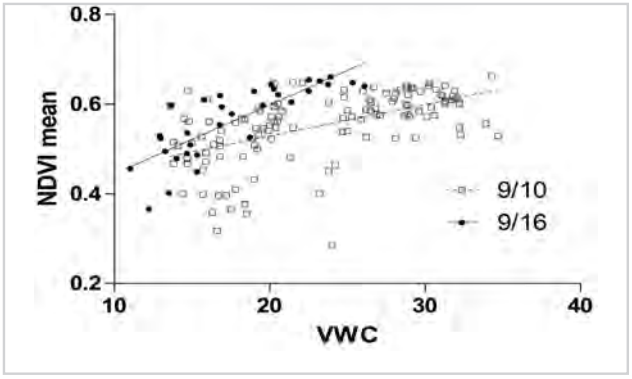

Figure 11. Association between soil moisture (volumetric water content – VWC) and canopy reflectance in wetting agent trial.

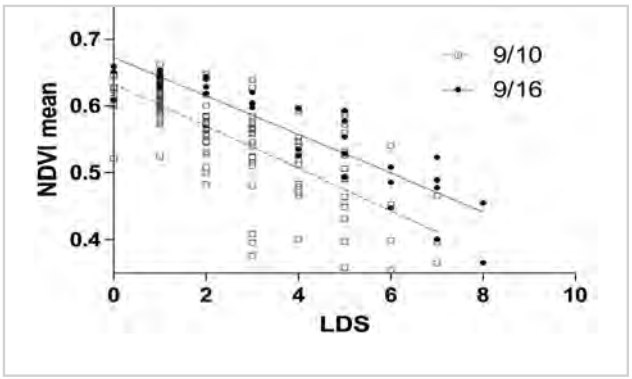

Figure 12. Association between localized dry spot (rated visually) and canopy reflectance in wetting agent trial.

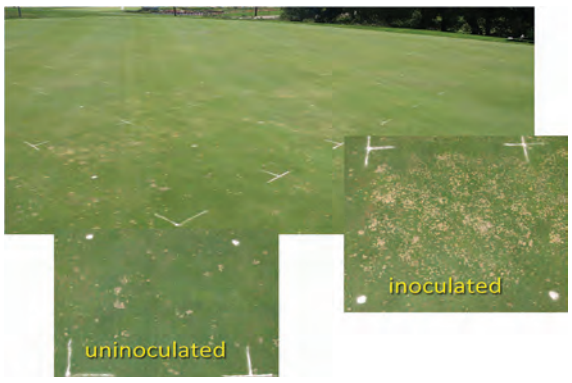

Figure 13. Dollar spot disease on inoculated and uninoculated plots.

effectiveness of different irrigation regimes in establishing turf from dry seeding, hydroseeding, and sod.

Other biotic and abiotic stresses

As mentioned above, many stresses that affect turfgrass will be detectable in changes in canopy reflectance. We routinely use the technique in assessing trials involving dollar spot disease, for example. Figure 13 shows symptoms of dollar spot as they develop in a recent trial, and Figure 14 shows how the disease pressure shows up in the canopy reflectance data.

What's needed before the tools are widely used by turf managers?

Experience – we need to have a better grasp of how the numbers change across species, management conditions, etc. It is a very young technique outside of research applications.

Calibration – the sensitivity of the tool to so many factors means that in order to isolate effects of interest, we need to learn to calibrate to remove extraneous noise (we use untreated control plots in research, and similar techniques can be used in management).

History – the more the tools are used on a particular turf area, the better the information. The advantage of these tools is that they automatically record and time-stamp the information, and if so-equipped will even record GPS information.

More computer tools – recording, analysing, and interpreting canopy reflectance data is dependent on computer software and training. At the moment the tools are research tools; widespread use of the techniques in industry will require computer tools that assist in the analysis and interpretation.

The tools and techniques are powerful, the equipment is easy to use and becoming more and more affordable all the time (currently low four figures for the equipment we use in research), and worth keeping an eye on if you're a turfgrass manager. Someday in the not too distant future you may be sending your crew out to take routine canopy reflectance readings of your turf, and using the data to make your job easier. •

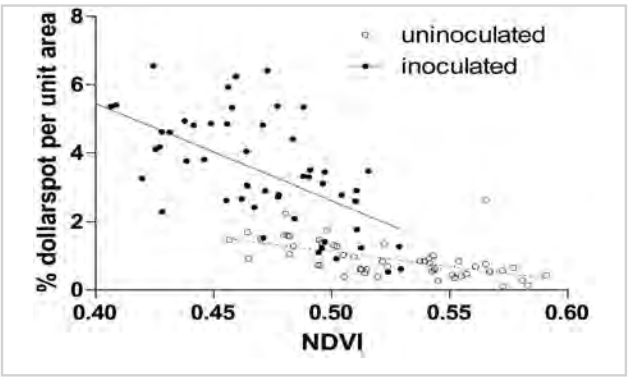

Figure 14. Association between canopy reflectance and dollar spot disease levels in trial plots.

Inaugural Field Day Langley, BC

Langley Events Centre and Willoughby Community Park

There was certainly a lot of hubbub surrounding the inaugural West Coast Sports Field Training Day hosted by WCTA Past President/STA Director and Manager of Parks Operations for the Township of Langley, Tab Buckner. Judging by the email and phone inquiries received by the Western Canada Turfgrass Association office, a lot of people were pleasantly surprised to learn a summertime event with education and a supplier trade show was being planned.

When the day was done, 106 delegates, 22 vendors, 5 demonstration station exhibitors and 2 world class speakers took part in the Sports Turf Association sanctioned event held August 29 at the Langley Events Centre and Willoughby Community Park in Langley, British Columbia.

This rain or shine indoor/outdoor event was modelled after the STA Field Day, the day-long educational forum and tradeshow held annually in Ontario for 26 years, and also in 2011 and 2013, where efforts to support Atlantic sports turf managers saw the STA deliver additional field days in Moncton, New Brunswick and Halifax, Nova Scotia respectively.

"We were excited to work with Tab Buckner on the first ever West Coast Training Day," commented Lee Huether, Executive Manger of the STA. "Our partnership with the WCTA has paved the way for events like this to take place and we're closer to achieving our goal of supporting sports turf managers from coast to coast."

The training day was designed for participation by all levels of sports turf management personnel; the formula included education, networking opportunities, a chance to visit suppliers at the outdoor tradeshow, live demonstrations and hands on equipment testing.

"It's been a long time since we've done any sort of field day," stated WCTA Executive Director Jerry Rousseau, "and while we've been involved with a lot of great golf events over the years, we've never done something of this scale for our sports turf members."

"At the end of the day we accomplished our goal of providing a low-cost, high quality education opportunity for our membership," said Tab Buckner. "We're calling the day a huge success and really want to thank all our sponsors, tradeshow vendors, speakers and of course everyone who attended for making it possible. I especially want to thank TOL Parks Department staff for getting things done and the Township of Langley itself for allowing this event to be hosted here."

Kwantlen University Turf Management Instructor Stan Kazymerchyk (L) welcomes speaker Mark Lucas from the University of California

Tab Buckner gives the signal for groups to move to the next demo station

Tradeshow Vendors

Photos © Jerry Rousseau, Western Canada Turfgrass Association

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26th Annual Field Day Mississauga, ON

Speakers (L-R)Eric Lyons, Sean Jordan and Jeff Fowler

Jeff Fowler, Penn State Cooperative Extension, took participants from the classroom to the field

With the arrival of October we have reached the end of both summer and the STA field day season.

We began in June on the east coast in Halifax Regional Municipality, travelled to the Township of Langley in August and returned to the City of Mississauga for the 26th annual event on September 19th.

At this final field day, a fixture on the turfgrass calendar for over a quarter-century, we welcomed more than 200 participants from Ontario's sports turf and turfgrass sector to the Mississauga Valley Community Centre and Park.

We thank our respected speakers for sharing with us their knowledge and expertise – watch for their articles in this and future editions of the Sports Turf Manager; our sponsors and exhibitors who lend their generous support, participation and are an integral part of the learning experience; and the City of Mississauga and all the parks and facilities personnel who assisted. We know just what is involved in hosting this event, be it in Nova Scotia, British Columbia or Ontario!

We have, from June to September, networked with hundreds of sports turf professionals from across the country. It has been our privilege and we look forward to seeing you at future events!
Better, safer sports turf. That's what it's all about.

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Football field at Mississauga Valley Park with the Absolute World Towers in the background, recent recipient of the international Emporis Skyscraper Award for the best in high-rise architecture.

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