Superintendent

FEATURES

Precision Turfgrass Management

by Aaron Johnsen
Emerging technology improves efficiency

Image 4: A soil moisture map of a fairway with problem irrigation heads circled.
Image courtesy of Dr. Van Cline.

Precision agronomy has been actively implemented by farmers across the country during the past decade. Precision agronomy is based on site-specific management units, which are areas with similar soil, microclimate and plant species that receive unique levels of inputs to obtain maximum yields. Site-specific management units are specified based on site data tied to GPS coordinates. Precision turfgrass management (PTM) is the precise application of inputs to individual units of turfgrass. Whether you know it or not, as a golf course superintendent you practice PTM by maintaining greens, tees, fairways, rough and native areas differently. Emerging technology will allow PTM on much smaller units.

Why practice PTM?

Let us examine why so many farmers have adopted precision agronomy to understand why PTM should be practiced. Farmers have adopted precision agronomy as a way to improve yield on every section of a farm. Higher yields have come from managing inputs on a small scale. It is not wise for a farmer to make crop management decisions at harvest time, because by that time yield is determined. Farmers have found additional benefits from precision agronomy, such as environmental friendliness, cost savings and pest reduction.

Unlike crops, turfgrass is not grown for yield. Some equivalents of yield on a golf course may include visual appearance and playability. Why wait for visual imperfections or reduced playability to make management decisions? A farmer does not wait for harvest to manage a crop. The data used in PTM can detect stress prior to its effect on visual aesthetics and playability, therefore, preventing or reducing stress. Further, precise input direction generated by practicing PTM leads to optimum plant health.

How do I start?

To begin practicing PTM, one needs to map and analyze data. Data maps are used to identify problems and delineate site-specific management units. Dr. Dana Sullivan of TurfScout believes that “superintendent involvement in delineating site-specific management units is critical to the success of PTM, because of their extensive knowledge of site conditions and history.” TurfScout is one of a few companies involved in PTM. TurfScout provides the equipment to collect and the software to analyze site data. Image 1 is an example of turfgrass health data collected on a golf green. The TurfScout software contains several powerful data analysis tools that summarize and display data. For example, it will convert data to a scale that highlights stressed turfgrass (see Image 2 on page 16).

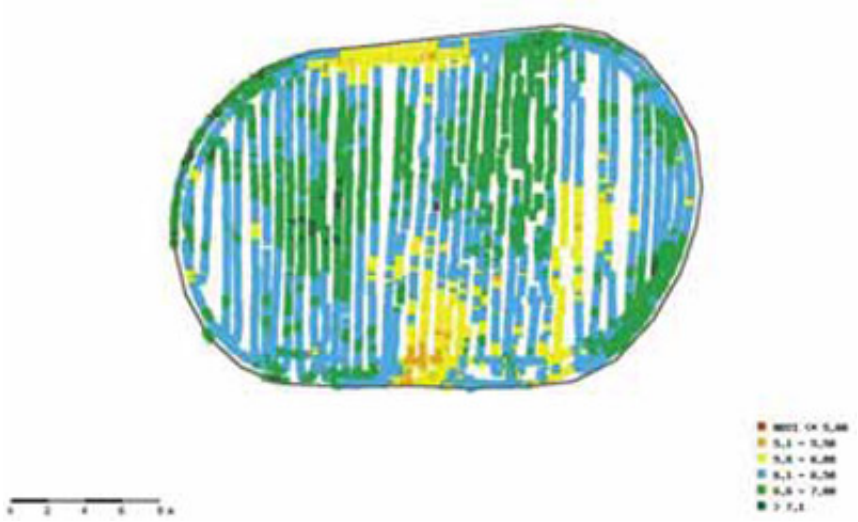

Image 1: Turfgrass health on a golf green measured with a reflectance sensor. Higher numbers equate to better plant health.
Image courtesy of Dr. Dana Sullivan.

Image 2: The turfgrass health ratings from Image 1 on a stress scale. Very stressed areas are highlighted in red, and stressed areas are highlighted in yellow.
Image courtesy of Dr. Dana Sullivan.

The Toro Company has developed PTM technology that collects soil moisture, compaction, salinity, topography and turfgrass health data, says Dr. Van Cline, senior agronomist with The Toro Company. Dr. Cline says, “The collection of multiple variables improves the delineation of site-specific management units.” At this time, The Toro Company is conducting limited business trials with its technology at several golf courses and sports fields across the country.

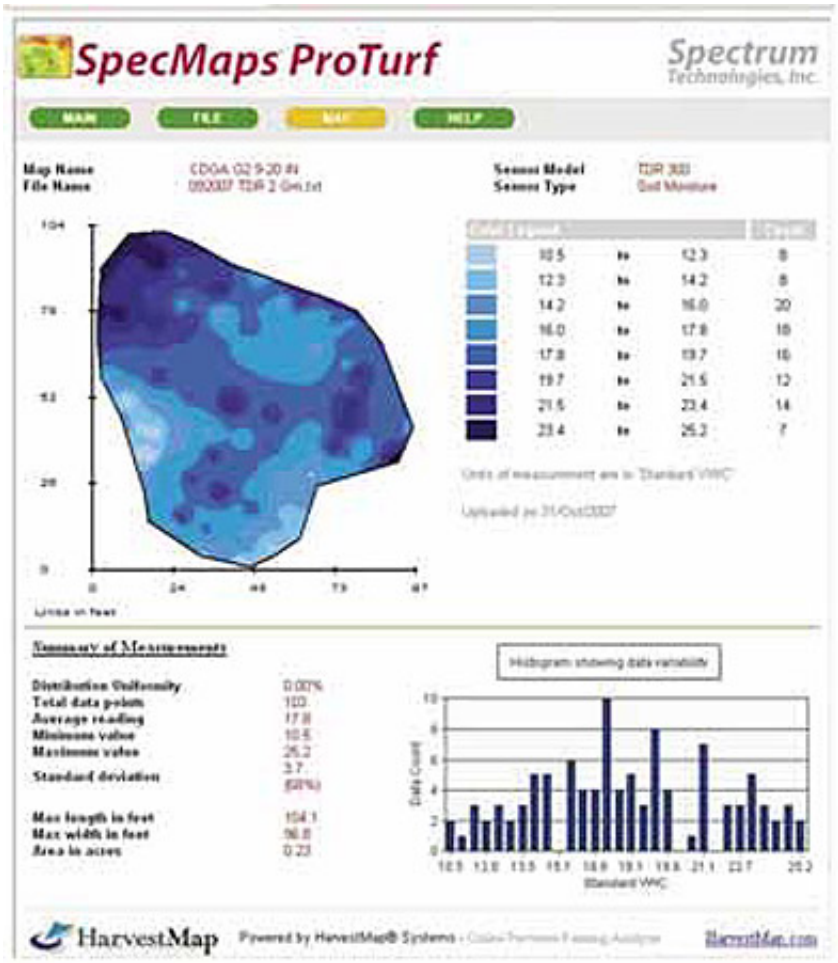

Image 3: A soil moisture map of a golf green and corresponding data statistics from SpecMaps software.
Image courtesy of Spectrum Technologies, Inc.

On a regional scale, there are companies, such as NuTec Soil, Inc., that provide soil fertility mapping and product application services. University turfgrass researchers are also a valuable resource, and can assist with data collection and outlining site-specific management units.

Individuals can create data maps and outline site-specific management units on their own. To create a map you need three things: coordinates, measurements and software.

Coordinates can be obtained from a GPS unit or by laying an x/y grid over a site. Measurements are collected from sensor technology, such as soil moisture sensors, compaction meters and light sensors. Some examples of mapping software include Microsoft Excel, DPlot by Hydesoft Computing, SpecMaps by Spectrum Technologies, Inc. and ArcGIS by Esri.

The first step to making a map is to collect data. One needs to collect both a measurement and the coordinates of that measurement. Some sensor equipment logs data as you record it and even allows GPS data to be stored with the measurement. Spectrum Technologies, Inc. offers several sensors that log data and can collect GPS coordinates at the same time. After data is collected, it needs to be entered into the computer either manually or through a download. Getting the data into a map depends on the software being used. Free and inexpensive software requires data manipulation to obtain usable maps and the user to outline site-specific management units. More pricey software reduces the manipulation required to obtain useable maps and has features that outline site-specific management units. Consult with experienced software users prior to selecting software.

How are superintendents using data maps?

Superintendents are using data maps to control and fine-tune irrigation, schedule aeration, manage salinity and manage trees. This is done with maps of soil moisture, compaction, salinity and light quantity. While data maps can be used to manage any area of a golf course, superintendents are mainly using maps of greens and fairways. This is because these areas receive the most inputs and require the best conditions.

At the present, the main use for PTM is to control and fine-tune irrigation practices. This is accomplished by detecting poor-performing and misaligned irrigation heads, placing soil moisture sensors and scheduling irrigation. Superintendents analyze individual irrigation head performance to find heads that do not spray uniformly. On soil moisture maps, this is represented as irrigation donuts, dry spots or wet spots. With soil moisture maps, one can find irrigation heads that hit the wrong areas. For example, greens surround heads meant to only water the rough that irrigate the green, too. Soil moisture maps are used to place soil moisture sensors in specific areas, such as ones in dry and wet areas. Superintendents use these soil moisture sensors and the knowledge behind their location to schedule future irrigation. The final way that soil moisture maps are being used is to create irrigation management zones. Areas of the map with similar soil moisture trends are classified based on the irrigation system configuration. Areas with similarities are irrigated in one manner, while other areas are irrigated differently. This creates optimum irrigation of the entire course.

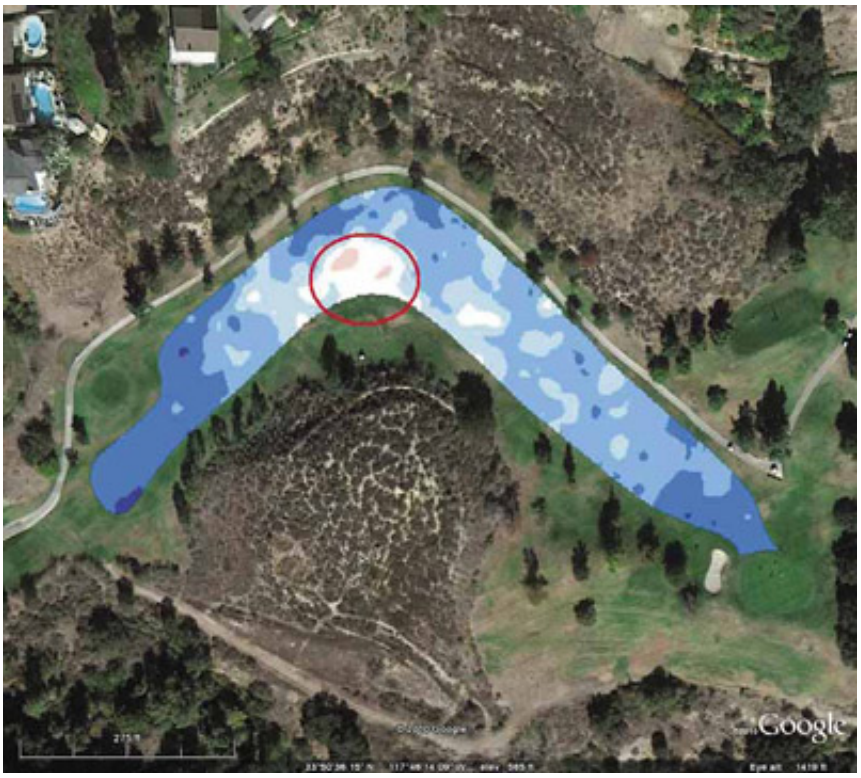

Image 5: Soil compaction on a golf fairway. The most compacted area of the fairway is circled.
Image courtesy of Dr. Van Cline.

Maps of soil compaction can be used to target aeration and rotate cart traffic. As is illustrated in Image 5, there is significant compaction at the bend in the fairway. With this information, cart direction signs can be placed to minimize long-term compaction problems. Further, a superintendent can use this image to justify intense aeration in this area to relieve compaction.

Salinity maps can be used to target leaching practices, which reduces wasteful water use. Several superintendents have followed the lead of irrigation site-specific management units by creating salinity site-specific management units. These units are used similarly to irrigation units to direct leaching activities to the most appropriate areas at the most appropriate time.

Light quantity and quality maps are being used to identify trees and justify trimming and removal of those trees. Although it is easy for a superintendent to understand tree removal and trimming with respect to turfgrass health, when a tree is not a problem for golfers, it can be difficult to communicate the need for removal or trimming. Companies that use computer software to generate light analysis have been effective at validating tree management, but these services can cost thousands of dollars. Light quantity and quality maps can be generated at a fraction of the cost.

Existing challenges

There are challenges to adopting PTM on any site. The first challenge is the upfront costs of equipment and labor. The complexity of the sensors, software and data interpretation add further resistance to PTM adoption. Even if these challenges are overcome, the existing infrastructure on a site, such as irrigation systems, sprayers and spreaders, may limit the adoption of PTM. While there are challenges to adopting PTM, the long-term benefits of

input savings, environment protection and improved playing conditions justify some investment in PTM. With the use of regional and national experts, the challenges with PTM can be overcome.

Data maps provide information and clarity on current conditions, thus promoting efficient management of inputs. As researchers continue to perfect PTM, golf course superintendents will refine their current site-specific management units of greens, tees, fairways and roughs to create improved playability and visual appearance.

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