Improving Turfgrass Health With Improved Water Management

By AARON JOHNSEN
Winfield Solutions

Water is essential to turfgrass health. Water is used in photosynthesis, cooling, and many other critical plant functions. In Minnesota, it has been well documented that the annual distribution of precipitation is not uniform enough to sustain healthy turfgrass growth. Therefore, it should be no surprise that irrigation is an essential part of turfgrass management.

I believe the desire to improve irrigation is driven by two factors, the financial cost of irrigating and the improvement in turfgrass conditions. In other regions of the country, the financial cost of irrigating can run into the tens and even hundreds of thousands of dollars. One superintendent in California saved $10,000 last summer by managing soil moisture occasionally. This summer he has hired someone to monitor soil moisture on a regular basis. He expects to save around $40,000. In Minnesota, we do not have this financial concern. With that said, there is a new "user fee" of 0.0008 cents for every gallon of water pumped during the season. In the future, the financial cost of irrigating may be a concern in Minnesota.

The greatest value that is obtained from managing irrigation better in Minnesota is the improvement of turfgrass conditions. The PGA Tour adopted the use of soil moisture sensors about a year ago. Their objective is to improve green firmness and develop uniformity across the course. Closer to home, Paul Diegnau, CGCS, at Keller Golf Course purchased a soil moisture sensor about two months ago. He has reported saving two irrigation cycles already this season from monitoring soil moisture.

Wilt on a creeping bentgrass fairway. Photo by Aaron Johnsen

Reducing excess water in the soil profile promotes a healthy air and water balance, which ultimately leads to healthier turfgrass.

Over the years, measuring evapotranspiration has been touted as a way to make informed irrigation decisions. My graduate studies and subsequent work with soil moisture sensors and turfgrass management has led me to determine that while evapotranspiration measurements are very useful, soil moisture sensors can be even more helpful in making informed irrigation decisions. What do you need to know if you are using or thinking about using soil moisture sensors?

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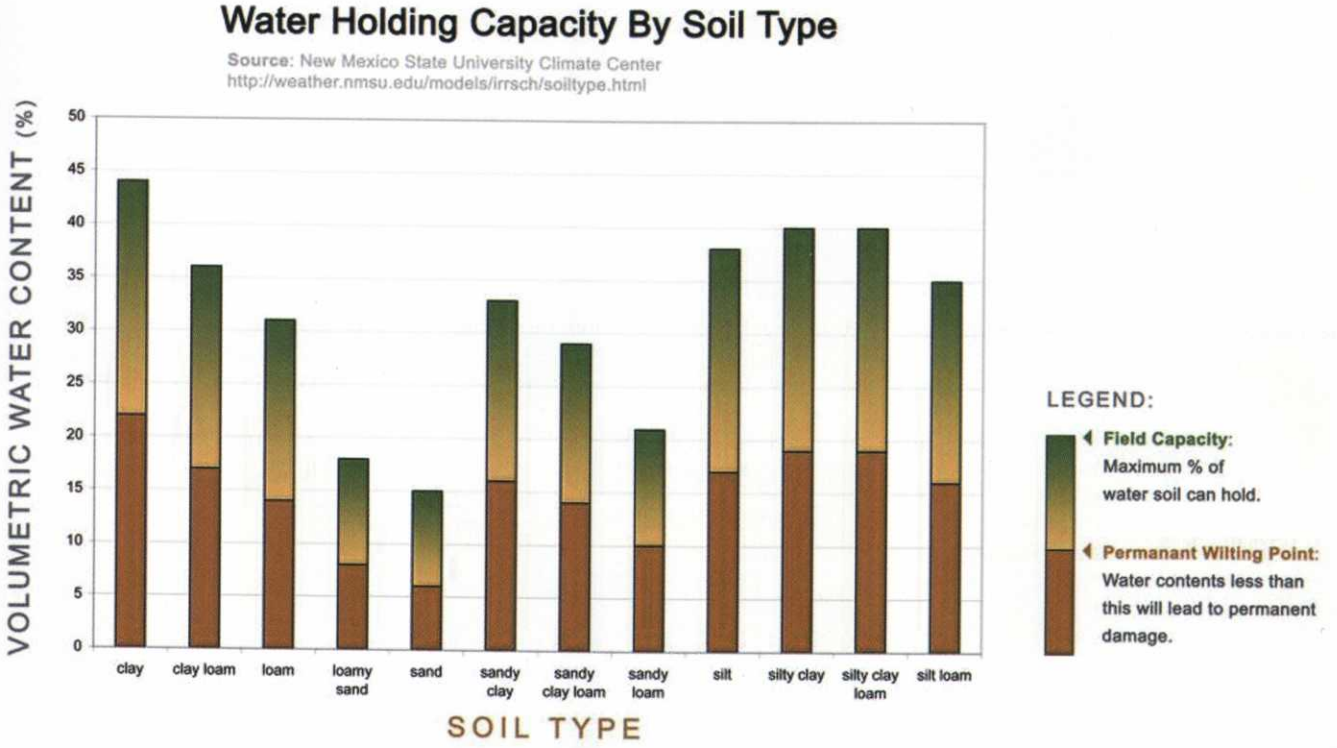

Approximate water holding capacity by soil type. Every soil has a different holding capacity. Photo by Spectrum Technologies

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What is soil moisture?

Soil moisture is the amount of water present in the soil. Water is held in three different zones in the soil: gravimetric, capillary, and hygroscopic. Gravimetric water is water in the soil pores that moves freely due to gravity. Capillary water is water held close enough to soil particles, so that it does not move due to gravity. Plants remove capillary water from the soil. Hygroscopic water is water held so closely to the soil particles that neither gravity nor plants can move the water. The point between the gravimetric and capillary stages is referred to as the field capacity point. The point between the capillary and hygroscopic stages is referred to as the wilting point.

How do you determine the field capacity and wilting point?

The scientific way to determine the field capacity and wilting point involves subjecting several soil samples to tests with lab equipment. The approximate field capacity and wilting point can be determined using your soil moisture meter. Here is how you do it:

1. Saturate a patch of turf.
2. Allow the area to dry for two hours.

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>
> *-Aaron Johnson*

3. Take a soil moisture measurement. This is your approximate field capacity point.
4. Take soil moisture readings about every four hours. For sandy soils, collect readings more frequently. For clay soils, collect readings less frequently.
5. Continue taking soil moisture measurements until you see wilt. This is the wilting point.
6. These steps should be repeated for each soil type, as every soil has a different field capacity and wilt point.

*Caution, it is best to take these measurements until severe wilt occurs, so do this in an area that can sustain damage.

What is the right amount of soil moisture for healthy turfgrass?

The "right" amount of water in the soil depends on management methods, desired conditions, and soil type. Considering the water available to a plant, capillary water, I suggest turfgrass managers initially target the 2/3 mark in capillary water. The 2/3 mark is calculated by subtracting the field capacity from the wilting point, dividing that number by 3, and then subtracting the final number from the field capacity. For example, if the wilt point of a soil is 10% and the field capacity is 25%, then the 2/3 mark is 20%. An initial optimum range of soil moisture for this soil would be 18% to 22%. It is my experience that superintendents lower their optimum value over time.

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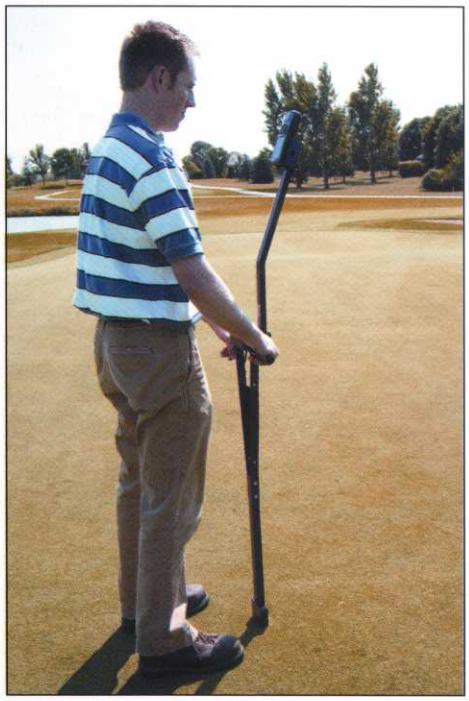
What are the sensor options?

There are several soil moisture sensor options on the market and a handful of manufacturers. With some exception, one sensor or manufacturer is not better than any other sensor or manufacturer. It really comes down to how the sensor will be used and what features are desired. Soil moisture sensors fall into three general categories: wired, wireless, and portable. Which type you select depends on where you want data, how often you want data, and how you want to use that data.

Wired soil moisture sensors, such as the Irrometer Watermark, Decagon Echo, and Spectrum Technologies WaterScout, are a sensor buried in the soil and wired back to a data logger. This is the lowest cost option, with individual sensors costing $75 to $250 and data loggers costing $200 and up. The negative of wired soil moisture sensors is the wire running under ground. Not only does the sensor have to be removed for certain maintenance practices such as aeration, but also the wire. In addition, depending on the data collection method, data must be recovered in the field and it is generally not available on the internet. If you want to collect soil moisture measurements below 8 inches in the soil, wired soil moisture sensors are your best option.



Using a portable soil moisture sensor with gps unit to map soil moisture on a green.
Photo by Scott Lemke

An example of a wired soil moisture sensor and the associated data logger.
Photo courtesy Spectrum Technologies

Wireless soil moisture sensors, such as the Toro TurfGuard and UGMO system, are a sensor placed in the ground that wirelessly sends data back to a base station. Both Toro TurfGuard and UGMO Systems relay data to the internet and record temperature and salinity. These features are very valuable, but they come with a higher cost. Base systems start at $4,000 and additional sensors start at $1,000. These sensors must still be removed from the soil for certain maintenance practices. In addition, wireless soil moisture sensors are not intended to be placed in the soil below 8 inches.

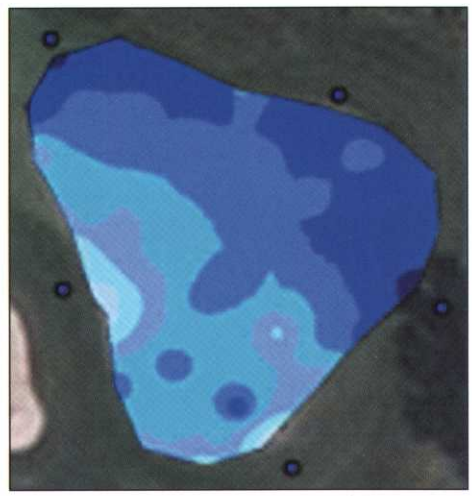
Portable soil moisture sensors, such as the Spectrum Technologies TDR300, Dynamax TH2O, and Campbell Science Hydroprobe, configure a sensor so it can be inserted from the soil surface. The data is displayed on the meter and some models store the data for future downloading to a computer. These meters are not permanently installed in the field, so maintenance issues are eliminated. However, a user is required to collect data and data over time is not as accessible. The cost for these sensors is $750 to $2,000.

How do I use this thing?

Soil moisture data is best used for scheduling irrigation, handwatering, and labor inputs portable meters can be used. Irrigation scheduling involves using the desired low and high marks. With these, allow the soil moisture to fall to the low mark. Once it reaches the low mark, schedule the next irrigation to return the soil moisture to the high mark. Irrigating in this manner requires fine-tuning initially and slight changes over the growing season.

Handwatering with soil moisture sensors has proved to be a good training tool and improved the consistency of greens at PGA golf tournaments. Portable soil moisture sensors are really the only sensor option for scheduling handwatering. I have seen two methods for this: (1) Someone collects soil moisture measurements and highlights areas on a map that are near the low mark. This map is used by a handwaterer to determine where to apply water. (2) The handwaterer probes greens for dry spots and immediately waters those spots until they reach the high mark.

Detecting soil moisture problems is done by mapping soil moisture. Data across a site is collected with portable soil moisture sensors. This data is downloaded into a software program, similar to attaching an e-mail. A map is produced, which can be used to detect irrigation performance issues and developing localized dry spots.



A map of soil moisture on a golf green.
Photo by Aaron Johnsen

Soil moisture sensors provide another data point on water use and availability, which is useful for both reducing expenditures and improving turfgrass conditions. There are several options on the market. Choosing a sensor depends on one's budget and anticipated uses. No matter which soil moisture sensor is selected, investing in a soil moisture sensor will reap many benefits.

*I will offer to visit anyone's site with my portable soil moisture meter to demonstrate the benefits and the value that can be obtained with one.

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(Editor's Note: Aaron Johnsen is a Professional Product Advisor with WinField Solutions and an adjunct lecturer at the University of Wisconsin - River Falls. He can be reached at arjohnsen@landolakes.com or 651.895.2601.)