Using wetting agents to improve irrigation efficiency

Greens with a water-repellent root zone require less water when treated with a wetting agent.

Following the horrendous drought experienced in many parts of the southeastern U.S. and other parts of the country this past year, much is being written about using best management practices for water conservation. Many of these practices are well documented in the turfgrass literature. One practice that has not been addressed as completely as others is using wetting agents to improve irrigation efficiency. In this article, we would like to share some of the results obtained from work we have done at the University of Georgia in this area and the practical implications resulting from that work.

Wetting agents and greens

Most putting greens in the U.S. are constructed with a sand-based root zone. However, the following discussion applies to both sand-based greens and push-up greens if the push-up green has anywhere from 2 inches (5.0 centimeters) or more of a sand or sand/organic matter mix over the original soil base. With this in mind, our research has shown that most sand-based root zones 18 months or older will have some degree of soil water repellency. We have written numerous articles in *GCM* over the years on this topic. Several references are listed at the end of this article. The reader is advised to read these articles by searching the *GCM* Archives, which are now available to all members (http://archive.lib.msu.edu/TIC/gcman/about.html).

Using a wetting agent maximizes the use of irrigation water on greens. **Photo by W. Dowe**

Before we can discuss the effects of treating a water-repellent soil with a wetting agent and the impact of this treatment on irrigation efficiency, it is important to review quickly some major points that are characteristic of water-repellent soils in comparison to non-water-repellent soils.

Characteristics of water-repellent soil

The most obvious characteristic of water-repellent soils is the occurrence of localized dry spots. However, research has shown that if water-repellent soil is found in one portion of a turfgrass area — in this case, a green — almost without exception, soil water repellency will be present throughout the green even though localized dry spots may not be apparent. In the same regard, the degree of severity of soil water repellency may range from slight to severe. The most-severe levels are found near the soil surface, and severity decreases with depth. It's also important to note that the depth of water repellency rarely exceeds 3 inches (7.6 centimeters).

One of the most important characteristics of water-repellent soil is the *critical moisture content.* When soil moisture is above this critical point, the water-repellency effect is temporarily eliminated, and the soil will display characteris-

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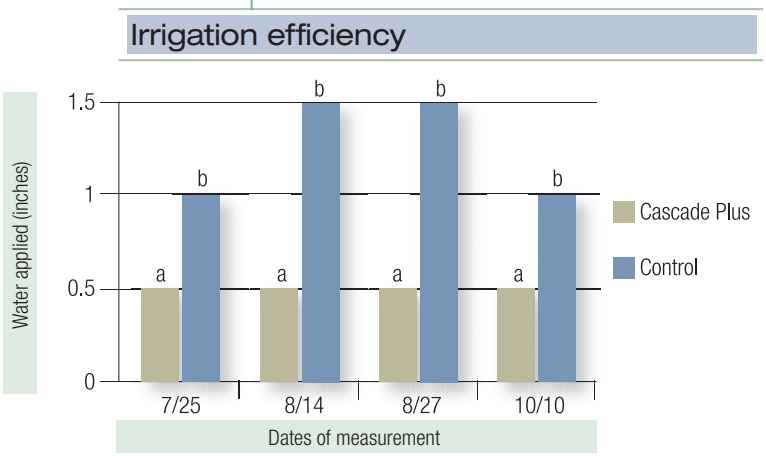

Figure 1. Amount of water required to bring soil moisture content up from 5% to 15%. Different letters at each observation date indicate a significant difference between the Cascade Plus treatment and the control.

tics similar to those of non-water-repellent soil. When soil moisture falls below this point, the soil will again show water repellency and will be difficult to wet without the use of a soil surfactant. This is the real value of using a soil surfactant: It allows the superintendent to maintain the soil at extremely low moisture content with confidence that the soil can be rewetted quickly when desired. In other words, if a wetting agent is not used, and if the soil water content is permitted to fall below the critical moisture point, the superintendent will find it extremely difficult — in some cases, almost impossible — to rewet the soil. Most superintendents have experienced this at one time or another.

Irrigation efficiency research

Methods

Over the past few years, we have investigated irrigation efficiency as affected by wetting agents when applied to a water-repellent soil. One of the first field studies completed was with Cascade Plus (Precision Laboratories) wetting agent. This study was conducted on a University of Georgia Crenshaw creeping bentgrass experimental green constructed according to USGA Green Section recommendations. The green was constructed in such a way that the top 4 inches (10.2 centimeters) of the soil profile show a consistent degree of water repellency ranging from moderate to severe.

Treatments were initiated in summer 2003. All the treatments were replicated, and the study was conducted for two years. The label rate of 16 fluid ounces was applied as a split application (8 fluid ounces and 8 fluid ounces/1,000 square feet on July 10 and July 17). Soil water repellency was monitored using the molarity of ethanol droplet test. Irrigation efficiency was determined periodically throughout the testing period by allowing the soil water content to drop to 4% or 5% and then determining how much water was necessary to bring soil moisture content up to approximately 15%.

Results

About two weeks after wetting agent application, the first irrigation efficiency measurement was conducted (Figure 1). To bring soil moisture content up to 15%, 0.5 inch (1.3 centimeters) of water was applied to the plots treated with Cascade Plus. In contrast, 1 inch (2.5 centimeters) of water was required by the control plots to reach the same level of soil moisture.

The second dry-down period and rewetting was conducted about one month after the initial application and revealed an even greater difference between the treated plots and the plots that were not treated. On this date (Aug. 14), the control plots required 1.5 inches (3.8 centimeters) of water to bring soil moisture up from 5% to 15%, but the wetting agent plots required only 0.5 inch (1.3 centimeters) of water.

The third irrigation efficiency measurement was taken six weeks after wetting agent application, and again there was a three-fold difference between the plots treated with the wetting agent and the control plots in terms of the amount of water required to attain 15% soil moisture content.

Perhaps the biggest surprise was the final measurement three months after the initial wetting agent application. At this time, the plots treated with Cascade Plus still required half as much water to bring soil moisture up to 15% as compared to the non-treated plots. On this date (Oct. 10), the plots treated with the wetting agent still showed significantly less soil water repellency than the control. The data were consistent over two years of testing. Previous research has also shown that Cascade Plus significantly reduces soil water repellency up to four months after initial application.

Additional studies

We have done either field or greenhouse stud-

Sand-based greens usually have become somewhat water-repellent by the time they are 2 years old. **Photo by P. O'Brien**

ies with other wetting agents and found, not the same, but similar results. Irrigation efficiency studies have been conducted in containers in a greenhouse with Tricure, Miser and Hydration wetting agents. Each study was fully replicated and the data were analyzed.

We also evaluated the wetting agent Surfside in a one-year field study. In this study, Surfside plots treated at a rate of 32 ounces/1,000 square feet (10.2 milliliters/square meter) required half as much water as the control to bring the soil moisture content up from 5% to 15%. Although this effect diminished in about three weeks, requiring reapplication of the wetting agent, it clearly demonstrates again how a wetting agent can dramatically improve irrigation efficiency. A study at the University of Arkansas has also shown improved irrigation efficiency with the wetting agent Revolution.

Conclusions

We have found few, if any, predominately sand-based root zones (80% sand with little or no fine-textured particles present) that were more than 2 years old and did not have some degree of soil water repellency. Although the visual symptoms of soil water repellency are localized dry spots, it should be remembered that the condition occurs throughout the green, even where visual symptoms are not evident. In other words, soil water repellency has invisible effects such as poor distribution of water, pesticides and fertilizers, which potentially lead to a less healthy turfgrass plant. With this in mind, we recommend treating the entire green rather than only spot-treating the most obvious problem areas. This will maximize the uniformity of water distribution throughout the green and also maximize irrigation efficiency.

In research conducted at the University of Georgia, irrigation efficiency improved regardless of the wetting agent used. However, it should be remembered that more than 80 wetting agents are currently on the market, and not all have been tested in this way. It does stand to reason that if the wetting agent can reduce soil water repellency enough to allow the soil to wet more readily, then irrigation efficiency should be improved.

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The research says

→ Most sand-based greens become water-repellent once they are more than 2 years old.

→ Localized dry spots are a visible sign of water-repellent soil, but soil can be water-repellent without showing visible signs.

→ Treating the entire green with a wetting agent will maximize the uniform distribution of water, pesticides and fertilizers and also maximize irrigation efficiency.

→ Preventing the soil from repelling water allows the soil to increase its moisture content more easily.