Water movement and repellency: putting wetting agents to work

Editor's note: *Water movement in soils is influenced by three processes: chemical, physical and water repellency. Chemical processes include high electrical conductivity, high bicarbonates, high sodium and low calcium. Physical processes include thatch and organic matter, hardpan and compaction. We will be covering all three in the next three issues; water repellency and wetting agents will be discussed this month. The author is senior research agronomist for Aquatrols.*

>> CONDUCTING a water drop penetration test; water drops on the surface of water repellent soil.

WATER REPELLENCY or soil hydrophobicity is the inability of soil to wet. The causes of soil water repellency are numerous; plant root exudates, fungal hyphae, and decomposing organic matter are just a few of the sources of hydrophobic coating on soil particles. This hydrophobic coating on sand particles prevents water from attaching to the particle and may interrupt the uniform movement of water through the soil profile. (To determine if soil is water repellent, a water drop penetration test should be performed. Take a core sample down to root depth. Air dry for approximately 2 weeks, then place water drops at one centimeter depths along the core and time how long it takes for the water drop to penetrate the soil core. Water repellency is defined: non-wettable [<5 seconds], strongly water repellent [60-600 seconds] and severely water repellent [600-3600 seconds]).

In highly managed turfgrass environments such as sports fields, water repellency tends to be more severe at the surface and declines farther along the soil profile. Typically, the top 3 cm of a coarse textured soil are the most hydrophobic. This top 3 cm is enough to significantly disrupt water movement. Water repellency at the surface is evident when runoff, puddling and slow infiltration occur. Water repellency significantly reduces irrigation distribution uniformity. Although not visually evident, the delay in water movement into the soil in an arid environment also causes water loss to evaporation. This water repellency and loss prevents your turf from getting the water it needs to survive and thrive and contributes to waste of water and run-off of soil directed chemicals such as fertilizer and pesticides.

Water repellency below the soil surface creates non-uniform distribution of water, and any material applied with water. Preferential flow paths or "fingered flow" are caused by physical and chemical processes but are also strongly associated with water repellency. Due to hydrophobic organic coatings, water molecules are repelled away from soil particles, decreasing access to numerous pore spaces. A re-occurring pathway of water flow to the bottom of the soil profile is formed. This preferential flow results in non-uniform distribution of water, fertilizers and pesticides, which can reduce turf quality and enable unsightly localized dry spots to develop.

Coarse textured soils go through numerous wet to dry cycles. It is challenging in a turfgrass environment to maintain soil at constant volumetric water content and prevent soil from falling below the critical water content or the soil water content where organic acids are prone to displaying hydrophobic coatings. Rewetting of soil particles is difficult when moisture is severely limiting. Acceptable moisture content, particularly on an in-play sport field, may be below this critical water content. A significant increase in applied water is needed to overcome the hydrophobic areas and achieve a goal of an even matrix flow of water.

Water repellency can be managed. Wetting agents are used to alleviate soil water repellency and improve water movement through the soil profile. The chemistry of a wetting agent is composed of a hydrophilic end and a hydrophobic end. The hydrophobic end will attach to the non-wettable organic acid on the soil particle. The hydrophilic or water-loving end of the surfactant molecule draws the water molecule closer to the soil particle, thereby successfully wetting the soil particle. By doing so, water is retained and soil volumetric water content increased. Plant available water is readily accessible in pore spaces. The wetting ability of the wetting agent helps to reduce preferential flow paths and rewets the soil readily.

Ask yourself if you have ever had difficulty getting certain areas of a field to absorb water, or if specific areas are always

quick to wilt. If the answer is yes, then you need to use a wetting agent to help maintain soils at a consistent volumetric water content and to improve distribution uniformity. Wetting agents can help you maintain healthier turf by aiding in the rewetting soils and preventing wasteful run-off of water and inputs to maximize use efficiency.

Another benefit of soil surfactants is their ability to break the cohesive forces of water, reducing surface tension which allows for faster penetration of water into the surface of the soil. This "penetrant" performance of surfactants prevents runoff, evaporation and puddling at the soil surface.

IMPORTANCE OF WATER

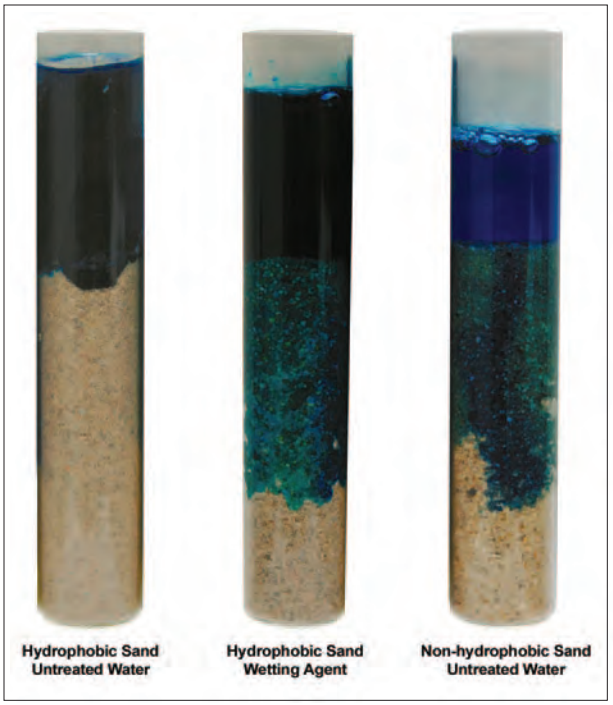
From both an environmental and economic stance, water is probably one of the most important components of your maintenance plan and budget. Wetting agents help water penetrate the soil surface and retain moisture in the soil profile. By doing so, less water is needed to maintain high quality turf, thus reducing both the cost of water and the costs associated with irrigating. Even in areas where rainfall is abundant or irrigation systems are used, wetting agents help maximize water use efficiency by improving distribution uniformity in the soil and enhancing water movement through the soil profile, reducing the amount of water you need to apply.

It is important to note that not all wetting agents are the same. Non-ionics are the most common surfactants used in turfgrass management. Numerous surfactant chemistries exist and performance characteristic as well as degree of phytotoxicity of each surfactant chemistry varies considerably. Some are better wetters and have no penetrant qualities, while others reduce surface tension but do not increase water content in the soil profile. Reduction in surface tension, induced rewetting, and hydrating soil particles are aspects of a wetting agent that vary based on chemical structure.

Rely on data from universities in your geographic area. Distributors should also be able to tell you the key components in the jug and how those ingredients work in the soil and at what rate phytotoxicity may occur. Simply stating a material is a block copolymer is not enough information. This term is generic and used to describe the majority of wetting agent chemistries.

As a turfgrass manager your job is to maintain quality turf. Water repellency can make your job more difficult leading to runoff, evaporation, LDS, and wasted water and chemical inputs, which result in poor turf quality and uneven turf surfaces. If you need assistance determining which wetting agent chemistry is right for you, discuss it with your distributor or a wetting agent manufacturer. Most will be able to determine your specific issue and find a wetting agent solution. ■

Mica McMillan is the senior research agronomist for the R&D department at Aquatrols Corporation. She handles all North American turfgrass research focusing on surfactant and soil-water quality product development. Mica is a graduate of Auburn University with a MS in Agronomy and Soils and is currently pursuing a PhD in Soil and Water Science at the University of Florida.



Selecting the right wetting agent for sportsturf

Editor's note: *Mark Howieson, PhD, is a technical team leader at Becker Underwood and Joe Lara is the turf and specialties product manager for the company.*

KEEPING SPORTS TURF HEALTHY under stressful conditions is no easy task. Among the many challenges sports turf managers face, soil moisture management is a primary concern. Water repellent soils are common in sand-based athletic fields and can result in irregular patches of wilted and drought-stressed turfgrass, often referred to as localized dry spot (LDS).

Soil wetting agents reduce the surface tension of water, allowing it to penetrate and wet the soil more easily. Irrigation and infiltration surfactants are designed to help increase water infiltration and irrigation uniformity. Before deciding on a wetting agent product, you should check university or reputable third-party trial data to support product claims.

No one product is best for every sports turf management program. When selecting a product, consider efficacy, management intensity, intended use, product longevity and price.

LONG-TERM

Many turf managers prefer the convenience of making only one application in the spring without follow-up applications. Long-term wetting agents generally persist for at least 3 months in the soil.

An important note to keep in mind is that long-term wetting agents have greater potential for development of phytotoxicity and discoloration if the applicator is not cautious. In addition, long-term wetting agents are more limited when it comes to tank-mix compatibility with other products (i.e. fertilizers, pesticides, plant growth regulators, etc.), in comparison to short-term wetting agents.

Long-term wetting agents are an excellent option for season-long prevention of LDS development on water repellent, sand-based fields in the Northern US. Using long-term products will minimize the number of applications needed during the growing season.

SHORT-TERM

Short-term wetting agents are typically applied at 2 to 4-week intervals and allow you to make applications only when environmental conditions demand treatment. Moreover, there is potential to incorporate the monthly application into existing turf management programs. Short-term wetting agents have greater flexibility with tank-mix options when compared to long-term wetting agents.

Because short-term wetting agents generally persist for only 28-30 days in the soil, more frequent applications are necessary, requiring more time and labor investment. However, short-term wetting agents typically reduce the risk of leaf discoloration and phytotoxicity during hot, dry weather, especially when compared to long-term wetting agents.

Short-term wetting agents are best selected for water repellent sand-based greens, especially in transition and warm season zones, although they are becoming more popular in cool season zones. An additional use for short-term wetting agents includes late season "rescue treatments" to correct symptoms of LDS.

Irrigation surfactants may be a low-cost alternative to conventional wetting agents to treat difficult-to-wet areas caused by thatch or low soil surface hydrophobicity. The cost is further reduced when the agent is injected into the irrigation system.

In general, irrigation surfactants are not as effective as a stand-alone wetting agent product to manage LDS or alleviate moderate to severe soil hydrophobicity. However, these agents are useful in difficult-to-wet native soil areas.

Wetting agents cannot alleviate soil water repellency from the turf canopy, but need to be watered into the soil to be most effective. Water long-term wetting agents into the soil immediately following application. Most short-term wetting agents need to be watered in within 24 hours of application. Always check the label and follow directions.

It is proven that wetting agents can help increase the water infiltration rate into the soil profile in hydrophobic soils. However, in areas with excessive thatch (greater than ½ inch) or soil organic matter (greater than 3.5%) the soil surface may retain moisture. Core-aerating and topdressing with sand to reduce thatch and organic matter content will help prevent moisture retention at the soil surface.

Moisture retention at the soil surface is exacerbated when wetting agents are not watered into the soil profile. If wetting agents are not watered in with a sufficient volume of water to penetrate the hydrophobic layer, a temporary "perched water table" may form above the hydrophobic layer that maintains excessive moisture at the surface.

If you know that you are dealing with hydrophobic soils or LDS, a wetting agent can help alleviate the symptoms and bring your turf back to a healthy-looking condition. Do some research to find out which products will work best for your situation. ■

Mark Howieson, Ph.D., is a technical team leader at Becker Underwood. Joe Lara is the turf and specialties product manager at Becker Underwood. Becker Underwood produces a variety of turf management solutions, including colorants, wetting agents, iron chelates and nutrient blends.