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. ■

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