

Water Repellency and Water Movement Problems

Given the homogeneous sand-based soil structure of most greens and tee boxes, it is often assumed that once water is applied evenly on the surface, it will continue its journey through the unsaturated soil profile as a uniform horizontal wetting front. Actually, water flow as a horizontal wetting front (both downward and lateral movement vectors) through a coarse sand green or tee box profile is now recognized as the exception rather than the rule.

Factors Affecting Water Movement

Water Repellency. Water repellency is common on sand-based soils used to build greens and tees. Over time, organic compounds produced by the natural degradation of plant residues and through microbial activity will accumulate and coat soil particles and aggregates in the soil profile. As these coatings are subjected to higher temperatures and low moisture conditions, they will polymerize and form a “wax-like” hydrophobic (non-polar) layer.

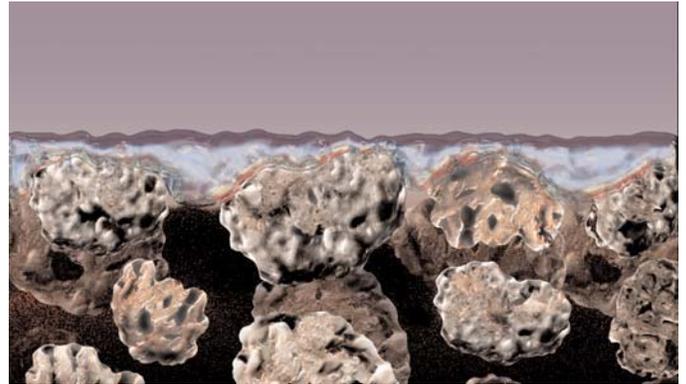
When water comes into contact with water repellent coatings (non-polar) on the soil surface, the boundary water molecules on the soil-water interface are repelled by the non-polar condition of the soil surface. This situation prevents "wetting" and reduces or eliminates the capillary suction (adhesion) needed to pull water uniformly through the soil matrix.

Without adhesion, gravity becomes the primary directional force on the water front. The flow of water through the soil now can become irregular which can lead to decreased infiltration capacity, areas in the soil profile that accumulate too much water ("wet spots"), or areas in the soil profile that have poor distribution of water ("dry spots").

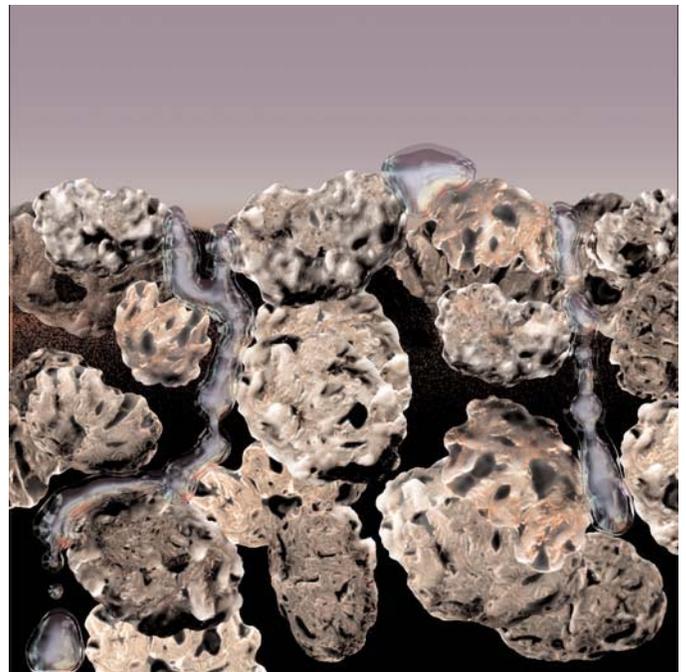
Capillary Suction. Water flow through a soil profile is strongly influenced by gravity and adhesion. Adhesion occurs as a result of water molecules at the wetting front attaching to the negative sites on the soil surface. Adhesion is needed to "wet" the soil and to provide the tension for capillary suction (vertically and horizontally) of water through pores in the soil matrix. As water molecules build on the soil surface, excess water is pulled downward by gravity to continue its vertical and horizontal movement through the soil matrix ("matrix flow"). Since gravity is nearly constant in soil profiles, any soil condition that reduces adhesion (or capillarity) will disrupt the uniformity of the wetting front, inhibit wetting and can promote preferential patterns of water movement.

Use of Soil Surfactants

The successful use of soil surfactants to address problems associated with water repellency in thatch and soils is well documented. A number of different soil surfactant products are available to the professional turf manager. These products may vary widely in their chemical structure and performance characteristics. Therefore, it is important that the professional turf manager choose his/her surfactants based on how they influence hydration (wetting/drainage) and capillary flow (distribution/uniformity).



Graphic depiction of uniform distribution of water on the surface of a sand-based soil profile.



Graphic depiction of poor infiltration and preferential flow of water through a sand-based soil profile under the influence of water repellency.

Structure

Structure Preventative Soil Surfactant is a blend of non-ionic surfactant chemistries designed to offer the turfgrass manager a means to effectively manage water repellent conditions in the soil profile. Used according to label directions, Structure preventative will act on water repellent soils to:

- Promote the uniform movement of water into and through the soil matrix
- Establish a pattern of hydration and re-hydration that will improve the amount of available water in the soil profile to meet water and transpirational demands of the plant
- Maintain a residual surfactant presence on water repellent soil particles that will allow soil hydration even under hot and dry environmental conditions

How Does Structure Work?

Water Repellency. When Structure surfactants are applied to the soil profile, they attach to water repellent (non-polar) areas on soil particles and create sites (Fig. 1A) where water can attach to soil surface (adhesion). Adhesion is strongly associated with hydration or "wetting" of a soil surface. Once adhesion of water molecules is restored on the water repellent soil surface by Structure surfactant molecules, water molecules will build on the soil surface. The surfactant chemistries in Adhesion Preventative Soil Surfactant were carefully selected for their ability to attach to non-polar surfaces and to establish optimum hydration (wetting) patterns.

Capillary Suction. Structure also plays a very important role in the uniform movement of water through a water repellent soil matrix. As excess water builds on the surfactant amended soil surface, it is pulled downward by gravity and is moved laterally by adhesion to continue its vertical and horizontal movement through the soil matrix ("matrix flow"). This directional influence by water's attraction to the surfactant amended soil surface (Fig. 1B) plays an essential role in water movement through the soil matrix – a hydraulic tension called "capillary suction."

Use Directions

Apply Structure at 4-6 oz/1000 sq. ft. in 2 gallons of water. For best results apply monthly, beginning at least one month prior to the anticipated beginning of stress conditions. Watering-in is not required, however, one irrigation cycle is recommended following application to enhance the distribution of Structure into the soil profile.

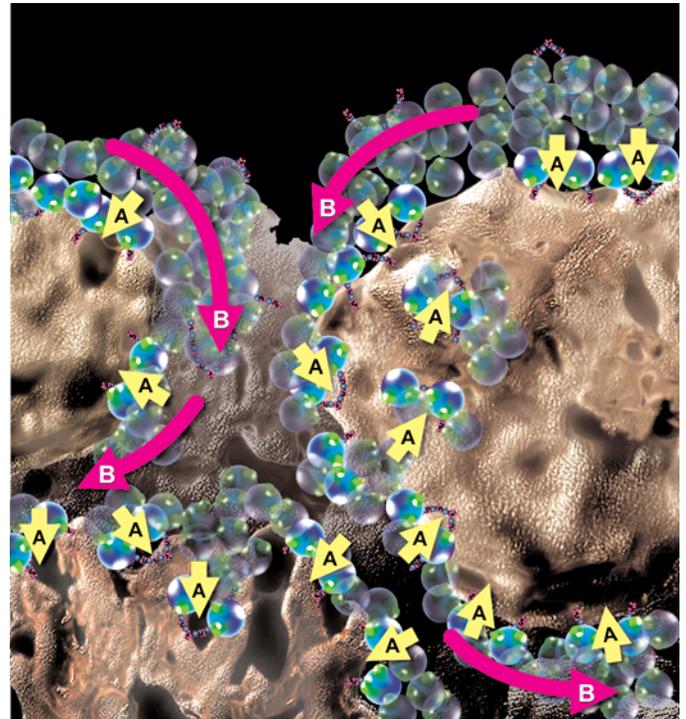


Figure 1. Structure Mode-of-Action

(A) Water molecules attach to Structure surfactants and restore adhesion. (B) Gravity in combination with restored adhesion improves capillary "suction" that moves water into and through the soil matrix.

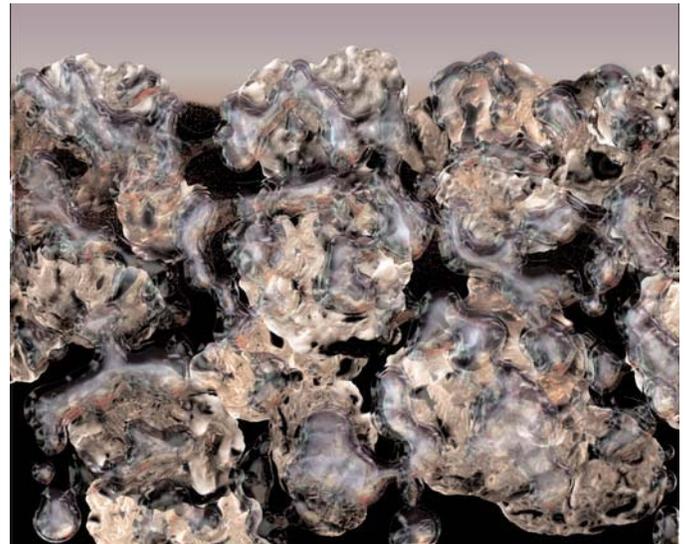


Figure 2. Graphic depiction of improved hydration and uniform movement of water through soil matrix treated with Structure preventative Soil Surfactant.



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