The Science Behind Wetting Agents

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Wetting agents have become invaluable tools in this era of turf management where fast and firm is a mandate and conservation of water is becoming a major issue. The number of wetting agents on the market is overwhelming and growing day by day. Marketing claims can sometimes make you believe that two wetting agents are as different as night and day. Conceptually, wetting agents are fairly simple and this article will attempt to help you understand how and why these products work (or don't work). But before we can begin to talk about how wetting agents work, we need to understand three basic properties of water; cohesion, adhesion and surface tension.

Water has a high degree of cohesion, and therefore, water molecules have a tendency to "stick" to other water molecules. You can see this property at work next time you are driving in the rain. Take a look at a raindrop as it runs down the windshield; it will veer off course from a straight line to gobble up other smaller rain drops on the window. Water's cohesive properties give rise to another important property: surface tension. Surface tension is a measure of how hard it is to break the surface of a liquid. The high surface tension of water allows some bugs to walk across its surface (Figure 1). The final important property, adhesion, describes the attraction of water to other materials. Adhesive forces between water and a material like wax paper are very low. When this is the case, cohesive forces overwhelm the adhesive forces and water forms a fairly round droplet (Figure 2). However, when adhesive forces between a material and water are high, the adhesive force overcomes the cohesive force of the water, and the droplet will "flatten out" as seen in Figure 3.

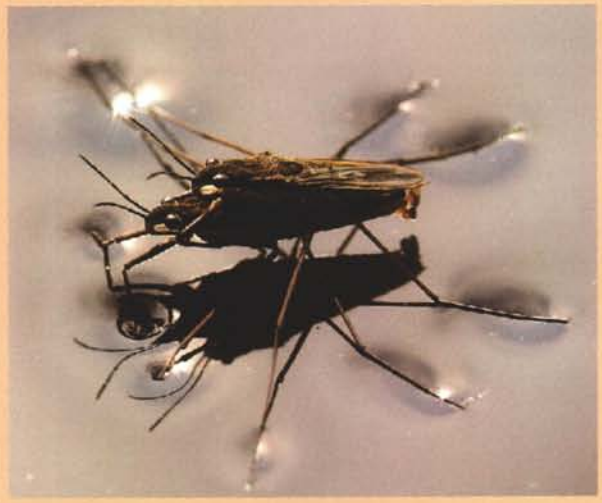

Figure 1. Two water striders take advantage of water's high surface tension. Photograph by Markus Gayda.

Figure 2. A drop of water sitting on wax paper forms a droplet because the water's cohesive forces are larger than the adhesive forces between the wax and the water.

Figure 3. When a surfactant is added to water, the cohesive forces decrease and the water droplet spreads out along the wax surface. The amount of water in this picture is exactly the same as in Figure 2.

Normally, most soils are highly adhesive to water (wettable). However, non-wettable soils (AKA hydrophobic soils) can develop when organic coatings form around soil particles and then are allowed to dry down to very low soil moisture levels. Many field studies, including some conducted in Wisconsin, have found that wetting agents can prevent the development of hydrophobicity in soils. During a surfactant trial last season, I gave new meaning to "firm" by watering to replace only 30% of the water lost to evapotranspiration (ET). Severe hydrophobicity and localized dry spot (LDS) symptoms developed on plots with no wetting agent, but LDS never appeared on treated plots. Figure 4 shows the soil moisture levels from two of the plots from the study. Notice how the control plot has very dry areas and very wet areas, while the wetting agent-treated plot has relatively constant, but mid-range soil moisture levels. In this case, the wetting agent prevented the development of LDS and kept soil moisture levels even across the plot area. At no time during the study period did significant LDS symptoms appear from plots treated with Aqueduct, Primer, Respond 2L, or Revolution.

Don't rely on marketing alone

More wetting agents are available this year than ever before. Unfortunately, very few of these products have been evaluated independently in field settings. Instead, most products are sold based on testimonials and/or marketing claims. Some products are purported to cure LDS, while others prevent it. Some manufacturers claim that their product holds water near in the upper part of the root zone; others claim that their product facilitates the downward movement of water. The most clever manufacturers claim that their products can do both! Actually, the science of wetting agents supports this notion. Here's the logic: In general, under wet, non-hydrophobic conditions, wetting agents will decrease the surface tension of water and facilitate downward water movement which will result in a very slight decrease

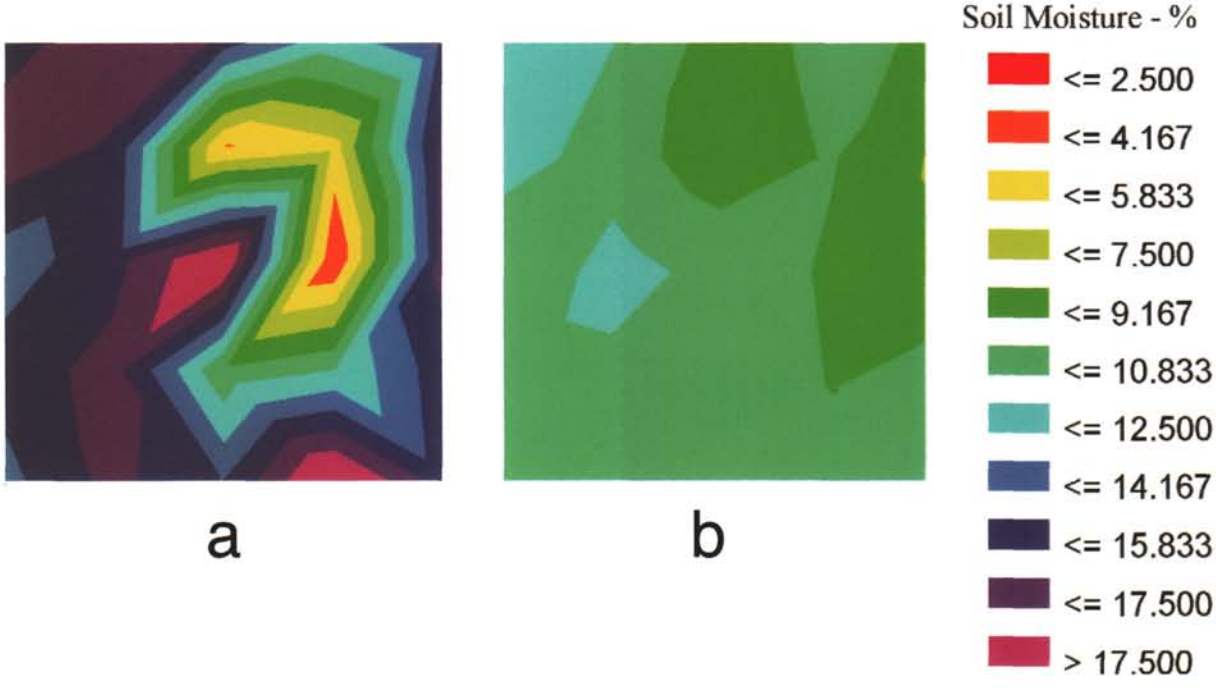

Figure 4. Soil moisture levels of a dry control plot (a) exhibiting symptoms of LDS and a wetting agent-treated plot (b) with no symptoms of LDS. Note the large range of soil moisture levels in the control plot compared with the relatively constant moisture levels found in the wetting agent-treated plot. Notice the relatively high soil moisture levels in the wettable regions of (a) and the relatively low moisture levels in the hydrophobic regions. Compare this to the almost constant, but middle range of soil moisture levels found in (b). Both plots are 6 by 6 feet.

in surface soil moisture.[1]

(However, the use of wetting agents is not a substitute for good subsurface drainage.) Under dry, hydrophobic conditions, wetting agents will keep the soil wettable and therefore significantly increase the amount of moisture in the upper soil surface.

Which product is best?

Now that we've established the basics of wetting agents and found that they will generally prevent hydrophobicity in dry weather, while facilitating downward water movement in wet weather, the next question is which product is best? The plethora of wetting agents on the market will vary in cost, application interval, phytotoxicity, and performance. The GCSAA conducted a multiple-site evaluation of several different wetting agents a few years ago. The results showed that wetting agent efficacy depended on location and climate, no clear "winner" emerged. Many new products have been developed since that study. If I were a golf course superintendent, the three main factors I'd consider before purchasing a wetting agent are: 1) What is the application interval? 2) How much will it cost? 3) What is the potential for phytotoxicity, 4) Are the claims backed by independent field trials? From the research I've studied and conducted, most wetting agents perform very well in the field. If field studies show a group of wetting agents to have phytotoxicity and good prevention of LDS, then it simply becomes a cost issue. If a manufacturer is not testing their product in the field, then I recommend you avoid it.

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[1] *When applied to turf with significant thatch, wetting agents will keep the thatch from turning hydrophobic, resulting in a softer feel to the turf which will give the impression that the wetting agent is holding water near the surface. If you have thatch, you should consider this fact (or test it out) before incorporating wetting agents into your maintenance schedule.*