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WETTING AGENTS

How Wetting Agents Work on Wet Ground

A Wisconsin study reveals more on how wetting agents respond in wet weather. *By Doug Soldat*

Superintendents have a plethora of wetting agents to choose from. Each product comes with a relatively non-descript list of proprietary ingredients yet a long list of potential benefits. Only 13% of superintendents surveyed by Karnok and Tucker (2009) indicated that they felt all wetting agents were basically the same in terms of performance. In addition, 72% felt that some wetting agents tend to hold water in the surface of the soil while others tend to keep the soil surface dry by moving water deeper. Indeed, some wetting agent manufacturers claim their products move water down through the root zone, while others claim to hold it near the surface, but others promise to do both. While the claim of doing both seems a bit like double-dipping, it's probably the closest to the truth.

Water has three properties that control its behavior in the soil and elsewhere. First, it has a high degree of cohesion, and therefore, water molecules have a tendency to "stick" to other water molecules. You can see this property the next time you are driving somewhere 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 the second important property: surface tension. Surface tension is a measure of how hard it is to break through the surface of a liquid. The high surface tension of water allows some bugs to walk across its surface. 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 that's the case, cohesive forces overwhelm the adhesive forces and water forms a fairly round droplet (think car wax). 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 across the wettable surface.

In general, wetting agents do two things; first they decrease the surface tension of the water, thus (to quote an oft-used marketing term) making "water wetter." In a soil with only wettable surfaces, decreasing the surface tension should lead to less water being held in the soil pores (remember, it will be flatter). Second, they prevent soils from becoming hydrophobic or non-wettable. Therefore, in a hydrophobic soil, using wetting agents will increase the moisture-holding capacity of the soil compared to an untreated, hydrophobic control area. However, if the soil does not become

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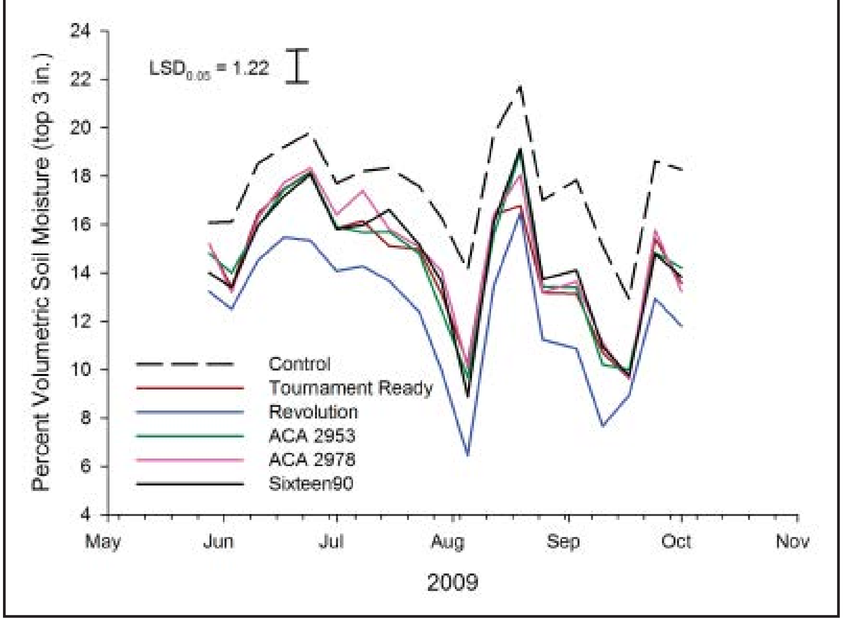
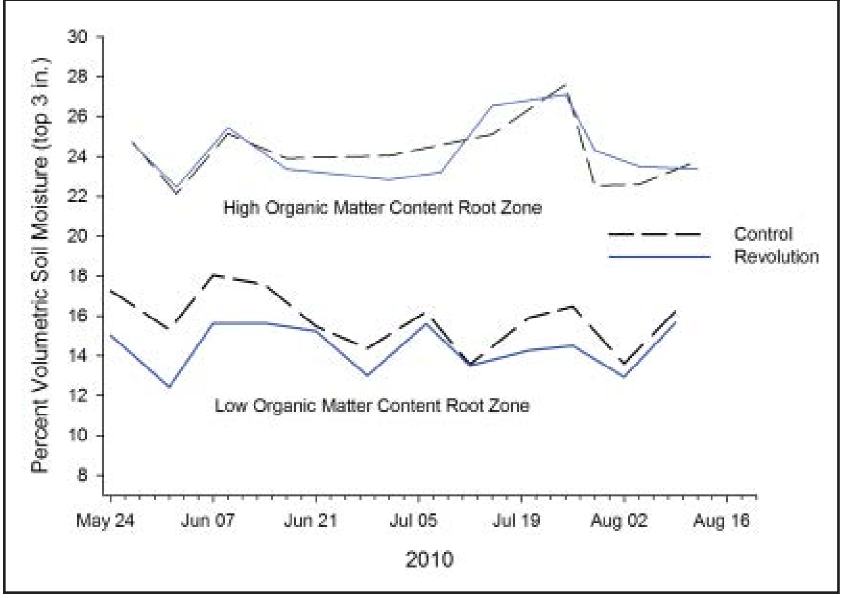
FIGURE 1: 2009 STUDY



Season-long soil moisture content in the upper three inches as affected by various wetting agents applied to a 1-year-old 'A4' creeping bentgrass sand putting green with 0.7% soil organic matter. 2009 was a very wet season.

FIGURE 2: 2010 STUDY



Soil moisture content in the upper three inches as on the same site (low organic matter content) and another higher organic matter content sand putting green in 2010 as affected by Revolution, the only wetting agent re-tested from the 2009 group. 2010 was wet as well, but results are much less pronounced than those seen in 2009.

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hydrophobic, using wetting agents can lead to slightly lower soil moisture than untreated areas. This phenomenon was observed and described in the August 2010 issue of *GCM* (Soldat et al., 2010), when a putting green soil treated with wetting agents (Aqueduct, Primer 604, or Revolution) had lower moisture content than the untreated control early in the season under wet conditions, and greater moisture content than the control later in the season under dry conditions. Hence, the marketing experts can have their cake and eat it too: Some wetting agents can decrease moisture under wet conditions and increase it under hydrophobic conditions. For more information on wetting agents see "Wetting Agents: What are they, and how do they work?" (Karnok et al., 2004).

But now let's take a closer look at some differences among products during two very wet years in Wisconsin. We definitely learned that the behavior of wetting agents can be site specific (soils, weather, etc.) from the 2004 GCSAA Wetting Agent Evaluation (Throssell et al., 2005a, 2005b). With this in mind, the following results are from a one-year-old A4 creeping bentgrass USGA putting green with no amendment. The organic matter content of the root zone averages a paltry 0.7%. The putting green was mowed six days a week at 0.125-inch with a Toro 1000. To this putting green, five wetting agents were applied and compared to a non-treated control. Each treatment was replicated three times in a randomized complete block design. We measured the volumetric soil moisture content in the upper three inches every week with a TDR probe.

The wetting agents evaluated in 2009 included Tournament-Ready from KALO, Inc. and four compounds from Aquatrols: Revolution, Sixteen90, and two experimental products, ACA 2953 and ACA 2978. In 2010, the same study was repeated on the same A4 putting green using other surfactants with only Revolution being the same from 2009. We also tested Revolution versus a control under the exact same conditions except on an 8-year-old L-93 sand-based putting green with about 4% organic matter.

Some wetting agents can decrease moisture under wet conditions and increase it under hydrophobic conditions.

The weather during 2009 was a superintendent's dream. We seemed to have a quarter inch of rain every four or five days with below average temperatures. In the Upper Midwest, 2010 was very hot and wet, which led to lots of dead annual bluegrass all over the state.

Figure 1 shows clear and consistent differences in soil moisture between the wetting agent treatments and the untreated control. For most of the season, the wetting agent treatments had significantly lower soil moisture than the untreated control. While Tournament-Ready, ACA 2953, 2978 and Sixteen90 tended to group together in soil moisture content, Revolution had significantly lower soil moisture than the others for most of the season. These results imply that in a sand-based, low-organic-matter root zone, the wetting agents tested decreased soil moisture, presumably leading to firmer playing conditions compared to the untreated control. Furthermore, it shows that all wetting agents are not identical, and some substantial differences in soil moisture can be seen among products.

In 2010, the only product tested from the 2009 group was Revolution. Again, we tested Revolution on the same low-organic-matter putting green as in 2009, and also on an 8-year-old sand root zone with substantial organic matter accumulation (~4%). Figure 2 shows the difference between the wetting agent treatment and the control on the low-organic-matter root zone is less dramatic in 2010 compared to 2009. The difference also appears to vanish in the high-organic-matter content root zone.

In conclusion, over the last two wet years we have learned quite a bit about how wetting agents behave in wet conditions. It appears that on low-organic-matter sand root zones, wetting agents can decrease the soil moisture content in the upper three inches. However, results vary. We saw differences in the degree to which moisture content decreased from 2009 to 2010. In addition, there was no difference in soil moisture content in 2010 on a high-organic-matter-content sand-based root zone.

This information will help clarify the role that wetting agents play under wet conditions. It would be beneficial for researchers to continue to evaluate and publish the performance of various wetting agents in wet conditions in a variety of soil types and drainage rates (i.e. high surface organic matter and/or poor internal drainage rates). In a perfect world, there would be a set of standard conditions under which all surfactants could be quickly and easily tested in laboratory conditions. Until then, superintendents must make decisions based on experience and peer recommendations, and piece together results from studies conducted under conditions that most closely approximate their own.

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