

Factors to Consider When Developing a Wetting Agent Program

A one-size-fits-all approach to developing a wetting agent program is not possible.

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Sand has a high propensity for hydrophobic conditions, making putting greens the most susceptible surface on a golf course.

There is a seemingly endless pipeline of new wetting agents available to help superintendents address various agronomic and playability challenges. Sifting through manufacturer claims to determine which products fit best in your wetting agent program can be difficult to downright overwhelming. Numerous agronomic and environmental factors influence wetting agent performance in turfgrass. Therefore, understanding how wetting agents interact with water and soils under different agronomic and environmental conditions is critical to developing an effective wetting agent program.

WHAT ARE WETTING AGENTS? A REFRESHER AND UPDATE

Wetting agents are surfactants — i.e., SURFace ACTive AgeNTS — that have been designed to improve moisture retention in hydrophobic — i.e., water-repellent — soils and overall soil moisture uniformity (Zontek and Kostka, 2012). They accomplish this through their ability to reduce the surface tension of water and restore the polar bond between water and soil particles (Bauer et al. 2017). Most wetting agents used in golf course maintenance are designed to uniformly increase water availability to turfgrass, which can ultimately reduce the

amount of water that must be applied to maintain healthy turfgrass.

Wetting agents have become a staple of golf course maintenance. In a 2013 [survey](#) funded by the USGA, more than 90 percent of superintendents reported using wetting agents in their agronomic programs. Numerous chemistries and products have been researched as wetting agents since the 1950s, but recommendations for specific products are difficult to ascertain because results from year to year and region to region are highly variable (Throssell, 2005; and Karnok, 2013). Furthermore, product claims, superintendent anecdotes, and

scientific research on wetting agents often contradict one another, which makes selecting a specific product difficult (Soldat, 2010; Karnok, 2013; and Bauer et al., 2017).

PRODUCT SELECTION

Despite a plethora of claims by manufacturers, many wetting agents provide very similar results on turfgrass. Differences among products may include the need to be watered in after application, tank-mix compatibility, and duration of efficacy. Most important, much of the variability in performance between products likely has little to do with the products themselves. Agronomic and environmental factors such as soil type, amount of organic matter present in the soil, application rate, and soil moisture can play a more significant role in wetting agent performance than product formulation.

Additionally, variation in product use from region to region can have more to

do with product pricing, marketing, and local industry professionals' recommendations than actual differences in product performance. Maximizing the performance of the wetting agent you select begins with knowing how agronomic and environmental factors impact wetting agent performance.

FACTORS INFLUENCING PRODUCT PERFORMANCE

Application timing and intervals:

It is best to treat hydrophobic soil conditions preventatively rather than curatively. Research has shown that applying wetting agents prior to the onset of hydrophobicity can result in fewer localized dry spots (LDS) and an increased ability to rewet soils if they become hydrophobic in the future (Song et al., 2014). Preventative wetting agent applications can also have a positive impact on turf performance during stressful conditions by

increasing water and nutrient availability and promoting deep rooting.

Unfortunately, determining follow-up application rates and intervals is difficult. Recent research indicates that products with higher labeled rates maintain longer residual effects from late fall applications (Bauer et al., 2017). However, a national study showed performance differences between these same products. This indicates that variables such as organic matter concentrations, soil type, and application rates may play a significant role in determining the appropriate application intervals for a given product (Throssell, 2005).

Degree of hydrophobicity: The degree of soil hydrophobicity plays a significant role in the performance of wetting agents. Soils become hydrophobic due to a coating of hydrophobic organic compounds on soil particles (Song et al., 2014). Furthermore, sand-based soils are more likely to be



The two dark areas of this hydrophobic soil core are less hydrophobic than the surrounding soil, which has allowed very limited infiltration.

hydrophobic due to the small specific surface area of sand particles (Song et al., 2014).

Increased application rates and post-application irrigation are needed to rewet soils with high levels of hydrophobicity. Also, additional applications are likely needed for extremely hydrophobic soils to regain their ability to hold moisture.

Pre- and post-application soil moisture: The amount of irrigation applied after a wetting agent application plays a critical role in product performance. Superintendents report varying results with the same product by simply altering post-application irrigation amounts, timing, and intervals. While there is no rule of thumb to guide irrigation after a wetting agent application, when doubt exists, the product should be watered in. Maintaining detailed notes on the irrigation procedures that follow a wetting agent application is critical to achieving and

repeating the desirable results. It is important to take note of the rate at which irrigation was applied. Slow irrigation rates are likely to decrease surface runoff, resulting in more accurate delivery of the wetting agent to its intended target.

Regular soil moisture meter use is imperative to maximize and fine tune the benefits of wetting agents. Soil moisture readings should be taken before and after wetting agent applications to determine how much irrigation is needed to achieve the desired effects of a particular product. Nearly every wetting agent label indicates how much irrigation water should be applied post application. However, few if any take into effect the soil moisture prior to application because other variables such as organic matter content and soil type are at play.

Organic matter: Organic matter concentrations play a considerable role in wetting agent performance

because wetting agents can become strongly bound to organic matter particles in the soil. Putting greens containing elevated levels of organic matter may be less likely to experience the same benefits from some wetting agents as those with low organic matter concentrations (Soldat, 2010).

Wetting agent applications should never replace sound organic matter management practices. Adequate organic matter dilution in the upper portion of the rootzone is the foundation for a healthy, firm putting surface. Excess organic matter will hold more water than desired with or without wetting agent applications. This is not to say wetting agents are not useful, but they should only complement proper organic matter management, not replace it.

It is well known that soil moisture inversely affects surface firmness. A recent two-year study examining the



These research plots show the benefits of wetting agents during drought conditions.



A water droplet test is a quick way to diagnose hydrophobic conditions.

effects of 13 wetting agent products on surface firmness yielded conflicting year-to-year results with the same products (Bauer et al., 2017). Despite some product claims regarding increased firmness, organic matter management and weather are much more likely to influence surface firmness than wetting agents. Some wetting agents also make claims about increased putting green speed. This is something that is also difficult to ascertain under all conditions. If in doubt, ask to see the data.

Soil types: A majority of wetting agent research has been performed on sand-based putting greens because of sand's propensity for hydrophobicity (Song et al., 2014). Although fine-textured soils have a low inclination for hydrophobic conditions, they can still benefit from wetting agent applications even though the results may not be as significant. It is important to note that soils that have been heavily modified with sand — e.g., native soil putting greens, fairways, and tees that have been topdressed with sand — are prone to similar hydrophobicity characteristics as sand-based soils.

Turf species: As mentioned earlier, the depth to which a wetting agent penetrates the soil varies based on organic matter content. Therefore, penetration depth can be controlled with proper organic matter management, wetting agent application rates,

and post-application irrigation. Anecdotal evidence suggests the depth to which a wetting agent penetrates the soil has considerable plant health implications, depending on the depth of root growth. For example, *Poa annua*, with its shallow root system, will likely require lower wetting agent application rates and less post-application irrigation than bentgrass to achieve the same effect.

Weather and seasonality: Superintendents often report that some wetting agents produce unfavorable playing conditions by softening the putting surface, but these claims are not known to have been replicated in research. Seasonal weather could play a role in these observations — specifically hot, humid, and wet conditions.

Spray volume and tank-mixing: When applying wetting agents, high spray volumes should be used so that the product is more easily moved into soil. When used as part of a tank mix with other products, wetting agents can sometimes enhance the efficacy of pesticides and fertilizers. Only tank mix products after determining that they are compatible.

Some pesticides may already contain adjuvants and surfactants to maximize their efficacy. Adding an adjuvant or surfactant to other pesticides could prevent the product from reaching its intended target or, even worse, result in a phytotoxic response.

Always follow labeled instructions when making plant protectant applications.

FREQUENTLY ASKED QUESTIONS

Confused yet? Don't worry, you're not alone. Many superintendents find themselves asking why there is so much variability when evaluating wetting agents. The above factors help us understand why that variability exists. Answering the following common questions about wetting agent use with a combination of anecdotal findings and scientific research can help you develop a successful wetting agent program.

Can wetting agents improve water use efficiency? Yes. Research has shown that wetting agents improve water use efficiency on sand-based putting greens (Soldat et al., 2010). Plots treated with a wetting agent under deficit irrigation — i.e., irrigated to replace only 30 percent of ET losses — yielded similar turf quality as plots irrigated to replace 100 percent of ET losses. During the second year of this two-year study, the deficit-irrigated plots exhibited drought symptoms; however, plots treated with wetting agents recovered by the end of the season while untreated plots did not.

Can wetting agents help manage LDS? Yes. Wetting agents can correct LDS and prevent it from developing. Preventative applications are better because they can improve soil moisture uniformity at lower rates than curative applications. Also, LDS is a problem that is easier to prevent than it is to fix. When making wetting agent applications to large areas, products that persist in the soil for longer periods of time can help reduce reapplication frequency.

Should I use a wetting agent to help flush excess salt from the upper profile? Wetting agents do not necessarily move salts, but they can help move water through the soil profile. This facilitates the flushing of salts, and possibly organic acids, that could contribute to LDS.

Are wetting agents effective on native, fine-textured soils? Yes.



*The surface tension of water is very difficult to break in hydrophobic soils without the use of wetting agents.
Photo by Stan Kostka.*

While fine-textured soils are less prone to hydrophobic conditions, wetting agents can still be an effective tool to maintain healthy turf. As with all wetting agents, make sure to leave an untreated check area to determine if a product is performing as intended.

Can wetting agents help mitigate wet conditions resulting from inclement weather? Yes.

Preventative wetting agent applications have been shown to help reduce soil moisture in the upper profile following heavy rain events (Soldat et al., 2010). However, soils with excess organic matter are less likely to experience this benefit as wetting agents tend to bind to organic matter. Managing organic matter and internal drainage are still the primary means for improving infiltration and surface firmness, but wetting agents can be a great supplement.

Can wetting agents provide firmer playing conditions? Research has not shown wetting agents to provide firmer surfaces under similar irrigation regimes. However, there are two factors to consider when answering this question in a real-world scenario:

1. Moisture uniformity
2. Using less water to maintain healthy turf

It is well documented that wetting agents improve soil moisture uniformity (Karcher et al., 2009). Maintaining uniform moisture in hydrophobic soils is nearly impossible. Oftentimes, turf adjacent to hydrophobic areas becomes overwatered because water applied to them does not penetrate; it moves laterally to the adjacent non-hydrophobic area. Additionally, putting greens with LDS often receive extra irrigation as a result of overcompensation.

Overirrigating non-hydrophobic areas increases the potential for turf decline and inconsistent playing conditions. By improving soil moisture uniformity with wetting agents, a putting green can be irrigated more evenly and with less water. This can indirectly lead to a firmer surface by simply reducing the amount of soil moisture needed to maintain healthy turf.

Will a late-fall application reduce the risk of winter injury on putting greens? Some superintendents make fall applications of wetting agents in an effort to minimize the risk of winter injury related to desiccation or saturated soils. Initial research shows that wetting agents can reduce the potential for winter injury on ultradwarf bermudagrass putting greens, but no research has been conducted on cool-season turf (DeBoer et al., 2017). Making a late-fall wetting agent appli-

cation is not a surefire way to prevent winter injury, but, given the potential benefits, limited risk, and small area to treat, it may be worth considering.

Can wetting agents cause a phytotoxic response? Yes. Some wetting agents have a phytotoxic effect on turf under certain conditions, mainly during hot weather and intense sunlight. Under these conditions, it is common practice to apply sufficient post-application irrigation to move the wetting agent off turf leaf blades and into the soil.

TESTING PRODUCTS

When determining which wetting agent to purchase, keep in mind that many may provide similar results. As with all products, use an untreated test area when evaluating product performance. Maintain accurate and detailed notes regarding application timing, weather, pre- and post-application soil moisture, irrigation amounts, application rates, and any other factors that may impact product performance. Lastly, it is advisable to seek the input of a third-party researcher or a USGA agronomist if you have any questions when selecting a wetting agent.

FUTURE OF WETTING AGENTS

Clearly, there is no one-size-fits-all approach to developing a wetting agent program. Given the myriad of products available, inconsistent research results, and numerous factors that influence their performance, providing a universal wetting agent program is not possible. Ongoing research is investigating how certain wetting agents perform under very specific conditions. Hopefully this will help us better understand these products and their use.

FIGURE 1: Water Droplet Penetration Test

The severity of hydrophobic conditions is based on the time it takes a water droplet to penetrate the soil.

Wettable	0 to 5 seconds
Slightly hydrophobic	6 to 60 seconds
Hydrophobic	60 to 600 seconds
Water repellent	> 600 seconds

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