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"Forte Plus" - A New Approach to Managing Water Repellency in Soils

Since their introduction into turfgrass management, soil surfactants have become staple products in most agronomic plans on golf courses. Their ability to lower the surface tension of water, promote improved water penetration and retention, and improve moisture uniformity in the rhizosphere are features that are integral to preventing and alleviating water repellency in soils, which is a major issue on most highly maintained turfgrass. Nevertheless, questions remain concerning disparate performance, chemistry selection, rates and timing to maximize efficacy across a wide variety of climates, turf types and soil conditions.

When soil surfactant chemistries were originally conceived, the idea was to spray a label-recommended amount of a wetting agent and that would prevent and/or alleviate water repellency in to soils over a set period of time (e.g. 30 days). In many instances, this approach would work well and nothing needed to be changed. However, it was not uncommon to hear reports of poor wetting agent performance from golf courses, even in the same geographic area, when using the same wetting agent chemistry at the same rates.

In the summer of 2015, we did some field work and began to investigate these questions of disparate wetting agent performance and quickly determined that each golf course, even in the same geographic location, had conditions that differed enough that one wetting agent chemistry (and rate) would not be appropriate for every location. Factors such as climate, turf type, soil texture and composition, thatch accumulation, irrigation frequency and amount, cultural practices and irrigation water quality are so variable from one site to the next, it made sense that one chemistry would not the be a perfect fit in every case. For example, one site might need a wetting agent that promoted more rapid penetration of the applied water to keep the surfaces drier during wet conditions while others needed a chemistry that would encourage more water retention in the soil during periods of drought. Some sites needed both.

To address this, we started working with golf courses on some field trials to see what combining wetting agent chemistries could do to (1) determine if we could promote more consistent performance across various varying golf course conditions and (2) add some flexibility to the decision making process when deciding which chemistries to use and at what rates. Moreover, we also did some work in the lab to see what effect surfactant chemistry combinations had one water droplet penetration times. The products we worked with in both trials were Forte (a soil penetrant) and varying polymer-based chemistries (e.g. CounterAct Firm, CounterAct Retain, etc.), thus birthing the program concept of "Forte Plus".

Field Trials:

The feedback we received from the golf courses trying the surfactant combination concept was overwhelmingly positive. Not only were we getting reports of improved performance but that they really liked the flexibility of adjusting their own wetting agent program by varying their rates (or products) as needed throughout the growing season. For example, when conditions were cooler and wetter in the spring, they would continue to use the penetrant chemistry (Forte) and use very little amounts of the polymer chemistries (e.g. CounterAct Firm, CounterAct Retain, etc.). However, when the summer months would approach and temperatures and ET rates were higher, they would still use Forte for the rapid water penetration but would increase the rates of their CounterAct products to promote some water retention in the soil.

The other benefit that we discovered during the field trials was that the rates that were being used were less than conventional chemistry labels would specify, leading to a lower application costs. Whereas conventional surfactant programs (e.g. CounterAct Firm) would specify applying the wetting agent at 190 ml / 100 m^2 every 30 days, a "Forte Plus" program would use Forte at 11 mL / 100 m^2 and CounterAct Firm at 30 – 90 mL / 100 m^2 depending on water repellency pressure.

WDPT in the Lab:

We also did some Water Droplet Penetration Testing (WDPT) with this "Forte Plus" concept to determine the effect that combination wetting agent programs had on penetration and immediately noticed that there were some synergies taking place. Figure 1 shows the water droplet penetration times of CounterAct Firm, Forte and Forte plus CounterAct Firm on fully hydrophobic USGA sands. Remarkably, the WDPT time of the combination treatment was faster than even

Forte alone and the resulting solution (Forte/CounterAct Firm) after penetration could conceivably improve performance of the penetrant by providing some longevity in the form of a heavier polymer chemistry.

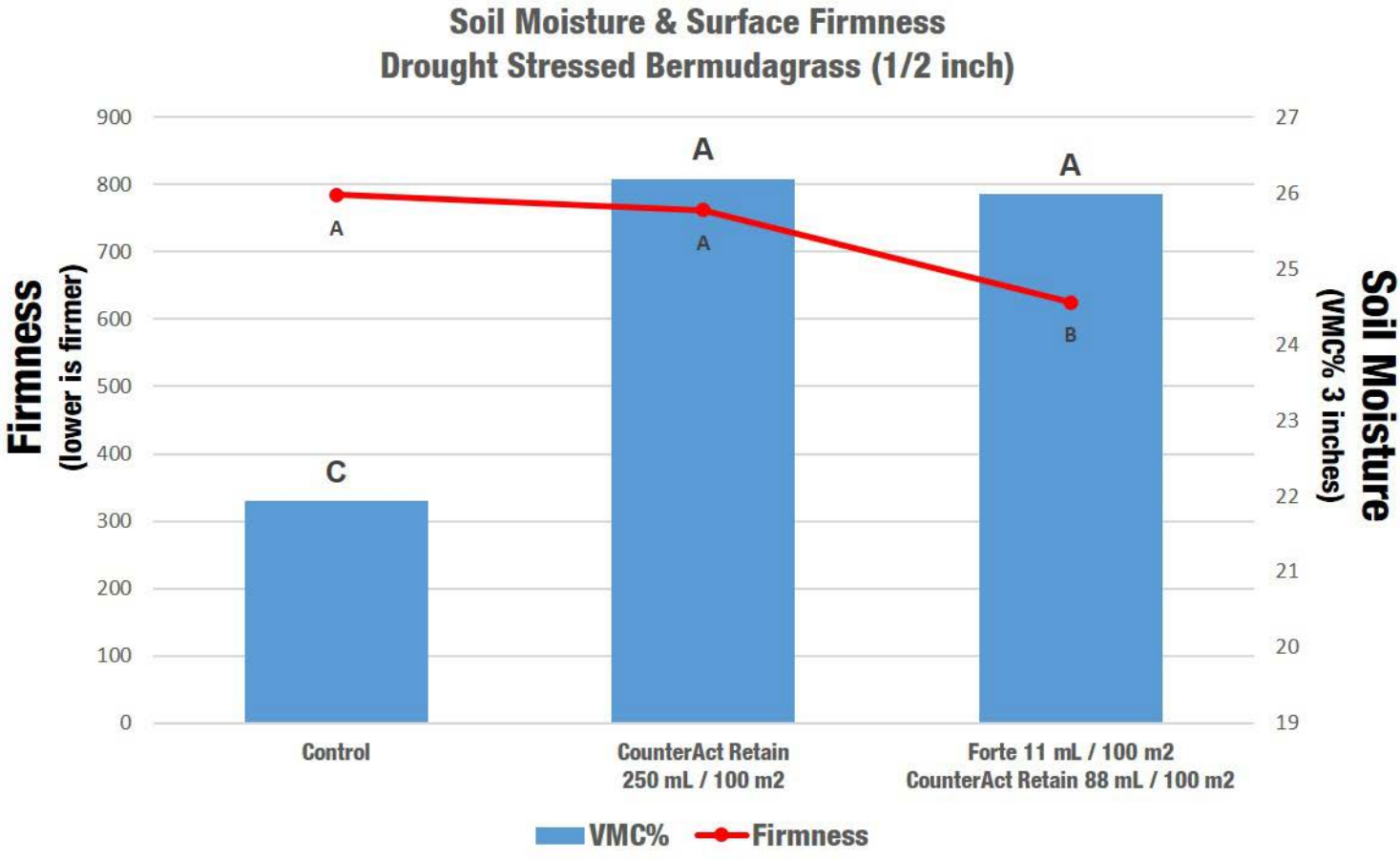
University Research

In 2016, Simplot Partners initiated a multi-year research project with Dr. Bernd Leinauer and his team at New Mexico State University to further explore this concept of "Forte Plus" in an effort to determine how different combinations of wetting agent chemistries performed when subjected to severe drought stress. The studies were conducted on both cool (Perennial Ryegrass) and warm season grasses (Bermudagrass) and drought stress was imposed by irrigating the plots well below required ET replacement (45% for Bermudagrass and 75% for Perennial Ryegrass). Plots were evaluated throughout the growing season by determining, turf quality (1-9 visual ratings), turf color (DGCI), turf health (NDVI), green cover (% from digital analysis of light box images), soil moisture (VMC%), soil uniformity (Std. Deviation) and surface firmness.

Unsurprisingly, after one year, every surfactant treatment outperformed the untreated control in helping to maintain uniform soil moisture and healthy turfgrass even when subjected to severe drought stress and those chemistries that are designed to promote water retention (CounterAct Retain and Rely II), were top performers when evaluated for soil moisture content.

When we look at the results of some of the Forte Plus treatments, we were encouraged to see that the data did support the concept using Forte in combination with other surfactants. For example, comments from the researchers indicated that Forte, in combination with CounterAct Firm, applied to Bermudagrass, resulted in the greatest green cover, dark green color, and the greatest turfgrass quality. Figure 2 does a nice job demonstrating the synergy that we can see with a Forte Plus program. In the data, we see that the addition of Forte to CounterAct Retain, significantly improves surface firmness without compromising the moisture holding capacity of the retention product (even when CounterAct Retain was sprayed below labeled rate).

It will take multiple years of research to gain a more comprehensive understanding of how these "Forte Plus" programs continue to help improve soil surfactant performance and we are excited to have New Mexico State University continue to investigate. However, these last couple of years of field trials, lab testing and university research have shown that there is some merit to using soil surfactant chemistries more flexibly and, by extension, more effectively.



Source: New Mexico State University, 2016

Treatments connected by the same letter are not statistically different at $p < 0.05$

Treatment	Time to Fully Penetrate (# seconds)
CounterAct Firm	9.42
Forte	3.90
Forte + CounterAct Firm	1.97