Soil Surfactant Effects on Soil Moisture Distribution and Wilting Resistance in a Creeping Bentgrass Rootzone

Erik Ervin[1], Xunzhong Zhang[1], Adam Nichols[1], Mike Johnson[2], and Don Spier[2]

[1]Crop and Soil Environmental Sciences, Virginia Polytechnic Institute and State University and [2]Precision Laboratories, Waukegan, Illinois

INTRODUCTION

Uniform absorption and infiltration of rainfall or irrigation on sand-based putting greens promotes creeping bentgrass (*Agrostis stolonifera*) health and reduces site-specific maintenance. Variable accumulation of thatch and mat organic layers often results in development of water-repellant areas of non-uniform moisture absorption. Soil surfactants are often applied in various combinations and timings by golf course superintendents to relieve water repellency and promote infiltration.

OBJECTIVE

- **To determine the effects of three commercially-available soil surfactants on the within-plot distribution of surface soil moisture and resulting creeping bentgrass wilting resistance.**

MATERIALS AND METHODS

This study was conducted on 4-yr old 'Penn A4' creeping bentgrass green mowed 6 times per wk at 3.3 mm. The rootzone sand conforms to USGA physical property recommendations. A fertilization program was followed that supplied 196 kg N ha^{-1}, while providing all other nutrients to maintain chemical soil test values at sufficient levels. Pesticides were applied preventively.

Soil surfactants were applied monthly as detailed in Table 1. Surfactants were watered-in with 5 mm irrigation immediately following surfactant application. Treatments were applied with a CO_2-pressurized (290 kPa) bicycle sprayer at 35 mL m^{-2}. Experimental design was a randomized complete block with four replications. Plot size was 1.8 x 2.7 m.

Irrigation was withheld during the summer to promote wilting events. Volumetric soil moisture content from 0 to 4 cm with a ML2 ThetaProbe (Dynamax, Houston, TX) was measured weekly at 18 equidistant locations in each experimental unit (Figure 1). SigmaScan software (Systat Software, San Jose, CA) was used to make color charts (Fig. 2-5) to visually represent these 18 readings across each plot. Subjective estimates of treatment effects on turf quality and percent plot wilting were made weekly to bi-weekly. Analysis of variance was conducted on data from individual sample days and means separated by LSD (0.05).

Table 2. Percent wilting of 'Penn A4' due to surfactant treatment during summer dry down cycles

	July 26	Aug 18	Aug 28	Sept 13
Treatment	---------- Percent Wilting ----------			
1. Cascade Plus™, then Magnus™	1 b	1 b	6 b	5 ab
2. Magnus™	1 b	1 b	2 b	2 b
3. Revolution™	1 b	2 b	18 ab	11 ab
4. Control	30 a	16 a	30 a	15 a

Figure 1. Use of the ML2 ThetaProbe and grid to take 18 volumetric soil moisture (0-4 cm) readings per plot

Table 1. Application details for the treatments

Treatment number	Treatment	Rate L ha^{-1}	Application dates
1	Cascade Plus™, then Magnus™	25 13	May 15 June, July, Aug, & Sept 15
2	Magnus™	13	Monthly May 15 to Sept 15
3	Revolution™	19	Monthly May 15 to Sept 15
4	Control	--	--

Cascade Plus is a blend of block copolymers and ethoxylated alcohols; Magnus is a blend of ethylene and propylene oxides; Revolution is a C_1-C_4 alkyl ether of methyl oxirane-oxirane copolymers.

RESULTS

- **By late July soil moisture had dropped into the red zone (4-8%, Figure 2) in the control plots resulting in average wilting of 30% (Table 2). All three surfactant programs were keeping soil moisture in the 10 to 22% range, with almost no noticeable wilting.**

- **By Aug 18 more extensive soil drying was apparent on the controls as indicated by increased red area in these plots (Figure 3). Less visual wilting of the controls was observed on this date (Table 2), but was still significantly greater than all three surfactants.**

- **Extensive soil drying was measured on all plots on Aug 25 (Figure 4). Some of the control plots had soil moisture at the 0 to 2% black zone level. Surfactant treatments were in the red, but soil drying was more uniform across plots. Revolution began to show a few hot spots and more of a tendency for localized wilting (Table 2) than the other two surfactant programs.**

- **Following extensive irrigation in early Sept to promote turf recovery, another minor dry down event occurred in late Sept (Figure 5). Control plots dried quicker and showed wilt faster than surfactant treatments. Magnus-alone (trt 2) had less wilt on Sept 13 than the control. Soil moisture levels remained at the yellow-green level (11-20%) longer and in a more uniform pattern due to all three surfactant programs. This occurrence was directly correlated with quicker recovery and maintenance of acceptable turf quality (data not shown).**

SUMMARY

Under extreme dry-down conditions all three surfactant programs maintained soil moisture at higher levels and more uniformly across plots, significantly delaying bentgrass wilting relative to the control.

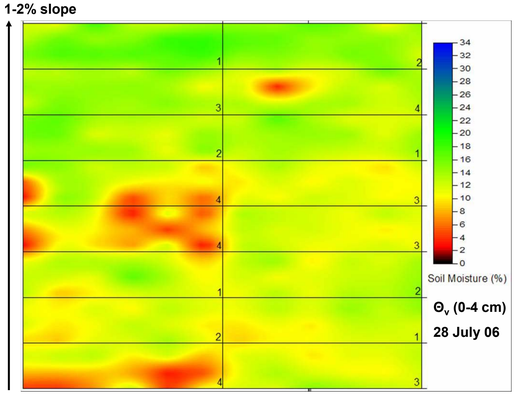

Figure 2. Color chart of volumetric soil moisture from 0-4 cm on 28 July as affected by soil surfactant treatment. Refer to Table 1 for treatment details.

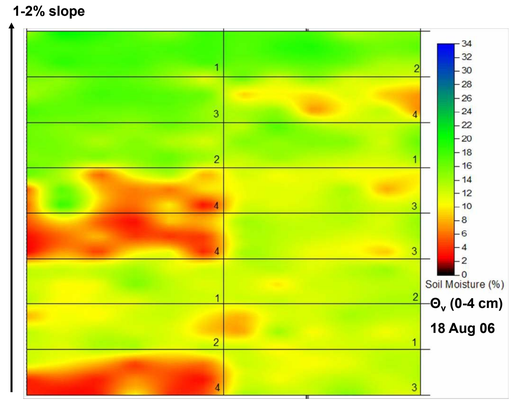

Figure 3. Color chart of volumetric soil moisture from 0-4 cm on 18 Aug as affected by soil surfactant treatment.

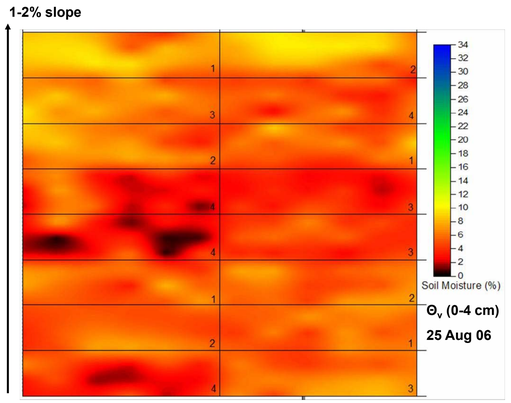

Figure 4. Color chart of volumetric soil moisture from 0-4 cm on 25 Aug as affected by soil surfactant treatment. End of dry-down.

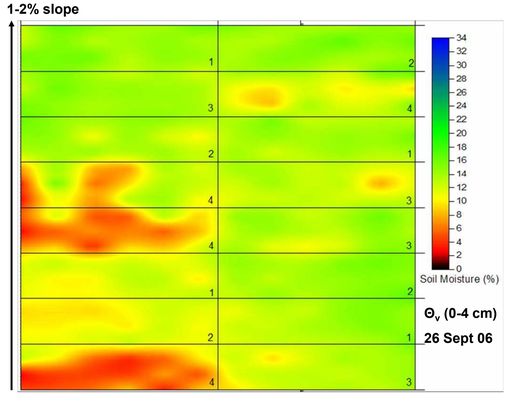

Figure 5. Color chart of volumetric soil moisture from 0-4 cm on 26 Sept as affected by soil surfactant treatment. Irrigation applied to promote recovery.