Annual report on USGA ID#: 2014-09-498

Is It True That Certain Wetting Agents Remove Organic Coatings from Water-Repellent Sand Particles?

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Objectives: To evaluate various wetting agents for effects of removing organic coatings from hydrophobic sand surface.

Soil water repellency, responsible for localized dry spot (LDS), is caused by formation of organic coatings, which builds up on sand surface over time during the decomposition of organic matters. Some wetting agents in turf market acclaim functions of removing organic coatings, and this needs to be confirmed by research-based experiments.

In 2015, we continued the laboratory study, and initiated a two-year field-based experiment. Laboratory experiments utilized naturally occurring hydrophobic sand collected from a USGA green with LDS. Sands were homogenized, and the hydrophobicity level was determined to be "moderate to high", based on water droplet penetration test (WDPT) and molarity of ethanol droplet test (MED; 2.2 molars). Sands were then packed uniformly into a tube system described in the proposal, and selected wetting agents were applied once at the label suggested rates, followed by three sequential washes (Fig 1). Leachates from wetting agents applications and three washes were collected and analyzed for dissolved (DOC) and particulate organic carbon (POC).

Sand Mass (g)	Depth (cm)	Diameter (cm)	Bulk density (g/cm^3)	Particle density (g/cm^3)	Porosity (%)	Pore volume (ml)
254	7.8	5	1.66	2.68	38	58

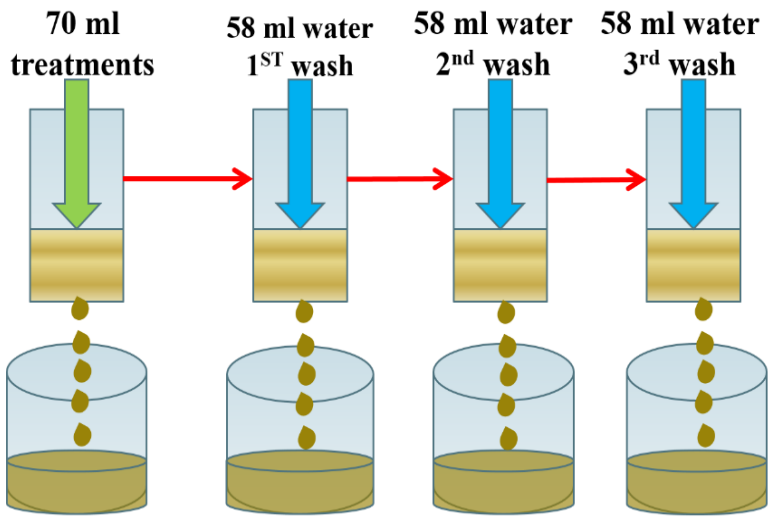

Fig 1. Sand tube properties and a sketch of wetting agent treatment application, followed by three wash events. After homogenization, the hydrophobic sands were packed uniformly to the same bulk density (1.66 g/cm^3), prior to wetting agent application at a higher volume than the pore volume (58ml). Three washing events at pore volume occurred 24h after wetting agent application. All leachates were collected for further analysis.

Three wetting agents in addition to water control

were arranged in a CRD with 3 replications, and the entire experiment was repeated. Data were subjected to ANOVA using Proc mixed procedure in SAS 9.4. No treatment by experimental run interactions occurred, hence, data were pool from the two runs.

Leachates collected after wetting agent application revealed that Matador® and OARS® resulted in 94% water retention, compared to water–treated sand columns (Table 1). Columns treated with OARS® continued water retention after 1st wash, while Matador®-treated columns yielded 12% more leachates compared to control.

Table 1. Leachate volume (ml) after wetting agent (WA) application and each wash event.

Treatment	WA application	1st wash	2nd wash	3rd wash
	---------- ml----------			
Matador	1 c3†	44 a2	55 a1	55 ab1
OARS	1 c3	16 d2	55 a1	56 a1
pHAcid	12 b4	41 b3	52 b2	55 b1
Water	17 a4	39 c3	49 c2	54 ab1

†Means followed by the same letters in each column are not significant different based on Fisher's protected LSD (P<0.05); Means followed by the same numbers in each row are not significant different based on Fisher's protected LSD (P<0.05).

After combining from all leachates, it showed that Matador® and OARS® removed significantly higher amount of organic carbon, especially as dissolved form (Fig 2). These results likely contributed to the reduced hydrophobicity of the treated sands, compared to control.

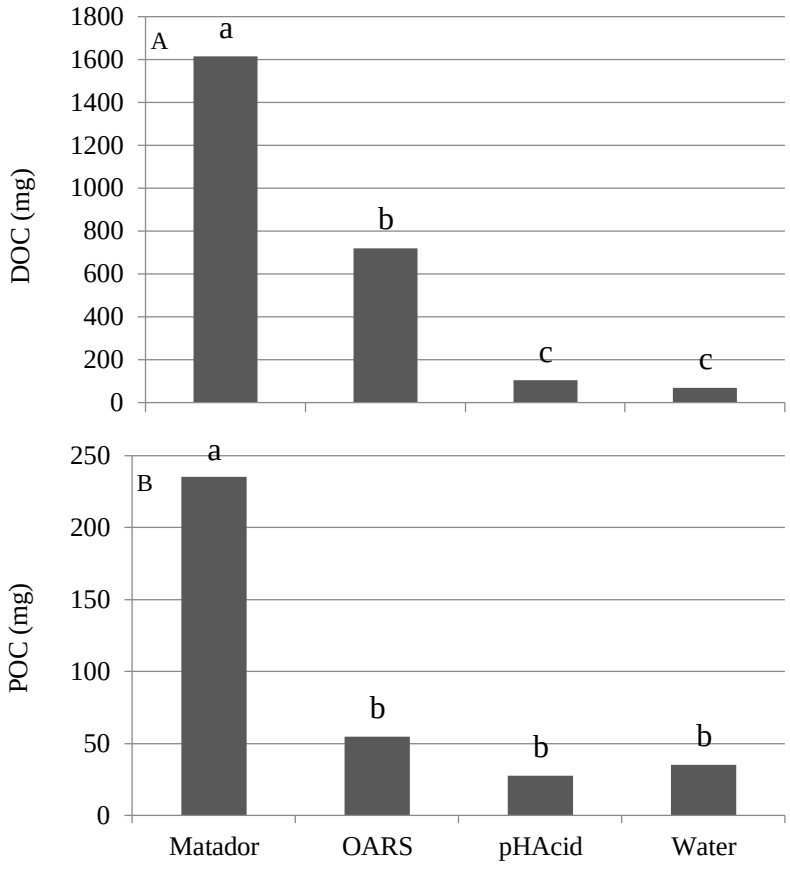

Fig 2. Total output of dissolved (DOC; A) and particulate (POC; B) organic carbon (mg) in all leachates combined after wetting agent application and three wash events. Bars labeled by the same letter were not significantly different based on Fisher's Protected LSD (P<0.05).

Field experiment, arranged as RCBD with 4 replications, involved monthly application (from May to September) of wetting agents described above, in addition to Hydro-Wet®, Tournament-Ready®, and Cascade Plus®. Hydrophobicity, measured as MED at 0-5 months after the initial treatment application (MAIT) showed that reduced hydrophobicity following applications of all wetting agents to various extents, with the only exception of pHAcid® (Table 2).

Table 2. Treatment effect on soil hydrophobicity, measured by molarity of ethanol droplet test (MED; molar) at 1 inch soil depth, from 0 to 5 months (May to October, respectively) after initial treatment application (MAIT).

Compound	0 MAIT	1 MAIT	2 MAIT	3 MAIT	4 MAIT	5 MAIT
	----------MED (molar) ----------					
Control	3.0 a3[†]	3.1 b23	3.3 a12	3.4 a1	3.1 a23	3.3 a12
pHAcid	2.9 a3	3.4 a1	3.2 a2	3.3 ab12	2.9 b3	3.1 ab23
Hydro-Wet	3.0 a1	3.1 b1	3.0 b1	3.1 bc1	2.6 c2	2.9 bc1
Tournament	3.0 a1	3.1 b1	3.1 a1	3.1 bc1	2.3 d3	2.7 cd2
OARS	3.0 a12	3.1 b1	2.8 b23	3.0 c12	2.3 d4	2.7 cd3
Matador	3.0 a1	3.1 b1	2.9 b12	2.7 c23	2.4 d4	2.6 d34
Cascade	2.9 a1	2.9 b1	2.9 b1	2.9 c1	2.3 d3	2.6 d2

[†]Means followed by the same letters in each column were not significantly different based on Fisher's protected LSD at $P<0.05$; Means followed by the same numbers in each row were not significantly different based on Fisher's protected LSD at $P<0.05$.

Summary

- Certain selected wetting agents were able to remove organic carbons from the sand-wetting agent system;
- Field experiment confirmed the effect of selected wetting agents, although the mechanism is yet to be determined.
- Research in 2016 will continue the field experiment, and focus on assessing sand particles by Scanning Electron Microscope.