THE INFLUENCE OF WETTING AGENTS AND GYPSUM ON SOIL PHYSICAL PROPERTIES

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Introduction: For as long as turf has been utilized for recreational purposes, compaction has posed a major problem for turf managers. Numerous investigations have centered on alleviating compaction. This includes common maintenance practices such as periodic cultivation, as well as proper construction techniques and addition of physical and chemical soil amendments. Only a few studies have examined the effects of wetting agents and/or gypsum on compacted soils. Wetting agents are routinely applied in combination with pesticides for improved effectiveness or on hydrophobic soils to increase wettability. Gypsum applications on turf have been limited to problem salt areas and as a source of calcium and/or sulfur where pH alteration is not wanted.

Wetting Agent Experiment

Many questions have arisen as to the effects of wetting agents on water in non-hydrophobic soils. Naiden (2) observed that Aqua-Gro reduced the bulk density of a heavily trafficked fairway. Morgan et al. (1) noted an increased infiltration rate on an uncompacted sandy loam when treated with Soil Penetrant. However, many other studies have shown no beneficial responses attributed to wetting agents.

This experiment was conducted to determine the effects of Hydro-Wet and Aqua-Gro on the structure of three soils. The wetting agents were applied at the rate of 0,25 ppm and 250 ppm, where 25 ppm is a "typical" rate applied to turf. Table 1 contains the compaction level applied percentages of sand, silt and clay and % moisture of field capacity (1/3 bar) for three soils. The compaction levels were selected after preliminary laboratory testing.

TABLE 1. PHYSICAL CHARACTERISTICS AND COMPACTION LEVELS FOR THREE SOILS IN THE WETTING AGENT EXPERIMENT

Soil Type	Sand	Silt	Clay	Compaction	1/3 bar Moisture by weight
	------------	%	------------	-psi-	-%-
Southgate clay loam	41.4	30.4	28.2	7	30.8
Hodunk sandy loam	73.0	18.6	8.4	66	15.8
Morley sandy loam	57.6	27.4	15.0	66	23.8

Saturated hydraulic conductivity (water flow through soil) and bulk density for the various treatments are shown in Table 2. It is obvious that all treatments and soils had very low hydraulic conductivities and high bulk densities indicating extremely compacted conditions. There was no meaningful influence of wetting agents on the Southgate clay loam or the Morley sandy loam. However, in the case of the Hodunk sandy loam, Hydro-Wet at 250 ppm and Aqua-Gro at 25 ppm increased the hydraulic conductivity by 1 mm per hour (or 1 inch per day) although these data have not yet been analyzed statistically. This increased hydraulic conductivity from a practical standpoint may not be significant. Bulk density was not influenced by any of the treatments.

TABLE 2. EFFECTS OF WETTING AGENT TREATMENTS ON SATURATED HYDRAULIC CONDUCTIVITY AND BULK DENSITY.

Soil Type	Wetting Agent	Rate of Application	Hydraulic Conductivity	Bulk Density
		ppm	mm/hr	g/cc
SCL*	0	0	0.18†	1.35
SCL	Hydro-Wet	25	0.06	1.35
SCL	Hydro-Wet	250	0.08	1.35
SCL	Aqua-Gro	25	0.10	1.35
SCL	Aqua-Gro	250	0.10	1.36
HSL	0	0	1.35	1.62
HSL	Hydro-Wet	25	1.47	1.61
HSL	Hydro-Wet	250	2.33	1.61
HSL	Aqua-Gro	25	2.28	1.61
HSL	Aqua-Gro	250	1.58	1.62
MSL	0	0	0.06	1.45
MSL	Hydro-Wet	25	0.08	1.45
MSL	Hydro-Wet	250	0.08	1.45
MSL	Aqua-Gro	25	0.08	1.45
MSL	Aqua-Gro	250	0.03	1.45

* SCL, HSL and MSL refer to Southgate clay loam, Hodunk sandy loam and Morley sandy loam, respectively.

† Each number is an average 6 values

Table 3 contains oxygen diffusion rates (ODR) and soil moisture content at time of ODR measurements. The ODR's for all treatments and soils were relatively low (the minimum critical ODR for root growth of moist turf species range from 5 to 20 g of O_2 X 10^{-8} cm $^{-2}$ min^{-1}). The low ODR can be attributed to high soil moisture content.

TABLE 3. EFFECTS OF WETTING AGENT TREATMENTS ON OXYGEN DIFFUSION RATES (ODR) AND SOIL MOISTURE CONTENT.

Soil Type	Wetting Agent	Rate of Application	Days of Draining: 2 — Soil depth (cm): 2	2 — 4	4 — 2	4 — 4	2 — Moisture, by Weight	4 — Moisture, by Weight
		ppm	-- g of $O_2 \times 10^{-8}$ cm^{-2} min^{-1} --				---- % -----	
SCL*	0	0	8.0†	8.2	8.9	8.1	34.7	33.3
SCL	Hydro-Wet	25	9.4	10.3	10.1	8.5	34.8	33.2
SCL	Hydro-Wet	250	9.1	8.9	10.1	8.8	34.6	33.5
SCL	Aqua-Gro	25	8.8	8.3	8.1	8.5	35.0	33.8
SCL	Aqua-Gro	250	9.7	9.8	8.5	8.7	34.9	33.8
HSL	0	0	10.3	10.9	9.1	10.3	24.0	23.3
HSL	Hydro-Wet	25	10.6	10.7	14.9	9.5	24.1	23.3
HSL	Hydro-Wet	250	11.1	11.1	12.3	9.6	24.1	23.2
HSL	Aqua-Gro	25	10.4	11.2	8.2	9.3	24.3	23.4
HSL	Aqua-Gro	250	10.6	11.0	15.0	9.8	24.2	23.4
MSL	0	0	13.1	12.9	10.2	9.4	31.1	30.0
MSL	Hydro-Wet	25	13.7	13.5	12.7	10.4	31.8	30.9
MSL	Hydro-Wet	250	14.4	14.0	10.2	10.0	31.4	30.5
MSL	Aqua-Gro	25	12.9	13.4	9.7	9.8	30.1	29.3
MSL	Aqua-Gro	250	13.9	13.7	10.1	9.8	30.0	29.2

* SCL, HSL and MSL refer to Southgate clay loam, Hodunk sandy loam and Morley sandy loam, respectively.

† Each number is an average of 30 readings.

Hydro-Wet and Aqua-Gro appeared not to dramatically improve or adversely alter the soil structure. Further research is in progress examining lower compaction rates to determine if these wetting agents improve water movement in the soil and reduce susceptibility of the soil to compaction.

Gypsum Field Studies

Four field experiments were initiated in 1976 to investigate the effects of gypsum (calcium sulfate) on physical properties of fine textured soils. The field plot locations, rates of gypsum applied, application methods and treatment dates are shown in Table 4. On Dearborn Country Club, Bay County Golf Course and Oakland County grounds gypsum was surface applied to 5' x 7' plots of established turf. In the Southgate Golf Course study the treatments were applied to the soil surface, incorporated into the top four inches and seeded the following day with a blend of several Kentucky bluegrasses.