RESEARCH REPORT

MARCH 2000

Irrigation Efficiency as Affected by Cascade™ Plus

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WP-0300CP

INTRODUCTION

Water-repellent soils have been observed for many years in grasslands (1) forests (3) and citrus groves (4). They have become an increasing problem on golf greens since 1960, when the United States Golf Association recommended that golf green topsoil mix should contain at least 90% sand (15). Symptoms of these water-repellent soils begin as small irregular shaped areas of turfgrass known as localized dry spots (3,4,6,7,8,9,10,14,17). If left untreated, these areas can increase in size and become excessively dry. Large areas of turfgrass can be severely damaged. Research has shown that the sand particles in the localized dry spots are covered with an organic coating, which renders them water repellent (4,5,6,7,8,9,10,11,14). The problem is most evident during late spring, summer and early fall.

Currently, hand watering, syringing, coring and the use of wetting agents are the best methods for controlling localized dry spots (4,5,6,7,8,9,10,14,17) caused by water-repellent soils. It is generally known that wetting agents can increase water infiltration into water-repellent soils. However, little research has been conducted on the effects of wetting agents on irrigation efficiency in golf green situations. Therefore, the objective of this research was to determine the effects of Cascade Plus on irrigation efficiency.

MATERIALS AND METHODS

The irrigation efficiency experiment was initiated January 13, 2000 in the University of Georgia Agricultural Greenhouses. The experiment was conducted using 25.4 cm diameter x 25.4 cm deep (10-inch diameter x 10-inch deep) pots which had been filled with non-water-repellent soil and water-repellent soil to simulate a localized dry spot on a golf green. Pots were filled with non-water-repellent soil (85% sand and 15% peat) to a depth of 19.0 cm (7.5 in.) and packed to a bulk density of 1.4 g/cm^3. A 7.6 cm diameter x 6.4 cm deep (3-inch diameter x 2.5-inch deep) paper cylinder was placed in the center of the pot on top of the non-water-repellent soil. The cylinder was packed to the top of the pot with water-repellent soil. The water-repellent soil was packed to a bulk density of 1.4 g/cm^3. Non-water-repellent soil was packed around the paper cylinder to the top of the pot. The non-water-repellent soil around the paper cylinder was also packed to a bulk density of 1.4 g/cm^3.

After the pots were packed with soil, the paper cylinder was carefully removed from the pot, leaving a 7.6 cm diameter x 6.4 cm deep (3-inch diameter x 2.5-inch deep) cylinder of water-repellent soil in the center of the pot to simulate a localized dry spot on a golf green. Initial volumetric soil water content (VWC) of the water-repellent soil was determined before treatment application. Initial VWC of the Cascade Plus-treated pots and control pots was 1.9% and 1.4%, respectively. Treatments were applied to the pots with a watering can. The following treatments were applied:

l.) Cascade Plus - 50.9 l/ha (16 oz./1000 ft^2) in 20,372.5 liters of water/ha (50 gallons of water/1000 ft^2)

2.) Control

Irrigation was applied in 1.3 cm (0.5 in.) increments and volumetric soil water content of the water-repellent soil was determined after each irrigation application. When the VWC of the water-repellent soil reached 15%, irrigation was terminated. Irrigation efficiency was determined by calculating the amount of water needed to raise the VWC of the water-repellent soil to approximately 15%.

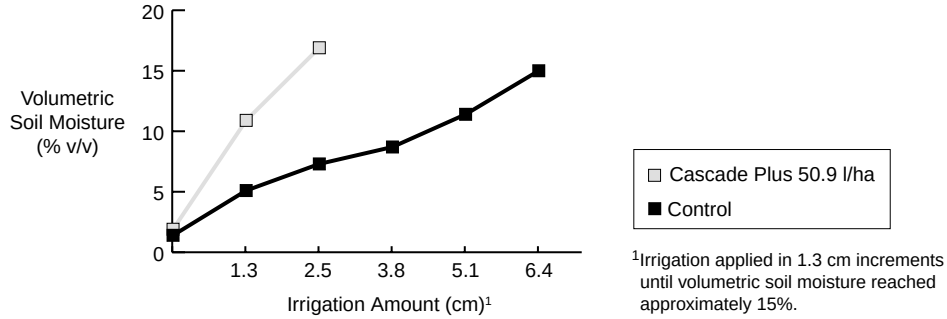
Volumetric soil water content (VWC) of the water-repellent soil was determined by time-domain reflectometry (TDR) (13). A single pair of stainless steel rods was inserted into the soil at a parallel distance of 1.9 cm (0.75 in.). The rods were 5.1 cm (2.0 in.) in length and had a diameter of 0.32 cm (0.13 in.). Soil electromagnetic capacitance was determined by pulsing a wave down the soil probes with a Trime-FM (Mesa Systems Co., Framingham, MA). The Trime-FM monitored the reflectance pattern and converted the readings into VWC (% volume/volume). The VWC readings were recorded from the LCD data screen on the Trime-FM. Four VWC readings of the water-repellent soil were taken per pot. Experimental design was a randomized complete block with four replications per treatment. Data were subjected to analysis of variance (ANOVA) procedures with treatment means separated by Duncan's Multiple Range Test at the 0.05 level of probability.

RESULTS AND DISCUSSION

Cascade Plus can increase irrigation efficiency

No difference in VWC was observed before treatment application **(Table 1 and Figure 1)**. After 1.3 cm (0.5 in.) and 2.5 cm (1.0 in.) of water had been applied, the VWC of the water-repellent soil in the treated pots was significantly higher than the VWC of the water-repellent soil in the control pots. The VWC of the water-repellent soil in the treated pots was 16.9% after 2.5 cm (1.0 in.) of water had been applied. Therefore, irrigation of the treated pots was terminated after 2.5 cm (1.0 in.) **(Table 1 and Figure 1)**. After 3.8 and 5.1 cm (1.5 and 2.0 in.) of water had been applied to the control pots, the VWC of the water-repellent soil was significantly less than the VWC of the water-repellent soil in the treated pots after 2.5 cm of water had been applied (16.9%) **(Table 1 and Figure 1)**. VWC of the water-repellent soil in the treated pots was 15.0% after 6.4 cm (2.5 in.) of water had been applied. Therefore, the data indicate that an additional 3.8 cm (1.5 in.) of water had to be applied to the control pots before the VWC of the water-repellent soil was comparable to the VWC of the water-repellent soil in the treated pots after only 2.5 cm (1.0 in.) had been applied **(Table 1 and Figure 1)**. Under the conditions of this study, it appears that Cascade Plus can increase irrigation efficiency. The data indicate that dry (VWC – 1.4%), untreated water-repellent soil requires more than twice as much irrigation to reach a comparable VWC of Cascade Plus-treated, water-repellent soil.

Figure 1. Volumetric soil moisture as affected by Cascade Plus.



[1]Irrigation applied in 1.3 cm increments until volumetric soil moisture reached approximately 15%.

Table 1. Volumetric soil moisture as affected by Cascade Plus.

Cascade Plus – 50.9 l/ha		Control	
Amount of Irrigation (cm)[1]	VSM (% v/v)[2]	Amount of Irrigation (cm)	VSM (% v/v)
0.0	1.9a[3]	0.0	1.4a
1.3	10.9a	1.3	5.1b
2.5	16.9a	2.5	7.3b
—	16.9a	3.8	8.7b
—	16.9a	5.1	11.4b
—	16.9a	6.4	15.0

[1] Irrigation applied in 1.3 cm increments until volumetric soil moisture reached approximately 15%.

[2] VSM – Volumetric Soil Moisture (% v/v).

[3] Means in the same row joined by the same letter are not significantly different at the 0.05 level of probability according to Duncan's Multiple Range Test.

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