Wetting Agent Effects on Rootzone Moisture Distribution Under Various Irrigation Regimes – Year 2 Summary

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Photo by Doug Karcher

Localized dry spot with minimal dew formation on untreated plots and border areas surrounding a wetting agent trial.

Summary. It is not clear how various wetting agent products affect moisture distribution throughout sand-based putting green rootzones. The objective of this research was to determine how localized dry spot (LDS) incidence, and soil moisture content and uniformity were affected by the application of five commercially available wetting agents. Wetting agents were applied during the 2008 and 2009 growing season and evaluated under conditions of frequent, moderate, and infrequent irrigation application. All of the wetting agents tested in this study significantly reduced LDS formation compared to the untreated control following a prolonged period of infrequent irrigation. In addition, none of the wetting agents significantly increased soil moisture values during periods of frequent or moderate irrigation. All wetting agent products significantly increased soil moisture uniformity compared to the untreated turf during periods of moderate and infrequent irrigation. These results suggest that these wetting agents can be used to effectively manage LDS and improve root-zone moisture distribution.

Abbreviations: LDS, localized dry spot

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Previous research on wetting agent efficacy (when applied to sand-based putting greens) has focused primarily on evaluating water drop penetration times or visual localized dry spot (LDS) symptoms. This research has demonstrated that most commercially-available wetting agents are effective in reducing soil hydrophobicity and decreasing LDS symptoms. However, many golf course superintendents are also concerned about how wetting agent applications affect soil moisture distribution throughout the putting green rootzone. A common belief is that some wetting agents move water rapidly through the rootzone while other products retain considerable moisture near the surface; but there are little data to substantiate such claims. Furthermore, there is variation in how irrigation practices are adjusted following wetting agent application, complicating the underlying cause of undesirable wetting agent effects. Some superintendents may not alter their irrigation practices, despite adding a wetting agent to their putting green management program. This may explain some of the anecdotal evidence that suggests wetting agent application contributes to excessive surface moisture and exacerbates summer bentgrass decline.

The objective of this research was to determine how commonly used wetting agents affect rootzone moisture distribution when applied to a sand-based putting green under wet, moderate, and dry irrigation regimes. This report summarizes the second year of treatments and evaluations for this project.

Materials and Methods

This experiment was conducted from June through August in 2008 and 2009 at the University of Arkansas Research and Extension Center in Fayetteville on a creeping bentgrass (*Agrostis stolonifera* cv. L-93) putting green built according to United States Golf Association specifications. The green was mowed at a 0.125 inch height six days per week and otherwise maintained under typical golf course conditions (Table 1).

Wetting agent treatments consisted of five commercially available wetting agent products plus an untreated control (Table 2). Treatments were applied according to manufacturer's label instructions and irrigated with 0.25 inch of water following application. Treatments were applied monthly from 8 June through 3 August, except for Cascade Plus, which was applied only on 8 and 15 June. Each treatment was applied to four replicate plots, measuring 6 by 6 ft each. Treatments were applied to the same plots in 2008 and 2009. Irrigation was applied judiciously (daily), moderately (every 2-3 d), and sparingly (only under severe drought stress) following the June, July, and August treatment applications, respectively, to compare the wetting agents under a range of irrigation management regimes and resultant soil moisture conditions.

Treatments were evaluated for LDS incidence and soil moisture characteristics. Localized dry spot incidence was rated weekly as a visual estimate of the percentage within each plot affected with LDS. Volumetric soil moisture was evaluated twice monthly by taking 36 measurements on a 1 by 1 ft grid at three sampling depths (3, 5, and 8 inch) within each plot with time domain reflectometry moisture probes (TDR 300, Spectrum Technologies, Plainfield, Ill., USA). From the moisture data, average rootzone moisture content and soil moisture variance (measured by standard deviation; n = 36) were calculated for each wetting agent at each sampling depth.

Results and Discussion

LDS incidence. Wetting agent treatment did not affect LDS incidence from June through mid July, while the experimental area received judicious and moderate irrigation. However as the irrigation regime transitioned from moderate to sparing in late July, wetting agent treatments significantly affected LDS incidence from then until the end of study (Fig. 1 and 2). From 29 July through the end of the study, all of the wetting agent products significantly reduced LDS incidence compared to the untreated control, except for Tricure on 29 July. After 29 July, there were no significant differences among wetting agents in LDS incidence.

Turf quality. Turf quality was significantly affected by treatments at the beginning of the trial (18 June) and from 6 August through the end of the study (Fig. 3). On 18 June, the untreated control had significantly lower quality than all of the wetting agent treatments, except for Cascade Plus. These differences were likely residual effects from the severe LDS formation that was present on the control plots during 2008. From 6 August through the end of the study, the untreated control had significantly lower quality than all of the wetting agent treatments, primarily due to high LDS incidence in the control plots (Fig. 2). There were no differences in turf quality among the wetting agent products throughout the study.

Soil moisture content. Soil moisture content was significantly affected by both sampling depth and wetting agent treatment. On average, volumetric soil moisture content at the 3, 5, and 8 inch depth was 21.5%, 15.0%, and 12.9%, respectively. The higher moisture content near the rootzone surface is most likely due to a higher concentration of organic material, which increases soil moisture retention.

There was a significant wetting agent treatment by evaluation date interaction with regard to soil moisture content. Since the wetting agent treatment by evaluation date by depth interaction was not significant, soil moisture content as affected by wetting agent will be discussed as averaged across sampling depths.

The only evaluation date on which wetting agent treatments significantly affected soil moisture content was 27 August, the final evaluation date, which followed a period of infrequent irrigation (Fig. 4). Earlier in the trial, when the experimental area was irrigated judiciously, turf treated with wetting agent had similar soil moisture content as untreated turf, regardless of the wetting agent product. Therefore, these wetting agents did not retain excessive moisture while the experimental area was kept relatively wet. On the final evaluation date, following a period when the experimental area was irrigated infrequently, the untreated control had significantly lower soil moisture content than all of the wetting agents, except Tricure.

Soil moisture variation. Soil moisture variation was significantly affected by both sampling depth and wetting agent treatment. On average, moisture was more uniform deeper in the rootzone. Soil moisture was significantly more variable at 3 inches than at 5 inches, and also at 5 inches than at 8 inches.

As with the soil moisture content evaluations, there was a significant wetting agent treatment by evaluation date interaction with regard to soil moisture variation, but the wetting agent treatment by evaluation date by depth interaction was not significant. Therefore, soil moisture variation, as affected by wetting agent, will be discussed as averaged across sampling depths.

Throughout the trial, the untreated turf had the highest variation in soil moisture, and was significantly more variable than all of the wetting agent treatments on the final three evaluation dates (Fig. 5). Although soil moisture content was not significantly affected by wetting agent treatments on 30 July and 13 August, soil moisture uniformity was significantly improved during that period. There were no differences among the wetting agent products with regard to soil moisture variability.

Conclusions

Based on the 2009 data, all wetting agent products appear to effectively reduce LDS incidence and increase soil moisture uniformity, over a wide range of depths (3 to 8 inch) compared to untreated turf. This should translate to more efficient irrigation management, allowing for longer periods between irrigation events and reduced hand-watering since isolated areas of drier rootzone conditions are less likely when using these wetting agents. In addition, there is no evidence that these wetting agents significantly increase surface soil moisture during periods of frequent irrigation or rainfall. These results suggest that these commonly used wetting agents can be used to manage LDS without adversely affecting rootzone moisture.

Table 1. Maintenance of the experimental area.

Maintenance practice	Description
Mowing	Six times per week at a 0.125 inch mowing height.
Fertility	0.5, 0.1, and 0.5 lb of N, K_2O, and P_2O_5, respectively, per 1000 ft^2 per month of active growth. Other nutrients applied according to soil test recommendations.
Irrigation	Frequent (June) – daily to prevent any drought stress symptoms. Moderate (July) – as needed to prevent moderate drought stress symptoms. Infrequent (August) – only to prevent extreme drought stress symptoms.
Growth regulation	Primo Maxx (trinexapac-ethyl) applied at 1/8 oz. per 1000 ft^2 per month of active growth.
Wetting agent application	Applied as treatment (see Table 2).
Cultivation	Hollow tine cultivation performed to affect 5% of the surface in the spring and fall.
Sand topdressing	Sand topdressing applied every 14 days throughout the growing season at an approximate rate of 4 ft^3 sand per 1000 ft^2.
Pesticides	Applied only on a curative basis.

Table 2. Wetting agent treatments.

Treatment	Description	Manufacturer
1. Control	Untreated control	
2. Cascade Plus	2 app's @ 8oz / 1000 ft^2 (7 days apart)	Precision Labs, Inc. (Waukegan, IL)
3. Magnus	4 oz/ 1000 ft^2 monthly	Precision Labs, Inc. (Waukegan, IL)
4. TriCure AD	6 oz / 1000 ft^2 monthly	Mitchell Products (Millville, NJ)
5. Revolution	6 oz / 1000 ft^2 monthly	Aquatrols, Inc (Paulsboro, NJ)
6. Primer Select	4 oz / 1000 ft^2 monthly	Aquatrols, Inc (Paulsboro, NJ)

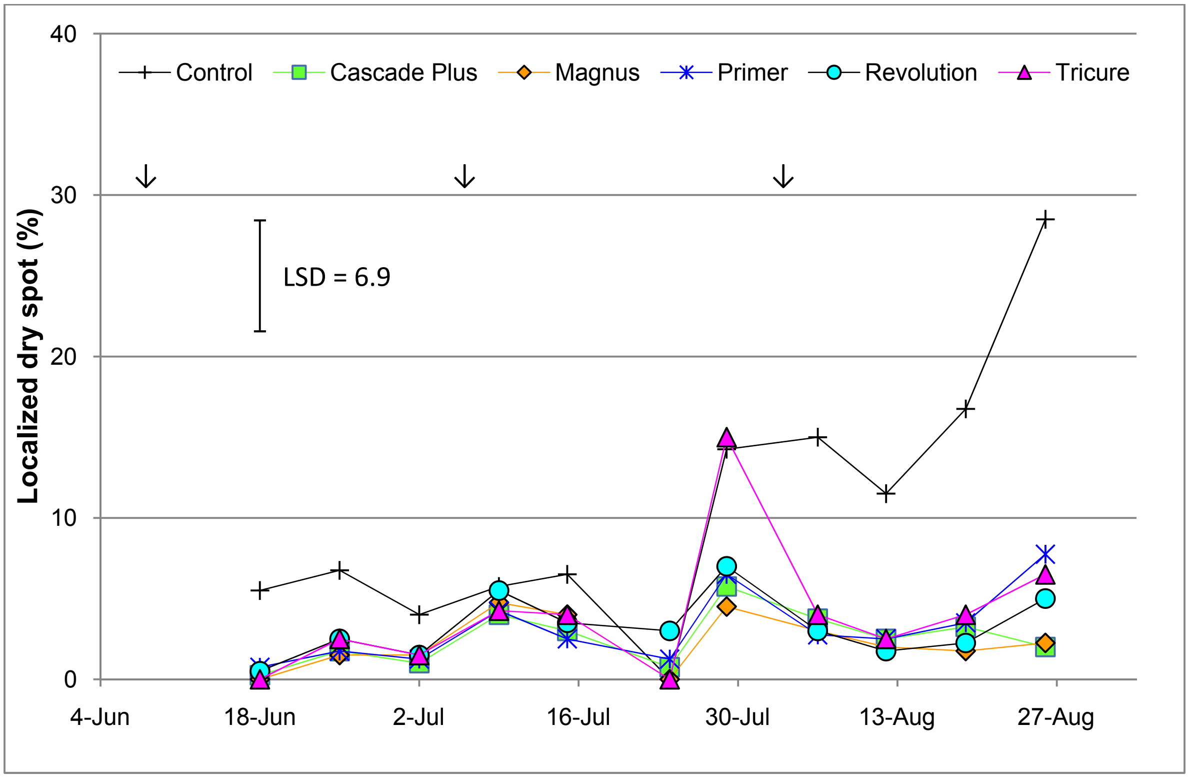

Fig. 1. Localized dry spot incidence as affected by wetting agent treatment. Arrows indicate wetting agent application dates (except for Cascade Plus, which was only applied on 8 and 15 June). Error bar represents Fisher's least significant difference (α = 0.05) for comparing treatments within evaluation dates.

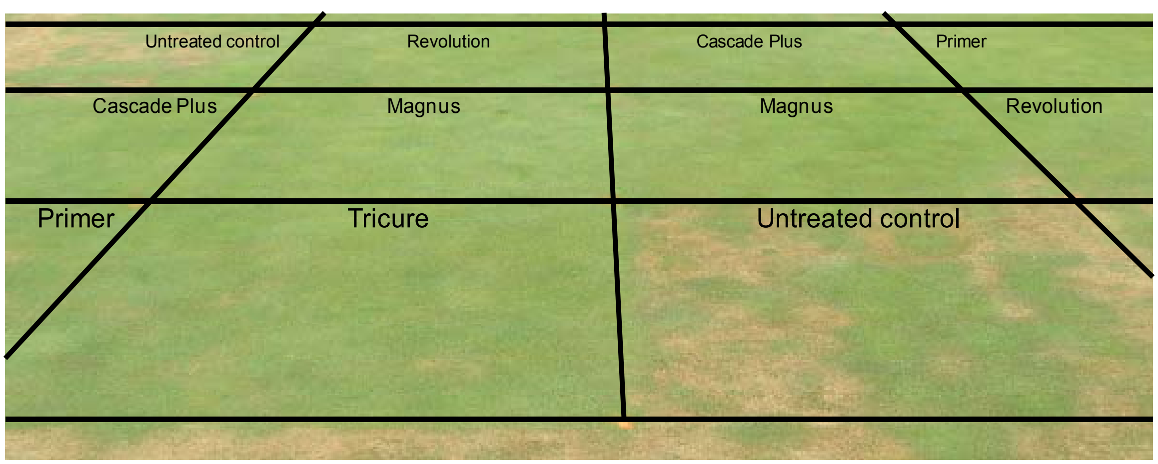

Fig. 2. Localized dry spot incidence on several plots in the trial following a prolonged period of drought stress. Note the LDS on the untreated control plots and the untreated border of the experimental area at the bottom of the photo. Photo taken on 26 August 2009.

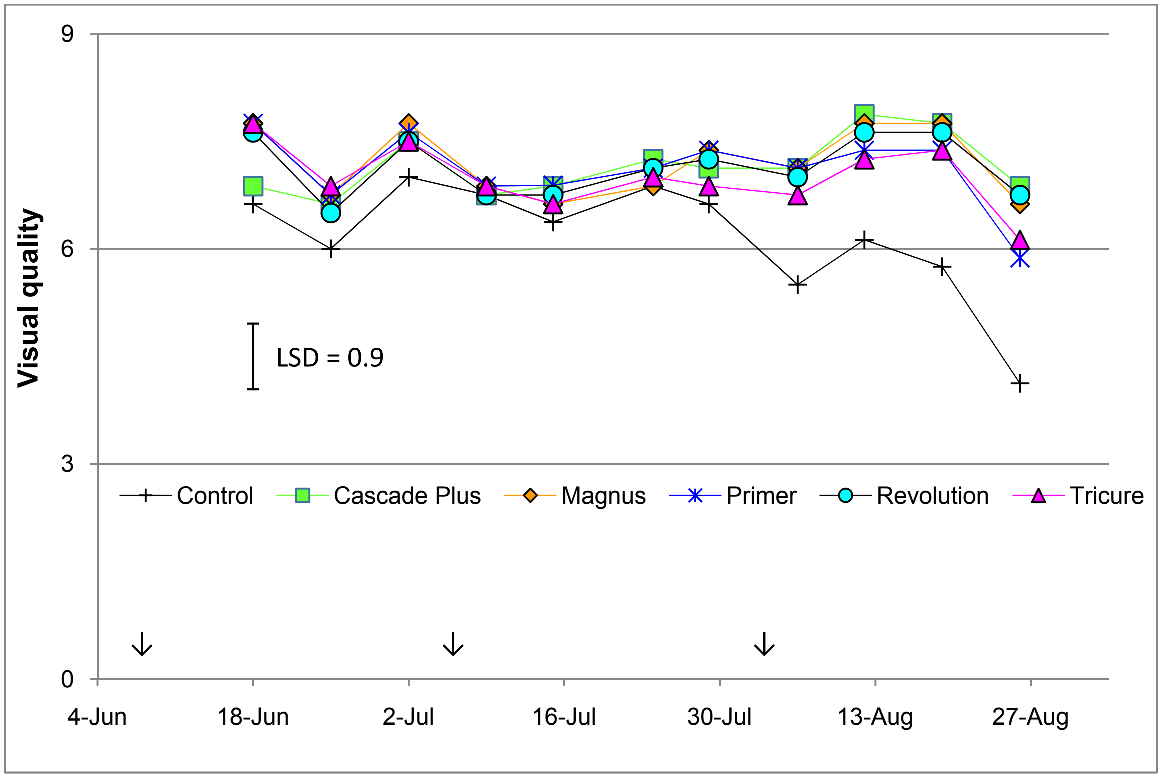

Fig. 3. Visual turf quality as affected by wetting agent treatment. Arrows indicate wetting agent application dates (except for Cascade Plus, which was only applied on 8 and 15 June). Error bar represents Fisher's least significant difference ($\alpha = 0.05$) for comparing treatments within evaluation dates.

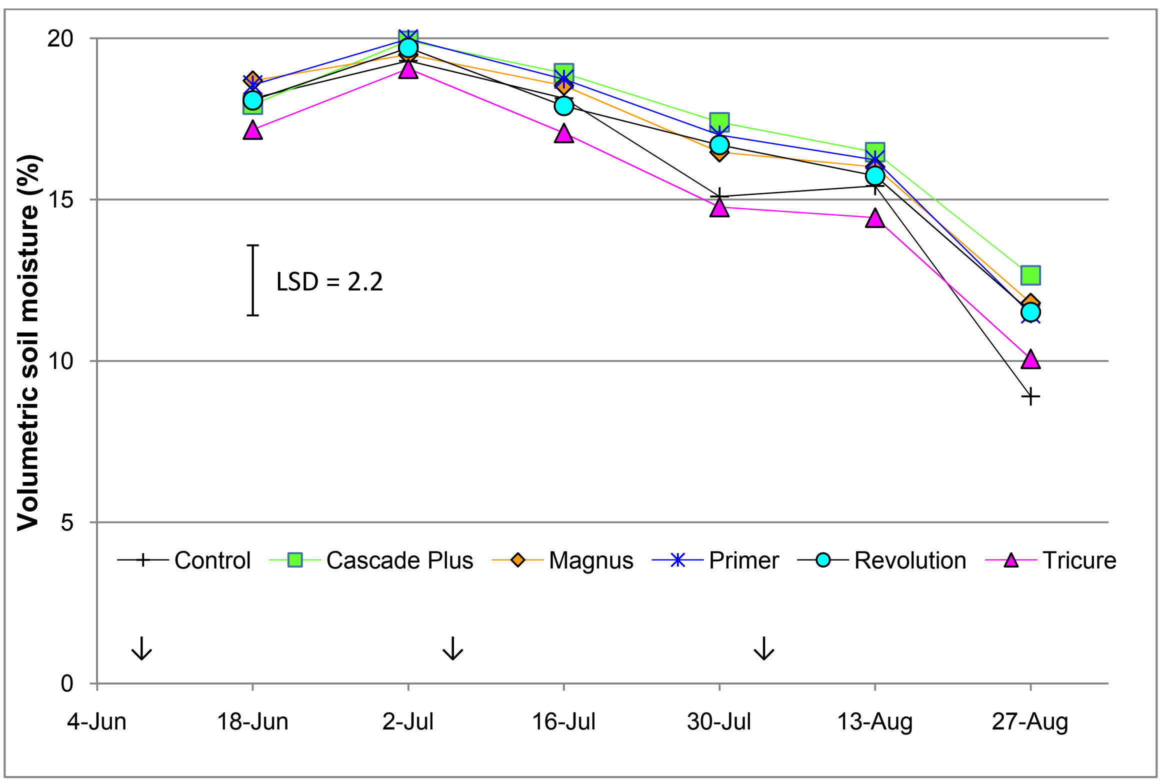

Fig. 4. Soil moisture as affected by wetting agent treatment. Arrows indicate wetting agent application dates (except for Cascade Plus, which was only applied on 8 and 15 June). Error bar represents Fisher's least significant difference ($\alpha = 0.05$) for comparing treatments within evaluation dates.

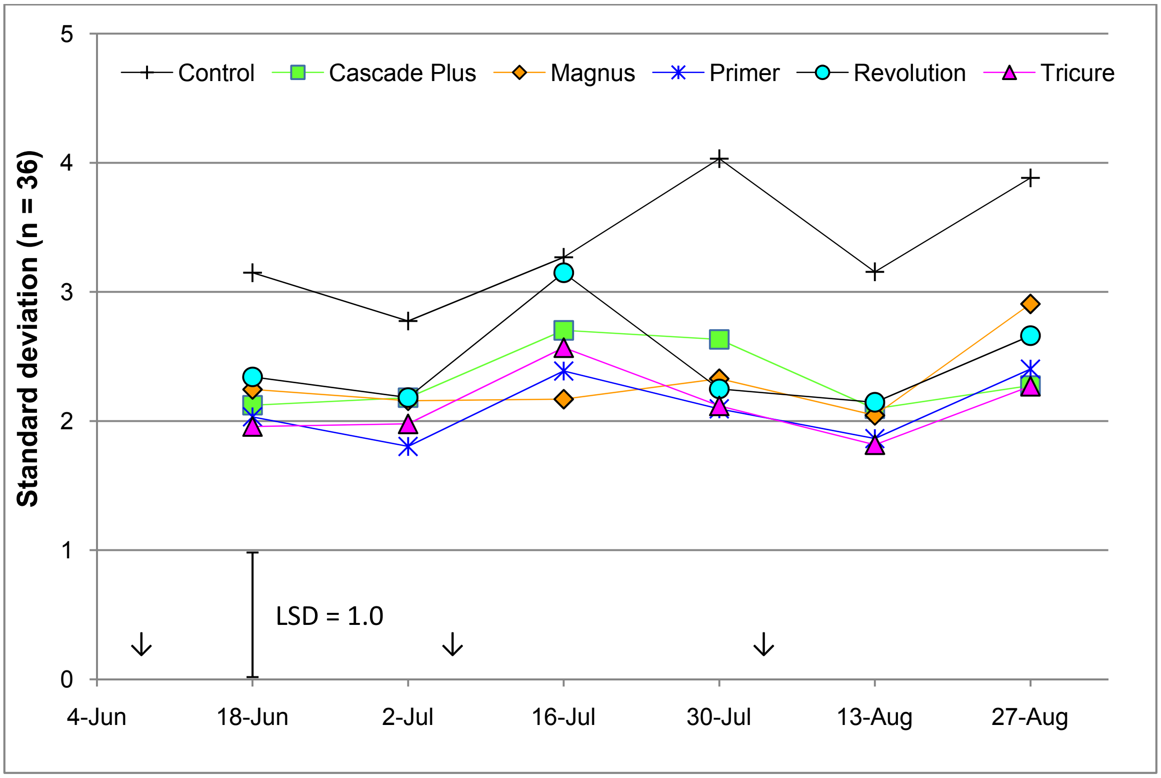

Fig. 5. Soil moisture variability, measured by standard deviation (n = 36), as affected by wetting agent treatment. Arrows indicate wetting agent application dates (except for Cascade Plus, which was only applied on 8 and 15 June). Error bar represents Fisher's least significant difference ($\alpha = 0.05$) for comparing treatments within evaluation dates.