

## Evaluation of Various Aquatrols Wetting Agents and Flutaloniil for Suppression of Localized Dry Spot on a Sand-based Rootzone

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**Objective:** To evaluate the effectiveness of two commercially available wetting agents, a widely prescribed fungicide and several experimental products for the suppression of localized dry spot (LDS) on an experimental sand-based rootzone.

### Experimental Procedures:

All products were applied with a pressurized CO<sub>2</sub> (30 psi) sprayer equipped to deliver 2.0 gallons of water per 1000 sq ft. All treatments were initiated on 6 May, 2004 except 1772 which was applied on 11 May. The ACA 2501, 1900, 1327 1772, and Sixteen 90 treatments were re-applied seven days after initial application. Primer Select was re-applied approximately every 21 days and Prostar 70 WP applied every 30 days until 6 July. The dates and rates of product application are listed in the data tables. Following the application of all treatments the plots were irrigated with a minimum of 0.25 inches of water via an overhead sprinkler system. The rootzone in the study area was a seven year old sand-based rootzone that conformed to USGA size guidelines and contains peat moss. Turf was creeping bentgrass 'Pennlinks' maintained at 0.150 inches by daily mowing and fertilized with approximately 3.0 lbs. of N/1000 sq ft. throughout the growing season. Plots were 6 ft x 6 ft, and arranged in a randomized complete block with four replications. Throughout the study the plots were only irrigated to prevent severe summer drought stress, rainfall during the study is noted in the graph on the final page of this report.

Product efficacy was assessed using visual ratings for overall turfgrass quality, color, and percentage area affected by LDS. Turfgrass quality was assessed on a 1 to 9 scale where 1 equals brown or dead turf and 9 equals optimal greenness, density and uniformity. Color was rated on a 1 to 9 scale where 9 = darkest green. Percent of plot area affected by localized dry spot was assessed on a linear 0 to 100 % scale where 0 = entire plot area green and healthy, and 100 = entire plot area affected. Rootzone water contents were recorded throughout the study using a Dynamax Theta Probe which measures the volumetric water content of the rootzone to a depth of 2.36 inches from the surface. The ability of the wetting agents to improve and/or sustain the wetability of the sand rootzone media with depth (0 to 6 cm) was determined on 14 day intervals using the water droplet penetration test. Briefly, five cores per plot were extracted and allowed to air-dry for 14 days at which point the ability of ultra-pure water to penetrate the edge of the soil core was determined using a small volume of water (approximately 1 mL) delivered using an eye-dropper at 1 cm depths from 0 (crown level) to 6 cm below the rootzone surface. Severity of hydrophobicity was classified based on the following scale: 0-5 seconds = wettable, 6-60 seconds = slightly hydrophobic, 61-600 seconds = strongly hydrophobic, and > 600 seconds = water repellent.

### Results:

Differences in turfgrass quality between the treated and untreated plots occurred on only three rating dates (Tables 1a-c and 2a-c). On 2 July, Prostar had significantly lower quality than the other treatments. On 23 July, Primer Select had superior turfgrass quality (8.5) compared to the untreated and all ACA 2501, 1327 and 1772 treatments. These plots, however, still had a turfgrass quality rating of 8.0 which is still considered very good. A substantial decline in overall turfgrass quality was observed in mid-August when turfgrass quality ratings fell below 7.0 for all treatments. On 16 Aug, Sixteen 90 had superior turfgrass quality (7.5) compared to the untreated plots, but was not different from the other treatments. On 27 Aug., Primer Select had superior quality (8.0), compared to the untreated plots and ACA 2501 at 6.0 oz. Overall, the average turfgrass quality ratings for the season were rather high (> 7.5), probably due to the favorable growing weather.

As with the turf quality ratings, few differences in turf color were observed. On 7 May, one day after application, the Prostar and ACA 2501 at 6.0 oz had significantly lower color than the untreated plots, but the ratings for all treatments remained > 7.5 which is still considered acceptable. On 17 May, the ACA 2501 at either 8.0 or 10.0 oz and 1327 treatments displayed lower color than the untreated plots. Again, however, the color ratings were very acceptable > 8.0. On 20 May, Primer Select and Sixteen 90 had higher color (9.0) than the untreated plots (8.3). On 9 July, 1327 and Prostar treatments had lower color than the untreated plots (9.0). On 6 and 16 August both Primer Select and Sixteen 90 had superior color (> 7.5) compared to the untreated plots (< 6.3). Only Sixteen 90, however, resulted in superior turf quality on either of these dates (Table 1c). Overall for turfgrass color ratings, results were similar to that of turfgrass quality in that when all ratings were averaged across the season, no differences between treatments were observed and all products were deemed safe when applied to this turf.

Rootzone water contents ranged from 14 to 29 % throughout the evaluation period (Tables 3 a-c). The highest water contents occurred from May to July and on the last two measurement dates, 30 August and 7 September. The water contents never fell below 20 % during that period for any treatment. Even during the short dry period from 9 to 27 August when rootzone water contents fell below 20% no treatment differences were observed. Although not statistically different, all treatments except ACA 2501 at 6.0 oz, 1900, and 1327 increased the seasonal average water content by approximately 2% during this study. This increase, however, is probably not practically important based on visual observations of the turfgrass.

The effects of localized dry spot were not evident until mid-August (Table 4). Damage from LDS was only slight, > 20%, and worst in the untreated plots. On all rating dates ACA 2501 at 8.0 oz and 1772 both decreased visually rated LDS compared to untreated plots. Primer Select and Sixteen 90 also decreased LDS compared to untreated plots on two of the three rating dates. All of these treatments reduced percent plot area affected by LDS to  $\leq 3.0$  %.

Water repellence of soil cores was only assessed for the ACA 2501, 1900, 1327 and 1772 treatments and water penetration times ranged from 1 to 288 seconds across all treatments, depths and dates, with no cores falling into the water repellent (> 600 seconds) category (Tables 5 a-b). Where improvements compared to untreated plots were observed, these results occurred primarily at the 0-3 cm depths but the greatest improvements occurred at the 0 and 1 cm depths. As expected progressive temporal effects for water repellence occurred throughout the study with the highest degree of water repellence occurring in June and July. Overall, however, no product performed consistently throughout the study compared to the untreated plots. On 19 May, all products resulted in better water penetration at 0 cm than the untreated control. By 2 June all treatments except ACA at the 10 oz application rate were superior than the untreated. On 17 and 30 June at the 0 cm depth, all treatments except ACA at the 6 and 10 oz rate improved water penetration. The most consistent performer during this study was 1772 which was better than the untreated on five of eight measurement dates at 0 cm and three of eight dates at the 1 cm depth.

In summary, the above average rainfall (21.5 inches) during the evaluation period and cooler than average growing temperatures certainly had significant effects on the results of this study. In a typical year, LDS would be more pronounced, water repellence more wide-spread and the effects of wetting agent products more noticeable on this sand-based rootzone.

## Acknowledgements

This research was supported by the Midwest Regional Turf Foundation and a grant-in-aid from the Aquatrols Corporation.

**Table 1a.** Visual quality<sup>b</sup> of ‘Penlinks’ creeping bentgrass grown on a sand-based rootzone as influenced by various Aquatrols wetting agent applications, 2004.

Treatment <sup>a</sup>	Rate oz / 1000 ft <sup>2</sup>	6 May	7 May	9 May	10 May	11 May	12 May	13 May	14 May	15 May	17 May
ACA 2501	6.0	8.3 a <sup>c</sup>	7.5 b	7.8 ab	7.8 a	7.8 a	7.5 a	7.8 a	8.3 a	8.0 a	8.3 a
ACA 2501	8.0	7.8 a	7.8 ab	8.0 a	7.5 a	7.5 a	7.3 a	7.5 a	7.8 a	8.3 a	8.5 a
ACA 2501	10.0	8.5 a	8.0 ab	7.9 ab	7.8 a	7.5 a	7.8 a	8.0 a	8.0 a	8.0 a	8.3 a
1900	8.0	8.3 a	8.0 ab	8.0 a	8.0 a	8.3 a	7.8 a	7.8 a	8.0 a	8.3 a	8.8 a
1327	8.0	8.3 a	7.8 ab	7.8 ab	7.8 a	8.0 a	7.5 a	7.8 a	7.8 a	8.0 a	8.8 a
1772	8.0	8.3 a	8.3 a	7.9 ab	7.5 a	8.3 a	7.0 a	7.5 a	7.8 a	8.0 a	8.3 a
Primer Select	4.0	8.3 a	7.8 ab	7.6 b	8.0 a	8.3 a	7.5 a	8.0 a	8.3 a	8.0 a	8.5 a
Sixteen 90	8.0	8.3 a	8.0 ab	8.0 a	8.0 a	8.3 a	7.8 a	8.0 a	7.8 a	8.5 a	8.8 a
Prostar 70 WP	4.5	8.3 a	7.5 b	7.9 ab	7.5 a	8.3 a	7.8 a	7.8 a	7.8 a	8.0 a	8.8 a
Untreated	---	8.3 a	8.0 ab	7.9 ab	8.0 a	8.0 a	7.8 a	7.5 a	8.0 a	8.5 a	8.8 a

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Visual turfgrass quality is based on a scale of 1 to 9 where 1 is brown, dead turf and 9 is dark green ideal turf.

<sup>c</sup> Means in the same column followed by the same letter are not significantly different according the LSD t-test (p=0.05).

**Table 1b.** Visual quality<sup>b</sup> of ‘Pennlinks’ creeping bentgrass grown on a sand-based rootzone as influenced by various Aquatrols wetting agent applications, 2004.

Treatment <sup>a</sup>	Rate	20 May	21 May	28 May	4 June	11 June	18 June	25 June	2 July	9 July	16 July
	oz / 1000 ft <sup>2</sup>										
ACA 2501	6.0	8.8 ab <sup>c</sup>	8.3 a	8.0 a	8.3 a	8.5 ab	7.8 a	8.8 ab	8.3 a	8.3 a	8.3 a
ACA 2501	8.0	9.0 a	8.5 a	7.8 a	8.3 a	8.8 ab	8.0 a	8.8 ab	8.5 a	8.8 a	8.3 a
ACA 2501	10.0	8.5 ab	8.0 a	8.0 a	8.0 a	8.5 ab	7.8 a	8.3 bc	8.3 a	8.5 a	8.0 a
1900	8.0	8.3 b	8.0 a	7.8 a	8.3 a	8.3 b	8.0 a	8.3 bc	8.5 a	8.5 a	8.0 a
1327	8.0	8.5 ab	8.5 a	8.0 a	8.0 a	9.0 a	8.0 a	8.3 bc	8.5 a	8.8 a	8.3 a
1772	8.0	8.8 ab	8.0 a	8.0 a	8.0 a	9.0 a	8.3 a	9.0 a	9.0 a	8.5 a	8.0 a
Primer Select	4.0	8.3 b	8.0 a	7.8 a	8.5 a	8.3 b	8.0 a	8.5 abc	8.8 a	8.8 a	8.3 a
Sixteen 90	8.0	8.8 ab	8.3 a	8.3 a	8.3 a	8.3 b	8.0 a	8.5 abc	8.5 a	8.8 a	8.5 a
Prostar 70 WP	4.5	8.5 ab	8.3 a	7.8 a	8.3 a	8.3 b	8.3 b	7.8 a	8.0 a	8.5 a	8.3 a
Untreated	---	8.5 ab	8.0 a	7.8 a	8.0 a	8.5 ab	8.0 a	8.5 abc	8.8 a	8.5 a	8.3 a

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Visual turfgrass quality is based on a scale of 1 to 9 where 1 is brown, dead turf and 9 is dark green ideal turf.

<sup>c</sup> Means in the same column followed by the same letter are not significantly different according the LSD t-test (p=0.05).

**Table 1c.** Visual quality<sup>b</sup> of ‘Penlinks’ creeping bentgrass grown on a sand-based rootzone as influenced by various Aquatrols wetting agent applications, 2004.

Treatment <sup>a</sup>	Rate oz / 1000 ft <sup>2</sup>	23 July	30 July	6 Aug.	9 Aug.	13 Aug.	16 Aug.	27 Aug.	30 Aug.	6 Sept.	Season
ACA 2501	6.0	8.0 b <sup>c</sup>	6.0 b	6.3 b	5.3 ab	4.8 a	5.5 ab	6.5 b	8.0 b	8.0 a	7.6 a
ACA 2501	8.0	8.0 b	6.8 ab	7.5 ab	6.3 ab	6.8 a	7.0 ab	7.8 ab	8.8 ab	8.3 a	7.9 a
ACA 2501	10.0	8.0 b	6.5 ab	6.8 ab	5.5 ab	5.5 a	5.5 ab	6.8 ab	8.0 b	8.0 a	7.6 a
1900	8.0	8.3 ab	6.3 ab	6.8 ab	5.3 ab	5.3 a	5.5 ab	6.8 ab	8.3 ab	8.0 a	7.7 a
1327	8.0	8.0 b	6.5 ab	6.3 b	5.0 b	6.0 a	5.8 ab	7.0 ab	8.5 ab	8.0 a	7.7 a
1772	8.0	8.0 b	7.0 ab	7.3 ab	6.3 ab	6.0 a	6.8 ab	7.8 ab	9.0 a	8.5 a	7.9 a
Primer Select	4.0	8.5 a	7.8 a	7.5 ab	7.3 a	6.8 a	7.3 ab	8.0 a	8.8 ab	8.5 a	8.1 a
Sixteen 90	8.0	8.3 ab	7.3 ab	8.0 a	6.5 ab	6.3 a	7.5 a	7.8 ab	9.0 a	8.3 a	8.1 a
Prostar 70 WP	4.5	8.3 ab	6.3 ab	6.3 b	6.0 ab	6.5 a	6.5 ab	7.5 ab	8.5 ab	8.0 a	7.8 a
Untreated	---	8.0 b	6.3 ab	6.3 b	5.8 ab	5.3 a	5.3 b	6.5 b	8.3 ab	7.8 a	7.7 a

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Visual turfgrass quality is based on a scale of 1 to 9 where 1 is brown, dead turf and 9 is dark green ideal turf.

<sup>c</sup> Means in the same column followed by the same letter are not significantly different according the LSD t-test (p=0.05).

**Table 2a.** Visual color<sup>b</sup> of ‘Pennlinks’ creeping bentgrass grown on a sand-based rootzone as influenced by various Aquatrols wetting agent applications, 2004.

Treatment a	Rate	6 May	7 May	9 May	10 May	11 May	12 May	13 May	14 May	15 May	17 May
	oz / 1000 ft <sup>2</sup>										
ACA 2501	6.0	8.0 b <sup>c</sup>	7.5 b	7.5 a	7.3 b	7.8 ab	7.5 a	8.0 a	8.0 a	8.0 a	8.3 ab
ACA 2501	8.0	8.0 b	7.8 ab	7.8 a	7.3 b	7.3 b	7.8 a	7.8 a	7.8 a	8.3 a	8.0 b
ACA 2501	10.0	8.3 ab	8.0 a	7.6 a	7.8 ab	7.8 ab	8.3 a	8.0 a	8.3 a	8.3 a	8.0 b
1900	8.0	8.3 ab	8.0 a	7.8 a	8.0 a	8.0 a	7.5 a	7.8 a	8.0 a	8.3 a	8.5 ab
1327	8.0	8.3 ab	8.0 a	7.5 a	7.8 ab	7.8 ab	8.0 a	8.0 a	8.0 a	8.0 a	8.0 b
1772	8.0	8.3 ab	8.0 a	7.8 a	7.8 ab	7.8 ab	7.8 a	7.5 a	7.8 a	8.5 a	8.3 ab
Primer Select	4.0	8.5 ab	7.8 ab	7.5 a	7.8 ab	7.8 ab	8.3 a	8.0 a	8.3 a	8.0 a	8.3 ab
Sixteen 90	8.0	8.8 a	8.0 a	8.0 a	7.8 ab	7.8 ab	8.3 a	8.0 a	7.8 a	8.5 a	8.5 ab
Prostar 70 WP	4.5	8.3 ab	7.5 b	7.8 a	7.5 ab	7.8 ab	8.0 a	8.0 a	8.0 a	8.3 a	8.5 ab
Untreated	---	8.3 ab	8.0 a	7.6 a	7.5 ab	7.8 ab	8.0 a	7.8 a	8.0 a	8.3 a	8.8 a

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Visual turfgrass color is based on a scale of 1 to 9 where 1 is light green and 9 is darkest green.

<sup>c</sup> Means in the same column followed by the same letter are not significantly different according the LSD t-test (p=0.05).

**Table 2b.** Visual color<sup>b</sup> of ‘Pennlinks’ creeping bentgrass grown on a sand-based rootzone as influenced by various Aquatrols wetting agent applications, 2004.

Treatment <sup>a</sup>	Rate	20 May	21 May	28 May	4 June	11 June	18 June	25 June	2 July	9 July	16 July
	oz / 1000 ft <sup>2</sup>										
ACA 2501	6.0	8.3 b <sup>c</sup>	8.3 bc	8.0 a	9.0 a	8.8 a	8.3 a	8.8 ab	8.5 ab	8.5 abc	8.3 ab
ACA 2501	8.0	8.8 ab	9.0 a	8.0 a	9.0 a	8.8 a	8.3 a	8.8 ab	8.8 ab	8.8 ab	8.5 a
ACA 2501	10.0	8.8 ab	8.0 c	7.8 a	8.5 a	8.5 a	8.0 a	8.5 ab	8.3 b	8.5 abc	7.8 b
1900	8.0	8.5 ab	8.3 bc	8.0 a	9.0 a	8.5 a	8.0 a	8.3 b	8.8 ab	8.8 ab	8.0 ab
1327	8.0	8.3 b	8.3 bc	8.0 a	9.0 a	8.8 a	8.5 a	8.3 b	8.8 ab	8.3 bc	8.3 ab
1772	8.0	8.5 ab	8.3 bc	8.0 a	8.8 a	9.0 a	8.5 a	9.0 a	9.0 a	8.8 ab	8.0 ab
Primer Select	4.0	9.0 a	8.5 abc	8.0 a	8.8 a	8.5 a	8.3 a	9.0 a	8.8 ab	9.0 a	8.3 ab
Sixteen 90	8.0	9.0 a	8.8 ab	8.0 a	8.5 a	9.0 a	8.5 a	8.5 ab	8.8 ab	8.5 abc	8.3 ab
Prostar 70 WP	4.5	8.8 ab	8.8 ab	8.0 a	8.5 a	8.5 a	8.3 a	8.3 b	8.5 ab	8.0 c	8.3 ab
Untreated	---	8.3 b	8.5 abc	8.0 a	8.8 a	8.8 a	8.3 a	8.8 ab	8.5 ab	9.0 a	8.0 ab

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Visual turfgrass color is based on a scale of 1 to 9 where 1 is light green and 9 is darkest green.

<sup>c</sup> Means in the same column followed by the same letter are not significantly different according the LSD t-test (p=0.05).

**Table 2c.** Visual color<sup>b</sup> of 'Pennlinks' creeping bentgrass grown on a sand-based rootzone as influenced by various Aquatrols wetting agent applications, 2004.

Treatment <sup>a</sup>	Rate	23 July	30 July	6 Aug.	9 Aug.	13 Aug.	16 Aug.	27 Aug.	30 Aug.	6 Sept.	Season
	oz / 1000 ft <sup>2</sup>										
ACA 2501	6.0	8.3 a <sup>c</sup>	6.0 a	6.5 ab	5.8 a	5.3 a	5.5 b	6.8 a	8.3 ab	8.0 a	7.7 a
ACA 2501	8.0	8.5 a	7.0 a	7.5 ab	6.5 a	6.3 a	7.3 ab	8.0 a	9.0 a	8.5 a	8.0 a
ACA 2501	10.0	8.5 a	6.5 a	6.5 ab	5.3 a	5.8 a	5.8 ab	7.3 a	8.0 b	8.0 a	7.7 a
1900	8.0	8.8 a	6.0 a	6.5 ab	5.5 a	5.5 a	6.0 ab	7.0 a	8.8 ab	8.3 a	7.8 a
1327	8.0	8.5 a	6.3 a	6.5 ab	5.8 a	5.8 a	5.8 ab	7.8 a	8.5 ab	8.5 a	7.8 a
1772	8.0	8.8 a	6.8 a	7.3 ab	7.0 a	6.0 a	6.8 ab	8.0 a	8.5 ab	8.8 a	8.1 a
Primer Select	4.0	8.8 a	7.3 a	7.8 a	7.0 a	6.3 a	7.5 a	8.3 a	9.0 a	8.8 a	8.2 a
Sixteen 90	8.0	8.5 a	6.8 a	7.8 a	6.3 a	5.8 a	7.5 a	8.0 a	9.0 a	8.5 a	8.1 a
Prostar 70 WP	4.5	8.5 a	6.0 a	6.8 ab	6.0 a	5.5 a	6.8 ab	7.8 a	8.8 ab	8.5 a	7.8 a
Untreated	---	8.5 a	6.3 a	6.3 b	5.8 a	5.3 a	5.5 b	7.0 a	8.3 ab	8.0 a	7.8 a

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Visual turfgrass color is based on a scale of 1 to 9 where 1 is light green and 9 is darkest green.

<sup>c</sup> Means in the same column followed by the same letter are not significantly different according the LSD t-test (p=0.05).

**Table 3a.** Rootzone volumetric water contents<sup>b</sup> of a sand-based rootzone as influenced by various Aquatrols wetting agent applications, 2004.

Treatment <sup>a</sup>	Rate oz / 1000 ft <sup>2</sup>	11 May	7 June	11 June	14 June	18 June	21 June	25 June	29 June	2 July	6 July
ACA 2501	6.0	26.4	21.8	28.0	23.2	23.6	22.6	23.9	23.8	23.9	21.2
ACA 2501	8.0	26.8	22.6	28.1	25.0	23.4	23.2	24.9	24.2	25.8	21.9
ACA 2501	10.0	26.8	21.5	28.6	24.0	23.0	23.0	24.6	23.7	24.8	21.6
1900	8.0	25.8	21.8	27.8	24.4	22.5	22.9	25.1	23.6	24.2	21.5
1327	8.0	26.1	22.0	27.7	23.6	22.9	22.8	24.2	22.7	24.4	21.1
1772	8.0	26.6	23.5	29.0	24.6	23.7	23.7	25.0	24.6	26.0	22.3
Primer Select	4.0	26.3	22.8	28.4	24.7	23.9	23.8	25.8	24.9	26.1	22.3
Sixteen 90	8.0	25.5	22.8	27.8	24.8	24.1	23.3	25.2	24.4	25.9	21.8
Prostar 70 WP	4.5	27.5	23.8	28.1	25.7	23.5	24.3	24.4	24.9	25.5	22.2
Untreated	---	25.8	22.0	28.8	24.0	22.8	23.0	25.0	24.4	24.3	21.4
LSD (0.05) <sup>c</sup>		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Water contents are measured to a depth of 2.36 inches.

<sup>c</sup> Means in the same column followed by the same letter are not significantly different according the LSD t-test (p=0.05).

**Table 3b.** Rootzone volumetric water contents<sup>b</sup> of a sand-based rootzone as influenced by various Aquatrols wetting agent applications, 2004.  
Volumetric water content

Treatment <sup>a</sup>	Rate oz / 1000 ft <sup>2</sup>	9 July	12 July	16 July	19 July	23 July	26 July	30 July	2 Aug.	6 Aug.	9 Aug.
ACA 2501	6.0	24.8	23.5	22.9	20.5	22.7	19.4	21.2	17.3	19.2	16.4
ACA 2501	8.0	25.8	24.6	23.9	21.8	23.7	21.5	23.0	19.1	21.2	18.6
ACA 2501	10.0	25.5	24.3	22.9	21.2	23.9	19.8	21.7	28.7	20.8	18.4
1900	8.0	24.5	23.9	22.6	20.9	23.1	19.8	21.8	18.3	21.0	17.7
1327	8.0	25.2	23.9	23.3	20.6	22.6	20.4	21.7	18.2	19.8	16.6
1772	8.0	26.1	24.9	24.0	22.2	24.4	22.4	23.3	18.5	22.8	19.2
Primer Select	4.0	25.5	24.9	24.5	22.3	24.6	21.9	22.9	20.1	23.7	19.8
Sixteen 90	8.0	25.5	24.7	24.1	22.0	24.3	21.1	22.9	18.8	22.5	19.1
Prostar 70 WP	4.5	26.4	24.5	24.2	22.0	24.2	21.1	23.0	19.7	22.9	18.9
Untreated	---	25.3	23.8	23.1	20.7	21.6	19.7	20.3	16.5	18.3	16.0
LSD(0.05) <sup>c</sup>		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Water contents are measured to a depth of 2.36 inches.

<sup>c</sup> Means in the same column followed by the same letter are not significantly different according the LSD t-test (p=0.05).

**Table 3c.** Rootzone volumetric water contents<sup>b</sup> of a sand-based rootzone as influenced by various Aquatrols wetting agent applications, 2004.

Treatment <sup>a</sup>	Rate oz / 1000 ft <sup>2</sup>	13 Aug.	16 Aug.	23 Aug.	27 Aug.	30 Aug.	7 Sept.	Season
ACA 2501	6.0	18.0	15.9	17.8	20.5	22.4	21.6	21.7
ACA 2501	8.0	20.7	18.5	20.1	23.0	23.9	24.4	23.1
ACA 2501	10.0	19.2	16.6	19.2	21.4	22.7	22.0	22.3
1900	8.0	19.4	16.8	18.2	20.9	22.8	23.2	22.1
1327	8.0	18.4	15.4	17.5	20.9	22.6	22.2	21.8
1772	8.0	21.2	18.7	20.4	23.6	24.9	25.1	23.5
Primer Select	4.0	21.6	18.9	21.6	24.2	25.0	25.9	23.7
Sixteen 90	8.0	21.5	18.1	21.0	23.8	24.0	23.8	23.2
Prostar 70 WP	4.5	21.1	18.5	19.9	22.9	23.6	23.3	23.3
Untreated	---	17.1	14.5	16.3	18.5	21.1	10.5	21.3
LSD (0.05) <sup>c</sup>		NS	NS	NS	NS	NS	NS	NS

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Water contents are measured to a depth of 2.36 inches.

<sup>c</sup> Means in the same column followed by the same letter are not significantly different according the LSD t-test (p=0.05).

**Table 4.** Localized dry spot (LDS) severity in ‘Pennlinks’ creeping bentgrass grown on a sand-based rootzone as influenced by various Aquatrols wetting agent applications, 2004.

Treatment <sup>a</sup>	Rate oz / 1000 ft <sup>2</sup>	9 Aug. ----- % <sup>b</sup> -----	13 Aug. ----- % <sup>b</sup> -----	16 Aug. ----- % <sup>b</sup> -----
ACA 2501	6.0	10.8 ab <sup>c</sup>	10.3 ab	14.0 ab
ACA 2501	8.0	1.3 b	2.5 b	1.3 b
ACA 2501	10.0	5.8 ab	6.8 ab	9.0 ab
1900	8.0	7.0 ab	6.3 ab	9.0 ab
1327	8.0	13.8 ab	10.5 ab	14.3 ab
1772	8.0	1.3 b	3.0 b	1.3 b
Primer Select	4.0	1.8 b	1.8 b	3.8 ab
Sixteen 90	8.0	2.5 ab	2.5 b	1.3 b
Prostar 70 WP	4.5	9.5 ab	7.0 ab	11.3 ab
Untreated	---	21.3 a	23.8 a	27.0 a

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Localized dry spot was visually assessed on a 0 to 100 % scale where 0 = no LDS observed and 100 is entire plot affected.

<sup>c</sup> Means in the same column followed by the same letter are not significantly different according the LSD t-test (p=0.05).

**Table 5a.** Water droplet penetration into soil cores of a sand-based rootzone as influenced by various Aquatrols wetting agent products, 2004.

Treatment <sup>a</sup>	Rate (oz / 1000 ft <sup>2</sup> )	Soil depth (cm)						
		0	1	2	3	4	5	6
		seconds <sup>b</sup>						
<b>5 May</b>								
ACA 2501	6.0	31 b	12 ba	6 a	3 a	2 a	2 a	1 a
ACA 2501	8.0	33 b	15 a	8 a	3 a	2 a	1 a	1 a
ACA 2501	10.0	26 b	11 a	7 a	4 a	2 a	2 a	1 a
1900	8.0	67 a	22 a	11 a	4 a	2 a	2 a	1 a
1327	8.0	48 ab	24 a	7 a	3 a	2 a	1 a	1 a
1772	8.0	33 b	16 a	6 a	5 a	2 a	1 a	1 a
Untreated	---	26 b	11 a	6 a	3 a	2 a	2 a	1 a
<b>19 May</b>								
ACA 2501	6.0	36 b	88 a	45 a	8 a	3 a	2 a	2 a
ACA 2501	8.0	21 b	43 ab	22 a	7 a	2 a	2 a	1 a
ACA 2501	10.0	17 b	19 b	12 a	4 a	2 a	1 a	1 a
1900	8.0	29 b	32 ab	20 a	7 a	2 a	2 a	2 a
1327	8.0	26 b	63 ab	26 a	4 a	2 a	2 a	1 a
1772	8.0	19 b	16 b	7 a	2 a	2 a	2 a	1 a
Untreated	---	106 a	53 ab	18 a	7 a	3 a	2 a	2 a
<b>2 June</b>								
ACA 2501	6.0	23 b	50 ab	54 a	23 a	7 a	3 a	3 a
ACA 2501	8.0	27 b	52 a	85 a	47 a	18 a	11 a	7 a
ACA 2501	10.0	54 ab	57 ab	38 a	20 a	6 a	3 a	1 a
1900	8.0	16 b	46 ab	35 a	15 a	4 a	3 a	2 a
1327	8.0	18 b	24 b	24 a	12 a	7 a	3 a	2 a
1772	8.0	15 b	39 b	38 a	26 a	13 a	4 a	2 a
Untreated	---	106 a	80 a	64 a	21 a	4 a	2 a	2 a
<b>17 June</b>								
ACA 2501	6.0	157 ab	184 a	112 a	48 a	11 a	5 a	3 a
ACA 2501	8.0	65 b	159 a	76 a	37 a	5 a	2 a	2 a
ACA 2501	10.0	126 ab	205 a	168 a	83 a	23 a	7 a	2 a
1900	8.0	102 b	198 a	113 a	22 a	9 a	3 a	2 a
1327	8.0	61 b	204 a	208 a	74 a	21 a	7 a	2 a
1772	8.0	47 b	211 a	165 a	65 a	11 a	7 a	2 a
Untreated	---	237 a	288 a	78 a	30 a	15 a	3 a	2 a

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

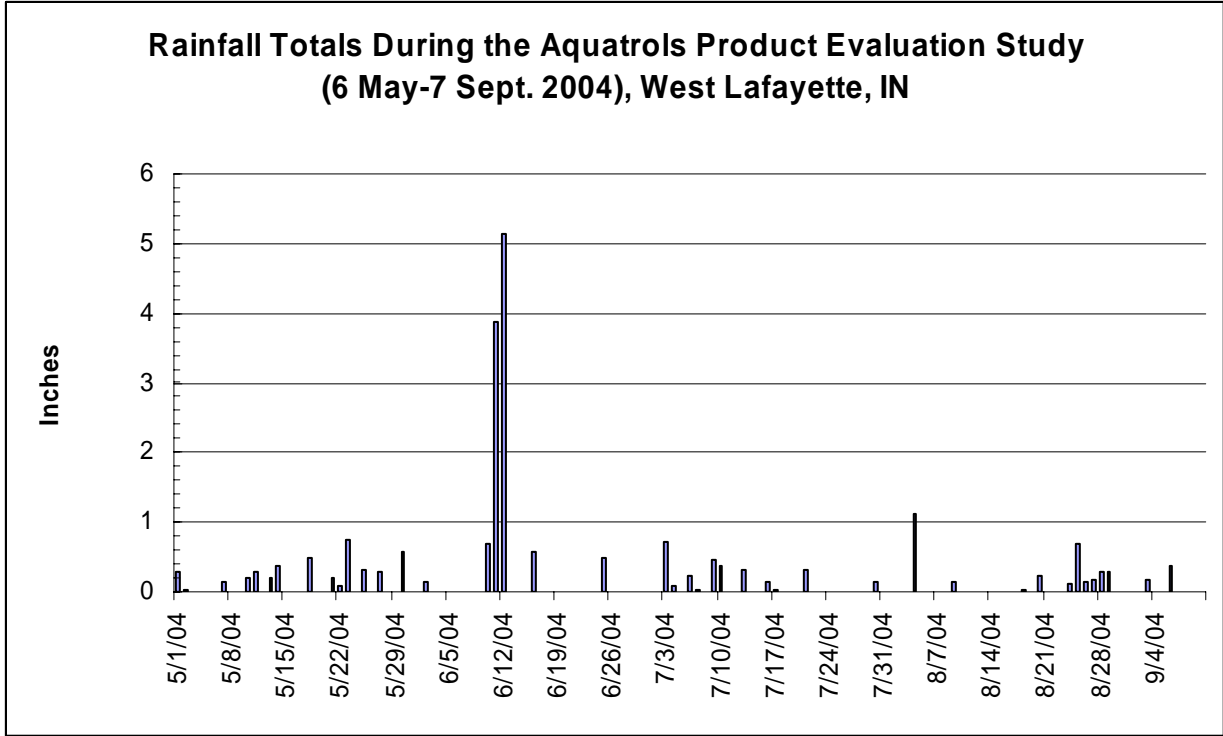
<sup>b</sup> Water droplet penetration times are the means of four replications with five sub-samples per plot.

**Table 5b.** Water droplet penetration into soil cores of a sand-based rootzone as influenced by various Aquatrols wetting agent products, 2004.

Treatment <sup>a</sup>	Rate (oz / 1000 ft <sup>2</sup> )	Soil depth (cm)						
		0	1	2	3	4	5	6
		seconds <sup>b</sup>						
<b>30 June</b>								
ACA 2501	6.0	61 ab	53 a	24 a	8 a	3 a	1 a	1 a
ACA 2501	8.0	102 a	98 a	37 a	11 a	4 a	2 a	1 a
ACA 2501	10.0	71 ab	66 a	37 a	10 a	4 a	2 a	1 a
1900	8.0	40 b	69 a	17 a	4 a	2 a	1 a	1 a
1327	8.0	24 b	31 a	13 a	4 a	3 a	1 a	1 a
1772	8.0	33 b	52 a	24 a	5 a	2 a	1 a	1 a
Untreated	---	53 ab	27 a	26 a	9 a	2 a	1 a	1 a
<b>14 July</b>								
ACA 2501	6.0	221 a	191 a	148 a	42 a	16 a	5 a	2 a
ACA 2501	8.0	178 ab	234 a	117 a	37 a	7 a	3 a	2 a
ACA 2501	10.0	194 ab	212 a	84 a	45 a	10 a	5 a	2 a
1900	8.0	106 ab	116 a	80 a	26 a	11 a	3 a	2 a
1327	8.0	87 b	128 a	116 a	20 a	6 a	3 a	2 a
1772	8.0	97 ab	122 a	82 a	21 a	8 a	2 a	1 a
Untreated	---	215 ab	240 a	110 a	49 a	19 a	5 a	2 a
<b>28 July</b>								
ACA 2501	6.0	185 a	207 a	81 a	48 a	5 a	2 a	2 a
ACA 2501	8.0	197 a	220 a	157 a	69 a	10 a	4 a	3 a
ACA 2501	10.0	248 a	220 a	149 a	31 a	6 a	3 a	2 a
1900	8.0	177 a	165 a	125 a	34 a	16 a	3 a	2 a
1327	8.0	198 a	228 a	137 a	42 a	6 a	3 a	2 a
1772	8.0	194 a	231 a	96 a	39 a	13 a	3 a	2 a
Untreated	---	290 a	247 a	141 a	79 a	11 a	3 a	2 a
<b>11 August</b>								
ACA 2501	6.0	79 a	83 ab	96 ab	57 ab	21 a	2 a	2 a
ACA 2501	8.0	68 a	89 ab	28 b	7 a	2 a	1 a	11 a
ACA 2501	10.0	72 a	100 ab	44 b	9 a	3 a	1 a	1 a
1900	8.0	76 a	185 a	69 ab	17 ab	4 a	2 a	1 a
1327	8.0	31 a	69 ab	57 ab	63 ab	22 a	2 a	1 a
1772	8.0	47 a	37 b	62 ab	17 ab	3 a	2 a	1 a
Untreated	---	67 a	156 ab	227 a	168 a	67 a	7 a	3 a

<sup>a</sup> All treatments were initially applied on 6 May, 2004, except 1772 which was initially applied on 11 May. All treatments except Primer Select and Prostar were re-applied on 13 May. Primer Select was re-applied on 26 May, 17 June, 8 July, 30 July, and 20 August. Prostar was re-applied on 4 June and 6 July. All treatments were applied in 2.0 gal water per 1000 ft<sup>2</sup> and irrigated immediately after application with 0.25 inches of water.

<sup>b</sup> Water droplet penetration times are the means of four replications with five sub-samples per plot.



**Figure 1.** Rainfall totals during the Aquatrols Product evaluation study.