

Precision Products Sand-based Rootzone Localized Dry Spot Rescue Trial -2008
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Objective: To evaluate the effects of four commercially available soil surfactants from Precision Laboratories for their ability to alleviate localized dry spot and wilt on a sand-based research putting green planted to creeping bentgrass.

Experimental Procedures:

This field study was conducted at the William H. Daniel Turfgrass Research and Diagnostic Center at Purdue University, West Lafayette IN, during the summer of 2008. The study area consisted of a mature stand of creeping bentgrass (*Agrostis stolonifera* 'Penlinks') and maintained according to typical green management practices for the region. It was mowed regularly at 0.140 inches with clippings collected, fertilized with approximately 4.25 lbs N/1000 ft²/yr⁻¹. Irrigation was applied to supplement rainfall and supply approximately 1.0 inch of water per growing week. Insecticides and fungicides were applied on a curative basis when needed due to pest outbreaks.

All treatments; Duplex ultra (0.38 oz/1000ft²), Magnus (4 oz/1000ft²), Liquid cascade (8 oz/1000ft²), Cascade 16G (3.5 lbs./1000ft²) were initially applied on 1 Sept., 2008, and both Cascade treatments were reapplied on 8 Sept. 2008. All liquid products were applied in 2 gal. water carrier 1000ft². Following product application all plots were irrigated by hand using a hand-held water meter to supply 0.25" water.

Plots were assessed for percentage wilted turf affected localized dry spot on a 0-100% linear scale where 0 = zero plot area affected and 100 % = entire plot completely wilted. Plots were also rated for overall visual turfgrass quality, greenness by reflectance, soil moisture content and water droplet penetration time. Creeping bentgrass quality was visually assessed on a 0-10 scale with 0=poor quality turf, 10=optimum greenness, density and uniformity and < 6= unacceptable putting green turf.

Canopy greenness was measured using a hand-held reflectance meter (FieldScout CM-1000, Spectrum Technologies Inc.). Five measurements were recorded per plot using a systematic grid pattern which measured the center and four corner areas of each plot which was then averaged into a single plot value which is reported as a unitless color index.

The soil water content in the upper 2 inches of the root zone was measured using a portable moisture sensor (Pogo Soil Moisture Sensor, Stevens Water Monitoring Systems, Inc., Beaverton, OR). Twenty-five locations in each plot on a grid pattern that measured the water content of cells located on one foot centers were recorded. These values were also averaged into a single plot value.

The ability of the surfactants to improve and/or sustain the wetting of the sand-based rootzone media with depth (0-3 cm) was determined throughout the study using the water droplet penetration method. Five soil cores were removed from each plot prior to treatment application, 7 days after initial treatment and 41 days after initial treatment. Cores were air dried for a minimum of 14 days at which time approximately .035 mL of distilled, deionized water was placed at 1

cm depths from 0-3 cm across the core and the time required for the droplet to infiltrate into the core was recorded. The severity of hydrophobicity was based on the following scale of water droplet penetration times: 0-5 sec = wettable, 6-60 secs = slightly hydrophobic, 61-600 sec = strongly hydrophobic, and > 600 sec = water repellent.

Each treatment was replicated three times and experimental plots measured 5 x 5 ft. All data was subjected to analysis of variance using the SAS system and significant treatment means separated using Fisher's protected least significant difference test at $P < 0.05$ level.

Results:

Localized Dry Spot/Wilt ratings (Table 1).

- All plots had equivalent levels of LDS/wilt upon initiation of the study ranging from 37-42% of plot area affected.
- By 2 Sept. both Cascade treatments and Magnus treatments had $\leq 12\%$ LDS, while the untreated control had 23%..
- By 11 Sept. both Cascade treatments had significantly less LDS than Duplex and the untreated control with $\leq 4\%$ LDS.
- Trends in product performance continued until the final rating date on 11 Oct., with Magnus and both Cascade treatments having $\leq 1.0\%$ and Duplex and the untreated = 17 and 21%.

Turfgrass Quality and Phytotoxicity (Table 2).

- All plots began the study with marginally acceptable turf quality (TQ) values ranging from 6.3-6.7, due to late-summer stress and wilt.
- Study mean TQ values were all superior to the untreated control for all products except Duplex ultra.
- Both Magnus and Cascade 16G were in the top statistical category on all five rating dates.
- Magnus and both Cascade products caused visible but very minor phytotoxicity/discoloration manifested as a mild yellowing of the turf canopy following the initial application on 2 September.
- The subsequent application of Cascade liquid caused this phenomenon to persist in those plots until 11 September.

Soil Moisture Measurements (Table 3).

- Volumetric water content values ranged from 6.6-16.9% soil moisture.
- Significant treatment differences were observed on 6 Sept. where the Cascade 16G treatment had superior soil moisture to Magnus or the Duplex ultra treatments.
- Significant treatment differences were also observed on 11 Oct. with all treatments having superior soil moisture compared to Duplex ultra.

Canopy Greenness (Table 4).

- There were no significant treatment differences evident for canopy greenness.

Water Droplet Penetration Times (Table 5).

- Water droplet penetration times (WDPT) ranged from 7 to 559 seconds with all plots being statistically similar prior to initiating the study.
- On 5 Sept. all treatments except Cascade 16G had superior WDPT at the 0 cm depth compared to the untreated control.
- It is important to note that the Cascade 16G treatment was equivalent to all other treatments.
- On the final evaluation date, 11 Oct., the two Cascade treatments were the only two products statistically different from the untreated control at the 1 cm depth.
- Additionally, for mean WDPT only Cascade liquid was statistically superior to the untreated control.

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Table 1. Visual localized dry spot-canopy wilt ratings as affected by four wetting agents on a sand-based research putting green containing mature ‘Pennlinks’ creeping bentgrass, Purdue University, 2008.

Product ‡	Localized dry spot					
	28 Aug.	2 Sept.	11 Sept.	21 Sept.	27 Sept.	11 Oct.
	----- visual rating (0-100%) -----					
Duplex ultra	36.7 a	16.7 a	27.3 a	35.7 a	41.7 a	21.0 a
Magnus	40.0 a	10.0 a	8.3 ab	6.7 bc	3.7 b	1.0 b
Cascade (granular)	39.3 a	9.3 a	1.3 b	1.8 c	3.3 b	0.7 b
Cascade (liquid)	41.7 a	11.7 a	3.3 b	2.3 c	2.8 b	0.0 b
Untreated	37.3 a	23.3 a	27.0 a	30.0 ab	33.3 a	17.3 a

† Localized dry spot (LDS) was visually rated on a 0 to 100% scale where 0= no LDS and 100=complete LDS across the entire plot.

‡ All treatments; Duplex ultra (0.38 oz/1000ft²), Magnus (4 oz/1000ft²), Liquid cascade (8 oz/1000ft²), Cascade 16G (3.5 lbs./1000ft²) were initially applied on 1 Sept., 2008, and both Cascade treatments were reapplied on 8 Sept. 2008. All liquid products were applied in 2 gal. water carrier 1000ft².

* Means in the same column followed by the same letter are not significantly different according to Fisher’s protected LSD t-test (P=0.05).

Table 2. Visual turf quality (TQ) and phytotoxicity ratings as affected by four wetting agents on a sand-based research putting green containing mature ‘Pennlinks’ creeping bentgrass, Purdue University, 2008.

Product §	Turf quality †					Phytotoxicity ‡		
	2 Sept.	11 Sept.	21 Sept.	27 Sept.	11 Oct.	TQ Mean	2 Sept.	11 Sept.
	----- visual rating (0-9) -----						(visual rating 0-5)	
Duplex ultra	6.7 a*	7.5 c	7.0 a	6.0 b	6.8 b	6.8 c	0.1 b	0.0 b
Magnus	6.3 a	8.2 ab	8.0 a	7.3 a	8.0 a	7.6 a	0.4 a	0.0 b
Cascade (granular)	6.3 a	8.5 a	8.0 a	7.6 a	7.8 a	7.7 a	0.4 a	0.1 b
Cascade (liquid)	6.5 a	7.3 c	7.7 a	7.8 a	8.0 a	7.5 ab	0.4 a	0.4 a
Untreated	6.5 a	7.8 bc	7.5 a	6.3 b	6.3 b	6.9 bc	0.0 b	0.0 b

† Turfgrass quality was visually rated on a 0 to 10 scale where 10= optimum greenness, density and uniformity, and < 6 unacceptable putting green turf.

‡ Phytotoxicity/injury was visually rated on a 0 to 5 scale where 0= no injury and 5 = severe yellowing.

§ All treatments; Duplex ultra (0.38 oz/1000ft²), Magnus (4 oz/1000ft²), Liquid cascade (8 oz/1000ft²), Cascade 16G (3.5 lbs./1000ft²) were initially applied on 1 Sept., 2008, and both Cascade treatments were reapplied on 8 Sept. 2008. All liquid products were applied in 2 gal. water carrier 1000ft².

* Means in the same column followed by the same letter are not significantly different according to Fisher’s protected LSD t-test (P=0.05).

Table 3. Evaluation of soil moisture as affected by four wetting agents on a sand-based research putting green containing mature ‘Pennlinks’ creeping bentgrass, Purdue University, 2008.

Product ‡	Volumetric water content †						Mean
	28 Aug.	6 Sept.	11 Sept.	18 Sept.	24 Sept.	11 Oct.	
Duplex ultra	6.6 a	10.7 c	8.8 a	7.6 a	10.8 a	11.1 b	9.3 a
Magnus	7.4 a	12.7 bc	11.5 a	9.0 a	14.6 a	16.2 a	11.9 a
Cascade (granular)	8.2 a	16.5 a	12.5 a	9.9 a	15.4 a	16.9 a	13.2 a
Cascade (liquid)	7.1 a	14.7 ab	11.0 a	8.0 a	14.0 a	15.2 a	11.7 a
Untreated	9.1 a	13.9 ab	12.5 a	9.4 a	13.8 a	14.2 a	12.1 a

† Volumetric water content was measured (0-2.25 cm depth) measured using a portable moisture sensor (Pogo Soil Moisture Sensor, Stevens Water Monitoring Systems, Inc., Beaverton, OR) which measured twenty-five locations in each plot on a systematic grid pattern that measured the water content of cells located on one foot centers which were averaged into a single plot value.

‡ All treatments; Duplex ultra (0.38 oz/1000ft²), Magnus (4 oz/1000ft²), Liquid cascade (8 oz/1000ft²), Cascade 16G (3.5 lbs./1000ft²) were initially applied on 1 Sept., 2008, and both Cascade treatments were reapplied on 8 Sept. 2008. All liquid products were applied in 2 gal. water carrier 1000ft².

* Means in the same column followed by the same letter are not significantly different according to Fisher’s protected LSD t-test (P=0.05).

Table 4. Evaluation of canopy greenness as affected by four wetting agents on a sand-based research putting green containing mature 'Pennlinks' creeping bentgrass, Purdue University, 2008.

Product ‡	Canopy greenness						Mean
	28 Aug.	2 Sept.	5 Sept.	11 Sept.	18 Sept.	11 Oct.	
	----- (index) -----						
Duplex ultra	270 a	309 a	302 a	294 a	252 a	223 a	276 a
Magnus	275 a	309 a	300 a	295 a	254 a	242 a	279 a
Cascade (granular)	278 a	324 a	303 a	289 a	244 a	229 a	280 a
Cascade (liquid)	262 a	295 a	290 a	268 a	249 a	237 a	268 a
Untreated	275 a	323 a	317 a	302 a	249 a	233 a	285 a

† Canopy greenness was measured using a hand-held reflectance meter (CM1000) with five measurements per plot recorded in a systemic grid pattern.

‡ All treatments; Duplex ultra (0.38 oz/1000ft²), Magnus (4 oz/1000ft²), Liquid cascade (8 oz/1000ft²), Cascade 16G (3.5 lbs./1000ft²) were initially applied on 1 Sept., 2008, and both Cascade treatments were reapplied on 8 Sept. 2008. All liquid products were applied in 2 gal. water carrier 1000ft².

* Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD t-test (P=0.05).

Table 5. Water droplet penetration times of sand-based rootzone cores as affected by four wetting agents on a sand-based research putting green containing mature 'Pennlinks' creeping bentgrass, Purdue University, 2008.

Treatment [†]	Soil depth (cm)				
	0	1	2	3	Average
Soil depth (cm)	27 Aug				
	seconds ‡				
Duplex Ultra	27 a*	405 a	462 a	467 a	340 a
Magnus	84 a	531 a	533 a	530 a	420 a
Cascade 16G (granular)	68 a	452 a	414 a	397 a	333 a
Cascade (liquid)	51 a	409 a	559 a	549 a	392 a
Untreated	62 a	405 a	393 a	382 a	311 a
	5 Sept				
	seconds				
Duplex Ultra	64 b	362 a	407 a	308 a	285 a
Magnus	5 b	228 a	365 a	309 a	227 a
Cascade 16G (granular)	87 ab	425 a	496 a	529 a	384 a
Cascade (liquid)	7 b	169 a	518 a	540 a	308 a
Untreated	183 a	403 a	449 a	378 a	353 a
	10 Oct				
	seconds				
Duplex Ultra	255 a	540 a	496 a	531 a	455 a
Magnus	162 a	373 bc	334 a	409 a	320 abc
Cascade 16G (granular)	108 a	258 cd	339 a	328 a	258 bc
Cascade (liquid)	94 a	168 d	202 a	290 a	188 c
Untreated	340 a	466 ab	358 a	307 a	368 ab

† All treatments; Duplex ultra (0.38 oz/1000ft²), Magnus (4 oz/1000ft²), Liquid cascade (8 oz/1000ft²), Cascade 16G (3.5 lbs./1000ft²) were initially applied on 1 Sept., 2008, and both Cascade treatments were reapplied on 8 Sept. 2008. All liquid products were applied in 2 gal. water carrier 1000ft².

‡ Approximately .35 mL of distilled, deionized water was placed at 1 cm depths from 0-3 cm across an air-dried core and the time required for the droplet to infiltrate into the core was recorded. Severity of hydrophobicity was based on the following scale of water droplet penetration times: 0-5 sec = wettable, 6-60 secs = slightly hydrophobic, 61-600 sec = strongly hydrophobic, and > 600 sec = water repellent.

* Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD (P=0.05).