Comparison of Three Commercially Available Wetting Agents

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Choosing a wetting agent can be tricky business. Marketing claims run rampant, with some of them solidly backed by data, and others not so much. Last summer, we evaluated three commercially available wetting agents, Revolution (Aquatrols), Tournament Ready (Kalo), and APSA-80 (Amway). While the summer of 2010 was too wet for localized dry spot to appear, we did find differences in the potential hydrophobicity of the soil. The greater the potential hydrophobicity, the greater the chance that localized dry spot would develop under moisture deficit conditions. Our research plots are flat, but it is likely that many of you experiences dry spots on knob or areas with deeper root zones due to non-uniform construction and or topdressing. This article will summarize our findings and help you make an informed decision when purchasing a wetting agent.

Study Conditions

The study was conducted on a L-93 USGA-specification sand putting green. The treatments consisted of an untreated control and different experimental wetting agents applied at the rates and frequencies listed in Table 1.

| Table 1. | Products | and rate | used. | All products | were ap- |
|-----------|----------|----------|-------|--------------|----------|
| plied mor | nthly. | | | | |

| Treatment Name | Rate * (oz/1000 ft ²) | | |
|------------------|-----------------------------------|--|--|
| Control | N/A | | |
| Revolution | 6 | | |
| APSA-80 | 4 | | |
| Tournament Ready | 8 innitially, 4 monthly | | |

*Treatments were applied in 2 gal/1000 ft² and immediately watered in with 0.25 in.

Wetting agents were applied on May 15, June 14, July 12, and August 8; data was collected through September 15. The putting green was mowed at 0.120 inches six days per week. Irrigation was applied at 30% of estimated ET until June 21, after which no irrigation was applied for the remainder of the season. The water drop penetration test was conducted on soil cores monthly during the study to determine potential soil hydrophobicity. To conduct the test, small drops of water were placed at 1 cm intervals down to a depth of 5 cm of an air dried soil core. A stopwatch was used to record the amount of time required for each drop to fully penetrate the soil core.



Turfgrass Color and Quality

Averaged over the season, turfgrass color and quality were statistically similar for all treatments (Table 2). In general, turfgrass quality was near 7 on a 1-9 scale, with 6 representing the minimally acceptable quality. Similarly color hovered near 300, which represents a healthy, adequately fertilized putting green based on our several years of experience using the color measuring device.

No statistical differences in color or were observed on any one particular date, however, differences in quality were observed on three individual dates (Table 3). There are very weak trends on these dates that suggest turf quality is highest with Revolution and lowest with APSA-80.

It would be premature to draw any conclusions from the results on these two dates considering differences were not observed in the other 17 dates. It is not surprising that few differences in turfgrass color or quality were observed because wetting agents have little effect on turf unless moisture stress is evident. However, some wetting agents are known to be phytotoxic and cause visible damage to the turf, or burn, shortly after application. This was not observed for any of the treatments based on daily inspection, and the color and quality results confirm that there is low potential for phytotoxicity with the wetting agents tested.

Soil Moisture and Soil Hydrophobicity

Like color and quality, soil moisture was not statistically different among the treatments (Table 2). This indicates that for this particular root zone, the wetting agents did not increase or decrease the moisture holding capacity compared to the non-treated control. We have observed that most wetting agents will significantly decrease soil moisture compared to the control in wet conditions on a sand root zone with low organic matter. This sand root zone had a moderate level of organic matter (~3%) which probably decreased the ability of the wetting agents to influence soil moisture under the wet conditions.

The water drop penetration test is particularly useful in the absence of moisture stress because we can predict the potential for localized dry spot to develop by pulling soil cores and allowing them to air-dry. Dry soil will show some resistance to penetration by a water drop placed on the surface, and the time it takes for the water drop to penetrate the soil is recorded and used as an indication of potential for localized dry spot to develop in actual moisture stressed conditions, and also can show the efficacy of the applied wetting agents. **Table 2.** Average turfgrass quality (1-9, 9=best) and green color index as measured by Spectrum CM-1000, with a range of 0-999, 999 being greenest. Column means are averages of over 19 weeks. Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Fisher's Protected LSD0.05. Results for July 15 are presented because this was the only single date when statistical differences were observed.

| Treatment | Average Turfgrass Color | Average Turfgrass Quality | Turfgrass Quality on July 15 | Avg. Soil Moisture |
|---------------------|-------------------------------|---------------------------------|------------------------------------|-----------------------|
| Control | 295 A | 7.04 A | 7.33 AB | 24.0 A |
| Revolution | 304 A | 7.45 A | 7.50 A | 24.2 A |
| APSA-80 | 290 A | 7.11 A | 6.17 B | 25.2 |
| Tournament Ready | 293 A | 7.08 A | 7.17 A | 26.1 A |

Table 3. Average turfgrass quality (1-9, 9=best) for the three dates during which significant quality differences were observed. Means followed by similar letters are not statistically different at the 95% confidence level. Means separated by Fisher's Protected LSD_{0.05}.

| Treatment | July 15 | July 25 | | |
|------------------|---------|---------|--|--|
| Control | 7.33 AB | 7.33 AB | | |
| Revolution | 7.50 A | 7.50 A | | |
| APSA-80 | 6.17 B | 7.00 B | | |
| Tournament Ready | 7.17 AB | 7.50 A | | |

Dekker and Ritsema (1999) proposed the following classification scheme that characterizes soils based on the time required for water drop penetration:

| Class | Water Drop Penetration Time (s) | Nomenclature |
|-------|------------------------------------|----------------------------------|
| 0 | <5 | Wettable, non-water repellant |
| 1 | 5-60 | Slightly water repellant |
| 2 | 60-600 | Stongly Water Repellent |
| 3 | 600-3600 | Severly Water Repellent |
| 4 | >3600 | Extremely water repellent |

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Water drop penetration tests revealed that no statistical differences existed before the trial was initiated (Table 4), most water drops took 70-100 seconds to fully soak into the soil between the thatch/air interface and 2 cm, and about 15-50 seconds at the deeper depths indicating a strongly water repellent soil surface and a slightly water repellent soil beneath the surface. This is a common phenomenon because hydrophobicity is associated with high soil organic matter and soil organic matter is more concentrated near the soil surface. After the treatments were imposed, fairly dramatic decreases in water drop penetration time were observed for Tournament Ready and Revolution, where the soil was lowered from strongly water repellent to slightly water repellent (Tables 5). Table 5 is an average of monthly data, and is representative of all months. APSA-80 had no effect on water drop penetration time, indicating that this product may not perform adequately under drought stress conditions, but we would need to confirm this result in a year with heavy moisture stress before making this proclamation confidently.

In conclusion, in this trial where localized dry spot did not develop due to consistent rainfall, all wetting agents treatments had statistically similar color, quality, and soil moisture compared to the non-treated control. When subjected to the water drop penetration test, Revolution and Tournament Ready were equally effective at reducing the hydrophobicity of the air-dried soil cores, while APSA-80 had no effect on time to penetration compared to the non-treated control. This suggests, but does not prove that APSA-80 would not be effective for preventing localized dry spot under drought stress conditions in the field, while Tournament Ready and Revolution would.

Table 4. Water drop penetration test results prior to the initiation of the trial. Cores were taken on May 10, 2010. Statistics were analyzed using log transformed values to meet equal variance assumptions and values converted back to seconds for ease of interpretation. Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Fisher's Protected LSD_{0.05}.

| | Depth of Water Droplet on Soil Core | | | | | |
|------------------|---------------------------------------------|-------|-------|-------|------|------|
| Treatment | 0 cm | 1 cm | 2 cm | 3 cm | 4 cm | 5 cm |
| | Time until water drop penetration - seconds | | | | | |
| Control | 126 A | 123 A | 86 A | 46 A | 39A | 20A |
| Revolution | 133 A | 127 A | 107 A | 37 A | 20A | 13 A |
| APSA-80 | 117 A | 119 A | 67 A | 54 A | 24 A | 18 A |
| Tournament Ready | 151 A | 104 A | 117 A | 115 A | 36 A | 42 A |

Table 5. Water drop penetration test results averaged over the season. Statistics were analyzed using log transformed values to meet equal variance assumptions and values converted back to seconds for ease of interpretation. Means within columns followed by similar letters are not statistically different at the 95% confidence level. Means separated by Fisher's Protected LSD_{0.05}.

| | Depth of Water Droplet on Soil Core | | | | | |
|------------------|---------------------------------------------|-------|--------|------|------|------|
| Treatment | 0 cm | 1 cm | 2 cm | 3 cm | 4 cm | 5 cm |
| | Time until water drop penetration - seconds | | | | | |
| Control | 161 A | 160 A | 144 A | 82 A | 47 A | 31 A |
| Revolution | 25 B | 28 B | 80 B | 80 A | 44 A | 32 A |
| APSA-80 | 186 A | 173 A | 117 AB | 67 A | 36 A | 29 A |
| Tournament Ready | 35 B | 54 B | 104 B | 42 A | 27 A | 25 A |