
Surfactant Effects on Municipal Sports Fields

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Abstract:

For turf managers, soil surfactants are important tools for improving water-use efficiently, maintaining turf quality and reducing expenses. The overall goal of this field trial was to evaluate the addition of three EO/PO block copolymer surfactants as a component of a sports field water management strategy in West Deptford, New Jersey, USA. Three irrigated soccer fields were split down the center, and treated with one of the three surfactants. An unirrigated softball field was also tested. Turf quality (TQ), volumetric water content (VWC) and chlorophyll content (CC) were measured weekly for a total of 24 weeks. The softball field treated with surfactant showed the greatest improvement. Turf quality, VWC and CC were higher in the surfactant treated area. On one of the soccer fields, the surfactant significantly reduced VWC when there was too much water on the field.

Keywords. Sports Turf, Soil Moisture, Distribution Uniformity, Turf/Landscape

Introduction:

Water restrictions and budget cuts are making it more difficult to maintain municipal sports fields in the United States. With the majority of the western USA being classified as in a severe drought or worse, using water as efficiently as possible is becoming increasingly important (Hiem, 2014). Cost is also a large factor in water savings. In 2013, municipal water costs in 30 US major cities saw an average of a 7% increase over the previous year, and between 2010 and 2014 increased 25% (Walton, 2013). These large price increases in water are opening up a lot of potential markets for surfactant use as a way to save water and money.

Surfactants are organic molecules that act as wetting agents by reducing the surface tension of water (Laha et al., 2009). For turf managers, soil surfactants could be an important tool for improving water-use efficiently, maintaining turf quality and reducing expenses (Oostindie et al., 2008). They have a wide variety of uses including sports turf, golf courses, agriculture and horticulture. Surfactants have been shown to increase soil water holding capacity, as well as, increase nitrogen use efficiency (Kostka, 2000; Lowery et al., 2002; Arriaga et al., 2009). These effects on soil physical properties may make them ideal to use in an environment that does not have the resources to allocate to high maintenance costs.

Surfactants improve water conversation in two ways; by reducing to soil water repellency (SWR) and preferential flow (PF). Soil water repellency and PF can significantly reduce irrigation efficiency and cause water and nutrient loss (Oostindie et al., 2008). Surfactants have been shown in golf course turf systems to reduce both SWR and PF patterns in soil (Tucker et al., 1990; Hallett et al., 2001). The majority of surfactant research is focused on highly managed golf course conditions. The site was chosen because it was maintained by the local government. The resources allocated to maintain this park declined due to budgetary cuts. The purpose of this experiment was to test the effectiveness of these three surfactant chemistries under these sports field conditions.

Materials and Methods:

Site Description:



Figure 1: Overview of the park and the fields that were treated. The soccer field is labeled 1-3 and the softball field is labeled number 4. (Google maps)

Surfactant	Rate	Frequency	Total Applications
EP/PO Block Co-Polymer 1	24oz/Acre	Every 3 Weeks	7
EP/PO Block Co-Polymer 2	16oz/1000sq/ft	Every 12 weeks	2
EP/PO Block Co-Polymer 3	6oz/1000sq/ft	Every 4 Weeks	5

Figure 2: Surfactant rates and number of applications.

The field site was scouted, and the optimal fields for the trial were chosen during the first visit. The EP/PO block co polymers were set to correspond with the number field. The fields (Figure 1) were then split in half and marked with spray paint. The surfactant was tank mixed and spray applied with a 20 foot Toro commercial sprayer according to Figure 2 by the facility manager. Each surfactant was spray applied on one half of each of the three soccer fields in a split block. Due to adequate rainfall none of the products were watered in. The total area of each of the fields was about two acres, making one acre treated and one control. The soil was a native sandy loam. The field was a mix of perennial rye and creeping bent grass that was reseeded yearly following aeration. The fertilizing regiment was extremely minimal. Urea was applied only when the turf appeared to be showing signs of nitrogen deficiency, and a starter fertilizer was applied following aeration and reseeding. The field was aerated, reseeded and fertilized during the 19th week of this trial.

The layout of the softball field made consistent treatment complicated. The field (Figure 1) had two light poles approximately 200 yards apart, which were used as a reference points to ensure the same area was treated. The EP/PO block copolymer 1 was tank mixed and spray applied with a 20 foot Toro commercial sprayer according to Figure 2 by the facility manager. The sprayer was lined up with one side in line with pole, driven in a straight line to the opposing pole and back. Foam dots were used to ensure a straight line and that there was no overlap. This made a 40 foot section treated with controls on either side. The soil was a native sandy loam with a very large, dry, problem area centrally located in the outfield. The 40 foot treatment divided the problem area in half. The field was a mix of perennial rye and creeping bent grass that was reseeded yearly following aeration. The fertilizing regiment was extremely minimal. Urea was applied only when the turf appeared to be showing signs of nitrogen deficiency, and a starter fertilizer was used following aeration and reseeding. The field was aerated, reseeded and fertilized during the 19th week of this trial.

Evaluations:

The field was evaluated weekly for 24 weeks. Turf quality was visually rated using a 1 to 10 scale (1=poor turf and 10=ideal turf) on the treated and untreated sections of each field. Soil VWC was measured with a Spectrum FieldScout TDR300 (Spectrum Technologies, 3600 Thayer Court, Aurora, IL 60504) moisture meter with the 3 inch (8cm) probes installed. Thirty readings were taken on a straight tangent across the treated and untreated sections of the field. Turf grass CC readings were taken at the same time using the Spectrum CM1000 (Spectrum Technologies, 3600 Thayer Court, Aurora, IL 60504) meter beginning at week three. Ten random soil cores at a depth of surface to four inches (10cm) were taken at the beginning and end of the trial on each section of the field and were sent to Harris labs for nutrient analysis.

Environmental Conditions:

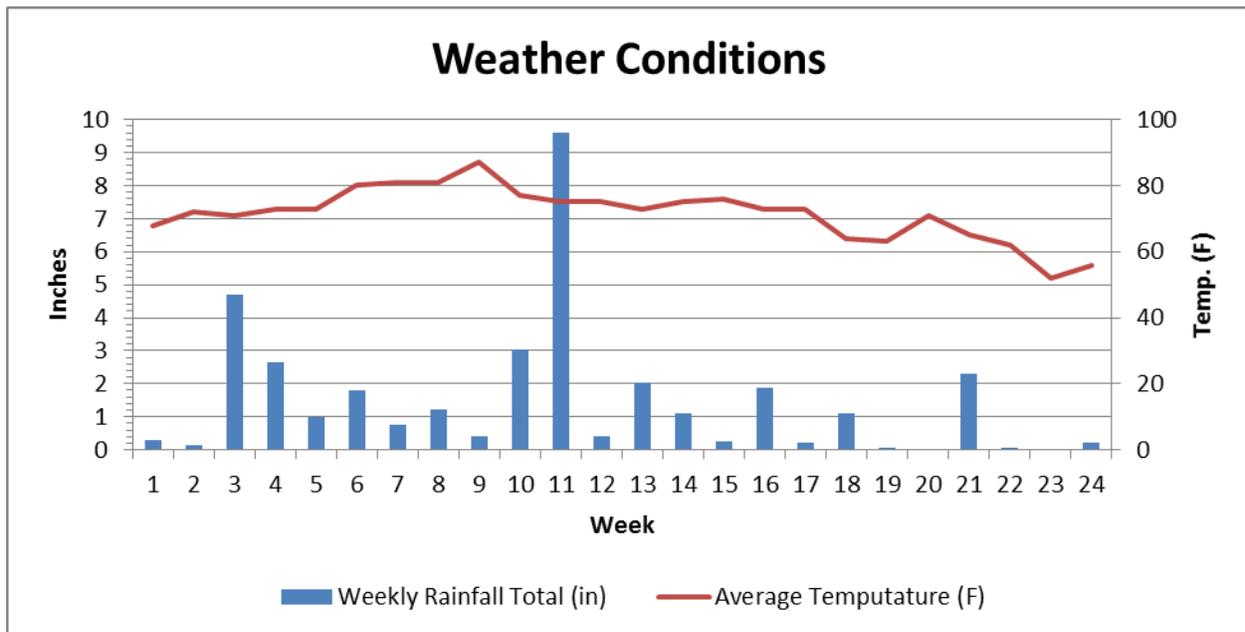


Figure 3: Weather conditions according to weather underground.

Figure 3 shows the weather conditions during summer months in Philadelphia, which is the closest recorded weather station. The summer of 2013 was one of the wettest summers on record for the Delaware Valley. A little over 35 inches of rain fell during this field trial. During the same time period in 2012 a little over 17 inches of rain fell in this area. The area typically averages 0.75 inches of rain per week and 41 inches for the year. The weather conditions made it challenging to see results because the turf grass was not under water stress during the trial.

Statistical Analysis:

After the data were collected, the results were graphed and data were analyzed. A two paired t-test was run on the volumetric water content and the chlorophyll content data. An asterisk on the graph indicates that the P value is less than 0.05.

Results:

Soccer Field One:

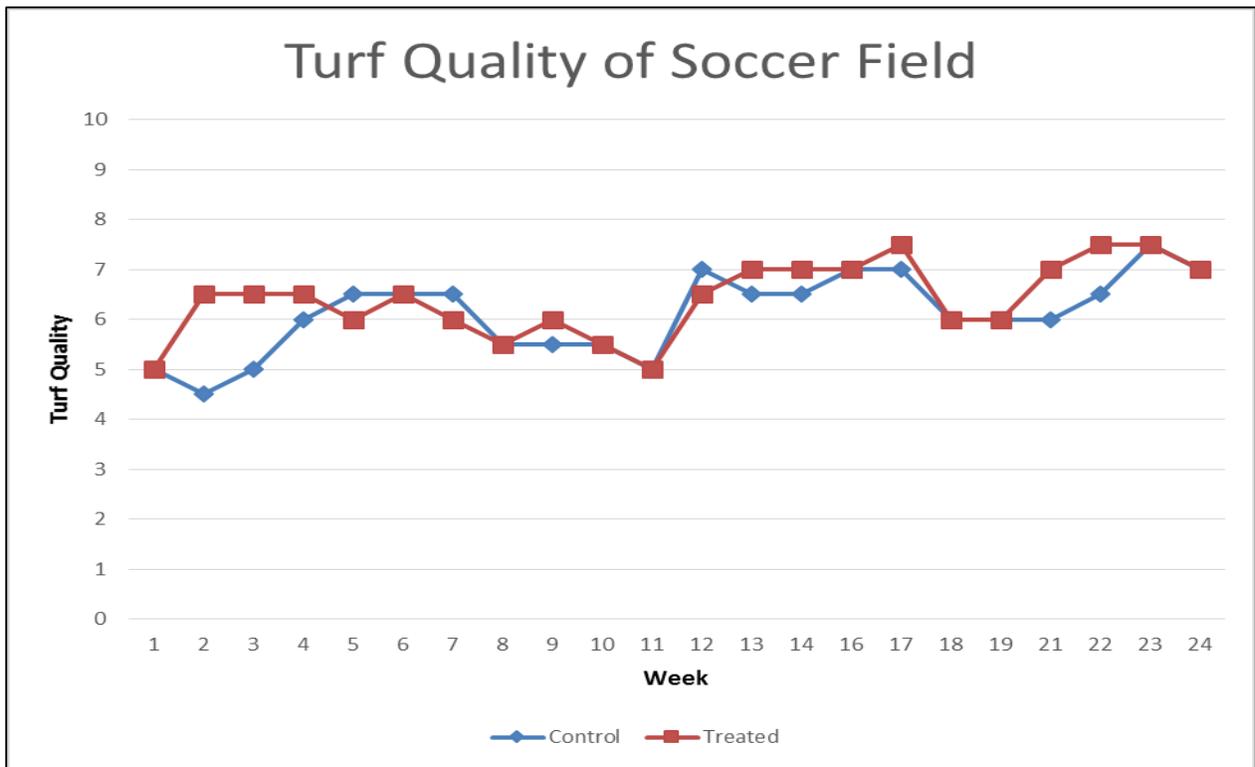


Figure 4: Turf quality of a soccer field treated with an EP/PO Block Co-Polymer

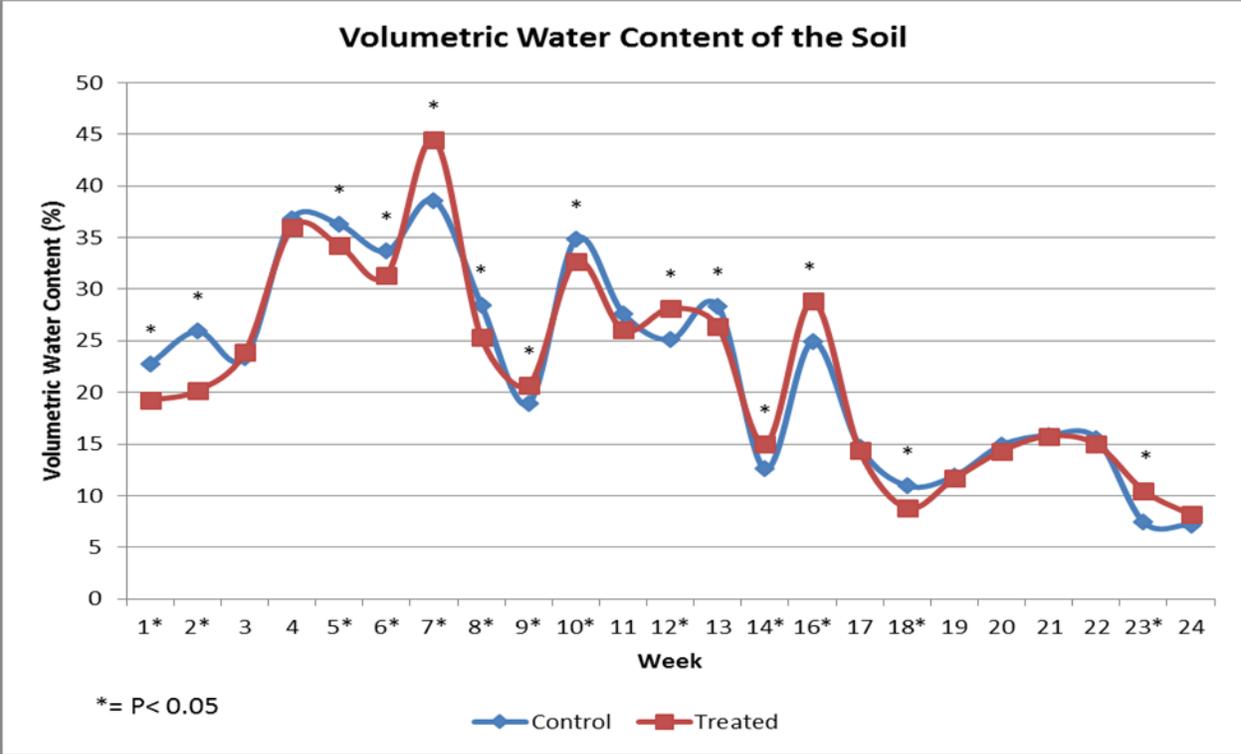


Figure 5: Volumetric water content of the soil on a soccer field treated with an EP/PO Block Co-Polymer

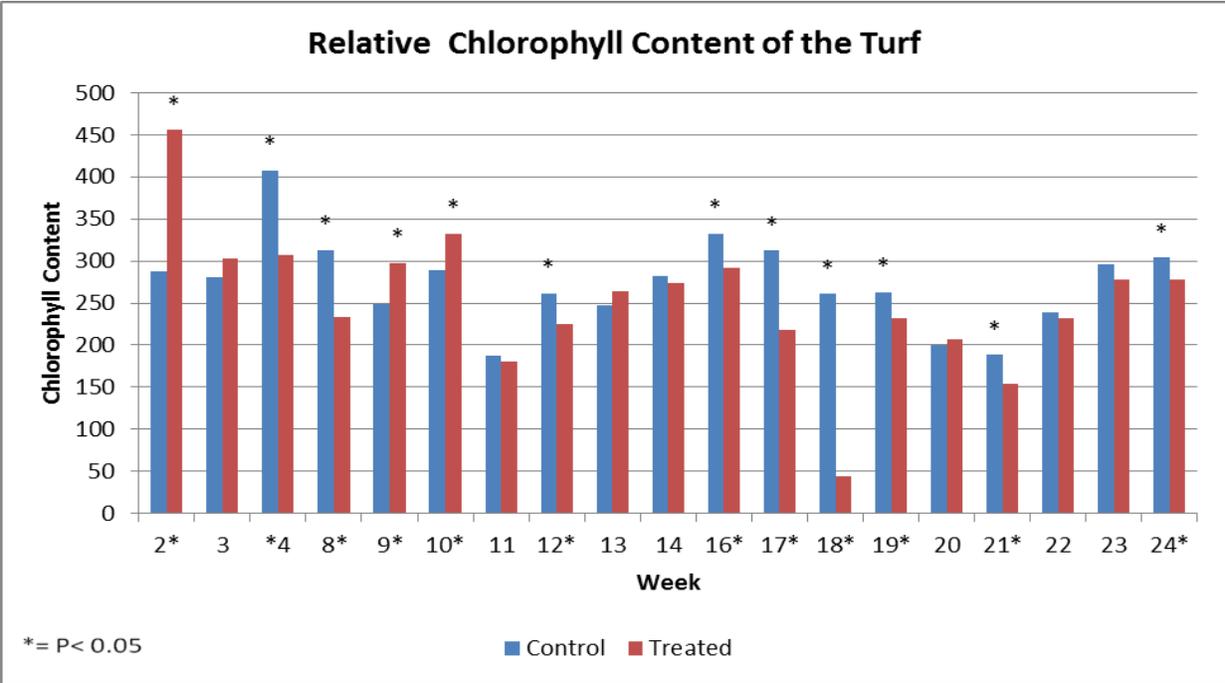


Figure 6: Relative chlorophyll content of the turf on a soccer field treated with an EP/PO Block Co-Polymer

The two sides of the field started the same and then the treatment exhibited a trending effect at week 2 (Figure 4). The TQ of the control area eventually improved after about 4 weeks. The two sides of the field demonstrated similar TQ for the majority of the trial. The treated side of the field exhibited a secondary trend toward improvement after the field was aerated and reseeded at week 19. The treated areas appeared to demonstrate a faster recovery. The control side eventually showed equal TQ after three weeks.

Many similarities in TQ were due to how this field was split. The control area was not nearly as worn as the treated area. There was significant wear around the goal areas, and these exhibited improvement throughout the season. These improvements were apparent in the pictures, but did not improve the treated side of the field enough to show up on in the overall turf quality.

Although there were statistical differences in VWC (Figure 5) no trends were seen in the data. The soils did appear to be very wet during the majority of the season and did not dip below ten percent on either side until the last week. The CC (Figure 6) seems to be closely in line with the VWC data and there were no trends in the data.

Soccer Field Two:

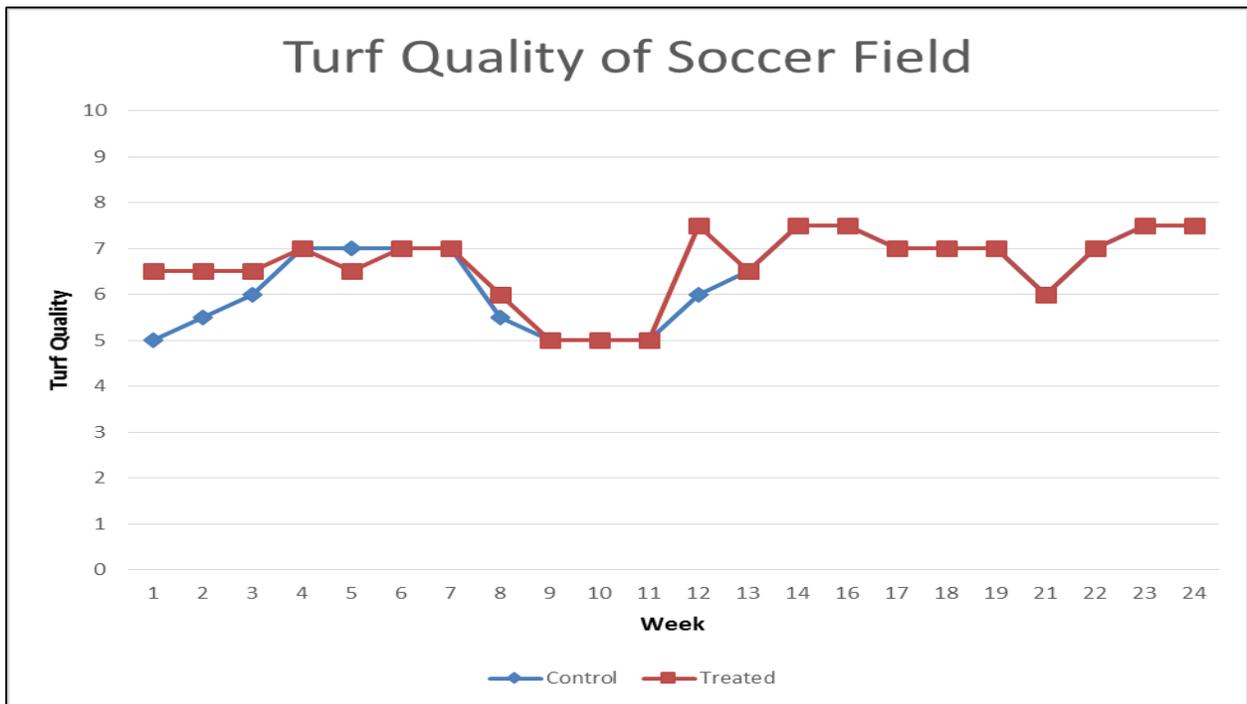


Figure 7: TQ of a soccer field treated with an EP/PO Block Co-Polymer

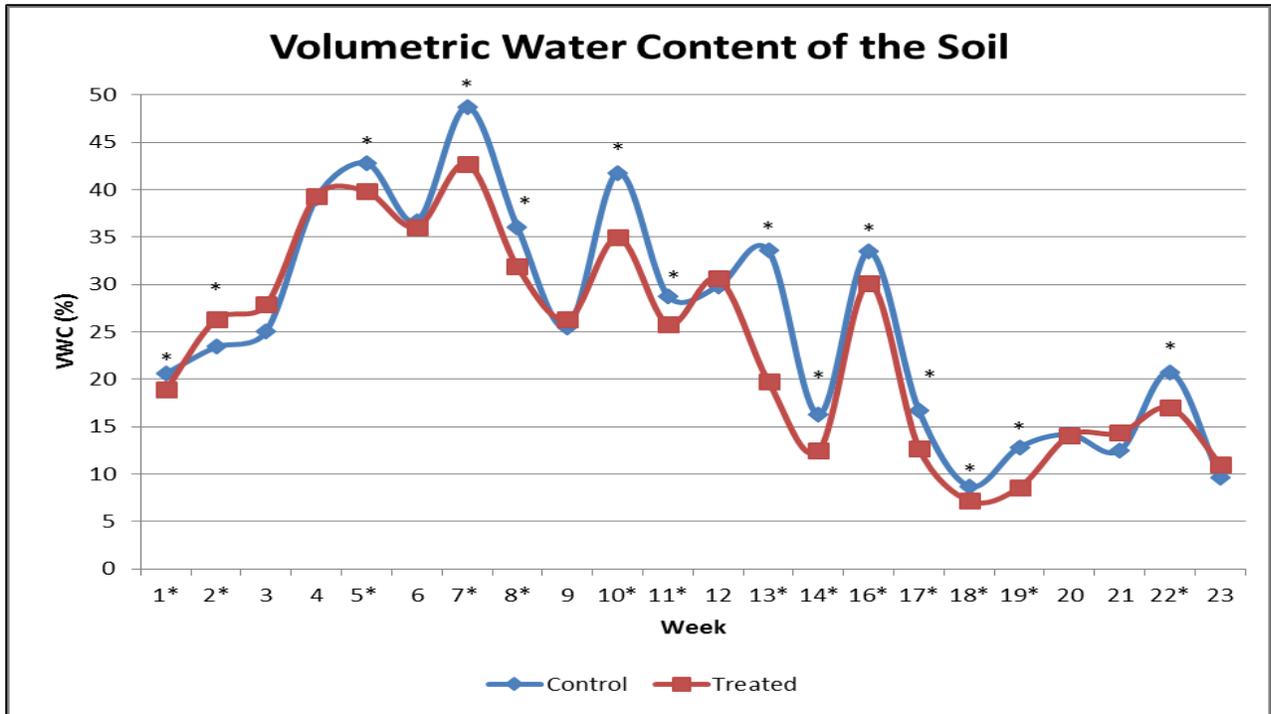


Figure 8: VMC of the soil in a soccer field treated with an EP/PO Block Co-Polymer

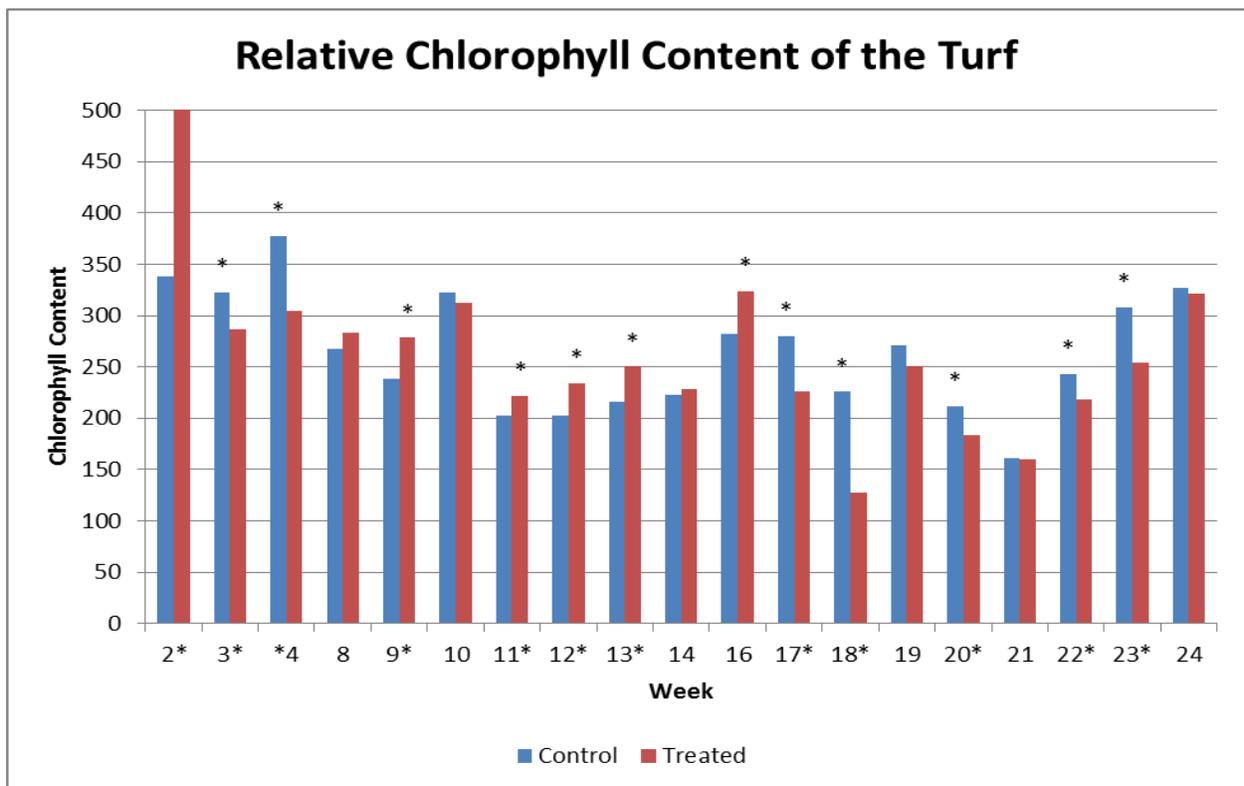


Figure 9: Relative CC of the turf on a soccer field treated with an EP/PO Block Co-Polymer

The treatment side initially had higher TQ (Figure 7). The control area eventually improved after about 3 weeks. The two sides of the field demonstrated similar TQ for majority of the trial. No overall differences were seen on the field.

The VWC was significantly lower on the treated side of the field throughout the season (Figure 8). The field started the same on both sides. The surfactant may have helped this field to drain excess water. Also, the treatment significantly improved the CC (Figure 9) on weeks 11, 12, 13, and 16. Weather conditions (Figure 3) indicate that these were particular wet and hot with week 11 receiving 9.5 inches of rain. The VWC (Figure 8) was also significantly lower during Week 11, 13 and 16. Indicating that the turf exhibited less stressed due to the presence of less water in the treated area of the field. Week 17 and 18 the CC significantly dropped and this is consistent with a significant drop in VWC on the treated side of the soccer field. Indicating that while under wet conditions the surfactant helped with drainage, however when the field dried out it put the plant under water stress.

Soccer Field Three:

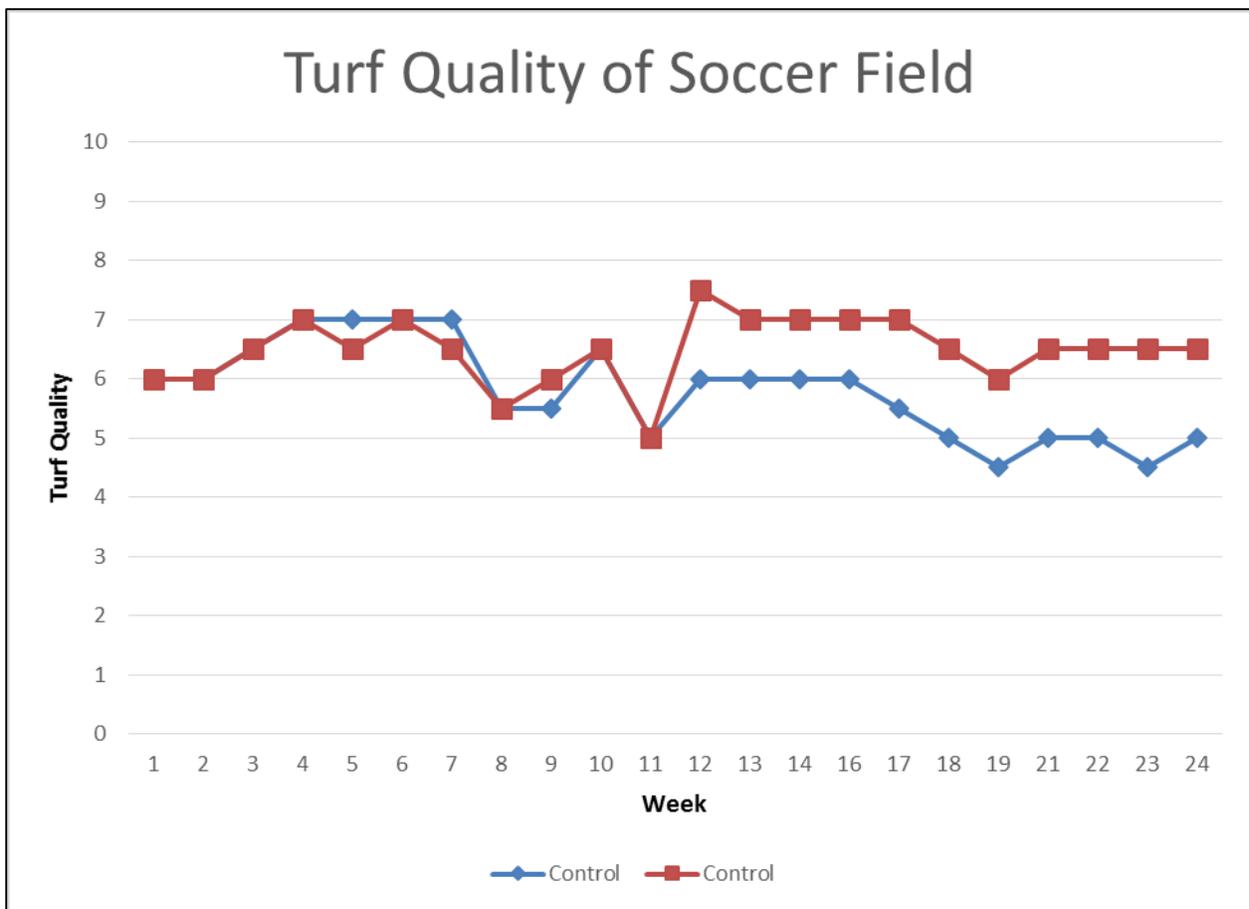


Figure 10: Turf quality of a soccer field treated with an EP/PO Block Co-Polymer

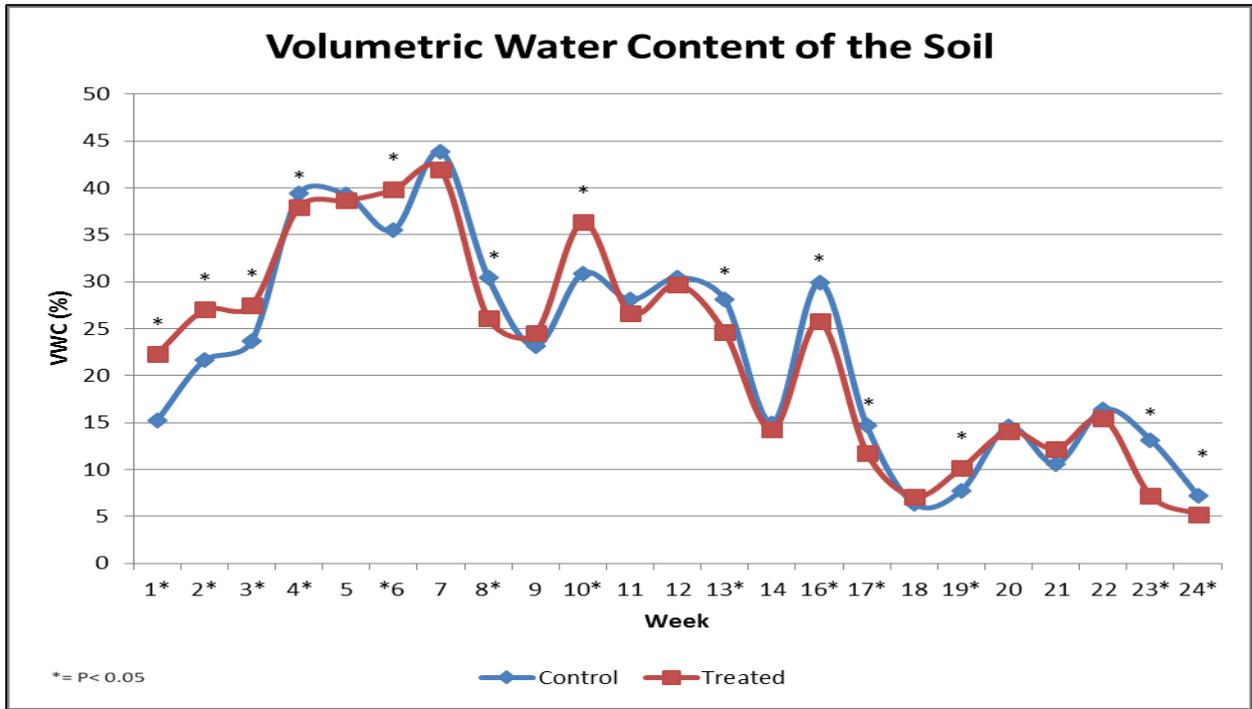


Figure 11: Volumetric water content of the soil on a soccer field treated with an EP/PO Block Co-Polymer

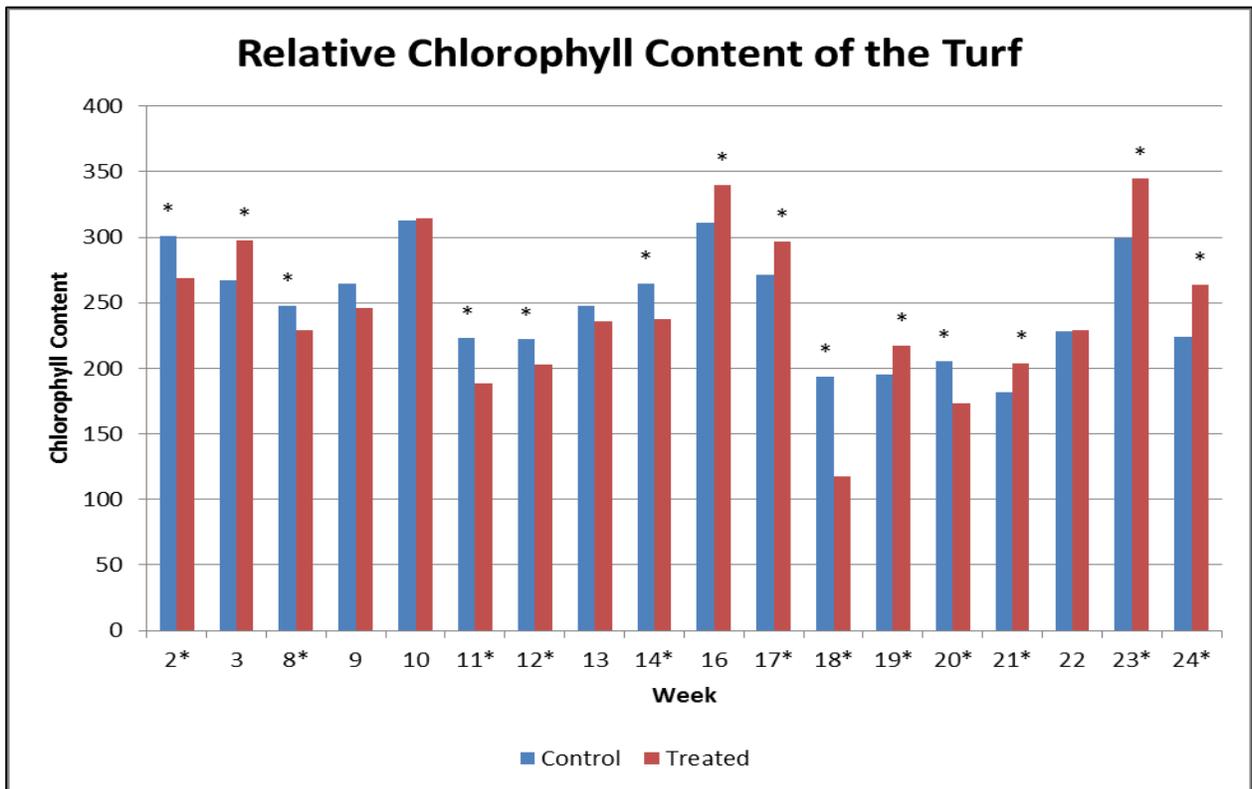


Figure 12: Relative chlorophyll content of turf on a soccer field treated with an EP/PO Block Co-Polymer

Turf quality (Figure 10) on the treated and untreated sides of the field started the season equal. This field was heavily infested by crab grass. It was then treated with an herbicide to try to combat infestation. After the treatment, the surfactant treated side trended to recover faster and maintained that trend of higher TQ through the duration of the trial.

There were no treatment effect on soil VWC (Figure 11). The CC (Figure 12) on this field exhibited some interesting trends when compared to the weather data. The beginning 14 weeks of the trial were the wettest, and during this time the control section exhibited significantly higher CC compared to the treated side. During five of the nine weeks data was collected the control was significantly higher. After 14 weeks, six of the final nine weeks the treated area had significantly higher CC. The VWC (Figure 11) decreased 50% on both sides during this time, indicating, that as the summer dried out the turf may have been less stressed on the treated side.

Softball Field Four:

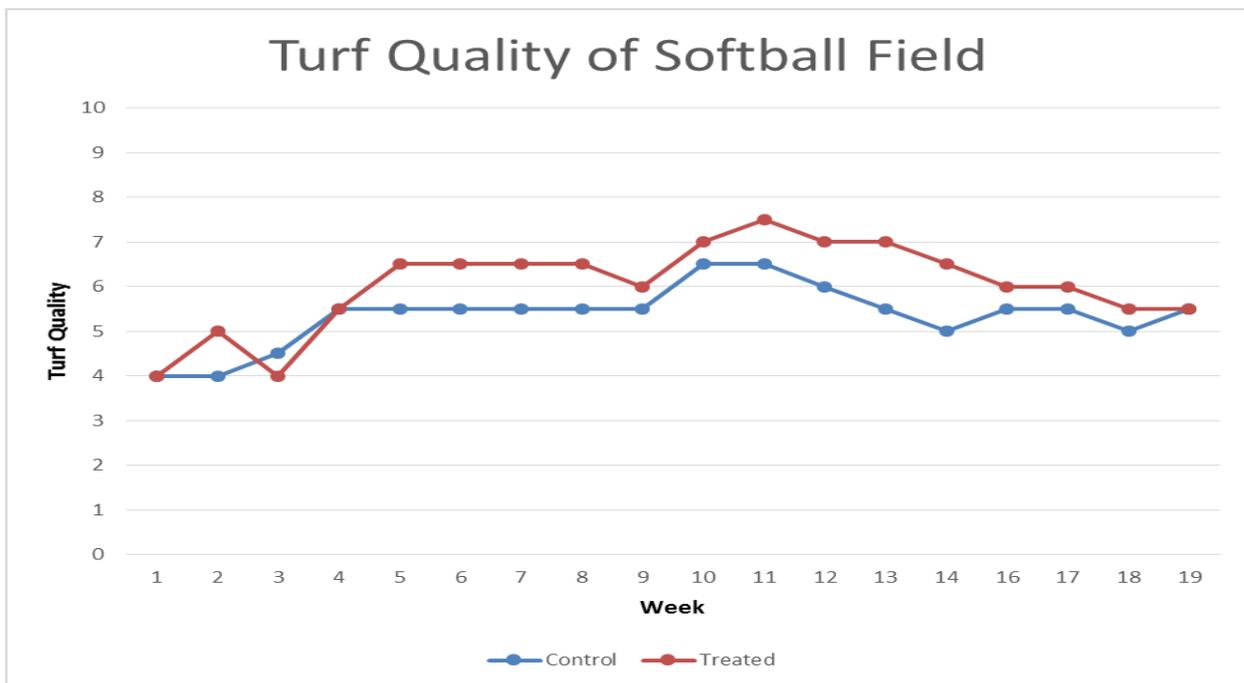


Figure 13: Turf quality of a softball field treated with an EP/PO Block Co-Polymer

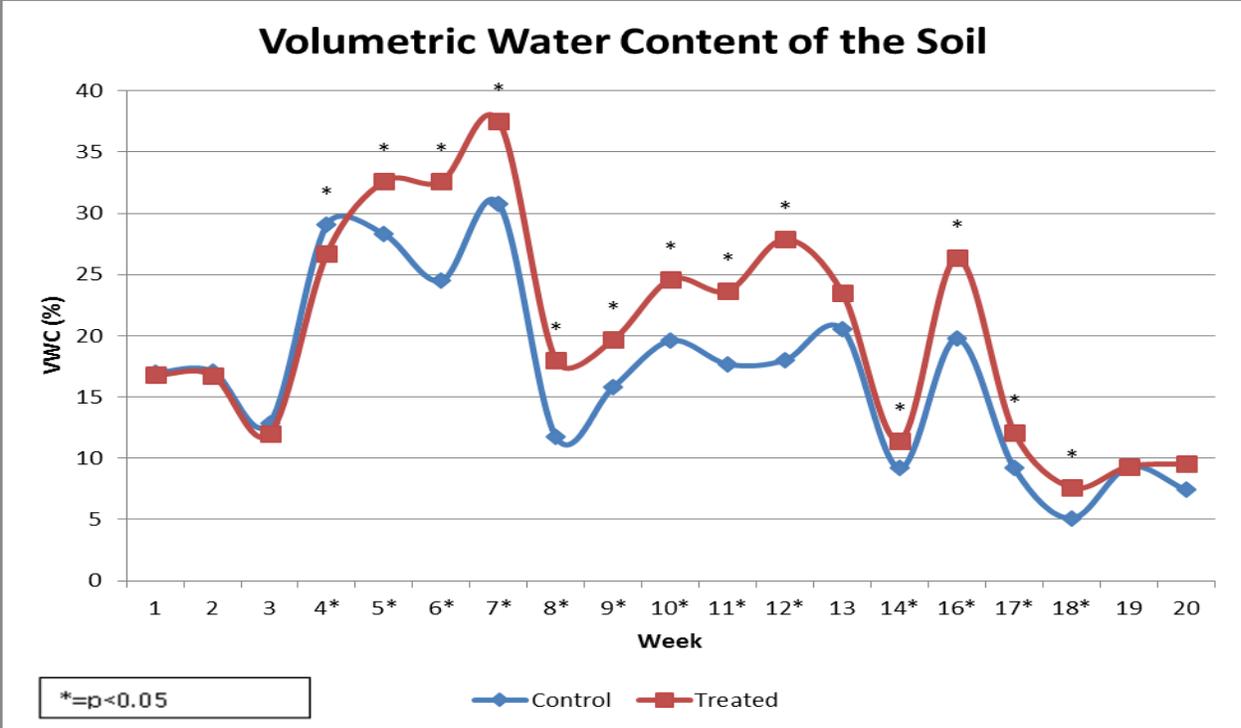


Figure 14: Volumetric water content of the soil on a soccer field treated with an EP/PO Block Co-Polymer

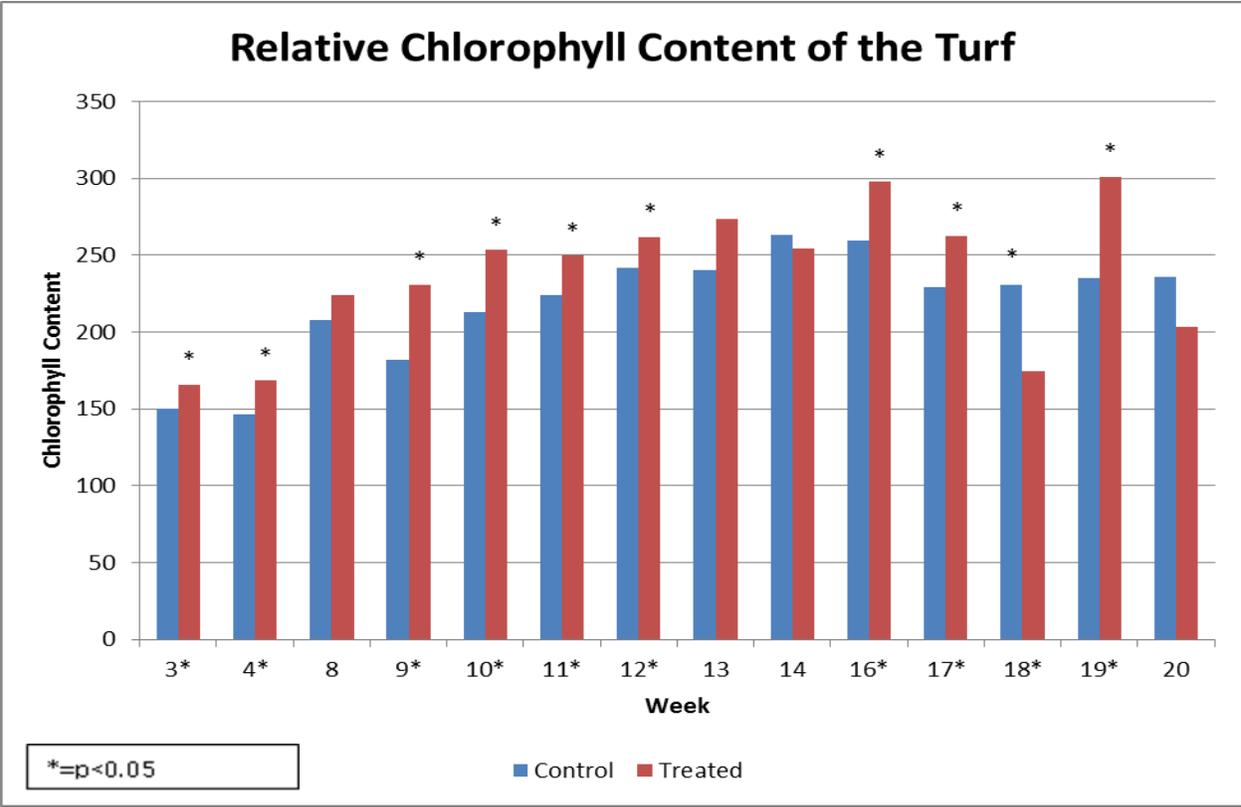


Figure 15: Relative chlorophyll content of the turf on a softball field treated with an EP/PO Block Co-Polymer

At the start of the season TQ (Figure 13) on the treated and untreated side of the field were equal. After about five weeks a trend in improvement was observed in the surfactant treated areas. The difference between treatments remained until the final week when the surfactant and control areas were similar. This observation suggest that this product may influence TQ.

At study initiation, soil VWC (Figure 14) were equivalent in the treated and untreated sections. Beginning at week 4 the VWC was significantly higher in the treated portion of the field and remained significantly higher than the control for all but two of the subsequent measurement dates. The surfactant treatment helped to retain soil water throughout the growing season.

On 10 of the 14 measurement dates, the CC (Figure 15) was significantly greater in the surfactant treated portion of the field, compared to the untreated area. Higher CC supports the visual TQ rating and indicates greater photosynthetic efficiency. It is also an indicator that the plants were less stressed throughout this trial.

Conclusions:

In conclusion, this trial demonstrates that all three of EP/PO block co-polymers would fit into a water management program at West Deptford Park, NJ. EP/PO block co-polymers 1 proved very effective on the unirrigated softball field. It improved TQ, soil VWC and turf CC. The chemistry demonstrated the largest treatment effects seen on any field during this trial. EP/PO block co-polymer 2 statically decreased soil VWC when the field was to wet and would be useful for draining a field that holds to much water. EP/PO block co-polymer 3 improved overall TQ and CC during the driest portion of the summer.

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