Prevention of Winter Desiccation on Fairway Turf in Nebraska

Darrell Michael and Dr. Bill Kreuser
Department of Agronomy and Horticulture
University of Nebraska-Lincoln

INTRODUCTION

Winter desiccation injury can severely impact golf courses in the northern Great Plains, however, little is known about prevention. The objective of this study was to evaluate the effectiveness of commonly used desiccation prevention treatments on retaining turf crown moisture content and its impact on turf survival.

MATERIALS AND METHODS

Site Characteristics

This study was conducted at the John Seaton Anderson Turfgrass (JSA) Research Facility in Mead, NE during the winter of 2014-2015. The plot space consisted of a mature stand of 'L-93' creeping bentgrass (*Agrostis stolonifera*) managed as a fairway, and the root zone was constructed following the recommendations of the USGA (2004). Plots were irrigated to replace 80% of potential evapotranspiration prior to the initiation of the study. A preventative snow mold application was made prior to initiation of the study with Banner Maxx™ (Syngenta, Greensboro, NC) on 11 November, 2014. Treatments were applied on 24 November, 2014 while the turf still had green color, and ceased fall growth. In an effort to promote winter desiccation, precipitation was withheld throughout the study by covering the plots with a 6 mil clear impermeable plastic cover prior to precipitation events. Covers were removed immediately after the precipitation events. The study was concluded at the end of April.

A similar field study was conducted on fairways in Kearney, Mullen, and Gering, NE during the winter of 2014-2015 which will hereafter be referred to as *Western Nebraska* sites. Sites were chosen to evaluate desiccation prevention treatments in areas that historically receive desiccation across Nebraska. The study was initiated on 20 November, 2014 while the turf still had green color, and ceased fall growth. Unlike the study conducted at Mead, NE, natural precipitation was not withheld from these sites. The study was concluded on 26 March, 2015.

The study at the Kearney site was conducted on a stand of 'T-1' creeping bentgrass. The study at the Mullen site was conducted on a mixture of fine fescue (*Festuca ssp.*) varieties. The study at the Gering site was conducted on 'Midnight' and 'Baron' Kentucky bluegrass (*Poa pratensis*).

Experiment Treatments

Mead

The overall goal of the study was to compare traditional desiccation prevention practices to newer spray-applied treatments (Table 1). Traditional desiccation treatments included a GreenJacket™ (GreenJacket™, Genoa City, WI) white woven permeable cover, a clear 3.5 mil clear impermeable cover, and sand topdressing at a thickness of 0.46 cm, which was enough to bury all of the turf except the very tips of the leaves. Spray-applied treatments included a combination of the horticultural spray oil, Civitas™, mixed with the turf colorant Harmonizer (Petro-Canada, Mississauga, ON, CA), Tournament Ready™ (KALO, Overland Park, KS) wetting agent, Foursome™ (Quali-Pro, Pasadena, TX) turf colorant at the 4x label rate, and Transfilm™ (PBI-Gordon, Kansas City, MO) anti-transpirant. Spray-applied treatments were applied using a CO_2-powered backpack sprayer with three Teejet AL 8005 nozzles at 234 kPa, calibrated to deliver a spray volume of 827.6 L ha^{-1}.

Western Nebraska

Treatments applied at the western sites were similar to the Mead site except the clear a GreenJacket™ white impermeable cover was substituted for the 3.5 mil clear cover treatment . Treatments were applied in applied in a similar fashion as the Mead site.

Measurements

Mead

Data collection included measuring the crown moisture content (CMC) and turf quality. Crown moisture content was measured monthly by taking nine 6.5 cm^2 plugs from each plot in a grid pattern, randomly selecting three plants from each plug, and isolating a total of 27 crowns per plot. Crowns were defined as the portion of the plant where the stem and roots joined (approximately 5 mm long). Once plant material was collected, the crowns were immediately isolated and weighed to determine their fresh weight. Crowns were then oven-dried at 70°C for 24 hr. Crown moisture content was calculated as the difference between the fresh and dry weight divided by the fresh weight of the plant material for each plot and reported in grams H_2O per gram fresh weight.

Visual turf quality of each plot was monitored weekly in the spring when three of four replications had broken dormancy . Turf quality ratings were taken to monitor spring green-up/survival among treatments. Ratings were taken on a 1-9 scale where 1 represented dead or brown turf and 9 represented dark green, uniform turf. A value of 6 was considered minimally acceptable. Ratings were taken weekly from the time of spring regrowth through the end of April.

Western Nebraska

Crown moisture content was measured once in the spring on 13 March with the same methods at the Mead site. Representative plugs of turf were collected and potted in the greenhouse where turf quality was monitored every other day to evaluate recuperative capacity. Turf quality was measured on the same scale as the Mead site.

Statistical Analysis

Individual plots (1.5 m x 2.7 m) were arranged in a randomized complete block design with 4 replications per treatment. Data were subjected to Analysis of Variance (ANOVA) and treatment means were separated using Fisher's Protected Least Significant Difference and Student's t-test at the 0.05 probability level. When necessary, data were transformed to meet the assumptions of ANOVA.

RESULTS

Mead

Crown Moisture Content

There was a significant treatment x month interaction for CMC ($p<0.001$) (Fig. 1). All treatments were statistically similar in both December and January. Divergence among treatments were first observed during February. The largest treatment differences that were observed were during the month of March.

At the March rating date, the 3.5 mil clear cover had the highest CMC (0.742 g H_2O g^{-1} tissue) followed by the GreenJacket™ permeable cover (0.677 g H_2O g^{-1} tissue) and sand topdressing (0.659 g H_2O g^{-1} tissue) which were all statistically similar and performed better than the non-treated control. The spray applied treatments all performed similar to the non-treated control.

Spring Recovery

Covers were removed on 15 March, 2015 as spring growth was first observed and forecasted weather temperatures called for several days with highs near 29 °C (84 °F). At time of cover removal, the 3.5 mil cover was the best performing treatment with a turf quality of 8.25 (Fig. 2). These plots were dark green in color, exhibiting no damage from winter. The GreenJacket™ white impermeable cover had the next highest quality with a mean of 3.85. All spray treatments were statistically worse than the both cover treatments when the covers were removed. The sand topdressing was the worst-performing treatment with a quality of 1.25 on 17 March.

Quality ratings generally rose as spring progressed and the highest observed qualities were typically observed on 29 April. However, the exception was the 3.5 mil clear impermeable cover which had a substantial decline in turf quality for two weeks following the initial rating due to freezing temperatures. On the last rating date, the highest performing statistical group contained all of the traditional desiccation prevention treatments. While not statistically different, the GreenJacket™ white permeable cover had the highest quality (8.5) followed by the clear impermeable 3.5 mil clear cover (7.25), and sand topdressing (6.5) which all out performed the non-treated control. All other treatments were statistically similar to the non-treated control.

Western Nebraska

Crown Moisture Content

The trends observed at the Kearney site were similar to the Mead site in that all three traditional desiccation prevention treatments were the best performing treatments with the highest CMC (Fig. 3). Although not statistically different, the GreenJacket™ white impermeable cover had the highest CMC (0.606 g H_2O g^{-1} tissue) followed by sand topdressing (0.597 g H_2O g^{-1} tissue), and GreenJacket™ white permeable cover (0.516 g H_2O g^{-1} tissue). All other treatments were statistically similar to the non-treated control which had a CMC of 0.251 g H_2O g^{-1} tissue. There were no significant treatment effects at either the Mullen (p-value = 0.414) which received winter watering, or the Gering site which sustained season-long snow cover (p-value = 0.0645) and both had 100% turf survival so results are not reported.

Spring Recovery

A significant treatment x week interaction was observed at the Kearney site ($p<0.001$). On 13 March, the GreenJacket™ white impermeable cover had the highest turf quality (4.75) when the covers were removed, and this was statistically greater than any other treatment (Fig. 4). The GreenJacket™ white impermeable cover, the GreenJacket™ white permeable cover, and sand topdressing were the only treatments which improved over the rating period. The GreenJacket™ white impermeable cover had the highest turf quality (9) on 26 March followed by GreenJacket™ white permeable cover (7.5) and sand topdressing (6.75). No other treatment had a turf quality greater than 3 at the end of the recovery period.

DISCUSSION

The winter of 2014-2015 proved to be a difficult winter for many turf mangers in Nebraska. The Kearney site received negligible snowfall, and by withholding precipitation from the Mead site, both sites were subjected to desiccating conditions and turf death. Traditional desiccation practices proved to be more effective than spray-applied treatments for keeping turf alive during lethal Nebraska winters. At the Mead site, plots covered with the 3.5 mil clear cover had the highest CMC, but when night temperatures dropped to -6°C a few days after cover removal, this turf was likely predisposed to low-temperature injury. However, this decline was not observed for the GreenJacket™ white permeable cover and sand topdressing which had a slightly lower CMC.

The GreenJacket™ white impermeable cover did not exhibit the same reduction of turf quality upon removal at the Mead site. This may be attributed the white color of the cover, which likely reduced soil warming compared to the clear cover. This also may be explained by timing of cover removal timing to prevent premature spring green-up. The GreenJacket™ white permeable cover and sand topdressing were the preferred methods of desiccation prevention at the Kearney site as these sustained crown moisture content and improved turf quality in the spring.

These findings suggest that the most important strategy for preventing desiccation is to providing physical protection to the crown of the plant and not allowing it to be exposed to wind and low temperatures. In this study, the GreenJacket^{TM} white permeable cover and sand topdressing resulted in plots with sustained crown moisture content throughout the winter and faster recovery in the spring without adverse effects.

Table 1. Desiccation prevention treatments applied at Mead and/or Western NE in fall of 2014.

Treatment	Mead	Western NE	Thickness or Rate
Untreated/uncovered control	x	X	-
Traditional desiccation prevention			
3.5 mil clear cover	X		3.5 mil
GreenJacket^{TM} white permeable cover	X		*
GreenJacket^{TM} white impermeable cover		X	*
Sand topdressing	X	X	0.46 cm
Spray-based treatments			
Civitas^{TM} + Harmonizer	X	X	51 + 3.2 L ha^{-1}
Foursome^{TM}, turf pigment	X	X	4.4 L ha^{-1}
Tournament Ready^{TM}, wetting agent	X	X	25.5 L ha^{-1}
Transfilm^{TM}, anti-transpirant	X	X	25.5 L ha^{-1}

*Variable thicknesses are not offered

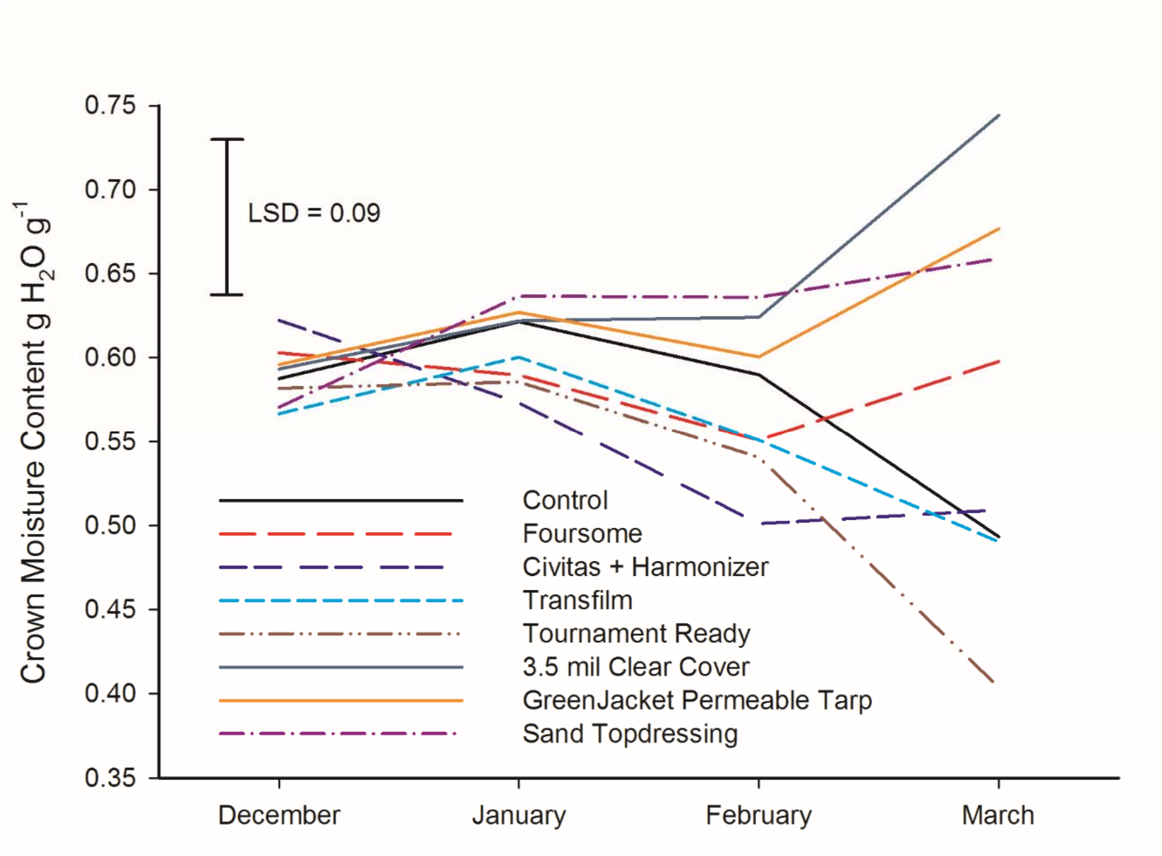

Figure 1. Crown Moisture content monitored through the winter months at the Mead site. The rise in crown moisture observed in March is likely due to spring regrowth.

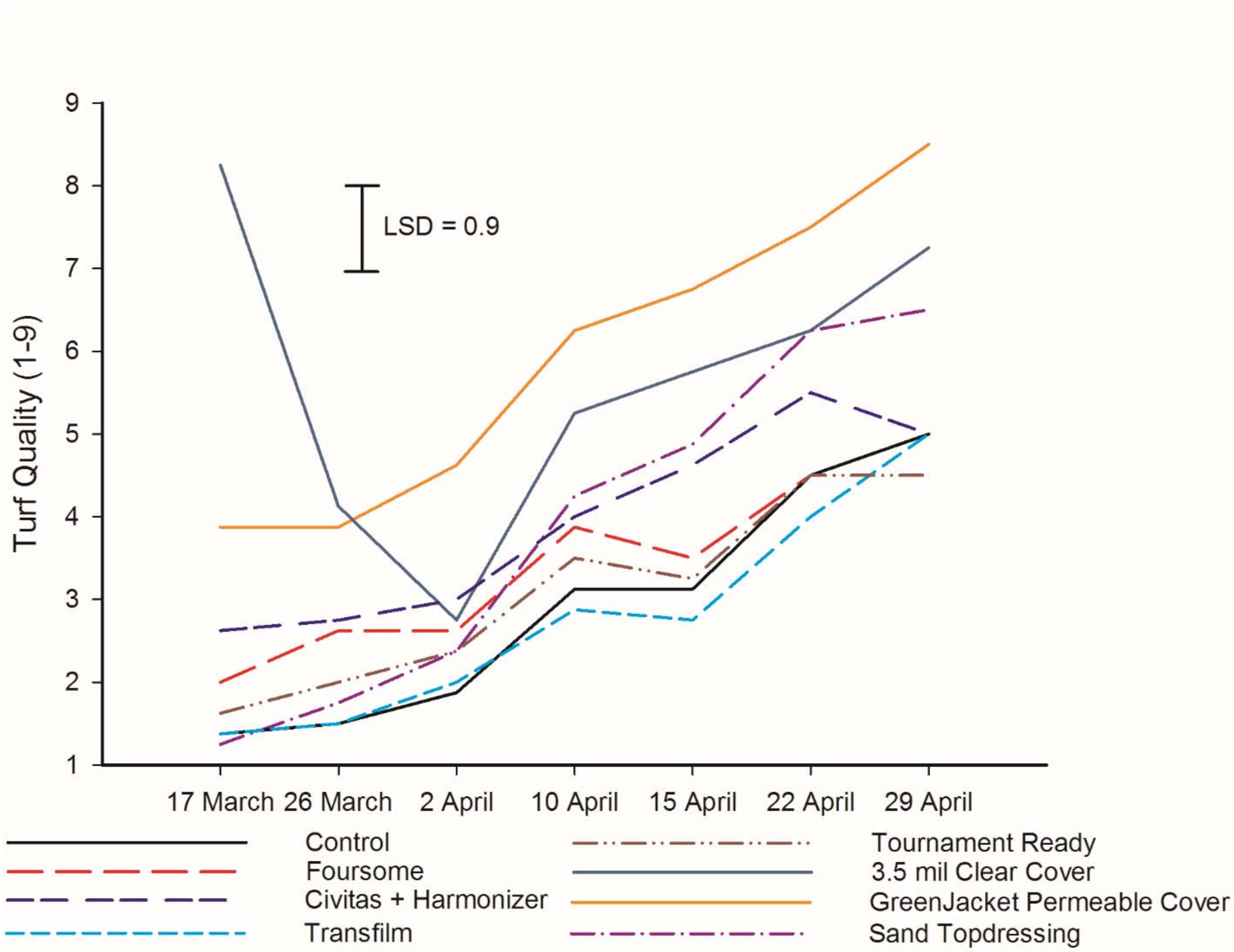

Figure 2. Quality ratings of study after removal of tarps at the Mead site. Assessment of quality aids in determining speed of recovery.

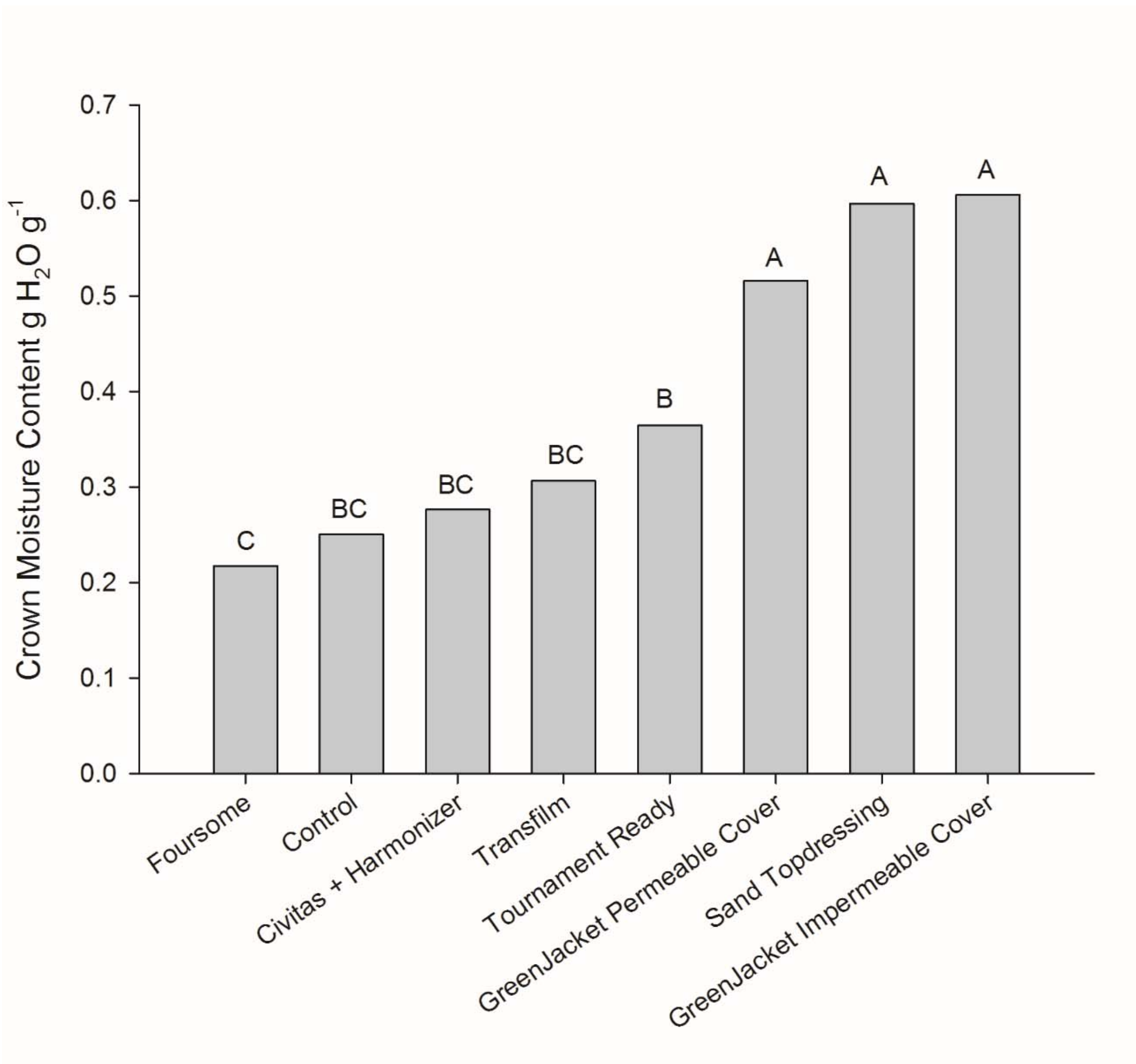

Figure 3. Crown moisture content levels at Kearney site taken on 11 March, 2015. Different letters signify a statistical difference.

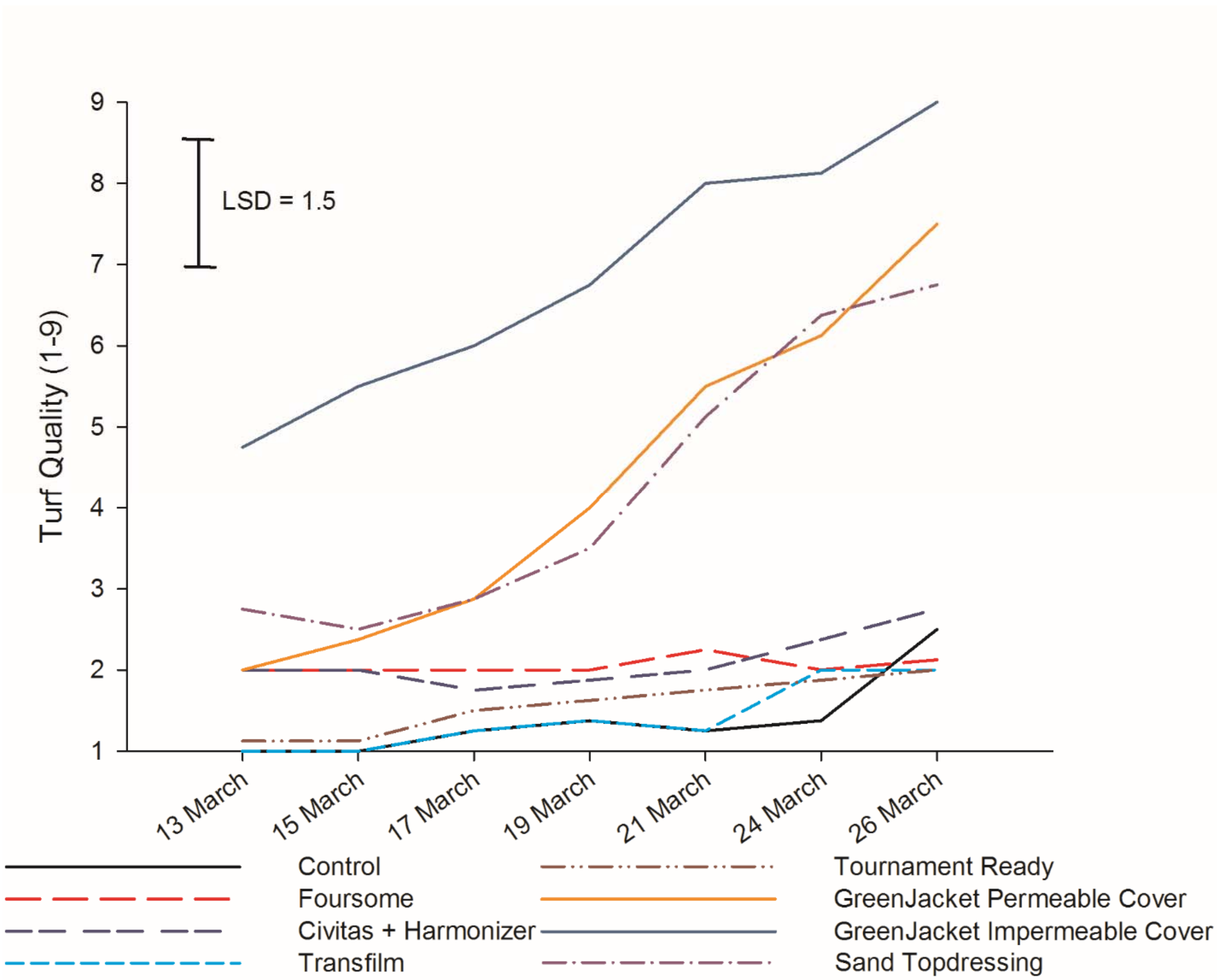

Figure 4. Recovery at Kearney site. Both GreenJacket™ covers and sand topdressing sustained crown moisture content and