

7-2017

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R. Braun

Kansas State University, rcbraun@purdue.edu

D. Bremer

Kansas State University, bremer@ksu.edu

J. Hoyle

Kansas State University, jahoyle@ksu.edu

See next page for additional authors

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Recommended Citation

Braun, R.; Bremer, D.; Hoyle, J.; and Bloedow, N. (2017) "Performance and Recovery of Turfgrasses Subjected to Drought and Traffic Stresses," *Kansas Agricultural Experiment Station Research Reports*: Vol. 3: Iss. 4. <https://doi.org/10.4148/2378-5977.7158>

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Authors

R. Braun, D. Bremer, J. Hoyle, and N. Bloedow

TURFGRASS RESEARCH 2017



JULY 2017

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Performance and Recovery of Turfgrasses Subjected to Drought and Traffic Stresses

Ross Braun, Dale Bremer, Jared Hoyle, and Nicholas Bloedow

Summary. This study is an effort to determine effects of drought and traffic in turfgrasses. During a 41-day summer drought in 2015 and 2016, warm-season (C4) grasses were more affected by traffic than cool-season (C3) grasses when percent green cover and turf quality were measured. This was because the non-trafficked plots in C4 grasses maintained higher percent green cover and turf quality throughout the drought due to better drought-stress tolerance than the C3 grasses. Regardless of traffic treatment or mowing height, C4 grasses maintained higher percent green cover and visual turf quality than C3 grasses during drought and recovery periods. There was a larger separation between traffic treatments within the higher (rough) height compared to the lower (fairway) height. Overall, traffic application during a drought will have a negative and accelerated impact on the above-ground portion of turfgrass, which will vary due to turf species and mowing height.

Rationale. One of the most important challenges facing golf course superintendents is decreasing water for irrigation. Increasingly, state and local drought restrictions may be imposed on turf managers with no regard for damage to turfgrass (Beard and Kenna, 2008). Traffic damage is another management issue commonly faced by superintendents. Traffic, such as that on or near cart paths where golfers tend to walk or drive carts into fairways and roughs, may cause substantial wear to turfgrass and also compact the soil. Significant research has been conducted separately on the issues of drought resistance and traffic tolerance in turfgrass. Results have indicated that turfgrasses vary widely in their ability to resist drought and tolerate traffic. However, little research has been conducted to investigate the combined effects of drought and traffic in turfgrasses. Given the increasing likelihood of irrigation restrictions for turfgrass at operational golf courses with areas of high traffic, it is imperative to conduct such research. Past research on traffic application in turfgrass has been conducted

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on turfgrass under well-watered conditions; further research is needed on the traffic tolerance of turfgrass species during drought stress.

Objective. To evaluate the effects of golf cart traffic on both warm- (C4) and cool-season (C3) turfgrass species maintained at two golf course-related heights (fairway- and rough-height) during a simulated drought period and the subsequent recovery period (without traffic) using a stationary drought shelter.

Study Description. A 2-yr field study was conducted under a stationary rainout shelter in Manhattan, KS, in 2015 and 2016 (Figures 1, 2, and 3). The soil was a Chase silty clay loam. The study included three main effects: 4 turfgrass species, 2 mowing heights, and 2 traffic rates, each treatment replicated 4 times. Two warm-season species, 'Sharps Improved II' buffalograss and 'Meyer' zoysiagrass, and two cool-season species, 'America' Kentucky bluegrass and 'Paragon GLR' perennial ryegrass, were maintained at golf course fairway- (1.6-cm) and rough-heights (6.4-cm) under a strip-split plot arrangement. Traffic rates consisted of no traffic (untreated) and traffic (16 passes per week) with an electric motorized golf cart with supplemental weight to simulate two golfers and equipment during the drought period only. Prior to and throughout the research trials, both warm- and cool-season grasses were maintained individually according to standard agronomic practices (fertility and pest control). In both years, a clear plastic greenhouse cover was installed during late June to exclude rainfall, and turfgrasses underwent a 41-day simulated drought period with no irrigation and simulated traffic applied to plots weekly. At the end of the 41-day drought period, the plastic cover was removed and turfgrasses received adequate water requirements via irrigation and precipitation during the 40-day recovery period.

Data collection for this study occurred from June 26 to September 18, 2015, and from June 23 to September 15, 2016. Visual turf quality, percent green cover using digital image analysis, turf firmness, and soil water content were measured at 4 days prior to drought period (baseline period), then measured weekly throughout both the drought and recovery periods each year. Soil bulk density and soil compaction measurements were measured during pre- and post-drought periods and post-recovery period. Root measurements were conducted immediately following the post-drought period in 2016 to evaluate the effects of drought and traffic on root length density, root surface area, average root diameter, and root biomass.

Results. Based on weather data collected from an on-site weather station positioned in full sun within 100 m of the study area, the monthly average air temperatures were slightly higher during the drought period of the study in 2016 compared to 2015 (data not shown). Soil water content during the 41-day drought was impacted significantly by turf species, with buffalograss consistently maintaining higher soil moisture than the other species in both years; only data for 2016 are shown (Figure 4). These differences may have been due to differences in evapotranspiration rates (ET) among species.



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For both percent green cover and visual turf quality, there were more dates with statistical differences between traffic treatments within its respective mow height in both mow heights of the C4 grasses compared to the C3 grasses, and this trend was observed in both years (data are presented for only 2016) (Figures 5 and 6). This was because the non-traffic treatments in C4 grasses maintained high percent green cover and turf quality throughout the drought due to better drought-stress tolerance than the C3 grasses. The fairway mow height displayed fewer statistical differences between traffic treatments compared to rough mow height within each turf species; therefore, traffic stress during a drought period may be more apparent on higher mowed turfgrass. The C4 grasses maintained and usually ended the 41-day drought period with higher percent green cover in both traffic treatments and at both mow heights compared to the C3 grasses, which in turn required less time to recover to higher percent green cover and turf quality. The ability of buffalograss to maintain higher soil moisture as the drought period progressed may have influenced its ability to maintain higher visual turf quality and percent green cover during the drought period. Overall, traffic application during a drought will have a negative and accelerated impact on the above-ground portion of turfgrass, which will vary due to turf species and mowing height.

Reference

Beard, J.B., and M.P. Kenna, editors. 2008. Water quality and quantity issues for turfgrasses in urban landscapes. Council for Agriculture Science and Technology, Ames, IA.



Figure 1. Field plots at Rocky Ford Turfgrass Research Center, Manhattan, KS, on June 24, 2016 (pre-drought period and no traffic applied).

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Figure 2. Field plots at Rocky Ford Turfgrass Research Center, Manhattan, KS, on August 6, 2016 (41 days of simulated drought with no irrigation and a total of 96 golf cart traffic passes applied inside the white lines).



Figure 3. Field plots at Rocky Ford Turfgrass Research Center, Manhattan, KS, on September 15, 2016 (40 days of recovery with no simulated golf traffic applied since August 6, 2016).

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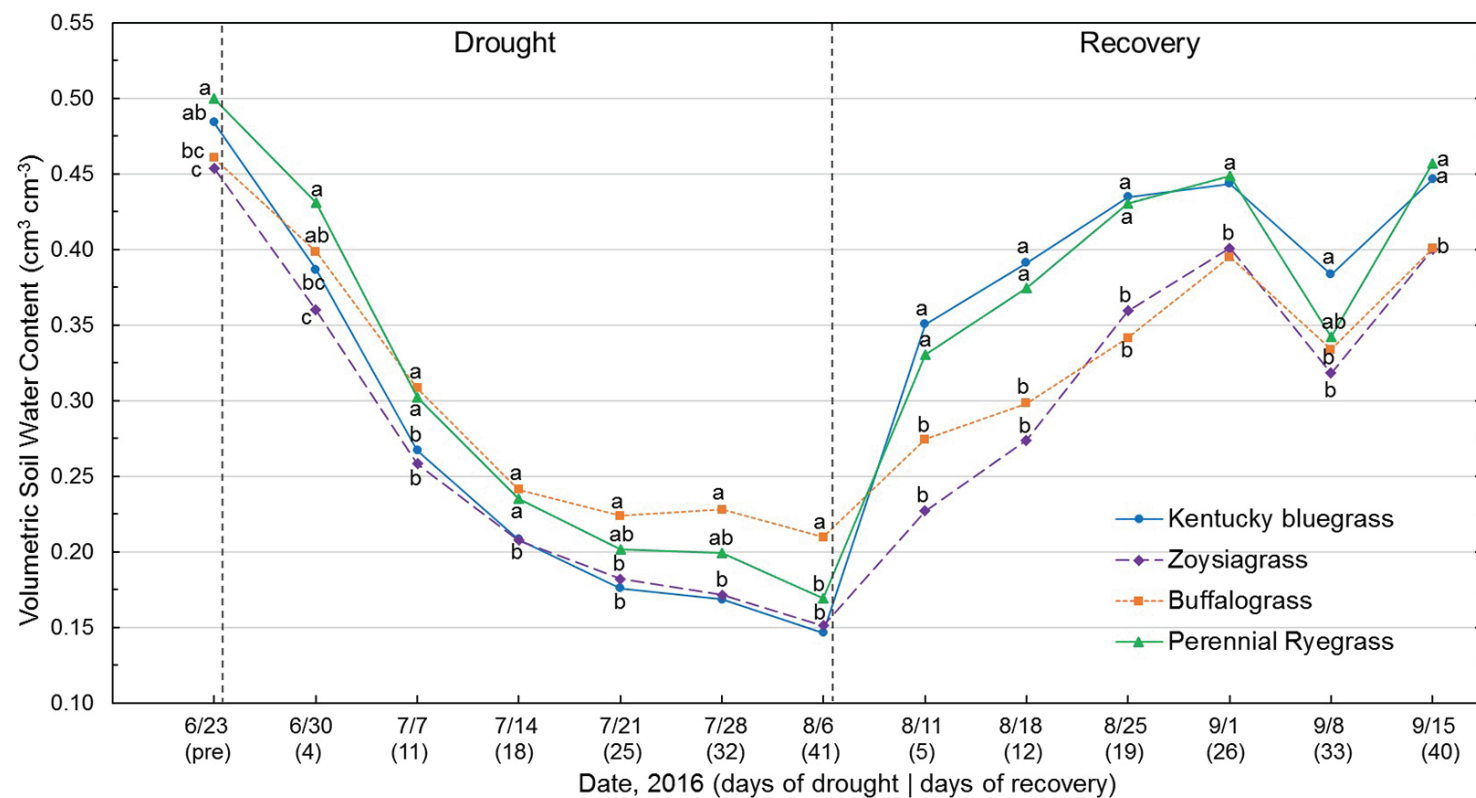


Figure 4. Effect of turf species on volumetric soil water content (θ_v , $\text{cm}^3 \text{cm}^{-3}$) in the 0 to 7.6-cm profile in Kentucky bluegrass, zoysiagrass, buffalograss, and perennial ryegrass (averaged from 4 measurements per plot) in year 2 (2016). The drought consisted of 41-days with no precipitation or irrigation and with 0 or 16 golf cart traffic passes per week for a cumulative total of 0 or 96 traffic passes by the end of the drought. The recovery consisted of 40-days with no traffic and the turfgrasses kept well-watered. On any given date, means with the same letter are not significantly different ($P \leq 0.05$ for June 23 [pre] and $P \leq 0.001389$ for all other dates).



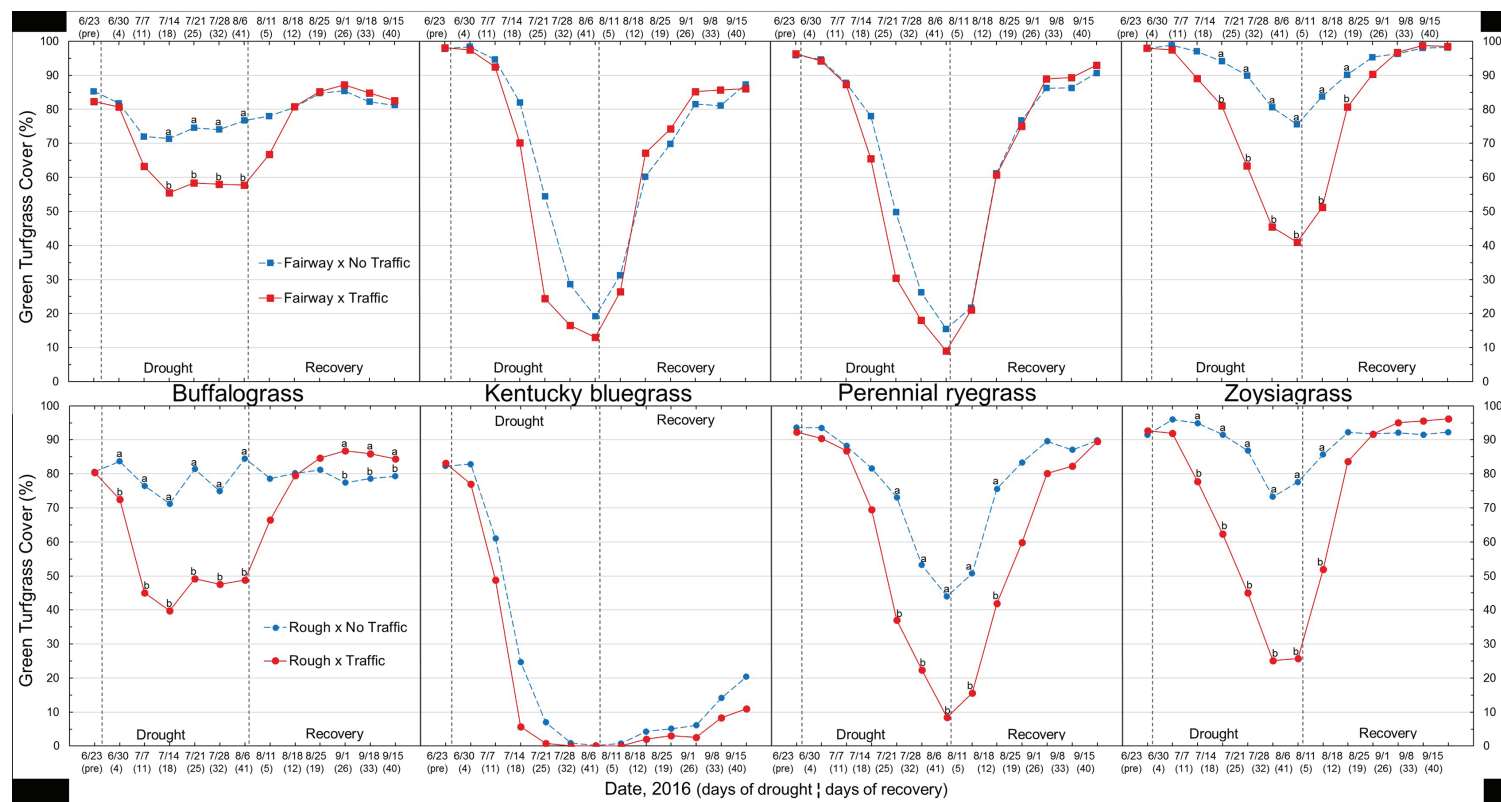


Figure 5. Comparison of percent green turfgrass cover between traffic treatments sliced by turf species, mow height, and date in year 2 (2016). Drought period consisted of a 41-day drought with no precipitation or irrigation and with 0 or 16 golf cart traffic passes per week for a total of 0 or 96 golf cart traffic passes by the end of the drought period. Recovery consisted of a 40-day period with no traffic and turfgrasses kept well-watered. Baseline period (June 23), drought period (June 30 to August 6), and recovery period (August 11 to September 15) were analyzed separately. At each date, within each mow height of each turf species, means with the same letter or no letters are not significantly different at $\alpha_{\text{bon}} = 0.00625$ for date June 23 (baseline period) and $\alpha_{\text{bon}} = 0.001$ for dates June 30 through September 15 (drought and recovery periods).



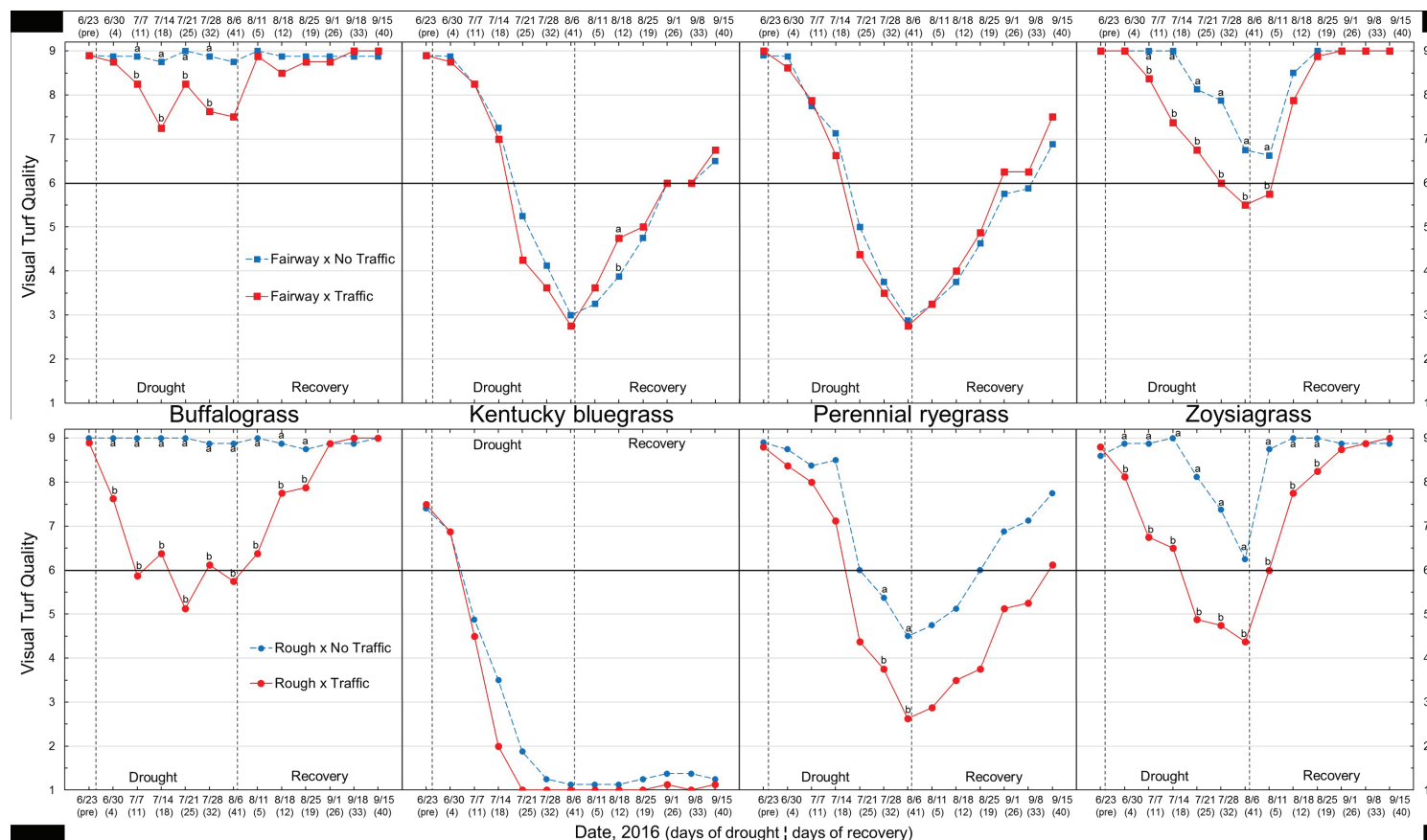


Figure 6. Comparison of visual turf quality between traffic treatments sliced by turf species, mow height, and date in year 2 (2016). Visual turf quality was rated on a 1 to 9 scale (1 = poorest quality, 6 = minimally acceptable, and 9 = highest quality) according to color, texture, density, and uniformity. Drought period consisted of a 41-day drought with no precipitation or irrigation and with 0 or 16 golf cart traffic passes per week for a total of 0 or 96 golf cart traffic passes by the end of the drought period. Recovery consisted of a 40-day recovery period with no traffic and turfgrasses kept well-watered. Solid horizontal black line signifies minimum rating for acceptable turf quality. Baseline period (June 23), drought period (June 30 to August 6), and recovery period (August 11 to September 15) were analyzed separately. At each date, within each mow height of each turf species, means with the same letter or no letters are not significantly different at $\alpha_{\text{bon}} = 0.00625$ for date June 23 (baseline period) and $\alpha_{\text{bon}} = 0.001$ for dates June 30 through September 15 (drought and recovery periods).

