Turfgrass Research 2020

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Water Savings and 'Innovation' Zoysiagrass Quality in Response to Irrigation Strategy

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Summary

Performance of 'Innovation' zoysiagrass was evaluated under four irrigation regimes: a) routine irrigation (1.2 inches weekly); b) evapotranspiration (ET)-based irrigation (60% of estimated ET); c) soil water sensor (SWS)-based irrigation; and d) no irrigation. The SWS-based irrigation method reduced water application by 72% and 56%, respectively, compared to routine or ET-based irrigation. Visual turf quality of turf receiving SWS-based irrigation remained above the minimal acceptable level throughout the study. Innovation zoysiagrass sustained acceptable quality for more than 21 days with no irrigation, and nonirrigated turf recovered fully within four weeks after irrigation treatments ceased and turf was well irrigated. Soil water sensors are useful for saving irrigation water, and Innovation zoysiagrass demonstrated good drought tolerance and recovery after drought.

Objective

To compare the irrigation strategies for water savings and effects on performance of Innovation zoysiagrass.

Rationale

Restrictions in water use have been increasing and thus demand for turf that requires less water and maintains good quality turf is increasing. Innovation zoysiagrass is a new warm-season turfgrass that was released jointly by Kansas State University and Texas A&M University in 2017 (Chandra et al., 2017). One potential advantage of Innovation is its water saving potential. The performance of Innovation zoysiagrass during drought has not yet been evaluated, and turf managers are also interested in how technology can be used to reduce irrigation requirements.

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Study Description

The study was conducted under a fixed, polyethylene-covered rainout shelter that prevented natural precipitation on an established area of Innovation zoysiagrass at the Rocky Ford Turfgrass Research Center in Manhattan, KS (Figure 1). Treatments included four different irrigation regimes: a) a total of 1.2 inches per week (routine irrigation); b) 60% of estimated evapotranspiration (ET-based irrigation); c) irrigation based on soil water sensors (SWS irrigation); and d) no irrigation.

Plots receiving routine irrigation were watered on Monday, Wednesday, and Friday (MWF) to provide 0.4 inches on each day. Those receiving ET-based irrigation were irrigated on MWF at 60% of estimated ET since the last irrigation based upon data collected from a nearby Kansas Mesonet weather station (*https://mesonet.k-state.edu/*). Irrigation based upon SWS was done when the soil water content reached 11%, which was determined to be the point at which wilt began to appear during the first dry-down. After reaching 11% soil water content, 0.6 inches of water was applied.

Plots measured 10- × 6-ft and were arranged in a randomized complete block design with three replicates. Soil type was a silty clay loam (fine, smectic, mesic Aquertic Argiudolls). Plots were hand watered using a fan nozzle and meter attached to a hose. The experiment ran from July 15 to August 29, 2019. Beginning on August 29, plots were irrigated with 100% of estimated ET three times each week for four weeks to evaluate recovery.

Data were collected weekly on turf quality, normalized difference vegetation index (NDVI), and green cover (GC). Turf quality was rated on a 1 to 9 scale in which 9 = optimum color, uniformity, and density; 6 was considered minimally acceptable quality (Morris and Shearman, 2000). Normalized difference vegetation indices were measured using a RapidSCAN CS-45 (Holland Scientific Inc., Lincoln, NE). Digital images were captured using a camera mounted on the top of a light box, and images were analyzed using a SigmaScan Pro 5.0 (Systat Software Inc., San Jose, CA) to determine the GC (Karcher and Richardson, 2005).

A soil water sensor (Model CS655, Campbell Scientific Inc., Logan, UT) was buried at a 4-inch depth in the center of each plot. Each sensor was wired to a datalogger CR10X (Campbell Scientific Inc.) powered with a 20 W solar panel. Data were recorded hourly and means presented herein represent daily averages. Data collection for all parameters continued through the four-week recovery period. All plots were mowed at 0.75 inches three times weekly throughout the experiment using a walk-behind reel mower and clippings were collected. Nitrogen was applied in early June and July, before the experiment began, to provide 1 lb/1,000 ft^2 in each application.

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Results

Irrigating plots based on SWS reduced the water application by 72% and 56%, respectively, compared to routine irrigation and ET-based irrigation (Figure 2). Plots receiving SWS-based irrigation (at approximately 11% soil water content) received water on only four occasions during the 45-day treatment period and averaged 20% soil water content (Figure 3). In contrast, plots receiving routine irrigation averaged 36% soil water content and those receiving ET-based irrigation averaged 30% soil water content. The use of soil water sensors substantially reduced water requirements.

Innovation receiving routine and ET-based irrigation maintained turf quality > 8, which was significantly higher than turf receiving SWS-based irrigation or nonirrigated plots (Figure 4). However, Innovation subjected to SWS-based irrigation had acceptable quality throughout the study period, with scores averaging > 7. Nonirrigated turf had acceptable turf quality for at least 21 days and then fell below acceptable quality. The high quality soil at the study site might have contributed to this.

Innovation plots receiving routine or ET-based irrigation had higher mean NDVI than plots receiving SWS-based irrigation or no irrigation (Figure 5). Green cover determined using digital images indicated no difference among irrigation treatments, although nonirrigated plots had lower GC than all irrigated turf (Table 1). After four weeks of re-watering, all plots recovered completely (data not shown).

References

Chandra, A., J. Fry, D. Genovesi, M. Meeks, M. Engelke, D. Okeyo, J. Moss, E. Ervin, X. Xiong, S. Milla-Lewis, J. Brosnan, J. Griffin, and L. Parsons. 2017. Registration of KSUZ 0802 zoysiagrass. J. Plant Registrations 11:100-106.

Morris, K.N. and R.C. Shearman. 2000. NTEP turfgrass evaluation guidelines. [Online] Available at *http://www.ntep.org/pdf/ratings.pdf* (accessed 21 January 2020). National Turfgrass Evaluation Program. Beltsville, MD.

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Table 1. Green cover of 'Innovation' zoysiagrass in response to irrigation treatments

Treatment	Green cover (%)
Routine irrigation	100a*
ET-based irrigation	100a
SWS-based irrigation	99a
Nonirrigated	97b

Treatments were routine irrigation (1.2 inches weekly), evapotranspiration (ET)-based irrigation (60% of ET), soil water sensor (SWS)-based irrigation, and no irrigation. Green cover was measured each week and averaged over a 45-day treatment period (n = 24).
*Means followed by different letters within a column are statistically different ($P < 0.05$).

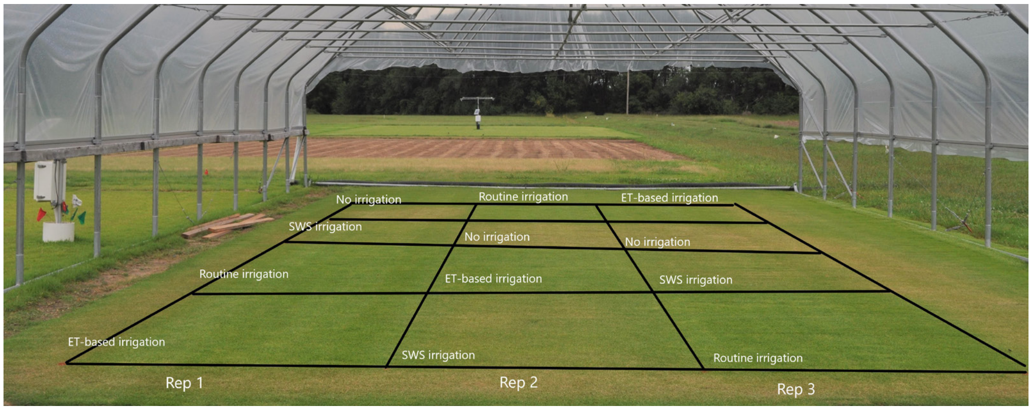

Figure 1. 'Innovation' zoysiagrass experiment on August 21, 2019, 37 days after irrigation treatments began.

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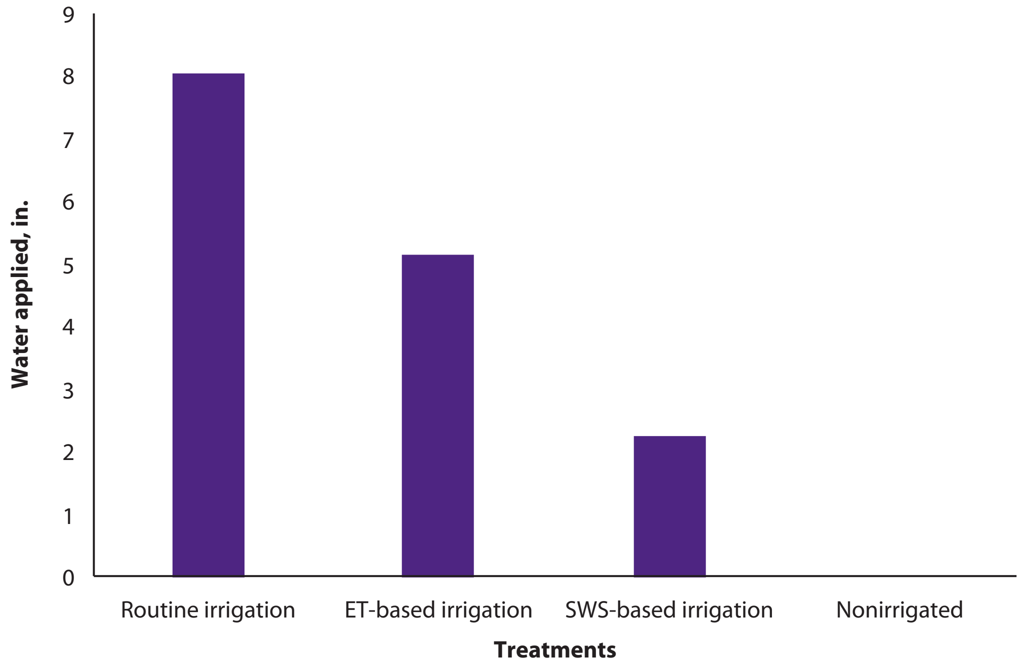

Figure 2. Total water applied to 'Innovation' zoysiagrass in four irrigation methods over 45 days. Treatments were routine irrigation (1.2 inches weekly), evapotranspiration (ET)-based irrigation (60% of ET), soil water sensor (SWS)-based irrigation, and no irrigation.

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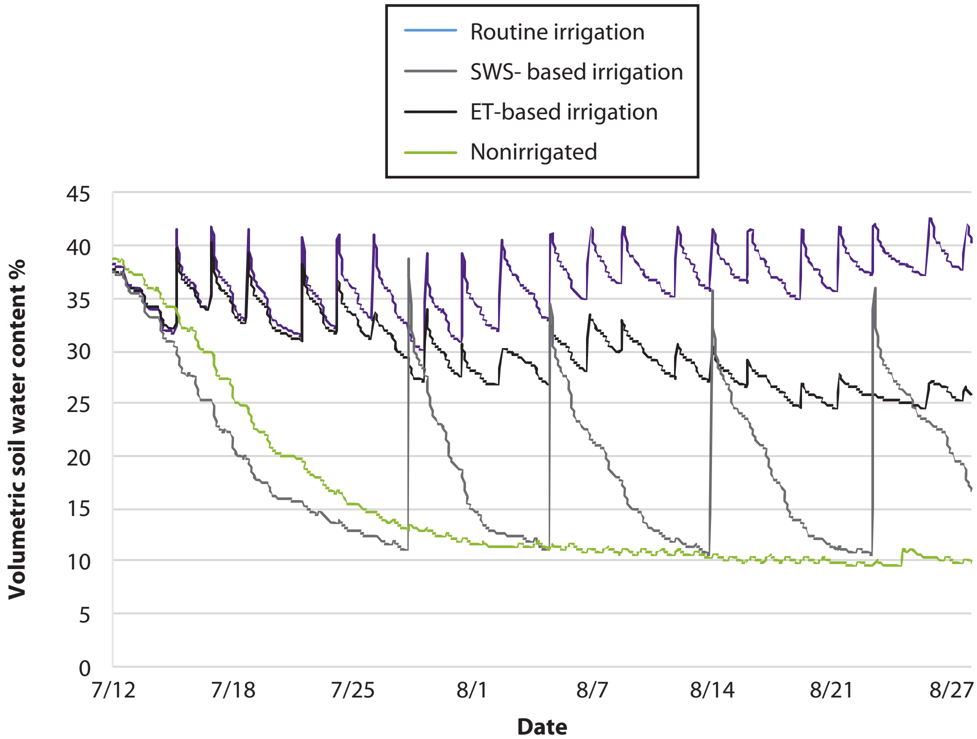

Figure 3. Volumetric soil water content (%) at a 4-inch depth under 'Innovation' zoysiagrass over a 45-day study period. Treatments were routine irrigation (1.2 inches weekly), evapotranspiration (ET)--based irrigation (60% of ET), soil water sensor (SWS)-based irrigation, and no irrigation. Soil water content was measured every hour with a soil water sensor installed in center of each plot; daily averages are presented. Spikes in the chart represent irrigation events.

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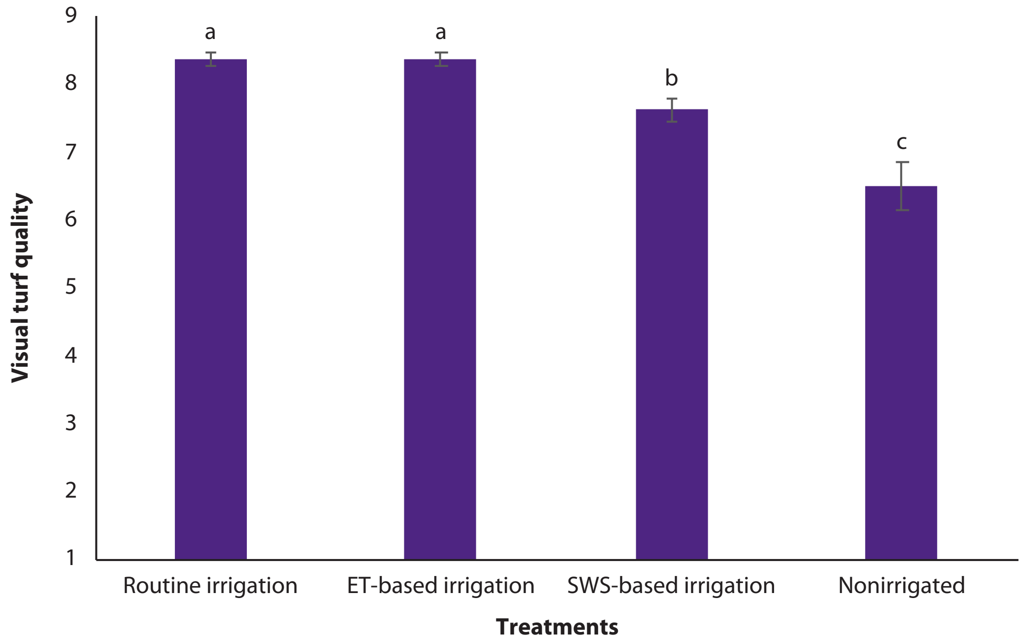

Figure 4. Mean turf quality of 'Innovation' zoysiagrass in response to routine irrigation (1.2 inches weekly), evapotranspiration (ET)-based irrigation (60% of ET), soil water sensor (SWS)-based irrigation, and no irrigation. Visual turf quality was rated weekly on a 1 to 9 scale (6 = minimum acceptable level; 9 = optimum) and averaged over a 45-day treatment period (n = 24). Treatments (bars) with different letters above are statistically different (*P* < 0.05).

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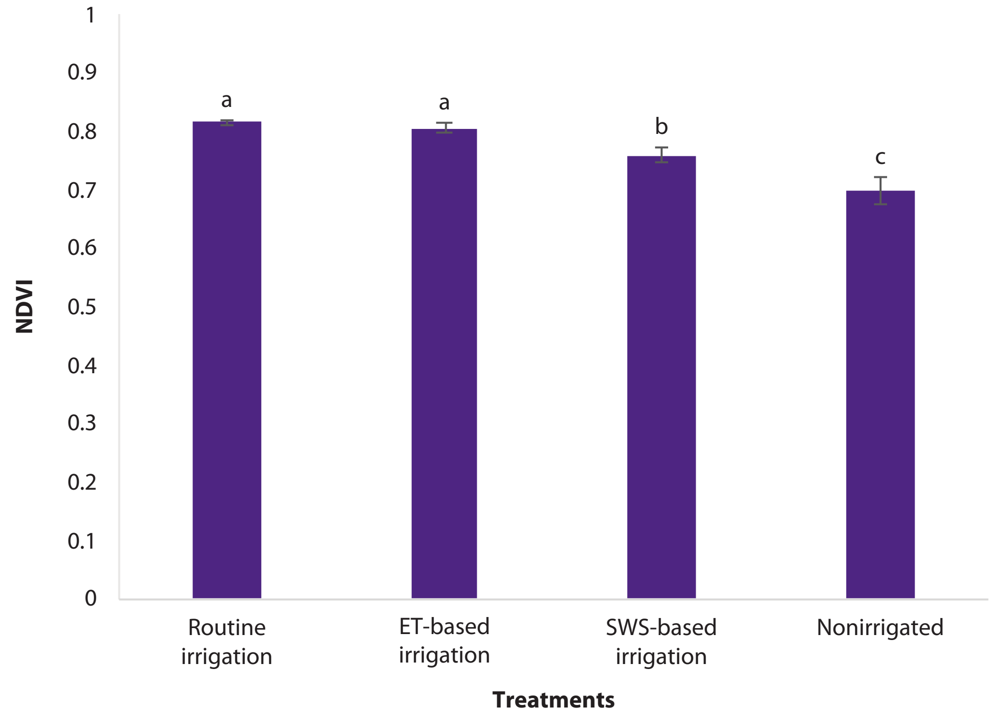

Figure 5. Mean normalized difference vegetation indices (NDVI) of 'Innovation' zoysiagrass in response to routine irrigation (1.2 inches weekly), evapotranspiration (ET)-based irrigation (60% of ET), soil water sensor (SWS)-based irrigation, and no irrigation. The NDVI was measured weekly and averaged over a 45-day treatment period (n = 24). Treatments (bars) with different letters above are statistically different (*P* < 0.05).

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