

TURFGRASS RESEARCH 2019



JULY 2019

K-STATE
Research and Extension

Kansas State University
Agricultural Experiment Station
and Cooperative Extension Service

K-State Research and Extension is an equal
opportunity provider and employer.

Minimal Water Requirements of Cool-Season Turfgrasses for Survival and Recovery After Prolonged Drought

Mu Hong, Dale Bremer, and Steve Keeley

Summary

Sodded tall fescue (TF) and Kentucky bluegrass (KBG) turfgrasses were exposed to prolonged drought at several levels of deficit irrigation from 0% to 50% of reference evapotranspiration (ET) within the first year of establishment. Tall fescue watered at 40% and 50% ET maintained minimally acceptable performance longer during the dry-down phases and recovered faster after rewatering than lower ET treatments. Tall fescue with no water input (0% ET) maintained minimally acceptable performance for about 5 weeks, which was longer than KBG watered at 50% ET, which remained acceptable for less than 3 weeks during the dry down. Although KBG watered at 50% ET performed best among irrigation treatments for a short period, all treatments went into dormancy similarly in 6–9 weeks and didn't recover after rewatering in either year. In both years of this study, TF and KBG were sodded the prior fall and thus, had been established for less than 1 year before exposure to severe drought and deficit irrigation. Results indicate that under the conditions of this study (i.e., limited or no irrigation during the first summer after fall sodding in good soil (silty clay loam) of the transition zone of Kansas), TF is a better selection than KBG.

Rationale

During prolonged droughts, water for turfgrass may be restricted or stopped, which may cause dormancy or even death of the turfgrass. The loss of turfgrass during severe droughts may result in unsatisfactory visual appearance and significant reestablishment and human labor costs. Previous studies have indicated that limited water applications during droughts may mitigate the severity of drought stress and improve

View all turfgrass research reports online at: <http://newprairiepress.org/kaesrr>



the ability of turfgrass to recover upon rewatering (Lewis et al., 2012; Goldsby et al., 2015). This indicates a possible strategy to achieve a balance between water conservation and turfgrass survival through droughty periods. Nevertheless, there has been little research on irrigation thresholds (water amounts) for preserving turfgrass survival during severe drought.

Objective

The objective of this study was to determine the minimum amount of water required for survival and recovery of two cool-season turfgrasses (TF and KBG) during prolonged drought in the first year of establishment after sodding.

Study Description

The study was conducted under a stationary rainout shelter with a commercial greenhouse design but open sides for air exchange in 2017 and an automatic rainout shelter in 2018 at Rocky Ford Turfgrass Research Center near Manhattan, KS. The soil was a silty clay loam. In 2017, an 83-day dry-down period (June 1 to August 22) was followed by a 40-day well-watered (recovery) phase. In 2018, a 60-day dry-down period (June 4 to August 3) was followed by a 50-day well-watered phase. Two turfgrass species included a blend of ‘Mallard’ and ‘Ridgeline’ Kentucky bluegrass (*Poa pratensis* L.), and a ‘Seed Research 8650’ tall fescue (*Schedonorus arundinaceus* Schreb.), which were sodded by September 28, 2016, and October 10, 2017, of the year before the dry down. They were mowed at 3.5-inch height. Six irrigation treatments included: 0%, 10%, 20%, 30%, 40%, and 50% ET replacement using data from an on-site weather station of the Kansas Mesonet Weather Data Library, Kansas State University (<http://mesonet.k-state.edu/>). Percentage green cover and visual quality (1 = dead turf; 6 = minimally acceptable turf for use in home lawns; and 9 = uniform, green and dense turf) were measured throughout the experiment.

Results

None of the TF treatments went into dormancy, even after 83 and 60 days of drought in 2017 and 2018, respectively. That was probably because of the drought avoidance mechanism of deep rooting in TF, which alleviated drought stress. However, KBG rapidly declined into dormancy in all irrigation treatments within a similar period in both years (about 11 weeks in 2017 and 7 weeks in 2018). Dormancy during drought and heat stress is a more typical survival mechanism in KBG than in tall fescue. Therefore, the more rapid decline into dormancy of KBG was likely a function of its drought-tolerance mechanism during the hot Kansas summers.

Tall fescue irrigated at 40% and 50% ET maintained green cover the highest and longest among irrigation treatments during prolonged drought stress in both years (Figure 1; data not shown for 2017, but results were similar). For example, TF at 50% ET maintained acceptable visual quality (≥ 6) and green cover $\geq 50\%$ for 6 weeks longer in 2017 and 3 weeks longer in 2018 than at 0% ET (Table 1).

K-STATE
Research and Extension

Kansas State University
Agricultural Experiment Station
and Cooperative Extension Service





Drought stress occurred earlier in KBG than TF. Specifically, green cover of KBG was similar among irrigation treatments until 18 days (June 19) and 12 days (June 16) into the dry down in 2017 and 2018, respectively, when green cover became lower in plots irrigated at 0% ET than 50% ET (Figure 1; data not shown for 2017). This divergence in percentage green cover between 50% and 0% ET treatments occurred about one week and two weeks earlier in KBG than in TF in 2017 and 2018, respectively.

Tall fescue maintained good performance much longer than KBG. For example, TF with no water input maintained visual quality ≥ 6 and green cover $\geq 50\%$ for about 5 weeks (Table 1). In contrast, KBG at 50% ET maintained visual quality ≥ 6 and green cover of $\geq 50\%$ for less than 3 weeks, which was only about 1 week longer than plots without water. Deep soils at the research site likely assisted TF in maintaining more green cover during the drought via TF's deep rooting ability.

Kentucky bluegrass didn't recover from dormancy in any irrigation treatment in either year. This was surprising because KBG typically has good drought tolerance, and previous studies at K-State have indicated it survived extended dry periods well (Lewis et al., 2012; Goldsby et al., 2015). The failure of KBG to survive extended drought in this study may have been related to its being sodded the prior fall, as opposed to the earlier studies in which it has been seeded; more research is needed to investigate this possibility.

In contrast to KBG, TF in all irrigation treatments recovered to acceptable performance (visual quality ≥ 6 and green cover $\geq 50\%$) in less than 5 and 8 weeks in 2017 and 2018, respectively (Table 2). Tall fescue irrigated at 50% ET during the dry-down periods recovered by 2 to 4 weeks in 2017 and 2018, which was faster than that with 10% and 20% ET by approximately 3 and 2 weeks, respectively, although it was only significant in 2017. In summary, under the conditions of this study (i.e., limited or no irrigation during the first summer after fall sodding in good soil of the transition zone of Kansas), TF is a better selection than KBG.

References

- Goldsby, A.L., D.J. Bremer, J.D. Fry, and S.J. Keeley. 2015. Response and recovery characteristics of Kentucky bluegrass cultivars to extended drought. *Crop Forage Turfgrass Manage.* 1:0. doi: 10.2134/cftm2014.0087.
- Lewis, J.D., D.J. Bremer, S.J. Keeley, and J.D. Fry. 2012. Wilt-Based irrigation in Kentucky bluegrass: effects on visual quality and irrigation amounts among cultivars. *Crop Sci.* 52:1881. doi: 10.2135/cropsci2012.01.0033.

K-STATE
Research and Extension

Kansas State University
Agricultural Experiment Station
and Cooperative Extension Service





Table 1. Average weeks during dry-down periods that tall fescue and Kentucky bluegrass maintained acceptable visual quality (≥ 6) and green cover $\geq 50\%$

Turfgrasses	Evapotranspiration	Weeks	
		2017	2018
Tall fescue	50%	11.4 A*	7.1 A
	40%	8.8 B	5.5 B
	30%	7.6 BC	5.5 B
	20%	7.3 BC	4.7 B
	10%	6.8 BC	4.5 B
	0%	5.3 C	4.7 B
Kentucky bluegrass	50%	2.8	2.2 A
	40%	2.1	1.7 AB
	30%	2.1	2.3 A
	20%	2.1	1.8 AB
	10%	1.8	1.5 BC
	0%	1.8	1.0 C

*For the same species, treatment means were significantly different at $P < 0.05$ probability level, indicated by different letters; no letter presented when $P > 0.05$.

Table 2. Average weeks during recovery periods that tall fescue required to recover to acceptable visual quality (≥ 6) and green cover $\geq 50\%$

Turfgrasses	Evapotranspiration	Weeks	
		2017	2018
Tall fescue	50%	1.5 B*	4.2
	40%	2.8 AB	6.2
	30%	3.2 AB	5.6
	20%	4.0 A	5.9
	10%	4.9 A	7.2
	0%	3.5 AB	6.7

*Treatment means were significantly different at $P < 0.05$ probability level, indicated by different letters; no letter presented when $P > 0.05$.

K-STATE
Research and Extension

Kansas State University
Agricultural Experiment Station
and Cooperative Extension Service



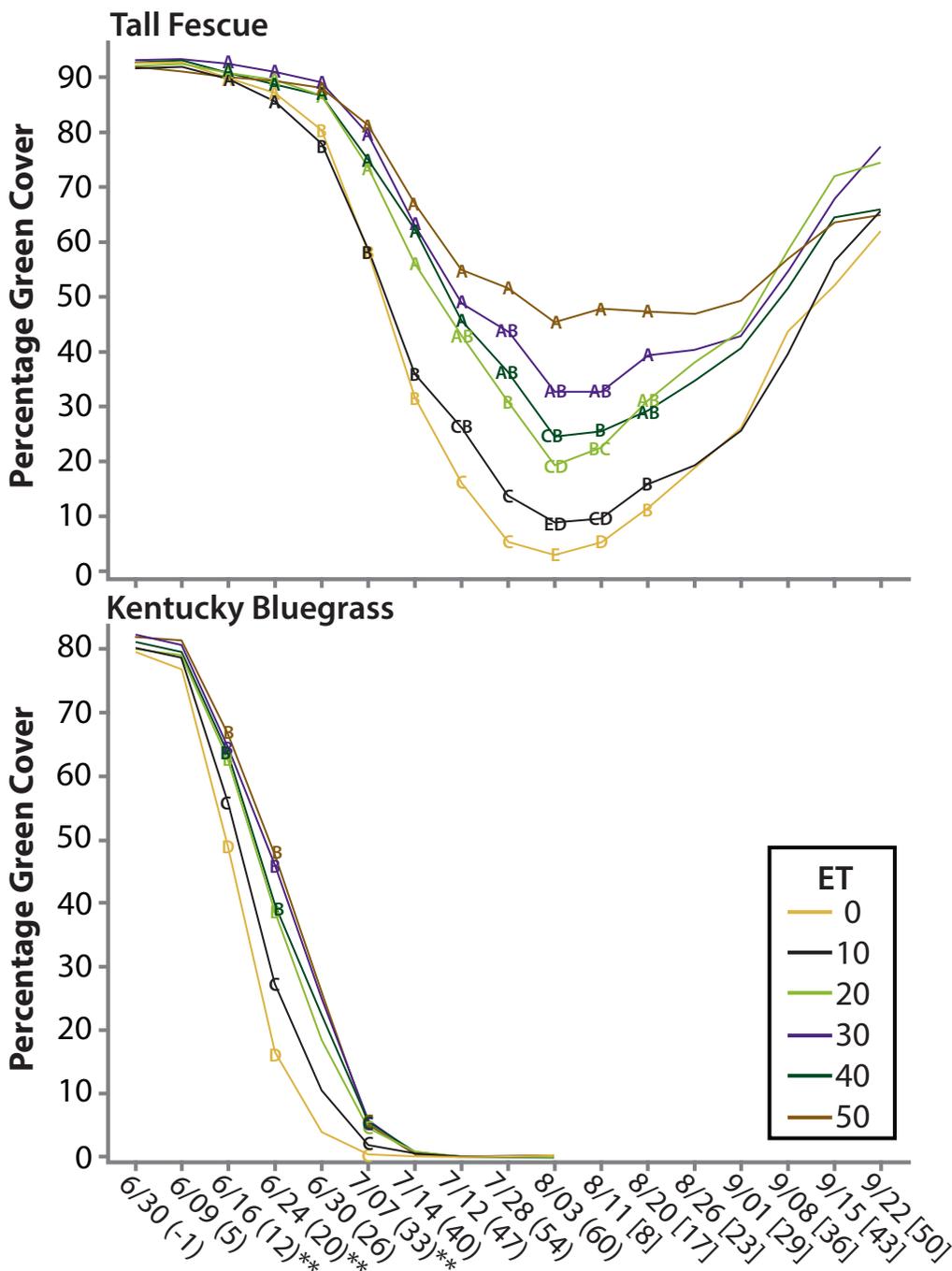


Figure 1. Percentage green cover of tall fescue and Kentucky bluegrass irrigated at 0% to 50% evapotranspiration (ET) replacement levels in 2018. Numbers in parentheses on x-axis denote days before (negative) or after (positive) the beginning of dry down. Number in square brackets denotes days after full irrigation. Different letters denote significantly different means within each day ($P < 0.05$). Mean comparisons were within species on all dates except where indicated by *, when treatment interactions were significant and thus, comparisons were across species.

