Drought Tolerance of Tall Fescue and Bluegrass Cultivars

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Photo by Doug Karcher

Kentucky bluegrass growing in a golf course rough

Summary. Newer cultivars of tall fescue, Kentucky bluegrass, and hybrid bluegrass may have improved drought tolerance and expand the range of cool-season turfgrasses for home lawn use in Arkansas. The objective of this research was to compare the drought tolerance of 42 cultivars of these species when maintained as a lawn.

Cultivars were established in fall 2006 and dried down during the summer of 2007 in a rain-out shelter, which prevented rainfall from reaching the plots. Green turf coverage was evaluated twice weekly as the cultivars were subjected to drought stress. The amount of time after irrigation was withheld until green turf coverage dropped to 50% and varied by over three weeks among cultivars. On average, the tall fescue cultivars were the most drought tolerant and Kentucky bluegrass the least, while there was no clear trend in drought tolerance among the hybrid bluegrass cultivars.

Abbreviations: KBG, Kentucky bluegrass; HBG, hybrid bluegrass; TF, tall fescue

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A desirable trait of cool-season lawn grasses, such as tall fescue (*Festuca arundinacea*) and Kentucky bluegrass (*Poa pratensis*), is that they stay relatively green throughout most of the year and do not go into complete winter dormancy like bermudagrass or zoysiagrass. The use of cool-season grasses for Arkansas lawns has been limited to northern regions of the state due to their poor heat and drought tolerance relative to warm-season grasses. In recent years, hybrid bluegrass cultivars, which are crosses between Kentucky bluegrass and Texas bluegrass (*P. pratensis* x *P. arachnifera*), have been released as a cool-season lawn turf option with improved heat and drought tolerance (Abraham et al., 2004). In addition, it has recently been demonstrated that there is variation in drought tolerance among cultivars within tall fescue (Karcher et al., 2008) and Kentucky bluegrass species (Richardson et al., 2008). Identifying cultivars of tall fescue, Kentucky bluegrass, and hybrid bluegrass with excellent drought tolerance may expand the use of cool-season turfgrasses for lawns in Arkansas. The objective of the following research was to determine the relative drought tolerance of various tall fescue, Kentucky bluegrass, and hybrid bluegrass cultivars.

Materials and Methods

This research was conducted at the University of Arkansas Research and Extension Center in Fayetteville, Ark. Forty-two cultivars of tall fescue, Kentucky bluegrass, or hybrid bluegrass (Table 1) were seeded into three replicate plots in the fall of 2006 on a native soil experimental area that was constructed under a rain-out shelter. The experimental area was maintained as a home lawn and was mowed weekly at a 2 inch height of cut. During the summer of 2007, drought stress was initiated by discontinuing irrigation and activating the rain-out shelter so that an automated, sliding roof would cover the plots, keeping them dry during rainfall events. Digital images were collected from each plot regularly during drought stress to evaluate green turf coverage over time and determine the drought tolerance characteristics of each cultivar. Non-linear regression (using a variable slope, Sigmoid curve) was performed on the digital image analysis data to predict $Days_{50}$ values for each cultivar, which are the estimated number of days after irrigation was withheld until green turf coverage decreased to 50%.

Results and Discussion

The 42 cultivars tested in this trial are ranked from most to least drought tolerant in Table 1. The number of days after irrigation was withheld until green turf coverage dropped to 50% ranged from 52 d for 2nd Millennium tall fescue to 29 d for Solar Green hybrid bluegrass. This range of greater than three weeks (23 d) is significant when considering that a rainfall event would be probable during this period on a non-irrigated lawn in Arkansas. In such a case, cultivars in this trial that were most drought tolerant would be much more likely to retain acceptable green turf coverage between rainfall events compared to the more drought sensitive cultivars and not need supplemental irrigation. The only cultivar that was statistically as drought tolerant as 2nd Millennium was TB 390, an experimental hybrid bluegrass cultivar (Fig. 1). There were three cultivars with drought tolerance as poor as Solar Green: Champlain, A00-1400 Kentucky bluegrass, and TB 676 hybrid bluegrass; the latter two being experimental cultivars (Fig. 1).

In general, the tall fescue cultivars were more drought tolerant (higher $Days_{50}$ values) than the bluegrasses. Ten of the eleven most drought tolerant cultivars were tall fescue whereas only one of the six least drought tolerant cultivars was tall fescue. All of the Kentucky bluegrass cultivars were among the bottom half of those tested with regard to drought tolerance. There was not a clear trend in drought tolerance among hybrid bluegrass cultivars with two of the four (TB 390 and Thermal Blue) having $Days_{50}$ values greater than 43, and the other two cultivars (TB 676 and Solar Green) having $Days_{50}$ values below 33.

Previous research has shown that drought tolerance among tall fescue cultivars is primarily a

function of high root/shoot ratio (Karcher et al., 2008). However, root/shoot ratios were not evaluated in the present study. The mechanisms responsible for improved drought tolerance in Kentucky bluegrass are less clear and do not appear to be related to root/shoot ratio (Richardson et al., 2008). Other factors, such as stomatal resistance, osmotic adjustment, reduced electrolyte leakage, and increased photosynthetic efficiency, probably play a greater role in the drought tolerance of Kentucky bluegrass compared to tall fescue. None of these factors were evaluated in the present study.

Conclusions

These results demonstrate that there are differences in drought tolerance among cool-season grasses used in Arkansas lawns. Therefore, drought tolerance screening should be performed routinely on these species so that cultivars may be selected that are best adapted for lawns where irrigation in not available or is limited.

Literature Cited

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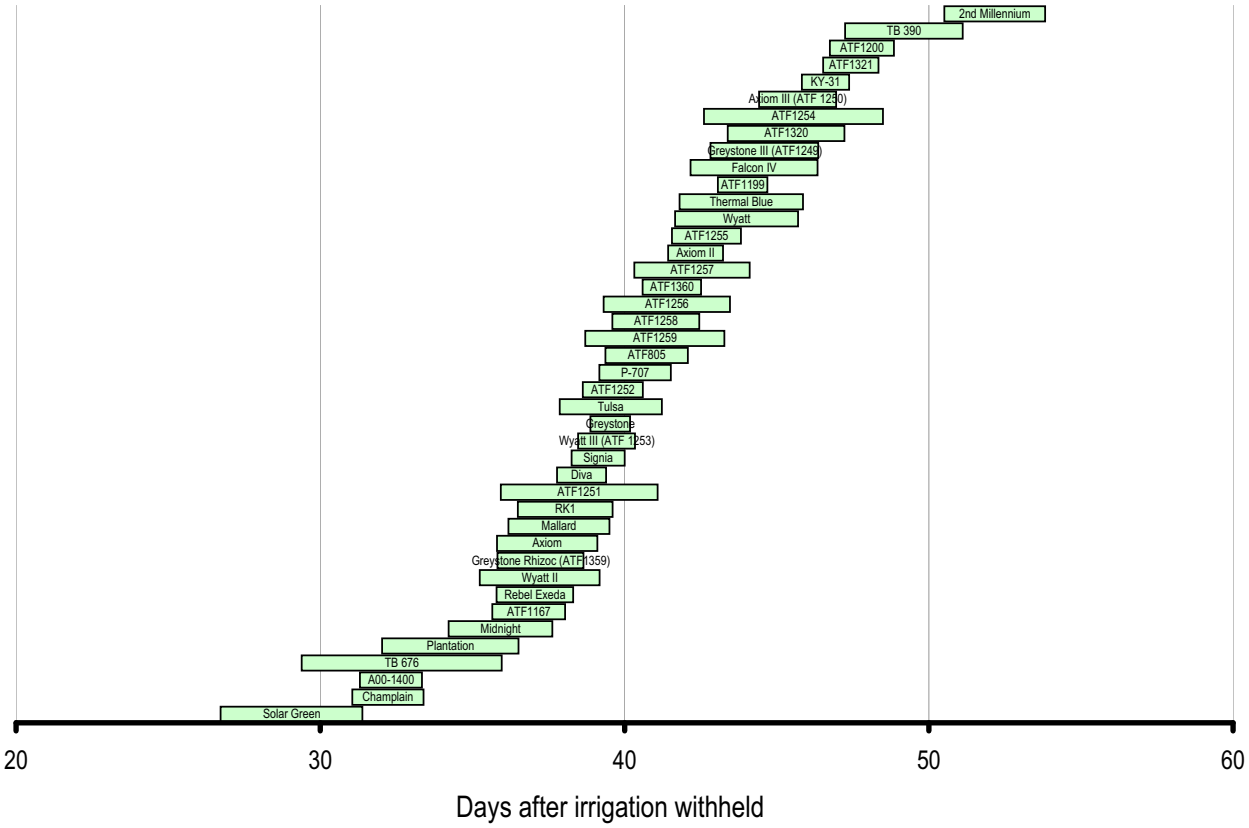

Fig. 1. Confidence intervals (95%) for the number of days after irrigation is withheld before cultivars reach 50% green cover. Cultivars with overlapping bars are not significantly different.

Table 1. Drought tolerance ranking of tall fescue, Kentucky bluegrass, and hybrid bluegrass selections based on the $Days_{50}$ values, the predicted number of days after irrigation is withheld when 50% green turf cover is reached.

Rank	Selection	Species[z]	$Days_{50}$
1.	2nd Millennium	TF	52.2
2.	TB 390	HBG	49.2
3.	ATF1200	TF	47.8
4.	ATF1321	TF	47.4
5.	KY-31	TF	46.6
6.	Axiom III (ATF 1250)	TF	45.7
7.	ATF1254	TF	45.6
8.	ATF1320	TF	45.3
9.	Greystone III (ATF1249)	TF	44.6
10.	Falcon IV	TF	44.3
11.	ATF1199	TF	43.9
12.	Thermal Blue	HBG	43.8
13.	Wyatt	TF	43.7
14.	ATF1255	TF	42.7
15.	Axiom II	TF	42.3
16.	ATF1257	TF	42.2
17.	ATF1360	TF	41.6
18.	ATF1256	TF	41.4
19.	ATF1258	TF	41.0
20.	ATF1259	TF	41.0
21.	ATF805	TF	40.7
22.	P-707	KBG	40.4
23.	ATF1252	TF	39.6
24.	Tulsa	TF	39.6
25.	Greystone	TF	39.5
26.	Wyatt III (ATF 1253)	TF	39.4
27.	Signia	TF	39.1
28.	Diva	KBG	38.6
29.	ATF1251	TF	38.5
30.	RK1	TF	38.1
31.	Mallard	KBG	37.9
32.	Axiom	TF	37.5
33.	Greystone Rhizoc (ATF1359)	TF	37.2
34.	Wyatt II	TF	37.2
35.	Rebel Exeda	TF	37.1
36.	ATF1167	TF	36.9
37.	Midnight	KBG	35.9
38.	Plantation	TF	34.3
39.	TB 676	HBG	32.7
40.	A00-1400	KBG	32.3
41.	Champlain	KBG	32.2
42.	Solar Green	HBG	29.1

[z] HBG = hybrid bluegrass, KBG = Kentucky bluegrass, and TF = tall fescue.