

Performance in the Transition Zone of Two Hybrid Bluegrasses, Kentucky Bluegrass, and Tall Fescue during Well-watered and Drought Conditions



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Introduction

Kentucky bluegrass (*Poa pratensis* L.) (KBG) is a high quality, cool-season turfgrass that is commonly used on fairways and roughs of golf courses in the U.S. Tall fescue (*Festuca arundinacea* Schreb.) (TF) is also a popular cool-season grass used in lawns and sometimes in golf course roughs. Hybrid bluegrasses (HBG), which are genetic crosses between native Texas bluegrass (*Poa arachnifera* Torr.) and KBG, have similar visual characteristics as KBG but may be more heat and drought resistant. Despite the potential for using HBG in lawns and golf course fairways and roughs, little scientific data are available about the field performances of HBG in the transition zone, including under well-watered and drought conditions.

Objectives

- Evaluate the visual quality, measure photosynthesis, and compare the general performances among two HBG, one KBG, and one TF during well-watered and drought conditions.
- Determine genetic rooting potentials of the same species and cultivars under well-watered conditions.

Materials and Methods

- Four turfgrasses ('Thermal Blue' HBG and 'Reveille' HBG), a KBG ('Apollo'), and a TF ('Dynasty'), were seeded in 32 plots (2.4 m²) under a rainout shelter near Manhattan, KS, USA in Sept. 2003 (Fig. 1); plots were bordered by metal edging (10 cm depth) to prevent lateral soil water movement. The study was conducted from 3 Aug. to 8 Oct., 2004 and 27 June to 15 Sept., 2005. All plots were mowed with a walk-behind rotary mower at a height of 7.62 cm twice weekly.
- Evapotranspiration (ET) was calculated with Penman-Monteith equation using climatological variables from a nearby weather station. Water was applied twice weekly according to irrigation treatment (well-watered = 100% ET replacement and water-deficit = 60% ET replacement).
- Treatments were arranged in a randomized complete block design with four replications.
- Photosynthesis was measured biweekly on clear days between 1100 and 1500 CDT with a Li-6400 (Licor) equipped with a custom-built surface chamber (Fig. 3). Gross photosynthesis (Pg) was estimated as the sum of photosynthesis measured by sunlit chamber and respiration measured by shaded chamber.
- Root cores (80 cm x 4.8 cm diam.) were collected after two years from well-watered plots, using a hydraulic soil probe (Fig. 2). Soil cores were divided into segments (0-30, 30-60, and 60-80 cm profiles), soil was washed from roots, and root lengths were measured using an image analysis system (WinRHIZO). Total root length in the 0-80 cm profile was calculated as the sum of root lengths from each depth.



Figure 1. Rainout shelter (180 m²) at Rocky Ford Turfgrass Research Center near Manhattan, KS. The rainout shelter automatically moved over plots (on tracks) when rainfall began, then retracted one hour after rainfall ended.

Results

Visual Quality:

- In well-watered plots, visual quality was highest in TF and lowest in Thermal Blue among species and cultivars. Visual quality was generally higher in Reveille than Thermal Blue during the second month of the study (Fig. 4A).
- In the drought treatment, TF also had the highest visual quality among species and cultivars. The visual quality of Reveille was greater than Thermal Blue and KBG as the plots dried, but then became similar to Thermal Blue and KBG during the severest part of drought (Fig. 4B). After termination of the drought treatment and upon re-watering (on 70 DOT), Thermal Blue and Reveille recovered faster than KBG, and both HBG had higher visual quality than KBG late in the study (Fig. 4B).

Gross Photosynthesis (Pg):

- In well-watered conditions, Pg was generally greatest in TF among species and cultivars (Fig. 5A).
- In the drought treatment, Pg was greater in TF than in Thermal Blue and KBG during the first two weeks, but Pg thereafter became similar among cultivars and species. There was generally no difference in Pg between TF and Reveille (Fig. 5B).

Total root length under different depths:

- Total root length in the 0-80 cm profile was greatest in Thermal Blue among species and cultivars; total root length in the 0-80 cm profile was similar among Reveille, KBG, and TF (Fig. 6A). From 86% (TF) to 96% (Thermal Blue) of total root length was found in the upper profile (0-30 cm) among species and cultivars.
- TF had more roots in the lower profile (60-80 cm) among species and cultivars (Fig. 6B).

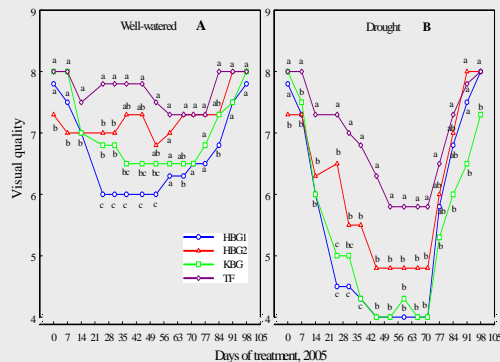


Figure 4. Visual quality of Thermal Blue (HBG1), Reveille (HBG2), KBG, and TF rated on a scale of 1 to 9 (1=poorest and 9=highest) under well-watered (A) and drought (B) conditions in 2005. Means followed with the same letter on a given day after treatment initiation (Days of treatment) are not significantly different (P=0.05).



Figure 2. A hydraulic soil probe was used for collection of root cores in this study

Conclusions

- In well-watered and drought treatments, TF had highest the visual quality and greatest Pg among species and cultivars.
- In the drought treatment, Reveille performed better than Thermal Blue, and both HBG (Thermal Blue and Reveille) recovered from drought more quickly than KBG.
- Under well-watered conditions, 86 to 96% of all roots were in the upper profile (0-30 cm) among species and cultivars, and TF had the deepest root system.
- In general, the performances ranked: TF > Reveille >= Thermal Blue = KBG.

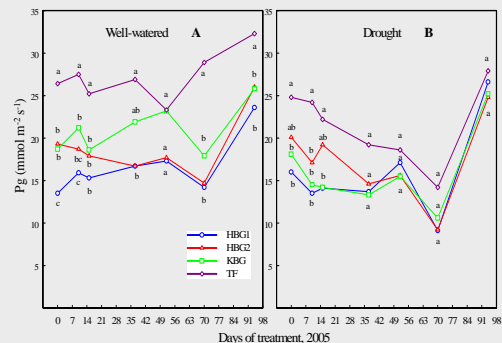


Figure 5. Gross photosynthesis (Pg; sum of photosynthesis and respiration) in Thermal Blue (HBG1), Reveille (HBG2), KBG, and TF in well-watered (A) and drought (B) plots in 2005. Means followed with the same letter on a given day after treatment initiation (Days of treatment) were not significantly different (P=0.05).

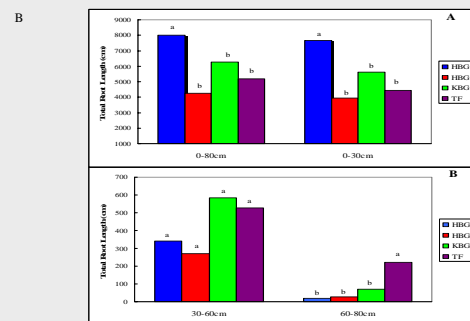


Figure 6. Comparisons of total root length in Thermal Blue (HBG1), Reveille (HBG2), KBG and TF in: the 0-80cm and 0-30 cm (A); and the 30-60 cm and 60-80cm (B) profiles after two years under well-watered conditions. Means followed with the same letter within a specific depth were not significantly different (P=0.05).



Figure 3. A custom-built surface chamber attached to a Licor 6400 (Li-6400) portable gas exchange system was used to measure photosynthesis.

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