Heat and Drought Performance of Texas Bluegrass Hybrid Turf

Does this new turfgrass live up to the hype?

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Figure 1
The visual appearance of Kentucky bluegrass (KBG, Apollo), Thermal Blue (TB, a hybrid bluegrass), and tall fescue (TF, Dynasty) varies after 36 days of temperature and irrigation deficit treatments. Front row is high temperature and back row is optimal temperature treatment. From left to right in both front and back rows: KBG (60% evapotranspiration [ET]), KBG (100% ET), TB (60% ET), TB (100% ET), TF (60% ET), and TF (100% ET).

Texas bluegrass hybrid turf, or "hybrid bluegrass" for short, is the latest turfgrass to enter the scene in the ongoing quest for more heat-tolerant, drought-resistant cool-season turfgrass. Hybrid bluegrass is a genetic cross between native Texas bluegrass (*Poa arachnifera* Torr.) and Kentucky bluegrass (*Poa pratensis* L.). It looks a lot like Kentucky bluegrass and could potentially be used for golf course tees, fairways, and roughs in areas where cool-season grasses are grown. Early reports claimed that hybrid bluegrass had greater heat tolerance and drought resistance than other cool-season grasses (Read et al., 1999), but because it is a relatively new turfgrass, research has been limited. Our research, consisting of both growth chamber and field studies, investigated the heat and drought performance of hybrid bluegrass in comparison to turf-type tall fescue and Kentucky bluegrass.

GROWTH CHAMBER STUDY

In the growth chamber study, which included Thermal Blue hybrid bluegrass, Dynasty tall fescue (*Festuca arundinacea* Schreb.), and Apollo Kentucky bluegrass, we established the grasses in lysimeters (Figure 1), split them into four groups, and subjected them to 48 days of one of the following treatments: 1) high temperature (95°F day/77°F night) and well watered (100% evapotranspiration [ET] replacement; 2) optimal temperature (72°F day/60°F night) and well watered; 3) high temperature and drought (60% ET replacement); 4) optimal temperature and drought. Irrigation treatments were applied every 3 days. The turfgrasses were mowed every 3 days at 2.5 in., and a nutrient solution was applied weekly in concert with the irrigation to prevent nutrient deficiencies.

We collected data on visual quality, photosynthesis rate, leaf electrolyte leakage (an indication of membrane integrity, which was of interest because heat/drought can cause membranes to rupture, possibly killing the plant), shoot growth, canopy temperature, and soil-surface temperature.

The hybrid bluegrass did indeed prove to be more heat tolerant than the tall fescue and Kentucky bluegrass (Figure 1). Under the high-temperature, well-watered treatment, hybrid bluegrass had higher visual quality, photosynthesis, and shoot growth, and

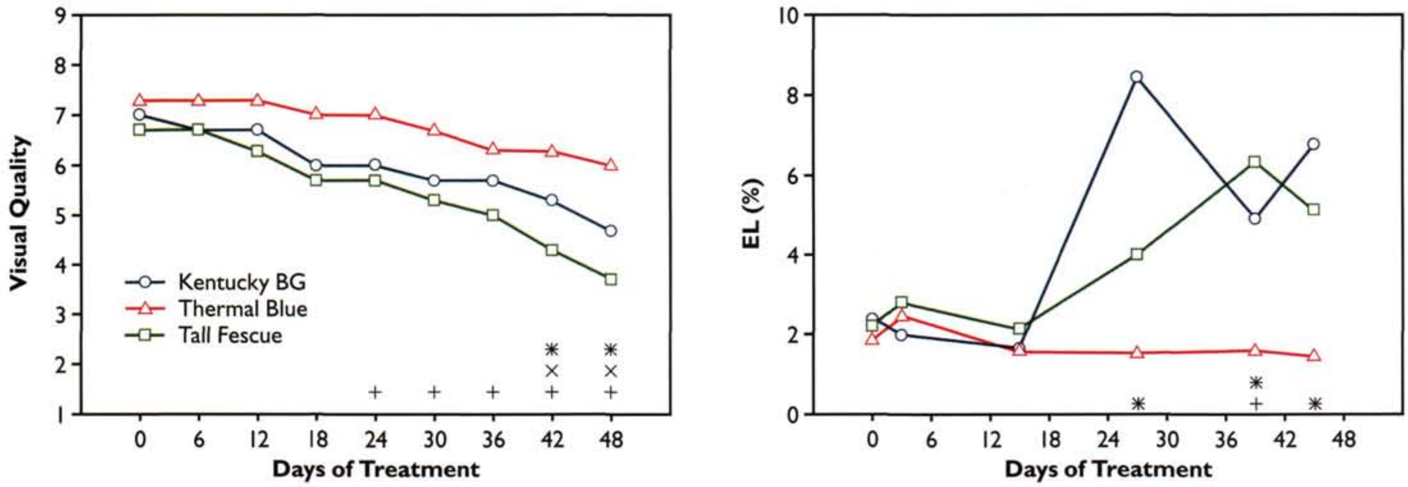


Figure 2. Effects of high temperature on: 1) visual quality, rated on a scale of 1 to 9 (1 = poorest and 9 = highest) (left), and 2) electrolyte leakage (right), in Kentucky bluegrass (Kentucky BG, Apollo), Thermal Blue (a hybrid bluegrass), and tall fescue (Dynasty). Symbols along the abscissa of each graph indicate significant differences (P = 0.05) between: Thermal Blue and Kentucky BG (✳), Thermal Blue and tall fescue (+), and Kentucky BG and tall fescue (×), on a given day after initiation of the heat treatment (Days of Treatment).

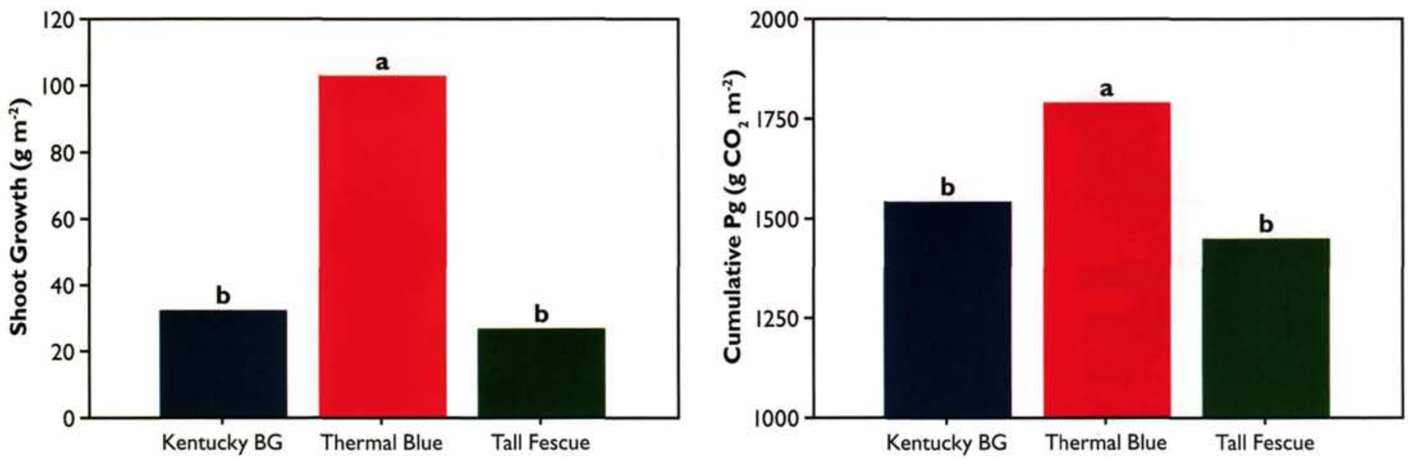


Figure 3. Effects of high temperature on: shoot growth (left) and cumulative photosynthesis (Pg) (right) in Kentucky bluegrass (Kentucky BG), Thermal Blue (a hybrid bluegrass), and tall fescue (Dynasty). Means with the same letters were not significantly different (P = 0.05).

lower electrolyte leakage (Figures 2 and 3) and soil surface temperatures. The superior heat tolerance of the hybrid bluegrass was probably due to more stable membranes and photosynthetic "machinery," which allowed it to continue growth under the high temperatures.

Under the high-temperature/drought combination treatment, the differences among grasses were not as great, but hybrid bluegrass did have higher visual quality and photosynthesis than tall fescue (Figure 4). Tall fescue's performance was poorer than we expected based on previous field observations. Undoubtedly, the restricted rooting volume in the lysimeters prevented it from taking advantage of its genetic capacity to form deeper roots than other cool-season grasses.

FIELD STUDY

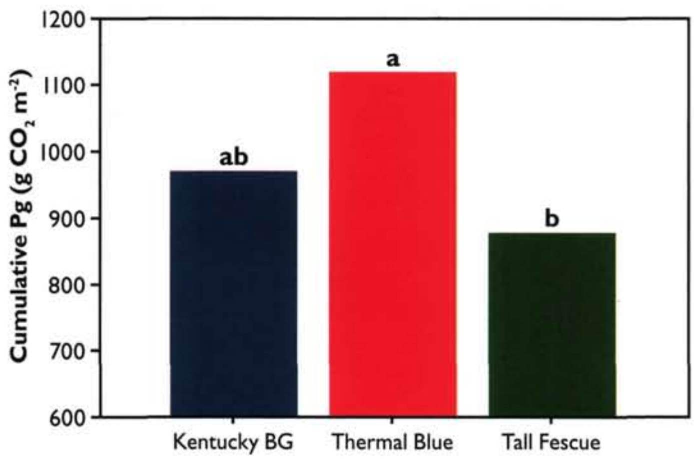
Based on our growth chamber results, we were cautiously optimistic about how hybrid bluegrass would perform under the combined effects of heat and drought in the field. We designed a field study to evaluate the drought performance of the same grasses we used in the growth chamber study, plus Reveille hybrid bluegrass. The plots were established under a large rain-out shelter (40 ft. × 40 ft.), which allowed us to control the amount of water the plots received. Mounted on steel tracks, the rain-out shelter automatically covered the plots whenever it rained. All grasses were mowed at 3 in. and fertilized with 3 lb. N per 1,000 sq. ft. per year. Other nutrients, such as P and K, were supplied according to soil test results.

Irrigation level was the main treatment and consisted of either 60% (drought) or 100% (well watered) ET replacement. The treatments were applied to individual plots (4.5 ft. × 6 ft.) by hand twice weekly using a metered hose-end nozzle. Plots were bordered by metal edging to prevent lateral water flow. Performance of the grasses was evaluated by taking visual quality ratings and measuring canopy photosynthesis. In addition, soil moisture in the 0 in. to 20 in. profile was measured weekly using time-domain reflectometry, and root samples were collected to a depth of 32 inches in order to investigate rooting characteristics of the grasses.

Our field results diverged from the growth chamber results, to say the least. In the field, the turf-type tall fescue dramatically outperformed the hybrid and Kentucky bluegrasses. The tall fescue had higher visual quality and photosynthesis rates than all other grasses under both drought and well-watered conditions (Figures 5 and 6). Furthermore, root samples revealed that the hybrid bluegrasses were similar to the Kentucky bluegrass in their rooting patterns, with greater than 90% of their root mass in the top 12 in. of soil. Tall fescue, by contrast, had 3 to 12 times greater root length in the lower profile (24 to 32 in.) than the other grasses.

It should be noted that high performance in this study was defined as grass that stayed green and turgid longer when water was limiting. Clearly, when that kind of performance is the goal, tall fescue is still the cool-season turfgrass of choice for golf course roughs in areas where summers are hot, such as the mid-continental U.S. The caveat is that soils must be conducive to deep root growth. In shallow or compacted soils, hybrid or Kentucky bluegrass may outperform the tall fescue, based on our growth chamber research. Another option for rough areas during summer would be to allow the turfgrass to go dormant. In that scenario, hybrid or Kentucky bluegrass may be the better choice, but

To control water inputs and ensure drought-like conditions, an automated rainout shelter mounted on steel tracks (background) moves to cover plots (foreground) when it rains.



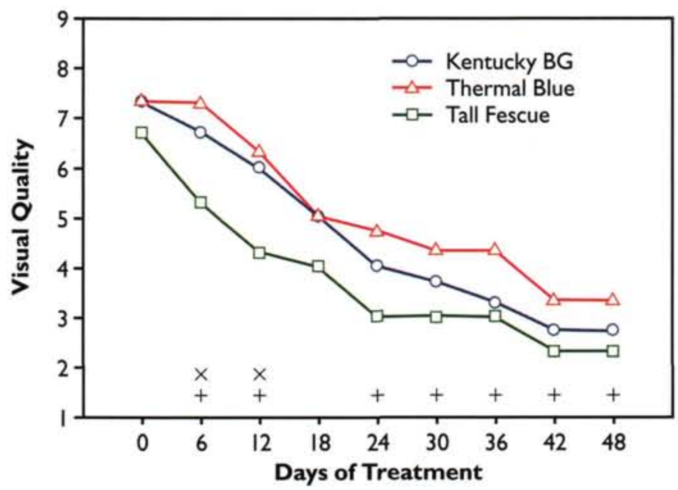


Figure 4. Effects of high temperature and drought combination on: 1) cumulative photosynthesis (Pg) (left), and 2) visual quality (right), in Kentucky bluegrass (Kentucky BG), Thermal Blue (a hybrid bluegrass), and tall fescue (Dynasty). Means with the same letters in the left graph were not significantly different (P = 0.05). Symbols along the abscissa of the right graph indicate significant differences (P = 0.05) between: Thermal Blue and tall fescue (+), and Kentucky BG and tall fescue (×), on a given day after initiation of high-temperature/drought combination treatment (Days of Treatment).

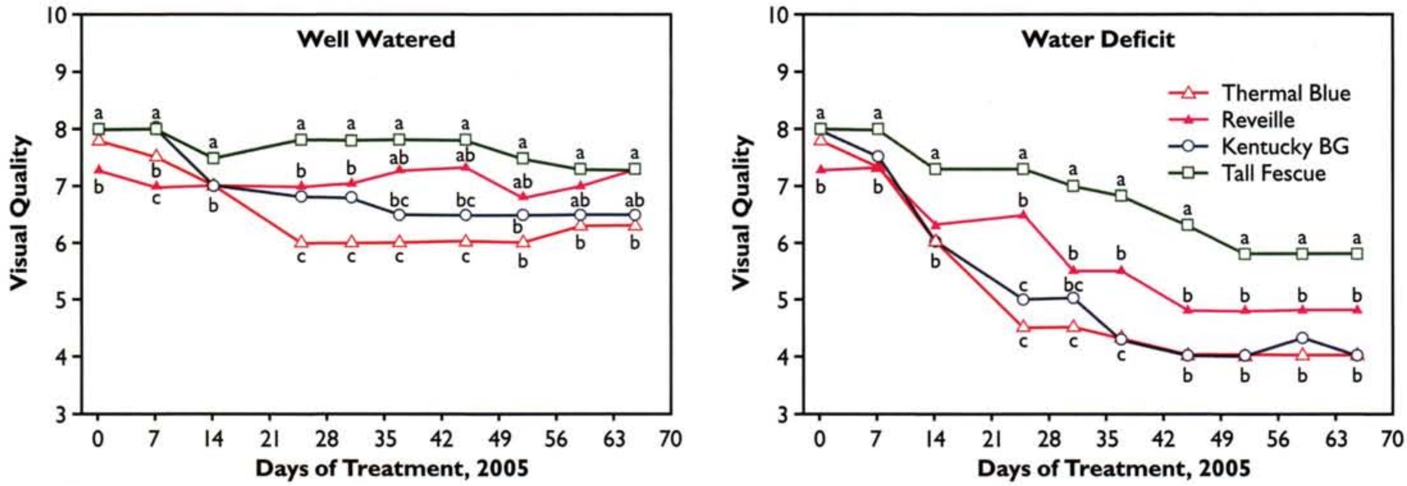


Figure 5. Visual quality (scale of 1 to 9, 9 = best) among turfgrasses under well-watered (left) and water-deficit (right) field conditions. Thermal Blue and Reveille are hybrid bluegrasses; Kentucky BG is Apollo, a Kentucky bluegrass cultivar; and Tall Fescue is the cultivar Dynasty. Means followed with the same letter on a given day after initiation of the water-deficit treatment (Days of Treatment) are not significantly different (P = 0.05).

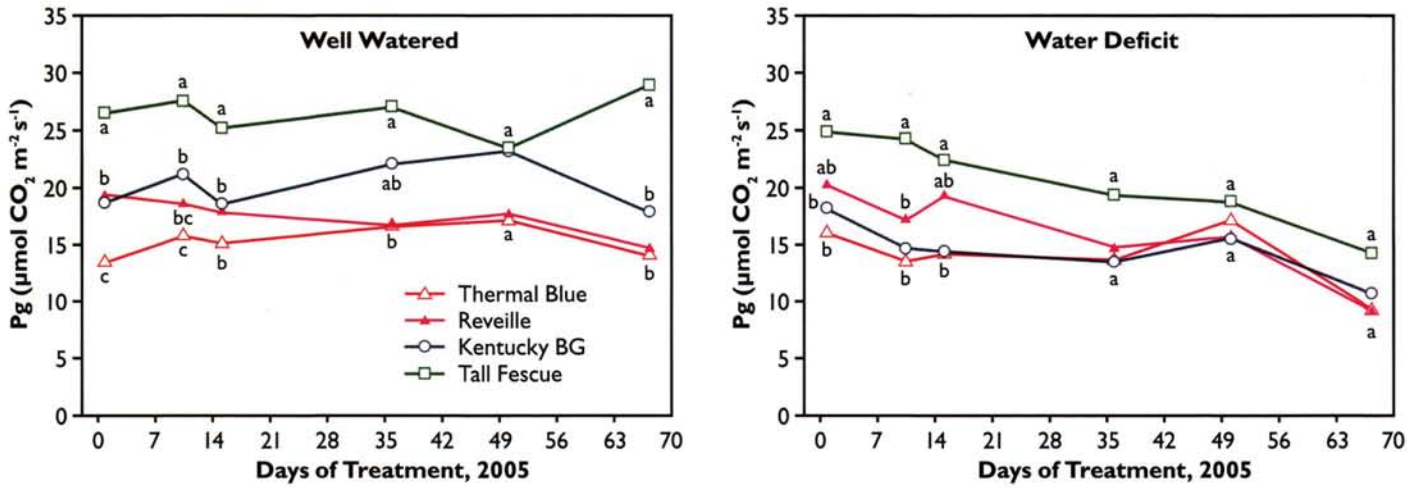


Figure 6. Gross photosynthesis (Pg) among turfgrasses under well-watered (left) and water-deficit (right) field conditions. Thermal Blue and Reveille are hybrid bluegrasses; Kentucky BG is Apollo, a Kentucky bluegrass cultivar; and Tall Fescue is the cultivar Dynasty. Means followed with the same letter on a given day after initiation of the water-deficit treatment (Days of Treatment) are not significantly different (P = 0.05).

that was not a subject of investigation in this study.

Between the hybrid bluegrasses, Reveille performed slightly better than Thermal Blue under the drought treatment, although the difference was usually not significant. Reveille's roots appeared to be more active, as it extracted more water from the 0-50 cm profile (data not shown). We also noticed that both hybrid bluegrasses recovered from the drought treatment slightly faster than the Kentucky bluegrass.

If you are interested in more detail on the research described herein, see Su et al., 2007 and 2008.

CONCLUSIONS

In summary, the performance of hybrid bluegrass was impressive under 95°F temperatures and 100% ET replacement in the growth chamber, but not so impressive under field conditions. In the field, the turf-type tall fescue provided the best drought resistance and overall performance. In the mid-continental U.S. and locations with a similar climate, where soils are reasonably deep, turf-type tall fescue will deliver green grass longer during a drought than the new hybrid bluegrasses we tested. Breeders have more hybrid bluegrasses on the way. Will they live up to the hype? Stay tuned.

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