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Which Kentucky Bluegrass Cultivars Perform Better with Less Water?

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Field research at Kansas State University indicates that water requirements may differ significantly among cultivars of Kentucky bluegrass *(Poa pratensis* L.*)* (KBG), depending upon desired turfgrass quality. Given the certainty of periodic drought, limited water availability, and increasing irrigation costs, having choices of KBG cultivars that may maintain better quality with less water is an attractive option. Ideally it would be helpful to select a turfgrass that can perform well with less water.

A helpful concept when discussing KBGs is their classification into phenotypic groups. Individual cultivars of KBG are classified into phenotypic groups based on common growth and stress performance characteristics gathered from field trials (Bonos et al., 2000). Previous research has indicated that such groupings may be useful in predicting drought tolerance. Because cultivar turnover is rapid in the turfgrass industry, determining the relative irrigation requirements of phenotypic groups may enable researchers to predict irrigation requirements of cultivars not included in any particular study.

IDEALLY IT WOULD BE HELPFUL TO SELECT A TURFGRASS THAT CAN PERFORM WELL WITH LESS WATER.

Using a rainout shelter (Fig. 5), we compared seasonal irrigation amounts among 28 KBG cultivars for two growing seasons. By shielding plots from rainfall, water could be withheld until wilt symptoms were evident. Our objectives were to identify KBG cultivars and phenotypic groups that maintain better visual quality with less irrigation, using wilt-based irrigation. We hypothesized that if visual quality was good at the beginning of the season, we could maintain minimally

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OTS HIGHLIGHT
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Table 1. Phenotypic groups and cultivars of Kentucky bluegrasses and hybrid bluegrasses.

Group†	Cultivar
Aggressive	Limousine Touchdown
BVMG‡	Baron Envicta Abbey
Common	Kenblue Wellington Park
Compact	Diva Skye Moonlight
Compact America	Langara Bedazzled Apollo Unique Kingfisher
Compact Midnight	Midnight Midnigt II Blue Velvet Nu Destiny Award
European§	Blue Knight Bartitia
Hybrid Bluegrasses	Thermal Blue Blaze Longhorn
Julia	Julia
Mid-Atlantic	Eagleton Preakness Cabernet
Shamrock	Shamrock

† Kentucky bluegrass classification groups as described in Bonos et al. (2000).
‡ BVMG, Baron, Victa, Merit, and Gnome.
§ Blue Knight and Bartitia have since been reclassified as "Other Type".

acceptable quality in KBG (for example, for a moderately-maintained lawn or golf course rough with in-ground sprinklers) by irrigating when at least 50% of a given cultivar showed signs of wilt. Two hybrid bluegrasses (P. *arachnifera* Torr. x P. *pratensis*) were also included in the study.

Methods

This study was conducted at the Rocky Ford Turfgrass Research Center near Manhattan, Kansas, USA. Data were collected for 105 days in 2007 (June 19 – October 1) and 108 days in 2009 (June 22 – October 7). Turfgrasses included 28 KBG cultivars and two hybrid bluegrasses (Table 1). Commercially available cultivars of KBG were selected to include representatives from major KBG phenotypic groups (Note: In the results section, only groups with three or more cultivars were used when comparing groups). Also, because visual quality was of interest, cultivars were selected based on performance in National Turfgrass Evaluation Program (NTEP) trials.

The plots were maintained well watered until the study began each year. Thereafter, water was withheld until 50% or more of a plot displayed drought stress. Water (2.54 cm) was then applied by hand to the individual plots. Turfgrass quality and drought stress symptoms were evaluated daily. This process continued until the end of the study, after which all plots were re-watered and allowed to recover. Plots were mown weekly at 7.6 cm.

Turfgrass quality evaluations, based on colour, density, and uniformity of the canopies, were made using a visual rating scale of 1 to 9, with 1 = brown turf, 6 = minimally acceptable for a home lawn or golf course rough, and 9 = optimum turf. Drought stress was defined as the turf displaying wilting, failure of the canopy to remain upright after foot traffic, and a general darkening colour of the turf. Because changes in drought stress were sometimes rapid from day to day, particularly under conditions of high temperatures, it was not unusual for irrigation to be applied when greater than 50% of a plot (for example, up to 70 or 80%) displayed drought stress.

Results

Total Water Applied and Days to Wilt between Irrigation Cycles

Water applications, averaged over the

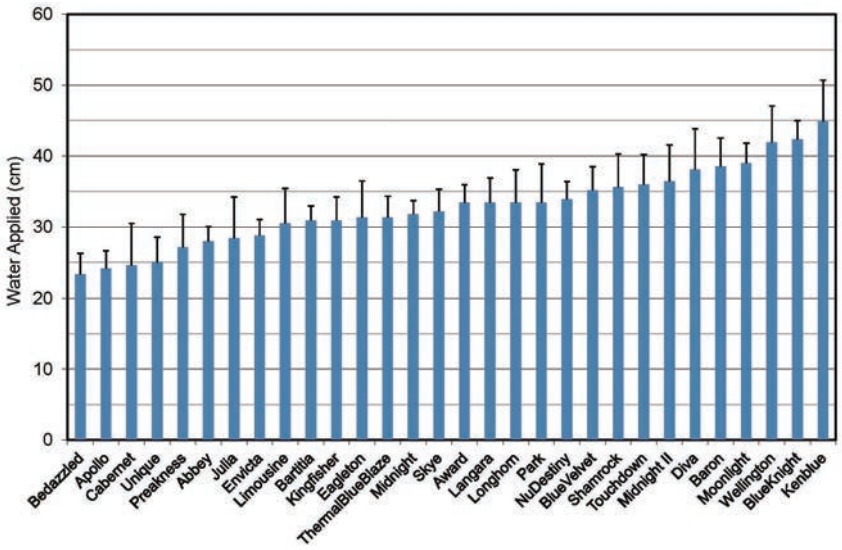

Figure 1. Water applied to Kentucky bluegrass cultivars and hybrid bluegrasses, averaged over the periods 19 June to 1 Oct. 2007 (105 days) and 22 June to 7 Oct. 2009 (108 days), at Manhattan, Kansas. Error bars denote standard error.

~3.5 month period in each year of the study, ranged widely from 23.3 cm (mean=2.2 mm/day) in Bedazzled to 44.9 cm (4.2 mm/day) in Kenblue (Fig. 1). In Bedazzled, Apollo, Cabernet, and Unique, 25.0 cm (2.3 mm/day) or less of water was applied, which was significantly less than Kenblue, Blue Knight, Wellington, Moonlight, Baron, Diva, Midnight II, Touchdown, Shamrock, and Blue Velvet; in the latter 10 cultivars, 35.1 cm (3.3 mm/day) or more of water was applied. However, there were no statistical differences among the 15 cultivars that received the least amount of water (Fig. 1, Bedazzled through Skye).

Days to wilt between irrigations, which was roughly inverse the amount of water applied (r=-0.91), ranged from 6.4 d in Kenblue to 13.1 d in Cabernet, a difference of nearly one week (Fig. 2). Days to wilt was greater in Cabernet, Bedazzled, Unique, and Apollo (11.9 to 13.1 d) than in the 18 bluegrasses with the least days to wilt (6.4 to 9.0 d; Kenblue through Park in Fig. 2). These intervals provide the practitioner with an estimate of irrigation frequency required to maintain the various KBGs at a performance level similar to this study, at least in the transition zone of the U.S. In addition to less frequent irrigation, cultivars with more days to wilt have a greater likelihood of receiving rainfall between irrigations; this could result in further water conservation and reduced irrigation costs.

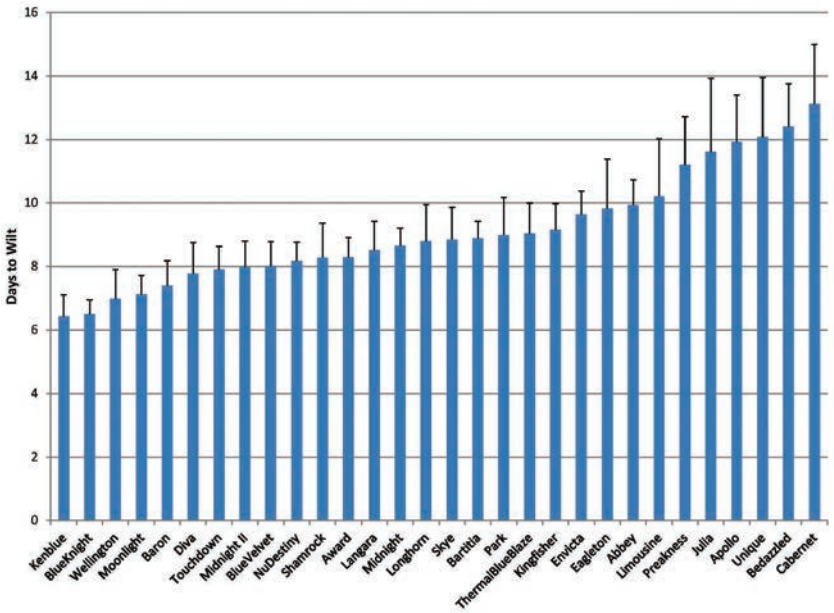

Figure 2. Days to wilt between irrigations among Kentucky bluegrass cultivars and hybrid bluegrasses, averaged over the periods June 19 - Oct. 1, 2007 (105 days) and June 22 - Oct. 7, 2009 (108 days), at Manhattan, Kansas.

Notably, all cultivars in the phenotypic group Mid-Atlantic (Cabernet, Eagleton, and Preakness) and four of five in the Compact America group (Apollo, Bedazzled, Kingfisher,

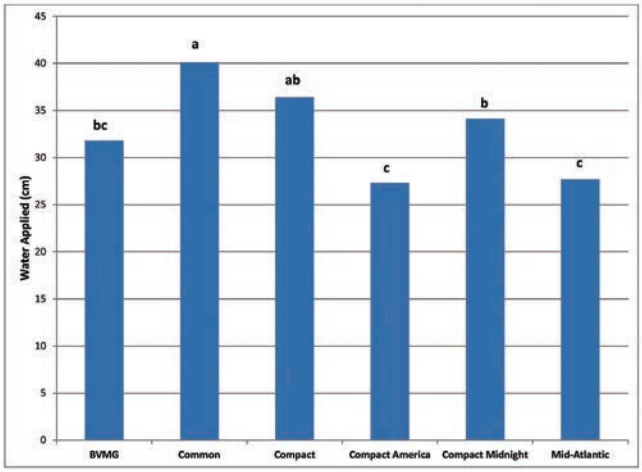

Figure 3. Water applied to Kentucky bluegrass phenotypic groups, averaged over the periods 19 June to 1 Oct. 2007 (105 days) and 22 June to 7 Oct. 2009 (108 days), at Manhattan, Kansas. The same letter above bars denoting different phenotypic groups indicates no significant difference.

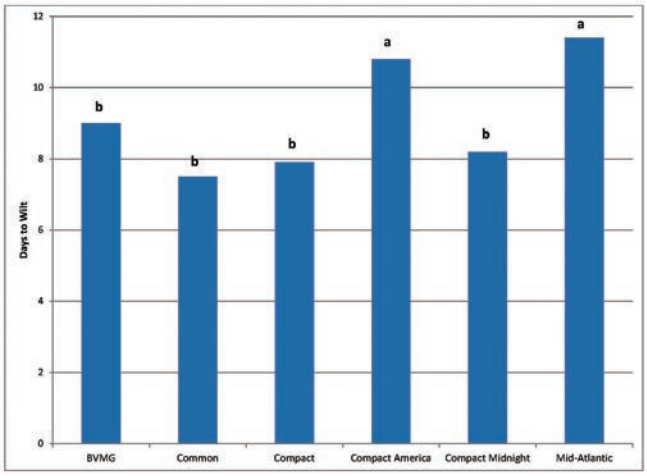

Figure 4. Days to wilt between irrigations among Kentucky bluegrass phenotypic groups, averaged over the periods 19 June to 1 Oct. 2007 (105 days) and 22 June to 7 Oct. 2009 (108 days), at Manhattan, Kansas. The same letter above bars denoting different phenotypic groups indicates no significant difference.

and Unique) were among the 15 cultivars that received the least amount of water (Table 1; Fig. 1). When averaged over all cultivars within each phenotypic group, 27.3 cm of water was applied to Compact America types and 27.7 cm to Mid-Atlantic types (both about 2.6 mm/day), which was less than the Common, Compact, and Compact Midnight groups (Fig. 3). The Common types received more water (40.1 cm, 3.8 mm/day) than all other groups except Compact. Days to wilt was also greater in Mid-Atlantic and Compact America than in all other groups (Fig. 4), indicating cultivars in Mid-Atlantic and Compact America could generally go longer without irrigation.

Visual Quality

With the exception of the Common types in 2007, the visual quality of all bluegrasses was acceptable (>6) at the beginning of the study in each year (Fig. 5). In all bluegrasses and in both years, however, visual quality declined to below what was considered minimally acceptable (Fig. 5). This indicates waiting until 50% wilt to apply irrigation was insufficient to maintain acceptable visual quality in KBG, at least for homeowners or superintendents who desire a moderate standard of quality in the stressful climate of the transition zone. Perhaps visual quality could have been maintained at acceptable levels by applying water when only 25% of the plot exhibited symptoms of drought stress; further research is required. Our method may be appropriate, however, for the typical homeowner with no in-ground sprinklers or superintendents with low-maintenance roughs on their golf courses, or where the primary concern is water conservation and some dormancy is acceptable. Visual quality in all bluegrasses generally remained above four and recovery was rapid in the fall after resuming irrigation (data not shown).

Although visual quality declined to less than six in all cultivars, the time required to do so ranged widely from 8.1 d in Kenblue to 44.8 d in Blue Velvet (data not shown for all cultivars; see Bremer et al. or Lewis et al., 2012 for greater detail). The decline was slower in Blue Velvet, Award, Midnight, Cabernet, Unique, and Nu Destiny (36 to 44.8 days) than in Park, Baron, Wellington, and Kenblue (8.1 to 14.2 days). Thus, four of five cultivars in the Compact Midnight group maintained quality longer than all cultivars in the Common group (Table 1). As a group, the Compact Midnight types remained above a quality of six for longer than the Common as well as the BVMG types, but also received more water than the Compact America and Mid-Atlantic groups (Fig. 3).

Relationships between Water Applied and Visual Quality

Ideally, cultivars or groups that require the least water would also have the highest visual quality. Those relationships are illustrated in the scatter biplot in Figure 6, in which cultivars with the most favorable characteristics appear in the lower right section. In general, irrigation applications were greater in bluegrasses with poorer quality (Fig. 6). This pattern probably resulted from improved cultivars with morphological properties that both enhanced turf quality and reduced evapotranspiration (water use). Such improved properties include compact or dwarfed growth habits, horizontal leaf orientation, and greater shoot density.

All 15 bluegrasses with the lowest water applications were also ranked among those with the highest visual quality (Fig. 6; there were no statistical differences among cultivars with average visual quality greater than 5.5). The amount of water applied to these 15 cultivars with superior turf quality was also below the mean water applied to all 30 bluegrasses (32.8 cm). Similarly, visual quality in 12 of the 15 bluegrasses that received the least water

Figure 5. Well-watered plots at beginning of dry-down study (June 4, 2007)(left). Kentucky bluegrass plots at two months into the study (August 4, 2007), in which drought stress is evident (right). Plots were sheltered from precipitation by the rainout shelter (upper left in each photo), which automatically moved on the tracks to cover the plots during rainfall. (Photos by Jason Lewis)

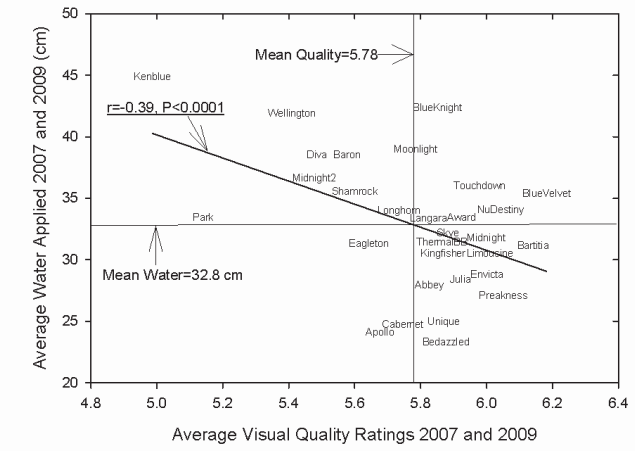

Figure 6. Water applied to Kentucky bluegrass cultivars and hybrid bluegrasses versus average visual quality ratings on a 1-9 scale with 9=optimum and 1=brown turf. Data were averaged over the periods June 19 - Oct. 1, 2007 (105 days) and June 22 - Oct. 7, 2009 (108 days).

was greater than the mean of all 30 bluegrasses (5.78), although all 15 were statistically similar.

In contrast to the 15 top performers, six cultivars were ranked within the group that received the most water and had the lowest visual quality (Fig. 6). Those six cultivars, which included Kenblue, Wellington, Midnight II, Baron, Diva, and Shamrock, had neither the high visual quality nor low water requirement traits we were screening for in this study.

Conclusions

Cultivar selection in KBG had significant impacts on water requirements and visual quality ratings. Among cultivars, differences in seasonal water applications were as great as 21.6 cm and differences in days to 50% wilt between irrigations were as great as 6.7 days (i.e., nearly one week). Based on statistical range tests, only 15 of the 30 cultivars were in the group that both received the least water and had the greatest visual quality. Results indicated that, under conditions similar to those in our study, KBG in the Compact America and Mid-Atlantic phenotypic groups can be selected for their lower irrigation requirements without sacrificing visual quality, and types from those two groups may represent the best selections for breeding efforts to achieve such goals. More detailed results from this study can be found in Bremer et al. (2012) and Lewis et al. (2012).

Acknowledgements

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References

Bonos, S.A., W.A. Meyer, and J.A. Murphy. 2000. Classification of Kentucky bluegrass genotypes grown as spaced-plants. HortScience 35:910–913.

Bremer, D., J. Lewis, S. Keeley, and J. Fry. 2012. Effects of wilt-based irrigation on visual quality and seasonal water applications on 30 bluegrasses in the transition zone. USGA Turfgrass and Environmental Research Online (TERO) 11(6): 1-12.

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 Science 52:1881–1890.