JEFF NUS, PH.D

# Thirsty but green

A Kansas State University study explores the minimum amount of water needed for Kentucky bluegrasses to survive while remaining green between irrigation cycles.

In most of the United States, watering the golf course is an important responsibility of the superintendent. It is equally important for golfers and course officials to understand that water availability, usage, and cost are major issues facing the golf course industry. Water impacts nearly every aspect of managing golf course turf, such as color, mowing operations, traffic control, disease development, and playability. In addition, a significant amount of the golf course maintenance budget is directly related to water — maintaining the irrigation system, energy costs to pump water, costs for using and storing water, and on and on.

**Editor's note**
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For nearly three decades, the USGA Turfgrass and Environmental Research Program has addressed these issues by funding the development of turfgrasses that use less water, studies to determine how much water turfgrasses use, and just how far they can be "pushed" to use less.

One such project at Kansas State University demonstrated a potential 30 percent savings in water when selecting a Kentucky bluegrass cultivar for golf course roughs. The researchers compared water use requirements among 28 Kentucky bluegrass cultivars and two hybrid bluegrasses (Kentucky bluegrass X Texas bluegrass) that were maintained under wilt-based irrigation. Water was applied when an individual cultivar plot started to wilt. In that way, each cultivar was maintained under far less than ideal moisture conditions in an effort to find the minimum

amount of water needed to have acceptable turf. The cultivar received one inch of water when visual symptoms of wilt appeared, rather than applying daily amounts of water to replace moisture lost from the leaf and soil surfaces.

"Deficit irrigation consumes less water than the turf would normally use under well-watered conditions. Although our irrigation strategies in this study often resulted in deficit irrigation, we didn't monitor the level of deficit during the study," Dr. Fry says. "We took the approach superintendents would often use, which is to apply about an inch of water when wilt first appears. It's practical and could be used with cultivars of other grasses."

Dr. Fry explains that this approach of irrigating in response to visual wilt saves water. "Across cultivars, our range of deficit irrigation levels ended up being 46 to 89 percent of evapotranspiration. In other words, we applied only 46 to 89 percent of the amount of water the cultivars would have received under well-watered conditions."

Dr. Steve Keeley, a co-investigator on the study, says, "It is important forsuperintendents to know the difference between water use rate and irrigation requirement, as well as how long the turf cultivars on their golf courses can go between irrigation cycles. Previous research has shown slight differences among cultivars in their water use rates. However, there is a difference between water use rate, which is typically measured under non-limiting moisture conditions, and irrigation requirement, which is not.

"This research shows some pretty dramatic differences in irrigation requirement. Knowledge of these cultivar differences is critical for making cultivar selection decisions, and superintendents certainly should be familiar with the capabilities of each grass on their golf courses in order to irrigate efficiently. That is, superintendents need to have a feel for how long each grass can go between irrigations," explains Dr. Keeley.

It would seem logical that turfgrasses with low water use rates also would have greater drought resistance. However, Dr. Dale Bremer, project leader, cautions that this is not always the case, because there are several factors determining drought resistance, which refers to the ability of turfgrasses to survive extended dry periods.

"There is not necessarily a strong connection between water use rates and drought resistance," says Dr. Bremer. "Turfgrass A may have higher water use rates than Turfgrass B, but if Turfgrass A also has deeper roots, it may be equally or even more resistant to drought than Turfgrass B. The deeper root system of Turfgrass A has greater ability to absorb soil moisture for a longer period between irrigations than Turfgrass B."

Dr. Fry points out that it is essential for superintendents to have a good idea of the rooting depth of their turf in order to irrigate efficiently. "A good superintendent will have an idea of how deep the majority of roots are across all playing areas. Knowing rooting depth helps the superintendent determine how deep the soil should be wetted during irrigation to impact the majority of the roots.

**Figure 1.** Water Applied Groups

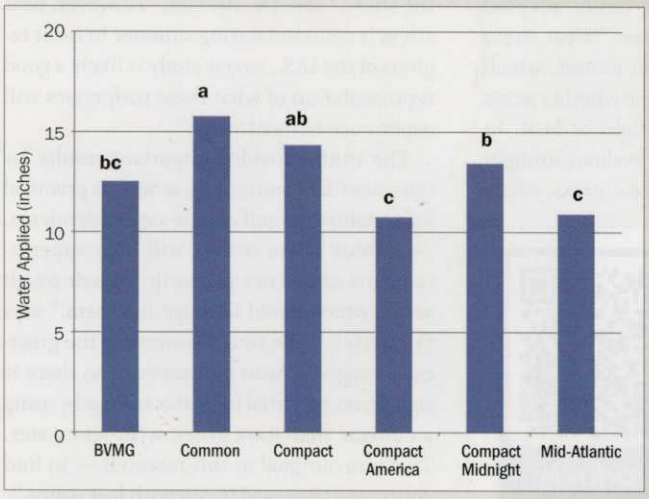



**Figure 2.** Days to wilt groups

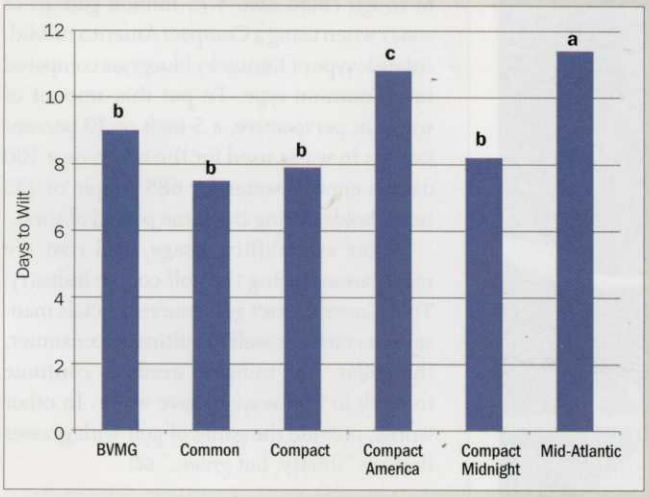
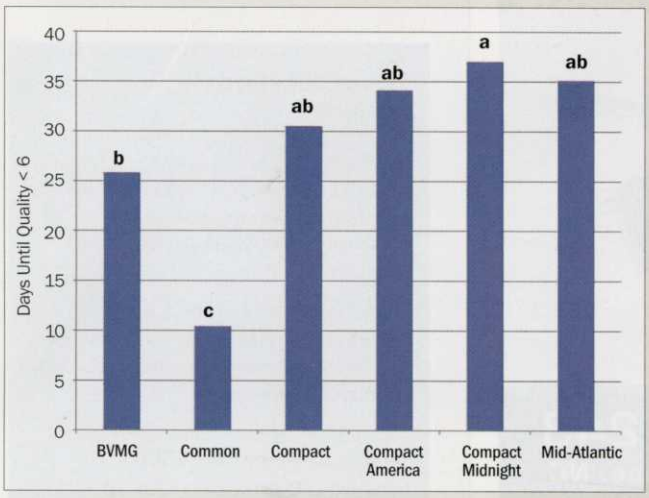



**Figure 3.** Days till less than 6 groups




"In turfgrasses, rooting is one of the primary means that grasses have to resist drought. In the Midwest, grasses that root deeply and extensively are able to avoid drought when the soil surface begins to dry down," Dr. Fry explains. "Those cultivars that can go the longest between irrigations before exhibiting wilt are the ones with the most extensive root systems."

Kentucky bluegrasses can be categorized by type, and the 28 Kentucky bluegrass cultivars and the two bluegrass hybrids used in this research study are listed by type in Table 1. To save water, it would be helpful if a particular type of Kentucky bluegrass outperformed the others under moisture-limiting conditions. This study determined the average water use rates and turf quality of the different Kentucky bluegrass types during the summer in Kansas.

"For our study, we generally selected cultivars that were best performers, in regards to visual quality, from the 2001 National Turfgrass Evaluation Program (NTEP) Kentucky Bluegrass Trial. The Common types (Kenblue, Park, and Wellington) were the exceptions, because they weren't best performers in nationwide studies by NTEP or in our study, even under well-watered conditions," says Dr. Bremer.

"In general, visual quality averaged over the study was similar among the cultivars with the exception of the Common types, which were lower. Cultivars in the Compact Midnight (Award, Blue Velvet, Midnight, Midnight II, and Nu Destiny) group tended to have equal or higher turf quality than cultivars in the Compact America (Apollo, Bedazzled, Kingfisher, Langara, and Unique) and Mid-Atlantic (Cabernet, Eagleton, and Preakness) types, but they also received more water." (See Figures 1-3).

**Acknowledgement**

This research project was co-funded by USGA, Turfgrass Producers International, and the Kansas Turfgrass Foundation.

Are there differences in growth characteristics between Kentucky bluegrass types that may help to explain differences in water use rates? Dr. Keeley notes, "We didn't specifically look at morphological characteristics in this research, but we do know some things about them. For example, the Mid-Atlantic types, which did well as a group in this study, have deep, extensive root and rhizome systems.

"Physiological differences may provide better clues in some cases. For example, the Common types are known to respond to drought by going dormant more quickly than other groups. While that can be a good mechanism to survive drought, it can lead to a higher irrigation requirement if you are trying to keep them green, as we were," explains Dr. Keeley. "The Compact America types are another good example of how physiological characteristics may play an important role. Previous research has shown this group to be more heat tolerant than other groups, and heat tolerance probably contributed to their lower irrigation requirement as a group."

This study provided important insight into the performance of Kentucky bluegrass cultivars under moisture-limited conditions, but Dr. Keeley cautions that these results may

not be applicable to other turfgrass species. "I would not expect to find such dramatic differences in most other cool-season turfgrass species. Kentucky bluegrass is particularly diverse. That is one of the things that makes it an interesting species to work with."

Dr. Bremer also cautions that the results of the study could have been different if it was conducted in areas of the country where Kentucky bluegrasses are better adapted than the hot transition zone. "Heat stress was a factor in our study in Kansas, which made it difficult to determine whether stress symptoms were from drought or heat. In cooler climates, one could evaluate drought effects alone, without the heat stress, which could certainly have changed the outcome of the study," says Dr. Bremer. "However, heat stress is common during summer in most regions of the U.S., so our study is likely a good representation of what these turfgrasses will experience in most areas."

The study provided important results for the scientific community, as well as practical information for golf course superintendents. "We think these results will help superintendents save water primarily in their rough areas, which could be huge for them," says Dr. Keeley. "The rough comprises the greatest acreage on most golf courses, so there is significant potential for water savings by using a cultivar that stays green with less water. That was our goal in this research — to find cultivars that stayed green with less water."

For example, a golf course with 35 acres of rough could save 4.75 million gallons of water when using a Compact America or Mid-Atlantic type of Kentucky bluegrass compared to a Common type. To put this amount of water in perspective, a 5-inch or 30 percent savings in water used for the rough over 100 days is enough water for 685 people or 135 households during the same period of time.

Water availability, usage, and cost are major issues facing the golf course industry. These costs impact golf course officials managing a course as well the ultimate consumer, the golfer. The industry needs to continue to work to find ways to save water. In other words, provide the game of golf with grasses that are "thirsty, but green." **GCI**

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**Literature cited**
bit.ly/R3RUyt

Bonos, S. A., W. A. Meyer, and J. A. Murphy. 2000. Classification of Kentucky bluegrass genotypes grown as spaced plants. HortScience 35:910-913. (TGIF Record Number 67878)

Brooks Gould, A. (ed.) 2004. Rutgers Turfgrass Proc. New Jersey Turfgrass Expo. 7-9 Dec. 2004. New Jersey Turfgrass Assoc. Atlantic City, New Jersey.

"Water Use Statistics." American Water Works Association — Home Water Information Conservation. Web. 15 May 2012. bit.ly/RGmbK8