Turf Leaf Orientation Affects Water Use

Study on zoysiagrass shows water-use rates differ in response to cultivar and fertility programs *By John Erickson*

The combination of population growth and drought conditions has intensified competition for public drinking water resources in many regions. As a result, thirsty grass is increasingly the target of water-use restrictions by regulatory agencies across the United States that limit irrigation of turfgrass. To help address these concerns, water management and conservation remain key focus areas of turfgrass industry and research programs.

So what can we do in order to reduce irrigation applied to turf? In order to answer this question, it is helpful to first look at a simplified equation representing water balance of turfgrass landscapes where water inputs are equal to water outputs:

Precipitation + *Irrigation*
=
ET + Drainage + Runoff

Evapotranspiration (ET) is the combined movement of water from the soil to the atmosphere by direct evaporation of water from the soil surface (evaporation) and by the biological use of water through plants (transpiration). From this water balance equation we can see that irrigation inputs can be reduced in a couple of notable ways. First, by shifting water outputs from drainage and/or runoff to ET, the plant (ET) uses more of the precipitation inputs and requires less irrigation inputs. This can occur, for example, with turfgrass species, varieties and management practices that favor deeper rooting habits, and thus an ability to acquire water from greater depths. Alternatively, but not necessarily mutually exclusive, irrigation inputs can be reduced by reducing turfgrass ET, which reduces the overall outputs in the equation above.

FIGURE 1

Empire zoysiagrass (A) was selected for its prostrate leaf-growth habit, while experimental TAES 5343-22 from the UF Turf Breeding Program in collaboration with Texas A&M was selected for its erect leaf-growth habit (B).

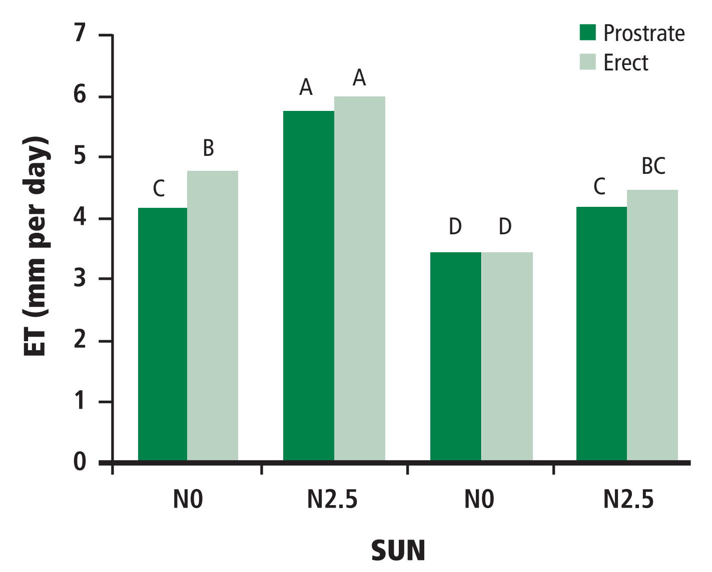
Determinants of ET are complex, but are related to both turf characteristics (White et al., 2001) and environmental conditions. Variation in ET can be as great among cultivars as it is among species (Green et al, 1991). While a number of morphological characteristics have been related to turf water use, leaf angle orientation has been related to water use in Kentucky bluegrass (Ebdon and Petrovic, 1998) and in several cool- and warm-season grasses (Kim and Beard, 1988). These studies reported that turfgrass with relatively horizontal leaf orientation (prostrate) had comparatively lower ET rates. Also, environmental conditions, especially light environment, can affect ET rates, whereby turfgrass growing in the shade uses less water (Feldhake et al., 1983). Finally, management conditions can also affect ET. One recent study showed that ET increased in warm-season turfgrass as nitrogen application rates increased (Barton et al., 2009).

Given the complex set of factors that contribute to ET rates, it's important to know how these factors interact with each other to develop integrated approaches to reduce water use in turfgrass systems. Thus, the question I wanted to answer in a recent study was how water-use rates of two zoysiagrass cultivars differing in leaf angle orientation, a key crop characteristic that affects ET, would vary across different management and environmental conditions that are also known to affect ET.

To answer this question, an outdoor pot experiment was conducted at the University of Florida during the summer of 2009. A

Continued on page 52

FIGURE 2



Daily ET rates for erect (red) and prostrate (blue) growing zoysiagrass cultivars in sun and about 50 percent shade with nitrogen treatments 0 (N0 and N2.5) grams per square meter in early July in Gainesville, Fla. Bars with the same letter do not differ significantly.

Continued from page 50

native fine sand was added to 24-inch long by 6-inch diameter PVC pots. Two coarse textured zoysiagrass cultivars were selected for erect and prostrate growth habit (Figure 1).

Empire zoysiagrass was selected for its prostrate leaf growth habit (mean leaf inclination of 17 degrees), while experimental TAES 5343-22 from the UF Turf Breeding Program in collaboration with Texas A&M was selected for its erect leaf growth habit (mean leaf inclination of 37 degrees). The field plugs were transplanted into the experimental pots in early April 2009, and were allowed to establish outside for three months before the experiment began.

Half of the pots became established under full natural sunlight, while half were under shade of about 50-percent full sunlight. Nitrogen treatments were 0 and 2.5 grams per square meter initiated three days before collection of water-use data in early July. PVC pots were weighed at sunrise and sunset of each day to measure water-use rates. After seven days of data collection, pots were harvested and turf growth and leaf area were measured. Each treatment was replicated three times.

Across the range of treatments, daily ET rates varied almost two-fold, averaging between 0.14 (3.5 millimeter) and 0.24 (6 mm) inches per day (Figure 2).

Nitrogen fertilization increased daily ET rates between 20 percent and 38 percent among all treatments. Similarly, turf growing in full sunlight also showed greater water-use rates compared to plants growing in the shade. The erect cultivar was associated with greater ET rates, but the effect of orientation differed with nitrogen fertilization and light environment. In full sun, the prostrate cultivar used less water but this effect appeared to diminish with increased N fertilization. In the shade, the prostrate cultivar used less water with increased N fertilization.

Water use was generally related with the amount of leaf area per pot and changes in leaf area per unit leaf weight. Thus, reduced water use by the prostrate cultivar was associated with reduced leaf-area density and leaf growth.

The take-home message from this study for turfgrass management is that we can achieve our goal of reduced water use through integrated approaches that include both cultivar selection and fertility management. I found that prostrate growth was associated with reduced water-use rates, but that the effects of prostrate growth on water use depended on N fertilization and light environment.

For superintendents looking to reduce water use, selection of a prostrate-growing cultivar coupled with a relatively low N fertilization has the potential to substantially reduce water use (about 30 percent in the present study). But keep in mind this also was associated with reduced turf growth.

Ongoing research will look at the effects of these factors on growth and quality as well as other factors that may influence water use.

John Erickson, Ph.D., is an assistant professor at the University of Florida.

REFERENCES

Green, R.L., S.I. Sifers, C.E. Atkins, and J.B. Beard. 1991. Evapotranspiration rates of eleven Zoysia genotypes. HortScience 26:264-266.

Ebdon, J.S. and A.M. Petrovic. 1998. Morphological and growth characteristics of low- and high-water use Kentucky bluegrass cultivars. Crop Sci. 38:143-152.

Kim, K.S. and J.B. Beard. 1988. Comparative turfgrass evapotranspiration rates and associated plant morphological characteristics. Crop Sci. 28:328-331.

Barton, L., G.G.Y. Wan, R.P. Buck, and T.D. Colmer. 2009. Nitrogen increases evapotranspiration and growth of a warm-season turfgrass. Agron. J. 101:17-24.

White, R.H., M.C. Engelke, S.J. Anderson, B.A. Ruemmele, K.B. Marcum, and G.R. Taylor, II. 2001. Zoysiagrass water relations. Crop Sci. 41:133-138.