Screening For Low Water Use In Kentucky Bluegrass

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In maintaining functional turfgrass during stressful summer periods, frequent applications of irrigation water are often needed. In a well irrigated turfgrass, as water resources become limited and competition for a finite water supply increases, the identification of selections that combine superior turfgrass quality with low consumptive water use (low evapotranspiration) becomes an overriding objective in turfgrass breeding programs.

The identification of turfgrasses with low evapotranspiration (ET) rates has been difficult because turfgrass ET is routinely assessed using weighing lysimeters which are relatively labor intensive and not well suited for mass screening. The emphasis of our research was to develop a technique to screen for Kentucky bluegrass (KBG) selections having a conservative water use pattern on the basis of plant measurements that are typically assessed by plant breeders.

Low ET rates under well watered conditions has been associated with turfgrass morphology that combine high canopy resistance components (high shoot density, horizontal leaf and shoot orientation, and high leaf densities) with low leaf area components (slow vertical leaf extension rate and a narrow leaf width). Much of this research has emphasized warm-season turfgrass and only a superficial treatment has been given to cool-season turfgrasses such as KBG.

We initiated a greenhouse study to determine the relationship between plant morphology and water use in 61 KBG cultivars with special emphasis on the relative importance of these morphological characteristics in predicting low- and high-water use types. We used a multivariate technique, discriminant analysis to predict or recognize low- or high-water-use types on the basis of several canopy resistance and leaf area measurements obtained from both unmown space plants and mowed turfgrass.

In developing cultivars for turf usage, plant breeders typically evaluate plant characteristics obtained from both space plant nurseries and dense-mowed swords. A multivariate technique was used because comparative water use is the sum total of each component which is operating simultaneously in combination, and therefore water use is a multivariate problem.

The 61 KBG cultivars were categorized based on ET rates conducted in the growth chamber across three temperature environments (77, 86 and 95˚F) as either low- or high-water use cases, with 28 cultivars categorized as low and 33 as high. Fourteen characteristics were evaluated, and all were included in the analysis. Compared to single plant morphology (space plant), turfgrass morphology was more efficient and required fewer predictors, and thus fewer measurements, in predicting the true or actual water use group.

Leaf angle from mowed turfgrass, a component of canopy resistance, was the most important predictor of water use group and predicted actual group membership in 72.1% of the cases. Correct classification was improved only slightly over leaf angle alone to 75.4% by incorporating a single leaf area component such as leaf width or leaf extension rate. A 75.4% correct classification rate was the best achieved and was as good as using all 14 variables in the analysis simultaneously. These results based on discriminant analysis indicate that identification of water conserving KBG is possible on the basis of a few simple plant measurements.

The 61 KBG cultivars evaluated in our study included 59 entries from the 1990 high-maintenance and 2 entries from the low-maintenance National Turfgrass Evaluation Program (NTEP) variety trial, sponsored by the USDA and the National Turfgrass Federation, Inc. NTEP evaluates turfgrass selections for overall turfgrass quality and other criteria conducted across a wide range of geographic environments. In this study a lower water use pattern in the 61 KBG cultivars was associated with higher shoot densities, a more horizontal leaf orientation, slower vertical leaf extension rates, and a narrower leaf width based on unmown space plant- and turfgrass-morphology. In addition, a lower water use pattern in 59 selections from the high-maintenance NTEP trial was associated with higher turf quality performance. We detected a significant negative correlation (r=-.50) between cultivar ET rate measured at 77˚F (a near optimum growth temperature for cool-season turfgrass) and the overall turf quality performance of a cultivar. In an effort to breed KBG for higher turfgrass quality performance under well irrigated and fertilized conditions, breeders have indirectly bred more conservative water use grasses. These results demonstrate an important relationship between characteristics that combine high canopy resistance with low leaf area components are also superior turf forming properties in KBG. It would appear that turfgrass breeding programs are developing KBG that combine both superior turf quality with lower consumptive water use. This will be important in reducing irrigation requirements in order to meet the challenges of a limited and finite water supply while maintaining high turfgrass quality standards.

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