INFLUENCE OF SOIL MOISTURE LEVEL ON TURFGRASS WATER USE AND GROWTH

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In this study, we subjected three warm-season grasses (Tifway bermudagrass, Meyer zoysiagrass, and common centipedegrass) to three irrigation regimes: well irrigated (WI), moderate stress (MS), and severe stress (SS). Significant accomplishments to date are:

A. Water use.

1. Evapotranspiration (ET) ranges for the three grasses under MS irrigation were: 2.5-3.1 (Tifway bermuda), 3.1-5.2 (Meyer zoysia), and 3.3-3.5 mm day^{-1} (common centipedegrass). Evapotranspiration rates for all grasses were 50-65% less than for the same cultivars reported from semi-arid or arid regions which reflects the influence of climate. Highest ET rates occurred in late summer, while late spring to mid-summer ET rates were 20% (bermuda), 40% (zoysia), and 6% (centipede) lower.

2. When comparing the WI versus MS irrigation programs (reflecting irrigation at 33% and 56% available soil water depletion), ET declined 13% to 18% for bermudagrass, while zoysiagrass had from +11% to -9% and centipedegrass +14% to -24% changes in ET. The positive increases in ET under the MS irrigation program occurred at times when increased deep rooting or root water extraction efficiency increased relative to the WI program. Thus, the higher ET under MS irrigation reflected better utilization of soil water and not an increase in applied irrigation.

B. Root Responses and Shoot Growth.

1. Tifway bermudagrass and common centipedegrass maintained good root length densities (RLD) at 0-10, 11-20, and 21-60 cm soil depths regardless of irrigation regime.

2. Meyer zoysiagrass rooting was most sensitive to increasing drought stress with RLD's declining 55% and 43% in the 0-10 and 11-20 cm zones, respectively, as stress increased from WI to SS. RLD's in the 21-60 cm zone increased slightly from WI to SS but root water extraction efficiency declined 56% indicating low viability of roots.

3. Total root length (in terms of cm/cm^2) in the 0-60 cm

zone for the WI, MS, and SS irrigation regimes, respectively, were 115, 109, 127 (bermuda), 55, 38, 36 (Meyer zoysia), and 213, 119, 139 (common centipede).

4. Soil water extraction by depth was closely related to RLD's at the same depths and these data can be used to explain the ET responses of each grass as it was subjected to drought stress.

5. Drought resistance rankings were:; Tifway bermudagrass (highest) >> common centipedegrass > Meyer zoysiagrass (least).

6. Meyer zoysiagrass exhibited initial wilt at -0.30 to -0.40 MPa soil water potential (at 15 cm), centipedegrass at -0.50 to -0.60 MPa, and bermudagrass did not exhibit wilt even at -0.70 MPa.

7. Within 1-3 days of reaching -0.40 MPa soil water potential, Meyer zoysiagrass started to show leaf firing (to dry by heat) from the leaf tip and margins down the whole leaf. Severe leaf firing and color loss occurred within 2-3 days of initial symptoms. The plant became semi-dormant and ET declined by 45-55%. Longer term shoot responses included decreased verdure and turf cover. Centipedegrass showed wilt at -0.50 MPa but leaf firing was not evident even at -0.70 MPa. Some loss of color would occur several days after wilting and verdure declined over time. Tifway bermudagrass exhibited only a slight decrease in visual quality even at -0.70 MPa soil water potential and no leaf firing, wilting or loss of verdure.

C. Irrigation Scheduling.

Based on water use savings and maintenance of adequate shoot quality/growth, the following irrigation regimes are suggested for growers using soil moisture sensors:

* Tifway bermudagrass at -0.40 MPa to -0.70 MPa at 15 cm depth or 56 - 76% soil water depletion (SWD) of the root zone.

* Meyer zoysiagrass at -0.30 MPa to -0.40 MPa at 15 cm depth or 42 - 56% SWD.

* Common centipedegrass at -0.50 to -0.60 MPa at 15 cm depth or 58 - 65% SWD.

The more frequent irrigation regime should be used in high use situations.

D. Implications to the USGA.

1. Unless zoysiagrasses other than Meyer exhibit substantial improvement in water use (at all irrigation regimes) and much better rooting when subjected to drought stress, this species may not prove to exhibit: (a) sufficiently low ET (water use), (b) drought tolerance, or (c) drought avoidance to achieve USGA water conservation goals.

2. Potential turfgrass releases from the USGA program should be evaluated in terms of ET, drought tolerance, and drought avoidance in field situations under expected drought stress conditions. The results of this project illustrate that: (a) estimation of ET from well irrigated conditions differs significantly from more stressed situations; (b) root systems may change dramatically and thus alter drought avoidance. These changes will not be evident in shallow lysemeters; and (c) some grasses may exhibit insufficient drought tolerance to use in drought stress conditions.

3. Potential releases that do seem to have deep root systems in near ideal conditions (such as zoysia does) must be evaluated not only under soil water stress but also under several soil conditions that are major causes for restricting potential rooting. Minimum conditions would be acid pH (surface or subsurface) and high bulk density (natural or from compaction). These two situations are the most prevalent soil conditions that limit maximum rooting. Unless a grass can maintain an adequate root system under soil moisture stress, acid pH, and/or high bulk densities for fine texture soils, the grass will either not exhibit necessary drought resistance and low ET or it will be limited in adaptation.