TEXAS A&M UNIVERSITY - Dr. James B. Beard,
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Plant Stress Mechanisms

1985 Grant - $91,000 (Third year of support)

From research conducted over the first three years, significant progress has been made. We have the potential to revolutionize our concepts of turfgrass water conservation.

Minimal Water Use Rates

1. The major warm and cool season turfgrass species vary substantially in water use rates. Initial data suggest that there may be as much variation among cultivars within a species as there is at the interspecies level.

2. The primary plant parameters affecting the evapotranspiration rate are a high canopy resistance and a low leaf blade area. These parameters are valid in interpreting the differentials in water use rates among eleven major warm season perennial turfgrasses. The morphological parameters can be easily assessed for use in screening thousands of clonal plantings for low water use rates in a breeding program. They are subject to modification by a number of cultural practices; thus, the turf manager can significantly affect the water use rate of a given turfgrass species.

3. Both warm and cool season turfgrass species possess significant differences in stomatal density and vary significantly in stomatal distribution over the leaf. In the case of warm season turfgrasses, there is a distinct relationship between the stomatal arrangement. A significantly higher stomatal density was found on the adaxial side of the leaf in comparison to the density found on the abaxial side, with the exception of Kentucky 31 tall fescue. There was no relationship between an increase in the evapotranspiration rate and a higher stomatal density.

4. It was found that potential evapotranspiration rate assessments across a range of warm season species can be reproduced in a water-heat stress simulation chamber. Growth inhibitors do possess a valid potential for use in reducing evapotranspiration rates of turfgrasses. The evapotranspiration rate increases as the cutting height is raised and as the nitrogen nutritional level is increased. The relative significance of an increased cutting height or nitrogen nutritional level on the evapotranspitation rate varies with the particular turfgrass species. In high nitrogen requiring turfgrasses, the evapotranspiration is most affected by changes in the nitrogen level, whereas, in low nitrogen requiring turfgrasses, evapotranspiration is affected by changes in mowing height.

5. There is genetic diversity within the bermudagrass species that contributes to a variance in potential evapotranspiration. This diversity can be measured and statistically analyzed.

Enhanced Rooting/Water Absorption

1. Initial experiments suggest that the root hair dimension of turfgrass root characterization has been overlooked and that over the past three decades, far too much emphasis has been placed on total root mass and depth. The rooting depths and total root weights of the major warm season turfgrasses vary substantially in terms of interspecies rooting potentials.

2. Spring root decline is a separate phenomenon rather than a result of other external stresses. There are two distinctly different dormancy phases for the root and shoot systems of warm season perennial grasses. The spring root decline response has occurred in all ten warm season grasses investigated, which indicates that it is common to most warm season perennial grasses used for turfgrass purposes.

3. Significant differences in rooting depth and root mass were found among the major cool season turfgrass species when grown under near optimum conditions. Certain cool season species, such as crested wheatgrass and the tall fescues, exhibited a stronger capability to sustain root growth under severe heat stress conditions.

Improved Drought Resistance

The major warm season turfgrass species vary greatly in drought avoidance and in drought resistance with comparative rankings being much different than had been previously assumed. Variations in drought avoidance and recovery is as great within most of the turfgrass species as the variation at the interspecies level.

Physiological Basis of Minimal Maintenance Turfgrasses

Genetic diversity in terms of minimal maintenance turfgrasses can be statistically evaluated.

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Breeding and Development of Zoysiagrass

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The USGA/TAES Zoysiagrass Breeding and Development Program is a diverse, multifacited approach to expand and improve existing cultivars of the *Zoysia* species. Constant observation of the plant collection reveals both the strengths and weaknesses of this turfgrass.

A taxonomic study of the *Zoysia* spp. germplasm was initiated to gain a better understanding of their breeding behavior. The genetic variability within the Oriental germplasm, collected four years ago in Southeast Asia with support from the USGA, continues to be evaluated in the field, greenhouse, and laboratory. Field notes were taken during the last year for fall color, growth rate, leaf type, spring greenup, flowering habit, percent cover, dormancy, and canopy temperature. Significant variation exists with the germplasm for all of these characters, and the probability of creating genotypes which possess favorable gene combinations are excellent. A test of the compatibility of the germplasm accessions was initiated during Spring 1985 in both the greenhouse and the field.

A commercially available Korean zoysiagrass seed stock was screened for tolerance to high soil temperatures and low soil moisture. Plants selected for superior performance during prolonged temperature and moisture stress, and those selected for their ability to recover from stress conditions differed significantly from an unselected base population. A field study using the selected and unselected populations was initiated to further examine the tolerance of this plant material to heat and moisture stress in the natural environment.