PLANT STRESS MECHANISMS

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Accomplishments to date:

A. Scientific Contributions:

1. Based on the development of a sophisticated set of physical experiments, it was proven that canopy resistance is the major factor controlling evapotranspiration rates from turfgrasses rather than stomatal resistance.

2. A high shoot density and more horizontal leaf orientation plus a low leaf area based on a slow leaf extension rate and narrow leaf width are the plant morphological factors that are most significant in controlling evapotranspiration from turfgrasses.

3. Stomatal density and size has little influence on evapotranspiration rates.

4. The first comprehensive understanding of root hair morphology and viability among the major warm-season turfgrass species has been developed. Based on this work, it is evident that a lack of root hair number, length and/or viability can contribute significantly to reduction in drought resistance.

5. The environmental factors inducing spring root decline has shown that carbohydrate partitioning away from the roots is strongly associated with the root dieback phenomenon.

6. The specific plant morphological and/or physiological characteristics most important in contributing to drought resistance of individual warm-season turfgrass species have been identified.

B. Breeding Contributions:

1. From a breeding strategy standpoint, it has been demonstrated that at the interspecies and intraspecies levels those with the deepest and most extensive root systems are characterized by a high verdure and shoot growth rate.

2. A great range in diversity has been found at the intraspecies level for the canopy resistance and leaf

area components controlling evapotranspiration. This indicates that the generic material is available to the breeder to develop low water use rate cultivars.

3. Among warm-season species, the key limiting factors affecting drought resistance have been delineated. These vary greatly among the major warm-season turfgrasses including shallow rooting, high evapotranspiration rates, slow stomatal closure, minimal wax covering of the leaf/stomatal surface under water stress, and inferior internal tissue water stress tolerance.

C. Cultural Contributions:

1. For the first time, the comparative rooting potentials of the major warm- and cool-season turfgrass species have been characterized and published. Under mowing, the rooting depths range from 12 inches to 8 feet.

2. The comparative drought resistance of the major warm-season turfgrass species and cultivars have been investigated and published.

3. The concepts with respect to high canopy resistance and low leaf area have shown specific cultural practices that can be used in lowering the evapotranspiration rate. For the most part these are based on a low leaf area and slow leaf extension rate. Included are a low cutting height, moderate to low nitrogen fertility level, judicious irrigation and the use of shoot growth inhibitors.

4. The lack of effectiveness of stomatal antitranspirants for use in reducing evapotranspiration from turfgrasses has been demonstrated.