Zoysiagrass, Salt Glands, and Salt Tolerance

Observing the density of salt glands may make selecting for salt-tolerant grasses a lot easier.

BY K. B. MARCUM, G. WESS, D. T. RAY, AND M. C. ENGELKE

Water shortages throughout the United States are resulting from rapid urbanization and drought. In the western U.S., limited water supplies have caused some municipalities to implement xeriscape programs. With 50% or more of total urban water consumption being utilized for landscape irrigation in western states, many municipalities are requiring use of recycled or other saline secondary water sources for turf landscapes.

Though there is increasing need for improved salt-tolerant turfgrass cultivars, breeding progress has been limited. Turf breeders typically need to select among hundreds or thousands of progeny to come up with an improved cultivar. Selection for salt tolerance among so many progeny is difficult, time-consuming, and expensive. Therefore, accurate and efficient salt-tolerance screening tools are needed to expedite turf cultivar development. These tools may be morphological or physiological markers that can be used to predict salt tolerance.

SALT GLANDS — A SALT-TOLERANCE MECHANISM IN TURF

Most plants, including grasses, exclude saline ions (sodium, chloride, etc.) from shoots and leaves to minimize their toxic effects. Saline ion exclusion from shoots has been associated with salt tolerance among grasses in a number of studies and is a major physiological process associated with salt tolerance.

Salt glands are found in a number of warm-season (C4) grasses, including bermudagrass, zoysiagrass, buffalograss, saltgrass (Distichlis spicata var. stricta), dropseeds (Sporobolus spp.), gramagrasses (Bouteloua spp.), and curly mesquite (Hilaria belangeri). Salt glands, which are actually miniature ion pumps, secrete salt from leaves and can be a major means of excluding saline ions in salt-tolerant grasses. In fact, in salt-tolerant grasses having active glands, secreted salt crystals can be seen on leaves of plants growing in salty soils.

Salt glands, which are modified leaf microhairs (trichomes), are microscopic two-celled structures that lie flat on the leaf surface in rows parallel to stomates. Unlike internal physiological plant markers, salt glands are externally visible and morphological. They can be easily observed on grass leaves. The goal of this research was to determine if salt gland density can be used to predict turfgrass salt tolerance, and if they can be used as an effective salt-tolerance selection tool by turfgrass breeders.

THE EXPERIMENT — SALT TOLERANCE

Fifteen zoysiagrasses (Japanese lawngrass, Zoysia japonica) were tested for salinity tolerance using a solution culture-hydroponics growing system. This system allows precise control of salinity levels and can accurately determine differences in salt tolerance among turfgrass varieties. It also allows monitoring of both root and shoot responses to salinity. To compare salt tolerance among entries, changes in shoot growth (clipping weight), root growth, and visual quality (percent green leaf area) were observed at six different salinity levels over a growth period of several months.

Throughout the experiment, grasses were clipped twice per week at one inch. As salinity increased, leaf clipping weight decreased linearly. The relative shoot growth and visual quality (percent green leaf area) at high salinity were used to indicate the relative salinity tolerance of varieties. The most salt tolerant varieties were El Toro and Palisades, and the least tolerant were Sunrise, K162, JS-23, and K157.

SALT GLANDS — A POTENTIAL TOOL FOR TURFGRASS BREEDING

Salt gland densities were determined for all entries, growing under both salt-free (control) and saline conditions. Densities were determined using a light microscope, with 120 observations taken on each zoysiagrass variety (each observation was a gland count).

It had been previously found that salt tolerance in zoysiagrasses and in general among Chloridoid warm-season grasses (bermudagrass, buffalograss, zoysiagrass, gramagrasses, Sporobolus, and saltgrass) was related to the amount of salt that the salt glands were able to secrete (the amount pumped out of the leaves).

In addition, results of this study show that salt tolerance and salt gland activity
Salt gland density on grasses grown in salt-free conditions predicted salinity tolerance as well as plants grown under saline conditions. This is the first report of a morphological (visual) trait that can be used to predict salt tolerance of grasses. Salt gland density is an innate, genetically controlled, heritable trait that does not require environmental stress conditions to express it.

Accurately screening hundreds or thousands of breeding selections for salt tolerance is difficult and expensive. Salt gland density is a much easier screening procedure that could expedite selection of salt-tolerant grasses in that the breeder need only measure salt gland density on leaves of plants growing under regular (non-salt) conditions.

**LITERATURE CITED**


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