Water Use Rate and Salinity Tolerance Study for Low Energy Input Ground Cover and Turfgrass Management

Lin Wu, M. A. Harivandi and James A. Harding

Salt concentration effects on buffalograss germplasm seed germination and seedling establishment

Increasing salinity problems in turfgrass culture demand aggressive breeding programs and development of more salt resistant turfgrass species and cultivars. There is considerable evidence that turfgrass are particularly sensitive to soil salinity during germination and early seedling growth. Buffalograss seed germination was substantially inhibited by 50 mM of NaC1. The rate of' seed germination under salt treatment was different among the nine buffalograss germplasms. No difference in plant dry weight and salt uptake was found among the germplasms treated with salt suggesting no genetic differentiation in salt resistance at the ploidy and population levels. (This result has been published in the International Turfgrass Society Research Journal.)

Salt tolerance and salt uptake in diploid and polyploid buffalograsses

Seed samples of diploid, tetraploid, and hexaploid buffalograss (*Buchloe dactyloides*) populations were collected from locations over a geographical latitudinal gradient from San Luis Potosi, Mexico (22. 19N, 101.10W), to Lincoln, Nebraska, the United States (40.49N, 96.41W). Seed samples and samples of vegetatively propagated clones were tested for salt tolerance and salt uptake. Under nutrient solution culture, young shoots separated from the established buffalograss clones were found to be more tolerant to salt than the seedlings. No significant difference in salt tolerance was found among the 9 buffalograss populations represented by the seedling dry weight. However, a significant difference was found in the percentage of seedling survivorship among the populations. Substantial genetic variation of salt tolerance was detected among the vegetatively propagated clones within buffalograss populations. Overall, the buffalograss can be considered to be a moderately salt sensitive species. Its wealth of genetic variation of salt tolerance represents a potential for rapid salt tolerance selection response.

A salt exclusion mechanism was found to be involved in the tolerance mechanism of buffalograss. A greater Na^+ concentration was found in the root tissue than in the shoot tissue, suggesting a preferential exclusion of Na^+ taken up by the shoots. The negative correlations between the plant tissue K^+ concentrations and Na^+/K^+ ratios indicate a partial substitution of K^+ by Na^+, and show less substitution of K^+ by the more salt tolerant plants than the less tolerant plants. Differential susceptibility to Ca^{2+} disorders at high Na^+/Ca^{2+} levels was detected between the salt tolerant and salt sensitive buffalograss genotypes. (A manuscript produced by this research project has been submitted to Journal of Plant Nutrition.)

Water use of buffalograss

Lysimetry has been used for measuring ET in turfgrass and is best utilized where the vegetation is homogeneous and well watered. Mini-lysimeter, as small as 6 liter in size, have been successfully used in turfgrass water-balance methods for monitoring potential ET (Vanbavel et al., 1978). Two meter by two meter turf plots of the 12 vegetatively propagated buffalograss cultivars were established in the experimental field at UC Davis during the summer 1992, and three replicate plots were used for each cultivar. A 25 cm deep, 20 cm diameter mini-lysimeter (buffalograss cultivar identical to the field plot) was placed in the center of each buffalograss plot. The buffalograss in the field plots and in lysimeters were allowed to become well established from the fall 1992 and spring 1993. The weekly ET rate measurement was started in May 1993.

Evapotranspiration was determined by repeated weighing of lysimeters under nonlimiting soil moisture conditions as described by Rogowski et al. (1977). ET rates have been measured weekly and the potential Kc values were calculated for each buffalograss line. Morphological characters which may be associated with drought tolerance such as density of stomata, and hair on leaf surface were recorded. Correlations between the water use and the morphological characteristics were examined. (The data of this study has been analyzed and it will be submitted to California Turfgrass Culture for publication.

Development of drought tolerant and low energy input buffalograss for turfgrass industry

Under the support of the Slosson Endowment Fund, one seed variety and two vegetatively propagated varieties of Buffalograss, *Buchloe dactyloides* (Nutt) Engelm. are benign released and patented. Buffalograss is a warm-season stoloniferous, sod-forming, perennial grass. It is a drought tolerant and important range grass found mainly in the central prairies of the United States with its full range of distribution extending from Canada to Mexico (U.S. Agriculture Handbook, 1959). The buffalograss is the only species of its genus. It contains diploid, tetraploid, and hexaploid races (Stebbins, 1975), of which only the latter occur in the Great Plains area. The diploid race mainly occurs in Central Mexico and southern Texas (Reeder, 1971) and it has rarely been researched for economical values. Hilite-25 and Hilite-15 buffalograss varieties developed under the support of the Slosson Fund are vegetatively propagated and the UCHL-1 is a seed variety. They are drought and heat resistant buffalograsses selected by mass selection. For the breeding purpose, seeds of diploid buffalograss germplasms were collected from three locations in Central Mexico, including San Jose, San Clayetano, and Venegas. The population sizes for the three populations used for the first selection cycle were 215 for the San Jose population, 350 for the San Clayetaon population, and 300 for the Venegas population, because a limited number of seeds was available. Plants were established from seeds and space planted in the experimental field at UC Davis. The plants were mowed weekly at 2 inches high during the growing season (from May to the end of October). Individual clones were selected for rapid vegetative growth, high turf density, and extended winter turf green color. About 80% of the plants were eliminated through the selection for the above characteristics. The remaining plants were subjected to drought stress during the following summer months by terminating the irrigation for a period of 8 weeks (from June 15 to August 15). Two male and two female plants from each of the three populations were selected for their superior performance under the drought stress. For the second selection cycle, a mass-cross was constructed by growing the selected six male and six female clones close together in the field and seeds were harvested from the female plants. Six hundred plants were propagated from the seed progeny, and were space planted in the field and were subjected to turfgrass management. Through the growing season, the plants were mowed weekly at 2 inches, irrigated every 10 days, one pond N applied in June and one pond N applied in August. Three female clones exhibited superior performance in rate of vegetative growth, high turf density, retain green color above freezing temperature, and superior drought tolerance were selected and two of the three clones were named 'Highlight 15' and 'Highlight 25'. For the seed variety, five female clones and three male clones were selected and polycrossed. A synthetic seed variety was developed from this polycross.

Existing buffalograss varieties such as Texoka, Sharps Improved, and Comanche reproduced sexually. These buffalograsses were developed for forage rather than turf purposes and are produced and distributed as seed commodity. These buffalograsses lack uniformity and density because the genetic variation exists in the seed progenies. In comparison to the existing vegetatively propagated tetraploid buffalograss 'Prairie' (2n = 4O) (Engelke and Lehman, 1991), the Highlight 15, Highlight 25 and the seed variety UCHL-1 are diploid (2n = 20) and have a short winter dormancy in the transition zone such as in California, a faster vegetative spreading rate, finer leaf blade, and thinner stolen textures.

Information for the buffalograss new cultivar release for commercial production has been distributed to the industry by the Office of Technology Transfer. In addition to the release of these new buffalograss cultivars, a DNA fingerprint method was developed for the cultivar differentiation. This method has been published in the Journal of the American Society for Horticultural Science, Vol. 119, 1994.

Lin Wu is Professor and James A. Harding is Professor, Department of Environmental Horticulture, University of California, Davis.

M. H. Harivandi is Farm Advisor, University of California, Alameda County