

In search of low-maintenance turf

Lin Wu □ M. Ali Harivandi

Several species show promise

Turfgrasses cover more than 25 million acres of land in this country, according to the Better Lawn and Turf Institute. This acreage includes over 50 million home lawns, 12,000 golf courses, countless parks, athletic fields, schools, and other areas. Most turfgrasses used in these areas were developed under conditions of intensive turf management and are poorly adapted to stress. They require large amounts of water, frequent mowing and fertilization, and intensive care to overcome disease, competition from weeds, shade stress, and traffic injury.

We estimate that low-maintenance varieties could be used on 50 percent of the 1.4 million acres of turfgrasses in California. This includes ground maintained for aesthetic purposes, for soil erosion control, or as the out-of-play areas of golf courses, parks, schools, and home lawns where plants need only to be green, withstand mowing, and have a uniform appearance.

For six years, we conducted research to evaluate environmental stress resistance among commercially available turfgrass species and to select alternatives for low-maintenance turf. This report summarizes the findings of several studies.

Turfgrass evaluation

Two conventional and ten nonconventional turfgrasses with both drought tolerance and turf potential were evaluated for performance as California turfgrasses (table 1). In field trials at the University of California Davis campus and the UC agricultural field station in Santa Clara County, plots were maintained as low-maintenance turf as follows: irrigation at approximately 50 percent evapotranspiration; fertilization with 1 to 1.5 pounds nitrogen per thousand square feet per year, weekly mowing at 1.5 to 2 inches height, and no thatch, disease, insect, or weed control.

Turf quality was evaluated monthly, seasonally, or both. "Quality" refers to the overall turf performance regarding density, color, texture, and weed, insect, and disease activity.

Among the 12 species evaluated, western and crested wheatgrasses, weeping and lemmongrasses, smooth brome, perennial ryegrass, and saltgrass performed very poorly. These grasses either failed to form a dense and uniform turf cover or rapidly declined in turf density, allowing increased weed invasion.

Torgrass at the Davis trial, tall fescue at Santa Clara, and buffalograss at both locations showed the greatest potential as low-maintenance turfgrasses. Both blue and sideoats grama performed well at Santa Clara. Sideoats grama, however, did not rate as high as buffalograss in turf performance, especially as measured by density.

Torgrass is a Mediterranean cool-season perennial species known for drought and heat resistance and tolerance of low soil fertility. It forms a dense turf during both winter and summer, exhibiting variation in rhizome production and deep rooting characteristics, good seed production, a nonshattering seedhead, no seed dormancy, and a high seed germination rate. We found no disease problems with torgrass in our trials. Our observations so far suggest that this species has potential as a commercially acceptable grass for low maintenance.

Buffalograss, a warm-season grass with drought resistance, low nutritional requirements, and short stature, is also a promising low-maintenance turfgrass. The winter dormancy characteristics of warm-season species such as buffalograss, however, is undesirable. This dormancy period lasts up to four months, although we found that buffalograss from different regions differed in winter color persistence. Buffalograss collected from Mexico exhibited a shorter dormancy than that from Texas and Colorado.

Problems with seed production seriously limit seed availability of buffalograss. This species is dioecious, monoecious, and also hermaphroditic, a characteristic that might be exploited to improve seed production.

Creeping bentgrass

Creeping bentgrass, *Agrostis palustris* Huds., is used extensively for golf and bowling greens in California. Under warm, dry summer conditions, golf greens require intensive care and frequent irrigation. These practices, particularly irrigation, encourage invasion by shallow-rooted, high-moisture-adapted annual bluegrass, *Poa annua* L. Since salinity-tolerant creeping bentgrass ecotypes have been found and a positive relationship is expected between such tolerance and osmotic stress resistance associated with drought tolerance, we were interested in selecting for drought and heat tolerance in this species.



Buffalograss collected from Mexico remained green well into December, while that collected from Texas appeared dormant.

We imposed severe drought stress on a salinity-tolerant creeping bentgrass turf in a study at Davis. Field irrigation was discontinued at the end of June 1980. Ninety percent of the turf had died by September, leaving 14 isolated patches of live turf. These were compared with 14 clones taken randomly from plants collected before drought. We measured the salt tolerance, heat tolerance, osmotic stress resistance, root/shoot ratio, leaf area, and stolon diameter of these two groups of plants to determine what characters are responsible for the survival of drought.

There was no apparent relationship between salinity/osmotic stress tolerance and drought selection. Plants surviving drought stress, however, had greater heat tolerance, a greater root/shoot ratio, smaller leaf area, and thinner stolons. These findings suggest that survival of drought in the tolerant creeping bentgrass selections resulted from a combination of both structural and physiological levels, which are characteristics commonly found in drought-adapted plants.

No simple characteristics can be used as a basis for selecting drought-adapted plants of this species. Nevertheless, this study did reveal a potential for improving adaptation to drought in creeping bentgrass. It appears to have promise as a turfgrass in areas of relatively high salinity and heat.

Red fescue

Red fescue, *Festuca rubra* L., is a fine-textured turfgrass that is not extensively grown in California but has a wide range of adaptation. It is rich in genetic variation for selection as a low-maintenance turfgrass. Ecotypes are reported growing on abandoned metal mine workings,

which often include nutrient deficiencies, unfavorable physical soil structure, excessive dryness, and exposure to metal toxicity. The metal mine ecotype might therefore be a genetic resource for improvement of this species as a turfgrass for infertile soils.

Metal-tolerant ecotypes of red fescue examined in a series of studies exhibited a slow leaf elongation rate and high tillering, both of which are important in a low-maintenance turf. Short-leaved genotypes produced less above-ground dry matter, remained healthy for a longer period at the same level of nutrient supply, and left more plant material after clipping than long-leaved genotypes. The short-leaf genotypes were also more tolerant of close mowing.

When individual plants were vegetatively propagated, distinct heat and disease resistance were found among the single-genotype turf plots. In further field testing for three years, selected metal-tolerant ecotypes of red fescue displayed turf quality superior to that of the 10 commercial cultivars evaluated.

Tall fescue

Until recently, tall fescue was generally not considered a desirable grass species for quality turf purposes. Very coarse leaves, lack of dark green color, low density, low tolerance to close mowing, and lack of stolons and/or rhizomes were the most obvious reasons. It did, however, show a high level of tolerance of diseases, drought, weed competition, and high traffic. Several new tall fescue cultivars with improved color, texture, density, and overall quality have recently entered the market (*California Agriculture*, September-October 1987). This grass is now

the front-runner of low-maintenance turfgrasses. It possesses most of the quality components of traditional turfgrasses, such as Kentucky bluegrass (*Poa pratensis* L.) and perennial ryegrass (*Lolium perenne* L.), while requiring much less care.

We examined the growth of four tall fescue cultivars under tree shade and as a lawn, recording shoot dry weight, tiller density, chlorophyll index, and visually evaluated turf quality. There were no significant differences in quality among 'Falcon', 'Rebel', and 'Houndog', but all performed significantly better than 'Alta' under tree shade. Shade caused more reduction in size than in density of plants. All four cultivars produced acceptable turf coverage under 70 percent tree shade. No shade-related disease problem was found in any of the four cultivars.

We also studied the relationship between root density distribution and turf quality degradation of drought-stressed tall fescue under field conditions. A two-year-old 'Olympic' tall fescue stand was mowed weekly to a 2.5-inch height. In September 1983 and May 1984, turf root density was measured in increments of 6 inches to a total depth of 36 inches. The highest root density (approximately 30 centimeters per cubic centimeter of soil) occurred in the first 6 inches below the soil surface. From 6 to 12 inches, root density dropped by half. Density was reduced to approximately 15 percent of the top level at a depth of 12 to 18 inches and remained constant from there down to 30 inches. Only a small number of roots were found below 30 inches.

Before drought treatment, tensiometers were installed in tall fescue plots at different soil depths. Irrigation was ter-

minated on May 15; pressure gauges of the tensiometers were checked every day. Once the pressure gauges at different depths indicated over 90 centibars or collapsed, three 4-inch-diameter areas of turf were collected and the proportion of fresh leaf area measured for an indication of turf quality degradation.

When soil moisture depletion exceeded the wilting point at 6 to 12 inches, the fresh turf leaf area was reduced by approximately 30 percent. This occurred more than 15 days after irrigation ended. The fresh leaf area was reduced to 50 percent 30 days after irrigation was terminated, when the soil moisture depletion reached 10 inches. It was further reduced by 70 percent when moisture depletion reached 24 inches. Thereafter, the leaf area remained constant until moisture depletion reached 36 inches, at which time the area dropped to 20 percent. During this moisture depletion process, the turf stand quality became increasingly lower as the leaf area decreased. Irrigation was restored after six weeks of drought stress. The 'Olympic' tall fescue recovered in three weeks.

Three conclusions may be drawn from these observations. First, after irrigation stopped, moisture was depleted from the surface down through the profile. Second, root density distribution may be positively related to the appearance of tall fescue under moisture stress. Third, tall fescue recovers from severe moisture stress if irrigation is resumed. Under field conditions, these findings would indicate that tall fescue, because of its deep root system, pattern of water use, and appearance, can withstand lengthy periods without irrigation.

Conclusions

The studies described here were undertaken to begin uncovering alternatives to high-maintenance turfgrasses for the California turf and landscape industry. The results of these projects have created new avenues of research for further investigations, some of which are currently under way at UC Davis and in the Santa Clara field station.

Lin Wu is Associate Professor, Department of Environmental Horticulture, University of California, Davis; and M. Ali Harivandi is Area Farm Advisor, Cooperative Extension, Alameda, Contra Costa, and Santa Clara counties. The authors express their appreciation for funding of these research projects from the Elvenia J. Slosson Endowment Fund for ornamental horticulture and for partial funding by the Northern California Turfgrass Council. They also thank Victor A. Gibeault and William B. Davis, UC Cooperative Extension at Riverside and Davis, respectively, for their suggestions.

TABLE 1. Grass species evaluated as low-maintenance turf

High	Low-maintenance potential	
	Medium	Low
Buffalograss, <i>Buchloe dactyloides</i> (Nutt.) Engelm.	Blue grama, <i>Bouteloua gracilis</i> (H.B.K.) Lag. ex Steud.	Weeping alkaligrass, <i>Puccinellia distans</i> (L.) Parl.
Tall fescue, <i>Festuca arundinacea</i> Schreb.	Sideoats grama, <i>B. curtipendula</i> (Michx.) Torr.	Lemmon alkaligrass, <i>P. lemmoni</i> (Vasey) Scribn.
Torgrass, <i>Brachypodium pinnatum</i> L.		Seashore saltgrass, <i>Distichlis spicata</i> (L.) Greene
		Smooth brome, <i>Bromus inermis</i> Leyss.
		Crested wheatgrass, <i>Agropyron desertorum</i> (Fisch.) Schult.
		Western wheatgrass, <i>A. smithii</i> Rydb.
		Perennial ryegrass, <i>Lolium perenne</i> L.