Turfgrass and Environmental Research Online

Using Science to Benefit Golf

in 2007 and 2008, University of Arizona faculty and students collected approximately 150 separate plants (clones) of native bunchgrasses from Arizona rangelands with histories of livestock grazing. Plants were evaluated for their potential use as turfgrasses in greenhouse trials. Top performing clones of blue grama (*Bouteloua gracilis*), slender grama (*B. repens*), hairy grama (*B. hirsuta*), sprucetop grama (*B. chondrosioides*), and wolftail (*Lycurus phleloides*) were also evaluated under field conditions for two years.

Volum 10, Number 12
June 15, 2011

PURPOSE

The purpose of *USGA Turfgrass and Environmental Research Online* is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 400 projects at a cost of $31 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of ***using science to benefit golf***.

Editor

Jeff Nus, Ph.D.
1032 Rogers Place
Lawrence, KS 66049
jnus@usga.org
(785) 832-2300
(785) 832-9265 (fax)

Research Director

Michael P. Kenna, Ph.D.
P.O. Box 2227
Stillwater, OK 74076
mkenna@usga.org
(405) 743-3900
(405) 743-3910 (fax)

Native Grass Development for Turf

D.M. Kopec, J. Gilbert, S.E. Smith, M. Pessarakli, S.P. Nolan, D. Fish, and G. Ruyle.

SUMMARY

In 2007 and 2008, University of Arizona faculty and students collected approximately 150 separate plants (clones) of native bunchgrasses from Arizona rangelands with histories of livestock grazing . Plants were evaluated for their potential use as turfgrass in greenhouse trials. Top performing clones of blue grama (*Bouteloua gracilis*), slender grama (*B. repens*), hairy grama (*B. hirsuta*), sprucetop grama (*B. chondrosioides*), and wolftail (*Lycurus phleloides*) were also evaluated under field conditions for two years. Results of these evaluations include:

- Blue grama collections produced robust size plants, but produced necrotic tillers and significant amounts of straw foliage in concentric rings from plant centers outward.
- Hairy grama, slender grama, and wolftail clones produced plants with high shoot densities during the establishment summer (2008), but could not maintain turf density under mowing in 2009 and 2010.
- Sprucetop grama produced the greatest number of acceptable plants, exhibiting minimal amounts of necrotic foliage (5% or less), at the end of the test in 2010.
- Sprucetop grama was normally distributed within its sampling population for quality indicating that standard phenotypic recurrent selection may be an appropriate breeding scheme for population improvement among selected plants.

There has been interest in the use of native grasses for turfgrasses in the Southwest. Nearly all warm- and cool-season grass species used in the U.S. as turfgrasses are originally from Europe, Eurasia, Africa, or the Far East. Grasses used in high maintenance situations that require close, frequent mowings and quick regrowth were imported by our ancestors.

D.M. KOPEC, Ph.D., Extension Turfgrass Specialist, Department of Plants Sciences; J. GILBERT, Senior Research Specialist, Department of Plants Sciences; S. E. SMITH, Ph.D., Assoc. Professor, School of Renewable and Natural Resources; M. PESSARAKLI, Ph.D., Research Associate Professor, Department of Plants Sciences; S.P. NOLAN, student, Department of Plant Sciences; D. FISH, Area Agric. Ext. Agent, Santa Cruz County; and G. RUYLE, Ph.D., Extension Specialist, School of Renewable and Natural Resources; University of Arizona, Tucson, AZ.

USGA Turfgrass and Environmental Research Online 10(12):1-5.
TGIF Record Number: 184007

Certain grasses native to North America have been utilized as amenity grasses or as groundcovers in low-maintenance sites, the most popular being blue grama (*Bouteloua gracilis*)(7). Cultivars of range grasses that have been used in turf situations have included warm-season species such as blue grama, buffalograss (*Buchloe dactyloides*), and sideoats grama (*Bouteloua curtipendula*). Seed collections of other species such as inland saltgrass (*Distichlis spicata*) and curly mesquite (*Hilaria belangeri*) are available from specialty seed companies. Cool-season grasses used as amenity grasses and for low-maintenance turfs include deschampsia (*Deschampsia* spp.) and prairrie junegrass (*Koleria* spp).

Cultivar development in native grasses has been complicated due to low seed yield, specialized or narrow ranges of adaptability, unknown cytogenetic problems, and difficulties in stand establishment (1, 3). Still, the use of native grasses has merit regarding enhancement and maintenance of native germplasm, maintenance of

Approximately 150 separate plant collection (clones) of native bunchgrasses from Arizona rangelands with histories of livestock grazing were collected for evaluation in 2007 and 2008. Shown above is sprucetop grama (*Bouteloua chondrosioides*) on the Santa Rita experimental range.

Plants were evaluated for their potential use as turfgrasses in greenhouse trials in 2007 and 2008.

native diversity used in landscapes, and potential savings in maintenance costs since amenity grasses often have reduced mowing and fertilizer requirements compared to conventional turfgrass species (7).

A collection and evaluation study was conducted to collect native grasses found on grazed rangelands at moderate elevations of southern Arizona. Once collected, individual plants (distinct genotypic clones) were initially evaluated in greenhouse trials for turf-type growth habit and for two years in the field for performance under repeated mowing.

Materials and Methods

Starting in the fall of 2007 and into the summer of 2008, individual plants were collected from rangelands with a known history of repeated grazing in southern Arizona. Collection areas ranged from low elevations of Tucson (1200-1500 meters) and in rural areas of Pima, Graham, Santa Cruz, and Cochise Counties. These locations feature native grazed stands of diverse *Bouteloua* species (4). Species collected included sprucetop grama (*B. chondroides*), blue grama (*B. gracilis*), hairy grama (*B. hirsuta*), and wolftail (*Lycurus phleloides*). These native grasses are bunchgrasses (reproduce by tillers) and are found in the southwestern range areas of Arizona and New Mexico (2). In total, there were about 150 distinct individual clones (genotypes) collected.

In the fall of 2008, individual plants (one of each clone) were grown in 1-gallon pots in a soilless mix in a greenhouse for 10 weeks, and were then measured for plant height and girth (width). Plants also received visual assignments for apparent density, and overall quality using a scale of 1-5 where 1 = unacceptable, 2 = poor, 3 = marginal, 4 = acceptable, 5 = excellent/superior. After two initial ratings, the plants were defoliated to a height of 4-6 cm. After 8 weeks of regrowth, all plants were again scored for the same variables. At that point, a mean "performance value" was calculated as the mean of the quality and density scores, both before and after the greenhouse defoliation (simulated grazing). From this performance value, the top 75% performers were selected for evaluation in the field.

Clones selected after data analysis and culling resulted in the following numbers by species for further field testing: Sprucetop grama (n = 34), blue grama (n = 5), hairy grama (n = 11),

Species	Quality (1-5)	Density (1-5)	Height/Width
Hairy Grama	2.8	3.0	4.2
Wolftail	3.1	3.4	4.0
Blue Grama	3.2	3.3	6.7
Sprucetop Grama	3.1	3.1	4.9

Table 1. Mean quality ratings (1-5, 5 = best), density ratings (1-5, 5 = most dense), and height/width ratios of hairy grama, wolftail, blue grama, and sprucetop grama in field tests in 2009 and 2010.

and wolftail (n = 64). These selected clones were vegetatively propagated into multiple ramets (producing four identical plant copies). Each plant was then grown in 10-cm diameter pots, and the four plant copies of each clone were transplanted into the field in August of 2008 in a randomized complete block field design. The field was irrigated at transplanting, and again at 10 and 30 days after transplanting, with two additional fall irrigations (September and October, 2008). In 2009 and 2010, four irrigations were made from mid-April to mid-August.

All plants were mowed three times per week during the growing months (April through November) at a height of 2.75 inches (7 cm) with a rotary mower starting August 2008. In 2009 and 2010 summers, all plants were scored for color, quality, density (1-5, 5=best), and when present, percent plot canopy straw (0-100%). Four ratings were conducted: June and August 2009, and June and September, 2010. These data represent key time events in which plant decline under mowing stress was readily evident.

Results

Greenhouse Trial

Height/width (H/W) fractions before and after defoliation were relatively consistent for individual clones in pre- and post-defoliation measurements up to a value of about 5 (Table 1). After defoliation, most clones exhibited increased height, with some variation remaining for low H/W ratio growth response for wolftail and sprucetop grama. Other species showed very little variation for H/W ratios following defoliation. Data suggested there might be considerable variation for growth habit in wolftail and sprucetop grama. These species also had relatively low H/W ratios before defoliation (data not shown).

The mean performance of individual clones in the greenhouse trials showed hairy grama had the least apparent turfgrass density values (2.8) compared to wolftail, blue grama, and sprucetop grama (3.1-3.4) (Table 1). Wolftail and blue grama tended to have the greatest density

Species	Clones	Quality (1-5)	Density (1-5)	Straw (%)
Hairy Grama	11	2.1	2.9	34.9
Wolftail	45	2.2	4.0	30.1
Blue Grama	5	2.3	3.6	35.5
Sprucetop Grama	34	3.2	3.3	8.1

Table 2. Number of clones evaluated, mean quality ratings (1-5, 5 = best), density ratings (1-5, 5 = most dense), and % straw (% of area of plant canopy9 that exhibited necrotic shoots) in field tests in 2009 and 2010.

Blue grama (left) exhibited necrotic spots in the center of the plants, whereas sprucetop grama maintained acceptable appearance with little appearance of necrotic straw (8%)(right).

scores (3.4 and 3.3, respectively), while sprucetop grama and hairy grama were slightly less dense in appearance (3.1 and 3.0) respectively (Table 1).

Field Trial

By September 2009, quality had decreased dramatically due to accumulated mowing stress and limited irrigation during the hot Tucson summer. Hairy grama and wolftail produced a sporadic open-type canopy with poor shoot density, while blue grama selections produced large concentric inner circles of necrotic shoots (6). All three of these species thus produced large amounts of necrotic straw (30-36%), which was unacceptable even as a low-maintenance amenity turf (Table 2). Sprucetop grama, however, maintained acceptable appearance with little appearance of necrotic straw (8%) (Table 2). This species did not rank as high in shoot density (3.3) as did blue grama (3.6) or wolftail (4.0), but it did have acceptable turfgrass quality at the end of the first summer (14 months after establishment) (Table 2).

By the end of year two, many of the 384 individual plants were of poor quality, as necrotic tissue prevailed with lack of new growth at the start of the 2010 season. This was most evident for blue grama, hairy grama, and wolftail. After two years of high summer temperatures, limited irrigation and rainfall, and mowing, there were still some plants that exhibited acceptable overall quality. Sprucetop grama had almost as many clones that were below the middle score (1 and 2) as above the middle score (4 and 5), and that the greatest number of plants for sprucetop grama actually had the "middle score" of 3. This suggests that variation for overall quality is a metric trait (normally distributed). In cross-pollinated species which exhibit such a distribution, breeders can increase the next generations performance when standard phenotypic recurrent selection is practiced.

Blue grama plants generally did not have good quality, as most clones had quality scores of 2 or less, while only one had a quality of 4.0 at the end of the trial. Wolftail plants were generally unadapted to mowing stress. Likewise, hairy grama plants had 75% of its plants with quality scores of 2.0, or less (unacceptable).

Regarding plant density, wolftail clones produced many individual plants with high shoot densities, but many of those shoots were highly necrotic, exhibiting large straw canopy percentages. Sprucetop grama did not have the greatest apparent density, although the distribution for this trait was near normally distributed as was turf quality across this species. The production of necrotic shoots and leaves was evidence of a lack of tolerance to mowing under Tucson summer

conditions, which generally intensified in 2010. A large number of sprucetop grama plants had 5% or less straw after two years of mowing and about 80 out of 134 plants of sprucetop grama had 10% or less straw.

Blue grama did produce large, robust plants in the spring and fall, but deteriorated severely in June-August in both years. This response is also typical of blue grama when grazed on the range (6). Wolftail plants (one clone out of 46) had above average quality at the close of the test, while otherwise, all wolftail plants performed poorly. Note that wolftail on the grazed rangelands is one of the last grass species to succumb to extended drought in that it maintains leaf turgor and full color longer than other range grasses (5). Perhaps a larger collection from diverse locations could be screened for tolerance to mowing.

This test showed that sprucetop grama clearly tolerated the summer heat and repeated mowing pressure under minimal irrigation. It also showed that quality and density of sprucetop grama was normally distributed, suggesting that phenotypic recurrent selection may be used to increase future population means for selected turf-type growth habits under mowing stress.

Acknowledgements

The authors wish to thank USGA's Turfgrass and Environmental Research Program for the financial support of this research.

Literature Cited

1. Brown, W. V., and G. E. Coe. 1951 A study sterility in *Hilaria belangeri* and *Hilaria mutica*. *Amer. J. Bot.* 38:823-830.

2. Desmond, R., and J. A. Montoya. 2006. Status and distribution of Chihuahuan desert grasslands in the United States and Mexico. Pages 27-31. *In* Xavier Basurto and Diana Hadley (eds.) Grassland Ecosystems, Endangered Species, and Sustainable Ranching in the Mexico–U.S. Borderlands. USDA Forest Service RMRS-P-40.

3. Kinney, M. S., J. T. Columbus and E.A. Friar. 2007. Dicliny in *Bouteloua* (Poaceae: Chlorideae): Implications for the evolution of dioecy. *Aliso* 23:605-614. (TGIF Record 174536)

4. Nicholson, R. A., and C. D. Bonham. 1977. Grama (Bouteloua Lag.) communities in a southeastern Arizona grassland. *Journal of Range Management* 30:427-431.

5. Ruyle, G., and D. Young. 1997. Arizona range grasses: their descriptions, forage value and grazing management. Ext Publication # 197-005. University of Arizona Tucson, AR.

6. Torell, L. A., K. C. McDaniel, and V. Koren. 2011. Estimating grass yield on blue grama range from seasonal rainfall and soil moisture measurements. *Rangeland Ecology and Management* 64:56-66.

7. Voigt, T. 2006. Turf and native grasses for naturalized roughs. 2006. *Golf Course Management* 74(9):89-92. (TGIF Record 115120)