NOTICE OF RELEASE OF

SOUTH TEXAS GERMPLASM SIDEOATS GRAMA

SELECTED CLASS OF NATURAL GERMPLASM

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ABSTRACT

South Texas Germplasm sideoats grama (*Bouteloua curtipendula* (Michx.) Torr. var. *caespitosa* Gould & Kapadia [Poaceae]) was cooperatively released in 2012 as a Texas Selected Native Plant Germplasm. This germplasm is a blend of 6 selected native populations of sideoats grama originating from the Rio Grande Plains and Edwards Plateau Ecoregions of South Texas. Components of South Texas Germplasm were selected from evaluations of 47 populations of sideoats grama native to southern Texas. Selection accessions included in the release were chosen based on proof of consistent seed fill and germination and of greater survival, plant vigor, seed production, and biomass production in comparison with other native accessions and commercially available cultivars when grown in the area of intended use. Prior to release, South Texas Germplasm was compared to sideoats grama cultivars 'Haskell', 'Premier', and 'Vaughn', in a 6-site variety trial utilizing transplanted and seeded experimental plots. South Texas Germplasm exhibited significantly higher 90-d seedling emergence at planting sites within the area of intended use of the germplasm, as well as superior performance in the outplanting experiment at 2 of 3 sites in South Texas. Field plantings at 19 locations have indicated excellent establishment ability of this germplasm in restoration seedings, with successful establishment measured in 89% of these plantings. Release of South Texas Germplasm sideoats grama provides the first ecotypic seed source of *Bouteloua curtipendula* var. *caespitosa* for use in south, central, and west Texas.

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KEY WORDS

Bouteloua, curtipendula, variety, *caespitosa,* Poaceae, restoration

NOMENCLATURE

USDA NRCS (2012a)

COLLABORATORS

South Texas Natives, Caesar Kleberg Wildlife Research Institute at Texas AM University, Kingsville, Texas; USDA Natural Resources Conservation Service E "Kika" de la Garza Plant Materials Center, Kingsville, Texas; Texas AgriLife Research–Beeville, Texas; Rio Farms Inc, Monte Alto, Texas; Rancho Blanco, Laredo, Texas; Texas AgriLife Research–Stephenville, Texas; Texas AgriLife Research–Uvalde, Texas; and USDA Natural Resources Conservation Service James E "Bud" Smith Plant Materials Center, Knox City, Texas.

Photos by Forrest S Smith

Species | *Bouteloua curtipendula* var. *caespitosa*
Common name | South Texas Germplasm
Accession number | 9109632

Representative plant of South Texas Germplasm sideoats grama.

Sideoats grama (*Bouteloua curtipendula* (Michx.) Torr. [Poaceae]) is a widespread native grass in North America. Throughout the temperate and arid regions of the US, this species is widely used in restoration and reclamation seedings. Eleven seed releases of the species have been made through the work of the USDA Natural Resources Conservation Service (NRCS) Plant Materials Program and its collaborators. These releases include 7 cultivars and 4 germplasms (USDA NRCS 2012b). In addition to these tested materials, a number of wild-harvested seed sources of sideoats grama are offered for sale by commercial seed companies.

JUSTIFICATION

No regionally adapted or locally originating (for example, ecotypic) seed source of sideoats grama has been available for restoration projects in South Texas. Two commercial varieties of sideoats grama have been historically used with some success in restoration plantings in the region: 'Haskell' and 'Premier'. Neither is considered ecotypic to the region as defined by the USDA NRCS Texas Range Planting Practice Standard Code 550 (USDA NRCS 2012c), nor by definitions of "genetically appropriate" plant materials accepted by most restoration and reclamation practitioners (Johnson and others 2010). The variety used most frequently in South Texas is the cultivar 'Haskell'. This release originates from more than 320 km (200 mi) north of the northernmost extent of the Rio Grande Plains of South Texas and is the rhizomatous, colonial form of sideoats grama var. *curtipendula* (USDA SCS 1983). This variety of sideoats grama is generally restricted in distribution to high rainfall zones along the Gulf Coast Prairies and Marshes within south Texas (Hatch and others 1999). Much more common in the central and western portions of the regions is the caespitose form of sideoats grama—'Premier', which is var. *caespitosa*. This cultivar release was derived from seed collected from a single plant in Chihuahua, Mexico, a location more than 482 km (300 mi) west of South Texas (USDA NRCS 2012d). In addition to concerns about adaptation as a function of distance of origin, 'Premier' is thought to have extremely low genetic diversity and adaptability because of the collection method; that is, it originated from only a single plant. In addition, work by Gould (1959) and Gould and Kapadia (1962) suggested that *B. curtipendula* var. *caespitosa* is highly apomictic in the southwestern portions of its range. 'Haskell' sideoats grama is also derived from a single source population; however, this cultivar does originate from within areas known to facilitate sexual reproduction of the species. Historically, another cultivar of sideoats grama, 'Uvalde', existed in the commercial seed trade. This variety did originate from the South Texas region, but no seed, and little information on the selection process or origin (except for Uvalde County, Texas [Smith and others 2004]), was available.

Our objective was to develop an ecotypic, genetically diverse restoration seed source of the appropriate botanical variety of sideoats grama for use in South Texas. Our goal was to develop a seed source derived from multiple native populations and with similar or superior performance to available cultivars in restoration applications and commercial seed production settings.

COLLECTION SITE INFORMATION

We obtained seed collections from native populations of sideoats grama from 47 locations within South Texas from 2001 to 2007. From evaluation of these 47 populations, we selected 6 (2 of the 6 were combined and treated as 1 accession in increase) for inclusion in South Texas Germplasm sideoats grama. Three collections came from private ranches in Atascosa (2) and Frio counties, and 3 were collected from rural road rights-of-way in Medina, Uvalde, and Val Verde counties. Soil series and surface textures of the collection sites were Imogene fine sandy loam, Duval loamy fine sand, Weigang sandy clay loam, Olmos gravelly loam, Ector gravelly loam, and Zorra clay loam (USDA NRCS 2012e). Collectors were instructed to obtain seed from as many plants as possible at each collection site

to maximize genetic diversity within each collection. Plant populations that make up South Texas Germplasm originate from the Rio Grande Plains and Edwards Plateau Ecoregions of Texas (Gould and others 1960).

DESCRIPTION

South Texas Germplasm is the non-rhizomatous, caespitose (bunchgrass) form of sideoats grama. Mature height of South Texas Germplasm is 80 to 90 cm (31–35 in). General characteristics of this release are similar to those of *Bouteloua curtipendula* var. *caespitosa* (Barkworth and others 2007). Morphologically, the populations that make up South Texas Germplasm exhibit considerable diversity, especially for leaf and mature spikelet color, and to a lesser degree culm width, leaf width and length, and plant height. All selected accessions flower and mature at similar intervals, typically 4 times per year when grown under irrigation in South Texas. South Texas Germplasm contains 363,800 seeds/kg (165,000 seeds/bulk lb), with a highly variable percent pure live seed (PLS) ranging from 30 to 60%. The recommended pure stand seeding rate is 5.6 to 11.2 kg/ha PLS (5–10 lb/ac PLS). Seed yields in commercial seed fields range from 112 to 448 bulk kg/ha/harvest (100–400 lb/ac/harvest), depending on production location, growing conditions, and year.

METHOD OF SELECTION

Initial Evaluation

For initial evaluation we grew transplants of each collection in the greenhouse. A number of the collections had poor seed viability, resulting in few plants for evaluation. Whenever possible, we established initial evaluation plots at 3 locations within the area of intended use of a South Texas sideoats grama seed source. These plots were established from 2002 to 2004; all were in Texas. Evaluation plantings consisted of paired row plantings of 50 outplants per accession at the USDA NRCS E "Kika" de la Garza Plant Materials Center (PMC) (near Kingsville), and 2 replicates of 10 outplants of each accession at Rancho Blanco (near Laredo) (Figure 1) and Rio Farms (near Monte Alto). Supplemental irrigation was provided in the initial year after outplanting, but no irrigation was provided in subsequent years. Plots were evaluated monthly during the initial year after outplanting, and bimonthly thereafter for a minimum of 3 y. Seed was collected from each accession throughout the evaluation period and tested for active seed germination (Figure 2).

Two cultivar seed releases, 'Haskell' and 'Premier', were included as standards for comparison, as was a selection from Pogue Agri Partners (a commercial seed company in Kenedy, Texas) that originated from northern Mexico near the southern extent of the South Texas region. At each field evaluation site,

Figure 1. Evaluation block (c) of collections of sideoats grama at Rancho Blanco near Laredo, Texas, during summer 2006.

each replicate of each accession was scored using a ranking system of 1 to 9 (1 representing superior performance, 9 representing poor performance) for a number of traits; however, only survival, plant vigor, seed production, and biomass production scores differed greatly among accessions. The greatest divergence in rankings occurred by the third evaluation year. In general, vigor and biomass production scores of the superior local (South Texas origin) collections excelled compared to the cultivars 'Haskell' and 'Premier'. From these field evaluations and germination trials at 3 sites, we chose 11 accessions for advanced evaluation of seed production traits and to increase seed for further use.

Advanced Evaluation

In autumn 2005, we planted half of each remaining original seed collection of the selected accessions in greenhouse flats to produce plants for advanced evaluation. We chose to combine accessions 9088961 and 9088942, and 9089167 and 9089178, respectively, because each pair of collections were extremely similar and originated from near one another on similar soils within the same land management units. Thus, we had 9 lines for increase and advanced evaluation. Accessions 9088518 and 9088948 were planted at the Texas AgriLife Research Station Beeville (TARSB) in isolated increase plots, as very few plants for increase were produced because the original collection size was limited. The other 7 selected populations were planted on similar soils at Rio Farms, near Monte Alto, but geographically isolated from one another to prevent cross-pollination. Initial population increase plot sizes in 2006 ranged from 2500 plants to less than 50 plants. From 2006 to 2011, each accession was increased until plots of about 4000 plants per accession were established. Accession 9093236 was added in 2008 following

Figure 2. Seed production field of one component of South Texas Germplasm sideoats grama.

completion of data collection in the initial evaluation. Accession 9088518 performed poorly at TARSB, producing seed with little to no viability, and was culled from consideration. Conversely, accession 9088948 had excellent seed production and viability at TARSB and was eventually established at Rio Farms.

Once established at Rio Farms, all plantings were similarly irrigated, fertilized, and intensively managed to evaluate seed production potential of each selection.

2006 Rio Farms Seed Yields

Plots of 5 of the accessions grown at Rio Farms were harvested at 4 similar dates with a Flail-Vac seed harvester in 2006. The annual mean production of these accessions was 96 kg/ha (86 lb/ac) after cleaning. The Flail-Vac harvest method compares poorly to combine harvesting of sideoats grama. With the Flail-Vac harvester only fully mature seed is obtained, as opposed to the "green" seed that can be obtained in combine harvest and that after-ripen. Furthermore, an excellent September seed crop was missed because rainfall prohibited field entry. We conservatively estimate yields from combine harvests would have exceeded 224 kg/ha/y (200 lb/ac/y). In support of this estimate, accession 9088634, which was grown in a small plot in the same production year at Rio Farms and was hand-harvested at the same intervals, yielded 415 kg/ha (371 lb/ac).

Seed Quality at Rio Farms

Samples from seed increase harvests from 2007 to 2011 at Rio Farms were sent to commercial seed laboratories for seed quality analyses. Results of these tests indicated seed quality of the selected accessions to be extremely variable. Production conditions were not consistent in the evaluation period (for example, drought and rainy years) and likely explain much of the variation observed. Across production years and harvests, mean PLS was 25% for the selected accessions.

Texas AgriLife Research Center Uvalde 2006 Seed Yield Trial

In spring 2006, we planted replicated plots of 5 of the selected accessions and 2 cultivars to assess seed production in the northwestern portion of South Texas. Each replicate consisted of 10 outplants, and plots were fully irrigated throughout the production year. A single seed harvest was made in September 2006 by hand-harvesting all ripe seed, and bulk seed yields were calculated on a per area basis for each accession or cultivar. Harvested seed was also tested for germination. Seed yields and percent active seed germination of the South Texas accessions were superior to the cultivars 'Haskell' or 'Niner' in this trial. Seed yields measured for 'Haskell' and 'Niner' were consistent with those reported (256 lb/acre and 132 lb/ac, respectively) for these varieties in the release publications for each (USDA SCS 1983; USDA SCS 1984). Net yields of germinating seed produced per acre showed large differences in seed production of the local populations and the 2 standards in this trial.

Advanced Evaluation Germination Trial

Also in spring 2006, we planted replicated outplant plots of the selected South Texas accessions at the Noble Foundation near Ardmore, Oklahoma; Texas AgriLife Research Center

Uvalde (TARCU); and Rio Farms in the Lower Rio Grande Valley of Texas. Our goal in this trial was to determine if seed production along a north to south gradient influenced seed germination percentage of resulting seed. All plantings were fully irrigated and intensively managed. The final seed crop of the production year from each accession at each location was collected and tested for active seed germination. At TARCU, the cultivars 'Niner' and 'Haskell' were also harvested and tested for comparison.

For most accessions, germination was highest in seed produced at Ardmore followed by seed produced at Uvalde and Rio Farms. Accession 9090402 was an exception, having the highest observed germination of seed produced at Uvalde. At Uvalde, the selected accessions exhibited higher germination than the cultivars 'Niner' and 'Haskell'. In general, this experiment indicated that seed germination of the selected accessions is enhanced when grown north of the area of natural origin. Long-term survival (greater than 2 y) of the South Texas selections, however, was zero in the Ardmore plots, whereas survival was near 100% in the Uvalde and Rio Farms plots.

Selection

Based on the advanced evaluation data, we selected 6 accessions (2 of 6 were combined as one accession) for inclusion in a blend of sideoats grama for use in South Texas (Figure 3). Selection was based in part on yield data, seed quality data, and observations in the seed increase fields, as well as initial evaluation observations and origin of the accessions.

Variety Trials

From 2010 to 2011, as part of a statewide research effort funded by the Texas Department of Transportation, we planted South Texas Germplasm sideoats grama, and the cultivar releases 'Haskell', 'Premier', and 'Vaughn' at 6 locations throughout Texas to evaluate and compare early growth and establishment characteristics. At each location, 3 replications of 10 outplants of each accession were established in fully irrigated rows, and at 5 of 6 locations, 3 broadcast-seeded and cultipacked plots (9.3 m^2 each [100 ft^2]) of each variety were planted. Data on plant performance at each location were collected, including plant height, cover, and biomass measurements in the outplant experiment, and seedling density at 30, 60, and 90 d after rainfall > 2.5 cm (1 in) in the seeded plots. Seed was collected from each variety when ripe in the outplant experiment, tested for seed germination, and sent to commercial labs for tetrazolium tests. While 2011 was an exceptional drought year throughout the evaluation area, the irrigated plots provided data on comparative plant morphology and percent germination of seed of the entries produced in a common setting. The seeded experiment yielded comparative emergence values under extremely adverse conditions. At one of the 6 evaluation locations (Imperial, Texas), none of the sideoats grama varieties planted survived in the outplant experiment, nor emerged in the seeded experiment. This site is characterized by high soil salinity and alkalinity, and sideoats grama appears to be poorly adapted to this type of site. Overall, South Texas Germplasm was the superior variety at the Uvalde and

Figure 3. Evaluation plot replicate of 1 of 6 selections of sideoats grama that make up South Texas Germplasm.

Kingsville evaluation sites. The most convincing data at the Kingsville and Uvalde sites related to seedling emergence at 90 d after seeding. South Texas Germplasm exhibited 300% higher seedling density at these evaluation sites in comparison to the available cultivar seed sources (Figure 4).

Seeding Trials

South Texas Germplasm sideoats grama has been direct seeded on more than 30 dry-land planting sites in the Rio Grande Plains, South Texas Sand Sheet, and Gulf Prairies Coast and Marshes Ecoregions of Texas. Nineteen of these sites have been sampled beyond 1 y after planting for emergence and persistence. South Texas Germplasm emerged and produced surviving plants in 89% of plantings that have been monitored. Soil textures of successful plantings include fine sandy loam, clay loam, clay, silt loam, and sandy clay loam.

Based on observations at these plantings, South Texas Germplasm successfully establishes and persists across a large variety of soils in South Texas. The germplasm is poorly adapted to saline and alkaline soils, and coarse sand or loamy sand surface textures. Limited trial plantings in the Edwards Plateau, Cross Timbers and Prairies, and Rolling Plains Ecosystems of Texas have also shown good establishment and longevity but have not been sufficiently replicated to make definitive recommendations for use of this selection in these areas. Furthermore, an existing variety of sideoats grama, 'Haskell', is known to have acceptable performance in these regions and is recommended for use there.

Seed Production, Harvest, and Cleaning

South Texas Germplasm sideoats grama is extremely drought hardy and will produce seed with modest irrigation after establishment. Frequent close cultivation stimulates seed production, and dormant season prescribed fire results in greater seed head density in the year following fire in comparison to unburned or mowed plots. Frequent pests in seed fields include thrips (*Thripidae* spp. Karney [Thysanoptera: Thripidae]) and rice stink bugs (*Oebalus pugnax* Fabricius [Hemiptera: Pentatomidae]). Control of either pest is difficult and requires repeated insecticide applications for control.

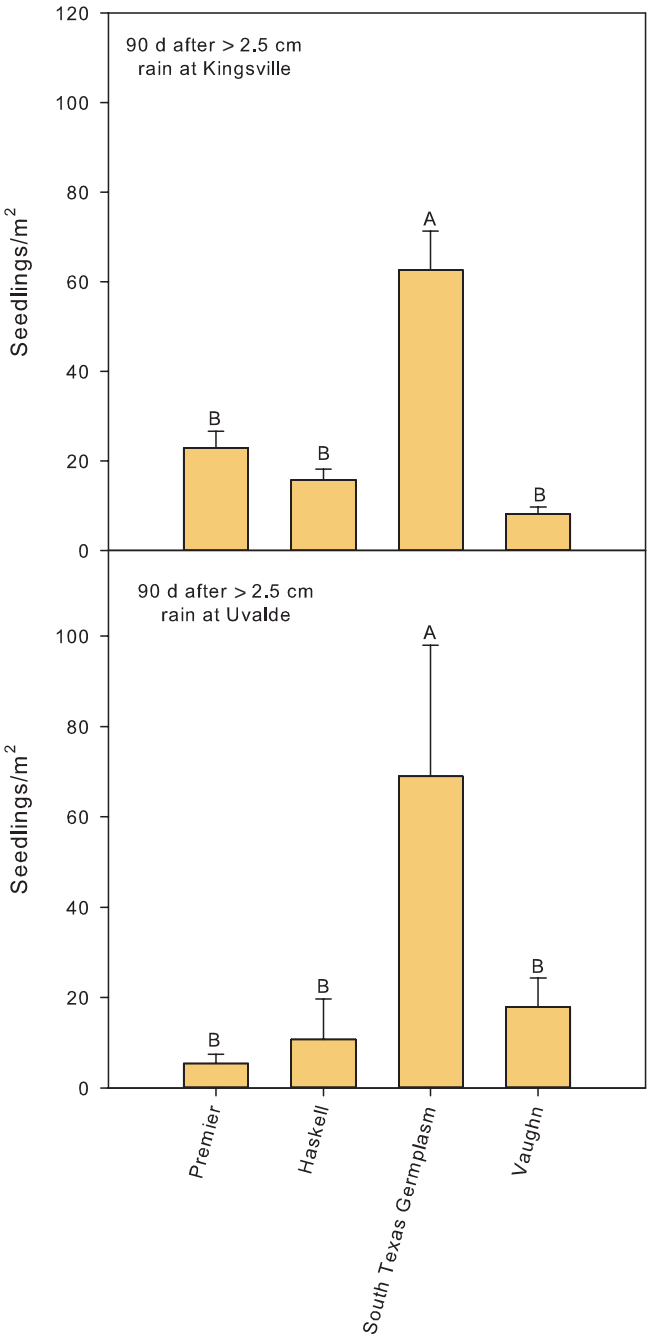

Figure 4. Seedling emergence of 4 sideoats grama varieties at Kingsville (*top*) and Uvalde (*bottom*), Texas. Statistical differences ($\alpha = 0.05$) between varieties are noted with different letters.

ECOLOGICAL CONSIDERATIONS

An Environmental Evaluation of Plant Materials Releases was completed using guidelines established by NRCS and the best available information for this species. Results of this evaluation determined South Texas Germplasm sideoats grama was suitable for release based on the criteria contained in this document. This conclusion was reached primarily because sideoats grama is a naturally occurring species in Texas, and planting it would not constitute an introduction of an exotic species into local ecosystems. Any negative impacts on other native plant species would likely be minimal to nonexistent. Also, release of this species will make available an additional native species for restoration and reclamation plantings and provide a native seed source beneficial for restoration of native habitats in South Texas.

ANTICIPATED CONSERVATION USE

South Texas Germplasm sideoats grama will provide a seed source of a native plant species for upland wildlife, highway rights-of-way, energy reclamation, and range plantings in South Texas.

AREA OF ADAPTATION

Based on our trial plantings and evaluations, South Texas Germplasm is recommended for use in the Rio Grande Plains (MLRA 83), Gulf Coast Prairies and Marshes (MLRA 150), and Coastal Sand Plains Ecoregions of Texas. Good performance is possible in adjacent areas of northern Mexico, the southern Edwards Plateau, and eastern Trans-Pecos Ecoregions of Texas; however, this use has not been extensively tested.

AVAILABILITY OF PLANT MATERIALS

G0 and G1 seed of South Texas Germplasm will be maintained by South Texas Natives. Certified commercial seed production has been licensed to Douglass W King Seed Company, San Antonio, Texas. Limited quantities of seed for research or evaluation purposes can be obtained by request from South Texas Natives (stn@tamuk.edu).

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