146 Seed increase field of Accession 9109995 silver bluestem in Alpine, Texas.

NOTICE OF RELEASE OF

SANTIAGO GERMPLASM SILVER BLUESTEM: A SELECTED CLASS OF NATURAL GERMPLASM

Colin Shackelford, Jameson S Crumpler, Forrest S Smith, Keith A Pawelek, John Reilley, Shelly D Maher, and Brandon Carr

ABSTRACT

Santiago Germplasm silver bluestem (*Bothriochloa laguroides* (DC.) Herter ssp. *torreyana* (Steud.) Allred & Gould [Poaceae]) was cooperatively released in 2017 as a Texas Selected Native Plant Germplasm. This germplasm is a blend of 3 native populations of *B. laguroides* selected through evaluation of 31 populations of silver bluestem and 21 populations of cane bluestem (*Bothriochloa barbinodis* (Lag.) Herter) originating from 2 ecoregions in West Texas: Southern Desertic Basins, Plains and Mountains and Western Edwards Plateau. To meet management needs within the area of intended use (West Texas), the accessions included in the release were selected based on proof of acceptable seed fill and germination, and on observations of greater survival, plant vigor, seed production, and biomass production in comparison with other native accessions, other silver bluestem germplasm releases, and a commercially available selection. Ocular estimated variables for selected accessions were 43 to 66% higher than non-selected accessions when averaged across 2 sites and 2 y. Plant height for selected accessions was 14% taller and canopy cover was 7% higher than non-selected accessions. Seed germination was 48% greater for the selected accessions. Release of Santiago Germplasm silver bluestem will provide an ecotypic seed source of a widespread native grass for use in West Texas. It provides the first ecotypic seed source of *B. laguroides* for use in the Western Edwards Plateau; the Southern Desertic Basins, Plains and Mountains; the Southern High Plains; and the Central Rolling Red Prairies ecoregions of Texas.

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KEY WORDS

Bothriochloa laguroides, West Texas, silver bluestem, restoration, Poaceae

NOMENCLATURE

Plants: USDA NRCS (2020)
Major Land Resource Areas (MLRA): USDA NRCS (2006)

Photos by Colin Shackelford

Species: *Bothriochloa laguroides* (DC.) Herter ssp. *torreyana* (Steud.) Allred & Gould (Poaceae)
Common name: Santiago Germplasm silver bluestem
Accession number: 9112293
Collaborators: Texas Native Seeds Program, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; Borderlands Research Institute, Sul Ross State University, Alpine, Texas; USDA NRCS E "Kika" de la Garza Plant Materials Center, Kingsville, Texas; USDA NRCS James E "Bud" Smith Plant Materials Center, Knox City, Texas

Silver bluestem (*Bothriochloa laguroides* (DC.) Herter ssp. *torreyana* (Steud.) Allred & Gould [Poaceae]) is a common, native warm-season grass found across the southern half of the US. Distribution extends primarily north to Nebraska, east to Georgia, west to Arizona, and south across northeastern Mexico (Powell 1994). Silver bluestem occurs in every county in the Trans Pecos of Texas (Powell 1994) and is one of the most widely distributed grasses in Texas, occurring in nearly every county (Turner and others 2003).

JUSTIFICATION

Throughout many temperate and semi-arid regions of Texas, silver bluestem has the potential for widespread use in restoration and reclamation seedings. Two releases of the similar species *Bothriochloa barbinodis* (Lag.) Herter (cane bluestem) have been developed for regions west of Texas: Saltillo Origin Germplasm cane bluestem developed in 2001 by the USDA Natural Resources Conservation Service (NRCS) Tucson Plant Materials Center (PMC); and Grant Germplasm cane bluestem developed in 2001 by the NRCS Los Lunas PMC in New Mexico. However, no regionally adapted or ecotypic seed source of silver bluestem has been developed for use in Texas. As a result, the West Texas Native Seeds Project (WTN) of the Texas Native Seeds Program (TNS), a collaborative effort of the Caesar Kleberg Wildlife Research Institute at Texas A&M Kingsville, the Borderlands Research Institute at Sul Ross State University, the USDA NRCS E "Kika" de la Garza PMC, and the USDA NRCS James E "Bud" Smith PMC, began work to collect, evaluate, and develop a seed release of a blend of local populations for use in West Texas. We based our approach on the theoretical and scientific basis that a locally adapted and regionally sourced seed selection would closely mirror the natural makeup of silver bluestem populations in the region and would have superior practical and ecological performance.

COLLECTION SITE INFORMATION

We obtained seed collections from native populations of silver bluestem and cane bluestem at 52 field locations in West Texas from 2011–2012 (Table 1), and after evaluation, we selected 3 populations for Santiago Germplasm silver bluestem. These 3 collections originated on road rights-of-way in Kinney, Reeves, and Brewster Counties (Figure 1). The selected accessions include Accession 9109995 collected from a Uvalde silty clay loam soil in Kinney County, Accession 9111584 collected from a Reakor loam soil in Reeves County, and Accession 9111617 collected from a Martillo-Butcherknife clay loam soil in Brewster County (USDA NRCS 2019).

DESCRIPTION

Santiago Germplasm silver bluestem is similar in general morphology to wild populations. Silver bluestem is a native, cespitose, perennial bunchgrass. Culms are erect from a geniculate base and can grow to 1.5 m (5 ft) tall and branch above the base at maturity. Leaves are basal and cauline. Sheaths are terete and glaucose with ciliate membrane ligules up to 3.5 mm (0.15 in) long. Culm nodes are glabrous or short pubescent. Leaf blades are flat or folded and can grow to 25 cm (10 in) in length and to 18 mm (0.7 in) in width. Panicles can be up to 20 cm (8 in) long, are silvery-white in color, and are contracted and oblong with a central axis to 15 cm (6 in) in length. Panicle rames number 12 or more, are less than 7 cm (3 in) long, with some rebranching. Sessile spikelets are less than 4.4 mm (0.2 in) long. The length of first glumes is 2.5 to 4.5 mm (0.1–0.2 in), and it does not have a glandular pit; the length of second glumes is similar. Upper floret lemmas are geniculate and twisted below with awns up to 15 mm (0.6 in) long. Pedicellate spikelets are up to 3 mm (0.1 in) long, shorter than sessile spikelets, and awnless. Caryopses are 1.6 to 2.5 mm (0.06–0.1 in) long, lanceolate, and amber in color.

TABLE 1

Bothriochloa *species collections from Texas evaluated in the development of Santiago Germplasm.*

Accession	Genus *Bothriochloa*, species	County	Location	Soil texture
9089003	*laguroides*	Uvalde	Highway 90 just east of Kinney county line	Loam
9090632	*laguroides*	Val Verde	Highway 163 north of Comstock	Loam
9109978	*laguroides*	Terrell	Longfellow Ranch HQ	Gravelly loam
9109980	*laguroides*	Val Verde	Highway 90 at Langtry	Channery loam
9109983	*barbinodis*	Terrell	Highway 349 south of Sheffield	Gravelly loam
9109986	*barbinodis*	Val Verde	Highway 90 west of Del Rio	Silty clay
9109989	*barbinodis*	Uvalde	Highway 55 south of campground	Silty clay loam
9109990	*barbinodis*	Pecos	Highway 349 south of Sheffield	Gravelly loam
9109991	*laguroides*	Brewster	Highway 67 near Hovey	Loam
9109992	*laguroides*	Pecos	I-10 west of Sheffield	Gravelly loam
9109993	*barbinodis*	Terrell	Longfellow Ranch NE Reiniger Pasture	Silty clay loam
9109994	*barbinodis*	Uvalde	Highway 55 and 334 at Laguna	Silty clay loam
9109995	*laguroides*	Kinney	Highway 334	Silty clay loam
9110001	*barbinodis*	Pecos	Highway 285 north of Sanderson	Gravelly loam
9110006	*barbinodis*	Terrell	TNC Independence Creek, North Canyon	Gravelly loam
9110008	*laguroides*	Terrell	TNC Independence Creek, North Canyon	Gravelly loam
9110014	*laguroides*	Pecos	Longfellow Ranch Reina Pasture	Gravelly loam
9110016	*laguroides*	Brewster	Highway 90 b/t Alpine and Marathon	Silt loam
9110045	*barbinodis*	Jeff Davis	TNC Davis Mountains Preserve	Very gravelly sandy loam
9110050	*barbinodis*	Brewster	FM 1703 west of Alpine	Very gravelly loam
9110051	*laguroides*	Terrell	Hwy 90 between Sanderson and Dryden	Gravelly loam
9110052	*laguroides*	Uvalde	Hwy 127 and 83, Concan	Clay
9110053	*laguroides*	Brewster	Hwy 90 west of Sanderson	Loam
9111577	*barbinodis*	Jeff Davis	Hwy 17 between Ft Davis and Marfa	Loam
9111584	*laguroides*	Reeves	I-10 east of Balmorhea, east of Hwy 2448	Loam
9111586	*laguroides*	Pecos	Hwy 1776 and Hwy 1450	Gravelly loam
9111590	*laguroides*	Jeff Davis	Hwy 90 east of Valentine	Clay loam
9111595	*barbinodis*	Presidio	Mimms Ranch, Marfa	Clay loam
9111597	*laguroides*	Presidio	Mimms Ranch, Marfa	Loam
9111602	*laguroides*	Brewster	Hwy 118 north of Alpine	Loam
9111605	*barbinodis*	Brewster	Hwy 118 south of Alpine	Clay loam
9111608	*barbinodis*	Jeff Davis	Caldwell Ranch	Gravelly loam
9111611	*barbinodis*	Jeff Davis	Caldwell Ranch	Very cobbly silt loam
9111615	*laguroides*	Uvalde	Hwy 1050 west of Utopia	Clay loam
9111617	*laguroides*	Brewster	Hwy 118 south of Alpine	Clay loam
9111619	*barbinodis*	Brewster	Hwy 118 north of Study Butte	Very gravelly sandy loam
9111621	*laguroides*	Brewster	Hwy 118 north of Study Butte	Very gravelly sandy loam
9111622	*barbinodis*	Brewster	Hwy 118 south of Alpine	Gravelly loam
9111626	*laguroides*	Presidio	Hwy 169 south of Marfa	Silt clay loam
9111640	*laguroides*	Dawson	Hwy 180 west of Lamesa	Fine sandy loam
9111641	*laguroides*	Gaines	Hwy 180 west of Lamesa	Loamy fine sand
9111652	*barbinodis*	Brewster	Mount Ord Ranch, Hwy 118 south of Alpine	Extremely gravelly loam
9111671	*laguroides*	Ector	K-Bar Ranch, south of Odessa	Very gravelly sandy loam
9111674	*laguroides*	Crane	K-Bar Ranch, south of Odessa	Loam
9111677	*laguroides*	Upton	Hwy 1492, south of Midland	Very gravelly sandy loam
9111681	*laguroides*	Martin	I-20 west of Big Spring	Loam
9111682	*laguroides*	Ward	Hwy 1776 north of the Pecos River	Very gravelly loam
9111700	*laguroides*	Culberson	County Rd 114, E-SE of Delaware Mtns	Loam
9111926	*barbinodis*	Coke	Butterfield Ranch, 8 mi S of Robert Lee	Clay loam
9111927	*laguroides*	Coke	FM 208 south of Robert Lee	Clay loam
9111928	*barbinodis*	Uvalde	Highway 55 north of Uvalde	Silt loam
9111929	*barbinodis*	Upton	Highway 349 south of Highway 67	Loam

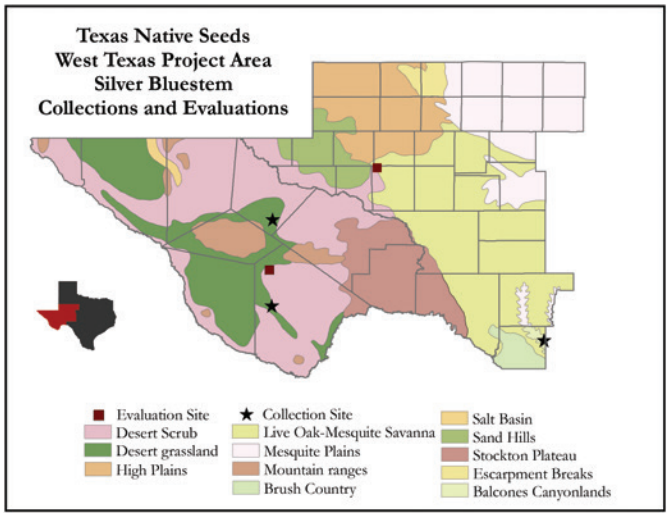

Figure 1. Collection and evaluation sites used in development of Santiago Germplasm silver bluestem (*Bothriochloa laguroides* (DC.) Herter ssp. *torreyana* (Steud.) Allred & Gould [Poaceae]).

Representative plants of Santiago Germplasm silver bluestem.

Plants produce seed mostly from May through November (Stubbendieck and others 2017). Silver bluestem has an average of 228,606 seeds/kg (503,991 seeds/lb). Percent pure live seed (PLS) of selected accessions included in Santiago Germplasm ranged from 24 to 40% between accessions. The recommended pure stand seeding rate is 1 to 2 lb pure live seed per acre. Seed yields in commercial production fields have averaged 69.5 kg per ha (62 bulk lb/ac) per year. Producers can expect 3 to 5 harvests per year depending on production location, growing conditions, and year.

Cleaned seed of Santiago Germplasm silver bluestem (size reference = a US dime).

Chromosome number reported for silver bluestem is 2n = 60. Ploidy analysis by the National Forest Genetic Electrophoresis Laboratory of each accession making up Santiago Germplasm confirmed *Bothriochloa* ploidy level first described by Gould (1975).

Silver bluestem is most common in moderately drained soils of prairies, pastures, woodlands, river bottoms, waste ground, and roadsides. It is a hardy perennial and is easily reestablished after droughts and overgrazing (Powell 1994). Forage value is good to fair for all classes of livestock and fair for big game (Powell 1994; Shaw 2012; Stubbendieck and others 2017). Silver bluestem naturally occurs in every county in the Trans Pecos of Texas (Powell 1994), and it is one of the most widely distributed grasses in Texas, occurring in nearly every county (Turner and others 2003)

METHOD OF SELECTION

As part of an effort to collect, evaluate, and release germplasms of a variety of native plants for West Texas, personnel from the West Texas Native Seeds Project of the Texas Native Seeds Program obtained seed collections of silver bluestem and cane bluestem from 52 field locations in West Texas from 2011–2012. These *Bothriochloa* species were selected for evaluation for use in revegetation plantings on rangelands and highway rights-of-way, and for use in upland wildlife habitat restoration plantings. A combined evaluation of both species was chosen because they have considerable overlap in distribution in West Texas and can often be found growing in mixed stands (Powell 1994).

Initial Evaluation

In March 2014, 52 accessions of silver bluestem and cane bluestem were seeded in greenhouse flats to produce plants for evaluation. Of 52 accessions, 50 germinated, and in May 2014 plants from these 50 accessions were installed in a randomized, complete block design, common-garden study with 2 replications made up of 10 plants of each accession at the Sierra la Rana evaluation site in Alpine, Texas (see Figure 1). During the first month of establishment, plants were irrigated as needed over a 1-mo period until established. They were then evaluated monthly throughout the growing season in 2014 under natural precipitation conditions. Data were collected on traits important for commercial seed production and ecological function. We estimated quality (1 to 10; best to worst) for plant vigor, foliage density, uniformity of the accession as a whole, forage (biomass) production, and seed production. We directly measured survival (expressed as a percentage of number of plants present/number of plants initially planted), plant height, and plant canopy cover. Mean performance in each category by year was used for selection of superior accessions. Seed was collected from each accession when ripe throughout the growing season. Three samples of 100 seeds each from the composited seed of each accession were tested for germination annually.

Advanced Evaluation

Following the initial evaluation during the summer of 2014, the 10 best-performing accessions (these showed greater than mean performance in the largest number of evaluation categories; Table 2) were selected for advanced evaluation plantings at the Sierra la Rana plant evaluation site in Alpine and the Railway Ranch plant evaluation site south of Odessa, Texas (see Figure 1).

In addition to the 10 highest-performing accessions, releases of Grant Germplasm cane bluestem developed by the Los Lunas PMC, Starr Germplasm longspike silver bluestem under development by the E "Kika" de la Garza PMC, and a commercially available selection of silver bluestem produced by Turner Seed Company in Breckenridge, Texas, were included in the evaluation. Transplants were grown from the original seed collections, breeder seed obtained from the PMC's for their releases, and commercial seed from the Turner Seed Company.

At the Alpine site, each accession, release, and commercial selection was planted in paired 10-plant replications. The intent of this design was to better evaluate uniformity of development, seed yields, seed quality, and seed harvestability. At the Odessa site, a randomized, complete block design of 2, 10-plant replications of each accession and existing releases was planted. Accession 9090632 had poor greenhouse emergence; the limited plants available were evaluated only at Odessa because that site is more representative of where the accession originated.

TABLE 2

Accessions selected for advanced evaluation and rationale for selection.

Accession	Selection criteria	Rank
9090632	• Vigor • Uniformity	• 9th • 6th
9109994	• Vigor • Foliage density • Seed production • Forage production	• 8th • 7th • 4th (tie) • 6th (tie)
9109995*	• Vigor • Foliage density • Uniformity • Seed production • Forage production	• 5th • 5th • 7th • 4th (tie) • 4th (tie)
9110014	• Vigor • Foliage density • Uniformity • Seed production • Forage production	• 2nd • 2nd • 3rd (tie) • 2nd • 3rd
9110045	• Vigor • Uniformity • Seed production • Forage production	• 10th (tie) • 3rd (tie) • 10th (tie) • 9th (tie)
9110050	• Uniformity • Active germination	• 2nd (tie) • 6th (tie)
9111584*	• Vigor • Foliage density • Uniformity • Seed production • Forage production • Active germination	• 6th (tie) • 7th (tie) • 3rd (tie) • 5th • 6th • 1st
9111617*	• Vigor • Foliage density • Uniformity • Seed production • Forage production	• 1st • 1st • 1st • 1st • 1st
9111621	• Vigor • Foliage density • Uniformity • Seed production • Forage production • Active germination	• 7th • 7th • 9th (tie) • 6th (tie) • 5th (tie) • 9th
9111622	• Vigor • Foliage density • Uniformity • Forage production	• 9th (tie) • 9th (tie) • 5th (tie) • 7th

Notes: Asterisk (*) denotes accessions included in Santiago Germplasm silver bluestem.

Plantings were irrigated during the first month until plants were well established, and then plants had natural precipitation conditions. We made quality estimates (1 to 10; best to worst) for plant vigor, foliage density, uniformity of the accession as a whole, forage (biomass) production, and seed production. We directly measured survival (expressed as a percentage of number of plants present/number of plants initially planted),

plant height, and plant canopy cover. Data were collected once a month for 1 growing season at each evaluation site. A composite sample of all annual seed production for each accession was tested for germination.

Selection

We selected 3 accessions to be released as Santiago Germplasm silver bluestem based on 1) data from an initial evaluation of 50 accessions on 1 site (Table 2); 2) advanced evaluation on 2 sites of the 10 best accessions from the initial evaluation (Tables 4 and 5); 3) seed quality and germination data (Tables 4 and 5); and 4) soil texture and ecological site information from the original collection locations (Table 1).

Mean scores for plant performance showed that selected accessions scored better than non-selected accessions (Table 3) as well as the Grant Germplasm cane bluestem, Starr Germplasm longspike silver bluestem, and Turner Seed Company silver bluestem planted as comparison standards. Plant performance scores for selected accessions were 43 to 66% higher across all ocular estimate variables than were non-selected accessions when averaged across sites and years. Plant height for selected accessions was on average 14% higher and canopy cover was 76% higher than non-selected accessions. Percent

TABLE 3

Comparative difference in evaluation scores of selected and non-selected accessions of silver bluestem at the 2 planting sites.

Category	Selected accessions	Non-Selected accessions	% Difference
Survival (%)	99.5	94.0	5.9
Plant vigor*	2.7	4.5	66.7
Foliage density*	2.7	4.5	66.7
Uniformity*	3.0	4.3	43.3
Seed production*	3.5	5.1	45.7
Forage production*	2.9	4.8	65.5
Plant height (cm)	85.3	74.8	14.0
Plant cover (%)	97.0	90.5	7.2
Active seed germ (%)	41.2	27.8	48.0

*Ocular estimates with 1 being the best and 10 being the poorest.

TABLE 4

Mean values for all evaluation criteria and active germination rates for non-selected accessions, selected accessions, and existing commercial releases at the Alpine evaluation site.

Accession	# Plants	Vigor*	Foliage density*	Uniformity*	Seed production*	Forage production*	Height	Cover	Germination (%) 2014	Germination (%) 2015
Accessions not selected – Alpine data										
9109994	9.5	3.3	3.3	3.5	4.3	3.8	69.3	91.0	36.7	11.3
9110014	10.0	4.5	4.5	4.0	5.3	4.8	66.5	78.3	16.3	19.0
9110045	9.0	5.3	5.3	4.0	5.8	5.8	60.3	81.0	31.7	25.0
9110050	10.0	4.8	4.8	4.8	5.5	4.8	73.8	93.8	45.0	23.0
9111621	10.0	3.5	3.3	4.5	5.8	4.0	66.0	87.3	42.7	14.0
9111622	10.0	5.8	5.5	5.8	6.8	6.3	58.0	79.0	37.0	25.7
Mean	9.8	4.5	4.4	4.4	5.5	4.9	65.6	85.0	34.9	19.7
Selected accessions – Alpine data										
9109995	10.0	2.5	2.0	2.3	2.8	2.8	71.3	98.0	32.3	34.0
9111584	9.75	2.5	2.8	2.5	3.8	3.0	79.8	97.8	63.7	26.7
9111617	10.0	2.5	2.8	2.5	4.8	2.8	78.8	92.8	36.0	14.3
Mean	9.9	2.5	2.5	2.4	3.8	2.8	76.6	96.2	44.0	25.0
Existing releases – Alpine data										
Release	**# Plants**	**Vigor***	**Foliage density***	**Uniformity***	**Seed production***	**Forage production***	**Height**	**Cover**	**Germination (%) 2014**	**Germination (%) 2015**
Grant	9.5	4.8	5.0	4.5	5.8	5.0	78.8	93.3	N/A	19.7
Starr	9.0	2.5	2.5	4.0	3.8	3.0	80.8	91.5	N/A	33.7
Turner	10.0	4.5	4.5	2.5	3.5	4.0	86.5	99.0	N/A	21.3
Mean	9.5	3.9	4.0	3.7	4.3	4.0	82.0	94.6		24.9

* Ocular estimates with 1 being the best and 10 the poorest. All other variables are direct measurements.

active germination was 48% higher for selected accessions as well (Table 3).

Accession **9109995** was selected as the easternmost high-performing accession from a clay loam ecological site from MRLA 81A. It had the highest score for vigor (a three-way tie with the other 2 accessions of Santiago Germplasm), foliage density, uniformity, seed production, and forage production at the Alpine site. Seed produced at Alpine during both years of evaluation had the third highest germination rate and the least variation (Table 4). This accession had the second highest score for vigor, foliage density, uniformity, seed production, and forage production at Odessa (Table 5).

Accession **9111584** was selected as the northernmost high-performing accession from a loamy ecological site from MRLA 42. It had the highest score for vigor (a three-way tie with the other 2 accessions of Santiago Germplasm), and the second highest score for foliage density, uniformity, seed production, and forage production at the Alpine site (Table 4). Seed germination was the highest at Alpine (Table 4) and Odessa (Table 5). Accession 9111584 was the fourth highest scoring accession for vigor, foliage density, and uniformity as well as the third highest scoring accession for seed production and forage production at the Odessa site (Table 5).

Accession **9111617** was selected as the southernmost high-performing accession from a clay loam ecological site from MRLA 42. It had the highest score for both vigor (a three-way tie with the other 2 accessions of Santiago Germplasm) and forage production as well as the second highest scores for foliage density and uniformity, and the fourth highest score for seed production at the Alpine site (Table 4). This accession also had the fourth highest score for vigor and forage production and the second best germination rate at the Odessa site (Table 5).

Seed Increase

Seed increase fields were started using greenhouse-grown plants derived from the original seed collections, which were outplanted on 30 cm (12 in) centers on 90 cm (36 in) bedded rows. Each accession was represented by approximately 400 plants. Seed was effectively harvested from these small,

TABLE 5

Mean values for all evaluation criteria and active germination rates for non-selected accessions, selected accessions, and existing commercial releases at the Odessa evaluation site.

									Germination (%)	
Accession	**# of Plants**	**Vigor***	**Foliage density***	**Uniformity***	**Seed production***	**Forage production***	**Height**	**Cover**	**2014**	**2015**
Accessions not selected – Odessa data										
9109994	10.0	3.0	3.0	3.0	3.5	3.8	93.3	99.0	N/A	20.7
9110014	9.5	6.7	6.7	7.0	6.3	6.3	64.3	83.7	N/A	47.7
9110045	10.0	4.5	4.5	3.3	3.3	4.0	81.3	97.0	N/A	23.0
9110050	10.0	5.5	5.3	5.3	7.0	6.5	77.3	95.0	N/A	28.7
9111621	10.0	1.8	1.8	2.0	1.8	1.8	100.8	100.0	N/A	40.3
9111622	10.0	5.3	5.5	5.3	6.8	5.8	81.0	100.0	N/A	16.0
Mean	9.9	4.4	4.4	4.3	4.8	4.7	83.0	95.8		29.4
Selected accessions – Odessa data										
9109995	10.0	2.0	1.8	2.5	2.5	1.8	95.5	100.0	N/A	38.0
9111584	10.0	3.3	3.3	4.0	3.3	3.5	93.3	99.3	N/A	53.7
9111617	10.0	3.5	3.8	4.5	4.0	3.8	93.3	94.3	N/A	52.0
Mean	10.0	2.9	2.9	3.7	3.3	3.0	94.0	97.8		47.9
Existing releases – Odessa data										
									Germination (%)	
Release	**# of Plants**	**Vigor***	**Foliage density***	**Uniformity***	**Seed production***	**Forage production***	**Height**	**Cover**	**2014**	**2015**
Grant	10.0	6.0	6.0	4.8	6.5	6.0	77.3	93.0	N/A	29.7
Starr	10.0	4.7	5.0	5.0	4.7	5.0	85.3	91.3	N/A	83.3
Turner	10.0	5.0	5.0	4.3	4.8	4.5	88.5	99.8	N/A	21.0
Mean	10.0	5.2	5.3	4.7	5.3	5.2	83.7	94.7		44.7

* Ocular estimates with 1 being the best and 10 the poorest. All other variables are direct measurements.

isolated seed increase plots throughout the 2014 and 2015 growing seasons using a Flail-Vac harvester. After air-drying, seed was readily cleaned from the stem and leaf material using a Clipper Seed Cleaner and was then tested for purity and quality. Average PLS from seeds harvested was 35%; average production was 0.75 kg (1.65 lb) of PLS per harvest. Estimated annual PLS yield using this production method was 69.5 kg/ha (62 lb/ac).

ECOLOGICAL CONSIDERATIONS

Silver bluestem is native and adapted to the area of intended use, thus no potential negative impacts of planting the species in this region are anticipated. Based on the natural distribution of this species, plants arising from this germplasm are unlikely to persist or spread beyond locations where the plant naturally occurs.

Silver bluestem reproduces readily from seed. This species does not show any potential for aggressive, rapid spread from seed, unlike exotic species encountered in this region. Aside from tillering via the root crown, silver bluestem does not exhibit any other apparent vegetative reproduction.

The release of Santiago Germplasm silver bluestem will provide a selected seed source of a native plant species for upland wildlife habitat improvement, critical area revegetation, highway and energy rights-of-way plantings, energy exploration and development reclamation, and rangeland plantings for West Texas.

ANTICIPATED CONSERVATION USE

Santiago Germplasm silver bluestem should be adapted to a broad range of soil textures and ecological sites across West Texas. Best adaptation should be on sites with deeper soils and moderate drainage (Powell 1994). Santiago Germplasm is recommended for inclusion in native seed mixes for upland wildlife plantings, highway rights-of-way revegetation, energy reclamation, and for inclusion in range seeding mixes. It is a fair to good livestock forage and can compete well with exotic grasses such as buffelgrass (*Pennisetum ciliare* (L.) Link [Poaceae]) (Powell 1994). Silver bluestem provides nesting cover for birds, foraging habitat for raptors, and fawning cover for deer (Hatch and others 1999).

ANTICIPATED AREA OF ADAPTATION

Based on the distribution of *Bothriochloa laguroides*, the collection sites of the 3 accessions that make up Santiago Germplasm and the location of the 2 evaluation sites used in development, the best performance of Santiago Germplasm will be predominantly in the western part of the Edwards Plateau (MRLA 81A), the Southern Desertic Basins, Plains and Mountains (MLRA 42), the Southern High Plains (MLRA 077C), and the Central Rolling Red Prairies (MLRA 078B) ecoregions. The release may be adapted to adjacent ecoregions, but evaluations have not been conducted outside of the aforementioned regions.

AVAILABILITY OF PLANT MATERIALS

The parent populations of each component of Santiago Germplasm will be maintained by the West Texas Native Seeds Project. Seed will be made available to growers agreeing to produce seed meeting Texas Department of Agriculture seed certification provisions for Texas Selected Native Plant Germplasm, and pending negotiation of a licensing agreement for production. G0 and G1 production fields will have a 7-y restriction on stand life. Certification through G2 will be allowed, but increase for seed production using G2 seed is prohibited. Rights to production and distribution of seed for commercial purposes will be limited to growers participating in production license agreements with the originating institutions. Seed for scientific research, further selection, or testing purposes can be obtained by e-mailing the corresponding author.

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