TEXAS A&M UNIVERSITY-KINGSVILLE
CAESAR KLEBERG WILDLIFE RESEARCH INSTITUTE
TEXAS NATIVE SEEDS
KINGSVILLE, TEXAS

And

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
JAMES E. "BUD" SMITH PLANT MATERIALS CENTER
KNOX CITY, TEXAS

And

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
E. "KIKA" DE LA GARZA PLANT MATERIALS CENTER
KINGSVILLE, TEXAS

And

SUL ROSS STATE UNIVERSITY
BORDERLANDS RESEARCH INSTITUTE
ALPINE, TEXAS

NOTICE OF RELEASE OF SANTIAGO GERMPLASM SILVER BLUESTEM SELECTED PLANT MATERIAL

Texas A&M University-Kingsville, Caesar Kleberg Wildlife Research Institute, *Texas Native Seeds*, the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), E. "Kika" de la Garza Plant Materials Center, James E. "Bud" Smith Plant Materials Center, Sul Ross State University, and the Borderlands Research Institute, announce the release of a selected plant material of silver bluestem [*Bothriochloa laguroides* (DC) Herter ssp. *torreyana* (Steud.) Allred and Gould] for West Texas.

This plant will be referred to as Santiago Germplasm silver bluestem and is released as a selected plant material class of certified seed (natural track). Santiago Germplasm was tested under the USDA NRCS accession numbers 9109995, 9111854, and 9111617. Seed of Santiago Germplasm silver bluestem will be identified by USDA NRCS accession number 9112293.

This alternative release procedure is justified because there are no existing commercial sources of silver bluestem ecotypic to the Edwards Plateau, Western Part (MLRA81A), the Southern Desertic Basins, Plains and Mountains (MLRA 42), the Southern High Plains (MLRA 77C); and the Central Rolling Red Plains (MLRA 78B) ecoregions of Texas. The potential for immediate use is high, especially for upland wildlife plantings, highway right-of-way revegetation, reclamation of energy exploration sites, and for inclusion in range seeding mixes.

A. Proposed Variety Name and Temporary Designation:

SANTIAGO GERMPLASM SILVER BLUESTEM

B. Family, kind, genus and species:

Family: Poaceae

Tribe: Andropogoneae

Kind: Silver bluestem, silver beardgrass

Genus and species: *Bothriochloa laguroides* (DC) Herter ssp. *torrevana* (Steud.) Allred and Gould

C. Origin and breeding history of the variety:

Collection Site Information (Figure 1):

Accession **9109995** was collected by Colin Shackelford of the *West Texas Native Seeds* project of *Texas Native Seeds* on May 24, 2012 from plants located along FM 334 in Kinney County, Texas at 29° 26' 45.45" N. latitude and 100° 07' 54.20" W. longitude. Soil series of the collection site is a Uvalde silty clay loam. The ecological site at this location is classified as a clay loam (MLRA 81A – Edwards Plateau, Western Part) (Web Soil Survey Staff 2014).

Accession **9111584** was collected by Colin Shackelford of the *West Texas Native Seeds* project of *Texas Native Seeds* on August 24, 2012 from plants located near Interstate 10 east of Balmorhea, Texas in Reeves County, Texas at 30° 58' 35.65" N. latitude and 103° 34' 16.46" W. longitude. Soil series of the collection site is a Reakor loam. This site is classified as a loamy desert grassland (MLRA 42 – Southern Desertic Basins, Plains and Mountains) (Web Soil Survey Staff 2014).

Accession **9111617** was collected by Colin Shackelford of the *West Texas Native Seeds* project of *Texas Native Seeds* on September 17, 2012 from native plants located on State Highway 118 south of Alpine, Texas in Brewster County, Texas at 29° 31' 2.51" N. latitude and 103° 34' 51.97" W. longitude. Soil series of the collection site is a Martillo-Butcherknife clay loam. This site is classified as a clay loam desert grassland (MLRA 42 – Southern Desertic Basins, Plains and Mountains) (Web Soil Survey Staff 2014).

Breeding history: Plants evaluated in the initial trials were grown from the original seed collections. Foundation seed of each of the accessions was also grown from isolated increase plots established using the original seed collection of each accession. All seed increase plots were grown in isolation from other *Bothriochloa laguroides* accessions, and from wild populations of the species. No intentional breeding, selection or genetic manipulation has been carried out on these accessions.

D. Objective description of the variety:

Description:

Santiago Germplasm silver bluestem is similar to the typical description for silver bluestem. It is a native, perennial bunch grass. Culms to 1.5 m tall, erect from a geniculate base, and branching above the base at maturity. Nodes are glabrous or short pubescent. Leaves are basal and cauline. Sheaths are terete and glaucouse. Ligules are a ciliate membrane up to 3.5 mm long. Blades up to 25 cm long, to 18 mm wide and are flat or folded. Panicles up to 20 cm long, contracted, oblong, and silvery-white with a central axis to 15 cm long. Panicle rames number 12 or more, some rebranching; rames are less than 7 cm long. Sessile spikelets are less than 4.4 mm long. First glumes are 2.5-4.5 mm long and without a glandular pit. Second glumes are 2.5-4.5 mm long. Upper floret lemmas are awned with awns to 15 mm long that are geniculate and twisted below. Pedicellate spikelets up to 3 mm long, shorter than sessile spikelets, neuter, awnless. Caryopsis are 1.6-2.5 mm long, lanceolate, and amber. Chromosome numbers *2n=60*. The plants produce seed mostly from May through November (Stubbendieck et al. 2017). Santiago Germplasm silver bluestem has an average of 503,991 seeds per pound with a planting rate of 1-2 pounds pure live seeds (PLS) per acre.

Silver bluestem is most common in well-drained soils of prairies, pastures, woodlands, river bottoms, waste ground, and roadsides (Stubbendieck et al. 2017). It is a hardy, perennial capable of reseeding itself 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 et al. 2017). 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 et al. 2003).

Potential Uses: Santiago Germplasm silver bluestem is recommended for upland wildlife plantings, highway rights-of-ways revegetation, energy exploration reclamation, and for inclusion in range seeding mixes. It is a fair to good livestock forage and competes well with exotic grasses such as buffelgrass [*Pennisetum ciliare* (L.) Link] (Powell, 1994). Meyer and Brown (1985) reported *in-vitro* dry matter digestibility of 44.6% and crude protein of 7.5% for silver bluestem. Willard and Schuster (1973) found that crude fiber was generally high (between 32% and 38%) in silver bluestem. Silver bluestem provides nesting cover for birds, foraging habitat for raptors and fawning cover for deer (Hatch et al. 1999).

E. Evidence

Method of Breeding and Selection:

Initial Evaluation

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 *Texas Native Seeds* obtained seed collections of silver bluestem from 35 field locations in West Texas and western South Texas from 2011-2012 (Table 1).

In March 2014, 35 accessions were seeded in greenhouse flats to produce transplants for evaluation. In May 2014, transplants of each accessions were planted in a randomized complete block design with 2-10 plant replications at the Sierra la Rana evaluation site in Alpine, Texas (Figure 1). Plants were irrigated after planting for approximately one month. They were evaluated monthly under natural precipitation conditions. Data was collected on important traits for commercial seed production and ecological function, including: survival (expressed as a percentage of number of plants present/number of plants initially planted), foliage density, uniformity of the accession as a whole, forage (biomass) production, seed production, plant height, and plant canopy cover. Accessions were given a score of 1 to 10 (1 being the best, 10 being the worst) based on visual observations. Data from each evaluation year was pooled, and mean performance in each category by year was used for selection of superior accessions. Seed was collected from all accessions during the growing season and tested for germination.

Advanced Evaluation

Following the initial evaluation, the 10 best performing accessions were selected for advanced evaluation plantings at both the Sierra la Rana plant evaluation site in Alpine and the Railway Ranch plant evaluation site near Odessa, Texas (Figure 1). Selections were made using a combination of collected plant performance data as well as seed germination test results. Accessions exhibiting greater than mean performance in the largest number of evaluation categories at Alpine were selected (Table 2).

In addition to the 10 highest performing accessions, the existing releases of Grant Germplasm cane bluestem [*Bothriochloa barbinodis* (Lag.) Herter] developed by the NRCS Los Lunas Plant Material Center in New Mexico; Starr Germplasm longspike silver bluestem [*Bothriochloa saccharoides* (Sw.) Rydb] under development by the NRCS E. “Kika” de la Garza Plant Materials Center in Kingsville, Texas; and a source of silver bluestem produced by Turner Seed in Breckenridge, Texas were included in the advanced evaluation plantings for comparison (Table 3 and 4).

Transplants were grown from the original seed collections, breeder seed for the releases, and commercial seed for the Turner Selection. Each accession and existing release was planted in paired 10 plant replications at the Sierra la Rana evaluation site in Alpine, Texas. The paired planting design was utilized to evaluate uniformity of development, seed yields, and seed quality.

A randomized complete block design with 2-10 plant replications of each accession and existing releases was planted at the Railway Ranch evaluation site. Accession 9090632 had a very low rate of greenhouse emergence. A decision was made to plant it only at the Odessa site because it better represents the origin of the accession.

Plantings were irrigated during the first month until plants were well established. Each planting grew under natural precipitation conditions after the first month. Data was collected once a month for one growing season at each evaluation site. Seed from each replicated planting was collected from each seed flush and combined for germination testing.

Selection

An examination of initial evaluation and advanced evaluation data from two sites, seed germination trials and quality data from seed germination trials, as well as soil texture and ecological site information from the original collection locations for each accession were used to select three accessions subsequently designated for release as Santiago Germplasm silver bluestem.

Mean scores for plant performance show that selected accessions scored better than non-selected accessions. Plant performance scores for selected accessions were 43-66% higher than non-selected accessions when averaged across sites and years. Plant height for selected accessions averaged 10% higher and canopy cover 6% higher than non-selected accessions. Percent active germination was 13% higher for selected accession (Table 2).

Accession **9109995** was selected as the easternmost high performing accession from a clay loam ecological site from MLRA 81A. It had the highest score for vigor, foliage density, uniformity, seed production, and forage production at Alpine. Germination over two years was the third highest and the accession had the least variation at Alpine. Accession 9109995 had the second highest score for vigor, foliage density, uniformity, seed production and forage production at Odessa.

Accession **9111584** was selected as the northernmost high performing accession from a loamy ecological site from MLRA 42. It had the highest score for vigor and the second highest score for foliage density, uniformity, seed production, and forage production at Alpine. Germination over two years was the highest at Alpine and one year of advanced evaluation at Odessa. 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 Odessa.

Accession **9111617** was selected as the southernmost high performing accession from a clay loam ecological site from MLRA 42. It had the highest score for both vigor and forage production and the second highest score for both foliage density and uniformity, and the fourth highest score for seed production at Alpine. Accession 9111617 had the fourth highest score for vigor and forage production as well as the second best germination when grown at Odessa.

F. Area of adaptation

Based on the distribution of *Bothriochloa laguroides*, the collection sites of the three accessions that comprise Santiago Germplasm, and the location of the two evaluation sites used in development (Alpine and Odessa, Texas), 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 77C); and the Central Rolling Red Prairies (MLRA 78B) ecoregions. Santiago Germplasm may be adapted to adjacent ecoregions, but evaluation plantings in these ecoregions are needed to confirm their adaptation**.**

G. Procedure for maintaining stock classes of seed

The parent populations of each component of Santiago Germplasm will be maintained by *Texas Native Seeds*. G0 seed is the seed that has been harvested from isolated plantings of the parent

lines. G1 seed is that which is harvested from plantings made using the G0 seed. G1 seed can be replanted for production of G2 seed. Increase of the variety using G2 seed is prohibited. Santiago Germplasm silver bluestem is released as a Selected Texas Native Germplasm by the *West Texas Native Seeds* project of *Texas Native Seeds* and is eligible for seed certification as a Texas Selected Native Germplasm by Texas Department of Agriculture. Breeder seed will be made up of equal amounts (by %PLS, +/- 10%) of each of the 3 accessions.

H. Additional restrictions

Foundation and certified seed fields have 7 year production limit. All commercial seed fields of Santiago Germplasm must be located in Texas and isolated from other cultivated varieties and wild populations of *Bothriochloa laguroides* by a minimum of 300 feet. Release of this variety will be limited to growers who have been selected by *Texas Natives Seeds* staff following submission of a written production proposal.
Will application be made to the Plant Variety Protection Office? YES__NO_X

If yes will the application specify that the variety is to be sold by variety name only as a class of certified seed? YES__ NO_X__

Ecological Considerations and Evaluation: 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 that Santiago Germplasm silver bluestem was suitable for release based on the criterion contained in this document. This conclusion is primarily because silver bluestem is a naturally occurring species in Texas and planting it would therefore not constitute an introduction of an exotic species into local ecosystems. Any negative impacts on other native plant species would likely be minimal to non-existent.

Conservation Use: 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 transport rights-of-way plantings, energy exploration and development reclamation, and rangeland plantings in West Texas.

Availability of Plant Materials: Breeder seed will be maintained by *Texas Native Seeds*. Generation 0 seed will be released to qualified growers under license agreement stipulating production requirements.

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Table 1. Collection locations of silver bluestem (*Bothriochloa laguroides*).

Accession	County	Location	Soil Texture
9089003	Uvalde	Highway 90 just east of Kinney county line	loam
9090632	Val Verde	Highway 163 north of Comstock	loam
9109978	Terrell	Longfellow Ranch HQ	gravelly loam
9109980	Val Verde	Highway 90 at Langtry	channery loam
9109991	Brewster	Highway 67 near Hovey	loam
9109992	Pecos	I-10 West of Sheffield	gravelly loam
9109995	Kinney	Highway 334	silty clay loam
9110008	Terrell	TNC Independence Creek, North Canyon	gravelly loam
9110014	Pecos	Longfellow Ranch Reina Pasture	gravelly loam
9110016	Brewster	Highway 90 b/t Alpine and Marathon	silt loam
9110051	Terrell	Hwy 90 between Sanderson and Dryden	gravelly loam
9110052	Uvalde	Hwy 127 and 83, Concan TX	clay
9110053	Brewster	Hwy 90 west of Sanderson	loam
9111584	Reeves	I-10 east of Balmorhea, east of Hwy 2448	loam
9111586	Pecos	Hwy 1776 and Hwy 1450	gravelly loam
9111590	Jeff Davis	Hwy 90 east of Valentine	clay loam
9111595	Presidio	Mimms Ranch, Marfa	clay loam
9111597	Presidio	Mimms Ranch, Marfa	loam
9111602	Brewster	Hwy 118 north of Alpine	loam
9111615	Uvalde	Hwy 1050 west of Utopia	clay loam
9111617	Brewster	Hwy 118 south of Alpine	clay loam
9111621	Brewster	Hwy 118 north of Study Butte	sandy loam
9111626	Presidio	Hwy 169 south of Marfa	silt clay loam
9111640	Dawson	Hwy 180 west of Lamesa	fine sandy loam
9111641	Gaines	Hwy 180 west of Lamesa	loamy fine sand
9111671	Ector	K-Bar Ranch, south of Odessa	sandy loam
9111674	Crane	K-Bar Ranch, south of Odessa	loam
9111677	Upton	Hwy 1492, south of Midland	sandy loam
9111681	Martin	I-20 west of Big Spring	loam
9111682	Ward	Hwy 1776 north of the Pecos River	very gravelly loam
9111700	Culberson	County Rd 114, E-SE of Delaware Mtns.	loam
9111926	Coke	Butterfield Ranch, 8 miles S of Robert Lee	clay loam
9111927	Coke	FM 208 south of Robert Lee	clay loam
9111928	Uvalde	Highway 55 north of Uvalde	silt loam
9111929	Upton	Highway 349 south of Highway 67	Loam

Table 2. Comparative difference in evaluation scores of selected and non-selected accessions of silver bluestem across all planting sites.

Category	Selected Accessions	Non-Selected Accessions	% Difference
% Survival	99.5	94.0	5.5
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	10.5
Plant Cover (%)	97.0	90.5	6.5
Active Seed Germ (%)	41.2	27.8	13.4

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

Table 3. Comparative performance of accessions 9109995, 9111584 and 9111617 and other silver bluestem sources, Sierra la Rene, Alpine. Texas*.

Accession	Plant[1/]	Vigor[2/]	Fol.[3/] Den.	Uni.[4/]	Seed Prod[5/]	Forage Prod[6/]	Ht. cm[/7]	Cover %[/8]	2014 Germ %[/9]	2015 Germ %[/10]
9109995	10.0	2.5	2.0	2.3	2.8	2.8	71.3	98.0	32.3	34.0
9111584	9.8	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
Grant	9.5	4.8	5.0	4.5	5.8	5.0	78.8	93.3	N/A	19.7
Starr	9	2.5	2.5	4.0	3.8	3.0	80.8	91.5	N/A	33.7
Turner	10	4.5	4.5	2.5	3.5	4.0	86.5	99.0	N/A	21.3
Mean	9.7	3.2	2.8	3.1	4.1	3.4	79.3	95.4	44	25

1/ Plant = number of plants; 2/ vigor; 3/ Fol. D = foliage density, 4/ Uni. = Uniformity; 5/ Seed Prod = seed production; 6/ Forage Prod = forage production; 7/ Ht. = height; 8/ Cover; 9/ 2014 Germ = 2014 germination first planting; 10/ 2015 Germ = Germination advanced planting.

Table 4. Comparative performance of accessions 9109995, 9111584 and 9111617 and other silver bluestem sources, Railway Ranch, Odessa, Texas*.

Accession	Plant[1/]	Vigor[2/]	Fol.[3/] Den.	Uni.[4/]	Seed Prod[5/]	Forage Prod[6/]	Ht. cm[7/]	Cover %[8/]	2014 Germ %[9/]	2015 Germ %[10/]
9109995	10	2.0	1.8	2.5	2.5	1.8	95.5	100	N/A	38
9111584	10	3.3	3.3	4.0	3.3	3.5	93.3	99.3	N/A	3.7
9111617	10	3.5	3.8	4.5	4.0	3.8	93.3	94.3	N/A	52
Grant	10	6	6.0	4.8	6.5	6.0	77.3	93.0	N/A	29.7
Starr	10	4.7	5.0	5.0	4.7	5.0	85.3	91.3	N/A	83.3
Turner	10	5.0	5.0	4.3	4.8	4.5	88.5	99.8	N/A	21
Mean	10	4.1	4.2	4.2	4.3	4.1	88.9	93		46

1/ Plant = number of plants; 2/ vigor; 3/ Fol. D = foliage density, 4/ Uni. = Uniformity; 5/ Seed Prod = seed production; 6/ Forage Prod = forage production; 7/ Ht. = height; 8/ Cover; 9/ 2014 Germ = 2014 germination first planting; 10/ 2015 Germ = Germination advanced planting.

***** Note: Vigor, foliage density, uniformity and seed production are based on ocular estimates where 1 = best and 10 = poor.

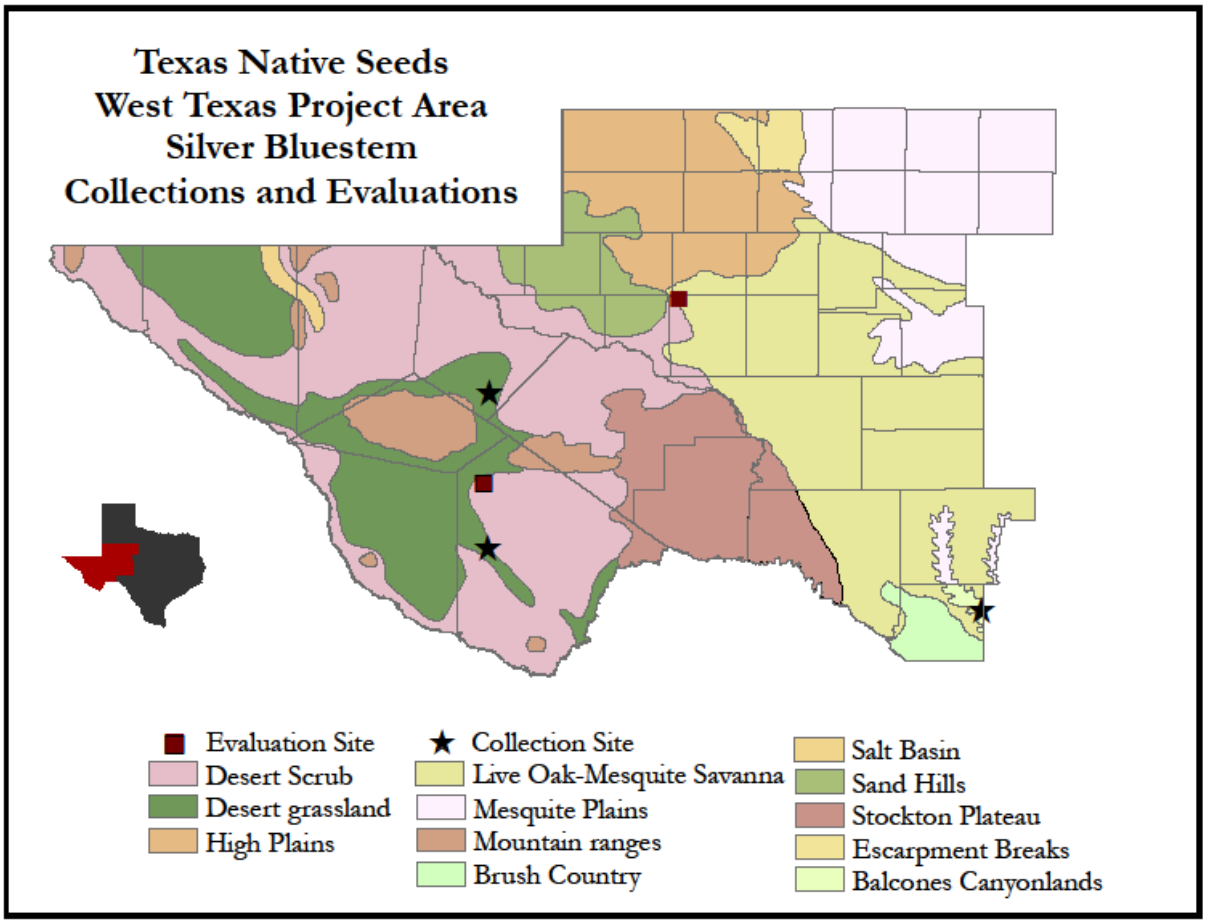

Figure 1. Collection and evaluation sites used in development of Santiago Germplasm silver bluestem.

MARKETING PLAN

SANTIAGO GERMPLASM SILVER BLUESTEM

January 2018

Distribute breeder seed to commercial grower.

January 2018

Finalize and obtain approval for release and print supporting documents (fact sheet & brochure).

Spring/Summer 2018

Draft press release and host celebration of release once seed is commercially available to customers.

Staff information booths at 2 landowner and consumer-oriented symposiums or conferences in West Texas.

Winter 2019

Present results and overview of development process at International Meeting of the Society for Range Management.

Publish “notice of release” article in Native Plant Journal.

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