

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
KINGSVILLE, TEXAS

and

TEXAS AGRICULTURAL EXPERIMENT STATION
BEEVILLE, TEXAS

and

TEXAS A&M UNIVERSITY
KINGSVILLE, TEXAS

NOTICE OF RELEASE OF MARIAH GERmplasm HOODED
WINDMILLGRASS

SELECTED CLASS OF NATURAL GERmplasm

The Natural Resources Conservation Service (NRCS), U.S. Department of Agriculture (USDA), Texas A&M University-Kingsville, and the Texas Agricultural Experiment Station at Beeville, Texas announce the release of a selected ecotype of hooded windmillgrass (*Chloris cucullata* Bisch.) for the south Texas ecoregion. Mariah Germplasm was tested under the accession number 9085313 or 313.

This plant will be referred to as Mariah Germplasm hooded windmillgrass and is released as a selected plant material class of certified seed (natural track).

This alternative release procedure is justified because there are no existing commercial sources of hooded windmillgrass. The potential for immediate use is high especially for roadside plantings and critical site revegetation.

Collection Site Information: Accession 9085313 was collected in 1999 from native plants located near the headquarters of the La Paloma Ranch in Kenedy county at 27° 15' N. latitude and 97° 54' W. longitude (MLRA 83C). It was growing on a Delfina loamy fine sand soil type with a 1% slope. Collection site elevation was 16 meters (52 feet) and average annual precipitation for this location is 63.5 centimeters (25 inches).

Description: Hooded windmillgrass is a native, perennial bunch grass. Mature foliage height ranges from 15 to 60 centimeters (0.5 to 2.0 feet) tall. Leaves are glabrous to scabrous with the sheaths almost always being glabrous. The leaf blades are linear to 20 centimeters (8 inches) long and 2 to 4 millimeters wide. It has a ligule that is a short-ciliate crown. Hooded windmillgrass will flower multiple times over the growing season, and flowers can be produced from May through October. The inflorescence will have 10 to 20 branches that are 2 to 5 centimeters long. The branches are flexuous or arcuate, borne in several close radiating verticels. Spikelets are at first straw-colored but later becoming tawny, closely-spaced and widely divergent, with about 14 to 18 spikelets per centimeter of rachis. Glumes are lanceolate to obovate and glabrous except for the scabrous midnerve. The first glume is 0.5 to 0.7 mm long and the second glume is 1 to 1.5 mm long. The lower lemma is broadly elliptic and glabrous except for the appressed-pilose keel and margins. It is 1.5 to 2.0 mm

long with an obtuse apex and an awn that is 0.3 to 1.5 mm long. Spikelets have one sterile floret, markedly inflated, with the upper margins inrolled usually 1.0 to 1.5 mm long, unawned or with an awn to 1.5 mm long. The chromosome number is $2n=40$. Hooded windmillgrass is found in northeastern Mexico and throughout Texas especially in the central and western parts of the state.

Potential Uses: Mariah Germplasm is recommended for roadside plantings, critical site revegetation and in range seeding mixes. It can be used in many types of conservation plantings, such as grassed waterways, streamside buffers, filter strips, and pond embankments.

Method of Breeding and Selection:

Initial evaluation: Mariah Germplasm was initially evaluated at the USDA-NRCS E, "Kika" de la Garza Plant Materials Center (PMC), Kingsville, Texas, from 2000 through 2001. A total of 43 accessions of windmillgrass were collected from throughout the state of Texas and were included in the study. From these initial evaluations, accessions 9085301 and 9085313 were determined to be the best accessions of hooded windmillgrass for vigor, growth form and development, and disease resistance (Table 1 and 2).

Table 1. Summary of Initial Evaluations of Windmillgrasses (*Chloris* spp.) from 2000 through 2001 on clay soils at Kingsville, Texas

Accession Number	Source (County)	Percent Survival	Foliage Density*	Seed Production*
9076951	Frio	100	5.2	3.9
9076977	Palo Pinto	95	6.5	4.5
9076946	Kleberg	100	5.3	5.4
9085229	Coleman	95	6.9	5.0
9085308	Lampasas	100	6.6	5.1
9085235	Lubbock	100	7.0	5.5
9085300	Bee	100	5.3	5.1
9085289	San Patricio	100	4.4	4.0
9085316	Kenedy	100	4.3	4.9
9085243	Burnet	100	6.1	3.7
9085285	Howard	100	6.2	4.8
9085288	Burleson	100	5.4	3.6
9085242	Austin	100	4.5	3.7
9085309	Kleberg	100	5.5	5.0
9085258	Goliad	100	4.6	4.8
9076968	Knox	100	7.0	4.3
9085264	DeWitt	100	4.4	4.8
9085260	San Patricio	100	3.1	3.8
9085240	Dimmit	95	5.3	4.5
9085234	Lubbock	100	7.4	4.8
9085301	Duval	100	5.4	4.7
9076971	Brown	100	6.5	4.3
9085313	Kenedy	100	4.6	5.0
9085245	Burnet	100	5.8	4.8
9076955	Kleberg	100	4.8	4.9
9085262	Refugio	100	2.9	4.3
BELL	-	100	3.3	4.2
9085265	DeWitt	100	4.1	4.8
9085259	Kleberg	100	4.4	4.8
9085271	Hidalgo	100	4.5	4.8
9085233	Andrews	100	7.4	3.8
9076974	Lubbock	100	7.7	4.5
9085283	Calhoun	100	3.7	3.8
9085276	Starr	100	5.3	4.3
9085291	Webb	100	4.9	4.8
Means	All Counties	99	5.5	4.6

*Ocular estimate (1 = Best)

Table 2. Summary of Initial Evaluations of Windmillgrasses (Chloris spp.) from 2000 through 2001 on sandy soils at Kingsville, Texas.

Accession Number	Source (County)	Percent Survival	Foliage Density*	Seed Production*
9076951	Frio	100	6.4	5.3
9076977	Palo Pinto	85	7.1	4.7
9076946	Kleberg	95	5.5	4.5
9085229	Coleman	95	6.8	4.7
9085308	Lampasas	100	7.1	5.0
9085235	Lubbock	90	6.7	5.2
9085300	Bee	100	5.4	5.4
9085289	San Patricio	95	5.2	4.0
9085316	Kenedy	100	4.8	4.6
9085243	Burnet	100	6.3	4.0
9085285	Howard	80	6.6	5.5
9085288	Burleson	100	5.5	4.2
9085242	Austin	100	5.9	4.8
9085309	Kleberg	83	6.5	6.5
9085255	Jim Hogg	100	5.8	4.7
9076968	Knox	85	7.2	4.6
9085240	Dimmit	90	5.0	4.7
9085234	Lubbock	65	7.1	5.0
9085301	Duval	85	5.8	4.5
9076971	Brown	100	7.0	4.7
9085313	Kenedy	100	5.5	5.5
9085245	Burnet	80	6.5	5.5
9076955	Kleberg	81	5.8	5.9
9085262	Refugio	100	4.0	4.8
BELL	-	100	4.0	5.0
9085258	Goliad	100	5.3	4.6
9085265	DeWitt	100	5.5	5.1
9085259	Kleberg	100	5.7	4.8
9085271	Hidalgo	100	5.9	4.6
9085233	Andrews	60	7.5	5.6
9076974	Lubbock	100	7.5	4.4
9085283	Calhoun	100	4.5	5.0
9085276	Starr	100	5.8	4.9
9085291	Webb	80	6.1	5.0
9085264	DeWitt	100	5.3	5.3
9085260	San Patricio	100	3.8	5.1
Means	All Counties	95	6.1	4.9

*Ocular estimate (1 = Best)

Advanced Evaluations: Advanced evaluation plots were established in 2002 at both the PMC in Kingsville and the Texas Agricultural Experiment Station (TAES) in Beeville. The Advanced evaluation plots at the PMC consisted of accessions 9085300, 9085301, and 9085313. The advanced evaluation plots at Beeville consisted of accessions 9085301, 9085313, and 9085316. Accessions 9085301 and 9085313 had the best field performance on these plots at the PMC during 2002 and 2003 (Table 3). Dr. Bill Ocumpaugh ranked 9085316 and 9085313 as his top two accessions at Beeville in 2002. Seed production rankings appear to favor accession 9085316 (Table 4). However, it became apparent upon looking at the growth form, harvest time and percent active germination that accession 9085316 was an intermediate form between hooded and shortspike windmillgrass. It was therefore eliminated from the hooded evaluations. The goal was a hooded windmillgrass that would have high active germination (>90%), have a high 2-day germination, produce multiple seed crops, and produce a satisfactory seed yield.

Table 3. Hooded Windmillgrass Advanced Evaluation in 2003 at Kingsville, Texas

Accession Number	Growth Habit	Percent Survival	Plant Vigor*	Foliage Density*	Seed Production*	Seed Shatter*
300	Bunch	100	5.4	5.4	5.5	5.0
301	Bunch	100	5.0	5.2	4.4	5.0
313	Very Spreading	100	5.3	4.6	6.8	5.0

*Ocular estimate (1 = Best)

Table 4. Hooded Windmillgrass Seed Harvest and Germination from Beeville, Texas in 2003.

Accession Number	Total Grams Harvested	2 Day Germination	Total Germination
300	65	93%	96%
301	118	76%	97%
313	97	87%	93%
316	318	56%	70%

- 12 hours dark 20oC (68oF) / 12 hours light 30oC (86oF).

Initial seed germination results indicated low germination from harvested seed at the PMC (ATR, 2001). In order to understand the cause of the low germination results from harvested seed, samples of the 2002 harvest from accession 9085313 was sent to two seed labs. Hulsey Seed Lab got 91% germination and Giddings TDA Seed Lab got 24% germination. Upon further investigation it was discovered that the majority of the harvested seed did not contain filled seed. Germination tests previously had been run on spikelets (apparently mostly empty), not bare caryopsis. Seed was collected from each plant of the advanced evaluation plots at Beeville in 2003. This harvest was tested in 2004 (Table 4). All of the accessions

appear to have good germination. Hooded windmillgrass appears to have a very high active germination (>90%) whereas shortspike windmillgrass will have an active germination of 60-70% and 20-30% dormant seed.

A field emergence study was established in May 2004 on a Victoria clay soil at the PMC. Ten by twenty foot flat plots were seeded at a rate of 20 PLS/ ft² and replicated three times for accessions 9085260, 9085283 and 9085313. These plots were not irrigated. Evaluation of these plots in November of 2004 (Table 5) indicated that accession 9085313 produced from 15 to 35% foliar cover.

Table 5. Windmillgrass Field Emergence Evaluation in 2004 at Kingsville, Texas

Accession Number	Rep	% Cover	Plant Vigor*	Foliage Density *	Foliage Production *	Uniformity *	Development Stage
260	1	50	4.0	4.0	4.0	4.0	Seed
260	2	60	4.0	4.0	4.0	4.0	Seed
260	3	70	2.0	2.0	2.0	2.0	Seed
283	1	35	4.0	4.0	4.0	4.0	Seed
283	2	30	5.0	5.0	5.0	5.0	Seed
283	3	70	3.0	3.0	3.0	3.0	Seed
313	1	15	6.0	6.0	6.0	6.0	Seed
313	2	35	5.0	6.0	6.0	5.0	Seed
313	3	15	6.0	6.0	6.0	6.0	Seed

*Ocular estimate (1= Best)

Seed Production: Average annual seed yields of Mariah Germplasm hooded windmillgrass at Kingsville have been 225 pounds per acre (252 kg ha⁻¹) (Table 6).

Indeterminate seed maturity is a factor that may influence economical seed yields of hooded windmillgrass. A typical combine-run harvest consists of complete seed units or filled seed, incomplete seed units or unfilled seed and other non-viable inert matter. Filled seed at Beeville, Texas ranged from 1.5 % to 3.7 % in 2003 (Table 7) and from 2.9% to 5.7% from an early May harvest in 2003 from Kingsville, Texas (Table 8). However, seed fill may be influenced by environmental conditions such as temperature and soil moisture. Data from hooded windmillgrass, accession 9085313, for both month of harvest as well as location shows a large variability in percentage of seed fill (Table 9 and 10). Therefore, location and ability to irrigate may dictate where seed production plantings of windmillgrass can be most economically grown.

Seed quality of harvested seed can be easily manipulated. Seed harvested by a combine at the PMC in Kingsville and then run through a *Westrup Laboratory* brush machine (used for polishing, hulling or scarifying seed), hammermill, and tabletop *Clipper* seed cleaner produced 95% pure seed.

Table 6. Seed Attributes for Hooded Windmillgrass Harvested in Kingsville

Acc #	Year Harvested	Harvest Weight (lb/acre)	Clean Seed (lb/acre)	Seeds/ lb	Seed Rate (PLS lb/acre)	Available Seed (lb)
313	2004	310	33	2,564,646	0.33	3.3
313	2005	143	6	2,424,360	0.33	0.6
301	2005	423	26	2,899,244	0.33	1

Table 7. Seed Fill Percentages from Windmillgrass Harvest in 2003 from Beeville, Texas

Species	Acc#	Harvest Weight (grams)	Total Grams Clean	Seeds/ Gram	Germ Average	Seed Fill
Hooded	300	645	6	4257	96%	9.5%
Hooded	301	118	9	6386	97%	8.0%
Hooded	313	97	5	5649	93%	5.8%
Hooded	316	318	11	6211	70%	3.5%

Table 8. Seed Fill Percentages from Windmillgrass Harvest on May 21, 2003 from Kingsville, Texas

Species	Acc#	Harvest Weight (grams)	Total Grams Clean	Seeds/ Gram	Germ Average	Seed Fill
Hooded	300	331	16	4539	86%	5%
Hooded	301	444	21	6843	90%	5%
Hooded	313	83	4	5340	94%	5%
Hooded	316	100	5	5447	83%	5%

Table 9. Seed Fill Percentages from Hooded Windmillgrass, Accession 313 Harvested in September, 2004 at Kingsville, Texas

Date Harvested	Percent Filled Seed			Average Filled Seed
	Rep 1	Rep 2	Rep 3	
9/21/2004	23	29	26	26%
8/25/2005	10	7	8	8%
11/08/2005	33	26	30	30%

Table 10. Seed Fill Percentages from Hooded Windmillgrass, Accession 313 Harvested at Different Locations and Different Years.

Location	Percent Filled Seed by Year		
	2003	2004	2005
Kingsville	7	15	8
Beeville	11	19	-
Knox City	-	15	42

Ecological Considerations and Evaluation: An Environmental Evaluation of Plant Materials Releases was completed using guidelines established by NRCS (USDA-NRCS, 2000), and the best available information for this species. Results of this evaluation determined that Mariah Germplasm hooded windmillgrass was suitable for release based on the criterion contained in this document. This conclusion is mainly due to the fact that hooded windmillgrass 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. Also, release of this species will make available an additional native species for rangeland planting, will provide a good seed source for quail and other birds and may provide unknown benefits by maintaining and contributing habitat that harbors beneficial insects and butterflies. It will also provide a native alternative to planting exotics species on highway right of ways.

Conservation Use: Mariah Germplasm hooded windmillgrass will provide a new native species for rangeland planting, erosion control, wildlife habitat, and water quality improvement. It has high active germination (>90%), has a high 2-day germination, and produces multiple seed crops. These species characteristics, along with its preferred adaptation to central and western portions of Texas, make it a good complimentary species with Welder Germplasm shortspike windmillgrass.

Area of Adaptation: Mariah Germplasm hooded windmillgrass is well adapted for use in the southern and central portions of Texas, coinciding with MLRA 83 (Rio Grande Plain), MLRA 78 (Central Rolling Red Plains), MLRA 80 (Central Prairies), MLRA 81 (Edwards Plateau), MLRA 82 (Texas Central Basin) and MLRA 150 (Gulf Coast Prairies). Current testing has not completely substantiated the northern limit of its range of adaptation. Existing test sites in Texas include Knox City and Nacogdoches. Additional will be planted in 2006 in Stephenville, TX, Oklahoma, Louisiana, and New Mexico.

Availability of Plant Materials: Breeder seed will be maintained by the USDA-NRCS E. “Kika” de la Garza Plant Materials Center, Kingsville, Texas.

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