



Smooth Cordgrass Varieties

Description and Performance

Smooth cordgrass (*Spartina alterniflora* Loisel.) is a perennial grass native to intertidal saline marshes along the Gulf of Mexico and Atlantic coasts. It is very important for coastal areas because it reduces coastal erosion. Smooth cordgrass stems reduce wave energy and build land. Its roots stabilize existing land. Reducing coastal erosion is especially important in Louisiana because it has the highest erosion rate of the continental United States.

To reduce erosion, smooth cordgrass plugs are installed in saline marsh restoration projects each year. In most cases, only one smooth cordgrass variety is used: 'Vermilion'. This variety was released by the USDA-NRCS (United States Department of Agriculture Natural Resources Conservation Service) in 1989. The widespread use of Vermilion could threaten Louisiana's restoration projects because every Vermilion plant is genetically the same. To adapt to environmental changes there must be genetic differences among plants. Ideally, many genetically different varieties should be installed in restoration projects. This would more closely mimic natural undisturbed smooth cordgrass marshes and increase the chances that plants will to adapt to environmental changes without human intervention.

In 1998, the LSU AgCenter initiated a smooth cordgrass breeding program to develop improved, genetically different smooth cordgrass varieties using traditional plant breeding techniques. Six improved, genetically different smooth cordgrass varieties were developed. Three varieties will be released in 2012 and the remaining three will be released in 2013.

Variety Descriptions

All smooth cordgrass varieties are clonal varieties that are increased by dividing stems attached to roots. Visual identification of smooth cordgrass varieties can be very difficult because the same variety can look dramatically different when grown in different conditions. Descriptions detailed below are common traits of each variety when grown with abundant fertilization. These descriptions may not describe each variety in every environmental condition. Definitive identification of each variety should be determined using molecular fingerprinting techniques.

Vermilion: This variety was released in 1989 by the USDA-NRCS Golden Meadow Plant Materials Center (PMC), Galliano, LA. Seeds from Vermilion Parish were collected and a plant from a single seed was found to be robust, spread vigorously and tolerate diurnal tidal

inundation and relatively high salinity. It has been used extensively in saline marsh restoration projects, because it is the only commercially available smooth cordgrass variety. Vermilion is tall with large stems, wide leaves and long panicles.

Cameron: This variety will be released in 2012 and was developed by the LSU AgCenter from a seed collected from Cow Island in Cameron Parish, LA. Cameron is as robust, vigorous and tolerates similar tidal inundation and high salinity levels as Vermilion. It is shorter than Vermilion and has a narrower stem and shorter panicle than Vermilion. Cameron produces more seeds that germinate than Vermilion. It is also genetically different from Vermilion and has been observed to recover after transplant faster than Vermilion in marsh environments.

Terrebonne: This variety is as robust, vigorous and tolerates similar inundation and salinity levels as Vermilion. It was developed by LSU AgCenter from seeds collected from Timbalier Island in Terrebonne Parish, LA. Terrebonne is shorter than Vermilion and has a smaller leaf width and larger panicle widths than Vermilion. It has been observed to recover faster after transplant than Vermilion and has a higher seed yield and seed germination than Vermilion. Terrebonne is genetically different from Vermilion and Cameron and will be released in 2012.

Jefferson: Jefferson was developed by the LSU AgCenter from seeds collected along the Barataria Waterway in Three Bayou Bay in Jefferson Parish, LA and will be released in 2012. Jefferson is shorter and genetically different than Vermilion, Cameron and Terrebonne. It has better seed yield and seed germination than Vermilion and has been observed to recover more quickly than Vermilion when transplanted in natural marsh environments.

St. Bernard: This variety will be released in 2013. It was developed by the LSU AgCenter from seeds collected from St. Bernard Parish, LA. Seeds were germinated at the USDA-NRCS Golden Meadow PMC to produce mature plants. Plants were allowed to pollinate with various smooth cordgrass plants that had been collected from sites in Texas and Louisiana. Seeds harvested from USDA-NRCS Golden Meadow PMC were germinated. One seed from that open pollination produced the plant that was vegetatively increased as St. Bernard. This variety, like Vermilion, is tall and has large stems. It has narrower leaves than Vermilion and Jefferson and shorter, narrower panicles than Vermilion, Terrebonne, and Jefferson. St. Bernard appears to recover more quickly after transplant than Vermilion, is genetically different from Vermilion, Cameron, Terrebonne, and Jefferson, and produces more seeds that germinate than Vermilion.

Las Palomas: Las Palomas was developed by the LSU AgCenter and will be released in 2013. Seeds were collected from the Las Palomas Wildlife Management Area one mile north of the Rio Grande River outlet of the Gulf of Mexico. Seeds were germinated at the USDA-NRCS Golden Meadow PMC to produce mature plants. Plants were allowed to pollinate with various smooth cordgrass plants that had been collected from ten sites in Texas and numerous sites in Louisiana. One germinated seed from that open pollination produced the plant that was vegetatively increased as Las Palomas. This variety is slightly shorter than Vermilion and St. Bernard. It has a smaller stem than Vermilion and Terrebonne. Las Palomas' leaves are as wide

as the leaves of Vermilion, Cameron and Jefferson. The panicles of Las Palomas are as long as Vermilion, Terrebonne, and Jefferson, but shorter than Cameron, and St. Bernard. Las Palomas panicles are as wide as Vermilion and Jefferson, narrower than Terrebonne, and wider than Cameron and St. Bernard. As with other LSU AgCenter varieties, Las Palomas seems to recover more quickly than Vermilion immediately after transplant. It is also genetically different from Vermilion, Cameron, Terrebonne, Jefferson, and St. Bernard.

Lafourche: Lafourche will be released in 2013. It was developed by the LSU AgCenter from seeds collected from Calumet Island in Lafourche Parish, LA. Lafourche is shorter than all varieties except Jefferson. It looks very similar to Vermilion for stem size, leaf width, and panicle length and width. Lafourche has wider leaves and longer panicles than St. Bernard. It also has wider panicles than Terrebonne, is genetically different from Vermilion and all other LSU AgCenter varieties, and recovers more quickly than Vermilion after transplant into natural marsh environments.

Variety Performance

Variety performance was compared in 11 replicated trials from 2001-2009 at six natural marsh environments and five freshwater production ponds (Table 1). The performance in natural environments was necessary to ensure plant performance and survival in natural marshes. The performance in freshwater production ponds is important for production of plants for restoration projects.

Table 1. Description of the environment, location, year, and site that smooth cordgrass variety performance was compared.

Environment	Location	Year	Site Description
Marsh	Grand Terre Island	2001	Man-made terraces
Marsh	Grande Terre Island	2003	Man-made terraces
Marsh	Cameron Parish	2003	Man-made terraces
Marsh	Rockefeller Wildlife Refuge	2008	Eroded marsh areas
Marsh	Cameron Parish	2008	Man-made terraces
Marsh	Rockefeller Wildlife Refuge	2009	Eroded marsh areas
Production Pond	Ben Hur Research Farm, Baton Rouge	2001	Freshwater Pond
Production Pond	Rice Research Station, Rayne	2005	Freshwater Pond
Production Pond	Rice Research Station, Rayne	2006	Freshwater Pond
Production Pond	Rice Research Station, Rayne	2008	Freshwater Pond
Production Pond	Rice Research Station, Rayne	2009	Freshwater Pond

Vigor of each variety was measured at every environment. It was visually estimated on a scale of 0-10, where 0 indicated a dead plant and 10 was an extremely vigorous, healthy, robust plant. Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche were as

vigorous as Vermilion in all marsh environments, except one (Table 2). One month after transplant to man-made terraces in Cameron Parish, Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche were more vigorous than Vermilion. This suggests that the six LSU AgCenter smooth cordgrass varieties recover more quickly after transplant than Vermilion, which make them ideal varieties for restoration in areas in which fast recovery is essential.

Table 2. Vigor of smooth cordgrass varieties evaluated at six marsh environments.

Variety	Grand Terre Island		Cameron Parish			Rockefeller Wildlife Refuge	
	2001	2003	2003	2008 [‡]	2009 [‡]	2008	2009
Cameron	6.7 a [†]	7.2 a	7.1 a	5.3 a	3.3 a	8.3 a	8.7 a
Terrebonne	5.7 a	5.6 a	6.6 a	6.0 a	3.7 a	9.0 a	7.7 a
Jefferson	6.3 a	5.6 a	7.8 a	4.7 a	4.3 a	7.3 a	8.0 a
St. Bernard	6.0 a	6.8 a	8.2 a	5.0 a	4.3 a	10.0 a	9.3 a
Las Palomas	6.4 a	7.6 a	8.5 a	4.0 a	4.3 a	8.3 a	8.7 a
Lafourche	6.3 a	8.6 a	7.0 a	5.0 a	2.0 a	8.0 a	8.3 a
Vermilion	6.5 a	7.8 a	8.8 a	1.0 b	4.7 a	10.0 a	9.3 a

[†]Values within a column followed by different letters are significantly different ($p<0.05$).

[‡]The 2008 and 2009 Cameron Parish data were collected from the same site. The 2008 data were collected one month after transplant and the 2009 data were collected one year after transplant.

In freshwater production ponds, Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche were as vigorous as Vermilion at Ben Hur Research Farm and at the Rice Research Station in 2008 and 2009 (Table 3). Cameron was less vigorous than Vermilion at the Rice Research Station in 2005 and 2006. Terrebonne and Jefferson were less vigorous than Vermilion at the Rice Research Station in 2005. The freshwater production ponds were not fertilized and received little production inputs. The variable vigor data found in freshwater production ponds indicate that production deficiencies, such as fertilization, may contribute to reduced vigor of Cameron, Terrebonne, and Jefferson.

Table 3. Vigor of smooth cordgrass varieties evaluated at five freshwater production ponds.

Variety	Ben Hur Research Farm	Rice Research Station			
	2001	2005	2006	2008	2009
Cameron	7.4 a [†]	6.0 b	5.7 b	7.0 a	7.3 a
Terrebonne	7.8 a	8.0 b	7.7 a	7.3 a	7.0 a
Jefferson	7.5 a	8.3 b	8.0 a	7.0 a	7.0 a
St. Bernard	4.9 a	9.7 a	10.0 a	8.3 a	9.0 a
Las Palomas	4.9 a	9.0 a	9.3 a	10.0 a	8.3 a
Lafourche	5.1 a	9.0 a	8.7 a	7.7 a	7.3 a
Vermilion	7.2 a	9.7 a	9.0 a	8.7 a	9.3 a

[†]Values within a column followed by different letters are significantly different ($p<0.05$).

Plant spread was calculated by measuring the linear growth of each plot on two perpendicular axes. Spread was measured for three marsh locations, because it took a very long time to measure. Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche spread as far as Vermilion in marsh environments (Table 4). In freshwater production ponds Terrebonne spread further than Vermilion at the Ben Hur Research Farm (Table 5). At the Rice Research Station, Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche spread as far as Vermilion.

Table 4. Plant spread of smooth cordgrass varieties evaluated at three marsh environments.

Variety	Grande Terre Island	Rockefeller Wildlife Refuge	
	2001	2008	2009
Cameron	1.6 a [†]	2.0 a	1.9 a
Terrebonne	1.2 a	1.8 a	1.6 a
Jefferson	1.3 a	1.5 a	1.8 a
St. Bernard	1.4 a	2.8 a	2.7 a
Las Palomas	1.8 a	1.9 a	2.2 a
Lafourche	1.5 a	2.9 a	2.5 a
Vermilion	1.2 a	2.6 a	2.5 a

[†]Values within a column followed by different letters are significantly different ($p < 0.05$).

Table 5. Plant spread of smooth cordgrass varieties evaluated at five freshwater production ponds.

Variety	Ben Hur Research Farm	Rice Research Station			
	2001	2005	2006	2008	2009
Cameron	1.1 b	1.6 a	1.2 a	1.8 a	1.9 a
Terrebonne	2.9 a	1.5 a	2.2 a	1.3 a	0.9 a
Jefferson	2.2 b	1.5 a	1.4 a	1.1 a	0.9 a
St. Bernard	2.3 b	2.8 a	4.0 a	2.2 a	2.4 a
Las Palomas	2.0 b	2.3 a	2.6 a	2.0 a	1.9 a
Lafourche	2.1 b	3.1 a	2.8 a	2.5 a	1.7 a
Vermilion	1.0 b	2.5 a	2.6 a	2.6 a	1.8 a

[†]Values within a column followed by different letters are significantly different ($p < 0.05$).

The performance of smooth cordgrass varieties was also determined by the number of stems per plot. The total number of smooth cordgrass stems per plot was counted at three marsh environments only because it was very labor intensive. Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche had as many stems as Vermilion at three marsh environments (Table 6). The number of stems at Cameron Parish was much lower than expected because less than two months after the plants were transplanted Hurricane Ike produced significant storm surge that flooded this site for an extended period. This was an excellent

opportunity to demonstrate that the LSU AgCenter varieties could perform as well as Vermilion after a major hurricane.

Table 6. Number of stems per plot for smooth cordgrass varieties evaluated at three marsh environments.

Variety	Cameron Parish	Rockefeller Wildlife Refuge	
	2009 [†]	2008	2009
Cameron	11.0 a [‡]	88.7 a	98.3 a
Terrebonne	10.7 a	73.3 a	67.0 a
Jefferson	9.3 a	78.0 a	71.0 a
St. Bernard	9.0 a	115.7 a	110.0 a
Las Palomas	7.7 a	87.0 a	96.7 a
Lafourche	9.9 a	105.7 a	92.0 a
Vermilion	16.0 a	92.7 a	92.3 a

[†]At Cameron Parish, 2009, the number of stems in a 100 cm² quadrat was recorded to efficiently utilize available time and resources.

[‡]Values within a column followed by different letters are significantly different ($p<0.05$).

When number of stems per plot was evaluated in freshwater production ponds, more variable results were found than for the marsh environments (Table 7). Cameron, Terrebonne, Jefferson, Las Palomas and Lafourche produced less stems than Vermilion in 2005. In 2006, Cameron, Terrebonne, Jefferson, and Lafourche produced less stems than Vermilion. In 2008 and 2009, all six LSU AgCenter varieties produced as many stems as Vermilion in freshwater production ponds. In 2005 and 2006, differences for plant vigor were also found at the Rice Research Station. These results suggest that some factor in 2005 and 2006 resulted in reduced plant vigor and growth. Additional research is needed to identify specific needs of smooth cordgrass in freshwater production to maximize smooth cordgrass production.

Table 7. Number of stems per plot for smooth cordgrass varieties evaluated in freshwater production ponds at the Rice Research Station, Rayne, LA.

Variety	Year			
	2005	2006	2008	2009
Cameron	68.3 b [†]	59.0 b	85.7 a	87.3 a
Terrebonne	78.7 b	74.3 b	75.0 a	73.7 a
Jefferson	83.7 b	82.3 b	63.0 a	66.0 a
St. Bernard	134.3 a	124.7 a	103.3 a	100.0 a
Las Palomas	110.0 b	118.0 a	100.3 a	96.7 a
Lafourche	60.3 b	70.3 b	99.0 a	103.3 a
Vermilion	138.3 a	121.7 a	102.7 a	107.0 a

[†]Values within a column followed by different letters are significantly different ($p<0.05$).

Seed production and germination were also evaluated to ensure that the varieties are capable of producing large amounts of viable seeds. It was not feasible to harvest seeds from natural environments due to time and labor constraints. The seed yield and germination potential were evaluated in freshwater production ponds. Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche produced more seeds that germinated than Vermilion (Table 8). Increased seed set and germination of smooth cordgrass varieties used in restoration projects will contribute to plant spread and the self-sustainability of sites, which do not require human intervention.

Table 8. Percent seed set and seed germination of smooth cordgrass varieties produced in freshwater production ponds at the Rice Research Station, Rayne, LA.

Variety	Seed Set (%)			Seed Germination (%)		
	2005	2008	2009	2005	2008	2009
Cameron	45.0 a [†]	55.3 a	44.3 a	82.3 a	79.7 a	74.3 a
Terrebonne	70.3 a	71.3 a	64.0 a	86.0 a	77.7 a	78.3 a
Jefferson	55.0 a	63.0 a	58.3 a	76.0 a	76.3 a	72.0 a
St. Bernard	55.0 a	58.3 a	65.7 a	70.7 a	82.3 a	69.7 a
Las Palomas	50.3 a	46.7 a	53.3 a	63.7 a	68.0 a	72.3 a
Lafourche	75.0 a	65.0 a	66.0 a	75.0 a	75.7 a	73.0 a
Vermilion	20.7 b	27.3 b	21.3 b	35.3 b	38.0 b	40.0 b

[†]Values within a column followed by different letters are significantly different ($p < 0.05$).

Summary

Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas, and Lafourche are six improved, genetically different smooth cordgrass varieties developed by the LSU AgCenter. All LSU AgCenter varieties recovered more quickly after transplant and were as vigorous, spread as far, and produced as many stems per plot as Vermilion in natural marsh environments. LSU AgCenter varieties always produced more seeds with higher germination rates than Vermilion. In freshwater production ponds, performance of the LSU AgCenter varieties was less consistent.

Restoration projects should utilize all available smooth cordgrass varieties to maximize the genetic diversity of the restored site and increase the production of viable seeds. Genetic diversity will allow restored areas to adapt to environmental changes, while production of viable seed will increase the self-sustainability of the site.

Variety Availability

Vegetative material of Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas, and Lafourche will be available from the LSU AgCenter Burden Center in Baton Rouge; direct requests for material to Carrie Knott, Coastal Plants Breeder, cknott@agcenter.lsu.edu. Plant patent applications have been submitted for Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas, and Lafourche. Vegetative material of Vermilion is available from the USDA-NRCS Golden Meadow Plant Materials Center.