LSU AgCenter Coastal Plants Program

Smooth Cordgrass Varieties: *Descriptions 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 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 the state has the highest erosion rate in 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, Vermilion, is used. This variety was released by the U.S. Department of Agriculture's Natural Resources Conservation Service in 1989. The widespread use of Vermilion could threaten Louisiana's restoration projects, however, 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 plants will 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.

Smooth Cordgrass transplant at Vermilion Bay, Louisiana. Photo by Matt Voitier

Variety Descriptions

All smooth cordgrass varieties are cloned varieties that are increased by dividing stems attached to roots. Visual identification of smooth cordgrass varieties can be extremely difficult because the same variety can look dramatically different when grown in different conditions.

Descriptions given below are common traits of each variety when grown with abundant fertilization. These descriptions may not apply to each variety in every environmental condition, however. Definitive identification of each variety should be done using molecular fingerprinting techniques.

Smooth Cordgrass plants building land at natural marsh environment, Cameron Parish, Louisiana. Photo by Carrie Knott

Vermilion: This variety was released in 1989 by the USDA Natural Resources Conservation Service's Golden Meadow Plant Materials Center at 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 also is genetically different from Vermilion and has been observed to recover faster than Vermilion after transplanting in marsh environments.

Terrebonne: This variety is as robust and 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 width than Vermilion. It has been observed to recover faster after transplanting 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 from 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 Plant Materials Center 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 the Golden Meadow Plant Materials Center 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 transplanting than Vermilion, is genetically different from Vermilion, Cameron, Terrebonne and Jefferson and produces more seeds that germinate than Vermilion.

Smooth cordgrass test plot, Cameron Parish, Louisiana. Photo by Carrie Knott

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 1 mile north of the Rio Grande River outlet of the Gulf of Mexico. Seeds were germinated at the USDA-NRCS Golden Meadow Plant Materials Center to produce mature plants. Plants were allowed to pollinate with various smooth cordgrass plants that had been collected from 10 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 transplanting. It also is 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 transplanting into natural marsh environments.

Variety Performance

Variety performance was compared in 11 replicated trials from 2001 through 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.

Vigor of each variety was measured in 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 and 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 constructed terraces in Cameron Parish, Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche were more vigorous than Vermilion. This suggests the six LSU AgCenter smooth cordgrass varieties recover more quickly after transplant than Vermilion, which makes them ideal varieties for restoration in areas where fast recovery is essential.

In freshwater production ponds at the LSU AgCenter's Ben Hur Research Farm and its Rice Research Station during 2008 and 2009, Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche were as vigorous as Vermilion (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 few production inputs. The variable vigor data found in freshwater production ponds indicates production deficiencies, such as fertilization, may contribute to reduced vigor of Cameron, Terrebonne and Jefferson.

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	Constructed terraces
Marsh	Grande Terre Island	2003	Constructed terraces
Marsh	Cameron Parish	2003	Constructed terraces
Marsh	Rockefeller Wildlife Refuge	2008	Eroded marsh areas
Marsh	Cameron Parish	2008	Constructed 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

Table 2. Vigor of smooth cordgrass varieties evaluated at 6 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 was collected from the same site. The 2008 data was collected one month after transplanting, and the 2009 data was collected one year after transplant.

Table 3. Vigor of smooth cordgrass varieties evaluated at 5 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.

The performance of smooth cordgrass varieties also was 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 the 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.

When number of stems per plot was evaluated in freshwater production ponds, more variable results were found than for the marsh environments. Cameron, Terrebonne, Jefferson, Las Palomas and Lafourche produced fewer stems than Vermilion in 2005. In 2006, Cameron, Terrebonne, Jefferson and Lafourche produced fewer stems than Vermilion. In 2008 and 2009, all six LSU AgCenter varieties produced as many stems as Vermilion in freshwater production ponds (Table 7).

Table 4. Plant spread of smooth cordgrass varieties evaluated at 3 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 5 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).

Table 6. Number of stems per plot for smooth cordgrass varieties evaluated at 3 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

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

During 2005 and 2006, differences in plant vigor also were found at the Rice Research Station. These results suggest some factor(s) 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.

Seed production and germination also were evaluated to ensure the varieties are capable of producing large amounts of viable seeds. It was not feasible to harvest seeds from natural environments because of 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 that do not require human intervention.

Table 7. Number of stems per plot for smooth cordgrass varieties evaluated in freshwater production ponds at the LSU AgCenter's 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).

Table 8. Percentage of seed set and seed germination of smooth cordgrass varieties produced in freshwater production ponds at the LSU AgCenter's 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 transplanting 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 use all available smooth cordgrass varieties to maximize the genetic diversity of the restored sites 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 sites.

Variety Availability

Vegetative material of Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche will be available from the LSU AgCenter's Burden Center in Baton Rouge. Requests for Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche should be directed to LSU AgCenter coastal plant breeder Carrie Knott at 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.

LSU AgCenter smooth cordgrass variety increases, Burden Center, Baton Rouge, Louisiana. Photo by Carrie Knott

Smooth cordgrass transplant at Vermilion Bay, Louisiana. Photo by Matt Voitier

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