KIKA DE LA GARZA PLANT MATERIALS CENTER KINGSVILLE, TEXAS

2001 ANNUAL TECHNICAL REPORT

E. "Kika" de la Garza
Plant Materials Center

2001

Annual Technical Report

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2001 Annual Technical Report
Kika de la Gaza Plant Materials Center
Kingsville, Texas

INTRODUCTION

The Kika de la Garza Plant Materials Center (PMC) located at Kingsville, Texas was established in April 1981. The PMC is operated by the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service, in cooperation with an Advisory Board from Texas A&M University-Kingsville, the Caesar Kleberg Wildlife Research Institute (CKWRI), the South Texas Association of Soil and Water Conservation Districts (STASWCD), and the Gulf Coast Association of Soil and Water Conservation Districts (GCSWCD). The Advisory Board provides overall guidance and direction toward meeting the Plant Material Center's objectives.

The objective of the Plant Materials Program is to provide cost effective vegetative solutions for soil and water conservation problems. This means identifying plants for conservation use, developing techniques for their successful use, providing for their commercial increase, and promoting their use in natural resource conservation and other environmental programs.

LOCATION AND FACILITIES

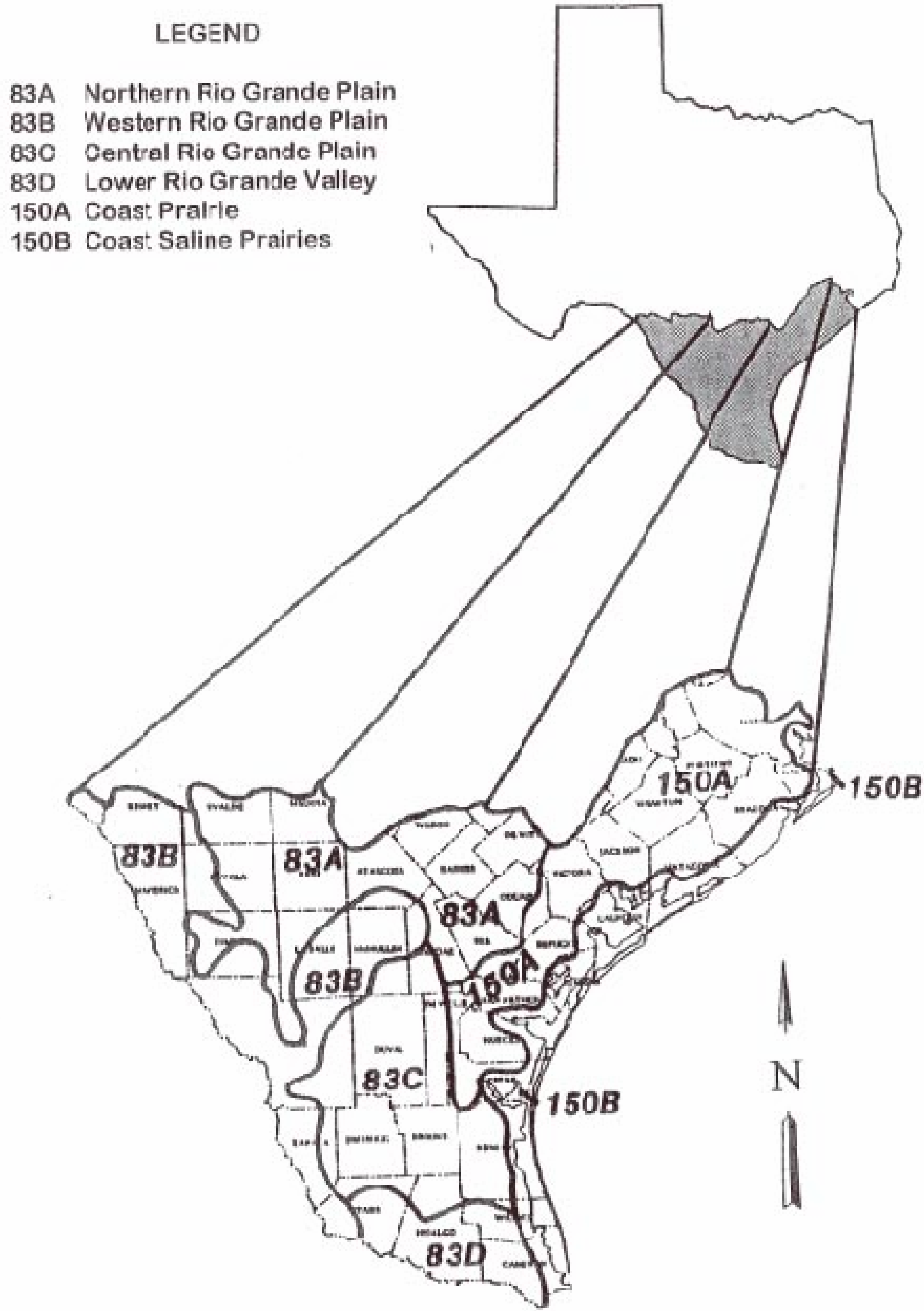
The Kika de la Garza PMC is located just outside of Kingsville on 76 acres of land leased from Texas A&M University-Kingsville and 5 acres leased from the King Ranch (see map inside back cover). The soils at the PMC are Raymondville clay loam and Victoria clay. The King Ranch annex has Delfina fine sandy loam soil and Willacy fine sandy loam soil. Topography of the PMC is flat.

Facilities consist of an office, greenhouse, seed cleaning barn, seed storage building, shop and equipment storage barn, and a fuel and pesticide storage complex. Limited irrigation water is available from a shallow pond located at the PMC and is for furrow irrigation. Specialized hydroponic tanks are located at the PMC for use in production and evaluation of aquatic plants.

INTERNET

You can access our website on the internet to find information about the Plant Materials Center. Information and publications will be added to our home page periodically to keep it up-to-date. The website address is accessed through http://www.tx.nrcs.usda.gov or http://plant-materials.nrcs.usda.gov.

The Kika de la Garza Plant Materials Center serves 6 Major Land Resource Areas (MLRA) totaling approximately 27 million acres of the southern portion of Texas.



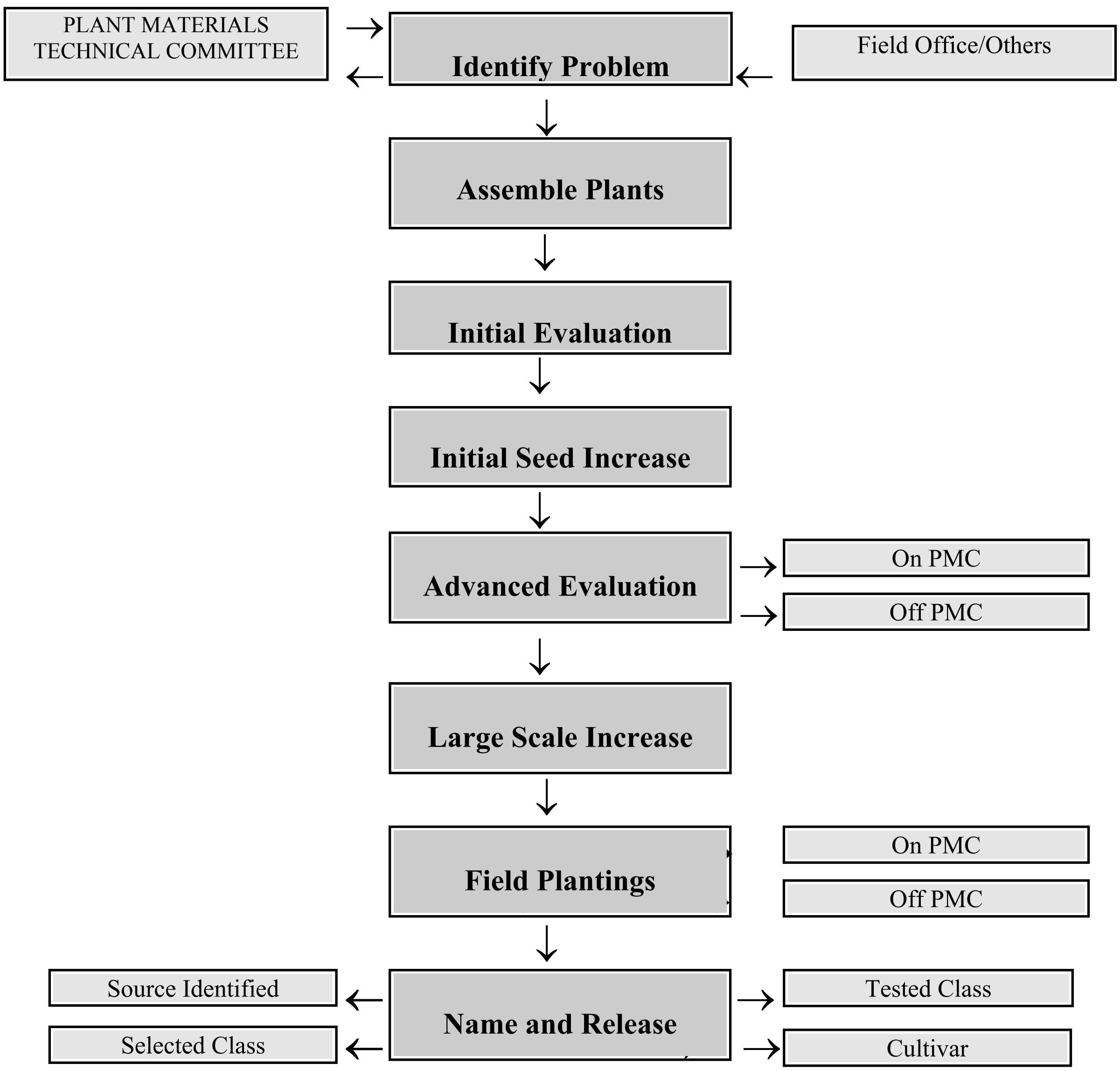
CLIMATE DATA

TEMPERATURE °F | RAINFALL (INCHES)

MONTH	HISTORICAL AVG.	2001 MONTHLY AVG.	2001 MAX	2001 MIN	HISTORICAL AVG.	2001 MONTHLY TOTAL
JANUARY	56.8	56	82	30	1.71	0.79
FEBRUARY	60.2	63	91	34	1.62	0.97
MARCH	66.9	62	86	37	0.86	1.65
APRIL	73.4	72	92	53	1.50	0.06
MAY	78.4	72	98	59	2.58	0.76
JUNE	82.9	86	102	70	3.05	1.57
JULY	84.9	91	101	80	2.13	0.64
AUGUST	84.9	87	102	70	2.72	4.81
SEPTEMBER	81.3	77	96	57	4.47	3.18
OCTOBER	73.8	70	95	45	3.17	1.16
NOVEMBER	65.0	61	86	36	1.26	10.08
DECEMBER	58.8	58	83	33	1.13	1.28
			TOTAL		**26.20**	**26.95**

PLANT MATERIALS PROGRAM
PLANT RELEASE PROCESS

The Plant Materials Program has established a sytematic process to evaluate and release plants to address the conservation problems outlined in the long-range program. The intensity and time of evaluation will vary according to the class of release. A cultivar will require many years of intense evaluation whereas a source identified plant can be released in 1-2 years with little evaluation. The following flow chart illustrates the steps invoved in this process.



LONG RANGE PROGRAM

PRIORITIES:

The Kika de la Garza Plant Materials Center's long range program has identified four high priority conservation needs to direct the operations at the PMC. These priorities have been established by the recommendations of the PMC Advisory Board, PMC Plant Technical Committee and field office surveys.

-Plant selection and cultural techniques to supply a better diversity of native forage for livestock.

-Plant selection and cultural techniques for addressing shoreline erosion and water quality issues of coastal and inland areas.

-Plant selection and cultural techniques to supply food, cover, and habitat for wildlife.

-Plant selection and cultural techniques for ecosystem restoration. Emphasis is on restoration sites with alkaline and saline soil problems, endangered species recovery and sand dune stabilization.

Pasture and Rangeland Grasses

-Warm-season native grasses
-Cool-season native grasses

Erosion Control and Water Quality Improvement

-Evaluation of vegetative barriers for cropland and gully erosion control
-Plants for coastal shoreline erosion control
-Plants for coastal water quality improvement

Wildlife Habitat Improvement

-Plants for wildlife upland habitat
-Plants for coastal water fowl habitat

Ecosystem Restoration

-Plant selection and cultural techniques for ecosystem restoration
-Plants for alkaline and saline soils
-Techniques for the restoration of endangered plant species

Study Number: 77IO16H

Study Title: Evaluation of Four Flower Trichloris (*Trichloris pluriflora*)

Introduction: Four flower trichloris (*Trichloris pluriflora*) is a warm-season perennial bunch grass native to Texas (Hitchcock, 1971). It is of particular interest because USDA-NRCS soil surveys have reported that four flower trichloris is one of two co-dominant climax species on numerous range sites in South Texas. Four flower trichloris is more commonly known as multi-flowered false rhodesgrass (Gould, 1975). Multi-flowered false rhodesgrass grows on plains and in dry woods in south Texas, Mexico, and in southern South America (Correll and Johnston, 1996; Hitchcock, 1971). Although the presence of multi-flowered false rhodesgrass is considered to be an indicator of good range condition, there is no known commercial variety of this chloris species.

Problem: There is a need for native, adapted seed available at a reasonable price for the restoration and reclamation of habitat in the South Texas Region.

Objective: The objective is to assemble, comparatively evaluate, select and release, and/or provide information on the propagation of four flower trichloris.

Discussion: Fourteen collections of four flower trichloris were seeded in the greenhouse in January 2001. Four collections were transplanted to the field in April 2001. All accessions had good survival and growth. These accessions also had over 88% seed germination within the first 15 days. We will continue to evaluate these accessions as well as any other collections that are received as part of the South Texas Natives Projects.

Study Number: 77I045PH

Study Title: Assembly and Evaluation of Saltgrass (*Distichlis spicata*)

Introduction: Saltgrass is a native, rhizomatous perennial warm-season grass (Hitchcock, 1971). It generally forms tight colonies on muddy saline sites (Correll and Johnston, 1996). Saltgrass plants are dioecious but have been known to be monoecious on rare occassions. Pistillate panicles have congested, irregular spreading spikelets while staminate panicles tend to be more open and taller (Gould, 1975). There are two varieties of saltgrass in Texas, *spicata* and *stricta* . *Distichlis spicata* var. *spicata* is found along seashores in coastal marshes from Nova Scotia to Florida, Texas, Mexico and the West Indies on the eastern coast. On the western coast this variety is found from Washington to Baja California and Sinaloa, Mexico. *Distichlis spicata* var. *stricta* occurs mostly in moist, saline inland areas of western U.S., east to the Dakotas, western Texas, Nebraska, Kansas, and Oklahoma, also including Coahuila and Chihuahua, Mexico.

Problem: There are over 3,000 miles of coastal shoreline along the Texas Gulf Coast. Many of these miles have eroding bluffs that need adapted plant material for stabilization. These bluffs along with coastal wetland berms and dredge spoil islands are all in need of low-cost planting techniques to provide an economical method of vegetatively stabilizing and enhancing these sites.

Most coastal revegetation projects are established with expensive transplants. If a seeded variety of a salt-tolerant grass could be developed, it would provide a low-cost technique for stabilization and enhancement of Texas coastal shorelines. Seeded plants along with turf-reinforcement matting may provide a low-cost environmentally friendly, stabilizing system for miles of eroding shorelines. Another alternative would be to find a hardy, salt-tolerant rhizomatous or stoloniferous variety that could be disked into the soil to stabilize eroding shorelines.

Objective: The objective is to assemble, comparatively evaluate, select and release and/or provide information on the propagation of saltgrass.

Discussion: Five accessions of saltgrass were vegetatively collected in the year 2000. These five collections were evaluated during 2001 (Table 1). Although all collections had good survival and production accession 9085361 from Calhoun County appeared to have the best overall performance. Seed was collected from all the accessions and will be germination tested in 2002. Furthermore, a replicated vegetative sprigging study of saltgrass, seashore dropseed, marshhay cordgrass and gulf cordgrass was initiated on October 15, 2001.

Table 1. Study 77I045PH Saltgrass

Accession number	Source (County)	% Survival	Foliage Density*	Resistance*	Seed Production (grams)
9085365	Brazoria	100	4.2	4.5	3
9085361	Calhoun	100	4.2	4.1	22
9076939	Nueces	100	5.3	5.7	20
9085364	Cameron	100	4.6	4.8	54
9085378	Chambers	90	5.6	5.8	7

*Ocular estimate (1=Best)

Study Number: 77I045W

Study Title: Evaluation of Coastal Wetland Species

Introduction: Constructed wetlands are receiving increased attention as viable systems for the treatment of wastewater from municipal, industrial and agricultural sources (Hammer, 1989). They are an innovative, economical and efficient method of pollution control. Environmental concerns regarding the coastal shrimp and other fish farms along the Texas Gulf coast have triggered protests and litigation. Coastal fish farms draw water and discharge water in to the coastal bays and estuaries. Major concerns involve the content of the wastewater discharge. The discharge may be high in suspended solids, turbidity and nutrients that may adversely affect the marine environment. Coastal fish farms utilize bay water, which can range in salinity levels from 15-35 parts per thousand. Most research on constructed wetlands has been done with fresh water emergent plants (Hammer, 1992; Doyle and Smart, 1993). Therefore, the selection and propagation of plants for saline wetlands is quite specific and virtually unknown.

The Texas Gulf Coast marshes are internationally significant migration and wintering habitat for North American waterfowl. Texas has seen an estimated 52% loss (8 million acres) in wetland acreage over the past 200 years. Anderson et al, (1996) found that waterfowl in Texas depend on wetlands to meet their pre-breeding nutritional needs. Therefore, it is important to construct wetland types under programs such as the USDA Wetlands Reserve Program and the USFWS Prairie Wetlands Program that will provide high value habitat for waterfowl and other water birds. Currently, there are only a few wetland plant vendors in Texas. Furthermore, the selection of plants is not targeted towards water bird food values.

Problem: There is a need for adapted wetland plants for constructed wetlands and wildlife habitat in South Texas.

Objectives: The objective of this study is to collect, evaluate, select and release, and/or provide information on the propagation of adapted wetland plants for South Texas.

Discussion: The PMC has collected and evaluated over 30 species of wetland plants. There are four species that have shown good adaptation to the harsh South Texas environment. California bulrush (*Scirpus californicus*), Olney bulrush (*Scirpus americanus*), American bulrush (*Scirpus pungens*) and soft-stem bulrush (*Scirpus tabernaemontani)* have been grown at the PMC for several years and appear to be good candidates for constructed wetlands. We have two pending projects with TAMU-

Kingsville, where we plan to evaluate these species in constructed wetlands for municipal wastewater treatment.

The PMC has evaluated many wetland plants over the year for waterfowl habitat enhancement. There are four species that have promising potential for use in improving this type of habitat. Gulfcoast spikerush (*Eleocharis cellulosa*), squarestem spikerush (*Eleocharis quadrangulata*), saltmarsh bulrush (*Scirpus robustus*) and creeping rivergrass (*Echinochloa polystachya*) have shown good survival and adaptation characteristics for South Texas. These species produce an abundance of seeds and/or tubers that make them highly desirable for waterfowl. See the respective plan for each species for more details.

Study Number: **77I046F**

Study Title: Evaluation of Coastal Shoreline Species

Introduction: For many years, the Shoreline Erosion Committee of the Texas State Association of Soil and Water Conservation Districts has implemented shoreline erosion control projects with smooth cordgrass. However, many of these projects, where bluffs were encountered, failed to completely solve the shoreline erosion problem. With the development of geotextiles, there is the opportunity to implement low-cost shoreline projects that address the problems of these highly eroding bluff sites.

Geosynthetic turf reinforcement mats provide a low-cost alternative to hard armor on eroding critical areas. The mats along with the root reinforcement of seeded or planted vegetation resist damage from wave energy and high velocity surface flows. On high energy wave sites, cellular concrete blocks are an alternative to concrete and rip-rap. Both of these erosion control materials provide for the opportunity to install native salt tolerant plant species. These plants are not only aesthetically appealing but their roots and stems may be a critical component of an effective erosion control system.

Problem: There are over 3,000 miles of coastal shoreline along the Texas Gulf Coast. Many of these miles have eroding bluffs that need adapted plant material for stabilization. These bluffs along with coastal wetland berms and dredge spoil islands are all in need of low-cost planting techniques to provide an economical method of vegetatively stabilizing and enhancing these sites.

Objective: The objective of this study is to evaluate a variety of species for coastal shoreline stabilization and provide technical information on the use and propagation of these species.

Discussion: This project was initiated in 1997 where five native coastal Texas plants (*Spartina patens*, *Spartina spartinae*, *Iva frutescens*, *Myrica pusilla*, and *Atriplex acanthocarpa*) were evaluated with concrete cellular blocks and turf reinforcement matting (Land and Water, Sept./Oct. 2000). Marshhay cordgrass (*Spartina patens*), Gulf cordgrass (*Spartina spartinae*), and Marsh elder (*Iva frutescens*) performed exceptionally well in this project.

In 2001 a second project was initiated to provide shoreline protection for an historic oyster shell building. The PMC developed a bioengineering design to safeguard the structure utilizing fabric encapsulated soil and native salt-tolerant plants. Seven encapsulated soil lifts were constructed at a 2:1 gradient. Twenty-four inch long containerized plants were placed horizontally every two feet between the soil lifts. Six-inch containerized material was planted vertically every one foot into the bench of the soil lifts. Marshhay cordgrass, gulf cordgrass, and marsh elder were the principal plants used in the construction. Project results should provide guidance on nonstructural, shoreline erosion practices for embankments and dunes along the Texas Gulf Coast.

Study Number: 77I048PH

Study Title: Assembly and Evaluation of Seashore Dropseed (*Sporobolus virginicus*)

Introduction: Seashore dropseed (*Sporobolus virginicus*), also called coastal dropseed, is a rhizomatous, perennial warm-season grass (Correll and Johnston, 1996). It is found along the Atlantic and Caribbean coasts from Virginia to Brazil, in the West Indies, along the Texas coast, and in South Africa (Gould, 1975). It prefers sandy or muddy seashores and saline marshes, and usually forms extensive colonies (Hitchcock, 1971). It is readily grazed when it is available (Hitchcock, 1971).

Problem: There are over 3,000 miles of coastal shoreline along the Texas Gulf Coast. Many of these miles have eroding bluffs that need adapted plant material for stabilization. These bluffs along with coastal wetland berms and dredge spoil islands are all in need of low-cost planting techniques to provide an economical method of vegetatively stabilizing and enhancing these sites.

Most coastal revegetation projects are established with expensive transplants. If a seeded variety of a salt-tolerant grass could be developed, it would provide a low-cost technique for stabilization and enhancement of Texas coastal shorelines. Seeded plants along with turf-reinforcement matting may provide a low-cost environmentally friendly, stabilizing system for miles of eroding shorelines. Another alternative would be to find a hardy, salt-tolerant rhizomatous or stoloniferous variety that could be disked into the soil to stabilize eroding shorelines.

Objective: The objective of this study is to assemble, comparatively evaluate, select and release and/or provide information on the propagation of seashore dropseed.

Discussion: Seven accessions of seashore dropseed were vegetatively collected in the year 2000. These 7 collections were evaluated during 2001 (Table 1). All collections had good survival and production. Accession 9085317 from Nueces County had the best vigor, foliage density, and seed production. Seed was collected from all the accessions and will be germination tested in 2002. Furthermore, a replicated vegetative sprigging study of seashore dropseed, saltgrass, marshhay cordgrass and gulf cordgrass was initiated on October 15, 2001.

Table 1. Study 77I048PH Seashore Dropseed

Accession number	Source (County)	% Survival	Foliage Density*	Resistance*	Seed Production (grams)
9085362	Calhoun	100	4.3	3.7	9
9085357	Kleberg	100	4.6	4.6	26
9085363	Brazoria	100	4.8	4.9	19
9076936	Nueces	100	4.8	5.2	7
9085317	Nueces	100	3.5	4.2	27
9085367	Cameron	100	4.2	4.3	11
9085321	Nueces	100	6.0	5.5	—

* Ocular estimate (1 = best)

Study Number: 77I049H

Study Title: Assembly and Evaluation of Brownseed Paspalum (*Paspalum plicatulum*)

Introduction: Brownseed paspalum (*Paspalum plicatulum*) is a native, warm-season, rhizomatous perennial bunchgrass. It is native to Georgia, Florida, and Texas, south to Argentina, and in the West Indies (Hitchcock, 1971). In Texas, it is common in east and southeast Texas, and in the coastal part of the Rio Grande Plains. It is occasionally found west to North Central Texas, and the northern Rio Grande Plains (Correll & Johnston, 1996). It prefers sandy to sandy loam soils (Gould, 1975), and can be found in open woods and on prairies (Correll and Johnston, 1996). *Paspalum texanu*m, previously recognized as its own species is now included under *Paspalum plicatulum* (Gould, 1975). Gould (1975) notes that although there are some differences between the two, the morphological variability and wide range of adaptability of *Paspalum plicatulum* could easily account for the character differences. Therefore, he does not recognize *Paspalum texanum* as a separate taxon. Hitchcock (1971) includes the Brazilian native, *Paspalum nicorae*, under *Paspalum plicatulum* for similar reasons. *Paspalum plicatulum* flowers throughout most of the year (Gould, 1975). Its fruit turns dark brown at maturity (Correll and Johnston, 1996), thereby earning its common name of brownseed paspalum.

Problem: There is a need for native, adapted seed available at a reasonable price for the restoration and reclamation of native habitat in the South Texas region.

Objective: The objective is to assemble, comparatively evaluate, select and release and/or provide information on the propagation of brownseed paspalum.

Discussion: Twenty-seven accessions of brownseed paspalum were collected and seeded in the greenhouse on January 2000. Twenty-two accessions were transplanted to the field in April 2000. Evaluations of the transplants occurred throughout 2000 and 2001. Three accessions stood out as top performers during this two-year evaluation, 9064475- Burleson County, 9064483- Gonzales County, and 9076967- Goliad County. Four other accessions also revealed good survival and production chacteristics, 9076888- Goliad County, 9064467- Lavaca County, 9085314 and 9085315 both from Kenedy County (Table 1). Greenhouse seed germination results from both winter 2000 and winter 2001 also show that accessions 9085314, 9085315, 9064475, and 9076888 have both good total germination after 60 days as well as early seed germination, within 15 days of initial seeding (Table 2 and 3).

A seed nursery to develop a South Texas ecotype of brownseed paspalum was initiated in the spring of 2001. A seed nursery for a Texas Gulf Coast ecotype is scheduled for the spring of 2002. The Kika de la Garza PMC is working in conjuction with Dr. Ocumpaugh from the Texas A&M Agricultural Experiment Station in Beeville to evaluate accessions of brownseed paspalum for early germination and seedling emergence.

Table 1. Study 77I049H Brownseed Paspalum.

Accession Number	Source (County)	% Survival	Foliage Density*	Resistance*	Seed Production*
9076963	Austin	70	7.4	6.6	5.9
9076967	Goliad	100	4.8	4.7	5.8
9085314	Kenedy	100	6.0	5.7	7.0
9076888	Goliad	80	6.4	6.0	5.9
9064462	Madison	57	6.9	7.1	6.1
9064463	Goliad	60	6.1	5.6	6.0
9076881	Calhoun	45	5.7	6.2	5.7
9064464	Freestone	80	7.4	7.2	6.4
9064475	Burleson	85	5.6	5.3	5.6
9064466	Matagorda	75	6.5	6.2	6.9
9064467	Lavaca	100	6.0	6.0	5.9
9085315	Kenedy	95	5.8	5.3	6.8
9064483	Gonzales	100	5.1	5.0	5.4
9064484	Freestone	100	6.4	6.3	5.9
9076890	Guadalupe	90	6.3	6.0	5.8
9076882	Calhoun	70	6.2	6.2	5.8
9076937	Kenedy	90	6.4	6.1	6.5
9085294	Nueces	85	6.2	5.5	6.0

*Ocular estimate (1 = Best)

Table 2. Study 77I049H Brownseed Paspalum Greenhouse Germination

Winter 2000

Accession Number	Origin (County)	15 Days %	30 Days %	45 Days %	60 Days %
9076937	Kenedy	2	6	18	30
9076963	Austin	0	2	18	30
9076881	Calhoun	16	20	22	46
9076882	Calhoun	8	12	16	76
9076888	Goliad	8	16	26	100
9076890	Guadalupe	24	42	46	88
9064486	Jackson	0	0	0	0
9064487	Jackson	0	0	0	0
9064488	Jackson	0	0	0	0
9064475	DeWitt	4	12	18	82
9064473	Brazos	0	0	0	0
9064467	Lavaca	10	10	14	54
9064466	Matagorda	4	6	6	62
9064464	Freestone	6	20	20	20
9064463	Goliad	16	22	24	36
9064462	Madison	6	8	12	30
9064482	Washington	0	0	0	0
9064483	Gonzales	4	4	6	78
9076966	Washington	0	0	0	0
9076967	Goliad	4	6	28	40
9085254	Jim Hogg	0	0	0	0
9085272	Hidalgo	0	0	2	10
9085274	Jim Hogg	0	0	0	0
9085290	San Patricio	0	0	0	6
9085294	Nueces	8	12	12	20
9064477	Burleson	0	0	0	4
9064484	Freestone	24	36	36	100
9085314	Kenedy	100	100	100	100
9085315	Kenedy	100	100	100	100

Table 3. Study 77I049H Brownseed Paspalum Greenhouse Germination

Winter 2001

Accession Number	Origin (County)	15 Days %	30 Days %	45 Days %	60 Days %
9076937	Kenedy	59	63	66	66
9076888	Goliad	86	88	91	91
9064463	Goliad	17	20	22	22
9064483	Gonzales	18	18	79	79
9076967	Goliad	53	54	66	66
9085254	Jim Hogg	2	2	7	8
9085272	Hidalgo	62	78	90	90
9085274	Jim Hogg	38	39	44	44
9085315	Kenedy	100	100	100	100
9085314	Kenedy	62	79	79	79
9064475	DeWitt	90	90	94	94

Study Number: 77I050JH

Study Title: Assembly and Evaluation of Native Legumes for South Texas

Introduction: Native, perennial legumes can add value to many range planting or wildlife food plots. First, most legumes provide a highly nutritious source of forage. Second, legumes help fix nitrogen in the surrounding soil thereby increasing the soil fertility of the planting site. Third, legumes can be used to add biodiversity to a site when planted with grasses and other forbs. Finally, legumes tend to have showy flowers and can add aesthetic value to a site, and be used in a native, perennial garden.

Problem: There is a need for native perennial legumes for range restoration, wildlife habitat and xeriscaping in South Texas. Currently, the only native legumes used in South Texas are partridge pea and Illinois bundleflower. Partridge pea is an annual species and Illinois bundleflower is a perennial species that has difficulties with survival and persistence in South Texas.

Objective: The objective is to assemble, evaluate, select and release and/or provide information on the propagation of native legumes for South Texas.

Discussion: *Dalea multiflorum* secured from Native American Seed had better survival and growth characteristics on both the clay soils of the PMC and the sandy loam soils of the PMC Annex than any of the other daleas (Table 1). The purple prairie clover (*D. purpurea*) from Washington County performed the best on the clay soils at the PMC compared to the other purple prairie clovers. The purple prairie clover from Austin County had better survival and growth characteristics on the sandy loam soils. Across all soils, the collection from Austin County appeared the best adapted to environmental conditions in Kingsville. Golden dalea (*D. aurea*) from Native American Seed had slightly better survival than the other collections on the clay soils at the PMC. However, all the collections struggled on clay soils. The golden daleas performed better on the sandy loam soils at the PMC Annex.

The prairie acacia (*Acacia angustissima*) from LaSalle County had the best survival, growth, and seed production of the three collections evaluated on both clay and sandy soils (Table 2). This species should have good commercial opportunities because of its adaptation and growth characteristics.

Table 1. Study 77I050JH Dalea species.

PMC (clay soil)

Species/ Accession Number	Source	% Survival	Foliage Density*	Resistance*	Seed Production*
D. multiflorum 9085248	Native American Seed	100	5.9	5.4	3.1
D. purpurea 9076964	Austin County	90	6.3	5.4	4.0
D. purpurea 441183	Knox City	90	5.7	5.1	4.1
D. purpurea 9076965	Washington County	100	5.5	4.9	3.4
D. aurea 9085247	Native American Seed	50	5.7	5.8	4.4
D. aurea 9076953	Jim Hogg County	40	5.9	5.3	4.2
D. aurea 9076952	Jim Hogg County	30	5.7	5.7	4.2

ANNEX (sandy soil)

Species/ Accession Number	Source	% Survival	Foliage Density*	Resistance*	Seed Production*
D. multiflorum 9085248	Native American Seed	70	5.2	4.4	3.5
D. purpurea 9076964	Austin County	40	5.2	5.3	3.0
D. purpurea 441183	Knox City	20	5.0	5.3	3.1
D. purpurea 9076965	Washington County	10	5.4	5.6	4.0
D. aurea 9076953	Jim Hogg County	50	4.0	4.1	3.0
D. aurea 9076952	Jim Hogg County	55	4.2	4.2	3.2

*Ocular estimate (1 = Best)

Table 2. Study 77I050JH Prairie Acacia.

PMC (clay soil)

Accession Number	Source	% Survival	Foliage Density*	Resistance*	Seed Production*
9076907	LaSalle County	100	3.4	3.3	3.5
9085305	Burleson County	75	7.5	7.5	8.5
9076909	Frio County	100	5.5	5.4	4.8

ANNEX (sandy soil)

Accession Number	Source	% Survival	Foliage Density*	Resistance*	Seed Production*
9076907	LaSalle County	100	3.1	4.1	3.6
9085305	Burleson County	100	4.0	4.5	4.2
9076909	Frio County	100	5.5	5.3	4.3

*Ocular estimate (1 = Best)

Study Number: 770I52H

Study Title: Assembly and Evaluation of Hooded Windmillgrass (*Chloris cucullata*)

Introduction: Hooded Windmillgrass (*Chloris cucullata*) is a native, perennial, warm-season grass that is often stoloniferous (Gould, 1975). Also known as 'Hooded Fingergrass', it can be found in prairies on sandy or gravelly soils, and occasionally on clayey soils (Correll and Johnston, 1996). It is native throughout Texas, Oklahoma, and New Mexico (Hitchcock, 1971) and the northeast portion of Mexico (Gould, 1975). In Texas, hooded windmillgrass is most abundant in the Rio Grande Plains, although it can be found throughout most of the state. It is rarest in the western plain, Trans-Pecos region, eastern, and southeastern Texas. Hooded windmillgrass has been known to hybridize with other chloris species, particularly *Chloris verticillata*. Hybridization had been most common in the Rio Grande Plains, and hybrids have been given the names *Chloris latisquamea* or more currently *C. subdolichostachya*. 'Bell' Rhodesgrass, a release variety of *Chloris gayana* will be used as a comparison standard. Hitchcock (1971, p.29) provides excellent illustrations that may assist in differentiation of the species. The windmillgrasses provide fair quality forage for livestock, and tend to increase with heavy grazing.

Problem: There is a need for native, adapted seed available at a reasonable price for restoration and reclamation of habitat in the South Texas region.

Objective: The objective is to assemble, comparatively evaluate, select and release, and/or provide information on the propagation of hooded windmillgrass.

Discussion: Hooded windmillgrass typically refers to *Chloris cucullata* and is identified as being a perennial bunchgrass with culms 15-60cm tall producing 14-18 spikelets per centimeter of rachis. The seeds tend to be smooth and black. According to Gould (1975) hooded windmillgrass hybridizes with *Chloris verticillata* and *Chloris andropogonoides* in areas where their ranges overlap. The hybrids are generally intermediate morphologically between the parents. Tetraploid populations with regular meiosis and good seed set have been sampled in San Patricio and Brazos counties. These hybrids make up the species *Chloris subdolichostachya*, commonly called shortspike windmillgrasss. This species is a strongly stoloniferous perennial grass with culums 30-70cm tall. The stoloniferous charcteristic makes this an extremely desirable plant, especially for roadside plantings.

Evaluations of collected windmillgrass indicated at least four different morphological types. Type 1 is the standard hooded variety (*C. cucullata*). Type 3 appears to be shortspike windmillgrass (*C.*

subdolichostachya). Type 2 is intermediate between type 1 and type 3. Type 4 is either fringed windmillgrass (*C. ciliata*) or an unidentified chloris species.

Forty-three accessions of windmillgrass were collected and seeded in the greenhouse in January 2000. Thirty-six accessions were transplanted to the field in April 2000. Evaluations of the transplants occurred on both clay soils and sandy soils at the PMC Annex throughout 2000 and 2001. Six accessions stood out as top performers for survival, vigor and foliage density, disease resistance and seed production. Four of these accessions appear to be shortspike windmillgrass: 9085289, 9085260, 9085262, and 9085283 (Table 1 and Table 2). Accessions 9085265 and 9085316 were the best performing hooded windmillgrass collections. Accessions 9085313 and 9085300 also showed good survival and growth characteristics. Seed germination results from the winter 2000 and winter 2001 greenhouse plantings (Table 3 and 4) and germination chamber (2001 seed harvest) trials (Table 5) revealed poor germination from the shortspike windmillgrass collections. The hooded windmillgrass accession 9085300 consistently showed the highest germination of the collections.

In order to develop a South Texas ecotype of hooded windmillgrass a seed nursery of this species was initiated in the spring of 2001. The Kika de la Garza PMC is also working with Dr. Ocumpaugh from the Texas A&M Agricultural Experiment Station in Beeville to evaluate accessions of windmillgrass for stolons, early germination and seedling emergence.

Table 1. Study 77I052H Hooded Windmillgrass at the PMC (clay soil).

Accession Number	Source (County)	Type	% Survival	Foliage Density*	Resistance*	Seed Production*
9076951	Frio	1	100	5.2	4.5	3.9
9076977	Palo Pinto	1	95	6.5	5.6	4.5
9076946	Kleberg	1	100	5.3	4.3	5.4
9085229	Coleman	1	95	6.9	6.2	5.0
9085308	Lampasas	1	100	6.6	5.9	5.1
9085235	Lubbock	1	100	7.0	6.3	5.5
9085300	Bee	1	100	5.3	4.8	5.1
9085289	San Patricio	3	100	4.4	3.7	4.0
9085316	Kenedy	1	100	4.3	3.4	4.9
9085243	Burnet	1	100	6.1	4.9	3.7
9085285	Howard	1	100	6.2	5.9	4.8
9085288	Burleson	1	100	5.4	4.7	3.6
9085242	Austin	4	100	4.5	4.7	3.7
9085309	Kleberg	4	100	5.5	4.4	5.0
9085258	Goliad	3	100	4.6	4.1	4.8
9076968	Knox	1	100	7.0	6.4	4.3
9085264	DeWitt	3	100	4.4	4.2	4.8
9085260	San Patricio	3	100	3.1	3.3	3.8
9085240	Dimmit	1	95	5.3	4.8	4.5
9085234	Lubbock	2	100	7.4	7.0	4.8
9085301	Duval	1	100	5.4	5.3	4.7
9076971	Brown	1	100	6.5	6.4	4.3
9085313	Kenedy	1	100	4.6	4.0	5.0
9085245	Burnet	1	100	5.8	5.3	4.8
9076955	Kleberg	1	100	4.8	4.3	4.9
9085262	Refugio	3	100	2.9	3.0	4.3
BELL	-	-	100	3.3	3.0	4.2
9085265	DeWitt	1	100	4.1	3.8	4.8
9085259	Kleberg	3	100	4.4	4.2	4.8
9085271	Hidalgo	1	100	4.5	4.4	4.8
9085233	Andrews	1	100	7.4	7.2	3.8
9076974	Lubbock	1	100	7.7	7.2	4.5
9085283	Calhoun	3	100	3.7	3.5	3.8
9085276	Starr	2	100	5.3	4.5	4.3
9085291	Webb	1	100	4.9	4.9	4.8

*Ocular estimate (1 = Best)

Table 2. Study 77I052H Hooded Windmillgrass at the Annex (sandy soil).

Accession Number	Source (County)	Type	% Survival	Foliage Density*	Resistance*	Seed Production*
9076951	Frio	1	100	6.4	6.2	5.3
9076977	Palo Pinto	1	85	7.1	6.7	4.7
9076946	Kleberg	1	95	5.5	5.7	4.5
9085229	Coleman	1	95	6.8	6.8	4.7
9085308	Lampasas	1	100	7.1	6.8	5.0
9085235	Lubbock	1	90	6.7	6.5	5.2
9085300	Bee	1	100	5.4	5.6	5.4
9085289	San Patricio	3	95	5.2	5.2	4.0
9085316	Kenedy	1	100	4.8	5.3	4.6
9085243	Burnet	1	100	6.3	6.5	4.0
9085285	Howard	1	80	6.6	6.6	5.5
9085288	Burleson	1	100	5.5	5.8	4.2
9085242	Austin	4	100	5.9	6.1	4.8
9085309	Kleberg	4	83	6.5	6.7	6.5
9085255	Jim Hogg	1	100	5.8	5.9	4.7
9076968	Knox	1	85	7.2	7.1	4.6
9085240	Dimmit	1	90	5.0	5.8	4.7
9085234	Lubbock	2	65	7.1	6.9	5.0
9085301	Duval	1	85	5.8	6.3	4.5
9076971	Brown	1	100	7.0	6.8	4.7
9085313	Kenedy	1	100	5.5	5.7	5.5
9085245	Burnet	1	80	6.5	6.6	5.5
9076955	Kleberg	1	81	5.8	6.0	5.9
9085262	Refugio	3	100	4.0	4.8	4.8
BELL	-	-	100	4.0	4.2	5.0
9085258	Goliad	3	100	5.3	5.3	4.6
9085265	DeWitt	1	100	5.5	5.8	5.1
9085259	Kleberg	3	100	5.7	5.8	4.8
9085271	Hidalgo	1	100	5.9	6.0	4.6
9085233	Andrews	1	60	7.5	7.3	5.6
9076974	Lubbock	1	100	7.5	7.2	4.4
9085283	Calhoun	3	100	4.5	4.8	5.0
9085276	Starr	2	100	5.8	5.9	4.9
9085291	Webb	1	80	6.1	6.2	5.0
9085264	DeWitt	3	100	5.3	5.4	5.3
9085260	San Patricio	3	100	3.8	4.3	5.1

*Ocular estimate (1 = Best)

Table 3. Study 77I052H Hooded Windmillgrass Greenhouse Germination

Winter 2000

Accession Number	Origin (County)	Type	15 Days %	30 Days %	45 Days %	60 Days %
9076946	Kleberg	1	0	1	12	20
9076951	Frio	1	1	3	15	44
9070955	Kleberg	1	0	2	15	27
9076968	Knox	1	35	100	100	100
9076971	Brown	1	7	18	54	72
9076974	Lubbock	1	0	0	3	4
9076977	Palo Pinto	1	19	69	100	100
9085229	Coleman	1	7	13	55	49
9085233	Andrews	1	0	1	7	10
9085234	Lubbock	2	2	3	65	100
9085235	Lubbock	1	1	2	22	25
9085236	Lubbock	2	0	0	0	0
9085240	Dimmit	1	0	1	18	23
9085242	Austin	4	41	55	69	88
9085243	Burnet	1	26	100	100	100
9085245	Burnet	1	6	39	100	100
9085255	Jim Hogg	1	0	1	3	3
9085258	Goliad	3	0	0	0	4
9085259	Kleberg	3	0	0	1	1
9085260	San Patricio	3	1	3	4	9
9085262	Refugio	3	0	0	4	14
9085264	Dewitt	3	1	1	4	4
9085265	Dewitt	1	0	0	3	3
9085271	Hidalgo	1	1	1	2	9
9085276	Starr	2	0	0	0	0
9085277	Starr	1	0	0	0	0
9085283	Calhoun	3	0	0	3	4
9085285	Howard	1	3	6	31	51
9085288	Burleson	1	11	24	100	100
9085289	San Patricio	3	0	0	15	24
9085300	Bee	1	0	10	73	81
9085301	Duval	1	0	5	76	89
9085291	Webb	1	0	1	5	6
Bell	—	5	13	100	100	100
9085308	Lampasas	1	57	87	87	—
9085309	Kleberg	4	1	2	7	—

Table 4. Study 77I052H Hooded Windmillgrass Greenhouse Germination.

Winter 2001

Accession Number	Origin (County)	15 Days %	30 Days %	45 Days %	60 Days %
76951	Frio	39	47	61	67
85240	Dimmit	100	100	100	100
85255	Jim Hogg	52	58	82	82
85258	Goliad	9	12	16	17
85264	DeWitt	8	9	16	17
85285	DeWitt	9	13	20	20
85271	Hidalgo	46	49	54	54
85276	Starr	6	6	7	7
85277	Starr	0	0	0	0
85300	Bee	100	100	100	100
85301	Duval	100	100	100	100
85291	Webb	14	21	54	54
85313	Kenedy	100	100	100	100
85316	Kenedy	34	37	45	45
85325	Uvalde	8	13	31	37
85329	Uvalde	100	100	100	100

Table 5. Study 77I052H Hooded Windmillgrass.

Germination Chamber

Accession Number	Origin (County)	Germination* (%)		
9085283	Calhoun	.0000		
9085259	Kleberg	.5000	.5000	
9085262	Refugio	.5000	.5000	
85316	Kenedy	.5000	.5000	
85313	Kenedy	1.0000	1.0000	
85271	Hidalgo	1.5000	1.5000	1.5000
85276	Starr	1.5000	1.5000	1.5000
9085289	San Patricio	1.5000	1.5000	1.5000
9085233	Andrews	2.0000	2.0000	2.0000
85240	Dimmit	2.0000	2.0000	2.0000
85258	Goliad	2.0000	2.0000	2.0000
9085260	San Patricio	2.5000	2.5000	2.5000
9085264	DeWitt	2.5000	2.5000	2.5000
9085265	DeWitt	2.5000	2.5000	2.5000
9076946	Kleberg	2.5000	2.5000	2.5000
9085235	Lubbock	3.0000	3.0000	3.0000
9085245	Burnet	3.0000	3.0000	3.0000
9085255	Jim Hogg	3.0000	3.0000	3.0000
9085285	Howard	3.0000	3.0000	3.0000
9076974	Lubbock	3.0000	3.0000	3.0000
9085291	Webb	3.5000	3.5000	3.5000
9085309	Kleberg	3.5000	3.5000	3.5000
9085229	Coleman	4.0000	4.0000	4.0000
85301	Duval	4.0000	4.0000	4.0000
9085308	Lampasas	5.5000	5.5000	5.5000
76951	Fio	5.5000	5.5000	5.5000
9076955	Kleberg	5.5000	5.5000	5.5000
9085243	Burnet	6.5000	6.5000	6.5000
9076968	Knox	8.0000	8.0000	8.0000
9076971	Brown	9.5000	9.5000	9.5000
9085234	Lubbock	10.5000	10.5000	10.5000
9085288	Burleson	11.0000	11.0000	11.0000
9076977	Palo Pinto		13.0000	13.0000
85300	Bee			14.0000

*30 day trial

Study Number: 77I053H

Study Title: Assembly and Evaluation of Pink Pappusgrass (*Pappophorum bicolor*)

Introduction: Pink pappusgrass (*Pappophorum bicolor*) is a native, warm-season perennial bunchgrass (Gould, 1975). It is known as pink pappusgrass because its spikelets usually have 2-3 fertile flowers that are purpulish-pink in color (Correll and Johnston, 1996). Pink pappusgrass can be found in Texas, Arizona, and into Mexico (Hitchcock, 1971). In Texas, it can be found in the southern coastal region, the Rio Grande Plains, the Edwards Plateau, the Rolling Plains or Reddish Prairies, and in the southeast part of the Trans-Pecos region (Gould, 1975). Pink pappusgrass grows on open valley land, grassy plains, along moist streambanks, in waste places and along roadsides where it is moist (Correll and Johnston, 1996; Gould, 1975; Hitchcock, 1971).

Problem: There is a need for native, adapted seed available at a reasonable price for restoration and reclamation of habitat in the South Texas region.

Objective: The objective is to assemble, comparatively evaluate, select and release, and/or provide information on the propagation of pink pappusgrass.

Discussion: Five accessions of pink pappusgrass were collected and seeded in the greenhouse in January 2000. Three accessions were transplanted to the field in April 2000. Evaluations of the transplants occurred throughout 2000 and 2001 (Table 1). Results from the evaluations indicated that there was not any significant difference between the three collections.

A seed nursery to develop a South Texas ecotype of pink pappusgrass is planned for the spring of 2002.

Table 1. Study 77I053H Pink Pappusgrass.

Accession Number	Source (County)	% Survival	Foliage Density*	Resistance*	Seed Production*	Seed Shatter*
9085241	Dimmit	100	4.9	4.7	4.8	4.9
9085257	Starr	100	4.6	4.6	4.4	5.0
9085302	Duval	100	4.8	4.7	4.5	5.3

*Ocular estimate (1= Best)

Study Number: 77I054H

Study Title: Assembly and Evaluation of Vine Mesquite (*Panicum obtusum*)

Introduction: Vine mesquite (*Panicum obtusum*) is a warm-season, stoloniferous, perennial grass native to Texas (Hatch, Schuster, and Drawe, 1999). It is large seeded for a grass, with spikelets from 3-3.8mm long (Hitchcock, 1971). Vine mesquite tends to grow in large colonies near water (Correll and Johnston, 1996). It prefers clayey soils of lowland pastures, swales, and ditches where soil is moist with periodical dry out (Gould, 1975). Vine mesquite grows in the coastal states from Virginia to Texas (Correll and Johnston, 1996). It can also be found from Missouri to Colorado and Utah, south to Arkansas, Texas, New Mexico, Arizona, and Northern Mexico (Hitchcock, 1971). In Texas, it grows throughout the state, with the exception of the extreme northeastern corner of the state (Gould, 1975). Vine mesquite is one of the top four grasses found in cattle diets in the mid-successional rangelands of the middle Gulf Coast of Texas. It provides good forage for livestock, and seed for wildlife (Hatch, Schuster, and Drawe, 1999).

Problem: There is a need for native, adapted seed available at a reasonable price for restoration and reclamation of habitat in the South Texas region.

Objective: The objective is to assemble, comparatively evaluate, select and release, and/or provide information on the propagation of vine mesquite.

Discussion: Twenty-nine accessions of vine mesquite were collected and seeded in the greenhouse in January 2000. Twenty-three accessions were tranplanted to the field in April 2000. Evaluations of the transplants occurred throughout 2000 and 2001. Results show that this species had poor seed production at the PMC as well as having weed control maintenance problems. This species has limited potential for commercial seed production.

Study Number: 77I055J

Study Title: Evaluation of Mallow (*Sphaeralcea* spp.) and Associated Species

Introduction: Several species of mallow are known to have value for various wildlife and livestock in Texas. The leaves of Lindheimer's globemallow (*Sphaerlacea lindheimeri*), also called woolly globemallow, are eaten by cattle and white-tail deer (Everitt, Drawe, and Lonard, 1999). Copper globemallow (*Sphaerlacea angustifolia*) leaves are also enjoyed by white-tail deer (Ajilvsgi, 1984). The leaves of pelotazo, also called Texas or sweet Indian mallow (*Abutilon fruticosum* or *A. incanum*) are readily eaten by deer, sheep and goats (Ajilvsgi, 1984). In addition, its seeds are eaten by bobwhite quail and mourning doves (Everitt, Drawe, and Lonard, 1999). False Indian mallow or pseudoabutilon (*Allowissadula lozani*) will also be observed, although its value to wildlife is unknown. False Indian mallow has several positive characteristics that make it worth looking at including upright growth, ample seed production, and adaptation to heavy clay soils.

Problem: There is a need for perennial forbs and shrubs for range restoration, wildlife habitat and xeriscaping in South Texas.

Objective: The objective of this study is to evaluate, release and/or provide information on the propagation of mallow species.

Discussion: Four mallow species were evaluated for adaptation to South Texas environmental conditions (Table 1). A collection of sweet Indian mallow (*Abutilon fruticosum* or *A. incanum*) from Karnes County (9064363) showed the best overall adaptation. It had 100 percent survival and excellent seed production. Furthermore, it was the only species to have any seed germination (34%) from a seed test conducted in August 2001. Copper globe mallow (*Sphaeralcea angustifolia*) from Tom Green County (9085266) showed excellent foliage characteristics due to its tolerance of drought conditions and production of a dense leaf canopy. However, seed production was poor along with small seed that would be difficult to harvest. This species also had seed shatter problems and poor seed germination.

Wooly globe mallow (*Sphaeralcea lindheimeri*) from Kleberg County (9085306) was very well adapted to Kingsville. Unfortunately, this plant is a trailing, low growing plant, making it very difficult for large-scale commercial seed production. However, this plant would make a very nice plant for xeriscaping. The orange flowers of the wooly globe mallow combined with the blue flowers of Texas bluebonnets would be very attractive.

Table 1. Study 77I055J Mallow.

Accession Number	% Survival	Foliage Density*	Resistance*	Seed Production*
9064363	100	5.7	5.3	4.0
9076976	75	3.7	4.6	4.5
9085266	70	2.7	3.2	5.3
9085306	100	4.8	4.7	3.9

*Ocular estimate (1= Best)

Study Number: 77I056F

Study Title: Evaluation of Riparian Shrubs and Small Trees for South Texas.

Introduction: Native shrubs and small trees play an important role in preventing shoreline erosion in riparian areas, coastal areas and on the edges of wetland sites in South Texas. The objective of this project is to evaluate native species that grow up to 6 or 7 feet in height or less, and have the potential to be good erosion control plants. We are seeking easily established, rapid-growing shrubs and small trees with well developed root systems and good survival. These plants should be easily reproduced from cuttings, and will readily spread under riparian conditions. Species that also provide food and/or habitat for riparian birds and other wildlife are preferred. Initially plants will be observed in order to evaluate survival, growth habits, reproduction success from cuttings, ease of establishment, general hardiness, and other desirable characteristics.

We are currently considering the following species, and have asked for outside assistance in making collections: Roughleaf Dogwood (*Cornus drummondii*), Southern Arrowwood (*Viburnum dentatum*), Squaw Huckleberry or Deer Berry (*Vaccimum stamineum*), Elderberry (*Sambucus canadensis*), Sandbar Willow (*Salix exigua*), Seep Willow (*Baccharis salicifolia*), Buttonbush (*Cephalanthus occidentalis*), Indigo Bush (*Amorpha fruticosa* var. *angustifolia*), Marsh Elder (*Iva frutescens*), Turk's Cap (*Malviscus arboreus* var. *drummondii*), Smooth Alder (*Almus serulata*), and Paw Paw (*Assimina parviflora*). Plantings will be added as the cuttings are received and the plants are ready.

Problem: There is a need for adapted riparian shrubs and trees for streambank erosion control and riparian wildlife habitat in South Texas.

Objective: The objective of this study is to assemble, evaluate, select, release, and/or provide information on the propagation of adapted South Texas riparian shrubs and trees.

Discussion: The Plant Materials Center has currently collected 13 species for evaluation:

- Roughleaf Dogwood (*Cornus drummondii*)
- Elderberry (*Sambucus canadensis*)
- Sandbar Willow (*Salix exigua*)
- Seep Willow (*Baccharis salicifolia*)
- Buttonbush (*Cephalanthus occidentalis*)
- False Indigo (*Amorpha fruticosa*)
- Marsh elder (*Iva frutescens*)

- Turk's cap (*Malviscus arboreus*)
- Swamp privet (*Forestiera acuminata*)
- Hachinal (*Heimia salicifolia*)
- Black Willow (*Salix nigra*)
- Barbados Cherry (*Malpighia glabra*)
- Brush holly (*Xylosma flexuosa*)

In the spring of 2001, we evaluated the potential of using stem-cuttings of five local riparian plants (see Appendix, Technical Note Vol. 4 No. 8). Swamp privet and roughleaf dogwood had no plants established from these stem-cuttings. Turk's cap had only a 15% establishment rate. False indigo and black willow were the most successful with respective establishment rates of 80 and 53 percent.

Finding riparian plants that are adapted to the South Texas environment is extremely difficult. Most riparian areas in Texas experience a fluctuating moisture regime ranging from several months of drought to sudden periods of flooding. Of the plants we have evaluated, it appears that seep willow and buttonbush are the most adapted to these conditions. The PMC plans to continue evaluating riparian trees and shrubs for general adaptation and to provide propagation guidelines for their use.

Study Number: STPMC-P-0125-WE

Study Title: Evaluation of Marshhay Cordgrass (*Spartina patens*)

Introduction: Marshhay grass (*Spartina patens* (Ait.)Muhl.) is a native, warm season, perennial grass. Marshhay cordgrass is commonly found in intermediate to brackish marshes along the Louisiana and Texas Gulf Coast. Its rhizomes and shoots are used for food while foliage provides shelter and nesting habitat for waterfowl such as geese and mottle ducks (Stutzenbaker, 1999).

Problem: There are over 3,000 miles of coastal shoreline along the Texas Gulf Coast. Many of these miles have eroding bluffs that need adapted plant material for stabilization. These bluffs along with coastal wetlands berms and dredge spoil islands are all in need of low-cost planting techniques to provide an economical method of vegetatively stabilizing and enhancing these sites.

Most coastal revegetation projects are established with expensive transplants. If a seeded variety of a salt-tolerant grass could be developed, it would provide a low-cost technique for stabilization and enhancement of Texas coastal shorelines. Seeded plants along with turf-reinforcement matting may provide a low-cost environmentally friendly, stabilizing system for miles of eroding shorelines. Another alternative would be to find a hardy, salt-tolerant rhizomatous or stoloniferous variety that could be disked into the soil to stabilize eroding shorelines.

Discussion: Sixteen accessions of marshhay cordgrass were vegetatively collected in 2000. These collections were evaluated during 2001 (Table 1). All collections had good survival and vegetative production. Accession 9076896 from Refugio County had the best vigor and foliage density. Accession 9067772 from Chambers County had the best overall performance having good survival and vigor as well as the best seed production. Seed was collected from all the accessions and will be germination tested in 2002. Furthermore, a replicated vegetative sprigging study of marshhay cordgrass, seashore dropseed, saltgrass, and gulf cordgrass was initiated on October 15, 2001.

Table 1. Study STPMC-P-0125-WE Marshhay Cordgrass.

Accession Number	Source (County)	% Survival	Foliage Density*	Resistance*	Seed Production (grams)
9067777	Refugio	100	5.2	5.2	18
9067778	Chambers	100	4.5	5.4	3
9067779	Chambers	90	4.1	4.2	20
9067780	Jefferson	100	4.1	4.4	—
9067781	Jefferson	100	4.3	4.3	9
9067782	Jefferson	90	4.5	4.5	13
9068211	Jefferson	80	4.8	5.0	—
9085338	Calhoun	67	8.8	6.5	—
9076896	Refugio	100	3.6	3.7	12
9067771	Chambers	90	5.1	4.8	5
9067772	Chambers	100	4.2	4.2	50
9067773	Galveston	100	4.3	4.5	2
9067774	Galveston	100	4.7	5.2	7
9067775	Matagorda	100	5.6	4.9	26
9067776	Matagorda	100	4.1	4.1	25
9085397	Nueces	100	4.5	4.5	1

*Ocular estimate (1= Best)

Study Number: STPMC-P-0126-WE

Study Title: Evaluation of Gulf Cordgrass (*Spartina spartinae*)

Introduction: Gulf cordgrass (*Spartina spartinae* (Trin.)Merr. Ex A.S. Hitch.) is a robust, perennial grass up to 1.2 meters tall (Stutzenbaker, 1999). Gulf cordgrass is found from Florida to Texas and eastern Mexico (Gould and Box, 1975) and flowers from spring to summer and rarely in the fall (Correll and Johnston, 1979). In Texas it is frequent to abundant throughout the Gulf Coast on moist saline soils on elevated ridges in intermediate to saline coastal marshes (Stutzenbaker, 1999). This species tends to form extensive, dense bunches which provides suitable nesting habitat for waterfowl (Hatch, Schuster, and Drawe, 1999).

Problem: There are over 3,000 miles of coastal shoreline along the Texas Gulf Coast. Many of these miles have eroding bluffs that need adapted plant material for stabilization. These bluffs along with coastal wetlands berms and dredge spoil islands are all in need of low-cost planting techniques to provide an economical method of vegetatively stabilizing and enhancing these sites.

Most coastal revegetation projects are established with expensive transplants. If a seeded variety of a salt-tolerant grass could be developed, it would provide a low-cost technique for stabilization and enhancement of Texas coastal shorelines. Seeded plants along with turf-reinforcement matting may provide a low-cost and environmentally friendly stabilizing system for miles of eroding shorelines. Another alternative would be to find a hardy, salt-tolerant rhizomatous or stoloniferous variety that could be disked into the soil to stabilize eroding shorelines.

Objective: The objective is to assemble, comparatively evaluate, select and release and/or provide information on the propagation of gulf cordgrass.

Discussion: Nineteen accessions of gulf cordgrass were vegetatively collected in 2000. These collections were evaluated during 2001 (Table 1). All collections had good survival and vegetative production. Accessions 9068194 (Brazoria County) and 9076889 (Kleberg County) had the best seed production. The best overall performance was from accession 9076889. Seed was collected from all accessions and will be germination tested in 2002. Furthermore, a replicated vegetative sprigging study of gulf cordgrass, seashore dropseed, seashore paspalum, and marshhay cordgrass was initiated on October 15, 2001.

Table 1. Study STPMC-P-0126-WE Gulf Cordgrass.

Accession Number	Source (County)	% Survival	Foliage Density*	Resistance*	Seed Production (grams)
9068197	Jackson	100	4.5	4.7	57
9068198	Calhoun	80	5.3	4.7	70
9068199	Refugio	100	5.5	4.9	153
9068201	San Patricio	100	5.2	5.0	117
9068204	Nueces	90	4.6	4.7	78
9068205	Kenedy	100	4.1	4.2	59
9085396	Nueces	100	6.0	5.7	21
9068206	Kenedy	100	7.0	6.0	21
9068202	San Patricio	100	7.0	6.0	19
9068200	Refugio	100	8.4	6.6	13
9076889	Kleberg	100	3.9	3.9	166
9068191	Chambers	100	4.6	4.6	170
9068192	Galveston	70	5.6	5.5	130
9068193	Galveston	100	4.8	4.7	116
9068194	Brazoria	100	3.2	3.2	45
9068195	Brazoria	100	5.0	4.9	94
9068196	Matagorda	100	4.4	4.3	104
9085369	Cameron	100	7.6	5.8	43
9068203	Nueces	100	7.8	6.2	23

*Ocular estimate (1= Best)

Study Number: STPMC-P-0127-CR

Study Title: Evaluation of Seashore Paspalum (*Paspalum vaginatum*)

Introduction: Seashore paspalum (*Paspalum vaginatum* Sw.) is a low growing perennial grass that is able to grow into thick stands (Stutzenbaker, 1999) because of its extensive creeping and rooting characteristics (Correll and Johnston, 1979). In Texas it is found infrequently along the Gulf Coast in poorly drained soils, shallow brackish ponds and marshes. Seashore paspalum provides seeds and roots as food for ducks and geese, it is also used as a shoreline stabilizer (Hatch, Schuster, and Drawe, 1999; Stutzenbaker, 1999).

Problem: There are over 3,000 miles of coastal shoreline along the Texas Gulf Coast. Many of these miles have eroding bluffs that need adapted plant material for stabilization. These bluffs along with coastal wetlands berms and dredge spoil islands are all in need of low-cost planting techniques to provide an economical method of vegetatively stabilizing and enhancing these sites.

Most coastal revegetation projects are established with expensive transplants. If a seeded variety of a salt-tolerant grass could be developed, it would provide a low-cost technique for stabilization and enhancement of Texas coastal shorelines. Seeded plants along with turf-reinforcement matting may provide a low-cost environmentally friendly, stabilizing system for miles of eroding shorelines. Another alternative would be to find a hardy, salt-tolerant rhizomatous or stoloniferous variety that could be disked into the soil to stabilize eroding shorelines.

Objective: The objective is to assemble, comparatively evaluate, select and release and/or provide information on the propagation of seashore paspalum.

Discussion: Seven accessions of seashore paspalum were vegetatively collected in 2000. These collections were evaluated during 2001 (Table 1). All collections had good survival. Accession 9085402 from Kleberg County had the best overall performance having good survival and foliage density. This accession was the only collection to produce any seed in Kingsville.

Table 1. Study STPMC-P-0127-CR Seashore Paspalum.

Accession Number	Source	% Survival	Foliage Density*	Resistance*	Seed Production (grams)
9085358	Kleberg Co.	100	4.5	4.8	—
9085360	Florida	100	3.9	3.9	—
9085364	Brazoria Co.	100	3.7	3.9	—
9085379	Chambers Co.	90	6.9	6.9	—
9085402	Kleberg Co.	100	3.7	3.3	9
9085395	Nueces Co.	100	3.8	3.8	—
9067665 ‘Brazoria’	LAPMC	100	3.5	4.0	—

*Ocular estimate (1= Best)

Study Number: STPMC-P-0128-WE

Study Title: Evaluation of Gulfcoast Spikerush (*Eleocharis cellulosa*)

Introduction: Gulfcoast spikerush (*Eleocharis cellulosa* Torr.) is coarse, perennial sedge growing up to 76 cm tall. This species forms extensive rhizomes and produces small whitish tubers. Guflcoast spikerush is found in flooded soils inundated with fresh to intermediate saline waters (Stutzenbaker, 1999). It is found in coastal states from North Carolina to Texas and Mexico. Flowering occurs in the spring and fall (Correll and Johnston, 1979). Waterfowl eat rhizomes and tubers of this plant (Stutzenbaker, 1999).

Problem: Texas wetlands provide critical habitat for migratory waterfowl as well as neotropical birds. Texas has seen as estimated 52% loss (8 million acres) in wetland acreage over the past 200 years. Therefore, it is important to construct wetland types that will provide high value habitat for birds and other wildlife.

Objective: The objective of this study is to assemble, evaluate and provide information on the propagation and use of gulfcoast spikerush.

Discussion: Gulfcoast spikerush (*Eleocharis cellulosa*) is a member of the Cyperaceae or sedge family (Correll and Johnston, 1996). It is a native, rhizomatous perennial, often forming extensive colonies. It grows from a tuberous rootstock and can reach 30 inches in height. Often there are small (3-6mm), whitish tubers found growing along the roots (Stutzenbaker, 1999). Gulfcoast spikerush is frequently found in fresh-water mud (Correll and Johnston, 1996) on the edges of ponds, creeks, and marshes, but can tolerate salinity of up to 3.5 parts per thousand (Stutzenbaker, 1999). It can be found in the coastal areas from North Carolina to Texas and south to Mexico, and also grows in the West Indies and Bermuda (Correll and Johnston, 1996). In Texas, it is present throughout South Texas predominately in the coastal regions and the Edward's Plateau (Hatch, Gandhi, and Brown, 1990), and more rarely in the Rio Grande Plains and east Texas (Correll and Johnston, 1996). It produces seed heads throughout the warm season (Keyes and Lloyd-Reilley, 1999). It can be used as a wetland restoration plant for South Texas. It also provides habitat for waterfowl and other wetland wildlife, including snow geese and mottled ducks (Stutzenbaker, 1999). Its seeds are an excellent food source for ducks (Martin and Uhler, 1939; Singleton, 1965; Stutzenbaker, 1999). Snow geese, mallards, mottled ducks and pintails will eat the tubers, and the geese will also eat the basal portions and rhizomes (Stutzenbaker, 1999). Gulfcoast spikerush generally requires little management. Plants seem to survive at a variety of water levels (Keyes and Lloyd-Reilley, 1999). Stutzenbaker (1999) notes that plants need to be dewatered in early spring after geese have fed there to allow new plants to regrow. He warns that deep flooding after geese have caused damage to the plants can result in a complete loss of stand. Gulfcoast spikerush may be propagated from rootstocks, division of rhizomes, or seed.

There have been few studies that have looked at the impact of seed storage methods on the germination of gulfcoast spikerush seed. The ability to dry-store gulfcoast spikerush seed could lead to more widespread use of the plant in coastal wetland projects. Use of transplants can limit use for large-scale projects because of time and labor costs required in producing and planting the material.

In April of 2001, the PMC conducted two germination studies on gulfcoast spikerush seed. The first study evaluated three different seed storage methods on seed germination. Seed was obtained from plants maintained in the wetland plant evaluation area at the Kika de la Garza Plant Materials Center in Kingsville, Texas. The seed was hand-harvested and hand cleaned in July of 2000. The seed was then split into thirds and stored one of three ways. The first third was stored in a container full of de-ionized water (wet-stored). The second third was treated with thiram (moist-stored). The last third was placed directly into a seed collection envelope (dry-stored). The seeds were germinated for eight weeks. Wet-stored seed had the best germination (17%), but it was not consistently better than either the moist or the dry-stored seed (Appendix Vol.4 No.2).

The second study evaluated germination of gulfcoast spikerush seed that had been harvested in three separate years and stored under different conditions. Seed was obtained from plants maintained in the wetland plant evaluation area at the Kika de la Garza Plant Materials Center in Kingsville, Texas. Seed from the gulfcoast spikerush plants was hand-harvested and cleaned. Half of the seed from each harvest year was placed directly into a seed collection envelope (dry-stored). The other half of the seed was stored submerged in a container of de-ionized water (wet-stored). Three years (1998, 1999, and 2000) were evaluated for the dry-stored seed, but only two years (1999 and 2000) of the wet-stored seed were available for evaluation. The initial study lasted for eight weeks. Germination was recorded at four and eight weeks. No significant differences in germination were found between harvest years or storage treatment for either the four week or eight week germination periods. Seed germination averaged only 5.6 % (Appendix Vol.4 No.4).

We also evaluated transplant splits conducted at four different times during the year: February, May, August, and November. When vegetative splitting of large plants was conducted in both August of 2000 and May of 2001, there was an immediate death loss of approximately 7.5% of the plants. However, six months after transplanting an increase in culms from 1.3 to 5 was observed when transplanting was done in August and an increase from 4.9 to 7.2 occurredwhen transplanting was done in May. The vegetative splitting that occurred in November of 2000 resulted in a death loss of 20% and there was no significant growth for 6 months with the number of culms changing from 3.6 to 3.8. The best results were from transplanting in February. There was no death loss and the number of culms increased from 3.5 to 10.3 six months later.

Study Number: STPMC-P-0129-WE

Study Title: Evaluation of Squarestem Spikerush (*Eleocharis quadrangulata*)

Introduction: Squarestem spikerush (*Eleocharis quadrangulata* (Michx.)Roem. & Schult.) is a four-edged, erect, rhizomatous perennial sedge that grows from 45-61 cm and forms dense colonies. It is found in freshwater marshes but is able to withstand low salt concentrations and occasional dry periods (Stutzenbaker, 1999). Squarestem spikerush occurs in most of the eastern United States including southeast Texas flowering in late spring into the fall (Correll and Johnston, 1979). Waterfowl eat this species' seeds and tubers.

Problem: Texas' wetlands provide critical habitat for migratory waterfowl as well as neotropical birds. Texas has seen an estimated 52% loss (8 million acres) in wetland acreage over the past 200 years. Therefore, it is important to construct wetland types that will provide high value habitat for birds and other wildlife.

Objective: The objective of this study is to assemble, evaluate and provide information on the propagation and use of squarestem spikerush.

Discussion: Squarestem spikerush (*Eleocharis quadrangulata*) is a member of the Cyperaceae or sedge family (Correll and Johnston, 1996). It is a native, rhizomatous perennial, often forming dense colonies, and can reach from 45 to 61 centimeters in height (Stutzenbaker, 1999). It gets its common name from its four-angled or squarish stems (Jones, 1982). Often there are small (2-5mm), whitish tubers found growing along the roots (Stutzenbaker, 1999). Squarestem spikerush is frequently found in fresh-water to slightly saline mud (0 to 0.5 ppt) on the edges of ponds, creeks, and marshes (Stutzenbaker, 1999). It prefers saturated soils that are frequently or continuously flooded (0-12" deep) during most of the growing season, with only occasional dry-down periods (Northrup, 1994). Squarestem spikerush grows throughout most of the Eastern United States, as far west as Wisconsin, Missouri, Oklahoma, and Texas. In Texas, it can be found in the East and Southeast regions, and more rarely in the northern part of the Rio Grande Plains and south to Jalisco, Mexico (Correll and Johnston, 1996). This species produces seed heads throughout the warm season (Keyes and Lloyd-Reilley, 1999). Squarestem spikerush can be used as a wetland restoration plant for south Texas. Its seeds and tubers are an excellent food source for ducks (Martin and Uhler, 1939; Singleton, 1965), and are heavily used by mallards, pin-tail, mottled and other puddleducks on the Texas Coast (Stutzenbaker, 1999). Snow geese, white-fronted geese, nutria and muskrats will eat the tubers and the basal portions of the plants (Stutzenbaker, 1999). Squarestem spikerush generally requires little management. Plants seem to survive at a variety of water levels (Keyes and Lloyd-Reilley, 1999). Stutzenbaker (1999) notes that squarestem spikerush can tolerate fire, periodic drawdowns, heavy livestock use and goose grazing and grubbing. He warns that long-term increase in salinity and water depth could result in the complete loss of a stand. Squarestem spikerush may be propagated from whole plant transplants (Stutzenbaker, 1999), rootstocks (Singleton, 1965), division of rhizomes (Keyes and Lloyd-Reilley, 1999) or by seed.

There have been few studies that have looked at the impact of seed storage methods on the germination of squarestem spikerush seed. The ability to dry-store squarestem spikerush seed could lead to more widespread use of the plant in coastal wetland projects. Use of transplants can limit use for large-scale projects because of time and labor costs required in producing and planting the material.

In April of 2001, the PMC conducted three germination studies on squarestem spikerush seed. First, a germination study of two different accessions of dry-stored squarestem spikerush was conducted. Germination of dry-stored seed harvested in 2000 from #9085359 (Chamber Co., TX) was compared to dry-stored seed from accession #9076917 (Ft. Bend Co., TX) from the 1998 and 2000 harvest years. Second, dry-stored seed from accession 9076917 was compared to thiram-treated seed of the same accession from the 2000 harvest. Third, germination differences between harvest years for accession 9076917 were also evaluated. The germination test lasted for eight weeks. Germination was monitored daily and evaluated at the end of four-weeks and at the end of the eight-week period. A significant accession difference in germination was found. The Ft. Bend accession (27.33%) was found to have significantly better germination than the Chambers accession (0%). A significant difference was also found between storage treatments. Seed from the Ft. Bend accession had better than 25% germination for both years of dry-stored seed, but only 2% germination for the thiram treated seed. No significant differences in harvest years were found for the dry-stored seed of the Ft. Bend accession. Both harvest years had a germination rate of more than 27% (Appendix Vol. 4 No. 5).

We also evaluated transplant splits conducted at four different times during the year: February, May, August, and November. When vegetative splitting of large plants was conducted in both February and May of 2001, there was a significant plant increase. There was no transplant shock or death loss when splitting was done in February of 2001. Plants increased from 3.7 culms to 6.7 culms six months later. When splitting was done in May of 2001 there was an immediate death loss of 5% but the plants quickly recovered and went from 2.5 culms to

6.8 culms six months later. Plants split in August of 2000 experienced a 2.5% immediate death loss and had poor growth over the six month period going from 2.0 culms to 3.7 culms. November was the worst period for transplanting with a 43% death loss. Plants never recovered over the six month period decreasing from 3.6 to 2.9 culms.

Study Number: STPMC-P-0130-WL

Study Title: Evaluation of Creeping River Grass (*Echinochloa polystachya*)

Introduction: Creeping river grass (*Echinochloa polystachya* (H.B.K.)Hitchc.) is a large, creeping perennial grass with decumbent stems. It is found in freshwater marshes throughout most of Texas flowering from March to November (Correll and Johnston, 1979). Creeping river grass occurs abundantly on the lower Gulf Coast in ditches and swales where waterfowl eat their seeds and are provided with cover (Hatch, Schuster, and Drawe, 1999).

Problem: Texas wetlands provide critical habitat for migratory waterfowl as well as neotropical birds. Texas has seen as estimated 52% loss (8 million acres) in wetland acreage over the past 200 years. Therefore, it is important to construct wetland types that will provide high value habitat for birds and other wildlife.

Objective: The objective of this study is to assemble, evaluate, and provide information on the propagation and use of creeping river grass.

Discussion: Creeping river grass (*Echinochloa polystachya*) is a native, warm-season, perennial grass, with stout culms creeping from the base (Correll and Johnston, 1996). It can grow to 1.5m in height (Stutzenbaker, 1999). It has been known to set roots from the lower nodes (Gould, 1975). Creeping river grass can easily be distinguished from other *Echinochloa* species by the presence of a ligule, which is a dense line of stiff yellow hairs (Hatch, Schuster and Drawe, 1999). The genus name, *Echinochloa*, is Greek for hedgehog grass and the panicle-type seed head, with its awned spikelets does look somewhat like a hedgehog (Hitchcock, 1971). It was previously known as *Panicum polystachyum* (Correll and Johnston, 1996). Other common names for *E. polystachya*, include mudflat millet, river grass (Stutzenbaker, 1999), and barnyard grass.

Creeping river grass can be found in swamps and ditches along the Gulf Coast from Louisiana to Brownsville, Texas, and also in the West Indies south to Argentina (Hitchcock, 1971). In Texas, it can be found in wet swales and ditches along the southern Gulf Coast (Hatch, Schuster, and Drawe, 1999), from the southern part of southeastern Texas to the coastal portion of the Rio Grande plains (Correll and Johnston, 1996). Creeping river grass prefers freshwater marshes where salinity is below 0.5 parts per thousand (Stutzenbaker, 1999). It will prosper on both organic and mineral soils (Stutzenbaker, 1999), but tends to prefer moist clay loam soils (Correll and Johnston, 1996). Creeping river grass will often form dense colonies on newly created mudflats that have formed after shallow flooding has occurred (Stutzenbaker, 1999). It is not tolerant of water levels over two feet, and prefers to have some periods of drawdown in order to spread laterally (Stutzenbaker, 1999).

Few studies have looked at the impact of seed storage methods on the germination of creeping river grass seed. The ability to dry-store creeping river grass seed could lead to more widespread use of the plant in coastal wetland projects. Use of transplants can limit use for large-scale projects because of time and labor costs required in producing and planting the material.

In April of 2001, the PMC conducted four germination studies on creeping river grass seed. These studies evaluated different storage methods, different harvest years, a combination of different growing conditions on seed germination and different storage methods, and germination of seed stored under different conditions combined with different harvest years. The first study compared germination of creeping river grass seed that had been stored two different ways: wet-stored and dry-stored (Appendix Vol. 4 No. 6). A significant difference in germination between storage methods was found. Wet-stored seed had significantly better germination (41%) than dry-stored seed (3%). The second study evaluated germination in wet and dry-stored seed harvested from plants grown under different conditions: wetland trough and irrigated field planting (Appendix Vol. 4 No. 7). A significant difference was found between wet-stored seed harvested from plants grown under different conditions. The seed harvested from plants grown partly submerged in a wetland trough had a significantly better germination (41%) than seed harvested from the irrigated dry-land field (0%). No significant difference in germination between growing conditions was found for the dry-stored seed. The third study compared germination of creeping river grass seed stored three different ways: wet, dry, and moist stored. This study indicated that a significant difference was found between storage methods. Dry stored seed had significantly better germination (34%) than either the wet or moist- stored seed (0%). Experimental data provided conflicting results with the first study which indicated that wet-stored seed had better germination. The fourth study evaluated germination of wet and dry-stored seed harvested in different years. This study showed a significant difference between harvest years for dry-stored seed, with the seed harvested in 2000 having a significantly higher germination (34%) than either 1998 (19%) and 1999 (1.5%) harvested seed. The 1998 harvested seed also showed a significantly higher germination than the 1999 harvested seed. These studies indicate that creeping river grass seed will have variable germination rates based on different harvest years and site conditions. Seed storage method does not appear to consistently influence seed germination rates.

Information on creeping river grass adaptation, use, establishment, and management is available in the June 2001 plant fact sheet (Appendix 2).

Study Number: STPMC-P-0131-WL

Study Title: Evaluation of Saltmarsh Bulrush (*Scirpus robustus*)

Introduction: Saltmarsh bulrush (*Scirpus robustus* Pursh.) is a rhizome producing, perennial sedge. Its stems are triangular and maybe up to 0.9m tall (Stutzenbaker, 1999). Saltmarsh bulrush occurs in brackish waters in the southeastern coast of Texas and is able to withstand a wide range of salinity. It flowers from spring to fall after which it produces seed that is known to be eaten by waterfowl (Correll and Johnston, 1979; Stutzenbaker, 1999).

Problem: Texas wetlands provide critical habitat for migratory waterfowl as well as neotropical birds. Texas has seen as estimated 52% loss (8 million acres) in wetland acreage over the past 200 years. Therefore, it is important to construct wetland types that will provide high value habitat for birds and other wildlife.

Objective: The objective of this study is to assemble, evaluate and provide information on the propagation and use of saltmarsh bulrush.

Discussion: Saltmarsh bulrush (*Scirpus robustus*), previously known as (*S. maritimus* var. *machrostacyus*), is a member of the Cyperaceae or sedge family (Hatch, Gandhi, & Brown, 1990). It is a native, rhizomatous perennial, with extensive culms tufted along the rhizome. Often there are tuber-like structures located basally (Correll and Johnston, 1996). Saltmarsh bulrush is frequently found in colonies in wet, brackish soils and in the shallow waters of ponds, lakes, and marshes (Jones, 1982). It can be found in the coastal marshes of southeast Texas and the Rio Grande Plains (Correll and Johnston, 1996). Saltmarsh bulrush is tolerant of alkalinity and has been known to grow in sandy or clay soils, and in fresh or brackish water. It should be noted however, that the site salinity maybe inversely correlated with both seed production and germination (Keyes and Lloyd-Reilley, 1999). It can be used as a wetland restoration plant for south Texas. It also provides habitat for waterfowl and other wetland wildlife and its seeds are an excellent food source for waterfowl and other wetland wildlife (Martin and Uhler, 1939; Prevost and Gresham, 1981). Salt-marsh bulrush may be propagated from rootstocks, division of rhizomes, or seed.

There have been few studies that have looked at the impact of seed storage methods on the germination of saltmarsh bulrush seed. The ability to dry-store saltmarsh bulrush seed could lead to more widespread use of the plant in coastal wetland projects. Transplants of this species can limit its use in large-scale projects because of time and labor costs required to produce and plant the material.

The PMC conducted two germination studies on saltmarsh bulrush seed. These studies evaluated different storage methods and different harvest years on seed germination. The first germination study was conducted using two accessions of saltmarsh bulrush (9076931 and 9076934) seed that was stored in three different ways (Appendix Vol. 4 No. 1). Seed was obtained from plants maintained in the wetland plant evaluation area at Kika de la Garza Plant Materials center in Kingsville, Texas. Seed of each accession was hand-harvested and stored either in a container full of de-ionized water (water-stored), treated with thiram (moist-stored), or placed directly into a seed collection envelope (dry-stored). The wet-stored seed was harvested in 1999. The moist and dry-stored seed was harvested in 2000. Results indicate that the wet-stored seed from both accessions had a significantly higher germination than either the moist or dry-stored seed. The second germination study used seed from the previously mentioned accession numbers that had been harvested in different years (Appendix Vol. 4 No. 3). Seed was obtained from plants maintained in the wetland plant evaluation area at Kika de la Garza Plant Materials Center in Kingsville, Texas. Seed from each accession was hand-harvested, cleaned, and placed directly into a seed collection envelope (dry-stored). Four years were evaluated for accession #9076931, but only two years were evaluated for accession #9076934. The initial study lasted four weeks, after which the three best harvest year/accession combinations were removed from the study. The three poorest harvest year/accession combinations were observed for an additional 7 weeks to determine if additional germination would occur. Accession #9076934 had good germination (55% and 62%) for 1999 and 2000 harvest years, respectively. Seed harvested in 1997 from accession #9076931 had good germination (48%). The 1998, 1999, and 2000 harvest years of accession #9076931 seed had poor germination (4%, 9%, and 2%, respectively) at four weeks; there was no significant improvement in germination (4%, 13.5%, and 4.5%) at eleven weeks.

Information on saltmarsh bulrush adaptation, use, establishment, and management is available from the June 2001 plant fact sheet (Appendix 2).

Study Number: STPMC-P-0133-WL

Study Title: Waterbird Habitat Project

Introduction: Sundown Island is a man-made island constructed by the Army Corp or engineers from the dredging of the Gulf Intracoastal Waterway in Lavaca Bay. Since being established the island has become a valuable nesting site for waterbirds along the Texas Gulf Coast. The Audubon Society leases the island in order to protect and manage the island.

This man-made island has either bare-ground or is vegetated primarily with short herbaceous grasses and forbs. While many waterbirds such as terns prefer nesting on bare ground, other birds such as herons and egrets prefer to nest in trees or tall shrubs.

Problem: Dredge spoil islands and other coastal sites are in need of native plant species and establishment techniques for improvement of water bird nesting along the Texas Gulf Coast.

Objective: The objective of this study is to assemble, evaluate and provide information on the establishment of native plant species on dredge spoil islands.

Discussion: The Audobon Society, which manages Sundown Island, along with its partners, the U. S. Fish and Wildlife Service and the PMC, established a test demonstration site for waterbird enhancement on the island. The Center installed four demonstration plots with 7 different native trees and shrubs as well as three planting treatments: no treatment, shelter treatment, and a shelter and weedmat treatment.

Huisache (*Acacia farnesiana*), retama (*Parkinsonia aculeata*), mesquite (*Prosopis glandulosa*), fiddlewood (*Citharexylum berlandieri*), colima (*Zanthoxylum fagara*) and granjeno (*Celtis pallida*) are adapted to Sundown Island. Huisache and retama had the best survival and vigor in our study. We would not recommend the use of marsh elder (*Iva frutescens*) or sweetbay (*Persea borbonia*). Where there is adequate seasonal rainfall there appears to be no advantage to using shelters or weedmat. However, where conditions are more xeric the use of short tree shelters is recommended to improve plant survival and vigor (Appendix Vol. 4 No. 10).

Study Number: STPMC-P-0134-WL

Study Title: Evaluation of Bundleflower (*Desmanthus* spp.)

Introduction: Native, perennial legumes are a desirable addition to range plantings for two main reasons. First, they can help fix nitrogen in the soil. Second, they are a valuable food source for wildlife. Foliage is eaten by cattle and deer, and the seeds are eaten by quail, doves, and other wild birds. Several species of the genus *Desmanthus* are native to South Texas. 'Sabine' Illinois bundleflower (*D. illinoensis*) has been released by the USDA as a native Texas legume, but it is not well adapted to the South Texas climate. It tends to die off during the hot, dry Texas summers, acting more as an annual than a perennial. *Desmanthus velutinus*, *D. reticulatus*, and *D. virgatus* var. *depressus* are some species of interest. A particular focus will be on accessions adapted to the South Texas climate, with an upright growth form and good seed production that will facilitate large-scale seed harvest. We are currently collecting *Desmanthus* spp. from South Texas sites that have good seed production and an upright growth form, as well as evaluating existing collections of seed at the PMC.

Problem: There is a need for perennial native legumes for range restoration, wildlife habitat and xeriscaping in South Texas.

Objective: The objective of this study is to assemble, evaluate, select, and release, and/or provide information on the propagation of *Desmanthus* spp.

Discussion: Seventy-three accessions of *Desmanthus* spp. were seeded in the greenhouse in January, 2001. Fifty-seven accessions were transplanted to the field in April, 2001. Seven accessions stood out as top performers during our evaluations in 2001, #9076962 (Cameron County), 322411 (Brazil), 4704A (Waller County), 2407B (Victoria County), 2408 (Texas), 29698R (Caldwell County), and 900538 (Val Verde County) (Table 1). Accession #9076962 was particularly impressive with not only good survival and vegetative production but also good seed production and seed germination. We will continue to evaluate these accessions in 2002 with specific attention focused on seed harvestability.

Table 1. Study STPMC-P-0134-WL *Desmanthus* spp.

Accession Number	Source (County)	% Survival	Foliage Density*	Resistance*	Seed Production*	% Seed Germination
2407 A	Victoria	100	6.3	4.5	4.0	16
29624	Washington	90	7.3	4.8	6.0	28
9076962	Cameron	100	6.0	4.3	3.5	52
9076959	Kleberg	90	7.0	4.5	4.0	16
907695 8	Kleberg	100	6.5	4.3	3.5	40
477961 B	Medina	100	7.5	5.0	5.5	40
322411	Brazil	100	5.5	4.0	6.0	64
29624 O	Washington	75	7.8	5.0	5.0	32
29583	Tom Green	100	7.5	4.8	4.0	4
2409	Knox	90	6.3	4.5	5.0	8
4703 A	Waller	100	6.3	4.3	4.0	28
4726 A	Austin	100	6.5	4.3	4.0	4
85332	Atascosa	100	6.3	4.3	4.0	28
29634	Lee	100	7.5	4.8	4.0	4
4704 A	Waller	100	6.0	4.3	3.0	24
38828	Wilson	100	7.0	4.5	5.5	20
9085381	Hidalgo	100	6.3	4.5	4.5	28
2407 B	Victoria	100	5.8	4.3	4.0	20
29665	Willacy	100	6.3	4.3	4.0	4
29698 B	Caldwell	100	6.8	4.5	4.0	12
38781	Schleicher	100	7	5.0	4.0	4
76961 A	McMullen	100	6.3	4.3	3.5	16
900525 B	Comal	100	7.0	4.5	4.5	4
29698 O	Caldwell	100	8.0	5.8	—	4
4689	Ft. Bend	100	6.3	4.3	4.0	12
9076957	Kleberg	100	6.3	4.3	4.0	4
29623	Walker	100	6.8	4.3	3.5	4
900526	Edwards	83	7.8	5.0	4.0	32
29662	Fayette	100	6.5	4.3	5.0	4
38703 B	Williamson	100	7.0	4.8	7.0	4
53724	Nueces	100	6.5	4.5	5.0	12
900529 B	Brewster	100	7.8	4.8	3.0	8
38746	Falls	100	7.8	4.5	5.0	4
29624 R	Washington	100	6.8	4.5	4.0	28
38701	Comal	100	7.5	5.0	4.0	4
38726 B	Burleson	100	6.5	5.5	5.0	4
29598	Bee	100	6.5	4.3	3.0	4
900529 A	Brewster	100	6.8	4.3	4.0	30
2408	Texas	100	6.0	4.3	4.0	4

*Ocular estimate (1= Best)

Table 1. Continued…

Accession Number	Source (County)	% Survival	Foliage Density*	Resistance*	Seed Production*	% Seed Germination
4691	Webb	100	8.5	6.0	4.0	4
38700 B	Comal	50	7.8	5.5	4.0	4
9053737	Jim Wells	100	6.8	4.8	4.0	4
38720	Travis	100	7.3	4.8	5.0	4
35758 B	Guadalupe	100	7.0	4.5	—	12
9085336	Kerr	100	7.5	4.8	5.0	4
29698 R	Caldwell	100	6.0	4.3	3.0	14
29603	Hays	100	6.8	4.8	4.0	4
43213	Walker	100	7.0	4.8	5.0	12
9053735	Kenedy	100	6.5	4.5	5.0	4
900538	Val Verde	100	5.0	4.0	3.5	4
29593	Williamson	100	7.8	5.0	5.0	4
29653	Motley	100	7.0	4.8	—	4
38824	Kendall	100	6.8	4.5	4.0	4
2406	Texas	100	8.5	5.8	—	12
4705	Williamson	100	7.5	4.8	4.5	8
9076950	Kerr	100	7.8	5.0	5.0	4

*Ocular estimate (1= Best)

Study Number: STPMC-P-0135-RA

Study Title: Evaluation of Texasgrass (*Vaseyochloa multinervosa*)

Introduction: Texasgrass (*Vaseyochloa multinervosa* (Vasey)Hitchc.) is a native, warm-season, rhizomatous, perennial bunchgrass (Correll and Johnston, 1996). A member of the Festucaceae tribe of grasses, it can grow from 40-100 cm. tall (Hitchcock, 1971). It flowers from April to November and has been reported only from the southeastern portion of Texas, although it may also be present along the coast of Tamaulipas, Mexico (Gould, 1975). Texasgrass prefers sandy soil, and may occur in sandy woods and open ground (Hitchcock, 1971), and on sandy riverbanks, coastal dunes, and sandy pastures (Gould, 1975). It is the only species in the monotypic North American genus *Vaseychloa* and appears to have no close relatives (Gould, 1975). Although it has been noted to be rare (Hitchcock, 1971), it is periodically abundant on local sites in the Coastal Bend region of Texas (Gould, 1975). Texasgrass provides a good to fair source of forage, and provides good wildlife cover (Hatch, Schuster, and Drawe, 1999). There is currently no known commercial variety of Texasgrass.

Problem: There is a need for native, adapted seed available at a reasonable price for the restoration and reclamation of habitat in the South Texas region.

Objective: The objective of this study is to assemble, evaluate, select, and release, and/or provide information on the propagation of Texasgrass.

Discussion: Four accessions of Texasgrass were seeded in the greenhouse in January 2001. Three accessions were transplanted to the field in May 2001. All three accessions had 100% survival at the Plant Materials Center. We will continue to evaluate these accessions as well as others that may arrive as part of the South Texas Natives Project.

Study Number: STPMC-P-0137- RA

Study Title: Rio Grande Plain Ecotype Project

Introduction: An initiative was developed in August of 2000 and is spearheaded by Caesar Kleberg Wildlife Research Institute to develop and promote native plants for the restoration and reclamation of habitat on private and public lands in South Texas. The goal of the initiative called the South Texas Natives Project is to provide economically viable sources of plants and seeds and to develop effective planting strategies for the restoration of South Texas plant communities.

Problem: There is a need for native adapted ecotypic plants for range restoration, wildlife habitat and xeriscaping in South Texas.

Objective: The PMC will establish a seed nursery for South Texas ecotypes of a variety of grasses, forbs, and legumes. Ecotypes will be developed for the Rio Grande Plain ecoregion. The ecotype region was established to be large enough to retain regional integrity and genetic adaptability. The seed nursery will consist of approximately 20 collections of each species. The nursery will consist of transplants that are isolated as necessary to maintain species integrity and diversity. The seed nursery will be hand harvested to ensure a complete spectrum of seed is harvested from each species. The nursery seed will be planted in production fields where it will then be harvested and bulked per species. The ecoregion seed will then be made available to commercial seed growers.

Discussion: In January 2001, 66 collections representing 9 species were collected for the Rio Grande Plain ecoregion. A small seed nursery was established consisting of the following species: four flower trichloris, plains bristlegrass, seacoast bluestem, hooded windmillgrass, brownseed paspalum, pink pappusgrass, prairie acacia, and orange zexmenia. The seed nursery will continue to expand in 2002 as more collections are received.

Study Number: STPMC-P-0139- RA

Study Title: Evaluation of Hall's Panicum (*Panicum hallii*)

Introduction: *Panicum hallii* is a warm-season perennial bunchgrass that grows 60-90 cm in height (Gould, 1975). There are two main varieties: *hallii* and *filipes* (USDA, 1994). *Panicum hallii* var. *hallii* (previously known as *Panicum hallii*) can be found from Oklahoma to Colorado to Texas and Arizona and down into Mexico (Hitchcock, 1971). Commonly known as Hall's panicum or panicgrass, it is found mostly in the rocky, dry uplands in the western two-thirds of Texas (Correll and Johnston, 1996), but can also be found on calcareous soils along the Gulf Coast. It is palatable for all livestock, but provides only fair quality forage (Hatch, Schuster, and Drawe, 1999). In addition, it tends to decrease under heavy grazing (Gay, Dwyer, Hatch, and Schickendanz, 1980). *Panicum hallii* var. *filipes* (previously known as *P. filipes*) can be found from Louisiana to Texas, and down into northeastern Mexico (Hitchcock, 1971). It is found along roadsides and in disturbed lowlands from North Central Texas, south to the Rio Grande Plains, and less frequently in West Texas, in all but the extreme Northern and Western portions of the Panhandle (Gould, 1975). It is commonly called Filly panicum (Hignight, Wipiff, and Hatch, 1988), although the common name, Hall's panicgrass, has been used as well (USDA, 1994). The latter name may come from the high degree of introgression found between the two varieties (Correll and Johnston, 1996). *Panicum hallii* var. *filipes* tends to be more productive than *P. hallii* var. *hallii*, but produces only fair to poor quality livestock forage. The seeds of both varieties can be eaten by birds (Hatch, Schuster, and Drawe, 1999). The two varieties can be distinguished from one another because *P. hallii* var. *filipes* tends to be taller, have longer, more relaxed leaf blades, larger, looser panicles, and smaller spikelets.

Problem: There is a need for native, adapted seed available at a reasonable price for restoration and reclamation of habitat in the South Texas region.

Objective: The objective is to assemble, comparatively evaluate, select and release, and/or provide information on the propagation of Hall's panicum.

Discussion: Four collections of Hall's panicum were seeded in the greenhouse in January 2001. All four accessions were transplanted to the field in May 2001. Three accessions had 100% survival and performed well during the year. Two accessions: 229051 (Maverick County) and 229052 (Nuevo Laredo, Mexico) had over 40% seed germination within the first 15 days. We will continue to evaluate these accessions, as well as any other collections that are received as part of the South Texas Native Project.

Study Number: STPMC-P-0140- RA

Study Title: South Texas Sand Plain Ecotype Project

Introduction: An initiative was developed in August of 2000 and is spearheaded by the Caesar Kleberg Wildlife Research Institute to develop and promote native plants for the restoration and reclamation of habitat on private and public lands in South Texas. The goal of the initiative called the South Texas Natives Project is to provide economically viable sources of plants and seeds, and to develop effective planting strategies for the restoration of South Texas plant communities.

Problem: There is a need for native adapted ecotypic plants for range restoration, wildlife habitat and xeriscaping in South Texas.

Objective: The PMC will establish a seed nursery of South Texas ecotypes of a variety of grasses, forbs, and legumes. Ecotypes will be developed for the South Texas Sand Plain ecoregion. The ecotype region was established to be large enough to retain regional integrity and genetic adaptability. The seed nursery will consist of approximately 20 collections of each species. The nursery will consist of transplants that are isolated as necessary to maintain species integrity and diversity. The seed nursery will be hand harvested to ensure a complete spectrum of seed is harvested from each species. The nursery seed will be planted in production fields where it will then be harvested and bulked per species. The ecoregion seed will then be made available to commercial seed growers.

Discussion: In 2001, 24 collections representing 5 species were collected for the South Texas Sand Plain Ecoregion. A small seed nursery was established consisting of the following species: brownseed paspalum, hooded windmillgrass, plains bristlegrass, four flower trichloris, and golden dalea. More seed collections and expansion of the seed nursery will continue in 2002.

Study Number: STPMC-P-0141- BU

Study Title: Agroforestry Project

Introduction: Agroforestry is the combination of forestry and agriculture to provide a more integrated, productive and sustainable land enterprise. Alley cropping is one of several practices that are considered under agroforestry. Alley cropping is the planting of trees with agronomic or forage crops planted in the alleys or rows between the trees. Alley cropping is used to enhance the economic productivity and diversity of the farming system. It not only enhances productivity but reduces surface water runoff, improves the utilization of nutrients and improves wildlife habitat.

Problem: No significant forage other than volunteer weeds is utilized within pecan groves and other hardwood forests. The incorporation of a perennial cool-season forage grass could enhance the economic productivity of these agriculture enterprises as well as provide additional erosion control, water quality and wildlife enhancement.

Objective: The objective of this study is to evaluate four cool-season grass mixtures incorporated with a pecan operation. Results from this demonstration project should give us valuable quantitative data on the economic feasibility of utilizing alley cropping within a pecan operation in Texas. It should also provide valuable information for other alley cropping systems such as land-use conversion from cropland to hardwood tree-forage systems.

Discussion: The Luling Foundation with funding from the USDA-NRCS-National Agroforestry Center established a test demonstration site of alley cropping with its partners the Caldwell-Travis Soil and Water Conservation District and the Kika de la Garza Plant Materials Center. The PMC installed the demonstration plots on September 19, 2001. The site consists of 16 quarter-acre plots that are in the alleys between existing mature pecan trees. The plots were seeded to one of four species: “Beefbuilder” annual ryegrass, “Lavaca” Canada wildrye, Virginia wildrye, or Texas bluegrass. Each species was replicated four times. Sampling will be done over a three-year period to determine forage production and forage quality for the different species.

Study Number: 77A034J

Study Title: Assembly and Evaluation of Orange Zexmania (*Zexmania hispida*)

Introduction: Orange zexmania (*Zexmania hispida* (H.B.K.)Gray), also known as hairy wedelia (*Wedelia hispida*), is a common, native, warm-season, perennial forb (Ajilvsgi, 1991). A member of the sunflower family (Asteraceae), it grows approximately 60 to 75 cm tall blooming from March to December (Jones, 1982). Its shrub-like form, bright yellow-orange flowers, and hardiness in both dry and moist conditions make it an attractive plant for landscape use. In addition, it is easily cultivated, and is often browsed by deer, sheep, and goats (Ajilvsgi, 1991). It is found in parts of Texas and Mexico. In Texas, it is found along the Edwards Plateau, the Rio Grande Plains, and less frequently in the Trans Pecos, and in the southern portions of north central and south east regions of Texas (Correll and Johnston, 1996).

Problem: There is a need for perennial forbs for range restoration, wildlife habitat and xeriscaping in South Texas.

Objective: The objective is to assemble, comparatively evaluate, select, and release and/or provide information on the propagation of orange zexmania.

Discussion: An initial evaluation plot containing two replications of 16 different accessions of orange zexmenia was planted on 4/12/94. The plot was evaluated for four years and it was determined that the release would be a composite of superior accessions from the north, south, east and west portions of the growing area. This will help assure a good stand of orange zexmania is obtained from a broad range of climatic conditions and terrains. Selection was made in the fall of 1998, based on germination studies, initial evaluation plot evaluations, and seed production data.

Currently, we are increasing seed production to prepare for an upcoming release. A new seed increase plot of accession #9076938 was planted in the spring of 1999. The accession is a composite of accessions #9061281 (El Dorado), #9064358 (Lockhart), #9064437 (Bandera), and #9064456 (Goliad). These four accessions were selected to be part of the release composite based on survival, foliage density, plant vigor, seed production data, germination data, and other agronomic characteristics that made the composite a superior selection for a wide range of Texas environments.

Study Number: 77A035J

Study Title: Assembly and Evaluation of Lazy Daisy (*Aphanostephus riddellii*)

Introduction: *Aphanostephus riddellii* T.&G., commonly known as perennial lazy daisy or Riddell's doze diasy (USDA, 1994) is a member of the sunflower (Asteraceae) family (Correll & Johnston, 1996). It grows from 22.5 to 30 cm tall, and its yellow-disked, white rayed flowers bloom from February to December (Jones, 1982). The common name lazy daisy comes from the fact that the buds droop in the morning when they are closed, and then slowly come erect when the flowers open at about mid-day (Ajilvsgi, 1991). *Aphanostephus riddellii* is the only perennial species of this genus in Texas (Turner, 1984). Lazy daisy grows mostly on well drained loam soils and caliche in pastures and woods (Jones, 1982). It can be found in Texas, New Mexico, and northern Mexico. In Texas, perennial lazy daisy grows on the Edward's Plateau, through the Plains Country, and on limestone cuestas of the Rio Grande Plains (Correll and Johnston, 1996). Although perennial lazy daisy may be found growing in conjunction with other *Aphanostephus* species, they have not been known to hybridize (Tuner, 1984).

Problem: There is a need for perennial forbs for range restoration, wildlife habitat and xeriscaping in South Texas.

Objective: The objective is to assemble, comparatively evaluate, select and release and/or provide information on the propagation of lazy daisy.

Discussion: Eight accessions of lazy daisy were collected from 1990 through 1993. These 8 collections were evaluated from 1995 until 1999. In 1999 it was decided to make a composite of three accessions: 9061254 (Goliad County, Texas), 9064442 (Jones County, Texas) and 9064455 (Goliad County, Texas). In 2001 3.8 pounds of lazy daisy seed was havested at the PMC. We plan to develop a plant fact sheet on this species in 2002. It is our long-range plan to release this as a horticultural plant for xeriscaping due to the difficulties in producing cost-effective large scale commercial seed.

Study Number: 77AO4I E

Study Title: Evaluation of Grass Hedges for Erosion Control in Texas

Introduction: The Natural Resource Conservation Service (NRCS) has promoted the use of terraces for soil erosion control for over forty years. More recently the concept of using vegetative barriers or grass hedges as a vegetative alternative has been investigated (Kemper et al., 1992). Vegetative barriers are narrow strips (30-90 cm wide) of stiff, erect, densely growing plants, usually grasses, planted across the slope perpendicular to the dominant slope. These barriers function to slow water runoff, trap sediment and prevent gully development (Dabney et al., 1993).

The greatest appeal of vegetative barriers is the low-cost method in developing a terrace. It could provide an option to conventional terraces without the need for heavy machinery. Furthermore, it would eliminate the movement and compaction of precious topsoil.

Problem: There is a need for low-cost methods to provide effective erosion control protection on Texas cropland.

Objective: The objective of this study is to evaluate seeding eastern gammagrass on heavy clay soils.

Discussion: Seeding vegetative barriers has the potential to be a low-cost method for erosion control on Texas cropland. This study evaluated the establishment of vegetative barriers by seeding "luka" eastern gamagrass on heavy, clay soils at the Kika de la Garza Plant Material Center. Flat drill seeding was compared to bedded seeding. There was no significant difference in seeding method one year after planting. The barriers had an average of 1-2 gaps/10 feet with an average gap size of 10-12 inches. Despite occasional larger gaps that occurred in the barriers, the double row seeding provided effective erosion control (Appendix Vol.4 No.9).

In this study, we also observed that the variety "luka" eastern gamagrass experienced some mortality problems during the summer in Kingsville, Texas. The mean gap size went from 9.0 to 9.7 inches and the maximum gap size went from 14.4 to 18.6 inches from February 2001 to October 2001. It was an extremely dry summer in Kingsville with the PMC receiving only 13.6 inches of rain from February to October. However, it is our intention to evaluate over the next couple of years the Texas variety "Medina" eastern gamagrass to see how well it survives and functions as a vegetative barrier in South Texas.

Study Number: 77A044 P

Study Title: Assembly and Evaluation of Armed Saltbush (*Atriplex acanthocarpa*)

Introduction: Armed saltbush (*Atriplex acanthocarpa* (Torr.)Wats.) is a native, saline tolerant, evergreen, perennial shrub with a woody root (Correll and Johnston, 1996). It can grow from 3-10 dm in height (Everitt and Drawe, 1993). It is a member of the pigweed (Chenopodiaceae) family (Jones, 1992).

Armed saltbush is also known by the common names huaha (Everitt and Drawe, 1993) and tubercled saltbush (USDA, 1994) because the bracts of the fruit have many flattened tubercles (Everitt and Drawe, 1993). It is dioecious, having male and female flowers on separate plants (Correll and Johnston, 1996).

Armed saltbush occurs in parts of South Texas (Jones, 1982) and Correll and Johnston (1996) record its presence from West Texas to southern New Mexico, and south into Mexico. Everitt and Drawe (1993) note that it is found predominately in the western half of Texas and less frequently in Cameron, Starr, Webb, and Zapata counties. Armed saltbush prefers well-drained, often alkaline soils.

Problem: There is an estimated 600,000 acres in South Texas that exhibit complex saline and alkaline soil problems. These soils need plants that are able to adapt to these specific problems.

Objective: The objective is to assemble, comparatively evaluate, select and release and/or provide information on the propagation of armed saltbush.

Discussion: Armed saltbush has been documented as having nutritious browse for cattle and deer (Garza and Fulbright, 1988). Garza and Fulbright (1988) also note that armed saltbush has higher crude protein levels than four-winged saltbush, a relative of armed saltbush. Armed saltbush has also been used for windbreaks, roadside cover, and as an ornamental (Correll and Johnston, 1996). It also has wildlife value, providing both shelter for birds and small animals, and a source of food for browsing animals. It is particularly useful for plantings on sites that have complex alkaline and saline soil problems.

Eleven accessions were collected and evaluated from 1995 until 1999. Evaluation plantings were made at the Center as well as at two off-Center sites. Studies conducted by the PMC (1998 Tech Note Vol. 1 No. 1) found armed saltbush to be more adapted to the dry saline conditions of South Texas than four-wing saltbush. Results indicate that transplants of armed saltbush are an effective method for revegetating salt-impacted sites. However, because of variable seed germination and difficult seed harvesting, the PMC has elected not to make a formal release of this species. Information on armed saltbush adaptation, use, establishment and management is available from the January 2001 plant fact sheet (Appendix 2).

Kika de la Garza Plant Materials Center

Kingsville, TX

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A GERMINATION STUDY OF SALT- MARSH BULRUSH SEED STORED UNDER DIFFERENT CONDITIONS

ABSTRACT

This germination study was conducted using two different accessions of salt-marsh bulrush (*Scirpus robustus*) seed that was stored three different ways. Seed was obtained from plants maintained in the wetland plant evaluation area at Kika de la Garza Plant Materials Center in Kingsville, Texas. Seed of each accession was hand- harvested and stored either in a container full of de-ionized water (wet-stored), treated with thiram (moist-stored), or placed directly into a seed collection envelope (dry-stored). The wet-stored seed was harvested in 1999. The moist and dry-stored seeds were harvested in 2000. Wet-stored seed of both accessions was found to have significantly higher germination than either the moist or the dry-stored seed.

INTRODUCTION

Salt-marsh bulrush (*Scirpus robustus*), previously known as (*Scirpus maritimus* var. *macrostachyus*), is a member of the Cyperaceae or sedge family (Hatch, Gandhi, & Brown, 1990). It is a native, rhizomatous perennial, with extensive culms tufted along the rhizome. Often there are tuber-like structures located basally (Correll & Johnston, 1996). Salt-marsh bulrush is frequently found in colonies in wet, brackish soils and in the shallow waters of ponds, lakes, and marshes (Jones, 1982). It can be found in the coastal marshes of southeast Texas and the Rio Grande Plains (Correll & Johnston). Salt-marsh bulrush is able to tolerate alkalinity and has been known to grow in sandy or clay soils, as well as in fresh or brackish water. It should be noted; however, that the site salinity may be inversely correlated with both seed production and germination (Keyes & Lloyd-Reilley, 1999). It can be used as a wetland restoration plant for South Texas. It also provides habitat for waterfowl and other wetland wildlife and its seeds are an excellent food source for ducks (Martin & Uhler, 1939; Prevost and Gresham, 1981). Salt-marsh bulrush may be propagated from rootstocks, division of rhizomes, or seed.

The main objective of this study is to evaluate how seed-storage methods affect germination of salt-marsh bulrush seed. This study will compare how salt-marsh bulrush seed stored wet, dry, or moistened with thiram will germinate. Germination of the two accessions will also be compared.

There have been few studies that looked at the impact of seed storage methods on germination in salt-marsh bulrush seed. A previous salt-marsh bulrush seed storage study conducted at the Kika de la Garza Plant Materials Center in the spring of 1999 found that seed stored in water in a cool place would germinate, but that dry-stored seed stored in a cool place would not (Kika de la Garza PMC, 1999). Prevost and Gresham (1981), also found better germination from seed stored in water or wet sand, than from dry-stored seed or seed kept on moist blotter paper. A second study conducted at the Kika de la Garza Plant Materials Center (2000) found that dry-stored seed from two accessions and three different harvest periods in 1999 had good germination. PMC staff concluded that under the right set of conditions, dry-stored seed will germinate. The ability to dry-store salt-marsh bulrush seed could lead to more widespread use of the plant in coastal wetland projects. Although wet-stored seed has been proven to have good germination, it makes large scale seeding difficult because wet seed is hard to broadcast. Additionally, wet-stored seed tends to pre-germinate in storage. This leaves the embryo partly exposed and makes it impossible to dry the seed out prior to seeding time without losing the majority of the germinable seed. Moist-stored seed might also provide a viable seed storage alternative for this species. Thiram (Tetramethylthiuram disulfide) is a chemical agent, which can be used to maintain seed moisture and reduce loss from seed decay. It has been used successfully with grasses and other plants.

MATERIALS AND METHODS

In this study, seed from accessions #9076931 (collection from Aransas Co., TX) and #9076934 (collection from Jackson Co., TX) salt-marsh bulrush was collected and cleaned by hand during the summer harvest seasons in 1999 and 2000 by staff members at the Kika de la Garza Plant Materials Center in Kingsville, Texas. Plants from which the seed was harvested were located in wet tanks in Block A (#9076934) and Block O (#9076931) of the wetland plant evaluation area at the PMC. Seed from each accession from the 1999 harvest was stored in a container of de-ionized water at 35ºF. This seed was designated as wet-stored. Seed from each accession from the 2000 harvest was separated in two parts. The first half was placed directly into a seed collection envelope and designated as dry-stored seed. The second half of the seed from each accession was dipped in a solution of Thiram 50WP and stored in a cloth seed bag. This seed was designated as moist-stored. Both the dry and moist stored seed was stored in a temperature and humidity controlled seed cooler at the Plant Materials Center at approximately 50ºF and 50% humidity.

On December 11th of 2000, seed was removed from the refrigerator and cooler for germination testing. For each of the two accessions, 200 seeds of the wet-stored seed, 200 seeds of the moist-stored seed, and 200 seeds of the dry-stored seed were tested. From each 200 seed sample, 50 seeds were placed on a separate set of two sheets of germination blotter that had been pre-moistened with de-ionized water and set into a plastic tray with a plastic lid. The process was repeated three additional times until there were four replications of each accession/storage method combination. The trays were then placed in a germination chamber set at 70ºF for 10 hours dark and 100ºF for 14 hours of light. Seeds remained in the germination chamber for 28 days and were checked for germination on a daily basis. Seeds were considered germinated when the root and the shoot exceeded the length of the seed.

RESULTS AND DISCUSSION

Data from this study was analyzed using SPSS for Windows. A descriptives table and one-way analysis of variance (ANOVA) were run for the factors accession and storage method. Tukey's Test for Honestly Significant Difference (Tukey's HSD) was run to pinpoint specific differences between treatment methods. Germination was the dependent variable for all tests.

No significant difference in germination was found between accessions. But, significant differences in germination were found between the three storage methods. According to Tukey's HSD, the wet-stored seed had a significantly higher percentage of germinated seed (76.25) than did either the moist-stored seed (7.00), or the dry-stored seed (3.75). Germination means for both the storage methods and the accessions can be found on Table 1.

The results of this study support the results of the 1999 research conducted at the Center, where wet-stored salt-marsh bulrush seed was found to significantly outperform dry-stored salt-marsh seed in a 28-day germination study (Kika de la Garza PMC, 1999). Although dry-stored seed has been known to achieve better than fifty percent germination (Kika de la Garza PMC, 2000), it appears that the germination of dry-stored seed is not consistently good.

There are several reasons why the germination results with dry-stored seed have been inconsistent. First, in accordance with past literature (Keyes & Lloyd-Reilley, 1999), there may be some seed dormancy. In addition, dry-stored seed may require more than 28 days to germinate. Many hard-shelled seeds need more time for moisture to penetrate the seed coat, allowing germination to occur. Finally, harvest year may play a role in the germination of salt-marsh bulrush. A future study is planned with dry-stored salt-marsh bulrush seed to determine if this is a factor in germination.

At the present time, we recommend the use of wet-stored seed for best results, if you wish to seed salt-marsh bulrush. New seedings should be placed in shallow areas of water (1/4" –3/8" deep) in the summer months when the air and water temperatures are hot. Seed will germinate in deeper water, but will not be able to root and will damp off. Salt-marsh bulrush seed can also be germinated in shallow trays of water in a nursery or germination chamber and mass produced as transplants. Vegetative propagation is a good alternative for small projects since salt-marsh bulrush propagates well from root stocks and rhizomes split from existing plants.

REFERENCES

Correll, D. S., and M.C. Johnston. 1996. Manual of the Vascular Plants of Texas. Richardson, TX: The University of Texas at Dallas.

Hatch, S. L., K.N. Gandhi, and L.E. Brown. 1990. Checklist of the Vascular Plants of Texas. College Station, TX: Texas Agricultural Experiment Station.

Jones, F. B. 1982. Flora of the Texas Coastal Bend. Sinton, TX: Welder Wildlife Foundation.

Keyes, K. L. and J. Lloyd-Reilley. 1999. Evaluation of Propagation Techniques of Selected Native South Texas Wetlands Plants Utilized By Waterfowl. Kingsville, TX: Kika de la Garza Plant Materials Center.

Kika de la Garza PMC. 1999. Salt-Marsh Bulrush: Two Germination Studies. Technical Reports, v. 2 (5), 40-46.

Kika de la Garza PMC. 2000. A Germination Study Of Dry-Stored Salt-marsh Bulrush Seed. Technical Reports, v.3 (4), 21-24

Martin, A. C. and F. M. Uhler. 1939. Food of Game ducks in the United States and Canada, Technical Bulletin #634. Washington DC: United States Department of Agriculture.

Prevost, M. B. and C. A.Gresham. 1981. Artificial establishment of salt-marsh bulrush seedlings in South Carolina. Wildlife Society Bulletin, v. 9 (4), 310-314.

Table 1.

Germination Means for Salt-Marsh Bulrush

ACC	STORAGE	GERMINATION
9076931	Wet	72.50^{a}
	Moist	0.00^{b}
	Dry	0.50^{b}
	Total	24.33
9076934	Wet	80.00^{1}
	Moist	14.00^{2}
	Dry	7.00^{2}
	Total	33.67
TOTAL	Wet	76.25^{x}
	Moist	7.00^{y}
	Dry	3.75^{y}
	Total	29.00

* Means for the same accession with the same superscript are not significantly different at the .05 probability level

Kika de la Garza Plant Materials Center

Kingsville, TX

Vol. 4 No. 2 Technical Note April 2001

A GERMINATION STUDY OF GULFCOAST SPIKERUSH SEED STORED UNDER DIFFERENT CONDITIONS

ABSTRACT

This germination study was conducted using gulfcoast spikerush seed that had been stored three different ways. Seed was obtained from plants maintained in the wetland plant evaluation area at Kika de la Garza Plant Materials Center in Kingsville, Texas. The seed was hand-harvested and hand-cleaned in July of 2000. The seed was then split into thirds and stored by three different methods. The first third was stored in a container full of de-ionized water (wet-stored). The second third was treated with thiram (moist-stored). The last third was placed directly into a seed collection envelope (dry-stored). The seeds were tested for germination for eight weeks. Wet-stored seed had the best germination, but it was not consistantly better than either the moist or the dry-stored seed.

INTRODUCTION

Gulfcoast spikerush (*Eleocharis cellulosa*) is a member of the Cyperaceae or sedge family (Correll & Johnston, 1996). It is a native, rhizomatous perennial, often forming extensive colonies. It grows from a tuberous rootstock and can reach 90cm in height. Often there are small (3-6mm), whitish tubers found growing along the roots (Stutzenbaker, 1999). Gulfcoast spikerush is frequently found in fresh-water mud (Correll & Johnston, 1996) on the edges of ponds, creeks, and marshes, but can tolerate salinities up to 3.5 ppt (Stutzenbaker, 1999). It can be found in coastal areas from North Carolina to Texas and south to Mexico, and also grows in the West Indies and Bermuda (Correll & Johnston, 1996). In Texas, it is present throughout South Texas (Keyes & Lloyd-Reilley, 1999), predominately in the coastal regions and the Edwards Plateau (Hatch, Gandhi, & Brown, 1990), and more rarely in the Rio Grande Plains and east Texas (Correll & Johnston, 1996). It produces seed heads throughout the warm season (Keyes & Lloyd-Reilley, 1999). It also provides habitat for waterfowl and other wetland wildlife, including snow geese and mottled ducks (Stutzenbaker, 1999). Gulfcoast spikerush seeds are an excellent food source for ducks (Martin & Uhler, 1939; Singleton, 1965; Stutzenbaker, 1999), snow geese, mallards, mottled ducks and pintails will eat the tubers, and the geese will also eat the basal portions and rhizomes (Stutzenbaker, 1999). Gulfcoast spikerush generally requires little management and can be used as a wetland restoration plant for south Texas. Plants seem to survive at a variety of water levels (Keyes and Lloyd-Reilley, 1999). However, Stutzenbaker (1999) notes that plants need to be dewatered in early spring after geese have fed there to allow new plants to regrow. He warns that deep flooding after geese have caused damage to the plants can result in a complete loss of the stand. Gulfcoast spikerush may be propagated from rootstocks, division of rhizomes, or seed.

The main objective of this study is to evaluate how seed-storage methods affect germination of gulfcoast spikerush seed. This study will compare how well gulfcoast spikerush seed stored wet, dry, or moistened with Thiram will germinate. Survival of seedlings obtained from this study will also be evaluated.

There have been few studies on the impact of seed storage methods on germination in gulfcoast spikerush seed. A previous gulfcoast spikerush seed storage study conducted at the Kika de la Garza Plant Materials Center in the spring of 1999 revealed that seed stored in water in a cool place did germinate (9.5% germination). However, dry-stored seed stored in a cool place had no germination at temperatures between 72º and 85ºF for 28 days (Kika de la Garza PMC, unpublished). PMC staff believe that under the right set of conditions, dry-stored seed will germinate.

The ability to dry-store gulfcoast spikerush seed could lead to more widespread use of the plant in coastal wetland projects. Use of transplants can limit use for large-scale projects because of time and labor costs required in producing and planting the material. Although some germination has been achieved with wet-stored seed, it makes large scale seeding difficult due to the fact that wet seed is hard to broadcast. Moist-stored seed might also provide a viable seed storage alternative for this species. Thiram (Tetramethylthiuram disulfide) is a chemical agent, which can be used to maintain seed moisture and reduce loss from seed decay. It has been used successfully on grasses and other plants.

MATERIALS AND METHODS

In this study, seed from accession #9076914 (collection from Aransas Co., TX) gulfcoast spikerush was collected and cleaned by hand in early July of 2000 by staff members at the Kika de la Garza Plant Materials Center in Kingsville, Texas. The plants from which the seed was harvested were located in a wet tank in Block A of the wetland evaluation area at the PMC. Once cleaned, the seed was divided into three parts. The first part of the seed harvest was stored in a container of de-ionized water in a refrigerator at 35ºF. This seed was designated as wet-stored. The second part was placed directly into a seed collection envelope and designated as dry-stored seed. The last part was dipped in a solution of Thiram 50WP and stored in a cloth seed bag. This seed was designated as moist-stored. Both the dry and moist stored seed was stored in a temperature and humidity controlled seed cooler at the Plant Materials Center at approximately 50ºF and 50% humidity.

On February 10th of 2001, seed was removed from the refrigerator and cooler for germination testing. For each of the three storage treatments, 200 seeds were tested. From each 200 seed sample, 50 seeds were placed on a separate set of two sheets of germination blotter that had been pre-moistened with de-ionized water and set into a plastic tray with a plastic lid. The process was repeated three additional times until there were four replications of each accession/storage method combination. The trays were then placed in a germination chamber set at 70ºF for 10 hours dark and 100ºF for 14 hours of light. Trays remained in the chamber for 28 days and checked for germination on a daily basis. Seeds were considered germinated when the root and the shoot exceeded the length of the seed. Once the shoot was at least ½" in height, a seedling was removed from the study and transplanted into one of four 6" pots with a sand and clay mix soil. Survival of these seedlings was recorded.

RESULTS AND DISCUSSION

Data from this study was analyzed using SPSS for Windows. A descriptives table and one-way analysis of variance (ANOVA) were run for the factor 'storage method'. Tukey's Test for Honestly Significant Difference (Tukey's HSD) was run to pinpoint specific differences between storage treatment methods. Germination was the dependent variable for all tests. Four-week and eight-week germination percentages were run.

No germination occurred until day 19 of the study, when wet-stored seed began to germinate. No germination occurred after week 7 of the study. No significant differences in germination were found between the three storage methods after four weeks or after eight weeks. Germination means for both the storage methods and the accessions can be found on Table 1. Of the forty-four seedlings removed from this study and transplanted into pots, only eleven survived a week after the study ended.

The results of this study support the results of the 2000 research conducted at the Center, where wet-stored gulfcoast spikerush seed was found to outperform dry-stored salt-marsh seed in a germination study. As with the first study, the germination difference between the two storage methods was not significant and overall germination was poor (Kika de la Garza PMC, 2000). Results indicate that fertility of gulfcoast spikerush seed may be consistently poor.

There are several reasons why the germination results with gulfcoast spikerush seed have been poor. First, there may be some seed dormancy. Secondly, the seed may require a longer period of time to germinate since many hard-shelled seeds take a long time for moisture to penetrate the seed coat, allowing germination to occur. Thirdly, we may not have found the right set of conditions needed to stimulate germination. Finally, harvest year may play a role here. A future study is planned with wet-stored and dry-stored gulfcoast spikerush seed to evaluate the impact of harvest year on germination.

At the present time, we recommend the use of vegetative splits to propagate this species. Gulfcoast spikerush propagates well from root stocks and rhizome splits from existing plants. Vegetative propagation is a good alternative for small projects. A May 1998 study at the Kika de la Garza Plant Material Center found that 100 percent of vegetative splits of gulfcoast spikerush survived, and had achieved 3-3.5 times the amount of original tillers after only six weeks (Keyes & Lloyd-Reilley, 1999). Stutzenbaker (1999) recommends transplanting whole plants in late winter on sites where the water level is low and there is periodic drying. On more northern sites, Singleton (1965) recommends transplanting rootstocks or whole plants in late spring or early summer. Less success has been had with seed, although Center staff have propagated small quantities of plants successfully by this method. Germination tends to be poor and seedling survival of plants grown from seed tends to be low.

REFERENCES

Correll, D. S. and M.C. Johnston. 1996. Manual of the Vascular Plants of Texas. Richardson, TX: The University of Texas at Dallas.

Hatch, S. L., K.N Gandhi and L.E. Brown. 1990. Checklist of the Vascular Plants of Texas. College Station, TX: Texas Agricultural Experiment Station.

Keyes, K. L. and J. Lloyd-Reilley. 1999. Evaluation of Propagation Techniques of Selected Native South Texas Wetlands Plants Utilized By Waterfowl. Kingsville, TX: Kika de la Garza Plant Materials Center.

Martin, A. C. and F. M. Uhler. 1939. Food of Game ducks in the United States and Canada, Technical Bulletin #634. Washington DC: United States Department of Agriculture.

Singleton, J. R. 1965. Waterfowl Habitat Management In Texas, Technical Bulletin #47. Austin, TX: Texas Parks and Wildlife Department.

Stutzenbaker, C. D. 1999. Aquatic and Wetland Plants of the Western Gulf Coast. Port Arthur, TX: Texas Parks and Wildlife Press.

Table 1.

Germination Means for Gulfcoast spikerush

Week	STORAGE	GERMINATION
4	Wet	4.00[a]
	Moist	2.00[a]
	Dry	0.50[a]
	Total	2.17
8	Wet	17.50*
	Moist	3.00*
	Dry	0.50*
	Total	7.00

* Means with the same superscript for each week are not significantly different at the 0.05 probability level.

Kika de la Garza Plant Materials Center

Kingsville, TX

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A GERMINATION STUDY OF SALT- MARSH BULRUSH SEED HARVESTED IN DIFFERENT YEARS

ABSTRACT

This germination study was conducted using two different accessions of salt-marsh bulrush (*Scirpus robustus*) seed harvested in different years. Seed was obtained from plants maintained in the wetland plant evaluation area at Kika de la Garza Plant Materials Center in Kingsville, Texas. Seed from each accession was hand-harvested, cleaned, and placed directly into a seed collection envelope (dry-stored). Four years were evaluated for one of the accessions (#9076931), but only two years of the second accession (#9076934) were available for evaluation. The initial study was maintained for four weeks, after which the three best harvest year/accession combinations were removed from the study. The three poorest harvest year/ accession combinations were observed for an additional 7 weeks to determine if additional germination would occur. Accession #9076934 had good germination (55% & 62%) for both the 1999 and 2000 harvest years, while accession #9076931 had good germination (48%) for the 1997 harvest year only. The 1998, 1999, and 2000 harvest years of accession #9076931 seed had poor germination (4%, 9%, & 2%) at four weeks and showed no significant improvement in (4%, 13.5%, & 4.5%) at eleven weeks.

INTRODUCTION

Salt-marsh bulrush (*Scirpus robustus*), previously known as (*Scirpus maritimus,* var. *macrostachyus*), is a member of the Cyperaceae or sedge family (Hatch, Gandhi, & Brown, 1990). It is also commonly known as leafy three square (Stutzenbaker, 1999). It is a native, rhizomatous perennial, with extensive culms tufted along the rhizome. Often there are tuber-like structures located basally (Correll & Johnston, 1996). Salt-marsh bulrush is frequently found in wet, brackish soils and in the shallow waters of ponds, lakes, and marshes (Jones, 1982). It is known to forming colonies of several acres, growing in association with marsh hay cordgrass (*Spartina patens*), also known as wiregrass (Stutzenbaker, 1999). The species has a worldwide distribution. In Texas, it can be found in the coastal marshes of southeast Texas and the Rio Grande Plains (Correll & Johnston, 1996). Salt-marsh bulrush is tolerant of alkalinity and has been known to grow in sandy or clay soils, and in fresh or brackish water. It can tolerate salinities up to 10ppt (Stutzenbaker, 1999). It should be noted; however, that the site salinity may be inversely correlated with both seed production and germination (Keyes & Lloyd-Reilley, 1999). Stutzenbaker (1999) notes that some degree of salinity is good for this plant, as it tends to decline under long-term freshwater conditions.

Salt-marsh bulrush can be used as a wetland restoration plant for south Texas since it can be grown from rootstocks, division of rhizomes, or seed. It also provides habitat for waterfowl and other wetland wildlife and its seeds are an excellent food source for ducks (Martin & Uhler, 1939; Prevost and Gresham, 1981; Stutzenbaker, 1999). Rhizomes and tubers are eaten by snow geese, muskrats and nutria (Stutzenbaker, 1999). It can also withstand heavy grazing by livestock (Stutzenbaker, 1999).

The main objective of this study is to evaluate the effect of harvest year on germination of salt-marsh bulrush seed. This study will evaluate how well salt-marsh bulrush seed germinates across accessions based on the harvest year. Germination of the two accessions will also be compared.

There have been few studies that looked at the impact of harvest year on germination of salt-marsh bulrush seed. In fact, few studies have been done with dry-stored seed most of which have yielded inconsistant results. A previous salt-marsh bulrush study conducted at the Kika de la Garza Plant Materials Center in the spring of 1999 found that seed stored in water in a cool place would germinate, but that dry-stored seed stored in a cool place would not (Kika de la Garza PMC, 1999). Prevost and Gresham (1981), also found better germination from seed stored in water or wet sand, than from dry-stored seed. However, a second study conducted at the Kika de la Garza Plant Materials Center (2000) found that dry-stored seed from two accessions and three different harvest periods within the same year had good germination. PMC staff believe that under the right set of conditions, dry-stored seed will germinate. Most of the previous germination studies with salt-marsh bulrush seed used very warm temperatures. However, PMC staff recently found salt-marsh bulrush seed that had germinated in their wet tanks when day temperatures were only about 40ºF. During a March 2000 telephone discussion, Jeanette Franke, Certified Seed Analyst at the Texas Department of Agriculture Seed Laboratory at Giddings, Texas suggested that some seeds prefer temperature extremes. This may be true of salt-marsh bulrush. A future study is planned to evaluate the effect of cool temperatures on germination of salt-marsh bulrush seed.

The ability to dry-store salt-marsh bulrush seed could lead to more widespread use of the plant in coastal wetland projects. Although wet-stored seed has been proven to have good germination, it makes large scale seeding difficult because wet seed is hard to broadcast. Additionally, wet-stored seed tends to pre-germinate in storage. This leaves the embryo partly exposed and makes it impossible to dry the seed out prior to seeding time without losing a majority of the germinable seed. Transplanting vegetative splits has been proven successful (Keyes & Lloyd-Reilley, 1999), but can be costly and time-consuming. This makes it impractical for use in large-scale projects.

MATERIALS AND METHODS

For this study, salt-marsh bulrush seed from accessions #9076931 (collection from Aransas Co., TX) and #9076934 (collection from Jackson Co., TX) was collected and cleaned by hand during the summer harvest seasons. Accession #9076931 was harvested in 1997 and 1998, and both accession were harvested in 1999 and 2000 by staff members at the Kika de la Garza Plant Materials Center in Kingsville, Texas. The plants from which the seed was harvested were located in wet tanks in Block A (#9076934) and Block O (#9076931) of the wetland plant evaluation area at the PMC. Seed from each accession, from different harvests was placed directly into a seed collection envelope. This was considered to be dry-stored seed. The seed was stored in a temperature and humidity controlled seed cooler at the Plant Materials Center kept at approximately 50ºF and 50% humidity.

On January 10th of 2001, seed was removed from the cooler for germination testing. For each of the two accessions, 200 seeds of each harvest year were tested. From each 200 seed sample, 50 seeds were placed on a separate set of two sheets of germination blotter that had been pre-moistened with de-ionized water and set into a plastic tray with a plastic lid. The process was repeated three additional times until there were four replications of each accession/storage method combination. The trays were then placed in a germination chamber set at 70ºF for 10 hours dark and 100ºF for 14 hours of light. Trays remained in the chamber for 28 days and checked for germination on a daily basis. Seeds were considered germinated when the root and the shoot exceeded the length of the seed.

As an addition to the main study, the three best accession/ harvest year combinations (#9076931 – 1997; 9076934 –1999, 2000) were removed from the study. The three poorest accession/harvest year combinations were evaluated for an additional 7 weeks under the same conditions to determine if additional germination would occur. It was the opinion of PMC staff, that perhaps some seeds may require more time to germinate than others. This addition to the study will help evaluate this hypothesis.

RESULTS AND DISCUSSION

Data from this study was analyzed using SPSS for Windows. A descriptives table (Table 1) and factorial analysis of variance (ANOVA) were run for the factors accession and harvest year. In addition, each accession was analyzed alone to compare harvest years using a one-way ANOVA. Tukey's Test for Honestly Significant Difference (Tukey's HSD) was run to pinpoint specific differences between harvest years. Germination was the dependent variable for all tests. Four-week germination was used for all accession/harvest year combinations. In addition, eleven-week data was used for the three accession/harvest year combinations that remained in the extended study.

The results of a factorial ANOVA run for the factors accession and harvest year found no significant main effect differences in four-week germination, nor did it find any interaction effect (Table 2). However, a one- way ANOVA did find a significant difference in four-week germination between accessions, with accession #9076934 (58.50%) having significantly better germination at four weeks than accession #9076931 (15.88%) (Table 3). No significant difference in four-week germination of both accessions was found between harvest years using a one-way ANOVA.

When the accessions were separated, a significant difference between harvest years was found using a one–way ANOVA (Table 4.) for the accession #9076931. According to Tukey's HSD, harvest year 1997 (Table 5.) had significantly better germination after four-weeks, than the other three harvest years. No significant difference between harvest years was found for the accession #9076934.

A one-way ANOVA (Table 6.) using eleven-week germination data was run for the three accession/harvest year combinations left for the extended study (#9076931-1998, 1999, 2000). A significant difference between harvest years was found for eleven-week germination. According to Tukey's HSD, #9076931-1999 had significantly higher eleven-week germination than the 1998 harvested seed (Table 7). It should be noted that the additional seven weeks in the germination chamber did not yield much increase in germination for the three years of #9076931. Harvest year 1998 showed no additional germination, while 1999 seed germination increased by 4.5 percent. Seed harvested in 2000 showed only a 2 percent increase.

The results of this study seem to support good germination potential for dry-stored salt-marsh bulrush seed, but actual germination appears to be inconsistent. A salt-marsh bulrush seed storage method study conducted by the Kika de la Garza Plant Materials Center (1999) yielded no germination for dry-stored seed of accession # 9076931 harvested in 1997. However, a second study conducted by the Kika de la Garza PMC (2000) had good success germinating dry-stored seed harvested in 1999. Accession #9076931 averaged 45.25 percent germination for three different harvest periods in 1999, while accession # 9076934 averaged 67.25 percent for the same three harvest periods. The combined germination from dry-stored seed for that study was a promising 56.25 percent. Then another seed storage study conducted by the Kika de la Garza PMC (2001) yielded poor results with dry-stored seed from the 2000 harvest season, obtaining only 0.5 percent germination for accession #9076931 and 7 percent germination for accession # 9076934. The results of this current study were mixed with one year of #9076931 having good germination (48%), and both years of #9076934 having germination above 50 percent. So, although dry-stored seed has been known to achieve better than fifty percent germination (Kika de la Garza PMC, 2000), it appears that the germination of dry-stored seed is not consistently good

Results indicate there are some reasons why the germination results with dry-stored seed have been inconsistent. First, in accordance with past literature (Keyes & Lloyd-Reilley, 1999), there may be some seed dormancy. Different seeds may be programmed to germinate after different periods of time. Another reason for inconsistent germination may be that different seeds have different germination triggers. For instance, a certain percentage of salt-marsh bulrush seed may germinate only under low temperatures, and certain percentage may germinate only when the temperatures are high, etc. A mechanism such as this could help ensure species survival under a variety of climatic conditions. Center staff noticed some of this when working with plants of a new accession (#9085394 – collection from Chambers Co., TX). Many seeds that dropped from the plant were found to have germinated when the temperatures were only about 40ºF during the day, others appeared to remain dormant. However, when the weather warmed up to about 80º F in the daytime, more seeds began to germinate. A future study is planned to explore the possibility of both hot and cold germination triggers for salt-marsh bulrush seed. Factors such as variety of light, temperature, accession, production year, and time may play a role in allowing salt-marsh bulrush seeds to germinate.

At the present time, we recommend the use of wet-stored seed for best results, if you wish to seed salt-marsh bulrush. New seedings should be placed in shallow areas of water (1/4" –3/8" deep) in the summer months when the air and water temperatures are hot. Seed will germinate in deeper water, but will not be able to root and will damp off. Salt-marsh bulrush seed can also be germinated in shallow trays of water in a nursery or germination chamber and mass produced as transplants. Seedlings take only a few months to mature and begin to propagate vegetatively on their own. Vegetative propagation by splitting is a good alternative for small projects. Salt-marsh bulrush propagates well from root stocks and rhizome splits from existing plants. In addition, whole plants can be transplanted.

REFERENCES

Correll, D. S. and M.C. Johnston. 1996. Manual of the Vascular Plants of Texas. Richardson, TX: The University of Texas at Dallas.

Hatch, S. L., K.N. Gandhi, and L.E. Brown. 1990. Checklist of the Vascular Plants of Texas. College Station, TX: Texas Agricultural Experiment Station.

Jones, F. B. 1982. Flora of the Texas Coastal Bend. Sinton, TX: Welder Wildlife Foundation.

Keyes, K. L. and J. Lloyd-Reilley. 1999. Evaluation of Propagation Techniques of Selected Native South Texas Wetlands Plants Utilized By Waterfowl. Kingsville, TX: Kika de la Garza Plant Materials Center.

Kika de la Garza PMC. 1999. Salt-Marsh Bulrush: Two Germination Studies. Technical Reports, v. 2 (5), 40-46.

Kika de la Garza PMC. 2000. A Germination Study Of Dry-Stored Salt-marsh Bulrush Seed. Technical Reports, v.3 (4), 21-24

Kika de la Garza PMC. 2001. A Germination Study Of Salt-Marsh Bulrush Seed Stored Under Different Conditions. Technical Reports, v. 4(1), 2-6.

Martin, A. C. and F. M. Uhler. 1939. Food of Game ducks in the United States and Canada, Technical Bulletin #634. Washington DC: United States Department of Agriculture.

Prevost, M. B. and C. A. Gresham.1981. Artificial establishment of salt-marsh bulrush seedlings in South Carolina. Wildlife Society Bulletin, v. 9 (4), 310-314.

Stutzenbaker, C. D. 1999. Aquatic and Wetland Plants of the Western Gulf Coast. Port Arthur, TX: Texas Parks and Wildlife Press.

Table 1.

DESCRIPTIVES FOR FOUR –WEEK AND ELEVEN -WEEK GERMINATION OF SALT-MARSH BULRUSH SEED BY ACCESSION AND HARVEST YEAR

Acc	Year	4-week Mean	4-week Std. Dev	4-week N	11-week Mean	11-week Std. Dev	11-week N
9076931	1997	48.0000	9.6609	4	-	-	-
	1998	4.0000	2.8284	4	4.0000	2.8284	4
	1999	9.0000	6.2183	4	13.5000	6.4031	4
	2000	2.5000	3.7859	4	4.5000	4.4347	4
	Total	15.8750	20.0993	16	7.3333	6.2861	12
9076934	1999	55.0000	20.1660	4	-	-	-
	2000	62.0000	10.8321	4	-	-	-
	Total	58.5000	15.4458	8	-	-	-
Total	1997	48.0000	9.6609	4	-	-	-
	1998	4.0000	2.8284	4	4.0000	2.8284	4
	1999	32.0000	28.2033	8	13.5000	6.4031	4
	2000	32.2500	32.6792	8	4.5000	4.4347	4
	Total	30.0833	27.5206	24	7.3333	6.2861	12

Table 2.

FACTORIAL ANOVA FOR THE FACTORS ACCESSION AND HARVEST YEAR WITH FOUR-WEEK GERMINATION AS THE DEPENDENT VARIABLE

Source		Sum of Squares	df	Mean Square	F	Sig.
ACC	Hypothesis	11130.250	1	11130.250	61.071	.081
	Error	182.250	1	182.250[a]		
YEAR	Hypothesis	5512.500	3	1837.500	10.082	.227
	Error	182.250	1	182.250[a]		
ACC*	Hypothesis	182.250	1	182.250	1.612	.220
YEAR	Error	2035.000	18	113.056[b]		

a. MS(ACC*YEAR)
b. MS (Error)

Table 3.

ONE-WAY ANOVA FOR THE FACTOR ACCESSION WITH FOUR-WEEK GERMINATION AS THE DEPENDENT VARIABLE

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9690.083	1	9690.083	27.579	.000
Within Groups	7729.750	22	351.352		
Total	17419.833	23			

Table 4.

ONE-WAY ANOVA FOR ACCESSION #9076931 WITH FOUR-WEEK GERMINATION AS THE DEPENDENT VARIABLE

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5596.750	3	1865.583	48.352	.000
Within Groups	463.000	12	38.583		
Total	6059.750	15			

Table 5.

TUKEY'S HSD[a] HOMOGENEOUS SUBSETS FOR ACCESSION #9076931 AND THE DEPENDENT VARIABLE FOUR-WEEK GERMINATION

Year	N	Subset for alpha =.05	
		1	2
2000	4	2.5000	
1998	4	4.0000	
1999	4	9.0000	
1997	4		48.0000
Sig.		.478	1.000

Means for groups in homogeneous subsets are displayed

a. Uses Harmonic Mean Sample Size =4.000.

Table 6.

ONE-WAY ANOVA FOR THE FACTOR HARVEST YEAR WITH ELEVEN-WEEK GERMINATION AS THE DEPENDENT VARIABLE

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	228.667	2	114.333	4.995	.035
Within Groups	206.000	9	22.889		
Total	434.667	11			

Table 7.

TUKEY'S HSD[a] HOMOGENEOUS SUBSETS FOR HARVEST YEAR AND THE DEPENDENT VARIABLE ELEVEN-WEEK GERMINATION

(All – 9076931) Year	N	Subset for alpha =.05 1	2
1998	4	4.0000	
2000	4	4.5000	4.5000
1999	4		13.5000
Sig.		.988	.061

Means for groups in homogeneous subsets are displayed

b. Uses Harmonic Mean Sample Size =4.000.

Kika de la Garza Plant Materials Center

Kingsville, TX

Vol. 4 No. 4 Technical Note July 2001

A GERMINATION STUDY OF GULFCOAST SPIKERUSH SEED HARVESTED IN DIFFERENT YEARS

ABSTRACT

This germination study was conducted using one accession of gulfcoast spikerush (*Eleocharis cellulosa*) seed that had been harvested in three different years, and stored under different conditions. Seed was obtained from plants maintained in the wetland plant evaluation area at Kika de la Garza Plant Materials Center in Kingsville, Texas. Seed from gulfcoast spikerush plants was hand-harvested and cleaned. Half of the seed from each harvest year was placed directly into a seed collection envelope (dry-stored). The other half of the seed was stored submerged in a container of de-ionized water (wet-stored). Three years (1998, 1999, & 2000) were evaluated for the dry-stored seed, but only two years (1999, 2000) of the wet-stored seed were available for evaluation. The initial study lasted eight weeks. Germination was recorded at four and eight weeks. No significant differences in germination were found between harvest years or storage treatment for either the four-week or eight-week germination periods. Seed germination averaged 5.6 percent.

INTRODUCTION

Gulfcoast spikerush (*Eleocharis cellulosa*) is a member of the Cyperaceae or sedge family (Correll & Johnston, 1996). It is a native, rhizomatous perennial, often forming extensive colonies. It grows from a tuberous rootstock and can reach 75cm in height. Often there are small (3-6mm), whitish tubers growing along the roots (Stutzenbaker, 1999). Gulfcoast spikerush is frequently found in fresh-water mud (Correll & Johnston, 1996) on the edges of ponds, creeks, and marshes, but can tolerate salinities up to 3.5 ppt (Stutzenbaker, 1999). It can be found in the coastal areas from North Carolina to Texas and south to Mexico, and also grows in the West Indies and Bermuda (Correll & Johnston, 1996). In Texas, it is present throughout South Texas (Keyes & Lloyd-Reilley, 1999), predominately in the coastal regions and the Edwards Plateau (Hatch, Gandhi, & Brown, 1990), and more rarely in the Rio Grande Plains and east Texas (Correll & Johnston, 1996). It produces seed heads throughout the warm season (Keyes & Lloyd-Reilley, 1999). It also provides habitat for waterfowl and other wetland wildlife, including snow geese and mottled ducks (Stutzenbaker, 1999) Its seeds are an excellent food source for ducks (Martin & Uhler, 1939; Singleton, 1965; Stutzenbaker, 1999). Snow geese, mallards, mottled ducks and pintails eat the tubers, while geese will also eat the basal portions and rhizomes (Stutzenbaker, 1999). It can be used as a wetland restoration plant for South Texas. Gulfcoast spikerush generally requires little management partly due to the fact that the plants seem to survive at a variety of water levels (Keyes and Lloyd-Reilley, 1999). Stutzenbaker (1999) notes that gulfcoast spikerush needs to be dewatered in early spring after geese have fed to allow new plants to regrow. He warns that deep flooding after geese have caused damage to the plants can result in a complete loss of the stand. Gulfcoast spikerush may be propagated from rootstocks, division of rhizomes, or seed.

The main objective of this study is to evaluate how harvest year and seed-storage methods affect germination of gulfcoast spikerush seed. This study will compare how well gulfcoast spikerush seed from different harvest years, that has been stored wet or dry will germinate. Survival of seedlings obtained from this study will also be evaluated.

Few studies have looked at the impact of seed storage methods and their effect on germination of gulfcoast spikerush seed. A previous 28 day gulfcoast spikerush seed storage study conducted at the Kika de la Garza Plant Materials Center in the spring of 1999 found that at temperatures between 72º and 85ºF, seed stored in water in a cool place would germinate (9.5% germination), but that dry-stored seed stored in a cool place would not. (Kika de la Garza PMC, unpublished). A second gulfcoast spikerush seed storage study conducted by the Kika de la Garza PMC (2001) also had the best success germinating wet-stored seed (17.5%). This study used temperatures between 70ºF and 100ºF. Minimal germination of dry stored seed was achieved during this study. Yeo and Thurston (1983) conducted a seed storage study with a different eleocharis species, dwarf spikerush (*Eleocharis coloradensis*) with similar results. Their study achieved 28 percent germination for uncut, wet-stored seed and only 4 percent germination for uncut dry-stored seed. PMC staff believes that under the right set of conditions, dry-stored seed will germinate.

The ability to dry-store gulfcoast spikerush seed could lead to a more widespread use of the plant in coastal wetland projects. Use of transplants can limit use for large-scale projects because of time and labor costs required in producing and planting the material. Although some germination has been achieved with wet-stored seed, it makes large scale seeding difficult because wet seed is hard to broadcast. Yeo and Thurston (1983) were able to increase germination of wet-stored seed by removing the basal ends of the seed pericarps on seed of dwarf spikerush, but again, this is not practical for large-scale projects. Additionally, cutting the pericarps had no effect on the germination of dry-stored seed (Yeo and Thurston, 1983).

MATERIALS AND METHODS

For this study, seed from accession #9076914 (collection from Aransas Co., TX) gulfcoast spikerush was collected and cleaned by hand during the summer harvest season. Seed was harvested in 1998, 1999, and 2000 by staff members at the Kika de la Garza Plant Materials Center in Kingsville, Texas. The plants from which the seed was harvested were located in wet tanks in Block A of the wetland plant evaluation area at the PMC. Seed from each harvest was split into two parts. Half the seed from each harvest was placed directly into a seed collection envelope. This was designated as dry-stored seed. This seed was stored in the temperature (50ºF) and humidity (50%) controlled seed cooler at the Plant Materials Center. The other half of the seed was stored submerged in a container of de-ionized water in a refrigerator at 35ºF. This seed was designated as wet-stored. Wet-stored seed was not available from the 1998 harvest.

On April 9th, 2001, seed was removed from the refrigerator and the cooler for germination testing. For each of the two storage methods, 150 seeds from each harvest year were tested. From each 150 seed sample, 50 seeds were placed on a separate set of two sheets of germination blotter that had been pre-moistened with de-ionized water and set into a plastic tray with a plastic lid. The process was repeated two additional times until there were three replications of each harvest year/storage method combination. The trays were then placed in a germination chamber that had been set at 70ºF for 10 hours dark and 100ºF for 14 hours of light. Seeds remained in the chamber for 56 days and checked for germination on a daily basis. Seeds were considered germinated when the root and the shoot exceeded the length of the seed. Germinated seedlings were removed from the study and planted in 1”x1” x 3” paper bands filled with moist potting soil. Survival was evaluated one week after the study had ended.

RESULTS AND DISCUSSION

Statistics were run using SPSS for Windows, version 10.0. A table of descriptives and a univariate Analysis of Variance (ANOVA) were run for the two dependent variables, four-week and eight week germination. Data was analyzed for the factors: storage treatment and harvest year. Surviving seedlings were counted and recorded. Seedling survival was approximately 25%.

No significant differences in germination between storage treatment or harvest years were found for the four- week germination period (Table1). Additionally, no significant differences in germination between storage treatment or harvest years were found for the eight -week germination period (Table 2). No interaction effect was found for the four-week or the eight-week germination period.

Table 1.

Descriptives Table for Four-Week Germination of Gulfcoast spikerush Seed

Year	Sd. Storage	Mean	Std. Dev.	N
1998	Dry	2.6667[a]	4.6188	3
	Total	2.6667[a]	4.6188	3
1999	Dry	2.0000[a]	3.4641	3
	Wet	0.6667[a]	1.1547	3
	Total	1.3333[a]	2.4221	6
2000	Dry	0.6667[a]	1.1547	3
	Wet	1.3333[a]	2.3094	3
	Total	1.0000[a]	1.6733	6
Total	Dry	1.7778[a]	3.0732	9
	Wet	1.0000[a]	1.6733	6
	Total	1.4667	2.5598	15

* Means in columns with the same superscript are not significantly different

Table 2.

Descriptives Table for Eight-Week Germination of Gulfcoast spikerush Seed

Year	Sd. Storage	Mean	Std. Dev.	N
1998	Dry	10.6667[x]	8.3267	3
	Total	10.6667[x]	8.3267	3
1999	Dry	5.3333[x]	4.1633	3
	Wet	2.6667[x]	3.0551	3
	Total	4.0000[x]	3.5777	6
2000	Dry	0.6667[x]	1.1547	3
	Wet	8.6667[x]	3.0551	3
	Total	4.6667[x]	4.8443	6
Total	Dry	5.5556[x]	6.3857	9
	Wet	5.6667[x]	4.2740	6
	Total	5.6000	5.4616	15

* Means in columns with the same superscript are not significantly different

Results of this study do not support previous seed storage studies with gulfcoast spikerush seed (Kika de la Garza PMC, 2001and 1999) that found wet-stored seed to have significantly better germination than dry-stored seed. No previous harvest year studies have been conducted with this species, but it appears that there is some consistency in germination, over time, within an accession. Unfortunately, germination has been consistently poor. Perhaps we are having trouble obtaining viable seed, or perhaps seed dormancy is high. More studies are need in order to determine if germination is consistent between different accessions or if some accessions would have superior germination to others.

REFERENCES

Correll, D. S. and M.C. Johnston. 1996. Manual of the Vascular Plants of Texas. Richardson, TX: The University of Texas at Dallas.

Hatch, S. L., K.N. Gandhi, and L.E. Brown. 1990. Checklist of the Vascular Plants of Texas. College Station, TX: Texas Agricultural Experiment Station.

Keyes, K. L. and J. Lloyd-Reilley. 1999. Evaluation of Propagation Techniques of Selected Native South Texas Wetlands Plants Utilized By Waterfowl. Kingsville, TX: Kika de la Garza Plant Materials Center.

Kika de la Garza PMC. 2001. A germination study of gulfcoast spikerush seed stored under different conditions. Technical Reports, v 4 (2), pp.

Kika de la Garza PMC. 1999. A germination study of wet-stored and dry-stored gulfcoast spikerush seed. Unpublished study.

Martin, A. C. and F. M. Uhler. 1939. Food of Game ducks in the United States and Canada, Technical Bulletin #634. Washington DC: United States Department of Agriculture.

Singleton, J. R. (1965). Waterfowl Habitat Management In Texas, Technical Bulletin #47. Austin, TX: Texas Parks and Wildlife Department.

Stutzenbaker, C. D. 1999. Aquatic and Wetland Plants of the Western Gulf Coast. Port Arthur, TX: Texas Parks and Wildlife Press.

Yeo, R. R. and J. R. Thurston. 1983. Dormancy in Seed of Dwarf Spikerush *Eleocharis coloradensis* (Britt.) Gilly). Journal of Aquatic Plant Management, v21, 92-95.

Kika de la Garza Plant Materials Center

Kingsville, TX

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A GERMINATION STUDY OF SQUARESTEM SPIKERUSH SEED HARVESTED IN DIFFERENT YEARS

ABSTRACT

This report consists of three germination studies. The first germination study compared dry-stored seed harvested in 2000 from #9085359 (Chambers Co., TX) to dry-stored seed from accession #9076917 (Ft. Bend Co., TX) harvested in 1998 and 2000. Second, dry-stored seed from accession #9076917 was compared to thiram-treated seed of the same accession from the 2000 harvest. Third, germination differences between harvest years for accession 9076917 were also evaluated. The germination test lasted for eight weeks. Germination was monitored daily and evaluated at the end of four-week and eight-week periods. A significant difference in germination was found between accessions. The Ft. Bend accession (27.33%) was found to have significantly higher germination than the Chambers accession (0%). A significant difference was also found between storage treatments. Seed from the Ft. Bend accession had more than 25% germination for both years of dry-stored seed, but only 2% germination for the thiram treated seed. No significant differences in harvest years were found for the dry-stored seed of the Ft. Bend accession. Both harvest years had a germination rate of more than 27 percent. Survival of the squarestem spikerush seedlings was poor.

INTRODUCTION

Squarestem spikerush (*Eleocharis quadrangulata*) is a member of the Cyperaceae or sedge family (Correll & Johnston, 1996). It is a native, rhizomatous perennial, often forming dense colonies, and can reach from 45 to 60cm in height (Stutzenbaker, 1999). Its common name is derived from its four-angled or squarish stems (Jones, 1982). Often there are small (2-5 mm), whitish tubers found growing along the roots (Stutzenbaker, 1999). Squarestem spikerush is frequently found in fresh-water to slightly saline mud (0 to 0.5ppt) on edges of ponds, creeks, and marshes (Stutzenbaker, 1999). It prefers saturated soils that are frequently or continously flooded (0-12" deep) during most of the growing season, with only occasional dry-down periods (Northrup, 1994). Squarestem spikerush grows throughout most of the Eastern United States, as far west as Wisconsin, Missouri, Oklahoma, and Texas. In Texas, it can be found in the East and Southeast regions, and more rarely in the northern part of the Rio Grande Plains and south to Jalisco, Mexico (Correll & Johnston, 1996). It produces seed heads throughout the warm season (Keyes & Lloyd-Reilley, 1999). Its seeds and tubers are an excellent food source for ducks (Martin & Uhler, 1939; Singleton, 1965), and are heavily used by mallards, pin-tail, mottled and other puddleducks on the Texas Coast (Stutzenbaker, 1999). Snow geese, white-fronted geese, nutria and muskrats will eat the tubers and the basal portions of the plants (Stutzenbaker, 1999). It can be used as a wetland restoration plant for south Texas. Squarestem spikerush generally requires little management. Plants seem to survive at a variety of water levels (Keyes and Lloyd-Reilley, 1999). Stutzenbaker (1999) notes that squarestem spikerush can tolerate fire, periodic drawdowns, heavy livestock use and goose grazing and grubbing. He warns that long-term increases in salinity and water depth could result in a complete loss of the stand. Squarestem spikerush may be propagated from whole plant transplants (Stutzenbaker, 1999), rootstocks (Singleton, 1965), division of rhizomes (Keyes & Lloyd-Reilley, 1999), or by seed.

The main objective of this study is to evaluate how accession, harvest year and seed-storage method affect germination of squarestem spikerush seed. This study will compare germination between two different accessions, as well as germination of squarestem spikerush seed of the same accession from different harvest years. Germination of seed from the same accession that has been dry-stored or treated with Thiram will also be compared. Survival of seedlings obtained from this study will also be evaluated.

There have not been any studies on the impact of seed storage methods on germination in squarestem spikerush seed. However, a few studies have been conducted with other spikerush species. A previous gulfcoast spikerush (*Eleocharis cellulosa*) seed storage study conducted at the Kika de la Garza Plant Materials Center in the spring of 1999 found that seed stored in water in a cool place would germinate (9.5% germination), but dry-stored seed stored in a cool place would not, when tested at temperatures between 72º and 85ºF for 28 days (Kika de la Garza PMC, unpublished). A second gulfcoast spikerush seed storage study conducted by the Kika de la Garza PMC (2001b) also had the best success from germinating wet-stored seed (17.5%). This study used temperatures between 70ºF and 100ºF. Minimal germination of dry stored seed was achieved during this study. Yeo and Thurston (1983) conducted a seed storage study with another eleocharis species, dwarf spikerush (*Eleocharis coloradensis*) with similar results. Their study achieved 28 percent germination for uncut, wet-stored seed and only 4 percent germination from uncut dry-stored seed. Staff at the Kika de la Garza Plant Materials Center have conducted two previous germination studies with dry-stored squarestem spikerush seed, resulting in no germination. However, PMC staff suspect that under the right set of conditions, dry-stored seed will germinate. PMC staff have had success germinating dry- stored seed of other wetland species from the sedge family, including gulfcoast spikerush (*Eleocharis cellulosa*) (Kika de la Garza PMC, 2001c) and salt-marsh bulrush (*Scirpus robustus*) (Kika de la Garza PMC, 2001a) at temperatures between 70º-100ºF.

The ability to dry-store squarestem spikerush seed could lead to more widespread use of the plant in coastal wetland projects. Use of transplants can limit use for large-scale projects because of time and labor costs required in producing and planting the material. Yeo and Thurston (1983) were able to increase germination of wet-stored seed by removing the basal ends of the seed pericarps on seed of dwarf spikerush, but again, this is not practical for large-scale projects. Additionally, cutting the pericarps had no effect on the germination of dry-stored seed (Yeo and Thurston, 1983). Although, it would be interesting to evaluate wet-stored seed of square-stem spikerush, due to limited seed production in 2000 there was not enough seed available to include wet-stored seed in this study. A germination study comparing wet-stored and dry-stored squarestem spikerush seed is planned for the future. There have been no previous harvest year or accession comparison studies with squarestem spikerush seed.

MATERIALS AND METHODS

Seed from accession #9076917 (collection from Fort Bend Co., TX) gulfcoast spikerush was collected and cleaned by hand during the summer harvest season. Seed was harvested in 1998 and 2000 by staff members at the Kika de la Garza Plant Materials Center in Kingsville, Texas. There was no seed produced during the 1999 growing season. The plants from which the seed was harvested were located in wet tanks in the wetland plant evaluation area at the PMC. Additionally, seed from a second accession, # 9085359 (collection from Chambers Co., TX) was collected at the original collection site during the summer of 2000, and cleaned by hand. Seed from both harvests of accession #9076917, and accession #9085359 was placed directly into a seed collection envelope at harvest time. This was designated as dry-stored seed and stored in a temperature and humidity controlled seed cooler at the Plant Materials Center. The cooler is kept at approximately 50ºF and 50% humidity. A small amount of seed from accession #9076917 2000 harvest was dipped in a solution of Thiram 50WP and placed in a cloth seed bag then stored in the temperature and humidity controlled seed cooler at the Plant Materials Center. This seed was designated as moist-stored. Thiram (Tetramethylthiuram disulfide) is a chemical agent, which can be used to maintain seed moisture and reduce loss from seed decay. It has been used successfully with grasses and other plants.

On April 9th of 2001, seed was removed from the seed cooler for germination testing. For each of the two storage methods, 150 seeds of accession #9076917 were tested. All of the 150 thiram –treated seed was from the 2000 harvest. Due to limited seed, out of the 150 dry-stored seeds, 100 seeds were from the 1998 harvest, and the remaining 50 seeds were from the 2000 harvest year. Seeds from different harvest years were tested in separate trays. In addition, a third sample of 150 dry-stored seeds from accession #9085359 was tested. From each of the three 150 seed samples, 50 seeds from each sample were placed on a separate set of two sheets of germination blotter that had been pre-moistened with de-ionized water and set into a plastic tray with a plastic lid. The process was repeated two additional times until there were three replications of each storage method for accession # 9076917, and three replications for accession # 9085359. The trays were then placed in a germination chamber that had been set at 70ºF for 10 hours of dark and 100ºF for 14 hours of light. They remained in the chamber for 56 days. Trays were checked for germination on a daily basis. Seeds were considered germinated when the root and the shoot exceeded the length of the seed.

The seeds were evaluated as three separate studies. First, dry-stored seed of the two accessions were compared. Second, seeds from accession #9076917 that had been stored differently (dry versus thiram) were compared. Finally, seeds from accession #9076917 that had been harvested in different years were evaluated. All studies were evaluated at four and eight weeks. Seedlings were removed from the study when the shoot reached at least ½" in height. The seedlings were planted in 1"x 1" x3" paper bands filled with moist potting soil and survival was monitored.

RESULTS AND DISCUSSION

Data from this study was analyzed using SPSS for Windows 10.0. A descriptives table and an independent samples t-test were run to compare accessions, storage methods, and harvest years. Levene's test for equality of variances was run along with each t-test to determine if variance of the samples were equal or unequal for purposes of interpreting the t-tests. Germination was the dependent variable for all tests. Data was evaluated for four-week germination and eight week germination periods.

Seeds began to germinate on day 16 of the studies, and continued until day 50, with the majority of the seeds germinating between days 24 and 45.
Of the 44 seedlings removed from the study and planted, only 8 seedlings or approximately 18% were living a week after the study ended.

Accession Comparison

Accession #9085359 did not have any seed germination throughout the study; whereas, accession #9076917 had a 8.667% and a 27.333% germination rate for the four and eight-week periods (Table 1). The results of an independent sample t-test confirmed a significant germination difference between accessions for both the four and eight week germination periods (Table 2).

Table 1.

Descriptives Table for the Accession Comparison

Week	Accession	N	Mean	Std. Dev.
4	9076917	3	8.6667^{a}	1.3333
	9085359	3	0.0000^{b}	0.0000
8	9076917	3	27.3333^{x}	0.6667
	9085359	3	0.0000^{y}	0.0000

* Means with the same superscript in the same sub-column are not significantly different.

Table 2.

Levene's Test for Equality of Variances and Independent Samples t-test for the Accession Comparison

Week	Var. =	Levene's Test		Independent Samples t-test			
		F	Sig.	t	Df	2-tail Sig.	Mean Diff.
4	Yes	16.000	.016				
	No			6.500	2	.023	8.667
8	Yes	16.000	.016				
	No			41.000	2	.001	27.333

Storage Method Comparison

After four-weeks, the dry-stored seed had more than 8% germination, while the thiram-treated seed had less than 1%. After eight-weeks the dry-stored seed had over 25% germination, while the thiram-treated seed had less than 2% (Table 3). The results of an independent samples t-test found that there was a significant difference in germination between storage methods for both the four-week and eight-week evaluation periods (Table 4).

Table 3.

Descriptives Table for the Storage Method Comparison

Week	Storage Method	N	Mean	Std. Dev.
4	Dry	3	8.6667[a]	2.3094
	Thiram	3	0.6667[b]	1.1547
8	Dry	3	27.3333[x]	1.1547
	Thiram	3	2.0000[y]	3.4641

* Means with the same superscript in the same sub-column are not significantly different

Table 4.

Levene's Test for Equality of Variances and Independent Samples t-test for the Storage Method Comparison

Week	Var. =	Levene's Test		Independent Samples t-test			
		F	Sig.	t	df	2-tail Sig.	Mean Diff.
4	Yes	3.200	.148	5.367	4	.006	8.000
	No						
8	Yes	6.400	.065	12.017	4	.000	25.333
	No						

Harvest Year Comparison

Dry-stored seed from both harvest years had similar germination rates at both four and eight weeks. At four weeks, the 1998 seed had 8% average germination, while the 2000 seed had 10% germination. After eight weeks, the 1998 seed had 27% average germination, while the tray of 2000 seed had 28% germination. Results indicate there was no significant differences in germination between the dry-stored seed. However, there was thiram-treated seed included in this study that had poorer germination than the dry-stored seed: less than 1 percent at four weeks and only 2 percent at eight weeks (Table 5). The results of an independent samples t-test found no significant differences in germination between harvest years for either the four-week or eight-week germination periods, despite the inclusion of the thiram-treated seed (Table 6.).

Table 5.

Descriptives Table for the Harvest Year Comparison

Week	Harvest Year	N	Mean	Std. Dev.
4	1998 - Dry	2	8.000[a]	2.8284
	2000 - Dry	1	10.000	0.0000
	2000 –Thiram	3	0.667	1.1547
	2000-Total	4	3.000[a]	4.7610
8	1998 –Dry	2	27.000[x]	1.4142
	2000- Dry	1	28.000	0.0000
	2000 –Thiram	3	2.000	3.4611
	2000 –Total	4	8.500[x]	13.3041

* Means with the same superscript in the same sub-column are not significantly different

Table 6.

Levene's Test for Equality of Variances and Independent Samples t-test for the Harvest Year Comparison

Week	Var. =	Levene's Test		Independent Samples t-test			
		F	Sig.	t	df	2-tail Sig.	Mean Diff.
4	Yes No	.632	.471	1.325	4	.256	5.000
8	Yes No	2.709	.175	1.851	4	.138	18.500

The combined results of these three studies provided us with some valuable information about squarestem spikerush seed. First, we learned that some accessions of this species have significantly better germination than others. Secondly, we know that dry-stored seed of this species does have the ability to germinate and can maintain seed viability over several years. Thirdly, we know that an accession of squarestem spikerush with good germination, will likely have good germination across harvest years. This gives us the potential to evaluate multiple collections of squarestem spikerush, with the potential of finding an accession with consistently good germination of dry-stored seed that is also a consistently good producer of viable seed. The accession with the superior germination (#9076917), unfortunately has not been a good seed producer. Other collections may produce larger quantities of viable seed. Germination of wet-stored seed should also be explored.

REFERENCES

Correll, D. S. and M.C. Johnston. 1996. Manual of the Vascular Plants of Texas. Richardson, TX: The University of Texas at Dallas.

Hatch, S. L., K.N. Gandhi, and L.E. Brown. 1990. Checklist of the Vascular Plants of Texas. College Station, TX: Texas Agricultural Experiment Station.

Keyes, K. L. and J. Lloyd-Reilley. 1999. Evaluation of Propagation Techniques of Selected Native South Texas Wetlands Plants Utilized By Waterfowl. Kingsville, TX: Kika de la Garza Plant Materials Center.

Kika de la Garza PMC. 1999. A germination study of wet-stored and dry-stored gulfcoast spikerush seed. Unpublished study.

Kika de la Garza PMC. 2001a. A germination study of salt-marsh bulrush seed stored under different conditions. Technical Reports, v 4 (1), pp.

Kika de la Garza PMC. 2001b. A germination study of gulfcoast spikerush seed stored under different conditions. Technical Reports, v 4 (2), pp.

Kika de la Garza PMC. 2001c. A germination study of gulfcoast spikerush seed harvested in different years. Technical Reports, v 4 (4), pp.

Martin, A. C. and F. M. Uhler. 1939. Food of Game ducks in the United States and Canada, Technical Bulletin #634. Washington DC: United States Department of Agriculture.

Northrup, K. 1994. Creating a functional wetland. Native Plant Society of Texas, 1994 Symposium Proceedings: The Gulf Prairies and Marshes and Its Many Ecosystems. October 14-16,1994 Corpus Christi, TX, pp 68-77.

Singleton, J. R. 1965. Waterfowl Habitat Management In Texas, Technical Bulletin #47. Austin, TX: Texas Parks and Wildlife Department.

Stutzenbaker, C. D. 1999. Aquatic and Wetland Plants of the Western Gulf Coast. Port Arthur, TX: Texas Parks and Wildlife Press.

Yeo, R. R. and Thurston, J. R. 1983. Dormancy in Seed of Dwarf Spikerush *Eleocharis coloradensis* (Britt.) Gilly). Journal of Aquatic Plant Management, v21, 92-95.

Kika de la Garza Plant Materials Center

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TWO GERMINATION STUDIES WITH CREEPING RIVER GRASS SEED: A LOOK AT THE IMPACT OF STORAGE METHOD AND GROWING CONDITIONS

ABSTRACT

This report discusses the results of two germination studies conducted at the Kika de la Garza Plant Materials Center with creeping river grass (*Echinochloa polystachya*) seed in Spring of 2000. The first study compared germination of creeping river grass seed stored two different ways: wet-stored and dry-stored. The second study evaluated germination in wet and dry-stored seed harvested from plants grown under different conditions: wetland trough and irrigated field planting. For the first study, results indicate a significant difference in germination between storage methods. Wet-stored seed had significantly better germination (41%) than dry-stored seed (3%). For the second study, a significant difference was found between wet-stored seed harvested from plants grown under different conditions, with the seed harvested from plants grown partly submerged in a wetland trough having significantly better germination (41%) than seed harvested from the irrigated field planting (0%). No significant difference in germination between growing conditions was found for the dry-stored seed.

INTRODUCTION

Creeping river grass (*Echinochloa polystachya*) is a native, warm-season, perennial grass, with stout culms creeping from the base (Correll & Johnston, 1996). It can grow to 1.5m in height (Stutzenbaker, 1999). It has been known to set roots from the lower nodes (Gould, 1975). Creeping river grass can easily be distinguished from other *Echinochloa* species by its ligule, which is a dense line of stiff yellow hairs (Hatch, Schuster and Drawe, 1999). The genus name, *Echinochloa,* is Greek for hedgehog grass and the panicle-type seed head, with its awned spikelets does look somewhat like a hedgehog (Hitchcock, 1971). Creeping river grass is a member of the panicaceae tribe of grasses (Hitchcock, 1971) and was previously known as *Panicum polystachyum* (Correll & Johnston, 1996). It goes by a variety of common names including: creeping river grass, (USDA-NRCS, 1994), mudflat millet, river grass (Stutzenbaker, 1999), and barnyardgrass.

Creeping river grass can be found in swamps and ditches along the Gulf Coast from Louisiana to Brownsville, Texas, and in the West Indies south to Argentina (Hitchcock, 1971). In Texas, it can be found in wet swales and ditches along the southern Gulf Coast (Hatch, Schuster, & Drawe, 1999), from the southern part of

Southeastern Texas to the coastal portion of the Rio Grande Plains (Correll & Johnston, 1996). Creeping river grass prefers freshwater marshes where salinities are below 0.5 parts per thousand (Stutzenbaker, 1999). It will prosper on both mineral and organic soils (Stutzenbaker, 1999), but tends to prefer moist clay loam soils (Correll & Johnston, 1996). Creeping river grass will often form dense colonies on newly created mudflats that have formed after shallow flooding has occurred (Stutzenbaker, 1999). It is not tolerant of water levels over two feet, and prefers to have some periods of drawdown in order to spread laterally (Stutzenbaker, 1999).

Creeping river grass produces forage in the late summer months. It is highly palatable to cattle (Hatch, Schuster, & Drawe, 1999). Its seeds are eaten by puddle ducks, and gallinules like to forage along the edges. It is also a good source of shelter for nutria and muskrats, and can provide a windbreak for waterfowl (Stutzenbaker, 1999). Hatch, Schuster, and Drawe (1999) note that creeping river grass is one of "the most important wetland plants for attracting upland game birds, songbirds, and waterfowl" (p.145). Creeping river grass can be propagated by transplanting rootstocks or vegetative splits, transplanting whole plants, or seed.

Only one germination study has been done with creeping river grass seed. The Kika de la Garza Plant Materials Center evaluated the germination potential of dry-stored seed harvested in 1998, and found that it had only two percent germination (1999, unpublished). Plant Materials Center staff suspect that under the right set of conditions, dry-stored seed has the potential for good germination. The ability to dry-store creeping river grass seed could lead to more widespread use of the plant in coastal wetland projects. The purpose of these two germination studies is to evaluate the effect of different storage methods on germination of creeping river grass seed, and to determine if growing conditions have a major impact on germination of this species.

MATERIALS AND METHODS

Seed used for this study was from creeping river grass accession #9076913, collected in San Patricio County Texas. Seed was harvested from two different locations at the Kika de la Garza Plant Materials Center in Kingsville, Texas. The first harvest location was the wetland plant research area at the PMC. Plants at this location were grown in pots submerged in 2-4 inches of water in a wetland trough. The second harvest location was in Block A at the Plant Materials Center. The Block A site was an irrigated field with Victoria clay soil type. Seed from each location was hand harvested by Plant Material Center staff in the summer of 1999 and cleaned in a seed blower to remove empty seed and chaff. Once cleaned, seeds from each harvest location were split into two parts. The first part of the seed harvest was stored in a container of de-ionized water in a refrigerator at 35ºF. This seed was considered to be wet-stored. The second part was placed directly into a seed collection envelope and stored in the temperature and humidity controlled seed cooler at the Plant Materials Center. The cooler is kept at approximately 50ºF and 50% humidity. This was considered to be dry-stored seed.

On April 11th of 2000, seed was removed from the refrigerator and cooler for germination testing. The storage method study used only wetland trough grown seed. For each of the two storage treatments, 100 seeds were tested. From each 100 seed sample, 50 seeds were placed on a separate set of two sheets of germination blotter that had been pre-moistened with de-ionized water and set into a plastic tray with a plastic lid. The process was repeated an additional time so there were two replications for each storage method. The trays were then placed in a germination chamber that had been set at 22ºC for 10 hours dark and 30ºC for 14 hours of light. They remained in the chamber for 28 days and checked for germination daily. Seeds were considered germinated when the root and the shoot exceeded the length of the seed.

The second study used wet and dry-stored seed harvested from both locations. For each harvest condition/storage method, 100 seeds were tested. From each 100 seed sample, 50 seeds were placed on a separate set of two sheets of germination blotter that had been pre-moistened with de-ionized water and set into a plastic tray with a plastic lid. The process was repeated an additional time so there were two replications of each harvest condition/storage method combination. The trays were then placed in a germination chamber that had been set at 22ºC for 10 hours dark and 30ºC for 14 hours of light. They remained in the chamber for 28 days and checked daily for germination. Seeds were considered germinated when the root and the shoot exceeded the length of the seed.

RESULTS AND DISCUSSION

Data from both studies was analyzed using SPSS for Windows, version 10.0. For the storage method study, a descriptives table and one-way ANOVA were run for the factor 'storage method'. For the growing conditions study, data was analyzed separately for wet-stored seed and dry-stored seed. For each storage method, a descriptives table and one-way analysis of variance (ANOVA) were run for the factor 'growing conditions'. Germination was the dependent variable for all tests.

The storage method study looked only at seed harvested from the wetland research area. Based on the means, it seemed that the wet-stored seed had better germination than the dry-stored seed (Table 1) which proved to be significant. According to the results of a one-way ANOVA, a significant difference in germination between wet-stored and dry-stored seed was found (Table 2). Wet-stored creeping river grass seed was found to have significantly better germination than dry-stored creeping river grass seed.

Table 1.

Table of Descriptives for the Storage Method Study

Storage Method	N	Mean	Std. Dev.	Std. Error
Wet	2	41.00[a]	4.2426	3.0000
Dry	2	3.00[b]	4.2426	3.0000
Total	4	0.00	22.2111	11.1056

* Means in columns with the same superscript are not significantly different

Table 2.

Analysis of Variance for the Storage Method Study

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1444.000	1	1444.000	80.222	.012
Within Groups	36.000	2	18.000		
Total	1480.000	3			

In the growing conditions study, data for the wet-stored seed was analyzed separately from data for the dry-stored seed. This was due to a significant difference in germination between storage methods found in the previous study and there was concern that this might confound the data. In the wet-stored seed study, results indicated a significant difference in seed germination due to the fact that seed from irrigated field planting did not germinate and the seed from the wetland research area had an average of 41 percent germination (Table 3). The results of a one-way ANOVA supported this difference, finding that the wetland grown seed had significantly better germination than the seed from the irrigated field planting (Table 4). For the dry-stored seed, the means were closer together (Table 5). No significant difference in germination between seed grown under different conditions was found by the one-way ANOVA (Table 6).

Table 3.

Table of Descriptives for the Growing Conditions Study: Wet-Stored Seed

Growing Condition	N	Mean	Std. Dev.	Std. Error
Wet Trough	2	41.000[a]	4.2426	3.0000
Irrig. Field	2	0.000[b]	0.0000	0.0000
Total	4	20.500	23.7978	11.8989

* Means in columns with the same superscript are not significantly different

Table 4.
Analysis of Variance for the Growing Conditions Study: Wet-Stored Seed

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1681.000	1	1681.000	186.778	.005
Within Groups	18.000	2	9.000		
Total	1699.000	3			

Table 5.
Table of Descriptives for the Growing Conditions Study: Dry-Stored Seed

Growing Condition	N	Mean	Std. Dev.	Std. Error
Wet Trough	2	3.000[a]	4.2426	3.0000
Irrig. Field	2	0.000[a]	0.0000	0.0000
Total	4	0.000	3.0000	1.5000

* Means in columns with the same superscript are not significantly different

Table 6.
Analysis of Variance for the Growing Conditions Study: Dry-Stored Seed

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.000	1	9.000	1.000	.423
Within Groups	18.000	2	9.000		
Total	27.000	3			

Based on these results, it appears that wet-stored seed tends to have better germination than dry-stored seed. It also appears that irrigated field plantings may not yield viable seed. These two pieces of information could influence the way creeping river grass is grown and the way its seed is stored. Additionally, it may have an impact on how creeping river grass can be used for projects. Wet-stored seed may limit its use for large-scale projects. Further germination testing of this species is needed, and is planned for the future.

REFERENCES

Correll, D. S. and M.C. Johnston. 1996. Manual of the Vascular Plants of Texas. Richardson, TX: The University of Texas at Dallas.

Gould, F. W. 1975. The Grasses of Texas. College Station, Texas: Texas A&M University Press.

Hatch, S. L., J. L. Schuster, and D. L. Drawe. 1999. Grasses of the Texas Gulf Prairies and Coastal Marshes. College Station, Texas: Texas A&M University Press.

Hitchcock, A. S. 1971. Manual of the Grasses of the United States. Volumes 1&2, 2nd Edition. Revised by Agnes Chase. New York: Dover Publications.

Stutzenbaker, C. D. 1999. Aquatic and Wetland Plants of the Western Gulf Coast. Port Arthur, TX: Texas Parks and Wildlife Press.

USDA-NRCS Ecological Sciences Division. 1994. Plants: Alphabetical Listing of Scientific Names. Baton Rouge: National Plant Data Collection Center

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TWO GERMINATION STUDIES WITH CREEPING RIVER GRASS SEED: A LOOK AT THE IMPACT OF STORAGE METHOD AND HARVEST YEAR

ABSTRACT

This report discusses the results of two germination studies conducted at the Kika de la Garza Plant Materials Center with creeping river grass (*Echinochloa polystachya*) seed in the Spring and early Summer of 2001. The first study compared germination of creeping river grass seed that had been stored three different ways: wet, dry, and moist-stored. The second study evaluated germination in wet and dry-stored seed harvested in different years. In the first study, a significant difference in germination between storage methods was found. Dry-stored seed had significantly better germination (34%) than either the wet or moist-stored seed (both 0%). In the second study, a significant difference was found between harvest years for dry-stored seed, with the seed harvested in 2000 having significantly better germination (34%) than either the 1998 (19%) or 1999 (1.5%) harvested seed. Additionally, the 1998 harvested seed had significantly better germination than the 1999 harvested seed.

INTRODUCTION

Creeping river grass (*Echinochloa polystachya*) is a native, warm-season, perennial grass, with stout culms creeping from the base (Correll & Johnston, 1996). It can grow up to 1.5m in height (Stutzenbaker, 1999). It has been known to set roots from the lower nodes (Gould, 1975). Creeping river grass can easily be distinguished from other *Echinochloa* species by its ligule, which is a dense line of stiff yellow hairs (Hatch, Schuster and Drawe, 1999). The genus name, *Echinochloa,* is Greek for hedgehog grass and the panicle-type seed head, with its awned spikelets does look somewhat like a hedgehog (Hitchcock, 1971). Creeping river grass is a member of the panicaceae tribe of grasses (Hitchcock, 1971) and was previously known as *Panicum polystachyum* (Correll & Johnston, 1996). It goes by a variety of common names including: creeping river grass, (USDA-NRCS, 1994), mudflat millet, river grass (Stutzenbaker, 1999), and barnyardgrass.

Creeping river grass can be found in swamps and ditches along the Gulf Coast from Louisiana to Brownsville, Texas, and in the West Indies south to Argentina (Hitchcock, 1971). In Texas, it can be found in wet swales and ditches along the southern Gulf Coast (Hatch, Schuster, & Drawe, 1999) from the southern part of Southeastern Texas to the coastal portion of the Rio Grande Plains (Correll & Johnston, 1996). Creeping river grass prefers freshwater marshes where salinities are below 0.5 parts per thousand (Stutzenbaker, 1999). It will prosper on both mineral and organic soils (Stutzenbaker, 1999), but tends to prefer moist clay loam soils (Correll & Johnston, 1996). Creeping river grass will often form dense colonies on newly created mudflats that have formed after shallow flooding has occurred (Stutzenbaker, 1999). It is not tolerant of water levels over 60cm, and prefers to have some periods of drawdown in order to spread laterally (Stutzenbaker, 1999).

Creeping river grass produces forage in the late summer months. It is highly palatable to cattle (Hatch, Schuster, & Drawe, 1999). Its seeds are eaten by puddle ducks and gallinules like to forage along the edges. It is also a good source of shelter for nutria and muskrats, and can provide a windbreak for waterfowl (Stutzenbaker, 1999). Hatch, Schuster, and Drawe (1999) note that creeping river grass is one of "the most important wetland plants for attracting upland game birds, songbirds, and waterfowl" (p.145). Creeping river grass can be propagated by transplanting rootstocks, vegetative splits, transplanting whole plants, or growing seed.

Few germination studies have been done with creeping river grass seed. The Kika de la Garza Plant Materials Center has conducted three previous germination studies with creeping river grass seed (2001a; 1999, unpublished). The first study evaluated the germination potential of dry-stored seed harvested in 1998, and found that it had only two percent germination (1999, unpublished). The second study (Kika de la Garza PMC, 2001a) compared germination of seed that had been harvested from plants grown under different conditions. It found that seeds harvested from plants grown in pots, submerged in several inches of water in a wetland trough had significantly better germination than seed that had been harvested from an irrigated field planting (Kika de la Garza PMC, 2001a). The third study conducted by the Kika de la Garza PMC (2001a) was a storage method germination study, which found that wet-stored seed harvested in 1999 had significantly better germination than dry-stored seed harvested the same year.

None of the previous studies have had much success with dry-stored seed. Plant Materials Center staff believe that under the right set of conditions, dry-stored seed has the potential for good germination. The ability to dry-store creeping river grass seed could lead to more widespread use of the plant in coastal wetland projects. The purpose of the two current germination studies is to evaluate the effect of different storage methods on germination of creeping river grass seed, and to determine if there is consistent germination between harvest years for this species.

MATERIALS AND METHODS

Seed used for these two studies was from creeping river grass accession #9076913, orginally collected in San Patricio County, Texas. Seed was harvested from plants grown in pots submerged in 2-4 inches of water in a wetland trough at the wetland plant research area at the Kika de la Garza Plant Materials Center in Kingsville, Texas. Seed was hand harvested by Plant Material Center staff in the summers of 1998, 1999, and 2000, and cleaned in a seed blower to remove empty seed and chaff. Seeds from different harvest years were kept separated. Once cleaned, the seed from the 2000 harvest was separated into three parts. The first part of the seed harvest was stored in a container of de-ionized water in a refrigerator at 35ºF. This seed was considered to be wet-stored. The second part was placed directly into a seed collection envelope. This was considered to be dry-stored seed. The last part was dipped in a solution of Thiram 50WP and stored in a cloth seed bag. This seed was considered to be moist-stored. Both the dry and moist stored seed was stored in the temperature and humidity controlled seed cooler at the Plant Materials Center. The cooler is kept at approximately 50ºF and 50% humidity. Seed from the 1999 harvest was split into two parts, with half wet-stored and half dry-stored. All of the 1998 harvested seed was stored dry.

On April 11th of 2000, seed was removed from the refrigerator and cooler for germination testing. The seed storage study used only seed harvested in 2000. For each of the three storage treatments, 200 seeds were tested. From each 200 seed sample, 50 seeds were placed on a separate set of two sheets of germination blotter that had been pre-moistened with de-ionized water and set into a plastic tray with a plastic lid. The process was repeated three additional times, until there were four replications for each storage method. The trays were then placed in a germination chamber set at 22ºC for 10 hours dark and 30ºC for 14 hours of light. They remained in the chamber for 28 days and checked daily for germination. Seeds were considered germinated when the root and the shoot exceeded the length of the seed.

The harvest year study included wet and dry-stored seed harvested in 1999 and 2000, and dry-stored seed from the 1998 harvest. For each harvest of grown condition/storage method, 200 seeds were tested. From each 200 seed sample, 50 seeds were placed on a separate set of two sheets of germination blotter that had been pre-moistened with de-ionized water and set into a plastic tray with a plastic lid. The process was repeated three additional times, until there were four replications of each harvest condition/storage method combination. The trays were then placed in a germination chamber set at 22ºC for 10 hours dark and 30ºC for 14 hours of light. They remained in the chamber for 28 days and checked daily for germination. Seeds were considered germinated when the root and the shoot exceeded the length of the seed.

RESULTS AND DISCUSSION

Results were analyzed using SPSS for Windows, version 10.0. For the storage method study a descriptives table and one-way analysis of variance (ANOVA) were run for the factor ‘storage method’. Tukey’s Test for Honestly Significant Difference (Tukey’s HSD) was run to pinpoint specific differences between storage methods. Wet-stored and dry-stored seed were analyzed separately in the harvest year study. For each, a descriptives table and one-way ANOVA were run for the factor ‘harvest year’. Tukey’s Test for Honestly Significant Difference (Tukey’s HSD) was run to pinpoint specific differences between harvest years. Germination was the dependent variable for all tests.

Results from the storage method study show the wet-stored and moist-stored seed had no germination, whereas the dry stored seed had 34 percent average germination

(Table 1). The results of a one-way ANOVA found that there was a significant difference in germination between storage methods (Table 2). Tukey's HSD indicated that the dry-stored seed had signifcantly better germination than either the wet-stored or moist-stored seed.

Table 1.

<u>Table of Descriptives for the Storage Method Study</u>

Storage Method	N	Mean	Std. Dev.	Std. Error
Wet	4	0.000[b]	0.0000	0.0000
Dry	4	34.000[a]	10.4563	5.2281
Thiram	4	0.000[b]	0.0000	0.0000
Total	12	11.333	17.6085	5.0831

* Means in columns with the same superscript are not significantly different

Table 2.

<u>Analysis of Variance for the Storage Method Study</u>

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.082.667	2	1541.333	42.293	.000
Within Groups	328.000	9	36.444		
Total	3410.667	11			

The harvest year study results for the wet-stored and dry-stored seed were analyzed separately. No germination occurred for the wet-stored seed regardless of harvest year, therefore no significant difference in germination was found. However, dry-stored seed from all three harvest years had some germination (Table 3). The result of a one-way ANOVA indicated that there was a significant difference in germination between harvest years for the dry-stored seed (Table 4). Tukey's HSD found the 2000 harvest seed to have significantly better germination than either the 1998 or 1999 harvested seed. Also, the 1998 harvested seed had significantly better germination than the 1999 harvested seed.

Table 3.

Table of Descriptives for the Harvest Year Study

Storage Method	N	Mean	Std. Dev.	Std. Error
1998 Dry	4	19.000[b]	2.5820	1.2910
Total	4	19.0000	2.5820	1.2910
1999 Dry	4	1.500[c]	1.9149	0.9574
Wet	4	0.000[x]	0.0000	0.0000
Total	8	0.7500	1.4880	0.5261
2000 Dry	4	34.000[a]	10.4563	5.2281
Wet	4	0.000[x]	0.0000	0.0000
Total	8	17.0000	19.4202	6.8661
Total Dry	12	18.1667	15.0020	4.3307
Wet	8	0.0000	0.0000	0.0000
Total	20	10.9000	14.6176	3.2686

* Means for the same storage method in columns, with the same superscript, are not significantly different

Table 4.

Analysis of Variance for the Harvest Year Study: Dry-Stored Seed

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.116.667	2	1058.333	26.532	.000
Within Groups	359.000	9	39.889		
Total		11			

Results of this storage method germination study did not support those of previous storage method germination studies with creeping river grass. The previous creeping river grass germination studies had little success with dry-stored seed; wet-stored seed had better germination. This storage method study yielded the best germination from dry-stored seed but no germination from either the wet-stored or thiram-treated seed.

There are several possible reasons why the results of this storage method study are opposite of what has previously been found to be true. First, wet-stored seed may have better germination initially, but may decline over time due to the seed deteriorating in the water. Second, seed quality may be inconsistent. Wet-storage may only work best with ‘hard seed’ or ‘dormant seed’. Seed that is ripe and ready to germinate may absorb too much water in wet-storage and cause the embryo to damp off. Third, there may be year to year differences in seed fertility that may affect the impact of storage method on germination. As we see in the harvest year study included in this report, there may be significant differences in germination between seed harvested in different years. Finally, it may be a combination of the presented factors.

The ability to germinate dry-stored seed is important. As mentioned earlier in this report, the ability to germinate dry-stored creeping river grass seed could have a major impact on the usefulness of this grass in larger-scale wetland projects. In addition, survival of seedlings from the dry-stored seed was approximately 92 percent, making it feasible to grow creeping river grass from seed. The results of this storage method study with creeping river grass seed are optimistic. Further study with dry-stored seed, and additional accessions is needed. The results of the harvest year germination study found that there was inconsistent germination between seed harvested from different years under dry-stored conditions. Since only one accession was used for this study, further studies with different accessions are needed in order to determine if the dry-stored method is the best for creeping river grass seed germination.

REFERENCES

Correll, D. S. and M.C Johnston. 1996. Manual of the Vascular Plants of Texas. Richardson, TX: The University of Texas at Dallas.

Gould, F. W. 1975. The Grasses of Texas. College Station, Texas: Texas A&M University Press.

Hatch, S. L., J. L. Schuster, and D. L. Drawe. 1999. Grasses of the Texas Gulf Prairies and Coastal Marshes. College Station, Texas: Texas A&M University Press.

Hitchcock, A. S. 1971. Manual of the Grasses of the United States, vol. 1& 2, 2nd Edition. Revised by Agnes Chase. New York: Dover Publications.

Kika de la Garza PMC. 2001. Two Germination Studies With Creeping River Grass Seed: A Look At The Impact Of Storage Method And Growing Conditions. Technical Reports, v.4 (6), pp.

Stutzenbaker, C. D. 1999. Aquatic and Wetland Plants of the Western Gulf Coast. Port Arthur, TX: Texas Parks and Wildlife Press.

USDA-NRCS Ecological Sciences Division. 1994. Plants: Alphabetical Listing of Scientific Names. Baton Rouge: National Plant Data Collection Center

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A STEM-CUTTING STUDY OF FIVE SOUTH TEXAS RIPARIAN PLANTS

ABSTRACT

Native shrubs and trees adapted to the South Texas environment are needed for the restoration and enhancement of riparian areas. The Kika de la Garza Plant Materials Center (PMC) evaluated the potential of using stem-cuttings of five local riparian plants. Swamp privet (*Forestiera acuminata*), and roughleaf dogwood (*Cornus drummondii*) had no plants established from these stem-cuttings. Turk's cap (*Malviscus arboreus*) had only a 15% establishment rate. False indigo (*Amorpha fruticosa*) and black willow (*Salix nigra*) were the most successful with respective establishment rates of 80 and 53 percent.

INTRODUCTION

Native shrubs and trees provide a variety of valuable services in the riparian environment. A riparian area is an ecosystem situated between the aquatic and upland environments, which is flooded periodically. The native riparian trees and shrubs found in this ecosystem provide benefits such as water quality improvement, erosion protection, stream water temperature regulation, wildlife habitat and recreation enhancement.

Despite the benefits that riparian areas provide, human activities have caused significant degradation. In a study by Judy et al (1984), it was found that 40% of the 666,000 miles of streams reviewed were adversely affected by turbidity, 32% by elevated temperature, 22% by bank erosion, and 21% by excess nutrients. Based on these disturbing statistics, it is clear that riparian areas need to be protected, managed and restored. The Kika de la Garza Plant Materials Center is currently evaluating riparian trees and shrubs adapted to the South Texas environment for the restoration of riparian environments. Five of these plants are roughleaf dogwood (*Cornus drummondii*), swamp privet (*Forestiera acuminata*), false indigo (*Amorpha fruticosa*), turk's cap (*Malviscus arboreus*), and black willow (*Salix nigra*).

Roughleaf dogwood is a member of the Cornaceae or dogwood family (Correll & Johnston, 1996). It is a native shrub or small tree that grows up to 5 meters tall. It is a valuable streambank plant because of its spreading, rhizomatous roots. Roughleaf dogwood can be found in damp woodlands and thickets and occassionally on dry hills in the eastern half of Texas. It is found frequently in the bottom woods of the San Antonio and lower Guadalupe rivers of South Texas (Jones, 1982).

Swamp privet is a member of the Oleaceae or olive family (Correll & Johnston, 1996). It is a native shrub or small tree that grows up to 3 meters tall. Its rooting and growth form can produce dense streamside thickets. It is found in lowland woods of east, southeast, and north-central Texas. Swamp privet is frequently found in the damp lowlands of the San Antonio and Guadalupe rivers (Jones, 1982).

Turk's cap is a member of the Malvaceae or mallow family (Correll & Johnston, 1996). It is a native shrub that grows up to 3 meters tall. It is found along streams and in palm groves in the Rio Grande plain, southern part of the Edwards Plateau, and along the Coastal Prairies and Marshes of southeast Texas (Everitt & Drawe, 1993).

False indigo is a member of the Fabaceae or legume family (Correll & Johnston, 1996). It is a native shrub that grows 2-3 meters tall. It is found widespread in most of Texas. However, it is absent in the Rio Grande Plain and is rare in east and far west Texas. It is locally found in the bottom woods of the Guadalupe River.

Black willow is a member of the Salicaceae or willow family (Correll & Johnston, 1996). It is a native tree that grows up to 20 meters tall. It is frequently found in alluvial soils along riparian areas throughout eastern Texas and the Texas Coastal Prairie and into the Rio Grande Plains (Everitt & Drawe, 1993).

The objective of this study is to evaluate the potential of these five native plants to root from vegetative cuttings. The ability to root from cuttings allows the plant to be planted bare-stem providing efficient and cost-effective restoration treatment.

MATERIALS AND METHODS

Each shrub cutting was cut from a donor tree and immediately immersed 12.5 to 15 cm into a one-gallon pot of sandy loam soil. Within 24 hours the pots were placed into a baby pool that had 5 to 7.5 cm of water which kept the soil continiously moist. The swamp privet, roughleaf dogwood, and false indigo were cut on March 13, 2001 while the black willow and turk's cap were cut on April 9, 2001. Eighteen cuttings of swamp privet were evaluated that ranged in diameter from ¼ - ½ inches. Thirty-seven cuttings of roughleaf dogwood were evaluated that ranged in diameter from ¼ to 1¼ inches. Forty-four false indigo cuttings were evaluated that ranged in diameter from $^{1}/_{8}$ to ½ inches. Thirty-four cuttings of turk's cap were evaluated that ranged in diameter from ¼ to $^{9}/_{16}$ inches. Fifty-one cuttings of black willow were evaluated that ranged in diameter from $^{1}/_{8}$ to $^{7}/_{8}$ inches. All cuttings were approximately 2 feet long and were measured 2 inches above the soil line.

RESULTS AND DISCUSSION

We had no success with stem-cuttings of swamp privet or roughleaf dogwood (Table 1). According to Nokes (1986), dogwoods will root from softwood or semi-hardwood cuttings taken in summer and hardwood cuttings in winter. However, she points out that small juvenile cuttings root best. She also mentions that dogwoods transplant better with a rootball than they do bare-rooted. All this seems to indicate that roughleaf dogwood and swamp privet are better planted as live transplants rather than as stem-cuttings for riparian restoration.

Table 1.

Survival of Riparian Shrub Stem-cuttings.

Species	Number	Size (in inches)	Percent Survival
Swamp Privet	**18**	**¼ - ½**	**0**
Roughleaf Dogwood	**37**	**¼ - ¼**	**0**
Turk's Cap	**34**	**¼ - $^{9}/_{16}$**	**15**
False Indigo	**44**	**$^{1}/_{8}$ – $^{1}/_{2}$**	**80**
Black Willow	**51**	**$^{1}/_{8}$ – $^{7}/_{8}$**	**53**

Fifteen percent of turk's cap cuttings established roots. Like roughleaf dogwood, Nokes (1986) states that softwood cuttings that are 4 to 6 inches in length and treated with IBA (Hormodin 2) root best. Large clumps of turk's cap can also be seperated and easily established as individual plants. It appears with the low survival rate of the stem-cuttings that live transplants would be the best method for plant establishment.

False indigo and black willow had good establishment success with 80 and 53% respectively developing roots from stem-cuttings. Nokes (1986) reports that false indigo may be propagated from softwood cuttings in late spring through summer and hardwood cuttings in the fall. Doran (1957) had 100 percent success in rooting untreated cuttings of false indigo taken in July and planted in sand. Nokes (1986) also points out that willows are the easiest of all plants to root from cuttings. She reports that black willow will root promptly from hardwood cuttings taken in the spring before buds leaf out.

The PMC plans to evaluate stem-cuttings of other South Texas species such as elderberry (*Sambucus canadensis*), sandbar willow (*Salix exigua*), seep willow (*Baccharis salicifolia*), and buttonbush (*Cephalanthus occidentalis*) in the near future. The PMC then plans to evaluate the most promising species on actual streambank restoration sites.

REFERENCES

Correll, D.S. and M.C Johnston. 1996. Manual of the Vascular Plants of Texas. Richardson, TX: The University of Texas at Dallas.

Everitt, J.H. and D.L. Drawe. 1993. Trees, Shrubs, and Cacti of South Texas. Lubbock, TX: Texas Tech University Press.

Judy, R.D. Jr., P.N. Seeley, T.M. Murray, S.C. Svirsky, M.R. Whitworth, and L.S. Ischinger. 1984. *1982 National fisheries survey, Vol. 1 technical report: initial findings*. U.S. Department of the Interior, Washington D.C.

Jones, F.B. 1982. Flora of the Texas Coastal Bend. Sinton, TX: Welder Wildlife Foundation.

Nokes, J. 1986. How to Grow Native Plants of Texas and the Southwest. Houston, TX: Gulf Publishing

Kika de la Garza Plant Materials Center

Kingsville, TX

Vol. 4 No. 9 Technical Note December 2001

AN EVALUATION OF EASTERN GAMAGRASS AS A VEGETATIVE BARRIER IN SOUTH TEXAS

ABSTRACT

Seeding vegetative barriers has the potential to be a low-cost method for erosion control on Texas cropland. This study evaluated the establishment of vegetative barriers by seeding "Iuka" eastern gamagrass on heavy, clay soils at the Kika de la Garza Plant Materials Center. Flat drill seeding was compared to bedded seeding. There was no significant difference in seeding method one year after planting. The barriers had an average of 1-2 gaps/10 feet with an average gap size of 10-12 inches. Despite occasional larger gaps that occurred in the barriers, the double row seeding provided effective erosion control.

INTRODUCTION

The Natural Resources Conservation Service (NRCS) has promoted the use of terraces for soil erosion control for over forty years. More recently the concept of using vegetative barriers or grass hedges as a vegetative alternative has been investigated (Kemper et. al., 1992). Vegetative barriers are narrow strips (1-3 feet wide) of stiff, erect, densely growing plants, usually grasses, planted across the slope perpendicular to the dominant slope. These barriers function to slow water runoff, trap sediment and prevent gully development (Dabney et. al., 1993).

Vegetative barriers are appealing because of the low-cost in developing a terrace. It could provide an option to conventional terraces without the need of heavy machinery. Furthermore, it would eliminate the movement and compaction of topsoil.

The objective of this study was to evaluate seeding eastern gamagrass (*Tripsacum dactyloides*) with a seed drill on flat ground compared to planting on bedded rows on the heavy clay soils at the Plant Materials Center (PMC).

MATERIALS AND METHODS

The study site was located at the Kika de la Garza Plant Materials Center, Kingsville, Texas. The seeding treatments were conducted on Victoria clay soil. A clean seedbed was prepared prior to planting. The unbedded site was planted with a Tye range drill utilizing only two of the planting tubes. Each tube put out 12 seeds/foot at a 1.44

pure live seed (pls) /foot rate. The bedded site was planted with a two-row John Deere planter. Each of the two planter units put out 26 seeds/foot at a 3.12pls /foot rate. The dimensions of the plot were five feet wide by 100 feet long. The seed was moist pre-chill "Iuka" eastern gamagrass. It was planted in good soil moisture at a depth of 1-$1^1/_2$ inches deep. The seed was tested on 4/20/2000 and was determined to have a 78% pls rating. However, when seed was tested at the PMC prior to fall planting the seed had only a 12 % germination rate. We wanted to plant the seed at a 4 pls /foot rate for the vegetative barriers. However, based on the germination rate and the equipment restrictions for obtaining high seed flows we were unable to reach the 4 pls/foot rates for either treatment.

Weed control during the year consisted of spraying 2,4-D at 48 oz./acre rate and Prowl at 32 oz./acre rate on March 6,2001. The ground was cultivated between treatments on March 7, 2001.

Evaluations of treatments were conducted in February 2001 and October 2001. Evaluations consisted of running 100 feet of measuring tape and recording along the distance the number of gaps between plants greater than 6 inches and measuring the gap size. At every ten-foot increment the height of the plants was also recorded.

RESULTS AND DISCUSSION

Statistics were run using SPSS statistical program for Windows, 10.0. Data for each plot was analyzed for the factors, replication and treatment. Descriptive tables were run for the number of gaps between plants, size of gaps between plants and height of plants.

There was a significant difference between the planting treatments when evaluated in February 2001 (Table 1). More gaps were present at the flat planting plot, 3.9 gaps per 10 feet, than at the bedded planting plot, 1.7 gaps per 10 feet. Furthermore, the flat planting plot had a mean gap opening of 11.1 inches and a maximum gap size of 36.5 inches per replication. The bedded treatment had a mean gap opening of 9.0 inches and a maximum gap size of only 14.4 inches per replication. The heights of the plants did not significantly differ by planting treatment with the mean height being 5.1 inches.

Table 1. Mean Dimensions of Gaps in the Eastern Gamagrass Barriers on February 27, 2001.

TREATMENT	# OF GAPS	GAP SIZE (INCHES)	LARGEST GAP SIZE (INCHES)	PLANT HEIGHT (INCHES)
FLAT	3.9	11.1	36.5	5.1
BEDDED	1.7	9.0	14.4	4.8

By October of 2001, one year after planting, there was no significant difference between the planting treatments (Table 2). The number of gaps per 10 feet for the flat planting had gone from 3.9 to 1.9 and for the bedded planting they went from 1.7 to 1.4. The average size of the gaps did not change dramatically over the year. The flat planting had a mean gap opening of 11.7 inches and the bedded planting had an opening of 9.7 inches. However, the maximum gap size, although not statistically significant, was still larger for the flat planting at 29.3 inches than for the bedded planting at 18.6 inches. The height of the plants after a full growing season was approximately 2 feet.

Table 2. Mean Dimensions of Gaps in the Eastern Gamagrass Barriers on October 16, 2001.

TREATMENT	# OF GAPS	GAP SIZE (INCHES)	LARGEST GAP SIZE (INCHES)	PLANT HEIGHT (INCHES)
FLAT	1.9	11.7	29.3	24.0
BEDDED	1.4	9.7	18.6	23.1

Results of this study indicate that bedded plantings will develop a stand earlier than flat planting. The beds seem to encourage earlier germination and growth on the heavy clay soils at the PMC. This could be a concern if planting in the spring and trying to get a good vegetative cover before the heat and drought of summer arrives. However, with a fall planting our results indicate that this is not as much of a concern because at the end of the year there was not a significant difference in the established stands for either treatment. This was despite the fact that the seeding rates for the flat planting were half the rate of the bedded planting at 1.44 pls/foot versus 3.12 pls/foot, respectively.

The maximum gap size especially for the flat planting is a point of concern. A gap of 29 inches defeats the purpose of a vegetative barrier. However, the seeding rate for the flat planting was only 1.44 pls/foot. Results indicate a seeding rate of 4 pls/foot would significantly reduce the size of these occasional large gaps. The bedded planting with a seeding rate of 3.12 pls/foot had a maximum gap of 18 inches. Eastern gamagrass when it is a mature plant can attain basal areas of 2-3 feet. So it is possible that these large gaps will decrease as the plants mature. Furthermore, we feel that with a double row planting there is less likelihood that these large gaps will line up. So there should always be at least one row that will provide an erosion control barrier.

In this study, we also observed that the variety “Iuka” eastern gamagrass had some mortality during the summer. The mean gap size went from 9.0 to 9.7 inches and the maximum gap size went from 14.4 to 18.6 inches from February 2001 to October 2001. It was an extremely dry summer in Kingsville with the PMC receiving only 13.6 inches of rain from February to October. However, future plans include an evaluation of the Texas variety “Medina” eastern gamagrass over the next few years to see how it survives and functions as a vegetative barrier in South Texas.

REFERENCES

Aase, J.K. and J.L. Pikul. 1995. Terrace formation in cropping strips protected by tall wheatgrass barriers. J. Soil Water Conserv. 50(1): 110-112.

Dabney, S., K. McGregor, L. Meyer, E. Grissinger, and G.R. Foster. 1993. Vegetative barriers for runoff sediment control. [Proceedings of the International Symposium on Integrated Resource Management and Landscape Modification for Environmental Protection.] 13-14 December, Chicago, IL. pp.60-70.

Dabney, S.M., Z. Liu, M. Lane, J. Douglas, S. Zhu, and D.C. Flanagan. 1999. Landscape benching from tillage erosion between grass hedges. Soil and Tillage Res. V.51(3/4):219-231.

Dabney, S.M., L.D. Meyer, G.H. Dunn, G.R. Foster, C.V. Alonso. 1996. Stiffgrass hedges, a vegetative alternative for sediment control. Proceedings of the Sixth Federal Interagency Sedimentation Conference, Vol, 2(X): 62-69.

Dabney, S.M., L.D. Meyer, W.C. Harmon, C.V. Alonso, G.R. Foster. 1995. Depositional patterns of sediment trapped by grass hedges. Transaction of ASAE 38:1719-1729.

Dabney, S.M., L.D. Meyer, and K.C. McGregor. 1997. Sediment control and Landscape Modification with grass hedges, In (S.Y. Wang, E.J. Langendoen, and F.D. Shields, JR., eds.) Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision, 20-22 May 1997, Oxford, MS, Univ. of Miss pp. 1093-1099.

Dewald, C.L., S. Bruckerhoff, S. Dabney, J. Douglas, J. Henry, J. Ritchie, D. Shepherd, and D. Wolf. 1996. Guidelines for the establishment of warm-season grass hedges for erosion control. J. Soil and Water Cons. 51: 16-20.

Dillaha, T.A., and J.C. Hayes. 1992. Vegetative filter strips: II. Application of Design procedures. ASAE Paper No. 922103. American Society of Agricultural Engineers, St. Joseph, MI.

Dunn G.H. and Dabney, S.M. 1996. Modulus of elasticity and moment of inertia of grass hedgestems. Transactions of the ASAE 39(3): 947-952.

Flanagan, D.C., G.R.Foster, W.H. Neibling, and J.P. Burt. 1989. Simplified equation for filter strip design. Trans. ASAE 31(6): 2001-2007.

Hayes, J.C. and T.A. Dillaha. 1992. Vegetative filter strips: I. Site suitability and procedures. ASAE Paper No. 922102. American Society of Agricultural Engineers, St. Joseph, MI.

Kemper, D., S. Dabney, L. Kramer, D. Dominick, and T. Keep. 1992. Hedging against erosion. J. Soil and Water Cons. 47(4):284-288.

Magette, W.L., R.B. Brinsfield, and J.D. Wood. 1989. Nutrient and sediment removal by vegetated filter strips. Trans. ASAE 32(2): 663-667.

McGregor, K.C. and S.M. Dabney. 1993. Grass hedges reduce soil loss on no-till and conventional-till cotton plots. Proc. So. Conserv. Till Conf. For Sustainable Agr. pp. 16-20.

Meyer, L.D., S.M. Dabney, and W.C. Harmon. 1995. Sediment trapping effectiveness of stiff-grass hedges. Transactions of ASAE 38(3): 809-815.

Natural Resources Conservation Service, U.S. Department of Agriculture. March 2001. Practice Standard, Vegetative Barriers.

Kika de la Garza Plant Materials Center

Kingsville, TX

Vol. 4 No. 10 Technical Note December 2001

A WATERBIRD HABITAT ENHANCEMENT STUDY ON SUNDOWN ISLAND

ABSTRACT

Dredge spoil islands and other coastal sites are in need of native plant species and establishment techniques for the improvement of waterbird nesting habitat along the Texas Gulf Coast. This study evaluated seven native species of trees and shrubs for survival and growth. It also evaluated the effects of three planting treatments: no treatment, shelter treatment, and shelter and weedmat treatment. Huisache and retama had the best survival and vigor of the tree species evaluated. Marsh elder and sweet bay had poor survival and vigor in this study. Short tree shelters were shown to improve survival and vigor on xeric planting sites.

INTRODUCTION

Sundown Island is a man-made island constructed by the Army Corp of Engineers in the dredging of the Gulf Intracoastal Waterway in Lavaca Bay. The island has become a valuable nesting site for waterbirds along the Texas Gulf Coast. The Audubon Society leases the island in order to protect and manage the island.

This man-made island has either bare-ground or short herbaceous grasses and forbs. While many waterbirds such as terns prefer nesting on bare-ground, other birds such as herons and egrets prefer to nest in trees or tall shrubs. Thus, the objectives of this study were to evaluate different plant material along with different planting techniques for the establishment of native Texas shrubs and trees.

MATERIALS AND METHODS

The study site was located on Sundown Island in Lavaca Bay, Texas. We established four locations and planted 10 plants of colima (*Zanthoxylum fagara*), huisache (*Acacia farnesiana*), mesquite (*Prosopis glandulosa*), and marsh elder (*Iva frutescens*) for each planting treatment. The planting treatments consisted of a 9-inch tall circular tree shelter, a tree shelter and a 3-foot by 3-foot weedmat, and a no treatment. Four replications of the tree shelter and weedmat with 10 plants each of fiddlewood (*Citharexylum berlandieri*) and retama (*Parkinsonia aculeata*) and 5 plants of sweet bay (*Persea borbonia*) were also established. Trees were planted on October 25, 2000.

The soil on Sundown Island was gravelly sand that had low nitrogen and potassium levels but high phosphorus levels. The pH ranged from 7.8 to 8.5. After planting and soil analysis, a 2 year 21 gram 20-10-5 Agriform fertilizer tablet was placed at each tree on December 5, 2000.

Evaluations of the treatments were conducted in March 2001 and October 2001. The evaluations consisted of measuring height and width in inches for each species as well as recording survival and plant vigor. Plant vigor was based on a subjective rating with 1 being the most vigorous and 10 being the least.

RESULTS AND DISCUSSION

Statistics were run using SPSS statistical program for Windows, 10.0. Data for each plot was analyzed for the factors, replication and treatment. Tukey's Test for Honestly Significant Difference (Tukey's HSD) was run to pinpoint specific difference when indicated by the ANOVA. Descriptive tables were run for survival, height, width and vigor.

In the spring of 2001, colima had significantly poorer survival than any other species (Table 1). It is believed the poor survival of the colima was a function of poor initial planting material. Table 2 indicates that the height and width of the colima plants were extremely small compared to the other species. But, on site 4 colima plants were comparable in size and at that site it had 100% survival.

Table 1. Survival Rate and Vigor of Tree Species at Sundown Island in March 2001.

SPECIES	SURVIVAL	VIGOR (1=BEST)
COLIMA	78%	6.4
MESQUITE	98%	6.2
MARSH ELDER	99%	4.2
FIDDLEWOOD	100%	4.1
HUISACHE	100%	4.9
RETAMA	100%	6.8
SWEET BAY	100%	5.9

Table 2. Mean Height and Width of Tree Species at Sundown Island.

SPECIES	MARCH HEIGHT (IN.)	2001 WIDTH (IN.)	OCTOBER HEIGHT (IN.)	2001 WIDTH (IN.)
COLIMA SITE 1	1.9	1.7	4.5	3.5
SITE 2	1.7	1.6	2.7	2.4
SITE 3	1.7	1.5	4.4	3.2
SITE 4	5.2	3.1	12.7	6.6
ALL	7.2	2.5	17.8	15.8

The vigor of the plants in March of 2001 showed significant differences for the various species as well as for the treatments. In the early spring, husache, marsh elder and fiddlewood were more vigorous than mesquite, colima and retama. Furthermore, the no treatment plants were less vigorous than the shelters and the shelters with weedmatting plants (Table 3).

Table 3. Vigor of Tree Species Based on Planting Treatment at Sundown Island.

TREATMENT	MARCH 2001 VIGOR (1=BEST)	OCTOBER 2001 VIGOR (1=BEST)
NONE	6.1	4.4
SHELTER	5.0	3.6
SHELTER & WEEDMAT	5.1	2.9

In the fall of 2001, retama, huisache and fiddlewood had significantly better survival than colima, marsh elder and sweet bay (Table 4). Sweet bay and marsh elder had a significant drop in survival after the summer season. Sweet bay decreased from 100% to 13% survival and marsh elder decreased from 99% to 15% survival. There also was a significant interaction between the species and treatments by planting site.

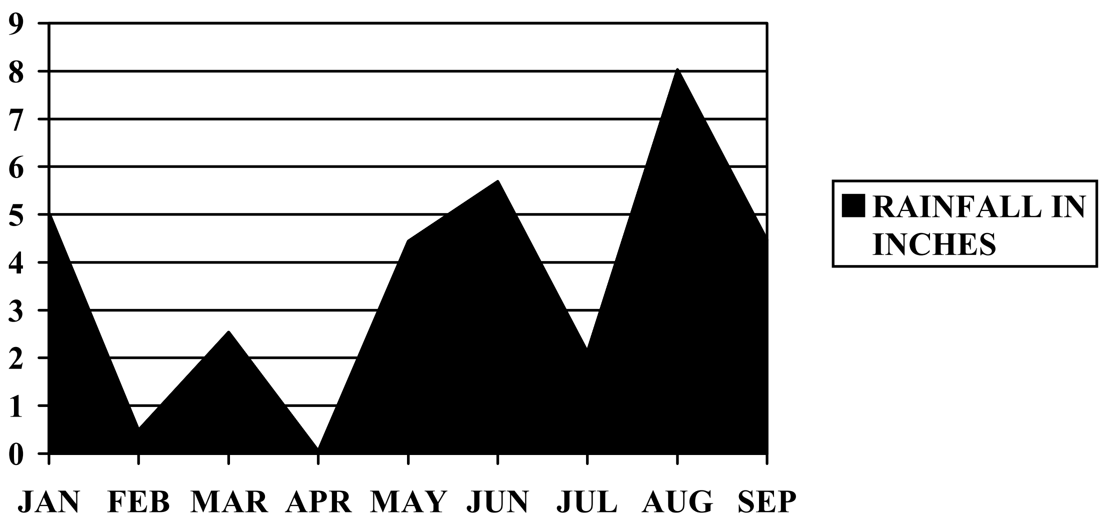
In October of 2001, the plants showed significant difference in vigor among the species and between the treatments. Sweet bay was the least vigorous and retama was the most vigorous. Plants were the least vigorous with no treatment and the most vigorous were those that received both shelter and weedmat.

Table 4. Survival Rate and Vigor of Tree Species at Sundown Island in October 2001.

SPECIES	SURVIVAL RATE	VIGOR (1=BEST)
SWEET BAY	13%	6.0
MARSH ELDER	15%	4.5
COLIMA	46%	3.7
MESQUITE	83%	3.9
FIDDLEWOOD	90%	3.7
HUISACHE	97%	3.1
RETAMA	100%	2.3

Rainfall in 2001 was plentiful at Sundown Island for the months of May through September (Table 5). This produced an abundance of weeds, especially sunflowers, on sites 1,2, and 4. This amount of rainfall appeared to mute any differences between the planting treatments.

Table 5. Rainfall in 2001 at Palacios/Sundown Island.



Site 3, which was the most xeric site on the island, provided some valuable information. While the other sites showed no difference in survival based on treatment, at this site the fall evaluation revealed significantly poorer survival for the no treatment versus the other treatments (Table 6). The no treatment had only a 23% survival rate whereas the shelter and weedmat treatment and the shelter only treatment had 62% and 65% survival rates respectively. Furthermore of the four species not receiving any treatment (colima, marsh elder, mesquite, and huisache) only huisache survived. It had a remarkable 90% survival rate. The survival rates and vigor of all the tree species across all the treatments at site 3 on Sundown Island for October, 2001 are listed in Table 7.

Table 6. Survival and Vigor of Tree Species Based on Treatment at Site 3 at Sundown Island in October 2001.

TREATMENT	SURVIVAL RATE	VIGOR (1=BEST)
NONE	23%	4.2
SHELTER	65%	3.2
SHELTER & WEEDMAT	62	2.7

Table 7. Survival Rate and Vigor of Tree Species Across All Treatments at Site 3 on Sundown Island in October 2001.

SPECIES	SURVIVAL RATE	VIGOR (1=BEST)
MARSH ELDER	0%	---
SWEET BAY	0%	---
COLIMA	33%	4.1
FIDDLEWOOD	60%	4.2
MESQUITE	66%	3.0
HUISACHE	97%	2.9
RETAMA	100%	1.8

In summary, huisache, retama, mesquite, fiddlewood, colima and granjeno (*Celtis pallida*) were able to adapt to Sundown Island. Granjeno was not planted in this study but was observed already growing on the island. In our study, huisache and retama had the best survival and vigor. We would not recommend the use of marsh elder or sweet bay. Where there is adequate seasonal rainfall there appears to be no advantage to using shelters or weedmat. However, where conditions are more xeric we would recommend the use of short tree shelters to improve plant survival and vigor.

REFERENCES

Conner, W.H. and G.R. Askew. 1993. Impact of saltwater flooding on red maple, redbay, and Chinese tallow seedlings. Castanea. 58(3): 214-219.

Correll, D.S. and M.C. Johnston. 1996. Manual of the Vascular Plants of Texas. Richardson, TX: The University of Texas at Dallas.

Everitt, J.H. and D.L. Drawe. 1993. Trees, Shrubs, and Cacti of South Texas. Lubbock, TX: Texas Tech University Press.

Fulbright, T.E., J.O. Kuti and A.R. Tipton. 1995. Effects of nurse-plant canopy temperatures on shrub seed germination and seedling growth. Acta Oecologica. 16(5): 621-632.

Grantz, D.A., D.L. Vaughn, R.J. Farber, Kim, Bong, L. Ashbaugh, T. Vancuren, R. Cambell, D. Bainbridge, and T. Zink. 1998. Transplanting native plants to revegetate abandoned farmland in the western Mojave Desert. Journal of Environmental Quality. 27(4).

Polley, H.W., C.R. Tischler, H.B. Johnson, and R.E. Pennington. 1999. Growth, water relations, and survival of drought-exposed seedlings from six maternal families of honey mesquite (Prosopis glandulosa): Responses to CO@ enrichment. Tree Physiology. 19(6): 359-366.

Tomar, O.S., R.K. Gupta, and J.C. Dagar. 1998. Afforestation techniques and evaluation of different tree species for waterlogged saline soils in semiarid tropics. Arid Soil Research & Rehabilitation. 12(4): 301-316.

Plant Fact Sheet
Armed Saltbush
(***Atriplex acanthocarpa***)

Kika de la Garza PMC
Kingsville, Texas

January 2001

INTRODUCTION

Armed Saltbush (*Atriplex acanthocarpa*) is a native, saline tolerant, evergreen, perennial shrub with a woody root (Correll & Johnston, 1996). It can grow from 3-10 dm in height (Everitt & Drawe, 1993). It is a member of the pigweed (Chenopdiaceae) family (Jones, 1982).

Armed saltbush is also known by the common names huaha (Everitt & Drawe, 1993) and tubercled saltbush (USDA 1994) because the bracts of the fruit have many flattened tubercles (Everitt & Drawe, 1993). It is dioecious, having male and female flowers on separate plants (Correll & Johnston, 1996).

ADAPTED AREA

Armed saltbush occurs in parts of South Texas (Jones, 1982), and Correll & Johnston (1996) record its presence form West Texas to southern New Mexico, and south into Mexico. Everitt and Drawe (1993) note that it is found predominately in the western half of Texas, and less frequently in Cameron, Starr, Webb, and Zapata counties. Armed saltbush prefers well-drained, often alkaline soils. Plant Material Center staff have found that it does not do as well on wet sites, as it appears to be susceptible to cotton root rot.

USES

Armed saltbush has wildlife value, providing shelter for birds and small animals. It has also been documented as having nutritious browse for cattle and deer (Garza & Fulbright, 1988). Garza and Fulbright (1988) also note that armed saltbush has higher crude protein levels than four-wing saltbush (*Atriplex canescens*), a close relative of armed saltbush. Armed saltbush has also been used for windbreaks, roadside cover, and as an ornamental (Correll & Johnston, 1996; Everitt & Drawe, 1993).

Four-wing saltbush has been used in the restoration of oil well reserve pits with high salinities (Mc Farland, et al, 1987). Armed saltbush can also be useful for plantings on such sites that exhibit complex alkaline and saline soil problems, and can be more adapted than four-wing saltbush in some situations. A 1988 study by Garza and Fulbright found armed saltbush to have higher concentrations of sodium in its leaves than four-wing saltbush. In addition, studies conducted by Kika de la Garza PMC (1998) have found armed saltbush to be better adapted to the dry saline conditions of South Texas than four-wing saltbush.

ESTABLISHMENT

Armed saltbush can be difficult to grow from seed, as it is very particular about the conditions under which it will germinate. Germination studies at the Plant Material Center using an 8 hour day temperature of 70 º F and a 16 hrs night temperature of 50ºF with various light conditions yielded a maximum of 16% germination. Yet, a greenhouse planting in the winter of 1999 yielded much higher germination, indicating that the seed will germinate under the right conditions. Testing conducted by the USDA National Seed Storage Laboratory in the year 2000 confirmed good germination potential. A seed sample of armed saltbush accession #9085310 sent to them in the Fall of 1999 was found to have 67% viable seed, 10% non-viable seed, and 23% empty seed (personal communication with Loren Weisner, NSSL Curator, January 25, 2001).

Plant Material Center staff has had fairly good success growing new plants of armed saltbush from cuttings. Cuttings are best made in the late spring, once new growth has started. They should be treated with a rooting hormone to help facilitate root growth. Cuttings can be transplanted after 3 months, but we suggest fall planting to give plants an oppotunity to get established before undergoing a hot, dry Texas summer. The use of tree shelters to optimize soil moisture and protect small plants from browsing animals is highly recommended (Kika de la Garza PMC, 1998).

MANAGEMENT

Once established, armed saltbush requires very little management. Weed control is the only management we do at the Plant Material Center, and even that is optional. For additional assistance regarding the production and establishment of armed saltbush, please contact the Plant Material Center at (361) 595-1313.

REFERENCES

Correll, D. S. and M.C. Johnston. 1996. *Manual of the Vascular Plants of Texas.* Richardson, TX: The University of Texas at Dallas.

Everitt, J. H. and D.L. Drawe. 1993. *Trees, Shrubs, and Cacti of South Texas.* Lubbock, TX: Texas Tech University Press.

Garza, A. Jr., and T.E. Fulbright. 1998. Comparative chemical composition of armed saltbush and four-wing saltbush. *Journal of Range Management*, 41 (5), 401-403.

Jones, F. B. 1982. *Flora of the Texas Coastal Bend.* Sinton, TX: Welder Wildlife Foundation.

Kika de la Garza PMC. 1998. An evaluation of saltbushes (Atriplex spp.) for restoration of alkaline and saline sites in south Texas. *Technical Note*, v1 (1),

Mc Farland, M. L., D. N. Ueckert and S. Hartman. 1987. Revegetation of oil well reserve pits in west Texas. *Journal of Range Management*, 40: 122-127.

USDA-NRCS. 1994. *Plants: Alphabetical Listing of Scientific Names.* Baton Rouge, LA: United States Department of Agriculture.

WHERE TO GET HELP

Contact your local Natural Resources Conservation Service (formerly Soil Conservation Service) office for more information. Look in the phone book under "United States Government". The Natural Resources Conservation Service will be listed under the subheading "Department of Agriculture."

Plant Fact Sheet
Creeping River Grass
(***Echinochloa polystáchya***)

Kika de la Garza PMC **June 2001**
Kingsville, Texas

INTRODUCTION

Creeping river grass (*Echinochloa polystáchya*) is a native, warm –season, perennial grass, with stout culms creeping from the base (Correll & Johnston, 1996). It can grow to five feet in height (Stutzenbaker, 1999). It has been know to set roots from the lower nodes (Gould, 1975). Creeping river grass can easily be distinguished from other *Echinochloa* species by the presence of a ligule, which is a dense line of stiff yellow hairs (Hatch, Schuster and Drawe, 1999). The genus name, *Echinochloa,* is Greek for hedgehog grass and the panicle-type seed head, with its awned spikelets does look somewhat like a hedgehog (Hitchcock, 1971).

Creeping river grass is a member of the panicaceae tribe of grasses (Hitchcock, 1971) and was previously known as *Panicum polystachyum* (Correll & Johnston, 1996). It goes by a variety of common names including: Creeping river grass, (USDA-NRCS, 1994), mudflat millet, river grass (Stutzenbaker, 1999), and barnyard grass.

ADAPTED AREA

Creeping river grass can be found in swamps and ditches along the Gulf Coast from Louisiana to Brownsville, Texas, and also in the West Indies south to Argentina (Hitchcock, 1971). In Texas, it can be found in wet swales and ditches along the southern Gulf Coast (Hatch, Schuster, & Drawe, 1999), from the southern part of Southeastern Texas to the coastal portion of the Rio Grande Plains (Correll & Johnston, 1996).

Creeping river grass prefers freshwater marshes where salinities are below 0.5 parts per thousand (Stutzenbaker, 1999). It will prosper on both mineral and organic soils (Stutzenbaker, 1999), but tends to prefer moist clay loam soils (Correll & Johnston, 1996). Creeping river grass will often form dense colonies on newly created mudflats that have formed after shallow flooding has occurred (Stutzenbaker, 1999). It is not tolerant of water levels over two feet, and prefers to have some periods of drawdown in order to spread laterally (Stutzenbaker, 1999).

USES

Creeping river grass produces forage in the late summer months. It is highly palatable to cattle (Hatch, Schuster, & Drawe, 1999). Its seeds are eaten by puddle ducks and gallinules like to forage along the edges. It is also a good source of shelter for nutria and muskrats, and can provide a windbreak for waterfowl (Stutzenbaker, 1999). Hatch, Schuster, and Drawe (1999) note that creeping river grass is one of "the most important wetland plants for attracting upland game birds, songbirds, and waterfowl" (p.145).

ESTABLISHMENT

Creeping river grass can be propagated by transplanting rootstocks or vegetative splits, transplanting whole plants, cuttings, or seed. Stutzenbaker (1999) suggests that transplants are best done in the later winter or early spring, while seed should be hand-broadcast in the late spring. Soils should be moist to wet at planting time whether you seed or transplant. Do not plant in areas subject to deep flooding. If propagating new plants from cuttings, it is recommended that the water be maintained at a level at or below the crown level (Keyes & Lloyd-Reilley, 1999). Creeping river grass can have seed yields of 98 pounds per acre, and averages 495,000 seeds per pound. A recent germination study conducted at the Kika de la Garza Plant Materials Center (2001) found that dry-stored seed had better germination than either seed stored in water, or thiram treated seed. However, for the accession tested, germination of dry-stored seed was not consistent between harvest years, and ranged from 1.5 to 34 percent. This variation in germination rate may be due in part to poor seed fill in some years.

MANAGEMENT

Water is a key factor for creeping river grass. Soils should be kept moist, or wet and water level should be kept at less than two feet (Stutzenbaker, 1999). Although some late spring and early summer drydown period is helpful for lateral growth, moist soil is necessary. Creeping river grass is not well suited for areas with extended drydown periods. Grazing should be rotational in nature and should be carefully managed. No grazing should be done the first year**.**

Creeping river grass is prone to root damage from fire ants, which like to build their mounds around the base during drydowns. It also has been known to get aphids. Furthermore, poor seed fill can be a problem, as can poor seed retention. For additional assistance regarding the production and establishment of creeping river grass, please contact the Plant Material Center at (361) 595-1313.

REFERENCES

Correll, D. S. and M.C. Johnston. 1996. *Manual of the Vascular Plants of Texas*. Richardson, TX: The University of Texas at Dallas.

Gould, F. W. 1975. *The Grasses of Texas*. College Station, Texas: Texas A&M University Press.

Hatch, S. L., J. L. Schuster, and D. L. Drawe. 1999. *Grasses of the Texas Gulf Prairies and Marshes.* College Station, Texas: Texas A&M University Press.

Hitchcock, A. S. 1971. *Manual of the Grasses of the United States, Volumes 1&2, 2nd Edition*. Revised by Agnes Chase. New York: Dover Publications.

Keyes, K., and Lloyd-Reilley, J. 1999. *Evaluation of Propagation Techniques of Selected Native South Texas Wetland Plants Utilized by Waterfowl.* Kingsville, TX: Kika de la Garza Plant Materials Center.

Kika de la Garza PMC. 2001. Two germination studies with creeping river grass seed: A look at the impact of storage method and harvest year. Technical Reports, v 4 (6), pp.

Stutzenbaker, C. D. 1999. Aquatic and Wetland Plants of the Western Gulf Coast. Port Arthur, TX: Texas Parks and Wildlife Press.

USDA-NRCS Ecological Sciences Division. 1994. Plants: Alphabetical Listing of Scientific Names. Baton Rouge: National Plant Data Collection Center

WHERE TO GET HELP

Contact your local Natural Resources Conservation Service (formerly Soil Conservation Service) office for more information. Look in the phone book under "United States Government". The Natural Resources Conservation Service will be listed under the subheading "Department of Agriculture."

Plant Fact Sheet
Salt-Marsh Bulrush
(*Scirpus robustus*)

Kika de la Garza PMC **June 2001**
Kingsville, Texas

INTRODUCTION

Salt-marsh bulrush (*Scirpus robustus*), previously known as (*Scirpus maritimus* var. *macrostachyus*), is a member of the Cyperaceae or sedge family (Hatch, Gandhi, & Brown, 1990). It is also commonly known as leafy three square (Stutzenbaker, 1999). It is a native, rhizomatous perennial, with extensive culms tufted along the rhizome. Often there are tuber-like structures located basally (Correll & Johnston, 1996).

ADAPTED AREA

Salt-marsh bulrush is frequently found in wet, brackish soils and in the shallow waters of ponds, lakes, and marshes (Jones, 1982). Often forming colonies of several acres, it commonly grows in association with marsh hay cordgrass (*Spartina patens*), also known as wiregrass (Stutzenbaker, 1999). The species has a worldwide distribution. In Texas, it can be found in the coastal marshes of southeast Texas and the Rio Grande Plains (Correll & Johnston, 1996).

Salt-marsh bulrush is tolerant of alkalinity and has been known to grow in sandy or clay soils, and in fresh or brackish water. It can tolerate salinities up to 10ppt (Stutzenbaker, 1999). It should be noted; however, that the site salinity may be inversely correlated with both seed production and germination (Keyes & Lloyd-Reilley, 1999). Yet, Stutzenbaker (1999) notes that some degree of salinity is good for this plant, as it tends to decline under long-term freshwater conditions.

USES

Salt-marsh bulrush can be used as a wetland restoration plant for south Texas. It also provides habitat for waterfowl and other wetland wildlife and its seeds are an excellent food source for ducks (Martin & Uhler, 1939; Prevost and Gresham, 1981; Stutzenbaker, 1999). Rhizomes and tubers are eaten by snow geese, muskrats and nutria (Stutzenbaker, 1999). It can also withstand heavy grazing by livestock (Stutzenbaker, 1999).

ESTABLISHMENT

Salt-marsh bulrush propagates best from root stock and rhizomes split from existing plants. In addition, whole plants can be transplanted successfully. Salt-marsh bulrush can also be propagated from seed with some degree of success.

For a wetland plant, seed production is fairly good. Salt-marsh bulrush averages 176,000 seeds per pound, and can produce between 30-50 pounds of seed per acre. We recommend the use of wet-stored seed (seed stored submerged in water and kept in a refrigerator or cooler) for the best results, if you wish to seed salt-marsh bulrush. New seedings should be done in shallow areas of water (1/4" –3/8" deep) in the summer months when the daytime air and water temperatures are hot (90-100ºF). Seed will germinate in deeper water, but will not be able to root and will damp off. Salt-marsh bulrush seed can also be germinated in shallow trays of water in a nursery or germination chamber and mass produced as transplants. Seedlings take only a few months to mature and begin to propagate vegetatively on their own.

Germination of wet-stored seed has ranged from 32% to 80%. We have been able to germinate dry-stored seed (seed stored in a bag or seed envelope in a seed cooler). Germination of dry-stored seed has been inconsistent, ranging from 0% to 67% (Kika de la Garza PMC, 1999; 2000; 2001a; 2001b). Additionally, we have seen seeds germinate in cold daytime temperatures (40-50ºF), but to date, best successes are with wet-stored seed and hot temperatures.

MANAGEMENT

Once established, salt-marsh bulrush requires little management. If it is maintained in pots or other containers, it may need to be split occasionally to allow the plants to continue to grow. It can be susceptible to the plant disease, rust. This can cause the plants to decline. Remove contaminated plant material to allow for healthy new growth. For additional assistance regarding the production and establishment of salt-marsh bulrush, please contact the Plant Material Center at (361) 595-1313.

REFERENCES

Correll, D. S. and M.C. Johnston. 1996. Manual of the Vascular Plants of Texas. Richardson, TX: The University of Texas at Dallas.

Hatch, S. L., K.N Gandhi, and L.E. Brown. 1990. Checklist of the Vascular Plants of Texas. College Station, TX: Texas Agricultural Experiment Station.

Jones, F. B. 1982. Flora of the Texas Coastal Bend. Sinton, TX: Welder Wildlife Foundation.

Keyes, K. L., and J. Lloyd-Reilley. 1999. Evaluation of Propagation Techniques of Selected Native South Texas Wetlands Plants Utilized By Waterfowl. Kingsville, TX: Kika de la Garza Plant Materials Center.

Kika de la Garza PMC. 1999. Salt-Marsh Bulrush: Two Germination Studies. Technical Reports, v. 2 (5), 40-46.

Kika de la Garza PMC. 2000. A Germination Study Of Dry-Stored Salt-marsh Bulrush Seed. Technical Reports, v.3 (4), 21-24

Kika de la Garza PMC. 2001a. A Germination Study of Salt-Marsh Bulrush Seed Stored Under Different Conditions. Technical Reports, v. 4(1), 2-6.

Kika de la Garza PMC. 2001b. A Germination Study Of Salt-Marsh Bulrush Seed Harvested In Different Years. Technical Reports, v.4 (3), pp.

Martin, A. C. and F. M. Uhler. 1939. Food of Game ducks in the United States and Canada, Technical Bulletin #634. Washington DC: United States Department of Agriculture.

Prevost, M. B., and C. A. Gresham. 1981. Artificial establishment of salt-marsh bulrush seedlings in South Carolina. Wildlife Society Bulletin, v. 9 (4), 310-314.

Stutzenbaker, C. D. 1999. Aquatic and Wetland Plants of the Western Gulf Coast. Port Arthur, TX: Texas Parks and Wildlife Press.

WHERE TO GET HELP

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