United States
Department of
Agriculture

Natural
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1999
ACTIVITY REPORT

Plant Materials Center
Brooksville, Florida

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Cover photograph: 'Martin Germplasm' eastern gamagrass (*Tripsacum dactyloides*)

STATE CONSERVATIONIST

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PLANT MATERIALS SPECIALIST

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NAT'L PLANT MATERIALS SPECIALIST

Richard White

Mission of the plant materials program: To assemble, test, and release new plant materials for conservation use; determine techniques for their successful use; provide for their commercial increase; and promote the use of plant materials in resource conservation and environmental programs.

PLANT MATERIALS CENTER STAFF

Clarence Maura, Jr.. . . . . Manager
Sharon Pfaff . . . . . .Agronomist
Mary Anne Gonter . . . . . .Biological Technician
Robert Santucci . . . . . .Biological Technician
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Gwen Peckham . . . . . Secretary

STATE PLANT MATERIALS TECHNICAL ADVISORY COMMITTEE

Purpose: Provides technical guidance for plant materials projects, collections, selections, and releases.

John D. Lawrence, State Resource Conservationist, Chairperson

Pete Deal, Rangeland Management Specialist	*Gainesville, FL*
Randy English, Resource Conservationist	*Marianna, FL*
Bill Harb, District Conservationist	*East Palatka, FL*
David Millard, District Conservationist	*Cocoa, FL*
Maelo Reyes, Soil Conservationist	*LaBelle, FL*
Darryl Williams, District Conservationist	*Crestview, FL*
Otto Bundy, Horticultural Systems	*Parrish, FL*
Rosemarie Garcia, Cargill Fertilizer, Inc.	*Ft. Meade, FL*
Dr. John Hovanesian, Coastal & Native Plants	*Milton, FL*
Dr. Oghenekome Onokpise, FAMU	*Tallahassee, FL*

PLANT MATERIALS RELEASED BY THE BROOKSVILLE, FL PMC

Year	Species	Cultivar	Cooperating Agency
1944	*Paspalum notatum* (Bahiagrass)	Pensacola	GA PMC
1960	*Panicum texanum* (Texas millet)	Artex	N/A
1962	*Lupinus elegans* (Mexican lupine)	Armex	N/A
1963	*Lupinus angustifolius* (Blue lupine)	Orlando	N/A
1969	*Aeschynomene americana* (American joint vetch)	F-149	N/A
1978	*Hemarthria altissima* (Limpograss)	Bigalta	Univ.FL-I.F.A.S.
		Greenalta	" " "
		Redalta	" " "
		Floralta	N/A
1978	*Arachis glabrata* (Perennial peanut)	Florigraze	N/A
1985	*Arachis glabrata* (Perennial peanut)	Arbrook	FL Agri. Exp. Sta.
1990	*Spartina patens* (Marshhay cordgrass)	Flageo	GA PMC & Ft. Valley Agri. College
1991	*Helianthus debillis* (Beach sunflower)	Flora Sun	N/A
1992	*Panicum amarum* (Bitter panicum)	Northpa	N/A
		Southpa	N/A
1994	*Spartina patens* (Marshhay cordgrass)	Sharp	GA PMC
1995	*Zea mexicana* (Mexican teosinte)	Chapingo	N/A
1996	*Panicum virgatum* (Switchgrass)	Miami	N/A
		Wabasso	N/A
		Stuart	N/A
1998	*Panicum hemitomon* (Maidencane)	Citrus	N/A
2000	*Tripsacum dactyloides* (Eastern gamagrass)	Martin	N/A
		St. Lucie	N/A

PUBLICATIONS AVAILABLE FROM THE BROOKSVILLE, FL PMC

1997 Technical Note No. 35: Collecting Plant Materials
1997 Plant Materials Program Fact Sheet
1997 Florida Native Plant Collection, Production and Direct Seeding Techniques: Interim Report
June 1995 - Oct. 1999 Semi-Annual Newsletter: Sunshine State's PMC Impact
1998 Forage Species on Sprayfields – Fact Sheet
Annual PMC Activity Reports

INTRODUCTION

The Florida Plant Materials Center (PMC) is located approximately 7 miles north of the City of Brooksville on U.S. Highway 41, 50 miles north of Tampa, and 15 miles inland from the Gulf of Mexico. The center is situated on 182 acres of property owned by the Federal Government.

There are 43 acres under cultivation, used for evaluation and production of plant materials. Most of the fields, both greenhouses and the shadehouse are watered by an automatic irrigation system, giving flexibility for the amount of water fields receive as well as allowing the PMC to comply with local water use restrictions. The remaining 139 acres are native woodlands and planted pines. The woodland is a mixture of planted and native pine with areas of hardwoods. The planted pine area is under a prescribed burn management program to stimulate tree production and develop a varying wildlife habitat. Two nature trails wind through the wooded area, and have selected trees and shrubs identified. These trails are frequently visited by many individuals, groups and organizations, both for self-interest and for educational purposes. In these areas two rare and endangered plant species, Cooley's water willow (*Justicia cooleyi*) and Sinkhole fern (*Blechnum occidental*), have been located, and are being monitored for protection. Wildlife, such as deer and wild turkey, are abundant in the wooded areas.

Soil at the Florida PMC is predominately Kendrick Loamy Fine Sand. Other types of soil at the Center consist of Arredondo Fine Sand, Blichton Loamy Fine Sand, Electra Variant Fine Sand, Fleminton Fine Sandy Loam, Floridana Variant Loamy Fine Sand, Kanapaha Fine Sand, Nobleton Fine Sand, Sparr Fine Sand, and Wauchula Fine Sand.

AREAS SERVED

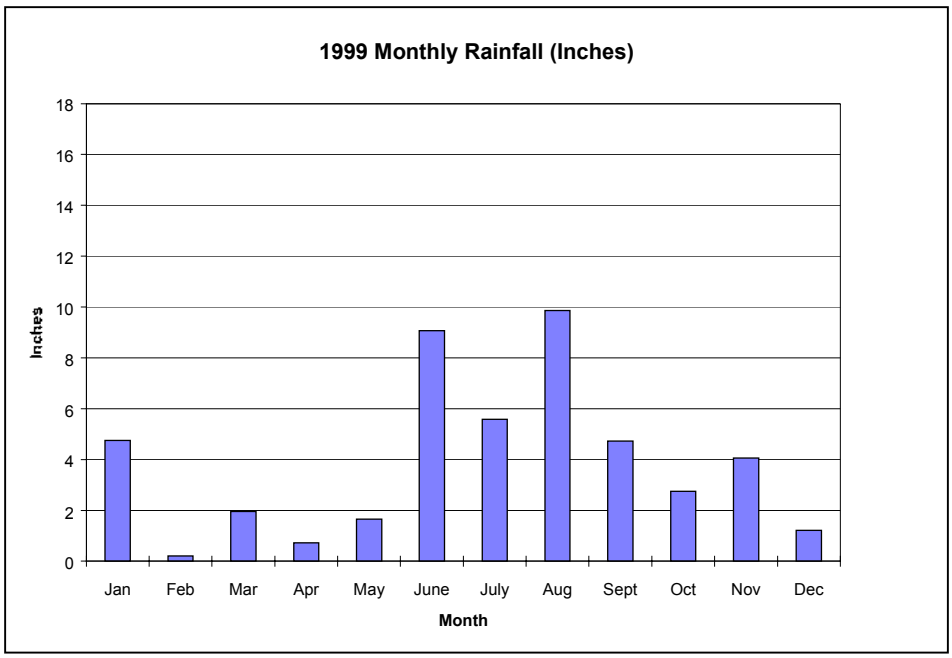
The Center presently serves the plant materials needs of the State of Florida and the coastal areas of Alabama, Georgia, South Carolina, and the Caribbean Area.

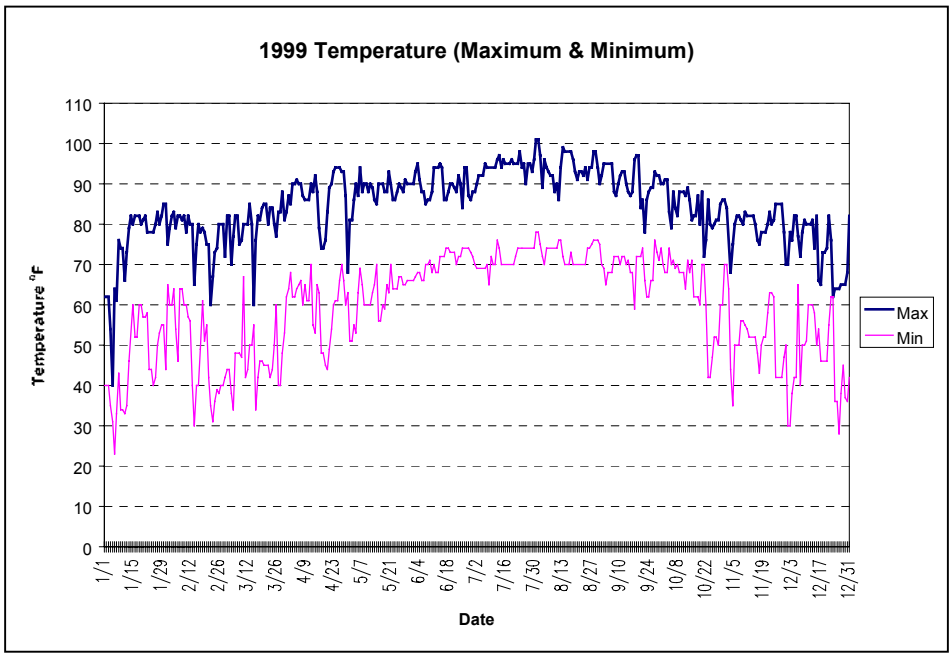
FACILITY USE - TOURS - VISITORS

In 1999, tours of the PMC were given to parties ranging from one individual to large groups. Interested individuals included personnel from the U. S. Forest Service, Florida Institute of Phosphate Research, Florida Department of Mines, Cargill Inc., and local ranchers. In January of 1999, the PMC hosted a two-day tour and training for staff from five field offices. NRCS employees learned about the PMC program through hands-on training, including methods of seed cleaning, plant propagation, and the plant evaluation process. In April of 1999, Dr. Oghenekome of FAMU once again brought several of his agricultural science students from Tallahassee to tour the Center. The PMC was also the site for training provided by the Florida Department of Agriculture, Division of Forestry, and the Southwest Florida Water Management District for their employees. In addition, in April of 1999, the STC Plant Materials Advisory Committee members toured reclaimed wetlands on Cargill Fertilizer, Inc. phosphate minedlands, near Bartow, FL. Included in the tour was a stop at the PMC native upland species direct seeding study site.

CLIMATIC CONDITIONS

Florida weather conditions in 1999 were drier than normal, especially during the spring. Once again, high spring temperatures and dry conditions caused wildfires throughout the state. Rain did not begin falling regularly until July, after which conditions returned to more normal averages.





The lowest temperature recorded at the Florida PMC in 1999 was 23°, which occurred on January 16. The last heavy frost occurred on March 16. The first frost occurred on December 1. There were 260 frost-free days in 1999. Rainfall for the year was 46.55 inches. The 20 - year rainfall average is 54.72 inches.

PLANT EVALUATION PROCESS

Assemble plant materials - Assemblies are planned to satisfy a specific objective(s) indicated in a project plan. Collections are made from a wide area within the occurrence of the species to insure diversity of ecotypes and variability within a species.

Initial evaluation - the process of recording performance of the plant under controlled conditions. It allows the observance of characteristics and performance of the various collected plants, in order to select the most promising for the proposed conservation use. These plantings are normally done at the Plant Materials Center but, off-center initial evaluation plantings can be done if it suits the purpose.

Advanced evaluations - intensive testing of selected plants that were superior in one or more attributes during the initial evaluation process. Cooperating agencies or other plant materials centers are encouraged to participate in this process. Plantings in areas where climatic conditions are significantly different than the PMC aids in determining range of adaptation for the plant materials.

Final evaluations - the plants that exhibits superior qualities for the intended use, are placed in field plantings on sites away from the PMC. This places them under actual growing conditions.

Release of new plant materials - This is the final step in the process. The plants usefulness for meeting conservation needs is documented. Insofar as possible, materials are released in cooperation with, or with concurrence of, cooperating agencies. Source identified, selected, tested, cultivar, and germplasm releases require less stringent evaluation and speed the release process.

NEW RELEASES FROM THE BROOKSVILLE, FL PMC

For several years, the Florida PMC has been working with eastern gamagrass (*Tripsacum dactyloides*), to develop cultivars for use in pasture and rangeland improvement. Two of the accessions in the original assembly were observed to have a very striking appearance. Native grasses are becoming very popular in Florida for xeriscape plantings, buffer strips and roadside beautification. In December of 1999 the Florida PMC prepared documentation for the selected class release of 'Martin Germplasm' and 'St. Lucie Germplasm' eastern gamagrass for this market (official release occurred in early 2000). These two releases originated in the Florida counties for which they are named. They were selected for their robust growth habits and attractive blue-green colored foliage. Eastern gamagrass is a native perennial, warm-season bunchgrass that is typically found along ponds, stream banks, shorelines, and channels. Although gamagrass prefers moist conditions, once plants are established they are relatively drought resistant. 'Martin Germplasm' and 'St. Lucie Germplasm' were released vegetatively, because both strains produce seed through cross-pollination, and offspring do not maintain the blue-green color of the foliage.

INITIAL EVALUATIONS

Lopsided Indiangrass (*Sorghastrum secundum*) 12I9602RNGE

Project Stage: Final year of a four year initial evaluation trial.

Background: There is a growing demand for seed sources of native species that can be used to restore native habitats. Lopsided indiangrass is one of the dominant grass species on native uplands in Florida. It is a warm-season perennial bunch grass, adapted to a wide variety of soils and hydrology regimes. It produces good quality livestock forage, is important for erosion control and also wildlife habitat. Lopsided indiangrass has good seed production, and seedling vigor compared to other Florida native species.

Objective: To evaluate, develop and release a Florida native variety of lopsided indiangrass for conservation use.

Summary: Assembly of a statewide collection of indiangrass was conducted in 1989 through 1996. PMC, Field and Area Office staff collected a total of 132 accessions. These accessions were then planted in the greenhouse in January of 1997. On November 4, 1997 seedlings were transplanted to the field in replicated plots.

Seed was originally established in the greenhouse because past attempts at direct seeding indiangrass at the PMC had not been successful. However, after greenhouse establishment, 111 accessions still had a good quantity of seed left over. This seed was directly planted into field plots on an irrigated site and a non-irrigated site. Planting date was January 23, 1997. Fields had been clean tilled for two or more years, and the seedbed was relatively weed-free. Overall emergence was outstanding. Contributing factors to this success were a clean seedbed, and the winter seeding date. Apparently, a winter seeding date allowed the indiangrass accessions to emerge and become well established before the summer weeds germinated.

All plots were evaluated for growth and seed production characteristics for three years. However, plants under irrigation tended to die after two growing seasons, after they had reached maturity. Plants on the non-irrigated site persisted longer, but plant densities diminished. Diseased plants from an irrigated plot were sent to a plant pathology lab. They reported that the roots were infested by the lesion nematode, *Pratylenchus zeae*, and that the association of this nematode with pathogenic fungi can stunt several grasses, including sorghum. In the case of lopsided indiangrass, it appears these pathogens can actually kill the plants after they reach a certain level of maturity. In native situations, lopsided indiangrass is a very short-lived perennial, and stand densities vary greatly from year to year. This is offset by prolific seed production and good seedling vigor. No accessions were found with marked disease resistance.

Along with drought and disease resistance characteristics, plants were rated on forage production, vigor, seed production, seedhead lodging and seed viability. Although several accessions had superior performance in a given category, none excelled in all categories and statistically significant variations were small. Twenty-five accessions, which showed superior performance in growth characteristics and/or seed production, were selected for further increase and evaluation (Table 1). Viability of seed collected from these 25 accessions in 1999 ranged

from 0 – 43%, with 10% being the average. In order to maximize genetic diversity, several of these accessions are to be planted in increase fields together to form a composite. Three accessions (9060186, 9060197, and 9060205) had a very similar blue-green color and very stiff, upright leaves and will be planted together to form one composite. Accession 9060120 from Santa Rosa County blooms several weeks earlier than all of the other accessions selected. It is to be increased and maintained as a single accession, since it is unlikely that it will cross-pollinate with any of the other accessions. The remaining accessions are to be lumped together to form one composite.

Table 1. Twenty-five superior lopsided indiangrass accessions selected from IE trials.

Accession No.	County	Collector
9059725	Citrus	PMC
9059727	Citrus (Ft. Cooper State Park)	PMC
9060105	Osceola	Fults/Benetis
9060110	Sarasota (Myakka State Park)	Lackman/Perry
9060118	Okeechobee	PMC
9060120	Santa Rosa	Hauer/Reyes/Pfaff
9060128	Desoto	PMC
9060133	Desoto	PMC
9060137	Desoto	PMC
9060146	Manatee	PMC
9060147	Manatee	PMC
9060168	Levy	PMC
9060173	Lake	PMC
9060182	Madison	PMC
9060184	Hamilton	PMC
9060186	Marion	PMC
9060187	Desoto	Crockett
9060197	Levy	PMC
9060199	Citrus	PMC
9060205	Gilchrist	Fults
9060207	Orange	Fults/Swims
9060208	Hernando	PMC
9060209	Citrus	PMC
9060210	Hernando	PMC
9060351	Dixie	Stephens/Porter

Chalky bluestem (*Andropogon glomeratus* var. *glaucopsis*) 12I9601RNGE

Project Stage: Final year of a four year initial evaluation trial.

Background: Chalky bluestem is a native warm season perennial bunch grass distributed throughout Florida, southern North Carolina, South Carolina and Georgia, and west to East Texas. It is adapted to flatwoods, seeps and the margins of freshwater marshes and ponds. It

produces high quality livestock forage, and is thought to be one of the most palatable native grasses on flatwoods sites. It is also an important plant for upland water quality and erosion control. Chalky bluestem is a prolific seed producer, and will readily colonize disturbed areas in wet flatwood sites.

Objective: To evaluate, develop and release a Florida native variety of chalky bluestem for conservation use.

Summary: In 1996, 91 accessions were assembled from throughout the state of Florida in the form of seed. These accessions were established in trays in the greenhouse in January of 1997. Seedlings were transplanted to replicated field plots in September of 1997.

However, most accessions had generous amounts of seed left over after greenhouse establishment, so an attempt was made to direct seed this species in field plots. In February of 1997, 88 accessions of chalky bluestem were direct seeded on a well-drained irrigated site and a poorly drained irrigated site at the PMC. Fields had been clean tilled for one or more years to provide a relatively weed-free seedbed. Previous attempts by the PMC and other researchers to direct seed this species had not been successful. However, emergence on both sites was tremendous. As with the lopsided indiangrass, it appears that a clean seedbed and a winter planting date were essential for successful establishment. The early planting date allowed the chalky bluestem seedlings to become established before warm season weeds began growing. Though it had been clean tilled, the poorly drained site experienced severe weed competition during the summer. The chalky bluestem seedlings that had emerged were able to continue growing on this site, and compete with the weeds. Almost all accessions produced prolific amounts of seed on both sites.

Direct seeded plots were evaluated for three years, and transplant plots were evaluated for two years. Evaluation criteria were the same as those used for lopsided indiangrass. Several accessions performed well in all trials and under all criteria. However, performance varied between years. Ten superior accessions from all major regions in Florida were selected (Table 2) in order to maximize genetic diversity. These ten accessions are to be planted together in an increase plot to form a composite, which is slated to undergo a short period of field testing prior to release.

Table 2. Ten superior chalky bluestem accessions selected from IE trials.

Accession No.	County	Collector
9060226	Orange	Fults
9060251	Nassua	PMC
9060277	Hardee	PMC
9060318	Brevard	Fults
9060331	Sarasota	Deal
9060340	Bay	PMC
9060347	Taylor	PMC
9060363	Citrus	PMC
9060394	Polk	Sheehan/Baxter
9060396	Polk	Sheehan/Baxter

Blue Maidencane (*Amphicarpum muhlenbergianum*) 12I9604FLST

Project Stage: Fourth and final year of an initial evaluation trial which began in 1996.

Background: Blue maidencane is a native, warm-season perennial rhizomatous grass distributed throughout Florida and coastal areas of Georgia and South Carolina. It is adapted to acid or neutral sandy soils that are wet for part of the year. It grows in sloughs and intermittently ponded areas in flatwoods range sites. Cattle preferentially graze this species, which produces high quality forage. Because it often forms solid stands, it is important for erosion control and maintaining water quality in fresh water systems.

Objective: To evaluate, develop and release a Florida native variety of blue maidencane for conservation use.

Summary: In 1996 through 1998, a total of 157 accessions were assembled from throughout the state of Florida in the form of root and shoot stock. This material was transplanted to 6" pots in the greenhouse. Transplants were placed on a well-drained irrigated field at the PMC in replicated plots in March of 1999. Plot size was 3' square with 4' alleys. Because this species spreads aggressively by rhizomes, plots could only be evaluated for one year, before accessions began growing together. Plants were evaluated according to forage production, rate of spread and canopy closure, disease resistance and vigor. Eleven accessions were identified which had superior ratings in these categories (Table 3). Accessions 9059859, 9060309 and 9060311 will be combined to form one accession, since they had very similar performance and come from the same basic location. Accessions 9059866, 9060066 and 9060067 will be combined for the same reasons. Selected accessions are to be increased in 2000 in preparation for advanced evaluation trials.

Table 3. Eleven superior blue maidencane accessions selected from IE trials.

Accession No.	County	Collector
9059859	Pasco	Deal/Pfaff
9060309	Pasco	Deal/Pfaff
9060311	Pasco	PMC
9059866	Charlotte	PMC
9060066	Sarasota (Myakka State Park)	Perry/Lackman
9060067	Sarasota (Myakka State Park)	Perry/Lackman
9059869	Palm Beach	PMC
9059956	Madison	PMC
9059971	Citrus	PMC
9060008	St. Johns	PMC
9060295	Polk	PMC

Wiregrass (*Aristida stricta*) 12I9235RNGE

Project Stage: A ten year project begun in 1996.

Background: Wiregrass is a warm-season perennial bunchgrass distributed throughout Florida and the southern portions of Mississippi through North Carolina. It is adapted to a broad range of soil and moisture regimes, from wet flatwoods to longleaf pine-turkey oak sandhills. Once established, it is very drought resistant and hardy. Wiregrass is considered to be one of the most important grasses in a pineland habitat, because of its ability to carry fire. In native situations, wiregrass contributes a large percentage of the fuel for understory burn management programs. New growth is readily grazed by livestock after a burn. Wiregrass also provides cover and nesting sites for wildlife. It does produce fair quantities of seed. However, it must undergo a summer burn in order for the seed to be viable.

Objective: To evaluate a broad assembly of wiregrass accessions for growth characteristics and seed production. If superior accessions are found, they may be released for conservation purposes.

Summary: In 1997 and 1998 a Florida state-wide assembly of wiregrass was conducted. To date, over 70 accessions have been collected in the form of plants or seed. Plants were placed in 6" pots in the PMC shadehouse, and are scheduled to be transplanted to replicated field plots in 2000 or 2001.

Hairawn Muhly (*Muhlenbergia capillaris*) 12I9236RNGE

Project Stage: A seven year project begun in 1996.

Background: Muhly is a hardy warm-season perennial bunchgrass distributed throughout Florida and several states in the southeastern US. It is adapted to a broad range of sites from seeps and marshes to longleaf pine-turkey oak sandhills. It is more common on wetter sites. In its vegetative state, muhly looks very similar to wiregrass, and fills the same roll. Early growth is grazed by livestock and wildlife. In native communities, it provides fuel for understory burn management programs, and cover for wildlife. Because of its attractive purple inflorescence, it is becoming very popular for use in buffers, highway beautification and as a xeriscape ornamental. It is known to produce viable seed, but more information is needed on pollination methods and seed production characteristics.

Objective: To evaluate, develop and release a Florida native variety of hairawn muhly for conservation use.

Summary: In 1997 through 1999, muhly was collected from throughout the state of Florida. A total of 94 accessions were collected vegetatively. Plants were placed in 6" pots in the PMC shadehouse, in preparation for being planted in replicated field plots at the PMC in early 2000.

ADVANCED EVALUATIONS

Maidencane (*Panicum hemitomon*) 12A9502FLST2

Project Stage: Increase and field adaptation trials.

Background: Maidencane is a perennial, warm season rhizomatous grass. It is adapted to fresh-water marshes, swamps, moist areas, and road ditches throughout Florida and the coastal areas of the southeastern states. It produces high quality forage, which is preferentially grazed by livestock throughout the growing season. Maidencane is also an important component in controlling erosion, and maintaining water quality in freshwater systems. This species has poor seed production, but can be established vegetatively with rootstock. Presently, the only commercially available cultivar of maidencane is 'Halifax', which is not as adapted to Central and South Florida as native Florida varieties. Because of demand, Citrus maidencane was released onto the commercial market as a selected class release. This accession has undergone initial evaluation at the Florida PMC. However, further advanced evaluation is warranted, to determine adaptability ranges.

Objective: To increase rootstock and test Citrus maidencane for use in improvement of water quality, pasture and rangeland improvement and erosion control throughout Florida.

Summary: An increase field of Citrus maidencane was planted at the PMC in July of 1999 to provide material for commercial growers, and future advanced evaluation trials. Prior to this, existing rootstock was used to plant four adaptation trials throughout Florida.

The first trial was planted in replicated plots at the Belleview effluent sprayfield during August of 1997. The purpose of the planting was to determine the adaptability of Citrus maidencane to a sprayfield environment, and compare dry matter production and uptake of nutrients to that of other forages. Plots were established by planting rhizomes in rows 6" deep with 1' between rows. Citrus maidencane established well and had enough forage to be clipped twice in 1998. Plots were clipped four times in 1999, on the same schedule as the other forages. Citrus maidencane had similar dry matter production and nutrient uptake as eastern gamagrass in this study. Results are reported in the Belleview Sprayfield discussion in the following section.

In June of 1998, Citrus maidencane was planted on 10 sites on Eglin Air Force Base. Four of the sites also had Halifax maidencane planted as a standard. The purpose of the plantings was to test adaptation and use in streambank stabilization in the Florida panhandle. Five of the sites were evaluated on 12/4/99. Citrus maidencane survived and established on all the evaluated sites, however, percent ground cover varied with the amount of upper story tree canopy over the site. Highest maidencane ground cover was 50% in an area with no direct overhead canopy. Lowest ground cover was 1% under a very heavy tree canopy. This species is obviously not shade tolerant. Halifax maidencane did not survive on the site with heavy canopy, and had an estimated 30% ground cover in an area with no canopy directly overhead.

In April of 1999, Citrus and Halifax maidencane were planted around a pond in Indian River Co. The purpose of the planting was for erosion control, and to test adaptability in Central Florida. Vero Beach FO staff conducted an evaluation one year after planting. Citrus

maidencane appeared taller and had spread more vigorously than Halifax. In one growing season, it had produced an 80 – 90% ground cover, while Halifax had produced a 40 – 50% cover. Both cultivars had gone dormant during the winter, however Citrus sent up new growth at the beginning of April, two weeks earlier than Halifax.

In August of 1999, Citrus and Halifax maidencane were established on replicated plots on reclaimed mined lands in Polk Co. The planting site was the edge of a lake reclaimed by Cargill Fertilizer Inc. Soils were sandtails and overburden topped with 6 to 12" of muck. Rhizomes were planted in rows 6" deep that began at the waterline and extended up the bank 25'. Plots were evaluated at five months. Results are shown in Table 4. Further evaluations are to be conducted in 2000 and 2001.

Table 4. Average five-month plant densities of Citrus and Halifax maidencane at Cargill lake shoreline; measurements taken at three levels on the slope.

	Lower Slope	Middle slope	Upper Slope
Accession	**Average % Ground Cover**		
Halifax Maidencane	6	6	3
Citrus Maidencane	16	13	8

Eastern Gamagrass (*Tripsacum dactyloides*) 12A9605RNSS

Project Stage: Increase and field adaptation trials.

Background: Eastern gamagrass is a warm-season perennial bunchgrass with a broad area of distribution throughout the US, including all of the southern states. It has received a great deal of attention in recent years because of its tremendous forage production. It typically grows in moist fertile sites, and is often found lining the edges of canals and freshwater bodies in Florida. Florida ecotypes are markedly different than strains from other states, in terms of growth and winter dormancy characteristics. There is a demand in Florida for commercial seed sources of local ecotypes. In 1996 through 1998 an assembly of eastern gamagrasses collected from Florida were evaluated for forage and seed production characteristics. Four accessions were selected with superior performance in these two categories; these were 9059213 (Clay Co.), 9059264 (Dixie Co.), 9059266 (Polk Co.), and 9059287 (Citrus Co.). All four accessions are apomictic and will not out-cross.

Objective: To increase seed stores of selected accessions of eastern gamagrass. Seed will be used for advanced evaluation trials in developing cultivars for use in buffer strips, pasture and rangeland improvement and for wildlife food and cover.

Summary: Plants of the four selected accessions were established in the greenhouse using seed in early 1999. Transplants were placed in field increase plots at the PMC in July of 1999. Meanwhile, seed continued to be hand collected from initial evaluation plots during the summer. Enough seed was collected to plant one partial and one complete adaptation trial in late 1999.

In August of 1999, two accessions, 9059213 and 9059264 were planted in replicated plots on reclaimed mined lands in Polk Co. The site was a lake shoreline reclaimed by Cargill

Fertilizer Inc. Soils are sandtails and overburden topped with 6" to 12" of muck. Seed was hand planted in rows 2" to 6" deep, at a rate of 4 seed per linear foot. Rows began at the waterline and extended up 25'. Seed had not received any type of dormancy breaking treatment prior to planting. Plots were evaluated for emergence at five months. Average emergence was 3 and 12 plants/m^2, for 9059213 and 9059264 respectively. Accession 9059213 apparently has greater seed dormancy than 9059264. Evaluations are to be conducted for two more years.

In September of 1999, all four eastern gamagrass accessions were planted in replicated plots at a reclaimed rock mine site in Citrus Co. Soils were heavy clays, and it was difficult to dig trenches at consistent depths. Planting depth ranged from ¼ to 2" deep. Each plot consisted of 60 seed planted in 15' long rows, with four feet between rows. Seed had not been pretreated for dormancy prior to planting, and none of the accessions emerged during the remaining months of 1999.

Perennial Peanut (*Arachis glabrata*) 12A9503CCOR

Project Stage: Five year project begun in 1999.

Background: Perennial peanut is a warm-season rhizomatous legume. Several strains have been developed for high-protein forage in the Southeast. However, other strains exist which could be useful as a low maintenance, soil stabilizing ground cover in groves, recreation areas, lawns and along roadsides. Perennial peanut has the potential to reduce non-point source pollution by reducing the use of nitrogen fertilizers that leach into the ground water. Perennial peanut forms a dense sod and is fairly drought and insect resistant. Because it is a legume, it does not require fertilization with nitrogen. Commercial forage varieties of perennial peanut were developed for maximum forage and protein production. However, in a ground cover situation, lower growing varieties would be more desirable, as long as maximum soil coverage and ability to compete with weedy species was still retained. This would minimize the amount of watering and mowing necessary to maintain the site.

Objective: To evaluate the performance of three accessions of perennial peanut for use as ground cover on coarse well-drained soils, such as those orange groves are placed on.

Summary: On 7/2/99 three strains of perennial peanut maintained at the Florida PMC (referred to as 'Waxy Leaf', 'Pointed Leaf' and 'Arblick') were established on a lot in the Emerald Hills subdivision in Citrus Co. The commercially available 'Ecoturf' was also planted as a standard. Soils are Lake fine sands, which are deep and excessively drained. The site had been in bahiagrass sod prior to planting. Rhizomes were hand-planted in shallow trenches placed 6" apart, in 6' x 10' plots, with four replicates. Ecoturf had been obtained from the Univ. of Florida, in Gainesville and had been dug with a sprig digger. The three PMC strains had been hand dug, so rhizomes were longer than Ecoturf rhizomes. Planting rate was estimated to be 120 – 140 bu./ac. Irrigation was not available at the time of planting; however, summer rains were adequate to keep plots moist. An underground sprinkler system was used later in the season to apply water daily at subsistence levels. Weeds were controlled by hand weeding. Soil samples were taken at the time of planting. Average pH was 5; P was adequate for plant needs, but N, K

and most of the micronutrients were low. Acid, nutrient-poor soils are very common in Florida, especially along roadsides. Six-month evaluations were conducted in mid-November. Results are shown below in Table 5.

Table 5. Average six-month performance of four accessions of perennial peanut on a Citrus Co. site, evaluated 11/18/99.

Accession	% Cover	Height (cm)	Spread Rating (1–9, 1=most)	Number of Blooms/m^2
Ecoturf	31b	3.3b	5.3b	5a
Waxy Leaf	57a	10.5a	3.8a	1b
Pointed Leaf	19bc	2.0b	6.0c	6a
Arblick	5c	3.0b	8.0d	2b

Accession means followed by different letters are significantly different by Tukey's HSD at P≤0.05.

Waxy Leaf had significantly higher % cover, height, and spread than the other three accessions during the first 6 months of establishment. Ecoturf and Pointed Leaf performed very similarly, with Arblick having very poor establishment on these droughty, nutrient-poor soils. Concerning showiness, Pointed Leaf and Ecoturf had the highest density of blooms, with Waxy Leaf having almost none. Evaluations are to continue for one to two more years.

ACTIVE PROJECTS IN 1999

Belleview - Perry Sprayfield Plant Materials Adaptation Study

Project Stage: Final year of a five year study begun in 1995.

Background: Disposal of treated municipal wastewater on open fields (referred to as sprayfields) is a rapidly expanding practice in Florida. In these systems, effluent water has been purified to reduce nitrates to an acceptable level. Most sprayfields in Florida are located on sandy soils, which have the ability to filter large volumes of water without ponding. However, because of the coarse nature of these soils, leaching of nitrates and other water-soluble nutrients is a serious concern. In 1990, the Brooksville PMC joined with the City of Ocala and the Marion Soil and Water Conservation District to study forage species that were adaptable to a sprayfield environment. Under a previous study, a large range of plant materials were planted and sampled for nutrient uptake. From this initial work, seven species were selected as being worthy of more extensive study.

Objective: To improve water quality, by identifying forage plant materials that are adaptable to the sprayfield environment. They must be quick to establish, able to tolerate excessive irrigation and low fertility, and competitive with invading weed species. These plant materials must provide maximum uptake of effluent nutrients and be commercially marketable as well.

Summary: Replicated plots of the selected plant materials were established on the site in 1996. Plant materials used are as follows:

Eastern gamagrass (*Tripsacum dactyloides*) (accession no. 9055975)
'Alamo' switchgrass (*Panicum virgatum*)
'Defuniak Source' switchgrass (*Panicum virgatum*) (accession no. 9059616)
'Floralta' limpograss (*Hermarthria altissima*)
'Mott' dwarf elephant grass (*Pennisetum purpureum*)
'Sharp' marshhay cordgrass (*Spartina patens*)
'Florigraze' perennial peanut (*Arachis glabrata*)

Two forage species commonly grown in Florida, 'Coastal' bermudagrass (*Cynodon dactylon*) and 'Pensacola' bahiagrass (*Paspalum notatum*) were planted as standards. Tissue samples were taken approximately three to four times throughout the 1997 through 1999 growing season from all plots, to determine nutrient uptake. Marshhay cordgrass did not establish well, and maidencane (*Panicum hemitomon*) was planted on half the marshhay plots in 1997.

Significant Findings: A great deal of useful information was gathered from this study. One species in particular displayed a superior ability to take up nitrogen and phosphorus from the effluent water. An in-depth discussion of research results is contained in the Belleview Sprayfield Final Report. Those wishing a copy may contact the Florida PMC. Following is a brief summary of the findings.

Total Dry Matter Production

Total dry matter production for 1997 through 1999 is shown in Table 6. Mott dwarf elephantgrass had highest dry matter production the first year after establishment. By the second and especially the third year, bermudagrass surpassed Mott in total production. Limpograss performed comparably to bermudagrass the first two years, but production diminished in 1999. The Floragraze perennial peanut was slow to establish. Low soil pH in the first year no doubt contributed to lower initial production. As pH levels increased, peanut production increased substantially. More favorable soil conditions and increased moisture also allowed bahiagrass production to increase substantially by 1999. Two of the eastern gamagrass plots suffered high plant losses for unknown reasons. For comparison, dry matter production based on averages of the two best replicates was 10,000 lbs./ac. in 1998 and 11,800 lbs./ac. in 1999, a difference of almost 1,500 lbs./ac. Other strains of gamagrass may have had higher forage production at the Belleview site, and the species warrants further testing.

Table 6. Average lbs./ac. total dry matter production for nine forage species grown at the Belleview sprayfield in 1997-1999.

	Dry Matter (lbs./ac.)			
Species	**1997**	**1998**	**1999**	**Average**
Mott	10,489*a**	13,866*ab*	18,156*b*	14,170*a*
Bermuda	8,785*b*	14,247*a*	22,860*a*	15,297*a*
Limpo	7,812*b*	13,311*ab*	12,284*cd*	11,136*b*
Peanut	5,072*c*	12,626*ab*	13,734*cd*	10,477*bc*
Bahia	5,356*c*	10,597*bc*	15,369*bc*	10,441*bc*
Gama	5,356*c*	8,358*c*	10,428*d*	8,047*de*
Alamo	2,492*d*	12,249*ab*	11,295*cd*	8,679*cd*
Defuniak	2,144*de*	7,371*c*	5,923*e*	5,146*f*
Sharp	786*e*	7,305*c*	9,955*de*	6,015*ef*
Mean	5,365	11,103	13,087	9,934

*Total DM amounts followed by the same letter are not significantly different according to Tukey's HSD at P<0.05.

Switchgrass tended to have relatively high production early in the season. However, by early June, Alamo plants had extended their growth points beyond the height at which they could be safely clipped. The Florida ecotype from Defuniak Springs had lower production than Alamo, and a smaller growth habit. It could usually be clipped until July. In 1998 and 1999, both switchgrasses were sampled in October, at the last clipping date. Although the material was dormant and of very low quality, this allowed total yearly production to be calculated. Unless it can be used in a rotation to provide early spring forage, switchgrass does not appear to be adaptable to a sprayfield environment.

Macro and Micro Nutrient Uptake

Nitrogen taken up by the nine species in 1997 through 1999 is shown in Table 7. Mott dwarf elephantgrass far surpassed bermudagrass in total N uptake, despite higher dry matter production by bermudagrass. An excessive amount of effluent water was applied in 1999. Mott was able to capture almost twice as much N (730 lbs./ac.) out of this water compared to bermudagrass, which took up 406 lbs./ac. Mott consistently displayed substantially higher N use compared to all other species during the three years of the study. Limpograss, perennial peanut and bahiagrass had similar uptake, with gamagrass N uptake being only slightly less.

Table 7. Pounds per acre of total N, harvested in nine species grown at the Belleview sprayfield 1997 - 1999.

	Total N (lbs./ac.)			
Species	**1997**	**1998**	**1999**	**Average**
Mott	270*a**	546*a*	730*a*	515*a*
Bermuda	219*b*	364*b*	406*b*	329*b*
Limpo	187*b*	343*bc*	236*cd*	256*c*
Peanut	125*c*	326*bcd*	297*bc*	249*c*
Bahia	134*c*	248*cde*	254*cd*	212*cd*
Gama	135*c*	220*de*	192*cde*	182*de*
Alamo	68*d*	223*de*	122*e*	138*ef*
Defuniak	44*de*	161*e*	102*e*	102*f*
Sharp	20*e*	158*e*	158*de*	112*f*
Mean	134	287	273	233

*Amounts followed by the same letter are not significantly different according to Tukey's HSD at P<0.05.

Mott had substantially higher P uptake than any of other species (Table 8). Bermudagrass had significantly lower P uptake than Mott despite having higher dry matter production in 1998 and 1999. Uptake of P by limpograss, peanut, and bahiagrass was similar, with gamagrass uptake being only slightly less.

Table 8. Pounds per acre of P uptake by nine species grown at the Belleview sprayfield in 1997 through 1999.

	P (lbs./ac.)			
Species	**1997**	**1998**	**1999**	**Average**
Mott	52	51	80	61*a**
Bermuda	28	36	58	41*b*
Limpo	27	36	41	35*bc*
Peanut	19	38	46	34*bc*
Bahia	18	26	44	29*cd*
Gama	17	24	35	25*de*
Alamo	9	23	22	18*ef*
Defuniak	7	21	24	17*f*

	P (lbs./ac.)			
Species	**1997**	**1998**	**1999**	**Average**
Sharp	2	20	33	18*ef*
Mean	20	30	42	31

*Amounts followed by the same letter are not significantly different according to Tukey's HSD at P<0.05.

Of the nine species, Mott also had substantially greater potassium use than any other species (Table 9). Despite this high use by Mott, soil tests indicate that the effluent water was supplying adequate K to meet plant needs. Uptake of K in the other eight species followed similar trends as for P uptake.

Table 9. Pounds per acre of K uptake by nine species grown at the Belleview sprayfield in 1997 through 1999.

	K (lbs./ac.)			
Species	**1997**	**1998**	**1999**	**Average**
Mott	495	485	734	571
Bermuda	168	212	399	260
Limpo	176	232	237	215
Peanut	120	238	299	219
Bahia	106	145	241	164
Gama	95	125	194	138
Alamo	61	129	106	99
Defuniak	31	92	97	73
Sharp	12	109	159	93

Three-year average uptake of other micronutrients by the nine species is shown in Table 10. Perennial peanut had highest Ca, Mg, Fe and B use of all the species. Effluent water appeared to have supplied adequate amounts of these nutrients; however, B may become deficient in peanut plots over time. Sharp marshhay cordgrass had greatest Na uptake (45.1 lbs./ac.). This is to be expected since marshhay cordgrass grows in coastal areas where it is adapted to being inundated by saltwater. It is somewhat surprising that gamagrass had the second highest uptake of Na (31.6 lbs./ac.). This would indicate that gamagrass has fair tolerance of saline soils.

Maidencane plots were sampled with the other species during the 1999 growing season. Total dry matter production was 10,870 lbs./ac., which was similar to gamagrass. However, total N uptake was 237 lbs./ac., which was closer to the performance for bahiagrass. Uptake of P and K was 34 and 233 lbs./ac. respectively. Uptake of the micronutrients was very similar to that of gamagrass.

Table 10. Three year average pounds per acre of uptake of micronutrients by nine species grown at the Belleview sprayfield (total S averages from 1998 and 1999 only).

	(lbs./ac.)

Species	Ca	Mg	Cu	Fe	B	Zn	Na	Al	TOTS
Mott	69	28	0.09	1.82	0.09	0.36	11.7	2.09	31
Bermuda	63	20	0.04	2.31	0.07	0.32	10.4	6.29	28
Limpo	32	26	0.05	0.90	0.07	0.24	18.4	1.20	20
Peanut	165	58	0.04	2.62	0.46	0.28	8.3	7.75	21
Bahia	49	25	0.03	1.56	0.08	0.26	8.9	3.64	20
Gama	25	12	0.04	0.80	0.09	0.18	31.6	1.02	15
Alamo	28	18	0.02	0.80	0.04	0.13	9.2	0.76	15
Defuniak	14	9	0.02	0.58	0.04	0.10	9.8	0.65	9
Sharp	28	13	0.02	0.58	0.03	0.11	45.1	0.75	13

In conclusion, of the nine species studied at the Belleview sprayfield, Mott dwarf elephantgrass displayed the greatest macronutrient uptake. Bermudagrass had the highest average forage production of the nine species, however, Mott far surpassed bermudagrass in N, P and K uptake. Limpograss, perennial peanut and bahiagrass performed similarly, and ranked third in production and uptake. The Florida ecotype of eastern gamagrass used in this study experienced some disease problems, which decreased production. Other more adapted strains may have had better performance. Switchgrass produced forage earlier than the other eight species, however, the forage it produced after April was largely unusable. Switchgrass is not well adapted to the sprayfield environment unless it can be used in a niche type system for winter grazing. Marshhay cordgrass ranked on the bottom end of forage production and nutrient uptake, and is not well adapted to the sprayfield environment either.

All of the species used in this study except Mott required regular applications of herbicides to control weeds. Once established, Mott required no weed control. Its dense canopy successfully shaded out most weed competition. Concerning continuous use of fields for effluent application, winter rye could be interseeded into several of the species used in this study to provide year round water use. However, it would be difficult to interseed into Mott because of the dense canopy.

Black-eyed Susan Wildflower Increase

Project Stage: Final year of a three year project begun in 1997.

Background: A cooperative project between the Florida DOT, the University of Florida/IFAS, and the Brooksville PMC. Federal and state transportation agencies are increasingly planting native wildflowers along roadsides. There is a move in Florida to limit seed sources to only Florida native varieties. In fact, a deadline of 1998 had been set by the Florida DOT, in which only Florida-grown seed of native species must be used for seeding Florida roadsides. However, there are currently no commercial sources which can supply the quantities of seed needed by the Florida DOT. Seed sources and cultural methods must be developed.

Black-eyed susan (*Rudbekia hirta*) was chosen as a good candidate for use by the Florida DOT. It is native to Florida and widely distributed throughout the state. It has been used extensively by other states for roadside beautification because of its showy flowers, long blooming period, and reseeding abilities. Cultural practices for producing this species have been developed at the NRCS Big Flats PMC in Corning, NY. These methods can be used in Florida and modified to fit the subtropical climate.

Objective: To develop a protocol for commercial seed production of Florida ecotypes of black-eyed susan. Secondly, to increase sources of a Florida ecotype of black-eyed susan for distribution to commercial growers.

Summary: In 1997, IFAS personnel collected and cleaned 17 accessions of black-eyed susan from the Panhandle of Florida. The Florida PMC conducted germination tests on this seed. Germination ranged between 35 and 76%, with the average being 60%. The seed was planted on tilled, relatively weed-free fields at the PMC on December 12, 1997. Soils are composed of Kendrick fine sands, which are very well-drained. Irrigation was applied at subsistence rates throughout the year. Fields were packed before and after planting. Seeding method was broadcasting with a cyclone seeder. The seeding rate was 35 pure live seed/ft^2 (approx. 1 pound of pls/ac). Seed weight of Florida ecotypes averaged approximately 1,500,000 seeds/pound. Accessions were planted in individual but not replicated plots (although most accessions had two entries each). Plots were contiguous, so that accessions cross-pollinated.

Significant Findings: Despite the fact that most accessions came from north Florida, substantial differences between accessions were noted, especially in relation to flowering date and seed yield. The earliest bloom date among the accessions was May 27th. Seed ripening was very uneven.

Seed yields ranged between 0.6 and 23 lbs./ac. in 1998. Harvest method affected seed yield. Three harvest methods were employed. Hand clipping proved to be the best method of obtaining maximum percentage of ripe weed-free seed, but is extremely labor intensive. A Prairie Habitat hand-held harvester (modified weedeater) was very inefficient. It tended to shatter seedheads, and much seed was lost on the ground. Less shatter may have occurred if seedheads were collected while still damp and less prone to shatter. A small flail-type forage harvester was fairly efficient if seedheads were collected early in the day, when the dew was still heavy. It was necessary to dry seed in a forced-air system when this method was employed. A second problem with this method was that it collected weed material also. Fields were relatively weed-free. However, a few stinkweed (*Chenopodium ambrosiodes*) plants populated the field. This species is a prolific seed producer, and the seeds are very similar in size to black-eyed susan. Therefore, they were very difficult to screen out. To limit weed contamination of harvested seed it was more practical to remove such weeds from the field before employing this harvest method. A combine could not be used because seed ripening between plots was too uneven, and individual plots were two small for efficient collection.

After the 1998 seed harvest, four accessions with the greatest seed production were allowed to grow for one more season. The remaining accessions were destroyed. Plots were harvested in 1999 with the self-propelled flail-type harvester. Despite being sprayed with Plateau herbicide early in the season, weed competition became quite severe in 1999. Most weed seeds

could be screened out of harvested seed. However, weed competition contributed to reduced yields in 1999.

Eglin Air Force Base Critical Site Revegetation

Project Stage: A five year project begun in 1997.

Background: A cooperative effort between Eglin Air Force Base, NRCS, Yellow River S&WCD and Florida Three Rivers RC&D. Natural resources personnel at Eglin AFB, in the Panhandle of Florida, wish to reclaim borrow pit areas on the Base. Unreclaimed areas are contributing high sediment loads to rivers and streams. Sedimentation especially threatens the Okaloosa darter, a fish on the endangered species list. Eglin personnel prefer to use species native to Eglin and are especially interested in restoring the longleaf pine/wiregrass habitat. However, the sites to be reclaimed are typically characterized by steep slopes, infertile soils, and high precipitation, causing severe water erosion. Seed and/or plant sources of species native to Eglin are not available commercially. In addition, native species often have poor seed production and seedling vigor. This project contains three separate studies. Study I tests the adaptability of commercially available native species established as transplants. Study II tests adaptability of three Florida native species established as transplants. Study III tests emergence of Florida native wiregrass and lopsided indiangrass by direct seeding.

Native Grass Transplants – Study I

Objective: To test five species of grasses native to the southeastern US, which are available on the commercial market. Transplants of these species need to be adaptable and able to rapidly establish on critical area sites. Effect of treating the soil with lime, fertilizer and mulch was also studied.

Summary: Transplants of 'Alamo' switchgrass (*Panicum virgatum*), sand cordgrass (*Spartina bakeri*), 'Flageo' marshhay cordgrass (*S. patens*), 'Iuka' and 'Pete' eastern gamagrass (*Tripsacum dactyloides*) were obtained from a commercial grower for this study. Seed of a north Florida ecotype of switchgrass, 'Defuniak Source', (accession no. 9059616) was also provided to the grower by the PMC for growing transplants for this study. The PMC provided tubelings of 'Croom Source' (accession no. 9059450) lopsided indiangrass (*Sorghastrum secundum*), which is not available commercially. Plants were established in replicated plots on treated and untreated soils on 4/28/98. A final evaluation was conducted in December of 1999 for survival and growth characteristics. Results are shown in Table 11.

Significant Findings: All species except lopsided indiangrass had high survival rates on both treated and untreated plots. Those species with greater than 100% survival were increasing either by seed or by rhizomes. Survival of Defuniak switchgrass is 104% in the untreated section because 10 seedlings were found in one of the plots. Most other untreated Defuniak plots had 100% survival, which was higher than survival on treated plots. This is surprising since

Defuniak was originally collected from standing water. It has a shorter, more compact growth habit than Alamo, but vigor was similar. Both types of switchgrass provided a relatively tall dense canopy. The forage and seed produced by this species is beneficial for wildlife food and cover.

Flageo survival was difficult to determine because many plants had begun to spread by rhizomes. Flageo did best on treated soils. Despite its rhizomatous growth habit, it did not provide a dense ground cover. Bakeri was the tallest species in the study. Because its leaves are very thin and wire-like, Bakeri has a very open canopy, and does not provide a great deal of ground cover either.

Lopsided indiangrass is adapted to native upland nutrient-poor soils, which accounts for the higher survival on untreated soils in this study. Those plants that did survive had good vigor, and some produced seedheads. Other strains of indiangrass more adapted to the soils of Eglin AFB may have had better survival. Eastern gamagrass transplants died out of all plots. The planting sites were most likely too dry for this species.

Table 11. Two year average percent survival and growth characteristics of 5 native grasses transplanted on treated and untreated soils on a critical area site at Eglin A.F.B. in 1998.

Treatment	Species	Avg. % Survival	Avg. Ht. (cm)	Avg. Wd. (cm)	Vigor (1 to 9)*
Untreated	Alamo	99	82	23	5
	Defuniak	104	73	27	5
	Bakeri	95	94	28	6
	Flageo	92	33	15	6
	Indiangrass	76	40	26	6
Treated	Alamo	98	97	28	5
	Defuniak	90	81	39	5
	Bakeri	95	117	37	5
	Flageo	102	37	26	5
	Indiangrass	41	50	27	6

*1=best, 9=dead

In conclusion, of the five species considered in this study, switchgrass had the greatest potential for use in stabilizing critical areas at Eglin AFB. This held true on soils treated with soil amendments and those that weren't. Both ecotypes in this study had the highest overall survival and provided the most biomass, compared to the two species of cordgrass studied. The drawback of the switchgrass types used in this study is that they have a bunch-type growth habit, and do not tend to spread rapidly. A rhizomatous growth habit would be more beneficial for stabilization of the steep slopes in these borrow pit areas. There are rhizomatous ecotypes of switchgrass growing naturally on Eglin AFB. Although seed production of these native populations is typically very poor, it may be beneficial to develop a strain for critical area stabilization purposes.

Another native species not included in this study has growth characteristics that make it very useful for stabilizing critical area sites. Bitter panicum (*Panicum amarum*) is native to coastal dunes in the southeastern US, and is not normally found inland. However, the cultivar

'Northpa' was planted on one of the sites adjacent to research plots at Eglin AFB. This species has a low dense growth habit and aggressive rhizomes. Being adapted to sterile dune soils, it proved to be highly adapted to the nutrient-poor borrow pit areas and was very successful in colonizing them.

Florida Native Grass Transplants - Study II

Objective: To test the ability of three Florida native upland grasses to colonize critical area sites when established as transplants.

Summary: In December of 1997, seed from wiregrass (*Aristida stricta*) and a rhizomatous form of little bluestem (*Schizachyrium scoparium*) was collected from a site in Eglin AFB that had been burned in April of 1997. Lopsided indiangrass seed was collected from a site in Walton Co. in October of 1996. Transplants of these three species were established by planting seed in 6" deep cone trays in the greenhouse at the PMC. Approximately 2300 wiregrass, 1000 indiangrass and 400 little bluestem seedlings were planted in replicated plots on two critical area sites on 10/28/98 at Eglin. Plants were placed on 1.5' centers. None of the soils had been limed, mulched or fertilized. A one-year evaluation was conducted in December of 1999. Results are shown in Table 12.

Table 12. One-year survival and performance of three Florida native grasses planted as transplants on two Eglin critical area sites.

Site and Species	% Survival	Plant Ht. (cm)	Canopy Wd. (cm)	Vigor (1 to 9)*
Site 1				
Wiregrass	83	21	14	5
Bluestem	62	14	13	4
Indiangrass	33	12	13	7
Site 2				
Wiregrass	92	18	10	5
Bluestem	74	12	10	4
Indiangrass	37	16	13	7

*1=best, 9=dead

Wiregrass had the greatest survival on both sites and plants had fairly good vigor. The bluestem had fair survival and many plants were vigorous enough to produce seedheads. Only one third of the Walton Co. ecotype of indiangrass plants survived, and vigor was poor. Not unexpectedly, all of these native grasses have been slow to establish. Fortunately, weed competition is almost non existent. The effect of fertilizer on wiregrass and bluestem establishment should also be studied. Evaluations are to be conducted for another two years.

Florida Native Grass Direct Seeding Trial – Study III

Objective: To test the ability of two Florida native upland grasses to colonize critical area sites when established by direct seeding during different seasons of the year.

Summary: Wiregrass collected from Eglin in 1997 and indiangrass collected from Ft. Cooper in 1997 (accession no. 9059727) were direct seeded on 5' x 5' plots at four sites. Trials were located on both treated and untreated soils. Seeding rate for wiregrass and indiangrass was 80 and 20 pure live seed/ft^2 respectively. Seedings were done by hand broadcasting seed on four dates, 4/28/98, 6/24/98, 10/28/98 and 1/7/99. Plots were raked before and after seeding. Evaluations were conducted in December of 1999. Results are shown in Tables 13 and 14.

Significant Findings: Lopsided indiangrass emerged from all seeding dates, but greatest emergence occurred from the fall and winter seedings on both soil types. Indiangrass seedling densities had decreased on the spring and summer planted plots from original counts. Droughty conditions during 1999 were the most likely cause. Seedlings on plots treated with lime, fertilizer and mulch appeared taller and more vigorous than untreated plots.

Wiregrass only emerged from the fall and winter plots. The reason for this is uncertain, however, similar results have been found in studies in central Florida. Since weed competition on the Eglin plots was minimal, higher moisture in the fall and early winter may have encouraged seed germination. Plots will be monitored for one to two more years to determine how well both species become established on these critical area sites.

Table 13. Average plant density and growth characteristics of lopsided indiangrass and wiregrass direct seeded on untreated critical area sites on Eglin AFB. Evaluations conducted in December of 1999.

Species	Planting Season	Density Plants/ft^2	Plant Ht. (cm)	Canopy Wd. (cm)	Vigor (1 to 9)*
Indiangrass	Spring	1	14	9	8
	Summer	1	30	12	6
	Fall	5	7	2	7
	Winter	9	6	1	8
Wiregrass	Spring	0			
	Summer	0			
	Fall	2	4	1	7
	Winter	11	6	1	6

*1=best, 9=dead

Table 14. Average plant density and growth characteristics of lopsided indiangrass and wiregrass direct seeded on treated critical area sites on Eglin AFB. Evaluations conducted in December of 1999.

Species	Planting Season	Density Plants/ft^2	Plant Ht. (cm)	Canopy Wd. (cm)	Vigor (1 to 9)*

Indiangrass	Spring	3	23	11	5
	Summer	7	21	9	7
	Fall	10	11	2	7
	Winter	6	8	1	7
Wiregrass	Spring	0			
	Summer	0			
	Fall	1	8	2	8
	Winter	5	9	1	7

*1=best, 9=dead

Developing Native Seed Sources For Mine Reclamation

Project Stage: A five year agreement that began in 1997.

Background: The phosphate industry reclaims thousands of acres of uplands in Florida each year, a portion of which could be revegetated with native upland species. However, reclamation efforts are limited because good quality native seed is difficult to obtain. The Florida PMC and others have developed a tremendous amount of valuable information in the past few years, in the areas of collecting and successfully establishing native upland species on reclaimed mined lands. Seed sources of many native species are being developed and prepared for release for commercial use. In January of 1997, the Florida PMC entered into a second five-year agreement with the Florida Institute of Phosphate Research (FIPR) to continue work begun previously under the former five-year agreement.

Objective: To develop seed sources of native upland species which are beneficial for improving range, pasture and forest land, controlling erosion, and providing wildlife habitat. Many native species cannot be harvested or planted with conventional equipment. Therefore, specialized harvesting, conditioning and planting methods also need to be developed.

Summary: The research conducted under this agreement falls into four basic categories:

1. Seed collection (hand or mechanical) and conditioning
2. Seed/seedling evaluation (laboratory, greenhouse and field)
3. Cultural management research
4. Reclaimed mined land direct seeding studies

Findings from the first agreement were compiled into a user's manual, Florida Native Plant Collection, Production and Direct Seeding Techniques, which was printed and made available for distribution in 1997. This manual contains general direct seeding guidelines, and comprehensive literature reviews on several grass and forb species with potential for use in a native seed mix.

Significant findings: Results from 1999 research gathered under each category are discussed in detail in the 1999 Annual Report to FIPR. Copies of this report can be requested from the Florida PMC. Summaries of some of the more pertinent work are outlined below:

Seed Evaluation

Effect of Seed Storage Methods on Switchgrass Seed Viability

Project Stage: A four-year study begun in 1997.

Background: Switchgrass seed is known to undergo dormancy. Previous research suggests that seed storage methods can influence dormancy. However, these studies were conducted in states which were cooler and drier than Florida.

Objective: To study the effect of different storage methods in a Florida environment on switchgrass seed dormancy.

Summary: Seed used in this study came from a crossing block of two Florida ecotypes of switchgrass, 'Miami Germplasm' and 'Stuart Germplasm' harvested in 1997. Half of the block had been fertilized. Seed from each fertility treatment was placed in an air-conditioned office and the seed barn, which has no climate control. The study was started 1/29/98. The control samples were kept in the seed cooler at 50 - 55°F with 45-50% humidity. Tests were periodically run between 1998 and 1999.

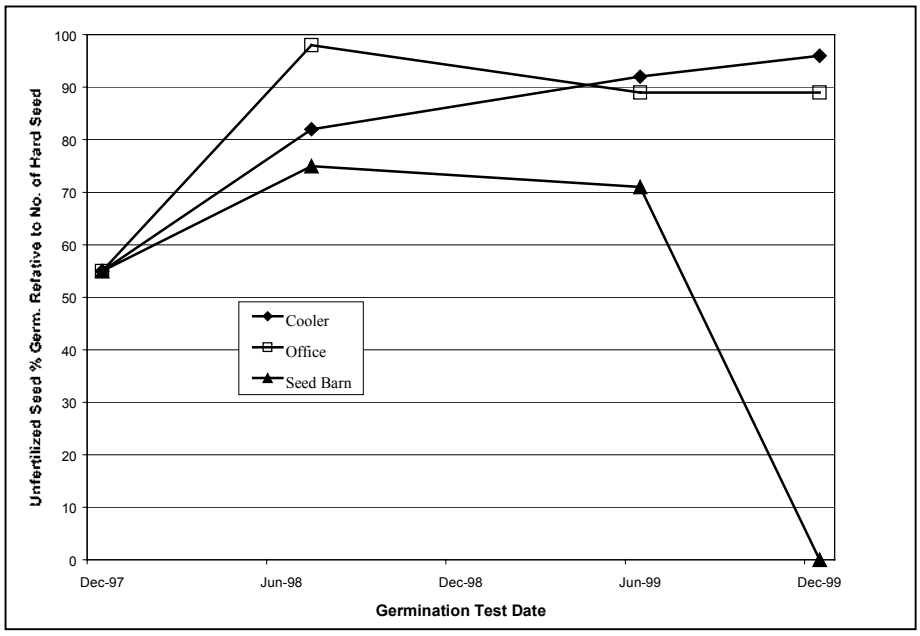


Figure 1. % Germination of switchgrass seed from unfertilized plots relative to number of hard seed under three storage treatments.

Significant findings: Seed stored in the seed barn with no climate control had peak germination 6 months after it was moved from the cooler. But after two years all seed stored in the seed barn had expired (Fig. 1 & 2). Results varied between seed lots as to which storage method promoted highest germination in the short term. In the long term, there appears to be very little difference in germination between storage in the seed cooler, verses storage in a temperature controlled building. Germination tests are to be continued for one to two more years.

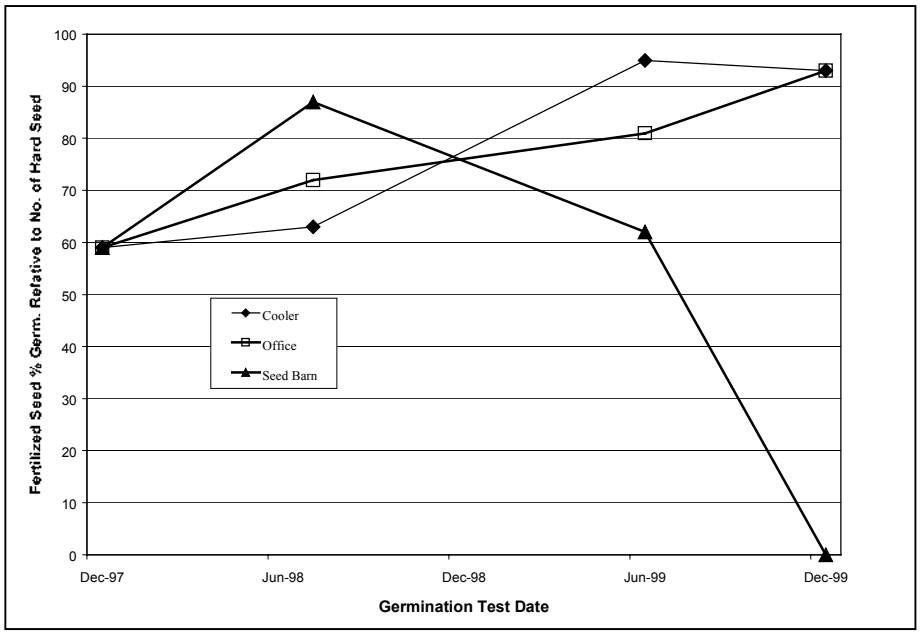


Figure 2. % Germination of switchgrass seed from fertilized plots relative to number of hard seed under three storage treatments.

Seed Treatment Methods for Promoting Germination of Eastern Gamagrass

Project Stage: A two-year study begun in 1999.

Background: Eastern gamagrass has several inherent traits that make it difficult to establish, including seed dormancy. Dormancy has been overcome by chilling seed on moist substrate. Maximum germination was obtained after chilling between two and four weeks, depending on the genetic population. Others have found that treatment with gibberellin (GA) increased germination. Since eastern gamagrass in Florida evolved under a milder climatic regime than more northern ecotypes, it was not known how they would respond to cold stratification.

Objective: To investigate methods of stimulating seed germination of Florida populations of eastern gamagrass.

Summary: Seed from two native Florida accessions of eastern gamagrass (9059213 and 9059264) was hand collected from plots established at the PMC. Seed was collected in July of 1999 and stored in a cooler at approximately 45^{o} F and 45% humidity until it was treated. Three treatments were applied to both accessions plus an untreated control. In the first treatment, GA-plus-chilling, seed was soaked in a solution of GA and tap water (105 mg GA (A.I.)/liter water) for 24 hours. Seed was then rinsed and drained. Damp seed was placed in plastic bags and refrigerated for 4 weeks at 35 to 45^{o} F. The chill-only treatment involved rinsing with water to moisten seed, draining, placing in plastic bags and refrigerating for 4 weeks. The GA-only treatment involved soaking seed in GA solution for 24 hours before planting. Dry untreated seed stored in the cooler was used as a control. All treatments were replicated four times with 38 seed

used per treatment. Seed was planted in containers of potting soil in the PMC greenhouse on September 22, 1999. Emergence was recorded every 7 to 10 days following planting.

Significant findings: All seed treatments had significantly higher germination than did untreated seed (Table 15). Highest germination was obtained with chilled GA-treated seed. The two accessions used in this study responded differently to chilling or GA alone. Chilling seed of accession 9059213 produced a similar response to the chilled GA treatment. Response to GA alone was significantly less than chilling. Chilling and GA alone produced very similar responses in accession 9059264, both of which promoted significantly lower germination than the chilled GA treatment.

Table 15. Forty-five-day greenhouse emergence of eastern gamagrass seed treated with three different seed treatments and an untreated control.

Treatment	45 Day Emergence*	
	9059213	9059264
	----------%	----------
GA + Chill	69a	59a
Chill	57ab	39bc
GA	17de	34cd
No Treatment	3e	9e

*Means followed by different letters are different ($P<0.05$) according to Tukey's HSD Test

The late fall seeding date and lower soil temperatures contributed to lack of germination in the untreated control. In April of 2000, seed began germinating again in all but the GA-plus-Chill trays. It may be beneficial to repeat this study in the summer, when temperatures are higher. The influence of seed age is not known either. Seed stored for one or more years may have higher germination rates without being treated.

Not only did the chilled GA treatment promote the highest germination it promoted very rapid germination (Figure 3). An average of 83% of the chilled GA seeds that did emerge in 45 days had already done so after just 10 days. Only 21% of the chilled seed and 10% of the GA-treated seed to germinate in 45 days had done so within the first 10 days after planting. None of the untreated seeds had emerged within the first 10 days. The chilled GA seedlings were also taller and more robust than the other treatments, with many seedlings having double shoots.

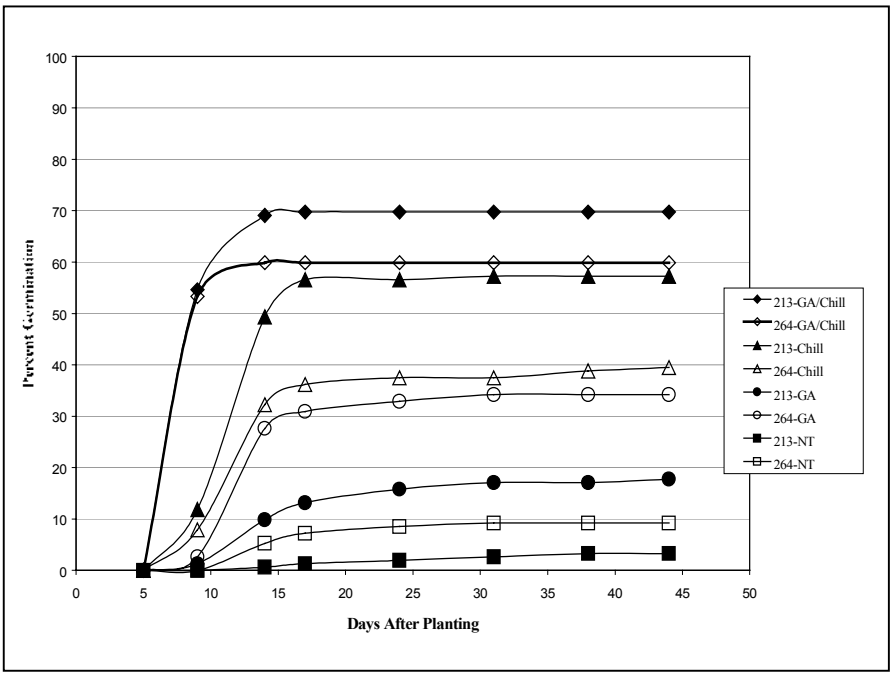


Figure 3. Percent germination of two Florida populations of eastern gamagrass seed (9059213 and 9059264) from four seed treatments: GA/Chill = soaked in GA and chilled for 4 weeks; Chill = chilled for 4 weeks; GA = soaked in GA; NT = no treatment.

In conclusion, it is apparent from the results of this study that Florida accessions of eastern gamagrass do have dormancy mechanisms. Chilling and GA both promoted germination in the two Florida accessions used in this study, but a combination of both treatments produced the greatest seed germination. In addition, this dual treatment promotes very rapid emergence and robust plants. Seed treated in this manner has the potential to dramatically increase field establishment success, if processes can be refined for large-scale plantings. It would be beneficial to repeat this study in the spring or summer, to determine if warmer soil temperatures would promote higher germination, especially in untreated seed.

Cultural Management Studies

Native Species Increase

Project Stage: A three to five year study begun in 1999.

Background: Based on results of direct seeding studies on reclaimed mined lands, several species of native forbs and grasses were selected for further increase and possible commercial release. These species are pinewoods bluestem (*Andropogon arctatus*), a rhizomatous little bluestem (*Schizachyrium scoparium*), three types of gayfeather (*Liatris elegans, L. gracilis and L. tenuifolia*), and paintbrush (*Carphephorus corymbosus*).

Objective: The purpose of the plantings was to increase the seed stocks of these six species, and to develop methods of growing and maintaining them under cultivation.

Summary: The six species were established in small increase plots on irrigated and non-irrigated fields at the Florida PMC in 1999. Depending on the species, plants were established by either direct seeding or from transplants started in the greenhouse. Sky blue lupine (*Lupinus diffusus*) was also direct seeded onto the non-irrigated site. Due to an apparent susceptibility to a soil-borne pathogen, all lupine plants died shortly after emergence.

Significant findings: Pinewoods bluestem and *Liatris elegans* both established well by direct seeding in the non-irrigated field, despite a very droughty spring. In fact, *L. elegans* appears to be easier to establish by direct seeding into the field, rather than starting transplants in the greenhouse. This species prefers very dry conditions, and does not establish well in moist soils. Both species produced seed in the fall, with *L. elegans* producing over 180 pounds of pure live seed per acre. All plots will continue to be maintained to determine stand longevity under various management practices.

Lopsided Indiangrass Residue Management Study

Project Stage: A five year study begun in 1996.

Background: Lopsided indiangrass is an important component of native uplands in Florida. It is also one of the species that has been successfully used to revegetate upland sites. Commercial sources are needed if adequate supplies of seed are to be available on the commercial market. It must be economically feasible for commercial producers to establish and maintain production fields of indiangrass. However, very little is known about growing this species under cultivation. Cultural methods, which will maximize viable seed production and stand longevity, need to be developed. Very little is known about how factors such as burning and clipping affect seed viability of lopsided indiangrass.

Objective: The objective of this project is to study the effects of canopy removal, the method of canopy removal, and the timing of such removal on stand persistence, seed production and seed viability of lopsided indiangrass.

Summary: A field of lopsided indiangrass was established on an irrigated site at the Florida PMC in March of 1996. Seed came from the Croom tract of the Withlacoochee State Forest in Hernando Co. Transplants raised in the greenhouse were planted on 2' centers. Many plants were choked out by weed competition during the 1996-growing season. Therefore, the field was reestablished in the fall of 1997 with transplants. Residue management treatments were applied in 1999 and were as follows: Winter burn (Feb.), summer burn (July), winter clipping (Feb.), summer clipping (July), and an untreated control. Plots were clipped with a forage harvester so that residue could be removed from the plots. Clipping height was 6-8". Plants burned to the ground in the Feb. burn treatment because they were dormant. However, most plants were very green in July, and would not burn well.

Significant findings: The number of plants in each plot were counted in July of 1999 before treatments were applied and in Oct. just before seed ripening. It was also noted whether plants had green shoots or if all leaf material looked brown and dead. Percent plant loss during the 1999 growing season and treatment effects on seed production are shown in Table 16. There was little difference in percent plant loss between the various treatments. However, summer burning reduced the size and vigor of plants severely. It is interesting to note that untreated plots had the greatest plant losses. Most untreated plants looked brown and dead by October. Managing residue apparently does affect stand longevity to a certain extent.

In 1998, the newly established Croom indiangrass field produced 75 pounds of seed per acre. Average seed viability was 26%. By 1999 seed production and viability was substantially lower. Highest production in 1999 occurred in the summer clipped plots, which averaged 20.6 lbs./ac. It is possible that soil-borne pathogens had severely reduced plant vigor by 1999, and residue management only marginally overcame disease symptoms. Statistically, there was no difference between any of the treatments except summer clipping and summer burning. Most summer burned plants did not produce seedheads. Those that did probably did not actually burn because of too much green matter. Seed viability varied greatly within replications. However, once replications were averaged, there was no significant difference in percent viable seed between any of the treatments in 1999.

Table 16. Lopsided indiangrass average percent plant loss, seed production (lbs./ac.), and % viable seed under 5 residue management treatments in 1999.

Treatment	% Plant Loss (Jan. to Oct.)	Seed (lbs./ac.)*	% Viable Seed
Winter Clip	29	16.3ab	12
Winter Burn	32	17.4ab	11
Summer Clip	25	20.6a	13
Summer Burn	37	3.9b	11
No Treatment	38	10.3ab	10

*Means followed by different letters are different ($P<0.05$) according to Tukey's HSD Test

Based on the results of this study, it appears that removing indiangrass residue to ground level while the plants are dormant (as in the case of the Feb. burn) does not hurt plant productivity. Neither does clipping above growing points (6") in early July. Summer burning, however, severely hurt plant productivity. Residue management is important for maintaining stand productivity. Of greater impact though are soil-borne pathogens. If seed production is to be commercially feasible, more research needs to be conducted on controlling pathogens in lopsided indiangrass production fields. It would also be beneficial to repeat this experiment and begin residue management practices the first year the field is established.

Avon Park Wiregrass Residue Management Study

Project Stage: A six year study begun in 1996.

Background: Wiregrass is considered an important component of pineland habitats, because of its ability to carry fire. In native situations, wiregrass contributes a large percentage of the fuel for understory burn management programs. Many public agencies and private conservation groups, among others, are interested in using wiregrass to revegetate native habitat. Dependable supplies of seed need to be available on the commercial market to meet this growing demand. In order to do this, it must be economically feasible for commercial producers to establish and maintain production fields of wiregrass. However, very little is known about growing this species under cultivation. Cultural methods, which will maximize viable seed production and stand longevity, need to be developed. It has been shown that wiregrass requires a growing season burn to produce viable seed. The effect of other factors such as fertility on seed viability is not well understood.

Although wiregrass requires fire to produce viable seed, burning is not always feasible. Clipping would be more practical in some situations, but it is not known if clipping will have the same effect as burning. Wiregrass evolved in very nutrient-poor soils, so it is not known how fertilization will interact with residue management treatments either.

Objective: To study the effects of method of canopy removal and fertility on seed production and seed viability of wiregrass.

Summary: A field of wiregrass was established on an irrigated site at the PMC with 4" tubelings in February of 1996. The seed source was from a wet flatwoods site at Avon Park Bombing Range. Transplants were planted on 2' centers. The field was extended with 6" tubelings planted in October of 1997. Soils on this site are predominately Kendrick fine sand which is well drained. Plants were allowed to become established, and the field was then divided into subplots in 1999.

This study is a split-plot design. Main plots are canopy removal method (burn vs. clip). Subplots are fertilization treatment (none vs. 50 lbs/ac of 0-10-20 applied just after canopy removal). Plots were clipped and burned 7/8/99 between 1:00 and 4:00 p.m. High temperature that day was 94^{o} F. Humidity was not recorded at the PMC, however, for the sake of comparison, relative humidity at the Tampa Airport on 7/8 was 68% at 1:00 p.m. The clipping treatment was done with a Grasshopper mower, which cut the stubble to a height of 1 to 2". Residue was left on the plots. For the burn treatment, plants were set on fire with a drip torch. Most plots were not dense enough to carry fire across the entire plot, so plants often had to be individually burned. Burning and clipping treatments are to be reapplied annually depending on condition of plants. Fertilizer was applied with a hand-held fertilizer spreader. Plot size is 10' x 40' and each treatment is replicated 4 times. Plots were harvested with the Flail-Vac Seed Stripper on December 8, 1999. Purity was estimated to be 42%. Seed samples were weighed and germination tests were conducted.

Significant findings: Pounds of seed/acre obtained from the clip vs. burn study and percent viable seed are shown in Table 17. There was no significant difference in pounds of seed

produced per residue or fertilizer treatment. This was especially true when calculated on a production per plant basis. Number of seed producing plants varied somewhat per plot, so plant numbers in each plot was used to more accurately determine actual production. Regarding seed viability, there were no differences between clipping and burning. Fertilization did not appear to affect fertility either. Higher rates of fertilizer may produce a response. Management treatments will be repeated for two more years if residue amounts are great enough to burn.

Table 17. Avon Park wiregrass clip vs. burn study, 1999 seed production in pounds per acre and grams per plant.

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Viable Seed
Burn/Fertilized	19.3	0.97	18
Burn/Unfertilized	24.3	1.21	21
Clip/Fertilized	21.7	1.05	21
Clip/Unfertilized	21.8	1.06	17
LSD (0.05)		0.51	

Avon Park Wiregrass Burn Frequency Study

Project Stage: A six year study begun in 1996.

Background: Although a growing season fire is known to stimulate viable seed production, there is some thought that burning annually reduces stand vitality. Little research has been done to document this or consider how fertilization interacts with burn frequency.

Objective: To study the relationship between burn frequency and fertility as it relates to seed production and viability.

Summary: A portion of the Avon Park wiregrass field discussed above was used for this study, which is a split-plot design. Main plots are burn frequency (annual, every 2 years or every 3 years). Subplots are fertilization treatment (none vs. 50 lbs/ac of 0-10-20 applied after canopy is removed or during the growing season on unburned plots). Plots were burned 7/8/99 as outlined above. Fertilizer was applied with a hand-held fertilizer spreader. Plot size is 10' x 40' with four replications. Plots were harvested with the Flail-Vac Seed Stripper on December 9, 1999.

Significant findings: Seed purity was estimated to be 24%. Number of seeds per gram for both studies averaged 2300 and had an average of 1,038,000 seed/lb. Number of flowering plants was counted in each plot just prior to harvest. Since all treatments were burned in 1999, the only differences in treatments was fertilization of half the plots. Unfertilized plots averaged 15.35 lbs. seed/ac., fertilized averaged 15 lbs. seed/ac. Production per plant of the unfertilized plants was 0.79 g, fertilized was 0.76 g. Fertilization did not affect seed viability, which was 25% and 26% for unfertilized and fertilized plots respectively. Soil tests revealed that K levels were extremely

low in the wiregrass plots. It may be beneficial to increase fertilizer rates. This study is to be continued for two more years.

Wekiwa Wiregrass Fertility Study

Project Stage: A six year study begun in 1996.

Background: Wiregrass grows in a broad range of ecotypes in Florida, from mesic flatwoods to xeric sandhills. Soil conditions, moisture and fertility vary widely in these ecotypes. Wiregrass (especially upland types) typically grow in very nutrient-poor environments. Wiregrass evolved under a fire regime, and requires a growing season fire to produce viable seed. Nitrogen is volatilized by burning, therefore, much of this nutrient, along with some of the phosphorous, is permanently lost by burning. On the other hand, beneficial nutrients such as Ca, K and Mg are released in the ash, and may be important for stimulating production of viable seed.

Objective: To determine the effect of N, P and K on seed viability of an upland ecotype of wiregrass, with K hypothesized to be the most essential nutrient for seed viability.

Summary: Seed from an uplands site in Wekiwa State Park was planted into six-inch cone trays in the greenhouse in 1996. In October of 1997, 2000 tubelings were transplanted into an irrigated field at the Florida PMC which had been kept clean tilled for two years. Within and between row spacing was two feet. Plot size is approximately 0.2 acres. The site is predominately Kendrick fine sand, which is well drained. In 1999, the field was broken into study plots to compare fertilization treatments (none vs. 50 lbs. K/ac. of 0-10-20, vs. 50 lbs. K/ac. 10-10-10) applied after canopy is removed. Plot size is 10' x 30', with 6 replications. The field was partially burned on 7/8 from 4:00 to 5:00 p.m., with the remainder being burned on 7/9/99 between 1:00 and 4:00 p.m. A temperature high on both days was 94^{o} F. Relative humidity at the Tampa airport on 7/8 was 72%, although it was probably higher than that at the Florida PMC because a thunderstorm was moving in. Humidity at the Tampa Airport on 7/9 between 1:00 and 4:00 p.m. was 74%. Plants were fired with a drip torch. The canopy was not dense enough to carry the fire over the entire field so many plants were burned individually. Some plants were too green, and would not completely burn. Plant counts were made prior to burning and prior to harvest in each plot. Seed was harvested with the Flail-Vac on December 9, 1999.

Significant findings: Seed purity was estimated to be 34%. Number of seed per gram averaged 2,500 with there being 1,135,000 seed/lb. There was no significant difference in seed production or viability between treatments (Table 18). Soil tests revealed that nutrients were low in most plots. Pounds of fertilizer applied may need to be increased. This study is to be continued for two more years.

Table 18. Wekiwa wiregrass fertilization study, 1999 seed production in lbs./ac. and grams per plant.

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Seed Viability
K	20.9	1.32	27
K & N	23.0	1.35	29
No treatment	21.8	1.21	26
LSD (0.05)		0.36	

Reclaimed Mined Land Direct Seeding Studies

Project Stage: A five year study begun in 1997.

Background: Direct seeding technology is necessary for successful revegetation of native species on reclaimed phosphate mined lands. An extensive series of studies were planted at a reclaimed mined land site near Bartow, Florida provided by Cargill Fertilizer, Inc. Lopsided indiangrass and wiregrass were direct seeded in sandtails and overburden soils during Jan. and May of 1997 through 1999.

Objective: To determine the effect of seeding method, seeding rate, and planting date on the establishment of wiregrass and lopsided indiangrass in monoculture and mix.

Summary: Six month emergence results were summarized and are to appear in the Proceedings of the 2nd Eastern Native Grass Symposium, held in Baltimore Maryland in November of 1999. Those desiring a copy of this paper may contact the Brooksville, Florida PMC.

MATERIAL SHIPMENTS - 1999

Species	Quantity
Perennial peanut - Floragraze (*Arachis glabrata*)	41 bu.
Perennial peanut - Arbrook (*Arachis glabrata*)	21 bu
Perennial peanut - Arblick (*Arachis glabrata*)	10 bu
Sunn hemp (*Crotalaria juncea*)	5 lbs.
Lanceleaf crotalaria (*Crotalaria lanceolata*)	8 lbs.
Beach sunflower- Flora Sun (H*elianthus debillis)*	20 plants
Bitter panicum - Northpa *Panicum amarum*)	400 plants
Bitter panicum - Southpa (*Panicum amarum*)	350 plants 1000 cuttings
Maidencane, Citrus (*Panicum hemitomon*)	13.5 bu.
Maidencane, Halifax (*Panicum hemitomon*)	1 bu
Tropic Lalo - (*Paspalum hieronymii*)	3 bu.
Marshhay cordgrass - Flageo (*Spartina patens*)	450 plants
Marshhay cordgrass - Sharp (*Spartina patens*)	450 plants
Teosinte, 'Chapingo' (*Zea mexicana*)	10 lbs.