Brooksville, Florida Plant Materials Center

Year 2001 Annual Technical Report

Issued May 2002

TABLE OF CONTENTS

Plant Materials Center Staff **2**

State Plant Materials Technical Advisory Committee **2**

Mission and Major Objectives **3**

Plant Evaluation Process **3**

Soils **3**

Climate **4**

Initial Evaluations **5**

Switchgrass (*Panicum virgatum*) (FLPMC-P-0001-RA) 5
Wiregrass (*Aristida stricta*) (FLPMC-P-9235-WO) 5
Hairawn Muhly (*Muhlenbergia capillaris*) (FLPMC-P-9236-RA) 6
Lopsided Indiangrass (*Sorghastrum secundum*) (FLPMC-P-9602-RA) 8
Chalky bluestem (*Andropogon glomeratus* var. *glaucopsis*) (FLPMC-P-9601-RA) 9
Reclaimed Minedlands Native Plant Materials Adaptability Study (FLPMC–P–9708-CR) 10

Advanced Evaluations **12**

Blue Maidencane (*Amphicarpum muhlenbergianum*) (FLPMC-P-9604-WE) 12
Eastern Gamagrass (*Tripsacum dactyloides*) (FLPMC-P-9605-RA) 14
Maidencane (*Panicum hemitomon*) (FLPMC-P-9502-BU) 17
Perennial Peanut (*Arachis glabrata*) (FLPMC-9303-CP) 18
Oklahoma Cooperative Eastern Gamagrass Forage Production Study (FLPMC-0005-RA) 20
Oklahoma Cooperative Eastern Gamagrass Seed Production Study (FLPMC-0006-RA) 21
Intercenter Adaptation of Blue-Green Eastern Gamagrass (*Tripsacum dactyloides*) (FLPMC –P-0002-BU) 22

Active Studies **24**

The Effect of Moist Chilling on Germination of Eastern Gamagrass (FLPMC-T-0107-RA) 24
Seed Treatment Methods for Promoting Germination of Eastern Gamagrass (FLPMC-T-0004-RA) 25
The Influence of Fertility and pH on Leaf Color of Blue-Green Eastern Gamagrasses (FLPMC-T-0004-RA) 27
Seed Production of Upland Native Plants (FLPMC-T-9902-CR) 27
Eglin AFB Critical Area Restoration with Florida Native Species (FLPMC-10CABA-Egl) 28
Eglin AFB Native Species Erosion Control Mats (FLPMC–T-0105-CR) 31
Department of Transportation Cooperative Wildflower Seed Increase (FLPMC-S-0104-OT) 32
Wiregrass Residue Management for Seed Production (FLPMC-T-9607-WO) 33
Wiregrass Burn Frequency Study (FLPMC-T-9608-WO) 35
Wiregrass Fertility Management Study (FLPMC-T-9609-WO) 38
Sunn Hemp Seed Production Study (FLPMC-T-0003-CP) 40

Plant Materials Released by the Brooksville, FL PMC **42**

Publications Available from the Brooksville, FL PMC **42**

Cover Picture: Harvesting chalky bluestem at the Plant Materials Center with a Flail-Vac seed stripper.

United States Department of Agriculture, Natural Resources Conservation Service, Plant Materials Center, 14119 Broad Street, Brooksville, FL 34601; Tel: (352) 796-9600

PLANT MATERIALS CENTER STAFF

Clarence Maura, Jr. ..... *Manager*
Sharon Pfaff ..... *Agronomist*
Mary Anne Gonter ..... *Biological Technician*
Robert Santucci ..... *Biological Technician*
Edmond Black ..... *Biological Technician*

PLANT MATERIALS SPECIALIST

Samuel A. Sanders

NAT'L PLANT MATERIALS SPECIALIST

Richard White

STATE PLANT MATERIALS TECHNICAL ADVISORY COMMITTEE

Greg Hendricks, State Resource Conservationist, Chairman ..... *Gainesville, FL*
Greg Garvey, RC&D Coordinator ..... *Homestead, FL*
Bill Harb, District Conservationist ..... *East Palatka, FL*
Mike Jones, District Conservationist ..... *Bonifay, FL*
David Millard, District Conservationist ..... *Cocoa, FL*
Ken Murray, NRPP Coordinator ..... *Gainesville, FL*
Jeff Woods, Resource Conservationist ..... *Lake City, FL*
Edwin Mas, Vegetative Materials Specialist ..... *Lajas, Puerto Rico*
Don Surrency, Plant Materials Specialist ..... *Thomson, GA*
Otto Bundy, Horticultural Systems ..... *Parrish, FL*
Mike Camizzi, Forestry Technician ..... *Eglin AFB, FL*
Rosemarie Garcia, Cargill Fertilizer, Inc. ..... *Ft. Meade, FL*
Dr. John Hovanesian, Coastal & Native Plants ..... *Milton, FL*
Dr. Oghenekome Onokpise, FAMU ..... *Tallahassee, FL*

MISSION AND MAJOR OBJECTIVES

The mission of the Plant Materials Program is to provide timely and effective vegetative solutions for identified resource needs. Superior accessions of adapted plants are developed, tested and released to commercial growers along with production and management methodology. Plant materials and state-of-the-art plant science technology are promoted to assist in conservation of natural resources and meeting the objectives of environmental programs. The use of native plant materials is emphasized. The major objectives of the Brooksville PMC are:

- Improve and maintain water quality
- Control erosion on cropland and stabilize critical areas
- Improve forage on pastures and rangeland
- Improve wildlife habitat

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 - Selections that exhibit superior qualities for the intended use are placed in field plantings on sites away from the PMC, 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.

SOILS

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.

CLIMATE

Florida weather conditions during the early months of 2001 were among the driest on record. Once again, high spring temperatures and dry conditions caused wildfires throughout the state. Rain did not begin falling regularly until June, however, amounts were well below normal averages. Total rainfall for the year was 50.87 inches. The 20 - year rainfall average is 54.72 inches.

Table 1. Year 2001 total monthly rainfall.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
2.19	0.88	5.98	0	0.48	11.48	10.89	4.40	12.94	0.44	0.74	0.45	50.87

The last frost occurred on March 16. The first frost occurred on December 21. There were 280 frost-free days in 2001. The lowest temperature recorded at the Florida PMC in 2001 was 20° F, which occurred on January 5.

Table 2. Year 2001 average monthly high and low temperatures.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
84	88	90	92	97	98	98	99	96	88	86	86
20	34	34	35	55	67	69	67	54	40	44	34

INITIAL EVALUATIONS

Switchgrass (*Panicum virgatum*) (FLPMC-P-0001-RA)

Project Stage: Establishment year of 3 to 4 years of initial evaluation and genetic selection. Increase and advanced evaluation phases are expected to take 5 or more years.

Cooperators: K. Quesenberry, Dep. of Agronomy, Univ. of Florida, Gainesville, and M. Williams USDA, ARS, STARS, Brooksville, FL

Introduction: Switchgrass has excellent potential for use in revegetating reclaimed minedlands and native areas, providing high quality livestock forage and wildlife food, controlling erosion and improving water quality. There are a few commercially available cultivars of switchgrass, such as Alamo, that are adaptable to Florida conditions. However, in initial studies, Florida ecotypes appear to have better performance than those from other states. The primary problem hindering development of a Florida cultivar of switchgrass has been poor seed production.

Objective: Develop one or more strains of Florida switchgrass with high seed production capabilities, and whose primary use will be for reclaiming native areas, wildlife food and cover, and controlling erosion. If selections are identified that produce high amounts of forage, these will be released for range and pasture improvement.

Progress: During the fall of 2000, a total of 88 accessions were collected from 42 counties in Florida in the form of plants and also seed if it was available. Sixteen accessions had been collected previously, so that the final assembly totaled 104 accessions. Seed was available from 80 accessions, and was planted in 6" cone trays in the greenhouse in December of 2000. Transplants of 104 accessions (originating from seed or from original plants if seed was not available) were planted in a crossing block at the PMC on August 2, 2001. Five plants were planted from each accession in a randomized complete block design. In the fall of 2002, each plant is to be evaluated for growth characteristics, and seed samples taken. Seed from the top 20% of superior performers will be used to establish the next generation in the selection cycle.

Growth characteristics in the assembly are highly diverse. Differences, especially in biomass production, are probably due to differences in ploidy level. Higher ploidy levels are known to have a more robust growth habit. An attempt was made, through the assistance of Dr. Quesenberry, to identify ploidy levels of several accessions. However, chromosomes were relatively small and exact counts could not be made. As time permits, more attempts will be made to determine if there are indeed differences in ploidy level between the various accessions.

Future Research Needs: Once a superior cultivar is developed, it will need to be tested for performance and adaptation in Florida, and surrounding states, prior to release.

Wiregrass (*Aristida stricta*) (FLPMC-P-9235-WO)

Project Stage: Develop new project plan and assemble genetically diverse accessions.

Introduction: 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. Livestock readily graze new growth after a burn. Wiregrass also provides cover and nesting sites for wildlife. It does produce fair quantities of seed if old residues are removed during the growing season.

Objective: To develop one or more varieties of wiregrass with good seedling establishment characteristics and high seed production.

Progress and Future Research Needs: Results from previous work with wiregrass, and consultations with plant breeders suggest that viable seed production could be rapidly improved in this species using genetic selection. Large assemblies of wiregrass plants from several stable populations (e.g. parks or preserves) need to be gathered to form the base population from which these selections are to be made. Once an assembly is established, individual plants will be evaluated for seed production, seed quality and growth characteristics.

Hairawn Muhly (*Muhlenbergia capillaris*) (FLPMC-P-9236-RA)

Project Stage: The second and final year of initial evaluation. Accessions with ornamental potential were selected for vegetative increase. Accessions with seed production potential were selected for placement in polycross nurseries to develop varieties with high seed production. Variety development and advanced evaluation for seed producers is expected to take 7 or more years. Ornamental varieties increased vegetatively may be release within 2 to 3 years.

Introduction: 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. Livestock and wildlife graze early growth. 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 Florida native varieties of hairawn muhly for conservation use, especially erosion control, native area restoration, xeriscapes and wildlife cover.

Progress: Muhly plants were collected from throughout the state of Florida in 1997 through 1999. In March of 2000, 94 accessions were planted in plots at the PMC. This included 3 accessions received from the GA PMC. Sharp marshhay cordgrass was planted as a standard of comparison. Plots were replicated 3 times. Evaluations were conducted in the fall, and seed samples were collected in 2000 and 2001. Plants were evaluated for forage and seed production, vigor, leaf and seed head attributes, lodging, drought and disease resistance.

Timing of seed collection appears to be very critical. Seed was not collected until at least the hard dough stage, and preferably when seed was completely ripe. However, collection could not be delayed too long, or ripe seed would quickly shatter. During the time between pollination and the hard dough stage, seed heads were covered with aphids. No attempt was made to control them with pesticides. Lady bug beetles and other natural predators were observed also, so some natural control was occurring. Amount of damage to seed caused by the aphids is unknown. Seed germination for all accessions averaged between 54% and 0% in 2000 with the median being 14%. Possibly because of droughty conditions, seed production was much lower in 2001, averaging between 25% and 0%, with the median being 3%.

Ten accessions with superior viable seed production and growth characteristics (Table 3) were selected for placement in a polycross nursery to develop a composite variety with high seed production. Two other accessions were also identified with consistently high seed viability in 2000 and 2001. These accessions are 9060304, collected from Jackson Co., and 9060428, collected from Bradford Co. They are much smaller and bloom a month earlier than most other collections in the assembly. These 2 accessions will be placed in isolation to increase the seed for advanced evaluation.

Table 3. The 10 selected hairawn muhly accessions with superior viable seed production and growth characteristics.

Accession No.	Overall Score*	Source/County	Collector
9059224	29	Levy	FL PMC
9059516	25	Manatee	FL PMC
9059523	29	Dixie	FL PMC
9059524	24	Taylor	FL PMC
9059544	29	Bay	FL PMC
9059885	30	Okeechobee	FL PMC
9060044	29	Brevard	Fults & Millard
9060048	25	Osceola	Fults
9060317	27	Hernando	FL PMC
9060437	27	Collier	FL PMC

*Overall score derived from the sum of seed production and growth characteristic scores. The best overall score in the assembly was 20 and the poorest was 36.

In addition to development of seed producing strains, 11 accessions were also selected for ornamental potential (Table 4). These types had superior bloom and foliage attributes that would make them valuable for use in roadside, buffer strip and xeriscape plantings. They are to be increased vegetatively for advanced evaluation.

Table 4. The 11 selected hairawn muhly accessions with superior ornamental qualities.

Accession No.	Overall Score*	Source/County	Collector
9059237	26	Pasco	FL PMC
9059516	25	Manatee	FL PMC
9059717	28	Citrus	FL PMC
9059812	24	Marion	FL PMC
9059825	27	Gilchrist	FL PMC
9059826	23	Suwanee	FL PMC
9059929	20	Jefferson	FL PMC
9060317	27	Hernando	FL PMC
9060424	25	Putnam	FL PMC
9060425	26	Putnam	FL PMC
9060428	24	Brandford	FL PMC

*Overall score derived from the sum of seed production and growth characteristic scores. The best overall score in the assembly was 20 and the poorest was 36.

Future Research Needs: Once superior accessions have been increased, they are to be placed in advanced evaluation studies throughout Florida, and possibly in other states. Advanced testing of ornamental selections could occur within 1 to 2 years if enough material is available. Development of seed producing cultivars could take between 3 and 5 years before material is available for advanced evaluations. Other studies need to include testing pesticides for use in controlling aphids on seedheads. Seeding studies will also need to be conducted in order to develop successful seed establishment technology for hairawn muhly.

Lopsided Indiangrass (*Sorghastrum secundum*) (FLPMC-P-9602-RA)

Project Stage: Development of composite varieties for foundation seed stock. The development and increase phases are expected to take 4 years of the remaining 7 to 8 years of this project.

Introduction: 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 native Florida varieties of lopsided indiangrass for conservation uses, especially for erosion control, native area restoration and wildlife cover.
Progress: A statewide collection totaling 132 accessions of indiangrass was assembled between 1989 through 1996. Initial evaluation trials were conducted on irrigated and non-irrigated fields at the PMC between 1997 and 1999. From these studies, 25 accessions were selected for advanced evaluation trials. Original seed collections of all accessions had been stored in the cooler at the PMC and were still viable. This seed was planted in cone trays in the greenhouse in April of 2000.

Accessions 9060186, 9060197, and 9060205 have a very similar blue-green color and very stiff, upright leaves. In February of 2001, they were randomly planted together on a very well drained irrigated site to form one composite (9060564). The remaining accessions (9059725, 9059727, 9060105, 9060110, 9060118, 9060120, 9060128, 9060133, 9060137, 9060146, 9060147, 9060168, 9060173, 9060182, 9060184. 9060187, 9060199, 9060207, 9060208, 9060209, 9060210, 9060351) were planted together in 2 fields (a well-drained nonirrigated and an irrigated site) in March of 2001 to form one composite ((9060565).

Seed was hand collected in October of 2001. Some but not all of the plants flowered. The 9060564 composite produced 28 lb/A of bearded seed (or an estimated 14 lb/A debearded) with 22% germination. The 9060565 composite averaged 23% germination. The irrigated field produced 23 lb/A bearded seed (estimated 11 lb/A debearded). The nonirrigated field produced 29 lb/A bearded seed (estimated 14 lb/A debearded).

In 2002, seed is to be collected from all plots and used to establish seedlings for a foundation field. Any additional seed produced by these blocks in 2003 or 2004 should also be collected and held in long-term storage (freezing) for reestablishment of foundation fields. It is expected that at least 3 years will be necessary to produce enough foundation seed for advanced evaluations and eventual release.

Future Research Needs: Once foundation seed is increased, advanced evaluations may need to be conducted around Florida to determine performance and adaptability. Further studies also need to be conducted to find ways to increase the longevity of production fields. Possible areas of study may include further residue management trials and inoculation of seedlings with protagonistic organisms such as mycorrhizae.

Chalky bluestem (*Andropogon glomeratus* var. *glaucopsis*) (FLPMC-P-9601-RA)

Project Stage: Development of a composite variety. Development and increase of a composite is expected to take another 3 years. Advanced evaluation is expected to require another 3 to 5 years before the material is released.

Introduction: 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, especially erosion control, wetland restoration and wildlife cover.

Progress: In 1996, 91 accessions were assembled from throughout the state of Florida in the form of seed. These accessions were planted in initial evaluation plots at the PMC in 1997, and underwent evaluation until 1999. Ten superior accessions were selected for increase and advanced testing (9060226, 9060251, 9060277, 9060318, 9060331, 9060340, 9060347,

9060363, 9060394, 9060396). Seed from original collections stored in the seed cooler was used to start seedlings in the greenhouse in April of 2000. In February of 2001, these ten accessions were randomly planted together on an irrigated, poorly drained site to form a composite. Seed was collected with the Flail Vac on November 15, 2001. Average germination was 52% with 13 lb/A being collected. Production may have been higher if multiple harvests were made at a slower brush speed.

All plants flowered in 2001, so that this material can be used to start seedlings for a foundation field. Seed needs to be collected again from this nursery for the next 1 to 2 years, to obtain enough material for planting foundation fields. Extra seed should be stored in long-term storage (freezing) to maintain stocks for future generations. It is expected that it will take 3 years to obtain enough seed from the foundation field for advanced evaluations and eventual release.

Future Research Needs: Once seed is available, the new cultivar needs to be tested for adaptation and performance throughout Florida, and possibly other states. Seed conditioning and seeding methodology also needs to be developed for this species to insure establishment success.

Reclaimed Minedlands Native Plant Materials Adaptability Study (FLPMC–P–9708-CR)

Project Stage: Final year of a seven-year study.

Introduction: The phosphate mine industry needs seed sources of Florida native species to restore reclaimed uplands. Since restored sites are primarily targeted for wildlife, a diversity of species is desired.

Objective: To study the ability of selected native species to establish by direct seeding.

Progress: Seed from native species was hand collected from various native sites in Florida between 1996 and 1998. Plantings were then done in Jan. and May of 1997, 1998 and 1999, on both overburden and sand tailings, at a site south of Bartow, provided by Cargill Fertilizer, Inc. Seed was hand-planted in 20' rows, with 3' between rows on both soils. Planting depth was generally ½ to ¾ inches. Seeding rate was generally 60 pure live seed (pls) per acre. 'Alamo' switchgrass (*Panicum virgatum*) was planted each time as a standard of comparison. Due to scarcity of seed, plots were not replicated. Overall, 23 species and 34 accessions were planted, with many species being planted on several of the planting dates. Final evaluations were made on all plots in May of 2001. Results were summarized in a final report for the Florida Institute of Phosphate Research (FIPR), which sponsored the project. The document is to be published by FIPR in early 2002.

Future Research Needs: Selected candidates from this study (*Liatris elegans* and *Andropogon ternarius/arctatus*) need to be increased for release. Progeny may possibly need to be tested for adaptability and performance on reclaimed minedland soils prior to release onto the commercial market. Three other species (*Schizachyrium stoloniferum*, *Pityopsis graminifolia* and *Sporobolus junceus*) showed good potential for use in a native seed mix. Assemblies need to be made and improved varieties developed for use in native restoration of uplands.

ADVANCED EVALUATIONS

Blue Maidencane (*Amphicarpum muhlenbergianum*) (FLPMC-P-9604-WE)

Project Stage: Increase of superior accessions and advanced evaluation. Advanced evaluations are expected to take 3 to 4 more years.

Introduction: 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, especially for erosion control and wetland restoration purposes.

Progress: From 1996 through 1998, a total of 157 accessions were assembled from throughout the state of Florida in the form of root and shoot stock. Initial evaluation plots were planted at the PMC in March of 1999. Because this species spreads aggressively by rhizomes, plots could only be evaluated for one year, before accessions began growing together. Eleven superior accessions were selected for advanced evaluation (Table 5). In March of 2000, accessions were increased by planting rhizomes in tubs. Accessions 9059859, 9060309 and 9060311 were combined to form accession 9060489, since they had very similar performance and come from the same basic location. Accessions 9059866, 9060066 and 9060067 were also combined to form accession 9060490 for the same reasons.

Table 5. Eleven superior blue maidencane accessions selected for increase and evaluation.

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

Enough material was available to plant advanced evaluation plots at two sites in 2000. The first site was planted on July 18, 2000 near Naples in Collier Co. This was a flatwoods site

that had recently been cleared of Brazilian pepper trees under the NRCS EQUIP cost-share program. Plot size was 5' x 10', with three rows per plot. Spacing between rows was 1', with 3' between plots. Plots were replicated 4 times. Planting rate was 80 bushels/acre, and it was determined that this rate was much higher than necessary. Rhizomes were laid out by hand in 4 – 6" deep trenches and covered with soil. 'Halifax' and 'Citrus Germplasm' maidencane were planted as standards. Maidencane plots were planted alternately with eastern gamagrass, so that plots would not grow together too quickly. Conditions were extremely dry at the time of this planting, which was very unusual for the area. There was very little subsoil moisture. Some rain did fall on the site within the next two weeks, however, conditions continued unseasonably dry into 2001. The landowner allowed his cattle to graze the site in early 2001, which negatively impacted the plants. In the spring of 2001, he fenced the research plots, and plants had come back well by the time of the June 7 evaluation (Table 6).

Table 6. Performance of blue and common maidencane on Collier County flatwoods site one year after planting.

	Plant	Canopy		Ground		Resistance[1]			
Accession	Ht. (cm)	Wd. (cm)	Vigor[1]	Cover (%)	Spread Rate[1]	Drought	Disease	Insect	Weed Competition[2]
9059869	9.7	7.0	4.3	18.8	3.5	4.5	5	5	6
9059956	6.0	4.7	5.3	5.3	6.7	6.3	5	5	6
9059971	9.0	7.7	4.0	12.0	4.0	4.7	5	5	4
9060008	7.7	7.0	3.8	21.8	3.5	5.0	5	5	4
9060295	7.7	5.3	5.6	7.5	5.0	6.0	5	5	4
9060489	9.5	5.5	5.8	7.8	5.8	5.8	5	5	6
9060490	10.5	6.3	4.0	14.5	3.5	4.6	5	5	5
Citrus	19.0	11.0	3.5	16.0	3.8	4.3	5	5	4
Halifax	12.5	5.8	5.0	7.8	6.0	5.8	5	5	6

[1]1 = most and 9 = none. [2]1 = least and 9 = most.

The second AE site was planted on Sept. 21, 2000 south of Bartow in Polk Co., on reclaimed minedlands next to a small lake. Plot size was 5' x 5' with 3 rows per plot, and 2.5' between rows. Planting rate was 40 bushels/acre with rhizomes being hand planted in trenches 3 – 6" deep. 'Halifax' and 'Citrus Germplasm' maidencane were also planted as standards, with all maidencane plots being replicated 4 times. Plots of eastern gamagrass were planted between maidencane plots to keep them from growing together too quickly. Soils were overburden that contained a heavy clay fraction. This soil tends to be very sticky when wet and crusts heavily when dry. The site was very wet at the time of planting due to recent heavy showers. However, at a site visit a month after planting it was discovered that the soils had dried out and crusted heavily. Plots were evaluated on May 1, 2001 for emergence (Table 7). Most plots were heavily infested with bermudagrass and torpedograss, and blue maidencane accessions were having a difficult time competing with these aggressive introduced grasses under severe drought conditions.

Table 7. Average emergence of blue and common maidencane on Polk Co. reclaimed minedlands site seven months after planting.

Accession	Number of Shoots
9059869	2.8
9059956	0.5
9059971	0.3
9060008	2.8
9060295	0.8
9060489	0.0
9060490	1.5
Citrus	10.5
Halifax	4.5

On January 18, 2001, a third set of AE plots was planted in Hamilton Co. near Jasper. The site was located on disturbed soils on the north side of a cypress marsh. Plot size was 2' x 9', with each plot consisting of one row each, established by hand planting rhizomes 3 to 6" deep. Planting rate was 40 bushels/A and plots were replicated 4 times. 'Citrus' and 'Halifax' were planted as standards of comparison. Plots of eastern gamagrass were planted between maidencane plots to keep them from growing together too quickly. Six-month evaluations were conducted June 25, 2001 (Table 8). Plots were partially shaded, which caused plants to be small and spindly.

Table 8. Performance of blue and common maidencane on Hamilton County cypress swamp border site 6 months after planting.

Accession	Plant Ht. (cm)	Canopy Wd. (cm)	Vigor[1]	Ground Cover (%)	Spread Rate[1]	Resistance[1]			Weed Competition[2]
						Drought	Disease	Insect	
9059869	22.3	7.3	5.7	3.0	8.7		5.8	5	2
9059956	21.5	8.3	4.8	4.5	7.5		4.8	5	2
9059971	20.8	6.3	5.5	3.5	8.3		5.5	5	2
9060008	26.5	19.8	3.3	9.0	6.5		3.1	5	2
9060295	26.0	9.3	5.5	3.5	8.3		5.3	5	2
9060489	22.0	4.0	6.5	1.5	9.0		6.0	5	2
Citrus	53.5	26.3	4.0	17.0	6.8		5.0	5	2
Halifax	39.0	12.5	5.0	7.5	7.8		5.3	5	2

[1]1 = most and 9 = none. [2]1 = least and 9 = most.

Future Research Needs: Three or more additional advanced evaluation sites are needed in Florida before superior accessions can be selected for release.

Eastern Gamagrass (*Tripsacum dactyloides*) (FLPMC-P-9605-RA)

Project Stage: Increase of superior accessions and advanced evaluation. Advanced evaluations are expected to take another 2 to 3 years.

Introduction: 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 Florida eastern gamagrasses was evaluated for forage and seed production characteristics. Four accessions were selected with superior performance in these two categories; they 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 evaluate, develop and release one or more accessions of eastern gamagrass for conservation use including for buffer strips, pasture and rangeland improvement and wildlife food and cover.

Progress: Advanced evaluation plots of all four eastern gamagrass accessions were planted at the Collier, Polk and Hamilton Co. sites discussed under the blue maidencane evaluations. At the Collier Co. site, which was planted July 18, 2000, plots were replicated 8 times, with each 5' x 10' plot having two rows, 2' apart. Seeding rate was 100 "good" seed/plot, or approx. 25 lbs./ac. "Good" seed were selected by hand sorting those that appeared healthy and viable. Seed had not been treated in any way to overcome dormancy. Most of the seed used had been stored in the cooler for 1 to 2 years (dry storage) or recently collected from the field. Planting depth was 2 to 4" and placement was in very dry soil. Results from the June 7, 2001 evaluation are shown in Table 9. Severe droughty conditions and livestock grazing had negatively impacted seedling survival. However, once the area was fenced, most plots were able to reestablish fairly well by the June evaluation.

Table 9. Performance of eastern gamagrass on Collier County flatwoods site one year after planting.

Accession	Plants/ plot	Plant Ht. (cm)	Canopy Wd. (cm)	Vigor[1]	Ground Cover (%)	Resistance[1]			Weed Competition[2]
						Drought	Disease	Insect	
9059213	2.7	20.3	21.0	4.9	5.6	5.5	5.1	5	5
9059264	3.3	16.8	21.1	5.0	5.8	5.4	5.1	5	4
9059266	10.5	17.0	16.5	4.3	11.8	4.5	4.9	5	5
9059287	8.3	14.5	19.3	4.3	9.3	4.8	5.0	5	6

[1]1 = most and 9 = none. [2]1 = least and 9 = most.

At the Polk Co. reclaimed minedland site, which was planted Sept. 21, 2000, plots were replicated 8 times, with each 5' x 5' plot having 3 rows 2.5' apart. Seeding rate was 25 "good" seed per plot, or a planting rate of approximately 13 lbs./ac. "Good" seed was selected using a

South Dakota Seed Blower, which separated out the lighter empty fruitcases. All seed had been collected from increase fields in 2000, and had not been chilled or treated to overcome dormancy in any way. Four plots of 'Pete' were planted as a standard of comparison. Seeding depth was kept to 1 to 2" because of the tendency of the soil to crust heavily. The site was visited 1 month after planting, and a few seedlings were seen emerging from a small number of plots, despite dry conditions and a heavy crust. Emergence was evaluated on May 1, 2001 (Table 10).

Table 10. Average emergence eastern gamagrass on Polk Co. reclaimed minedlands site seven months after planting.

Accession	Number of Plants
9059213	0.9
9059264	1.0
9059266	1.8
9059287	3.1
Pete	1.8

At the Hamilton Co. cypress swamp site planted January 18, 2001, plots were replicated 8 times except for Pete, which was replicated 4 times, with each plot being one 9' row, with 2' between adjacent maidencane plots. Seeding rate was 20 "good" seed per plot, or a seeding rate of 60,000 "good" seed/acre (approx. 21 lbs./ac.) All seed had been collected from increase fields in 2000 and stored in an air-conditioned building. "Good" seed was selected using a South Dakota Seed Blower. Pete was planted as a standard of comparison. Seeding depth was 2". Plots were evaluated on June 25, 2001 (Table 11).

Table 11. Performance of eastern gamagrass on Hamilton County cypress swamp border site 6 months after planting.

Accession	Plants/ plot	Plant Ht. (cm)	Canopy Wd. (cm)	Vigor[1]	Ground Cover (%)	Resistance[1]			Weed Competition[2]
						Drought	Disease	Insect	
9059213	5.1	17.6	8.9	5.4	4.2		5.8	5	2
9059264	6.2	17.2	12.0	5.4	4.9		5.9	5	2
9059266	7.1	13.2	10.9	5.4	6.1		5.6	5	2
9059287	11.3	15.1	11.4	5.0	9.4		5.8	5	2
Pete	10.8	26.5	15.8	4.5	10.8		5.8	5	2

[1]1 = most and 9 = none. [2]1 = least and 9 = most.

A fourth AE planting was established at the Aucilla area landfill in Madison Co. on June 25, 2001. Plots were established along an embankment around a wetland constructed for mitigation purposes. Soils ranged from heavy clays prone to severe crusting, to coarse sands. Plot size was 6' x 10' with each plot containing 3 rows on approximately 1' spacings, with 1 to 2 feet between plots. Planting depth was 1/2 to 1". The four Florida accessions were planted as untreated and treated seed. Seed treated to overcome dormancy was soaked in gibberellic acid [105 mg GA (A.I.)/liter of water] for 24 hours and then chilled for 3 weeks. Seeding rate was 50 "good" seed per plot or 60,000 "good" seed/acre (approx. 21 lbs./ac.) All seed had been

collected from increase fields in 2000 and stored in an air-conditioned building. "Good" seed was selected using a South Dakota Seed Blower. All treatments were replicated 4 times. Soil moisture was good at the time of planting. However the summer of 2001 was very droughty, and the site was extremely dry when plots were evaluated on December 3, 2001. Despite this, most accessions established fairly well. There was no apparent difference between the treated and untreated seedling emergence (Table 12). Seed may not have been chilled long enough to overcome dormancy.

Table 12. Performance of eastern gamagrass on Madison County constructed wetland site 6 months after planting.

Accession	Treatment	Plants/ plot	Plant Ht. (cm)	Canopy Wd. (cm)	Vigor[1]	Resistance[1]			Weed Competition[2]
						Drought	Disease	Insect	
9059213	GA/Chill	11.5	17.8	9.5	5	5	4.3	5	4
	Untreated	12.9	17.2	9.4	5	5	4.1	5	3
9059264	GA/Chill	13.6	18.2	9.5	5	5	4.1	5	4
	Untreated	11.7	16.5	9.3	5	5	4.1	5	3
9059266	GA/Chill	12.4	17.4	9.4	5	5	4.1	5	4
	Untreated	12.7	17.3	9.4	5	5	4.1	5	4
9059287	GA/Chill	12.6	17.4	9.4	5	5	4.1	5	4
	Untreated	12.4	17.2	9.34	5	5	4.1	5	4

[1]1 = most and 9 = none. [2]1 = least and 9 = most.

Future Research Needs: Two or more additional advanced evaluation sites are needed in Florida before superior accessions can be selected for release. If seed production of this species is to become economical, production field management technology needs to be developed, especially in such areas as fertility and plant spacing.

Maidencane (*Panicum hemitomon*) (FLPMC-P-9502-BU)

Project Stage: Advanced evaluation and field plantings to develop more adaptation data and establishment technology for commercial growers. Studies are expected to be complete within 2 to 3 years.

Introduction: 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. An assembly of this species underwent initial

evaluation at the Florida PMC, from which 'Citrus Germplasm' was selected. Because of demand, this accession was released onto the commercial market as a selected class release.

Objective: To test 'Citrus Germplasm' maidencane for adaptability and usefulness in improvement of water quality, pasture and rangeland improvement and erosion control throughout Florida. Also, to develop successful stand establishment technology.

Progress: As mentioned under the blue maidencane section, 'Halifax' and 'Citrus Germplasm' common maidencane were planted in the advanced evaluation sites in Collier, Polk and Hamilton Co. The common maidencane plots were planted in a similar fashion to the blue maidencane plots at a rate of 40 bushels/acre. Evaluation results can be found in the tables showing the blue maidencane performance data.

Future Research Needs: Conduct three or more advanced evaluation studies along with blue maidencane. Citrus Germplasm maidencane should also be tested out of state, possibly at other PMC's to determine adaptability outside of Florida.

Perennial Peanut (*Arachis glabrata*) (FLPMC-9303-CP)

Project Stage: Final year of evaluations in preparation for commercial release.

Introduction: 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 tolerant 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 an area.

Objective: To evaluate the performance of two accessions of perennial peanut for use as ground cover in citrus groves and in urban landscapes.

Progress: On 7/2/99 two strains of perennial peanut maintained at the Florida PMC (referred to as 'Waxy Leaf', and 'Pointed Leaf') were established on a lot in the Emerald Hills subdivision in Citrus Co. The commercially available 'Ecoturf' and 'Arblick' were also planted as standards of comparison. 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 other three strains had been hand dug from plots at the PMC, 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. A six-month evaluation was conducted in mid-November of 1999. Results are shown below in Table 13. Waxy Leaf was the quickest to establish, in the short-term, producing the most ground cover. The waxy coating on the leaves of this accession may make it more drought tolerant than the other species.

Table 13. Average performance of four strains of perennial peanut on a Citrus Co. site, six months after planting.

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.

One-year evaluation data for the Citrus County site is shown in Table 14. All strains had established well except Arblick, which did poorly in 2000. Waxy Leaf was substantially taller than the other three accessions and had produced the greatest percentage of ground cover on this irrigated site. On a non-irrigated site at the PMC, Waxy Leaf grows much lower. Plots were not mowed prior to evaluation, and this may also affect growth habit. Pointed leaf produced a very low growing dense sod at the Citrus Co. site and a tremendous number of bright yellow blooms, making it an excellent candidate for use along roadsides. Mowing treatments were done on all plots after the July evaluation.

Table 14. Average performance of four strains of perennial peanut on a Citrus Co. site one year after planting.

Accession	Cover (%)	Height (cm)	Spread Rating (1–9, 1=most)	Number of Blooms/ft^2
Ecoturf	82a	6b	2.8a	4b
Waxy Leaf	95a	11a	3.5a	5b
Pointed Leaf	79a	3bc	3.0a	12a
Arblick	30b	2c	6.8b	2b

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

Percent cover declined for most species in 2001 because of severe drought conditions during the spring and summer. Arblick appears to be the most drought tolerant of the 4 accessions. Once established, it was able to aggressively colonize the area surrounding the plots despite unfavorable conditions.

Waxy leaf continued to be substantially taller than the other three accessions, with a heavier canopy prior to mowing. While close mowing did not adversely affect Waxy Leaf in the spring, it removed most of the leaves in the early summer after plant height increased. Plants

required several weeks to produce new leaves. At this site, Waxy Leaf should not be mowed below 5 inches during the summer months, when stems extend several inches above the ground. Perhaps because of the waxy coating on the leaves, this accession appeared to have less insect and leaf disease problems than the other accessions.

Despite droughty conditions in 2001, Pointed Leaf produced the lowest, densest sod and a tremendous number of bright yellow blooms. Leaves were a darker green color than the other 3 accessions, which added to its attractiveness.

Table 15. Average performance of four strains of perennial peanut on a Citrus Co. site two years after planting.

Accession	Cover %	Height (cm)	Spread Rating (1–9, 9=0)	No. of Blooms/ m^2	Insect Injury (1-9, 1=0)	Disease Rating (1-9, 1=0)
Ecoturf	71a	6.5a	4.8b	21b	4	5
Waxy Leaf	74a	8.0a	6.0c	2b	2	2
Pointed Leaf	80a	6.5a	6.3c	52a	2	4
Arblick	70a	6.8a	3.0a	30ab	3	4

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

In additions to the Citrus Co. study, perennial peanut plantings established during the 1990's throughout Florida were evaluated in preparation for developing release documents in early 2002. To avoid duplication, the results of these studies will be reported only in the release documents.

Future Research Needs: Methods of speeding stand establishment need to be investigated, including influence of planting rate, irrigation, fertilization and the potential of establishing stands with sod. Demonstration plantings also need to be established in the future to promote these varieties to commercial growers.

Oklahoma Cooperative Eastern Gamagrass Forage Production Study (FLPMC-0005-RA)

Project Stage: Second year of a four-year study.

Introduction: The Oklahoma Agriculture Research Service has been in the process of developing superior strains of eastern gamagrass for forage and pasture improvement in the southeastern US. In the winter of 2000, they asked PMC's in the southeast region to host forage production studies that included four strains of gamagrass they had developed.

Objective: Provide the Oklahoma ARS with performance data on their four strains of gamagrass, in comparison to the four Florida strains currently undergoing advanced evaluation.

Progress: The four OK strains used are identified as FGT I, FT II, FT IV, and FT 94-8. The 4 FL strains used are 9059213, 9059264, 9059266, 9059287. 'Pete' was planted as a standard of comparison. Plants were established at the FL PMC in April of 2000, and allowed to establish

during the first year of the study. Oklahoma ARS supplied tubelings of their accessions. The FL PMC accessions were established primarily with divisions of plants. The irrigation system went down for a short while after planting and FL accessions consequently had to be replanted later with larger divisions. Plots size is 9' x 18', with three rows, each row containing 6 plants on 3' centers. First year clipping data was obtained in 2001 (Table 16) on May 8, June 21, August 14, and October 5. While the OK strains were clipped to 8", the FL strains were clipped to 10" because of higher growing points. Thus far, Florida accessions have had greater forage production than most of the OK strains. Accession FT 94-8 contains genetic material gathered from Homestead, FL, and it performed well in Florida's semi-tropical climate also. The Oklahoma ARS is conducting forage quality tests, the data from which are not yet available.

Table 16. Eastern gamagrass dry matter production in the Oklahoma cooperative study in 2001 at the Brooksville PMC.

	Harvest				Total
Cultivar	**1**	**2**	**3**	**4**	**Avg DM**
	----------(lbs/ac)----------				
9059287	794.29	1930.78	3664.34	3134.91	9524.32
9059213	807.88	1639.14	3561.72	2560.82	8569.55
9059266	650.18	2543.49	3328.93	1900.85	8423.45
FT 94-8	748.99	1441.12	3519.03	2709.92	8419.07
9059264	341.63	1228.57	2770.19	2521.99	6862.37
FT II	656.31	1201.77	2340.44	2038.18	6236.71
FGT I	485.17	1216.42	1849.73	1839.42	5390.74
Pete	577.33	757.63	1905.12	1743.19	4983.28
FT IV	455.58	952.70	1752.16	1762.43	4922.88

Future Research Needed: Once this study is complete, cooperative studies can be conducted with the ARS Cattle Research Station next to the FL PMC, in which selected cultivars are planted in field plantings. The purpose of the plantings would be to study cattle response to the selected accessions, develop grazing systems that will help maintain stand quality, and promote the use of eastern gamagrass for pasture improvement in Florida.

Oklahoma Cooperative Eastern Gamagrass Seed Production Study (FLPMC-0006-RA)

Project Stage: Second year of a four-year study.

Introduction: An associate study to the Oklahoma ARS forage production study.

Objective: Provide the Oklahoma ARS with seed production data on two of their strains of gamagrass, in comparison to the four Florida strains currently undergoing advanced evaluation.

Progress: The two OK strains used are identified as FGT I and FT II. The 4 FL strains are those used in the forage study. 'Pete' was also planted as the standard of comparison. Plants were established at the FL PMC in April of 2000, in the same manner as discussed under the forage production section. Plot size is 3' x 33', with 12 plants per row on 3' centers. Seed was collected in 2001 by hand clipping all seed stalks on the date when the largest percentage of seed had ripened. Possibly due to an extremely droughty spring, and extreme dry conditions in August, neither Pete nor the OK strains produced significant amounts of seed. The FL accessions were harvested in mid to late August and the South Dakota Seed Blower was used to remove the light seed that had not filled (Table 17). Production was relatively low when compared to gamagrass seed production in other states, where yields are commonly 200 lbs./ac. or more.

Table 17. Eastern gamagrass seed production in the Oklahoma cooperative study in 2001 at the Brooksville PMC.

Accession	Collection Date	Total Wt.	Cleaned Wt.	Heavy Seed	Heavy Seed
		(g)	(g)	(%)	(lbs/ac)
9059213	8/15/01	185.6	146.9	79	36
9059264	8/30/01	6.8	5.0	73	1
9059266	8/30/01	146.4	113.4	77	28
9059287	8/17/01	52.5	40.8	78	10

Future Research Needed: Two factors, row spacing and fertility, need to be investigated, to determine their influence on gamagrass seed production in Florida. A third factor that may be worth investigating is the effect of spring clipping on reproductive tiller production. It was observed in the forage production study that many of the accessions clipped on June 21 produced reproductive tillers by August 13. The average number of reproductive tillers produced by 9059266, FT94-8, 9059213, FT II, FT IV, Pete, 9059287 and 9059264 was 11, 9, 8, 7, 6, 2, 0.3, and 0.1 respectively. Had these tillers been allowed to mature, a seed crop may have been obtained in addition to the two forage clippings.

Intercenter Adaptation of Blue-Green Eastern Gamagrass (*Tripsacum dactyloides*)

(FLPMC –P-0002-BU)

Project Stage: Advanced evaluation, demonstration and field plantings to develop more adaptation data and establishment technology for commercial growers. Studies are expected to be complete within 2 to 3 years.

Introduction: Eastern gamagrass is a Florida native perennial grass that is relatively insect and disease resistant. Once established, plants are also fairly tolerant of droughty conditions. Eastern gamagrass is one of the most useful native species for removing excess nitrates and

phosphates from the soil. It also provides high quality food and cover for wildlife, making it an excellent choice for buffer strips. Eastern gamagrass has been gaining popularity in recent years for use in xeriscapes, backyard conservation projects and plantings along roadsides. 'Martin Germplasm' (9056069) and 'St. Lucie Germplasm' (9059278) eastern gamagrass were released onto the commercial market in 2000 by the FL PMC, because their attractive blue-green color and pleasing growth habits enhanced their use in conservation plantings. A pre-varietal release was done because of the great need for native plant materials. However, additional adaptation and performance data on these two accessions would be beneficial to commercial growers.

Objectives: This study was initiated to determine the adaptation range of Martin and St. Lucie in other states. Both strains originated in southeast Florida. Requests for these releases have come from states as far north as Kentucky. Other Florida strains of eastern gamagrass were not cold hardy enough to survive beyond plant hardiness zone 8.

Progress: Plants of both strains were sent to PMC's at Americus, GA; Booneville, AR; Nacogdoches, Knox City, and Kingsville, TX; Galliano, LA; and Coffeeville, MS in June of 2000. PMC staff agreed to document winter hardiness and survival for at least a three-year period.

In 2000, both strains winter killed at the MS and AR PMC's, and could not establish at the GA PMC because of drought. Fifty percent of the plants initially survived establishment at the Kingsville, TX PMC, and had become well established by early 2002. At this location, it was noted that plants did not have a distinctive blue-green color.

Seventy percent of each type established at the Knox City, TX PMC, and were able to survive the winters there. Six of the 10 St. Lucie plants survived at Nocogdoches, TX, but only 1 of the 10 Martin plants survived, possibly because of drought. Surviving plants were noted as being relatively small, and had not yet produced seed heads.

Future Research Needs: This study is to continue for 1 more year. More adaptation, field and demonstration plantings would be useful to provide commercial growers in Florida with performance data for these two species. It has also been noticed at the PMC that the bluish color of the leaves vary depending on field location. A study to determine the effect of fertility and soil pH on foliage color was initiated in 2001.

ACTIVE STUDIES

The Effect of Moist Chilling on Germination of Eastern Gamagrass (FLPMC-T-0107-RA)

Project Stage: A 12 month study.

Introduction: 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. In published studies, maximum germination was obtained by chilling seed between two and four weeks, depending on the genetic population. Since eastern gamagrass in Florida evolved under a milder climatic regime than more northern ecotypes, it was not known how seed from Florida ecotypes would respond to cold stratification.

Objective: To investigate the influence of the length of chill time on seed germination of two Florida ecotypes of eastern gamagrass.

Progress: Seed from 2 Florida accessions of eastern gamagrass (9059213 and 9059266) was hand collected from increase blocks at the PMC on July 25 and August 21, 2000 respectively. Seed was cleaned with a South Dakota Seed Blower to remove as many empty fruitcases as possible. Remaining percentage of filled seed was not tested, however it was estimated to be approximately 60%, based on past findings. Seed was stored in an air-conditioned building at room temperature. For all treatments, seed was soaked in tap water for 24 hours, drained and placed in a plastic bag. Damp seed was refrigerated at 35 to 45^{o} F for 0, 1, 2 , 3, 4, 5, 6, 7 or 8 weeks. Damp seed was then planted in 6" cone trays of potting soil in the greenhouse on October 5, 2001. Each tray held 38 seed and 2 trays or reps of each treatment were planted. Emergence was recorded every 3 to 5 days for 53 days. Trays were then placed out in the shade house to allow any ungerminated seed to undergo natural cold stratification through the winter months. Final emergence counts were taken on May 1, 2002.

Table 18. Greenhouse emergence at 3 dates of 9059213 and 9059266 eastern gamagrass seed chilled from 0 to 8 weeks.

	Days After	Weeks of Moist Chilling									
Accession	Planting	0	1	2	3	4	5	6	7	8	LSD
					% germination						(0.05)
213	14	3	15	33	41	31	45	31	36		16.2
	42	11	26	43	50	37	49	33	49		19.3
	7 months	46	42	49	50	37	50	33	50		25.0
266	14	11	14	17	29	17	33	38	41	43	15.8
	42	30	42	38	49	38	45	50	59	59	21.1
	7 months	39	47	47	52	43	45	51	59	59	20.5

Based on the results of this experiment, maximum germination of 9059213 occurred in seed that was chilled between 3 and 5 weeks (Table 18). Differences between the treatments

were most obvious in the first 2 weeks after planting. After undergoing natural winter stratification, there was no significant difference between any of the treatments in 9059213.

Accession 9059266 reacted somewhat differently to chilling. In general, the longer the chill time, the greater was the emergence at 14 days. However, differences in emergence were only statistically different between seed that had been chilled 2 weeks or less and seed that had been chilled 6 weeks or more. Statistically, differences had virtually disappeared after 4 weeks, although greatest germination still occurred from 7 and 8 week chilled seed. In both accessions, seed that had been chilled for 4 weeks had a noticeable reduction in emergence compared to 3 and 5 week treatments. It is uncertain why this occurred.

In conclusion, based on the results of this study, seed of both accessions needs to be chilled at least 3 to 5 weeks to overcome dormancy. In 9059213, emergence began to drop if seed was chilled beyond 5 weeks in the short term, but not in the long term. In 9059266, the longer chill periods (up to 8 weeks) appeared to improve germination, even in the long term.

Future Research Needs: Since this experiment was conducted using only a total of 72 seed per accession, it may be useful to repeat it using a greater number of seed.

Seed Treatment Methods for Promoting Germination of Eastern Gamagrass

(FLPMC-T-0004-RA)

Project Stage: A 12 month study.

Introduction: Researchers have shown that chilling eastern gamagrass seed on moist substrate and treatment with gibberellin (GA) increased germination. In a previous study using two Florida ecotypes (9059213 and 9059264), it was found that a combination of GA and chilling for 4 weeks significantly increased germination compared to untreated seed or GA used alone. The two ecotypes responded somewhat differently to the treatments, indicating that some types undergo greater seed dormancy than others. Degree of seed dormancy needed to be investigated in other ecotypes as well. In addition, it was not known whether drying stratified seed prior to planting would reduce germination.

Objective: To investigate methods of stimulating seed germination in a southern Florida ecotype of eastern gamagrass, and influence of drying on stratified seed.

Progress: Seed from eastern gamagrass accession 9059266 (originating in Polk Co. in south central Florida) was hand collected from an increase block at the PMC. Seed was collected in September of 2000, cleaned with a South Dakota Seed Blower to remove as many empty fruitcases as possible. Remaining percentage of filled seed was not tested, however it was estimated to be 60%, based on past findings. Seed was stored in an air-conditioned building at room temperature. Four basic treatments were applied (GA/Chill, Chill, GA or Water Soak). The original experiment was to include a drying treatment of 2 and 7 days for each seed treatment, however due to time constraints this did not occur. Length of chill time was varied instead.

For the GA-plus-chilling treatment, 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 either 22, 23 or 28 days at 35 to 45^{o} F. The 23 and 28 day samples were placed on a paper towel and allowed to air dry for 1 day in a seed barn under uncontrolled conditions (drying occurred in early September under relatively hot humid conditions).

The chill-only treatment involved soaking seed for 24 hours in tap water, draining, placing in plastic bags and refrigerating for 22, 23 or 28 days. The 23 and 28 day treatments were allowed to air dry 1 day prior to planting. The GA-only treatment involved soaking seed in GA solution for 24 hours. Seed was either air dried for 7 days, 2 days or planted damp. Under the fourth treatment, seed was soaked in tap water for 24 hours and planted damp or allowed to dry for 2 days. Dry untreated seed was planted 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 7, 2001. Following planting, emergence was recorded every 7 to 10 days for 81 days. Trays were then moved to the shadehouse where they were subjected to natural cold stratification through the winter months. Final counts were made on May 1, 2002 to determine if there was any additional response to natural stratification.

Table 19. Greenhouse emergence of 9059266 eastern gamagrass seed at 6 dates under a variety of treatments.

	Day After Planting					
Treatment	7	14	28	56	81	235
	% Germination					
GA/Chill 22 days/Plant damp	15	32	39	40	41	41
GA/Chill 23 days/Dry 1 day	18	39	45	45	45	45
GA/Chill 28 days/Dry 1 day	24	57	59	59	59	59
Chill 22 days/Plant damp	28	51	55	55	56	56
Chill 23 days/Dry 1 day	17	49	52	52	52	52
Chill 28 days/Dry 1 day	13	48	53	53	53	53
GA/Plant damp	1	8	29	34	34	34
GA/Dry 2 days	3	38	50	52	52	52
GA/Dry 7 days	3	37	53	53	53	53
Water soak 24 hours/Plant damp	0	9	28	30	30	31
Water soak 24/dry 2 days	0	41	53	53	53	54
NT (dry seed)	0	21	44	47	48	51
LSD (0.05)	7.6	12.6	13.1	12.8	12.9	12.3

As in past studies, chilling and/or a combination of GA and chilling promoted very rapid germination within the first 2 weeks (Table 19). After 28 days (4 weeks), some of the GA and Water Soak treatments had similar emergence to the Chilled and GA/Chilled treatments. By 56 days, none of the treatments were significantly higher than the untreated seed, suggesting that this ecotype may not have as great a degree of seed dormancy as other more northern types. What was interesting in these results was that two of the treatment combinations may have actually suppressed seed germination. The 22 and 23 day GA/Chill combinations had significantly lower germination after 4 weeks than the 28 day GA/Chill treatment. This phenomena did not occur in the Chill only treatments however. Seed treated with GA may need

at least 4 weeks of cold stratification to obtain full germination. The second interesting phenomena was that, in all but the Chill treatments, seed allowed to dry for at least 1 day had significantly greater germination than seed that was planted damp. There was also no significant difference between GA treated seed that was dried for 2 days verses 7 days. For unknown reasons, emergence of seed planted damp remained significantly lower, even after 8 months.

In conclusion, the results of this study suggest that either chilling for at least 22 days or a combination of GA and chilling for 28 days promotes very rapid germination in accession 9059266. In addition, it was found that drying seed prior to planting promoted greater germination over planting damp seed.

Future Research Needs: Tests need to be conducted to determine if similar results can be obtained with GA and cold stratified seed under field conditions. Further research may also need to be conducted to determine how long seed can be dried before it reverts back to a dormant state.

The Influence of Fertility and pH on Leaf Color of Blue-Green Eastern Gamagrasses (FLPMC-T-0004-RA)

Project Stage: First year of a three-year study.

Introduction: 'Martin Germplasm' and 'St. Lucie Germplasm' eastern gamagrass have potential for use in ornamental settings because of their blue-green colored foliage. However, at some sites, this attractive foliage color was not always noticeable. The factors that influence foliage color in these two accessions need to be determined.

Objective: To investigate the influence of different pH and fertility levels on the foliage color of Martin and St. Lucie eastern gamagrass.

Progress: On August 1, 2001, plots were established on 3 irrigated sites at the Brooksville PMC. Previous pH samples taken from these sites ranged from 4.9 to 6.0. Three fertility treatments are to be applied in 2002, including 0, 50, 100 and 200 lbs./ac. of 10-10-10. Each plot consists of 2 or 3 plants with 1 border plant between treatments.

Future Research Needs: As mentioned under the Advanced Evaluation section of this report, it would be useful to make several demonstration plantings to determine how these two accessions perform under a variety of conditions.

Seed Production of Upland Native Plants (FLPMC-T-9902-CR)

Project Stage: Increase of selected native accessions.

Introduction: Based on results of direct seeding studies on reclaimed mined lands and at the PMC, 2 species were selected for further increase and possible commercial release. These species are splitbeard bluestem (*Andropogon ternarius*) (formerly thought to be *Andropogon arctatus*) and gayfeather (*Liatris elegans*).

Objective: To increase, test and release native species for restoring dry sandy uplands.

Progress: A *Liatris elegans* seed increase plot was established in January of 2001. One row was established using corms from a previous PMC planting. The remaining rows were established by direct seeding. In June of 2001, plants were clipped to a height of 10, 12, 14 or 16 inches to promote development of additional seedheads. There were no visually discernable differences in the effect of the different clipping heights. Future tests should include even lower clipping levels. Three hand collections were made in November of 2001, and a final collection was made with the Flail Vac at a slow brush speed. Seed was debearded and tested for germination (Table 5). Debearding may have damaged seed, as average viability was lower than in previous years.

Table 5. Viable seed production by *Liatris elegans* and *Andropogon ternariu* in 2000.

Species	Accession Number	Collection Date	Seed Viability (%)	Pounds Pure Seed/ Acre *
Liatris elegans	9059730	11/6/01	14	1.7
		11/13/01	42	3.5
		11/16/01	8	8.3
		11/21/01	6	4.4
Andropogon ternarius	9060084	11/21/01	92	11

* Amount shown is for debearded *L. elegans* seed, and dehulled *A. ternarius* seed.

Andropogon ternarius seedlings were started in the greenhouse and than transplanted to the field in July of 2001. Plants established well, and all bloomed in the fall. Seed was collected with the Flail Vac in November. Only one harvest was made, and a higher brush speed was used to collect the maximum amount of seed. Unfortunately, a large percentage of the seed was not yet ripe, and collecting at higher brush speeds increases the amount of stems and leaves that are collected. Making several collections at lower brush speeds could significantly increase the amount of seed collected, and reduce the amount of inert matter that must be removed from the seed. A hammermill was very effective at dehulling seed.

Future Research Needs: Tests need to be conducted on both *Liatris elegans and Andropogon ternarius* to determine if debearding or dehulling damages seed and reduces viability. Management of residue and top growth of both species also needs to be tested to find ways to maintain stands and increase seed production.

Eglin AFB Critical Area Restoration with Florida Native Species (FLPMC-10CABA-Egl)

Study I

Project Stage: Final year of a five-year study.

Introduction: Eglin Air Force Base in the Florida Panhandle is interested in restoring borrow pits and other critical areas with native vegetation. They would prefer to use seed sources from the Base. The PMC has been working with them to collect, grow and plant native species on critical area sites.

Objective: Determine the ability of local Eglin and other Florida ecotypes of native grasses to colonize critical areas.

Progress: 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 October 29, 1998 at Eglin. Plants were placed on 1.5' centers. None of the soils had initially been limed, mulched or fertilized. In 2000 and 2001, down slope portions of each plot were fertilized. A final evaluation was conducted on June 26, 2001. Results are shown in Table 20.

Table 20. Three-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	82	31	36	4
Bluestem	57	20	24	4.6
Indiangrass	26	29	31	6
Site 2				
Wiregrass	87	34	30	4
Bluestem	66	24	25	3.3
Indiangrass	17	27	32	6

*1=best, 9=dead

Because soils on these sites had not been treated to improve pH or fertility, growth of the native species had been slow. Severe drought conditions had also discouraged growth, though the wiregrass and bluestem plants had fair vigor. Wiregrass had the greatest survival on both sites. The bluestem had fair survival and many plants had begun to send out rhizomes. Less than one third of the Walton Co. ecotype of indiangrass plants survived, and vigor was poor. Because of the harsh conditions, weed competition was almost non existent. Based on the results of this study, wiregrass and creeping bluestem are good candidates for use in revegetating critical areas. Because they are so slow to establish, however, they may not be good candidates for stabilizing steep slopes. Improving soil pH and fertility may encourage slow growing natives to establish more rapidly.

Study II

Project Stage: Final year of a five-year study.

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.

Progress: 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 soils (incorporated with lime and fertilizer) 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. Final evaluations were conducted May 26, 2001.

Plant densities for both species were lowest in the untreated plots (Table 21). Lopsided indiangrass emerged from all seeding dates on untreated soils. Greatest wiregrass emergence on untreated plots occurred from the winter seedings. In natural systems wiregrass typically averages 5 plants/m^2. Winter seeded wiregrass densities on untreated plots were almost 3 times this amount, though plants were small. Extreme drought conditions most likely discouraged growth and also reduced plant densities.

Table 21. Average plant density and growth characteristics of lopsided indiangrass and wiregrass direct seeded on untreated critical area sites on Eglin AFB. Evaluations conducted May 26, 2001.

Species	Planting Season	Density Plants/m^2	Plant Ht. (cm)	Canopy Wd. (cm)	Vigor (1 to 9)*
Indiangrass	Spring	4	30	14	4
	Summer	5	34	19	4
	Fall	5	16	8	7
	Winter	8	24	14	6
Wiregrass	Spring	0			
	Summer	0			
	Fall	0.6	10	23	4.5
	Winter	17	16	10	5.3

*1=best, 9=dead

On plots that had been treated with lime and fertilizer, plant densities were greater and plants were slightly larger and more robust than on untreated plots (Table 22). Those plots in lower areas that received more moisture also had much more vigorous plants. Indiangrass once again established well on any planting date. Wiregrass was able to establish on all planting dates, however, much greater densities occurred from winter plantings.

Table 22. Average plant density and growth characteristics of lopsided indiangrass and wiregrass direct seeded on treated critical area sites on Eglin AFB. Evaluations conducted on May 26, 2001.

Species	Planting Season	Density Plants/m^2	Plant Ht. (cm)	Canopy Wd. (cm)	Vigor (1 to 9)*
Indiangrass	Spring	9	39	20	5.2
	Summer	10	30	14	5
	Fall	15	33	21	5
	Winter	9	25	10	6.8
Wiregrass	Spring	1	12	8	4.5
	Summer	2	16	11	4.5
	Fall	2	23	19	5
	Winter	11	15	12	5

*1=best, 9=dead

In conclusion, much useful information was gathered from this study. Treating soil with lime and fertilizer increased plant densities and plant size to some degree. Indiangrass was able to establish on all planting dates, however wiregrass only established well from winter seedings. Because these native species are so slow to establish on upland sites, they are not good candidates for restoring critical areas with steep slopes. This study did illustrate, however, that wiregrass and indiangrass could be successfully direct seeded on flatter areas.

Future Research Needs: It may be beneficial to develop seed sources of Florida ecotypes of native grasses and forbs that are vigorous and have high viable seed production, for use in restoring critical area sites.

Eglin AFB Native Species Erosion Control Mats (FLPMC–T-0105-CR)

Project Stage: First year of a four-year study.

Introduction: Natural resources personnel at Eglin Air Force Base wish to restore borrow pits and other critical areas with native species. Because many of these areas have very steep slopes, erosion is a serious problem, and native species often grow too slowly to stabilize critical areas. Biodegradable mats made out of coconut fiber (coir) are often used to stabilize severe slopes. Establishing grasses and forbs on these mats prior to placement on the site could potentially be used to revegetate critical areas with slow growing native species.

Objective: Develop methods of establishing native species on coir mats, and determine if these vegetated mats can successfully colonize and control erosion on critical areas with high slopes.

Progress: On December 4 and 5 of 2001, Eglin personnel supplied a seed stripper pulled with an ATV to collect seed from two native sites. In addition, PMC personnel made hand collections of selected grasses and forbs. The two sites ranged from xeric to mesic and were dominated by

wiregrass. Growing season burns had effectively stimulated the wiregrass to flower and produce viable seed. Seed germination tests were conducted at the PMC laboratory (Table 23) in order to calculate seeding rates. Coir blanket mats (1/4 to 1/2" thick) measuring 3' x 40' were placed on asphalt and plastic at the PMC and were framed with 2" x 4" wood. Mats were seeded on February 14, 2002 and covered with approximately 1/2" of potting soil. Because of cooler weather, seed did not begin to germinate for 1 to 2 months. Once plants have develop a strong root system, they will be transported to Eglin AFB and placed on critical area sites.

Table 23. Laboratory germination of various native species collected from Eglin AFB in 2001.

Site	Species	Common Name	Seed Viability (%)
Indigo Pond	*Andropogon gyrans*	Elliot bluestem	46
	Andropogon ternarius	Splitbeard bluestem	32
	Liatris spp.	Gayfeather	48
	Pityopsis	Grass leaf golden aster	42
	Schizachyrium stoloniferum	Creeping bluestem	4
Range 78	*Aristida beyrichiana* (stripper mix)	Wiregrass	39
	Aristida beyrichiana (hand clipped)	Wiregrass	35
	Schizachyrium stoloniferum	Creeping bluestem	0

Future Research Needs: Once established, mats will need to be evaluated for 2 to 3 years to determine if this is a viable method of stabilizing critical areas with native species.

Department of Transportation Cooperative Wildflower Seed Increase (FLPMC-S-0104-OT)

Project Stage: First year of a three- to four-year study.

Introduction: The Florida Department of Transportation (DOT) would like to use Florida ecotypes of native wildflowers to beautify roadways and reduce mowing costs. However, there are very few Florida sources of wildflowers on the commercial market. Dr. Jeff Norcini of the University of Florida, IFAS has been working under a grant from the DOT to develop Florida seed sources, and has asked the Brooksville PMC to help increase the seed for commercial growers.

Objective: To develop propagation and cultural management protocols, develop harvest methods, and increase seed stocks of two species of Florida wildflowers.

Progress: Seed of yellowtop (*Flaveria linearis*) collected from a south, central and north Florida location was brought to the PMC in the summer of 2001. Seed was started in flats in the greenhouse, and seedlings were transplanted to cone trays. Once seedlings develop a vigorous root system, they are being transplanted to the field. It has been noted that the south and north

ecotypes of yellowtop have displayed a completely different growth habit. An accession of blackeyed susan (*Rudbeckia hirta*) is also being increased in a similar manner. A specialized vacuum harvester is being developed to collect the seed. Since blackeyed susan is a biennial, and yellowtop is a perennial, seed increase fields are expected to be productive for 2 or more years.

Future Research Needs: Herbicide tolerance information needs to be developed for these two wildflower species.

Wiregrass Residue Management for Seed Production (FLPMC-T-9607-WO)

Project Stage: Final year of a six-year study.

Introduction: 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 are needed to meet this growing demand, and so it must be economically feasible for commercial producers to establish and maintain production fields of wiregrass. Cultural methods, which will maximize viable seed production and stand longevity, need to be developed. However, very little is known about growing this species under cultivation. It has been shown that wiregrass requires a growing season burn to produce viable seed, but 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.

Progress: A field of wiregrass was established on an irrigated site at the PMC with 4" tubelings in February of 1996. Transplants were planted on 2' centers. The field was extended with 6" tubelings planted in October of 1997. The seed source was from a wet flatwoods site at Avon Park Bombing Range. Soils in the study plots are predominately well drained Kendrick fine sand. Plants were allowed to establish for 2 years, and the field was then divided into subplots in 1999 in 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). In 1999, plots were clipped and burned on July 8 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. 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.

Table 24. Wiregrass canopy removal method study, 1999 percent seed viability and pure 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	

Pounds of seed/acre obtained in 1999 from the clip vs. burn study and percent viable seed are shown in Table 24. 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 or fertilizer treatments.

Clipping and burning treatments were applied for the second year of this study on July 12, 2000. High temperature for the day at the PMC was 94^{o} F. The Brooksville airport reported the relative humidity at the airport to be 65% at 3:53 p.m. Half of each plot was fertilized (150 lbs. K/ac.) in split applications (applied on 8/1 and 8/23). Fertilizer treatments were increased three-fold in 2000 in an attempt to elicit a larger response. Plots were harvested with the Flail-Vac Seed Stripper on December 12, 1999. Average seed purity was estimated to be 56%. Seed samples were weighed and germination tests were conducted.

In 2000, there was again no significant difference in pounds of seed produced per residue or fertilizer treatment (Table 25). This is good news for land managers who want to manage wiregrass for seed but may be restricted from burning at an appropriate time. Number of seed producing plants varied somewhat per plot, so plant numbers in each plot were used to more accurately determine actual production. Average germination had increased slightly over 1999 levels. Total pounds of seed produced per acre decreased slightly from 1999 levels. Removing residue annually may have negatively impacted the plants and decreased plant populations. Burned fertilized and unfertilized treatment plant losses were 12% and 8% respectively between 1999 and 2000. Clipped fertilized and unfertilized treatment plant losses were 6% and 10% respectively.

Table 25. Wiregrass canopy removal method study, 2000 percent seed viability and pure seed production in pounds per acre and grams per plant.

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Viable Seed
Burn/Fertilized	15.6	1.0	28
Burn/Unfertilized	18.5	0.9	26
Clip/Fertilized	18.0	1.0	25

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Viable Seed
Clip/Unfertilized	17.5	1.0	25
LSD (0.05)		0.4	6

In 2001, plots were burned or clipped August 6 between 1:00 and 5:00 p.m. in the same manner outlined above. Burning was delayed in 2001 for several reasons, including weather conditions, which were not conducive to burning until the beginning of August. Unfortunately, some plants had already begun to produce reproductive tillers by this date, and appeared to be severely set back by the later burn. High temperature on August 6 was 32^{o}C (92^{o}F) at the PMC. Relative humidity at the Brooksville Airport was recorded as 55% at 3:53 p.m. Since there had been very little response to the fertilizer treatments the previous 2 years, N was included in the fertilizer application in 2001 in an attempt to increase plant vigor and reduce plant losses. Applications were made earlier in the season when plants had begun to actively grow. Fertilizer was applied to all fertilized treatments in 2 applications, with 50 lb/A of N&K (in the form of 10-10-10) being applied on June 5 when plants were actively growing. On September 4, 50 lb/A of 10-10-10 was applied, after plants had put on a substantial amount of leaf tissue but had not yet begun to bloom. Flowering plants were counted and plots were harvested when the entire stand was ripe on November 26. Seed purity was estimated to be 44%.

The late timing of the growing season burn appeared to have substantially reduced seed production in 2001 (Table 26). More seed was produced on the clipped fertilized plots than on the burned unfertilized plots. When production was placed on a per plant basis, however, there was no significant difference between any of the treatments. Neither was there a significant difference in seed viability. Fertilizer was most likely applied too late in the growing season in 2001 to provide any boost to seed production in the short term.

Table 26. Wiregrass canopy removal method study, 2001 percent seed viability and pure seed production in pounds per acre and grams per plant.

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Viable Seed
Burn/Fertilized	10.7	0.9	15
Burn/Unfertilized	9.4	1.0	15
Clip/Fertilized	17.6	1.1	11
Clip/Unfertilized	14.0	1.0	15
LSD (0.05)	6.9	0.5	3.2

In conclusion, it was determined in this study that plants mowed closely to expose the plant crown had the same seed production and viability as plants that had been burned. Mowing gives seed producers greater flexibility in managing stands to obtain optimum production.

Wiregrass Burn Frequency Study (FLPMC-T-9608-WO)

Project Stage: Final year of a six-year study.

Introduction: 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.

Progress: A portion of the Avon Park source 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 shortly after the time of canopy removal on burned and unburned plots). Plots were burned 7/8/99 as outlined above. Fertilizer was then 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. Seed purity was estimated to be 24%. Number of seeds per gram averaged 2300 and had an average of 1,038,000 seed/lb. Flowering plants were counted in each plot just prior to harvest. Since all treatments were burned in 1999, the only difference in treatments in 1999 was fertilization. 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 significantly affect seed viability, which was 25% and 26% for unfertilized and fertilized plots respectively.

On July 12, 2000, the 1-year frequency plots were burned in this study. Half of each plot was then fertilized (150 lbs. K/ac.) in split applications (applied 8/1 and 8/23). Fertilizer rates were increased three-fold in an attempt to elicit a greater response. Plots were harvested in December. Purity was estimated to be 56%. Number of flowering plants was recorded for each plot just prior to harvest. Even though 2 and 3-year cycle plots weren't burned, many plants still flowered. Flowering appears to be related to plant size and the amount of old growth shading the crown. Seed samples were harvested from unburned plots also. As would be expected, seed production was higher in burned plots, but not greatly so (Table 27), especially when placed on a per plant basis. Fertilizer did seem to increase viability in the burned treatment, but not in the unburned treatments. It is surprising that the burned, unfertilized treatment had no higher germination than the unburned treatments. Plant losses in annually burned plots between 1999 and 2000 were 15% and 18% for fertilized and unfertilized treatments respectively.

Table 27. Wiregrass burn frequency study, 2000 percent seed viability, and pure seed production in pounds per acre and grams per plant.

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Viable Seed
1 Year/Fertilized	27.8	1.0	26
1 Year/Unfertilized	27.1	0.9	17
2 Year/Fertilized	15.8	0.6	17
2 Year/Unfertilized	16.1	0.7	17
3 Year/Fertilized	14.8	0.7	13

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Viable Seed
3 Year/Unfertilized	14.2	0.6	14
LSD (0.05)		0.4	9

In 2001, 1 and 2-year cycle plots were burned on August 6 between 1:00 and 5:00 p.m. as outlined in the previous study. Fertilizer was applied to all fertilized treatments in 2 applications, with 50 lb/A of N&K (in the form of 10-10-10) being applied on June 5 when plants were actively growing. On September 4, 50 lb/A of 10-10-10 was applied, after plants had put on a substantial amount of leaf tissue but had not yet begun to bloom. Plots were harvested on Nov. 26. Average seed purity was estimated to be 44%. Seeds were heavier than the previous years, averaging 3,450 seed/g or 1,565,500 seed/lb. The increased weight may have been partially due to many of the seed being infected with a smut-like fungus commonly found on wiregrass.

Table 28. Wiregrass burn frequency study, 2001 percent seed viability, and pure seed production in pounds per acre and grams per plant.

Treatment*	Seed Produced lbs./ac.	Seed/ Flowering Plant (g)	% Viable Seed
1 Year/Fertilized (burned)	15.2	1.0	22
1 Year/Unfertilized (burned)	11.5	0.9	14
2 Year/Fertilized (burned)	13.6	0.9	16
2 Year/Unfertilized (burned)	11.5	0.9	8
3 Year/Fertilized (unburned)	25.4	1.6	29
3 Year/Unfertilized (unburned)	19.1	1.2	29
LSD (0.05)	4.6	0.4	6.6

*Burned 8/6/01, fertilized with 56 kg K&N ha^{-1} on 6/2 and 56 kg K&N ha^{-1} on 9/4.

The late timing of the 2001 burn severely reduced plant vigor in burned plots. Seed production and viability in burned plots was actually lower than in the 3-year cycle unburned plots (Table 28). The use of N fertilizer in 2001 produced some significant but mixed results. In burned plots, there was no significant difference in seed production between fertilized and unfertilized treatments. However, fertilized burned treatments had significantly higher seed viability. This would indicate that additional N gave burned plants the energy to fill more of the seed they produced, even though it didn't stimulate greater overall vegetative tiller production.

Conversely, fertilized unburned plots had higher seed production compared to unfertilized unburned treatments, but seed viability was the same for both treatments. In this case, additional N may have stimulated greater growth and plant vigor in unburned plants, thus increasing total seed production, but not seed fill. The amount of seed produced by the unburned plants in 2001 was surprisingly high compared to yields in previous years. It is uncertain whether this was simply due to management factors or if environmental conditions had a greater influence.

In the short term, burn frequency did not appear to significantly affect plant persistence. Plant losses between 1999 and 2001 on both fertilized and unfertilized treatments averaged 19%,

20% and 21% for 1, 2 and 3-year cycles respectively. It was too early to determine if the use of N fertilizer slowed plant losses.

Wiregrass Fertility Management Study (FLPMC-T-9609-WO)

Project Stage: Final year of a six-year study.

Introduction: 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 grows 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.

Progress: Seed collected from an uplands site in Wekiwa State Park was planted into six-inch cone trays in the greenhouse in 1996. In October of 1997, 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. 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 harvest in each plot. Seed was harvested with the Flail-Vac on December 9, 1999. 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 29) in 1999. Soil tests revealed that nutrients were low in most plots.

Table 29. Wiregrass fertilization study, 1999 percent seed viability, and 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

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Seed Viability
No treatment	21.8	1.21	26
LSD (0.05)		0.36	

In the second year of this study, fertilizer treatments were increased three-fold (150 lbs. K/ac., 150 lbs. N & K/ac.) from 1999 levels. All plots were burned on July 12, 2000. Fertilizer was then applied in split applications (applied 8/1 and 8/23). Seed was harvested with the Flail-Vac in December. Flowering plants in each plot were counted just prior to harvest. Seed was weighed, and purity averaged 56%. Seed were smaller in 2000 than in 1999, with there being an average of 1,667 seed per gram and 756,667 seed per pound in 2000. There was no difference in seed viability or production between any of the treatments (Table 30) in 2000 and viable seed production had decreased from 1999 levels. Intensive annual burning appeared to be stress the plants in this study. Plant numbers dropped 31% in both fertilized treatments between 1999 and 2000, while unfertilized treatments lost 37%.

Table 30. Wiregrass fertilization study, 2000 percent seed viability, and seed production in lbs./ac. and grams per plant.

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Viable Seed
K	13.1	1.2	21
K & N	14.3	1.2	23
No treatment	12.6	1.1	23
LSD (0.05)		0.7	8

In 2001, all plots were burned on August 6 between 11:00 am and 5:00 p.m. as outlined in the wiregrass residue management study. Fertilizer was applied in 2 applications, with 50 lbs./ac. K or N&K being applied on June 5 when plants were actively growing. On September 4, 50 lbs./ac. K or N&K was applied, after plants had put on a substantial amount of leaf tissue but had not yet begun to bloom. Plots were harvested on Nov. 26. Average seed purity was estimated to be 44%.

The late timing of the burn appeared to severely reduce seed production in 2001, as many of the plants had already begun to bloom prior to burning (Table 31). Plants may be able to flower and produce viable seed without being burned annually, if the crown in not shaded by old plant residues. In 2001, seed production and viability had dropped substantially from previous levels. None of the fertilizer treatments appeared to significantly affect viable seed production. Fertilizer, especially N, was most likely applied too late in the growing season to affect plant vigor or production of reproductive tillers.

Table 31. Wiregrass fertilization study, 2000 percent seed viability, and seed production in lbs./ac. and grams per plant.

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Viable Seed
K	10.4	1.1	13

Treatment	Seed Produced lbs./ac.	Seed per Plant (g)	% Viable Seed
K & N	11.5	1.1	9
No treatment	9.7	0.9	9
LSD (0.05)		0.4	5

Future Research Needs: Greater progress may be made in improving wiregrass viable seed production through genetic selection rather than cultural management practices. Based on the results of these three wiregrass studies, it would appear that plants do not need to be burned or clipped annually to flower and produce viable seed. Flowering may be more dependant on the amount of old residues shading the crown. It may also be beneficial to apply N fertilizer at the time of spring regrowth, to increase plant size and persistence. More research needs to be done to verify these factors. A longer term burn frequency study will be necessary to determine whether stands of wiregrass are affected by annual burning.

Sunn Hemp Seed Production Study (FLPMC-T-0003-CP)

Project Stage: Final year of a two-year study.

Introduction: Sunn hemp (*Crotalaria juncea*) is an annual legume that grows very rapidly and produces a substantial amount of nitrogen and biomass. Cotton and vegetable farmers in the southern US are becoming very interested in using sunn hemp as a green manure crop. Because of its ability to suppress weeds and root knot nematodes, sunn hemp can also potentially reduce pesticide use. In 1983, the Hawaii PMC and the University of Hawaii jointly released the sunn hemp cultivar 'Tropic Sun'. Currently, the only commercial source of sunn hemp seed is from Hawaiian growers, and seed costs are too high to be economical for cover crop use. Efforts have been made to produce seed in the southeastern US, however sunn hemp typically does not set seed until fall or winter. Therefore, a semi-tropical climate is necessary for seed production.

Objective: Determine locations in Florida where the climate is conducive to sunn hemp seed production. Secondly, study the effect of planting date on seed production.

Progress: Seed was distributed to 15 cooperators throughout Florida. They were asked to plant seed on 3 dates, one month apart. First seeding date in north Florida was June 1, in central Florida July 1, and in south Florida August 1. Plot size was typically 0.3 acres with a planting rate of 10 pounds per acre. The winter of 2000 was unusually cool, with the first frost occurring earlier than normal. As would be expected, most plantings in north and central Florida were killed by frost before viable seed could be produced. Several producers in south Florida reported that their plantings had been frosted, but the oldest plantings had resprouted from the roots and bloomed again. In June of 2001, Baron Collier Company (a grower in Collier Co.) combined their 2 acre stand of sunn hemp. They obtained over 200 pounds of seed that had 66% seed viability. Sakata Seed Company in Lee Co. hand harvested 50 pounds of seed from a 1 acre tract, which they planned to increase in the future. Based on the results of this study, it was

determined that sunn hemp seed can be economically produced in coastal counties of Florida below the 27th parallel.

Future Research Needs: Future seed production studies are needed in south Florida, to determine such factors as best planting date to maximize production. The role of pollinators also needs to be better defined for this crop.

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	" " "
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. 2001	Semi-Annual Newsletter: Sunshine State's PMC Impact
1998	Forage Species on Sprayfields – Fact Sheet
2000	Fact Sheet: Gully Stabilization in North Florida
2000	Plant Materials Center, Brooksville, Florida - Visitor Information
Through 2001	Annual PMC Activity Reports