

DEVELOPING SEED SOURCES OF FLORIDA NATIVE UPLAND GRASS SPECIES ¹

by

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Abstract. There is a growing movement in Florida to revegetate upland sites with Florida native species. Lack of commercial seed sources hinders this work. Several obstacles must be overcome to develop reliable plant materials. Florida natives often have poor seed production or require specific management techniques such as burning, to produce viable seed. Lack of seedling vigor often causes natives to be overwhelmed by robust introduced weed populations. The Florida Plant Materials Center is working with the Florida Institute of Phosphate Research to develop seed sources of Florida natives. The five-phase plant materials program of assembly, initial evaluation, increase of superior accessions, advanced and field testing, has been used to address this problem. Materials tested in this manner can be released with more complete planting and management guidelines, and better assurance of establishment success. Currently, six species of seed-producing native Florida grasses are under evaluation: Eastern gamagrass [*Tripsacum dactyloides* (L.) L.], lopsided indiagrass [*Sorghastrum secundum* (Ell.) Nash], chalky bluestem [*Andropogon glomeratus* var. *glaucoptis* (Ell.) C. Mohr], hairawn muhly [*Muhlenbergia capillaris* (Lam.) Trin.], switchgrass (*Panicum virgatum* L.), and wiregrass (*Aristida beyrichiana* Trin. & Rupr.). In addition the highly rhizomatous vegetatively propagated Florida species, blue maidencane [*Amphicarpum muhlenbergianum* (Schult.) Hitchc.] is currently under evaluation, while 'Citrus Germplasm' maidencane (*Panicum hemitomon* Schult.) was released commercially by the Florida Plant Materials Center in 1998.

Introduction

There has been a recent surge of interest in reclaiming Florida uplands to native species. The phosphate industry, as well as many public and private conservation groups, has been involved in this effort. Direct seeding has the potential to be the most economical method of revegetating large acreages, compared to planting seedlings. However, one of the greatest hindrances to this work has been lack of commercial sources of seed for Florida native species. Many of the desirable Florida native grasses and forbs have poor seed production and viability, especially those with rhizomatous root systems (Yarlett, 1996; Pfaff and Gonter, 1996). Florida upland species evolved under a regime of summer fires, and may require burns of fairly specific timing and intensity to produce viable seed (Platt et al., 1994). In addition, native seedlings often lack vigor, and have difficulty competing with the abundant number of robust introduced weed species in Florida. These problems have discouraged the development of commercially available Florida cultivars.

The Brooksville, Florida Plant Materials Center (PMC) joined the Florida Institute of Phosphate Research (FIPR) in the early 1990's to identify and develop those native species with the greatest potential for use in an upland seed mix. Early work included screening a broad range of candidates for seed production and growth characteristics, in reference to adaptability to reclaimed upland minedland sites. Several good candidates were found (Pfaff and Gonter, 1996). The purpose of the current work is to develop reliable, commercially available seed sources of these promising species. This includes developing cultural practices for stand establishment and seed production.

Materials and Methods

The USDA plant materials program has been in operation since the 1940's, with 26 centers stationed throughout the US. A multi-step process is employed to develop quality plant materials for conservation uses, with emphasis on using natives. Development of superior cultivars can take decades. Because demand for native species is currently high, abbreviated procedures have been developed to shorten the time it takes to release plant materials onto the commercial market. As will be seen from the following discussion, these short cuts have strong advantages and disadvantages.

The first step in plant material development is assembly. There is much controversy about the benefits of revegetating with only local ecotypes

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versus combining propagules from different populations to get more genetic diversity (Havens, 1998). Unless plant materials are being developed for a specific locale (e.g. a park or preserve), targeted species are assembled from as wide a genetic range as possible, while staying within the same ecoregion. If a species grows in only a limited area, and demand is great, the PMC can immediately release material collected from a given site as a "Source Identified" commercial release. Seed gathered directly from the site or grown under cultivated conditions will carry this designation. The plants undergo no evaluation, therefore, very little is known about plant performance other than what is observed in the field. Nothing is known about establishment on other sites. Neither has any genetic manipulation occurred. Commercial growers and reclamationists take on a larger share of risk when they use "Source Identified Seed". Collecting, establishing commercial production fields and planting native seed on reclamation sites is extremely expensive. The chances of failure are high if appropriate planting and management technology is not available.

The second step up the plant materials development ladder is initial evaluation. Assembled materials are usually planted at the PMC in replicated trials, possibly on one or more soil types. Accessions are evaluated for establishment, growth and seed production characteristics for one to four years. Longer-term evaluations provide more information on resistance characteristics, as well as persistence. One or more superior performers are then selected and increased. Again, if demand is great, superior accessions can be released at this point as a "Selected" commercial release. With this type of release, performance of various accessions of the selected species is now known under conditions at the PMC; however, testing has not been conducted on other sites or on more than one generation. Therefore, accessions may or may not breed true, and desirable characteristics may not show up in all of the offspring. Cultural methods to promote viable seed production may not be known at this point either. Because of the tremendous demand for native species, the PMC is releasing many native plant materials in the "Selected" class. However, growers and reclamationists still share a larger percentage of the risk using "Selected" class materials, because a large amount of growing and management technology is still missing.

Selected plant materials must be increased to provide adequate amounts of material for further evaluations. This is the third step in the process, but increase plots must also be planted to provide material for larger scale evaluations further along in the process, and for commercial growers.

The fourth step is advanced evaluations. Offspring from superior accessions are planted on multiple sites, usually in replicated plots, to verify performance and heritability of desirable characteristics. Trials typically last from two to four years. Advanced evaluation trials are designed to prove genetic superiority, and whether heritability of distinctive traits is stable. Superior performers selected from advanced evaluation trials can be released as "Tested" materials.

If advanced evaluations are extended to include replicated studies of adaptation ranges, establishment, management, and/or production technology of two or more generations, then the selection can be released as a "Cultivar" or "Variety". Testing has proven the heritability of superior traits and performance, as well as the adaptation range. These are the highest quality releases available and carry the lowest risk for users. They include a great deal of technology to insure establishment and production success.

The fifth step in the plant materials development process is known as field plantings. Large-scale plantings of the cultivar are established along with a standard of comparison under a variety of soils, climate and land use conditions. Field plantings are useful for gathering performance or cultural management information under actual use conditions. Field plantings add to the body of technology available for a cultivar, but are not necessary for release onto the commercial market.

Florida Native Plant Materials Development Progress

Lopsided indiagrass [*Sorghastrum secundum* (Ell.) Nash] is one of the dominant upland grass species in Florida. It is beneficial for erosion control, livestock forage and wildlife use. It has relatively high seed production and seedling vigor, making it one of the best candidates for use in a native seed mix. In the fall of 1996, the PMC completed assembly of 138 accessions of lopsided indiagrass, collected from over 48 of the 67 counties in Florida. Trials were established on irrigated and non-irrigated plots at the PMC in 1997. Evaluations were conducted for three years. All accessions lived only two years on the irrigated site, due to soil-borne pathogens. Several accessions persisted throughout the three years on the non-irrigated site. No accession showed superior performance in all evaluation criteria. Twenty-five top performers were selected out of this assembly, and are in the process of being increased for further evaluation. To maximize genetic diversity, superior accessions will be allowed to

cross with each other. Composite material is to go through a short period of advanced evaluation prior to commercial release.

Because demand is high, and the need for technology is great, some seeding and cultural management trials have already been conducted for this species. Results from seeding trials are reported in another paper in these proceedings entitled, "Seeding Two Native Grass Species on Reclaimed Phosphate Minedlands". Initial seedling establishment has been quite good. However, persistence is a problem. In an effort to begin developing cultural practices that will make seed production economically profitable for commercial seed growers, a residue management trial was conducted at the PMC (USDA NRCS Plant Materials Center, 1999). Summer and winter clipping and burning treatments were applied to a three-year-old stand of lopsided indiagrass. Summer burning significantly reduced plant populations and the amount of seed produced per acre (Table 1). Highest production came from summer clipped plots. Overall, seed production was poor during the third year of this stand. Seed produced in 1998, prior to application of any residue management treatments, was an average of 75 lbs./ac. for the field with 26% viability. This species appears to be very susceptible to soil pathogens, and stands only persist for two to three years. Further cultural management technology must be developed before seed production can become economically feasible.

Table 1. Lopsided indiagrass average % plant loss, seed production (lbs./ac.), and % viable seed under 5 residue management treatments in 1999.

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

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

Chalky bluestem [*Andropogon glomeratus* var. *glaucoptis* (Ell.) C. Mohr] is normally found around the margins of fresh water bodies and in wet flatwoods sites. It has excellent seed production and good potential for use in erosion control, water quality, livestock forage and wildlife cover. Chalky bluestem was assembled in the form of seed from 43 counties in Florida, in the fall of 1996. A total of 91 accessions

were collected. Initial evaluation trials were established on a well drained and a poorly drained irrigated site at the PMC. Evaluations were conducted for three years, and ten superior performers were selected in the fall of 1999. Superior accessions are to be planted together in an increase block to maximize the genetic diversity of the release. Increased material will be used for advanced evaluation trials, to develop base-line adaptability and establishment technology.

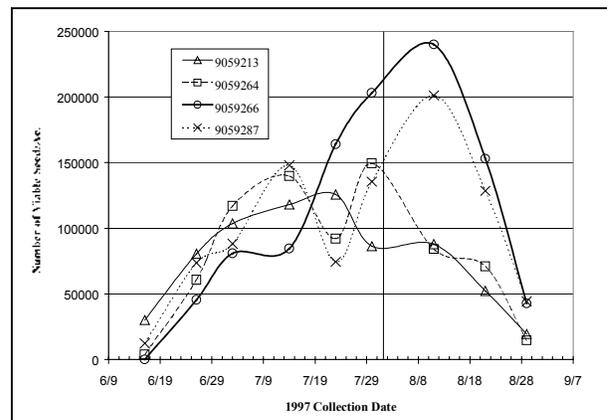


Figure 1. Number of viable seed/ac. collected weekly from 4 accessions of eastern gamagrass.

Eastern gamagrass [*Tripsacum dactyloides* (L.) L.] has received intense scrutiny in the US 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. An assembly of Florida ecotypes of eastern gamagrass planted at the PMC was evaluated in 1996 and 1997 for seed production and plant performance (USDA NRCS Plant Materials Center, 1996). Seed was collected weekly during the growing season from selected accessions, and checked for viability. Although Florida accessions of eastern gamagrass produce seed June through August, it was discovered that maximum viability occurred within two weeks of August 1 in both years. An example of this is shown in Figure 1 for the top four seed producing accessions in 1997. These four accessions were planted in increase plots in 1999 at the PMC, in preparation for advanced evaluation trials.

One of the accessions, 9059213 (originally collected from Clay Co.) was evaluated for forage production in a trial that included accessions from four other states. The test took place at the PMC in 1996 through 1998 on irrigated, well-drained coarse sandy soils. Accession 9059213 produced a maximum of 16,141 pounds of dry matter per acre (18,094 kg/ha) and was second in 3-year average production (USDA NRCS Plant Materials Center, 1998). This same test was also conducted at five other PMC's, including

Georgia, Mississippi, Arkansas, East and Northwest Texas. Florida accessions winter killed at all locations except Americus, GA and Nacogdoches, TX. Having evolved in a subtropical climate, Florida accessions did not have dormancy mechanisms that would keep them from beginning spring regrowth too early in the season in more northern climates. This test was a good opportunity to determine adaptation ranges and forage production characteristics for superior eastern gamagrass selections from the southeast region.

Although not associated with the FIPR work, two accessions of eastern gamagrass were found in the original Florida assembly with a very attractive blue-green color and robust growth habit. These accessions have great potential for use in xeriscape landscape plantings and in buffer strips. They were vegetatively released onto the commercial market in March of 2000.

Hairawn muhly [*Muhlenbergia capillaris* (Lam.) Trin.] grows on a variety of sites from very dry to marshy. It has fair seed production, and seedling vigor under favorable conditions. Potted muhly plants held in the PMC shadehouse were observed to vigorously seed into adjacent pots if seedheads weren't kept cut back. Ninety-four accessions of muhly have been collected from around the state, and were planted in an initial evaluation trial at the PMC in March of 2000.

Wiregrass (*Aristida beyrichiana* Trin. & Rupr.) is often the dominant grass species in Florida uplands. Foresters have long preferred this species for pine forest understory because of its ability to carry fire. Much information has recently been developed for establishment practices for this species. This information was also reported in the paper "Seeding Two Native Grass Species on Reclaimed Phosphate Minedlands". Cultural management effects, including canopy removal, fertility and burn frequencies, on viable seed production are being studied at the PMC. No conclusions can be drawn until two more years of data are collected.

Switchgrass (*Panicum virgatum* L.) has also received a great deal of attention as a forage grass for livestock. It produces a tremendous amount of high quality, palatable forage in the early part of the growing season. It provides cover for wildlife, birds and other small animals eat the seed. The Florida PMC has been working to develop Florida strains of switchgrass for many years. Several accessions have been found with excellent forage production characteristics. The one limiting factor, however, has been reliable production of viable seed. A project is currently being developed with the University of Florida, Gainesville, to assemble

a state-wide collection of switchgrass. Collections are to undergo an intensive three-year breeding program to develop one or more strains with high seed production characteristics. It is expected that this project will take at least five years before a strain is developed and ready for advanced field evaluations.

Several native grasses in Florida are desirable candidates for revegetation, which produce little or no viable seed. Instead, they have an extensive rhizomatous root system, and can be fairly easily established by sprigging or diking rhizomes into prepared sites (Yarlett, 1996). Such is the case with common maidencane (*Panicum hemitomon* Schult.) and blue maidencane [*Amphicarpum muhlenbergianum* (Schult.) Hitchc.]. Common maidencane typically grows along the edges of marshes, lakes, and freshwater bodies throughout Florida. However, it can also be found in sandhill sites. It is used for erosion control and protecting water quality. In 1998, the PMC released 'Citrus Germplasm' maidencane as a selected release onto the commercial market. Though it has been formally released, advanced evaluation trials continue to be conducted, in order to establish off-site performance and adaptation range.

Blue maidencane can typically be found in the moisture zone above common maidencane in mesic sites. It also has tremendous potential for use in erosion control and maintaining water quality, because of its extensive fibrous root system. Approximately 150 blue maidencane accessions gathered from around the state were placed in initial evaluation trials in 1999. Eleven superior performers were selected and are in the process of being increased in 2000, in preparation for advanced evaluation trials.

Conclusions

Over the past five years, the Florida PMC has been conducting a large body of assembly and evaluation work to begin meeting the demand for native species. Six species of Florida seed producing native grasses, along with one vegetatively reproduced grass are being moved rapidly through the evaluation process. One species, maidencane, has already been commercially released. The pressing need for commercial releases, however, must also be balanced with technology development. Native species are typically more expensive and difficult to establish than commercially available introduced cultivars, that have undergone decades of selective breeding. Two to four additional years of testing on native species can provide a great deal of vital information necessary for successful stand establishment and production.

Literature Cited

- Havens, K. 1998. The genetics of plant restoration, an overview and a surprise. *Restoration & Management Notes*. 16:1 (Summer). pp. 68-72.
- Pfaff, S.L. and M.A. Gonter. 1996. Florida Native Plant Collection, Production and Direct Seeding Techniques: Interim Report. USDA NRCS, Brooksville, FL and FL Inst. Of Phosphate Res. Bartow, FL. 61 pp.
- Platt, W.J., G.W. Evans, and M.M. Davis. 1994. Effects of fire season on flowering of forbs and shrubs in longleaf pine forest. *Oecologia*. 76:353-363.
- USDA NRCS Plant Materials Center. 1995 - 1996 Activity Report. Brooksville, FL. pp. 17-18.
- USDA NRCS Plant Materials Center. 1998 Activity Report. Brooksville, FL. pp. 19-21.
- USDA NRCS Plant Materials Center. 1999 Activity Report. Brooksville, FL. pp. 31-32.
- Yarlett, L. L. 1996. Common Grasses of Florida and the Southeast. Florida Native Plant Society. Spring Hill, FL. 168 pp.