USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service
Plant Materials Program

# 2011 ANNUAL TECHNICAL REPORT

## NORMAN A. BERG NATIONAL PLANT MATERIALS CENTER

Finding innovative vegetative solutions for emerging conservation challenges in Delaware, Maryland, Pennsylvania and Virginia for over 77 years.


A collection of international correspondence received by the Norman A. Berg National Plant Materials Center throughout its 77 year history

UNITED STATES DEPARTMENT OF AGRICULTURE

NATURAL RESOURCES CONSERVATION SERVICE

NORMAN A. BERG NATIONAL PLANT MATERIALS CENTER

# 2011 ANNUAL TECHNICAL REPORT




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## TABLE OF CONTENTS

## PLANT MATERIALS CENTER HISTORY

The National Observational Nursery Project was established in Beltsville, Maryland in 1935 as a conservation plant nursery for the Soil Conservation Service (SCS) Division of Nurseries. By 1939, the campus of buildings and greenhouses had been constructed by the Civilian Conservation Corps. In the early years, vast quantities of grass seed and trees were produced to facilitate SCS programs restoring farmland devastated by the Dust Bowl. Over time, the nursery's mission would evolve to address diverse resource concerns, from finding alternative oil and rubber crops to supporting the nation's war effort in Europe, collecting and distributing foreign plant materials, and developing native conservation plant releases.

In May 2009 the National Plant Materials Center was renamed the Norman A. Berg National Plant Materials Center (NPMC) honoring Norman A. Berg, an early SCS administrator and life-long conservationist. Mr. Berg's legacy has inspired generations of conservationists, having a positive and lasting impact on NRCS.

Current research activities at the NPMC include designing optimal forage for managed grazing systems, increasing diversity in NRCS conservation plantings, and designing herbaceous buffers to control poultry house emissions.

Since 1939, the NPMC has had 12 Managers (see Table 1), including landscape restoration pioneer Franklin J. Crider and current National Program Leader John Englert.

**Table 1: National plant materials center managers, 1939 to present.**

| CENTER MANAGERS | DATES OF SERVICE |
|---|---|
| Franklin J. Crider | 1939 - 1948 |
| Wilmer W. Steiner | 1948 - 1955 |
| Robert B. Thornton | 1955 - 1968 |
| H. Wayne Everett | 1969 - 1973 |
| Gilbert Lovell | 1973 - 1978 |
| Michael McCrary | 1978 - 1979 |
| Stephen K. Salvo | 1979 - 1983 |
| James Briggs | 1983 - 1989 |
| J. Eric Scherer | 1990 - 1991 |
| J. Scott Peterson | 1991 - 1994 |
| John Englert | 1995 - 2008 |
| Jeremy West | 2009 - 2012 |

## SITE AND CLIMATE INFORMATION

The NPMC is located in Beltsville, Maryland (Latitude 39N 1' 1.9482" and Longitude 76W 51' 7.7574"). It is located in the Northern Coastal Plain region of the North Atlantic Slope Diversified Farming Land Resource Area (MLRA) (see Figure 1). This area is characterized by rapid urbanization and the resultant development-related water quality degradation.

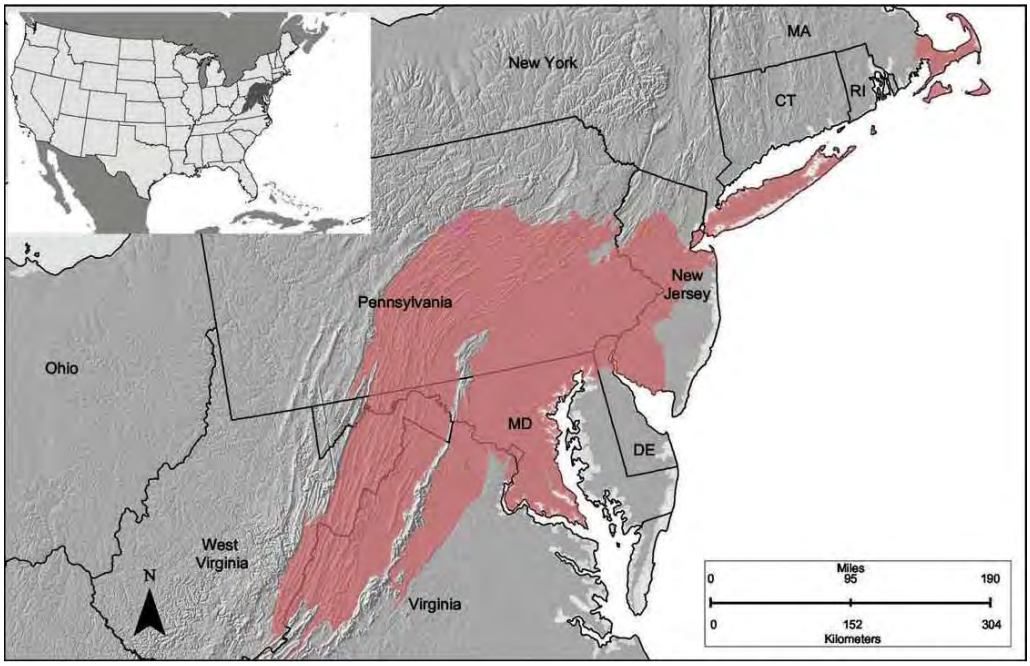


**Figure 1: The North Atlantic Slope Diversified Farming Land Resource Area (red) covers approximately 40,865 square miles of nine mid-Atlantic states and the District of Columbia (MLRA Explorer Custom Report).**

The 285 acre, NRCS-owned farm site is on the east campus of the Beltsville Agricultural Research Center, among approximately 7,000 acres of federal properties utilized by such entities as Agricultural Research Service, Secret Service and National Aeronautics and Space Administration. The principle use of the surrounding federal properties is agricultural research.

The NPMC's mean elevation is 147 feet above sea level. The most common soil map units are Russett-Christiana complex (30%) and Christiana- Downer complex (24%). Other soil map units include the Downer-Hamonton complex (8%), frequently flooded Zekiah and Issue soils (8%) and others (31%). Surface soil textures tend to be silt loam (34%) or fine sandy loam (30%) with some loamy sand (20%) or sandy loam (10 %). Forty-one percent of the soils at the NPMC belong to Non-irrigated Land Capability Class 2 and are soils with moderate limitations for crop production. Twenty-two percent of the soils belong to Land Capability Class 3 and are soils with severe limitations for crop production. Less than 3% of the total acreage belongs to Land Capability Class 1 with few limitations. Over 63% of the NPMC is considered prime farmland, with 22% of this area considered farmland of state importance and 12% requiring irrigation to reach prime potential.

Based on climate data provided by the University of Maryland, precipitation in Beltsville during 2011 was slightly less than the average summer precipitation over the preceding 70 years (see Figure 2). The months of August and September in 2011 showed increases of 189% and 146% over the 70-year monthly averages. Excessive August precipitation was largely due to Hurricane Irene and in September to Tropical Storm Lee.

Snow fall in 2011 was negligible, with only 10.9 inches. . The average monthly temperature during 2011 was approximately 3 degrees higher than the preceding 70 years, with the greatest increases of 4.9 and 5.4 degrees in November and December, respectively (see Figure 3). Only January was colder than the 70 year average.

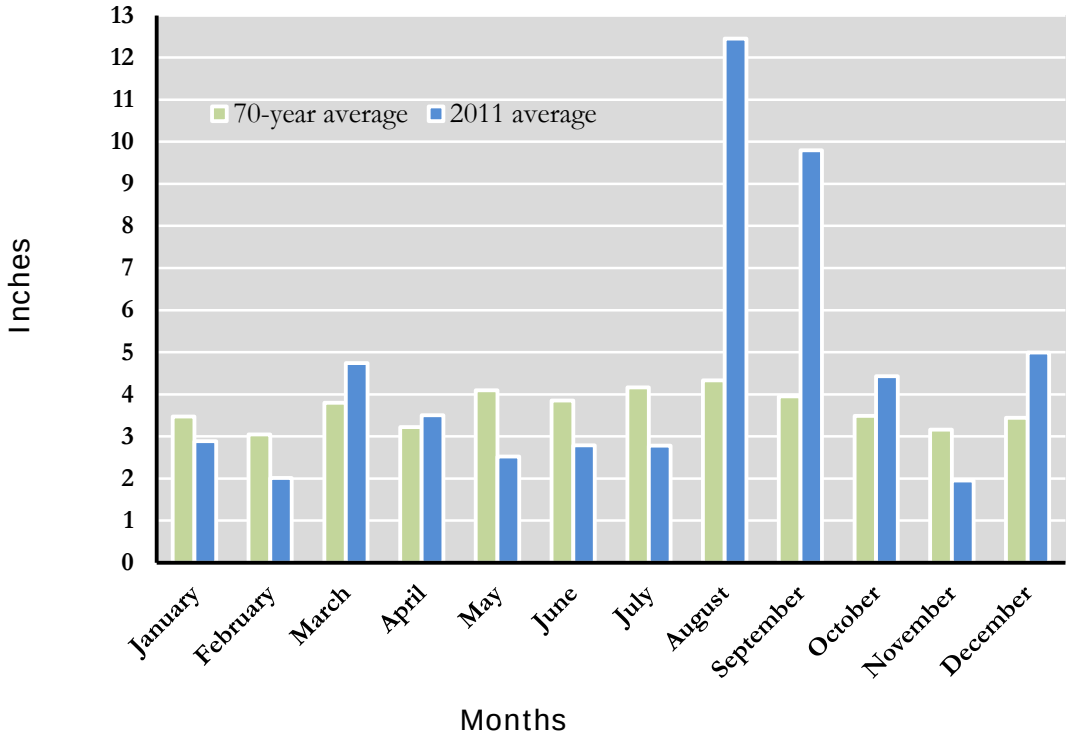


Figure 2: Beltsville weather data: average monthly precipitation (snow and rainfall) for 1941-2011 and 2011. Data provided by University of Maryland, Department of Atmospheric and Oceanic Science.

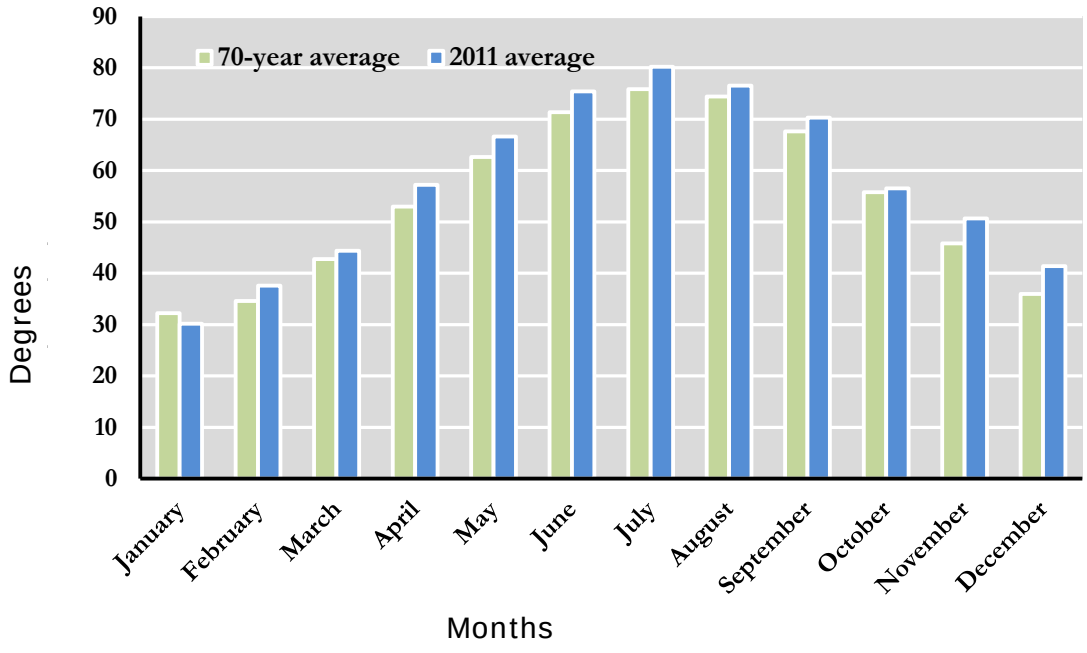


Figure 3: Beltsville weather data: average monthly temperatures for 1941-2011 and 2011. Data provided by University of Maryland, Department of Atmospheric and Oceanic Science.

## SERVICE AREA

The NPMC does not have a defined Service Area. The NPMC's area of focus is the Chesapeake Bay, in particular the states of Delaware, Maryland, southern Pennsylvania and northern Virginia. The NPMC also plays an integral role supporting the Plant Materials Program nationwide.

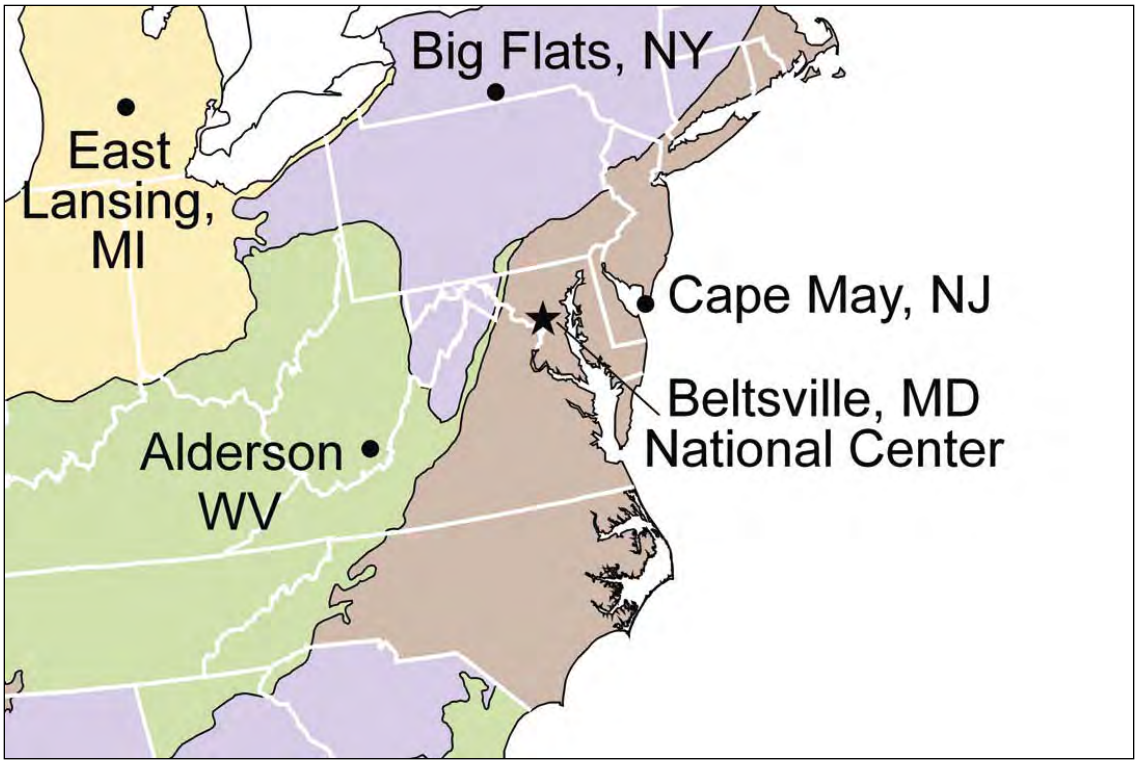


**Figure 4: Map showing the NPMC focus area and adjacent PMCs.**

# LONG RANGE PLAN

The Long Range Plan (LRP), or strategic plan, for the NPMC is designed to guide operations from 2012 through 2017. The LRP was adopted in 2012, from goals and objectives determined by the PMC State Conservationist Advisory Committee in 2011. The LRP was developed in collaboration with the Cape May PMC. The goals and objectives are utilized by both NPMC and Cape May PMC, with each PMC responsible for specific research activities or strategies.

The 2012-2017 LRP GOALS and OBJECTIVES are listed below:

**GOAL I: MANAGE AND RECOVER EXCESS NUTRIENTS TO REDUCE IMPACTS TO SURFACE AND GROUND WATER EFFICIENTLY AND ECONOMICALLY.**

Obj. A: Develop cover crop/green manure technical resources.
Obj. B: Enhance NRCS field staff capacity with training and public understanding of nutrient management and ground water quality with information/education.

**GOAL II: IMPROVE SOIL HEALTH AND SOIL QUALITY WHILE MINIMIZING INPUTS AND MAXIMIZING OUTPUTS TO INCREASE SUSTAINABLE YIELDS ON WORKING AGRICULTURAL LANDS AND FORESTS.**

Obj. A: Evaluate plants to improve soil quality.
Obj. B: Evaluation and management of desirable plants for bio-fuels.
Obj. C: Enhance NRCS field staff capacity with training and public understanding of soil health and quality issues with information/education.

**GOAL III: MANAGE NATURAL RESOURCES TO ENSURE CLEAN AND ABUNDANT AIR AND WATER FOR HEALTHY AND SUSTAINABLE ECOSYSTEMS, BEING RESPONSIVE TO CHANGING ENVIRONMENTAL FACTORS.**

Obj. A: Develop vegetative methods to protect water quality.
Obj. B: Plant materials evaluations for environmental mitigation.
Obj. C: Enhance NRCS field staff capacity with training and public understanding of conservation challenges with information/education.

**GOAL IV: MAINTAINING, PROTECTING AND RESTORING HEALTHY PLANT AND ANIMAL COMMUNITIES WITH SUSTAINABLE HABITATS THAT WILL PROVIDE ECOSYSTEM BENEFITS.**

Obj. A: Conserve pollinators/beneficial insects.
Obj. B: Vegetative methods to improve wildlife habitat.
Obj. C: Invasive plant control in critical areas, weed control/invasives without herbicides.
Obj. D: Enhance NRCS field staff capacity with training and public understanding of sustainable and healthy plant and animal communities with information/education.

# 2011 TECHNOLOGY TRANSFER

## PUBLICATIONS

- 2010 Annual Technical Report
- 2010 Great Smoky Mountains National Park (annual report)
- Conservation Cover (327) Maryland Job Sheet – Warm-Season Grasses
- Norman A. Berg National PMC 2010 Progress Report of Activities
- Odor Eaters – Indigenous Plants a Practical Solution for Poultry Pollution (newspaper article)
- Plant Fact Sheet, American Vetch
- Plant Fact Sheet, Culver's Root
- Plant Fact Sheet, Swamp Milkweed
- Warm-Season Grass Management Trials in Maryland (abstract)
- Warm-Season Grass Management Trials in Maryland (poster)
- Warm Season Grass May Benefit Effectiveness of House Fans (newspaper article)
- Warm-Season Grasses Ability to Mitigate Poultry Tunnel Fan Emissions (abstract)
- Warm Season Grasses Ability to Mitigate Poultry Tunnel Fan Emissions on the Delmarva Peninsula (poster)

**TRAINING SESSIONS**

- Basics of Plant Propagation (training-general public)
- Delmarva Hay and Pasture Conference (presentation/training-general public/NRCS)
- Innovative Storm Water Management Using Native Plants (training-general public)
- ONE Training for New Employees (presentation/training)
- Pollinator Conservation Short Course (training-general public/SCD staff)
- Pollinator Conservation Short Course (training-NRCS/Federal agencies)

**PRESENTATIONS/EXHIBITS/TOURS**

- 9th Annual Mid-Atlantic Crop Management School (presentation/program outreach)
- 66th SWCS International Annual Conference (exhibit/program outreach)
- 66th SWCS PMC Tour (PMC tour-general public)
- 2011 Maryland State Fair (exhibit/program outreach)
- American Society of Agronomy – Northeastern Branch Meeting (presentation)
- Earth Day 2011, APHIS Pollinator Event (exhibit/program outreach)
- Greenbelt Garden Club PMC Tour (PMC tour-general public)
- Lahr Symposium Tour (PMC tour-general public)
- MD NRCS State Office Field Tour (PMC tour-NRCS)
- NAPPC-NACD Farmer-Rancher and the Pollinator Advocate Awards Reception (exhibit/program outreach)
- National PMC/Cape May PMC Long Range Planning Session (presentation)
- Vegetative Environmental Buffers of Poultry Facilities (project tour-general public/NRCS)
- Yale University Federal Career Month (presentation/program outreach)

# 2011 STUDIES

The NPMC staff works with the Technical Advisory Committee and Regional Plant Materials Specialist to plan and develop research studies addressing conservation challenges identified in the Long Range Plan. All studies active in 2011 are listed in Table 2.

**Table 2: Study numbers, names and objectives for active 2011 studies at the NPMC.**

| |
|---|
| **ID Number:** MDPMC-P-0801-BU<br>**Name:** Development of a Mid-Atlantic Composite Release of Beaked Panicgrass (*Panicum anceps* Michx.)<br>**Objective:** Develop a composite release of beaked panicgrass for soil erosion/sediment control.<br>**Status:** Concluded in 2012. |
| **ID Number:** MDPMC-P-0802-BU<br>**Name:** Development of a Mid-Atlantic Composite Release of Gray Goldenrod (*Solidago nemoralis* Aiton)<br>**Objective:** Develop a composite release of gray goldenrod for soil erosion/sediment control.<br>**Status:** Concluded in 2012. |
| **ID Number:** MDPMC-P-9801-BU<br>**Name:** Evaluation and Release of Indiangrass (*Sorghastrum nutans*) for the Mid-Atlantic U.S.<br>**Objective:** Develop a selected class composite release of Indiangrass for wildlife plantings.<br>**Status:** Concluded in 2012. |
| **ID Number:** MDPMC-P-9803-BU<br>**Name:** Development of a Mid-Atlantic Composite Release of Virginia Wildrye (*Elymus virginicus)*, Southeastern Wildrye *(E. glabriflorus)*.<br>**Objective:** Develop a conservation plant release for soil erosion/sedimentation control and wildlife.<br>**Status:** Concluded in 2012. |
| **ID Number:** MDPMC-T-10-PA<br>**Name:** Adaptation Trial of Superior Warm-Season Grasses (gamma grass, big bluestem, Indiangrass and switchgrass) Selected for Advanced Testing<br>**Objective:** Evaluate the area of adaptation for gamma grass, big bluestem, Indiangrass and switchgrass.<br>**Status:** Data collection to continue in 2012. |
| **ID Number:** MDPMC-T-0501-PA<br>**Name:** Native Warm-Season Grass Forage Variety Trial<br>**Objective:** Provide producers with the latest information on variety performance in Maryland's growing conditions.<br>**Status:** Project will continue with an offsite evaluation and palatability study. |

**ID Number:** MDPMC-T-0502-PA
**Name:** Cool-season grass forage variety trial
**Objective:** Provide producers with the latest information on variety performance in Maryland's growing conditions.
**Status:** Concluded in 2012.

**ID Number:** MDPMC-T-0503-PA
**Name:** Bermudagrass forage variety trail
**Objective:** Provide producers with the latest information on production of commercially available Bermudagrass.
**Status:** Project will continue with offsite evaluation.

**ID Number:** MDPMC-T-0602-WI
**Name:** Plant species for use as vegetative environmental buffers (VEBs) to improve air quality and poultry production facilities
**Objective:** Develop VEBs to improve air quality at poultry production facilities.
**Status:** Project will continue with offsite evaluation.

**ID Number:** MDPMC-T-0803-WI
**Name:** Warm-Season Grass Management Trials
**Objective:** Determine optimal methods for renovating warm-season grass stands to increase diversity and provide improved wildlife habitat.
**Status:** Concluded in 2012.

**ID Number:** MDPMC-T-0804-BU
**Name:** Effects of nitrogen fertility on the seed production of two native plant species: Southeastern wildrye (*Elymus glabriflorus*) and beaked panicgrass (*Panicum anceps*)
**Objective:** Maximize seed production while minimizing fertilization inputs.
**Status:** Data collection to continue in 2012.

**ID Number:** MDPMC-T-0804-WI
**Name:** Wildflower Persistence Study
**Objective:** Determine the persistence of Maryland native wildflowers in established warm-season grass stands.
**Status:** Concluded in 2012.

**ID Number:** MDPMC-T-9604-RE
**Name:** NRCS-NPS Great Smoky Mountains Revegetation Project
**Objective:** Provide seed cleaning services to Great Smoky Mountain National Park to facilitate parkland revegetation efforts.
**Status:** Need will be reassessed annually by NPS.

# DEVELOPMENT OF A MID-ATLANTIC COMPOSITE RELEASE OF BEAKED PANICGRASS – FINAL REPORT

**ID Number:** MDPMC-P-0801-BU

## Introduction

Beaked panicgrass (*Panicum anceps* Michx.) is primarily a clump-forming, warm-season, perennial grass with two subspecies. One is a lowland ecotype, *P. anceps* ssp. *rhizomatum* Hitch & Chase, and is found only in the Coastal Plain. The other, an upland ecotype, *P. anceps* ssp. *anceps* Michx, is evenly distributed throughout the range. Both subspecies are rhizomatous, but *P. anceps* ssp. *rhizomatum's* rhizomes are longer. Researchers at the Norman A. Berg National Plant Materials Center (NPMC) and Dr. Sara Tangren of Chesapeake Natives, Inc., studied 17 populations of beaked panicgrass from Maryland and Virginia (see Figure 5). The goal was to select a source-identified release useful for soil stabilization, grazing and re-vegetation of mined sites and other disturbed areas. Beaked panicgrass is common in the Piedmont and less so on the Coastal Plain, yet it is tolerant to a wide range of habitats including well-drained sandy to waterlogged sites.

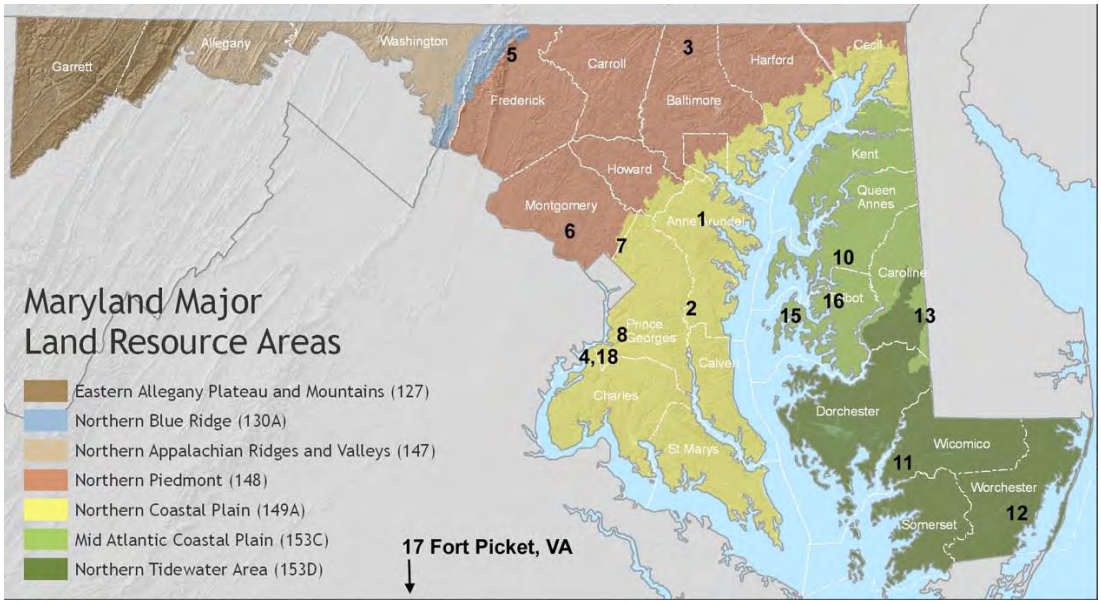


**Figure 5: Parent population locations of beaked panicgrass indicated by NRCS propagation numbers. The map shows parent population by geologic province, with all but one accession originating in Maryland. Please note the population from Fort Picket, VA. Map courtesy Amanda Moore USDA, NRCS 2009.**

Beaked panicgrass has tremendous potential for soil stabilization. In the 1940s, 1960s and 1980s various conservation organizations were experimenting with beaked panicgrass. This research involved meadow establishment, forage production on poor soils, surface mine stabilization, germination requirements (Kujawski, 2001) and developing a cultivar for soil stabilization purposes (Grabowski, 2004). Livestock and deer graze beaked panicgrass from early spring to late fall. Livestock grazing should be deferred through the summer to improve plant vigor and density. The plant produces prodigious amounts of seed that are a food source for terrestrial and water birds.

## Experimental Design and Conduct

Multiple methods were used to locate wild populations of beaked panicgrass, including examining herbarium vouchers. Table 3 lists the propagation numbers, county and site location for the Maryland and Virginia parent populations.

**Table 3: Collection data of parent beaked panicgrass populations, by county, site location and relative population size. Please note that it is common for herbaceous plant population abundance to be estimated visually in categories of one to 10, 10 to 100, 100 to 1000, etc.**

| Propagation # | County | Site Location | Approximate # plants in population |
|---|---|---|---|
| 1 | Anne Arundel | Piney Orchard Power Line | 10,000 |
| 2 | Anne Arundel | Sands Road Telephone Line | 100 |
| 3 | Baltimore | Parkton Verizon Power Line | 50 |
| 4 | Charles | Kabin on the Korner | 10,000 |
| 5 | Frederick | Auburn Road | 10,000 |
| 6 | Montgomery | Potomac Power Line | 1,000 |
| 7 | Prince George's | Sellman Road Power Line | 1,000 |
| 8 | Prince George's | Foust Road Telephone Line | 1,000 |
| 9 | Queen Anne's | Lands End Rd TL | 25 |
| 10 | St. Marys | Queens Landing Road | 10,000 |
| 11 | Wicomico | Rt 352 Telephone Line | 10,000 |
| 12 | Worcester | Rt 376 Telephone Line | 5 |
| 13 | Worcester | Rt 611 Telephone Line | 100 |
| 14 | Caroline | Sand Hill Road, Rt 404 and Noble Rd. | 10,000 |

*Seed Germination:* There has been limited experimentation on the germination of beaked panicgrass populations. Tests performed in conjunction with Chesapeake Natives, Inc. demonstrated that beaked panicgrass seed germination responds well to cold moist stratification. Treatments for the 12 accessions propagated out of the 14 parent populations included origin of the seed (parent population) and cold stratification duration (30, 60, or 90 days). Seed was sown into 179 (98 and 144 cell) trays using a seed-sowing machine. Cold stratification was at 40°F and 50% humidity. As the length of stratification increased, so did the germination percentage. The highest germination percentage, approximately 50%, occurred after 90 days, and then the germination percentages level off (see Figure 6). Propagation requires 14 to 15 weeks from germination to finished plug.

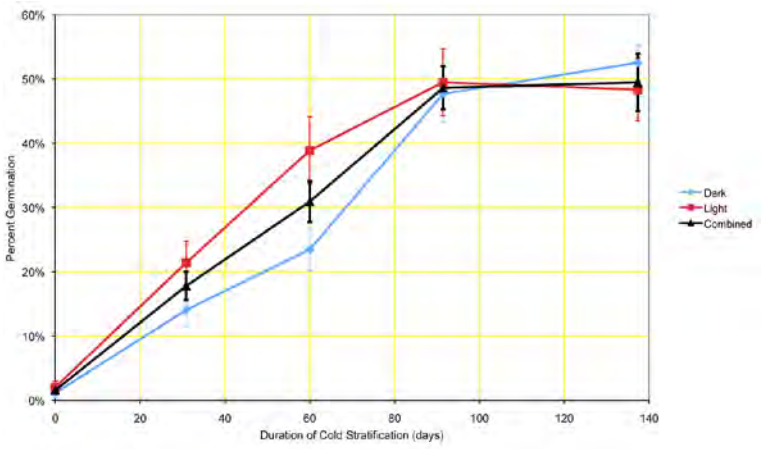


**Figure 6. All treatments show increased germination percentages with cold stratification. The percent germination increases with the number of days in cold stratification, until 90 days when germination rates become stable regardless of treatment.**

*Parent Population Seed Germination Results*: A significant source of variation in the germination experiments was due to the collection site (see Figure 7). Whether the differences are due to parent population's genetics, seed collection date or other factors cannot be determined, and needs further examination. Such a determination would require multiple collections from the same sites and multiple years.

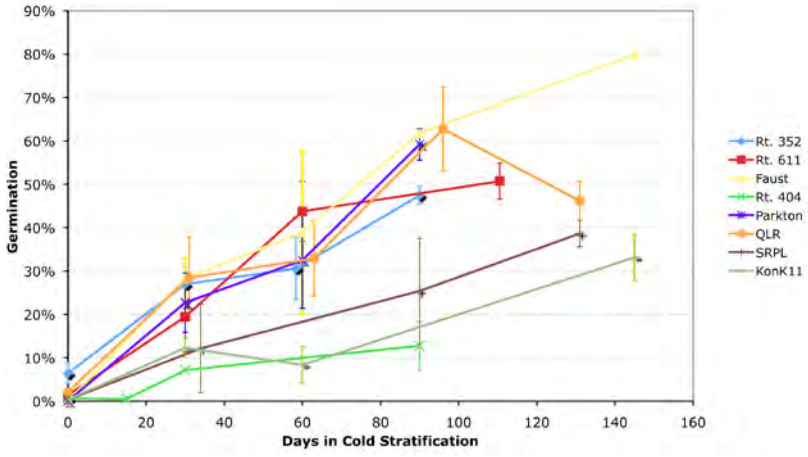


**Figure 7. Germination in all eight lines increased with stratification time. The rate of the increase was affected by collection site.**

*P. anceps* ssp. *rhizomatum:* The Rt. 404 collection site in Caroline County Maryland, (see Figure 1, and Propagation #14 of Table 1) had a significantly low germination percentage, approximately 12% after 90 days cold stratification (see Figure 7). A small amount of seed was collected from a large parent population, this seed produced only five plugs and it was not possible to advance it to the trials. Three distinguishing collection site features were noted:

1. Uniform sized plants and seed maturity date.
2. Large population (over 10,000 plants).
3. Small seed size

The habitat, location and seed size suggest that this population may be subspecies *rhizomatum*. Nine other populations were collected in the Maryland Coastal Plain region; all had good germination rates. If this population is subspecies *rhizomatum*, then the individual plants would be closely related and contain limited genetic diversity. Confirming this requires a second Rt. 404 site visit in order to observe the root structure of the population. This rhizomatous species could be superior to the clump forming species since it would most likely be highly successful in fully populating a site.

*Evaluation Fields Establishment*: Starting in mid-May 2008, the beaked panicgrass evaluation fields were established at three different geographic areas covered by this project:

1. Coastal plain east of the Chesapeake Bay – A farm in Talbot County.
2. Coastal plain west of the Chesapeake Bay – On the NPMC grounds located in Prince George's County.
3. Piedmont – A farm in Carroll County.

*Field layout:* Field layout and installation considerations included: the number of accessions for each species, the number of replicate blocks to be planted, plant vigor, size and the width of the small plot combine.

In May 2008, three replications of one year-old beaked panicgrass multipot-plugs (one inch in width by four inches in length) were planted in 14 rows with 10 plants in each row. Each plant was planted two feet apart with four feet between rows and with five foot borders. The field was irrigated during plant establishment for the first growing season only during dry periods using hoses and impact sprinklers when less than one inch of precipitation occurred during a week. Weed competition was limited by spring herbicide applications of surflan (active ingredient oryzalin, 3oz/gal) SedgeHammer$^{tm}$ (active ingredient halosulfuron .9 oz/gal) and three way amine (active ingredient 2, 4 D, dicamba, and mcpp .75 oz/gal). Mechanical cultivation also limited weed competition and achieved 100% groundcover in only two growing seasons (see Figure 8).

Beaked panicgrass (see Figures 8 and 9) consists primarily of low basal foliage until the culms begin to send up panicles in June. By July, the plants are approximately three feet tall, with the upper foot or so consisting primarily of panicles. The plants continue to produce new panicles into the fall. Based on ten, half gram samples it is estimated that beaked panicgrass seed contain an average of 4,640,260 seeds per pound. When planted in a no-till seed drill seed at a rate of approximately 20 seeds per square foot, each pound contains enough seeds to plant over five acres.

**Figure 8. Rows of beaked panicgrass growing in a sandy loam, July 2009 at the NPMC.**

**Figure 9. A close up image of a two-year old beaked panicgrass clump clearly showing the characteristic growth ring which is just becoming apparent. Grass blades radiate outward from an empty circle.**

## Discussion and Results

Beaked panicgrass tolerates a wide range of habitats, from well-drained sandy soil to waterlogged sites. It prefers growing in 35 percent shade and tolerates full sun situations. This adaptability makes it a perfect candidate for various conservation uses including: wet or mesic soils meadow establishment, and forage production for cattle and horses on poor soils. Ground nesting birds benefit from beaked panicgrass seed and habitat. The short stature and clump forming growth compliment wildflowers which can attract a diversity of pollinators.

Due to small seed size and large volume of seed produced per plant, care should be taken when cleaning beaked panicgrass seed. The seed cleans relatively easily; the NPMC uses an Eclipse 324 three screen clipper, 25 percent air setting, and a 12 x 12 (.018 inch x .018 inch) wire screen to achieve 73 percent pure seed. The moderate germination percentages (50%), lengthy cold stratification period (90 days) and over one year establishment period should be considered in critical areas in which a quick cover is required. Autumn sowing of a nurse crop, such as annual rye, in combination with beaked panicgrass, should alleviate this challenge.

It is important to note that even though beaked panicgrass collection sites varied widely throughout Maryland and Virginia (see Figure 1); the physical appearance of the various populations was very similar (see Figure 8). Spring green up, flowering dates and seed set were all observed to occur at roughly the same time. These similarities were consistent at all three evaluation sites.

*Project Termination:* After consultation with partners from the conservation seed industry it was determined that commercial seed growers were meeting the conservation needs for beaked panicgrass seed. Ernst Conservation Seed, Inc. currently offers a Mid-Atlantic provenance, beaked panicgrass (Worchester County Maryland) and will receive seed from this project in order to bolster the genetic diversity of its product. Additional seed will be deposited in Agricultural Research Service, National Plant Germplasm System, for long-term preservation of this species. Plants will be donated (September 2012) to local government and non-profit watershed agencies (City of Hyattsville, Parks Department and the Anacostia Watershed Society).

**References**

Grabowski, Janet, B. Baldwin and P. Meints. (2004). Selecting for Improved Seedling Establishment in Beaked Panicum. *Jamie L. Whitten Plant Materials Center 2004 Annual Technical Report.* p.16-17.

Kujawski, J., K.M. Davis (2001). Propagation protocol for production of container *Panicum anceps* plants; USDA NRCS – National Plant Materials Center, Beltsville, Maryland. In: Native Plant Network. www.nativeplantnetwork.org (accessed 3/12/11).

Tangren, S.A., C.F. Puttock (2010). *Maryland State Highway Administration Research Report; Development of Native Seed for SHA Projects: 3 Beaked Panicgrass* Project Number MD-2009-SP608B4K Final Reports. p.33.

# DEVELOPMENT OF A MID-ATLANTIC COMPOSITE RELEASE OF GRAY GOLDENROD - FINAL REPORT

**ID Number:** MDPMC-P-0802-BU

## Introduction

Gray goldenrod (*Solidago nemoralis* Aiton) is an herbaceous perennial plant that blooms in late summer and fall with potential value in a variety of conservation applications. Among its uses are wildlife habitat creation and providing hardy groundcover in harsh, sunny conditions in the Coastal Plain and Piedmont regions of the Mid-Atlantic. In 2009 researchers from the USDA Natural Resources Conservation Service's Norman A. Berg National Plant Materials Center (NPMC), in cooperation with Dr. Sara Tangren of Chesapeake Natives, Inc., implemented plans to develop a selected class, composite release of gray goldenrod.

After two successful years of establishment, mortality rates soared. Due to this high mortality, efforts to develop a composite release of gray goldenrod were abandoned. Gray goldenrod has the potential to be an important conservation plant if cultural practices can be developed to manage the short lived nature of the plant.

## Experimental Design and Conduct

An assembly of 12 Maryland provenance gray goldenrod populations was compiled for the study. Figure 10 shows collected parent population locations by Major Land Resource Area.

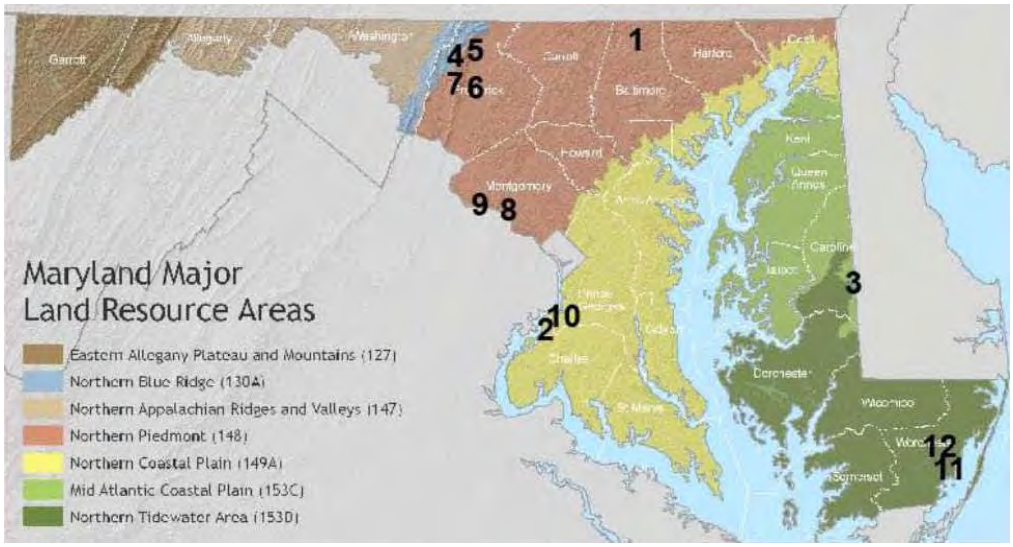


**Figure 10: Parent population locations of gray goldenrod indicated by NRCS propagation numbers. The map shows parent population by major land resource area, with the greatest number of populations coming from the Northern Piedmont. Map courtesy of Amanda Moore USDA, NRCS 2009.**

Although significant wild populations of gray goldenrod are rare, populations were collected from all three geographic areas covered by this project: Coastal Plain east of the Chesapeake Bay, Coastal Plain west of the Chesapeake Bay, and Piedmont (see Table 4).

**Table 4: Gray goldenrod site collection data, by propagation and accession numbers.**

| Propagation # | Accession # | Maryland County | Town | Site Description |
|---|---|---|---|---|
| 1 | 9106024 | Prince George's | Accokeek | Beretta Telephone Line |
| 2 | 9106025 | Caroline | Denton | Sand Hill Road |
| 3 | 9106026 | Frederick | Thurmont | Rt 15 CFSP Entrance |
| 4 | 9106027 | Montgomery | Potomac | Potomac Power Line |
| 5 | 9106028 | Worcester | Berlin | Rt 376 Telephone Line |
| 6 | 9106029 | Worcester | Assateague | Rt 611 Telephone Line |
| 7 | 9106030 | Charles | Indian Head | Kabin on the Korner |
| 8 | 9106031 | Frederick | Harmon | Gambrill Pk Rd |
| 9 | 9106032 | Baltimore | Parkton | Parkton Verizon Power Line |
| 10 | 9106033 | Frederick | Thurmont | Catoctin Hollow & Mink Farm Rd |
| 11 | 9106034 | Montgomery | Poolesville | River Road |
| 12 | 9106035 | Frederick | Hansonville | Rt 15, 1/4 mi N of Cemetery Dr. |

*Seed Germination*: In July, gray goldenrod reaches its maximum height of two to three feet. Seed ripens in the autumn and should be collected when the heads are brown and have become fluffy. Since germination percentages of fresh seed are low, 90 days of cold moist pretreatment is recommended. For this study, the seed were a pretreated with 90 days in a cold (40 degrees F) moist environment. The seedlings were grown in a greenhouse for approximately 10 weeks with greenhouse conditions maintained at approximately 70 degrees F.

*Evaluation Field Establishment:* In mid-May 2008, gray goldenrod evaluation fields were established in the three geographic areas covered by this project:

1. Coastal plain east of the Chesapeake Bay – Farm in Talbot County, MD,
2. Coastal plain west of the Chesapeake Bay – NPMC, Prince George's County, MD,
3. Piedmont – Farm in Carroll County, MD.

Field layout considerations included weed mat width, mower width (used to cut grass between the weed mats), number of accessions for each species, number of replicate blocks to be planted and small plot combine width (used to harvest the seed). A map of the ultimate field configuration can be seen in Figure 11. To suppress weed competition and make delineation among the 12 accessions easier, weed mat was laid using the model 1275FA mulch layer, Holland Transplanter Company (see Figure 12) pulled by standard farm tractor. Holes were burned in the weed mat with a modified electric charcoal starter. The modified electric charcoal starter was faster and provided more consistent holes than manually cutting "X"s for the plants. The electric charcoal starter was modified by bending the last four inches of the looped heating element perpendicular to its original design, creating a four inch long "U" shaped working surface, and securing the burner's handle to a four foot wooden tool handle (e.g., rake or broom). The electric charcoal starter modification and use are outside the tool's intended purpose; please exercise caution to avoid injury to staff or damage to equipment or infrastructure. The electric charcoal starter's heating element is extremely hot.

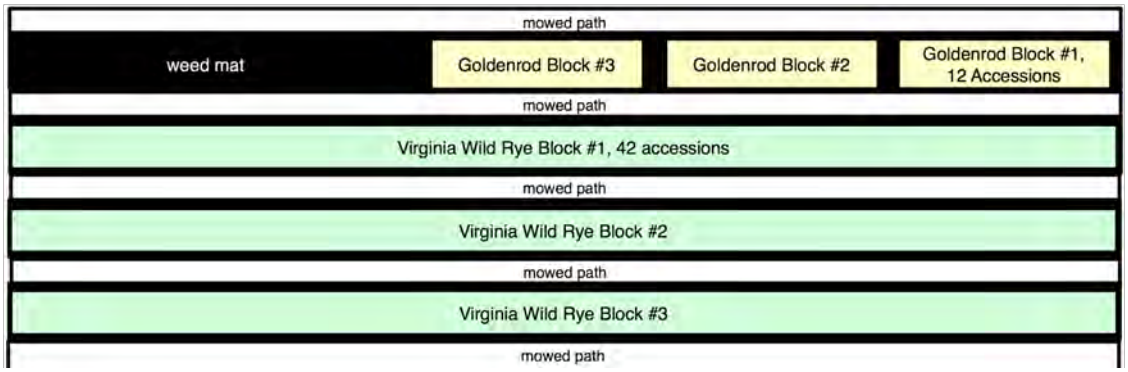


**Figure 11: Farm field map. The yellow rectangles show the locations of the gray goldenrod replication blocks. Adjacent plantings of Virginia wildrye can be seen below the gray goldenrod blocks utilized for this study.**

**Figure 12: NPMC staff using the mulch layer attachment to lay weed mat in preparation for planting the breeder blocks. Completed, weed mat covered beds can be seen to the left of the tractor.**

Once openings were burned in the weed mat, holes in the soil were made using a round dibble the approximate size of the plugs and the seedling plugs were planted and firmed into place. Accession numbers were painted onto the weed mat next to each accession plot using white permanent paint pens. In the weeks after planting, supplemental overhead irrigation was applied when rainfall totaled less than one inch per week.

The gray goldenrod field plots consist of a three foot by five foot rectangle of 15 plants. While most goldenrods are rhizomatous, gray goldenrod (eastern race) is one of the few exceptions (see Figure 13). Werner (1976) and Werner and Platt (1976), suggest that the lack of rhizomes relative to other goldenrod species is an adaptation to drier habitats, where an increase in vegetative growth would cause more demand for water than the soil could provide.

**Figure 13: A gray goldenrod plant being dug from the field. Basal foliage rosette is green and full. The root mat is fibrous and large and lacks the long rhizomes indicative of other goldenrods.**

## Discussion and Results

Gray goldenrod quickly establishes, attracts native pollinators, grows vigorously, withstands xeric growing conditions and is attractive in flower and flowers profusely; it was not long lived in the conditions provided in this study. During the first two years the plants flowered profusely and thrived. However, by the third year approximately 75 percent of the plants were dead. This high mortality rate was observed at all three test sites in the same year. Conservation seed industry partners are familiar with gray goldenrod being short-lived and use a two-year seed production period. There was no observed correlation between the high mortality and any of the highly varied physical characteristics among the selected gray goldenrod accessions (see Figure 14). Gray goldenrod seedlings were observed establishing at the NPMC downwind from the parent plants where the species had not been previously established or observed. The study concluded before second generation seedling longevity could be determined.

**Figure 14: This photograph shows gray goldenrod flowering period variation and plot design. Within the weed mat are three sets of five goldenrod plants arranged in rows. Each row has a painted label that indicates the accession. Note the considerable variation among the visible accessions. The accession at left (labeled R), has green flower buds while the accession in the center (labeled P) is a little past full bloom and starting to set some seed and the accession plot on the right (labeled O) is at peak bloom.**

*Solidago nemoralis* ssp. *decemflora*: It is important to note that gray goldenrod has eastern and western races. Populations west of the Appalachians (*S. nemoralis* ssp. *decemflora*) are tetraploid whereas populations in the east (*S. nemoralis* ssp. *nemoralis*) are predominantly diploid. Considered the same species, the western race is adapted to grow in prairies and the eastern race is adapted to grow in fields and open wood (savannah) edges. The western variety is an aggressive tetraploid, strongly rhizomatous and widely regarded as an agricultural weed. The western variety's native range does not extend into Maryland, and care should be taken that the aggressive western variety is not used.

*Project Termination:* After considerable plant mortality in the study's third year, consultation with partners from the conservation seed industry and continuous project evaluation revealed the limited potential for a gray goldenrod release in the Mid-Atlantic, it was decided that limited demand did not warrant further work. Gray goldenrod's short lifespan severely limits its suitability as a conservation release. The costs in time and materials to produce plants with such a short lifespan are simply too great and should be carefully considered before release efforts are renewed.

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Werner, P.A. (1976). Ecology of plant populations in successional environments. *Systematic Botany* **1**: 246-268.

Werner, P.A. and Platt, W.J. (1976). Ecological relationships of co-occurring goldenrod species (*Solidago*: Compositae). *American Naturalist* **110**: 959-971.

# EVALUATION AND RELEASE OF INDIANGRASS (SORGHASTRUM NUTANS) FOR THE MID-ATLANTIC U.S.

**Study No:** MDPMC-P-9801-BU

**Study Leader:** R. Jay Ugiansky, NPMC Resource Conservationist

**Objective:** Assemble a collection of Indiangrass from the Mid-Atlantic region, select for short, upright growth, disease resistance and uniform seed maturity and release as a selected class composite for general conservation

**Introduction:** Available Indiangrass (*Sorghastrum nutans*) varieties have been selected for use in critical area plantings or for forage. They are poorly adapted to the mid-Atlantic region and for use in wildlife plantings. These varieties are tall and highly competitive, growing in dense patches. Forbs are out-competed resulting in plantings with little wildlife value. Indiangrass is a perennial native warm-season (C4) tall bunch grass growing one to two meters tall in loose bunches from short, scaly rhizomes. Blooms occur in August with seed maturation in September.

**Procedure:** The initial evaluation block was planted at the University of Maryland, Keedysville farm in 1997 with all seed collected by Dr. Harry Swartz.

**Indiangrass accessions and collection site:**

- 9080079 (US 460, VA)
- 9080078 (Ft. Pickett, VA)
- 9080077 (Barclay, MD)
- 9080076 (Whiting RR, NJ)
- 9080075 (PG Co., MD)
- 9080073 (Lansdowne, VA)
- 9080074 (National Archives, MD)

Selections will be made over several generations for short stature and stiff stems to produce a release for use in developing and improving wildlife habitat.

**Potential Products:** Mid-Atlantic germplasm Indiangrass release.

**Status of Project:** In April/May 1999, 862 plants from seven accessions were transplanted to the NPMC and planted in a crossing block. In 2001, 14 individuals from each accession were dug and planted in a randomized crossing block. Seed was harvested from each accession in the crossing block in 2002. 200 plugs were grown from the seed harvested from each accession to establish a foundation field. The plugs were planted in a random pattern in rows three feet apart. Seed was harvested in 2004 and 2005 from this field and additional plants were started in 2004. Heights and seed maturity varied widely making seed harvest difficult. This variation precluded release of this material without further selection.

Plants were selected that were short and matured uniformly. In the spring of 2007, 23 plants were dug and divided. Plants were potted and grown for one month outside under automatic overhead irrigation to allow for re-growth of roots prior to field planting. A total of 105 plants survived (between two and eight divisions of each clump), and were planted in a random crossing block and irrigated. All 105 survived and grew well, but few seed heads were produced resulting in a small seed harvest in 2007. Seed harvested from selected plants in 2008 were planted in 2009 for further evaluation. Thousands of seed were germinated in 2009 and grown in deep plug trays. In 2010, plants were selected with stiff stems and upright growth and transplanted to quart size containers. Plants with short stiff stems were outnumbered by plants without these traits. Due to the high degree of variability many generations of selection are required to obtain a uniform population. Because the use of a selection with these characteristics would be limited the additional work required for a release is not justified at this time. Plant materials will be distributed to parties interested in continuing this work.

# DEVELOPMENT OF MID-ATLANTIC COMPOSITE RELEASES OF VIRGINIA AND SOUTHEASTERN WILDRYES – FINAL REPORT

**ID Number:** MDPMC-P-9803-BU

**Introduction**

Virginia wildrye (*Elymus virginicus*) and southeastern wildrye (*Elymus glabriflorus*) are native, perennial, cool-season bunchgrasses. They have a multitude of beneficial characteristics, including rapid and high germination rates (85%), long term seed viability, suitability for slope and critical area stabilization, tolerance of well-drained sandy to waterlogged sites and providing palatable and nutritious grazing. Researchers at the USDA Natural Resources Conservation Service's Norman A. Berg National Plant Materials Center (NPMC) and Dr. Sara Tangren of Chesapeake Natives, Inc., studied 39 populations of wildrye from Maryland, Delaware and West Virginia (see Figure 15.) The study's goal was to select composite releases useful for habitat restoration, wildlife and wetland plantings in the Coastal Plain and Piedmont regions of the Mid-Atlantic.

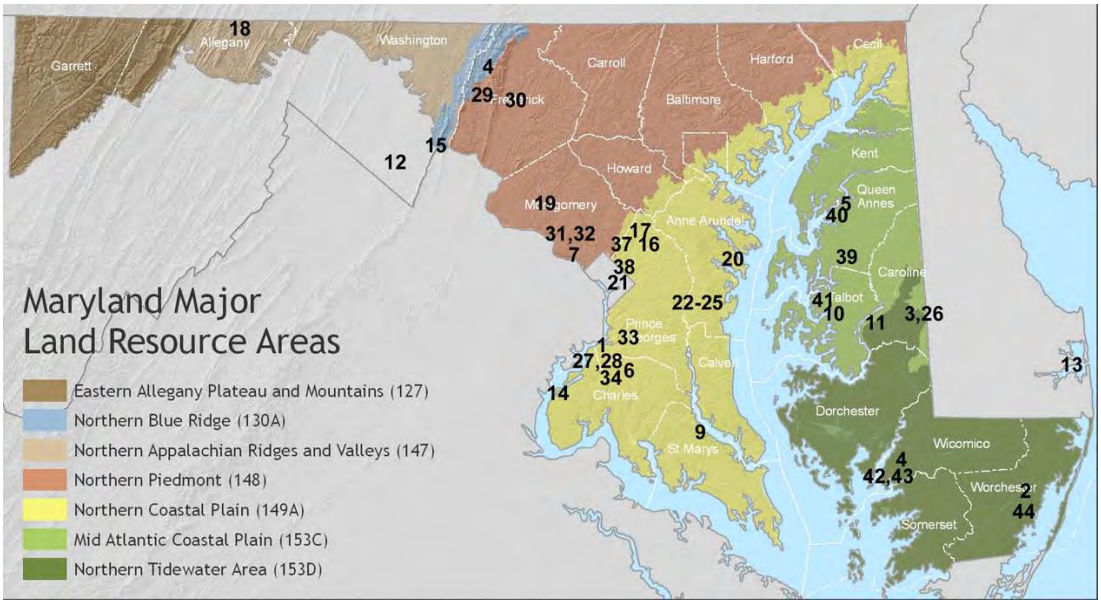


**Figure 15. The NRCS propagation numbers added to a Major Land Resource Area map of Maryland to indicate the location of the wildrye parent populations. Map courtesy Amanda Moore USDA, NRCS 2009.**

New developments in *Elymus* spp's taxonomy (Barkworth et al, *Flora of North America North of Mexico* 2006) have resulted in splitting Virginia wildrye (*E. virginicus*) into new taxa, including southeastern wildrye (*E. glabriflorus*) and early wildrye (*E. macgregorii*). Due to this re-classification, the 39 accessions were re-classified.

Complications experienced during this project:

- At the time of collection, the investigators were unaware of the multiple taxa involved,
- The natural distribution of the new taxa remains unknown with the data from this study being the most significant contribution to date,
- Accession replications were planted too closely with many accessions self sowing into one another during the three-year study,
- The original seed collection was not placed in long-term seed storage.

## Experimental Design and Conduct

Multiple methods were used to locate native populations, including examining herbarium vouchers. Thirty-nine accessions were sampled for herbarium vouchers and the study was completed during the winter of 2010 – 2011. Table 5 provides a complete plant listing by genus, specific epithet, with county, site description and relative population size. Blanks occur either because no field note was made or it was not possible to estimate the quantity of wildrye plants since more than one type of wildrye was present.

The first test performed at the NPMC consisted of three replications: 15 plants of each of the 39 accessions randomly planted into weed mat for weed control.

In mid-May, researchers established wildrye evaluation fields at three sites (see Figure 15):

4. Coastal plain east of the Chesapeake Bay – A private farm in Talbot County,
5. Coastal plain west of the Chesapeake Bay – On the NPMC grounds in Prince George's County,
6. Piedmont – A farm in Carroll County.

Field layout considerations included weed mat width, mower width (used to cut grass between the weed mats), number of accessions for each species, number of replicate blocks to be planted and the small plot combine width (used to harvest the seed) (see Figure 16).

A weed mat effectively suppresses weed competition and makes it easier to delineate among the 39 accessions planted during the course of this release effort. Once the weed mat was in position, holes to accommodate the plants were burned in the mat with a modified electric charcoal starter.

**Table 5: Wildrye species identification and collection locations. The species and varieties in red require further verification.**

| Propagation Number | Accession Number | Genus | Species | County | Site Description | Plants in population |
|---|---|---|---|---|---|---|
| 1 | 9094225 | *Elymus* | *glabriflorus* | Prince George's | Beretta Telephone Line | 50 |
| 2 | 9094226 | *Elymus* | *glabriflorus* | Worcester | under TL across rd from Oakley's Farm Mkt | 100 |
| 3 | 9094227 | *Elymus* | *glabriflorus* | Caroline | | |
| 4 | 9094228 | *Elymus* | *glabriflorus* | Wicomico | Wicomico City | 6 |
| 5 | 9094229 | *Elymus* | *glabriflorus* | Queen Annes | Land's End Road | |
| 6 | 9094230 | *Elymus* | *glabriflorus* | Charles | Chapel Hill | 100 |
| 7 | 9094231 | *Elymus* | *glabriflorus* | Montgomery | Cabin John Power Line | 10 |
| 8 | 9094232 | *Elymus* | *macgregorii* | Montgomery | River Road | |
| 9 | 9094233 | *Elymus* | *glabriflorus* | St. Marys | Dos Santos Way | 200 |
| 10 | 9094234 | *Elymus* | *glabriflorus* | Talbot | behind guard rail on Rt 50 northbound | 10 |
| 11 | 9094235 | *Elymus* | *glabriflorus* | Caroline | Bethlehem Road | 24 |
| 12 | 9078782 | *Elymus* | *macgregorii* | Jefferson, WV | Charlestown, WVA Rte 51 Altona Swamp | |
| 13 | 9080017 | *Elymus* | *glabriflorus* | Sussex, DE | LA Bay S Canal Mouth N side | |
| 14 | 9080167 | *Elymus* | *virginicus* | Charles | Jct 224/225 Mattawoman Creek | |
| 15 | 9085127 | *Elymus* | *virginicus* | Washington | C&O Canal from Harper's Ferry RR bridge | |
| 16 | 9085131 | *Elymus* | *virginicus* | Prince George's | Lemon's Br Rd., Uhler Natural Area | |
| 17 | 9085132 | *Elymus* | *virginicus* | Prince George's | Patuxent Wildlife Research Center | |
| 18 | 9085137 | *Elymus* | *virginicus* | Allegany | Marley Branch S of Flintstone on Williams Rd. | |
| 19 | 9085141 | *Elymus* | *virginicus* | Montgomery | Between Seneca Creek and Tschiffely Rd. | |
| 20 | 9085154 | *Elymus* | *virginicus* | Anne Arundel | Bembe Beach Rd across from Port Annapolis Dr. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 21 | 9080003 | *Elymus* | *virginicus* | | | |
| 22 | 9094250 | *Elymus* | *virginicus* | Anne Arundel | Patuxent River bank | 5000 |
| 23 | 9094251 | *Elymus* | *virginicus* | Anne Arundel | Patuxent River Road aka Harwood Road | 31 |
| 24 | 9094252 | *Elymus* | *glabriflorus* | Anne Arundel | Sands Road | 1000 |
| 25 | 9094253 | *Elymus* | *glabriflorus* | Anne Arundel | Sands Road | 28 |
| 26 | 9094254 | *Elymus* | *glabriflorus* | Caroline | stream along Sand Hill Rd | |
| 27 | 9094255 | *Elymus* | *glabriflorus* | Charles | Marshall Hall Road | 200 |
| 28 | 9094256 | *Elymus* | *glabriflorus* | Charles | Marshall Hall Road | 100 |
| 29 | 9094257 | *Elymus* | *virginicus* | Frederick | Gambrill Pk Rd | 1000 |
| 30 | 9094258 | *Elymus* | *virginicus* | Frederick | Old Frederick Rd | 1000 |
| 31 | 9094259 | *Elymus* | *glabriflorus* | Montgomery | Potomac Power Line | 1000 |
| 32 | 9094260 | *Elymus* | *glabriflorus* | Montgomery | Potomac Power Line | 10 |
| 33 | 9106011 | *Elymus* | *glabriflorus* | Prince George's | Ted's Towing & Auto Service, Rt. 210 | 24 |
| 37 | 9106015 | *Elymus* | *glabriflorus* | Prince George's | Sellman Road Power Line, | |
| 38 | 9106016 | *Elymus* | *glabriflorus* | Prince George's | Anacostia River | |
| 39 | 9106017 | *Elymus* | *glabriflorus* | Queen Annes | Grange Hall Rd. | |
| 40 | 9106018 | *Elymus* | *glabriflorus* | Queen Annes | Spaniard Neck Rd | |
| 41 | 9106019 | *Elymus* | *virginicus* | Talbot | parking lot at dock, Skipton Landing Rd. | 7 |
| 44 | 9106022 | *Elymus* | *glabriflorus* | Worcester | railroad tracks east of Snow Hill | 200 |

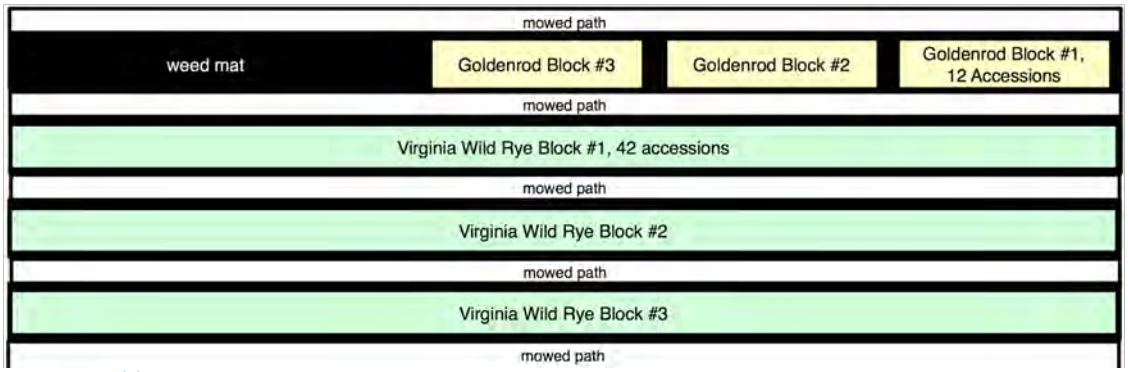


**Figure 16. Farm field map. The green rows show the locations of the Virginia wildrye replication blocks. Adjacent plantings of gray goldenrod can be seen above the wildrye blocks utilized for this study.**

Using the modified electric charcoal starter was faster than manually cutting "X"s with a utility knife. The electric charcoal starter was modified for this purpose by bending the last four inches of the looped heating element perpendicular to its original design, creating a four inch long "U" shaped working surface, and securing the burner's handle to a four foot wooden tool handle (e.g., rake or broom). The electric charcoal starter modification and use are outside the tool's intended purpose; please exercise caution to avoid injury to staff or damage to equipment or infrastructure. The electric charcoal starter's heating element is extremely hot.

Plants were placed in individual holes burned through the weed mat.


**Figure 17. NPMC staff using the mulch layer attachment to place weed mat in preparation for planting the breeder blocks. Completed, weed mat covered beds can be seen to the left of the tractor.**

Weed mat holes were dibbled and seedling plugs were firmed into place. Accession numbers were painted onto the weed mat next to each accession plot using permanent paint pens. In the weeks after planting, supplemental irrigation was applied as needed.

Virginia wildrye field plots consisted of a three foot by five foot rectangle of 15 plants (see Figure 18). Randomized complete block design was used for all accessions.

**Figure 18. Rows of Southeastern wildrye in black plastic weed mat with painted accession labels visible in foreground.**

## Discussion and Results

*Species Height and Observations*: The six observed taxa had heights that varied greatly among the species, while remaining consistent within species. This height variability was consistent across the three planting sites.

1. Southeastern wildrye – the tallest of all species, ranges from 3.3 to 4.3 feet tall. It flowers two to four weeks later than Virginia wildrye (blooms mid June in Maryland).
2. Southeastern wildrye variety *australis* - ranges from 3.3 to 4.3 feet and is more glaucus.
3. Early wildrye – ranges from 2.7 to 4.3 feet tall. Is the earliest flowering, reaching antithesis a month before the others, and prefers moist, shaded conditions.

Several accessions fit neatly into the varieties described in *Flora of North America North of Mexico* (2006), whereas others did not. From the accessions that were completed, the following generalizations can be made:

1. Virginia wildrye - *Flora of North America North of Mexico* (2006) now includes four varieties of Virginia wildrye. Within this species two varieties were apparent:
   a. The variety v*irginicus* ranged from 1.8 to 2.8 feet tall.
   b. The variety *intermedius* ranged from 2.2 to 3.0 feet tall; it originated from the coastal plain west of the Chesapeake Bay. Both of these short varieties tended to be leafier than other accessions.

*Species Frequency in Maryland:*
Southeastern wildrye was the most common species of the collected accessions, representing 26 out of the 39 accessions, or 74 percent. Populations were found throughout Maryland, from Tidewater to Piedmont, but predominately in Coastal Plain soils (see Figure 15).

Virginia wildrye was found to be the second most common species, with 13 out of 39, or 33 percent. It was found growing west of the Chesapeake Bay in the Coastal Plain, Piedmont and Ridge and Valley soils.

Early Wildrye was the least common species of the collected accessions, representing only two out of 39, or 5 percent. Both populations were found on the Potomac River floodplain. It is important to note that early wildrye was not known to occur in Maryland or West Virginia prior to this release effort. Due to the new wildrye identification key in *Flora of North America North of Mexico* (2006), it may be possible to identify new populations, but further work is necessary.

There were no observations showing a connection between relative population size and relative prevalence in Maryland. This is illustrated by the only two accessions of early wildrye. Both accessions may be from the same population stretching all the way up the Potomac River from Washington DC into West Virginia, probably including hundreds of thousands of individuals.

While no wildrye was found growing in excessively well drained soils, it was found in moist to well drained locations. It was initially expected that the various wildrye species would all be found in similar site conditions (specifically in regards to soil moisture). However, this was not found to be the case.

*Mid-Atlantic Wildrye Identification Key*: A simplified, or laymen, Mid-Atlantic wildrye identification key should be developed for use by conservationists, hydrologists, seed producers and land managers in the Mid-Atlantic region. The groundwork for the production of such a key was covered as part of this project. This key would provide the following benefits:

- Allow for more efficient and accurate collections.
- Inventory additional populations.
- Map natural geographic distributions.
- Facilitate restoration planning and landscape design.

*Project Successes*:
- Local farmers can produce southeastern and Virginia wildrye seed.
- Wildrye seed easily harvests, cleans and germinates reliably and quickly.
- Southeastern wildrye's longevity in storage, quick germination and cool season growth should make it effective for slope stabilization.

*Lessons Learned*: The following steps are needed for production of a successful source identified release:
- Publish a layman's identification guide to the local wildrye taxa.

- Establish the geographic distribution of wildrye taxa by revisiting herbarium vouchers and working with local groups.
- Collect seeds of the various wildrye taxa and establish accession plots in separate fields.
- Provide adequate space between accession plots to minimize seed shattered from one plot do not establish in the next plot.
- Each wildrye species should be tested in critical areas, buffers, wetlands and landscapes for various conservation applications.

*Project Termination*: It was decided that the limited demand for a mid-Atlantic wildrye did not warrant further work. In order to preserve the genetic diversity resulting from this project, seed will be donated (September 2012) to Ernst Conservation Seed, Inc. and the USDA Agricultural Research Service's National Plant Germplasm System. Plants will be donated (September 2012) to local government and non-profit watershed agencies (City of Hyattsville, Parks Department and the Anacostia Watershed Society).

## References

Barkworth, M.E., J.J.N. Campbell & B. Salomon (2006). *Elymus* L. *In*: Flora North America Editorial Committee (Eds.). *Flora of North America North of Mexico* Vol. 24: 288-343. Magnoliophyta: Commelinidae (in part) Poaceae, part 1. Oxford University Press, New York. Manuscript. Version also available at www.herbarium.usu.edu/webmanual (accessed on 5/01/09).

Bureau of Land Management (Updated March 2012) Technical Protocol for the Collection, Study, and Conservation of Seeds from Native Plant Species for Seeds of Success. Version available at http://www.nps.gov/plants/sos/index.htm (accessed on 7/6/12).

# ADAPTATION TRIAL OF SUPERIOR WARM-SEASON GRASSES (GAMMA GRASS, BIG BLUESTEM, INDIANGRASS AND SWITCHGRASS) SELECTED FOR ADVANCED TESTING

**Study ID Code:** MDPMC-T-10-PA

**Study Leader:** Shawn Belt, NPMC Horticulturist

**Objective:** To evaluate the area of adaptation for Eastern gamagrass, big bluestem, Indiangrass and switchgrass cultivars.

**Introduction:** Plant materials selected for release are tested to determine their area of adaptation. The NPMC works with PMCs, universities, private industry and other government agencies to determine the performance of selected plants in the mid Atlantic region. There have been a limited number of evaluations conducted on prevarietal gamma grass, big bluestem, Indiangrass and switchgrass releases. Data from these trials can be used to improve NRCS planting guidelines.

**Potential Products:** Technology Transfer and Comparative Evaluation

**Resource Consideration/Problems:** Water Quality, Erosion Control, Pastureland Improvement. Switchgrass, Eastern gamagrass, big bluestem and Indiangrass are important components of the following conservation practices: conservation cover (327), critical area plantings (342) and pasture and hay plantings (512).

**Progress or Status:** Plugs of the tested grasses were planted in June 2008 or May 2009. Data collection began in 2011 and will continue annually. Table 6 shows a planting map of the observation trial. Each observational unit consists of individuals planted on one foot centers into a 20 foot long linear row. Ten feet of space was between rows with a seven foot border on either end of the row. Three selections of Eastern gamma grass; 14 selections of big bluestem; nine selections of Indiangrass, and 19 selections of switchgrass are being evaluated for survival, height, width, boot stage and flowering dates. Maximum growth size measurements were collected at the boot stage period.

Initial data (Tables 7 and 8) suggest that the Eastern gamagrass variety 'Meadowcrest' is the largest; however; 'Pete' and 'Highlander' have higher rates of survival. There were no a major differences in the plant size of the 14 big bluestem varieties and only accession 9094220 had a higher survival rate. The Indiangrass varieties 'Rumsey', 591811 and 9044933, produced larger plants and all varieties survived well. The switchgrass varieties expressed no major differences in plant size or survival percentages. However, in this trial EG 1101 from Blade Energy was smaller in size and had a lower rate of survival.

**Table 6: Field planting map, showing warm-season grass varieties as planted by row. The top of this map is North, with Soil Conservation Road immediately to the East of the end of the rows.**

| | | | | |
|---|---|---|---|---|
| **Row 1** | Meadowcrest Eastern gamagrass | Pete Eastern gamagrass | Highlander Eastern Gamagrass | Empty |
| **Row 2** | Suther Germplasm Big Bluestem | Southlow Michigan Big Bluestem | Niagara Big Bluestem | 9093699 Big Bluestem |
| **Row 3** | Bonanza' Big Bluestem | Goldmine Big Bluestem | Roundtree Big Bluestem | Bonilla Big Bluestem |
| **Row 4** | Kaw Big Bluestem | Earl Big Bluestem | OZ-70 Big Bluestem | 9046932 Big Bluestem |
| **Row 5** | 9094220 Big Bluestem | Camp Dawson Big Bluestem | Empty | Empty |
| **Row 6** | Prairie View Germplasm Indiangrass | Empty | Empty | Empty |
| **Row 7** | Suther Germplasm Indiangrass | Coastal Germplasm Indiangrass | Southlow Michigan Indiangrass | Nebraska 54 Indiangrass |
| **Row 8** | Americus Indiangrass | Rumsey Indiangrass | 591811 Indiangrass | 9046933 Indiangrass |
| **Row 9** | Alamo Switchgrass | Blackwell Switchgrass | Bo Master Switchgrass | Carthage Switchgrass |
| **Row 10** | Cave In Rock Switchgrass | Dacotah Switchgrass | EG 1101 Switchgrass | EG 1102 Switchgrass |
| **Row 11** | Forestburg Switchgrass | High Tide Switchgrass | Kanlow Switchgrass | Pathfinder Switchgrass |
| **Row 12** | Shawnee Switchgrass | Shelter Switchgrass | Sunburst Switchgrass | Switchgrass Southlow |
| **Row 13** | Timber Switchgrass | Empty | Empty | Empty |

Table 7: Height, width, boot stage month, flowering month and survival for 2011.

| Species/Release Name | Accession Number | Height (inches) | Width (inches) | Boot Stage (month) | Flowering (month) | Survival (%) |
|---|---|---|---|---|---|---|
| **Eastern Gamagrass –** *Tripsacum dactyloides* | | | | | | |
| Meadowcrest | 591483 | 47.9 | 51.0 | June | July | 70 |
| Pete | | 26.0 | 26.0 | May | June | 95 |
| Highlander | | 36.3 | 38.0 | June | July | 85 |
| **Big Bluestem –** *Andropogon gerardii* | | | | | | |
| Suther Germplasm | 9082318 | 40.0 | 29.9 | August | September | 100 |
| Southlow Germplasm | 642398 | 40.5 | 30.1 | June | July | 100 |
| Niagara | 315656 | 40.4 | 29.9 | June | July | 100 |
| | 9093699 | 40.4 | 29.9 | August | September | 100 |
| Bonanza | | 40.9 | 30.0 | August | September | 100 |
| Goldmine | 641702 | 41.4 | 29.1 | August | September | 90 |
| Roundtree | 674216 | 41.8 | 29.9 | June | July | 100 |
| Bonilla | 315658 | 41.9 | 30.1 | June | July | 100 |
| Kaw | 421276 | 41.9 | 31.1 | June | July | 95 |
| Earl | 408932 | 41.9 | 31.1 | July | August | 100 |
| OZ-70 | | 41.9 | 31.3 | July | August | 100 |
| (unreleased) | 9046932 | 41.8 | 31.5 | June | July | 100 |
| (unreleased) | 9094220 | 41.2 | 30.5 | June | July | 60 |
| Camp Dawson | 9093698 | 42.2 | 30.3 | June | July | 95 |
| **Indiangrass –** *Sorghastrum nutans* | | | | | | |
| Prairie View | 642387 | 29.6 | 25.0 | August | September | 100 |
| Suther Germplasm | 9081282 | 29.8 | 25.0 | July | August | 100 |
| Southlow Michigan | 9094765 | 30.0 | 26.0 | July | August | 100 |
| Coastal | 642396 | 30.4 | 26.0 | July | August | 100 |
| Nebraska-54 | 91096307 | 30.3 | 26.0 | August | September | 100 |
| Americus | 514673 | 30.6 | 26.0 | August | September | 100 |
| Rumsey | 315747 | 46.2 | 26.0 | August | September | 100 |
| (unreleased) | 591811 | 47.2 | 26.0 | July | August | 100 |
| (unreleased) | 9046933 | 47.0 | 26.0 | July | August | 100 |
| **Switchgrass –** *Panicum virgatum* | | | | | | |
| Alamo | 422006 | 31.7 | 30.0 | August | September | 100 |
| Blackwell | 421520 | 31.5 | 29.5 | July | August | 95 |
| Bo Master | 91096039 | 31.1 | 30.0 | July | August | 85 |
| Carthage | 421138 | 31.6 | 30.0 | July | August | 100 |
| Cave In Rock | 469228 | 31.3 | 29.6 | July | August | 100 |
| Dacotah | 537588 | 30.8 | 29.2 | July | August | 80 |
| EG 1101 | Blade Energy Co. | 28.1 | 27.2 | August | September | 40 |
| EG 1102 | Blade Energy Co | 30.6 | 28.9 | August | September | 95 |
| Forestburg | 478001 | 30.3 | 28.7 | August | September | 90 |
| High Tide Germplasm | 9094764 | 30.2 | 29.0 | July | August | 100 |
| Kanlow | 421521 | 31.8 | 30.6 | August | September | 100 |
| Pathfinder | 9106040 | 31.7 | 30.5 | August | September | 100 |
| Shawnee | 591824 | 31.6 | 30.5 | August | September | 100 |
| Shelter | 430240 | 31.5 | 30.3 | July | August | 100 |
| Sunburst | 9106041 | 31.5 | 30.3 | July | August | 100 |
| Southlow | 9084512 | 31.1 | 29.7 | August | September | 85 |
| Timber | 9081259 | 31.3 | 29.8 | July | August | 100 |
| Trail Blazer | 9106042 | 31.2 | 29.8 | July | August | 90 |

Table 8: List of cultivars and accessions in the study.

| Species/Release Name | NRCS Accession Number | Origin | Source of Plant Material |
|---|---|---|---|
| **Eastern Gamagrass –** *Tripsacum dactyloides* | | | |
| Meadowcrest | 591483 | Beltsville, MD | Big Flats PMC |
| Pete | 421612 | Kansas and Oklahoma | Manhattan PMC |
| Highlander | 634941 | Montgomery Co., TN | MS PMC |
| **Big Bluestem –** *Andropogon gerardii* | | | |
| Suther Germplasm | 9082318 | Cabarrus Co., NC | Cape May PMC |
| Southlow Germplasm | 642398 | Lower peninsula MI | Rose Lake PMC |
| Niagara | 315656 | Erie Co., NY | Big Flats PMC |
| | 9093699 | WV composite | Roundstone Seed Co. |
| Bonanza | 341701 | derived from 'Pawnee' - Pawnee Co., NE | Sharp Bros. Seed Co. |
| Goldmine | 641702 | derived from Kaw | Sharp Bros. Seed Co. |
| Roundtree | 674216 | Moorehead, IA | Sharp Bros. Seed Co. |
| Bonilla | 315658 | Bonilla, ND | Sharp Bros. Seed Co. |
| Kaw | 421276 | Manhattan KS | Manhattan PMC |
| Earl | 408932 | Riley Co., KS | Manhattan PMC |
| OZ-70 | 16052 | Ozark Region | Elsberry PMC |
| (unreleased) | 9046932 | New Eng. composite | Big Flats PMC |
| (unreleased) | 9094220 | South MA | Cape May PMC |
| Camp Dawson | 9093698 | Kingwood, WV | WV PMC |
| **Indiangrass –** *Sorghastrum nutans* | | | |
| Prairie View | 642387 | Central & Southern Indiana | Ernst Conservation Seed |
| Suther Germplasm | 9081282 | Cabarrus Co., NC | Ernst Conservation Seed |
| Southlow Michigan | 642396 | Lower peninsula MI | Ernst Conservation Seed |
| Coastal | 9094765 | CT, RI, &MA | Cape May PMC |
| Nebraska-54 | 9106307 | Nebraska composite | Sharp Bros. Seed Co. |
| Americus | 514673 | AL & GA | Jimmy Carter PMC |
| Rumsey | 315747 | Jefferson Co., IL | Ernst Conservation Seed |
| (unreleased) | 591811 | NY | Big Flats PMC |
| (unreleased) | 9046933 | New England composite | Big Flats PMC |
| **Switchgrass –** *Panicum virgatum* | | | |
| Alamo | 422006 | Frio River TX | Ernst Conservation Seed |
| Blackwell | 421520 | Blackwell, OK | Ernst Conservation Seed |
| Bo Master | | NC ARS and NC State Univ. | Ernst Conservation Seed |
| Carthage | 421138 | Carthage, NC | Cape May PMC |
| Cave In Rock | 469228 | southern Illinois | Ernst Conservation Seed |
| Dacotah | 537588 | Breien, ND | Sharp Bros. Seed Co. |
| EG 1101 | | Blade Energy Co. | Blade Energy Co. |
| EG 1102 | | Blade Energy Co. | Blade Energy Co. |
| Forestburg | 478001 | Sanbourn Co., SD | Sharp Bros. Seed Co. |
| High Tide Germplasm | 9094764 | Perryville, MD | Cape May PMC |
| Kanlow | 421521 | Wetumah, OK | Sharp Bros. Seed Co. |
| Pathfinder | 9106040 | NE & KS | Sharp Bros. Seed Co. |
| Shawnee | 591824 | nursery cross | Ernst Conservation Seed |
| Shelter | 430240 | Pleasants Co., WV | Ernst Conservation Seed |
| Southlow | 9106038 | MI | Rose Lake PMC |
| Sunburst | 9106041 | WI | Cape May PMC |
| Timber | 9081259 | NC | Cape May PMC |
| Trail Blazer | 9106042 | NE | Sharp Bros. Seed Co. |

# NATIVE WARM-SEASON GRASS FORAGE VARIETY TRIAL

**Study No:** MDPMC-T-0501-PA

**Study Leader:** R. Jay Ugiansky, Resource Conservationist

**Objective:** Determine the yield of warm-season grass varieties grown in Maryland in a simulated rotational grazing system by harvest date and annual total. Forage production information helps farmers optimize sustainable production, conserving natural resources and benefiting their bottom line. Total yield and harvest date growth curve data will be used to refine grazing models in the C-Graze software used for planning and optimizing managed grazing systems.

**Introduction:** Native warm-season grasses in a rotational grazing system provide valuable summer forage when cool-season grasses are less productive. Native warm-season grasses are useful for forage and pasture, wildlife habitat, soil stabilization and biofuels. There are many cultivars, selected ecotypes and source identified native warm-season grasses available today, here referred to collectively as varieties. With many varieties and a lack of comparative forage production information for Maryland, it is difficult to decide which varieties will provide the best forage production. Many forage varieties have not been adequately tested in Maryland and other non-forage varieties are available that may prove valuable for forage production. Better forage productivity data is needed to effectively utilize these grasses. This trial is being conducted jointly by Maryland NRCS and Maryland Cooperative Extension, with annual funding from Maryland Grazing Lands Conservation Initiative Coalition.

**Procedure:** The trial includes 36 varieties of eight different species (Eastern gamagrass, switchgrass, big bluestem, Indiangrass, little bluestem, coastal little bluestem, Florida paspalum, and coastal panicgrass). The trial was conducted on Galestown-Evesboro loamy sands, 0-8% slope, somewhat excessively drained (available water holding capacity in a 60-inch soil profile is 3.7 inches) at the NPMC located in Beltsville, Maryland. With the exception of Eastern gamagrass, varieties were seeded in six-row plots with five-inch row spacing using a cone-seeder. Eastern gamagrass varieties were seeded in two, 30-inch rows per plot. All varieties were seeded June 16, 2005. Switchgrass, little bluestem and Florida paspalum were seeded at eight pounds PLS per acre and the other species were planted at 10 pounds, as shown in Table 9. The trial was planted in a randomized complete block design with four replications. Plot size is three feet by 20 feet with yield measurements taken from the entire plot area. Soil test (October 4, 2007) values were pH 5.5, P = 111 ppm (very high), and K = 85 ppm (medium). Pelletized dolomitic lime was applied at one ton per acre in early May 2008. Nitrogen was applied at a rate of 100 pounds per acre at the beginning each growing season except the seeding year and 2011. Irrigation was only applied during establishment (2005 and 2006) and was not applied in 2007, 2008 or 2009. The trial will continue for a minimum of four years as a simulated grazing system.

The plots were not harvested until 2007 to allow grasses to fully establish. Cuttings were made using a Carter flail-type harvester and cut to a height of eight inches. Harvests were made three times each growing season (Table 9). Harvested material was weighed green in the field and samples were collected for dry matter determinations from two of the four replications.

**Potential Products:** Maryland grazing standards and recommendations. Growth curve data obtained from study will be used to refine the grazing models in the C-Graze computer program. Yearly summary reports and final report.

**Status of Project:** Three harvests per season were made in 2007, 2008 and 2009, and two harvests were made in 2010 and 2011. Yields increased in 2010 with only two harvests despite adverse hot-dry weather; however forage quality at time of harvest was visibly reduced due to over maturity. Nitrogen was not applied in 2011 and combined with very dry weather in May, June and July the yields were significantly reduced. The yields of switchgrass and

coastal panicgrass varieties were not as affected as much as the Eastern gamagrass varieties. Under these dry lower fertility conditions the yields of Eastern gamagrass were comparable to the switchgrass and coastal panicgrass varieties. Yields of big bluestem, Indiangrass, Florida paspalum, and little bluestem, were reduced more severely in 2011 than switchgrass or Eastern gamagrass varieties.

The Eastern gamagrass varieties and 'Carthage' switchgrass continued to be among the highest yielding over the four years. 'Meadowcrest' Eastern gamagrass was the highest yielding of all varieties but not significantly higher yielding than the other Eastern gamagrass varieties, the highest yielding switchgrass varieties or 'Atlantic' coastal panicgrass. Eastern gamagrass varieties began growth earlier and produced greater yields at the first harvest than other varieties. This early season growth was the major contributor to greater season total yield.

The Florida paspalum exhibited excellent stand establishment and yielded well in 2008 considering it is an unimproved collection. Yields decreased in 2009 and continued to decline in 2010 and 2011, indicating poor persistence.

Field-size evaluations of establishment, persistence and palatability of promising varieties/selections under actual rotational grazing management are presently being established and will further the study of native warm-season grass forage varieties. These studies will be conducted at the University of Maryland Wye Research and Education Center and at the ARS Beltsville Agricultural Research Center with data collected in the 2012 calendar year.

**Table 9: Forage yield (lbs/acre) by species, variety and year.**

| | | Forage Yield (lb/acre) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Stand | 2007 | 2008 | 2009 | 2010 | ----------2011---------- | | | '08-'11 |
| Species/Variety | Jul-08 | Total | Total | Total | Total | Jul. 28 | Nov. 18 | Total | Average |
| **Eastern Gamagrass –** *Tripsacum dactyloides* | | | | | | | | | |
| Meadowcrest | 99 | **2,873** | **11,090** | **9,336** | **16,737** | 6,291 | 1,668 | 7,959 | **11,280** |
| Highlander | 91 | **3,442** | **12,120** | **10,582** | **14,009** | 5,281 | 1,514 | 6,795 | **10,876** |
| Pete | 89 | **2,377** | **9,861** | **10,311** | **14,433** | 4,510 | 1,889 | 6,399 | **10,251** |
| Verl | 86 | **2,864** | **11,015** | **8,957** | **12,757** | 4,573 | 1,450 | 6,022 | **9,688** |
| **Switchgrass –** *Panicum virgatum* | | | | | | | | | |
| Carthage | 100 | **9,790** | **9,764** | **9,251** | **13,632** | 4,239 | 3,098 | 7,336 | **9,996** |
| Kanlow | 80 | **8,303** | **8,632** | **8,362** | **12,180** | 4,609 | 2,103 | 6,713 | **8,972** |
| Cave in Rock | 86 | **6,963** | **9,019** | **7,757** | **10,291** | 5,413 | 2,537 | 7,949 | **8,754** |
| Blackwell | 95 | **5,879** | **9,313** | **7,020** | **9,574** | 4,355 | 1,725 | 6,079 | **7,997** |
| Shelter | 87 | **3,608** | **7,796** | **8,153** | **8,891** | 4,645 | 2,019 | 6,664 | **7,876** |
| Shawnee | 96 | **6,666** | **9,523** | **7,938** | **8,387** | 4,096 | 1,358 | 5,454 | **7,826** |
| Hightide Germplasm | 68 | **3,293** | **5,428** | **4,195** | **5,014** | 2,059 | 1,034 | 3,093 | **4,432** |
| **Coastal Panicgrass –** *Panicum amarum* | | | | | | | | | |
| Atlantic | 79 | **9,934** | **8,849** | **8,477** | **11,306** | 4,030 | 2,999 | 7,028 | **8,915** |
| **Big Bluestem –** *Andropogon gerardii* | | | | | | | | | |
| Niagara | 95 | **1,149** | **6,899** | **7,029** | **7,531** | 1,591 | 498 | 2,088 | **5,887** |
| Suther Germplasm | 86 | **2,089** | **6,594** | **5,994** | **8,932** | 877 | 1,075 | 1,952 | **5,868** |
| Rountree | 98 | **1,737** | **6,295** | **6,174** | **6,413** | 1,459 | 825 | 2,284 | **5,292** |
| Southlow Michigan Germplasm | 85 | **849** | **5,864** | **5,178** | **6,585** | 1,293 | 615 | 1,908 | **4,884** |
| **Indiangrass –** *Sorghastrum nutans* | | | | | | | | | |
| NY unreleased | 94 | **1,995** | **7,083** | **6,477** | **7,795** | 662 | 961 | 1,624 | **5,745** |
| Osage | 93 | **4,503** | **7,108** | **5,158** | **7,918** | 672 | 1,312 | 1,985 | **5,542** |
| Americus | 91 | **4,525** | **7,065** | **5,540** | **6,802** | 656 | 1,348 | 2,004 | **5,353** |
| Suther Germplasm | 99 | **3,906** | **6,416** | **5,803** | **5,606** | 1,384 | 964 | 2,348 | **5,043** |
| Southlow Michigan Germplasm | 86 | **1,412** | **6,586** | **4,911** | **5,379** | 239 | 509 | 748 | **4,406** |
| MD unreleased | 90 | **1,776** | **5,140** | **4,867** | **5,635** | 200 | 994 | 1,194 | **4,209** |
| Rumsey | 85 | **2,869** | **5,590** | **5,049** | **4,866** | 534 | 703 | 1,237 | **4,185** |
| NE-54 | 96 | **2,386** | **5,955** | **5,646** | **4,045** | 439 | 357 | 796 | **4,111** |
| Holt | 90 | **1,085** | **4,821** | **3,527** | **3,215** | 346 | 557 | 903 | **3,117** |
| **Florida Paspalum –** *Paspalum floridanum* | | | | | | | | | |
| MD unreleased 9078766 | 93 | **5,672** | **9,053** | **6,193** | **2,603** | 523 | 65 | 588 | **4,609** |
| **Little Bluestem –** *Schizachyrium scoparium* | | | | | | | | | |
| Aldous | 86 | **2,410** | **5,374** | **2,169** | **2,844** | 21 | 601 | 621 | **2,752** |
| Cimarron | 76 | **4,587** | **4,640** | **1,551** | **3,742** | 0 | 293 | 293 | **2,556** |
| Camper | 80 | **2,564** | **4,556** | **1,315** | **2,687** | 247 | 430 | 677 | **2,309** |
| Southlow Michigan Germplasm | 87 | **1,068** | **4,234** | **2,072** | **2,716** | 115 | 78 | 193 | **2,304** |
| Blaze | 83 | **1,268** | **3,562** | **916** | **3,059** | 0 | 0 | 0 | **1,884** |
| Coastal little blue | 95 | **1,060** | **3,583** | **1,312** | **778** | 103 | 458 | 561 | **1,558** |
| Mean | 89 | **3,591** | **7,151** | **5,851** | **6,992** | 2,046 | 1,126 | 3,172 | **5,741** |
| LSD[1/] (0.05) | 15 | **1,705** | **2,033** | **2,321** | **4,025** | 1,242 | 885 | 1,807 | **1,977** |
| % CV[2/] | 12 | **34** | **20** | **28** | **41** | 43 | 56 | 41 | **25** |

1/ = least significant difference test at 5% level of probability; 2/ = coefficient of variation

# COOL-SEASON GRASS FORAGE VARIETY TRIAL

**Study No:** MDPMC-T-0502-PA

**Study Leader:** R. Jay Ugiansky, NPMC Resource Conservationist

**Objective:** Determine the yield of cool-season grass varieties grown in Maryland in a simulated rotational grazing system by harvest date and annual total. Forage production information helps farmers optimize sustainable production, conserving natural resources and benefiting their bottom line. Total yield and harvest date growth curve data will be used to refine grazing models in the C-Graze software used for planning and optimizing managed grazing systems.

**Introduction:** Maryland farmers can benefit from a greater knowledge of variety performance in Maryland growing conditions. This information enables farmers to make more informed decisions for sustainably maximizing forage production. This variety trial is being conducted by Maryland NRCS and University of Maryland to provide the latest information on the agronomic performance of publicly and privately developed cool-season grass varieties. Collected data will benefit the farmers in Maryland and surrounding states, seed industry, Maryland Cooperative Extension and NRCS.

The cool-season grass forage variety trial was seeded September 25, 2005 at the NPMC. Seed dealers and grass breeders were invited to submit entries of released varieties or advanced breeding lines that they would like evaluated in Maryland. The 18 cool-season grass entries in this trial are varieties of tall fescue, orchardgrass, Alaska brome, pasture brome, festulolium and perennial ryegrass.

**Procedure:** The trial was planted in a randomized complete block with four replications. Plot size is three feet by 20 feet with yield measurements taken from the entire plot area. Stand ratings were recorded to capture information for establishment and persistence. The trial will continue as a simulated grazing system for a minimum of four years. Cuttings were made using a Carter flail-type harvester and cut to a height of three inches when the grasses achieved a target height of 10 – 12 inches. Establishment was limited by drought in the fall of 2005 and spring of 2006. The first significant rainfall after seeding did not occur until October 7 and 8, 2006. Supplemental irrigation was applied as needed to maintain survival, but was not sufficient for optimal growth. Replication 1 was eliminated from the data analysis because of severe stand mortality of many of the entries due to variations in the soils that amplified the effects of the drought. Fertilizer applications of phosphorus and potash were applied to meet soil test recommendations. Nitrogen was applied at a rate of 60 pounds of available nitrogen in April, after the first harvest and again in the fall. Cuttings were made for all plots when 10 – 12 inches of height was achieved by the tallest and faster growing varieties.

**Status of Project:** In the 2010 season, yields were on average lower than in 2008 or 2009. These lower yields may be due to both weather and fewer harvests in 2010. June, July and early August were dry and the plots were overtaken by crabgrass and other warm-season annual grasses, invalidating the late summer and fall harvest data. The tall fescue varieties consistently yielded significantly higher and had better persistence than varieties of other species. The tall fescue variety 'Kora' yielded the highest for the four-year average, but not significantly higher than the lowest yielding tall fescue variety 'Enhance'. 'Kora', 'Select' and 'Enhance' are low endophyte or endophyte-free varieties. Varieties of orchardgrass, festulolium, perennial ryegrass and bromegrass had poor persistence with many not persisting into the 2010 season. Data collection was concluded in 2010.

Tall fescue varieties are a good choice for farmers requiring reliable and persistent high yielding forage. When choosing among varieties of tall fescue considering the animal health effects that standard endophyte varieties can have, other considerations may be more important than yield, such as choosing among low endophyte, friendly endophyte and standard endophyte varieties.

The poor orchardgrass persistence in this study is consistent with persistence problems being experienced by hay and pasture producers throughout the Mid-Atlantic Region. We are seeing numerous cases of reduced vigor (fewer cuttings and lower annual yields) and early death of orchardgrass stands compared to only 6 to 8 years ago. Some hay growers in Southern Maryland have reported complete stand losses within a year of seeding. So the results of this study are consistent with, and reflect, what is happening on many farms. Efforts are being made to identify possible causes for this reduced vigor and early stand loss through other studies and field surveys.

An additional study is proposed to provide frequent and cumulative dry matter yield data for refining seasonal growth curves used in the C-graze planning tool. This proposed study will make use of a rising plate meter and calibration cuttings to obtain a database of meter readings that correspond to yields of various species/varieties of forage grasses. A database of rising plate meter readings for forage grasses in Maryland would enable further measurements on working farms and provide refinements to growth curve models in Maryland.

**Table 10. 2007 to 2010 yield comparison of cool-season forage cultivars by annual total and 4-year average at the USDA-NRCS National Plant Materials Center, Beltsville, Maryland.**

| Species/Variety | Marketer | Forage Yield (lb/acre) | | | | |
|---|---|---|---|---|---|---|
| | | 2007 | 2008 | 2009 | 2010 | 4-Year Average |
| **Tall Fescue** | | | | | | |
| Kora | DLF-Intl. Seeds | 3,616 | 5,770 | 7,224 | 3,706 | 5,079 |
| BAR FA BTR9 | Barenbrug USA | 3,350 | 6,135 | 5,801 | 4,087 | 4,843 |
| BAR FA 6FRD | Barenbrug USA | 3,413 | 5,837 | 6,321 | 3,788 | 4,840 |
| Select | FFR Cooperative | 3,383 | 5,902 | 6,161 | 3,751 | 4,799 |
| BAR FA 9301A | Barenbrug USA | 3,581 | 5,832 | 5,655 | 2,854 | 4,480 |
| Max Q Jesup | Pennington | 3,307 | 5,574 | 4,835 | 3,833 | 4,387 |
| KY-31 | Public | 3,447 | 4,315 | 5,125 | 2,968 | 3,964 |
| Enhance | Allied Seed | 3,373 | 4,434 | 4,721 | 2,696 | 3,805 |
| **Perennial ryegrass** | | | | | | |
| Remington | Barenbrug USA | 2,516 | 3,027 | 2,799 | 536 | 2,220 |
| **Orchardgrass** | | | | | | |
| Benchmark Plus | FFR Cooperative | 1,911 | 2,545 | 2,464 | 561 | 1,870 |
| Extend | Allied Seed | 1,856 | 2,821 | 2,138 | 0 | 1,704 |
| Mean | | 3,069 | 4,745 | 4,840 | 2,616 | 3,818 |
| LSD[1/] (0.05) | | NS[3/] | 1,908 | 1,921 | 1,422 | 1,384 |
| % CV[2/] | | 28 | 24 | 23 | 32 | 21 |

1/ = least significant difference test at 5% level of probability; 2/ = coefficient of variation; 3/ = not significant

**Table 11. 2010 yield comparison of cool season forage cultivars by harvest date and season total at the USDA-NRCS National Plant Materials Center, Beltsville, Maryland.**

| Species/Variety | Marketer | 2010 Forage Yield (lb/acre) | | |
|---|---|---|---|---|
| | | 28-Apr | 15-Jun | Total |
| **Tall Fescue** | | | | |
| BAR FA BTR9 | Barenbrug USA | 572 | 3,514 | 4,087 |
| Max Q Jesup | Pennington | 774 | 3,058 | 3,833 |
| BAR FA 6FRD | Barenbrug USA | 881 | 2,907 | 3,788 |
| Select | FFR Cooperative | 839 | 2,911 | 3,751 |
| Kora | DLF-Intl. Seeds | 443 | 3,263 | 3,706 |
| KY-31 | Public | 455 | 2,513 | 2,968 |
| BAR FA 9301A | Barenbrug USA | 723 | 2,130 | 2,854 |
| Enhance | Allied Seed | 424 | 2,271 | 2,696 |
| **Perennial ryegrass** | | | | |
| Remington | Barenbrug USA | 80 | 456 | 536 |
| **Orchardgrass** | | | | |
| Benchmark Plus | FFR Cooperative | 161 | 400 | 561 |
| Extend | Allied Seed | 0 | 0 | 0 |
| Mean | | 487 | 2,130 | 2,616 |
| LSD[2/] (0.05) | | 461 | 1,192 | 1,422 |
| % CV[3/] | | 56 | 33 | 31.91 |

1/ = not harvested; 2/ = least significant difference test at 5% level of probability; 3/ = coefficient of variation; 4/ = not significant

**Table 12. 2009 yield comparison of cool season forage cultivars by harvest date and season total at the USDA-NRCS National Plant Materials Center, Beltsville, Maryland.**

| Species/Variety | Marketer | 2009 Forage Yield (lb/acre) | | | | |
|---|---|---|---|---|---|---|
| | | May 12 | June 30 | Aug. 17 | Nov. 5 | Total |
| **Tall Fescue** | | | | | | |
| Kora | DLF-Intl. Seeds | 2,334 | 2,455 | 1,368 | 1,067 | 7,224 |
| BAR FA 6FRD | Barenbrug USA | 1,948 | 2,150 | 1,131 | 1,092 | 6,321 |
| Select | FFR Cooperative | 2,137 | 1,827 | 1,206 | 991 | 6,161 |
| BAR FA BTR9 | Barenbrug USA | 1,844 | 1,799 | 1,075 | 1,083 | 5,801 |
| BAR FA 9301A | Barenbrug USA | 2,008 | 2,065 | 696 | 886 | 5,655 |
| KY-31 | Public | 1,943 | 1,524 | 714 | 945 | 5,125 |
| Max Q Jesup | Pennington | 1,440 | 1,552 | 1,013 | 829 | 4,835 |
| Enhance | Allied Seed | 1,991 | 1,781 | 298 | 651 | 4,721 |
| **Perennial ryegrass** | | | | | | |
| Remington | Barenbrug USA | 1,271 | 1,309 | 37 | 181 | 2,799 |
| **Orchardgrass** | | | | | | |
| Benchmark Plus | FFR Cooperative | 1,402 | 822 | 107 | 133 | 2,464 |
| Extend | Allied Seed | 1,394 | 744 | nh[1/] | nh[1/] | 2,138 |
| Mean | | 1,792 | 1,639 | 695 | 715 | 4,840 |
| LSD[2/] (0.05) | | NS[4/] | 926 | 609 | 409 | 1,921 |
| % CV[3/] | | 33 | 33 | 51 | 33 | 23 |

1/ = not harvested; 2/ = least significant difference test at 5% level of probability; 3/ = coefficient of variation; 4/ = not significant

**Table 13. 2008 Yield comparison of cool season forage cultivars by harvest date and season total at the USDA-NRCS National Plant Materials Center, Beltsville, Maryland.**

| Species/Variety | Marketer | 2008 Forage Yield (lb/acre) | | | | | | Stand |
|---|---|---|---|---|---|---|---|---|
| | | April 18 | May 7 | June 3 | July 2 | Nov 7 | Total | 6/3/0 |
| **Tall Fescue** | | | | | | | | |
| BAR FA BTR9 | Barenbrug USA | 565 | 1,064 | 1,210 | 1,939 | 1,357 | 6,135 | 97.7 |
| Select | FFR Cooperative | 766 | 1,168 | 854 | 2,116 | 999 | 5,902 | 92.7 |
| BAR FA 6FRD | Barenbrug USA | 692 | 991 | 902 | 2,338 | 915 | 5,837 | 95.0 |
| BAR FA 9301A | Barenbrug USA | 510 | 1,069 | 1,198 | 2,670 | 385 | 5,832 | 98.3 |
| Kora | DLF-Intl. Seeds | 565 | 927 | 1,109 | 2,173 | 997 | 5,770 | 81.0 |
| Max Q Jesup | Pennington | 663 | 1,158 | 783 | 2,031 | 938 | 5,574 | 93.3 |
| Enhance | Allied Seed | 665 | 1,019 | 722 | 2,029 | nh[1/] | 4,434 | 100.0 |
| KY-31 | Public | 640 | 1,041 | 600 | 1,637 | 397 | 4,315 | 98.3 |
| **Perennial ryegrass** | | | | | | | | |
| Remington | Barenbrug USA | nh[1/] | 352 | 697 | 1,979 | nh[1/] | 3,027 | 74.3 |
| **Orchardgrass** | | | | | | | | |
| Extend | Allied Seed | 281 | 633 | 373 | 1,354 | 179 | 2,821 | 48.3 |
| Benchmark Plus | FFR Cooperative | 384 | 549 | 467 | 1,145 | nh | 2,545 | 48.3 |
| Mean | | 521 | 906 | 810 | 1,946 | 561 | 4,745 | 84 |
| LSD[2/] (0.05) | | 353 | 495 | 362 | NS[4/] | NS[4/] | 1,908 | 29 |
| % CV[3/] | | 40 | 32 | 26 | 26 | 101 | 24 | 20 |

1/ = not harvested; 2/ = least significant difference test at 5% level of probability; 3/ = coefficient of variation; 4/ = not significant

**Table 14. 2007 yield comparison of cool season forage cultivars by harvest date and season total at the USDA-NRCS National Plant Materials Center, Beltsville, Maryland.**

| Species/Variety | Marketer | Forage Yield (lb/acre) | | | | | Stand |
|---|---|---|---|---|---|---|---|
| | | May 4 or *9 | May 23 | June 22 | Nov 29 | Total | 4/23/07 |
| **Tall Fescue** | | | | | | | |
| Kora | DLF-Intl. Seeds | *1,210 | 811 | 1,162 | 433 | 3,616 | 85.3 |
| BAR FA 9301A | Barenbrug USA | *838 | 724 | 1,336 | 683 | 3,581 | 84.3 |
| KY-31 | Public | *725 | 627 | 1,228 | 867 | 3,447 | 95.0 |
| BAR FA 6FRD | Barenbrug USA | *1,059 | 777 | 940 | 636 | 3,413 | 80.0 |
| Select | FFR Cooperative | *1,302 | 734 | 900 | 447 | 3,383 | 82.7 |
| Enhance | Allied Seed | *570 | 482 | 1,494 | 827 | 3,373 | 86.0 |
| BAR FA BTR9 | Barenbrug USA | 948 | 595 | 901 | 906 | 3,350 | 77.7 |
| Max Q Jesup | Pennington | *751 | 765 | 1,048 | 591 | 3,155 | 85.0 |
| **Festulolium** | | | | | | | |
| Perun | DLF-Intl. Seeds | 837 | 505 | 1,479 | nh[1/] | 2,821 | 70.3 |
| **Perennial ryegrass** | | | | | | | |
| Remington | Barenbrug USA | 538 | 491 | 1,350 | 138 | 2,516 | 86.7 |
| **Orchardgrass** | | | | | | | |
| Benchmark Plus | FFR Cooperative | *624 | 646 | 1,066 | 203 | 2,539 | 80.0 |
| Extend | Allied Seed | *476 | 762 | 983 | 151 | 2,372 | 71.0 |
| Intensive | Barenbrug USA | 497 | 455 | 985 | nh[1/] | 1,937 | 62.0 |
| Mean | | 790 | 626 | 1,149 | 576 | 2,996 | 78.9 |
| LSD[2/] (0.05) | | NS[4/] | NS[4/] | NS[4/] | 379 | 1,110 | NS |
| % CV[3/] | | 50 | 33 | 27 | 53 | 22 | 15 |

1/ = not harvested; 2/ = least significant difference test at 5% level of probability; 3/ = coefficient of variation; 4/ = not significant

# BERMUDAGRASS FORAGE VARIETY TRIAL

**Study No:** MDPMC-T-0503-PA

**Study Leader:** R. Jay Ugiansky, NPMC Resource Conservationist

**Objective:** Determine the yield of seeded and sprigged Bermudagrass varieties in Maryland in a simulated rotational grazing system by harvest date. Forage production information helps farmers optimize production sustainably conserving natural resources. Total yield and harvest date growth curve data will be used to refine grazing models in the C-Graz software used for planning and optimizing managed grazing systems.

**Introduction:** High-use areas often become devoid of plant cover at agricultural operations with livestock. These areas not only produce negligible forage but are significant sources of sediment and nutrient runoff and dust. Bermudagrass has shown potential as plant cover and forage for high-use areas however; there is a little knowledge and experience in the use of commercial varieties in Maryland. This knowledge will enable farmers to make informed decisions, maximize production in a sustainable manner, conserve natural resources and benefit their bottom line.

This variety trial was conducted by Maryland NRCS and University of Maryland Cooperative Extension to develop information on the agronomic performance of commercially available Bermudagrass varieties. Information gathered will benefit the farmers of Maryland and surrounding states, the Maryland Cooperative Extension and NRCS. Commercially available varieties of Bermudagrass (sprigged and seeded) that have potential for superior hardiness, durability and/or forage production under high-use conditions in Maryland will be included in the trial.

Common Bermudagrass is not been intentionally planted and is considered a weed, but it has been observed surviving high-use conditions in Maryland where other forages and plant cover has been destroyed by livestock activity. There are commercial varieties of Bermudagrass selected for forage or turf that would be cold hardy in Maryland. However, there is little knowledge of how these commercial varieties of Bermudagrass will perform under high-use conditions in Maryland. Commercial varieties of Bermudagrass, especially the seeded varieties, have not been used extensively in Maryland for grazing. Greater knowledge is needed for Bermudagrass to be recommended for grazing. Seeded varieties of Bermudagrass have been discouraged in Maryland due to the aggressive, weedy nature of common Bermudagrass. However, there is an increasing interest on the part of the turf grass industry in using Bermudagrass in Maryland.

**Procedure:** Seed and sprigs were purchased from commercial sources or obtained from a PMC (Table 15). Seeded varieties were planted in three foot by 20 foot plots with a six row cone seeder with six inch row spacing at a rate of eight pounds PLS per acre. Sprigged varieties were established by hand spreading sprigs over freshly tilled plots, then lightly tilling sprigs into the soil and then firmly packing the soil with a Brillion seeder.

Fertilizer applications of phosphorous and potash were applied to meet soil test recommendations. Nitrogen was applied at a rate of 75 pounds per acre of available nitrogen when growth at start of spring growth.

Table 15: Yield comparisons of Bermudagrass cultivars by harvest date and season total at the NPMC, Beltsville, Maryland.

| | Forage Yield (lbs/acre) | | | | |
|---|---|---|---|---|---|
| | 2009 | | | 2010 | 2009-2010 |
| Variety | Total | June 10 | Oct. 13 | Total | Average |
| Midland 99 | **11,476** | 2,523 | 7,073 | **9,596** | **10,536** |
| Ozark | **11,571** | 2,744 | 5,849 | **8,593** | **10,082** |
| Tiffton 44 | **9,364** | 2,221 | 6,243 | **8,463** | **8,913** |
| Sungrazer Plus | **9,285** | 1,634 | 5,095 | **6,729** | **8,007** |
| Riata | **8,644** | 2,630 | 4,324 | **6,954** | **7,799** |
| Quickstand | **7,327** | 983 | 4,678 | **5,661** | **6,494** |
| Tuffcote | **6,570** | 763 | 4,935 | **5,699** | **6,134** |
| Mean | **9,199** | 1,907 | 5,535 | **7,442** | **8,321** |
| LSD[1/] (0.05) | **NS[3/]** | 739 | NS | **2,056** | **2,349** |
| % CV[3/] | **21** | 22 | 18 | **16** | **16** |

1/ = least significant difference test at 5% level of probability; 2/ = coefficient of variation; 3/ = not significant

Yield was taken from the three feet by 20 feet plot area. Harvests were made using a Carter flail-type harvester and cut to a height of eight inches when grasses reached the mid to late boot stage. Data on traits such as persistence, tolerance to diseases and insects and rate of recovery will be collected as appropriate. The tests will be conducted for four years as a simulated grazing system.

**Potential Products:** Maryland grazing standards and recommendations. Growth curve data obtained from study is will be used to refine the grazing models in the C-Graze computer program. Yearly summary reports and final report.

**Status of Project:** Summaries of yields and stand scores to date are reported in Table 15. Varieties are grouped according to species/type and are ranked according to the two year average yield. For the 2009 and 2010 average yield data, 'Midland 99' and 'Ozark' yielded significantly higher than all other varieties except for 'Tiffton 44'. 'Quickstand' and 'Tuffcote' yielded significantly lower than 'Midland 99', 'Ozark' and Tiffton 44'. The two seeded varieties 'Sungrazer Plus' and 'Riata' yielded lower than the improved sprigged varieties but higher than the older sprigged selection 'Quickstand' and 'Tuffcote'. Yield comparisons in this trial may not translate well to actual yields in field conditions under heavy animal use. Qualities that may result in higher yields may result in lower persistence or tolerance to heavy animal use. Additional studies have been established and are ongoing at several cooperating horse farms to determine tolerance of available Bermudagrass varieties to the over-grazing and heavy wear of horse pasture heavy-use/sacrifice areas.

# PLANT SPECIES FOR USE AS VEGETATIVE ENVIRONMENTAL BUFFERS (VEB) TO IMPROVE AIR QUALITY AROUND POULTRY PRODUCTION FACILITIES

**Study ID Code:** MDPMC-T-0602-WI

**Study Leader:** Shawn Belt, NPMC Horticulturist

**Objective:** To determine plants that survive the hostile environment adjacent to poultry fans, to improve air quality, increase the diversity of potential plants used and to quantify the amount of ammonia, dust and odors remediated.

**Introduction:** The Delmarva Peninsula is home to one of the country's highest concentrations of poultry farms. The 2007 National Agricultural Statistical Service placed poultry and egg production as the most valued commodity in Maryland and Delaware and the second most valued commodity in Pennsylvania. Poultry houses generate dust, odor and ammonia which are expelled by the ventilation system. Ammonia is the gas of greatest concern to the poultry industry; plants have the ability to absorb aerial ammonia. Dust (a pollutant regulated by the Environmental Protection Agency) is linked to respiratory effects in poultry workers and can be a nuisance for neighbors who live near farms. Ammonia emitted from poultry houses has been linked to degradation of both air and water quality in the Chesapeake Bay. Warm season grass, tree and shrub buffers absorb gaseous ammonia, precipitate out dust by slowing the air speed from exhaust fans and deflect the odor plume into the atmosphere above the buffer in a very cost-effective way. Odor from poultry houses typically travels downwind, along the ground, in a concentrated plume. By planting grasses, trees and shrubs around poultry houses farmers can disrupt the plume and mix it with the prevailing winds to dilute odor. Reductions in odor of up to 70% have been measured at a distance of 50 feet behind a four row windbreak (George Malone and David Parker 2012). The 2008 tech note *Windbreak Plant Species for Odor Management around Poultry Production Facilities* speculated that certain street trees could survive poultry farm emissions due to their ability to tolerate urban conditions and emissions. The primarily native street trees used in this study were derived from that tech note.

**Potential Products:** Technology Transfer

**Resource Consideration/Problems:** Air and water quality.
Air - High levels of gaseous ammonia, odors and dusts [particulate matter (p.m.) 2.5 and 10] expelled by poultry farms
Water - Nutrient uptake by vegetative buffers can reduce nutrients which are expelled by poultry farms improving water quality.

**Progress or Status:** Designing and testing poultry windbreaks involves many variables: poultry farm type (broiler or egg), fan to plant distances, fan types, aspect, potential snow loads, soil types, and roads. In order to accurately test various plant species, different amounts of time are necessary. Grasses should survive at least one to two years, while shrubs and trees should survive a minimum of three years. Figure 19 shows the three different ventilation fan configurations. Fan configuration type 1 (denoted by the blue lines) is a single row of tunnel fans opposite test plants. Fan configuration type 2 (denoted by the yellow lines) has two rows of tunnel fans. Fan configuration type 3 (denoted by the red lines) is sidewalls fans which, although smaller and produces less velocity, run more frequently and emit higher amounts of ammonia and dust. Evergreens (denoted by green lines) serve as visual screens.

Figure 20 shows the test site soil types, quantities, and locations of the and plants listed in Table 16 show the plants currently being tested and the fan type emissions warm season grasses are being tested at 12 sites on the Delmarva Peninsula and Pennsylvania. To date all plants have survived.

**Figure 19: Poultry farm fan types shown by colored line: fan type 1 (blue lines) are single rows of tunnel fans, fan type 2 (yellow lines) are double rows of tunnel fans and fan type 3 (red lines) are sidewall fans. Visual screens composed of evergreen plantings are also indicated (green lines).**

Figure 20 shows the twelve test sites, locations, and soil types in Maryland, Delaware and Pennsylvania. The lower number test sites (1 – 6) were used primarily to test warm season grasses in 2008 - 2010. Test sites 7 – 12 are the more recent sites (2009 – present).

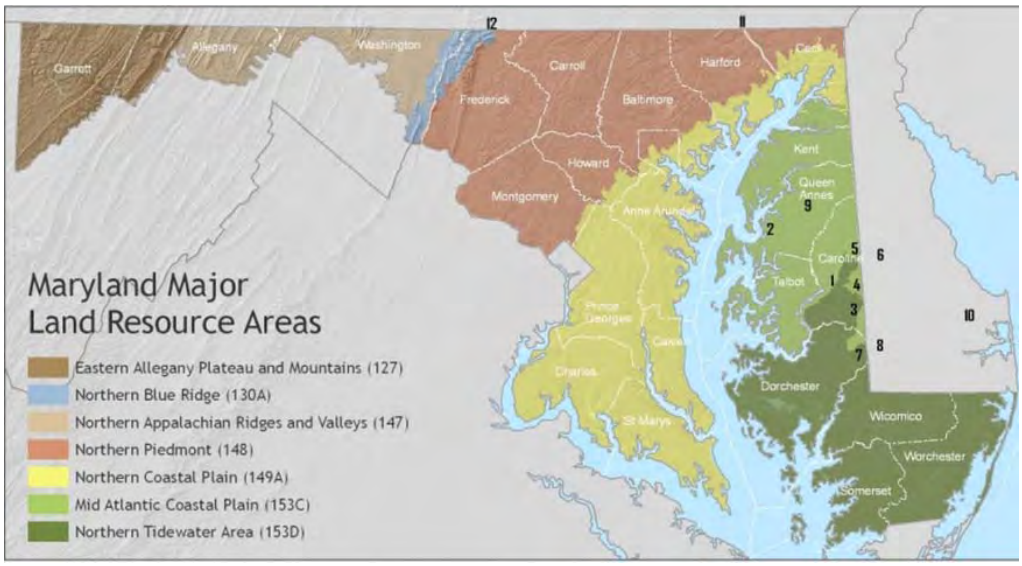


**Figure 20: Test sites in Maryland, Delaware and Pennsylvania by MLRA soil type.**

Table 16: Six VEB test sites in MD, DE and PA. Information identifying an individual farm obscured.

**Biglersville, PA:** all plants irrigated and mulched

| Botanical Name | Common Name | Qty. | Distance from fans (ft) | Average height (cm) |
|---|---|---|---|---|
| *Acer rubrum* | Red Maple | 8 | 34 | 100 |
| *Alnus serrulata* Panbowl | Alder | 6 | 34 | 99.17 |
| *Celtis occidentalis* | Hackberry | 6 | 45 | 78 |
| *Juniperus virginiana* | Eastern Red Cedar | 8 | 45 | 64 |
| *Miscanthus x giganteus* | Giant Miscanthus | 30 | 30 | 170 |
| *Morella pennsylvanica* | Bayberry | 8 | 30 | 72.5 |
| *Panicum amarum* Atlantic | Coastal Switchgrass | 24 | 30 | 115 |
| Panicum virgatum Northwind | Switchgrass | 90 | 30 | 125 |
| *Panicum virgatum* Thundercloud | Switchgrass | 30 | 30 | 150 |
| *Populus deltoides x nigra* Spike | Poplar | 12 | 45 | 252.86 |
| *Quercus rubra* | Red Oak | 10 | 45 | 107 |
| *Robinia pseudoacacia* | Black Locust | 11 | 34 | 132 |
| *Salix alba x matsudana* Austree | Hybrid Willow | 55 | 45 | 260 |
| *Salix purpurea* Streamco | Purpleoisier Willow | 62 | 34 | 100 |
| Thuja *occidentalis* Affinity | Northern White Cedar | 8 | 56 | 163.12 |
| Thuja occidentalis | Northern White Cedar | 8 | 56 | 55 |
| *Thuja standishii x plicata* Green Giant | Arborvitae | 6 | 56 | 156.67 |
| *Ulmus americana* Valley Forge | American Elm | 17 | 45 | 188 |

**Grantville, PA:** irrigation, 67% plant survival

| Botanical Name | Common Name | Qty. | Distance from fans (ft) | Average height (cm) |
|---|---|---|---|---|
| *Ulmus americana* New Harmony | American Elm | 1 | 37 | 81 |
| *Ulmus americana* Valley Forge* | American Elm | 2 | 37 | 84 |

**Denton, MD:** no irrigation, 100% plant survival

| Botanical Name | Common Name | Qty. | Distance from fans (ft) | Average height (cm) |
|---|---|---|---|---|
| *Ulmus americana* New Harmony | American Elm | 2 | 20 | 89 |
| *Ulmus americana* Valley Forge | American Elm | 6 | 20 | 84 |

**Queen Anne's Co., MD:** no irrigation, 90% plant survival

| Botanical Name | Common Name | Qty. | Distance from fans (ft) | Average height (cm) |
|---|---|---|---|---|
| *Ulmus americana* New Harmony | American Elm | 3 | 30 | 165 |
| *Ulmus americana* Valley Forge | American Elm | 8 | 30 | 164 |

**Centreville, MD:** no irrigation, 100% plant survival

| Botanical Name | Common Name | Qty. | Distance from fans (ft) | Average height (cm) |
|---|---|---|---|---|
| *Ulmus americana* New Harmony | American Elm | 2 | 40 | 246 |

**Rhodesdale, MD:** irrigation, 100% plant survival

| Botanical Name | Common Name | Qty. | Distance from fans (ft) | Average height (cm) |
|---|---|---|---|---|
| *Ulmus americana* New Harmony | American Elm | 2 | 30 | 94 |
| *Ulmus americana* Valley Forge | American Elm | 4 | 30 | 88 |

Table 17 shows the twenty-five plant species tested, location, quantity, fan type, and when the test was initiated. In addition, table x shows the quantity of plants species tested in each year, 2008 four species (four grasses, one tree), 2009 one species (tree), 2010 seven species (two shrubs, five trees) and 2011 thirteen species (six grasses, four shrubs and three trees).

**Table 17: Test plant species by fan type, site location and initial test year. Site locations can be found in Figure 19.**

| Plant Species | Botanical Name | Fan Type | Site Location | Initial Test Year |
|---|---|---|---|---|
| Switchgrass | *Panicum virgatum (6 cultivars)* | 1, 2, 3 | 1, 2, 3, 8, 11, 12 | 2008 |
| Giant Miscanthus | *Miscanthus x giganteus* | 1, 2, 3 | 1, 2, 3, 8, 11, 12 | 2008 |
| Coastal Switchgrass | *Panicum amarum* Atlantic | 1, 2, 3 | 1, 2, 3, 8, 11, 12 | 2008 |
| Osage Orange | *Maclura pomifera* White Shield | 1, 2 | 11, 12 | 2008 |
| American Elm | *Ulmus Americana* Valley Forge, New Harmony | 1, 2, 3 | 3, 5, 6, 11, 12 | 2009 |
| Bayberry | *Morella pennsylvanica* | 1, 2 | 7, 8, 11, 12 | 2010 |
| Smooth Alder | *Alnus serrulata* Panbowl | 1, 2, 3 | 5, 8, 11, 12 | 2010 |
| Red Oak | *Quercus rubra* | 1, 3 | 11, 12 | 2010 |
| Northern White Cedar | *Thuja occidentalis* Affinity | 1, 3 | 11 | 2010 |
| Black Locust | *Robinia pseudoacacia* | 1, 3 | 11, 12 | 2010 |
| Hackberry | *Celtis laevigata, Celtis occidentalis* | 1, 2 | 8, 11, 12 | 2010 |
| Red Maple | *Acer rubra* | 1, 3 | 11, 12 | 2010 |
| Saltmeadow Cordgrass | *Spartina patens* | 1, 2 | 3, 7, 11 | 2011 |
| Big Bluestem | *Andropogon gerardii* | 1, 2 | 4, 7, 8, 11, 12 | 2011 |
| Florida Paspalum | *Paspalum floridatum* Mid Atlantic | 1,2 | 4, 7, 8, 11, 12 | 2011 |
| Eastern gamagrass | *Tripsacum dactyloides* Pete, Meadowcrest | 1, 2 | 4, 8, 11 | 2011 |
| Giant Cane | *Arundinaria gigantea* | 1, 2, 3 | 4, 7, 11 | 2011 |
| Emory Sedge | *Carex emoyorii* | 1, 2 | 8, 9, 11 | 2011 |
| Chinquapin | *Castanea pumila* Golden | 1, 3 | 11 | 2011 |
| Purple Osier Willow | *Salix purpurea* Allegany, Fish Creek, Onodaga | 1, 2, 3 | 4,11 | 2011 |
| Hybrid Purple Osier Willow | *Salix purpurea x miyabeana* Millbrook | 1,2,3, | 4,11 | 2011 |
| Wax Myrtle | *Morella cerifera* | 1, 2 | 6, 7, 8 | 2011 |
| Chestnut Oak | *Quercus prinus* | 1, 3 | 11 | 2011 |
| Scholar Tree | *Sophora japonica* | 1, 3 | 11 | 2011 |
| Southern Magnolia | *Magnolia grandiflora* | 1, 3 | 7, 11 | 2011 |

In 2009 and 2010 'New Harmony' and 'Valley Forge' American elms were planted at various sites in Maryland, Delaware and Pennsylvania. These two cultivars of American elm were introduced by the U.S. National Arboretum and have been tested for tolerance to the Dutch elm disease which has decimated elm populations throughout the U.S. Elms are adaptable to various cultural growing conditions and soils, grow quickly (up to three feet a year) and have been used extensively for street trees. Table 18 shows the survival and growth of the plants which were planted in 2009 and 2010.

Table 18: Test plant survival and growth by farm and location.

## Biglersville, PA

| Plant # | Site # | Farm type | Cultivar | Year Planted | Fan dist (ft.). | Fan type | Irrigation | Height (cm) | Width (cm) | notes |
|---|---|---|---|---|---|---|---|---|---|---|
| 32 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 240 | 140 | |
| 33 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 280 | 140 | |
| 34 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 230 | 140 | |
| 35 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 230 | 140 | |
| 36 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 160 | 55 | |
| 37 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 240 | 90 | |
| 38 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 240 | 90 | |
| 39 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 190 | 55 | |
| 40 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 220 | 110 | |
| 41 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 220 | 110 | |
| 42 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 220 | 110 | |
| 43 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 245 | 110 | |
| 44 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 235 | 110 | |
| 45 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 200 | 110 | |
| 46 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 300 | 110 | |
| 47 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 265 | 110 | |
| 48 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | yes | 235 | 110 | |
| 49 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | no | 70 | 30 | control 75% survival |
| 50 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | no | dead | | control |
| 51 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | no | 70 | 35 | control avg. ht 67.5 cm x wd. 30 cm |
| 52 | 12 | Egg | Valley Forge | 2010 | 35 | 1 | no | 60 | 25 | control |
| | | | ***Totals*** | | | | | **208** | **97** | |

## Grantville, PA

| Plant # | Site # | Farm type | Cultivar | Year Planted | Fan dist (ft.). | Fan type | Irrigation | Height (cm) | Width (cm) | notes |
|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 10 | Broiler | Valley Forge | 2009 | 37 | 3 | intermittent | | | dead Spr - '11 |
| 29 | 10 | Broiler | Valley Forge | 2009 | 37 | 3 | intermittent | | | dead Spr - '11 |
| 30 | 10 | Broiler | Valley Forge | 2009 | 37 | 3 | intermittent | | | dead Spr - '11 |
| 31 | 8 | Broiler | Valley Forge | 2009 | 25 | 2 | no | | | dead Spr - '11 |
| | | | ***Totals*** | | | | | **0** | **0** | |

**Denton, MD**

| Plant # | Site # | Farm type | Cultivar | Year Planted | Fan dist (ft.). | Fan type | Irrigation | Height (cm) | Width (cm) | notes |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 3 | Broiler | Valley Forge | 2009 | 20 | 1 | no | | | dead sum-'11 |
| 21 | 3 | Broiler | Valley Forge | 2009 | 20 | 1 | no | | | dead sum-'11 |
| 22 | 3 | Broiler | Valley Forge | 2009 | 20 | 1 | no | | | dead sum-'11 |
| 23 | 3 | Broiler | Valley Forge | 2009 | 20 | 1 | no | | | dead sum-'11 |
| 24 | 3 | Broiler | Valley Forge | 2009 | 20 | 1 | no | | | dead sum-'11 |
| 25 | 3 | Broiler | Valley Forge | 2009 | 20 | 1 | no | | | dead sum-'11 |
| 26 | 3 | Broiler | Valley Forge | 2009 | 20 | 1 | no | | | dead sum-'11 |
| 27 | 3 | Broiler | Valley Forge | 2009 | 20 | 1 | no | | | dead sum-'11 |
| | | | ***Totals*** | | | | | **0** | **0** | |

**Queen Anne's Co., MD**

| Plant # | Site # | Farm type | Cultivar | Year Planted | Fan dist (ft.). | Fan type | Irrigation | Height (cm) | Width (cm) | notes |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 1 | Broiler | New Harmony | 2009 | 30 | 3 | no | 90 | 40 | |
| 11 | 1 | Broiler | New Harmony | 2009 | 30 | 3 | no | 140 | 100 | |
| 12 | 1 | Broiler | Valley Forge | 2009 | 30 | 3 | no | | | dead sum-'11 |
| 13 | 1 | Broiler | Valley Forge | 2009 | 30 | 3 | no | 100 | 30 | |
| 14 | 1 | Broiler | Valley Forge | 2009 | 30 | 3 | no | 130 | 55 | |
| 15 | 1 | Broiler | Valley Forge | 2009 | 30 | 3 | no | 135 | 60 | |
| 16 | 1 | Broiler | Valley Forge | 2009 | 30 | 3 | no | 150 | 70 | |
| 17 | 1 | Broiler | Valley Forge | 2009 | 30 | 3 | no | 150 | 70 | |
| 18 | 1 | Broiler | Valley Forge | 2009 | 30 | 3 | no | | | dead sum-'11 |
| 19 | 1 | Broiler | Valley Forge | 2009 | 30 | 3 | no | 230 | 120 | |
| | | | ***Totals*** | | | | | **141** | **68** | **80% survival** |

**Centreville, MD**

| Plant # | Site # | Farm type | Cultivar | Year Planted | Fan dist (ft.). | Fan type | Irrigation | Height (cm) | Width (cm) | notes |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | Broiler | New Harmony | 2009 | 40 | 3 | no | 203 | 61 | |
| 2 | 2 | Broiler | New Harmony | 2009 | 40 | 3 | no | 246 | 92 | dead (voles) |
| | | | ***Totals*** | | | | | **225** | **77** | **100% survival** |

**Rhodesdale, MD**

| Plant # | Site # | Farm type | Cultivar | Year Planted | Fan dist (ft.). | Fan type | Irrigation | Height (cm) | Width (cm) | notes |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 7 | Broiler | New Harmony | 2009 | 30 | 2 | intermittent | | | dead sum-'11 |
| 4 | 7 | Broiler | Valley Forge | 2009 | 30 | 2 | intermittent | | | dead sum-'11 |
| 5 | 7 | Broiler | Valley Forge | 2009 | 30 | 2 | intermittent | | | dead sum-'11 |
| 6 | 7 | Broiler | Valley Forge | 2009 | 30 | 2 | intermittent | | | dead sum-'11 |
| 7 | 7 | Broiler | Valley Forge | 2009 | 30 | 2 | intermittent | | | dead sum-'11 |
| 8 | 7 | Broiler | Valley Forge | 2009 | 30 | 2 | intermittent | | | dead sum-'11 |
| 9 | 1 | Broiler | New Harmony | 2009 | 30 | 3 | no | 75 | 30 | |
| | | | | ***Totals*** | | | | **75** | **30** | |

In well maintained sites which are more than thirty feet from single or sidewall fans, high survival rate and quick growth are possible. Irrigation plays an important role in the endurance of American elms during the establishment period (initial 1- 2 growing seasons). Broiler farms (higher ammonia emissions) are a more challenging environment than egg farms (higher dust emissions.)

Cooperators for this work include the following individuals:
Dr. Paul Paterson, Prof., Dept. of Poultry Science, Penn State Univ.,
Dr. George (Bud) Malone, Extension Poultry Specialist (Retired), Univ. of DE
James Passwaters, Delmarva Poultry Industry, Georgetown DE
Dr. Cathleen Hapeman, USDA, ARS, Beltsville, MD
Dr. Laura McConnell, USDA, ARS, Beltsville, MD

# WARM-SEASON GRASS MANAGEMENT TRIALS

**Study No:** MDPMC-T-0803-WI

**Study Leader:** R. Jay Ugiansky, NPMC Resource Conservationist

**Objective:** Evaluate vegetative response to disturbance treatments on native warm-season grass (NWSG) stands for excessively thick stands and stands of normal thickness. Evaluate effectiveness of over-seeding new, Maryland wildflower mixes based on timing, disturbance intensity and seeding rate treatments.

**Introduction:** Wildflowers are food for insect larvae and provide pollen and nectar to pollinators. A diverse mix of wildflowers with blooms throughout the growing season is especially valuable to pollinators while supporting populations of beneficial insects, such as those that prey on crop pests. Wildflowers in grass plantings provide a varied food source and structural complexity to support a diverse community of birds, mammals and insects.

Warm-season grasses can come to dominate conservation plantings, resulting in limited plant species diversity, lack of structural complexity and a compromised ability to support diverse wildlife. Maryland NRCS is working to increase the wildflower diversity in its conservation plantings and thereby increase the ability of these plantings to support greater wildlife diversity. This study will determine methods for renovating warm-season grass stands to increase diversity and improve wildlife habitat. The study is being conducted at the National Plant Materials Center in Beltsville, Maryland in cooperation with Maryland NRCS State Biologist Steve Strano.

**Procedure:** Two separate treatment areas, Area 1 (Locust Field, NPMC) and Area 2 (C2, NPMC), with different soils and existing plant compositions will be used for the study. Area 1 (dry) is a well-drained site with soil dominated by Indiangrass and will be planted with dry wildflower mix treatments. Area 2 is a mesic site with soil dominated by warm-season grasses and will be planted with mesic wildflower mix treatments. All study plots will be evaluated for percent cover of existing vegetation and open ground before and after treatment application. The treatments for the species mixes are identical.

**Treatments:**

A. Time of mowing/disking effects (T)
   - Late summer – mow and disk (September)
   - Late summer mow – fall (dormant) disk (November)
   - Fall (dormant) mow (November) – spring disk (March)
   - Late winter/early spring – mow and disk (March)

B. Intensity of disking effects/percent bare ground (D = Disk or C = Chisel plow)
   - 25 percent bare ground
   - 50 percent bare ground
   - 100 percent bare ground
   - No disk (control)

C. Overseeding
   - None - Control (x)
   - ½ pound PLS per acre rate (w)
   - ½ pound PLS per acre rate with small grain nurse crop (oats at 20 pounds per acre) (g)
   - 4 pounds PLS per acre rate (c)

**Wildflower Mixes:**
   - Area 1: Indiangrass plot – Use Maryland native wildflower mix for dry sites
   - Area 2: Warm-season grass plot – Use Maryland native wildflower mix for mesic sites

**Response Evaluation:**
The following responses will be evaluated for a period of three years:

A. Percent cover (based on cover classes)
   - Total
   - Desirable grasses
   - Desirable forbs
   - Weeds – any problematic species
   - Litter (based on what is visible)
   - Bare ground (based on what is visible)
B. Litter depth (based on depth classes, using most representative depth class for plot)
C. Vegetative composition (species)

**Potential Products:** New and/or revised seeding recommendations for NRCS programs; technical notes and fact sheets.

**Status of Project:** Pretreatment evaluations were conducted in fall 2008, and post treatment evaluations were conducted in fall 2009, 2010, and 2011. Summary of 2011 data are shown in Figures 21 to 24. Comparisons of data over 4 evaluations seasons are shown in Figures 25 to 28. Summary of 2010 and 2011 data for seeded forb species mean percent cover of seeded plots are shown in figures 29 and 30. As of 2011 the data indicates the following:

1) The fall disking treatments had the greatest reduction in NWSGs and improvements to forb establishment. These improvements were still measurable three seasons after treatment. After 3 seasons NWSGs disked in the fall had less cover than NWSGs disked in spring, especially on the dry site. NWSGs may be more susceptible to critical damage when disked in the fall, or alternatively, spring disking may have a positive effect on NWSGs. The difference in percent cover of NWSGs between fall and spring disk was more pronounced in the 100% bare ground disking treatment, but was apparent in the 25% and 50% disking treatments, however the timing of the disking treatment was more important. Spring disking is not very effective at persistently reducing cover of well-established, tall-statured NWSGs.

2) Intensity of disking made little difference in persistent reductions of grass cover or improvement in establishment of forbs. Temporary reductions in grass cover did allow some establishment of forbs.

3) Disking was more effective in reducing cover of tall-statured NWSGs at the site with well-drained soils (dry site) with Indiangrass as the primary NWSG. Plots at this site had Indiangrass cover reduced whereas the switchgrass and big bluestem cover remained the same or increased, suggesting that Indiangrass is more susceptible to damage by disking.

4) Larger scale evaluations should be conducted to determine the most effective and efficient methods for reducing the NWSG cover in established stands. In addition to disking, other methods of disturbance should be evaluated, including plowing and herbicide treatment.

5) The timing of disturbance to NWSGs should be evaluated further. Currently, the most common time for disking and burning NWSGs is in the early spring, because it is more convenient for managers, and it leaves wildlife cover standing through the winter. If fall disturbance is more effective, then current management practices will need to be re-evaluated.

6) Wildflower establishment was affected more by species than any other variable. Many wildflowers species were not found in any of the plots whereas a few were commonly found as shown in figures 29 and 30.

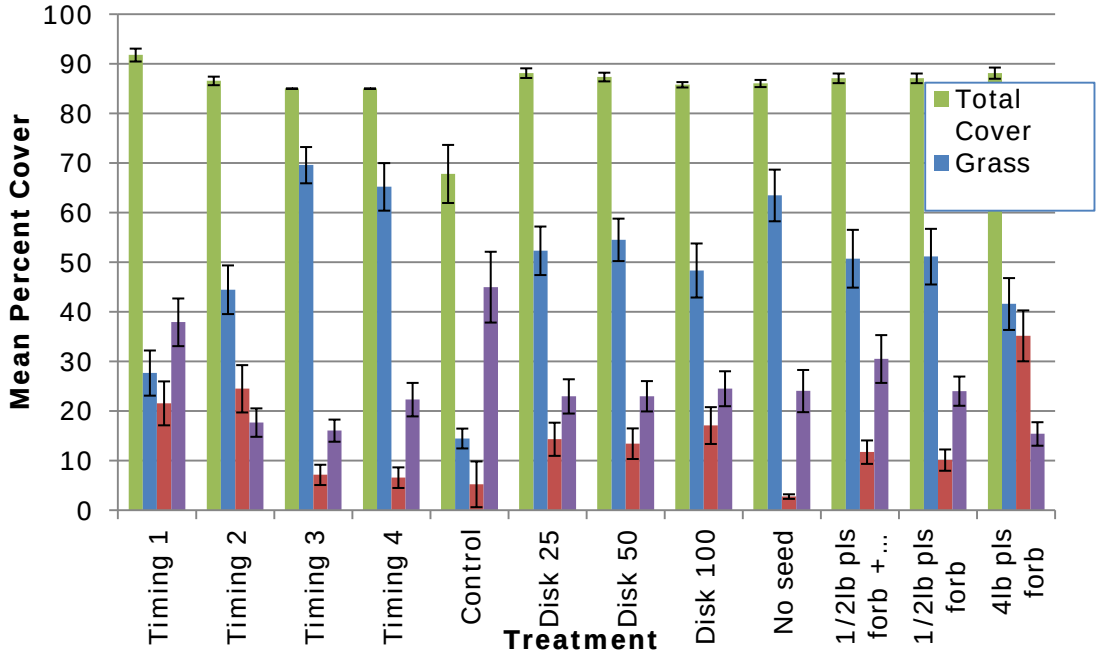


Figure 21: Comparison of mean percent cover at dry site (Locust Plot) 3 seasons after treatments (Fall 2011). Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments represent the target amount of bare ground after disking (25%, 50%, and 100% bare ground). Last 4 treatments are seeding rates. Error bars represent +/- 1 standard error. Percent cover based on cover class midpoints.

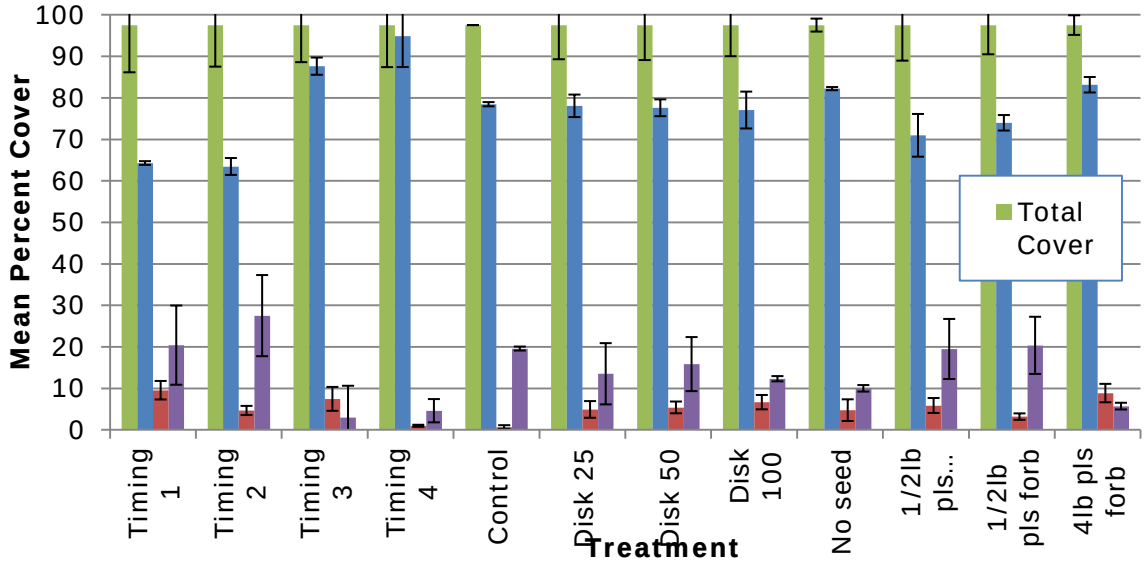


Figure 22: Comparison of mean percent cover at "mesic" site (C2 Plot) 3 seasons after treatments (Fall 2011). Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments represent the target amount of bare ground after disking (25%, 50%, and 100% bare ground). Last 4 treatments are seeding rates. Error bars represent +/- 1 standard error. Percent cover based on cover class midpoints.

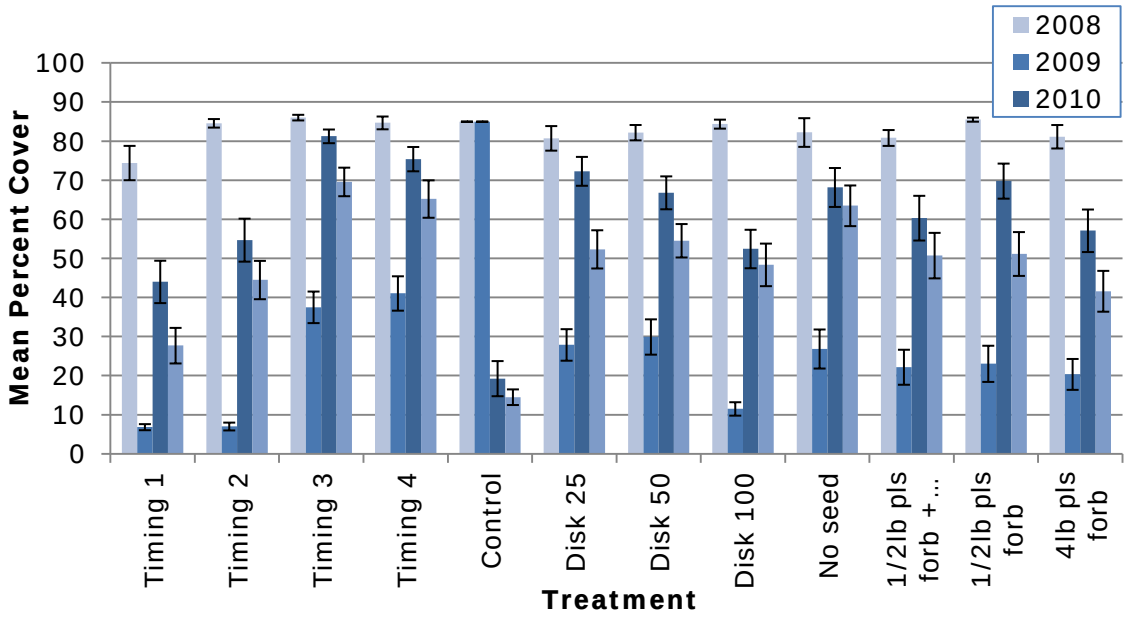


Figure 23: Comparison of mean percent cover of grass at dry site (Locust Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments represent the target amount of bare ground after disking (25%, 50%, and 100% bare ground). Last 4 treatments are seeding rates. Error bars represent +/- 1 standard error. Percent cover based on cover class midpoints.

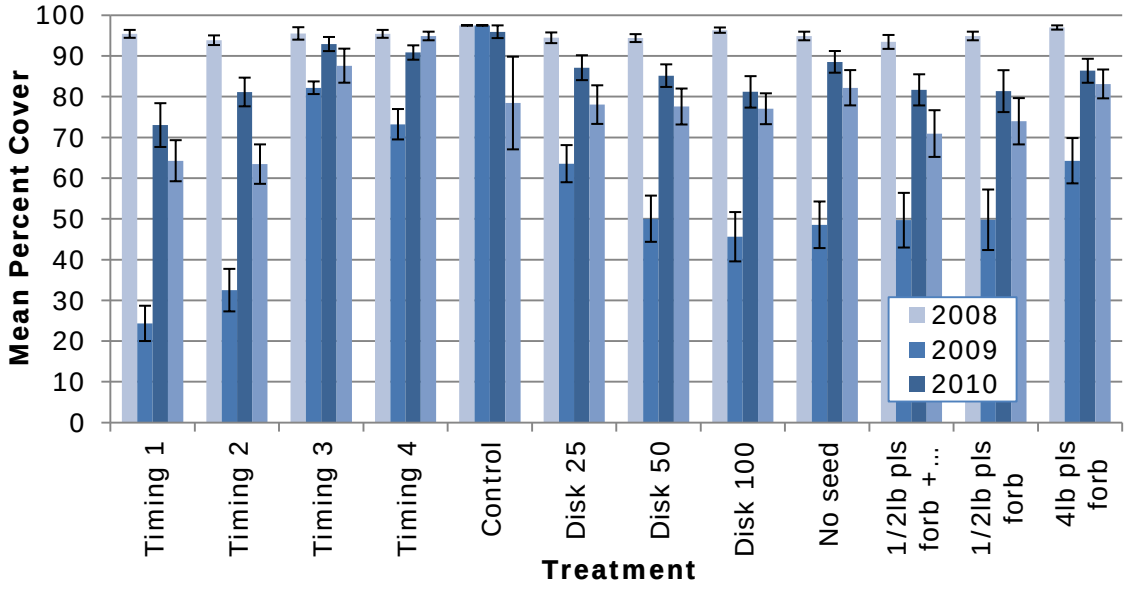


Figure 24: Comparison of mean percent cover of grass at "mesic" site (C2 Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments represent the target amount of bare ground after disking (25%, 50%, and 100% bare ground). Last 4 treatments are seeding rates. Error bars represent +/- 1 standard error. Percent cover based on cover class midpoints.

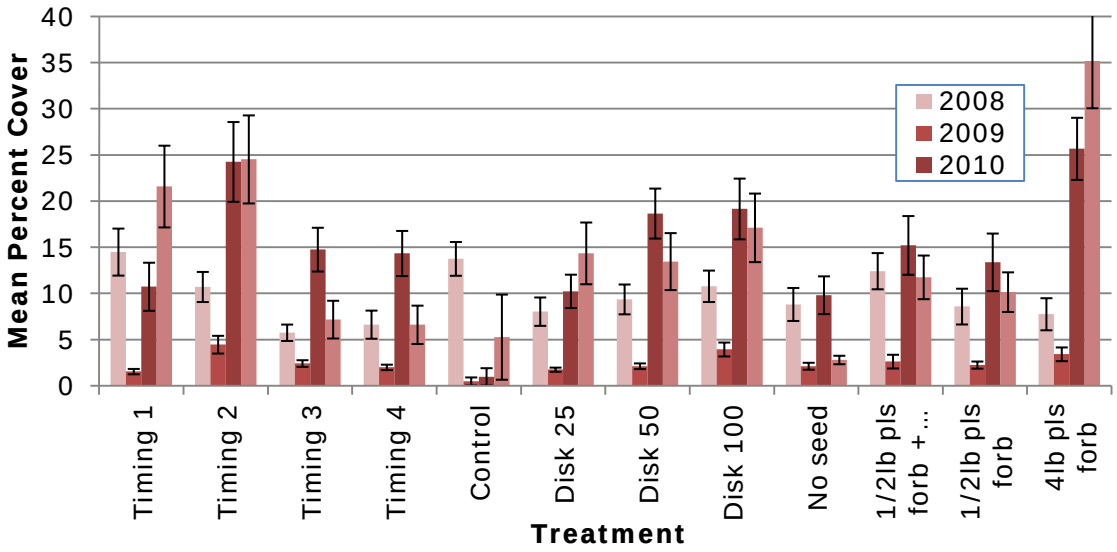


Figure 25: Comparison of mean percent cover of forbs at "dry" site (Locust Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments represent the target amount of bare ground after disking (25%, 50%, and 100% bare ground). Last 4 treatments are seeding rates. Error bars represent +/- 1 standard error. Percent cover based on cover class midpoints.

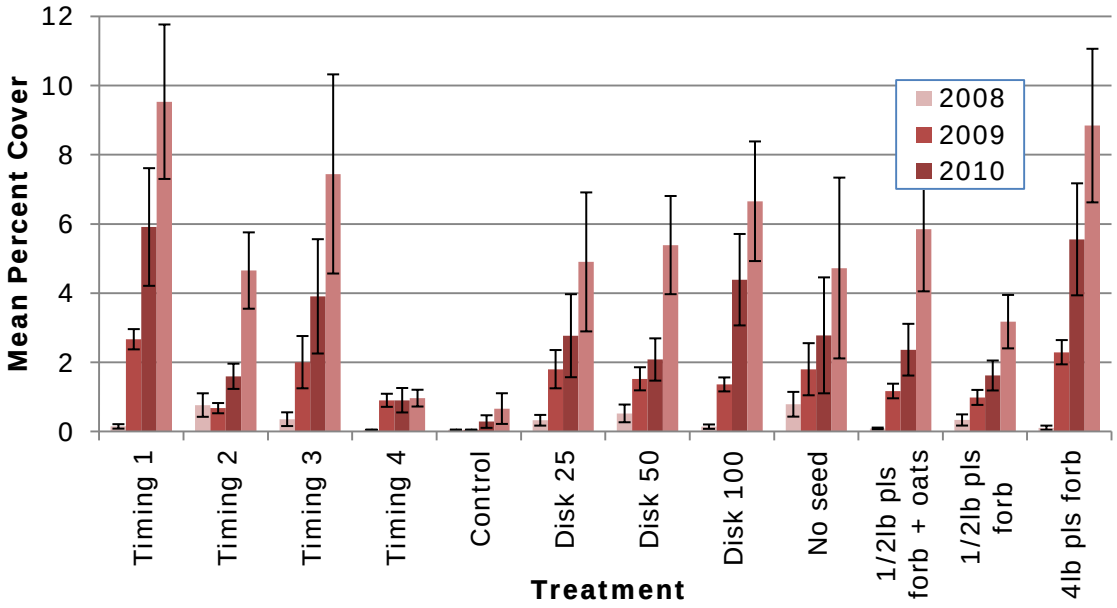


Figure 26: Comparison of mean percent cover of forbs at "mesic" site (C2 Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments represent the target amount of bare ground after disking (25%, 50%, and 100% bare ground). Last 4 treatments are seeding rates. Error bars represent +/- 1 standard error. Percent cover based on cover class midpoints.

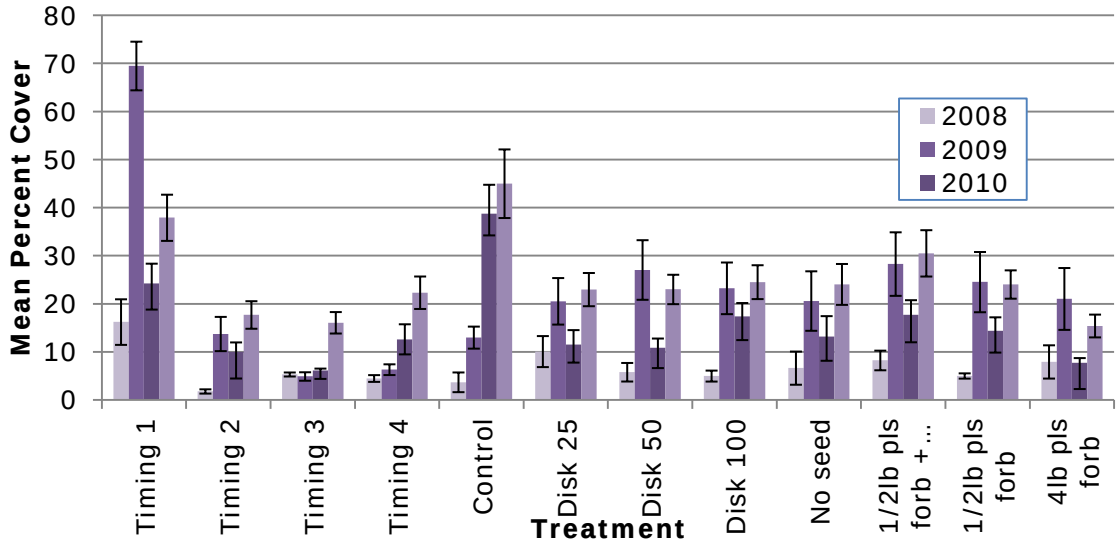


Figure 27: Comparison of mean percent cover of weeds at "dry" site (Locust Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments represent the target amount of bare ground after disking (25%, 50%, and 100% bare ground). Last 4 treatments are seeding rates. Error bars represent +/- 1 standard error. Percent cover based on cover class midpoints.

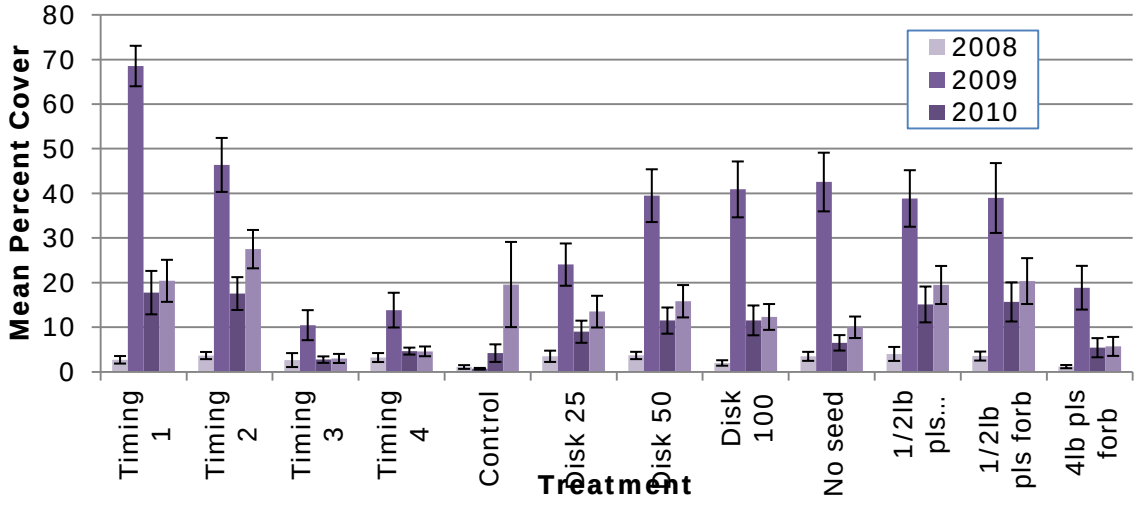


Figure 28: Comparison of mean percent cover of weeds at "mesic" site (C2 Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments represent the target amount of bare ground after disking (25%, 50%, and 100% bare ground). Last 4 treatments are seeding rates. Error bars represent +/- 1 standard error. Percent cover based on cover class midpoints.

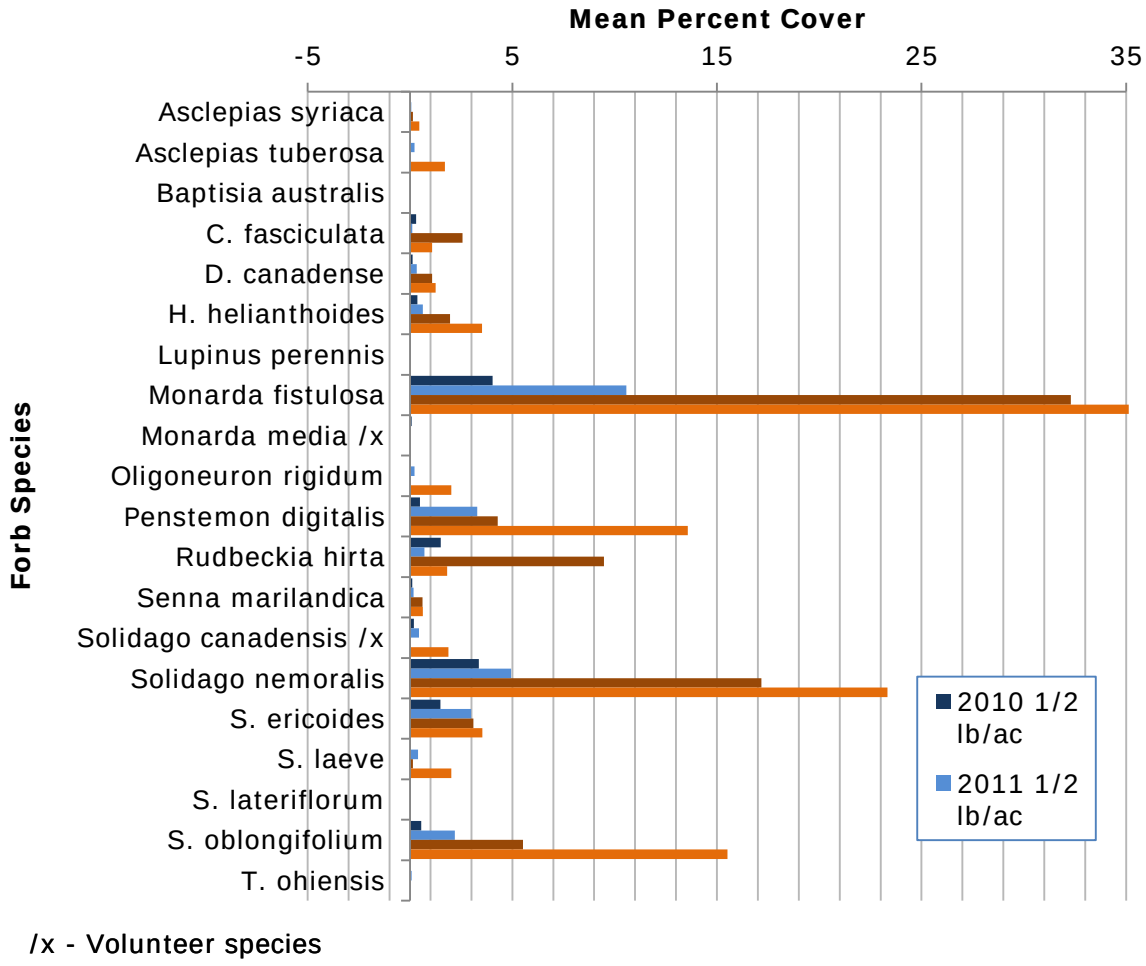


Figure 29: Forb species mean percent cover at "dry" site (Locust Plot) 2 and 3 growing seasons after treatments, for plots seeded with forbs at 1/2 and 4 lb/ac PLS. Mean percent cover for Monarda fistulosa 2011 4 lb/ac is 50%.

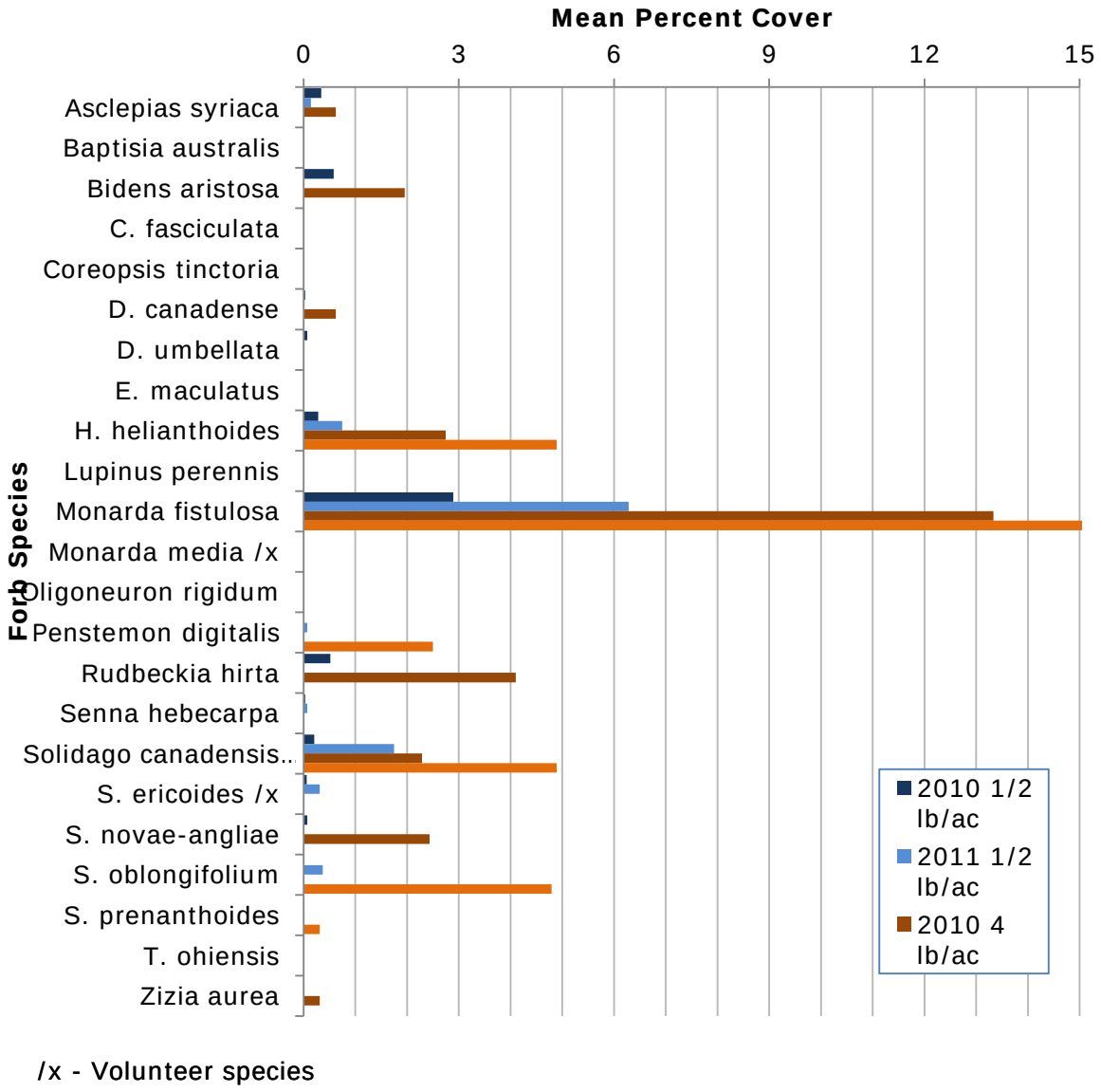


Figure 30: Forb species mean percent cover at "mesic" site (C2 Plot) 2 and 3 growing seasons after treatments, for plots seeded with forbs at 1/2 and 4 lb/ac PLS. Mean percent cover for Monarda fistulosa 2011 4 lb/ac is 22.8%.

# EFFECTS OF NITROGEN FERTILITY ON THE SEED PRODUCTION OF THREE NATIVE PLANT SPECIES: SOUTHEASTERN WILDRYE (ELYMUS GLABRIFLORUS), BEAKED PANICGRASS (PANICM ANCEPS) AND GRAY GOLDENROD (SOLIDAGO NEMORALIS)

**Study No:** MDPMC-T-0804-BU

**Study Leaders:** Shawn Belt, NPMC Horticulturist; Sara Tangren, Chesapeake Natives Inc.; and Andrew Ritsvey, University of Maryland Cooperative Extension

**Objective:** To investigate the most efficient fertilization rate (0, 30 or 60 pounds nitrogen per acre) in order to maximize seed production, while at the same time minimizing fertilization inputs. This study not only potentially saves production costs for producers, but will minimize nutrients reaching the Chesapeake Bay.

**Introduction:** The Maryland State Highways Administration (SHA) has identified a need for locally native and affordable seed for statewide conservation activities. Three species have been identified for evaluation, including southeastern wildrye (*Elymus glabriflorus*), beaked panic grass (*Panicum anceps*) and grey goldenrod (*Solidago nemoralis*). The highly disturbed soils that SHA must revegetate are diverse, tough environments for plant life. The chances that some of the seed in an order will be well adapted to a particular stabilization site are optimized if that seed originated from a genetically diverse local collection. The use of locally native seed also preserves Maryland's natural heritage and supports local agriculture. This project has been established in order to make such seed more affordable and more available to SHA for use in roadside soil stabilization projects.

**Procedure:** For each species tested, the test plots consist of 270 plants (three fertilization rates by three replications = nine plots by 30 plants per plot). Each plot contains three rows of 10 plants (see Figure 31). In order to minimize the potential of nutrient contamination from adjacent plots only the center eight plants (highlighted in red) were harvested and evaluated.

X X X
X X X
X X X
X X X
X X X
X X X
X X X
X X X
X X X
X X X

**Figure 31: Plot structure showing three rows of 10 plants. "Red" plants were harvested and evaluated while "black" plants were used to minimize adjacency issues.**

A soil analysis of the top six inches of soil was conducted in March 2009. A low rating of organic matter (2.1%) with an estimated nitrogen release of 85 pounds per acre and nitrate ($NO_3$) of four parts per million (very low rating) was reported. The level of potassium was also low. In order that the deficient level of potassium is not an additional limiting factor potassium sulfate (0-0-50) was applied to the test plots.

The spring of 2009 the various rates of slow release nitrogen were broadcast into the test fields. Evaluation of the plant height, time of seed set, seed viability and number of reproductive tillers was conducted August through September 2009 (see Tables 19 and 20).

**Status of Project:** Seed weight and tiller count data were collected in 2009 on the three plant species. Data were not collected for the following year (2010). After consultation with project partner Andrew Ristvey it was decided that it is necessary to have data from two consecutive years. Since the study plants are well established, this study is being repeated in 2012 - 2013. When the project is concluded in 2013, all seed will be deposited with the National Plant Germplasm System so that the genetic variations of the seed collections are preserved long-term.

**Table 19: Beaked panicgrass fertility trial results from 2009. 2012 data will be included in the 2013 ATR.**

| Repetition | Treatment | Seed Wt (g) | Notes |
|---|---|---|---|
| 1 | high | 190.6 | |
| 2 | high | 136.9 | |
| 3 | high | 187.9 | |
| 1 | low | 198.2 | |
| 2 | low | 167.4 | |
| 3 | low | 137.6 | |
| 1 | medium | 181.7 | |
| 2 | medium | 147.2 | |
| 3 | medium | 269.9 | Data point discarded – worker accidentally cut sample |
| Grand Mean seed weight | | 165 grams | |
| LSD [1](0.05) | high | 171.8 grams | |
| | low | 167.7 grams | |
| | medium | 155.6 grams | |
| %CV[2] 14.58 | | | |
| [1]least significant difference test at 5% level of probability | | | |
| [2]coefficient of variation | | | |

**Table 20: Southeastern wildrye fertility trial results from 2009. 2012 data will be included in the 2013 ATR.**

| Repetition | Treatment | Seed Wt (g) |
|---|---|---|
| 1 | high | 226.9 |
| 3 | high | 194.3 |
| 2 | high | 198.1 |
| 1 | low | 194.3 |
| 2 | low | 204.3 |
| 3 | low | 192.5 |
| 1 | medium | 192.0 |
| 2 | medium | 242.6 |
| 3 | medium | 200.7 |
| Grand Mean seed weight | | 205 grams |
| LSD[1] (0.05) | medium | 211.77 grams |
| | high | 206.43 grams |
| | low | 197.03 grams |
| %CV[2] 9.83 | | |
| [1]least significant difference test at 5% level of probability | | |
| [2]coefficient of variation | | |

# WILDFLOWER PERSISTENCE STUDY

**Study No:** MDPMC-T-0804-WI

**Study Leader:** R. Jay Ugiansky, Resource Conservationist

**Objective:** Evaluate established wildflower species persistence within an established warm-season grass stand. Evaluate species included in the **WARM-SEASON GRASS MANAGEMENT TRIAL**, plus additional promising species. Species will be planted as plugs to better ensure establishment in the first year and remove germination and other field establishment variables.

**Introduction:** Wildflowers are food for insect larvae and provide pollen and nectar to pollinators. A diverse mix of wildflowers with blooms throughout the growing season is especially valuable to pollinators while supporting populations of beneficial insects, such as those that prey on crop pests. Wildflowers in grass plantings provide a varied food source and structural complexity to support a diverse community of birds, mammals and insects.

Warm-season grasses can come to dominate conservation plantings, resulting in limited plant species diversity, lack of structural complexity and a compromised ability to support diverse wildlife. Maryland NRCS is working to increase the wildflower diversity in its conservation plantings and thereby increase the ability of these plantings to support greater wildlife diversity. This study will determine the optimal methods for renovating warm-season grass stands to increase diversity and improve wildlife habitat. The study is being conducted at the National Plant Materials Center in Beltsville, Maryland in cooperation with Maryland NRCS State Biologist Steve Strano.

**Procedure:**
First year:
- Mow warm-season grass stand.
- Kill three inch diameter circles within the warm-season grass using the broad spectrum herbicide glyphosate.
- Plant 10 – 15 plugs of each wildflower species into the cleared circles (one species per circle).
- Make initial evaluations of height and vigor.

Second year and fifth year:
- Evaluate for survival, height and vigor in the second and fifth years.

**Potential Products:** New seeding recommendations for NRCS programs. Technical Notes and Plant Fact Sheets.

**Status of Project:** Second year evaluation was completed in the fall of 2008 by University of Maryland Students as part of a capstone class project. Summary of species established (2007), second year evaluation (2008) and fifth year persistence (2011) are included in Table 21. By the end of the study, the study plots were overtaken by crown vetch. The very aggressive crown vetch outcompeted and killed the warm-season grasses and likely killed wildflowers as well. The 3 species that remained at the end of the trial endured both warm-season grass and crown vetch competition. These 3 species are continuing to gain in vigor and continued persistence would be expected.

This study has informed the creation of an eFOTG job sheet for Conservation Cover (327), "Herbaceous Plantings for Pollinator Habitat".

Table 21: Wildflower species planted in 2007 and persisting in 2008 and 2011.

| Wildflower species planted | |
|---|---|
| *Asclepias incarnata* | *Lespedeza capitata* |
| *A. syriaca** | *L. nutale** |
| *A. syriaca* | *Monarda media* |
| *Aster oblongifolius* | *M. punctata** |
| *Astragalus canadensis* | *Penstemon digitalis** |
| *Baptisia australis* | *Rudbeckia hirta* |
| *B. tinctoria** | *R. hirta** |
| *Bidens aristosa* | *Senna hebacarpa* |
| *Chamaecrista fasciculata* | *S. hebacarpa** |
| *Coreopsis tinctoria* | *S. marylandica* |
| *Desmanthus illinoensis* | *Solidago rigida* |
| *D. canadensis* | *Symphyotrichum laeve* |
| *D. ciliare** | *S. lateriflorus* |
| *D. paniculatum** | *S. loblongifolium* |
| *Helenium flexuosum** | *Trichostema dichotomum** |
| *Heliopsis helianthoides* | *Vicia americana* |

*** = MARYLAND ECOTYPE. NOTE: ALL OTHERS PURCHASED FROM A COMMERCIAL SOURCE.**

| Wildflower species persisting in second year (2008) | |
|---|---|
| *Asclepias incarnata*[1] | *Monarda media*[3] |
| *Baptisia tinctoria*[2] | *Rudbeckia hirta*[1] |
| *Bidens aristosa*[1] | *R. hirta**[3] |
| *Coreopsis tinctoria*[2] | *Senna hebacarpa*[1] |
| *Desmanthus illinoensis*[1] | *S. marylandica*[3] |
| *Desmodium ciliare*[2] | *Symphyotrichum laeve*[3] |
| *Helenium flexuosum**[1] | S. OBLONGIFOLIUM[3] |
| *Heliopsis helianthoides*[3] | *Trichostema dichotomum**[1] |
| *Lespedeza capitata*[1] | *Vicia americana*[2] |

* **= MARYLAND ECOTYPE. NOTE: ALL OTHERS PURCHASED FROM A COMMERCIAL SOURCE.**

**1** = Species persisted, >80% height, 1-3 vigor
**2** = Species not thriving, <10% height, 9-10 vigor
**3** = Species not established and replanted October 2008

| Wildflower species persisting in fifth year (2011) | |
|---|---|
| *Heliopsis helianthoides* | *S. hebacarpa** |
| *Senna hebacarpa* | *S. marylandica* |

* **= MARYLAND ECOTYPE. NOTE: ALL OTHERS PURCHASED FROM A COMMERCIAL SOURCE.**

# NRCS-NPS GREAT SMOKY MOUNTAINS REVEGETATION PROJECT

**Study No:** MDPMC-T-9604-RE

**Study Leader:** Shawn Belt, Horticulturist

**Objective:** Provide seed cleaning services to Great Smoky Mountain National Park (GRSM) to facilitate parkland revegetation efforts at GRSM and the Foothills Parkway using site collected seed.

**Introduction:** The current Interagency Agreement between Great Smoky Mountains National Park (GRSM) and the Norman A. Berg National Plant Materials Center (NPMC) was signed in March 2010, for the fiscal years 2011-2013 and is funded on an annual basis. GRSM and Foothills Parkway (FHP) have a need to preserve their native plant resources and revegetate parklands. The National Park Service (NPS) requires that restoration of native plants will be accomplished using germplasm from populations as closely genetically related as possible to park populations. GRSM has harvested seed from indigenous populations, but does not have the personnel, expertise, facilities or equipment needed to clean, process, test and store the seed. The NPMC does have the personnel and is equipped to clean, process and store quantities of seed sufficient to meet NPS needs within the required time frame. Technical expertise as necessary to achieve this goal will be provided by the NPMC under this agreement.

**Progress or status:**

*Seed Cleaning*

This is the first report for the 2011-2013 contract period. The Cades Cove increase fields and FHP harvest resulted in over 392 lbs. of bulk grass, legume, wildflower, tree and shrub seed. Table 22 lists the 22 different lots of seed cleaned (removed from the fruit for the woody species de-bearded and then run through a clipper for the grasses and wildflowers) by NPMC staff to yield 71 lbs. Pure Live Seed (PLS = bulk x purity x viability). The 11 different types of woody plant seed were especially labor intensive and time consuming to clean due to the type of seed cleaning machinery the NPMC possesses, which is specifically designed for grasses and wildflowers.

*NPMC's Seed Cleaning Facility*

With the 2010 purchase of the Eclipse 2 screen clipper, NPMC staff members are still learning optimal equipment operation and continuously improving seed cleaning methods. The last section of Table 22 lists five lots in which our efforts resulted in low amounts of PLS. Those lots were cleaned for a second time and samples sent to the Kansas Seed Testing Lab to make sure we are continuing to deliver high quality seed to GRSM.

*Virginia Wildrye Increase Field at the NPMC*

In 2010 an attachment to the current agreement was created for the production of 300 lbs. of Virginia wildrye (*Elymus virginicus*) seed. This native, perennial, cool season grass germinates quickly, making it a highly used species for slope stability and revegetating disturbed sites throughout the park. Another important benefit of Virginia wildrye seed is it maintains high viability percentages over a long period (over ten years) while in storage. Ideally, native seed mixes contain up to 25% Virginia wildrye for these reasons.

The one-half acre increase field plants (planted spring 2010) are currently well established. Field maintenance during seedling establishment included soil testing, soil amendment application (primarily lime), supplemental watering when necessary, pre-emergant herbicide application, and tillage. After establishment only pre-emergant herbicide application and mowing to limit weed pressure were necessary.

The field was harvested for the first time in September 2011, as shown in Figures 2 and 3. The increase field yielded over 50 lbs. of bulk seed. Subsequent Virginia wildrye harvests will significantly increase as the plants continue growing.

Table 22: Seed harvested and cleaned in 2011, by common name.

| Common Name | Species Code | Harvest year | Bulk (lbs) | P.L.S. (lbs) | Seed Test Date | Source |
|---|---|---|---|---|---|---|
| ***Cades Cove Increase Fields*** | | | | | | |
| Big bluestem | ANGE | 2011 | 54.5 | 2.9 | 10-2011 | Cades Cove |
| Bushy bluestem | ANGL2 | 2011 | 18.6 | 1.9 | 10-2011 | Cades Cove |
| Common sneezeweed | HEAU | 2011 | 2.7 | 0.2 | * | Cades Cove |
| Swamp sunflower | HEAN2 | 2011 | 3.2 | 0.6 | * | Cades Cove |
| Roundheaded lespedeza | LECA8 | 2011 | 1.8 | 0.2 | * | Cades Cove |
| Wild bergamot | MOFI | 2011 | 0.9 | 0.0 | * | Cades Cove |
| Mountain mint | PYMU | 2011 | 7.8 | 1.8 | 10-2011 | Cades Cove |
| Beard grass | SAGI | 2011 | 13.1 | 1.0 | 10-2011 | Cades Cove |
| Little bluestem | SCSC | 2011 | 40.3 | 14.9 | 10-2011 | Cades Cove |
| Maryland senna | SEMA1 | 2011 | 25.0 | 11.8 | 10-2011 | Cades Cove |
| Indiangrass | SONU2 | 2011 | 173.6 | 24.4 | 10-11 | Cades Cove |
| ***Totals*** | | | **341.5** | **59.9** | | |
| ***Foothills Parkway Woody Species*** | | | | | | |
| Devil's walking stick | ARSP2 | 2011 | 0.5 | 0.4 | * | FHP |
| Redbud | CECA4 | 2011 | 8.6 | 4.2 | 10-11 | FHP |
| Persimmon | DIVI5 | 2011 | 8.9 | 0.4 | * | FHP |
| Carolina buckthorn | FRCA13 | 2011 | 1.8 | 0.8 | * | FHP |
| Hairy lespedeza | LEHI2 | 2011 | 1.9 | 0.9 | * | FHP |
| Virginia creeper | PAQU2 | 2011 | 3.3 | 0.1 | * | FHP |
| Black cherry | PRSE2 | 2011 | 3.8 | 0.2 | * | FHP |
| Flameleaf sumac | RHCO | 2011 | 1.2 | 0.2 | * | FHP |
| Smooth sumac | RHGL | 2011 | 2.9 | 1.9 | * | FHP |
| Sumac | RHUS | 2011 | 2.6 | 1.4 | * | FHP |
| Grape | VITIS | 2011 | 14.1 | 1.0 | * | FHP |
| ***Totals*** | | | **49.6** | **11.5** | | |
| ***Re-Cleaned Seeds from 2011*** | | | | | | |
| Wild quinine | PAIN3 | 2010 | 2.8 | 0.5 | 9-2011 & 1-2012 | Cades Cove |
| Big bluestem | ANGE | 2010 | 18.8 | 18.8 | 9-2011 & 1-2012 | Cades Cove |
| Little bluestem | SCSC | 2010 | 10.8 | 4.6 | 9-2011 & 1-2012 | Cades Cove |
| Indiangrass | SONU2 | 2010 | 176.0 | 86.7 | 9-2011 & 1-2012 | Cades Cove |
| Beard grass | SAGI | 2010 | 4.9 | 3.5 | 9-2011 & 1-2012 | Cades Cove |
| ***Totals*** | | | **49.6** | **11.5** | | |

* Lots with too little seed for testing

*Distribution*

The NPMC distributed five different shipments of seed totaling 143 lbs. in 2011. Some uses for this cleaned seed included: plug production for the Cades Cove increase fields and revegetation of three FHP sites (pull offs E, F and Bridge 8E14 – 22). Figure 1 shows the seed harvest, distribution and storage trends over a five year period.

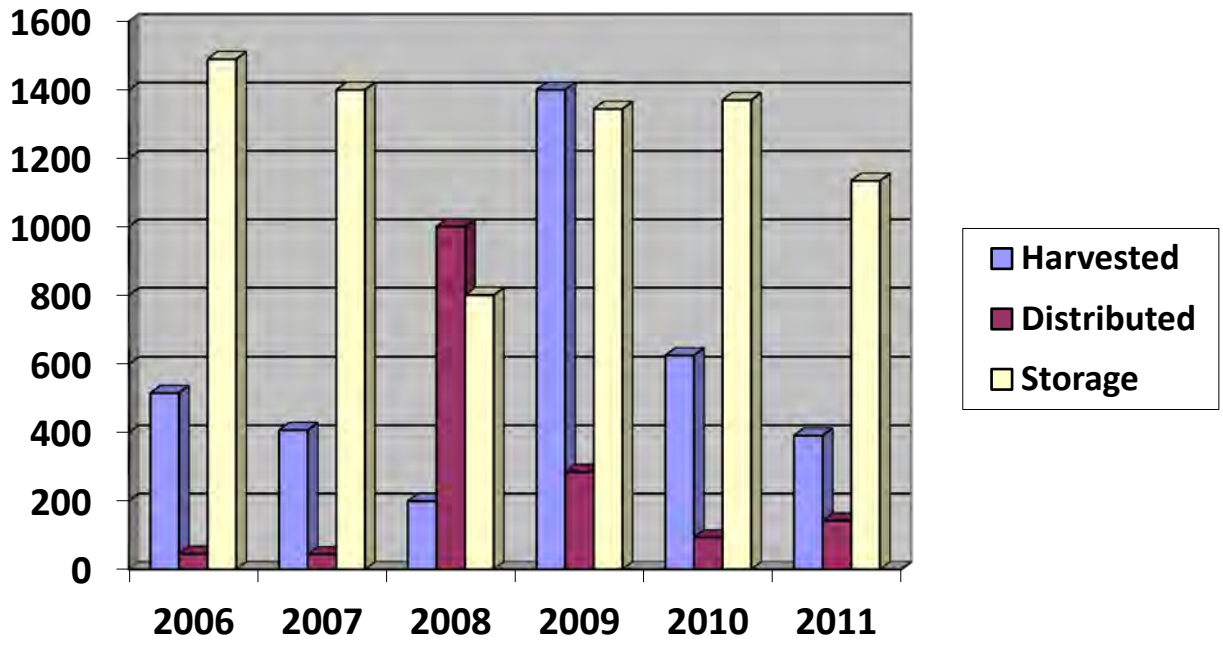


**Figure 32: 2006 – 2011 Seed Harvested, Distributed and Stored**

**Figure 33: September 2011 Virginia wildrye harvest at the NPMC.**


**Figure 34: Close up image of Virginia wildrye seed.**