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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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.

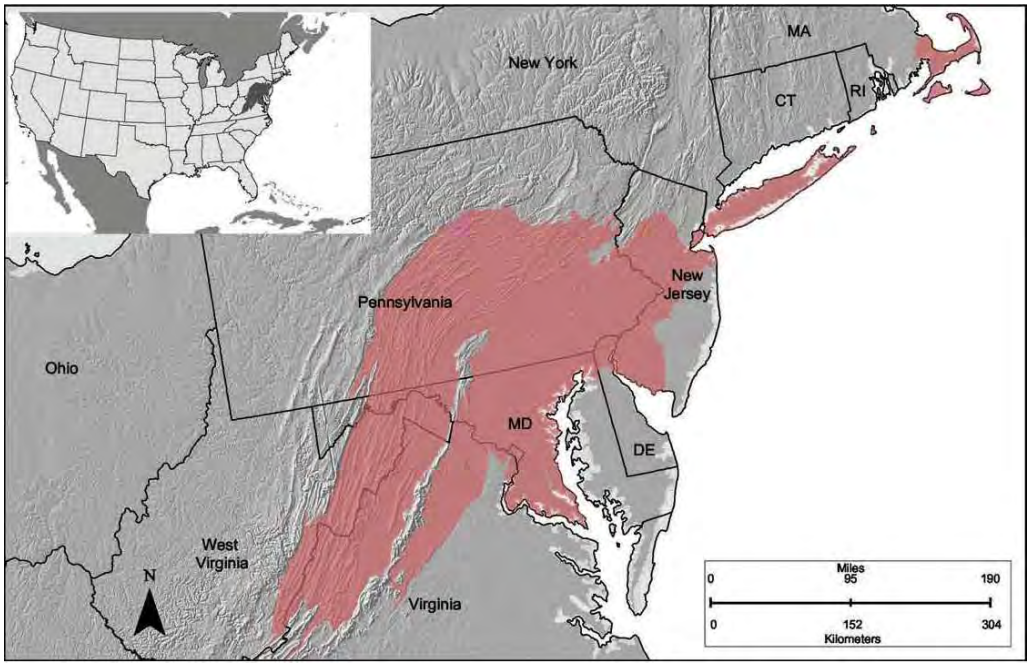

Figure 1: The North Atlantic Slope Diversified Farming Land Resource Area (red) covers approximately 40,865 square miles of nine mid-Atlantic states and the District of Columbia (MLRA Explorer Custom Report).

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.

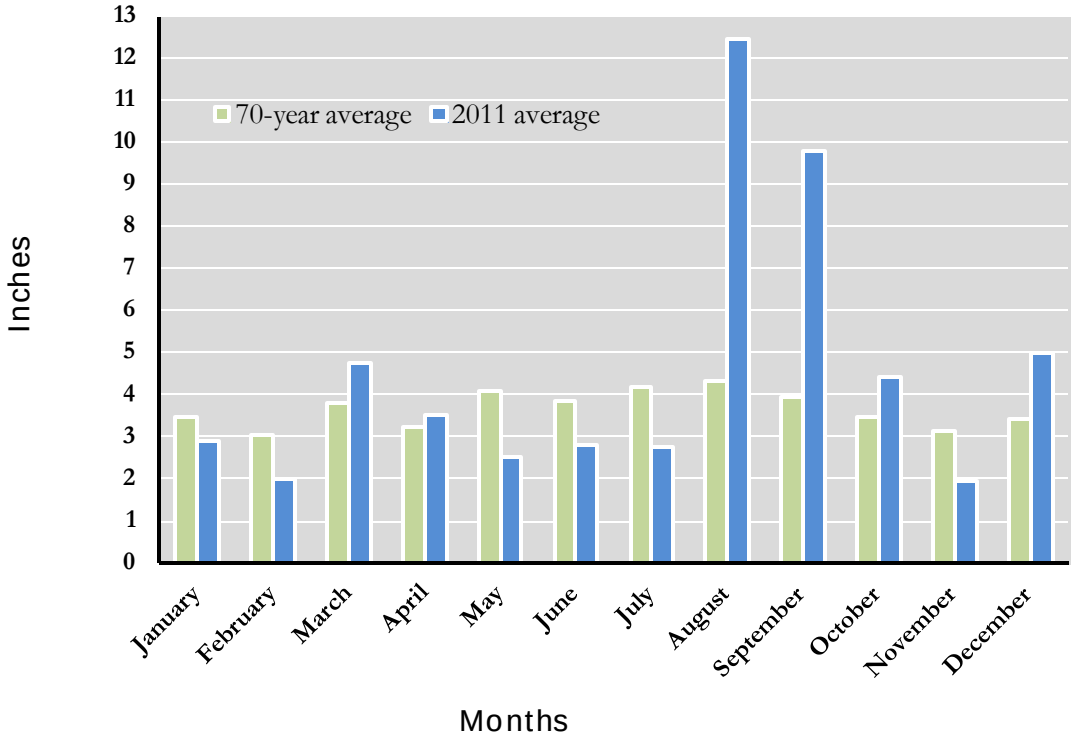

Figure 2: Beltsville weather data: average monthly precipitation (snow and rainfall) for 1941-2011 and 2011. Data provided by University of Maryland, Department of Atmospheric and Oceanic Science.

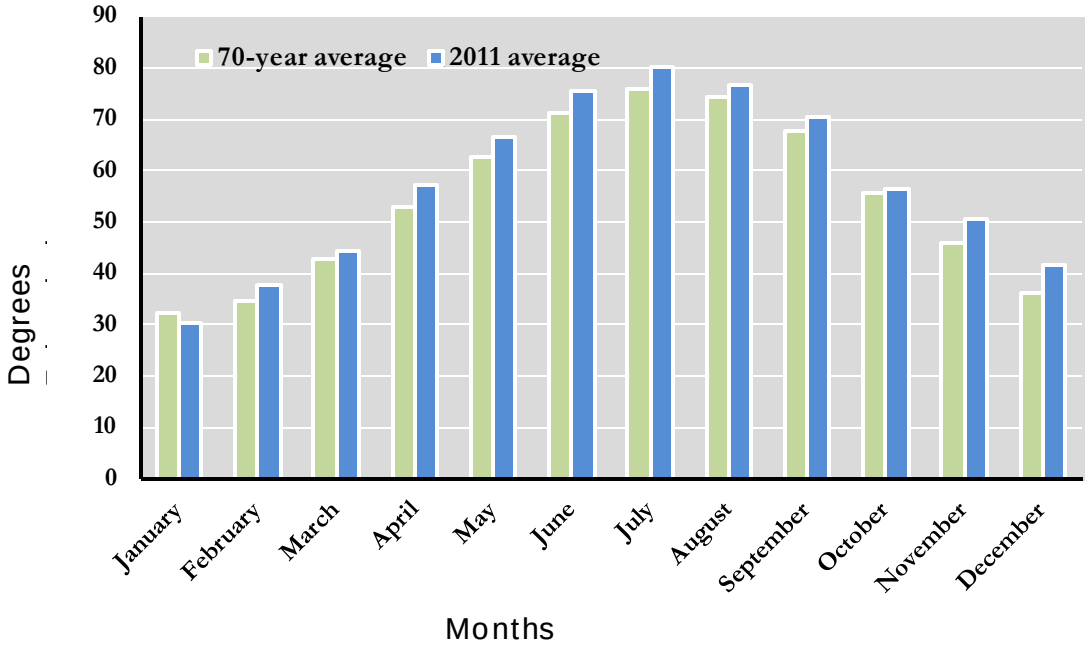

Figure 3: Beltsville weather data: average monthly temperatures for 1941-2011 and 2011. Data provided by University of Maryland, Department of Atmospheric and Oceanic Science.

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.

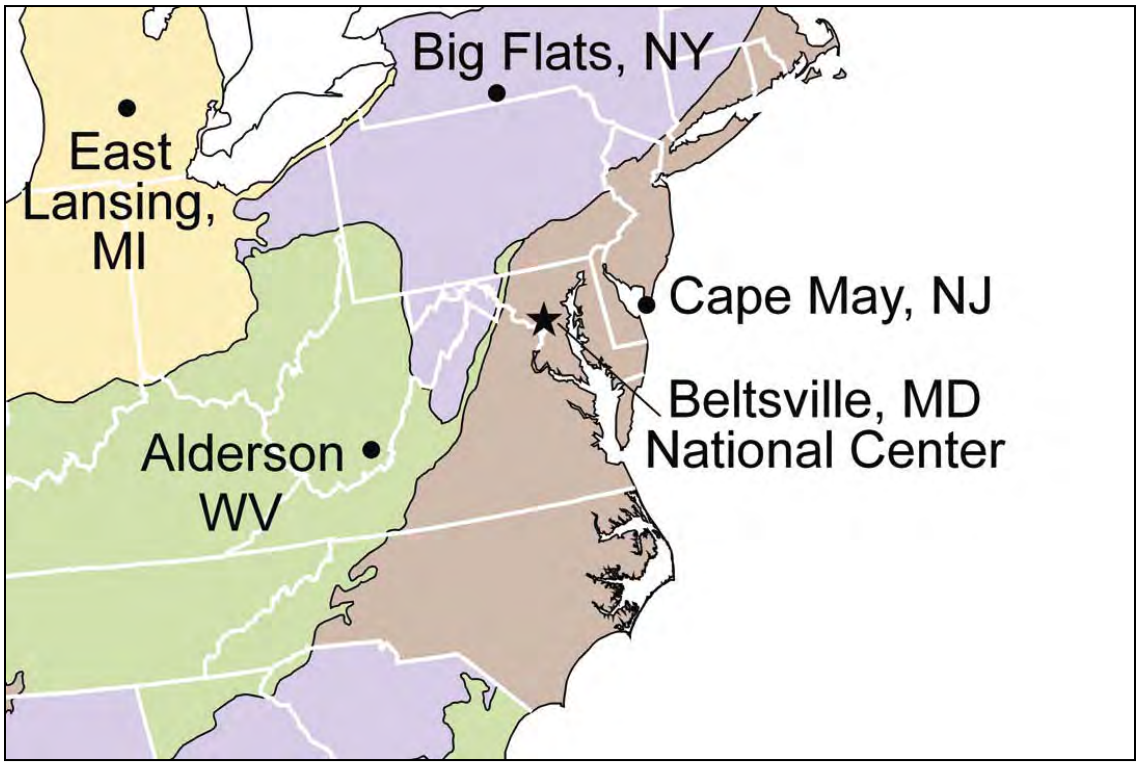

Figure 4: Map showing the NPMC focus area and adjacent PMCs.

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

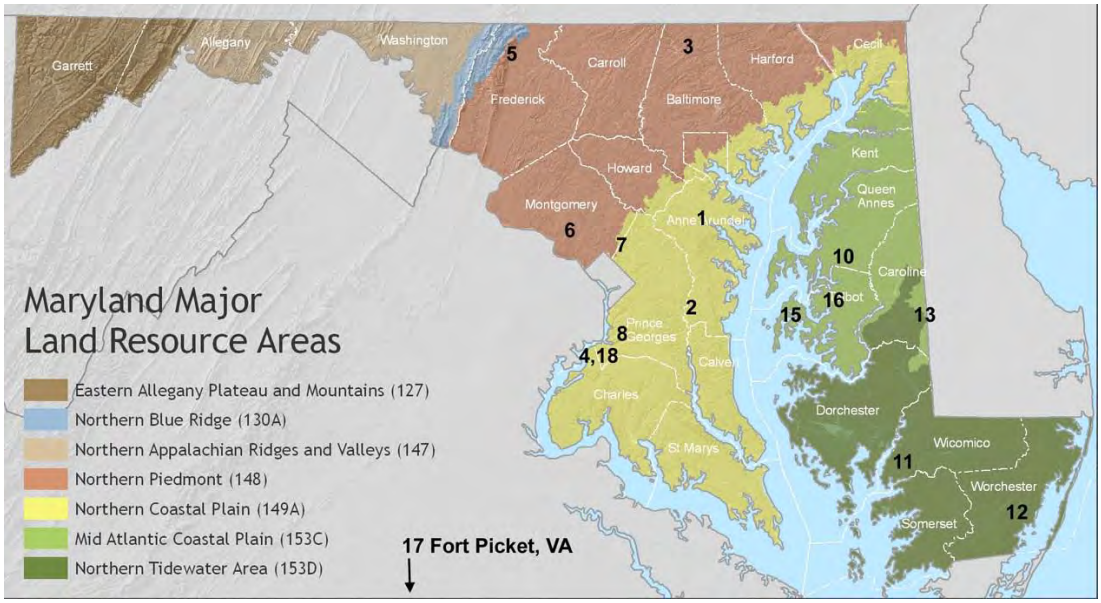

Figure 5: Parent population locations of beaked panicgrass indicated by NRCS propagation numbers. The map shows parent population by geologic province, with all but one accession originating in Maryland. Please note the population from Fort Picket, VA. Map courtesy Amanda Moore USDA, NRCS 2009.

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 40ºF 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.

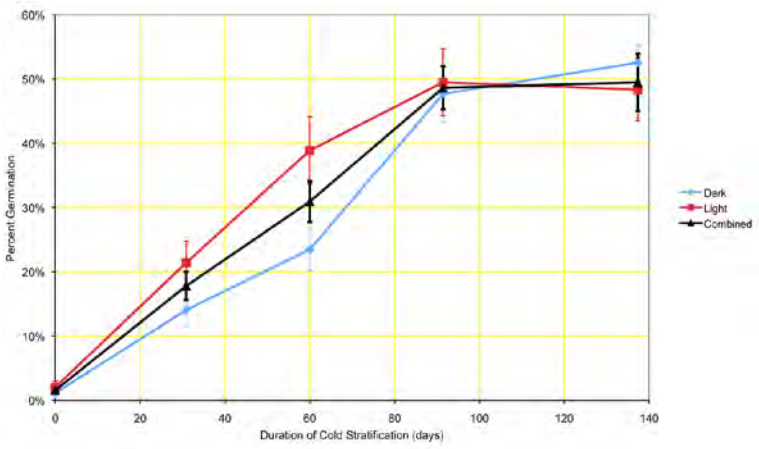

Figure 6. All treatments show increased germination percentages with cold stratification. The percent germination increases with the number of days in cold stratification, until 90 days when germination rates become stable regardless of treatment.

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.

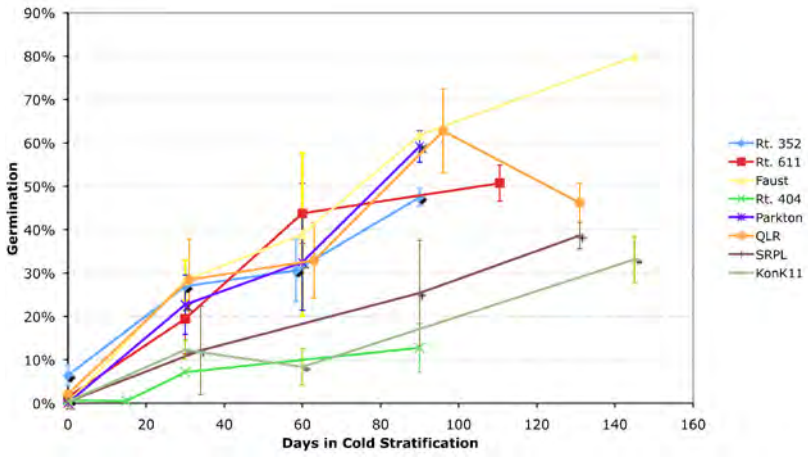

Figure 7. Germination in all eight lines increased with stratification time. The rate of the increase was affected by collection site.

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

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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.

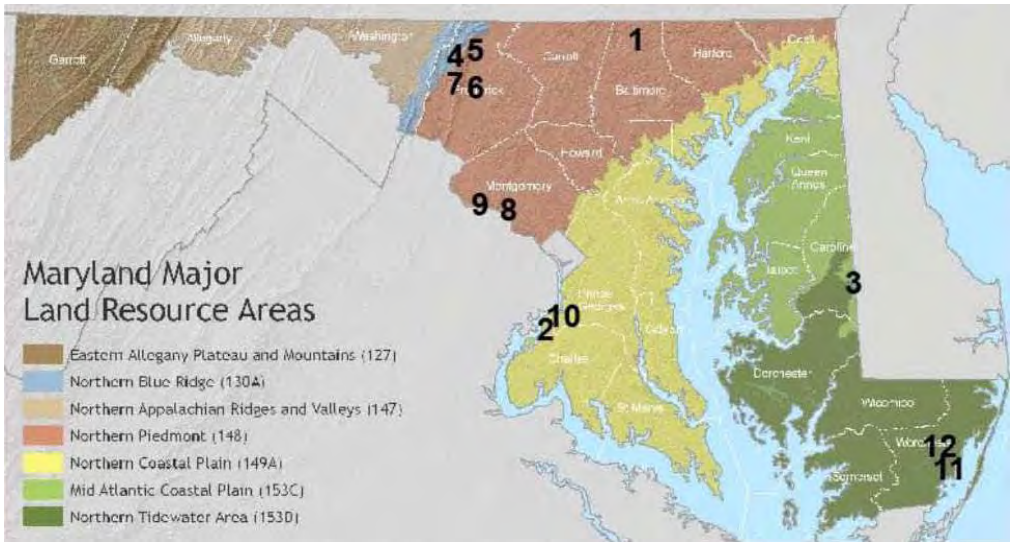

Figure 10: Parent population locations of gray goldenrod indicated by NRCS propagation numbers. The map shows parent population by major land resource area, with the greatest number of populations coming from the Northern Piedmont. Map courtesy of Amanda Moore USDA, NRCS 2009.

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.

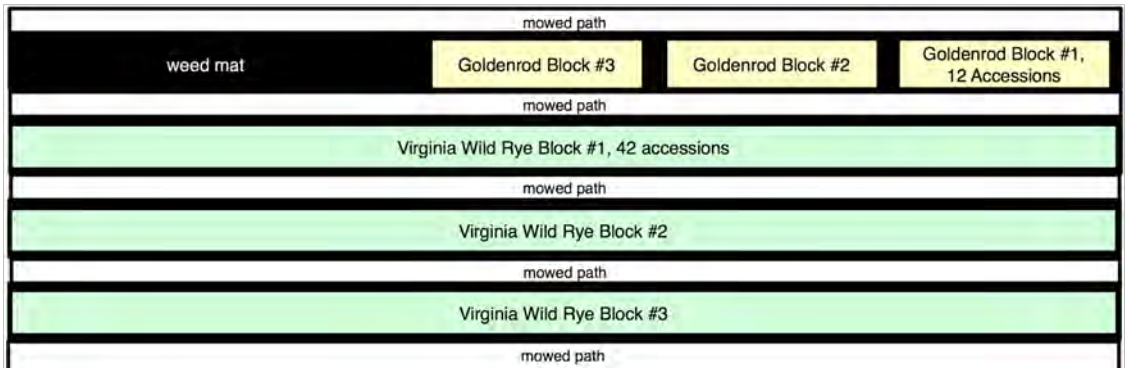

Figure 11: Farm field map. The yellow rectangles show the locations of the gray goldenrod replication blocks. Adjacent plantings of Virginia wildrye can be seen below the gray goldenrod blocks utilized for this study.

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.

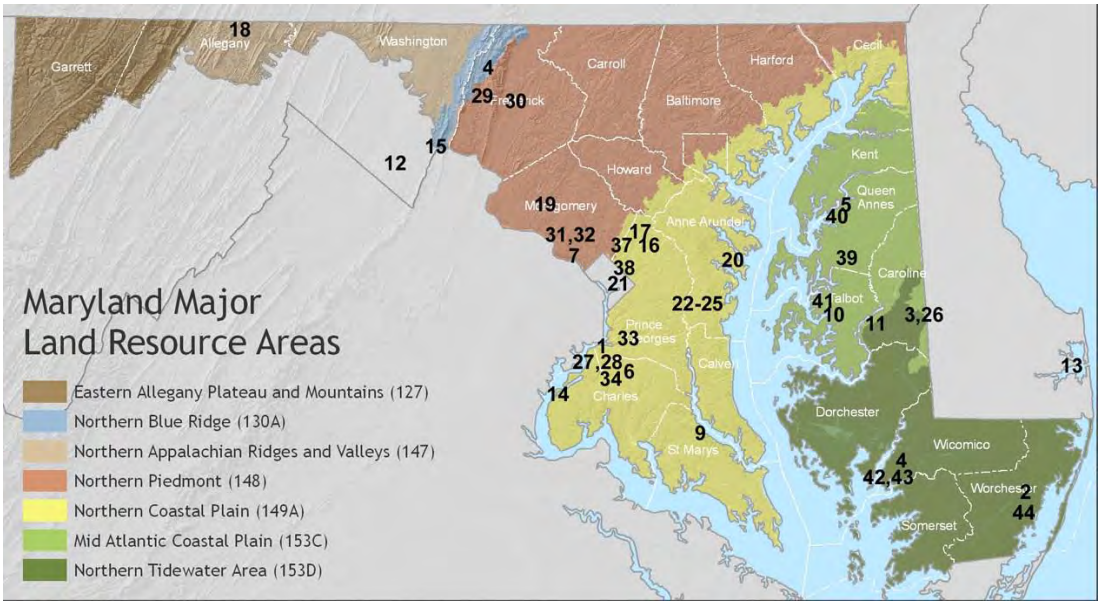

Figure 15. The NRCS propagation numbers added to a Major Land Resource Area map of Maryland to indicate the location of the wildrye parent populations. Map courtesy Amanda Moore USDA, NRCS 2009.

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.
2. The variety v*irginicus* ranged from 1.8 to 2.8 feet tall.

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).

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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	Bonaza' 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 6/3/0
		April 18	May 7	June 3	July 2	Nov 7	Total	
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 4/23/07
		May 4 or 9	May 23	June 22	Nov 29	Total	
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).

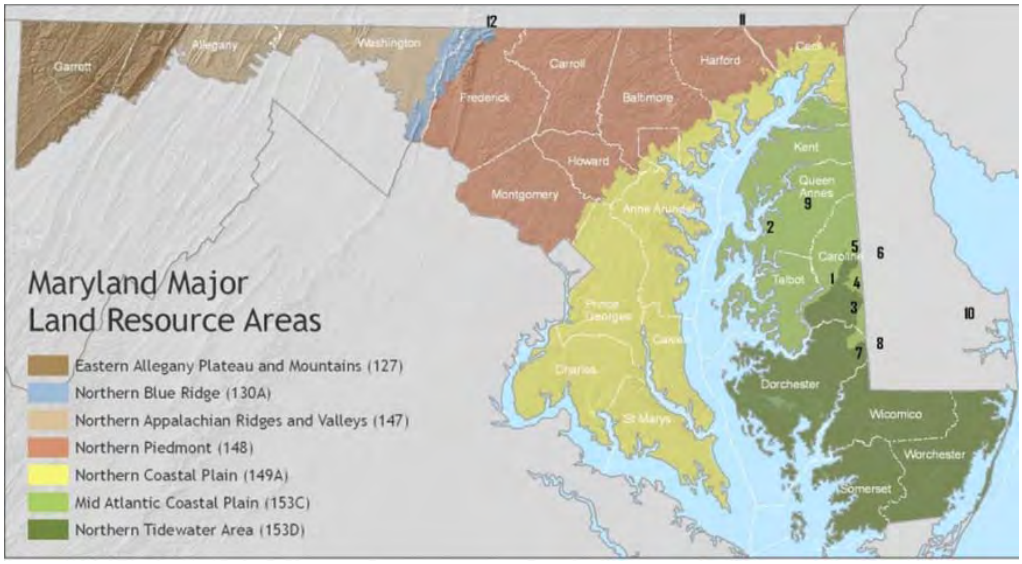

Figure 20: Test sites in Maryland, Delaware and Pennsylvania by MLRA soil type.

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

[redacted] Farm* - Biglersville, PA

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

*all plants were irrigated and mulched

[redacted] Farm* - Grantville, PA

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

*irrigation, 67% plant survival

[redacted] Farm* – Denton, MD

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

*no irrigation 100% plant survival

[redacted] Farm* – Queen Anne's Co., MD

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

* no irrigation, 90% plant survival

[redacted] Farm* – Centreville, MD

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

*no irrigation, 100% plant survival

[redacted] Farm* - Rhodesdale, MD

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

*irrigation, 100% plant survival

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.

[redacted] Farm - 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**	

[redacted] Farm - 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**	

[redacted] Farm – 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**	

[redacted] Farm – 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**

[redacted] Farm – 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**

[redacted] Farm - 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.

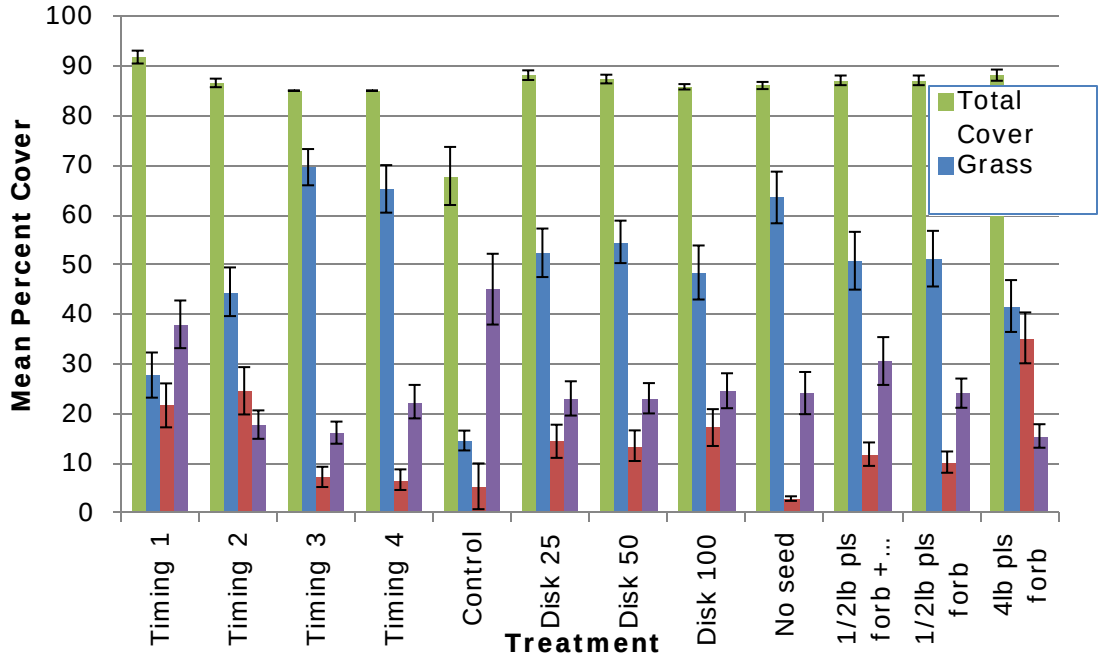

Figure 21: Comparison of mean percent cover at dry site (Locust Plot) 3 seasons after treatments (Fall 2011). Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments represent the target amount of bare ground after disking (25%, 50%, and 100% bare ground). Last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

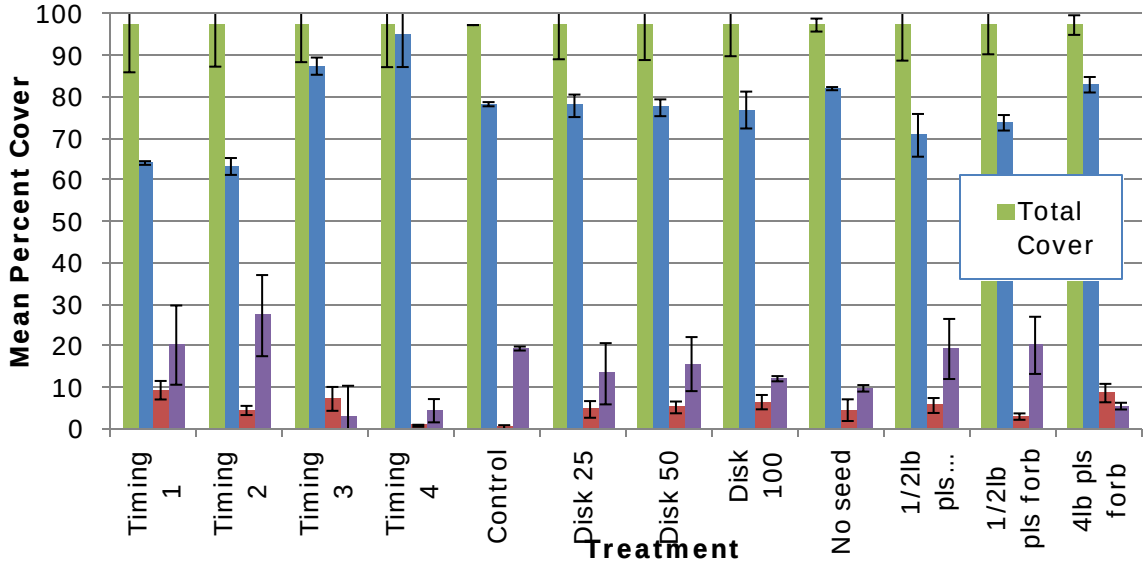

Figure 22: Comparison of mean percent cover at "mesic" site (C2 Plot) 3 seasons after treatments (Fall 2011). Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments represent the target amount of bare ground after disking (25%, 50%, and 100% bare ground). Last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

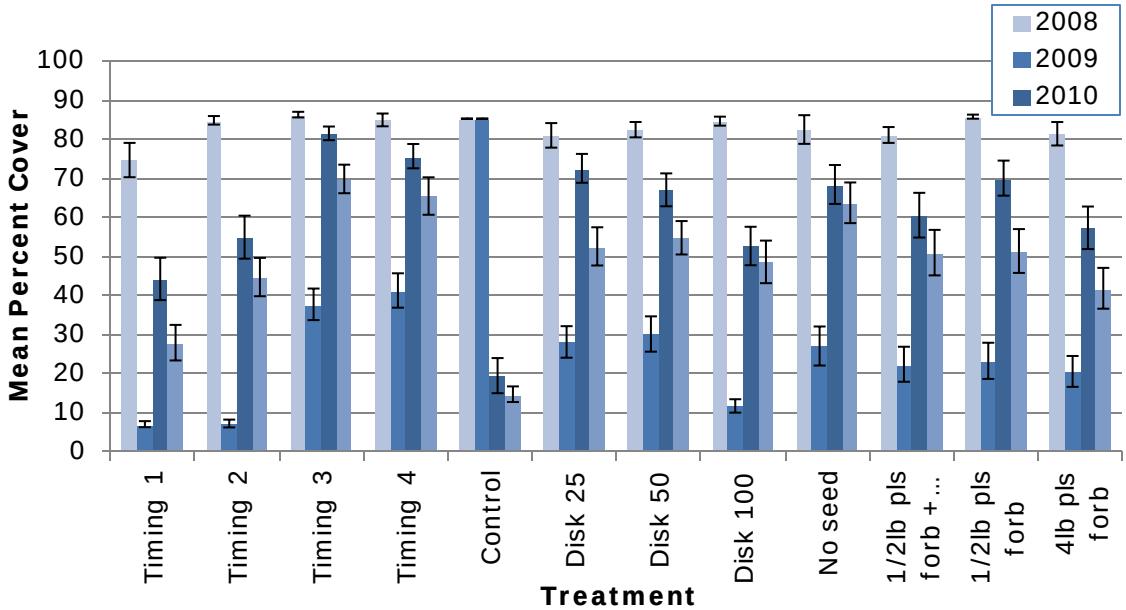

Figure 23: Comparison of mean percent cover of grass at dry site (Locust Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments 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.

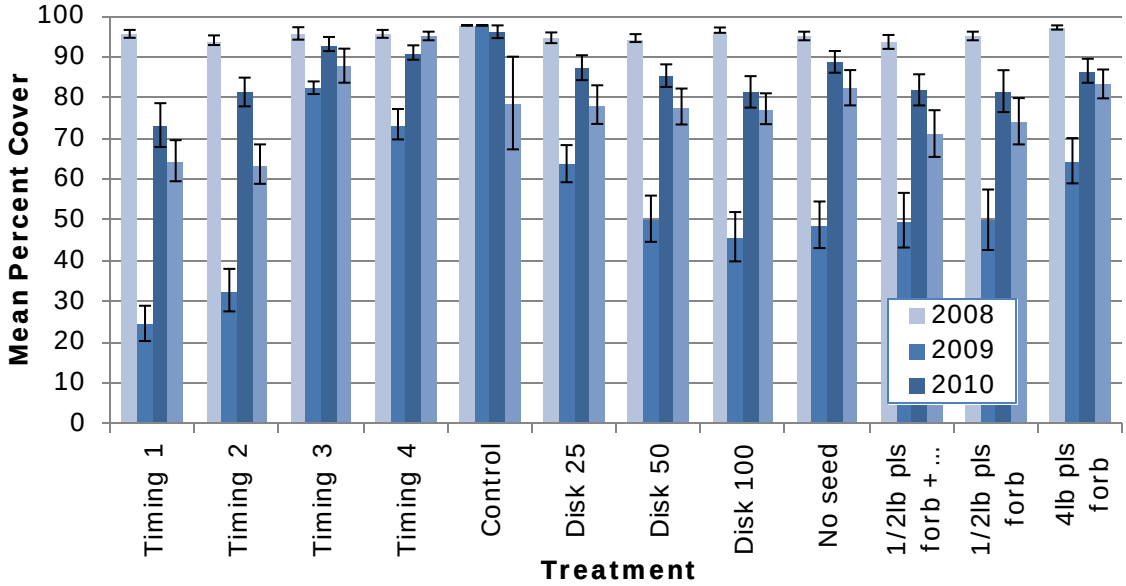

Figure 24: Comparison of mean percent cover of grass at "mesic" site (C2 Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments 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.

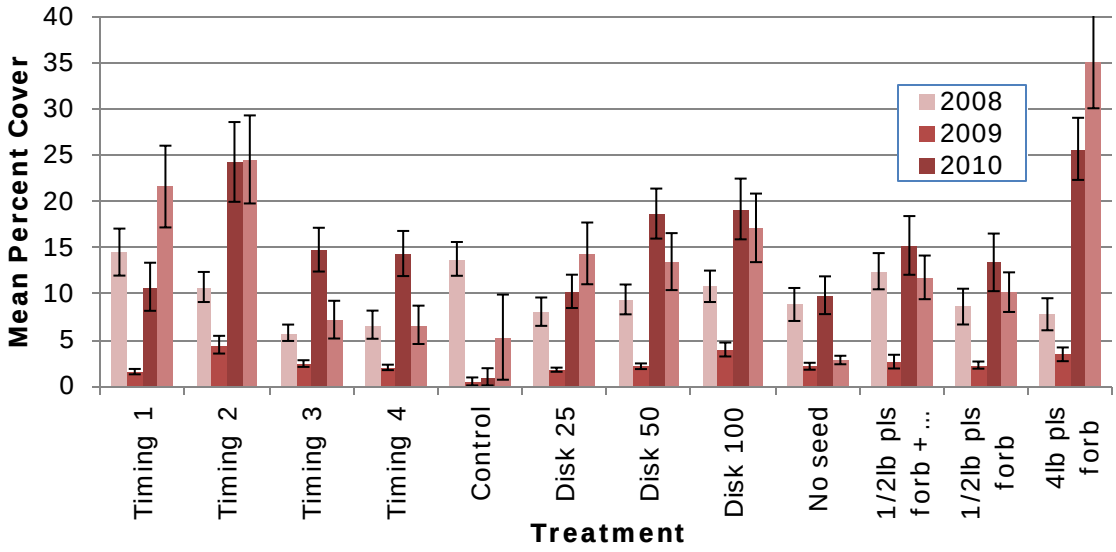

Figure 25: Comparison of mean percent cover of forbs at "dry" site (Locust Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments 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.

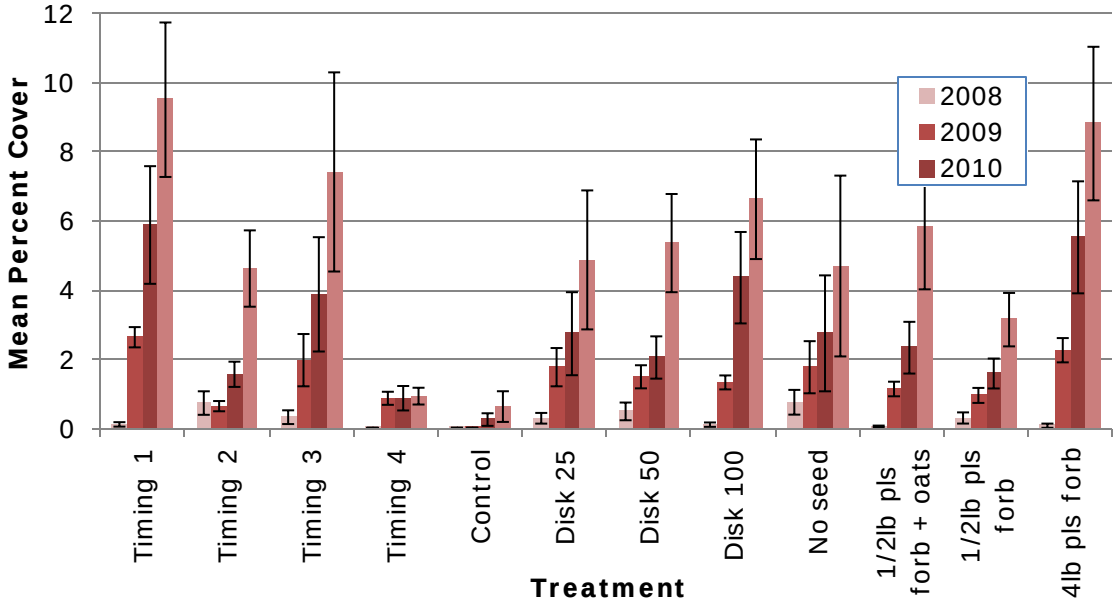

Figure 26: Comparison of mean percent cover of forbs at "mesic" site (C2 Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments 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.

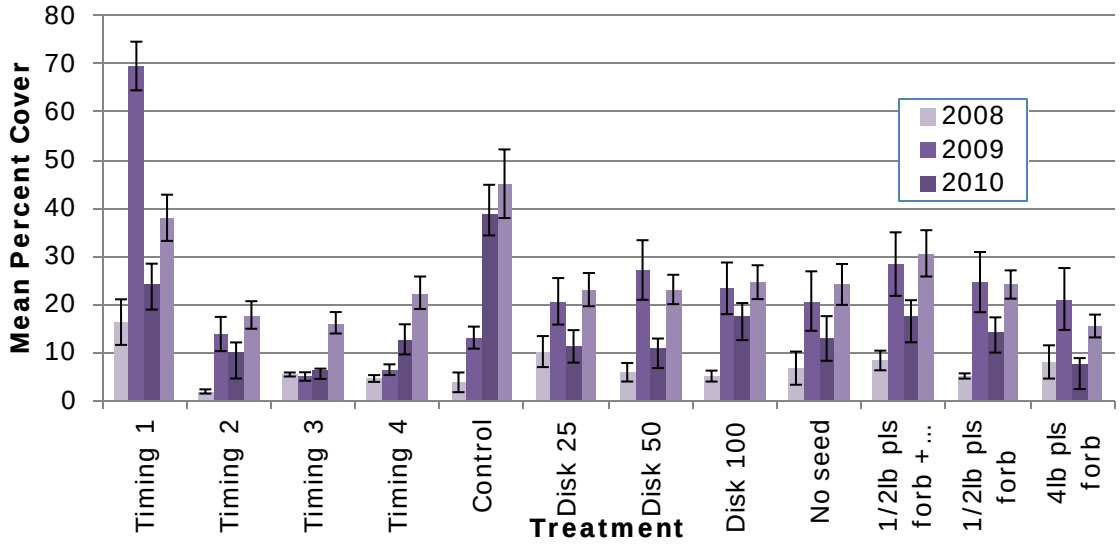

Figure 27: Comparison of mean percent cover of weeds at "dry" site (Locust Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments 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.

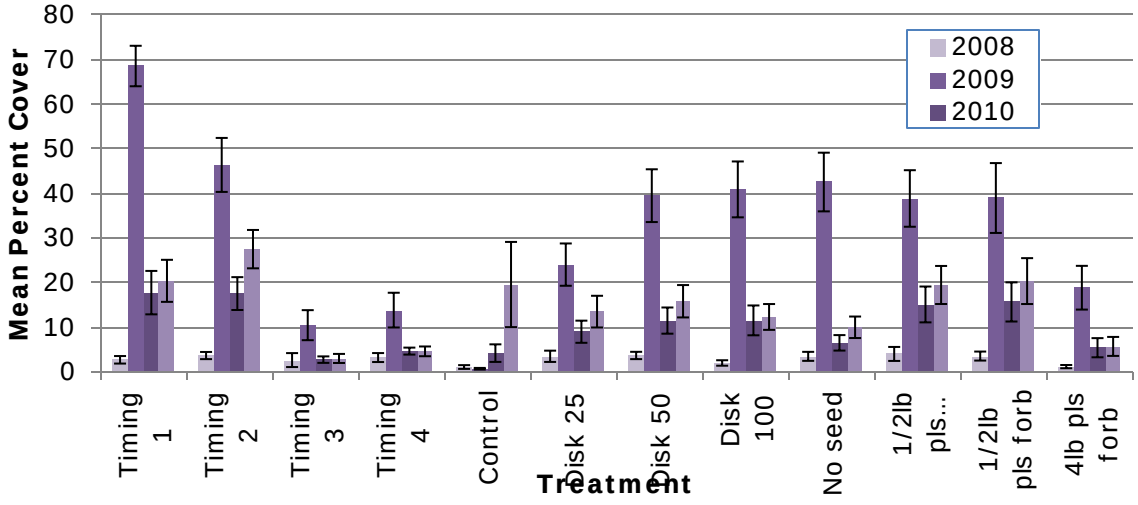

Figure 28: Comparison of mean percent cover of weeds at "mesic" site (C2 Plot) for each treatment over evaluation period (4 years). 2008 is pre-treatment, 2009 data is from fall of first growing season. Timing treatments are time of disking and seeding (1 = Sep, 2 = Dec, 3 & 4 = Mar). Disk treatments 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.

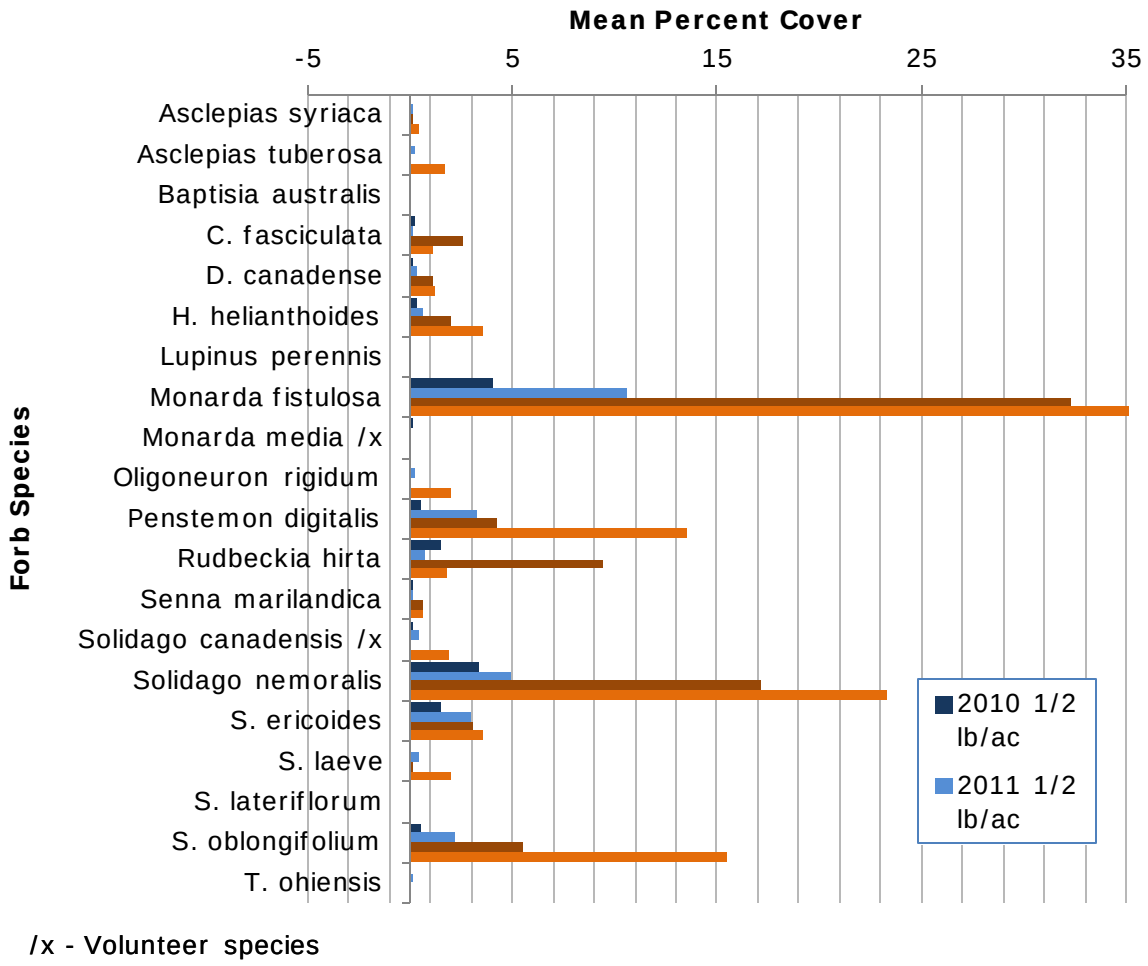

Figure 29: Forb species mean percent cover at "dry" site (Locust Plot) 2 and 3 growing seasons after treatments, for plots seeded with forbs at 1/2 and 4 lb/ac PLS. Mean percent cover for Monarda fistulosa 2011 4 lb/ac is 50%.

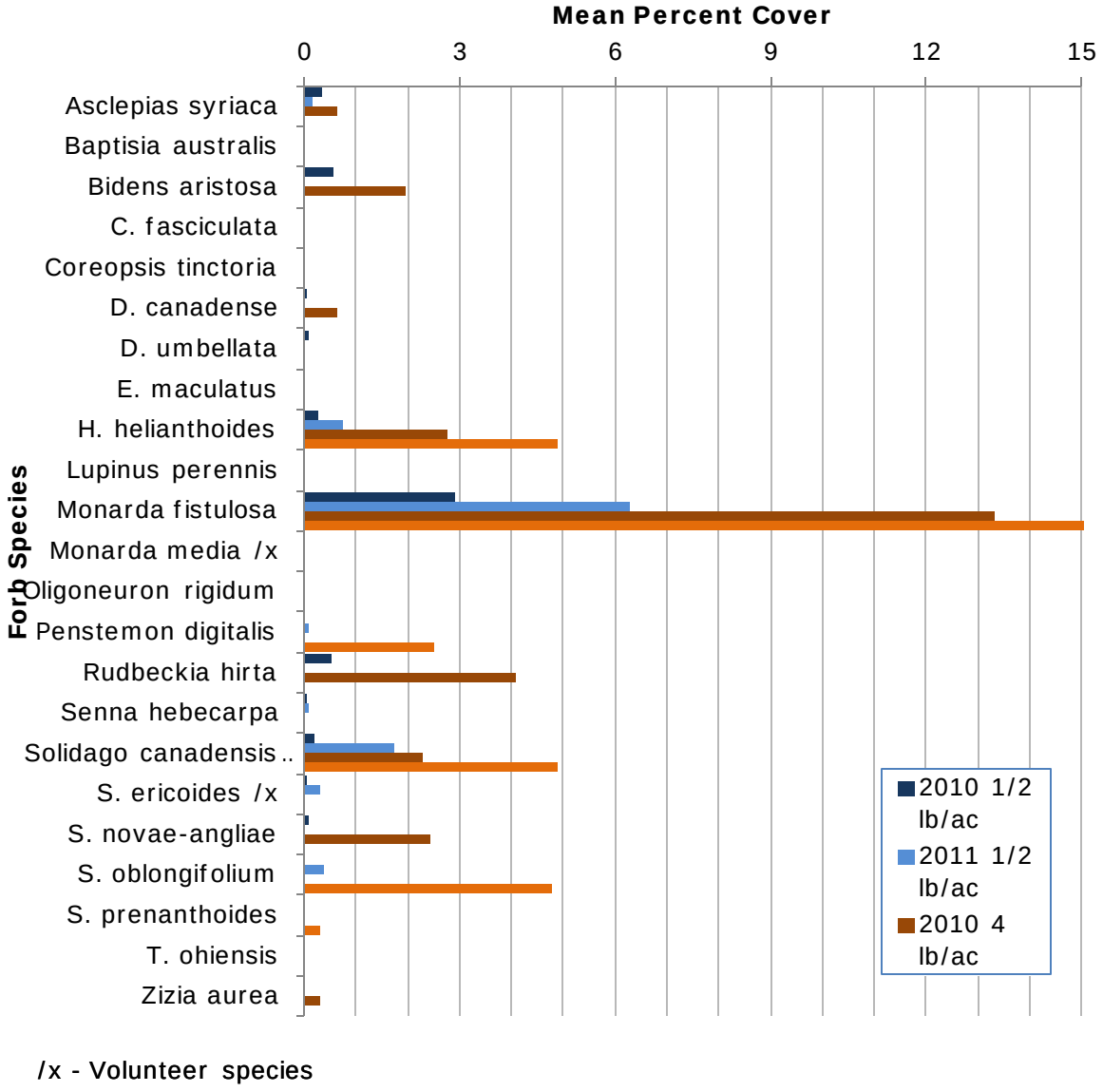

Figure 30: Forb species mean percent cover at "mesic" site (C2 Plot) 2 and 3 growing seasons after treatments, for plots seeded with forbs at 1/2 and 4 lb/ac PLS. Mean percent cover for Monarda fistulosa 2011 4 lb/ac is 22.8%.

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.

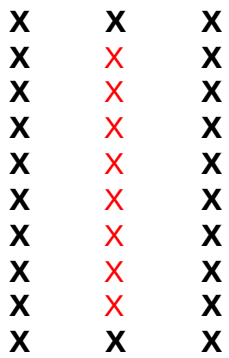

Figure 31: Plot structure showing three rows of 10 plants. "Red" plants were harvested and evaluated while "black" plants were used to minimize adjacency issues.

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	9-11 & 1-12	Cades Cove
Big bluestem	ANGE	2010	18.8	18.8	9-11 & 1-12	Cades Cove
Little bluestem	SCSC	2010	10.8	4.6	9-11 & 1-12	Cades Cove
Indiangrass	SONU2	2010	176.0	86.7	9-11 & 1-12	Cades Cove
Beard grass	SAGI	2010	4.9	3.5	9-11 & 1-12	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.

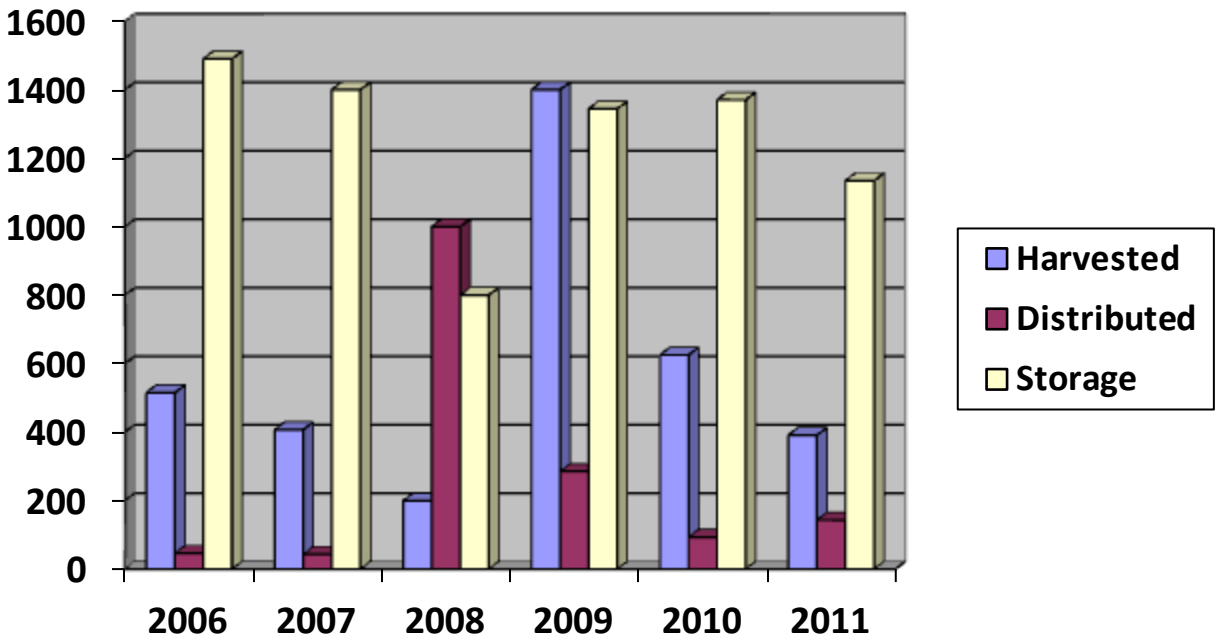

Figure 32: 2006 – 2011 Seed Harvested, Distributed and Stored

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

Figure 34: Close up image of Virginia wildrye seed.