Elsberry Plant Materials Center

2009 Annual Technical Report

Pale Purple Coneflower
(*Echinacea pallida*)

PLANT SOLUTIONS FOR CONSERVATION NEEDS
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ELSBERRY PLANT MATERIALS CENTER
2009

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ELSBERRY PLANT MATERIALS CENTER

VISION – Excellence in developing plant science technology to help people help the land.

MISSION – To assist land users, federal, state and local partners, and industry growers in Illinois, Iowa and Missouri, in protecting, conserving, and improving natural resources by providing plant materials and plant related technology.

STRATEGY – The Elsberry Plant Materials Center vision and mission is advanced through evaluating and selecting superior plants, developing cultural and management technology, promoting the use of plants and related technology, through field and demonstration plantings, leading tours, and training NRCS employees and others on plant science technology. Plant Materials Committees in Illinois, Iowa and Missouri identify and prioritize plant materials technology needs and the three state conservationists establish direction and funding for the center.

GOALS – The Elsberry Plant Materials Center (PMC) provides plants for conservation, produces foundation seeds and plants or their equivalent, and promotes their use in solving natural resource problems on both private and public land. Beneficial uses for these plant materials include livestock forages, biomass and timber production, carbon sequestration, air quality, erosion reduction, wetland restoration, wildlife food and cover, water quality improvement, stream bank and riparian area protection, and other unique conservation needs. In addition to conservation plant release, the PMC also develops establishment and management technology for successful use of plants in resource conservation programs.

TACTICS – Specialists at the center identify plants that show promise for addressing a specific conservation need, develops related technology and test their performance in the field. After species are proven beneficial for solving the conservation problem, they are released to the private sector for commercial production for general public use. Opportunities for success are to continue working through NRCS field offices, soil and water conservation districts and other conservation partners who come in contact with clients in need of special plants and related technology for special situations. USDA programs that emphasize and utilize plant materials and plant science technology include Conservation Technical Assistance, Environmental Quality Incentive Program, Conservation Reserve Program, Wetlands Reserve Program, Grassland Reserve Program, and Wildlife Habitat Incentive Program with some opportunities in the Conservation Security Program, Resource Conservation and Development, and the Small Watershed and Flood Prevention program. The Elsberry Plant Materials Center also has the opportunity to support increasing interest in urban conservation by providing plants with unique landscape architecture value in addition to their erosion and sediment control, water and air quality benefits. Emerging opportunities in the agricultural sector lie in biomass for bioenergy production and carbon sequestration.

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Elsberry Plant Materials Center
Elsberry, Missouri

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INTRODUCTION

The Elsberry Plant Materials Center (PMC) was established in June 1934 and is the oldest Center in the nation. It is one of 27 PMC's in the United States. The Center is located approximately 60 miles northwest of St. Louis, Missouri, on Highway 79. It includes 243 acres of various soil types. The Elsberry PMC primarily serves Illinois, Iowa and Missouri; however, it makes significant contributions to other states in the Midwest region.

Emphasis is focused on using native plants as a healthy way to solve conservation problems and protect ecosystems. The program seeks to address priority needs of field offices and land managers in both public and private sectors by working with a broad range of plant species, including grasses, forbs, legumes, trees, and shrubs.

The Elsberry PMC assembles tests, selects and develops improved plants and reliable techniques for successfully establishing and maintaining plants for conservation uses.

Of particular importance is finding suitable plants for wetland situations, high traffic areas, wildlife food and habitat, farmstead and field windbreaks, wind barriers, pastures, landscape and beautification, roadside restoration, riparian plantings, woodland, and erosion control on cropland. Each of the three states served by the Center has identified its plant materials problems, needs and priorities. PMC activities are directed toward meeting the needs and priorities set forth in the states' long-range plans. As early as 1939 the Center began searching for plants to respond to specific conservation problems. During the PMC's earlier existence it produced 10,000,000 seedlings for use in windbreaks during the dust bowl era. Today the Elsberry Plant Materials Center is still striving to solve a new realm of conservation problems in an ever changing world.

PLANT MATERIALS CENTER OPERATIONS

The Center's operations are carried out in accordance with policies set forth in the National Plant Materials Handbook.

Guided by the Center's Multi-Year Business Plan, plant species are collected (mainly local field collections [95%]). Other collections come from locations within the species range in the United States. Center personnel then prepare the seed/plant for planting. Each collection is given an identification number (accession) and planted in a uniform nursery. Initial evaluation data is recorded on such factors as seedling emergence and vigor, rate of growth, disease and insect resistance, and ability to spread. Also recorded are date and amount of bloom, seed production, winter hardiness, and foliage characteristics. Selections are made and seed increased for advanced evaluation plantings. Field plantings are then conducted to determine plant performance and soil and climatic adaptation throughout its intended area of use. Evaluations are made comparing selected candidate accessions with "standards of comparison" such as cultivars or varieties that are already in the commercial market, or other species used for the same purpose.

After several years (10-15) of evaluation, selected accessions are cooperatively released with the USDA-Agricultural Research Service (ARS), State Agricultural Experiment Stations, Conservation Commissions, Universities, Departments of Transportation, and/or other interested agencies. The Center releasing a named variety is responsible for maintaining the breeder and foundation seed. These fields undergo annual inspections by the Missouri Crop Improvement Association to insure that seed is available to commercial producers and ultimately to the public for solving conservation problems.

Additional avenues have been established and used by the Plant Materials discipline to release plants to the commercial market: Source Identified Releases, Selected, and Tested Releases. These three new avenues provide a quicker release of plants as compared to cultivar release (10-15 years).

The Elsberry Plant Materials Center has released over 80 plants during its 72-year history. In 2009, Northern and Western Missouri Pale Purple Coneflower (*Echinacea pallida*) were released as source-identified releases. Pale purple coneflower is a perennial forb that has an aesthetically pleasing flower. Currently, the Elsberry Plant Materials Center has 83 active releases and of these 83 releases, 80 of them are native to the Elsberry PMC service area. For more information regarding Elsberry PMC releases, please contact the Elsberry Plant Materials Specialist.

CLIMATIC DATA – CALENDAR YEAR 2009
TEMPERATURE (Fahrenheit)

Month	75 Year Monthly High Average	2009 Monthly High Average	2009 Monthly High Departure	75 Year Monthly Low Average	2009 Monthly Low Average	2009 Monthly Low Departure
January	38.14	32.9	-5.24	18.49	15.9	-2.59
February	43.11	45	1.89	23.09	25.78	+2.69
March	53.07	57.77	4.7	37.31	35.87	-1.44
April	66.85	63.83	-3.02	42.96	50.7	+7.74
May	76.41	75.25	-1.16	57.54	47.19	-10.35
June	85.32	86.96	1.64	71.77	64.36	-7.41
July	89.54	76.03	-13.51	65.48	62.64	-2.84
August	87.59	79.35	-8.24	63.41	59.96	-2.84
September	80.40	71.16	-9.24	50.33	54.63	-3.45
October	69.35	57.80	-11.55	44.03	42	+4.3
November	50.65	52.13	1.48	33.05	33.24	-2.03
December	42.03	35.4	-6.63	23.40	26.5	+0.19
Total 2009	65.21	61.13	-4.07	44.24	43.23	-1.5

	2009	Typical
Last Killing Frost (26° and below)	*March 13*	*April 15*
First Killing Frost (26° and below)	December 5	October 15
Number of Frost-Free Days	230	184

CLIMATIC DATA – CALENDAR YEAR 2009
Precipitation (Inches)

Month	77 Year Average	2009 Total	Departure
January	1.96	0.45	-1.51
February	1.95	1.72	-0.23
March	3.17	2.84	-0.33
April	3.63	5.44	+1.81
May	4.11	5.82	+1.71
June	3.76	5.59	+1.83
July	3.40	6.64	+3.24
August	3.36	3.20	-0.16
September	3.25	3.69	+0.44
October	3.01	11.56	+8.55
November	2.92	5.23	+2.31
December	2.47	4.29	+1.82
Total	36.99	56.47	+19.48

Study: 29I093R

Study Title: Miscellaneous Herbaceous Plant Evaluation.

Study Leader: Bruckerhoff, S. B.

Introduction:

Plants arrive at the Plant Materials Center (PMC) from many sources and for many different purposes. Most of the plants are assigned to a specific study. Plants are also received that are not tied to a specific study. These can be from other PMC's for area of adaptation or plants in advanced stages of evaluation. Plants are received from individuals who are interested in an unfamiliar species or a plant with unusual characteristics. Many species existing on the center are not involved with an active study addressing a specific problem.

Problem:

Keeping track of numerous miscellaneous plants around the PMC without an organized evaluation system became inefficient. This study organizes miscellaneous plant material coming into the center for evaluation.

Objective:

Evaluate winter hardiness, insect and disease resistance, and vigor of plants for climatic adaptation. Plants brought in for other specific reasons like forage production, landscape beautification, shoreline stabilization, etc., will be evaluated accordingly.

Procedure:

As miscellaneous plants are received at the center, they are assigned an accession number and as much background information as available or necessary are documented. The accession is then assigned a location for planting that best suits its needs for evaluation. Plants are evaluated as necessary. Many plants are left for plant identification sessions or demonstrations for several years.

Discussion:

1984-1990

This study was initiated in April 1984 in the PMC pipeline area. There are approximately 150 different accessions of the following species of plants: Indiangrass, switchgrass, big bluestem, purpletop, little bluestem, buffalograss, wheatgrass, fescue, timothy, ryegrass, redtop, orchardgrass, kura clover, blackeyed susan, and lespedeza. Factors involved in evaluations dealt with area of adaptation.

1991-1994

Approximately 75 accessions were added during 1991. Forty of them were warm season grasses used in three FEP (Field Evaluation Planting) variety studies: 29A111G, 29A118G, and 29A127G. Twenty-six were accessions of common cool season grasses and legumes used for pasture and hay in the three-state area. These were commonly used for plant identification sessions.

1995-1998

The accessions added in 1997 are being looked at for forage. They include 'Steadfast' birdsfoot trefoil, 'Mandan' Canada wildrye, and several bermudagrasses including Hardy and OK-74-12-6. Also zoysia grass, centipedegrass, and buffalograss from the Fort Leonard Wood Wear Tolerance Study are being looked at for adaptation. Several big bluestem accessions from Study 29I097G are being evaluated as landscape plants.

1999

The accessions added in 1999 are a Lincoln County Missouri collection of Virginia wildrye and a Crawford County Missouri collection of Virginia wildrye variation geneses. These species are being looked at for shade tolerance for riparian areas and covercrop for tree plantings.

2000

No new accessions were added in 2000. Two species that are getting the most interest are the Lincoln County accessions of Virginia wildrye and 'Tufcote' bermudagrass.

The Lincoln County accession of Virginia wildrye is a shade tolerant cool season grass that has potential for a cover crop for woody plantings as well as a possible buffer species along riparian areas. This accession should be in commercial production and available soon.

The 'Tufcote' bermudagrass accession was tested at Fort Leonard Wood for wear tolerance and showed very good potential. It could be used on playgrounds, sports fields, lawns, as well as having potential for high livestock use areas. This species is not native and does show potential for spreading so it should not be planted in areas where it could escape and cause problems.

2001

Three new species of native legumes were added in 2001. Native legumes are seldom used in mixtures with warm season grasses planted for pastures primarily because of their cost, lack of availability, and lack of knowledge on which ones will perform best in a mixture.

The following species were planted for observational evaluation: goats rue, *Tephrosia virginiona;* sensitive brier, *Schrankin uncinata;* and Sampson's snakeroot, *Orbexilium peduncolatum*.

The Lincoln County Missouri collection of Virginia wildrye, accession 9083169, has shown excellent vigor and seed production. Forage quality is comparable to tall fescue, spring

green-up earlier than tall fescue and seedhead emergence is approximately two weeks later than tall fescue. This accession is scheduled for release in 2002.

2002

One new collection was planted in the miscellaneous block. Accession 9083240, western wheatgrass, *Pascopyrum smithii*, was planted as greenhouse plugs May 10, 2002. This material was collected in Audrain County, Missouri.

The Lincoln County Missouri collection of Virginia wildrye, accession 9083169, was released as a selected class and given the name Cuivre River. The Cuivre River selection has early vigorous growth that is earlier than tall fescue. Booting occurred at the end of May to the first week of June at Elsberry. This is approximately two weeks later than tall fescue.

Although Cuivre River was released as a selection and only limited testing has been done, its anticipated uses are wildlife food/cover, plant diversity in wetland and riparian plantings, covercrop for woody plantings, erosion control, and forage.

Cuivre River has not been tested for grazing but forage clippings were taken at different stages of growth and compared to tall fescue clippings from adjacent plots. Forage quality of the Cuivre River selection compared favorably to tall fescue as indicated by data below.

Clipping Date	Percent Protein		Percent ADF		Percent NDF	
	TF	VWR	TF	VWR	TF	VWR
4/24/02		27		26		47
5/30/01	9	12	40	34	61	60
10/11/01	15	15	31	34	52	55
11/15/01	20	17	22	24	37	44

TF = tall fescue; VWR = Cuivre River Virginia wildrye; ADF = acid detergent fiber; NDF = neutral detergent fiber.

2003

One new accession was added during 2003 and this was the medium height, forage type switchgrass that was selected and isolated from the low growing switchgrass assembly.

2004

Three accessions of cluster fescue, *Festuca paradoxa*, were added during 2004. The plants were germinated in the greenhouse from seed and transplanted April 7, 2004, to the initial evaluation area, tier F/a. The accessions established well and had excellent survival the first year. The plants will be evaluated on percent stand, vigor, height, and seed production next year. See collection information below.

Genus	Species	Common Name	Accession No.	**Origin**
Festuca	paradoxa	Cluster fescue	9083254	**Tucker Prairie, MO**
Festuca	paradoxa	Cluster fescue	9083255	**Paintbrush Prairie, MO**
Festuca	paradoxa	Cluster fescue	9083252	**Harrison Co, MO**

2005

No new accessions were added in 2005. The *Festuca paradoxa* was evaluated along with the other species in the forage quality study. The plants became very dormant by early summer and did not recover but made significant regrowth in the fall.

2006/2008

New accessions planted are as follows;

Observational Nursery

Genus	Species	Common Name	Accn No.	From	**Date Pltd**
Desmodium	glabellum	Dillenius Tick Trefoil	9055415	MIPMC	5/5/06
Desmodium	glabellum	Dillenius Tick Trefoil	9005087	MIPMC	5/5/06
Desmodium	paniculatum	Panicledleaf Tick Trefoil	9055428	MIPMC	5/5/06
Calamovilfa	longifolia	Prairie Sandreed	9086408	MIPMC	5/5/06
Elymus	riparius	Riverbank Wildrye	9086450	MIPMC	5/5/06
Elymus	canadensis	Icy Blue Canada Wildrye	9084347	MIPMC	5/5/06
Salix	sericea	Riverbend Silky Willow		MIPMC	6/15/06
Paspalum	floridam	Harrison Florida Paspalum	9043874	ETPMC	4/15/06
Bouteloua	gracilis	Blue grama	421782	KSPMC	4/20/07

2009

No new species were planted during 2009.

Study: 29I097G

Study Title: Assembly and Evaluation of Big Bluestem, *Andropogon gerardii Vitman.*

Study Leader: Bruckerhoff, S. B.

Introduction:

Big bluestem is a tall, warm-season, perennial, native grass with stiff, erect culms; flattened and keeled sheaths; membranous ligules; and flat or folded leaf blades. Big bluestem has developed a very efficient spreading root system that may reach depths of 5-8 feet (150-200 cm). Big bluestem reaches a mature height of 3-4 feet (90-120 cm) in northern latitudes, and 6-8 feet (180-240 cm) or more in the southern part of its natural range. Although short rhizomes may be present, it usually makes a bunch type growth. Big bluestem is composed of many ecotypes with a wide range of adaptation to soil and climate. Big bluestem is one of the most widespread and important forage grasses of the North American tallgrass prairie region. It is usually associated with one or more of the other three dominant species, Indiangrass *(Sorghastrum nutans* (L) Nash.), switchgrass *(Panicum virgatum L.),* and little bluestem (*Schizachyrium scoparium* (Michx.) Nash.). Big bluestem occurs on subirrigated lowlands, nearly level to gently undulating glacial till plains, overflow sites, level swales and depressions, residual and glacial uplands, and stream terraces and bottomlands along rivers and tributaries. The abundant, leafy forage is palatable to all classes of livestock.

Problem:

There is a need for an adapted variety of big bluestem for pasture and range seedings, surface mine reclamation, critical area planting, recreational area development and other conservation uses in Arkansas and Southern Missouri.

Objective:

The objective is to assemble, evaluate, develop and cooperatively release an adapted variety and/or varieties of big bluestem for conservation use in the following Major Land Resource Areas: 116A, 116B, 117, 118, and 119.

Cooperators:

USDA-NRCS Plant Materials Center at Elsberry, Missouri and the USDA-NRCS Plant Materials Center at Booneville, Arkansas.

Assembly:

The assembly consists of vegetative materials from adapted ecotypes throughout Northwestern Arkansas and Southwestern Missouri Major Land Resource Areas: 116A, 116B, 117, 118, and 119. Collection dates were between November 9 and 13, 1987. Four collection sites per county within the geographic area of collection were made. The number of sites was determined by the size of the county. The study plan supplement lists the states and the number of sites per county.

Procedure:

Four collections per county in the targeted Major Land Resource Areas were requested. The intent was to get a broad genetic base of plant material; therefore, the site selection attempt was to get as diverse sampling as practical when selecting superior big bluestem plants in the field. If a county had more than one Major Land Resource Area, collections were made in each area. Collections were from typical locations, which included natural grasslands (range), relic areas, and road right-of-ways. Avoided areas were those that may have been artificially seeded. Where possible, collections came from diverse soil textural types, such as sandy and silty; or range site groupings such as: (1) Run-in sites represented by overflow, or subirrigated; (2) normal upland sites represented by sandy, silty or clayey. Six subsamples (6" x 6" x 8" deep) were collected vegetatively at each site.

The samples were transported in material provided by the Plant Materials Center that included cartons, plastic bags, accession data sheets, and instructions for handling.

Plant Materials Center personnel picked up the cartons containing the samples at designated central locations within each administrative area in November 1987.

Transplanting procedures included temporary storage and handling. The samples were first assigned accession numbers and placed in temporary storage. On February 15, 1988, each subsample was transplanted into separate containers and maintained under controlled greenhouse conditions. The plants were then divided between two locations, Elsberry, Missouri and Booneville, Arkansas Plant Materials Centers, and established in space plant initial evaluation nurseries.

Discussion:

1987-1989

A total of 370 accessions (collections) of big bluestem were initially collected during November, 1987, from the targeted areas: 194-Missouri; 85-Arkansas; 82-Oklahoma; and 8-Illinois. Individual plantlets were separated, transplanted into cone-tainers, and grown out in Forrest Keeling Nursery's greenhouse from February until May 1998. More than 4400 individual plantlets were transplanted into a space plant nursery with two replications and six plants per replication. The nursery is located in Field #14 at the PMC and was planted June 1988. The entire nursery was irrigated three times weekly in 1988 to insure good survival. Data collected in 1988 was mostly survival. Data collected in 1989 included survival, vigor, disease resistance, plant size, foliage size, and abundance and visual seed production. Accessions from each state were selected from the above criteria. The numbers selected from each state were as follows: Arkansas-14, Missouri-46, and Oklahoma-13. Table #1 shows the 73 accessions selected from the initial space plant nursery located in Field #14 on the PMC. These plants were vegetatively removed from the initial evaluation nursery in November 1989.

1990-1991

The plants selected in 1989 were transplanted into cone-tainers and grown out in the greenhouse that winter. These plants were planted in an isolated crossing block in Field #1 on May 23, 1990. Fifteen bulk pounds of clean seed were harvested in 1991.

1992-1993

The seed harvested in 1991 was sorted by weight and grown in cone-tainers in the greenhouse from January until April. Approximately 500 plants were planted in Field #7 in April and May 1992 for further evaluation.

Beginning in July 1993, the great flood began flooding approximately 86 acres on the PMC. The area where this planting was located was completely inundated with approximately eight feet of water. Just prior to the flooding of this site (July 8, 1993), the PMC staff uprooted 62 selections of big bluestem and re-established them to an upland site on the PMC (Field #8).

1994-1996

The nursery block established in Field #8 in July 1993 was evaluated for forage quality and quantity, seed production, plant maturity differences, and disease and insect resistance. Twenty-eight of the 62 plants were selected and allowed to cross. Seed from this crossing block is a composite of the original 73 accessions collected and is the breeders' block for the new accession 9078831. Seed was harvested in 1995 and 1996 and a seed increase plot will be established in 1997. The Booneville PMC also has made their selection and both will be included in the advanced evaluation.

1997-1998

The diversity in the original nursery block containing all 370 accessions is tremendous. There is a lot of variation within this species. The need for plant diversity for prairie restoration led to the release of the source-identified composite of all 370 accessions. This composite was given the accession number 9062323 and given the name OH-370 which stands for a composite of 370 collections made from the Ozark Highlands of Southern Missouri, Northern Arkansas, Eastern Oklahoma, and Southern Illinois. This plant was released in April 1997.

A 0.4-acre increase planting of 9078832 was planted May 22, 1997, in Field # 6. This planting was established in a conventional seedbed in 36" rows. The first year the planting produced 10 pounds bulk clean seed and in 1998 it produced 27 pounds bulk clean seed. The 1998 seed tested poorly but it is not known why. When seed becomes available from the Arkansas PMC the study will begin an advanced evaluation to compare the new accession, 9078831 with available varieties and also the accession Booneville has selected out of the original assembly of 370 collections.

The original planting was again evaluated the spring of 1997 looking for a tall, stiff stemmed, upright plant to use in wind barriers. Wind erosion is a problem in the flat and sandy crop fields in the bootheel area of Missouri. Switchgrass windbarriers are being tried in areas where field windbreaks using trees are not acceptable. Big bluestem was requested by the Missouri plant materials committee as an additional species to go along with switchgrass since the nursery is still intact. Five accessions (Table #2) were selected and increased vegetatively in the greenhouse and transplanted into an isolation block in Field #4. This block contained 126 plants and of those, 34 plants were selected to represent the crossing block that will serve as the breeders' block for a wind barrier selection. The final accessions represented in this block are 9065960, 9056913, and 9056914.

Selections were also made for landscape and beautification (Table # 3). These selections were transplanted into the rod row initial evaluation area for further evaluation.

1999

The increase plot of 9078831 was expanded in 1999 but did not develop as the 1997 original increase plot did. This accession is scheduled for release as a pre-varietal selection in 2000 if enough seed is available and field plantings are successful.

The wind barrier selection block was again evaluated in 1999 and narrowed down to a single accession, 9066960 (Table #2).

No additional selections were made for landscape plants in 1999 (Table #3).

2000

The increase plot of 9078831 was again expanded in 2000 but again was very slow to germinate. Seed was sent for testing and the sample contained a high percentage of dormant seed. This pre-varietal selection was scheduled to be released in 2000 and given the name OZ-70 that stands for Ozark Highland composite of 70 collections. The release has been delayed until a solution can be found for its high seed dormancy.

Seed was harvested from the wind barrier block and an increase planting will be made in 2001.

2001

The increase plot of 9078831 (OZ-70) was again expanded in 2001 but this year it was planted the first week of March to allow for stratification. Seed harvested in 2000 was used in the planting because seed less than one year old appears to have more dormancy than seed that has had time in storage. The portion of the plot that was planted in 2001 established well and even produced a small amount of seed the first year.

Seed harvested from the wind barrier accession was propagated in the greenhouse and transplanted into an evaluation nursery. The evaluation nursery has approximately 250 plants on a three-foot grid. These plants will be evaluated for two additional years for height, biomass production and lodging. This plant will be released as a tall, stiff stemmed selection.

2002

Field testing has shown possible problems with establishment of OZ-70 big bluestem. A trial was started using replicated plots to compare the establishment of OZ-70 with 'Rountree' big bluestem. First year data indicates that Rountree establishes quicker with higher stand density than OZ-70. It also indicated that the winter dormant plots (planted March 14, 2002) of OZ-70 were better than the spring planted plots (planted June 21, 2002). This was reversed with the Rountree. This information supports the high seed dormancy problem indicated in seed tests. These plots will be monitored one more year to see if the slow establishment has to do with the long-term density of the plots.

A comparison between new seed and one-year-old seed is planned for 2003. Seed tests indicate a problem with seed dormancy in new seed. Storage for one year could help rectify this problem.

2003

A trial comparing new (previous year's harvest) and older seed (one to five years old) was conducted in 2003. Establishment was quicker if new seed was winter dormant planted. This supports that newly harvested seed has higher seed dormancy but all lots of seed developed into successful stands the establishment year.

The technical review committee recommended proceeding with a Selected Release for this accession and OZ-70 Germplasm Big Bluestem was released December 2003.

Release Documentation

The OZ-70 selection has very good forage production and vigor that appears to be comparable or better than Rountree. OZ-70 is approximately two weeks later in booting than Rountree and forage quality is better when tested at Elsberry (see below). Rountree exhibits considerable more rust when compared to OZ-70 in Southern Missouri. OZ-70 also has very good seed production with a 2003 yield of 280 bulk pounds of clean seed per acre.

Forage clippings of OZ-70 Germplasm were compared with Rountree. These samples were replicated and taken at different stages of growth. Forage quality of the OZ-70 selection compared favorably to Rountree as indicated by following data.

Clipping Date	**Percent Protein**		**Percent ADF**		**Percent NDF**	
	OZ-70	**Rountree**	**OZ-70**	**Rountree**	**OZ-70**	**Rountree**
6/19/02	**14.3**	**8**	**30.9**	**35.7**	**55.8**	60.8
7/8/02	**8.2**	**5.8**	**34.1**	**33.0**	**59.3**	60.5
8/30/02*	11.4	11.9	34.3	34.7	54.6	56.6

*Regrowth material from 7/8/02 clipping.
ADF=acid detergent fiber; NDF=neutral detergent fiber.

OZ-70 Germplasm big bluestem was compared to 'Rountree' big bluestem for establishment and Rountree was quicker to establish indicating better seedling vigor when new (previous year's harvest) seed was planted. A seeding trial was conducted in 2003 and compared seed harvested in 2002, 2001, and a mixture of seed harvested in 1997 through 2000.

The results below indicate some seed dormancy in new crop seed but all plots developed very good to excellent stands and had seedhead production the first year.

	Stems Per Row Foot	**Percent Cover**
Winter dormant planting, 2002 seed	**16**	**92**
Winter dormant planting, 2001 seed	**14**	**78**
Winter dormant planting, 97-00 seed	**8**	**65**
Spring planting 2002 seed	**10**	**60**
Spring planting 2001 seed	**14**	**87**
Spring planting 97-00 seed	**10**	**75**

2004

The tall, erect, lodging resistant big bluestem currently being evaluated as a wind barrier selection, (accession 9083274) was increased for advanced testing. Seed was harvested in 2003 from the remaining plants in the final evaluation block. The increase block established well but no seed was harvested in 2004. Limited seed production is anticipated for 2005 and available for advanced testing in 2006.

Shorter growing collections were also isolated and evaluated. Six collections were narrowed to three (accessions 9056902, 9056905, and 9056906) and allowed to cross. This composite (accession 9078832) was harvested in 2003 and used to establish an increase block in 2004. Seed production is anticipated for 2005 and available for advanced testing in 2006. This selection will be evaluated for use in vegetative buffers and filters.

2005

The two increase blocks of big bluestem that were established in 2004 (tall, lodging resistant, - accession number 9083274 and shorter growing, - accession 9078832) both produced seed in 2005. These blocks were planted April 28, 2004. Accession 9083274 produced 65.7 bulk pounds on 0.183 acre for a yield of 359 bulk pounds per acre. Accession 9078832 produced 144.9 bulk pounds on 0.51 acre for a yield of 287 bulk pounds per acre.

2006

The two increase blocks of big bluestem planted April 28, 2004 were again managed for seed production. Neither plot was enlarged.

The tall, lodging resistant accession, 9083274, yielded 59.1 bulk pounds on 0.183 acre for a yield of 323 bulk pounds per acre. The year was very dry during parts of the growing season. Seed quality was poor resulting in a very poor percent PLS.

The shorter growing accession, 9078832, yielded 193.2 bulk pounds on 0.51 acre for a yield of 379 bulk pounds per acre. Again seed quality was not very good resulting in a poor percent PLS.

The shorter growing accession (9078832) also is very resistant to lodging and these characteristics look good for this accession's use in conservation programs. With adequate seed on hand for field plantings and grower interest, this accession was released as a selected class release in 2006 as Refuge Germplasm (see 2006 releases section for release notice).

2007

The tall, lodging resistant accession (9083274) increase plot yielded 50.3 bulk pounds on 0.183 acre. The plot was also expanded by a few rows but was slow to establish. Seed from the breeder's block was limited and possibly of poor quality due to a very dry summer. Seed harvested in 2005 from the increase plot was used in the biofuels study plots (MOPMC-T-0716).

The increase field of Refuge Germplasm big bluestem (9078832) has begun showing different heights that indicate contamination of the breeder plot. It was decided to move and isolate the breeder's block and reestablish a new foundation field.

2008

The increase plot of the tall, lodging resistant accession (9083274) of big bluestem was flooded for an extended period of time in 2008 and was destroyed. A new breeders block was establish vegetatively and a new increase field is planned for 2010.

The increase plot of Refuge Germplasm big bluestem (9078832) was also destroyed in 2008.

2009

The new breeders block of the tall, lodging resistant accession (9083274) of big bluestem established in 2008 did very well in 2009. Approximately 5% of the 400 plants in the block were rouged before seed development due to lack of desired characteristics. Five pounds of bulk seed was harvested and used to reestablish an increase field. This accession is currently being evaluated in a biofuels study and also an inter center strain trial for big bluestem.

Study 29I097G - Assembly and Evaluation of Big Bluestem, *Andropogon gerardii*, Vitman. **Table #1**

Accessions Selected for Crossing Block

Collector	State	County	Accession Number	MLRA	Soil
Levonna S. Vekman	Arkansas	Faulkner	9056956	118	Leadville
Mark L. Kennedy	Arkansas	Fulton	9056968	116A	Geesville
Luther O. Shaw	Arkansas	Izard	9056920	116A	Mako
NRCS-Field Office	Arkansas	Logan	9056964	118	Taff
NRCS-Field Office	Arkansas	Madison	9056962	118	Leadvale
Stephen T. Ford	Arkansas	Madison	9056945	117	Nixa-SL
John Y. Harrington	Arkansas	Madison	9056923	116A	Estate-SC
John Y. Harrington	Arkansas	Madison	9056952	116A	Estate-SC
Lane L. Gentry	Arkansas	Perry	9056922	119	Clebit
John D. Kopf	Arkansas	Scott	9056936	119	Carnasaw
Jeremy R. Funk	Arkansas	Sharp	9056914	116A	Gepp
NRCS-Field Office	Arkansas	White	9057058	118, 134	
NRCS-Field Office	Arkansas	White	9057060	118,134	
Robert S. Garner	Arkansas	Yell	9056908	119,118	Clebit-FSL
H. Dan Philbrick	Missouri	Barry	9056832	116B	
Dudley W. Kaiser	Missouri	Benton	9056840	116B	Bardley
NRCS-Field Office	Missouri	Camden	9056724	116A	Gatewood
William K. Quage	Missouri	Cedar	9056800	116B	Hector
Patricia A. Beneke	Missouri	Cole	9056821	115	Goutewood
Patricia A. Beneke	Missouri	Cole	9056806	115	Gatewood
Melodie Marshall	Missouri	Crawford	9056820	116B	
Melodie Marshall	Missouri	Crawford	9056886	116B	
Melodie Marshall	Missouri	Crawford	9056767	116B, 116A	Lebanon
Myron C. Hartzell	Missouri	Dent	9056773	116B	Coulstone
Myron C. Hartzell	Missouri	Dent	9056763	116B	Lebanon
John L. Lumb	Missouri	Douglas	9056833	116B	Doniphan
Art Kitchen	Missouri	Franklin	9056855	115	Crider
Art Kitchen	Missouri	Franklin	9065771	115	Union
NRCS-Field Office	Missouri	Gasconade	9056848	116B	Gladden
Clayton P. Robertson	Missouri	Gasconade	9056875	116B	
H. Lane Thurman	Missouri	Greene	9056716	116B	Chirty Silt Loam
NRCS-Field Office	Missouri	Hickory	9056839	116A	
Stanley Lamb	Missouri	Iron	9056774	116A	Midco
Howard Combes	Missouri	Howell	9056753	116A	Doniphan
Joe H. Everett	Missouri	Jefferson	9056842	115	GL
NRCS-Field Office	Missouri	LaClede	9056741	116A	Cherty Silt Loam
Kees VanderMer	Missouri	LaClede	9056791	116A	Union
Cecile Allen	Missouri	Lawrence	9056709	116B	Viraton
Ron R. McMurtrey	Missouri	McDonald	9056719	116A	
Larry E. Lewis	Missouri	Miller	9056732	116B	SIL
Larry E. Lewis	Missouri	Miller	9056868	116B	SIL
Henry E. Knipker	Missouri	Moniteau	9056890	116B	Glensted
Mary Beth Roth	Missouri	Morgan	9056831	116B	

Study 29I097G – Assembly and Evaluation of Big Bluestem, *Andropogon gerardii*, Vitman.

Table #1 - continued

Collector	State	County	Accession Number	MLRA	Soil
Mary Beth Roth	Missouri	Morgan	9056837	116B	
Stephen E. Robbins	Missouri	Organ	9056770	116A	
William R. Dilbeck	Missouri	Polk	9056828	116B	
NRCS-Field Office	Missouri	Pulaski	9056746	116A	Wilderness
Clarence Wagy	Missouri	Reynolds	9056701	116A	
Charles E. Johnson	Missouri	Ripley	9056895	116A	
Charles E. Johnson	Missouri	Ripley	9056894	116A	
Steve Wall	Missouri	Shannon	9056762	116A	
Claude A. Peifer	Missouri	Ste. Genevieve	9056819	116B	Bloomsdale
Edward L. Templeton	Missouri	St. Francois	9056845	116A	Crider
Carl Wehrman and Dude Davidson	Missouri	Taney	9056712	116A	Clarksville
Jeff A. Lamb	Missouri	Texas	9056728	116A	Goss
NRCS-Field Office	Missouri	Wayne	9056854	116A	
Patrick L. Adams	Missouri	Washington	9056817	116A	Silty Clay Loam
Patrick L. Adams	Missouri	Washington	9056870	116A	Silty Clay Loam
John N. Emerson	Missouri	Webster	9056737	116B	
Dan D. Divine	Missouri	Wright	9056733	116B	
Andrew R. Inman	Oklahoma	Adair	9056996	117	Hector Complex
Billy D. Dudley	Oklahoma	Cherokee	9057010	116A, 117	Newtonia
Billy D. Dudley	Oklahoma	Cherokee	9057016	116A, 117	Talpa-Rock
Kenneth W. Swift	Oklahoma	Choctaw	9057025	112	Muskogee SL
Warren R. Sanders	Oklahoma	Coal	9057005	119	Boham
Steve D. Clark	Oklahoma	Latimer	9057014	118, 119	Stigler SL
Robert E. Blackman	Oklahoma	Mayes	9056995	112, 116A	Hector
Sam L. Viles	Oklahoma	McIntosh	9057035	118	Karma SL
Patrick I. Bogart	Oklahoma	Okmulgee	9057032	112, 118	Taloka SL
Patrick I. Bogart	Oklahoma	Okmulgee	9057037	112, 118	Taloka SL
NRCS-Field Office	Oklahoma	Ottawa	9057030	116A, 112	ETA-SL
William R. Bin	Oklahoma	Pushmatoho	9957052	119	Bosville
William R. Bin	Oklahoma	Pushmatoho	9057046	119	Bernow FSL

Wind Barrier Selection Isolation Block **Table #2**

Collector	State	County	Accession Number	MLRA	Soil
	Arkansas	Logan	9056960	118	Laedvale

Study 29I097G – Assembly and Evaluation of Big Bluestem, *Andropogon gerardii*, Vitman.

Landscape Selection Rod Row Area **Table #3**

Collector	State	County	Accession Number	MLRA	Soil
Clarence Wagy	Missouri	Carter	9056703	N116A	Opequon
Clarence Wagy	Missouri	Reynolds	9056708	N116A	Clarksville
Myron Hartzell	Missouri	Dent	9056812	116A	Elsah
Kenneth W. Swift	Oklahoma	Latimer	9057025	119	Freestone Variant - Bernow Variant Complex
	Oklahoma	McCurtain	9057049	1336	Kinta Clay Loam
Dennis W. Shirk	Missouri	Maries	9056877	116A	Lebanon
Larry B. Cash	Arkansas	Carroll	9056934	116A	Nixa

Study: **29I108G**

Study Title: Assembly and Evaluation of Low Growing, Rhizomatous Switchgrass, *Panicum virgatum L.* for Use in Waterways, Filter Strips and Other Conservation Uses.

Study Leader: Bruckerhoff, S. B.

Introduction:

Switchgrass is a warm-season, perennial, native grass. Plants are usually green or glaucous, with numerous scaly creeping rhizomes. Culms are erect, tough and hard, one to two meters rarely to three meters tall; sheaths glabrous; blades 10-60 centimeters long, three to 15 millimeters wide, flat glabrous, or sometimes pilose above or near the base, rarely pilose all over; panicle 15-50 centimeters long; acuminate; first glume clasping, two-thirds to three-fourths as long as the spikelet. Switchgrass frequents a wide variety of habitat, usually sunny including dry or moist prairies, moist seepage of rocky glades and buff escarpments, gravel bars of streams, open woods and along railroad tracks.

Problem:

There is a need for an adapted variety of a dense low growing, strongly rhizomatous switchgrass for use in waterways, filter strips, and for other conservation uses in Missouri, Illinois, Iowa, and adjacent states.

Objective:

The objective is to assemble, select, and develop a dense low growing strongly rhizomatous switchgrass, with good seedling vigor and seed characteristics, for use in waterways and streambank corridors.

Procedure:

The assembly consists of the collection of vegetative material from adapted ecotypes in Iowa, Illinois, and Missouri. The targeted collection area includes the following Major Land Resource Areas: 102b, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 131, and 134. Five collections from each NRCS administrative area were requested.

Vegetative collections were taken from natural prairie stands, prairie remnants or individual short growing plants growing in areas that are seasonally wet like a waterway. Total height of the plant was to be no more than three feet.

The samples were collected when the plant was dormant in the fall, divided into plantlets in the winter and placed into square open bottom containers and grown out in the greenhouse. Twelve plants per collection were grown out in the greenhouse.

The plants were planted into a randomized complete block with three replications. Each plot had three plants and all plants were planted on four-foot spacing. A border row was planted around the three replications. This study was planted into a clean tilled seedbed with recommended fertility and weed control. Plants were evaluated for survival, vigor, height, and spread that included rhizomatous characteristics, disease and insect resistance, lodging, and seed production.

Discussion:

1990-1991

The collections of *Panicum virgatum* L., low growing highly rhizomatous switchgrass was initiated in November 1990 and extended through 1991. One hundred eighteen collections were obtained from Major Land Resource Areas 102B-116, 131 and 134 in Missouri, Illinois and Iowa. The total number of collections received was 22-Illinois; 28-Iowa and 68-Missouri. All collections were assigned accession numbers and stored in a cool damp building.

1992-1993

The collections were vegetatively propagated in cone-tainers and placed in the greenhouse in January 1992. These plants were then transplanted in Field #7c on the PMC on June 9, 1992, in a randomized complete block with three replications. Baseline evaluations were taken this year; survival, spread, height, and number of panicles per plant. More detailed evaluations were scheduled for succeeding years.

Beginning in July 1993, the great flood began inundating the area where this project was located. Prior to the flooding of this site (July 2, 1993), additional evaluations were started and 67 accessions were vegetatively moved to an upland site on the PMC for continued evaluation. Table #1 lists the selected accessions, origins, and collectors.

1994-1995

Evaluations were continued on the 67 accessions during 1994 and 1995. The original planting in Field #7c that was flooded in 1993 was also checked for survivors. The planting was flooded by as much as eight feet of water for almost eight weeks. Nine plants were found that showed life and were dug up and moved to an upland site. These nine plants represented three accessions (Table #2).

Five accessions were selected out of the block of 67 for a short growing rhizomatous type. The five accessions (Table #3) were allowed to cross and seed was harvested and grown out in the greenhouse. The five accessions were also dug and increased in the greenhouse in containers.

1996

The five selected accessions (Table #3) were planted into a crossing block June 26, 1996. Half the block was from clonal material from each of the five accessions and the other half was from seed harvested from each of the five plants that were allowed to cross with each other. The accessions of each half of the planting were replicated five times with five plants per replication. Unwanted plants will be eliminated and the remainder of the block will be used for seed increase.

1997-1998

The three accessions (Table #2) of flood tolerant switchgrass were vegetatively increased in the greenhouse. Approximately 250 plants were transplanted April 1997 in Field #7. This is now the breeders' block for the accession 9083170 that is a composite of the three accessions listed in Table #2. Seed was harvested from this plot the first year and used to start a small increase plot in 1998. A small amount of seed was harvested from this increase plot the first year. It is also planned to increase the size of this plot in 1999.

The low growing switchgrass block containing five accessions (Table #3) was again evaluated in 1997. Thirty-five plants were selected from the block of 250. Selected plants were allowed to cross and produce seed. This seed was also used to start an increase field in 1998. This small increase plot produced minimal seed the first year. Seed was again harvested from the 35 plants in 1998 and will be used to make the increase plot size bigger in 1999. The 35 selected plants are the breeder's block for the new accession 9083172 that is a composite of the five accessions in Table #3.

1999

The increase plot of flood tolerant switchgrass, accession 9083170, was expanded in May 1999. This planting did not do well, possibly poor seed germination combined with a very dry summer. Weed control was also poor. Establishment of field plantings was also poor. Expanding the increase plot will again be planned for 2000. Seed was harvested from the breeder's block and the 1998-increase plot. This seed was small due to dry weather.

The increase plot of low growing switchgrass, accession 9083172, was also expanded in May 1999. This planting also did poorly, again possibly poor seed germination combined with a very dry summer. Weed control was also poor. Field testing will begin when seed becomes available. Expanding the increase plot will be planned for year 2000. Seed was harvested from the original 35-plant breeder's block and also the increase field. This seed was also small due to dry weather.

2000

Increase plots of the flood tolerant switchgrass, accession 9083170, and the low growing switchgrass, accession 9083172, were again planted in 2000. These plantings were very sparse and slow to establish. The plantings made in 1999 contained some plants with minimal seed produced. Plantings will again be tried in 2001 with more stratification.

2001

The increase plots of the low growing switchgrass, accession 9083172, that were planted in 1998 and 1999 have filled in and produced seed. The plots planted in 2000 and 2001 have failed. This accession appears to have high seed dormancy and combined with excessive weed competition caused poor establishment. An increase planting is planned for 2002 on an upland site with less weed problems.

The increase plots of the flood tolerant switchgrass, accession 9083170 that was planted in 1998 produced seed in 2001. The 1999 planting was very thin and the 2000 and 2001 plantings have failed. This accession appears to have high seed dormancy. Another increase planting is planned in 2002 with additional stratification.

Accession 9062244 was observed in the nursery block in field eight as having high forage production (very leafy), medium height, and late maturity. Protein analysis of a sample taken was 15.6%. This plant was increased in the greenhouse from vegetative material and planted into a 200-plant nursery in 2000. Unwanted plants were rogued out and seed was harvested in 2001. Plants that germinate quicker from the heaviest seed will be placed in an evaluation nursery in 2002.

2002

The low growing switchgrass, accession 9083172, increase plots had limited seed production in 2002. The 17.3-pound bulk seed produced will be used in the field-planting program for advanced testing. An additional 1.5 acres increase field was planted in 2002. No seed was harvested the establishment year from this plot.

The flood tolerant switchgrass, accession 9083170, increase plots also had limited seed production in 2002. The 32.5-pound bulk seed produced will be used in the field-planting program. Due to an extremely wet spring, no additional seed increase field was planted in 2002.

The medium height forage type switchgrass, accession 9062244, was propagated in the greenhouse and plants were selected for quick establishment and seedling vigor. These plants were transplanted into an evaluation nursery in Field #1 at the PMC.

2003-2004

The low growing switchgrass, accession 9083172, increase plots have been expanded but are slower than expected to develop and produce seed. Available seed is being used in the field planting program for advanced testing.

The flood tolerant swithgrass, accession 9083170, increase plots have been expanded but are also slower than expected to develop and produce seed. Available seed is being used in the field planting program for advanced testing.

The medium height forage type switchgrass, accession 9062244, was again propagated in the greenhouse and the evaluation nursery was expanded in 2003. The plants were allowed to develop and mature in 2004 with evaluations to begin in 2005.

2005

Seed was harvested from the low growing and flood tolerant increase plots. Both of these accessions are being evaluated in the field planting program with mixed results. Seed dormancy is a problem and results in poor and inconsistent establishment.

The medium height switchgrass accession will be placed into a study of its own and go through a recurrent selection process in the development of an improved forage type switchgrass.

2006

Seed was again harvested from the low growing and flood tolerant increase plots. Both are showing poor stand development on heavy soil types with moderate to heavy clay content. These two selections will undergo more testing and selection to improve seedling vigor.

2007

Seed from the low growing and flood tolerant selections were put in the germinator and selected for quick germination, five days or less. Two new evaluation plots were established from the plants selected out of the germinator.

2008

In 2008, plans were to compare germination of seed taken off the selected plots with that of seed taken from the original plots. The data shows the difference between seed that has been stratified and seed that had no stratification period. Within each treatment, low growing, flood tolerant and 'Cave-in-Rock' switchgrass were test for superior germination. The low growing and flood tolerant switchgrass had both SG0 (original) seed and the cycle 1 (selected) seed tested. In the case of the low growing switchgrass, the cycle 1 (selection) made a significant increase in germination. The flood tolerant switchgrass did not appear to have any statistical difference. 'Cave-in-Rock' switchgrass was tested as a comparison.

2009

The two varieties of switchgrass were tested in the fall using seed that was harvested during the 2009 growing season. Comparisons between seed produced in 2008 (Table 1) and seed produced in 2009 (Table 2) are similar in their results. In all cases, except the non-stratified flood tolerant switchgrass from the spring 2009 tests (Table 1), the cycle 1 selections improved in germination. It is worth noting, that the flood tolerant switchgrass, both SG0 and cycle 1 plots, were inundated for approximately 4 weeks just prior to flowering. Also seed from Cave-in-Rock switchgrass for the spring 2009 test (Table 1) was older seed and not from the current growing season. The fall 2009 tests (Table 2) were ran using current growing season seed and is a more accurate test. This test will be ran once more using 2009 growing season seed and if the results show that the cycle 1 selections are still superior, then plans will be to move forward with production plots and field testing.

Table 1

Switchgrass Germination Test Spring 2009

	Non-Stratified					Stratified				
	Day 7	Day 14	Day 21	Day 28	% Germ	Day 7	Day 14	Day 21	Day 28	% Germ
Low Growing Switchgrass SG0	9	15	1	1	25	51	5	0	0	56
Low Growing Switchgrass Cycle 1	36	32	0	1	68	78	6	1	0	85
Flood Tolerant Switchgrass SG0	16	10	2	0	27	70	3	0	0	73
Flood Tolerant Switchgrass Cycle 1	15	5	2	1	22	70	5	1	0	76
Cave-in-Rock Switchgrass	37	44	0	0	81	80	5	0	0	85

There were 4 replications of 100 seeds per germination tray using seed harvested in 2008, with exception of Cave-in-Rock switchgrass. C-I-R seed came from a seed lot that was harvested from 1994 through1997.

Stratified seed (cold/moist) was put in the cooler for 2 weeks.

Non-statified seed was taken directly from the storage room and entered into the growth chamber.

Table 2

Switchgrass Germination Test Fall 2009

	Non-Stratified					Stratified				
	Day 7	Day 14	Day 21	Day 28	% Germ	Day 7	Day 14	Day 21	Day 28	% Germ
Low Growing Switchgrass SG0	1	6	2	1	10	38	4	0	1	43
Low Growing Switchgrass Cycle 1	1	6	3	2	12	41	7	1	1	49
Flood Tolerant Switchgrass SG0	0	3	0	0	3	48	3	0	0	51
Flood Tolerant Switchgrass Cycle 1	0	5	1	1	6	58	4	1	0	63
Cave-in-Rock Switchgrass	2	3	2	1	7	41	4	0	1	46

There were 4 replications of 100 seeds per germination tray using seed harvested in 2009.

Stratified seed (cold/moist) was put in the cooler for 2 weeks.

Non-statified seed was taken directly from the storage room and entered into the growth chamber.

Study No. 29A116W

Study Title: Evaluation of Miscellaneous Trees and Shrubs.

Study Leader: Cordsiemon, R.

Introduction:

The evaluation of woody plant materials on the USDA-NRCS Elsberry Plant Materials Center began in 1989. Since that time plants have been added for multiple purposes. The evaluations of these plant materials have been in cooperation with the USDA-ARS, Plant Introduction Station, Ames, Iowa; Missouri Department of Conservation; and other plant materials centers.

Problem:

Trees and shrubs are needed to provide for windbreaks, recreation, and multipurpose use in the Midwest Region and provide multiple wildlife benefits throughout the three-state area. New selections, collections and public and private releases need to be evaluated as potential conservation species.

Objective:

The objectives of this study are to assemble and evaluate woody plant materials (both collections in the wild and also released cultivars) for conservation uses, area of adaptation, and to select and increase limited quantities of promising woody plants for advanced evaluation. Superior accessions or those exhibiting unique characteristics will be placed in field evaluations and field plantings in the three-state area being served by the PMC.

Assembly:

Plant materials of various woody species representing many species have been planted on the PMC. The sources include other PMC's, commercial nurseries, and other agencies.

Discussion:

1994-2004

This study is a long-term ongoing evaluation of miscellaneous trees and shrubs that are not part of a collection made over several years. New species will be planted as they arrive at the Center. Although this study was started in 1989, it includes some species from past studies. Presently there are 29 different species included. Twenty-two are exhibiting 100 percent survival. Five species have failed to survive.

The trees and shrubs in this study are often utilized during plant identification courses held at the Center.

There were no evaluations conducted and no new species added in 2004. There are two new species planned for 2005 that will be received from the Plant Introduction Station in Ames, Iowa. The entire assembly is scheduled to be evaluated in 2005. Very little attention was given to this study in 2004 because the PMC was understaffed.

2005

An evaluation of survival was made in the summer of 2005. Trees and shrubs that had died were noted. The condition of the trees were also evaluated. Black chokeberry (*Aronia melanocarpa)* and common buttonbush (*Cephalanthus occidentalis)* were added to this study. These trees and shrubs will again be evaluated for their survivability and use in conservation.

2006

In April, three new species were added for evaluation, Musclewood (*Carpinus caroliniana*), Bur oak (*Quercus macrocarpa*), and Laurel willow (*Salix pentandra*). There were five trees planted of each species and evaluated for general conditions of the plants (bud break, plant injury, etc.) The buttonbush (*Cephalanthus occidentalis*) and black chokeberry (*Aronia melanocarpa*) were replanted in the fall, 11/14/2005, after dying from an earlier spring planting. They too were evaluated, but for survival, height, spread, injury, type of care given, plant performance, and variations among plants.

2007

Evaluations were taken on tree species sent from the ARS - Plant Introduction Station in Ames, Iowa. Data was sent back to ARS via their online evaluation forms. Also survival of the miscellaneous tree assembly was taken. In August the Three State Technical Review Committee recommended several species of trees to be eliminated from the assembly. The primary species that were recommended for removal were non-native species or species that were performing poorly.

2008

In 2008, the trees and shrubs present in the study were evaluated for survival. Trees from the Plant Introductory Station in Ames, IA were evaluated and data was sent via online evaluation forms. The Introductory Station also sent 2 new species for evaluation, Physocarpus opulifolius (Common Ninebark) and Quercus alba (White Oak). They were planted on 5/2/08. There were no trees eliminated from the evaluation block in 2008. The recommended trees for removal are still scheduled to be removed.

2009

The Miscellaneous Trees and Shrubs study had several older species removed from the plot. Data was taken and the extra space will be prepared for future evaluations and observational plantings.

List of species included in study. **Table #1**

Common Name	Genus	Species	Accession Number	Alternate No.	Source	Date Planted
'Densehead' mountain ash	*Sorbus*	*alnifolia*		7761	F.K. Nursery	11/65
'Ruby' redosier dogwood	*Cornus*	*stolonifera*	443229		Big Flats PMC	5/89
Late lilac	*Syringa*	*villosa*	9006228		Bismarck PMC	5/89
'Redstone' cornelian cherry dogwood	*Cornus*	*mas*	9055585		Elsberry PMC	5/89
'Roselow' sargent crabapple	*Malus*	*sargenti*	477986		Roselake PMC	5/89
'Elsmo' lacebark elm	*Ulmus*	*parvifolia*	9004438		Asia	5/89
Blueleaf honeysuckle	*Lonicera*	*korolkowi*	9062152		Nebraska	5/89
Birch	*Betula*	*species*	502295		Ames, IA	4/90
Willow oak	*Quercus*	*phellos*		4723	Ames, IA	4/90
Fragrant epaulettetree	*Pterostyrax*	*hispida*		A80779	Ames, IA	4/90
Bradford pear	*pyrus*	*calleryana*		19173	Ames, IA	4/69
Prairie rose	*Rosa*	*setigera*	495616		Ames, IA	4/90
Ural false spirea	*Sorbaria*	*sorbifolia*		7778	Ames, IA	4/90
Weeping lilac	*Syringa*	*pekinensis*	478008		Ames, IA	4/90
Flameleaf sumac	*Rhus*	*copallina*		7764	Ames, IA	4/90
Western paper birch	*Betula*	*occidentalis*	495882		Ames, IA	4/90
Amur honeysuckle	*Lonicera*	*mackii*	477998		Ames, IA	4/90
Mountain ash	*Sorbus*	*reducta*		A-8371	Ames, IA	4/90
Blackhaw	*Viburnum*	*prunifolium*		2813	Ames, IA	4/90
Largeleaf dogwood	*Cornus*	*macraphylla*		10178	Ames, IA	4/90
Border privet	*Ligustrum*	*obtusifolium*	477010		Ames, IA	4/90
Willow oak	*Quercus*	*phellos*		4724	Ames, IA	4/90
Arrowwood	*Viburnum*	*dentatum*			Elsberry, MO	4/90
Redbud	*Cercis*	*canadensis*	496399		Ames, IA	5/91
Birch	*Betula*	*species*	14942		Ames, IA	5/91
'Wichita' osage orange	*Maclura*	*pomifera*			Kansas	5/91
'Denmark' osage orange	*Maclura*	*pomifera*			Denmark, IA	6/92
Magenta	*Malus*	*species*	514275		Roselake PMC	4/93

Common Name	Genus	Species	**Accession Number**	**Alternate No.**	**Source**	**Date Planted**
Ocean view beach plum	*Prunus*	*maritima*	518824		Cape May PMC	5/93
'Sandy' rugosa rose	*Rosa*	*rugosa*			Cape May PMC	5/93
Wildwood bayberry	*Myrica*	*pennsylvanica*	548966		Cape May PMC	5/93
Wildwood bayberry	*Myrica*	*pennsylvanica*	434150		Cape May PMC	5/93
Wildwood bayberry	*Myrica*	*pennsylvanica*	548964		Cape May PMC	5/93
Ocean view beach plum	*Prunus*	*maritima*	518822		Cape May PMC	5/93
Ocean view beach plum	*Prunus*	*maritima*	518823		Cape May PMC	5/93
'Oahe' hackberry	*Celtis*	*occidentalis*	476982		Bismarck PMC	5/93
'King Red' Russian olive	*Elaeagnus*	*angustifolia*	434029		NPMC	5/93
Black Chokeberry	*Aronia*	*melanocarpa*	9083269	Ames 27371	Ames, IA	11/05
Common Buttonbush	*Cephalanthus*	*occidentalis*	9083270	Ames 27336	Ames, IA	11/05
Musclewood	*Carpinus*	*caroliniana*	9083283	Ames 27963	Ames, IA	04/06
Bur Oak	*Quercus*	*macrocarpa*	9004392	Ames 26202	Ames, IA	04/06
Laurel Willow	*Salix*	*pentandra*	9083284	Ames 27971	Ames, IA	04/06
Common Ninebark	*Physocarpus*	*opulifolius*	9083321	Ames 27970	Ames, IA	05/08
White Oak	*Quercus*	*alba*	9083322	Ames 27340	Ames, IA	05/08

Study 29A116W - Evaluation of Miscellaneous Trees and Shrubs — **Table #2**

Plt. No.	Sc. Name	Accn. / Alt. No.	Date Plt.	No. Plt.	No. Survived 90	91	92	98	99	OO	O1	O2	O3	Ave. Ht. (Ft.) 90	91	92	98	99	OO	O1	O2	O3	Ave. Wd. (Ft.) 90	91	92	98	99	OO	O1	O2	O3
1	Sorbus alnifolia	7761	11/65	2	2	2	2	2	2	2	2	2	2	21	22	22	25	26	25.7	26	26	26	8.2	8.2	8.2	12	12.4	12.9	13.3	13.3	13
2	Cornus stolonifera	443229	5/9/1989	4	4	4	4	4	4	4	4	4	4	0.7	3.7	3.9	4	4.7	4.7	5.3	5.4	5.4	1.8	3.6	4.8	3.5	4	4.2	4.7	4.9	5
3	Syringa villosa	9006228	5/9/1989	4	4	4	3	0	0	0	0	0	0	0.4	0.7	2.3	0	0	0	0	0	0	1.2	1.3	2.4	0	0	0	0	0	0
4	Cornus mas	9055585	5/9/1989	3	3	3	3	3	3	3	3	3	3	1.4	1.9	2.8	4.5	5	5	6.2	6.4	6.4	0.4	0.8	1.4	4.5	5	5.5	6.5	7	7.3
5	Malus sargentii	477986	5/9/1989	3	3	3	3	0	0	0	0	0	0	2	2.7	2.9	0	0	0	0	0	0	1	1.7	2.6	0	0	0	0	0	0
6	Ulmus parvifolia	9004438	5/9/1989	2	2	2	2	2	2	2	2	2	2	5.4	9.6	12	27	27	27.6	28.3	28.4	28.6	3.3	6.4	7.4	16	16.5	17	18	18.4	18
7	Lonicera korolkowi	9062152	5/9/1989	6	6	6	6	6	6	6	6	6	6	4	6.8	8	12	12	12.4	12.8	12.9	12.9	5.6	8.8	9.8	13	13.3	13.8	14	14.3	14.2
8	Betula species	502295	4/16/1990	3	1	1	1	1	1	1	1	1	1	3.4	3.4	4.1	6	6.5	6.8	7.5	7.7	7.9	1.5	1.9	2.8	5	5.7	6	6.5	6.8	7
9	Quercus phellos	4723	4/16/1990	4	4	4	4	4	4	4	4	4	4	1.7	2.6	4.1	23	23	23	23	23	23	1	1.8	3.7	12	12	12.9	12.9	13	13.2
10	Pterostyrax hispida	A-8079	4/16/1990	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Pyrus calleryana	19173	4/21/1969	2	2	2	2	2	2	1*	1	1	1	27	27	27	29	30	17*	18	18	18	20	20	21	33	33.6	15*	15.5	15.8	16.3

Study 29A116W - Evaluation of Miscellaneous Trees and Shrubs - Table #2 continued

Plt. No.	Sc. Name	Acc./ Alt. No	Date Plt.	No. Plt.	No. Survived 90	91	92	98	99	O0	O1	O2	O3	Ave. Ht. (Ft.) 90	91	92	98	99	O0	O1	O2	O3	Ave. Width (Ft.) 90	91	92	98	99	O0	O1	O2	O3
12	Rosa setigera	495616	4/16/1990	2	2	2	2	2	2	2	2	2	2	1.5	3.7	4.7	6.6	7	7	7	7	7	1.6	5.5	5.9	10	10.4	10.7	11	11.3	11
13	Sorbaria sorbifolia	7778	4/16/1990	7	7	7	7	7	7	7	7	7	7	1	1.8	2.3	5	5	5	5	5	5	0.6	1.8	2.1	6	6.5	6.9	7.1	7.3	7.5
14	Syringa pekinensis	478008	4/16/1990	3	2	2	2	2	2	2	2	2	2	1	1	1.5	7	7.3	7.7	8	8.2	8.4	0.7	1	2	7.5	7.8	8	8.2	8.5	8.7
15	Rhus copallina	7764	4/16/1990	4	2	2	2	2	2	2	2	2	2	1.6	2.9	5.3	7	7.7	7.9	8.2	8.4	8.6	0.8	2.8	5.3	8	8.3	8.5	8.9	9	9.2
16	Betula occidentalis	495882	4/16/1990	3	2	2	2	2	2	2	2	2	2	1.3	4.5	3	8	8.8	9.1	8.8	9	9.2	0.3	2.4	3.9	5	5.6	5.9	6.2	6.7	6.9
17	Lonicera maackii	477998	4/16/1990	4	3	3	3	3	3	3	3	3	3	0.7	1.5	2.7	7.8	7.9	7.9	7.9	7.9	7.9	0.6	1.2	2.7	4.5	5	5.5	5.9	6.2	6.5
18	Sorbus reducta	A-8371	4/16/1990	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	Viburnum prunifolium	2813	4/16/1990	4	2	2	2	2	2	2	2	2	2	2.6	2.7	3.4	8	8.5	8.7	9	9	9.2	0.7	1.3	2.4	5	5.3	5.5	6	6.4	6.7
20	Cornus macraphylla	10178	4/18/1990	3	3	3	3	3	3	3	3	3	3	1.7	2.2	3	7.5	7.9	8	8.2	8.2	8.2	0.5	0.9	1.7	4.5	5	5.4	5.7	6	6.3
21	Ligustrum obtusifolium	477010	4/18/1990	4	3	3	3	0	0	0	0	0	0	1.4	2.4	2.6	0	0	0	0	0	0	0.8	2.3	2,3	0	0	0	0	0	0
22	Quercus phellos	4724	4/18/1990	4	4	4	4	4	4	4	4	4	4	1.3	3.1	4.4	13	13	13.5	14	14	14.1	0.8	2.4	3.8	12	12.4	12.7	13.4	13.7	14.1

Study 29A116W - Evaluation of Miscellaneous Trees and Shrubs - Table #2 continued

Plt No	Sc. Name	Acc./ Alt. No	Date Plt.	No. Plt.	No. Survived 90	91	92	98	99	O0	O1	O2	O3	Ave. Ht. (Ft.) 90	91	92	98	99	O0	O1	O2	O3	Ave. Width (Ft.) 90	91	92	98	99	O0	O1	O2	O3
23	Viburnum dentatum	9062310	4/91	5	4	4	4	4	4	4	4	4	4	2	4.3	4.5	7	7	7	7	7	7	0.5	2	2.4	4.5	4.7	4.9	5.3	5.5	5.7
24	Cercis canadensis	496399	5/8/1991	3	3	3	3	3	3	3	3	3	3	0.5	3.2	3.7	11	11	11.6	11.9	12	12	0.25	0.5	2.7	10	10.5	10.8	11.4	11.7	12
25	Betula nigra	14942	5/8/1991	5	3	3	3	3	3	3	3	3	3	0.5	0.7	1.4	11	11	11.7	12.3	12.6	12.8	0.4	0.4	1.4	7	7.4	7.9	8.2	8.5	8.7
26	Maclura pomifera		4/92	1	1	1	1	1	1	1	1	1	1	0.5	0.5	1	13	13	13.5	13.9	13.9	13.9	0.25	0.3	2.5	13	13.2	13.7	14.3	14.6	15.3
27	Maclura pomifera		6/19/1992	1	1	1	1	1	1	1	1	1	1	0.5	0.5	1	13	13	13.5	14	14	14	0.25	0.3	0.5	7	7.3	7.7	8	8.3	8.5
28	Eleagnus umbellata		4/26/1999	5				5	5	5	5	5	5				2.5	3	3	3	3.3	4.5			1.5	2	3	3.4	3.8	4	4.5
29	Salix Mat. X Alba		4/14/1995	2				2	2	2	2	2	2				30	31	31	31	31	31.2				10	10.5	11	11.3	11.5	12.4

Study: 29I124G

Study Title: Production of Native Iowa Ecotypes of Grasses and Forbs for Roadside, Critical Areas, and All Other Vegetative Plantings Where Native Grasses and Forbs are Now Being Planted.

Study Leader: Cordsiemon, R.

Introduction:

Well-adapted native grass, legume, and forb plantings offer many advantages as low cost sustainable vegetative cover for management of soil and water resources. Native plant communities resist noxious weed invasion, provide excellent erosion control, and generally require relatively low maintenance.

These characteristics make them an excellent selection for use in roadside plantings, critical areas, long term land retirement programs, and all other vegetative plantings where mono-cultures of native grasses are being planted. This is especially true along public transportation right-of-ways. These transportation corridors constitute a major land resource and management problem in the state of Iowa. Based on 1987 Natural Resources Inventory (NRI) data, over one million acres of Iowa land are devoted to rural transportation.

Proper vegetation management along these corridors is an important element in controlling soil loss and unwanted weedy plant species. Many of these acres are now seeded to introduced cool-season grass and legume species which are often invaded by noxious weeds requiring extensive mowing or herbicide treatment programs. These management techniques are expensive and can also result in additional water quality problems where herbicides are used extensively.

Managing or re-seeding these acres to promote native grasses, legumes, and forbs offers a low cost environmentally sound approach to roadside vegetation management. Herbicide use, soil erosion, and most mowing can be reduced significantly where a vigorous native grass, legume, and forb mixture dominates a roadside right-of-way. In addition, these goals are consistent with on-going NRCS programs designed to improve ground and surface water quality, reduce soil loss and increase wildlife habitat.

Problem:

Many adapted native species are either currently not commercially available or available only in very limited quantities. When native species are available, the origin is often from considerable distance away and adaptation can be a concern. The species that are available are often as a ‘variety’ that has been developed for pasture and hay. These are generally high forage producing and more vigorous than wild collections of seed that have not been through an evaluation and breeding program. Seed of local origin that have not been improved or selected for superior forage yield is more likely to remain in a prairie mixture without crowding out other species and becoming monoculture. There is a need for additional native grass, legume, and forb species for use in roadside and other types of conservation plantings.

Objective:

The objective of this study is to accelerate the collection and increase of selected native grass, legume, and forb species through a cooperative program between the University of Northern Iowa (UNI), USDA Natural Resources Conservation Service (NRCS), and the Iowa Roadside Integrated Vegetation Management Program (IRVM).

Cooperators:

The USDA Natural Resources Conservation Service, Plant Materials Center; the University of Northern Iowa; and the Integrated Roadside Vegetation Management Office.

Procedures:

The state of Iowa was divided into three zones: North, Central, and South (Table #1). Seed collected from within each zone was kept separate from the other zones. The IRVM office organized seed collections from each zone. Collections were made from native prairie remnants throughout each zone striving for a relatively equal and representative collection. Seed from each collection site was inventoried by location and a small portion was started in the greenhouse at UNI and transplanted into plots. The remainder of the seed was sent to the PMC, cleaned, and seeded for increase plots. Seed from the plots at UNI was hand harvested and also used to start increase plots or mixed with additional seed and became available to seed growers. When enough seed becomes available, the species is released as 'Source Identified' germplasm from the zone in which it was collected. Source identified seed has not been improved by evaluation and selection or plant breeding procedures.

Discussion:

The study officially started October 1, 1990, at the beginning of fiscal year 1991 with agreements signed. Seed collections had started earlier in the year and seed was available for increase plots the spring of 1991. Most of the plots started from 1991 to 1993 were destroyed in the flood the summer of 1993. Plant re-establishment started in 1994 and new plots have been started each year.

2000

New increase plots established in 2000 were *Liatris asper*, rough blazing star; *Monarda fistulosa*, horsemint; and *Lobilia siphilitica*, great blue lobelia. Surflan was used for weed control and the horsemint was not resistant.

New plant releases for 2000 were Northern Iowa Germplasm Big Bluestem, Northern Iowa Germplasm Tall Dropseed, Northern Iowa Germplasm Roundhead Lespedeza, and Southern Iowa Germplasm Prairie Blazing Star.

2001

There were no new plant releases through the plant materials program in 2001 but seed of previous releases was allocated to growers. Initial seed increase is now in production at the new UNI Native Roadside Vegetation Center at the University of Northern Iowa, Cedar Falls, Iowa. A new plot of Southern Iowa June grass was established at the PMC from plants started in the greenhouse. This species exhibits very slow growth and a serious problem is weed control.

2002

There were no new increase plots established in 2002. Seed production and allocation to growers continued on previously established plots.

New plant releases for 2002 were Northern, Central and Southern Iowa Germplasm New England Aster, Northern and Southern Iowa Germplasm Pale Purple Coneflower, Southern and Central Iowa Germplasm Rigid Goldenrod, and Southern Iowa Germplasm Tall Dropseed.

2003

In 2003 there were no new plantings or increases added. Production and allocations to growers continued from previously established plots. Weed control was maintained by using a non-selective herbicide in late winter/early spring on most plots, followed by a pre-emergent herbicide on all plots. Late spring and summer weed control was achieved by manual labor and selective herbicides.

There were eight new plant releases for 2003. They were Southern Iowa Germplasm Wild Burgamot (*Monarda fistulosa*), Northern, Central, and Southern Iowa Germplasm Rough Blazing Star *(Liatris aspera*), Northern Iowa Germplasm Purple Prairie Clover (*Dalea purpurea*), Central Iowa Germplasm Switchgrass (*Panicum virgatum*), Northern and Central Iowa Germplasm Junegrass (*Koelaria macanthra*). Refer to the table of contents for a complete list of PMC releases.

2004

The Iowa Ecotype Program continued to produce seed for the three different zones on the center in 2004. Although there were no new plots established and no plot increases, the PMC plans to introduce five new Iowa releases in 2005. Weed control was very similar to that of 2003, with the use of non-selective herbicide early and manual labor and selective herbicide later in the growing season. There were some plots taken out of production in 2004 because of consistently low seed production.

2005

The releases scheduled for 2005 were held off until 2006 because there was a lack of available seed. Plots were maintained the same as the past two years. Unproductive plots that had a supply of seed on inventory were mowed and not maintained or harvested.

2006

In fiscal year 2006 the PMC released Central Iowa Germplasm Pale Purple Coneflower (*Echinacea pallida*), 9068612. Future releases are still planned. Each species that the PMC is working with should have a release from each of the three zones. Those releases that are not represented will be a priority for the next few years. Fiscal year 2007 is scheduled to have two releases, northern and central zones of wild bergamot, (*Monarda fistulosa*). In fiscal year 2008 and 2009 the PMC will finish out the Iowa Ecotype Program with the releases of southern zone purple prairie clover, (*Dalea purpurea*), southern zone Junegrass, (*Koeleria macanthra*), and northern and southern zones of switchgrass, (*Panicum virgatum*). The Elsberry PMC and the University of Northern Iowa cooperatively grow and have seed on hand for commercial production.

2007

The Iowa Ecotype Program had two more releases in 2007 with the release of Northern and Central Iowa Germplasm horsemint (also known as wild bergamot), *Monarda fistulosa*. There are limited quantities of seed from both zones currently available and being produced at the Elsberry PMC. More production plots are being phased out as the Tallgrass Prairie Center in Iowa continues to grow and manage more production plots. Plots at the Elsberry PMC that have been taken out of production are being mowed until needed for other uses or the plot needs to be re-established.

2008

In 2008, Iowa ecotype plots, primarily from southern collections, were maintained and harvested for seed production.

2009

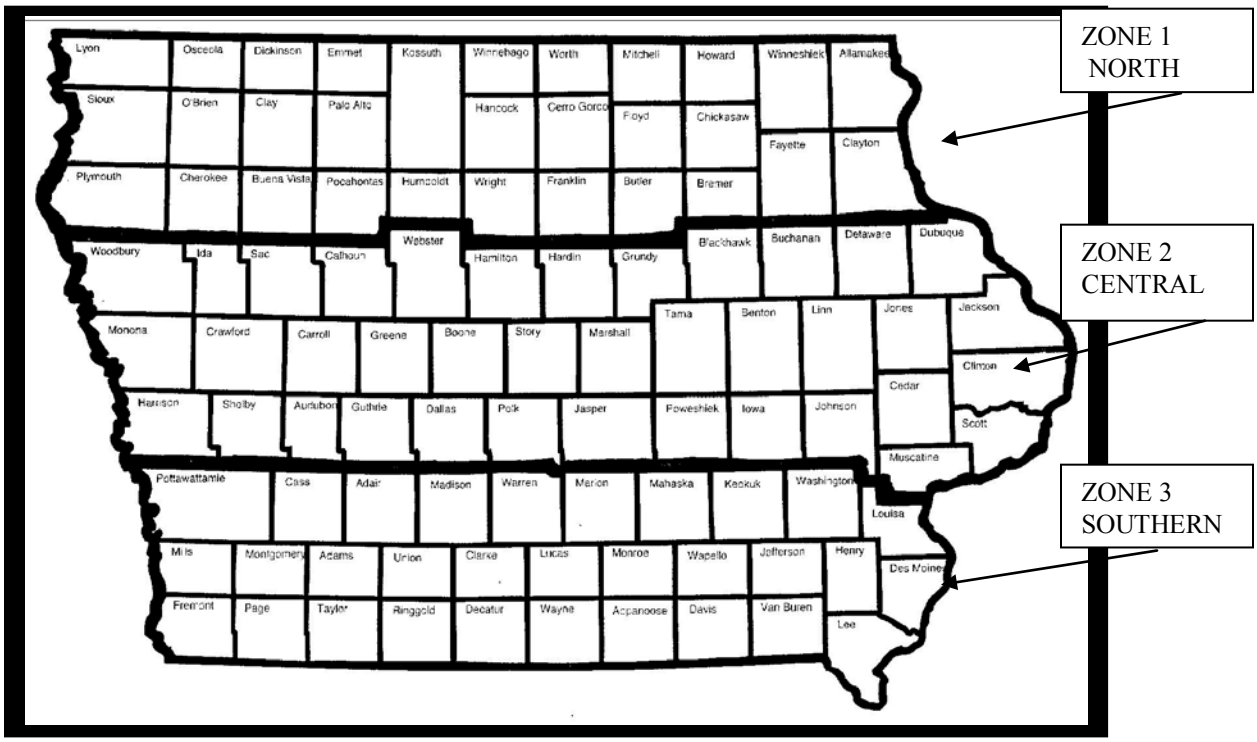
Few plots are left in production from the Iowa Ecotype Program. This past growing season only four plots were harvested for seed production. The southern zones for little bluestem and pale purple coneflower and central zones of little bluestem and prairie blazing star produced small amounts of seed and will be added to inventory. Emphasis on this program has fallen off and the PMC will continue to harvest readily available seed and hold on inventory, if there is ever a need to re-establish these stands. The Tallgrass Prairie Center, located on the campus of the University of Northern Iowa, is currently maintaining the releases from this program and has seed available to potential growers.

Ecotype Species		Iowa Geographic Zones - Year of Release		
Common Name	**Scientific Name**	**Northern**	**Central**	**Southern**
Pale Purple Coneflower	*Echinacea pallida*	2002	2006	2002
Purple Prairie Clover	*Dalea purpurea*	2003	1998	***TBD***
Switchgrass	*Panicum virgatum*	***TBD***	2003	***TBD***
Junegrass	*Koeleria macanthra*	2003	2003	***TBD***
Horsemint	*Monarda fistulosa*	2007	2007	2003
Rough Blazing Star	*Liatris aspera*	2003	2003	2003
New England Aster	*Aster novae-angliae*	2002	2002	2002
Tall Dropseed	*Sporobolus compositus*	2002	1996	2002
Stiff Goldenrod	*Oligneuron rigidum*	1998	2002	2002
Big Bluestem	*Andropogon gerardii*	2000	1998	2000
Prairie Blazing Star	*Liatris pycnostachya*	1999	1999	2000
Bushclover	*Lespedeza capitata*	2000	1996	1997
Little Bluestem	*Schizachrium scoparium*	1999	1997	1999
Rattlesnake Master	*Eryngium yuccifolium*	1998	1999	1999
Indiangrass	*Sorghastrum nutans*	1996	1996	1998
Canada Wild Rye	*Elymus canadesis*	1995	1995	1997
Oxeye False Sunflower	*Heliopsis helianthoides*	1996	1995	1997
Sideoats gramma	*Bouteloua curtipendula*	1995	1995	1995

Study: 29I124G – Native Iowa Ecotypes

TABLE #1

IOWA ECOTYPE ZONE MAP



Study: 29A137O

Study Title: Wetland/Riparian Propagation, Establishment, and Demonstration

Study Leader: Cordsiemon, R.; J. Kaiser

Introduction:
There is a growing interest in wetland restoration throughout the conservation community. Government programs, such as USDA-Wetland Reserve Program, the USFWS Partners for Wildlife, Wetland Restoration Program, the Missouri Department of Conservation (MDC) Private Lands Wetland Program, and private programs sponsored by Ducks Unlimited and Waterfowl USA have all focused on the need for a suitable supply of plants in wetland restoration efforts.

The increasing use of wetlands as filters in agricultural waste management and the control of non-point source pollution also indicate the need for a greater knowledge base for proper plant selection.

Understanding wetland ecosystems will require improved and increased quality of information on wetland plants and ecosystems. Innovative approaches to field management and additional training of personnel in wetland conservation and management will also be needed. Intra- and interagency coordination and information exchange among state and federal agencies will help standardize monitoring and management strategies.

Problem:
Information is largely unavailable related to the propagation, adaptation, and potential use of many of the wetland species found in the Midwest. Wetland plants of interest often have multi-use potential providing wildlife benefits, shoreline stabilization, water quality improvement, and/or aesthetic benefits. They are also needed to fulfill conservation needs resulting from increased demands in wetland development and water treatment. The ability to document this information or to observe the interaction of selected species is restricted by the availability of plants and plant communities especially under controlled conditions. Proper use of species to address conservation problems is limited by specific knowledge and technology for using these plants.

Objectives:
The objectives of the Elsberry PMC wetland study are to:

1. Provide a demonstration of various plant materials for wetland conservation and aesthetic values.
2. Provide an area for interagency research on the biology of selected wetland plants.

Discussion:

1994 – 1999

A large wetland was constructed in Field #4 on the Plant Materials Center in July 1994. Selected plant materials were planted with the intent of evaluating these plants for flood tolerance. The PMC has been working with a flood tolerant switchgrass since 1991. As a result, it was placed in this wetland for further testing along with six accessions of eastern gamagrass which were found growing in wet conditions: accessions 9078842, 9078844 and 9078843 were collected in Atchison County, Missouri, 9078845 collected in Holt County, Missouri, 9078840 collected in

Chariton County, Missouri and 9078846 was collected in Clinton County, Missouri. Local collections of bermudagrass and swamp milkweed were planted in the spring of 1998. Two collections of prairie cordgrass (Cuivre Island and Lost Creek) were also planted in this wetland. The switchgrass, eastern gamagrass and the prairie cordgrass were planted in 1997. All plants in this wetland were given time to establish prior to the beginning of the flooding operation which took place in October 1999. The wetland was flooded to a depth of 40 inches. This water remained in the wetland until early spring of 2000. Once the water is drained out of the wetland and enough time elapses for plant regrowth, evaluations on survival will take place.

The following Tables #1, #2, #3 and #4 reflect the plants' performance.

2000

Water was drained out of the wetland in segments because the drainpipe was not functioning properly. This operation started on March 21, 2000 and ended on March 30, 2000. The prairie cordgrass were the first plants to begin green up (March 30) followed by the bermudagrass planting. 'Cave-In-Rock' switchgrass sod (23 plugs) was planted on the west side of the flood tolerant switchgrass (sod) for comparison with other plant species in the wetland. On June 1, 2000, flood tolerant switchgrass was seeded in a plot 50 feet long and three feet wide. On August 9 an evaluation of the seeded flood tolerant switchgrass revealed no germination had taken place in the plot seeded on June 1. Poor germination has been experienced with this selection since 1998. There was no flooding of the wetland this fall to allow the Cave-In-Rock to get fully established. The following is a listing of percent survival of plants included in this study. The best performing plants in this study are Cuivre Island and Lost Creek collection of *Spartina pectinata*, *Tripsacum dactyloides* accessions 9078843, 9078845, and 'Pete'; and *Cynodon dactylon*. The following tables reflect the different plants' performance before and after a flooding event.

2001

The objective of the flooding was to parallel flood events that were occurring on the Mississippi River during that same time event. Began pumping turbid water into wetland on April 24, 2001 to flood the wetland to a depth of approximately 32 inches of water, which was achieved by April 27, 2001. The water was allowed to remain in the wetland for seven days. Water was then allowed to drain out of the wetland starting on April 30, 2001. All the water was drained out of the wetland by May 1, 2001. On May 8 evaluations were conducted to document re-growth after flooding. Again on June 11 a quick flooding scenario was conducted in the wetland to simulate a flash flooding event, similar to what was occurring on the Mississippi River. Thirty-four inches of turbid water was pumped into the wetland. The PMC began draining the water out of the wetland on June 15. The process of draining the water out of the wetland was completed on June 19.

The following is a listing of plant vigor ratings for each accession/variety included in this study. Plant evaluations for vigor were taken on June 21 and 26, 2001.

2002-2003

Plant performance evaluations were performed on April 24, 2002 and May 27, 2003. The wetland was not burned in 2002; however it was burned in 2003 and in previous years to remove accumulated vegetation. Flooding of the wetland began on April 29, 2002 and June 10, 2003. A total of 45 inches of water was pumped into the wetland (2002) and 42 inches in 2003 before the de-watering process began. All water was drained out of the wetland by May 17, 2002 and July 7, 2003. The plants were under water for 17 days in 2002 and 22 days in 2003. Once all the water was drained out of the wetland, follow-up evaluations took place on June 2002 and August 2003. The flood event in 2003 was to inundate the site for more than 20 days to test the switchgrass, *Panicum virgatum.* Table #4 reflects the plant performances during 2003 before and after the flood event. Previous years' plant performances can be found on Tables #1 - #3.

2003-2004

Switchgrass, *Panicum virgatum,* accessions 9062193, 9062235, 9083170 were compared to Cave-In-Rock. The percent was 76%, 77%, and 78% survival compared to Cave-In-Rock at 65%. The composite 9083170 Flood Tolerant switchgrass is the next generation of the three accessions 9062193, 9062235, and 9083170 which did perform from seed that was planted in 2000. Vigor was slow with only 20% stand the first growing season. Flood events occurred in 2001, 2002, and 2003 with the stand increasing in density to 85% by spring of 2004.

Prairie cordgrass, *Spartina pectina,* accessions 9083166 Cuivre Island and 9083167 Lost Creek planted on the 3'X 3' grid was a solid block in two growing seasons. The cordgrass planted on the 10'x 10' grid was a solid block in six growing seasons. The vegetative spread averaged 1.5 feet during a growing season. The flooding events did enhance the plants' ability to flourish and produce seed that spread seedlings in the wetland cell.

Virginia wildrye, *Elymus virginicus,* accession 9083169 Cuivre River was vegetatively transplanted in 2001. In the flood event of early spring 2002 there was 100% survival of the plants; however the flood event of 2003 late spring to early summer did result in a decline in the plants with 47% survival by spring 2004. Many seedlings were observed that came from seed in the soil that developed fall 2003 and spring 2004.

2004

The wetland cell was not burned and there was no flooding in 2004. A new block was added to the wetland for evaluation. The block contained 16 plants of low growing switchgrass, *Panicum virgatum,* erect big bluestem, and short growing big bluestem, *Andropogon gerardii*. 'Cave-In-Rock' switchgrass was added to the block as a check. The plants were transplanted from plugs grown in the greenhouse in order to get good established plants. They were evaluated for survival in October and only the low growing and 'Cave-in-Rock' switchgrasses were needed; three and four plants respectfully. The block will be flooded in late April to June of 2005 and the entire wetland planting will be evaluated.

2005

In 2005 there was no activity with this study. The warm season grasses, erect big bluestem, 9083274 and short-growing known as Refuge, 9078832, and low growing switchgrass, 9083172, and Cave-in-Rock, 469228, were allowed to establish. Then control of broadleaf weeds was addressed. The flooding sequences are again planned for 2006, but with lack of help may be put off indefinitely.

2006

A re-evaluation of this study was done and a determination was made to evaluate the warm season grasses and other plants in the wetland cell if time and labor is available. A survival evaluation was done on the warm season grasses (bluestems and switchgrasses). Those plants that have died were replaced.

2007

The wetland cell was mowed and the eastern side of the cell has been cleaned and made available for new specie evaluations. There were no flooding sequences in 2007 and plants that are in the wetland cell have been maintained. Plans are to flood the cell in 2008 and simulate the flooding sequence of the Mississippi River in 2007. Evaluations will be taken for survival and regrowth after the flooding event. Potentially new flood tolerant species may be added to the study in 2008.

2008

The warm season grasses, erect (commonly called Epic) big bluestem, 9083274 and Refuge, 9078832, and low growing switchgrass, 9083172, and Cave-in-Rock, 469228, were flooded in April as the plants began to emerge. The height of each plant was between 1/2 to 3 inches. The big bluestems did not progress and the switchgrasses were slow, showing very little growth. After 14 days of inundation the water was dropped and the switchgrasses flourished. Both big bluestems were very slow to recover and did not become full plants as they had in 2007. They were very spindly. The switchgrass plants performed very well after the water was drained. Based on observations from this study, the selected big bluestem accessions would not be a beneficial plant for use in frequently flooded or wetland situations. Refer to Table #5 for plant performance.

2009

There were no evaluations performed in this study in 2009. Information for several different sedges in frequently flooded areas is of growing interest. Different sedge species from the ongoing sedge study could be a possibility for evaluation. This study will stay active on an “as needed” basis.

Study 29A1370 - Wetland Species in Wetland at Elsberry PMC							Table #1
Plugs Planted 5-2-97 (Eastern Gamagrass)							
2002 Data	**Began Flooding on 4/24/02**						
2003 Data	**Began Flooding on 6-10-03**						
	Total # Planted	**Active Growing**	**Weed Comp.**	**Disease/ Insect**	**Developed Seed Head**	**Vigor**	**Ave. Ht.**
Eastern Gamagrass 9078840 Chariton, Missouri. 5' spacing, planted 5/2/97.							
						25 plants planted	
Dates Evaluated							
7/9/1998	20	20	severe	moderate	yes	good	2'5"
9/29/1999	20	20	moderate	light rust	yes	good/exc	3'5"
5/11/2000	19	17	moderate	moderate	none	poor	6"
9/19/2000	13	13	mod/sev	light rust	none	good	2'5"
6/26/2001	20	20	light	none	yes	good	3'4"
4/24/02 (BFE)	18	18	light	none	none	good	8"
6/17/02 (AFE)	15	15	light	none	yes	exc	2'
5/27/03 (BFE)	**15**	**15**	**light**	**none**	**yes**	**exc.**	**2'**
8/5/03 (AFE)	*						
Percent surviving as of 6/17/02 was 75%							
Eastern Gamagrass 9078844 Atchison, Missouri. 7' spacing, planted 5/2/97.							
						18 plants planted	
Dates Evaluated							
7/9/1998	12	12	severe	moderate rust	yes	poor	2'5"
9/29/1999	12	12	moderate	moderate rust	yes	fair	2'5"
5/11/2000	12	10	moderate	moderate	none	poor	6"
9/19/2000	12	13	severe	light rust	Yes	fair	2'
6/26/2001	12	9	light	light rust	yes	fair	2'10"
4/24/02 (BFE)	9	9	light	none	none	fair	7"
6/17/02 (AFE)	9	9	light	none	none	exc.	2'
5/27/03 (BFE)	*						
8/5/03 (AFE)	*						
Percent surviving as of 6/17/02 was 75%							
Eastern Gamagrass 9078842 Atchison, Missouri. 15' spacing, planted 5/2/97.							
						9 plants planted	
Dates Evaluated							
7/9/1998	5	5	severe	none	yes	fair	2'
9/29/1999	5	5	severe	none	yes	fair	2'5"
5/11/2000	5	3		none	0	poor	6"
9/19/2000	5	4	severe	none	none	fair	1'8"
6/26/2001	3	3	light	none	yes	fair	2'2"
4/24/02 (BFE)	4	4	light	none	none	fair	7"
6/17/02 (AFE)	4	4	light	none	none	exc.	2'
5/27/03 (BFE)	*						
8/5/03 (AFE)	*						
Percent surviving as of 6/17/02 was 44%							
Rating for Vigor: 1=Excellent; 9=Poor							
Rating for Weed Competition and Dis/Insect: 1=Excellent; 9=Severe							
*** = Cannot determine rows of plants**							

Study 29A1370 - Wetland Species in Wetland at Elsberry PMC						Table #1-continued	
	Total # Planted	Active Growing	Weed Comp.	Disease/ Insect	Developed Seed Head	Vigor	Ave. Ht.
Eastern Gamagrass 9078846 Clinton, Missouri. 8' spacing, total planted 5/2/97.							
						16 plants planted	
Dates Evaluated							
7/9/1998	11	11	severe	none	yes	good	2'
9/29/1999	11	11	moderate	none	yes	good	2'5"
5/11/2000	8	8	moderate	none	none	poor	7"
9/19/2000	10	10	severe	light rust	none	fair	2'
6/26/2001	8	8	light	light rust	yes	good	3'2"
4/24/02 (BFE)	10	10	light	none	none	good	8"
6/17/02 (AFE)	10	10	light	none	yes	exc.	2'6"
5/27/03 (BFE)	*						
8/5/03 (AFE)	*						
Percent surviving as of 6/17/02 was 63%							
Eastern Gamagrass 9078843 Atchison, Missouri. 15' spacing, planted 5/2/97.							
						9 plants planted	
Dates Evaluated							
7/9/1998	13	13	severe	none	yes	poor	2'5"
9/29/1999	13	13	moderate	none	yes	moderate	3'
5/11/2000	5	5		none	none	poor	7"
9/19/2000	10	10	severe	slight rust	none	fair	2'
6/26/2001	4	4	light	light	none	fair	2'6"
4/24/02 (BFE)	4	4	light	light	none	fair	8"
6/17/02 (AFE)	4	4	light	light	none	good	2'
5/27/03 (BFE)	*						
8/5/03 (AFE)	*						
Percent surviving as of 6/17/02 was 44%							
Eastern Gamagrass 9078845 Holt, Missouri. 8' spacing, planted 5/2/97.							
						16 plants planted	
Dates Evaluated							
7/9/1998	12	12	severe	none	yes	good	3'5"
9/29/1999	12	12	severe	none	yes	good	3'
5/22/2000	12	9	severe	none	none		8"
9/19/2000	16	16	severe	slight rust	yes	good	2'5"
6/26/2001	10	10	light	none	yes	good	3'2"
4/24/02 (BFE)	10	10	light	none	none	good	8"
6/17/02 (AFE)	10	10	light	none	none	exc.	2'6"
5/27/03 (BFE)	*						
8/5/03 (AFE)	*						
Percent surviving as of 6/17/02 was 63%							
Rating for Vigor: 1=Excellent; 9=Poor							
Rating for Weed Competition and Dis/Insect: 1=Excellent; 9=Severe							
BFE - Before Flooding Event							
AFE - After Flooding Event							
*** = Cannot determine rows of plants**							

Study 29A1370 - Wetland Species in Wetland at Elsberry PMC						Table #1-continued	
Eastern Gamagrass 9078845 Holt, Missouri 8' spacing, planted 5/2/97							
	Total Plant #	**Active Growing**	**Weed Comp.**	**Disease/ Insect**	**Developed Seed Head**	**Vigor**	**Ave. Ht.**
Pete Eastern Gamagrass 5' spacing, 25 total planted 5/2/97.							
						25 plants planted	
Dates Evaluated							
7/9/1998	21	21	severe	light	21/21	good	3' 5"
9/29/1999	21	21	severe	light	21/21	good	3'
5/11/2000	21	20		light		fair	10"
9/19/2000	21	21	severe	light rust	17/21	exc.	3'
6/26/2001	19	19	light	none	none	exc.	4'4"
4/24/02 (BFE)	19	19	light	none	none	exc.	8"
6/17/02 (AFE)	14	14	light	none	yes	exc.	2'
5/27/03 (BFE)	*						
8/5/03 (AFE)	*						
Percent surviving as of 6/17/02 was 56%							
BFE - Before Flooding Event							
AFE - After Flooding Event							
Rating for Vigor: 1=Excellent; 9=Poor							
Rating for Weed Competition and Dis/Insect: 1=Excellent; 9=Severe							
*** = Cannot determine rows of plants**							
.							

Study 29A1370 - Wetland Species in Wetland at Elsberry PMC							**Table #2**
Plugs Planted 6-24-97 (Flood Tolerant Switchgrass)							
2002 Data: Flood Event from 4/29/02 to 5/17/02							
2003 Data: Flooding began 6/10/03							
	% Cover/ Plant #	**Active Growing**	**Weed Comp.**	**Disease/ Insect**	**Developed Seed Head**	**Vigor**	**Ave. Ht.**
Switchgrass 9062213 3' spacing, 41 total planted (plugs) 6/24/97.							
Dates Evaluated							
7/9/1998		35 plants	moderate	none	all plants	poor/fair	2'
9/29/1999		35 plants	moderate	none	all plants	fair	2' 5"
4/26/2000		35 plants	moderate	none	none	exc.	5" regrowth
9/19/2000	85% row	35 plants	moderate	none	all plants	exc.	4'5"
6/26/2001		33 plants	light	none	none	exc.	3' 4"
4/24/02 (BFE)		31 plants	light	none	none	good	6"
6/17/02 (AFE)		31plants	light	none	none	exc.	2' 6"
5/27/03 (BFE)		**32 plants**	**light**	**none**	**none**	**exc.**	**1' 7"**
8/5/03 (AFE		**32 plants**	**light**	**none**	**none**	**good**	**2' 5"**
Percent surviving as of 6/17/02 was 76%							
Switchgrass 9062235 4' spacing, 31 total planted (plugs) 6/24/97.							
Dates Evaluated							
7/9/1998		22 plants	moderate	none	all plants	poor/fair	5' 5"
9/29/1999		22 plants	moderate	none	all plants	fair	5'
4/26/2000		26 plants	moderate	none	none	exc.	6' 5"
9/19/2000		26 plants	moderate	none	All plants	exc.	4' 5"
6/26/2001		24 plants	light	none	none	exc.	2' 9"
4/24/02 (BFE)		20 plants	light	none	none	good	6"
6/17/02 (AFE)		20 plants	light	none	none	good	2'
5/27/03 (BFE)		**23 plants**	**light**	**none**	**none**	**exc.**	**1' 8"**
8/5/03 (AFE)		**23 plants**	**light**	**none**	**none**	**good**	**2' 9"**
Percent surviving as of 6/17/02 was 65%							
Switchgrass 9062193 5' spacing; 25 total planted (plugs) 6/24/97.							
Dates Evaluated							
7/9/1998		17 plants	moderate	none	all plants	fair	3' 5"
9/29/1999		17 plants	moderate	none	all plants	good	4' 5"
4/26/2000		21 plants	moderate	none	all plants	exc.	6' 5"
9/19/2000		21 plants	moderate	none	all plants	exc.	5'
6/26/2001		20 plants	light	none	none	exc.	3' 6"
4/24/02 (BFE)		16 plants	light	none	none	good	5"
6/17/02 (AFE)		14 plants	light	none	none	exc.	2' 6"
5/27/03 (BFE)		**19 plants**	**light**	**none**	**none**	**exc.**	**1' 5"**
8/5/03 (AFE)		**19 plants**	**light**	**none**	**none**	**good**	**2' 8"**
Percent surviving as of 6/17/02 was 56%							
BFE - Before Flooding Event							
AFE - After Flooding Event							
*** = Cannot determine rows of plants**							

Study 29A1370 - Wetland Species in Wetland at Elsberry PMC						Table #2 - continued	
	% Cover/ Plant #	Active Growing	Weed Comp.	Disease/ Insect	Developed Seed Head	Vigor	Ave. Ht.
Evaluation Dates:		4/24/02 & 6/17/02					
Cave-In-Rock Switchgrass 23 plants planted.							
Dates Evaluation							
4/18/2000	23	23	severe	none	none	good	5"
9/19/2000	9	growing	severe	none	yes	poor	2'
		weak					
6/21/2001	21	21	light	light	none	good	2' 6"
4/24/02 (BFE)	10	10	light	none	none	good	8"
6/17/02 (AFE)	12	12	light	light	none	good	2' 6"
5/27/03 (BFE)	**16**	**16**	**light**	**light**	**none**	**good**	**1' 5"**
8/5/03 (AFE)	**16**	**16**	**light**	**light**	**none**	**fair**	**2' 6"**
Percent surviving as of 6/17/02 was 52%							
Flood Tolerant Switchgrass, seeded 50' row plus 3' wide.							
Dates Evaluated							
Seeded 6/1/00 50' x 40" plot - .0038 ac. Rate 6# PLS/ac.							
9/19/2000	15%-	fair	moderate	none	6/5 5%	good	8"
	20% of						
	50' row						
6/21/2001	22	22	light	none	none	exc.	3'
4/24/02 (BFE)	16	16	light	none	none	good	5"
6/17/02 (AFE)	33	33	light	none	none	good	1' 6"
5/27/03 (BFE)	**45%**	**45%**	**light**	**none**	**none**	**good**	**1' 6"**
8/5/03 (AFE)	**45%**	**45%**	**light**	**none**	**none**	**good**	**2' 5"**
Flood tolerant switchgrass plugs block, 63 plants planted 5/25/99.							
Dates Evaluated							
4/26/2000	92%	58 plants	none	none	6/5 100%	exc.	6' 5"
9/19/2000	95%	95%	none	none	6/5 100%	exc.	4' 5"
6/21/2001	80%	66 plants	light	none	none	exc.	3'
4/24/02 (BFE)	85%	66 plants	light	none	none	good	6"
6/17/02 (AFE)	85%	66 plants	light	none	none	good	2'
5/27/03 (BFE)	**85%**	**66 plants**	**light**	**none**	**none**	**good**	**1' 3"**
8/5/03 (AFE)	**85%**	**66 plants**	**light**	**none**	**none**	**fair**	**2' 2"**
Bermudagrass block plugs, planted 5/25/99.							
Dates Evaluated							
9/28/1999	35%	100%	light	none	50%	exc.	3"
4/26/2000		100%	light	none	none	exc.	3-5"
9/19/2000	100%	100%	light	none	100%	exc.	9"
6/21/2001	100%	100%	none	none	none	exc.	6"
4/24/02 (BFE)	100%	50%	none	none	none	good	2"
6/17/02 (AFE)	90%	90%	none	none	none	good	3"
5/27/03 (BFE)	**100%**	**100%**	**none**	**none**	**none**	**fair**	**1"**
8/5/03 (AFE)	**100%**	**100%**	**none**	**none**	**none**	**fair**	**1"**
BFE = Before Flood Event							
AFE = After Flood Event							

Study 29A1370 - Wetland Species in Wetland at Elsberry PMC						Table #2 - continued			
	% Cover/ Plant #	Active Growing	Weed Comp.	Disease/ Insect	Developed Seed Head	Vigor	Ave. Ht.		
Swamp milkweed block 8 rows plugs, 1' center planted 5/25/99.									
Dates Evaluated									
9/28/99	8 plants		severe foxtail	none	none	poor	9"		
5/11/2000	46 plants		moderate	none	none	poor	8"		
9/19/2000	30%	30%	moderate	none	30%	fair	1' 2"		
6/26/2001	54	54	light	none	none	good	2' 2"		
4/24/02 (BFE)	No plants observed; heavy mulch cover of weeds								
6/17/02 (AFE)	41	41	light	none	none	good	1'		
5/27/03 (BFE)	**50**	**50**	**light**	**none**	**none**	**good**	**1' 3"**		
8/5/03 (AFE)	**50**	**50**	**light**	**none**	**none**	**fair**	**1' 7"**		
Cardinal flower, planted 8 plants on 4/17/01 and on 5/1/01									
4/24/2001	BFE		8	none	8	good	2"		
5/8/2001	AFE		8	none	8	good	3"		
6/11/2001	BFE		16	none	16	good	10"		
6/26/2001		7	moderate	none	none	poor	10"		
4/24/02 (BFE)		19	none	none	none	exc.	1' 1"		
6/17/02 (AFE)		19	none	none	none	good	2'		
5/27/03 (BFE)		**11**	**light**	**none**	**none**	**good**	**7"**		
8/5/03 (AFE)		**8**	**light**	**none**	**none**	**poor**	**1' 6"**		
BFE - Before Flooding Event									
AFE - After Flooding Event									

Study 29A1370 - Wetland Species in Wetland at Elsberry PMC							**Table #3**	
Prairie Cordgrass								
2002 Data: Flood Event from 4/29/02 to 5/17/02								
2003 Data: Flooding Began 6/10/03								
	Total # Planted	**Active Growing Spreading**	**Weed Comp.**	**Disease/ Insect**	**Developed Seed Head**	**Vigor**	**Ave. Ht. Seed Head**	**Average Forage Height**
							10' x 10'	
Prairie Cordgrass Collection, planted 9/29/97							3 | 2 | 1	
East →							6 | 5 | 4	
							9 | 8 | 7	
7/9/1998	9	6" average	severe	none	NA	exc.	-	-
8/1/1999	9	30" average	moderate	none	9/9	good	-	-
9/19/2000	9	4'.5" ave.	none	none	9/9	exc.	6'.5"	5'.0 forage
6/21/2001	9	6'	light	none	none	exc.	6'	45"
4/24/02 (BFE)	9	7.5'	light	none	none	exc.	none	17"
6/17/02 (AFE)	9	8'	light	none	none	exc.	none	36"
5/27/03 (BFE)	**9**	**8.5'**	**light**	**none**	**none**	**exc.**	**none**	**30"**
8/5/03 (AFE)	**9**	**8.5'**	**light**	**none**	**none**	**exc.**	**6.5'**	**40"**
Percent surviving as of 6/17/02 was 100%								
Cuivre Island Prairie Cordgrass Collection, planted 5/15/98					↑		3' x 3'	
					North		4 |3 | 2| 1	
							8 | 7| 6| 5	
7/9/1998	8	5.'5"	severe	none	6 plants	good/exc.	4'.0"	4'.0"
5/25/1999	8	1'.5" each	moderate	none	none	exc.	none	
		direction						
Lost Creek Prairie Cordgrass Collection, planted 5/15/98							3'x3'	
							12|11|10|9	
							16|15|14|13	
7/9/1998	8	6"	severe	none	4 plants	good/exc.	4'.0"	4'.0"
5/25/1999	8	1'.5" each	moderate	none	none	exc.	none	
		direction						
9/19/2000								
Total block for both collections			none	none	35%	exc.	6' 0"	5' 0"
								More lodging Cuivre
								Island collection
9/19/2000								
14' x 13'5" total spread of blocks			none	none	35%	exc.	6'.0"	More lodging Cuivre
								Island collection
9/19/2000								
3' x 3' block is filled in total								
prairie cordgrass			none	none	35%	exc.	6'.0"	More lodging Cuivre
								Island collection
6/26/2001		solid	none	none	none	exc.	6',0"	50"
4/24/02 (BFE)		80%	none	none	none	exc,	15"	
6/17/02 (AFE)		solid block	none	none	none	exc.	48"	
5/27/03 (BFE)		**solid block**	**none**	**none**	**none**	**exc.**	**none**	**29"**
8/5/03 (AFE)		**solid block**	**none**	**none**	**none**	**exc.**	**6.5'**	**42"**
BFE - Before Flooding Event								
AFE - After Flooding Event								

Study: 29A1370 - Wetland/Riparian Propagation, Establishment, and Demonstration

Table #4

Genus/Species	Common Name	Accession No.	Vigor Rating BFE	Vigor Rating A FE	Date of Rating BFE	Date of Rating A FE
Tripsacum dactyloides	Eastern gamagrass	9098840	*	*	5/27/03	8/5/03
Tripsacum dactyloides	Eastern gamagrass	9078844	*	*	5/27/03	8/5/03
Tripsacum dactyloides	Eastern gamagrass	9078842	*	*	5/27/03	8/5/03
Tripsacum dactyloides	Eastern gamagrass	9078846	*	*	5/27/03	8/5/03
Tripsacum dactyloides	Eastern gamagrass	9078843	*	*	5/27/03	8/5/03
Tripsacum dactyloides	Eastern gamagrass	9078845	*	*	5/27/03	8/5/03
Tripsacum dactyloides	Eastern gamagrass	Pete	*	*	5/27/03	8/5/03
Panicum virgatum	Switchgrass	9062193	Exc.	Good	5/27/03	8/5/03
Panicum virgatum	Switchgrass	9062235	Exc.	Good	5/27/03	8/5/03
Panicum virgatum	Switchgrass	9062213	Exc.	Good	5/27/03	8/5/03
Panicum virgatum	Switchgrass	C-I-R	Good	Fair	5/27/03	8/5/03
Panicum virgatum	Switchgrass Direct Seeded 2001	9083170 Flood-Tolerant	Exc.	Good	5/27/03	8/5/03
Spartina pectinata	Prairie cordgrass	Cuivre Island	Exc.	Exc.	5/27/03	7/5/03
Spartina pectinata	Prairie cordgrass	Lost Creek	Exc.	Exc.	5/27/03	7/5/03
Cynondon dactylon	Bermuda grass	Elsberry	Fair	Fair	5/27/03	7/5/03
Asclepias incarnata	Swamp milkweed	Iowa	Good	Fair	5/27/03	7/5/03
Lobelia cardinalis	Cardinal flower	Forrest Keeling	Good	Poor		7/5/03
Carex scoparia	Broomsedge	MDC	Died			7/5/03
Elymus virginicus	Virginia Wildrye	Cuivre River	Fair	Top Growth Died	5/27/03	7/5/03
Spartina pectinata	Prairie cordgrass Seedlings		Exc.	Exc.	5/27/03	7/5/03
Panicum virgatum	Plugs of switchgrass	9062213 9062235 9062193	Good	Fair	5/27/03	7/5/03

BFE = Before Flood Event **AFE = After Flood Event**

- **= Cannot determine rows from plants/seed that germinated**

Study: 29A1370 - Wetland/Riparian Propagation, Establishment, and Demonstration

Table #5

Genus/Species	Common Name	Accession No.	Vigor Rating		Date of Rating	
			BFE	A FE	BFE	A FE
Andropogon gerardii	**Epic Big Bluestem**	9083274	Exc.	Fair	4/14/08	5/5/08
Andropogon gerardii	**Refuge Big Bluestem**	9078832	Exc.	Fair	4/14/08	5/5/08
Panicum virgatum	**Low Growing Switchgrass**	9083172	Exc.	Exc.	4/14/08	5/5/08
Panicum virgatum	**Cave-in-Rock Switchgrass**	469228	Exc.	Exc.	4/14/08	5/5/08

BFE = Before Flood Event **AFE = After Flood Event**

- **= Cannot determine rows from plants/seed that germinated**

Study: 29I141G

Study Title: Assembly and Evaluation of Little Bluestem, *Schizachyrium scoparium*, Nichx.

Study Leader: Bruckerhoff, S. B.

Introduction:

Little bluestem is a native warm season prairie grass. It was a major component making up as much as 50 percent of the tall grass prairie that was native to much of the Elsberry PMC service area. It can also be a major component of glade areas and mixed grass prairies. Little bluestem can be found in prairies, open woods, dry hills, and fields, from Quebec and Maine to Alberta and Idaho, south to Florida and Arizona.

Problem:

There are no current varieties of little bluestem on the market that have an origin within the three-state service area. Available varieties do not always perform as well as expected. There is a need for an adapted and improved variety of little bluestem for pasture and range seedings, surface mine reclamation, critical area planting, wildlife plantings, recreational area development and other conservation uses in Missouri, Iowa, and Illinois.

Objective:

The objective is to assemble, evaluate, develop and cooperatively release an adapted variety and/or varieties of tested class of little bluestem for conservation use in Missouri, Iowa, and Illinois.

Procedure:

Vegetative material from native ecotypes was collected throughout the states of Missouri, Iowa, and Illinois. A minimum of three collections per Major Land Resource Area/state was requested. (Approximately 60 collections total.) Field selection of collected plant material was based on forage quantity and plant vigor.

Each collection (accession) was one individual plant. A collection was made up of more than one plant if they were in the same immediate area (within five feet) and appeared to be clones of each other.

Discussion:

1996

The study was approved in July 1996. Collection instructions were sent out and plants were dug in October and November. The samples were picked up shortly after collection and stored in the packing shed at the Plant Materials Center. At this time we received 113 collections from the three-state area. There are a few additional collections expected.

1997 - 1998

The collections were vegetatively propagated in containers in January and grown out in the greenhouse until April. These plants were then transplanted in Field #1 on the PMC April 22-24, 1997 in a randomized complete block with four replications (see Table #2 for map of plot layout). Thirteen additional collections were made in the summer of 1997 and planted into the replications August 14-15, 1997. This brought the total accessions represented to 130: 79 from Missouri, 20 from Illinois, 27 from Iowa, and four standards of comparison. A list of collectors can be seen in

Table #1. First year evaluation consisted of survival. The second year evaluations consisted of survival, height, late dormancy, and form.

1999

The assembly was evaluated in 1999 for forage amount and vigor (Tables #3 and #4). The higher rated plants will have forage quality samples taken in 2000.

2000

The assembly was evaluated for mid season forage production, quality and vigor on June 27, 2000. The entire planting was then clipped to a height of six inches on June 28, 2000. The assembly was evaluated for amount of regrowth and vigor on July 25, 2000 and forage quality samples were taken on August 1, 2000. The assembly was clipped the second time on August 2, 2000 and evaluations for regrowth amount and vigor were taken October 24, 2000.

2001

Evaluations from previous years were correlated and the best plants from the top 10-20 percent of the total accessions were propagated in the greenhouse from clonal material from each individual plant. Plants were then isolated in two locations. A northern region was established containing plants from Iowa, northern Missouri, and northern Illinois. A southern region was established containing plants from southern Missouri and central and southern Illinois. These isolation blocks will receive additional evaluation to remove unwanted plants and the remaining plants will be allowed to produce seed. Plants from this seed will be selected for the next evaluation nursery. After further evaluation, plants from the nursery planted in 2003 will be used as a breeder's block for improved selections. Plants selected for each region can be found in Table #5.

2002

The south region crossing block did very well in 2002. Very few plants were rouged out and seed was harvested from each accession in the block. This seed will be used to establish the next evaluation nursery scheduled for 2003.

The north region crossing block did not do well in 2002. Weed control became a problem and many of the plants were reestablished and did not make seed. Filling in additional plants is scheduled for 2002 and also seed production from this crossing block.

2003

Seed from the south region crossing block was evaluated for quick establishment and plants were grown in the greenhouse for establishment of the recurrent selection evaluation nursery. Approximately 500 plants were transplanted on three foot centers in this evaluation block.

The plants will be allowed to develop and be evaluated for forage. Plants in the north region crossing block were not all equally matured and no seed was harvested from this block.

2004

The plants in the southern region evaluation block were given 2004 to develop and mature. Evaluation of this block will begin in 2005.

Seed was harvested from the northern region crossing block, cleaned, and planted in the greenhouse. These plants were evaluated for quick establishment and seedling vigor. Selected plants will be transplanted into an evaluation nursery.

2005

The plants in the southern region nursery were evaluated based on vigor, amount of forage production, leafiness, drought resistance, disease and insect resistance, and late maturity. Of

312 plants 195 plants were selected (62.5%) and allowed to cross pollinate. Seed was collected from the selected plants to establish a foundation field next year. This south region selection was given the accession number 9083271.

Greenhouse plants selected for seedling vigor from seed harvested from the northern crossing block were transplanted into an evaluation nursery.

2006

A .75 acre foundation field (G1) of southern region selection (accession 9083271) was planted in field #12 on the PMC. Establishment was good but no seed was harvested the first year. Some plants did produce seed but there was not enough to justify a harvest.

The northern region crossing block was evaluated for survival and missing plants were reestablished with greenhouse plants selected for seedling vigor. This evaluation nursery had no further evaluation or selection.

2007

The southern region selection (accession 9083271) G0 block (field 11) was harvested in 2007 but seed was very limited. This seed was used to expand the foundation (G1) field (Field 12). The small expanded portion of the field established poorly. The larger part of the G1 field produced 58.9 pounds bulk seed from approximately 0.60 acre. This seed will be used for field plantings for additional testing.

The northern region crossing block was evaluated for forage production, seed production and late maturity. This block started with 506 plants with a survival of over 95%. There were 159 of these selected and allowed to cross pollinate. Seed was harvested individually from the 159 and will be placed in the germinator and plants germinating the quickest will go to the next evaluation block.

2008

The southern region selection (accession 9083271) of little bluestem, G0 block (field 11) was harvested in 2008 and produced 11.1# bulk seed. Seed was very limited. This seed will be used to establish a new foundation (G1) plot in field 7 because the original increase plot in field 12 has to much indiangrass contamination from the adjoining plot. The G1 plot in field 12 produced 107.6 pounds bulk seed from approximately 0.60 acre. This seed will be used for field plantings for additional testing.

The northern region crossing block (Cycle 2) of little bluestem was again evaluated for forage production, seed production and late maturity. The top 20 individual plants were selected and allowed to cross pollinate. Seed was harvested individually from the 20 plants and placed in the germinator and the plants that germinated the quickest were added to the next block (Cycle 3, Breeders Block at FKN).

2009

The southern region selection (accession 9083271) of little bluestem, G0 block (field 11) was harvested in 2009 and produced 16.4# bulk seed. This seed will be used to enlarge the foundation (G1) plot in field 7 that was planted in 2009 but did not produce seed the first year. The G1 plot in field 12 produced 58.1# bulk seed from approximately 0.60 acre. This seed will be allocated to seed growers interested in producing the new release in 2010.

The northern region crossing block (Cycle 2) of little bluestem was again narrowed to the top 20 plants again and allowed to cross pollinate. Seed was harvested individually from the 20 selections and placed in the germinator and the plants that germinated the quickest were added to the Cycle 3, Breeders Block at FKN. Undesirable plants in this block were rouged out.

Study No. 29I142G

Study Title: Production of Native Missouri Ecotypes of Grasses, Legumes and Forbs for Roadsides, Critical Areas, and All Other Vegetative Plantings Where Native Plants are Now Being Planted.

Study Leader: Cordsiemon, R.C.

Introduction:

Well-adapted native grass, legume and forb plantings offer many advantages as a low cost sustainable vegetative cover for management of soil and water resources. Native plant communities resist noxious weed invasion, provide excellent erosion control, and generally require relatively low maintenance.

These characteristics make native plants an excellent selection for use in roadside plantings, wildlife habitat enhancement, long-term land retirement programs, public land and all other vegetative plantings where mono-cultures of grasses are presently being planted. This is especially true along public transportation corridors that constitute a major land resource and management problem in the state of Missouri. Based on 1987 National Resource Inventory (NRI) data, over one million acres of Missouri land are devoted to rural transportation. Other federal and state agencies also own a significant land base in Missouri.

Proper vegetation management along these corridors is an important element in controlling soil loss and unwanted weedy plant species. Many of these acres are now seeded to introduce cool-season grass and legume species which are often invaded by noxious weeds requiring extensive mowing or herbicide treatment programs. These management techniques are expensive and can also result in additional water quality problems where herbicides are used extensively.

Managing or reseeding these acres to promote native grasses and forbs offers a low cost environmentally sound approach to roadside vegetation management. Herbicide use, soil erosion, and most mowing can be reduced significantly where a vigorous native grass and forb mixture dominates a roadside right-of-way. In addition, these goals are consistent with on-going NRCS programs designed to improve ground and surface water quality, reduce soil loss and increase wildlife habitat.

Problem:

Many adapted forb, legume and grass species of native origin are either currently not commercially available or available only in very limited quantities, which make them very expensive. Species that are available are often varietal releases that have undergone an evaluation and selection process or a plant-breeding program. Most varieties are designed for high forage production and are highly vigorous plants. They are generally excellent for pasture and hay production but can be too domineering for diversified mixtures. Their origins are often not from within the state in which they are being planted. There is a need for additional native species for use on public lands and other types of conservation plantings with origins close to where they are being planted.

Objective:

The objective of this study is to accelerate the availability of selected native grass, legume and forb species.

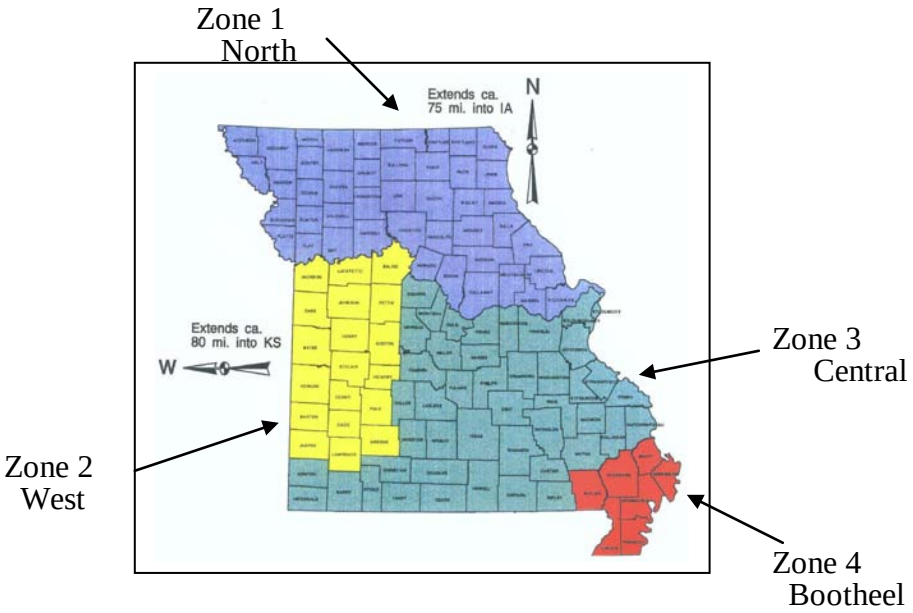
Cooperators:

The Missouri Department of Conservation (MDC), USDA Natural Resources Conservation Service (NRCS), Plant Materials Center (PMC), the University of Missouri at Columbia, Missouri (UMC), and the National Audubon Society-Audubon Missouri (NAS).

Procedures:

The state of Missouri was divided into four zones: Northern Glaciated Plains, Zone #1; Western Prairie, Zone #2; Ozarks, Zone #3; and the Bootheel Region, Zone #4 (See Table #1). Plant materials were collected as seed by the study coordinator, selected personnel from USDA-NRCS, MDC, UMC, and other knowledgeable interested persons. Collections were made from prairie remnants throughout each zone striving for a relatively equal and representative sample. Large collections from one site were not allowed to dominate the mixture from throughout the zone. Seed from each collection site was inventoried by location. Seed collected from within each zone was kept separate from the other zones. Increase plots were and will be established, as seed becomes available. Each species will be released as 'Source Identified' germplasm from the zone in which it was collected. Evaluation and selection or plant breeding procedures has not improved 'Source Identified' seed.

Table #1



Discussion:

1997

The Missouri Ecotype Enhancement Program was officially started as a plant materials study with the signing of the study plan in December of 1997. This plan is an agreement between cooperators and funded by a grant from the MDC. Several meetings preceded the document signing that included MDC, NRCS, UMC, Department of Transportation, Missouri Department of Natural Resources, and other interested individuals.

The initial grant from MDC to UMC was received July 1997 and a program coordinator was hired by UMC in September 1997 to work at the Elsberry Plant Materials Center.

1998

A grant was given to UMC once again by MDC that would fund the program through August of 1999. Goals were established for 1998 collections. Some species from 1997 were recollected and new species were added.

1999

The Missouri Ecotype program continued during 1999 and the species released listed in Table #2. Beginning in September, the Lincoln County Soil and Water Conservation District took over as the administrator for the Missouri Ecotype Program replacing UMC. MDC funded the program for the 1999-2000 fiscal year.

2000

The Missouri Ecotype program continued through August until funding was depleted. The program was continued under direction of Missouri Audubon Society and MDC in cooperation with the NRCS Plant Materials Center.

2001

The Missouri Ecotype program is growing increase plots at Elsberry and also at the Charles Green Conservation area near Ashland, Missouri.

2002

MDC took over as administrator of this study and is currently still funding the program with the aid of grants. The Missouri Ecotype program is continuing to increase plots at the Elsberry PMC and Green Conservation Area. New collections are being made of both old and new species.

2003

MDC is continuing to administrate the Missouri Ecotype program. All plots are still in production and seed is being allocated. The PMC is planning to increase plots for seed production in 2004.

2004

In the spring of 2004, the plots of zones 1 and 2 sideoats gramma, *Bouteloua curtipendula*, and zone 1 river oats, *Chasmanthium latifolium*, were increased for seed production. There were no

new releases from the Missouri Ecotype Program in 2004 and there are no releases scheduled for 2005. Plans are to increase river oats-zone 1 again in 2005. Becky Erickson, Missouri Ecotype Program Coordinator, has several production plots located at the Green Conservation Area in Ashland, Missouri. The number of plots on the Green Area has increased over the past year and now sustains almost 35 different ecotypes. Plans for both the Plant Materials Center and the plots at the Green Conservation Area are to sustain the plots already established and increase the plots that display good seed production and survival. This will allow for potential releases as early as 2006.

2005

Chasmanthium latifolium, river oats from the northern zone were increased in the late summer of 2005. Plans are to increase several other better seed producing species in the spring of 2006, such as the big bluestem (northern zone), little bluestem (northern zone), sideoats gramma (northern and western zones), tall dropseed (northern and western zones), pale purple coneflower (northern and western zones), grayhead coneflower (northern zone), and Virginia wild rye (northern zone).

2006

Supplemental funding for the Missouri Ecotype Program was not extended past the agreement date of June 2007. Plans are to continue growing the species that have been previously released or have potential for high use in the commercial market. The PMC planted production plots of big bluestem (northern zone), little bluestem (northern zone), sideoats gramma (northern and western zones), tall dropseed (northern and western zones), pale purple coneflower (northern and western zones), and grayhead coneflower (northern zone) in the spring of 2006. A fall planting of Virginia wild rye (northern zone) was also planted. The plots were increased to provide more seed production and averaged ¼ to two acres in size.

2007

Production plots of sideoats grama were increased to help meet the demand for higher priority species requested by seed growers. In FY 2008, plans are to again increase these production plots. The PMC continued to put efforts into a select group of species (production species started in 2006) as they are the priority for most commercial growers interested in Missouri ecotypes. Those species are big bluestem (northern zone), little bluestem (northern zone), sideoats gramma (northern and western zones), tall dropseed (northern and western zones), pale purple coneflower (northern and western zones), and grayheaded coneflower (northern zone). Plans are to release northern Missouri sideoats grama in 2008. With growing interest in southern zone little bluestem, the Elsberry PMC will expand the production plot in 2008.

2008

The flood of 2008 dramatically affected seed production of Northern Missouri germplasm sideoats grama, Northern Missouri germplasm big bluestem, and Northern Missouri germplasm tall dropseed. All three production fields were in the floodplain (field 7) and required transplanting to salvage the plantings. The entire 0.3 acre plot of sideoats grama was moved to field #1 and approximately a 0.1 of an acre of big bluestem was moved to field #1 also.

Approximately 0.1 of an acre of tall dropseed was moved next to the northern zone of big bluestem production plot. Plans are to increase both northern and western zones of pale purple coneflower by dormant planting both plots in December or January. Northern and western zones of sideoats grama will potentially be planted with the pale purple coneflower as a companion crop to discourage heavy weed competition. Both species would be harvested for seed production. The Northern Missouri germplasm little bluestem is doing well, despite heavy inundation of water from spring rains in the south half of the production plot. Seed production remains consistent in the north half of the plot.

2009

All of the plots that were moved because of the 2008 flood survived and produced seed in 2009. The seed harvested will be used to start new production fields. The northern and western zones of pale purple coneflower were planted with a companion species, sideoats grama. Both plots were mowed during the growing season to discourage weed competition. In 2009, the northern and western zones of pale purple coneflower were released, they will be known as Northern Germplasm pale purple coneflower and Western Germplasm pale purple coneflower (*Echinacea pallida*). Find the release notices for both at the end of this report.

Study ID Code: MOPMC-P-0001-WO, WL, WE

Study Title: Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* Michx.

Study Leader: Cordsiemon, R.

Description:

Bur oak is a large-size tree 60-80 feet tall and 2-3 feet in diameter (max. 170 by 7 feet); crown rounded with large, heavy branches. Leaves are deciduous, oblong to ovate; 6-12 inches long; characteristically 5-9 lobed, with rounded lobes. Fruit matures in one year; acorns are 3/5-2 inches long, ellipsoidal, brown, enclosed for 1/3 to all of its length in a characteristic fringe-margined cup. Twigs are stout; yellow-brown to gray, often with characteristic corky wings. Winter buds; 1/8-1/4 inch long, hairy. Bur oak is one of the largest American Oaks. Commonly distributed throughout Missouri, Iowa and Illinois, bur oak are is important bottomland tree, frequently found in moist flats, wetlands, and undulating flood plains. Important associates of bur oak include red maple, American elm, silver maple, swamp white oak, sycamore and eastern cottonwood.

Objective:

The objective of this study is to select a local source, fast growing, and high nut producing bur oak.

Materials and Methods:

Field collections were assembled, accessioned, and held in storage until the collection period ended. The assemblage of collections began at the PMC in October 2000 and ended mid-December 2000. After the collection period was over the seed was stratified and planted in the greenhouse using the Root Pruning Method (RPM) containers. The plants will be transplanted in Field #7 on the PMC in mid to late April 2002. The design will be a randomized complete block with one plant per plot: one block for the Iowa collections, one for the Illinois collections and one block for the Missouri collections.

Discussion

2000

A total of 24 collections were made from the PMC three state service area: seven from Iowa, two from Illinois and 15 from Missouri. As these collections arrived at the PMC they were given accession numbers and placed in stratification for 120 days (cool moist storage 38 degrees Fahrenheit). At the time this report was being developed, these collections were being germinated in the greenhouse.

2001

The 24 collections of bur oaks were taken out of the germination trays and placed in containers (3 5/8” x 6”) and allowed to grow to approximately one foot tall. These plants were later transplanted into one-gallon size containers and placed in the portable greenhouse. In early December 2001 the plants were transported to the root cellar for over wintering. The scheduled

planting date is April 2002. The plantings will be randomized complete block designs with one block for Iowa's collections, one block for Illinois' collections and one block for Missouri's collections. Refer to Table #1 for collection information.

2002

Three assemblies of bur oaks were planted in April 2002 representing each state's collections, Iowa, Illinois and Missouri. Iowa's collections were planted in Field #6 on April 18, 2002, Illinois' collections were planted in Field #12 on April 17, 2002, and Missouri's collections were planted in Field #7 on April 18 – 19, 2002. These collections were evaluated for height, spread, vigor, and insect and disease resistance. The evaluation data was not documented in this year's report but will be in the 2003 Annual Technical Report. Table #1 reflects collection information.

2003

The three assemblies of bur oak representing the Missouri, Illinois, and Iowa collections were evaluated in October 2003. Performance characteristics evaluated were height, spread, vigor, and insect/disease resistance. The 2003 plant performance summaries can be found in Tables #2 and #8.

2004

All three plantings, Missouri, Iowa, and Illinois, were evaluated again for height, spread, vigor, and insect/disease resistance. Evaluation data for 2004 can be found in Tables #3 and #9. The Iowa and Missouri plantings originally were planted with two trees of each collection in each replication. Not all collections had enough material to allow for two trees in each replication, but most did. In 2004, the lesser dominant tree was removed to allow the dominant tree to grow without competition. There are some replications that had trees die and the extra (non-dominant) trees were, in some cases, used to replace trees that died. The 2005 evaluations will reflect the replacement trees. Fertilizer, 13-13-13, was added to the three plantings to encourage growth and healthier plants.

2005

Evaluations were taken in September for height, spread, vigor, and insect/disease resistance on the three plantings. Fertilizer, 13-13-13, again was added to each tree. Acorns were produced on a few trees in the Missouri accession in field #7. Evaluation data for 2005 can be found in Tables # 4 and #10.

2006

In early spring, all three plots of bur oaks were sprayed with an ounce per acre rate of Oust to control grass and weed competition. There was good control through mid-summer. Late summer broadleaf weeds and grasses encroached back around the tree. Fertilizer, 13-13-13, was also added at a rate of 8 oz. per tree. An evaluation for acorn production was done on all three plots (five year old trees); Missouri plot (Rep. 3, tree MO-11) produced several acorns and in the Iowa plot (Rep. 3, tree IA-5; Rep. 6, tree IA-6; and Rep. 7, tree IA-5) all produced significant amounts of acorns. There were no height, spread, and insect/disease resistant evaluations taken this year.

2007

In 2007, the seven surviving trees from Illinois in field #12 were moved to field #11 to make room for another planting. During the summer, these seven trees stressed heavily due to drought conditions. There were no evaluations for the Illinois trees and a determination will be made in FY 2008 if there is a need to continue with an Illinois source bur oak. There were no evaluations made on the Illinois planting in FY 2007. Missouri and Iowa bur oak plots look good and are performing well. Oust again was used in the spring to control white clover and grasses around the trees. Missouri source bur oaks have been susceptible to small galls that cover the leaf surface, possibly caused by small wasps. The damage is mostly cosmetic and seems to be mainly associated with the Missouri plot, but is also evident in the Iowa planting. The Iowa and Missouri plots were evaluated again for height, spread, vigor, insect/disease resistance, and acorn production. This year the trees were measured at 24 inches high to get a diameter measurement on the trunk. This will help determine how well each tree is performing against other trees in the planting. The Iowa planting had six trees that produced acorns, while the Missouri planting did not have any trees produce in 2007. The drought conditions could possibly have been the reason for little to no acorn production. The Iowa and Missouri evaluation data can be found in Tables #5 and #11.

2008

The remaining Illinois source trees died in FY08 and plans to start a new evaluation block of trees from Illinois were discontinued. The Missouri and Iowa source bur oak trees are doing very well. Again they were evaluated and plans are to evaluate the plots once more in FY09, before selections from each plot are made. Selections will consist of using a hydraulic tree spade and physically moving the trees to a new location, where they will be planted in a new crossing block. There will be a block for both Missouri and Iowa collections. The trees will be analyzed using statistical software based on the data that has been recorded over the past 7 years. Trees from accessions possessing superior characteristics will be selected for the crossing block. Data for 2008 can be found in Tables #6 and #12.

2009

Both plantings, IA and MO, were evaluated in October of 2009. The plantings were sprayed with a non-selective herbicide around the base of the trees in early spring to allow moisture and fertilizer to access the trees roots. 13-13-13 was also added to both plantings. All trees with limbs lower than 30 inches were cut. Once the evaluations have been analyzed, selections for superior trees will be made in FY10 and a new block will be established after the trees go dormant in the fall of 2010. Data for 2009 can be found in Tables #7 and #13.

Table # 1

Study Title: Assembly, Evaluation and Selection of Bur Oak *Quercus macrocarpa* Michx.

Temporary No.	State	County	MLRA	Collector
MO-1	Missouri	Calloway	115	Thomas L. Wekenborg
MO-2	Missouri	Chariton	NA	Charles Lewis
MO-3	Missouri	Shannon	053	Randy Misser
MO-4	Missouri	Lincoln	115	Jimmy Henry
MO-5	Missouri	Lincoln	115	Jimmy Henry
MO-6	Missouri	Lincoln		Wayne Lovelace
MO-7	Missouri			
MO-8	Missouri	Pike		Keith Jackson
MO-9	Missouri	Pike		Keith Jackson
MO-10	Missouri	Pike		Keith Jackson
MO-11	Missouri	Pike		Keith Jackson
MO-12	Missouri	Howard	N/A	Robert D. Dewitt
MO-13	Missouri	Boone	N/A	Robert D. Dewitt
MO-14	Missouri	St. Charles	115	Dan Crigler
MO-15	Missouri	Moniteau	115	Douglas Wallace
IL-1	Illinois	Clark	N/A	David E. Hiatt
IL-1	Illinois	Jasper	113	Dennis D. Clency
IA-1	Iowa	Dickinson	103	Tim K. Moran
IA-2	Iowa	Dickinson	103	Tim K. Moran
IA-3	Iowa	Dickinson	103	Tim K. Moran
IA-4	Iowa	Wayne	N/A	Duane Bedford
IA-5	Iowa	Decatur	109	Kevin Reynolds
IA-6	Iowa	Bremer	104	Richard J. Cornes
IA-7	Iowa	Black	104	Rick Cordes

Study MOPMC-P-0001-WE, WL
Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx. **Table #2**

2003 Evaluation

Summary of Iowa Collections, Located in Field #6

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	1.1	0.4	0.8	1.1	1.3	0.6	0.8	1.0	0.8	1.0	1.2	1.2	**0.93**
IA-2	0.7	0.8	0.8	0.8	1.2	1.0	1.3	0.8	0.8	0.8	1.1	1.3	**0.95**
IA-3	0.8	0.7	0.8	1.1	0.9	0.7	0.6	0.8	0.9	1.0	0.9	0.8	**0.81**
IA-4	1.3	1.3	1.2	0.8	0.8	1.0	0.0	0.9	1.3	1.1	0.9	0.0	**1.07**
IA-5	1.1	1.3	1.3	0.7	1.3	1.2	2.0	1.9	1.0	1.4	1.7	0.8	**1.30**
IA-6	0.8	0.7	1.0	1.1	1.0	1.0	0.4	0.3	0.5	1.1	0.6	0.7	**0.77**
IA-7	1.1	1.3	0.8	1.0	1.8	1.0	0.8	0.5	0.5	1.7	0.9	1.6	**1.08**

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1		0.3	0.2	0.2	0.0			0.1	0.2	0.1	0.2	0.3	**0.17**
IA-2		0.3		0.1	0.2	0.2	0.1	0.2	0.1	0.0	0.0	0.2	**0.15**
IA-3			0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	**0.08**
IA-4		0.2	0.1	0.1	0.1		0.0	0.1	0.1	0.2	0.2		**0.14**
IA-5		0.3	0.1	0.1	0.3	0.1	0.1	0.3	0.0	0.0	0.0	0.1	**0.13**
IA-6				0.2	0.2	0.1		0.0	0.1	0.2	0.0	0.2	**0.13**
IA-7	0.2	0.3	0.1		0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	**0.11**

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	4	5	4	3	4	6	4	4	6	4	4	4	**4.33**
IA-2	4	4	4	4	3	4	6	4	5	5	4	3	**4.17**
IA-3	dead	4	3	3	4	4	6	6	4	4	5	6	**4.45**
IA-4	3	3	3	4	4	4		4	3	4	4		**3.60**
IA-5	3	3	3	4	3	3	2	2	6	3	3	3	**3.17**
IA-6	4	4	3	3	4	4		9	7	4	6	6	**4.91**
IA-7	3	3	4	3	2	4	4	7	7	3	4	3	**3.92**

Summary of Insect and Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	3	3	2	2	2	2	5	4	3	2	3	2	**2.73**
IA-2	2	2	2	2	3	2	3	5	4	4	3	2	**2.91**
IA-3	2	3	3	3	2	3	3	3	2	4	3	3	**2.91**
IA-4	2	2	3	2	2		4	4	3	2	3		**2.78**
IA-5	3	2	3	3	3	2	2	2	4	2	2	2	**2.45**
IA-6	2	2	2	2	3	2	4	3	4	3	4	3	**2.91**
IA-7	3	3	2	2	2	3	2	3	3	3	4	3	**2.73**

Study 29I142G - Missouri Ecotype Releases

Table #2

Missouri Ecotype Releases from the Elsberry Plant Materials Center

Scientific Name	Release Name	Common Name	Accession Number	Cooperating Agency(ies)	Type of Release	Year of Release
Schizachyrium scoparium , Michx.	Southern MO	little bluestem	9079006	MOPMC, MDC	N	2004
Ratibida pinnata	Northern MO	grayheaded coneflower	9079060	MOPMC, MDC	N	2004
Sporobolus compositus var.	Northern MO	tall dropseed	9079040	MOPMC, MDC, NAS	N	2001
Coreopsis palmata	Northern MO	prairie coreopsis	9079028	MOPMC, MDC, NAS	N	2001
Coreopsis palmata	Western MO	prairie coreopsis	9079029	MOPMC, MDC, NAS	N	2001
Echinacea pallida	Northern MO	pale purple coneflower	9079032	MOPMC, MDC, NAS	N	2008
Echinacea pallida	Western MO	pale purple coneflower	9079033	MOPMC, MDC, NAS	N	2008
Liatris pycnostachya	Northern MO	prairie blazing star	9079020	MOPMC, MDC, NAS	N	2001
Liatris pycnostachya	Western MO	prairie blazing star	9079021	MOPMC, MDC, NAS	N	2001
Elymus virginicus L.	Northern MO	Virginia wildrye	9079044	MOPMC,UMC,MDC,MODOT	N	1999
Sorghastrum nutans (L) Nash.	Northern MO	Indiangrass	9079036	MOPMC,UMC,MDC,MODOT	N	1999
Sorghastrum nutans (L) Nash.	Western MO	Indiangrass	9079037	MOPMC,UMC,MDC,MODOT	N	1999
Andropogon gerardii Vitman	Northern MO	big bluestem	9079000	MOPMC,UMC,MDC,MODOT	N	1999
Schizachyrium scoparium , Michx.	Northern MO	little bluestem	9079004	MOPMC,UMC,MDC,MODOT	N	1999

Cooperating Agencies: MOPMC=Missouri Plant Materials Center; UMC=University of Missouri at Columbia; MDC=Missouri Department of Conservation; MODOT=Missouri Department of Transportation; NAS=National Audubon Society-Audubon Missouri;. Grow Native.

N=native releases; collected within the USA, occurring naturally in the USA. Generally refers to a plant which occurs naturally in a particular region, state ecosystem or habitat without direct or indirect human activity.

Nat.=naturalized releases; collected from a population within the USA, but were originally introduced to the USA sometime in the past.

I=introduced; means that the original collection from which the release was made was not from within the USA.

Study MOPMC-P-0001-WE, WL **Table #3**
Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx.

2004 Evaluation

Summary of Iowa Collections, Located in Field #6

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	2.2	4.0	2.8	2.9	2.6	2.4	2.2	2.3	3.7	3.6	3.6	3.5	**3.0**
IA-2	2.9	3.1	2.4	2.7	2.9	3.1	2.4	3.6	3.5	3.4	3.7	3.8	**3.1**
IA-3	3.7	2.3	2.5	3.0	2.7	3.2	2.4	dead	3.6	2.5	3.3	3.4	**3.0**
IA-4	3.0	4.0	3.4	4.1	3.2	3.1	3.8	3.1	4.4	3.8	4.1	4.3	**3.7**
IA-5	4.3	3.7	4.9	3.7	3.5	3.2	3.2	3.2	3.5	dead	3.2	2.6	**3.5**
IA-6	2.3	3.0	2.4	2.4	3.6	3.5	dead	dead	3.4	3.1	2.2	3.5	**2.9**
IA-7	3.5	3.2	3.2	3.2	3.7	3.6	3.2	4.1	2.4	3.4	3.8	4.1	**3.5**

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	2	3.6	2.5	3.2	2.9	2.5	3	2	3.8	3.7	3	3.2	**3.0**
IA-2	2.7	2.7	2.4	2.1	2.2	2.8	3	3	2.6	3	2.9	2.6	**2.7**
IA-3	3.7	2.1	2.8	2.7	2.4	3.3	1.5	dead	3.3	3.1	2.2	3.6	**2.8**
IA-4	3	2.6	3.1	3.4	3	3.4	5	3.7	3	3.1	3.4	3.4	**3.3**
IA-5	4.4	3.2	3.3	4.1	3.8	2.5	2	3.4	2.9	dead	3.1	2.4	**3.2**
IA-6	2	3.6	2.2	2.4	3.4	3.4	dead	dead	3.8	3.2	2.6	2.5	**2.9**
IA-7	2.8	2.6	2.3	2.4	3.5	3.2	3.3	3.5	2.2	3.7	3	3.4	**3.0**

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	5	3	5	3	4	5	4	5	3	3	3	4	**3.9**
IA-2	4	3	5	5	4	4	5	3	4	4	3	4	**4.0**
IA-3	2	5	4	3	5	4	6	dead	3	4	5	3	**4.0**
IA-4	3	3	2	2	3	3	2	3	2	2	3	2	**2.5**
IA-5	1	3	1	2	2	4	5	3	4	dead	4	5	**3.1**
IA-6	5	3	5	4	3	3	dead	dead	3	3	5	4	**3.8**
IA-7	3	4	3	3	2	3	4	4	4	3	3	3	**3.3**

Summary of Insect and Disease Resitance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	2	3	3	3	1	4	2	3	2	2	2	2	**2.4**
IA-2	1	2	2	1	2	2	4	2	2	2	3	2	**2.1**
IA-3	2	2	3	3	2	3	2	dead	2	2	2	2	**2.3**
IA-4	2	3	2	2	3	2	3	2	3	2	2	1	**2.3**
IA-5	2	2	2	2	1	3	3	3	3	dead	5	2	**2.5**
IA-6	2	2	2	2	2	1	dead	dead	1	1	1	2	**1.6**
IA-7	2	3	2	1	2	2	2	2	2	2	4	2	**2.2**

Study MOPMC-P-0001-WE, WL

Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx. **Table #4**

2005 Evaluation

Summary of Iowa Collections, Located in Field #6

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	3.6	4.5	4.3	4.6	5.1	3.5	4.7	3.9	5.3	5	4.9	5.4	4.6
IA-2	4.3	4.6	3.8	3.8	4.5	4.9	3.6	4.4	4.6	4.9	5.2	5	4.5
IA-3	6.3	4	4	5.6	3.7	5.2	4	Dead	6	4.5	5.2	4.3	4.8
IA-4	5.2	5.4	4.8	6	4.6	5.1	5.8	5.2	6.2	5.4	6.3	6	5.5
IA-5	5.8	5.6	6.3	5.3	5.2	4.6	4.6	5	5.2	Dead	5	2.9	5
IA-6	3.5	5.2	4.2	4.5	5	4.5	Dead	Dead	4.3	5.1	3.2	4.4	4.4
IA-7	4.5	Dead	5.8	5.2	5.5	5	4.7	4.6	Dead	4.7	4.9	5.7	5.1

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	2.6	3	2.3	3.6	5.1	3.4	3.8	3.6	3.7	4	4.2	3.3	3.6
IA-2	2.6	3.2	2.6	3.6	3	3.5	3.6	3.6	3.6	3.2	3.6	3.1	3.3
IA-3	4.2	2.6	3	4	2	3	2.6	Dead	4.9	3	2.4	4.3	3.3
IA-4	4	3	3.5	5	3.6	4	4.7	4	3.4	4	3.4	4.4	3.9
IA-5	4.3	3.4	4.5	4	3.6	5	3.7	4	3.2	Dead	3	3.4	3.8
IA-6	2.2	4	2.5	3.5	2.5	4	Dead	Dead	3.6	4.2	2.4	2.6	3.2
IA-7	2.8	Dead	2.3	3.4	3.5	3.5	4.2	3.9	Dead	3	4	4	3.5

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	6	3	5	3	1	3	4	5	3	2	3	3	3.4
IA-2	5	4	5	5	5	2	6	3	3	3	3	3	3.9
IA-3	2	5	4	5	5	5	5	Dead	2	4	4	3	4.0
IA-4	3	3	3	1	3	3	1	2	2	3	2	6	2.7
IA-5	1	3	1	2	2	3	3	2	3	Dead	4	2	2.4
IA-6	6	3	5	3	3	4	Dead	Dead	3	3	6	4	4.0
IA-7	9	Dead	5	4		2	3	3	Dead	5	3	2	4.0

Summary of Insect/Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	3	2	2	2	2	2	2	2	3	3	2	2	2.3
IA-2	2	2	3	3	4	2	3	2	3	3	3	2	2.7
IA-3	3	4	2	7	3	4	1	Dead	1	3	2	2	2.9
IA-4	1	2	1	1	1	3	1	1	1	2	1	2	1.4
IA-5	2	3	2	2	3	1	1	3	1	Dead	2	1	1.9
IA-6	2	3	1	2	3	2	Dead	Dead	2	2	2	4	2.3
IA-7	9	Dead	5	3		1	1	3	Dead	2	2	2	3.1

Study MOPMC-P-0001-WE, WL
Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx. **Table #5**

2007 Evaluation

Summary of Iowa Collections, Located in Field #6

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	9.8	10.2	9.0	9.7	8.4	9.0	9.8	9.5	10.1	9.5	9.1	10.6	9.56
IA-2	8.0	9.4	7.5	7.2	6.8	7.5	9.8	9.4	9.7	8.2	8.6	6.7	8.23
IA-3	11.8	8.0	8.5	8.0	7.2	8.5	8.5	dead	11.4	9.0	8.9	8.5	8.94
IA-4	9.7	9.2	10.2	9.7	9.6	9.6	11.0	10.6	11.7	12.0	11.9	10.6	10.48
IA-5	11.6	10.8	11.0	9.8	9.6	7.6	8.3	11.2	10.6	dead	9.5	6.9	9.72
IA-6	5.6	9.0	7.7	9.3	9.3	7.0	dead	dead	10.8	8.9	8.0	7.3	8.29
IA-7	9.8	7.5	9.3	9.0	9.1	9.4	10.2	9.6	5.8	9.2	11.0	11.2	9.26

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	6.7	7.3	6.9	8.5	7.0	6.8	8.0	7.6	9.7	8.2	9.7	7.2	7.80
IA-2	5.7	8.0	7.4	6.8	6.0	7.5	9.3	8.1	9.8	6.9	7.9	6.0	7.45
IA-3	10.6	6.6	6.8	8.0	5.0	6.7	7.4	dead	10.0	7.2	5.6	8.6	7.50
IA-4	6.9	6.5	8.0	9.6	9.0	7.7	11.5	9.8	8.8	9.2	10.2	10.9	9.01
IA-5	11.0	8.9	9.2	8.2	8.0	8.7	9.3	11.5	8.3	dead	10.0	6.0	9.01
IA-6	5.0	8.5	6.8	7.5	10.2	8.2	dead	dead	9.5	8.4	5.7	7.0	7.68
IA-7	7.7	4.0	8.0	7.6	8.0	8.2	10.7	10.0	4.0	6.6	10.0	9.9	7.89

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	4	5	6	3	5	6	4	5	3	3	3	3	4.17
IA-2	5	5	6	7	8	6	3	4	3	5	5	7	5.33
IA-3	3	7	6	5	7	6	5	dead	2	5	5	4	5.00
IA-4	5	5	3	3	3	5	1	1	1	1	1	1	2.50
IA-5	2	4	2	3	4	4	4	1	2	dead	3	6	3.18
IA-6	7	5	5	4	4	6	dead	dead	2	5	5	6	4.90
IA-7	4	8	6	5	5	3	2	4	7	4	1	1	4.17

2007 Evaluation
Summary of Iowa Collections, Located in Field #6 **Table #5 - Continued**

Summary of Insect/Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	5	3	4	3	3	5	4	3	3	3	1	3	3.33
IA-2	3	3	3	3	4	4	2	3	2	3	4	3	3.08
IA-3	4	2	3	3	3	3	1	dead	3	8	3	3	3.27
IA-4	4	3	2	2	1	2	3	1	3	3	2	2	2.33
IA-5	3	3	3	2	3	3	3	2	2	dead	3	2	2.64
IA-6	2	3	3	2	2	3	dead	dead	2	2	3	3	2.50
IA-7	3	3	5	3	3	3	3	3	2	4	2	3	3.08

Summary of Trunk Diameter Measured at 24 Inches High

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	5	6.5	5.5	8	6.25	6.75	5	5.5	7.75	6.5	7	6.25	6.33
IA-2	5.5	5.75	5.5	5	4	6.25	6.75	5.75	6.25	6.25	6	3.5	5.54
IA-3	8.25	4	5.75	5	6	5.5	4.5	dead	5.75	6.75	5.75	5.25	5.68
IA-4	9.25	8.2	7.75	8.5	7.25	8	9	8.25	7	7	9.5	9	8.23
IA-5	10	6.5	8.25	7.5	7.75	7.75	6.25	7.75	7.25	dead	6	4.5	7.23
IA-6	3.5	6.5	4.75	5.5	7.5	6	dead	dead	6.5	5.5	4.25	6	5.60
IA-7	6	3.5	5.25	5	7.5	6.75	6	5.75	2.25	6.25	6.75	5.75	5.56

Sumary of Acorn Presence

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12
IA-1	no	no	no	no	no	no	no	no	YES	no	no	no
IA-2	no	no	no	no	no	no	no	no	no	no	no	no
IA-3	no	no	no	no	no	no	no	dead	no	no	no	no
IA-4	no	no	no	no	no	no	no	no	no	no	no	no
IA-5	YES	no	no	no	no	no	no	YES	no	dead	YES	YES
IA-6	no	no	no	YES	no	no	dead	dead	no	no	no	no
IA-7	no	no	no	no	no	no	no	no	no	no	no	no

Study MOPMC-P-0001-WE, WL
Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx. **Table #6**

2008 Evaluation

Summary of Iowa Collections, Located in Field #6

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	11.3	12.2	10.7	10.8	10.0	9.9	10.0	11.3	12.2	10.6	10.0	11.7	10.9
IA-2	8.2	10.7	9.4	9.4	8.3	8.8	11.1	10.4	12.2	9.0	8.9	8.2	9.6
IA-3	13.2	9.1	10.3	9.4	9.7	9.4	9.3	DEAD	13.2	10.2	10.0	8.8	9.4
IA-4	12.0	12.0	12.5	13.2	11.2	11.1	12.2	12.3	12.9	13.4	12.4	12.3	12.3
IA-5	13.0	11.4	13.3	12.0	11.1	9.3	10.6	13.0	12.6	DEAD	10.4	8.8	10.5
IA-6	6.8	10.6	8.9	10.9	10.8	9.2	DEAD	DEAD	11.5	9.9	8.6	9.4	8.1
IA-7	10.2	8.3	11.1	10.0	10.0	11.6	12.0	11.7	8.4	11.6	13.3	12.2	10.9

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	7.5	8.9	6.9	7.5	8.5	7.6	7.6	8.1	9.6	8.5	7.8	6.1	7.9
IA-2	5.6	7.7	8.3	7.4	6.1	8.1	9.4	8.4	10.4	6.7	8.8	6.7	7.8
IA-3	9.9	6.4	7.4	8.7	6.0	7.6	8.4	DEAD	11.2	7.4	8.0	8.9	7.5
IA-4	7.0	7.9	11.7	8.9	10.1	8.3	11.0	8.7	9.5	12.1	9.5	9.2	9.5
IA-5	11.4	8.8	11.4	9.2	8.4	10.0	10.8	11.5	8.4	DEAD	9.6	7.5	8.9
IA-6	5.9	10.0	8.7	8.6	11.4	8.9	DEAD	DEAD	8.2	8.6	4.8	8.2	6.9
IA-7	7.1	5.3	7.0	7.5	10.7	7.9	9.6	10.3	5.2	10.3	9.8	10.4	8.4

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	8	9	7	8	8	8	8	8	8	8	9	8	8.1
IA-2	7	7	7	6	6	6	7	8	9	7	7	6	6.9
IA-3	10	7	7	7	7	7	7	DEAD	10	7	8	7	7.0
IA-4	9	9	10	10	10	9	10	10	10	10	10	10	9.8
IA-5	10	9	10	9	9	9	9	10	9	DEAD	8	7	8.3
IA-6	6	8	7	8	9	6	DEAD	DEAD	8	6	7	7	6.0
IA-7	8	5	8	7	9	9	9	8	5	8	10	10	8.0

Summary of Insect/Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	8	8	8	9	8	8	8	8	7	9	10	9	8.3
IA-2	7	8	9	9	8	8	7	8	8	9	9	7	8.1
IA-3	9	8	7	9	9	9	8	DEAD	9	8	8	9	7.8
IA-4	7	9	9	10	10	9	10	10	10	10	10	10	9.5
IA-5	7	9	9	9	9	8	10	10	10	DEAD	9	8	8.2
IA-6	7	9	8	9	10	6	DEAD	DEAD	9	8	9	10	7.1
IA-7	8	8	8	8	8	9	9	8	8	9	10	10	8.6

2008 Evaluation

Summary of Iowa Collections, Located in Field #6

Summary of Diameter @ 24"

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	2.00	2.50	2.25	3.00	2.50	2.50	2.00	2.25	2.50	2.75	2.50	2.50	2.44
IA-2	2.25	2.50	2.75	2.00	1.75	2.25	2.75	2.50	3.00	2.50	2.25	1.50	2.33
IA-3	3.25	1.75	2.25	1.75	2.25	2.25	2.00	DEAD	2.50	2.25	2.25	1.75	2.02
IA-4	3.25	3.50	3.25	3.75	3.00	3.25	3.75	3.25	3.00	3.50	3.50	3.25	3.35
IA-5	3.50	2.50	3.50	2.50	3.00	2.50	2.50	3.50	2.75	DEAD	2.50	2.00	2.56
IA-6	1.25	2.25	2.00	2.25	3.00	2.00	DEAD	DEAD	2.50	2.25	2.00	2.50	1.83
IA-7	2.50	1.50	2.25	2.00	2.75	2.75	2.75	2.50	1.00	2.25	3.00	2.25	2.29

Summary of Circumference

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	6.28	7.85	7.07	9.42	7.85	7.85	6.28	7.07	7.85	8.64	7.85	7.85	7.65
IA-2	7.07	7.85	8.64	6.28	5.50	7.07	8.64	7.85	9.42	7.85	7.07	4.71	7.33
IA-3	10.21	5.50	7.07	5.50	7.07	7.07	6.28	DEAD	7.85	7.07	7.07	5.50	6.35
IA-4	10.21	10.99	10.21	11.78	9.42	10.21	11.78	10.21	9.42	10.99	10.99	10.21	10.53
IA-5	10.99	7.85	10.99	7.85	9.42	7.85	7.85	10.99	8.64	DEAD	7.85	6.28	8.05
IA-6	3.93	7.07	6.28	7.07	9.42	6.28	DEAD	DEAD	7.85	7.07	6.28	7.85	5.76
IA-7	7.85	4.71	7.07	6.28	8.64	8.64	8.64	7.85	3.14	7.07	9.42	7.07	7.20

Acorns Present

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Total
IA-1	N	N	N	N	N	N	N	N	N	N	N	N	0
IA-2	N	N	N	N	N	N	YES	N	N	N	YES	N	2
IA-3	N	N	N	YES	N	YES	N	DEAD	N	N	N	N	2
IA-4	N	N	N	N	N	N	N	N	N	N	N	N	0
IA-5	N	N	N	YES	YES	N	N	YES	YES	DEAD	YES	N	5
IA-6	N	N	N	YES	N	YES	DEAD	DEAD	N	N	N	N	2
IA-7	N	N	N	N	N	YES	YES	N	N	N	YES	N	3

Study MOPMC-P-0001-WE, WL
Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx. **Table #**

2009 Evaluation

Summary of Iowa Collections, Located in Field #6

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	12.9	14.7	12.9	14.2	11.8	12.4	12.8	13.9	13.3	10.9	11.6	15.2	13.1
IA-2	9.4	12.1	11.1	11.8	9.4	11.3	12.6	13.2	14.3	10.4	10.8	9.5	11.3
IA-3	16.1	12.2	11.9	12.0	11.6	12.1	11.1	DEAD	14.6	11.4	12.3	10.7	12.4
IA-4	13.2	13.9	13.7	15.8	12.7	13.7	15.3	15.6	15.0	15.2	15.7	15.6	14.6
IA-5	14.8	13.7	15.0	13.1	12.6	11.6	12.5	14.6	14.4	DEAD	11.5	11.4	13.2
IA-6	7.2	12.2	10.4	12.7	12.3	10.7	DEAD	DEAD	14.2	11.9	10.9	12.7	11.5
IA-7	11.9	11.4	16.0	14.1	13.3	13.8	15.1	13.7	9.9	14.9	14.6	14.3	13.6

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	7.9	9.4	7.2	10.4	10.4	8.7	6.9	7.1	8.0	9.3	10.2	9.7	8.8
IA-2	8.8	11.4	9.3	9.5	7.8	8.7	9.9	8.7	8.9	9.4	9.9	6.0	9.0
IA-3	11.7	7.5	9.6	9.2	7.2	7.5	8.3	DEAD	12.3	8.7	9.3	9.2	9.1
IA-4	9.5	9.2	11.7	14.1	11.2	12.0	17.0	11.8	13.0	14.1	12.1	12.9	12.4
IA-5	13.2	11.0	14.0	11.0	9.4	13.2	9.6	11.0	9.2	DEAD	10.7	9.7	11.1
IA-6	6.5	11.2	9.1	10.3	10.8	10.3	DEAD	DEAD	10.6	10.2	7.8	10.8	9.8
IA-7	9.8	6.8	9.5	9.1	10.6	9.8	10.7	11.5	5.2	9.5	12.1	10.8	9.6

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	3	1	5	1	3	4	4	4	4	4	2	3	3.2
IA-2	5	3	5	4	6	4	4	5	2	4	3	6	4.3
IA-3	1	4	4	4	4	5	4	DEAD	3	3	3	4	3.5
IA-4	1	1	1	1	3	2	1	1	1	1	1	1	1.3
IA-5	1	2	1	2	3	2	3	1	2	DEAD	3	3	2.1
IA-6	8	2	4	3	2	5	DEAD	DEAD	2	3	4	3	3.6
IA-7	3	4	2	3	2	2	1	2	6	2	2	2	2.6

Summary of Insect/Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	3	4	6	2	5	5	3	4	4	4	1	3	3.7
IA-2	2	2	5	3	6	6	4	5	3	5	3	5	4.1
IA-3	3	3	6	4	2	3	3	DEAD	3	2	3	5	3.4
IA-4	1	2	1	1	1	1	1	2	1	1	1	2	1.3
IA-5	3	2	2	2	2	2	3	3	2	DEAD	2	2	2.3
IA-6	6	2	3	2	1	5	DEAD	DEAD	3	3	2	1	2.8
IA-7	3	2	2	2	1	4	4	5	2	2	2	4	2.8

Summary of Diameter @ 24"

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Avg.
IA-1	2.95	3.42	3.18	3.82	3.58	3.50	2.95	3.18	2.87	3.82	3.34	3.18	3.32
IA-2	2.87	3.34	2.39	3.11	2.07	3.11	3.58	2.87	3.42	2.79	3.18	1.75	2.87
IA-3	3.82	2.31	3.18	2.63	2.95	2.71	2.63	DEAD	3.18	3.03	2.95	2.63	2.91
IA-4	4.70	3.98	4.38	4.78	4.22	4.22	4.54	4.30	3.82	4.54	4.38	4.70	4.38
IA-5	4.30	3.18	4.06	3.42	4.14	3.42	3.18	3.50	3.58	DEAD	2.87	2.39	3.46
IA-6	1.75	3.18	2.71	2.71	3.50	2.47	DEAD	DEAD	3.34	3.03	2.39	3.03	2.81
IA-7	2.95	1.83	3.03	3.11	3.58	3.90	3.50	3.26	1.67	3.34	4.30	3.26	3.14

Summary of Visible Acorn Production

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12
IA-1	N	N	N	Y	N	N	N	N	N	N	Y	N
IA-2	N	N	N	N	N	N	N	N	N	Y	N	N
IA-3	N	N	N	N	N	N	N	DEAD	N	N	N	N
IA-4	N	N	N	N	Y	N	Y	N	N	N	Y	N
IA-5	N	N	N	Y	Y	N	N	N	N	DEAD	Y	Y
IA-6	N	N	N	N	N	Y	DEAD	DEAD	N	N	N	N
IA-7	N	N	N	N	N	Y	Y	N	N	N	N	N

Study MOPMC-P-0001-WE, WL **Table #8**
Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx.

2003 Evaluation

Summary of Missouri Collections, Located in Field #7

Summary of Height (Feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Average
MO-1	2.1	1.2	2.1	1.5	1.3	1.6	1.7	1.8	1.7	1.6	**1.7**
MO-2	1.7	2.0	1.6	2.2	1.5	0.8	0.6	0.6	0.7	1.1	**1.3**
MO-3	1.4	1.1	0.6	0.4	0.8	1.3	1.9	2.0	1.4	2.0	**1.3**
MO-4	1.6	1.3	1.7	1.9	2.1	0.7	1.5	1.3	1.5	1.2	**1.4**
MO-5	1.5	1.1	1.3	1.1	1.2	1.4	0.6	1.6	1.1	1.4	**1.2**
MO-6	1.6	0.0	0.0	0.0	0.0	2.0	1.0	2.0	1.7	1.9	**1.7**
MO-7	1.8	1.8	1.6	1.8	1.5		1.0	1.0	1.3	1.4	**1.4**
MO-8	1.1	0.7	1.2	0.5	1.1	2.1	1.6	1.9	2.1	1.6	**1.4**
MO-9	1.8	1.4	1.6	2.3	1.0	1.5	1.5	2.1	1.4	1.7	**1.6**
MO-10	2.0	1.5	2.3	2.3	1.6	0.8	1.5	1.3	1.5	1.3	**1.6**
MO-11	1.2	2.0	2.0	2.0	0.9	0.6	1.5	1.8	2.2	1.5	**1.6**
MO-12	2.0	1.9	1.7	1.1	0.8	1.3	1.5	1.5	2.0	1.5	**1.5**
MO-13		2.1	1.7	2.1	1.5	2.1	2.1	1.6	2.0	1.4	**1.9**
MO-14	1.8	1.8	2.3	1.7	1.1	1.3	1.2	1.5	1.7	1.4	**1.6**
MO-15			1.2	1.4	1.6						**1.4**

Summary of Spread (Feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Average
MO-1	0.1	0.2	0.2	0.0	0.0	0.2	0.5	0.3	0.3	0.2	**0.2**
MO-2	0.4	0.2	0.2	0.3	0.4	0.1	0.1	0.2	0.0	0.4	**0.2**
MO-3	0.1	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.1	**0.1**
MO-4	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.0	0.1	**0.1**
MO-5	0.1	0.1	0.1	0.0	0.1	0.2	0.2	0.1	0.3	0.1	**0.1**
MO-6	0.2								0.1	0.3	**0.2**
MO-7	0.2	0.1	0.1	0.2	0.3		0.0	0.3	0.1	0.2	**0.2**
MO-8	0.3	0.2	0.3	0.1	0.3	0.3	0.1	0.2	0.1	0.1	**0.2**
MO-9	0.3	0.1	0.2	0.3	0.1	0.3	0.1	0.3	0.0	0.3	**0.2**
MO-10	0.3	0.2	0.2	0.1	0.1		0.4	0.2	0.1	0.0	**0.1**
MO-11	0.1	0.2	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.3	**0.1**
MO-12	0.3	0.3	0.3	0.2	0.1	0.0	0.2	0.2	0.3	0.1	**0.2**
MO-13		0.0	0.1	0.2	0.1	0.3	0.1	0.1	0.3	0.2	**0.2**
MO-14	0.2	0.2	0.2	0.3	0.4	0.2			0.3	0.2	**0.2**
MO-15			0.1	0.1	0.1						**0.1**

2003 Evaluation

Table #8 - continued

Summary of Missouri Collections, Located in Field #7

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Average
MO-1	1	4	1	3	4	2	4	2	2	3	**2.6**
MO-2	1	1	3	1	3	7	7	8	8	5	**4.4**
MO-3	3	4	8	8	5	4	7	1	4	5	**4.9**
MO-4	3	3	2	1	1	7	3	5	3	4	**3.2**
MO-5	3	4	4	4	4	4	8	3	4	4	**4.2**
MO-6	3					2	5	1	2	1	**2.2**
MO-7	2	7	3	2	3		6	5	4	4	**4.0**
MO-8	2	7	4	8	4	1	3	1	1	3	**3.4**
MO-9	2	4	3	1	5	6	3	1	4	2	**3.1**
MO-10	1	4	1	1	3	6	3	4	2	6	**3.1**
MO-11	4	1	1	1	5	8	3	2	1	4	**3.0**
MO-12	1	1	1	1	4	4	3	3	1	4	**2.3**
MO-13		1	2	1	3	1	1	3	1	4	**1.9**
MO-14	2	1	8	2	4	4	4	3	2	4	**3.4**
MO-15		3		4	3						**3.3**

Summary of Insect and Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Average
MO-1	2	3	2	3	4	2	5	3	2	3	**2.9**
MO-2	2	2	4	2	3	4	4	4	5	2	**3.2**
MO-3	3	3	4	4	4	5	3	2	4	2	**3.4**
MO-4	2	3	4	2	2	4	4	3	5	2	**3.1**
MO-5	3	4	3	4	3	2	3	4	4	3	**3.3**
MO-6	4					2	3	2	3	2	**2.4**
MO-7	2	3	3	4	4		3	2	4	3	**3.1**
MO-8	2	4	4	5	3	2	4	3	2	2	**3.1**
MO-9	3	3	3	2	3	3	4	2	2	3	**2.8**
MO-10	2	2	2	2	2	4	2	5	3	4	**2.8**
MO-11	4	2	3	3	3	5	3	3	2	3	**3.1**
MO-12	2	2	2	4	3	4	2	2	4	2	**2.7**
MO-13		2	2	4	2	2	2	3	2	3	**2.4**
MO-14	3	2	3	3	2	4	3	2	3	3	**2.8**
MO-15		4	4	3	3						**3.5**

R = Tree was originally MO-6 accession, but was replaced with MO-15 accession

Study MOPMC-P-0001-WE, WL **Table #**
Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx.

2004 Evaluation

Summary of Missouri Collections, Located in Field #7

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	3.0	3.2	3.2	2.8	3.7	2.4	3.9	dead	dead	2.4	**3.1**
MO-2	2.8	3.4	dead	3.1	3.6	dead	dead	dead	dead	2.6	**3.1**
MO-3	3.8	3.4	3.3	3.1	2.8	2.1	2.8	2.7	1.7	2.4	**2.8**
MO-4	3.6	3.1	2.9	3.3	3.0	1.3	3.1	3.1	3.2	2.8	**2.9**
MO-5	1.9	2.8	3.1	3.8	3.3	2.8	dead	2.8	2.9	3.3	**3.0**
MO-6	3.4	R	R	R	R	2.2	3.0	3.0	1.5	3.0	**2.7**
MO-7	3.9	dead	2.5	2.8	2.1	dead	dead	2.6	dead	3.6	**2.9**
MO-8	3.2	2.1	3.0	2.2	2.6	2.4	3.0	3.6	2.7	3.2	**2.8**
MO-9	4.3	2.8	4.2	2.6	2.4	2.5	1.3	4.2	1.6	3.4	**2.9**
MO-10	3.2	3.4	3.3	2.7	2.2	2.6	2.3	2.5	2.2	dead	**2.7**
MO-11	2.6	3.1	2.5	2.1	1.7	2.8	2.4	2.4	2.7	3.0	**2.5**
MO-12	2.4	2.4	3.0	2.0	2.2	2.0	2.7	2.6	2.4	3.2	**2.5**
MO-13	3.8	3.8	2.8	3.6	2.9	3.1	2.9	2.4	3.2	1.7	**3.0**
MO-14	3.5	3.3	2.6	2.8	1.7	2.1	dead	2.1	2.9	2.6	**2.6**
MO-15		3.9	3.1	3.0	3.1						**3.3**

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	2.4	3.5	3.2	2.5	3.7	2.7	3.8	dead	dead	2.2	**3.0**
MO-2	3.2	3	dead	3.1	2.3	dead	dead	dead	dead	3	**2.9**
MO-3	3	2.6	3.5	2.9	2.6	2.3	2.3	2.7	1.7	3	**2.7**
MO-4	2.6	2.8	2.5	2.6	2.3	1.1	2.9	2.4	3	3	**2.5**
MO-5	1.8	3	2.3	3.4	3.3	2.5	dead	2.5	2.6	2.6	**2.7**
MO-6	2.6	R	R	R	R	2	2.1	2.6	1.2	2.4	**2.2**
MO-7	3.3	dead	2.6	3.5	2.1	dead	dead	2.8	dead	4	**3.1**
MO-8	2.9	1.9	3.3	1.8	2.2	2.6	2.4	3.1	2.7	3.1	**2.6**
MO-9	4.2	2.7	3.2	2.3	2.4	2.1	1.3	4.3	1.5	2.9	**2.7**
MO-10	2.9	2.8	2.7	3	2.2	2.2	2.1	2	2.7	dead	**2.5**
MO-11	2.6	2.8	2.6	1.8	1.9	2.4	2	2.6	3.4	3.3	**2.5**
MO-12	1.5	2.8	2.7	2	2.3	2.4	2.7	3	3	4.2	**2.7**
MO-13	3.4	3.1	2.9	3.6	3	2.9	2.6	2.3	3.2	1.2	**2.8**
MO-14	2.1	4.4	2.3	3.4	2.1	2.1	dead	2.7	2.5	3.1	**2.7**
MO-15		3.3	3.3	2.7	3.1						**3.1**

2004 Evaluation **Table # - continued**

Summary of Missouri Collections, Located in Field #7

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	4	4	3	5	2	4	1	dead	dead	5	**3.5**
MO-2	5	4	dead	3	5	dead	dead	dead	dead	4	**4.2**
MO-3	3	4	3	4	4	5	4	4	7	4	**4.2**
MO-4	3	4	4	4	4	8	3	4	3	4	**4.1**
MO-5	6	5	4	1	3	4	dead	4	4	4	**3.9**
MO-6	4	R	R	R	R	5	4	4	8	4	**4.8**
MO-7	3	dead	5	3	6	dead	dead	5	dead	1	**3.8**
MO-8	3	6	3	6	5	4	4	2	4	3	**4.0**
MO-9	1	5	3	4	4	5	7	1	7	4	**4.1**
MO-10	4	4	3	3	4	5	4	6	5	dead	**4.2**
MO-11	4	4	5	6	6	4	5	4	3	3	**4.4**
MO-12	6	5	4	6	5	5	3	4	4	2	**4.4**
MO-13	3	3	4	2	3	3	4	6	4	7	**3.9**
MO-14	4	4	5	3	6	5	dead	4	4	4	**4.3**
MO-15		2	3	3	3						**2.8**

Summary of Insect and Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	3	5	3	2	4	1	2	dead	dead	3	**2.9**
MO-2	4	2	dead	2	4	dead	dead	dead	dead	2	**2.8**
MO-3	3	4	3	3	2	2	2	2	3	2	**2.6**
MO-4	2	2	3	3	2	1	2	2	2	1	**2.0**
MO-5	1	3	2	2	2	1	dead	2	2	2	**1.9**
MO-6	4	R	R	R	R	2	2	2	1	2	**2.2**
MO-7	3	dead	2	2	2	dead	dead	2	dead	1	**2.0**
MO-8	4	3	3	4	3	1	3	2	3	2	**2.8**
MO-9	2	2	3	2	1	3	1	3	2	2	**2.1**
MO-10	3	4	2	2	1	2	1	3	2	dead	**2.2**
MO-11	3	3	3	2	3	2	2	2	2	2	**2.4**
MO-12	2	2	4	4	2	3	1	1	3	1	**2.3**
MO-13	5	2	3	1	2	2	3	2	4	3	**2.7**
MO-14	6	3	2	3	2	2	dead	2	3	3	**2.9**
MO-15		2	3	3	1						**2.3**

R = Tree was originally MO-6 accession, but was replaced with MO-15 accession

Study MOPMC-P-0001-WE, WL | **Table #**

Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa*, Michx.

2005 Evaluation

Summary of Missouri Collections, Located in Field #7

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	4.5	4.0	6.5	3.3		3.6	4.6	Dead	Dead	4.0	**4.4**
MO-2	3.6	4.5	Dead	4.4		Dead	Dead	Dead	Dead	5.3	**4.5**
MO-3	5.0	5.0	4.3	4.3		1.9	3.6	3.8	Dead	2.9	**3.9**
MO-4	4.9	4.4	4.3	4.6		1.0	4.3	4.4	5.3	4.5	**4.2**
MO-5	3.7	5.0	4.3	4.3		3.8	Dead	3.8	5.8	3.2	**4.2**
MO-6	6.4	R	R	R		1.0	3.9	4.0	Dead	3.5	**3.8**
MO-7	6.1	Dead	3.9	3.3		Dead	Dead	3.5	Dead	6.0	**4.6**
MO-8	6.2	4.0	3.4	3.9		Dead	Dead	4.6	4.8	4.7	**4.5**
MO-9	6.1	3.7	5.0	3.0		3.2	Dead	5.0	Dead	3.9	**4.3**
MO-10	4.0	4.2	Dead	3.2		Dead	3.6	3.0	4.0	Dead	**3.7**
MO-11	3.7	4.0	3.8	Dead		3.2	3.3	3.7	4.7	4.4	**3.9**
MO-12	3.2	6.7	3.4	3.1		Dead	4.1	4.0	3.8	4.6	**4.1**
MO-13	4.3	4.2	4.0	4.7		3.6	3.7	3.4	5.0	Dead	**4.1**
MO-14	4.0	5.0	Dead	4.0		2.8	Dead	4.8	4.0	4.0	**4.1**
MO-15		5.2	4.3	4.7							**4.7**

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	3.5	4.0	5.0	2.0		3.0	3.3	Dead	Dead	3.5	**3.5**
MO-2	3.2	3.6	Dead	3.6		Dead	Dead	Dead	Dead	4.0	**3.6**
MO-3	3.0	3.7	3.6	3.0		1.0	2.9	2.8	Dead	2.5	**2.8**
MO-4	3.3	3.1	2.7	3.0		1.0	2.8	2.3	4.0	2.9	**2.8**
MO-5	2.3	3.6	3.0	3.0		2.4	Dead	3.2	1.8	3.0	**2.8**
MO-6	3.7	R	R	R		1.0	3.0	3.0	Dead	2.9	**2.7**
MO-7	4.3	Dead	2.6	3.7		Dead	Dead	3.0	Dead	4.4	**3.6**
MO-8	4.0	3.0	2.8	2.0		Dead	Dead	2.5	3.2	2.7	**2.9**
MO-9	6.0	3.0	2.4	1.4		1.8	Dead	4.0	Dead	1.5	**2.9**
MO-10	3.0	3.7	Dead	3.0		Dead	2.7	2.5	2.0	Dead	**2.8**
MO-11	3.0	3.0	2.5	Dead		2.2	2.6	2.6	3.7	3.0	**2.8**
MO-12	1.2	3.3	2.5	2.5		Dead	3.0	3.2	3.0	4.0	**2.8**
MO-13	3.0	3.0	3.0	3.3		2.8	2.8	2.0	4.6	Dead	**3.1**
MO-14	3.0	2.2	Dead	3.6		2.3	Dead	3.2	2.5	4.0	**3.0**
MO-15		4.8	3.4	3.3							**3.8**

2005 Evaluation

Table # - continued

Summary of Missouri Collections, Located in Field #7

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	3	3	1	6		6	3	Dead	Dead	4	**3.7**
MO-2	4	2	Dead	4		Dead	Dead	Dead	Dead	3	**3.3**
MO-3	3	2	3	4		8	4	4	Dead	6	**4.3**
MO-4	4	4	7	4		8	3	5	2	5	**4.7**
MO-5	7	3	5	3		5	Dead	4	3	6	**4.5**
MO-6	2	R	R	R		8	5	5	Dead	5.0	**5.0**
MO-7	2	Dead	7	5		Dead	Dead	5	Dead	1	**4.0**
MO-8	2	4	7	7		Dead	Dead	3	2	3	**4.0**
MO-9	1	2	5	8		6	Dead	1	Dead	8	**4.4**
MO-10	5	4	Dead	6		Dead	6	6	6	Dead	**5.5**
MO-11	6	4	6	Dead		6	6	4	2	4	**4.8**
MO-12	8	2	6	7		Dead	5	5	4	3	**5.0**
MO-13	5	2	5	4		5	3	6	2	Dead	**4.0**
MO-14	5	3	Dead	5		7	Dead	4	6	3	**4.7**
MO-15		1	4	5							**3.3**

Summary of Insect and Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	2	4	2	2		2	4	Dead	Dead	3	**2.7**
MO-2	3	2	Dead	2		Dead	Dead	Dead	Dead	2	**2.3**
MO-3	4	3	2	1		1	2	1	Dead	1	**1.9**
MO-4	3	5	4	2		8	2	3	2	2	**3.4**
MO-5	5	4	4	3		2	Dead	1	2	2	**2.9**
MO-6	3	R	R	R		8	2	2	Dead	1	**3.2**
MO-7	5	Dead	4	2		Dead	Dead	1	Dead	1	**2.6**
MO-8	3	3	3	4		Dead	Dead	3	3	2	**3.0**
MO-9	2	2	2	6		4	Dead	3	Dead	8	**3.9**
MO-10	5	5	Dead	4		Dead	3	1	2	Dead	**3.3**
MO-11	4	4	1	Dead		3	2	2	3	3	**2.8**
MO-12	5	2	3	1		Dead	3	3	1	4	**2.8**
MO-13	4	1	5	4		2	2	1	3	Dead	**2.8**
MO-14	4	3	Dead	3		1	Dead	4	2	1	**2.6**
MO-15		3	4	2							**3.0**

R = Tree was originally MO-6 accession, but was replaced with MO-15 accession

Replication #5 was removed and used in another study offsite of the PMC

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Study MOPMC-P-0001-WE, WL
Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx. **Table # 11**

2007 Evaluation

Summary of Missouri Collections, Located in Field #7

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	8.3	7.3	10.7	7.9	Gone	7.8	9.9	Dead	Dead	7.5	**8.5**
MO-2	7.4	7.7	Dead	8.5	Gone	Dead	Dead	Dead	Dead	8.7	**8.1**
MO-3	10.3	8.8	8.3	8.6	Gone	3.9	8.1	6.6	Dead	7.5	**7.8**
MO-4	10.4	8.2	7.0	9.1	Gone	Dead	9.8	7.6	10.7	8.1	**8.9**
MO-5	7.9	9.8	8.9	9.6	Gone	6.7	Dead	7.9	11.1	8.2	**8.8**
MO-6	10.4	R	R	R	R	Dead	7.4	7.6	Dead	6.0	**7.9**
MO-7	11.6	Dead	8.2	8.1	Gone	Dead	Dead	6.3	Dead	10.0	**8.8**
MO-8	9.8	8.0	6.1	8.8	Gone	4.7	Dead	9.5	9.8	9.9	**8.3**
MO-9	11.0	5.9	7.3	3.0	Gone	5.1	Dead	8.8	Dead	7.5	**6.9**
MO-10	8.7	7.0	5.5	9.0	Gone	4.4	7.4	6.4	9.2	Dead	**7.2**
MO-11	6.9	9.1	8.0	4.0	Gone	7.3	8.1	7.4	10.2	9.6	**7.8**
MO-12	5.5	11.5	6.0	7.0	Gone	4.5	7.5	7.8	8.2	8.0	**7.3**
MO-13	7.8	9.1	6.6	8.5	Gone	7.6	7.6	8.9	7.7	Dead	**8.0**
MO-14	6.0	9.8	6.4	8.2	Gone	6.7	Dead	9.0	8.3	7.0	**7.7**
MO-15		9.6	9.0	8.8	Gone						**9.1**

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	9.3	6.2	11.5	8.8	Gone	6.0	9.5	Dead	Dead	9.0	**8.6**
MO-2	7.6	9.0	Dead	10.0	Gone	Dead	Dead	Dead	Dead	7.1	**8.4**
MO-3	9.0	8.4	10.0	7.6	Gone	3.4	8.2	7.2	Dead	7.3	**7.6**
MO-4	10.2	8.0	5.7	7.3	Gone	Dead	9.4	6.0	12.0	6.6	**8.2**
MO-5	6.5	8.0	8.0	9.0	Gone	6.0	Dead	7.0	10.3	6.8	**7.7**
MO-6	8.0	R	R	R	R	Dead	7.2	8.0	Dead	7.1	**7.6**
MO-7	11.5	Dead	9.0	7.8	Gone	Dead	Dead	8.6	Dead	9.3	**9.2**
MO-8	6.9	9.0	6.5	6.0	Gone	4.0	Dead	9.2	11.0	8.0	**7.6**
MO-9	11.5	8.0	7.0	2.8	Gone	5.0	Dead	9.0	Dead	6.0	**7.0**
MO-10	6.5	11.5	4.3	6.4	Gone	3.7	7.7	7.0	7.8	Dead	**6.9**
MO-11	6.0	10.0	6.3	3.4	Gone	6.4	7.8	7.8	10.8	7.3	**7.3**
MO-12	5.0	8.0	8.0	6.0	Gone	3.7	7.0	7.9	8.2	11.0	**7.2**
MO-13	7.2	9.0	7.0	8.8	Gone	9.2	6.7	8.0	10.1	Dead	**8.3**
MO-14	4.8	11.0	6.5	7.5	Gone	5.2	Dead	9.2	6.9	8.2	**7.4**
MO-15		11.0	9.5	8.0	Gone						**9.5**

2007 Evaluation
Summary of Missouri Collections, Located in Field #7 **Table 11 - Continued**

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	4	5	1	5	Gone	4	4	Dead	Dead	5	**4.0**
MO-2	5	4	Dead	3	Gone	Dead	Dead	Dead	Dead	3	**3.8**
MO-3	2	3	3	3	Gone	8	4	5	Dead	5	**4.1**
MO-4	2	3	5	3	Gone	Dead	3	5	2	4	**3.4**
MO-5	6	2	4	3	Gone	4	Dead	5	1	4	**3.6**
MO-6	2	R	R	R	R	Dead	5	4	Dead	5	**4.0**
MO-7	1	Dead	4	4	Gone	Dead	Dead	6	Dead	2	**3.4**
MO-8	3	4	6	4	Gone	7	Dead	3	2	2	**3.9**
MO-9	1	6	4	9	Gone	6	Dead	2	Dead	5	**4.7**
MO-10	5	5	8	4	Gone	7	5	5	5	Dead	**5.5**
MO-11	7	3	4	8	Gone	4	3	5	2	3	**4.3**
MO-12	7	1	6	5	Gone	7	4	4	4	3	**4.6**
MO-13	6	3	7	3	Gone	4	4	4	4	Dead	**4.4**
MO-14	7	3	6	3	Gone	6	Dead	3	4	4	**4.5**
MO-15		2	3	4	Gone						**3.0**

Summary of Insect and Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	3	4	3	3	Gone	6	7	Dead	Dead	3	**4.1**
MO-2	3	2	Dead	2	Gone	Dead	Dead	Dead	Dead	4	**2.8**
MO-3	3	3	2	3	Gone	3	4	3	Dead	3	**3.0**
MO-4	3	3	3	3	Gone	Dead	3	3	2	2	**2.8**
MO-5	3	3	4	3	Gone	2	Dead	5	2	3	**3.1**
MO-6	2	R	R	R	R	Dead	2	3	Dead	3	**2.5**
MO-7	2	Dead	2	3	Gone	Dead	Dead	6	Dead	3	**3.2**
MO-8	4	3	4	3	Gone	8	Dead	3	2	3	**3.8**
MO-9	2	2	2	2	Gone	4	Dead	2	Dead	2	**2.3**
MO-10	2	4	2	3	Gone	2	3	2	3	Dead	**2.6**
MO-11	6	3	3	2	Gone	3	2	2	3	4	**3.1**
MO-12	2	3	3	5	Gone	4	2	2	7	3	**3.4**
MO-13	3	4	5	4	Gone	2	2	3	4	Dead	**3.4**
MO-14	4	1	2	3	Gone	3	Dead	3	3	4	**2.9**
MO-15		2	3	5	Gone						**3.3**

2007 Evaluation
Summary of Missouri Collections, Located in Field #7 **Table #11 - Continued**

Summary of Diameter of Trunk at 24 Inch Height

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	8.50	5.75	11.25	5.75	Gone	5.75	9.00	Dead	Dead	6.25	**7.5**
MO-2	5.25	5.25	Dead	6.75	Gone	Dead	Dead	Dead	Dead	5.75	**5.8**
MO-3	7.00	6.75	6.75	5.50	Gone	1.75	4.75	4.50	Dead	4.25	**5.2**
MO-4	8.50	5.75	5.75	6.75	Gone	Dead	8.75	6.25	6.75	5.25	**6.7**
MO-5	6.25	9.00	5.75	6.50	Gone	6.75	Dead	5.00	8.00	5.75	**6.6**
MO-6	9.25	R	R	R	R	Dead	7.75	6.50	Dead	5.00	**7.1**
MO-7	9.25	Dead	6.25	4.75	Gone	Dead	Dead	4.50	Dead	7.50	**6.5**
MO-8	7.25	7.75	4.25	7.00	Gone	2.25	Dead	6.75	9.25	8.50	**6.6**
MO-9	13.00	5.00	6.50	1.00	Gone	4.00	Dead	9.00	Dead	5.00	**6.2**
MO-10	5.50	8.00	2.50	5.00	Gone	2.75	4.25	4.50	5.00	Dead	**4.7**
MO-11	5.25	6.25	6.50	1.75	Gone	6.25	5.50	4.50	8.50	6.00	**5.6**
MO-12	3.50	8.00	5.00	3.50	Gone	2.25	6.50	5.50	5.75	8.00	**5.3**
MO-13	5.75	9.50	5.75	8.00	Gone	7.25	6.50	5.00	5.75	Dead	**6.7**
MO-14	5.50	6.00	2.50	7.50	Gone	5.25	Dead	9.75	6.50	5.25	**6.0**
MO-15		9.00	8.00	7.00	Gone						**8.0**

Summary of Visible Acorn Production

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
MO-1	no	no	no	no	Gone	no	no	Dead	Dead	no
MO-2	no	no	Dead	no	Gone	Dead	Dead	Dead	Dead	no
MO-3	no	no	no	no	Gone	no	no	no	Dead	no
MO-4	no	no	no	no	Gone	Dead	no	no	no	no
MO-5	no	no	no	no	Gone	no	Dead	no	no	no
MO-6	no	R	R	R	R	Dead	no	no	Dead	no
MO-7	no	Dead	no	no	Gone	Dead	Dead	no	Dead	no
MO-8	no	no	no	no	Gone	no	Dead	no	no	no
MO-9	no	no	no	no	Gone	no	Dead	no	Dead	no
MO-10	no	no	no	no	Gone	no	no	no	no	Dead
MO-11	no	no	no	no	Gone	no	no	no	no	no
MO-12	no	no	no	no	Gone	no	no	no	no	no
MO-13	no	no	no	no	Gone	no	no	no	no	Dead
MO-14	no	no	no	no	Gone	no	Dead	no	no	no
MO-15		no	no	no	Gone					

R = Tree was originally MO-6 accession, but was replaced with MO-15 accession
Replication #5 was removed and used in another study offsite of the PMC

Study MOPMC-P-0001-WE, WL
Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx.

2008 Evaluation

Summary of Missouri Collections, Located in Field #7 Table #12

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	9.3	8.3	11.4	Dead	Gone	8.0	10.0	Dead	Dead	7.8	**9.1**
MO-2	8.5	8.8	Dead	10.0	Gone	Dead	Dead	Dead	Dead	Dead	9.1
MO-3	11.1	9.8	10.4	9.2	Gone	3.5	3.5	9.3	7.8	Dead	8.1
MO-4	11.0	10.0	Dead	10.7	Gone	Dead	Dead	10.8	10.0	11.8	10.7
MO-5	7.3	10.9	10.2	10.8	Gone	8.0	8.0	Dead	8.0	11.2	9.3
MO-6	12.1	R	R	R	Gone	Dead	Dead	8.5	8.6	Dead	9.7
MO-7	12.3	Dead	9.3	Dead	Gone	Dead	Dead	Dead	8.7	Dead	10.1
MO-8	11.3	9.0	Dead	9.8	Gone	Dead	Dead	Dead	10.6	10.1	10.2
MO-9	11.8	5.8	8.3	2.0	Gone	Dead	Dead	Dead	10.6	Dead	7.7
MO-10	10.0	8.0	Dead	10.2	Gone	Dead	Dead	8.7	Dead	10.2	9.4
MO-11	6.9	9.5	9.2	Dead	Gone	9.0	9.0	9.2	8.8	11.0	9.1
MO-12	5.5	12.1	Dead	Dead	Gone	3.7	3.7	9.0	9.8	9.2	7.6
MO-13	8.8	10.0	8.2	9.3	Gone	9.1	9.1	8.5	9.2	8.9	9.0
MO-14	7.6	11.0	Dead	9.3	Gone	8.1	8.1	Dead	9.1	9.6	9.0
MO-15		11.0	10.3	10.0	Gone						10.4

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	9.1	8.4	12.5	Dead	Gone	6.0	9.0	Dead	Dead	8.8	**9.0**
MO-2	8.2	8.5	Dead	8.2	Gone	Dead	6.8	Dead	Dead	Dead	**7.9**
MO-3	11.0	7.7	11.0	8.3	Gone	1.7	7.4	Dead	6.6	7.6	**7.7**
MO-4	11.2	9.0	Dead	7.0	Gone	Dead	7.0	10.3	7.3	10.2	**8.9**
MO-5	6.6	9.8	8.0	8.6	Gone	6.2	7.5	9.7	6.4	Dead	**7.9**
MO-6	11.0	R	R	R	Gone	Dead	7.0	Dead	7.0	7.0	**8.0**
MO-7	12.0	Dead	7.3	Dead	Gone	Dead	9.2	Dead	7.0	Dead	**8.9**
MO-8	7.5	7.8	Dead	5.9	Gone	Dead	8.6	10.9	8.0	Dead	**8.1**
MO-9	11.3	7.5	8.0	1.0	Gone	Dead	6.7	Dead	9.6	Dead	**7.4**
MO-10	7.1	10.5	Dead	6.4	Gone	Dead	Dead	7.7	Dead	6.9	**7.7**
MO-11	6.0	9.7	7.2	Dead	Gone	6.0	8.0	10.0	7.5	7.5	**7.7**
MO-12	6.0	10.7	Dead	Dead	Gone	1.0	10.4	9.2	8.8	7.0	**7.6**
MO-13	7.0	10.5	8.2	8.6	Gone	7.8	Dead	9.0	6.8	6.6	**8.1**
MO-14	5.4	11.0	Dead	8.4	Gone	5.4	8.4	7.8	8.7	Dead	**7.9**
MO-15		10.7	8.8	6.8	Gone						**8.8**

2008 Evaluation
Summary of Missouri Collections, Located in Field #7 **Table #12 continued**

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	3	4	1	Dead	Gone	4	3	Dead	Dead	5	**3.3**
MO-2	4	4	Dead	2	Gone	Dead	Dead	Dead	Dead	3.0	**3.3**
MO-3	1	3	2	3	Gone	8	3	5.0	Dead	4	**3.6**
MO-4	1	4	Dead	3	Gone	Dead	2	4	3	4	**3.0**
MO-5	6	2	3	3	Gone	3	Dead	5	2	5.0	**3.6**
MO-6	1	R	R	R	Gone	Dead	4	4.0	Dead	6	**3.8**
MO-7	1	Dead	4	Dead	Gone	Dead	Dead	5.0	Dead	2.0	**3.0**
MO-8	2	5	Dead	5	Gone	Dead	Dead	3	2	3.0	**3.3**
MO-9	1	8	5	9	Gone	Dead	Dead	2.0	Dead	5.0	**5.0**
MO-10	3	6	Dead	5	Gone	Dead	4.0	Dead	4.0	Dead	**4.4**
MO-11	7	3	3	Dead	Gone	4	4	4	2	3	**3.8**
MO-12	7	1	Dead	Dead	Gone	8	4	3	4	4	**4.4**
MO-13	4	2	6	4	Gone	3	4.0	4	4	Dead	**3.9**
MO-14	6	2	Dead	4	Gone	4	Dead	3	4	4.0	**3.9**
MO-15		2	2	3	Gone						**2.3**

Summary of Insect and Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	3	3	2	Dead	Gone	4	3	Dead	Dead	3	**3.0**
MO-2	2	4	Dead	3	Gone	Dead	Dead	Dead	Dead	2.0	**2.8**
MO-3	3	2	2	2	Gone	5	3	4.0	3	3	**3.4**
MO-4	3	4	Dead	3	Gone	Dead	2	3	3	2	**2.9**
MO-5	3	3	2	2	Gone	3	Dead	2	2	Dead	**2.1**
MO-6	2	R	R	R	Gone	Dead	4	Dead	Dead	5	**2.8**
MO-7	2	Dead	2	Dead	Gone	Dead	Dead	Dead	Dead	3.0	**1.8**
MO-8	3	4	Dead	4	Gone	Dead	Dead	3	2	3.0	**3.2**
MO-9	2	6	1	1	Gone	Dead	Dead	Dead	Dead	Dead	**1.7**
MO-10	2	5	Dead	3	Gone	Dead	4.0	Dead	3.0	4	**4.2**
MO-11	6	2	2	Dead	Gone	5	3	4	2	2	**3.3**
MO-12	2	1	Dead	Dead	Gone	4	5	2	2	3	**2.7**
MO-13	4	1	3	2	Gone	1	4.0	2	2	Dead	**2.4**
MO-14	3	2	Dead	2	Gone	3	Dead	3	3	3.0	**2.7**
MO-15		3	2	3	Gone						**2.7**

2008 Evaluation
Summary of Missouri Collections, Located in Field #7 **Table #12 continued**

Summary of Diameter of Trunk at 24 Inch Height

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	2.75	2.25	4.25	Dead	Gone	2.00	2.25	Dead	Dead	3.00	**2.8**
MO-2	2.25	2.00	Dead	2.75	Gone	Dead	2.25	Dead	Dead	Dead	**2.3**
MO-3	3.50	2.50	2.50	2.25	Gone	1.00	2.00	Dead	1.75	1.75	**2.2**
MO-4	2.75	2.00	Dead	2.50	Gone	Dead	2.00	2.75	2.25	3.50	**2.5**
MO-5	1.75	3.00	2.50	2.50	Gone	2.50	1.75	3.00	1.75	Dead	**2.3**
MO-6	3.25	R	R	R	Gone	Dead	1.75	Dead	2.50	2.50	**2.5**
MO-7	3.50	Dead	2.50	Dead	Gone	Dead	2.75	Dead	2.00	Dead	**2.7**
MO-8	2.75	2.50	Dead	2.50	Gone	Dead	3.00	3.50	2.50	Dead	**2.8**
MO-9	4.50	1.25	2.25	0.25	Gone	Dead	1.75	Dead	3.50	Dead	**2.3**
MO-10	2.25	1.50	Dead	1.75	Gone	Dead	Dead	2.25	Dead	1.50	**1.9**
MO-11	1.75	2.25	2.25	Dead	Gone	2.25	2.25	3.25	1.75	2.00	**2.2**
MO-12	1.25	3.25	Dead	Dead	Gone	0.75	3.00	2.25	2.25	2.50	**2.2**
MO-13	2.25	2.75	2.00	3.00	Gone	2.75	Dead	2.50	2.00	2.50	**2.5**
MO-14	2.00	2.50	Dead	2.50	Gone	2.25	2.00	2.25	3.25	Dead	**2.4**
MO-15		4.00	3.00	2.75	Gone						**3.3**

Summary of Visible Acorn Production

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
MO-1	N	N	YES	Dead	Gone	N	N	Dead	Dead	N
MO-2	N	YES	Dead	N	Gone	Dead	N	Dead	Dead	Dead
MO-3	N	N	N	N	Gone	N	N	Dead	N	N
MO-4	N	N	Dead	N	Gone	Dead	N	N	N	N
MO-5	N	N	N	N	Gone	N	N	N	N	Dead
MO-6	N	R	R	R	Gone	Dead	N	Dead	N	N
MO-7	N	Dead	N	Dead	Gone	Dead	N	Dead	N	Dead
MO-8	N	N	Dead	N	Gone	Dead	N	N	N	Dead
MO-9	N	N	N	N	Gone	Dead	N	Dead	N	Dead
MO-10	N	N	Dead	N	Gone	Dead	Dead	N	Dead	N
MO-11	N	YES	N	Dead	Gone	N	N	YES	N	N
MO-12	N	YES	Dead	Dead	Gone	N	N	N	N	N
MO-13	N	N	N	N	Gone	N	Dead	N	N	N
MO-14	N	N	Dead	N	Gone	N	N	N	N	Dead
MO-15		N	N	N	Gone					

R = Tree was originally MO-6 accession, but was replaced with MO-15 accession
Replication #5 was removed and used in another study offsite of the PMC

Study MOPMC-P-0001-WE, WL
Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa* , Michx.

2009 Evaluation

Summary of Missouri Collections, Located in Field #7 Table #13

Summary of Height (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	10.6	10.0	12.6	DEAD		8.3	14.0	DEAD	DEAD	10.3	**11.0**
MO-2	11.9	9.0	DEAD	11.4		DEAD	DEAD	DEAD	DEAD	10.9	**10.8**
MO-3	13.3	13.0	12.4	10.9		DEAD	11.3	8.6	DEAD	10.3	**11.4**
MO-4	13.7	10.4	DEAD	11.9		DEAD	13.4	10.3	11.8	10.3	**11.7**
MO-5	10.1	12.1	14.3	12.3		10.0	DEAD	9.6	13.7	11.8	**11.7**
MO-6	13.2				removed	DEAD	9.2	9.8	DEAD	7.9	**10.0**
MO-7	13.4	DEAD	10.2	DEAD		DEAD	DEAD	9.3	DEAD	11.9	**11.2**
MO-8	12.9	10.0	DEAD	9.6		DEAD	DEAD	11.2	11.7	12.3	**11.3**
MO-9	13.0	3.0	10.3	DEAD		DEAD	DEAD	10.9	DEAD	10.7	**9.6**
MO-10	11.6	7.2	DEAD	10.2		DEAD	11.4	DEAD	11.3	DEAD	**10.3**
MO-11	5.2	10.0	9.5	DEAD		8.6	10.0	9.9	11.8	13.0	**9.8**
MO-12	6.0	13.8	DEAD	DEAD		DEAD	8.6	11.8	14.2	10.4	**10.8**
MO-13	9.3	11.2	10.1	11.1		11.0	8.3	10.6	9.8	DEAD	**10.2**
MO-14	8.5	11.0	DEAD	9.4		11.0	DEAD	9.2	10.6	10.0	**10.0**
MO-15		13.0	11.8	11.5							**12.1**

Summary of Spread (feet)

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	11.6	9.4	14.0	DEAD		8.4	9.3	DEAD	DEAD	8.6	**9.9**
MO-2	6.8	9.4	DEAD	8.3		DEAD	DEAD	DEAD	DEAD	9.2	**8.4**
MO-3	13.0	8.8	8.8	8.9		DEAD	8.0	6.5	DEAD	9.5	**9.1**
MO-4	14.0	8.0	DEAD	8.0		DEAD	12.0	7.8	8.8	9.1	**9.7**
MO-5	6.9	11.0	11.6	9.6		8.6	DEAD	7.8	11.8	8.4	**9.5**
MO-6	9.6				removed	DEAD	7.9	8.2	DEAD	6.4	**8.0**
MO-7	11.8	DEAD	9.0	DEAD		DEAD	DEAD	9.4	DEAD	11.6	**10.5**
MO-8	7.8	8.4	DEAD	7.3		DEAD	DEAD	9.1	12.3	10.8	**9.3**
MO-9	11.0	2.5	8.8	DEAD		DEAD	DEAD	12.7	DEAD	8.4	**8.7**
MO-10	7.6	9.4	DEAD	6.6		DEAD	6.8	DEAD	8.1	DEAD	**7.7**
MO-11	1.5	9.3	6.9	DEAD		6.6	9.5	9.3	11.6	8.4	**7.9**
MO-12	5.0	9.7	DEAD	DEAD		DEAD	7.6	10.3	10.8	12.0	**9.2**
MO-13	7.5	9.6	4.6	9.6		9.3	6.3	8.8	13.6	DEAD	**8.7**
MO-14	7.0	12.0	DEAD	8.7		8.3	DEAD	11.6	10.5	7.6	**9.4**
MO-15		10.0	8.8	7.7							**8.8**

2009 Evaluation
Summary of Missouri Collections, Located in Field #7 Table #13 continued

Summary of Vigor (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	3	4	1	DEAD	GONE	5	4	DEAD	DEAD	5	**3.7**
MO-2	5	4	DEAD	3	GONE	DEAD	DEAD	DEAD	DEAD	4.0	**4.0**
MO-3	1	3	2	4	GONE	DEAD	4	6.0	DEAD	4	**3.4**
MO-4	1	4	DEAD	3	GONE	DEAD	1	5	2	4	**2.9**
MO-5	6	2	3	4	GONE	5	DEAD	6	2	6.0	**4.3**
MO-6	1					DEAD	5	3.0	DEAD	5	**3.5**
MO-7	1	DEAD	4	DEAD	GONE	DEAD	DEAD	5.0	DEAD	2.0	**3.0**
MO-8	2	5	DEAD	6	GONE	DEAD	DEAD	3	2	2.0	**3.3**
MO-9	1	8	5	DEAD	GONE	DEAD	DEAD	3.0	DEAD	5.0	**4.4**
MO-10	3	8	DEAD	6	GONE	DEAD	5.0	DEAD	4.0	DEAD	**5.2**
MO-11	9	5	5	DEAD	GONE	6	4	3	3	3	**4.8**
MO-12	7	1	DEAD	DEAD	GONE	DEAD	6	3	3	4	**4.0**
MO-13	5	1	6	5	GONE	5	6.0	5	4	DEAD	**4.6**
MO-14	5	2	DEAD	5	GONE	6	DEAD	3	3	5.0	**4.1**
MO-15		2	2	3	GONE						**2.3**

Summary of Insect and Disease Resistance (1-9 Rating) 1=Very Good 9=Poor

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	1	3	1	Dead		3	3	Dead	Dead	4	**2.5**
MO-2	3	4	Dead	2		Dead	Dead	Dead	Dead	4.0	**3.3**
MO-3	3	2	3	4		Dead	3	5.0	Dead	2	**3.1**
MO-4	2	4	Dead	2		Dead	2	5	3	3	**3.0**
MO-5	4	3	3	3		2	Dead	6	1	5.0	**3.4**
MO-6	2					Dead	3	2.0	Dead	3	**2.5**
MO-7	1	Dead	4	Dead		Dead	Dead	3.0	Dead	2.0	**2.5**
MO-8	3	3	Dead	4		Dead	Dead	2	2	2.0	**2.7**
MO-9	1	5	3	Dead		Dead	Dead	3.0	Dead	3.0	**3.0**
MO-10	2	7	Dead	5		Dead	2.0	Dead	3.0	Dead	**3.8**
MO-11	9	4	2	Dead		3	2	2	4	3	**3.6**
MO-12	4	2	Dead	Dead		Dead	6	3	2	2	**3.2**
MO-13	3	2	4	3		2	5.0	3	2	Dead	**3.0**
MO-14	4	1	Dead	2		3	Dead	2	3	3.0	**2.6**
MO-15		3	3	2							**2.7**

2009 Evaluation
Summary of Missouri Collections, Located in Field #7 Table #13 continued

Summary of Diameter of Trunk at 24 Inch Height

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Avg.
MO-1	3.66	2.87	4.78			2.63	3.98	DEAD	DEAD	3.42	**3.6**
MO-2	3.03	2.55	DEAD	3.42		DEAD	DEAD	DEAD	DEAD	3.1	**3.0**
MO-3	3.50	3.18	3.58	2.95		DEAD	2.71	2.2	DEAD	3.03	**3.0**
MO-4	4.14	2.55	DEAD	3.18		DEAD	4.14	2.31	3.34	3.03	**3.2**
MO-5	2.15	3.50	3.03	3.11		3.18	DEAD	2.39	4.30	3.2	**3.1**
MO-6	3.98				removed	DEAD	3.50	3.3	DEAD	2.39	**3.3**
MO-7	4.62	DEAD	2.87	DEAD		DEAD	DEAD	2.7	DEAD	3.5	**3.4**
MO-8	3.50	3.03	DEAD	2.71		DEAD	DEAD	3.50	4.22	4.1	**3.5**
MO-9	5.18	1.11	2.87	DEAD		DEAD	DEAD	4.5	DEAD	1.9	**3.1**
MO-10	3.03	2.07	DEAD	2.31		DEAD	2.1	DEAD	2.9	DEAD	**2.5**
MO-11	1.91	3.18	2.95	DEAD		2.87	2.87	2.63	3.98	3.03	**2.9**
MO-12	1.59	4.14	DEAD	DEAD		DEAD	2.87	3.26	3.50	4.14	**3.3**
MO-13	3.18	3.74	2.47	3.50		3.66	2.6	2.79	3.42	DEAD	**3.2**
MO-14	2.39	3.34	DEAD	3.03		3.34		3.90	3.66	2.9	**3.2**
MO-15		4.14	4.38	3.50							4.0

Summary of Visible Acorn Production

Acc. No.	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
MO-1	N	N	Y	DEAD		N	N	DEAD	DEAD	N
MO-2	N	N	DEAD	N		DEAD	DEAD	DEAD	DEAD	N
MO-3	N	N	N	N		DEAD	N	N	DEAD	N
MO-4	Y	N	DEAD	N		DEAD	N	N	N	N
MO-5	N	N	N	N		N	DEAD	N	Y	N
MO-6	N				removed	DEAD	N	N	DEAD	N
MO-7	N	DEAD	N	DEAD		DEAD	DEAD	N	DEAD	N
MO-8	N	N	DEAD	N		DEAD	DEAD	N	N	N
MO-9	N	N	N	DEAD		DEAD	DEAD	N	DEAD	N
MO-10	N	N	DEAD	N		DEAD	N	DEAD	N	DEAD
MO-11	N	N	N	DEAD		N	N	N	N	N
MO-12	N	Y	DEAD	DEAD		DEAD	N	N	N	N
MO-13	N	Y	N	N		N	N	N	N	DEAD
MO-14	N	N	DEAD	N		N	DEAD	N	N	N
MO-15		N	N	N						

R = Tree was originally MO-6 accession, but was replaced with MO-15 accession
Replication #5 was removed and used in another study offsite of the PMC

Study MOPMC-P-001 Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa*, Michx.

Plot Layout: 5-11-02

Field 7 - Missouri Collections — **2 ROWS** — **Table #14**

Reps				Reps
12	Border Plant		Border Plant **3**	
	14 ←	accessions	→ 1	
	13	"	2	
	12	"	3	
	11	"	4	
	10	"	5	
	9	"	6	
10	8	"	7	**1**
	7	"	8	
	6	"	9	
	5	"	10	
	4	"	11	
	3	"	12	
	2	"	13	
	1	"	14	
	14 ←	accessions	→ 1	
	13	"	2	
	12	"	3	
	11	"	4	
	10	"	5	
	9	"	15	
9	8	"	7	**2**
	7	"	8	
	6	"	9	
	5	"	10	
	4	"	11	
	3	"	12	
	2	"	13	
	1	"	14	
	Repeat ←	accessions	→ Repeat	
8	14		1 to 14	**3**
	to 1		replacing 6 with 15	
7	Repeat ←	accessions	→ Repeat	**4**
	14		1 to 14	
	to 1		replacing 6 with 15	
6	Repeat ←	accessions	→ Repeat	
	14		1 to 14	**5**
	to 1		replacing 6 with 15	
13	Border Plant		Border Plant **1**	

NORTH

FOURTEEN ACCESSIONS PER REPLICATION. FIVE REPLICATIONS PER ROW.

TWO ROWS TOTALING 10 REPLICATIONS AND 70 PLANTS.

Study MOPMC-P-001 Assembly, Evaluation and Selection of Bur Oak, *Quercus macrocarpa*, Michx.								
Plot Layout: 5-30-02							**Table # 15**	
Two plants planted per location				**BP=Border Plant (only one plant planted)**				
FIELD 6 - Iowa Collections								
			2 ROWS					
		3 (BP)		**3 (BP)**				**NORTH**
REPS		**2**		**6**		**REPS**		
		5		**2**				
		6		**7**				
12		**4**		**1**		**1**		
		7		**3**				
		1		**5**				
		3		**4**				
		4		**5**				
		7		**3**				
		5		**7**				
11		**1**		**2**		**2**		
		3		**6**				
		2		**1**				
		6		**4**				
		4		**1**				
		7		**3**				
		2		**2**				
10		**1**		**7**		**3**		
		3		**5**				
		5		**4**				
		6		**6**				
		5		**7**				
		4		**3**				
9		**3**		**1**				
		7		**4**		**4**		
		1		**6**				
		2		**2**				
		6		**5**				
		1		**4**				
		6		**2**				
		5		**5**				
8		**3**		**3**		**5**		
		7		**1**				
		4		**6**				
		2		**7**				
		1		**2**				
		6*		**5**				
		4		**7**				
7		**2**		**1**		**6**		
		7		**3**				
		3		**6***				
		5		**4**				
		2 (BP)		**1 (BP)**				
	*ONLY ONE OF PLANT 6 PLANTED IN THESE							
	LOCATIONS. RAN OUT OF PLANT 6.			**(BP=Border Plant)**				

Study ID Code: MOPMC-T-0105, PA

Study Title – Compatibility Study Using Native Warm Season and Cool Season Grasses with Native Legumes and Forbs

Study Leader: Bruckerhoff, S. B.

Introduction:

Herbaceous plantings using native species are often a single grass species or a mixture of grasses with few legumes or forbs. These types of plantings are typical for forage, conservation cover or even wildlife plantings. Many native forbs and legumes are compatible with native grass species in a native prairie. In a planting using native species it is important to know which ones are most likely to compete with the grasses during the establishment period. Forb and legume seed are more expensive than the grass seed and most plantings lack diversity.

Problem:

There is little to no documented information regarding the compatibility of native warm and cool season grasses with native legumes and forbs in a pasture or range seeding. As a result of the lack of this needed information, the PMC Advisory Committee has directed the PMC to initiate this study.

Objective:

The objective of this study is to determine which native forbs and legumes will establish the easiest and persist the longest with specific native grasses.

Procedure:

Secure seed of the following native cool and warm season grasses, forbs, and legumes.

- **Cool Season Grasses:** Virginia wildrye, Western wheatgrass, Junegrass, and Porcupinegrass.
- **Warm Season Grasses:** Eastern gamagrass, Little bluestem, Big bluestem, Indiangrass, and Switchgrass.
- **Forbs:** Oxeye daisy, Prairie coreopsis, and Grayheaded coneflower.
- **Legumes:** Bush clover, Showy tick trefoil, Purple prairie clover, White prairie clover, Illinois bundleflower, Goat's rue, Wild senna, and Lead plant.

Plots of a native warm season grass mixture, native cool season grass mixture and warm and cool season grass mixture will be established in four replications. Native legumes and forb mixtures will be planted with the grass mixtures. Plots will be planted in the spring and also as winter dormant plantings. All species will also be planted at the same time in the spring and winter except one warm and cool season grass mixture.

Plots will be mowed for weed control during the establishment year. The forage will be removed two to three times a year from half the plot the following years to assimilate rotational grazing.

Discussion:

2001

A site was prepared on the PMC using glyphosate to kill existing vegetation that consisted of mostly annual weedy species. The area was then plowed, disked and planted to an annual covercrop of 80% oats and 20% wheat. Plot composition of species can be seen in Table #1. Seeding rates are 40 pure live seed per square foot with 60% being the grass component and 40% being the forb and legume component.

2002

The winter dormant plots were planted January 8 and 9, 2002 using a plot planter. Seeding depth was one fourth inch for all species except the eastern gamagrass which was planted three fourths to one inch deep. The spring plots were planted May 20 and 21. All seed was planted at a depth of one fourth to one half inch with the exception of eastern gamagrass which again was planted at a depth of three fourths to one inch. All species that required treatment were stratified and/or scarified and inoculated. The plot map of the winter dormant planting is Table #2 and the spring planting is Table #3.

Mowing throughout the summer was the weed control method used. The plots were mowed when vegetation reached six to eight inches. Mowing height was three to four inches.

All plots were evaluated toward the end of the growing season for species composition. Most of the grasses were represented in the plots but in very low densities. Only sideoats gramma and Virginia wildrye appeared in plots in densities in the moderate range. The only legumes/forbs that were identified even at low densities were winter dormant planting Illinois bundleflower, grayheaded coneflower, and prairie coreopsis. Spring planting was Illinois bundleflower and wild senna.

2003/2004

The plots were evaluated for specie density during 2003 and 2004 (see Tables 4 and 5). A winter burn was conducted on all plots in early 2004.

Most species that were planted were identified in the plots although some in very low densities. The specie in the legume/forb mixture showing up in the highest concentration is grayheaded coneflower. Others most consistently found were showy tick trefoil, oxeye daisey, Illinois bundleflower(spring seeding only), and purple prairie clover (spring seeding only).

Most of the grass components of the plots established well but were not very thick stands. The sideoats gramma was high density and the plots with western wheatgrass, Junegrass, and porcupine grass were very poor or none at all.

2005/2006

The plots were again evaluated in 2005 and 2006 (see Tables 4 and 5). The only maintenance to the plots during this period was a burn in March of 2005.

Most of the species planted could be found in the 2006 evaluation although most of the legumes and forbs were in very low densities. Evaluations were visual estimates on a one to nine scale with plants to square feet estimates on the scale. The 2006 evaluation was done by the visual estimate method and also actual counts of three, random one square foot samples per plot. The

table below is actual counts. In comparing the evaluation methods it showed the visual estimates somewhat under estimated the grass species, especially when the densities were high; and over estimated some of the very low densities. Visual estimates were above zero when a few scattered plants could be seen in a plot, but when only three actual counts of one square foot each were made, several had counts of zero.

Species density (stems/sq ft) five years after planting (planted 2002, density at end of 2006)

Winter Dormant Seeding (1/8/2002)				Spring Planting (5/26/2002)			
Grasses	**St/sqft**	**Legumes**	**St/sqft**	**Grasses**	**St/sqft**	**Legumes**	**St/sqft**
Eastern gamagrass (Plot #8)	**13.3**	**Grayheaded coneflower**	**2.575**	**Switchgrass (Plot #4)**	**24.2**	**Grayheaded coneflower**	**1.338**
Virginia wildrye (Plot #6)	**8.6**	**Oxeye false sunflower**	**0.250**	**Siedoats grama**	**18.2**	**Bush clover**	**0.325**
Switchgrass (Plot #1)	**7.3**	**Wild senna**	**0.113**	**Virginia wildrye (Plot #1)**	**15.1**	**Desmodium Showy tick trefoil**	**0.275**
Eastern gamagrass (Plot #3)	**5.8**	**Desmodium**	**0.100**	**Switchgrass (Plot #11)**	**13.4**	**Oxeye false sunflower**	**0.125**
Indiangrass	**5.5**	**Illinois bundleflower**	**0.013**	**Indiangrass**	**11.7**	**Purple prairie clover**	**0.113**
Virginia wildrye (Plot #5)	**5.0**	**Bush clover**	**0.013**	**Eastern gamagrass (Plot #3)**	**11.2**	**Illinois bundleflower**	**0.050**
Little bluestem	**3.9**	**Purple prairie clover**	**0**	**Eastern gamagrass (Plot #8)**	**8.3**	**White prairie clover**	**0**
Switchgrass (Plot #4)	**2.7**	**White prairie clover**	**0**	**Virginia wildrye (Plot #5)**	**2.1**	**Goat's rue**	**0**
Sideoats grama	**2.3**	**Goat's rue**	**0**	**Big bluestem**	**1.4**	**Lead plant**	**0**
Big bluestem	**0.3**	**Lead plant**	**0**	**Little bluestem**	**0**	**Prairie coreopsis**	**0**
Western wheatgrass	**0**	**Prairie coreopsis**	**0**	**Western wheatgrass**	**0**	**Wild senna**	**0 not planted**
Porcupine grass	**0**			**Porcupine grass**	**0**		
Junegrass	**0**			**Junegrass**	**0**		
Total stems/sq ft In 8 plots	**54.7**		**3.064**		**105.6**		**2.226**

Total stem counts for grass species were higher in the spring planting than the winter dormant planting with 105.6 compared to 54.7. Total stem counts of the forb legume mix were higher in the winter dormant planting with 3.064 compared to 2.226 even though the seed was stratified.

2007

The plots were not burned in 2007 and no stem counts were made. A mid summer (June or July) mowing of plots is planned for 2008.

2008/2009

No evaluations were taken during 2008 or 2009. The plots were mowed once each year in May for weed control and to delay flowering. Mowing was at a height of 8 to 12 inches. A final evaluation for plant composition will be done in 2010 or 2011.

Study ID Code: MOPMC-T-0106, BU

Study Title: Collection and Evaluation of Native Cool Season Grasses and Sedges for Filter Strips

Study Leader: Cordsiemon, R.

Description:

A need has developed out of a three-state technical review committee and approved by the State Conservationists Advisory Committee to evaluate different native cool season grasses and sedges for filter strips.

Grasses and sedges to be considered are Virginia wildrye, *Elymus canadensis*; Canada wildrye, *Elymus canadensis*; Junegrass, *Koeleria crista;* bluejoint, *Calamagrostic canadensis*; sweet woodreed, *Cinna arundinacea*; river oats, *Uniola latifolia*; longhair sedge, *Carex cosmosa*; Frank sedge, *Carex frankii*; shoreline sedge, *Carex hyalinolepis*; wheat sedge, *Carex atherodes*; raven's foot sedge, *Carex crus-corvi* Shuttlew; short sedge, *Carex shortina*; hop sedge, *Carex lupulina* Muhl.; crested sedge, *Carex cristatella* Britton; bristle bract sedge, *Carex tribuloides*; and greater straw sedge, *Carex normalis*.

Objective:

There is little to no documented information regarding native cool season grasses and sedges being used in filter strip situations. In an attempt to respond to this lack of information, the PMC has been directed to initiate this study. Depending upon the performance of selected native cool season grasses and sedges in filter strip situations, previous recommendations may change to include those native cool season grasses and sedges performing excellently in this situation.

Discussion:

2001

The study plan for this study was initiated and approved by the State Conservationists' Advisory Committee in August of 2001. Selected field offices in the PMC service area will be contacted in the spring of 2002 requesting their participation in this collection, however everyone is welcomed to participate. One to three collections per state per species are being requested, both seeds and plants. The plants will be grown in the PMC greenhouse and later transplanted in randomized complete blocks. Each block will be one foot wide and five feet long with approximately 30 plants per plot. The spacing of the plants in the blocks will be six inches x six inches.

2002-2003

Collections of native sedges and cool season grasses began on July 2, 2002. The following chart reflects a listing of the collections made as of the time this report was developed. The collection period was extended one more year to make collections of those species that have not been made or those species needing more collections. Fourteen additional collections were made in the state of Missouri and eleven were made in Iowa during 2003. Samples of seed from each different species were planted in the greenhouse to determine the germination percentage. The results will be documented in

the 2004 Annual Technical Report. Field #10 on the PMC has been selected as the site for this study because of the access to water. Two collections of river oats were planted (vegetatively) on September 9, 2002. Both collections were performing with fair to good vigor.

2004

The planting site for this project was changed from Field #10 to Field #7. There is still available water and space. There were two separate wetland cells constructed by using a landscraper in order to simulate a wetland environment. The wetland cells measure 20 feet x 200 feet and are made up of several different individual blocks. The blocks themselves measure 5 feet x 20 feet (refer to Table #2 for map). Collections that did well in the greenhouse were stepped up in plug containers. They were planted in Field #7 on May 3 and were evaluated for percent stand, percent cover, lodging, and survival in late June (refer to Table #3). The west cell contains 17 blocks that include 100 plants per block of a particular species. The east cell contains 27 different collections consolidated into 11 different blocks. These collections were added together because they did not contain 100 plants. All blocks were planted on one foot by one foot spacing. Each collection will be evaluated three times in 2005, (late winter, summer, and fall) for percent stand and cover, lodging, and survival. The cells will be kept fairly damp throughout the growing season and will be treated with a pre-emergent grass herbicide in the sedge plots to help control annual grasses.

2005

Two evaluations were completed (refer to Table # 5) in 2005. Six species were selected based on evaluations for increase plantings. The species selected for increase are larger straw sedge (*Carex normalis*), Crested Sedge (*Carex cristella*), Fox Sedge (*Carex vulpinoidea*), Crowfoot Sedge (*Carex crus-corvi*), Franks Sedge (*Carex frankii*), and Green Bulrush (*Scirpus atrovirens*). The increase plantings are scheduled for January 2006.

2006

On February 15, 2006 the six selected species were planted into production blocks. The blocks were 0.25 acre in size. The plots were planted to cereal rye the season prior to planting and mowed in the fall, plowed in January 2005, disked and rolled prior to planting. Plots were planted in 8" rows with the plot planter on the surface to 1/4" deep. All six species (larger straw sedge (*Carex normalis*), Crested Sedge (*Carex cristella*), Fox Sedge (*Carex vulpinoidea*), Crowfoot Sedge (*Carex crus-corvi*), Franks Sedge (*Carex frankii*), and Green Bulrush (*Scirpus atrovirens*)) were planted at an estimated rate of 40 pure live seed per square foot. See figure 1 for production plantings in field 7A. Plots were sprayed with both Poast (grass herbicide) and 2,4-D (broadleaf herbicide). When the plots were sprayed no sedges were present, weed competition was extreme with white clover dominating the plots. The plots were evaluated several times throughout the growing season, but the selected sedges were not observed. Plans are to replant the same plots with the same species at a later date (April) in 2007. The selected species will be put in the germinator to check germination percent.

2007

On April 25, 2007, the six selected species were planted again in the same areas of field 7 in an attempt to establish production plots of each. Again all six species (larger straw sedge (*Carex normalis*), crested sedge (*Carex cristella*), fox sedge (*Carex vulpinoidea*), crowfoot sedge (*Carex crus-corvi*), franks sedge (*Carex frankii*), and green bulrush (*Scirpus atrovirens*)) were planted at an estimated rate of 40 pure live seed per square foot. Neither Poast, nor 2,4-D were used; instead a new chemical called Stinger was used to control weed competition. Several seedlings were identified, but the plots still struggled to establish. Weed competition again became a problem by late summer and drought conditions did not help in the survival of these wetland species. After speaking with Chris Hoag, Aberdeen PMC in Idaho, it was determined that water would play a huge factor in establishing the different species of sedges.

Seed from the PMC evaluation plots was depleted after planting plots in April 2007. The decision was made to make more collections of the same species from the US Fish and Wildlife Refuge in Annada, Missouri. Candy Chambers, assistant manager of the Clarence Cannon Refuge, assisted in collecing the seed. Collections were made from June to August 2007; some by hand and two were harvested by using the plot combine. Plans for FY 2008 are to plant production plots at the Clarence Cannon Refuge in Annada where the amount and level of water is easily controlled.

Species of Sedges Collected from Clarence Cannon Refuge in 2007		
Scientific Name	**Common Name**	**Amount Collected in Lbs.**
Carex vulpinoidea	Fox Sedge	82.9
Carex hyalinolepis	Thinscale Sedge	6.1
Carex frankii	Franks Sedge	0.3
Carex crus-corvi	Crowfoot sedge	1.2
Carex lupulina	Hops Sedge	0.3
Carex cristella	Crested Sedge	0.2
Scirpus atrovirens	Green Bulrush	0.1

2008

In 2008, plans were to establish 5 plots at the Clarence Cannon Refuge in Annada, MO in late June. The flood, that occurred most of the summer, engulfed most of the bottom ground. The 20 x 40 ft. plots would have to wait until November in order to be planted. The five species that will be planted are crested sedge, ravenfoot sedge, Franks sedge, hops sedge, and green bulrush. They will be evaluated for how well they establish and ability to survive in the controlled water levels.

The six plots in field 7 at the PMC were planted in April of 2007 and were inundated with water for 4 weeks during the flood. When the flood waters had receded, it was obvious that Franks, crowfoot, fox, and crested sedge had survived and showed signs of flourishing without the extra competition.

2009

The plots of Franks, crowfoot, fox, and crested sedge were maintained in field 7. There is an emphasis on seed production from these four species so that field testing may begin. Thinscale sedge is showing promise of competing well vegetatively and might be a possible plant material to use in place of Reeds canarygrass. There was very little seed harvested in 2009 and only crested sedge and green bulrush were harvested from field 7. The production plots in field 7 are filling in well and seed production in the future years should be good.

Table #1

Study MOPMC-T-0106, BU - Collection and Evaluation of Native Cool Season Grasses and Sedges for Filter Strips

Initial Collections

Scientific Name	Common Name	Collector	City, State	Temp. Acc. No
Carex crus-corvi	Ravens foot sedge	Dennis Shirk	Vienna, MO	MO-1
Carex grayii	Gray sedge	Dennis Shirk	Vienna, MO	MO-2
Carex atherodes	Slough Sedge	Dennis Shirk	Vienna, MO	MO-3
Carex vulpinoidea Michx.	Fox sedge	Dennis Shirk	Vienna, MO	MO-4
Carex vulpinoidea Michx.	Fox sedge	Kaiser & Henry	Elsberry, MO	MO-5
Carex hyalinolepis Steud.	Thinscale scale	Kaiser & Henry	Elsberry, MO	MO-6
Carex crus-corvi Shuttlew	Crowfoot sedge	Kaiser & Henry	Elsberry, MO	MO-7
Carex hyalinolepis Steud.	Thinscale sedge	Paul Freese	Albany, MO	MO-8
Carex vulpinoidea Michx	Fox sedge	Kaiser & Henry	Elsberry, MO	MO-9
Scirpus atrovirens	Green bulrush	Kaiser & Henry	Elsberry, MO	MO-10
Scirpus atrovirens	Green bulrush	Kaiser & Henry	Elsberry, MO	MO-11
Carex frankii Kunth.	Franks sedge	Paul Frese	Albany, MO	MO-12
Carex lupulina Muhl.	Hop sedge	Raleigh Redman	Warrensburg, MO	MO-13
Carex grayii	Gray's sedge	Raleigh Redman	Warrensburg, MO	MO-14
Carex hyalinolepis Steud.	Thinscale sedged.	Raleigh Redman	Warrensburg, MO	MO-15
Carex frankii Kunth	Frank's sedge	Lingwall & Ellis	Ralls Co., MO	MO-17
Carex crus-corvi	Crowfoot sedge	Lingwall & Ellis	Ralls Co., MO	MO-18
Carex hyalinolepis Stued.	Thinscale sedge	Lingwall & Ellis	Ralls Co., MO	MO-19
Carex frankii Kunth	Frank's sedge	Raleigh Redman	Warrensburg, MO	MO-20
Chasmanthium latifolium	River oats	J. Kaiser	Troy, MO	MO-21

Table # 1-Study MOPMC-T-0106, BU - cont.

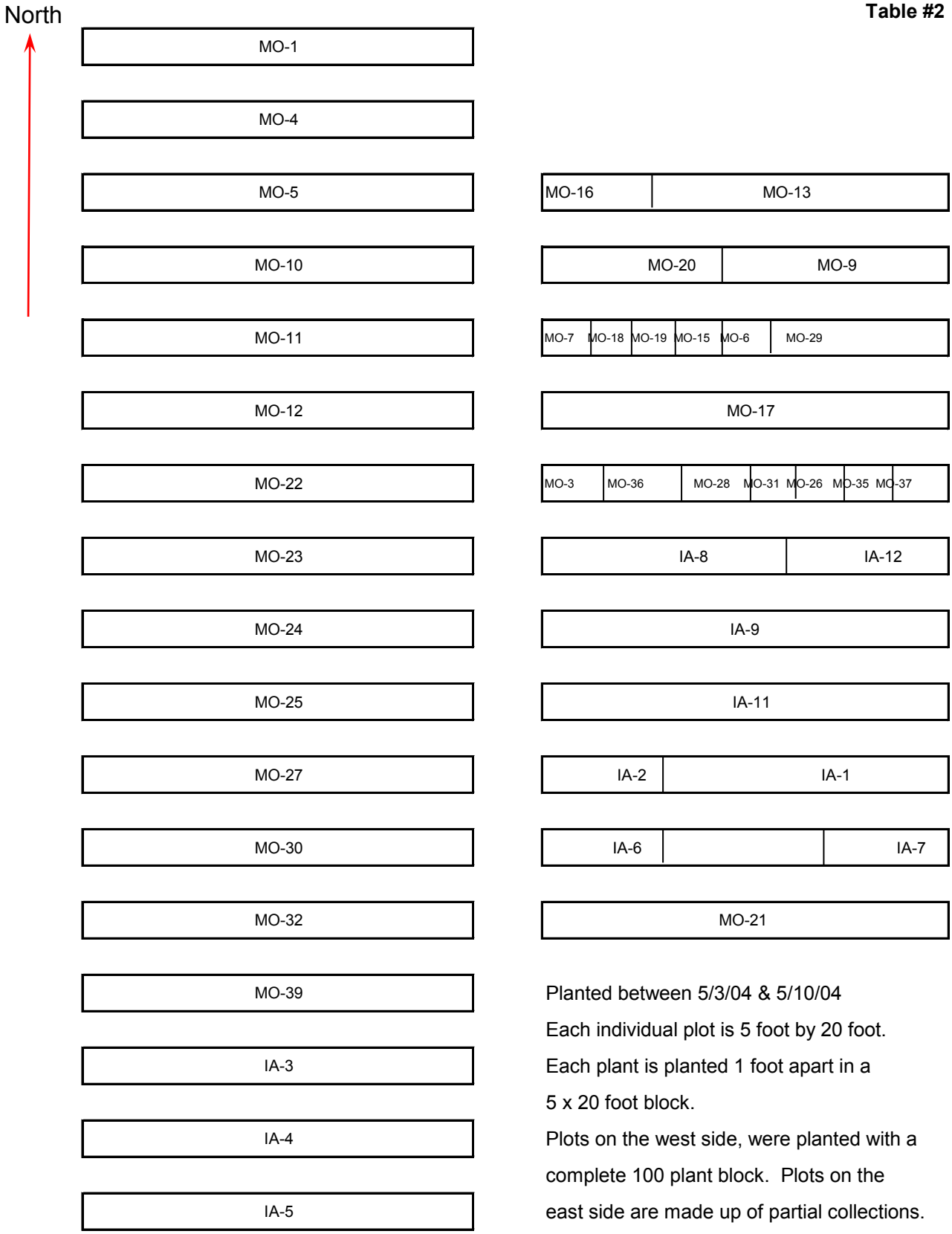
Scientific Name	Common Name	Collector	City, State	Temp. Acc. No
Chasmanthium latifolium	River oats	Travis Dinsdale	Springfield, MO	MO-22
Chasmanthium latifolium	River oats	Rodney Doolen	Puxico, MO	MO-23
Chasmanthium latifolium	River oats	J. Kaiser	Troy, MO	MO-24
Chasmanthium Latifolium	River oats	William Brouk	Benton, MO	MO-25
Carex crus-corvi Shuttlew	Ravensfoot sedge	J. Kaiser J. Henry	BK Leach Wildlife Area	MO-26
Carex shartina	Short sedge	J. Kaiser J. Henry	BK Leach Wildlife Area	MO-27
Carex	Shoreline sedge	J. Kaiser J. Henry	BK Leach Wildlife Area	MO-28
Carex hyalinoepis	Thinscale sedge	J. Kaiser J. Henry	BK Leach Wildlife Area	MO-29
Carex vulpinoidea Michx.	Fox sedge	J. Kaiser J. Henry	BK Leach Wildlife Area	MO-30
Carex crus-corvi Shuttlew	Ravensfoot sedge	J. Kaiser J. Henry	BK Leach Wildlife Area	MO-31
Carex vulpinoides Michx	Fox sedge	J. Kaiser J. Henry	BK Leach Wildlife Area	MO-32
Scipus atrovirens	Green bulrush	Aaron Jeffries	Howard Co, MO	MO-33
Carex frankii	Frank's sedge	Aaron Jeffries	Howard Co, MO	MO-34
Carex lupulina	Hop sedge	Aaron Jeffries	Howard Co, MO	MO-35
Carex shortina	Short sedge	Aaron Jeffries	Howard Co, MO	MO-36
Scirpus acutus	Hard-stemmed bulrush	Aaron Jeffries	Howard Co, MO	MO-37
Scirpus atrovirens	Green bulrush	Paul Frese	Gentry Co, MO	MO-38
Chasmanthium latifolium	River oats	Travis Dinsdale	Webster Co, MO	MO-39
Carex hyalinoepis Steud.	Thinscale sedge	Dave Hiatt	Martinsville, IL	IL-1

Table 1-Study MOPMC-T-0106, BU - cont.

Scientific Name	Common Name	Collector	City, State	Temp. Acc. No
Carex lupulina Muhl.	Hop sedge	Christine Talige	Fairfield, IA	IA-1
Carex cristatella Britton	Crested sedge	Tim Meyer	Williamsburg, IA	IA-2
Carex cristatella Britton	Crested sedge	Tim Meyer	Williamsburg, IA	IA-3
Carex vulpineidea	Fox sedge	Tim Meyer	Williamsburg, IA	IA-4
Scirpus atrovirens	Green bulrush	Tim Meyer	Williamsburg, IA	IA-5
Juncus interior Weigand	Inland rush	Tim Meyer	Williamsburg, IA	IA-6
Calamagrostis Canadensis	Bluejoint	Tim Meyer	Williamsburg, IA	IA-7
Scirpus atrovirens	Green bulrush	Tim Meyer	Williamsburg, IA	IA-8
Carex normalis	Larger straw sedge	Tom Hurford	Atlantic, IA	IA-9
Carex tribuloides	Bristle bract sedge	Tom Hurford	Atlantic, IA	IA-10
Carex normalis	Larger straw sedge	Tom Hurford	Atlantic, IA	IA-11
Scirpus atrovirens	Green bulrush	Tom Hurford	Atlantic, IA	IA-12

Sedge, Rush, and Cool Season Grass Plot - Field #7

Table #2



Planted between 5/3/04 & 5/10/04

Each individual plot is 5 foot by 20 foot.

Each plant is planted 1 foot apart in a 5 x 20 foot block.

Plots on the west side, were planted with a complete 100 plant block. Plots on the east side are made up of partial collections.

Study ID Code: MOPMC-T-0106, BU			Table #3
Collection and Evaluation of Native Cool Season Grasses and Sedges for Filter Strips			
	MISSOURI COLLECTIONS		
Collection	**Common Name**	**Scientific Name**	**# of Plants**
MO-1	Crowfoot Sedge	Carex crus-corvi	100 Plants
MO-3	Slough Sedge	Carex obnupta	7 plants
MO-4	Fox Sedge	Carex vulpinoidea	100 Plants
MO-5	Fox Sedge	Carex vulpinoidea	100 Plants
MO-6	Thinscale Sedge	Carex hyalinolepis	8 Plants
MO-7	Crowfoot Sedge	Carex crus-corvi	47 Plants
MO-9	Franks Sedge	Carex frankii	45 Plants
MO-10	Green Bulrush	Scirpus atrovirens	100 Plants
MO-11	Green Bulrush	Scirpus atrovirens	100 Plants
MO-12	Franks Sedge	Carex frankii	100 Plants
MO-13	Hop Sedge	Carex lupulina	25 Plants
MO-15	Thinscale Sedge	Carex hyalinolepis	3 Plants
MO-16	Franks Sedge	Carex frankii	75 Plants
MO-17	Franks Sedge	Carex frankii	76 Plants
MO-18	Crowfoot Sedge	Carex crus-corvi	11 Plants
MO-19	Thinscale Sedge	Carex hyalinolepis	3 Plants
MO-20	Franks Sedge	Carex frankii	54 Plants
MO-21	River Oats	Chasmathium latifolium	76 Plants
MO-22	River Oats	Chasmathium latifolium	100 Plants
MO-23	River Oats	Chasmathium latifolium	100 Plants
MO-24	River Oats	Chasmathium latifolium	100 Plants
MO-25	River Oats	Chasmathium latifolium	100 Plants
MO-26	Crowfoot Sedge	Carex crus-corvi	6 Plants
MO-27	Bottlebrush Sedge	Carex comosa	100 Plants
MO-28	Thinscale Sedge	Carex hyalinolepis	9 Plants
MO-29	Thinscale Sedge	Carex hyalinolepis	13 Plants
MO-30	Fox Sedge	Carex vulpinoidea	100 Plants
MO-31	Crowfoot Sedge	Carex crus-corvi	11 Plants
MO-32	Fox Sedge	Carex vulpinoidea	100 Plants
MO-35	Hop Sedge	Carex lupulina	19 Plants
MO-36	Squarrose Sedge	Carex squarrosa	6 Plants
MO-37	Hard-stemmed Sedge	(hard-stemmed bulrush) Schoenoplectus acutus	18 Plants
MO-39	River Oats	Chasmathium latifolium	100 Plants

Table 3 - continued			
	IOWA COLLECTIONS		
Collection	**Common Name**	**Scientific name**	**# of Plants**
IA-1	Hop Sedge	Carex lupulina	23 Plants
IA-2	Crested Sedge	Carex cristatella	52 Plants
IA-3	Crested Sedge	Carex cristatella	100 Plants
IA-4	Fox Sedge	Carex vulpinoidea	100 Plants
IA-5	Green Bulrush	Scirpus atrovirens	100 Plants
IA-6	Inland Rush	Juncus interior	17 Plants
IA-7	Bluejoint	Calamagrostis canadensis	23 Plants
IA-9	Larger Straw Sedge	Carex normalis	76 Plants
IA-8	Green Bulrush	Scirpus atrovirens	38 Plants
IA-11	Larger Straw Sedge	Carex normalis	76 Plants
IA-12	Green Bulrush	Scirpus atrovirens	60 Plants
Shoreline sedge is the same as thinscale sedge			
Crowfoot sedge is the same as ravenfoot sedge			

Study ID Code: MOPMC-T-0106, BU **Table #4**

Collection and Evaluation of Native Cool Season Grasses and Sedges for Filter Strips

Sedge, Cool Season Grass, and Bulrush Evaluation

DATE:___6/22/04___

Collection #	Name	Number of Plants	Percent Stand	Percent Cover	Lodging (1-9 Rating)	Notes
MO-1	Crowfoot Sedge	100	100	20	1	
MO-4	Fox Sedge	100	100	20	1	
MO-5	Fox Sedge	100	100	20	1	
MO-10	Green Bulrush	100	100	15	1	
MO-11	Green Bulrush	100	100	15	1	
MO-12	Franks Sedge	100	100	25	1	
MO-22	River Oats	100	80	5	1	
MO-23	River Oats	100	100	5	1	
MO-24	River Oats	100	95	5	1	
MO-25	River Oats	100	95	5	1	
MO-27	Bottlebrush Sedge	100	100	20	1	
MO-30	Fox Sedge	100	100	15	1	
MO-32	Fox Sedge	100	100	15	1	
MO-39	River Oats	100	80	5	1	
IA-3	Crested Sedge	100	100	30	1	
IA-4	Fox Sedge	100	100	15	1	
IA-5	Green Bulrush	100	100	20	1	
MO-13	Hop Sedge	25	100	25	1	
MO-16	Franks Sedge	75	100	25	1	
MO-9	Franks Sedge	45	100	25	1	
MO-20	Franks Sedge	54	100	20	1	
MO-29	Thinscale Sedge	13	100	15	1	
MO-6	Thinscale Sedge	8	100	20	1	
MO-15	Thinscale Sedge	3	66	15	1	
MO-19	Thinscale Sedge	3	33	15	1	
MO-18	Crowfoot Sedge	11	100	15	2	
MO-7	Crowfoot Sedge	47	100	20	2	
MO-17	Franks Sedge	76	100	10	1	
MO-37	Hard-stemmed Sedge	18	100	10	1	
MO-35	Hop Sedge	20	100	20	1	
MO-26	Crowfoot Sedge	6	100	10	2	
MO-31	Crowfoot Sedge	11	100	25	1	
MO-28	Thinscale Sedge	9	100	10	1	
MO-36	Squarrose Sedge	6	85	15	1	
MO-3	Slough Sedge	7	100	15	1	
IA-12	Green Bulrush	60	100	10	1	

Table #4 - continued

Collection #	Name	Number of Plants	Percent Stand	Percent Cover	Lodging (1-9 Rating)	Notes
IA-8	Green Bulrush	38	100	10	1	
IA-9	Larger Straw Sedge	76	100	20	1	
IA-11	Larger Straw Sedge	76	100	10	1	
IA-1	Hop Sedge	23	100	15	1	
IA-2	Crested Sedge	52	100	25	1	
IA-7	Bluejoint	21	92	15	1	
IA-6	Inland Rush	16	96	15	1	
MO-21	River Oats	76	95	5	1	

1-9 Rating 1 = No Lodging 9 = Severe Lodging

Study MOPMC-T-0106, BU - Collection and Evaluation of Native Cool Season Grasses and Sedges

Table #5

2005 Evaluation Averages For Each Species

Name	Collection #		% Stand	% Cover	Lodging	Vigor
Bluejoint	IA-7		62.5	47.5	4	6
Bottlebrush Sedge	MO-27		100	82.5	4	6
Crested Sedge	IA-2		100	54.5	5	1
Crested Sedge	IA-3		100	85	5.5	1
Crowfoot Sedge	MO-1		100	90	3	1
Crowfoot Sedge	MO-7		100	95	4.5	2
Crowfoot Sedge	MO-18		100	90	4	2
Crowfoot Sedge	MO-26		100	90	5	3
Crowfoot Sedge	MO-31		100	95	7	2
Fox Sedge	IA-4		100	72.5	4.5	3
Fox Sedge	MO-4		99	95	5	2
Fox Sedge	MO-5		100	87.5	5	2
Fox Sedge	MO-30		100	87.5	5.5	3
Fox Sedge	MO-32		100	80	4.5	4
Franks Sedge	MO-9		100	90	3	3
Franks Sedge	MO-12		100	85	2.5	1
Franks Sedge	MO-16		100	92.5	3	3
Franks Sedge	MO-17		98.5	75	3	5
Franks Sedge	MO-20		100	85	3	3
Green Bulrush	IA-5		100	57.5	4.5	4
Green Bulrush	IA-8		100	87.5	5	4
Green Bulrush	IA-12		100	72.5	4.5	4
Green Bulrush	MO-10		99.5	52.5	3	5
Green Bulrush	MO-11		100	50	3	6
Hop Sedge	IA-1		100	92.5	7	2
Hop Sedge	MO-13		100	85	2	3
Hop Sedge	MO-35		100	90	3	2
Inland Rush	IA-6		95		3.5	4
Larger Straw Sedge	IA-9		100	95	5.5	2
Larger Straw Sedge	IA-11		100	92.5	5	1
River Oats	MO-21					9
River Oats	MO-22		70	15	1	9
River Oats	MO-23		97	25	1	9
River Oats	MO-24		95	20	1	9
River Oats	MO-25		90	20	1	9
River Oats	MO-39		85	15	1	9
Slough Sedge	MO-3		100	62.5	3.5	5

Study MOPMC-T-0106, BU - Collection and Evaluation of Native Cool Season Grasses and Sedges

Table #5 - continued

2005 Evaluation Averages For Each Species

Name	Collection #		% Stand	% Cover	Lodging	Vigor
Squarrose Sedge	MO-36		100	50	5	5
Thinscale Sedge	MO-6		100	80	4.5	1
Thinscale Sedge	MO-15		100	75	2	2
Thinscale Sedge	MO-19		100	65	2	5
Thinscale Sedge	MO-28		100	70	2	4
Thinscale Sedge	MO-29		100	77.5	1.5	2

Lodging
1 = No Lodging 9= Severe Lodging

Vigor
1= Highly Vigorous 9= Low Vigor

Study: MOPMC-P-0613-PA, WL

Study Title: Evaluation and Release of a Shade Tolerant Big Bluestem, *Andropogon gerardii*, L., for Silvopasture

Study Leaders: Van Sambeek, J., D. Wallace, G. Garrett, S. Bruckerhoff

Introduction:

Big bluestem is one of the most widespread important forage grasses of the North American tallgrass prairie region. It is usually associated with one or more of the other three dominant species; Indiangrass, switchgrass, and little bluestem. Big bluestem occurs on sub-irrigated lowlands, nearly level to gently undulating glacial till plains, overflow sites, level swales and depressions, residual and glacial uplands, and stream terraces and bottomlands along rivers and tributaries. The abundant, leafy forage is palatable to all classes of livestock.

The Elsberry PMC initiated a big bluestem collection from the Ozark region (Missouri, Arkansas, and Oklahoma) in 1988 to develop an improved big bluestem that would be better adapted to this region. The collection effort resulted in an assembly of 370 big bluestem accessions and three releases, OZ70 germplasm, a selected release for forage; Refuge germplasm, a medium height selection for buffers, filters and wildlife; and OH370 germplasm, a source identified release for diversity.

Problem:

There is limited information available on species selected for forage to be primarily used for savannas and silvopasture systems throughout Missouri.

Objective:

An existing PMC big bluestem collection displays an amazing range of morphological and phonological characteristics – color, plant height, blade width, stem erectness, rust resistance, spring emergence, anthesis, etc. This collection has never been evaluated for shade attributes that might be valuable in silvopasture systems or with savanna restoration efforts. This study will select and evaluate for forage production in relation to shade tolerance.

Cooperators:

The USDA Natural Resources Conservation Service, Plant Materials Center and the University of Missouri, Columbia, Horticulture and Agroforestry Research Center, HARC.

Procedure:

Randomized complete block design with three replications, five shade levels: full sun, 30% shade, 55% shade, 78% shade with sunflecks, and 80% shade.

Twenty-two accessions of big bluestem were selected based on original collection site descriptions and phenotypic characteristics such as leaf width, and chlorophyll content. These collections came from previous work (Study 29I097G) at the Elsberry and Arkansas PMC's and were assembled in 2005 at the University of Missouri Agroforestry Center (HARC). Additional species being evaluated are eastern gamagrass, Canada wildrye, riveroats, cluster fescue, and tall fescue. Plants were started in the greenhouse and planted in replicated plots the spring 2006.

Forty-five pots for each accession were randomized within each treatment. Above ground dry weight, leaf weight, and forage quality (acid detergent fiber, neutral detergent fiber, crude protein) will be collected for each accession.

Discussion:

2005/2006

Key Findings:

All big bluestem accessions exhibited growth reductions in harvested seasonal biomass (summer plus fall harvest in 2005) under reduced light, although four accessions had produced greater biomass at 70% of full sunlight than under full sunlight (Table 1). Response of most accessions closely approximated a linear relationship between harvested biomass and percentage reduction in light from full sunlight. When fitted to the equation $Y = MX + B$ where Y is g/pot harvested biomass and X is percent reduction from full sunlight, M approximates decrease in biomass per percent reduction in full sunlight and B approximates yield under full sun. We hypothesize the best accessions for most agroforestry practices will exhibit a compromise between relatively low values for M and relatively high values for B such as exhibited by PMC-6925, a high producing shade tolerant accession, compared to PMC-6974, an accession that did poorly under increasing shade (fig. 1). Yield data was also fitted to a second order polynomial and first derivative solved to estimate the percent of full sunlight produced maximum yields (estimated peak biomass production was at 76 % and >100% of full sunlight for PMC-6925 and PMC-6974, respectively).

Analysis of summer 2005 big bluestem biomass for forage quality showed highly significant interactions for Crude Protein (CP), Acid Detergent Fiber (ADF), and Relative Feed Value (RFV) under differing shade levels with and overall increase in CP and ADF and an overall decrease in RFV as shade levels increased (Table 2). Neutral Detergent Fiber (NDF) and Total Digestible Nutrients (TDN) also showed significant and very significant responses, respectively, to increasing shade levels.

Table 1.—Seasonal biomass production in 2005 for 21 accessions of big bluestem under five light regimes, coefficients for linear regression for each accession, and calculated percentage of full sunlight for maximum biomass yield.

State of origin	PMC number	2005 combined summer and fall biomass (g/pot) under five light regimes					Reg. coeff. for mx + b		Max. yield
		Full sun	70%	45%	20%	Sunfleck	b	x	% fs
AR	6967(02)	71	70	51	31	38	77	-0.51	>100
MO	6832(04)	85	81	67	39	32	92	-0.66	89
MO	6812(05)	75	85	61	37	44	86	-0.52	80
MO	6885(06)	96	86	79	32	42	104	-0.76	88
AR	6896(07)	94	82	73	43	50	98	-0.61	95
AR	6972(08)	88	81	78	42	52	94	-0.53	85
MO	6807(10)	91	76	64	47	46	92	-0.57	>100
AR	6974(12)	94	73	53	23	27	97	-0.89	>100
AR	6902(13)	90	80	58	32	46	94	-0.68	>100
MO	6802(14)	110	89	89	52	60	112	-0.66	>100
AR	6905(15)	88	75	67	40	45	91	-0.58	>100
OK	7049(16)	103	92	74	54	53	107	-0.65	>100
MO	6741(17)	87	93	77	52	56	96	-0.47	79
AR	6925(19)	91	96	89	65	58	100	-0.41	76
MO	6838(21)	96	96	78	45	57	105	-0.64	86
MO	6704(22)	73	67	57	37	35	77	-0.48	98
AR	6935(24)	85	64	60	26	37	86	-0.65	>100
OK	7039(25)	78	72	57	52	53	79	-0.34	>100
MO	OZ-70(26)	88	62	54	18	26	89	-0.83	>100
MO	Rountree	85	88	79	55	56	92	-0.41	78
OK	7007(29)	67	54	32	17	20	68	-0.62	>100

Figure 1.—Individual pot biomass in 2005 for shade tolerant PMC-6925 (squares) and intolerant PMC-6974 (diamonds) and fitted linear and quadratic responses as a function of full sunlight.

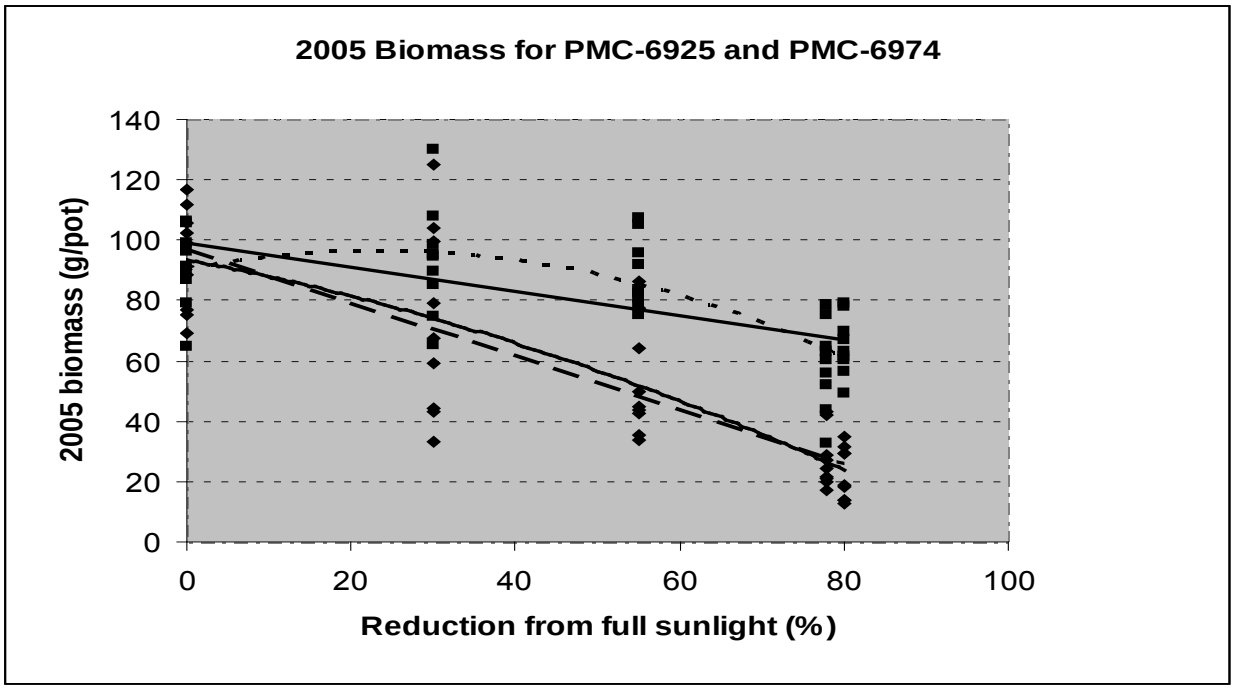


Table 2.– Summer 2005 forage quality mean and standard deviation (SD) averaged across 21 big bluestem (BBS) under five light regimes for percent crude protein (CP=true protein plus non-protein nitrogen), acid detergent fiber (ADF=highly indigestible fiber), neutral detergent fiber (NDF=cell wall or structural components), total digestible nutrients (TDN=111.8 + 0.95 CP - 0.36 ADF- 0.7 NDF), and relative feed value (RFV=(%DDM x %DMI)/1.29 or relative to full bloom alfalfa set at 100).

Light regime	**CP (%)**		**ADF (%)**		**NDF (%)**		**TND (%)**		**RFV**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Full sun	6.2	1.0	36.0	3.2	63.5	2.6	60.2	3.3	89.4	6.8
70 % of full sun	6.2	1.5	39.2	3.6	65.7	3.3	57.6	4.0	83.0	8.0
45 % of full sun	6.9	1.9	40.0	3.9	65.9	3.4	57.7	4.4	81.8	8.1
20% of full sun	8.7	1.9	40.8	3.0	66.4	2.4	58.9	3.9	80.2	5.9
22% sunfleck	8.3	1.9	40.2	2.8	65.6	2.5	59.3	3.8	81.9	5.7
Sign: Shade	***		***		*		**		***	
5% LSD	0.5		1.2		1.5		1.3		2.5	
Interaction sign.: Shade x Acces.	***		ns		ns		**		ns	

2007

Key Findings:

Analysis of 2006 forage quality data compared to 2005 results (Table 3) showed that general trends for 2006 were similar to 2005. TDN and RVF values decreased as shade levels increased; while crude protein, ADF and NDF, values increased for all combined accessions.

Table 3. Seasonal forage quality in 2005 and 2006 for combined accessions of big bluestem under four light regimes.

	CP (%)		**ADF (%)**		**NDF (%)**		**TDN (%)**		**RFV**	
Light regime	*2005 Mean*	*2006 Mean*	*2005 Mean*	*2006 Mean*	*2005 Mean*	*2006 Mean*	*2005 Mean*	*2006 Mean*	*2005 Mean*	*2006 Mean*
Full sun	6.2	5.0	36.0	35.6	63.5	62.9	60.2	59.7	89.4	90.4
70 % of full sun	6.2	4.4	39.2	36.2	65.7	64.0	57.6	58.2	83.0	88.4
45 % of full sun	6.9	4.3	40.0	37.7	65.9	65.3	57.7	56.6	81.8	85.0
20% of full sun	8.7	4.6	40.8	39.1	66.4	66.5	58.9	55.6	80.2	82.0
5% LSD	0.5	0.4	1.2	1.1	1.5	1.4	1.3	1.3	2.5	2.5

Substantial variation exists among the 21 big bluestem accessions for total forage production (sum of boot-stage plus fall harvest) in both 2005 and 2006 (Table 4). Both boot-stage and fall biomass yields for big bluestem plants were substantially lower in 2006 than in 2005 when the plants were first established. Examination of the root systems after the 2006 growing season indicated plants were heavily root-bound with many roots circling the inside of the 2-gallon pots. The number of days to mid-boot or late-boot (just before inflorescence emerges from the sheath of a flag leaf) showed greater variability among the big bluestem accessions during the 2006 growing season than the 2005 growing season. In addition, four accessions (PMC-6832, 6896, 6295, and 7007) in 2006 had plants that failed to flower especially at the lowest light levels.

Table 4. Seasonal biomass production in 2005 and 2006 for 21 accessions of big bluestem under five light regimes with sunfleck treatment yielding 22% of full sunlight.

State of origin	**PMC number**	**2005 combined summer and fall biomass (g/pot) under five light regimes**					**2006 combined summer and fall biomass (g/pot) under five light regimes**				
		Full sun	70%	45%	20%	Sun fleck	Full sun	70%	45%	20%	Sun fleck
AR	6967(02)	71	70	51	31	38	28	23	24	29	28
MO	6832(04)	85	81	67	39	32	38	32	26	27	31
MO	6812(05)	75	85	61	37	44	31	33	28	32	34
MO	6885(06)	96	86	79	32	42	41	45	41	27	34
AR	6896(07)	94	82	73	43	50	21	19	21	17	22
AR	6972(08)	88	81	78	42	52	19	22	31	29	24
MO	6807(10)	91	76	64	47	46	31	25	35	36	38
AR	6974(12)	94	73	53	23	27	67	56	51	42	43
AR	6902(13)	90	80	58	32	46	24	24	34	31	27
MO	6802(14)	110	89	89	52	60	58	43	49	52	50
AR	6905(15)	88	75	67	40	45	20	29	26	29	28
OK	7049(16)	103	92	74	54	53	23	33	39	46	48
MO	6741(17)	87	93	77	52	56	24	30	30	37	30
AR	6925(19)	91	96	89	65	58	31	37	45	32	43
MO	6838(21)	96	96	78	45	57	30	30	39	38	43
MO	6704(22)	73	67	57	37	35	31	35	40	39	34
AR	6935(24)	85	64	60	26	37	26	28	40	26	30
OK	7039(25)	78	72	57	52	53	29	19	24	27	22
MO	OZ70(26)	88	62	54	18	26	27	37	41	28	25
MO	Rountree	85	88	79	55	56	37	47	46	42	41
OK	7007(29)	67	54	32	17	20	30	31	33	31	32
Means	-----	87	79	67	40	44	29	32	33	31	31

Study ID Code: MOPMS-T-0615-WL-WO

Study Title – Direct Seeding of Woody Shrubs for Establishing Shrub Cover for Wildlife Habitat of the Following Species. False Indigo Bush, *Amorpha fruticosa*,(a native legume), American Plum, *Prunus americana,* Roughleaf Dogwood, *Cornus drummondii,* Fragrant Sumac, *Rhus aromatica,* Chokecherry *Prunus virginiana,* Arrow-wood *Viburnum dentatum,* American Hazelnut, *Corylus Americana, (*all are native woody shrubs.)

Study Leader: Kaiser, J. U.

Introduction:

The direct seeding of seed in shrub species planted for wildlife habitat are typically planted as one to three year old bare root stock. Direct seeding (planting seed of woody species rather than plants) is an alternative method of establishing woody shrub species for wildlife habitat.

Problem:

The establishment period of seedlings for wildlife habitat, especially for small size plantings for quail covey winter habitat, is challenging because of loss from wildlife damage, drought, and poor survivability of the seedling species.

Objectives:

The objective of this study is to test an establishment technique for woody species using seed rather than seedlings. Direct seeding and management techniques will be tested in three replicated plots to determine which species can adequately establish and perform by direct seeding.

Procedure:

Randomized complete block with split plots design and three replications. Each species is evaluated in its own randomized complete block.

The seedlings will be evaluated during and after the first growing season for average seedling height, vigor, density (plants/sq.ft.) and establishment techniques and weed management.

In additional growing season will be evaluated for plant density.

<u>Evaluation Criteria-</u>

Legume: Species	Seeds/Lb	Planting Date	Seeding Rate	Seeds/Sq. Ft.	Plot Size	Split Plot
False indigobush	**59,200**	**May 8, 2006**	**15# PLS/acre**	**20 PLS/Sq. ft.**	**30’x50’**	**10’x50’**

Treatments between plots – Establishment Techniques

1) Prepared seedbed, broadcast seed and harrow.
2) Prepared seedbed, broadcast seed and light disk-in.
3) Prepared seedbed , drill seed 7.5 inch spacing

Treatments within plots (split plot) -Weed Management

1) No management (control/check)
2) Mowing above canopy of developing seedlings
3) Post emergent herbicides application for grass control.

Evaluation Criteria

Table for Woody Species

WOODY SPECIES	PLANTING DATE	SEEDS/ POUND	PLOT SIZE 45.5 X 33 FT	PLOT SEEDIN G RATE	BULK SEEDS/ SQ. FT.
Roughleaf dogwood	9-6-06	15,700	1,500 sq ft.	1# bulk	10.5
American plum	9-6-06	1,500	1,500 sq. ft.	1# bulk	1.0
Aromatic sumac	9-6-06	5,060	1,500 sq. ft.	1# bulk	3.4
Chokecherry	9-6-06	6,855	1,500 sq. ft.	1# bulk	4.6
Arrowwood	9-6-06	20,400	1,500 sq. ft.	1# bulk	13.6
American hazelnut	9-6-06	490	1,500 sq. ft.	1# bulk	0.33

Treatments between plots- Establishment techniques

1) Prepared seedbed, broadcast seed and light disk-in.

Treatments within plots (split plot)-Weed Management

1) No management (control/check)
2) Mowing above canopy of developing seedling
3) Post emergent herbicides application for grass control.

Plot size 33’ x 45.5’, (1500 sq. ft.) - Split block 33’x 15.15’ (500 sq .ft.) .

The seed will be collected from species from the assemblies at the Elsberry PMC, except for fragrant sumac that was provided by the Missouri Department of Conservation state tree nursery.

This management will be done for the 1st year after seeding and documented for what is applied. The releases will be compared to determine which species can perform by direct seeding under field conditions.

Discussion:

2006

False indigo bush

The evaluation blocks with the treatments and management of false indigobush were planted May 8, 2006, using a randomized split plot design, with 3 replications and 3 treatments.

Treatment 1- Broadcast and harrow in prepared seedbed. Management was a Check (No weed control), Mowed and sprayed with the herbicide Poast Plus (sethoxydim).

Treatment 2 – Broadcast and disk-in (light incorporation of seed) in a prepared seedbed. Management was a Check (No weed control), Mowed and sprayed with the herbicide Poast Plus (sethoxydim).

Treatment 3- Drilled (TruaxDrill) in a prepared seedbed. Management was a Check (No weed control), Mowed, and sprayed with the herbicide Poast Plus (sethoxydim).
After a dry spring the area received 2.25" of rain in May and 1.1" rain on June 3.
On June 6 the herbicide treatment was used; for the split plot for all three treatments of establishment. The application rate of 24 oz/acre of Poast Plus (sethoxydim) was sprayed directly over the top of the split plots. The herbicide did an excellent control on the annual grasses; however this provided a release of broadleaf species during the growing season, especially common purslane (*Portulaca oleracea*).

Mowing started on the split plots for all three treatments of establishment on 6-9-06, sequential mowing was conducted during the growing season to suppress canopy closure of annual grasses and broadleaf weeds. A total of six mowings were conducted during the growing season. The mowing height initially was three inches after planting the first month. By the end of the growing season a height of 12 inches of the stubble was remaining.

The false indigobush seedlings were evaluated at the end of the growing season for stand, density of plants/square foot, and vigor rating on a scale of 1 = Excellent and 9 = Very Poor, 0= None. The seedlings were also measured for height in feet.

The following chart explains the results during this first year growing season.

False Indigobush	Check			Mowed			Herbicide		
Treatments	Rating and Plants/ Sq Ft.	Av. Vigor Rating	Av. Height inches	Rating and Plants/ Sq Ft.	Av. Vigor Rating	Av. Height inches	Rating and Plants/ Sq Ft.	Av. Vigor Rating	Av. Height inches
Broadcast/Harrow									
Rep 1	9=1/25 sq'	9'	1"	0=0/25 sq'	0	0	7=2/25 sq'	1	15"
Rep 2	0=0/25 sq'	0	0	7=2/25 sq'	7	3"	5-4/25 sq'	3	10"
Rep 3	7=3/25 sq'	7	4"	7=2/25 sq'	7	3"	1=16/25 sq'	3	12"
Disk In									
Rep 1	0=0/25 sq'	0	0	7=2/25 sq'	7	3"	3=6/25 sq'	3	8"
Rep 2	0=0/25 sq'	0	0	5=4/25 sq'	7	5"	3=7/25 sq'	5	6"
Rep 3	7=2/25 sq'	7	2"	0=0/25 sq'	0	0	1=23/25 sq'	1	18"
Drilled									
Rep 1	0=0/25 sq'	0	0	7=2/25 sq'	9	1"	3=6/25 sq'	3	12"
Rep 2	9=1/25 sq'	7	3"	7=3/25 sq'	7	5"	1=11/25 sq'	3	8"
Rep 3	5=4/25 sq'	5	5"	9=1/25 sq'	7	2"	1=18/25 sq'	3	8"

Ratings: 1=Excellent, 3=Good, 5=Fair, 7=Poor, 9=Very Poor, 0=None

Summary of Results

False Indigobush

The check treatments exhibited on average for the three replications. a very poor stand density in plants/square foot, with each treatment having at least one rep having zero plants/per square foot. Plant vigor was very poor with limited growth because of competition of annual grasses and broadleaf weeds in dense shading of the block.

The mowed treatments exhibited on average for the three replications a poor stand density in plants/square foot with poor average seedling vigor and plant height.

The herbicide treatments on average for all three replications exhibited good plants/square foot with all treatments having good vigor ratings and plant growth response.

The checks and mowed treatments were dominated with annual grasses and several broadleaf weed species. The herbicide treatment controlled the annual grasses through the growing season with only competition from broadleaf weeds, heavy common purslane; and smartweed, however light still penetrated the canopy to aid the seedling development which is critical.

Discussion:

2007

False Indigobush Plots

Study Plan was changed in 2007 to use herbicides treatments to address broadleaf weed pressure and annual grass pressure. Mowing and no weed control were not effective in the establishment of false indigobush from seed in 2006.

The plots reps were accidentally sprayed in the wrong areas, so no replication of treatments could be evaluated for uniformity between reps. Observational notes were taken for the herbicides and were noted in the study plan folder.

Summary of Results

False indigobush will need treatments of herbicide such as Poast Plus (sethoxydim) to control annual grass competition if direct seeded; however direct seeding is not the desired method of establishment especially in fields that have weed pressure of annual grasses and multiple species of broadleaf weeds that will shade and stunt the seedlings of false indigobush.

American Plum, Roughleaf Dogwood, Fragrant Sumac, Chokecherry, Arrow-wood, American Hazelnut

The six woody species were direct seeded in the random split plots with three replications on September 6, 2006. This seeding time was selected for a warm (fall) stratification period to follow with cold (winter) stratification. The species were seeded in a prepared (disked) seedbed that had soybean residue. All species were seeded by hand using a cyclone seeder except for the American hazelnut and American plum seed that was evenly spread by hand. All plots were lightly disked to cover the seed for fall. A late fall application of Roundup (glyphosate) was applied to control winter annuals.

Discussion:
2007

American Plum, Roughleaf Dogwood, Fragrant Sumac, Chokecherry, Arrow-wood, American Hazelnut

March 26, 2007- All 3 reps of chokecherry had seedling emergence 1 inch in height. No other species emerged.

April 9, 2007- All 3 reps of chokecherry were damaged by late freeze, seedlings were 2 inches in height. All 3 reps of American Plum had emergence of 1 inch in height.

April 23, 2007- No change to chokecherry. All American Plum 3 inches in height had good seedling color.

May 22, 2007- Treatment of Poast Plus (sethoxydim) rate of 24 oz./acre had been applied in split plots for grass control. In plot observed American Plum tallest 12 inches in height, chokecherry

still stunted 3 inches in height,. Roughleaf Dogwood and Aromatic Sumac were each 1 inch in height. No American Hazelnut or Arrowwood observed in any reps.

June 6 2007- Treatment of mowing was applied for the split plots. Moderate to heavy foxtail developed in uncontrolled split plots and mowed plots. Sprayed plot clean of grass pressure. Some broadleaf weeds (*Conyza canadensis* marestail) developing in reps with all treatments.

June 27, 2007- Treatment of second mowing for the split plots.

September 5 2007- Completed direct seeding for 2nd year of plots and reps for all 6 species to be observed in 2008.

October 12 2007- Conducted actual stem count

Summary of Results after first year of the plantings
Average plants/sq. ft. and average heights for all three reps.

Control Plots- (No treatments)

1)	**American Plum**	**1 plant/23 sq. ft. or 4.3 plants/100 sq. ft. Average height 12.5 inches, tallest 24 inches.**
2)	**Aromatic Sumac**	**No plants observed, heavy foxtail and clover in all 3 reps**
3)	**Chokecherry**	**No plants observed, heavy foxtail and clover in all 3 reps.**
4)	**Roughleaf dogwood**	**No plants observed, heavy foxtail and clover in all 3 reps.**
5)	**American Hazelnut**	**No plants germinated during the whole growing season, predation of seed over winter in all 3 reps.**
6)	**Arrowwood**	**No plants germinated during the whole growing season in all three reps.**

Mowed Plots- Conducted two mowing treatments during the growing season to 1 foot in height.

1)	**American Plum**	**1 plant/62.5 sq. ft. or 1.6 plants/100 sq. ft. Average height 10 inches, tallest 24 inches.**
2)	**Aromatic Sumac**	**No plants observed, heavy foxtail and clover in all 3 reps.**
3)	**Chokecherry**	**No plants observed, heavy foxtail and clover in all 3 reps.**
4)	**Roughleaf dogwood**	**No plants observed, heavy foxtail and clover in all 3 reps.**
5)	**American Hazelnut**	**No plants germinated during the whole growing season, predation of seed over winter in all 3 reps.**
6)	**Arrowwood**	**No plants germinated during the whole growing season in all three reps.**

Sprayed Plots- 1 application treatment of Poast Plus (sethoxydim) rate of 24 oz./acre.

1) **<u>American Plum</u>** **1 plant/10 sq. ft. or 10 plants/100 sq. ft. Average heights 15 inches, tallest 40 inches.**
2) **<u>Aromatic Sumac</u>** **1 plant /43 sq. ft. or 2.3 plants /100 sq. ft. Average height 5 inches, tallest 10 inches.**
3) **<u>Chokecherry</u>** **1 plant/ 215 sq.ft. or 0.5 plant/100 sq. ft. Average height was stunted by freeze and drought, tallest was 4 inches.**
4) **<u>Roughleaf dogwood</u>** **1 plant/750 sq. ft. or 0.1 plant/100 sq. ft. Only 2 plants counted in plots, tallest was 6 inches.**
5) **<u>American hazelnut</u>** **No plants germinated during the whole growing season, predation of seed over winter in all 3 reps.**
6) **<u>Arrowwood</u>** **No plants germinated during the whole growing season in all three reps.**

Direct Seeding Study Evaluation						
Species:						
	Actual Plant Counts for Replications					
American Plum						
10/12/2007	**Rep 1**	**Rep 2**		**Rep 3**		**Ave. for the**
Date/Plot	**500 sq ft**	**500 sq ft**	**Height "**	**500 sq ft**	**Height "**	**3 Reps**
Control Plot	7 plants	29 plants	Ave. 14"	29 plants	Ave. 12 "	**1 plant/23 sq. ft.**
	1 plant 71sq.'	1 plant/ 17 sq.'	Tallest 17 "	1 plant/ 17 sq.'	Tallest 19"	**Ave. Ht 12.5 "**
Weed Pressure	Heavy Foxtail	light foxtail		light foxtail contained 13 of the		**Tallest 24 "**
				29 in one area of the plot		
Mowed Plot	13 plants	7 plants	Ave. 8 "	4 plants	Ave. 10	**1 plant/62.5 sq.ft.**
	1 plant/ 38 sq.'	1 plant/ 71 sq.'	Tallest 16 "	1 plant/125 sq.'	Tallest 12"	**Ave. Ht. 10 "**
	Heavy foxtail	light foxtail moderate clover		light foxtail moderate clover		**Tallest 24 "**
Sprayed Plot	62 plants	63 plants	Ave. 12"	34 plants	Ave. 12 "	**1 plant/10 sq. ft.**
	1 plant/ 8 sq.'	1 plant/ 8sq.'	Tallest 16"	1plant/15 sq.'	Tallest 18"	**Av. Ht. 15 "**
Grass control	Moderate Marestail			heavy clover		**Tallest 40 "**
Species						
Aromatic Sumac						
10/12/2007						
Control Plot	No Plants observed heavy Foxtail Pressure and moderate clover for all three reps					
Mowed Plot	No Plants observed heavy Foxtail Pressure and moderate clover for all three reps					
Sprayed Plot	17 plants	18 plants	Ave. 7 "	0 plants	None	**1 plant/43 sq. ft.**
	1 plant/ 29 sq.	1 plant/28 sq.'	Tallest 10"	0 plants	None	**Av. Ht. 5 "**

	Rep 1	Rep 2		Rep 3		Ave. for the
	500 sq ft	**500 sq ft**	**Height "**	**500 sq ft**	**Height "**	**3 Reps**
Species						
Chokecherry						
10/12/2007						
Control Plot	No Plants observed heavy foxtail pressure and moderate clover for all three reps.					
Mowed Plot	No Plants observed heavy foxtail pressure and moderate clover for all three reps.					
Sprayed Plot	0 plants	7 plants	Tallest 4 "	0 plants	None	**1 plant/215 sq. ft.**
	died from drought	1 plant/71 sq.'	effect by drought			**Ave. 3 "**
						Tallest 4"
Species						
Roughleaf						
Dogwood						
10/12/2007						
Control Plot	No Plants observed heavy foxtail pressure and moderate clover for all three reps.					
Mowed Plot	No Plants observed heavy foxtail pressure and moderate clover for all three reps.					
Sprayed Plot	2 plants	0 plants		0 plants		**1 Plant/750 sq. ft.**
						Ave. 2 "
						Tallest 6 "
Species						
Hazelnut	No plants germinated during the whole growing season, predation of seeds over winter					**No Plants**
Arrowwood	No plants germinated during the whole growing season.					**No Plants**

Factors that had effect on first year growing season results.

1) Late freeze in April that effected the chokecherry species
2) Drought during the growing season from March to the end of October 2007 rainfall was 9 inches below normal for the study site.
3) Competition from the heavy grass pressure foxtail and broadleaf weeds, clover and mainly (*Conyza canadensis)* marestail.
4) Marestail did not affect the American Plum in the plots sprayed for grass control, enough light was getting to the lower canopy for the development of the plum seedlings.

Again in 2007 the six woody species were direct seeded in the random split plots with three replications on September 5, 2007. The plots were seeded west of the 2006 plots using the same procedure in a prepared (disked) seedbed that had soybean residue. All species were seeded by hand using a cyclone seeder except for the American hazelnut and American plum seed that was evenly spread by hand. All plots were rolled to cover the seed for fall. A late fall application of Roundup (glyphosate) was applied to control winter annuals.

2008

<u>American Plum, Roughleaf Dogwood, Fragrant Sumac, Chokecherry, Arrow-wood, American Hazelnut</u>

4-16-2008 the treatment of Prowl was applied at 2 quarts/acre to the 3 reps for all the species.

5-30-2008 Evaluation was conducted in for this direct seeding plot that was planted in September of 2007 the initial results listed below in the spreadsheet.

The Spring of 2008 was a very wet year and the species were developing well by May 30th especially the Prowl treatment with an average for:
1) Aromatic Sumac at 13 plants/25 sq.ft.area or 0.5 plants/sq.ft,
2) Chokecherry at 11 plants/25 sq. ft. area or 0.44 plants/sq.ft.
3) American Plum at 6.67 plants/25 sq.ft. or 0.26 plants/sq.ft
4) Roughleaf Dogwood 1.33 plants/25 sq.ft. or 0.05 plants/sq.ft.
5) American Hazelnut and Arrowwood did not have any germination occurring in the control or Prowl plots.

Table1

Direct Seeding Study
2007 Seeding Plots **Treatments:** **C=Control/No Treatment** **Species:** **R**
PL=Prowl Applied 4-16-08 **A**
PT=Poast Not Applied to Date in Plots **C**
W=Severe Big Flower Vetch/Clover

	Rep 1							Rep 2							Rep 3	
	Treatment	C	PL	PT	C	PL	PT	Treatment	C	PL	PT	C	PL	PT	Treatment	C
Date		#/25 sq ft			Height				#/25 sq ft			Height				#
					Inches							Inches				
5/13/2008	RL Dogwood	0	0	0	0	0	0	RL Dogwood	2	0	0	1	0	0	RL Dogwood	
5/30/2008	RL Dogwood	1	1	6	2	2	2	RL Dogwood	0 W	4	5	0	2	2	RL Dogwood	
	RL Dogwood							RL Dogwood							RL Dogwood	
	RL Dogwood							RL Dogwood							RL Dogwood	
5/13/2008	A Sumac	0	4	2	0	1	1	A Sumac	1	0	3	1	0	1	A Sumac	
5/30/2008	A Sumac	0	17	3	0	2	3	A Sumac	0 W	14	3	0	3	3	A Sumac	
	A Sumac							A Sumac							A Sumac	
	A Sumac							A Sumac							A Sumac	
5/13/2008	Chokecherry	1	7	13	2.5	2	2.5	Chokecherry	14	4	18	3	2	3	Chokecherry	
5/30/2008	Chokecherry	18	13	12	4	5	5	Chokecherry	0 W	7	5		3	4	Chokecherry	W
	Chokecherry							Chokecherry							Chokecherry	

	Chokecherry							Chokecherry							Chokecherry
5/13/2008	Arrowwood	0	0	0	0	0	0	Arrowwood	0	1	0	0	2	0	Arrowwood
5/30/2008	Arrowwood	0	0	0	0	0	0	Arrowwood	0	1	0	0	7	0	Arrowwood
	Arrowwood							Arrowwood							Arrowwood
	Arrowwood							Arrowwood							Arrowwood
5/13/2008	Am. Plum	0	3	5	0	3	3	Am. Plum	1	2	0	1	2	0	Am. Plum
5/30/2008	Am. Plum	2	4	3	6	7	7	Am. Plum	3	5	2	7	6	5	Am. Plum
	Am. Plum							Am. Plum							Am. Plum
	Am. Plum							Am. Plum							Am. Plum
5/13/2008	Am. Hazelnut	0	0	0	0	0	0	Am. Hazelnut	0	0	0	0	0	0	Am. Hazelnut
5/30/2008	Am. Hazelnut	0	0	0	0	0	0	Am. Hazelnut	0	0	0	0	0	0	Am. Hazelnut
	Am. Hazelnut							Am. Hazelnut							Am. Hazelnut
	Am. Hazelnut							Am. Hazelnut							Am. Hazelnut

Note: 5/13/08 Very wet; standing water

6-20-2008- Flood waters began to enter field 7 from Mississippi River overtopping the main levees. Flooding of field 7 and the direct seeding study was under water of depths of 6 feet for one month.

7-22-2008- Flood waters receded off of field 7 and the Direct Seeding Study.

8-16-2008- Final check of plots that were seeded in 2006 and 2007 resulted from the flood water killed all woody species in the direct seeding study. STUDY WAS TERMINATED.

2006-2008 SUMMARY

Direct Seeding's of woody shrub species can be viable with the following species.

1) American Plum-seeded at the 1 # bulk seeding rate for 1500 sq.ft.
Adequate plants germinated in 2007 from 2006 planting 1 plant/10 sq. ft. or 10 plants/100 sq. ft. Average heights 15 inches, tallest 40 inches. These results can be accomplished if grass control herbicides, such as Prowl and/or Poast are applied in the first growing season. Adequate plants did germinated, see Table 1 above with the Prowl treatment, from the 2007 planting in 2008, but could not be evaluated for the growing season with the flooding in 2008.

2) Aromatic Sumac-seeded at the 1 # bulk seeding rate for 1500 sq.ft.
Plants germinated from 2006 planting in the Spring of 2007 1 plant /43 sq. ft. or 2.3 plants /100 sq. ft. average height 5 inches, tallest 10 inches. by the end of the growing season. These plants had been sprayed with Poast for grass species controlled.

Adequate plants did germinated in the Prowl treatment, see Table 1 above, from the 2007 planting in 2008, but could not be evaluated for the growing season with the flooding in 2008.

3) Chokecherry-seeded at the 1 # bulk seeding rate for 1500 sq.ft.
Plants germinated from 2006 planting; 1 plant/ 215 sq.ft. or 0.5 plant/100 sq. ft.
Tallest was 4 inches, however a late freeze/drought in the Spring of 2007 killed or stunted these plants. Adequate plants did germinated in the Prowl treatment, see Table 1 above, from the 2007 planting in 2008, but could not be evaluated for the growing season with the flooding in 2008.

4) Roughleaf Dogwood- seeded at the 1# bulk seeing rate for 1500 sq.ft.
Plants germinated from 2006 planting in the Spring of 2007, 1 plant/750 sq. ft. or 0.1 plant/100 sq. ft. only 2 plants counted in plots that had the grass controlled by Poast, tallest was 6 inches. A few plants did germinated in the Prowl treatment, see Table 1 above, from the 2007 planting in 2008, but could not be evaluated for the growing season with the flooding in 2008.

5) Arrowwood- seeded at the 1# bulk seeing rate for 1500 sq.ft.
No plants germinated from the 2006 or the 2007 plantings with any treatments.

6) American Hazelnut- seeded at the 1# bulk seeing rate for 1500 sq.ft.
No plants germinated from the 2006 or the 2007 plantings with any treatments.

Study: MOPMC-T-0716-BF

Study Title: In-Field Weathering Effects on Biomass Yield and Biofuel Quality of Warm Season Grasses.

Study Leaders: Bruckerhoff, S., Douglas, J.

Introduction:

Dedicated energy crops grown for direct combustion or gasification to generate electricity; ethanol production for transportation fuel; or thermochemical conversion into other by products, require different biofuel quality (McLaughlin et al., 1996). For direct combustion or gasification, biofuel quality needs to have low concentration of alkali metals, especially potassium, low levels of total ash-forming materials, and higher calcium content to mitigate slagging and fouling of conventional boilers (Baxter et al., 1998, Miles et al., 1996). Conversely, for ethanol fermentation and thermochemical conversion by gasification, the biofuel quality must have low moisture, nitrogen, and ash content and a high concentration of lignocellulose in the biomass (McKendry, 2002).

Time and frequency of harvest play a major role in biofuel quality. Nitrogen and ash content of 'Alamo' switchgrass (*Panicum virgatum* L.), 'Highlander' eastern gamagrass (*Tripsacum dactyloides* [L.] L.) and caucasian bluestem (*Bothriochloa baldhii* [Retz.] S.T. Blake) were reduced in a single fall harvest regime compared to a two harvest regime, which consisted of an early summer and early fall harvest in Mississippi (Grabowski et al., 2004). Deferring native grass species for two years in Canada produced the greatest biomass yield with highest cellulosic content for ethanol production as compared to three and four year deferral period, which seem to favor livestock forage for beef cattle (Jefferson et al., 1999). Exposing standing biomass to natural field weathering has shown to be advantageous for achieving biofuel quality. Delaying switchgrass harvest from the fall to spring in Pennsylvania reduced moisture and mineral content to a level suitable for all biofuel conversion systems (Alder et al., 2006). However, these authors reported lower yields due to loss of leaves and panicles during the winter months, and difficulty during the harvesting operations because of the brittleness of the biomass and lodging from snowfall. In contrast, Boe and Lee (2005) found little to no difference in biomass yield in the northern Great Plains from fall to spring, but clipping height was adjusted from 10 cm in the fall to near ground level in the spring, resulting in higher yields due to heavier stems near the base of the plant.

Problem:

There is limited information available on biofuel quality and biomass yield of warm season grasses in relation to effects of weathering in the field throughout the winter.

Objective:

Cultivars/selections of warm season grasses will be compared in replicated plots to evaluate the effects of fall, winter and early spring harvest on dry matter production and biofuel quality.

Cooperators:
Steve Bruckerhoff, USDA-NRCS, Elsberry, Missouri
Bill Kuenstler, USDA-NRCS, Fort Worth, Texas
Jerry Lemunyon, USDA-NRCS, Fort worth, Texas
Jim Kiniry, USDA-ARS, Temple, Texas
Brian Baldwin, Mississippi State University, Starkville, Mississippi
Ray Cragar, USDA-NRCS, Knox City, Texas
Joel Douglas, USDA-NRCS, Fort Worth, Texas

Procedure:

Randomized split plot design with four replications.

Species/cultivars or selections (see list below) from appropriate sources will be planted by seed or propagules (*miscanthus*) into plots containing seven rows with 36" spacing and 20 feet long. Interior five rows will be clipped for biomass and grab samples will be taken for fuel quality estimates. Outside rows will be border rows. Plots will be planted April/May 2007. Irrigation will be applied as needed during the establishment year only. Timing and rate of fertilizer amendments will be determined at a later date.

Species/cultivars to be tested	Seeding rate(seeds/row ft--#/ac
'Cave-in-rock' switchgrass	50 PLS/row ft - 2.80#PLS/ac
'Kanlow' switchgrass	50 PLS/row ft - 2.80#PLS/ac
'Rumsey' Indiangrass	50 PLS/row ft - 4.16#PLS/ac
9083274 big bluestem (MOPMC)	50 PLS/row ft - 5.03#PLS/ac
'Alamo' switchgrass	50 PLS/row ft - 2.8#PLS/ac
Miscanthus (sterile)	3 ft spacing within and between rows

Supporting evaluations

Stems or plants per row foot at end of first growing season

Harvest Treatments

A 14' 6" swath will be clipped from the center of each plot beginning at seed maturity (2008-2010) and every six weeks until spring (2009-2011).

Harvest Dates (approximate)
September 15
November 1
December 15
February 1
March 15

Biomass production and biofuel quality of N, lignin, ADF, NDF, ash (total) caloric value, Ca, Mg, S, P, K and gross energy will be determined at each harvest date.

This study is being replicated at four locations, Elsberry, Missouri; Knox City, Texas; Temple, Texas and Starkville, Mississippi.

Discussion:

2007

The study site was fallowed in 2006 using roundup and tillage. The site was then tilled and rolled in 2007 prior to establishment of the plots April 19, 2007. Preemergant chemical weed control was used after planting using atrazine on the switchgrass, plateau on the big bluestem and Indiangrass, and prowl on the *miscanthus*. The study was planted using a randomized split plot design with four replications. (See table #1.) The switchgrass plots encountered herbicide damage and were replanted June 4, 2007. During establishment, the plots were irrigated, weeded, and roto-tilled as needed. The plots were evaluated for first year establishment, stem counts, and a visual rating of percent stand. (See table #2.) Any segments of a row missing plants will be filled in with live plants the spring of 2008 to ensure all rows being complete.

Plot Layout **MOPMC-T-0716-BF** **Table #1**

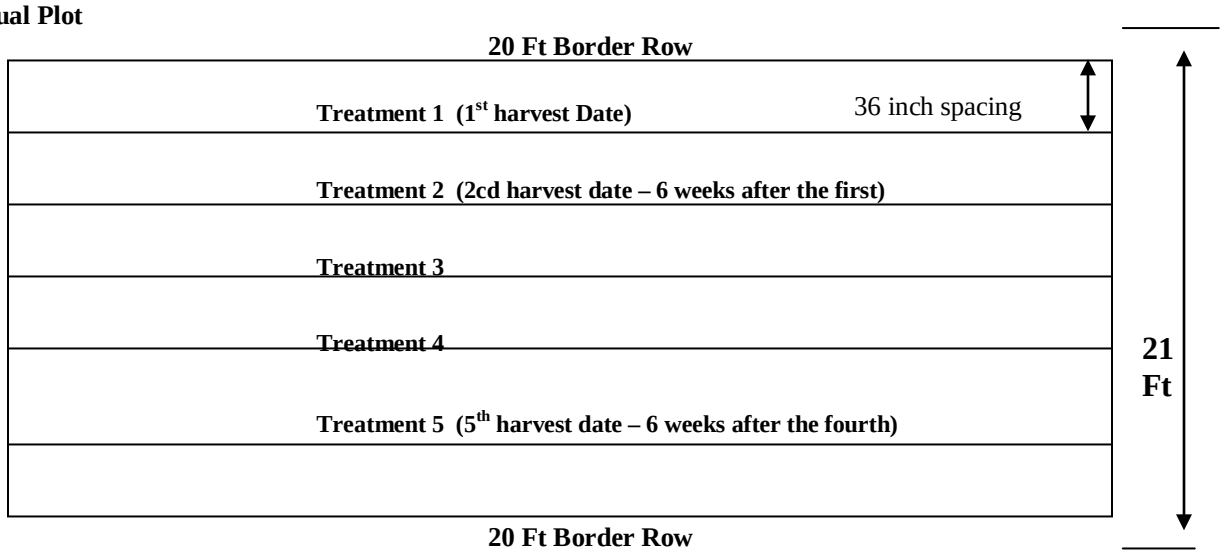
North

Rep 1	Plot 4	**10 FOOT ROADWAY**	Plot 1	Plot 6	Plot 3	Plot 5	Plot 2
			5 ft Roadway				
Rep 2	Plot 2		Plot 5	Plot 1	Plot 4	Plot 6	Plot 3
Rep 3	Plot 5		Plot 3	Plot 6	Plot 2	Plot 4	Plot 1
Rep 4	Plot 3		Plot 2	Plot 4	Plot 5	Plot 1	Plot 6

Plot #

1	'Cave-In-Rock'	Switchgrass	4		Miscanthus
2	9083274	Big bluestem	5	'Kanlow'	Switchgrass
3	'Alamo'	Switchgrass	6	'Rumsey'	Indiangrass

Individual Plot



Discussion

2008

The plots established very well in 2007. During 2008 the plots were first burned, rototilled between the rows, and 100# actual N (nitrogen) applied as urea and incorporated. Greenhouse grown plugs were planted into any open space of about 4 inches or more within the row, very few plants were necessary. The plots also received chemical weed control.

The plots were harvested one row at a time (1/1000 acre) and evaluated for lodging, and biomass production. (See Table #3) Rows were harvested randomly with row one being harvested at anthesis (at least 50% of seed mature). Row 2 was harvested six weeks after row 1 and that sequence maintained through row 5.

2009

The plots were harvested and evaluated again in 2009 as they were in 2008. All plots received 50# actual N (nitrogen) in May. Biomass production is in table #4 and element contents are in table #5.

2008/09 Averages for Lodging and Biomass Quantity Table #3

	Lodging at Harvest 1=No Lodging 5=Extreme Lodging						Yield (Pounds/Acre)					
	Seed Maturity Cutting	2nd Cutting	3rd Cutting	4th Cutting	5th Cutting	Ave.	Seed Maturity Cutting	2nd Cutting	3rd Cutting	4th Cutting	5th Cutting	Ave.
Cave-In-Rock Switchgrass	1.3	1.3	1.4	1.5	1.5	1.4	9,944	10,177	11,628	6,749	6,880	9076
Big Bluestem 9083274 (Epic)	2.0	2.0	2.8	3.6	3.8	2.8	11,118	12,264	10,802	7,788	8,698	10134
Alamo Switch	3.7	2.8	1.9	2.0	1.5	2.4	15,894	15,818	12,944	12,879	12,514	14010
'Freedom' Miscanthus	1.3	1.0	1.1	1.0	1.0	1.1	21,630	24,388	23,619	29,011	24,515	24633
Kanlow Switch	2.3	2.3	3.4	2.1	1.6	2.3	15,835	15,124	15,869	12,182	12,624	14327
Rumsey Indiangrass	4.3	4.3	4.3	4.3	4.4	4.3	13,150	12,811	13,528	10,097	11,192	12156

The data in the chart above shows lodging ratings and amount of biomass harvested starting at seed maturity and continuing every six weeks for four more cuttings. These cuttings started approximately mid Sept. and ran through the beginning of March.

2009/10 Averages for Lodging and Biomass Quantity Table #4

	Lodging at Harvest 1=No Lodging 5=Extreme Lodging						Yield (Pounds/Acre)					
	Seed Maturity Cutting	2nd Cutting	3rd Cutting	4th Cutting	5th Cutting	Ave.	Seed Maturity Cutting	2nd Cutting	3rd Cutting	4th Cutting	5th Cutting	Ave.
Cave-In-Rock Switchgrass	3.5	**2.6**	**3.4**	**3.5**	**3.1**	**3.22**	9,219	**9,329**	**9,717**	**9,238**	**8,543**	**9,209**
Big Bluestem 9083274 (Epic)	1.5	**1.8**	**3.8**	**4.1**	**4**	**3.04**	9,951	**10,994**	**10,553**	**6,997**	**8,245**	**9,348**
Alamo Switch	1.6	**1.9**	**2.5**	**2.4**	**2.6**	**2.20**	12,605	**12,810**	**11,967**	**11,873**	**11,560**	**12,163**
'Freedom' Miscanthus	1.1	**1**	**1**	**1**	**1.1**	**1.04**	22,756	**27,880**	**18,434**	**25,780**	**23,271**	**23,624**
Kanlow Switch	2.5	**2.9**	**4**	**3.8**	**3.1**	**3.26**	11,694	**11,950**	**14,123**	**10,277**	**12,492**	**12,107**
Rumsey Indiangrass	3.1	**3.6**	**3.5**	**4.3**	**3.5**	**3.60**	11,048	**12,269**	**11,157**	**10,084**	**9,925**	**12,107**

The data in the chart above shows lodging ratings and amount of biomass harvested starting at seed maturity and continuing every six weeks for four more cuttings. These cuttings started approximately mid Sept. and ran through the beginning of March.

LSD All - Pairwise Comparison Tests for Harvest Date **Table #5**

Test of: adf

Common Name	Harvest Date	Mean	Homogeneous Groups
Alamo	30-Mar	55.639	A
	5-Jan	54.524	A
	17-Feb	53.855	AB
	26-Nov	52.301	AB
	14-Oct	50.681	B
Big bluestem	24-Mar	57.072	A
	9-Feb	56.761	A
	30-Dec	55.467	A
	18-Nov	54.292	A
	6-Oct	49.376	B
Cave-in-Rock switchgrass	24-Feb	59.652	A
	12-Jan	58.556	A
	2-Dec	55.607	B
	21-Oct	48.528	C
	10-Sep	44.29	D
Indiangrass	9-Feb	56.689	A
	30-Dec	56.229	A
	24-Mar	55.669	A
	18-Nov	54.120	A
	6-Oct	49.779	B
Kanlow - switchgrass	26-Jan	55.301	A
	5-Nov	53.16	B
	17-Dec	52.87	B
	1-Oct	48.39	C
Miscanthus	30-Mar	64.703	A
	5-Jan	63.888	A
	17-Feb	63.678	AB
	26-Nov	60.49	B
	14-Oct	53.456	C

LSD All - Pairwise Comparison Tests for Harvest Date

Test of: ash

Common Name	Harvest Date	Mean	Homogeneous Groups
Alamo	26-Nov	4.9827	A
	14-Oct	4.9414	A
	5-Jan	4.1785	AB
	17-Feb	3.6878	B
	30-Mar	3.2326	B
Big bluestem	6-Oct	4.7315	A
	18-Nov	3.8060	B
	30-Dec	3.7489	BC
	9-Feb	3.3331	BC
	24-Mar	2.8810	C
Cave-in-Rock switchgrass	10-Sep	5.1766	A
	21-Oct	4.9133	A
	2-Dec	3.7896	B
	24-Feb	3.1248	C
	12-Jan	2.8344	C
Indiangrass	6-Oct	7.1609	A
	18-Nov	6.8226	AB
	30-Dec	5.7877	BC
	24-Mar	5.494	C
	9-Feb	3.356	D
Kanlow - switchgrass	1-Oct	4.3667	A
	5-Nov	3.72	AB
	17-Dec	3.4192	AB
	26-Jan	3.164	B
Miscanthus	14-Oct	3.9713	A
	26-Nov	3.8251	A
	5-Jan	2.2902	A
	17-Feb	1.9681	A
	30-Mar	1.8321	B

LSD All - Pairwise Comparison Tests for Harvest Date

Test of: ndf

Common Name	Harvest Date	Mean	Homogeneous Groups
Alamo	30-Mar	86.931	A
	17-Feb	85.749	A
	5-Jan	85.589	A
	26-Nov	81.657	B
	14-Oct	81.101	B
Big bluestem	24-Mar	86.276	A
	9-Feb	85.797	A
	30-Dec	84.199	A
	18-Nov	83.899	A
	6-Oct	78.742	B
Cave-in-Rock switchgrass	24-Feb	88.06	A
	12-Jan	87.918	A
	2-Dec	85.728	A
	21-Oct	77.782	B
	10-Sep	74.832	B
Indiangrass	9-Feb	87.248	A
	24-Mar	84.509	AB
	30-Dec	84.16	B
	18-Nov	82.592	B
	6-Oct	78.213	B
Kanlow - switchgrass	26-Jan	86.61	A
	17-Dec	85.431	A
	5-Nov	85.158	A
	1-Oct	80.313	B
Miscanthus	30-Mar	89.191	A
	17-Feb	88.551	A
	5-Jan	88.317	A
	26-Nov	87.394	A
	14-Oct	81.009	B

LSD All - Pairwise Comparison Tests for Harvest Date

Test of: p

Common Name	Harvest Date	Mean	Homogeneous Groups
Alamo	14-Oct	0.1075	A
	26-Nov	0.0750	B
	5-Jan	0.0450	C
	17-Feb	0.0425	C
	30-Mar	0.0425	C
Big bluestem	6-Oct	0.0746	A
	9-Feb	0.0475	B
	30-Dec	0.0417	BC
	24-Mar	0.0400	BC
	18-Nov	0.0275	C
Cave-in-Rock switchgrass	10-Sep	0.1275	A
	21-Oct	0.0975	B
	2-Dec	0.0675	C
	24-Feb	0.0575	C
	12-Jan	0.0575	C
Indiangrass	6-Oct	0.0825	A
	18-Nov	0.0550	AB
	9-Feb	0.0550	AB
	24-Mar	0.0450	B
	30-Dec	0.0400	B
Kanlow - switchgrass	1-Oct	3.3446	A
	5-Nov	1.7496	B
	17-Dec	1.6349	B
	26-Jan	1.2268	B
Miscanthus	14-Oct	0.0825	A
	26-Nov	0.07	AB
	30-Mar	0.0425	ABC
	17-Feb	0.035	BC
	5-Jan	0.02254	C

LSD All - Pairwise Comparison Tests for Harvest Date

Test of: k

Common Name	Harvest Date	Mean	Homogeneous Groups
Alamo	14-Oct	0.755	A
	26-Nov	0.2650	B
	5-Jan	0.1250	BC
	30-Mar	0.1175	BC
	17-Feb	0.0725	C
Big bluestem	6-Oct	0.6775	A
	18-Nov	0.4325	AB
	9-Feb	0.32	B
	24-Mar	0.275	B
	18-Nov	0.2179	B
Cave-in-Rock switchgrass	10-Sep	0.5800	A
	21-Oct	0.2525	B
	2-Dec	0.1500	C
	24-Feb	0.0800	CD
	12-Jan	0.0450	D
Indiangrass	6-Oct	0.6575	A
	18-Nov	0.4225	AB
	24-Mar	0.2375	BC
	9-Feb	0.1400	BC
	30-Dec	0.1275	C
Kanlow - switchgrass	1-Oct	0.6425	A
	5-Nov	0.1825	B
	17-Dec	0.0975	B
	26-Jan	0.0375	B
Miscanthus	14-Oct	0.5750	A
	26-Nov	0.2550	B
	30-Mar	0.1275	C
	17-Feb	0.1275	C
	5-Jan	0.0500	C

LSD All - Pairwise Comparison Tests for Harvest Date

Test of: S

Common Name	Harvest Date	Mean	Homogeneous Groups
Alamo	14-Oct	0.0400	A
	26-Nov	0.0150	B
	17-Feb	0.0100	B
	30-Mar	0.0100	B
	5-Jan	0.0100	B
Big bluestem	6-Oct	0.0200	A
	9-Feb	0.0150	AB
	18-Nov	0.0100	B
	24-Mar	0.0100	B
	30-Dec	0.0088	B
Cave-in-Rock switchgrass	10-Sep	0.0300	A
	21-Oct	0.0225	AB
	2-Dec	0.0150	BC
	12-Jan	0.0125	C
	24-Feb	0.0100	C
Indiangrass	18-Nov	0.0125	A
	9-Feb	0.0125	A
	24-Mar	0.0100	A
	30-Dec	0.0100	A
	6-Oct	0.0100	A
Kanlow - switchgrass	1-Oct	0.0275	A
	26-Jan	0.0175	AB
	17-Dec	0.0150	AB
	5-Nov	0.0100	B
Miscanthus	14-Oct	0.0175	A
	26-Nov	0.0175	A
	17-Feb	0.0100	A
	30-Mar	0.0100	A
	5-Jan	0.0100	A

Study: MOPMC-P-0717-PA, WL

Study Title: Evaluation and Release of a Shade Tolerant Little Bluestem for Silvopasture

Study Leaders: Van Sambeek, J., D. Wallace, G. Garrett, S. Bruckerhoff

Introduction:

Little bluestem is one of the most widely distributed native grasses in North America. It will grow on a wide variety of soils but is very well adapted to well-drained, medium to dry, infertile soils. The plant has excellent drought and fair shade tolerance, and fair to poor flood tolerance. Little bluestem is considered less valuable for grazing due to its tussock growth form and perceived lower forage quality. In Missouri, it is often found growing as an understory plant in open woodlands, savannas, and transitional forested areas.

The Elsberry PMC initiated a little bluestem collection from the Ozark region (Missouri, Arkansas, and Oklahoma) in 1996 to develop an improved little bluestem that would be better adapted to this region. The collection effort resulted in an assembly of 130 little bluestem accessions.

Problem:

There is limited information available on species selected for forage to be primarily used for savannas and silvopasture systems throughout Missouri.

Objective:

An existing PMC little bluestem collection displays an amazing range of morphological and phonological characteristics – color, plant height, blade width, stem erectness, rust resistance, spring emergence, anthesis, etc. This collection has never been evaluated for shade attributes that might be valuable in silvopasture systems or with savanna restoration efforts. This study will select and evaluate for forage production in relation to shade tolerance.

Cooperators:

The USDA Natural Resources Conservation Service, Plant Materials Center and the University of Missouri, Columbia, Horticulture and Agroforestry Research Center, HARC.

Procedure:

A randomized complete block design with three replications, five shade levels: full sun, 30% shade, 55% shade, 55% shade with sunflecks, and 80% shade will be used for the study.

Twenty-eight accessions of little bluestem are selected based on original collection site descriptions that indicated collections were associated with woodland conditions. These collections came from previous work (Study 29I141G) at the Elsberry PMC and will be assembled in 2008 at the University of Missouri Agroforestry Center (HARC). Additional varieties being evaluated are the little bluestem Northern region assembly and the bluestem Southern region assembly. Plants will be started in the greenhouse and planted in replicated plots the spring 2008.

Forty-five pots for each accession will be randomized within each treatment. Above ground dry weight, leaf weight, and forage quality (acid detergent fiber, neutral detergent fiber, crude protein) will be collected for each accession.

Discussion:

2007

Collection reports from PMC study 29I141G were reviewed and 28 accessions were selected based on woodland site descriptions (Table #1). Two selections under evaluation at the PMC and two established cultivars will also be included.

Study MOPMC-P-0717-PA, WL				**Table #1**
PMC Accessions Selected For Shade Tolerance Evaluation				
		Location Description		
Accn No.	**State Code**	**Soil Type**	**County**	**Site**
9078847	IA-1	Gara	Clarke	Woods Edge (WE)
9078848	IA-2	Gara	Clarke	WE
9078850	IA-4	Monona	Woodbury	WE
9078852	IA-6	Hamburg	W. Pottawattamie	Woods (W)
9078858	IA-12	Haydon	Dallas	Open Woods (OW)
9078961	IA-27	Cresco	Scott	OW
9078873	IL-1	Rodman	Kane	W
9078875	IL-3	Miami Casco	Kane	OW
9078876	IL-4	Rozetta	Pike	WE
9078880	IL-8	Ashbury	Will	Ditch
9078882	IL-10	Hamburg	Henderson	W
9078887	IL-15	Bloomfield	Mason	OW
9078888	IL-16	Ava	Marion	W/G Lode
9078891	IL-19	SOGN	Calhoun	Glade
9078894	MO-1	Winnegan	Chariton	W
9078895	MO-3		Cape	
9078898	MO-6	Keswick	Putnum	OW
9078899	MO-7	Midco	Ripley	OW
9078902	MO-10	Captina	Carter	WE
9078905	MO-13	Clarksville	Butler	W (Row)
9078915	MO-23		Perry	
9078917	MO-25	Gorin	Monroe	OW
9078921	MO-29	Goss	Montgomery	
9078956	MO-64	-	Shannon	Glade
9078959	MO-67	-	Wayne	OW
9078960	MO-68	Keswick	Pike	WE
9083271			Composite Selection (South Region)	
9083317			Composite Selection (North Region)	
421553	'Aldous'	Kansas Flinthills		
421552	'Cimarron'	Eastern Kansas and Oklahoma		

Study: MOPMC-T-0718-WE, WL

Study Title: Evaluation of the Flood Tolerance of Planted Oak Seedlings Derived from Different Seed Origins

Study Leaders: Coggshall, M., University of Missouri
Cordsiemon, R., Elsberry Plant Materials Center

Introduction:

Many plant species exhibit wide amplitude in terms of their capacity to occupy a range of positions along a hydrologic gradient. The presence or absence of a particular tree species in a bottomland hardwood forest is primarily dependent upon soil moisture gradients, stream deposition patterns, and flooding season and duration (Hodges, 1997). In the Midwestern U.S., there is considerable interest in restoring native ecosystems on former bottomland sites that are now being devoted to marginal agriculture (Kruse and Groninger, 2003). Oak seedlings are a major component of these restoration efforts

Problem:

Little is known about whole tree responses to a variety of flooding treatments for different oak seedlings used in WRP and other wetland programs.

Objective:

The specific objectives of the proposed research are: 1) to determine the effect of controlled flooding treatments, including inundation, on the survival and regrowth of planted oak seedlings in the Flood Laboratory located at the NRCS Plant Materials Center (PMC) in Elsberry, Missouri; 2) to contrast these flooding results with additional flood evaluations using planted seedlings in the Flood Tolerance Laboratory (FTL) at the Horticulture and Agroforestry Research Center (HARC) in New Franklin, Missouri; and 3) initiate a potted seedling study as a means to further expand our knowledge base of how plants respond to controlled flooding events.

Procedure:

A total of 1,746 test trees were established as 1-0 bare root seedlings in the PMC Flood Laboratory (Field #4) in May 2007. Spacing was 4’ x 10’. The entire test planting covers 1.60 acres. A total of seven different oak species were planted including: bur oak (12 seedlots), chinkapin oak (2 seedlots), pin oak (6 seedlots), northern red oak (9 seedlots), shumard oak (8 seedlots), swamp white oak (27 seedlots) and white oak (25 seedlots). Each seedlot contains 18 seedlings which were established in a series of 18 single tree plots. All seedlots planted in the PMC planting were also common to the FTL planting at HARC. The experimental design for this planting is a randomized complete block design with 18 replications. Replication boundaries were defined based on slope position within the Elsberry Flood Laboratory to the extent possible.

Discussion:

2007

Collection of first year seedling survival, height and diameter data in the PMC planting will be made in the winter of 2007/2008. Flooding treatments will coincide with the natural flooding for calendar year 2007 of the Mississippi River, based upon flood stage data from the nearest river gauging station to the Elsberry planting site. Survival data will be collected immediately following the end of the first flooding period and re-growth potential. Flooding will be assessed as a function of shoot growth in the year following. This data will be contrasted with results obtained from the flood treatments that are planned in the HARC FTL**,** which will be initiated following the completion of the first growth flush in the spring 2008.

2008

In 2008, the PMC staff flooded the evaluation plot from 2 -24 inches. The water was left on the trees for 16 days, beginning the first part of April to mimic the flood stage of the Mississippi River in 2007 at the Winfield Lock and Dam. Mark Coggeshall and students collected data in late summer.

2009

The wetland cell was saturated for most of the growing season and impossible to maintain. Mr. Coggeshall and his team did not make it to the PMC to do any further evaluations. In 2010, a decision will be made to determine whether to continue with the study or not.

Study: MOPMS-T-0719-CR/RI07-016

Study Title: Critical Area Roadside Vegetation Establishment

Study Leader: Kaiser, J., Plant Materials Specialist

Introduction:

This study will be installed in Carter County, Missouri. The plant materials evaluation process will be conducted by the USDA NRCS, Elsberry Plant Materials Program, the Big Spring RC&D Program, and assistance from Missouri Department of Transportation (MODOT). Evaluation of plant materials species data will be collected in the fall and spring to analyze plant performance over time of the study. Results will be provided to MODOT and within NRCS for technology transfer for products.

Problem Statement:

Lack of permanent vegetation on roadside excavated slopes along Missouri State Highway 60 in southern Missouri has left large areas of the right-of-way unprotected from soil erosion. There is erosion occurring on large areas of slope that range from slight to severe. The silt from this erosion is leaving deposition in the drainage systems and moving it off site to areas that are within the national scenic river watershed.

This proposal will test methods to establish permanent vegetation in these areas and control the erosion.

The soils from a representative area have been tested to have very low pH (4.3) along with very low phosphorus (P) and medium to high for Potassium (K) content. The slopes are steep (2.0:1) which will not allow conventional farm equipment to be used for seedbed preparation and seeding.

With the pH so low, any nutrients applied such as N, P and K will not be available to the plants. Raising the pH to a range of 5.5 to 6.5 is critical for grasses to survive and flourish.

This means that ground limestone, hydrated lime, or pelletized hydrated lime must be applied to the slopes. The ground limestone is least expensive, but must be applied 4-6 months before planting to allow enough time for acid buffering in addition to the lime. Temporary mulch (about 1-1.5 ton/acre) will be placed after the liming operation. The temporary mulch will begin to decay, and within four-six months be ready to seed using a hydroseeder/mulcher.

Hydrated lime and pelletized hydrated lime can be a substitute to be placed at time of planting; and the buffering effect is almost immediate.

Objective:

The objective of this study is to test an establishment technique for permanent vegetation on critical area sites of constructed right-of-ways to control soil erosion.

Procedure:

Randomized split plot complete block design with three replications. The length of the slope 80 feet (average) by 90 feet full plot width (45 foot split).

SITE 1 S=Standard MODOT Fertility and Lime

Erosion Control Techniques-consist of 90 feet full plots of the following:

Fiber/Mulch-90 feet full plot

Blanket – 90 feet full plot

Treatments Seeding Mixtures-45 feet split plots

1-MODOT Warm Season Mix

2-NRCS Critical Area Warm Season Mix

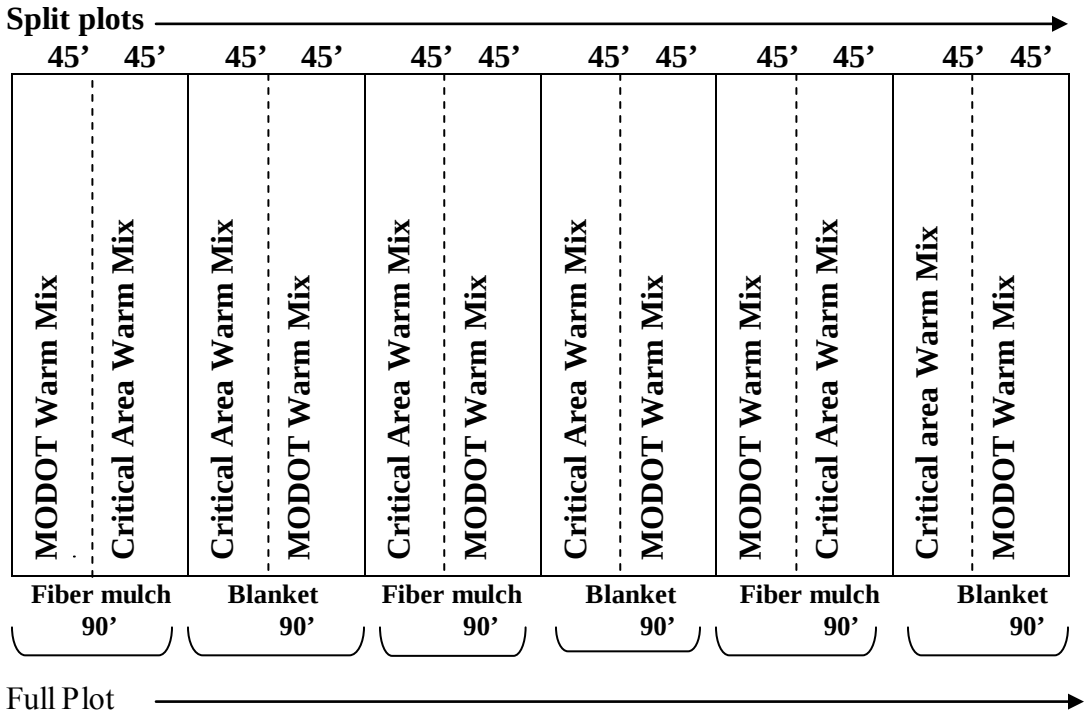
Split plots based on comparing MODOT warm season mix to NRCS Critical Area Warm season mix with 80 PLS/sq. ft. See attachment 1 for the listing of MODOT specifications and NRCS species and rates for the seeding mixture treatments.

All plots will be hydro seeded with the seeding mixes listed in amendment 1.

The 90 feet wide full plots will compare fiber mulch to blanket material, with three replications

Total six full plots; and 12 split plots for the 540 feet width by 80 feet length of slope = approx. 1 acre for treatment site 1.

June 6, 2006
Site #1 – Standard Fertility and Lime
Treatment 1 – Seeding Mixtures
A-MODOT Warm Season Mix
B-Critical Area Warm Season Mix



MODOT Standard Fertilizer: Lime Applied to All of Site 1

90' Full Plots Either Fiber Mulch/Stick Plus or Blanket Material

45' Split Plots – Treatment A-MODOT Warm Season Mix
Treatment B – Critical Area Warm Season Mix

Approximate Site Area: 540 ft x 80 ft = 43,200 sq. ft.
Approximate 1 acre in size

SITE 2 R=Recommended Soil Test Fertility and Lime

Erosion Control Techniques-consist of 90 feet full plots of the following;

Fiber/Mulch-90 feet full plot

Blanket – 90 feet full plot

Treatments Seeding Mixtures-45 feet Split plots

1-MODOT Warm Season Mix

2-NRCS Critical Area Warm Season Mix

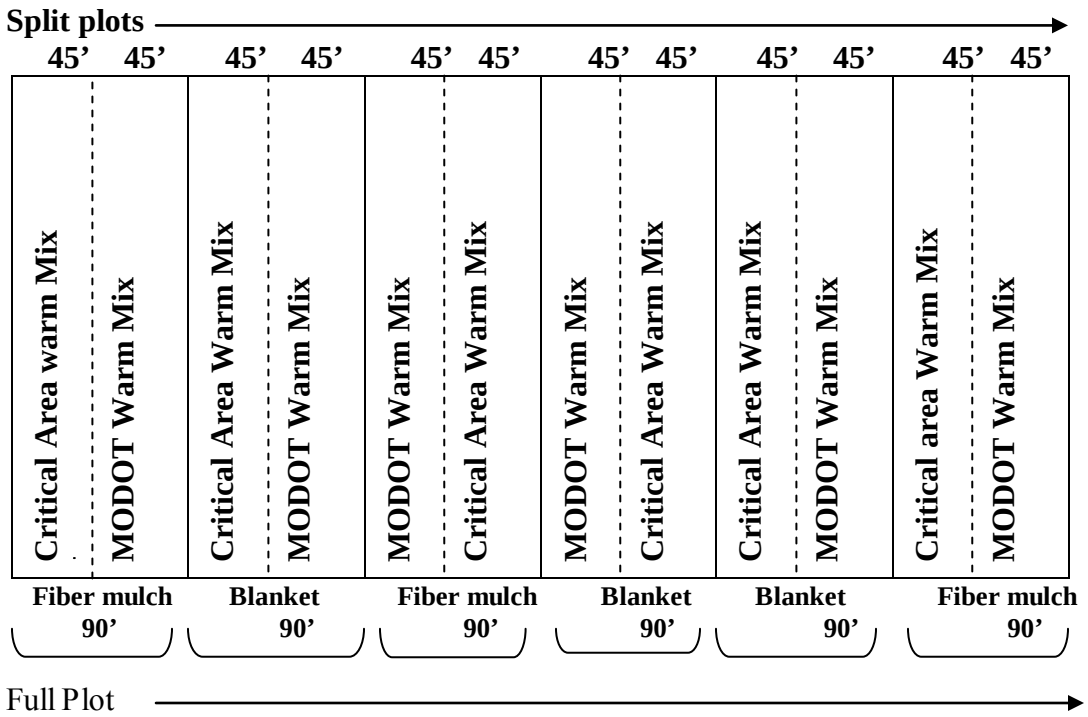
Split plots based on comparing MODOT warm season mix to NRCS Critical Area Warm season mix with 80 PLS/sq. ft. See attachment 1 for MODOT specifications and NRCS Critical Area species listing of species and rates for the seeding mixture treatments.

All plots will be hydro seeded with the seeding mixes listed in amendment 1.

The 90 feet wide full plots will compare fiber mulch to blanket material, with three replications.

Total 6 full plots and 12 split plots is the 540 feet width by 80 feet length of slope = approx. 1 acre for treatment site 1.

Site #2 – Recommended Fertility and Lime
Treatment 2 – Mulches
A-Fiber Mulch/Stick Plus
B-Blanket Material



Recommended fertility and lime according to soils test all Site 2

45' Split Plots Either Critical Area Warm Season Mix or MODOT Warm Season Mix

90' Full Plots – Treatment A - Fiber Mulch/Stick Plus
Treatment B – Blanket Materials

Approximate Site Area: 540 ft x 80 ft = 43,200 sq. ft.
Approximate 1 acre in size

SITE 3-The Cool Season Mix

Erosion Control Techniques-consist of 90 feet full plots of the following;

Fiber/Mulch-90 feet full plot

Blanket – 90 feet full plot

Treatments Fertilizer 45 feet split plots

S=Standard MODOT fertility

R=Recommended fertility and lime from soil test.

See attachment 1 for the listing of MODOT cool season mix species and rates for the seeding mixture used on Site 3.

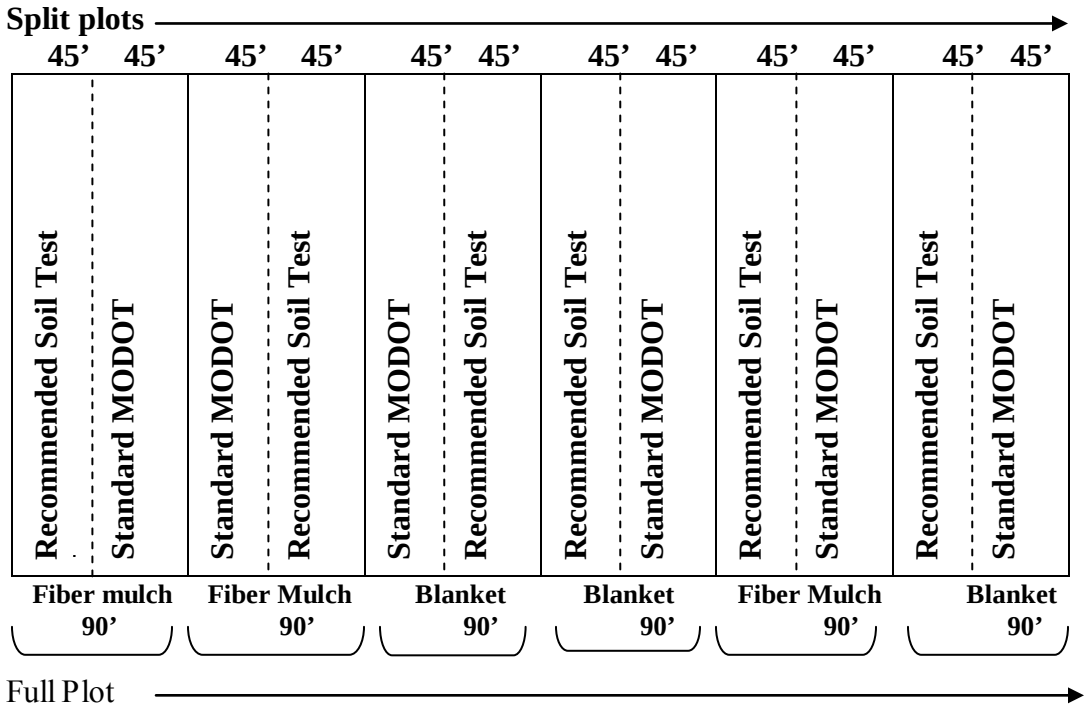
All plots will be hydro seeded with the seeding mixes listed in amendment 1.

The 90 feet wide full plots will compare fiber mulch to blanket material, with three replications

Total six full plots; and 12 split plots for the 540 width by 80 feet length of slope = approx. 1 acre for treatment site 1.

June 8, 2006
Site #3 – Cool Season Mix
Treatment 1 – Fertility and Lime
A-Standard MODOT
B-Recommended Fertility and Lime Test

Treatment 2 – Mulch
A-Fiber Mulch/Stick Plus
B-Blanket Material



MODOT Cool Season Species Mix Applied to All of Site 3

45 ft. Split Plots – Treatment 1 – Fertility and Lime
A – Standard MODOT
B- Recommended Fertility: Lime Soil Test

90 ft Full Plots – Treatment 2 – Mulch
A – Fiber Mulch/Stick Plus
B – Blanket Material

Approximate Site: Area 540 ft. x 80 ft = 43,200 sq. ft.
Approximately 1 acre in size

<u>Amendment 1</u> Contains the species in the mixtures for site 1, 2 and 3 along with the seeding rates.

Site 1 and 2		Site 1 and 2		Site 3	
A-MODOT		B-NRCS Critical Area Warm Season Mixture Species		MODOT Cool Season Mixture	
Indiangrass	8	Indiangrass	11.7	Tall fescue	80
Big bluestem	4	Switchgrass	7.2	Annual ryegrass	10
Little bluestem	6	Little bluestem	9.60	Perennial ryegrass	5
Sideoats grama	4	Broomsedge	2.25	White clover	5
Switchgrass	2	Tall dropseed	2.28	Oats	10
Virginia or Canada wildrye	2	Canada wildrye	10		
Tall dropseed	0.5	Annual lespedeza	11.22		
Purple prairie clover	0.5	Oats	20		
Annual ryegrass	10				
Perennial ryegrass	5				
Red fescue	10				
Redtop	0.5				
Partridge pea	2				
White clover	5				
Grayheaded coneflower	0.25				
Black-eyed Susan	0.25				
Oats	20				

Discussion:

2007

<u>Establishment Techniques were completed in May 2007.</u>

Size of each three sites is approximately one acre for a total of three acres.

MODOT shaped the slope and applied hydrated lime and fertilizer rates at the time of hydro seeding according to there standard and the soil test data.

Seed was obtained according to the species and rates listed on Amendment 1. Each species mix was hydro seeded on site.

MODOT provided fiber mulch and blankets on treatment sites 1, 2 and 3, and will provide labor and material for application according to their standards for fiber blankets.

MODOT provided the seed from their specifications for the warm season mix and cool season mix for use in the treatments for the three sites.

Each plot size is 90 feet wide by average length of slope 80 feet, with
three replications for a total of 540 feet for the approximate 1 acre size per site

Three sites were applied according to the experimental design.

All hydro seeded sites and treatments were completed May 2007.

FIRST YEAR RESULTS FROM 2007
Summary of Seeding Mixtures and Establishment Techniques
At MODOT Sites 1, 2, and 3

Site 1 - Utilization of Fiber Mulch, Standard Fertility Recommendations and MODOT Warm Season Mixture

White clover, switchgrass, perennial rye, little bluestem and Indiangrass (refer to table 1) ranked highest in frequency of occurrence of any species in the MODOT seeding mixture with fiber mulch and a MODOT standard fertility recommendation. White clover had the highest frequency of occurrence (2.9), but the increase was not significantly greater than switchgrass or perennial rye (2.3 and 1.9). The low occurrence of cool season grasses (annual rye, oats, red fescue, redtop and Virginia wildrye) on this site may be due to the planting date. Cool season grasses and small grains are typically planted for optimal germination in the spring from
March 1-April 15 and acceptable to May 15, these seedings were completed in mid-May. Warmer soil temperatures encountered in May probably contributed to the lack thereof or poor germination of cool season grasses and small grains and being able to develop an adequate root system before the summer period.

The low occurrence of partridge pea was somewhat surprising. Partridge pea is considered a pioneer species on disturbed sites, occurring frequently on the sites with low vegetative competition. Perhaps early germinating perennial grasses may have prevented partridge pea from occurring more frequently. The lack of or low occurrence of forb species may be due to seed dormancy. Natural stratification of the seed over fall and winter may provide the mechanism to break seed dormancy and increase occurrence of these species in subsequent years.

Site 1 – Utilization of Fiber Mulch, Standard Fertility and NRCS Critical Area Species Mixture

Switchgrass, little bluestem and Indiangrass (refer to table 2) were the main species in the NRCS critical area seeding mixture that occurred most frequently on this site with fiber mulch and a MODOT standard fertility recommendation. Switchgrass and little bluestem had a significantly greater occurrence than the other species in the mixture. The low occurrence of the Canada

wildrye and oats is probably due to later than recommended planting date for cool season grasses in Missouri. It is interesting to note that Canada wildrye did persist on these dry and coarse soil conditions during the summer months. The annual lespedeza did not express itself the first year; however, hard seeded legumes species such as annual lespedeza may remain dormant until next year due to dormancy imposed by seed appendages. It is anticipated that mechanically scarifying the seed will enhance germination resulting in a higher frequency of occurrence. Furthermore, it is anticipated that seed germination may be improved through natural weathering of the seed coat during fall and winter months. A greater degree of occurrence of the species is expected in subsequent years.

The lack of occurrence of broomsedge bluestem may be an anomaly due to the close resemblance of seedlings of little bluestem at the early developmental stage of the grasses. Misidentification of the two grasses would not be uncommon at the time the data was collected. Perhaps identification of the two bluestems will be easier to determine in subsequent years.

Site 1 – Utilization of Erosion Blanket, Standard Fertility and MODOT Warm Season Critical Area Seeding Mixture

Warm season native grasses were the dominating species in the mixture with switchgrass, little bluestem and Indiangrass (refer to table 3) among the most frequently occurring of all species seeded with an erosion control blanket and MODOT standard fertility. The same trend specie occurrence was also evident in the MODOT and NRCS mixtures, standard fertility and fiber mulch plantings. Low occurrence or lack thereof of annual and perennial cool season grasses, and warm season forbs and legumes can be explained by a mid-May planting date that is not conducive for cool season grass establishment, seed dormancy in grasses, forbs and legumes, and possible vegetative competition from early establishing perennial grasses. It is interesting to note that the cool season species (e.g. rye, white clover, and oats) were much less frequent using erosion blanket compared to the fiber mulch. These species could have germinated but the blanket may have trapped excess heat at the soil surface during the summer that desiccated the species due to limited moisture and drying of the soil during the summer.

Site 1 Utilization of Erosion Blanket, Standard Fertility and NRCS Warm Season Critical Area Seeding Mixture

Switchgrass, little bluestem and indiangrass (refer to table 4) were the most frequently occurring species in the NRCS mixture with the blanket protection and standard fertility. Switchgrass had a significantly higher frequency of occurrence than the other species in the mixture. A similar trend in species occurrence and frequency was encountered in the fiber mulch planting. Low occurrence or lack thereof of annual and perennial cool and warm season grasses, and warm season forbs and legumes is related to planting date and seed dormancy in grasses, forbs and legumes that restricted seed germination, and seedling mortality enforced by stressful environment beneath the erosion control blanket.

MOPMS-T-0719-CR/RI07-016
Tables 1 and 2; 3 and 4 Statistics from Site 1

MoDOT	Table 1			Table 2		
Standard						
Fertility						
	MoDOT	Fiber Mulch		NRCS	Fiber Mulch	
	Species	Means		Species	Means	
Site 1	White clover	2.9167	A*	Switchgrass	4.6667	A*
	Switchgrass	2.2500	AB	Little bluestem	3.6667	A
	Perennial rye	1.9167	ABC	Indiangrass	1.0833	B
	Little Bluestem	1.2500	BCD	Canada wildrye	0.3333	B
	Indiangrass	1.1667	BCD	Oats	0.1667	B
	Annual rye	0.5833	CD	Tall dropseed	0.1667	B
	Sideoats grama	0.5833	CD	Annual lespedeza	0	B
	Partridge pea	0.3333	CD	Broomsedge	0	B
	Big bluestem	0.1667	D			
	Oats	0.1667	D			
	Purple prairie clover	0.0833	D			
	Black-eyed Susan	0	D			
	Grayheaded coneflower	0	D			
	Red fescue	0	D			
	Redtop	0	D			
	Tall dropseed	0	D			
	Virginia wildrye/Cuivre River	0	D			
*Means within column followed by the same letters are not significant difference test at P <0.05						

MoDot	Table 3			Table 4		
Standard						
Fertility	MoDOT	Blanket		NRCS	Blanket	
	Species	Means		Species	Means	
Site 1	Switchgrass	4.6667	A*	Switchgrass	5.0000	A*
	Little bluestem	3.3330	AB	Little bluestem	3.2500	B
	Indiangrass	2.5000	B	Indiangrass	1.5000	C
	Big bluestem	0.4167	C	Oats	1.1667	C
	Partridge pea	0.4167	C	Canada wildrye	0.1667	C
	Virginia wildrye Cuivre River	0.3333	C	Annual lespedeza	0	C
	Perennial rye	0.0833	C	Broomsedge	0	C
	Annual rye	0	C	Tall dropseed	0	C
	Black-eyed Susan	0	C			
	Grayheaded coneflower	0	C			
	Oats	0	C			
	Purple Prairie clover	0	C			
	Red fescue	0	C			
	Redtop	0	C			
	Sideoats grama	0	C			
	Tall dropseed	0	C			
	White clover	0	C			
*Means within column followed by the same letters are not significant difference test at P <0.05						

Site 2 Fiber Mulch
Similar results to Site 1-
The fertility levels for species development at this stage have not been expressed at this time.

Recommended Soil Test MODOT Warm Season Mixture

Perennial rye and little bluestem and/or broomsedge (refer to table 5) have the highest frequency of occurrence of any species in the MODOT warm seeding mixture with fiber mulch and with the recommended fertility levels from the soil test. Perennial rye had the highest frequency of occurrence (4.25) but the increase was not significantly greater than little bluestem (2.2). The cool season species were similar to Site 1; except for the perennial rye. The other cool season species, forbs and legumes did not increase in frequency of occurrence with the increase fertility levels during the initial growing season; however this can be related to other issues and not because of fertility.

Site 2 Fiber Mulch

Recommended Soil Test NRCS Critical Area Mixture

Switchgrass, little bluestem and Indiangrass were (refer to table 6) the main species in the NRCS critical area seeding mixture that occurred most frequently on this site with fiber mulch for the recommended soil test. The highest frequency was switchgrass with a mean of 4.5. All other warm season species did express occurrence in the mixture.

The cool season specie, Canada wildrye (0.4) occurred in the mixture with the fiber mulch. The warm season legume, annual lespedeza, did not occur in the sampling. This could be contributed by hard seed if no scarification of seed occurred before planting.

Site 2 Blanket

Recommended Soil Test MODOT Warm Season Mixture

Little bluestem (4.7) and switchgrass (4.7) has the highest frequency of occurrence (refer to table 7) for the warm season species in the MODOT mixture.

The cool season species, especially the perennial rye, was much less frequent in the blanket (0.5) verse in the fiber mulch (4.25). The species may have germinated but the blanket could have trapped heat at the surface during the summer that desiccated the species with limited moisture and drying of the soils during the summer. The legume specie of partridge pea was not prevalent within the mixture. The other legumes did not occur in the sampling.

Site 2 Blanket

Recommended Soil Test NRCS Critical Area Mixture

Switchgrass has the highest frequency of occurrence (4.5) [refer to table 8], comparable to the standard soil test. The other warm season specie little bluestem/broomsedge (2.8) was more frequent than the Indiangrass or other warm season species. Similar to the fiber mulch, the blanket had the same mean (0.4) for the cool season specie Canada wildrye (0.4) as did occur in the mix. The warm season legume, annual lespedeza, did not occur in the sampling. This could be contributed by hard seed if no scarification of seed occurred before planting.

Results of frequency of species were similar to the standard soil test verse the recommended soil test.

MOPMS-T-0719-CR/RI07-016
Tables 5 and 6 Statistics results for Site 2

Recommended						
Soil Test	**TABLE 5**			**TABLE 6**		
	MoDOT	**Fiber Mulch**		**NRCS**	**Fiber Mulch**	
	Species	**Means**		**Species**	**Means**	
Site 2	Perennial rye	4.2500	A*	Switchgrass	4.5000	A*
	Little bluestem	2.2500	AB	Little bluestem	2.8333	B
	Switchgrass	1.5833	B	Indiangrass	1.2500	C
	White clover	0.9167	B	Canada wildrye	0.4167	C
	Indiangrass	0.5833	B	Tall dropseed	0.3333	C
	Partridge pea	0.5833	B	Annual lespedeza	0	C
	Purple prairie clover	0.2500	B	Broomsedge	0	C
	Sideoats grama	0.1667	B	Oats	0	C
	Annual rye	0.0833	B			
	Big bluestem	0	B			
	Black-eyed Susan	0	B			
	Grayheaded coneflower	0	B			
	Oats	0	B			
	Red Fescue	0	B			
	Redtop	0	B			
	Tall dropseed	0	B			
	Virginia wildrye/Cuivre River	0	B			
*Means within column followed by the same letters are not significant difference test at P <0.05						

Recommended						
Soil Test	**TABLE 7**			**TABLE 8**		
	MoDOT	**Blanket**		**NRCS**	**Blanket**	
	Species	**Means**		**Species**	**Means**	
Site 2	Little bluestem	4.6667	A*	Switchgrass	4.5000	A*
	Switchgrass	4.6667	A	Little bluestem	2.8333	B
	Indiangrass	1.3333	B	Indiangrass	1.2500	C
	Perennial rye	0.5833	B	Canada wildrye	0.4167	C
	Big bluestem	0.2500	B	Tall dropseed	0.3333	C
	Redtop	0.2500	B	Annual lespedeza	0	C
	Partridge	0.1667	B	Broomsedge	0	C
	Sideoats grama	0.0833	B	Oats	0	C
	Tall dropseed	0.0833	B			
	Annual rye	0	B			
	Black-eyed susan	0	B			
	Grayheaded coneflower	0	B			
	Oats	0	B			
	Purple prairie clover	0	B			
	Red Fescue	0	B			
	Virginia wildrye Cuivre River	0	B			
	White clover	0	B			
*Means within column followed by the same letters are not significant difference test at P <0.05						

Site 3 – Cool Season Mixture, Erosion Blanket and Standard MODOT Fertility and Soil Test Recommendation

Perennial rye, tall fescue and white clover were the primary species referred to in tables 9 and 10 and occurred most frequently in the mixture when planted with the erosion control blanket. Perennial rye (9.3) and the tall fescue (8.3) were found to have a high occurrence. Soil fertility treatment had limited effect on the overall frequency of occurrence of species in the mixture (4.4 for MODOT standard fertility versus 4.8 for recommended soil test); however, this is the first year of the seeding. This mixture contained only three perennial species having a much higher seeding rate than used in Site 3 (tall fescue 80#/acre). See amendment 1 that contains the seeding rates/acre. The tall fescue appears to be better adapted for the cool season species with the blanket material than other cool season species in Site 1 and Site 2. The perennial rye was seeded at the same rate as with the warm season mixtures in Site 1 and 2

Site 3 – Cool Season Mixture, Fiber Mulch and Standard MODOT Fertility and Soil Test Recommendation

The same trend in species occurrence was found in the fiber mulch as compared to the erosion control blanket (refer to tables 11 and 12). Tall fescue provided the highest frequency of occurrence. It is interesting to note that frequency of occurrence of cool season species in the fiber mulch (1.3) was considerably less than the frequency reported for the same species planted with the erosion control blanket (4.6). Onsite visual appearance had better erosion control with blanket versus fiber mulch. The better erosion control may have enhanced species development of perennial rye, tall fescue and white clover.

Tables 9 and 10, 11 and 12 Statistics results for Site 3

Cool Season Mix							
	TABLE 9				**TABLE 10**		
		Standard				**Recommended**	
	MoDOT	**Fertility**			**MoDOT**	**Soil Test**	
	Species	**Means**			**Species**	**Means**	
Site 3	Perennial rye	9.3333	A*	**Site 3**	Perennial rye	14.833	A*
Blanket	Tall fescue	8.3333	A		Tall fescue	5.6667	B
	White clover	4.1667	AB		White clover	3.0000	C
	Oats	0.0833	B		Annual rye	0	D
	Annual rye	0	B		Oats	0	D
*Means within column followed by the same letters are not significant difference test at P <0.05							
Cool Season Mix							
	TABLE 11				**TABLE 12**		
		Standard				**Recommended**	
	MoDOT	**Fertility**			**MoDOT**	**Soil Test**	
	Species	**Means**			**Species**	**Means**	
Site 3	Tall fescue	1.3333	A*	**Site 3**	Tall fescue	0.7500	A*
Fiber Mulch	Perennial rye	0.8333	AB		Perennial rye	0.0833	A
	White clover	0.3333	AB		White clover	0.0833	A
	Annual rye	0	B		Annual rye	0	A
	Oats	0	B		Oats	0	A
*Means within column followed by the same letters are not significant difference test at P <0.05							

References:

1) The tables above contain the attachment from the spreadsheet for the statistical ranking of the species.

2) The amendment 1 contains the species and seeding rates that were used in Sites 1, 2 and 3.

3) The soil test for the sites was collected by MODOT, results of the recommended soil nutrients applied is part of MODOT records, along with there standard fertility recommendations.

3 YEAR RESULTS FROM 2007 through 2009
Summary of Seeding Mixtures and Establishment Techniques
MODOT Site's 1, 2, and 3 located in Van Buren Missouri.

Site 1 - Utilization of Erosion Blanket,
Standard Fertility
NRCS Warm Season Critical Area Seeding Mixture

Table 1 is standard fertilizer and lime effects on plant density of NRCS critical area warm season seeding mixture with the application of erosion Control blanket, Van Buren MO.

Species	Site 1			
	2007	2008	2009	3 year Average
Grass	-----plant/m^2			plant/m^2
switchgrass	2.0 a[/1]	7.7 a	5.4 a	5.0 a
little bluestem	1.3 b	1.5 b	1.9 b	1.5 b
Indiangrass	0.6 c	0.7 c	2.7 b	1.4 b
broomsedge bluestem	0.5 c	0 d	0.0 c	0.0 c
tall dropseed	0.1 c	0 cd	0.0 c	0.0 c
Canada wildrye	0 c	0.1 d	0.1 c	0.0 c
oats	0 c	0 d	0 c	0.2 c
Legume				
annual lespedeza	0 c	0.1 cd	0.0 c	0.0 c

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

The evaluations conducted in 2009 illustrated in the above table a significant trend of switchgrass being the dominant species on site. Indiangrass increased in 2009 as the next prevalent species followed by little bluestem. The switchgrass density for plants/meter^2 is higher with this seeding mixture compared to the MODOT seeding mixture in table 2.

The site had an average between the reps of 30% rill erosion on site after the fall of 2009 which accounts for the better establishment of vegetation using erosion blanket.

<u>Summary</u> <u>3 Year Average for Site 1 Table 1 Mixture and Treatment.</u>
For Site 1 this seeding mixture has the highest stand of switchgrass 5.0 plant/m^2. Switchgrass provided the most cover in the first year and still the dominant species in the 3rd year. Little bluestem and indiangrass are increasing in the vegetation by the 3rd year. Perennial grass species account for 7.9 plant/m^2 which is adequate plant cover along with the erosion control blanket. This erosion blanket treatment is the best control for least amount of erosion on this site.

Site 1 – Utilization of Erosion Blanket,
Standard Fertility
MODOT Warm Season Seeding Mixture

Table 2 is standard fertilizer and lime effects on plant density of MODOT warm season seeding mixture with the application erosion control Blanket, Van Buren MO.

Species	Site 1			
	2007	2008	2009	3 year Average
Grass	-----			Plant/m^2
	plant/m^2			
switchgrass	1.9 a[/1]	5.7 a	4.3 a	4.1 a
little bluestem	1.3 ab	1.9 b	1.0 cde	1.4 bc
Indiangrass	1.0 b	1.3 bc	3.3 ab	1.9 b
big bluestem	0.2 c	0 d	0.3 de	0.1 e
tall dropseed	0 c	0.04 d	0.0 e	0.0 e
sideoats grama	0 c	0.6 cd	2.4 bc	0.7 cd
Canada wildrye	0.1 c	0 d	0.0 e	0.1 e
perennial ryegrass	0.04 c	0 d	0 e	0.0 e
annual rye	0 c	0 d	0 e	0.0 e
redtop	0 c	0 d	0 e	0.0 e
red fescue	0 c	0 d	0 e	0.0 e
oats	0 c	0 d	0 e	0.0 e
Legume				
white clover	0 c	2.0 b	0.0 e	0.7 cd
partridge pea	0.2 c	0.7 cd	1.7 bcd	0.8 cd
purple prairie clover	0 c	0 d	0 e	0.0 e
Forbs				
gray headed coneflower	0 c	0 d	0 e	0.0 e
black-eyed susan	0 c	0 d	0 e	0.0 e

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

The evaluations conducted in 2009 illustrates a slight decrease from 2008 with switchgrass, but still being the dominant species on site. Little bluestem and indiangrass is significant less than switchgrass; however indiangrass is increasing on this site with more plant/m^2 than little bluestem.

The legume species of white clover in 2009 did not persist on the site. Partridge pea has doubled in the amount of plant/m^2 since 2008, now being the only legume species on site.

The site had an average between the reps of only 30% rill erosion on site after the fall of 2009 which accounts for the better establishment of vegetation using erosion blanket.

<u>Summary</u> <u>3 Year Average for Site 1 Table 2 Mixture and Treatment.</u>

For Site 1 this seeding mixture has the highest perennial grass species.
Warm season grasses dominant the stand, 8.3 plant/meter^2, which is adequate plant cover.
This mixture should eliminate all cool season grass species, perennial and annual species, because they do not establish on these sites.
Switchgrass, 4.1 plant/m^2, was the dominant species for the 3 year average. Indiangrass, little bluestem, sideoats grama is providing increasing vegetation by the 3rd year.

Legumes can provide benefit to these sites for fixing nitrogen for the perennial grasses. White clover was establishing the 2nd year but did not persist into the 3rd year. Partridge pea increased each year on the site and was the only legume persisting on this site. Other legumes and forbs in this mixture did not establish.

The erosion blanket treatment is the best control for least amount of erosion on this site.

Site 1 –Utilization of Fiber Mulch,
Standard Fertility
NRCS Warm Season Critical Area Seeding Mixture

Table 3 is standard fertilizer and lime effects on plant density of NRCS critical area warm season seeding mixture with the application of fiber mulch for erosion control, Van Buren, MO.

Species	Site 1			
	2007	2008	2009	3 year Average
Grass	-----plant/m^2-----			plant/m^2-----
switchgrass	1.9 a[/1]	2.9 a	3.5 a	2.8 a
little bluestem	1.5 a	0.7 b	1.4 b	1.2 b
Indiangrass	0.4 b	0.4 b	1.7 b	0.8 b
broomsedge bluestem	0.0 b	0.0 b	0.0 c	0.0 c
tall dropseed	0.1 b	0.0 b	0.0 c	0.0 c
Canada wildrye	0.1 b	0.0 b	0.0 c	0.0 c
oats	0.1 b	0.0 b	0.0 c	0.0 c
Legume				
annual lespedeza	0.0 b	0.6 b	0.0 c	0.2 c

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

The evaluations conducted in 2009 illustrates a significant trend of switchgrass being the dominant species on site.
The switchgrass density is about double for plants/meter^2 with this seeding mixture compared to the MODOT seeding mixture in table 4.

Little bluestem and indiangrass are the next prevalent species, with an increase in 2009 especially with indiangrass; but significant less than switchgrass.

In the fall of 2009 the average between the reps was 70% rill erosion on site. This erosion accounts for the lack of established vegetation, compared to average 30% for the erosion blankets.

<u>Summary</u> <u>3 Year Average for Site 1 Table 3 Mixture and Treatment.</u>

For Site 1 switchgrass provided the most cover in the first year and still the dominant species in the 3rd year. Little bluestem and indiangrass did provide increased vegetation by the 3rd year. Perennial grass species account for 4.8 plant/m^2 which is not adequate plant cover.

This fiber mulch treatment did not provide erosion control, 70% rill and gully erosion on this site.

Site 1 - Utilization of Fiber Mulch,
Standard Fertility
MODOT Warm Season Seeding Mixture

Table 4 is standard fertilizer and lime effects on plant density of MODOT warm season seeding mixture with application of fiber mulch for erosion Control, Van Buren MO.

Species	Site 1			
	2007	2008	2009	3 year Average
Grass	-----plant/m^2-----			Plant/m^2
switchgrass	0.9 ab[/1]	1.4 b	2.1 ab	1.4 b
little bluestem	0.5 bcd	0.5 b	1.2 bc	0.7 bc
Indiangrass	0.5 bcd	0.4 b	2.8 a	1.2 b
big bluestem	0.1 d	0.1 b	0.1 c	0.1 c
tall dropseed	0.0 d	0.0 b	0.0 c	0.0 c
sideoats grama	0.2 cd	1.1 b	2.0 ab	1.1 b
Canada wildrye	0.0 d	0.0 b	0.0 c	0.0 c
perennial ryegrass	0.8 abc	0.2 b	0.0 c	0.3 c
annual rye	0.2 cd	0.0 b	0.0 c	0.1 c
redtop	0.0 d	0.0 b	0.3 c	0.1 c
red fescue	0.0 d	0.0 b	0.2 c	0.1 c
oats	0.0 d	0.0 b	0.0 c	0.0 c
Legume				
white clover	1.2 a	4.8 a	1.1 bc	2.3 a
partridge pea	0.1 cd	0.3 b	1.7 ab	0.7 bc
purple prairie clover	0.0 d	0.0 b	0.0 c	0.0 c
Forbs				
gray headed coneflower	0.0 d	0.0 b	0.0 c	0.0 c
black-eyed susan	0.0 d	0.0 b	0.0 c	0.0 c

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

The evaluations conducted in 2009, an increase indiangrass, followed by switchgrass, sideoats grama, and little bluestem.

The legume white clover is decreasing in persistence. Partridge pea did increase by the 3rd year, probably do to the hard seed coat breaking down and plants developing more plants this 3rd year.

The rill erosion percentage rating has been increasing during 2009 in the fiber mulch treatment, regardless of the species planted on Site 1.

In the fall of 2009 the average between the reps was 70% erosion on site, which accounts for the lack of established vegetation, compared to an average of 30% for the erosion blankets.

Above annual rainfall again in 2009 and the loss of the fiber mulch since seeding illustrates the need for plant species to establish quickly.

Erosion blankets are needed for adequate site protection for vegetation to become established to control erosion.

Summary 3 Year Average for Site 1 Table 4 Mixture and Treatment.

Warm season grasses dominant the stand, 4.5 plant/meter^2, however not adequate perennial cover for this site. This mixture should eliminate all cool season grass species, perennial and annual species, because they did not persist significantly on this site.

Switchgrass provided the most cover in the first year and still the dominant species in the 3rd year with an average of 1.4 plant/ meter^2 Indiangrass, little bluestem, sideoats grama is providing increasing vegetation by the 3rd year.

Legumes can provide benefit to these sites for fixing nitrogen for the perennial grasses. White clover was establishing the first year and succeeding years, with a decrease in 2009, it did maintain on site, 2.3 plant/meter^2 for the 3 year average. Partridge pea increased each year on the site and was the dominate legume by the 3rd year average of 3.0 plant/meter^2. Other legumes and forbs in this mixture did not establish.

This fiber mulch treatment did not provide erosion control, 70% rill and gully erosion on this site.

Site 2 – Utilization of Erosion Blanket,
Recommended Soil Test Fertility
NRCS Warm Season Critical Area Seeding Mixture

Table 5 is recommended fertilizer and lime effects on plant density for NRCS critical area warm season seeding mixture with application of erosion blanket. (Fertilizer applied at planting only).

Species	Site 2			
	2007	2008	2009	3 year Average
Grass		plant/m^2		plant/m^2
switchgrass	1.8 a[/1]	5.4 a	3.6 a	3.6 a
little bluestem	1.1 b	1.8 b	1.9 b	1.6 b
Indiangrass	0.5 c	0.4 c	0.8 c	0.6 c
broomsedge bluestem	0.0 c	0.0 c	0.0 d	0.0 d
tall dropseed	0.1 c	0.0 c	0.0 d	0.0 d
Canada wildrye	0.2 c	0.0 c	0.0 d	0.1 d
oats	0.0 c	0.0 c	0.0 d	0.0 d
Legume				
annual lespedeza	0.0 c	0.2 c	0.5 cd	0.2 cd

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

Switchgrass is the dominant species with a decrease in plant/meter² followed by little bluestem an increase with indiangrass in 2009. The other warm season grass species did not increase in the two years. This site had an average between the reps of 42% rill erosion by the fall of 2009.

<u>Summary</u> <u>3 Year Average for Site 2 Table 5 Mixture and Treatment.</u>

For Site 2 switchgrass provided the most cover in the first year and still the dominant species in the 3rd year at 3.6 plant/m^2. The switchgrass shows a decrease in the 3 year average in plants/m^2 over the standard fertility in site 1 table 1. Little bluestem and Indiangrass did increase in vegetation by the 3rd year. The additional fertility did not show an increase in plant/m^2 for the warm season species that developed on this site.

Perennial warm season grass species account for 5.8 plant/m^2 which is marginal plant cover. Erosion was higher 42% average on this site for the three years.

Site 2 – Utilization of Erosion Blanket,
Recommended Soil Test Fertility
MODOT Warm Season Seeding Mixture

Table 6 recommended fertilizer and lime effects on plant density of MODOT warm season seeding mixture with erosion blanket for erosion control, Van Buren, MO. (fertilizer applied at planting only).

Species	Site 2			
	2007	2008	2009	3 year Average
Grass	--plant/m^2-			plant/m^2
switchgrass	0.6 b[/1]	3.8 a	3.5 a	2.6 a
little bluestem	0.9 ab	1.6 bc	2.0 b	1.5 b
Indiangrass	0.2 b	2.2 b	2.2 b	1.5 b
big bluestem	0.0 b	0.1 d	0.0 c	0.0 c
tall dropseed	0.0 b	0.0 d	0.0 c	0.0 c
sideoats grama	0.1 b	0.1 d	0.0 c	0.1 c
Canada wildrye	0.0 b	0.0 d	0.0 c	0.0 c
perennial ryegrass	1.7 a	0.0 d	0.0 c	0.0 c
annual rye	0.0 b	0.0 d	0.0 c	0.0 c
redtop	0.0 b	0.0 d	0.0 c	0.0 c
red fescue	0.0 b	0.0 d	0.0 c	0.0 c
oats	0.0 b	0.0 d	0.0 c	0.0 c
Legume				
white clover	0.4 b	0.0 d	0.0 c	0.1 c
partridge pea	0.2 b	0.9 cd	1.5 b	0.9 bc
purple prairie clover	0.1 b	0.0 d	0.0 c	0.0 c
Forbs				
gray headed coneflower	0.0 b	0.0 d	0.0 c	0.0 c
black-eyed susan	0.0 b	0.0 d	0.0 c	0.0 c

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

The switchgrass, indiangrass, and little bluestem are comparable with plants/m^2 in 2009. In comparison to the standard fertility, with the same mixture and erosion treatment in table 1 there was a 3 year average of adequate cover at 7.9 grass species /m^2 compared to table 6 with marginal cover at 5.7 grass species /m^2. The other warm and cool season species did not increase.

This site had an average between the reps of 42% rill erosion on site by the fall 2009.

<u>Summary</u> <u>3 Year Average for Site 2 Table 6 Mixture and Treatment.</u>

For Site 2 the three major grasses that developed were switchgrass, little bluestem and indiangrass.
Switchgrass provided the most cover in the first year and still the dominant species in the 3rd year average of 2.6plant/m^2. The switchgrass has a decrease in the 3 year average over the standard fertility in site 1 table 2. Little bluestem and Indiangrass did provide increased vegetation by the 3rd year. The additional fertility did not show an increase in plants/m^2 for the warm season species that developed on this site.

Perennial grass species account for 5.7plant/m^2 which is marginal plant cover.
Table 5 has a 3 year average seeding mixture at (5.9) grass plants/m^2 comparable to (5.7) grass plants/m^2in table 6; however table 5 used only 6 grasses to 11 grasses in table 6. This mixture should eliminate all cool season grass species, perennial and annual species, because they do not establish on these sites.

Erosion was higher 42% average on this site for the three years.

Site 2 – Utilization of Fiber Mulch,
Recommended Soil Test Fertility
NRCS Warm Season Critical Area Seeding Mixture

Table 7 is recommended fertilizer and lime effect on plant density NRCS critical area warm season seeding mixture with application of fiber mulch for erosion control. Van Buren, MO (fertilizer applied at planting only).

Species	Site 2			
	2007	2008	2009	3 year Average
Grass		-plant/m^2		plant/m^2
switchgrass	1.8 a[/1]	5.0 a	2.5 ab	3.1 a
little bluestem	1.1 b	0.9 b	1.5 bc	1.2 b
Indiangrass	0.5 c	0.1 b	0.7 cd	0.4 c
broomsedge bluestem	0.0 c	0.0 b	0.0 d	0.0 d
tall dropseed	0.1 c	0.0 b	0.0 d	0.0 d
Canada wildrye	0.2 c	0.0 b	0.0 d	0.1 d
oats	0.0 c	0.0 b	0.0 d	0.0 d
Legume				
annual lespedeza	0.0 c	0.4 b	1.8 a	0.7 bc

1-Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

Switchgrass ranked high however decreased in 2009 but still the dominant species followed by little bluestem.

The main reason for the decrease is the amount of 85% rill erosion by the fall of 2009.

A slight increase for indiangrass, the other warm season grasses species did not increase during the 3rd growing season.

Annual lespedeza increased in 2009 again hard seed that continues to germinate 3 years after planting.

<u>Summary</u> <u>3 Year Average for Site 2 Table 7 Mixture and Treatment.
For Site 2 switchgrass provided the most cover in the first year and still the dominant species in the 3rd year, average 3.1 plant/m^2. Little bluestem and Indiangrass did provide increased vegetation by the 3rd year. The warm season perennial grass species account for 4.7plant/m^2 which is not adequate plant cover. This fiber mulch treatment did not provide erosion control, 85% rill and gully erosion on this site. This erosion is the cause of inadequate vegetation establishment.

Site 2 – Utilization of Fiber Mulch,
Recommended Soil Test Fertility
MODOT Warm Season Seeding Mixture

Table 8 is recommended fertilizer and lime effect on plant density of MODOT's warm season seeding mixture, with application of fiber mulch. (fertilizer applied at planting only). Van Buren MO.

Species	Site 2			
	2007	2008	2009	3 year Average
Grass	-----plant/m^2---			plant/m^2
switchgrass	1.9 a[/1]	1.2 a	1.2 a	1.4 a
little bluestem	1.9 a	0.4 b	0.8 ab	1.0 ab
Indiangrass	0.5 b	0.1 bcd	1.1 ab	0.6 bc
big bluestem	0.1 b	0.0 d	0.0 d	0.0 d
tall dropseed	0.0 b	0.0 d	0.0 d	0.0 d
sideoats grama	0.0 b	0.0 d	0.3 cd	0.2 c
Canada wildrye	0.0 b	0.0 d	0.0 d	0.0 d
perennial ryegrass	0.2 b	0.0 cd	0.0 d	0.0 d
annual rye	0.0 b	0.0 d	0.0 d	0.0 d
redtop	0.1 b	0.0 d	0.0 d	0.0 d
red fescue	0.0 b	0.0 d	0.0 d	0.0 d
oats	0.0 b	0.0 d	0.0 d	0.0 d
Legume				
white clover	0.0 b	0.0 d	0.0 d	0.0 d
partridge pea	0.1 b	0.3 bc	0.7 bc	0.3 c
purple prairie clover	0.0 b	0.0 d	0.0 d	0.0 d
Forbs				
gray headed coneflower	0.0 b	0.0 d	0.0 d	0.0 d
black-eyed susan	0.0 b	0.0 d	0.0 d	0.0 d

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

The evaluations conducted in 2009 the plant/m^2 is the same for the stand of switchgrass and the dominant species on site.

Indiangrass is the next prevalent species with an increase in 2009; and is comparable to the switchgrass. Little bluestem in this mixture is showing an increase.

This composite mixture is providing even less vegetation over time in the number of plant/meter^2.The decrease in stand can be explained by the amount of rill erosion with the fiber

mulch. The site had an average between the reps of 85% rill erosion on the site by the fall of 2009, similar to site 1 table 4 with the fiber mulch treatment.

<u>Summary</u> <u>3 Year Average for Site 2 Table 8 Mixture and Treatment.</u>

Site 2 warm season grasses are the components of the vegetation cover, 3.2 plant/meter^2, however inadequate perennial vegetation is on this site. This mixture should eliminate all cool season grass species, perennial and annual species, because they did not establish on this site.

Switchgrass provided the most cover in the first year and still the dominant species in the 3rd year with an average of 1.4 plant/ meter^2. Indiangrass, little bluestem, sideoats grama did increase the vegetation on the site to the 3.2plant/m^2 by the 3rd year.

Partridge pea increased each year on the site and was the only established legume by the 3rd year. Other legumes and forbs in this mixture did not establish.

The additional fertility did not show an increase in plant/m^2 for the warm season or legumes species that developed on this site.

This fiber mulch treatment did not provide erosion control, 85% rill and gully erosion on this site, which is the main reason for inadequate vegetation on this site.

Site 3
Utilization of Erosion Blanket
Standard Fertility
MODOT Cool Season Mixture.

Table 9 is standard fertilizer and lime effects on plant density of MODOT cool season seeding mixture with application of erosion control Blanket. Van Buren, MO. (fertilizer applied at planting only).

Species	Site 3			
	2007	2008	2009	3 year Average
Grass	-----plant/m^2-			plant/m^2
tall fescue	0.5 a[/1]	0.1 b	0.2 a	0.3 b
perennial ryegrass	0.3 ab	0.0 b	0.0 a	0.1 b
annual rye	0.0 b	0.0 b	0.0 a	0.0 b
oats	0.0 b	0.0 b	0.0 a	0.0 b
Legume				
white clover	0.1 ab	1.5 a	0.3 a	0.7 a

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

For 2009 the white clover decreased and tall fescue slight increase in the stand.

This site had an average between the reps of 40% rill erosion by the fall of 2009.

<u>Summary</u> <u>3 Year Average for Site 3 Table 9 Mixture and Treatment.</u>

Site 3 the cool season grass species did not persist on this site to provide adequate vegetation for this site. The cool season perennial grasses only resulted in 0.4 plant/m^2.

The white clover was the main species by the 2nd year; however only 1.5 plant/m^2. In 2009 the white clover reduced in the stand to only 0.3 plant/m^2.

The erosion blanket did provide erosion control, by the end of 3rd year, 40% rill erosion on site.

The cool season species did not perform with the erosion blankets. The species could have been affected by the heating of the blanks in the summer months after establishment with a desiccation of any growth from this south slope exposure; however rainfall during the year was normal for the establishment year.

Site 3
Utilization of Erosion Blanket
Recommended Soil Fertility
MODOT Cool Season Mixture.

Table 10 is illustrate recommended fertilizer and lime effect on plant density of MODOT cool season seeding mixture with an erosion control blanket.
Van Buren, MO. (fertilizer applied at planting only).

Species	Site 3			
	2007	2008	2009	3 year Average
Grass	-	----		plant/m^2
	plant/m^2			
tall fescue	0.3 a[/1]	0.0 a	0.0 a	0.1 a
perennial ryegrass	0.8 a	0.0 a	0.0 a	0.0 a
annual rye	0.0 a	0.0 a	0.0 a	0.0 a
oats	0.0 a	0.0 a	0.0 a	0.0 a
Legume				
white clover	0.0 a	0.5 a	0.0 a	0.2 a

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

White clover was on site the 2nd year however it did not persist by the 3rd year. Tall Fescue did not persist on the site after the 2nd year.

This site had an average between the reps of 40% rill erosion by the fall of 2009.

<u>Summary</u> <u>3 Year Average for Site 3 Table 10 Mixture and Treatment.</u>

Site 3 the cool season grass species did not persist for adequate vegetation on this site with the additional fertility the establishment year. The cool season perennial grasses only resulted in 0.1 plant/m^2.

The white clover was the main species by the 2nd year; however only 0.5 plant/m^2. In 2009 the white clover did not persist in the stand.

The erosion blanket did provide erosion control, by the end of 3rd year only 40% rill erosion.

The cool season species did not perform with the erosion blankets. The species could have been affected by the heating of the blanks in the summer months after establishment with a desiccation of any growth from this south slope exposure; however rainfall during the year was normal for the establishment year.

Site 3
Utilization of Fiber Mulch
Standard Soil Fertility
MODOT Cool Season Mixture.

Table 11 is standard fertilizer and lime effect on plant density of MODOT cool season seeding mixture with fiber mulch application for erosion Control. Van Buren, MO (fertilizer applied at planting only).

Species	Site 3			
	2007	2008	2009	3 year Average
Grass	-----plant/m^2			plant/m^2
tall fescue	3.3 a[/1]	0.1 b	1.1 ab	1.5 ab
perennial ryegrass	3.7 a	0.0 b	0.5 b	1.4 ab
annual rye	0.0 b	0.0 b	0.3 b	0.1 c
oats	0.0 b	0.0 b	0.0 b	0.0 c
Legume				
white clover	1.7 ab	4.9 a	2.7 a	3.3 a

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

White clover was the dominant species for 2009, but decreased from 2008. Tall fescue slight increase; however plants were small and not providing adequate erosion control.

This site had an average between the reps of 78% rill erosion by the fall of 2009.

<u>Summary</u> <u>3 Year Average for Site 3 Table 11 Mixture and Treatment.</u>

Site 3 the cool season perennial grass species did not persist on this site to provide adequate vegetation for this site. The cool season perennial grasses resulted in 2.9 plant/m^2.

The white clover was the main species by the 2nd year; with 4.9 plant/m^2. In 2009 the white clover decreased to 2.7 plant/m^2. The legume species did not provide cover for erosion control the species remained small and development was marginal.

The fiber mulch did not provide erosion control, by the end of 3rd year 78% rill erosion was on this site.

Site 3
Utilization of Fiber Mulch
Recommended Fertility
MODOT Cool Season Mixture.

Table 12 is recommended fertilizer and lime effect on plant density of MODOT cool season seeding mixture with fiber mulch application for erosion control. Van Buren, MO. (fertilizer applied at planting only).

Species	Site 3			
	2007	2008	2009	3 year Average
Grass	- plant/m^2-			plant/m^2
tall fescue	2.3 b[1]	0.5 b	1.0 ab	1.3 b
perennial ryegrass	5.9 a	0.1 b	0.3 b	2.1 a
annual rye	0.0 d	0.0 b	0.3 b	0.1 c
oats	0.0 d	0.0 b	0.0 b	0.0 c
Legume				
white clover	1.2 c	4.7 a	1.9 a	2.6 a

1 – Means WITHIN year column followed by the same letters are not significantly different a P<0.05.

In 2009 white clover was the dominant species. Tall fescue slight increase; however plants were small and not providing adequate erosion control.

This site had an average between the reps of 78% rill erosion by the fall of 2009.

<u>Summary</u> <u>3 Year Average for Site 3 Table 12 Mixture and Treatment.</u>

Site 3 the cool season grass species did not provide adequate vegetation on this site with the additional fertility the establishment year. The cool season perennial grasses results were 3.4 plant/m^2 for the 3 year average. The cool season grass species did not persist on this site to provide adequate vegetation for erosion control.

The white clover was the main species by the 2nd year; with 4.7plant/m^2. In 2009 the white clover did decrease in the stand to 1.9plant/m^2. The white clover did not provide erosion control the species remained small and development was marginal.

The fiber mulch did not provide erosion control, by the end of 3rd year 78% rill erosion was on this site.

Study: MOPMC-P-0820-UR

Study Title: Evaluation and Release of Native Plants for Urban Landscaping.

Study Leader: Bruckerhoff, S. B.

Introduction:

Plants for urban landscaping have been an ever increasing market for many years. Recently the use of herbaceous native species is also increasing. This type of vegetation can be used for its aesthetics and also in areas to help control erosion, runoff and improve water quality.

Problem:

There are few current varieties of little bluestem, big bluestem or broomsedge bluestem on the market that have been specifically selected for landscape purposes. There is demand in the nursery industry for this type of plant material and current collections already in place on the PMC can provide desirable germplasm.

Objective:

The objective is to assemble, evaluate, develop and release adapted selections of little bluestem, big bluestem and broomsedge bluestem for landscape use in Missouri, Iowa, and Illinois.

Procedure:

Native plants with desirable landscape and/or ornamental characteristics will be assembled and evaluated. Plants will be selected from existing assemblies at the PMC and also collected from native prairie remnants within the service area. Plants selected for evaluation will be collected vegetatively or by seed depending on the species and trait being selected for.

Existing assemblies of big and little bluestem will be evaluated for color, upright growth form, and stability during the dormant season. During the growing season colors may be deep and rich, or abnormally pale. Autumn colors will have reddish tints to leaves and elaborate seedheads.

Selected plants will be vegetatively collected, increased in the greenhouse, and transplanted into increase plots. Plants maintaining desired characteristics when mature will be divided (cloned) and made available to commercial growers as improved native landscape plants.

Seed will be collected of broomsedge bluestem (and other native species that naturally exhibit attractive characteristics for urban landscaping) and placed in the germinator. Selections will be made on quick germination. Selected plants will be placed in an evaluation nursery where undesirable plants will be culled. Remaining plants will remain for seed production to establish an increase field. This selection will be for color and quick establishment. Seed from the increase field will be made available to commercial growers.

Discussion:

2008/2009

Plants of big and little bluestem in evaluation plantings at the PMC were visually evaluated for color and form. After going dormant, the plants were dug in the fall of 2008, divided into multiple plants and grown out in the greenhouse. These plants (approximately 700 little bluestem and 300 big bluestem) were put on three foot spacings in a block for each species. After a year establishment period, the better plants will be selected for increase.

Seed of Broomsedge bluestem was collected from 17 locations throughout Missouri and placed in the seed germinator. Seed germinating within a seven day period was transplanted into plug flats and transplanted into a crossing block including plants from all locations.

Study: MOPMC-P-0821-BF

Study Title: Evaluation and Release of an Iowa Source, stiff stemmed Indiangrass, *Sorghastrum nutans,* for Biofuel.

Study Leader: Cordsiemon, R., Elsberry Plant Materials Center

Introduction:

The Northern Germplasm, Central Germplasm, and Southern Germplasm production fields of Iowa Ecotype Indiangrass will be evaluated for biofuel potential. This study will develop a new selection of Indiangrass for Iowa that has high biomass production, lodging resistance, and is quick to establish.

Objective:

Switchgrass (*Panicum virgatum* L.) and giant cane (Miscanthus giganticus) are commonly used in the evaluation of herbaceous species for biofuels. Another warm season species that is showing potential is Indiangrass (*Sorghastrum nutans*). The objective is to develop an Indiangrass that has the potential for use in the biofuel industry.

Discussion:

2008

In March, 2008, plants were selected out of each zone from the Iowa Ecotype Study. The ecotype zones break the state of Iowa up into 3 separate zones. There is a northern, central, and southern zone. The PMC has production plots of each zone of Indiangrass and from these plots, 3 to 4 plants were selected. They were selected based on their visual robust, tall standing stature and ability not to lodge. These plants were separated into plugs and propagated in the greenhouse. There were 3 plants from the northern zone, 4 plants from the central zone, and 3 plants from the central zone. 40 plugs were started from each plant that was selected. An evaluation planting was established at Forrest Keeling Nursery with 10 plants per replication and 4 replications. The plants were allowed to cross pollinate and an equal amount of seed was taken off each plant. The seed will be used to start seedlings in the germinator and selections will be made based on how quick the seed germinates.

2009

An evaluation block was established using the seedlings that germinated within 7 days of entering the growth chamber. The seedlings were transplanted into conetainers and allowed to establish in the greenhouse and were then planted in the southeast corner of field #7F. There are 224 plants in the evaluation block. The plants will be evaluated individually for basal spread, height at seedhead, height of foliage, 5 random stem counts for diameter, and late winter evaluation for lodging and overall plant rating. Data will be

Study: MOPMC-P-0822-PA,WL

Study Title: Inter Center Strain Trial – Yield and Persistence of 11 Big Bluestem Sources in Kansas, Missouri, Arkansas, and Mississippi

Study Leader: Cordsiemon, R., Elsberry Plant Materials Center

Introduction:

Big bluestem cultivars developed by NRCS and ARS, and NRCS prevarietal releases and selections will be evaluated for yield and persistence in replicated plots in Booneville, AR; Coffeeville, MS; Elsberry, MO and Manhattan, KS. There have been several prevarietal releases of big bluestem made in recent years by Booneville, AR and Elsberry, MO PMCs. Comparative evaluations of these prevarietal releases and a selection from the Manhattan, KS PMC are needed to further document their performance and adaptation in other geographical regions. Information gained from these plantings may be used to provide data to support elevating lower class releases (e.g. source id and selected class) to a higher release category (e.g. tested class or cultivar).

In addition to these releases, standard big bluestem cultivars commonly used in NRCS conservation plantings and programs will be included in the trial along with other cultivars developed by the USDA-ARS, Lincoln, NE.

Procedure:

Big bluestem entries will be established in 6-ft x 9-ft plots at PMCs in Booneville, AR; Elsberry, MO; Coffeeville, MS; and Manhattan, KS in 2008. All PMCs, except Coffeeville, will send a packet of seed of their respective entry to participating PMCs (see table above). Participating PMC will start seed in the greenhouse and grow out approximately 100 seedlings of each entry. Plants will be transplanted in the field in late spring or early summer using the same plot layout on page 6.

Elsberry will provide live propagules of Refuge germplasm for each location (72 plants x 4 locations = 288 plus 15 -25 extras per location for replacements).

Evaluations will start when 50% of the first entry reaches the late boot stage (1st seed head emerging) of growth. Height measurements will be recorded from the center 4 plants from each of the four replications. Yield will be determined by sampling four plants from the center of each row with a cutting height of 8 inches. The average plot weight (average weight of the 4 plants) will be determined for each big bluestem entry by replication and a grab sample collected for dry matter. After harvest, all remaining plants will be cut and removed from the plot. A second harvest will be made within 2-4 weeks after the first killing frost. The average plant height of entry in each of the four replications from the center 4 plants will be measured and recorded.

List of entries included in the ICST.

Name/Accession#	Source	PMC Responsible For Securing and Distributing Seed to Participating PMCs
Hampton Germplasm (9056854)	**Booneville**	**Randy King**
OZ-70 Germplasm (9078831)	**Elsberry**	**Steve Bruckerhoff**
Refuge Germplasm (9078832)	**Elsberry**	**Steve Bruckerhoff**
9083274	**Elsberry**	**Steve Bruckerhoff**
Local ecotype (9079000)	**Elsberry**	**Steve Bruckerhoff**
Rountree (474216)	**Elsberry**	**Steve Bruckerhoff**
Kaw (421276)	**Manhattan**	**Rich Wynia**
483446	**Manhattan**	**Rich Wynia**
Pawnee	**Stock Seed**	**Rich Wynia**
Bonanza	**Stock Seed**	**Rich Wynia**
Goldmine	**Sharp Bros.**	**Rich Wynia**

Discussion:

2008

In the spring of 2008, the 4 Plant Materials Centers provided plant material of the big bluestem that they were working with or were responsible for. Seedling plugs were provided in most cases. In 2008, the evaluation plot was given a year to establish and evaluations are to start in 2009.

2009

The big bluestem ICST plot was fertilized with 50 lb. per acre (8 lb. bulk for the plot) and 100 lb. of pellet lime on April 21, 2009. On July 31 and November 3, the plots were cut and 4 plants were weighed and calculated to determine the amount of forage per acre. Grab samples were taken to determine dry matter yield. The July 31 represents the first cutting and November 3 represents the amount of regrowth. Also on those dates, the plots were evaluated for plant height, vigor, and disease and insect resistance. See table #1 for a summary of the evaluations for 2009 at the Elsberry PMC.

Summary of Data for Big Bluestem Inter-Center Strain Trial for 2009								Table #1
Release Name	**Accession**	Dry Material			Vigor		Height	
		Tons/Acre	**Tons/Acre**	**Tons/Acre**	**7/31/2009**	**11/3/2009**	**7/31/2009**	**11/3/2009**
Northern	9079000	4.9	0.3	5.17	2.5	3.5	7.7	1.2
OZ-70	9078831	4.8	0.3	5.12	2.0	1.5	6.9	1.7
Bonanza	641701	4.7	0.2	4.96	3.0	5.0	6.9	0.9
Hampton	9056854	4.4	0.2	4.61	1.0	4.5	7.1	1.1
Epic	9083274	4.2	0.3	4.55	2.0	2.5	6.7	1.6
Goldmine	641702	4.2	0.2	4.37	1.5	4.5	6.8	1.0
Rountree	474216	4.1	0.2	4.29	4.0	3.5	7.7	1.1
Kaw	421276	4.1	0.2	4.29	3.0	3.5	6.4	1.1
Kansas	483446	3.6	0.2	3.80	2.5	4.0	6.0	1.2
Refuge	9078832	2.9	0.1	3.01	1.5	3.5	5.9	1.1
Pawnee	9055679	2.5	0.2	2.72	4.0	5.0	6.6	0.9

Vigor Ratings 1=Excellent 3=Good 5=Fair 7=Poor

Herbaceous and Woody Seed and Plant Production at the Elsberry PMC 2009

The plant and seed inventory at the Elsberry PMC is used for field plantings, special plantings, demonstration plantings, research studies and commercial release.

Name	Seed Harvested in 2008	Seed Harvested in 2009
Herbaceous Species	**Bulk (Pounds)**	**Bulk (Pounds)**
'Rountree' big bluestem *Andropogon gerardii*	835.0 Foundation	310.5 Foundation
Refuge Big Bluestem (9078832) *Andropogon gerardii*	0 Re-establishing Plot	0.5 Re-establishing Plot
'Rumsey' Indiangrass *Sorghastrum nutans*	194.6 Foundation	43.0 Foundation
'Cave-In-Rock' switchgrass *Panicum virgatum*	1654.6 Foundation	1470.9 Foundation
'OH-370' big bluestem *Andropogon gerardii*	0 Did Not Harvest	0 Did Not Harvest
'OZ-70' big bluestem *Andropogon gerardii*	311.1 SG1	265.7 SG1
'Alexander' tick trefoil *Desmodium canadense*	0.7 SG1	0 SG1
Flood tolerant switchgrass *Panicum virgatum*	81.5 Re-establishing Plot	1.2 Re-establishing Plot
Low growing switchgrass *Panicum virgatum*	20.3 Re-establishing Plot	3.4 Re-establishing Plot
'Bobwhite' soybean *Glycine spp.*	0 Destroyed by Flood	0 Destroyed by Flood
Cuivre River Virginia Wildrye *Elymus virginicus*	0 Destroyed Seed - Poor	0 Destroyed Seed - Poor
Iowa Ecotype Plantings (6 Species; 7 Plots)	22.3 Total	6.0 Total
Missouri Ecotype Plantings (6 Species; 12 Plots)	226.3 Total	446.7 Total

Herbaceous and Woody Seed and Plant Production – continued

Name:	Seed Harvested & Plant Inventory as of December 2008		Seed Harvested & Plant Inventory as of December 2009	
Woody Species	**Plants**	**Seed Bulk (Pounds)**	**Plants**	**Seed Bulk (Pounds)**
'Union' tulip tree Liriodendron tulipifera (9055584)	0	0	0	0
American hazelnut (9083247) (Composite) Corylus americana	100	100.0	0	11
American plum (9083241) (Composite) Prunus Americana	350	29.3	0	8.8
'Redstone' Cornelian cherry (9055585) *Cornus mas*	0	0	0	0
Chokecherry (9083259) *Prunus virginicus*	0	0	0	0
Missouri Covey False Indigo Bush *Amorpha fruticosa* (9083248)	200	1.1	0	6.1
Iowa Covey False Indigo Bush *Amorpha fruticosa* (9083249)	95	5.2	0	8
Illlinois Covey False Indigo Bush *Amorpha fruticosa* (9083250)	100	5.1	0	8.7

UNITED STATES DEPARMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
ELSBERRY, MISSOURI

NOTICE OF RELEASE OF NORTHERN MISSOURI GERMPLASM
PALE PURPLE CONEFLOWER
SOURCE IDENTIFIED CLASS OF NATURAL GERMPLASM

The Natural Resources Conservation Service (NRCS), U.S. Department of Agriculture announce the release of a source identified ecotype of pale purple coneflower (*Echinacea pallida*, Nutt.) for Northern Missouri counties.

As a source identified release, this plant will be referred to as Northern Missouri Germplasm pale purple coneflower to document its original collections. Northern Missouri Germplasm pale purple coneflower released as a source identified type of certified seed (natural track). It has been assigned the NRCS accession number 9079032.

This alternative release procedure is justified because there are no existing commercial sources of pale purple coneflower collected from numerous native sites throughout this specific region. Propagation material of specific ecotypes is needed for roadside plantings and prairie restoration and enhancement. The potential for immediate use is high.

Collection Site Information: Collections were taken from native prairie remnants within the counties north of the Missouri River in the glaciated plains region of northern Missouri. There were a total of 20 collections from 14 different counties.

Ecotype Description: Pale purple coneflower is a perennial native prairie wildflower which grows 2 to 3 feet tall. The leaves are mostly basal; elongate-oval, blades 7 inches by ¾ inch with leaf stalks from 6 inches for basal leaves to ¾ inch for stem leaves; parallel veins in the blades; bulb-based hairs above and below. There is a single head at the top of a stalk having stiff hairs and a few small leaves. The heads are pale to deep rose-purple, drooping rays, 1 ½ inches long, dark purple disk flowers on a conical base, the disk about 1 inch tall and 1 inch in diameter; flowering from May to July; rays often last until August. The fruits (seeds) are 1/8 inch long, squarish and pointed at one end; no plume; fruiting begins in late June; often fruits persist in the head through the winter.

Environmental Impact Assessment: Northern Missouri Germplasm pale purple coneflower is a collection of naturally occurring germplasm and has been unaltered. Northern Missouri Germplasm pale purple coneflower did not meet the assessment of a plant which could become invasive based on guidelines adopted by the NRCS Plant Materials Program.

Anticipated Conservation Use: The potential uses of Northern Missouri Germplasm pale purple coneflower include roadside and wildlife plantings, prairie creations and restorations, landscaping, a beneficial component in pollinator plantings and for increasing plant diversity in prairie communities. Northern Missouri Germplasm pale purple coneflower can be used as a beneficial component in pollinator plantings.

Potential Area of Adaptation: Pale purple coneflower occurs throughout the tallgrass prairie biome, and common on limestone glades, barrens, bald knobs, fields, along railroads, and prairies, rarely in dry rocky woods. The range is from Illinois and Michigan to Minnesota and Nebraska, south to Georgia, Alabama, Louisiana, and Texas.

Availability of Plant Materials: G1 material of Northern Missouri Germplasm pale purple coneflower is being produced in limited supply by the Elsberry Plant Materials Center. For information contact USDA, NRCS, Plant Materials Center, 2803 N. Hwy 79, Elsberry, Missouri 63343 (573 898-2012).

References:

Flora of Missouri; pp. 1560-1562; Steyemark, J. A; Iowa State University Press, Ames, IA 1968.

An Illustrated Guide to Iowa Prairie Plants; p. 43, Christiansen, P. and Muller, M.; University of Iowa Press, Iowa City, IA 1999.

Prepared by:

Ron Cordsiemon, USDA NRCS Plant Materials Center, 2803 North Hwy 79, Elsberry, Missouri, 63343.

Signatures for release of:

Northern Missouri Germplasm pale purple coneflower (*Echinacea pallida,* Nutt.)

J.R. Flores
State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
Columbia, Missouri

9-17-09
Date

Richard Sims
State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
Des Moines, Iowa

09/03/09
Date

William J. Gradle
State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
Champaign, Illinois

8-28-2009
Date

for Michael D. Hubbs
Director
Ecological Sciences Division
United States Department of Agriculture
Natural Resources Conservation Service
Washington, D.C.

National Program Leader - Plant Materials

9-30-09
Date

UNITED STATES DEPARMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
ELSBERRY, MISSOURI

NOTICE OF RELEASE OF WESTERN MISSOURI GERMPLASM
PALE PURPLE CONEFLOWER
SOURCE IDENTIFIED CLASS OF NATURAL GERMPLASM

The Natural Resources Conservation Service (NRCS), U.S. Department of Agriculture announce the release of a source identified ecotype of pale purple coneflower (*Echinacea pallida*, Nutt.) for Western Missouri counties.

As a source identified release, this plant will be referred to as Western Missouri Germplasm pale purple coneflower to document its original collections. Western Missouri Germplasm pale purple coneflower released as a source identified type of certified seed (natural track). It has been assigned the NRCS accession number 9079033.

This alternative release procedure is justified because there are no existing commercial sources of pale purple coneflower collected from numerous native sites throughout this specific region. Propagation material of specific ecotypes is needed for roadside plantings and prairie restoration and enhancement. The potential for immediate use is high.

Collection Site Information: Collections were taken from native prairie remnants within the counties of western Missouri, primarily from the Osage plains. There were a total of 17 collections from seven different counties.

Ecotype Description: Pale purple coneflower is a perennial native prairie wildflower which grows 2 to 3 feet tall. The leaves are mostly basal; elongate-oval, blades 7 inches long by ¾ inch with leaf stalks from 6 inches for basal leaves to ¾ inch for stem leaves; parallel veins in the blades; bulb-based hairs above and below. There is a single head at the top of a stalk having stiff hairs and a few small leaves. The heads are pale to deep rose-purple, drooping rays, 1 ½ inches long, dark purple disk flowers on a conical base, the disk about 1 inch tall and 1 inch in diameter; flowering from May to July; rays often last until August. The fruits (seeds) are 1/8 inch long, squarish and pointed at one end; no plume; fruiting begins in late June; often fruits persist in the head through the winter.

Environmental Impact Assessment: Western Missouri Germplasm pale purple coneflower is a collection of naturally occurring germplasm and has been unaltered. Western Missouri Germplasm pale purple coneflower did not meet the assessment of a plant which could become invasive based on guidelines adopted by the NRCS Plant Materials Program.

Anticipated Conservation Use: The potential uses of Western Missouri Germplasm pale purple coneflower include roadside and wildlife plantings, prairie creations and restorations, landscaping, and for increasing plant diversity in prairie communities. Western Missouri Germplasm pale purple coneflower can be used as a beneficial component in pollinator plantings.

Potential Area of Adaptation: Pale purple coneflower occurs throughout the tallgrass prairie biome, and common on limestone glades, barrens, bald knobs, fields, along railroads, and

prairies, rarely in dry rocky woods. The range is from Illinois and Michigan to Minnesota and Nebraska, south to Georgia, Alabama, Louisiana, and Texas.

Availability of Plant Materials: G1 material of Western Missouri Germplasm pale purple coneflower is being produced in limited supply by the Elsberry Plant Materials Center. For information contact USDA, NRCS, Plant Materials Center, 2803 N. Hwy 79, Elsberry, Missouri 63343 (573 898-2012).

References:

Flora of Missouri; pp. 1560-1562; Steyemark, J. A; Iowa State University Press, Ames, IA 1968.

An Illustrated Guide to Iowa Prairie Plants; p. 43, Christiansen, P. and Muller, M.; University of Iowa Press, Iowa City, IA 1999.

Prepared by:

Ron Cordsiemon, USDA NRCS Plant Materials Center, 2803 North Hwy 79, Elsberry, Missouri, 63343.

Signatures for release of:

Western Missouri Germplasm pale purple coneflower (*Echinacea pallida* Nutt.)

J.R. Flores
State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
Columbia, Missouri

Date 9-14-09

William J. Gradle
State Conservationist
United States Department of Conservation
Natural Resources Conservation Service
Champaign, Illinois

Date 8-28-2009

Richard Sims
State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
Des Moines, Iowa

Date 09/03/09

National Program Leader - Plant Materials

for Michael D. Hubbs
Director
Ecological Sciences Division
United States Department of Agriculture
Natural Resources Conservation Service
Washington, D.C.

Date 9-30-09

Releases From Elsberry Plant Materials Center By Year

Scientific Name	Release Name	Common Name	Accession Number	Secondary Agency(ies)	Type of Release	Year of Release
Echinacea pallida (Nutt.)	Northern MO	pale purple coneflower	9079032		N	2009
Echinacea pallida (Nutt.)	Western MO	pale purple coneflower	9079033		N	2009
Bouteloua curtipendula (Michx.) Torr.	Northern MO	sideoats grama	9079072		N	2008
Corylus americana Walt.	Sun Harvest	American hazelnut	9083247		N	2007
Monarda fistulosa L.	Northern Iowa	wild bergamot	9068678	UNI, IARV, IAT, ICIA	N	2007
Monarda fistulosa L.	Central Iowa	wild bergamot	9068679	UNI, IARV, IAT, ICIA	N	2007
Andropogon gerardii Vitman.	Refuge	big bluestem	9078832		N	2006
Echinacea pallida Nutt.	Central Iowa	pale purple coneflower	9068612	UNI, IARV, IAT, ICIA	N	2006
Prunus americana	Midwest Premium	American plum	9083241		N	2006
Amorpha fruticosa L	Missouri Covey False Indigo Bush	false indigo bush	9083248		N	2005
Amorpha fruticosa L	Iowa Covey False Indigo Bush	false indigo bush	9083249		N	2005
Amorpha fruticosa L	Illinois Covey False Indigo Bush	false indigo bush	9083250		N	2005
Andropogon gerardii	OZ-70	big bluestem	9078831		N	2004
Desmodium spp.	Northern MO	showy tick trefoil	9079012	MDC	N	2004
Ratibida pinnata, barnh.	Northern MO	grayheaded coneflower	9079060	MDC	N	2004
Schizachyrium scoparium (Michx.) Nash	Southern MO	little bluestem	9079006	MDC	N	2004
Dalea purpurea	Northern Iowa	purple prairie clover	9068608	UNI, IARV, IAT, ICIA	N	2003
Panicum virgatum L.	Central Iowa	switchgrass	9068706	UNI, IARV, IAT, ICIA	N	2003
Koeleria macrantha	Central Iowa	prairie Junegrass	9068621	UNI, IARV, IAT, ICIA	N	2003
Koeleria macrantha	Northern Iowa	prairie Junegrass	9068620	UNI, IARV, IAT, ICIA	N	2003
Monarda fistulosa L.	Southern Iowa	wild bergamot	9068680	UNI, IARV, IAT, ICIA	N	2003
Liatris aspera, Michx.	Southern Iowa	rough blazing star	9068686	UNI, IARV, IAT, ICIA	N	2003
Liatris aspera, Michx.	Central Iowa	rough blazing star	9068685	UNI, IARV, IAT, ICIA	N	2003
Liatris aspera, Michx.	Northern Iowa	rough blazing star	9068684	UNI, IARV, IAT, ICIA	N	2003
Elymus virginicus L.	Cuivre River	Virginia wildrye	9803169	MDC	N	2002
Aster novae-angliae L.	Central Iowa	New England aster	9068682	UNI, IARV, IAT, ICIA	N	2002
Aster novae-angliae L.	Northern Iowa	New England aster	9068681	UNI, IARV, IAT, ICIA	N	2002
Aster novae-angliae L.	Southern Iowa	New England aster	9068683	UNI, IARV, IAT, ICIA	N	2002
Echinacea pallida Nutt.	Northern Iowa	pale purple coneflower	9068611	UNI, IARV, IAT, ICIA	N	2002
Echinacea pallida Nutt.	Southern Iowa	pale purple coneflower	9068613	UNI, IARV, IAT, ICIA	N	2002
Sporobolus compositus var. com.	Southern Iowa	tall dropseed	9062315	UNI, IARV, IAT, ICIA	N	2002
Solidago rigida L.	Southern Iowa	rigid goldenrod	9068619	UNI, IARV, IAT, ICIA	N	2002
Solidago rigida L.	Central Iowa	rigid goldenrod	9068618	UNI, IARV, IAT, ICIA	N	2002
Coreopsis palmata	Northern MO	prairie coreopsis	9079028	MDC, NAS	N	2001
Coreopsis Palmuta Nutt.	Western MO	prairie coreopsis	9079029	MDC, NAS	N	2001
Sporobolus compositus var. comp.	Northern MO	tall dropseed	9079040	MDC, NAS	N	2001
Liatris pycnostachya, Michx.	Western MO	prairie blazing star	9079021	MDC, NAS	N	2001
Liatris pycnostachya, Michx	Northern MO	prairie blazing star	9079020	MDC, NAS	N	2001
Sporobolus compositus (Poir.) Merr.	Northern Iowa	tall dropseed	9062313	UNI, IARV, IAT, ICIA	N	2000
Andropogon gerardii	Northern Iowa	big bluestem	9068614	UNI,IARV,IAT,ICIA	N	2000
Liatris pycnostachya, Michx	Southern Iowa	prairie blazing star	9068628	UNI, IARV, IAT, ICIA	N	2000

Scientific Name	Release Name	Common Name	Accession Number	Secondary Agency(ies)	Type of Release	Year of Release
Lespedeza capitata Michx.	Northern Iowa	roundhead lespedeza	9062284	UNI, IARV, IAT, ICIA	N	2000
Andropogon gerardii Vitman	Southern Iowa	big bluestem	9068616	UNI, IARV, IAT, ICIA	N	1999
Schizachyrium scoparium, Michx.	Northern Iowa	little bluestem	9062319	UNI, IARV, IAT, ICIA	N	1999
Eryngium yaccifolium Michx.	Southern Iowa	rattlesnake master	9068604	UNI, IARV, IAT, ICIA	N	1999
Eryngium yaccifolium Michx.	Central Iowa	rattlesnake master	9068603	UNI, IARV, IAT, ICIA	N	1999
Schizachyrium scoparium, Michx.	Southern Iowa	little bluestem	9962321	UNI, IARV, IAT, ICIA	N	1999
Liatris pycnostachya, Michx	Northern Iowa	prairie blazing star	9068626	UNI, IARV, IAT, ICIA	N	1999
Liatris pycnostachya, Michx	Central Iowa	prairie blazing star	9068627	UNI, IARV, IAT, ICIA	N	1999
Elymus virginicus L.	Northern MO	Virginia wildrye	9079044	UMC,MDC,MODOT	N	1999
Sorghastrum nutans (L) Nash.	Northern MO	Indiangrass	9079036	UMC,MDC,MODOT	N	1999
Andropogon gerardii Vitman	Northern MO	big bluestem	9079000	UMC,MDC,MODOT	N	1999
Sorghastrum nutans (L) Nash.	Western MO	Indiangrass	9079037	UMC,MDC,MODOT	N	1999
Schizachyrium scoparium, Michx.	Northern MO	little bluestem	9079004	UMC,MDC,MODOT	N	1999
Andropogon gerardii Vitman	Central Iowa	big bluestem	9068615	UNI,IARV,IAT,ICIA	N	1998
Dalea purpurea	Central Iowa	purple prairie clover	9068609	UNI,IARV,IAT,ICIA	N	1998
Eryngium yuccifolium Michx.	Northern Iowa	rattlesnake master	9068602	UNI,IARV,IAT,ICIA	N	1998
Solidago rigida L.	Northern Iowa	rigid goldenrod	9068617	UNI,IARV,IAT,ICIA	N	1998
Sorghastrum nutans (L.) Nash.	Southern Iowa	Indiangrass	9062318	UNI,IARV,IAT,ICIA	N	1998
Andropogon gerardii Vitman.	OH-370	big bluestem	9062323	ARPMC	N	1997
Cornus drummondii C.A. Meyer	Corinth	roughleaf dogwood	9055632		N	1997
Cornus drummondii C.A. Meyer	Jefferson	roughleaf dogwood	9055650		N	1997
Cornus drummondii C.A. Meyer	Tazewell	roughleaf dogwood	9055667		N	1997
Cornus drummondii C.A. Meyer	Nicholson	roughleaf dogwood	9055594		N	1997
Desmodium canadense L.	Alexander	showy tick trefoil	9057110		N	1997
Elymus canadensis L.	Southern Iowa	Canada wildrye	9062277	UNI,IARV,IAT,ICIA	N	1997
Heliopsis helianthoides (L.) Sweet	Southern Iowa	oxeye false sunflower	9068607	UNI,IARV,IAT,ICIA	N	1997
Lespedeza capitata Michx.	Southern Iowa	roundhead lespedeza	9062283	UNI, IARV, IAT, ICIA	N	1997
Liriodendron tulipifera L.	Union	tulip poplar	9055584		N	1997
Schizachyrium scoparium (Michx.) Nash	Central Iowa	little bluestem	9062320	UNI,IARV,IAT,ICIA	N	1997
Heliopsis helianthoides (L.) Sweet	Northern Iowa	oxeye false sunflower	9068605	UNI,IARV,IAT,ICIA	N	1996
Lespedeza capitata Michx.	Central Iowa	roundhead lespedeza	9062282	UNI, IARV, IAT, ICIA	N	1996
Sorghastrum nutans (L). Nash	Central Iowa	Indiangrass	9062317	UNI,IARV,IAT,ICIA	N	1996
Sorghastrum nutans (I). Nash	Northern Iowa	Indiangrass	9062316	UNI,IARV,IAT,ICIA	N	1996
Sporobolus compositus (Poir.) Merr.	Central Iowa	tall dropseed	9062314	UNI,IARV,IAT,ICIA	N	1996
Bouteloua curtipendula (Michx.) Torr.	Central Iowa	sideoats grama	9062279	UNI,IARV,IAT,ICIA	N	1995
Bouteloua curtipendula (Michx.) Torr.	Northern Iowa	sideoats grama	9062278	UNI,IARV,IAT,ICIA	N	1995
Bouteloua curtipendula (Michx.) Torr.	Southern Iowa	sideoats grama	9062280	UNI,IARV,IAT,ICIA	N	1995
Elymus canadensis L.	Northern Iowa	Canada wildrye	9062275	UNI,IARV,IAT,ICIA	N	1995
Elymus canadensis L.	Central Iowa	Canada wildrye	9062276	UNI,IARV,IAT,ICIA	N	1995
Elymus canadensis L.	Southern Iowa	Canada wildrye	9062277	UNI,IARV,IAT,ICIA	N	1995
Heliopsis helianthoides (L.) Sweet	Central Iowa	oxeye false sunflower	9068606	UNI,IARV,IAT,ICIA	N	1995
Panicum virgatum L. *	Shawnee	switchgrass	591824		N	1995
Cornus mas L.	Redstone	cornelian cherry dogwood	516476		I	1991
Ulmus parvifolia Jacq.	Elsmo	lace bark elm	9004438		I	1990
Andropogon gerardii Vitman.	Rountree	big bluestem	474216	MOA	N	1983
Sorghastrum nutans (L.) Nash.	Rumsey	Indiangrass	315747	MOA	N	1983
Acer ginnala Maxim.	Flame	Amur maple	483442		I	1978
Glycine sp. L **	Bobwhite	soybean	421822	MOPMC,ARS, MOA,	I	1975
Panicum virgatum L.	Cave-In-Rock	switchgrass	469228	MOA	N	1974

Scientific Name	Release Name	Common Name	Accession Number	Secondary Agency(ies)	Type of Release	Year of Release
Bromus inermis Leyss.	Elsberry	smooth brome	469227	MOA	Nat.	1954

* Primary Agencies: ARS=Agricultural Research Service; NEARD=Nebraska Agricultural Research Division; MOPMC=Missouri Plant Materials Center; IAA=Iowa Agricultural Experiment Station at Ames; PARP=Purdue Agricultural Research Program

** Primary Agency: MDC=Missouri Department of Conservation

N=native releases; collected within the USA, occurring naturally in the USA. Generally refers to a plant which occurs naturally in a particular region, state ecosystem or habitat without direct or indirect human activity.

Nat.=naturalized releases; collected from a population within the USA, but were originally introduced to the USA sometime in the past.

I=introduced; means that the original collection from which the release was made was not from within the USA.

Releases From Elsberry Plant Materials Center

Alphabetically

Scientific Name	Release Name	Common Name	Accession Number	Secondary Agency(ies)	Type of Release	Year of Release
Acer ginnala Maxim.	Flame	Amur maple	483442		I	1978
Amorpha fruticosa L	Missouri Covey False Indigo Bush	false indigo bush	9083248		N	2005
Amorpha fruticosa L	Iowa Covey False Indigo Bush	false indigo bush	9083249		N	2005
Amorpha fruticosa L	Illinois Covey False Indigo Bush	false indigo bush	9083250		N	2005
Andropogon gerardii L.	OZ-70	big bluestem	9078831			2004
Andropogon gerardii Vitman.	Northern Iowa	big bluestem	9068614	UNI,IARV,IAT,ICIA	N	2000
Andropogon gerardii Vitman.	Southern Iowa	big bluestem	9068616	UNI, IARV, IAT, ICIA	N	1999
Andropogon gerardii Vitman.	Northern MO	big bluestem	9079000	UMC,MDC,MODOT	N	1999
Andropogon gerardii Vitman.	Central Iowa	big bluestem	9068615	UNI,IARV,IAT,ICIA	N	1998
Andropogon gerardii Vitman.	OH-370	big bluestem	9062323	ARPMC	N	1997
Andropogon gerardii Vitman.	Rountree	big bluestem	474216	MOA	N	1983
Andropogon gerardii Vitman.	Refuge	big bluestem	9078832		N	2006
Aster novae-angliae L.	Central Iowa	New England Aster	9068682	UNI, IARV, IAT, ICIA	N	2002
Aster novae-angliae L.	Northern Iowa	New England Aster	9068681	UNI, IARV, IAT, ICIA	N	2002
Aster novae-angliae L.	Southern Iowa	New England Aster	9068683	UNI, IARV, IAT, ICIA	N	2002
Bouteloua curtipendula (Michx.) Torr.	Central Iowa	sideoats grama	9062279	UNI,IARV,IAT,ICIA	N	1995
Bouteloua curtipendula (Michx.) Torr.	Northern Iowa	sideoats grama	9062278	UNI,IARV,IAT,ICIA	N	1995
Bouteloua curtipendula (Michx.) Torr.	Southern Iowa	sideoats grama	9062280	UNI,IARV,IAT,ICIA	N	1995
Bouteloua curtipendula (Michx.) Torr.	Northern MO	sideoats grama	9079072		N	2008
Bromus inermis Leyss.	Elsberry	smooth brome	469227	MOA	Nat.	1954
Coreopsis Palmata Nutt.	Northern MO	prairie coreopsis	9079028	MDC, NAS	N	2001
Coreopsis Palmata Nutt.	Western MO	prairie coreopsis	9079029	MDC, NAS	N	2001
Cornus drummondii C.A. Meyer	Corinth	roughleaf dogwood	9055632		N	1997
Cornus drummondii C.A. Meyer	Jefferson	roughleaf dogwood	9055650		N	1997
Cornus drummondii C.A. Meyer	Tazewell	roughleaf dogwood	9055667		N	1997
Cornus drummondii C.A. Meyer	Nicholson	roughleaf dogwood	9055594		N	1997
Cornus mas L.	Redstone	cornelian cherry dogwood	516476		I	1991
Corylus, americana Walt.	Sun Harvest	American hazelnut	9083247		N	2007
Dalea purpurea	Northern Iowa	purple prairie clover	9068608	UNI, IARV, IAT, ICIA	N	2003
Dalea purpurea	Central Iowa	purple prairie clover	9068609	UNI,IARV,IAT,ICIA	N	1998
Desmodium spp.	Northern MO	showy tick trefoil	9079012	MDC	N	2004
Desmodium canadense L.	Alexander	showy tick trefoil	9057110		N	1997
Echinacea pallida Nutt.	Northern Iowa	pale purple coneflower	9068611	UNI, IARV, IAT, ICIA	N	2002
Echinacea pallida Nutt.	Southern Iowa	pale purple coneflower	9068613	UNI, IARV, IAT, ICIA	N	2002
Echinacea pallida Nutt.	Central Iowa	pale purple coneflower	9068612	UNI, IARV, IAT, ICIA	N	2006
Echinacea pallida (Nutt.)	Northern MO	pale purple coneflower	9079032		N	2009
Echinacea pallida (Nutt.)	Western MO	pale purple coneflower	9079033		N	2009
Elymus canadensis L.	Northern Iowa	Canada wildrye	9062275	UNI,IARV,IAT,ICIA	N	1995
Elymus canadensis L.	Central Iowa	Canada wildrye	9062276	UNI,IARV,IAT,ICIA	N	1995

Scientific Name	Release Name	Common Name	Accession Number	Secondary Agency(ies)	Type of Release	Year of Release
Elymus canadensis L.	Southern Iowa	Canada wildrye	9062277	UNI,IARV,IAT,ICIA	N	1995
Elymus virginicus L.	Cuivre River	Virginia wildrye	9803169	MDC	N	2002
Elymus virginicus L.	Northern MO	Virginia wildrye	9079044	UMC,MDC,MODOT	N	1999
Eryngium yuccifolium Michx.	Southern Iowa	rattlesnake master	9068604	UNI, IARV, IAT, ICIA	N	1999
Eryngium yuccifolium Michx.	Central Iowa	rattlesnake master	9068603	UNI, IARV, IAT, ICIA	N	1999
Eryngium yuccifolium Michx.	Northern Iowa	rattlesnake master	9068602	UNI,IARV,IAT,ICIA	N	1998
Glycine sp. L **	Bobwhite	soybean	421822	MOPMC,ARS, MOA,	I	1975
Heliopsis helianthoides (L.) Sweet	Southern Iowa	oxeye false sunflower	9068607	UNI,IARV,IAT,ICIA	N	1997
Heliopsis helianthoides (L.) Sweet	Northern Iowa	oxeye false sunflower	9068605	UNI,IARV,IAT,ICIA	N	1996
Heliopsis helianthoides (L.) Sweet	Central Iowa	oxeye false sunflower	9068606	UNI,IARV,IAT,ICIA	N	1995
Koeleria macrantha	Central Iowa	prairie Junegrass	9068621	UNI, IARV, IAT, ICIA	N	2003
Koileria macrantha	Northern Iowa	prairie Junegrass	9068620	UNI, IARV, IAT, ICIA	N	2003
Lespedeza capitata Michx.	Northern Iowa	roundhead lespedeza	9062284	UNI, IARV, IAT, ICIA	N	2000
Lespedeza capitata Michx.	Southern Iowa	roundhead lespedeza	9062283	UNI, IARV, IAT, ICIA	N	1997
Lespedeza capitata Michx.	Central Iowa	roundhead lespedeza	9062282	UNI, IARV, IAT, ICIA	N	1996
Liatris aspera, Michx.	Southern Iowa	rough blazing star	9068686	UNI, IARV, IAT, ICIA	N	2003
Liatris aspera, Michx.	Central Iowa	rough blazing star	9068685	UNI, IARV, IAT, ICIA	N	2003
Liatris aspera, Michx.	Northern Iowa	rough blazing star	9068684	UNI, IARV, IAT, ICIA	N	2003
Liatris pycnostachya, Michx	Northern MO	prairie blazing star	9079020	MDC, NAS	N	2001
Liatris pycnostachya, Michx	Northern Iowa	prairie blazing star	9068626	UNI, IARV, IAT, ICIA	N	1999
Liatris pycnostachya, Michx	Central Iowa	prairie blazing star	9068627	UNI, IARV, IAT, ICIA	N	1999
Liatris pycnostachya, Michx.	Western MO	prairie blazing star	9079021	MDC, NAS	N	2001
Liriodendron tulipifera L.	Union	tulip poplar	9055584		N	1997
Monarda fistulosa L.	Northern Iowa	wild bergamot	9068678	UNI, IARV, IAT, ICIA	N	2007
Monarda fistulosa L.	Central Iowa	wild bergamot	9068679	UNI, IARV, IAT, ICIA	N	2007
Monarda fistulosa L.	Southern Iowa	wild bergamot	9068680	UNI, IARV, IAT, ICIA	N	2003
Panicum virgatum L.	Central Iowa	switchgrass	9068706	UNI, IARV, IAT, ICIA	N	2003
Panicum virgatum L.	Cave-In-Rock	switchgrass	469228	MOA	N	1974
Panicum virgatum L. *	Shawnee	switchgrass	591824		N	1995
Prunus americana	Midwest Premium	American plum	9083241		N	2006
Ratibida pinnata, Barnh.	Northern MO	grayheaded coneflower	9079060	MDC	N	2004
Schizachyrium scoparium (Michx.) Nash	Southern MO	little bluestem	9079006	MDC	N	2004
Schizachyrium scoparium (Michx.) Nash	Central Iowa	little bluestem	9062320	UNI,IARV,IAT,ICIA	N	1997
Schizachyrium scoparium, Michx.	Northern Iowa	little bluestem	9062319	UNI, IARV, IAT, ICIA	N	1999
Schizachyrium scoparium, Michx.	Southern Iowa	little bluestem	9962321	UNI, IARV, IAT, ICIA	N	1999
Schizachyrium scoparium, Michx.	Northern MO	little bluestem	9079004	UMC,MDC,MODOT	N	1999
Solidago rigida L.	Southern Iowa	rigid goldenrod	9068619	UNI, IARV, IAT, ICIA	N	2002
Solidago rigida L.	Central Iowa	rigid goldenrod	9068618	UNI, IARV, IAT, ICIA	N	2002
Solidago rigida L.	Northern Iowa	rigid goldenrod	9068617	UNI,IARV,IAT,ICIA	N	1998
Sorghastrum nutans (L) Nash.	Northern MO	Indiangrass	9079036	UMC,MDC,MODOT	N	1999
Sorghastrum nutans (L) Nash.	Western MO	Indiangrass	9079037	UMC,MDC,MODOT	N	1999
Sorghastrum nutans (L). Nash	Central Iowa	Indiangrass	9062317	UNI,IARV,IAT,ICIA	N	1996

Scientific Name	Release Name	Common Name	Accession Number	Secondary Agency(ies)	Type of Release	Year of Release
Sorghastrum nutans (l). Nash	Northern Iowa	Indiangrass	9062316	UNI,IARV,IAT,ICIA	N	1996
Sorghastrum nutans (L.) Nash.	Southern Iowa	Indiangrass	9062318	UNI,IARV,IAT,ICIA	N	1998
Sorghastrum nutans (L.) Nash.	Rumsey	Indiangrass	315747	MOA	N	1983
Sporobolus compositus (Poir.) Merr.	Northern Iowa	tall dropseed	9062313	UNI, IARV, IAT, ICIA	N	2000
Sporobolus compositus (Poir.) Merr.	Central Iowa	tall dropseed	9062314	UNI,IARV,IAT,ICIA	N	1996
Sporobolus compositus var. com.	Southern Iowa	tall dropseed	9062315	UNI, IARV, IAT, ICIA	N	2002
Sporobolus compositus var. comp.	Northern MO	tall dropseed	9079040	MDC, NAS	N	2001
Ulmus parvifolia Jacq.	Elsmo	lace bark elm	9004438		I	1990
* Primary Agencies: ARS=Agricultural Research Service; NEARD=Nebraska Agricultural Research Division; MOPMC=Missouri Plant Materials						
Center; IAA=Iowa Agricultural Experiment Station at Ames; PARP=Purdue Agricultural Research Program						
** Primary Agency: MDC=Missouri Department of Conservation						
N=native releases; collected within the USA, occurring naturally in the USA. Generally refers to a plant which occurs naturally in a particular						
region, state ecosystem or habitat without direct or indirect human activity.						
Nat.=naturalized releases; collected from a population within the USA, but were originally introduced to the USA sometime in the past.						
I=introduced; means that the original collection from which the release was made was not from within the USA.						

-Studies/Projects at the Elsberry Plant Materials Center
Studies 1958 through 2009

Study/Project Number System: Initially the numbers were assigned numerically plus the year the study/project was initiated. Later a different numbering system was adopted which involved the designated state number, a letter to denote the type of project/study and finally a numerical number.

Study/ Project Number	Title	Annual Technical Report/ Page Reference	
		ATR	Page
2-58	Quaker Comphrey Evaluation	1962	28
3-58	Comparison of Winter Annual Cover Crops	1962	30
6-62	Fertilizer Rate Study on Midland Bermudagrass, *Cynodon dactylon*	1963	47
10-59	Interseeding Cover Crops in Corn	1963	52
14-61	Evaluation of *Lotus corniculatus* L. Strains	1966	24
15-61	Evaluation of Bermudagrass Strains	1965	17
17-61	Black Locust, *Robinia pseudoacacia* L. Trials	1967	35
18-61	The Rate, Date and Method of Seeding *Lespedeza daurica schimadae*	1962	23
19-61	Living Fence Trials	1968	26
20-61	Plants for Bank stabilization	1962	10
21-62	Evaluation of Legumes for wildlife	1962	11
23-63	Evaluation of *Phalaris arundinacea* L. 'Ioreed' Reed Canarygrass Strains	1964	13
24-72	Method of Seeding Creeping Foxtail	1962	24
25-63	Advanced Evaluation of Plant Materials for Grass Waterways	1968	27
26-63	Evaluation of Japanese Pagodatree, *Sophoro japonica*, for Posts	1962	16
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