United States Department of Agriculture
Natural Resources Conservation Service

2009 ANNUAL TECHNICAL REPORT

Manhattan Plant Materials Center

Serving Kansas, Nebraska, northern Oklahoma, and northeastern Colorado

Notices

The 2009 Annual Technical Report (ATR) is a report to the plant materials discipline and cooperating agencies. This ATR is a compilation of preliminary reports of results from various studies conducted by the Plant Materials Center (PMC) Staff at Manhattan, Kansas. Conclusions may change with continued investigations or upon further analysis. Written authorization must be obtained from the authors before publishing data from these reports. Contact the PMC Manager for more information at 3800 South 20th Street, Manhattan, KS 66502, or (785) 539-8761. Refer to our Web site: http://plant-materials.nrcs.usda.gov/ for additional information about the Plant Materials Program.

This ATR uses currently accepted scientific names as they appear in the PLANTS (Plant List of Accepted Nomenclature, Taxonomy, & Symbols) database where practical. PLANTS is maintained by the National Plant Data Collection Center. See the Web site at http://plants.usda.gov/. The Flora of the Great Plains, University Press of Kansas, is the authority regarding the usage of common names of plants native or naturalized to North America. Hortus Third, Macmillian Publishing Company, New York is the authority regarding the usage of common names of introduced species.

Mention of trade and company names does not imply any guarantee, warranty, or endorsement by the U. S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) and does not imply its approval to the exclusion of other products that are also suitable.

Acronyms used in this report to identify various Plant Materials Centers are those listed in POMS (Plant Materials Operations and Management System).

This document conforms to the *Manhattan Plant Materials Center Style Manual for Technical Documents* (Copies available upon request).

On the cover: UL – dotted gayfeather seed increase field; UR – Rich Wynia and Mark Janzen gather Sunn hemp forage in 90 day harvest; ML – Summer crew harvesting big bluestem ICST plots; MR – Echinacea seed increase field; LL – Dawning of a new day at the PMC; LR – Jerry Longren and Don Garwood dig desert false indigo plant selection. Photography by John M. Row, Plant Materials Specialist

[This page intentionally left blank]

U. S. DEPARTMENT OF AGRICULTURE

NATURAL RESOURCES CONSERVATION SERVICE

2009 ANNUAL TECHNICAL REPORT

Manhattan Plant Materials Center

CONTENTS

FOREWORD AND ACKNOWLEDGEMENTS

The Manhattan Plant Materials Center (PMC) at Manhattan, Kansas, is a federally owned and operated facility under the administration of the Kansas State Office of the Natural Resources Conservation Service (NRCS). Conservation plant research underway at the PMC is directed by the PMC's Long-Range Plan with guidance from a State Conservationists' Plant Materials Advisory Committee with representation from Kansas, Nebraska, Oklahoma, and Colorado. The PMC maintains cooperative agreements for plant testing and development with the Agricultural Experiment Stations (Kansas State University [KSU], University of Nebraska-Lincoln [UNL], and Oklahoma State University); Kansas Biological Survey, U. S. Department of Interior (USDI) Fish & Wildlife Service, U. S. Department of Agriculture (USDA) Agricultural Research Service (ARS), U. S. Army-Fort Riley Military Reservation, U. S. Army-Corps of Engineers, and Kansas Department of Wildlife and Parks.

The PMC was established in 1936 as a Soil Conservation Service (SCS) nursery. It is located on a 169 acre irrigated farm in the Kansas River Valley, 10 miles west and south of Manhattan, Kansas. Initial and advanced evaluations of new plant materials, seed increase plantings of promising accessions, and foundation seed increases of released plant materials are located at this site. Field evaluation plantings are located off the PMC at federal and state cooperator sites. Field plantings are located in the PMC's service area on conservation district cooperator sites.

The PMC acknowledges the efforts of the following individuals who have contributed to its accomplishments: Dr. Walter Fick, Agronomy Department, KSU; Dr. Wayne Geyer, Horticulture, Forestry and Recreation, KSU; Vernon Schaffer, Agronomy Department, KSU; and Mary Knapp, State Climatologist, KSU. It also recognizes the assistance of Mary D. Shaffer, Public Affairs Specialist, and Karen F. Churchman, Secretary, NRCS, Salina, Kansas. Assistance provided by these individuals is greatly appreciated.

INTRODUCTION

The purpose of the annual technical report is to inform the plant materials discipline of the Natural Resources Conservation Service (NRCS), its cooperators, and others interested in plant materials work of progress and new developments.

Mission: *The mission of the Manhattan Plant Materials Center* (PMC) *is to develop and transfer plant materials and plant technology for the conservation of natural resources. In working with a broad range of plant species, including grasses, forbs, trees, and shrubs, the program seeks to address priority needs of field offices and land managers in both public and private sectors. Emphasis is focused on using native plants as a healthy way to solve conservation problems and protect ecosystems.*

Objectives: The objectives of plant materials activities are to select and develop special and improved plants and to determine reliable techniques for successfully establishing and maintaining plants for conservation uses. These uses include controlling soil erosion and improving soil on all lands. Finding suitable plants for stabilizing critical high-yielding sediment sources, including sand dunes, streambanks, and shorelines; windbreaks and shelterbelts; toxic or problem soils; improving forage quantity and quality for pasture and rangelands; wildlife food and cover; beautification; and recreation areas are of particular importance. Culturally significant plants, threatened and endangered species and invasive species are also areas of concern.

Long-range Priorities: Each of the states served by the PMC has identified its plant material problems, needs, and priorities in its respective current state's long-range Plant Materials Program. PMC activities are directed toward meeting the needs and priorities as set forth in the long-range plans of the four states.

The major priority items identified are:

1. Suitable plants and improved methods of establishment on critical areas for stabilization and erosion control. These critical areas include saline and alkali areas; surface mine areas, streambank and shoreline protection, road cuts and fills, blowout areas, etc.

2. Selected varieties of grasses and legumes for use in range seeding, interseeding, and pasture planting. This will include the development of techniques for production, re-establishment, and maintenance.

3. Woody selections with superiority in hardiness and resistance to drought, heat, disease, and insects for use in field and farmstead windbreaks.

4. Shrub species to supplement or replace those most commonly used for the shrub row in multiple-row windbreaks, for interplanting with trees in single-row windbreaks, and for specific needs in recreational developments.

5. Shrubs, browse, and herbaceous plants to provide improved cover and food for upland game birds, waterfowl, and other wildlife species.

6. Studies leading to improvements in cultural practices to improve plant establishment, maintenance, pest control, yield, harvest, and seed processing technology.

Service Area: The PMC primarily serves Nebraska, Kansas, northern Oklahoma, and northeastern Colorado. The service area consists of an area with much diversity and is covered by five regions designated as:

Western Great Plains Range and Irrigated
Southwestern Prairies Cotton and Forage
Central Great Plains Winter Wheat and Range
Central Feed Grains and Livestock
East and Central Farming and Forest

Service Area Description: This area, in general, was originally native grass prairie. It is dissected by a number of major streams. Areas of timber follow the stream courses and extend to the slopes in the east where sufficient precipitation supports a mixed hardwood forest. Elevations range from 700 to 5000 feet. Annual precipitation rates vary from 42 inches in parts of Oklahoma and southeast Kansas to 12.7 inches at the other extreme in northeastern Colorado. Distribution of the rainfall is typical of a warm-season grassland climate with 75 percent of the total falling from April to September. Temperatures fluctuate widely and can be accompanied by high winds and long periods without effective precipitation. Soils vary widely from the clay pans of southeast Kansas and northeast Oklahoma to the loess-derived silt loams of the High Plains and the Sandhill Region of northern Nebraska.

Location: The PMC is located in the Kansas River Valley, 10 miles west and south of Manhattan, Kansas, at an elevation of 1030 feet, longitude 96°37' and latitude 39°37'.

Facilities: The facility includes 169 acres of land, 10 buildings, 2 greenhouses, a lathhouse with walk-in cooler, and 4 irrigation wells. Portions of the land holdings are used by Kansas State University Agricultural Experiment Station under provisions of a multi-year working agreement.

Climate and Soils: The soils found on the PMC are Belvue silt loam (formerly Haynie very fine sandy loam), Eudora silt loam, Bourbonais-Bismarckgrove complex, Stonehouse-Eudora complex (formerly Carr-Sarpy complex), and Fluvents (formerly Sarpy loamy fine sand). The PMC is in Major Land Resource Area 76. Average annual precipitation is 34.8 inches (30-year average 1971-2000). The average frost-free period is 178 days. Prevailing surface winds are southerly in the summer months and northerly in the winter months.

OUTREACH

Outreach activities consist of providing assistance to Native American Indian tribes of the Central Great Plains. The PMC provides assistance in the collection and propagation of culturally significant plants. Such efforts result in the establishment of plant propagation nurseries, and educational and ceremonial displays. Ethnobotanical information and plant descriptions may also be provided. In 2009 technical assistance with an outdoor classroom was provided in Oklahoma to Wyandotte Nation in Miami and collection and propagation of red-root willow for the Creek Nation, Okmulgee (Table 1). See page 6 of Technology Transfer for further information regarding outreach activities in 2009.

Table 1. Plant materials provided to tribes in 2009.

Tribe/Entity	Location	Plant Material
Wyandotte Nation	Miami, OK	Warm-season grasses and forbs
Creek Nation	Okmulgee, OK	Red-root willow

COOPERATIVE EFFORTS

The PMC is involved in many collaborative efforts with cooperating universities, USDA ARS, seedsmen, and nurserymen. The PMC, at a minimum, provides seed for research and quite often technical assistance is provided. On-site studies include land for the study, and in some cases, labor and other PMC resources are provided. The following list is not comprehensive but captures many of the cooperative efforts the PMC was involved with in 2009.

Cooperator	Affiliation	Research Interest
Dr. John Burd	USDA ARS-Plant Sci. and Water Cons. Res. Lab.	Aphid research
Dr. Mike Casler	USDA ARS-Dairy Forage Res. Central Univ. of Wisconsin	Adaptation zones of switchgrass populations
Dustin Edmunsen	Mid-West Seed Services	Isoelectric comparison of switchgrass
Dr. Ray Fall	Univ. of Colorado	Measure atmospheric impact: biofuel grasses
Dr. Steven Fransen	Washington State Univ. Prosser	Warm-season grass trials; grass-legume mixtures
Amir Hass	USDA ARS	Rain garden/bioretention pond research
Karla Hernandez/ Vance Owens	South Dakota State Univ.	Prairie cordgrass biofuel study
Julia Hu	Clemson Univ. Genomics Inst.	Genomic research: switchgrass
Dr. Loretta Johnson	KSU	Ecotypic variation in big bluestem
Tim Menard	USDI FWS-Marais des Cygnes NWR	Mead's milkweed recovery
David Price	USDA ARS-Dairy Forage Res. Central Univ. of Wisconsin	Genetic diversity of North American bluestem populations
Dr. Tim Springer	USDA ARS-Southern Plains Res. Sta.	Sand bluestem comparison trials

TECHNOLOGY TRANSFER

The dissemination of information resulting from plant materials work is in the form of presentations, tours, and printed materials. Printed materials include newsletters, release brochures, technical notes, planting guides, conservation plant fact sheets, national news articles, reports, etc. While most of the publications and events listed here occurred in 2009, the list may include those not previously reported. Author's given name is reduced to initials following first appearance in this section of the annual technical report. Any deviation from this scheme indicates that the author's given name is not known.

Events and Presentations

Conference Room: The PMC conference room is used by federal, state, and local conservation agencies for meetings and training activities. Approximately 40 people used the facility this year for the following activities:

Kansas Stream Mitigation Meeting
Nebraska Plant Materials Workshop
WEPS Model Meeting

Presentations: Presentations are made by PMC Staff to update various groups about local, regional, and national Plant Materials Program activities and to facilitate technology transfer.

To Bridge a Gap Conference. Plant Materials Program Review and How It Relates to Native Americans. April 7, 2009. Durant, OK. Mark A. Janzen.

Oklahoma Tribal Conservation Advisory Council. Plant Materials Program Review and How It Relates to Native Americans. April 8, 2009. Shawnee, OK. M. A. Janzen.

Conservation Planning/Technical Guide Meeting. Program Overview with Kansas Forest Service. May 12, 2009. Salina, KS. M. A. Janzen.

Nebraska Plant Materials Training Session. Overview of Plant Materials Studies. Manhattan, KS. August 19, 2009. M. A. Janzen.

Nebraska Plant Materials Committee Meeting. Plant Materials Specialist's Report and Overview of PMC Activities. Lincoln, NE. August 27, 2009. M. A. Janzen.

Kansas NRCS Area Specialists' Meeting. September 10, 2009. Salina, KS. Richard L. Wynia.

Manhattan Plant Materials Center Program Involvement with Threatened and Endangered Plant Species. August 19, 2009. Manhattan Plant Materials Center, Manhattan, KS. John M. Row.

Tours: The PMC Staff welcomes visitors and readily conducts tours. The number of visitors was down in calendar year 2009; however, more than 70 people visited the PMC, of which 65 toured the PMC. The following groups are representative of the yearly interest in the Plant Materials Program:

Kansas NRCS Employees
Native Seed Powwow Group
Southern Illinois University Biology Students

Training Sessions: The PMC Staff puts on training sessions or takes part in training sessions to train staff, cooperators, and the general public about various aspects of the Plant Materials Program.

Kansas Crop Improvement Association: Native Seed Powwow, Manhattan PMC, April 14, 2009. R. L. Wynia
Orientation for Biological Science Aids, Manhattan PMC, May 18, 2009. J. M. Row. Trainees: 4

Inter-Agency Personnel Training, Manhattan PMC, May 21, 2009. R. L. Wynia and J. M. Row. Trainees: 1

Ticks, Manhattan PMC, May 21, 2009. Jerry D. Longren. Trainees: 10

Woody Plant Evaluation at Manhattan PMC, August 18, 2009. J. M. Row. Trainees: 1

PMC Training for Plant Materials Program Employees, Manhattan PMC, August 18, 2009. R. L. Wynia and J. M. Row. Trainees: 1

2009 Nebraska NRCS Employee Workshop. Manhattan PMC, August 19, 2009. R. L. Wynia and M. A. Janzen. Trainees: 16

Seed Technologist I Short Course. September 17, 2009. J. M. Row. Trainees: 1

Publications

Field Office Technical Guide (FOTG): Updates to the FOTG are made when new information becomes available. The following standards and specifications were updated in 2009:

Access Control, Standard/Statement of Work (472). Salina, KS, February 2009. M. A. Janzen. 4p.

Tree/Shrub Establishment, Standard/Specification/Statement of Work (612). Salina, KS, February 2009. M. A. Janzen. 6p.

Form KS-ECS-4, Grass Seeding Field Sheet. Salina, KS, February 2009. M. A. Janzen. 3p.

Newsletters: The PMC publishes a quarterly newsletter that is distributed to cooperators and customers in the PMC's service area. The newsletter is also available to the general public via the Internet. The newsletter has been published and distributed since 1994.

Plants for the Heartland. Volume 16. Issue 1. 2009. R. L. Wynia and J. M. Row. 2p.

Plants for the Heartland. Volume 16. Issue 2. 2009. M. A. Janzen and J. M. Row. 2p.

Plants for the Heartland. Volume 16. Issue 3. 2009. J. M. Row. 4p.

Plants for the Heartland. Volume 16. Issue 4. 2009. R. L. Wynia and J. M. Row. 2p.

Plants for the Heartland. Volume 16. Issue 5. 2009. J. M. Row and R. L. Wynia. 2p.

Plants for the Heartland. Volume 16. Issue 6. 2009. J. M. Row. 2p.

2008 King of the Prairie! Greenwood County, Kansas, Katie Hancock and M. A. Janzen. *In:* Plants for the Heartland. Volume 16. Issue 2. 2009. M. A. Janzen and J. M. Row. 2p.

Plant Fact Sheets: Plant fact sheets are produced for the PLANTS Database that are of benefit to the Plant Materials Program and NRCS programs.

Fremont's Leather Flower (*Clematis fremontii*) Plant Fact Sheet. Plant Materials Program Web site. USDA NRCS. 2009. J. M. Row. 2p.

Pitcher Sage (*Salvia azurea* var. *grandiflora*) Plant Fact Sheet. Plant Materials Program Web site. USDA NRCS. 2009. R. L. Wynia. 2p.

Compass Plant (*Silphium laciniatum*) Plant Fact Sheet. Plant Materials Program Web site. USDA NRCS. 2009. R. L. Wynia. 2p.

Plant Guides: Plant guides are produced for the PLANTS Database that are of benefit to the Plant Materials Program and NRCS programs.

Fremont's Leather Flower (*Clematis fremontii*) Plant Guide. Plant Materials Program Web site. USDA NRCS. 2009. J. M. Row. 2p.

Pale Purple Coneflower (*Echinacea pallida*) Plant Guide. Plant Materials Program Web site. USDA NRCS. 2009. R. L. Wynia. 4p.

Smooth Oxeye (*Heliopsis helianthoides*) Plant Guide. Plant Materials Program Web site. USDA NRCS. 2009. R. L. Wynia. 3p.

Little Walnut (*Juglans microcarpa*) Plant Guide. PLANTS Database. USDA NRCS National Plant Data Center, Baton Rouge, LA. 2009. R. L. Wynia. 3p.

Pitcher Sage (*Salvia azurea* var. *grandiflora*) Plant Guide. Plant Materials Program Web site. USDA NRCS. 2009. R. L. Wynia. 3p.

Compass Plant (*Silphium laciniatum*) Plant Guide. Plant Materials Program Web site. USDA NRCS. 2009. R. L. Wynia. 3p.

Reports: Annual and technical reports produced by PMC Staff documenting plant materials activities for a given period of time.

2008 Annual Technical Report, Manhattan Plant Materials Center. Salina, KS. 140p.

2008 Progress Report of Activities, Manhattan Plant Materials Center. Salina, KS. 4p.

Five-year report to the U. S. Fish and Wildlife Service (USFWS): Propagation of Mead's milkweed at Manhattan Plant Materials Center (PMC). Kansas NRCS State Office, Salina, Kansas. April 2009. 30p.

Technical Notes: Technical Notes are developed by the Plant Materials Program for the benefit of its customers.

Plant Materials Technical Note 1, Cool/Warm Season Grass Varieties, Kansas, February 2009. M. A. Janzen. 4p.

PLANT MATERIALS DEVELOPMENT FLOW CHART

Assembly	Initial Evaluations	Initial Seed/ Plant Increase	Advanced Evaluations	Field Evaluation Plantings	Seed/Plant Increase	Field Plantings	Release
FORBS AND LEGUMES							
		Asclepias tuberosa (SI)					
					Echinacea angustifolia	*Echinacea angustifolia*	
					Liatris punctata	*Liatris punctata*	
					Silphium *laciniatum* (S)	**Silphium** *laciniatum* (S)	
GRASSES AND GRASS-LIKE PLANTS							
Muhlenbergia *pungens*						*Bouteloua gracilis* (F)	
Redfieldia flexuosa		*Calamovilfa gigantea* (F)					
Scirpus sp.	*Panicum virgatum*		*Panicum virgatum*				
Sporobolus giganteus			*Schizachyrium scoparium*				
TREES AND SHRUBS							
		Amorpha fruticosa			*Betula nigra*	*Betula nigra* (T)	
	Celtis occidentalis	*Amorpha canescens* (S)		*Celtis occidentalis* (S)			
		Ceanothus herbaceous	**Fraxinus** *pennsylvanica* (S)				
	Platycladus orientalis	*Cotoneaster lucida* (F)		*Platycladus orientalis* (S)		*Prunus americana* (F)	
	Quercus macrocarpa	*Prunus americana*			*Prunus angustifolia*	*Prunus angustifolia*	*Prunus angustifolia* (F)
		Cephalanthus occidentalis		*Ulmus pumila* (S)	*Ribes aureum* var *villosum*	*Ribes aureum* var *villosum* (F)	
		Salix exigua (S)		*Ulmus parvifolia*			

Release Type: F-Formal SI-Source Identified S-Selected T-Tested

SELECTION AND INITIAL INCREASE OF SUPERIOR PLANTS

Initial increase is the production of seed or other propagules of potentially useful plants selected on the basis of initial or advanced evaluation for further evaluation or research. The following accessions are currently in the status of initial seed or plant increase.

Accession No.	PI No.	Common Name	Species	Study No.
9049944	514675	lead plant	*Amorpha canescens*	20I023H
ORIGIN/SOURCE: A polycross composed of accessions 9013351, Comanche Co., KS; 9013344, Washita Co., OK; 9013354, Stephens Co., OK; and 9017622, Saline Co., KS				
9050575		desert false indigo	*Amorpha fruticosa*	20I042E
ORIGIN/SOURCE: A polycross composed of accessions 9050277, Holt Co., NE; 9050280, Dickinson Co., KS; 9050307, Colfax Co., NE; 9050308, Cheyenne Co., KS; 9050314, Dodge Co., NE; 9050318, Kingman Co., KS; 9050321, Howard Co., NE; 9050324, Harvey Co., KS; 9050349, Haskell Co., OK; 9050384, Sumner Co., KS; and 9050400, Clay Co., KS				
9034682		river birch	*Betula nigra*	20I010K
ORIGIN/SOURCE: Houston Co., MN				
9050018		big sandreed	*Calamovilfa gigantea*	20I032X
ORIGIN/SOURCE: A polycross composed of accessions 9026760, Reno Co., KS; 9026777, Payne Co., OK; 9035891, Lipscomb Co., TX; 9042800, Garza Co., TX; 9042911, Winkler Co., TX; 9049764, Rice Co., KS; 9049765, Stafford Co., KS; 9049823, Stafford Co., KS; and 9049866, Comanche Co., KS				
9049952	514676	New Jersey tea	*Ceanothus herbaceous var pubscens*	20I024H
ORIGIN/SOURCE: A polycross composed of accessions 9013414, Osborne Co., KS; and PI-421286, Wabaunsee Co., KS				
9050496		common buttonbush	*Cephalanthus occidentalis*	20I043E
ORIGIN/SOURCE: A polycross composed of accessions 9050287, Hodgeman Co., KS; 9050296, Miami Co., KS; 9050311, Douglas Co., KS; 9050323, Harvey Co., KS; 9050340, Cleveland Co., OK; 9050359, Harvey/Reno Co., KS; 9050360, Osage Co., KS; 9050371, Butler Co., KS; 9050375, Montgomery Co., KS; 9050389, Douglas Co., KS; 9050392, Johnston Co., OK; and 9050395, Logan Co., OK				
	325270		*Cotoneaster lucidus*	20I033K
ORIGIN/SOURCE: USSR				
9023353		black sampson	*Echinacea angustifolia*	20I018S
ORIGIN/SOURCE: A polycross composed of accessions PI-421340, Butler Co., KS; PI-421331, Logan Co., OK; PI-421362, Ellis Co., KS; PI-421307, Noble Co., OK				

Selection and Initial Increase of Superior Plants (continued).

Accession No.	PI No.	Common Name	Species	Study No.
9049894		dotted gay-feather	*Liatris punctata*	20I022S
ORIGIN/SOURCE: A polycross composed of PI-421419, Woodson Co., KS; PI-421497, Lane Co., KS; and PI-421488, Rush Co., KS				
9049968		switchgrass	*Panicum virgatum*	20I039E
ORIGIN/SOURCE: Roger Mills Co., OK				
9049945	514677	American plum	*Prunus americana*	20I028J
ORIGIN/SOURCE: A polycross composed of accessions 9013483, Gove Co., KS; 9013498, Valley Co., NE; 9013500, Valley Co., NE; 9013515, Harlan Co., NE; and 9013544, Kingman Co., KS				
9049970		Chickasaw plum	*Prunus angustifolia*	20I029J
ORIGIN/SOURCE: A polycross composed of accessions 9013486, Gove Co., KS; 9013519, Kingfisher Co., OK; 9013524, Roger Mills Co., OK; 9013527, Woods Co., OK; 9013528, Woods Co., OK; 9013543, Gray Co., KS; 9013547, Garfield Co., OK; and 9013548, Kingfisher Co., OK				
9050270		buffalo currant	*Ribes aureum var villosum*	20I036X
ORIGIN/SOURCE: A polycross composed of accessions 9049770, Morris Co., KS; 9049773, Ellis Co., KS; 9049806, Holt Co., NE; 9049810, Sheridan Co., NE; and 9049884, Loup Co., NE				
9050135		sandbar willow	*Salix exigua*	20I040E
ORIGIN/SOURCE: Brown Co., KS				
9050148		sandbar willow	*Salix exigua*	20I040E
ORIGIN/SOURCE: Sarpy Co., NE				
	421557	compass plant	*Silphium laciniatum*	20I020H
ORIGIN/SOURCE: Okmulgee Co., OK				

SEED AND PLANT PRODUCTION

Cultivar	Genus/Species	Common Name	Origin	Class	Acres
		HERBACEOUS			
		Forbs			
Riley	*Chamaecrista fasciculata*	showy partridge pea	Riley Co., KS	FND	0
Kaneb	*Dalea purpurea*	purple prairie clover	Riley Co., KS	FND	1.12
Reno Germplasm	*Desmanthus illinoensis*	Illinois bundleflower	Reno Co., KS	G2	0
9023353	*Echinacea angustifolia*	blacksampson	unknown	SFP	0.17
Prairie Gold	*Helianthus maximiliani*	Maximilian sunflower	KS	FND	0.2
Midas	*Heliopsis helianthoides var scabra*	false sunflower	KS	FND	0.12
Kanoka	*Lespedeza capitata*	round-head lespedeza	KS, OK	FND	0
9049894	*Liatris punctata*	dotted gay-feather	KS	G2	0.19
Eureka	*Liatris pycnostachya*	thickspike gay-feather	KS	FND	0.07
Sunglow	*Ratibida pinnata*	grayhead prairie coneflower	unknown	FND	0.24
Nekan	*Salvia azurea var grandiflora*	pitcher sage	KS	FND	0.16
421557	*Silphium laciniatum*	compass plant	Okmulgee Co., OK	G2	0.02
Grasses					
Kaw	*Andropogon gerardii*	big bluestem	Riley Co., KS	FND	1.0
Garden	*Andropogon hallii*	sand bluestem	Garden Co., NE	SFP	0.68
El Reno	*Bouteloua curtipendula*	sideoats grama	Canadian Co., OK	FND	0.84
Pronghorn	*Calamovilfa longifolia*	prairie sandreed	NE	FND	0.75
9050018	*Calamovilfa gigantea*	giant sandreed	KS, OK, TX	SFP	0.60
Bend	*Eragrostis trichodes*	sand lovegrass	KS, OK	FND	0.24
Blackwell	*Panicum virgatum*	switchgrass	Blackwell, OK	FND	1.23
Kanlow	*Panicum virgatum*	switchgrass	Wetumka, OK	FND	0.72
Barton	*Pascopyrum smithii*	western wheatgrass	Barton Co., KS	FND	2.0
Southwind	*Phragmites australis*	common reed	KS, OK	FND	0.8
Aldous	*Schizachyrium scoparium*	little bluestem	KS Flinthills	FND	2.4
Cimarron	*Schizachyrium scoparium*	little bluestem	KS, OK	FND	0.82
Cheyenne	*Sorghastrum nutans*	yellow Indian grass	Fort Supply, OK	SFP	0.35
Osage	*Sorghastrum nutans*	yellow Indian grass	KS, OK	FND	1.0
Atkins Germplasm	*Spartina pectinata*	prairie cordgrass	Washington Co., NE	G2	0.83
Pete	*Tripsacum dactyloides*	eastern gamagrass	KS, OK	FND	0.4
		WOODY			
9049944	Amorpha canescens	lead plant	KS, OK	G2	0.07
9050575	Amorpha fruticosa	desert false indigo	KS, NE, OK	G1	0.07
9034682	Betula nigra	river birch	Houston Co., MN	G1	0.15
9049952	Ceanothus herbaceous var pubscens	New Jersey tea	KS	G2	0.11
9050496	Cephalanthus occidentalis	common buttonbush	KS, OK	G1	0.08
325270	Cotoneaster lucidus		USSR	FND	0.05
Pink Lady	Euonymus bungeanum	winterberry	China	FND	0.03
9049945	Prunus americana	American plum	KS, NE	FND	0.05
9049970	Prunus angustifolia	Chickasaw plum	KS, OK	FND	0.12
Lippert	Quercus macrocarpa	bur oak	Stillwater, OK	FND	0.02
Konza	Rhus aromatica var serotina	aromatic sumac	KS	FND	0.09
9050270	Ribes aureum var villosum	buffalo currant	KS, NE	FND	0.05
9050135	Salix exigua	sandbar willow	Brown Co., KS	G1	0.09
9050148	Salix exigua	sandbar willow	Sarpy Co., NE	G1	0.11
9004450	Juglans microcarpa	little walnut	Beckham Co. & Washita Co., OK	SFP	0.1

DISTRIBUTION OF PLANT MATERIALS IN 2009

The Plant Materials Program distributes plant materials to conservation districts; cooperating universities, federal and state agencies, and private entities. These materials are provided for conservation field trials, seed or plant increase, research, demonstration plantings, and for educational purposes. The following table shows the distribution of plant materials from the PMC. A total of 26 seed and plant orders were shipped to 16 states with over 206 pounds of seed, 388 plants, and 150 rhizomes distributed in 2009.

Herbaceous Plant Materials

		Seed Orders			Plant Orders		
State	Use	Number	Number of Packets	Bulk Pounds	Number	Number of Rhizomes	Number of Plants
Kansas	CD	1	3	0.2	2		72
	FA				1		86
	SA				2		70
	UNIV	2	2	0.1			
Subtotal		3	5	0.3	5	0	228
Nebraska	CI	1	1	0.1			
	NRD				4		130
Subtotal		1	1	0.1	4	0	130
Oklahoma	FA	3	11	0.2	1		30
	OR	1	16	0.2			
Subtotal		4	27	0.4	1	0	30
Colorado	UNIV	2	6	0.7			
Other States	CI	4		141.9			
	FA	1		1.0	1	150	
	PMC	3		3.6			
	PVT	1	1	0.1			
	UNIV	3	6	0.6			
Subtotal		14	13	147.9	1	150	0
Total		22	46	148.7	11	150	388

Legend: CD=Conservation Districts, CI=Commercial Increase, FA=Federal Agencies, NRD=Natural Resource Districts, OR=Outreach, PMC=Plant Materials Centers, PVT=Private Institutions, RES=Research, SA=State Agencies, UNIV=Universities

Woody Plant Materials

		Seed Orders			Plant Orders		
State	Use	Number	Number of Packets	Bulk Pounds	Number	Number of Cuttings	Number of Plants
Nebraska	NRD	1		2.0			
Montana	CI	1		5.0			
Oklahoma	CD	1		50.0			
Utah	RES	1		0.6			
Total		4		57.6	0	0	0

YEAR 2009 CLIMATALOGICAL DATA FOR MANHATTAN

2009 Data

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg Max	40.8	53.1	57.3	64.3	76.5	87.5	85.9	86.4	77.9	60.5	60.1	34.6	65.4
Avg Min	15.3	21.8	29.7	38.6	50.4	62.2	60.8	59.4	50.0	36.4	33.0	13.7	39.3
Avg Mean	28.0	37.4	43.5	51.5	63.5	74.9	73.4	72.9	64.0	48.4	46.5	24.1	52.3
High	64	73	83	87	93	100	97	100	87	78	77	62	83.4
Low	0	8	9	22	40	52	50	45	35	27	22	-8	25.2
Max† > 90	0	0	0	0	2	14	18	11	0	0	0	0	45
Precip	0.04	0.65	3.01	5.25	0.98	8.48	6.55	4.50	2.03	4.00	1.21	1.99	38.69
PMC‡	-	-	1.92	6.05	0.59	9.08	5.71	5.63	2.48	3.67	2.09[α]	0.86[α]	-
Precip†	7	8	9	12	15	13	16	11	10	16	10	14	141
Snow	1.5	1.8	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.9	30.0
Heat DD*	1146	1918	667	420	116	9	0	10	76	514	554	1267	6697
Cool DD*	0	0	0	14	68	305	259	255	46	0	0	0	2093

Normal Values (1971-2000)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg Max	39.5	46.8	57.5	67.9	77.5	87.1	92.5	90.8	82.1	70.7	54.5	42.9	67.5
Avg Min	16.1	21.5	31.4	42.2	52.5	62.3	67.3	65.1	55.5	43.2	30.2	19.9	42.3
Avg Mean	27.8	34.2	44.5	55.1	65.0	74.7	79.9	78.0	68.8	57.0	42.4	31.4	54.9
Precip	0.86	1.00	2.59	3.07	5.08	5.23	4.10	3.27	3.67	2.77	2.10	1.06	34.8
Snow	4.8	4.9	3.4	0.9	0.1	0	0	0	0	0.2	1	3.7	18.8
Heat DD*	1153	864	637	315	106	7	0	4	48	265	679	1042	5120
Cool DD*	0	0	0	17	106	298	461	405	163	15	0	0	1465

Departure From Normal

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg Max	1.3	6.3	-0.2	-3.6	-1.0	0.4	-6.6	-4.4	-4.2	-10.2	5.6	-8.3	-2.1
Avg Min	-0.8	0.3	-1.7	-3.6	-2.1	1.0	-6.5	-5.7	-5.5	-6.8	2.8	-6.2	-3.0
Avg Mean	0.2	3.2	-1.0	-3.6	-1.5	0.2	-6.5	-5.1	-4.8	-8.6	4.1	-7.3	-2.6
Precip	-0.82	0.41	0.42	2.18	-4.1	3.25	2.45	1.23	-1.64	1.23	-0.89	0.93	3.89
Snow	-3.3	5.7	3.4	-0.9	-0.1	0.0	0.0	0.0	0.0	-0.2	-1.0	16.2	11.2
Heat DD*	7	186	-30	105	10	2	0	6	28	249	125	225	1577
Cool DD*	0	0	0	-3	-38	7	-202	-150	-117	-15	0	0	-628

*Daily values were computed from mean temperatures. Each degree that a day's mean is below (or above) 65°F is counted for 1 heating (or cooling) degree day. † Number of days; PMC Rain Gauges: ‡ Gauge in operation March 9 to October 30; [α]Vantage Pro2™

Official Recording Station, Manhattan, Kansas

CLIMATIC SUMMARY 2009

Temperature Extremes: -8ºF December 10; 100ºF June 24 and August 10

First Killing Frost*: October 7 (low of 31ºF) *Frost = 32ºF or less

Last Killing Frost: April 12 (low of 30ºF)

Number of Frost Free Days: 177

Temperature: January continued the wide temperature swings of the previous year. While the average temperature was only 2 tenths of a degree warmer than normal, the average daily range between high and low temperatures was almost 5 degrees greater than normal. February stood in contrast to the cooler than normal trend seen over the winter. Temperatures averaged 3 degrees warmer than normal. New record highs were set on the 1st and the 9th. Another feature of the month was the large daily temperature swings, averaging over 30 degrees, with no subzero readings or record low settings for the month. March came in on a warm wind, and left with an icy blast. A new record high was set on March 6th, but overall temperatures averaged 1°F cooler than normal. A wind storm March 23, with gusts in excess of 90 mph was another major feature of 2009 weather events. Damage to roofs, signs, and trees were common, and several trucks were blown over on area highways. Large clouds of topsoil blackened the sky in some areas. Despite a warm period during the last week of April, overall temperatures were cooler than normal. Freezing temperatures were observed as late as the 15th of the month. May was cooler than normal. Warm weather really did not arrive until the end of the month with the warmest reading occurring on May 31. June was slightly warmer than normal. The big feature for the month was the heat wave from the 22nd to the 27th. While temperatures did not set records, high humidity values brought the heat indices well above 100. Only a thunderstorm on the 25th brought lows below 70 during the period. July was the second coolest on record since 1890. Two new record lows were set on the 18th and the 29th. The cooler than normal trend continued into August, with a mean temperature of 72.9°F making August the 6th coolest since 1890. Only 1 day reached 100°F, compared to the average of 4 days. No records were set. September continued the cooler than normal pattern of the summer with a mean of 64°F. It was the 5th coolest September since 1890. However, there were no freezing temperatures for the month. Despite a warm beginning, October was much cooler than normal. Three record cool highs were recorded on the 11th, 12th, and 15th. A new record low was recorded on the 11th. The first frost of the season occurred on the 7th, a week earlier than normal. In contrast to the rest of the fall, November was warmer than normal. Much colder than normal temperatures in December was the 7th coldest on record.

Precipitation: January started out the year drier than normal, the 8th driest on record. The dry trend continued in February with below normal precipitation and below normal snowfall. March was slightly wetter than normal. The March 27-28 snow storm provided the most snow since December 2008. However, below normal precipitation for the season, both in snowfall and in overall moisture were observed. April ended on a wet note, finishing the month over 2 inches wetter than normal. Hail was reported near I-70 on the 26th. Despite 13 days with precipitation of which three produced thunder storms, none produced significant damage or rainfall. Most of the rain events were the result of very light drizzle. June was much wetter than normal. The extra moisture brought the annual total to above normal as well. July was also wetter than normal and the 19th wettest on record. While precipitation was greater than normal, it was well below the record for August. There were 10 days with precipitation in September; however, the total for the month was well below normal. Despite the dry conditions, Manhattan was still 2 inches ahead for the year. October had 16 days with rain with the monthly total 1.23 inches greater than normal. In contrast to the rest of the fall November was drier than normal. Only a trace of snow was recorded on the 16th and 17th. A new record snowfall at 19.9 inches was set in December. A blizzard/winter storm was a major event from the 24th through the 26th. The event started out as rain, then changed to snow on the 24th, with wind and continued snow through the 26th. Drifts of over 2 feet created travel hazards, particularly on the 25th.

Excerpts from Monthly Weather Summary for Manhattan, Mary Knapp, State Climatologist. Additional comments by John M. Row.

STUDIES

Studies are planned and developed by the PMC Staff to solve high-priority problems identified in the Center's Long-Range Program. All PMC studies are listed as part of the National Plant Materials Program projects. Currently 23 studies were active in on-site (On) and off-site (Off) locations in 2009 (Table 1). Details of active studies can be found on the subsequent pages.

Table 1. Status of studies conducted by PMC Staff.

Study No.	Study Name	Site Location	Status	Start Date	End Date	Project No.
20A107T	Seed storage study	On	Active	1973	2020	RN 1.1
20A126L	Adaptation trials of superior grasses and forbs selected for advanced testing	On	Active	1992	2050	NA 1.1
20A127K	Evaluation of PMK-1 for resistance to ash borers	On	Active	1997	2009	CP 4.1
20A215H	Rrps of little bluestem	On	Active	1992	2012	RA 1.1
20C007Ta	Propagation of Mead's milkweed	On	Active	1996	2012	NA 1.1
20I003L	Evaluation of miscellaneous grasses	On	Active	1970	2020	NA 1.1
20I010K	Evaluation of miscellaneous trees and shrubs	On	Active	1961	2050	CP 4.1
20I026K	Evaluation of hackberry	On	Active	1979	2012	CP 4.1
20I037K	Evaluation of selected common hackberry	On	Active	1988	2013	CP 4.1
20I038K	Bur oak seed source study	On	Active	1991	2015	CP 4.1
20I039E	Evaluation of switchgrass germplasm for rhizomatous characteristics	On	Active	1992	2012	CP 4.1
20I041K	Evaluation of Siberian elm	Off	Active	1997	2020	CP 4.1
20I042E	Initial evaluation of false indigo for use in streambank stabilization, shoreline protection, and wetland restoration and enhancement	On	Active	1997	2009	WQ 3.1
KSPMS-T-9902-OT	Assist Native American Tribes with the reestablishment of culturally significant plants	OK, KS, NE	Active	1999	2020	- - -
KSPMS-T-0001-CR	Conservation field trial: reclamation of blue shale outcrop sites in Jewell County, Kansas	Off	Active	2000	2012	ML 1.1
KSPMS-T-0201-CR	Plant species for revegetation of natural and man-induced saline areas	Off	Active	2002	2012	CP 3.1
KSPMC-T-0502-RA	Laboratory evaluation of plant materials to determine seed analysis, germination, and propagation techniques	On	Active	2004	2020	RA 1.1
KSPMC-P-0601-RA	Increasing seedling vigor and stand establishment of giant sandreed	On	Active	2006	2012	RA 1.1
KSPMS-T-0705-PA	Evaluation of 'Laramie' Tifton burclover interseeding trial in established cool-season forage grasses	Off	Active	2006	2012	PA 1.1
KSPMC-ST-0801-RA	Big bluestem Inter Center Strain Trial	On	Active	2008	2011	RA 1.1
KSPMC-T-0802-RA	Evaluate sand bluestem germplasm lines with improved seedling establishment under field conditions	On	Active	2008	2011	RA 1.1
KSPMC-T-0803-RA	Evaluation of miscellaneous forbs and legumes	On	Active	2008	2020	RA 1.1
KSPMC-T-0901-CP	Evaluate the adaptability of 'Tropic Sun' Sunn Hemp (*Crotalaria juncea* L.)	On	Active	2009	2009	CP 1.1

Advanced Evaluations

Seed Storage Study

Study No. 20A107T

Study Leader: John M. Row, Plant Materials Specialist

Introduction: Long-term storage facilities can provide a source of valuable seed stocks without maintaining large numbers of plants for seed production. Bass (1980) underlined the importance of maintaining small samples of many kinds of seeds, indefinitely, for breeding purposes. Seeds stored in unheated buildings are, however, subject to wide fluctuations in temperature and humidity in eastern Kansas, where the average annual humidity ranges from 51 to 81% and average annual temperatures range from -9° to 33°C (16° to 92°F). Such conditions are detrimental to the longevity of grass seeds in storage (Priestly *et al*. 1985).

In 1973, the USDA-SCS built a seed storage facility to preserve valuable seed stocks at the Manhattan Plant Materials Center (PMC), Manhattan, Kansas. This facility is rodent proof and is temperature and humidity controlled. Although the storage requirements for many plant species are known, there is little information available documenting the benefits of a controlled versus an uncontrolled environment for storing native plant seeds in eastern Kansas. Harrington's (1959) rule of thumb is that the percent relative humidity (RH) + temperature in degrees Fahrenheit should not exceed 100 for safe seed storage. Rincker and Maguire (1979) and Rincker (1981) found that even after 14 years, germination was greater than 80% for several grasses stored at -15°C (5°F) and 60% RH (Ackigoz and Knowles 1983).

This study was set up initially to compare the viability and longevity of warm-season and cool-season grasses when the seed storage facility was newly constructed in 1973. Forbs and legumes were added to the study in 1979.

Objective: Evaluate how controlled temperature and humidity and uncontrolled warehouse conditions affect native plant seeds.

Procedure: Seeds of 21 plant species were assembled. Eighteen of the species were native, consisting of 5 forbs, 2 legumes, 11 warm-season grasses, and 1 cool-season grass. Three introduced cool-season grasses were also included in the study.

Seed storage facilities consisted of a seed storage facility with a room with a controlled environment and an uninsulated temporary seed storage facility without a controlled environment. The temporary seed storage facility was wood frame on a concrete slab with clapboard siding. It was subject to wide fluctuations in temperature and humidity. The seed storage facility was of all metal construction and insulated throughout. The environmentally controlled seed storage room itself was sealed to exclude outside air and humidity was.

Temperature and humidity in the seed storage room were controlled by a UNA-DYN (Model A30T) 2 tower, desiccant bed dehumidifier and a standard air conditioning unit. Temperature controls were set to maintain 18.3°C (65°F) summer, 12.8°C (55°F) fall-spring, and -1.1° to 7.2°C (30 to 45°F) in the winter. Relative humidity was maintained between 10 to 20%. A hygro-thermograph was used to monitor temperature and humidity. Each seed lot was divided into 2 portions and placed in burlap and/or cotton duck bags for storage. One sack of each lot was placed in the warehouse in a steel drum to prevent rodent damage. Pest strips containing 2-2 dichlorovynyl dimethyl phosphate (Vapona) (20% AI) were placed in each barrel for insect control. The second sack of each seed lot was placed on shelves inside the seed storage room. The initial purity and germination test and subsequent germination tests were conducted in accordance with the Association of Official Seed Analysts Rules for Seed Testing (Anonymous 1978). Samples of all lots were taken annually thereafter and sent to the Kansas State Board of Agriculture Seed Laboratory through 1993 for standard germination tests. Kansas Crop

Improvement Association conducted germination tests from 1994 to the present. Seed lots were removed from the study when germination test results for that lot dropped below 10% of the original test.

No testing was conducted for years 17 and 19 (therefore no data [ND]) in the grasses since year-to-year changes were slight in most cases. No testing was conducted in years 11 and 13 for the forbs. Later on, it was decided that it was not a good idea to skip a year of testing in case viability for a particular lot was declining, so testing was resumed on an annual basis. Testing was discontinued for the uncontrolled storage environment entries after 13 years for warm-season grasses, 7 years for cool-season grasses, and after 6 years for most forbs. Testing was discontinued in 2000 for cool-season grasses in a controlled storage environment following 27 years of study. Results for cool-season grass seed germination test results were last reported in the 2007 Annual Technical Report.

Potential Products: Information Technology

Progress or Status:

Warm-Season Grasses

Seeds of most of the warm-season chaffy grasses continued to decline in germination. The viability of 'Garden' sand bluestem (*Andropogon hallii* Hack.) stands at the 48% level, the same as the mean for the past 7 years. The viability of 'Kaw' big bluestem (*Andropogon gerardii* Vitman) and buffalo grass (*Bouteloua dactyloides* [Nutt.] Engelm.) has leveled off the past serveral years. 'Aldous' little bluestem (*Schizachyrium scoparium* Michx.), at 65% viability has declined a point from past years and is 1 less than the 17 year mean of 66%. At 75% viability, 'Osage' Indian grass (*Sorghastrum nutans* [L.] Nash) was 1 point off the 7-year mean of 76%. Interestingly, the current level of viability is 1 point higher than the original germination test of 36 years ago. 'El Reno' sideoats grama (*Bouteloua curtipendula* Michx.) was on the rebound at 68%, the same level of viability as 5 years ago. Among the non-chaffy warm-season grasses the viability of 'Pete' eastern gamagrass (*Tripsacum dactyloides* [L.] L.) dropped to its lowest point in 7 years. The viability of 'Blackwell' (*P. virgatum* L.) an upland-type of switchgrass, increased 2 points to 90% buffering a trend of gradual decline. The viability of 'Kanlow' switchgrass (*Panicum virgatum* L.), a lowland-type of switchgrass, improved once again as test results continue on an up and down trend. 'Bend' sand lovegrass (*Eragrostis trichodes* [Nutt.] Wood) improved to 57%, up 1 point from 2 years ago. Refer to Tables 1A, 1B, and 1C for germination test results of warm-season grasses for the past 35 years.

The levels of viability maintained by each of the grasses that remain in this study exceed the minimum acceptable level established in Kansas seed certification standards.

Forbs

Two forb entries remain in the controlled storage environment test following 30 years of storage, 'Kaneb' purple prairie clover (*Dalea purpurea* Vent.), and 'Prairie Gold' Maximilian sunflower (*Helianthus maximiliani* Schrad.) continue to show viability (Tables 2A and 2B). 'Kanoka' round-head lespedeza (*Lespedeza capitata* Michx.), which was added to the study in 1985, continues to be viable following 24 years of storage in a controlled storage environment. Prairie Gold dropped 14 points in germination over last year's results and will be dropped from the study. Kaneb fell back to 68% total viability, the same level as years 28 and 29. Kanoka was up 2 points from the previous year.

Table 1A. Germination test results for selected warm-season grasses over a period of years under controlled and uncontrolled storage environments.

Species	Entry	Storage	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Andropogon gerardii	Kaw	Cont.	63	74	82	73	65	73	87	77	81	78	74	66	78	80	69	88	57
		Uncont.	63	77	68	77	65	62	42	29	13	1	TE						
Andropogon hallii	Garden	Cont.	74	80	77	79	81	81	86	70	87	78	81	78	85	71	70	88	79
		Uncont.	74	76	75	74	76	73	68	24	33	30	13	4	1	TE			
Bouteloua curtipendula	El Reno	Cont.	22	66	76	69	73	73	72	70	69	74	76	71	64	71	78	86	73
		Uncont.	22	72	74	79	74	68	66	64	45	31	24	5	TE				
Bouteloua dactyloides	PMT-1181	Cont.	73	72	72	73	70	74	60	70	44	57	71	57	61	76	74	45	67
		Uncont.	73	60	71	76	81	67	62	66	43	50	42	48	18	4	TE		
Eragrostis trichodes	Bend	Cont.	77	82	68	78	76	73	72	76	73	71	83	60	61	67	67	63	ND
		Uncont.	77	78	72	57	51	20	9	22	0	TE							
Panicum virgatum	Blackwell	Cont.	85	90	89	92	92	92	95	91	94	95	94	93	93	91	92	98	95
		Uncont.	85	91	91	90	92	81	84	81	80	71	62	43	25	10	TE		
Panicum virgatum	Kanlow	Cont.	66	70	70	72	74	68	67	73	72	70	77	74	61	65	67	68	65
		Uncont.	66	74	65	71	64	54	45	37	31	16	13	2	TE				
Schizachyrium scoparium	Aldous	Cont.	70	78	76	70	73	66	78	69	64	72	68	59	74	60	64	81	60
		Uncont.	70	71	76	67	63	54	44	36	22	12	6	4	6	TE			
Sorghastrum nutans	Osage	Cont.	75	64	78	75	71	74	84	72	79	69	76	63	74	59	67	88	70
		Uncont.	75	68	83	70	48	44	30	5	7	0	TE						
Spartina pectinata	PMK-1800	Cont.	67	75	68	60	48	55	54	56	24	11	51	46	64	45	48	38	24
		Uncont.	67	63	34	0	TE												
Tripsacum dactyloides	Pete	Cont.	10	41	27	43	24	39	31	46	41	36	47	31	43	37	32	58	28
		Uncont.	10	50	40	46	35	40	17	26	24	4	TE						

Table 1B. Germination test results for selected warm-season grasses over a period of years under the controlled storage environment.

Species	Entry	0	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Andropogon gerardii	Kaw	63	ND	77	ND	60	68	61	70	40	45	40	52	39	41	30	36	47	27	28
Andropogon hallii	Garden	74	ND	88	ND	73	82	75	76	74	71	37	71	56	65	47	48	57	49	39
Bouteloua curtipendula	El Reno	22	ND	88	ND	75	79	69	67	70	68	74	66	64	69	62	68	60	62	61
Bouteloua dactyloides	PMT-1181	73	ND	75	ND	61	69	75	72	45	67	67	60	72	71	66	49	57	59	63
Eragrostis trichodes	Bend	77	50	ND	70	55	ND	64	66	48	53	30	50	51	28	33	26	42	56	47
Panicum virgatum	Blackwell	85	ND	96	ND	93	93	90	90	96	88	85	87	93	92	91	91	89	89	82
Panicum virgatum	Kanlow	66	ND	77	ND	73	59	63	69	66	79	57	64	63	71	58	66	49	64	62
Schizachyrium scoparium	Aldous	70	ND	65	ND	66	ND	67	68	61	76	62	72	64	70	61	67	63	67	65
Sorghastrum nutans	Osage	74	ND	78	ND	71	93	85	78	60	75	83	81	78	89	77	72	79	78	78
Spartina pectinata	PMK-1800	67	ND	17	ND	9	16	3	1	TE										
Tripsacum dactyloides	Pete	10	ND	47	ND	53	50	46	47	43	45	43	44	42	35	42	38	39	38	37

Table 1C. Germination test results for selected warm-season grasses over a period of years under the controlled storage environment.

Species	Entry	0	35	36
Andropogon gerardii	Kaw	63	28	29
Andropogon hallii	Garden	74	49	48
Bouteloua curtipendula	El Reno	22	57	68
Bouteloua dactyloides	PMT-1181	73	63	63
Eragrostis trichodes	Bend	77	57	
Panicum virgatum	Blackwell	85	88	90
Panicum virgatum	Kanlow	66	56	61
Schizachyrium scoparium	Aldous	70	66	65
Sorghastrum nutans	Osage	74	73	75
Tripsacum dactyloides	Pete	10	39	36

Table 2A. Germination test results for selected forbs over a period of years under controlled and uncontrolled storage environments.

Species	Entry	Storage	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Dalea purpurea	Kaneb	Cont.	81	77	84	83	87	85	82	86	83	82	86	ND	86	ND	81	64	77
		Uncont.	81	83	83	77	79	82	75	59	39	20	18	TE					
Helianthus maximiliani	Prairie	Cont.	66	70	67	68	81	72	77	65	69	71	61	ND	62	ND	38	39	62
	Gold	Uncont.	66	65	57	36	38	1	TE										
Heliopsis helianthoides	Midas	Cont.	78	74	68	68	65	61	69	33	49	54	54	ND	39	ND	31	36	56
		Uncont.	78	65	65	56	51	40	6	TE									
Lespedeza capitata	9026784	Cont.	83	89	86	94	85	ND	88	ND	80	91	92	89	84	97	68	72	43
		Uncont.	83	83	30	32	ND	ND	15	TE									
Liatris pycnostachya	Eureka	Cont.	56	44	17	13	15	24	ND	6	15	11	10	ND	13	ND	11	3	3
		Uncont.	56	30	2	TE													
Ratibida pinnata	Sunglow	Cont.	82	89	81	82	79	70	68	62	60	55	39	ND	24	ND	6	11	11
		Uncont.	82	93	76	24	8	2	TE										
Salvia azurea var *grandiflora*	Nekan	Cont.	30	33	37	26	29	33	26	21	22	19	11	ND	26	ND	23	4	21
		Uncont.	30	30	14	14	6	5	TE										

Table 2B. Germination test results for selected forbs over a period of years under the controlled storage environment.

Species	Entry	0	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dalea purpurea	Kaneb	81	71	85	68	54	60	96	76	67	63	77	68	68	74	68
Helianthus maximiliani	Prairie Gold	66	43	17	79	19	20	11	40	17	20	25	30	16	20	6
Heliopsis helianthoides	Midas	78	26	22	34	11	10	30	25	8	6	6	5	1	TE	
Lespedeza capitata	Kanoka	83	79	69	59	70	64	66	60	62						
Liatris pycnostachya	Eureka	56	0	TE												
Ratibida pinnata	Sunglow	82	4	TE												
Salvia azurea var *grandiflora*	Nekan	30	9	7	4	3	TE									

Tables Legend: Cont. = controlled; Uncont. = uncontrolled; ND = no data; TE = testing ended

Literature Cited:

Ackigoz, E. and R. P. Knowles. 1983. Long-term storage of grass seeds. *Canadian Journal of Plant Science* 63:669-674.

Bass, L. N. 1980. Seed viability during long-term storage. *Horticultural Reviews* 2:117-141.

Harrington, J. F. 1959. Drying, storing, and packaging seed to maintain germination vigor. *Seedsman's Digest* 11:16.

Priestly, D. A., V. I. Cullinan, and J. Wolfe. 1985. Differences in seed longevity at the species level. *Plant, Cell and Environment* 8:557-562.

Rincker, C. M. 1981. Long-term subfreezing storage of forage crop seeds. *Crop Science* 21:424-427.

Rincker, C. M. and J. D. Maguire. 1979. Effect of seed storage on germination and forage production of seven grass cultivars. *Crop Science* 19:857-860.

Adaptation Trials of Superior Grasses and Forbs Selected for Advanced Testing

Study No. 20A126L

Study Leader: John M. Row, Plant Materials Specialist

Introduction: Part of the release process for a superior plant material selected for release is to test the plant's area of adaptation. The Manhattan Plant Materials Center (PMC), Manhattan, Kansas, is often called upon by other PMCs and other entities for the purpose of testing superior plants that they have selected for release.

Objective: The purpose of this study is to provide a standard means by which superior plants will be evaluated for adaptation.

Procedure: The experimental design used for this study is a randomized complete-block with a 3X replicated planting. The superior plant will be established in 3.05-m (10-ft) rod rows with 1.83-m (6-ft) spacing (unless otherwise specified) between rows with a Kincaid Cone Planter (Kincaid Equipment Manufacturing, Haven, KS, USA). A known cultivar will be planted adjacent to the superior plant as a standard of comparison (if available). Plantings are irrigated as needed during the initial growing season to aid establishment. Factors for evaluation will include plant vigor, stand, seed production, and resistance to disease, drought, and cold.

Potential Products: Information technology and cultivar release.

Progress or status: The following warm-season grass species are currently under test at Manhattan: big bluestem (*Andropogon gerardii* Vitman), blue grama (*Bouteloua gracilis* [Willd. ex Kunth] Lag. ex Griffiths), and little bluestem (*Schizachyrium scoparium* [Michx.] Nash), which is part of an Inter Center Strain Trial (ICST) to test the adaptation of to the local climate. Forbs that are currently under test are a number of tick-trefoils: Dillenius' tick-trefoil (*Desmodium glabellum* [Michx.]) and panicledleaf tick-trefoil (*Desmodium paniculatum* [L.] DC.); Penstemons: Cobaea penstemon, (*Penstemon cobaea* Nutt.), narrow beardtongue (*Penstemon angustifolius* Nutt. ex Pursh), and large beardtongue (*Penstemon grandiflorus* Nutt.); Tifton burclover (*Medicago rigidula* [L.] All.).

Grasses

Big Bluestem: The ability to establish a stand of native grass from seed in crucial to the success of a released variety. Therefore, carry-over seed from the big bluestem ICST spaced plant nursery, Study No. KSPMC-ST-0801-RA, was used to plant rod rows of 9 entries.

Big bluestem prevarietal releases and cultivars under test in rod row seeding at Manhattan.

Release Name	Accession Number	Origin	Source of Plant Material
Hampton Germplasm	9056854	AR, MO, and OK	Booneville PMC
OZ-70 Germplasm	9078831	73 accessions from AR, MO, and OK	Elsberry PMC
	9083274	Logan Co., AR	Elsberry PMC
Rountree	474216	Monona County, IA	Elsberry PMC
Kaw	421276	Flint Hills south of Manhattan, KS	Manhattan PMC
	483446	southcentral KS and eastern OK	Manhattan PMC
Pawnee	9005159	Pawnee County, NE	Stock Seed Farms
Bonanza	641701	derived from Pawnee	Stock Seed Farms
Goldmine	641702	derived from Kaw	Sharp Bros. Seed Co.

The trial, planted 17 June 2008, was not evaluated the establishment year. Maintenance consisted of mowing several times throughout the growing season to control weed competition. Released cultivars

ranked the highest for stand taking the top 5 spots in 2009. Stand counts revealed that 'Kaw' had the best stand followed by an experimental line, Accession 483446. 'Bonanza' which was derived from 'Pawnee' ranked third, while 'Goldmine' which was derived from Kaw ranked fourth. Pawnee ranked fifth. Goldmine was superior in plant height followed by accessions 483446 and 9083274 rounding out the top three for height.

Stand and plant height means for nine big bluestem prevarietal release and cultivar seeding trial at Manhattan.

Entry	Stand (%)		Plant Height (cm)	
	Mean	Range	Mean	Range
Kaw	62.2 A	46.7 – 80.0	147 ABC	127 - 164
Bonanza	60.6 A	50.0 – 80.0	147 ABC	128 - 166
483446	51.1 AB	40.0 – 66.7	153 AB	138 - 176
Goldmine	40.5 ABC	8.3 – 68.3	165 A	137 - 187
Pawnee	35.5 ABC	15.0 – 63.3	135 BC	116 - 156
9083274	22.2 BC	10.0 – 45.0	155 AB	152 - 184
Rountree	9.4 C	0.0 – 23.3	115 CD	119 - 137
OZ-70 Germplasm	7.7 C	5.0 – 15.0	105 D	74 - 127
Hampton Germplasm	0 -	0	- NA	-

Means in a column followed by the same letter are not significantly different at P<0.05
NA – Not Available; insufficient data

Blue grama: Compare performance of blue grama accessions 421282, 421283, 9050485, with 'Hachita' and Bad River Ecotype blue grama releases in an ICST. Participating PMCs are James E. Bud PMC, Knox City, Texas, and Elsberry PMC, Elsberry, Missouri. The Manhattan PMC provided seeds of accessions 421282, 421283, and 9050485, to participating PMCs. Participating PMCs were invited to add a "standard of comparison" of their choice. On June 10, 2008, a replicated planting was made at Manhattan involving five accessions listed in the following table. The James E. Bud PMC established rod-row plantings of 421282, 421283, and 9050485, in 2007.

Accession	Release Name	Origin
421282		southern Nebraska/ northwest Kansas
421283		western Kansas/Texas Panhandle
9050485		Nebraska
591814	Bad River Ecotype	Haakon County, South Dakota
439880	Hachita	Hachita Mountain, New Mexico

Results of blue grama ICST at Manhattan, Kansas and Knox City, Texas, for the 2009 growing season.

Location / Accession	Manhattan		Knox City		
	% Stand	Plant Vigor	% Stand	Plant Height	Plant Vigor
421282	54.0	3.3	95	46	5
421283	61.1	2.7	80	56	5
9050485	48.9	3.3	65	48	5
591814	69.9	7.0	-	-	-
439880	58.0	3.3	-	-	-

Established stands at Manhattan were disappointing and not of the caliber attained in previous plantings at the PMC. Bad River produced the best stand; however, the plants were smallest in stature of any of the entries. Hachita had the greatest plant height of any entry which was also observed in previous blue grama trials. Hachita is the best forage producer but produces little if any seed at Manhattan.

Little Bluestem: Seeds of Accession 9029926, OK Select Germplasm little bluestem were planted 17 June 2008, at the request of the James E. Bud PMC, Knox City, Texas. 'Cimarron' little bluestem was included as a "standard of comparison." Accession 9029926 was superior to Cimarron in stand, plant height, and vigor. Clumps were leafier, bushier, with yellower foliage than Cimarron.

Stand and plant height means for little bluestem ICST at Manhattan.

Entry	Stand %	Plant Height (cm)	Plant Vigor†
9029926	88.5	100	1.0
Cimarron	72.6	92.7	2.7

†1-9, best-worst

Forbs

Maintenance in the forbs consisted of disking between the rows with no in-row maintenance this year.

Desmodium Species: Three desmodium selections were established as part of an ICST at the request of the plant materials specialist for Michigan. The Rose Lake PMC, East Lansing, Michigan, provided container grown plants for the trial.

Desmodium spaced plant nursery entries at Manhattan.

Accession	Release Name	Species	Common Name
9005087	Marion	*Desmodium glabellum*	Dillenius' tick-trefoil
9055415	Alcona	*Desmodium glabellum*	Dillenius' tick-trefoil
9055428	Grant	*Desmodium paniculatum*	panicledleaf tick-trefoil

Plants were set out 7 June 2005, in rod rows with in-row spacing of 45.7 cm (18 in) apart. Accession 9055428 was rated best for vigor of the 3 entries, but produced the least flower stalks. The poor performance in flowering was due to deer browse. This was the final year of evaluation for the desmodiums.

Desmodium spaced plant nursery percent stand and mean vigor rating at Manhattan.

Accession	Stand (%)	Plant Vigor†	Plants Blooming (%)
9005087	30	3.5	100
9055415	70	4.5	85.7
9055428	60	1.0	33.3

†1-9, best-worst

Penstemon Species: Cobaea penstemon, a native forb of interest back in the 1970s, when Accession 9004455 came into being with the pooling of seed collected from accessions PMK-1474 from Riley Co., Kansas, and PMK-1983 from Osage Co., Oklahoma, after a period of initial evaluation at Manhattan. It is desirable to compare the performance of Accession 9004455 with commercially available Cobaeas as well as other popular penstemon species. The accessions assembled for the trial were established in 164-mL (10-in^3) single cell Ray Leach "Cone-tainers"^{TM} before planting them in a spaced plant nursery in Field B-3. Enough plants were available to establish at least 2 replications of 5 plants each per accession.

Penstemon species planted at Manhattan.

Accession	Species	Common Name	Origin
9026604	*Penstemon angustifolius*	narrow beardtongue	Garden Co., NE
9004455	*Penstemon cobaea*	Cobaea penstemon	Riley Co., KS and Osage Co., OK
9050493	*Penstemon cobaea*	Cobaea penstemon	Taney and Ozark Counties, MO
9050491	*Penstemon cobaea*	Cobaea penstemon	Ozark Co., MO
9082707	*Penstemon grandiflorus*	large beardtongue	Lyman Co., SD, Emmons, Grant and Ransom Counties, ND, Polk Co., MN

All accessions declined in vigor from the previous year.

***Penstemon angustifolia*:** Stand declined for Accession 9026604. A small plant that begins blooming in early May and reaches full bloom by mid-May provides some early color to the landscape. Due to its short stature, 18.5 to 30 cm tall (25.6 cm, 4-year mean), mechanical seed harvest would be difficult.

***Penstemon cobaea*:** Accession 9050493 was the best in terms of plant vigor with a rating of 2.4, while Accession 9050491 maintained a perfect stand. Plant height was similar for the 3 accessions in 2009 with means ranging from 54.8 to 66.2 cm.

***Penstemon grandiflorus*:** Accession 9082707 has declined significantly in terms of plant vigor. Height varied over a 4-year period from 54 to 76 cm with a mean height of 64 cm. The plants produced numerous, large, showy flowers which were attractive to pollinators. This accession produced a greater number of flowering stalks than any other entry in the trial.

Penstemon spaced plant growth data and percent stand.

Plant Symbol	Accession	Stand (%)	No. Plants Blooming	Bloom (%)	Plant Height*	Plant Vigor†
PEAN	9026604	60	2	33.3	21.4	NR
PECO	9004455	80	7	87.5	66.2	3.5
PECO	9050491	100	12	80.0	54.8	3.3
PECO	9050493	88	19	86.4	65.4	2.4
PEGR	9082707	76	10	52.6	67.4	6.0

*cm; †rating 1-9, best-worst; NR=not rated

Evaluation of 'Laramie' Tifton Burclover for Winter Hardiness: Laramie, Accession SA 10343 from the Australian Medicago Resource Center, Adelaide, South Australia, was collected in Russia in 1974 and evaluated in Wyoming since 1994 where survival was good except for 2001. Laramie was selected for its winter hardiness, ability to self-regenerate, nitrogen-fixing ability, high quality, and large quantity forage production, early and prolific seed production, ability to compete with weeds, and palatability. Laramie was evaluated for winter hardiness at the request of Bud Davis, formerly NRCS Agronomist Salina, Kansas. There is interest in Kansas for an adapted annual Medicago for use as a cover and pasture crop. Laramie was planted 20 September 2006, in Field B-3 in rod rows. Laramie persists in patches cover on average a 0.89 m^2 area. Mean plant height was 14.3 cm.

Evaluation of PMK-1 Green Ash for Resistance to Ash Borers

Study No. 20A127K

Study Leader: John M. Row, Plant Materials Specialist

Introduction: Green ash (*Fraxinus pennsylvanica* Marsh.) was widely planted in the Northern Plains as a windbreak and landscape tree. Larval damage by the lilac (ash) borer, *Podosesia syringue*, and banded ash clearwing, *Podosesia aureocincta*, have severely reduced the use of green ash, especially in the more southern portion of the tree's range. Larvae bore into the young tree trunk near the soil line, weakening the seedling so that they may break off in the wind. Tree borers are among the most difficult insect pests to control because the insects feed within the tree. Thus, pesticides are generally ineffective in controlling ash borers. Keeping trees healthy and growing vigorously helps to reduce or prevent borer attack.

Problem: The Manhattan Plant Materials Center (PMC), Manhattan, Kansas, has germplasm of green ash that has been tested as PMK-1 for many years. PMK-1 has not been formally tested to determine if it has ash borer resistance or if there are management methods in ash establishment that might limit or lessen ash borer damage to trees.

Objective: To test PMK-1 for borer resistance.

Procedure: Seeds of PMK-1 were surface sterilized with a 10:1 solution consisting of purified water and sodium hypochlorite (5.25% AI) for 20 minutes and then stratified 60 days warm stratification at 20ºC (68ºF) followed by a 60-day pre-chill at 4ºC (39ºF). After completing the stratification process, the seeds were placed on blotters in germination boxes and allowed to germinate in a plant growth chamber at 20º-30ºC (68º-83ºF) 16h/8h (night/day). The seedlings were transplanted to 656-mL (40-in^3) deepot™ cells (Stuewe & Sons, Inc., Tangent, OR) later batches were transplanted to 164-mL (10-in^3) single cell Ray Leach "Cone-tainers"™, and additional stratified seeds were direct seeded into cone-tainers. On 27 September 2001, 2-0 deepot™ stock and cone-tainer stock were transplanted to 6 plots at the Kansas Crop Improvement Association (KCIA) headquarters in Manhattan, Kansas. The KCIA site was chosen because of a history with borer problems on green ash. The 2-tree plots consisted of 1 deep potted plant and 1 cone-tainer plant (designated A and B respectively) spaced 50 to 60 cm (19.7 to 23.6 in) apart on a Wymore silty clay loam soil. Six 2-tree plots at the PMC were divided into 2 areas. One area was a compacted, rocky, old roadbed (critical area site designated CA), and the other site was the typical Belvue silt loam soil on the PMC. All plantings were caged to reduce browse damage by herbivores.

Potential Products: Cultivar Release

Progress or Status: No new borer activity was detected at either the KCIA site or the PMC site this year. Due to past borer activity PMK-1 has been withdrawn from consideration for release thus ending this study.

Literature Cited:

Association of Official Seed Analysts (AOSA). 1999. Rules for testing seeds. AOSA. Stillwater, OK. CD

Young, J. A. and C. G. Young. 1992. Seeds of Woody Plants in North America. Dioscorides Press. Portland, OR. 407 p.

Evaluation of Little Bluestem

Study No. 20A215H

Study Leader: Richard L. Wynia, Plant Materials Center Manager

Introduction: Little bluestem (*Schizachyrium scoparium* Michx.) is a native, warm-season, perennial bunchgrass with a deep, fibrous root system. It is widely distributed over much of North America extending from Quebec, Canada, and Maine west to Alberta, Canada, and Idaho, and southward to Arizona and Florida. It occurs with other tall-grass prairie species, such as big bluestem, Indian grass, and switchgrass, in the plains where moisture conditions are favorable. In the drier mixed-grass prairie it is associated with blue grama, sideoats grama, green needlegrass, western wheatgrass, prairie sandreed, and needle-and-thread. It possesses moderate drought and shade tolerance. It also tolerates a wide range of soils with adequate soil moisture.

Problem: There is a need for an adapted cultivar of little bluestem for range seeding, critical area planting, recreational area development, and other conservation uses in western Kansas and Nebraska.

Objective: To utilize recurrent selection techniques to improve 421554, (PMK-1840) germplasm and select a superior little bluestem cultivar for the Kansas/Nebraska Service Area.

Procedure: Flats of little bluestem were planted in the greenhouse in spring 1992. Seedlings were selected at the 2- to 3-leaf stage and transplanted to 164-mL (10-in^3) single cell Ray Leach "Cone-tainers"^{TM} for continued development in the greenhouse. Seedlings were selected based on performance and root morphology. Criteria such as speed of germination, coleoptile length, and subcoleoptile internode root production were used to select seedlings in the greenhouse screening. Plants were transplanted to a 2- x 2-m (7- x 7-ft) spaced plant field nursery at the Manhattan Plant Materials Center, Manhattan, Kansas, approximately 6 weeks later.

Plants will be evaluated for vigor, forage production, flowering date, disease resistance, seed production, and seed size. A grid-type evaluation system will be used to make selections of plants for inclusion in a polycross nursery. Evaluations will be conducted for 2 to 3 years with 10 to 20% of the nursery plants selected. Seed from the selected plant polycross will be tested against standard varieties or used to begin another cycle of recurrent phenotypic selection.

Potential Products: Cultivar Release

Progress or Status: Minimal maintenance and observations were conducted this year. Seed was not collected from plots this year.

Increasing Seedling Vigor and Stand Establishment of Giant Sandreed

Study No. KSPMC-P-0601-RA

Study Leader: Richard L. Wynia, Plant Materials Center Manager

Introduction: Giant sandreed (*Calamovilfa gigantea* [Nutt.] Scribn. & Merr.) is a tall, native, robust, rhizomatous, warm-season perennial grass. It is found growing on sandy hills, dunes, and along stream margins in southern Kansas, Oklahoma, from Texas to Arizona, and from Kansas to Utah.

Problem: The genus Calamovilfa in general has weak seedling vigor and trouble with stand establishment. To ensure a varieties' success in the commercial market place it must have a certain level of seedling vigor and ability to form a productive stand in a reasonable length of time. Commercial seed producers will not tolerate or produce a cultivar with substandard vigor and slow establishment.

Objective: Improve stand establishment of giant sandreed by selecting plants with improved seed production qualities.

Procedure: A bulk seed sample was first divided into 3 fractions based on weight (Heavy, Heavy 2X, and Heaviest) using a South Dakota Seed Blower to determine which weight fraction had the best germination. An unsorted sample was kept as a control. Approximately 1 pound of seed was then blown on the South Dakota Seed Blower at full air strength on a full length column for 1 minute. To provide adequate separation, only 50-100 ml of seed was blown at a time. The light sample trapped at the top of the column was collected, labeled, and set aside. The heavier seed from the bottom of the column was also collected. A uniform sample was pulled from this material and labeled as the "Heavy" fraction. The rest of the heavy seed was run through the blower again at full air strength on a full length column for 1 minute. The seed from the top of the column was labeled and set aside. A uniform sample was pulled from the bottom of the column and labeled as the "Heavy 2X" fraction since it had been blown twice. The remaining seed from the bottom of the column was run through the Dakota Seed Blower again at full air power and full length column for 1 minute, but yielded little separation. The column was then shortened by removing the middle section, and the remaining seed was blown at full air power for 1 minute in the short column. A uniform sample of the seed remaining in the bottom of the blower was collected and labeled as the "Heaviest" fraction. Seed weights for each fraction, Unsorted, Heavy, Heavy 2X, and Heaviest were obtained on an analytical balance using 10 replications of 100 seeds. Seed size and speed of germination will be evaluated after every cycle of selection to assess improvements.

Potential Product: Technology Transfer and Cultivar Release

Progress or Status: Seed was harvested from the plots this year.

Big Bluestem Inter Center Strain Trial

Study No. KSPMC-ST-0801-RA

Study Leader: Richard L. Wynia, Plant Materials Center Manager

Introduction: Big bluestem, *Andropogon gerardii* Vitman, is a warm-season, perennial grass native to the tall and mid-grass regions of the central and southern Great Plains States of North America. It is generally characterized as a tall grass and has short thick rhizomes and a deeply penetrating root system. It is considered an excellent native forage grass and has high potential for use in establishing range, hay, and pasture land and in stabilizing critically eroding areas. There have been several prevarietal releases of big bluestem made in recent years by Plant Materials Centers (PMCs) in Booneville, Arkansas, and Elsberry, Missouri. Comparative evaluations of these prevarietal releases and a selection from the Manhattan Plant Materials Center, Manhattan, Kansas, 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 identified 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, Nebraska.

Objective: Evaluate big bluestem prevarietal releases across locations for potential upgrade in class of release.

Procedure: Big bluestem entries were established at the following PMCs: Booneville, Arkansas; Elsberry, Missouri; Coffeeville, Mississippi; and Manhattan, Kansas; in 2008. Plants were grown out by each participating PMC, (see Table 1). At Manhattan, plants were transplanted from 164 mL (10 in^3) single cell Ray Leach "Cone-tainers"™ to randomized plots on a 2.74 m x 5.49 m (9 ft x 18 ft) plot spacing on a Belvue silt loam in Field C-2, 9 June 2008. The individual plants were spaced 0.9 m (3 ft) apart.

Table 1. Big bluestem prevarietal releases and cultivars under test in Inter Center Strain Trial.

Release Name	Accession Number	Origin	Source of Plant Material
Hampton Germplasm	9056854	AR, MO, and OK	Booneville PMC
OZ-70 Germplasm	9078831	73 accessions from AR, MO, and OK	Elsberry PMC
Refuge Germplasm	9078832	AR	Elsberry PMC
	9083274	Logan Co., AR	Elsberry PMC
Northern Missouri Germplasm	9079000	accessions from northern MO	Elsberry PMC
Rountree	474216	Monona County, IA	Elsberry PMC
Kaw	421276	Flint Hills south of Manhattan, KS	Manhattan PMC
	483446	southcentral KS and eastern OK	Manhattan PMC
Pawnee	9005159	Pawnee County, NE	Stock Seed Farms
Bonanza	641701	derived from Pawnee	Stock Seed Farms
Goldmine	641702	derived from Kaw	Sharp Bros. Seed Co.

Progress or Status: Four plants per plot were hand harvested 23 July and 27 October 2009. Plant height was measured prior to harvest. Disease, vigor, and plant uniformity ratings were also performed 22 July. All-Pairwise Comparisons Tests were run on all data (Analytical Software, 1985-2003). Although not rated, there were several incidents of insect damage to foliage.

Initial Harvest: Hampton Germplasm produced the greatest amount of forage, 7.9 metric tons (t.)/ha, which was not significantly different from 6 other lower producing entries. The least production was from Refuge Germplasm at 3.3 t., which was not significantly different from 6 other entries that produced more forage. Kaw was 4th in production with Accession 483446 ranking 9th (Table 2). Relative yields are for

comparative purposes and may not be realized in real world applications. Rountree had the greatest plant height 22 July at 212 cm while Kaw ranked 8th at 167 cm and Accession 483446 ranked 10th at 142 cm (Table 3). Northern Missouri Germplasm ranked first for least incidence of disease which was not significantly different from 5 other entries. Pawnee had the most disease while Kaw ranked 6th and Accession 483446 ranking 9th. The plants were evaluated for uniformity with Rountree ranking 1st followed by Refuge, while 486446 was 3rd and Kaw 7th.

Aftermath Harvest: In terms of regrowth, Kaw ranked first at 259 kg, followed by Accession 483446, with Hampton 8th in forage production (Table 4). Kaw produced the greatest number of culms (12.8) in regrowth, followed by Accession 483446 with Hampton coming in last in 11th place at 2.3 culms. Accession 483446, ranked 1st at 138 cm followed by Accession 9083274 at 134 cm, and Kaw was 3rd at 123 cm in plant height (Table 5). Hampton ranked at the bottom at just 68 cm.

Table 2. Mean comparisons of initial harvest yield, big bluestem ICST, 23 July 2009, Manhattan.

Entry	Dry Matter Yield (g)	t./ha*†	
Hampton	2631.3	7.9	A
OZ-70	2443.9	7.3	AB
Rountree	2108.9	6.3	ABC
Kaw	2100.9	6.3	ABC
Pawnee	1870.9	5.6	ABCD
Goldmine	1845.2	5.5	ABCD
No. Missouri	1789.0	5.3	ABCD
Bonanza	1562.6	4.7	BCD
483446	1460.2	4.3	CD
9083274	1184.6	3.5	CD
Refuge	1119.3	3.3	D

*Relative yields due to plant spacing; †Means in a column followed by the same letter are not significantly different from one another at P<0.05.

Table 3. Mean comparisons of plant height, disease, and uniformity, big bluestem ICST, 22 July 2009, Manhattan.

Entry	Plant Height† (cm)		Plant Disease† Rating (1-9)*		Plant Uniformity† Rating (1-9)	
Rountree	211.8	A	3.0	AB	1.3	A
No. Missouri	203.9	AB	2.8	A	3.0	BCD
Bonanza	185.2	BC	4.5	CD	2.5	ABCD
Hampton	182.8	C	3.0	AB	2.5	ABCD
Pawnee	176.6	CD	5.8	D	3.0	BCD
Goldmine	175.1	CD	5.0	CD	2.0	ABC
OZ-70	174.6	CD	3.0	AB	3.5	CD
Kaw	166.9	CD	4.3	BC	2.8	ABCD
Refuge	161.1	D	3.0	AB	1.8	AB
483446	141.7	E	4.8	CD	2.3	ABC
9083274	132.3	E	3.8	ABC	4.0	D

*Rating 1-9, least-most; †Means in a column followed by the same letter are not significantly different from one another at P<0.05.

Table 4. Mean comparisons of aftermath harvest yield, big bluestem ICST, 27 October 2009, Manhattan.

Entry	Dry Matter Yield (g)	kg./ac*†	
Kaw	213.9	259	A
483446	213.5	258	A
OZ-70	153.1	185	AB
Goldmine	147.6	178	B
No. Missouri	131.2	159	BC
9083274	126.4	153	BC
Rountree	115.2	139	BC
Hampton	109.7	133	BCD
Pawnee	82.7	100	CD
Refuge	48.3	58	D
Bonanza	47.4	57	D

*Relative yields due to plant spacing; †Means in a column followed by the same letter are not significantly different from one another at P<0.05.

Table 5. Mean comparisons of plant height and number of culms, big bluestem ICST, Manhattan, 26 October 2009.

Entry	Plant Height† (cm)		No. of Culms†	
483446	137.9	A	11.4	A
9083274	133.6	A	9.8	AB
Kaw	123.3	AB	12.8	A
Bonanza	97.2	BC	4.4	C
No. Missouri	96.2	BC	4.6	C
OZ-70	91.3	CD	2.8	C
Goldmine	91.3	CD	6.0	BC
Pawnee	82.3	CD	2.5	C
Refuge	78.9	CD	5.1	BC
Rountree	77.6	CD	2.4	C
Hampton	67.6	D	2.3	C

†Means in a column followed by the same letter are not significantly different from one another at P<0.05.

Literature Cited:

Analytical Software, 1985-2003. Statistix®8 Analytical Software. Tallahassee, FL. 396 p.

Cultural Evaluations and Special Studies

Propagation of Mead's Milkweed

Study No. 20C007Ta

Study Leader: John M. Row, Plant Materials Specialist

Introduction: Mead's milkweed (*Asclepias meadii* Torr. *ex* Gray) is a federally-listed, threatened species. The Plant Materials Program Strategic Plan has identified the recovery of threatened species as an emerging regional and national resource need. This study was initiated in 1996 at the request of the Kansas Biological Survey, Lawrence, Kansas. Seeds were collected that year on the Rockefeller Native Prairie (RNP) near Lawrence. Germination studies were conducted on the few seeds that were available for collection. The initial seedlings obtained from the germination studies were transplanted to single cell Ray Leach "Cone-tainers"™ in 1997 and grown out in the greenhouse-lathhouse-complex; the first field planting that year was to a buffalo grass-tall grass (BG-TG) mixed prairie. In 1998 plantings were made in 2 additional field scenarios: Red Group and Yellow Group on the "Salac Prairie" on the Manhattan Plant Materials Center (PMC), Manhattan, Kansas, and Blue Group and White Group monoculture plantings on a tilled site on the PMC. The Blue Group plants were lifted and transplanted in a row 2.74 m (5.8 ft) from the White Group spring 2002. The prairie plantings were made in open areas of the existing sod where maintenance consists of an annual spring burn. The monoculture plants receive some weed control and tillage of adjacent areas for the first 5 years, afterwhich all tillage was curtailed. The Salac Prairie evolved from a grass-forb seeding mixture study involving various species native to the central Great Plains. Established in 1973, it has been allowed to persist as a prairie since the time when that study was completed. The (BG-TG) mixed prairie evolved from a buffalo grass cultivar trial established in 1992. Grasses and forbs native to the local area began to invade the plots as the study ended. The prairie is currently dominated by Indian grass (*Sorghastrum nutans* [L.] Nash), Illinois bundleflower (*Desmanthus illinoensis* [Michx.] MacM. ex B.L. Robins. & Fern.), and round-head lespedeza (*Lespedeza capitata* Michx.).

Problem: The need exists to learn more about propagation requirements and establishment techniques for establishing Mead's milkweed plants in native prairie. The information will lend itself to recovery efforts for the species.

Objectives: Collect enough seed from identified native populations to establish a maintenance population. The maintenance population will be used to conduct further research on germination requirements, seed storage, and cultural techniques. Monitor the established prairie and monoculture plantings throughout the growing season and collect growth measurements and reproductive data. Collect additional seeds from the RNP near Lawrence, Kansas. Obtain or collect seeds from other plant populations in eastern Kansas to compare performance with the Rockefeller collections.

Procedure: Continue to monitor established plants in the Red, Yellow, Blue, White, Orange, and BG-TG groupings. Refer to previous reports for details on procedures carried out on various phases of this study (USDA NRCS, 2004).

Progress or Status: Established Field Plantings**.** An increase in stand from 2008 was noted for the Red Group while stand declined for the BG-TG, Blue and White Groups. There was no change in stand for the Yellow Group with no recovery noted from plants previously buried by past rodent activity, Table 1. Flowering and fruit production was the best in 6 years. A wetter than normal growing season for the second year in a row may explain the flush in follicle production in 2009. In observations 13 May 2009, indications of reproduction were detected for all groups except yellow and orange. However, only stems in the Red Group were developed to the stage where numbers of buds could be determined. Changes in reproductive activity between 28 May 2009 and 1 June were noted (Tables 2 through 5) indicating that timing of observations can be critical to data collection. The Blue Group had the most flowering plants with 7, producing 10 umbels yielding 156 buds, followed by the BG-TG with 6 plants producing 11 umbels and 147 buds. In the Red Group 2 additional plants produced an umbel for a total of 3 plants in reproductive mode in 2009. Not all buds developed into flowers and were aborted. Twelve follicles were produced this year, 7 in the BG-TG, 4 in the Blue Group, and 1 in the White Group. No follicles were

produced in the Red Group. Plant growth was down for most parameters measured this year (Tables 6 through 9). Several plants produced ramets in the White and Blue groups. The only increases were for leaf width and leaf length in the Red Group and plant length and leaf width in the Blue Group. In comparing differences in plant growth between flowering and non-flowering plants, measurements of plant length, leaf width and length, and stem caliper were greater in flowering plants with only a couple of exceptions, Table 10. Leaf counts revealed that non-flowering plants possessed a greater number of leaves per stem than for flowering plants which was true for all groups.

Table 1. Spring recovery and percent stand of established plants by group.

Group	Established Plants	Spring Recovery	Established Stand	Current Stand	Previous Years Stand
Yellow	7	1	85.7	14.3	14.3
Red	16	11	87.5	68.8	68.8
Blue	10	8	100.0	80.0	90.0
White	11	6	91.7	54.5	54.5
BG-TG	7	6	100.0	85.7	85.7

Table 2. Summary of BG-TG mixed prairie flowering by date of observation.

	28 May 2009			1 June 2009			Observed Totals		
Plant No.	No. of Umbels	Buds/ Umbel	Flowers/ Umbel	No. of Umbels	Buds/ Umbel	Flowers/ Umbel	No. of Buds	No. of Flowers	No. of Follicles
1	1	-	12	3	-	7.7	26	26	1
3	2	12.5	-	2	-	12	25	12	1
4	5	13.8	-	5	5	10.8	69	54	5
5	1	12	-	1	-	12	12	12	-
6	1	-	14	1	-	PB	NO	14	-
7	1	15	-	1	-	15	15	15	-
Total	11	-	-	13	-	-	147	133	7
Mean	1.8	13.4	13	2.2	-	11.7	-	-	-

NO = Not Observed; PB = Past Bloom

Table 3. Summary of Blue Group flowering by date of observation.

	28 May 2009				1 June 2009		Observed Totals		
Plant No.	Potential Umbels	No. of Umbels	Buds/ Umbel	Flowers/ Umbel	Buds/ Umbel	Flowers/ Umbel	No. of Buds	No. of Flowers	No. of Follicles
4	2	2	10	-	-	10	20	20	-
7	1	1	-	-	2	14	14	14	1
8	2	2	15	-	1	12	30	12	1
9	3	2	21.5	-	-	21.5	43	43	2
11	1	1	9	-	10.5	-	21	20	-
12	1	1	4	12	1	8	12	12	-
13	NO	NO	NO	NO	1	16	16	16	-
Total	10	9	-	-	-	-	156	137	4
Mean	1.7	1.5	13.3	-	5.0	14.1	-	-	-

NO = Not Observed

Table 4. Summary of White Group flowering by date of observation.

	28 May 2009		1 June 2009			Observed Totals		
Plant No.	No. of Umbels	Buds/ Umbel	No. of Umbels	Buds/ Umbel	Flowers/ Umbel	No. of Buds	No. of Flowers	No. of Follicles
4	1	13	1	-	13	13	13	1
7	2	NA	2	-	-	-	-	-
9	1	7	1	4	-	7	-	-
10	0	0	1	-	-	-	-	-
Total	4	-	5	-	-	20	13	1
Mean	1.3	-	1.3	-	-	-	-	-

NA = Not Available

Table 5. Summary of Red Group in the Salac Prairie flowering by date of observation.

	13 May 2009		28 May 2009			1 June 2009		Observed Totals	
Plant No.	No. of Umbels	Buds/ Umbel	No. of Umbels	Buds/ Umbel	Flowers/ Umbel	Flowers/ Umbel	Remarks	No. of Buds	No. of Flowers
Unk	1	10	1	-	13	PB	flowers yellowing	10	13
12	2	11	2	-	-	11	flowers yellowing	22	11
17	1	15	1	4	-	-	shoot browsed	15	NO
Total	4	-	4	-	-	-	-	47	24
Mean	1.3	12	1.3	-	-	-	-	-	-

NA = Not Available; NO = Not Observed; PB = Past Bloom; Unk = Unknown

Table 6. Summary of plant growth (length and width measurement means) for the Red Group “Salac Prairie” 11-year old plants.

Date	13 May 2009		1 June 2009	
		Range		Range
No. of Plants	10	---	10	---
No. of Stems	19	---	14	---
Plant Length (cm)	18	11-33	28	14-52
No. of stems sampled	19	---	14	---
Leaf Width (mm)	7	2-19	11.3	2-31
No. sampled	16	---	10	---
Leaf Length (mm)	44	24-58	62	44-85
No. sampled	16	---	13	---
Stem Caliper (mm)	---	---	1.6	0.5-3.9
No. sampled	---	---	16	---

Table 7. Summary of plant growth (length and width measurement means) for the Buffalo Grass-Tall Grass (BG-TG) prairie 12-year old plants.

Date	12 May 2009		1 June 2009	
		Range		Range
No. of Plants	6	---	6	---
No. of Stems	19	---	17	---
Plant Length (cm)	20	13-27	47	22-68
No. of stems sampled	17	---	16	---
Leaf Width (mm)	12	2-28	25	3-47
No. sampled	16	---	17	---
Leaf Length (mm)	46	36-61	64	51-90
No. sampled	16	---	17	---

Table 8. Summary of plant growth (length and width measurement means) for the White Group 11-year old plants.

Date	12 May 2009		1 June 2009	
		Range		Range
No. of Plants	5	---	6	---
No. of Stems	8	---	10	---
Plant Length (cm)	18	9-26	33	17-41
No. of stems sampled	7	---	10	---
Leaf Width (mm)	14	8-20	20	3-30
No. sampled	6	---	10	---
Leaf Length (mm)	41	23-52	59	32-78
No. sampled	6	---	10	---

Table 9. Summary of plant growth (length and width measurement means) for the Blue Group 11-year old plants.

Date	12 May 2009		1 June 2009	
		Range		Range
No. of Plants	7	---	8	---
No. of Stems	12	---	12	---
Plant Length (cm)	18	14-23	44	27-69
No. of stems sampled	7	---	12	---
Leaf Width (mm)	12	2-21	25	5-40
No. sampled	7	---	11	---
Leaf Length (mm)	44	32-62	72	51-94
No. sampled	7	---	12	---

Table 10. Size comparisons of plant length, leaf width, length, and stem caliper of flowering and non-flowering Mead's milkweed plants 1 June 2009.

	Stem Samples		Leaf Samples			Stem Samples		No. Leaves
Group	No.	Length (cm)	No.	Width (mm)	Length (mm)	No.	Caliper (mm)	
White f*	4	39	4	26	69	4	2.3	9
White n**	6	29	5	18	52	6	2.4	11
Blue f*	10	47	10	27	71	10	3.5	9
Blue n**	2	29	2	8	79	2	1.6	16
Red f*	3	44	3	22	76	4	3.3	8
Red n**	8	25	8	5	58	12	1.0	13
BGTG f*	11	55	11	32	71	11	3.8	10
BGTG n**	5	27	6	13	53	5	1.6	15

f*=flowering; n**=non-flowering

Maturing follicles were enclosed in mesh bags in order to capture all the seeds once follicles opened. There was a problem with predation by perhaps grasshoppers or rodents eating into the mesh bags and in some cases destroying seeds. There was a slight incidence of damage by a seed boring insect to a few seed units. Twenty-one seeds were recovered from 4 follicles collected from the Blue Group and 195 seeds recovered from 6 follicles from the BG-TG.

Plants grown in forestry peat pellets for 1 year were planted on the Marais des Cygnes National Wildlife Refuge in the spring 2009. The peat pellet stock was transferred from the plant cooler 27 April just prior to the anticipated ship date. By 11 May, 63% emergence had been obtained with a final tally of 84%. Multiple shoots were noted on 38% of the pellets (Table 11). Sixty-two percent of the pellets contained a single shoot where the mean shoot height 12 May was 14.2 mm. Consistant rains eliminated the need for watering. An estimated 80% survival rate was determined in August as plants began to senesce. Five plants of the same stock were planted in Field C-2 at the PMC, along with several Goetz plants.

Table 11. Number of shoots emerging from 1-0 peat pellet stock.

No. of Shoots	No. of Pellets with Shoots	% of Pellets
Single	46	62.2
Double	19	25.7
Triple	8	10.8
Quadruple	1	.01
Total Observed	74	100

Literature Cited:

USDA NRCS. 2004. 2004 Annual Technical Report, Manhattan Plant Materials Center, Manhattan, KS. 112p.

Conservation Field Trial: Revegetation of an Exposed Blue Shale Outcrop Site in Jewell County, Kansas

Study No. KSPMS-T-0001-CR

Study Leader: Mark A. Janzen, Plant Materials Specialist

Introduction: Past management and natural slumping has exposed raw shale areas ranging in size from 1 to 5 acres. The geology of the area is such that the underlying impervious shale layer conducts groundwater along its interface with the overlying soil. Where the shale outcrops on hillsides, natural springs occur. Slumping results where the overlaying soil on hillsides becomes saturated and subsequently moves. Once these areas are exposed, they are prone to water erosion, resulting in offsite deposition, which degrades the downslope plant communities. Because of the exposed shale, the quality of water flowing offsite is also a primary concern. The quality of the water flowing offsite is very acidic (pH 3-5) which also results in severe degradation of the downstream plant communities. This study is being conducted in cooperation with the Kansas Department of Health and Environment and the Jewell County Conservation District.

Problem: The need exists to evaluate plant species for potential use for site revegetation and subsequent stabilization.

Objective: Evaluate common reed (*Phragmites australis* [Cav.] Trin. Ex Steud.) for establishment, survival, rate of spread, and stabilization potential on a typical blue shale site.

Procedure: One typical blue shale site was selected for the planting and evaluation of the adaptability and survival of common reed. Approximately 2,000 common reed sprigs were planted on 18 April 2000, with assistance from the Manhattan Plant Materials Center, Manhattan, Kansas. The sprigs were hand planted within select reaches of the primary drainageways within the study area in Jewell County. Planting was restricted to those areas within the study area that appeared to have the greatest potential for supplemental moisture. The plantings will be monitored for establishment, survival, and spread. Evaluations will continue through 2010.

Potential Product: Technology Transfer

Progress or Status: Vegetation continues to spread over the planting area. Management of the area has been limited, which includes an unsuccessful attempt to burn the area. Upper reaches of the slopes remain unvegetated. The soils and plant ecology remain fragile. Affective area of exposed shale seems to be expanding due to management of adjacent resources. Few native grass species such as big bluestem, little bluestem and switchgrass are beginning to establish in the stabilized vegetated areas of blue shale. Seed collections were made from these native plants. Plants will be established in Ray Leach “Cone-tainers” and re-established in a field planting within the non-vegetated areas of the blue shale to determine if these plants have adaptability to blue shale sites and tolerance to low PH soils. Continued management is needed for vegetation improvement.

Evaluation of 'Laramie' Tifton Burclover Interseeding Trial in Established Cool-Season Forage Grasses

Study No. KSPMS-T-0705-PA

Study Leader: Mark A. Janzen, Plant Materials Specialist

Introduction: 'Laramie' Tifton burclover (*Medicago rigidula* [L.] All.) is an annual legume that has potential both as a cover crop and companion crop with many grain and forage crops. Laramie germinates in the fall providing winter cover and nitrogen fixation until it reaches maturity in late May or June. This study will evaluate the potential Laramie has as a potential cover crop as well as its ability to sustain itself over time.

Procedure: Utilized perennial cool-season forage grasses from study number 20C006G from the Wallace County study site. Laramie was broadcast into the west one-half of the replicated plot in the fall 2006. No incorporation of the seed was applied. By applying to one-half of the perennial cool-season forage grasses it provides a visual observation to the affects of a nitrogen fixing cover.

Progress or Status: The broadcast seeding of 'Laramie' annual medicago was evaluated October 2009. Numerous plants were established throughout the planted area. Plants displayed good health and vigor. It is interesting to note that in 2008 few plants were identified in the planted area. Continued evaluation of the planting will continue to determine the plants ability to reseed itself, ultimately determining the longevity of the plant. This plant is displaying some potential for a companion cover crop.

Evaluate Sand Bluestem Germplasm Lines with Improved Seedling Establishment under Field Conditions

Study No. KSPMC-ST-0802-RA

Study Leaders: Dr. Tim Springer, Agricultural Research Service (ARS), Woodward, Oklahoma, and Richard L. Wynia, Plant Materials Center Manager

Introduction: Sand bluestem, *Andropogon hallii* Hack., is a warm-season, perennial grass native to the southern and western parts of the Great Plains Region. This tall, vigorous, strongly rhizomatous sod-forming grass is primarily adapted to deep, sandy soils. It is an important component of sand hills prairie. It is one of the most valuable erosion-control grasses for sandy soils. Sand bluestem is considered an excellent native forage grass and has high potential for use in establishing range, hay and pasture land, and in stabilizing critically eroding areas.

Recurrent phenotypic mass selection was used to create 2 synthetic populations from 2 lines of sand bluestem developed at USDA's Southern Plains Range Research Station (SPRRS), Woodward, Oklahoma. The base populations, designated 'AB Medium' and 'CD Tall', were originally selected for growth, re-growth, disease resistance, leafiness, seedling vigor, and plant height. AB Medium (Syn-0 population) was released in 2004, as 'Chet' sand bluestem.

Problem: Seedling establishment under field conditions needs improvement.

Objective: Evaluate sand bluestem germplasm lines with improved seedling establishment under field conditions at multiple locations.

Procedure: From the 2-base populations of AB Medium and CD Tall, selection criterion was to germinate seed at a reduced water potential and generate seedlings with ability to germinate under water deficit conditions. Seed units were placed in germination chambers in clear plastic boxes with a blotter substrate moistened with 17 mL of a water potential solution of D-mannitol at -0.8 MPa. After 7 days in the germinator all germinated seedlings were removed, washed with deionized water and planted in a soil mixture and maintained in the greenhouse. Two cycles of selection were made using this method thus yielding the base population and 2 selected populations designated Syn-1 and Syn-2. Approximately 7% of the base populations exposed to the D-mannitol germinated. Seed of the 6 populations (Table 1) were increased and used to plant replicated plots at 3 test locations: Woodward, Oklahoma; Knox City, Texas; and Manhattan, Kansas. Selections will be evaluated for establishment, forage yield, and persistence.

Table 1. Selected populations used in this study.

Population
Medium height Syn-0 (Chet)
Medium height Syn-1
Medium height Syn-2
Tall height Syn-0
Tall height Syn-1
Tall height Syn-2

Potential Products: Cultivar Release and Technology Transfer

Progress or Status: The entries from Table 1 were established in 2 x 10 m (6.6 x 32.8 ft) plots in a randomized complete-block design with 4 replications at SPRRS, and Plant Materials Centers at Knox City and Manhattan in 2008. The seeding population was equivalent to 108 pure live seed per m^2. At Manhattan the planting was installed on 10 June 2008, on a Belvue silt loam soil in Field B-1. Stand emergence data was recorded at 30, 60, and 90 days. Seedling emergence (plants/m^2) was determined using the grid system method as determined by Vogel and Masters (2001).

Literature Cited: Vogel, K. P. and R. A. Masters. 2001. Frequency grid – a simple tool for measuring grassland establishment. *Journal of Range Management* 54:653-655.

Evaluate the Adaptability of 'Tropic Sun' Sunn Hemp (*Crotalaria juncea* L.)

Study No. KSPMC-T-0901-CP

Study Leader: Ramona Garner, East Regional Plant Materials Specialist

Introduction: Sunn Hemp (*Crotalaria juncea*) has been touted as a great green manure and cover crop since the 1930s, when it was reported to be an excellent soil-improving crop. Sunn hemp produces high organic matter yields while fixing large amounts of nitrogen. However, the difficulty in acquiring seed and cheap fertilizer prices caused many farmers to abandon the use of this crop. Energy costs have brought leguminous cover crops back to the forefront for sustainable agriculture production and have led to efforts to increase production of sunn hemp seed.

Sunn hemp is a tropical or sub-tropical plant that acts like a summer annual when grown in the continental United States. Sunn hemp's adaptation to a wide range of soils and superior performance on poor sandy soils has attracted attention. As a cover crop, sunn hemp can produce 5,000-6,000 pounds of biomass per acre in southern climates in 60-90 days. It also can produce 120-140 pounds of nitrogen in the same amount of time.

The anticipated use of sunn hemp is as a 30-45 day green manure crop. Sunn hemp does not produce seed above 28 degrees N latitude (southern tip or Florida or Texas). Since it does not produce seed throughout most of the US and is sensitive to frost, it has little potential to become a weed pest.

Objective: Determine the areas of the country with the potential to use sunn hemp for green manure and cover crops.

Procedure: Each plant materials center received seed to plant an approximately 10.1 x 14 m (33 X 46 ft) block. The seed was inoculated with a cow pea type inoculant, *Bradyrhizobium* sp. The planting at the Manhattan Plant Materials Center (PMC), Manhattan, Kansas, was drilled on 21 May 2009 at a seeding rate of 50 lbs/acre on 17.8 cm (7 in) row spacing. The seed bed was disked and harrowed. The previous crop was soybeans. No irrigation water was applied due to season-long ample rainfall. An electric fence was used to protect the plots from deer. Chickenwire was attached at ground level to discourage rabbits. An unfenced, drill cleanout strip of sunn hemp was maintained adjacent to the block to monitor browse activity. Plant height was recorded at each harvest interval of 30, 60, and 90 days after planting. Three, 0.5 m^2 plots, per clipping date per rep, were clipped just above the soil surface for a total of 12 per harvest. Fresh clipped material was weighed for each harvest. Grab samples were collected from each of the 3, 0.5 m^2 plots, from each replication. Grab sample wet weights and dry weights were determined for each sample. One whole, above ground portion of plant from replications 1 and 3 were saved from each harvest date. These samples were sent to Nacogdaoches, Texas, for % N analysis. The date when the following events occurred was recorded, first flowers appeared, first frost, and killing frost. An antermath harvest following the above procedures was taken on 26 October.

Potential Products: Technology Transfer - national tech note, state tech notes, refereed journal article

Progress or Status: First emergence was noted 28 May 2009. Forage harvests at 30 day intervals were conducted 19 June, 21 July, and 20 August. First flowering was noted on 9 September. Ample and timely rains throughout the growing season produced little stress for the sunn hemp. Plant competition perhaps provided the greatest amount of stress. A dry fall and high winds began to stress the plants by early October. On 5 October lots of leaves had senesced due to the weather the previous week. First frost on 7 October caused more senescence and the interior of the stand became visible. No evidence of fruiting was noted and only the tenderest growth was affected by the frost. Although the antermath harvest was taken on 26 October 2009, after a killing frost (per the study plan), 2 October when the mean plant height was 4.2 m (13.8 ft) would have provided the greatest end of growing season yield. Refer to Table 1 for forage dry matter yields.

Table 1. Sunn hemp mean forage dry matter yield, Manhattan.

Harvest Interval (days)	Plant Height (m)	Dry Matter Yield (t./ha)
30	0.2	3.7
60	1.8	6.4
90	2.8	13.8
Aftermath	3.7	23.9

Initial Evaluations

Evaluation of Miscellaneous Grasses

Study No. 20I003L

Study Leader: John M. Row, Plant Materials Specialist

Introduction: This study serves as a clearinghouse for the evaluation of miscellaneous collections of grasses received by the Manhattan Plant Materials Center (PMC), Manhattan, Kansas, which have potential for conservation use. These collections may be tested for adaptation to the local climate in a rod-row planting. Standards of comparison may be included such as an existing cultivar that is available in the seed trade.

Objective: Provide a means to test plant materials where limited seed or plants are available.

Procedure: Plant seeds or plants in a non-replicated 6.1 m (20 ft) rod row with a between row spacing of 2.2-m (6-ft), except where noted. Plants will be spaced 1 foot apart in the row at the PMC unless otherwise specified. A standard of comparison may also be included. Evaluation factors include: plant vigor, stand, seed production, growth factors, and resistance to disease, drought, and cold.

Potential Products: Cultivar Release and Technology Transfer

Progress or Status: Canada wild rye (*Elymus canadensis* [L.]), riverbank wild rye (*E. riparius* [Wieg.]), and little bluestem (*Schizachyrium scoparium* [Michx.] Nash), are species currently under test in this study.

Canada Wild Rye and Riverbank Wild Rye: The plant materials specialist for Michigan initiated an ICST to test the adaptation of Accession 9084347, Icy Blue Germplasm Canada wild rye and Accession 9086450, riverbank wild rye (*E. riparius* [Wieg.]). The Rose Lake PMC provided 20 plants of each accession which were planted in rod rows 24 May 2006. Four replants were established in 2007 for Accession 9084347. Stand declined for both wild rye entries this year. Plants were also less vigorous.

Arizona Cottontop: The James E. Bud PMC, Knox City, Texas, initiated an ICST to test the adaptation of Accession 469253 Arizona cottontop (*Digitaria californica* [Benth.] Henr.). Twenty plants were planted in a rod row 9 June 2008, in Field C-2. The plants did not survive the winter.

Little Bluestem: The James E. Bud PMC, initiated an ICST to test the adaptation of Accession 9029926, OK Select Germplasm little bluestem (*Schizachyrium scoparium* [Michx.] Nash). Twenty plants were planted in a rod row 9 June 2008, in Field C-2. 'Cimarron' little bluestem was included as a "standard of comparison." Cimarron declined in stand to 95% while Accession 9029926 maintained a 100% stand, Table 1. Forage yield was 1.7% greater than that of Cimarron.

Table 1. Evaluation data for little bluestem, *Schizachyrium scoparium*, 2009.

Accession	Plant Height (cm)	Stand (%)	Produced Seed
421552	131	95	N.O.
9029926	164	100	N.O.

N.O. = Not Observed

Evaluation of Miscellaneous Trees and Shrubs

Study No. 20I010K

Study Leader: John M. Row, Plant Materials Specialist

Introduction: Plantings of woody materials were initiated in 1961. Since that time plants have been added for evaluation with multiple objectives in mind. The evaluation of woody plant materials has been a cooperative effort between the Manhattan Plant Materials Center (PMC), Manhattan, Kansas, and interested parties in the central Great Plains. These include: Kansas State University-Department of Horticulture and Forestry; the USDA Agricultural Research Service (ARS) Plant Introduction System NC-7 Trials; the USDA Forest Service; State and Extension Foresters, and Natural Resources Conservation Service (NRCS) staff foresters and biologists of Oklahoma, Nebraska, Kansas, and Colorado; and the Plains and Prairie Forestry Association (formerly the Great Plains Agricultural Council GP-13 Forestry Committee).

Problem: Adapted tree and shrub selections are needed to provide for windbreak, recreation, and multi-purpose use in the High Plains and provide multiple wildlife benefits throughout the 4 state area.

Objectives: Identify superior specimens of shrubs and trees which have potential to solve conservation problems; produce or have produced, limited quantities of promising woody plants for field evaluation and field plantings; fulfill tree improvement committee efforts to find and test superior specimens and origins of woody plants; find a suitable replacement for the American and Siberian elms in Midwest urban conservation plantings; and develop and cooperatively release the best adapted cultivars for multiple uses in the area served by the PMC.

Procedure: Containerized or bareroot stock is spaced 4.88 m (16 ft) apart in rows spaced 4.88 m apart. Drip irrigation is used to aid in establishment which may be needed for several years. In the miscellaneous woody tables, number established (No. EST) column, a number in parentheses (n) may appear below the number established indicating the initial number of woody plants planted. Percent survival is based on the number of plants established rather than the number planted. So, if a tree or shrub planted in a given year did not recover the following spring, it was considered to have not established. There may be a variety of reasons why the plant material failed to establish, such as unfavorable environmental conditions in the initial growing season, planting stock in poor condition, and predation. Such conditions may not have any reflection on the plant material itself. It is possible that the plant material is simply not adapted to the site. However, in an initial evaluation, an attempt to reestablish the plant material should be made before declaring a plant material as not adapted to the site. The way percent survival is currently calculated may change data reported in past reports. In cases where it is clear that herbicides killed the plant, the survival rate is adjusted to compensate for such an intervention. Once woody stock has been established on site it can be evaluated for adaptation for a period of time, as much as 20 years or more for long lived species. This nursery is located primarily on a Belvue silt loam soil in fields F and G. Due to wildlife pressures, newly established woody entries must be fenced to reduce browse and rub damage caused by deer.

Potential Products: Information Technology and Cultivar Release

Progress or Status: The assembly consists of 137 accessions representing 98 species in 60 genera, of which 31 are named cultivars. Fifty-one percent of the species are native to North America. The plant materials come from many sources such as other PMCs, NRCS field collections, and ARS collections: High Plains Horticulture Research Station (HPHRS) at Cheyenne, Wyoming; Southern Plains Range Research Station (SPRRS), Woodward, Oklahoma; the North Central Regional Plant Introduction Station (NCRPIS), Ames, Iowa; and the US Forest Service's Rocky Mountain Forest and Range Experiment Station (RMFRS), University of Nebraska-Lincoln (UNL), Nebraska. Participating PMCs include TXPMC, Knox City, Texas; GAPMC, Americus, Georgia; KSPMC, Manhattan, Kansas; National PMC (MDPMC), Beltsville, Maryland; MIPMC, East Lansing, Michigan; MOPMC, Elsberry, Missouri; and NDPMC, Bismarck, North Dakota.

Thirty-five accessions were evaluated this year. There were 6 new acquisitions this year, Table 1.

Table 1. New acquisitions to the miscellaneous tree and shrub evaluations in 2009.

Species	Common Name	Accession Number	Origin/Source
Chilopsis linearis	desert willow	9050543	Meade Co., KS /KSPMC
Pinus sylvestris var. *mongolica*	Mongolian pine	9076718	Nenjiang, China/ NDPMC /NCRPIS
Pinus sylvestris var. *mongolica*	Mongolian pine	9076719	Shangzhi, China/ NDPMC /NCRPIS
Populus tremuloides	quaking aspen	9050535	Platte Co., NE /NCRPIS
Rhus copallinum	shining sumac	9050537	Iroquois Co., IL /NCRPIS
Taxodium distichum	bald cypress	9050542	Real Co, TX /NCRPIS

Pine Wilt Disease continued to plague the Scots pine plantings with continued losses resulting in the removal of the affected trees.

Refer to Table 2, List of Miscellaneous Trees and Shrubs for further information regarding plot designations. Refer to Figures 1 and 2, for plot locations in fields F and G. An x designates location of an existing plant in the plot. Trees and shrubs removed in 2009 are listed in Table 3. Evaluation data are presented in Table 4.

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2009. Page 1

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
				Block 1		
B1 17 1-10	1976	9004450		*Juglans microcarpa*	little walnut	Washita & Beckman Co., OK /KSPMC
B1 18 1-25	1964			*Taxodium distichum*	baldcypress	/Commercial/KSU Ext. Forestry
B1 E 1-13	1990	483442	Flame	*Acer ginnala*	Amur maple	Eastern Asia /MOPMC
B1 E 14-35	1990	468117	Indigo	*Cornus amomum*	silky dogwood	Clinton Co., MI /MIPMC
B1 E 36-48	1990	478000	Midwest	*Malus baccata mandshurica*	Manchurian crab apple	Manchuria /NDPMC
B1 3 1-20	2006	9069052	Riverbend GP	*Salix* sp.	willow	/MIPMC
				Block 2		
B2 1 1	19XX	566824	Boomer	*Quercus macrocarpa*	bur oak	Custer Co., OK /TXPMC, Knox City
B2 2 1	19XX	9004392	Lippert	*Quercus macrocarpa*	bur oak	Payne Co., OK /KSPMC
B2 E 1-5	2008	9050529		*Celastrus scandens*	American bittersweet	Winneshiek Co., IA /NCRPIS
B2 S	1930s	20-1303		*Syringa vulgaris*	common lilac	
				Block 2		
B3 E1 1-23	1975	70314		*Castanea mollisima*	Chinese chestnut	/MDPMC
B3 E2 1-31	1975	70314		*Castanea mollisima*	Chinese chestnut	/MDPMC
B3 SE 17-26	1977	514275	Magenta	*Malus* sp.	hybrid crabapple	Clinton Co., MI /MIPMC
B3 SW 9-42	1987	483442	Flame	*Acer ginnala*	Amur maple	Eastern Asia /MOPMC
C1 20 A-E	1961	9004302		*Fraxinus pennsylvanica*	green ash	Butler Co., KS /KSPMC
C1 21 A-E	1961	9004304		*Fraxinus pennsylvanica*	green ash	Franklin Co., KS /KSPMC
C3 W1 6-42	1967	20-1068		*Juniperus chinensis phitzeriana*	Phitzer juniper	/Riley Co., KS /KSPMC
C3 W2	1968	9001209		*Picea pungens*	Colorado blue spruce	Forrest Keeling Nursery, Elsberry, MO /KSPMC
E3 21 5-7	2001	9050416		*Quercus prinoides*	dwarf chinkapin oak	Salem, NE /NCRPIS
				Block 1		
F1 1 1-2	1985	9049957		*Platanus occidentalis*	sycamore	Brownville, NE /UNL
F1 1 10-19	1966	107630		*Ligustrum vulgare*	Cheyenne European privet	/NCRPIS
F1 2 1	1985	9049957		*Platanus occidentalis*	sycamore	Brownville, NE /UNL
F1 2 2-3	1985	9049956		*Platanus occidentalis*	sycamore	Burt Co., NE /UNL
F1 2 4	1985	9049957		*Platanus occidentalis*	sycamore	Brownville, NE /UNL
F1 2 5	1985	9049955		*Platanus occidentalis*	sycamore	Marysville, KS /UNL
F1 3 1	1985	9049956		*Platanus occidentalis*	sycamore	Burt Co., NE /UNL
F1 3 2-3	1985	9049955		*Platanus occidentalis*	sycamore	Marysville, KS /UNL
F1 3 4-5	1985	9049956		*Platanus occidentalis*	sycamore	Burt Co., NE /UNL
F1 4 3-5	1997	9050263		*Celtis laevigata*	sugarberry	Newark, OH /NCRPIS
F1 11 2-11	1989	9055585	Redstone	*Cornus mas*	Cornelian cherry dogwood	Cen Europe /NY /MOPMC
F1 12 1-2	1984	325270		*Cotoneaster lucida*	cotoneaster	USSR /MDPMC
F1 12 3-12	2007	9083247		*Corylus americana*	American hazelnut	/MOPMC
F1 13 1-5	2007	9050524		*Elaeagnus* X 'Jefmorg'	Silverscape®olive	Lincoln-Oakes Nursery, Bismarck, ND
F1 13 6-10	2007	9050522		*Physocarpus opulifolius*	common ninebark	Bucks Co., PA /NCRPIS
F1 14 1-5	2007	9082687		*Ribes americanum*	American black currant	/NDPMC
F1 14 6-10	2008	9050530	June Bride™	*Philadelphus microphyllus*	littleleaf mock orange	Sevier Co., UT /NCRPIS
F1 15 1-5	2008	9050531	Center Glow	*Physocarpus opulifolius*	common ninebark	/NCRPIS
F1 18 1-5	1990	477010		*Ligustrum obtusifolium*	border privet	/MIPMC /NCRPIS
F1 19 1-5	2006	9050500	Iroquois Beauty	*Photinia melanocarpa*	black chokeberry	/NCRPIS
F1 19 6-10	2006	323957	McKenzie	*Photinia melanocarpa*	black chokeberry	/NDPMC/NCRPIS
F1 20 1-5	2003	9050482	Royal Guard	*Viburnum rufidulum*	southern black haw	Holden Arboretum /NCRPIS
F1 20 6-10	2003	9050483		*Viburnum rufidulum*	southern black haw	ISU Hort. Farm /NCRPIS

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2009. Page 2

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
F1 21 1-5	2001	9050417		*Spiraea flexuosa*		Northern Mongolia /NCRPIS
F1 21 6-10	2001	9050418		*Xanthoceras sorbilolium*	yellowhorn	Northern China/NCRPIS
F1 22 1-5	2002	9050425		*Cornus sanguinea*	blood-twig dogwood	IA /NCRPIS
F1 22 6-10	2002	9050426		*Cornus sanguinea*	blood-twig dogwood	IA /NCRPIS
F1 23 1-5	2002	9050427		*Cotinus coggygria*	smokebush	IA /NCRPIS
F1 23 6-10	2006	9050498		*Hydrangea arborescens radiata*	silver leaf hydrangea	/NCRPIS
F1 24 1-5	2002	9050429		*Sorbus aucuparia*	mountain ash	IA /NCRPIS
F1 24 6-10	2002	9050430		*Sorbus torminalis*	wild service tree	IA /NCRPIS
F1 25 1-5	2002	9050431		*Shepherdia argentea*	silver buffalo berry	IA /NCRPIS
F1 25 6-10	2002	9050432		*Sorbus torminalis*	wild service tree	IA /NCRPIS
F1 26 1-6	1985	9050007		*Syringa vulgaris*	common lilac	Phillips Co., KS /KSPMC
			Block 2			
F2 4 1-10	1967	9006095	McDermand	*Pyrus ussuriensis*	Harbin pear	Morden, Manitoba, CAN /NDPMC
F2 6 1-6	1998	various		*Castanea mollissima*	Chinese chestnut	/MDPMC
F2 7 1-6	1998	various		*Castanea mollissima*	Chinese chestnut	/MDPMC
F2 8 1-6	1998	various		*Castanea mollissima*	Chinese chestnut	/MDPMC
F2 9 1-4	1989	9050011		*Diospyros virginiana*	common persimmon	IA /NCRPIS
F2 11 1-5	2007	9050519		*Celtis reticulata* var *laevigata*	netleaf hackberry	Union Co., NM/NCRPIS
F2 11 6-10	2007	9050518	September Sun	*Alnus maritima*	seaside alder	Oklahoma/NCRPIS
F2 12 1-5	2007	9050520		*Cercis canadensis*	red bud	Van Buren Co., IA/NCRPIS
F2 12 6-10	2007	9050521		*Cercis canadensis*	red bud	Keokuk, Lee Co., IA /NCRPIS
F2 13 1-5	2007	9050523		*Ptelea trifoliata*	common hop-tree	Van Buren Co., IA /NCRPIS
F2 13 6-10	2007	9076686		*Crataegus chrysocarpa*	fireberry hawthorn	/NDPMC
F2 14 1-5	2008	9050532		*Quercus alba*	white oak	Richardson Co., NE /NCRPIS
F2 14 6-10	2009	9050537	Morton Prairie Flame	*Rhus copallinum*	shining sumac	Iroquois Co., IL /NCRPIS
F2 15 6-10	2009	9050543		*Chilopsis linearis*	desert willow	Meade Co., KS /KSPMC
F2 24 1-5	1973	9006225		*Syringa pekinensis*	Peking lilac	/NDPMC
F2 24 6-10	1973	9034667		*Forsythia europaea* X *ovata*	early forsythia hybrid	/NCRPIS
			Block 3			
F3 2 1-11	1967	9001069		*Quercus palustris*	pin oak	/Manhattan Nurs., Manhattan, KS /KSPMC
F3 3 2-6	2002	486339	Dynasty	*Ulmus parvifolia*	lace-bark elm	IA /NCRPIS
F3 5 1-5	1969	9004305		*Fraxinus pennsylvanica*	green ash	Butler Co., KS /KSPMC
F3 7 1	2003	9050478	Varen	*Betula papyrifera*	paper birch	NDSU /NCRPIS
F3 7 2-4	2006	9050499		*Populus alba*	white poplar	South Korea/NCRPIS
F3 7 6-10	2003	9050481		*Tilia cordata*	littleleaf linden	Ukraine /NCRPIS
F3 7 7-11	2009	9050535	NE-Arb Prairie Gold	*Populus tremuloides*	quaking aspen	/NCRPIS
F3 8 1-5	2003	9050479		*Carpinus betulus*	European hornbeam	Ukraine /NCRPIS
F3 8 6-10	2003	9050480		*Carpinus betulus*	European hornbeam	Ukraine /NCRPIS
F3 10 1-10	1971	9034682		*Betula nigra*	river birch	Houston Co., MN /NCRPIS
F3 12 1-10	2006	9050497		*Celtis occidentalis*	common hackberry	Forest Keeling Nurs., Elsberry, MO /KSPMC
F3 13 1-10	2006	9066615		*Celtis occidentalis*	common hackberry	Oklahoma/KSPMC/NMPMC
F3 14 1-5	2006	9050501	J. N. Select	*Carpinus caroliniana*	American hornbeam	MN, WI/NCRPIS
F3 14 6-10	2006	9050503		*Ulmus thomasii*	rock elm	Dixon Co., NE/NCRPIS

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2009. Page 3

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
F3 15 1-10	2006	9050502		*Foresteria pubescens* var *pubescens*	elbow bush	/NCRPIS
F3 19 1-10	1971	9004302		*Fraxinus pennsylvanica*	green ash	Butler Co., KS
F3 20 1-5	1971	341756	Groeneveld	*Ulmus* X *hollandica*	Holland elm hybrid	/NCRPIS
F3 20 6-10	1973	265620	Hessei	*Fraxinus excelsior*	European ash	W. Germany /NCRPIS
F3 21 1-5	1972	9034674		*Quercus* sp.	Swedish hybrid oak	/UNL /NCRPIS
F3 21 6-10	1972	9017646		*Quercus robur*	English oak	/ISU Hort Farm /NCRPIS
F3 22 6-10	1990	9050022		*Quercus phellos*	willow oak	TN /NCRPIS
F3 23 6-10	1972	9004392	Lippert	*Quercus macrocarpa*	bur oak	Payne Co., OK
F3 24 1-10	1973	434253	Athens	*Quercus acutissima*	sawtooth oak	/GAPMC
				Block 4		
F4 5 10-11	1973	323932	Emerald Sea	*Juniperus conferta*	shore juniper	/MDPMC
F4 10 9-13	1975	9004334		*Juniperus* sp.	columnar juniper	Custer Co., NE /PI Sta., Cheyenne, WY
F4 11 1-10	2006	9050504		*Cupressus bakeri*	Modoc cypress	/Lawyer Nurs., Plains, MT /KSU
F4 12 1-5	2009	9076719		*Pinus sylvestris* var. *mongolica*	Mongolian pine	Shangzhi, China/ NDPMC /NCRPIS
F4 12 6-10	2009	9076718		*Pinus sylvestris* var. *mongolica*	Mongolian pine	Nenjiang, China/ NDPMC /NCRPIS
F4 13 1-5	2009	9050542		*Taxodium distichum*	bald cypress	Real Co, TX /NCRPIS
F4 18 1-10	1982	477011	Affinity	*Thuja occidentalis*	northern white cedar	/MIPMC
F4 19 1-6	1976	343949		*Pinus sylvestris*	Scots pine	Ankara, Turkey /MDPMC
F4 20 7-9	1976	343948		*Pinus sylvestris*	Scots pine	Ankara, Turkey /MDPMC
F4 21 1-10	1974	9034668		*Picea abies*	Norway spruce	/Griffith St. Nurs., Wisconsin Rapids, WI /KSPMC
F4 22 1-9	1973	9004363		*Pinus strobiformis*	Mexican white pine	Lincoln Co., NM/Rky Mtn Exp Sta., NE /KSPMC
F4 23 1-10	1973	9004364		*Pinus nigra*	Austrian pine	N. Turkey /Rky Mtn Exp Sta., NE /KSPMC
F4 25 8-17	1973	9034669		*Pinus heldreichii*	Heldreich pine	Yugoslavia /Rky Mtn Exp Sta., NE /MDPMC
				Block 1		
G 1 W'-B	1991	250278	Elsmo	*Ulmus parvifolia*	lace-bark elm	Rochester, NY /MOPMC
G 1 C-E	1974	9004437		*Ulmus parvifolia*	lace-bark elm	Woodward /SO, OK /KSPMC
G 2 W'-Z'	1991	250278	Elsmo	*Ulmus parvifolia*	lace-bark elm	Rochester, NY /MOPMC
G 2 A-E	1963	9004439		*Ulmus* species	Offerle elm	Edwards Co., KS /KSPMC
G 3 B-E	1963	9013711		*Ulmus parvifolia*	Chinese elm	/ARS, Woodward, OK /KSPMC
G 3 F-J	1963	9004256		*Celtis occidentalis*	common hackberry	Pottawatamie Co., KS /KSPMC
G 4 A-E	1963	9004440		*Ulmus* species	hybrid elm	/KSU Horticulture Farm
G 8 F-J	1963	9004255		*Celtis occidentalis*	common hackberry	Central Oklahoma
G 9 F-J	1963	9034679		*Carya illinoensis*	pecan	/KSU Forestry, KS
G 10 F-J	1963	9034680		*Carya illinoensis*	pecan	/KSU Forestry, KS
G 2 K-O	1963	9004329		*Juniperus virginiana*	eastern red cedar	/KSU Forestry, KS
G 4 K-O	1963	9004333		*Juniperus virginiana*	eastern red cedar	Harper Co., OK /KSPMC
G 6 K-O	1963	9004332		*Juniperus virginiana glauca*	silver eastern red cedar	/USDA-ARS, Woodward, OK /KSPMC
G 8 K-O	1963	9034671		*Pinus ponderosa*	ponderosa pine	/KSU Forestry, KS
G 15 U-Y	1964	9034673		*Quercus acutissima*	sawtooth oak	/GAPMC, Americus
				Block 2		
G2 16 1-8	1976	9004462	Sapparo Autumn Gold	*Ulmus* species	elm	/Univ. of WI/PI Sta. Ames, IA
G2 17 1-3	1977	9004312		*Juglans nigra*	black walnut	Doniphan Co., KS /KSPMC

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2009. Page 4

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
G2 23 6-8	1981	9030309		*Aesculus glabra*	OH buckeye	/PI Sta. Ames, IA
G2 24 6-7	1981	9030308	Royal Red	*Acer plantanoides*	Norway maple	/PI Sta. Ames, IA
				Block 3		
G3 16 1-8	1976	9008245		*Quercus acutissima*	sawtooth oak	/TXPMC, Knox City
G3 18 1-8	1976	9004392		*Quercus macrocarpa*	bur oak	City Park, Stillwater, OK
G3 19 7	1976	9034858		*Castanea crenata*	chestnut hybrid	MOPMC
				Block 1		
HQ1 1 1	1966	9050506		*Nyssa sylvatica*	black gum	/Forrest Keeling Nursery, Elsberry, MO /KSPMC
HQ1 1 2				*Carya illinoensis*	pecan	
HQ1 1 3	1963	9050509		*Pseudotsuga menziesii*	Douglas fir	MOPMC
HQ1 1 4-11	1968	9001209		*Picea pungens*	Colorado blue spruce	/Forest Keeling Nursery, Elsberry, MO
HQ1 2 1	1983	9005161		*Crataegus phaenopyrum*	Washington hawthorn	DuPage Co., Ill. /MOPMC
HQ1 2 2	1977	514275	Magenta	*Malus* sp.	hybrid crabapple	Clinton Co., MI /MIPMC;
HQ1 2 3	1964	9050507		*Pinus edulis*	pinyon pine	/ARS, Woodward, OK
HQ1 2 4-6	1968	9001209		*Picea pungens*	Colorado blue spruce	/Forest Keeling Nursery, Elsberry, MO
HQ1 3 1	1966	9050505		*Tilia* X *euchlora*	Redmond Crimean linden	/Plumfield Nursery, Fremont, NE
HQ1 4 1,3	1982	9030989		*Forsythia ovata*	early forsythia	/NCRPIS
HQ1 4 2	1988	9049784		*Ribes odoratum*	buffalo currant	Dickinson Co., KS /KSPMC
HQ1 5 1-4	1982	9030990	Blue Star	*Juniperus squamata*	blue star juniper	Holland /NCRPIS
HQ1 5 1-4				*Yucca glauca*	soapweed	
HQ1 7 1	1984	20-1846		*Picea abies*	Norway spruce	/Griffith State Nursery, Wisconsin Rapids, WI
HQ1 7 2	1964	9004392	Lippert	*Quercus macrocarpa*	bur oak	Payne Co., OK
HQ1 8 1		9050508		*Caragana boisii*	Siberian pea shrub	/ARS Hort. Sta., Cheyenne, WY
HQ1 8 2		483442	Flame	*Acer ginnala*	Amur maple	Eastern Asia /MOPMC
HQ1 8 3	1977	9004363		*Pinus strobiformis*	Mexican white pine	Lincoln Co., NM/Rky Mtn Exp Sta., NE
HQ1 9 1	1988			*Cerus canadensis*	red bud	Riley Co., KS
HQ1 9 2	1967	9001069		*Quercus palustris*	pin oak	/Manhattan Nursery, Manhattan, KS
				Block 2		
HQ2 1 1-15				*Crataegus phaenopyrum*	Washington hawthorn	/Lawyer Nursery, Plains, MT
HQ2 2 1-15		113095	Centennial	*Cotoneaster integerrimus*	cotoneaster	China /NDPMC
HQ2 2 2-14		540442	Regal	*Prunus tenella*	dwarf flowering almond	/NDPMC
HQ2 2 16	1976	9050510		*Syringa oblata dilatate*	Korean early lilac	/ARS Hort. Sta., Cheyenne, WY
HQ2 3 1	1977	421614		Ulmus davidiana var japonica	Japanese elm	/ARS Nursery Crops Res. Lab., Delaware, OH
HQ2 3 2				*Pinus ponderosa*	ponderosa pine	
HQ2 3 3		516476	Redstone	*Cornus mas*	Cornelian cherry dogwood	Asia /MOPMC
HQ2 3 4-15				*Syringa vulgaris*	common lilac	
HQ2 3 16	1976	9050511		*Spiraea sargentiana*	Sargent spirea	/ARS Hort. Sta., Cheyenne, WY
HQ2 3 17	1992			*Quercus robur*	English oak	Ill. /McKendree College
HQ2 3 18	1992	9004392	Lippert	*Quercus macrocarpa*	bur oak	Payne Co., OK /KSPMC
HQ2 3 19	1977	514275	Magenta	*Malus* sp.	hybrid crab apple	Clinton Co., MI /MIPMC
HQ2 4 1-6	1992			*Pyracantha*	firethorn	Blueville Nursery, Manhattan, KS
HQ2 4 7	1992	483442	Flame	*Acer ginnala*	Amur maple	E. Asia /MOPMC
HQ2 4 8	1992	478000	Midwest	*Malus baccata mandshurica*	Manchurian crab apple	Asia /Canada/NDPMC
HQ2 4 9	1966	9034666		*Euonymus atropurpureus*	wahoo	Riley Co., KS /KSPMC
P W 1	1966	9050512		*Liquidambar styraciflua*	American sweetgum	/Forest Keeling Nursery, Elsberry, MO
P W 2	1965	9050514		*Juniperus virginiana canaerti*	Canert juniper	/Nelson Nursery, Enid, OK

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2009. Page 5

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
P W 3	1966	9050513		*Juniperus horizontalis glauca*	blue creeping juniper	/MIPMC
P W 4	1966	9000399		Quercus rubra	northern red oak	Greenwood Co, KS /KSPMC
P W 5-6	1971	9001455	Emerald	Fraxinus sp.	ash	Marshall Nursery, Arlington, NE /KSPMC
P 21 1-6	2001	9050416		*Quercus prinoides*	dwarf chinkapin oak	Salem, NE /PI Sta. Ames, IA
P 22 1-5	2001	566597	Patriot	*Ulmus* hybrid	elm	US Nat'l Arboretum /NCRPIS
P S 1-6, 8-10	1977	399400		*Pinus nigra*	Austrian pine	Yugoslavia /NCRPIS
P S 7, 11-30	1981	9034670		*Pinus nigra*	Austrian pine	/KSU Forestry
PQ S 31-50	1977	399402		*Pinus sylvestris*	Scots pine	Yugoslavia /NCRPIS
Q S 51-70	1977	399403		*Pinus sylvestris*	Scots pine	Yugoslavia /NCRPIS
Q S 71-90	1977	399404		*Pinus sylvestris*	Scots pine	Yugoslavia /NCRPIS

Table 3. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs removed in 2009.

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Germplasm Release Name	Genus/ Species	Common Name	Origin/ Source
F4 3 6-10	1968	9004461		Platycladus orientalis	oriental arborvitae	/OK State Nursery Norman, OK /KSPMC
F4 1 6-10	1972	9004434		Platycladus orientalis	oriental arborvitae	Deuel Co., NE /HPHRS

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs. Page 1

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
B2 3 1-5		9050529	bitter sweet	08	08	5	5	100							
			Celastrus scandans		09	5	5	100				23	47		
C1 20 A-E	FRPE	9004302	green ash	61	70	5	5	100	2			605	798	17	
			Fraxinus pennsylvanica		74		5	100	3			658	1054	20	
			Butler Co., KS /KSPMC		78		5	100	3			650	1150		
					79		5	100	3			800	1150		
					83		5	100	3	4	3	800	1175	27	
					85		4	80	3		4		1219	28	
					86		4	80	5	5		975		29	
					88		4	80	1			933		34	
					90		4	80	3	5					
					93		4	80					1372	36	
					05		4	80					1411		
					06		4	80						41	
C1 21 A-E	FRPE	9004304	green ash	61	70	5	5	100	1			566	833	17	
			Fraxinus pennsylvanica		74		5	100	3			622	1041	21	
			Franklin Co., KS /KSPMC		78		5	100	3			800	1100		
					79		5	100	1			800	1100		
					83		5	100	3	4	3	900	1310	30	
					85		5	100	3				1280	30	
					86		5	100	6			762			
					88		5	100	2			733		33	
					90		5	100	1	1					
					93		5	100					1292	36	
					05		4	80					1416		
					06		4	80						44	
E3 (see bur oak map)		9050077	white oak	95	02	4	4	100					448	6	
			Quercus alba		05		4	100					568	10	
			Lancaster Co., NE /KSPMC		07		4	100					728	12	
E3 21 5-7 /P21 1-6	QUPR	9050416	dwarf chinkapin oak	01	01	9	9	100					23		
			Quercus prinoides		02		8	89	6	7	5	26	31		Leaf cutter bee damage
			/NCRPIS		03		8	89				42	41		
					04		8	89				67	66		Some deer browse
					05		8	89		5	4	93	83		
					06		8	89		1	4	109	109		Nos. - 7 severe MD; 6 - DD

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F1 1 1-2; 2 1,4	PLOC	9049957	*Platanus occidentalis* Brownville, NE /UNL-Lincoln	85	85	4	4	100	3		2	89	178		
					86		4	100	4	4		260	240		
					87		4	100	5			442	487	6	
					88		4	100	3	3	3	553	615	10	
					89		4	100	5	5		587	714	13	
					95		4	100					1213	27	
					04		4	100					1786	36	
					09		4	100					2063	40	
F1 1 10-19	LIVU	107630	Cheyenne European privet *Ligustrum vulgare* /NDPMC	66	70	10	5	50	1			290	320		
					71		5	50	1			320	396		
					73		5	50	1						
					74		5	50	1			411	503		
					75		5	50	5			490	620		
					76		5	50	5			506	650		
					78		5	50	3			650	650		
					79		5	50	1			600	500		
					87		5	50	4			630	300		
					95		5	50					332		
					98		5	50					351		
					00		5	50					366		
F1 2 2-3; 3 1,4-5	PLOC	9049956	*Platanus occidentalis* Burt Co., NE /UNL-Lincoln	85	85	5	5	100	3		2	93	189		
					86		5	100	2	4		176	290		
					87		5	100	3			401	492	6	
					88		5	100	2	3	2	505	607	10	
					89		5	100	4	5		545	707	12	
					95		5	100					1225	25	
					04		5	100					1625	31	
					09		5	100					1770	33	
F1 2 5; 3 2-3	PLOC	9049955	*Platanus occidentalis* Marysville, KS /UNL-Lincoln	85	85	3	3	100	2		2	102	183		
					86		3	100	1	4		200	310		
					87		3	100	3			453	512	7	
					88		3	100	2	3	2	557	615	11	
					89		3	100	4	5		608	723	14	
					95		3	100					1304	30	
					04		3	100					1787	39	
					09		3	100					1925	44	
F1 4 3-5	CELA	9050263	sugarberry *Celtis laevigata* /NCRPIS	97	97	3	3	100	5				107		
					99		3	100					337		
					00		3	100					465		
					01		3	100	1				558		
					02		3	100	4	1	3	509	593		
					06		3	100					908	18	
					07		3	100				753	1005	20	

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F1 11 1-11	COMA21	9055585	Cornelian cherry dogwood	89	89	11	11	100	2	5		3	8		
			Cornus mas		90		11	100	2	4	2	31	78		1,4-5 - frost damage, some die back
			Central Europe /NY		91		11	100				45	98		
			/MOPMC		92		11	100				53	135		
					93		11	100		3		92	173		
2-11					99	10	10	100				259	334		Good fruiting; 1- herbicide damage
					03	10	10	100					353		All but 2 with good fruit production
					08		10	100					365		
F1 12 3-12	COMA3	9083247	American hazelnut	07	07	10	10	100				13	44		
			Corylus Americana		08		10	100				28	51		
			/MOPMC		09		10	100				47	60		
F1 13 1-5	ELAEA	9050524	Silverscape®olive	07	07	5	5	100				60	69		
			Elaeagnus X 'Jefmorg'		08		5	100				210	225		
			Lincoln-Oakes Nursery		09		5	100				314	315		
			/NDPMC												
F1 13 6-10	PHOP	9050522	common ninebark	07	07	3	3	100				65	45		
			Physocarpus opulifolius		08		3	100				118	91		
			Bucks Co., PA /NCRPIS		09		3	100				167	116		
F1 14 1-5	RIAM2	9082687	American black currant	07	07	3	3	100				32	51		
			Ribes americanum		08	5	5	100				51	60		Two replants
			/Big Sioux Nursery		09		5	100				63	63		
			Watertown, SD												
			/NDPMC												
F1 14 6-10	PHMI4	9050530	littleleaf mock orange	08	08	5	5	100				42	46		
			Philadelphus microphyllus		09		5	100				37	40		
			Sevier Co., UT /NCRPIS												
F1 15 1-5	PHOP	9050531	common ninebark	08	08	5	5	100				67	56		
			Physocarpus opulifolius		09		5	100				78	94		
			/NCRPIS												
F1 18 1-5	LIOB	477010	border privet	90	90	5	5	100	1	2	1	58	55		
			Ligustrum obtusifolium		91		5	100				84	79		
			/MIPMC/NCRPIS		92		5	100				111	102		
					93		5	100				190	137		
					94		5	100	2			235	164		
					99		5	100				386	288		Excellent fruit production
					05		5	100					296		

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs. Page 4

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F1 19 1-5	PHME13	9050500	black chokeberry	06	06	4	4	100					54		
			Photinia melanocarpa		07	(5)	4	100				36	48		
			/NCRPIS		08		4	100				51	67		
					09		4	100				43	63		
F1 19 6-10	PHME13	323957	black chokeberry	06	06	5	5	100				42	46		
			Photinia melanocarpa		07		5	100				47	47		
			/NDPMC		08		5	100				69	72		
					09		5	100				86	77		
F1 20 1-5	VIRU	9050482	southern black haw	03	03	4	4	100	7			51	39		
			Viburnum rufidulum		04	(5)	3	80	6			30	34		
			/NCRPIS		05		3	80				38	62		
					06		3	80					76		
					07		3	80				83	160		
					08		3	80				121	161		
F1 20 6-10	VIRU	9050483	southern black haw	03	03	5	5	100	6			36	44		
			Viburnum rufidulum		04		5	100	5			33	46		
			/NCRPIS		05		5	100				47	69		
					06		5	100					84		
					07		5	100				102	130		
					08		5	100				142	162		
F1 21 1-5	SPFL9	9050417	spiraea	01	01	5	5	100	2			56	78		Weed comp; leaf cutter bee damage
			Spiraea flexuosa		02		5	100	6	6	2	42	49		Heavy deer browse
			/NCRPIS		03		5	100	5			49	64		Fall flowers - 3 plants
					04		5	100	6			44	58		
					05		4	80				48	53		No. 5 - gone
					06		3	60				64	73		
F1 21 6-10	XASO3	9050418	yellowhorn	01	01	5	5	100	3			34	60		Weed comp; leaf cutter bee damage
			Xanthoceras sorbifolium		02		5	100	4	7	3	39	56		Medium deer browse
			/NCRPIS		03		5	100	4			81	89		No. 5 - die back; recovered summer
					04		5	100	5			93	105		
					05		5	100				117	134		
					06		5	100		2	1	177	178		
					08		5	100							First flowering and fruit production
F1 22 1-5	COSA81	9050425	blood-twig dogwood	02	02	5	5	100	4	4	4	27	80		Heavy browse
			Cornus sanguinea		03		5	100	3			69	106		No. 3 - tip breakage - boring insect
			/NCRPIS		04		5	100	6		7	170	148		
					05		5	100				260	198		
					06		5	100				297	224		Second flush - flowering/fruiting-Sept.
					07		5	100				363	256		

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs. Page 5

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F1 22 6-10	COSA81	9050426	blood-twig dogwood	02	02	5	5	100	3	6	5	42	57		Medium browse
			Cornus sanguinea		03		5	100	6		5	74	81		
			/NCRPIS		04		5	100	3		4	181	169		
					05		5	100				241	212		
					06		5	100				259	226		Second flush - flowering/fruiting-Sept
					07		4	80				236	240		No. 1 – dead
F1 23 1-5	COCO10	9050427	smokebush	02	02	5	5	100	2	3	2	50	84		Slight browse
			Cotinus coggygria		03		5	100	1			92	151		
			/NCRPIS		04		5	100	4			137	219		
					05		5	100				185	258		
					06		5	100				243	307		
					07		5	100				253	329		
F1 23 6-10	HYAR6	9050498	silver leaf hydrangea	06	06	5	5	100				15	36		
			Hydrangea arborescens		07		4	80				31	35		
			radiata		08		4	80				45	51		
			/NCRPIS		09		3	60				49	49		
F1 24 1-5	SOAU	9050429	mountain ash	02	02	5	5	100	6	7	4	20	46		Browse
			Sorbus aucuparia		03		3	60	5			39	93		
			/NCRPIS		04		2	40	3			53	120		
					05		2	40				88	180		
					06		2	40				123	238		Deer damage
					07		2	40				148	296		
F1 24 6-10	SOTO8	9050430	wild service tree	02	02	5	5	100	5	5	6	16	61		Browse
			Sorbus torminalis		03		5	100	6			21	68		
			/NCRPIS		04		5	100	3	6	6	17	92		No. 2 - girdled by deer
					05		5	100				28	139		
					06		5	100				40	180		
					07		5	100				36	186		
F1 25 1-3	SHAR	9050431	silver buffalo berry	02	02	2	2	100	6	6	7	14	61		Browse
			Shepherdia argentea		03		2	100	3			31	104		
			/NCRPIS		04		2	100	5			82	176		Mechanical damage
					05	1	1	100				117	211		No. 1 - Disked out.
					06	(2)	1	100				146	268		
					07		1	100				191	315		
F1 25 6-10	SOTO8	9050432	wild service tree	02	02	4	4	100	7	1	2	16	47		Browse
			Sorbus torminalis		03		4	100	8			23	39		No. 9 - replanted
			/NCRPIS		04		3	60	5	5	5	17	60		No. 3 - deer damage
					05		3	60				25	104		
					06		3	60				36	144		
					07		3	60				41	174		

Table 4. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs. Page 6

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F1 26 1-6	SYVU	9050007	common lilac	85	91	6	6	100							Transplanted from Field G
			Syringa vulgaris		92		6	100				106	121		Powdery mildew
			Phillips Co., KS /KSPMC		93		6	100				152	150		No. 6 - leaves dried up early
					94		6	100							Mildew
					95		5	83					186		
					05		5	83					252		
					09		5	83					266		
F2 4 1-10	PYUS2	9006095	Harbin pear	67	70	10	10	100	3			210	238		
			Pyrus ussuriensis		71		10	100	3			213	322		
			Morden, Manitoba, CAN		73		10	100	3						
			/NDPMC		74		10	100	3			488	533		
					75		10	100	3			549	610		
					76		10	100	3			640	732		
					78		10	100	3			670	750		
					79		10	100				770	770		
					83		10	100	3	4	3	1000	825		
					88		10	100	2	2	3	1280	880		
					93		9	90					1045	24	Good fruit production; No. 6 - wind
					96		9	90	1				1119		damage
					01		8	80	4				974	24	
					07		8	80					1159	33	
F2 9 1-4	DIVI5	9050011	common persimmon	89	89	4	4	100	9	3		3	13		
			Diospyros virginiana		90		4	100	1			22	45		
			/NCRPIS		91		4	100				29	68		
					92		4	100				70	129		
					93		4	100		3	5	125	203		
					98		4	100				345	476		Mean shoot growth - 42-cm
					99		4	100					605		Nos. 1 & 2 - herbicide damage
					03		4	100					605		No. 1 - a resprout; fruit amount - 5
					08		4	100					767		
F2 11 1-5	CELAR	9050519	netleaf hackberry	07	07	5	5	100				26	47		
			Celtis laevigata var		08		5	100				30	50		
			canadensis		09		5	100				35	51		
			Union Co., NM												
			/NCRPIS												
F2 11 6-10	ALMA7	9050518	seaside alder	07	07	4	4	100				42	64		
			Alnus maritime subsp.		08	(5)	4	100				91	110		
			oklahomensis		09		4	100				150	184		
			Tishomingo, OK/ISU,												
			Ames, IA /NCRPIS												

Table 4. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs. Page 7

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F2 12 1-5	CECA4	9050520	red bud	07	07	5	5	100				49	58		
			Cercis canadensis		08		5	100	5			74	72		
			Van Buren Co., IA		09		5	100				94	78		
			/NCRPIS												
F2 12 6-10	CECA4	9050521	red bud	07	07	5	5	100				51	65		
			Cercis canadensis		08		5	100	3			77	80		
			Keokuk, Lee Co., IA		09		5	100				103	104		
			/NCRPIS												
F2 13 1-5	PTTR	9050523	common hop-tree	07	07	5	5	100				59	115		
			Ptelea trifoliate		08		5	100				115	151		
			Van Buren Co., IA		09		5	100				189	191		
			/NCRPIS												
F2 13 6-10	CRCH	9076686	fireberry hawthorn	07	07	5	5	100				15	37		
			Crataegus chrysocarpa		08		5	100					51		
			Lincoln-Oakes Nursery		09		5	100				32	55		
			/NDPMC												
F2 14 1-5	QUAL	9050532	white oak	08	08	5	5	100				47	59		
			Quercus alba		09		5	100				65	81		
			Richardson Co., NE												
			/NCRPIS												
F2 14 6-10	RHCO	9050537	shining sumac	09	09	5	5	100				86	69		
			Rhus copallinum												
			Iroquois Co., IL /NCRPIS												
F2 15 6-10	CHLI	9050543	desert willow	09	09	5	5	100				23	47		
			Chilopsis linearis												
			Meade Co., KS /KSPMC												
F2 24 1-5	SYPE2	9006225	Peking lilac	73	73	5	5	100	3			78	70		
			Syringa pekinensis		74		5	100	3			157	130		
			/NDPMC		75		5	100	3			210	230		
					76		5	100	3			310	315		
					78		5	100	3			440	400		
					79		5	100	1			440	500		
					83		5	100	1	3	2	700	610		
					93		5	100					665		
					02		5	100					768		
					07		5	100					793		

Table 4. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F2 24 6-10	FORSY	9034667	early forsythia hybrid	73	73	5	5	100	1			88	73		
			Forsythia europaea X		74		5	100	1			116	143		
			ovata		75		5	100	3			142	189		
			/NCRPIS		76		5	100	3			180	201		
					77		5	100	3			210	215		
					78		5	100	3			315	255		
					79		5	100	1			300	300		
					83		5	100	1	2	2	470	350		
					93		5	100					350		
					02		5	100					305		
					07		5	100					252		
F3 2 1-11	QUPA2	9001069	pin oak	67	70	11	9	82	3						
			Quercus palustris		71		9	82	5			290	332		
			/Manhattan Nursery		74		9	82	5			457	518		
			Manhattan, KS		75		9	82				488	700		
					76		9	82				670	762		
					78		8	73				800	960		
					01		8	73					1334	37	
					07		7	67					1670	43	
F3 3 2-6	ULPA	486339	lace-bark elm	02	02	3	3	100	4	1	3	19	58		
			Ulmus parvifolia		03	5	5	100				30	78		Added 2 new plants
			/NCRPIS		04		5	100	2	2	2	73	163		Good clean foliage
					05		5	100				123	250		
					06		5	100					317		
					07		5	100					384		
F3 7 1-5	BEPA	9050478	paper birch	03	03	5	5	100					147		
F3 7 1			*Betula papyrifera*		04		1	20	6	5	3	86	173		
			western North Dakota		05		1	20				82	188		
			/NCRPIS		06		1	20					191		Deer damage
					07		1	20				89	201		
					08		1	20				136	245		
F3 7 2-4	POAL7	9050499	white poplar	06	06	3	3	100					168		No. 2 - deer damage
			Populus alba		07		3	100				268	315		
			South Korea /NCRPIS		08		3	100					499		
					09		3	100				486	778		
F3 7 6-10	TICO2	9050481	littleleaf linden	03	03	2	2	100				20	40		
6			*Tilia cordata*		04		1	50	5	4	5	51	67		
			Ukraine /NCRPIS		05		1	50				83	110		
					06		1	50					167		
					07		1	50				127	240		
					08		1	50				196	300		

Table 4. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs. Page 9

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F3 7 7-11	POTR5	9050535	quaking aspen	09	09	5	5	100				100	189		
			Populus tremuloides												
			Platte Co., NE/NCRPIS												
F3 8 1-5	CABE8	9050479	European hornbeam	03	03	5	5	100				22	67		
			Carpinus betulus		04		5	100	4	4	5	38	83		
			Ukraine /NCRPIS		05		4	80				58	104		
					06		4	80					156		
					07		4	80				75	158		
					08		4	80				111	204		
F3 8 6-10	CABE8	9050480	European hornbeam	03	03	3	3	100				28	62		
			Carpinus betulus		04		3	100	5	4	3	32	61		
			Ukraine /NCRPIS		05		3	100				43	73		
					06		3	100					90		
					07		3	100				48	73		
					08		3	100				87	119		
F3 10 1-10	BENI	9034682	river birch	71	83	10	10	100	1	4	3	1100	1220		
			Betula nigra		86		10	100				1280	1300		
			Houston Co., MN		95		10	100					1359		
			/NCRPIS		07		10	100					1525	32	
F3 12 1-10	CEOC	9050497	common hackberry	06	06	10	10	100					78		
			Celtis occidentalis		07		10	100				60	90		
			Forest Keeling Nursery		08		10	100				75	100		
			Elsberry, MO		09		10	100				74	125		Heavy deer browse
F3 13 1-10	CEOC	9066615	common hackberry	06	06	10	10	100					116		
			Celtis occidentalis		07		10	100				106	138		
			Oklahoma		08		10	100				162	204		
			/KSPMC/NMPMC		09		10	100				216	298		Heavy deer browse
F3 14 1-5	CACA18	9050501	American hornbeam	06	06	5	5	100					60		
			Carpinus caroliniana		07		5	100				43	66		
			MN, Wisc. /NCRPIS		08		5	100				68	80		
					09		5	100				89	112		
F3 14 6-10	ULTH	9050503	rock elm	06	06	5	5	100					69		
			Ulmus thomasii		07		5	100				29	66		
			Dixon Co., NE /NCRPIS		08		5	100				88	86		
					09		5	100				31	69		
F3 15 1-10	FOPOP	9050502	elbow bush	06	06	10	10	100					92		
			Foresteria pubescens var		07		9	90				20	106		
			pubescens		08		9	90				23	127		
			/NCRPIS		09		9	90					165		

Table 4. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F3 19 1-10	FRPE	9004302	green ash	71	75	10	10	100	1			305	457		
			Fraxinus pennsylvanica		76		10	100	1			396	518		
			Butler Co., KS /KSPMC		78		10	100	1			475	670		
					86		10	100	5			732	1200		
					87		10	100	5				1043		
					88		10	100	2	3		798			
					90		10	100	4	2					
					95		9	90					1173		No. 1 – dead
					05		8	80					1236		
F3 20 1-5	ULMUS	341756	Holland elm hybrid	71	75	5	4	80	5			225	430		
			Ulmus X *hollandica*		76		4	80	5			290	470		
			/NCRPIS		77		4	80	3			335	500		
					78		4	80	3			390	550		
					79		4	80	3			400	650		
					86		4	80	5			457	1200		
					95		3	60					1104		No. 1 – top dead
					05		3	60					1214		
F3 20 6-10	FREX80	265620	European ash	73	73	5	5	100				30	174		
			Fraxinus excelsior		74		5	100				61	226		
			West Germany /NCRPIS		75		5	100	5			104	310		
					76		5	100	5			155	350		
					77		5	100	3			244	457		
					78		5	100	3			260	490		
					79		5	100	1			347	536		
					96		4	80					664	24	No. 4 - is a sucker
					07		1	20					822	34	
F3 21 1-5	QUERC	9034674	Swedish hybrid oak	72	72	5	5	100	3			9	37		
			Quercus sp.		73		5	100	3			27	61		
			/UNL-Lincoln /NCRPIS		74		5	100	3			52	113		
					75		5	100	5			132	192		
					76		5	100	5			183	275		
					77		5	100	5			250	350		
					78		5	100	5			290	430		
					79		5	100	5			350	500		
					83		5	100	3	6	4	500	650	15	
					88		5	100	3	3	3	661			
					89		5	100					873		
					90		5	100	4	8	9				
					93		5	100					897	23	No. 3 - top out
					96		5	100	8				941		
					01		5	100					1000	29	
					06		5	100					1200	28	

Table 4. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F3 21 6-10	QURO2	9017646	English oak	72	72	4	4	100	3			15	73		
			Quercus robur.		73	(5)	4	100	5			61	107		
			/ISU Hort Farm /NCRPIS		74		4	100	3			94	183		
					75		4	100	5			138	295		
					76		4	100	5			195	365		
					77		4	100	5			220	435		
					78		4	100	5			270	525		
					79		4	100	3			350	600		
					83		4	100	1	1	1	600	780	18	
					88		4	100	2		9	740		25	
					89		4	100	2	1	9		909		
					90		4	100	3						
					96		4	100	5				951	32	No. 6 - top dead
					01		4	100					984		
					06		4	100					1123	32	
F3 22 6-10	QUPH	9050022	willow oak	90	90	5	5	100		2	3	22	32		
			Quercus phellos		91		4	80				21	34		Severe deer browse
			central TN /NCRPIS		92		4	80				52	81		
					93		4	80				97	151		No. 9 - small
					94		4	80	4			137	241	1	No. 9 - winter injury
					98		3	60							1 dead, mechanical
					99		3	60					363		
					04		3	60					504		
					09		3	60				408	832		Severe competition
F3 23 6-10	QUMA2	9004392	bur oak	72	72	5	5	100	5			17	26		
			Quercus macrocarpa		73		5	100	3			82	125		
			Payne Co., OK /KSPMC		74		5	100	3			76	184		
					75		5	100	3			160	300		
					76		5	100	3			240	365		
					78		5	100	3			330	512		
					79		5	100	1			425	600		
					81		5	100	1		8	800	670	18	
					83		5	100	1	6	1		840	25	
					85		5	100	1				980		
					89		5	100	1				980	29	
					90		5	100	1						
					93		5	100	1				1021	32	
					96		5	100	1				1112		
					01		5	100	1				1171	36	
					07		5	100					1318	38	

Table 4. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs. Page 12

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F3 24 1-10	QUAC80	434253	sawtooth oak	73	73		10	100	3			64	66		
			Quercus acutissima		74		10	100	3			111	137		
			/GAPMC		75		10	100	3			200	270		
					76		10	100	3			275	305		
					78		10	100	3			400	550		
					79		10	100	3			450	650		
					83		10	100	1	3	3	650	800	20	
					89		10	100	3		1		951		
					93		10	100					959	43	No. 8 - suckers
					02		10	100					1230	30	
					07		9	90					1242	33	No. 4 - top gone
F4 5 10-11	JUCO12	323932	shore juniper	73	75	7	7	100	5			100	25		
			Juniperus conferta		76	(9)	7	100	3			160	25		
			/MDPMC		78		7	100	3			170	40		
					79		7	100	3			245	50		
					83		7	100	2	3	3	400	50		
					93		7	100					59		
					02		7	100	3	5			46		
					07		7	100		2		224	42		
F4 10 9-13	JUNIP	9004334	columnar juniper	75	78	5	5	100	5			60	175		
			Juniperus sp		79		5	100	5			70	220		
			Custer Co., NE /HPHRS,		83		5	100	3	5	3	160	430		Cedar-Apple rust
					99		5	100					963		
					04		5	100					1060		
					09		5	100				199	1112		
F4 11 1-10	CUBA	9050504	Modoc cypress	06	06	10	10	100				17	35		
			Cupressus bakeri		07		9	90				28	45		
			/Lawyer Nursery Plains,		08		6	60		6		39	54		
			MT		09		6	60				53	58		
F4 12 1-5	PISYM	9076719	Mongolian pine	09	09	4	4	100				42	44		
			Pinus sylvestris var. *mongolica*			(5)									
			Shangzhi, China /NCRPIS												
F4 12 1-10	PISYM	9076718	Mongolian pine	09	09	5	5	100				51	55		
			Pinus sylvestris var. *mongolica*												
			Nenjiang, China /NCRPIS												
F4 13 1-5	TADI2	9050542	bald cypress	09	09	5	5	100				35	77		
			Taxodium distichum												
			Real Co., TX /NCRPIS												

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F4 18 1-10	THOC2	477011	northern white cedar	82	83	10	10	100	5	5	3	47	73		
			Thuja occidentalis		96		10	100	3				472		
			/MIPMC		07		10	100					590		No. 3 - competition
F4 19 1-6	PISY	343949	Scots pine	76	76	(9)	4		7			20	15		
			Pinus sylvestris		77	6	6	100	5			40	30		
			/MDPMC		78		6	100	5			50	45		
					79		6	100	3			85	65		
					83		6	100	2	3	3	230	210	4	
					95		6	100					745		
					00		6	100					1027		
					05		6	100							
					07		4	67					1120		Nos. 1- dying; 3 & 5 - dead
F4 20 7-9	PISY	343948	Scots pine	76	76	(9)	1		7			30	15		
			Pinus sylvestris		77	3	3	100	7			20	20		
			/MDPMC		78		3	100	7			35	32		
					79		3	100	5			40	60		
					83		3	100	3	3	3	215	185	2	
					86		3	100				340	370		
					95		3	100					691		
					00		3	100					924		
					05		3	100							No. 9 - 90% dead
					07		1	33					975		Nos. 7 - dying; 8 & 9 - dead
F4 21/ 1-10	PIAB	9034668	Norway spruce	74	74	10	10	100	5			23	27		
			Picea abies		75		10	100	5			25	40		
			/Griffith State Nursery		76		10	100	5			40	60		
			Wisconsin Rapids, WI		77		10	100	3			60	75		
			/KSPMC		78		10	100	3			80	100		
					79		10	100	3			110	120		
					83		10	100	4			230	240	4	
					94		10	100	1				642		
					98		10	100					832		
					02		8	80							
					03		8	80					932		
					07		8	80							Nos. 6-7 - dead
					08		8	80					1083		No. 8 - dying

Table 4. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F4 22/ 1-10	PIST3	9004363	Mexican white pine	73	74	10	10	100	5						
			Pinus strobiformis		75		10	100	3			50	60		
			Lincoln Co. NM /RMFRS		76		10	100	3			75	95		
			/KSPMC		78		9	90	3			140	120		
					79		9	90	3			150	160		
					83		9	90	2			350	340	7	
					93		9	90					677	15	
					02		8	80					985		
					07		6	60					1149		Nos. 1, 5, & 8 - dead
F4 23/ 1-10	PINI	9004364	Austrian pine	73	75	10	10	100	3			70	75		
			Pinus nigra		76		10	100	3			120	110		
			N. Turkey /RMFRS		78		10	100	3			190	195		
			/KSPMC		79		10	100	3			200	220		
					83		10	100	1			430	465	15	
					93		10	100					843	23	No. 10 - disease resistant
					02		10	100					1112		Nos. 1 - dying: 4 - dead
					07		6	60					1010		
F4 25/ 8-20	PIHE	9034669	Heldreich pine	73	73	13	13	100	7						
			Pinus leucodermis		74	(20)	10	77	7						
			Yugoslavia /RMFRS, NE		75		8	61	7			10	15		
			/MDPMC		76		8	61	5			20	25		
					78		7	54	7			27	33		
					79		7	54	7			27	35		
					83		6	46	7			70	85		
					93		6	46					258		
					03		5	38					494	8	
					07		3	23					552		
GA 1 1-4	ULPA	250278	Chinese elm	91	91	10	10	100				14	53		
2 1-4			Ulmus parvifolia		92		10	100					59		
G 1/ A-B			Rochester, NY /MOPMC		93		10	100				60	96		
					94		10	100	2			84	113		Deer browse
					95		10	100					138		1 destroyed by deer, heavy browse
					05		10	100					742	11	

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
G 1/ B-E	ULPA	9004437	Chinese elm	74	77	4	3	75	3			130	175		
			Ulmus parvifolia		78		3	75	3			185	215		
			Woodard, OK /NRCS SO,		79		3	75	3			220	300		
			Stillwater, OK /KSPMC		83		3	75	4			400	600	8	
					93		3	75						16	
					98		3	75					1285		
					02		3	75					1321		
					03		3	75						30	
					04		3	75					1604		
					07		3	75					1783	31	E - top missing
G 2/ A-E	ULMUS	9004439	Offerle elm	63	70	5	5	100	5			323	643	10	
			Ulmus species		74		4	80	5			451	991	14	
			Edwards Co., KS /KSPMC		78		4	80	3			500	1050		
					79		4	80	1			500	1100		
					83		4	80	2			650	1330	27	
					93		4	80						33	
					97		3	60							C - dead
					02		2	40					1585	42	
					07		2	40					1775	45	
G 3/ A-E	ULPA	9013711	Chinese elm	63	70	5	5	100	3			457	640	11	
			Ulmus parvifolia		74		4	80	3			564	914	18	
			/USDA ARS, Woodard, OK		78		4	80	3			500	1500		
			/KSPMC		79		4	80	3			650	1450	28	
					83		4	80	3			600	1300	35	
					93		4	80							
					97		4	80					1574		
					02		4	80					1699	39	
					07		4	80					1850	42	D - top broken; E - main stem broken
G 3/ F-J	CEOC	9004256	common hackberry	63	66	5	5	100	2			415	445	6	
			Celtis occidentalis		70		5	100	2			530	713	15	
			Pottawatamie Co., KS		74		5	100	3			615	927	20	
			/KSPMC		78		5	100	5			500	850		
					93		2	40						45	
					97		2	40					1387		
					02		2	40					1433	55	
					07		2	40					1588	56	

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
G 4/ A-E	ULMUS	9004440	hybrid elm	63	70	5	5	100	3			299	689	10	
			Ulmus species		74		5	100	4			439	1006	15	
			/KSU Horticulture Farm		78		5	100	3			400	1100		
			Manhattan, KS		79		5	100	3			400	1300		
					83		5	100	5			400	1250	24	
					93		5	100						31	
					97		5	100					1428		
					02		5	100					1487	37	
					07		5	100					1600	40	B - top dead
G 8/ F-J	CEOC	9004255	common hackberry	63	66	5	5	100	1			390	427	5	
			Celtis occidentalis		70		5	100	3			597	668	14	
			Central Oklahoma /KSPMC		74		5	100	2			732	920	22	
					78		5	100	3			900	1100		
					79		5	100	1				1125		
					83		4	80	7			800	1200	33	I, J - much dead wood - herbicide
					93		3	60						45	
					97		3	60					1707		
					02		3	60					1960	54	
					07		3	60					1933	56	
G 9/ F-J	CAIL2	9034679	pecan	63	70	5	5	100	5			183	326		
			Carya illinoensis		74		5	100	3			427	628	9	
			/KSU Forestry, KS		83		5	100	3			450	1150	16	
					93		5	100						23	
					97		5	100					1747		
					02		5	100					1823	26	
					07		5	100					1905	28	
G 10/ F-J	CAIL2	9034680	pecan	63	70	5	4	80	4			207	290		
			Carya illinoensis		74		4	80	3			436	695	10	
			/KSU Forestry, KS		78		4	80	5			450	800		
					79		4	80	3			500	880		
					83		4	80	3			600	760	23	
					93		4	80						31	
					97		4	80					1833		
					02		4	80					1996	36	
					07		4	80					2176	39	
G 2/ K-O	JUVI	9004329	eastern red cedar	63	70	5	5	100	1			323	421	9	
			Juniperus virginiana		74		5	100	1			451	567	15	
			/KSU Forestry, KS		78		5	100	3			500	750		
					79		5	100	1			500	750		
					83		5	100	3			600	760		
					02		5	100					1055		
					07		5	100					1149		

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
G 4/ K-N	JUVI	9004333	eastern red cedar	63	70	4	4	100	1			299	351	6	
			Juniperus virginiana		74		4	100	1			457	564	12	
			Harper Co., OK		78		4	100	1			500	700		
					83		4	100	3			600	825		
					02		4	100					1126		
					07		4	100					1266		
G 6/ K-O	JUVI	9004332	silver eastern red cedar	63	70	5	5	100	1			378	424	9	
			Juniperus virginiana		74		5	100	1			530	530	17	
			/SPR Sta.		78		5	100	3			550	700		
					83		5	100	4			750	900		
					02		5	100					1256		
					07		4	80					1303		
G 8/ K-O	PIPO	9034671	ponderosa pine	63	70	5	3	60	7			131	152		
			Pinus ponderosa		74		3	60	7			296	375	9	
			/KSU Forestry, KS		78		3	60	5			300	550		
					83		3	60	5			500	1250		
					02		3	60					1530		
					07		3	60					1682		
G 9/ K-O	PINI	9013469	Austrian pine	63	70	5	5	100	6			143	140		
			Pinus nigra		74		5	100	4			311	341		
			/KSU Forestry, KS		78		5	100	3			500	600		
					79		5	100	5			500	670		
					83		5	100	3			700	750		
					97		5	100							
					02		3	60					1311		
					07		0	0							
G 15/ U-Y	QUAC80	9034673	sawtooth oak	64	70	5	4	80	4			286	390	6	
			Quercus acutissima		74		4	80	3			533	701	12	
			/GAPMC		75		4	80	4			579	732		
					78		4	80	3			900	1000		
					79		4	80	3			850	1000		
					93		3	60					938	39	
					96		2	40					1055		
					98		2	40					1098	43	
					03		2	40						45	
					04		2	40					1205		
					09		2	40					1213	48	

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs.

Plot Location		PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
G1 17	1-3	JUNI	9004312	black walnut	77	77	3	3	100	3			10	45		
				Juglans nigra		78		3	100	1			80	117		
				Doniphan Co., KS		79		3	100	1			250	240		
						83		3	100		1		550	575	9	
						93		3	100					1155	18	
						01		3	100					1329	24	
						06		3	100					1600	31	
G2 16	1-8	ULMUS	9004462	elm	76	76	8	8	100	3			110	130		
				Ulmus sp.		77		8	100	3			270	174		
				/NCRPIS		78		8	100	1			420	315		
						79		8	100	1			600	400		
						83		8	100	1	3	3	900	860		
						86		8	100				914	1200		
						00		8	100					1551		
						05		8	100					1713		
G2 23	6-8	AEGL	9030309	OH buckeye	81	81	3	3	100				15	52		
				Aesculus glabra		82		3	100				15	58		
				/NCRPIS		83		3	100	6	6	3	24	64		Leaves dropping 8/20.
						85		3	100	5		8		88		
						86		3	100	4	4	5	95	142		
						91		3	100				206	236		
						93		3	100					278		
						05		3	100					501		
G2 24	6-7	ACPL	9030308	Norway maple	81	81	3	3	100				21	118		
				Acer plantanoides		82		3	100				30	104		
				/NCRPIS		83		2	67	6	5	5	55	110		
						85		2	67	5			120	274	5	
						87		2	67	5	5	5	100	280		
						93		1	33					364		
						05		1	33					478		
G3 16	1-8	QUAC80	9008245	sawtooth oak	76	76	8	8	100	5			25	40		
				Quercus acutissima		77		8	100	5			90	70		
				/TXPMC, Knox City		78		8	100	3			150	170		
						79		8	100	5			220	300		
						83		8	100	3	3	3	420	550	7	
						85		8	100	1	1	2	427	518		
						95		8	100					953	18	
						00		8	100					1055		
						05		8	100					1095	23	

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
G3 18 1-8	QUMA2	9004392	bur oak	76	76	8	8	100	3			15	80		
			Quercus macrocarpa		77		8	100	3			80	140		
			City Park, Stillwater, OK		78		8	100	3			100	180		
			/KSPMC		79		8	100	3			260	300		
					81		8	100	3				425		
					83		8	100	3	1	4	560	575	13	
					85		8	100	5			457	518	23	
					86		8	100	2			549	600		
					89		8	100						22	
					93		8	100					853	27	
					95		8	100					933	30	
					00		8	100					1048		
					05		8	100					1042	35	
G3 19 7	CACR27	9034858	chestnut hybrid	76	76	1	1	100	5			5	15		
			Castanea crenata		77	(8)	1	100	3			25	45		
			/MOPMC		78		1	100	3			80	90		
					79		1	100	3			180	200		
					83		1	100	1	1	2	520	440		
					85		1	100	1			460	457		
					93		1	100					679		
					95		1	100					738		
					00		1	100					884		
					05		1	100					842		
HQ1 1/1	NYSY	9050506	black gum	66	66	1	1	100							
			Nyssa sylvatica		06	1	1	100					1050	22	
			/Forrest Keeling Nursery, Elsberry, MO												
HQ1 2/2	MALUS	514275	hybrid crab apple	77	77	1	1	100							
			Malus sp.		07	1	1	100					900	29	
			Clinton Co., MI /MIPMC												
HQ1 3/1	TIEU3	9050505	Redmond Crimean linden	66	66	1	1	100							
			Tilia X *euchlora*		06	1	1	100				1483	1580	88	
			/Plumfield Nursery, Fremont, NE												
HQ1 5/1-10	JUSQ2	9030990	blue star juniper	82	82	4	4	100				10	5		Plants not hardened off; failed to
			Juniperus squamata		83	(10)	4	100				12	6		establish.
			Holland /NCRPIS		91		4	100				43	18		
					96		4	100	3			53	24		
					98		4	100				63	27		
					06		3	75				61	30		Declining; competition from grasses

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
HQ1 8/3	PIST3	9004363	Mexican white pine	77	77	1	1	100							
			Pinus strobiformis		06	1	1	100					1150		
			Lincoln Co., NM /RMFRS, NE												
HQ2 2/16	SYOBD	9050510	Korean early lilac	76	76	1	1	100							
			Syringa oblate dilatate		06	1	1	100				24	268		
			/HPHRS												
HQ2 3/1	ULDAJ	421614	Japanese elm	77	77	1	1	100							
			Ulmus davidiana var		82	1	1	100	1	3	3	475	470	6	
			japonica		83	1	1	100	1	2	3	450	600	9	
			/USDA ARS Nurs. Crops		06	1	1	100					1925	75	
			Res. Sta., Delaware, OH												
P 22 1-5	ULMUS	566597	elm	01	01	5	5	100					103		
			Ulmus hybrid		02		5	100	1	2	2	74	125		Medium browse
			/NCRPIS		03		5	100				81	109		Severe rubbing and browse damage
					04		5	100			7	104	156		Heavy deer browse
					05		5	100				154	225		
					06		5	100		3	7	212	293		
P/S 1-6, 8-10	PINI	399400	Austrian pine	77	77	9	9	100	7			13	12		
			Pinus nigra		78	(10)	9	100	7			30	23		
			/NCRPIS		79		9	100	5			47	48		
					83		9	100	3			205	210	3	
					86		9	100	5			296	380		No. 9 produced seed
					96		9	100					668		
					01		9	100					817		
					06		8	89					1039		
P/S 7, 11-30, 55, 57, 83, 85	PINI	9034670	Austrian pine	81	83	25	25	100	5		3	28	22		
			Pinus nigra		86	(26)	23	92	5			64	62		No. 55 - produced seed
			/KSU Forestry, Manhattan, KS		95		23	92					337		
					01		23	92					615	20	
					05		23	92					750		
PQ/S 31-35, 37-50	PISY	399402	Scots pine	77	77	20	20	100	3			14	21		
			Pinus sylvestris		78		20	100	3			33	36		
			/NCRPIS		79		20	100	3			52	56		
					83		19	95	2		3	230	225	4	
					86		19	95	5			345	342		Nos. 48 & 50 - produced seed
					96		19	95					728		
					01		19	95					844	25	
					06		13	65					1009		

Table 4. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs.

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
P/W 1/ 1	LIST2	9050512	sweetgum	66	66	2	2	100							
			Liquidambar styraciflua		06		1	50				1564	1430	72	
			/Forest Keeling Nursery, Elsberry, MO												
P/W 1/ 2	JUVI	9050514	Canert juniper	65	65	1	1	100							
			Juniperus virginiana canaerti		06	1	1	100							Over topped with vines
			/Nelson Nursery, Enid, OK												
P/W 1/ 3	JUHO2	9050513	blue creeping juniper	66	66	1	1	100							
			Juniperus horizontalis glauca		07		1	100							
			/MIPMC												
P/W 1/ 4	QURU	9000399	northern red oak	66	66	1	1	100							
			Quercus rubra		06	1	1	100				1501	1130	44	
			Greenwood Co., KS /KSPMC												
P/W 1/ 5-6	FRPE	9001455	ash	71	71	2	2	100							
			Fraxinus *sp.*		06	2	2	100					1225	65	
			/Marshall Nursery, Arlington, NE												
Q/S 51-54, 56, 58-70	PISY	399403	Scots pine	77	77	18	18	100	3			18	24		
			Pinus sylvestris		78	(20)	18	100	3			35	36		
			/NCRPIS		79		18	100	3			55	57		
					83		18	100	1	4	3	245	240	5	
					86		18	100	5			381	413		52, 53, 58, 61-62, 65, 68 - prod. seed
					96		18	100					819		
					01		18	100					945	28	
					06		13	72					1178		
Q/S 71-82, 84, 86-90	PISY	399404	Scots pine	77	77	18	18	100	5			12	16		
			Pinus sylvestris		78	(20)	18	100	5			26	21		
			/NCRPIS		79		18	100	5			40	36		
					83		18	100	3	3	3	175	175	2	
					86		18	100	5			294	315		
					96		18	100					714		
					01		18	100					832	31	
					06		18	100					991		

Legend for miscellaneous tree and shrub evaluations:

Plot Location: Field number, row number, and plot (numbered spaces in the row).

E.g., B3 1 9-14 = Field Row Plot numbers
B3 1 9-14

CAN COV: Crown width or ground cover as measured in centimeters
DD: Deer Damage
DI: Disease Resistance, rating 1-9
IN: Insect Resistance, rating 1-9
MD: Mechanical Damage
NO. EST: Number Established
NO. SRV: Number Surviving
* May not agree with current plot number designations.

PCT SRV: Percent Survival
PLT DBH: Diameter at Breast Height in centimeters, measured at 137 cm above the ground
PLT HGT: Total plant height as measured in centimeters
VI: Plant Vigor, rating 1-9
YR PLT: Year Planted
YR REC: Year of Record

Figure 1. Plot Map Field F. Study No. 20I010K - miscellaneous trees and shrubs. ▲ North ▲

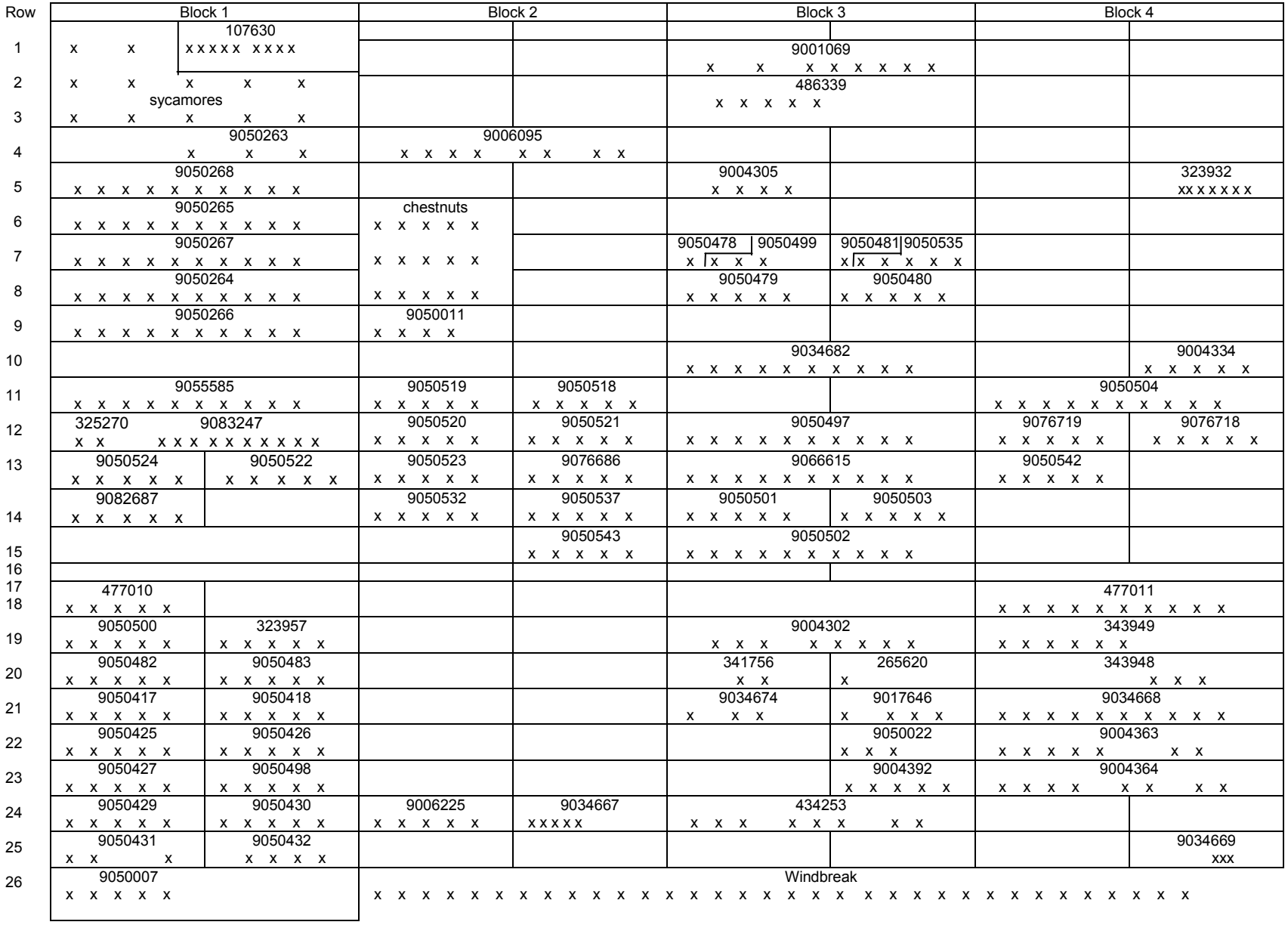
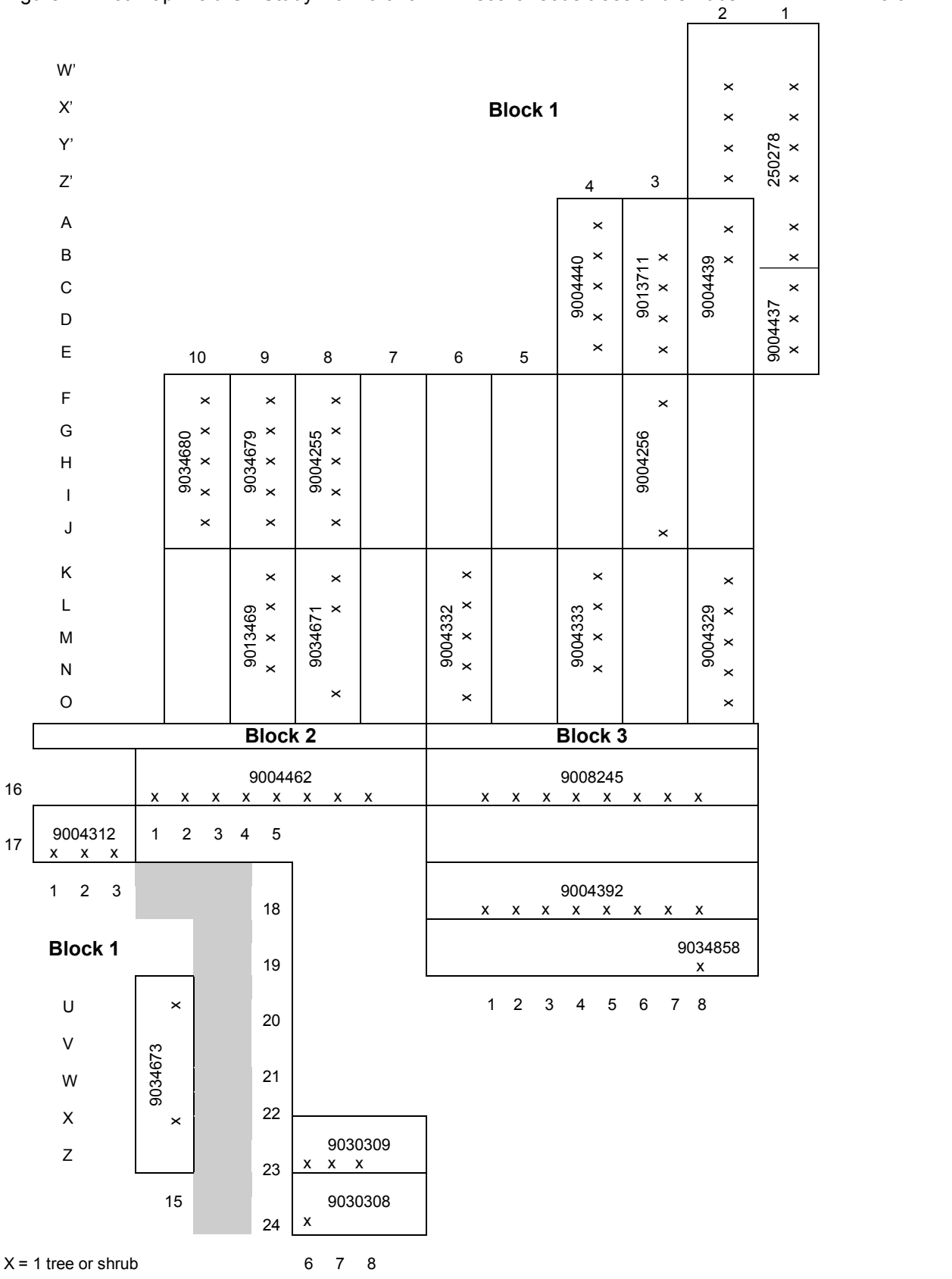


Figure 2. Plot Map Field G. Study No. 20I010K – miscellaneous trees and shrubs. ▲ North ▲



Evaluation of Selected Common Hackberry

Study No. 20I037K

Study Leader: John M. Row, Plant Materials Specialist

Introduction: The selection of woody plant materials is typically lengthy. The process can take 20 years or more. George and Frank (1973) observed that tree seedlings having larger stem diameters at 1 year continued to display that same characteristic following the second growing season in the nursery. Green ash (*Fraxinus pennsylvanica* Marsh.) seedlings graded into 4 grades based on height and stem diameters were field grown for 29 years. The growth rate of grade 1 stock exceeded the other grades in both diameter and height over the 29-year period. Grade 2 stock, likewise exceeded grades 3 and 4. Similar results were observed for American elm (*Ulmus americana* L.) where grade 1 stock exceeded two other grades in height for 20 years and diameter for 15 years. Clausen (1963) reported that birch trees originally classified as small, medium, and large, maintained their relative position after 9 years in the field. A hypothesis was developed whereby superior seedling trees of common hackberry (*Celtis occidentalis* L.) might be selected from the nursery bed. The criteria for selection would be to select seedlings based on height, stem caliper, and form. It was theorized that such seedlings would prove to be superior. The work of George and Frank supports this theory. If true, the established trees would become the source material and eliminate the amount of time required to establish a productive seed orchard.

Problem: There are no reliable seed sources for hackberry cultivars adapted to western parts of Nebraska, Kansas, Oklahoma, and northeastern Colorado. Existing nursery stock is often of unknown origin and therefore of questionable quality. A tested and proven superior cultivar is needed to provide consistent, high quality plant material for farmstead and field windbreak plantings. The process for selecting quality nursery stock is lengthy.

Objective: Evaluate and select a superior source of common hackberry as an adapted native tree for use in windbreak and wildlife plantings in western Kansas, Nebraska, Oklahoma, and northeastern Colorado.

Procedure: The best single seedling was selected from 30 different accessions growing in a seedling production nursery at the Manhattan Plant Materials Center, Manhattan, Kansas. The origin of all accessions was from collection locations south of the Platte River in Nebraska. Seedlings (n) originating from Kansas (11), Nebraska (4), Missouri (8), Oklahoma (5), Iowa (1), and Arkansas (1), were selected. The 1-0 seedlings were planted in a spaced plant nursery on 9.1 m (30 ft) spacing, on a Belvue silt loam soil, 21 March 1988, in Field D-1 at Manhattan. Plants will be evaluated for vigor; growth rate and uniformity; resistance to insects, disease, and climatic factors.

Potential Products: Cultivar Release

Progress or Status: Minimal observation and site maintenance were performed this year.

Literature Cited:

Clausen, K. E. 1963. Nursery selection affects survival and growth of birch. USDA Forest Service Research Note LS-31. Lake States Forest Experiment Station. Washington, DC

George, E. J. and A. B. Frank. 1973. Graded nursery stock in shelterbelt type planting evaluated over 29-year span. *Tree Planters' Notes* 24:30-32.

Bur Oak Seed Source Study

Study No. 20I038K

Study Leader: John M. Row, Plant Materials Specialist

Introduction: Bur oak (*Quercus macrocarpa* Michx.) is a hardy, drought resistant, long-lived tree adapted to a wide range of growing conditions. On favorable sites it may attain heights of up to 30.5 m (100 feet). Bur oak is well known for its deep taproot system which provides drought tolerance and resistance to wind-throw. The principal factor discouraging the use of bur oak in Great Plains shelterbelts has been slow growth, especially the first year after planting.

Bur oak is widely distributed in the Great Plains. Its range extends from Texas north to central Saskatchewan. Most of the native populations are found on deep soils in bottomlands and occasionally on upland sites. A Nebraska study, reported by Dickie and Bagley (1980), suggested that there is considerable genetic variability in the species and that further evaluation is warranted. At the 1990 Great Plains Tree Improvement Committee (GP13) meeting, a motion was passed to initiate a bur oak seed source study for the Great Plains of North America.

Problem: No known cultivars of bur oak are available for conservation use. Superior bur oak cultivars are needed for watershed protection, for multi-row windbreaks, for landscape plantings for farmsteads and parks, for reforestation on disturbed lands, and for wildlife plantings throughout the Great Plains.

Objective: The principal objectives of the study are to determine the nature and extent of genetic variation present among bur oak families from selected sources in the Great Plains, to provide genetically improved bur oak seed for shelterbelt planting, provide germplasm that can be used for selection and trait improvement as well as advanced generation breeding, and to survey acorn weevil *Curculio* sp. distribution and its impact on seed quality.

Procedure: Acorns were collected from individual trees displaying superior phenotypic characteristics in the fall of 1990. Seed collections, consisting of 400 acorns, were shipped to the Nebraska Forest Service, Lincoln, Nebraska, for assembly of collections. Thirty acorns of selected accessions were shipped to trial sites for grow out. The Manhattan Plant Materials Center (PMC), Manhattan, Kansas, requested 52 accessions from central Great Plains sources. The PMC received only 22 accessions due to a poor acorn crop in some parts of the Great Plains. In addition to these collections, 2 local collections were included in the study at Manhattan, 'Lippert', Accession 9004392, and Accession 9050065. Accession 9050065, a collection that was made on the PMC, was also entered in the GP13 assembly for planting out at other trial sites. Acorns were planted in a soil-less mix in 656-mL (40-in^3) deepot^{TM} cells (Stuewe & Sons, Inc., Tangent, OR) in the spring of 1991 and placed in the greenhouse for grow out. Only enough trees from 16 accessions were available for the planting. The plot layout consisted of 5 replications with 2 plants per plot. The plants were spaced 4.6 x 4.6 m (15 x 15 ft) apart in a randomized complete-block design in the fall of 1992. A second collection was conducted in the fall of 1992. Sixteen accessions were received by the PMC from the second collection. These acorns were grown out in the greenhouse in 1993 and planted in the field 14 June 1993. There were enough seedlings to establish a 68.6 x 91.4 m (225 x 300 ft) field plot consisting of 26 accessions (Figure 1). The plot was surrounded by a border row composed of trees from the same sources. Some of the northern sources and individual trees of other entries did poorly. These were replaced by either white oak, (*Quercus alba* L.), Accession 9050077, or by green ash, (*Fraxinus Pennsylvania* Marsh.), Accession 9050087, to provide adequate competition for the remaining trees. A complete list of sources established at the Manhattan PMC, is listed in Table 1.

Table 1. Sources of bur oak established in the seed source study at Manhattan PMC.

Source ID	County	State	Accession Number	MLRA
275	Riley	KS	9050065	076
KSPMC	Payne	OK	9004392	80A
122	Bottineau	ND	9050153	055A
125	Shelby	IA	9050154	107
132	Pennington	MN	9050155	056
137	Allamakee	IA	9050156	105
225	Doniphan	KS	9050157	106
241	Thayer	NE	9050164	075
245	Gage	NE	9050158	106
246	Jefferson	NE	9050163	075
249	Douglas	NE	9050169	107
253	Nance	NE	9050160	102B
262	Dickinson	KS	9050159	075
265	Johnson	NE	9050161	106
267	Richardson	NE	9050162	106
269	Nemaha	KS	9050165	106
271	Miami	KS	9050166	112
274	Harvey	KS	9050167	075
501	Holt	MO	9050168	107
510	Platte	MO	9050169	107
520	Lafayette	MO	9050170	107
521	Howard	MO	9050171	115
523	Cherokee	OK	9050172	117
554	Creek	OK	9050173	084A
556	Sequoyah	OK	9050174	117
567	Woodward	OK	9050175	078

Potential Products: Cultivar Release

Progress or Status: Minimal observation and site maintenance were performed this year.

Literature Cited:

Dickie, S. G. and W. T. Bagley 1980. Variability of *Quercus macrocarpa* Michx. in an eastern Nebraska provenance study. *Silvae Genetica* 29:171-176.

► North ►

Figure 1. Plot Map Field E-2, PMC, Manhattan, KS. Study No. 20I038K - Bur Oak Seed Source Study.

B	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	B
B	520-1-1 9050170	520-1-2 9050170	267-1-1 9050162	267-1-2 9050162	137-1-1 9050156	137-1-2 9050156	567-1-1 9050175	567-1-2 9050175	Border	Border	Border	Border	Border	Border	B
B	125-1-1 9050154	125-1-2 9050154	246-1-1 9050163	246-1-2 9050163	392-1-1 9004392	392-1-2 9004392	262-1-1 9050159	262-1-2 9050159	274-1-1 9050167	274-1-2 9050167	265-1-1 9050161	265-1-2 9050161	510-1-1 9050169	510-1-2 9050169	B
B	253-1-1 9050160	253-1-2 9050160	087-1-1 9050087	523-1-2 9050172	521-1-1 9050171	521-1-2 9050171	225-1-1 9050157	225-1-2 9050157	267-1-1 9050162	267-1-2 9050162	122-1-1 9050153	122-1-2 9050153	245-1-1 9050158	245-1-2 9050158	B
B	501-1-1 9050168	501-1-2 9050168	087-1-1 9050087	275-1-2 9050065	249-1-1 9050176	249-1-2 9050176	241-1-1 9050164	241-1-2 9050164	132-1-1 9050155	132-1-2 9050155	556-1-1 9050174	556-1-2 9050174	554-1-1 9050173	554-1-2 9050173	B
B	267-2-1 9050162	267-2-2 9050162	241-2-1 9050164	241-2-2 9050164	249-2-1 9050176	087-2-2 9050087	501-2-1 9050168	501-2-2 9050168	125-2-1 9050154	125-2-2 9050154	225-2-1 9050157	225-2-2 9050157	271-1-1 9050166	271-1-2 9050166	B
B	275-2-1 9050065	087-2-2 9050087	392-2-1 9004392	392-2-2 9004392	271-2-1 9050166	271-2-2 9050166	554-2-1 9050173	554-2-2 9050173	265-2-1 9050161	265-2-2 9050161	137-2-1 9050156	137-2-2 9050156	556-2-1 9050174	556-2-2 9050174	B
B	246-2-1 9050163	246-2-2 9050163	567-2-1 9050175	567-2-2 9050175	122-2-1 9050153	122-2-2 9050153	523-2-1 9050172	523-2-2 9050172	269-2-1 9050165	269-2-2 9050165	274-2-1 9050167	274-2-2 9050167	520-2-1 9050170	520-2-2 9050170	B
B	087-3-1 9050087	521-3-2 9050171	253-2-1 9050160	253-2-2 9050160	132-2-1 9050155	132-2-2 9050155	245-2-1 9050158	245-2-2 9050158	521-2-1 9050171	521-2-2 9050171	510-2-1 9050169	510-2-2 9050169	262-2-1 9050159	087-2-2 9050087	B
B	262-3-1 9050159	262-3-2 9050159	249-3-1 9050176	077-3-2 9050077	510-3-1 9050169	510-3-2 9050169	087-3-1 9050087	523-3-2 9050172	253-3-1 9050160	253-3-2 9050160	125-3-1 9050154	125-3-2 9050154	077-3-1 9050077	554-3-2 9050173	B
B	225-3-1 9050157	225-3-2 9050157	269-3-1 9050165	269-3-2 9050165	137-3-1 9050156	137-3-2 9050156	271-3-1 9050166	271-3-2 9050166	265-3-1 9050161	265-3-2 9050161	556-3-1 9050174	556-3-2 9050174	267-3-1 9050162	267-3-2 9050162	B
B	241-3-1 9050164	241-3-2 9050164	501-3-1 9050168	501-3-2 9050168	392-3-1 9004392	392-3-2 9004392	245-3-1 9050158	245-3-2 9050158	520-3-1 9050170	520-3-2 9050170	132-3-1 9050155	132-3-2 9050155	122-3-1 9050153	122-3-2 9050153	B
B	262-4-1 9050159	262-4-2 9050159	269-4-1 9050165	269-4-2 9050165	245-4-1 9050158	245-4-2 9050158	274-3-1 9050167	274-3-2 9050167	275-3-1 9050065	275-3-2 9050065	246-3-1 9050163	246-3-2 9050163	567-3-1 9050175	567-3-2 9050175	B
B	132-4-1 9050155	132-4-2 9050155	501-4-1 9050168	501-4-2 9050168	567-4-1 9050175	567-4-2 9050175	249-4-1 9050176	249-4-2 9050176	253-4-1 9050160	253-4-1 9050160	520-4-1 9050170	520-4-2 9050170	125-4-1 9050154	125-4-2 9050154	B
B	241-4-1 9050164	241-4-2 9050164	521-4-1 9050171	521-4-2 9050171	271-4-1 9050166	271-4-2 9050166	392-4-1 9004392	392-4-2 9004392	556-4-1 9050174	556-4-2 9050174	267-4-1 9050162	267-4-2 9050162	510-4-1 9050169	510-4-2 9050169	B
B	265-4-1 9050161	265-4-2 9050161	274-4-1 9050167	087-4-2 9050087	225-4-1 9050157	225-4-2 9050157	137-4-1 9050156	137-4-2 9050156	275-4-1 9050065	275-4-2 9050065	523-4-1 9050172	523-4-2 9050172	122-4-1 9050153	122-4-2 9050153	B
B	267-6-1 9050162	267-6-2 9050162	392-5-1 9004392	392-5-2 9004392	271-5-1 9050166	271-5-2 9050166	087-5-1 9050087	122-5-2 9050153	554-5-1 9050173	554-5-2 9050173	246-4-1 9050163	246-4-2 9050163	554-4-1 9050173	554-4-2 9050173	B
B	249-5-1 9050176	249-5-2 9050176	501-5-1 9050168	501-5-2 9050168	245-5-1 9050158	245-5-2 9050158	265-5-1 9050161	265-5-2 9050161	556-5-1 9050174	556-5-2 9050174	521-5-1 9050171	521-5-2 9050171	262-5-1 9050159	262-5-2 9050159	B
B	275-5-1 9050065	275-5-2 9050065	523-5-1 9050172	523-5-2 9050172	087-5-1 9050087	077-5-2 9050077	274-5-1 9050167	087-5-2 9050087	269-5-1 9050165	269-5-2 9050165	225-5-1 9050157	225-5-2 9050157	241-5-1 9050164	241-5-2 9050164	B
B	253-5-1 9050160	253-5-2 9050160	246-5-1 9050163	246-5-2 9050163	267-5-1 9050162	267-5-2 9050162	520-5-1 9050170	520-5-2 9050170	125-5-1 9050154	125-5-2 9050154	567-5-1 9050175	567-5-2 9050175	137-5-1 9050156	137-5-2 9050156	B
B	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	B

Legend: Entry-Rep-Tree = 520-1-1
Accession No. = 9050170

Evaluation of Switchgrass Germplasm for Rhizomatous Characteristics

Study No. 20I039E

Study Leader: Richard L. Wynia, Plant Materials Center Manager

Introduction: Switchgrass (*Panicum virgatum* L.) is a perennial, warm-season grass that is widely distributed over much of the continental United States. It occurs naturally with other tall-grass prairie species such as big bluestem and Indian grass. Forage quality of switchgrass is generally recognized as being excellent for grazing. In addition to its forage value, it is widely used in areas where soil-conserving practices are needed. Switchgrass is also recognized as a species of wide diversity in growth forms, which often proves valuable in a plant-breeding program. Heritable variation has been observed in endemic strains collected from native grasslands. Newell and Eberhart (1959, 1961) discussed the heritability of certain morphological characteristics from switchgrass strains collected in different locations in the Great Plains of North America. Their studies indicated that a significant proportion of the total variation is due to genetic differences. A source material collected in Roger Mills Co., Oklahoma, Accession 9049968, was screened using recurrent selection techniques to select for a highly rhizomatous type of switchgrass at the Manhattan Plant Materials Center (PMC) Manhattan, Kansas.

Objective: The goal of this work is to select superior seed to improve the germination and seedling vigor of rhizomatous switchgrass to promote rapid establishment of this species for re-vegetation projects, waterway establishment, and commercial seed production.

Procedure: Selected materials from the various stress tests were grown out in the greenhouse. Plants from this pool were established in a poly-cross nursery. The largest, healthiest plants were transplanted to the field in a Latin Square design. Seed was harvested at the end of the 2008 growing season and compared to the data from the previous year to mark any improvements in germination and seed size. There were three plants that did not survive to produce seed for 2008. Four 100 seed replicates were planted to moist blotter in 10.16 x 10.16 cm (4 x 4 in) plastic boxes from each seed collection. The seeds were tested for germination in a growth chamber set at 21°C (70°F) with 12 hours light and 12 hours dark for 21 days. The germination was counted and recorded at 7-, 14-, and 21-day intervals.

Potential Products: Cultivar Release

Progress or Status: Seed was harvested from 61 of the original 64 switchgrass plants in 2008. Forty-four of the individual plants had less than 1.5 grams of total yield. The remaining plants had from 1.7 to 14.85 grams of seed. The mean seed weight of the 17 plants was 3.63 grams. The 2008 harvest of individual switchgrass plants was cleaned and stored at ambient room temperature 21°C (70°F) until they were tested for germination. Switchgrass seed units were placed in plastic germination boxes on moist blotters in a germinator which maintained a constant 21°C (70°F) temperature. Germination counts were taken at 7-, 14-, and 21- day intervals. Switchgrass seed of varieties produced for foundation seed in Kansas must meet or exceed 50% germination plus dormant seed to be eligible to be Foundation Seed. Thus, switchgrass with germination less than 50% will not meet Kansas Crop Improvement Association (KCIA) standards for Foundation Seed. Five of the plants in the nursery had a germination percentage equal to or greater than 50%. Of the 61 plants in the nursery, 8 had enough seed to conduct germination tests. The mean germination of the 8 plants was 52%. Of the 8 plants where germination tests were conducted, 5 or 63% had germination percentages equal to or greater than 50% required by KCIA for foundation seed production. Results of the 2009 harvest are not currently available. The plants will be harvested again in 2010 to see if seed yields and satisfactory germination percentages remain consistent across time and environments.

Literature Cited:

Newell, L. C. and S. A. Eberhart. 1961. Clone and progeny evaluation in the improvement of switchgrass, *Panicum virgatum* L. *Crop Science* 1:117-121.

Evaluation of Siberian Elm

Study No. 20I041K

Study Leader: Richard L. Wynia, Plant Materials Center Manager

Introduction: Siberian elm (*Ulmus pumila* L.) has been planted and tested in the Central and Northern Plains States since the early 1900s. This species once became of interest to researchers because of its apparent rapid rate of growth. Thus, early tests indicated that it warranted further distribution and additional adaptability studies. Extremes in weather conditions have proven challenging to the species over the years on the plains states. It begins blooming early in the year if weather conditions permit and is one of the last deciduous trees to defoliate in the fall. Therefore, this species tends to be frequently damaged by freezes early in the spring or fall of the year. Early fall ice or sleet storms on the plains tend to damage Siberian elm more severely because of the late loss of leaves and brittle wood that is subject to breakage. This species is also susceptible to a number of diseases such as Tubercularia canker and Botryodiplodia canker and wet wood. Common insect pests are cankerworm and elm leaf beetle.

Despite these faults and its relative short life span there are many locations where Siberian elm can be effectively utilized in shelterbelts and windbreaks.

Problem: The need exists to develop an improved Siberian elm for use in shelterbelt and windbreak conservation practices in semiarid regions of the service area: northeastern Colorado, western Kansas, western Nebraska, and southeastern Wyoming.

Objectives: Select individual seedlings from the available germplasm with the following characteristics: improved initial survival, growth rate, insect and disease resistance, drought resistance, and earlier fall defoliation.

Procedures: Siberian elm accessions grown in raised beds at the Manhattan Plant Materials Center (PMC) Manhattan, Kansas, were lifted on 25 March 1999. Seedling production by the various accessions met with mixed success. Some accessions produced abundant, healthy seedlings and other accessions produced limited numbers of seedlings. The production of a limited number of seedlings by some accessions caused evaluation plots to be limited in number and scope. Evaluation plots were designated for western Nebraska and eastern Colorado to test the accessions in the environment in which it will be used.

A randomized evaluation plot containing 11 accessions and 3 seedlings per plot with 3 replications, (Figure 1) was established on 15 April 1999, in Akron, Colorado. The plot was established in a recently tilled area on the USDA Agricultural Research Station (ARS) Central Great Plains Research Station, 4 miles east of Akron. The elm seedlings were planted using a tractor-drawn tree planter which made the planting quick and efficient. Due to the extremely windy conditions experienced the day of planting, the weed barrier fabric (1.83 m (6 ft) Sunbelt) was not installed until 19 May 1999.

The Akron Site is located in Logan County, Colorado. The planting was established in cooperation with the ARS at Akron. The site is located within Major Land Resource Area (MLRA) 72. Average annual precipitation is 40.6 cm (16 in). The soils are classified as a Rago silt loam.

A randomized evaluation plot containing 11 accessions and 3 seedlings per plot with 3 replications, (Figure 2) was established on 18 May 1999, in Sidney, Nebraska. The plot was established in a disked area that was planted to wheat the previous growing season. The elm seedlings were planted by hand and then a tractor was used to install the 1.83 m (6 ft) Sunbelt weed barrier fabric to the plot.

The Sidney site is located in Cheyenne County, Nebraska. The planting was established in cooperation with the Nebraska State Forestry Service. The planting was established on the Tom Knighttengale farm located approximately 4 miles north of Sidney, Nebraska. The site is located within MLRA 72. Average annual precipitation is 40.6 cm (16 in). The soils are classified as Goshen silt loam.

Factors for evaluation include survival, plant growth, vigor, winter injury, disease, and insect resistance.

Potential Products: Cultivar Release

Progress or Status: Siberian elm studies in Sydney, Nebraska, and Akron, Colorado, were reviewed in 2009 with data collected on tree condition, height, and leaf retention. There were distinct observational differences between accessions that were documented with measurements and visually.

Survival declined overall at both locations. The most dramatic change was noted in the number of living trees with dead branches. In 2006 the percent of living trees with dead branches was just over 6% at Akron. That percentage jumped to over 70% in 2009. Most of the dead branches occurring at or below 1.2 m (4 ft) at Akron were the attributed to deer damage. At Sidney in 2006 the percent of trees with dead branches was over 30%, more than doubling by 2009 at just over 70%, Table 1. In terms of plant growth there was not a significant difference in plant height at either location. Perhaps the most important factor beyond survival and die back is foliage retention going into winter. Earlier leaffall was identified as a desirable attribute of a deciduous shelterbelt tree in this study. There were some differences within plantations and between planting sites. Timing of the evaluation is critical in selecting for such an attribute. Leaf fall data and other evaluation factors are referred to in Tables 2 and 3, Akron and Sidney, respectively. The applicability of a future Siberian elm selection will be evaluated to determine the future of this study.

Table 1. Overall Observational Data for Siberian Elm Survival at Akron, Colorado and Sidney, Nebraska

Location	No. of Trees	Year	Observation	
Akron	135		% Survival	% with Dead Branches
		2005	97.8	N.O.
		2006	97.8	6.1
		2009	89.6	70.2
Sidney	99			
		2005	92.9	N.O.
		2006	84.5	30.3
		2009	77.8	70.1

N.O. – Not Observed

Figure 1. Plot Map. Study No. 20I041K - Siberian Elm, *Ulmus pumila*, FEP - Akron, CO ▲ North ▲

Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border
Border	9050214 1-1	9050184 1-1	9050217 1-1	9050225 2-1	9050214 2-1	9050219 2-1	9050225 3-1	9050241 3-1	9050228 3-1	Border
Border	9050214 1-2	9050184 1-2	9050217 1-2	9050225 2-2	9050214 2-2	9050219 2-2	9050225 3-2	9050241 3-2	9050228 3-2	Border
Border	9050214 1-3	9050184 1-3	9050217 1-3	9050225 2-3	9050214 2-3	9050219 2-3	9050225 3-3	9050241 3-3	9050228 3-3	Border
Border	9050226 1-1	9050233 1-1	9050241 1-1	9050233 2-1	9050241 2-1	9050235 2-1	9050184 3-1	9050224 3-1	9050240 3-1	Border
Border	9050226 1-2	9050233 1-2	9050241 1-2	9050233 2-2	9050241 2-2	9050235 2-2	9050184 3-2	9050224 3-2	9050240 3-2	Border
Border	9050226 1-3	9050233 1-3	9050241 1-3	9050233 2-3	9050241 2-3	9050235 2-3	9050184 3-3	9050224 3-3	9050240 3-3	Border
Border	9050213 1-1	9050222 1-1	9050240 1-1	9050184 2-1	9050240 2-1	9050213 2-1	9050222 3-1	9050216 3-1	9050233 3-1	Border
Border	9050213 1-2	9050222 1-2	9050240 1-2	9050184 2-2	9050240 2-2	9050213 2-2	9050222 3-2	9050216 3-2	9050233 3-2	Border
Border	9050213 1-3	9050222 1-3	9050240 1-3	9050184 2-3	9050240 2-3	9050213 2-3	9050222 3-3	9050216 3-3	9050233 3-3	Border
Border	9050216 1-1	9050228 1-1	9050224 1-1	9050224 2-1	9050222 2-1	9050226 2-1	9050226 3-1	9050219 3-1	9050235 3-1	Border
Border	9050216 1-2	9050228 1-2	9050224 1-2	9050224 2-2	9050222 2-2	9050226 2-2	9050226 3-2	9050219 3-2	9050235 3-2	Border
Border	9050216 1-3	9050228 1-3	9050224 1-3	9050224 2-3	9050222 2-3	9050226 2-3	9050226 3-3	9050219 3-3	9050235 3-3	Border
Border	9050219 1-1	9050235 1-1	9050225 1-1	9050228 2-1	9050217 2-1	9050216 2-1	9050213 3-1	9050217 3-1	9050214 3-1	Border
Border	9050219 1-2	9050235 1-2	9050225 1-2	9050228 2-2	9050217 2-2	9050216 2-2	9050213 3-2	9050217 3-2	9050214 3-2	Border
Border	9050219 1-3	9050235 1-3	9050225 1-3	9050228 2-3	9050217 2-3	9050216 2-3	9050213 3-3	9050217 3-3	9050214 3-3	Border
Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border

Legend: Accession No. = 9050214
Rep-Tree = 1-1

Figure 2. Plot Map. Study No. 20I041K - Siberian Elm, *Ulmus pumila*, FEP - Sidney, NE ▲ North ▲

Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border
Border	9050213 3-1	9050240 3-1	9050217 3-1	9050184 3-1	9050217 2-1	9050226 2-1	9050217 1-1	9050219 1-1	9050233 1-1	Border
Border	9050213 3-2	9050240 3-2	9050217 3-2	9050184 3-2	9050217 2-2	9050226 2-2	9050217 1-2	9050219 1-2	9050233 1-2	Border
Border	9050213 3-3	9050240 3-3	9050217 3-3	9050184 3-3	9050217 2-3	9050226 2-3	9050217 1-3	9050219 1-3	9050233 1-3	Border
Border	Border	9050233 3-1	9050226 3-1	9050214 3-1	9050240 2-1	9050233 2-1	9050214 1-1	9050226 1-1	9050240 1-1	Border
Border	Border	9050233 3-2	9050226 3-2	9050214 3-2	9050240 2-2	9050233 2-2	9050214 1-2	9050226 1-2	9050240 1-2	Border
Border	Border	9050233 3-3	9050226 3-3	9050214 3-3	9050240 2-3	9050233 2-3	9050214 1-3	9050226 1-3	9050240 1-3	Border
Border	Border	9050224 3-1	9050222 3-1	9050213 2-1	9050219 2-1	9050184 2-1	9050184 1-1	9050213 1-1	9050222 1-1	Border
Border	Border	9050224 3-2	9050222 3-2	9050213 2-2	9050219 2-2	9050184 2-2	9050184 1-2	9050213 1-2	9050222 1-2	Border
Border	Border	9050224 3-3	9050222 3-3	9050213 2-3	9050219 2-3	9050184 2-3	9050184 1-3	9050213 1-3	9050222 1-3	Border
Border	Border	9050228 3-1	9050219 3-1	9050222 2-1	9050224 2-1	9050214 2-1	9050228 2-1	9050228 1-1	9050224 1-1	Border
Border	Border	9050228 3-2	9050219 3-2	9050222 2-2	9050224 2-2	9050214 2-2	9050228 2-2	9050228 1-2	9050224 1-2	Border
Border	Border	9050228 3-3	9050219 3-3	9050222 2-3	9050224 2-3	9050214 2-3	9050228 2-3	9050228 1-3	9050224 1-3	Border
Border	Border	Border	Border	Border	Border	Border	Border	Border	Border	Border

Legend: Accession No. = 9050217
Rep-Tree = 1-1

Table 1. Initial evaluation data: Study No. 20I041K - Siberian elm (*Ulmus pumila*), Akron, CO

Accession Number	Origin/Source	YR PLT	YR REC	EVA DAT	NO PLT	NO SRV	PCT SRV	FOL DEN	FOL RET	PLT HGT	BAS DIA	Remarks Plot Designation: e.g. 2/1 = rep/ tree no.
9050184	Roger Mills Co., OK	99	00		9	9	100			173		
			01			9	100			244		
			02			9	100			245		
			03	288		9	100		2.1	282		
			05	291		9	100	94	6.7	353	10.4	
			06	247		9	100		8.3	356		
			09	278		9	100		8.3	426		1/2 – DB; 2/1-3 – DB; 3/1,3 - DB
9050213	Woodward Co., OK	99	00		9	9	100			157		
			01			9	100			238		
			02			9	100			241		
			03	288		9	100		2.0	289		
			05	291		9	100	67	5.0	341	10.6	
			06	247		9	100		7.6	348		
			09	278		9	100		4.1	416		1/1,2 – DB; 2/2,3 – DB; 3/1 - DB
9050214	Beaver Co., OK	99	00		9	9	100			180		
			01			9	100			262		
			02			9	100			262		
			03	288		9	100		4.1	276		2/1 – DB
			05	291		9	100	78	5.7	342	12.0	
			06	247		9	100		7.8	356		2/1 – DB
			09	278		8	89		6.0	404		1/3 – DB; 2/1,2 – DB; 3/1,3 – DB; 3/2 – Dd
9050216	Ellis Co., OK	99	00		9	9	100			171		
			01			9	100			257		
			02			9	100			261		
			03	288		9	100		1.7	304		
			05	291		9	100	83	6.0	345	12.0	
			06	247		9	100		8.8	335		2/3 – DB; dying
			09	278		7	78		6.3	449		1/1 – Dd; 1/2,3 DB; 2/1,2 - DB; 2/3 - Dd; 3/3-DB
9050217	Ellis Co., OK	99	00		9	9	100			173		
			01			9	100			253		
			02			9	100			254		
			03	288		9	100		1.3	298		
			05	291		9	100	72	5.3	308	11.2	
			06	247		9	100		5.6	318		2/3 – DB
			09	278		7	78		5.8	347		1/1,3 – 75% DB; 1/2 – DB; 2/1 – Dd; 2/3 – 67% DB; 3/2 – Dd; 3/3 - DB
9050219	Stevens Co., KS	99	00		9	9	100			185		
			01			9	100			268		
			02			9	100			273		
			03	288		8	89		1.8	310		2/1 – Dd
			05	291		8	89	75	5.5	359	11.5	
			06	247		8	89		8.0	367		
			09	278		8	89		6.9	468		3/1,3 – DB

Table 1. Initial evaluation data: Study No. 20I041K - Siberian elm (*Ulmus pumila*), Akron, CO

Accession Number	Origin/Source	YR PLT	YR REC	EVA DAT	NO PLT	NO SRV	PCT SRV	FOL DEN	FOL RET	PLT HGT	BAS DIA	Remarks
9050222	Custer Co., OK	99	00		9	9	100			180		
			01			9	100			269		
			02			9	100			267		
			03	288		9	100		3.3	301		
			05	291		9	100	100	7.0	342	11.1	
			06	247		9	100		8.8	349		1/2 – DB
			09	278		8	89		8.6	434		1/2 – DB; 2/1 – DB; 2/3 – Dd; 3/1,3 – DB
9050224	Custer Co., OK	99	00		9	9	100			180		
			01			9	100			271		
			02			9	100			278		
			03	288		9	100		6.0	319		
			05	291		9	100	100	7.0	381	11.6	
			06	247		9	100		8.6	392		
			09	278		9	100		8.3	470		1/1-3 – DB; 2/1-3 – DB; 3/1-3 – DB
9050225	Custer Co., OK	99	00		9	9	100			164		
			01			9	100			248		
			02			9	100			251		
			03	288		9	100		2.3	278		3/1 – DB
			05	291		7	78	100	6.2	359	11.5	2/1 – Dd; 3/1 – Dd
			06	247		8	89		8.2	339		2/1 – Resprout, DB
			09	278		7	78		7.8	434		1/1,2 – DB; 2/1 – Dd; 2/2 – DB; 3/3 – DB
9050226	Custer Co., OK	99	00		9	9	100			173		
			01			9	100			258		
			02			8	89			260		3/3 – Dd
			03	288		8	89		4.3	290		
			05	291		8	89	100	6.2	337	11.5	
			06	247		8	89		8.5	347		
			09	278		8	89		6.9	409		1/2,3 – DB; 2/1,3 – DB; 2/2- 25% DB; 3/2 – 50% DB
9050228	Custer Co., OK	99	00		9	9	100			167		
			01			9	100			252		
			02			9	100			256		
			03	288		9	100		3.0	297		
			05	291		9	100	94	6.7	359	10.9	
			06	247		9	100		8.3	368		
			09	278		9	100		7.1	426		1/1-3 – DB; 2/2 – DB; 2/3 – 75% DB; 3/1-3 – DB
9050233	Harper Co., OK	99	00		9	9	100			154		
			01			9	100			237		
			02			9	100			245		
			03	288		9	100		3.0	264		3/3 – DB
			05	291		9	100	83	6.0	312	10.9	
			06	247		9	100		7.6	322		3/3 – DB
			09	278		9	100		7.2	402		1/1-3 – DB; 2/1-3 – DB; 3/1-3 – DB

Table 1. Initial evaluation data: Study No. 20I041K - Siberian elm (*Ulmus pumila*), Akron, CO

Accession Number	Origin/Source	YR PLT	YR REC	EVA DAT	NO PLT	NO SRV	PCT SRV	FOL DEN	FOL RET	PLT HGT	BAS DIA	Remarks
9050235	Garfield Co., OK	99	00		9	9	100			169		
			01			9	100			261		
			02			9	100			262		
			03	288		9	100		2.8	317		
			05	291		9	100	83	6.0	370	11.2	
			06	247		9	100		7.9	380		
			09	278		9	100		6.8	437		1/1-3 – DB; 2/2-3 – DB; 3/1-2 – DB
9050240	Cotton Co., OK	99	00		9	9	100			163		
			01			9	100			245		
			02			9	100			249		
			03	288		9	100		3.4	267		1/2 – DB
			05	291		8	89	94	6.7	354	11.9	1/2 – Dd
			06	247		8	89		8.8	367		1/2 – DB
			09	278		6	67		8.9	414		1/1 – DB; 1/3 - 50% DB; 2/2 – DB; 3/1-2 – Dd
9050241	Cotton Co., OK	99	00		9	9	100			178		
			01			9	100			252		
			02			9	100			255		
			03	288		9	100		4.8	278		1/2 – DB
			05	291		9	100	94	6.7	328	10.5	
			06	247		9	100		7.8	328		1/2 – DB
			09	278		8	89		8.5	414		1/1 – Dd; 1/2 – DD; 1/3 – DB; 2/1-3 – DB; 3/1 – 75% DB; 3/2 – 25% DB

Legend for Siberian elm evaluations:
DB: Die Back (Dead Branches)
Dd: Dead
DD: Deer Damage
EVA DAT: Evaluation Date (Julian Calender Date)
FOL DEN: Foliage Density: Percent
FOL RET: Foliage Retention, rating 1=0%, 9=100%
NO. PLT: Number of trees planted
NO. SRV: Number Surviving
PCT SRV: Percent Survival
Plot Designation: e.g. 2/1 = rep/ tree no.
YR PLT: Year Planted
YR REC: Year of Record

Calendar Conversion

Julian Calender Dates	Gregorian Calender Dates
247	9/04
278	10/05
288	10/15
291	10/18

Table 2. Initial evaluation data: Study No. 20I041K - Siberian elm (*Ulmus pumila*), Sidney, NE Page 1

Accession Number	Origin/Source	YR PLT	YR REC	EVA DAT	NO PLT	NO SRV	PCT SRV	FOL DEN	FOL RET	PLT HGT	BAS DIA	Remarks Plot Designation: e.g. 2/1 = rep/ tree no.
9050184	Roger Mills Co., OK	99	00		9	9	100			186		
			01			9	100			232		
			02			9	100			285		
			03	288		9	100		3.7	312		
			05	291		9	100	67	5.0	326	11.4	
			06	247		9	100		8.0	332		2/1 – DB
			09	279		8	89		7.0	357		1/1-3 – DB; 2/1 – Dd; 2/2 – DB; 3/1– 25% DB; 3/2 – 75% DB; 3/3 33% DB
9050213	Woodward Co., OK	99	00		9	9	100			139		
			01			8	89			176		3/1 – Dd
			02			8	89			242		
			03	288		8	89		1.8	271		
			05	291		8	89	29	2.7	315	10.9	
			06	247		7	67		6.9	323		1/1 – Dd
			09	279		7	67		7.3	370		1/3 – DB; 2/1,3 – DB; 2/2 – 50% DB; 3/2– 25% DB; 3/3 – 50% DB
9050214	Beaver Co., OK	99	00		9	9	100			197		
			01			9	100			243		
			02			9	100			290		
			03	288		8	89		4.0	315		1/2 – Dd
			05	291		7	78	93	6.6	365	11.9	3/1 – Dd
			06	247		6	67		7.2	332		1/2 – Dd; 2/2 – DB; 3/2 – 75% DB
			09	279		6	67		8.0	358		1/1 – Resprout, 75% DB; 2/2 – 75% DB; 3/1-2 – Dd; 3/3 – DB
9050217	Ellis Co., OK	99	00		9	9	100			178		
			01			9	100			215		
			02			9	100			255		
			03	288		7	78		1.9	272		2/3 – Dd; 3/3 – Dd
			05	291		8	89	50	3.9	323	11.9	
			06	247		6	67		8.9	287		1/2-3 – Dd; 2/1 – DB; 2/3 – Dd; 3/1 – DB
			09	279		6	67		7.5	365		2/1-2 – 25% DB; 3/1 – 25% DB
9050219	Stevens Co., KS	99	00		9	9	100			165		
			01			9	100			193		1/3 – resprout from base
			02			9	100			261		
			03	288		9	100		2.3	279		
			05	291		9	100	67	4.0	289	13.1	
			06	247		8	89		7.9	210		1/1 – 90% DB; 1/2-3 – DB; 2/1-2 – DB; 2/3 – Dd; 3/1-3 – DB
			09	279		6	67		7.3	308		1/1 – Dd; 1/2-3 – 25% DB; 2/1 – DB; 2/3 50% – DB; 3/1-2 – 50% DB; 3/1– Dd
9050222	Custer Co., OK	99	00		9	9	100			155		
			01			9	100			193		
			02			9	100			256		
			03	288		9	100		3.0	278		
			05	291		9	100	56	4.4	318	11.5	
			06	247		8	89		8.4	332		1/2 – 50% DB; 2/3 – 50% DB; 3/3 – Dd
			09	279		7	78		8.7	392		1/2 – Dd; 2/2 – DB; 2/3 – 33% DB; 3/1 – 13% DB; 3/2 – DB

Table 2. Initial evaluation data: Study No. 20I041K - Siberian elm (*Ulmus pumila*), Sidney, NE

Accession Number	Origin/Source	YR PLT	YR REC	EVA DAT	NO PLT	NO SRV	PCT SRV	FOL DEN	FOL RET	PLT HGT	BAS DIA	Remarks
9050224	Custer Co., OK	99	00		9	9	100			175		
			01			9	100			207		
			02			9	100			249		
			03	288		9	100		3.7	272		
			05	291		9	100	78	6.0	315	10.6	
			06	247		8	89		8.9	322		1/1 – DB; 3/2 – Dd
			09	279		8	89		7.4	381		1/1,3 – DB; 1/2 – 75% DB; 2/1-3 – DB; 3/1,3 – DB
9050226	Custer Co., OK	99	00		9	9	100			165		
			01			9	100			200		
			02			9	100			257		
			03	288		8	89		4.7	291		
			05	291		9	100	78	5.7	345	13.4	
			06	247		8	89		8.8	334		1/1 – DB; 2/1 – DB; 2/2 Dd; 3/1 – 98% DB; 3/2 – 50% DB
			09	279		6	67		7.0	369		1/1 33% – DB;2/1 – Dd; 2/3 – 33% DB; 3/1 – Dd; 3/2-3 – 50% DB
9050228	Custer Co., OK	99	00		9	9	100			172		
			01			9	100			206		
			02			9	100			230		
			03	288		8	89		4.1	247		3/1 – Dd
			05	291		8	89	81	5.6	292	13.2	
			06	247		8	89		7.5	309		3/3 – 50% DB
			09	279		8	89		7.8	332		1/1 – DB; 1/2 – 25% DB; 2/1 – DB; 3/2-2 – DB; 3/3 – 75% DB
9050233	Harper Co., OK	99	00		9	9	100			150		
			01			9	100			190		
			02			9	100			226		
			03	288		9	100		3.3	251		
			05	291		9	100	75	4.8	290	12.3	
			06	247		8	89		8.6	331		3/3 – Dd
			09	279		8	89		6.8	387		2/2 – DB; 3/2 – DB
9050240	Cotton Co., OK	99	00		9	9	100			165		
			01			9	100			211		
			02			9	100			254		
			03	288		8	89		4.3	276		1/2 – DB; 2/3 – Dd
			05	291		8	89	99	5.0	351	12.5	
			06	247		8	89		9.1	363		1/2 – DB; 1/3 – 50% DB;
			09	279		7	78		7.8	364		1/1 – 75% DB; 1/2 – DB; 1/3 – Dd; 2/2 – 33% DB; 3/1-2 – 25% DB; 3/3 – 50% DB

Evaluation of False Indigo for Use in Streambank Stabilization, Shoreline Protection, and Wetland Restoration and Enhancement

Study No. 20I042E

Study Leader: John M. Row, Plant Materials Specialist

Introduction: False indigo (*Amorpha fruticosa* L.) is a native legume, deciduous, medium-to-tall growing shrub native to North America. Its range is from New Hampshire west to Saskatchewan, south to Texas, New Mexico, Arizona, California, east to Florida, and north to New England. False indigo has application for erosion control along shorelines and streambanks, for wildlife food and cover, and for ornamental purposes.

Problem: The Long-Range Plan for the Manhattan Plant Materials Center (PMC), Manhattan, Kansas, has listed 4 program objectives that pertain to developing and using plant materials to address improving water quality, riparian vegetation, streambank and shoreline protection, and wetland restoration and enhancement. The need exists for plant species of known origin and adaptability that are not currently available for conservation work in the central Great Plains.

Objective: Assemble, test, and release adapted false indigo selections for streambank stabilization and shoreline protection, wetland restoration and enhancement plantings, and for the improvement of wildlife habitat.

Procedure: Seeds from 84 accessions were planted to 164 mL (10 in^3) single cell Ray Leach "Cone-tainers"^{TM} in the spring of 2001. Seeds of accessions with poor quality seed had to be replanted, but establishment was successful for most accessions. Enough seedlings were established from 76 of the accessions to support an initial evaluation planting. The plants were transplanted to a spaced plant evaluation nursery in Field C-3-D-3, 29 May 2002, on a Stonehouse-Eudora complex soil. The plot layout consisted of 3 plants per plot with 3 replications in a randomized complete-block design (Figure 1). In-row spacing was 0.9 m (3 ft) and the between row spacing was 4.57 m (15 ft). The plots were irrigated throughout the growing season of the establishment year. Maintenance consists of mowing, disking, and hand weeding between the rows.

Potential Products: Information Technology and Cultivar Release.

Progress or Status: Selected plants were lifted with a tree spade and moved to a breeder's block in Field B-1 to a location suitable for seed production on the PMC. Some plants were maintained in the old plots to evaluate management factors associated with seed production.

Plant Species for Revegetation of Natural and Man-induced Saline Areas

Study No. KSPMS-T-0201-CR

Study Leader: Mark A. Janzen, Plant Materials Specialist

Introduction: Small areas of pasture and rangeland have been damaged through the spillage of brine water associated with oil drilling activity. Natural saline seeps have formed in cropland fields due to cropping practices, soil geology, and drainage configuration. These areas while small in size (typically less than 5 acres) are extremely erosive and contribute heavy sediment loads (including contaminants) to adjacent water bodies. Because these sites are typically high in salts, poor in soil structure, and low in organic matter, revegetation is extremely difficult without considerable economic input.

Objective: To evaluate various plant species for use in revegetating saline areas and to evaluate the effect of various surface treatments on plant species establishment.

Procedure: Sixteen different species/selections were seeded at 4 different locations: Perry and Okmulgee in Oklahoma; El Dorado and Eureka in Kansas. Sixteen different soil amendment treatments were applied at the Eureka and El Dorado sites. The Manhattan Plant Materials Center, Manhattan, Kansas, assisted with installation of the trials. Soil salinity analyses were performed on all sites prior to and following species establishment. Refer to Table 1, for a list of plant species that were included in this study. Treatments for the Kansas locations are provided in Figure 1. The Okmulgee and Perry locations were seeded in the spring of 2002. The Eureka and El Dorado sites were seeded in May 2003. In 2006, an additional site was selected in Greenwood County, Kansas, as part of a Resource Conservation and Development project. In 2007 an additional site totaling 2.3 acres near Eureka was selected for an additional planting. Based on the findings on the other Kansas sites, horse manure was applied and incorporated by deep ripping prior to drilling grass. Within the 2.3 acres, 18 replicated plots were established with various surface treatments that included:

Manure & Wheat Straw	Manure	Native Hay	Wheat Straw	Gypsum & Wheat Straw	Compost	Manure	Manure & Wheat Straw	Compost
Wheat Straw	Gypsum & Wheat Straw	Compost	Manure	Native Hay	Manure & Wheat Straw	Gypsum & Wheat Straw	Wheat Straw	Native Hay

The entire 2.3 acres of the Eureka site was seeded to a mix of the following grasses:

Alkali sacaton
Tall wheatgrass
Alkali-grass
Switchgrass ('Kanlow')
Western wheatgrass
Russian wild rye
Inland saltgrass
Four-wing saltbush

Locations will be evaluated for plant species establishment, growth, and persistence. Evaluations will be completed on an annual basis.

Potential Products: A summary of the study with appropriate recommendations regarding soil amendments and species selection will be developed and provided in the form of a technical note.

Progress or Status: This study initiated with 2 planting sites in Kansas and 2 planting sites in Oklahoma. Only the 2 sites in Kansas, Eureka and El Dorado, remain active sites. Due to heavy grazing and continued overflow of water, the El Dorado site is slowly transitioning back to its original barren eroded state. Primary vegetation at this site is inland saltgrass that has been heavily grazed. The

vegetation at the Eureka site remains limited to the areas where residue was added after planting. Little spread of grass into the non-residue areas is happening.

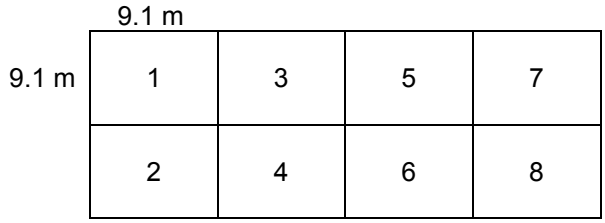
The Eureka planting continues to improve. Prior to planting heavy amounts of horse manure, compost and crop residues were incorporated into the soil. Currently there is a good stand of mixed grass on the site.

Initial observations indicate that organic matter incorporated into the soil along with seeding salt tolerant grasses is very important in establishing vegetation on these sites.

Table 1. Plant species per location.

Plant Species	Location			
	Okmulgee	Perry	El Dorado	Eureka
Havard's panic grass	X		X	X
Alkali sacaton, 'Saltalk'	X	X	X	X
Big sacaton / 434453	X	X	X	X
Four-wing saltbush			X	X
Texas dropseed / 9029930	X	X	X	X
Texas dropseed / 9029932	X	X	X	X
Sideoats grama, 'Premier'	X	X	X	X
Inland saltgrass	X	X	X	X
Blue panicum	X	X	X	X
Alkali-grass, 'Fults'	X	X	X	X
Switchgrass, 'Kanlow'	X	X	X	X
Western wheatgrass, 'Barton'	X	X	X	X
Western wheatgrass / Knox City source	X		X	X
Tall wheatgrass, 'Jose'	X	X	X	X
Russian wild rye, 'Bozoiski-Select'	X	X	X	X
Western indigo / Knox City source	X		X	X
Illinois bundleflower, Reno Germplasm	X		X	X
Showy partridge pea, 'Riley'	X		X	X

Figure 1. Surface treatments for each site.



Treatment No.	
1 – Control: no amendment	5 – Incorporated wood chips* (manure)
2 – Incorporated gypsum	6 – Incorporated gypsum and wood chips* (manure)
3 – Incorporated straw	7 – Annual crop**
4 – Incorporated gypsum and straw	8 – Incorporated gypsum then seed annual crop**

*Wood chips applied at Eureka location; manure at El Dorado location
**Perennial species seeded 1 year after seeding of annual crop

Rate of Amendment Application and Incorporation

Gypsum – 385.4 net cwt/ha (7.8 t/ac) El Dorado; 523.8 net cwt/ha (10.6 t/ac) Eureka
Manure – 741.2 net cwt/ha (15 t/ac)
Wood chips – 642.4 net cwt/ha (13 t/ac)
Straw – 148.2 net cwt/ha (3 t/ac)

Rate of Surface Mulch Application

Straw – 148.2 net cwt/ha (3 t/ac)
Surface mulch will be applied to ½ of each treatment immediately after seeding of the perennial plant species.

Evaluation of Miscellaneous Forbs and Legumes

Study No. KSPMC-T-0803-RA

Study Leader: John M. Row, Plant Materials Specialist

Introduction: This study serves as a clearinghouse for the evaluation of miscellaneous collections of forbs and legumes received by the Manhattan Plant Materials Center (PMC), Manhattan, Kansas, which have potential for conservation use. These collections may be tested for adaptation to the local climate in a rod-row planting. Standards of comparison may be included such as an existing cultivar that is available in the seed trade. This study replaces Study No. 20I009S, which was closed in 1990.

Objective: Provide a means to test plant materials where limited seed or plants are available.

Procedure: Plant seeds or plants in a 6.1 m (20 ft) rod row with a between row spacing of 2.2 m (6 ft), except where noted. A standard of comparison may also be planted. Factors for evaluation may include plant vigor, stand, seed production, growth factors, and resistance to disease, drought, and cold.

Seeds of Accession 9085672, prairie acacia (*Acacia angustissima* [Mill.] Kuntze), were received from the James E. "Bud" Smith PMC, Knox City, Texas, in 2008. Plants were established in 164 mL (10 in^3) single cell Ray Leach "Cone-tainers"^{TM} in the spring. Twenty plants were set out 30 June 2008 in a rod row in Field B-3. The stand at the end of the growing season was 80%.

Potential Products: Cultivar Release and Technology Transfer

Progress or Status: Accession 9085672 failed to recover in the spring. Plants were well anchored in the soil and appeared to have established. Due to the late planting in 2008, a new set of plants from 2-0 stock were established in 2009 for further evaluation.

New Studies Initiated

One new study was initiated in 2009. The study plan for each of the following named studies can be found on subsequent pages.

Study No.	Study Name
KSPMC-T-0901-CP	Evaluate the adaptability of 'Tropic Sun' Sunn Hemp (*Crotalaria juncea* L.)

Note: The documents that follow are signed documents; they may not conform to the style manual for the 2009 Annual Technical Report. The only modifications have been formatting to fit this report.

UNITED STATES DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE STUDY PLAN	
Study ID Code	KSPMC-T-0901-CP
Title	**Adaptability of 'Tropic Sun' Sunn Hemp**
National Project No.	PM-T-0901
Study Type	ICST
Study Status	Active
Location	Tucson, AZ; Boonville, AK; Lockford, CA; Meeker, CO; Brooksville, FL; Americus, GA; Aberdeen, ID; Manhattan, KS; Galliano, LA; Beltsville, MD; East Lansing, MI; Coffeeville, MS; Elsberry, MO; Bridger, MT; Fallon, NV; Cape May, NJ; Los Lunas, NM; Corning, NY; Bismark, ND; Corvallis, OR; Kingsville, TX; Nacogdoches, TX; Knox City, TX; Pullman, WA; Alderson, WV.
Study Leader	Ramona Garner, East Regional Plant Materials Specialist
Duration	2009
Cooperators	AZPMC, ARPMC, CAPMC, UCEPC, FLPMC, GAPMC, IDPMC, KSPMC, LAPMC, MDPMC, MIPMC, MSPMC, MOPMC, MTPMC, NVPMC, NJPMC, NMPMC, NYPMC, NDPMC, ORPMC, STXPMC, NTXPMC, ETXPMC, WAPMC, WVPMC
Land Use	CP
Vegetative Practices	Primary 340 Cover and Green Manure Secondary
Description	Sunn Hemp (*Crotalaria juncea*) has been touted as a great green manure and cover crop since the 1930s, when it was reported to be an excellent soil-improving crop. Sunn hemp produces high organic matter yields while fixing large amounts of nitrogen. However, the difficulty in acquiring seed and cheap fertilizer prices caused many farmers to abandon the use of this crop. Energy costs have brought leguminous cover crops back to the forefront for sustainable agriculture production and have led to efforts to increase production of sunn hemp seed. This study attempts to determine the areas of the country with the potential to use sunn hemp for green manure and cover crops. The anticipated use of sunn hemp is as a 30-45 day green manure crop. Sunn hemp does not produce seed above 28 degrees N latitude (southern tip or Florida or Texas). Since it does not produce seed through most of the US and is sensitive to frost it has little potential to be weedy. In order to merge the data from all centers it is important that we keep methodology as uniform as possible. This study attempts to determine the areas of the country with the potential to use sunn hemp for green manure and cover crops. In order to merge the data from all centers it is important that we keep methodology as uniform as possible.

Status of Knowledge	Sunn hemp is a tropical or sub-tropical plant that acts like a summer annual when grown in the continental United States. Sunn hemp's adaptation to a wide range of soils and superior performance on poor sandy soils has attracted attention. As a cover crop, sunn hemp can produce 5,000-6,000 pounds of biomass per acre in southern climates in 60-90 days. It also can produce 120-140 pounds of nitrogen in the same amount of time.
Experimental Plan	Each plant materials center will receive seed to plant an approximately 33' X 46' block 1. The planting should be done after any chance of frost has past. The planting date for tomatoes would be a good guide. 2. The block will be drilled at a seeding rate of 50 lbs/acre. Row spacing of approximately 8". The seed bed will be well prepared and weed free. 3. The seed will be inoculated with a cow pea type *Bradyrhizobium* sp. which will be sent along with the seed. Heat and direct sunlight kill bacteria in stored inoculum, even while packaged. Since a short period of heat can reduce the number of live bacteria the package should be kept in a cool place and out of direct sunlight - even when taking it to the field (keep it off the dashboard). The preferred storage place for inoculum is the refrigerator (do not freeze). 4. The seed should be thoroughly coated with inoculum to achieve the best distribution; the inoculum should be mixed with seed in a large tub or bucket not the planter seedbox. Seed should be coated with an adhesive (sticker) before inoculant is added. Commercial adhesives are available, but sticker can be made from a 1:10 mixture of corn syrup, sugar water (2 cups sugar:1 quart of water) or from a dilute soda (make sure the soda is flat). Mix seed with enough sticker to moisten all seed. To the moistened seed add inoculant and mix to thoroughly coat the seed. Air dry by spreading the coated seed in a cool shaded place. The seed will need to be dry to flow through the seeder. If the seed does not flow, it can be coated with corn starch. Give yourself time for the seed to dry but the seed must be used within 24 hours of inoculation. 5. Irrigation after planting is up to you, some will have to others may not have that option. Just record as much information about when and amounts of irrigation and natural precipitation as possible. Watering should follow the schedule for a forage crop in your area. 6. It may beneficial to put up a fence to protect the plot from deer. 7. Record planting date, date of emergence and date of complete stand. 8. Record height of plant at time of clipping. 9. Clipping dates will be 30 days, 60 days and 90 days after planting date. Three, 0.5 m^2 per clipping date per rep will be clipped just above the soil surface (total of 12 per harvest). Fresh clipped material will be weighed for each harvest and reported in the "Data Collection Form". A grab samples will be collected from each of the three, 0.5 m^2 from each replication and bulked to achieve a sample size of ~250 grams. Grab sample wet weights will reported in the Data Collection Form. After the grab sample is dry, report the dry weight in the Data Collection Form. Samples can be either air-dried or dried in a forced-air oven at 60ºC for 24-30 hrs. If air dried, dry the sample loosely for 1 week then weigh the sample every 2 days until the weight is near stable. **DO NOT** allow the sample to mold. 10. Record the date first flowers appear. 11. Record the date of last frost.

	12. Record the height of the material when it is killed by frost. 13. Repeat samples from borders within the plot.
Technology Transfer Products	national tech note, state tech notes, refereed journal article
Literature Cited	Rotar, P.P. and R.J. Joy. 1983. 'Tropic Sun' sunn hemp (*Crotalaria juncea* L.)Res. Ext. Ser. 36. Hawaii Inst. Trop. Agric. and Human Resour., Univ. of Hawaii, Honolulu. USDA-NRCS. 1999. Sunn Hemp: A Cover Crop for Southern and Tropical Farming Systems. Technical Note No.10 Soil Quality Institute, Auburn, AL

Reviewed by: Central Regional Plant Materials Specialist: __Joel Douglas_____

Approvals: Plant Materials Center Manager

___Richard L. Wynia /s/_____Date:__5/27/2009_____

State Resource Conservationist

___Terry M. Conway /s/_____Date:__6/01/2009_____

State Conservationist Advisory Committee Chair

___Eric B. Banks /s/_____Date:__6/03/2009_____

Plot Plan
National Plant Materials Sunn Hemp Evaluation

Sunn hemp tends to have a dramatic edge affect. Make sure you have room between clip sites to avoid the effect.

Sunn hemp will regrow after clipping. Make sure you mark the clipped sites to avoid them when doing and after frost harvest.