United States Department of Agriculture
Natural Resources Conservation Service

2011 ANNUAL TECHNICAL REPORT

Manhattan Plant Materials Center

Serving Kansas, Nebraska, northern Oklahoma, and northeastern Colorado

http://plant-materials.nrcs.usda.gov/kspmc

Notices

The 2011 Annual Technical Report (ATR) is a report to the plant materials discipline and cooperating agencies. This ATR compiles the results of preliminary reports from various studies conducted by the Manhattan 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 Manhattan 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/kspmc/ 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 the Great Plains of central 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 centers are those listed in the Plant Materials Operations and Management System (POMS) database.

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

On the cover: UL–American plum seed increase in full bloom; UR–Landscape planting of ‘Midas’ false sunflower; ML–Edie Hadle admires Echinacea crop at the PMC; MR–Winter sunrise at the PMC; LL–Planting crew planting liatris at the PMC; LR–Jennifer Hopwood (left), Midwest Pollinator Outreach Coordinator for the Xerces Society, talks pollinators with PMC Field Day attendee.

U. S. DEPARTMENT OF AGRICULTURE

NATURAL RESOURCES CONSERVATION SERVICE

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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 Manhattan PMC is directed by the PMC's Long-Range Plan (LRP) 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 [OSU]); Kansas Biological Survey, U. S. Department of Interior (USDI) U.S. Fish and Wildlife Service (USFWS), USDA Agricultural Research Service (ARS), U. S. Army-Fort Riley Military Reservation, U. S. Army Corps of Engineers (USACE), and Kansas Department of Wildlife, Parks, and Tourism (KDWPT).

The Manhattan 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 Manhattan 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. Assistance provided by these individuals and entities 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, haylands, 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 Manhattan PMC identified its plant material problems, needs, and priorities in its respective current state's long-range Plant Materials Program. The PMC's 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 Manhattan 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 Manhattan 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 Manhattan 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 (MLRA) 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 Manhattan 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 2011, technical assistance was provided to the Peoria, Wyandotte, and Cherokee Nations in Oklahoma concerning plant materials and cultural preservation.

COOPERATIVE EFFORTS

The Manhattan PMC collaborates on many 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 2011.

Cooperator	Affiliation	Research Interest
Karla Hernandez/	South Dakota State University	Prairie cordgrass biofuel study
Dr. Vance Owens	South Dakota State University	Prairie cordgrass biofuel study
Dr. Loretta Johnson	KSU	Ecotypic variation in big bluestem
Brendon McCampbell	Fort Hays State University	Native flora garden
Dr. Justin Moss	OSU	Ornamental selection of native grasses
Dr. Tim Springer	USDA ARS-Southern Plains Research Station (SPRS)	Sand bluestem comparison trials
Dr. Tim Springer	USDA ARS-SPRS	Quail preference for native grass and forb seeds
Dr. Orley R. Taylor	University of Kansas	Milkweed biology and reproduction

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 2011, the list may include those not previously reported. Author's given name is reduced to initials following first appearance in this section of the ATR. Any deviation from this scheme indicates that the author's given name is not known.

Events and Presentations

Conference Room: The Manhattan PMC's conference room is used by federal, state, and local conservation agencies for meetings and training activities. Approximately 130 people used the facility this year for the following activities:

Maximilian Sunflower Collaboration Meeting
Milkweed Propagation Meeting
North American Butterfly Association (NABA) Summer Butterfly Count Kickoff Meeting
State Conservationist's Plant Materials Advisory Committee Meeting

Events: Events hosted by the Manhattan PMC.

Celebrating 75 Years – 1936-2011. Manhattan PMC Field Days. June 7 and June 8, 2011. Participants: ~150

2nd Annual Manhattan Butterfly Count. July 13, 2011. Participants: 7

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

Cow Creek Cooperative Riparian Project. November 16, 2010. Stillwater, OK. Mark A. Janzen.

Habitat Creation and Management for Native Pollinating Insects at the Manhattan Plant Materials Center, Kansas. 52nd Annual Meeting of the International Plant Propagator's Society Western Region. Sacramento, CA. September 21, 2011. P. Allen Casey.

Manhattan Plant Materials Center Overview and Pollinator Review. Kansas NRCS Area I Personnel Meeting. February 15, 2011. Quinter, KS. Richard L. Wynia.

Manhattan Plant Materials Center Program Update. State Conservationist's Plant Materials Advisory Committee Meeting. June 6, 2011. Manhattan PMC, Manhattan, KS. R. L. Wynia.

Manhattan Plant Materials Center Program Update. Nebraska Plant Materials Committee Meeting. September 14, 2011. Lincoln, NE. R. L. Wynia.

Peoria Nation and Plant Materials. Tar Creek Renovation Project. April 25, 2011. Miami, OK. M. A. Janzen.

Plant Materials and Cultural Preservation. Fort Larned. November 30, 2010. Larned, KS. M. A. Janzen.

Plant Materials and Cultural Preservation Program. Wyandotte Multi-Nation Informational Program. April 26, 2011. Miami, OK. M. A. Janzen.

Plant Materials and Cultural Preservation Program. Cherokee Nation. July 13, 2011. Tahlequah, OK. M. A. Janzen.

Plant Materials and the Kit Carson Correctional Facility. April 5, 2011. Burlington, CO. M. A. Janzen.

Plant Materials Issues. State Specialist's Meeting. June 29, 2011. Salina, KS. M. A. Janzen.

Plant Materials. Manhattan Plant Materials Center Field Day. June 7 and June 8, 2011. Manhattan, KS. M. A. Janzen.

Plant Materials Program Update. Colorado Plant Materials Meeting. April 5, 2011. Denver, CO. M. A. Janzen.

Plant Materials Specialist's Report. Nebraska Plant Materials Committee Meeting. September 14, 2011. Lincoln, NE. M. A. Janzen.

Pollinators and the Plants That They Use. March 31, 2011. Kansas Native Plant Society. Topeka, KS. P. A. Casey.

Study of Sunn Hemp (*Crotalaria juncea* L.): A Potential Biofuel and Cover Crop for the Central Great Plains. Kansas Natural Resources Conference (KNRC). January 21, 2011. Wichita, KS. P. A. Casey.

Viability of Native Warm-Season Grass Seed Stored Under Two Different Environments following 35 Years of Storage. 52nd Annual Meeting of the International Plant Propagator's Society Western Region. Sacramento, CA. September 21, 2011. John M. Row.

Tours: The Manhattan PMC Staff welcomes visitors and readily conducts tours. The number of visitors was down in calendar year 2011; however, approximately 115 people visited the PMC, of which 110 toured the PMC. The following groups are representative of the yearly interest in the PMP:

Colorado NRCS Employees
Kansas NRCS Employees
Missouri NRCS PMP Staff
Nebraska NRCS Employees
Oklahoma NRCS Employees
State Conservationist's Plant Materials Advisory Committee

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

Entering Data in Plant Materials Operations and Management System (POMS). Manhattan PMC, March 17, 2011. J. M. Row. Trainees: 1

Making Seed and Plant Collections for the Plant Materials Program. Manhattan PMC Field Day Breakout Session. June 8, 2011. Manhattan, KS. J. M. Row and Christine Taliga. Trainees: 30

North American Butterfly Association (NABA) Summer Butterfly Count, Counting Procedures and Butterfly Identification. July 13, 2011. Manhattan, KS. J. M. Row. Trainees: 4

Orientation for Biological Science Aids, Manhattan PMC, May 23, 2011. J. M. Row. Trainees: 4

Shipping Plant Materials in Plant Materials Operations and Management System (POMS). Manhattan PMC, April 5, 2011. J. M. Row. Trainees: 1

Tree Spade Operations and Maintenance. Manhattan PMC, September 15, 2011. Jerry D. Longren. Trainees: 6

Interviews

Newscast: Personal interview and filming of Manhattan PMC Staff or radio interview and broadcast concerning plant materials-related events.

Kansas Manhattan Plant Materials Center. Kansas NRCS Manhattan Plant Materials Center Celebrates 75 Years of Service. YouTube Slide Show of June 7 Field Day. Kansas NRCS. September 9, 2011. 1:50 min. http://www.youtube.com/watch?v=3sVKcfrE8Gw

Manhattan PMC Field Day. Jeff Wichman, K-State Radio Network Interviews Richard Wynia for K-State Research and Extension's Agriculture Today about the June 7 Field Day. May 20, 2011. 4:45 min.

Publications

Abstracts: Published in conference proceedings or program.

Evaluation and Use of Sunn Hemp (*Crotalaria juncea* L.) at the Manhattan Plant Materials Center, Manhattan, Kansas. P. A. Casey, R. L. Wynia, and J. M. Row. Transcending Borders—Landscapes and Legends, 64th Society for Range Mangement (SRM) Annual Meeting. Billings, MT. February 6-10, 2011.

Brochures: Brochures produced by the PMP or co-authored with other units of government.

Plant Release Brochures

'Blackwell' Switchgrass. R. L. Wynia. Manhattan PMC, Manhattan, KS. April 2011. 2p.

Chisholm Germplasm Chickasaw Plum. J. M. Row, Manhattan PMC. Salina, KS. March 2011. 2p.

'El Reno' Sideoats Grama. R. L. Wynia. Manhattan PMC, Manhattan, KS. April 2011. 2p.

'Kanlow' Switchgrass. R. L. Wynia. Manhattan PMC, Manhattan, KS. May 2011. 2p.

'Kaw' Big Bluestem. R. L. Wynia. Manhattan PMC, Manhattan, KS. April 2011. 2p.

Journal Articles: Articles written or co-authored by PMP staff published in referred journals.

Chinese Chestnut Performance on the Western Fringe of Its Adaptability in the Eastern Great Plains of Kansas. J. M. Row, Wayne A. Geyer, and P. A. Casey. 101st Annual Report of the Northern Nut Growers Association. East Lansing, MI. Vol. 101. 3p.

Newsletters: Periodically, the Manhattan PMC publishes its newsletter, Plants for the Heartland, and distributes it to cooperators and customers in the PMC's service area. The PMCs newsletters are also available to the public via the internet. From time-to-time, the PMC Staff makes contributions to the newletters of other organizations.

Plants for the Heartland. Vol. 18. Issue 1. 2011. P. A. Casey, R. L. Wynia, and J. M. Row. 2p.

Plants for the Heartland. Vol. 18. Issue 2. 2011. J. M. Row. 2p.
Plants for the Heartland. Vol. 18. Issue 3. 2011. J. M. Row and M. A. Janzen. 2p.

Woody Notes. Vol. 1. No. 1. J. M. Row. 4p.

World's smallest flowering plants. P. A. Casey. *In:* Kansas Native Plant Society Newsletter. Lawrence, KS. Vol. 33 No. 1. 2011. 14p.

Plant Fact Sheets: Plant fact sheets are produced for the PLANTS Database and NRCS PMP Web sites (Refer to the Notices page of this report for these web addresses) that are of benefit to the PMP and NRCS programs and its cooperators.

Fragrant Sumac (*Rhus aromatica* Marsh.) Plant Fact Sheet. PMP Web site. USDA NRCS. 2011. R. L. Wynia. 2p.

Golden Currant (*Ribes aureum* Marsh.) Plant Fact Sheet. PMP Web site. USDA NRCS. 2011. R. L. Wynia. 2p.

Leadplant (*Amorpha canescens* L.) Plant Fact Sheet. PMP Web site. USDA NRCS. 2011. P. A. Casey. 2p.

Osage Orange (*Maclura pomifera* Marsh.) Plant Fact Sheet. PMP Web site. USDA NRCS. 2011. R. L. Wynia. 2p.

Sago Pondweed (*Stuckenia pectinata* (L.) Boerner) Plant Fact Sheet. PMP Web site. USDA NRCS. 2011. P. A. Casey. 2p.

Plant Guides: Plant guides are produced for the PLANTS Database and NRCS PMP web sites that are of benefit to the PMP and NRCS programs and its cooperators.

Leadplant (*Amorpha canescens* L.) Plant Guide. PMP Web site. USDA NRCS. 2011. P. A. Casey. 3p.

Osage Orange (*Maclura pomifera* Marsh.) Plant Guide. PMP Web site. USDA NRCS. 2011. R. L. Wynia. 3p.

Sago Pondweed (*Stuckenia pectinata* (L.) Boerner) Plant Guide. PMP Web site. USDA NRCS. 2011. P. A. Casey. 4p.

Posters: Posters are produced and/or presented by Manhattan PMC Staff at various functions.

Biomass yield, seeding rate, adaptation and photosynthetically active radiation (FI-PAR) interception measurements of the annual legume (*Crotalaria juncea* L.) in Manhattan, Kansas. R. L. Wynia, J. M. Row, and P. A. Casey. Kansas Natural Resources Conference. Wichita, KS. January 20-21, 2011.

Phenotypic variation of big bluestem ecotypes across the Great Plains precipitation gradient. Hannah Tetreault, C. Rodewald, M. Mendola, R. Goad, J. Olsen, E. McCrea, N. Bello, T. Morgan, R. Wynia, S. Baer, B. Maricle, and L. Johnson. "Evolution 2011" Meeting. University of Okahoma, Norman, OK. June 17-21, 2011.

Evaluation and Use of Sunn Hemp (*Crotalaria juncea* L.) at the Manhattan Plant Materials Center, Manhattan, Kansas. P. A. Casey, R. L. Wynia, and J. M. Row. Transcending Borders – Landscapes and Legends, 64th SRM Annual Meeting. Billings, MT. February 6-10, 2011.

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

2010 Annual Technical Report*, Manhattan Plant Materials Center. J. M. Row, M. A. Janzen, P. A. Casey, R. L. Wynia. USDA NRCS. Salina, KS. 106p.

2011 Progress Report of Activities*, Manhattan Plant Materials Center. USDA NRCS. Salina, KS. 6p.

Technical Notes: Technical notes are developed by the PMP to convey technical information.

Directory of Vendors for Grass, Forb, Tree, and Shrub Releases from the Manhattan Plant Materials Center. Kansas Plant Materials Technical Note KS-30. USDA NRCS. Salina, KS. September 2011. P. Allen Casey. 4p.

Pollinator Biology and Habitat Technology. Kansas Biology Technical Note KS-37. May 31, 2011, Salina, KS. M. A. Janzen. 23p.

* In addition to plant fact sheets, plant guides, and Plants for the Heartland newsletter, document titles followed by an asterisk can be found on the World Wide Web. Go to http://plants.usda.gov/ or http://plant-materials.nrcs.usda.gov/kspmc/ to find these documents.

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							
					Echinacea angustifolia	*Echinacea angustifolia*	
	Asclepias incarnata				*Liatris punctata*	*Liatris punctata*	
	Asclepias viridis				*Silphium laciniatum*	*Silphium laciniatum* (S)	
GRASSES AND GRASS-LIKE PLANTS							
Muhlenbergia pungens			*Andropogon gerardii*			*Bouteloua gracilis* (C)	
Redfieldia flexuosa		*Calamovilfa gigantea*		*Calamovilfa gigantea* (T)			
	Panicum virgatum		*Panicum virgatum*				
Scirpus sp.							
			Schizachyrium scoparium	*Sporobolus giganteus*			
TREES AND SHRUBS							
		Amorpha fruticosa			*Betula nigra*	*Betula nigra* (T)	
		Amorpha canescens			*Celtis occidentalis* (S)	*Amorpha fruticosa*	
			Castanea Mollissima (S)			*Amorpha canescens* (S)	
		Ceanothus herbaceous				*Ceanothus herbaceous* (S)	
		Cotoneaster lucida (S)		*Platycladus orientalis*	*Platycladus orientalis* (S)		
	Quercus macrocarpa					*Prunus americana* (S)	
		Cephalanthus occidentalis		*Ulmus pumila* (S)	*Ribes aureum* var *villosum*	*Ribes aureum* var *villosum* (S)	
		Salix exigua		*Ulmus parvifolia*		*Salix exigua* (S)	

Anticipated Release Type: C-Cultivar 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				
9050600		common hackberry	*Celtis occidentalis*	20I026K
ORIGIN/SOURCE: A composite of accessions 9004261, Pierce Co., NE; 9004262 and 9004263 Cheyenne Co., KS; 9004264 and 9004265, Sherman Co., KS; 9004266, Dickinson Co., KS; 9013415, Greeley Co., NE; 9013417, Wallace Co., KS; 9013437, Gove Co., KS; 9013440, Sheridan Co., KS; 9013446, Phillips Co., KS; 9030313, KSU Forestry; and 9030314, NE.				
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				

Selection and Initial Increase of Superior Plants (continued).

Accession No.	PI No.	Common Name	Species	Study No.
	325270	hedge cotoneaster	*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				
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				
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	0.12
Reno Germplasm	*Desmanthus illinoinensis*	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	0.05
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
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	1.2
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	1.6
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	0.26
Chisholm Germplasm	*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 2011

The Plant Materials Program distributes plant materials to conservation districts, cooperating universities, federal and state agencies, municipalities, and private entities. These materials are provided for conservation field trials, seed or plant increase, research and demonstration plantings, and educational purposes. The following table shows the distribution of plant materials from the Manhattan PMC. A total of 33 seed and plant orders were shipped to 12 states with over 543 pounds of seed, over 1400 plants, and 790 rhizomes distributed.

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		136.5	3	200	70
	CI	2		206.2			
	MUN				1	400	
	UNIV	2	6	6.2	1	190	
Subtotal		5	6	348.9	5	790	70
Oklahoma	CD	1	198	3.0	1		1025
	ARS	2		5.0			
Subtotal		3	198	8.0	1	0	1025
Colorado	CD	1		2.6			
Nebraska	CI	1	1				
	NRD				1		8
Other States	CI	4		147.0			
	PMC	2	1	8.4			
	UNIV	1		21.4			
Subtotal		9	2	179.4	1	0	8
Total		17	206	536.3	7	790	1103

Legend: ARS=Agricultural Research Service, CD=Conservation Districts, CI=Commercial Increase, MUN=Municipalities, NRD=Natural Resource Districts, PMC=Plant Materials Centers, SA=State Agencies, UNIV=Universities

Woody Plant Materials

		Seed Orders		Plant Orders		
State	Use	Number	Bulk Pounds	Number	Number of Cuttings	Number of Plants
Kansas	CD			1		75
	SA			1		39
	UNIV			1		3
Subtotal		0	0	3	0	117
Nebraska	NRD			1		24
Oklahoma	CD			1		160
Subtotal		0	0	2	0	184
Other States	CD	2	1.7			
	CI	1	1.3			
	PMC	1	4.3			
Subtotal		4	7.3	0	0	0
Total		4	7.3	5	0	301

YEAR 2011 CLIMATALOGICAL DATA FOR MANHATTAN

2011 Data

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg Max	34.5	40.9	54.2	67.6	74.8	88.8	98.0	92.5	79.1	72.5	55.4	44.1	66.9
Avg Min	14.1	16.3	31.8	42.8	51.7	65.3	74.3	68.4	52.3	43.7	31.9	24.5	43.1
Avg Mean	24.3	28.6	43.0	54.8	63.3	77.0	86.1	80.4	65.7	58.1	43.7	34.3	54.9
High	57	58	81	88	89	98	100	107	98	91	77	66	83.4
Low	-10	5	15	30	37	54	57	48	42	31	17	7	25.2
Max[1] > 90	0	0	0	1	3	13	26	17	3	1	0	0	64
Precip[1]	5	6	8	9	14	10	8	12	6	6	6	6	96
Precip	0.69	0.89	1.20	2.89	5.48	5.20	2.18	2.80	1.37	2.66	4.26	3.43	33.05
PMC[2]	0.39	0.34	1.76	3.64	5.28	3.94	3.20	3.26	1.34	2.60	4.59	3.91	34.25
Snow	12.8	13.4	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.7
Heat DD*	1262	1019	672	307	163	0	0	0	94	263	662	922	5363
Cool DD*	0	0	6	10	108	361	656	478	116	48	0	0	1782

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	-5.0	-5.9	-3.3	-0.3	-2.7	1.7	5.5	1.7	-3.0	1.8	0.9	1.2	-0.6
Avg Min	-2.0	-5.2	0.4	0.2	-0.8	3.0	7.0	3.3	-3.2	0.5	1.7	4.6	0.8
Avg Mean	-3.5	-5.6	-1.5	-0.3	-1.7	2.3	6.2	2.4	-3.1	1.1	1.3	2.9	0.0
Precip	-0.17	-0.12	-1.39	-0.18	0.40	-0.03	-1.92	-0.47	-2.30	-0.11	2.16	2.37	-1.76
Snow	8.0	8.5	0.1	-0.9	-0.1	0.0	0.0	0.0	0.0	-0.2	-1.0	-3.7	10.7
Heat DD*	109	155	35	-8	57	-7	0	-4	46	-3	-18	-121	243
Cool DD*	0	0	6	-7	2	63	195	73	-48	33	0	0	317

*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. [1]Number of days; [2]PMC Precipitation; T=Trace

Official Recording Station, Manhattan, Kansas

CLIMATIC SUMMARY 2011

Temperature Extremes: -6ºF February 3; 110ºF July 28

First Killing Frost*: October 20 (low of 27ºF) *Frost = 32ºF or less

Last Killing Frost: April 5 (low of 32ºF) Number of Frost Free Days: 198

Temperature: January was colder than normal. While no new records were set, the month ended in the colder third of the record. February was a month of contrasts with a 78 degree range between the warmest and coldest readings. The mean temperature for the month was 28.6°F, which was 5.6 degrees cooler than normal. This placed it as the 21st coldest February on record. The warm weather that ended the month of March could not overcome the chilly weather that dominated the month. March ended 1.5 degrees cooler than normal. The warmest day of the month was the 23rd when it reached 85°F. April was cooler than normal. The last freeze occurred on the 5th when temperatures dipped to 32°F. May was cooler than normal, despite having a very warm start to the month. May 10th reached a high of 100°F which was a record for the date. June was warmer than normal. High temperatures were recorded the end of the month. July ranked as the 6th warmest in Manhattan records, as warm as July 1934, when the average temperature was 90.1°F. Ten days of 100+ temperatures marks the run as the 5th most for July. The record occurred in 1901 when 20 consecutive days were above 100°F. No record temperatures were set during the month. August recorded warmer than normal temperatures. With a mean temperature of 80.5°F, it was the 26th warmest since 1890. The warmest August was in 1934 where the mean temperature was 86.6°F, and there were 23 days with high temperatures above 100°F. Four days exceeded 100°F this year, equal to the average of 4 days. No records were set. In contrast to most of the summer, September was cooler than normal at -2.5 degrees below normal. October was warmer than normal. While the highs were warmer than normal, the lows ranged below normal. The first frost of the season occurred on the 18th, which was a week later than average. November was just slightly warmer than normal with the swing between daily highs and lows less than average. The largest swing was on the 1st. Temperatures that day went from a high of 74°F to a low of 32°F. December was warmer than average, but no records were set.

Precipitation and Storms: Drier than normal conditions prevailed in January. Although precipitation was below normal, snowfall was average for the month. This was the 4th snowiest January since 1896. The snowiest was 1979, when Manhattan had 26.6 inches. Precipitation was a study in contrasts for February. Manhattan had 13.4 inches of snow, almost three times the average for the month. The total precipitation (rain/melted snow) was only 0.89 inches, leaving a deficit for the month of -0.11 inches, and -0.28 inches for the year. March precipitation was below normal, although we had slightly greater than average snowfall. Fog was common with it being observed on 10 days. April was drier than normal. The month was marked by more wind than usual and 3 days with thunder. Some minor tree damage was reported on the 14th and 15th. Hail was reported on the 3rd. May was wetter than normal. There were 3 days with thunderstorms. The heaviest rains fell on the 25th and 26th, when almost half of the monthly precipitation fell. The highest daily rainfall total was 1.50 inches on May 25. Strong winds on the 30th left some down limbs. June was slightly drier than normal. The greatest rainfall was recorded on the 2nd. Additional heavy rains north of Manhattan resulted in localized flooding. The total precipitation of 2.18 inches made for the 34th driest July since 1890. August precipitation was less than normal, continuing a drier than average summer. The rainfall pattern continued to be below average in September with 2.3 inches below normal for the month and -6.13 inches for the year. Of the 11 days with precipitation, only 2 had amounts greater than .05 inch. October was slightly drier than normal. Seven days with precipitation gave a break in the dry fall pattern. Most of the moisture fell on the 12th. The month ended 0.10 inches below normal. November precipitation was slightly more than double the average for the month. December was wetter than average with 3.43 inches of precipitation, it ranked as the third wettest December since 1890. Most of the precipitation fell as rain, rather than snow. The year ended 1.75 inches below normal.

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 Manhattan PMC Staff, Kansas Plant Materials Specialist, or other PMP collaborators to solve high-priority problems identified in the Center's Long-Range Program. All of the PMC's studies are listed as part of the National Plant Materials Program projects. Currently 22 studies were active in on-site (On) and off-site (Off) locations in 2011 (Table 1). Details of active studies can be found on the subsequent pages.

Table 1. Status of studies conducted by Manhattan PMC Staff or Kansas Plant Materials Specialist.

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	2030	NA 1.1
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	2030	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
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	2015	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
KSPMS-T-095-PA	Plant adaption study for sandy seeding site	Off	Active	2009	2015	PA 1.1
KSPMC-T-1001-WL	Survey of pollinating insects at the Manhattan PMC	ON	Active	2010	2015	WL 1.1
KSPMC-T-1003-WL	Evaluation of Chinese chestnut	On	Active		2015	WL 1.1

Advanced Evaluations

Seed Storage Study

Study No. 20A107T

National Project Nos. Critical Areas 1.1, Cropland 2.1, Natural Areas 1.1, Pasture/Hayland 2.1, Rangeland 1.1, Water Quality 4.1

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 PMC. 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.

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 (see tables) 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. The protocol calls for seed lots to be removed from the study when germination test results for that lot fall 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 discontinued for the uncontrolled storage environment entries after 13 years for warm-season grasses, after seven years for cool-season grasses, and after six years for most forbs. In 2000, testing discontinued 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 ATR.

Potential Products: Information Technology

Progress or Status:

Warm-Season Grasses

One-half of the warm-season chaffy grasses showed an increase in germination from last year, while 3 entries were down. The viability of 'Garden' sand bluestem (*Andropogon hallii* Hack.) stands at the 31% level, up 2 points from last year's test. The viability of 'Kaw' big bluestem (*Andropogon gerardii* Vitman) also increased by 4 points to 27%. Buffalo grass (*Bouteloua dactyloides* [Nutt.] Engelm.) was down 8 points, falling to 60%. 'Aldous' little bluestem (*Schizachyrium scoparium* Michx.), dropped 1 point from last year, stands at 60%. The viability of 'Osage' Indian grass (*Sorghastrum nutans* [L.] Nash) dropped 5 points to 72%, the same level as eight years ago. 'El Reno' sideoats grama (*Bouteloua curtipendula* Michx.) up 9 points at 66% was just 2 points lower than two years ago. Among the non-chaffy warm-season grasses, the viability of 'Pete' eastern gamagrass (*Tripsacum dactyloides* [L.] L.) was up 1 point at 32%. 'Blackwell' (*P. virgatum* L.) an upland-type of switchgrass, down 6 points from last year to 85%, tying the initial germination, and the same level it was 12 years ago. The viability of 'Kanlow' switchgrass (*Panicum virgatum* L.), a lowland-type of switchgrass, increased 5 points to 61% level of two years ago. 'Bend' sand lovegrass (*Eragrostis trichodes* [Nutt.] Wood) increased to 40%, 17 point increase over last year. Refer to Tables 1A, 1B, and 1C for germination test results of warm-season grasses for the past 38 years.

The warm-season grasses in this study continue to sustain a level of viability that exceeds the minimum acceptable level established in Kansas Seed Certification Standards, except for big bluestem and sand bluestem.

Forbs

'Prairie Gold' Maximilian sunflower (*Helianthus maximiliani* Schrad.) was dropped from the study last year following two years of extremely low germination. This left one forb entry in the controlled storage environment test following 32 years of storage, 'Kaneb' purple prairie clover (*Dalea purpurea* Vent.), which continues 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 26 years of storage in a controlled storage environment. Kaneb improved 6 points to 70%, 4% higher than last year. Kanoka was down 4 points from the previous year to 52%, its lowest level in the study so far.

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

Species/Initial Purity	Entry	Storage	Years of 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
Purity: 82.31		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
Purity: 96.39		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
Purity: 92.17		Uncont.	22	72	74	79	74	68	66	64	45	31	24	5	TE				
Bouteloua dactyloides	PMT-	Cont.	73	72	72	73	70	74	60	70	44	57	71	57	61	76	74	45	67
Purity: 58.20	1181	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
Purity: 99.83		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
Purity: 99.98		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
Purity: 99.52		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
Purity: 85.06		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
Purity: 87.39		Uncont.	75	68	83	70	48	44	30	5	7	0	TE						
Spartina pectinata	PMK-	Cont.	67	75	68	60	48	55	54	56	24	11	51	46	64	45	48	38	24
Purity: 77.71	1800	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
Purity: 99.55		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	Years of Storage 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.

		Years of Storage				
Species	Entry	0	35	36	37	38
Andropogon gerardii	Kaw	63	28	29	23	27
Andropogon hallii	Garden	74	49	48	29	31
Bouteloua curtipendula	El Reno	22	57	68	57	66
Bouteloua dactyloides	PMT-1181	73	63	63	68	60
Eragrostis trichodes	Bend	77	57	23	40	
Panicum virgatum	Blackwell	85	88	90	91	85
Panicum virgatum	Kanlow	66	56	61	56	61
Schizachyrium scoparium	Aldous	70	66	65	61	60
Sorghastrum nutans	Osage	74	73	75	77	72
Tripsacum dactyloides	Pete	10	39	36	31	32

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

			Years of Storage																
Species/Initial Purity	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
Purity: 98.61		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
Purity: 99.66	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
Purity: 98.72		Uncont.	78	65	65	56	51	40	6	TE									
Lespedeza capitata	Kanoka	Cont.	83	89	86	94	85	ND	88	ND	80	91	92	89	84	97	68	72	43
Purity:		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
Purity: 97.80		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
Purity: 82.02		Uncont.	82	93	76	24	8	2	TE										
Salvia azurea var	Nekan	Cont.	30	33	37	26	29	33	26	21	22	19	11	ND	26	ND	23	4	21
grandiflora Purity: 98.57		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.

		---------- Years of Storage ----------																
Species	Entry	0	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Dalea purpurea	Kaneb	81	71	85	68	54	60	96	76	67	63	77	68	68	74	68	64	70
Helianthus maximiliani	Prairie Gold	66	43	17	79	19	20	11	40	17	20	25	30	16	20	6	6	TE
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	56	52						
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

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Adaptation Trials of Superior Grasses and Forbs Selected for Advanced Testing

Study No. 20A126L

National Project Nos. Critical Areas 1.1, Cropland 2.1, Natural Areas 1.1, Pasture/Hayland 2.1, Rangeland 1.1, Water Quality 4.1

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 PMC 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. Observations will generally be carried out for 3 growing seasons post establishment.

Potential Products: Information Technology and Plant 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. Currently no forb entries are being tested in this study.

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 (Table 1).

Table 1. 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. Stand ranged from

91.1% for 'Kaw' to 28.3% for Hampton Germplasm in 2011. Once again stand improved for all entries following four years of plant growth. Kaw surpassed 'Bonanza' for the 1st place ranking. Accession 483446 took over 3rd place and 'Pawnee' improved a notch to 4th place after two years in 5th place. 'Goldmine' dropped 2 places to 5th while Accession 9083274 remained steady in 6th place. 'Rountree' regained 7th place trading places with OZ-70 Germplasm which ended up 8th in the study, with Hampton staying at the bottom of the rankings in 9th place. Though not significantly different from the the top 5 entries Kaw produced the best stand (Table 2).

Table 2. Stand means for 9 big bluestem prevarietal release and cultivar seeding trial at Manhattan, Kansas.

Entry	Stand (%)		Rank		
	Mean†	Range	2009	2010	2011
Kaw	91.1 a	86.7 – 98.3	1	2	1
Bonanza	88.3 a	78.3 – 95.0	3	1	2
483446	81.1 ab	78.3 – 85.0	2	4	3
Pawnee	73.9 ab	63.3 – 88.3	5	5	4
Goldmine	71.1 abc	46.7 – 88.3	4	3	5
9083274	57.8 bcd	18.3 – 78.3	6	6	6
Rountree	41.1 d	21.7 – 71.7	7	8	7
OZ-70 Germplasm	37.2 d	23.3 – 46.7	8	7	8
Hampton Germplasm	28.3 d	8.3 – 58.3	9	9	9

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

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 10 June 2008, a replicated planting was made at Manhattan involving five accessions listed in Table 1. The James E. Bud PMC established rod-row plantings of 421282, 421283, and 9050485, in 2007.

Table 1. Blue grama ICST entries under test at Manhattan, Kansas.

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

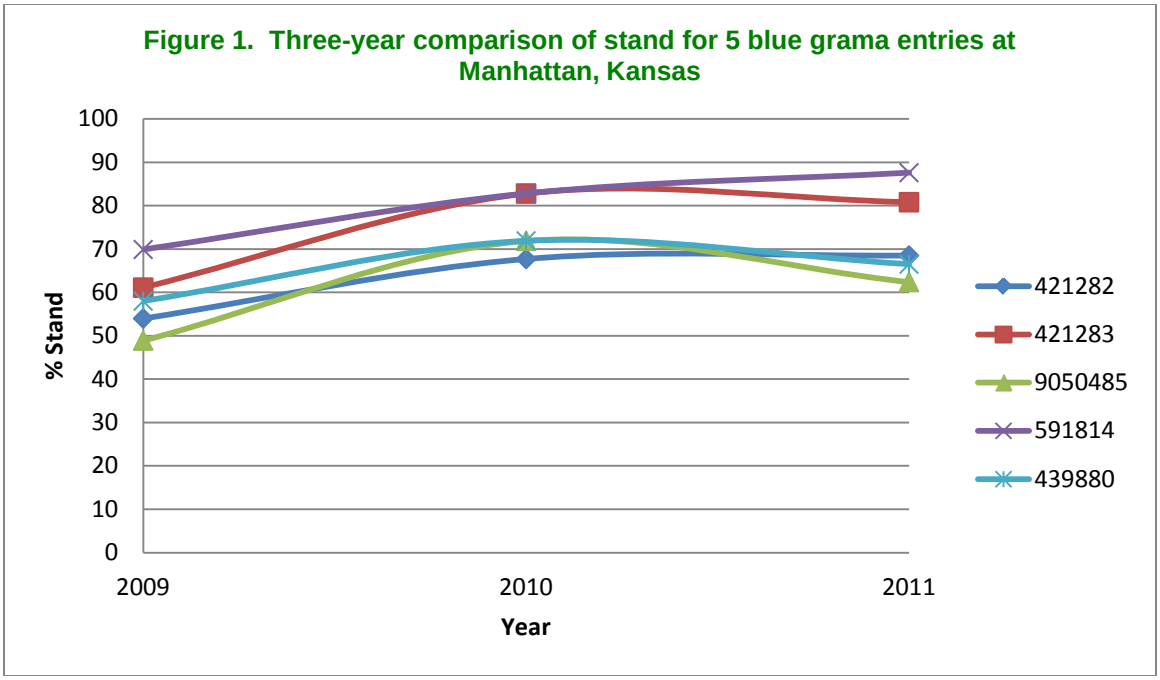
N/A = Not Applicable

Table 2. Results of blue grama ICST at Manhattan, Kansas, for the 2011 growing season.

Location / Accession	Manhattan		
	% Stand	Foliage Height[1]	Plant Height[1]
421282	68.5	32.1	54.3
421283	80.8	27.4	52.1
9050485	62.4	35.7	54.6
591814	87.6	17.8	52.6
439880	66.5	39.4	72.7

[1]Centimeters

Figure 1. Three-year comparison of stand for 5 blue grama entries at Manhattan, Kansas



Stand improved for Accession 591814 which had the best stand all three years of the study. Accession 421283 tied Accession 591814 in 2010, but its stand reduced slightly in 2011. Accessions 439880 and 9050485 had reduced stands and 421282 increased slightly (Fig. 1). Plant growth was down for all entries except 591814 (Table 2) which showed an increase in plant height. Of the 3 entries that were planted at Knox City, accessions 421282, 421283, and 9050485, 421282 had the best stand at 95% following three years of observation.

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." A sprayer malfunction caused herbicide damage to some of the plots in 2010, biasing any evaluations that might have been made for that year. The situation did not improve in 2011 as losses occurred due to the herbicide damage, so this comparison trial was discontinued.

Evaluation of Little Bluestem

Study No. 20A215H

National Project No(s). Rangeland 1.1

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 tallgrass 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 PMC, 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 two to three 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: Plant 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

National Project No(s). Rangeland 1.1, Critical Areas 1.1

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 Plant Release

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

Big Bluestem Inter Center Strain Trial

Study No. KSPMC-ST-0801-RA

National Project No(s). Cropland 2.1, Rangeland 1.1

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 with 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 PMCs in Booneville, Arkansas, and Elsberry, Missouri. Comparative evaluations of these prevarietal releases and a selection from the Manhattan PMC, are needed to further document their performance and adaptation in other geographical regions. Information gained from these plantings may be used to provide data to support elevating lower class releases (e.g., source 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"^{TM} to randomized plots on a 2.74 m x 5.49 m (9 ft x 18 ft) plot spacing on a Belvue silt loam (coarse-silty, mixed, superactive, nonacid, mesic Typic Udifluvents) soil in Field C-2, 9 June 2008. Soil test results are provided in Table 2. The individual plants were spaced 0.9 m (3 ft) apart. Plant height was measured prior to each forage harvest. Four plants per plot were hand harvested by shearing the plants at ~20.3 cm (8 in) above ground level and weighed (Fig. 1). A grab sample of each plot was taken to determine dry matter yield. Means were separated using the least significant differences test (LSD; $P<0.05$) (Analytical Software, 1985-2003).

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.

Table 2. Soil test results for big bluestem ICST, Manhattan, April 2009.

Depth of Sample (in)	pH	Mehlich3-P[1] ppm	K ppm	OM %
0-6	7.2	42	214	0.4
6-18	7.4	41	202	0.3

[1](MF-2586, 2003)

Potential Product: Technology Transfer and Cultivar Release

Figure 1. Summer crew harvesting big bluestem plots in ICST first cut.

Progress or Status: The plots were fertilized with 96 lbs of N per acre. Prior to the first forage harvest plots were measured for plant height and evaluated for plant vigor, disease, and insects. The first cut was conducted 21 July 2011 at the late boot stage and an aftermath harvest was conducted 14 November 2011.

First Harvest: 'Rountree' ranked 1st in dry-matter yield, at 7 metric tons per hectare (t/ha), was significantly different from the other 10 entries at Manhattan. Accession 483446 (a Manhattan PMC entry) showed improvement with a 2nd place ranking though not significantly different from 7 other entries in the study. 'Kaw' fell back to 4th place after a 1st place ranking in 2010. 'Goldmine', a derivative of Kaw, ranked 6th, well down from 2nd place last year and 'Bonanza' a derivative of 'Pawnee', ranked 9th, staying in the bottom of the field (Table 3). Pawnee improved to 7th place after a 10th place ranking last year. Hampton Germplasm continued to decline, falling to 8th place. Rountree's 1st place rank for plant vigor was significantly different from all other entries except Northern Missouri Germplasm which ranked 2nd. Plant heights were reduced this year due to season-long drought. Rountree was significantly taller than Northern Missouri by 27 cm prior to the July forage harvest. Mean plant heights ranged from 173 cm

(68 in) to 115 cm (45 in). There was not a significant difference in vigor for most to the entries with Refuge Germplasm being least vigorous of the 11 entries once again. Plant disease ranged from 2.5 to 5.0, with Northern Missouri having the least incidence of disease and Bonanza the most. Insect resistance ranged from 1.8 to 4.5 with Hampton and Pawnee being the most resistance and Bonanza being the most susceptible (Table 4).

Table 3. Mean comparisons of first harvest yield[1], big bluestem ICST, 21 July 2011, Manhattan.

Entry	Dry Matter Yield (kg/plot)	(t/ha[2])		Rank Previous Year
Rountree	2.3	7.0	A[3]	3
483446	1.6	4.8	B	4
OZ-70	1.5	4.5	BC	5
Kaw	1.5	4.5	BC	1
Northern Missouri	1.5	4.4	BC	6
Goldmine	1.3	3.9	BCD	2
Pawnee	1.3	3.7	BCD	10
Hampton	1.2	3.5	BCD	7
Bonanza	1.1	3.4	BCD	8
Refuge	1.0	2.9	CD	9
9083274	0.8	2.4	D	11

[1]Relative yields due to plant spacing; [2]Metric tons/hectare; [3]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 plant height, disease and insect resistance, and plant vigor, big bluestem ICST, 19 July 2011, Manhattan.

Entry	Plant Height[1] (cm)		Rank Previous Year	Disease	Insects	Plant Vigor[1] Rating (1-9)[2]	
Rountree	173	A	1	3.0	3.8	2.0	A
Northern Missouri	146	B	3	2.5	2.0	3.0	AB
Bonanza	140	BC	2	5.0	4.5	4.0	BC
Pawnee	139	BC	6	4.0	1.8	4.0	BC
Goldmine	138	BCD	4	4.8	4.0	4.0	BC
OZ-70	129	BCD	7	3.0	4.3	3.8	BC
9083274	127	BCD	8	4.0	3.5	4.8	CD
483446	125	BCD	9	3.8	3.5	3.8	BC
Kaw	122	CD	5	3.5	2.5	4.3	BC
Hampton	117	CD	10	4.3	1.8	3.5	BC
Refuge	115	D	11	4.5	2.5	5.8	D

[1]Means in a column followed by the same letter are not significantly different from one another at P<0.05; [2]Rating 1-9, least-most

Aftermath Harvest: Kaw and 483446 held the 1st and 2nd rankings while Refuge and Bonanza rounding out the bottom of the field again this year for aftermath harvest yield. Yields were significantly lower than the first harvest (Table 5) due to continued drought and extremely warm weather the latter part of the summer. See deviations in weather at Manhattan (Table 6).

Table 5. Mean comparisons of aftermath harvest yield[1], big bluestem ICST, 14 November 2011, Manhattan.

Entry	Dry Matter Yield (kg/plot)	(t/ha[2])		Rank Previous Year
Kaw	0.283	0.8	A[3]	1
483446	0.254	0.8	AB	2
9083274	0.246	0.7	AB	6
Rountree	0.208	0.6	ABC	4
Hampton	0.202	0.6	ABC	7
OZ-70	0.192	0.6	ABC	5
Pawnee	0.178	0.5	ABC	9
Goldmine	0.172	0.5	BC	3
Northern Missouri	0.165	0.5	BC	8
Refuge	0.128	0.4	C	10
Bonanza	0.119	0.4	C	11

[1]Relative yields due to plant spacing; [2]Metric tons/hectare; [3]Means in a column followed by the same letter are not significantly different from one another at P<0.05.

Table 6. Precipitation and temperature deviations at Manhattan during the big bluestem ICST.

	Rainfall (in)		Temperature (°F)	
Year	Apr-Sep	Yearly Total	Apr-Sep	Yearly Total
2008	9.64	8.45	-2.75	-2.4
2009	3.37	3.89	-3.25	-2.6
2010	3.1	-1.46	0.52	-0.6
2011	-4.5	-1.76	0.97	0.0
Normal[1]	24.42	34.8	70.25	54.9

[1]Based on 30-year averages at Official Recording Station, Manhattan, Kansas

Accession 9083274 had the greatest plant height following regrowth, at 141 cm (55.5 in) it was substantially taller but not significantly different from Accession 483446, yet significantly different from the remaining entries. Accession 483446 had the most vigor followed by Kaw at the end of the season (Table 7).

Table 7. Mean comparisons of plant height and plant vigor, big bluestem ICST, Manhattan, 31 October 2011.

Entry	Plant Height[1] (cm)		Rank Previous Year	Plant Vigor[1] Rating (1-9)[2]	
9083274	141	A	1	2.0	AB
483446	123	AB	6	1.5	A
Kaw	119	B	4	1.8	A
OZ-70	113	BC	3	2.0	AB
Hampton	110	BCD	5	2.0	AB
Goldmine	107	BCD	2	2.3	ABC
Northern Missouri	104	BCD	11	4.0	D
Bonanza	97	CD	9	3.0	BCD
Pawnee	95	CD	10	3.8	D
Refuge	95	CD	7	3.3	CD
Rountree	91	D	8	3.3	CD

[1]Means in a column followed by the same letter are not significantly different from one another at P<0.05; [2]Rating 1-9, least-most

Total Biomass Yield: In combining the first and second cuttings, Rountree remained significantly different from the other 10 entries in total biomass yield (TBY). Kaw edged out OZ-70 to rank 3rd in TBY in 2011 (Table 8) Kaw ranked 1st in 2010.

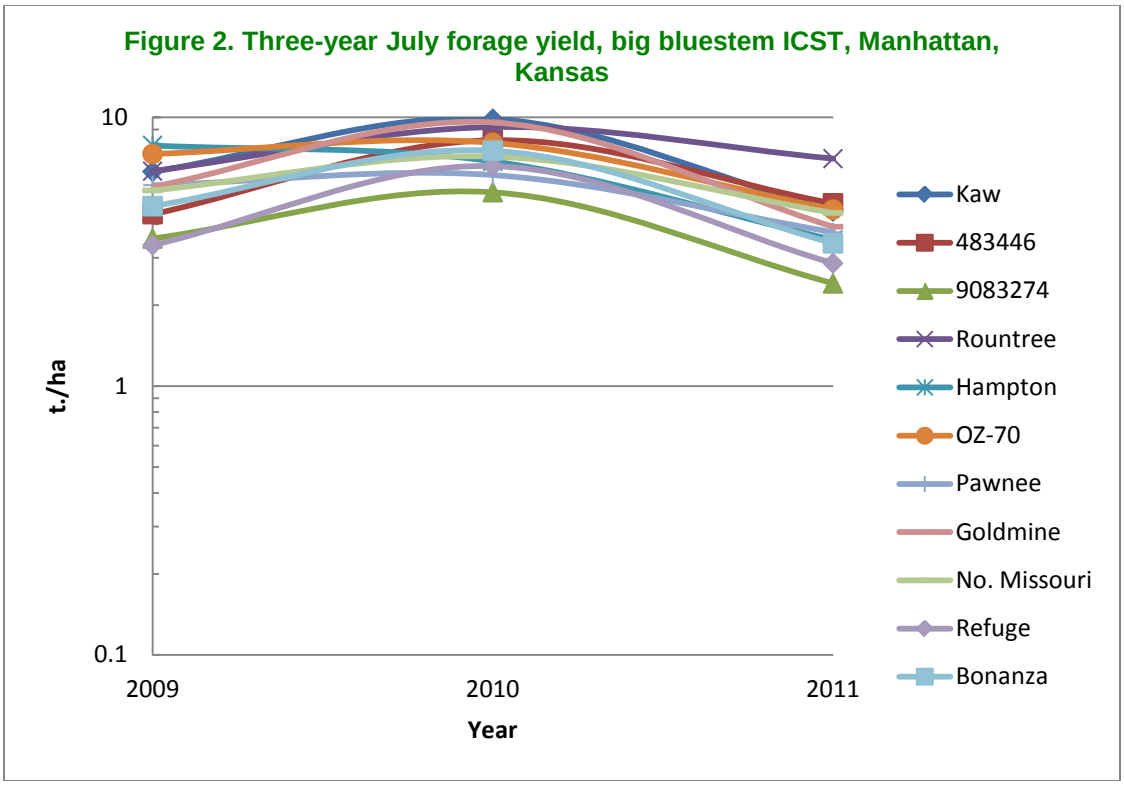
Table 8. Mean comparisons of total biomass yield[1], big bluestem ICST, 2011 growing season, Manhattan.

Entry	Dry Matter Yield (kg/plot)	(t/ha[2])		Rank Previous Year
Rountree	2.6	7.6	A[3]	3
483446	1.9	5.5	B	4
Kaw	1.8	5.3	B	1
OZ-70	1.7	5.1	BC	5
Northern Missouri	1.6	4.9	BC	6
Goldmine	1.5	4.4	BCD	2
Pawnee	1.4	4.3	BCD	10
Hampton	1.4	4.1	BCD	8
Bonanza	1.3	3.8	CD	7
Refuge	1.1	3.3	D	9
9083274	1.1	3.2	D	11

[1]Relative yields due to plant spacing; [2]Metric tons/hectare; [3]Means in a column followed by the same letter are not significantly different from one another at P<0.05.

Summary: Hampton and OZ-70 were the most productive followed by Rountree, Kaw, Goldmine, and Pawnee in the initial harvest July 2009. In 2010 Kaw edged out Goldmine and Rountree with 483446 a not too distant 4th. In 2011, Rountree was significantly better than all other entries, 483446, OZ-70, Kaw, and Northern Missouri rounded out the top 5 rankings. With the exception of Goldmine in 2009, the eastern ecotypes rounded out the top 5 with 9083274, Rountree, and Hampton (with OZ-70 in the mix) being consistently in the top 5 (Fig. 2).

Figure 2. Three-year July forage yield, big bluestem ICST, Manhattan, Kansas



In terms of regrowth, Kaw and 483446 out produced all other entries in aftermath yields (AMY) followed by 9083274, with Refuge and Bonanza on the bottom (Fig. 3). In terms of TBY Hampton, OZ-70, Kaw, Rountree, and Goldmine were the top producers in 2009. Kaw took over the lead in 2010 followed by Goldmine, Rountree, with 483446 joining the top 5, followed by OZ-70. By the 3rd year, Rountree was

significantly better than 483446, Kaw, OZ-70, and Northern Missouri, with Northern Missouri joining the top 5 for the first time. In comparing 3-year means, TBY for Rountree was 8.4 t/ha though not significantly different from the next 5 entries, Table 9. Kaw ranked second with Goldmine and 486446 ranking 4th and 5th, respectively. Bonanza in 9th place, led the bottom 3.

Plant height followed these same trends for the July harvests (Fig. 5). Rountree was the tallest with the exception of Bonanza in a tie in 2010, with Northern Missouri ranked 2nd all three years, and Kaw was in the middle of the pack. Fall height measurements were deceiving for some entries as only a few culms were produced in the regrowth. Foliage height would have been more representative as plant height did not correlate with AMY.

Table 9. Three-year mean comparisons of total biomass yield[1], big bluestem ICST, Manhattan.

Entry	Total Biomass Yield (t/ha[2])	
Rountree	8.4	A[3]
Kaw	7.9	AB
OZ-70	7.4	AB
Goldmine	7.1	ABC
483446	6.8	ABC
Hampton	6.7	ABC
Northern Missouri	6.2	BCD
Pawnee	5.6	CD
Bonanza	5.5	CD
Refuge	4.7	D
9083274	4.4	D

[1]Relative yields due to plant spacing; [2]Metric tons/hectare; [3]Means in a column followed by the same letter are not significantly different from one another at P<0.05.

Figure 3. Three-year aftermath yield, big bluestem ICST, Manhattan, Kansas

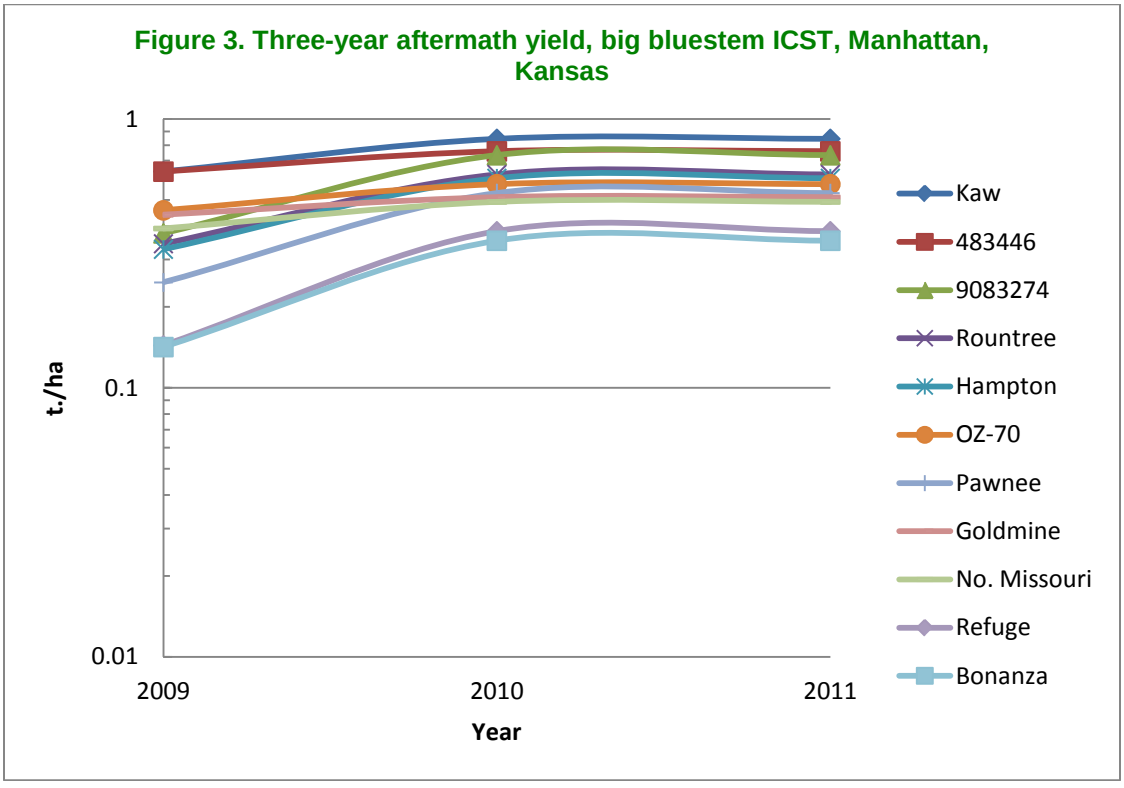


Figure 4. Three-year total biomass yield, big bluestem ICST, Manhattan, Kansas

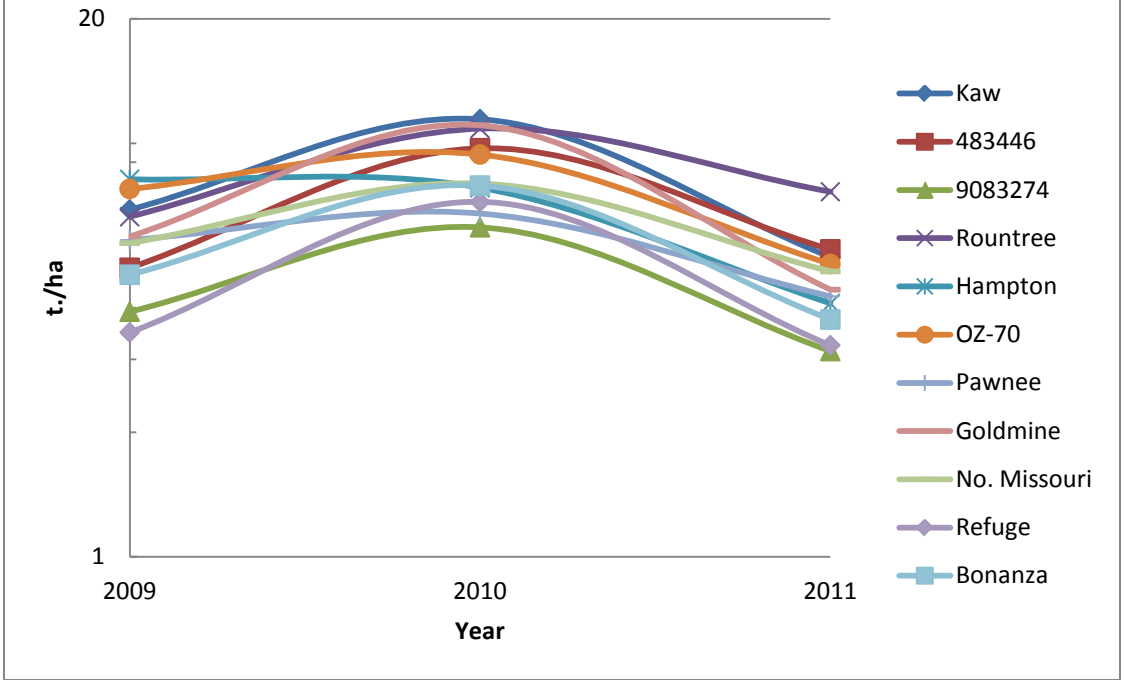
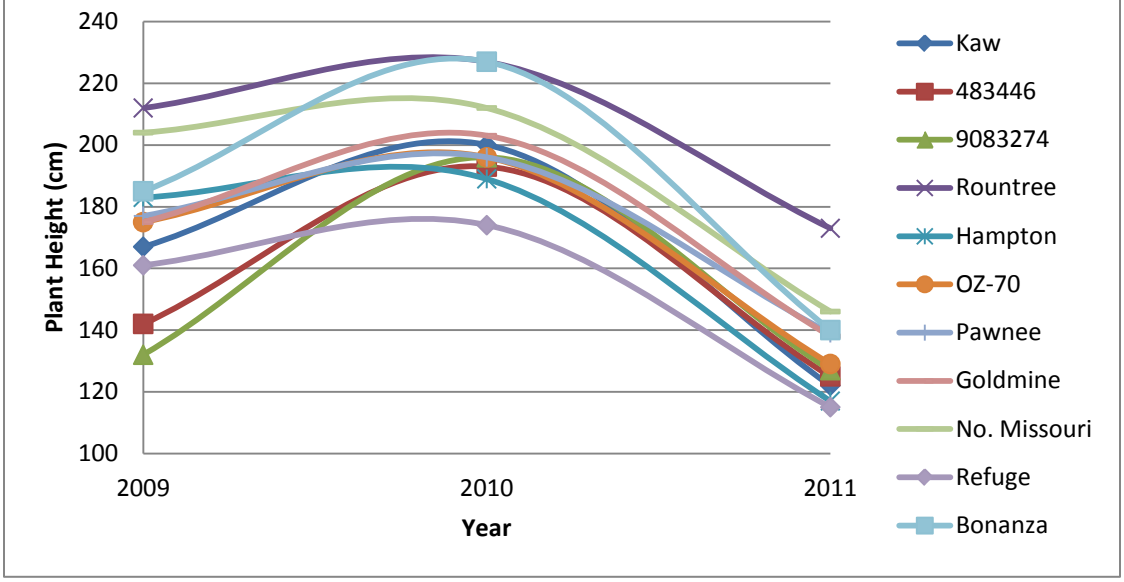


Figure 5. July mean plant height, big bluestem ICST, Manhattan, Kansas



A synopsis for each entry is provided below with Tables 10 and 11 providing a complete set of rankings.

Synopsis for each Entry

Bonanza: was in 8th place in 2009, with 7 entries significantly better in the July harvest. In TBY it was in the bottom 27%. In the second year, Bonanza moved up to 6th place in the July harvest and 7th in TBY. By the third year of harvesting plots, Bonanza had fallen to 9th place in July and 11th in TBY. It ranked in the upper 3rd for plant height at mid-summer, but only in the lower 3rd in the fall. It was the most susceptible of any entry for disease and insects in 2011.

Goldmine: was 6th in forage yield in the 2009 July harvest and 5th in TBY. It improved to 2nd place in 2010. However, Goldmine could not sustain the ranking in the third year, dropping to 6th place in the July harvest and 9th in TBY. Plants were of medium height and susceptible to disease.

Hampton: was off to a good start leading the other 10 entries in the initial harvest year in July, was 8th in AMY, but retained 1st place in TBY. By the second year, Hampton had dropped to 8th place. Vigorous appearing plants were in the lower 3rd for plant height, and medium for disease.

Kaw: started out in 4th placed in the initial harvest but performed best later in the growing season to take 1st place in the AMY all three years. In July harvest the second year; Kaw was on top with Goldmine a close 2nd. The third year, Kaw dropped back to 4th place in the July harvest and 3rd in TBY. It was in the middle of the range for plant height.

Northern Missouri: with tall, narrow plants, it started out in 7th place in forage yield the initial July harvest, increased to 5th place in AMY and 7th in TBY. It stayed in 7th place in the July 2010 harvest with AMY declining to 8th place but moved up to 6th in TBY and moved up to 5th the July harvest and TBY in 2011. Northern Missouri was in the upper 3rd for plant height in mid-summer and tended to be in the lower 3rd in the regrowth, the vigorous plants were disease free with little insect problems.

OZ-70: started out in 2nd place the initial harvest year but dropped to 5th the second year, rebounding to 3rd in the July 2010 harvest and was in the upper 3rd in TBY. Plants of medium height showed little disease problems, and susceptible to insects.

Pawnee: was ranked 5th in the July 2009 harvest but only 9th in TBY. Disease took a toll in 2010 as Pawnee fell to 10th place in the July harvest and was 9th in TBY. Pawnee rebounded to 7th place in 2011. In the lower 3rd for plant height, the disease prone plants were of medium vigor and free of foraging insects.

Refuge: was a poor forage producer, it stayed at or near the bottom in forage yield. Consistently short in stature and width, the plants were of poor vigor and susceptible to insects.

483446: started out slow in 2009 in 9th place in the July harvest but improved to 2nd place for the aftermath harvest (maintained all three years) below Kaw, yet it was 8th in TBY. In 2010, 483446 improved to 4th place in the July harvest. By 2011, it was in 2nd place for forage yield in July. Plant growth comes on late with short stature early and most of its growth in the regrowth period. Its medium to tall plants displayed fair vigor with susceptibility to insects and disease.

9083274: was 10th in the initial July harvest and 6th in the aftermath harvest. In 2010, it was in last place in July and 6th in the fall harvest. It remained on the bottom in 2011 for the July harvest and improved to 3rd in the AMY. In total yield it was the worst of the entries except for beating out Refuge for the bottom in 2009. This entry was the one of the worst for plant height in summer with a better ranking in the 2nd half of the growing season, although a bit dubious as only a few seed culms was produced in the regrowth. The plants were of poor vigor and medium for disease.

Rountree looked good all season long in terms of forage production over the course of the study. Entries such as OZ-70 and Kaw were in the upper 3rd of the rankings. By the 3rd year, Kaw, 483446, and Rountree were the best performers at Manhattan.

Table 10. Three-year summary of rankings for biomass yields and plant heights, big bluestem ICST, Manhattan.

Entry	Summer Yield			Aftermath Yield			Total Biomass Yield			Plant Height July			Plant Height Aftermath		
/Year	09	10	11	09	10	11	09	10	11	09	10	11	09	10	11
Bonanza	8	6	9	11	11	11	9	7	9	3	2	3	4	9	8
Goldmine	6	2	6	4	3	8	5	2	6	6	4	5	7	2	6
Hampton	1	8	8	8	7	5	1	8	8	4	10	10	11	5	5
Kaw	4	1	4	1	1	1	3	1	3	8	5	9	3	4	3
N. MO	7	7	5	5	8	9	7	6	5	2	3	2	5	11	7
OZ-70	2	5	3	3	5	6	2	5	4	7	7	6	6	3	4
Pawnee	5	10	7	9	9	7	6	10	7	5	6	4	8	10	9
Refuge	11	9	10	10	10	10	11	9	10	9	1	11	9	7	10
Rountree	3	3	1	7	4	4	4	3	1	1	1	1	10	8	11
483446	9	4	2	2	2	2	8	4	2	10	9	8	1	6	2
9083274	10	11	11	6	6	3	10	11	11	11	8	7	2	1	1

Table 11. Three-year summary of rankings for disease, insects and plant vigor, big bluestem ICST, Manhattan.

Entry	Disease			Insects			Vigor 1			Vigor 2		
/Year	09	10	11	09	10	11	09	10	11	09	10	11
Bonanza	5	--[1]	9	--	--	8	3	5	5	--	--	5
Goldmine	7	--	8	--	--	6	4	3	5	--	--	4
Hampton	2	--	6	--	--	1	1	1	3	--	--	3
Kaw	4	--	3	--	--	3	2	4	6	--	--	2
N. MO	1	--	1	--	--	2	3	1	2	--	--	8
OZ-70	2	--	2	--	--	7	2	2	4	--	--	3
Pawnee	8	--	5	--	--	1	4	4	5	--	--	7
Refuge	2	--	7	--	--	3	6	7	8	--	--	6
Rountree	2	--	2	--	--	5	3	1	1	--	--	6
483446	6	--	4	--	--	4	5	6	4	--	--	1
9083274	3	--	5	--	--	4	7	4	7	--	--	3

[1]Not Rated

Literature Cited:

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

MF-2586. 2003. Soil Test Interpretations and Fertilizer Recommendations. Kansas State University, Dept. of Agronomy, Throckmorton Hall, Manhattan, Kansas.

Evaluation of Chinese Chestnut

Study No. KSPMC-ST-1003-WL

National Project No(s). Wildlife 1.1

Study Leader: John M. Row, Plant Materials Specialist

Introduction: Chinese chestnut was introduced from Asia in 1907, because it displayed resistance to chestnut blight that decimated the American chestnut [*Castanea*. *dentata* (Marsh.) Borkh]. The best seedlings and varieties bear abundant crops annually. Nut yields greater that 59 kg (130 lbs) per tree have been reported (Harris *et al.* 1980). Chinese chestnut (*C. mollissima* Blume) was first planted at Manhattan in 1967 in the Woody Plant Observation Nursery at the Manhattan PMC. As interest in the chestnuts grew, chestnuts were collected from the 8 trees representing PI-70314. Fifty-five of the seedlings that were produced were planted along the driveway coming into the PMC. At that time, the purpose was purely landscape oriented. With exposure to the public, increased interest was drawn to the wildlife aspect of the trees as their fruits were valued by deer and squirrel, and more recently wild turkeys. In more recent times, human interest began to grow as a few people were interested in the chestnuts for human consumption. This interest has exploded to the point that the Asian population in the Manhattan area has shown an increased demand for the nuts for human consumption. This demand holds promise for small farmers located near population centers with large Asian populations.

In Kansas, Chinese chestnut grows to a medium-sized tree. The mean height of the trees at 35 years of age was 8.6 m (28.3 ft) with a range of 5.9 to 11.1 m (19.5 to 36.7 ft) at Manhattan. PI-70314 is represented by trees variable in size, shape, nut production, and fruit maturity.

Objective: Evaluate trees produced from selections at the PMC based on form, nut production, and wildlife considerations. Select trees superior in nut production for advanced testing with known cultivars.

Background: Initially trees were selected based on form and nut production. Consideration was given to wildlife in terms of food, roosting, and cover potential. Nuts were collected from selected trees that were the largest to be found and assigned accession number 9050102. A general representation of nuts from the remaining trees was also collected. Nuts from the two collections were grown out and planted in Field F-2 in the woody observation nursery at the PMC. As interest in the chestnuts grew, an additional selection was made of superior nuts from selected trees. These were assigned accession number 9050494 and grown out to establish a selection nursery aimed at finding superior nut producing trees.

Procedure: Seedling trees derived from half-sib families were planted in 2006 in Field E-1, on a Belvue silt loam(coarse-silty, mixed, superactive, nonacid, mesic Typic Udifluvents) soil on the PMC, in rows spaced 16 feet apart with trees spaced 15 feet apart in the row for a total of 168 trees. Determine nut production and maturity date for each tree. Collect data on plant growth factors such as tree height and width, disease and insect resistance, and fruit maturity may be included.

Row of young chestnut trees, 3rd year after planting at Manhattan.

Potential Products: Plant Release and Technogy Transfer

Progress or Status: Currently 162 or 96% of trees are under observation for nut production. The remaining 4% consists of losses and culled trees. A broad range of plant heights exists across the planting. A couple of factors affecting plant performance were seedling quality at time of planting and location within the plantation. Trees on the west, south, and east perimeters tended to not fare as well as trees on the north perimeter and interior of the plantation. In 2010, the mean plant height increased 142 cm over the previous year with a slower increase of 80 cm in 2011 (Table 1). The tallest trees were not necessarily the most productive. The tallest tree in 2011 at 711 cm produced 96 husks (288 nuts) while the mean was 64 husks (192 nuts). The most productive tree at 450 cm was shorter than the median tree height of 467, produced 357 husks, essentially 1071 nuts. The number of husks was counted for each tree. The mean number of nuts per husk was determined to be 3. Nut weight was determined through random sampling in the plantation. Husk production increased exponentially over the previous two years. Mean nut yield per tree was 1.3 kg (2.9 lbs) and 2.4 kg (5.4 lbs) in 2010 and 2011, respectively. Production in 2011 increased by 54% over 2010 yields. Nut maturity date was earlier for trees selected for nut production (Table 2).

Table 1. Mean plant height, number of husks per tree, and nut maturity date for 162 Chinese chestnut trees at Manhattan, Kansas, for three crop years.

Crop Year	Tree Height (cm)	Tree Height Range	Median Tree Height	No. of Husks	Nut Maturity Date
2009	239	64-440	244	11	September 28
2010	381	54-573	388	14	October 1
2011	461	116-711	467	42	October 7

Table 2. Mean nut yield data after culling poor producing trees at Manhattan, Kansas, for three crop years.

Crop Year	Tree Height (cm)	No. of Husks	Cull Criteria Nuts/Tree	% of Trees	Nut Maturity Date
2009	285	32	≥ 27	29.6	September 27
2010	420	37	≥ 30	34.0	September 29
2011	494	104	≥ 120	33.3	October 5

Maturing fruits are often attractive to insects. In 2010, a number of insect species were observed feeding on the developing fruits. Sap sucking insects such as leaf-legged bugs were numerous and a few stink bugs were also found. Their feeding activity attracted butterflies, primarily red admirals and comas, and numerous flies. In lesser numbers were cucumber beetles and harvestmen. Foliar predators were also present, mainly grasshoppers and bagworms. They chewed up the foliage, but were not a major detriment to the trees. Nocturnal moths were found hiding in empty husks that remained on the trees after the nuts had fallen.

Literature Cited:

Harris, H., J. D. Norton, and J. C. Moore. 1980. Three New Chinese Chestnuts: AU Cropper, AU-Leader, and AU-Homestead – Their History and Production. Circular 247. Agr. Exp. Sta. Auburn Univ., Auburn, Alabama. 8p.

Cultural Evaluations and Special Studies

Propagation of Mead's Milkweed

Study No. 20C007Ta

National Project No(s). Natural Areas 1.1

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"^{TM} in 1997 and grown out in the greenhouse-lathhouse-complex; the first field planting that year was to a buffalo grass-tallgrass (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 PMC, 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 in 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 five 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 illinoinensis* [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 the 2004 ATR for details on procedures carried out on various phases of this study (USDA NRCS, 2004).

Potential Product: Technology Transfer

Progress or Status: Established Field Plantings**.** Spring recovery improved over 2010 for most groups despite a drier than normal beginning to the year. There was no change in the Yellow Group, the Blue Group declined, and the greatest comeback over 2010 was observed in the BG-TG Group (Table 1). In May, the development of flower buds was noted with three plants in the White Group, four in the BG-TG Group, and 1 in the Red Group producing buds. By June they were either destroyed by herbivores or aborted perhaps due to the drier and warmer than normal weather conditions. The Blue and White groups were over taken by large broadleaf weeds and woody invaders competing for the available light and moisture made observations difficult. The biggest surprise was in the unprecedented vegetative recruitment in the BG-TG Group where 37 stems were counted 12 May. Of those about 30 were generated from rhizomes produced by the mother plants. Mean height of the off shoots was 27.8 cm on

10 June. Leaf width was 1.2 cm and leaf length was 5.6 cm. The distance from the mother plants ranged from 7 to 70 cm with a mean of 36 cm. The mean diameter of these stems was 1.7 mm. Additonal plant growth data can be found in Tables 2-5.

Table 1. Spring recovery and survival of established plants by group.

Group	Established Plants	Spring Recovery	Initial % Survival	Current Stand	Previous Years Stand	Change
Yellow	7	1	85.7	14.3	14.3	0
Red	16	9	87.5	56.3	50.0	6.3
Blue	10	2	100.0	20.0	30.0	-10
White	11	7	91.7	63.6	45.5	18.1
BG-TG	7	6	100.0	85.7	42.9	42.8

Table 2. Summary of plant growth (length and width measurement means) for the Red Group “Salac Prairie” 13-year old plants.

Date	28 April 2011		12 May 2011		6 June 2011	
		Range		Range		Range
No. of Plants	7	---	9	---	6	---
No. of Stems	13	---	20	---	10	---
Plant Length (cm)	7	1-17	---	---	27.9	15-42.5
No. of stems sampled	11	---	---	---	10	---
Leaf Width (mm)	9.5	2-29	---	---	6.5	<1-12
No. sampled	2	---	---	---	8	---
Leaf Length (mm)	34	21-65	---	---	54.5	25-80
No. sampled	2	---	---	---	8	---

Table 3. Summary of plant growth (length and width measurement means) for the Buffalo Grass-Tallgrass (BG-TG) prairie 14-year old plants.

Date	28 April 2011		12 May 2011		6 June 2011	
		Range		Range		Range
No. of Plants	5	---	6	---	6	---
No. of Stems	32	---	37	---	29	---
Plant Length (cm)	1.8	0.3-3.1	---	---	34.3	29-53
No. of stems sampled	3	---	---	---	23	---
Leaf Width (mm)	---	---	---	---	17.1	6-30
No. sampled	---	---	---	---	15	---
Leaf Length (mm)	---	---	---	---	62.9	40-72
No. sampled	---	---	---	---	15	---

Table 4. Summary of plant growth (length and width measurement means) for the White Group 13-year old plants.

Date	28 April 2011		6 June 2011	
		Range		Range
No. of Plants	4	---	6	---
No. of Stems	11	---	10	---
Plant Length (cm)	2.4	0.1-5.0	29.3	---
No. of stems sampled	11	---	10	---
Leaf Width (mm)	---	---	20.5	8-28
No. sampled	---	---	8	---
Leaf Length (mm)	---	---	59.6	48-69
No. sampled	---	---	8	---

Table 5. Summary of plant growth (length and width measurement means) for the Blue Group 13-year old plants.

Date	28 April 2011		12 May 2011	
		Range		Range
No. of Plants	2	---	2	---
No. of Stems	3	---	3	---
Plant Length (cm)	0.35	0.2-0.5	---	---
No. of stems sampled	3	---	---	---

Flowering Mead's milkweed plant in the BG-TG plot at Manhattan, Kansas

Literature Cited:

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

Laboratory Evaluation of Plant Materials to Determine Seed Analysis, Germination, and Propagation Techniques

Study No. KSPMC-T-0502-RA

National Project No(s). Forestland 1.1, Natural Areas 1.1, Rangeland 1.1, Water Quality 4.1

Study Leader: John M. Row, Plant Materials Specialist

Introduction: The Plant Materials Program deals with a wide variety of plant materials, many of which are not in common use in the seed industry. Therefore, little is known about their germination and propagation requirements. Additionally, purity analysis information and techniques for testing such seeds are lacking. Many of these species are difficult to germinate or the mechanisms required for successful germination are unknown. This study serves as a clearinghouse for species that are not a part of other Manhattan PMC studies.

Objective: Develop procedures and techniques for testing seeds based on literature reviews and on the wealth of current knowledge about seed development and germination. Establish species protocols based on the results of experiments and study trials.

Procedure: Conduct replicated trials set at various seed-blower settings; temperature regimes in germination tests, time frames, and planting depths. Evaluate seedlings and seedling vigor; conduct viability tests.

Potential Products: Technology Transfer

Progress or Status: Fremont's leather flower, *Clematis fremontii* S. Wats., is currently under study.

Plant production of Fremont's leather flower. Fremont's leather flower, described as one of our rarest plants, is a protected species in Missouri (FGCM, 2009). A collection of Fremont's leather flower was made in Webster Co., Nebraska, in 2008. It was assigned Accession No. 9050534, being a rare endemic, it is desirable to attempt to collect viable seed units and to propagate them and return plants to the place of origin to expand the local plant population.

Achenes were placed in fine mesh sacks and surface sterilized using 10:1 solution of purified water and sodium hypochlorite (5.25% AI) for 20 minutes with agitation and allowed to soak for 5 additional minutes. The seeds were triple rinsed in purified water for 2 to 3 minutes each rinse. The achenes were placed between blotters moistened with purified water in plastic germination boxes. The seeds were stratified at 3º to 4ºC (37.4º to 39.2ºF) for approximately 3 months. The boxes were checked weekly and watered as needed. In late March, achenes were removed from stratification and used to replant cone-tainers from the previous year. Eight more achenes germinated and developed into seedlings. Eight plants that were produced previously were returned to Webster County.

Number of seeds per pound in 'Konza' aromatic sumac, *Rhus aromatic* var *serotina.* The number of seeds per pound in Konza was not known. Seeds were drawn from three crop years, 2003-2005. One hundred seed counts, made by hand, were weighed and an average number of seeds per pound were determined for each crop year. In all 12,700 seeds were counted. The high, low, and out of range counts were rejected. An average number of seeds per pound of 17,973 were determined for Konza based on 89% of the counts for the three crop years. Refer to Table 1, for seed count data.

Table 1. Seed count data for three crop years of Konza aromatic sumac.

Crop Year	No. of Counts	No. of Counts Accepted	Mean Weight 100 Seeds (g)	No. of Seeds Per Pound
2003	42	36	2.53	17,997
2004	48	44	2.39	18,966
2005	37	33	2.68	16,957

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

Study No. KSPMS-T-0001-CR

National Project No(s). Critical Areas 1.1

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 PMC. The sprigs were hand planted within select reaches of the primary drainageways within the study area in Jewell County (Fig.1). 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 2015.

Potential Product: Technology Transfer

Progress or Status: Monitoring continues as vegetation establishes over the planting area. Areas remain unvegetated due to the fragile slopes. Producer plans to complete a prescribed burn for management of the site. As the soils begin to stabilize, native grass species such as big bluestem, little bluestem, and switchgrass are beginning to establish in the stabilized vegetated areas of blue shale.

An evaluation of the native grass study plot that was planted in 2010 was completed. Plot establishment the first year following seeding was very successful with 260 of the 263 plants surviving (Fig. 2). Evaluations in 2011 yielded a decline in plant health along with the loss of an additional 29 plants. A soils test from this planting site indicated a pH of 2.8--3.0. Despite the low pH, a few native plants remain healthy. There appears to be some adaptation of the selected native grass in the study to these types of soils. Evaluation of the study planting will continue.

Figure 1. Before and after shots of Phragmites planting on exposed blue shale outcrop treatment site in Jewell County, Kansas.

Figure 2. Native species planting on exposed blue shale outcrop site in Jewell County, Kansas

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

Study No. KSPMS-T-0201-CR

National Project No(s). Critical Areas 1.1

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 PMC, 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 Fig. 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 2007, as part of a Resource Conservation and Development project, 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, compost, and various crop residues were 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 was then 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

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 two sites in Kansas, Eureka and El Dorado, remain active sites. These 2 sites were not evaluated in 2011.

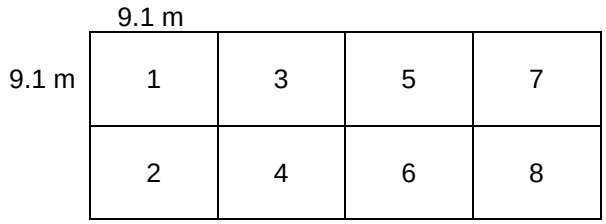
The 2007 Eureka site planting continues to be grazed with adjacent pasture. Saline area was not grazed as hard in 2011 as in 2010. The study plots were reflagged in 2011 for observational comparison of residue treatments in each plot. This site continues to improve with vegetation slowly spreading into open areas. Areas that continue to be subjected to water overflow remain thinly covered with vegetation.

Observations from the site plantings within this study indicate that the initial application of organic matter both incorporated and surface applied is critical to the establishment of vegetation on saline sites. Type of organic matter doesn't appear to be as critical as incorporating organic matter to promote water infiltration and percolation of salts from the surface. Monitoring of this study will continue for several years.

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

Study No. KSPMS-T-0705-PA

National Project No(s). Cropland 1.1

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.

Potential Product: Technology Transfer

Progress or Status: The broadcast seeding of Laramie annual medicago was evaluated in June 2011. At the time of evaluation, Laramie had produced seed and plants could not be easily identified. Based on the amount of Laramie seed on the ground, the plant appears to be doing very well (Fig.1).

Observations do not indicate any difference in cool-season grass plots in comparing the control and the area seeded with Laramie. Soil testing may need to be part of future evaluations of the study. This study will continue for several additional years.

Figure 1. Burclover seed units litter the ground in cool-season grass plots at Wallace County, Kansas, study site.

Plant Adaption Study for Sandy Seeding Site

Study No: KSPMS-T-095-PA

National Project No(s). Critical Areas 1.1, Cropland 3.1

Study Leader: Mark A. Janzen, Plant Materials Specialist

Introduction: Irrigation water tables are dropping in areas of Western Kansas making it nearly impossible to crop some of these acreages that consist of sandy soils and low rainfall. As a result some of these irrigated acres have been planted to native grasses under the Conservation Reserve Enhancement Program (CREP). It has been very difficult to achieve stands of grass to provide adequate protection of the natural resources. Species selected for this study are well adapted to coarse soils and to areas with low rainfall. Most of these species have been tested under similar conditions and released by Plant Materials Centers as new cultivars. This study will evaluate these species in a planting to determine adaptability to sandy soil in a Western Kansas climate.

Objective: To evaluate the adaptability of both existing and new cultivars on a sandy planting site. These cultivars are adapted to coarse soils and generally require little moisture.

Procedure: Species meeting the adaptation requirements for this study were assembled. Cultivars and germplasm releases were included along with experimental lines from Centers, where available. These species have characteristics for being adapted to the deep sandy soils and climate of the study site located in southeastern Kearney County, Kansas. The assembled seed was planted in plots ~1.5 x 6.1 m (5 x 20 ft) with 5 rows per plot spaced ~30.5 cm (1 ft) apart in a Randomized Complete Block Design replicated 3 times. A wheat straw mat was placed on the seeded plots and stapled down to simulate residue and reduce the potential for wind erosion.

Species planted include:

'Vavilov' Siberian wheatgrass
'Pronghorn' prairie sandreed
'Bend' sand lovegrass
9066585 and 9066789, needle-and-thread
9066233, sandhill muhly
Borden County Germplasm sand dropseed
PMT-389 Arizonia cottontop
'Nogal' black grama
'Garden' sand bluestem
'Volga' mammoth wildrye
'Paloma' Indian ricegrass
9066585, blowout grass
9050018, big sandreed
Potter County Germplasm spike dropseed
'Viva' galleta grass

Potential Products: Cultivars with adaptive traits to the study site will be incorporated into the eField Office Technical Guide and into technical notes.

Progress or Status: This study contains 15 replicated plots with plant materials obtained from 6 Centers were drilled April 1, 2009. Soil moisture conditions at the time of planting were good.
A wheat straw mat was installed and anchored across the plots.

Initial review of the study indicated poor results in the plots. Species identified included sand bluestem, sand lovegrass, black grama, prairie sandreed, sand dropseed and needle-and-thread. Other non-planted species showing up in the plots include little bluestem, sideoats grama and blue grama.

The study was evaluated in 2011 for plot development. Initial species along with non-planted species continue to persist and spread in the study. Wheat straw mat installed at planting has decomposed and no longer providing erosion control (Fig. 1).

Following the installation of the study, extra seed from the study was broadcasted into a dune area near the study planting. Wheat straw mat (6 foot wide) was applied to a portion of the seeding. Evaluations of the dune area in 2011 indicate a good stand of broadcast species confined to the area of the wheat straw

mat. There were no seedlings of the broadcasted species found outside of the mat area. When considering the differences in the two plantings, one explanation is that the study plots, even with depth bands on the drill, allowed seed placement too deep, thus effecting germination and establishment of the grasses.

This study may need to be expanded to look at the affects of cover crops as well as seed placement (depth) in the establishment of native grass on sandy soil sites.

Figure 1. Dune area two years after application of wheat straw mat on sandy seeding site, Kearney County, Kansas.

Initial Evaluations

Evaluation of Miscellaneous Grasses

Study No. 20I003L

National Project Nos. Critical Areas 1.1, Rangeland 1.1

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 PMC, 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. Observations will generally be carried out for 3 growing seasons post establishment.

Potential Products: Plant Release and Technology Transfer

Progress or Status: Little bluestem (*Schizachyrium scoparium* [Michx.] Nash) is currently under test in this study. Arizona cottontop (*Digitaria californica* [Benth.] Henr.) was dropped from this study in 2009 however, a single volunteer plant was found in 2010.

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; however they did produce viable seed. Seed that had fallen on the ground germinated in the spring 2009 but were destroyed. One volunteer plant that was found in the planting area in 2010, 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 was damaged due to a malfunction in herbicide application which stunted the plants in 2010, which affected stand as plants were killed biasing the observation. The stand of Accession 9029926 declined from 100% a year ago to 90% in 2011, herbicide damage was not thought to be the cause of the decline (Table 1). The plants were not clipped in 2010 or 2011.

Table 1. Evaluation data for little bluestem, *Schizachyrium scoparium*, at Manhattan, Kansas, 2011.

Accession	Plant Height (cm) 7/22/2011	Plant Height (cm) 10/27/2011	Stand (%)
421552	77	109	65
9029926	98	146	90

Accession 9029926 out performed Accession 421552 in terms of plant growth each year of the study at Manhattan. Although the entries were clipped only once, Accession 9029926 obviously produced more biomass than Cimarron from looking at the plant heights (Table 2).

Table 2. Four-year summary of plant height[1] for little bluestem, *Schizachyrium scoparium*, at Manhattan.

Year	Accession	
	421552	9029926
2008	100	116
2009	131	164
2010	NM	130
2011	109	146

[1]Centimeters; NM=Not Measured

Evaluation of Miscellaneous Trees and Shrubs

Study No. 20I010K

National Project Nos. Forestland 1.1, Natural Areas 1.1, Urban 1.1

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 PMC, and interested parties in the central Great Plains. These include: Kansas State University (KSU)-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 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 a four-state area which includes Colorado, Kansas, Nebraska, and Oklahoma.

Objectives: Identify superior specimens of trees and shrubs 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 Manhattan PMC.

Procedure: Containerized or bareroot stock is spaced 3.05 m (10 ft) apart in rows spaced 4.88 m (16 ft) apart. Drip irrigation is used to aid in establishment which may be needed for several years. 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 (coarse-silty, mixed, superactive, nonacid, mesic Typic Udifluvents) 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.

Note: 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.

Potential Products: Information Technology and Plant Release

Progress or Status: The assembly consists of 148 accessions representing 102 species in 60 genera, of which 29 are named cultivars. Forty-nine 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.

Seventy-four accessions were evaluated this year. There were 8 new acquisitions in 2011 (Table 1).

Table 1. New acquisitions to the miscellaneous tree and shrub evaluations in 2011.

Species	Common Name	Accession Number	Origin/Source
Aronia arbutifolia	red chokeberry	658641	Pickens Co., NC /NDPMC/NCRPIS
Carya illinoinensis	pecan	9050605	Ste. Genevieve Co., MO /NCRPIS
Diospyros virginiana	persimmon	9050606	St. Charles Co., MO /NCRPIS
Gymnocladus dioicus	Kentucky coffeetree	9050577	Kingfisher Co., OK /KSPMC
Gymnocladus dioicus	Kentucky coffeetree	9050580	Riley Co., KS /KSPMC
Quercus bicolor	swamp white oak	9050607	Adair Co., MO /NCRPIS
Quercus bicolor	swamp white oak	9050608	Polk Co., IA /NCRPIS
Viburnum mongolicum	Mongolian viburnum	9050609	Asia /NCRPIS

The growing season was marked with periods of drought and high temperatures impacting plant performance in 2011. Leaf scorch was a problem for a number of entries due to the high temperatures which detracted from plant appearance. Disease and insect issues were also detractors for a number of entries. Despite improvements in fencing, deer continue to get into fenced off areas and browse and rub on young trees and shrubs, often inflicting severe damage resulting in the removal of stems which sets back growth and affects plant performance. A thumbnail sketch of plant performance for 40 of the 74 entries evaluated in 2011 follows:

Thumbnail sketch of woody plant performance for the 2011 growing season.

Format: Scientific name, Common name, Accession or Plant Introduction number, Observations

Trees

Betula papyrifera, paper birch, 9050478, foliage unattractive due to disease and insects; 1 surviving plant struggles, poor vigor.

Carpinus betulus, European hornbeam, two entries: 9050479 and 9050480, these entries have finally taken off after struggling the first five years; uniformity lacking; scorch, disease, sunburn/wind, insects detract from foliage.

Carpinus caroliniana, American hornbeam, 9050501, foliage attractive early, deteriorating as summer progresses; plants lack uniformity.

Carya illinoinensis, pecan, 9050605, foliar diseases late, insects heavy on some plants.

Celtis laevigata var *canadensis*, netleaf hackberry, 9050519, clean foliage all season, distractions were insect damage and slight disease issues to foliage; plant uniformity medium.

Cercis canadensis, red bud, 2 entries: 9050520, foliage not clean all season, distractions were insects and foliar diseases (leaf spot); plants lack uniformity; 9050521, foliage unattractive, plants fairly uniform.

Cupressus bakeri, Modoc cypress, 9050504, foliage looks good overall, some brown patches due to disease or winter injury; bagworms on 50% of plants; poor form due to damage to growing points; making small gains in growth.

Diospyros virginiana, common persimmon, 9050606, foliage attractive most of the season, declining into fall with some disease and insect damage.

Ginkgo biloba, ginkgo, 9050582, foliage unsightly season long due to leaf scorch, compounded by foliar diseases showing up late in the season; plants lack uniformity.

Gymnocladus dioicus, Kentucky coffeetree, 2 entries: 9050577 and 9050580, clean foliage all season; deer browse.

Pinus sylvestris var *mongolica*, Mongolian pine, 2 entries: 9076718 and 9076719, growth slow, a slight yellowing of needles during the winter months, but needles typically reattain their dark green color in the spring, brown needles due to drought; 9076718 poor form due to deer damage.

Platanus occidentalis var *glabrata*, smooth sycamore, 9050583, foliage attractive from a distance, at closer look disease and leaf scorch are an issue on interior leaves; vigorously growing.

Populus alba, white poplar, 9050499, tree no. 1 dead, tree no. 2 dying?; leaves mostly brown could be due to drought stress, tree no. 3 foliage is okay but thin on lower stems and pale in color; plants fast growing, lack uniformity.

Populus tremuloides, quaking aspen, 9050535, insects, disease, and deer damage detract from plant appearance; uniformity lacking in part due to severe deer damage; trees lack vigor; suckering.

Ptelea trifoliata, common hoptree, 9050523, foliage unattractive due to insect feeding which discolors leaves, attractive fruits; plants lack uniformity, subject to windthrow, some suckering; host plant for giant swallowtail butterfly.

Quercus alba, white oak, 9050532, foliage detractors, disease and insect activity affecting mainly the lower leaves, foliage otherwise attractive; plants lack uniformity.

Quercus bicolor, swamp white oak, 2 entries: 9050607, insect activity and a mild case of scorch detract slightly from otherwise clean foliage; 9050608, has more leaf scorch than 9050607.

Sorbus aucuparia, mountain ash, 9050429, heat stress slight; good foliage appearance, slight insect and disease issues; tree no. 2, severe mechanical damage.

Sorbus torminalis, wild service tree, 2 entries: 9050432, foliage attractive all season, insignificant insect and disease problems, plant growth not uniform among plants; 9050430, some unsightly foliage due to insect and disease activity (leaf spot or anthracnose), plant growth not uniform. Increased growth observed in both accessions.

Taxodium distichum, bald cypress, 9050542, clean foliage overall, attractive; plants lack uniformity; bagworms.

Tilia cordata, littleleaf linden, 9050481, foliage attractive early, declining in appearance with the season; growth steady.

Ulmus thomasii, rock elm, 9050503, foliage unattractive season long due to disease; plants lack vigor, poor uniformity.

Shrubs

Alnus maritime subsp. *oklahomensis*, seaside alder, 9050518, leaf scorch detracted from foliage appearance, some yellowing (lightening) of older foliage; plants fairly uniform.

Caragana microphylla, littleleaf peashrub, 9050581, attractive, clean foliage, plant uniformity lacking.

Chilopsis linearis, desert willow, 9050543, virtually disease and insect free; plants moderately uniform, good plant vigor; many attractive flowers.

Cornus sanguinea, blood-twig dogwood, 2 entries: 9050425, foliage unattractive all season, degrading further by late summer; leaf edges cupping or curling, increased growth but plants declining; 9050426, foliage unsightly all season, leaf edges cupped or curled; remaining plants dying, only 1 plant holding on.

Corylus americana, American hazelnut, 9083247, foliage appearance good overall, leaf scorch; plants lack uniformity, beginning to produce fruit.

Cotinus coggygria, smokebush, 9050427, foliage looks good overall, some yellowing of leaves on individual plants, 1 individual with disease, plant uniformity average, 1 stunted.

Crataegus chrysocarpa, fireberry hawthorn, 9076686, foliage unsightly, slow growth, plants lack uniformity and vigor, disease and insect plagued. Plants not adapted.

Elaeagnus X 'Jefmorg', Silverscape®olive, 9050524, clean foliage most of the summer, beginning to deteriorate by late summer, plant growth fairly uniform but slowing down; plant no. 3 produced fruit, average fruit size 7.1x8.7 mm (dry fruit). One hundred and three fruits were collected in the fall (viability of seed units under investigation).

Foresteria pubescens var pubescens, elbow bush, 9050502, leaf scorch and disease detract from foliage appearance, softened by small leaf size; plants tall and narrow growth habit, subject to windthrow.

Hydrangea arborescens radiata, silverleaf hydrangea, 9050498, plants lack uniformity, heat stress, older foliage unattractive due to disease and heat stress. Plants struggle with little gains in growth.

Photinia melanocarpa, black chokeberry, 2 entries: 9050500, leaf scorch, plants lack uniformity, plants unattractive, have struggled all summer, declining; 323957, clean foliage most of the summer, declining in appearance with disease showing up late summer; plants fairly uniform growth; good flowering and fruiting.

Physocarpus opulifolius, common ninebark, 2 entries: 9050522, foliage unsightly due to disease (leaf spot), plants uniform, little additional growth; 9050531, attractive foliage, degrading late in the season as foliar diseases appear (leaf spot); plants lack uniformity, may be due to soils or site location.

Rhus copallinum, shining sumac, 9050537, (Fig. 1) overall attractive appearance; late season foliar diseases appear late in the growing season; good vigorous growth this year negated by severe deer damage.

Ribes americanum, American black currant, 9082687, foliage unsightly most of the season due to foliar diseases; the three original plants fairly uniform growth.

Shepherdia argentea, silver buffalo berry, 9050431, no noticeable insect damage, leaf drop slight, little if any disease noted, increased growth observed.

Spiraea flexuosa, spiraea, 9050417, older foliage unattractive, diseased and heat stressed, new growth looks good in late August; slow growing, not adapted to site.

Viburnum rufidulum, southern black haw, 2 entries: 9050482, foliage clean, slight discoloring due to disease, lighter green than 9050483; 9050483, clean foliage most of the summer, foliar diseases detracting appearance by late summer. Both accessions show good growth.

Xanthoceras sorbifolium, yellowhorn, 9050418, many blooms, flowers and fruits attractive, produces seed with some recruitment noted; clean foliage, but leaves beginning to show some disease late in the season; plant no. 2, 20% of foliage diseased; plant uniformity in 2 groups, 3 plants in 1and 2 in the other; plants showing good growth.

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

Figure 1. Shining sumac plants in second growing season in the miscellaneous shrub plots at Manhattan, showing typical layout of plantings.

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2011. 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 C4 19-21	1981	9004384		*Prunus serotina*	black cherry	Ann Arundel Co., MD /MDPMC
B1 C5 19-20	1981	9007345		*Prunus serotina*	black cherry	Hampshire Co., WV /MDPMC
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 3 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 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 15 6-10	2010	9050581	Mongolian Silver Spires	*Caragana microphylla*	littleleaf peashrub	/NCRPIS
F1 18 1-5	1990	477010		*Ligustrum obtusifolium*	border privet	/MIPMC /NCRPIS

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2011. Page 2

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
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
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*	silverleaf 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 hoptree	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 1-5	2010	9050584		*Tetradium* sp.	bee-bee tree	/NCRPIS
F2 15 6-10	2009	9050543		*Chilopsis linearis*	desert willow	Meade Co., KS /KSPMC
F2 18 1-5	2011	658641		*Aronia arbutifolia*	red chokeberry	Pickens Co., NC /NDPMC
F2 18 6-10	2011	9050609		*Viburnum mongolicum*	Mongolian viburnum	Asia /AA-FCRS, Morden, CN /NCRPIS
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

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2011. Page 3

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
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
F3 15 1-10	2006	9050502		*Foresteria pubescens* var *pubescens*	elbow bush	/NCRPIS
F3 16 1-5	2010	9050582		*Ginkgo biloba*	ginkgo	/NCRPIS
F3 16 6-10	2010	9050583		*Plantanus occidentalis* var *glabrata*	sycamore	Real Co., TX /NCRPIS
F3 18 1-10	1971	9004302		*Fraxinus pennsylvanica*	green ash	Butler Co., KS
F3 19 1-5	1971	341756	Groeneveld	*Ulmus* X *hollandica*	Holland elm hybrid	/NCRPIS
F3 19 6-10	1973	265620	Hessei	*Fraxinus excelsior*	European ash	W. Germany /NCRPIS
F3 20 1-5	1972	9034674		*Quercus* sp.	Swedish hybrid oak	/UNL /NCRPIS
F3 20 6-10	1972	9017646		*Quercus robur*	English oak	/ISU Hort Farm /NCRPIS
F3 21 6-10	1990	9050022		*Quercus phellos*	willow oak	TN /NCRPIS
F3 22 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 1 4-6	2011	9050605		*Carya illinoinensis*	pecan	Ste. Genevieve Co., MO /NCRPIS
F4 2 1-5	2011	9050608		*Quercus bicolor*	swamp white oak	Polk Co., IA /NCRPIS
F4 2 6-10	2011	9050607		*Quercus bicolor*	swamp white oak	Adair Co., MO /NCRPIS
F4 3 1-5	2011	9050606		*Diospyros virginiana*	common persimmon	St. Charles Co., MO /NCRPIS
F4 4 1-5	2011	9050580		*Gymnocladus dioicus*	Kentucky coffeetree	Riley Co., KS /KSPMC
F4 4 6-10	2011	9050577		*Gymnocladus dioicus*	Kentucky coffeetree	Kingfisher Co., OK /KSPMC
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 16 1-10	1982	477011	Affinity	*Thuja occidentalis*	northern white cedar	/MIPMC
F4 18 1-6	1976	343949		*Pinus sylvestris*	Scots pine	Ankara, Turkey /MDPMC
F4 20 1-10	1974	9034668		*Picea abies*	Norway spruce	/Griffith St. Nurs., Wisconsin Rapids, WI /KSPMC
F4 21 1-9	1973	9004363		*Pinus strobiformis*	Mexican white pine	Lincoln Co., NM/Rky Mtn Exp Sta., NE /KSPMC
F4 22 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

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2011. Page 4

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
G 8 F-J	1963	9004255		*Celtis occidentalis*	common hackberry	Central Oklahoma
G 9 F-J	1963	9034679		*Carya illinoinensis*	pecan	/KSU Forestry, KS
G 10 F-J	1963	9034680		*Carya illinoinensis*	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
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 illinoinensis*	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 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				*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 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

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2011. Page 5

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	
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
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 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
B1C4 19-21	PRSE2	9004384	black cherry	81	82	3	3	100	1	2	2	155	160		
			Prunus serotina		83		3	100	1	2	3	240	260		
			Ann Arundel Co., MD		05		3	100					941		
			/MDPMC		10		2	67					1163		
B1C5 19-20	PRSE2	9007345	black cherry	81	82	2	2	100	1	2	2	175	190		
			Prunus serotina		83		2	100	1	3	2	265	275		
			Hampshire Co., WV		05		2	100					990		
			/MDPMC		10		2	100					1213		
B1 E 14-35	COAM2	468117	silky dogwood	90	11	20	15	75					268		Losses due to comp.
			Cornus amomum												
			Clinton Co., MI												
			/MIPMC												
B2 3 1-5		9050529	bitter sweet	08	08	5	5	100							
			Celastrus scandans		09		5	100				23	47		
			IA /NCRPIS		10		5	100							
					11		5	100				31	54		
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	
					10		3	60					1425	45	WD, severe
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	
					10		1	20					1325	63	WD, severe

Table 3. 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
E3 (see bur oak map)		9050077	white oak *Quercus alba* Lancaster Co., NE /KSPMC	95	02 05 07	4	4 4 4	100 100 100					448 568 728	6 10 12	
E3 21 5-7 /P21 1-6	QUPR	9050416	dwarf chinkapin oak *Quercus prinoides* /NCRPIS	01	01 02 03 04 05 06 10 11	9	9 8 8 8 8 8 8 8	100 89 89 89 89 89 89 89	6	7 1	5 4	26 42 67 93 109 207	23 31 41 66 83 109 179 204		IN - LCB DB, some Nos. - 6 DD; 7 MD, severe No. 2 - DD, severe; No. 3 - DD
F1 1 1-2; 2 1,4	PLOC	9049957	*Platanus occidentalis* Brownville, NE /UNL-Lincoln	85	85 86 87 88 89 95 04 09	4	4 4 4 4 4 4 4 4	100 100 100 100 100 100 100 100	3 4 5 3 5	4 3 5	2 3	89 260 442 553 587	178 240 487 615 714 1213 1786 2063	6 10 13 27 36 40	
F1 1 10-19	LIVU	107630	Cheyenne European privet *Ligustrum vulgare* /NDPMC	66	70 71 73 74 75 76 78 79 87 95 98 00 05 11	10	5 5 5 5 5 5 5 5 5 5 5 5 5 5	50 50 50 50 50 50 50 50 50 50 50 50 50 50	1 1 1 1 5 5 3 1 4			290 320 411 490 506 650 600 630	320 396 503 620 650 650 500 300 332 351 366 342 372		
F1 2 2-3; 3 1,4-5	PLOC	9049956	*Platanus occidentalis* Burt Co., NE /UNL-Lincoln	85	85 86 87 88 89 95 04 09	5	5 5 5 5 5 5 5 5	100 100 100 100 100 100 100 100	3 2 3 2 4	4 3 5	2 2	93 176 401 505 545	189 290 492 607 707 1225 1625 1770	6 10 12 25 31 33	

Table 3. 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 2 5;	PLOC	9049955	*Platanus occidentalis*	85	85	3	3	100	2		2	102	183		
3 2-3			Marysville, KS /UNL-		86		3	100	1	4		200	310		
			Lincoln		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	97	97	3	3	100	5				107		
			Celtis laevigata		99		3	100					337		
			/NCRPIS		00		3	100					465		
					01		3	100	1				558		
					02		3	100	4	1	3	509	593		
					06		3	100					908	20	
					07		3	100				753	1005	22	
					11		3	100					1152	34	
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 - HD
					03		10	100					353		All but 2 with good fruit production
					08		10	100					365		
					10		4	40							HD
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		
					10		10	100		3	2	86	85		1 produced fruit
					11		10	100		3	3	140	129		5 produced fruit
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		10		5	100		5	2	422	380		2,3 – WD
					11		5	100		3	2		386		
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		
					10		3	100		4	1	260	142		
					11		3	100	1	5	1	259	145		

Table 3. 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 14 1-5	RIAM2	9082687	American black currant	07	07	3	3	100				32	51		
			Ribes americanum		08	5	5	100				51	60		1,2 - replants
			/Big Sioux Nursery		09		5	100				63	63		
			Watertown, SD		10		5	100		6	1	96	86		
			/NDPMC		11		4	80		5	1	119	95		
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		10		5	100	8			25	31		Not adapted
					11		3	60		3	1	34	35		
F1 15 1-5	PHOP	9050531	common ninebark	08	08	5	5	100				67	56		
			Physocarpus opulifolius		09		5	100				78	94		
			/NCRPIS		10		5	100		2	1	149	135		
					11		5	100	4	3	2	171	154		
F1 15 6-10	CAMI48	9050581	littleleaf peashrub	10	10	3	3	100		1	1	30	80		
			Caragana microphylla		11	(5)	3	100		1	1	86	147		
			/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		
					10		5	100		3	1	558	396		
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		
					10		4	80				53	69		
					11		4	80		5	4	63	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		
					10		5	100				117	100		
					11		5	100		2	2	174	145		

Table 3. 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 20 1-5	VIRU	9050482	southern black haw	03	03	4	4	100	7			51	39		F1 20 1-5
			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		
					11		3	80		1	2	89	300		
F1 20 6-10	VIRU	9050483	southern black haw	03	03	5	5	100	6			36	44		F1 20 6-10
			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		
					11		5	100		2	2	259	265		
F1 21 1-5	SPFL9	9050417	spiraea	01	01	5	5	100	2			56	78		Weed comp; IN - LCB
			Spiraea flexuosa		02		5	100	6	6	2	42	49		DB, heavy
			/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		4	80				64	73		
					11		4	80	7	6	1	114	101		Scorch
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		DB, medium
			/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
					11		5	100					330		
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		
					11		5	100	4	5	3		321		

Table 3. 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 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
					11		2	20	7	6	3	361	230		
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		
					11		5	100		2	1		411		
F1 23 6-10	HYAR6	9050498	silverleaf 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		
					10		3	60				68	81		
					11		3	60	6	5	2	99	81		Unsightly foliage
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		DD
					07		2	40				148	296		
					11		2	40		2	2	305	431		No. 2 – MD, severe
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		
					11		5	100		4	3	82	352		No. 5 – MD, severe
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		MD
					05	1	1	100				117	211		No. 1 - Disked out.
					06	(2)	1	100				146	268		
					07		1	100				191	315		
					11		1	100				256	435		

Table 3. 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
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 - DD
					05		3	60				25	104		
					06		3	60				36	144		
					07		3	60				41	174		
					11		3	60				108	201		
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 - WD
					96		9	90	1				1119		
					01		8	80	4				974	24	
					07		8	80					1159	33	
					11		8	80					1297		
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 - HD
					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		10		5	100		7	3	90	98		
			/NCRPIS		11		5	100		2	4	139	132		

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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 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,		10		4	100		2	2	212	243		2 – WD
			Ames, IA /NCRPIS		11		4	100				231	255		Scorch
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		10		5	100		7	6	138	110		
					11		5	100	3	7	7	184	151		
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		10		5	100		7	7	180	171		IN - LCB; GH
					11		5	100	5	8	6	239	214		
F2 13 1-5	PTTR	9050523	common hoptree	07	07	5	5	100				59	115		
			Ptelea trifoliata		08		5	100				115	151		
			Van Buren Co., IA		09		5	100				189	191		
			/NCRPIS		10		5	100			8	252	257		WD; IN - WF; attractive fruits
					11		5	100		2	5	307	242		
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		10		5	100		8		42	81		
					11		5	100		7	6	54	86		
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		10		5	100		4	3	100	159		IN - BW; 1 - rub
			/NCRPIS		11		5	100		4	3	138	216		BW
F2 14 6-10	RHCO	9050537	shining sumac	09	09	5	5	100				86	69		
			Rhus copallinum		10		5	100				133	102		
			Iroquois Co., IL /NCRPIS		11		5	100		3	2	228	148		DD - severe
F2 15 1-5	TETRA25	9050584	*Tetradium* sp.	10	11	5	5	100				170	177		
F2 15 6-10	CHLI	9050543	desert willow	09	09	5	5	100				23	47		
			Chilopsis linearis		10		4	80				176	147		
			Meade Co., KS /KSPMC		11		4	80		1	1	280	232		

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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 18 1-5	ARARA3	658641	red chokeberry *Aronia arbutifolia* Pickens Co., NC/NDPMC	11	11	5	5	100				49	68		
F2 18 6-10	VIBUR	9050609	Mongolian viburnum *Viburnum mongolicum* Asia /AA-FCRS, Morden, CN /NCRPIS	11	11	5	5	100				41	79		
F2 24 1-5	SYPE2	9006225	Peking lilac *Syringa pekinensis* /NDPMC	73	73	5	5	100	3			78	70		
					74		5	100	3			157	130		
					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		
F2 24 6-10	FORSY	9034667	early forsythia hybrid *Forsythia europaea* X *75vate* /NCRPIS	73	73	5	5	100	1			88	73		
					74		5	100	1			116	143		
					75		5	100	3			142	189		
					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 *Quercus palustris* /Manhattan Nursery Manhattan, KS	67	70	11	9	82	3						
					71		9	82	5			290	332		
					74		9	82	5			457	518		
					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	
					11		7	67					1784	45	

Table 3. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs. Page 10

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 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 5 1-5	FRPE	9004305	green ash	69	69	5	5	100	1						
			Fraxinus pennsylvania		71		5	100	2			213	271		
			Butler Co., Kans.		72		5	100	1			335	355		
					73		5	100	1			259	419		
					74		5	100	1			335	518		
					75		5	100	1			365	580		Abundant fruiting
					76		5	100	1			488	610		Moderate fruiting
					80		5	100	1			730	950		
					82		5	100	2			800	1100		
					83		5	100	2	4	5	900	1075		
					89		5	100	2	4			1099		
					90		4	80	2	5					
					03		4	80					1178	33	
					08		4	80					1149	34	
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		DD
					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 - DD
			Populus alba		07		3	100				268	315		
			South Korea /NCRPIS		08		3	100					499		
					09		3	100				486	778		
					10		3	100		2	3		902		2 - Premature leaf fall
					11		2	67				540	941		No. 1 - dead, No. 2 - declining
F3 7 6-10 6	TICO2	9050481	littleleaf linden	03	03	2	2	100				20	40		
			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		
					11		1	50		2	3	396	473		
F3 7 7-11	POTR5	9050535	quaking aspen	09	09	5	5	100				100	189		
			Populus tremuloides		10		5	100		8	3	106	195		
			Platte Co., NE/NCRPIS		11		4	80		5	6	163	161		No. 10 – DD, severe

Table 3. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs. Page 11

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 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	
					10		10	100					1611		3 – WD, top
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		DB, heavy
					10		10	100		6	5	176	197		
					11		10	100				231	288		
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		DB, heavy
					10		10	100		2	2	346	384		
					11		10	100				488	480		
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		
					10		5	100		4	3	138	181		
					11		5	100		5	3	162	198		Scorch

Table 3. 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 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		
					10		5	100		7	2	32	65		
					11		5	100	8	7	3	37	63		DB
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		
					10		9	90		2	1	36	229		
					11		9	90		5	1	63	243		Windthrow, scorch
F3 16 1-5	GIBI2	9050582	ginkgo	10	10	5	5	100		4	1	41	63		
			Ginkgo biloba		11		5	100		5	2	55	90		Scorch
			/NCRPIS												
F3 16 6-10	PLOC	9050583	smooth sycamore	10	10	5	5	100		3	2	107	182		
			Platanus occidentalis var		11		5	100	1	4	4	222	333		
			glabrata												
			/NCRPIS												
F3 18 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		
					05		8	80					1236		No. 1 – dead
					10		8	80					1083		9 – major top damage; declining
F3 19 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		
					11		2	40					1436		

Table 3. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs. Page 13

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 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 20 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	
					11		5	100					1669	34	
F3 20 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	
					11		3	75					1170	35	No. 1 - dead

Table 3. 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	QUPH	9050022	willow oak	90	90	5	5	100		2	3	22	32		
			Quercus phellos		91		4	80				21	34		DB, severe
			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		Comp., severe
F3 22 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	
					93										
					96		5	100	1				1021	32	
					01		5	100	1				1112		
					07		5	100					1171	36	
					11		5	100					1318	38	
							5	100					1314	40	
F3 24 1-10	QUAC80	434253	sawtooth oak	73	73	10	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 1 4-6	CAIL2	9050605	pecan	11	11	5	5	100		4	6	32	54		
			Carya illinoinensis												
			Ste. Genevieve Co., MO												
			/NCRPIS												

Table 3. 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 2 1-5	QUBI	9050608	swamp white oak *Quercus bicolor* Polk Co., IA /NCRPIS	11	11	5	5	100			6	56	110		BW
F4 2 6-10	QUBI	9050607	swamp white oak *Quercus bicolor* Adair Co., MO /NCRPIS	11	11	5	5	100			5	37	81		BW
F4 3 1-5	DIVI5	9050606	common persimmon *Diospyros virginiana* St. Charles Co., MO /NCRPIS	11	11	5	5	100		3	5	54	82		
F4 4 1-5	GYDI	9050580	Kentucky coffeetree *Gymnocladus dioicus* Riley Co., KS /KSPMC	11	11	5	5	100		1	2	37	62		DB
F4 4 6-10	GYDI	9050577	Kentucky coffeetree *Gymnocladus dioicus* Kingfisher Co., OK /KSPMC	11	11	5	5	100		1	2	24	57		DB
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		
					10		4	40							DD – 25%
					11		4	40		4	5	91	88		BW

Table 3. 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 12 1-5	PISYM	9076719	Mongolian pine	09	09	4	4	100				42	44		
			Pinus sylvestris var		10	(5)	4	100				62	77		DD – 50%
			mongolica		11		4	100			1	78	89		
			Shangzhi, China /NCRPIS												
F4 12 1-10	PISYM	9076718	Mongolian pine	09	09	5	5	100				51	55		
			Pinus sylvestris var		10		5	100				72	86		DD, severe – 100%
			mongolica		11		5	100			1	90	78		
			Nenjiang, China /NCRPIS												
F4 13 1-5	TADI2	9050542	bald cypress	09	09	5	5	100				35	77		
			Taxodium distichum		10		5	100				128	140		DD
			Real Co., TX /NCRPIS		11		5	100		1	3	185	188		BW
F4 16 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 – Comp.
					11		10	100					719		
F4 18 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
					11		2	33					1213		
F4 20/ 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 3. 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 21/ 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 22/ 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		DB
					95		10	100					138		1 destroyed by deer, heavy browse
					05		10	100					742	11	
					10		10	100					1167		Canopy encroachment

Table 3. 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 3. 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 illinoinensis		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 illinoinensis		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 3. 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 3. 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	
						11		3	100					2016		
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		
						10		8	100					1850		
G2 23	6-8	AEGL	9030309	Ohio 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		
						10		3	100					579		No. 2 removed – encroachment
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		
						10		1	33					654		

Table 3. 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 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	
					10		8	100					1256	28	No. 1 – top broken
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	
					10		8	100					1203	39	
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		
					11		1	100					945		
HQ1 1/1	NYSY	9050506	black gum	66	66	1	1	100							
			Nyssa sylvatica		06		1	100					1050	22	
			/Forrest Keeling Nursery, Elsberry, MO		10		1	100					1175	24	
HQ1 2/2	MALUS	514275	hybrid crab apple	77	77	1	1	100							
			Malus sp.		07		1	100					900	29	
			Clinton Co., MI /MIPMC		11		1	100		8			935		Cedar-Apple rust; WD

Table 3. 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 3/1	TIEU3	9050505	Redmond Crimean linden	66	66	1	1	100							
			Tilia X *euchlora*		06		1	100				1483	1580	88	
			/Plumfield Nursery,		10		1	100				1457	1800	90	
			Fremont, NE												
HQ1 8/3	PIST3	9004363	Mexican white pine	77	77	1	1	100							
			Pinus strobiformis		06		1	100					1150		
			Lincoln Co., NM /RMFRS,		11		1	100					1230		
			NE												
HQ2 2/16	SYOBD	9050510	Korean early lilac	76	76	1	1	100							
			Syringa oblate dilatate		06		1	100				732	268		
			/HPHRS		10		1	100				631	276		
HQ2 3/1	ULDAJ	421614	Japanese elm	77	77	1	1	100							
			Ulmus davidiana var		82		1	100	1	3	3	475	470	6	
			japonica		83		1	100	1	2	3	450	600	9	
			/USDA ARS Nurs. Crops		06		1	100					1925	75	
			Res. Sta., Delaware, OH		11		1	100	9				1650	74	Declining
HQ2 4/9	EUAT	9034666	wahoo	66	66	1	1	100							
			Euonymus atropurpureus		10		1	100				815	437		
			Riley Co., KS /KSPMC												
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		DB, heavy
					05		5	100				154	225		
					06		5	100		3	7	212	293		
					10		5	100					679		
					11		5	100					704		
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 – PS
					96		9	100					668		
					01		9	100					817		
					06		8	89					1039		
					11		7	78					1131		

Table 3. 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/S 7, 11-30, 55, 57, 83, 85	PINI	9034670	Austrian pine *Pinus nigra* /KSU Forestry, Manhattan, KS	81	83 86 95 01 05 10	25 (26)	25 23 23 21 21 20	100 92 92 84 84 80	5 5		3	28 64	22 62 337 615 750 914	 20 	 No. 55 – PS
PQ/S 31-35, 37-50	PISY	399402	Scots pine *Pinus sylvestris* /NCRPIS	77	77 78 79 83 86 96 01 06 10	20	20 20 20 19 19 19 19 13 5	100 100 100 95 95 95 95 65 25	3 3 3 2 5		 3 	 230 345 	21 36 56 225 342 728 844 1009 1005	 4 25 	 Nos. 48 & 50 – PS PW
P/W 1/ 1	LIST2	9050512	sweetgum *Liquidambar styraciflua* /Forest Keeling Nursery, Elsberry, MO	66	66 06 10	2	2 1 1	100 50 50				 1564 	 1430 1487	 72 76	
P/W 1/ 2	JUVI	9050514	Canert juniper *Juniperus virginiana canaerti* /Nelson Nursery, Enid, OK	65	65 06 10	1	1 1	100 100							 Over topped with vines
P/W 1/ 3	JUHO2	9050513	blue creeping juniper *Juniperus horizontalis glauca* /MIPMC	66	66 07 10	1	1 1	100 100							
P/W 1/ 4	QURU	9000399	northern red oak *Quercus rubra* Greenwood Co., KS /KSPMC	66	66 06 10	1	1 1 1	100 100 100				 1501 	 1130 1189	 44 51	
P/W 1/ 5-6	FRPE	9001455	ash *Fraxinus sp.* /Marshall Nursery, Arlington, NE	71	71 06 10	2	2 2 2	100 100 100					 1225 1245	 65 70	

Table 3. 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
Q/S 51-54, 56, 58-70	PISY	399403	Scots pine *Pinus sylvestris* /NCRPIS	77	77	18	18	100	3			18	24		
					78	(20)	18	100	3			35	36		
					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 – PS
					96		18	100					819		
					01		18	100					945	28	
					06		13	72					1178		
					10		12	67					1053		PW
Q/S 71-82, 84, 86-90	PISY	399404	Scots pine *Pinus sylvestris* /NCRPIS	77	77	18	18	100	5			12	16		
					78	(20)	18	100	5			26	21		
					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		
					10		11	61					950		PW

Table 3. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs.

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

Data Element Designations

CAN COV: Crown width or ground cover as measured in centimeters
DI: Disease Resistance, rating 1-9
IN: Insect Resistance, rating 1-9
NO. EST: Number Established
NO. SRV: Number Surviving
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

Plot Remarks: Frequently Used Abbreviations

BW: Bagworms
Comp.: Competition
DB: Deer Browse
DD: Deer Damage
GH: Grass Hoppers
HD: Herbicide Damage
IN: Insects
LCB: Leaf Cutter Bee
MD: Mechanical Damage
PS: Produced Seed
PW: Pine Wilt
WD: Wind Damage
WF: White Flies

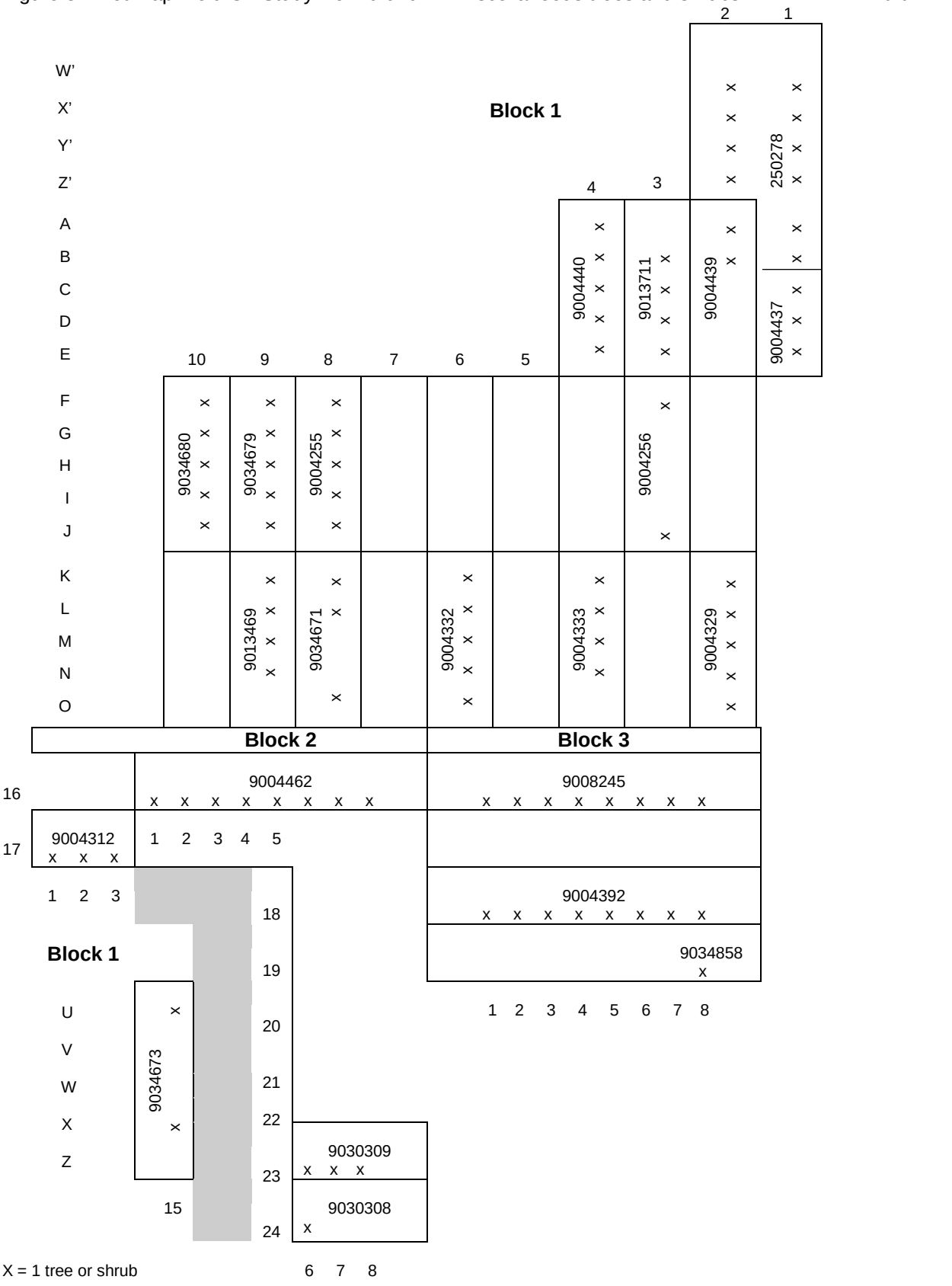
* May not agree with current plot number designations.

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

Row	Block 1	Block 2	Block 3	Block 4
1	x x 107630 x x x x x x x x x			x x x x x 9050605
2	x x x x x		9001069 x x x x x x x x	x x x x x 9050608 | x x x x x 9050607
3	sycamores x x x x x		486339 x x x x x	x x x x x 9050606
4	9050263 x x x	9006095 x x x x x x x x		x x x x x 9050580 | x x x x x 9050577
5			9004305 x x x x	323932 x x x x x x
6		chestnuts x x x x x		
7		x x x x x	9050478 | 9050499 x | x x x	9050481 | 9050535 x | x x x x x
8		x x x x x	9050479 x x x x x	9050480 x x x x x
9		9050011 x x x x		
10			9034682 x x x x x x x x x x	9004334 x x x x x
11	9055585 x x x x x x x x x x	9050519 x x x x x | 9050518 x x x x x		9050504 x x x x x x x x x x
12	9083247 x x x x x x x x x x	9050520 x x x x x | 9050521 x x x x x	9050497 x x x x x x x x x x	9076719 x x x x x | 9076718 x x x x x
13	9050524 x x x x x | 9050522 x x x x x	9050523 x x x x x | 9076686 x x x x x	9066615 x x x x x x x x x x	9050542 x x x x x
14	9082687 x x x x x | 9050530 x x x x x	9050532 x x x x x | 9050537 x x x x x	9050501 x x x x x | 9050503 x x x x x	
15	9050531 x x x x x | 9050581 x x x x x	9050584 x x x x x | 9050543 x x x x x	9050502 x x x x x x x x x x	
16			9050582 x x x x x | 9050583 x x x x x	477011 x x x x x x x x x x
17				
18	477010 x x x x x	658641 x x x x x | 9050609 x x x x x	9004302 x x x | x x x x x	343949 x x
19	9050500 x x x x | 323957 x x x x x		341756 x x | 265620 x	
20	9050482 x x x | 9050483 x x x x x		9034674 x x x | 9017646 x x x x	9034668 x x x x x x x
21	9050417 x x x x x | 9050418 x x x x x		9050022 x x x	9004363 x x x x x x x
22	9050425 x x x x x | 9050426 x x x x x		9004392 x x x x x	9004364 x x x x | x x | x x
23	9050427 x x x x x | 9050498 x x x x x			
24	9050429 x x x x x | 9050430 x x x x x	x x x x x 9006225 | x x x x x 9034667	434253 x x x | x x x | x x	
25	9050431 x x x | 9050432 x x x x			9034669 xxx
26	9050007 x x x x x	x x x x x x x x x x x x x x x x x x Windbreak x x x x x x x x x x x x x x x x x x		

x = tree or shrub

Figure 3. Plot Map Field G. Study No. 20I010K – miscellaneous trees and shrubs. ▲ North ▲



Evaluation of Selected Common Hackberry

Study No. 20I037K

National Project Nos. Cropland 2.1, Natural Areas 1.1, Wildlife 1.1

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 PMC. 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 (coarse-silty, mixed, superactive, nonacid, mesic Typic Udifluvents) soil, 21 March 1988, in Field D-1 at Manhattan. The plants are being evaluated for vigor; growth rate; 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

National Project Nos. Cropland 2.1, Forestland 1.1, Natural Areas 1.1, Wildlife 1.1

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: A limited number of cultivars of bur oak are available for conservation use. Superior bur oak selections are needed for watershed protection, multi-row windbreaks, landscape plantings for farmsteads and parks, 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 PMC 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 (Fig. 1). The plot was surrounded by a border row composed of trees from the same sources. The planting, located in Field E-3, was on a Eudora silt loam soil (coarse-silty, mixed, superactive, mesic Fluventic Hapludolls). 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: Plant 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

National Project Nos. Critical Areas 1.1

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 PMC.

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: Plant Release

Progress or Status: Activity in 2011 consisted of plot maintenance.

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

National Project Nos. Critical Areas 1.1, Cropland 2.1

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 PMC 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, (Fig. 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, (Fig. 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: Plant Release

Progress or Status: A site visit was not made in 2011.

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 Miscellaneous Forbs and Legumes

Study No. KSPMC-T-0803-RA

National Project Nos. Critical Areas 1.1, Natural Areas 1.1, Rangeland 1.1

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 PMC, 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. Observations will generally be carried out for 3 growing seasons post establishment.

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}.

Potential Products: Plant Release and Technology Transfer

Progress or Status: Twenty plants of prairie acacia were set out 30 June 2008, in a rod row on a Belvue silt loam (coarse-silty, mixed, superactive, nonacid, mesic Typic Udifluvents) soil in Field B-3. The stand at the end of the growing season was 80%. The plants were well anchored in the soil and appeared to have established but failed to recover in the following spring. Due to the late planting in 2008, a decision was made to try again. A new set of plants from 2-0 stock was established in 2009 for further evaluation. In the spring 2010, a 90% recovery rate was observed with 1 plant disturbed by rodent activity. The mean height of plants was 47 cm. The young plants flowered and a few produced seed. Stand was 100% as the rodent affected plant recovered in 2011. The plants were more vigorous this year with increased plant growth, plant height was 67 cm and plant width was 92 cm. Eight plants flowered with 7 producing seed. This plot will be destroyed in 2012 following spring recovery.

Technology Development

Survey of Pollinating Insects at the Manhattan PMC

Study No. KSPMC-T-1001-WL

National Project Nos. Wildlife 1.1

Study Leader: John M. Row, Plant Materials Specialist

Collaborator: P. Allen Casey, Soil Conservationist, Elsberry PMC, Missouri

Introduction: Pollinators are keystone species to which many plants rely on to complete their reproductive lifecycle (Shepherd *et al*. 2003). Insects by far are the most numerous group of all of the pollinators. Pollinating insects are also considered to be an indicator species and can be used to determine ecosystem health (Shepherd *et al*. 2003). Pollinating insects provide for heterogeneity of the floral gene pool, larger fruit and seed size, and more even development of fruits or seeds. Bees are often the insect pollinators that are commonly referred to, and they are one of the biggest contributors to pollination. However, there are many other types of insect pollinators that are involved in pollinating flora. There is a need to identify what species of pollinating insects occur at the Manhattan PMC, in order to develop artificial nesting sites and best management practices (BMPs) to increase the populations of those species. Increasing pollinator numbers will provide for better fruit and seed development for many of the plant materials that are being produced and evaluated. The objective of this study is to utilize aerial net capture, pan, and malaise trapping techniques to capture as many pollinating insects as possible and then identify them as close to species as possible. The data will then be used for determination of appropriate BMPs and development of appropriate artificial nesting sites.

Objectives: Determine what species are present at the PMC so that appropriate BMP's for pollinating insects can be implemented. Determine nesting preferences for solitary bees and protect areas on the PMC for ground-nesting bee habitat.

Procedure: Use various devices such as plastic bowl traps of various colors, filled ¾ full with water and a few drops of dish soap, placed at various locations around the PMC near blooming flowers multiple times during the growing season to collect insects. Sample multiple times in multiple locations on the PMC with an aerial net, the aerial net is primarily used to catch butterflies, but can also used to sweep vegetation to catch all insects. A malaise trap (Fig. 1) may also be set up to collect insects utilizing a given area or crop. Insects that are caught may be killed and mounted to entomology pins and added to the PMC's museum display cases for study and observation.

Figure 1. Malaise trap setup next to canola field.

Potential Products: Technology Transfer

Progress or Status: The PMC changed its management practices from disking field roads to controlling broadleaf weed problems with herbicides whenever possible to avoid disturbing ground nesting bees. There were 465 insect specimens mounted to pins with collection location labels, representing 7 Orders in the Class Insecta (Table 1). One hundred and twenty-six specimens have been identified to Family and 68 to the species level.

Table 1. Number of mounted specimens identified to taxonomic level in the PMC's insect collection.

	Odonta	Orthoptera (grasshoppers)	Hemiptera (true bugs)	Coleoptera (beetles)	Diptera (flies)	Lepidoptera (butterflies and moths)	Hymenoptera (bees and wasps)
Order	1	15	4	26	58	78	289
Family	0	0	2	9	1	61	53
Species	0	0	2	8	0	54	4

Lepidopterans: Several additional Lepidopterans were added to the PMC's collection in 2011 along with true bugs. The 2nd Annual Manhattan Summer Butterfly Count sponsored by the PMC was primarily carried out by Earth Team Volunteers 13 July. The count was conducted as part of the 37th North American Butterfly Association (NABA) Butterfly Count where volunteers converge on count circles 15 miles in diameter and conduct a one-day census of all butterflies observed within these areas. Groups surveyed the PMC grounds, Konza Prairie, and other areas in the Manhattan Butterfly Count Circle including the Sunset Zoo and the KSU Gardens in Manhattan. While 12 species were counted on the PMC, a total of 41 species represented by 363 individuals were counted by seven observers in three parties in the Manhattan Count Circle. The Manhattan count was just one of many counts conducted in association with the NABA across North America. This year's particapants were Diane Barker, Dale Foster, Barbara Green, Jim Mayhew, Jacque Staats, John Row, and Poornima Viswanathan.

Solitary Bees: Nest blocks were constructed by Allen Casey, former career intern at the PMC, and positioned at various locations around the PMC early April 2010, to benefit and attract Wood- and Tunnel-nesting solitary bees. Holes were drilled into wooden blocks of rough pine approximately 58.4 x 8.9 x 14.6 cm (23 x 3.5 x 5.75 in) composed of scrap lumber. Four columns of holes were drilled into each block 1.9 cm (¾ in) apart, 12.7 to 14 cm (5 to 5.5 in) deep using 7.9 and 9.5 mm (5/16 and 3/8 in) drill bits. A sloping roof was attached to each block offering a 1.9 cm (¾ in) overhang at the top. The front of the blocks were lightly charred using a butane torch, to make the face a black color because the darker face is more attractive to nesting female bees (Bosch and Kemp 2001). The wooden nest blocks were attached to posts approximately 102 cm above the ground facing southeast. Nests housed in aluminum cans with the top removed were filled with reeds collected from common reed, *Phragmites australis*, and located 208 cm (82 in) above the ground and 30.5 cm (12 in) under the eave of the PMCs office patio, Table 2. One can nest faced south and 1 faced west. Over time the south wind sucked the reeds out of the south facing can. In 2011 a nest was constructed of PVC pipe, with one end capped off, filled with reeds and located in a residential area of Manhattan, Kansas. The surrounding environs for the office location consisted of lawn, native tall grasses and forbs, trees, and shrubs, adjacent to open fields. The can nest (west exposure) faced a medium sized tree just 71 cm (28 in) away. Nest Block 1 was located near the PMC office adjacent to a hedgerow and medium sized trees opening out to a mowed area and tilled fields. Two of the nest blocks were located adjacent to windbreaks, one facing a mowed strip leading out to a tilled field, and the other situated along a windbreak next to a field road facing out to a field of switchgrass just 457 cm (15 ft) away in 2010, the switchgrass was taken out in 2011. The residential environs consisted of a large area of lawn, with beds of domestic and native forbs, vegetables, trees, and shrubs. Random sampling was used to determine sizes of openings using a caliper.

Table 2. Details of various nest venues located at Manhattan, Kansas.

Nest Type	Wooden Nest Block	Aluminum Can with Reeds	PVC Pipe with Reeds
Exposure	SE	W*	NE
Location	Field Border	Rural Building Eave	Residential Building Eave
Date Installed	April 2010	April 2010	2011
Height Above Ground	102 cm (40.2 in)	208.3 cm (82 in)	226.1 cm (89 in)
Opening Diameter	6 to 8.8 mm	2.9 to 4.8 mm	4.0 to 6.7 mm
Occupancy	.08 to 0.4%	20%	17%
Seasons in Use	2	2	1

*View blocked by medium sized tree

A fall survey of solitary bee nests revealed that there was little interest in the nest blocks. Each block contained 1192 holes of various sizes yet occupancy ranged from only .08 to 0.4% while occupancy in reed ranged from 17 to 20%. The can nest filled with reeds of variable length had an occupancy rate of 20% over a 2-year period while a PVC pipe filled with reed had 17% occupancy in 1 year. The can nest contained reeds of variable length from 6.35 to 16.5 cm (2.5 to 6.5 in) and openings ranged from 2.9 to 4.8 mm. The reeds in the PVC pipe were approximately 15.2 cm (6 in) in length with openings ranging from 4.0 to 6.7 mm, Table 3. In the can nest the smallest openings were used by a species of bee that partitioned brood cells with mud and larger openings were partitioned with plant material. Forty-seven percent of occupied reeds were capped with mud. The reeds in the PVC pipe were primarily partitioned with plant material.

Table 3. Comparison of wooden nest blocks at 3 locations on the PMC.

	Block 1	Block 2	Block 3
Exposure	SE	SE	SE
Location	Field Border[1]	Field Border[2]	Field Border[1]
Height Above Ground	107 cm (42 in)	96.5 cm (38 in)	103 cm (40.5 in)
Height of Openings Above Ground	107-163 cm (42-64 in)	96.5-155 cm (38-61 in)	103-164 cm (40.5-64.5 in)
Opening Diameter	5.8-6.7 mm	6.0-6.9 mm	7.2x7.9-7.5x8.76 mm
Occupied Opening Diameter	6.5 mm	6.4 mm	7.7 mm
Occupancy	0.42 %	.08%	0.17%
Seasons in Use	2	2	2

[1]Southside of windbreak; [2]Eastside of windbreak

The lack of success with the wooden nest blocks may be that the openings were rough rather than smooth and Blocks 1 and 3 were less sheltered from the south wind. The openings in Block 3 tended to be oblong which may have contributed to a lack of acceptance by solitary bees. The blocks offered a wide range of opening locations above the ground. Occupied locations were either near the top at 156 cm (61.5 in) while the majority was clustered around 121 cm (47.5 in) above the ground. This observation agrees with the literature that nest blocks should be located at least 122 cm (4 ft) above the ground (Vaughan *et al.* 2007). It is unclear why the blocks received little acceptance by solitary bees for nest sites, however the one trait they all have in common is rough openings. The species of bees using the various nest boxes was not determined.

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