United States Department of Agriculture
Natural Resources Conservation Service

2012 ANNUAL TECHNICAL REPORT

Manhattan Plant Materials Center

Serving Kansas, Nebraska, northern Oklahoma, and northeastern Colorado

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/plantsanimals/plants/centers/?cid=stelprdb1083319

Notices

The 2012 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://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/plantsanimals/plants/centers/?cid=stelprdb1083319 for additional information about the Plant Materials Program (PMP).

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–harvesting 'Aldous' little bluestem with Shelbourne header; UR–swamp milkweed seed increase field in full bloom; ML–red admiral butterfly visits New Jersey tea in spring; MR–summer crew planting 'Nekan' pitcher sage plasticulture seed increase field; LL–woody plant production; LR–Monarch catapillar forages on swamp milkweed follicle

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U. S. DEPARTMENT OF AGRICULTURE

NATURAL RESOURCES CONSERVATION SERVICE

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Manhattan Plant Materials Center

National Program Leader

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Central Region Plant Materials Specialist

Joel L. Douglas

Plant Materials Specialists

Mark A. Janzen, Kansas, Nebraska, and Oklahoma
Christine Taliga, Colorado

Plant Materials Center Personnel

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John M. Row, Plant Materials Specialist
Donald R. Garwood, Biological Science Technician
Jerry D. Longren, Biological Science Technician

Seasonal Positions

Skylar G. Henke, Biological Science Aid (Plants)
Spencer A. Hockenbery, Biological Science Aid (Plants)
Paul F. Gleue, Biological Science Aid (Plants)
Sean M. Thomas, Biological Science Aid (Plants)

Earth Team Volunteers

Dr. Wayne A. Geyer, Forester
Butterfly Group

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FOREWORD AND ACKNOWLEDGEMENTS

The Manhattan PMC at Manhattan, Kansas, is a federally owned and operated facility under the administration of the Kansas State Office of the 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 ATR is to inform the plant materials discipline of the NRCS, its cooperators, and others interested in plant materials work of progress and new developments.

Mission: *The mission of the Manhattan Plant Materials Center 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 Plant Materials LRP. The PMC's activities are directed toward meeting the needs and priorities as set forth in the PMLRPs 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 KSU Agricultural Experiment Station under provisions of an annual 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 2012, technical assistance was provided to the Kickapoo and Caddo Nations in Oklahoma, and the Potawatomi and Kickapoo Nations in Kansas 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 2012.

Cooperator	Affiliation	Research Interest
Denise Costich	USDA ARS-R.W. Holley Center For Agriculture and Health	Cold tolerance of eastern gamagrass
Dr. Loretta Johnson	KSU	Ecotypic variation in big bluestem
Brendon McCampbell	Fort Hays State University	Native flora garden
Dr. Tim Springer	USDA ARS-Southern Plains Range Research Station (SPRRS)	Sand bluestem comparison trials
Dr. Tim Springer	USDA ARS-SPRRS	Quail preference for native grass and forb seeds
Dr. Orley R. Taylor	University of Kansas	Milkweed biology and reproduction
Dr. Chuck West	University of Arkansas	Eastern gamagrass research
Patrick Lienin	University of Connecticut	Ecological Risk Assessment

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 2012, 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:

Kansas NRCS Student Trainees
Kansas State Plant Materials Committee Meeting
Milkweed Seed Production and Propagation Meeting
North American Butterfly Association (NABA) Summer Butterfly Count Kickoff Meeting
Soil Health and Cover Crop Meeting

Events: Events hosted by the Manhattan PMC.

3rd Annual Manhattan Butterfly Count. July 12, 2012. Participants: 8

Manhattan PMC Field Day. September 12, 2012. Participants: ~40

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.

Chinese chestnut, a nut crop tree for eastern Kansas. Kansas Agricultural Experiment Station Annual Conference. October 16, 2012. Manhattan, KS. Wayne A. Geyer.

Manhattan Plant Materials Center Program Update. Kansas Plant Materials Committee Meeting. June 27, 2012. Manhattan, KS. Richard L. Wynia.

Manhattan Plant Materials Center Program Update. Nebraska State Plant Materials Committee Meeting. August 16, 2012. Lincoln, NE. R. L. Wynia.

Manhattan Plant Materials Center Field Day. September 12, 2012. Manhattan PMC, Manhattan, KS. R. L. Wynia and John M. Row.

Manhattan Plant Materials Center Program Update. State Conservationist's Plant Materials Advisory Committee Meeting. November 7, 2012. Video Teleconference, Manhattan, KS. R. L. Wynia.

Plant Materials Display. Oklahoma Invasive Plant Council Meeting. July 10, 2012. Edmond, OK. Mark A. Janzen.

Plant Materials/Forestry, Kansas Forestry Association. February 23, 2012. Topeka, KS. M. A. Janzen.

Plant Materials/Forestry, Kansas NRCS Area 4 District Conservationist's Meeting. February 15, 2012. Manhattan, KS. M. A. Janzen.

Plant Materials/Forestry, Kansas Area 2 District Conservationist's Meeting. May 5, 2012. Pratt, KS. M. A. Janzen.

Plant Materials Review. Kansas Plant Materials Committee Meeting. June 26, 2012. Manhattan, KS. M. A. Janzen.

Plant Materials Review. Oklahoma Plant Materials Committee Meeting. July 11, 2012. Stillwater, OK. M. A. Janzen.

Plant Materials, Kansas Forestry Association. July 19, 2012. Manhattan, KS. M. A. Janzen.

Plant Materials Review. Nebraska Plant Materials Committee Meeting. August 16, 2012. Lincoln, NE. M. A. Janzen.

Plant Materials. Manhattan Plant Materials Center Field Day. September 12, 2012. Manhattan, KS. M. A. Janzen.

Plant Materials Update. American Seed Trade Association (ASTA) Environmental and Conservation Seed Committee Meeting. November 4, 2012. Kansas City, MO. R. L. Wynia.

Tours: The Manhattan PMC Staff welcomes visitors and readily conducts tours. The number of visitors was down in calendar year 2012; however, approximately 87 people visited the PMC, of which 82 toured the PMC. The following groups are representative of the yearly interest in the PMP:

Kansas NRCS Employees
Nebraska NRCS Employees
Kansas State Plant Materials Committee
Snyder Home School Group

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.

Hand Tool Maintenance, Field Crop Roguing Techniques, Irrigation Pipe Setup and Operation. Manhattan PMC, May 22, 2012. Paul Gleue. Trainees: 3

Orientation for Biological Science Aids, Manhattan PMC, May 21, 2012. J. M. Row. Trainees: 3

Plant Identification. Snyder Home School Group. Manhattan PMC, October 15, 2012. Manhattan, KS. J. M. Row. Trainees: 3

Publications

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

Plant Release Brochures

'Barton' Western Wheatgrass. R. L. Wynia. Manhattan PMC, Manhattan, KS. June 2012. 2p.

Cheyenne Indiangrass. R. L. Wynia. Manhattan PMC. Manhattan, KS. June 2012. 2p.

'Konza' Aromatic Sumac. R. L. Wynia. Manhattan PMC, Manhattan, KS. February 2012. 2p.

'Lippert' Bur Oak. R. L. Wynia. Manhattan PMC, Manhattan, KS. March 2012. 2p.

'Osage' Indiangrass. R. L. Wynia. Manhattan PMC, Manhattan, KS. June 2012. 2p.

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

Field Emergence and Plant Density of Sand Bluestem Lines Selected for Increased Seed Germination. Tim L. Springer, R. L. Wynia, and Gary L. Rea. *Crop Science* 52:2826-2829. Crop Science Society of America. Madison, WI. 2012.

Field Office Technical Guide (FOTG): Updates to the FOTG are made when new information becomes available. The following conservation standards and specifications were updated in 2012:

Forest Stand Improvement. Standard, Specification, and Statement of Work. Salina, KS. 2/29/2012. M. A. Janzen. 9p.

Forest Trails and Landings. Standard and Statement of Work. Salina, KS. 2/29/2012. M. A. Janzen. 4p.

Hedgerow Planting. Standard and Statement of Work. Salina, KS. 2/12/2012. M. A. Janzen. 6p.

Silvopasture Establishment. Standard and Statement of Work. Salina, KS. 2/29/2012. M. A. Janzen. 5p.

Tree/Shrub Establishment. Standard, Specification, and Statement of Work. Salina, KS. 2/19/2012. M. A. Janzen. 7p.

Windbreak/Shelterbelt Renovation. Standard, Specification, and Statement of Work. Salina, KS. 2/29/2012. M. A. Janzen. 8p.

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.

Plants for the Heartland. Vol. 19. Issue 1. 2012. J. M. Row. 2p.

Plants for the Heartland. Vol. 19. Issue 2. 2012. M. A. Janzen, R. L. Wynia, and J. M. Row. 2p.

Plants for the Heartland. Vol. 19. Issue 3. 2012. R. L. Wynia and J. M. Row. 2p.

Woody Notes. Vol. 2. No. 1. 2012. J. M. Row. 4p.

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

False Sunflower (*Heliopsis helianthoides* [L.] Sweet) Plant Fact Sheet. PMP Web site and PLANTS Database. USDA NRCS. August 2012. Christine Taliga and R. L. Wynia. 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.

Bur Oak (*Quercus macrocarpa* Michx.) Plant Guide. PMP Web site and PLANTS Database. USDA NRCS. November 2012. J. M. Row, W. A. Geyer, and Guy Nesom. 5p.

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

Chinese chestnut, a nut crop tree for eastern Kansas. W. A. Geyer and J. M. Row. Kansas Agricultural Experiment Station Annual Conference, Manhattan, Kansas. October 16, 2012.

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

2011 Annual Technical Report*, Manhattan Plant Materials Center. J. M. Row, M. A. Janzen, R. L. Wynia, and P. A. Casey. USDA NRCS. Salina, KS. 113p.

* 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							
					Asclepias incarnata *Asclepias tuberosa* *Asclepias viridis*		
GRASSES AND GRASS-LIKE PLANTS							
Muhlenbergia pungens *Koeleria macrantha* *Redfieldia flexuosa*	*Panicum virgatum*	*Calamovilfa gigantea*	*Panicum virgatum*	*Calamovilfa gigantea* (T)			
TREES AND SHRUBS							
		Amorpha fruticosa				*Amorpha fruticosa*	
				Castanea mollissima (S)			
				Platycladus orientalis	*Platycladus orientalis* (S)		
	Quercus macrocarpa						
		Cephalanthus occidentalis		*Ulmus pumila* (S) *Ulmus parvifolia*			

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.
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				
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				
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				
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				

DISTRIBUTION OF PLANT MATERIALS IN 2012

The PMP 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 16 seed and plant orders were shipped to 15 states with over 903 pounds of seed, over 573 plants, and 42 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		321
	CI	1		2.2			
	UNIV	1	9	4.9	1	30	
Subtotal		2	9	7.1	2	30	321
Oklahoma	CD				2		238
	CI	1		114.2			
	OR	1		0.2			
Subtotal		2		114.4	2	0	238
Colorado	PMP	1		4.4			
Nebraska	CI	1		43.9			
Other States	ARS	1		4.9			
	CD	2		2.9			
	CI	2		668.8			
	PMC	2	1	0.7	1	12	
	PMP	1	53	24.0			
	UNIV	3		0.2			
Subtotal		13	54	749.8	1	12	
Total		17	63	871.3	5	42	559

Legend: ARS=Agricultural Research Service, CD=Conservation Districts, CI=Commercial Increase, OR=Out Reach, PMC=Plant Materials Centers, PMP=Plant Materials Program, UNIV=Universities

Woody Plant Materials

		Seed Orders		Plant Orders		
State	Use	Number	Bulk Pounds	Number	Number of Cuttings	Number of Plants
Kansas	CD			1		12
	OR	1	29			
	UNIV			1		2
Subtotal		1	29	2	0	14
Other States						
	PMC	2	2.8			
	PMP	1	0.1			
Subtotal		3	2.9	0	0	0
Total		4	31.9	2	0	14

Legend: CD=Conservation Districts, OR=Out Reach, PMC=Plant Materials Centers, PMP=Plant Materials Program, UNIV=Universities

YEAR 2012 CLIMATALOGICAL DATA FOR MANHATTAN

2012 Data

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg Max	47.5	47.7	69.3	72.4	82.2	89.1	99.0	89.5	80.7	67.6	60.5	45.6	71.0
Avg Min	22.2	24.8	43.9	46.7	57.9	65.2	73.0	62.4	53.7	41.8	31.5	22.6	45.5
Avg Mean	35.0	36.3	56.6	59.6	70.1	77.2	86.0	75.9	67.2	54.7	46.0	34.1	58.2
High	70	65	85	93	96	105	107	102	100	87	80	69	88.3
Low	8	7	23	35	44	45	64	52	40	26	14	6	30.3
Max[1] > 90	0	0	0	2	4	12	28	14	7	0	0	0	67
Precip[1]	4	14	11	12	8	5	4	11	8	5	1	6	89
Precip	0.02	2.12	2.71	2.11	1.35	4.15	0.69	4.31	2.83	0.62	0.62	0.35	21.88
PMC[2]	0.04	2.03	2.31	2.39	1.47	3.74	0.64	5.02	3.05	0.52	.72	0.27	22.20
Snow	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	5.3
Heat DD*	929	820	283	206	35	22	0	1	74	341	572	960	4240
Cool DD*	0	0	49	38	206	386	651	339	140	21	0	0	1830

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	7.2	1.1	12.3	5.1	5.5	3.0	7.5	-0.7	-1.1	-2.1	5.1	3.1	3.8
Avg Min	4.7	3.5	13.6	5.0	4.3	2.2	4.7	-3.4	-2.1	-1.4	0.7	2.6	2.9
Avg Mean	5.9	2.4	13.0	5.1	4.9	2.6	6.1	-2.1	-1.6	-1.8	2.9	2.9	3.4
Precip	-0.61	1.04	0.22	-1.06	-3.74	-1.55	-3.73	0.19	-0.6	-2.07	-1.11	-0.72	-13.74
Snow	-4.7	-1.8	-1.5	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-2.3	-11.74
Heat DD*	-185	-49	-381	-136	-64	14	0	-2	13	48	-88	-86	-916
Cool DD*	0	0	46	12	103	91	189	-65	-36	-7	-2	0	332

*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 (may not be accurate in winter during snow events)

Official Recording Station, Manhattan, Kansas

CLIMATIC SUMMARY 2012

Temperature Extremes: 107ºF July 26; 6ºF December 27

Last Killing Frost*: March 10 (low of 28ºF); April 27 (low of 32 ºF at the PMC)

First Killing Frost: October 20 (low of 27ºF)

*Frost = 32ºF or less

Growing Season Number of Days: 211

Temperature: Warmer than average temperatures were predominant in January, despite lows in the single digits. The average temperature was 35.5ºF, which was 7.7 degrees warmer than normal. It was the 13th warmest January since 1985. A record high of 70ºF was tied on the 6th of the month. The mild winter continued into February with the mean temperature averaging 2.3 degrees warmer than normal. The number of days with a high temperature above 50ºF was greater than what is typical for February as were the days with lows below freezing. There were no subzero readings or any record setting lows for the month. March was the warmest on record. The mean of 57.4 was 1.4 degrees warmer than the previous set in 1910. There were no new record highs for the month, but 5 record warm lows were set. These occurred from March 16 to March 20. Officially the last temperature below freezing was a low of 28ºF on the 10th which makes it the earliest date for a late freeze on record. The warmer than average temperatures which continued in April, were not to the extent seen in March. The average was 5.1 degrees warmer than normal. Officially no freezing temperatures were recorded in April. However, frost was observed in Ashland Bottoms where Erma Leuthold recorded a low temperature of 30ºF on April 27. May was warmer than average with temperatures averaging 2.3 degrees warmer than normal. One high record temperature was tied on the 27th when the mercury reached 96ºF matching the previous record set in 1926. Temperatures were warmer than average in June with 4 days above 100. It was the 25th warmest June on record. July was the 6th warmest on record. No individual records were set; 19 days were in triple digit temperatures. The record is 27 days set in 1934. A change came in August with cooler temperatures. The average temperature of 75.9ºF was 2 ½ degrees cooler than normal. September started off warm, but the overall trend was cooler than normal, in contrast to much of the summer. The monthly mean temperature of 67.2ºF was in the coolest 25 out of 122 years. October was cooler than normal in contrast to most of the year. It was the 20th coldest October out of 123 years on record. In contrast to October, November was warmer than average by 2.6 degrees. A record high was tied on the 22nd and a new record was set on the 23rd, when a high of 73ºF beat the previous high of 72ºF set in 1914. December started out warm but transitioned into colder weather just in time for the holidays. Temperatures ranged from a high of 69ºF on the 3rd to a low of 6ºF on the 27th. The average temperature of 34ºF placed it 39th out of 117 years, and moved 2012 into the 7th warmest year on record.

Precipitation and Storms: Trace amounts of snow were recorded for January. The 0.02 inches of precipitation recorded ties as the 6th driest January on record. A wet trend returned in February with 0.41 inches greater than normal precipitation. Most of the precipitation fell as rain, with snowfall running below average for the month and the season. Greater than normal precipitation continued in March but only slightly so. No snow was reported for the month. April precipitation was -1.06 inches below normal, but the deficit for the year-to-date was only -0.46 inches. May was drier than normal with precipitation well below normal. Until rainfall on the 31st, it was the driest May on record. With moisture at the end of the month, it tied for 3rd driest May on record. The continued below average rainfall continued in June with a very dry spell to start the month. The month ended 1.55 inches below average and the year-to-date deficit stood at almost 6 inches below normal with the driest July being 1935 when the total rainfall was only 0.04 inches. Rain toward the end of August pushed the monthly total above normal. Unfortunately, it was too late to be of much benefit to fall crops. The below normal precipitation which was received in September, continued with only 2.83 inches, extending the dry pattern for the year. Precipitation for October was down 2.07 inches continuing the below normal trend. Not much help was received in November which was much drier than normal with the 11th being the only one day seeing precipitation.

November was the 86th driest of 124 years. December saw a lower than average snowfall with the greatest amount for the month, 2.8 inches, falling on the 20th. Trace amounts on the 25th did not add to the total for the month. The year ended with 21.88 inches of precipitation which was 13.74 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 LRP. All of the PMC's studies are listed as part of the National PMP projects. The primary project number is listed for each study. Currently 20 studies were active in on-site (On) and off-site (Off) locations in 2012 (Table 1). Details of active studies can be found on the subsequent pages. Studies that were not evaluated in 2012 are listed in Table 2.

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	RA 1.1
20A126L	Adaptation trials of superior grasses and forbs selected for advanced testing	On	Active	1992	2030	CA 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	CA 1.1
20I010K	Evaluation of miscellaneous trees and shrubs	On	Active	1961	2030	CP 2.1
20I030K	Evaluation of lace-bark elm	On/Off	Active	1979	2012	CP 2.1
20I037K	Evaluation of selected common hackberry	On	Active	1988	2013	CP 2.1
20I038K	Bur oak seed source study	On	Active	1991	2018	CP 2.1
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 2.1
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	CA 1.1
KSPMS-T-0201-CR	Plant species for revegetation of natural and man-induced saline areas	Off	Active	2002	2015	CA 1.1
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	CP 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
KSPMC-T-1201-WL	Production and management techniques for milkweed species	On	Active	2012	2017	WL 1.1

Table 2. Studies not evaluated or saw miminal activity in 2012.

Study No.	Study Name	Site Location	Status	Last Reported
20A126L	Adaptation trials of superior grasses and forbs selected for advanced testing	On	Dormant	2011
20I037K	Evaluation of selected common hackberry	On	Active	1997
20I038K	Bur oak seed source study	On	Active	2007
20I039E	Evaluation of switchgrass germplasm for rhizomatous characteristics	On	Dormant	2009
20I041K	Evaluation of Siberian elm	Off	Active	2010

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 from foundation seed stocks. 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. RH 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 (AOSA) Rules for Seed Testing (Anonymous 1978). Samples of all lots were taken annually (Fig.1) 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.

Figure 1. Seed sample being drawn from a seed lot for retesting

No testing was conducted for years 17 and 19 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.

Variables that could affect test results: fluctuations in year-to-year germination test results may be due to the set of storage conditions: temperature, humidity, and moisture content of the seed at the time of the test. A lack of uniformity in the seed lot is especially a problem in non-flowable seed stocks and inconsistency in sampling procedures. Variation in germinator environment and inconsistency in handling the seed sample and reading the test create opportunities for variation in the laboratory along with different people making the observations over the course of this study and the environment under which the seed was produced.

Potential Products: Information Technology

Progress or Status: Germination test results continued the up-and-down trend that has been observed since the inception of this study for seed stored in the controlled environment (described in the procedures section of this report).

Warm-Season Grasses

Two warm-season chaffy grass entries showed an increase in germination from last year, while 3 entries were down. The viability of 'Garden' sand bluestem (*Andropogon hallii* Hack.) was at the 38% level, an increase of 7 points from last year's test. The viability of 'Kaw' big bluestem (*Andropogon gerardii* Vitman) which increased by 4 points to 27% in 2011, declined 9 points in 2012 to its lowest mark thus far. Buffalo grass (*Bouteloua dactyloides* [Nutt.] Engelm.) was unchanged from last year. 'Aldous' little bluestem (*Schizachyrium scoparium* Michx.) dropped 1 point in 2011 to 60%; increased 2 points in 2012 to 62%. The viability of 'Osage' Indian grass (*Sorghastrum nutans* [L.] Nash) dropped 5 points to 72% in 2011; increased 3 points in 2012. 'El Reno' sideoats grama (*Bouteloua curtipendula* Michx.) was up 9 points at 66% in 2011; dropped 4 points this year. Among the non-chaffy warm-season grasses, the viability of 'Pete' eastern gamagrass (*Tripsacum dactyloides* [L.] L.) was down 1 point at 31%. 'Blackwell' (*P. virgatum* L.), an upland-type of switchgrass, was up 3 points over 2012 at 88% which tied with the results of 4 years ago. The viability of 'Kanlow' switchgrass (*Panicum virgatum* L.), a lowland-type of switchgrass, increased 5 points to 61% in 2011; dropped 7 points in 2012. 'Bend' sand lovegrass (*Eragrostis trichodes* [Nutt.] Wood) inched up a point to 41%. Refer to Tables 1A, 1B, and 1C for germination test results of warm-season grasses for the past 39 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

One forb entry remains in the controlled storage environment test following 33 years of storage: 'Kaneb' purple prairie clover (*Dalea purpurea* Vent.), which continues to show viability (Tables 2A, 2B, and 2C). 'Kanoka' round-head lespedeza (*Lespedeza capitata* Michx.), which was added to the study in 1985, continues to be viable following 27 years of storage in a controlled storage environment (Tables 2A and 2B). Kaneb was down 3 points to 67%. Kanoka was down 4 points in 2011 at 52%, its lowest level in the study so far; fell another 6 points in 2012.

Conclusions

Seeds in storage deteriorate over time—the rate of deterioration is dependent on seed quality, the method by which seeds are stored, and other factors. Seeds of warm-season grasses stored under controlled conditions were viable up to 23 years of storage. Ten seed lots remained viable after 39 years of storage in the controlled environment. Seed lots under uncontrolled storage conditions lost their viability from 8 to 13 years following storage. Seeds of an upland ecotype switchgrass, namely Blackwell, had the best viability of all grasses in the study with 88% viability, tested out initially at 85% 39 years ago. It is potentially possible to store seeds of certain species or cultivars under specific environmental conditions indefinitely. How the seed was grown may be a factor. Seeds stored in uncontrolled environments should not be held more than 2 to 4 years because of a substantial reduction in viability.

Most forb seeds in the uncontrolled storage environment were dropped from the study due to loss of viability in 6 to 7 years. Seeds of purple prairie clover, a hard seeded legume, were viable the longest. In the controlled storage environment, the longevity of forb seeds was extended another 10 to 12 years for thickspike gayfeather, grayhead prairie coneflower, and pitcher sage. Maximilian sunflower, with a checkered history of germination test results, still had 6% viability after 31 years of storage. The entry with the seeds viable the longest was purple prairie clover with a viability of 67% after 33 years of storage.

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-1181	Cont.	73	72	72	73	70	74	60	70	44	57	71	57	61	76	74	45	67
Purity: 58.20		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-1800	Cont.	67	75	68	60	48	55	54	56	24	11	51	46	64	45	48	38	24
Purity: 77.71		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	39
Andropogon gerardii	Kaw	63	28	29	23	27	18
Andropogon hallii	Garden	74	49	48	29	31	38
Bouteloua curtipendula	El Reno	22	57	68	57	66	62
Bouteloua dactyloides	PMT-1181	73	63	63	68	60	60
Eragrostis trichodes	Bend	77	57	23	40	41	
Panicum virgatum	Blackwell	85	88	90	91	85	88
Panicum virgatum	Kanlow	66	56	61	56	61	54
Schizachyrium scoparium	Aldous	70	66	65	61	60	62
Sorghastrum nutans	Osage	74	73	75	77	72	75
Tripsacum dactyloides	Pete	10	39	36	31	32	31

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	46					
Liatris pycnostachya	Eureka	56	0	TE														
Ratibida pinnata	Sunglow	82	4	TE														
Salvia azurea var *grandiflora*	Nekan	30	9	7	4	3	TE											

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

		Years of Storage	
Species	Entry	0	33
Dalea purpurea	Kaneb	81	67

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

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Evaluation of Little Bluestem

Study No. 20A215H

National Project No. 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 as this study has been terminated.

Increasing Seedling Vigor and Stand Establishment of Giant Sandreed

Study No. KSPMC-P-0601-RA

National Project Nos. 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 collected from plants that produced seed this year.

Evaluation of Chinese Chestnut

Study No. KSPMC-ST-1003-WL

National Project No. 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. Other considerations were given to wildlife in terms of a food source, 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 4.88 m (16 ft) apart with trees spaced 4.57 m (15 ft) 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.

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. Visual evaluations of seed production in 2012 consisted of number of husks and husk size determinations. Seven percent of the trees produced no husks, while 43% produced greater than 100 husks. Forty-one percent produced few husks (less than 100), while 6% were loaded with husks consisting of several hundred or more. Husk size was medium to small for most trees with 49% medium, 43% small and 5% small to medium. There were few large husks due to the droughty growing season. Nut maturity date was earlier than normal due to drought.

Young chestnut trees, producing a nut crop in the 3rd year after planting at Manhattan.

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. 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 PMP 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. 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).

Milkweed Terminology: Ortet – the original plant from which members of a clone descended. Ramet – an independent member of a clone.

Potential Product: Technology Transfer

Progress or Status: Established Field Plantings**.** Spring recovery was early in 2012 due to the warmer than normal conditions. Ortets and their associated ramets were measured 18 days earlier than in 2011, showed greater growth (Tables 2-4). Plant populations stayed the same for 3 groups and increased for 2 of the groups over last year's stand (Table 1).

The hot, dry summer caused plants to senesce early. The BG-TG prairie was inadvertently fertilized and herbicide residue from the fertilizer spreader cannot be ruled out. Either herbicide damage or damage

from a frost that was recorded on 27 April is suspected causes of injury to numerous ramets. Most of the BG-TG ortets and ramets had senesced by mid-June. The White and Blue Groups may have been impacted as well along with drought. Deformed leaves in the Blue Group suggest herbicide injury.

A single ortet survives in the Yellow Group. Stand in the Blue Group increased by one over last year. The BG-TG remained the same for stand but the number of ramets increased. The number of ortets found in the Red Group increased again in 2012 with appearance of one additional ortet. During a 1 May observation, frost or herbicide damage was noted on some stems. Additionally, herbivory impacted reproduction. In the BG-TG prairie, flower buds were noted on at least 13 ramets. Follicles formed but none reached maturity. Developing follicles of an ortet and its associated ramets displayed the effect of herbicide damage 25 September, Fig. 1. It will be interesting to see if the affected ortets and associated ramets recover in the coming year.

Ramet production was most prominent in the BG-TG where at least 38 ramets were detected. On 1 May a lone ramet was detected 420 cm from its ortet.

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

Group	Established Ortets	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	68.8	56.3	0
Blue	10	3	100.0	30.0	20.0	10
White	11	9	91.7	81.8	63.3	18.5
BG-TG	7	6	100.0	85.7	85.7	0

Table 2. Summary of plant growth (length and width measurement means) for the Red Group “Salac Prairie” 14-year old ortets.

Date	10 April 2012		21 May 2012		13 June 2012	
		Range		Range		Range
No. of Ortets	5	---	5	---	8	---
No. of Stems	5	---	8	---	9	---
No. of Ramets	0	---	1	---	1	---
Plant Length (cm)	16.2	12-21	37.3	27-49	35.3	19.7-49
No. of stems sampled	5	---	8	---	9	---
Leaf Width (mm)	---	---	5.4	2-14	5.4	2-15
No. sampled	---	---	8	---	9	---
Leaf Length (mm)	---	---	41.5	22-55	41.9	21-57
No. sampled	---	---	8	---	9	---

Table 3. Summary of plant growth (length and width measurement means) for the BG-TG prairie 15-year old ortets.

Date	10 April 2012		21 May 2012	
		Range		Range
No. of Ortets	4	---	6	---
No. of Stems	15	---	13	---
No. of Ramets	38	---	ND	---
Plant Length (cm)	10	5-16.5	37.2	24.7-46.5
No. of stems sampled	15	---	13	---
Leaf Width (mm)	---	---	25.6	15-42
No. sampled	---	---	12	---
Leaf Length (mm)	---	---	63.3	54-75
No. sampled	---	---	12	---

Table 4. Summary of plant growth (length and width measurement means) for the White Group 14-year old ortets.

Date	10 April 2012		20 April 2012		18 May 2012		13 June 2012	
		Range		Range		Range		Range
No. of Ortets	6	---	8	---	6	---	6	---
No. of Stems	15	---	15	---	13	---	10	---
Plant Length (cm)	3.5	1.2-7	15.2	4.2-25.4	28.8	12.7-43.5	30.2	22.7-41
No. of stems sampled	15	---	10	---	13	---	7	---
Leaf Width (mm)	---	---	---	---	20.1	5-34	---	---
No. sampled	---	---	---	---	11	---	---	---
Leaf Length (mm)	---	---	---	---	57.4	42-72	---	---
No. sampled	---	---	---	---	11	---	---	---

Table 5. Summary of plant growth (length and width measurement means) for the Blue Group 14-year old ortets.

Date	10 April 2012		20 April 2012		18 May 2012	
		Range		Range		Range
No. of Ortets	1	---	2	---	2	---
No. of Stems	1	---	3	---	2	---
Plant Length (cm)	8.5	---	9.7	2.6-16.8	28.5	27.8-29.1
No. of stems sampled	1	---	2	---	2	---
Leaf Width (mm)	---	---	---	---	14.5	12-17
No. sampled	---	---	---	---	2	---
Leaf Length (mm)	---	---	---	---	67	50-80
No. sampled	---	---	---	---	2	---

Figure 1. Twisted pedicels show evidence of herbicide damage on Mead's milkweed ortet in the BG-TG plot at Manhattan, Kansas, 25 September 2012.

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 Nos. Forestland 1.1, Natural Areas 1.1, Rangeland 1.1, Water Quality 4.1

Study Leader: John M. Row, Plant Materials Specialist

Introduction: The PMP 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 Development; Technology Transfer

Progress or Status: partidge pea, *Chamaecrista fasciculata* (Michx.) Greene was under study in 2012.

Partridge Pea Referee. Developing a Standard Germination Protocol for Partridge Pea (*Chamaecrista fasciculata*)

Background: Partridge pea (*C. fasciculata*) has been recently identified as a species of interest for further research by the Southern Region of the AOSA. This species, native to the Eastern United States, is emerging as a commonly used crop in soil conservation and as a food source for wildlife. Currently, there is no set protocol or rules defined by AOSA for the germination testing of this species. Preliminary studies have been conducted by the Kentucky State Testing Laboratory to determine which substrate, temperature, and additional methods will assist in dormancy breaking, as well as, reduce the presence of disease. These studies included the use of paper toweling, covered petri dishes with blotters, and between blotters as the substrata and temperatures of a constant 20°C, and alternating 15-25°C, 20-30°C and 20-35°C. The addition of a special procedure similar to 6.8(o.) (AOSA 2011) currently used for the germination testing of crownvetch (*Securigera varia* [L.] Lassen), was also tested for effectiveness. Using the preliminary research, two germination methods have been selected for this referee along with the addition of the special procedure (Lentz and Tillery 2012).

Purpose: The purpose of this referee is to determine if a new method for germination is capable of producing uniform results for this species which is not yet found in the AOSA Rules for Testing Seeds. More specifically, the purpose is to compare efficiency in dormancy-breaking using two methods of testing for germination with the addition of a special procedure similar to that used with crownvetch. The goal of this referee was to obtain data to support a rule proposal for the addition of partridge pea to the AOSA Rules for Testing Seed, Methods of testing for laboratory germination (Table 6A) (Lentz and Tillery 2012).

Procedure: Three partridge pea seed lots (labeled A, B, and C) were tested by two methods using substrates of rolled paper towels (T) and between blotters (B) moistened with water. Seed for the referee was supplied by Caudill Seed Company, Louisville, Kentucky. Four replicates of 25 seeds each were planted for each seed lot onto both substrates. Samples were prechilled for 7 days at 10°C. Following prechill, samples were moved to a germination temperature of 15-25°C. First count was conducted at 7

days (removing normal seedlings) and recorded. A final count was conducted at 14 days (removing normal seedlings) and recorded. At final count, the number of hard seed was recorded and the seeds were removed from the substrate. Any remaining abnormal seedlings were recorded and removed from the substrate. Once the 14-day count was completed, the seed coat on each seed was cut on the radicle end of any swollen seeds remaining on the substrate. The number of swollen seeds that were cut was recorded. The cut, swollen seeds were returned to germinate at 15-25°C for an additional 7 days and another count of normal seedlings produced was performed and recorded. Comments or deviations from the above procedure were noted for each test (Lentz and Tillery 2012). AOSA Rules for Testing Seeds Volume 4; Seedling Evaluation (2011 version) for Fabaceae, Legume Family V – Small-seeded, pages 65-68, were referred to in evaluating seedlings.

Progress: Results of the Manhattan PMCs participation in the referee: the T substrate contributed to a greater number of abnormal seedlings though not significantly different from the B substrate. Standard germination (germinating seedlings – abnormal seedlings) was significantly greater on the B substrate than on the T substrate at P<.05, Table 1. There was a significant difference in the number of seedlings at Day 7 with few additional seedlings by Day 14. There were a significantly greater number of swollen seed units on the rolled paper towel substrate than on the B substrate. In comparing seed lots, Lot C was slow in germinating but there was not a significant difference in the number of seedlings produced by any lot in the trial. However, there was a significant difference in the number of swollen seeds with Lot C having more than Lots A or B, Table 2. There was no advantage in cutting swollen seed units, similar to procedure 6.8 (o.), as only 1 seedling, in 1 replication of 1 seed lot, resulted from this procedure.

Table 1. Treatment means[1] for partridge pea at Day 7 and Day 14, swollen seeds,standard germination and abnormal seedlings for 25 seeds.

Substrate[2]	Number of seedlings		Swollen seed units	Standard Germ %	Abnormal Seedlings
	Day 7	Day 14			
B	5.1 A	2.3 A	5.4 B	29.6 A	3.7 A
T	1.1 B	1.8 A	7.4 A	11.2 B	5.8 A

[1]Means in a column followed by the same letter are not significantly different from one another at P<0.05.
[2]B=Between blotters; T=rolled paper towel

Table 2. Means[1] for 3 partridge pea seed lots at Day 7 and Day 14, swollen seeds, standard germination, hard seed, and abnormal seedlings for 25 seeds.

Seed Lot	Number of seedlings		Swollen seed units	Standard Germ %	Hard Seed	Abnormal Seedlings
	Day 7	Day 14				
A	1.8 A	1.3 A	7.0 B	12 A	7.8 A	7.3 A
B	1.3 A	1.3 A	5.5 B	10 A	10.5 A	6.3 A
C	0.3 A	2.8 A	9.8 A	12 A	8.3 A	3.8 A

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

Results from the collective efforts of all referee sites may differ from the results reported here.

References

AOSA Rules for Testing Seeds Volume 1. Principles and Procedures (2011 version) p. 6-10. Association of Official Seed Analysts. Ithaca, New York.

AOSA Rules for Testing Seeds Volume 4. Seedling Evaluation (2011 version) p. 65-68. Association of Official Seed Analysts. Ithaca, New York.

Lentz, A. P. and T. Tillery. 2012. Developing a Standard Germination Protocol for Partridge Pea (*Chamaecrista fasciculata*). AOSA/SCST 2011-2012 Partridge Pea Germination Referee. Region V South. University of Kentucky Seed Testing Laboratory. Louisville.

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

Study No. KSPMS-T-0001-CR

National Project No. 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 of this study continues as vegetation continues to establish over the planting area. There are areas that remain unvegetated due to the fragile slopes. 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. Evaluations in 2011 yielded a decline in plant health along with the loss of an additional 29 plants. The 2012 evaluations indicated >50% loss of plants with only a few switchgrass and little bluestem plants being healthy. The remaining plants are in poor condition showing severe stress from drought and soil pH. A soils test from this planting site indicated a pH of 2.8 - 3.0. Evaluation of the study planting will continue.

Figure 1. and Figure 2. Little bluestem establishing within common reed

Figure 3. Native grass study plot

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

Study No. KSPMS-T-0201-CR

National Project No. 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 2012.

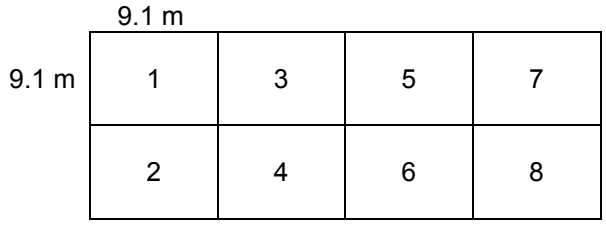
Observations from the site plantings within this study indicate that the initial application of organic matter both incorporated and surface applied is critical to the establishment of vegetation on saline sites. The type of organic matter does not appear to be as critical as application and incorporation to assist with

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. Cropland 1.1 and Pastureland 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 March 2012. At the time of evaluation, Laramie was actively growing with plants throughout the planting. Additional Laramie seed could be found on the ground, which may still germinate or provide a seed bank for future production. The plant appears to be doing very well.

Observations do not indicate a significant 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 years.

Figure 1. Laramie seedlings within cool-season grass planting

Plant Adaption Study for Sandy Seeding Site

Study No. KSPMS-T-095-PA

National Project Nos. Critical Areas 1.1, Cropland 3.1, and Pastureland 1.1

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 PMCs, 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 FOTG and into technical notes.

Progress or Status: This study contains 15 replicated plots that were drilled April 1, 2009, with plant materials obtained from 6 PMCs. 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 March 2012, 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.

It remains very difficult to establish native vegetation on similar sandy sites in the area. Additional investigations into soil health have indicated a hardpan on these sandy soils that restricts root

development and native vegetation establishment. Additional evaluations of cover crops including stacking of cover crops are being evaluated and will continue to be evaluated.

Figure 1. Restricted root development of sorghum cover crop, Gray County, Kansas

Figure 2. Native grass planting on sandy site in Finney County, Kansas

Production and management techniques for milkweed species

Study No. KSPMC-T-1201-WL

National Project No. Wildlife 1.1

Study Leaders: John M. Row, Plant Materials Specialist; Richard L. Wynia, Plant Materials Center Manager; Chip Taylor, Professor

Introduction: Milkweeds and nectar sources are declining due to the development and widespread use of herbicides in cropland, rangeland, pastures, and roadsides. Development of property in the U.S. consumes habitat of wildlife at the rate of 6,000 acres a day or 2.2 million acres a year. The use of the non-selective systemic herbicide glyphosate in genetically modified corn, soybeans, and alfalfa has resulted in the loss of 100 million acres of butterfly habitat. There is very little known about the biology and life history of milkweed species in relation to their potential to be grown in cultivated situations for seed production. Milkweeds have been designated as weed species and the emphasis has been on eradicating the different species from cultivated crop situations.

Objective: To discover the best propagation methods, and the techniques that will be needed to plant, manage, harvest, and process the species to provide adequate seed production to stimulate acceptable pollinator habitat creation.

Procedure: Seeds of swamp milkweed, *Asclepias incarnata* L., and green antelopehorn, *Asclepias viridis* Walter, provided by Monarch Watch for this study, were direct seeded to 288-cell plug trays filled with PRO-MIX plug and germination medium (PRO-MIX 'PGX') one seed per cell and over-wintered in a dormant state in the Manhattan PMC's plant cooler for 12 weeks. The trays were moved to the greenhouse in the spring once seedlings began to immerge as temperatures were beginning to rise in the cooler. Another set of seeds were germination tested and the subsequent seedlings were transplanted to 72-cell plug trays containing PRO-MIX 'PGX' and moved to the greenhouse after a few days incubation in a laboratory incubator at 25/15°C alternating temperature and 8 hours of light. After 6 weeks in the greenhouse, seedlings produced in the 288-cell plug trays were transplanted to 72-cell plug trays. Seedlings of each species were transplanted to four different field settings, conventional planting, white single-row weed barrier, black double-row weed barrier, and raised bed with no weed barrier using a waterwheel planter. The swamp milkweed was sheared several times before planting with a minimum of 2 to 4 leaves remaining on the seedlings at planting time. This reduced plant stress and made handling the seedling easier. Follicles (pods) were hand-harvested when they began to split open.

Potential Products: Technology Transfer

Progress or Status: Swamp milkweed seedling production was more successful than green antelopehorn seedling production, Table 1. Germination in the 288-cell plug trays was 74% and 71% for the swamp milkweed and green antelopehorn, respectively. A total of 1,253 milkweed seedlings were produced, 1,193 of them were planted out.

Table 1. Seedling production of *A. incarnata* and *A. viridis* at Manhattan, Kansas

Species	Direct Seeded to 72-Cell Plug Trays	Lab Transplants to 72-Cell Plug Trays	Green House Transplants	Total Seedlings
Asclepias incarnata	71	211	428	710
Asclepias viridis	73	60	410	543

Establishment of seed production plots was more successful for swamp milkweed, Table 2. Challenges facing establishment were the hot, dry weather and weeds. The conventional plots (no weed barrier) were taken over by weeds rather quickly. This required mechanical weed control. The swamp milkweeds being taller were easier for the weeding crew to see and little damage was caused to the plants. The story was much different for the green antelopehorn. The weeding crew had to locate the plants and weed around them. The crew had trouble finding the plants and many were hoed out or their tops were shaved off by the hoe as some plants recovered later in the growing season. Due to problems with

getting water to the green antelopehorn, either not enough initially or too much water later on, was detrimental to establishment. Some plants senesced under the stresses of summer, of which, a few plants recovered. One or two managed to flower late.

Table 2. Seedling survival under 3 plant production regimes[1] in initial plantings for *Asclepias incarnata* and *A. viridis* at Manhattan, Kansas, 28 August 2012.

Species	W-SR-WB	B-DR-WB	CP
	% Stand		
A. incarnata	100	99.5	83.1
A. viridis	64	59	33.7

[1]CP=Conventional Planting; W-SR-WB=White-Single Row-Weed Barrier; B-DR-WB=Black-Double Row-Weed Barrier

Follicles were gathered daily during the harvest period which began 20 September as a few follicles began to open in the conventional plot. At the peak of harvest 15 October to 26 October follicles were harvested twice a day. The first ripe follicles in the plasticulture were found 11 October. Follicles were kept separate by plot throughout harvest and throughout the seed cleaning process. The bulk harvest was dried down in a forage drier at low heat and forced air until dry, after which bulk weights were obtained. A device for separating the seeds from the floss and follicles was fabricated out of metal components patterned after a similar device designed by Monarch Watch. Seed yield was 8.65 pounds gleaned from 16.83 pounds of bulk material. The percentage of clean seed varied by plot as the harvest season progressed, large groups of follicles were harvested en masse thus including more pedicels and stalks. The overall yield was 51.3% clean seed, Table 3.

Table 3. Seed production of swamp milkweed under 4 field settings at Manhattan, Kansas

Plot[1]	Bulk Weight (lbs)	Clean Seed Weight (lbs)	% Clean Seed	Seed Yield (lbs/ac)
CP	5.6	3.25	58.0	216.7
W-SR-WB	3.87	1.85	47.8	276.4
B-DR-WB	6.3	3.0	47.6	167.6
RB-N-WB	1.06	0.55	51.9	137.5
Total Production	16.83	8.65	51.3	169.6

[1]CP=Conventional Planting; W-SR-WB=White-Single Row-Weed Barrier; B-DR-WB=Black-Double Row-Weed Barrier

High winds were a problem for swamp milkweed causing stem breakage and lodging resulting in many follicles at or near ground level by late summer, is some cases insects weakened stems just above ground level where the plant would snap off in the wind.

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 Manhattan 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

Little Bluestem: The James E. Bud PMC, initiated an Inter Center Stain Trial 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% in 2010 to 90% in 2011, herbicide damage was not thought to be the cause of the decline. Table 1, summarizes plant height for the 5 years of observation. Stand counts on Cimarron were discontinued due to the losses from the herbicide damage.

Table 1. Five-year plant height summary for little bluestem, *Schizachyrium scoparium*, in observational trials at Manhattan, Kansas.

Accession / Year	Plant Height (cm)	Plant Height (cm)	Plant Height (cm)	Plant Height (cm)	Plant Height (cm)
	2008	2009	2010	2011	2012
421552	100	131	NM	109	134
9029926	116	164	130	146	149

NM=Not Measured

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 (2009), Accession 9029926 obviously produced more biomass than Cimarron from looking at the plant heights. It was unfortunate that herbicide damage impacted this trial.

Evaluation of Miscellaneous Trees and Shrubs

Study No. 20I010K

National Project Nos. Cropland 2.1, 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: KSU-Department of Horticulture and Forestry; the USDA 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-one accessions were evaluated this year. There were no new plantings in 2012.

The growing season was plagued with drought and high temperatures impacting plant performance in 2012. Leaf scorch was a problem for an increased 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. Leaf cupping indicative of changes in environmental conditions affected several species this year. 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 44 of the 71 entries evaluated in 2012 follows:

Thumbnail sketch of woody plant performance for the 2012 growing season.

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

Trees

Betula papyrifera, paper birch, 9050478, foliage unattractive due to leaf scorch and senescence late summer; 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, severe leaf scorch, disease and insects affect appearance; plants lack uniformity.

Carya illinoinensis, pecan, 9050605, foliage unattractive due to drought causing leaf scorch, diseases late, insects heavy on some plants, bagworms.

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

Cercis canadensis, red bud, 2 entries: 9050520, foliage not clean all season, distractions were insects and foliar diseases (leaf spot), plants lack uniformity, few flowers and fruits; 9050521, foliage unattractive due leaf spot, anthracnose, cupped leaves and slight scorch, and insect damage, plants fairly uniform in height.

Cupressus bakeri, Modoc cypress, 9050504, foliage looks good overall, some brown patches due to disease or winter injury; bagworms on 50% of plants, severe on 2 plants; poor form due to damage to growing points; making small gains in growth. Plants responded well to droughty conditions this year.

Diospyros virginiana, common persimmon, 9050606, foliage attractive most of the season, declining in the fall with some disease (leaf spot) and insect damage.

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

Gymnocladus dioicus, Kentucky coffeetree, 2 entries: 9050577 leaf spot and insect damage to leaflets, early senescence, a couple of trees with red petioles; and 9050580, insect damage, overall good, clean foliage began to deteriorate late July; 1 with pink-to-red stems; 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; 9076719 older leaves yellow with tips firing late summer.

Platanus occidentalis var *glabrata*, smooth sycamore, 9050583, though leaf scorch and senescence detracted from foliage appearance, fairly attractive overall this year; plants similar in height but not quite uniform.

Populus alba, white poplar, 9050499, trees No. 1 and 2 dead; tree No. 3 leaf scorch and senescence detract from appearance; 90% of leaves senesced by mid September.

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; an excellent browse species.

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 especially leaf miner detract from foliage appearance, foliage otherwise attractive, bright yellow in fall; plants lack uniformity.

Quercus bicolor, swamp white oak, 2 entries: 9050607, bag worms and leaf scorch were a problem this year; 9050608, leaf scorch and insects detracted from foliage.

Sorbus aucuparia, mountain ash, 9050429, leaflets curled, leaf scorch, heat stress causing fruit to drop; good foliage appearance, slight insect and disease issues; tree No. 2, severe mechanical damage. Plants lack uniformity.

Sorbus torminalis, wild service tree, 2 entries: 9050432, dark green foliage, leaf scorch and leaf spot made for less attractive foliage as the summer progressed; however, the yellow-to-orange fall foliage made up for it, insignificant insect problems and moderate disease, plants somewhat columnar but plant growth not uniform among plants; severe mechanical damage to the trunk of 1 plant; 9050430, leaf scorch was a big detractor to foliage appearance this year, yellow-to-orange fall foliage; columnar plants yet growth not uniform.

Taxodium distichum, bald cypress, 9050542, clean foliage overall, attractive; plants lack uniformity; bagworms and a slight browsing by insects, perhaps grasshoppers; vigorous growth.

Tilia cordata, littleleaf linden, 9050481, foliage unattractive especially late in the season due to leaf spot, slight leaf scorch, leaf curl and cupping and some insect issues; growth steady.

Ulmus parvifolia, ‘Dynasty’ lace-bark elm, 486339, attractive plants with good, clean foliage; reddish colored fruits; exfoliating bark; fairly uniform height but plants vary in width and main stem diameter.

Ulmus thomasii, rock elm, 9050503, foliage yellowing in summer, unattractive season long due to disease; plants lack vigor, poor uniformity; struggling (may suffer from plant competition in adjacent row), not adapted to site.

Shrubs

Alnus maritime subsp. *oklahomensis*, seaside alder, 9050518, stressed this year 60% of leaves senesced by late July, leaf scorch detracted from foliage appearance, some yellowing (lightening) of older foliage; plants fairly uniform, attractive cones.

Aronia arbutifolia, red chokeberry, 658641, leaf edges scorched, foliage turned pale by late summer; slight incidence of insect and disease. Plants recovered from harsh summer conditions by fall with new foliage, the older foliage, however, unattractive.

Caragana microphylla, 'Mongolian Silver Spires' littleleaf peashrub, 9050581, attractive, clean foliage overall, slight insect or response to drought, armed prickles, silver colored leaves, good contrast plant, plant uniformity lacking.

Chilopsis linearis, desert willow, 9050543, virtually disease and insect free; very clean foliage, plants moderately uniform, good plant vigor; many large, attractive flowers develop into fruits with mature seeds; attractive to pollinators. Winter kill on young growth overcome by new annual growth.

Cornus mas, 'Redstone' Cornelian cherry dogwood, 9055585, established in 1989, these plants have performed well with attractive foliage and fruits. The drought stressed the plants this year, leaf scorch and shriveled fruits were a problem. The plant would perform better in part shade.

Cornus sanguinea, blood-twig dogwood, 2 entries: 9050425, foliage unattractive all season due to leaf scorch, degrading further by late summer; leaf edges cupping or curling, increased growth but plants declining; 9050426, foliage unsightly all season due to leaf rolling, leaf spot, and insect chewing; remaining plants dying, only 1 plant holding on; producing fruit.

Corylus americana, American hazelnut, 9083247, foliage unattractive all season in stark contrast to 2011, slight to moderate leaf scorch, severe on some stems, across the 10 plants in this planting; leaf rolling, older leaves yellowing, in some cases browning, yet colorful fall foliage; plants fairly uniform if the 3 end plants are excluded (may be a soil issue or smaller planting stock), produces fruit.

Cotinus coggygria, smokebush, 9050427, foliage looks good overall, some leaf spot but not overwhelming, leggy appearance on stems make for unattractive specimens, plant uniformity average, 1 stunted (more compact).

Crataegus chrysocarpa, fireberry hawthorn, 9076686, foliage less unsightly early as disease and insect issues were reduced by the hot, dry summer, slow growth, plants lack uniformity and vigor. Plants browsed; not adapted.

Elaeagnus X 'Jefmorg', Silverscape®olive, 9050524, plants stressed in 2012; clean foliage most of the summer, beginning to deteriorate by late summer, 2 plants produced a few fruits this year. One hundred and three fruits collected in the fall of 2011, were sent to the Southern Region Native Plant Coordinator, USDA Forest Service, National Seed Laboratory, Dry Branch, Georgia, for analysis. About half of the seeds were cut open. The seeds looked full with an x-ray but once they were cut open it was apparent that they were not viable. Under a magnifier, it looked like the flower tissue that the seed formed around had hardened around a thin embryo cavity filled with white "cottony" material. It was assumed this was also deteriorated flower tissue.

Foresteria pubescens var pubescens, elbow bush, 9050502, leaf scorch and disease detract from foliage appearance, softened by small leaf size, with leaves yellowing by fall; 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 were shed over the course of the summer and replaced with clean foliage. Plants survive but not adapted to site, No. 1 dying.

Photinia melanocarpa, black chokeberry, 2 entries: 9050500, leaf scorch, plants lack uniformity, plants unattractive due to insects and disease, have struggled all summer, declining; small fruit; 323957, declining in appearance with disease showing up late summer; plants fairly uniform growth; good flowering and fruiting; large fruits blue-black late July.

Physocarpus opulifolius, common ninebark, 2 entries: 9050522, foliage unsightly due to leaf scorch and leaf spot as season progressed, plants uniform; 9050531, leaf scorch, foliage degrading late in the season as foliar diseases appear (leaf spot) but masked by dark green foliage; plants lack uniformity, may be due to soils or site location.

Rhus copallinum, shining sumac, 9050537, overall attractive appearance; late season foliar diseases and bronzing appear late in the growing season and early leaf senescence due to drought.

Ribes americanum, American black currant, 9082687, foliage unsightly most of the season due to leaf scorch; fruits dried up, plants had a shriveled appearance; the three original plants fairly uniform growth but poor vigor; No. 5 dying.

Shepherdia argentea, silver buffalo berry, 9050431, no noticeable insect damage, leaf drop slight, some leaf yellowing, cause undetermined; little if any disease noted, increased growth observed; mechanical damage.

Spiraea flexuosa, spiraea, 9050417, clean foliage overall, leaf scorch late; secondary flowering; severe plant competition on several plants; slow growing, remarkably plants show increased growth over past years when they appeared to not be adapted to site.

Tetradium sp., bee-bee tree, 9050584, plants unattractive season long due to leaf margins yellowing, foliar diseases and leaf scorch; red fall foliage.

Viburnum rufidulum, southern blackhaw, 2 entries: 9050482 and 9050483: glossy green foliage began to deteriorate in appearance by late July as plants were showing stress and foliar diseases appearing; Accession 9050482, leaves turning red revealing a slight disease presence in September and beginning to fall; plant No. 3 heavy fruited; 9050483 loaded with fruit, beginning to turn, had attractive fall foliage.

Xanthoceras sorbifolium, yellowhorn, 9050418, as these plants reached maturity they have been reliable bloomers; flowers and fruits attractive, produces seed with recruitment noted (in the canopy of the 5 plants spaced 10 feet apart, 20 seedlings were found and in adjacent rows 14 seedlings were found); prolific fruiting this year; leaf scorch and anthracnose detracted foliage appearance; plant uniformity in 2 groups, 3 plants in 1 and 2 in the other group; plants showing good growth (Fig. 1).

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. Yellowhorn plants in their ninth growing season in the miscellaneous shrub plots at Manhattan PMC, with seed pods opened.

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2012. 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
				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
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

Table 2. Initial evaluation: Study No. 20I010K - list of miscellaneous trees and shrubs under evaluation in 2012. Page 2

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
F1 20 1-5	2003	9050482	Royal Guard	*Viburnum rufidulum*	southern blackhaw	Holden Arboretum /NCRPIS
F1 20 6-10	2003	9050483		*Viburnum rufidulum*	southern blackhaw	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
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

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Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
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
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

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Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
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
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

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Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	
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.

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	SESC	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		
					12		5	100	8						
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

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
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
E3 (see bur oak map)		9050077	white oak	95	02	4	4	100					448	6	
			Quercus alba		05		4	100					568	10	
			Lancaster Co., NE /KSPMC		07		4	100					728	12	
E3 21 5-7 /P21 1-6	QUPR	9050416	dwarf chinkapin oak	01	01	9	9	100					23		
			Quercus prinoides		02		8	89	6	7	5	26	31		IN - LCB
			/NCRPIS		03		8	89				42	41		
					04		8	89				67	66		DB, some
					05		8	89		5	4	93	83		
					06		8	89		1	4	109	109		Nos. - 6 DD; 7 MD, severe
					10		8	89					179		
					11		8	89				207	204		No. 2 - DD, severe; No. 3 - DD
F1 1 1-2; 2 1,4	PLOC	9049957	*Platanus occidentalis*	85	85	4	4	100	3		2	89	178		
			Brownville, NE /UNL-Lincoln		86		4	100	4	4		260	240		
					87		4	100	5			442	487	6	
					88		4	100	3	3	3	553	615	10	
					89		4	100	5	5		587	714	13	
					95		4	100					1213	27	
					04		4	100					1786	36	
					09		4	100					2063	40	

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 1 10-19	LIVU	107630	Cheyenne European privet	66	70	10	5	50	1			290	320		
			Ligustrum vulgare		71		5	50	1			320	396		
			/NDPMC		73		5	50	1						
					74		5	50	1			411	503		
					75		5	50	5			490	620		
					76		5	50	5			506	650		
					78		5	50	3			650	650		
					79		5	50	1			600	500		
					87		5	50	4			630	300		
					95		5	50					332		
					98		5	50					351		
					00		5	50					366		
					05		5	50					342		
					11		5	50					372		
F1 2 2-3;	PLOC	9049956	*Platanus occidentalis*	85	85	5	5	100	3		2	93	189		
3 1,4-5			Burt Co., NE /UNL-Lincoln		86		5	100	2	4		176	290		
					87		5	100	3			401	492	6	
					88		5	100	2	3	2	505	607	10	
					89		5	100	4	5		545	707	12	
					95		5	100					1225	25	
					04		5	100					1625	31	
					09		5	100					1770	33	
F1 2 5;	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	

Table 3. Initial evaluation data: Study No. 20I010K - miscellaneous trees and shrubs. Page 4

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F1 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
					12		10	100				164	156		
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		
					12		5	100					410		
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		
					12		3	100				244	147		DB
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		
					12		4	80				98	89		
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		
					12		3	60	9				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 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		
					12		5	100				180	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	1472		
			/NCRPIS		12		3	100				165	213		
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		
					12		5	100				197	162		
F1 20 1-5	VIRU	9050482	southern blackhaw	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		
					12		3	80				119	333		

Table 3. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs. Page 6

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F1 20 6-10	VIRU	9050483	southern blackhaw	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	260	265		
					12		5	100				321	298		
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
					12		4	80				146	114		
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		
					12		5	100							20 seedlings in canopy; abundant fruiting
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		
					12		4	80					311		
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		
					12		2						252		

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 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		
					12		5	100					413		
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
					12		2						456		No. 1 - mostly dead
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
					12		5	100					361		
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		
					12		1	100					437		Poor form

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 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		
					12		3	60				140	324		
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		Good fruit production; No. 6 - WD
					96		9	90	1				1119		
					01		8	80	4				974		
					07		8	80					1159		
					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		

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
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		
					12		5	100				153	155		
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
					12		4	100				229	261		
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	184	136		No. 1 & 2 – stunted growth
					11		5	100	3	7	7	211	193		
					12		5	100					237		
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		
					12		5	100					272		No. 3 - young reddish pods
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		
					12		5	100				308	260		
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		
					12		5	100				57	83		
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
					12		5	100				170	272		

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
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
					12		5	100				241	177		
F2 15 1-5	TETRA25	9050584	bee-bee tree	10	11	5	5	100				170	177		
			Tetradium sp.		12		5	100				215	233		
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		
					12		4	80					295		
F2 18 1-5	ARARA3	658641	red chokeberry	11	11	5	5	100				49	68		
			Aronia arbutifolia		12		5	100				44	81		
			Pickens Co., NC/NDPMC												
F2 18 6-10	VIBUR	9050609	Mongolian viburnum	11	11	5	5	100				41	79		
			Viburnum mongolicum		12		5	100				57	74		
			Asia /AA-FCRS, Morden, CN /NCRPIS												
F2 24 1-5	SYPE2	9006225	Peking lilac	73	73	5	5	100	3			78	70		
			Syringa pekinensis		74		5	100	3			157	130		
			/NDPMC		75		5	100	3			210	230		
					76		5	100	3			310	315		
					78		5	100	3			440	400		
					79		5	100	1			440	500		
					83		5	100	1	3	2	700	610		
					93		5	100					665		
					02		5	100					768		
					07		5	100					793		
					12		4	80					623		
F2 24 6-10	FORSY	9034667	early forsythia hybrid	73	73	5	5	100	1			88	73		
			Forsythia europaea X		74		5	100	1			116	143		
			68vate		75		5	100	3			142	189		
			/NCRPIS		76		5	100	3			180	201		
					77		5	100	3			210	215		
					78		5	100	3			315	255		
					79		5	100	1			300	300		
					83		5	100	1	2	2	470	350		
					93		5	100					350		
					02		5	100					305		
					07		5	100					252		
					12		5	100					245		

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 2 1-11	QUPA2	9001069	pin oak	67	70	11	9	82	3						
			Quercus palustris		71		9	82	5			290	332		
			/Manhattan Nursery		74		9	82	5			457	518		
			Manhattan, KS		75		9	82				488	700		
					76		9	82				670	762		
					78		8	73				800	960		
					01		8	73					1334	37	
					07		7	67					1670	43	
					11		7	67					1784	45	
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		
					12										
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		
					12		1	20	9			121	314		Not adapted
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

Table 3. Initial evaluation data: Study No. 20I010K – miscellaneous trees and shrubs. Page 12

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F3 7 6-10	TICO2	9050481	littleleaf linden	03	03	2	2	100				20	40		
6			*Tilia cordata*		04		1	50	5	4	5	51	67		
			Ukraine /NCRPIS		05		1	50				83	110		
					06		1	50					167		
					07		1	50				127	240		
					08		1	50				196	300		
					11		1	50		2	3	396	473		
					12		1	50				418	505		
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		5	100		5	6	163	161		No. 10 – DD, severe
					12		5	100				134	140		DD, severe
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		
					12		4	80					364		
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		
					12		3	100					318		
F3 10 1-10	BENI	9034682	river birch	71	83	10	10	100	1	4	3	1100	1220		Multi-stem
			Betula nigra		86		10	100				1280	1300		
			Houston Co., MN		95		10	100					1359		
			/NCRPIS		07		10	100					1525		
					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		

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 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
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		12		5	100					122		Severe scorch
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		12		5	100					455		
			/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

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 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		
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	
					12		1	20					1072	37	
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	

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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
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
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	

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 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
					12		8	80					1288	35	
F4 1 4-6	CAIL2	9050605	pecan	11	11	5	5	100		4	6	32	54		
			Carya illinoinensis		12		5	100					72		
			Ste. Genevieve Co., MO /NCRPIS												
F4 2 1-5	QUBI	9050608	swamp white oak	11	11	5	5	100			6	56	110		BW
			Quercus bicolor		12		5	100				69	114		
			Polk Co., IA /NCRPIS												
F4 2 6-10	QUBI	9050607	swamp white oak	11	11	5	5	100			5	37	81		BW
			Quercus bicolor		12		5	100				53	92		
			Adair Co., MO /NCRPIS												
F4 3 1-5	DIVI5	9050606	common persimmon	11	11	5	5	100		3	5	54	82		
			Diospyros virginiana		12		5	100				78	109		
			St. Charles Co., MO /NCRPIS												
F4 4 1-5	GYDI	9050580	Kentucky coffeetree	11	11	5	5	100		1	2	37	62		DB
			Gymnocladus dioicus		12		5	100				31	72		
			Riley Co., KS /KSPMC												
F4 4 6-10	GYDI	9050577	Kentucky coffeetree	11	11	5	5	100		1	2	24	57		DB
			Gymnocladus dioicus		12		5	100				39	83		Late leafing out
			Kingfisher Co., OK /KSPMC												

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 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		
					12		5	100					1155		
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
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		12		4	100				112	93		
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		12		5	100				113	124		
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
					12		5	100				246	241		DD
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		

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 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 & 5 – dying; 3 – dead
					11		2	33					1213		
					12		2	33					1341		No. 5 – 80% dead
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
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
					12		2	20					1153		No. 2 – 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		
					12		5	50							Nos. 1 & 9 – dead; No. 10 – 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 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		
					12		3	23					607		
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		
					10		10	100					1167		Canopy encroachment
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		
					98		3	75					1285		
					02		3	75					1321		
					04		3	75					1604		
					07			75					1783		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	
					12		2	40						45	

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 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
					12		4	80						44	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	
					12		2	40						59	
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
					12		5	100						44	
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	
					12		3	60					1829	59	

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 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	
					12		5	100						30	
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	
					12		4	80						43	
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		
					12		5	100					1223		
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		
					12		4	100					1324		
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		5	100					1303		
					12		5	100					1357		

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 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	43	
					12		3	60						45	
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	
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		

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
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		
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	

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 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,		10		1	100					1175	24	
			Elsberry, MO		12		1	100				759	1190	24	
HQ1 2/2	MALUS	514275	hybrid crab apple	77	77	1	1	100							
			Malus sp.		07		1	100					900		Multistem
			Clinton Co., MI /MIPMC		11		1	100		8			935		Cedar-Apple rust; WD
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		12		1	100					1240		
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												

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 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		
					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		
P/S 7, 11-30, 55, 57, 83, 85	PINI	9034670	Austrian pine	81	83	25	25	100	5		3	28	22		
			Pinus nigra		86	(26)	23	92	5			64	62		No. 55 – PS
			/KSU Forestry, Manhattan, KS		95		23	92					337		
					01		21	84					615		
					05		21	84					750		
					10		20	80					914		
PQ/S 31-35, 37-50	PISY	399402	Scots pine	77	77	20	20	100	3			14	21		
			Pinus sylvestris		78		20	100	3			33	36		
			/NCRPIS		79		20	100	3			52	56		
					83		19	95	2		3	230	225		
					86		19	95	5			345	342		Nos. 48 & 50 – PS
					96		19	95					728		
					01		19	95					844		
					06		13	65					1009		
					10		5	25					1005		PW
P/W 1/ 1	LIST2	9050512	sweetgum	66	66	2	2	100							
			Liquidambar styraciflua		06		1	50				1564	1430	72	
			/Forest Keeling Nursery, Elsberry, MO		10		1	50					1487	76	
P/W 1/ 2	JUVI	9050514	Canert juniper	65	65	1	1	100							
			Juniperus virginiana canaerti		06		1	100							Over topped with vines
					10										
			/Nelson Nursery, Enid, OK												

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/W 1/ 3	JUHO2	9050513	blue creeping juniper	66	66	1	1	100							
			Juniperus horizontalis glauca		07		1	100							
			/MIPMC		10										
P/W 1/ 4	QURU	9000399	northern red oak	66	66	1	1	100							
			Quercus rubra		06		1	100				1501	1130	44	
			Greenwood Co., KS		10		1	100					1189	51	
			/KSPMC												
P/W 1/ 5-6	FRPE	9001455	ash	71	71	2	2	100							
			Fraxinus sp.		06		2	100					1225	65	
			/Marshall Nursery,		10		2	100					1245	70	
			Arlington, NE												
Q/S 51-54,	PISY	399403	Scots pine	77	77	18	18	100	3			18	24		
56, 58-70			*Pinus sylvestris*		78	(20)	18	100	3			35	36		
			/NCRPIS		79		18	100	3			55	57		
					83		18	100	1	4	3	245	240		
					86		18	100	5			381	413		52, 53, 58, 61-62, 65, 68 – PS
					96		18	100					819		
					01		18	100					945		
					06		13	72					1178		
					10		12	67					1053		PW
Q/S 71-82,	PISY	399404	Scots pine	77	77	18	18	100	5			12	16		
84, 86-90			*Pinus sylvestris*		78	(20)	18	100	5			26	21		
			/NCRPIS		79		18	100	5			40	36		
					83		18	100	3	3	3	175	175		
					86		18	100	5			294	315		
					96		18	100					714		
					01		18	100					832		
					06		18	100					991		
					10		11	61					950		PW

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 B3, Row 1, Plot numbers 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
PLT SYM: Plant Symbol
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 ▲

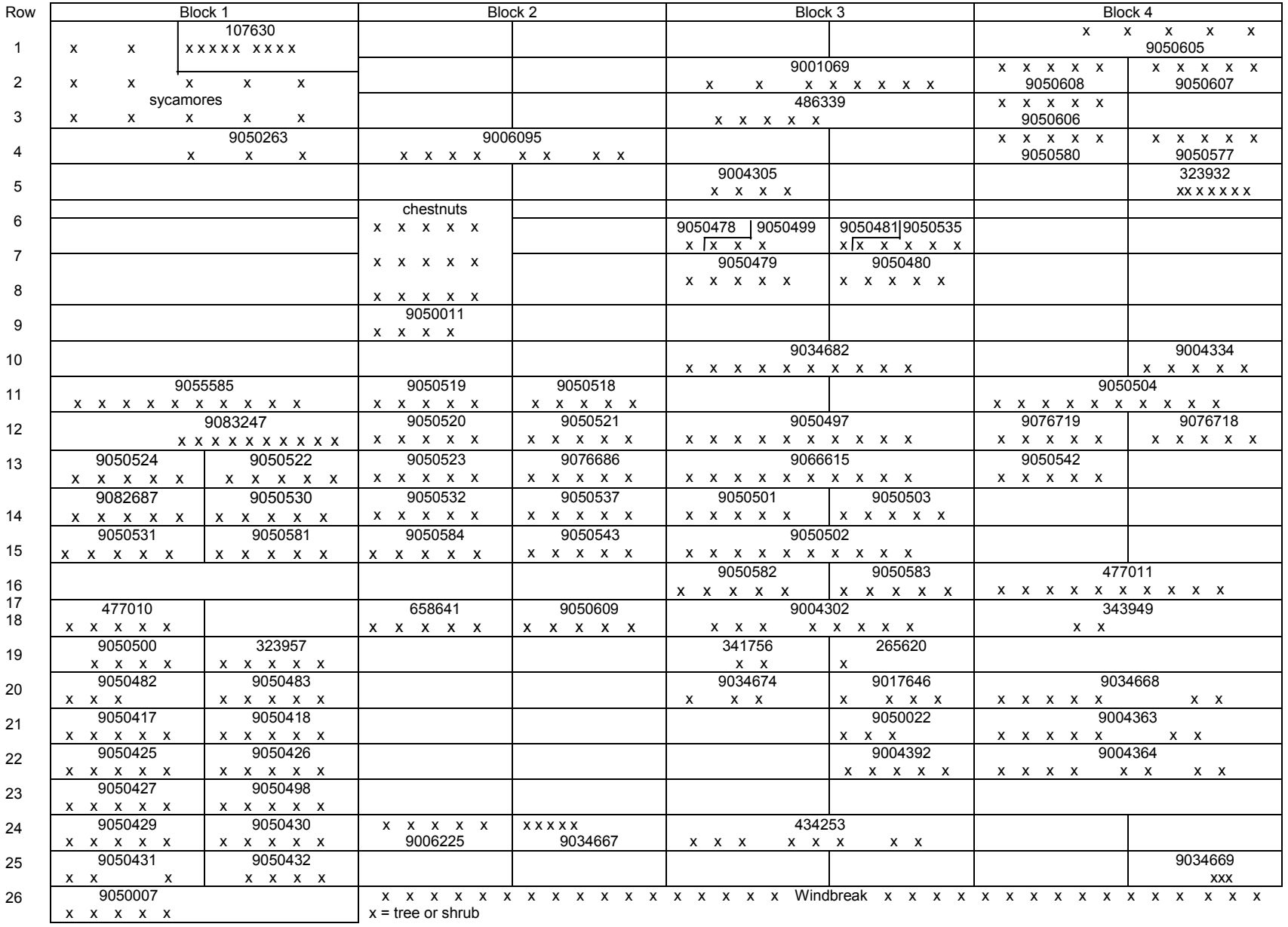
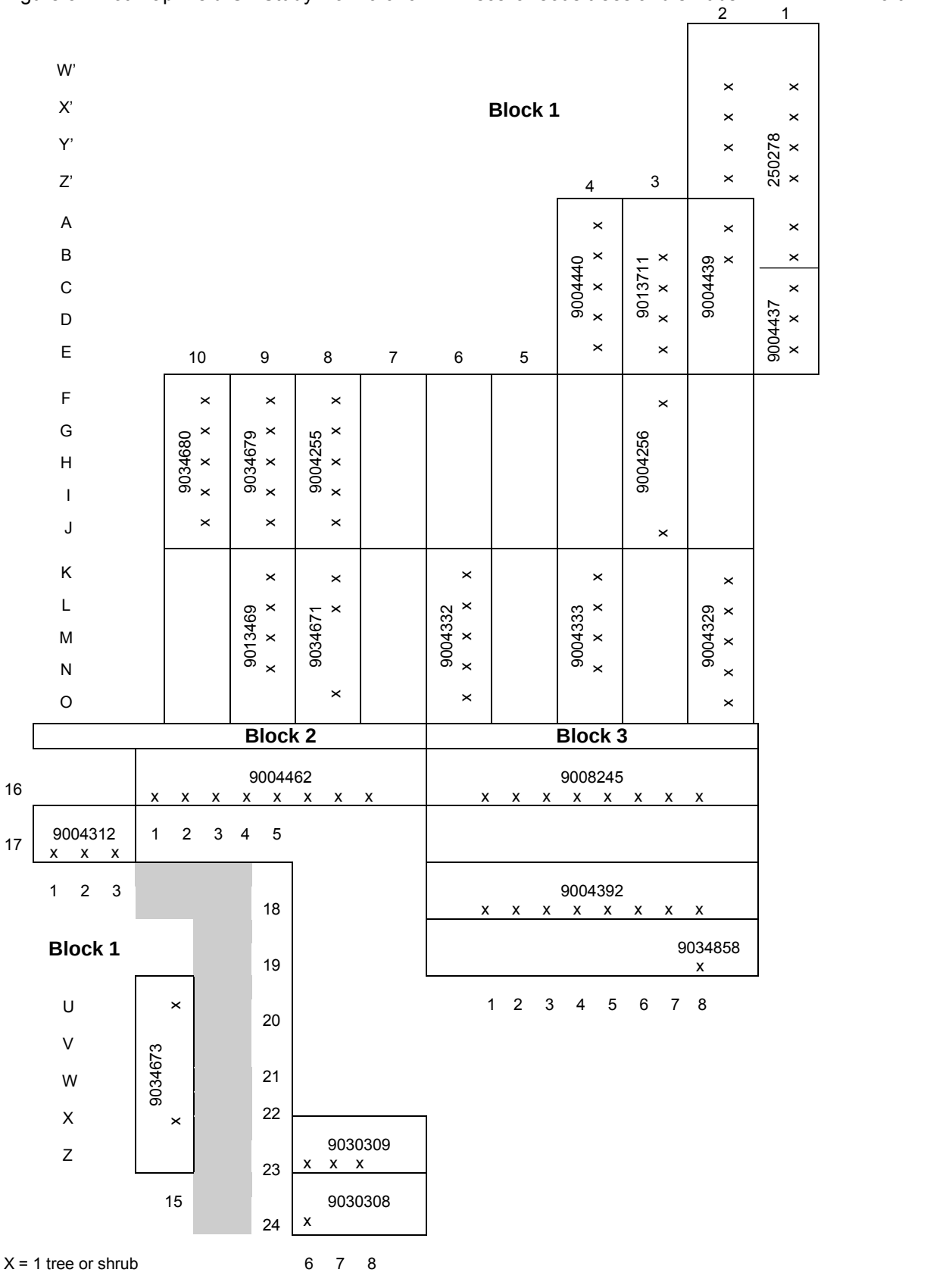


Figure 3. Plot Map Field G. Study No. 20I010K – miscellaneous trees and shrubs. ▲ North ▲



Evaluation of Lace-bark Elm

Study No. 20I030K

National Project Nos. Cropland 2.1 and Urban 1.1

Study Leader: John M. Row, Plant Materials Specialist

Introduction: Lace-bark or Chinese elm (*Ulmus parvifolia* Jacq.) is a small tree which under optimum growing conditions can reach heights of 15 to 24-m (50 to 80-ft). This species is often confused with Siberian elm (*U*. *pumila* L.). Chinese elm flowers in the fall and is characterized by distinct exfoliating bark. Lace-bark elm exhibits a resistance to the elm leaf beetle and it may provide a drought-tolerant tree for windbreaks in the Central Great Plains.

Purpose: Assemble, test, and release a cultivar of lace-bark elm as an adapted tree for use in windbreak plantings in the more arid regions of Kansas and Oklahoma.

Procedure: Seed was collected from established trees found growing in Kansas and Oklahoma in 1979. The seed collections were accessioned and planted in a nursery bed during the spring of 1979 and 1980. Sixteen accessions of *U*. *parvifolia* and one accession of *U*. *pumila* were established in a spaced planting at the Manhattan PMC. Fourteen accessions of *U*. *parvifolia* and one accession of *U*. *pumila* were established at Sheridan Wildlife Area, Quinter, Kansas, and at Meade Wildlife Area, Meade, Kansas. The Manhattan and Quinter plantings were established on 3.6- x -4.6 m (12- x 15-ft) spacing while the Meade planting was 3.6- x -3.6 m (12- x 12-ft). All three plantings were completed in 1982 using 1-0 and 2-0 stock.

Evaluation Factors: Criteria for selection are based on plant vigor, disease and insect resistance, and stress tolerance.

Potential Products: Technology Transfer

Progress or Status: Emphasis on lace-bark elm was downgraded in importance in 1990 with the de-emphasis program wide on introduced species. The need to document how the planting at Quinter has performed over the last few years with extreme drought conditions was recognized in 2012 to record 30 years of survival and growth. Sixty-seven trees were surviving in 2012; the same number as in 1985, which was 53% of trees planted. The trees have struggled over the years on a tough upland site with heavy deer pressure. Heavy browsing, in many cases severe, was noted each visit over the course of this study. During a site visit in 1985, five cows were found in the same field as the planting and trampling on one of the plots by the cattle was noted. Deer, rabbits, and occasional cows impacted the growth rate and performance of the trees in this study. In 1987, the tallest tree was only 91 cm (3 ft) in height at 5 years old. Competing vegetation was often described as of little consequence, but sometimes over-towered some trees making it difficult to get an accurate count of surviving trees. The deer have continually browsed many trees leaving only short stubs with the only remaining growth occurring from suckers. Trees that managed to grow beyond the browse line and survive rubbing by deer have taken off in recent years and put on substantial growth while others continued to struggle. Many trees have blown over from recent storms yet cling to life. Plant height in 2012 ranged from 36 to 755 cm (14 in to 24.8 ft) with a mean of 237 cm (7.8 ft). Height means for each accession at Quinter, with out of range measurements culled from the analysis appear in Table 1. There was not a significant difference in height for most accessions. At Manhattan, the tallest lace-bark elm was 14.96 m (49 ft) in accession 9023366. The tallest Siberian elm was 19.5 m (64 ft) with a mean height of 17.1 m (57.8 ft) for accession 9030616. In contrast, at Quinter, the mean height for accession 9030616 was only 4.1 m (13.5 ft). Data collected at various intervals for Quinter and Manhattan can be found in Tables 2 and 3. Lace-bark elm is a survivor as evidence by its ability to withstand less than ideal growing conditions at Quinter.

Table 1. Adjusted mean height and survival for lace-bark elm following 30 years of observation at Sheridan Wildlife Area, Quinter, KS.

Accession	Origin/Source	Survival %	Adjusted Mean Height[1] (cm)	
9023366	Stephens Co., OK	44	535	a
9013707	Sumner Co., KS	56	517	a
9013708	Woodward Co., OK	56	516	a
9004438	Elsberry, Mo	56	507	a
421613	Woodward Co., OK	56	470	a
9019877	Riley Co., KS	44	461	a
9013709	Finney Co., KS	67	446	ab
9013711	Woodward Co., OK	67	419	ab
9013706	Harper Co., KS	78	416	ab
9030616	KSU Forestry	22	413	ab
9019878	Riley Co., KS	44	401	ab
9017673	Sedgwick Co., KS	67	386	ab
9023365	Comanche Co., OK	33	181	bc
9019876	Harper Co., KS	44	70	c

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

Table 2. Initial evaluation data: Study No. 20I030K - Lace-bark elm (*Ulmus parvifolia*), Manhattan, KS

Plot Location		PLT SYM	Accession Number	Origin/Source	YR PLT	YR REC	NO PLT	NO SRV	PCT SRV	NUM FRT	SD AMT	SD FILL	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
B3 1	1-6	ULPA	9013709	Finney Co., KS	82	83	6	6	100				4	3	2	110	95		
						84		6	100							145	140		1-6 – deer browse
						85		6	100				4	6	2	298	250	3	
						86		6	100	2	6		3	5		235	317	4	2, 5 – produced seed
						87		6	100		2		3	6	2	483	373	5	1-2, 4 – canker
						88		6	100		5	1	6	6	2	454	423		4-5 – dying; canker
						89		5	83		5				2				one tree died; canker
						96		4	67		5		4				678		1 – superior
						01		4	67					5			682	11	
						12		4	67								1189		
B3 2	1-6	ULPA	9013706	Harper Co., KS	82	83	6	6	100				3	3	2	115	155		
						84		6	100							158	155		3 – deer browse
						85		6	100				5	4	2	287	304	3	6 – dead, suckering from base
						86		6	100	3	4		3	3		194	315	3	1-2, & 4 – produced seed
						87		6	100		8		4	4	2	392	395	6	3, 5 – canker
						88		6	100		8	1	4	3	2	365	489		
						89		6	100		8				1				one tree only suckers
						96		6	100		7		4				748		
						01		6	100					1			888	14	
						12		5	83								1171		
B3 3	1-6	ULPA	9017673	Sedgwick Co., KS	82	83	6	6	100				3	3	2	125	115		
						84		6	100							158	166		1-6 – deer browse
						85		6	100				3	4	2	327	275	3	
						86		6	100	5	6		2	5		302	360	4	1-3, 5-6 – produced seed
						87		6	100		3		1	3	2	494	416	5	3 – canker
						88		6	100		7	2	4	4	2	451	431		
						89		6	100		5				2				
						96		6	100		4		3				686		
						01		5	83					6			702	10	
						12		5	83								978		1 – ice/wind damage
B3 4	1-6	ULPA	9013707	Sumner Co., KS	82	83	6	6	100				3	4	2	110	110		
						84		6	100							122	185		1-6 – deer browse
						85		6	100				3	4	2	327	275	4	bare branches on south side
						86		6	100	4	5		3	3		228	323	3	1-3, & 5 – produced seed
						87		6	100		3		5	8	2	460	354		3-4, & 6 – regrowth from canker
						88		6	100		7	2	6	6	2	498	481		
						89		6	100		8				2				three trees only suckers
						96		5	83		6		5				701		
						01		5	83					2			738	12	
						12		5	83								974		

Table 2. Initial evaluation data: Study No. 20I030K - Lace-bark elm (*Ulmus parvifolia*), Manhattan, KS

Plot Location	PLT SYM	Accession Number	Origin/Source	YR PLT	YR REC	NO PLT	NO SRV	PCT SRV	NUM FRT	SD AMT	SD FILL	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
B3 5 1-6	ULPA	9019877	Riley Co., KS	82	83	6	6	100				4	4	3	85	120		
					84		6	100							133	174		
					85		6	100				3	3	2	270	278	3	6 – dead, suckering from base
					86		6	100	1	6		3	4		227	327	3	3 – produced seed
					87		6	100		5		4	7	3	424	433	5	2-3, 6 – canker
					88		6	100		7	2	6	5	2	442	489		
					89		6	100		8				2				one tree only suckers
					96		5	83		9		7				684		
					01		3	50					4			713	11	
					12		3	50								1039		5 – top dead
B3 6 1-6	ULPA	9019878	Riley Co., KS	82	83	6	6	100				4	3	2	70	115		
					84		6	100							144	177		1-2 – deer browse
					85		6	100				3	4	2	363	338	4	
					86		6	100	1	6		3	4		213	312	4	6 – produced seed
					87		6	100		7		4	7	2	447	416	5	1, 3 – winter kill; 5 – freeze dam.
					88		6	100		5	2	4	3	2	499	504		
					89		6	100		9				2				two trees only suckers
					96		3	50		9		6				760		
					01		4	67					6			819	12	
					12		3	50								1057		
B3 7 1-5	ULPA	9019879	Sedgwick Co., KS	82	83	5	5	100				3	4	2	145	130		
					84		5	100							204	188		1 – deer browse
					85		5	100				1	2	2	401	303	4	excellent uniformity
					86		5	100	2	6		2	3		274	352	5	2, 5 – produced seed
					87		5	100		7		4	8	3	455	421	8	1-2, 5 – cold damage
					88		5	100		4	3	7	8	2	543	432		
					89		5	100		9				2				three trees only suckers
					96		4	80		5		4				663		2 - superior
					01		4	80					5			643	11	
					12		4	80								980		
B3 8 1-3	ULPA	9013710	Sumner Co., KS	82	83	3	3	100				6	4	3	60	50		
					84		2	67							63	70		2-3 – deer browse
					85		2	67				7	2	2	196	154	8	
					86		3	100				8	4		118	157	1	
					87		3	100		0		8	5	2	260	185	5	1 – suckering
					88		3	100		0		9	5	2	256	350		
					89		3	100		0				3				two trees only suckers
					96		1	33		4		6				562		
					01		2	67					1			640	15	
					12		1	33								722		2 – leader dead

Table 2. Initial evaluation data: Study No. 20I030K - Lace-bark elm (*Ulmus parvifolia*), Manhattan, KS

Plot Location	PLT SYM	Accession Number	Origin/Source	YR PLT	YR REC	NO PLT	NO SRV	PCT SRV	NUM FRT	SD AMT	SD FILL	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
B3 8 4-6	ULPA	9019876	Harper Co., KS	82	83	3	3	100				8	3	3	45	50		4 – very poor
					84		3	100							67	69		4-6 – deer browse
					85		2	67				8	2	2	100	91	0.5	
					86		2	67				9	5		125	115	0.5	
					87		2	67		0		8	3	3	207	175	3	
					88		3	100		0		8	2	2	254	286		
					89		3	100						2				one missing; one tree a sucker
					96		1	33		9		4				700		
					01		3	100				3				481	8	
					12		3	100								859		
B3 9 1-6	ULPA	9013708	Woodward Co., OK	82	83	6	6	100				4	3	2	130	110		
					84		6	100							165	183		3-4 - deer browse
					85		6	100				5	3	2	278	264	4	3 – stunted
					86		6	100	2	4		3	3		267	323	3	1, 4 – produced seed
					87		6	100		6		5	7	2	360	393	4	1, 5-6 – canker
					88		6	100		8	2	8	8	2	285	542		1, 3 – canker killed tops
					89		6	100						2				four trees only suckers
					96		1	17		9		7				484		
					01		2	33					3			567	8	
					12		2	33								875		
B3 10 1-6	ULPA	421613	Woodward Co., OK	82	83	6	6	100				3	3	3	135	125		
					84		6	100							165	164		4 & 6 – deer browse
					85		6	100				3	1	2	304	289	3	
					86		6	100				3	4		235	325	3	5 – regrowth from base
					87		6	100		5		5	7	2	389	398	5	5 – dead, regrowth from base
					88		6	100		5		6	6	2	438	446		
					89		6	100		6				3				one only a sucker
					96		5	83		5		4				687		
					01		5	83					5			736	14	
					12		5	83								1032		
B3 11 1-6	ULPA	9013711	Woodward Co., OK	82	83	6	6	100				4	2	2	125	110		6 – replanted
					84		6	100							135	148		1, 3-6 – deer browse
					85		6	100				4	3	2	321	274	3	
					86		6	100				2	3		265	338	3	
					87		6	100		9		3	2	1	427	461	6	1,3 – canker
					88		6	100		9	0	7	7	3	427	477		
					89		6	100		8								
					96		5	83		7		5				689		
					01		4	67					3			869	14	
					12		4	67								1195		4 – top broken

Table 2. Initial evaluation data: Study No. 20I030K - Lace-bark elm (*Ulmus parvifolia*), Manhattan, KS

Plot Location	PLT SYM	Accession Number	Origin/Source	YR PLT	YR REC	NO PLT	NO SRV	PCT SRV	NUM FRT	SD AMT	SD FILL	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
B3 12 1-6	ULPA	9023365	Comanche Co., OK	82	83	6	6	100				2	2	2	115	155		
					84		6	100							153	183		5 – deer browse
					85		6	100				6	4	2	209	238	2	2-4 – dead, suckering from base
					86		6	100				6	3		140	192	1	
					87		6	100		0		8	5	3	223	320	3	regrowth from suckers
					88		6	100										only suckers remain
					89		6	100										all trees only suckers
					96		6	100		8		6				631		
					01		6	100					3			767	10	
					12		6	100								1103		
B3 13 1-6	ULPA	9023366	Stephens Co., OK	82	83	6	6	100				4	4	3	90	105		5 – replanted
					84		6	100							140	157		1-2 – deer browse
					85		6	100				3	3	3	289	282	4	5 – stunted
					86		5	83	1	5		2	3		275	394	4	6 – produced seed
					87		6	100		9		5	4	3	327	398	6	4, 6 – excellent trees
					88		6	100		9	1	4	5	2	422	479		
					89		6	100		7				6				two trees only suckers
					96		6	100		7		4				770		
					01		6	100					2			950	14	
					12		6	100								1273		
B3 14 1-6	ULPA	9004438	Rochester, NY	82	83	6	6	100				1	1	2	170	170		
					84		6	100							186	228		
					85		6	100				2	3	2	324	378	4	1 – top dead
					86		6	100	2	4		1	5		313	475	5	1, 3 – produced seed
					87		6	100		9		2	4	2	423	510		1-2 – canker
					88		6	100		7	1	3	3	2	473	563		
					89		6	100		8				8				
					96		6	100		8		4				902		
					01		6	100					2			1021	14	
					12		6	100								1367		
B3 15 1-6	ULPU	9030616	KSU Forestry	82	83	6	6	100				1	3	5	290	300		6 – replanted
					85		5	83				1	2	7	463	762	12	
					86		5	83		5		1	5		494	770	14	
					87		5	83		-		1	2	9	724	858	18	1 – canker
					88		5	83		-		1	1	9				
					89		5	83		9				9				one tree missing
					96		5	83		-		1				1359		
					01		5	83					2			1615	35	
					12		5	83								1762		

Table 2. Initial evaluation data: Study No. 20I030K - Lace-bark elm (*Ulmus parvifolia*), Manhattan, KS

Plot Location	PLT SYM	Accession Number	Origin/Source	YR PLT	YR REC	NO PLT	NO SRV	PCT SRV	NUM FRT	SD AMT	SD FILL	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
B3 16 1-6	ULPA	9026786	McClain Co., OK	82	83	6	6	100				3	2	3	40	55		
					85		6	100				7	2	2	156	184	0.8	3,4-5 – heavily browsed
					86		6	100	1	5		5	5		139	211	2	1 – produced seed
					87		6	100		9		6	2	2	224	322	2	5 – canker
					88		6	100		8		8	3	2	268	327		
					89		6	100		9				8				one tree only a sucker
					96		6	100		2		4				784		
					01		6	100					3			905	12	
					12		6	100								1134		

Legend for lace-bark elm evaluations at Manhattan, KS:

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

E.g., B3 1 9-14 = Field B3, Row 1, Plot numbers 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. 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
PLT SYM: Plant Symbol
ULPA: *Ulmus parvifolia*
ULPU: *U. pumila*
VI: Plant Vigor, rating 1-9
YR PLT: Year Planted
YR REC: Year of Record

Table 3. Initial evaluation data: Study No. 20I030K - Lace-bark elm (*Ulmus parvifolia*), Quinter, KS

Accession Number	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	PLT HGT Mean	Remarks
421613	82	82	9	9	100	39	14
		84		6	67	35	
		85		5	56	46	
		90		5	56	77	
		93		5	56	101	
		12		5		470	
9004438	82	82	9	8	89	45	9
		84		8	89	36	
		85		5	56	48	B2 – 2 - a sucker
		90		5	56	82	
		93		5	56	103	
		12		5		439	
9013706	82	82	9	9	100	45	12
		84		8	89	43	
		85		8	89	46	
		90		8	89	65	
		93		8	89	85	
		12		7	78	416	
9013707	82	82	9	9	100	40	10
		84		7	78	25	
		85		5	56	52	
		90		5	56	76	
		93		5	56	101	
		12				422	
9013708	82	82	9	9	100	48	7
		84		8	89	36	
		85		6	67	46	
		90		6	67	67	
		93		6	67	93	
		12				351	
9013709	82	82	9	8	100	45	5
		84		6	67	37	
		85		6	67	42	
		90		6	67	80	
		93		6	67	98	
		12				466	

Table 3. Initial evaluation data: Study No. 20I030K - Lace-bark elm (*Ulmus parvifolia*), Quinter, KS

Accession Number	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	PLT HGT Mean	Remarks
9013711	82	82	9	9	100	46	3
		84		7	78	37	
		85		6	67	48	
		90		6	67	82	
		93		6	67	108	
		12				419	
9017673	82	82	9	9	100	40	6
		84		6	67	26	
		85		5	56	31	B2 – 2 - a sucker
		90		5	56	54	
		93		5	56	63	
		12				354	
9019876	83	84	?	4	44	31	2
		85		4	44	37	
		90		4	44	62	
		93		4	44	77	
		12				185	
9019877	82	82	9	8	100	36	8
		84		5	56	33	
		85		4	44	51	
		90		4	44	75	
		93		4	44	96	
		12				461	
9019878	82	82	9	7	78	32	1
		84		4	44	38	
		85		4	44	45	B2 – 2 - a sucker
		90		4	44	72	
		93		4	44	85	
		12				401	
9023365	82	82	9	9	100	39	13
		84		6	67	25	
		85		3	33	31	B1 – 3 - a sucker
		90		3	33	56	
		93		3	33	63	
		12				167	
9023366	82	82	9	9	100	32	11
		84		4	44	19	
		85		4	44	24	B1 – 3 - a sucker; B2 – 1 - a sucker
		90		4	44	55	
		93		4	44	75	
		12				380	

Table 3. Initial evaluation data: Study No. 20I030K - Lace-bark elm (*Ulmus parvifolia*), Quinter, KS

Accession Number	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	PLT HGT Mean	Remarks
9030616	82	82	9	8	89	62	4
		84		4	44	41	Dieback and regrowth noted
		85		3	33	62	B1 – stepped on by cattle
		90		3	33	67	
		93		3	33	73	
		12				422	

Legend for lace-bark elm evaluations at Quinter, KS:

Plot Location: Block and plant number

E.g., B3 – 1 = Block (B3) Plant Number (1)

Data Element Designations

NO. PLT: Number Planted
NO. SRV: Number Surviving
PCT SRV: Percent Survival
PLT HGT: Total plant height as measured in centimeters
YR PLT: Year Planted
YR REC: Year of Record

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"™.

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 plants performed well despite the drought. Growing season precipatitation at Manhattan was 18.6 in (Mar.-Sep.). Approximately 4% of the foliage was scorched at the 24 July observation. The plants were not as tall as in 2011 when growing conditions were more favorable (Table 1). This plot will be destroyed in 2013 following spring recovery.

Table 1. Four-year plant evaluation summary for prairie acacia (*Acacia angustissima*), Accession 9085672, at Manhattan, Kansas.

Year	Plant Height (cm)	Plant Width (cm)	% Stand	% Flowering	% Seed Production
2009	10	---	100	10	---
2010	47	94	90*	NQ	NQ
2011	67	92	100	80	70
2012	56	136	100	100	100

*Rodent disturbance; NQ-not quantified

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

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 BMPs 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 Manhattan 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 519 insect specimens mounted to pins with collection location labels, representing 8 Orders in the Class Insecta (Table 1). One hundred and sixty-eight specimens have been identified to 19 Families and 98 to the species level.

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

Order	Odonta (dragonflies)	Orthoptera (grasshoppers)	Hemiptera (true bugs)	Neuroptera (green lacewings)	Coleoptera (beetles)	Diptera (flies)	Lepidoptera (butterflies and moths)	Hymenoptera (bees and wasps)
Order	1	15	6	2	29	80	99	289
Family	0	0	4	2	11	11	81	61
Species	0	0	2	0	9	0	75	12

Lepidopterans: Several additional specimens in the Order Lepidoptera were added to the PMC's insect collection in 2012. The collection of specimens was minimized due to the drought. The 3rd Annual Manhattan Summer Butterfly Count sponsored by the PMC was primarily carried out by Earth Team Volunteers 12 July. The count was conducted as part of the 38th 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, Marlatt Park, Wildcat Creek Park, Sojourner Truth Park, University for Man Garden, and the KSU Gardens. While 14 species were counted at the PMC, a total of 28 species represented by 165 individuals were counted by eight observers in three parties in the Manhattan Butterfly Count Circle. The count was down from the previous year with 13 less species and 198 less individuals, yet 2 new species were added to the count circle. The Manhattan Butterfly Count was just one of many counts conducted in association with the NABA across North America.

Manhattan Count Circle Summary

Manhattan, KS. Yr. 3, 39.1413°, -96.6394°, center at 1500 ft. NW of jct. of S 20th St. and W 40th Ave, Manhattan. Grasslands, forb seed production fields, riparian areas, woody corridors, flower gardens, butterfly gardens. 12 July 2012; 0830-1900 hrs; sun AM 76-100%, PM 76-100%; 83-102°F; wind 0-5 mi/hr. 8 observers in 3 parties. Total party-hours 12; total party-miles on foot 18. Observers: Dru Clarke, Clyde Ferguson, Barbara Green, Angel Olson, Jody Olson, Sofiya Roblewsky, John Row (compiler), and Jacque Staats.
Butterflies Observed: Pipevine Swallowtail (Sw) 2, Black Sw. 3, Giant Sw. 11, Eastern Tiger Sw. 4, Checkered White 6, Clouded Sulphur (Su) 5, Orange Su. 6, Cloudless Su. 3, Little Yellow 3, Sleepy Orange 2, Dainty Su. 17, 'Summer' Spring Azure 2, Variegated Fritillary (Fr) 15, Great Spangled Fr. 12, Silvery Checkerspot 4, Pearl Crescent 11, Question Mark 1, Hackberry Emperor 4, Little Wood-Satyr 2, Com. Wood-Nymph 7, Monarch 2, Silver-spotted Skipper (Sk) 8, Northern Cloudywing 3, Horace's Duskywing 1, Common Checkered-Sk. 1, Fiery Sk. 17, Tawny-edged Sk. 8, Sachem 2. Unidentified Species: Skipper 1, large fritillary 1, small sulfur 1. Total 28 species, 165 individuals. Immatures: Black Sw. 12 caterpillars. Field Notes: Severe drought.

Solitary Bees: The artificial nest blocks that were put up at the PMC in 2010 showed no new activity this year. Since one of the nest blocks had to be taken down, the holes were re-drilled with a goal to smooth the openings to make them more attractive to solitary bees. Originally, 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. Refer to the 2011 ATR for further details regarding site location. The refurbished nest block was hung under the east facing eave on the PMCs office in October 2012. In 2011, an artificial nest was constructed of PVC pipe with one end capped off, filled with sections of common reed stems, and located in a residential area of Manhattan, Kansas. 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. Openings ranged in size from 4.0 to 6.7 mm. The nest was 226.1 cm (89 in) above the ground facing northeast. The occupancy rate in 2011 was only 17%, but by the second year, occupancy was 99%. By early April, approximately 28% of the holes appeared to have bee activity and over the course of the summer, the bee activity continued until nearly every opening was occupied. Many of the reeds were completely filled and capped off with soil or plant material. Of the occupied reeds, 64% were capped with plant material and 36% were capped with soil. Those capped with plant material were of various colors from greens, pink, yellow, and salmon. Over time, the colors began to fade, Fig. 2. Bees of various sizes and descriptions were observed using the nest.

Figure 2. Solitary bee nest with 99% occupancy 27 August 2012

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