United States Department of Agriculture
Natural Resources Conservation Service

2007 ANNUAL TECHNICAL REPORT

Manhattan Plant Materials Center

Serving Kansas, Nebraska, northern Oklahoma, and northeastern Colorado

Notices

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

This report 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 their 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.

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.

Abbreviations of state names used in the text are according to The Gregg Reference Manual Ninth Edition. W.A. Sabin, McGraw-Hill Companies, Inc., 2001, with the exception of tables with space limitations where two-letter postal designations are used.

On the cover: The changing seasons at the PMC. UL – Pin oak in fall color near the seed technology laboratory; UR – spring recovery of foundation grass fields; ML – a summer vista; MR – the chestnut grove in winter; LL – 'Kanlow' switchgrass spring burn; LR – 'Prairie Gold' Maximilian sunflower seed increase field in early fall. Photography by John M. Row, PMC Specialist

UNITED STATES DEPARTMENT OF AGRICULTURE

NATURAL RESOURCES CONSERVATION SERVICE

MANHATTAN PLANT MATERIALS CENTER

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FOREWORD AND ACKNOWLEDGEMENTS

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

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

The PMC acknowledges the efforts of the following individuals who have contributed to its accomplishments. Elizabeth Murray, Research Assistant, KSU Entomology Department, insect identification; Dr. Walter Fick, Agronomy Department, KSU; Dr. Wayne Geyer, Horticulture, Forestry and Recreation, KSU; Vernon Schaffer, Agronomy Department, and Judith O'Mara, Plant Pathology, KSU: Mary Knapp, State Climatologist. It also recognizes the assistance of Mary D. Shaffer, Public Affairs Specialist, NRCS, Salina, Kansas. Assistance provided by these individuals is greatly appreciated.

INTRODUCTION

The purpose of the Manhattan PMC technical report is to inform the NRCS plant materials discipline, its cooperators, and others interested in plant materials work of progress and new developments.

Mission: The Mission of the NRCS Plant Materials Program

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

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

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

The major priority items identified are:

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

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

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

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

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

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

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

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

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

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

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

Climate and Soils: The soils found on the PMC are Belvue silt loam (formerly Haynie very fine sandy loam), Eudora silt loam, Bourbonais-Bismarckgrove complex, Stonehouse-Eudora complex (formerly Carr-Sarpy complex), and Fluvents (formerly Sarpy loamy fine sand). The PMC is in Major Land Resource Area 76. Average annual precipitation is 34.8 inches. 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 2007 technical assistance was provided in Oklahoma to Langston University in Langston, and the Shawnee Tribe in Miami. Plant materials were provided in Nebraska to AiKiRuti healing garden in Winnebago, and to Julia Sage, Ponca Tribe at Bloomfield, (Table 1). See page 6 of Technology Transfer for further information regarding outreach activities in 2007.

Table 1. Plant materials provided to tribes in 2007.

Tribe/Entity	Location	Plant Material
AiKiRuti	Winnebago, Nebr.	prairie cordgrass rhizomes, rooted dogwood cuttings
Ponca	Bloomfield, Nebr.	sweetgrass

COOPERATIVE EFFORTS

The Manhattan PMC is involved in many collaborative efforts with cooperating universities, USDA ARS, seedsmen, and nurserymen. The PMC, at a minimum, provides seed for research and quite often technical assistance is provided. On-site studies include land for the study, and in some cases, labor and other PMC resources are provided. The following list is not comprehensive but captures many of the cooperative efforts the PMC was involved with in 2007.

Cooperator	Affiliation	Research Interest
Dr. Mike Casler	USDA ARS-Dairy Forage Res. Cen. Univ. of Wisconsin	Adaptation zones of switchgrass populations
Dr. Steven Fransen	Washington State Univ. Prosser	Warm-season grass trials; grass-legume mixtures
Dr. Wayne Geyer	KSU	Evaluation of green ash
Alicia Greene/ Dr. Stacy Hutchinson	KSU	Infiltration study using warm-season native grasses
Dr. Lawrence Hagen	USDA ARS-Wind Erosion Res. Unit	Wind erosion effects
Dr. Tim Springer	USDA ARS-Southern Plains Res. Sta.	Sand bluestem comparison trials
Gail Wilson	KSU	Warm-season grass C3-C4 evaluations

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. The following publications and events occurred in 2007. Author's given name is reduced to initials following first appearance in this section of the annual technical report. Any deviation from this scheme indicates that the author's given name is not known.

Year 2007 publications and events.

Conference Room: The PMC conference room is used by federal, state, and local conservation agencies for meetings and training activities. Over 35 people used the facility this year for the following activities:

Kansas Water Office
National Plant Materials Advisory Committee
Nebraska NRCS State Plant Materials Committee

Host: National Plant Materials Advisory Committee Meeting, Manhattan PMC, April 3, 2007.

Newsletters: The Manhattan PMC publishes a quarterly newsletter that is distributed in the service area to all field locations. The newsletter has been published and distributed since 1994.

Plants for the Heartland. Winter 2007. Richard L. Wynia, John M. Row, and Mark A. Janzen. 4p.

Plants for the Heartland. Spring 2007. J. M. Row, M. A. Janzen, and R. L. Wynia. 3p.

Plants for the Heartland. Summer 2007. J. M. Row, M. A. Janzen, and R. L. Wynia. 4p.

Plants for the Heartland. Fall 2007. R. L. Wynia, M. A. Janzen, and J. M. Row. 3p.

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

American Licorice (*Glycyrrhiza lepidota*) Plant Fact Sheet. PLANTS Database. USDA, NRCS National Plant Data Center, Baton Rouge, La. August 2007. R. L. Wynia. 2p.

Bluejoint Reedgrass (*Calamagrostis canadensis*) Plant Fact Sheet. PLANTS Database. USDA, NRCS National Plant Data Center, Baton Rouge, La. January 2007. R. L. Wynia. 2p.

Kentucky Coffeetree (*Gymnocladus dioicus*) Plant Fact Sheet. PLANTS Database. USDA, NRCS National Plant Data Center, Baton Rouge, La. February 2007. J. M. Row and Wayne Geyer. 2p.

Prairie sandreed (*Calamovilfa longifolia*) Plant Fact Sheet. PLANTS Database. USDA, NRCS National Plant Data Center, Baton Rouge, La. July 2007. R. L. Wynia. 3p.

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

American Licorice (*Glycyrrhiza lepidota*) Plant Guide. PLANTS Database. USDA, NRCS National Plant Data Center, Baton Rouge, La. August 2007. R. L. Wynia. 3p.

Blue grama (*Bouteloua gracilis*) Plant Guide. PLANTS Database. USDA, NRCS National Plant Data Center, Baton Rouge, La. June 2007. R. L. Wynia. 3p.

Giant Sandreed (*Calamovilfa gigantea*) Plant Guide. PLANTS Database. USDA, NRCS National Plant Data Center, Baton Rouge, La. March 2007. R. L. Wynia. 2p.

Kentucky Coffeetree (*Gymnocladus dioicus*) Plant Guide. PLANTS Database. USDA, NRCS National Plant Data Center, Baton Rouge, La. February 2007. J. M. Row and W. Geyer. 6p.

Sideoats grama (*Bouteloua curtipendula*) Plant Guide. PLANTS Database. USDA, NRCS National Plant Data Center, Baton Rouge, La. June 2007. R. L. Wynia. 4p.

Presentations: Presentations are made by PMC staff to update various groups about plant materials program activities and facilitate technology transfer.

2007 Native Grass Research Symposium. March 1, 2007. Haskell Indian Nations University, Lawrence, Kans. R. L. Wynia.

Plant Materials Program Overview for Langston University. June 12, 2007. Manhattan Plant Materials Center, Manhattan, Kans. R. L. Wynia.

Kansas Variance Policy. June 27, 2007. NRCS Area Specialist's Meeting, Salina, Kans. M. A. Janzen.

Plant Materials Overview. July 24, 2007. Langston University, Langston, Okla. M. A. Janzen.

Nebraska Plant Materials Committee Meeting, Manhattan Plant Materials Center Update. August 21, 2007. State Office, Lincoln, Nebr. R. L. Wynia.

Nebraska Plant Materials Committee Meeting, Plant Materials Report and Program Overview. August 21, 2007. State Office, Lincoln, Nebr. M. A. Janzen.

Manhattan Plant Materials Center Program Involvement with Threatened and Endangered Plant Species. Manhattan PMC, Manhattan, Kans. August 23, 2007. J. M. Row.

State Conservationist's Advisory Committee. Plant Materials Specialist's Report and Program Overview. September 11, 2007. M. A. Janzen.

Switchgrass for waterways. October 3, 2007. Haskell Indian Nations University, Lawrence, Kans. R. L. Wynia.

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

2006 Progress Report of Activities. Manhattan Plant Materials Center, Manhattan, Kans. 4p.

Technical Notes: Technical Notes are developed by the plant materials program for the benefit of its customers.

Forestry Technical Note KS-10 Forestry-Conservation Tree/Shrub Plantings Suitability Groups, Windbreak Suitability Groups, and Plantings for Kansas. Salina, Kans. May 16, 2007. 12p.

Training Sessions: The PMC staff puts on training sessions or takes part in training sessions to train staff, cooperators, and the general public about various aspects of the plant materials program.

Orientation for Biological Science Aids, Manhattan PMC, May 14, 2007. J. M. Row. Trainees: 4

Seed Technology Training for PMC Staff, 2007. June 5, 2007. J. M. Row. Trainees: 2

Nebraska Training Workshop. Manhattan PMC. August 23, 2007. M. A. Janzen and R. L. Wynia.

Riparian Vegetation, Manhattan, Kans. September 6, 2007. M. A. Janzen.

Tours: The PMC staff welcomes visitors and readily conducts tours. The number of visitors was down in calendar year 2007; however, more than 25 people visited the PMC, of which 20 toured the PMC. The following groups are representative of the yearly interest in the Manhattan Plant Materials Program:

National Plant Materials Advisory Committee
Nebraska NRCS State Plant Materials Committee

PLANT MATERIALS DEVELOPMENT FLOW CHART

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

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

SELECTION AND INITIAL INCREASE OF SUPERIOR PLANTS

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

Accession No.	PI No.	Common Name	Species	Study No.
9049944	514675	lead plant	*Amorpha canescens*	20I023H
ORIGIN/SOURCE: A polycross composed of accessions 9013351, Comanche Co., Kans.; 9013344, Washita Co., Okla.; 9013354, Stephens Co., Okla.; and 9017622, Saline Co., Kans.				
9034682		river birch	*Betula nigra*	20I010K
ORIGIN/SOURCE: Houston Co., Minn.				
9050018		big sandreed	*Calamovilfa gigantea*	20I032X
ORIGIN/SOURCE: A polycross composed of accessions 9026760, Reno Co., Kans.; 9026777, Payne Co., Okla.; 9035891, Lipscomb Co., Tex.; 9042800, Garza Co., Tex.; 9042911, Winkler Co., Tex.; 9049764, Rice Co., Kans.; 9049765, Stafford Co., Kans.; 9049823, Stafford Co., Kans.; and 9049866, Comanche Co., Kans.				
9049952	514676	New Jersey tea	*Ceanothus herbaceous* var *pubscens*	20I024H
ORIGIN/SOURCE: A polycross composed of accessions 9013414, Osborne Co., Kans.; and PI-421286, Wabaunsee Co., Kans.				
9050496		common buttonbush	*Cephalanthus occidentalis*	20I043E
ORIGIN/SOURCE: A polycross composed of accessions 9050287, Hodgeman Co., Kans.; 9050296, Miami Co., Kans.; 9050311, Douglas Co., Kans.; 9050323, Harvey Co., Kans.; 9050340, Cleveland Co., Okla.; 9050359, Harvey/Reno Co., Kans.; 9050360, Osage Co., Kans.; 9050371, Butler Co., Kans.; 9050375, Montgomery Co., Kans.; 9050389, Douglas Co., Kans.; 9050392, Johnston Co., Okla.; and 9050395, Logan Co., Okla.				
	325270		*Cotoneaster lucidus*	20I033K
ORIGIN/SOURCE: USSR				
9023353		blacksamson	*Echinacea angustifolia*	20I018S
ORIGIN/SOURCE: A polycross composed of accessions PI-421340, Butler Co., Kans.; PI-421331, Logan Co., Okla.; PI-421362, Ellis Co., Kans.; PI-421307, Noble Co., Okla.				
9049894		dotted gayfeather	*Liatris punctata*	20I022S
ORIGIN/SOURCE: A polycross composed of PI-421419, Woodson Co., Kans.; PI-421497, Lane Co., Kans.; and PI-421488, Rush Co., Kans.				

Selection and Initial Increase of Superior Plants (continued)

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

SEED AND PLANT PRODUCTION

Cultivar	Genus/Species	Common Name	Origin	Class	Acres
		HERBACEOUS			
		Forbs			
Riley	*Chamaecrista fasciculata*	showy partridge pea	Riley Co., Kans.	FND	0.5
Kaneb	*Dalea purpurea*	purple prairie clover	Riley Co., Kans.	FND	1.12
Reno Germplasm	*Desmanthus illinoensis*	Illinois bundleflower	Reno Co., Kans.	G2	0
9023353	*Echinacea angustifolia*	blacksamson		SFP	0.17
Prairie Gold	*Helianthus maximiliani*	Maximilian sunflower	Kans.	FND	0.35
Midas	*Heliopsis helianthoides* var *scabra*	false sunflower	Kans.	FND	0.12
Kanoka	*Lespedeza capitata*	round-head lespedeza	Kans., Okla.	FND	0
9049894	*Liatris punctata*	dotted gayfeather	Kans.	G2	0.19
Eureka	*Liatris pycnostachya*	thickspike gay-feather	Kans.	FND	0.07
Sunglow	*Ratibida pinnata*	grayhead prairie coneflower	unknown	FND	0.48
Nekan	*Salvia azurea* var *grandiflora*	pitcher sage	Kans.	FND	0.16
421557	*Silphium laciniatum*	compass plant	Okmulgee, Co., Okla.	G2	0.02
		Grasses			
Kaw	*Andropogon gerardii*	big bluestem	Riley Co., Kans.	FND	1.0
Garden	*Andropogon hallii*	sand bluestem	Garden Co., Nebr.	SFP	1.27
El Reno	*Bouteloua curtipendula*	sideoats grama	Canadian Co., Okla.	FND	0.84
9050485	*Bouteloua gracilis*	blue grama		SFP	1.37
Pronghorn	*Calamovilfa longifolia*	prairie sandreed	Nebr.	FND	0.75
9050018	*Calamovilfa gigantea*	giant sandreed	Kans., Okla., Tex.	SFP	0.85
Bend	*Eragrostis trichodes*	sand lovegrass	Kans., Okla.	FND	0.24
Blackwell	*Panicum virgatum*	switchgrass	Blackwell, Okla.	FND	1.23
Kanlow	*Panicum virgatum*	switchgrass	Wetumka, Okla.	FND	0.72
Barton	*Pascopyrum smithii*	western wheatgrass	Barton Co., Kans.	FND	1.0
Southwind	*Phragmites australis*	common reed	Kans., Okla.	FND	0.8
Aldous	*Schizachyrium scoparium*	little bluestem	Kansas Flinthills	FND	2.4
Cimarron	*Schizachyrium scoparium*	little bluestem	Kans., Okla.	FND	1.57
Cheyenne	*Sorghastrum nutans*	yellow Indian grass	Fort Supply, Okla.	SFP	0.35
Osage	*Sorghastrum nutans*	yellow Indian grass	Kans., Okla.	FND	1.0
Atkins Germplasm	*Spartina pectinata*	prairie cordgrass	Washington Co., Nebr.	G2	0.83
Pete	*Tripsacum dactyloides*	eastern gamagrass	Kans., Okla.	FND	1.0
		WOODY			
9049944	*Amorpha canescens*	lead plant	Kans., Okla.	G2	0.07
9034682	*Betula nigra*	river birch	Houston Co., Minn.	G2	0.15
9049952	*Ceanothus herbaceous* var *pubscens*	New Jersey tea	Kans.	G2	0.11
325270	*Cotoneaster lucidus*		USSR	FND	0.05
Pink Lady	*Euonymus bungeanum*	winterberry	China	FND	0.03
9049945	*Prunus americana*	American plum	Kans., Nebr.	FND	0.05
9049970	*Prunus angustifolia*	Chickasaw plum	Kans., Okla.	FND	0.12
Lippert	*Quercus macrocarpa*	bur oak	Stillwater, Okla.	FND	0.02
Konza	*Rhus aromatica* var *serotina*	aromatic sumac	Kans.	FND	0.09
9050270	*Ribes aureum* var *villosum*	buffalo currant	Kans., Nebr.	FND	0.05
9050135	*Salix exigua*	sandbar willow	Brown Co., Kans.	G2	0.09
9050148	*Salix exigua*	sandbar willow	Sarpy Co., Nebr.	G2	0.11
9004450	*Juglans microcarpa*	little walnut	Beckham Co. & Washita Co., Okla.	SFP	0.1

DISTRIBUTION OF PLANT MATERIALS IN 2007

The following table shows the distribution of plant materials from the Manhattan PMC. A total of 49 seed and plant orders were shipped to 16 states and 6 plant materials centers during the calendar year 2007. Over 443 pounds of seed and 671 plants were shipped to conservation districts, universities, federal and state agencies, private entities, and foreign countries. These materials were used in field trials, research, seed or plant increase, demonstration plantings, and for educational purposes.

Herbaceous Plant Materials

		Seed Orders			Plant Orders		
State	Use	Number	Number of Packets	Bulk Pounds	Number	Number of Rhizomes	Number of Plants
Kansas	CD				2		540
	CI	2		83.3			
	PVT	1	2	0.1			
	UNIV	5	5	4.7	4		112
Subtotal		8	7	88.1	6	0	652
Nebraska	CI	2	1	27.2			
	CD	2	14	1.0			
Subtotal		4	15	28.2	0	0	
Missouri	CI	1		67.4			
	PMC	2	3	1.5			
Subtotal		3	3	68.9	0	0	
Other States	CI	1		67.9			
	FA	2		1.2			
	PMC	5	10	2.6			
	PVT	2		38.0			
	UNIV	8		60.9			
Subtotal		18	10	170.6	0	0	
FC	RES	2	2	1.4			
Total		35	37	357.2	6	0	652

Legend: CD=Conservation Districts CI=Commercial Increase FA=Federal Agencies FC=Foreign Countries GPP=Germ Plasm Preservation OR=Outreach PMC=Plant Materials Centers PVT=Private Institutions RC&D=Resource Conservation & Development RES=Research S&EF=State and Extension Forestry UNIV=Universities

Woody Plant Materials

		Seed Orders		Plant Orders		
State	Use	Number	Bulk Pounds	Number	Number of Cuttings	Number of Plants
Kansas	CD			1		19
	S&EF	1	17.8			
Subtotal		1	17.8	1	0	19
Nebraska	OR			1	20	
	S&EF	1	7.7			
Subtotal		1	7.7	1	20	0
Michigan	PMC			1	36	
Missouri	UNIV	1	0.2			
Montana	CI	1	4.4			
Oklahoma	RC&D	1	56.3			
Subtotal		3	60.9	1	36	0
Total		5	86.4	3	56	19

YEAR 2007 CLIMATOLOGICAL DATA FOR MANHATTAN, KANSAS

2007 Data

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg Max	39.5	43.2	66.9	66.2	78.6	85.1	90.7	95.0	85.4	73.6	59.5	39.8	68.6
Avg Min	20.2	19.3	42.4	40.9	57.4	63.9	67.9	71.1	57.3	45.5	27.9	18.8	44.4
Avg Mean	29.9	31.2	54.6	53.6	68.0	74.5	79.3	83.1	71.3	59.6	43.7	29.3	56.5
High	61	71	86	89	90	92	98	105	96	94	79	63	
Low	-1	0	18	14	44	50	54	57	44	29	9	5	
Min† < 10	5	7	0	0	0	0	0	0	0	0	1	3	16
Min† < 32	27	23	8	6	0	0	0	0	0	4	23	30	121
Max† > 90	0	0	0	0	0	5	19	24	11	1	0	0	60
Precip	0.63	1.24	4.31	3.67	11.94	5.93	4.66	2.24	1.96	4.36	0.12	3.71	44.77
PMC‡	-	-	4.08	3.00	11.61	4.66	3.24	2.55	2.22	3.70	0.20	-	-
Precip†	9	12	14	12	17	12	15	17	10	11	3	14	102
Snow	11.1	5.8	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	14.9	36.3
Heat DD*	1089	946	343	360	25	3	0	0	22	211	661	1072	4730
Cool DD*	0	0	25	33	122	287	443	560	212	44	0	0	1723

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	0.0	-3.6	9.4	-1.7	1.1	-2.0	-1.8	4.2	3.3	2.9	5.0	-3.1	1.1
Avg Min	4.1	-2.2	11.0	-1.3	4.9	1.6	0.6	6.0	1.8	2.3	-2.3	-1.1	2.1
Avg Mean	2.1	-3.0	10.1	-1.5	3.0	-0.2	-0.6	5.1	2.5	2.6	1.3	-2.1	1.6
Precip	-0.23	0.24	1.72	0.6	6.86	0.7	0.56	-1.03	-1.71	1.59	-1.98	2.65	9.97
Snow	6.3	0.9	-0.9	-0.9	-0.1	0.0	0.0	0.0	0.0	-0.2	1.0	11.2	17.3
Heat DD*	-65	82	-294	45	-81	-5	0	-4	-26	-54	-18	30	-391
Cool DD*	0	0	25	16	16	-12	-19	155	49	29	0	0	258

*Daily values were computed from mean temperatures. Each degree that a day's mean is below (or above) 65°F is counted for one heating (or cooling) degree day. † Number of days. ‡ Gauge in operation March 13 to November 30.

Official Recording Station, Manhattan, Kans.

CLIMATIC SUMMARY 2007

Temperature Extremes: -1ºF January 16; 105ºF August 15
First Killing Frost*: October 23 (low of 31ºF)

Last Killing Frost: April 15 (low of 30ºF)

Number of Frost Free Days: 191

*Frost = 32ºF or less

Temperature: The overall temperature for January was slightly warmer than normal despite the cold end of the month. The warmer than normal low temperatures were responsible for the abnormality. February was a direct contrast to last year, temperatures averaged 3 degrees cooler than normal. However, no sub-zero readings or any record lows were recorded. March started out cold but was warmer than normal the remainder of the month. April was a month of contrasts with a cold start and record low temperatures set on the 7th and 8th. Warm weather ended the month though it was not enough to offset the early cold temperatures. The month averaged almost 2 degrees cooler than normal. May was slightly warmer than normal followed by a slightly cooler than normal June with only 9 days with temperatures above 90 degrees. The cooler than normal trend continued in July; however, August put an end to the cooler than normal summer with 9 days above 100ºF and was among the 20 warmest on record. September continued the warm trend with a monthly mean of 71.5ºF. The warm trend continued in October but quickly gave way to more seasonal temperatures the end of the month. The first frost occurred on the 23rd, just over a week later than normal. November was cooler than last year and very close to normal. Warm conditions through mid-month gave way to winter. Temperatures ranged from a high of 79 to a low of 9. December was slightly cooler than normal.

Precipitation: January started the year in direct contrast to 2006. While the month finished slightly drier than normal, it was much wetter than the previous year. Much of the precipitation came in the form of snow. With over 11 inches, the amount was more than double the normal amount. February continued the wet trend of 0.24 inches greater than normal. Snowfall was also greater than seen in the last few years with almost an inch more than normal. A snowy start, March ended on a wet note with rain on 8 of the last 10 days of the month. Rainfall was 1.72 inches greater than normal. Manhattan was spared from several severe weather outbreaks across the state in March. The wetter than normal trend continued in April with precipitation 2.37 inches above normal. After the wetter start to the month May was the 3rd wettest for the month on record. The 4.18 inches that fell on the 24th set a record for the date but not a new record for the month. Although there was some flooding in the area, we were spared the tornadic activity that plagued other areas of the state. June was wetter than normal with 12 days with precipitation. Manhattan missed the heaviest rains, which resulted in widespread flooding in southeast Kansas. The wet weather pattern continued in July with the month ending 0.56 inches above normal and 10.49 inches ahead of last year. The biggest rainfall event occurred on July 20 when 2.08 inches of rain fell in an hour causing considerable street flooding. Rainfall was only slightly below normal for the month of August. September continued the dry pattern of August. While 10 days had precipitation only one had amounts greater than a quarter of an inch. Despite the dry conditions, Manhattan remained 9 inches above normal for the year. October was wetter than normal. However, no new records were set. November started out dry but ended the month with 2 inches of snow the 24th producing only a tenth of an inch of moisture. December was the second snowiest on record at 14.9 inches. A major ice storm hit the area the 11th and 12th when 2.5 inches of rain fell while temperatures were below freezing. It was capped by 0.5 inches of snow for an additional .05 inches of precipitation. Widespread tree and power line damage resulted in large-scale power outages that lasted several days.

Excerpts from Monthly Weather Summary for Manhattan, Mary Knapp, State Climatologist

STUDIES

Studies are planned and developed by the PMC staff to solve high-priority problems identified in the Center's Long-Range Program. All PMC studies are listed as part of the National Plant Materials Program projects. Twenty-one studies were active in on-site and off-site (OS) trials in 2007 (Table 1.1). Details of active studies can be found on the subsequent pages.

Table 1.1. Status of studies conducted by PMC staff.

Study No.	Study Name	Location	Status	Start Date	End Date	Project No.
20A107T	Seed storage study.	KSPMC	Active	1973	2020	RN 1.1
20A126L	Adaptation trials of superior grasses and forbs selected for advanced testing.	KSPMC	Active	1992	2050	NA 1.1
20A127K	Evaluation of PMK-1 and other *Fraxinus pennsylvanica* germ plasm for resistance to ash borers.	KSPMC	Active	1997	2010	CP 4.1
20A215H	Rrps of little bluestem (*Schizachyrium scoparium*).	KSPMC	Active	1992	2008	RN 1.1
20C006G	Evaluation of perennial cool-season forage grasses.	OS KS	Closed	1996	2007	PH 1.1
20C007Ta	Propagation of Mead's milkweed (*Asclepias meadii*).	KSPMC	Active	1996	2010	NA 1.1
20C007Tb	Propagation of earleaf gerardia (*Agalinis auriculata*).	KSPMC	Inactive	1996	------	NA 1.1
20C008L	Evaluation of plant materials for use in soil bioengineering techniques.	KSPMC	Inactive	1998	------	WA 3.1
20I003L	Evaluation of miscellaneous grasses.	KSPMC	Active	1970	2020	NA 1.1
20I010K	Evaluation of miscellaneous trees and shrubs.	KSPMC	Active	1961	2050	CP 4.1
20I026K	Evaluation of hackberry (*Celtis* sp.).	KSPMC/ OS KS	Active	1979	2010	CP 4.1
20I031K	Evaluation of Oriental arborvitae (*Platycladus orientalis*).	KSPMC/ OS OK	Active	1979	2007	CP 4.1
20I037K	Evaluation of selected common hackberry (*C. occidentalis*).	KSPMC	Active	1988	2008	CP 4.1
20I038K	Bur oak seed source study.	KSPMC	Active	1991	2015	CP 4.1
20I039E	Evaluation of switchgrass (*P. virgatum*) germplasm for rhizomatous characteristics.	KSPMC	Active	1992	2010	CP 4.1
20I041K	Evaluation of Siberian elm (*Ulmus pumila*).	OS CO/NE	Active	1997	2020	CP 4.1
20I042E	Initial evaluation of false indigo (*Amorpha fruticosa*) for use in streambank stabilization, shoreline protection, and wetland restoration and enhancement.	KSPMC	Active	1997	2007	WQ 3.1
KSPMS-T-9902-OT	Assist Native American Tribes with the reestablishment of culturally significant plants.	OK, KS, NE	Active	1999	2020	- - -
KSPMS-T-0001-CR	Conservation field trial: reclamation of blue shale outcrop sites in Jewell County, Kansas.	OS KS	Active	2000	2010	ML 1.1
KSPMS-T-0201-CR	Plant species for revegetation of natural and man-induced saline areas.	OS KS	Active	2002	2010	CP 3.1
KSPMC-T-0501-RA	Longevity of native warm-season grass seed: storage viability vs. seedling vigor/stand establishment.	KSPMC/ OS KS	Active	2005	2008	RA 1.1
KSPMC-T-0502-RA	Laboratory evaluation of plant materials to determine seed analysis, germination, and propagation techniques.	KSPMC	Active	2004	2020	RA 1.1
KSPMC-P-0601-RA	Increasing seedling vigor and stand establishment of big sandreed (*Calamovilfa gigantea*).	KSPMC	Active	2006	2008	RA 1.1
KSPMS-T-0705-PA	Evaluation of 'Laramie' annual medicago (*Medicago rigidula* [L.) All.) interseeding trial in established CRP.	OS KS	Active	2006	2008	PA 1.1

A. Advanced Evaluations

1. Study No. 20A107T - Seed storage study.

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

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

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

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

Seed storage facilities consisted of a seed storage building with controlled environment and an uninsulated building (hereafter referred to as the warehouse) without a controlled environment. The warehouse was wood frame on a concrete slab with clapboard siding. The warehouse was subject to wide fluctuations in temperature and humidity. The seed storage building was of all metal construction and insulated throughout. The storage room itself was sealed to exclude outside air and humidity.

Temperature and humidity in the seed storage building were controlled by a UNA-DYN (Model A30T) two tower, desiccant bed dehumidifier and a standard air conditioning unit. Temperature controls were set to maintain 18.3°C (65°F) summer, 12.8°C (55°F) fall-spring, and -1.1° to 7.2°C (30 to 45°F) in the winter. Relative humidity was maintained between 10 to 20 percent. A hygro-thermograph was used to monitor temperature and humidity. Each seed lot was divided into two 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% active ingredient) were placed in each barrel for insect control. The second sack of each seed lot was placed on shelves inside the seed storage building. The initial purity and germination test and subsequent germination tests were conducted in accordance with the Association of Official Seed Analysts Rules for Seed Testing (Anonymous 1978). Samples (100 g) of all lots were taken annually thereafter and sent to the Kansas State Board of Agriculture Seed Laboratory through 1993 for standard germination tests. Kansas Crop Improvement Association conducted germination tests from 1994 to the present. Seed lots were removed from the study when germination test results for that lot dropped below 10 percent of the original test.

No testing was conducted for years 17 and 19 (therefore no data [ND]) in the grasses since year-to-year changes were slight in most cases. No testing was conducted in years 11 and 13 for the forbs. Later on, it was decided that it was not a good idea to skip a year of testing in case viability for a particular lot was declining, so testing was resumed on an annual basis. Testing was discontinued for the uncontrolled storage environment entries after 13 years for warm-season grasses, 7 years for cool-season grasses, and after 6 years for most forbs. Testing was discontinued for cool-season grasses in a controlled storage environment following 27 years of study. Refer to Tables 1.2A and 1.2B for cool-season grass germination test results.

Potential Products: Information Technology

Progress or Status:

Warm-Season Grasses

Most of the warm-season chaffy grasses declined in germination again this year. The viability of 'Garden' sand bluestem (*Andropogon hallii* Hack.) dropped the most by 10 percentage points to 39%, however, its lowest point 8 years ago was 37% viability. 'Aldous' little bluestem (*Schizachyrium scoparium* Michx.) declined by just percentage points continuing an up-and-down trend the past few years. 'Osage' Indian grass (*Sorghastrum nutans* [L.] Nash) remained steady with no change. 'Kaw' big bluestem (*Andropogon gerardii* Vitman) improved by one point from the previous year. Among the non-chaffy warm-season grasses, the viability of 'El Reno sideoats grama (*Bouteloua curtipendula* Michx.) and 'Pete' eastern gamagrass (*Tripsacum dactyloides* [L.] L.) declined by 1 percentage point from last year. The smooth seeded switchgrasses declined in viability this year. The viability of 'Blackwell' (*P. virgatum* L.), an upland-type of switchgrass, declined 7 percentage points, after remaining steady the past two years, to the lowest level to date. 'Kanlow' switchgrass (*Panicum virgatum* L.) a lowland-type of switchgrass, declined 2 percentage points from last year's test. The greatest increase this year was 'Bend' sand lovegrass (*Eragrostis trichodes* [Nutt.] Wood) which showed the best improvement of any of the warm-season grass entries with a 14 percentage point increase over last year. At 56% germination this was the highest level of viability for Bend in the last 10 years. Buffalograss (*Bouteloua dactyloides* [Nutt.] Engelm.), showed improvement with a 2 percentage point increase over last year's test. Refer to Tables 1.1A and 1.1B for germination test results of warm-season grasses for the past 34 years.

Forbs

Three entries remain in the controlled storage environment test following 28 years of storage. One legume, 'Kaneb' purple prairie clover (*Dalea purpurea* Vent.), and two genera of the Asteraceae family, 'Prairie Gold' Maximilian sunflower (*Helianthus maximiliani* Schrad.) and 'Midas' false-sunflower (*Heliopsis helianthoides* [L.] Sweet var. *scabra* [Dun.] Fern.) continue to show viability (Tables 1.3A and 1.3B). 'Kanoka' round-head lespedeza (*Lespedeza capitata* Michx.), which was added to the study in 1980, continues to be viable following 22 years of storage in a controlled storage environment. Prairie Gold dropped 14 percentage points in germination from a year ago returning to the level of 5 years ago. The germination level for Midas has declined to 1% and will be dropped from the study. Kaneb purple prairie clover remained steady at 68% total viability while round-head lespedeza improved from last year by 2 percentage points.

Table 1.1A Germination test results for selected warm-season grasses over a period of years under controlled and uncontrolled storage environments.

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

Table 1.2A Germination test results for selected cool-season grasses over a period of years under controlled and uncontrolled storage environments.

Species	Entry	Storage	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Thinopyrum ponticum	Jose	Cont.	89	91	94	98	94	95	93	92	91	85	80	89	78	73	50	61	36
		Uncont.	89	94	95	92	83	60	9	2	TE								
Bromus inermis	Elsberry	Cont.	ND	ND	ND	54	49	37	17	9	12	2							
		Uncont.	ND	ND	ND	54	21	8	3	TE									
Pascopyrum smithii	Barton	Cont.	10	46	59	75	81	84	79	75	55	64	49	72	65	55	75	52	84
		Uncont.	10	51	70	79	52	32	7	2	TE								
Phalaris arundinacea	Ioreed	Cont.	82	92	87	77	83	88	81	81	73	70	80	75	67	68	70	77	56
		Uncont.	82	88	77	70	52	16	1	TE									

Table 1.1B Germination test results for selected warm-season grasses over a period of years under the controlled storage environment.

Species	Entry	0	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Andropogon gerardii	Kaw	63	ND	77	ND	60	68	61	70	40	45	40	52	39	41	30	36	47	27	28
Andropogon hallii	Garden	74	ND	88	ND	73	82	75	76	74	71	37	71	56	65	47	48	57	49	39
Bouteloua curtipendula	El Reno	22	ND	88	ND	75	79	69	67	70	68	74	66	64	69	62	68	60	62	61
Bouteloua dactyloides	PMT-1181	73	ND	75	ND	61	69	75	72	45	67	67	60	72	71	66	49	57	59	63
Eragrostis trichodes	Bend	77	50	ND	70	55	ND	64	66	48	53	30	50	51	28	33	26	42	56	
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 1.2B Germination test results for selected cool-season grasses over a period of years under controlled storage environment.

Species	Entry	Storage	0	17	18	19	20	21	22	23	24	25	26	27	28
Thinopyrum ponticum	Jose	Cont.	89	ND	36	ND	14	7	7	TE					
Pascopyrum smithii	Barton	Cont.	10	ND	75	ND	67	18	18	14	9	4	TE		
Phalaris arundinacea	Ioreed	Cont.	82	ND	42	ND	41	31	23	22	15	16	8	2	TE

Table 1.3A Germination test results for selected forbs over a period of years under controlled and uncontrolled storage environments.

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

Table 1.3B Germination test results for selected forbs over a period of years under the controlled storage environment.

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

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

Literature Cited:

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

2. Study No. 20A126L - Adaptation trials of superior grasses and forbs selected for advanced testing.

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

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

Procedure: The superior plant will be established in 6.1-m (20-ft) rows with a 2.1-m (6-ft) spacing (unless otherwise specified) between rows. A known cultivar will be planted adjacent to the superior plant as a standard of comparison (if available) in a 3X replicated planting. Plantings are irrigated as needed during the initial growing season to aid establishment.

Evaluation Factors: Factors for evaluation will include plant vigor, stand, seed production, and resistance to disease, drought, and cold.

Potential Products: Information technology and cultivar release.

Progress or status: The following warm-season grass species is currently under test at the Manhattan PMC: prairie sandreed (*Calamovilfa longifolia* [Hook.] Schribn.) which is part of an inter-center strain trial. Forbs that are currently under test are a number of tick-trefoils: Dillenius' tick-trefoil (*Desmodium glabellum* [Michx.]), Illinois tick-trefoil (*Desmodium illinoense* Gray), and panicledleaf tick-trefoil (*Desmodium paniculatum* [L.] DC.); Penstemons: Cobaea penstemon, (*Penstemon cobaea* Nutt.), narrow beardtongue (*Penstemon angustifolius* Nutt. ex Pursh), and large beardtongue (*Penstemon grandiflorus* Nutt.); hairy vetch (*Vicia villosa* Roth); Tifton burclover (*Medicago rigidula* [L.] All.).

a. Prairie sandreed: The plant materials specialist for Michigan requested that the Manhattan PMC participate in an inter-center strain trial to test the adaptation of a selection of prairie sandreed to our local climate. The Rose Lake PMC at East Lansing, Michigan, provided both plants and seed for the trial. Twelve plants of accession 9086408 were planted one foot apart in a rod row in Field B-3 at Manhattan. Refer to Study No. 20I003L, page 41, for further information on the spaced plants. Hulled seed was planted in 0.3-m (10 foot) rod rows spaced 0.18-m apart with 3 replications on May 26, 2005, with a Kinkaid Plot Planter. 'Pronghorn' prairie sandreed was planted as a standard of comparison. Stand improved for both accession 9086408 and Pronghorn, 97.7% and 85.0%, respectively. Plant height was 151.2 cm and 158.3 cm, respectively.

b. Desmodium Species: The plant materials specialist for Michigan requested that the Manhattan PMC participate in an inter-center strain trial to test the adaptation of three Desmodium selections to our local climate. The Rose Lake PMC at East Lansing, Michigan, provided both plants and seed for the trial. The Manhattan PMC added two entries to the planting at Manhattan. One local collection and a collection from McPherson County, Kansas, were added to the trial that was established from seed. In all, five accessions were placed in the trial. Refer to Table 2.1, for a listing of the entries.

Table 2.1 Five Desmodium seed collections planted at Manhattan, Kans., June 7, 2005.

Accession	Cultivar	Species	Common Name
9005087	Marion	*Desmodium glabellum*	Dillenius' tick-trefoil
9013451	CNS	*Desmodium illinoense*	Illinois tick-trefoil
9050393	CNS	*Desmodium* sp.	tick-trefoil
9055415	Alcona	*Desmodium glabellum*	Dillenius' tick-trefoil
9055428	Grant	*Desmodium paniculatum*	panicledleaf tick-trefoil

Seed was planted in 0.3-m (10 foot) rod rows spaced 0.18-m apart with 3 replications on May 26, 2005, with a Kinkaid Plot Planter. Plants were set out June 7, 2005, in rod rows with an in-row spacing of 45.7 cm (18 in) apart. Poor stands were obtained from seed even though it was scarified. The dry weather is thought to have been a factor in the lack of success in establishing a stand. Stand improved for accessions 9005087 and 9055428 while stand declined for accessions 9050393 and 9055415, which ranged from 12.5 to 37.5 percent, in this the third growing, Table 2.2. The improvement in stand was due to increased plant size for accessions that showed improvement from the previous year.

Table 2.2 Desmodium seeding trial: second year plant growth data, percent stand, insect and disease ratings at Manhattan, Kans.

Accession	No. New Seedlings	Stand (%)	No. of Plants Evaluated	Foliage Height (cm)	Plant Height (cm)	Insect Resistance*	Disease Resistance*
9005087	0	37.5	8	57.1	70.4	5	2
9013451	0	0	0	---	---	---	---
9050393	0	27.8	7	45.1	83.4	4	2
9055415	0	12.5	3	56.0	73.0	4	1
9055428	0	21.3	2	54.3	69.7	5	2

*Rating (1-9 = Best – Worst)

The stand declined for all entries in the spaced plant nursery. However, there was an increase in plant height, Table 2.3. Accession 9055428 continued to perform the best of the three entries. This was the final year of evaluation for the Desmodiums.

Table 2.3 Desmodium spaced plant growth data and percent stand at Manhattan, Kans.

Accession	No. of Plants Surviving	No. of Plants Blooming	Stand (%)	Foliage Height (cm)	Plant Height (cm)	Bloom (%)
9005087	5	2	50	50.1	75.9	40
9055415	5	5	50	60.8	72.4	100
9055428	6	3	60	71.6	92.1	50

c. Penstemon Species: Cobaea penstemon was a native forb of interest back in the 1970s, when Accession 9004455 came into being with the pooling of seed collected from accessions PMK-1474 from Riley Co., Kansas, and PMK-1983 from Osage Co., Oklahoma, after a period of initial evaluation at Manhattan, Kansas. It is desirable to compare the performance of 9004455 with commercially available Cobaeas as well as other popular penstemon species. The accessions assembled, Table 2.4, for the trial was established as cone-tainer stock before planting them in a spaced plant nursery in field B-3 at the PMC. Enough plants were available to establish at least 2 replications of 5 plants each per accession, except for accession 9026604.

Table 2.4 Penstemon species planted at Manhattan, Kans.

Accession	Species	Common Name	Origin
9026604	*Penstemon angustifolius*	narrow beardtongue	Garden Co., Nebr.
9004455	*Penstemon cobaea*	Cobaea penstemon	Riley Co., Kans. and Osage Co., Okla.
9050493	*Penstemon cobaea*	Cobaea penstemon	Taney and Ozark Counties, Mo.
9050491	*Penstemon cobaea*	Cobaea penstemon	Ozark Co., Mo.
9082707	*Penstemon grandiflorus*	large beardtongue	Lyman Co., S. Dak., Emmons, Grant and Ransom Counties, N. Dak., Polk Co., Minn.

There was an increase in the number of plants in bloom over the previous year. However, heavy browsing impacted flowering. It is believed that deer in some cases, removed entire flower stalks thus reducing the number. Accession 9004455 experienced the least amount of browse damage, while 9050491 was impacted the most. Some plants did not produce a flower stalk at all. Accession 9004455 produced vigorous plants and was superior in seed production, Table 2.5.

Table 2.5 Penstemon spaced plant growth data and percent stand at Manhattan, Kans.

Plant Symbol	Accession	No. of Plants Surviving	Stand (%)	No. of Plants Blooming	Bloom (%)	Foliage Height*	Plant Height*
PEAN	9026604	8	80	6	75	25.5	18.3
PECO	9004455	9	90	4	44.4	37.8	60.7
PECO	9050491	15	100	11	73.3	29.9	47.1
PECO	9050493	22	88	20	90.9	41.8	57.5
PEGR	9082707	25	100	23	92	36.8	54.2

*cm

d. Evaluation of hairy vetch populations for winter hardiness: Dr. Thomas Devine, USDA ARS, Beltsville, Maryland, requested assistance from the plant materials program in evaluating hairy vetch (*Vicia villosa*) for winter hardiness. Dr. Devine is evaluating hairy vetch as a cover crop for increasing soil fertility and suppressing weeds in organic farming systems. Dr. Devine has identified five hairy vetch populations (K-12, B-35, AUEC, Groff's selection, and a common source from Nebraska) with potential for organic farming systems but lack of information on winter hardiness restricts their use in northern climates. The objective of this study is to determine winter hardiness of the five hairy vetch populations at multiple locations in the northern regions of the U.S. Eleven PMCs were asked to participate. Locations: Aberdeen, Idaho; Alderson, W. Va.; Big Flats, N.Y.; Bismarck, N. Dak.; Bridger, Mont.; Cape May, N.J.; Corvallis, Oreg.; Elsberry, Mo.; Manhattan, Kans.; Pullman, Wash.; and Rose Lake, Mich.

The five hairy vetch entries were planted September 20, 2006, in Field B-3 in a RCBD with 3 replications in 3.05-m (10-ft) rod rows. The number of seedlings per plot were counted late fall and early the following spring on the interior 2.432 meters of each plot, Table 2.6. Rabbits clipped off seedlings but this did not appear to impact survival. As the seedlings developed into young plants, it became difficult to obtain accurate seedling counts in the spring of 2007 which may account for some of the decrease in numbers.

Table 2.6 Emergence and number of seedling means for five hairy vetch populations at Manhattan, Kans.

Entry	Emergence (%) 9/27/2006	No. Seedlings 12/04/2006	No. Seedlings 04/04/2007
AUEC	7.0	19.7	7
B-35	9.3	17.7	15
Common	5.6	18.0	19
Groff's Selection	18.3	23.0	26
K-12	11.3	11.3	8

e. Evaluation of 'Laramie' Tifton burclover for winter hardiness: Laramie is accession SA 10343 from the Australian Medicago Resource Center, Adelaide, South Australia. SA 10343 was collected in Russia in 1974 and evaluated in Wyoming since 1994 where survival was good except for 2001. Laramie was selected for its winter hardiness, ability to self-regenerate, nitrogen-fixing ability, high quality, and large quantity forage production, early and prolific seed production, ability to compete with weeds, and palatability. Laramie was evaluated for winter hardiness at the request of Bud Davis, Agronomist, NRCS, Salina, Kansas. There is interest in Kansas for an adapted annual Medicago for use as a cover and pasture crop. Laramie was planted September 20, 2006, in Field B-3 in a RCBD with 3 replications in 3.05-m (10-ft) rod rows. Laramie out performed the hairy vetch populations in all elements that were evaluated, Table 2.7. The same problem with seedling counts mentioned earlier applied equally to Laramie. Plant height and canopy width were 5 cm and 14.7 cm, respectively.

Table 2.7 Emergence and number of seedling means for five hairy vetch populations at Manhattan, Kans.

Entry	Emergence (%) 9/27/2006	No. Seedlings 12/04/2006	No. Seedlings 04/04/2007
Laramie	70.0	35.7	27.7

3. Study No. 20A127K - Evaluation of PMK-1 green ash for resistance to ash borers.

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

Problem: The Manhattan PMC has germ plasm of green ash that has been tested as PMK-1 for several years. PMK-1 has not been formally tested to determine if it has ash borer resistance or if there are management methods in ash establishment that might limit or lessen ash borer damage to trees.

Objective: To test PMK-1 for borer resistance.

Procedure: Seeds of PMK-1 were pretreated and then stratified 60 days warm stratification at 20ºC followed by a 60 day prechill at 4ºC. At the end of pretreatment the seeds were placed on blotters in germination boxes and allowed to germinate in a plant growth chamber at 20º-30ºC (night/day). The seedlings were transplanted to 656-ml (40-in^3) "deep pot cells," later batches were transplanted to 164-ml (4-in^3) Ray Leach "Cone-tainers"^{TM}, and additional stratified seeds were direct seeded into cone-tainers. On September 27, 2001, 2-0 deep pot stock and cone-tainer stock were transplanted to 6 plots at the Kansas Crop Improvement Association (KCIA) headquarters in Manhattan, Kansas. The KCIA site was chosen because of a history with borer problems on green ash. The 2-tree plots consisted of 1 deep potted plant and 1 cone-tainer plant (designated A and B respectively) spaced 50 to 60 cm (19.7 to 23.6 in) apart on a Wymore silty clay loam soil. Six 2-tree plots at the PMC were divided into two areas. One area was a compacted, rocky, old roadbed (critical area site designated CA), and the other site was the typical Belvue silt loam soil on the PMC. All plantings were caged to reduce browse damage by herbivores.

Potential Products: Cultivar Release

Progress or Status: No borer activity was detected at either the KCIA site or the PMC site this year.

Literature Cited:

Association of Official Seed Analysts. 1999. Rules for Testing Seeds. 126 p.

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

4. Study 20A215H: Evaluation of little bluestem.

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

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

Objective: To utilize recurrent selection techniques to improve 421554, (PMK-1840) germ plasm 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 two-to-three leaf stage and transplanted to cone-tainers 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 approximately six weeks later.

Evaluation Factors: 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 percent of the nursery plants selected. Seed from the selected plant polycross will be tested against standard varieties or used to begin another cycle of recurrent phenotypic selection.

Potential Products: Cultivar Release

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

5. Study No. KSPMC-P-0601-RA: Increasing seedling vigor and stand establishment of big sandreed (*Calamovilfa gigantea* [Nutt.]).

Introduction: Big sandreed (*Calamovilfa gigantea* [Nutt.]) 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 big sandreed by selecting plants with improved seed production qualities.

Procedure: A bulk seed sample was first divided into three 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 one pound of seed was then blown on the South Dakota Seed Blower at full air strength on a full length column for one 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 one 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 one 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 one 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.

Evaluating Factors: Seed size and speed of germination will be evaluated after every cycle of selection to assess improvements.

Potential Product: Technology Transfer and Cultivar Release

Progress or Status: Seed was collected from a number of the better plants in the nursery this year. Seed unit weights of 100 were measured on plants that produced sufficient seed. Germination tests will be conducted to determine germination speed and vigor of seedlings from the nursery plants.

B. Cultural Evaluations and Special Studies

1. Study No. 20C006G - Evaluation of perennial cool-season forage grasses.

Introduction: Little information is available regarding the establishment, persistence, and management of adapted cool-season perennial grasses for use in MLRAs 72, 77, and 78. The use of adapted cool-season grasses can provide a livestock producer an option for lengthening the green-grazing period. This study is being conducted in cooperation with KSU's Agronomy Department.

Problem: The need exists to evaluate the adaptability and performance of cool-season perennial grass forage species for potential use in grazing strategies.
Objective: Evaluate various native and introduced cool-season perennial grasses for site adaptation and performance.

Procedure: Eleven different varieties of cool-season grasses (Table 1.1) were seeded in a randomized complete block design at 3 sites in Kansas: Clark, Phillips, and Wallace counties. Plots 1.5 x 6 m (5 x 20 ft), consisting of 5 rows spaced 0.3 m (1 ft) apart, were planted with a Kincaid plot planter. Each cultivar was replicated 4X.

Table 1.1 Cool-season grass varieties in trials at three Kansas locations.

Cultivar	Common Name	Species
'Hycrest'	crested wheatgrass	*Agropyron cristatum*
CNS	smooth bromegrass	*Bromus inermis*
'Jose'	tall wheatgrass	*Thinopyrum ponticum*
'Rush'	intermediate wheatgrass	*Elytrigia intermedia*
'Reliant'	intermediate wheatgrass	*Elytrigia intermedia*
'Slate'	intermediate wheatgrass	*Elytrigia intermedia*
'Barton'	western wheatgrass	*Pascopyrum smithii*
'Mankota'	Russian wild rye	*Psathyrostachys juncea*
'Bozoisky-Select'	Russian wild rye	*Psathyrostachys juncea*
'Manska'	pubescent intermediate wheatgrass	*Thinopyrum intermedium*
'Luna'	pubescent wheatgrass	*Thinopyrum intermedium*

CNS=Cultivar Not Stated

Potential Products: Technology Transfer and Revision of FOTG

Evaluation Factors: All varieties will be evaluated for establishment, persistence, forage quantity, and quality.

Progress or Status: Closed. A broadcast seeding of an annual medic species was conducted in the fall of 2006 over half of the plots at the Wallace County site are now covered under Study No. KSPMS-T-0705-PA.

2. Study No. 20C007Ta - Propagation of Mead's milkweed.

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

Problem: The need exists to learn more about propagation requirements and establishment techniques. 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. Plants produced in Germination Trial 2 (GT-2) were carried over in 2006 to determine ability to maintain the plants in the containers for an extended period. Containers used in the study were 50- x-150-mm peat pellets; 4-in^3 and 10-in^3 Ray Leach Single Cell "Cone-tainers"™ containing PRO-MIX 'BX' growing medium or commercial topsoil, and 15-in^3 plant bands containing PRO-MIX 'BX'. The container stock was transplanted to the Nelson Environmental Study Area near Lawrence, Kansas, by Galen Pittman.

Progress or Status: Established Field Plantings**.** The stand declined in 2007 for all groups listed in Table 2.1, except for the Red Group, which remained steady from the previous year.

Table 2.1 Spring recovery and percent stand of established plants by group.

Group	Established Plants	Spring Recovery	Established Stand (%)	Current Stand (%)	Change From Previous Year (%)
Yellow	7	4	85.7	57.1	-14.3
Red	16	11	87.5	68.8	0
White[1]	11	5	91.7	45.5	-9.0
BG-TG	7	6	100.0	85.7	-14.3
Prairie[2] (all)	30	21	91.1	70.5	-6.7

Monoculture[1]; Prairie[2] - Yellow, Red, BG-TG Groups;

Plants flowered in the Red, White, Blue, and BG-TG Groups once again. In all, eight plants flowered, producing over 230 flowers, an increase from last year. One follicle was produced in the BG-TG which succumbed to drought and produced no seeds. This was the second year for flowering in the Red Group with the same plant flowering. Refer to Tables 2.2 to 2.4 for flower data for the BG-TG, White, and Blue groups.

Table 2.2 Summary of BG-TG mixed prairie flowering events.

	May 11		May 30
Plant No.	No. of Umbels	Buds/ Umbel	Flowers/Umbel
2	1	14	5
4	5	---	25, 25, 17, 21, 20

Table 2.3 Summary of Blue Group monoculture flowering events.

	June 5		
Plant No.	No. of Umbels	Buds/ Umbel	Flowers Open
7	1	18	17
10	1	16	0
11	1	20	20

Table 2.4 Summary of White Group monoculture flowering events.

	May 30			June 5	
Plant No.	No. of Umbels	Buds/ Umbel	Flowers/ Umbel	Buds/ Umbel	Flowers/ Umbel
1	1	---	23	---	---
11	1	9, 12	---	8	12

Salac Prairie plants, for the most part, remained in a juvenile growth habit in their tenth growing season (Tables 2.5 and 2.6). They have yet to develop the type of stems and leaves capable of supporting an inflorescence, with one exception. A single plant produced an umbel with 10 buds. However, stem caliper has increased for many plants that did not flower.

Table 2.5 Summary of plant growth (length, width, and caliper) means for the Red Group "Salac Prairie" nine-year old plants.

Date	5/11	6/5	
			Range
No. of Plants	10	11	---
No. of Stems	18	21	---
Plant Length (cm)	18.8	30.6	10.2-46.1
No. of stems sampled	18	21	---
Leaf Width (mm)	---	8.1	3-32
No. sampled	---	17	---
Leaf Length (mm)	---	56.6	28-96
No. sampled	---	17	---
Stem Caliper (mm)	---	1.3	0.9-3.4
No. sampled	---	17	---

Table 2.6 Summary of plant growth (length, width, and caliper) means for the Yellow Group "Salac Prairie" nine-year old plants.

Date	5/11	6/5	
			Range
No. of Plants	4	3	---
No. of Stems	4	3	---
Plant Length (cm)	18.9	31.6	28.8-35
No. of stems sampled	4	3	---
Leaf Width (mm)	---	6.7	5-8
No. sampled	---	3	
Leaf Length (mm)	---	60.7	58-64
No. sampled	---	3	---
Stem Caliper (mm)	---	0.9	0.9-1
No. sampled	---	3	---

No one group dominated in the plant growth factors measured as was true in 2006 when the BG-TG plants were superior to plants in the other groups for the four plant characteristics measured. On average, the White Group produced the widest leaves and stem calipers were greater than for the other groups, Table 2.8. BG-TG plants averaged 2.4 cm greater plant length, over the top competitor, Table 2.7. The Blue Group had the longest leaves, Tables 2.9, followed by the White Group. In comparing growth data means for various plant parts, flowering plants were larger than non-flowering plants once again (Table 2.10). In the Red Group, plant length was only slightly greater (+0.7 cm) than the average for non-flowering Red Group plants.

Table 2.7 Summary of plant growth (length, width, and caliper) means for the Buffalo Grass-Tall Grass (BG-TG) prairie ten-year old plants.

Date	5/11	6/5	
			Range
No. of Plants	6	6	---
No. of Stems	14	15	---
Plant Length (cm)	31.0	42.7	20-63.7
No. of stems sampled	13	15	---
Leaf Width (mm)	---	23.1	2-63
No. sampled	---	14	---
Leaf Length (mm)	---	64.6	25-85
No. sampled	---	14	---
Stem Caliper (mm)	---	2.9	1-5
No. sampled	---	15	---

Table 2.8 Summary of plant growth (length, width, and caliper) means for the White Group nine-year old plants.

Date	5/11	6/5	
			Range
No. of Plants	5	5	---
No. of Stems	8	6	---
Plant Length (cm)	24.4	40.3	26-59.8
No. of stems sampled	8	6	---
Leaf Width (mm)	---	29	6-45
No. sampled	---	6	---
Leaf Length (mm)	---	68.2	48-80
No. sampled	---	6	---
Stem Caliper (mm)	---	3.3	0.9-5
No. sampled	---	6	---

Table 2.9 Summary of plant growth (length, width, and caliper) means for the Blue Group nine-year old plants.

Date	5/11	6/5	
			Range
No. of Plants	8	10	---
No. of Stems	12	18	---
Plant Length (cm)	20.5	32.8	15-56
No. of stems sampled	12	18	---
Leaf Width (mm)	---	24.1	10-38
No. sampled	---	14	---
Leaf Length (mm)	---	69.5	42-96
No. sampled	---	14	---
Stem Caliper (mm)	---	2.1	0.8-4
No. sampled	---	18	---

Table 2.10 Size comparisons of plant length, leaf width and length, and stem caliper of flowering and non-flowering Mead's milkweed plants at Manhattan, Kans. June 5, 2007.

			Plant Samples		Leaf Samples			Stem Samples	
Group	No. Plants	No. Stems	No. Stems	Length (cm)	No.	Width (mm)	Length (mm)	No.	Caliper (mm)
White f*	2	3	3	53.0	3	44.3	76.7	3	5.0
White n**	3	3	3	27.7	3	13.7	59.7	3	1.6
Blue f*	3	3	3	49.5	3	27.0	88.0	3	3.7
Blue n**	7	15	15	29.5	11	23.3	64.5	11	1.8
Red f*	1	1	1	43.0	1	32.0	96.0	1	3.4
Red n**	11	17	18	42.3	15	6.8	56.5	15	1.1
BGTG f*	2	6	6	60.5	5	49.8	77.2	6	4.7
BGTG n**	4	9	9	30.9	9	8.0	57.6	9	1.8
All f*	8	13	13	51.5	12	38.3	84.5	13	4.2
All n**	25	44	45	32.6	38	13.0	59.6	38	1.6

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

Containerized Stock. Plants grown in various container soil mix combinations were transplanted to several sites on the Nelson Environmental Study Area near Lawrence, Kansas. Four of the largest and most vigorous plants were planted in a small "butterfly" garden. Most of these plants had multiple ramets and flowered. Eighteen plants were planted in a 5000-ft square prairie demonstration plot. No follicles were produced. The survival rate was reported as good.

Literature Cited:

Betz, Robert F. 1989. Ecology of Mead's milkweed (*Asclepias meadii* Torrey). Proc. Eleventh North Amer. Prairie Conf. T.B. Bragg & J. Stubbendieck, eds. Univ. of Nebr. at Lincoln. p. 187-191.

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

Weaver, J. E. 1968. Prairie Plants and Their Environment. Univ. of Nebr. Press. Lincoln & London. 276p.

3. Study No. KSPMS-T-0001-CR - Conservation Field Trial: Revegetation of an exposed blue shale outcrop site in Jewell County, Kansas.

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 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 2000 common reed sprigs were planted on April 18, 2000. The sprigs were hand planted within select reaches of the primary drainageways within the study area. Planting was restricted to those areas within the study area that appeared to have the greatest potential for supplemental moisture.

Potential Product: Technology Transfer

Evaluation Factors: The plantings will be monitored for establishment, survival, and spread. Evaluations will continue through 2010.

Progress or Status: This study the past couple of years has been reviewed to monitor the growth of common reed on the planting site and to provide technical assistance to the district conservationist and landowner. Areas of the planting site remain unvegetated; however, common reed is slowly encroaching into these areas. Considering initial site conditions, this study has been a success.

Recommendations to the landowner and district conservationist based on the 2007 review include completing a prescribed burn and conducting rotational grazing of the planting.

Landowner is very pleased with the success of the planting.

Literature Cited:

Hamilton, Vernon L. 1981. *Soil Survey for Jewell County, Kansas*. Soil Conservation Service, U.S. Department of Agriculture, Washington, D.C.

Schaller, F.W. and P. Sutton, (eds.) 1978. *Reclamation of Drastically Disturbed Lands*. American Society of Agronomy, Madison, Wis., p. 1-10

4. Study No. KSPMC-T0501-RA - Longevity of native warm-season grass seed: storage viability vs. seedling vigor/stand establishment.

Introduction: Native warm-season grass seeds can remain viable for long periods of time under certain storage conditions. Buffalo grass seeds found in the 25-year old sod of a sod house in western Kansas were still germinable. The Manhattan Plant Materials Center (PMC) built a seed storage facility in 1973,

where temperature and humidity levels are controlled. This has enabled the PMC to store carry-over seed lots for extended periods of time. Controlled storage is necessary in cultivar development and to meet the fluctuating needs for foundation seed by the seed industry. Periodic seed tests have indicated good viability under standardized temperature and moisture conditions in laboratory tests. Although seedling vigor has been questioned, it has not been investigated. Growers have questioned their ability to obtain a stand with carry-over seed.

Objective: Plant seed of warm-season grass species from multiple harvest years in comparison trials to test the ability to establish an acceptable stand for seed production purposes.

Procedure 2006 Trials: Six native, warm-season grass species were selected for the study (Table 4.1). Seed samples were drawn from seed lots stored at the PMC to retest their germinability in the seed lab.

Table 4.1 Grass cultivar information for the 2006 warm-season grass trials.

Accession	Cultivar	Species	Common Name	Crop Years
421276	Kaw	*Andropogon gerardii*	big bluestem	1973, 1990, 2005
421277	Garden	*Andropogon hallii*	sand bluestem	1973, 1989*, 1993, 2005
421281	El Reno	*Bouteloua curtipendula*	sideoats grama	1973, 1993-1994, 2005
421520	Blackwell	*Panicum virgatum*	switchgrass	1973, 1990, 2005
421553	Aldous	*Schizachyrium scoparium*	little bluestem	1973, 2005
421594	Osage	*Sorghastrum nutans*	Indian grass	1973, 1989, 2005

*naked caryopses

Table 4.2, lists species, cultivar names, crop years, germination, purity, and test date information for each entry included in the plantings, including the estimated number of seeds planted per foot of row. Seeds were planted (30 PLS/ft) in a 3.0 m (10 ft) row, 1 row per plot with 3 replications using a Kinkaid Plot Planter with 2.5 cm depth bands. Plantings were made at two locations, Manhattan PMC and KSU's North Agronomy Farm (NAF), in 2006 on two planting dates each site. The PMC plantings were made on May 19, 2006, in Field B-3, and June 7, 2006, in Field D-1, on a Belvue silt loam soil (0-1 percent slope). The NAF plantings were made on May 18, 2006, and June 7, 2006, on a Smolan silt loam soil (1-4 percent slope). Each species was represented by 3 crop years, exceptions were an additional crop year of sand bluestem which was hulled seed (naked caryopses), and there were only two crop years of little bluestem. The mid-seed age of sideoats grama was a blend of 1993 and 1994 crop years (Table 4.1). Evaluate stand and maintain for two growing seasons. Management: fertilizer - none; irrigation - none; weed control - pre-emergent and post-emergent herbicides; and mowing if needed. Stand was determined by using the line intercept method. Stand was measured near the end of the growing season.

Table 4.2 Seed analysis information for crop years under test in 2006 trials.

Cultivar	Crop Year	Purity	Standard Germination %	Dormant Seed %	Pure Live Seed %	Test Date	Seeding Rate: seeds planted per foot of row
Aldous	1973	85.06	57	6	53.59	1/04/06	56.0
Aldous	2005	98.36	63	13	74.75	12/30/05	40.1
Garden	1973	96.39	53	4	54.94	1/04/06	54.6
Garden*	1989	99.32	64	0	63.56	5/08/06	47.2
Garden	1993	69.00	60	1	42.09	4/26/06	71.3
Garden	2005	93.34	75	0	70.00	1/25/06	42.9
Kaw	1973	82.31	33	14	38.69	1/04/06	77.5
Kaw	1990	96.40	80	2	79.05	4/20/06	38.0
Kaw	2005	92.21	73	11	77.46	2/17/06	38.7
Osage	1973	87.39	70	9	69.04	1/04/06	43.5
Osage	1989	93.73	58	9	62.80	4/20/06	47.8
Osage	2005	99.05	33	53	85.18	5/10/06	35.2
Blackwell	1973	99.88	89	0	88.89	1/5/06	33.7
Blackwell	1990	99.29	69	0	68.51	4/20/06	43.8
Blackwell	2005	99.94	68	3	70.96	3/17/06	42.3
El Reno	1973	92.17	59	1	55.30	1/4/06	54.2
El Reno	93-94	99.21	82	0	81.35	5/8/06	36.9
El Reno	2005	96.26	55	5	57.76	1/24/06	51.9

*naked caryopses

Procedure 2007 Trials: The trials this year included the same six native, warm-season grass species that were selected for study in 2006. See Table 4.3, for crop years that were included in the trials for 2007. Two plantings were made ten days apart on June 8 and June 18 in Field C-1 on the PMC on a Belvue silt loam soil. The number of seeds to plant per foot of row was determined by information contained in Table 4.4. Each species was represented by 3 crop years. Exceptions were an additional crop year of sand bluestem which was hulled seed. The mid-seed age for sideoats grama was a blend of the 1989 and 1993 crop years. The plantings were made according to the procedure described earlier.

Table 4.3 Grass cultivar information for the 2007 warm-season grass trials.

Accession	Cultivar	Species	Common Name	Crop Years
421276	Kaw	*Andropogon gerardii*	big bluestem	1973, 1996, 2006
421277	Garden	*Andropogon hallii*	sand bluestem	1973, 1989*, 1995, 2006
421281	El Reno	*Bouteloua curtipendula*	sideoats grama	1973, 1989&1993†, 2006
421520	Blackwell	*Panicum virgatum*	switchgrass	1973, 1988, 2006
421553	Aldous	*Schizachyrium scoparium*	little bluestem	1973, 1994, 2006
421594	Osage	*Sorghastrum nutans*	Indian grass	1973, 1993, 2006

*naked caryopses; †blended crop years

Table 4.4 Seed analysis information for crop years under test in 2007 trials.

Cultivar	Crop Year	Purity	Standard Germination %	Dormant Seed %	Pure Live Seed %	Test Date	Seeding Rate: seeds planted per foot of row
Aldous	1973	85.06	66	1	56.99	1/5/07	52.6
Aldous	1994	84.09	44	0	37.00	5/1/07	81.1
Aldous	2006	95.58	33	32	62.13	1/16/07	48.3
Garden	1989	99.32	65	0	64.56	4/30/07	46.5
Garden	1973	96.39	48	1	47.23	1/04/07	63.5
Garden	1995	97.45	71	0	69.19	4/30/07	43.4
Garden	2006	92.30	80	0	73.84	5/11/07	40.6
Kaw	1973	82.31	27	0	22.22	1/19/07	135.0
Kaw	1996	78.24	61	2	49.29	5/3/07	60.9
Kaw	2006	91.16	56	15	64.72	2/05/07	46.4
Osage	1973	94.16	73	5	73.44	1/19/07	40.8
Osage	1993	87.51	47	9	49.01	4/30/07	61.2
Osage	2006	98.13	18	41	57.90	4/13/07	51.8
Blackwell	1973	99.88	88	1	87.89	1/17/07	34.1
Blackwell	1988	97.46	49	0	47.76	5/1/07	62.8
Blackwell	2006	99.39	54	12	65.60	2/26/07	45.7
El Reno	1973	92.17	62	0	57.15	1/4/06	52.5
El Reno	89-93	99.21	80	0	79.37	5/1/07	37.8
El Reno	2006	99.02	77	8	84.17	2/2/07	35.6

*naked caryopses

Evaluating factors: Stand

Potential Products: Technology Transfer

Progress or Status: Location No. 1 - Manhattan PMC, Fields B-3 and D-1. There was not a significant difference in second year stands produced by any age class of seed for the May 19 planting except for big bluestem (Table 4.5). A poor stand was obtained from the 33-year-old seed of big bluestem which was significantly different from acceptable stands obtained from 1-year-old and 16-year-old seed. A similar outcome was observed in the June 7 planting. Once again, there was a significant difference in the 33-year-old seed. Although a better stand than the May planting, a 46% stand is still not acceptable for commercial seed production purposes. Stands for the 1-year-old and 16-year-old seed were acceptable and not significantly different from each other. The best stands of sideoats grama were produced by the 33-year-old and 1-year-old seed. Even though there was a significant difference in the mid-aged seed, a 91% stand would be acceptable to a grower. While an 80% stand of Indian grass obtained from current year's seed would be acceptable, there was a significant difference in stand from 33-year-old with a 95% stand. Although the 36% stand obtained from 1-year-old little bluestem seed was not significantly different from the 33-year-old seed, it is not an acceptable stand. Better results were obtained the June planting date where the 1-year-old seed improved 33 percentage points. Though not significantly different from the 33-year-old seed, the 81% stand is preferable to a 69% stand.

Stands improved for all entries by the end of the second growing season with one exception. The stand of big bluestem established from 16-year-old seed, June 7 planting was 11% less than the initial year (Table 4.6). The greatest increase was with the June 7 planting date for Indian grass where the stand produced by 1-year-old seed increased by 116% followed by the 1-year-old little bluestem (Table 4.4). While some of the increases may be attributed to seed that was dormant the initial year, germinated the second year as in the case of the 1-year-old Indian grass seed. The greatest increase was due to increased growth of the developing plants.

Location No. 2 - NAF KSU. There were significant differences among seed ages for three of the six species in the May planting. A significant difference was observed in stand between the 33-year-old seed and the 1-year-old and 16-year-old seed of big bluestem (Table 4.7). In the case of sideoats grama, there was a significant difference in stand between the current year's crop and the 12-13 age class of seed. While the stand produced by the 33-year-old seed was not significantly different from the current year's seed, the 78% stand was preferred of the two stands. There were significant differences among all three seed ages of sand bluestem in the May planting. The 1-year-old seed produced the best stand followed by the 12-year-old seed.

Sixty percent of the time the 33-year-old seed produced the best stands, though not statistically different from the younger age classes. Few, if any stands, were acceptable for commercial seed production. Perhaps a third growing season would allow for some improvement.

2007 Trials: Stands obtained from the June 8 planting were very good to excellent for most entries. Exceptions were a 41% stand of little bluestem produced from 1-year-old seed where the two older age classes performed well with no significant difference between the 34-year-old seed and 13-year-old seed (Table 4.8). The stand of Indian grass at 56% produced from 1-year-old seed was significantly different from the 34-year-old seed. Although an acceptable stand of switchgrass was obtained from 1-year-old seed, the stand was significantly different from the older age classes. Stands from the second planting date, June 18, were worse for big bluestem, Indian grass, and little bluestem than the June 8 planting date. Stands of Indian grass were unacceptable for all three age classes of seed. The resulting stands were not significantly different between the three age classes of seed. The 34-year-old seed of big bluestem was down 31 percentage points from the June 8 planting and significantly different from stands of the 1-year-old and 11-year-old age classes of seed. Less desirable stands of little bluestem were obtained the second planting date. The worst was a 34% stand for the current year's seed which was significantly different from the two older age classes of seed. Stands of sideoats grama were comparable to the first planting date. Though similar, there was a significant difference in stand of the mid-age classes of seed over the youngest and oldest seed ages. All three stands were considered excellent as were those of the first planting date. Stands of sand bluestem were in a similar situation where there was a significant difference between the 34-year-old seed and the 12-year-old seed; however, they differed by only 7 percentage points. All three stands were acceptable. Switchgrass stands were slightly better than the first planting date.

Table 4.5 Second year stand for six warm-season grass cultivars for two planting dates and different age classes of seed, Manhattan PMC, Manhattan, Kansas.

Species	Crop Year	Seed Age (Yrs)	Stand (%)	
			Planting Date	**Planting Date**
			May 19	**June 7**
big bluestem				
	2005	1	83 a[1]	86 a
	1990	16	68 a	59 a
	1973	33	34 b	46 b
% CV[2]			**18**	**17**
Indian grass				
	2005	1	80 a	80 b
	1989	17	68 a	88 ab
	1973	33	65 a	95 a
% CV			**14**	**4**
little bluestem				
	2005	1	36 a	69 a
	1973	33	65 a	81 a
% CV			**45**	**24**
sideoats grama				
	2005	1	88 a	97 a
	1994-1993	12-13	85 a	91 b
	1973	33	82 a	98 a
% CV			**23**	**2**
sand bluestem				
	2005	1	80 a	87 a
	1993	13	87 a	88 a
	1973	33	79 a	75 a
% CV			**17**	**11**
switchgrass				
	2005	1	87 a	96 a
	1990	16	81 a	95 a
	1973	33	88 a	98 a
% CV			**9**	**2**

[1]Means in columns for a given cultivar and planting date followed by the same letter are not significantly different at P<0.05
[2]Percent Coefficient of Variation

Table 4.6 Percent change in stand for six warm-season grass cultivars for two planting dates and different age classes of seed following the second growing season, Manhattan PMC, Manhattan, Kansas.

		Stand (%)					
Species	**Seed Age**	**Planting Date May 19**			**Planting Date June 7**		
		Year		**%**	**Year**		**%**
	(Yrs)	**Initial**	**Second**	**Change**	**Initial**	**Second**	**Change**
big bluestem							
	1	80	83	4	73	86	18
	16	62	68	10	66	59	-11
	33	26	34	31	36	46	28
Indian grass							
	1	57	80	40	37	80	116
	17	54	68	26	64	88	38
	33	43	65	51	69	95	38
little bluestem							
	1	29	36	24	37	69	86
	33	49	65	33	57	81	42
sideoats grama							
	1	80	88	10	83	97	5
	12-13	75	85	13	77	91	18
	33	72	82	14	91	98	8
sand bluestem							
	1	64	80	25	71	87	23
	13	70	87	24	68	88	29
	33	57	79	39	50	75	50
switchgrass							
	1	76	87	14	84	96	14
	16	64	81	27	74	95	28
	33	80	88	10	92	98	7

Seed dormancy was a contributing factor in reduced stands for some entries once again. The current year's crop of Indian grass was impacted the most with a high degree of dormancy where 41% of pure live seed was dormant (Table 4.6). As mentioned in last year's report, another factor that could contribute to a reduced stand is the distribution of pure live seed in the row. This is a bigger problem where a large number of seeds need to be planted to meet the 30 PLS seeding rate. In big bluestem, two to three times as much of the 34-year-old seed had to be planted compared to the 1-year-old and 11-year-old seed, respectively. This was not a problem in the first planting; however, it was a problem for the second planting date. The best stands were obtained with sideoats grama for both planting dates. Overall the first planting date produced the best stands.

Table 4.7 Second growing season stand for six warm-season grass cultivars for two planting dates in 2006 and different age classes of seed (2007 data), NAF, KSU, Manhattan, Kansas.

Species	Crop Year	Seed Age (Yrs)	Stand (%)	
			Planting Date	
			May 18	June 7
big bluestem				
	2005	1	76 a[1]	69 a
	1990	16	59 a	30 b
	1973	33	19 b	9 b
% CV[2]			**16**	**36**
Indian grass				
	2005	1	63 a	53 a
	1989	17	53 a	39 a
	1973	33	69 a	58 a
% CV			**39**	**48**
little bluestem				
	2005	1	42 a	35 a
	1973	33	46 a	39 a
% CV			**21**	**41**
sideoats grama				
	2005	1	73 b	83 a
	1994-1993	12-13	82 a	84 a
	1973	33	78 ab	96 a
% CV			**5**	**8**
sand bluestem				
	2005	1	64 a	70 a
	1993	12	47 b	56 a
	1973	33	23 c	62 a
% CV			**17**	**13**
switchgrass				
	2005	1	56 a	65 a
	1990	15	61 a	56 a
	1973	33	69 a	47 a
% CV			**25**	**42**

[1]Means in columns for a given cultivar and planting date followed by the same letter are not significantly different at P<0.05
[2]Percent Coefficient of Variation

Table 4.8 First year stand for six warm-season grass cultivars for two planting dates and different age classes of seed in 2007, Field C-1, Manhattan PMC, Manhattan, Kansas.

Species	Crop Year	Seed Age (Yrs)	Stand (%)	
			Planting Date	
			June 8	June 18
big bluestem				
	2006	1	87 a[1]	79 a
	1996	11	84 a	77 a
	1973	34	79 a	48 b
% CV[2]			**8**	**8**
Indian grass				
	2006	1	56 b	16 a
	1995	12	62 ab	8 a
	1973	34	78 a	14 a
% CV			**14**	**48**
little bluestem				
	2006	1	41 b	34 b
	1994	13	88 a	79 a
	1973	34	89 a	69 a
% CV			**10**	**17**
sideoats grama				
	2006	1	94 a	93 b
	1993-1989	14-18	96 a	96 a
	1973	34	97 a	93 b
% CV			**3**	**1**
sand bluestem				
	2006	1	84 a	84 ab
	1995	12	80 a	82 b
	1973	34	81 a	89 a
% CV			**5**	**4**
switchgrass				
	2006	1	79 b	88 a
	1988	19	86 a	84 a
	1973	34	82 ab	86 a
% CV			**1**	**8**

[1]Means in columns for a given cultivar and planting date followed by the same letter are not significantly different at P<0.05
[2]Percent Coefficient of Variation

Summary: While there were a few instances where it might be undesirable to plant carry-over seed, there is little evidence to suggest avoiding it. Success or failure may have as much to do with seed dormancy and planting date than age of carry-over seed. Planting the current year's crop of seed may lead to problems initially in obtaining an acceptable stand for commercial seed production purposes. However, given enough time as was the case with 1-year-old Indian grass seed an acceptable stand was in the making by the second growing season. Better stands were obtained at the PMC on land better suited to seed production for both planting dates than were obtained on the NAF with few exceptions.

5. Study No. KSPMS-T-0705-PA – Evaluation of 'Laramie' annual medicago (*Medicago rigidula* [L.] All.) interseeding trial in established CRP.

Introduction: A study for adaptability as a nitrogen fixing cover and pasture crop.

Procedure: Utilized perennial cool-season forage grasses from study number 20C006G from the Wallace County study site. Annual medicago was broadcast into the west ½ of the replicated plot in the fall 2006. No incorporation of the seed was applied. By applying to ½ of the perennial cool-season forage grasses it provides a visual observation to the affects of a nitrogen fixing cover.

Progress or Status: The annual medicago broadcast planting was reviewed spring 2007. There were established medicago plants through the entire seeding area. At the time of evaluation, many of these plants were in bloom. Since this plant is an annual, continued evaluations will be needed to evaluate the plants ability to reseed itself. Initial broadcast seeding was a success.

C. Initial Evaluations

1. Study No. 20I003L – Evaluation of miscellaneous grasses.

Introduction: This study serves as a clearinghouse for the evaluation of miscellaneous collections of grasses received by the Center that 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 6.1-m (20-ft) rod row with a spacing of 2.2 m (6 ft) between rows, except where noted. A standard of comparison may also be planted.

Evaluating factors: Plant vigor, stand, seed production, growth factors, and resistance to disease, drought, and cold.

Potential Products: Cultivar Release and Technology Transfer

Progress or Status: Big bluestem (*Andropogon gerardii Vitman*), prairie sandreed, (*Calamovilfa longifolia* [Hook.] Scribn.), Canada wild rye (*Elymus canadensis* [L.]), riverbank wild rye (*E. riparius* [Wieg.]), sweetgrass, (*Hierochloë odorata* [L.] Beauv., and northern sweetgrass, (*Hierochloë odorata* [Schrank] Borbás spp. *artica* [J. Presl] G. Weim.), are species currently under test in this study. See Table 1.1 for evaluation data collected in 2007 for these grasses.

Big bluestem: Twelve plants of accession 9057029 were planted one foot apart in a rod row in Field B-3 at Manhattan PMC at the request of the Booneville Plant Materials Center, Booneville, Arkansas.

Prairie sandreed: The plant materials specialist for Michigan requested that the Manhattan PMC participate in an inter-center strain trial to test the adaptation of a selection of prairie sandreed to our local climate. The Rose Lake PMC at East Lansing, Michigan, provided both plants and seed for the trial. Twelve plants of accession 9086408 were planted one foot apart in a rod row in Field B-3 at Manhattan.

Canada wild rye and riverbank wild rye: The plant materials specialist for Michigan requested that the Manhattan PMC participate in an inter-center strain trial to test the adaptation of accession 9084347, Icy blue Canada wild rye (*Elymus canadensis* [L.]) and accession 9086450, riverbank wild rye (*E. riparius* [Wieg.]). Twenty plants of each accession were planted in rod rows May 24, 2006. Four replants were established in 2007 for accession 9084347.

Table 1.1 Evaluation data for miscellaneous grasses, 2007.

Accession	Species	Plant Height (cm)	Stand (%)	Produced Seed
9057029	*Andropogon gerardii*	207.2	83.3	Y
9086408	*Calamovilfa longifolia*	190.8	100	Y
9084347	*Elymus canadensis*	105.9	100	Y
9086450	*E. riparius*	63.1	100	Y

Sweetgrass Intercenter Strain Trial: Sweetgrass is a culturally significant plant to the American Indians with potential as a conservation plant and a plant community species for restorations. Five plant materials centers have been working with various strains of sweetgrass, Upper Colorado Environmental Plant Center, Meeker, Colorado; Manhattan Plant Materials Center, Manhattan, Kansas; Bridger Plant Materials Center, Bridger, Montana; Rose Lake Plant Materials Center, East Lansing, Michigan; and Bismarck Plant Materials Center, Bismarck, North Dakota. In 2002, each center shared some of its material with the other centers to establish a comparison trial of the different strains of material. 'Radora', a release from South Dakota State University, was planted as a standard of comparison.

Ten plants of each line were spaced 0.7 m (2 ft) apart in rod rows in Field B-1 on a Belvue silt loam soil, June 2002, Table 1.1. Establishment was difficult due to hot, dry weather at the time the plants were received. Establishment was also hampered by local herbivore activity. Radora was received late and did not establish. In 2003, replacement plants, where available, were planted to fill in the missing spaces. The sweet grass trial was finalized in 2005. The plots remain to observe their continued spread, flowering, and seed production. Rhizomes were harvested and propagated for outreach purposes in 2007.

Table 1.1 Sweetgrass Intercenter Strain Trial Plot Layout.

Plot	Source	Species
Border	KSPMC	*Hierochloë odorata*
9063128	NDPMC	*Hierochloë odorata*
9050243	KSPMC	*Hierochloë odorata*
9070988	COEPC	*Hierochloë hirta*
9063351	MTPMC	*Hierochloë odorata*
9070255	MIPMC	*Hierochloë hirta*
Radora	SDSU	*Hierochloë odorata*
Border	KSPMC	*Hierochloë odorata*

North ►

2. Study No. 20I010K - Evaluation of miscellaneous trees and shrubs.

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 PMC and interested parties in the Central Great Plains Region. These include: Kansas State University-Department of Horticulture and Forestry; the USDA Agricultural Research Service (ARS) Plant Introduction System NC-7 Trials; the USDA Forest Service; State and Extension Foresters and 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 multipurpose use in the High Plains region and provide multiple wildlife benefits throughout the four-state area.

Objectives: Identify superior specimens of shrubs and trees which have potential to solve conservation problems; produce or have produced, limited quantities of promising woody plants for field evaluation and field plantings; fulfill tree improvement committee efforts to find and test superior specimens and origins of woody plants; find a suitable replacement for the American and Siberian elms in Midwest urban

conservation plantings; and develop and cooperatively release the best adapted cultivars for multiple uses in the area served by the PMC.

Procedure: Containerized or bare root stock is spaced 16 ft apart in rows spaced 16 ft apart. Drip irrigation is used to aid in establishment which may be needed for several years. In the miscellaneous woody tables, number planted (No. PLT) has been changed to number established (No. EST). The initial number of woody plants planted in a given plot is shown in parentheses where the number disagrees with the number established. This change results from the belief that a tree or shrub planted in a given year that does not recover the following spring did not establish. 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, predation, etc. 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. 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 change brings changes to the data in terms of survival ratings that were reported previously. In cases where it is clear that herbicides killed the plant, the survival rate is adjusted to compensate for such an intervention. This nursery is located primarily on a Belvue silt loam soil in fields F and G.

Potential Products: Information Technology and Cultivar Release

Progress or Status: The assembly consists of 141 accessions representing 94 species in 57 genera, of which 26 are named cultivars. Over 45 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 (HPHR Sta.) at Cheyenne, Wyoming; Southern Plains Research Station (SPR Sta.), Woodward, Oklahoma; the North Central Regional Plant Introduction Station (NCR PI Sta.), Ames, Iowa; and the U S Forest Service's Rocky Mountain Forest and Range Experiment Station (RMFR Exp. Sta.), University of Nebraska-Lincoln (UNL), Nebraska. Participating PMCs include, KCPMC, GAPMC, Americus, Georgia; Knox City, Texas; 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 ten new acquisitions this year, Table 2.1, and five accessions were removed, refer to Table 2.5 for further information.

Table 2.1 New acquisitions to the miscellaneous tree and shrub evaluations at Manhattan PMC.

Species	Common Name	Accession Number	Origin/Source
Alnus maritima	seaside alder	9050518	Oklahoma /NCR PI Sta.
Celtis laevigata var *reticulata*	netleaf hackberry	9050519	Union Co., NM /NCR PI Sta.
Cercis canadensis	red bud	9050520	Van Buren Co., Iowa /NCR PI Sta.
Cercis canadensis	red bud	9050521	Keokuk, Lee Co., Iowa /NCR PI Sta.
Corylus americana	American hazelnut	9083247	/MOPMC
Crataegus chrysocarpa	fireberry hawthorn	9076686	/NDPMC
Elaeagnus x 'Jefmorg'	Silverscape®olive	9050524	/Lincoln-Oakes Nursery, Bismarck, N. Dak.
Physocarpus opulifolius	ninebark	9050522	Bucks Co., PA /NCR PI Sta.
Ptelea trifoliata	common hop tree	9050523	Van Buren Co., Iowa /NCR PI Sta.
Ribes americanum	American black currant	9082687	/NDPMC

Drought and wildlife pressures continue to impact the success of newly established woody entries in this study. Browsing and rubbing by deer has increased steadily over the past 9 to 10 years requiring year-round fencing of new plantings. Such fencing poses problems for plot maintenance.

Pines: Drought, disease, and insects have caused declines in the pine entries the last few years. One hundred and sixty pines from 13 accessions (Table 2.2) represented by seven pine species have been under test at the PMC for more than 30 years. Six accessions of Scots pine have been under test since the 70s. These accessions performed well until repeated periods of drought coupled with nematode and borer infestations (Pine Wilt Disease) devastated one accession, 9004365. We are gradually seeing decline in the other accessions as well as the other pine species.

Table 2.2 Pine accessions under evaluation at Manhattan PMC

Species	Common Name	Accession Number	Origin
Pinus sylvestris	Scots pine	343949	/MDPMC
Pinus sylvestris	Scots pine	343948	/MDPMC
Pinus nigra	Austrian pine	9004364	N. Turkey /RMFR Exp Sta.
Pinus leucodermis	Heldreich pine	9034669	Yugoslavia /RMFR Exp Sta.
Pinus ponderosa	ponderosa pine	9034671	/KSU Forestry, Kans.
Pinus nigra	Austrian pine	9013469	/KSU Forestry, Kans.
Pinus strobiformis	Mexican white pine	9004363	Lincoln Co., N. Mex. /RMFR Exp Sta.
Pinus nigra	Austrian pine	399400	/NCR PI Sta.
Pinus nigra	Austrian pine	9034670	/KSU Forestry, Manhattan, Kans.
Pinus sylvestris	Scots pine	399402	/NCR PI Sta.
Pinus sylvestris	Scots pine	399403	/NCR PI Sta.
Pinus sylvestris	Scots pine	399404	/NCR PI Sta.
Pinus edulis	pinyon pine	9050507	/SPR Sta.

Symptoms mimicking Sphaeropsis (*formerly Diplodia*) tip blight that were observed in the spring 2007 were attributed to environmental stress which was a relief that an entire windbreak that forms the PMC's south border was not on its way out. However, the Scots pines in that windbreak have been dying off a few trees at a time. Last year was no exception and it looks like the trend will continue. We are seeing some Sphaeropsis in the PMC's ponderosa pines and Dothistroma needle blight in the Austrian pines.

False Spiraea: Five accessions of false spiraea representing several species (Table 2.3) were planted in Field F-1 on the PMC in 1997. Establishment was 100% successful for the five entries. There were no losses the first six years of evaluation. Accession 9050264, *Sorbaria sp*., an accession from Poland performed the best. The plants begin to leaf out early and are often damaged by freezing temperatures in the early spring. By year six, all accessions experienced some degree of dieback. The worst was accession 9050267, *S. sorbifolia*, an accession from China. It bounced back that year with heavy flowering. The attractive flowers of the false spiraea draw in many insect species. Dieback and drought opened up opportunities for *Ulmus parvifolia* to invade and compete with the spiraea. The spiraeas have declined over the last several years mainly due to competition from elms. This resulted in reductions in stand and plant growth. Accession 9050264, suffered the least. The false spiraeas are not recommended due to their invasive nature. They are quite successful in spreading by vegetative means and can also reproduce by seed. The plants were removed at the end of the growing season following 11 years of evaluation.

Table 2.3 Five false spiraea accessions under evaluation at Manhattan PMC

Species	Common Name	Accession Number	Origin
Sorbaria tomentosa	Lindley false spiraea	9050268	Poland /NCR PI Sta.
Sorbaria sorbifolia	Ural false spiraea	9050265	North Korea /NCR PI Sta.
Sorbaria sorbifolia	Ural false spiraea	9050267	China /NCR PI Sta.
Sorbaria sp.	false spiraea	9050264	Poland /NCR PI Sta.
Sorbaria sorbifolia var. *stellipila*	Ural false spiraea	9050266	South Korea /NCR PI Sta.

Refer to Table 2.4, List of Miscellaneous Trees and Shrubs for further information regarding plot designations. Plot locations can be found in Plot Maps, refer to MAPS Figures 1.1 and 1.2, an x

designates location of an existing plant in the plot. Plants removed at the end of the evaluation period are listed in Table 2.5. Evaluation data are presented in Table 2.6.

Table 2.4 Study No. 20I010K Initial Evaluation: List of Miscellaneous Trees and Shrubs, Manhattan, Kans. PMC 2007

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., Okla. /KSPMC
B1 18 1-25	1964			*Taxodium distichum*	baldcypress	/Commercial/KSU Ext. Forestry
				Block 2		
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., Mich. /MIPMC
B1 E 36-48	1990	478000	Midwest	*Malus baccata mandshurica*	Manchurian crab apple	Manchuria /NDPMC
B1 2 1-10	1984	9012932		*Cotoneaster zabelli*	cotoneaster	France /MDPMC
B1 3 1-20	2006	9069052	Riverbend GP	*Salix* sp.	willow	/MIPMC
B2 1 1	19	566824	Boomer	*Quercus macrocarpa*	bur oak	Custer Co., Okla. /KCPMC, Tex.
B2 2 1	19	9004392	Lippert	*Quercus macrocarpa*	bur oak	Payne Co., Okla. /KSPMC
B2 S	1930s	20-1303		*Syringa vulgaris*	common lilac	
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., Mich. /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., Kans. /KSPMC
C1 21 A-E	1961	9004304		*Fraxinus pennsylvanica*	green ash	Franklin Co., Kans. /KSPMC
C3 W1 6-42	1967	20-1068		*Juniperus chinensis phitzeriana*	Phitzer juniper	Riley Co., Kans. /KSPMC
C3 W2	1968	9001209		*Picea pungens*	Colorado blue spruce	Forrest Keeling Nursery, Elsberry, Mo.
E3 21 5-7	2001	9050416		*Quercus prinoides*	dwarf chinkapin oak	Salem, Nebr. /NCR PI Sta.
				Block 1		
F1 1 1-2	1985	9049957		*Platanus occidentalis*	sycamore	Brownville, Nebr. /UNL-Lincoln
F1 1 10-19	1966	107630		*Ligustrum vulgare*	Cheyenne European privet	/NCR PI Sta.
F1 2 1	1985	9049957		*Platanus occidentalis*	sycamore	Brownville, Nebr. /UNL-Lincoln
F1 2 2-3	1985	9049956		*Platanus occidentalis*	sycamore	Burt Co., Nebr. /UNL-Lincoln
F1 2 4	1985	9049957		*Platanus occidentalis*	sycamore	Brownville, Nebr. /UNL-Lincoln
F1 2 5	1985	9049955		*Platanus occidentalis*	sycamore	Marysville, Kans. /UNL-Lincoln
F1 3 1	1985	9049956		*Platanus occidentalis*	sycamore	Burt Co., Nebr. /UNL-Lincoln
F1 3 2-3	1985	9049955		*Platanus occidentalis*	sycamore	Marysville, Kans. /UNL-Lincoln
F1 3 4-5	1985	9049956		*Platanus occidentalis*	sycamore	Burt Co., Nebr. /UNL-Lincoln
F1 4 3-5	1997	9050263		*Celtis laevigata*	sugarberry	Newark, Ohio /NCR PI Sta.
F1 5 1-10	1997	9050268		*Sorbaria tomentosa*	Lindley false spirea	Lublin, Poland /NCR PI Sta.
F1 6 1-10	1997	9050265		*Sorbaria sorbifolia*	Ural false spirea	North Korea /NCR PI Sta.
F1 7 1-10	1997	9050267		*Sorbaria* sp.	false spirea	P R China /NCR PI Sta.
F1 8 1-10	1997	9050264		*Sorbaria sorbifolia*	Ural false spirea	Lublin, Poland /NCR PI Sta.
F1 9 1-10	1997	9050266		*Sorbaria sorbifolia* var *stellipila*	Ural false spirea	South Korea /NCR PI Sta.
F1 11 2-11	1989	9055585	Redstone	*Cornus mas*	Cornelian cherry dogwood	Cen Europe /N.Y./MOPMC
F1 12 1-2	1984	325270		*Cotoneaster lucida*	cotoneaster	USSR /MDPMC
F1 12 3-12	2007	9083247		*Corylus americana*	American hazelnut	/MOPMC
F1 13 1-5	2007	9050524		*Elaeagnus* X 'Jefmorg'	Silverscape®olive	/Lincoln-Oakes Nursery, Bismarck, N. Dak.

Table 2.4 Study No. 20I010K Initial Evaluation: List of Miscellaneous Trees and Shrubs, Manhattan, Kans. PMC 2007 (continued)

Location (F	R	No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
F1	13	6-10	2007	9050522		*Physocarpus opulifolius*	common ninebark	Bucks Co., Penn. /NCR PI Sta.
F1	14	1-5	2007	9082687		*Ribes americanum*	American black currant	/NDPMC
F1	18	1-5	1990	477010		*Ligustrum obtusifolium*	border privet	/MIPMC/NCR PI Sta.
F1	19	1-5	2006	9050500	Iroquois Beauty	*Photinia melanocarpa*	black chokeberry	/NCR PI Sta.
F1	19	6-10	2006	323957		*Photinia melanocarpa*	black chokeberry	/NDPMC/NCR PI Sta.
F1	20	1-5	2003	9050482	Royal Guard	*Viburnum rufidulum*	southern blackhaw	/Holden Arboretum/NCR PI Sta.
F1	20	6-10	2003	9050483		*Viburnum rufidulum*	southern blackhaw	/ISU Hort. Farm/NCR PI Sta.
F1	21	1-5	2001	9050417		*Spiraea flexuosa*		Northern Mongolia /NCR PI Sta.
F1	21	6-10	2001	9050418		*Xanthoceras sorbilolium*	yellowhorn	Northern China / NCR PI Sta., Ames, Iowa
F1	22	1-5	2002	9050425		*Cornus sanguinea*	bloodtwig dogwood	Iowa /NCR PI Sta.
F1	22	6-10	2002	9050426		*Cornus sanguinea*	bloodtwig dogwood	Iowa /NCR PI Sta.
F1	23	1-5	2002	9050427		*Cotinus coggygria*	smokebush	Iowa /NCR PI Sta.
F1	23	6-10	2006	9050498		*Hydrangea arborescens radiata*	silver leaf hydrangea	/NCR PI Sta.
F1	24	1-5	2002	9050429		*Sorbus aucuparia*	mountain ash	Iowa /NCR PI Sta.
F1	24	6-10	2002	9050430		*Sorbus torminalis*	wild service tree	Iowa /NCR PI Sta.
F1	25	1-5	2002	9050431		*Shepherdia argentea*	silver buffaloberry	Iowa /NCR PI Sta.
F1	25	6-10	2002	9050432		*Sorbus torminalis*	wild service tree	Iowa /NCR PI Sta.
F1	26	1-6	1985	9050007		*Syringa vulgaris*	common lilac	Phillips Co., Kans. /KSPMC
						Block 2		
F2	4	1-10	1967	9006095	McDermand	*Pyrus ussuriensis*	Harbin pear	Morden, Manitoba, Can. /NDPMC
F2	7	1-6	1998	various		*Castanea mollissima*	Chinese chestnut	/MDPMC
F2	8	1-6	1998	various		*Castanea mollissima*	Chinese chestnut	/MDPMC
F2	9	1-6	1998	various		*Castanea mollissima*	Chinese chestnut	/MDPMC
F2	10	1-4	1989	9050011		*Diospyros virginiana*	common persimmon	Iowa /NCR PI Sta.
F2	11	1-5	2007	9050519		*Celtis laevigata* var *reticulata*	netleaf hackberry	Union Co., N. Mex. /NCR PI Sta.
F2	11	6-10	2007	9050518	September Sun	*Alnus maritima*	seaside alder	Oklahoma /NCR PI Sta.
F2	12	1-5	2007	9050520		*Cercis canadensis*	red bud	Van Buren Co., Iowa /NCR PI Sta.
F2	12	6-10	2007	9050521		*Cercis canadensis*	red bud	Keokuk, Lee Co., Iowa /NCR PI Sta.
F2	13	1-5	2007	9050523		*Ptelea trifoliata*	common hoptree	Van Buren Co., Iowa /NCR PI Sta.
F2	13	6-10	2007	9076686		*Crataegus chrysocarpa*	fireberry hawthorn	/NDPMC
F2	24	1-5	1973	9006225		*Syringa pekinensis*	Pekin lilac	/NDPMC
F2	24	6-10	1973	9034667		*Forsythia europaea* X *ovata*	early forsythia hybrid	/NCR PI Sta.
						Block 3		
F3	2	1-11	1967	9001069		*Quercus palustris*	pin oak	/Manhattan Nursery Manhattan, Kans.
F3	3	1-5	2002	486339	Dynasty	*Ulmus parvifolia*	lace-bark elm	Iowa /NCR PI Sta.
F3	5	1-5	1969	9004305		*Fraxinus pennsylvanica*	green ash	Butler Co., Kans. /KSPMC
F3	7	1	2003	9050478	Varen	*Betula papyrifera*	paper birch	/NDSU/NCR PI Sta.
F3	7	2-4	2006	9050499		*Populus alba*	white poplar	South Korea /NCR PI Sta.
F3	7	6-10	2003	9050481		*Tilia cordata*	littleleaf linden	Ukraine /NCR PI Sta.
F3	8	1-5	2003	9050479		*Carpinus betulus*	European hornbeam	Ukraine /NCR PI Sta.

Table 2.4 Study No. 20I010K Initial Evaluation: List of Miscellaneous Trees and Shrubs, Manhattan, Kans. PMC 2007 (continued)

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
F3 8 6-10	2003	9050480		*Carpinus betulus*	European hornbeam	Ukraine /NCR PI Sta.
F3 10 1-10	1971	9034682		*Betula nigra*	river birch	Houston Co., Minn. /NCR PI Sta.
F3 12 1-10	2006	9050497		*Celtis occidentalis*	common hackberry	/Forest Keeling Nursery Elsberry, Mo.
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	Minn., Wis. /NCR PI Sta.
F3 14 6-10	2006	9050503		*Ulmus thomasii*	rock elm	Dixon Co., Nebr. /NCR PI Sta.
F3 15 1-10	2006	9050502		*Foresteria pubescens* var *pubescens*	stretchberry	/NCR PI Sta.
F3 18 1-10	1971	9004302		*Fraxinus pennsylvanica*	green ash	Butler Co., Kans. /KSPMC
F3 19 1-5	1971	341756	Groeneveld	*Ulmus* X *hollandica*	Holland elm hybrid	/NCR PI Sta.
F3 19 6-10	1973	265620	Hessei	*Fraxinus excelsior*	European ash	W. Germany /NCR PI Sta.
F3 20 1-5	1972	9034674		*Quercus* sp.	Swedish hybrid oak	/UNL /NCR PI Sta.
F3 20 6-10	1972	9017646		*Quercus robur*	English oak	/ISU Hort Farm /NCR PI Sta.
F3 21 6-10	1990	9050022		*Quercus phellos*	willow oak	Tennessee /NCR PI Sta.
F3 22 6-10	1972	9004392	Lippert	*Quercus macrocarpa*	bur oak	Payne Co., Okla. /KSPMC
F3 23 1-10	1973	434253	Athens	*Quercus acutissima*	sawtooth oak	/GAPMC
				Block 4		
F4 1 9-10	1968	9004461	Woodward	*Platycladus orientalis*	Oriental arborvitae	/Okla. State Nursery Norman, Okla.
F4 3 6-10	1972	9004434		*Platycladus orientalis*	Oriental arborvitae	/Deuel Co., Nebr. /HPHR Sta.
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., Nebr. /HPHR Sta.
F4 11 1-10	2006	9050504		*Cupressus bakeri*	Modoc cypress	/Lawyer Nursery Plains, Mont. /KSU Forestry
F4 17 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 19 7-9	1976	343948		*Pinus sylvestris*	Scots pine	Ankara, Turkey /MDPMC
F4 20 1-10	1974	9034668		*Picea abies*	Norway spruce	/Griffith St. Nursery Wisconsin Rapids, Wis.
F4 21 1-9	1973	9004363		*Pinus strobiformis*	Mexican white pine	Lincoln Co., N. Mex. /RMFR Exp. Sta.
F4 22 1-10	1973	9004364		*Pinus nigra*	Austrian pine	N. Turkey /RMFR Exp. Sta. /KSPMC
F4 25 8-17	1973	9034669		*Pinus heldreichii*	Heldreich pine	Yugoslavia /RMFR Exp. Sta. /MDPMC
				Block 1		
G 1 W'-B	1991	250278	Elsmo	*Ulmus parvifolia*	lace-bark elm	Rochester, N.Y. /MOPMC
G 1 C-E	1974	9004437		*Ulmus parvifolia*	lace-bark elm	Woodward Co., Okla. /NRCS SO, Okla.
G 2 W'-Z'	1991	250278	Elsmo	*Ulmus parvifolia*	lace-bark elm	Rochester, N.Y. /MOPMC
G 2 A-E	1963	9004439		*Ulmus* sp.ecies	Offerle elm	Edwards Co., Kans. /KSPMC
G 3 B-E	1963	9013711		*Ulmus parvifolia*	Chinese elm	/SPR Sta.
G 3 F-J	1963	9004256		*Celtis occidentalis*	common hackberry	Pottawatamie Co., Kans. /KSPMC
G 4 A-E	1963	9004440		*Ulmus* sp.	hybrid elm	/KSU Horticulture Farm
G 8 F-J	1963	9004255		*Celtis occidentalis*	common hackberry	Central Oklahoma /KSPMC
G 9 F-J	1963	9034679		*Carya illinoensis*	pecan	/KSU Forestry, Kans.
G 10 F-J	1963	9034680		*Carya illinoensis*	pecan	/KSU Forestry, Kans.
G 2 K-O	1963	9004329		*Juniperus virginiana*	eastern red cedar	/KSU Forestry, Kans.
G 4 K-O	1963	9004333		*Juniperus virginiana*	eastern red cedar	Harper Co., Okla. /KSPMC

Table 2.4 Study No. 20I010K Initial Evaluation: List of Miscellaneous Trees and Shrubs, Manhattan, Kans. PMC 2007 (continued)

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
G 6 K-O	1963	9004332		*Juniperus virginiana glauca*	silver eastern red cedar	/SPR Sta.
G 8 K-O	1963	9034671		*Pinus ponderosa*	ponderosa pine	/KSU Forestry, Kans.
G 9 K-O	1963	9013469		*Pinus nigra*	Austrian pine	/KSU Forestry, Kans.
G 15 U-Y	1964	9034673		*Quercus acutissima*	sawtooth oak	/GAPMC
				Block 2		
G2 16 1-8	1976	9004462	Sapparo Autumn Gold	*Ulmus* sp.ecies	elm	/Univ. of Wis. /NCR PI Sta. Ames, Iowa
G2 17 1-3	1977	9004312		*Juglans nigra*	black walnut	Doniphan Co., Kans. /KSPMC
G2 23 6-8	1981	9030309		*Aesculus glabra*	Ohio buckeye	/NCR PI Sta. Ames, Iowa
G2 24 6-7	1981	9030308	Royal Red	*Acer plantanoides*	Norway maple	/NCR PI Sta. Ames, Iowa
				Block 3		
G3 16 1-8	1976	9008245		*Quercus acutissima*	sawtooth oak	/KCPMC
G3 18 1-8	1976	9004392		*Quercus macrocarpa*	bur oak	City Park, Stillwater, Okla. /KSPMC
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.
HQ1 1 2				*Carya illinoensis*	pecan	
HQ1 1 3	1963	9050509		*Pseudotsuga menziesii*	Douglas fir	/MOPMC
HQ1 1 4-11	1968	9001209		*Picea pungens*	Colorado blue spruce	/Forest Keeling Nursery, Elsberry, Mo.
HQ1 2 1	1983	9005161		*Crataegus phaenopyrum*	Washington hawthorn	DuPage Co., Ill. /MOPMC
HQ1 2 2	1977	514275	Magenta	*Malus* sp.	hybrid crabapple	Clinton Co., Mich. /MIPMC
HQ1 2 3	1964	9050507		*Pinus edulis*	pinyon pine	/SPR Sta.
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, Nebr.
HQ1 4 1,3	1982	9030989		*Forsythia ovata*	early forsythia	/NCR PI Sta. Ames, Iowa
HQ1 4 2	1988	9049784		*Ribes odoratum*	buffalo currant	Dickinson Co., Kans. /KSPMC
HQ1 5 1-4	1982	9030990	Blue Star	*Juniperus squamata*	blue star juniper	Holland /NCR PI Sta.
HQ1 5 1-4				*Yucca glauca*	soapweed	
HQ1 7 1	1984	20-1846		*Picea abies*	Norway spruce	/Griffith State Nursery Wisconsin Rapids, Wis.
HQ1 7 2	1964	9004392	Lippert	*Quercus macrocarpa*	bur oak	Payne Co., Okla. /KSPMC
HQ1 8 1		9050508		*Caragana boisii*	Siberian pea shrub	/HPHR Sta.
HQ1 8 2		483442	Flame	*Acer ginnala*	Amur maple	E. Asia /MOPMC
HQ1 8 3	1977	9004363		*Pinus strobiformis*	Mexican white pine	Lincoln Co., N. Mex. /RMFR Exp. Sta., Nebr.
HQ1 9 1	1988			*Cercis canadensis*	red bud	Riley Co., Kans. /KSPMC
HQ1 9 2	1967	9001069		*Quercus palustris*	pin oak	/Manhattan Nursery, Manhattan, Kans.
HQ2 1 1-15				*Crataegus phaenopyrum*	Washington hawthorn	/Lawyer Nursery, Plains, Mont. /KSPMC
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	/NPHR. Sta.

Table 2.4 Study No. 20I010K Initial Evaluation: List of Miscellaneous Trees and Shrubs, Manhattan, Kans. PMC 2007 (continued)

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin /Source
HQ2 3 1	1977	421614		*Ulmus davidiana* var *japonica*	Japanese elm	/ARS Nursery Crops Res. Lab., Delaware, Ohio
HQ2 3 2				*Pinus ponderosa*	ponderosa pine	
HQ2 3 3		516476	Redstone	*Cornus mas*	Cornelian cherry dogwood	Asia /MOPMC
HQ2 3 4-15				*Syringa vulgaris*	common lilac	
HQ2 3 16	1976	9050511		*Spiraea sargentiana*	Sargent spirea	/NPHR Sta.
HQ2 3 17	1992			*Quercus robur*	English oak	Illinois /McKendree College
HQ2 3 18	1992	9004392	Lippert	*Quercus macrocarpa*	bur oak	Payne Co., Okla. /KSPMC
HQ2 3 19	1977	514275	Magenta	*Malus* sp.	hybrid crab apple	Clinton Co., Mich. /MIPMC
HQ2 4 1-6	1992			*Pyracantha*	firethorn	Blueville Nursery, Manhattan, Kans.
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., Kans. /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, Okla.
P W 3	1966	9050513		*Juniperus horizontalis glauca*	blue creeping juniper	/MIPMC
P W 4	1966	9000399		*Quercus rubra*	northern red oak	Greenwood Co., Kans. /KSPMC
P W 5-6	1971	9001455	Emerald	*Fraxinus* sp.	ash	/Marshall Nursery, Arlington, Nebr. /KSPMC
P 21 1-6	2001	9050416		*Quercus prinoides*	dwarf chinkapin oak	Salem, Nebr. /NCR PI Sta.
P 22 1-5	2001	566597	Patriot	*Ulmus* hybrid	elm	/US Nat'l Arboretum /NCR PI Sta.
P S 1-6, 8-10	1977	399400		*Pinus nigra*	Austrian pine	Yugoslavia /NCR PI Sta.
P S 7, 11-30	1981	9034670		*Pinus nigra*	Austrian pine	/KSU Forestry
PQ S 31-50	1977	399402		*Pinus sylvestris*	Scots pine	Yugoslavia /NCR PI Sta.
Q S 51-70	1977	399403		*Pinus sylvestris*	Scots pine	Yugoslavia /NCR PI Sta.
Q S 71-90	1977	399404		*Pinus sylvestris*	Scots pine	Yugoslavia /NCR PI Sta.

Table 2.5 Study No. 20I010K Initial Evaluation: List of Miscellaneous Trees and Shrubs Removed, Manhattan, Kans. PMC 2007

Location (F R No.)	Yr Pltd	Accn. No. or PI No.	Cultivar	Genus/ Species	Common Name	Origin/ Source
B1 2 1-10	1984	9012932		*Cotoneaster zabelli*	cotoneaster	France
F1 5 1-10	1997	9050268		*Sorbaria tomentosa*	Lindley false spirea	Lublin, Poland /NCR PI Sta.
F1 6 1-10	1997	9050265		*Sorbaria sorbifolia*	Ural false spirea	North Korea /NCR PI Sta.
F1 7 1-10	1997	9050267		*Sorbaria* sp.	false spirea	P R China /NCR PI Sta.
F1 8 1-10	1997	9050264		*Sorbaria sorbifolia*	Ural false spirea	Lublin, Poland /NCR PI Sta.
F1 9 1-10	1997	9050266		*Sorbaria sorbifolia* var *stellipila*	Ural false spirea	South Korea /NCR PI Sta.
G 9 K-O	1963	9013469		*Pinus nigra*	Austrian pine	/KSU Forestry, Kans.

Refer to page 72, Legend for miscellaneous trees and shrub evaluations.

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans.

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
B1 3 1-20	SALIX	9069052	willow	06	06	7	7	100				30	55		
			Salix sp.		07	(20)	6	86				77	84		
			/MIPMC												
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., Kans. /KSPMC		78		5	100	3			650	1150		
					79		5	100	3			800	1150		
					83		5	100	3	4	3	800	1175	27	
					85		4	80	3		4		1219	28	
					86		4	80	5	5		975		29	
					88		4	80	1			933		34	
					90		4	80	3	5					
					93		4	80					1372	36	
					05		4	80					1411		
					06		4	80						41	
C1 21 A-E	FRPE	9004304	green ash	61	70	5	5	100	1			566	833	17	
			Fraxinus pennsylvanica		74		5	100	3			622	1041	21	
			Franklin Co., Kans.		78		5	100	3			800	1100		
			/KSPMC		79		5	100	1			800	1100		
					83		5	100	3	4	3	900	1310	30	
					85		5	100	3				1280	30	
					86		5	100	6			762			
					88		5	100	2			733		33	
					90		5	100	1	1					
					93		5	100					1292	36	
					05		4	80					1416		
					06		4	80						44	
E3 (see bur oak map)		9050077	white oak	95	02	4	4	100					448	6	
			Quercus alba		05		4	100					568	10	
			Lancaster Co., Nebr.		07		4	100					728	12	
			/KSPMC												
E3 21 5-7 /P21 1-6	QUPR	9050416	dwarf chinkapin oak	01	01	9	9	100					23		
			Quercus prinoides		02		8	89	6	7	5	26	31		Leaf cutter bee damage
			/NCR PI Sta.		03		8	89				42	41		
					04		8	89				67	66		Some deer browse
					05		8	89		5	4	93	83		
					06		8	89		1	4	109	109		No. – 7 severe MD; No. – 6 DD

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 5 1-10	SOTO7	9050268	Lindley false spiraea	97	97	10	10	100	2						
			Sorbaria tomentosa		99		10	100	7				145		
			Poland/NCR PI Sta.		00		10	100				228	148		
					01		10	100	9				153		
					02		10	100	5			216	147		20% die back; few flowers
					07		7	70				103	100		
F1 6 1-10	SOSO2	9050265	Ural false spiraea	97	97	10	10	100	3						
			Sorbaria sorbifolia		99		10	100	2				153		
			North Korea/NCR PI Sta.		00		10	100				185	155		
					01		10	100	3				171		
					02		10	100	6			228	150		40% die back; heavy flowering
					07		8	80				146	81		
F1 7 1-10	SOSO2	9050267	Ural false spiraea	97	97	10	10	100	5						Insect damage
			Sorbaria sorbifolia		99		10	100	4	9			143		
			China/NCR PI Sta.		00		10	100				179	158		
					01		10	100	7				177		
					02		10	100	7			215	171		50% die back; heavy flowering
					07		10	100				180	92		
F1 8 1-10	SORBA	9050264	false spiraea	97	97	10	10	100	1						Wind damage
			Sorbaria sp.		99		10	100	1				211		
			Poland/NCR PI Sta.		00		10	100				254	218		
					01		10	100	1				213		No. 3 - winter injury
					02		10	100	3			275	215		15% die back; mod. flowering
					07		9	90				248	210		
F1 9 1-10	SOSOS	9050266	Ural false spiraea	97	97	10	10	100	9						
			Sorbaria sorbifolia var.		99		10	100	2				144		
			stellipila		00		10	100				216	153		
			South Korea/NCR PI Sta.		01		10	100	5				169		
					02		10	100	5			244	157		30% die back; mod. flowering
					07		9					393	106		
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
			C. Europe /N.Y. /MOPMC		91		11	100				45	98		
					92		11	100				53	135		
					93		11	100		3		92	173		
2-11					99	10	10	100				259	334		Good fruiting; 1- herbicide damage
					03	10	10	100					353		All but 2 with good fruit production

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 12 3-12	COMA3	9083247	American hazelnut *Corylus Americana* /MOPMC	07	07	10	10	100				13	44		
F1 13 1-5	ELAEA	9050524	Silverscape®olive *Elaeagnus* X 'Jefmorg' Lincoln-Oakes Nursery /NDPMC	07	07	5	5	100				60	69		
F1 13 6-10	PHOP	9050522	ninebark *Physocarpus opulifolius* Bucks Co., Penn. /NCR PI Sta.	07	07	3	3	100				65	45		
F1 14 1-5	RIAM2	9082687	American black currant *Ribes americanum* /Big Sioux Nursery Watertown, S. Dak. /NDPMC	07	07	3	3	100				32	51		
F1 18 1-5	LIOB	477010	border privet *Ligustrum obtusifolium* /MIPMC/NCR PI Sta.	90	90	5	5	100	1	2	1	58	55		
					91		5	100				84	79		
					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		
F1 19 1-5	PHME13	9050500	black chokeberry *Photinia melanocarpa* /NCR PI Sta.	06	06	4	4	100					54		
					07	(5)	4	100				36	48		
F1 19 6-10	PHME13	323957	black chokeberry *Photinia melanocarpa* /NDPMC	06	06	5	5	100				42	46		
					07		5	100				47	47		
F1 20 1-5	VIRU	9050482	southern blackhaw *Viburnum rufidulum* /NCR PI Sta.	03	03	4	4	100	7			51	39		
					04	(5)	3	80	6			30	34		
					05		3	80				38	62		
					06		3	80					76		
					07		3	80				83	160		
F1 20 6-10	VIRU	9050483	southern blackhaw *Viburnum rufidulum* /NCR PI Sta.	03	03	5	5	100	6			36	44		
					04		5	100	5			33	46		
					05		5	100				47	69		
					06		5	100					84		
					07		5	100				102	130		

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 21 1-5	SPFL9	9050417	*Spiraea flexuosa*	01	01	5	5	100	2			56	78		Weed comp; leaf cutter bee damage
			/NCR PI Sta.		02		5	100	6	6	2	42	49		Heavy deer browse
					03		5	100	5			49	64		Fall flowers - 3 plants
					04		5	100	6			44	58		
					05		4	80				48	53		No. 5 - gone
					06		3	60				64	73		
F1 21 6-10	XASO3	9050418	yellowhorn	01	01	5	5	100	3			34	60		Weed comp; leaf cutter bee damage
			Xanthoceras sorbifolium		02		5	100	4	7	3	39	56		Medium deer browse
			/NCR PI Sta.		03		5	100	4			81	89		5 - die back; recovered summer
					04		5	100	5			93	105		
					05		5	100				117	134		
					06		5	100		2	1	177	178		
F1 22 1-5	COSA81	9050425	bloodtwig dogwood	02	02	5	5	100	4	4	4	27	80		Heavy browse
			Cornus sanguinea		03		5	100	3			69	106		3 - tip breakage - boring insect
			/NCR PI Sta.		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		
F1 22 6-10	COSA81	9050426	bloodtwig dogwood	02	02	5	5	100	3	6	5	42	57		Medium browse
			Cornus sanguinea		03		5	100	6		5	74	81		
			/NCR PI Sta.		04		5	100	3		4	181	169		
					05		5	100				241	212		
					06		5	100				259	226		Second flush - flowering/fruiting-Sept
					07		4	80				236	240		No. 1 - dead
F1 23 1-5	COCO10	9050427	smokebush	02	02	5	5	100	2	3	2	50	84		Slight browse
			Cotinus coggygria		03		5	100	1			92	151		
			/NCR PI Sta.		04		5	100	4			137	219		
					05		5	100				185	258		
					06		5	100				243	307		
					07		5	100				253	329		
F1 23 6-10	HYAR6	9050498	silver leaf hydrangea	06	06	5	5	100				15	36		
			Hydrangea arborescens radiata		07		4	80				31	35		
			/NCR PI Sta.												
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		
			/NCR PI Sta.		04		2	40	3			53	120		
					05		2	40				88	180		
					06		2	40				123	238		Deer damage
					07		2	40				148	296		

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 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		
			/NCR PI Sta.		04		5	100	3	6	6	17	92		2 - girdled by deer
					05		5	100				28	139		
					06		5	100				40	180		
					07		5	100				36	186		
F1 25 1-3	SHAR	9050431	silver buffaloberry	02	02	2	2	100	6	6	7	14	61		Browse
			Shepherdia argentea		03		2	100	3			31	104		
			/NCR PI Sta.		04		2	100	5			82	176		Mechanical damage
					05	1	1	100				117	211		No. 1 - Disked out.
					06	(2)	1	100				146	268		
					07		1	100				191	315		
F1 25 6-10	SOTO8	9050432	wild service tree	02	02	4	4	100	7	1	2	16	47		Browse
			Sorbus torminalis		03		4	100	8			23	39		No. 9 - replanted
			/NCR PI Sta.		04		3	60	5	5	5	17	60		3 - deer damage
					05		3	60				25	104		
					06		3	60				36	144		
					07		3	60				41	174		
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., Kans.		93		6	100				152	150		No. 6 - leaves dried up early
			/KSPMC		94		6	100							Mildew
					95		5	83					186		
					05		5	83					252		
F2 4 1-10	PYUS2	9006095	Harbin pear	67	70	10	10	100	3			210	238		
			Pyrus ussuriensis		71		10	100	3			213	322		
			Morden, Manitoba, Can.		73		10	100	3						
			/NDPMC		74		10	100	3			488	533		
					75		10	100	3			549	610		
					76		10	100	3			640	732		
					78		10	100	3			670	750		
					79		10	100				770	770		
					83		10	100	3	4	3	1000	825		
					88		10	100	2	2	3	1280	880		
					93		9	90					1045	24	Good fruit production; No. 6 - wind
					96		9	90	1				1119		damage
					01		8	80	4				974	24	
					07		8	80					1159	33	

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 10 1-4	DIVI5	9050011	common persimmon	89	89	4	4	100	9	3		3	13		
			Diospyros virginiana		90		4	100	1			22	45		
			/NCR PI Sta.		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		No. 1& 2 - herbicide damage
					03		4	100					605		No. 1 - a resprout; fruit amount - 5
F2 11 1-5	CELAR	9050519	*netleaf hackberry* *Celtis laevigata* var *reticulata* *Union Co., N. Mex.* /NCR PI Sta.	07	07	5	5	100				26	47		
F2 11 6-10	ALMA7	9050518	seaside alder *Alnus maritime* subsp. *oklahomensis* Tishomingo, Okla./ISU, Ames, Iowa /NCR PI Sta.	07	07	4 (5)	4	100				42	64		
F2 12 1-5	CECA4	9050520	red bud *Cercis canadensis* Van Buren Co., Iowa /NCR PI Sta.	07	07	5	5	100				49	58		
F2 12 6-10	CECA4	9050521	red bud *Cercis canadensis* Keokuk, Lee Co., Iowa /NCR PI Sta.	07	07	5	5	100				51	65		
F2 13 1-5	PTTR	9050523	common hoptree *Ptelea trifoliate* Van Buren Co., Iowa /NCR PI Sta.	07	07	5	5	100				59	115		
F2 13 6-10	CRCH	9076686	fireberry hawthorn *Crataegus chrysocarpa* Lincoln-Oakes Nursery /NDPMC	07	07	5	5	100				15	37		

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 23 1-5	SYPE2	9006225	Pekin 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		
F2 23 6-10	FORSY	9034667	early forsythia hybrid	73	73	5	5	100	1			88	73		
			Forsythia europaea X		74		5	100	1			116	143		
			ovata		75		5	100	3			142	189		
			/NCR PI Sta.		76		5	100	3			180	201		
					77		5	100	3			210	215		
					78		5	100	3			315	255		
					79		5	100	1			300	300		
					83		5	100	1	2	2	470	350		
					93		5	100					350		
					02		5	100					305		
					07		5	100					252		
F3 2 1-11	QUPA2	9001069	pin oak	67	70	11	9	82	3						
			Quercus palustris		71		9	82	5			290	332		
			/Manhattan Nursery		74		9	82	5			457	518		
			Manhattan, Kans.		75		9	82				488	700		
					76		9	82				670	762		
					78		8	73				800	960		
					01		8	73					1334	37	
					07		7	67					1670	43	
F3 3 2-6	ULPA	486339	lace-bark elm	02	02	3	3	100	4	1	3	19	58		
			Ulmus parvifolia		03	5	5	100				30	78		Added 2 new plants
			/NCR PI Sta.		04		5	100	2	2	2	73	163		Good clean foliage
					05		5	100				123	250		
					06		5	100					317		
					07		5	100					384		

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 5 1-5	FRPE	9004305	green ash	69	69	5	5	100	1						
			Fraxinus pennsylvania		71		5	100	2			213	271		
			Butler Co., Kans. /KSPMC		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		No. 1 - blown down 6/03 - rot
					90		4	80	2	5					
					03		4	80					1178	33	
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		
			W. North Dakota /NCR PI		05		1	20				82	188		
			Sta.		06		1	20					191		Deer damage
					07		1	20				89	201		
F3 7 2-4	POAL7	9050499	white poplar	06	06	3	3	100					168		No. 2 - deer damage
			Populus alba		07		3	100				268	315		
			South Korea /NCR PI Sta.												
F3 7 6-10	TICO2	9050481	littleleaf linden	03	03	2	2	100				20	40		
			Tilia cordata		04		1	50	5	4	5	51	67		
			Ukraine /NCR PI Sta.		05		1	50				83	110		
					06		1	50					167		
					07		1	50				127	240		
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 /NCR PI Sta.		05		4	80				58	104		
					06		4	80					156		
					07		4	80				75	158		
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 /NCR PI Sta.		05		3	100				43	73		
					06		3	100					90		
					07		3	100				48	73		
F3 10 1-10	BENI	9034682	river birch	71	83	10	10	100	1	4	3	1100	1220		
			Betula nigra		86		10	100				1280	1300		
			Houston Co., Minn.		95		10	100					1359		
			/NCR PI Sta.		07		10	100					1525	32	

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 12 1-10	CEOC	9050497	common hackberry	06	06	10	10	100					78		
			Celtis occidentalis		07		10	100				60	90		
			Forest Keeling Nursery Elsberry, Mo.												
F3 13 1-10	CEOC	9066615	common hackberry	06	06	10	10	100					116		
			Celtis occidentalis		07		10	100				106	138		
			Oklahoma /KSPMC/NMPMC												
F3 14 1-5	CACA18	9050501	American hornbeam	06	06	5	5	100					60		
			Carpinus caroliniana		07		5	100				43	66		
			Minn., Wisc. /NCR PI Sta.												
F3 14 6-10	ULTH	9050503	rock elm	06	06	5	5	100					69		
			Ulmus thomasii		07		5	100				29	66		
			Dixon Co., Nebr. /NCR PI Sta.												
F3 15 1-10	FOPOP	9050502	stretchberry	06	06	10	10	100					92		
			Foresteria pubescens var *pubescens*		07		9	90				20	106		
			/NCR PI Sta.												
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., Kans. /KSPMC		78		10	100	1			475	670		
					86		10	100	5			732	1200		
					87		10	100	5				1043		
					88		10	100	2	3		798			
					90		10	100	4	2					
					95		9	90					1173		No. 1 - dead
					05		8	80					1236		
F3 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		
			/NCR PI Sta.		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		

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F3 19 6-10	FREX80	265620	European ash	73	73	5	5	100				30	174		
			Fraxinus excelsior		74		5	100				61	226		
			W. Germany /NCR PI Sta.		75		5	100	5			104	310		
					76		5	100	5			155	350		
					77		5	100	3			244	457		
					78		5	100	3			260	490		
					79		5	100	1			347	536		
					96		4	80					664	24	No. 4 - is a sucker
					07		1	20					822	34	
F3 20 1-5	QUERC	9034674	Swedish hybrid oak	72	72	5	5	100	3			9	37		
			Quercus sp.		73		5	100	3			27	61		
			/UNL-Lincoln /NCR PI Sta.		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	
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 /NCR PI		74		4	100	3			94	183		
			Sta.		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	

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
F3 21 6-10	QUPH	9050022	willow oak	90	90	5	5	100		2	3	22	32		
			Quercus phellos		91		4	80				21	34		Severe deer browse
			C. Tenn. /NCR PI Sta.		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		
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., Okla. /KSPMC		74		5	100	3			76	184		
					75		5	100	3			160	300		
					76		5	100	3			240	365		
					78		5	100	3			330	512		
					79		5	100	1			425	600		
					81		5	100	1		8	800	670	18	
					83		5	100	1	6	1		840	25	
					85		5	100	1				980		
					89		5	100	1				980	29	
					90		5	100	1						
					93		5	100	1				1021	32	
					96		5	100	1				1112		
					01		5	100	1				1171	36	
					07		5	100					1318	38	
F3 23 1-10	QUAC80	434253	sawtooth oak	73	73		10	100	3			64	66		
			Quercus acutissima		74		10	100	3			111	137		
			/GAPMC		75		10	100	3			200	270		
					76		10	100	3			275	305		
					78		10	100	3			400	550		
					79		10	100	3			450	650		
					83		10	100	1	3	3	650	800	20	
					89		10	100	3		1		951		
					93		10	100					959	43	No. 8 - suckers
					02		10	100					1230	30	
					07		9	90					1242	33	No. 4 - top gone
F4 1 6-10	PLOR80	9004461	Oriental arborvitae	68	75	5	5	100	3			396	427		
			Platycladus orientalis		76		5	100	3			396	457		
			/Okla. State Nursery		78		5	100	3			600	550		
			Norman, Okla. /KSPMC		79		5	100	5			600	640		
					83		5	100	3	3	4	700	620		
					93		5	100					820		
					96		2								Removed Nos. 6,7, and 10
					07		2						981		

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 3 6-10	PLOR80	9004434	Oriental arborvitae	72	75		5	100	5			115	175		
			Platycladus orientalis		76		5	100	5			180	250		
			Deuel Co., Nebr. /HPHR		78		4	80	5			270	400		
			Sta.,		79		4	80	5			320	470		
					83		4	80	4	5	4	550	575		
					96		4	80					796		
					06		4	80					845		
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., Nebr. /HPHR		83		5	100	3	5	3	160	430		Cedar-Apple rust
			Sta.,		99		5	100					963		
					04		5	100					1060		
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, Mont.												
F4 17 1-10	THOC2	477011	northern white cedar	82	83	10	10	100	5	5	3	47	73		
			Thuja occidentalis		96		10	100	3				472		
			/MIPMC		07		10	100					590		No. 3 - competition
F4 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		No. 1 - dying; 3 & 5 - dead

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 19 7-9	PISY	343948	Scots pine	76	76	(9)	1		7			30	15		
			Pinus sylvestris		77	3	3	100	7			20	20		
			/MDPMC		78		3	100	7			35	32		
					79		3	100	5			40	60		
					83		3	100	3	3	3	215	185	2	
					86		3	100				340	370		
					95		3	100					691		
					00		3	100					924		
					05		3	100							No. 9 - 90% dead
					07		1	33					975		No. 7 - dying; 8 & 9 - 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, Wis.		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		7	70							Nos. 6-8 - dead
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 /RMFR		76		10	100	3			75	95		
			Exp. Sta. /KSPMC		78		9	90	3			140	120		
					79		9	90	3			150	160		
					83		9	90	2			350	340	7	
					93		9	90					677	15	
					02		8	80					985		
					07		6	60					1149		Nos. 1, 5, 8 - dead
F4 22/ 1-10	PINI	9004364	Austrian pine	73	75	10	10	100	3			70	75		
			Pinus nigra		76		10	100	3			120	110		
			N. Turkey /RMFR Exp. Sta.		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		No. 1 - dying: No. 4 - dead
					07		6	60					1010		

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 24/ 8-20	PIHE	9034669	Heldreich pine	73	73	13	13	100	7						
			Pinus leucodermis		74	(20)	10	77	7						
			Yugoslavia /RMFR Exp.		75		8	61	7			10	15		
			Sta., Nebr. /MDPMC		76		8	61	5			20	25		
					78		7	54	7			27	33		
					79		7	54	7			27	35		
					83		6	46	7			70	85		
					93		6	46					258		
					03		5	38					494	8	
					07		3	23					552		
GA 1 1-4	ULPA	250278	Chinese elm	91	91	10	10	100				14	53		
2 1-4			*Ulmus parvifolia*		92		10	100					59		
G 1/ A-B			Rochester, N.Y. /MOPMC		93		10	100				60	96		
					94		10	100	2			84	113		Deer browse
					95		10	100					138		1 destroyed by deer, heavy browse
					05		10	100					742	11	
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, Okla. /NRCS		79		3	75	3			220	300		
			SO, Stillwater, Okla.		83		3	75	4			400	600	8	
			/KSPMC		93		3	75						16	
					98		3	75					1285		
					02		3	75					1321		
					03		3	75						30	
					04		3	75					1604		
					07		3	75					1783	31	E - top missing
G 2/ A-E	ULMUS	9004439	Offerle elm	63	70	5	5	100	5			323	643	10	
			Ulmus species		74		4	80	5			451	991	14	
			Edwards Co., Kans.		78		4	80	3			500	1050		
			/KSPMC		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	

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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,		78		4	80	3			500	1500		
			Okla. /KSPMC		79		4	80	3			650	1450	28	
					83		4	80	3			600	1300	35	
					93		4	80							
					97		4	80					1574		
					02		4	80					1699	39	
					07		4	80					1850	42	D - top broken; E - main stem broken
G 3/ F-J	CEOC	9004256	common hackberry	63	66	5	5	100	2			415	445	6	
			Celtis occidentalis		70		5	100	2			530	713	15	
			Pottawatamie Co., Kans.		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	
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, Kans.		79		5	100	3			400	1300		
					83		5	100	5			400	1250	24	
					93		5	100						31	
					97		5	100					1428		
					02		5	100					1487	37	
					07		5	100					1600	40	B - top dead
G 8/ F-J	CEOC	9004255	common hackberry	63	66	5	5	100	1			390	427	5	
			Celtis occidentalis		70		5	100	3			597	668	14	
			Central Oklahoma /KSPMC		74		5	100	2			732	920	22	
					78		5	100	3			900	1100		
					79		5	100	1				1125		
					83		4	80	7			800	1200	33	I, J - much dead wood – herbicide
					93		3	60						45	
					97		3	60					1707		
					02		3	60					1960	54	
					07		3	60					1933	56	
G 9/ F-J	CAIL2	9034679	pecan	63	70	5	5	100	5			183	326		
			Carya illinoensis		74		5	100	3			427	628	9	
			/KSU Forestry, Kans.		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	

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 10/ F-J	CAIL2	9034680	pecan	63	70	5	4	80	4			207	290		
			Carya illinoensis		74		4	80	3			436	695	10	
			/KSU Forestry, Kans.		78		4	80	5			450	800		
					79		4	80	3			500	880		
					83		4	80	3			600	760	23	
					93		4	80						31	
					97		4	80					1833		
					02		4	80					1996	36	
					07		4	80					2176	39	
G 2/ K-O	JUVI	9004329	eastern red cedar	63	70	5	5	100	1			323	421	9	
			Juniperus virginiana		74		5	100	1			451	567	15	
			/KSU Forestry, Kans.		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		
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., Okla.		78		4	100	1			500	700		
					83		4	100	3			600	825		
					02		4	100					1126		
					07		4	100					1266		
G 6/ K-O	JUVI	9004332	silver eastern red cedar	63	70	5	5	100	1			378	424	9	
			Juniperus virginiana		74		5	100	1			530	530	17	
			/SPR Sta.		78		5	100	3			550	700		
					83		5	100	4			750	900		
					02		5	100					1256		
					07		4	80					1303		
G 8/ K-O	PIPO	9034671	ponderosa pine	63	70	5	3	60	7			131	152		
			Pinus ponderosa		74		3	60	7			296	375	9	
			/KSU Forestry, Kans.		78		3	60	5			300	550		
					83		3	60	5			500	1250		
					02		3	60					1530		
					07		3	60					1682		
G 9/ K-O	PINI	9013469	Austrian pine	63	70	5	5	100	6			143	140		
			Pinus nigra		74		5	100	4			311	341		
			/KSU Forestry, Kans.		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							

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

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 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		
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., Kans.		79		3	100	1			250	240		
						83		3	100		1		550	575	9	
						93		3	100					1155	18	
						01		3	100					1329	24	
						06		3	100					1600	31	
G2 16	1-8	ULMUS	9004462	elm	76	76	8	8	100	3			110	130		
				Ulmus sp.		77		8	100	3			270	174		
				/NCR PI Sta.		78		8	100	1			420	315		
						79		8	100	1			600	400		
						83		8	100	1	3	3	900	860		
						86		8	100				914	1200		
						00		8	100					1551		
						05		8	100					1713		
G2 23	6-8	AEGL	9030309	Ohio buckeye	81	81	3	3	100				15	52		
				Aesculus glabra		82		3	100				15	58		
				/NCR PI Sta.		83		3	100	6	6	3	24	64		Leaves dropping 8/20.
						85		3	100	5		8		88		
						86		3	100	4	4	5	95	142		
						91		3	100				206	236		
						93		3	100					278		
						05		3	100					501		
G2 24	6-7	ACPL	9030308	Norway maple	81	81	3	3	100				21	118		
				Acer plantanoides		82		3	100				30	104		
				/NCR PI Sta.		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		

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
G3 16 1-8	QUAC80	9008245	sawtooth oak	76	76	8	8	100	5			25	40		
			Quercus acutissima		77		8	100	5			90	70		
			/KCPMC		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	
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, Okla.		78		8	100	3			100	180		
			/KSPMC		79		8	100	3			260	300		
					81		8	100	3				425		
					83		8	100	3	1	4	560	575	13	
					85		8	100	5			457	518	23	
					86		8	100	2			549	600		
					89		8	100						22	
					93		8	100					853	27	
					95		8	100					933	30	
					00		8	100					1048		
					05		8	100					1042	35	
G3 19 7	CACR27	9034858	chestnut hybrid	76	76	1	1	100	5			5	15		
			Castanea crenata		77	(8)	1	100	3			25	45		
			/MOPMC		78		1	100	3			80	90		
					79		1	100	3			180	200		
					83		1	100	1	1	2	520	440		
					85		1	100	1			460	457		
					93		1	100					679		
					95		1	100					738		
					00		1	100					884		
					05		1	100					842		
HQ1 1/1	NYSY	9050506	black gum	66	66	1	1	100							
			Nyssa sylvatica		06	1	1	100					1050	22	
			/Forrest Keeling Nursery, Elsberry, Mo.												
HQ1 2/2	MALUS	514275	hybrid crab apple	77	77	1	1	100							
			Malus sp.		07	1	1	100					900	29	
			Clinton Co., Mich. /MIPMC												

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
HQ1 3/1	TIEU3	9050505	Redmon Crimean linden	66	66	1	1	100							
			Tilia X *euchlora*		06	1	1	100				1483	1580	88	
			/Plumfield Nursery, Fremont, Nebr.												
HQ1 5/1-10	JUSQ2	9030990	blue star juniper	82	82	4	4	100				10	5		Plants not hardened off; failed to
			Juniperus squamata		83	(10)	4	100				12	6		establish.
			Holland /NCR PI Sta.		91		4	100				43	18		
					96		4	100	3			53	24		
					98		4	100				63	27		
					06		3	75				61	30		Declining; competition from grasses
HQ1 8/3	PIAY	9004363	Mexican white pine	77	77	1	1	100							
			Pinus strobiformis		06	1	1	100					1150		
			Lincoln Co., N. Mex. /RMFR Exp. Sta., Nebr.												
HQ2 2/16	SYOBD	9050510	Korean early lilac	76	76	1	1	100							
			Syringa oblate dilatate		06	1	1	100				24	268		
			/HPHR Sta.												
HQ2 3/1	ULDAJ	421614	Japanese elm	77	77	1	1	100							
			Ulmus davidiana var		82	1	1	100	1	3	3	475	470	6	
			japonica		83	1	1	100	1	2	3	450	600	9	
			/USDA ARS Nurs. Crops Res. Sta., Delaware, Ohio		06	1	1	100					1925	75	
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
			/NCR PI Sta.		03		5	100				81	109		Severe rubbing and browse damage
					04		5	100			7	104	156		Heavy deer browse
					05		5	100				154	225		
					06		5	100		3	7	212	293		
P/S 1-6, 8-10	PINI	399400	Austrian pine	77	77	9	9	100	7			13	12		
			Pinus nigra		78	(10)	9	100	7			30	23		
			/NCR PI Sta.		79		9	100	5			47	48		
					83		9	100	3			205	210	3	
					86		9	100	5			296	380		No. 9 produced seed
					96		9	100					668		
					01		9	100					817		
					06		8	89					1039		

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
P/S 7, 11-30, 55, 57, 83, 85	PINI	9034670	Austrian pine *Pinus nigra* /KSU Forestry, Manhattan, Kans.	81	83 86 95 01 05	25 (26)	25 23 23 23 23	100 92 92 92 92	5 5		3	28 64	22 62 337 615 750	 20 	 No. 55 produced seed
PQ/S 31-35, 37-50	PISY	399402	Scots pine *Pinus sylvestris* /NCR PI Sta.	77	77 78 79 83 86 96 01 06	20	20 20 20 19 19 19 19 13	100 100 100 95 95 95 95 65	3 3 3 2 5		3	14 33 52 230 345	21 36 56 225 342 728 844 1009	 4 25 	 No. 48 & 50 produced seed
P/W 1/ 1	LIST2	9050512	sweetgum *Liquidambar styraciflua* /Forest Keeling Nursery, Elsberry, Mo.	66	66 06	2	2 1	100 50				1564	1430	72	
P/W 1/ 2	JUVI	9050514	Canert juniper *Juniperus virginiana canaerti* /Nelson Nursery, Enid, Okla.	65	65 06	1 1	1 1	100 100							 Over topped with vines
P/W 1/ 3	JUHO2	9050513	blue creeping juniper *Juniperus horizontalis glauca* /MIPMC	66	66 07	1	1 1	100 100							
P/W 1/ 4	QURU	9000399	northern red oak *Quercus rubra* Greenwood Co., Kans. /KSPMC	66	66 06	1 1	1 1	100 100				1501	1130	44	
P/W 1/ 5-6	FRPE	9001455	ash Fraxinus *sp.* /Marshall Nursery, Arlington, Nebr.	71	71 06	2 2	2 2	100 100					1225	65	

Table 2.6 Study No. - 20I010K Initial Evaluation: Misc. Woody Plant Materials Manhattan, Kans. (continued)

Plot Location	PLT SYM	Accession Number	Species Origin/Source	YR PLT	YR REC	NO. EST	NO. SRV	PCT SRV	VI	DI	IN	CAN COV	PLT HGT	PLT DBH	Plot Remarks
Q/S 51-54, 56, 58-70	PISY	399403	Scots pine *Pinus sylvestris* /NCR PI Sta.	77	77	18	18	100	3			18	24		
					78	(20)	18	100	3			35	36		
					79		18	100	3			55	57		
					83		18	100	1	4	3	245	240	5	
					86		18	100	5			381	413		52,53,58,61-62,65,68 prod. seed
					96		18	100					819		
					01		18	100					945	28	
					06		13	72					1178		
Q/S 71-82, 84, 86-90	PISY	399404	Scots pine *Pinus sylvestris* /NCR PI Sta.	77	77	18	18	100	5			12	16		
					78	(20)	18	100	5			26	21		
					79		18	100	5			40	36		
					83		18	100	3	3	3	175	175	2	
					86		18	100	5			294	315		
					96		18	100					714		
					01		18	100					832	31	
					06		18	100					991		

Legend for miscellaneous trees 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

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
* May not agree with current plot number designations.

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

3. Study No. 20I026K - Evaluation of hackberry.

Introduction: Common hackberry (*Celtis occidentalis* L.) is a small-to-medium tree 9.1- to 15.2-m (30-to 50-ft) tall and 0.5 to 0.6 m (18 to 24 in) in diameter varying greatly in response to habitat. Potentially the species may attain heights upwards of 30.5 to 39.6 m (100 to 130 ft) and trunk diameters up to 1.2 m (4 ft). The crown is normally rounded and composed of large spreading branches. Hackberry is drought resistant and has survived extremely dry periods on the Great Plains. It is a long-lived species, believed to live 150 to 200 years (USDA Forest Service 1965; Rehder 1940).

A native to North America, common hackberry is commonly found throughout the eastern three-quarters of the Great Plains and stretching on east to the east coast. Hackberry grows on rich, moist soils along streambanks, on flood plains, and on rocky hillsides in open woodlands. In western Nebraska, hackberry grows on the north side of sand dunes and in river valleys.

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

On-Center evaluations of plant materials for western Nebraska and western Kansas have proven to be unsatisfactory. Extreme differences in climate make initial evaluation at Manhattan unreliable and insufficient. For this reason, initial evaluations are being conducted where the species is needed.

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

Procedure: The original assembly consisted of 43 accessions. The seed was planted in a seedling nursery in the fall of 1979. Seedlings 0.3-m (1-ft) tall were lifted in the fall of 1980 and placed in cold storage. An initial evaluation planting (IEP) at the Manhattan PMC and field evaluation plantings (FEP) at the Tribune Experiment Station and Sheridan Wildlife Area near Quinter, Kansas, were made in the spring of 1981. A field planting was made at Valentine, Nebraska. The only successful plantings were the Manhattan IEP and the Tribune FEP. The Manhattan IEP consists of 1 to 6 plants per plot in a non-replicated randomized planting; refer to Figures 2.1 and 2.2 in the MAPS section of this report for plot locations. The Tribune FEP was established in a completely randomized design, 3 plants/plot and 3 replications. The spacing between plants was 4.6 x 5.5 m (15 x 18 ft).

Potential Products: Cultivar Release

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

Literature Cited:

Rehder, A. Manual of Cultivated Trees and Shrubs. The Macmillan Company, New York, 1940, 996 p.

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4. Study No. 20I031K - Evaluation of Oriental arborvitae.

Introduction: Oriental arborvitae (*Platycladus orientalis* [L.] Franco) is a medium-sized tree reaching heights of 9 to 11 m (30 to 36 ft) at maturity. Growth habit is normally pyramidal or bushy. Many cultivars exhibiting unique characteristics of growth form and color have been selected for landscape use.

Oriental arborvitae is native to Asia occurring in northern and western China and Korea. It is an aromatic evergreen with scale-like appearance. Male and female flowers are borne on the same tree but usually on separate twigs or branches. Flower buds form in the fall and develop into small cones, 1.1-to-2.5-cm (0.4-to-1-in) long with 6 to 8 scales per cone. The cones mature the following spring. *Platycladus orientalis* is easily distinguished from a similar species native to the U.S.; eastern white cedar (*Thuja occidentalis* L.) which has a vertical disposition of leaf sprays, thick cone scales, and wingless seed.

Oriental arborvitae is adapted to a wide range of soil types and excellent survival can generally be expected from the use of bare-root stock.

Problem: Eastern red cedar (*Juniperus virginiana* L.) and Rocky Mountain juniper (*J. scopulorum* Sarg.) are two commonly planted evergreens in the Western Great Plains which serve as alternate hosts for cedar apple rust. In addition, eastern red cedar is often considered a weed pest in poorly managed pasture and rangeland. Evergreen species that do not pose a threat to fruit orchards or occur as a weed pest are needed for use in field and farmstead windbreaks. Diversity within windbreak plantings is desirable to ensure continued function with outbreaks of specific disease and insect pests. Oriental arborvitae offers a potential alternative evergreen for use in place of or in addition to eastern red cedar or Rocky Mountain juniper.

No adapted cultivars of oriental arborvitae are available for use in Major Land Resource Areas (MLRAs) 64, 65, 67, 71-73, and 77-80 in western Nebraska and Kansas. Oriental arborvitae is available through the Oklahoma State Forestry Nursery, but this material is unproven over a large portion of the total area for which the species could be adapted. A tested and proven cultivar of oriental arborvitae is needed to provide consistent high quality plant material for farmstead and field windbreak plantings in the Great Plains.

On-Center evaluation of plant materials for the Western Great Plains area has proven to be unsatisfactory. Evaluation of plant materials at Manhattan cannot adequately test for extremes of climate encountered in the High Plains of western Kansas, Nebraska, and Oklahoma. For this reason, initial evaluation will need to be conducted off-Center in areas for which the plant material is intended for eventual use.

Objectives: Select a superior accession or accessions of oriental arborvitae for use in windbreak and wildlife plantings in western Kansas, Nebraska, and Oklahoma.

Initial evaluation must be conducted off the PMC in MLRAs for which the plant has been selected. Planting, evaluation, and plot maintenance should be conducted in a precise and controlled manner as outlined by the study plan.

Procedure: Fifty-five accessions were assembled from seed collections in Kansas, Nebraska, Oklahoma, and 27 foreign countries. Insufficient seedling numbers caused by low germination narrowed the field to 35 accessions to be evaluated. Accessions (n) were planted at the Manhattan PMC, Kansas (35); Southern Plains Range Research Station, Woodward, Oklahoma (18); Mead, Nebraska (16); Alliance, Nebraska (22); Sheridan Wildlife Area, Quinter, Kansas (26); and Knox City PMC, Texas (15). All plantings were made in 1983, using 2-0 stock in a randomized complete block design. With the exception of the Manhattan PMC and Knox City PMC, plantings contained 3 replications with 3 trees per plot on a 3- x 4.6-m (10- x 15-ft) spacing. The Manhattan and Knox City plantings were non-replicated plots consisting of 6 trees per plot and 5 trees per plot, respectively. Refer to MAPS Figure 3.1 for plot locations at Manhattan.

Evaluation Factors: Factors for evaluation include survival, rate of growth, vigor, plant size, uniformity, foliage density, and stress due to climatic factors, insects, and disease. Special attention will be given to winter hardiness in northern plantings.

Potential Products: Cultivar Release

Progress or Status: Archiving seed of each tree was continued this year. It is desirable to retain seed of each tree before they are removed from the plantation. Seed was collected from each individual tree that produced seed at Manhattan. The amount of fruit was rated for each tree before collecting cones (Table 4.1). A representative sample of cones was collected from each tree. The collection process began once cones had begun to open exposing the mature seeds. Collecting continued until enough cones were collected from each tree to fill up to an 11.5- x 12-cm (4.5- x 5-in) cloth bag. The cones were dried down and placed in the seed storage building until the collections can be processed. This was the fourth and final year of seed collecting. Only trees that were identified as selections and those that have produced little seed in the past were collected from this year. Fruit production was down affecting seed fill and the amount of seed produced. The decline was noted in 71% of the accessions. Twenty-five year height measurements were taken at Manhattan this year. Individual heights ranged from 318 to 1005 cm (10.4 to 33 ft) for accessions 9014890 and 9013567, respectively. Mean tree heights ranged form 463 to 963 cm (15.2 to 31.6 ft), represented by accessions 9019850 and 9013567, respectively. Refer to Table 4.2a and Table 4.2b, for a summary of evaluation data for individual accessions.

Table 4.1 Four year mean fruit production ratings*, Platycladus *orientalis* IEP at Manhattan, Kans.

Accession	2004	2005	2006	2007	4-Yr Mean
9010077	5.5	6.0	5.0	6.0	5.6
9012467	7.0	8.5	7.5	6.3	8.1
9013566	4.0	9.0	3.0	1.0	4.3
9013567	8.5	8.2	6.0	7.2	7.5
9013570	6.5	8.2	6.2	6.3	6.8
9013571	6.0	5.5	5.0	6.5	5.8
9013573	8.0	9.0	7.0	8.0	8.0
9013574	7.3	8.5	4.3	5.0	6.3
9013575	7.2	7.2	4.2	3.8	5.6
9013576	7.2	6.6	5.6	4.8	6.1
9013577	8.3	7.3	7.0	4.8	6.9
9013578	7.5	7.5	6.3	7.0	7.1
9013579	7.5	6.3	5.3	6.0	6.3
9013580	9.0	9.0	9.0	9.0	9.0
9014890	7.8	6.2	6.4	5.4	6.5
9015329	8.0	9.0	9.0	9.0	8.8
9017764	4.7	3.0	2.0	4.7	3.6
9017879	4.3	6.7	5.3	5.7	5.5
9019848	4.0	4.7	3.3	6.8	4.7
9019849	7.2	7.5	6.5	8.3	7.4
9019850	9.0	8.5	9.0	9.0	8.9
9019853	5.2	2.6	1.6	4.4	3.5
9019854	7.0	6.0	8.0	8.0	7.3
9021012	8.0	8.0	7.0	9.0	8.0
9023359	6.3	5.2	5.2	5.0	5.4
9026610	4.8	5.5	4.2	7.0	5.4
9026687	8.2	7.5	6.5	6.8	7.3
9026780	6.4	6.0	5.2	5.0	5.7

* Rating (1-9, none – severe)

Literature Cited:

Schopmeyer, C. S., Technical Coordinator, 1974. Seeds of Woody Plant in the United States. Agriculture Handbook No. 450. USDA Forest Service, Washington, D.C., p. 805-809.

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans.

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
J 1	1-6	9010076	France	83	83	6	6	100	4												
					84		5	83	6												
					85		5	83	5	1	2		6								
					86		5	83	7												
					87		5	83	7	3	6	3	7	6	7					9	
					88		5	83	6	1	2	4		6	8		5	0		0	
					89		5	83	6		1										
					90		5	83	9	4		8									
J 1	7-12	9010077	France	83	83	6	6	100	3												
					84		6	100	5												
					85		6	100	5	1	2		8								
					86		6	100	8												
					87		6	100	8	2	5	3	9	5	6					5	
					88		6	100	7	1	2	2		3	4		6	1	10/13	7	3
					89		4	67	5	4	1	3									
					90		2	33	8	1		7									
					92		2	33													
					94		2	33													
					98		2	33			8										
					99		2	33		5						2				1	
					02		2	33												2	
					07		2	33										2		6	
J 1	13-18	9011202	England	83	83	6	6	100	3												
					84		6	100	6												
					85		6	100	6	1	4		7								
					86		6	100	8												
					87		6	100	7	1	8	4	8	8	9					8	
					88		6	100	7	4	3	3		9	9		6	0		0	
					89		6	100	6	1	2	5									
					90		6	100	9	4		7									
J 1	19-24	9012467	France	83	83	6	6	100	3												
					84		6	100	5												
					85		6	100	4	1	2		2								
					86		6	100	7												
					87		6	100	6	2	7	2	4	3	4					7	
					88		6	100	6	1	2	2		3	3		6	1	9/23	9	9
					89		6	100	5	1	5	2									
					90		6	100	7	1		4									
					92		6	100													
					94		6	100													
					98		6	100			8										
					99		6	100		3						1				7	
					02		6	100												5	
					07		6	100												6	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
J 1	25-30	9013567	Russell Co., Kans.	83	83	6	6	100	2												
					84		6	100	1												
					85		6	100	1	1	2		3								
					86		5	83	1												
					87		6	100	2	1	5	3	2	8	8					7	
					88		6	100	2	3	1	1		6	8		6	1	9/8	9	6
					89		6	100	1	1	1	1									
					90		6	100	3	1		1									
					92		6	100													
					94		6	100													
					98		6	100			3										
					99		6	100		2						2				7	
					02		6	100												5	
					07		6	100												7	
J 1	31-36	9013568	Seward Co., Kans.	83	83	6	6	100	6												
					84		3	50	7												
					85		3	50	7	1	2		1								
					86		3	50	9												
					87		3	50	7	1	2	3	1	1	2					0	
					88		1	17	9	1	2	8		1	1		2	0			
					89		1	17	9	1	1	9									
J 1	37-42	9013569	Wallace Co., Kans.	83	83	6	6	100	5												
					84		6	100	6												
					85		6	100	7	1	2		5								
					86		6	100	9												
					87		6	100	8	1	9	3	5	2	4					4	
					88		6	100	9	2	4	5		2	3		6	1	9/18	9	4
					89		3	50	8	1	1	9									
					90		3	50	9			6									
J 1	43-48	9013570	Webster Co., Nebr.	83	83	6	6	100	3												
					84		6	100	2												
					85		6	100	3	1	3		5								
					86		6	100	2												
					87		6	100	3	2	5	3	4	9	9					8	
					88		6	100	5	4	5	3		6	8		6	1	9/8	5	2
					89		6	100	1	1	3	7									
					90		6	100	7			3									
					92		6	100													
					94		6	100													
					98		6	100			4										
					99		6	100		2						7				7	
					02		6	100												4	
					07		4	67												7	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot	Location	Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
J 1	49-54	9013571	Custer Co., Okla.	83	83	4	4	100	7												
					84		2	50	2												
					85		2	50	3	1	3		3								
					86		2	50	3												
					87		2	50	1	3	6	2	3	5	6					4	
					88		2	50	3	2	1	2		6	7		2	2		8	3
					89		2	50	4	3	6	2									
					90		2	50	6			4									
					92		2	50													
					94		2	50													
					98		2	50			7										
					99		2	50		4						4				4	
					02		2	50												4	
					07		2	50												7	
J 1	55-60	9013572	Oklahoma Co., Okla.	83	83	6	6	100	3												
					84		6	100	4												
					85		6	100	4	1	3		8								
					86		6	100	6												
					87		6	100	7	4	7	3	5	6	6					8	
					88		6	100	6	3	5	3		5	3		5	1	9/18	9	4
					89		2	100	5	1	1	3									
					90		2	100	7			5									
					92		1	50													
					94		1	50													
					98		1	50			9										
					99		0	0													
J 2	1-6	9017764	Spain	83	83	6	6	100	2												
					84		6	100	4												
					85		6	100	4	1	2		4								
					86		6	100	4												
					87		6	100	4	5	7	3	2	7	8					6	
					88		6	100	5		1	4		7	9		6	2	9/23	9	8
					89		6	100	4	6	1	2									
					90		6	100	9			7									
					92		3	50													
					94		3	50													
					98		3	50			2										
					99		3	50		3						3				1	
					02		3	50												2	
					07		3	50												5	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
J 2 7-12	9017879	USSR	83	83	6	6	100	3												
				84		5	83	5												
				85		5	83	5	1	2		5								
				86		5	83	6												
				87		5	83	5	3	5	3	5	5	6					7	
				88		5	83	6	3	4	6		4	5		5	1	9/29	9	8
				89		5	83	5	1	1	2									
				90		5	83	9	2		6									
				92		3	50													
				94		3	50													
				98		3	50			3										
				99		3	50		4						1				2	
				02		3	50												3	
				07		3	50												6	
J 2 13-18	9018973	Japan	83	83	6	6	100	4												
				84		4	67	5												
				85		4	67	7	1	3		7								
				86		4	67	7												
				87		4	67	7	1	5	2	3	6	8					9	
				88		4	67	6	1	3	2		7	8		4	0			
				89		4	67	5	5	1	1									
				90		4	67	9	2		9									
J 2 19-24	9019848	Clark Co., Okla.	83	83	6	6	100	3												
				84		6	100	3												
				85		6	100	1	1	2		2								
				86		6	100	2												
				87		6	100	1	1	1	2	4	6	7					4	
				88		6	100	3	2	2	1		6	7		6	3	10/13	5	1
				89		6	100	2	4	1	1									
				90		6	100	5	4		2									
				92		6	100													
				94		6	100													
				98		6	100			6										
				99		6	100		2						3				2	
				02		6	100												2	
				07		6	100												7	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
J 2 25-30	9019849	Harper Co., Kans.	83	83	6	6	100	3												
				84		6	100	4												
				85		6	100	4	1	1		2								
				86		6	100	5												
				87		6	100	5	2	4	2	2	5	7					7	
				88		6	100	4	1	1	2		5	7		6	3	9/29	9	7
				89		6	100	3	1	1	6									
				90		6	100	4	5		3									
				92		6	100													
				94		6	100													
				98		6	100			5										
				99		6	100		5						3				5	
				02		6	100												5	
				07		6	100												8	
J 2 31-36	9019850	Washita Co., Okla.	83	83	6	6	100	3												
				84		6	100	5												
				85		6	100	5	1	1		1								
				86		6	100	7												
				87		6	100	7	4	3	2	3	1	2					8	
				88		5	83	8	4	2	7		1	1		5	0			
				89		5	83	7	9	1	2									
				90		5	83	8			8									
				92		2	33													
				94		2	33													
				98		2	33			4										
				99		2	33		2						1				9	
				02		2	33												9	
				07		2	33												9	
J 2 37-42	9019853	Woodward Co., Okla.	83	83	6	6	100	3												
				84		6	100	4												
				85		6	100	3	1	2		5								
				86		6	100	3												
				87		6	100	4	1	5	2	3	6	8					2	
				88		6	100	4	2	1	2		4	5		6	6	9/18	1	1
				89		6	100	5	1	1	6									
				90		6	100	8	6		3									
				92		5	83													
				94		5	83													
				98		5	83			1										
				99		5	83		4						2				1	
				02		5	83												1	
				07		5	83												4	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
J 2 43-48	9019854	Wallace Co., Kans.	83	83	6	6	100	5												
				84		6	100	6												
				85		6	100	5	1	1		4								
				86		6	100	8												
				87		6	100	6	2	2	1	4	1	1					9	
				88		4	67	9	3	2	8		1	1		5	0			
				89		3	50	7	1	1	3									
				90		3	50	8	3		7									
				92		2	33													
				94		2	33													
				98		2	33			8										
				99		1	17		2										7	
				02		1	17												7	
				07		1	17												8	
J 2 49-54	9020979	Portugal	83	83	6	6	100	5												
				84		5	83	9												
				85		4	67	8	1	2		4								
				86		4	67	9												
				87		4	67	9	1	7	3	4	2	3					0	
				88		1	17	9			9					0	0			
				89		0	0													
J 2 55-59	9021012	Portugal	83	83	5	5	100	4												
				84		5	100	5												
				85		4	80	3	1	4		4								
				86		4	80	5												
				87		4	80	6	4	7	7	2	6	7					9	
				88		4	80	7	7	1	4		6	6		4	0			
				89		2	40	5	9	1	4									
				90		2	40	8	9		7									
				92		2	40													
				94		1	20													
				98		1	20			6										
				99		1	20		2						1				2	
				02		1	20												5	
				07		1	20												9	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
L 1	1-6	9013573	Harlan Co., Nebr.	83	83	6	6	100	4												
					84		5	83	7												
					85		5	83	6	1	1		2								
					86		5	83	8												
					87		5	83	7	1	3	2	3	2	3					9	1
					88		5	83	8	2	2	3		1	2		5	1		9	9
					89		5	83	5	1	3	2									
					90		4	67	8												
					92		1	17													
					94		1	17													
					98		1	17			2										
					99		1	17		2						1				6	
					02		1	17												6	
					07		1	17												8	
L 1	7-12	9013574	Harlan Co., Nebr.	83	83	6	6	100	3												
					84		6	100	3												
					85		6	100	2	1	2		1								
					86		6	100	3												
					87		6	100	4	1	4	2	1	8	7					5	1
					88		6	100	1	1	4	1		6	8		6	1	9/23	9	7
					89		6	100	2	1	4	1									
					90		6	100	1												
					92		6	100													
					94		6	100													
					98		6	100			3										
					99		6	100		2						2				5	
					02		6	100												2	
					07		6	100												5	
L 1	13-18	9013575	Harlan Co., Nebr.	83	83	6	6	100	3												
					84		6	100	2												
					85		6	100	1	1	2		1								
					86		6	100	1												
					87		6	100	3	1	5	2	3	9	8					5	1
					88		6	100	2	4	7	2		7	9		6	2	9/23	9	6
					89		6	100	3	1	2	1									
					90		6	100	5												
					92		6	100													
					94		6	100													
					98		6	100			2										
					99		6	100		4						3				5	
					02		5	83												3	
					07		5	83												4	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
L 1	19-24	9013576	Tulsa Co., Okla.	83	83	6	6	100	3												
					84		6	100	5												
					85		6	100	3	1	2		4								
					86		6	100	5												
					87		6	100	5	2	3	2	6	3	5					6	
					88		5	83	5	9	6	7		2	3		6	0			
					89		5	83	5	4	6	5									
					90		5	83	3												
					92		5	83													
					94		5	83													
					98		5	83			6										
					99		5	83		4						2				4	
					02		5	83												4	
					07		5	83												5	
L 1	25-30	9013577	Greeley Co., Kans.	83	83	6	6	100	3												
					84		6	100	4												
					85		6	100	3	1	2		3								
					86		6	100	4												
					87		6	100	5	2	3	1	7	6	6					6	
					88		5	83	6	8	5	7		7	9		6	1	9/18	9	9
					89		6	100	6	2	2	5									
					90		6	100	5												
					92		4	67													
					94		4	67													
					98		4	67			5										
					99		4	67		3						3				5	
					02		4	67												4	
					07		4	67												5	
L 1	31-36	9013578	Kingfisher Co., Okla.	83	83	6	6	100	4												
					84		6	100	4												
					85		6	100	4	1	3		4								
					86		6	100	5												
					87		6	100	6	2	5	2	8	5	7					7	
					88		6	100	7	3	1	3		7	6		6	0			
					89		6	100	5	1	1	1									
					90		6	100	6												
					92		6	100													
					94		6	100													
					98		6	100			2										
					99		6	100		2						2				4	
					02		6	100												4	
					07		6	100												7	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
L 1	37-42	9013579	Rooks Co., Kans.	83	83	6	6	100	3												
					84		6	100	4												
					85		6	100	3	1	2		4								
					86		6	100	4												
					87		6	100	2	1	3	3	4	7	7					8	
					88		5	83	4	5	2	2		5	8		5	0			
					89		5	83	4	2	1	5									
					90		5	83	5												
					92		4	67													
					94		4	67													
					98		4	67			4										
					99		4	67		2						3				4	
					02		4	67												4	
					07		4	67												6	
L 1	43-48	9013580	Woodward Co., Okla.	83	83	6	6	100	3												
					84		6	100	5												
					85		6	100	4	1	3		7								
					86		5	83	7												
					87		5	83	7	4	8	4	8	7	9					8	
					88		5	83	7	8	5	6		6	9		5	1	9/18	9	5
					89		4	67	6	8	1	5									
					90		4	67	8												
					92		1	17													
					94		1	17													
					98		1	17			3										
					99		1	17		2						2				4	
					02		1	17												4	
					07		1	17												9	
L 1	49-54	9014890	Portugal	83	83	6	6	100	4												
					84		5	83	5												
					85		6	100	4	1	3		6								
					86		5	83	4												
					87		5	83	5	1	5	4	5	6	7					2	
					88		5	83	5	2	4	3		6	8		5	0			
					89		5	83	5	2	1	2									
					90		5	83	7												
					92		5	83													
					94		5	83													
					98		5	83			4										
					99		5	83		2						2				5	
					02		5	83												3	
					07		5	83												5	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
L 1	55-59	9015329	France	83	83	5	5	100	5												
					84		4	80	6												
					85		4	80	4	1	3		3								
					86		4	80	4												
					87		4	80	6	5	7	4	4	7	8					7	2
					88		4	80	7	7	1	6		7	8		4	0			
					89		4	80	7	4	1	5									
					90		3	60	9												
					92		1	20													
					94		1	20													
					98		1	20			2										
					99		1	20		3						4				4	
					02		1	20												5	
					07		1	20												9	
L 2	1-6	9023359	Sumner Co., Kans.	83	83	6	6	100	3												
					84		6	100	4												
					85		6	100	3	1	3		3								
					86		6	100	4												
					87		6	100	3	2	4	2	5	6	8					1	
					88		6	100	6	2	3	3		8	9		6	3	9/23	2	1
					89		6	100	4	2		2									
					90		6	100	7												
					92		6	100													
					94		6	100													
					98		6	100			1										
					99		6	100		3						2				2	
					02		6	100												2	
					07		6	100												5	
L 2	7-12	9026610	Beaver Co., Okla.	83	83	6	6	100	3												
					84		6	100	5												
					85		6	100	3	1	2		3								
					86		6	100	3												
					87		6	100	2	1	5	2	4	6	7					3	
					88		6	100	3	1	1	2		6	8		6	4	9/23	3	2
					89		6	100	3	2	2	2									
					90		6	100	4												
					92		6	100													
					94		6	100													
					98		6	100			1										
					99		6	100		2						2				2	
					02		6	100												4	
					07		6	100												7	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
L 2 13-18	9026687	Manhattan PMC	83	83	6	6	100	4												
				84		6	100	6												
				85		6	100	5	1	1		4								
				86		6	100	7												
				87		6	100	4	2	7	2	6	4	6					9	
				88		6	100	5	1	9	3		3	3		6	1	9/23	9	3
				89		6	100	2	1	6	1									
				90		6	100	4												
				92		6	100													
				94		6	100													
				98		6	100			4										
				99		6	100		3						1				2	
				02		6	100												3	
				07		6	100												7	
L 2 19-24	9026780	Oklahoma State Nursery	83	83	6	6	100	7												
				84		5	83	6												
				85		6	100		1	2		4								
				86		4	67	4												
				87		4	67	5	1	6	5	7	7	9					5	
				88		4	67	6	2	8	4		6	7		4	0			
				89		4	67	6	1	1	3									
				90		4	67	5												
				92		3	50	7												
				94		3	50													
				98		3	50													
				99		3	50		3						3				3	
				02		3	50												1	
				07		3	50												5	
L 2 25-30	9004461	(space reserved)																		
L 2 31	9013566	Deuel Co., Nebr.	83	83	1	1	100	3												
				84		1	100	3												
				85		1	100	2	1	2										
				86		1	100	2												
				87		1	100	3	2	4	2		7	8					4	
				88		1	100	4	2	3	2		6	7		1	1	9/08	8	4
				89		1	100	5	1	1	1									
				90		1	100	5												
				92		1	100													
				94		1	100													
				98		1	100			8										
				99		1	100		3						2				4	
				02		1	100												1	
				07		1	100												1	

Table 4.2a Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	NO EST	NO SRV	PCT SRV	VI	DI	IN	CT	UN	FOL ABU	FOL DIS	FOL DEN	NUM BLM	NUM FRT	MAT DAT	FRT AMT	SD FILL
L 2 32-33	9019852	Sedgwick Co., Kans.	83	83	2	2	100	4												
				84		2	100	5												
				85		2	100	6	1	1		3								
				86		2	100	9												
				87		2	100	7	3	2	4	2	2	3					0	
				88		2	100	8	7	1	8		1	2		2	1			
				89		2	100	9	1	7	4									
				90		2	100	9												
L 2 34-35	9023358	Ford Co., Kans.	83	83	2	2	100	5												
				84		2	100	9												
				85		2	100	9	1	2		1								
				86		2	100	9												
				87		2	100	9	7	5	6	3	2	2					0	
				88		1	50	9	7	2	8		2	4		1	0			
				89		1	50	9	1	1	7									
				90		0	0	9												
L 2 36-46	9026780	Oklahoma State Nursery	83	83	3	3	100													
				84		3	100	8												
				85		2	67	4	1	2		2								
				86		2	67	5												
				87		2	67	4	1	4	3	3	6	7					6	
				88		2	67	5	2	4	4		5	6		2	0			
				89		2	67	3		1										
				90		2	67	4												
				92		2	67													
				94		2	67													
				98		2	67			3										
				99		2	67		3						2				1	
				02		2	67												1	
				07		2	67												5	
L 2 47-48	9019852	Sedgwick Co., Kans.	83	83	2	2	100													
				84		2	100													
				85		2	100	4	1	2		3								
				86		2	100	5												
				87		2	100	4	2	4	1	4	4	5					9	
				88		2	100	5	1	1	3		3	4		2	0			
				89		2	100	4	1	1	1									
				90		2	100	3												
				92		2	100													
				94		2	100													
				98		2	100			7										
				99		2	100		4						2				7	
				02		2	100												6	
				07		2	100												7	

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans.

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
J 1	1-6	9010076	France	83	83	26	45	
					84	26	45	
					85	50	73	
					86	84	113	
					87	141	166	
					88	182	203	
					89			1-2 – winter stress
					90	201	211	Removed All
J 1	7-12	9010077	France	83	83	25	40	
					84	30	55	
					85	56	82	Multiple stem plants
					86	69	100	7 - produced seed
					87	95	111	
					88	112	153	
					89			7, 9, 11-12 – winterkill on stems
					90	262	247	7, 9, 11-12 – dead
					92		293	
					94		340	
					98		409	
					99		408	10 – Golden foliage
					02		410	
					07		555	8 – woody competition
J 1	13-18	9011202	England	83	83	25	42	
					84	22	47	
					85	30		
					86	70	70	
					87	125	101	
					88	163	150	Multiple stem plants
					89		181	
					90	209	555	Seiridium canker; removed all
J 1	19-24	9012467	France	83	83	30	35	
					84	27	56	
					85	58	92	Multiple stem plants; excellent uniformity
					86	70	109	
					87	92	153	
					88	111	185	
					89			
					90	174	215	
					92		286	
					94		309	
					98		377	
					99		379	
					02		405	
					07		483	24 – woody competition

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
J 1 25-30	9013567	Russell Co., Kans.	83	83	46	90	
				84	64	122	
				85	120	185	
				86	157	222	
				87	244	292	Multiple stem plants
				88	298	337	
				89			
				90	374	401	
				92		512	
				94		599	
				98		644	
				99		679	
				02		699	
				07		963	25, 28, 30 – woody competition
J 1 31-36	9013568	Seward Co., Kans.	83	83	12	25	33 died – replaced 11/2
				84	13	35	
				85	26	57	Multiple stem plants
				86	31	74	
				87	52	103	leaf miner
				88	67	128	
				89			36 – dead mid-summer
J 1 37-42	9013569	Wallace Co., Kans.	83	83	16	30	
				84	20	42	
				85	30	53	Multiple stem plants
				86	43	64	
				87	56	86	
				88			Aphids 11/10
				89			39-40 - dead
				90	98	108	41 – nearly dead; 42 - dead
J 1 43-48	9013570	Webster Co., Nebr.	83	83	39	73	43 – produced seed
				84	59	102	
				85	94	120	
				86	143	181	
				87	233	252	Bagworms
				88	259	290	Aphids; 48 – vigor = 2
				89			
				90	359	334	Minor cankers
				92		390	44 – top dead
				94		455	
				98		532	
				99		530	
				02		577	48 – heavy wind damage
				07		671	46 – dead, woody competition

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
J 1	49-54	9013571	Custer Co., Okla.	83	83	27	49	
					84	48	91	
					85	93	135	
					86	129	165	
					87	207	237	
					88	245	275	
					89			
					90	335	323	Low winter injury; some tip burn
					92		380	
					94		424	
					98		461	
					99		483	
					02		523	
					07		603	Woody competition
J 1	55-60	9013572	Oklahoma Co., Okla.	83	83	32	53	
					84	37	62	
					85	53	103	3 Multiple stem plants
					86	132	124	
					87	153	175	Leaf miner
					88	130	183	Aphids; canker; 3 trees removed for lateral construction
					89			
					90	228	211	Seiridium canker; low winter injury
					92		248	
					94		286	Golden foliage
					98		340	
					99			Dead; bagworms
J 2	1-6	9017764	Spain	83	83	25	47	
					84	30	70	
					85	70	110	
					86	110	159	5 – produced seed
					87	171	217	
					88	220	262	
					89			
					90	265	289	Small twig cankers
					92		392	
					94		441	
					98		493	
					99		533	
					02		567	
					07		603	5 – heavy woody competition

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
J 2 7-12	9017879	USSR	83	83	24	43	
				84	30	61	
				85	67	90	
				86	97	127	
				87	139	167	Aphids
				88	163	201	Canker; No. 12 – 50% winter injury; Aphids
				89			12 – some winterkill
				90	205	222	Winter injury
				92		259	
				94		273	
				98		336	
				99		333	9 – top dead
				02		347	
				07		468	12 – woody competition
J 2 13-18	9018973	Japan	83	83	19	38	
				85	60	78	
				86	78	109	
				87	124	160	
				88	157	199	Aphids 11/10
				89			
				90	193	220	Heavy winter injury
J 2 19-24	9019848	Clark Co., Okla.	83	83	25	57	
				84	37	84	
				85	90	155	
				86	129	176	22 – produced seed
				87	180	247	
				88	213	297	
				89			
				90	302	351	One tree – heavy Seiridium canker
				92		442	
				94		504	
				98		549	
				99		560	
				02		594	
				07		678	24 – severe woody competition

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
J 2 25-30	9019849	Harper Co., Kans.	83	83	22	36	
				84	35	61	
				85	67	94	
				86	107	130	
				87	151	186	30 – mechanical damage
				88	190	225	mechanical damage
				89			
				90	282	273	Lots of small cankers
				92		374	
				94		405	
				98		453	
				99		458	
				02		484	
				07		553	
J 2 31-36	9019850	Washita Co., Okla.	83	83	21	38	
				84	31	55	
				85	56	82	Multiple stem plants
				86	79	108	
				87	104	142	
				88	109	160	31 – 40% winter injury; 34 – dead
				89			31-32, 35 – winter injury
				90	160	180	34 – dead; 35 – dying, removed
				92		229	
				94		254	
				98		314	
				99		318	
				02		362	
				07		464	
J 2 37-42	9019853	Woodward Co., Okla.	83	83	23	51	
				84	39	71	
				85	80	127	
				86	113	161	39, 42 – produced seed
				87	167	221	leaf miner
				88	188	261	
				89			
				90	261	277	Seiridium canker
				92		345	
				94		378	
				98		449	
				99		456	
				02		490	
				07		676	

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
J 2 43-48	9019854	Wallace Co., Kans.	83	83	20	29	
				84	27	47	
				85	44	80	Multiple stem plants
				86	71	93	
				87	111	142	
				88	98	139	44, 45 – 40% winter injury; 47, 48 - dead
				89			44-45 – winter injury
				90	152	161	Seiridium canker; Removed 45, 47-48
				92		251	
				94		273	
				98		315	
				99		303	44 – dead; bagworms
				02		335	
				07		435	
J 2 49-54	9020979	Portugal	83	83	10	14	
				84	12	16	
				85	20	30	Multiple stem plants
				86	24	35	
				87	39	60	
				88			51 – 90% dead 6/13, dead 8/12
				89			3 trees dead
J 2 55-59	9021012	Portugal	83	83	20	40	
				84	29	59	
				85	59	110	
				86	98	141	
				87	142	192	
				88	184	225	55 – canker; 2 trees removed for lateral construction
				89			
				90	194	232	Seiridium canker
				92		281	
				94		297	
				98		383	
				99		380	
				02		411	
				07		495	56 – woody competition

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
L 1	1-6	9013573	Harlan Co., Nebr.	83	83	17	31	3 - died – replaced 11/2
					84	20	35	
					85	40	65	Multiple stem plants
					86	56	85	
					87	82	115	
					88	82	148	
					89			Bagworms; 3 – dying – winterkill
					90	136	177	3 - dead
					92		258	
					94		285	
					98		336	
					99		361	
					02		411	
					07		487	
L 1	7-12	9013574	Harlan Co., Nebr.	83	83	29	59	
					84	43	86	
					85	75	146	
					86	130	173	
					87	199	238	
					88	242	287	Aphids
					89			Bagworms
					90	331	347	
					92		451	
					94		511	
					98		547	
					99		562	
					02		624	
					07		825	
L 1	13-18	9013575	Harlan Co., Nebr.	83	83	31	75	
					84	49	103	
					85	92	170	
					86	129	201	
					87	205	273	
					88	257	334	Bagworms; 16-18 half dead; aphids
					89			Bagworms
					90	318	379	
					92		444	
					94		511	
					98		531	
					99		533	14, 17 – top dead
					02		569	
					07		719	17 – severe woody competition

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
L 1	19-24	9013576	Tulsa Co., Okla.	83	83	23	46	
					84	34	61	
					85	72	110	
					86	96	139	
					87	153	199	
					88	171	230	20 – winterkill; 22 – Top dead, 40% winter injury; aphids
					89			Bagworms
					90	243	286	
					92		372	
					94		415	
					98		452	
					99		427	21, 24 – top dead; 19 – 75% dead
					02		466	
					07		600	
L 1	25-30	9013577	Greeley Co., Kans.	83	83	22	53	
					84	29	68	
					85	56	118	
					86	92	154	
					87	151	207	
					88	176	255	27 – 35% winter injury; 28 – winterkill; aphids
					89			30 – bagworms
					90	235	284	Removed 27-28
					92		372	
					94		399	
					98		439	
					99		438	
					02		479	
					07		598	29 – woody competition
L 1	31-36	9013578	Kingfisher Co., Okla.	83	83	23	48	36 died – replaced 11/2
					84	32	72	
					85	58	90	
					86	95	134	
					87	168	197	
					88	175	221	
					89			
					90	244	265	
					92		338	
					94		362	
					98		423	
					99		434	
					02		482	
					07		611	

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
L 1 37-42	9013579	Rooks Co., Kans.	83	83	22	57	
				84	36	66	
				85	75	120	
				86	115	152	
				87	200	234	
				88	240	287	42 – winterkill, canker
				89			
				90	338	315	Removed 42
				92		476	
				94		513	
				98		581	
				99		605	
				02		652	
				07		737	37, 38 – severe woody competition
L 1 43-48	9013580	Woodward Co., Okla.	83	83	30	59	
				84	23	55	
				85	38	100	
				86	75	113	
				87	151	181	47 - 35% winterkill
				88	170	233	43, 44, 48 – Seiridium canker.; aphids
				89			
				90	228	261	Removed –
				92		340	
				94		405	
				98		479	
				99		513	
				02		595	
				07		725	Severe woody competition
L 1 49-54	9014890	Portugal	83	83	25	50	
				84	32	57	
				85	69	102	
				86	88	143	
				87	171	211	
				88	214	260	Aphids
				89			
				90	306	296	
				92		351	
				94		391	
				98		441	
				99		436	
				02		462	
				07		526	Severe woody competition

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location		Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
L 1	55-59	9015329	France	83	83	22	42	58 died – replaced 11/2
					84	21	48	
					85	57	105	59-nearly dead
					86	71	122	
					87	144	193	
					88	136	204	
					89			
					90	209	262	Removed 56, 58; 59 – dead
					92		393	
					94		412	
					98		457	
					99		487	
					02		483	
					07		570	Severe woody competition
L 2	1-6	9023359	Sumner Co., Kans.	83	83	21	44	
					84	26	60	
					85	66	118	
					86	104	153	
					87	159	227	
					88	180	261	3 – Seiridium canker; aphids
					89			
					90	259	289	
					92		375	
					94		413	
					98		463	
					99		474	
					02		515	
					07		624	1 - woody competition
L 2	7-12	9026610	Beaver Co., Okla.	83	83	23	39	
					84	36	63	
					85	80	128	
					86	127	165	7, 11 – produced seed
					87	186	235	
					88	202	288	
					89			
					90	322	338	
					92		447	
					94		489	
					98		521	
					99		520	
					02		579	
					07		658	

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
L 2 13-18	9026687	Manhattan PMC	83	83	12	25	17-18 died – replaced 11/2
				84	21	42	
				85	78	85	Multiple stem plants
				86	85	118	
				87	140	173	18 – bagworms
				88	156	215	Bagworms
				89			
				90	236	254	
				92		323	
				94		373	
				98		436	
				99		434	
				02		471	
				07		561	
L 2 19-24	9026780	Oklahoma State Nursery	83	83	17	31	24 died – replanted 11/2
				84	22	43	
				85	54	95	
				86	93	141	
				87	161	206	Multiple stem plants
				88	200	229	Aphids, bagworms
				89			
				90	276	271	
				92		394	
				94		415	
				98		465	
				99		462	
				02		513	
				07		625	23 – woody competition
L 2 25-30	9004461						Space reserved
L 2 31	9013566	Deuel Co., Nebr.	83	83	40	62	
				84	50	88	
				85	96	141	
				86	132	180	
				87	210	229	Multiple stem plant; leaf miner
				88	237	270	
				89			
				90	353	307	
				92		364	
				94		378	
				98		396	
				99		421	
				02		451	
				07		515	Slight woody competition

Table 4.2b Study No. - 20I031K Initial Evaluation: Oriental arborvitae (*Platycladus orientalis*), Manhattan, Kans. (continued)

Plot Location	Accession Number	Origin/Source	YR PLT	YR REC	CAN COV	PLT HGT	Plot Remarks
L 2 32-33	9019852	Sedgwick Co., Kans.	83	83	17	32	
				84	28	51	
				85	32	65	Multiple stem plants
				86	45	79	
				87	61	114	
				88	66	131	32 – 55% winter injury; 33 – 25% winter injury
				89			32 – bagworms
				90	86	156	
L 2 34-35	9023358	Ford Co., Kans.	83	83	13	13	Yellow tips
				84	13	12	
				85	22	29	Multiple stem plants
				86	36	38	
				87	43	48	
				88	60	65	34 - 10% winter injury; 35 – winterkill
				89			
				90			34 - dead
L 2 36-46	9026780	Oklahoma State Nursery	83	83	- -	- -	no data
				84	16	29	
				85	56	95	
				86	106	135	
				87	178	211	Mechanical damage
				88	203	256	Aphids
				89			
				90	310	315	
				92		409	
				94		490	
				98		569	
				99		582	
				02		624	
				07		749	
L 2 47-48	9019852	Sedgwick Co., Kans.	83	83	- -	- -	No data
				85	52	98	
				86	94	132	
				87	151	191	
				88	168	230	
				89			
				90	242	271	
				92		356	
				94		393	
				98		415	
				99		427	48 – top dead
				02		478	
				07		504	Severe woody competition

Refer to legend on page 70. Note: Most numbers in remarks are specific tree numbers within the plot.

5. Study No. 20I037K - Evaluation of selected common hackberry.

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

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

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

Procedure: The best single seedling was selected from 30 different accessions growing in a seedling production nursery at the PMC, Manhattan, Kansas. The origin of all accessions was from collection locations south of the Platte River in Nebraska. Seedlings (n) originating from Kansas (11), Nebraska (4), Missouri (8), Oklahoma (5), Iowa (1), and Arkansas (1), were selected. The 1-0 seedlings were planted in a spaced plant nursery on 9.1 m (30 ft) spacing, on a Belvue silt loam soil, March 21, 1988, in Field D-1 at the PMC.

Evaluating Factors: Plant vigor; growth rate and uniformity; and resistance to insects, disease, and climatic factors.

Potential Products: Cultivar Release

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

Literature Cited:

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

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

6. Study No. 20I038K - Bur oak seed source study.

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

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

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

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

Procedure: Acorns were collected from individual trees displaying superior phenotypic characteristics in the fall of 1990. Seed collections, consisting of 400 acorns, were shipped to the Nebraska Forest Service, Lincoln, Nebraska, for assembly of collections. Thirty acorns of selected accessions were shipped to trial sites for grow out. The Manhattan PMC requested 52 accessions from Central Great Plains sources. The PMC received only 22 accessions due to a poor acorn crop in some parts of the Great Plains. In addition to these collections, two local collections were included in the study at Manhattan, 'Lippert', accession 9004392 and accession 9050065. Accession 9050065, a collection that was made on the Center, was also entered in the GP13 assembly for planting out at other trial sites. Acorns were planted in a soil-less mix in 102 cm^3 (40 cu in) deep pots in the spring of 1991. The "cone-tainers" were placed in the greenhouse for grow out. Only enough trees from 16 accessions were available for the planting. The plot layout consisted of 5 replications with 2 plants per plot. The plants were spaced 4.6 x 4.6 m (15 x 15 ft) apart in a randomized complete block design in the fall of 1992. A second collection was conducted in the fall of 1992. Sixteen accessions were received by the PMC from the second collection. These acorns were grown out in the greenhouse in 1993 and planted in the field June 14. There were enough seedlings to establish a 68.6- x 91.4-m (225- x 300-ft) field plot consisting of 26 accessions, Map 6.1. The plot was surrounded by a border row composed of trees from the same sources. Some of the northern sources and individual trees of other entries did poorly. These were replaced by either white oak, (*Quercus alba*), accession 9050077, or by green ash, (*Fraxinus pennsylvania*), accession 9050087, to provide adequate competition for the remaining trees. A complete list of sources established at Manhattan is listed in Table 6.1.

Table 6.1. Sources of bur oak established in the seed source study at Manhattan, Kans.

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

Potential Products: Cultivar Release

Progress or Status: Fifteen-year measurements were taken this year. The Platte Co., Missouri, source had the greatest mean height of 868 cm and a diameter at breast height (DBH) of 20.4 cm (Table 6.2). Overall, the height ranged from 1103 cm (Lafayette Co., Missouri) to 205 cm (Gage Co., Nebraska) and DBH ranged from 32 cm (Holt Co., Missouri) to 3.6 cm (Johnson Co., Nebraska) for individual trees.

Table 6.2 Fifteen-year mean height and DBH measurements for 26 bur oak accessions planted at Manhattan, Kans.

Source ID	County	State	Accession Number	Percent Survival	Mean Height* (cm)	Mean DBH* (cm)
510	Platte	MO	9050169	80	868 a	20.4 a
520	Lafayette	MO	9050170	100	862 a	19.5 ab
521	Howard	MO	9050171	90	861 a	18.4 abc
556	Sequoyah	OK	9050174	100	803 ab	17.2 abcde
523	Cherokee	OK	9050172	70	801 ab	17.7 abcd
567	Woodward	OK	9050175	90	794 abc	17.3 abcde
262	Dickinson	KS	9050159	90	770 abcd	18.1 abc
271	Miami	KS	9050166	100	756 abcde	17.4 abcd
554	Creek	OK	9050173	90	744 bcde	18.5 abc
267	Richardson	NE	9050162	100	735 bcdef	16.7 abcdef
225	Doniphan	KS	9050157	100	731 bcdefg	15.8 bcdefgh
275	Riley	KS	9050065	80	727 bcdefg	16.3 bcdefg
246	Jefferson	NE	9050163	100	711 bcdefg	15.2 cdefgh
274	Harvey	KS	9050167	80	708 bcdefg	16.4 bcdefg
137	Allamakee	IA	9050156	90	686 bcdefgh	12.7 ghi
269	Nemaha	KS	9050165	100	682 cdefgh	14.0 defgh
253	Nance	NE	9050160	100	663 defgh	13.3 fgh
241	Thayer	NE	9050164	100	654 defgh	13.4 efgh
501	Holt	MO	9050168	100	643 efgh	14.1 defgh
245	Gage	NE	9050158	100	626 fghi	15.6 bcdefgh
249	Douglas	NE	9050169	80	621 fghi	13.2 fgh
KSPMC	Payne	OK	9004392	100	616 ghi	14.0 defgh
265	Johnson	NE	9050161	100	591 hi	12.3 hi
125	Shelby	IA	9050154	90	525 ij	9.4 ij
132	Pennington	MN	9050155	80	482 j	7.4 j
122	Bottineau	ND	9050153	90	477 j	7.5 j

* Means with the same letter in a column are not significantly different Pr > F <.0001

Literature Cited:

Dickie, S. G. and W. T. Bagley 1980. Variability of *Quercus macrocarpa* Michx. in an eastern Nebraska provenance study. Silvae Genet. 29(5/6):171-176.

7. Study No. 20I039E - Evaluation of switchgrass germ plasm for rhizomatous characteristics.

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

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

Procedure: Selected materials from the various stress tests were grown out in the greenhouse. Plants from this pool were established in a poly-cross nursery. The largest, healthiest plants were transplanted to the field in a Latin Square design. Seed was harvested at the end of the growing season and compared to the data from the previous year to mark any improvements in germination and seed size. Four 100 seed replicates were planted to moist blotters in 10.16 x 10.16 cm (4 x 4 in) plastic boxes from each seed collection. The seeds were tested for germination in a growth chamber set at 24^{o}C with 8 hours light and 16 hours dark for 30 days. The germination was counted and recorded at 10-, 20-, and 30-day intervals.

Evaluation Factors: Data such as plant height, spread, disease resistance, and flowering date, will be collected on the plants throughout the growing season.

Potential Products: Cultivar Release

Progress or Status: Seeds from most of the 64 rhizomatous switchgrass plants were collected in 2006. The seed was processed and stored at room temperature prior to testing. Four individual plants or 6% produced no seed while 14 plants or 22% produced a total of 5 grams or less. Thus 28% of the plants produced little or no seed in 2006. Germination percentage of the individual plants ranged from 0.0-to-81.75% germination at 30 days. Two plants had very good germination with 74.25 and 81.75% at 30 days. These same plants had relatively good total seed yield of 34.6 and 45.6 grams and relatively large 100 seed weights at .15 and .14 grams, respectively. The change in total germination between the 20- and 30-day counts was in most cases small. Therefore, in future germination trials the interval between counts will be 7, 14, and 21 days after initiation of the trial. The next step will be to compare the 2006 and 2007 results to see if the seed yield and excellent germination are retained in the same plants.

Literature Cited:

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

8. Study No. 20I041K - Evaluation of Siberian elm.

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

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

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

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

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

A 3-replication, randomized evaluation plot containing 15 accessions and 3 seedlings per plot (Appendix Figure 5.1) was established on April 15, 1999, in Akron, Colorado. The plot was established in a recently tilled area on the USDA ARS Central Great Plains Research Station, 4 miles east of Akron. The elm seedlings were planted using a tractor-drawn tree planter which made the planting quick and efficient. Due to the extremely windy conditions experienced the day of planting, the weed barrier fabric (1.83-m (6-ft) Sunbelt) was not installed until May 19, 1999.

The Akron Site is located in Logan County, Colorado. The planting was established in cooperation with the USDA ARS Central Great Plains Research Station at Akron, Colorado. The site is located within MLRA 72. Average annual precipitation is 40.6 cm (16 in). The soils are classified as a Rago silt loam.

A 3-replication, randomized evaluation plot containing 11 accessions and 3 seedlings per plot (Appendix Figure 5.2) was established on May 18, 1999, in Sidney, Nebraska. The plot was established in a disked area that was planted to wheat the previous growing season. The elm seedlings were planted by hand and then a tractor was used to install the 1.83-m (6-ft) Sunbelt weed barrier fabric to the plot.

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

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

Potential Products: Cultivar Release

Progress or Status: A site visit was not made this year.

Table 8.1 Study No. – 20I041K Initial Evaluation: Siberian elm (*Ulmus pumila*), Akron, Colo.

Accession Number	Origin/Source	YR PLT	YR REC	NO PLT	NO SRV	PCT SRV	FOL DEN	PLT HGT	BAS DIA	Remarks Plot Legend: e.g. 2-214-1 = rep-last three digits accn. no. – tree no.
9050184	Roger Mills Co., Okla.	99	00	9	9	100		173		
			01		9	100		244		
			02		9	100		245		
			03		9	100		282		
			05		9	100	94	353	10.4	
			06		9	100		356		
9050213	Woodward Co., Okla.	99	00	9	9	100		157		
			01		9	100		238		
			02		9	100		241		
			03		9	100		289		
			05		9	100	67	341	10.6	
			06		9	100		348		
9050214	Beaver Co., Okla.	99	00	9	9	100		180		
			01		9	100		262		
			02		9	100		262		
			03		9	100		276		2-214-1 – DBK
			05		9	100	78	342	12.0	
			06		9	100		356		2-214-1 – DBK
9050216	Ellis Co., Okla.	99	00	9	9	100		171		
			01		9	100		257		
			02		9	100		261		
			03		9	100		304		
			05		9	100	83	345	12.0	
			06		9	100		335		2-216-3 – DBK; dying
9050217	Ellis Co., Okla.	99	00	9	9	100		173		
			01		9	100		253		
			02		9	100		254		
			03		9	100		298		
			05		9	100	72	308	11.2	
			06		9	100		318		2-217-3 – DBK
9050219	Stevens Co., Kans.	99	00	9	9	100		185		
			01		9	100		268		
			02		9	100		273		
			03		8	89		310		
			05		8	89	75	359	11.5	
			06		8	89		367		2-219-1 – dead

Table 8.1 Study No. – 20I041K Initial Evaluation: Siberian elm (*Ulmus pumila*), Akron, Colo. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO PLT	NO SRV	PCT SRV	FOL DEN	PLT HGT	BAS DIA	Remarks
9050222	Custer Co., Okla.	99	00	9	9	100		180		
			01		9	100		269		
			02		9	100		267		
			03		9	100		301		
			05		9	100	100	342	11.1	
			06		9	100		349		1-222-2 – DBK
9050224	Custer Co., Okla.	99	00	9	9	100		180		
			01		9	100		271		
			02		9	100		278		
			03		9	100		319		
			05		9	100	100	381	11.6	
			06		9	100		392		
9050225	Custer Co., Okla.	99	00	9	9	100		164		
			01		9	100		248		
			02		9	100		251		
			03		9	100		278		3-225-1 – DBK
			05		7	78	100	359	11.5	
			06		6	67		339		2-225-1 – DBK, resprout; 3-225-1 – dead
9050226	Custer Co., Okla.	99	00	9	9	100		173		
			01		9	100		258		
			02		8	89		260		
			03		8	89		290		
			05		8	89	100	337	11.5	
			06		8	89		347		3-226-3 – dead
9050228	Custer Co., Okla.	99	00	9	9	100		167		
			01		9	100		252		
			02		9	100		256		
			03		9	100		297		
			05		9	100	94	359	10.9	
			06		9	100		368		
9050233	Harper Co., Okla.	99	00	9	9	100		154		
			01		9	100		237		
			02		9	100		245		
			03		9	100		264		3-233-3 – DBK
			05		9	100	83	312	10.9	
			06		9	100		322		3-233-3 – DBK

Table 8.1 Study No. – 20I041K Initial Evaluation: Siberian elm (*Ulmus pumila*), Akron, Colo. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO PLT	NO SRV	PCT SRV	FOL DEN	PLT HGT	BAS DIA	Remarks
9050235	Garfield Co., Okla.	99	00	9	9	100		169		
			01		9	100		261		
			02		9	100		262		
			03		9	100		317		
			05		9	100	83	370	11.2	
			06		9			380		
9050240	Cotton Co., Okla.	99	00	9	9	100		163		
			01		9	100		245		
			02		9	100		249		
			03		9	100		267		1-240-2 – DBK
			05		8	89	94	354	11.9	
			06		8	89		367		1-240-2 – DBK
9050241	Cotton Co., Okla.	99	00	9	9	100		178		
			01		9	100		252		
			02		9	100		255		
			03		9	100		278		1-241-2 – DBK
			05		9	100	94	328	10.5	
			06		9	100		328		1-241-2 – DBK

Legend for Siberian elm evaluations:

DBK: Die back
FOL DEN: Foliage Density, rating 1-9
NO. PLT: Number of trees 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

Table 8.2 Study No. – 20I041K Initial Evaluation: Siberian elm (*Ulmus pumila*), Sidney, Nebr.

Accession Number	Origin/Source	YR PLT	YR REC	NO PLT	NO SRV	PCT SRV	FOL DEN	PLT HGT	BAS DIA	Remarks Plot Legend: e.g. 2-214-1 = rep-last three digits accn. no. – tree no.
9050184	Roger Mills Co., Okla.	99	00	9	9	100		186		
			01		9	100		232		
			02		9	100		285		
			03		9	100		312		
			05		9	100	67	326	11.4	
			06		9	100		332		2-184-1 – DBK
9050213	Woodward Co., Okla.	99	00	9	9	100		139		
			01		8	89		176		
			02		8	89		242		
			03		8	89		271		
			05		8	89	29	315	10.9	
			06		7	67		323		1-213-1 – dead; 3-213-1 – dead
9050214	Beaver Co., Okla.	99	00	9	9	100		197		
			01		9	100		243		
			02		9	100		290		
			03		8	89		315		
			05		7	78	93	365	11.9	
			06		6	67		332		1-214-1 – dead; 1-214-2 – 75% DBK; 2-214-2 – DBK; 3-214-1 & 2 – dead
9050217	Ellis Co., Okla.	99	00	9	9	100		178		
			01		9	100		215		
			02		9	100		255		
			03		8	89		272		
			05		8	89	50	323	11.9	
			06		6	67		287		1-217-1 – DBK; 2-217-1 – DBK; 2-217-3 – dead; 3-217-2 & 3 – dead
9050219	Stevens Co., Kans.	99	00	9	9	100		165		
			01		9	100		193		1-219-3 – resprout from base
			02		9	100		261		
			03		8	89		279		
			05		8	89	67	289	13.1	
			06		8	89		210		1-219-1 thru 3 – DBK; 2-219-1 &2 – DBK; 2-219-3 – dead; 3-219-1 – 90% DBK, 2&3 DBK
9050222	Custer Co., Okla.	99	00	9	9	100		155		
			01		9	100		193		
			02		9	100		256		
			03		9	100		278		
			05		9	100	56	318	11.5	
			06		8	89		332		1-222-3 – dead; 2-222-3 – 50% DBK; 3-222-2 – 50% DBK

Table 8.2 Study No. – 20I041K Initial Evaluation: Siberian elm (*Ulmus pumila*), Sidney, Nebr. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO PLT	NO SRV	PCT SRV	FOL DEN	PLT HGT	BAS DIA	Remarks
9050224	Custer Co., Okla.	99	00	9	9	100		175		
			01		9	100		207		
			02		9	100		249		
			03		9	100		272		
			05		9	100	78	315	10.6	
			06		8			322		1-224-2 – dead; 3-224-1 – DBK
9050226	Custer Co., Okla.	99	00	9	9	100		165		
			01		9	100		200		
			02		9	100		257		
			03		8	89		291		
			05		9	100	78	345	13.4	
			06		7	78		334		1-226-1 – 98% DBK; 1-226-2 – 50% DBK; 2-226-1 – DBK; 2-226-2 dead; 3-226-1 – DBK
9050228	Custer Co., Okla.	99	00	9	9	100		172		
			01		9	100		206		
			02		9	100		230		
			03		8	89		247		
			05		8	89	81	292	13.2	
			06		8	89		309		1-228-1 – dead; 1-228-3 – 50% DBK
9050233	Harper Co., Okla.	99	00	9	9	100		150		
			01		9	100		190		
			02		9	100		226		
			03		9	100		251		
			05		9	100	75	290	12.3	
			06		8			331		1-233-3 – dead
9050240	Cotton Co., Okla.	99	00	9	9	100		165		
			01		9	100		211		
			02		9	100		254		3-240-2 – DBK
			03		8	89		276		
			05		8	89	99	351	12.5	
			06		8	89		363		2-240-3 – dead; 3-240-2 – 50% DBK; 3-240-3 – DBK

9. Study No. 20I042E - Evaluation of false indigo for use in streambank stabilization, shoreline protection, and wetland restoration and enhancement.

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

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

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

Procedure: Seeds from 84 accessions were planted to 25.4-cm^3 Ray Leach Single Cell "Cone-tainers"™ in the spring of 2001. Seeds of accessions with poor quality seed had to be replanted, but establishment was successful for most accessions. Enough seedlings were established from 76 of the accessions to support an initial evaluation planting. The plants were transplanted to a spaced plant evaluation nursery in Field C-3-D-3, May 29, 2002, on a Stonehouse-Eudora complex soil. The plot layout consisted of 3 plants per plot with 3 replications in a RCB design, refer to MAPS Figure 6.1. In-row spacing was 0.9 m (3 ft) and the between row spacing was 4.57 m (15 ft). The plots were irrigated throughout the growing season of the establishment year. Maintenance consists of mowing, disking, and hand weeding between the rows.

Potential Products: Information Technology and Cultivar Release.

Progress or Status: Plant competition remained keen due to dry periods during the growing season. The larger plants had an advantage over their smaller neighbors. Some of the smaller plants succumbed to the fierce competition. Interestingly there were not that many losses. Plant height and number of basal stems per plant were the main focus this year. Plant height decreased for a number of accessions due to dieback. The mean plant height was 276 cm and the mean number of stems was 16. Fruit production was very poor due to late spring freezing temperatures and droughty conditions. Refer to Table 9.1 for information on individual accessions.

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans.

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9008041	no. plains /NDPMC	02	02	9	9	100							3		106	89	1	5
			03		9	100	4/14	9		8	9			7		142		11
			04		9	100		9	3	8	8							
			05		9	100										175		
			06		9	100				6	8							
			07		9	100						8				183		14
9050188	Lyon Co., Kans.	02	02	9	9	100							2		80	77	1	5
			03		9	100	4/15	7		5	7			3		149		6
			04		9	100		9	5	9	5							
			05		9	100										216		
			06		9	100				8	5							
			07		8	89						6				225		11
9050250	Johnson Co., Nebr.	02	02	9	9	100							2		105	114	2	5
			03		9	100	4/14	9		8	6			2		192		9
			04		9	100		9	3	9	4							
			05		9	100										253		
			06		9	100				9	4							
			07		9	100						5				272		16
9050251	Pawnee Co., Nebr.	02	02	9	9	100							3		72	109	1	4
			03		9	100	4/15	3		3	8			3		186		6
			04		9	100		9	4	9	4							
			05		9	100										257		
			06		9	100				9	5							
			07		9	100						5				292		11
9050253	Lincoln Co., Nebr.	02	02	9	9	100							3		67	102	1.0	5
			03		9	100	4/15	3		3	9			5		180		8
			04		9	100		9	4	8	6							
			05		9	100										279		
			06		9	100				9	5							
			07		9	100						7				302		10
9050261	Douglas Co., Kans.	02	02	9	9	100							2		112	110	1.0	5
			03		9	100	4/15	8		7	6			3		195		9
			04		9	100		9	3	9	3							
			05		9	100										267		
			06		9	100				9	4							
			07		9	100						5				294		16

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050262	Wheeler Co., Nebr.	02	02	9	9	100							2		98	101	1	8
			03		9	100	4/14	9		9	7			3		166		11
			04		9	100		9	3	9	3							
			05		9	100										240		
			06		9	100				9	5							
			07		9	100						7				263		17
9050269	Holt Co., Nebr.	02	02	9	9	100							4		102	102	2	6
			03		9	100	4/14	9		9	8			3		167		9
			04		9	100		9	3	9	4							
			05		9	100										216		
			06		9	100				9	5							
			07		9	100						7				222		17
9050271	Neosho Co., Kans.	02	02	9	7	78							2		69	84	1	3
			03		7	78	4/16	6		6	6			3		153		6
			04		7	78		6	3	7	3							
			05		7	78										238		
			06		5	56				5	4							
			07		5	56						7				235		12
9050272	Crawford Co., Kans.	02	02	9	9	100							2		106	116	1	6
			03		9	100	4/14	9		9	3			3		194		7
			04		9	100		9	3	9	3							
			05		9	100										263		
			06		9	100				8	5							
			07		9	100						6				271		12
9050273	Anderson Co., Kans.	02	02	9	8	89							2		91	82	1	5
			03		8	89	4/14	5		5	6			3		159		9
			04		8	89		8	3	8	3							
			05		8	89										224		
			06		8	89				8	3							
			07		8	89						5				244		16
9050274	Dickinson Co., Kans.	02	02	9	9	100							2		106	105	1	7
			03		9	100	4/15	9		9	5			2		186		8
			04		9	100		9	3	9	3							
			05		9	100										265		
			06		9	100				9	4							
			07		9	100						6				291		18

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050275	Shawnee Co., Kans.	02	02	9	8	89							2		105	101	1	6
			03		8	89	4/14	6		5	9			3		170		10
			04		8	89		7	4	7	5							
			05		8	89										239		
			06		7	78				7	5							
			07		7	78						6				282		17
9050277	Holt Co., Nebr.	02	02	9	9	100							4		109	115	2	6
			03		9	100	4/14	8		6	7			5		182		9
			04		9	100		9	2	9	5							
			05		9	100										253		
			06		9	100				9	5							
			07		9	100						7				269		18
9050279	Wheeler Co., Nebr.	02	02	9	9	100							3		103	135	1	8
			03		9	100	4/13	9		6	9			3		220		11
			04		9	100		9	2	9	4							
			05		9	100										286		
			06		9	100				8	6							
			07		8	89						8				313		20
9050280	Dickinson Co., Kans.	02	02	9	9	100							1		102	114	1	5
			03		9	100	4/14	6		5	7			2		196		9
			04		9	100		9	3	9	3							
			05		9	100										274		
			06		9	100				9	4							
			07		9	100						6				294		18
9050284	Reno Co., Kans.	02	02	9	8	89							2		73	129	1	5
			03		8	89	4/15	3		1	8			3		222		8
			04		8	89		8	3	8	2							
			05		8	89										305		
			06		8	89				8	4							
			07		8	89						6				295		14
9050285	Hodgeman Co., Kans.	02	02	9	9	100							2		79	113	1	5
			03		9	100	4/15	1		1	8			3		206		8
			04		9	100		9	4	9	3							
			05		9	100										295		
			06		9	100				9	4							
			07		9	100						6				318		14

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050292	Nuckolls Co., Nebr.	02	02	9	9	100							2		112	122	1	6
			03		9	100	4/15	7		7	5			3		205		13
			04		9	100		9	2	9	3							
			05		9	100										276		
			06		9	100				9	4							
			07		9	100						6				269		18
9050293	Buffalo Co., Nebr.	02	02	9	9	100							2		81	104	1	6
			03		9	100	4/14	5		5	7			3		186		7
			04		9	100		9	3	9	3							
			05		9	100										267		
			06		9	100				9	5							
			07		9	100						6				278		
9050294	Greeley Co., Nebr.	02	02	9	9	100							2		95	126	2	5
			03		9	100	4/14	8		7	6			4		200		8
			04		9	100		9	2	9	3							
			05		9	100										272		
			06		9	100				9	5							
			07		9	100						6				313		14
9050295	Miami Co., Kans.	02	02	9	9	100							2		115	89	1	6
			03		9	100	4/14	8		6	6			3		156		12
			04		9	100		9	3	9	4							
			05		9	100										228		
			06		9	100				9	4							
			07		9	100						6				237		17
9050297	Pawnee Co., Nebr.	02	02	9	9	100							3		81	100	1	4
			03		9	100	4/15	1		1	8			4		182		6
			04		9	100		9	3	9	2							
			05		9	100										250		
			06		9	100				9	4							
			07		9	100						5				259		11
9050298	Cuming Co., Nebr.	02	02	9	9	100							3		111	119	2	5
			03		9	100	4/14	7		4	7			4		215		12
			04		9	100		9	3	9	3							
			05		9	100										277		
			06		9	100				9	4							
			07		9	100						5				292		14

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050299	Pratt Co., Kans.	02	02	9	9	100							2		90	105	1	7
			03		9	100	4/15	6		5	7			3		177		13
			04		9	100		9	3	9	3							
			05		9	100										261		
			06		9	100				9	5							
			07		9	100						7				262		23
9050300	Russell Co., Kans.	02	02	9	9	100							1		70	111	1	5
			03		9	100	4/16	4		2	9			2		191		9
			04		9	100		9	3	9	5							
			05		9	100										277		
			06		9	100				9	6							
			07		9	100						7				289		16
9050307	Colfax Co., Nebr.	02	02	9	9	100							2		128	116	1	8
			03		9	100	4/15	7		7	5			3		208		14
			04		9	100		9	3	9	4							
			05		9	100										293		
			06		9	100				9	5							
			07		9	100						6				306		23
9050308	Cheyenne Co., Kans.	02	02	9	9	100							3		110	127	1.2	6
			03		9	100	4/14	5		3	8			2		212		14
			04		9	100		9	4	9	4							
			05		9	100										301		
			06		9	100				9	5							
			07		9	100						7				331		22
9050309	Sioux Co., Nebr.	02	02	9	9	100							4		64	73	1	6
			03		9	100	4/15	2		0	9			6		109		12
			04		9	100		9	6	5	8							
			05		9	100										163		
			06		9	100				4	9							
			07		7	78						9				124		10
9050310	Douglas Co., Kans.	02	02	9	9	100							2		99	104	1	4
			03		9	100	4/16	5		3	9			3		200		8
			04		9	100		9	3	9	4							
			05		9	100										276		
			06		9	100				9	4							
			07		9	100						6				293		12

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050312	Knox Co., Nebr.	02	02	9	9	100							4		111	119	1	7
			03		9	100	4/14	8		8	6			3		200		12
			04		9	100		9	2	9	4							
			05		9	100										279		
			06		9	100				9	4							
			07		9	100						6				316		
																		19
9050313	Knox Co., Nebr.	02	02	9	9	100							4		105	126	1.8	7
			03		9	100	4/14	7		7	7			4		221		10
			04		9	100		9	2	9	3							
			05		9	100										282		
			06		9	100				6	5							
			07		9	100						7				303		20
9050314	Dodge Co., Nebr.	02	02	9	9	100							2		110	125	1.3	6
			03		9	100	4/14	8		8	6			2		239		8
			04		9	100		9	3	9	3							
			05		9	100										319		
			06		9	100				9	5							
			07		8	89						6				346		22
9050315	Trego Co., Kans.	02	02	9	9	100							3		92	105	1.6	7
			03		9	100	4/15	5		4	8			3		180		11
			04		9	100		8	4	7	6							
			05		9	100										264		
			06		9	100				8	6							
			07		9	100						7				289		15
9050316	Kiowa Co., Kans.	02	02	9	9	100							2		79	130	1	6
			03		9	100	4/15	3		1	8			3		218		9
			04		9	100		9	3	9	3							
			05		9	100										309		
			06		9	100				9	5							
			07		9	100						6				333		18
9050317	Smith Co., Kans.	02	02	9	9	100							2		108	114	1	5
			03		9	100	4/15	7		4	8			3		195		12
			04		9	100		9	2	9	4							
			05		9	100										278		
			06		9	100				9	3							
			07		9	100						6				299		16

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050318	Kingman Co., Kans.	02	02	9	9	100							2		94	100	1	7
			03		9	100	4/15	5		4	8			2		195		11
			04		9	100		9	2	9	4							
			05		9	100										275		
			06		9	100				9	5							
			07		9	100						6				294		18
9050319	Keith Co., Nebr.	02	02	9	9	100							3		75	92	1	6
			03		9	100	4/15	4		1	9			4		152		9
			04		9	100		9	3	9	6							
			05		9	100										221		
			06		9	100				9	7							
			07		9	100						8				233		10
9050321	Howard Co., Nebr.	02	02	9	9	100							3		102	122	1	8
			03		9	100	4/14	9		8	8			3		205		14
			04		9	100		9	3	9	4							
			05		9	100										277		
			06		9	100				9	5							
			07		9	100						6				292		21
9050324	Harvey Co., Kans.	02	02	9	9	100							2		102	110	1	5
			03		9	100	4/15	8		7	6			4		201		8
			04		9	100		9	3	9	3							
			05		9	100										287		
			06		9	100				9	3							
			07		9	100						6				305		16
9050325	Neosho Co., Kans.	02	02	9	9	100							2		103	114	1	6
			03		9	100	4/16	6		5	7			2		189		11
			04		9	100		9	3	9	3							
			05		9	100										250		
			06		9	100				9	5							
			07		9	100						6				293		15
9050327	Graham Co., Kans.	02	02	9	9	100							2		86	105	1	7
			03		9	100	4/15	5		5	7			3		199		13
			04		9	100		9	3	9	5							
			05		9	100										277		
			06		9	100				8	5							
			07		9	100						7				290		17

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050328	Cherokee Co., Kans.	02	02	9	9	100							1		93	91	1	5
			03		9	100	4/16	6		6	6			3		160		8
			04		9	100		9	3	9	3							
			05		9	100										231		
			06		9	100				8	5							
			07		8	89						6				237		14
9050329	Cherokee Co., Kans.	02	02	9	9	100							1		80	93	1	5
			03		9	100	4/14	6		6	6			3		177		8
			04		9	100		9	3	9	3							
			05		9	100										237		
			06		9	100				8	6							
			07		9	100						6				235		14
9050334	Cotton Co., Okla.	02	02	9	9	100							3		82	117	1	7
			03		9	100	4/19	2		2	8			3		185		13
			04		9	100		8	5	8	4							
			05		9	100										266		
			06		9	100				9	6							
			07		9	100						7				259		15
9050335	Cotton Co., Okla.	02	02	9	9	100							2		94	115	1	6
			03		9	100	4/18	3		3	8			3		187		11
			04		9	100		9	3	9	2							
			05		9	100										263		
			06		9	100				9	3							
			07		9	100						6				255		15
9050336	Johnson Co., Nebr.	02	02	9	9	100							2		116	102	1	6
			03		9	100	4/15	5		4	7			3		212		10
			04		9	100		9	4	9	4							
			05		9	100										273		
			06		9	100				9	6							
			07		9	100						7				292		19
9050337	Linn Co., Kans.	02	02	9	9	100							3		110	113	1	4
			03		9	100	4/15	7		7	6			3		185		8
			04		9	100		9	3	9	4							
			05		9	100										253		
			06		9	100				9	5							
			07		9	100						6				272		13

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050342	Cleveland Co., Okla.	02	02	9	9	100							1		70	86	1	6
			03		9	100	4/17	2		0	9			2		190		9
			04		9	100		9	4	8	4							
			05		9	100										250		
			06		9	100				8	5							
			07		8	89						7				229		13
9050343	Cleveland Co., Okla.	02	02	9	9	100							2		80	119	1	5
			03		9	100	4/18	3		3	7			2		234		7
			04		9	100		9	3	9	4							
			05		9	100										339		
			06		9	100				9	4							
			07		9	100						7				352		15
9050344	Harper Co., Kans.	02	02	9	9	100							1		102	115	1	7
			03		9	100	4/16	4		3	8			3		215		10
			04		9	100		9	3	9	4							
			05		9	100										304		
			06		9	100				9	4							
			07		9	100						7				316		11
9050345	Elk Co., Kans.	02	02	9	9	100							2		107	101	1	7
			03		9	100	4/14	6		6	6			3		184		11
			04		9	100		9	2	9	2							
			05		9	100										244		
			06		9	100				9	4							
			07		9	100						4				224		17
9050346	Greenwood Co., Kans.	02	02	9	9	100							1		108	102	1	6
			03		9	100	4/13	9		9	3			3		171		8
			04		9	100		9	2	9	3							
			05		9	100										231		
			06		9	100				9	4							
			07		9	100						5				240		14
9050348	Cleveland Co., Okla.	02	02	9	8	89							3		103	118	1	7
			03		8	89	4/19	5		4	7			3		219		14
			04		8	89		8	2	8	3							
			05		8	89										291		
			06		8	89				7	5							
			07		8	89						6				297		16

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050349	Haskell Co., Okla.	02	02	9	9	100							2		87	97	1	6
			03		9	100	4/15	4		3	8			2		197		8
			04		9	100		9	4	9	1							
			05		9	100										267		
			06		9	100				9	4							
			07		9	100						5				248		21
9050353	Nance Co., Nebr.	02	02	9	9	100							3		117	115	1	6
			03		9	100	4/15	8		7	8			3		203		14
			04		9	100		9	3	9	4							
			05		9	100										270		
			06		9	100				9	5							
			07		9	100						7				284		16
9050354	Reno Co., Kans.	02	02	9	9	100							1		116	135	1	8
			03		9	100	4/16	5		5	7			4		225		12
			04		9	100		9	1	9	2							
			05		9	100										306		
			06		9	100				9	3							
			07		9	100						5				325		16
9050355	Reno Co., Kans.	02	02	9	9	100							2		75	139	1	4
			03		9	100	4/15	2		2	8			3		216		9
			04		9	100		9	3	9	4							
			05		9	100										293		
			06		9	100				8	4							
			07		7	78						6				287		11
9050356	Jefferson Co., Okla.	02	02	9	9	100					9		1		88	104	1.0	6
			03		9	100	4/18	1		1	2			3		205		10
			04		9	100		9	3	9								
			05		9	100					3					276		
			06		9	100				9								
			07		9	100						5				231		18
9050361	Chautauqua Co., Kans.	02	02	9	9	100							3		97	103	1	6
			03		9	100	4/18	4		3	8			3		186		9
			04		9	100		9	3	9	2							
			05		9	100										234		
			06		9	100				9	4							
			07		9	100						6				231		20

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050362	Alfalfa Co., Okla.	02	02	9	9	100							1		73	124	1.0	6
			03		9	100	4/18	0		0	9			2		214		7
			04		9	100		9	3	9	3							
			05		9	100										298		
			06		9	100				9	4							
			07		9	100						5				309		19
9050365	McIntosh Co., Okla.	02	02	6	6	100							2		47	71	1	2
			03		6	100	4/16	3		2	8			2		141		7
			04		6	100		6	2	6	3							
			05		6	100										219		
			06		6	100				6	4							
			07		6	100						5				221		14
9050366	Dodge Co., Nebr.	02	02	9	9	100							2		88	108	1	3
			03		9	100	4/15	8		7	8			3		186		5
			04		9	100		9	3	9	4							
			05		9	100										263		
			06		9	100				8	6							
			07		9	100						7				280		16
9050367	Thomas Co., Nebr.	02	02	9	9	100							4		90	90	1.0	8
			03		9	100	4/14	4		3	9			5		149		13
			04		9	100		9	4	9	5							
			05		9	100										235		
			06		9	100				9	7							
			07		9	100						8						17
9050372	McPherson Co., Kans.	02	02	9	9	100							2		112	96	1	7
			03		9	100	4/15	6		6	6			3		182		13
			04		9	100		9	3	9	3							
			05		9	100										256		
			06		9	100				8	4							
			07		9	100						6				254		19
9050373	Butler Co., Kans.	02	02	9	8	89							4		96	102	1	6
			03		8	89	4/15	4		4	7			3		171		11
			04		8	89		8	3	8	4							
			05		8	89										236		
			06		8	89				8	4							
			07		8	89						5				264		25

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050374	Montgomery Co., Kans.	02	02	9	8	89							2		121	103	1	6
			03		8	89	4/15	6		5	7			2		191		15
			04		8	89		8	5	8	4							
			05		8	89										257		
			06		8	89					5							
			07		8	89						7				249		18
9050377	Woodson Co., Kans.	02	02	9	9	100							2		91	92	1	6
			03		9	100	4/14	8		8	5			3		148		8
			04		9	100		9	2	9	4							
			05		9	100										212		
			06		9	100				9	3							
			07		9	100						5				216		15
9050378	Republic Co., Kans.	02	02	9	9	100							3		109	124	1	5
			03		9	100	4/15	3		3	8			4		220		11
			04		9	100		9	3	9	4							
			05		9	100										291		
			06		9	100				9	4							
			07		9	100						6				309		14
9050379	Richardson Co., Nebr.	02	02	9	9	100							2		99	120	2	6
			03		9	100	4/15	5		5	6			2		211		8
			04		9	100		9	2	9	3							
			05		9	100										283		
			06		9	100				9	4							
			07		8	100						7				310		17
9050383	Norton Co., Kans.	02	02	9	9	100							3		62	114	1	6
			03		9	100	4/15	6		4	9			5		191		12
			04		9	100		9	4	9	5							
			05		9	100										275		
			06		9	100				9	7							
			07		9	100						7				296		10
9050384	Sumner Co., Kans.	02	02	9	9	100							1		93	125	1	6
			03		9	100	4/16	9		8	4			2		202		9
			04		9	100		9	3	9	3							
			05		9	100										288		
			06		9	100				9	4							
			07		9	100						6				302		19

Table 9.1 Study No. – 20I042E Initial Evaluation: False indigo (*Amorpha fruticosa*), Manhattan, Kans. (continued)

Accession Number	Origin/Source	YR PLT	YR REC	NO. PLT	NO. SRV	PCT SRV	SPR REC DAT	NO. BLM	BLM AMT	NO. FRT	FRT AMT	FRT PER	DI*	HEA STR	CAN COV	PLT HGT	STM BRK†	NO. BAS STM/PLT
9050388	Antelope Co., Nebr.	02	02	9	9	100							3		96	111	1.0	5
			03		9	100	4/14	7		5	8			4		183		7
			04		9	100		9	4	9	4							
			05		9	100					7					253		
			06		9	100				9								
			07		9	100						8				271		14
9050391	Washington Co., Kans.	02	02	9	9	100							3		92	87	1	5
			03		9	100	4/15	7		7	6			1		154		8
			04		9	100		9	3	9	5							
			05		9	100										225		
			06		9	100				9	3							
			07		9	100						5				232		20
9050394	Pottawatomie Co., Kans.	02	02	9	8	89							3		97	105	2	6
			03		8	89	4/16	2		1	8			3		188		8
			04		8	89		8	4	8	3							
			05		8	89										271		
			06		8	89				7	5							
			07		8	89						6				292		13
9050400	Clay Co., Kans.	02	02	9	9	100							1		88	101	1	7
			03		9	100	4/16	7		5	7			3		167		13
			04		9	100		9	3	9	4							
			05		9	100										240		
			06		9	100				9	5							
			07		9	100						6				261		22

† 1-5 Rating = (Best-Worst)

Legend for false indigo plant evaluations:

BLM AMT: Bloom Amount
CAN COV: Crown width or ground cover as measured in centimeters
DI: Disease Resistance, rating 1-9
FLW AMT: Amount of Flowers, rating 1-9
FRT AMT: Fruit Amount, rating 1-9
FRT PER: Fruit Persistance, rating 1-9
HEA STR: Heat Stress, rating 1-9
NO. BAS STM /PLT: Number of basal stem per plant
NO. BLM: Number of plants blooming
NO. FRT: Number of plants producing fruit
NO. PLT: Number of plants planted
NO. SRV: Number Surviving
PCT SRV: Percent Survival
PLT HGT: Total plant height measured in centimeters
SPR REC: Spring Recovery Date
STM BRK: Stem Breakage, rating 1-5
YR PLT: Year Planted
YR REC: Year of Record

10. Study No. KSPMS-T-0201-CR - Plant species for revegetation of natural and man-induced saline areas.

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: Eighteen different species/selections will be seeded at four different locations: Perry, Oklahoma (1 site); Okmulgee, Oklahoma (2 sites); El Dorado, Kansas (1 site); and Eureka, Kansas (1 site). Sixteen different soil amendment treatments will be applied at the Eureka and El Dorado sites. Soil salinity analysis will be performed on all sites prior to and following species establishment. Plant species to be used are provided in Table 10.1. Treatments for the Kansas locations are provided in Figure 11.1. Okmulgee and Perry locations will be seeded in the spring of 2002. Evaluations will be completed annually through 2006. Locations will be evaluated for plant species establishment, growth, and persistence.

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 planting sites in Kansas and Oklahoma. Oklahoma sites did not materialize so two sites remain in Kansas from the original study. In 2006 an additional site was selected in Greenwood County, Kansas, as part of a Resource Conservation & Development project. Since determining from initial study that organic matter is very important, this new study concentrated on adding increased amounts of organic matter to the site prior to planting. Initial results have been favorable with the establishment of grasses and weeds on the site.

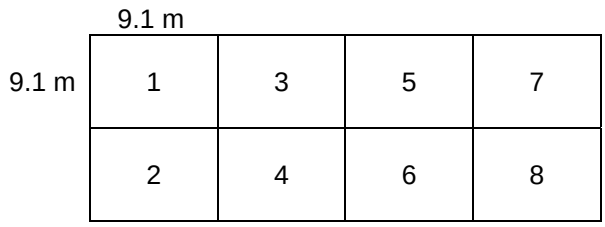
Study was expanded in 2007 with the planting of vegetative materials in the initial study sites. Plants included inland saltgrass, alkali sacaton, and tall wheatgrass. These three grasses seem to do the best in these high salt sites. Due to the late planting date, establishment of these plants was not good. Transplanting the plants earlier in 2009 may provide for better establishment success.

Evaluation of these sites will continue for several more years. Technical materials and recommendations for materials should come from the study.

Table 10.1 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	X		X	X
Tall wheatgrass, 'Jose'	X	X	X	X
Russian wildrye, 'Bozoiski-Select'	X	X	X	X
Western indigo / Knox City	X		X	X
Illinois bundleflower, Reno Germplasm	X		X	X
Showy partridge pea, Riley Germplasm	X		X	X

Figure 10.1 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.

Figure 1.1 Plot Map Field F. Study No. 20I010K – Trees and shrubs, Manhattan PMC. ▲ North ▲

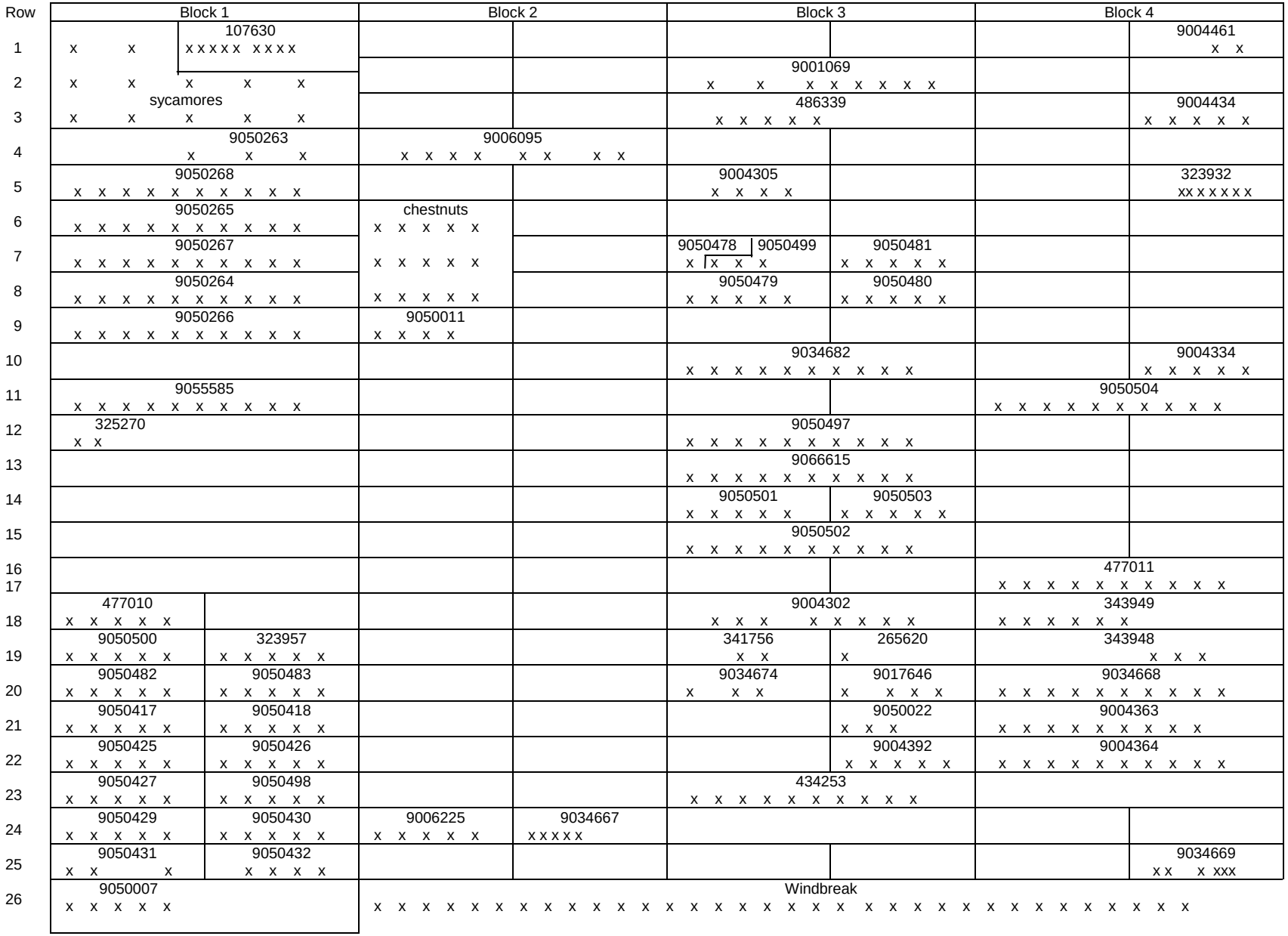
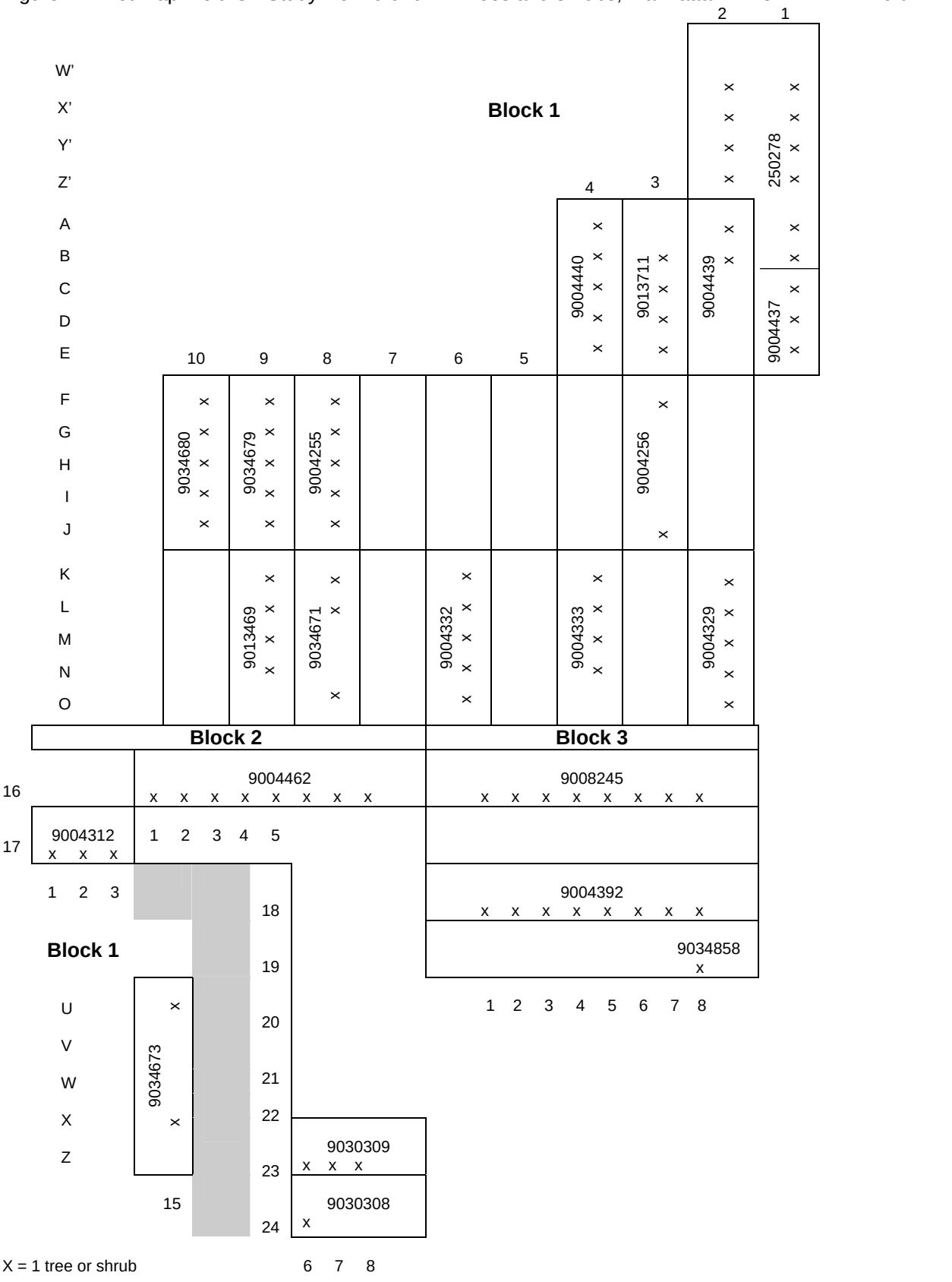


Figure 1.2 Plot Map Field G. Study No. 20I010K – Trees and shrubs, Manhattan PMC. ▲ North ▲



▲ North ▲

Figure 2.1 Plot Map Field B-3. Study No. 20I026K, Hackberry, *Celtis* sp., IEP, Manhattan, PMC**.**

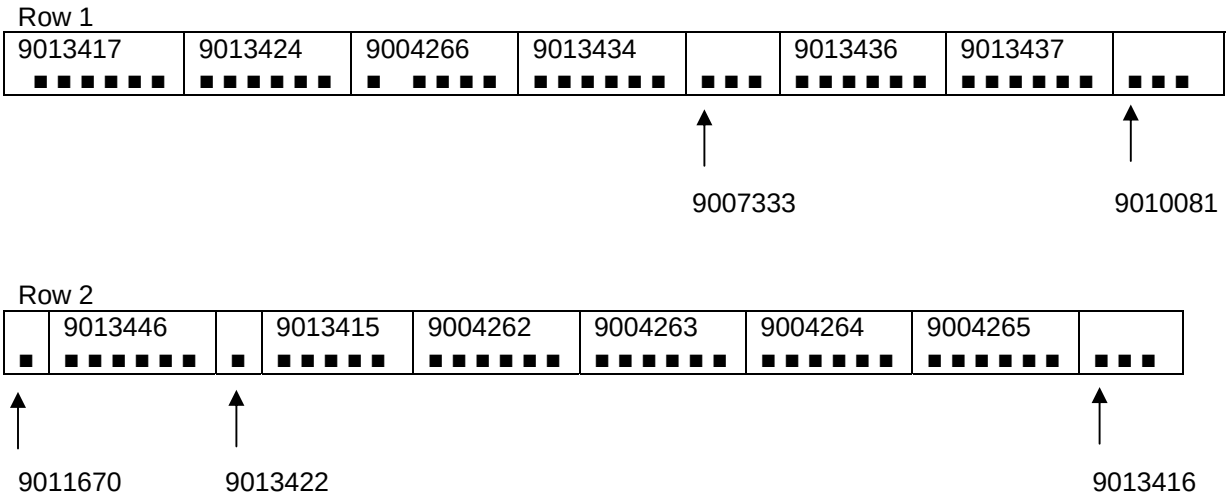
Row W

■	9026646
■	9026643
■	9026641
■ ■	9023017
■	9026672
■ ■ ■	9017884
■	9026427
■	9022741
■	9021223
■	9015678
9030314 ■■■■■■■	
9030313 ■■■■■■■	
9013440 ■■■■■■■	
9013439 ■■■■■■	
9013438 ■■■■■■■	

■ = 1 tree

▲ North ▲

Figure 2.2 Plot Map Field B-3. Study No. 20I026K, Hackberry, *Celtis* sp., IEP, Manhattan, PMC.



■ = 1 tree

Figure 3.1 Plot Map Fields J and L. Study No. 20I031K - Oriental arborvitae, *Platycladus orientalis,* IEP, Manhattan PMC.

Field J

Col. 2	9017764 X X 0 0 X 0	9017879 0 X X 0 0 X	9018973 0 0 0 0 0 0	9019848 X X X X X X	9019849 X X X X X X	9019850 X X 0 0 0 0	9019853 0 X X X X X	9019854 0 0 0 X 0 0	9020979 0 0 0 0 0 0	9021012 0 X 0 0 0
Col. 1	9010076 0 0 0 0 0 0	9010077 0 X 0 X 0 0	9011202 0 0 0 0 0 0	9012467 X X X X X X	9013567 X X X X X X	9013568 0 0 0 0 0 0	9013569 0 0 0 0 0 0	9013570 X X X X X X	9013571 0 0 X 0 0 X	9013572 X 0 0 0 0 0

Field L

Col. 2	9023359 X X X X X X	9026610 X X X X X X	PMK-2925 X X X X X X	9026780 X 0 X 0 X 0	Blank	9013566 X	9019852 0 0	9026780 X X 0	9019852 X X	
Col. 1	9013573 0 0 0 0 X 0	9013574 X X X X X X	9013575 X X X X X X	9013576 X 0 X X X X	9013577 X X 0 0 X X	9013578 X X X X X X	9013579 X X X X 0 0	9013580 0 0 X 0 0 0	9014890 X 0 X X X X	9015329 0 0 X 0 0

Legend: X – existing tree; 0 – missing tree

◄ North ◄

► North ►

Figure 4.1 Plot Map Field E-2. Study No. 20I038K - Bur Oak Seed Source Study - Manhattan PMC.

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

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

Figure 5.1 Plot Map. Study No. 20I041K - Siberian Elm, *Ulmus pumila*, FEP - Akron, Colo. ▲ North ▲

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

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

Figure 5.2 Plot Map. Study No. 20I041K - Siberian Elm, *Ulmus pumila*, FEP - Sidney, Nebr. ▲ North ▲

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

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

Figure 6.1 Plot Map Part 1, Field C-3. Study No. 20I042E - false indigo, *Amorpha fruticosa,* IEP, Manhattan PMC. ▲ North ▲

Rep 1	101 9050384	102 9008041	103 9050345	104 9050285	105 9050373	106 9050355	107 9050361	108 9050262	109 9050310	110 9050253
	120 9050324	121 9050277	122 9050313	123 9050336	124 9050327	125 9050309	126 9050362	127 9050294	128 9050366	129 9050327
	139 9050335	140 9050348	141 9050251	142 9050354	143 9050292	144 9050367	145 9050316	146 9050353	147 9050337	148 9050271
	158 9050317	159 9050269	160 9050379	161 9050344	162 9050307	163 9050308	164 9050378	165 9050394	166 9050329	167 9050391
Rep 2	201 9050292	202 9050334	203 9050284	204 9050312	205 9050319	206 9050324	207 9050272	208 9050294	209 9050373	210 9050349
	220 9050279	221 9050313	222 9050354	223 9050378	224 9050251	225 9050299	226 9050356	227 9050325	228 9050188	229 9050374
	239 9050297	240 9050309	241 9050253	242 9050348	243 9050337	244 9050277	245 9050372	246 9050394	247 9050383	248 9050343
	258 9008041	259 9050321	260 9050345	261 9050280	262 9050271	263 9050273	264 9050261	265 9050379	266 9050342	267 9050355
Rep 3	301 9050345	302 9050355	303 9050354	304 9050391	305 9050384	306 9050344	307 9050280	308 9050310	309 9050374	310 9050321
	320 9050379	321 9050300	322 9050343	323 9050325	324 9050346	325 9050317	326 9050298	327 9050275	328 9050295	329 9050388
	339 9050342	340 9050293	341 9050314	342 9050377	343 9050361	344 9050188	345 9050319	346 9050378	347 9050365	348 9050269
	358 9050356	359 9050365	360 9050307	361 9050372	362 9050373	363 9050297	364 9050400	365 9050277	366 9050251	367 9050299

Part 2 ⟶

Figure 6.1 Plot Map Part 2, Field D-3. Study No. 20I042E - false indigo, *Amorpha fruticosa,* IEP, Manhattan PMC (continued). ▲ North ▲

Part 1 ←

Rep 1	111 9050329	112 9050299	113 9050377	114 9050366	115 9050343	116 9050372	117 9050328	118 9050318	119 9050400
	130 9050293	131 9050383	132 9050346	133 9050388	134 9050250	135 9050298	136 9050188	137 9050284	138 9050342
	149 9050275	150 9050300	151 9050280	152 9050314	153 9050279	154 9050325	155 9050356	156 9050274	157 9050319
	168 9050272	169 9050334	170 9050315	171 9050297	172 9050312	173 9050349	174 9050261	175 9050273	176 9050295
Rep 2	211 9050328	212 9050269	213 9050275	214 9050388	215 9050310	216 9050307	217 9050308	218 9050391	219 9050317
	230 9050300	231 9050377	232 9050285	233 9050336	234 9050344	235 9050316	236 9050365	237 9050293	238 9050367
	249 9050327	250 9050362	251 9050262	252 9050361	253 9050400	254 9050298	255 9050315	256 9050314	257 9050329
	268 9050384	269 9050366	270 9050318	271 9050346	272 9050335	273 9050274	274 9050353	275 9050295	276 9050250
Rep 3	311 9050394	312 9050279	313 9050313	314 9050294	315 9050312	316 9050328	317 9050292	318 9050272	319 9050353
	330 9008041	331 9050271	332 9050285	333 9050250	334 9050274	335 9050334	336 9050335	337 9050321	338 9050309
	349 9050315	350 9050316	351 9050383	352 9050284	353 9050253	354 9050374	355 9050348	356 9050318	357 9050362
	368 9050261	369 9050349	370 9050308	371 9050273	372 9050367	373 9050262	374 9050336	375 9050324	376 9050337